1.7 DATASTREME OCEAN: A NEW DISTANCE-LEARNING COURSE FOR PRECOLLEGE TEACHERS ON THE BASICS OF OCEANOGRAPHY

Ira W. Geer[1], Joseph M. Moran[1], Robert S. Weinbeck[2], David R. Smith[3], Bernard A. Blair[1]
Edward J. Hopkins[4], H. J. Niebauer[4], and Elizabeth W. Mills[1]

[1]American Meteorological Society, Washington, DC; [2]State University of New York at Brockport, Brockport, NY; [3]U.S. Naval Academy, Annapolis, MD; and [4]University of Wisconsin-Madison, Madison, WI

1. INTRODUCTION

DataStreme Ocean is a new semester-long distance-learning course for precollege teacher enhancement that is partially delivered via the Internet. *DataStreme Ocean* is a major initiative of the American Meteorological Society (AMS) and the National Oceanic and Atmospheric Administration (NOAA) Cooperative Program for Earth System Education (AMS/NOAA CPESE). Teachers who successfully complete *DataStreme Ocean* earn three hours of graduate credit from the State University of New York (SUNY) at Brockport and agree to serve as ocean resource teachers in their schools and school districts.

DataStreme Ocean is modeled after *DataStreme Atmosphere* and *DataStreme Water in the Earth System (WES)*, two highly successful AMS teacher enhancement courses (Geer *et al.*, 2002; Weinbeck *et al.*, 2002). *DataStreme Ocean* explores the ocean in the Earth system with special emphasis on (1) the flow and transformations of materials and energy into and out of the ocean, (2) the physical and chemical properties of the ocean, (3) ocean circulation, (4) marine life and its adaptations, (5) interactions between the ocean and the other components of the Earth system, and (6) the human/societal impacts on and response to those interactions. The approach is inquiry-based and consistent in methodology and goals with the *National Science Education Standards*.

Since the project's inception in spring 2002, principal activities have consisted of framing the conceptual approach of *DataStreme Ocean*, developing learning materials, designing the course homepage, training Local Implementation Team (LIT) leaders, pilot offering of the course in fall 2003, and preparation for beta-testing the course in spring 2004.

Corresponding author's address: Joseph M. Moran, American Meteorological Society, Education Program, 1120 G Street NW, Suite 800, Washington, DC 20005-3826; email moran@dc.ametsoc.org.

2. MATERIALS DEVELOPMENT

First drafts of the *DataStreme Ocean* textbook and study guide were prepared in 2002-03. The customized 15-chapter textbook was co-authored by M. Grant Gross of Washington College (MD) and Elizabeth Gross of the Scientific Committee on Oceanic Research. Participating teachers explore twelve principal themes that are arranged by chapter, each corresponding to one week of the *DataStreme Ocean* course plus three optional themes. Themes are organized so that concepts build logically upon one another as the ocean and its role in the Earth system are demonstrated to follow patterns described by physical laws. Central to each week's theme are twice-weekly *Benchmark Investigations*. The first part of each investigation appears in the study guide and the second part is delivered via the *DataStreme Ocean* homepage on Tuesdays and Thursdays during the course offering. Online components of investigations are written to current and/or archived environmental data. The course homepage also features *Weekly Ocean News*, *Supplemental Information*, and links to user-friendly products on the websites of a number of federal and state agencies that provide teachers with a wealth of oceanographic data and imagery that will enhance the teaching of oceanography and stimulate student interest.

Week 1 examines the ocean's place in the Earth system. The second week focuses on the characteristics of the ocean basin and the role played by plate tectonics in shaping its features. Week 3 deals with the unique physical and chemical properties of water and week 4 covers the origin and distribution of marine sediment with emphasis on ocean resources. Week 5 investigates air-sea interactions and the flow of heat energy into and out of the Earth-atmosphere-ocean system. The next three weeks focus on the dynamic ocean: surface and deep-ocean currents, waves and tides, and shoreline processes. Weeks 9 and 10 examine marine ecosystems and life in the ocean. The following two weeks explore the ocean's role in short-term climate variability and long-term climate change. Optional chapters in the text consider future trends in ocean science (Chapter A), ocean stewardship (Chapter B), and public policy and the ocean (Chapter C).

Each text chapter opens with a *Case-in-Point*, an authentic case or issue that highlights or applies one or more of the main concepts covered in the chapter. The *Case-in-Point* is followed by a sample *Driving Question*, a broad-based query that links chapter concepts and provides a central focus from the beginning of the chapter. Chapter content is science-rich and informs additional driving questions. Each chapter closes with a list of *Basic Understandings*. *Essays* at the end of each chapter address in some depth a specific topic that builds on a concept introduced in the narrative. Examples include *Profiling the Ocean Depths, Moving the Cape Hatteras Lighthouse,* and *Marine Sanctuaries*.

DataStreme Ocean is pedagogically guided by a teaching approach (*Project-Based Science*) that seeks to engage learners in exploring their world by investigating meaningful questions. *DataStreme Ocean* incorporates driving questions, investigations, collaboration, technology, and artifacts. The course text offers one *driving question* per chapter but each chapter plus investigations inspire additional driving questions. Each investigation has printed and electronic components that make use of environmental data available on the Internet. Investigations promote critical thinking as participants engage in observation, prediction, data analysis, and inference. *Collaboration* involves participants in collegial interactions with their mentors (members of their *DataStreme Ocean Local Implementation Team*). *DataStreme Ocean* participants gain experience in retrieving and analyzing real-world data (some in real-time) and sharing interpretations. Throughout the course, participants assemble learning materials (*artifacts*) in their "ocean bag" for assessment purposes and future reference.

DataStreme Ocean is a teacher enhancement course that is aligned with the goals of the *National Science Education Standards*. The design of course learning materials models a science content-rich and motivationally enhancing teaching approach adapted for electronic delivery to adult learners. *DataStreme Ocean* provides professional teachers with scientifically authentic knowledge and tools that they can use to devise inquiry-based lessons for their students.

3. LIT LEADER TRAINING

Teachers play a key role in implementing all AMS education programs (Geer *et al.*, 1999). Teachers who have participated in prior AMS Maury and DataStreme programs assist in the training of *DataStreme Ocean* participants through local implementation teams (LITs). These teacher-trainers first undergo their own training to acquire the necessary background in the subject matter and structure of *DataStreme Ocean*.

Twenty-two teachers who had completed training through the Maury Project and other AMS education programs were selected to serve as LIT leaders. An additional group of teachers from the same programs were selected as LIT members. Each LIT was also joined by a scientist (e.g., a NOAA or Sea Grant oceanographer) or college/university instructor with expertise in oceanography. Subsequent to these pairings, LIT leaders and some LIT members attended a summer workshop from 24 June to 2 July 2003 hosted by the University of Washington in Seattle, WA. The *DataStreme Ocean* summer workshop primarily focused on course content, organization, and delivery. Teachers visited many NOAA facilities including the Northwest Fisheries Science Center (NWFSC), Pacific Marine Operations Center, NOAA Sand Point Campus, and the Pacific Marine Environmental Laboratory (PMEL). Staff scientists at each facility provided the teachers with an overview of operations and addressed a number of oceanographic topics (e.g., ocean/atmosphere monitoring in the tropical Pacific, marine productivity, tsunamis, ARGO floats).

The second phase of training for the *DataStreme Ocean* LIT leaders and members was their participation in the pilot testing of the course during the fall semester 2003. LIT members mentored each other as they took the course and provided valuable feedback in preparation for the national beta-test implementation of the *DataStreme Ocean* in spring semester 2004.

4. FUTURE ACTIVITY

During the beta-testing phase, each LIT will offer *DataStreme Ocean* to an average of 8 teachers using learning materials that were revised based on experiences and recommendations received from LIT members during fall 2003. Participating teachers will utilize a revised study guide and full-color textbook. LIT members and participating teachers will serve an important role in critiquing materials, especially in terms of its appropriateness for the intended audience. Based on feedback received during the beta-test, we will complete a final revision of the course learning materials.

In subsequent semesters, LITs will facilitate the offering of *DataStreme Ocean* in an expanded national network, depending on the availability of funding. Throughout the *DataStreme Ocean* program, a formative evaluation process will be ongoing. This will allow course revision on an almost continual basis, ensuring that the course is scientifically up-to-date and pedagogically appropriate for the intended audience.

5. CONCLUSIONS

DataStreme Ocean is about to enter its beta-test phase of development. Feedback from LIT members received to date is very encouraging and convinces us that the DataStreme model is an effective means of introducing

teachers to the basic understandings of oceanography in an Earth system context. *DataStreme Ocean* promises participating teachers and their students an exciting and highly motivational learning experience.

DataStreme Ocean is a major initiative of AMS/NOAA CPESE, a program that is designed to enhance public understanding of the fluid Earth system emphasizing the atmospheric, oceanic, and hydrologic sciences and to promote activity that will contribute to greater human resource diversity in the nation's scientific workforce. Through CPESE, the AMS assists NOAA in the advancement of its goals directed toward environmental assessment and prediction, protection of life and property, and the fostering of global environmental stewardship. NOAA's success in meeting its mission objectives is highly dependent upon synergistic relationships between it and the users of its products and services. CPESE nurtures this synergy through precollege teacher, introductory undergraduate, and general educational activity. Fundamental to CPESE are (1) *breadth*, demonstrating the comprehensive need for describing and predicting changes in the Earth's environment and conserving and wisely managing the nation's coastal and marine resources; (2) *visibility*, increasing pubic awareness of the ways environmental assessment, prediction, and stewardship touch the lives of all Americans every day; and (3) *diversity*, promoting educational activity and outreach to attract members of groups underrepresented in science, technology, engineering, and mathematics to study and consider careers in those fields, including those for which NOAA has employment needs and opportunities.

For additional information on *DataStreme Ocean*, go to http://www.ametsoc.org/amsedu/DS-Ocean.

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