Teaching Introductory Weather and Climate Using Popular Movies

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ABSTRACT

Addressing the need for an introductory atmospheric science course for nonscience majors, a course was developed that provides a general understanding of atmospheric processes by examining how meteorological events are portrayed in movies. The course also uses films to study the causes of, impacts associated with, and potential adaptations to climate change. Anonymous student course evaluations indicate that students believe incorporating movie clips into lectures helps them learn course material and generates positive student attitudes toward atmospheric science. © *2014 National Association of Geoscience Teachers*. [DOI: 10.5408/13-014.1]

Key words: meteorology, climate, instruction, movies, film

INTRODUCTION

Educational and popular films offer useful alternatives to traditional teaching methods when used appropriately. Movies are effective teaching tools partly because they appeal to both visual and auditory learners (Lipiner, 2011). Additionally, movies allow students to experience things they might not otherwise. Films can virtually transport students to faraway places and/or potentially dangerous situations, while never leaving the safe comfort of the classroom. There are major differences, however, between the educational genre of film and motion pictures created purely for entertainment. "Real movies" with famous actors, action, and drama are much more captivating than their instructional counterparts for most students. Recognizing this, some teachers have effectively employed popular media as an integral part of their pedagogical approach.

Popular movies can be valuable teaching tools for a wide variety of nonscience subjects such as language (Wang and Zhang, 2012), vocabulary (Csomay and Petrovic, 2012), culture (Bu, 2012), cross-cultural management (Pandey, 2012), human rights (Banks, 2009), political science (Bostock, 2011), and history (Woelders, 2007). Commonalities appearing in several of these accounts include higher rates of student participation and success. Additionally, the popularity of feature films can improve student attitudes toward a given subject and foster student engagement with content that they find intimidating and/or irrelevant. As a case in point, Hart (2011) says that movies can be used to help nursing students make connections between their career paths and public health concepts, which many nursing students initially think are unrelated to nursing.

Increasingly, films are also being used in the instruction of STEM disciplines. Laursen and Brickley (2011) found that documentary films help students in grades 6–14 learn specific material and better understand the scientific method in general. Others have also found desirable results from incorporating more mainstream media into their instruction. This is not surprising given the popularity of movies and television shows with science and/or science fiction related themes such as *Avatar*, *Star Trek*, and *Harry Potter* to name a few. Dubeck et al. (1995) found that incorporating science fiction films into their introductory-level science courses at Temple University caused many students' attitudes toward science to improve, and watching films enhanced their understanding of science as a process. Their students' reactions to film segments used in class were "consistently positive," and "they (students) clearly were more interested in the film segments than in the traditional demonstrations or lectures" (p. 49). Schock (2012) reports that science fiction films and television shows are being used to teach core engineering topics and engineering ethics at a number of universities including Penn State, Syracuse, Frostburg State, and DeVry–Pomona in California. Films can even be used in math-based courses as Gardner and Davidson (2010) demonstrate how The Three Stooges' films can reduce student anxiety about course content while providing a source of data for applied statistical analysis. Similarly, Alderman and Popke (2002) show how humor in popular media not only enhances the classroom environment, but also increases critical awareness of social and geographical issues.

Not everyone is convinced that using film is an appropriate way to teach students, however. While many educators have found that films can be quite effective in helping students learn (e.g., Arroio, 2010; Arroio and Farias, 2011; Blickenstaff, 2011), others have expressed concern that popular films perpetuate misunderstandings about science by blurring the distinction between fact and fiction (Barnett et al., 2006). Going a step further, Kirby (2003) argues that scientific consultants on fictional films can use that medium to promote their own ideas and skew public perception of scientific debates. One of the greatest determinants of how effective using popular movies can be to educate students is the instructor's ability and willingness to discuss the film or clip before and/or after viewing in class (Aitken, 1994; Royce, 2002; Barnett and Kafka, 2007; Laprise and Winrich, 2010; Eick and King, 2012).

In this paper, I discuss how extensively using films in an introductory weather and climate course at Eastern Kentucky University (EKU) has affected student attitudes toward atmospheric science. It traces anonymous student comments

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TABLE I: Enrollments figures by students' year in school (percentage of total course enrollment) for Meteorology and Hollywood Weather. Over 72% of students taking Meteorology are upperclassmen (juniors and seniors); conversely over 63% of students taking Hollywood Weather are underclassmen (freshmen and sophomores).

Course Title	Semesters Taught (# of Course Sections)	Freshman	Sophomore	Junior	Senior
Meteorology	Fall 2007–Fall 2012 (16 sections)	28 (6.0%)	100 (21.6%)	141 (30.5%)	194 (41.9%)
Hollywood Weather	Fall 2009–Fall 2012 (8 sections)	92 (24.8%)	142 (38.3%)	72 (19.4%)	65 (17.5%)

on course evaluations from a time when only one atmospheric science course, a 300-level course titled "Meteorology," was available, through the development and implementation of a new, additional 100-level course titled, "Hollywood Weather." All topics in Hollywood Weather are introduced with segments from movies, but the clips mostly provide examples to go along with what is largely taught via lecture and discussion. Anonymous comments from student evaluations show that students believe this approach helps them to learn course material and that it cultivates positive student feelings about atmospheric science. The growing popularity of Hollywood Weather at EKU is illustrated by large course enrollments and the increased diversity of different majors taking the course. Hollywood Weather also attracts a larger number of freshmen and sophomores than Meteorology.

SETTING AND TARGET POPULATION

Eastern Kentucky University is a regional, coeducational, public institution of higher education with approximately 14,000 undergraduate and 2,000 graduate students. Until fall 2009, only one atmospheric science course appeared in EKU's undergraduate catalog: Meteorology. This meant that all types of students took this class regardless of their year in school, major, or level of interest in the subject. Of all Meteorology students from Fall 2007 through Fall 2012, only 6% were freshmen, 21.6% were sophomores, 30.5% juniors, and 41.9% seniors ($N = 463$; Table I). These students majored in disciplines from each of EKU's five colleges, with the largest cohorts being undeclared, education, and aviation majors (Table II). Middle-grade education majors and aviation majors were required to take this course, but the course was an elective for all others. The wide range in student preparedness and expectations for the course made teaching this class extremely difficult. My teaching evaluations from Meteorology revealed that some students appreciated a rigorous course and enjoyed the subject for what it was. As a student from Fall 2007 said, "This class was the most challenging of my semester. I enjoyed the challenge though, and wish there was another course like this to take." Others were dissatisfied with the course and at least some were left with ill feelings toward atmospheric science in general. A different student in the same section taught during Fall 2007, wrote "I'm not a science person, so it wasn't for me. I shouldn't have taken it."

A large number of student complaints on Meteorology course evaluations related to the course's level of difficulty. The following quotes from two different students in different semesters typify such remarks: "The material was hard to grasp and overwhelming," and "There was so much material and so many small ideas that it was hard to understand the big ideas." In efforts to improve student learning and overall interest in Meteorology, I experimented with alternative teaching tools to supplement my lectures including starting class with current daily weather discussions, having students keep weather journals, giving in-class demonstrations, collecting observations outside and doing analysis back inside, giving extra assignments from lab manuals, and bringing in guest speakers. Each approach enhanced the class in its own way, but the fact that there was only one option for taking an atmospheric science course at EKU remained an issue. The math prerequisite for Meteorology was a problem for some students and numerous students outwardly expressed a desire for a lower-division version of the course. A student from Fall 2008 said, "I hate that I had to take this class to graduate. If I could have taken something else I would have." Another student from Spring 2009 had similar feelings as they said, "This is way beyond what a _____ major would need to know about meteorology. I can't fathom why it is required."

The need for an additional lower-level course was not based on the comments of struggling students alone. Some students were bored and even irritated by having to hear the same material repeated over and over for those who had trouble understanding what was being taught. As one student wrote on their course evaluation, "It went a little slow and I often found myself not paying attention because I had already understood the material being covered." Another was more direct in offering the following advice to improve the course, "Don't let slackers in the class so the people that want to learn can!"

The demand for an alternative to Meteorology posed an interesting problem: finding a way to structure the new course so that it was more than just a simplified version of

TABLE II: Enrollment figures by college of students' majors for Meteorology and Hollywood Weather. Hollywood Weather has been more effective at attracting students from the colleges of Health Science and Justice and Safety, as well as from nonaviation majors from the College of Business and Technology than Meteorology.

	Arts and Sciences	Business and Technology[1]	Education	Health Science	Justice and Safety	Undeclared	Aviation[1]
Meteorology	62 (13.4%)	12 (2.6%)	113 (24.4%)	10 (2.2%)	13 (2.8%)	156 (33.7%)	97 (21.0%)
Hollywood Weather	87 (23.5%)	41 (11.1%)	42 (11.3%)	62 (16.7%)	73 (19.7%)	64 (17.3%)	2 (0.5%)

[1]Aviation is in EKU's College of Business and Technology, but has its own separate column here because aviation majors greatly outnumber all other majors from the College of Business and Technology taking Meteorology.

the existing course. A breakthrough occurred when I began incorporating clips from popular movies into Meteorology lectures. The films provided something the students could relate to. Students who barely paid attention and/or never said a word in class before began making comments and asking questions about the movies. My in-class observations were affirmed by student comments on course evaluations at the end of the term. Comments about the films were so encouraging that in Fall 2009 I offered a new 100-level course titled Hollywood Weather as an alternative and complement to Meteorology. In the new course, movie clips had a feature role.

METHODOLOGY

There is considerable overlap in the student learning objectives of Meteorology and Hollywood Weather (Appendix A). Besides Hollywood Weather being less detailed and more conceptual, the most substantial pedagogical difference is that every topic covered in Hollywood Weather is introduced and/or illustrated with film. This differs from others who have used a single film as a pedagogical supplement (e.g., Gold and Revill, 1996; Algeo, 2007; Monfredo, 2010). Loading DVDs onto a laptop and searching for the desired segment(s) of each film wastes class time, especially if you choose to use multiple clips. To save time, I extract the portion of each DVD I want to show using *Magic DVD Ripper* software. (Please see discussion section for legal details.) The resulting file can then be embedded into a PowerPoint presentation. This allows seamless transition between film and lecture. The Prof. Hacker blog of *The Chronicle of Higher Education* (Mittel, 2010) offers useful advice on how to rip clips from DVDs.

Hollywood Weather is offered once per week for two hours and 45 minutes over a 16-week semester. The extended class time allows enough time to show a full movie (if desired) and discuss it all on the same day. In Fall 2012, three full-length films were shown in class along with segments from 54 other feature films (Appendix B). Of all 57 movies, only three were documentaries: *Inside Hurricane Katrina* (2005), *March of the Penguins* (2005), and *An Inconvenient Truth* (2006). The length of movie segments ranged from just a few seconds to about 15 minutes. In each case, students were given a preview of what to expect and what to watch for prior to showing the actual footage. Students were also informed about whether or not the movie about to be viewed was based on a true story. While this detail may not be central to specific course goals, including this information is important since many students see all film as fiction, especially when the events portrayed took place before the student was born (Royce, 2002). After showing the clip, an explanation was given as to the scientific accuracy of what had just been shown and questions encouraged. Since audiovisual redundancy benefits comprehension (Drew and Grimes, 1987; Fox, 2004), clips were sometimes shown again for added emphasis before moving on to the next topic.

The amount of class time dedicated to viewing movies varies from week to week, but totals approximately one-quarter to one-third of class time over the course of the semester. The loss of lecture time makes it critical for any instructor using this methodology to carefully decide what he or she believes is most important for a particular group of students to learn. In a 100-level course like Hollywood Weather, I wish to impart a general understanding of fundamental concepts without inundating those students with details. Scaling back the depth allows me to cover a wide breadth of topics in an efficient manner.

My approach in Hollywood Weather is to keep the course conceptual rather than mathematical, and focused on a deep understanding of science. For reinforcement, I provide multiple examples of the same or similar concepts and relate things that we see in different movies to one another. When explaining cloud formation, for instance, I first introduce Hollywood Weather students to the core concepts leading to cloud development (e.g., humidity, saturation, lifting, adiabatic cooling, environmental lapse rates, and condensation) after showing the opening "crash" scene of *Alive* (1993). These ideas are brought up again during the next class when we watch portions of *The Spirit of St. Louis* (1957) in which Charles Lindbergh (Jimmy Stewart) encounters clouds over Newfoundland and icing over the North Atlantic. Later in the course, when we watch movies depicting more complex situations involving clouds, students are able to build on this knowledge. When watching *The Perfect Storm* (2000), and *Twister* (1996), for example, students are challenged to consider moisture sources, lifting mechanisms, and the role of latent heat in storm development. At no time do I ask Hollywood Weather students to calculate air temperature and dew points for a rising/sinking air parcel and determine atmospheric stability. While those are important concepts that are covered in the more advanced Meteorology course, I do not feel they are necessary in a 100-level course. By reducing some details and continually reinforcing key concepts, I feel that Hollywood Weather students are more likely to retain those concepts over the long term. While student learning has not been evaluated relative to other courses as of yet, anonymous student comments on course evaluations show that students like the way Hollywood Weather is taught and think that incorporating the movie clips into class helps them learn. Student ratings on IDEA evaluations also show that Hollywood Weather students think that they learn a lot in the course (see theideacenter.org for information about IDEA evaluations).

A lesson plan showing how I use movie clips to teach about thunder and lightning is available online at: http://dx.doi.org/10.5408/13-014s1.

RESULTS

Hollywood Weather was developed with two major goals in mind: (1) educating students, particularly nonscience majors, about weather and climate, and (2) improving student attitudes toward atmospheric science. Anonymous course evaluations and anecdotal evidence indicate that students believe supplementing lecture and discussion with movie clips is effective in helping them learn the material. These sources of information also show that students really like the course in general. A third unintended benefit of Hollywood Weather has been the attraction of more students from other areas on campus and more freshmen and sophomores than Meteorology.

The following anonymous student comments from Hollywood Weather course evaluations support the asser-

tion that supplementing lecture and discussion with film can be an effective teaching strategy:

"Watching movies helped to better retain the information."

"I thought it was very fun to learn about the facts/exaggerations of weather portrayed in Hollywood. I learned a lot and actually remembered it!"

"Putting movie clips with the material made it easier for me to comprehend."

"I had no prior knowledge about weather prior to this class, now I know much more than the average person."

"The movies were something I could identify with to learn the material."

"The combination of movies and lectures kept my attention."

"Showing the movies and then explaining the facts and myths really helped me to make sense of the material."

"The combination of lecture and videos made it less difficult to learn the material."

"This particular approach made the material much easier to understand and more interesting than other science classes I've had."

Several sections of Hollywood Weather and Meteorology have been assessed using course evaluations from the IDEA Center (theideacenter.org). IDEA evaluations further illustrate that Hollywood Weather students feel that they learn a lot in the class. The IDEA student evaluation form includes questions that students answer using a Likert Scale (1 = No apparent progress, 2 = Slight progress, 3 = Moderate progress, 4 = Substantial progress, 5 = Exceptional progress). For the item that reads, "Gaining factual knowledge (terminology, classifications, methods, trends)," the average response among Hollywood Weather students was 4.46 ($N = 193$). Meteorology students gave this same item an average response of 4.25 ($N = 298$). For the item that reads, "Learning fundamental principles, generalizations, or theories," the average response in Hollywood Weather was 4.28 and in Meteorology was 4.15.

Numerous journal articles encourage teachers to capitalize on movies' ability to attract students' attention and stimulate their thinking about course material (e.g., Dubeck et al., 1995; Cavanaugh, 2002; Laprise and Winrich, 2010). Keeping students' attention and generating student participation in large classes can be challenging since students' classroom engagement typically decreases in larger classes, especially for lower attaining students (Blatchford et al., 2011). I have found that Hollywood Weather students are equally or more engaged than students in my other classes, despite the fact that enrollments have averaged 46.9 students per section of the course (the average enrollments in Meteorology have been 30.3 students per section since Hollywood Weather was created). The following student comments on course evaluations indicate that incorporating movie clips into lectures is also effective in improving student attitudes toward the discipline:

"Fun, easy way to learn difficult subject matter. It's a great intro for something people wouldn't normally consider taking."

"Very unique class. It took a not so popular subject and made it interesting. I'm very satisfied that I took this course!"

"I loved this class! I hated weather before and now I appreciate it more."

"Before this class I couldn't have cared less about how the weather works, now I am a lot more aware and interested."

"This was (unexpectedly) my favorite class this semester. I learned a lot about weather that I did not know before."

"Very entertaining class. It was the only class I haven't missed all semester. EKU should investigate offering other classes like this."

"I don't really even like science and I thought it was interesting."

"It is a very interesting class even for me and I'm a nursing major."

"Movies made the material interesting, so I wanted to learn."

"Class was interesting and helps people learn a lot about the weather. Some tips from the class may help to save someone's life. It taught me how much I underestimate the weather."

Once again, student ratings on the IDEA evaluation instrument support the claim that the approach used in Hollywood Weather is effective in cultivating positive feelings toward atmospheric science. The IDEA evaluation form asks students to respond to the following statement using a Likert scale in which 1 = Definitely false, 2 = More false than true, 3 = In between, 4 = More true than false, 5 = Definitely true: "As a result of taking this course, I have more positive feelings toward this field of study." The average response among Hollywood Weather students was 4.20 ($N = 193$); the average among Meteorology students was 3.96 ($N = 298$).

Enrollment data shows that Hollywood Weather has been successful in attracting students who were not taking Meteorology in the past, particularly students from the colleges of Health Science and Justice and Safety (Table II). Majors from these colleges include disciplines such as public health, nursing, fire safety, and criminal justice. The result has been a positive inertia spread by the students themselves. When asked, "Would you recommend this class to a friend?" on course evaluations, 92.9% of Hollywood Weather students from Fall 2012 responded affirmatively. As one student wrote, "I told my roommate to take this class because it's the best way to learn about weather." Comments like this are further indication that the course has been successful in getting students excited to learn about atmospheric science, not turning them away.

DISCUSSION

While my experiences in Hollywood Weather have been overwhelmingly positive, I do not advocate teaching with film blindly. First, teachers must be willing to incorporate movies into their instruction and give up some of their class time to show the films. Second, educators should be aware of legal issues associated with extracting and showing film clips. Third, the films must be procured, the classroom must be equipped with appropriate technology, and teachers must be prepared with alternative plans if/when technology fails. Fourth, and most importantly, teachers must not rely on the films to educate students on their own. In Hollywood Weather, movies attract student attention and provide the basis for discussion, but content is still primarily delivered through lecture.

Deciding to Incorporate Movies into Class

The decision to use films in class should involve careful consideration of a course's student learning objectives. As discussed, there is no consensus in the peer-reviewed literature on the short- and long-term impacts that teaching with film has on learning. Anonymous comments on course evaluations from Hollywood Weather provide evidence that the course is effective in generating positive student attitudes towards learning, and student IDEA ratings show that Hollywood Weather students think they are gaining factual knowledge and learning fundamental principles, but student evaluations do not ensure that meaningful learning has occurred. Unfortunately, data needed for quantitative assessment (e.g., student performance on a common set of criteria in different courses and/or longitudinal data on students' retention of the material) are not available. Gathering and analyzing such data in the future would produce valuable insight into Hollywood Weather's effectiveness at educating students. Related to concerns about the effectiveness of this approach, using one-fourth to one-third of class time to show films and movie clips could be difficult for instructors who strive to cover as much content as possible. Some teachers rationalize such an approach by thinking that his or her course may be the only science course that many of their students take in college. I caution against this and argue that cramming as much material into an introductory course as possible could turn lots of students against science completely. As explained, Hollywood Weather covers the same topics as any traditional introductory weather and climate course, just in a more general, less detailed way. In my experience, this approach has resulted in more positive student attitudes toward atmospheric science.

Legal Concerns

Educators thinking about using popular films in their classrooms should be apprised of legal concerns. If you own or rent the DVD you are using, the doctrine of fair use (see section 107 of the copyright law [title 17, U.S. Code]) allows teachers to show short portions of the DVD in class, but it does not allow you to make copies (U.S. Copyright Office, 2011). In the case of extracting movie clips from DVDs to show in the classroom, the 1998 Digital Millennium Copyright Act (DMCA) applies. The DMCA made it illegal to bypass code that locks down a piece of software, hardware, or other digital object, which includes ripping clips from DVDs (U.S. Copyright Office, 1998). This legislation was later softened via a number of exemptions. Most recently, an exemption passed on 28 October 2012 allows all college and university faculty, all college and university students, and K–12 educators to legally extract short portions of motion pictures, distributed either by online services or on DVD, for educational purposes (U.S. Copyright Office, 2012). Even though software is available to rip Blu-ray disks as of this writing, it remains illegal to do so under the DMCA. This may change in the future since section 1201 of Title 17 of the U.S. Code provides that the classes of works that should be exempted from the DMCA will be determined every three years.

Media and Technology

After making the decision to use film clips in class and ensuring that a particular use is legal, the movies must be obtained. In my case, I use four ways to do this: (1) personal purchase, (2) borrowing from others, (3) asking my department to make purchases, and (4) YouTube. Building a DVD library over time lessens the financial burden of procuring films all at once and I continually add new movies/clips to Hollywood Weather's repertoire. My best resource for new ideas has been offering extra credit to students who make suggestions for new movies or clips and provide a justification or rationale for including the new material.

The technological requirements of Hollywood Weather include having a means to play your videos, a projection system, an audio system, and a screen. Sometimes things don't go as planned. I have had days when the audio and/or video would not cooperate. My best suggestion for the few times that technology fails is to resort to using the old-fashioned chalk board. Students may not like this as much, but they appreciate the films even more the next time class runs smoothly.

Remember, You Are the Teacher

The final consideration for using popular films in the classroom relates to the teacher's willingness and ability to discuss what has been seen and to help students make the connections between the film and reality. This course cannot be taught by simply turning on a movie and letting it do the teaching. This is true for all genres of film. It is equally imperative for teachers to evaluate and discuss educational documentaries and popular movies since neither are unbiased representations of reality (Aitken, 1994; Kennedy and Lukinbeal, 1997). Teachers must think critically about which films to use and how best to use them. Take the choice of showing something that is scientifically inaccurate, for example. While it is human nature to remember our own mistakes and those of others more poignantly than our successes, opinions vary on whether or not pointing out erroneous information in movies is an effective way to help students learn. While some educators feel that scientific misrepresentations are hurdles to accurate understanding (Barnett et al., 2006), others view them as opportunities for critical thinking (Monfredo, 2010). The long-term implications of using misinformation from movies to teach students are beyond the scope of this paper, but short-term benefits have been realized. As long as teachers are clear in their discussions about a movie clip, I strongly encourage them to capitalize on the opportunity to expose a film's inaccuracies to garner students' attention and hopefully enhance student learning and understanding. Thankfully, examples from Hollywood abound.

CONCLUSION

Developing and teaching an introductory weather and climate course using popular movies as an integral part of the pedagogical approach has positively affected numerous parties at EKU including students, the instructor (me), the pre-existing Meteorology course, and the Department of Geography and Geology. Student evaluations of Hollywood Weather have been overwhelmingly positive. Students feel that the movies enhance their learning experience, the general classroom vibe is lively, and I enjoy teaching enthusiastic students. The Meteorology course has benefitted as well. Moving away from the "one size fits all" model has allowed students the opportunity to better match their level of interest and preparedness to the course they ultimately sign up for. This has alleviated much of my previous frustration that arose from trying to challenge the better students while not leaving the struggling ones behind. The number of requests to override Meteorology's math prerequisite have substantially decreased, and having better prepared students overall has allowed me to reduce the amount of repetition and cover more material in greater detail than before. The Department of Geography and Geology has enjoyed a boost in the number of student credit hours generated from Hollywood Weather's large enrollments, even though Meteorology's enrollments have declined slightly and enrollments in other departmental offerings have not noticeably changed. Moreover, the large number of freshmen and sophomores taking Hollywood Weather, combined with the increased diversity of different majors it attracts, could ultimately bring new majors to the department over time. For example, on course evaluations from Spring 2011, one Hollywood Weather student wrote, "I loved this class so much that I chose Geo as my major :) ." As Hollywood Weather's popularity grows, more students may elect to take Meteorology and the demand for additional upper-division atmospheric science courses may increase as well.

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APPENDIX A: Student learning outcomes for Hollywood Weather and Meteorology.

Students successfully completing Hollywood Weather will be able to:

1. Describe the general physical and chemical structure of earth's atmosphere.
2. Understand fundamental processes in the Earth's climate system, such as the greenhouse effect, what causes seasons, the relationship between air pressure and wind, how/why clouds form, and how climate controls determine climate types.
3. Explain the general physical dynamics of complex systems such as midlatitude cyclones, thunderstorms, tornadoes, and hurricanes, and identify the potential hazards associated with each.
4. List causes of climate change and potential impacts/outcomes.
5. Evaluate the validity of how weather is portrayed in popular media given knowledge of what happens in the real world.
6. Integrate course material into understanding how and why weather and climate affect themselves and society in general.

Students successfully completing Meteorology will be able to:

1. Describe the general physical and chemical structure of Earth's atmosphere.
2. Describe different forms of energy and energy transfer, and understand how changes in various energy fluxes affect the atmosphere on daily, seasonal, and longer time scales.
3. Explain the dynamics of cloud/fog and precipitation formation, compute when and where clouds will form, and evaluate what types of clouds and precipitation might occur under a given set of circumstances.
4. Analyze the forces affecting air pressure and wind, and apply that knowledge to explain circulation patterns from local to global scales.
5. Integrate course material to describe the physical dynamics and hazards associated with powerful weather systems, such as midlatitude cyclones, tropical cyclones, thunderstorms, and tornadoes.
6. Understand natural and anthropogenic causes of climate change, give examples of past and possible future impacts associated with climate change, and evaluate potential adaptation and mitigation strategies.

APPENDIX B:

Topics covered and films shown in GEO 115 Hollywood Weather during Fall 2012. Some films are useful in illustrating multiple topics, which may go beyond the general list provided here. Take the first film on this list, *Alive*, for example. I use *Alive* to discuss atmospheric composition and structure, but I also use the plane crash scene to introduce friction and air turbulence, lifting mechanisms and cloud formation, air pressure and wind, and the greenhouse effect.

Topics	Films/Clips
Atmospheric composition and structure	*Alive* (1993), *Apollo 13* (1995), *Hidalgo* (2004), *Total Recall* (1990)
Solar energy, Earth/sun geometry, greenhouse effect	*2012* (2009), *30 Days of Night* (2007), *Sunshine* (2007), *Heidi* (1937), *Dumb and Dumber* (1994)
Air pressure and wind	*The Spirit of St. Louis* (1957), *Winnie the Pooh and the Blustery Day* (1968), *The Quiet Man* (1952), *Wind* (1992), *Final Destination* (2000)
Climate types, climate controls, and general global circulation patterns	*Dances With Wolves* (1990), *Raiders of the Lost Ark* (1981), *Master and Commander* (2003), *March of the Penguins* (2005), *Misery* (1990), *The Way Back* (2010), *Forest Gump* (1994), *Doctor Zhivago* (1965), Jaws (1975), *Finding Nemo* (2003), *The Donner Party* (2009), *Touching the Void* (2003)
Drought	*The Grapes of Wrath* (1940)
Urban heat islands	*Rear Window* (1954), *Summer of Sam* (1999)
Thunderstorms, thunder, and lightning	*Back to the Future* (1985), *Frankenstein* (1931), *The Natural* (1984), *The Bad Seed* (1956), *Return of the Jedi* (1983), *Caddyshack* (1980), *The Curious Case of Benjamin Button* (2008), *Sweet Home Alabama* (2002), *The Shawshank Redemption* (1994), *Up* (2009)
Flash floods	*Into the Wild* (2007)
Tornadoes	*Twister* (1996)
Tropical cyclones	*The Little Mermaid* (1989), *Swiss Family Robinson* (1960), *Rescue From Gilligan's Island* (1978), *Inside Hurricane Katrina* (2005)
Air masses and fronts	*Year Without a Santa Claus* (1974), *Rudolph the Red-Nosed Reindeer* (1964), *The Way Back* (2010), *Master and Commander* (2003)
Mid-latitude cyclones	*The Shining* (1980), *The Perfect Storm* (2000)
Cyclones and climate change	*Day After Tomorrow* (2004)
Climate change (causes, impacts, and adaptive strategies)	*An Inconvenient Truth* (2006), *Animals United* (2010), *WALL-E* (2008), *Waterworld* (1995), *Happy Feet Two* (2011), *Ice Age* (2002), *Ice Age: The Meltdown* (2006)