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**ABSTRACT**

Presented are abstracts of 700 computer programs in marine science. The programs listed are categorized under a wide range of headings which include physical oceanography, chemistry, coastal and estuarine processes, biology, pollution, air-sea interaction and heat budget, navigation and charting, curve fitting, and applied mathematics. The introduction explains where programs are available and how to obtain them. It also explains the procedures involved for submitting a program. For each program, the titles, language, and hardware are given along with a brief description of what the program can do, who wrote it, and where it is available. A list of other National Oceanographic Data Center (NODC) programs, a general index, a language index, a hardware index, an institution index, and a Federal information processing standard software summary are also included. (MR)

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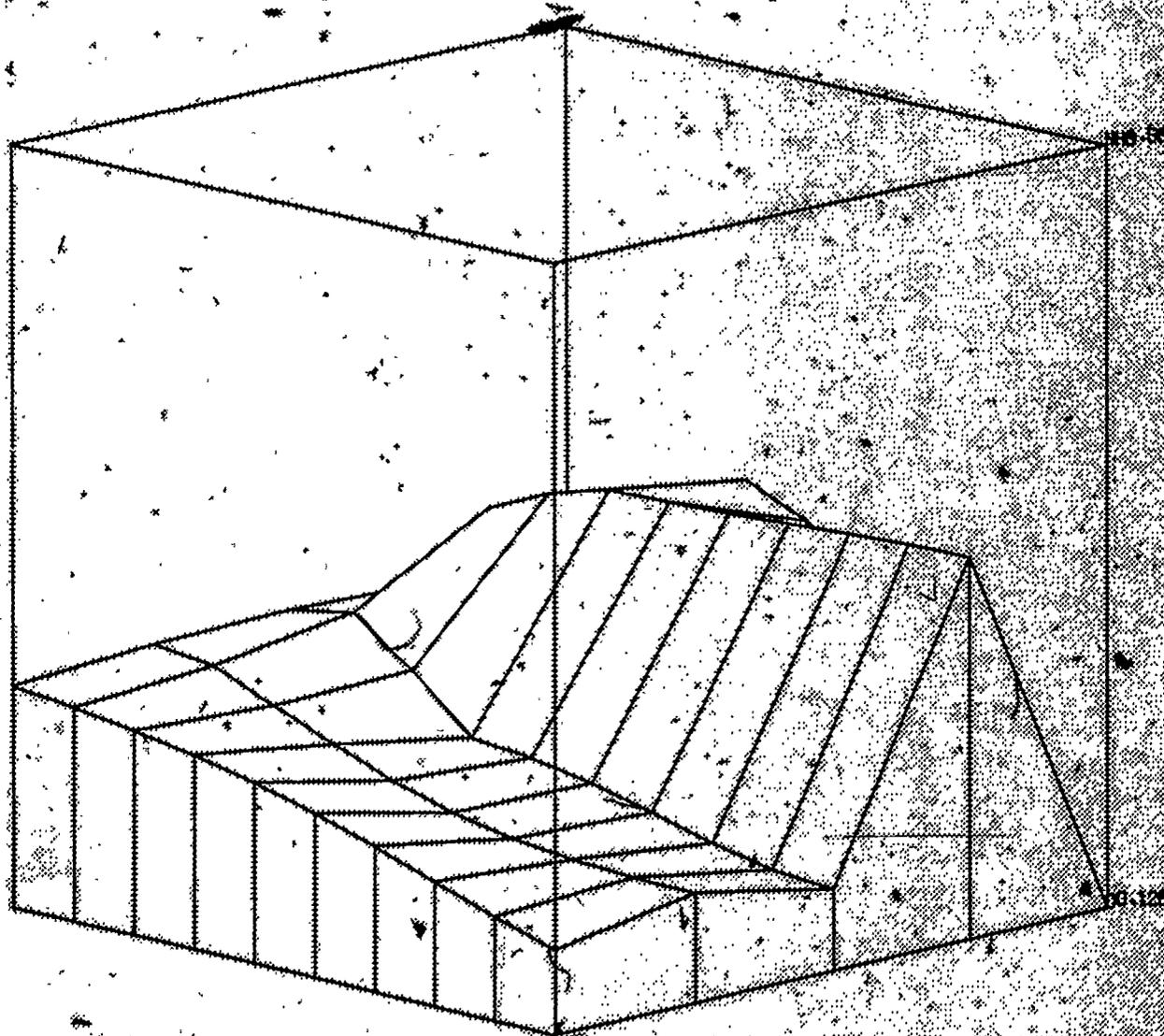
# Computer Programs In Marine Science

U.S. DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
Environmental Data Service

U.S. DEPARTMENT OF HEALTH,  
EDUCATION & WELFARE  
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KEY TO OCEANOGRAPHIC RECORDS DOCUMENTATION NO. 5

**Computer Programs In  
Marine Science**

Compiled by Mary A. Firestone

**NATIONAL OCEANOGRAPHIC DATA CENTER**

**WASHINGTON, D.C.**

**April 1976**

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## INTRODUCTION

Since the last edition of "Computer Programs in Oceanography" (compiled by Cloyd Dinger) was published in 1970, the National Oceanographic Data Center (NODC) has received many requests from scientists throughout the international oceanographic community for updated information on available programs. The present edition is in answer to this demand. Abstracts of seven hundred programs have been supplied by nearly eighty institutions in ten countries (See table, pages vii-viii).

Those familiar with the previous edition will note several changes. Four new chapters have been added -- Fisheries, Engineering, Coastal and Estuarine Processes, Pollution -- and the title has been changed to reflect a broader interest than was implied in the term "oceanography". In addition to the institution, language, and hardware indexes, a general index has been provided, allowing the reader to search by parameter, method, author, etc. And, most importantly, the number of abstracts has nearly doubled.

Most of the programs listed herein are not available from the NODC. If the NODC holds a copy of the program, it will be so noted at the end of the abstract, and the form will be described (listing, deck, etc.); copies of these materials can be supplied. Requests which involve small amounts of materials and labor will be answered free of charge; for larger requests, an itemized cost estimate will be provided, and work will begin after funds or a purchase order have been received. (Contact the Oceanographic Services Branch, telephone (202) 634-7439.)

Many programs available in published form can be obtained from the following sources, as noted in the abstracts:

National Technical Information Service (NTIS)  
U. S. Department of Commerce  
5285 Port Royal Road  
Springfield, VA 22161 Telephone (703) 321-8543

Assistant Public Printer  
U. S. Government Printing Office (GPO)  
Washington, DC 20402 Telephone (202) 783-3238

When ordering from NTIS or GPO, include the order number of the document, as well as payment in the form of check or money order. Telephone orders are accepted by both agencies if the purchaser has a deposit account.

Inclusion of information on a particular program does not guarantee that the program will always be available. When the originator feels that a program has become obsolete, support for that program often is discontinued. Every effort has been made to exclude all programs which definitely are not available to anyone. About one hundred programs from the previous edition have been retained because the NODC holds a reproducible, documented copy, or the originators have stated that they still support the programs. Judging from the requests received at NODC, many of these older programs are still of interest to the scientific community.

The NODC cannot assume responsibility for the accuracy of the abstracts, except those originated by our organization, or for the proper functioning of the programs. Most of these programs will not work, without modification, on a system other than the system for which they were designed.

Reports describing program libraries are available from several other federal agencies. "Scientific Program Library Abstracts" describes programs in the following categories: Regression and curve-fit, statistical analysis, matrix operations, simultaneous equations, numerical analysis, approximation of special function, operations research, computer simulation, time series analysis, sorts, applications programs, and miscellaneous. These programs were either written for or adapted to run on a Burroughs B5500 computer containing 32.6K 48-bit words of magnetic core storage, magnetic disk mass storage, and seven-channel tape drives. Contact:

Bureau of Mines, Division of ADP  
U. S. Department of the Interior  
P. O. Box 25407, Federal Center  
Denver, CO 80225

"Computer Software for Spatial Data Handling" is scheduled for publication in the summer of 1976; address inquiries to the Commission on Geographical Data Sensing and Processing of the International Geographical Union, 226 O'Conner Street, Ottawa, Ontario, Canada.

Several general-purpose programs are documented in "Computing Technology Center Numerical Analysis Library," report number CTC-39, available from NTIS for \$12.00 paper copy, \$2.25 microfiche. The Computing Technology Center is operated by the Nuclear Division of Union Carbide Corporation at the Oak Ridge National Laboratory in Oak Ridge, Tennessee.

"Argonne Code Center: Compilation of Program Abstracts," report number ANL-7411, supplement 8, may also be obtained from NTIS, for \$13.60 paper copy, \$4.25 microfiche. The Argonne Code Center is located at the Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439. Programs maintained by the Center are chiefly intended for use in nuclear reactor research. Included in the Environmental and Earth Science category are programs for the following: Environmental impact studies, geology, seismology, geophysics, hydrology and ground water studies, bioenvironmental systems analyses, meteorological calculations relating to the atmosphere and its phenomena, studies of airborne particulate matter, climatology, etc.

Persons or organizations wishing to contribute program information for use in future editions and for reference in answering requests are asked to use standard form 185, Federal Information Processing Standard Software Summary; several copies of the form are printed as the last pages in this book, beginning on page 226.

The technical assistance of the following NODC personnel is acknowledged, with appreciation:

Albert M. Bargeski  
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<p>Environmental Data Service: National Oceanographic Data Center National Geophysical and Solar-Terrestrial Data Center Center for Experiment Design and Data Analysis National Environmental Satellite Service National Ocean Survey National Weather Service: Techniques Development Laboratory Environmental Research Laboratories: Pacific Marine Environmental Laboratory Atlantic Oceanographic and Meteorological Laboratories National Marine Fisheries Service: Southwest Fisheries Center: La Jolla Laboratory Honolulu Laboratory Southeast Fisheries Center</p>	<p>Department of the Army: Coastal Engineering Research Center Department of the Navy: Civil Engineering Laboratory (Port Hueneme, CA) Naval Postgraduate School (Monterey, CA) Fleet Numerical Weather Central (Monterey, CA) Naval Undersea Research and Development Center (San Diego, CA) Naval Electronics Laboratory (San Diego, CA) Naval Undersea Center (Pasadena, CA) Naval Underwater Systems Center (New London, CT, and Newport, RI) Naval Surface Weapons Center (Silver Spring, MD) Naval Research Laboratory (Washington, DC) Fleet Weather Facility (Suitland, MD) Naval Oceanographic Office (Washington, DC) Defense Mapping Agency Hydrographic Center (Washington, DC) Naval Academy (Annapolis, MD)</p>	<p>U. S. Department of the Interior: Geological Survey: National Center (Reston, VA) Woods Hole, MA Menlo Park, CA Corpus Christi, TX U. S. Department of Transportation: Coast Guard: Oceanographic Unit (Washington, DC) Ice Patrol (New York, NY) Environmental Protection Agency: Gulf Breeze, FL</p>

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FFA

# PHYSICAL OCEANOGRAPHY

Transport Computations from  
Atmospheric Pressure

Language - FORTRAN I and IV  
Hardware - IBM 1620/IBM 1130

Computes the steady-state mass transport in the ocean from atmospheric pressure data, according to a system of analysis designed by Dr. N.P. Fofonoff. Input: Sea level pressure cards from the extended forecast division of the U.S. National Weather Service. Output: Meridional and zonal components of Ekman transport, total meridional transport, integrated transport, and integrated geostrophic transport (mean monthly values for the specified grid of alternate five degrees of latitude and longitude in the northern hemisphere. FORTRAN I program is listed in FRB manuscript series report (Ocean. and Limnol.) No. 163, by Dr. Charlotte Froese, 1963.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

Copy on file at NODC (FORTRAN I version for  
IBM 1620 only - above report)

STD Computations  
STP02

Language - FORTRAN IV  
Hardware - IBM 1130

Computes derived oceanographic quantities for Bisset-Berman STD casts. Printed output: Pressure, temperature, salinity, depth, sigma-t, specific volume anomaly, potential temperature and density, dynamic height, potential energy anomaly, oxygen content; sound velocity optional. FRB Manuscript Report (unpublished) No. 1071, by C.A. Collins, R.L.K. Tripe, and S.K. Wong, Dec. 1969.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

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Hydrographic Cast Computations  
HYDRO

Language - FORTRAN IV  
Hardware - IBM 1130

Computes derived oceanographic quantities for hydrographic casts. Printed output: Pressure, temperature, salinity, depth, sigma-t, specific volume anomaly, potential temperature and density, dynamic height, potential energy anomaly, oxygen content; sound velocity optional. FRB Manuscript Report (unpublished) No. 1071, by C.A. Collins, R.L.K. Tripe, and S.K. Wong, Dec. 1969.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

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Digitizes STD Data  
DEEP

Language - FORTRAN  
Hardware - Hewlett-Packard 2115A

Digitizes salinity-temperature-depth data on line, using time as a criterion for selecting points. Input are frequencies from the Bisset-Berman STD system and station heading data through a teletype. Output, on paper tape, has station identification fields, time interval between data points, and the STD data. Technical report No. 152 (unpublished manuscript), by A. Huyer and C.A. Collins, Dec. 1969. (See program WET, next page.)

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Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

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STD Processing  
WET

Language - FORTRAN  
Hardware - Hewlett-Packard 2115A

For shipboard processing of digitized salinity-temperature-depth data. Input is on paper tape (output from program DEEP). Output: The following parameters at standard pressures -- temperature, salinity, sigma-t, delta-d, specific gravity anomaly, specific volume anomaly, geopotential anomaly, and potential energy. Technical Report No. 152 (unpublished manuscript), by A. Huyer and C.A. Collins, Dec. 1969.

Pacific Biological Station  
Fisheries Research Board of Canada  
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Station Data Retrieval  
HYDROSEARCH

Language - ALGOL  
Hardware - Burroughs 6700

Provides easy, inexpensive retrieval of hydrographic station data, with selection criteria expressed in terms of data properties. Output: Summary listing, detailed listing, cards, tape, or disk file. The program can be run either in batch mode or interactively; users can be local or remote via dial-up, ARPANET or FTS. User's Guide available.

Ed Coughran  
University of California, San Diego  
P.O. Box 109  
La Jolla, CA 92037

Available from originator only

Telephone (714) 452-4050

STD Data Processing

Language - FORTRAN IV  
Hardware - CDC 3300

Processes salinity-temperature-depth recorded in the field. BCF Special Scientific Report-Fisheries No. 588, "Processing of Digital Data Logger STD Tapes at the Scripps Institution of Oceanography and the Bureau of Commercial Fisheries, La Jolla, California," by Dr. James H. Jones, June 1969.

Oceanic Research Division  
Scripps Institution of Oceanography  
P.O. Box 109  
La Jolla, CA 92037

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Salinity Anomaly  
ISALBP

Language - FORTRAN II  
Hardware - CDC 3100

Calculates the salinity anomaly from a standard T/S or Theta/S curve for North Atlantic Central water developed by L.V. Worthington. The results are output on the line printer. Author - A.B. Grant (June 1968).

Director  
Bedford Institute of Oceanography  
P. O. Box 1006  
Dartmouth, N. S. B2Y 4A2

Available from originator only

Oxygen Saturation, Oxygen Anomaly  
ISATBP

Language - FORTRAN II  
Hardware - CDC 3100

Calculates the percentage of oxygen saturation in seawater, according to tables and formulae by Montgomery (1967), as well as an oxygen anomaly on a sigma-t surface, according to a tabulated curve by Richards and Redfield (1955). The results are output on the line printer, station by station. Author - A.B. Grant (June 1968).

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Available from originator only

Plot\*Theta-S Curves

Language - FORTRAN II  
Hardware - CDC 3100/PDP-8/CalComp Plotter

Plots potential temperature vs. salinity. Input on cards. Output: Printed listing and punched paper tape. Station plot uses a PDP-8 computer, paper tape reader, and CalComp Plotter: Author - R. Reiniger.

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Plots Station Positions

Language - FORTRAN II  
Hardware - CDC 3100/PDP-8/CalComp Plotter

Plots cruise station positions on Mercator projection and writes in station number. "PLOTL" plotting routine used with PDP-8 and CalComp plotter. Author - R. Reiniger (Sept. 1968).

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Nutrient Concentrations  
PEAKS

Language - FORTRAN II  
Hardware - CDC 3150

Reduces a set of discretely sampled voltages from the Technicon AutoAnalyzer to a set of peak heights and thence to a set of nutrient concentrations. Input: Magnetic tape produced by a Techal-Digitizer and Kennedy Incremental Recorder; card deck containing identifiers for all samples and standards. Output: Tables of peak heights and of derived nutrient concentrations. Up to 8 parameters and 400 samples can be accommodated per run.

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Available from originator only

Telephone (902) 426-3676

STD Tables and Plots  
STD

Language - FORTRAN IV  
Hardware - HP 2100A/Disk/CalComp  
optional

Reduces data from Guildline STD and Hewlett Packard data logger to tables of salinity-temperature-depth information and prepares it for plotting. The equation giving salinity as a function of conductivity ratio, temperature, and pressure is due to Dr. Andrew Bennett.

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Consistency of Physical and Chemical Data  
C 18 A 18 X

Language - COBOL and FORTRAN subroutines  
Hardware - IBM 360-50/48K/Disk/2 tape units

Performs consistency check of physical and chemical data obtained during oceanographic cruises. Input: Disk pack with recorded and sorted data, parameter card indicating whether the input corresponds to physical or chemical data. Output: Listing of inconsistent data.

Capitan de Fragata Nestor Lopez Ambrosioni Available from originator only  
Centro Argentino de Datos Oceanograficos  
Avenida Montes de Oca 2124  
Buenos Aires, Republica Argentina Telephone 21-0061

Calculation of Thermometric Values  
C 18 A 23 X

Language - COBOL and FORTRAN subroutines  
Hardware - IBM 360-50/58K/Disk/2 tape units

Calculates thermometric depth and corrected temperatures. Input: Disk with physical data and calibration table of reversing thermometers. Output: Listing of evaluated and accepted physical data.

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Centro Argentino de Datos Oceanograficos  
Avenida Montes de Oca 2124  
Buenos Aires, Republica Argentina Telephone 21-0061

Station Data System Final Values  
C 18 A 32 X FQ

Language - COBOL and FORTRAN subroutines  
Hardware - IBM 360-50/64K/Disk/2 tape units

Interpolates temperature, salinity, and oxygen at standard depths; calculates sigma-t and sound velocity at observed and standard depths; also calculates specific volume anomaly and dynamic depth anomaly at standard depths. Input: Disk pack with accepted primary data records. Output: Listing of observed and computed values at observed and standard depths.

Capitan de Fragata Nestor Lopez Ambrosioni Available from originator only  
Centro Argentino de Datos Oceanograficos  
Avenida Montes de Oca 2124  
Buenos Aires, Republica Argentina Telephone 21-0061

Daily Seawater Observations

Language - FORTRAN IV  
Hardware - CDC CYBER 74

Input: Daily observations of temperature and salinity. Output: (1) Quarterly statistics, (2) annual statistics, (3) listing of seven-day normally weighted means for one year, and (4) plot of normally weighted means for one year. Author - H. Somers. Early version in FORTRAN II-D for the IBM 1620.

Marine Environmental Data Service Available from originator only  
580 Booth Street  
Ottawa, Ont. K1A 0H3 Telephone (613) 995-2011

Data Management System for Physical and Chemical Data  
OCEANS V

Language - COBOL, FORTRAN, PL/1, machine lang.  
Hardware - CDC 6400 under SCOPE 3.3, 125K octal words/IBM 360-85 under MVT, 200K decimal bytes

The OCEANS V system is designed to make available any physical, chemical, or meteorological

data collected as manual recordings or analog traces. The system is divided into a number of modules and presently processes data collected using Nansen bottles and mechanical bathythermographs. There are three stages to the system: (1) edit and quality control of newly collected data, (2) addition of these data to existing historical data, and (3) retrieval/report from these historical data.

D. Branch  
Marine Environmental Data Service  
580 Booth Street  
Ottawa, Ont. K1A 0H3

Available from originator only  
Telephone (613) 995-2011

Mass Transport and Velocities  
GEOMASS

Language - FORTRAN II  
Hardware - PDP 8 E/12K

Calculates velocities at standard depths between two stations relative to deepest common depth; also calculates trapezoidally mass transport between successive depths and cumulative mass transport from surface. Assumes deepest common depth is level of no motion. Author - C. Peter Duncan.

Donald K. Atwood  
Marine Sciences Department  
University of Puerto Rico  
Mayaguez, PR 00708

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Telephone (809) 892-2482

Station Data  
TWIRP

Language - FORTRAN IV  
Hardware - PDP 10

Interpolates oceanographic data; calculates sigma-t, dynamic depth anomaly, potential temperature, and delta-t. Input: Observed thermometric depths, temperature, salinity, and chemistry. Output: Temperature, salinity, sigma-t, potential temperature, delta-t at observed depths and all of these plus dynamic height anomaly interpolated to standard depths. Author - C. Peter Duncan.

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Thermometer Correction, Thermometric Depth  
GIESE 04

Language - FORTRAN IV  
Hardware - PDP 10

Corrects thermometers and calculates thermometric depth, as per formulae by Keyte. Input: Thermometer number, uncorrected reading, auxiliary thermometer reading, data, cruise number, station number, wire out. Output: Corrected temperatures, corrected unprotected thermometer readings, and thermometric depth. Author - Mary West.

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University of Puerto Rico  
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Available from originator only  
Telephone (809) 892-2482

Oceanography Station Computer Program

Language - FORTRAN IV  
Hardware - Burroughs 6700/2125 words

Processes observed station data to obtain interpolated values of temperature, salinity, oxygen, specific volume anomaly, dynamic depth, sigma-t, and sound velocity. The three-point Lagrange interpolation equation and the Wilson sound velocity formula are used in the computations. Running time is two seconds per station.

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Ciudad Universitaria  
Mexico 20, D.F.

Copy on file at NODC.

Telephone 548-65-00, ext. 537

Flexible System for Biological, Physical,  
and Chemical Data.  
SEDHYP (System d'Exploitation des Donnees  
en Hydrologie Profonde)

Language - FORTRAN IV  
Hardware - XDS Sigma 7/40K 32 bit words with  
overlay

A very flexible system of about 5,000 cards which computes, interpolates, lists, and plots physical, chemical, and biological parameters. Input includes: List of the parameters to be listed, computed, interpolated, plotted, and copied on files; method of computation and interpolation; name of the parameter to be used as "interpolator"; list of the interpolation levels; format of the processed data. Output: Listings of the observed, computer, or interpolated parameters; plots of one parameter versus another parameter with all the curves on the same graph, or by groups of N curves on the same graph; copy of the values of one parameter on a working file for further use by other programs. The options, input on cards, are analysed and controlled; each station is stored in "common" area; then parameters are computed and interpolated. Files in a new format (FICPAR) are created; each file contains all the values of all the stations for one parameter. The plot is realized from two files of the FICPAR type. Documentation: Presentation de SEDHYP, Dec. 1973; also, Catalogues des methodes de calcul, d'interpolation et de reduction, Dec. 1973.

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Telephone 80.46.50, telex. 94-627

Subroutines for Physical, Chemical and  
Biological Parameters  
CO4 SAL, C44 TETA, C 46 SIGM Z, etc.

Language - FORTRAN IV  
Hardware - XDS Sigma 7

Subroutines compute the following parameters: Depth, pressure, salinity, potential temperature, sigma-o, oxygen saturation percent, sigma-t, delta-st, potential sigma, alpha, delta-alpha, sigma-stp, nitrate, saturated oxygen, apparent oxygen utilization, sound velocity, dynamic depth, potential energy anomaly, salinity or temperature flux, Vaisala frequency. Input: Value of all parameters to be used in the computations and the catalog identification number of the chosen method. Documentation: "Catalogue des methodes de calcul des parameters physiques, chimiques et biologiques," Dec. 1973.

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Interpolation Subroutines  
INTERP1, INTERP2, etc.

Language - FORTRAN IV  
Hardware - XDS Sigma 7

Subroutines interpolate the values of a parameter at different levels; for each subroutine, the method is different: spline function, polynomial interpolation, linear interpolation, Lagrange polynomial interpolation. Input: The values of the parameter to be interpolated, the corresponding values of the parameter to be used as "interpolator" (e.g., depth), list of the levels of the "interpolator" for which interpolation is asked, the number of points to be used. Documentation: "Catalogue des methodes d'interpolation," Dec. 1973.

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Processes STD and CTD Data  
SEDSTD (Systeme d'Exploitation des  
DONNEES STD, CTD)

Language - FORTRAN IV  
Hardware - XDS Sigma 7/25K words

The system includes programs to copy the raw data from paper tape onto magnetic tape, to produce validated data from the raw data using calibration information, and to process the validated data. It is possible to reprocess the stations from raw data or validated data on magnetic tape. Option information to be supplied includes: identification number of the stations to be processed, whether the data are raw or validated, list of the depth levels to be listed, and scale of the parameters to be plotted. Output: Listings of depth or pressure, temperature, salinity (observed or computed from conductivity), oxygen, oxygen saturation percent, sigma-t, potential temperature, potential conductivity, delta-alpha, and delta-d for each station; plots of temperature, salinity, oxygen and sigma-t vs. depth, and temperature vs. salinity for each station; magnetic tape files of raw and validated data. Documentation: Presentation de SEDSTD, Dec. 1973.

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29273 Brest Cedex, France

Available from originator only

Telephone 80.46.50, telex 94-627

Reads, Calculates, Interpolates Station Data  
CAPRICORN

Language - FORTRAN IV  
Hardware - IBM 360-65/320K bytes

Reads oceanographic station data from cards or NODC formatted 120-character-per-record tape. If desired, it can edit the NODC tape and/or calculate and interpolate oceanographic parameters for each station or calculate and interpolate variables at specified sigma theta surfaces or potential temperatures. (See subroutines F3, SECPG, EDIT, and PLTDT.)

Ruth McMath  
Department of Oceanography  
Texas A&M University  
College Station, TX 77843

Available from originator only

Telephone (713) 845-7432

Station Data Calculations  
F3

Language - FORTRAN IV  
Hardware - IBM 360-65

This subroutine takes as input, through its common blocks, the observed values for depth, temperature, salinity, and, if available, oxygen, phosphate, silicate, nitrate, and nitrite. It then interpolates salinity and temperature to standard depths, using either a linear means or by weighting two Lagrangian three-point polynomials (depending on whether there are three or four properly distributed data points). The subroutine calculates the following for both the observed and standard depths: potential temperature, thermocline anomaly, specific volume anomaly, sigma-t, the sigma values for depths of 0, 1000, 2000, 3000, 4000, and 5000 meters. Computations of sound velocity, dynamic height, and transport functions are made for standard depths only. The computation for stability is made at the observed depths only. The values of oxygen, phosphate, silicate, nitrate, and nitrite are simply printed out, if they are read. Subroutine F3 is a composite of programs written by various authors: The original "F" program was written by Kilmer and Durbury for the IBM 650. This program was expanded by Nowlin and McLellan for the IBM 7094 and again by Eleuterius for the IBM 360. The Scripps SNARKI program provided the basis for much of the present version. (See program CAPRICORN.)

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Plots Station Data  
PLTEDT

Language - FORTRAN IV  
Hardware - IBM 360-65/Houston Omnigraphic  
Plotter

This subroutine generates a plot tape to make any of the following 13 plots: Temperature vs. depth, salinity vs. depth, sigma-t vs. depth, temperature vs. salinity, oxygen vs. sigma-t, oxygen vs. temperature, temperature vs. silicate, potential temperature vs. salinity, phosphate vs. depth, sound velocity vs. depth, stability vs. depth, silicate vs. depth, oxygen vs. depth. The size of the plots is 11 x 17 inches. (See program CAPRICORN)

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Calculates Station Data  
SECPG

Language - FORTRAN IV  
Hardware - IBM 360-65

This subroutine computes the depths that correspond to input density surfaces. It then interpolates temperature, salinity, oxygen, phosphate, nitrate, and nitrite to these computed depths. Using these interpolated values for temperature and salinity, the following are calculated at each computed depth: Potential temperature, thermosteric anomaly, specific volume anomaly, sigma theta for depths of 0, 1000, 2000, 3000, 4000, and 5000 meters, transport, dynamic height and acceleration potential. Uses Lagrangian interpolation or linear interpolation, depending on point distribution. (See program CAPRICORN)

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Station Data  
HYD2

Language - HP ASA Basic FORTRAN  
Hardware - HP 2100/13K words/Keyboard/CalComp  
Plotter, paper tape punch, and  
magnetic tape unit optional

Computes station data. Input: Header information, depth, temperature, salinity, oxygen and silicate from a user-specified device. Output: Station data including depth, temperature, salinity, oxygen, silicate, pressure, potential temperature, dynamic height, etc. Plot or tape output optional.

Chris Polloni  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543.

Available from originator only

Telephone (716) 548-1400

Brunt-Vaisala Frequency  
QBVFRQ

Language - FORTRAN IV  
Hardware - XDS Sigma 7/204 words

Subprogram computes the Brunt-Vaisala frequency (radians/sec) from station data. Input: Gravitational acceleration, pressure, temperature, salinity. Requires double precision of program ATG.

Information Processing Center  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Dynamic Height  
DYNHT

Language - FORTRAN IV  
Hardware - XDS Sigma 7/85 words

Subprogram calculates an array of dynamic heights for specified arrays of pressure and specific volume anomalies.

Jacqueline Webster  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Potential Energy Anomaly  
PEN

Language - FORTRAN IV  
Hardware - XDS Sigma 7/103 words

Subprogram computes the potential energy anomaly from pressure and specific volume anomaly.

Jacqueline Webster  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Various Parameters from Station Data  
OCCOMP

Language - FORTRAN IV  
Hardware - XDS Sigma 7/23K words

Computes various oceanographic parameters from NODC format station data; interpolates parameters to standard depths; computes geostrophic velocity and volume transport for successive stations.

Mary Hunt  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Specific Volume Anomaly  
SVANQM

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Subroutine computes the specific volume anomaly, given the pressure and the specific volume, from an empirical formula devised by Fofonoff and Tabata.

Mary Hunt  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Copy on file at NODC (listing; documentation)  
Telephone (617) 548-1400

Pressure Subroutine  
PRESS

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Subroutine computes a series of pressures from a given series of depths, temperatures, salinities, and their latitude. The equation for pressure is integrated by successive approximations.

Mary Hunt  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Copy on file at NODC (listing, documentation)  
Telephone (617) 548-1400

Reads Station Data  
DATA

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Subroutine reads oceanographic station data cards and returns the information therein to the user, one station for each call.

Mary Hunt Available from originator only  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543 Telephone (617) 548-1400

Geostrophic Velocity Difference Subroutine  
VEL Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Computes geostrophic velocity difference between two oceanographic stations, according to a formula described by N.P. Fofonoff and Charlotte Proese.

Mary Hunt Copy on file at NODC (listing, documentation)  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543 Telephone (617) 548-1400

Volume Transport  
VTR Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Computes volume transport between two stations.

Mary Hunt Available from originator only  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543 Telephone (617) 548-1400

Sigma-t  
SIGMAT and DSIGMT Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Subroutine computes sigma-t from temperature and salinity by Knudsen's formula, rewritten by Fofonoff and Tabata. DSIGMT is the double-precision form of SIGMAT.

Mary Hunt Copy on file at NODC (listing, documentation)  
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Woods Hole, MA 02543 Telephone (617) 548-1400

Adiabatic Temperature Gradient  
ATG Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Subroutine calculates adiabatic temperature gradient for specified values of pressure, temperature, and salinity, using an empirical formula developed by N.P. Fofonoff.

Mary Hunt Copy on file at NODC (listing, documentation)  
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Potential Temperature  
POTEMP Language - FORTRAN IV  
Hardware - XDS Sigma 7/100 words

Subprogram computes the potential temperatures at a given temperature, salinity, and pressure, using a formula derived from a polynomial fit to laboratory measurements of thermal expansion.

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Available from originator only  
Telephone (617) 548-1400

Specific Volume  
SPVOL

Language - FORTRAN IV  
Hardware - XDS Sigma 7/129 words

Subprogram computes the specific volume (ml/g) of seawater at a given temperature, pressure, sigma- $\theta$ , and sigma-t, using formula by V.W. Ekman (rewritten by Fofonoff and Tabata). Input: values of sigma-t as calculated by subprogram SIGMAT.

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Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Oxygen  
OPLOT

Language - FORTRAN IV  
Hardware - CDC 3300

Computes oxygen in ml/l and percent saturation.

U.S. Coast Guard Oceanographic Unit  
Bldg. 159-E, Navy Yard Annex  
Washington, DC 20590

Available from originator only  
Telephone (202) 426-4642

Chlorophyl  
CHLO

Language - FORTRAN IV  
Hardware - CDC 3300

Computes chlorophyl in mg/l.

U.S. Coast Guard Oceanographic Unit  
Bldg. 159-E, Navy Yard Annex  
Washington, DC 20590

Available from originator only  
Telephone (202) 426-4642

Salinity  
SALTY

Language - FORTRAN IV  
Hardware - CDC 3300

Computes salinity in ppt with temperature correction and shear correction between each standard water sample.

U.S. Coast Guard Oceanographic Unit  
Bldg. 159-E, Navy Yard Annex  
Washington, DC 20590

Available from originator only  
Telephone (202) 426-4642

Temperature-Salinity Class Volume  
TSVOL

Language - FORTRAN IV  
Hardware - CDC 3300

Calculates volume of water by T-S class, area within which station is located (in sq. km) and total volume for each T-S class.

U.S. Coast Guard Oceanographic Unit  
Bldg. 159-E, Navy Yard Annex  
Washington, DC 20590

Available from originator only  
Telephone (202) 426-4642

Thermometer Correction  
THERZ

Language - FORTRAN IV  
Hardware - CDC 3300

Corrects deep-sea reversing thermometers using calibration factors; computes thermometric depth for unprotected thermometers, lists bad thermometers and their malfunctions, computes observed L-Z, plots L-Z curve (on line), computes used L-Z and picks from the L-Z curve the depths for the other bottles.

U.S. Coast Guard Oceanographic Unit Available from originator only  
Bldg. 159-E, Navy Yard Annex  
Washington, DC 20590 Telephone (202) 426-4642

Transport  
XPORT

Language - FORTRAN IV  
Hardware - CDC 3300/CalComp Plotter

Calculates sigma-t, dynamic heights, solenoidal values of average temperature and salinity volume flow, current velocity at top of each solenoid, distance (n.m.) between stations, specific heat, heat and salt transport, net volume flow for each pair of stations, net volume flow in form of cold core and warm water for each station and plots solenoid graph on off-line plotter.

U.S. Coast Guard Oceanographic Unit Available from originator only  
Bldg. 159-E, Navy Yard Annex  
Washington, DC 20590 Telephone (202) 426-4642

Plots Temperatures, Lists Mixed Layer Depths  
WEEKPLOT

Language - FORTRAN  
Hardware - Burroughs 6700/Less than 20K words/  
CalComp Plotter

Plots sea temperature for one-degree quadrangles for the eastern tropical Pacific Ocean; also, computes and lists mixed layer depths. Mixed layer depths are computed by an empirical formula and modified by reports received from tuna fishing vessels. Input: Disk files of synoptic marine radio weather reports, prepared separately from punched cards.

A.J. Good Available from originator only  
Southwest Fisheries Center  
National Marine Fisheries Service, NOAA  
P.O. Box 271  
La Jolla, CA 92037 Telephone (714) 453-2820, ext. 325

Constants for Harmonic Synthesis of Mean Sea  
Temperatures, HARMONIC

Language - ALGOL  
Hardware - Burroughs 6700/Less than 30K words/  
Disk input and output

Computes five constants to be used in harmonic synthesis of mean sea temperatures, by one-degree quadrangles. Monthly variations of mean sea temperature are treated by a Fourier series analysis. Disk file of constants, by one-degree quadrangles for the Pacific Ocean.

A.J. Good Available from originator only  
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National Marine Fisheries Service, NOAA  
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Vertical Section Plots  
ESTPAC

Language - FORTRAN 63  
Hardware - CDC 3600/32K words/3 tape units/  
Calcomp Plotter

Constructs vertical temperatures and salinity sections from STD magnetic tape on 30-inch-wide

plotting paper. The product of the two dimensions (station distance  $\times$  depth) of a data array times four must not exceed 32,000. NOAA Technical Report NMFS CIRC-365.

Kenneth A. Bliss  
Southwest Fisheries Center  
National Marine Fisheries Service, NOAA  
P.O. Box 271  
La Jolla, CA 92037

Available from originator only

Telephone (714) 453-2820

Converts STD Data  
RDEDTP

Language - FORTRAN  
Hardware - CDC 3600/15K words/2 tape units

Reads raw STD data from tape, converts to engineering units, removes extraneous values, smooths and writes a new tape. U.S. Fish and Wildlife Service Spec. Sci. Rept. Fish. 588, by James H. Jones, 1969. This program is presently in the state of revision.

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Southwest Fisheries Center  
National Marine Fisheries Service, NOAA  
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La Jolla, CA 92037

Available from originator only

Telephone (714) 453-2820

Corrects STD Data  
TPMOD

Language - FORTRAN  
Hardware - CDC 3600/10K words/2 tape units

Reads STD data from output of program RDEDTP, calibrates data, adds station location and data, and writes a final corrected tape. U.S. Fish and Wildlife Service Spec. Rept. Fish. 588, by James J. Jones, 1969.

Kenneth Bliss  
Southwest Fisheries Center  
National Marine Fisheries Service, NOAA  
P.O. Box 271  
La Jolla, CA 92037

Available from originator only

Telephone (714) 453-2820

Environmental Dynamics Subroutines  
OCEANLIB

Language - BASIC  
Hardware - IBM 360/Dartmouth DTSS

A series of subroutines: ALPHA calculates Alpha 35, 0, P for any depth by interpolating standard values from a random access file; GRAV computes the resultant gravity at any latitude, using the international gravity formula. SIGMAT calculates sigma-o and sigma-t using empirical formulas of Knudsen for sigma-o and LaFond for sigma-t. DENSITY calculates the in situ density of seawater, using empirical formulas developed by LaFond and others. SOUND computes sound velocity using the empirical formula developed by Leroy in 1968. POSIT computes the direction and distance between points on the earth's surface, using spherical trigonometry, allowing the earth's radius to vary.

LCDR W.C. Barney  
Environmental Sciences Department  
U.S. Naval Academy  
Annapolis, MD 21402

Available from originator only

Telephone (301) 267-3561

Geostrophic Current  
CURRENT

Language - BASIC  
Hardware - IBM 360/Dartmouth DTSS/14.5K

Calculates geostrophic current at standard depths between adjacent stations using method of

dynamic height or geopotential anomalies. Requires OCEANLIB subroutines.

LCDR W.C. Barney  
Environmental Sciences Department  
U.S. Naval Academy  
Annapolis, MD 21402

Available from originator only

Telephone (301) 267-3561

Monthly Sonic Layer Depth

Language - FORTRAN  
Hardware - IBM 7074

Calculates sonic layer depth from BT traces and converts position to plot on Mercator base without overprints. OS No. 53480. Author - D.B. Nix.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only

Telephone (301) 763-1449

Vertical Temperature Gradients

Language - FORTRAN  
Hardware - IBM 7074

Computes, from geographic station data, the vertical temperature gradient largest in absolute magnitude between successive standard depths, for each station. These gradients are tabulated in frequency distribution format, and averages are calculated for each one-degree square. OS No. 20126 Part 2. Author - C.S. Caldwell.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only

Telephone (301) 763-1449

Water Clarity

Language - FORTRAN V  
Hardware - UNIVAC 1108/3K words/Drum

Combines data taken with Scripps illuminometer, transmissometer, Secchi disk and Forel-Ule Scale. Logarithmic combination of parameters are summed over observation intervals to yield meter by meter results. Input: Diffuse attenuation coefficients, transparency readings, depths of observations via cards. Output: Visibility loss at specific levels of the water column and contrast loss expressed in decibel values.

Philip Vinson  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only

Telephone (202) 433-3878

Oceanographic Data Computation  
TPCONV

Language - FORTRAN EXTENDED  
Hardware - CDC 6500/15K 60 bit words/Two tape units

Assembles temperature, salinity, and sound velocity at forty standard oceanographic depths from any preselected ocean area onto magnetic tape. Also included for each oceanographic station is the layer depth, layer sound velocity, in-layer gradient, below-layer gradient, axis depth and axis depth sound velocity. Output used by program SUMMARY. NUC Tech. Note 1223.

John J. Russell  
Naval Undersea Center  
Code 14  
San Diego, CA 92132

Available from originator only

Telephone (714) 225-6243

Variance and Standard Deviation  
SUMMARY

Language - FORTRAN EXTENDED  
Hardware - CDC 6500/63K 60 bit words/Disk/  
Two tape units

Orders selected oceanographic data at each of forty standard levels and selects maximum, 10, 20, 30, 40, 50, 60, 70, 80, 90, 25 and 75th percentiles, and minimum. Also computes variance and standard deviation at each of the forty standard depths. Input: Data generated by the program TPCONV. Output: Deck of eighty-one cards - two cards at each of the forty standard depths. First card contains maximum, percentiles (above), minimum, number of observations, and identification at one depth. The second card contains variance, number of observations, mean, depth number, and identification. NUC Tech. Note 1224

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San Diego, CA 92132

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Sigma-T  
INVREJ

Language - ANSI FORTRAN  
Hardware - CDC 3300

Removes inversions in sigma-t profiles prior to calculation of buoyance-frequency profile. The following options are available: binomial smoothing, minima rejection, maxima rejection, and local smoothing.

K. Crocker  
Naval Underwater Systems Center  
Newport, RI 02840

Available from originator only  
Telephone (401) 841-3307

STD Processing  
OCEANDATA

Language - ANSI FORTRAN  
Hardware - CDC 3300/UCC plotter

Converts raw Plessey CTD-STD data (frequency or period average) to parametric form, corrects salinity for time constant mismatch, rejects invalid data, averages data by designated intervals (normally 1 decibar). Provides listing, plots, disk and tape files of corrected raw data and reduced data. Several special purpose editions available.

K. Crocker  
Naval Underwater Systems Center  
Newport, RI 02840

Available from originator only  
Telephone (401) 841-3307

Internal Waves  
WITCOMB

Language - USASI FORTRAN  
Hardware - CDC 3300 / 26K words

Calculates internal wave eigenvalues (dispersion curves) and eigenfunctions as solutions to the linear internal wave equation. Input: Density as a function of depth in the ocean from the surface to the bottom. Data points do not have to be equally spaced in depth. Output: Density profile (smoothed), buoyance-frequency profile, dispersion curves (all listings); plotter tape for preceding plus eigenfunctions. Performs numerical integration of internal wave equation using assumed values of frequency and wavenumber until boundary conditions are satisfied by trial and error.

Alan T. Massey  
Naval Underwater Systems Center  
Newport, RI 02840

Available from originator only  
Telephone (401) 841-4772

Interpolation for Oceanographic Data

Language - FORTRAN  
Hardware - CDC 3200/IBM 1620

Interpolates the values of depth, temperature, and salinity at isentropic levels (constant values of the density functions). Uses a four-point Lagrangian polynomial. Exception: Modifications are made where common oceanographic conditions distort the polynomial. Technical Report TM-312 by J. Farrell and R. Lavoie, Feb. 1964.

Naval Underwater Systems Center  
Newport, RI 02840

Copy on file at NODC (above report)

STD-S/V Data  
S2049

Language - FORTRAN V  
Hardware - UNIVAC 1108/CalComp Plotter

Performs general purpose processing of STD-S/V data; includes conversion to oceanographic units, editing, ordering relative to increasing depth, calculation of dependent variables, and plotting of results. Input: Pressure or depth, temperature, salinity or conductivity, and sound speed in units of frequency, period or geophysical units. Density computed by integration of P, T, S throughout the water column; sound speed by Wilson's equation; potential temperature by Pofonoff's equation. Output: Magnetic tape, listing, plots of profiles, T vs. S, cross-sections, geographic contours; measured parameters plus density, sound speed, potential quantities, Brunt-Vaisala frequency.

Michael Fecher  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only  
Telephone (203) 442-0771, ext. 2834

Thermometric Depth Calculation  
CAST

Language - HP FORTRAN IV under RTE  
Hardware - HP 2100S/12K words core/10K  
for RTE/CalComp Plotter

Uses thermometer readings from Nansen bottles to calculate thermometric depths of the bottles, following method described in instructions for filling out Naval Oceanographic Office "A Sheet." Thermometric depths are printed with input data; L-Z graph is plotted.

J. Dean Clamons  
Shipboard Computing Group, Code 8003  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only  
Telephone (202) 767-2024

Thermometer Data File Handler  
THERMO

Language - HP FORTRAN IV under RTE  
Hardware - HP 2100S/12K words core/10K for RTE

Maintains and builds a disk file containing correction factors for thermometers used on Nansen casts. Program is interactive and can add, delete, change, or list data for each thermometer.

J. Dean Clamons  
Shipboard Computing Group, Code 8003  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only  
Telephone (202) 767-2387

Internal Gravity Waves  
DISPER

Language - FORTRAN  
Hardware - CDC 3800

Calculates frequency - wavenumber dispersion relations for internal gravity wave models. Input: Brunt-Vaisala frequency distribution, wavenumber range, mode number range. Output: Frequency as a function of wavenumber for specified modes, in tabular or line printer plot form. NRL Report 7294, "Numerical Calculation of Dispersion Relations for Internal Gravity Waves," by T.H. Bell, Sept. 1971.

T. H. Bell  
Ocean Sciences Division  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only

Telephone (202) 767-3122

Sea Surface Temperature  
Analysis Model  
MEDSST

Language - FORTRAN/COMPASS  
Hardware - CDC 3100/CDC 3200/32K 24 bit words

Performs a synoptic sea-surface temperature analysis, using a Laplacian relaxation technique to generate the final field. EPRF Program Note 5, "Mediterranean Sea-Surface Temperature Analysis Program MEDSST," by A.E. Anderson, Jr., S.E. Larson, and L. I'Anson.

Sigurd Larson  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

Available from originator only

Telephone (408) 646-2868

Objective Thermocline Analysis

Language - FORTRAN IV-H  
Hardware - IBM 360/CDC 6500

Reads digitized bathythermograph traces and then analyzes them objectively by Gaussian and non-Gaussian methods for the top, center, and base of the main thermocline. Additionally, such features as multiple thermoclines, inversions, and thermal transients are identified and their key points are included in the information data printout. "Objective Digital Analysis of Bathythermograph Traces," thesis by Eric F. Grosfils, Dec. 1968.

Naval Postgraduate School  
Monterey, CA 93940

Available from NTIS, Order No. AD 689 121/LK,  
\$5.75 paper, \$2.25 microfiche.

Wet Bulb Temperature  
WETBLB

Language - FORTRAN IV  
Hardware - CDC 6600

Computes the wet bulb temperature from the inputs of dry bulb temperature, pressure, and relative humidity. This is sometimes useful for generating homogeneous archive outputs (filling in missing wet bulb temperatures from the other variables).

Jerry Sullivan  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

Available from originator only

Telephone (202) 634-7288

Internal Wave Oscillations  
ZMODE

Language - FORTRAN  
Hardware - CDC 6600 & 7600 (original program),  
UNIVAC 1108 (modified version)/31K  
words

Computes eigenfunctions and dispersion relations for internal wave oscillations in a density-stratified water column, using Newton-Raphson approximation technique to obtain solutions for eigenfrequencies and associated mode functions. Input: STD data on cards. Output: Tabular output of density, Brunt-Vaisala frequency, dispersion relations, eigenfunctions. User's Manual (RDA-TR-2701-001) by R&D Associates, Santa Monica, California, for implementation on CDC 6600 and CDC 7600; modified User's Manual by A. Chermak for AOML's UNIVAC 1108.

Andrew Chermak  
Ocean Remote Sensing Laboratory  
Atlantic Oceanographic and  
Meteorological Laboratories, NOAA  
15 Rickenbacker Causeway  
Miami, FL 33149

Available from originators only

Telephone (305) 361-3361

### Isentropic Interpolation

Language - FORTRAN  
Hardware - IBM 360-65/61K bytes

Provides values of several variables at selected density ( $\sigma_t$ ) levels; interpolation by cubic spline, with modifications for oscillation. Input: NODC SD2 (station data) file. Output: Interpolated values of depth, temperature, salinity, pressure, specific volume anomaly, dynamic height and acceleration potential, on magnetic tape. Author - Douglas R. Hamilton.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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### Potential Temperature and/or Density POTDEN

Language - Assembler  
Hardware - IBM 360-65/50K bytes

Reads the NODC SD2 (station data) file and replaces temperature and/or  $\sigma_t$  with potential temperature and/or density. Requires subroutine PODENS. Author - Walter Morawski.

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National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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### SIGMAT

Language - FORTRAN  
Hardware - IBM 360-65/740 bytes (object form)

Computes  $\sigma_t$ , giving a rounded floating point answer accurate to four significant decimal digits (xx.xx); also returns the computed variable FS (a function of  $\sigma_t$ ), a short floating point number. Author - Robert Van Wie.

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National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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### Dynamic Depth Anomaly DYANOM

Language - FORTRAN IV-G  
Hardware - IBM 360-65

Subroutine computes dynamic depth anomaly. Author - Robert Van Wie.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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### Computes Salinity from Conductivity, T, P SALINE

Language - FORTRAN  
Hardware - IBM 360-65

Computes salinity from conductivity in milli mhos/cm, pressure in decibars, and temperature in degrees C. Valid for temperature range 0-30 degrees C, salinity range 20-40 ppt, pressure range 0-3000 decibars; measurements outside these ranges may cause a significant error in the resulting salinity computation. Author - Philip Hadsell.

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National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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Volume Transport Function  
QFUN

Language - FORTRAN  
Hardware - IBM 360-65

Computes the volume transport function at each depth of a hydrographic station. Author - Ralph Johnson.

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National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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Telephone (202) 634-7439

Potential Temperature, Potential Density  
PODENS

Language - FORTRAN IV-G  
Hardware - IBM 360-65

Computes potential temperature and potential density from depth, temperature, and salinity. Author - Dave Pendleton.

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National Oceanographic Data Center  
NOAA/EDS  
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Volume Transport  
VOLTRN

Language - FORTRAN IV  
Hardware - IBM 360-65

Computes volume transport between any two stations, according to the formulas in D. Pendleton's "Specifications for a subroutine which computes the transport function," NODC, August 29, 1972. Author - Ralph Johnson.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

Copy on file at NODC  
Telephone (202) 634-7439

Computes Pressure  
PRESSR

Language - FORTRAN IV  
Hardware - IBM 360-65

Computes pressure from latitude, depth, temperature, salinity, and sigma-t. Must be called serially through a cast since the calculation of pressure at each depth after the surface involves the depth, density, and pressure of the preceding depth. Author - Sally Heimerdinger.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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Telephone (202) 634-7439

Temperature Difference Calculations  
TEMPDIFF

Language - Assembler  
Hardware - IBM 360-65/36K bytes

Takes selected BT's or sections of the BT geofile and sums the temperature difference for each Marsden square, one degree square and month; these may be summed over 10, 15, or 20-meter intervals. Input: BT records sorted by Marsden (ten-degree) squares. Author - Walter Morawski.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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Telephone (303) 634-7439

RENAS Data Processing and Analysis  
Programs; Data Management System (DMS)

Language - FORTRAN\*  
Hardware - UNIVAC 1106/PDP-11

Data Processing:

DMSSED is a general-purpose editor for DMS files; editing may be by hand or by algorithm. (PDP-11)

DMSCHP automatically chops a DMS time series into profiles. (PDP-11)

AACAL aligns, calibrates, and pre-edits data from Aanderaa current meter; output is DMS file. (PDP-11)

MK2CAL transcribes and calibrates Mark II Cyclesonde (unattended current profiler) data; output is DMS file. (PDP-11)

DERIVE appends to a DMS file new quantities derived from the input file; repertoire is expandable. (UNIVAC, PDP-11)

DMSORT concatenates DMS files from various sources, sorts according to selected keys, segments into class intervals, and outputs a DMS file. (UNIVAC)

MATRIX 01 interpolates data in depth-time coordinates to a uniform grid with various input and output options. (UNIVAC)

Data Analysis:

PLSAD computes a wide variety of statistical and dynamical quantities from time series of STD and/or PCM profiles; requires data on a uniform, rectangular grid. (UNIVAC)

IWEG computes internal wave eigenvalues and eigenfunctions. (UNIVAC)

CHRSEC computes dynamical fields and internal wave rays for x, z sections; requires mean sigma-t and mean velocity fields on a common level but otherwise nonuniform grid. (UNIVAC)

SPKTRA computes auto- and cross-spectra by Tukey (correlation) method. (UNIVAC)

CMXSPC computes auto- and cross-spectra in polarized form for single or a pair of complex-valued series; input is selected output of SPKTRA. (UNIVAC)

TIDES4 computes amplitude and phases for specified frequencies by least-squares; for pairs of series, tidal ellipse parameters are computed. (UNIVAC)

METFLX computes all meteorological fluxes from observed meteorological parameters by bulk formulas. (UNIVAC)

EMPEIG1 computes cross covariance matrix and finds its eigenvalue and (orthogonal) eigenvectors. (UNIVAC)

(\*Reading and writing DMS files in machine-level language)

Christopher N.K. Mooers or Henry T. Perkins Available from originator only  
Division of Physical Oceanography  
Rosenstiel School of Marine and Atmospheric Science  
University of Miami  
10 Rickenbacker Causeway  
Miami, FL 33149 Telephone (305) 350-7546

# CHEMISTRY

## CO<sub>2</sub> and D.O. SAT

Language - FORTRAN  
Hardware - IBM 360/less than 5000 bytes

Calculates percent saturation of dissolved oxygen and concentration of free CO<sub>2</sub>. Follows standard methods (American Public Health Association, 1971) for oxygen and Garrels and Christ (1965) for CO<sub>2</sub> ("Minerals, Solutions, and Equilibria," R.M. Garrels and C. Christ, Harper and Row). Input: Data cards with sample identification, temperature, pH, phenolphthalein alkalinity, bicarbonate alkalinity, and dissolved oxygen. An average correction factor for total dissolved solids is included in each run. Output: Printed and punched sample identification, temperature, dissolved oxygen, percent saturation, carbonate alkalinity, bicarbonate alkalinity, bicarbonate, K<sub>1</sub>, and free CO<sub>2</sub>. "A Computer Program Package for Aquatic Biologists," by Paul J. Godfrey, Lois White, and Elizabeth Keokosky.

Paul J. Godfrey  
Department of Natural Resources  
Cornell University, Fernow Hall  
Ithaca, NY 14850

Copy on file at NODC (listing, documentation)

Telephone (607) 256-3120

## Alkalinity ALCT

Language - FORTRAN IV  
Hardware - CDC 3150

Calculates total alkalinity, carbonate alkalinity, pH, and log (k(A)) for a potentiometric alkalinity titration. Endpoints are found by Gram plot method; complete procedure has been described by Dyrssen and Sillen. Input: Paper tape from DATOS data set and ASR-33 Teletype; a set of sample salinities on disk, tape, or cards; one or two cards containing run information. Output: Line printer plots of the titration curves; extensive information about each sample run; and a summary sheet with the four parameters for each sample.

John L. Barron  
Bedford Institute of Oceanography  
P. O. Box 1006  
Dartmouth, N. S. B2Y 4A2

Available from originator only

Telephone (902) 426-3676

## Specific Conductivity with Pressure Effect

Language - FORTRAN  
Hardware - IBM 360

Computes specific conductivities from measured values of resistance for the electrolytic solution and the pressures at which the measures were made. Also determines other useful quantities needed to determine the effect of pressure on the ionic conductance through the upper 2000 meters of the ocean's water column. The conductivity increase which results solely from solution concentration changes during compression is determined and found to be a significant error source. Thesis by Michael E. Mays, Dec. 1968.

U.S. Naval Postgraduate School  
Monterey, CA 93940

Available from NTIS, Order No. AD 686 654,  
\$4.75 paper copy, \$2.25 microfiche.

## Percentage Saturation of Oxygen in Estuarine Waters, B528

Language - FORTRAN IV-G  
Hardware - IBM 360-65

Computes the percentage saturation of dissolved oxygen in estuarine or brackish water. Because of the temperature compensation at a fixed 25 degrees C in the conductivity measurements, salinity is given as input and is used to compute chlorinity. This computed chlorinity, with the

accompanying temperature, is used to determine the oxygen solubility of the water. The maximum percentage saturation of the dissolved oxygen in the water is calculated from the given oxygen content and the computed oxygen solubility. The same procedure is used to ascertain the minimum percentage saturation of oxygen. Independent of the dissolved oxygen data, there is another set of measured temperature and conductivity from which salinity is computed. Author - Patricia A. Fulton.

Computer Center Division  
U.S. Geological Survey  
National Center  
Reston, VA 22092

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Telephone (703) 860-7106

Water Chemistry - Dielectric Constant  
M0101

Language - FORTRAN IV  
Hardware - IBM 360-65

Calculates the dielectric constant of water (0 to 360 degrees C [water saturated for T over 100 degrees C]), the density of water (0 to 360 degrees C), the extended Debye-Hueckel activity coefficients of charged species, the activity products for 33 hydrolysis reactions including oxides, hydroxides, carbonates, sulfides, and silicates, the concentrations and activities of ten ion pairs or complexes, and of 22 aqueous species, the oxidation potential calibrations, the standard state oxidation potentials and Eh values at equilibrium for 13 redox reactions, moles and ppm of cations at equilibrium with 42 solid phases and the chemical potentials for each of the 42 reactions along with activity product/equilibrium constant ratios for the hydrolysis reactions.

Computer Center Division  
U.S. Geological Survey  
National Center  
Reston, VA 22092

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Telephone (703) 860-7106

# COASTAL AND ESTUARINE PROCESSES

## Three-Dimensional Estuarine Circulation Model

Language - FORTRAN IV  
Hardware - UNIVAC 1108/40K 6 character words

Produces a fully three-dimensional simulation of estuarine circulation for arbitrary lateral and bottom geometry, inflowing rivers, openings to the sea, salinity, wind effect, and other related parameters.

Alan J. Fuller  
Department of Meteorology (IFDAM)  
University of Maryland  
Space Science Building  
College Park, MD 20742

Available from originator only

Telephone (301) 454-2708

## Multi-Layer Hydrodynamical- Numerical Model

Language - FORTRAN IV  
Hardware - CDC 6500/CDC 7600

Computes the current patterns using a two-layer hydrodynamical-numerical model for bays, estuaries, and sections of coastline. This program applies the finite difference hydrodynamic equations to a two-layer system. As optional output, it can produce currents and layer elevation fields, surface pollutant diffusion fields, and detailed special point information. EPRF Tech. Note. 2-74, "A Multi-Layer Hydrodynamic-Numerical Model," by T. Laevastu.

Taivo Laevastu  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

Available from originator only

Telephone (408) 646-2937

## Single Large Hydrodynamical- Numerical Model

Language - FORTRAN IV  
Hardware - CDC 6500/IBM 360

Computes tidal, permanent, and wind-induced flows for bays, estuaries, or sections of the coastline, using the finite difference form of the hydrodynamic equations. Input includes bottom bathymetry and tides at an open boundary. Output: Wave elevation and current speed and direction fields, diffusion of pollutants field, if desired; detailed data for up to twelve points. EPRF Technical Note 1-74, "A Vertically Integrated Hydrodynamical-Numerical Model," by T. Laevastu.

Kevin M. Rabe  
Research Facility Environmental Prediction  
Naval Postgraduate School  
Monterey, CA 93940

Available from originator only

Telephone (408) 646-2842

## Estuarine Model NONLNRA

Language - FORTRAN  
Hardware - IBM 370-165/150K characters

Solves a system of non-linear algebraic equations for a vertical plane estuary model. Output: Salinity and two velocity component profiles as a function of two space variables.

L.J. Pietrafesa  
Center for Marine and Coastal Studies  
North Carolina State University  
Raleigh, NC 27607

Available from originator only

Telephone (919) 787-6074

Provides predictions of unsteady salinity intrusion in a one-dimensional estuary of varying cross-section, using finite difference solution to the equations of motion and conservation of salt; coupling is accounted for through a density term in the momentum equation. Input: Schematized geometry, upstream inflows as a function of time, ocean salinity and tidal elevations at the ocean. Output: (1) Surface elevations, cross-sectional discharges and salinities as a function of time; (2) high-water slack salinities by tidal cycle; (3) longitudinal dispersion coefficients; (4) plots. Technical Report No. 159, "Prediction of Unsteady Salinity Intrusion in Estuaries: Mathematical Model and User's Manual," by M.L. Thatcher and D.R.F. Harleman, Ralph M. Parsons Laboratory, Massachusetts Institute of Technology, 1972. Also MIT Sea Grant Publications 72-21.

M. Llewellyn Thatcher  
Southampton College  
Southampton, NY 11968

Available from MIT or from the author.

Telephone (516) 283-4000

Dynamic Deterministic Simulation  
SIMUDELTA

Language - FORTRAN IV  
Hardware - IBM 360/5 tape units/CalComp  
Plotter optional

Simulates growth of a subaqueous deposit where a fresh water stream enters a saline basin. Tidal effects and longshore transport also are included. Input: Stream width and depth, water discharge, sediment load, profile of basin bottom, tidal range, length of tidal cycle, and transport parameter. Output: Tables of particle trajectories, graphs of distribution of different size grains in deposit, plots of delta development in plan, and elevation views.

K. Kay Shearin  
University of Delaware  
P.O. Box 2826  
Lewes, DE 19958

Available from originator only

Telephone (302) 645-6674

Beach Simulation Model

Language - FORTRAN IV  
Hardware - IBM 1130/16K words/3 disks/  
CalComp Plotter

A computer simulation model to study relationships among barometric pressure, wind, waves, longshore currents, beach erosion, and bar migration. Fourier series are used to represent major trends in weather and wave parameters. Barometric pressure plotted as a function of time; longshore current velocity computed as function of first derivative of barometric pressure. Nearshore area represented by a linear plus quadratic surface with bars and troughs generated by normal and inverted normal curves. Wave and current energies computed for storm and poststorm recovery periods are used to simulate coastal processes which cause erosion and deposition. A series of maps are produced to show changes in nearshore topography through time. ONR Tech. Report No. 5, "Computer Simulation Model of Coastal Processes in Eastern Lake Michigan," Williams College.

William T. Fox  
Department of Geology  
Williams College  
Williamstown, MA 01267

Available from originator only

Telephone (413) 597-2221

Estuarine Density Currents and Salinity  
DENSITY

Language - FORTRAN  
Hardware - IBM 370-155/250K bytes

Performs numerical calculation of steady density currents and salinities in an estuary in three dimensions by numerical solution of finite-difference equations for a number of quasi-timesteps. Input: Local geometry, depths, tidal currents, latitude, boundary salinities. Output: x-y-z

paper plot of velocities and vector representation of circulation patterns with complementary 35mm color slides. Determines primary orientation of 45° oblique photographs, identifies specific dye patch movements, and averages velocity over a known time span. "Airphoto Analysis of Estuarine Circulation," by H.G. Weise, M.Oc.E. Thesis.

Dennis Best or L.S. Slotta  
Ocean Engineering Program  
Oregon State University  
Corvallis, OR 97331

Available from originator only  
Telephone (503) 754-3631

Upwelling  
CSTLUPWL

Language - FORTRAN  
Hardware - CDC 6400/150K characters/2 tape units

Provides sigma-t and three velocity component profiles as a function of two space variables for a steady-state, two-dimensional upwelling. Input. Independent variable and independent parameter sizes.

L.J. Pietrafesa  
Center for Marine and Coastal Studies  
North Carolina State University  
Raleigh, NC 27607

Available from originator only  
Telephone (919) 787-6074

Mathematical Water Quality Model  
for Estuaries

Language -- FORTRAN IV  
Hardware - IBM 360/350K

Computation of water quality parameters of dissolved oxygen, biological oxygen demand, etc., for the Neuse Estuary, North Carolina. Input: Upstream discharge and water quality data. Output: Water levels, velocities, and water quality parameters at downstream locations. Uses numerical solution of shallow-water systems matched with explicit solutions of the mass balance equation. Sea Grant Report, in preparation.

Michael Amein  
Dept. of Civil Engineering  
North Carolina State University  
Raleigh, NC 27607

Available from originator only  
Telephone (919) 737-2332

Computation of Flow through  
Masonboro Inlet, North Carolina

Language - FORTRAN IV  
Hardware - IBM 360/350K

Computation of discharges and water levels at complex coastal inlets. Implicit numerical solution of one-dimensional shallow water equations. Input: Tidal elevations at sea, water levels on the land side of inlets. Output: Velocity, discharges, and water levels. Sea Grant Report UNC-SG-73-15. Also, Journal of Waterways and Harbors Div., Proc. ASCE, Vol. 10, No. WW1, February 1975, pp. 93-110.

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Dept. of Civil Engineering  
North Carolina State University  
Raleigh, NC 27607

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Telephone (919) 737-2332

Circulation in Pamlico Sound

Language - FORTRAN  
Hardware - IBM 360/320K

Provides the water surface elevations, water velocity plots, and flows through inlets for Pamlico and Albemarle Sounds, North Carolina. Input: Wind fields, inflows, ocean tides.

Michael Amein  
Department of Civil Engineering  
North Carolina State University  
Raleigh, NC 27607

Available from originator only

Telephone (919) 737-2332

Three-Dimensional Simulation Package  
AUGUR

Language - FORTRAN IV/COMPASS  
Hardware - CDC 6400/SCOPE 3.4 Operating System

AUGUR is a general three-dimensional simulation package designed to handle general spatial bookkeeping problems and basic input-output of data, thus leaving the main problem of modeling to the user. The specifications are:

- (1) to handle 1 to a maximum of 33,000 volumes;
- (2) to handle a one-, two-, or three-dimensional space in any one of the following structures:
  - (a)  $1 \times 1 \times 1$
  - (b)  $1 \times NR \times 1$
  - (c)  $1 \times NR \times ND$
  - (d)  $1 \times 1 \times ND$
  - (e)  $NC \times 1 \times 1$
  - (f)  $NC \times NR \times 1$
  - (g)  $NC \times NR \times ND$
  - (h)  $NC \times 1 \times ND$where NC = maximum volumes along the west to east axis  
NR = maximum volumes along the south to north axis  
ND = maximum volumes along the lower to upper axis
- (3) to determine the following information of each volume:
  - (a) corner coordinates
  - (b) volume centroid
  - (c) centroids of the volume's faces
  - (d) projected areas onto XY, XZ, and YZ planes of the volume's faces
  - (e) the volume measurement
- (4) to allow the user to handle:
  - (a) 1 to 40 state variables in each volume
  - (b) velocities at the centroid of each volume or (but not both) at the centroids of each face of the volume
  - (c) boundary conditions for state variables and velocities
- (5) to allow the user to initialize all state variables and velocities of each volume;
- (6) to allow the user to define the corner coordinates of each volume;
- (7) to set up the space in a right-handed coordinate system;
- (8) to allow free field data input (to a certain extent);
- (9) to use Adams-Bashforth predictor equation for the simulation with Euler's equation as a starter with the option to replace these equations;
- (10) to be able to save the simulated data on tape in order to continue the simulation later on or to plot the data;
- (11) to provide the option of suppressing certain output.

Due to the generality of the specifications, AUGUR requires much more computer core storage than a program written for a specific model. In order to reduce the core requirement, AUGUR has been subdivided into semi-independent parts called overlays, thus allowing only currently needed programs to occupy core while keeping the unneeded ones on disk until later. Further reduction of core is made possible by keeping in core only those data arrays of volumes which are to be used immediately and storing the data arrays of volumes not currently in use on disk. University of Washington Ref. No. M74-88, NSF GX 33502, IDOE/CUEA Technical Report 7, "AUGUR, A Three-Dimensional Simulation Program for Non-Linear Analysis of Aquatic Ecosystems," by D.L. Morishima, P.B. Bass, and J.J. Walsh, November 1974.

Department of Oceanography  
University of Washington  
Seattle, WA 98195

Copy on file at NODC (Program code on magnetic tape). Documentation (above report) available from NTIS, Order No. PB 245 566, \$8.00 paper, \$2.25 fiche.

Salinity Distribution in One-Dimensional  
Estuary, ARAGORN

Language - FORTRAN  
Hardware -

A model is constructed for an estuary to predict the salinity distribution for a given fresh-water inflow, with application to the upper Chesapeake Bay and the Susquehanna River. Based on a salt continuity equation in which the seaward salt advection is balanced by turbulent diffusion toward the head of the bay. In final form, it is a linear, second-order, and parabolic partial differential equation with variable coefficients which are functions of both space and time. Tech. Report 54, Ref. 69-7, by William Boicourt, May 1969.

Chesapeake Bay Institute  
The Johns Hopkins University  
Baltimore, MD 21218

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Modeling an Ocean Pond

Language - FORTRAN  
Hardware - IBM 370-155

Models hydrodynamic characteristics of coastal waters, using the Galerkin weighted-residual method through which the finite element scheme can be implemented without a knowledge of the particular variational principle of the governing equation. Marine Technical Report 40, "Modeling an Ocean Pond: A Two-Dimensional, Finite Element Hydrodynamic Model of Ninigret Pond, Charlestown, Rhode Island", by Hsin-Pang Wang, University of Rhode Island, 1975.

Department of Mechanical Engineer-  
ing and Applied Mechanics  
University of Rhode Island  
Kingston, RI 02881

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includes listing)

Estuarine Chemistry  
MYACHEM

Language - FORTRAN IV/WATFIV  
Hardware - IBM 370

From raw hydrographic data and nutrient chemistry data absorbances, computes actual values as compared with standards, along with instantaneous tide height of station. Estuarine low salinity procedures are applied. Output: Formatted concentrations of nitrite, nitrate, ammonia, urea, dissolved oxygen, silicate, and phosphate. Author - Stephen A. Macko.

B.J. McAlice  
Ira C. Darling Center (Marine Laboratory)  
University of Maine at Orono  
Walpole, ME 04573

Available from originator only

Telephone (207) 563-3146

Estuarine Tides  
TIDES

Language - WATFIV FORTRAN  
Hardware - IBM 370

Computes instantaneous tide height, range, and tide character, given corrections. Author - Stephen A. Macko.

B.J. McAlice  
Ira C. Darling Center (Marine Laboratory)  
University of Maine at Orono  
Walpole, ME 04573

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Mathematical Model of Coastal Upwelling:  
Drift, Slope, and Littoral Currents  
OCE01P07

Language - FORTRAN IV  
Hardware - IBM 360-40/23K bytes

Calculates and prints drift, slope, and littoral current tables, as well as their corresponding

Flux tables - a total of 33 tables. Input: Orientation of the coast, latitude of the site, direction of the wind, velocity of the wind. Output: For drift currents, the results are presented in ten tables, corresponding to each tenth of the H/D ratio, where H is the depth of the site and D is the depth of the friction layer (a function of latitude and wind velocity); in each table the drift currents are shown at 20 levels of the local depth; at each level, values for the following elements are given - velocity, angle with the wind, direction, angle with the slope, slope component of velocity, and component of velocity parallel to the coast. The drift fluxes are presented in an eleventh table and calculated at each tenth of the H/D ratio, giving values for the following elements - rate of flow ( $m^3/sec$ ), angle with the wind, angle with the slope, direction, slope component of the rate of flow, and component of the rate of flow parallel to the coast. Slope currents and fluxes and littoral currents and fluxes are presented in tables similar to those of drift currents and fluxes, but without values for angle of currents and fluxes with the wind.

CF Emmanuel Gama de Almeida  
Diretoria de Hidrografia e Navegacao  
BCO Nacional de Dados Oceanograficos  
Primeiro Distrito Naval - Ilha Fiscal  
Rio de Janeiro - GB-20.000, Brasil

Copy on file at NODC (listing,  
documentation in English and  
Portuguese)

#### Beach and Nearshore Maps

Language - FORTRAN IV  
Hardware - IBM 1130/8K words

Topographic maps of the beach and nearshore area are computed and plotted based on nine profiles from a baseline across the beach. Profiles are spaced at 100-foot intervals along the beach with survey points at five-foot intervals along each profile. Linear interpolation is made parallel to the baseline between adjacent profiles. Numbers and symbols are printed to form the maps. Profiles for a series of days are used to print maps of erosion and deposition by subtracting elevations for each day from the elevations for the previous day. ONR Tech. Report No. 4, "Beach and Nearshore Dynamics in Eastern Lake Michigan", by Davis and Fox, 1971.

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Williams College  
Department of Geology  
Williamstown, MA 01267

Available from originator only

Telephone (413) 597-2221

#### Numerical Model, Dynamics and Kinematics of Partially Mixed Estuaries

Language - FORTRAN  
Hardware -

A real-time numerical model is developed to describe the dynamics and kinematics of partially mixed estuaries. The governing equations are formally laterally averaged and realistic estuarine bathymetry is included. The external inputs to the model are salinity and tidal amplitude as a function of time at the ocean boundary and the freshwater discharge at the river boundary. The model includes the continuity, salt, and momentum balance equations coupled by equations of state. The numerical technique conserves volume, salt, and momentum in the absence of dissipative effects. Simulations show that using a constant vertical eddy viscosity and diffusivity produce unrealistic salinity distributions, but have minor effects on the surface amplitudes; results from the application of the model to the Potomac Estuary, using a stability dependent eddy viscosity and diffusivity, yield distributions comparable to field observations. Further numerical experimentation illustrates the response of the circulation to changes in the boundary friction and the river discharge. Reference 75-9, Technical Report 91, "A Numerical Investigation into the Dynamics of Estuarine Circulation," by Alan Fred Blumberg, October 1975.

Cheasapeake Bay Institute  
The Johns Hopkins University  
Baltimore, MD 21218

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# ENGINEERING

Deep Ocean Load Handling Systems  
DOLLS

Language - FORTRAN IV  
Hardware - CDC 6600

Provides a capability to evaluate any selected deep ocean load handling system on the basis of critical mission parameters; allows comparison of candidate systems, development of an optimum system, and sensitivity analyses. Input: Mission objectives, mission scenario, mission parameters, analytical parameters. Output: Scenario with times and costs in individual step and cumulative form. "A Method for Evaluation and Selection of Deep Ocean Load Handling Systems," Vol. I, Final Report, Vol. II, User's Manual; supplementary Letter Report.

L.W. Hallanger  
Civil Engineering Laboratory  
Naval Construction Battalion Center  
Port Hueneme, CA 93043

Copy on file at NODC (Deck)  
Telephone (805) 982-5787

Load Motion and Cable Stresses  
CABI

Language - FORTRAN IV  
Hardware - CDC 6600

Determines the transient and/or steady-state load motion and cable stresses in a vertically suspended load due to excitation at top or release from non-equilibrium position. Uses the method of orthogonal collocation in the "length" variable in order to reduce the equations to a set of ordinary differential equations. These are solved by a predictor-corrector method. Input: Cable length, cable density,  $E_a$ , load radius, load density, fluid density, added mass and drag coefficient on load (sphere only), initial tension at load, frequency and amplitude of forced motion. Output: Time history of cable tensions, velocities, and time history of load motion.

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Naval Construction Battalion Center  
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Telephone (805) 982-4625

Soil Test Data  
TRIAx

Language - FORTRAN IV  
Hardware - CDC 6600/100K characters

Uses standard technique for reduction of triaxial soil test data. Input: Axial displacement of sample, axial load, original area, original height, consolidation pressure, volume change, and pore water pressure. Output: Axial strain, pore water pressure change, principal stress difference,  $A$ , minor and major principal effective stress, principal stress ratio,  $P$ ,  $Q$ .

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Telephone (805) 982-5624

Dynamic Stress Response of  
Lifting Lines, CABANA

Language - FORTRAN IV  
Hardware - CDC 6600/2 tape units

Predicts dynamic responses of a lift line/payload system with long line length. Response operators are calculated from explicit equations; the output spectrum is used in a statistical calculation to determine the probability distributions. Inputs: Cable physical properties and elasticity, payload physical descriptions, surface excitation in the form of displacement spectrum or acceleration spectrum. Output: Dynamic tension or payload motion operators as a function of frequency, probability distribution of dynamic tension and motion, and design peak

tension. CEL Technical Report R-703, "Dynamic Stress Response of Lifting Lines for Oceanic Operations," by C.L. Liu, Nov. 1970.

Francis C. Liu  
Civil Engineering Laboratory  
Naval Construction Battalion Center  
Port Hueneme, CA 93043

Copy on file at NODC (Deck)

Telephone (805) 982-4613

Dynamic Response of Cable System  
SNAPLG

Language - FORTRAN IV  
Hardware - CDC 6600

Determines dynamic responses of a two-dimensional cable system in the ocean with in-line masses, based on lumped mass approximation; equations of motion were solved numerically by predictor-corrector method; cable segment takes tension only. Input: Cable static position, cable physical and elastic properties, in-line mass characteristics, current profile, surface excitation in sinusoidal form. Output: Tension and mass point location as functions of time. CEL Tech. Note N-1288, "Snap Loads in Lifting and Mooring Cable Systems Induced by Surface Wave Conditions," by F.C. Liu, Sept. 1973.

Francis C. Liu  
Civil Engineering Laboratory  
Naval Construction Battalion Center  
Port Hueneme, CA 93043

Copy on file at NODC (Deck)

Telephone (805) 982-4613

Changes in Electromechanical Cable  
RAMSC

Language - FORTRAN IV  
Hardware - CDC 6600

Determines the internal and external changes of a multi-strand electromechanical cable under end constraints and loadings. Based on helical wire model, equations are solved numerically by progressive iteration. Input: Cable construction details, wire physical properties, external loadings and constraints. Output: Cable end torque or torsion, elongation, internal changes. Note: RAMSC and RADAC have been combined to form program TAWAC.

Francis C. Liu  
Civil Engineering Laboratory  
Naval Construction Battalion Center  
Port Hueneme, CA 93043

Copy on file at NODC (Deck)

Telephone (805) 982-4613

End Responses in Electromechanical Cable  
RADAC

Language - FORTRAN IV  
Hardware - CDC 6600

Predicts the elongation, end rotation, or end moment of a double-armored electromechanical cable. Based on helical wire model, the problem is solved numerically by progressive iteration. Input: Cable physical and elastic properties, end loadings and/or conditions, detailed description of cable construction. Output: End responses in the form of end moment or end torsions, cable elongation, cable geometric changes, wire tensions. Note: RAMSC and RADAC have been combined to form program TAWAC.

Francis C. Liu  
Civil Engineering Laboratory  
Naval Construction Battalion Center  
Port Hueneme, CA 93043

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Telephone (805) 982-4613

Unmanned Free-Swimming Submersible  
UFSS Plotting Program

Language - BASIC  
Hardware - HP 9830A/4K words core/24K words  
additional/Plotter plus ROM

Calculates radius of mission possible for theoretical UFSS (Unmanned Free-Swimming Submersible) when internal energy usage (hotel load) is varied. Uses simple iteration to select relative

speed for most efficient energy usage per actual distance covered. Input: Minimum, maximum, and increment on external volume and hotel load of UFSS; responses (yes or no) for speed matrix; response (yes or no) for another run with an ocean current one half knot greater than previous plot. Output: Speed matrix (if desired) up and downstream, matrix of radii covering volume and hotel load variations; graphic output of radii matrix as a function of external volume and hotel load as a parameter. Documentation: OTD-OI-74-02-01.

Edward J. Finn  
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Washington, DC 20375

Available from originator only  
Telephone (202) 767-2112

Unmanned Free-Swimming Submersible  
UFSS Variable Hotel Load

Language - BASIC  
Hardware - HP 9830A/2K words

Calculates ranges possible with theoretical UFSS when internal energy usage (hotel load) is varied, using iteration to determine speed for most efficient energy usage per actual distance covered. Input: Minimum, maximum and increment on external volume of UFSS and on hotel load in watts; response to question on desire to have most efficient speeds printed. Output: Matrix of ranges covering volume and hotel load variations; speed matrix (if desired); terminal plot of data in the matrix. Documentation: OTD-OI-74-01-01.

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Unmanned Free-Swimming Submersible  
Nominal UFSS Program

Language - BASIC  
Hardware - HP 9830A/2K words

Calculates distance covered by theoretical unmanned free-swimming submersible vehicle with specific energy package, using iteration to determine speed for most efficient energy usage per actual distance covered. Output: Data about model; most efficient speed with ocean current and range (one-way) as a function of external volume of the UFSS.

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Steady-State Trapezoidal  
Array Configurations

Language - FORTRAN V  
Hardware - UNIVAC 1108

Steady-state configurations under forces due to currents are determined. Finite element (lump mass) three-dimensional statics equations are solved using Skop's method of imaginary reactions. NUSC/NL Tech. Memo. SA2302-0170-72, "On the Parameters Governing Steady State Distortion of a Bottom Moored, Subsurface Buoyed, Linear Cable Array in Various Current Fields," by J.D. Wilcox, Sept. 1972.

J.D. Wilcox  
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Anchor Last, Buoy System  
Development Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

Equations of motion for a surface or subsurface buoy system initially stretched out are solved

as the anchor is dropped. The equations of motion for buoy, cable (modeled as a number of lump masses) and anchor are integrated in the time domain, using a fourth order Runge-Kutta algorithm. Velocity-squared drag and hydrodynamic masses concentrated at each lump. Input: Physical parameters of items to be modeled. Output: x-z positions, tensions and angles, sequential plots. NUSC/NL Technical Memorandum TA12-134-71, March 1971.

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Cable-Towed Buoy Configurations  
in a Turn

Language - FORTRAN V  
Hardware - UNIVAC 1108

Steady-state configurations under forces due to a ship on a turn are determined. The three-dimensional steady state cable equations are integrated with a fourth order Runge-Kutta algorithm from the towed body up to the ship. Input: Physical parameters of items to be modeled. Output: Buoy attitude x-y-z positions, ship speed, buoy speed, tensions and angles. Three-dimensional plots available. Project CORMORAN Memo 0132 (4.10.3), "Steady State Towline Configurations in a Turn," Sept. 1973.

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Free-Floating Spar  
Array Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

The equations of motion for spar buoy, cable (lump mass model), and an extended three-leg structure are solved in the time domain using a fourth order Runge-Kutta algorithm. Auxiliary computation of spar buoy bending in the waves is included. Input: Physical parameters of the items to be modeled. Output: Spar buoy x-z motions and tilt, hydrophone motions on the ends of the three-leg structure. NUSC/NL Technical Memorandum No. TA12-257-71, Nov. 1971.

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Free-Floating Spar  
Buoy Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

The equations of motion for the spar buoy are solved in the time domain using a fourth order Runge-Kutta algorithm. Auxiliary computations of the spar buoy bending due to waves are included. NUSC Tech. Memo. No. TA12-257-71, "The Spar Buoy System," by G.T. Griffin, Nov. 1972. NUSC Tech. Memo. No. 2212-90-67, "A Guide for the Design of Spar Buoy Systems," by K.T. Patton, July 1967.

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Ship Suspended Array Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

Equations of motion for a vertically suspended cable array are solved in the time domain as the ship drifts and responds to waves. The cable is broken up into a elastically connected lump masses, each having two degrees of freedom. The  $2 \times n$  equations of motion are solved simultaneously in the time domain using a fourth order Runge-Kutta algorithm. Velocity-squared

viscous forces and hydrodynamic masses are concentrated at each lump. NUSC Tech. Memo. No. 2212-202-68, "A Study of the Stability of the Five-Hydrophone, Ship-Suspended General Dynamics Array," by G.T. Griffin, Oct. 1968.

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Available from originator only

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#### Boomerang Corer Descent/Ascent Trajectories

Language - /  
Hardware - /

Boomerang corer trajectories due to currents are calculated. The three-dimensional body equations are integrated in the time domain using a fourth order Runge-Kutta algorithm.

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#### Buoy-Ship Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

The equations of motion for the buoy moving in a plane (3-D Heave, Surge and Pitch) and constrained by the A-frame and vangs are solved in the time domain using a fourth order Runge-Kutta algorithm. Ship response to the quasi-random sea state is computed using Lewis's dimensionless RAO's. NUSC letter ser. TA12:83, "Results of First Order Study of Ship-to-Buoy Mooring Study:"

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#### Buoy System Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

Six degree-of-freedom equations of motion for the buoy are solved in the time domain using a fourth order Runge-Kutta integration algorithm. These equations are coupled with the set of partial differential equations for cable dynamics through tensions and velocities at the buoy. The equations of motion for the cable are solved in the space-time domain using a method of characteristics approach, i.e., a modification of Hartree's method. Output motions and tensions for the buoy and along the cable are plotted as power spectra using FFT methods. The program has been used for the design of oceanographic and acoustic buoy systems and for evaluation of NOAA Data Buoy design.

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#### Fixed Thin Line Array Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

Equations of motion for the cable array are solved in the time domain for excitation by currents. The array is broken up into  $n$  elastically connected lump masses, each having three degrees of freedom. The  $3 \times n$  equations of motion are solved simultaneously, using a fourth order Runge-Kutta algorithm. Velocity-squared viscous forces and hydrodynamic masses are concentrated at each lump.

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Fixed Thin Line Array  
Steady State Configurations

Language - FORTRAN-V  
Hardware - UNIVAC 1108

Steady-state configurations under forces due to currents are determined. The three dimensional steady-state cable equations are integrated using a fourth order Runge-Kutta algorithm. One fiftieth the array length is typically used as the integration step size.

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Marine Corer Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

The equations of motion for a corer free-falling through the water column (or, for the case of a cable-lowered corer, free-falling through its trip height) are integrated in the time domain, using a fourth order Runge-Kutta algorithm. Upon impact with the bottom, frictional forces due to the sediment are introduced and the corer comes to rest. Output: Terminal velocity, velocity at impact, penetration of corer and compaction of recovered sample. "An Analysis of Marine Corer Dynamics," by K.T. Patton and G.T. Griffin, Marine Technology Society Journal, Nov.-Dec. 1969.

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Steady-State Buoy System Configurations

Language - FORTRAN V  
Hardware - UNIVAC 1108

Steady-state configurations under forces due to winds and currents are computed. The three-dimensional cable equations are integrated with a fourth order Runge-Kutta algorithm from the buoy down to the anchor. An iterative method is used to modify the buoy's displacement until the vertical cable projection matches the water depth; 1/1000 the cable length is used as the integration step size. Instrument packages mounted in or on the line can be accounted for also. Output: Buoy drift and cable x-y-z positions, tensions, two angles and stretch as functions of cable length. Three-dimensional plots also available. NUSC Tech. Memo. 2212-212-68, "On the Equilibrium Configuration of Moored Surface Buoys in Currents," by K.T. Patton, Oct. 1968. USL Tech. Memo. 2212-116-69, "A Study of Three NAFI Buoy Moorings," by G.T. Griffin, June 1969. NUSC Tech. Memo. 2212-170-69, "An Analysis of Optimizing NAFI Buoy Shallow Water Moorings," by G. Griffin and P. Bernard, Sept. 1969.

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Steady-State Subsurface Buoy System  
Configurations

Language - FORTRAN V  
Hardware - UNIVAC 1108

Steady-state configurations under forces due to currents are computed. The three-dimensional cable equations are integrated with a fourth order Runge-Kutta algorithm from the buoy down to the anchor; 1/1000th the line length is typically used as the integration step size. Output: x-y-z cable positions, tensions, stretch and angles (all in dimensionless form) as a function of dimensionless cable length. Three-dimensional plots also available. NUSC Report

4379, "Nondimensional Steady State Cable Configurations," by G.T. Griffin, Aug. 1972; NUSC Tech. Memo. TA12-50-73, "Remote Terminal Usage to Compute Subsurface Single Leg Array Configurations" by G.T. Griffin, Nov. 1973.

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#### Towed Array Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

Equations of motion for the towline, towed array, and drogue are solved in the time domain for response to ship motions, etc. The equations are integrated using a fourth order Runge-Kutta algorithm. The program first computes the steady-state configuration and tensions which serve as initial conditions for the dynamics section. Also, using the steady-state data, the Strouhal excitation frequencies and amplitudes are computed along the towline.

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#### Towed System Configurations

Language - FORTRAN V  
Hardware - UNIVAC 1108

Steady-state configurations for towed systems are determined. Effects of current and ship turns can be included. The three-dimensional cable equations are integrated with a fourth order Runge-Kutta algorithm from the towed body up to the ship. For steady ship turns, the centrifugal force is also integrated up the cable. 1/100th to 1/1000th the cable length is used as the integral step size. Output: x-y-z positions, tensions, stretch, and angles as functions of cable length. Can be dimensionless. Three-dimensional plots also available. NUSC Tech. Memo. 933-0175-64, "Towline Configurations and Forces" by K.T. Patton, Oct. 1964; NUSC/NL Report No. 4379, "Nondimensional Steady State Cable Configurations," by G.T. Griffin, Aug. 1974; Project CORMORAN Memo. D112/4.10.3, "Two-dimensional Steady-State Towed System Configurations," by G.T. Griffin, March 1973.

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#### Towed System Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

Equations of motion for the towed body and for the cable (when treated as a lump mass model of n lumps) are solved in the time domain using a fourth order Runge-Kutta algorithm. The towed body is allowed six degrees of freedom, and each cable element has three. "Dynamics of a Cable-Towed Body System," by G.T. Griffin, MS Thesis, University of Rhode Island, Kingston, Jan. 1974.

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#### Trapezoidal Array Deployment Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

Equations of motion for a trapezoidal array are solved in the time domain as the second anchor is lowered and the ship is underway. The two subsurface buoys and the four cables are broken

up into six elastically connected lump masses, each having three degrees of freedom. The eighteen equations of motion are solved simultaneously in the time domain, using a fourth order Runge-Kutta algorithm. Velocity-squared viscous forces and hydrodynamic masses are concentrated at each lump. NUSC Report No. 4141, "Dynamics of Trapezoidal Cable Arrays," by G.T. Griffin and K.T. Patton, March 1972.

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#### Trapezoidal Array Dynamics

Language - FORTRAN V  
Hardware - UNIVAC 1108

Equations of motion for a subsurface trapezoidal cable array are solved in the time domain for response to currents. The two subsurface buoys and the three cables are broken up into six elastically connected lump masses, each having three degrees of freedom. The eighteen equations of motion are solved simultaneously using a fourth order Runge-Kutta algorithm. Velocity-squared viscous forces and hydrodynamic masses are concentrated at each lump. NUSC Report No. 4141, "Dynamics of Trapezoidal Cable Arrays," by G.T. Griffin and K.T. Patton, March 1972.

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#### Steady-State Cable Laying

Language - FORTRAN IV  
Hardware -

The three-dimensional steady-state cable equations are integrated using an Euler method. Ship speed and cable payout rate constant. Output: x-y-z positions of the cable and tensions. "Final Report to NUSL - Analysis of Cable Laying," by J. Schram, 1969.

R. Pierce  
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#### Towed Array Configurations

Language - FORTRAN V  
Hardware - UNIVAC 1108

Steady-state towed array configurations are computed. The two-dimensional cable equations are integrated with a fourth order Runge-Kutta algorithm from the drogue up to the ship; 1/1000th the total cable length is used as the integrated step size. Output: x-z positions, tensions, stretch, and angle as functions of cable length. Plot routine available.

S. Rupinski  
Naval Underwater Systems Center  
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Telephone (203) 442-0771

#### Cable Configuration

Language - FORTRAN IV  
Hardware - IBM 1800

Computes the equilibrium configuration and tensions of a cable towing a submerged body for faired, unfaired, and discontinuous (lower part faired) cables. The output on the line printer gives the values of the input data followed by various calculated values. The solution is found for the "heavy general cable" law of cable loadings as described by M.C. Eames (1968). Execution time: About 30 seconds for each case. NIO Program No. 168. Author - Catherine Clayson.

National Institute of Oceanography  
Wormley, Godalming, Surrey, England

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# GEOLOGY AND GEOPHYSICS

Convection in Variable Viscosity Fluid  
CONVEC

Language - FORTRAN IV  
Hardware - CDC 6600/140K bytes/Disc/  
Tektronix graphics terminal

Computes streamlines, temperatures, and shear heating in a highly viscous fluid of variable viscosity (Earth's upper mantle), relief gravity, and heat flow. "ADI Solution of Free Convection in a Variable Viscosity Fluid," by M.H. Houston, Jr., and J.-Cl. De Bremaecker, Jour. Comp. Phys., Vol. 16, No. 3, 1974.

J.-Cl. De Bremaecker  
Rice University  
P.O. Box 1892  
Houston, TX 77001

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Telephone (713) 528-4141

Gravitational Attraction, Two Dimensional  
Bodies, TALWANI 2-D GRAVITY, W9206

Language - FORTRAN IV-H  
Hardware - IBM 360-65

Calculates the vertical component of gravitational attraction of two-dimensional bodies of arbitrary shape by approximating them to many-sided polygons. The technique is from Talwani, Worzel, and Landisman in J.G.R., Vol. 64(1), 1959. Output: Gravity values are printed in tables; the calculated profile and the observed profile (if one exists) are plotted on the line printer in either a page size plot or an extended plot with the x-axis running down the page. Contains option of units in miles, kilofeet, or kilometers.

Computer Center Division  
U.S. Geological Survey  
National Center  
Reston, VA 22092

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X-Ray Diffraction Analysis

Language - FORTRAN IV  
Hardware - XDS Sigma 7/20K 32 bit words/RAD

Provides mineralogic analysis of marine sediments from X-ray diffraction data. Input: Tape containing data generated by X-ray diffractometer. Output: List of "d" spacings, 20 angles, intensities and peak heights of diffraction maxima, list of minerals and estimated amounts in samples analyzed.

John C. Hathaway  
Office of Marine Geology  
U.S. Geological Survey  
Woods Hole, MA 02543

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Telephone (617) 548-8700

Sediment Grain Size Analysis

Language - FORTRAN IV  
Hardware - IBM 1130

Calculates statistical parameters for sediment grain size analysis. Moment measures routine (Sheppard's correction applied) from Schlee and Webster (1965); linear interpolation for Folk and Inman Graphic Measures. Input: Phi size, cumulative frequency percent couplets. Output: Moment measure of mean, standard deviation, skewness, kurtosis, Folk Graphic Measures, Inman Graphic Measures, mode and median values, histogram plots.

Gerald L. Shideler  
U.S. Geological Survey  
P.O. Box 6732  
Corpus Christi, TX 78411  
Telephone (512) 888-3241

Program maintained by:  
Computer Center Division  
U.S. Geological Survey  
Federal Center  
Denver, CO 80225

Magnetic Anomalies  
MAG2D

Language - FORTRAN IV  
Hardware - XDS Sigma 7/32K 32 bit words/  
Plotter

Computes theoretical magnetic anomalies for two-dimensional bodies magnetized in any specified direction. Vertical, horizontal, and total field anomalies are computed at a series of observation points equally spaced along a profile. A graphic display of the anomaly and the bodies may be output to the CalComp or Versatec Plotter. A line printer plot of the anomaly is made. Modification of program by W.B. Joyner, USGS, Silver Spring, MD. Requires Woods Hole Oceanographic Institution subroutines, MOVE, AXIS, SYMBOL, NUMBER and PLOTDFER.

James M. Robb  
U.S. Geological Survey  
Office of Marine Geology  
Woods Hole, MA 02543

Copy (main program) on file at NODC  
(listing, documentation)

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Geophysical Data Reduction and  
Plotting Programs

Language - OS3 FORTRAN IV/COMPASS  
Hardware - CDC 3300

A system of programs to process and plot marine gravity, magnetic, and bathymetric data. The programs check for data errors, merge geophysical data with navigation, and plot the processed data as profiles or on computer-generated Mercator projection charts. Tech. Report. No. 180, by M. Gemperle and K. Keeling, May 1970.

Geophysics Group  
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Oregon State University  
Corvallis, OR 97331

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Processing and Display of Marine  
Geophysical Data

Language - OS3 FORTRAN IV/COMPASS  
Hardware - CDC 3300

A system of programs to process and plot marine gravity, magnetic, and bathymetric data using improved navigation techniques and standard data formats. The navigation programs use EM Log and Doppler Speed Log data and gyro headings combined with Magnavox 706 satellite navigator fixes to determine data point positions and Eotvos corrections. All outputs from processing programs and inputs to plotting programs are in standard NGSDC format for marine geophysical data. Tech. Report. by M. Gemperle, G. Connard, and K. Keeling (in press, 1975).

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Marine Seismic Data Reduction  
and Analysis

Language - OS3 FORTRAN IV  
Hardware - CDC 3300

A series of programs to reduce, display, and analyze marine seismic data. These data include reversed and single-ended seismic refraction, wide-angle reflection, and marine micro-earthquakes. Supplementary programs compute seismic wave arrival times and distances using theoretical earth models consisting of plane dipping layers. Tech. Report by S.H. Johnson et al (in press, 1975).

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A Library of Geophysics Subroutines  
GLIB

Language - OS3 FORTRAN IV/COMPASS  
Hardware - CDC 3300

The library consists of various subroutines commonly used in geophysical data reduction and plotting and not available in the OS3 FORTRAN library. The subroutines fall into five general categories: (1) Plotting - general purpose plotter subroutines, (2) Time and data conversion, (3) Arithmetic functions not contained in the OS3 FORTRAN library, (4) File control programs peculiar to the OS3 operating system, (5) Miscellaneous subroutines. Tech. Report by K. Keeling, M. Gemperle, and G. Connard (in press, 1975).

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Reduction, Display and Storage of Navigation, Language - FORTRAN IV (most of the programs)  
Gravity, Magnetic and Depth Data Hardware - IBM 1130/Peripherals described below

Processes data recorded by a data logger, prepares profiles and maps, and provides reduced data in a form suitable for data banking and interpretation. The first stage of the processing is to de-multiplex the data to separate disk files, and at the same time automatically edit where possible and flag errors that occur. The second stage is to filter data affected by ship motion, and the third stage is to optimize the navigation by merging dead-reckoning, hyperbolic or satellite data, and from this calculate depths, and gravity and magnetic anomalies. Graphical presentation of the data is in the form of profiles and maps. The maps include the ship's track and posted geophysical values or profiles along the ship's track. The finally reduced data may be stored on magnetic tape in any of the International Geophysical Data Exchange Formats. With this system it is possible to reduce data and produce maps and final reports within three weeks of the end of the survey. The complete system can be used at sea with one engineer and one operator/programmer, or the data logger alone may be used at sea and then only an engineer would be required.

The IBM 1130 has a central processing unit with 8K 16-bit words of core storage, an integral disk drive, and a console typewriter. Peripherals include two extra IBM disk drives, a Data Disc fixed-head disk drive, Tektronix Model 4012 visual display unit with a Tektronix Model 4610-1 hard copy unit, a 76 cm CalComp drum plotter, Facit punch tape input/output, and two RDL Series 10500 magnetic tape decks. A Data Dynamics 390 teletypewriter is used for off-line punch tape preparation and, when necessary, as a remote terminal via a Modem linked in parallel with the visual display unit.

Equipment that has been successfully interfaced with the Decca Data Logger include a Decca Main Chain Mk 21 Receiver, Decca Hifix, Sperry Gyrocompass Mk 227, Microtechnica Gyrocompass, LaCoste and Romberg Shipborne Gravity Meter, Askania Gss2 and Gss3 Gravity Meters, Anschutz Gyro-Stabilized Platform, Barringer Proton Magnetometer, Edo-Western Precision Depth Recorder (333C-26) linked to an Edo-Western Digitrack (261C), Two-Component Magnetic Log, Walker Electric Log, and a Marquart Doppler Sonar 2015A.

"Computer System for Reduction, Display and Storage of Navigation, Gravity, Magnetic and Depth Data Recorded in Continental Shelf or Deep-Ocean Areas," a series of twelve software manuals, produced by the Department of Geodesy and Geophysics, Cambridge University, Oct. 1974, under contract to the National Environment Research Council.

Computer Unit  
Institute of Oceanographic Sciences  
Research Vessel Base, No. 1 Dock  
Barry, South Glamorgan, Wales, UK

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Computation and Plotting of Magnetic  
Anomalies and Gradients

Language - FORTRAN II  
Hardware - IBM 7094/CalComp plotter

Computes the anomaly profiles for total field, horizontal and vertical components, first and second vertical derivatives, and first and second horizontal derivatives over a uniformly magnetized two-dimensional polygon of irregular cross-section. Output may be printed or plotted. "Potential Applications of Magnetic Gradients to Marine Geophysics," by William E. Byrd, Jr., June 1967; program modified and expanded from Talwani and Heirtzler (1964).

Department of Geology and  
Geophysics  
Massachusetts Institute of  
Technology  
Cambridge, MA 02139

Available from NTIS, Order No. AD 655 892/LK,  
\$5.75 paper, \$2.25 microfiche.

Geomagnetic Field  
MFIELD

Language - FORTRAN IV  
Hardware - XDS Sigma 7/372 32 bit words\*

Calculates regional total geomagnetic field at a specified latitude and longitude and time. Subroutine is initialized with the harmonic coefficients from any specified input device via a separate subroutine. Shared variables are placed in COMMON. (See I. A. G. A. Commission 2, Working Group 4, 1969. International Geomagnetic Reference Field 1965. J. Geophys. Res., 74, pp. 4407-4409.) \*Subroutine COEFF requires 271 words.

Robert C. Groman  
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Marine Geophysical Data Reduction

Language - FORTRAN IV  
Hardware - IBM 360-65

Corrects soundings for sound velocity variations (if desired), computes residual magnetic anomalies from magnetic total-intensity values, and reduces marine gravity values to free-air anomalies corrected for Eotvos effect and drift. Each geophysical data point is associated with a date-time group, a geographic position, and an approximate mileage along track. The output is in the form of separate magnetic tapes and listings each for bathymetric, magnetic, and gravity data, in a format suitable for direct input to display or analytical programs. NOAA Technical Memorandum ERL AMOL-11, "A Computer Program for Reducing Marine Bathymetric, Magnetic, and Gravity Data," by Paul J. Grim, Atlantic Oceanographic and Meteorological Laboratories, Miami, Florida, January 1971.

Paul J. Grim, Code D621  
Marine Geology and Geophysics Branch  
National Geophysical and Solar-  
Terrestrial Data Center, NOAA/EDS  
Boulder, CO 80302

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listing)

Plots Profiles of Bathymetry and Magnetic  
or Gravity Anomalies

Language - FORTRAN IV  
Hardware - IBM 360-65/CalComp 563 Plotter

Produces bathymetric and magnetic anomaly profiles in a form suitable for publications with little or no additional drafting. The horizontal scale can be the distance along the trackline in nautical miles or kilometers, or degrees of latitude or longitude. The input consists of digitized bathymetric and magnetic anomaly data on separate magnetic tapes. The horizontal and vertical axes of the profiles are determined automatically with reference to the maximum and minimum values of the input data. Control cards contain variables that further determine how the data are to be plotted. The program can also be used for plotting gravity anomaly profiles by substituting the gravity anomaly in milligals for the magnetic anomaly in gammas on the input tape. One of the control card variables causes the vertical axis to be labeled either gammas or milligals. Magnetics and bathymetry can be plotted together (the bathymetry is always below the magnetics) or either can be plotted separately. In addition, the same data can be replotted in a different manner (for example, with a different vertical exaggeration) if desired. ESSA Technical Memorandum ERLTM-AQML 8, "Computer Program for Automatic Plotting of Bathymetric and Magnetic Anomaly Profiles," by Paul J. Grim, Atlantic Oceanographic and Meteorological Laboratories, Miami, Florida, July 1970.

Paul J. Grim, Code D621  
Marine Geology and Geophysics Branch  
National Geophysical and Solar-  
Terrestrial Data Center, NOAA/EDS  
Boulder, CO 80302

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listing)

**Lists Raw Data  
ZLIST**

Language -  
Hardware - UNIVAC 1108

Lists a single file of MG&G standard raw data tape, according to a standard format. Requires subroutine DLIST (HRMIN). Author - R.K. Lattimore.

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**Plots Trackline  
QCKDRAW**

Language -  
Hardware - UNIVAC 1108

Using as input the standard MG&G navigation cards, plots a trackline with or without tick marks delineating time intervals. The user is given external control of the map size, latitude and longitude map boundaries, the number of files to be mapped, the time marks, and annotation. The trackline is plotted up to the boundary limits specified, allowing the user to plot only a sector of the navigation deck loaded. Because the size of the actual plotting sheet is 28 inches, internal boundaries may also be required. In this case, bookkeeping devices within the program will assign trackline to the appropriate submaps and plot each in sequence. Author - J.W. Lavelle.

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**Plots Contour-Crossing Intervals  
DOUBLX**

Language -  
Hardware - UNIVAC 1108

Calculates contour-crossing intervals, determine highs and lows along a trackline, and plots both, using as input a USA Standard format data tape. Annotation of the extreme is also provided. The user is given control of the map size, the latitude and longitude boundaries, the number of files to be mapped, the contouring interval, and the data field from which the data is chosen. If the data which are being handled require more than one plotting sheet, an appropriate choice of latitude and longitude boundaries will allow the entire job to be handled at one time, with the plots drawn consecutively. Author - J.W. Lavelle.

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**Plots Geophysical Data  
PLOTZ**

Language -  
Hardware - UNIVAC 1108

Produces a plotter tape to display raw depth, magnetic, or gravity data vs. time, with the aspect-ratio automatically determined to facilitate comparison with the original records. Scale factor (fathoms, gammas, or gravity meter units per inch) must be specified; if maximum and minimum values are not specified, the raw data will be scanned and the values determined. Requires subroutines LIMITS, DIGICT, HRMIN, PLOT (includes PLOTS and FACTOR), NUMBER, SYMBOL. Author - R.K. Lattimore.

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Lists Every Hundredth Value  
SNOOP

Language -  
Hardware - UNIVAC 1108

Scans a tape containing data in the standard MG&G format, listing every 100th value and the last value before an end-of-file mark. Author - R.K. Lattimore.

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Navigation Computations  
TPNAV

Language -  
Hardware - UNIVAC 1108

Accepts standard MG&G navigation data cards, computes course and speed made good and Eotvos correction between adjacent positions, compares this with input course and speed if given; creates a binary tape with position, azimuth, and distance information required for interpolation of position in programs FATHOM, GAMMA, and GAL. Author - R.K. Lattimore.

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Edits Geophysical Data  
ZEDIT

Language -  
Hardware - UNIVAC 1108

Performs two editing functions on MG&G standard raw data tape: (a) Deletion by index number; (b) insertion of new data by date-time group; such data can be put on tape (e.g., output from program HANDY) or in card format, one value per card. Data to be inserted must be ordered by date-time group. Requires subroutines DLIST (HRMIN). Author - R.K. Lattimore.

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Geophysical Data Conversion  
HANDY

Language -  
Hardware - UNIVAC 1108

Converts data in the MG&G standard data-card format to a binary tape suitable for input to the raw-data editing, evaluation, and processing programs (e.g., FATHOM, PLOTZ, ZEDIT). Requires subroutine DLIST (HRMIN). Author - R.K. Lattimore.

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Lists Geophysical Data  
LISTP

Language -  
Hardware - UNIVAC 1108

Lists the contents of a tape containing one or more files of reduced marine geophysical data.  
Require subroutine PPLIST (modification of PTLIST). Author - R.K. Lattimore.

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Course, Speed, Eotvos Correction  
LOXNAV

Language -  
Hardware - UNIVAC 1108

Accepts standard MG&G navigation data cards, computes courses and speed made good and Eotvos  
correction between adjacent positions; if course and speed are given on input, compares input  
with computed values. Author - R.K. Lattimore.

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Converts Geophysical Data  
PHONEY

Language -  
Hardware - UNIVAC 1108

Converts marine geophysical data from 120-column image (10 images to the block), even-parity  
BCD on 7-track tape (produced by program UNIFOO on the CDC 6600) to the standard MG&G storage  
format. Author - R.K. Lattimore.

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Sound Velocity Variation and Navigation  
FATHOM

Language -  
Hardware - UNIVAC 1108

Given smooth-track navigation data and sounding values indexed by time, the program corrects  
for sound-velocity variation (if desired), ship's draft (if desired), and computes latitude,  
longitude, and distance along track for each observation; the output is in the standard MG&G  
reduced-data format. Requires subroutines GP, HRMIN, QUIT (TPLIST). Author - R.K. Lattimore.

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Regional Field, Residual Magnetic Anomaly  
GAMMA

Language -  
Hardware - UNIVAC 1108

Given smoothed-track navigation data and total-field magnetic measurements indexed by time, the program computes regional field, residual magnetic anomaly, latitude, longitude, and distance along track for each observation. Output is in the standard MG&G reduced-data format. The regional field is computed as follows: For each input navigation point, or for each 20 n. m. interval along track (if navigation points are farther apart), a regional-field value is computed according to the method of Cain et al using the IGRF 1965 parameters. Regional field values for each observation are interpolated linearly. Requires subroutines FIELD, GOFIND, GPMAG, HRMIN, SETUP, QUIT\* (TPLIST). Author - R.K. Lattimore.

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Gravity  
GAL

Language -  
Hardware - UNIVAC 1108

Given smoothed-track navigation data and gravity meter dial readings indexed by date/time, this program will (1) compute Eotvos correction between adjacent navigation points; (2) reduce the dial reading to observed gravity corrected for instrument drift and Eotvos effect; (3) determine latitude, longitude, and distance along track for the observations; (4) compute the free-air anomaly from the 1930 International formula for theoretical gravity. Requires subroutines GOFIND, GPGAL, HRMIN, QUIT (TPLIST). Author - R.K. Lattimore.

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Plots Profiles of Geophysical Data  
DISPLOT

Language -  
Hardware - UNIVAC 1108/offline CalComp plotter

This program will scale and generate the necessary plotter commands to produce a graph of sounding, depth, magnetic or gravity value vs. distance along track. The source data consist of as many as four magnetic tapes containing unformatted standardized geophysical data, such as are produced by MG&G reduction programs (Grim, 1971). As many as nine Y-quantities may be plotted against one X-axis. Options provide for: (1) converting distance in nautical miles to kilometers; (2) scanning the data and annotating the upper X-axis, at the appropriate point, with crossings of even degrees of latitude or longitude; (3) omitting all axes; (4) plotting the profile reversed, or from right to left against distance values which increase from left to right; (5) drawing the zero Y ordinate; and (6) "Assembling" a single profile from more than one source, i.e., from different places on a single tape, or from different tapes. The input data are not edited. Multiple profiles may overlap one another as indicated by space limitations or aesthetics. NOAA Technical Memorandum ERL AOML-11, "A Computer Program for Reducing Marine Bathymetric, Magnetic, and Gravity," by Paul J. Grim, January 1971. Authof - Robert K. Lattimore, October 1971.

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Converts Digitizer Data  
DYGIT

Language -  
Hardware - UNIVAC 1108

Converts digitizer data on punched cards to MG&G standard raw-data tape. Requires subroutine DLIST (HMRMIN). Authors - Developed by J.W. Lavelle, modified for 1108 by R.K. Lattimore.

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Meteorological Laboratories/NOAA  
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Edits Reduced Geophysical Data  
EDIT

Language -  
Hardware - UNIVAC 1108

Performs editing operations on a file of reduced marine geophysical data as follows: (a) Deletions (maximum 2000); (b) insertion of new data or modification of single points (maximum 1500); (c) block adjustments to Z1, Z2, Z3, Z4 (maximum 1500 points). The total number of editing operations may not exceed 2499; with the exception of deletions, like operations must be grouped together and ordered by index number. Permitted modifications (b above) include replacing Z1, Zr on a card, interpolating geographic position and mileage given date/time and Z1-Z4, and insertion of completely-specified data, i.e., date/time, latitude, longitude, distance along track, Z1, Z2, Z3, Z4. Requires subroutines QUE, QTWO, QUETWO, DAY, TPLIST. Author - R.K. Lattimore.

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Seamount Magnetization

Language - FORTRAN  
Hardware - IBM 7074

Computes the magnitude and direction of magnetization of a uniformly magnetized body from its shape and magnetic intensity. OS No. 53533. Author - G. Van Voorhis.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Observation Draping (Gravity)

Language - FORTRAN  
Hardware - IBM 7074

Reduces observation data taken with Lacoste-Romberg sea/air or submarine gravimeters to observed gravity value and free-air anomaly. Interpolates geographic position from smoothed fix, course, and speed. Generates BC chart and x,y coordinates for Mercator projection for each station. OS No. 53543. Author - R.K. Lattimore.

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True Ocean Depth  
FATHCR

Language - FORTRAN  
Hardware - UNIVAC 1108/10K words

Given the Fathometer depth and velocity profile, computes the true ocean depth. The velocity profile is broken into constant gradient segments, the travel time integrated along the profile, and the profile is extrapolated to continue to the estimated travel time of the Fathometer record.

Peter D. Herstein  
Naval Underwater Systems Center  
New London, CT 06320

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Telephone (203) 442-0771, ext. 2305

Plots Track and Data Profile  
TRACK

Language - FORTRAN  
Hardware - CDC 3600/3800

Plots a track and the superimposed bathymetry or magnetic profile on a polar stereographic projection. This profile series is plotted perpendicular to the track, using uncorrected meters or fathoms. Input: Data on tape, map parameters, and command words via cards.

James V. Massingill  
Environmental Sciences Section  
Naval Research Laboratory  
Washington, DC 20375

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GEODATA

Language - FORTRAN  
Hardware - CDC 3600/3800

Stores navigation, bathymetry, and magnetic data on magnetic tape in BCD form. Uses the format recommended by the National Academy of Sciences.

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Environmental Sciences Section  
Naval Research Laboratory  
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Geophysical Data Storage and Retrieval  
GEOFILE

Language - FORTRAN IV  
Hardware - CDC 3150/32K words/Disk/3 tape units

Data storage and retrieval system for BIO's geophysical data. The programs sort, edit, merge, and display data recorded at sea. Input: Magnetic tapes from BIODAL shipboard data logging system, bathymetry data on punched cards, and navigation data. Output: Magnetic tape containing all information recorded during cruises relevant to processing of geophysical data, sorted by geographical location. Computer note BI-C-73-3.

Larry Johnston  
Bedford Institute of Oceanography  
P. O. Box 1006  
Dartmouth, N. S. B2Y 4A2

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Telephone (902) 426-3410

Magnetic Signatures  
MAGPLOT

Language - FORTRAN  
Hardware - CDC 3600/CDC 3800/706,768 words/On-line plotter

Separates and characterizes the various components of magnetic noise in magnetometer records taken from a sensor towed at sea. Gives a printout of histogram data for each of three wavelength filters: N (amplitude) vs. amplitude; N (wavelength) vs. wavelength. Also produces plots of filtered magnetic fields as function of distance. Program is briefly described in NRL Formal Report No. 7760, "Geological and Geomagnetic Background Noise in Two Areas of the North Atlantic."

Perry B. Alers  
Naval Research Laboratory  
Washington, DC 20375

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#### Sediment Size

Language - FORTRAN  
Hardware - UNIVAC 1108/9K 36 bit words

Produces frequency distributions for soil particle size values; applied to marine sediments.

Joseph Kravitz  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (202) 433-2490

#### Bottom Sediment Distribution Plot

Language - FORTRAN V  
Hardware - UNIVAC 1108/23K/Drum/3 tape units/  
CalComp 905/936 system

Produces a plot of bottom sediment notation on a Mercator projection, and a list of all data, including cores, within specified area.

William Berninghausen  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1189

#### Sand, Silt, and Clay Fractions DSDP/GRAIN

Language - ALGOL  
Hardware - Burroughs 6700/19K words

Computes sand, silt, and clay fractions in sediments. The laboratory method consists of dispersing the sediment in Calgon solution, sieving the sand fraction, and pipetting the silt and clay fractions. Input: Three card files for laboratory data and one card file for interpreting an identifier attached to each sediment sample. Output: Listing with option for ternary plots and punched cards.

Peter B. Woodbury  
Deep Sea Drilling Project  
Box 1529  
La Jolla, CA 92037

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Telephone (714) 452-3526

#### Soil and Sediment Engineering Test Data

Language - FORTRAN II-D  
Hardware - IBM 1620 II/IBM 1627 Model I Plotter

Engineering Index of Core Samples: Reduces data and tabulates results for tests on bulk wet density, vane shear strengths, original water content, liquid limit, plastic limit, and specific gravity of solids; in addition, from the above results, other index properties are simultaneously computed and tabulated; the output table lists results in columns representing each depth segment analyzed.

Grain Size Analysis with Direct Plotting: Input data are sample identification, sample weights, hydrometer readings, and sieve readings. Output on plotter is a particle size distribution curve. Another program provides output on cards of a table with proper headings and values for particle diameters and percent finer by weight.

Carbonate - Organic Carbon Analysis of Sediments: Reduces data from the carbon determinator and tabulates results of the analysis of deep ocean sediments for carbonate and organic carbon percentages; output is in same format as in program for engineering index properties, to which the output from this program is added.

Direct Shear Test with Direct Plotting: Reduces data and plots shear stress vs. shear displacement with appropriate headings and labels; another program, Direct Shear Test, uses the same data formats but presents the results in the form of tabulations rather than plots.

Triaxial Compression Test with Direct Plotting: Reduces the data from triaxial compression tests and plots stress vs. strain with headings for sample identification, lateral pressure, etc. Another program reduces the same raw data and presents the results in the form of tabulations, one for each test.

Consolidation Test (E vs. log time plot): Reduces the data obtained from consolidation test readings. Input includes sample identification and characteristics and test characteristics. The output is in two forms: plots and punched cards. The log of time is plotted vs. the void ratio. The cards are used as input to the next consolidation test program.

Consolidation test (E vs. log P and C(V) vs. log P plots): Develops plots for void ratio vs. log of pressure and coefficient of consolidation vs. log of pressure. The input consists of output cards from the previous program, together with the values of void ratio and pressure at 100% consolidation and the time and void ratio at 50% consolidation. These data were obtained from the plots of void ratio vs. log of time in accordance with the Terzaghi consolidation theory.

Permeability Test with Direct Plotting: Reduces test data and plots curve of permeability vs. time with appropriate headings and labels. The plotting scale is a variable incorporated in the program since permeability values for fine-grained soils vary throughout a wide range.

Settlement Analysis: Estimates settlement values from laboratory test results, for deep ocean foundation investigations. Input: Sediment properties and structure characteristics. Output: A table listing total settlement, footing dimensions, structure load, change in thickness of incremental layers and corresponding depth in sediment, initial stress, and change in stress.

Summary Plots: Plots the results from the laboratory analysis of core samples. The input data are the output results on cards from the previous programs and miscellaneous analyses. Since the link system of programing is used, the items to be plotted can be increased or decreased with slight modifications, depending on the user's requirements. Output is a sequence of plots. The depth into the sediment, column is plotted with reference to the ordinate, and the various properties along the abscissa on variable scales.

NCEL Report No. R 566, "Computer Reduction of Data from Engineering Tests on Soils and Ocean Sediments," by Melvin C. Hironaka.

Civil Engineering Laboratory  
Naval Construction Battalion Center  
Port Huéname, CA 93043

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\$5.75 paper, \$2.25 microfiche.

# BIOLOGY

## WHOI Biology Series

FTAPE  
FLISHT  
CHKSPIT  
SELECT  
CHANAT  
PREPLOTG  
PLOTSPECG  
STATAB

Language - FORTRAN IV  
Hardware - XDS Sigma 7/plotter optional  
9,000 words  
9,054 words  
32,430 words  
58 words  
16,751 words  
12,200 words  
18,000 words  
4,164 words

FTAPE generates a tape containing station data, species data, and systematic order information. FLISHT prints a list in systematic order of the species from the tape, including stations, numbers, sizes, and weights, with a final summary. Subsets can be specified with subroutine SELECT.

CHKSPIT summarizes catch information from any specified set of stations on the tape made by FTAPE, including data for all species, a listing of the top-ranking species by number and weight, various diversity indices, and percent similarity between sets. CHANAT analyzes a transect for faunal breaks, following the method of Backus et al (1965, "The Mesopelagic Fishes Collected during Cruise 17 of the RV CHAIN, with a Method for Analyzing Faunal Transects," Bull. Mus. Comp. Zool. Harvard 134 (5):139-158), using the data on the tape made by FTAPE.

PREPLOTG and PLOTSPECG plot a distribution map for any species on the tape made by FTAPE, with indications of vertical distribution, catch rates, and negative data; the two programs must run together; input includes a tape from NODC with world map outlines; output can be plotted on CalComp or Versatec Plotters.

STATAB prints in readable format the information contained in the station data file made by FTAPE or on the input cards.

R.L. Haedrich  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

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Telephone (617) 548-1400, ext. 354

Optimal Ecosystem Policies  
OEP

Language - FORTRAN  
Hardware - IBM 370/180K/REGION=180

To approximate optimal management policy for an aquatic stream ecosystem, program produces a sequence of converging values of an objective function, optimal values of decision variables, and simulation of the ecosystem using optimal decisions. Input: Parameter values (defaults built in), program constants, species interaction matrices. Deterministic or Monte Carlo simulations (user specified) are fit to state equations, from which the optimal policy is found, using the discrete maximum principle.

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Wildlife Sciences  
Virginia Polytechnic Institute  
and State University  
Blacksburg, VA 24601

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Telephone (703) 951-6944

Inverse Problem in Ecosystems Analysis

Language - FORTRAN IV  
Hardware - UNIVAC 1108/10K 6 character words

Performs systematic analysis and modeling of interacting species in complex ecosystems, using a

previously unpublished iterative technique for regression analysis as well as statistical hypothesis testing. Input: a user-written subroutine defining the general structure of the ecosystem and a set of species population vs. time data to be analyzed. Output: A mathematical model of the ecosystem which has the most simple structure adequate to explain the observations. For an example, see "A Systematic Approach to Ecosystems Analysis," by Curtis Mobley, J. Theoretical Biology, 41, 119-136 (1973). Program documentation in NRI Tech. Ref. 72-84.

Curtis Mobley  
Dept. of Meteorology (IFDAM)  
University of Maryland  
College Park, MD 20742

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Telephone (301) 454-2708

Toxicity Bioassay  
PROBIT ANALYSIS

Language - FORTRAN IV Level G  
Hardware - IBM 360/4K bytes

A routine method for the analysis of all-or-none acute toxicity bioassay data. Input: Number of concentrations, tabular text statistics (F, "t," Chi-square), number of organisms tested and number dead in each concentration and control. In general, mortality must be related to concentration. A minimum of three concentrations, with a partial kill both above and below 50% is required. Output: LC<sub>30</sub>, 50, 70, 90 values with upper and lower 95% confidence limits; intercept, slope and standard error of regression line, and several additional measures of goodness. "Probit Analysis," by D.J. Finney, Cambridge University Press, 1971. Program written by A.L. Jensen, School of Natural Resources, University of Michigan, Ann Arbor, Michigan 48104.

Patrick W. Borthwick  
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Environmental Protection Agency  
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FL 32561

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Telephone (904) 932-5326

Species Affinities  
REGROUP

Language - FORTRAN  
Hardware - CDC 3600

The program first determines the numbers of occurrences and joint occurrences of the species in the set of samples; it then calculates an index of affinity for each pair of species. The species are ordered in terms of the numbers of affinities they have, and this list is printed along with a list of names, code numbers, and numbers of occurrences. The program then determines the largest group that could be formed, tests to see whether that many species all have affinity with each other and, if they do, prints out the group. If they do not, it tries the next smaller group, etc. Those species which had affinity only with this group - and/or earlier groups -- are listed. The remaining species are reordered and the process continues until all species have been put either in groups or in the list of species with affinities with groups. Limits -- 200 species. Author - E.W. Fager.

Scripts Institution of Oceanography  
P.O. Box 1529  
La Jolla, CA 92037

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Productivity  
OXYGEN

Language - FORTRAN IV  
Hardware - CDC 6600

Determines productivity by oxygen diurnal curve method. Input includes oxygen concentration and oxygen probe parameters. Output contains net and gross productivity and R/R plus original data. Author - William Longley.

Marine Science Institute  
The University of Texas  
Port Aransas, TX 78373

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Species Diversity  
JOB

Language - FORTRAN IV  
Hardware - CDC 6600/50 K 60 bit words

Calculates species diversity index for numbers of organisms and/or weight of organisms, utilizing the diversity index equation derived from Margalef. The program calls subroutine SEASON, which calculates seasonal averages for a given station, seasonal limits being indicated by a control card. This subroutine outputs mean, standard deviation, and range of diversity indices for each seasonal group. Other desired groupings may be entered by a groupings control card. Author - A.D. Eaton.

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Port Aransas, TX 78373

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Productivity  
ECOPROD

Language - FORTRAN IV  
Hardware - CDC 6600/25 K 60 bit words

Computes gross and net productivity, respiration, P/R ratio, photosynthetic quotient, efficiency, and diffusion coefficient, given sunlight data and diurnal measures of oxygen and/or carbon dioxide. Author - William Longley.

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Port Aransas, TX 78373

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Concentrations per Square Meter of Surface

Language - FORTRAN IV  
Hardware - IBM 7074-II/7040 DCS/2231 words

Computes various chemical and biological compound concentrations as well as productivity rates per square meter of water surface from integrated values on per volume basis. Ten concentrations and rates are integrated over up to seven pairs of optional depth limits. Report UWMS-1006, June 1966. Source deck has 771 cards. Authors - Lellonie D. Gillespie and Linda S. Green.

Department of Oceanography  
University of Washington  
Seattle, WA 98105

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Combined Chlorophyll and Productivity

Language - FORTRAN IV  
Hardware - CDC 6400

Computes assimilation of productivity in seawater; also computes the quantities of chlorophyll A, B, and C, and the amount of carotenoids in seawater. The chlorophyll program determines the amount of plankton pigments using the equations of Richards and Thompson. The productivity program (Carbon 14) determines the production of marine phytoplankton by using Neilsen's method. Output consists of both printed matter and of library cards; the cards may be used as input to a multiple regression program to derive a relation between productivity and chlorophyll A; a plot routine may be called to graph one or several variables as a function of depth, or to display the horizontal distribution of any given property. Written by Marsha Wallin, Nov. 1963, based on two programs prepared in 1962 for the IBM 709 by M.R. Rona; revised in 1969 for the CDC 6400.

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Phytoplankton Numbers, Volumes and Surface  
Areas by Species

Language - FORTRAN IV and MAP  
Hardware - IBM 7094-II/7040 DCS/23,836 words

Two programs, differing only in input format, compute concentrations of cell numbers, cell surface areas, and cell and plasma volumes in marine phytoplankton populations, with option to compute mean cell areas, mean cell volumes, and mean plasma volumes, as well as the ratios: cell area to cell volume and cell area to plasma volume. The input quantities are obtained from microscopic examination of seawater samples. A subroutine computes the area, volume, and plasma volume of a cell from measured dimensions of diverse species. Source deck has 1221 cards. Special Report No. 38, M66-41, July, 1966, by Paavo E. Kovala and Jerry D. Larrance.

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Program to Generate a Taxonomic Directory  
of Deep-Ocean Zooplankton

Language - FORTRAN IV  
Hardware - UNIVAC 1108/20K words

Generates a data file (taxonomic directory) which classifies and catalogs various species of deep-ocean zooplankton collected in water samples for the purpose of studying the population and distribution statistics of these species. Input: Cards containing either the phylum, class, order, genus, or species name and the appropriate identifying numbers associated with each of these categories. NUSC Technical Memorandum No. TL-104-71, May 1971.

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Deep-Ocean Zooplankton Distribution

Language - FORTRAN IV  
Hardware - UNIVAC 1108/30K words

The purpose of the program is to study the distribution statistics of the deep-ocean zooplankton species within a particular taxonomic category. The distribution characteristics of the individual species are examined for both the individual net samples which have been collected at various sampling depths and the combined net samples for a given tow. Input: Station data, sample data, species abundance data on cards, and a hash table species directory (program available for generating such a hash table). Records total count for each species to which the various organisms collected in the samples belong. For the individual net samples, computes the percentage of the total taxonomic category which each species in the sample represents. For the combined net samples, both the percentage of the total taxonomic category and the percentage of the entire sample (all taxa included) are computed. Finally, the population density of each species within its taxonomic category is calculated. NUSC Technical Memorandum No. TL-107-71, May 1971.

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Deep-Ocean Zooplankton Population Statistics

Language - FORTRAN IV  
Hardware - UNIVAC 1108/30K

Produces population statistics for both the individual net samples collected at various depths and for the combined net samples. Input: Station data, sample data, species abundance data on cards, and a taxonomic directory on mass storage device. Each species is identified by phylum and class with the aid of the taxonomic directory. The organisms are counted according to the phylum or class. Total counts for the entire sample are calculated for each category. The population densities of each category are computed. Also calculated is the percentage of the total sample that each taxonomic category represents. NUSC Technical Memorandum No. TL-106-71, May 1971.

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#### PIGMENT RATIO

Language - FORTRAN IV  
Hardware - IBM 360/less than 5000 bytes

Computes ratios: Chl a/Carot, Pheo/Carot, (Chl a + Pheo)/Carot, Chl b/Carot, Chl c/Carot, and Fluor/(Chl a + Pheo). Input: Sample identification, chlorophylls a, b, c, carotenoids, pheopigments, and fluorescence on cards. Output: Printed sample identification and ratios. "A Computer Program Package for Aquatic Ecologists," by Paul J. Godfrey, Lois White, and Elizabeth Keokosky.

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#### SUCCESSION

Language - FORTRAN IV  
Hardware - IBM 360/4440 bytes

Computes succession rate of community based on measure proposed by Jassby and Goldman of relative change in each species' biomass. See "A Quantitative Measure of Succession Rate and Its Application to the Phytoplankton of Lakes," by A.D. Jassby and C.R. Goldman, 1974, Amer. Naturalist 108:688-693. Input: Integrated species biomasses and sampling date in calendar days. Output: Printed sample identification values, dates defining interval in each succession rate, and succession rate. "A Computer Program Package for Aquatic Ecologists," by Paul J. Godfrey, Lois White, and Elizabeth Keokosky.

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#### Species Abundance SPECIES

Language - PL/I  
Hardware - IBM 360/250K

This series of three programs was developed to accept species abundance data in its simplest form, check it for errors, produce lists of species abundances where comparisons may be made between days, depths, lakes, stations or years, and convert the input data to a form acceptable to packaged programs. Output: Listings of species abundances, summary data including total abundance, number of species and diversity, and subtotals within user-determined groups, punched output of summary data. "A Computer Program Package for Aquatic Ecologists," by Paul J. Godfrey, Lois White, and Elizabeth Keokosky.

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#### Yield Per Recruit RYLD, BIOM

Language - FORTRAN IV  
Hardware - IBM 1130

Computes the approximate yield of a fish stock per recruitment by either of two methods (arithmetic or exponential approximations), or simply computes the stock biomass when there is no fishing. Output: An equilibrium yield matrix with up to 400 entries corresponding to 20 ages at entry and 20 multipliers. Technical Report No. 92 (unpublished manuscript), No. 1968.

Authors - L.V. Pienaar and J.A. Thomson. Earlier version written by L.E. Gales, College of Fisheries, University of Washington.

Fisheries Research Board of Canada Copy on file at NODC (above report)  
Biological Station  
Nanaimo, B.C.

Chlorophyll  
CHLOR

Language - FORTRAN  
Hardware - IBM-370

Calculates chlorophyll in  $\text{mg/m}^3$  according to B&P extraction, spectrophotometric technique.  
Input: Raw absorbences. Author - Stephen A. Macko.

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Phytoplankton Population Density

Language - WATFIV FORTRAN  
Hardware - IBM 370

Computes species densities and population percentages and relative diversity from cell counts.  
Output formatted according to taxonomy in FAO Fisheries Technical Paper #12. Author - Stephen A. Macko.

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Species Diversity  
DVRSTY

Language - WATFIV FORTRAN  
Hardware - IBM 370

From unformatted raw data, produces species diversity, and diversity matrix.

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# FISHERIES

Length Frequency Analysis  
LENFRE

Language - FORTRAN  
Hardware - Burroughs 6500

Uses three methods of stratification to expand sample length frequencies in different strata. The program was developed for tuna fishery samples. Input: Sample length frequencies for up to 80 strata, alpha and beta for the length-weight relation, von Bertalanffy growth parameters. Output: Tables of sample length frequencies, expanded length frequencies (expanded by total catch), weight in each length interval, by strata; total frequencies for all strata combined; average length and weights and age; catch per unit effort.

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Yield per Recruit for Multi-Gear Fisheries  
MGEAR

Language - FORTRAN  
Hardware - Burroughs 6500/6,200 words

Computes estimates of yield per recruit and several related parameters for fisheries that are exploited by several gears which may have differing vectors of age specific fishing mortality. The Ricker yield equation is used. Input is limited to 4 types of gear, 30 age intervals, and 10 levels of fishing mortality. Output: Besides tables of yield per recruit, landings per recruit when fish below minimum size are caught and then discarded dead, average weight of fish in catch, and yield per recruit per effort as functions of minimum size and amount of fishing effort are provided for each gear and for the entire fishery. The program has been used for evaluating proposed minimum size regulations for the yellowfin tuna fishery of the tropical Atlantic, a fishery exploited by four types of vessels (hait boats, small purse seiners, large purse seiners, and longliners) having quite different vectors of age specific fishing mortality.

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Resources Allocation in Fisheries Management  
PISCES

Language - FORTRAN IV  
Hardware - IBM 370/125K

Uses a Monte Carlo simulation to predict the effect of fisheries management programs upon the distribution and abundance of angler consumption. Input: State fisheries agency data and management plan. Output: (1) Predictions of the number and location of angler-days throughout a state; (2) Standard deviations. "PISCES: A Computer Simulator to Aid Planning in State Fisheries Management Agencies," by R.D. Clark, MS Thesis, VPI&SU.

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Computer-Implemented Water Resources  
Teaching Game, DAM

Language - FORTRAN IV  
Hardware - IBM 370/120K/Interactive terminal  
desirable

Using a simulation of an existing reservoir system, this computer-assisted instructional game illustrates the management of a large multiple-use reservoir system. Input: Student management decisions for (1) a regional planning commissioner, (2) a fisheries manager, (3) a power company executive, (4) a recreation specialist, and (5) a city mayor. Output: Status of reservoir system, including human components.

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A Generalized Exploited Population Simulator  
GXPOPS

Language - FORTRAN  
Hardware - Burroughs 6500/CDC 3600

GXPOPS is a generalized exploited population simulator designed for use on a wide variety of aquatic life history patterns. Population processes programed into the present version are (1) month-specific and density-independent mortality rates on the recruited population, (2) density-independent growth, (3) sex-specific and age-specific, but density-independent, maturation, (4) reproductive success due to random mating, and (5) density-dependent or density-independent recruitment. Mortality, growth, and maturation can be made density-dependent through the addition of subroutines. The unit length of time is the reproductive cycle, commonly a year in temperate species; computations are performed each one-twelfth of a unit, thereby representing a month for most species.

There are three output options. For each year the complete output option lists monthly (1) the average year class size, yield in numbers and weight for any six consecutive year classes, (2) the total initial population size, (3) the average total fishable population, (4) the total yield in numbers and weight, and (5) the average sex ratio. Annual summaries of initial population, average population, average fishable population, yield in number and weight, and the spawning success are provided by year class for the total population and for the fishable total population. The moderate option lists only the monthly summary totals and the annual summary by year class. The minimum option, suited for long simulations, lists only the annual summary by year class and for the total and fishable total population. GXPOPS is dimensioned to handle the computations for up to 30 year classes, but, in order to economize on space, the output is dimensioned to list up to 6 consecutive year classes only. The FORMAT statements must be rewritten to list an additional number of year classes. "A general life history exploited population simulator with pandalid shrimp as an example," by William W. Fox, Jr., Fishery Bulletin, U.S., 71 (4): 1019-1028, 1973.

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Generalized Stock Production Model  
PRODFIT

Language - FORTRAN  
Hardware - CDC 3600/Burroughs 6500

Input: (Option 1) A catch and fishing effort history and a vector of significant year class numbers are read in; the catch per unit effort is computed internally and the averaged fishing effort vector is computed with subroutine AVEFF; (Option 2) The vectors of catch per unit effort and averaged (or equilibrium) fishing effort are read in directly. Output includes a listing of the input data, the transformed data, initial parameter estimates, the iterative solution steps, the management implications of the final model  $U_{max}$ ,  $U_{opt}$ ,  $f_{opt}$ , and  $Y_{max}$  and their variability indices, the observed and predicted values and error terms, estimates of the catchability coefficient, and a table of equilibrium values. ( $U_{max}$  is the relative density of the population before exploitation;  $U_{opt}$  is the relative population density providing the maximum sustainable yield;  $f_{opt}$  is the amount of fishing effort to obtain the maximum sustainable yield; and  $Y_{max}$  is the maximum sustainable yield.) "Fitting the generalized stock production

model by least-squares and equilibrium approximation," by William W. Fox, Jr, Fishery Bulletin, U.S., in press.

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Normal Distribution Separator  
TCPA1

Language - FORTRAN  
Hardware - Burroughs 6700

Separates a length-frequency sampling distribution into K component normal distributions. Used to estimate age group relative abundance in length samples of unageable species. The method is statistically superior to graphical procedures. Also, the program will produce estimates of the percent composition by age group and the number of fish in the sample from each age group. Output includes a plotted histogram, the observed frequencies, and all estimated values. The value of K may be from one to ten. "Estimation of parameters for a mixture of normal distributions," by V. Hasselblad, Technometrics 8(3):431-441, 1966. Author - Victor Hasselblad; modified by Patrick K. Tomlinson.

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Spawner-Recruit Curve Fitting  
TCPA2

Language - FORTRAN  
Hardware - Burroughs 6700

Estimates the parameters of the Ricker spawner-recruit curve,  $R = ASE^{-bs}$ , from fitting the logarithmic transformation  $\ln(R/S) = \ln A - bs$ , by the method of least squares. S is the spawning bio-mass, R is the recruit biomass, and A and b are constants. From the fitted curve a table of spawning stocks and resultant recruitments is produced. The curve is discussed in "Handbook of computations for biological statistics of fish populations," by W.E. Ricker, Bull. Fish. Res. Bd. Canada (119):1-300, 1958. Author - Patrick K. Tomlin.

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Weight-Length Curve Fitting  
TCPA3

Language - FORTRAN  
Hardware - Burroughs 6700

Fits a curve giving weight as a function of length of the form  $W = aL^b$  where W is the weight and L is length. It produces a table of fitted weights and lengths and provides various related statistics. The method of fitting involved linearization by common logarithms and the usual least-squares procedure for fitting a straight line. Author - Norman J. Abramson; modified by Patrick K. Tomlinson and Catherine L. Berude.

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Estimates ages composition using a double sampling scheme with length as strata. Also provides estimates assuming simple random sampling of aged fish. Under the double sampling scheme, the first sample is of lengths (length frequency) to estimate length-strata sizes; the second or main sample is for ages. The second sample can be drawn (1) independently, (2) as a subsample of the first, or (3) as a subsample within length strata. "A method of sampling the Pacific albacore (*Thunnus germon*) catch for relative age composition," by D.J. Mackett, Proc. World. Sci. Meet. Biol. Tunas & Rel. Sp., FAO Fish. Rpt. No. 6, Vol. 3, 1963. Author - D.J. Mackett.

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Best Current Estimate of Numbers, Percentages, Language - FORTRAN  
and Weights of Fish Caught, TCPB2 Hardware - Burroughs 6700

Given any number of length detail cards for fish sampled during a given bimonthly (or other) period, this program calculates by primary area and gear: (1) The number of fish sampled at each length-frequency interval; (2) the percentage of fish sampled at each length-frequency interval; (3) the smoothed percentage of fish sampled at each length-frequency interval; (4) the average weight of the fish. With the input of the corresponding catch data the program makes estimates of the number of fish caught at each length-frequency interval for the given period by primary area and gear. The program also makes estimates for the given period for both gears combined for each of the primary and secondary areas of (1) through (4) above. It estimates the same thing for each gear separately and for each of the secondary areas. Finally the program makes estimates for the given period and all preceding periods of that year combined for each gear separately and both gears combined for each of the primary and secondary areas of (1) through (4) above and the total weight of fish caught at each length-frequency interval. Limitations: (a) The cards for each period must be kept separately and the periods must be in chronological order; (b) gear 2 must follow gear 1 in the catch cards; (c) although any number of periods may be run consecutively, it must be kept in mind that all of the periods will be summed to compute the best current estimate; (d) the maximum number of length frequencies is 80, gears 2, and primary areas 7. Author - Christopher T. Psaropoulos.

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Length-Frequency Distribution of Market Measurement Sampling, TCPB3 Language - FORTRAN  
Hardware - Burroughs 6700

Given any number of length detail cards for fish sampled with input of corresponding catch data during a year period, this program (using the same methods as TCPB2) summarizes, by quarter, market measurement area code, and for each gear, or combined: (1) The average weight, and the number of fish caught at each quarter; (2) the raw and smoothed percentage of fish sampled and caught at each length-frequency interval; (3) the number of fish sampled and caught at each length-frequency interval. Author - Christopher T. Psaropoulos.

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Von Bertalanffy Growth Curve Fitting  
TCPC1

Language - FORTRAN  
Hardware - Burroughs 6700

Fits the von Bertalanffy growth-in-length curve to unequally spaced age groups with unequal sample sizes for separate ages. It fits the equation  $D_t = \text{length (at age } t) = A + BR^t$ ;  $0 < R < 1$  (1) by least squares when data of the form (length, age) are given in pairs  $(L_t, t)$ . The program minimizes the function  $Q = \sum_{i=1}^n (L_t - A - BR^t)^2$  by use of the partial derivatives evaluated near zero.

Output is in the von Bertalanffy form, where  $A = L_\infty$ ,  $R = e^{-k}$  or  $K = -\log_e R$ ,  $B = -L_\infty L^{k t_0}$  or  $t_0 = [\log_e(-B) - \log_e A] / K$ .

The output gives values of the expected length at age using equation (1) evaluated at ages selected by the user. The pairs  $(L_t, t)$  may be read into the program in two different ways. The first assumes that no type of ordering or sorting has occurred and that each  $(L_t, t)$  represents a single fish. The second method allows for frequency distributions and the user provides a triple  $(L_t, t, m)$  where  $m$  is the number of times (or some weighting factor) the pair  $(L_t, t)$  is to be used. Author - Patrick K. Tomlinson.

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Von Bertalanffy Growth Curve for Unequal  
Age Intervals  
TCPC2

Language - FORTRAN  
Hardware - Burroughs 6700

Uses the method of Tomlinson and Abramson to fit length at age data to the von Bertalanffy growth equation  $L_t = L_\infty (1 - e^{-k(t-t_0)})$  where  $L_t = \text{length at time } t$ ,  $L_\infty = \text{asymptotic length}$ ,  $K = \text{growth constant}$ , and  $t_0 = \text{theoretical time at which } L_t = 0$ . The age intervals do not need to be equal. Limitations: The number of lengths for each age group must be at least two and not more than 500. (If only one length, or a single mean length, is available for a given age group, it may be punched twice.) The maximum number of age groups is 40. The output includes: (1) estimates of  $L_\infty$ ,  $K$ , and  $t_0$  from each iteration of the fitting process; (2) final estimates of  $L_\infty$ ,  $K$ , and  $t_0$ ; (3) standard errors of  $L_\infty$ ,  $K$ , and  $t_0$ ; (4) fitted lengths for age 0 through the maximum included in the input; (5) mean lengths of the samples at each age group; (6) standard errors of the mean lengths in the samples; (7) the number of lengths in each age group; (8) variance-covariance matrix; (9) standard error of estimate. "Computer programs for fisheries problems," by Norman J. Abramson, Trans. Amer. Fish. Soc. 92(3):310, 1963. Fitting a von Bertalanffy growth curve by least squares including tables of polynomials," by Patrick K. Tomlinson and Norman J. Abramson, Fish. Bull. Calif. Dept. Fish & Game 116:69 p., 1961. Author - N.J. Abramson. (See also TCPC 3)

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Von Bertalanffy Growth Curve for  
Equal Age Intervals  
TCPC3

Language - FORTRAN  
Hardware - Burroughs 6700

Similar to TCPC2. However, the age intervals must be equal with at least two observed lengths at each age. The program always yields estimates when a least-squares solution exists, and immediately terminates the run when there is no solution. In this respect it is superior to TCPC2, which occasionally does not converge to estimates even when a solution exists. Author - N.J. Abramson.

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Von Bertalanffy Growth Curve Fitting  
TCPC4

Language - FORTRAN  
Hardware - Burroughs 6700

Estimates the parameters  $K$  and  $L_{\infty}$  of the von Bertalanffy growth-in-length curve when only the lengths of individual fish at two points in time are known. This allows the curve to be fitted to tag release and recovery data. Fits equation (1) by least squares when data are of the form (initial length, final length, time elapsed).

$$L_t + \Delta_t = L_t R^{\Delta_t} + A(1 - R^{\Delta_t}); 0 < R < 1 \quad (1)$$

$L_t$  is the initial length;  $L_t + \Delta_t$  is the final length, and  $\Delta_t$  is the time elapsed. Given  $n$  triples ( $L_t$ ,  $L_t + \Delta_t$ ,  $\Delta_t$ ) and equation (1), the program minimizes the function.

$$Q = \sum^n [L_t + \Delta_t - L_t R^{\Delta_t} - A(1 - R^{\Delta_t})]^2$$
 by use of the partial derivations evaluated

near zero. Output is in the von Bertalanffy form, where  $L = A$  and  $K = \log_e R$ . The output gives values of the expected length using equation (1) evaluated at an initial length and time lapse selected by the user. The user enters one initial length and a time lapse. The program computes the final lengths. The triples are punched on cards, with one triple per card. No provisions are made for frequency distributions or weighting factors. The program will handle up to 5000 triples. Author - Patrick K. Tomlinson.

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Estimation of Linear Growth and von  
Bertalanffy Growth Equation from Tag Data  
TCPC5

Language - FORTRAN  
Hardware - Burroughs 6700

This program is used to estimate the rate of linear growth per unit time and the parameters  $L_{\infty}$  and  $K$  of the von Bertalanffy growth equation from data on the lengths at release and at recapture, and the times at liberty for two or more tagged fish. Known bias(es) in the lengths at release for fish of one or two groups can be corrected by use of the constants  $a$  and  $b$  in the equation  $y = a + bx$ , where  $x$  is the uncorrected length and  $y$  is the corrected length. Before estimating  $L_{\infty}$  and  $K$  by the method of program TCPC4, the program calculates the mean rate of linear growth per time interval and its standard deviation. If option 1 is specified, the data for any fish which grew at rates which differ by three or more standard deviations from the mean rate are eliminated; if option 2 is specified, no data are eliminated. Author - Patrick K. Tomlinson; modified by Jo Anne Levatin.

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Fishing Power Estimation  
TCPD1

Language - FORTRAN  
Hardware - Burroughs 6700

Estimates the fishing power of individual vessels or class relative to a standard vessel or

class and the densities of fish by time-area strata relative to a standard time-area stratum. Program first estimates log fishing powers, using the method described by Robson (1966). Then the estimates are converted from log relative fishing power and log density to the original scales, employing a bias-correcting factor given in Laurent (1963). The program handles up to 2000 catch observations from a combined total of not more than 200 distinct boats and time-area strata; it arbitrarily selects the lowest numbered boat as the standard vessel and the lowest numbered area-data in which the standard vessel fished as the standard time-area strata. "Log-normal distribution and the translation method: description and estimation problems" by Andre G. Laurent, Jour. Amer. Stat. Assn. 58(301):231-235, 1963. "Estimation of the relative-fishing power of individual ships," by D.S. Robson, Res. Bull. Inter. Comm. NW. Atlantic. Fish. (3):5-14, 1966, Author - Catherine L. Berude.

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Survival Rate Estimation  
TCPE1

Language - FORTRAN  
Hardware - Burroughs 6700

Estimates a survival rate from the age composition of a sample. Computes a number of statistical measures associated with a vector of catch number  $N_0, N_1, \dots, N_I$  where  $N_j$  = number of fish caught of (coded) age "j." Four options are available:

Option 1 assumes that (a) recruitment and annual survival are constant for all age groups entered in catch vector; (b) all ages in catch vector are fully available to sampling gear; (c) ages are known for all fish in catch vector. Computes estimate of survival rate, variance of survival rate, standard error of survival rate, 95% confidence interval for survival rate, instantaneous mortality rate, variance of instantaneous mortality rate, standard error of Z (total mortality), 95% confidence interval for Z, and Z interval obtained from S interval.

Option 2 tests the hypothesis that the relative frequency in the 0-age group as compared to the older ages does not deviate significantly from the expected frequency under option 1 assumptions and computes a chi-square statistic associated with the difference between the best estimate and Heinke's estimate. If this statistic exceeds CHI (a chi-square value for desired confidence level) the catch numbers are recorded as follows:  $N_1 \rightarrow N_0; N_2 \rightarrow N_1; N_3 \rightarrow N_2; \dots; N_I \rightarrow N_{I-1}$  and the above computations are made for the new vector  $N_0, \dots, N_{I-1}$ . This test is repeated until the statistics are less than CHI, a theoretical chi-square value with one degree of freedom which specifies the significance level of the test. CHI is entered on a control card. If the statistic is less than CHI, the output is the same as in option 1.

Option 3 is to be used when assumptions (a) and (b) of option 1 hold but it is not possible to age fish whose coded age is greater than "K." Option 3 assumes that the recorded relative frequencies are not reliable for fish of ages  $K+1, K+2, \dots, I$  in the vector of catch numbers; it sums the catch for ages  $K+1$  to  $I$  and computes the same output as in option 1 using the catch vector  $N_0, N_1, \dots, N_K, m$  where  $m = N_{K+1} + \dots + N_I$ .

Option 4 permits the user to subdivide the catch curve into a number of segments. The assumptions listed under option 1 may be satisfied for the consecutive age groups in one segment but not for age groups in different segments of a catch curve. Because segmentation of a catch curve may be exploratory, the program allows the use of overlapping segments, i.e., one age group may appear in more than one segment. Option 4 computes the same output as option 1.

"The analysis of a catch curve," by D.C. Chapman and D.S. Robson, Biometrics 16:354-368, 1960. "Catch curves and mortality rates," by D.S. Robson and D.G. Chapman, Trans. Am. Fish. Soc. 90:1810189, 1961. Author.- Lawrence E. Gales.

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Fishing Mortalities Estimation  
TCPE2

Language - FORTRAN  
Hardware - Burroughs 6700

Uses the method of Murphy (1965) and Tomlinson (1970) to estimate the population (P) of a cohort of fish at the beginning of each of several consecutive time intervals (i) and the coefficients of catchability (q) and of fishing mortality (F) for each interval when the catches (C), effort (f), and the coefficients of natural mortality (M) for each interval and F for either the first or last interval are known. When estimates of F and M are not available, various trial values can be used to obtain estimates which appear to be reasonable. "A solution of the catch equation," by G.I. Murphy, J.Fish.Res.Bd.Can. 22(1):191-202, 1965. "A generalization of the Murphy catch equation," by P.K. Tomlinson, J.Fish.Res.Bd.Can. 27(4): 824-825, 1970. Author - Patrick K. Tomlinson; modified by Jo Anne Levatin.

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Relative Yield per Recruit at Various  
Fishing Intensities  
TCPF1

Language - FORTRAN  
Hardware - Burroughs 6700

Calculates the relative yield in weight per recruit at various fishing intensities by the method of Beverton (1963: Formula 1)). With option 1, the program calculates the ratios of the yields per recruit at selected values of  $E = (F/(F+M))$  to the yield per recruit at  $E = 1$ . M is the coefficient of natural mortality; F is the coefficient of fishing mortality. With option 2, it calculates the relative yield per recruit at selected levels of F. Limitations: No more than ten values of M, nor more than 1000 values of E or F, can be used for a single problem; in option 1, M cannot equal 0. "Maturation, growth and mortality of clupeid and engraulid stocks in relation to fishing," by R.J.H. Beverton, Rapp.Proc.-Verb. 154:44-67, 1963. Author - Christopher T. Psaropoulos.

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Yield Curves with Constant Rates  
TCPF2

Language - FORTRAN  
Hardware - Burroughs 6700

Using the incomplete beta-function, evaluates the Beverton and Holt yield equation and produces an array of coordinates for plotting yield isopleths. "Allometric growth and the Beverton and Holt yield equation," by G.J. Paulik and L.E. Gales, Amer.Fish.Soc., Trans. 93(4):369-381, 1964. Author - Lawrence E. Gales.

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Eumetric Yield  
TCPF3

Language - FORTRAN  
Hardware - Burroughs 6700

Uses Beverton and Holt's (1957: 36:4.4) equation to compute the population in numbers, the biomass, the yield in numbers, and the yield in weight theoretically obtainable from one recruit with various combinations of growth, mortality, and age of entry into the fishery. "On the

dynamics of exploited fish populations," by R.J.H. Beverton and S.J. Holt, Fish.Inves., Minis. Agr.Fish.Food, Ser.2, 19:533 p., 1957. Author - Lawrence E. Gales; modified by Christopher T. Psaropoulos.

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Piecewise Integration of Yield Curves  
TCPF4

Language - FORTRAN  
Hardware - Burroughs 6700

Computes an approximate yield isopleth for a given number of recruits to a fishery when both growth and natural mortality are estimated empirically. The calculations are carried out using a modified form of Ricker's method for estimating equilibrium yield. The program is extremely general in that growth, natural mortality and fishing mortality rates need not be measured using the same time intervals. Fishing mortality rates can be age specific (up to 400 different rates can be applied during the life of the fish) but the over-all level of fishing mortality can be varied by means of multipliers which apply to all of the individual age specific rates. The range and the intervals between ages at first capture can also be varied by the user.

The program has two approximation options: (1) an exponential mode which assumes that the biomass of the stock changes in a strictly exponential manner during any interval when growth, natural mortality, and fishing rates are all constant (Ricker, 1958: Equation 10.4); (2) an arithmetic mode which uses the arithmetic mean of the stock biomass at the start and at the end of any interval during which all three rates are constant as an estimate of the average biomass present during the interval (Ricker, 1958: Equation 10.3).

The program will compute and print out at specified times the biomass of the stock when only natural mortality and growth are present. This biomass vector is useful for determining the optimum harvest times for stocks that may be completely harvested at one time. "A generalized computer program for the Ricker model of equilibrium yield per recruitment," by G.J. Paulik and W.F. Bayliff, J.Fish.Res.Bd.Canada 24:249-252, 1967. "Handbook of computations for biological statistics of fish populations," by W.E. Ricker, Fish.Res.Bd.Canada Bull. (119):300 pp. Author - Lawrence E. Gales.

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Piecewise Integration of Yield Curves When  
Age is Unknown  
TCPF5

Language - FORTRAN  
Hardware - Burroughs 6700

Performs piecewise integration of yield curves when age is unknown. Different mortality rates may be associated with intervals in the lifespan and growth is calculated as a function of length from a transformed von Bertalanffy growth curve. Yield isopleths are given as functions of length-at-entry and fishing mortality. Note that program TCPF4 provides von Bertalanffy growth parameters from unaged fish which can be used with this program. The amount of growth a fish will put on during an interval of time is a function of the size at the beginning of the interval, not age. Similarly, survival is usually given as a function of time elapsed, not age. Therefore, growth during an interval and survival during the interval can be combined to produce yield, even though age is unknown. Author - Patrick K. Tomlinson.

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Constants in Schaefer's Model  
TCPF6

Language - FORTRAN  
Hardware - Burroughs 6700

Uses three simultaneous equations to solve for the constants,  $a$ ,  $M$ , and  $k_2$ , in Schaefer's (1957) model for determining the status of a stock of fish in regard to fishing. Schaefer (1957) used an iterative procedure to evaluate these constants, but in another publication (Schaefer and Beverton, 1963), it was indicated that evaluation of the constants by the solution of three simultaneous equations would be acceptable. "A study of the dynamics of the fishery for yellow-fin tuna in the eastern tropical Pacific Ocean" by M.B. Schaefer, Bull. Inter-Amer. Trop. Tuna Comm. 2(6):245-285, 1957. "Fishery dynamics - their analysis and interpretation," by M.B. Schaefer and R.J.H. Beverton, pp. 464-483 in, M.N. Hill, The Sea, Vol. 2, Interscience Publishers, New York, 1963. Author - Christopher T. Psaropoulos.

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Schaefer Logistics Model of Fish Production  
TCPF7

Language - FORTRAN  
Hardware - Burroughs 6700

Pella and Tomlinson (1969) discussed a generalization of Schaefer's (1954) logistic model to explain changes in catch as related to effort upon a given population and they presented a computer program useful in estimating the parameters of the model when observed catch-effort data are available. However, in their scheme, it is necessary to use numerical methods for approximating the expected catch. Also, the user is required to provide guesses of the parameters and limits to control searching. In general, this program TCPF7 uses the same procedure for estimating the parameters as that described in Pella and Tomlinson. Exceptions: The user only needs to supply catch, observed effort, and elapsed time for each of  $n$  time intervals; the program will make the guesses and set the values used in the search. "A generalized stock production model," by J.J. Pella and P.K. Tomlinson, Inter-Amer. Trop. Tuna Comm., Bull. 13(3):421-496, 1969. "Some aspects of the dynamics of populations important to the management of the commercial marine fisheries," by M.B. Schaefer, Inter-Amer. Trop. Tuna Comm., Bull. 1(2):25-56. Author - Patrick K. Tomlinson.

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Fits Generalized Stock Production Model  
TCPF8

Language - FORTRAN  
Hardware - Burroughs 6700

Fits the generalized stock production model described by Pella and Tomlinson (1969) to catch and effort data. This model estimates equilibrium yield as a function of effort or population size. The production curve is allowed to be skewed. "A generalized stock production model," by Jerome J. Pella and Patrick K. Tomlinson, Inter-Amer. Trop. Tuna Comm., Bull. 13(3):419-496. Authors - Pella and Tomlinson; modified by Catherine L. Berude.

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Biometry - Linear Regression Analysis  
TCSA1

Language - FORTRAN  
Hardware - Burroughs 6700

Performs an analysis of regression with one or more Y-values corresponding to each X-value. The Model I Regression is based on the following assumptions: (a) that the independent variable X is measured without error, where the X's are "fixed"; (b) that the expected value for the variable Y for any given value X is described by the linear function  $\mu_y = \alpha + \beta X$ ; (c) that for any given value of X the Y's are independently and normally distributed.  $Y = \alpha + \beta X + \epsilon$ , where  $\epsilon$  is assumed to be normally distributed error term with a mean of zero; (d) that the samples along the regression line have a common variance,  $\sigma^2$ , constant and independent of the magnitude of X or Y. In Model II Regression, the independent variable and the dependent variable are both subject to error. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Generalized Weighted Linear Regression Language - FORTRAN  
for Two Variables, TCSA2 Hardware - Burroughs 6700

Computes the regression line  $Y_i = b_0 + b_1 x_i$  where the  $Y_i$  may have different weights. The user may transform the data by any of three transformations, natural logarithms of X, Y, and/or W (weight), common logarithms of X, Y, and/or W, and/or powers of X, Y, and/or W. The two variables and the weights may be transformed independently. The program normalizes the weights (or the transformations of the weights) by dividing each weight by the mean weight. Produces printer plots of the data and deviations. Author - Lawrence E. Gales; modified by Patrick E. Tomlinson and Christopher T. Psaropoulos.

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Linear Regression, Both Variables Subject Language - FORTRAN  
to Error, TCSA3 Hardware - Burroughs 6700

Computes a regression in which both the dependent and the independent variable are subject to error. There are several methods for obtaining solution to the equation in a Model II case, depending upon one's knowledge of the error variances or their ratios. Since this situation is not too likely to arise in the biological sciences, the authors adapted a relatively simple approach in which no knowledge of these variances is assumed -- the Bartlett's three-group method. This method does not yield a conventional least squares regression line and consequently special techniques must be used for significance testing (Sokal and Rohlf, 1969). The user may transform the data by any of three transformations: natural logarithms of X and/or Y; common logarithms of X and/or Y; powers of X and/or Y. The program produces printer plots of the data and derivations. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Author - Walter Ritter O.; modified by Christopher T. Psaropoulos.

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Biometry - Product-Moment Correlation Language - FORTRAN  
Coefficient, TCSB1 Hardware - Burroughs 6700

Computes the Pearson product-moment, correlation coefficient for a pair of variables and its

confidence limits. In addition, the program computes and prints the means, standard deviations, standard errors, and covariances for the variable, as well as the equation of the principal and minor axes. The confidence limits for the slope of the principal axis are also computed and the coordinates of eight points are given for plotting confidence ellipses for bivariate means. Biometry, by Robert R. and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969.

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Cooley-Lonnes Multiple-Regression Analysis  
TCSB2

Language - FORTRAN  
Hardware - Burroughs 6700

Computes a multiple-regression analysis for a single criterion and a maximum of 49 predictor variables. The Gauss-Jordan method is used in the solution of the normal equations. There is no restriction in the number of subjects for which score vectors may be presented. Output: Basic accumulations, means, standard deviations, dispersion matrix, and correlation matrix are printed and/or punched as required. Additional printed output, appropriately labeled, includes: The multiple-correlation coefficient; the F test criterion for multiple R, with its degrees of freedom; the beta weights; the squared beta weights; the B weights; and the intercept constant. Additional punched output includes: The beta weights; the B weights, and the intercept constant. Multivariate Procedures for Behavioral Sciences, by William W. Cooley and Paul R. Lonnes, John Wiley and Sons, Inc., New York. Modified by Walter Ritter O.

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Biometry - Goodness of Fit to Discrete  
Frequency Distribution, TCSC1

Language - FORTRAN  
Hardware - Burroughs 6700

Provides several options for the following operations: (1) Computes a binomial or Poisson distribution with specified parameters; (2) computes the deviations of an observed frequency distribution from a binomial or Poisson distribution of specified parameters or based on appropriate parameters estimated from the observed data; AG-test for goodness of fit is carried out; (3) A series of up to 10 observed frequency distributions may be read in and individually tested for goodness of fit to a specific distribution, followed by a test of homogeneity of the series of observed distributions; (4) A specified expected frequency distribution (other than binomial or Poisson) may be read in and used as the expected distributions; this may be entered in the form of relative frequencies or simply as ratios; the maximum number of classes for all cases is thirty; in the case of binomial and Poisson, the class marks cannot exceed 29. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Basic Statistic for Ungrouped Data  
TCSC2

Language - FORTRAN  
Hardware - Burroughs 6700

Reads in samples of ungrouped continuous or meristic variates, then ranks and optimally performs transformations on these data. Output consists of a table of the various statistics computed: mean, median, variance, standard deviation, coefficient of variation,  $g_1$ ,  $g_2$ , and the Kalmogorov Smirnov statistic  $D_{max}$  resulting from a comparison of the observed sample with a normal distribution based on the sample mean and variance; these are followed by their standard errors and 100 (1 -  $\alpha$ )% confidence intervals where applicable. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Basic Statistic for Data Grouped into a Frequency Distribution, TCSC3

Language - FORTRAN  
Hardware - Burroughs 6700

Similar to TCSC2, but intended for data grouped into a frequency distribution.

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Biometry - Single Classification and Nested Anova, TCSD1

Language - FORTRAN  
Hardware - Burroughs 6700

Performs either a single classification or a k-level nested analysis of variance following the techniques presented in Sokal and Rohlf (1969). The basic anova table as well as the variance components are computed. The program allows for unequal sample sizes at any level. The input parameters are reproduced in the output, followed by a standard anova table giving SS, df, MS, and  $F_s$ . For nested anovas with unequal sample sizes, synthetic mean squares and their approximate degrees of freedom (using Satterthwaite's approximation) are given below each MS and df. Each  $F_s$  is the result of dividing the MS on its line by the synthetic MS from the level above it. When sample sizes are equal, the synthetic mean squares and their degrees of freedom are the same as their ordinary counterparts, but are printed out nevertheless by the program. No pooling is performed. The anova table is followed by a list of the estimated variance components expressed both in the original units and as percentages; these in turn are followed by a table of the coefficients of the expected mean squares. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Factorial Anova  
TCSP2

Language - FORTRAN  
Hardware - Burroughs 6700

Reads in data for a complete factorial analysis of variance with no replications. Using the technique described in Sokal and Rohlf (1969, Section 12.5), it is possible to use this program for single classification anova with equal sample sizes, multi-way analysis of variance with equal replications, and other completely balanced designs. Produces the standard anova table and provides as well an optional output of a table of deviations for all possible one-, two-, three-, four-way (and more) tables. The output is especially useful as input to various programs for testing differences among means and can be inspected for homogeneity of interaction terms. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Sum of Squares STP  
TCSD3

Language - FORTRAN  
Hardware - Burroughs 6700

Tests the homogeneity of all subsets of means in anova, using the sums of squares simultaneous test procedure of Sokal and Rohlf (1969, Section 9.7). Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Student-Newman-Keuls Test  
TCSD4

Language - FORTRAN  
Hardware - Burroughs 6700

Performs a Student-Newman-Keuls a posteriori multiple range test. The SNK procedure is an example of a stepwise method using the range as the statistic to measure differences among means. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Test of Homogeneity of Variances  
TSCE1

Language - FORTRAN  
Hardware - Burroughs 6700

Performs Bartlett's test of homogeneity of variances and the  $F_{\max}$  test. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Test of Equality of Means with  
Heterogeneous Variances, TCSE2

Language - FORTRAN  
Hardware - Burroughs 6700

Performs an approximate test of the equality of means when the variances are assumed to be heterogeneous. The method differs from an ordinary single classification anova in that the means are weighted according to the reciprocal of the variance of the sample from which they were taken, and a special error MS must be used to take the weighting into account. The input parameters are reproduced in the output along with a listing of the means and variances for each sample. These are followed by the sample variance ratio  $F_0$  and the degrees of freedom required for looking up the critical F-value. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Tukey's Test for Nonadditivity  
TCSE3

Language - FORTRAN  
Hardware - Burroughs 6700

Performs Tukey's test for nonadditivity to ascertain whether the interaction found in a given set of data could be explained in terms of multiplicative main effects. This test is also useful when testing for nonadditivity in a two-way Model I anova without replication in experiments where it is reasonable to assume that interaction, if present at all, could only be due to multiplicative main effects. It partitions the interaction sum of squares into one degree of freedom due to multiplicative effects of the main effects on a residual sum of squares to represent the other possible interactions or to serve as error in case the anova has no replication. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Kruskal-Wallis Test  
TSCE4

Language - FORTRAN  
Hardware - Burroughs 6700

The Kruskal-Wallis test is a non-parametric method of single classification anova. It is called non-parametric because their null hypothesis is not concerned with specific parameters (such as the mean in analysis of variance) but only with distribution of the variates. This is based on the idea of "ranking" the variates in an example after pooling all groups and considering them as a single sample for purposes of ranking. This program performs the Kruskal-Wallis test for equality in the "location" of several samples. The input parameters and sample sizes are reproduced in the output, followed by the Kruskal-Wallis statistic H (adjusted, if necessary), which is to be compared with a chi-square distribution for degrees of freedom equal to  $a-1$ . Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - Fisher's Exact Test  
TCSE5

Language - FORTRAN  
Hardware - Burroughs 6700

Performs Fisher's exact test for independence in a  $2 \times 2$  contingency table. The computation is based on the hypergeometric distribution with four classes. These probabilities are computed assuming that the row and column classifications are independent (the null hypothesis) and that the row and column totals are fixed. Biometry, by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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Biometry - R x C Test of Independence in  
Contingency Tables, TCSE6

Language - FORTRAN  
Hardware - Burroughs 6700

Performs a test of independence in an R x C contingency table by means of the G test. Optionally it carries out an a posteriori test of all subsets of rows and columns in the R x C contingency table by the simultaneous test procedure. Biometry by Robert R. Sokal and F. James Rohlf, W.H. Freeman and Company, San Francisco, 1969. Modified by Walter Ritter O.

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# POLLUTION

## Monte Carlo Spill Tracker

Language - PL/1 Optimizer  
Hardware - IBM 370-168/216 K bytes (characters)

Provides insight on likely oil spill trajectories in a given region by season, using Monte Carlo sampling of Markov wind model at one- or three-hourly intervals; spill movement assumed to be linear combination of momentary wind and current vectors. Input: Map of area, output files from analysis of TDF-14 data, current hypothesis, postulated spill launch points. Output: Estimates of the likelihood of spill reaching various areas; estimates of the statistics of the time to reach such areas. See publications MITSG 74-20, "Primary, Physical Impacts of Offshore Petroleum Developments," by Stewart and Devanney, MIT Sea Grant Project Office, April 1974.

J.W. Devanney III  
Massachusetts Institute of Technology  
Room 5-207  
Cambridge, MA 02139

Available from originator only

Telephone (617) 253-5941

## Thermal Pollution Model

Language - FORTRAN IV  
Hardware - CDC 6500/CDC 1604/20K 60 bit words

Simulates the dispersion of heat from a source. Output is a printout of current and heat fields.

Kevin M. Rabe  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

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Telephone (408) 646-2842

## Substance Advection/Diffusion Routine

Language - FORTRAN  
Hardware - CDC 6500

Simulates the advection and diffusion of pollutants. The program uses a Lagrangian approach with a Fickian diffusion equation. Input: Current data, pollutant release location, concentration and time of release. Output: Pollutant spread fields. EPRF Tech. Note 1-74, "A Vertically Integrated Hydrodynamical-Numerical Model."

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## Danish Advection Program

Language - FORTRAN  
Hardware - CDC 3100/CDC 6500

Computes advection of pollutants (or mass) in a fluid in two dimensions. Input: Velocities in X and Y, mass and grid spacing in X and Y, all for each grid point; timestep and total time or advection. Output: Initial gridpoint of field advected and final field after total advection. Quasi-Lagrangian method used, utilizing mass, center of mass, and width of mass distribution, all for each grid point. Storage requirement is grid-size dependent: for NX by NY grid,  $(NX*NY*7) + (NX+1)*28$  words. "A Method for Numerical Solution of the Advection Equation," by L.B. Pederson and L.P. Prahm, Meteorological Institute, Denmark, Aug. 1973, 36 pp.

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Ecological Statistical Computer Programs  
ECOSTAT

Language - ANS FORTRAN\*  
Hardware - IBM 360/370\*\*

The system was developed as part of an extensive study undertaken by the County Sanitation Districts of Los Angeles and the Southern California Coastal Water Research Project to provide insight into the ecological effects of ocean discharge of treated wastewaters. Biological and physical data for analysis were available from semi-annual benthic surveys on the Palos Verdes Shelf. Due to the nature of the analysis and the probability that the system would be used by other agencies, it was decided that the programs would be made general and easily implemented and used in other computing environments and sampling studies. The system differs from other statistics packages in that it allows the user to define a taxonomic structure on encountered species and employ the resultant groupings in the calculation of diversity indices, T and F statistics, linear correlation coefficients, one-way analysis of variance, dissimilarity coefficients, and abiotic-biotic relationship tables. The user can also specify station groupings to be used in computing statistics.

Output: (1) Summary information: (a) raw data, (b) species distribution, (c) dominant species; (2) Univariate statistics: (a) means, standard deviations by parameter for each station, (b) community diversity (8 measures - Brillouin's, Gleason's, Margalef's, Shannon-Weaver's, Simpson's, scaled Shannon-Weaver's, scaled Simpson's, scaled standard deviation), (c) T and F statistics between regions by parameter, (d) dissimilarity coefficients by taxon between regions, between samples for each station, between surveys by region, (e) ANOVA tables among surveys by region; (3) Multivariate statistics: (a) linear correlation coefficients by region between parameters; (4) Abiotic-biotic relationships: (a) means, standard deviations, ranges of physical parameters for each partition of relative abundance, (b) dominant species occurring at physical parameter class interval pairs.

(\*With the following IBM extensions: Object-time dimensions transmitted in COMMON, INTEGER\*2, END parameter in a READ, literal enclosed in apostrophes, mixed-mode expressions, NAMELIST, T format code.)

(\*\*For all programs except BIOMASS, ABUNDANCE, and DIVERSITY, a direct access storage device is required. Since all data sets are accessed sequentially a tape system is possible, however, and with as few as three drives all analyses with the exceptions of those between surveys may be accomplished. The generation of Table VO (ANOVA among surveys) using five surveys, for example, requires a minimum of ten files to be open simultaneously, and, unless there are ten tape drives available, this would be impossible without using disk storage.)

"Ecological Statistical Computer Programs, User Guide," by Bruce Weinstein, Los Angeles County Sanitation Districts, August 1975.

Data Processing  
Technical Services Department  
Los Angeles County Sanitation Districts  
1955 Workman Mill Road  
Whittier, CA 90601

Available from originator only

Telephone (213) 699-7511

# CURRENTS AND TRANSFER PROCESSES

## Drift Bottle Statistics

Language - PL/1 Optimizer  
Hardware - IBM 360-168/200K

Used for determination of spatial and temporal conditions in drift bottle trajectories. Input: Standard NODC 80 character drift bottle records, formatted according to NODC Pub. M-6 in either card or tape form. Bottle records must be roughly sorted by launch point location to facilitate identification of recoveries occurring from a common launch event. Output: Launch and recovery group size distributions; pairwise correlations in recovery location and date. Recovery group size vs. launch group size; Chi-square tests of independent trajectory, hypothesis, etc. Brief discussion of results for U.S. Atlantic Coast available in publication MITSG 74-20, "Primary, Physical Impacts of Offshore Petroleum Developments," by Stewart and Devanney, MIT Sea Grant Project Office, April 1974.

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## Drift Bottle Plots

Language - PL/1  
Hardware - IBM 370-168/SC4020 CRT

Plots launch and recovery locations of drift bottles. Input: Data files screened and formatted by CNDNSDTA. Output: CRT plots of launch and recovery positions. See publication MITSG 74-20, "Primary, Physical Impacts of Offshore Petroleum Developments," by Stewart and Devanney, MIT Sea Grant Project Office, April 1974.

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## Reformat and Sort Drift Bottle Data CNDNSDTA

Language - PL/1  
Hardware - IBM 370-168/250K/Disk

Reformats into condensed record format (28 characters), screens for bottle configuration, and sorts by launch point, filing into on-line (disk) storage. Input: Standard NODC 80 character drift bottle records per NODC publication M-6. Output: All drift bottles launched within "r" miles of "N" launch points are reformatted and filed in "N" separate data file.

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## Current Profiles from Tilt Data

Language -  
Hardware -

Calculates current profiles generated from tilt data obtained from Niskin current array. Current magnitude and direction are computed at each sensor from tilt and azimuth data by means of numerical algorithms developed from analysis of the three-dimensional cable equations. Input: Physical parameters to be modeled. Output: Profiles can be generated at a given time using one method. Profiles can also be generated for one-hour increments from the averaged data which have been curve fitted between sensor stations.

Gary T. Griffin  
Naval Underwater Systems Center  
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Available from originator only

Telephone (203) 442-0771

#### Current Meter Data

CREATE-C  
CURRENT  
CURRPLOT

Language - FORTRAN  
Hardware - CDC 3300/Disk/UCC Plotter  
20K words  
20K words  
28K words

CREATE-C creates a disk file of raw data digitized from Braincon current meter film and consisting of arc endpoints and angles; listing also produced. CURRENT converts raw data to current speed, direction, etc.; according to particular calibration and gives basic statistics: minimum and maximum speed, means, standard deviations, etc. Input: disk file from CREATE-C and a data card giving information about the data (e.g., format) and about the current meter used (type, observation time, etc.). Output: Listing of converted data and statistics and a new disk file of converted data. Using this data file and a plot data card, CURRPLOT prepares a tape for the UCC Plotter to give plots of speed vs. time, direction vs. time, and progressive vector plot. Plots are broken up into one-week units.

K. Crocker  
Naval Underwater Systems Center  
Newport, RI 02840

Available from originator only

Telephone (401) 841-3307

#### Current data SPECTRUM

Language - FORTRAN  
Hardware - CDC 3300

Using processed data file from CURRENT and a preprocessing data card, gives autocorrelation and auto power spectrum for current speed and velocity components with preprocessing options for filtering, condensing, etc.

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#### Optimized Multi-layer HN Model

Language - CDC FORTRAN EXTENDED  
Hardware - CDC 7600 or 6500 w/CDC 3100/157K  
octal (60 bit) words on 7600

Computes surface deviations and integrated current velocities based on hydrodynamic equations for small-scale coastal and open ocean areas for up to three selected layers. The finite difference scheme proposed by Hansen (1938) is extended to multiple layer cases optimized for ease in practical application and for computer computation. Intermediate data tape prepared on CDC 3100. EPRF Tech. Paper 15-74, by R.A. Bauer.

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Naval Postgraduate School  
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#### Mean Drift Routine

Language - FORTRAN  
Hardware - CDC 6500/CDC 1604

Generalized routine to simulate the drift of an object, given the current structure, wind fields, and object leeway. EPRF Tech. Note 1-74, "A Vertically Integrated Hydrodynamical-Numerical Model."

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Search and Rescue Planning  
NSAR

Language - FORTRAN Extended  
Hardware - CDC 6500/54K words

Provides an estimate of an object's position in the ocean at the time a search is initiated. Computes drift as a resultant of two components. In all cases 100 percent of the surface current is applied. Wind effects are handled through a series of leeway codes options. Input: FNWC surface wind and current field analysis and prognosis; object starting time and position, datum time, last known position, navigation error factors, leeway factors. Output: Datum points (latitude, longitude) for each datum time. OPNAV INST 3130.5A, 7 Dec. 1972, FNWC Tech. Note 60, August 1970.

LCDR John Gossner  
Fleet Numerical Weather Central  
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Current Meter Turbulence

Language - FORTRAN  
Hardware - IBM 7074

Gives an indication of turbulence in the ocean by computing measures of the deviations from means over various lengths of time. OS No. 572-2. Author - Robert R. Gleason.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only

Telephone (301) 763-1449

In-Situ Current

Language - FORTRAN V  
Hardware - UNIVAC 1108/1K words/Drum

Converts one-minute averages of Interocean Type II current meter to standard vectorial values. Produces vectorial angle and velocity for each data point and then combines vectorially to yield a mean value for entire period. Input: Card images of data points taken from Russtrak recorders. Output: Printout of vectorial and five-minute average values, current speed and direction in knots, and degrees true.

Philip Vinson  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only

Telephone (202) 433-3878

Water Displacement  
DISPLA

Language - FORTRAN  
Hardware - UNIVAC 1108/1,200 36 bit words/  
3 tape units

Computes water displacement resulting from ocean current action. Input: Current speed and direction values on tape produced by current meter print program. Output: Individual and cumulative displacements per selected unit time in nautical miles; tabular printout, tape, or both.

Gerald Williams  
U.S. Naval Oceanographic Office  
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Available from originator only

Telephone (202) 433-4187

Current Meter Print

Language - FORTRAN  
Hardware - UNIVAC 1108/10K 36 bit words/Drum/  
3 tape units

Calculates ocean current speeds and directions from Geodyne A101 optical current meters. Values are converted to knots and degrees and are vectorially averaged over one-minute data frames, ten scans per frame. Input: Observed current parameters from meter converted from optical film to magnetic tape; parameters are in arbitrary units dependent on meter design. Output: Current speed and direction data; tabulated printout and tape. Tape output drives plotter program.

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Current Meter Plot

Language - FORTRAN  
Hardware - UNIVAC 1108/9K 36 bit words/3 tape  
units/CalComp Plotter

Produces plotter tape to plot ocean current speed and direction information. Program calls CalComp subroutines. Input: Current speed and direction data on tape produced by Current Meter Print Program. Output: Histograms, polar plots, and point plots.

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U.S. Naval Oceanographic Office  
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Convert Current Meter Tape  
MAGPACK

Language - FORTRAN V  
Hardware - UNIVAC 1108/EXEC 8/Instructions 647  
words/Data 707 words/2 tape units

Converts binary data on tape from Geodyne MK III current meter to BCD tape, formatted and blocked for further processing, with edited time, compass, vane, tilt, and speed rotor counts. Binary data decoded with FORTRAN field functions and output blocked and formatted with subroutine NAVIO. Author - Peter J. Topoly.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

Current Meter Data  
MPRINTO

Language - FORTRAN V  
Hardware - UNIVAC 1108/EXEC 8/Instructions  
2 tape units

Computes frame and scan values of current meters (Geodyne A101 optical and MK III magnetic); calculates normalized unit vectors for vectorial speed, lists data, and produces packed BCD tape. Input: BCD tape with rotor counts of compass, vane, speed, and tilt. Output: Packed BCD tape of frame data and averaged frame data (pack rate and averaging rate optional). Author - Peter J. Topoly.

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U.S. Naval Oceanographic Office  
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Current Meter Clock Sequence  
XTAL

Language - FORTRAN IV Extended  
Hardware - XDS Sigma 7/48K words (192K bytes)

Verifies sequence of crystal clock count values from VAC or Geodyne 850 current meters. Bad

clock values are identified by use of differencing techniques. Input: Clock values on tape in CARP format. Output: Statistics of clock performance with catalog of erroneous values.

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Telephone (617) 548-1400

Current Meter Calibration  
CASDEC

Language - FORTRAN IV, Extended  
Hardware - XDS Sigma 7/48K words (192K bytes)

Applies calibration parameters to raw VACM current meter data on tape in CARP format, identifies and removes bad values, and stores the output on tape in standard buoy format.

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Current Meter Data Reduction and Editing  
CARP

Language - HP Assembly Language  
Hardware - HP 2100/8K locations/Cassette reader/Keyboard device

Transfers current meter data from VACM cassette or Geodyne 850 cartridge magnetic tape to nine-track computer compatible tape and flags data cycles which have errors.

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Woods Hole Oceanographic Institution  
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Surface Current Summary  
SUFUR

Language - Assembler  
Hardware - IBM 360-65

Produces a statistical summary of surface current observations for each Marsden (ten-degree) square, one-degree square, or five-degree square and month for a given area. Author - Jeffrey Gordon.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

Copy on file at NODC  
Telephone (202) 634-7439

Vector Time Series  
CURPLT6

Language - FORTRAN IV  
Hardware - CDC 6400 (SCOPE 3.4)/115K (octal)  
10-character words/CalComp  
936/905 Plotting System

Computes and plots statistics, histograms, time series, progressive vector diagram and spectra for time series of current meter data. Input: Current meter time series on tape in CDC 6400 binary format; maximum number of data points is 5326. Output: Listing and tape for off-line plotter. Perfect Daniel frequency window used to compute spectral estimate from FFT-generated periodogram values.

James R. Holbrook  
Pacific Marine Environmental  
Laboratory, NOAA  
3711 Fifteenth Avenue, N.E.  
Seattle, WA 98105

Available from originator only  
Telephone (206) 442-0199

Processes Current Instrument Observations    Language - FORTRAN II  
Hardware - IBM 1620 II

Several programs and subroutines for processing Michelsens Container data (automatic current and temperature measurements), for processing Ekman current meter data, and for harmonic analysis and power spectrum analysis. NATO Subcommittee on Oceanographic Research Technical Report No. 37 (Irminger Sea Project), "Some FORTRAN II Programs for Computer Processing of Oceanographic Observations," by H.E. SWEERS, Feb. 1967.

Geophysical Institute  
University of Bergen  
Bergen, Norway

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Current Meter Data Processing System

Language - MS FORTRAN  
Hardware - CDC 3150/20K words/2 tape units/  
CalComp Plotter

Processes data primarily from Brainçon or Aanderaa moored current meters; performs automatic editing, tidal analysis residuals, tide prediction, filtering, plotting; power spectra and statistical means and histograms are generated. Also performs file management.

Doug Gregory  
Bedford Institute of Oceanography  
P. O. Box 1006  
Dartmouth, N. S. B2Y 4A2

Available from originator, only.

Telephone (902) 426-2390

# TIDES

## Astronomical Tide Prediction

Language - FORTRAN IV  
Hardware - IBM 360-195/80K bytes

Computes hourly values and time and heights of high and low astronomical tides by harmonic method. Input: Tidal constituent constants. Technical Memorandum WBTM TDL-6.

N.A. Pore  
Techniques Development Laboratory  
National Weather Service, NOAA  
8060 Thirteenth Street  
Silver Spring, MD 20910

Available from originator only

Telephone (301) 427-7614

## Tides in the Open Sea

Language - FORTRAN 60  
Hardware -

Predicts tides in the open sea, utilizing the basic hydrodynamic equations, for the principal lunar semidiurnal constituent M2. Application is made to the analysis of the tidal regime in the Gulf of Mexico. Thesis by Thomas H. Gainer, Jr., May 1966.

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Monterey, CA 93940

Available from NTIS, Order No. AD 489 096/LK,  
\$4.75 paper, \$2.25 microfiche.

## Harmonic Analysis of Data at Tidal Frequencies

Language - FORTRAN IV  
Hardware - CDC 6600\*/140K

For analyzing equally spaced short-period data (15 days or 29 days), this program utilizes the standard Fourier analysis and traditional methods of the former Coast and Geodetic Survey. Either a vector (polar form) or scalar variable may be analyzed; for vector series, the program allows either a major-minor axis analysis or a north-east component approach. No data series may exceed 7,000 terms without re-dimensioning in the program, and no series of other than 15 or 29 days of uniformly spaced data can be analyzed. The program accepts input via magnetic tape or punched cards in any format with the restriction that, for vectors with magnitude and direction in the same record, the angles must precede the amplitudes in the record. For vectors specified by one file of amplitudes and one file of directions, the amplitude file must be read first. Output: mean amplitudes and phases of 26 tidal constituents. NOAA Technical Report NOS 41, "A User's Guide to a Computer Program for Harmonic Analysis of Data at Tidal Frequencies," by R. E. Dennis and E. E. Long, July 1971.

(\*The program is executable with minor adjustments on any compatible machine having a 140K memory and access to arcsine and arccosine systems functions. Computing time is approximately 1.5 seconds per station on the CDC 6600.)

Charles R. Muirhead  
Chief, Oceanographic Surveys Branch  
National Ocean Survey, NOAA  
6001 Executive Boulevard  
Rockville, MD 20852

Deck available from originator only; for above report (including program listing), contact Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Price: \$.70, stock number 0317-0022. Telephone (301) 443-8501

## Theoretical Radial Tidal Force

Language - MAD  
Hardware - IBM 7090

Input: (1) astronomical data from the nautical almanac; (2) the solar ephemeris obtained from the same source (only the earth-sun radius vector is needed); (3) list of local constants,

altitude and longitude in degrees of arc and minutes, elevation in centimeters. Output: Lunar, solar, and total tidal forces and the vector date. Program accomodates maximum of 725 hours (30 days) of data in core storage. Author - Henry L. Pollak.

Dept. of Earth and Planetary  
Sciences  
414 Space Research Coordination  
Center  
University of Pittsburg  
Pittsburg, PA 15213

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# WAVES

## Hurricane Storm Surge Forecasts SPLASH I

Language - FORTRAN IV  
Hardware - CDC 6600/77K words

Predicts hurricane storm surges for landfalling storms, using numerical solutions of linearized transport equations with surface wind forcing and time history bottom stress. Input: Basin data and storm variables, such as intensity, size, and vector storm motion. Output: Storm surge envelopes, storm definitions, and astronomical tides.

Celso S. Barrientos  
Techniques Development Laboratory  
National Weather Service, NOAA  
8060 Thirteenth Street  
Silver Spring, MD 20910

Available from NTIS: Magnetic tape, Order No. COM-75-10180/AS, \$250 domestic, \$312 foreign; User's Guide, Order No. COM-75-10181/AS, \$3.25 domestic, \$5.25 foreign  
Telephone (301) 427-7613

## Hurricane Storm Surge Forecasts SPLASH II

Language - FORTRAN IV  
Hardware - CDC 6600/77K octal words

Predicts storm surges for storms with general track and variant storm conditions, using numerical solutions of linearized transport equations with surface wind forcing and time history bottom stress. Input: Basin data, storm variables, and geographical description of storm track. Output: Storm surge envelopes, space-time history of surges, storm characteristics, and astronomical tides.

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Available from NTIS: See SPLASH I  
Telephone (301) 427-7613

## East Coast Storm Surge

Language - FORTRAN IV  
Hardware - IBM 360-195/185K bytes

Predicts storm surges generated by extratropical storms for eleven stations along the U.S. East Coast. Forecast equations derived by statistical screening regression. Input: National Meteorological Center PE model sea-level pressure forecasts. Output: Storm surge forecasts to 48 hours at 6-hour intervals, for 11 locations. NOAA Technical Memorandum NWS TDL-50.

N.A. Fore  
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National Weather Service  
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Silver Spring, MD 20910

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## Wave Forecasts

Language - FORTRAN IV  
Hardware - IBM 360-195/410K bytes

Forecasts wind waves and swells for the Atlantic and Pacific Oceans, using singular method based on the Sverdrup-Munk forecasting system. Input: National Meteorological Center 1000-mb PE model wind forecasts; Output: Wind wave and swell grid printed charts to +48 hours. Technical Memoranda WBTM TDL-13 and TDL-17.

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#### Wave Bottom Velocity

Language - FORTRAN IV G Level 21  
Hardware - IBM 360-75/96K

Computes and plots maximum bottom (horizontal) orbital velocity versus still water depth for Airy waves of given height and period. Output: log-log graph of  $u(\max)$  at sea floor vs. water depth for each wave; also, a listing of the wave's steepness,  $u(\max)$  at bottom, wave length, and celerity is produced.

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#### French Spectro-Angular Wave Model

Language - FORTRAN IV/COMPASS  
Hardware - CDC 6500/CDC 7600

Computes sea-state, using a spectral approach involving sixteen directions and six periods, devised by Gelei et al. Input: Wind speed and direction. Output: Significant wave height period of highest energy and direction of maximum energy fields. Detailed spectral breakdown for up to twelve points.

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#### Surf Prediction Model

Language - FORTRAN IV  
Hardware - CDC 3100/16K 48 bit words

Produces calculated wave ray paths, including the wave information and refraction and shoaling coefficients, using a modified Dobson approach to the solution of the general wave refraction. Technical Report No. 16, by B.S.L. Smith and F.E. Camfield, College of Marine Studies, University of Delaware.

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#### Singular Wave Prediction Model

Language - FORTRAN  
Hardware - CDC 3100/CDC 3200/32K 24 bit words

Produces a wave height analysis for semi-enclosed seas. Uses a modified geostrophic wind derived from a local pressure analysis to generate an analysis of the sea state. Output: Wave height (ft), wave period (sec), wind speed ( $m\ sec^{-1}$ ) and wind direction (degrees). EPRF Program Note 8, "The Wave 32 Program," by S. Larson and A.E. Anderson, Jr.

Sigurd Larson  
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Wave Interaction with Current  
CAPGRAY

Language - FORTRAN  
Hardware - IBM 370-145/2000K Region

Calculates wave length, wave number, wave slope, and wave energy changes for waves in the capillary-gravity subrange as they interact with non-uniform current. A perturbation scheme using the gravity contribution of the capillary-gravity wave as the perturbation parameter was used to integrate the energy equation exactly. Input: Wave number K for waves with no current.

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Center for Marine and Coastal Studies  
North Carolina State University  
Raleigh, NC 27607

Available from originator only

Telephone (919) 737-2212

Shipborne Wave Recorder Analysis  
SBWRO

Language - FORTRAN IV  
Hardware - IBM 1800

Given values of the highest and second highest crests, the lowest and second lowest troughs, the number of zero crossings, and the number of crests in a short record from the NIO shipborne wave recorder, computes the spectral width parameters and the significant wave height and also the predicted maximum height in a period of three hours, outputs the results on line-printer and on disk. NIO Program No. 89. Author - Eileen Page.

National Institute of Oceanography  
Wormley, Godalming, Surrey, England

Copy on file at NODC (listing, documentation)

Storm Surge

Language - FORTRAN IV  
Hardware - UNIVAC 1108/10K words

Numerical models, based on the hydrodynamic equation and local depth fields, are used to determine the flood levels expected from specific hypothetical storms. Publication TM-35, "Storm Surge on the Open Coast; Fundamentals and Simplified Prediction," May 1971.

(1) For program release:  
Colonel James L. Trayers  
Commander and Director  
Coastal Engineering Research Center  
Kingman Building  
Fort Belvoir, VA 22060

Available from originator only

(2) For program information:  
D. Lee Harris  
Chief, Oceanography Branch  
Coastal Engineering Research Center

Wave Refraction

Language - FORTRAN IV  
Hardware - UNIVAC 1108/15K words/Plotter

Calculates and plots surface wave rays. Input: Depth grid; xy and angle starting point of rays. Output: Plotted output of shoreline and wave rays; listing of wave ray x, y, angle, time and depth. Publication TM-17, "A Method for Calculating and Plotting Surface Wave Rays," Feb. 1966.

(1) For program release:  
Colonel James L. Trayers  
Commander and Director  
Coastal Engineering Research Center  
Kingman Building  
Fort Belvoir, VA 22060

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(2) For program information  
D. Lee Harris  
Chief, Oceanography Branch  
Coastal Engineering Research Center

Water-Wave Teaching Aids

Language - FORTRAN  
Hardware - IBM 360-40

In teaching the engineering applications of water-wave theory, it is often desirable to have students make numerical calculations based on the various wave theories. This is practical, however, only for the simplest of the water-wave theories, as the computations involved with higher order theories are quite tedious and time-consuming. This collection of programs and subroutines represents an attempt to relieve students of these lengthy and detailed computations, so that they can use the theoretical results in solving realistic problems. At the same time, there are dangers inherent in developing and using computer programs for teaching purposes. The principal difficulty is the "black box" syndrome, where the students merely punch some numbers into a card and, later, get more numbers back from the machine, without the vaguest idea of what happened in between. In order to avoid this difficulty, and, in addition, to provide wide flexibility, it was decided that the best format for this collection would be many short, single-function subroutines, which compute some of the more tedious intermediate results for a given problem, and which can be easily modified or added to by the user. The disadvantage of this approach is that it requires some knowledge of FORTRAN on the part of the student. It is believed, that this disadvantage is outweighed by the advantage of making the computational processes both clear and flexible.

LENG1 computes wave length and speed, given the water depth and wave period, using small-amplitude (and Stokes' second-order) wave theory. Values are returned to the calling program through the CALL statement and are also printed out during execution. LENG3 uses Stokes' third-order wave theory.

PROF1 computes water surface elevations,  $\eta(x)$  or  $\eta(t)$ , over a wave period, using linear wave theory; returns arrays of  $x$ ,  $t$ , and  $\eta$  through the CALL statement; prints input data and the three arrays. Alternate subroutines PROF2 and PROF3 accomplish the same purpose using Stokes' second- and third-order wave equations.

Subroutines UMAX1, WMAX1, UTMAX1, and WTMAX1 compute  $u(\max)$ ,  $w(\max)$ , the partial derivative of  $u$  with respect to  $t(\max)$ , or the partial derivative of  $w$  with respect to  $t(\max)$ , i.e., the maximum flow velocities in the  $x$  and  $z$  directions and their corresponding temporal accelerations, as a function of  $z$ , from  $z = -h$  to  $z = \eta(\max)$ , using linear wave theory. Returns arrays of  $z$  and  $u(\max)$  etc., for  $z = -h, -(29/30)h, -(28/30)h, \dots$  for  $z$  less than  $\eta(\max)$ , through the CALL statement; prints the input data and the two arrays. Alternative sets of routines carry out the same purpose using Stokes' second- and third-order equations.

Subroutines UOFT1, WOFT1, UTOFT1, and WTOFT1 compute values of  $u(t)$ ,  $w(t)$ , the partial derivative of  $u$  with respect to  $t$ , or the partial derivative of  $w$  with respect to  $t$ , i.e., the horizontal and vertical flow velocities and their accelerations, over a wave period ( $T$ ) at a given depth ( $z$ ) using linear wave theory. Returns arrays of  $t$  and  $u(t)$ , etc., for  $t = 0, T/40, 2T/40, \dots, T$ , through the CALL statement; prints the input data and the two arrays. Alternative sets of routines carry out the same purpose using Stokes' second- and third-order equations.

The following four programs, dealing with spectra, were adapted (with permission) from the Share program G1 BE TISR, written at Bell Laboratories by M.J.R. Healy, 1962: DETRND removes the mean, or the mean and linear trend (slope) from a time series  $X(I)$ ,  $I = 1, N$ ; AUTCOV computes the autocovariance,  $Y(K)$ ,  $K = 0, L$ , of the time series  $X(I)$ ,  $I = 1, N$ ; CRSCOV computes the auto- and cross-covariances,  $ZXX(K)$ , etc., of the two sequences  $X(I)$ ,  $Y(I)$ ,  $I = 1, N$ , for lags from 0 to  $L$ ; FOURTR computes either the sine or cosine transform,  $Y(K)$ ,  $K = 1, H + 1$ , of the series  $X(K)$ ,  $K = 1, N + 1$  (smoothing of either is optional, with coefficients .25, .50, .25).

PROFILE computes and plots the wave profile given a spectrum (in the form of the Fourier coefficients). Output: A printer plot (on a printer with a 132-character line) of  $\eta$  vs.  $t$ .

REFL1 computes and prints water surface profiles for the partial (two-dimensional) reflection of a linear (small-amplitude) wave from a structure.

FORCE AND MOMENT computes the total force and moment (about the base, or "mud line") on a circular cylindrical pile as a function of time, using linear theory integrated to the actual water surface. A table of  $F$  and  $M_0$  vs.  $t$  is printed out.

EDIST computes the force distribution on a pile, using linear theory. Prints out the data and the force distribution as a function of time.

Listed and documented in Hydrodynamics Laboratory Technical Note No. 13, "Water Wave Teaching Aids," by R.H. Cross, Sept. 1968.

Department of Civil Engineering      Copy on file at NODC (above report)  
Massachusetts Institute of Technology  
Cambridge, MA 02139

# AIR-SEA INTERACTION AND HEAT BUDGET

Markovian Analysis of TDF-14 Wind Data

Language- PL/I Optimiz

Hardware - IBM 370-180/260K bytes (characters)

Produces 9 x 9 and 33 x 33 matrices of wind transition probabilities for user-supplied interval. Assumes wind can be modeled as a Markov process, in which likelihood of wind speed and direction in next interval depends only on current wind speed and direction. Input: TDF-14 formatted tapes of hourly and three-hourly weather station data, available from National Climatic Center, Asheville, NC 28801. Output: Wind transition matrices by season, steady-state probabilities, distribution of wind speed by direction. See publication MITSG 74-20, "Primary, Physical Impacts of Offshore Petroleum Development," by Stewart and Devanney, MIT Sea Grant Project Office, April 1974.

J.W. Devanney III  
Massachusetts Institute of Technology  
Room 5-207  
Cambridge, MA 02139

Available from originator only

Telephone (617) 253-5941

Summarizes Weather Reports  
SYNOP

Language - FORTRAN (ALGOL input routine)

Hardware - Burroughs 6700/Less than 20K words

Processes synoptic marine radio weather reports to produce summaries of various items, by month. The validity of the data is checked against long-term mean values. Input: Disk files prepared separately from punched cards. Output: Printed summaries by one-, two-, and five-degree quadrangles, of sea and air temperatures, heat budget information, and barometric pressure; also punched cards for selected summary items.

A.J. Good  
Southwest Fisheries Center  
National Marine Fisheries Service, NOAA  
P.O. Box 271  
La Jolla, CA 92037

Available from originator only

Telephone (714) 453-2820, ext. 325

Pyranometer and Radiometer Time Series  
RAD

Language - FORTRAN

Hardware - CDC 6400/53K words

Converts pyranometer and new radiometer readings to radiant intensity. Input: Cards with punched values of time, voltage values from a net radiometer, pyranometer, humidity sensor, air thermistor, wind speed detector, and values of sea-surface temperature. Output: Listing of the above values converted to proper units plus computed values of net solar radiation, evaporative and conductive fluxes, total flux, effective back radiation, transmittance, solar altitude, and albedo.

R.K. Reed  
Pacific Marine Environmental  
Laboratory, NOAA  
3711 Fifteenth Avenue N.E.  
Seattle, WA 98105

Available from originator only

Telephone (206) 442-0199

Ocean Climatology Analysis Model  
ANALYS

Language - FORTRAN

Hardware - CDC 1604/16K 48 bit words/Drum/  
3 tape units

Produces monthly climatological data fields. Input: Synoptic fields, first-guess climatology field. Uses a Laplacian relaxation technique. Computer Applications, Inc., Tech. Report,

"Documentation of Subroutine ANALYS," by J.N. Perdue.

Kevin M. Rabe  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

Available from originator only

Telephone (408) 646-2842

Hurricane Heat Potential Model

Language - FORTRAN IV  
Hardware - CDC 6500/20K 60 bit words/Varian  
Plotter optional

Computes the hurricane heat potential using the station temperature profiles in the form of punched cards in 4-D format. Output: a profile plot, hurricane heat potential, final Varian plot of area with all heat potentials plotted. Thesis by LCDR Shuman.

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Mixed Layer Depth Analysis Model  
MEDMLD

Language - FORTRAN/COMPASS  
Hardware - CDC 3100/CDC 3200/32K 24 bit words/  
Drum/3 tape units

Generates an analyzed mixed layer depth field using ship reports and a first-guess field in the form of an adjusted climatological MLD field. The program uses a Laplacian analysis and relaxation scheme to generate the final field. Output: An analyzed mixed layer depth field on a synoptic basis. EPRF Programming Note 7, "Mediterranean Mixed Layer Depth Analysis Program MEDMLD," by A.E. Anderson, Jr.

Sigurd Larson  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

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Telephone (408) 646-2868

Atmospheric Water Content Model

Language FORTRAN (CDC 3100 MSOS)  
Hardware - CDC 3100/12K octal words (24 bit)/  
15K octal words with system (MSOS)

Computes total grams of water present in atmospheric column surrounding ascent of radiosonde. The method used is based on Smithsonian tables and formulae. Compressibility of moist air is assumed equal to one. Output: Various intermediate values plus geometric height and total quantity of water in grams.

T. Laevastu or A. Stroud  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

Available from originator only

Telephone (408) 646-2937

Ocean-Atmospheric Feedback Model

Language - FORTRAN IV  
Hardware - CDC 6500/70K 60 bit words

Simulates the response of the surface air to sea-surface properties and also the processes of

mesoscale feedback mechanisms: EPRF Tech. Paper 2-72, "The Effects of Oceanic Fronts on Properties of the Atmospheric Boundary Layer," by T. Laevastu, K. Rabe, and G.D. Hamilton.

Kevin M. Rabe  
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Naval Postgraduate School  
Monterey, CA 93940

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Telephone (408) 646-2842

Wind Computation from Ship Observations  
TRUWIND

Language - FORTRAN  
Hardware - CDC 1604/16K 48 bit words

Calculates the true wind direction in degrees and speed in knots, given the direction and speed of the ship and the observed wind direction and speed. EPRF Program Note 16, "Program TRUWIND," by Baldwin van der Bijl.

Taivo Laevastu  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

Available from originator only.

Telephone (408) 646-2937

Mie Scattering Computations

Language - FORTRAN  
Hardware - CDC 3800/CDC 6600/32K

Uses Mie scattering theory to compute the angular distribution of scattered radiation from spherical particles, for a range of values of index of refraction and size parameter  $\alpha = 2\pi r/\lambda$  (where  $r$  = particle radius and  $\lambda$  = wavelength of incident radiation).

James W. Fitzgerald  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only

Telephone (202) 767-2362

Solar Radiation Conversion

Language - FORTRAN  
Hardware - IBM 7074

Averages the radiation readings from the Eppley pyrheliometer and Beckman-Whitley radiometer for every 15 minutes. Converts from MV to Langleys/min. and calculates net radiation from both instruments. A modification of this program was made to include a Thornthwaite net radiometer. Authors - S.M. Lazanoff; modified by Mary E. Myers.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only

Telephone (301) 763-1449

Wind Stress

Language - FORTRAN  
Hardware - IBM 7074

Determines wind stress on the ocean surface. OS No. 53462. Author - W.H. Gemmill.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

Two-Dimensional Power Spectrum for SWOP AI

Language - FORTRAN  
Hardware - IBM 7074

Determination of spectrum associated with the spatial distribution of energy as obtained from an instantaneous picture of the ocean taken from aircraft (SWOP II). OS NO. 53484. Author - C.M. Winger.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

Prediction of Vertical Temperature Change

Language - FORTRAN  
Hardware - IBM 7074/Benson-Lehner Plotter

A technique based primarily on heat budget and wind mixing calculations has been developed for predicting the vertical thermal structure of the ocean; the technique essentially modifies the initial thermal structure through incident solar radiation, back radiation, sensible and evaporative heat exchange, convective heat transfer in the water mass, and wind mixing. Predictions are made at six-hour intervals until 1200Z on the date of forecast. The predicted BT is printed out, and also can be plotted with a Benson-Lehner Model J plotter. Authors - W.H. Gemmill and D.B. Nix. Informal manuscript report IMR No. 0-42-65, Oct. 1965. (See also IMR No. 0-45-65 by B. Thompson and IMR No. 0-13-66 by Barnett and Amstutz.) Program listings separate from reports.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Copy on file at NODC (Above reports 0-42-65 and 0-45-65; also listings)  
Telephone (301) 763-1449

Cloud Cover and Daily Sea Temperature

Language - FORTRAN  
Hardware - IBM 7074

Divides cloud cover into three groups and computes mean temperature by hour of day and by day for each depth. OS No. 53414. Author - D.B. Nix.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

# ICE

Sea Ice Studies  
YARIT, FLIP, SALPR, RITE

Language - FORTRAN IV.  
Hardware - IBM 7090-94

A generalized program with several options that allow considerable latitude in the specification of input and output data. A main program reads in the input data and summarizes the results of each year's integration. Subroutine YARIT calculates the temperature and thickness changes of the ice and snow for each time step during the year. Subroutine FLIP takes the monthly values of the independent energy fluxes at the upper boundary and produces smoothed values for each time step. Subroutine SALPR calculates the salinity profile for each time step. Finally, subroutine RITE writes the temperature profile, ice thickness and mass changes for each ten-day period throughout the year. Memorandum RM-6093-PR, "Numerical Prediction of the Thermodynamic Response of Arctic Sea Ice to Environmental Changes," by G.A. Maykut and N. Untersteiner, Nov. 1969. Prepared for U.S. Air Force Project Rand.

The Rand Corporation  
1700 Main Street  
Santa Monica, CA 90406

Available from NTIS, Order No. AD 698 733/LK,  
\$7.00 paper, \$2.25 microfiche.

Wind Drift and Concentration of Sea Ice  
ICEGRID MODIFIED

Language - FORTRAN 60  
Hardware - IBM 1604

Takes into consideration the effects of melting on the production of five-day forecasts of the wind drift and concentration of sea ice, using equations after Zubov and an earlier program of Knodle. Uses a 26x21 grid-point array with variable scale. Output fields are concentration, direction, and distance of movement. Incorporates programs ICEMELT and ICEGRID. Thesis by Kenneth M. Irvine, 1965.

Naval Postgraduate School  
Monterey, CA 93940

Available from NTIS, Order No. AD 475 252/LK,  
\$4.25 paper, \$2.25 microfiche.

Iceberg Drift  
ICE-PLOT

Language - FORTRAN IV  
Hardware - CDC 3300/31K words

Provides twelve hours of iceberg drift, iceberg input for Ice Bulletin, and map outline for FAX broadcast. Input: Twelve-hour average wind field, monthly surface current, and initial iceberg position (or previous, updated position if not a new berg). Output: Listing of new iceberg positions, Ice Bulletin message form, and map of approximate new iceberg positions. Vector addition of average winds and currents using four geographical "courses," twenty minutes (lat./long.) apart.

CDR A.D. Super  
International Ice Patrol  
U.S. Coast Guard  
Bldg. 110, Coast Guard Support Center  
Governors Island, NY 10004

Available from originator only

Telephone (212) 264-4798

Ice Drift Analysis/Forecast

Language - FORTRAN II  
Hardware - CDC 160A/8K 12 bit words/3 tape  
units

Forecast or analyzed geostrophic winds and average sea-surface currents on magnetic tape are required input. The geostrophic winds are averaged over the time period specified by type-writer input. The ice drift equations are applied to the resultant wind, and sea surface currents are added. Output is in the form of forecast or analyzed ice drift (movement) at predetermined locations (points) to a maximum of 207.

Lt. Roland A. Garcia, USN  
Fleet Weather Facility Suitland  
Suitland, MD 20373

Copy on file at NODC (listing, documentation)  
Telephone (301) 763-5972

# SOUND

Normal Mode Calculations  
NORMOD3

Language - FORTRAN IV  
Hardware - CDC 6500/60K octal words/CalComp  
or other plotter

Calculates discrete normal modes and resulting propagation losses for depths and ranges of interest. This is a deep water version of a program originally written by Newman and Ingenito (NRL Report No. 2381, 1972). Appropriate for deep profiles and moderate frequencies (~100 Hz), the program uses a finite difference technique to generate mode shapes from the bottom up to the surface. It searches for appropriate eigenvalues yielding proper number of zero crossings and zero pressure at the surface. NOL Tech. Report 74-95.

Ira M. Blatstein  
Naval Surface Weapons Center  
White Oak  
Silver Spring, MD 20910

Available from originator only

Telephone (202) 394-2583

Horizontal Range  
RANGE

Language - FORTRAN  
Hardware - CDC 6400

Computes horizontal range from a receiver to a sound source as a function of the D/E angle, the sound speed profile, the source and receiver depths, and the water depth and bottom slope at the point of bottom reflection. Assumes that the surface is flat, no horizontal variations in sound speed profile, and a flat earth. Only the two-dimensional case is considered. NOL Tech. Note 9856.

M. M. Coate  
Naval Surface Weapons Center  
Code 221  
White Oak  
Silver Spring, MD 20910

Available from originator only

Telephone (202) 394-2334

Sound Scattering by Organisms  
SKAT

Language - FORTRAN IV  
Hardware - CDC 1604/16K 48 bit words

Simulates the scattering of sound by organisms of various shapes and dimensions.

Taivo Laevastu  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

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Telephone (408) 646-2937

Normal Mode Propagation Model

Language - FORTRAN V  
Hardware - UNIVAC 1108/Drum

Produces propagation loss as a function of range and depth, time history of received pulses, mode enhancement information, ray equivalents, group velocity, phase velocity of modes, using as input sound velocity profiles, frequency, source and receiver depths, bottom topography and composition, and selection of modes. For certain plots, plotting programs are required. NUSC Report 4887-II.

William G. Kanabis  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only

Telephone (203) 442-0771, ext. 2353

Sound Refraction Corrections,  
FITIT

Language - FORTRAN  
Hardware - CDC 3300

Computes data and fits polynomial functions to variable used to correct for bending of non-reflecting, nonvertexing sound rays. Least-squared-error type fitting (stepwise regression not used, but would improve program). Input: Sound velocity profile, limits of integration, domain of polynomial. Output: First to fifth degree polynomials, accuracy of FIT.

A.E. Vaas,  
Naval Underwater Systems Center  
Newport, RI 02840.

Available from originator only  
Telephone (401) 841-3435

Beam Patterns and Widths  
GBEAM

Language - FORTRAN V  
Hardware - UNIVAC 1108/18K words/IGS Plotting  
System

Computes beam patterns and their beam widths for three-dimensional array with arbitrary element spacings, taking into consideration individual element's directionality, selectable delay, and shading. Also calculates directivity index and/or reverberation index. Formulation based on three-dimensional spherical and solid geometry. Directivity index and reverberation index calculations are carried out by two-dimensional parabolic numerical integration. NUSC Technical Report 4687.

Ding Lee or Gustave A. Leibiger  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only  
Telephone (203) 442-0771

Statistics of Acoustic Measurements and  
Predictions - STAMP

Language - FORTRAN V  
Hardware - UNIVAC 1108/60K variable

A general purpose processing program which includes a module for performing statistics of acoustic measurements and predictions. Storage requirement is variable; program is segmented. 60K is the maximum. User's Guide in preparation.

Richard B. Lauer  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only  
Telephone (203) 442-0771, ext. 2827

Propagation Loss  
FAST FIELD PROGRAM

Language - FORTRAN IV  
Hardware - UNIVAC 1108

Calculates underwater acoustic propagation loss as a function of range for a point monochromatic source in a medium with an arbitrary sound speed profile versus depth. Special input-output requirement: Sound speed profile fitting program. NUSC Report Nos. 1046 and 4103.

Frederick R. DiNapoli  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only,  
Telephone (203) 442-0771, ext. 2647

Bottom Reflectivity

Language - FORTRAN II  
Hardware - UNIVAC 1108

Computes three acoustic reflection coefficients as a function of incident angle and frequency. The program accounts for differences in path length, depth of source and receivers, water bottom slope, velocity gradient, and recorded travel time. USL Tech. Memo. Nos. 913-4-5 and 907-144-65. The later report also serves to document a supplemental program (USL No. 0429, in FORTRAN) for computing means and standard deviations of the three reflection coefficients. Program No. 0289.

R. Whittaker  
Naval Underwater Systems Center  
New London, CT 06320

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Telephone (203) 442-0771, ext. 2316

#### Pattern Function Calculations

Language - FORTRAN IV  
Hardware - UNIVAC 1108

Computes transducer pattern functions needed in the sonar equations when estimating search performance of acoustic torpedoes. The desired parameters include the transmit and receive directivity indexes and the volume and boundary reverberation indexes. In a vehicle employed in circular search, the reverberation indexes are functions of turn rate and elapsed time in the ping cycle. The output is used by the "Sonar in Refractive Water" program. Report AP-PROG-C-7035, "Pattern Function Calculations," by Herbert S. Kaplan, Associated Aero Science Laboratories, Inc., Pasadena, for NUSC, Apr. 1967.

Naval Undersea Center  
Pasadena Laboratory  
3202 E. Foothill Blvd.  
Pasadena, CA 91107

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#### Rayleigh-Morse Bottom Reflection Coefficients RAYMOR

Language - FORTRAN V  
Hardware - UNIVAC 1108

Computes Rayleigh-Morse bottom reflection coefficients, also phase changes of the reflected and transmitted acoustic wave. Author - J.C. Reeves.

Naval Undersea Center  
Pasadena Laboratory  
3202 E. Foothill Blvd.  
Pasadena, CA 91107

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#### Light and Sound Instruction D

Language - FORTRAN  
Hardware - IBM 7074

Computes the convergence zone parameters using the  $V_x$  method (equations of Donald Cole), by one-degree quadrangle, by month, and by season. OS No. 20112. Author - M.C. Church.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only

Telephone (301) 763-1449

#### Propagation Loss S1587

Language - FORTRAN V  
Hardware - UNIVAC 1108/CalComp or Stromberg-Carlson 4060 plotter

Produces printed tables and plotted contours of single-frequency near-surface propagation loss. NUSC/NL Technical Memorandum No. 2070-356-70 and memo serial PA4-101, 2 May 1973.

T.A. Garrett  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only

Telephone (203) 442-0771, ext. 2991

#### AMOS Propagation Loss S1797

Language - FORTRAN V  
Hardware - UNIVAC 1108/Stromberg-Carlson 4060 plotter

Computes and plots AMOS and modified AMOS propagation loss as a function of range, frequency, or depth. NUSC Technical Memorandum PA4-225-71 and memo serial PA4-101, 2 May 1973.

T.A. Garrett  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only  
Telephone (203) 442-0771, ext. 2991

# SOUND VELOCITY

Sound Speed Computation Model  
SOVEL

Language - FORTRAN  
Hardware - CDC 3100/CDC 3200/CDC 1604/32K  
14 bit words/1 tape unit

Computes sound speed from salinity-temperature-depth data. EPRF Program Note 10, "Program SOVEL," by T. Laevastu.

Taivo Laevastu  
Environmental Prediction  
Research Facility  
Naval Postgraduate School  
Monterey, CA 93940

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Telephone (408) 646-2337

Sound Velocity  
SONVEL

Language - FORTRAN IV-H.  
Hardware - XDS Sigma 7

Subroutine computes the speed of sound in seawater from the temperature, salinity, and pressure, according to W.D. Wilson's formulas.

Mary Hunt  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only

Telephone (617) 548-1400

Sound Velocity: Wilson's Formula  
WLSND, SVELFS, VELPRS

Language - FORTRAN  
Hardware - IBM 360-65/2218 bytes (object form)

Computes sound velocity using Wilson's equations. WLSND is used when pressure is computed from depth and FS is computed from salinity. SVELFS is used when pressure is computed from depth and FS is the entering argument; in this case, FS is usually computed in SIGMAT. VELPRS is used when pressure is not computed but is an entering argument; atmospheric pressure is included; successive computation starting at the ocean is not necessary here. Author - Robert Van Wle.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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Telephone (202) 634-7439

Depth Correction  
MTCOR

Language - FORTRAN IV  
Hardware - XDS Sigma 7/1419 32 bit words

Calculates depth correction for sound velocity using Matthews' tables. Established coefficients are used to approximate Matthews' tables. The Matthews' table number 1-52 must be specified.

Robert C. Groman  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only

Telephone (617) 548-1400

Sound Velocity

Language - FORTRAN  
Hardware - UNIVAC 1108/6,100 36 bit words

Adjusts sound velocity values for marine sediments, as recovered from laboratory velocimeter.

to in situ conditions of temperature, pressure, and salinity. Wilson's formula for sound speed in water is used to apply corrections.

Joseph Kravitz  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (202) 433-2490

Sonic Velocities through Solid Samples  
DSDP/SONHAM.

Language - ALGOL  
Hardware - Burroughs 6700/7K words

Computes sonic velocities through solid samples from technicians' data taken from a Hamilton frame device (Dr. Edwin R. Hamilton, Naval Undersea Center, San Diego, CA 92132), and interprets a key associated with each sample which defines its origin. Input: One card file for the velocity data and key, and another card file for interpreting the key. Output: Listing with option for punched cards; listing includes five superimposed histograms of velocities at different levels of refinement.

Peter B. Woodbury  
Deep Sea Drilling Project  
Box 1529  
La Jolla, CA 92037

Available from originator only  
Telephone (714) 452-3256

Light and Sound Instruction B

Language - FORTRAN  
Hardware - IBM 7074

Computes the harmonic mean sound velocity, travel time, and correction ratio at 100-fathom depth intervals by one-degree square. OS No. 20111. Author - M.C. Church.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only  
Telephone (301) 763-1449

# SOUND — RAY PATH

Continuous Gradient Ray Tracing System  
CONGRATS

Language - FORTAN V  
Hardware - UNIVAC 1108/50K 36 bit words/Disk  
drum with 250K words/2.tape  
units/CalComp Plotter

Draws ray diagrams, computes eigenrays, and calculates propagation loss and reverberation. Uses ray tracing method in which sound speed is represented as a function of depth with a continuous gradient; and the ray equations can be integrated in closed form. Input: Sound speed profile, bottom profile, sonar and target geometry, frequency, beam patterns, pulse length (number of these required depends on output desired). Output: Ray diagrams, propagation loss vs. range, pulse shape at a point, reverberation vs. time. NUSL Report No. 1052, "CONGRATS I: Ray Plotting and Eigenray Generation" by H. Weinberg, Oct. 1969; NUSL Report No. 1069, "Continuous Gradient Ray Tracing System (CONGRATS) II: Eigenray Processing Programs," by J.S. Cohen and L.T. Einstein, Feb. 1970; NUSC Report No. 4071, "Continuous Gradient Ray Tracing System (CONGRATS) III: Boundary and Volume Reverberation," by J.S. Cohen and H. Weinberg, April 1971; and other reports.

Henry Weinberg or Jeffrey S. Cohen  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only  
Telephone (203) 442-0771, ext. 2589 or 2989

Acoustic Performance and Evaluation -  
Digigraphics, APE-DIGI

Language - FORTRAN  
Hardware - CDC 3300/64K/CDC 274 Digigraphics  
console, controller, software

The model simulates and displays, on a real time basis, the acoustic propagation characteristics of any given ocean medium including ray paths, intensity loss vs. range curves, and iso-loss contours. Includes provisions for transducer patterns, target characteristics, and certain receiving circuit characteristics. Input: Ocean profile (SUP, BT), operating frequency, db levels for iso-loss contours. Graphic and tabular output. The math model employed is a substantial extension of an ORL program and is based on the theory of ray-path acoustics as presented in "Physics of Sound in the Sea" and a work by Officer; also included are the works of Schulkin and Marsh for adsorption coefficients, Wilson for sound velocity calculations, and two Vitro Laboratory studies of Torpedo MK48 acoustic performance. NUSC TD 130, "Operation Procedures for Exercising the Acoustic Performance and Evaluation-Digigraphics Simulation Model (APE-DIGI)," July 1971.

Ronald P. Kasik  
Naval Underwater Systems Center  
Newport, RI 02840

Available from originator only  
Telephone (401) 841-3435

Ray Path  
S0434B

Language - FORTRAN  
Hardware - UNIVAC 1108/30K/CalComp Plotter

Produces plots of travel vs. range for D, SR, BR, SRB, BRS, SBSR, BSBR paths, grazing angles for first three bottom bounce paths. Estimates ray paths and travel times by approximating true profile with linear segmented profile. Input: Source, receiver configuration, velocity profile, and plot requirements.

Peter D. Herstein  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only  
Telephone (203) 442-0771, ext. 2305

Determination of critical ratio of trigonometric functions of acoustic angles involved in connection with the convergence interval for a 3-layer model of the ocean. OS No. 53483. Author - C.M. Winger.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only  
Telephone (301) 763-1449

GRASS Underwater Acoustics  
Prediction System

Language - FORTRAN 63  
Hardware - CDC 3800/Drum Scope, 2.1 CalComp  
Plotter

DTSTOV	DTSTOV	7,679 48 bit words
VFC	VFC	20,832 48 bit words
CTOUR	CTOUR	27,452 48 bit words
PRFPLT	PRFPLT	11,622 48 bit words
SERPENT	SERPENT	36,784 48 bit words
RAPLOT	RAPLOT	12,118 48 bit words
LOSSPLOT	LOSSPLOT	19,543 48 bit words

DTSTOV converts salinity, temperature, and depth (STD) data to sound speed profiles, using Leroy's second equation (Eq. [7] in J. Acoust. Soc. Am. 46: 216-226, [1969]). Input: cards and data-identifying parameters. Output: Profile ranges, latitudes, longitudes, depths, temperatures, salinities, and sound speeds punched and/or printed. Pressures may be printed as an option.

VFC is used: To examine input bottom-topography and sound speed data for consistence and physical meaningfulness; to extend all input sound speed profiles to the ocean bottom; to perform earth curvature corrections; to determine derivatives of sound speed data. Two-dimensional sound speed field is modeled using a combination of cubic spline and linear interpolation schemes. Input: Bottom topography in the form of non-uniformly spaced range-depth pairs; sound speed profiles (possibly generated by DTSTOV); program control parameters and data identification numbers. Output: A magnetic tape (coefficient tape) containing corrected and extended sound speed profiles and their first and second derivatives and bottom topography; a printer listing and printer plots of input and output profiles.

CTOUR generates three-dimensional isometric and contour plots of the sound speed fields. The program interpolates value of sound speed at each point using a combination of cubic spline and linear interpolation schemes, then calls contouring and isometric plotting routines. Input: Magnetic (coefficient) tape generated by VFC; contour levels, control parameters, and grid specifications. Output: A CalComp contour and three-dimensional isometric plot of the sound speed field; a printer listing of contour levels and values of sound speed at grid intersections.

PRFPLT generates CalComp plots of sound speed profiles. The vertical gradients and curvatures corresponding to a profile are plotted on the same graph as its sound speeds. A cubic spline interpolation scheme is used. Input: Magnetic (coefficient) tape generated by VFC, program control and data identification numbers on cards. Output: CalComp plots showing input data points and effect of interpolation in depth.

SERPENT traces rays through a two-dimensional range and depth dependent sound speed field bounded by a flat surface and variable bottom topography; calculates random, coherent, and statistical intensities for multiple receivers at user-selected ranges and depths. An iterative ray tracing scheme is used based upon expansion of ray depth, range, and sine in terms of an increment of ray arc length. Iteration step size depends upon sound speed field in rays' vicinity. Input: Coefficient tape from VFC and cards containing source information, receiver information, surface information, output requests, parameters governing ray iteration, run identification information, and bottom loss data. Output: A magnetic tape containing ray statistics, (optional), a magnetic tape containing transmission loss information (optional), a printer listing of ray information; transmission loss information, etc.

RAPLOT generates CalComp ray plots (ray depth vs. range from ray source). Input: The ray statistics plot generated by SERPENT, control parameters on cards which select the number of plots to be generated, the rays to be displayed on each plot, the plot size, scaling parameters, etc. Output: Labeled CalComp plots showing rays and bottom profile and a printer listing of input and control parameters.

LOSSPLOT generates CalComp plots of transmission loss vs. range. Calculated and experimental values of transmission loss may be displayed on the same plot. Input: Transmission loss tape generated by SERPENT; control parameters and graph titles on cards; experimental measurements or theoretical values of transmission loss on cards. Output: Labeled CalComp plots of transmission loss vs. range. If requested, plots will display random, coherent, and statistical losses together with input experimental data or theoretical curves.

"GRASS: A Digital Computer Ray Tracing and Transmission Loss Prediction System, Vol. 1 - Over-all description," NRL Report 7621, Dec. 1973; "...Vol. 2 - User's Manual," NRL Report 7642, Dec. 1973.

John J. Cornyn, Jr.  
Naval Research Laboratory  
Code 5493C  
Washington, DC 20375

Available from originator only

Telephone (202) 767-3585

Sonar in Refractive Water

Language - FORTRAN IV  
Hardware - UNIVAC 1108/30K words

Traces sound rays, computes reverberation, computes acquisition laminae (vertical plane), in a linear gradient or continuous gradient medium. Output: Tape to be used by program RAY SORT. NUC Technical Publication No. 164, "Digital Computer Programs for Analyzing Acoustic Search Performance in Refractive Waters," by Philip Marsh and A.B. Poynter, Dec. 1969, two volumes. NUC Programs 800000 and 800001. See also NEWFIT and Pattern Function Calculations, which prepare input for this program.

Naval Undersea Center  
Pasadena Laboratory  
3202 E. Foothill Blvd.  
Pasadena, CA 91107

Available from NTIS, Order Nos. AD 863 777 and AD 863 778, \$6.00 each volume in paper, \$2.25 each volume in microfiche.

Sorts Sound Ray Data  
RAY SORT

Language - FORTRAN IV  
Hardware - UNIVAC 1108/31K (450 instructions)

Sorts certain sound ray data (from tape written by the "Sonar in Refractive Water" program) by depth, initial ray angle, and depth-intersection number. (See reference for above program)

Naval Undersea Center  
Pasadena Laboratory  
3202 E. Foothill Blvd.  
Pasadena, CA 91107

Available from NTIS: See "Sonar in Refractive Water."

Acoustic Ray Tracing

Language - FORTRAN II  
Hardware - IBM 7090

Calculates underwater sound propagation. Program requires input which describes the source, the field, the surface, and the bottom. Output is a report on magnetic tape which gives ray path, slope, curvature, and length. Also given are reflection and extrema statistics, travel time, wave front curvature, and intensity. Technical Report No. 1470764.

Trident/ASW Library  
Arthur D. Little, Inc.  
35 Acorn Park  
Cambridge, MA 02140

Available from NTIS, Order No. AD 605 328,  
\$4.75 paper, \$2.25 microfiche.

A series of 19 programs for the calculation of the acoustical field in long-range (several hundred to several thousand miles), low-frequency underwater sound propagation in the deep ocean. Involves the calculation of ray trajectories, and intensity calculations that are based on the mapping of ray densities into the far-acoustical field. Input from NODC data tapes or from Fleet Numerical Weather Central cards. Technical Report 150, "The Hudson Laboratories Ray Tracing Program," by H. Davis, H. Fleming, W.A. Hardy, R. Mingingham, and S. Rosenbaum, June 1968. "Reference Manual," by M. Klerer and J. May, Hudson Laboratories, Revised July 1965; manual reprinted in above report.

The Hudson Laboratories of  
Columbia University  
145 Palisade Street  
Dobbs Ferry, NY 10522

Available from NTIS: Order No. AD 678 759,  
\$10.00 paper, \$2.25 microfiche.

## RAYTRACE

Language - FORTRAN IV  
Hardware - XDS Sigma 7/CalComp plotter

RAYTRACE is a straightforward, easy-to-use acoustic ray tracing program which produces a plot and a listing. The user specifies a single-valued velocity profile, source depth, maximum range, a range increment at which points are computed and the length of the plot axes in inches. All axis scaling and labeling is done automatically. The discrete velocity profile supplied is smoothed by linear interpolation. Rays are constructed as arcs of circles between profile depths. At surface and bottom rays are reflected according to the equal angle law. Any number of rays with different initial angles measured from the horizontal may be plotted. In addition to the plot output, RAYTRACE produces the following printed output for each ray at integral multiples of the specified range increment: (1) range; (2) depth of ray at that range; (3) angle of the tangent to the ray at that range measured from the horizontal; (4) total travel time from the source to that range along the ray; (5) total distance from the source to that range along the ray path. Whenever a vertex occurs on a ray, the range is set to that of the vertex, an output point is computed, and incrementing of output range continues from that of the vertex. Originally written by C. Olmstead, the program has been modified by Bergstrom, Fink, M. Jones, and R.C. Spindel.

Woods Hole Oceanographic Institution Copy on file at NODC (listing, documentation)  
Woods Hole, MA 02543

# NAVIGATION AND CHARTING

Plots Maps, Grids, Tracks  
MAP

Language - FORTRAN IV  
Hardware - IBM 360-65/CalComp, Houston Omni-  
graphic, or Gerber plotter/2 tape  
units

Generates a plot tape to draw a map according to the user's specifications of latitude and longitude, projection, kind of grid, and size of map. Projection options: Mercator, Miller, square, cylindrical stereographic, Lambert equal-area cylindrical, sinusoidal equal-area, flat-polar sinusoidal equal-area, Mollweide homolographic, and Lambert Conic Conformal. Grid lines and coastal lines are drawn at the user's option; if coastal lines are plotted, a land mass data tape is needed. There is an entry which returns (x, y) plotter coordinates for latitude and longitude of a point, enabling the user to plot station positions, ship's track, etc.

Ruth McMath  
Department of Oceanography  
Texas A&M University  
College Station, TX 77843

Available from originator only

Telephone (713) 845-7432

Astronomic Position, Azimuth Method

Language - FORTRAN IV (H or G)  
Hardware - IBM 360-65/38K bytes

Calculates the latitude and longitude of an astronomic observation station, given measured horizontal angles between stars and fixed mark along with observation times. A set of observation equations is solved by the method of least squares to obtain corrections to assumed values of latitude, longitude, and the azimuth of the reference mark, as well as probable errors for these three quantities. The adjustment is iterated five times or until the corrections become less than 0.005 seconds, either of which causes a program halt. Output: A table of input information and a record of the process of refinement for each set of station data read in. A previous version of this program was written in ALGOL for the Burroughs 220, in single precision. Author - Spencer Roedder.

Computer Center Division  
U.S. Geological Survey  
National Center  
Reston, VA 22092

Copy on file at NODC (deck, documentation)

Telephone (703) 860-7106

Satellite Rise and Set Times  
ALERT, ASORT

Language - FORTRAN IV  
Hardware - IBM 1130/5836 words (ALERT), 12040  
words (ASORT)

Calculates the rise and set times and time of closest approach of satellites. Output: Listing of ALERT information and punched cards for next program, ASORT sorts the output of rise times of satellites from program ALERT into chronological order. A listing is printed on the IBM 1132. FRB Manuscript Report No. 1071, by C.A. Collins, R.L.K. Tripe, and S.K. Wong, Dec. 1969.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

Copy on file at NODC (listing, documentation)

Satellite Navigation

Language - FORTRAN/Assembler  
Hardware - IBM 1800

A set of programs for various aspects of satellite navigation. The programs fall naturally into two sections: those involved in the on-line reduction of data from the satellite, and those involved in the analysis, both on-line and off-line. NIO Report N. 20, Aug. 1969.

National Institute of Oceanography  
Wormley, Godalming, Surrey, England

Copy on file at NODC (listing, documentation)

Loran/Decca Coordinates Calculation  
HNAV

Language - FORTRAN IV  
Hardware - IBM 1800

Given a Decca, Loran-A, or Loran-C fix, calculates the latitude and longitude. The method for a hyperbolic system with separate master is used for all cases. The constants for the hyperboloids are calculated in meters for both Loran and Decca, thus allowing a fix to be calculated if one Loran reading and one Decca reading are known. NIO Program No. 165. Uses SDANO and other subroutines. Author - M. Fasham.

National Institute of Oceanography  
Wormley, Godalming, Surrey, England

Copy on file at NODC (listing, documentation)

Loran/Decca File Initialization  
HNVI

Language - FORTRAN IV  
Hardware - IBM 1800

Given input data on a master-slave pair, HNVI calculates certain geodetic values and stores them on a tape file for later use by program HNAV. NIO Program No. 164. Author - M. Fasham.

National Institute of Oceanography  
Wormley, Godalming, Surrey, England

Copy on file at NODC (listing, documentation)

Geodetic Distance and Azimuth  
SDANO

Language - FORTRAN IV  
Hardware - IBM 1800

Given the geographical coordinates of two points, this subroutine calculates the geodetic distance and azimuths between them. Based on the method of E.S. Sodano for a non-iterative solution of the inverse and direct geodetic problems. NIO Program No. 46. Author - M. Fasham.

National Institute of Oceanography  
Wormley, Godalming, Surrey, England

Copy on file at NODC (listing, documentation)

General Map Projection

Language - MAD  
Hardware - IBM 7090/CalComp 763 plotter

Conversion or generation of latitude and longitude values to map projection coordinates. Includes all commonly employed projections of sphere. Oblique cases may be automatically obtained. Author - W.R. Tobler.

Department of Geography  
University of Michigan  
Ann Arbor, MI 48104

Copy on file at NODC (listing, documentation)

Finite Map Projection Distortions

Language - MAD  
Hardware - IBM 7090

Programs and subroutines to estimate the errors introduced by the substitution of map projection coordinates for spherical coordinates. Statistical computations of finite distortion are related to Tissot's indicatrix as a general contribution to the analysis of map projections. Technical Report No. 3, "Geographical Coordinate Computations" Part II, by W.R. Tobler, Dec. 1964.

Plots Mercator Grid  
CHART

Language - FORTRAN  
Hardware - IBM 1800/16K words/Plotter

Produces Mercator grid on 30-inch drum or flatbed plotter, with various scale and tick mark options. Input: Card defining upper right coordinate of chart.

Michael Moore  
Scripps Institution of Oceanography  
P.O. Box 1529  
La Jolla, CA 92037

Available from originator only  
Telephone (714) 452-4194

Navigational Satellite Passes  
ALRTX

Language - FORTRAN  
Hardware - IBM 1800/16K words

Given satellite orbital parameters and station description cards, produces listing of satellite passes to occur for a given area and time.

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Scripps Institution of Oceanography  
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Available from originator only  
Telephone (714) 452-4194

Loran or Omega Conversion  
GEPOS

Language - FORTRAN IV  
Hardware - HP 2100S/Keyboard/Paper tape reader

Converts Loran-C or Omega information from line-of-position reading to geographic coordinates or geographic coordinates to line-of-position, using method described in Naval Oceanographic Office Informal Report NO. N-3-64 by A.C. Campbell. Input: Line-of-position readings, time, date, initialization parameters; designed to process EPSCO 4010 data logger paper tapes. Output: Listings of converted geographic coordinates and magnetic tape with same data in a format compatible with plotting program TMERC.

Chris Polloni  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Cruise Track  
TMERC

Language - FORTRAN IV  
Hardware - HP 3100A/16K words/Keyboard/CalComp Plotter

Draws a Mercator chart and cruise track from navigation data. Data format is fixed, compatible with program GEPOS. Input: Geographic coordinates and time (normally GMT).

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Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Transformation of Spherical Coordinates  
ROTGUT

Language - FORTRAN IV  
Hardware - XDS Sigma 7/5,500 words

Performs various operations using transformation of spherical coordinates. Output: Rotation

about a pole, transformation to the new coordinate system, weighted or unweighted mean pole computation using Fisher's distribution, rotation for closest approach and pole of best small-circle fit.

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Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Sum of Finite Rotations on a Sphere  
SUMRO1

Language - FORTRAN IV  
Hardware - XDS Sigma 7

Using coordinate transformation, calculates the sum of finite rotations on a sphere. Requires the latitude and longitude of the pole of rotation, and amount of rotation for each set. Output: Listing of the input rotations plus the resultant rotation and its tensor.

Christine Wooding  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Loran Fix  
LRFIX

Language - FORTRAN  
Hardware - IBM 1800/16K words

Produces position fix from station position and reading pairs cards.

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Scripps Institution of Oceanography  
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Available from originator only  
Telephone (714) 452-4194

Earth Spherical Subroutines  
ESTCH, ESTC2, ESTPL

Language - FORTRAN  
Hardware - IBM 1800

ESTCH converts earth spherical to plotter coordinates. Input: Decimal latitude and longitude. Output: Chart position for a call PLOT (I, X, Y). ESTC2 converts earth spherical to plotter coordinates with inside check. Input and output: Same as ESTCH. ESTPL converts earth spherical to polar coordinates; not valid for over 200 miles, or over the poles. Input: Starting latitude and longitude, end latitude and longitude. Output: Distance (miles), angle (degrees) relative to true North (decimal units).

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La Jolla, CA 92037

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Telephone (714) 452-4194

Plan Course and Schedule  
CRUIS and Subroutines

Language - FORTRAN  
Hardware - IBM 1800/16K words

CRUIS is used to plan steaming and station time and fuel consumption. Subroutines: SAILB calculates the distance between two points by either great-circle sailing or Mercator sailing, whichever makes the most sense. SAILG calculates great-circle distance and courses. SAILM calculates rhumbline (Mercator) course and distance.

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Degree Conversions  
DEGFR, DEMI

Language - FORTRAN  
Hardware - IBM 1800

DEGFR converts integer degrees and real minutes to real degrees. DEMI converts decimal degrees to integer degrees and decimal minutes.

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Available from originator only

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Mercator Degrees  
DMRCT

Language - FORTRAN  
Hardware - IBM 1800

From latitude in degrees, gives Mercator projected latitude in degrees. Expansion (continued fraction) + 77 degrees.

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Available from originator only

Telephone (714) 452-4194

Magnetic Field Components  
MAGFI

Language - FORTRAN  
Hardware - IBM 1800

Converts latitude (N+), Longitude (E+) to colatitude and east longitude. Input: Geoid latitude, longitude, date (years and decimals of a year). Output: Magnetic field (gammas), north component and east component of magnetic field, vertical component of magnetic field.

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Annotated Track on Stereographic Projection  
ANNOT

Language - FORTRAN  
Hardware - CDC 3600/3800/CalComp Plotter

Plots an annotated track (bathymetry or magnetics data) along a track (navigation) on a stereographic projection.

James V. Massingill  
Environmental Sciences Section  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only

Telephone (202) 767-2024

Annotates Chart  
CORBT

Language - HP FORTRAN IV under RTE  
Hardware - HP 2100S/15K words

Reads position and bathymetry information from a disk file and annotates the depth on a Mercator chart at the position given. This is a revision of the bathymetry processing section of program OCEANO written by the NRL Propagation Branch.

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Shipboard Computing Group, Code 8003  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only

Telephone (202) 767-2387

Bathymetric or Magnetics Chart  
PROFL

Language - HP FORTRAN IV under RTE  
Hardware - HP 2100S/10K words

Plots bathymetric or magnetic data as a function of distance along track or distance on a Mercator chart. The data file (disk) is read, and the track length or chart distance is calculated. The dependent variable is then plotted against this value.

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Naval Research Laboratory  
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Telephone (202) 767-2387

Mercator Chart Digitization  
ANTRK

Language - HP FORTRAN under RTE  
Hardware - HP 2100S/8K locations/Disk/  
Summagraphic Digitizing Tablet

The operator digitizes the Mercator chart position, which the program converts to latitude and longitude; the annotated data value is then entered, and position and value are written on the disk. Input: Information to define chart and the output of a digitizing tablet.

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Naval Research Laboratory  
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Telephone (202) 767-2387

Bathymetric Chart Digitization  
DGBTH

Language - HP FORTRAN IV under RTE  
Hardware - HP 2100S/7200 locations/Disk/  
Summagraphics digitizing tablet

Produces a disk file containing the digitized bathymetry values as a function of time; also messages to the operator. The program has automatic procedures for redefining the origin when the chart is shifted and when the recording instrument changes phase. Input: Control information necessary to define a coordinate axis and values from a digitizing tablet.

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Shipboard Computing Group, Code 8003  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only  
Telephone (202) 767-2387

Plots on Stereographic Chart  
ANNOT

Language - HP FORTRAN IV under RTE  
Hardware - HP 2100S

Reads a disk file containing bathymetry and position, then annotates the depth information on a stereographic projection chart at the position given. Modification of Woods Hole program.

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Available from originator only  
Telephone (202) 767-2387

Plots Navigation Data  
OCEAN

Language - HP FORTRAN IV under RTE  
Hardware - HP 2100S/15K background words

Reads disk file containing navigation data and plots positions on Mercator chart. This is a revision of the navigation processing in program OCEANO written by the NRL Propagation Branch.

Robert A. O'Brien, Jr.  
Shipboard Computing Group, Code 8003  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only

Telephone (202) 767-2387

Long Base Line Acoustic Tracking

Language - HP FORTRAN IV under RTE  
Hardware - HP 2100S

Real-time local navigation using a bottom distributed acoustic transponder system. Will navigate the ship and a towed body. Input: Real-time data from the transponders giving ranges, depth of towed body; also requires a sound speed profile and location of the transponders. Output: Position of ship and/or towed body; information is logged on magnetic tape.

J. Dean Clamons  
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Washington, DC 20375

Available from originator only

Telephone (202) 767-2024

FAA Plot

Language - FORTRAN  
Hardware - UNIVAC 1108/Concord Digital Plotter

Accepts three card images and a supplied set of FAA data cards as input. The output is a magnetic tape to drive the E-51, E-103, E-108 Concord Digital Plotters, using the echelon mode. The end product is a film positive with a plus symbol for the position of the FAA plots. The Mercator, transverse Mercator, and Lambert conic conformal projection with two standard parallels are the three projections which can be used to plot program outputs. O.S. No. 65652. Authors - Ronald M. Bolton and J. Parrinello.

Automated Cartography Office,  
Code NA  
Defense Mapping Agency  
Hydrographic Center  
Washington, DC 20390

Available from originator only

Distance and Azimuth  
CIRAZD

Language - FORTRAN  
Hardware - UNIVAC 1108

Finds the distance and azimuth between two points on the earth's surface when the earth is assumed to be a sphere. If either pole is used for the center point, the angle given is with respect to grid north. By use of trigonometric identities and absolute value functions, this program avoids many of the computational problems usually found in distance computations. O.S. No. 55690. Author - Barry Turrett.

Automated Cartography Office,  
Code NA  
Defense Mapping Agency  
Hydrographic Center  
Washington, DC 20390

Available from originator only

Parametric Map

Language - FORTRAN II  
Hardware - UNIVAC 1108

Generates any hyperbolic navigation system by using parametric equations. Generates plotting coordinates for loran-A, loran-C, Omega, and Decca charts. Will process all lattice lines that fall within a specified geographic area. Can be displayed on any of the following map projections: Mercator, transverse Mercator, Lambert conformal conic, oblique Mercator, polyconic. O.S. No. 53012. Authors - R.A. Bolton, R.M. Bolton.

Automated Cartography Office, Code Available from originator only  
NA  
Defense Mapping Agency  
Hydrographic Center  
Washington, DC 20390

Loran to Geographic and  
Geographic to Loran Conversion

Language - FORTRAN V  
Hardware - UNIVAC 1108/15K words

Computes a geographic fix, given two loran readings, or computes the time difference reading at a given point for any two specified loran pairs. Uses Sodano inverse method. Informal Manuscript Report IMR No. N-3-64.

Kay Fox  
Navigational Science Division  
Defense Mapping Agency  
Hydrographic Center  
Washington, DC 20390

Available from originator only

Telephone (301) 763-1184

Loran Coordinate Computation

Language - FORTRAN  
Hardware - UNIVAC 1108/34K words

Computes charting coordinates along lines of latitude or longitude for loran hyperbolas at specified intervals. Uses Lambert's method of computing the geodesic and involves convergence by iteration. Informal Manuscript Report IMR No. N-1-64.

Kay Fox  
Navigational Science Division  
Defense Mapping Agency  
Hydrographic Center  
Washington, DC 20390

Available from originator only

Telephone (301) 763-1184

Loran Skywave Correction

Language - FORTRAN  
Hardware - /15K words

Computes the loran-A or loran-C skywave corrections over a specified area. Uses Sodano inverse method. Input: Station positions, spheroid parameters, propagation velocity, area of coverage. Output: For Loran A, the nighttime skywave corrections from master, from slave, and from both; for Loran C, the daytime corrections as well.

Kay Fox  
Navigational Science Division  
Defense Mapping Agency  
Hydrographic Center  
Washington, DC 20390

Available from originator only

Telephone (301) 763-1184

Individual Point Generator for Map  
Projections

Language - FORTRAN II  
Hardware - IBM 7074

Converts geographic positions to discrete points in rectangular coordinates on the following projections: Mercator, Transverse Mercator, gnomonic, polar stereographic, azimuthal equidistant, Lambert conformal conic (with one or two standard parallels), Lambert azimuthal equal area polar, Lambert equal area cylindrical, Miller, Albers equal-area conic, rectified skew, orthomorphic, and oblique Mercator. Cartographic data may be produced in either graphic or tabular form. OS No. 55646 main program (each of the 13 projection subroutines has its own open shop number). Authors - Ronald Bolton, Louis Rowen, Gregory Vega. Informal report IR No. 69-23.

"Computer Programs and Subroutines for Automated Cartography" by J. Parrinello, March 1969.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only  
Telephone (301) 763-1449

Individual Point Generator for Distance  
and Azimuth Computations

Language - FORTRAN II  
Hardware - IBM 7074

Uses the geodetic latitude and longitude of two points to compute the distance and azimuth from one point to the other. Results will be in tabular form with the distance in meters and the azimuth and back azimuth in degrees, minutes, and seconds. OS No. 65616. Author - R.M. Bolton.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

Geodetic Datum Conversion

Language - FORTRAN  
Hardware - IBM 7074

Transforms geodetic coordinates from one datum to another by utilizing a given shift (in terms of rectangular space coordinates) between the origins of two datums and applying this shift, together with differences in the spheroidal parameters, in formulas derived for this purpose, OS No. 55305. Author - Robert M. Willems.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

Geodetic Datum Reduction

Language - FORTRAN  
Hardware - IBM 7074

Reduces geodetic positions from one geodetic datum to another by use of the Vening Meinesz equations. The preferred datums involved are European datum, North American datum, and Tokyo datum. OS No. 55301. Author - D.J. Findlay.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only  
Telephone (301) 763-1449

Geodetic Position Computation and Plot

Language - FORTRAN  
Hardware - IBM 7074

Computes geodetic positions at desired intervals along incremental or miscellaneous azimuths. Option to plot or list. Plot uses the LAMB subroutine with two standard parallels. OS No. 55321. Author - Merle L. Nelson. An informal report IR No. 69-35 lists this and additional programs and describes procedures for production of secondary phase correction charts and tables. These supplementary programs, written by Edwin Stephenson and Barbara Gray, are in 7074 Autocoder or FORTRAN.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

Astronomic Latitude

Language - FORTRAN  
Hardware -

Programs for determination of first-order astronomic latitude by the Sterneck method and also by the method of "Polaris and South Star"; subroutines for the Baldini, the Garfinkel, and the U.S. Coast and Geodetic Survey (now National Ocean Survey) refraction models. Informal report IR No. 68-21, "Investigations in Determining Astronomic Latitudes and The Computer Programs," by Larry Borquin, April 1968.

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U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

#### Sounding Plot

Language - FORTRAN  
Hardware - CDC 3100/IBM 7074/CalComp plotter

Accepts lorac, lorán, or Raydist lane values, plots ship's track and soundings in UTM mode. OS No. 58419. Author - G.R. Bills.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

#### Single Integration

Language - FORTRAN  
Hardware - IBM 7074

Equally spaced time series data are integrated once using Tick's method. The data must be sampled at a rate of at least twice the Nyquist frequency. Informal report IM No. 66-36. OS No. 66-36. Author - E.B. Ross.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (301) 763-1449

#### Sodano Inverse

Language - FORTRAN  
Hardware - CDC 3100

Computes the normal section length and the forward and reverse azimuths of the geodesic between two points for which the geographic coordinates are known. This computation is useful in determining azimuth and distance between triangulation stations for which geographic positions have been determined but which are not connected by direct observation. OS No. 4326. Authors - Andrew Campbell; modified by C.E. Pierce.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Copy on file at NODC (Deck, documentation)

Telephone (301) 763-1449

#### Adjusts a State Plane Coordinate Traverse

Language - FORTRAN IV  
Hardware - IBM 360-30/IBM 2311 disk/65K bytes

Computes a plane-coordinate traverse adjustment using condition equations and the method of least squares. The normal equations are solved using the Cholesky method. The program will adjust a network with as many as 250 stations, 600 observed directions, 250 measured distances, and 99 condition equations. It is limited to either a Lambert or traverse Mercator projection. Corrections are supplied for the reduction of observed data to grid data and options are available for various types of azimuth and position control. Documentation, "A Computer Program to Adjust a State Plane Coordinate Traverse by the Method of Least Squares" by Jeanne H. Holdahl and Dorothy E. Dubester, Sept. 1972.

Joseph F. Dracup  
National Geodetic Survey, NOAA/NOS  
6001 Executive Boulevard  
Rockville, MD 20852

Copy on file at NODC (Above report; includes listing)

Telephone (301) 496-8650

Geodesy, Marine Surveying and Mapping,  
Nautical and Aeronautical Charting  
NOS SCIENTIFIC SUBROUTINE SYSTEM

Language - FORTRAN IV  
Hardware - IBM 360-65

The purpose of this system is to make accessible the tools to accelerate and simplify solutions to various scientific problems encountered in the National Ocean Survey disciplines. The user may use the system in the development of his subroutine library. Several aspects were considered in the design and organization of the subroutines so that this purpose could be accomplished. The subroutines were designed so the user need be concerned only with the input and output parameters, not with the internal design of the subroutine. The reference to any subroutine by the problem program is straightforward, thus minimizing user effort. The subroutines are purely computational in function and do not contain any reference to input or output operation. The problem program must be designed so that it contains whatever input/output operations are needed for the solution of the problem. Some routines are in double precision mode to optimize accuracy of the computations; the problem program must be designed to meet this requirement. Although the subroutines are FORTRAN IV programs, there is no restriction on the symbolic programming language which may be used in the problem. The subroutines are uniformly documented and are accompanied by comment statements in sufficient detail to permit the user to gain familiarity with the techniques and method of use of the routine. Following are descriptions of individual subroutines:

ANGLE converts an angle expressed in seconds of arc to degrees, minutes, and seconds of arc. The angle, which may be positive or negative, is partitioned into its divisions by successive approximations for each of the divisions. A table is then searched for adjusting the decimal seconds to the desired precision to be used in the user's callable routine. (894 bytes)

ANLIS computes the long distance or geodetic distance and azimuths between two stations whose geodetic positions are known. Evaluation is based on equations of the Andoyer-Lambert method for solving the inverse position problem. This method is valid for distances up to 6000 miles. (5612 bytes)

APCTN computes the state plane coordinates from geographic positions and the inverse for stations in zones 2 to 9 of the Alaska plane coordinate system. (6524 bytes)

APCWN computes the state plane coordinates from geographic positions and the inverse for stations in zone 1 of the Alaska plane coordinate system. (4388 bytes)

APOLY computes the American polyconic grid coordinates of a station from geographic positions and the inverse. (4320 bytes)

CGSPC computes the geodetic position (latitude, longitude) and azimuth of an observed station from a station of known geodetic position, with azimuth and distance to the observed station given. Evaluation is based on equations for the forward position computation and is valid for distances up to 600 miles. (2606 bytes)

CUBIC approximates a third-order curve by interpolating coordinates between given points. The evaluation is based on a method which expresses a cubic curve by using two parametric equations and then choosing values for the parameters in the two equations. (1974 bytes)

EXCES computes the spherical excess of a spherical triangle as determined from two angles and a side opposite one of them. The method is valid for triangles whose sides are less than 100 miles in length. (884 bytes)

GMLIC computes the geodetic distance and azimuths between two stations whose geodetic positions are known. Evaluation is based on equations of the Gauss midlatitude method for solving the inverse position problem. This method is valid for distances up to 600 miles. (2452 bytes)

HIFIX computes the hyperbolic coordinates of a ship expressed in HIFIX phase differences from

geographic positions, and the inverse. Evaluation is based on Campbell's equations to determine the geographic position of ship from HIFIX phase differences. (5662 bytes)

LORAN computes the hyperbolic coordinates of ship expressed in loran time differences from geographic positions, and the inverse. The program is applicable to loran-A, loran-C, or a mixture of the two systems. Two configurations of fixed stations may be used. In the triad configuration, two pairs of fixed stations are used, each pair having one station, the master station, in common, and a slave station. In the tetrad configuration, two pairs of fixed stations are used, each pair having a separate master station and a slave station. Evaluation is based on Campbell's equations. (6444 bytes)

OMEGA computes the hyperbolic coordinates of a ship expressed in Omega lane values from geographic positions, and the inverse. Evaluation is based on a modification of Campbell's equations. (5708 bytes)

SODIN computes the geodetic distance and azimuths between two stations whose geodetic positions are known, using the Sodano method for solving the inverse position problem. This method is valid for distances up to 6000 miles. (4622 bytes)

SODPN computes the geodetic position (latitude, longitude) and azimuth of an observed station from a station of known geodetic position, with azimuth and distance to the observed station given. Evaluation is based on equations of the Sodano method for solving the direct position problem. This problem is valid for distances up to 6000 miles. (4986 miles)

TPFIX computes the geographic position, forward azimuth, back azimuth, and distance of an observing station using angles observed at that station to three fixed stations whose geographic positions are known. The computations include the effect of spherical excess. Evaluation is based on the method of resection to determine the position of an unknown station. (3178 bytes)

UTMCO computes the universal transverse Mercator (UTM) grid coordinates of a station from geographic positions, and the inverse. This routine is designed to work for UTM zones 1 to 60, zone width 6 degrees, in both the Northern and Southern Hemispheres, within the latitude band of 80 degrees and 30 minutes north to 80 degrees and 30 minutes south, and 5 degrees and 45 minutes plus or minus from the central meridian of the major UTM zone. (7930 bytes)

Milton Stein  
ADP Programming Branch  
National Ocean Survey, NOAA  
6001 Executive Boulevard  
Rockville, MD 20852

Copy on file at NODC (User's Guide; includes listing)

Telephone (301) 496-8026

Computes Geographic Positions

Language - SPS  
Hardware - IBM 1620

Computes geographic positions, given starting position, azimuth, and length on any one of six spheroids. Three types of computations can be obtained: single positions, a loop, or a traverse. Control is by job card. Length input may be in meters, feet, statute or nautical miles, or electronic lanes. USGS Program No. 15.

ADP Programming Branch  
National Ocean Survey, NOAA  
6001 Executive Boulevard  
Rockville, MD 20852

Copy on file at NODC (listing, documentation)

LORAN C (Version 2)

Language - SPS  
Hardware - IBM 1620/100K\*

Computes tables giving the points of intersection of LORAN C hyperbolas with meridians and/or parallels of the earth spheroid. Microsecond values are computed at intervals varying from 1 1/4 minutes to 20 minutes for any or all of four possible pairs of stations. Program can also be used to compute microsecond values at grid intersections. \*Can be modified for use on IBM 1620 of 60K capacity.

ADP Programing Branch  
National Ocean Survey, NOAA  
6001 Executive Boulevard  
Rockville, MD 20852

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Compute Great-Circle Path  
GCIRC

Language - FORTRAN IV-G  
Hardware - IBM 360-65/1200 bytes

Computes distance (nautical miles) and initial course (degrees) of a great-circle path between two locations. Requires subroutines COS, SIN, ARCOS. Author - Ralph Johnson.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

Copy on file at NODC

Telephone (202) 634-7439

Map Projections and Grids  
MAP

Language - FORTRAN IV  
Hardware - IBM 360-40/CalComp 763 plotter

Provides a wide variety of map projections and grids to facilitate the display of geographical data. The subroutine has been written in as modular a form as possible to allow for ease of insertion or deletion of routines. Provides the following projections: Mercator, Miller, square, cylindrical stereographic, Lambert equal-area cylindrical, flat-polar equal-area sinusoidal, equal-area sinusoidal, Mollweide homolographic, polar stereographic, Lambert equal-area polar, Colligan's equal-area projection of the sphere, azimuthal equidistant, transversed sinusoidal, transversed Mollweide. Author - John O. Ward.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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Telephone (202) 634-7439

# GRAPHIC DISPLAY

## Vertical Bar Graphs

Language - MASTER FORTRAN  
Hardware - CDC 3300/34 17K words/CalComp  
Plotter

Reads and edits bar graph parameters and data; calls the CalComp software which generates a plot tape. The CalComp Plotter draws the graphs as vertical bars for any set of data which has less than 101 items. The program uses numeric data and bar graph descriptive data as input. Major parameter categories are X access, Y access, titles, groups, and bar labels. File output is produced on CalComp continuous line plotter which draws individual bars; bars may have labels and may be shaded; there are four different types of shading.

James C. Cheap  
Department of Water Resources  
Computer Systems Division  
1416 Ninth Street  
Sacramento, CA 95814

Available from originator only

## X-Y Plots. MUDPAK

Language - FORTRAN  
Hardware - CDC 3600/24K words/CalComp Plotter

Generates plots of several dependent (y) variables vs. a common independent (x) variable. Numerous user options control type of plot, titling, etc. Exhaustively plots all data from files, one plot per data set (data sets defined by change in key field value). Input: From 1 to 10 card or tape files, comprising 15 dependent variables, file definition cards, plot axis cards, title cards. Output: 11-inch or 30-inch CalComp plots (uses standard CCPLLOT routine) and diagnostic listing.

Peter B. Woodbury  
Deep Sea Drilling Project  
Box 1529  
La Jolla, CA 92037

Available from originator only

Telephone (714) 452-3526

## Plotting Program PROFL

Language - FORTRAN IV  
Computer - CDC 3600

Plots data values against depth or other parameters.

David Wirth  
Oceanic Research Division  
Scripps Institution of Oceanography  
P.O. Box 109  
La Jolla, CA 92037

Available from originator only

## Dendrograph

Language - FORTRAN, ASSEMBLER  
Hardware - IBM 360 or 370/45K for 360/CalComp  
Plotter and/or 132 character line  
printer

Draws a two-dimensional diagram depicting the mutual relationships among a group of objects whose pairwise similarities are given. Input: A distance or correlation type matrix. Output: Printer and/or CalComp plot of the dendrograph. This program is a modification of a program by McCammon and Wenninger in Computer Contribution 48, Kansas Geological Survey. The changes are dynamic storage allocation and printer plots. The size of the input matrix is limited by the amount of core available; core is dynamically allocated at execution time.

Dennis T. O. Kam  
Hawaii Institute of Geophysics  
University of Hawaii at Manoa  
2525 Correa Road  
Honolulu, HI 96822

Available from originator only

Telephone (808) 948-8952

Beach and Nearshore Maps

Language - FORTRAN IV  
Hardware - IBM 1130/8K words

Topographic maps of the beach and nearshore area are computed and plotted based on nine profiles from a baseline across the beach. Profiles are spaced at 100-foot intervals along the beach with survey points at five-foot intervals along each profile. Linear interpolation is made parallel to the baseline between adjacent profiles. Numbers and symbols are printed to form the maps. Profiles for a series of days are used to print maps of erosion and deposition by subtracting elevations for each day from the elevations for the previous day. ONR Tech. Report No. 4, "Beach and Nearshore Dynamics in Eastern Lake Michigan," by Davis and Fox, 1971.

William T. Fox  
Williams College  
Department of Geology  
Williamstown, MA 01267

Available from originator only

Telephone (413) 597-221

X-Y Plots in a Flexible Format  
MEDSPLOT

Language - FORTRAN  
Hardware - CDC CYBER 74/60K octal words/  
CalComp or Zeta Plotter

General purpose program to produce x-y coordinate plots in a flexible format. Point and line plots are available in either a time-sharing (interactive) or batch mode. The prime objective of the program is to permit very flexible control over the plot size and labeling at run time through the use of control cards. Input: (1) Control cards with plot description, (2) any formatted BCD file with fixed length records containing one pair of x-y coordinates, on tape or disk. Output: x-y coordinate plot and summary listing. The x-y coordinates are transferred directly from data. User-controlled range checks and multiple plots can be obtained, based on the sort sequence of a control field in each data record. This field will be in addition to the data fields to be plotted. Can use either an off-line CalComp Plotter or an on-line Zeta Plotter connected with a telephone line.

D. Branch  
Marine Environmental Data Service  
580 Booth Street  
Ottawa, Ont. K1A 0H3

Available from originator only

Telephone (613) 995-2011

Plots Hydro Cast Data  
PLOG

Language - FORTRAN IV  
Hardware - IBM 1130/IBM 1627 plotter

Plots the results of hydrographic casts in a format suitable for publication. Produces 8 1/2-by 10-inch plots of log (10) depth vs. temperature, salinity, and oxygen.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

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Plots STD Data  
STPOL

Language - FORTRAN IV  
Hardware - IBM 1130/IBM 1627 plotter

Plots digitized STD data in a format suitable for publication. The plotter draws and labels axes and plots temperature and salinity vs. depth.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

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Plots Temperature-Salinity  
PSAL1

Language - FORTRAN  
Hardware - IBM 1130

Plots T-S and expanded T-S curves. Another program, PSAL3, plots oxygen, salinity, and temperature-oxygen curves. FRB Manuscript Report No. 1071, by C.A. Collins, R.L. Tripe, and S.K. Wong, Dec. 1969.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

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Section Plotting

Language - FORTRAN  
Hardware - CDC 3100/PDP-8/CalComp Plotter

The program uses the CDC 3100 plotting subroutines to generate data for the PDP-8 plotting program. The user may specify a legend (up to 480 characters), label sizes, scale factors, the parameter to be plotted, and the isopleths to be determined. The plotting is done on a CalComp 31-inch plotter under control of the PDP-8. Cruise data is read from magnetic tape by the CDC 3100 in modified CODC (MEDS) format or Bedford Institute format. An iterative method is used in conjunction with an interpolation function to determine isopleth depths. The interpolation function is described in a Bedford Institute report, BIO 66-3 (unpublished manuscript) by R.F. Reiniger and C.K. Ross, Feb. 1966.

Director  
Bedford Institute of Oceanography  
P. O. Box 1006  
Dartmouth, N. S. B2Y 4A2

Available from originator only

Horizontal Histograms  
HISTO

Language - FORTRAN IV-H  
Hardware \* XDS Sigma 7

Produces horizontal bar histograms on a line printer for any variable on magnetic tape in a standard WHOI format. Format described in a technical report, Ref. No. 69-55, "A Nine Channel Digital Magnetic Tape for Storing Oceanographic Data," by John A. Maltais, July 1969.

Richard E. Payne  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only

Telephone (617) 548-1400

Printer Plots  
LISPLO

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Lists and plots the data stored on WHOI format magnetic tape. See HISTO format reference. Output is on the line printer. Three types of plot are possible: (1) Variable vs. time or sequence number, (2) angle and speed vs. time, and (3) two variables (one on a minus and one on a plus scale) vs. time.

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Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

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128

Plot of Frequency Distribution  
THISTO

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Produces a two-dimensional frequency distribution of samples averaged over chosen interval against time. Input: Control cards and data on 9-track tape. Output: A line printer plot of averaged compass, wave, direction, and speed against time.

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Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1500

Velocity Vector Averages  
VECTAV

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Produces a 9-track tape in WHOI format of east and north velocity vector averages and their corresponding polar representations. (See HISTO format reference.)

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Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Progressive Vectors  
PROVEC

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7/PDP-5 driven CalComp  
Plotter optional

Computes progressive vectors from direction and speed values. Input: Control cards and tape in WHOI format. See HISTO format reference. Output: Listing of progressive vectors and/or a tape to be used with a PDP-5 driven CalComp for a plot of the vectors.

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Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Plots Data Along Track  
TRACK

Language - FORTRAN IV  
Hardware - XDS Sigma 7/2986 32 bit words\*/  
CalComp or Versatec plotter

Plots data in profile along a ship's track. Map is in Mercator projection. The ship's heading is used to determine the orientation of the data. Standard CalComp software is used. Input data can be in any WHOI format or in a user-specified format and can be from any device, but typically from a nine-track magnetic tape; also input are run-time parameters to specify scales and other options. \*Another version of the program exists for the Hewlett-Packard minicomputer and works in a 16K word environment.

Robert C. Groman  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400, ext. 469

Profile versus Time or Distance  
PROFILE

Language - FORTRAN IV  
Hardware - XDS Sigma 7/4010 32 bit words\*/  
CalComp or Versatec plotter

Plots in profile versus time or cumulative distance, all WHOI standard formats or a user-supplied format. Uses standard CalComp software. Input: Data from any device and run-time parameters to specify scales and other options. Output: Plot tape for offline use and printed information about the run. \*Another version of this program exists for the Hewlett-Packard minicomputer and works in a 16K word environment.

Robert C. Groman  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400, ext. 469

Plots Navigation with Any Other Data Type  
DEEP6

Language - FORTRAN IV  
Hardware - Hewlett-Packard minicomputer/  
16K 16 bit words/CalComp plotter

Merges and plots x-y navigation with another data type. For each data point a linearly interpolated position is calculated. Plots can be annotated x-y charts, data profiles along the ship's track, or profiles vs. time or distance. Input: x-y navigation data in meters or fathoms; a time series of data to be merged with the navigation; and input parameters specifying scales and options.

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Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400, ext. 469

Line Printer Plots  
GRAPH2

Language - FORTRAN, COMPASS  
Hardware - CDC 3800/4112 octal (2122 decimal)  
locations\*

This subroutine is intended to be valuable for scientists who want a fast and economical method of producing plots of their data but do not require the high resolution (100 points per inch) of the CalComp plotter. Modified by Dianna L. Denton from a program written at the University of Wisconsin. NRL Memorandum report 2046 (NRL Computer Bulletin 12), Aug. 1969. (\*excluding the common block (11031 octal - 4633 decimal) and system library routines).

Research Computation Center  
Naval Research Laboratory  
Washington, DC 20375

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Magnetic Signatures  
MAGPLOT

Language - FORTRAN  
Hardware - CDC 3600/CDC 3800/706,768 words/On-line plotter

Separates and characterizes the various components of magnetic noise in magnetometer records taken from a sensor towed at sea. Gives a printout of histogram data for each of three wavelength filters: N(amplitude) vs. amplitude; N(wavelength) vs. wavelength. Also produces plots of filtered magnetic fields as function of distance. Program is briefly described in. NRL Formal Report, No. 7760, "Geological and Geomagnetic Background Noise in Two Areas of the North Atlantic."

Perry B. Alers  
Naval Research Laboratory  
Washington, DC 20375

Available from originator only  
Telephone (202) 767-2530

Sequential Plotting

Language - FORTRAN  
Hardware - IBM 360-65

Subroutines produce plots using a digital computer output printer. The consecutive x, y data points are plotted with symbols consisting of letters and numerals. Permits rapid plotting of either a single- or a multivalued curve when high resolution is not required. NELC Report 1613 by R.G. Rock, March 1969.

Naval Electronics Laboratory Center  
San Diego, CA 92152

Copy on file at NODC (documented listing)

Machine Plotting on Mercator Projection

Language - FORTRAN 63  
Hardware - CDC 1604/CalComp 165 plotter

Utilizes meridional parts to locate data points on Mercator-projection maps, using a shared-time plotting routine. The contour outlines can also be plotted by straight-line segments. NUWC Report TP-89 by L.A. Smothers, Dec. 1968. Final version of program written by K.K. Starr.

Ocean Sciences Department  
Naval Undersea Research and  
Development Center  
San Diego, CA 92132

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Overlay Plotting  
OVLPLT

Language - FORTRAN  
Hardware - UNIVAC 1108/12K plotter compatible  
with Integrated Graphics System

Performs overlay plots on the FR-80 graphic system using the Integrated Graphics System. No knowledge of IGS required by user. Fitting of data into bounds of "good looking" graph.

Peter D. Herstein  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only  
Telephone (203) 442-0771, ext. 2305

Physical Data Plot  
FRAME

Language - FORTRAN  
Hardware - CDC 3300

Using arrays of profile data and specification parameters, this subroutine prepares a tape for the UCC plotter to provide a profile plot of depth vs. temperature, conductivity, salinity, sigma-t, and sound speed.

K. Crocker  
Naval Underwater Systems Center  
Newport, RI 02840

Available from originator only  
Telephone (401) 841-3307

Reformats Data, Plots Track Chart  
MASTRACK

Language - FORTRAN V  
Hardware - UNIVAC 1108/Instructions 5K words/  
Data 5K words/2K Plotter buffer/  
3 tape units/CalComp Plotter

Decodes blocked BCD data tapes in NGSDC format into UNIVAC SDF format and plots user-scaled Mercator track charts annotated with any and all underway parameters. Author - Peter J. Topoly.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only  
Telephone (202) 763-1449

Produce Contour Charts  
GRIDIT, REGRIDIT, AUTOMATED CONTOUR

Language - FORTRAN  
Hardware -

Three programs which enable the user to graphically produce a contour chart by the computer-plotter method. GRIDIT produces a digitized matrix from data points which have been screened for gross errors. REGRIDIT produces a digitized matrix from raw unchecked data points. AUTOMATED CONTOUR constructs a contour chart from a digitized matrix. An example is given for use of the program in contouring the bathymetry of the ocean bottom. Informal manuscript report IM No. 67-4, "An Automated Procedure for Producing Contour Charts," by Roger T. Osborn, Feb. 1967.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Copy on file at NODC. (Above report; includes listing)  
Telephone (301) 763-1449

Profile Plots, Time Axis  
PROFL3

Language - FORTRAN IV  
Hardware - IBM 360-67/110K bytes for 1500 values per profile/Plotter

Makes profile plots of up to three values along a time axis. Uses Benson-Lehrner plotter or easy conversion to CalComp. Input: Cards with specifications for profiles (scales, values, titles, symbols, etc.) and formats, and data cards with Julian day, hour, minute, and one to three values.

Graig McHendrie  
Office of Marine Geology  
U.S. Geological Survey  
345 Middlefield Road  
Menlo Park, CA 94025

Available from originator only

Telephone (415) 323-8111, ext. 2174

Profile Plots, Distance Axis  
PFLDST

Language - FORTRAN IV  
Hardware - IBM 360-67/130K bytes for 1500 values per profile/plotter

Produces profile plots of up to three values along a cumulative distance axis. Uses Benson-Lehrner plotter or easy conversion to CalComp. Input: Cards with specifications for each profile (scale, values, symbols, title, etc.) and formats, and data cards with Julian day, hour, minute, latitude, longitude, and one to three values.

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Map Plots  
MAPPLT

Language - FORTRAN IV  
Hardware - IBM 360-67/244K bytes for 7500 nav. or 6000 data points/Plotter

Makes map plots of either data values or navigation data on a Mercator, transverse Mercator, conic, or Lambert conformal projection. Maximum map size is 28 x 61 inches. Assumes equatorial radius of earth is 251,117,000 inches and that west longitude and south latitude are input as negative values. Uses Benson-Lehrner plotter or easy conversion to CalComp. Input: Eleven cards with title, formats, and map window specifications followed by data on either cards or tape. Navigation data: Julian day, hour, minute, latitude, longitude. Data values: minute (or sequence no.) value, latitude, longitude.

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Plots Scattergram  
SCTGM4 and SCTGM5

Language - FORTRAN IV  
Hardware - IBM 360-65

These subroutines plot a simple scattergram from a set of data pairs. The data are first adjusted to fit in a range of 1 to 100, then rounded, and the scattergram is generated by

subtracting the origin from each data point and then fixing, or truncating, the number to yield a set of subscript pairs. The location for each subscript pair in the black array is filled with the number of occurrences and finally a plot is produced. These routines ignore out of bound points.

Paul Sabol  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

Available from originator only

Telephone (202) 634-7344

X-Y Plots  
EBTPLT

Language - FORTRAN IV  
Hardware - CDC 6600/FR80 Precision Microfilm  
Recorder

A generalized x-y plot package. Allows various manipulations of axes as well as special character plotting.

Robert Dennis  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

Available from originator only

Telephone (202) 634-7340

Displays VHRR Satellite Data  
VSDMD

Language - FORTRAN  
Hardware - CDC 6600/54K words/Digital Muirhead  
Displayer/NESS displayer run by  
CDC 924

Displays VHRR data from the ingest tape on the Digital Muirhead Displayer (DMD) in 5000 mode (5000 picture elements per scan line; 5000 maximum scan lines per picture). The program uses a two spot running mean of 5000 spots of a possible 6472 along each scan made by the VHRR instrument. It converts each averaged spot via lookup table to a display grayscale. The starting scan line, the number of scan lines to be processed, the starting spot, and the grayscale lookup table are controlled by data cards.

John A. Pritchard  
National Environmental Satellite  
Service, NOAA  
Suitland, MD 20233

Available from originator only

Telephone (301) 763-8403

Microfilm Plots of VHRR Satellite Data  
SVHRR4KM

Language - FORTRAN H Extended  
Hardware - IBM 360-195/FR-80 Precision Microfilm  
Recorder/256K 8 bit bytes

Displays the VHRR data from the VHRR ingest tape in the form of printed characters on 16mm microfilm in blocks of 128 characters by 48 characters. Each printed character will represent a square four kilometers on a side at the subsatellite point, is obtained by averaging four lines and six spots along each scan line of data from the VHRR ingest tape, and then is determined by a character lookup table. The program is capable of utilizing 3840 digital spots of a possible 4842.

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Vertically Analyzed Contours of Oceanographic  
Temperatures and Salinities, VACOTS

Language - FORTRAN 63  
Hardware - CDC 3600/CalComp plotter/32K words

Provides a rapid and accurate means of constructing vertical cross sections of sea temperatures and salinities. Although this program has been designated to use STD data recorded on magnetic tape, other versions are being used to contour biological, chemical, and other physical oceanographic data. Each vertical section is divided into two parts: the upper section for the contours from the surface to 300-m, and the lower section from 300 m to 1000 m. Running time: To analyze and plot contours at intervals of 1 degree C for temperature and 0.1 parts per thousand for salinity from the surface to 1000 m for 50 stations requires four minutes of computer time on the CDC 3600 and 25 minutes on the CalComp 30-inch plotter. Author - Forrest Miller.

Southwest Fisheries Center  
National Marine Fisheries Service, NOAA  
P.O. Box 271  
La Jolla, CA 92037

Copy on file at NODC (deck, documentation)  
Telephone (714) 453-2820

Oxygen, Phosphate, Density Plots

Language - FORTRAN IV  
Hardware - IBM 360-65/CalComp plotter/33K bytes

Plots oxygen vs. phosphate, oxygen vs. sigma-t, and phosphate vs. sigma-t (single or multiple station) for purposes of quality control and study of water types. Input: Hydrographic data in ICES format. Author - Marilyn Borkowski.

Southeast Fisheries Center  
National Marine Fisheries Service, NOAA  
75 Virginia Beach Drive  
Miami, FL 33149

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General Mercator Plot

Language - FORTRAN IV  
Hardware - IBM 360-65/CalComp Plotter/42K bytes

Plots any variable on a Mercator projection; has option of writing in value or making a point plot, and of connecting the points with lines. Input: Any header cards in ICES format. Projection plot may be in any scale per degree, and may include a coastline (obtained from a digitized world tape layout). Author - Marilyn Borkowski.

Southeast Fisheries Center  
National Marine Fisheries Service, NOAA  
75 Virginia Beach Drive  
Miami, FL 33149

Copy on file at NODC documented listing)

Plotter Commands  
PLOT, DVR10

Language - Assembly language under RTE  
Hardware - HP 2100S

These subroutines are modifications of the HP subroutine PLOT and the RTE driver DVR10. Together they control a CalComp or CalComp compatible .01" or .0025" incremental step drum plotter with three-pen operation. Equipment type is identified through subchannel. Plot increments are calculated in double precision integer.

Robert A. O'Brien, Jr.  
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Naval Research Laboratory  
Washington, DC 20375

Available from originator only  
Telephone (202) 767-2387

# TIME AND SPECTRAL SERIES ANALYSIS

## Spectral Analysis Subroutines

Language - FORTRAN  
Hardware - UNIVAC 1108/30K

Given digital time and spectral series, produces autospectral autocorrelation plots and listings, and phase angle vs. frequency plots.

Peter D. Herstein  
Naval Underwater Systems Center  
New London, CT 06320

Available from originator only  
Telephone (203) 442-0771, ext. 2970

## Scalar Time Series TEMPL7

Language - FORTRAN IV  
Hardware - CDC 6400 (SCOPE 3.4)/100K (octal)  
10 character words/CalComp  
936/905 Plotting System

Computes and plots statistics, histogram, time series, and spectrum for time series of any scalar quantity. Input: Scalar time series on tape in CDC 6400 binary format; maximum number of data points is 5236. Output: Listing and tape for off-line plotter. Perfect Daniel frequency window used to compute spectral estimates from FFT generated periodogram values.

James R. Holbrook  
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Laboratory, NOAA  
3711 Fifteenth Avenue N.E.  
Seattle, WA 98105

Available from originator only

Telephone (206) 442-0199

## Time Series Plotting

Language - FORTRAN 32  
Hardware - CDC 3100/PDP-8/CalComp Plotter

The program uses the CDC 3100 plotting subroutines to generate data for the PDP-8 plotting program. The user may specify a legend (up to 480 characters), label sizes, scale factors, the parameter to be plotted and the isopleths to be determined. The plotting is done on a CalComp 31 inch plotter under control of the PDP-8. Cruise data is read from magnetic tape by the CDC 3100 in Bedford Institute format. Time is plotted along the X axis (drum movement) and depth along the Z axis (pen movement). Stations are plotted to the nearest day. Author - D.J. Lawrence. June 1969.

Director  
Bedford Institute of Oceanography  
P. O. Box 1006  
Dartmouth, N. S. B2Y 4A2

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Telephone (902) 426-3584

## Time Series Analysis Programs TSAP

Language - MS FORTRAN  
Hardware - CDC 6400 or CDC 3150/Disk/3 tape  
units/CalComp Plotter

A series of programs that edit digitized time series data, produce plots, probability distributions, perform fast Fourier transforms on data and convert Fourier coefficients into power and cross spectra. Input: Digitized magnetic tape output from program A TO D and data cards. Output: CalComp plots, printer plots, option dump of data tape, magnetic tape of Fourier coefficients, listing of spectra, disk file of spectra. Computer Note BI-C-74-2, May 1974.

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Time Series - Analog to Digital  
A TO D

Language - MS FORTRAN  
Hardware - CDC 3150/32 K-words/1500 tracks on  
scratch disk/2 tape units/Crown  
CI822 tape recorder and Airpax  
FPS24 discriminators for BIO  
A-D converter

Digitizes analog time series data at fixed time intervals; removes means and trends, and writes data on digital magnetic tape; processes data from sensors used in air-sea interaction studies.  
Input: Up to 12-channel magnetic tape read in through on-line A-D converter; control cards.  
Output: Summary listing and digital magnetic tape. Computer Note BI-C-74-1, Feb. 1974.

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Time Series Routines  
ARAND SYSTEM

Language - FORTRAN/COMPASS (assembly)  
Hardware - CDC 3300/OS-3 time-sharing  
operating system/Less than 32 K  
4 character words/Graphics:  
Tektronix 4002 or 4010 graphics  
terminal, CalComp 1627 II drum in-  
cremental X-Y plotter. Hewlett-  
Packard 7200A graphics plotter

(Number in parentheses at end of  
each abstract is key to references  
at end of series.)

ACFFT computes the autocorrelation or autocovariance function of a single time series using a variation of the convolution property of the discrete Fourier transform in conjunction with a fast Fourier transform algorithm. (2, 4, 5)

ACORR computes the autocorrelation function of a time series for a given number of lags. (3)

ACRPLT is designed to plot estimated autocorrelation or partial autocorrelation functions; standard error designations are included. Provision is made for the inclusion of confidence intervals that correspond to hypotheses that all theoretical correlation values beyond a certain lag are zero. CalComp or Tektronix. (3, 6)

ALIGN aligns cross correlation or cross covariance values, shifting the estimates so that a specified lag becomes lag zero. It is intended for use prior to computing estimates of the squared coherence and phase spectra of two time series. (2, 7)

AMPHCO determines the amplitude, phase, and the squared coherence, given the spectral density functions, the cospectrum and the quadrature spectrum of two time series. (1, 7, 8)

ARMAP produces realizations or observed time series of an autoregressive, moving average, or mixed regressive-moving average process. The order of the autoregressive and/or moving average operator cannot exceed three; one realization is produced per call and there is no restriction on the length of the observed time series. (3, 6)

AUTO calculates values of the biased autocovariance function. (1, 9)

AUTOPLT is designed to plot autocorrelation or autocovariance functions on the CalComp 1627 II plotter. The routine scales the values, determining the range of the values to be plotted on the Y-axis. (2)

AXISL is a plotting aid allowing for general purpose axis drawing and labeling. It is written in assembly language and uses elements of the COMPLIT drivers. (3)

CCFFT employs the convolution property of the discrete Fourier transform in conjunction with

the fast Fourier transform algorithm to compute the cross-correlation (covariance) function. (2, 4, 5)

CCORR computes the biased auto- and cross-correlation functions of two time series. (1)

COHPLT accepts squared-coherency spectrum values and plots coherency on a hyperbolic arctangent scale which allows a constant length confidence interval to be constructed. (2, 7)

COMPLOT is a set of subroutines intended to provide a basis for easily programing graphics applications. These subroutines expand relatively simple instructions specified by the programmer to include all of the necessary details for the plotting device. COMPLOT was designed to be utilized in a time-sharing environment with any of the above plotting devices; also, provisions have been made for plotting on combinations of these devices. (3)

CONFID determines multiplicative factors used in constructing confidence intervals for mean-lagged product spectral estimation. (1, 7)

CONFID1 determines the multiplicative factors necessary to construct confidence intervals for power spectral estimates found by averaging short modified periodograms, as in FOUSPC, FOUSPC1, FOUSPC2, and FFTPS. (3, 10)

CONMODE is a series of subprograms designed as aids to conversational programing with the following four objectives: (1) to allow the user to respond in as natural a way as possible within the limitations of the operating system available; (2) To make all responses entered by the user consistent in use; (3) To provide a complete set of input/output subprograms for conversational-mode use; (4) To allow ease in usage from a programing point of view, with fairly fast and efficient execution. (3)

COPH computes squared-coherence and phase estimates, given power spectral, cospectral, and quadrature spectrum estimates. The phase estimates can be in either degrees or radians. Similar to AMPHCO. (2)

COSTR computes the discrete cosine transform of an even function (array of values). Goertzel's method is used. (1)

CPEES is a conversational program used in modeling. CPEES picks up information output on file by the CUSID routine, asks the user a few questions, and then determines initial or final parameter estimates for the identified model. Calls USPE and USES, getting preliminary and final parameter estimates. (3, 6)

CPAT1 is a conversational calling program for the plotting routine PLTSPC, used to plot spectral estimates with confidence intervals and bandwidth. The program allows the user to plot as many data sets as he likes from the same or different files. (2)

CPAT2 is a conversational program to produce plots of frequency dependent data using routine PLTFRQ. The program allows the user to plot as many data sets as he likes from the same or different files. (2)

CROPLT is designed to plot the cross correlation (covariance) functions of two time series on the CalComp 1627 II plotter. The routine automatically scales the values, determining the range of values to be plotted on the Y-axis. (2)

CROSS computes the two cross covariance functions (biased) of two time series. (1, 9)

CUSID is the first of a series of three conversational programs that collectively perform model identification, parameter estimation (see CPEES), and forecasting (see CUSFO) for autoregressive integrated moving average models. This program corresponds to the identification phase in the modeling process, accepting time series data and computing the autocorrelation and partial correlation functions of the series after seasonal and/or nonseasonal difference operators have been applied. The routine is designed for use at a Teletype or a Tektronix graphics terminal; selection of graphics output of the data and correlation functions on either the CalComp plotter or the graphics terminal is available. (3, 6, 11, 12)

CUSFO computes and plots forecasts from the original data and a fitted model. See CUSID. (3)

CZT computes z-transform values of a finite sequence of real data points using the chirp z-transform algorithm. Points at which transform values will be computed must lie on circular or spiral contours in the complex plane. The contour may begin at any point in the plane and the constant angular frequency spacing between points on this contour is arbitrary. A special contour of particular importance is the unit circle in which case a Fourier transform is computed. (2, 13, 14)

DATPLT is a general purpose plot routine for time series data. (3)

DEM0D1 estimates values of the energy spectrum of a time series using complex demodulates. The frequencies (in cycles per data interval) at which spectral estimates are to be computed are input in the form of an array, allowing one to consider isolated frequencies or a collection of related frequencies, such as an arithmetic progression. Only every Lth value of the complex demodulate at a particular frequency is computed and averaged to form the spectral estimate at that frequency, where L is specified by the user. (1, 15, 16)

DEM0D2 finds the complex demodulate at the given frequency, given a time series, an array of filter weights, a selection integer, and a single frequency. The values of the complex demodulate at the given frequency are returned either as real and imaginary parts of complex numbers or in terms of amplitudes and phases. As in DEM0D1, the calculations use the method of Goertzel for the evaluation of discrete Fourier transforms. (1, 15, 16)

DEM0D3 accepts output from DEM0D2 and calculates an energy spectrum estimate at a single frequency. (1, 15, 16)

DETREND removes a mean or linear trend from a time series, writing over the input array. (1)

DIFF12 computes first or second forward differences of a series. (1)

EUREKA finds either the solution to the matrix equation  $R \cdot f = g$  where  $R$  is a Toeplitz matrix (i.e., a symmetric matrix with the elements along the diagonals equal) and  $f$  is a column vector, or the solution of the normal equations which arise in least-square filtering and prediction problems for single-channel time series. (1, 17, 18)

EXSMO computes a triple exponentially smoothed series. (1, 9)

FFIN, a free-form input routine, allows for the reading of numeric information in BCD that is relatively format free. FFIN returns a single value on each call, and operates by reading 160 characters (2 cards or 2 card images) and advancing a pointer through the buffer on each subsequent call until more information must be input or reading is complete. A companion routine, FFINI, operates exactly as FFIN except that the buffer is cleared and new information input on each call. Both routines set the EOF bit if an end of file is encountered. (3)

FFTCNV computes the convolution of a series with a weighting function using the fast Fourier transform algorithm. The program is designed for the convolution of long series with a relatively short weighting function. (2, 4, 5)

FFTPS uses a fast Fourier transform algorithm to compute spectral estimates by a method of time averaging over short, modified periodograms. (1, 7, 10)

FFTS computes the direct or inverse transform of real or complex data, using a power of two fast Fourier transform algorithm. (2)

FFTSPEC finds a raw or modified periodogram for a sequence of real data points using a power of two fast Fourier transform algorithm, i.e., the absolute value squared of raw or Hanned Fourier coefficients are found and suitably scaled. This subroutine is intended for use with time series whose length is slightly smaller than or equal to a power of two. (3)

FILTER1 designs symmetrical, non-recursive digital filters. It is conversational in form and is intended for use at a Tektronix 4002 graphic terminal. Two design techniques are supported, corresponding to the subroutines GENER1 and FIVET. Outputs include an array of filter weights and the attained frequency response. (2)

FIVET designs non-recursive symmetrical digital filters. The design technique is known as the 5T's method and requires that the specifications be given for the desired frequency response

function, the maximum allowable deviation from the desired response, and the bandwidth of transitions in the attained response corresponding to discontinuities in the desired response. (2, 19)

FOLD performs polynomial multiplication or, equivalently, the complete transient convolution of two series. (1, 17)

FOURTR takes the Fourier transform of real data; many output options are available. (1, 20)

FOUSPC finds the Fourier transforms of segments of a time series. The segments must be of equal length, but may abut, overlap, or be in any order relative to the given time series. FOUSPC can be used in conjunction with SPEC to estimate power spectra by a method of time averaging over short, modified periodograms. Note that if one is not interested in examining the Fourier-like coefficients of each segment before passing on to spectral estimates, then FOUSPC1 or FOUSPC2 should be used. (1)

FOUSPC1 computes the power spectrum of a time series by a method of averaging over short, modified periodograms. (3, 7)

FOUSPC2 is similar to FOUSPC1, but accepts two time series, computing the cross spectral matrix at specified frequencies. (1)

FRESPON computes the frequency response of a filter. (1)

GAPH computes and plots estimated gain and phase functions of a time invariant linear system. The gain values are plotted on a logarithmic scale and both gain and phase plots include confidence interval constructions. Input includes smoothed power and cross spectra estimates. (3, 7)

GENER1 is a filter design program. It may also be used to generate weights of lag window or data window, although the routine WINDOW is specifically designed to perform this task and is therefore somewhat easier to use. (1, 26)

GENER2 generates an arithmetic progression. (1)

GENER3 designs a symmetrical low-pass filter given an array containing desired frequency responses at equally spaced frequencies from zero to one-half cycle per data interval. (1)

LOGPLT plots power spectral estimates on a base ten logarithmic scale, the output device being a CalComp 1627 II plotter. The subroutine automatically scales the estimates, determining the range of values to be plotted on the Y-axis. The estimates must have been computed at equally spaced frequencies. An 80% or 95% confidence interval (computed using routine CONFID) is also plotted. (2)

NOIZT tests a time series to determine if it can be considered a realization of a white noise process. The test is a frequency domain test involving the integrated spectrum of the series. The results are plotted with 80% and 95% confidence regions. (2, 7, 21)

PHAPLT plots the phase estimates with 95% confidence intervals on the CalComp 1627 II plotter. The phase estimates must have been computed at equally spaced frequencies and, in order to generate approximate confidence intervals, the associated squared-coherency estimates at these same frequencies must be given. (2, 7)

PLTFOR graphs an initial segment of time series data followed by a set of forecasts that include upper and lower probability limits as generated by CUSFO or USFO. (3)

PLTFRQ allows frequency dependent functions to be plotted versus any arithmetic progression of frequencies, using the CalComp 1627 II plotter. The routine scales the frequency values, determining the range of the values to be plotted on the Y-axis. (2)

PLTSPC is designed to plot power spectra on the CalComp 1627 II plotter. The routine scales the spectral estimates, automatically determining the range of values to be plotted on the Y-axis. Also, the plotting of spectral window bandwidth and confidence intervals is possible. The bandwidth of the spectral window associated with any lag window the user may have used, is

computed by WINDOW and the multiplicative factors needed to determine confidence intervals can be found using the CONFID routines. (2)

POLRT computes the real and complex roots of a polynomial with real coefficients. (1, 9, 17)

POLYDV divides one polynomial by another or deconvolves one signal by another. (1, 17)

PROPLT produces a profile plot on either the Tektronix graphics terminals or the CalComp plotter or both, and is intended for use with the routine TIMSPEC which produces spectra from segments of a long record, the segments being equally spaced in time. This profile is not a true perspective view, as the frequency (horizontal) axis of each spectrum is of constant length and separated on the time (vertical) axis by a constant amount. (3)

PSQRT computes the coefficients of the square root of a power series or polynomial. (1, 17)

RANDM generates a (pseudo) random sample from one of four possible population distributions, with the size of the sample specified by the user. The population mean is fixed at zero; the variance or scale parameter is user definable. Provisions have been made for repeated calls to RANDM; that is, one can generate a number of independent random samples from the same or different populations. (3, 22)

RCTFFT computes the discrete Fourier transform of real data using the Cooley-Tukey fast Fourier transform algorithm. The number of data points must be a power of two. (1)

RESPON computes the square of the absolute values of the frequency response of a general filter. (1)

REVERS performs bit-reversing on an array of complex data points. REVERS is written in COMPASS and is used in programs employing the fast Fourier transform algorithm. (1)

RPLACE changes specified values of a time series. The indices of the values to be changed and the new values themselves are read in by RPLACE according to a format specified by the user. (1)

RRVERS performs bit-reversing on an array of real data points; the subroutine is written in COMPASS and is used in FFTPS. (1)

SARIT produces a series by serial computations on one or two other series; there are seven different choices for the series to be produced. (1)

SERGEN generates a time series by adding random numbers or noise to a signal, in this case a trigonometric series. Inputs include amplitudes or coefficients of the trigonometric series, an array of random numbers, and a parameter specifying the desired signal level to noise level ratio. (1, 23)

SHAPE designs a filter which will shape a given series into a desired output series. (1, 17)

SINTR calculates the discrete sine transform of a series of data points. (1)

SMO calculates a smoothed or filtered series, given a time series, a selection integer, and a weighting function. (1, 9)

SPEC accepts output from FOUSPC, computing either the power spectrum of a single time series or the cross spectral matrix of two time series. In the latter case, FOUSPC must be called twice with different time series at each call, but with the same arithmetic progression of frequencies. (1)

SPECT1 is a conversational main program designed to estimate, output, and plot the autocorrelation and auto spectral functions of a single time series. It is intended for use at a teletypewriter. (2)

SPECT2, a conversational main program for use at a teletypewriter, computes power spectral, squared coherence, and phase estimates. The program allows the correlation functions of the two time series involved, the power spectral, squared coherence, and phase estimates to be

output on a combination of devices, including the Teletype, line printer, CalComp plotter and disk. (2, 7)

TAUTOPLT is designed to plot autocorrelation or autocovariance functions on a Tektronix 4002 graphics terminal; the routine scales the values, determines the range of the values to be plotted on the Y-axis. (2)

TCOHPLT, designed for use with a Tektronix graphics terminal, plots coherence estimates on a hyperbolic arctangent scale, allowing the construction of confidence intervals whose length is independent of frequency. (2, 7)

TCROPLT plots the cross correlation (covariance) functions of two time series on the Tektronix graphics terminal; the routine automatically scales the values, determining the range of values to be plotted on the Y-axis. (2)

TFORM1 calculates values of the spectral density function at any arithmetic progression of frequencies on  $[0, 1/2]$  cycles per data interval, given autocorrelation or autocovariance function of a time series and an array to be used as a weighting kernel. This weighting kernel can be generated using the routine WINDOW. (2, 7, 8)

TFORM2 computes the co- and quadrature spectrum estimates for an arithmetic progression of frequencies on the interval zero to one half cycles per data interval, given the auto and cross correlation functions. Similar to TRANFRM except that it does not produce the associated auto-spectral estimates. (2, 7, 8)

TIMSPC finds power spectral estimates computed from segments of a long time series, the beginning of each segment being equally spaced in time. The computational approach is a direct one via a fast Fourier transform algorithm and the technique is appropriate for segment lengths slightly less than or, ideally, exactly equal to a power of two. Thus, the routine allows one to compute a type of "time varying" spectra and these spectra can be graphically examined with the aid of a profile plot (PROPLT) or a contour plotting routine. (3)

TLOGPLT plots power spectral estimates on a logarithmic scale and is designed for use with a Tektronix graphics terminal. The routine automatically scales the estimates, determining the range of values to plot on the Y-axis. The estimates must have been computed at equally spaced frequencies. An 80% or 95% confidence interval (computed using routine CONFID) is also plotted. (2)

TNOIZT performs a frequency domain test to determine if a time series can be considered a white noise or purely random process. The test is appropriate for detecting departures from whiteness due to periodic effects, and is intended for use in conjunction with a test based on the autocorrelation function for detecting local correlation. The routine plots theoretical integrated spectrum values with 80% and 95% confidence regions, the integrated spectrum estimates of the time series being computed from Fourier coefficients input to TNOIZT. These Fourier coefficients may be computed using the FOURTR or RCTFFT routine. (2, 7, 21)

TPHAPLT plots the phase estimates with 95% confidence intervals on a Tektronix 4002 graphics terminal. The phase estimates must have been computed at equally spaced frequencies and, in order to generate approximate confidence intervals, the associated squared-coherency estimates at these same frequencies must be given. (2, 7)

TPLTRQ is designed to plot frequency response function (or any function of frequency) on a Tektronix graphics terminal. The routine scales the frequency values, determining the range of the values to be plotted on the Y-axis. (2)

TPLTSPC is designed to plot power spectra on a Tektronix graphics terminal. The routine scales the spectral estimates, automatically determining the range of values to be plotted on the Y-axis. Also, the plotting of spectral window bandwidth and confidence intervals is possible. The bandwidth of the spectral window associated with any lag window the user may have used is computed by WINDOW and the multiplicative factors needed to determine confidence intervals can be found using the CONFID routine. (2)

TRISMO is designed for smoothing spectral estimates evenly spaced over the interval  $[0, 1/2]$  (including end points), or equivalently, zero to the Nyquist frequency. The spectral window

applied is a triangular one and the smoothing or convolution is done in a recursive fashion, making it relatively fast. (3, 24)

TSGEN is a conversational program for the generation of a wide variety of time series. More specifically, the program constructs realizations of autoregressive integrated moving average processes where the noise process or "random shock" terms involved may be input from file or generated within the program. In the latter case, a selection of one of four possible families of distributions for the noise is allowed. TSGEN can be run from any Teletype-like terminal, including the Tektronix graphics terminals. (3, 25, 6)

TSPECT1 and TSPECT2 are respectively versions of SPECT1 and SPECT2 that are suitable for use at a Tektronix graphics terminal. (2)

TRANFR calculates values of the spectral density function given the autocorrelation (or autocovariance) function of a time series and an array to be used as a weighting kernel. This weighting kernel can be generated using the routine WINDOW. (1, 7, 8)

TRANFRM calculates spectral density functions, the cospectrum, and the quadrature spectrum, given the autocorrelation (or autocovariance) functions, the cross correlation (or cross covariance) functions of two time series and an array to be used as a weighting kernel. This weighting kernel can be generated using the routine WINDOW. (1, 7, 8)

TTYCON, written in COMPASS, is designed to be used in conversational programs for the output of alphanumeric messages and the input of signed numbers, integer or floating point, and alphanumeric characters. (2)

TTYNUM is designed to be used in conversational programs for the output of one or more alphanumeric messages and the input of one or more signed numbers (integer or floating point) or eight-character alphanumeric identifiers. (2)

UNLEAV is primarily designed for use with RECTFFT. The routine takes an array of interleaved coefficients and separates them, sending the coefficients into two distinct arrays of one half the length of the input array. The length of the input array must be of the form  $M+2$  where  $M$  is a power of 2. (1)

USES accepts initial parameter estimates for a seasonal or nonseasonal autoregressive-moving average model and then employs the (possibly differenced and transformed) time series being modeled, computing final parameter estimates. These final parameter estimates are output, along with their covariance and correlation matrix, the residuals from the fitted model, and the sample autocorrelation function of these residuals, and chi-square statistic based on the residual autocorrelations. (3)

USFO generates forecasts with upper and lower probability limits, given the original time series data and a fitted nonseasonal or seasonal autoregressive-integrated-moving average model. Weights for updating forecasts are also output. USFO thus represents the fourth and final stage in a successful modeling attempt, beginning with model identification (USID, CUSID), preliminary estimation of parameters (USPE, CPEES), and final parameter estimated and diagnostic checking (USES, CPEES). (3)

USID accepts a time series as input, possibly transforms and differences the series in seasonal and/or nonseasonal fashion, and then finds the sample autocovariance, autocorrelation, and partial autocorrelation functions. This marks the first of the four programs employed in model identification, parameter estimation, and forecasting, the remaining subroutines being USPE, USES and USFO. Conversational programs (CUSID) and support graphics (ACRPLT) are available for USID. (3, 6, 11, 12)

USPE accepts output from USID and chooses for the order of the autoregressive and moving average parts in modeling possibly transformed and differenced time series data; a conversational calling routine for USPE is CPEES. (3)

WINDOW generates an array to be used as a weighting function or lag window. One of six different lag windows may be selected: The rectangular or box car window, the Parzen lag window, the Bartlett or triangle window, the Tukey or cosine window, the Lanczos data window, and the Lanczos-squared data window. (1, 7)

WINDOW1 generates a symmetrical array of weights for use as a data window, as required, for example, in the spectrum estimation procedures of the ARAND routines FOUSSPC, FOUSSPC1, FOUSSPC2, and FFTPS. Two basic window shapes are available, the first having a spectral window very similar to the Tukey or cosine window, while the second produces the Parzen spectral window. (1, 10)

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Director, Computer, Center  
Oregon State University  
Corvallis, OR 97331

Available from originator only  
Telephone (503) 754-2494

Generates Arbitrary Filter  
HILOW

Language - FORTRAN IV  
Hardware - IBM 1800

Generates a lowpass, bandpass, or highpass filter defined by three parameters, with or without its conjugate; punches the multipliers on cards; and lists its amplitude response over the full frequency range. NIO Program No. 158. Author - D.E. Cartwright.

National Institute of Oceanography  
Wormley, Godalming, Surrey, England

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Two-Dimensional Autocorrelation

Language - FORTRAN  
Hardware - IBM 7090/IBM 1401

Applies regression and correlation analyses to a sample of ocean terrain. Computes variance and covariance as function of position in data field. Ref. Arthur D. Little, Inc., Technical Report No. 1440464, "Statistical Analyses of Ocean Terrain and Contour Plotting Procedures," by Paul Switzer, C. Michael Mohr, and Richard E. Heitman, April 1964. Appendices B and C of report describe (but do not list) two routines used: (1) "Correlation Constants" (IBM 7090), (2) "Local Means and Variances" (IBM 1401).

Trident/ASW Library  
Arthur D. Little, Inc.  
35 Acorn Park  
Cambridge, MA 02140

Copy on file at NODC (listing); documentation  
(above report) available from NTIS, Order No.  
AD 601 538/LK, \$4.75 paper, \$2.25 microfiche.

Time Series Analysis  
BLACKY

Language - FORTRAN IV  
Hardware - IBM 360

Computes, for two simultaneous time series, cross spectra, power spectra, phase and coherence. Subprograms obtain the filtered series, remove the trend, and compute the auto- and cross correlations. This NEGS library program is listed in a thesis by John G. McMillan, June 1968. The thesis uses digital analysis by program BLACKY in the study of temperature fluctuations near the air-sea interface, the wave field at the same point, and the downstream wind velocity.

Naval Postgraduate School  
Monterey, CA 93940

Thesis available from NTIS, Order No. AD 855  
533/LK, \$3.25 paper, \$2.25 microfiche.

Spectral Analysis of Time Series

Language - FORTRAN IV/ALGOL 60  
Hardware - UNIVAC 1108/Burroughs B5500

Finds the spectra, cospectra, quadspectra, coherence, and phase of two series or a single spectrum of one series, using the fast Fourier transform (algorithm of Cooley and Tukey, 1965).  
Special Report No. 6, by Everett J. Fee, March 1969.

The Librarian  
Center for Great Lakes Studies  
University of Wisconsin-Milwaukee  
Milwaukee, WI 53201

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Spectra Programs  
DETRND, AUTCOV, CRSCOV, FOURTR

Language - FORTRAN IV  
Hardware - IBM 360-40

DETRND removes the mean, or the mean and linear trend (slope), from a time series. AUTCOV computes the autocovariance of the time series. CRSCOV computes the auto- and cross-covariances of two sequences. FOURTR computes either the sine or cosine Fourier transform. Smoothing of either is optional. Technical Note 13, "Water Wave Teaching Aids," by Ralph H. Cross. Adapted (with permission) from a program written at Bell Laboratories by M.J.R. Healy, 1962.

Hydrodynamics Laboratory  
Massachusetts Institute of Technology  
Cambridge, MA 02139

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Analysis of Non-Linear Response Surface

Language - FORTRAN IV  
Hardware - IBM 1130

Analyzes the data from response surface experiments when two or three factors are measured. Options allow calculation of maximum likelihood estimates of power transformations of both independent and dependent variables, and the plotting of their relative maximum likelihood graphs, as a measure of the precision of the principal estimates. The data is then subjected to analysis of variance, using orthogonal polynomials, and principle component analysis; specified contours of the dependent variable are plotted, both without and with transformation. FRB Technical Report No. 87 by J.K. Lindsey, Aug. 1968.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

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Multiple Discriminant Analysis  
MULDA

Language - FORTRAN IV  
Hardware - IBM 1130

A complete multiple discriminant analysis is performed by six interrelated programs which are executed in succession through the link feature in 1130 FORTRAN. Will accept up to 25 variates and as many as 10 groups. Any number of additional data cards can be read and processed after the discriminant analysis has been completed. The value of the discriminant function, classification chi-squares, and probabilities of group membership are computed and printed for each additional m-variate observation. FRB Technical Report No. 112 (unpublished manuscript), by L.V. Pienaar and J.A. Thomson, March 1969.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

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Fourier Analysis  
LIQ1

Language - FORTRAN  
Hardware - IBM 7096/32K

Obtains amplitudes and phases of frequency components in any record. Standard Fourier analysis plus use of Tukey cosine window to reduce edge effects. Author - Alsop.

Lamont-Doherty Geological Observa- Copy on file at NODC (deck, documentation)  
tory  
Columbia University  
Palisades, NY 10964

Cluster Analysis

Language - FORTRAN  
Hardware - IBM 1800

Carries out a single linkage cluster analysis using data in the form of an upper triangular similarity matrix. Output: (1) similarity level of clustering cycle; (2) a list of the linkages that occur at that similarity level; (3) at the end of the cycle, the cluster numbers and a list of the entities making up each cluster are printed. Running time: A matrix of order 60 took approximately 15 minutes to cluster. NIO Program No. 166. Author - M. Fasham.

National Institute of Oceanography Copy on file at NODC (listing, documentation)  
Wormley, Godalming, Surrey, England

Probability Distribution  
WEIBUL

Language - FORTRAN IV  
Hardware - IBM 370/120K

Parameters for a Weibull probability distribution are calculated from low, most probable, and high estimates of random variables.

Robert T. Lackey  
Department of Fisheries and  
Wildlife Sciences  
Virginia Polytechnic Institute and  
State University  
Blacksburg, VA 24061

Available from originator only

Statistics from WHOI Format  
STATS

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Computes and lists statistical quantities related to variables stored on tape in WHOI standard format. See HISTO format reference.

Richard W. Payne  
Wood Hole Oceanographic Institution  
Woods Hole, MA 02543

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Telephone\*(617) 548-1400

Extended Normal Separator Program  
ENORMSEP

Language - FORTRAN IV  
Hardware - IBM 360-651/168K where K is 1024  
bytes

Separates a polynomial distribution into its component groups where no a priori information is available on the number of modes, their overlap points, or variance. Transformation of frequency distribution by probit analysis, polynomial regression analysis, and program NORMSEP (Hasselblad, 1966). Input: Observed frequency distribution together with values for identification and control purposes. Output: means, variances, and numerical representation of the separated groups.

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Honolulu, HI 96812

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Telephone (808) 946-2181

Single Integration

Language - FORTRAN  
Hardware - IBM 7074

Equally spaced time series data are integrated once using Tick's method. The data must be sampled at a rate of at least twice the Nyquist frequency. Informal report IM No. 66-36. OS No. 66-36. Author - E.B. Ross.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

Available from originator only  
Telephone (301) 763-1449

# CURVE FITTING

## Fits a Smooth Curve SMOOTH

Language - FORTRAN IV  
Hardware - IBM 360-65

Fits a smooth curve between supplied points that passes exactly through those points. Author - Dave Pendleton.

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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## Curve Fitting: Velocity Profile NEWFIT

Language - FORTRAN V  
Hardware - UNIVAC 1108/25K

Fits a velocity profile with a series of curve segments having continuous first derivatives at points of intersection. Output: Printed listings of original data, fitted data, and coefficients of curve segments; also, cards for input to program "Sonar in Refractive Water". NEWFIT is the main routine of the program described in Report AP-PROG-C-8070, "A New Curve-Fitting Program," by Melvin O. Brown, Associated Aero Science Laboratories, Inc., Pasadena, for NUSC, Feb. 1968.

Naval Undersea Center  
Pasadena Laboratory  
3202 E. Foothill Blvd.  
Pasadena, CA 91107

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## Least-Squares Curve Fitting in Two, Three, and Four Dimensions UCF, BCF, TCF

Language - FORTRAN II  
Hardware - CDC 3100

Three subroutines, UCF, BCF, and TCF (for Univariate, Bivariate, and Trivariate Curve Fit), for use in two-, three-, and four-space. Curve coefficients calculated by reduction technique due to P.D. Crout (1941). Output: printout of coefficients, in normalized floating point, and differences curve-to-points, in same format. Satellite subroutine SYMMET is called to solve  $m$  simultaneous equations in  $x$ . BIO Computer Note 68-1-C by F.K. Keyte, Jan. 1968.

Director  
Bedford Institute of Oceanography  
P.O. Box 1006  
Dartmouth, N.S., Canada B2Y 4A2

Copy on file at NODC (Report with listing and documentation)

## Subroutine for Fitting a Least-Squares Distance Hyperplane to Measured Data

Language - FORTRAN V  
Hardware - UNIVAC 1108

A subroutine for modeling measured data in  $k$ -space by a least-squares distance hyperplane, and numerically compared with ordinary least squares. Minimizes the sum of the squares of the perpendicular distances from the points  $X_m$  to the hyperplane model. Input: Points  $X_m = (x_{m1}, x_{m2}, \dots, x_{mk})$  in  $k$ -space, where each component  $x_{m1}$  is in error. Output: Normal form of the hyperplane:  $AX' - p = 0$  ( $AA' = 1$ );  $p$  is the distance from the origin of the coordinate axes to the hyperplane. NUSC/NL Tech. Memo. No. PA4-121-74, "A Computer Subroutine for Fitting a Least Squares Distance Hyperplane to Measured Data," by M.J. Goldstein.

Marvin J. Goldstein  
Naval Underwater Systems Center  
New London, CT 06320

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Telephone (203) 442-0771, ext. 2415

**Fits Polynomial  
P3TERM**

Language - FORTRAN IV  
Hardware - IBM 360-65

This routine fits a polynomial function  $Y(x) = a_0 + a_1x + a_2x^2 + \dots + a_mx^m$  to the data  $(x_1, Y_1), (x_2, Y_2) \dots (x_n, Y_n)$  by using the least squares criterion. The method is very accurate and should perform well for up to a 20-term polynomial and 100 data points.

Jerry Sullivan  
Center for Experiment Design and  
Data Analysis  
Washington, DC 20235

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**Least-Squares Plot**

Language - FORTRAN  
Hardware - IBM 7074

Fits an n-degree polynomial (max. n = 10) or an exponential function to data points (max. 300), plotting the actual curve and the computed curve for comparison or plotting the data points only to help identify the type of curve they represent. OS No. 10112. Author - James S. Warden.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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**Temperature, Salinity Corrections  
CURVFIT N1S512**

Language - FORTRAN  
Hardware - UNIVAC 1108/DEC PDP-9/6K words

Determines corrections for electronically measured temperature and salinity data, using linear and curvilinear regression techniques. Input: Temperatures or salinity data collected simultaneously with electronic sensors, reversing thermometers, and Niskin bottles. Output: Corrections for a range of possible observed values, equations of best fit linear, parabolic, and cubic equations, and standard error of estimate.

Harry Iredale  
U.S. Naval Oceanographic Office  
Washington, DC 20373

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Telephone (202) 433-3257

**Bartlett's Curve Fitting**

Language - FORTRAN  
Hardware - IBM 1800

Bartlett's method for computing the best value for fitting a linear relationship or an exponential relationship. The 70% and 90% confidence limits on the slope are also found. The program takes a maximum of 99 sets of data, each with a maximum of 500 points. NIO Program No. 174. Author - Maureen Tyler.

National Institute of Oceanography  
Wormley, Godalming, Surrey, England

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**Curve Fitting  
CRVFT**

Language - FORTRAN II  
Hardware - GE 225

Finds either best least-squares fit to n points within specified standard deviation "sigma", or fits a specified "M-curve" order curve -- the former executed by M-curve Negative, the latter by M-curve non-negative. In either case "SD" is the actual standard deviation as calculated. BIO Computer Note 66-5-C, Appendix 5; also, a 14-page writeup is in the "COPE" catalog (1965) of the Woods Hole Oceanographic Institution. Author - F.K. Keyte.

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# APPLIED MATHEMATICS

Linear Interpolation  
LININT

Language - PL/1  
Hardware - IBM 360-65/144 (hex) bytes

Computes a linear interpolation on fullword fixed binary integers. Author - Robert Van Wie.

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NOAA/EDS  
Washington, DC 20235

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Lagrangian Three-Point Interpolation  
LAG3PT

Language - PL/1  
Hardware - IBM 360-65

Computes a Lagrangian three-point interpolation; calls subroutine LININT. Author - Robert Van Wie.

Oceanographic Services Branch  
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Calculates Spline Coefficient  
SPLCOF

Language - FORTRAN IV  
Hardware - IBM 360-65

Calculates spline coefficient for use by routine SPLINE. Author - Dave Pendleton.

Oceanographic Services Branch  
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Washington, DC 20235

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Interpolating by Cubic Spline  
SPLINE

Language - FORTRAN IV  
Hardware - IBM 360-65/832 bytes (object form)

Performs interpolation by cubic splines. This method fits a cubic spline between adjacent points while insuring that the first two derivatives remain continuous. The endpoints (X(1) and X(N)) use an extrapolation of the curvature at points X(2) and X(N-1). Author - Dave Pendleton.

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Washington, DC 20235

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Program for Smoothing Data  
Using the Cubic Spline

Language - FORTRAN IV  
Hardware - UNIVAC 1108

Fits measured data with the smoothing cubic spline, using an extension of Reinsch's technique which brings the second derivative of the spline to zero at its end points. The extension allows end conditions on either first or second derivatives. Input: Set of sample data  $(x_i, y_i)$ ,  $i = 0, 1, \dots, n \geq 2$ ;  $x_0 < x_1 < \dots < x_n$  and end conditions on either the first or second derivative and a smoothing parameter  $S \in (N - \sqrt{2N}, N + \sqrt{2N})$  where  $N = n + 1$ . Output: Smoothed data values

$y_1$  and pointwise approximations to the first and second derivatives at the points  $x_1$ . NUSC Tech. Memo. No. PA4-48-74, "On a Computer Program for Smoothing Data Using the Cubic Spline," by M.J. Goldstein.

Marvin J. Goldstein  
Naval Underwater Systems Center  
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Telephone (203) 442-0771, ext. 2415

Solve Algebraic Equations  
MATRIX

Language - USASI FORTRAN  
Hardware - CDC 3300/20K words

Solves  $n$  linear-algebraic equations in  $n$  unknowns, using Cholesky's method.

Alan T. Massey  
Naval Underwater Systems Center  
Newport, RI 02840

Available from originator only  
Telephone (401) 841-4772

Checks Angles  
TWOPI

Language - FORTRAN IV  
Hardware - IBM 360-65/CDC 6600

In the use of angles, this routine assures that any angle remains between  $0^\circ$  and  $360^\circ$ .

Robert Dennis  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

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Trigonometry Subroutines  
ASSUB, SAS, ASA

Language - FORTRAN  
Hardware - IBM 1800

ASSUB calculates trig other side. Input: 1 angle, 2 sides. Output: Two possible side lengths; if either or both returned sides are zero, these values are undefined. SAS calculates other side. Input: Side, angle, side. Output: Length of other side. ASA calculates other two sides. Input: Angle, side, angle. Output: Length of other two sides.

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Available from originator only  
Telephone (714) 452-4194

Inter-Active Calculations  
DSDP/CALC

Language - ALGOL  
Hardware - Burroughs 6700/6K words

Provides inter-active computing abilities for persons with the occasional need to do numerical calculations involving small amounts of data. The user may address either the "definition level" or "evaluation level" of ten independent working spaces in which any number of expressions may be defined. The program can save the total working environment for later use. Input: General arithmetic expressions defined in terms of alpha-numeric identifiers, system intrinsic functions and previously defined expressions. An expression is evaluated by assigning values to the independent variables in either an identifier prompting mode or free-field input mode.

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Deep Sea Drilling Project  
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Available from originator only  
Telephone (714) 452-3526

# DATA REDUCTION, EDITING, CONVERSION, INVENTORY, RETRIEVAL, AND SPECIAL INPUT-OUTPUT

Thermometer Correction  
TCPLO

Language - FORTRAN IV  
Hardware - XDS Sigma 7/12, 500 words/2 tape  
units/CalComp Plotter

Plots thermometer correction curves and prints the calibration data for each thermometer. Formulas used are from "On Formulas for Correcting Reversing Thermometers," by F.K. Keyte.

Mary Hunt  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Thermometer Correction, Depth Computation  
HYD1

Language - HP ASA Basic FORTRAN  
Hardware - HP 2100/HP 2116/12K words/Keyboard/  
CalComp Plotter/Paper tape  
optional

Corrects thermometer readings and computes depth or pressure. Input: Station information, including thermometer readings, and thermometer calibrations. Output: Depth and corrected temperature for each station.

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Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Areal Concentration  
INTEGRATE

Language - FORTRAN IV  
Hardware - IBM 360/3676 bytes

Performs integration of samples taken at discrete depths to produce areal concentrations. Integration is of form  $N[d_{n+1}-d_n][(A_{n+1}+A_n)/2]$  where  $d$  = depth and  $A$  = values of a variable for each of  $N$  depths. Input: Data cards containing sample identification codes and depth values along with substance to be integrated. An unlimited number of depths and variables may be integrated. Output: Printed output includes sample identification codes, list of depths and variable values, a depth-weighted average for each depth interval, and the running sum; punched output includes identification codes and integration from surface to selected depths. "A Computer Program Package for Aquatic Ecologists," by Paul J. Godfrey, Lois White, and Elizabeth Keokosky.

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Cornell University, Fernow Hall  
Ithaca, NY 14850

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Unweighted Averages  
AVERAGE

Language - FORTRAN IV  
Hardware - IBM 360/5824 bytes

Calculates unweighted averages over depth; depths for which data are averaged may be controlled. Input: Data cards with sample identification codes, depth and variables to be averaged; if average is to be controlled by a variable such as thermocline depth, this must also be included. Output: Printed or punched averages of several variables in a form similar to the input data, i.e., one variable after another on each card, thus suitable for use in packaged programs. "A Computer Program Package for Aquatic Ecologists," by Paul J. Godfrey, Lois White, and Elizabeth Keokosky.

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Telephone (607) 256-3120

**Bathymetric Data Reduction**

Language - FORTRAN  
Hardware - IBM 7074

Processes data gathered while navigating with any circular and/or hyperbolic system. Eight options are available pertaining to position conversion, form of input, data smoothing, special corrections, and interpolation of position-dependent values such as contour crossings. OS No. 53559.

Data Systems Office  
U.S. Naval Oceanographic Office  
Washington, DC 20235

Available from originator only

Telephone (301) 763-1449

**Julian Day Conversion**  
JDAYWK

Language - FORTRAN IV  
Hardware - IBM 360-65

Computes the date from the Julian day.

Paul Sabol  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

Available from originator only

Telephone (202) 634-7344

**Julian Date Conversion Routines**  
JULDAY, JULIAN, JULYAN, JULSEC, CESLUJ

Language - FORTRAN IV  
Hardware - IBM 360/CDC 6600/PDP-11

Given the month (1-12), day, and year, JULDAY returns the Julian Day. JULIAN calculates month (in 10-character words) and day, given the year and Julian date. JULYAN calculates month (digital) and day from given year and Julian date. JULSEC yields Julian seconds from Julian day, hour, minute, and second. CESLUJ computes the Julian date, hour, minute, and second, given Julian seconds.

Robert Dennis  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

Available from originator only

Telephone (202) 634-7344

**Day of the Week**  
NDAYWK

Language - FORTRAN IV  
Hardware - IBM 360-65

This subroutine returns the day of the week for any date in the nineteenth or twentieth century. Modifications include conversion of the function to a subroutine so Julian day can be extracted and addition of an array containing an alphanumeric description of the day.

Paul Sabol  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

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**Date Calculations**  
DAYWK, NWDAT, NXTDY, YSTDY

Language - FORTRAN  
Hardware - IBM 1800

Given year (4 digits) and Julian Day (1-366), DAYWK produces the day of the week (1-7, Sun.-Sat.). Given packed date (bits 0-3 month, 4-8 day, 9-15 year), NWDAT produces following date, packed and unpacked. Given day, month, year, NXTDY returns day, month, year of next day. Given packed date, YSTDY produces preceding date (packed).

Michael Moore  
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La Jolla, CA 92037

Available from originator only  
Telephone (714) 452-4194

Julian Day Subroutines  
CLEJL, CLJUL.

Language - FORTRAN  
Hardware - IBM 1800

Both subroutines calculate Julian Day. Input formats vary. CLEJL format, 01 Nov. 70; CLJUL format, day (1-31), year (00-99), month (1-12).

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Time Conversion  
DTIME

Language - FORTRAN  
Hardware - IBM 1800

Calculates hours, minutes, and seconds, given thousandths of hours.

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Current Meter Data Reduction

Language - FORTRAN IV  
Hardware - IBM 1800

Converts data in the form of angular positions of the rotor and compass arcs from Braincon type 316 current meters into values of current speed and direction, tilt direction, N-S and E-W current components and displacements in kilometers from any arbitrary origin. Data are output to lineprinter with column headings and magnetic tape without headings. Author - W.J. Gould.

National Institute of Oceanography  
Wormley, Godalming, Surrey  
United Kingdom

Copy on file at NODC (listing, documentation)

Reduction and Display of Data Acquired  
at Sea

Language - FORTRAN II  
Hardware - IBM 1130/Disk/CalComp 30" plotter

A system of programs (navigation, gravity, topography, magnetics) for the reduction, storage, and display of underway data acquired at sea. A large number of the programs utilize navigation points together with raw digitized geophysical data presented as a time series, where the different data may be read at unequal intervals. Technical Report No. 1, by Manik Talwani, August 1969.

Lamont-Doherty Geological Observa-  
tory  
Columbia University  
Palisades, NY 10964

Available from NTIS, Order No. AD 693 293/LK,  
\$10.00 paper copy, \$2.25 microfiche.

Hydrographic Data Reduction  
TWO FIVE

Language - FORTRAN 63  
Hardware - CDC 3600

Processes raw data to obtain corrected depth, temperature, salinity, and oxygen, as follows: (1) from protected deep-sea reversing thermometer readings, obtains corrected in situ temperature; (2) from unprotected deep-sea reversing thermometer readings, obtains the thermometric depth, corrected for gravity variations and for the mean density of the overlying water column in any ocean; (3) fits least-squares curves to wire length vs. (wire length minus thermometric depth) to determine the accepted depth; (4) calculates salinity from raw salinity readings; (5) calculates dissolved oxygen concentrations from titrations. Report (unpublished manuscript) by Norma Mantyla, Oct. 1970.

Marine Life Research Group  
Scripps Institution of Oceanography  
P.O. Box 1529  
La Jolla, CA 92037

Copy on file at NODC (above report)

Station Data Reduction  
SYNOP

Language - FORTRAN II, FAP  
Hardware - IBM 7094-7040 DCS/25,335 words (main program), 2058 words (subroutines)

Reduces data from raw shipboard observations. Corrects thermometers and computes thermometric depths, wire angle depths, salinities from bridge readings, oxygen values from titrations; then computes sigma-t, oxygen saturation percent, and apparent oxygen utilization. Technical Report No. 181 (M67-8), "Processing of Oceanographic Station Data: A Coordinated Computer-Compatible System," by Eugene E. Collias, Jan. 1968.

Department of Oceanography  
University of Washington  
Seattle, WA 98105

Available from NTIS, Order No. AD 670 472/LK,  
\$5.75 paper, \$2.25 microfiche.

Thermometer Correction  
TCHK2

Language - FORTRAN VI  
Hardware - IBM 1130

Corrects deep-sea reversing thermometers, computes thermometric depths, allows spurious values to be removed from L-Z table, smooths the L-Z table, and punches smoothed depth and observed temperature and salinity and oxygen values onto cards in CODC format. Two other thermometer correction programs are available: TCHK1 uses the L/Z method; TCHK3 computes pressure. FRB Manuscript report No. 1071 (unpublished manuscript), by C.A. Collins, R.L.K. Tripe and S.K. Wong, Dec. 1969.

Pacific Biological Station  
Fisheries Research Board of Canada  
P. O. Box 100  
Nanaimo, B. C. V9R 5K6

Copy on file at NODC (above report)

Read NODC Format Station Data

Language - FORTRAN IV  
Hardware - XDS Sigma 7

READTAPE  
MASTER  
ENVIR  
DETAIL

1,000 words  
200 words  
118 words  
280 words

Subprogram READTAPE reads, unpacks, and returns to the user NODC oceanographic station data records, one station at a time. Subprogram MASTER takes information from master record and returns the information to the calling program. Subprogram ENVIR takes information from the first 24 characters of master or observed detail record and returns the information to the calling program in usable form. Subprogram DETAIL takes the information from an observed detail record and returns to the calling program correct values for all variables and suitable indicators for special conditions. Input to all subprograms: NODC station data on cards or tape.

Mary Hunt  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543

Available from originator only  
Telephone (617) 548-1400

Reads NODC Station Data Tape  
EDIT

Language - FORTRAN IV  
Hardware - IBM 360-65

This subroutine reads a NODC station data tape (120 characters per record), checks the indicators in characters 81-120, sets the decimal points, then prints the master records, observed station data, and standard station data for each station. See program CAPRICORN.

Ruth McMath  
Department of Oceanography  
Texas A&M University  
College Station, TX 77843

Available from originator only

Telephone (713) 845-7432

Converts NODC Format Data to BNDO Format  
TRANSNODC

Language - FORTRAN IV  
Hardware - XDS Sigma 7/2 tape or disk units

This system prepares data in NODC format for introduction into the Poseidon system; header data are listed, stations are selected and separated into cruises with inventories at the cruise level, and output is provided in BNDO format. Report, "Transcodage des donnees NODC."

Mr. Stanislas, BNDO  
Centre National pour l'Exploitation  
des Oceans  
Boite Postale 337  
29273 Brest Cedex, France

Copy on file at NODC.

Telephone 80.46.50, telex 94-627

Converts Data to BNDO Format  
TRANSCOD

Language - FORTRAN IV  
Hardware - XDS Sigma 7/2 tape or disk units

This system prepares data in out-of-house formats for introduction into the Poseidon system; header data are listed, stations are selected and separated into cruises with inventories at the cruise level, and output is provided in BNDO format. Input formats are those of ORSTOM, SHOM, etc.

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Reads BNDO Format Data  
LSTA 1142

Language - FORTRAN IV  
Hardware - XDS Sigma 7

This subroutine is used to read easily the physical, chemical, and biological data in the complex and very flexible BNDO format. Data may be on disk, tape, or cards. After the call, the station is stored in a common area.

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Editing for WHOI format  
SCRUB

Language - FORTRAN IV-H  
Hardware - XDS Sigma 7

Provides several methods by which data stored in WHOI standard format may be edited and tested. Output is the corrected version of the data on 9-track tape. See HISTQ format reference.

Richard E. Payne  
Woods Hole Oceanographic Institution  
Woods Hole, MA 02543.

Available from originator only  
Telephone (617) 548-1400

Mailing Labels  
MAILER

Language - ALGOL  
Hardware - Burroughs 6700/16K words

Generates 4-up peel-off mailing labels on the line printer. Options: Bulk mail handling, sorting by user defined key, rejection of records by user defined key. Input: Addresses on punched cards; privileged information may be included which is not printed.

Peter B. Woodbury  
Deep Sea Drilling Project  
Box 1529  
La Jolla, CA 92037

Available from originator only  
Telephone (714) 452-3526

Fortran Access to Scientific Data  
FASD

Language - FORTRAN II, CODAP-1  
Hardware - CDC 1604/4850 48 bit words

Designed to be used as a subroutine, FASD accomplishes the dual purpose of converting an existing data base to FASD format as well as providing a convenient unpack data handling tool. For user convenience, I/O tape status checking, bit shifting, data bias manipulation, etc., have been absorbed by the package so that raw data can be made immediately available from the FASD pack; or raw data can be packed into the FASD format by a single instruction. Available functions are fixed or floating point READ, WRITE, READ IDENT only, and SKIP. The present data base is NODC station data. Access time is 44 seconds for 1,000 random length observations. A table of pointers is maintained to insure accurate transmission of observation data. The FASD format provides an extremely tight pack of thermal structure data where the observation format consists of an identification (parameters such as position, metering device, station number, date time group) and a temperature profile. The FASD format is not computer word length oriented. Input: (1) Raw data to be packed into the FASD format, or (2) magnetic tape containing data in the FASD format. Output: If input (1), a magnetic tape containing FASD packed data; if input (2), raw data are output to the driving program.

Alan W. Church, Code 80  
Fleet Numerical Weather Central  
Monterey, CA 93940

Copy on file at NODC (listing)

Reproduce and Serialize Deck  
DUPE

Language - FORTRAN IV  
Hardware - CDC 6600

Reproduces, lists, and serializes source or data decks. Program options allow reproduction without serialization and up to 999 reproductions and listings of the input deck. Input may be any standard FORTRAN or alphanumeric punch deck.

Jack Foreman  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

Available from originator only  
Telephone (202) 634-7344

Flags Suspicious Data Values  
EDITQ

Language - FORTRAN IV  
Hardware - IBM 360-65

EDITQ is designed as a computationally fast and efficient means of flagging suspiciously large or small values in a series of data. The data series is fitted with a least-squares fit straight line under the assumption that the programmer limits the length of the data series to regions sufficiently small so that the straight line is locally a good approximation to the trend.

Donald Acheson  
Center for Experiment Design and  
Data Analysis, NOAA/EDS  
Washington, DC 20235

Available from originator only

Telephone (202) 634-7286

Format Free Input Subroutine  
QREAD

Language - FORTRAN  
Hardware - IBM 1800

A format free input subroutine for cards or other sources. Input: Integer array with first eight variables set to determine input.

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La Jolla, CA 92037

Available from originator only

Telephone (714) 452-4194

Meters vs. Fathoms  
MATBL

Language - FORTRAN  
Hardware - IBM 1800/16K words

Produces table of corrected depths in meters vs. raw fathoms.

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A File-Independent, Generalized Application  
System, GAS

Language - FORTRAN IV-G, Assembler, PL/1-F  
Hardware - IBM 360-65

Development of GAS was based on the following premises: (1) most files of oceanographic data consist of identification fields (location, date, etc.), an independent variable (perhaps water depth or time), and one or more dependent variables (e.g., water temperature or dissolved oxygen); (2) a system could be designed to treat these items uniformly, i.e., instead of tailoring programs to a discrete data file, the basic units could be extracted and transmitted to a generalized applications system from which many products could be derived. As a result, GAS has "n" number of applications programs, rather than a theoretical maximum of "n" times the number of files. Only one extra program was necessary -- the conversion module which provides a link between the various data files and the GAS system. The system of applications programs is tailored to an intermediate file created by this conversion module. Version 1 of the conversion module can access the files for Nansen casts, mechanical bathythermographs (BT), and expendable bathythermographs (XBT); soon to be added are the continuous salinity-temperature-depth (STD) file, ICES ocean surface reference file, and data from cooperative oceanographic research projects.

Application / Display  
Program

File-Access  
Subprogram

Conversion  
Program

File-Create Subprogram

Following are descriptions of individual programs and subroutines:

GASDIPBS reads the NODC GAS file and, on one pass of the data, produces any one of three different printouts, depending on the control card entry. Author - Gary Keull (44K, FORTRAN IV-G).

GASSAMPC prints the first three and the last basic master records only of a GAS formatted data set and gives a record count. Author - Gary Keull (38K, FORTRAN IV-G).

GASEINV prints out a geographic inventory of GAS data by ten-degree square, one-degree square, and month, and gives counts of all one degrees and ten degrees and a total number of stations processed. Author - Gary Keull (40K, FORTRAN IV-G).

GASCCI reads GAS records and prints out country code, reference identification number, and from add to consec numbers. Also gives a total station count. Author - Gary Keull (40K, FORTRAN IV-G).

GASVAPRT reads the output of the program GASVASUM and prints vertical array summaries. Author - Walter Morawski (48K, FORTRAN IV-G).

GVAREFRM takes the GAS vertical array summary programs summed records and produces a 110 character output record. Author - Gary Keull (30K, FORTRAN IV-G).

GASTHERM computes the depth of the thermocline and mixed layer if desired. Also outputs a temperature gradient analysis. Author - Walter Morawski (40K, Assembler).

GASMASK reads the basic and supplementary master information and produces a detailed printout of master information and headings for each station. Author - Judy Yavner (100K, PL/1-F).

INDATA reads GAS records and transfers all the fields present into a common area in core of the calling program. With each call to this subroutine, all master and independent-dependent parameter pairs are transferred to the common area. Author - Walter Morawski (748 bytes (object form), Assembler).

Subroutine CANADA computes Canadian ten-degree, five-degree, two-degree, one-degree, and quarter-degree squares from latitude and longitude degrees and minutes. Authors - Walter Morawski and Gary Keull (5K, FORTRAN IV-G).

Subroutine CREATE creates GAS records when called from a user's program. Author - Walter Morawski (630 bytes (object form), Assembler).

GAS accesses the major files of NODC and creates records compatible with the GAS system. Author - Walter Morawski (96K, FORTRAN IV-G).

MONTH80 selects all stations with a month entry that corresponds to a particular control card entry. Author - Gary Keull (44K, Assembler).

CHEM80 selects all stations with a non-zero chemistry percentage that corresponds to a control card entry. Author - Gary Keull (44K, Assembler).

DEPTH80 selects all stations with a maximum depth greater than the control card entry. Author - Gary Keull (24K, Assembler).

LATLON80 selects an area based on latitude and longitude degrees and minutes entered in a control card. Author - Gary Keull (44K, Assembler).

GASORDER selects certain GAS records (specified by cruise and consec numbers) from an input tape and inserts a sort-order number in an unused area. The output, when sorted on this order number, will be in whatever order the user has specified on the control cards. Author - Walter Morawski (38K, Assembler).

GASVASUM reads GAS type 1, 2, or 3 records and produces three output GAS format records that contain a vertical array summary. (Depth, Max, Avg, Min, Number, Standard Deviation). Summaries are at NODC standard levels, five meter intervals, or ten meter intervals, depending on the input. Author - Walter Morawski (86K, FORTRAN IV-G).

ALTERGAS reads a primary GAS file and finds matches to these records in an auxiliary GAS file. Before outputting, records may be altered and a single file of records may be altered in any way. Author - Walter Morawski (90K, FORTRAN IV-G).

GASB accesses several major files at NODC and creates records compatible with GAS. Author - Walter Morawski (90K, FORTRAN IV-G with Assembler input-output routines).

NODCSQ takes the latitude and longitude fields from the GAS master fields and computes the NODC ten-degree, five-degree, two-degree, one-degree, quarter-degree, and six-minute squares and replaces them into the master field arrays. Author - Walter Morawski (2K, FORTRAN IV-G).

NAMES prints the names of the dependent and independent parameters of the GAS system. At present, there are 29 names which may be printed all at once or singularly; this subroutine is used in program GASDIPBS for output type 2 listings. Author - Gary Keull (28K, FORTRAN IV-G).

SD2GAS accesses the NODC SD2 (station data 2) file, selects upon various criteria, and outputs GAS records of various types; user may at same time output regular SD2 records for use by non-GAS programs. The following options are available:

- A. Standard and/or observed depths only will be returned;
- B. If a value is missing at a particular level, it may be interpolated;
- C. Doubtful and questionable data may or may not be included;
- D. Chemistry values may be shifted to NODC prescribed nearest standard levels.

Output formats available:

- 1 Basic GAS master fields;
- 2 Basic GAS master fields and all supplementary fields present;
- 0 Basic GAS master fields and one independent-dependent parameter pair;
- 1 Basic GAS master fields and parameter pairs at five-meter intervals;
- 2 Basic GAS master fields and parameter pairs at ten-meter intervals;
- 3 Basic GAS master fields and parameter pairs at Nansen levels;
- 4 Basic GAS master fields and parameter pairs whenever they appeared in that particular record;
- 5 Basic GAS master fields and parameter pairs at depth intervals specified by the user.

Author - Walter Morawski (96K, FORTRAN IV-G).

GASSCUDS summarizes SCUDS (surface current-ship drift) records by area, ten-degree, five-degree, two-degree, one-degree, quarter degree, one-tenth-degree squares, year, month, or day. Outputs produced are optional. Variations include two print formats or two tape formats. Parameters include all geographic information, month, year, day, north and east components, resultant speed and direction, total observations, number of calms, max and mean speeds, and standard deviation. Also available is a distribution of individual observations by speed and direction. Authors - Gary Keull and Walter Morawski (80K, FORTRAN IV-G).

Oceanographic Services Branch  
National Oceanographic Data Center  
NOAA/EDS  
Washington, DC 20235

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Telephone (202) 634-7439

Other NODC Programs

Hardware - IBM 360-65

#### STD Data:

STDRETV retrieves records from the STD geofile; sections are made on the basis of optional select fields; with one exception, these select fields are located in the master records. Author - Robert Van Wie (Assembler).

#### Station Data:

SD2TOSD1 converts station data from SD2 variable length record to SD1 80 or 83 byte records. Author - Walter Morawski (36K bytes, Assembler).

SDCHAR processes a series of 83 byte records to construct a one-record-per-station file of variable length character records. Author - Robert Van Wie (92K bytes, PL/1).

SDPRT2 produces an edited listing of the SD2 variable length record or data in the 80 byte format. Author - Sally Heimerdinger (36K bytes, Assembler).

SDSELECT selects SD1 records by Marsden square, one-degree square, or card type. Author - Michael Flanagan (24K bytes, Assembler).

SD2MSTCT counts the number of SD2 records and prints the first 50 records and the last record. Author - Elmer Freeman (50K bytes, Assembler).

SD2SAMP selects five records from SD2 tape; used to give users a sample of SD2 data. Author - Walter Morawski (36K bytes, Assembler).

SDGEOIV reads SD2 master file and summarizes the number of stations by month, year, one-degree square, five-degree square, and modified Canadian (ten-degree) square; best results are obtained when running against a geographically sorted file. Author - Michael Flanagan (14K bytes, PL/1).

MAKE120 converts an 80 or 83 byte record from the NODC station data geofile to the 120 character zone-edit format for the IBM 7074. Author - Walter Morawski (36K bytes, Assembler).

DEPTH selects full station data records with depths greater than a given hundred-meter interval. Author - J. Gordon (17K bytes, Assembler).

CRUCON reads either the SD2 file or SD2 master file and prints the NODC cruise consec number inventory. Author - Walter Morawski (36K bytes, Assembler).

CODCCONV converts station data in the format of the Marine Environmental Data Service (formerly CODC - Canadian Oceanographic Data Center) to the NODC format. A table of control cards is required to convert the Canadian cruise reference numbers to the NODC system. Author - Walter Morawski (24K bytes, Assembler).

SUPERSEL selects from the SD2 geofile or master file by Canadian (ten-degree) square. Input file is sorted in Canadian square order; output is identical in format, but contains only the data from the desired Canadian squares. Author - Walter Morawski (36K bytes, Assembler).

SDPASS retrieves SD2 records from either the cruise-sorted file, the geosorted file, or the master file. Output is on one of four formats: (1) the original variable length record; (2) a series of 80 byte fixed-length records; (3) 105 byte fixed-length records; (4) undefined records. Author - Robert Van Wie (Assembler).

#### Expendable Bathythermograph Data:

XORDER selects XBT data by cruise consec number, inserts a sort number in an unused space; the output, when sorted on this number, will be in whatever order was specified by the user on control cards. Author - Walter Morawski (36K bytes, Assembler).

XBEVALU compares production with standard sample XBT's; sorts input by reference number and consec number before testing and evaluation; prints evaluation statistics. Author - Michael Flanagan (PL/1).

XBTQKOUT enables the user to choose the type of XBT output and the mode of output. Author - Philip Hadsell (60K bytes, FORTRAN IV-G).

XBCONV converts data from seven-track tapes in old NODC XBT format to new NODC format suitable for nine-track tape. Input: Contractor-processed XBT's. Output on disk. Author - Pearl Johnson (56K bytes, PL/1-4).

XBTCOUNT gives a station count of XBT data from either the cruise file or the geofile. Author - Elmer Freeman (Assembler).

XBFNWC, run after XBFNWSUM, reads control cards providing cruise and other master information and, for each cruise, converts (or deletes) Fleet Numerical Weather Central XBT data to the NODC XBT tape record format. Author - Judy Yavner (50K bytes, PL/1).

XBFNWSUM provides a summary of the cruises contained on a file of XBT data from Fleet Numerical Weather Central. Author - Judy Yavner (22K bytes, PL/1).

XBSELECT retrieves from the XBT data file by inputting the desired FORTRAN "if" statements. Author - Philip Hadsell (9K bytes, FORTRAN IV-G).

RETXBT retrieves records from the XBT cruise file or the XBT geofile. Author - Robert Van Wie (Assembler).

XBTCONV converts the XBT binary-character formatted records to an undefined all-character record with a maximum length of 2500 bytes; primarily used to satisfy requests for XBT data on seven-track tape. Author - Sally Heimerdinger (650 bytes plus 2 times the sum of the buffer lengths, Assembler).

XBMSINV, using the subroutine XBREAD, reads cruise-ordered XBT data and produces a summary of each cruise (one line per cruise), indicating the NODC cruise number, the number of observations per cruise, the beginning and ending dates, the NODC ship code, and the originator's cruise number. Author - Philip Hadsell (FORTRAN).

XBGEOSUM prints a summary of the number of observations within given seasons, one-degree squares, ten-degree squares, and quadrants. Author - Philip Hadsell (80K bytes, FORTRAN IV-G).

Mechanical Bathythermograph Data:

RETBAT retrieves records from the BT cruise file or the BT geofile. Author - Robert Van Wie (Assembler).

BTLISTC provides edited printout with headings of the NODC geographically-sorted bathythermograph file. Author - Michael Flanagan (2600 bytes, Assembler).

BTGEOIV reads the bathythermograph file, summarizes the number of stations by month, year, one-degree square, five-degree square, and Marsden square. Author - Charlotte Sparks (14K bytes, PL/1).

Other NODC programs:

SCHNINE prints data from H1-9 surface current file; produces simultaneously any one of the following combinations: (1) edited listing of the entire file; (2) edited listing and punched cards, both for the entire file; or (3) edited listing, unedited listing, and magnetic tape, all for only the first 100 records. Author - Rosa T. Washington (Less than 56K bytes, PL/1).

SCMULTI outputs surface current data in any one of the following combinations: (1) edited listing of the entire file; (2) edited listing and punched cards for the entire file; or (3) edited listing, unedited listing, and magnetic tape, all for only the first 100 records. Author - Rosa T. Washington (72K bytes, PL/1).

DRYLAND reads a sequential tape file and identifies any one-degree square which is completely on land. Author - Robert Van Wie (30K bytes, PL/1).

CANWMO computes a WMO square, given a Modified Canadian square. Requires subroutines GRIDSQ, TENSQ, and WMO. Author - Robert Van Wie (FORTRAN).

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Reformatted Station Output      Language - FORTRAN  
IBM 1      Hardware - IBM 370

Outputs formatted hydrographic and nutrient chemical data by station; input is NOAA format raw data. Author - Stephen A. Macko.

B.J. McAlice  
Ira C. Darling Center (Marine Laboratory)  
University of Maine at Orono  
Walpole, ME 04573

Available from originator only  
Telephone (207) 563-3146

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68	FORTRAN	B 6700	BIOMETRY-BASIC STATISTIC FOR GROUPED DATA
68	FORTRAN	B 6700	BIOMETRY-SINGLE CLASSIFICATION ANOVA
68	FORTRAN	B 6700	BIOMETRY-FACTORIAL ANOVA TCSO2
69	FORTRAN	B 6700	BIOMETRY-SUM OF SQUARES STP TCSO3
69	FORTRAN	B 6700	BIOMETRY-STUDENT-NEWMAN-KEULS TEST TCSO4
69	FORTRAN	B 6700	BIOMETRY-TEST OF HOMOGENEITY
69	FORTRAN	B 6700	BIOMETRY-TEST OF EQUALITY
70	FORTRAN	B 6700	BIOMETRY-TUKEY'S TEST
70	FORTRAN	B 6700	BIOMETRY-KRUSKAL-WALLIS TEST TCSE4
70	FORTRAN	B 6700	BIOMETRY-FISHER'S EXACT TEST TCSE5
71	FORTRAN	B 6700	BIOMETRY-R X C TEST OF INDEPENDENCE MAP
29	FORTRAN		NUMERICAL MCL ESTUARY DYNAMICS & KINEMATICS
28	FORTRAN		SALINITY DISTRIBUTION IN ONE-DIMENSIONAL ESTUARY
1	FORTRAN	HP 2115A	DIGITIZES STC DATA DEEP
2	FORTRAN	HP 2115A	STD PROCESSING WET
58	FORTRAN	B 6700	NORMAL DISTRIBUTION SEPARATOR TCPA1
58	FORTRAN	B 6700	SPAWNER-RECRUIT CURVE FITTING TCPA2
58	FORTRAN	B 6700	WEIGHT-LENGTH CURVE FITTING TCPA3
59	FORTRAN	B 6700	AGE COMPOSITION ESTIMATION TCPB1
59	FORTRAN	B 6700	ESTIMATE CATCH NUMBERS PERCENT WEIGHT
59	FORTRAN	B 6700	LENGTH-FREQUENCY DISTRIBUTION
60	FORTRAN	B 6700	VON BERTALANFFY GROWTH CURVE FITTING TCPCL
60	FORTRAN	B 6700	VON BERTALANFFY GROWTH UNEQUAL AGE INTERVAL
60	FORTRAN	B 6700	VON BERTALANFFY GROWTH EQUAL AGE INTERVAL
61	FORTRAN	B 6700	VON BERTALANFFY GROWTH CURVE FITTING TCPCL4
64	FORTRAN	B 6700	ESTIMATION OF LINEAR GROWTH
61	FORTRAN	B 6700	FISHING POWER ESTIMATION TCPD1
62	FORTRAN	B 6700	SURVIVAL RATE ESTIMATION TCPE1
63	FORTRAN	B 6700	FISHING MORTALITIES ESTIMATION TCPE2
63	FORTRAN	B 6700	RELATIVE YIELD PER RECRUIT
17	FORTRAN	CDC 6600	INTERNAL WAVE OSCILLATIONS ZMODE
17	FORTRAN	CDC 7600	INTERNAL WAVE OSCILLATIONS ZMODE
87	FORTRAN	CDC 6400	PYRANOMETER AND RALICMETER TIME SERIES RAC
152	FORTRAN	IBM 360/65	XBTQKUT
18	FORTRAN	IBM 360/65	ISENTROPIC INTERPOLATION
18	FORTRAN	IBM 360/65	SIGMAT

18 FORTRAN	IBM 360/65	SALINITY FROM CONDUCTIVITY T P SALINE
19 FORTRAN	IBM 360/65	VOLUME TRANSPORT FUNCTION QFUN
22 FORTRAN	IBM 360	CO2 AND DC SAT
97 FORTRAN	IBM 360/65	SOUND VELOCITY WILSONS FORMULA WLSND
97 FORTRAN	IBM 360/65	SOUND VELOCITY WILSONS FORMULA SVELFS
97 FORTRAN	IBM 360/65	SOUND VELOCITY WILSONS FORMULA VELPRS
116 FORTRAN	CDC 3300	VERTICAL BAR GRAPHS
4 FORTRAN	IBM 360/50	CONSISTENCY OF PHYSICAL AND CHEMICAL DATA
4 FORTRAN		CALCULATION OF THERMOMETRIC VALUES
4 FORTRAN		STATIC DATA SYSTEM FINAL VALUES
102 FORTRAN		RAY TRACING KLERER-MAY USER LANGUAGE
135 FORTRAN	IBM 7090	FOURIER ANALYSIS L101
134 FORTRAN	IBM 7090	TWO-DIMENSIONAL AUTOCORRELATION
134 FORTRAN	IBM 1401	TWO-DIMENSIONAL AUTOCORRELATION
118 FORTRAN	CDC 3100	SECTION PLOTTING
118 FORTRAN	PDP-8	SECTION PLOTTING
79 FORTRAN	CDC 3150	CURRENT METER DATA PROCESSING SYSTEM TIDE
135 FORTRAN	IBM 7074	LEAST SQUARES PLOT
139 FORTRAN	UNIVAC 1108	TEMPERATURE SALINITY CORRECTIONS CURVEFIT N19512
139 FORTRAN	PDP-9	BARTLETT'S CURVE FITTING
121 FORTRAN		PRODUCES CANTCUR CHARTS GRICIT
121 FORTRAN		PRODUCES CANTCUR CHARTS AUTOMATED CONTROL
100 FORTRAN	IBM 7074	CRITICAL ACUSTIC RATIO
97 FORTRAN	UNIVAC 1108	SOUND VELOCITY FOR MARINE SEDIMENTS
98 FORTRAN	IBM 7074	LIGHT AND SOUND INSTRUCTION B
45 FORTRAN	IBM 7074	LIGHT AND SOUND INSTRUCTION D
144 FORTRAN	IBM 7074	BATHYMETRIC DATA REDUCTION
14 FORTRAN	IBM 7074	MONTHLY SONIC LAYER DEPTH
14 FORTRAN	IBM 7074	VERTICAL TEMPERATURE GRADIENTS
137 FORTRAN	IBM 7074	SINGLE INTEGRATION
111 FORTRAN	IB7 7074	GEODETTIC DATUM REDUCTION
111 FORTRAN	IB7 7074	GEODETTIC POSITION COMPUTATION AND PLOT
111 FORTRAN		ASTRONOMIC LATITUDE
112 FORTRAN	CDC 3100	SOUNDING PLOT
112 FORTRAN	IBM 7074	SCOUNDING PLOT
112 FORTRAN	IBM 7074	SINGLE INTEGRATION
112 FORTRAN	CDC 3100	SOUNDING INVERSE
89 FORTRAN	IBM 7074	SOLAR RADIATION CONVERSION
89 FORTRAN	IBM 7074	WIND STRESS
89 FORTRAN	IBM 7074	TWO-DIMENSIONAL POWER SPECTRUM FOR SWOP II
90 FORTRAN	IBM 7074	PREDICTION OF VERTICAL TEMPERATURE CHANGE
90 FORTRAN	IBM 7074	CLOUD COVER AND DAILY SEA TEMPERATURE
46 FORTRAN	IBM 7074	SEAMOUNT MAGNETIZATION
46 FORTRAN	IBM 7074	OBSERVATION DRAPING GRAVITY
48 FORTRAN	UNIVAC 1108	SEDIMENT SIZE
76 FORTRAN	IBM 7074	CURRENT METER TURBULENCE
76 FORTRAN	UNIVAC 1108	WATER DISPLACEMENT DISPLA
105 FORTRAN	UNIVAC 1108	FAA PLOT
109 FORTRAN	UNIVAC 1108	DISTANCE AND AZIMUTH CIRAZD
109 FORTRAN	UNIVAC 1108	PARAMETRIC MAP
110 FORTRAN	UNIVAC 1108	LORAN TC GEOGRAPHIC AND/GEOPHIC TC LCRAN
110 FORTRAN	UNIVAC 1108	LORAN COORDINATE COMPUTATION
110 FORTRAN	UNIVAC 1108	LORAN SKYWAVE CORRECTION
15 FORTRAN	CDC 3200	INTERPOLATION FOR OCEANOGRAPHIC DATA
15 FORTRAN	IBM 1620	INTERPOLATION FOR OCEANOGRAPHIC DATA
75 FORTRAN	CDC 3300	CURRENT METER DATA CREATE-C
75 FORTRAN	CDC 3300	CURRENT METER DATA CURRENT
75 FORTRAN	CDC 3300	CURRENT METER DATA CURRLOT
75 FORTRAN	CDC 3300	CURRENT METER DATA SPECTRUM
93 FORTRAN	CDC 6400	HORIZONTAL RANGE
120 FORTRAN	CDC 3800	LINE PRINTER PLOTS
16 FORTRAN	CDC 3800	INTERNAL GRAVITY WAVES DISPER

107	FORTTRAN	CDC 3800	ANNCTATED TRACK ON STEREOGRAPHIC PROJECTION
89	FORTTRAN	CDC 3800	MIE SCATTERING COMPUTATIONS
47	FORTTRAN	CDC 3600	PLOTS TRACK AND DATA PROFILE TRACK
47	FORTTRAN	CDC 3800	PLCTS TRACK AND DATA PROFILE TRACK
47	FORTTRAN	CDC 3800	GECDATA
47	FORTTRAN	CDC 3600	GECDATA
47	FORTTRAN	CDC 3600	MAGNETIC SIGNATURES MAGPLOT
47	FORTTRAN	CDC 3800	MAGNETIC SIGNATURES MAGPLOT
107	FORTTRAN	CDC 3600	ANNCTATED TRACK ON STEREOGRAPHIC PROJECTION
125	FORTTRAN	UNIVAC 1108	SPECTRAL ANALYSIS SUBROUTINES
47	FORTTRAN	UNIVAC 1108	TRUE CCEAN DEPTH FATHCR
142	FORTTRAN	CDC 3300	SOLVE ALGEBRAIC EQUATIONS MATRIX
121	FORTTRAN	CDC 3300	PHYSICAL DATA PLCT FRAME
99	FORTTRAN	CDC 3300	ACOUSTIC PERFORMANCE AND EVALUATION
94	FORTTRAN	CDC 3300	SOUND REFRACTICN CCRRECTIONS FITIT
15	FORTTRAN		SIGMA-T INVREJ
15	FORTTRAN		STD PROCESSING CCEANDATA
15	FORTTRAN		INTERNAL WAVES WITCCMB
84	FORTTRAN	IBM 360/165	WAVE INTERACTION WITH CURRENT CAPGRAY
24	FORTTRAN	IBM 370/165	ESTUARINE MODEL NGMLNRA
26	FORTTRAN	CDC 6400	UPWELLING CSTLUPWL
126	FORTTRAN	CDC 3300/OS3	TIME SERIES ARAND ACFFT
126	FORTTRAN	CDC 3300/OS3	TIME SERIES ARAND ACORR
126	FORTTRAN	CDC 3300/OS3	TIME SERIES ARAND ACRPLT
126	FORTTRAN	CDC 3300/OS3	TIME SERIES ARAND ALIGN
126	FORTTRAN	CDC 3300/OS3	TIME SERIES ARAND APPACD
1	FORTTRAN I	IBM 1620	TRANSPORT COMPUTATIONS FROM ATMOSPHERIC PRESSURE
146	FORTTRAN II	IBM 7094	STATION DATA REDUCTION SYNOP
5	FORTTRAN II	PDP 8E	MASS TRANSPORT AND VELOCITIES GEOMASS
79	FORTTRAN II	IBM 1620	PRCCESSES CURRENT INSTRUMENT OBSERVATIONS
94	FORTTRAN II	UNIVAC 1108	BOTTOM REFLECTIVITY
148	FORTTRAN II	CDC 1604	FORTTRAN ACCESS TO SCIENTIFIC DATA FASD
48	FORTTRAN II	IBM 1620	SOIL AND SEDIMENT ENGINEERING TEST DATA
145	FORTTRAN II	IBM 1130	REDUCTION AND DISPLAY CF DATA ACQUIRED AT SEA
101	FORTTRAN II	IBM 7090	ACOUSTIC RAY TRACING
138	FORTTRAN II	CDC 3100	LEAST SQUARES CURVE FITTING 2 3 & 4 DIMENSICNS
139	FORTTRAN II	GE 225	CURVE FITTING CRVFT
2	FORTTRAN II	CDC 3100	SALINITY ANCMALY ISALBP
3	FORTTRAN II	CDC 3100	OXYGEN SATURATION CXYGEN ANGMALY ISATBP
3	FORTTRAN II	PDP-8	PLCT THETA-S CURVES
3	FORTTRAN II	CDC 3100	PLCT THETA-S CURVES
3	FORTTRAN II	CDC 3100	PLCTS STATION PCSITICNS
3	FORTTRAN II	PDP-8	PLCTS STATION POSITIONS
3	FORTTRAN II	CDC 3150	NUTRIENT CONCENTRATION PEAKS
91	FORTTRAN II	GDC 160A	ICE DRIFT ANALYSIS/FORECAST
110	FORTTRAN II	IB7 7074	INDIVIDUAL PCINT GENERATOR FOR MAP PROJECTIONS
111	FORTTRAN II	IB7 7074	INDIVIDUAL PCINT GENERATOR FOR DISTANCE
39	FORTTRAN IV	CDC 3300	GEOPHYSICAL DATA REDUCTION AND PLOTTING
39	FORTTRAN IV	CDC 3300	PROCESSING/DISPLAY MARINE GEOPHYSICAL DATA
39	FORTTRAN IV	CDC 3300	MARINE SEISMIC DATA REDUCTION AND ANALYSIS
39	FORTTRAN IV	CDC 3300	A LIBRARY CF GEOPHYSICAL SUBROUTINES GLIB
7	FORTTRAN IV	IBM 360/65	REAC CALC INTERP STATION DATA CAPRICORN
7	FORTTRAN IV	IBM 360/65	STATION DATA CALCULATIONS F3
8	FORTTRAN IV	IBM 360/65	PLCTS STATION DATA PLTEDT
8	FORTTRAN IV	IBM 360/65	CALCULATES STATION DATA SECPG
103	FORTTRAN IV	IBM 360/65	PLCTS MAPS GRIDS TRACKS MAP
5	FORTTRAN IV	B 6700	CCEANCGRAHY STATION CCMPUTER PROGRAM
25	FORTTRAN IV	IBM 360	DYNAMIC DETERMINISTIC SIMULATION SIMUDELT
83	FORTTRAN IV	IBM 360/75	WAVE BCTTCM VELCCITY
91	FORTTRAN IV	IBM 7090-94	SEA ICE STUDIES YARIT
91	FORTTRAN IV	IBM 7090-94	SEA ICE STUDIES FLIP.
91	FORTTRAN IV	IBM 7090-94	SEA ICE STUDIES SALPK

91	FORTTRAN	IV	IBM 7090-94	SEA ICE STUDIES RITS
38	FORTTRAN	IV	CDC 6600	CONVECTION INVARIABLE VISCOSITY FLUID CCNVEC
116	FORTTRAN	IV	CDC 3600	PLGTTING PRCGRAM PRCFI
2	FORTTRAN	IV	CDC 660Q	STD DATA PRCCSSING
25	FORTTRAN	IV	IBM 360/65	MIT SALINITY INTRUSION PROGRAM
28	FORTTRAN	IV	IBM 370	ESTUARINE CHEMISTRY MYACHEM
28	FORTTRAN	IV	IBM 370	ESTUARINE TIDES
24	FORTTRAN	IV	UNIVAC 1108	THREE DIMENSIONAL ESTUARINE CIRCULATION MODEL
50	FORTTRAN	IV	UNIVAC 1108	INVERSE PROBLEM IN ECOSYSTEM ANALYSIS
5	FORTTRAN	IV	PDP 10	STATION DATA THIRP
5	FORTTRAN	IV	PDP 10	THERMOMETER CORRECTION THERMOMETRIC DEPTH
147	FORTTRAN	IV	IBM 360/65	READS NCDC STATION DATA TAPE
51	FORTTRAN	IV	CDC 6600	PRODUCTIVITY OXYGEN
52	FORTTRAN	IV	CDC 6600	SPECIES DIVERSITY JCB
52	FORTTRAN	IV	CDC 6600	PRODUCTIVITY ECOPROD
27	FORTTRAN	IV	CDC 6400	THREE-DIMENSIONAL SIMULATION PACKAGE AUGUR
52	FORTTRAN	IV	IBM 7094	CONCENTRATIONS PER SQUARE METER OF SURFACE
118	FORTTRAN	IV	XDS SIGMA 7	HCRIZNTAL HISTOGRAMS HISTO
118	FORTTRAN	IV	XDS SIGMA 7	PRINTER PLCTS LISPLC
119	FORTTRAN	IV	XDS SIGMA 7	PLOT OF FREQUENCY DISTRIBUTION THISTO
119	FORTTRAN	IV	XDS SIGMA 7	VELOCITY VECTOR AVERAGES VECTAV
119	FORTTRAN	IV	XDS SIGMA 7	PROGRESSIVE VECTORS PROVEC
119	FORTTRAN	IV	XDS SIGMA 7	PLOTS DATA ALCNG TRACK
119	FORTTRAN	IV	XDS SIGMA 7	PROFILE VERSUS TIME OR DISTANCE
120	FORTTRAN	IV	HP MINI	PLOTS NAVIGATION WITH ANY OTHER DATA TYPE DEEP6
102	FORTTRAN	IV	XDS SIGMA 7	RAYTRACE
97	FORTTRAN	IV	XDS SIGMA 7	SOUND VELOCITY SONVEL
97	FORTTRAN	IV	XDS SIGMA 7	DEPTH CORRECTION MICOR SOUND VELOCITY
148	FORTTRAN	IV	XDS SIGMA 7	EDITING FOR WHOI FORMAT SCRUB
143	FORTTRAN	IV	XDS SIGMA 7	THERMOMETER CORRECTION TCPLC
8	FORTTRAN	IV	HP 2100	STATION DATA HYD2
8	FORTTRAN	IV	XDS SIGMA 7	BRUNT-VAISALA FREQUENCY OBVFRQ
9	FORTTRAN	IV	XDS SIGMA 7	DYNAMIC HEIGHT DYNHT
9	FORTTRAN	IV	XDS SIGMA 7	POTENTIAL ENERGY ANOMALY PEN
9	FORTTRAN	IV	XDS SIGMA 7	VARIOUS PARAMETERS FROM STATION DATA OCCOMP
9	FORTTRAN	IV	XDS SIGMA 7	SPECIFIC VOLUME ANLMALY SVANOM
9	FORTTRAN	IV	XDS SIGMA 7	PRESSURE SUBRCUTINE PRESS
10	FORTTRAN	IV	XDS SIGMA 7	READS STATION DATA
10	FORTTRAN	IV	XDS SIGMA 7	GESTROPHIC VELOCITY DIFFERENCE VEL
10	FORTTRAN	IV	XDS SIGMA 7	VOLUME TRANSPORT VTR
10	FORTTRAN	IV	XDS SIGMA 7	SIGMA-T SIGMAT AND DSIGMT
52	FORTTRAN	IV	CDC 6400	COMBINED CHLOROPHYLL AND PRODUCTIVITY
53	FORTTRAN	IV	IBM 7094	PHYTOPLANKTON NUMBERS VOLUME SURFACE AREA
134	FORTTRAN	IV	UNIVAC 1108	SPECTRAL ANALYSIS OF TIME SERIES
136	FORTTRAN	IV	IBM 370	PRECIPABILITY CISTRIBUTION WEIBUL
56	FORTTRAN	IV	IBM 370	RESOURCES ALLCCATION IN FISHERIES MGT PISCES
56	FORTTRAN	IV	IBM 370	WATER RESOURCES TEACHING GAME DAM
25	FORTTRAN	IV	IBM 1130	BEACH SIMULATION MDEL
25	FORTTRAN	IV	IBM 1130	BEACH AND NEARSHORE MAPS A-S
113	FORTTRAN	IV	IBM 360/65	NGS SCIENTIFIC SUBROUTINE SYSTEM ANGLE
93	FORTTRAN	IV	CDC 1604	SCUND SCATTERING BY ORGANISMS SKAT
72	FORTTRAN	IV	CDC 6500	THERMAL PELLTICN MDEL
72	FORTTRAN	IV	CDC 1604	THERMAL PELLTICN MDEL
134	FORTTRAN	IV	IBM 360	TIME SERIES ANALYSIS BLACKY
83	FORTTRAN	IV	CDC 6500	FRENCH SPECTRC-ANGULAR WAVE MODEL
83	FORTTRAN	IV	CDC 7600	FRENCH SPECTRC-ANGULAR WAVE MODEL
83	FORTTRAN	IV	CDC 3100	SURF PREOICTICN MDEL
24	FORTTRAN	IV	CDC 6500	MULTI-LAYER HYDRODYNAMIC-NUMERICAL MODEL
24	FORTTRAN	IV	CDC 7600	MULTI-LAYER HYDRODYNAMICAL-NUMERICAL MDEL
24	FORTTRAN	IV	CDC 6500	SINGLE LARGE HYDRODYNAMICAL-NUMERICAL MDEL
24	FORTTRAN	IV	IBM 360	SINGLE LARGE HYDRCLYNICAL-NUMERICAL MDEL
88	FORTTRAN	IV	CDC 6500	HURRICANE HEAT POTENTIAL MODEL

88	FORTTRAN IV	CDC 6500	OCEAN-ATMOSPHERE FEEDBACK MODEL
80	FORTTRAN 60	IBM 360/195	TIDES IN THE OPEN SEA
15	FORTTRAN EXT	CDC 6500	VARIANCE AND STANDARD DEVIATION SUMMARY
101	FORTTRAN IV	UNIVAC 1108	SONAR IN REFRACTIVE WATER
101	FORTTRAN IV	UNIVAC 1108	SONAR IN REFRACTIVE WATER
101	FORTTRAN IV	UNIVAC 1108	SORTS SCUND RAY DATA RAY SORT
45	FORTTRAN IV	UNIVAC 1108	PATTERN FUNCTION CALCULATIONS
141	FORTTRAN IV	UNIVAC 1108	SMOOTHING DATA USING THE CUBIC SPLINE
94	FORTTRAN IV	UNIVAC 1108	PROPAGATION LOSS FAST FIELD PROGRAM
14	FORTTRAN EXT	CDC 6500	OCEANOGRAPHIC DATA COMPUTATION TPCONV
136	FORTTRAN IV	IBM 360/65	EXTENDED NORMAL SEPARATOR PROGRAM ENCRMSEP
124	FORTTRAN IV	IBM 360/65	CXYGEN PHOSPHATE DENSITY PLGTS
124	FORTTRAN IV	IBM 360/65	GENERAL MERCATOR PLOT
112	FORTTRAN IV	IBM 360/30	ADJUSTS A STATE PLANE COORDINATE TRAVERSE
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM ANLIS
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM APCTN
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM APCWN
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM APOLY
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM CGSPC
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM CUBIC
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM EXCEB
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM GMLIC
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM HIFIX
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM LORAN
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM OMEGA
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM SODIN
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM SODPN
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM TPFIX
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM UTMCO
80	FORTTRAN IV	CDC 6600	HARMONIC ANALYSIS OF DATA AT TIDAL FREQUENCIES
82	FORTTRAN IV	CDC 6600	HURRICANE STORM SURGE FORECASTS SPLASH I
82	FORTTRAN IV	CDC 6600	HURRICANE STORM SURGE FORECASTS SPLASH II
82	FORTTRAN IV	IBM 360/195	EAST COAST STORM SURGE
82	FORTTRAN IV	IBM 360/195	WAVE FORECASTS
80	FORTTRAN IV	IBM 360/195	ASTRONOMICAL TIDE PREDICTION
30	FORTTRAN IV	CDC 6600	DEEP OCEAN LCAC HANDLING SYSTEMS DOLLS
30	FORTTRAN IV	CDC 6600	LOAD MOTION AND CABLE STRESSES CAB1
30	FORTTRAN IV	CDC 6600	SOIL TEST DATA TRIAX
30	FORTTRAN IV	CDC 6600	DYNAMIC STRESS RESPONSE OF LIFTING LINES CABANA
31	FORTTRAN IV	CDC 6600	DYNAMIC RESPONSE OF CABLE SYSTEM SNAPLG
31	FORTTRAN IV	CDC 6600	CHANGES IN ELECTROMECHANICAL CABLE RAMSC
31	FORTTRAN IV	CDC 6600	END RESPONSES IN ELECTROMECHANICAL CABLE RADAC
17	FORTTRAN IV	IBM 360	OBJECTIVE THERMOCLINE ANALYSIS
17	FORTTRAN IV	CDC 6500	OBJECTIVE THERMOCLINE ANALYSIS
91	FORTTRAN 60	IBM 1604	WIND-DRIFT AND CONCENTRATION OF SEA ICE ICEGRID
145	FORTTRAN IV	IBM 1800	CURRENT METER DATA REDUCTION
137	FORTTRAN IV	IBM 1800	CABLE CONFIGURATION
134	FORTTRAN IV	IBM 1800	GENERATES ARBITRARY FILTER HILOW
84	FORTTRAN IV	IBM 1800	SHIPBORNE WAVE RECORDER ANALYSIS SBWRO
104	FORTTRAN IV	IBM 1800	LORAN/DECCA COORDINATES CALCULATION HNAV
104	FORTTRAN IV	IBM 1800	LORAN/DECCA FILE INITIALIZATION HNV1
104	FORTTRAN IV	IBM 1800	GEODEIC DISTANCE AND AZIMUTH SOANO
12	FORTTRAN IV	B 6700	PLOT TEMP LIST MIXED LAYER DEPTH WEEKPLCT
4	FORTTRAN IV	CDC CYBER 74	DAILY SEAWATER OBSERVATIONS
135	FORTTRAN IV	IBM 360/40	SPECTRA PROGRAMS DETRND AUTCOV CRSCCV FCURTR
25	FORTTRAN IV	IBM 360/65	MIT SALINITY INTRUSION PROGRAM
40	FORTTRAN IV	IBM 7074	COMPUTATION AND PLOTTING OF MAGNETIC ANOMALIES
135	FORTTRAN IV	IBM 1130	ANALYSIS OF NON-LINEAR RESPONSE SURFACE
135	FORTTRAN IV	IBM 1130	MULTIPLE DISCRIMINANT ANALYSIS MULGA
103	FORTTRAN IV	IBM 1130	SATELLITE RISE AND SET TIMES ALERT ASORT
54	FORTTRAN IV	IBM 1130	YIELD PER RECRUIT RYLC BICM

103	FORTTRAN IV	IBM 360/65	ASTRONOMIC POSITION AZIMUTH METHOD
22	FORTTRAN IV	IBM 360/65	PERCENTAGE SATURATION OF OXYGEN IN ESTUARY
23	FORTTRAN IV	IBM 360/65	WATER CHEMISTRY DIELECTRIC CONSTANT
38	FORTTRAN IV	IBM 360/65	GRAVITATIONAL ATTRACTION TWO-DIMENSIONAL BODIES
38	FORTTRAN IV	XOS SIGMA 7	X-RAY DIFFRACTION ANALYSIS
39	FORTTRAN IV	XOS SIGMA 7	MAGNETIC ANOMALIES MAG20
122	FORTTRAN IV	IBM 360/61	PROFILE PLCTS TIME AXIS PROF13
122	FORTTRAN IV	IBM 360/61	PROFILE PLCTS DISTANCE AXIS PFLDST
122	FORTTRAN IV	IBM 360/61	MAP PLCTS MAPPLT
38	FORTTRAN IV	IBM 1130	SEDIMENT GRAIN SIZE ANALYSIS
40	FORTTRAN IV	IBM 1130	REDUCTION DISPLAY STORAGE GEOPHYSICAL DATA
117	FORTTRAN IV	IBM 1130	PLCTS HYDRO CAST DATA PLOG
117	FORTTRAN IV	IBM 1130	PLOTS STD DATA STP01
118	FORTTRAN IV	IBM 1130	PLCTS TEMPERATURE-SALINITY PSAL 1
1	FORTTRAN IV	IBM 1130	TRANSPORT COMPUTATIONS FROM ATMOSPHERIC PRESSURE
1	FORTTRAN IV	IBM 1130	STD COMPUTATIONS STP02
1	FORTTRAN IV	IBM 1130	HYDRO CAST COMPUTATIONS
42	FORTTRAN IV	UNIVAC 1108	LISTS RAW DATA ZLIST
42	FORTTRAN IV	UNIVAC 1108	PLCTS TRACKLINE QCKDRAW
42	FORTTRAN IV	UNIVAC 1108	PLCTS CURCROSS CROSSING INTERVALS OCUBLX
42	FORTTRAN IV	UNIVAC 1108	PLCTS GEOPHYSICAL DATA PLOT2
43	FORTTRAN IV	UNIVAC 1108	LISTS EVERY HUNDRETH VALUE SNOOP
43	FORTTRAN IV	UNIVAC 1108	NAVIGATION COMPUTATIONS TPNV
43	FORTTRAN IV	UNIVAC 1108	EDITS GEOPHYSICAL DATA ZEDIT
43	FORTTRAN IV	UNIVAC 1108	GEOPHYSICAL DATA CONVERSION HANOV
44	FORTTRAN IV	UNIVAC 1108	LISTS GEOPHYSICAL DATA LISTP
44	FORTTRAN IV	UNIVAC 1108	COURSE, SPEED, EOTVCS CORRECTION LOXNAV
44	FORTTRAN IV	UNIVAC 1108	CONVERTS GEOPHYSICAL DATA PHONEY
44	FORTTRAN IV	UNIVAC 1108	SOUND VELOCITY VARIATION AND NAVIGATION FATHOM
45	FORTTRAN IV	UNIVAC 1108	REGIONAL FIELD RESIDUAL MAGNETIC ANOMALY GAMMA
45	FORTTRAN IV	UNIVAC 1108	GRAVITY GAL
45	FORTTRAN IV	UNIVAC 1108	PLCTS PROFILES OF GEOPHYSICAL DATA DISPLOT
46	FORTTRAN IV	UNIVAC 1108	CONVERTS DIGITIZER DATA OYGYT
46	FORTTRAN IV	UNIVAC 1108	EDITS REDUCED GEOPHYSICAL DATA EBIT
125	FORTTRAN IV	COC 6400	SCALAR TIME SERIES TEMPL7
78	FORTTRAN IV	CDC 6400	VECTOR TIME SERIES CURPLT6
51	FORTTRAN IV	IBM 360	TOXICITY BICASSAY PCBIT ANALYSIS
139	FORTTRAN IV	IBM 360/65	FITS POLYNOMIAL P3TERM
142	FORTTRAN IV	IBM 360/65	CHECKS ANGLES THOPI
142	FORTTRAN IV	COC 6600	CHECKS ANGLES THOPI
122	FORTTRAN IV	IBM 360/65	PLCTS SCATTERGRAM SCTGM4 SCTGMS
123	FORTTRAN IV	COC 6600	X-Y PLOTS EBPLT
148	FORTTRAN IV	COC 6600	REPRODUCE AND SERIALIZE DECK DUPE
148	FORTTRAN IV	IBM 360/65	FLAGS SUSPICIOUS DATA VALUES EBIT
144	FORTTRAN IV	IBM 360/65	JULIAN DAY CONVERSION JDAYWK
144	FORTTRAN IV	IBM 360/65	JULIAN DATE CONVERSION ROUTINES JULDAY
144	FORTTRAN IV	IBM 360/65	JULIAN DATE CONVERSION ROUTINES JULIAN
144	FORTTRAN IV	IBM 360/65	JULIAN DATE CONVERSION ROUTINES JULYAN
144	FORTTRAN IV	IBM 360/65	JULIAN DATE CONVERSION ROUTINES JULSEC
144	FORTTRAN IV	IBM 360/65	JULIAN DATE CONVERSION ROUTINES CESLUJ
144	FORTTRAN IV	IBM 360/65	DAY OF THE WEEK NDAYWK
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127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CGNPLT
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CCMPLCT
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CCNFID
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CCNFID 1
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CONMODE
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CCPH
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	COSTR
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CPEES
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CPLT1
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CPLT2
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CRCPLT
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CROSS
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CUSID

127	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	CUSFC
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	CZT
128	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	DATPLT
128	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	LEM0D1
128	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	DEM0D2
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	DEM0D3
128	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	CETRND
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	DIFF12
128	FORTTRAN		CCC 3300/CS3	TIME SERIES	ARAND	EUREKA
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	EXSMC
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	FFINI
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	FFTCNV
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	FFTPS
128	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	FFTS
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	FFTSPC
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	FILTER1
132	FCRTRAN		CDC 3300/CS3	TIME SERIES	ARAND	TSGEN
132	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	TSPECT1
132	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	TSPECT2
132	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	TRANFR
132	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	TRANFRM
132	FCRTRAN		CDC 3300/CS3	TIME SERIES	ARAND	TTYCON
132	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	ITYNUM
132	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	UNLEAV
132	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	USES
132	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	USFO
132	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	USID
132	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	USPE
132	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	WINDOW
126	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	ACFFT
126	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	ACCRR
126	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	ACRPLT
126	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	ALIGN
126	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	AMPACO
126	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	ARMAP
126	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	AUTO
126	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	AUTOPLT
126	FCRTRAN		CDC 3300/OS3	TIME SERIES	ARAND	AXISL
126	FORTTRAN		CDC 3300/CS3	TIME SERIES	ARAND	CCFFT
133	FCRTRAN		CDC 3300/CS3	TIME SERIES	ARAND	WINDCWL
128	FORTTRAN		CDC 3300/OS3	TIME SERIES	ARAND	FIVET
51	FORTTRAN		CDC 3600	SPECIES AFFINITIES	REGROUP	
123	FCRTRAN	63	CDC 3600	VERTICALLY ANALYZED	CCNTOURS	VACOTS
13	FCRTRAN		CDC 3600	CONVERTS STD DATA	R0EDTP	
13	FORTTRAN		CDC 3600	CORRECTS STD DATA	TPMGD	
116	FCRTRAN	IV	CDC 3600	PLCTTING PR0GRAM	PRCFL	
116	FORTTRAN		CDC 3600	X-Y PLOTS	M0DPAK	
12	FORTTRAN	63	CDC 3600	VERTICAL SECTION	PLCTS	ESTPAC
47	FORTTRAN		CDC 3600	PLCTS TRACK ANG. DATA	PROFILE TRACK	
47	FCRTRAN		CDC 3600	GEGDATA		
47	FORTTRAN		CDC 3600	MAGNETIC SIGNATURES	MAGPLOT	
107	FORTTRAN		CDC 3600	ANNCTATED TRACK ON	STEREOGRAPHIC	PR0JECTION
104	FORTTRAN	63	CDC 3800	GRASS UNDERWATER	AC0USTICS	PREDICTION
101	FCRTRAN	63	CDC 3800	GRASS UNDERWATER	AC0USTICS	PREDICTION
120	FORTTRAN		CDC 3800	LINE PRINTER	PLCTS	
100	FORTTRAN	63	CDC 3800	GRASS UNDERWATER	AC0USTICS	PREDICTION
100	FORTTRAN	63	CDC 3800	GRASS UNDERWATER	AC0USTICS	PREDICTION
100	FCRTRAN	63	CCC 3800	GRASS UNDERWATER	AC0USTICS	PREDICTION
100	FORTTRAN	63	CDC 3800	GRASS UNDERWATER	AC0USTICS	PREDICTION

100	FORTTRAN 63	CDC 3800	GRASS UNDERWATER ACCUSTICS PREDICTION SERPENT
89	FORTTRAN	CDC 3800	MIE SCATTERING COMPUTATIONS
16	FORTTRAN	CDC 3800	INTERNAL GRAVITY WAVES DISPER
107	FORTTRAN	CDC 3800	ANNCTATED TRACK ON STEREOGRAPHIC PROJECTION
47	FORTTRAN	CDC 3800	PLOTS TRACK AND DATA PROFILE TRACK
47	FORTTRAN	CDC 3800	GECDATA
47	FORTTRAN	CDC 3800	MAGNETIC SIGNATURES MAGPLOT
4	FCRTRAN	CDC 6400	DATA MGT SYS FOR PHYS CHEM DATA OCEANSV
78	FCRTRAN IV	CDC 6400	VECTOR TIME SERIES CURPLT6
93	FORTTRAN	CDC 6400	HORIZNTAL RANGE
26	FCRTRAN	CDC 6400	UPWELLING CSTLUPWL
125	MS FORTTRAN	CDC 6400	TIME SERIES ANALYSIS PROGRAMS TSAP
125	FORTTRAN IV	CDC 6400	SCALAR TIME SERIES TEMPLT7
27	FORTTRAN IV	CDC 6400	THREE-DIMENSIONAL SIMULATION PACKAGE AUGUR
87	FORTTRAN	CDC 6400	PYRANOMETER AND RADIOMETER TIME SERIES RAD
52	FCRTRAN IV	CDC 6400	COMBINED CHLOROPHYLL AND PRODUCTIVITY
24	FORTTRAN IV	CDC 6500	MULTI-LAYER HYDRODYNAMIC-NUMERICAL MODEL
88	FORTTRAN IV	CDC 6500	HURRICANE HEAT POTENTIAL MODEL
24	FORTTRAN IV	CDC 6500	SINGLE LARGE HYDRODYNAMICAL-NUMERICAL MODEL
14	FCRTRAN EXT	CDC 6500	OCEANOGRAPHIC DATA COMPUTATION TPCONV
83	FORTTRAN IV	CDC 6500	FRENCH SPECTRC-ANGULAR WAVE MODEL
93	FORTTRAN IV	CDC 6500	NORMAL MODE CALCULATIONS NORMOD 3
76	FORTTRAN	CDC 6500	SEARCH AND RESCUE PLANNING NSAR
72	FCRTRAN IV	CDC 6500	THERMAL POLLUTION MODEL
75	FORTTRAN	CDC 6500	MEAN DRIFT ROUTINE
15	FORTTRAN EXT	CDC 6500	VARIANCE AND STANDARD DEVIATION SUMMARY
17	FORTTRAN IV	CDC 6500	OBJECTIVE THERMCLINE ANALYSIS
88	FORTTRAN IV	CDC 6500	OCEAN-ATMOSPHERE FEEDBACK MODEL
17	FORTTRAN IV	CDC 6500	WET BULB TEMPERATURE WETBLA
31	FORTTRAN IV	CDC 6600	DYNAMIC RESPONSE OF CABLE SYSTEM SNAPLG
31	FORTTRAN IV	CDC 6600	CHANGES IN ELECTROMECHANICAL CABLE RAMSC
31	FCRTRAN IV	CDC 6600	END RESPONSES IN ELECTROMECHANICAL CABLE RACAC
51	FORTTRAN IV	CDC 6600	PRODUCTIVITY OXYGEN
80	FORTTRAN IV	CDC 6600	HARMONIC ANALYSIS OF DATA AT TIDAL FREQUENCIES
30	FORTTRAN IV	CDC 6600	DEEP OCEAN LOAD HANDLING SYSTEMS DCLLS
30	FORTTRAN IV	CDC 6600	LOAD MOTION AND CABLE STRESSES CAB1
30	FCRTRAN IV	CDC 6600	SOIL TEST DATA TRIAX
30	FORTTRAN IV	CDC 6600	DYNAMIC STRESS RESPONSE OF LIFTING LINES CABANA
148	FCRTRAN IV	CDC 6600	REPRODUCE AND SERIALIZE DECK DUPE
57	FORTTRAN	CDC 6600	A GENERALIZED EXPLICITED POPULATION SIMULATOR
123	FORTTRAN IV	CDC 6600	X-Y PLOTS EBPLT
123	FORTTRAN	CDC 6600	DISPLAYS VHRR SATELLITE DATA VSDPD
146	FORTTRAN 63	CDC 6600	HYDROGRAPHIC DATA REDUCTION TWO FIVE
142	FCRTRAN IV	CDC 6600	CHECKS ANGLES TWOPI
82	FORTTRAN IV	CDC 6600	HURRICANE STORM SURGE FORECASTS SPLASH I
82	FORTTRAN IV	CDC 6600	HURRICANE STORM SURGE FORECASTS SPLASH II
57	FORTTRAN	CDC 6600	GENERALIZED STOCK PRODUCTION MODEL PROFIT
38	FORTTRAN IV	CDC 6600	CONVECTION INVARIABLE VISCOSITY FLUID CONVEC
17	FORTTRAN	CDC 6600	INTERNAL WAVE OSCILLATIONS ZMODE
2	FCRTRAN IV	CDC 6600	STD DATA PROCESSING
52	FORTTRAN IV	CDC 6600	SPECIES DIVERSITY JCB
52	FORTTRAN IV	CDC 6600	PRODUCTIVITY ECOPROD
24	FORTTRAN IV	CDC 7600	MULTI-LAYER HYDRODYNAMICAL-NUMERICAL MODEL
83	FORTTRAN IV	CDC 7600	FRENCH SPECTRC-ANGULAR WAVE MODEL
75	FORTTRAN	CDC 7600	OPTIMIZED MULTI-LAYER HN MODEL
17	FORTTRAN	CDC 7600	INTERNAL WAVE OSCILLATIONS ZMODE
117	FORTTRAN	CDC CYBER	X-Y PLOTS IN A FLEXIBLE FORMAT MEDSPLOT
4	FORTTRAN IV	CDC CYBER 74	DAILY SEAWATER OBSERVATIONS

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3 FORTRAN II	PDP-8	PLOTS STATION POSITIONS
3 FORTRAN II	PDP-8	PLOT THETA-S CURVES
118 FORTRAN	PDP-8	SECTION PLOTTING
5 FORTRAN II	PDP 8E	MASS TRANSPORT AND VELOCITIES GEOMASS
139 FORTRAN	PDP-9	BARTLETT'S CURVE FITTING
5 FORTRAN IV	PDP 10	STATION DATA THIRP
5 FORTRAN IV	PDP 10	THERMOMETER CORRECTION THERMOMETRIC DEPTH
20 FORTRAN	PDP-11	GENERAL PURPOSE EDITOR DMSEC
20 FORTRAN	PDP-11	TIME SERIES INTO PRCFILES DMSCHP
20 FORTRAN	PDP-11	AANDERAA CURRENT METER DATA AACAL
20 FORTRAN	PDP-11	CURRENT PROFILER DATA MK2CAL
20 FORTRAN	PDP-11	APPENDS NEW DATA TO FILE DERIVE

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143 FORTRAN	HP 2100	THERMOMETER CORRECTION DEPTH COMP HYD1
8 FORTRAN IV	HP 2100	STATION DATA HYD2
3 FORTRAN IV	HP 2100A	STD TABLES AND PLCTS STD
16 FORTRAN IV	HP 2100S	THERMOMETER DATA FILE HANDLER THERMO
105 FORTRAN IV	HP 2100S	LORAN OR CMEGA CONVERSION GEPOS
107 FORTRAN IV	HP 2100S	ANNCTES CHART
108 FORTRAN IV	HP 2100S	BATHYMETRIC CR MAGNETICS CHART PROFL
108 FORTRAN IV	HP 2100S	MERCATOR CHART DIGITIZATION ANTRK
108 FORTRAN IV	HP 2100S	BATHYMETRIC CHART DIGITIZATION DGBTH
108 FORTRAN IV	HP 2100S	PLCTS ON STEREOGRAPHIC CHART ANNCT
108 FORTRAN IV	HP 2100S	PLCTS NAVIGATION DATA CCEAN
16 FORTRAN IV	HP 2100S	THERMOMETRIC DEPTH CALCULATION CAST
124 ASSEMBLY	HP 2100S	PLOTTER COMMANDS PLCT DVRIC
109 FORTRAN IV	HP 2100S	LONG BASE LINE ACCLUSTIC TRACKING
2 FORTRAN	HP 2115A	STD PROCESSING WET
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105 FORTRAN IV	HP 3100A	CRUISE TRACK TMERC
32 BASIC	HP 9830A	UNMANNED FREE-SWIMMING SUBMERSIBLE
32 BASIC	HP 9830A	UNMANNED FREE-SWIMMING SUBMERSIBLE HCTEL LGAD
31 BASIC	HP 9830A	UNMANNED FREE-SWIMMING SUBMERSIBLE PLOT
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51 FORTRAN IV	IBM 360	TOXICITY BICASSAY PROBIT ANALYSIS
54 FORTRAN IV	IBM 360	SUCCESSION
54 FORTRAN IV	IBM 360	SPECIES ABUNDANCE
134 FORTRAN IV	IBM 360	TIME SERIES ANALYSIS BLACKY
24 FORTRAN IV	IBM 360	SINGLE LARGE HYDRODYNAMICAL-NUMERICAL MODEL
143 FORTRAN IV	IBM 360	AREAL CONCENTRATION INTEGRATE
143 FORTRAN IV	IBM 360	UNWEIGHTED AVERAGES AVERAGE
73 FORTRAN	IBM 360	ECOLOGICAL STATISTICAL PROGRAMS ECCSTAT
26 FORTRAN IV	IBM 360	MATHEMATICAL WATER QUALITY MODEL FOR ESTUARIES

26	FORTTRAN	IV	IBM 360	COMPUTATION OF FLOW THROUGH MASONBORO INLET NC
26	FORTTRAN	IV	IBM 360	CIRCULATION IN PAMLICC SOUND
116	FORTTRAN		IBM 360	DENDROGRAPH
25	FORTTRAN	IV	IBM 360	DYNAMIC DETERMINISTIC SIMULATION SIMUDEL
54	FORTTRAN	IV	IBM 360	PIGMENT RATIO
13	BASIC		IBM 360	ENVIRONMENTAL DYNAMICS SUBROUTINES OCEANLIB
13	BASIC		IBM 360	GEOSTROPHIC CURRENT
22	FORTTRAN		IBM 360	CO2 AND DC SAT
22	FORTTRAN		IBM 360	SPECIFIC CONDUCTIVITY WITH PRESSURE EFFECT
17	FORTTRAN	IV	IBM 360	OBJECTIVE THERMOCLINE ANALYSIS
112	FORTTRAN	IV	IBM 360/30	ADJUSTS A STATE PLANE COORDINATE TRAVERSE
28	FORTTRAN	IV	IBM 360/40	MATHEMATICAL MODEL OF COASTAL UPWELLING
86	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS PROFILE
86	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS REFL1
86	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS FORCE AND MOVEMENT
135	FORTTRAN	IV	IBM 360/40	SPECTRA PROGRAMS DETRND AUTCOV CRSCCV FCURTR
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS PROFILE
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS UMAX1
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS UTMAX1
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS WMAX1
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS LENG1
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS DETRND
85	FORTRAN		IBM 360/40	WATER WAVE TEACHING AIDS WTMAX2
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS UCFT1
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS WCFT1
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS UTCFT1
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS WTCFT1
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS AUTCOV
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS CRSCOV
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS FCURTR
85	FORTTRAN		IBM 360/40	WATER WAVE TEACHING AIDS EDSIT
115	FORTTRAN	IV	IBM 360/40	MAP PROJECTIONS AND GRIDS MAP
4	COBOL		IBM 360/50	CONSISTENCY OF PHYSICAL AND CHEMICAL DATA
4	FORTTRAN		IBM 360/50	CONSISTENCY OF PHYSICAL AND CHEMICAL DATA
122	FORTTRAN	IV	IBM 360/61	PROFILE PLCTS TIME AXIS PROFILE
122	FORTRAN	IV	IBM 360/61	PROFILE PLCTS DISTANCE AXIS PROFILE
122	FORTTRAN	IV	IBM 360/61	MAP PLCTS MAPPLT
41	FORTRAN	IV	IBM 360/65	PLCTS PROFILES OF BATHYMETRY AND MAGNETIC
150	FORTTRAN	IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASCIPBS
150	FORTRAN	IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASSAMFC
150	FORTTRAN	IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASEINV
150	FORTRAN	IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASCCI
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150	FORTRAN	IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GVAREFRM
150	FORTRAN	IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS CANADA
150	FORTRAN	IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GAS
150	FORTRAN	IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASVASUM
150	PL/1		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GAS THERM
150	ASSEMBLER		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASTHERM
150	ASSEMBLER		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS INDATA
150	ASSEMBLER		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS CREATE
150	ASSEMBLER		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS MONTH80
150	ASSEMBLER		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS CHEM80
150	ASSEMBLER		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS DEPTH80
150	ASSEMBLER		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS LATLON80
150	ASSEMBLER		IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASCRDR
20	ASSEMBLER		IBM 360/65	TEMPERATURE DIFFERENCE CALCULATIONS
120	FORTTRAN		IBM 360/65	SEQUENTIAL PLCTTING
144	FORTTRAN	IV	IBM 360/65	JULIAN DATE CONVERSION ROUTINES JULIAN

144	FORTTRAN IV	IBM 360/65	JULIAN DATE CCNVERSION ROUTINES JULYAN
144	FORTTRAN IV	IBM 360/65	JULIAN DATE CONVERSION ROUTINES JULSEC
144	FORTTRAN IV	IBM 360/65	JULIAN DATE CCNVERSION ROUTINES CESLUJ
144	FORTTRAN IV	IBM 360/65	DAY OF THE WEEK NDAYWK
124	FORTTRAN IV	IBM 360/65	OXYGEN PHOSPHATE DENSITY PLCTS
124	FORTTRAN IV	IBM 360/65	GENERAL MERCATOR PLOT
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM LCRAN
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM CMEGA
114	FORTTRAN IV	IBM 360/65	NCS SCIENTIFIC SUBROUTINE SYSTEM SODIN
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM SODPN
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM TPFIX
114	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM UTMCO
138	FORTTRAN IV	IBM 360/65	FITS A SMCCTH CURVE
18	FORTTRAN	IBM 360/65	ISENTROPIC INTERPLATION
18	ASSEMBLER	IBM 360/65	POTENTIAL TEMP AND/OR DENSITY POTDEN
18	FORTTRAN	IBM 360/65	SIGMAT
18	FORTTRAN IV	IBM 360/65	DYNAMIC DEPTH ANOMALY DYANCH
18	FORTTRAN	IBM 360/65	SALINITY FROM CONDUCTIVITY T P SALINE
78	ASSEMBLER	IBM 360/65	SURFACE CURRENT SUMMARY SUFCUR
148	FORTTRAN IV	IBM 360/65	FLAGS SUSPICIOUS DATA VALUES EDITQ
38	FORTTRAN IV	IBM 360/65	GRAVITATIONAL ATTRACTION TWO-DIMENSIONAL BODIES
153	ASSEMBLER	IBM 360/65	RETXBT
153	ASSEMBLER	IBM 360/65	XBCCNV
153	ASSEMBLER	IBM 360/65	RETB
153	ASSEMBLER	IBM 360/65	BTLISTC
153	FORTTRAN IV	IBM 360/65	XBSELECT
153	FORTTRAN IV	IBM 360/65	XBMSIV
153	FORTTRAN IV	IBM 360/65	XBGEOSUM
153	FORTTRAN IV	IBM 360/65	CANWMC
153	PL/1	IBM 360/65	BTGECIV
153	PL/1	IBM 360/65	SCHNINE
153	PL/1	IBM 360/65	SCHULTT
153	PL/1	IBM 360/65	DRYEAND
103	FORTTRAN IV	IBM 360/65	ASTRONOMIC POSITION AZIMUTH METHOD
23	FORTTRAN IV	IBM 360/65	WATER CHEMISTRY DIELECTRIC CONSTANT
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM ANGLE
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM ANLIS
113	FORTTRAN IV	IBM 360/65	NCS SCIENTIFIC SUBROUTINE SYSTEM APTCN
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM APCMN
113	FORTTRAN IV	IBM 360/65	NCS SCIENTIFIC SUBROUTINE SYSTEM APOLY
113	FORTTRAN IV	IBM 360/65	NPS SCIENTIFIC SUBROUTINE SYSTEM CGSPC
113	FORTTRAN IV	IBM 360/65	NCS SCIENTIFIC SUBROUTINE SYSTEM CUBIC
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM EXCEB
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM GMLIC
113	FORTTRAN IV	IBM 360/65	NOS SCIENTIFIC SUBROUTINE SYSTEM HIFIX
19	FORTTRAN	IBM 360/65	VOLUME TRANSPRT FUNCTION QFUN
19	FORTTRAN IV	IBM 360/65	PCTENTIAL TEMP AND DENSITY PDENS
19	FORTTRAN IV	IBM 360/65	VOLUME TRANSPRT VOLTRN
19	FORTTRAN IV	IBM 360/65	COMPUTES PRESSURE PRESSR
139	FORTTRAN IV	IBM 360/65	FITS POLYNOMIAL P3TERM
136	FORTTRAN IV	IBM 360/65	EXTENDED NCRPAL SEPARATOR PROGRAM ENORMSEP
25	FORTTRAN IV	IBM 360/65	MIT SALINITY INTRUSION PROGRAM
103	FORTTRAN IV	IBM 360/65	PLOTS MAPS GRIDS TRACKS MAP
152	ASSEMBLER	IBM 360/65	SDPRT2
152	ASSEMBLER	IBM 360/65	SDSELECT
152	ASSEMBLER	IBM 360/65	SD2MSTCT
152	ASSEMBLER	IBM 360/65	SD2SAMP
152	ASSEMBLER	IBM 360/65	MAKE120
152	ASSEMBLER	IBM 360/65	DEPTH

152	ASSEMBLER	IBM 360/65	CRUCON
152	ASSEMBLER	IBM 360/65	COOCCCNV
152	ASSEMBLER	IBM 360/65	SUPERSEL
152	ASSEMBLER	IBM 360/65	SDPASS
152	ASSEMBLER	IBM 360/65	XORDER
152	ASSEMBLER	IBM 360/65	XBTCLCNT
152	FORTTRAN	IBM 360/65	XBTQKCUT
152	PL/1	IBM 360/65	SDGECIV
152	PL/1	IBM 360/65	XBEVALU
152	PL/1	IBM 360/65	XBCCRV
152	PL/1	IBM 360/65	XBFNWC
152	PL/1	IBM 360/65	XBTNWSHM
142	FORTTRAN IV	IBM 360/65	CHECKS ANGLES TWOPI
122	FORTTRAN IV	IBM 360/65	PLCTS SCATTERGRAM SCTGM4 SCTGMS
22	FORTTRAN IV	IBM 360/65	PERCENTAGE SATURATION OF OXYGEN IN ESTUARY
25	FORTTRAN IV	IBM 360/65	MIT SALINITY INTRUSION PROGRAM
115	FORTTRAN IV	IBM 360/65	CCMPUTE GREAT CIRCLE PATH GCIRC
144	FORTTRAN IV	IBM 360/65	JULIAN DAY CONVERSION JOAYWK
144	FORTTRAN IV	IBM 360/65	JULIAN DATE CONVERSION ROUTINES JULDAY
7	FORTTRAN IV	IBM 360/65	READ CALC INTERP STATION DATA CAPRICORN
7	FORTTRAN IV	IBM 360/65	STATION DATA CALCULATIONS F3
147	FORTTRAN IV	IBM 360/65	READS NODC STATION DATA TAPE
8	FORTTRAN IV	IBM 360/65	PLCTS STATION DATA PLTDT
8	FORTTRAN IV	IBM 360/65	CALCULATES STATION DATA SECPG
97	FORTTRAN	IBM 360/65	SOUND VELOCITY WILSONS FORMULA WLSND
97	FORTTRAN	IBM 360/65	SOUND VELOCITY WILSONS FORMULA SVELFS
97	FORTTRAN	IBM 360/65	SOUND VELOCITY WILSONS FORMULA VELPRS
141	PL/1	IBM 360/65	LINEAR INTERPOLATION LININT
141	PL/1	IBM 360/65	LAGRANGIAN THREE POINT INTERPOLATION LAG3PT
141	FORTTRAN IV	IBM 360/65	CALCULATES SPLINE COEFFICIENT SPLCOF
141	FORTTRAN IV	IBM 360/65	INTERPOLATING BY CUBIC SPLINE
151	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS ALTERGAS
151	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASB
151	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS NODCSQ
151	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS NAMES
151	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS SD2 GAS
151	ASSEMBLER	IBM 360/65	SDRETV
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150	FORTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASDIPBS
150	FORTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASSAMPC
150	FORTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASEINV
150	FORTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASCCI
150	FORTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASVPR
150	FORTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GVAREFRM

150	FCRTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS CANADA
150	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GAS
150	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASVASUM
151	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS ALTERGAS
151	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASB
151	FCRTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS NOQCSQ
151	FORTTRAN IV	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS NAMES
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150	ASSEMBLER	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASTHERM
150	ASSEMBLER	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS INDATA
150	ASSEMBLER	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS CREATE
150	ASSEMBLER	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS MONTH8C
150	ASSEMBLER	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS CHEM8C
150	ASSEMBLER	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS DEPTH8C
150	ASSEMBLER	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS LATLON8C
150	ASSEMBLER	IBM 360/65	FILE INDEPENDENT GEN APP SYS GAS GASCRDR
151	ASSEMBLER	IBM 360/65	SDRETV
151	ASSEMBLER	IBM 360/65	SD2TCS01
152	ASSEMBLER	IBM 360/65	SDPRT2
152	ASSEMBLER	IBM 360/65	SUPERSEL
152	ASSEMBLER	IBM 360/65	SDPASS
152	ASSEMBLER	IBM 360/65	XORDER
152	ASSEMBLER	IBM 360/65	XBTCUNT
153	ASSEMBLER	IBM 360/65	RETXET
153	ASSEMBLER	IBM 360/65	XBTCNV
153	ASSEMBLER	IBM 360/65	RETB
153	ASSEMBLER	IBM 360/65	BTLISTC
152	FCRTRAN	IBM 360/65	XBTKCUT
153	FORTTRAN IV	IBM 360/65	XBSELECT
153	FORTTRAN IV	IBM 360/65	XBMSINV
153	FORTTRAN IV	IBM 360/65	XBGECSUM
153	FORTTRAN IV	IBM 360/65	CANWMG
151	PL/1	IBM 360/65	SD2CHAR
152	PL/1	IBM 360/65	SDGECIV
152	PL/1	IBM 360/65	XBEVALU
152	PL/1	IBM 360/65	XBCCNV
152	PL/1	IBM 360/65	XBFNWC
152	PL/1	IBM 360/65	XBTNWSUM
153	PL/1	IBM 360/65	BTGECIV
153	PL/1	IBM 360/65	SCHNINE
153	PL/1	IBM 360/65	SCMULTI
153	PL/1	IBM 360/65	DRYLAND
18	FORTTRAN	IBM 360/65	ISENTROPIC INTERPOLATION
18	ASSEMBLER	IBM 360/65	POTENTIAL TEMP AND/OR DENSITY POTDEN
18	FORTTRAN	IBM 360/65	SIGMAT
18	FORTTRAN IV	IBM 360/65	DYNAMIC DEPTH ANOMALY DYANCM
18	FORTTRAN	IBM 360/65	SALINITY FROM CONDUCTIVITY T P SALINE
19	FORTTRAN	IBM 360/65	VOLUME TRANSPCRT FUNCTION QFUN
19	FCRTRAN IV	IBM 360/65	POTENTIAL TEMP AND DENSITY PODENS
19	FORTTRAN IV	IBM 360/65	VOLUME TRANSPCRT VCLTRA
19	FORTTRAN IV	IBM 360/65	COMPUTES PRESSURE PRESSR
20	ASSEMBLER	IBM 360/65	TEMPERATURE DIFFERENCE CALCULATIONS
115	FORTTRAN IV	IBM 360/65	COMPUTE GREAT CIRCLE PATH GCIRC
115	FCRTRAN IV	IBM 360/40	MAP PROJECTIONS AND GRIDS MAP
78	ASSEMBLER	IBM 360/65	SURFACE CURRENT SUMMARY SUFCUR

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41 FORTRAN IV IBM 360/65 MARINE GEOPHYSICAL DATA REDUCTION  
41 FORTRAN IV IBM 360/65 PLOTS PROFILES OF BATHYMETRY AND MAGNETIC

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142 FORTRAN IV IBM 360/65 CHECKS ANGLES TWOPI  
142 FORTRAN IV CDC 6600 CHECKS ANGLES TWOPI  
122 FORTRAN IV IBM 360/65 PLOTS SCATTERGRAM SCTGM4 SCTGMS  
123 FORTRAN IV CDC 6600 X-Y PLOTS EBTPLT  
148 FORTRAN IV CDC 6600 REPRODUCE AND SERIALIZE DECK DUPE  
148 FORTRAN IV IBM 360/65 FLAGS SUSPICIOUS DATA VALUES EDITQ  
144 FORTRAN IV IBM 360/65 JULIAN DATE CONVERSION JDAYWK  
144 FORTRAN IV IBM 360/65 JULIAN DATE CONVERSION ROUTINES JULOAY  
144 FORTRAN IV IBM 360/65 JULIAN DATE CONVERSION ROUTINES JULIAN  
144 FORTRAN IV IBM 360/65 JULIAN DATE CONVERSION ROUTINES JULYAN  
144 FORTRAN IV IBM 360/65 JULIAN DATE CONVERSION ROUTINES JULSEC  
144 FORTRAN IV IBM 360/65 JULIAN DATE CONVERSION ROUTINES CESLUJ  
17 FORTRAN IV CDC 6500 DAY OF THE WEEK-NDAYWK  
WET BULB TEMPERATURE WETBLA

ENVIRONMENTAL PROTECTION AGENCY, GULF BREEZE, FL

51 FORTRAN IV IBM 360 TOXICITY BIOASSAY PRCBIT ANALYSIS

ENVIRONMENTAL RESEARCH LABORATORIES, PACIFIC MARINE ENVIRONMENTAL LABORATORY, SEATTLE, WA

125 FORTRAN IV CDC 6400 SCALAR TIME SERIES TEMPL7  
87 FORTRAN IV CDC 6400 PYRANOMETER AND RADIOMETER TIME SERIES RAD  
78 FORTRAN IV CDC 6400 VECTOR TIME SERIES CURPLT6

ENVIRONMENTAL RESEARCH LABORATORIES, ATLANTIC OCEANOGRAPHIC AND METEOROLOGICAL LABORATORIES, MIAMI, FL

17 FORTRAN CDC 6600 INTERNAL WAVE OSCILLATIONS ZMODE  
17 FORTRAN CDC 7600 INTERNAL WAVE OSCILLATIONS ZMODE  
42 FORTRAN IV UNIVAC 1108 LISTS RAW DATA 2LIST  
42 FORTRAN IV UNIVAC 1108 PLOTS TRACKLINE QCKDRAW  
42 FORTRAN IV UNIVAC 1108 PLOTS CONTOUR CROSSING INTERVALS DOUBLX  
42 FORTRAN IV UNIVAC 1108 PLOTS GEOPHYSICAL DATA PLOT2  
43 FORTRAN IV UNIVAC 1108 LISTS EVERY HUNDRETH VALUE SNOOP  
43 FORTRAN IV UNIVAC 1108 NAVIGATION COMPUTATIONS TPNVAV  
43 FORTRAN IV UNIVAC 1108 EDITS GEOPHYSICAL DATA ZEDIT  
43 FORTRAN IV UNIVAC 1108 GEOPHYSICAL DATA CONVERSION HANDY  
44 FORTRAN IV UNIVAC 1108 LISTS GEOPHYSICAL DATA LISTP  
44 FORTRAN IV UNIVAC 1108 COURSE, SPEED, ECTVCS CORRECTION LCXNAV  
44 FORTRAN IV UNIVAC 1108 CONVERTS GEOPHYSICAL DATA PHONEY  
44 FORTRAN IV UNIVAC 1108 SOUND VELOCITY VARIATION AND NAVIGATION FATHOM  
45 FORTRAN IV UNIVAC 1108 REGIONAL FIELD RESIDUAL MAGNETIC ANOMALY GAMMA  
45 FORTRAN IV UNIVAC 1108 GRAVITY GAL  
45 FORTRAN IV UNIVAC 1108 PLOTS PROFILES OF GEOPHYSICAL DATA DISPLOT  
46 FORTRAN IV UNIVAC 1108 CONVERTS DIGITIZER DATA DYGIT  
46 FORTRAN IV UNIVAC 1108 EDITS REDUCED GEOPHYSICAL DATA EDIT

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59	FORTRAN	B 6700	AGE COMPOSITION ESTIMATION TCPB1
59	FORTRAN	B 6700	ESTIMATE CATCH NUMBERS PERCENT WEIGHT
59	FORTRAN	B 6700	LENGTH-FREQUENCY DISTRIBUTION
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60	FORTRAN	B 6700	VON BERTALANFFY GROWTH UNEQUAL AGE INTERVAL
60	FORTRAN	B 6700	VON BERTALANFFY GROWTH EQUAL AGE INTERVAL
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64	FORTRAN	B 6700	ESTIMATION OF LINEAR GROWTH
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62 FORTRAN	B 6700	SURVIVAL RATE ESTIMATION TCPE1
63 FORTRAN	B 6700	FISHING MORTALITIES ESTIMATION TCPE2
63 FORTRAN	B 6700	RELATIVE YIELD PER RECRUIT
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64 FORTRAN	B 6700	PIECEWISE INTEGRATION OF YIELD CURVES TCPF4
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65 FORTRAN	B 6700	CONSTANTS IN SCHAEFER'S MODEL TCPF6
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68 FORTRAN	B 6700	BIOMETRY-SINGLE CLASSIFICATION ANOVA
68 FORTRAN	B 6700	BIOMETRY-FACTRIAL ANOVA TCSD2
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69 FORTRAN	B 6700	BIOMETRY-STUDENT-NEWMAN-KEULS TEST TCSD4
69 FORTRAN	B 6700	BIOMETRY-TEST OF HOMOGENEITY
69 FORTRAN	B 6700	BIOMETRY-TEST OF EQUALITY
70 FORTRAN	B 6700	BIOMETRY-TUKEY'S TEST
70 FORTRAN	B 6700	BIOMETRY-KRUSKAL-WALLIS TEST TCSE4
70 FORTRAN	B 6700	BIOMETRY-FISHER'S EXACT TEST TCSE5
71 FORTRAN	B 6700	BIOMETRY-R X C TEST OF INDEPENDENCE MAP

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73 ANS FORTRAN IBM 370	ECCOLOGICAL STATISTICAL PROGRAMS ECOSTAT

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117 FORTRAN	CDC CYBER	X-Y PLOTS IN A FLEXIBLE FORMAT MEDSPLCT
4 FORTRAN IV	CDC CYBER 74	DAILY SEAWATER OBSERVATIONS
4 FORTRAN	IBM 6400	DATA MGT SYS FOR PHYS CHEM DATA OCEANSV
4 COBOL	IBM 360/85	DATA MGT SYS FOR PHYS CHEM DATA OCEANSV
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72 PL/1	IBM 370/168	MONTE CARLO SPILL TRACKER
135 FORTRAN IV	IBM 360/40	SPECTRA PROGRAMS DETRND AUTCOV CRSCOV FCURTR
85 FORTRAN	IBM 360/40	WATER WAVE TEACHING AIDS PRCF1
85 FORTRAN	IBM 360/40	WATER WAVE TEACHING AIDS UMAX1
85 FORTRAN	IBM 360/40	WATER WAVE TEACHING AIDS UTMAX1
85 FORTRAN	IBM 360/40	WATER WAVE TEACHING AIDS WMAX1
85 FORTRAN	IBM 360/40	WATER WAVE TEACHING AIDS LENG1
85 FORTRAN	IBM 360/40	WATER WAVE TEACHING AIDS DETRND
85 FORTRAN	IBM 360/40	WATER WAVE TEACHING AIDS WTMAX2

85	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS UOFF1
85	FCRTRAN	IBM 360/40	WATER WAVE TEACHING AIDS WGFT1
85	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS UTCFT1
85	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS WTCFT1
85	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS AUTCOV
85	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS CRSCOV
85	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS FCURTR
86	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS PRCFIL
86	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS REFL1
86	FORTTRAN	IBM 360/40	WATER WAVE TEACHING AIDS FORCE AND MOVEMENT
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87	PL/1	IBM 370/180	MARKOVIAN ANALYSIS OF TDF-14 WIND DATA
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74	PL/1	IBM 360/168	DRIFT BOTTLE/STATISTICS
74	PL/1	IBM 360/168	DRIFT BOTTLE PLCTS
74	PL/1	IBM 360/168	REFORMAT AND SCRT DRIFT BOTTLE DATA

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123	FORTTRAN	IBM 360/195	MICROFILM PLCTS OF VHRR SATELLITE DATA

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139	FORTTRAN	IBM 1800	BARTLETT'S CURVE FITTING
145	FORTTRAN IV	IBM 1800	CURRENT METER DATA REDUCTION
37	FCRTRAN IV	IBM 1800	CABLE CONFIGURATION
134	FORTTRAN IV	IBM 1800	GENERATES ARBITRARY FILTER HILOW
136	FORTTRAN	IBM 1800	CLUSTER ANALYSIS
84	FCRTRAN IV	IBM 1800	SHIPBORNE WAVE RECORDER ANALYSIS SBWRO
103	FCRTRAN	IBM 1800	SATELLITE NAVIGATION
104	FCRTRAN IV	IBM 1800	LORAN/DECCA COORDINATES CALCULATION HNAV
104	FORTTRAN IV	IBM 1800	LORAN/DECCA FILE INITIALIZATION HNV1
104	FCRTRAN IV	IBM 1800	GEOCENTRIC DISTANCE AND AZIMUTH SDANO

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123	FORTTRAN 63	CDC 3600	VERTICALLY ANALYZED CONTOURS VACCTS
12	FCRTRAN IV	B 6700	PLCT TEMP LIST MIXED LAYER DEPTH WEEKPLCT
12	ALGOL	B 6700	CONSTANTS FOR FARMONIC SYNTHESIS MEAN SEA TEMP
12	FORTTRAN 63	CDC 3600	VERTICAL SECTION PLOTS ESTPAC
13	FCRTRAN	CDC 3600	CONVERTS STD DATA RDECTP
13	FORTTRAN	CDC 3600	CORRECTS STD DATA TPMCD
56	FORTTRAN	B 6700	LENGTH FREQUENCY ANALYSIS LENFRE
56	FORTTRAN	B 6700	YIELD PER RECRUIT FOR MULTI-GEAR FISHERIES
57	FORTTRAN	B 6700	A GENERALIZED EXPLICITED POPULATION SIMULATOR
57	FCRTRAN	CDC 6600	A GENERALIZED EXPLICITED POPULATION SIMULATOR
57	FORTTRAN	CDC 6600	GENERALIZED STOCK PRODUCTION MODEL PRCDFIT
57	FORTTRAN	B 6700	GENERALIZED STOCK PRODUCTION MODEL PRCDFIT
87	FORTTRAN	B 6700	SUMMARIZES WEATHER REPORTS

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124 FORTRAN IV IBM 360/65 OXYGEN-PHOSPHATE DENSITY PLCTS  
 124 FORTRAN IV IBM 360/65 GENERAL MERCATOR PLOT

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112 FORTRAN IV IBM 360/30 ADJUSTS A STATE PLANE COORDINATE TRAVERSE  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM ANGLE  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM ANLIS  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM APCTN  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM APCWN  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM APOLY  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM CGSPC  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM CUBIC  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM EXCEB  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM GMLIC  
 113 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM HIFIX  
 114 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM LORAN  
 114 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM OMEGA  
 114 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM SCGIN  
 114 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM SCOPN  
 114 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM TPFIX  
 114 FORTRAN IV IBM 360/65 NOS SCIENTIFIC SUBROUTINE SYSTEM UTMCO  
 114 SPS IBM 1620 COMPUTES GEOGRAPHIC POSITIONS  
 114 SPS IBM 1620 LORAN C VERSION 2  
 80 FORTRAN IV CDC 6600 HARMONIC ANALYSIS OF DATA AT TIDAL FREQUENCIES

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82 FORTRAN IV CDC 6600 HURRICANE STORM SURGE FORECASTS SPLASH I  
 82 FORTRAN IV CDC 6600 HURRICANE STORM SURGE FORECASTS SPLASH II  
 82 FORTRAN IV IBM 360/195 EAST COAST STORM SURGE  
 82 FORTRAN IV IBM 360/195 WAVE FORECASTS  
 80 FORTRAN IV IBM 360/195 ASTRONOMICAL TIDE PREDICTIONS

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 30 FORTRAN IV CDC 6600 LOAD MOTION AND CABLE STRESSES CABL  
 30 FORTRAN IV CDC 6600 SOIL TEST DATA TRIAX  
 30 FORTRAN IV CDC 6600 DYNAMIC STRESS RESPONSE OF LIFTING LINES CABANA  
 31 FORTRAN IV CDC 6600 DYNAMIC RESPONSE OF CABLE SYSTEM SNAPLG  
 31 FORTRAN IV CDC 6600 CHANGES IN ELECTROMECHANICAL CABLE RAMSC  
 31 FORTRAN IV CDC 6600 END RESPONSES IN ELECTROMECHANICAL CABLE RACAC  
 48 FORTRAN II IBM 1620 SOIL AND SEDIMENT ENGINEERING TEST DATA

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 17 FORTRAN IV CDC 6500 OBJECTIVE THERMOCLINE ANALYSIS  
 91 FORTRAN 60 IBM 1604 WIND DRIFT AND CONCENTRATION OF SEA ICE ICEGRIQ  
 97 FORTRAN CDC 3100 SOUND SPEED COMPUTATION MODEL SOVEL  
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 97 FORTRAN CDC 1604 SOUND SPEED COMPUTATION MODEL SOVEL  
 93 FORTRAN IV CDC 1604 SOUND SCATTERING BY ORGANISMS SKAT  
 72 FORTRAN IV CDC 6500 THERMAL POLLUTION MODEL  
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72 FORTRAN	CDC 3100	DANISH ADVECTION PROGRAM
134 FORTRAN IV	IBM 360	TIME SERIES ANALYSIS BLACKY
83 FORTRAN IV	CDC 6500	FRENCH SPECTRC-ANGULAR WAVE MODEL
83 FORTRAN IV	CDC 7600	FRENCH SPECTRC-ANGULAR WAVE MODEL
83 FORTRAN IV	CDC 3100	SURF PREDICTION MODEL
83 FORTRAN	CDC 3100	SINGULAR WAVE PREDICTION MODEL
83 FORTRAN	CDC 3200	SINGULAR WAVE PREDICTION MODEL
22 FORTRAN	IBM 360	SPECIFIC CONDUCTIVITY WITH PRESSURE EFFECT
24 FORTRAN IV	CDC 6500	MULTI-LAYER HYDRODYNAMIC-NUMERICAL MODEL
24 FORTRAN IV	CDC 7600	MULTI-LAYER HYDRODYNAMICAL-NUMERICAL MODEL
24 FORTRAN IV	CDC 6500	SINGLE LARGE HYDRODYNAMICAL-NUMERICAL MODEL
24 FORTRAN IV	IBM 360	SINGLE LARGE HYDRODYNAMICAL-NUMERICAL MODEL
87 FORTRAN	CDC 1604	OCEAN CLIMATOLOGY ANALYSIS MODEL ANALYS
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75 FORTRAN	CDC 7600	OPTIMIZED MULTI-LAYER HN MODEL
75 FORTRAN	CDC 3100	OPTIMIZED MULTI-LAYER HN MODEL
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75 FORTRAN	CDC 1604	MEAN DRIFT ROUTINE
80 FORTRAN 60	IBM 360/195	TIDES IN THE OPEN SEA

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76 FORTRAN	CDC 6500	SEARCH AND RESCUE PLANNING NSAR

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14 FORTRAN EXT	CDC 6500	OCEANOGRAPHIC DATA COMPUTATION TPCONV
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101 FORTRAN IV	UNIVAC 1108	SONAR IN REFRACTIVE WATER
101 FORTRAN IV	UNIVAC 1108	SORTS SCUND RAY DATA RAY SORT
45 FORTRAN IV	UNIVAC 1108	PATTERN FUNCTION CALCULATIONS
45 FORTRAN V	UNIVAC 1108	RAYLEIGH-MORSE BOTTOM REFLECTION COEFFICIENTS

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141 FORTRAN IV	UNIVAC 1108	SMOOTHING DATA USING THE CUBIC SPLINE
121 FORTRAN	UNIVAC 1108	OVERLAY PLOTTING OVLPLT
99 FORTRAN V	UNIVAC 1108	CONTINUOUS GRADIENT RAY TRACING SYSTEM CONGRATS
99 FORTRAN	UNIVAC 1108	RAY PATH SC434E
93 FORTRAN V	UNIVAC 1108	NORMAL MODE PROPAGATION MODEL
94 FORTRAN V	UNIVAC 1108	BEAM PATTERNS AND WIDTHS GBEAM
94 FORTRAN V	UNIVAC 1108	STATISTICS ACOUSTIC MEASUREMENTS AND PREDICTIONS

94	FORTTRAN IV	UNIVAC 1108	PROPAGATION LCSS FAST FIELD PROGRAM
94	FORTTRAN II	UNIVAC 1108	BOTTOM REFLECTIVITY
45	FORTTRAN V	UNIVAC 1108	PROPAGATION LCSS
45	FORTTRAN V	UNIVAC 1108	AMOS PROPAGATION LCSS
36	FORTTRAN V	UNIVAC 1108	TOWED SYSTEM DYNAMICS
36	FORTTRAN V	UNIVAC 1108	TRAPEZOIDAL ARRAY DEPLOYMENT DYNAMICS
37	FORTTRAN V	UNIVAC 1108	STEADY STATE CABLE LAYING
37	FORTTRAN V	UNIVAC 1108	TOWED ARRAY CONFIGURATIONS
37	FORTTRAN V	UNIVAC 1108	TRAPEZOIDAL ARRAY DYNAMICS
125	FORTTRAN	UNIVAC 1108	SPECTRAL ANALYSIS SUBROUTINES
47	FORTTRAN	UNIVAC 1108	TRUE OCEAN DEPTH FATHCR
53	FORTTRAN IV	UNIVAC 1108	GENERATES ZOOPLANKTON TAXONOMIC DIRECTORY
53	FORTTRAN IV	UNIVAC 1108	DEEP OCEAN ZOOPLANKTON DISTRIBUTION
53	FORTTRAN IV	UNIVAC 1108	DEEP OCEAN ZOOPLANKTON POPULATION STATISTICS
74			CURRENT PROFILES FROM TILT DATA
16	FORTTRAN V	UNIVAC 1108	STD-S/V DATA S2049
32	FORTTRAN V	UNIVAC 1108	STEADY STATE TRAPEZOIDAL ARRAY CONFIGURATIONS
32	FORTTRAN V	UNIVAC 1108	ANCHOR LAST-BUCY SYSTEM DEVELOPMENT DYNAMICS
33	FORTTRAN V	UNIVAC 1108	CABLE TOWED BUCY CONFIGURATIONS IN A TURN
33	FORTTRAN V	UNIVAC 1108	FREE-FLOATING SPAR-ARRAY DYNAMICS
33	FORTTRAN V	UNIVAC 1108	FREE-FLOATING SPAR-BUCY DYNAMICS
33	FORTTRAN V	UNIVAC 1108	SHIP SUSPENDED ARRAY DYNAMICS
34	FORTTRAN V	UNIVAC 1108	BOEMERANG CORER DESCENT/ASCENT TRAJECTORIES
34	FORTTRAN V	UNIVAC 1108	BUCY-SHIP DYNAMICS
34	FORTTRAN V	UNIVAC 1108	BUCY-SYSTEM DYNAMICS
34	FORTTRAN V	UNIVAC 1108	FIXED THIN LINE ARRAY DYNAMICS
35	FORTTRAN V	UNIVAC 1108	FIXED THIN LINE ARRAY STEADY STATE CONFIGURATION
35	FORTTRAN V	UNIVAC 1108	MARINE CORER DYNAMICS
35	FORTTRAN V	UNIVAC 1108	STEADY-STATE BUCY SYSTEM CONFIGURATIONS
36	FORTTRAN V	UNIVAC 1108	STEADY-STATE SUBSURFACE BUCY SYSTEM CONFIGURATION
36	FORTTRAN V	UNIVAC 1108	TOWED ARRAY DYNAMICS

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142	FORTTRAN	CDC 3300	SOLVE ALGEBRAIC EQUATIONS MATRIX
121	FORTTRAN	CDC 3300	PHYSICAL DATA PLOT FRAME
99	FORTTRAN	CDC 3300	ACOUSTIC PERFORMANCE AND EVALUATION
94	FORTTRAN	CDC 3300	SOUND REFRACTION CORRECTIONS FITIT
15	FORTTRAN		SIGMA-T INVREJ
15	FORTTRAN		STD PROCESSING OCEAN DATA
15	FORTTRAN		INTERNAL WAVES WITCOMB
15	FORTTRAN	CDC 3200	INTERPOLATION FOR OCEANOGRAPHIC DATA
15	FORTTRAN	IBM 1620	INTERPOLATION FOR OCEANOGRAPHIC DATA
75	FORTTRAN	CDC 3300	CURRENT METER DATA CREATE-C
75	FORTTRAN	CDC 3300	CURRENT METER DATA CURRENT
75	FORTTRAN	CDC 3300	CURRENT METER DATA CURRLOT
75	FORTTRAN	CDC 3300	CURRENT METER DATA SPECTRUM

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93	FORTTRAN IV	CDC 6500	NORMAL MODE CALCULATIONS NORMOD 3
93	FORTTRAN	CDC 6400	HORIZONTAL RANGE

NAVY, NAVAL RESEARCH LABORATORY, WASHINGTON, DC

120	FORTTRAN	CDC 3800	LINE PRINTER PLCTS
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124 ASSEMBLY	HP 2100S	PLCTTER CCMMANDS P&ET DVRI0
100 FORTRAN 63	CDC 3800	GRASS UNDERWATER ACCUSTICS PREDICTION DTSTOV
100 FORTRAN 63	CDC 3800	GRASS UNDERWATER ACOUSTICS-PREDICTION VFC
100 FORTRAN 63	CDC 3800	GRASS UNDERWATER ACCUSTICS PREDICTION CTOUR
100 FORTRAN 63	CDC 3800	GPASS UNDERWATER ACCUSTICS PREDICTION PRFPLT
100 FORTRAN 63	CDC 3800	GRASS UNDERWATER ACCUSTICS PREDICTION SERPENT
101 FORTRAN 63	CDC 3800	GRASS UNDERWATER ACCUSTICS PREDICTION RAFLCT
101 FORTRAN 63	CDC 3800	GRASS UNDERWATER ACCUSTICS PREDICTION LCSSPLOT
16 FCRTAN IV	HP 2100S	THERMCMETRIC DEPTH CALCULATION CAST
16 FORTRAN IV	HP 2100S	THERMCMETER DATA FILE HANDLER THERMO
16 FCRTAN	CDC 3800	INTERNAL GRAVITY WAVES DISPER
16 FORTRAN IV	CDC 3200	SEA SURFACE TEMPERATURES ANALYSIS
31 BASIC	HP 9830A	UNMANNED FREE-SWIMMING SUBMERSIBLE PLOT
32 BASIC	HP 9830A	UNMANNED FREE-SWIMMING SUBMERSIBLE HOTEL LOAD
32 BASIC	HP 9830A	UNMANNEC FREE-SWIMMING SUBMERSIBLE
107 FORTRAN	CDC 3800	ANNCTATED TRACK ON STEREOGRAPHIC PROJECTION
107 FCRTAN IV	HP 2100S	ANNOTES CHART
108 FORTRAN IV	HP 2100S	BATHYPETRIC CR MAGNETICS CHART PROFL
108 FORTRAN IV	HP 2100S	MERCATOR CHART DIGITIZATION ANTRK
108 FORTRAN IV	HP 2100S	BATHYPETRIC CHART DIGITIZATION DGBTH
108 FCRTAN IV	HP 2100S	PLCTS ON STEREOGRAPHIC CHART ANNOT
108 FORTRAN IV	HP 2100S	PLCTS NAVIGATION DATA OCEAN
109 FORTRAN IV	HP 2100S	LONG BASE LINE ACCUSTIC TRACKING
89 FCRTAN	CDC 3800	MIE SCATTERING COMPUTATIONS
47 FORTRAN	CDC 3600	PLCTS TRACK AND DATA PROFILE TRACK
47 FORTRAN	CDC 3800	PLOTS TRACK AND DATA PROFILE TRACK
47 FORTRAN	CDC 3800	GECDATA
47 FORTRAN	CDC 3600	GEODATA
47 FCRTAN	CDC 3600	MAGNETIC SIGNATURES MAGPLCT
47 FCRTAN	CDC 3800	MAGNETIC SIGNATURES MAGPLOT
107 FORTRAN	CDC 3600	ANNCTATED TRACK ON STEREOGRAPHIC PROJECTION

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91 FORTRAN II CDC 180A ICE DRIFT ANALYSIS/FORECAST

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139 FORTRAN	IBM 7074	LEAST SQUARES PLOT
139 FORTRAN	UNIVAC 1108	TEMPERATURE SALINITY CORRECTIONS CURVEFIT NIS512
139 FORTRAN	PDP-9	BARTLETT'S CURVE FITTING
121 FORTRAN V	UNIVAC 1108	REFORMATS DATA PLOTS TRACK CHART MASTRACK
121 FORTRAN		PRODUCES CONTOUR CHARTS GRICIT
121 FORTRAN		PRODUCES CONTOUR CHARTS AUTOMATED CONTOUR
100 FORTRAN	IBM 7074	CRITICAL ACCUSTIC RATIC
97 FORTRAN	UNIVAC 1108	SOUND VELOCITY FOR MARINE SEDIMENTS
58 FORTRAN	IBM 7074	LIGHT AND SOUND INSTRUCTION B
45 FCRTAN	IBM 7074	LIGHT AND SOUND INSTRUCTION D
144 FORTRAN	IBM 7074	BATHYPETRIC DATA REDUCTION
14 FORTRAN	IBM 7074	MONTHLY SONIC LAYER DEPTH
14 FCRTAN	IBM 7074	VERTICAL TEMPERATURE GRADIENTS
14 FORTRAN V	UNIVAC 1108	WATER CLARITY
137 FORTRAN	IBM 7074	SINGLE INTEGRATION
110 FORTRAN II	IB7 7074	INDIVIDUAL POINT GENERATOR FOR MAP PROJECTIONS
111 FORTRAN II	IB7 7074	INDIVIDUAL POINT GENERATOR FOR DISTANCE
111 FORTRAN	IB7 7074	GEODETIC DATUM REDUCTION
111 FORTRAN	IB7 7074	GEODETIC POSITION COMPUTATION AND PLOT

111 FORTRAN		ASTRONOMIC LATITUDE
112 FORTRAN	CDC 3100	SOUNDING PLCT
112 FORTRAN	IBM 7074	SOUNDING PLCT
112 FORTRAN	IBM 7074	SINGLE INTEGRATION
112 FORTRAN	CDC 3100	SODANO INVERSE
89 FORTRAN	IBM 7074	SOLAR RADIATION CONVERSION
89 FORTRAN	IBM 7074	WIND STRESS
89 FORTRAN	IBM 7074	TWO-DIMENSIONAL POWER SPECTRUM FOR SWOP II
90 FORTRAN	IBM 7074	PREDICTION OF VERTICAL TEMPERATURE CHANGE
90 FORTRAN	IBM 7074	CLOUD COVER AND DAILY SEA TEMPERATURE
46 FORTRAN	IBM 7074	SEACUNT MAGNETIZATION
46 FORTRAN	IBM 7074	OBSERVATION CRAPING GRAVITY
48 FORTRAN	UNIVAC 1108	SEDIMENT SIZE
48 FORTRAN IV	UNIVAC 1108	BOTTOM SEDIMENT DISTRIBUTION PLOT
76 FORTRAN	IBM 7074	CURRENT METER TURBULENCE
76 FORTRAN V	UNIVAC 1108	IN-SITU CURRENT
76 FORTRAN	UNIVAC 1108	WATER DISPLACEMENT DISPLA
77 FORTRAN V	UNIVAC 1108	CURRENT METER PRINT
77 FORTRAN V	UNIVAC 1108	CURRENT METER PLOT
77 FORTRAN V	UNIVAC 1108	CONVERT CURRENT METER TAPE
77 FORTRAN V	UNIVAC 1108	CURRENT METER DATA PRINTO

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109 FORTRAN	UNIVAC 1108	FAA FLCT
109 FORTRAN	UNIVAC 1108	DISTANCE AND AZIMUTH CIRAZD
109 FORTRAN	UNIVAC 1108	PARAMETRIC MAP
110 FORTRAN	UNIVAC 1108	LORAN TO GEOGRAPHIC AND GEOGRAPHIC TO LCRAN
110 FORTRAN	UNIVAC 1108	LORAN COORDINATE COMPUTATION
110 FORTRAN	UNIVAC 1108	LORAN SKYWAY CORRECTION

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13 BASIC	IBM 360	ENVIRONMENTAL DYNAMICS SUBROUTINES OCEANLIB
13 BASIC	IBM 360	GESTROPHIC CURRENT

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84 FORTRAN	IBM 360/165	WAVE INTERACTION WITH CURRENT & PGRAY
24 FORTRAN	IBM 370/165	ESTUARINE MODEL NONLNR
26 FORTRAN	CDC 6400	UPWELLING CSTLUPWL
26 FORTRAN IV	IBM 360	MATHEMATICAL WATER QUALITY MODEL FOR ESTUARIES
26 FORTRAN IV	IBM 360	COMPUTATION OF FLOW THROUGH MASONBRC INLET NC
26 FORTRAN IV	IBM 360	CIRCULATION IN PAMLIC SOUND

OREGON STATE UNIVERSITY, CORVALLIS, OR

126 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND ACFFT
126 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND ACCRR
126 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND ACRPLT
126 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND ALIGN
126 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND AMPACO
126 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND ARMAP
126 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND AUTO
126 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND AUTCPLT

126	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	AXISL
126	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CCFFT
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CCORR
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CCNPLT
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	COMPLT
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CGNFID
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CGNFID 1
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CGNMODE
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CCPH
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	COSTR
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CPEES
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CPLT1
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CPLT2
127	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	CROPLT
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CROSS
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CUSID
127	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CUSFO
128	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	CZT
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	DATPLT
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	DEM0D1
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	DEMCD2
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	DEM0D3
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	GETRND
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	DIFF12
128	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	EUREKA
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	EXSMG
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	FFIN
128	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	FFINI
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	FFTCNV
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	FFTPS
128	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	FFTS
128	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	FFTSPC
128	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	FILTER1
128	FORTTRAN	CDC 3000/OS3	TIME	SERIES	ARAND	FIVET
129	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	FCLD
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	FCURTR
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	FOUSPC
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	FCUSPC1
129	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	FCUSPC2
129	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	FRESPON
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	GAPH
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	GENER1
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	GENER2
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	GENER3
129	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	LOGPLOT
129	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	NC12T
129	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	PHAPLT
129	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	PLTFOR
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	PLTFRQ
129	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	PLTSPC
130	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	PCLRT
130	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	PCLYDV
130	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	PROPLT
130	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	PSQRT
130	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	RANCM
130	FORTTRAN	CDC 3300/OS3	TIME	SERIES	ARAND	RCTFFT
130	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	RESPON
130	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	REVERS
130	FORTTRAN	CDC 3300/CS3	TIME	SERIES	ARAND	RPLACE

130 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND RRVRS
130 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND SARIT
130 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND SERGEN
130 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND SHAPE
130 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND SINTR
130 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND SMO
130 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND SPEC
130 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND SPECT1
130 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND SPECT2
131 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TAUTOPLT
131 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TCOHPLT
131 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TCROPLT
131 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TFORM1
131 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TFORM2
131 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TIMSPC
131 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TLGGPLT
131 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TNCIPLT
131 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TPHAPLT
131 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TPLTRQ
131 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TPLTSPC
131 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TRISMO
132 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TSGEN
132 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TSPECT1
132 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TSPECT2
132 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TRANFR
132 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TRANFRM
132 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND TTYCON
132 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND TTYNUM
132 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND UNLEAV
132 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND USES
132 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND USFC
132 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND USIC
132 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND USPE
132 FORTRAN	CDC 3300/CS3	TIME SERIES ARAND WINDOW
133 FORTRAN	CDC 3300/OS3	TIME SERIES ARAND WINDOW1
25 FORTRAN	IBM 370/155	ESTUARINE DENSITY CURRENTS AND SALINITY
39 FORTRAN IV	CDC 3300	GEOPHYSICAL DATA REDUCTION AND PLOTTING
39 FORTRAN IV	CDC 3300	PROCESSING/DISPLAY MARINE GEOPHYSICAL DATA
39 FORTRAN IV	CDC 3300	MARINE SEISMIC DATA REDUCTION AND ANALYSIS
39 FORTRAN IV	CDC 3300	A LIBRARY OF GEOPHYSICAL SUBROUTINES GLIB

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91 FORTRAN IV	IBM 7090-94	SEA ICE STUDIES YARIT
91 FORTRAN IV	IBM 7090-94	SEA ICE STUDIES FLAP
91 FORTRAN IV	IBM 7090-94	SEA ICE STUDIES SALPR
91 FORTRAN IV	IBM 7090-94	SEA ICE STUDIES RITE

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38 FORTRAN IV	CDC 6600	CONVECTION INVARIABLE VISCOSITY FLUID CONVEC
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142 FORTRAN	IBM 1800	TRIGONOMETRY SUBROUTINES ASSUB SAS ASA
116 FORTRAN IV	CDC 3600	PLOTTING PROGRAM PRCL

149 FORTRAN	IBM 1800	FORMAT FREE INPUT SUBROUTINE QREAD
149 FORTRAN	IBM 1800	METERS VS PATHCMS MATBL
144 FORTRAN	IBM 1800	DATE CALCULATIONS DAYWK
144 FORTRAN	IBM 1800	DATE CALCULATIONS NWDAT
144 FORTRAN	IBM 1800	DATE CALCULATIONS NXTDY
144 FORTRAN	IBM 1800	DATE CALCULATIONS YSTOY
145 FORTRAN	IBM 1800	JULIAN DAY SUBROUTINES CLEJL
145 FORTRAN	IBM 1800	JULIAN DAY SUBROUTINES CLJUL
145 FORTRAN	IBM 1800	TIME CONVERSION DTIME
146 FORTRAN 63	CDC 6600	HYDROGRAPHIC DATA REDUCTION TWO FIVE
2 FORTRAN IV	CDC 6600	STD DATA PROCESSING
105 FORTRAN	IBM 1800	PLCTS MERCATOR GRID CHART
105 FORTRAN	IBM 1800	NAVIGATIONAL SATELLITE PASSES ALRTX
106 FORTRAN	IBM 1800	LORAN FIX LRFIX
106 FORTRAN	IBM 1800	PLAN COURSE AND SCHEDULE CRUIS
106 FORTRAN	IBM 1800	EARTH SPHERICAL SUBROUTINES ESTCH ESTC2 ESTPL
107 FORTRAN	IBM 1800	DEGREE CONVERSIONS DEGFR DEMI
107 FORTRAN	IBM 1800	MERCATOR DEGREES DMRCT
107 FORTRAN	IBM 1800	MAGNETIC FIELD COMPONENTS MAGFI
51 FORTRAN	CDC 3600	SPECIES AFFINITIES REGROUP
116 FORTRAN	CDC 3600	X-Y PLCTS MUCPAK
2 ALGOL	B 6700	STATION DATA RETRIEVAL HYDROSEARCH
142 ALGOL	B 6700	INTERACTIVE CALCULATIONS DSDP/CALC
98 ALGOL	B 6700	SCUNC VELOCITY THRU SCLID SAMPLES DSDP/SCN
148 ALGOL	B 6700	MAILING LABELS
48 ALGOL	B 6700	SAND SILT AND CLAY FRACTIONS DSDP/GRAIN

SOUTHAMPTON COLLEGE, SOUTHAMPTON, NY

25 FORTRAN IV IBM 360/85 MIT SALINITY INTRUSION PROGRAM

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7 FORTRAN IV	IBM 360/65	READ CALC INTERP STATION DATA CAPRICRN
7 FORTRAN IV	IBM 360/65	STATION DATA CALCULATIONS F3
8 FORTRAN IV	IBM 360/65	PLCTS STATION DATA PLTDT
8 FORTRAN IV	IBM 360/65	CALCULATES STATION DATA SECPG
103 FORTRAN IV	IBM 360/65	PLCTS MAPS GRIDS TRACKS MAP

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5 FORTRAN IV B 6700 CCEANOGRAHY STATION COMPUTER PROGRAM

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79 FORTRAN II IBM 1620 PROCESSES CURRENT INSTRUMENT OBSERVATIONS

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25 FORTRAN IV IBM 360 DYNAMIC DETERMINISTIC SIMULATION SIMUDELT

UNIVERSITY OF HAWAII, HONOLULU, HI

116 FORTRAN	IBM 360	DENDROGRAPH
116 FORTRAN	IBM 370	DENDROGRAPH

UNIVERSITY OF ILLINOIS, URBANA, IL

83 FORTRAN IV IBM 360/75 WAVE BCTTCM VELOCITY

UNIVERSITY OF MAINE, WALPCLE, ME

153 FORTRAN	IBM 370	REFORMATTED STATION OUTPUT IBM 1
28 FORTRAN IV	IBM 370	ESTUARINE CHEMISTRY MYACHEM
28 FORTRAN IV	IBM 370	ESTUARINE TICES
55 FORTRAN	IBM 370	CHLCRCPHYLL CHLOR
55 FORTRAN	IBM 370	PHYTOPLANKTON POPULATION DENSITY
55 FORTRAN	IBM 370	SPECIES DIVERSITY

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24 FORTRAN IV	UNIVAC 1108	THREE DIMENSIONAL ESTUARINE CIRCULATION MODEL
50 FORTRAN IV	UNIVAC 1108	INVERSE PROBLEM IN ECOSYSTEM ANALYSIS

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20 FORTRAN	PDP-11	GENERAL PURPOSE EDITOR DMSD
20 FORTRAN	PDP-11	TIME SERIES INTO PROFILES CMSCHP
20 FORTRAN	PDP-11	AANDERAA CURRENT METER DATA AACAL
20 FORTRAN	PDP-11	CURRENT PROFILES DATA MK2CAL
20 FORTRAN	PDP-11	APPENDS NEW DATA TO FILE DERIVE
20 FORTRAN	UNIVAC 1106	APPENDS NEW DATA TO FILE DERIVE
20 FORTRAN	UNIVAC 1106	CONCATENATES SORTS SEGMENTS OUTPUTS DMSCRT
20 FORTRAN	UNIVAC 1106	INTERPOLATES TO UNIFORM GRID MATRIX 01
20 FORTRAN	UNIVAC 1106	TIME SERIES STD OR PCM PROFILES PLSAD
20 FORTRAN	UNIVAC 1106	INTERNAL WAVES IWEG
20 FORTRAN	UNIVAC 1106	DYNAMICAL FIELDS INTERNAL WAVE RAYS CHRSEC
20 FORTRAN	UNIVAC 1106	AUTC AND CRSS SPECTRA TUKEY METHOD
20 FORTRAN	UNIVAC 1106	AUTC AND CRSS SPECTRA POLARIZED FORM CMXSPC
20 FORTRAN	UNIVAC 1106	AMPLITUDES PHASES LEAST SQUARES TIDES4
20 FORTRAN	UNIVAC 1106	METEOROLOGICAL FLUXES METFLX
20 FORTRAN	UNIVAC 1106	CROSS COVARIANCE MATRIX EMPEIGI

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104 MAD	IBM 7090	GENERAL MAP PROJECTION
104 MAD	IBM 7090	FINITE MAP PROJECTION DISTORTIONS

UNIVERSITY OF PITTSBURGH, PITTSBURGH, PA

80 MAD	IBM 7090	THEORETICAL FACIAL TIDAL FORCE
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28 FORTRAN	IBM 370/155	MODELING AN OCEAN POND
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UNIVERSITY OF PUERTO RICO, MAYAGUEZ, PR

5-FORTRAN II	PDP 8E	MASS TRANSPRT AND VELOCITIES GEOMASS
5 FORTRAN IV	PDP 10	STATION DATA THIRP
5 FORTRAN. IV	PDP 10	THERMCMETER CORRECTION THERMOMETRIC DEPTH

UNIVERSITY OF TEXAS, PORT ARANSAS, TX

147 FORTRAN IV	IBM 360/65	READS NCDC STATION DATA TAPE
51 FORTRAN IV	CDC 6600	PRODUCTIVITY CYXGEN
52 FORTRAN IV	CDC 6600	SPECIES DIVERSITY JOB
52 FORTRAN IV	CDC 6600	PRODUCTIVITY ECCPRCD

UNIVERSITY OF WASHINGTON, SEATTLE, WA

146 FORTRAN II	IBM 7094	STATION DATA REDUCTION SYNOP
27 FORTRAN IV	CDC 6400	THREE-DIMENSIONAL SIMULATION PACKAGE AUGUR
52 FORTRAN IV	IBM 7094	CONCENTRATIONS PER SQUARE METER OF SURFACE
52 FORTRAN IV	CDC 6400	COMBINED CHLOROPHYLL AND PRODUCTIVITY
53 FORTRAN IV	IBM 7094	PHYTOPLANKTON NUMBERS VOLUME SURFACE AREA
53 MAP	IBM 7094	PHYTOPLANKTON NUMBERS VOLUME SURFACE AREA

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134 FORTRAN IV	UNIVAC 1108	SPECTRAL ANALYSIS OF TIME SERIES
134 ALGOL	B 67CO	SPECTRAL ANALYSIS OF TIME SERIES

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY, BLACKSBURG, VA

136 FORTRAN IV	IBM 370	PROBABILITY DISTRIBUTION WEIBUL
56 FORTRAN IV	IBM 370	RESOURCES ALLOCATION IN FISHERIES MGT PISCES
56 FORTRAN IV	IBM 370	WATER RESOURCES TEACHING GAME DAM
50 FORTRAN	IBM 370	OPTIMAL ECOSYSTEM POLICIES CEP

WILLIAMS COLLEGE, WILLIAMSTOWN, MA

25 FORTRAN IV	IBM 1130	BEACH SIMULATION MODEL
29 FORTRAN IV	IBM 1130	BEACH AND NEARSHORE MAPS A-S

WOODS HOLE OCEANOGRAPHIC INSTITUTION, WOODS HOLE, MA

118 FORTRAN IV	XDS SIGMA 7	HORIZONTAL HISTOGRAMS HISTO
118 FORTRAN IV	XDS SIGMA 7	PRINTER PLOTS LISPLO
119 FORTRAN IV	XDS SIGMA 7	PLCT CF FREQUENCY DISTRIBUTION THISTC
119 FORTRAN IV	XDS SIGMA 7	VELOCITY VECTOR AVERAGES VECTAV
119 FORTRAN IV	XDS SIGMA 7	PROGRESSIVE VECTORS PROVEC
119 FORTRAN IV	XDS SIGMA 7	PLOTS DATA ALONG TRACK
119 FORTRAN IV	XDS SIGMA 7	PROFILE VERSUS TIME OR DISTANCE
120 FORTRAN IV	HP MINI	PLCTS NAVIGATION WITH ANY OTHER DATA TYPE DEEP6
102 FORTRAN IV	XDS SIGMA 7	RAYTRACE
97 FORTRAN IV	XDS SIGMA 7	SOUND VELOCITY SONVEL

97	FORTTRAN	IV	XDS	SIGMA	7	DEPTH CORRECTION MICOR SOUND VELOCITY
148	FORTTRAN	IV	XDS	SIGMA	7	EDITING FOR WHCI FORMAT SCRUB
143	FORTBAN	IV	XDS	SIGMA	7	THERMOMETER CORRECTION TCPLC
143	FORTTRAN		HP	2100		THERMOMETER CORRECTION DEPTH COMP HYD1
8	FORTTRAN	IV	HP	2100		STATION DATA HYC2
8	FORTTRAN	IV	XDS	SIGMA	7	BRUNT-VAISALA FREQUENCY OBVFRQ
9	FORTTRAN	IV	XDS	SIGMA	7	DYNAMIC HEIGHT DYNHT
9	FORTTRAN	IV	XDS	SIGMA	7	POTENTIAL ENERGY ANOMALY PEN
9	FORTTRAN	IV	XDS	SIGMA	7	VARIOUS PARAMETERS FROM STATION DATA OCCOMP
9	FORTTRAN	IV	XDS	SIGMA	7	SPECIFIC VOLUME ANOMALY SVANOM
9	FORTTRAN	IV	XDS	SIGMA	7	PRESSURE SUBROUTINE PRESS
10	FORTTRAN	IV	XDS	SIGMA	7	REACS STATION DATA
10	FORTTRAN	IV	XDS	SIGMA	7	GECSTROPHIC VELOCITY DIFFERENCE VEL
10	FORTTRAN	IV	XDS	SIGMA	7	VOLUME TRANSPORT VTR
10	FORTTRAN	IV	XDS	SIGMA	7	SIGMA-T SIGMAT AND DSIGMT
10	FORTTRAN	IV	XDS	SIGMA	7	ADIABATIC TEMPERATURE GRADIENT ATG
10	FORTTRAN	IV	XDS	SIGMA	7	POTENTIAL TEMPERATURE POTEMP
10	FORTTRAN	IV	XDS	SIGMA	7	SPECIFIC VOLUME SPVOL
136	FORTTRAN	IV	XDS	SIGMA	7	STATISTICS FROM WHCI FORMAT STATS
105	FORTTRAN	IV	HP	2100S		LORAN OR CMEGA CONVERSION GEPOS
105	FCRTRAN	IV	HP	3100A		CRUISE TRACK TMERC
105	FORTTRAN	IV	XDS	SIGMA	7	TRANSFORMATION OF SPHERICAL COORDINATES ROTGUT
106	FORTTRAN	IV	XDS	SIGMA	7	SUM OF FINITE RECTANGLES ON A SPHERE SUMROT
41	FORTTRAN	IV	XDS	SIGMA	7	GECMAGNETIC FIELD MFIELD
50	FORTTRAN	IV	XDS	SIGMA	7	WHOI BIOLOGY SERIES FTAPE
50	FORTTRAN	IV	XDS	SIGMA	7	WHOI BIOLOGY SERIES FLISHT
50	FORTTRAN	IV	XDS	SIGMA	7	WHOI BIOLOGY SERIES CHKSPIT
50	FORTTRAN	IV	XDS	SIGMA	7	WHOI BIOLOGY SERIES SELECT
50	FORTTRAN	IV	XDS	SIGMA	7	WHOI BIOLOGY SERIES CHANAT
50	FORTTRAN	IV	XDS	SIGMA	7	WHOI BIOLOGY SERIES PREPLOTG
50	FORTTRAN	IV	XDS	SIGMA	7	WHOI BIOLOGY SERIES PLOTSPECG
50	FCRTRAN	IV	XDS	SIGMA	7	WHOI BIOLOGY SERIES STATAB
77	FORTTRAN	IV	XDS	SIGMA	7	CURRENT METER CLOCK SEQUENCE XTAL
78	FORTTRAN	IV	XDS	SIGMA	7	CURRENT METER CALIBRATION GASDEC
78	FORTTRAN	IV	XDS	SIGMA	7	CURRENT METER DATA REDUCTION AND EDITING CARP

# FEDERAL INFORMATION PROCESSING STANDARD SOFTWARE SUMMARY

01. Summary date			02. Summary prepared by (Name and Phone)						03. Summary action					
Yr.	Mo.	Day	05. Software title						New	Replacement	Deletion			
<input type="text"/>	<input type="text"/>	<input type="text"/>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
04. Software date									Previous Internal Software ID					
Yr.	Mo.	Day							07. Internal Software ID					
06. Short title														
08. Software type			09. Processing mode			10. Application area								
<input type="checkbox"/> Automated Data System <input type="checkbox"/> Computer Program <input type="checkbox"/> Subroutine/Module			<input type="checkbox"/> Interactive <input type="checkbox"/> Batch <input type="checkbox"/> Combination			General <input type="checkbox"/> Computer Systems Support/Utility <input type="checkbox"/> Scientific/Engineering <input type="checkbox"/> Bibliographic/Textual			Management/Business <input type="checkbox"/> Process Control <input type="checkbox"/> Other			Specific		
11. Submitting organization and address						12. Technical contact(s) and phone								
13. Narrative														
14. Keywords														
15. Computer manufr and model			16. Computer operating system			17. Programing language(s)			18. Number of source program statements					
19. Computer memory requirements			20. Tape drives			21. Disk/Drum units			22. Terminals					
23. Other operational requirements														
24. Software availability						25. Documentation availability								
Available <input type="checkbox"/>		Limited <input type="checkbox"/>		In-house only <input type="checkbox"/>		Available <input type="checkbox"/>		Inadequate <input type="checkbox"/>		In-house only <input type="checkbox"/>				
26. FOR SUBMITTING ORGANIZATION USE														

185-101

Standard Form 185  
- 1974 July  
U.S. Dept. of Commerce—NBS  
(FIPS. Pub. 30)

## INSTRUCTIONS

01. **Summary Date.** Enter date summary prepared. Use Year, Month, Day format: YYMMDD.
02. **Summary Prepared By.** Enter name and phone number (including area code) of individual who prepared this summary.
03. **Summary Action.** Mark the appropriate box for new summary, replacement summary or deletion of summary. If this software summary is a replacement, enter under "Previous Internal Software ID" the internal software identification as reported in item 07 of the original summary, and enter the new internal software identification in item 07 of this form, complete all other items as for a new summary. If a software summary is to be deleted, enter under "Previous Internal Software ID" the internal software identification as reported in item 07 of the original summary, complete only items 01, 02, 03 and 11 on this form.
04. **Software Date.** Enter date software was completed or last updated. Use Year, Month, Day format: YYMMDD.
05. **Software Title.** Make title as descriptive as possible.
06. **Short Title.** (Optional) Enter commonly used abbreviation or acronym which identifies the software.
07. **Internal Software ID.** Enter a unique identification number or code.
08. **Software Type.** Mark the appropriate box for an Automated Data System (set of computer programs), Computer Program, or Subroutine/Module, whichever best describes the software.
09. **Processing Mode.** Mark the appropriate box for an Interactive, Batch, or Combination mode, whichever best describes the software.
10. **Application Area.**  
**General:** Mark the appropriate box which best describes the general area of application from among:  

Computer Systems Support/Utility	Process Control
Management/Business	Bibliographic/Textual
Scientific/Engineering	Other

**Specific:** Specify the sub-area of application, e.g. "COBOL optimizer" if the general area is "Computer Systems Support/Utility", "Payroll" if the general area is "Management/Business"; etc. Elaborate here if the general area is "Other."
11. **Submitting Organization and Address.** Identify the organization responsible for the software as completely as possible, to the Branch or Division level, but including Agency, Department (Bureau, Administration), Service, Corporation, Commission, or Council. Fill in complete mailing address, including mail code, street address, city, state, and ZIP code.
12. **Technical Contact(s) and Phone:** Enter person(s) or office(s) to be contacted for technical information on subject matter and/or operational aspects of software. Include telephone area code. Provide organization name and mailing address, if different from that in item 11.
13. **Narrative.** Describe concisely the problem addressed and methods of solution. Include significant factors such as special operating system modifications, security concerns, relationships to other software, input and output media, virtual memory requirements, and unique hardware features. Cite references, if appropriate.
14. **Keywords.** List significant words or phrases which reflect the functions, applications and features of the software. Separate entries with semicolons.
15. **Computer Manufacturer and Model.** Identify mainframe computer(s) on which software is operational.
16. **Computer Operating System.** Enter name, number, and release under which software is operating. Identify enhancements in the Narrative (item 13).
17. **Programming Language(s).** Identify the language(s) in which the software is written, including version, e.g., ANSI COBOL, FORTRAN V, SIMSCRIPT II.5, SLEUTH II.
18. **Number of Source Program Statements.** Include statements in this software, separate macros, called subroutines, etc.
19. **Computer Memory Requirements.** Enter minimum internal memory necessary to execute software, exclusive of memory required for the operating system. Specify words, bytes, characters, etc., and number of bits per unit. Identify virtual memory requirements in the Narrative (item 13).
20. **Tape Drives.** Identify number needed to operate software. Specify, if critical, manufacturer, model, tracks, recording density, etc.
21. **Disk/Drum Units.** Identify number and size (in same units as "Memory"—item 19) needed to operate software. Specify, if critical, manufacturer, model, etc.
22. **Terminals.** Identify number of terminals required. Specify, if critical, type, speed, character set, screen/line size, etc.
23. **Other Operational Requirements.** Identify peripheral devices, support software, or related equipment not indicated above, e.g., optical character devices, facsimile, computer-output microfilm, graphic plotters.
24. **Software Availability.** Mark the appropriate box which best describes the software availability from among: Available to the Public, Limited Availability (e.g., for government use only), and For In-house Use Only. If the software is "Available", include a mail or phone contact point, as well as the price and form in which the software is available, if possible.
25. **Documentation Availability.** Mark the appropriate box which best describes the documentation availability from among: Available to the Public, Inadequate for Distribution, and For In-house Use Only. If documentation is "Available", include a mail or phone contact point, as well as the price and form in which the documentation is available, if possible. If documentation is presently inadequate, show the expected availability date.
26. **For Submitting Organization Use.** This area is provided for the use of the organization submitting this summary. It may contain any information deemed useful for internal operation.