Remote Sensing of Ice Sheets for Underrepresented and Handicapped Middle School Students

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"Abstract-" ***The NSF Science and Technology Center for the Remote Sensing of Ice Sheets (CReSIS) combines the expertise of researchers from 6 universities, several industries, and federal laboratories to study and conduct research to achieve a better understanding of the mass balance of the polar ice sheets. CReSIS is the only NSF Science and Technology Center dedicated to developing techniques and technologies for determining the contribution of ice sheets to sea level rise. CReSIS is led by the University of Kansas with Elizabeth City State University, University of Pennsylvania, The Byrd Polar Center at Ohio State University, Haskell Indian Nation and The University of Maine as partners.***

In addition to its strong research and science mission, CReSIS education and outreach efforts are designed to impact the entire educational pipeline. The purpose of the CReSIS Education Program is to prepare future generations of scientists and engineers who are capable of assuming responsibility for our future work. These future leaders in polar science and engineering should more closely mirror the diversity in our world.

Because our primary goal is to train our own replacements, our first priority is the graduate students who are most likely to begin supporting CReSIS' work in the near term. As a logical extension of that notion, our secondary focus is on generating a diverse pool of talented undergraduates to begin filling graduate student roles in Center activities. Thirdly, we must continue to provide opportunity, motivation, and focused supplemental content for K-12 students in order to create larger pools of STEM-capable and interested students at the college level. CReSIS engages directly with students in the classroom or through informal educational opportunities, letting them see firsthand what our researchers do and participate in project-based investigations and authentic research. (CReSIS, 2006)

This paper details the CReSIS middle school outreach strategy, the program organization, logistics, participant descriptions and outcomes.

I. Introduction

During the summer of 2006 thirteen middle school students and seventeen undergraduate students participated in a summer research based experience on the campus of Elizabeth City State University (ECSU). The program was based on prior ECSU remote sensing informal education programs which included the You Be the Scientist with Satellite Imagery program (Hayden 2001, 2002). Middle school students participated in lunchtime seminars on Holistic Ice Sheet Modeling. They also were involved in remote sensing and GPS training. All participants were African American and one was handicapped. Figure 1 shows the middle school participants and the program director Dr. Darnell Johnson.

Figure 1. Participants and Program Director

The thirteen participants worked with a CReSIS staff and scientist on projects that involved learning the fundamentals of climate change and remote sensing. The target population was composed of African American and handicapped middle school students in the region of northeastern North Carolina. Students provided their own transportation to and from the ECSU site each day. Parents were actively involved in opening activities, field trips and closing program activities during which students received a certificate and a stipend. Students participated in several Lunch Research Seminars on Holistic Ice Sheet Modeling lead by Dr. Terrance Hughes from the University of Maine. During the seminars Dr. Hughes discussed his first order approach to ice sheet modeling and its impacts on global climate warming.

II. Remote Sensing and GPS Training

The remote sensing workshop for the CReSIS program focused on increasing student's awareness and knowledge of the science of remote sensing. At the beginning of the workshop students were given a short lecture on remote sensing. The lecture provided an introduction and history of remote sensing, exposed students to terms and tools used, and gave students examples of how remote sensing is used on a daily basis. Examples of images were also shown to students. The introduction defined remote sensing, explained terms, and provided a brief history of the science. Terms that were explained included the electromagnetic spectrum, pixels, and bands. Photos of early photographers such as Nadar and examples of the first photos taken were shown.

The students used three Internet based sites for training in remote sensing, the Center of Excellence in Remote Sensing Education and Research (CERSER) website, the Google Earth website, and the Earth Observatory website. CERSER is a remote sensing facility which focuses on education and research on coastal areas, oceans, and ice sheets. The CERSER website exposed students to technology that is available at Elizabeth City State University. Students were given an overview of the equipment used to gather data and the steps required to process the data.

The Google Earth website was used to expose students to an interactive form of remote sensing. Students were given a location in the United States and asked to find the location. Google earth combines the Google search with satellite imagery, maps, terrain, and 3D buildings.

Figure 2. Participants during the GIS Training

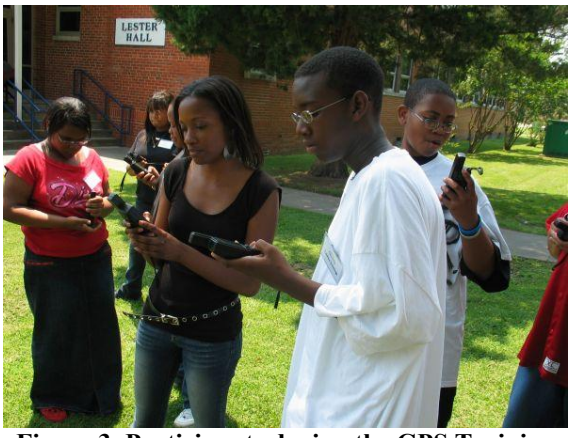

Figure 3. Participants during the GPS Training

The Earth Observatory website provides for obtaining satellite imagery and scientific information about our planet. It provides. The site focuses on the Earth's climate and environmental change. Students were asked to explore the website, view images, and read the scientific information associated with the imagery.

Descriptions of images were required and students were asked to compare and contrast images of Antarctica explaining the similarities and differences that were noted. Two students were selected to present their work during the

closing program. During the GPS training workshop participants learned how to operate the Magellan GPS 310 Receiver. This device is a handheld 12 Parallel-channel receiver with a quadrifilar helix antenna. Figures 2 and 3 show the Remote sensing and GPS training workshops.

Figure 4. Ice Sheet Modeling Overview

III. Seminars on Holistic Ice Sheet Modeling

Students were required to read and reported on the Bangor Daily News Special Features on "Our Changing World: Understanding the Science of Climate Change. The lunchtime seminars and several afternoon sessions presented the basics of glaciological theory used to interpret data collected from expeditions showcased in the morning sessions. The sessions focused on polar research conducted by Dr. Hughes to give it a personal touch.

•An Antarctic project in 1968-1969 drilling holes through Meserve Glacier, which flows down the side of Wright Valley, one of the Dry Valleys in the Transantarctic Mountains west of the main American base of operations, McMurdo Station, on Ross Island in the Ross Sea. Three holes were drilled and both temperature and inclinations were logged down the boreholes. Measurements had to be repeated the following year, when temperatures down the boreholes had attained equilibrium and the repeated inclinations of the boreholes delivered the vertical profile of downslope ice velocities. The drilling operation and data were presented. Data showed the effect of temperature on the flow of ice.

•Deception Island: This collapsed volcanic caldera north of the Antarctic Peninsula was studied for the mechanism by which large slabs of ice calved from an ice wall initially 100 m high that formed when a crater blew the snout off a glacier flowing from the caldera rim into the caldera.

• Byrd Glacier and its vicinity in the Transantarctic Mountains: Byrd Glacier is the largest ice stream supplying East Antarctic ice to the Ross Ice Shelf. It drains ten percent of East Antarctica and passes through a deep fjord 26 km wide. Data collected were used to produce detailed maps of the surface elevations and velocities of Byrd Glacier over its 26 km width and 150 km length. Now Earth-orbiting satellites deliver these data.

• Greenland's Jakobshavn Isbrae: It has been the world's fastest-known ice stream, with velocity measurements dating from 1964. In recent years its velocity has doubled to over 12 km/a. The 1986 data were presented and compared with recent data from satellites that show the large changes in ice velocity and elevation.

The text for the afternoon sessions was *Holistic Ice Sheet Modeling: a First-Order Approach.* Holistic modeling of dynamic system is based on addressing six questions: (1) What are its most energetic parts? (2) What factors force motion in these parts? (3) Which of these factors vary over time? (4) What physical processes cause the time variations? (5) Can these processes be quantified theoretically? (6) What experiments will test the theories? Answers to these questions were then proposed for ice sheets as one dynamic system in Earth's climate machine. The stability of the Greenland and Antarctic ice sheets was linked to the floating fraction of basal ice.

IV. The Closing Program

The CReSIS middle school experience culminated with student PowerPoint presentations that demonstrated what was

learned after two week of interaction with scientists that enhanced their understanding of technology for ice sheet research. Each student was awarded notebooks, tote bags, and a $100.00 stipend for completion of rigorous study efforts and participation. Parent and school administrators gave positive comments of the summer program and expressions of gratitude to faculty and staff for the opportunity of their students to gain understanding of remote sensing with ice sheets and sea level rise. Parents participated in all activities by providing transportation and encouragement throughout the entire program. The highlight of the closing activities was the heartfelt acknowledgement given by Dr. Terrance Hughes to students, parents, administrators, and Elizabeth City State University faculty for their roles in this great experience for future scientists. Dr. Hughes was presented with a plaque and ribbon as a token of appreciation by students and faculty. Figure 5 is a photo of a CReSIS participant and the director during the closing program.

Figure 5 – CReSIS Closing Program

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