

Enhancing Diversity in the Geosciences through National Dissemination of the AMS Online Weather Studies Distance Learning Course

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The American Meteorological Society (AMS) Education Program has embarked on a National Science Foundation-funded initiative aimed at increasing the number of minority undergraduates who are introduced to the atmospheric sciences. The initiative's ultimate goal is to help increase diversity in the nation's scientific workforce by encouraging minorities (traditionally underrepresented in science, mathematics, engineering, and technology) to consider a career in science. One-hundred faculty members from minority-serving colleges and universities will teach "Online Weather Studies," a distance-learning course on the basics of weather and climate developed and serviced by the AMS. The course is partially delivered via the Internet and employs a highly motivational approach whereby students learn about weather as it happens in near-real time. To facilitate implementation of the course, participating faculty members attend a one-week orientation workshop hosted by the NWS at its training center in Kansas City, Missouri. Participating faculty join a collegial online network to share ideas and teaching strategies related to their offering of "Online Weather Studies."

The nation faces a serious challenge in attracting members of racial and ethnic minority groups to science and science-related careers (including teaching). The number of minorities in the scientific workforce remains well below their overall representation in the nation's population (Jones 2002). While the U.S. Bureau of the Census (2000) reports that about 27% of the U.S. population is African American, Hispanic/Latino, American Indian/Alaska Native, or Native Hawaiian/Other Pacific Islander, these groups make up only about 7% of the total science and engineering workforce (National Science Foundation 2000b). This lack of diversity in the scientific/engineering workforce is directly related to the relatively low enrollment of minorities in undergraduate and graduate science and engineering majors.

Underrepresentation is especially acute in the geosciences, including the atmospheric sciences. The National Science Foundation (2000a) reports that minorities earn almost 15% of all B.S. degrees in science and engineering but only 4.6% of bachelor's degrees in the geosciences. Minorities earn only 3.3% of all master's degrees and 5% of all Ph.D. degrees in the geosciences.

A formidable obstacle in attracting undergraduates to the geosciences, particularly at minority-serving institutions, is lack of access: students have no opportunity to enroll in introductory courses in the geosciences because none are offered at their college or university. For example, the majority of the nation's undergraduate minority-serving institutions do not offer an introductory meteorology course. This was confirmed by our perusal of college and university home pages. Of the 112 Hispanic-serving institutions (HSIs) listing courses, 21% offer weather courses. Of the 48 historically black colleges and universities' (HBCUs) home pages that include

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course listings, only 12.5% offer a weather course. Of the 15 tribal colleges and universities (TCUs) that list courses on their home pages, only a few offer weather courses. Of the 13 Alaska Native and Native Hawaiian (AN/NH)-serving institutions, three offer a weather course. Of the more than 270 institutions identified as HBCUs, HSIs, TCUs, and AN/NH-serving institutions, only two (Jackson State University and University of Miami) offer an undergraduate degree in atmospheric science (AMS/University Corporation for Atmospheric Research 2000).

To help increase undergraduate access to the geosciences, the AMS Education Program is making available an introductory weather and climate course, "Online Weather Studies." The course already has been offered at more than 140 colleges and universities nationwide through spring 2003, including many minority-serving institutions. Now, thanks to National Science Foundation (NSF) funding and the cooperation of the NWS, AMS has an opportunity to expose more undergraduates to the geosciences by bringing this course to more institutions serving large numbers of minority students. This AMS Geosciences Diversity/National Dissemination Project has NSF support over a 4.5-yr period, which began in 2001, to introduce "Online Weather Studies" to 100 minority-serving college and universities. This program is proving to be very successful, as 52 faculty members, representing 48 minority-serving institutions, have already joined the Diversity Project. Project support is from the NSF's Opportunities for Enhancing Diversity in the Geosciences (OEDG) and Course, Curriculum, and Laboratory Improvement—National Dissemination (CCLI-ND) programs.

ONLINE WEATHER STUDIES. "Online Weather Studies" is an innovative, 12- to 15-week introductory college-level, online course on the fundamentals of atmospheric science (Geer et al. 2001). Current weather data are delivered via the Internet and coordinated with investigations keyed to the day's weather. The principal innovation of "Online Weather Studies" is that students analyze weather as it happens in near-real time—a highly motivational learning experience. The AMS Education Program, with support from the NSF, designed and services this course. It is available to colleges and universities as a user-friendly turnkey package with electronic and printed components.

"Online Weather Studies" can be offered by meteorology instructors as well as by science faculty having no prior teaching experience or formal training

in the atmospheric sciences. Faculty volunteers who have already taught the course are available to assist instructors offering the course for the first time. Also, AMS staff meteorologists are prepared to answer questions on all aspects of course delivery and content.

The course has been offered in various formats ranging from strictly online (with few or no formal classroom meetings) to a laboratory role in a traditional lecture course. AMS has developed a course home page, textbook, study guide, faculty manual CD, and secure instructor's home page. The "Online Weather Studies" home page delivers student investigations (two per week), current weather data and maps, satellite imagery, composite radar displays, a daily weather summary, and forecasts. Meteorological data, supplied in learner-friendly formats by the Cooperative Program for Operational Meteorology, Education and Training (COMET), are updated hourly, 24 hours a day, and seven days a week, year-round. The customized full-color textbook features a traditional sequence of topics, and each of the 15 chapters provides background information for each week's investigations. (Three of the chapters are independent of the course delivery schedule to accommodate variations in academic calendars among institutions.) The study guide contains the first part of each investigation. AMS Education staff in Washington, D.C., writes the second part of each investigation to current weather conditions, and that part is posted on the course home page by noon EST on Monday and Wednesday of each week. All 30 of the investigations provide an inquiry-based learning experience. The faculty manual CD contains course guidance material (e.g., chapter-by-chapter learning objectives and suggestions for course implementation in a variety of settings), test bank questions and answers, and textbook images. The secure faculty home page provides chapter discussions, answer keys to current and archived online portions of investigations, and strategies that address diversity issues and critical thinking.

When an institution licenses "Online Weather Studies," the course instructor receives one copy of the textbook, study guide, and faculty manual CD, as well as information for access to course and faculty home pages. The students purchase the textbook and study guide through their institution's bookstore as they would for any other course, and the instructor shares the course home page information. The AMS provides course instructors with updated materials as they become available.

AMS GEOSCIENCES DIVERSITY/NATIONAL DISSEMINATION PROJECT.

The new NSF funding is helping minority-serving institutions implement “Online Weather Studies.” Eligible colleges and universities include those listed by the U.S. Department of Education as historically black colleges and universities, Hispanic-serving institutions, tribal colleges and universities, or Alaska Native or Native Hawaiian-serving institutions. Also eligible are other accredited postsecondary institutions that can document a minority enrollment of at least 30% of their total student population. Minority students are defined as members of African American, Hispanic American, American Indian, Alaskan Native, Native Hawaiian, and Native Pacific Islander groups. Over a 4.5-yr period, 100 minority-serving institutions are expected to participate in the program.

The AMS Diversity Project encourages and facilitates participation in “Online Weather Studies.” Prior to an instructor’s initial offering of the course, he or she is invited to attend a workshop at the NWS Training Center (NWSTC) in Kansas City, Missouri. Participants become part of a virtual community where they can share ideas and teaching strategies related to the course. Also, a mentoring program allows students to network with professional meteorologists and makes them aware of opportunities for internships, summer research, and career counseling. Meteorologists-in-charge (MICs) at NWS Weather Forecast Offices across the nation have volunteered their time to help make these opportunities possible. Also, participants are invited to the educational symposium of the AMS Annual Meeting, where they attend a special diversity session and are encouraged to present a paper or poster.

NWSTC FACULTY WORKSHOP. The workshop at the NWSTC explores the latest operational technologies for sensing, analyzing, and forecasting weather; examines teaching strategies that promote critical thinking through technology; and reviews an array of classroom and laboratory applications. This intensive one-week workshop includes lectures, tutorials, hands-on laboratory exercises, and field trips. NWS and other NOAA scientists and experienced weather educators explore a variety of meteorological concepts and the challenges and rewards of teaching weather at least partially online.

Participants are provided with all necessary course materials to teach “Online Weather Studies.” They develop their ability to interpret and analyze weather information acquired through direct and remote

sensing of the Earth–atmosphere system, and examine the properties and life cycle of weather systems, with emphasis on systems responsible for hazardous conditions. They also collaborate on the design of student investigations.

The 22 participants at the inaugural NWSTC workshop in May 2002 and the 25 participants at the May 2003 workshop represent a variety of 2- and 4-year minority-serving colleges and universities from around the United States and its territories. Eighteen teach at historically black colleges and universities, 11 are faculty members at Hispanic-serving institutions, 3 represent tribal colleges, 14 are from institutions where minority students are a substantial part of the total student population, and 1 is involved in an NSF-funded program to introduce the geosciences to Native American students.

Participants represent a broad range of scientific disciplines, including geography (10), meteorology (8), geology (6), physics (6), chemistry (3), environmental science (3), science education (3), biology (2), astronomy (1), biochemistry (1), computer science (1), earth science (1), plant ecology (1), and soil physics (1). Only about one-third had previously taught a meteorology course. Five other professors are participating in this program but have yet to attend the NWSTC workshop.

Featured speakers at the two workshops covered a variety of meteorological topics. Max Mayfield, director of the Tropical Prediction Center/National Hurricane Center, discussed the properties and evolution of tropical cyclones. Elizabeth Quotone, of the WSR-88D Radar Operations Center, described the capabilities of weather radar. Roderick A. Scofield, of the National Environmental Satellite, Data, and Information Service, reviewed various satellite products and demonstrated how remote sensing is improving forecasting. Louis W. Uccellini, director of NCEP, updated advances in numerical weather prediction. Joseph T. Schaefer, director of the Storm Prediction Center (SPC), covered the ser-



FIG. 1. Faculty participants learn about the NWS ASOS.

vices provided by the SPC. At the initial workshop, John E. Jones Jr., deputy director of the NWS, outlined the structure and operations of the NWS and presented an overview of NWS diversity initiatives. Percy W. Thomas, training division chief of the NWS Office of Climate, Water, and Weather Services, highlighted the importance education plays in saving lives as well as promoting diversity in the scientific workforce.

William Porter, professor at Elizabeth City State University, described how “Online Weather Studies” promotes critical thinking. Participants worked collaboratively through a number of investigations incorporating, for example, upper-air analysis, the Coriolis effect, El Niño and La Niña, and weather map interpretation. Finally, Jasper Harris, professor at North Carolina Central University, led a discussion on how to recruit students for “Online Weather Studies.”

Participants were also provided opportunities to observe and participate in NWS operational activities. NWSTC Instructor Jerry Griffin presented a daily weather briefing and, with other NWSTC staff, led a tour of the facilities. Participants were introduced to the

Automated Surface Observing System (ASOS; Fig. 1), a model cooperative observer station, and the Aviation Weather Center, collocated with the NWSTC. On a field trip to the Topeka, Kansas, NWS Forecast Office, participants observed the Advanced Weather Interactive Processing System in action, learned how forecasts are prepared, and witnessed the launch of a radiosonde balloon (Fig. 2). Another field trip took participants to the 18th and Vine historic district in downtown Kansas City, Missouri, where they toured the Negro Leagues Baseball Museum and the American Jazz Museum.

Most participants in the NWSTC workshop have attended or will attend the annual education symposium at the AMS Annual Meeting. Through a poster session, they share experiences in either offering or planning their initial offering of “Online Weather Studies.” Seventeen of the diversity project participating institutions have already offered the course through spring 2003, and about 450 students have taken it. Figure 3 shows a student at Paine College leading a map discussion in her weather class.

In the postworkshop survey, the vast majority of 2002 and 2003 participants gave the NWSTC workshop an overall rating of excellent in terms of its educational value, and unanimously recommended offering it to future instructors of “Online Weather Studies.” Participants felt that the workshop would have a long-term positive impact on their teaching of weather and student advisement, and they were more confident in offering the course the following fall or spring semester. The next NWSTC workshop is scheduled for 16–21 May 2004.

CONCLUSIONS. We anticipate that faculty participating in the AMS “Online Weather Studies” diversity program will deliver highly motivational learning experiences that will encourage their students to consider additional studies in science, perhaps leading to careers in the geosciences or science teaching. All students of “Online Weather Studies”



FIG. 2. Witnessing a radiosonde launch at the Topeka, Kansas, NWS Forecast Office.



FIG. 3. Shunette Woods, a student at Paine College, a historically black college in Augusta, Georgia, leads a map discussion in her “Online Weather Studies” class.

will become more scientifically literate citizens, with heightened awareness of the nature of scientific inquiry, critical thinking, and the capabilities and limitations of science and technology. For additional information on this AMS diversity project, see www.ametsoc.org/amsedu/online/info/diversity.html.

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FOR FURTHER READING

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