Thirty Years of Meteorological Education at a Historically Black University

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ABSTRACT

Since 1975, the Jackson State University Meteorology Program (JSUMP) has played a unique role in the preparation of minorities for careers in the atmospheric sciences. Through external partnerships, incorporation of undergraduate research, summer internships, and involvement in activities of the professional societies, the JSUMP has graduated around 55 atmospheric scientists from underrepresented minorities between 1978 and 2008. In recent years, about half of the graduates have continued on to graduate school. These contributions are important to the National Oceanic and Atmospheric Administration's (NOAA) goal to develop a more diverse workforce, in particular for the National Weather Service. The JSUMP has also become active in outreach activities to K–12 schools and the general public through workshops, camps, and Web sites. © *2013 National Association of Geoscience Teachers*. [DOI: 10.5408/08-073.1]

Key words: meteorology, minority, undergraduate, Mississippi, atmospheric

INTRODUCTION AND HISTORICAL BACKGROUND

The Jackson State University (JSU) Meteorology Program, resident within the Department of Physics, Atmospheric Sciences and Geoscience and contained within the university's College of Science, Engineering and Technology, prepares minority meteorology majors for careers in the atmospheric sciences. The Meteorology Program is designed to enhance the number of minority professional meteorologists and boost the number of those professionals available to pursue advanced studies within the atmospheric sciences. From the program's humble beginnings in the mid-1970s, the JSU Meteorology Program (JSUMP) has grown in both students and capabilities. After some 30 y and over 60 graduates (only about five of whom were white or international students), there are now about 30 majors pursuing a bachelor's of science (BS) in meteorology. Beginning in 1975, JSU was the only historically black college/university (HBCU) offering an undergraduate degree in atmospheric science or meteorology. In 2008, North Carolina A&T University began offering a BS in atmospheric science. According to Williams et al. (2007), 2,698 bachelor degrees in meteorology were awarded in the United States over the 6 y period from 1995 to 2001, with only 45 of them being earned by African Americans. Hence, only about 1.7% of BS degrees in meteorology were earned by African Americans during the period, which is far below the 2000 census demographics of African Americans making up 12% of the United States population. Between 1995 and 2001, JSU produced 23 bachelor degrees in meteorology, 20 of them to African Americans. While the absolute number is small, it is significant because it indicates that JSU has been producing over 40% of all bachelor degrees earned in atmospheric science in the United States by African Americans.

During the past 30 y, members of underrepresented groups have also made tremendous strides in obtaining advanced degrees within scientific fields. African Americans within the atmospheric sciences, however, have continued to lag behind compared to other fields (Czujko and Henly, 2003), primarily due to the lack of a "pipeline" of candidates available to enter graduate study. Over the period, African Americans comprised less than four percent of the master's degrees earned and less than two percent of the doctoral degrees (Williams et al., 2007). Although still far below the general population demographics, the fact that this is equal to or greater than the numbers for bachelor degrees is nevertheless evidence that a disproportionate number of African American meteorologists are successful at continuing on to advanced degrees. Various factors often contribute to the lack of African American participation, such as persistent stereotyping and bias, lack of role models, inadequate faculty interest or support, the need for dedicated and understanding mentors, and economic constraints of both students and HBCUs. However, the preparation of minority atmospheric scientists is of growing importance, as non-white, non-Hispanic groups are projected by the U.S. Census Bureau to comprise approximately 50% of the United States population by 2050.

The JSUMP is specifically designed to help minority students overcome both real and perceived obstacles (Huntoon and Lane, 2007). Through innovative academic, professional, and operational training and federally sponsored research and internship initiatives, the capacity of the Meteorology Program continues to expand and to increase student opportunities for graduate education and for successful careers in meteorology. Recruitment of minorities into technical, engineering, and science degree programs is made more difficult due to many high school graduates either entirely lacking or possessing poor backgrounds in mathematics and science. Very few have had opportunity for any exposure to the geosciences. These factors contribute to disproportionately low numbers of minority students initially enrolling in meteorology and atmospheric science programs.

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However, after recruitment and initial enrollment, minority students still must be retained within the atmospheric science programs until completion of their degree.

According to statistics compiled through 2002 by the Mississippi Institutes of Higher Learning (IHL), only one half of all Mississippi students who initially enroll in community college, college, or university ultimately complete a bachelor's degree. The percentage for African Americans who complete a bachelor's degree is about 35%. In mathematics, engineering, and science, this number is much less, at only 8%. Due in particular to the rigorous mathematics requirements and, in many cases, changes of major, it is also commonly the case that more than 4 y of study are required to successfully complete these degrees.

The First Twenty Years

In 1975, the Mississippi State Board of Trustees of Higher Education authorized Jackson State College (as it was then known) to offer a program in meteorology leading to a bachelor of science degree. President John A. Peoples charged Dr. Charlie Smith, chair of the Department of General Science, to develop the Meteorology Program. Through the efforts of the college, the University Corporation for Atmospheric Research (UCAR), the American Meteorological Society (AMS), and the National Oceanic and Atmospheric Administration (NOAA), a curriculum was finalized and approved by IHL. In the fall of 1978, National Weather Service (NWS) meteorologist Dr. Keith W. Johnson joined the faculty through a cooperative agreement between the college and NOAA. At the same time, the first intensive survey of African American representation in federal meteorology jobs was published (Bacon-Bercey, 1978).

Except for an extended sabbatical during 1981–1983, Johnson was the driving influence behind the Meteorology Program until his retirement in 1995. Other faculty members making shorter-term contributions to the program during this period included Drs. Pieter J. Feteris, Lonzy J. Lewis, and Arthur C. Pike. Unfortunately, Dr. Lewis is still the only African American to have served on the JSUMP faculty. Johnson began the JSU Meteorology Program with three initial students. The first graduate, Ms. Patricia Brown, received her degree in August 1980 and is currently a senior hydrologist with the National Weather Service Forecast Office (NWSFO), New Orleans, LA. Throughout this period, the program remained quite small, was in substandard facilities, and had only very limited funding for research. Over the 13 y from 1980 through 1992, there were only nine graduates.

Changing Paradigms for Quality Education

Dr. R. Suseela Reddy joined the faculty in 1994 and was joined in 1995 by Dr. Paul J. Croft and in 1996 by Dr. Patrick J. Fitzpatrick. Croft assumed coordination of the program and led the program toward the university's goal of becoming research intensive through various government-sponsored grants. An external review of the JSUMP conducted under the leadership of UCAR in 1997 helped develop a blueprint for improving the program. During this period, there were major physical improvements, increased enrollment, and expanded participation with the larger atmospheric community. In 1999, Fitzpatrick authored the now classic reference book *Natural Disasters: Hurricanes* (Fitzpatrick, 1999). He departed JSU in the summer of 2001, followed by the departure of Croft the subsequent summer. Dr. Loren D. White became assistant professor in 2002 after 3 y as visiting faculty, and Dr. Heping Liu joined the faculty in 2004.

JSU has been a university affiliate of UCAR since 1990, and faculty and staff have played active leadership and committee roles in the National Weather Association and AMS. The installation of Dr. Ronald Mason as university president in 2000 and of Dr. Quinton L. Williams as department chair in 2003 encouraged a growing emphasis on preparing students for graduate school, expanding research activities, and gradually building the foundation for a graduate program in meteorology. Increasingly, partnerships with other universities have been developed for minority recruiting and for research activities.

Mr. John Shoemake, Weather Laboratory assistant and retired Navy meteorologist, provided important assistance to the JSUMP from 2002 to 2007. He was instrumental in helping students with weather observation, basic weather forecasting, and satellite interpretation skill development, as well as submission of summer internship applications. On the occasion of his retirement from JSU, Mr. Shoemake was recognized with the Susan Oakley service award by the Jackson chapter of the AMS. Mr. Kantave Greene (2002 graduate of the program) has since assumed these duties.

INGREDIENTS FOR SUCCESS

The following sections will primarily focus on specifics of programs, approaches, and resources to prepare students for graduate education and research-focused professional opportunities. However, it must be understood that the success of these ingredients has hinged greatly upon strong student–faculty interaction, a long-term institutional commitment by the university, and continuing support by federal agencies. It should also be understood that none of these elements is necessarily specific to training of minority students, but that they are nevertheless more critical for student populations that are lacking in role models, awareness of professional opportunities, and support structures. The large contribution of the JSUMP to nationwide diversity in the atmospheric sciences is of course facilitated by the largely African American composition of the university as a whole and JSU's development over the last few decades to become one of the premier HBCUs in the country in terms of research funding.

Faculty Research

The first known peer-reviewed research publication from the JSUMP was an article in *Weather and Forecasting* by Croft et al. (1997) that included substantial collaboration with NWS forecast offices. Between 1997 and 2008, more than 25 manuscripts have been accepted for publication in peer-reviewed scientific journals (Fig. 1). The significant jump in publications around 2005 was tied to culmination of research funded by NOAA over the previous few years, hiring of new faculty, and an increasing emphasis by the university on peer-reviewed publications. There have also been four NWS technical papers with coauthorship by JSU faculty and students. Recently, Liu was the first faculty member at JSU to coauthor an article in *Science* (Randerson et al., 2006).

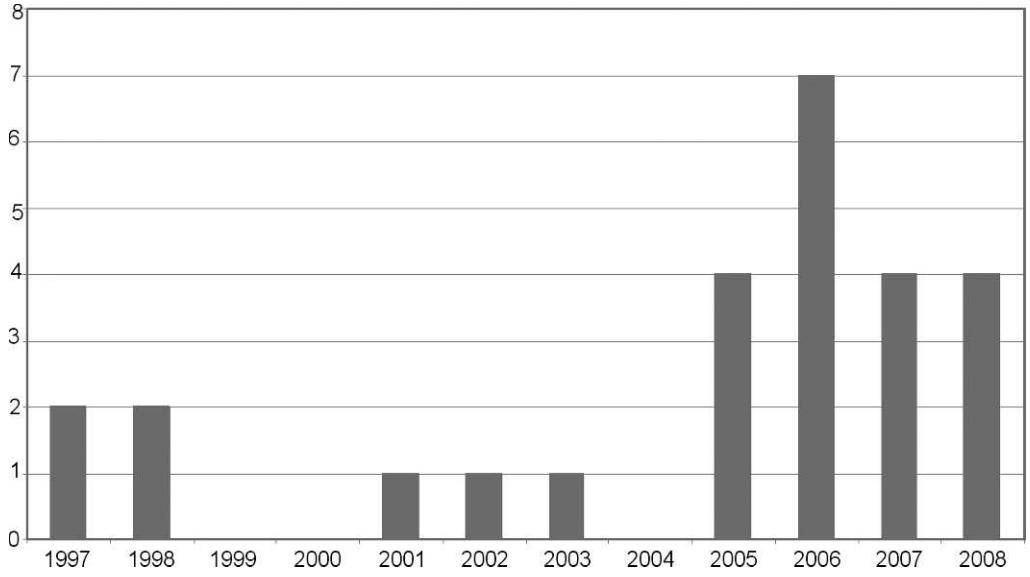

FIGURE 1: Peer-reviewed articles published by JSUMP each year since 1997 (up to September 2008).

Reddy has worked primarily in the research areas of tropical cyclones, climatology, solar variations, air–ocean interfaces, and numerical modeling. White's research concentrations have been in meteorological data collection networks (Mississippi Mesonet), land surface–atmosphere interaction, and numerical modeling. Liu has research expertise in micrometeorology and biosphere–atmosphere interactions.

A small cadre of professional meteorologists and technical staff has supported the faculty and has been critical in assisting research efforts and individual student development. Mr. Duanjun Lu, research associate, is responsible for the programming and data assimilation efforts for the various numerical weather prediction models run daily within the Meteorology Program. Other research staff and visitors supported through grants over the past decade have included Jan Hafner (1999–2001), Yongzuo Li (1999–2001), Roman Zelazny (2002–2003), and Monesa Watts (2001–2005).

Details about specific research initiatives will be discussed in the "Outside Partnerships and Funding" section. Since many projects have been part of larger programs within the School of Science and Technology or with other universities, it is difficult to clearly identify the amount of funding coming specifically to the Meteorology Program. Funding sources have included NOAA, National Aeronautics and Space Administration (NASA), National Science Foundation (NSF), Army, Navy, state agencies, and private foundations. There have also been informal contributions in the form of partner purchases of shared equipment for the Mississippi Mesonet. In general, research projects have tended to focus on mesoscale numerical modeling (e.g., Lu et al., 2006), hurricanes, boundary layer observations, and scientific visualization techniques.

Internships, Mentoring, and Student Research

The JSUMP faculty and staff provide significant student support through individual mentoring, professional and research opportunities, club activities, state-of-the-art facilities, and outreach efforts. When combined, these efforts provide a strong framework for preparing minority atmospheric scientists (Gregerman et al., 1998). They also help to provide a level of camaraderie and community that is essential and necessary for success.

Mentoring focuses both on student learning and professional development. These are accomplished through personal interaction and specific research opportunities under the direction of faculty and/or professional staff. The mentor and mentee are expected to form a professional partnership in which both investigate a specific meteorological research problem. This approach is tested by having the student endure the rigors of manuscript and presentation preparations, and culminates with students gaining confidence to interact professionally with outside researchers (Lopatto, 2004). The mentoring activities develop a strong professional bond between faculty and students. Faculty members seek to challenge students to perform to the best of their individual abilities. Students gain an appreciation of what is required to be a scientist, and the mentor gains an appreciation for the difficulties faced by aspiring minority scientists.

Aside from opportunities within faculty and staff research projects, students are provided a variety of other professional opportunities. These include direct collaboration and/or consultation with researchers, operational meteorologists, or broadcasters. The Significant Opportunities in Atmospheric Research and Science (SOARS) program of UCAR (Windham et al., 2004; Pandya et al., 2007) matches students with scientists at the National Center for Atmospheric Research (NCAR). Faculty and students have also worked with various components of NOAA, including the National Data Buoy Center (NDBC), National Environmental Satellite Data Information Service (NESDIS), National Severe Storms Laboratory (NSSL), Storm Prediction Center (SPC), National Coastal Data Development Center (NCDDC), National Centers for Environmental Prediction (NCEP), and NWS. For several years, the Army High Performance Computing Research Center (AHPCRC) Sum-

mer Institute in Minneapolis, MN, provided students exposure to supercomputing applications in meteorology. Most such partnerships have involved summer internship opportunities. Those with an interest in broadcast meteorology have also had internships or part-time employment with local television and radio stations.

All of the previously mentioned opportunities are critical to individual development, particularly when students author an abstract/preprint and make a presentation at a national meeting or conference (Fig. 2). By the time they complete their degree, most students attend at least two major scientific conferences. Participation at these meetings provides students with a chance to directly interact with professionals from the broader scientific community. In addition, JSU meteorology majors have served as volunteer workers at conferences. Over the last few years, students attending the annual AMS meeting have taken advantage of the "Colour of Weather" event to network with other minority scientists and students (Joseph et al., 2008). Opportunities also include involvement with local scientific chapters and/or organizations.

Within the JSUMP, performance of daily routines common to an operational weather office helps increase employability of graduates. Students take regular weather observations and manually encode the information in support of the NWS Cooperative Observer Program weather observing site on campus. In addition, students collect and analyze current and forecast weather maps, charts, and satellite/radar imagery for display within the JSU Weather Laboratory. Students are encouraged to prepare and present a daily "Weather Briefing" of current and forecast weather. This typically includes discussion of the latest vertical atmospheric sounding profile, satellite and radar data, and output of various numerical models. Recently, aviation flight conditions and 24 h aviation weather forecasts have been regularly included in the briefings.

Outreach Activities

The JSUMP is engaged in various outreach activities that actively involve faculty, staff, and students. Activities include speaking to high school science classes, serving on scholarship and awards panels, judging science fairs, and helping with training activities for current science teachers (Mississippi Academy for Science Teaching [MAST]). At the national level, JSUMP faculty and students have been regular contributors to the AMS Board on Women and Minorities.

FIGURE 2: Undergraduate meteorology student Shari Dixon during research presentation.

During recent summers, a 1 wk "Weather Camp" has been initiated by Dr. White, with NOAA funding, to expose high school students to the opportunities of study in the atmospheric sciences. Students participate in learning activities, field trips, and project presentations. The camp supplements a school visitation program that was originally begun to support the Piney Woods Country Life School in rural Rankin County, MS. This program currently also provides speakers and student role models for Blackburn Middle School, Smith Elementary School, and St. Therese Elementary School in Jackson, MS. JSUMP students seek these opportunities to give back and provide support to their community. Outreach to the public and the scientific community also occurs through the JSUMP Web site (http://weather.jsums.edu) and the "Discussions on Weather and Climate" weblog (http://jsuweather.blogspot.com). A "Severe Weather and Media Expo" was hosted by the JSUMP in 2002, as were two scientific meetings ("Seminar on Mesoscale Modeling for the Gulf Coast States" in 2000; "Workshop on Mesoscale and Microscale Meteorological Modeling for Military Applications" in 2004) sponsored by the AHPCRC, and a planning workshop ("Mississippi Mesonet Stakeholders Workshop" in 2002).

Development of Facilities

Facilities available to JSU meteorology majors are primarily within Just Science Hall on the JSU main campus. These facilities include meteorological observing equipment, computing platforms, classrooms and laboratories, and faculty office spaces. Just Science Hall underwent major renovation during 2000–2001, while significant capital improvements have taken place on the campus as a whole since the late 1990s. Computer laboratories available include Sparc-20, SGI, IBM RISC/6000, and Linux workstations and numerous personal computers. Access to the Mississippi Center for Supercomputing Research (at the University of Mississippi), an Origin 2100, and two Linux clusters provides capability for numerical modeling and data analysis by faculty, staff, and students. Three laboratory spaces are dedicated for Meteorology Program use. They include: the Weather Laboratory, where daily weather observational, analysis, and forecasting are carried out by students; the High Performance Computing Laboratory, where faculty, staff, and students work with numerical models and presentations are made; and the Micrometeorology Laboratory, where faculty and staff perform research with microscale meteorological and air pollution data. Funding for an upgrade of the High Performance Computing Laboratory was secured in 2008 through a UCAR Unidata equipment grant. The Trent Lott Geospatial and Visualization Research Center, located at the Mississippi e-Center, a nearby JSU research campus, offers access to remote-sensing and geographic information system (GIS) platforms and applications.

Weather instruments, books, periodicals, and other reference materials are available for student use within the Weather Laboratory. Climatological data, current meteorological charts, satellite and radar imagery, and forecast

products are primarily accessed through the Internet. In particular, the JSUMP Web site acts as a portal to various data. These resources are used for classroom lecture material, student assignments, and preparation of forecasts. In addition, the Meteorology Program has access to various software packages for data analysis and visualization (e.g., GrADS, Vis5d, GRLevel2 Analyst).

The initiation of the Mississippi Mesonet network of meteorological observing systems in 2004 has given the JSUMP access to real-time research-grade atmospheric data. Currently, seven stations are operational, with several more funded for installation (Fig. 3). Components for three portable automated observing systems have also been received by donation and are used for teaching and research. Various radiometric measurements have been made from the building roof in association with aerosol investigations.

Curriculum Development and Preparation for Graduate School

In 2007, the curriculum was significantly revised in order to improve preparation for graduate school, as well as to more closely tailor instruction to current professional requirements. One modification to the curriculum was to require all students to participate in a mentored research project during their senior year, even if they are not being supported by a research grant. Although fewer credit hours are required in the new curriculum (124 hours, per state requirements), new courses were developed to explicitly cover numerical modeling and to begin practice at synoptic analysis at an earlier stage. At the same time, course prerequisites were strengthened, and most existing courses were significantly revised. All changes were made consistent with recommendations of the AMS and with the "Standard 1340" professional requirements for the NWS.

The JSUMP has been offering research-oriented training workshops since 2003, focusing in particular on numerical modeling, remote sensing, and GIS skills. These workshops have evolved over time along with the software and technology, and have included both graduate and undergraduate students from JSU and other universities.

The Meteorology Program course work is designed to expose students to general scientific concepts, basic theories, and principles in atmospheric sciences, "real-world" applications, and current operational skills. This is accomplished through intense lecture, laboratory, and seminar sessions and individual self-study, as well as undergraduate research under the supervision of instructors. Every opportunity is made to encourage critical thinking and foster the growth of problem-solving skills. A comprehensive exam for seniors was initiated in the fall of 2008 to help assess the effectiveness of the curriculum.

Course work is offered through various media. For example, use is made of online training modules developed by UCAR's Cooperative Program for Operational Meteorology, Education, and Training (COMET) (http://www.meted.ucar.edu/), videos and case study animations. Faculty members have made use of resources from COMET faculty workshops, AMS Online Weather Studies, and NWS Virtual Institute for Satellite Integration Training (VISIT) teletraining (Mostek et al., 2004) to improve and complement their instruction. It is stressed that students must combine technological skills with scientific knowledge in order to develop skill at public speaking/briefing, document preparation, and data analysis.

FIGURE 3: Undergraduate meteorology student Quincy Jones helping with installation of rain gauge at a Mississippi Mesonet site.

NWS personnel from the Jackson Weather Forecast Office (WFO) have assisted as adjunct faculty, in particular to help prepare students for NWS forecasting duties. Since 2003, senior meteorology majors have participated in national forecasting contests as a component of their course work. Special seminars have been presented for the students by various well-known scientists and agency administrators. Field trips have been utilized to give firsthand examination of tornado damage paths and atmospheric observation systems (Riggs, 2004) (Fig. 4).

Over half of the JSU Meteorology Program graduates since 2002 have gone on to pursue graduate studies at various universities. Most have enrolled in Howard University's Atmospheric Science Program through a NOAA-funded partnership. Others have gone to the University of Oklahoma, Purdue University, and the University of Utah. In 2006, Andrea Sealy was the first JSU meteorology alumnus to complete a PhD, and others are currently at various points in their doctoral studies. Providing a pipeline to prepare students for advanced degrees in atmospheric sciences has been a major focus of JSU's partnerships with Howard University (Levine et al., 2007; Morris et al., 2007). Undergraduate research at JSU and external summer research internships have been important components of developing the pipeline toward graduate study (González, 2001).

OUTSIDE FUNDING AND PARTNERSHIPS

Aside from direct grants, the JSUMP has enjoyed numerous institutional partnerships over the years. These partnerships have helped augment faculty research and student training programs. Recent partners have included: NWS, AHPCRC, the Army Corps of Engineers Waterways Experiment Station, NASA, NDBC, the Mississippi Department of Environmental Quality (DEQ), and NCAR. These grants and collaborations have resulted in many preprint

FIGURE 4: Undergraduate meteorology majors, faculty, and staff visiting atmospheric flux observing site in Ross Barnett Reservoir, MS.

and peer-reviewed publications, often coauthored with JSU students. Some projects also serve as both direct and indirect educational and outreach initiatives with the local community.

Most funded projects have involved hiring of undergraduate meteorology majors and graduate computer science majors to give them meteorological research experience. Students are also regularly encouraged to apply for external scholarships and fellowships. Some of the student awards received have included NOAA Student Career Experience Program (SCEP), NOAA Hollings Scholarship, AMS Weather Channel Scholarship, AMS Minority Scholarship, AMS Industry Scholarship, and NOAA EPP/MSI (Educational Partnership Program with Minority Serving Institutions) scholarship.

NOAA Funding and NCAS

Since the founding of the program, there has been a close relationship with NOAA. Most NOAA grants have had a major emphasis on training of students to continue to graduate studies in atmospheric science and other fields relevant to the mission of NOAA (Hathaway et al., 2002; Robinson et al., 2007). The most interdisciplinary of these grants was ERAISA (Environmental Risk Assessment Integrated Systems Approach; 2001–2004), which used GIS in order to apply hydrometeorological inputs via the Pearl River for shellfish management in Mississippi Sound. The PDAS-RAP (Promoting Diversity in Atmospheric Sciences through Research, Applications, and Partnership; 2001–2002) and IDAS-RAP (Increasing Diversity in Atmospheric Sciences through Research, Applications, and Partnership; 2003–2004) projects aimed specifically at providing opportunities for students to work directly with NWS forecast offices on operationally oriented projects, such as tornado databases and wet microbursts. Beginning in 2006, JSU's environmental sciences program has received funding for an Atmospheric Dispersion Project from NOAA's Atmospheric Research Laboratory (ARL) and NWS to model atmospheric chemistry and transport interactions in the Gulf Coast region. The JSUMP has been involved with various aspects of the project, including coordination of field observations.

The principal NOAA grant currently is supported through Howard University's NOAA Center for Atmospheric Science (NCAS) (Morris et al., 2007). Since 2001, JSU has contributed to NCAS in four main areas: (1) developing a workforce of professional meteorologists from underrepresented minorities; (2) improving numerical modeling of the planetary boundary layer and tropical cyclones; (3) applying numerical models to air-quality forecasting; and (4) measuring atmospheric parameters within the central Gulf Coast region. Graduates are encouraged to apply for graduate study through Howard University's program in atmospheric science (HUPAS).

During 2004–2005, JSUMP faculty and staff worked in concert with JSU's National Center for Biodefense Communications (NCBC) to assist NWS's Integrated Surface Observing System (ISOS) office in developing a plan to modernize the Cooperative Observing System (COOP). This included a small grant, as well as participation in a national planning forum in Norman, OK.

NSF and NASA

From 1997–2000, JSU participated as a partner with Howard University in the NSF-sponsored Center for the Study of Terrestrial and Extraterrestrial Atmospheres (CSTEA) HBCU Academic and Research Consortium (CHARC). With an emphasis on encouraging minorities to pursue advanced degrees in atmospheric sciences, this was in many ways a predecessor to NCAS.

A variety of research grants from NASA between 1998 and 2002 helped to build an emphasis on developing methods to forecast tropical cyclone intensity changes and on the role of boundary layer processes over the Gulf of Mexico. The NASA projects also opened up collaborations for satellite sensing of aerosols and water vapor over the region.

Army, Navy, and Others

For several years, the Department of Defense sponsored broad interdisciplinary projects within the College of Science, Engineering, and Technology at JSU. The High Performance Visualization Center Initiative (HPVCI) (later known as High Performance Computing Visualization Initiative, HPCVI) supported a variety of research efforts between 1999 and 2006, initially under the Navy and then under the Army Corps of Engineers. It also brought JSU together with Jones County Junior College to develop online content for an introductory distance learning course in meteorology and a pre-meteorology curriculum for the junior college. Over a similar time frame, JSUMP faculty collaborated with the AHPCRC. Besides encouraging research activity in high-resolution numerical modeling, AHPCRC provided training/internship opportunities for students and sponsored various scientific workshops.

Smaller research projects have been sponsored through the Mississippi DEQ and the U.S. Department of Agriculture Forest Service (USFS). The DEQ grant helped fund studies of ground-level ozone in Mississippi that led to a master of science degree in environmental science for JSUMP graduate Kantave Greene. Between 2002 and 2004, JSUMP faculty and staff worked with the USFS to calculate climatological

fire weather danger indexes across the continental United States.

CURRENT ASSESSMENT OF JSU METEOROLOGY PROGRAM

Impact of Graduates

Of the approximately 60 alumni who have received bachelor's degrees in meteorology from JSU, about 25% are government employees with NWS and another 25% are broadcast weather personnel with television stations (Fig. 5). Approximately 13% are currently teaching science at the secondary level or higher. About 20% have gone on to graduate school (of which the vast majority have been from the last decade). Several JSU graduate students from computer science and environmental science have worked with the Meteorology Program on research projects, and in some cases have continued on to careers in atmospheric science. Currently, JSU alumni are employed by NOAA at NWS Headquarters, several NWS Weather Forecast Offices, two River Forecast Centers, NCEP, and NESDIS. Some have begun careers in other federal agencies, such as the Naval Oceanographic Office and Office of Budget and Management.

The most publicly visible graduate of the JSUMP is 1986 graduate, Ms. Vivian Brown, who can be seen regularly on The Weather Channel. Other JSU Meteorology Program graduates are in the broadcast field at local affiliate stations throughout the nation. Also, three additional graduates have followed in Vivian Brown's footsteps in other roles at The Weather Channel.

In 2004, Ashton Robinson-Cook (currently pursuing a PhD at the University of Oklahoma) was one of the founding members of the student section "Potential Energy" of the *Bulletin of the American Meteorological Society* (Robinson-Cook, 2004). Andrea Sealy (JSU class of 1999) was the first graduate to complete a PhD in atmospheric science in 2006 (from Howard University). Several others have begun work toward doctoral degrees.

Unmet Needs, Challenges, and Opportunities

Although the JSUMP has been quite successful in its mission, significant challenges remain. Some involve externalities that can be managed but not completely controlled, so that it is not realistic to claim that funding is the only impediment to progress. Probably, the foremost and most challenging need is to effectively recruit promising minority students from a nationwide pool into a specialized field of study that is rarely understood to be a career option among minority communities. Heretofore, the JSUMP has been quite dependent upon individuals being motivated enough to seek out information about JSU through Internet search engines or through contact with local forecasters. In many cases, personal relationships with previous JSUMP students have encouraged prospective students. Recently, several alumni have expressed interest in banding together to fund a scholarship for incoming freshmen. Although a steady trickle of students has continued into the Meteorology Program, it is likely that there are many more students who would be interested if they were aware of the opportunity. Some potential for increased contacts exists by continuing to make staff at the NWS WFOs aware of the JSUMP through convention participation. Expanding the outreach to high

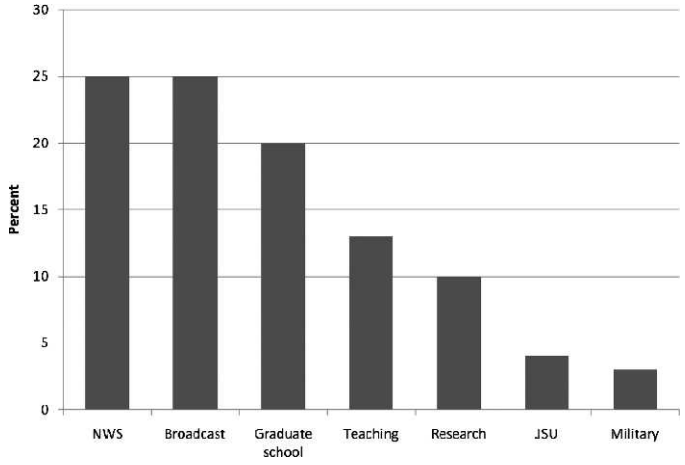

FIGURE 5: Career distribution for JSUMP graduates as of 2008. Note that the category "Graduate School" is given regardless of field of study and could lead to a variety of career options. Also, those whose current professional status is unknown were not included.

school students and the public through Weather Camps, tours, and media publicity has the potential to help recruitment, although the impact is primarily limited to the local area. Formal statistics on student origins have not been kept, but in general there has been a nearly even divide between in-state and out-of-state students. Many of those from out of state have had family connections either with Mississippi or with JSU.

The graduation rate of meteorology majors at JSU is fairly typical (around 40%) for the physical sciences. One study of science and engineering students indicated a nationwide graduation rate for whites of around 46% (Huang et al., 2000). These can be contrasted against the earlier mentioned statewide graduation rate for African Americans in mathematics, engineering, and science of less than 10% in 2002. Yet it is still troubling that social pressures and poor preparation (especially in mathematics) often prevent students from progressing through the curriculum even when they initially appear quite promising. The personal attention of a small academic program facilitates intervention when challenges arise, but often it is too late. For those students with adequate grades, scholarships and undergraduate research awards help with the economic barriers, especially when completion of a degree takes longer than expected. There is of course a dilemma in how to grow the JSUMP without losing these strengths, especially if growth in funding (including tenure-track faculty) does not occur proportionately with enrollment.

It is hoped that development of a graduate program in meteorology at JSU will help to address some of the funding shortfalls that have limited growth, as well as providing a more economical alternative for those wanting to pursue a master's degree. A graduate program would be an asset for helping to secure increased funding through research grants and improving the reputation of the program through more peer-reviewed publications. It would also open up the opportunity to use graduate teaching assistants for some of the introductory courses.

SUMMARY

The Meteorology Program at JSU continues to fill a unique niche that presents great potential for growth and nationwide impact, but it also faces continuing challenges. This is all the more significant in light of the fairly limited state funding that has been traditionally available to the program. Progressing from a purely teaching emphasis to an undergraduate program with significant research exposure, the JSUMP is now in a phase of preparing to also build a graduate program that would capitalize upon the investments of NOAA and other agencies, while cognizant of economic realities. The JSUMP will continue to provide opportunities for students from underrepresented and often underserved communities to pursue their dreams of careers in meteorology and to help NOAA fulfill its mission in serving the nation. This lasting legacy has been built through the contributions of many past faculty, staff, alumni, and external supporters of meteorology education at JSU.

As other minority-serving institutions consider initiating new undergraduate meteorology programs (Williams et al., 2007) or otherwise seek to impact the education of underserved minorities in STEM fields, it is hoped that the example of the JSUMP will be an encouragement. Much of what has worked at JSU could be expected to be transferrable. However, it must be understood that an environment conducive to individualized student–faculty interaction, long-term institutional commitment, and the active support of federal agencies form the fertile foundation that is the key to the success of any specific activities or initiatives. As the barriers to success vary with each individual student and over time, faculty and staff need to be ever seeking understanding, undeterred by discouragements, and able to balance a multiplicity of approaches and interventions. Unfortunately, anecdotal evidence continues to indicate that social and cultural divides continue to prevent the development of informal peer-to-peer mentoring when minority students are immersed into the majority institutions, especially if they have not had much exposure to the majority culture during their previous education. Hence, the unique contribution of HBCUs and other minority-serving institutions in adding diversity to scientific disciplines (specifically at the undergraduate level) can be expected to continue for the foreseeable future.

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