Online Science: Incorporating Current Data
and Issues with AMS Weather Studies & AMS Ocean Studies

Dr. James A. Brey
Director, Education Program
American Meteorological Society

Dr. Ira W. Geer
Dr. Joseph M. Moran
Dr. Robert S. Weinbeck
Elizabeth W. Mills
Bernard A. Blair
Edward J. Hopkins
Thomas P. Kiley, Jr.
Emily E. Ruwe

Introduction

The American Meteorological Society views introductory college-level courses to be important avenues for promoting scientific literacy among the public. Additionally, it is from these courses that future teachers often receive their only college-level training in the sciences. As such, the AMS Education Program considers the development of high-caliber, scientifically authentic educational materials to be one of its top priorities. In striving to reach that goal, the AMS has produced a suite of introductory college-level courses that engage students by investigating current topics in Earth science and making use of the most up-to-date, real-world environmental data.

The Fundamentals

Developed by the AMS with support from NSF and NOAA, AMS Weather Studies, AMS Ocean Studies, and coming soon with support from NASA, AMS Climate Studies, are introductory college-level courses available for implementation at undergraduate institutions nationwide. These highly-motivational courses place students in learning environments where they investigate the atmosphere and world ocean using real-world, current environmental data. More than 500 colleges and universities throughout the United States have already offered these unique courses, with more than 70 percent offered in online or blended learning environments.

Each course consists of a fully-integrated set of printed and online learning materials. AMS Weather Studies and AMS Ocean Studies course packages each include a new, completely revised, hardcover 15-chapter textbook, an Investigations Manual with 30 lab-style activities and a course website providing weekly current weather and ocean investigations along with access to environmental data streams. AMS Climate Studies, which is currently under development and expected to be available fall 2010, will be comprised of a similar suite of learning materials.

The AMS Ocean Studies Student Package is also unique, in that it makes use of an inflatable globe. Oceanography comes alive in three-dimensions, helping the student understand complex oceanographic principles. The Investigations Manual utilizes the inflatable globe in many of its activities, demonstrating concepts such as the Coriolis force, plate tectonics, ocean circulation and even tidal bulging. Additionally, the intricacies of tsunami trajectories become much clearer in three-dimensions.
Course Origins

AMS Weather Studies, AMS Ocean Studies and AMS Climate Studies are all based on the development of the AMS DataStreme series of graduate-level courses for pre-college teachers.

AMS DataStreme courses offer training to in-service teachers for graduate credit. They began with the national implementation of DataStreme Atmosphere in fall 1996, followed by DataStreme Water in the Earth System in fall 2001 and DataStreme Ocean in fall 2003 [Smith 2006]. In the DataStreme model, AMS offers the course materials through Local Implementation Teams (LITs) across the U.S. during fall and spring semesters. A LIT typically includes an experienced master teacher, a geoscientist employed at a local college or university, and a scientist involved in real-world operation, often a NOAA employee or AMS Certified Broadcast Meteorologist. LITs recruit up to eight teachers per semester and then act as instructors and mentors to those taking the particular AMS DataStreme course.

Development of AMS Weather Studies was spurred by recommendations from college faculty attending AMS undergraduate faculty enhancement workshops conducted at the NOAA/National Weather Service Training Center in the mid-1990s, and the success of DataStreme Atmosphere. AMS Weather Studies was pilot-tested in spring semester 1999 by 14 meteorology workshop participants and DataStreme leaders at their colleges. It was made available to all institutions the following fall [Geer 2006]. The course has now been implemented at over 413 institutions in the U.S. and Canada.

AMS Ocean Studies was pilot-tested in spring 2005, mostly by faculty already offering the Weather course, and was made available for public offering in fall 2005. Approximately 70 of the colleges offering AMS Ocean Studies also offer the AMS Weather Studies course; further expanding geoscience study opportunities for students. The materials have now been used at 133 colleges and universities nationwide.

As mentioned, AMS Climate Studies is currently under development and will undergo the same rigorous testing using the DataStreme model. The course materials are on track to be available for use at undergraduate institutions in fall 2010.

Course Structure

Overview

AMS Weather Studies and AMS Ocean Studies are fully-integrated course packages containing both printed and online learning materials. The courses include comprehensive 15-chapter textbooks, Investigations Manuals with 30 laboratory-style activities each, course websites, faculty websites, and faculty resource CDs. Instructors can use these materials in any combination that best meets their individual institutional needs.

Figure 1. AMS Weather Studies (left) and AMS Ocean Studies (right).
Textbook

The two textbooks that serve as the foundation for *AMS Weather Studies* and *AMS Ocean Studies* are Dr. Joseph M. Moran’s “Weather Studies: Introduction to Atmospheric Science” and “Ocean Studies: Introduction to Oceanography”, respectively. The weather text will soon be available in a new 4th edition, while the oceanography text is currently in its 2nd edition. Each is full-color, hardcover and includes 15 chapters exploring the atmosphere and world ocean from an Earth-system perspective.

The textbooks follow a similar format with each chapter opening with a *Case-in-Point* section … an authentic, relevant and real-life event or issue that highlights or applies one or more of the main concepts covered in the chapter. In essence, the *Case-in-Point* previews the chapter and is intended to engage reader interest early on. One example, Chapter 12 of the oceanography text entitled, “The Ocean and Climate Change,” opens with a discussion of the shrinking Arctic sea ice cover and its effect on Inuit population and polar bear habitat. The *Case-in-Point* is followed by a sample *Driving Question*, a broad-based query that links chapter concepts and provides a central focus for that week’s study. The driving question leads students into the chapter narrative, which is concluded with *Basic Understandings and Review* and *Critical Thinking Questions*. Each chapter is completed with one or more *Essays* with an in-depth exploration of a chapter concept.

The textbook is typically used in conjunction with the rest of the course package, but can also be used stand-alone in a traditional lecture-style course.

Investigations Manual

Each course also uses an Investigations Manual that includes 30 lab-type investigations; two per textbook chapter. In the case of *AMS Ocean Studies*, an inflatable globe (to represent the ocean in true three-dimensional spatial relationship) packaged with the Manual guides visualization of ocean phenomena, including tides, El Niño/La Niña, ocean currents and tsunami. In the tides investigation, for example, students create model lunar-induced tidal bulges on the globe and deduce tides at equatorial and mid-latitude locations. In another investigation, students cut and tape scaled strips of recent Pacific Ocean sea surface temperatures and anomalies on the globe in order to compare this data to segments showing major past El Niño and La Niña events.

Course Websites

The secure course websites include current topic investigations, called *Current Weather Studies* and *Current Ocean Studies* respectively, as well as items entitled *Weekly Ocean News, Supplemental Information* and links to valuable real-time data and informational websites including chapter self-test questions and geoscience career information. The twice-weekly *Current Weather Studies* and weekly *Current Ocean Studies* enhance the Investigations Manual activities with an analysis of timely data. The *Weekly Ocean News*, which consists of links to current events in weather and ocean news as well as notable historical events, is freshly prepared and updated as the week progresses. Website links are organized into categories to assist the student in exploring relevant websites.

The AMS recently collaborated with UCAR’s *Cooperative Program for Operational Meteorology, Education and Training* (COMET) to provide supplemental, online course material for *AMS Weather Studies*. *MetEd*, a secure website maintained by COMET, provides online training for students, professionals, professors and weather enthusiasts in meteorology and related subjects. A chapter-by-chapter link located on the AMS course website directs students to several selected MetEd modules that correspond with textbook chapters. Subjects discussed in the modules offer an in-depth look at topics introduced in the text and are presented at a more advanced level. Access to *MetEd* allows professors to
offer the course at a more advanced level, or provide talented students an opportunity to learn more and explore the field of meteorology in depth. A similar concept is being developed for *AMS Ocean Studies*.

**Faculty Resource Materials**

Course instructors receive a *Faculty CD* containing a faculty manual, Investigations Manual answer forms compatible with course management systems, test bank questions, textbook images and PowerPoint® presentations. The faculty manual describes the course and its components and contains suggestions for course implementation in a variety of classroom settings. Included for each text chapter is an outline, a summary and learning objectives. The CD Investigations Manual answer forms are available in Respondus® … a test-generating software that is compatible with many course management systems.

A secure faculty website delivers answers to chapter *Review and Critical Thinking*, Investigations Manual, and *Current Weather Studies* and *Current Ocean Studies* questions. The website also includes Respondus-formatted answer forms.

**Course Implementation**

The courses can be offered completely online, blended, or in traditional face-to-face learning environments by experienced faculty or those entirely new to teaching the subject matter. Mentoring by course instructors already offering the course and AMS staff is available to all new instructors.

**Course Licensing Procedure**

A license is required for institutions using the full course packages (Fig. 1), which include the textbook, Investigations Manual, and course and faculty websites, or the Investigations Manual and/or course website alone. A license is not required for institutions that use only the textbook. Students enrolled in the course receive local institutional credit and purchase course materials through their college bookstore.

**Conclusion**

*AMS Weather Studies* and *AMS Ocean Studies* have together introduced real-world geoscience education at more than 500 institutions, many of which had not previously offered a course in these disciplines. The courses deliver highly motivational learning experiences that encourage additional student exploration of the geosciences, possibly even leading to careers in science or science education.

The AMS will continue to encourage more institutions to offer *AMS Weather Studies* and *AMS Ocean Studies*, and will continually update the course to fit the changing needs of colleges and incorporate the very latest in Earth science research and applications. The AMS is also excited to build upon its suite of introductory courses with the upcoming national dissemination of *AMS Climate Studies* in fall 2010.

**References**


Co-Authors

Dr. James A. Brey
Director, Education Program
American Meteorological Society
1120 G Street, NW, Suite 800
Washington, DC  20005
http://www.ametsoc.org/amsedu
Phone: (202) 737-1043 x457
Fax: (202) 737-0445

Dr. Joseph M. Moran
Associate Director, Education Program
American Meteorological Society
1120 G Street, NW, Suite 800
Washington, DC  20005
http://www.ametsoc.org/amsedu
Phone: (202) 737-1043
Fax: (202) 737-0445

Elizabeth W. Mills
Education Program
American Meteorological Society
1120 G Street, NW, Suite 800
Washington, DC  20005
http://www.ametsoc.org/amsedu
Phone: (202) 737-1043 x456
Fax: (202) 737-0445

Edward J. Hopkins
Environmental Sciences Department
University of Wisconsin-Madison
1225 West Dayton Street
Madison, WI 53706
http://www.wisc.edu
Phone: (608) 262-1605
Fax: (608) 263-4190

Emily E. Ruwe
Education Program
American Meteorological Society
1120 G Street, NW, Suite 800
Washington, DC  20005
http://www.ametsoc.org/amsedu
Phone: (202) 737-1043 x452
Fax: (202) 737-0445

Dr. Ira W. Geer
Senior Education Fellow, Education Program
American Meteorological Society+
1120 G Street, NW, Suite 800

Dr. Robert S. Weinbeck
Associate Director, Education Program
American Meteorological Society
1120 G Street, NW, Suite 800
Washington, DC  20005
http://www.ametsoc.org/amsedu
Phone: (202) 737-1043 x455
Fax: (202) 737-0445

Bernard A. Blair
Education Program
American Meteorological Society
1120 G Street, NW, Suite 800
Washington, DC  20005
http://www.ametsoc.org/amsedu
Phone: (202) 737-1043 x454
Fax: (202) 737-0445

Thomas P. Kiley, Jr.
Education Program
American Meteorological Society
1120 G Street, NW, Suite 800
Washington, DC  20005
http://www.ametsoc.org/amsedu
Phone: (202) 737-1043 x458
Fax: (202) 737-0445