Implementation of NOAA Direct Readout Satellite Data Capabilities in Florida's Public Schools

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Abstract

In 1992 a precollege outreach program designed to bring weather satellite imagery into the classroom was developed jointly by the Florida Technological Research and Development Authority and The Florida State University Department of Meteorology. This initiative incorporates the NOAA Direct Readout Satellite-data ingest program into Florida public school districts for the enhancement of education in a variety of curriculum areas.

1. Introduction

In "Why My Kids Hate Science," a special contribution to *Newsweek*, Robert M. Hazen (1991), coauthor of *Science Matters: Achieving Scientific Literacy* (Hazen and Trefil 1989), describes the trend toward the scientific illiteracy of our nation's students. The meteorological community has recognized this disturbing trend and has appointed committees (the American Meteorological Society's Board on School and Popular Meteorological and Oceanographic Education, and the Board on Women and Minorities) to address the problem. In December 1990, the American Meteorological Society (AMS) published the *Guide to Establishing School and Popular Educational Activities* (Smith and Snow 1990). This guide outlined methods to rejuvenate an awareness of meteorology and oceanography as sciences of great importance in everyday life. One product of these efforts is Project ATMOSPHERE. Project ATMOSPHERE is an AMS educational program that promotes studies in atmospheric sciences at elementary and secondary schools. The goal of the program is to help teachers effectively utilize atmospheric topics to stimulate student interest

and understanding in science and mathematics (Houghton 1990, 1991; Snow and Smith 1990; Smith and Geer 1991; Smith et al. 1991).

The university science and mathematics communities also recognize this disturbing trend of scientific illiteracy of our nation's elementary and secondary students. Many of the United States' most prominent university science and math departments are finding themselves reteaching the remedial levels of science and math because incoming students cannot apply basic principles to either real-world or hypothetical problems. This problem is exacerbated in universities with first-class undergraduate and graduate science and math disciplines. For example, because of the complexity of the processes that interact to comprise the total earth-atmosphere system, meteorology and other earth and space science programs are finding it difficult to train students in both the fundamentals and complexities of these earth/atmosphere processes within a four- or five-year undergraduate program framework.

During the 1992 annual meeting of the American Educational Research Association, Seymour Sarason, a prominent scholar on educational methods, strongly asserted that the problems facing the nation's schools would not be addressed in a satisfactory manner unless substantial structural changes to the educational system were put into effect. In order to address the severity of this problem and the suggested need for structural changes in our nation's science education programs, The Florida State University (FSU) Department of Meteorology polled middle and high school science coordinators in Florida who applied to participate in EXPLORES! (see section 2). The most interesting result was that the science teachers at the middle and high school levels were receptive to university involvement and mentorship in the educational programs that are performed at the precollege level. So often, faculty members at the university level are

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willing to point out and lament the deficiencies of incoming freshman science and math students, and place the blame for those deficiencies squarely on the middle and high school teachers and the colleges of education that trained those teachers. Our findings indicate that these teachers desperately need the university science and math disciplines to "show them the way."

In other words, the responsibility of training qualified students to begin rigorous university programs in science and math belongs to the universities!

2. Florida EXPLORES!

To encourage an enhanced scientific awareness in the state of Florida, the Florida Technological Research and Development Authority (TRDA) created an initiative to provide funds to make weather satellite ground stations available in Florida's public schools. Funding for this initiative was provided by the Florida Department of Education, as well as proceeds from the sale of space shuttle *Challenger* memorial license plates. This initiative was developed to help spark interest in and direct students toward careers in the physical and earth sciences and mathematics, and provide them with the proper background training so that they can succeed in their future scientific endeavors. In response to this initiative, the FSU Department of Meteorology proposed a program to place 30 NOAA direct-readout satellite-data ground stations at middle and high schools throughout the state and provide the necessary training so that these systems could be used to their maximum extent. This combination of providing the ground stations, training and curriculum, and the capability to network the schools is unique when compared to all other efforts of its kind. The placement of these ground stations in Florida's schools coincides with the observance of the International Space Year 1992—the 500th anniversary of the voyage and explorations of Columbus. In honor of all scientific explorations past, present, and future, the program was christened Florida EXPLORES! (Experimental Program for Learning the Operations and Resources of Environmental Satellites).

In order to pave the way for the implementation of this program, four demonstration direct-readout satellite-data ground stations were constructed. These ground stations are receiving automatic picture transmissions (APTs) from operating polar-orbiting satellites and weather facsimile (WEFAX) data from geosynchronous (GOES) weather satellites with direct-readout capabilities. At the present time, APT in the range of 137–138 MHz are available from four United States civilian satellites (NOAA-9, -10, -11, and -12)

and two Russian satellites. WEFAX images are available on 1691 MHz from *GOES 7* and *METEOSAT 3*.

One ground station is located at FSU and is dedicated to the development of research project ideas, curricula, and training materials for Florida's public school teachers. A second ground station is located at the Spaceport Florida Laboratories (SFL) in Titusville (adjacent to the Kennedy Space Center, Spaceport USA, Space Camp, and TRDA), and serves as a centrally located training instrument for Florida's public school teachers. The third ground station is located at Wakulla County Middle School (WCMS), Crawfordville, which allows for hands-on development and testing of elementary, middle, and high school curricula and teacher training materials by public school teachers and students in cooperation with the FSU Department of Meteorology. The fourth ground station is located at the GTE Challenger Center in the Florida Museum of Science and Industry (MOSI) in Tampa. These four stations allow for the continued development and testing of new ideas by FSU researchers, public school teachers, students, and the space and science education staffs at SFL and MOSI.

In addition to the four demonstration ground stations, 30 additional ground stations designed to receive APT from polar-orbiting satellites were constructed. A competitive statewide search, application, and selection process was undertaken. The ground stations were then awarded to the top 30 applicants. Dozens of criteria were used for this difficult selection process. Approximately 60% of the stations were placed in high schools and the remaining 40% in middle schools.

Furthermore, each school in the state is linked by computer via the Florida Information Resource Network (FIRN). This network provides electronic mail capability and educational bulletin board access to all of Florida's public school teachers. The FSU Department of Meteorology and its network of 30 schools have entered into an agreement with the Florida Department of Education to provide satellite images and curriculum activities to FIRN for statewide distribution. Using this distribution method, schools without ground stations will have access to selected imagery via telecommunications.

3. Curriculum development

After awarding the ground stations, an intensive program to develop materials for the teachers and students began. These materials and projects were developed to take advantage of the existing capabilities and facilities of each school selected, and to

provide a wide variety of activities for the various educational and interest levels that Florida's diverse school-age population exhibits. Using the resources available to us, an instructional guide to weather satellites was created to provide information concerning the history of weather satellites, how satellites are placed in orbit, how they function, their capabilities and instrumentation, etc. Pictures and diagrams were used wherever possible to help teachers and students visualize the amazing capabilities of these spaceborne earth-observing stations. NOAA Technical Report NESDIS No. 44, by R. J. Summers (1989), was provided to each participant by Douglas Brown at NOAA Educational Affairs to instruct the teachers and

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students on how the direct-readout ground station components work to receive satellite signals and how these components transform the signals into visual images. Instructions on how to set up the ground station, including installation of computer video and receiver boards and antenna construction, were also provided. A one-week workshop was held that afforded numerous opportunities for the participants to gain hands-on knowledge of the ground stations.

In addition, an instructional guide of basic meteorological knowledge was prepared for the teachers and students using the ground stations. It is important that these teachers acquire a good understanding of the various types of meteorological phenomena that can be observed via satellite so that they can then use this information to accurately train their students. Workshop sessions on weather phenomena, satellite imagery interpretation, and developing observational skills were also held. With this knowledge, the ground stations can be used to their maximum capabilities, providing an extraordinary learning experience for both the teachers and students. Units for the meteorological curriculum included basics such as temperature, humidity, winds, thunderstorms, hurricanes and tornadoes, safety precautions and procedures, regional and local climate, and the hydrologic cycle and its importance, as well as more complicated issues such as radiative transfer, the dispersion of pollution, and global climate change.

Specifications for constructing school-made weather stations are also being made available to interested

industrial arts and vocational skills teachers statewide to augment the overall state science curriculum. In this way, the industrial arts curriculum could complement the earth and space science curriculum, allowing students access to a total hands-on/minds-on educational experience. In addition, some of the network schools are using maximum and minimum thermometers and raingages to take daily weather observations. The meteorological observations collected from school-made or purchased instruments will allow for ground-truth comparisons between observations of meteorological phenomena from earth-orbiting platforms and surface-based instrumentation, as well as provide the network of National Weather Service offices in Florida with additional cooperative stations that will have the ability to report climatological data. Several students involved in the project are already actively involved in meteorological and oceanographic studies, which they hope will evolve into science fair projects. In addition, extracurricular groups such as science clubs and "exploratory" science groups are using the ground stations as a centerpiece of their activities.

It is not the intent of the investigators to delve solely into the area of meteorology, but into all of the areas of earth and space sciences that can be studied using weather satellite imagery. In addition to the basic meteorological curriculum, ideas for a general science curriculum were developed to take advantage of the unique earth-observing capabilities of orbiting weather satellites. Educational packets addressing other aspects of earth sciences such as geography, ocean currents, volcanic eruptions, forest fires, etc., were prepared. Communication skills, both oral and written, were also addressed in the form of journalism, media center, and graphic arts activities, such as the production of homemade weather shows, newsletters, posters, pamphlets, etc.

The FSU Department of Meteorology will continue to serve as a consultant to public school teachers and students with questions concerning any aspect of the operation or dissemination of information from the direct-readout ground stations. During 1993, the network will be expanded by upgrading the existing APT stations to include WEFAX, and adding at least 25 new APT stations. It is hoped that via this program, long-lasting professional relationships can be established between the FSU Department of Meteorology and the public schools of the state of Florida.

4. Conclusions

In summary, EXPLORES! was created with the goal of upgrading the interest, confidence, and skill

level in Florida's public school basic science and mathematics courses. Each weather satellite ground station will serve as an experimental tool to teach and apply science concepts as basic as the scientific method to those as complex as orbital mechanics and global climate change. Multimedia presentations are emphasized during all aspects of teacher training and curriculum development, including slides, movies, videotapes (AM Weather and The Weather Channel), magazines, and newspapers (local papers, *USA Today*, the *New York Times*, and newspaper curricula such as those available from "How the Weatherworks"), in addition to the more conventional modes of chalk, overheads, paper handouts, and most important, observation! It is expected that EXPLORES!, along with model programs using ground stations or weather instrumentation in other states (e.g., Pennsylvania, North Dakota, North Carolina, Maryland, and Utah), will enhance the earth and space science curricula in schools nationwide and become a model program for other states to emulate. It is hoped that EXPLORES! will guide the young scientific minds of the future into the proper avenues of study for careers in the sciences.

University-level science and math departments must take responsibility for demonstrating how we expect future scientists to be trained. It is our responsibility to pass along new research methods, techniques, and equipment and provide the infrastructure to offer continuing education to middle and high school teachers as needed. The process of scientific discovery is not a static one; it is one that is constantly evolving. As such, our training tools and methods need to be continually evolving. If we wish to have future meteorologists trained to address the complexities associated with the earth-atmosphere system, we must expose them to science as it really is, a continuous EXPLORATION!

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