6. Education and Outreach
10-11-06

Below we include descriptions for our two more explicit Formal and Informal Education projects, involving support for the SMILE program and for an interactive display at the HMSC. First we list the activities of workshops and short courses, which we consider science outreach.

A. Science Outreach

In Tables 3.1 and 4.1 are a number of activities involving workshops and short courses. These are usually listed as having zero funding, since any funding for most of these is usually included in the annual administrative funds. Some were specifically funded activities or projects. We repeat the short descriptions found in Section 3 for completeness. See the longer descriptions for these projects in Section 4.

Davis: NOAA: NESDIS (Dan Flanagan, GOES-R HES Design Team).
CIOSS Fellow Curt Davis has served on the HES Design Team, providing scientific oversight for the engineering designs that are being developed for the HES instrument.

Davis: NOAA: NESDIS/HQ, NESDIS/STAR. NIST. NASA. ONR.
CIOSS Fellow Curt Davis chaired a panel that reviewed plans for the next generation buoy for optical calibration and validation of ocean color sensors. The evaluation team included CIOSS and NIST members.

Freilich, Chelton: NOAA: NESDIS/STAR (Chang); NWS (tropical and severe weather forecast offices).
The objectives of this effort is to establish a partnership between the research and operational communities with a common goal of establishing a sustained data record of high-quality satellite measurements of ocean vector winds that satisfies the needs of both communities. This is being achieved through a series of workshops at approximately yearly intervals. To date, two workshops have been conducted, one in February 2005 and the other in June 2006.

Freilich: NOAA: NWS (Jeffrey Lorens, NWS Western Region).
Approximately half-day presentations of satellite microwave wind measurement techniques, bases, and interpretation focused specifically for training of WFO forecast personnel having marine prediction responsibilities, as part of the annual Western Region Marine Forecaster Training Workshop (Freilich has presented annually since 2000). The present internet COMET training module on scatterometry is based on lectures presented by Freilich at COMAP as well as at the WR Marine Forecaster Training Workshops (http://meted.ucar.edu/npoess/scatterometry/)
Freilich/Milliff/Stamus: NOAA: NWS (NOAA Regional Forecast Offices).
Site visits and associated training sessions in the use and interpretation of QuikSCAT measurements, coupled with written forecaster and SOO surveys at WFOs with marine forecast responsibility, have been conducted by Milliff and Stamus over the past 12 months. Guidance from Milliff and Stamus has significantly increased the use and perceived value of QuikSCAT measurements at some WFOs, while the formal written and oral feedback from the SOOs and forecasters is being used to guide the development of enhanced forecaster vector wind products and requirements for new and more capable vector wind measurement systems.

Kurapov, Allen, Egbert, Samelson: NOAA: NOS (Aikman); JCSDA (Bayler). NRL (Kindle).
The goal of this workshop is to bring together experts on coastal modeling and data assimilation to define the state of the art in coastal modeling. This is a first step in helping NOAA/NOS to look forward to its role as the National Backbone for coastal modeling in the IOOS efforts.

Letelier, Abbott, Strutton (CDR Workshops): NOAA: NESDIS/STAR, NESDIS/HQ, PPI/Climate Office, NPOESS/IPO, NMFS. NASA/GSFC.
Workshops to Develop Consensus on Production of Ocean Color Climate Data Records. Task II, additional outreach. Themes 1 and 5. NOAA Mission Goal: Climate.
Two workshops were planned and one has been held. The other is yet to come. The first involved various NOAA Line Offices and NASA and produced a concise statement of what the requirements for CDRs (see the report on the CIOSS web page). The next is still in planning and will again bring NOAA, NASA and academic research scientists together to develop more specific plans for ocean color CDRs.

Strub: NOAA: NMFS (Wilson), NESDIS/CoastWatch (Foley).
This short course brought 30 NMFS and Marine Sanctuary research scientists to CIOSS for a 3-day course on the use of satellite data in fisheries-related studies. CIOSS provided the venue and the first half-day of lectures on ocean remote sensing. Wilson and Foley then led the rest of the workshop, which was a hands-on exploration of available satellite data and GIS software.

Strub, Barth: NOAA: PPI/Climate Office (Koblinsky), NMFS (Peterson), NOS (Aikman).
Workshop on Climate Impacts on California Current Ecosystems (jointly supported by CIOSS and JIMAR). Numerous NMFS participants. Task I, core outreach. Theme 5. NOAA Mission Goal: Climate.
CIOSS is co-sponsoring this workshop with the Joint Institute for Marine Observations (JIMO) at Scripps, at the request of Chet Koblinsky (NOAA/Climate). The objectives are: to define the present state of knowledge regarding the effects of climate variability on components of the California Current Ecosystem; and to provide the conceptual framework for future observing and modeling systems that would be necessary to monitor those effects.
In an additional "science outreach" activity with a potentially large impact, CIOSS Fellows Dudley Chelton and Mike Freilich led an effort to write a letter to the NRC Panel that was writing the Decadal Survey Report, with recommendations for future Earth-observing satellite missions for research and operational applications. The initial draft report was weak in its recommendations for ocean-related satellite measurements. The letter written by Chelton and Freilich, with input from other oceanographers, provided suggestions for improvements to the draft report that would include the needs of the oceanographic community.

**Oceans Community Letter to the NRC Earth Science Decadal Survey**

CIOSS Fellows Dudley Chelton and Mike Freilich led a recent effort to summarize the scientific needs for new and continuing oceanographic satellite observations over the next decade and communicated those needs to the members of the NRC Earth Science Decadal Survey. The Decadal Survey is nearing the end of the process of establishing a prioritized list, to be used by NOAA, NASA and USGS in formulating future Earth-observing satellite missions for research and operational applications. Preliminary reports of the Survey, as posted on their web page, had given insufficient attention to many of the satellite observations needed by the oceanographic and climate research communities, for both research and operational applications. The summary drafted by Chelton and Freilich, with the help of over a dozen oceanographic colleagues, took the form of a 10-page open letter from the oceanographic community to members of the Survey.

Of the seven interdisciplinary Thematic Panels of the Decadal Survey, the oceanographic needs relate strongly to five: *Climate Variability and Change; Weather; Land-Use Change, Ecosystem Dynamics and Biodiversity; Water Resources and the Global Hydrologic Cycle; and Solid Earth Hazards, Resources and Dynamics*. Five oceanographic parameters were identified in the letter: ocean vector winds, sea surface temperatures, sea surface heights, hyperspectral ocean color measurements and sea surface salinity. The letter was posted on the CIOSS web site ([http://cioss.coas.oregonstate.edu/CIOSS/letter.html](http://cioss.coas.oregonstate.edu/CIOSS/letter.html), where it can still be read) and the availability of the letter for electronic signature was broadly announced to the oceanographic community. The web interface provided an opportunity for signatories to post their individual comments. During the three weeks that the letter was posted, it was signed by 753 scientists, including 324 non-U.S. scientists representing 34 countries; individual comments were posted by 75 of these signatories.

The letter, list of signatures and comments were delivered to the Co-Chairs of the Decadal Survey and discussed by their Executive Committee and the leaders of their seven Thematic Panels during their 2-4 May 2006 meeting. The letter was well-received by the Executive Committee, who expressed the opinion that the letter’s thoroughness, number of signatures and strong international contributions gave it considerable credibility and “clout.” A number of points of synergy were noted between the oceanographic needs and those from the atmospheric and terrestrial communities, which will help to avoid some of the “head-to-head” competition for resources.

The next step is to develop plans for multi-disciplinary, shared missions, so the work is far from over. However, there is now a much greater awareness of the need for oceanographic observations among the Survey members, due to the efforts of Chelton, Freilich and the members of the international oceanographic community that helped with the letter.
B. Formal and Informal Education

During years 1 and 2, we established a working relationship with the Oregon State University (OSU) program known as SMILE (Science and Mathematics Investigative Learning Experiences). Our contribution to SMILE, falling under the heading of **Formal Education**, came from Task I funds during the first year and from a separate supplemental proposal during the second year. Based on the initial success of this partnership, we moved ongoing funding for SMILE to Task II (Additional Outreach) in Year 3, making them one of the projects funded from the rest of our “base” funding.

The other organized outreach activity under Task I, is an effort in **Informal Education**. This is a collaboration between CIOSS, the Hatfield Marine Science Center (HMSC) and a new academic program at OSU in Informal Education, formally housed in and supported by Oregon Sea Grant. In this project, we are providing partial support for the development of a pilot “satellite oceanography exhibit,” that will be set up in the public wing of HMSC. This activity is part of the PhD thesis material of Molly Phipps, a student in the Informal Education program. Professor Shawn Rowe is her advisor.

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**Davis-Butts: NOAA: NESDIS/CoastWatch (Foley); Coast Guard speaker at the HS Challenge.**

Development of an Oceanographic Remote Sensing Curriculum for the SMILE High School Program. Graduate students, Molly Phipps and Bronwen Rice; participation by various other graduate and undergraduate students. (Task II, additional outreach). Theme 5. NOAA Mission Goal: Weather and Water.

**Project Description**

**Project Goals**—The short-term and long-term goals of this project are to: 1) engage researchers and graduate students in the development and delivery of club activities and problem –based scenario in a context of ocean sciences; 2) provide learning opportunities in ocean sciences for high school students in club settings and through an on-campus challenge event; 3) involve undergraduate and graduate students as mentors to facilitate team engagement and progress and to serve as college-student and career role models; 4) promote greater aspirations for and preparations to enter higher education among SMILE high school students; 5) enhance students’ capacity for science-based decision-making; and 6) increase awareness of science-based careers among SMILE high school students.

**Ocean Sciences Challenge** —Through the NOAA/CIOSS partnership, The SMILE Program engages high school students in club activities and a culminating problem-based learning event centered on oceanography, mapping and oceanographic remote sensing. Each spring, SMILE high school participants visit Western Oregon and Oregon State Universities to participate in the annual Challenge Event. SMILE continues to use its successful scenario-based learning model developed using environmental health scenarios to bring ocean sciences problems to high school students.

**Afterschool SMILE Clubs** - SMILE Clubs, consisting of approximately 20 students and two classroom teachers serving as club advisors, meet weekly after school. The clubs provide content and process skills enrichment through instructional materials linked to Oregon standards and benchmarks. In the club setting, advisors engage students in activities that support their
preparation for the spring college connection event, High School Challenge. Approximately, one-third of the club time is allocated to activities designed to help the students successfully engage in the challenge.

**Professional Development**—This project provides professional development learning opportunities for high school teachers serving as SMILE Club advisors. Workshop sessions were developed to help these teachers gain content knowledge, pedagogy expertise, and experience with the activities that they conducted with their students during club meetings. Workshops with sessions focused on this project were held in August 2005 and February 2006. Funding through the Oregon University System’s University-Schools Partnerships Program through the Department of Education’s No Child Left Behind legislation supported these workshops.

**Populations Served**—This project directly serves approximately 200 high school students and 17 teachers in 10 high schools all over Oregon. SMILE high school students are from underrepresented minority (54% Hispanic, 17% Native American, 1.5% African American, 6% multi-ethnic backgrounds), low-income, and/or rural families. Sixty percent are girls. Overall, 71% of SMILE students are from schools rated medium to very-high poverty level, and most communities with SMILE Clubs are rural, have higher rates of high school dropout and lower rates of college entrance than the state averages for these occurrences. In addition to serving as SMILE Club advisors, the 24 SMILE high school teachers have regular high school teaching positions in science and mathematics. Thus SMILE teacher workshops impact more students than simply those in the program. In addition, 35 university students from OSU and Western Oregon University will receive training and experience in mentoring outreach.

**2005 High School Challenge Event**—On April 15 & 16, 2005, SMILE high school students engaged in the scenario-based challenge in the context of an oil remediation conference in a community created for the scenario, Pete’s Bay. Having gathered preliminary information, members from each student team functioned in one of six specialist roles to gain additional information to inform their teams’ proposed plans. The specialist areas included: GIS mapping; oil recovery and remediation; shoreline habitat assessment; communications; oil spill modeling and probability; and weather. Using the information from each specialist area, teams developed and later presented their plans for allocating resources and methods to address the near-shore oil spill. One hundred and forty-four of 213 high school SMILE students participated in the Challenge.

Students were given base maps and examined and collected data from other maps to compile an environmental sensitivity index (ESI) map for the area, an activity shown in the photograph.
above. Students worked on inter-club teams to collect data pertinent to the developing situation, examine options for oil recovery or remediation, develop a community action plan informed by the data, and implement strategies to communicate that plan. (The professional development and club activities leading to this challenge were detailed in the report for the last reporting period.)

2006 Project Focus — The April 2006 SMILE High School Challenge Event (occurring at the beginning of the next reporting period) involved a fisheries management scenario. The challenge takes place in twelve coastal communities off of Oregon. For each community, the students are invited to participate in a community meeting along with business people, commercial fishermen, fishermen’s wives, ecologists, fisheries managers, people who operate ecotourism businesses, sport fishermen, and other stakeholders. Challenge participants gather information about their individual coastal communities and each community’s context and decide which issues are important to their community. With this information, student participants then decide which types of fisheries management tools are best for their particular set of concerns. They share their reports in a community forum on adapting the fishery for the future.

2006 Accomplishments — During the Summer 2005 SMILE Teachers Workshop, high school SMILE Club advisors were engaged in basic oceanography experiences and introduced to fisheries management issues. Specific sessions at the workshop and those that would be presented in the high school clubs through January 2006 include:

- Seeing Satellite Data: working teachers and students through how to see the data in satellite images. Satellite SST and chlorophyll-a data were presented using different color palates to help people see the data presented in satellite images. This activity was developed because we got feedback that the students were not able to use satellite images we had presented to them in the past because they were not used to looking at this type of data display.
- Common Ground: a video presentation on marine reserves created by PISCO. This video was shown to introduce the teachers and students to some issues surrounding fisheries. Liz Riley, PISCO outreach coordinator, facilitated the video showing.
- Fisheries Management Panel: a panel of experts led by Jim Good (emeritus oceanography faculty) shared diverse perspectives about the need for and methodologies around marine protected areas. Other panelists included Gil Sylvia, a resource economist, and Terry Thompson, an ex-commercial fisherman and Lincoln County Commissioner.
- Shoebox Satellites: In this activity students made landscapes in shoeboxes and then put lids on the boxes that had holes drilled in them at regular intervals. They traded the boxes and used a measuring stick to create a topographic map of their landscape. This was a way to introduce them to how satellites sample and to model an altimeter.
- Bottle Biology: Students explored the concept of eutrophication by creating a terrarium system where they over fertilized the soil, which in turn over fertilized the water and killed the algae. (In the picture below, teachers work on Bottle Biology activities.)
Between the Summer 2005 and Winter 2006 workshops, the challenge planning team focused on defining the scope of the challenge, identifying and involving various partners, and preparing for the Winter 2006 SMILE Teachers Workshop. The winter workshop addressed the following pre-challenge activities, designed to prepare the students for successful challenge engagement:

- **Mayan Math:** Students decode a Mayan codex to figure out what kind of counting system the Maya used. This will help students with basic problem solving and investigating skills.
- ** GNOME revisited:** Students use the NOAA GNOME model for a different purpose than its use last year for oil spills. They explore how currents move small things on the surface of the ocean using the Santa Barbara Channel modeling environment. The model is used as a tool to see what might happen to planktonic fish larvae during different upwelling conditions. This helps them to determine a good place to put a marine reserve so that the larvae stay in their general fishing ground so that a reserve would have maximum benefit to the local community.
- **Population Crash:** This activity uses data from the Orange Roughy fishery that was quickly over-exploited. It introduces the idea of catch per unit effort and ways to try to stop a population crash before it is too late.
- **Seamounts and Upwelling:** Seamounts are often hotspots of activity for ocean life because they cause disturbances in the currents and cause local upwelling. Students will build flumes and make some underwater seamounts. They will flow water through the flume and inject colored water just upstream of the mountains to observe how the flow is altered by the obstruction.
- **Natural Resources:** The ocean is a natural resource just like other natural resources. The students will pick a natural resource in their community and explore the issues surrounding its management.
CIOSS Five Year Review

To help frame the challenge, various faculty and community members were involved in discussions about the challenge. Flaxen Conway, a sociologist who works with fishing families, helped the challenge team ground the challenge scenario in reality. Kaety Hildenbrand, a liaison between the fishing community and the scientific community in Newport, provided a number of contacts within the fishing community. Michael Harte, along with some Marine Resource Management graduate students, helped to bring in some of the science content. Recruitment continues for both faculty and graduate student experts and college student team mentors during the challenge.

**Project Accomplishments**—Teacher workshop sessions were implemented as planned. The Table 1 shows the percentage of teachers participating and their overall ratings of the oceanography-based sessions.

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Number Of Participants</th>
<th>Percentage of HS Teachers Attending</th>
<th>Rating of quality of workshop session</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2005</td>
<td>12</td>
<td>71%</td>
<td>Good – 33.3% Excellent – 66.7%</td>
</tr>
<tr>
<td>February 2006</td>
<td>17</td>
<td>100%</td>
<td>Good – 64.7% Excellent – 35.3%</td>
</tr>
</tbody>
</table>

Activities developed through this project are being made available to others through placement on the CIOSS web site. Ongoing meeting between SMILE and CIOSS personnel will help to ensure that the planned activities are addressing both CIOSS and SMILE program needs.

**Assessment:** The SMILE Program includes assessment of student-learning outcomes at all levels. In terms of the high school club activities and the Challenge, SMILE will develop and implement tools to assess changes in students’:

- awareness of ocean sciences careers
- awareness of the pathways to ocean sciences careers;
- interest in STEM careers, in general, and ocean-sciences careers, specifically;
- attitudes toward science;
- expectations for going to college; and
- personal connections to higher education.

The assessment data will help to quantify the impact of the CIOSS-SMILE partnership on participating underrepresented and underserved high school students.
Challenges Encountered in the High School Program — Engaging more teachers and university participants in the summer workshop remains challenging. While summer schedules interfere with full participation, the benefits to the teachers, students, and partnership warrant more careful consideration of how to increase the rate of participation in the workshop. Identifying oceanography faculty and graduate students who want to participate in the planning and implementation of workshop sessions and the high school challenge went smoother this year, but the level of participation still remains below the desired level. While college students were engaged as team mentors during the 2005 challenge, many of them expressed uncertainty about their roles and their expected activities to support the success of the students they were mentoring. This result led the planning team to rethink how to equip the college students to serve more effectively as team mentors. The mentor preparation sessions have been restructured to address the areas of need identified through HSC 2005.

Conclusion — The CIOSS-SMILE partnership uses an established program and network to impact precollege students and K-12 teachers by bringing the expertise of ocean sciences faculty and graduate students, to provide content for professional development workshops for teachers, as well as in-club and on-campus learning experiences for the students The SMILE Program’s campus-based Challenge Event is an important part of Oregon State University’s efforts to provide opportunities for underrepresented minority and other educationally underserved students, encouraging them to get excited about learning science and math, to prepare for the academics of college, and to develop self-reliance and visions for the future. Challenge problems on remote sensing and oceanography topics support SMILE students in gaining awareness of oceanography content and related technology far beyond what is available to them in or out of the classroom. For some, it may spark an interest in pursuing a career in oceanography, remote sensing or related technical fields. Through its partnership with SMILE, CIOSS reaches underrepresented students who demonstrate an interest in science and mathematics, classroom teachers of mathematics and science, and underrepresented community members around the state of Oregon.
Phipps, Rowe: NOAA: Oregon Sea Grant.

Project description

The Informal Education program conducts research into the way in which visitors to science museums interact with and learn from interactive displays. Thus, in the partnership between the Informal Education program and HMSC’s Visitor Center, the Visitor Center serves as a laboratory to study this interaction, with real displays and real visitors. CIOSS is providing some of the funds needed to construct a pilot display based on satellite observations of the ocean. Present plans are for the exhibit to be conceptually built on a computer-based design known as a Goal Based Scenario (GBS). A description of GBS is provided by Molly Phipps:

“Goal-based scenarios are interactive computer-based learning-aids that provide structured frameworks for learning where the learner assumes a role within a simulation. The GBS model, developed by Schank, Fano, Bell, & Jona (1993), draws on theories of anchored instruction (Cognition and Technology Group at Vanderbilt), cognitive apprenticeship (Collins et al., 1989), and case-based learning (e.g. Williams, 1992). Cased-based instruction is used in professional graduate programs (e.g. Williams, 1992), in undergraduate classrooms (e.g. Schoenfield-Tascher, Jones, & Persichitte, 2001, Foster, 1994), and on the Internet (e.g. Schaller, Allison-Brunnell, & Nagel, n.d.). According to Schoenfield-Tascher et al. (2001) GBS require learners to accomplish a task in an appropriate context while anchored instruction merely requires that information be presented in an appropriate context. Case-based instruction draws upon the social context of learning from cognitive apprenticeship and the structured learning environment of anchored instruction. According to Williams (1992), cognitive apprenticeship focuses on three different domains: content of instruction, teaching methods, and the sequence of lessons.

“Anchored instruction requires a macrocontext to help students learn how to solve complex problems in an authentic situation that helps anchor the complex problems and to provide a context for a story. This story is used to present the problem and to give the pertinent information. Both learning methods emphasize creating authentic activities that are coherent, meaningful, and purposeful. According to Collins et al. (1989, as cited in Williams, 1992), the developers of cognitive apprenticeship, the real skills of expert problem solvers cannot be acquired in a traditional classroom setting, because these skills are derived from solving problems in the real world. Case-based scenarios have been used in legal and medical education since the late 19th Century, but are still a novelty to most educators (Williams, 1992).

“GBS’s rely on the idea that skills must be learned in the appropriate context and that the context cannot be separated from learning the context-appropriate skills (Schank et al., 1993, and references therein). The open-ended nature of GBS’s afford a more realistic idea of the scientific world and the nature of science.

“The questions and answers in some GBS’s were developed using the ASK system designed by Ferguson, Bareiss, Birnbaum, & Osgood (1992) which mimics Aesopic dialog. An Aesopic dialog is one where the student asks questions and the teacher answers in stories (Ferguson et al., 1993).
“Ferguson et al (1992) believe that one reason that talking to experts is so important in learning how to solve problems is that experts not only answer questions, they also help ask appropriate questions and tell appropriate stories. Unfortunately, experts are usually much too busy to spend their time telling every novice their stories. Ferguson et al. (1992) illustrate three cases where a computer-based ASK systems are used to teach relative novices job-specific skills. Learners navigate through an ASK system to find the specific answers to their questions either by browsing through topics of the same hierarchical level, or by zooming through ever more specific topics in any given area (Ferguson et al., 1992).

“The basic idea of GBS is that learners learn best, and are more engaged, when an exhibit is interactive and has a clear goal. There should be some problem that the visitor needs to solve and the information we want to portray should be presented as a tool to solve the problem they are faced with. When Bell et al. (1993) used a GBS exhibit on sickle cell anemia (Sickle Cell Councilor) where visitors acted as genetic councilors to couples concerned about having a child with sickle cell anemia. The visitors could perform simulated genetic experiments and ask questions of four different experts.”

With respect to the creation of a satellite oceanography exhibit, there is a primary problem with exhibits on current science: it often takes more than 90 seconds for a visitor to understand the significance of the science, but research indicates that most visitors spend about 90 seconds at an exhibit. Bell et al. (1993) found that visitors spent significantly more time interacting with the Sickle Cell Councilor (the GBS) than the average 90 seconds. Visitors spent 7 minutes interacting with the Sickle Cell Councilor and more than ½ of the visitors who spent more than 30 seconds with the exhibit completed the goal.

The plan at HMSC is to create a GBS (using software developed locally called the “MediaPresenter” program) with satellite oceanography as a tool for the visitor to use. An example plan would be to use the recent spate of seabird deaths (summer, 2005) as the hook for the exhibit. Visitors will assume the role of a scientist trying to determine what is killing so many birds along the Oregon Coast. Informal discussions with visitors during summer 2005 about the dead birds on the beach indicate a high level of interest in why there were so many dead birds on the beaches. This topic received attention in the West Coast media, with NPR interviews with local scientists. By trying to figure out what is killing the birds, visitors will be able to ask questions and see video clip responses from science experts. A number of local experts have been identified as participants.

As an initial step, a lecture/presentation at HMSC will be set up with the experts, who will give presentations and then answer questions from the visitors. The presentations, questions and answers will be recorded, to determine the key questions and answers to be used in the interactive display. It is hoped that a pilot interactive display can be developed by this summer or fall.