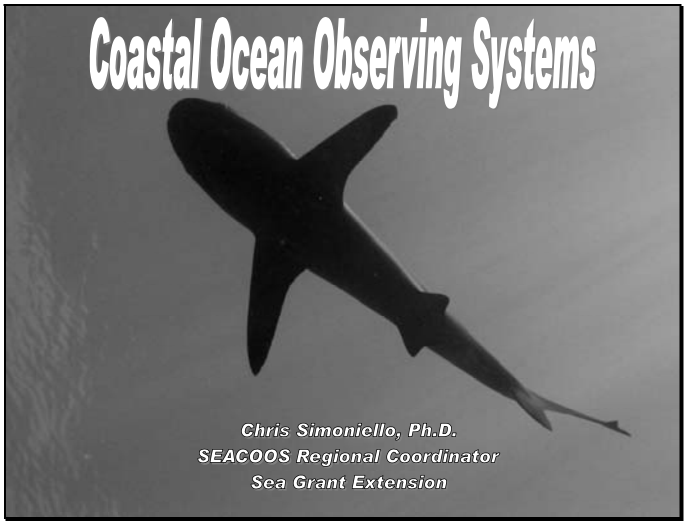
Slide 1



Slide 2

Why observe the oceans?

" We've made the investment needed to venture into the skies, and it has paid off mightily. We've neglected the oceans, and it has cost us dearly. This is the time to do for [the oceans in] the 21st century what our predecessors did for space. "

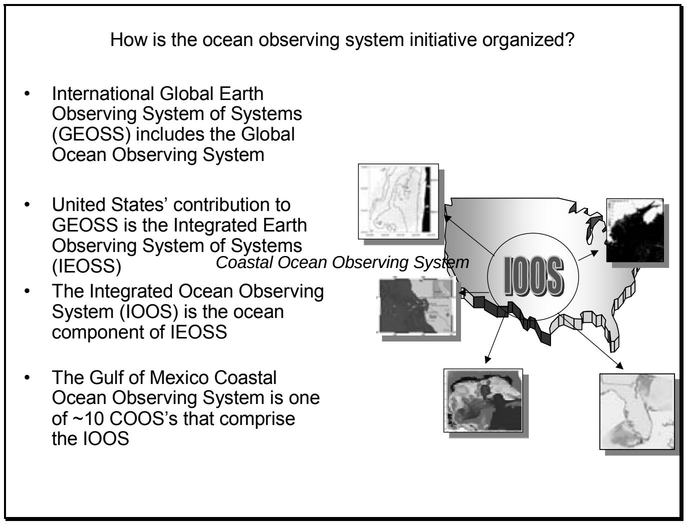
- Sylvia Earle

- 97% of water on earth is salt water
- 78% of all evaporation occurs over oceans
- 95% of U.S. foreign trade passes through ports and harbors
- 50% of all materials shipped through U.S. waters are hazardous
- 25% of U.S. natural gas production and about 17% of U.S. oil production come from the Outer Continental Shelf
- 80% of pollution to the marine environment comes from land-based sources, such as runoff pollution
- Coastal states earn 85% of all U.S. tourism revenues.

Without the oceans, our planet would not be habitable. The oceans play a significant role for us in climate and weather, food production, commerce, energy, recreation, and national security. Due to our dependency, the ever-changing environment and the potential for human-induced consequences, it is critical that we develop and maintain an adequate understanding of the oceans. To accomplish this, we must systematically and routinely observe them.

The ocean observation community has begun to create a system that provides for constructive interactions between operational measurements of ocean conditions, ongoing scientific discovery and technological innovation in the ocean environment, and delivery of relevant and practical information for ocean users.

Slide 3



The global community has consistently expressed the need for a coordinated ocean observing system. In 1992 countries participating at the United Nations Conference on Environment and Development (know as the Earth Summit) in Rio de Janeiro agreed to work toward establishing a Global Ocean Observing System (GEOOS). Following this, the United States National Ocean Research Leadership Council (NORLC) took the lead to establish a sustained Integrated Ocean Observation System (IOOS) that would serve as the United States contribution to GOOS.

In 2000, NORLC established a federal interagency office called Oceans.US and charged it with development of the IOOS. Oceans US has envisioned the creation of a national network of regional ocean observing systems that will form the backbone of coastal observations for the IOOS. and services.

These regional associations are charged with integrating the various ocean observing efforts that are already underway within each region, as well as planning for expanding these systems as needed. These efforts seek to address many of the issues discussed earlier including how to fill gaps in the observation networks and how to address overlaps in the current systems.

The regional efforts are also incorporating end-users into the implementation process and building data delivery systems that can better meet the needs of coastal user communities. The Gulf of Mexico Coastal Ocean Observing System (GCOOS) is one of the regional systems that is currently being developed. Another system in the south that has been operating over the past four years is the Southeast Atlantic Coastal Ocean Observing System (SEACOOS). There are at least 10 regional systems being developed at the current time.

Slide 4

What is GCOOS?

- Gulf of Mexico Coastal Ocean Observing System (GCOOS)
- Regional
  TX, LA, MS, AL, FL
- Umbrella organization to coordinate coastal ocean observing system research activities in the Gulf of Mexico

GCOOS is the applied research program to establish an end-to-end regional ocean observing system in the Gulf of Mexico. It will be responsible for collecting, managing, and disseminating observations and information products of the coastal ocean off of Texas, Louisiana, Mississippi, Alabama, and Florida.

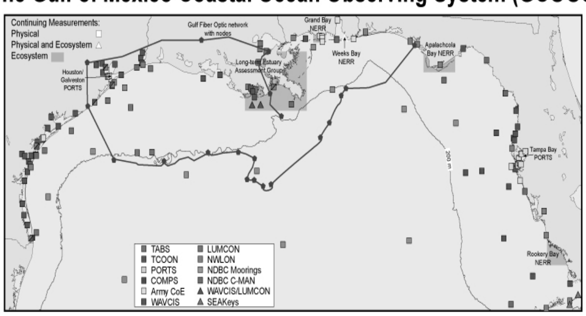
This regional effort establishes an "umbrella" organization for coordinating ongoing sub-regional observing system research activities in the coastline of the four-state region and developing new region-wide capabilities. This initiative is a partnership that incorporates the coastal ocean observing efforts of a number of these sub-regional systems.

Information on GCOOS can be found at their website:http://www-ocean.tamu.edu/GCOOS/

Slide 5

GCOOS – Subsystem components

The Gulf of Mexico Coastal Ocean Observing System (GCOOS)

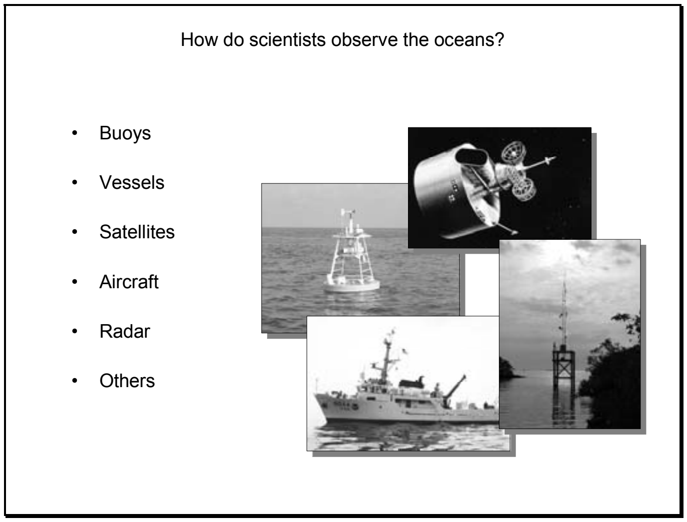


GCOOS is a regional effort to establish an "umbrella" organization for coordinating ongoing sub-regional observing system research activities in the coastline of the four-state region and developing new region-wide capabilities. This initiative is a partnership that incorporates the coastal ocean observing efforts of a number of these sub-regional systems.

There currently are a number of ocean observing subsystems and platforms that are operated by a variety of governmental and/or universities entities. These regional efforts will link these subsystems together for regional and nation-wide use and application.

The picture above provides an example of the number of observing systems and entities in the Gulf of Mexico region.

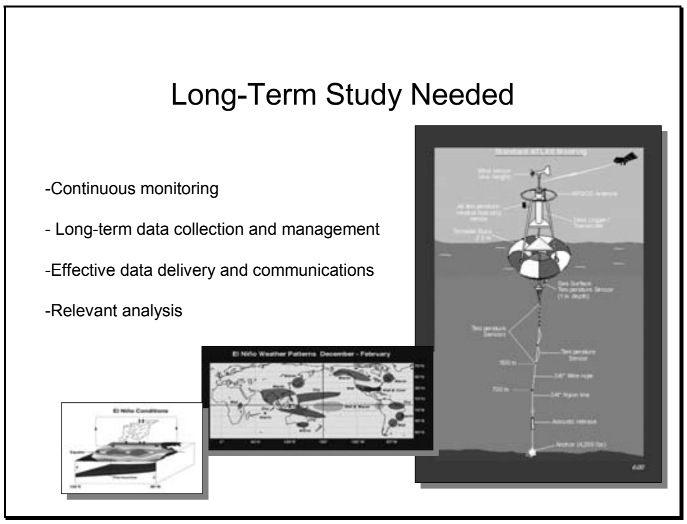
Slide 6



The platforms used for collection of the observation data are diverse. They include but are not limited to: fixed platforms, buoys; research and survey vessels; remote sensing from satellites and aircraft; and remote sensing from land, such as radar.

Combined, these data can provide observations at varying spatial and temporal resolutions. This diversity provides opportunities for meeting many different end-user requirements.

Slide 7



It is not enough to merely take periodic "snapshots" of the oceans. To develop a thorough understanding of ocean processes, their interactions with our coastlines, and their impacts on our future, we must implement these comprehensive integrated systems that incorporate a full range of elements.

These elements include continuous and long-term measurement, data management, communications, and analysis to produce outputs that are comprehensive and relevant to specific audiences.

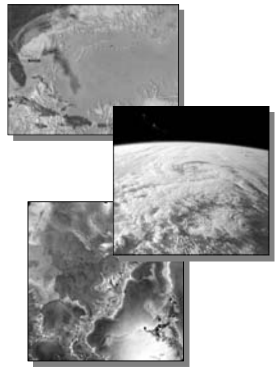
All the ocean observing systems rely on a complicated network of physical infrastructure, developing technologies, scientific research, and public education that will allow for the transfer raw data collected in the open ocean into information that is meaningful to our everyday lives.

One successful example of such a network is the Tropical Atmosphere Ocean (TAO) project that established a system to support the detection, understanding, and prediction of El Nino and La Nina climate events. TAO consists of a physical array of moored buoys in the Equatorial Pacific Ocean constantly relaying data. In addition to measuring ocean conditions, the system has contributed greatly to the public's understanding of the global weather cycles. Analysis of this data improves public safety efforts by providing substantial lead-times in planning and preparing for weather-related impacts associated with predicted El Nino and La Nina events.

Slide 8

What ocean conditions can be monitored?

Examples:
- Physical Ocean Conditions
  - Temperature
  - Currents
  - Waves
  - Water Level
- Atmospheric Conditions
  - Winds
  - Pressure
  - Fog
- Biological/Ecological Conditions
  - Nutrients
  - Chlorophyll
  - Contaminants
  - Benthic Habitat

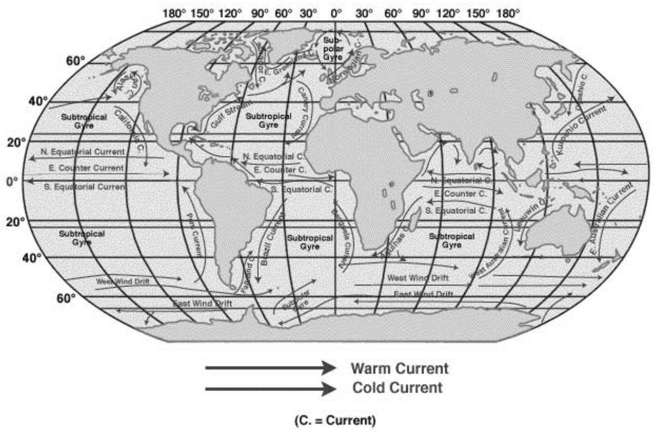


A wide range of ocean condition variables can be measured using different types of sensors on the observation platforms. The examples shown here represent a fraction of the potential observation variables.

The key to developing successful and sustainable coastal ocean observation systems is to implement the most appropriate and cost-effective combinations of platforms and sensors to meet critical user needs.

Slide 9

Surface currents as an example of "then" and "now"



Surface currents of the ocean: Currents in red transport warm water poleward. Currents in blue transport cold water towards the equator.

How we measure both surface and bottom currents has improved as technology has advanced. The information serves a wide variety of purposes ranging from improving weather forecasts to aiding US Coast Guard Search and Rescue missions.

Slide 10

Ocean currents

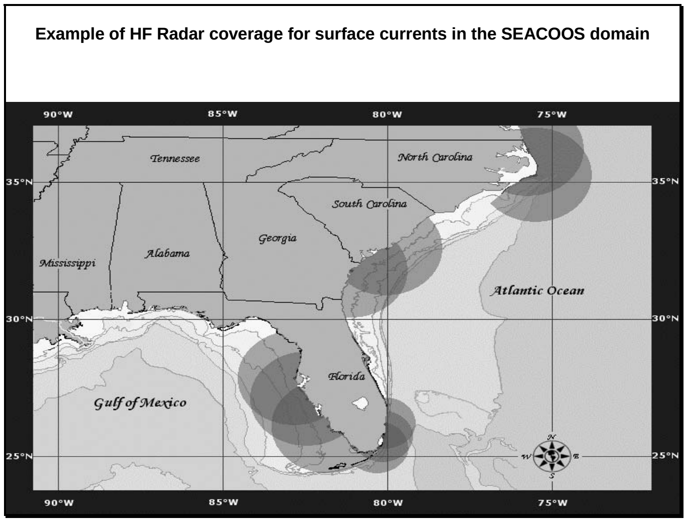
- Influenced by earth's rotation, gravity, winds, solar heating, bathymetry
- Water circulates in both horizontal and vertical planes
- Important in the heat budget of the planet
- Affect weather and climate (e.g. El Niño)
- Traditional ways to measure surface currents include: drifters/drogues, tracer compounds (radioisotopes, fluorescent dyes), cargo spills (e.g. sneakers, bathtub toys), letters in bottles, & floating vegetation (e.g. sea beans, mangrove seeds)
- Modern methods include Acoustic Doppler Current Profilers, High Frequency Radar, and spectroradiometers

Ocean circulation varies on time and space scales ranging from hours to thousands of years, for example in response to the tidal cycle, season or Milankovitch Cycles (astronomical cycles).

Traditional methods of study required expensive and extensive ship time. Even then, all we would get is a "snapshot" in time.

Modern methods provide continuous, real-time data that allow researchers to answer circulation-related questions that require much finer resolution, on much larger spatial scales.

Slide 11

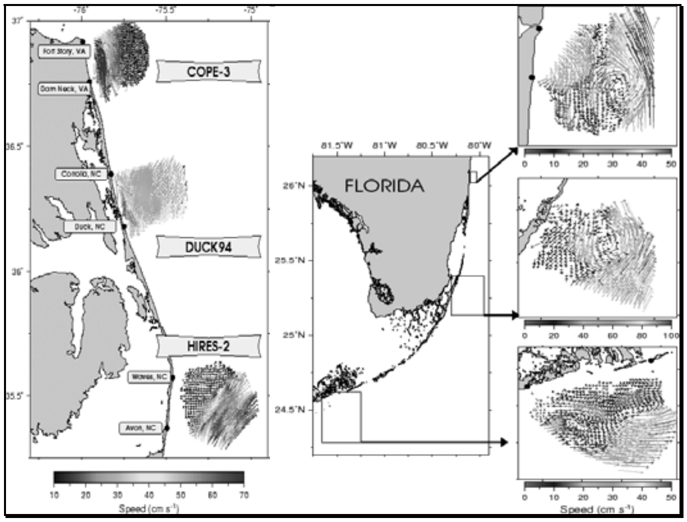


High Frequency Radar allows measurements of surface currents on time and space scales previously not possible.

The present challenge is ground-truthing or verifying that data acquired via this technique is in agreement with accepted methodologies (e.g. Acoustic Doppler Current Profilers).

The example shows HF Radar coverage for surface currents in the Southeast Atlantic Coastal Ocean Observing System region.

Slide 12

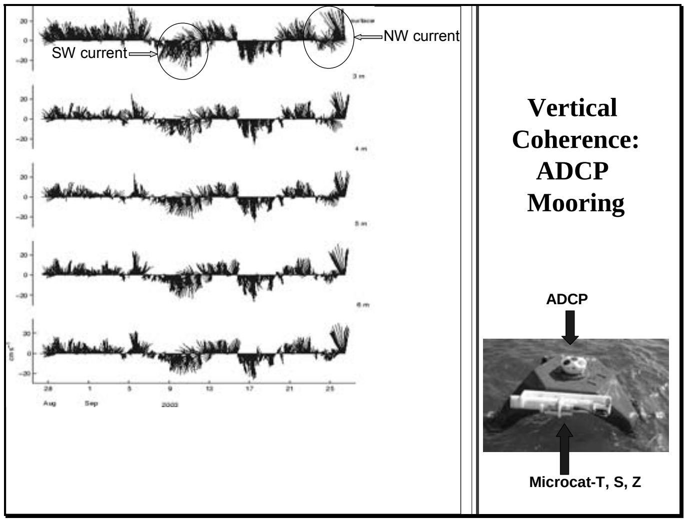


This image is an example of a product generated from HF Radar data-cooler colors (blues and greens) represent slower current speeds; warmer colors (reds and yellows) indicate faster currents.

Compare this data presentation format to the ADCP information shown in the next slide. Images like this could be used to teach students a variety of lessons. For example, what might explain the intense current moving to the norhtwest in the upper right hand image (the Florida Current which eventually feeds into the Gulf Stream). What conditions make it possible for currents to run in opposite directions/set up eddies? (duration, intensity, and direction of wind; fetch of basin; bathymetry, topography, etc). Real-time information like this could be used in the classroom throughout the year to track circulation patterns.

A more detailed approach would be to apply the information to specific questions. For example, students could make predictions about how phytoplankton stay in the photic zone by controlling buoyancy to maintain position in favorable currents. Or, the information could be used to explore how new beaches might form by tracking the transport of mangrove seeds/other vegetation. Examples are only limited by the creativity of your students!

Slide 13



Acoustic Doppler Current Profiler (ADCP) data. Note x-axis is time and y-axis is current speed in centimeters per second. As you move from top to bottom of figure, water depth of each ADCP unit increases from the surface to 6 meters. This differs from the HF Radar image which only gives surface currents. The direction of the current is indicated by the direction the vectors are pointing.

Think about the significance of currents moving in different directions at different times of the year and at different depths. What does this mean for planktonic organisms that drift with currents? How might larvae use currents to transition between on-shore/off-shore habitats and find life-stage appropriate conditions? Also consider factors that influence near-shore profiles, for example, river discharge, heavy precipitation…where do you live? What factors are involved?

For an interactive map that allows you to look at surface currents in relation to land masses, rivers and bathymetry, go to the www.seacoos.org web site. From the data accessing and mapping menu, select Merged Observations Products. Then select Coastal Wind Observations and keep zooming in on the interactive map until you get the resolution you desire. The most recent image will be pulled up unless you actively select another day/time. On the image shown at bottom right, ADCP = Acoustic Doppler Current Profiler; Microcat instrument measures Temperature (T), Salinity (S) and Depth (Z).

Slide 14

Application of COOS information: 2003 Summer Upwelling Event

- Anomalous cold water along the southern Atlantic coast in June-July 2003 (water at the beach more than 20ºF/ 11ºC colder than normal!)
- Data showed prolonged period of winds blowing offshore (from the west)
- Concluded warm surface water was pushed offshore, colder deeper water flowed towards the coast to balance out pressure gradient

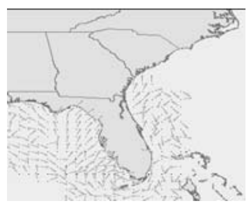
A real life example of how integrated COOS sea surface temperature, wind and ocean circulation data were applied to explain an unusual phenomenon. An important aspect of coastal ocean observing systems is that archived information is available for comparisons. When unusual events happen, they can be put in context and compared to "normal" conditions.

This baseline data is very valuable to researchers who seek to understand and predict climate variability and global warming trends. Think of it as monitoring the pulse of the ocean. We need to understand the "routine" before we can appreciate subtle- and not-so-subtle variations.

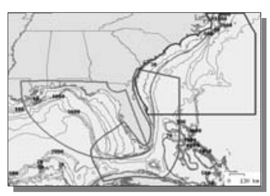
Slide 15

Modeling – Add Value to Observations

- Fill in the Gaps, providing information lfor areas not covered by direct measurements.



-Makes predictions and provides short-term forecasts for region.



Modeling is a critical component in applying coastal ocean observations to practical uses. Models help fill the data gaps to create more complete observation coverage.

Since observation platforms collect data only at certain limited points, models provide the mechanism to determine how those observations project to other areas. They can effectively turn data points into spatial data coverages.

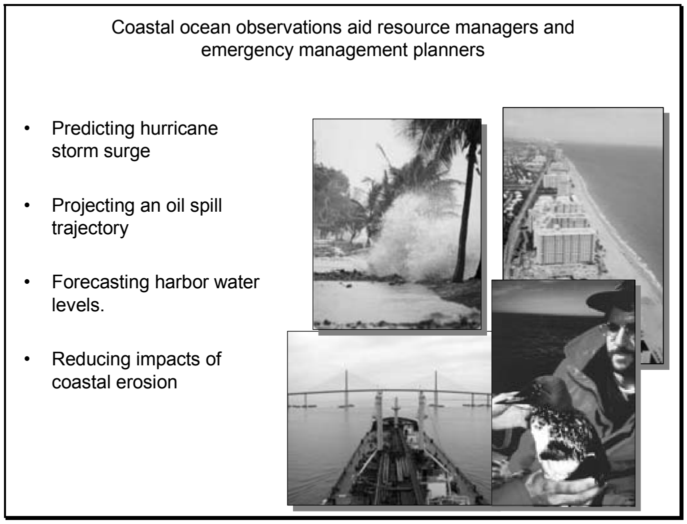
In addition, modeling is the value-added component that allows observations to be turned into useful forecasts. Circulation and other models can be combined with observational data for forecasts that are incredibly useful to coastal ocean users.

Slide 16

There are many valuable applications of Coastal Ocean Observing Systems data

- The following 3 slides provide selected examples of the many societal benefits of an integrated ocean observing system…

Slide 17



There are numerous ocean models that depend on observation data. These selected examples show how models can contribute directly to management decisions that protect property and the environment, and save lives. Basically, data acquired from COOS sensors are incorporated into mathematical models and improve their predictive capability.

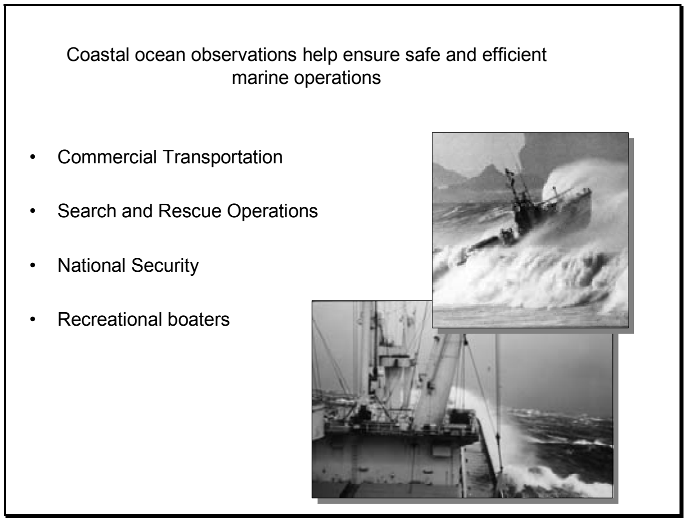
Hurricane evacuations are based on impacts from potential storm surge and cost approximately $1 million per mile. Predications using models coupled with real-time observations can significantly improve the accuracy and timeliness of forecasts to be used in making evacuation decisions.

Oil spill response and recovery efforts are highly dependent on ocean conditions, forecasts and potential impacts. Trajectories are projected through models that incorporate real-time observations. Predicted paths are then used in efforts to contain oil spills as well as to mobilize the necessary resources in response to oil spills.

The safe and efficient operations of ships in busy ports and harbors is highly dependent on accurate coastal ocean information. Models utilize combined information about water levels, winds, waves, and currents to provide forecasts that are critical to safe marine operations by harbor pilots and others. Many busy ports now use real-time data from the PORTS system (Physical Oceanographic Real Time System). You can get an idea of the type of information available by checking out the Tampa Bay P.O.R.T.S. web site (http://ompl.marine.usf.edu/PORTS/index.html).

We currently utilize ocean models to meet a variety of user needs. In the future, more wide-spread observation coverage, more consistent long-term observations, and more refined ocean models will combine to greatly expand the possible uses.

Slide 18



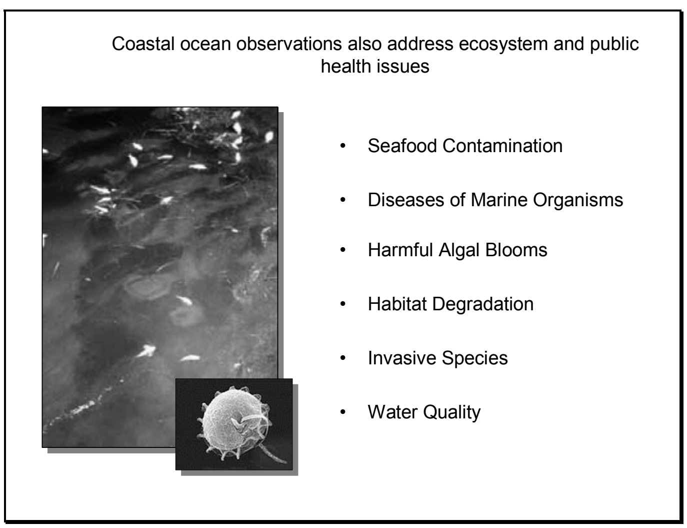
Safe and efficient coastal marine operations require accurate real-time data and timely forecasts of storms, coastal flooding and precipitation, along with coastal winds, currents, waves, ice-fields, depths, temperatures, water level and visibility.

Weather-related impacts on marine operations can be significant in the volatile coastal ocean environment. Ocean conditions are important factors in the planning and implementation of search and rescue efforts and national security operations. Even slight improvements in timeliness and accuracy of data can have profound consequences in life or death situations.

The international trend in commercial shipping is toward fewer but larger vessels. With more detailed and up-to-date information about water levels, currents and obstructions, the newer, deeper-draft ships can operate more efficiently and safely in U.S. harbors.

Not only are real-time data and forecasting important for these sectors, but the development of hindcasts and nowcasts for planning can enhance and improve future operations.

Slide 19



While most existing ocean observation system capabilities are focused on physical ocean conditions, an increasing number of sensors incorporate ecological monitoring and modeling and are helping to address numerous ecosystem and public health issues.

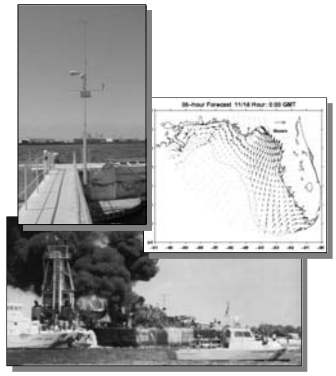
Using observational data associated with weather and ocean conditions, public health officials can monitor and predict when seafood contamination, abundance of pathogens, or contaminants might pose concern for public health. Such information can guide when shellfish areas should be closed, or when no swimming advisories are posted.

Appropriate time series data make it possible for scientists and natural resource managers to monitor changes in habitat, track harmful algal bloom events, and forecast long-term ecosystem changes. Ultimately, they will provide information to help us set policy that safeguards our resources and guides usage in a sustainable fashion.

Slide 20

What are the goals of all regional coastal ocean observing systems?

- Developmental – create an integrated regional system.
- Scientific – improve understanding of regional coastal ocean processes.
- Operational – implement timely and relevant information delivery system.

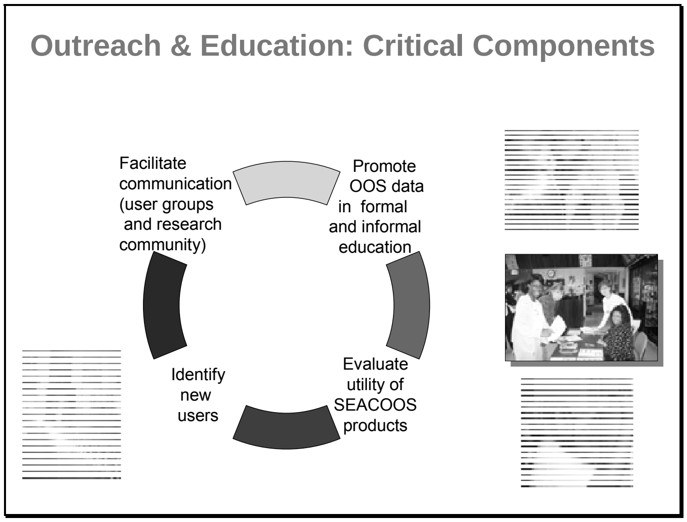


Developmental goals include the design, development, deployment, evaluation, and improvement of a model-based, real-time, integrated, multi-purpose regional coastal ocean observing system for the Gulf of Mexico in partnership with federal, state, and local agencies and regional users.

Scientific goals include the identification and understanding of the processes that control regional-scale cross-shelf and along-shelf exchange, cyclogenesis, physical/chemical/geological/biological response to wind forcing, response to climate variability, ecosystem health and variability, etc.

Operational goals include implementation of a system that delivers information about the coastal ocean to users in a timely and useful manner in support of Ocean.US objectives including: improving marine safety, mitigating natural hazards, maintaining national security, detecting climate change and ensuring public health.

Slide 21



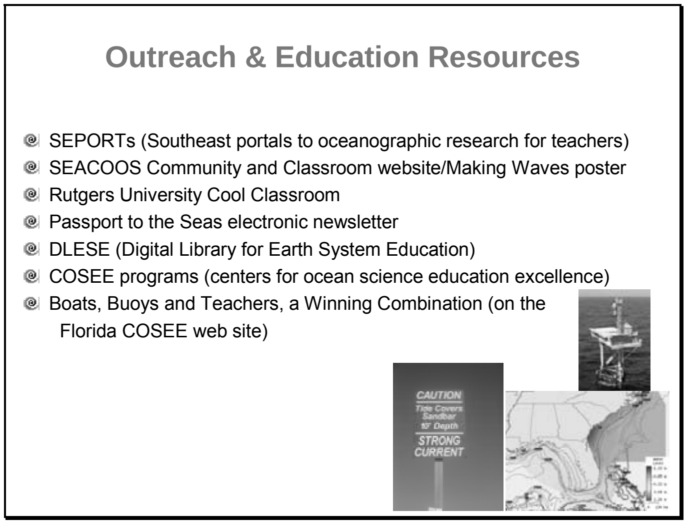
Without an informed citizenry, and a science and technology literate workforce, the Integrated Ocean Observing System will not be successful. Outreach efforts provide useful products and services that meet the needs of the marine and coastal resource user. Outreach efforts also help identify new users and their needs, and relay that information to ocean scientists and technicians who develop new research and products to meet these new needs and demands.

Education efforts target K-12 and post-secondary students and educators as a specific user audience. Included are the formal domain of pre-college students (K-12) and their teachers, undergraduates, and graduate students. The informal domain includes museums, aquariums, environmental centers, and youth groups, such as 4-H and Y's, and their educators.

The educational component works to develop educational curricula that incorporates COOS data and applications, and to prepare educational materials including posters, newsletters, and presentations that expose COOS to the audience.

In doing so, they help to ensure the long-term sustainability and applicability of the programs through ongoing public exposure in science education arenas. In addition to linking educators to valuable information resources, education efforts also help to expand the relevance of the entire coastal ocean observing program to the broadest possible audience. Finally, these efforts serve to train the nation's future scientists and resource managers.

Slide 22



There are many resources on the internet that can be utilized in outreach and education efforts. Other efforts involve training teachers who then provide this information and new knowledge back into their classrooms. This COSEE summer teacher institute is one example.

Places that teacher can go include the following:

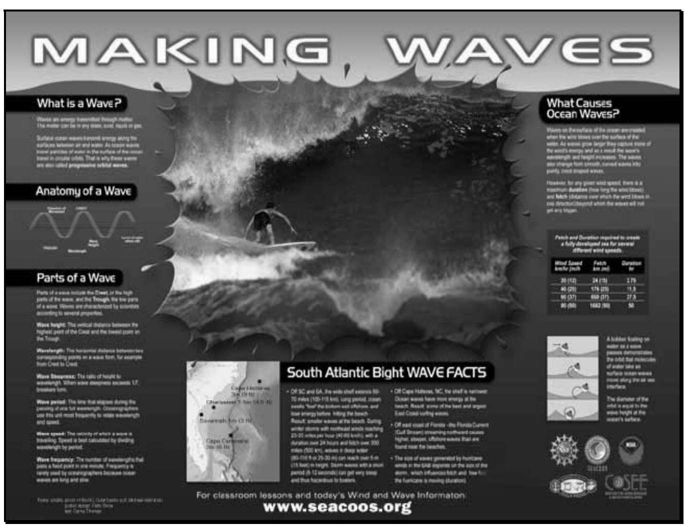
SEPORTS: link via COSEE websites. COSEE web sites: www.cosee.net; Central Gulf of Mexico COSEE, http://cosee-central-gom.org; Florida COSEE, http://floridacosee.net; Southeast COSEE, www.scseagrant.org/se-cosee/

SEACOOS, www.seacoos.org

Rutgers Cool Classroom, http://www.coolclassroom.org

People, Projects and ProgramsDLESE, www.dlese.org

Slide 23

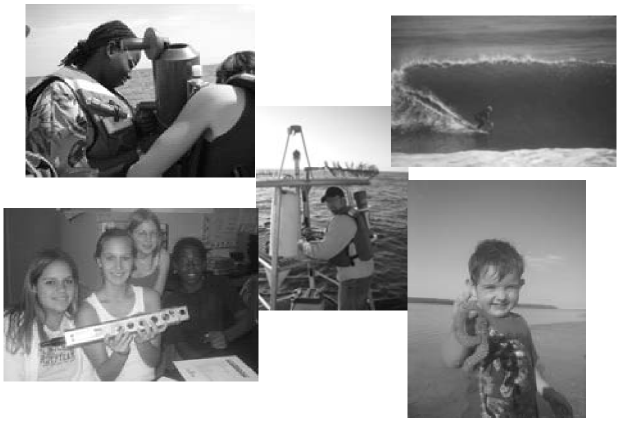


This slide is an example of an educational resource that was developed in by SEACOOS and regional COSEE. You can receive this "Making Waves" poster free of charge. Go to the SEACOOS website for more information.

A second poster highlighting hurricanes will be available soon from SEACOOS.

Slide 24

COOS in the Classroom: A sample lesson plan



The following is a sample lesson plan that can be used to highlight coastal ocean observing system activities.

Slide 25

Ocean Observing Activity

Chris Simoniello and Heather Butler

Objective: Inquiry based learning to understand how technology is applied in ocean and atmospheric sciences to improve the health and safety of people and to protect property

- Standards**: Strand C** Force and Motion
- *Standard 1* The student understands that types of motion may be described, measured and predicted
- Benchmark SC.C.1.3.1
- Benchmark SC.C.1.3.2
- *Standard 2* The student understands that the types of force that act on an object and the effect of that force can be described, measured and predicted
- Benchmark SC.C.2.3.2
- **Strand D** Processes that Shape the Earth
- *Standard 1* The student recognizes that processes in the lithosphere, atmosphere, hydrosphere and biosphere interact to shape the Earth
- *Standard 2* The student understands the need for protection of the natural systems of Earth
- Benchmark SC.D.2.3.2 The student knows the positive and negative consequences of human action on the Earth's systems
- **Strand G** How living things interact with their environment
- *Standard 2* The student understands the consequences of using limited natural resources Benchmark SC.G.2.3.4
- **Strand H** The nature of science
- *Standard 1* The student uses the scientific processes and habits of mind to solve problems
- Benchmark SC.H.1.3.1
- Benchmark SC.H.1.3.4
- *Standard 3* The student understands that science, technology and society are interwoven and interdependent
- Benchmark SC.H.3.3.4
- Benchmark SC.H.3.3.7

Slide 26

Supplies
*Ocean Observing System Overview (go to www.seacoos.org then follow link under Community and Classroom to COOS 101 presentation
*Art supplies (paper, colored pencils, markers, crayons, etc)
*Optional art supplies for 3-D sensors (paper towel cylinders, pipe cleaners, etc)

Step by Step
1. What information is needed to increase safety for those who use the ocean for business and pleasure? Brainstorm and list ideas below

2. Choose EITHER A or B below…NOT BOTH!

A. Create a sensor and describe how it works, what data it collects and provide an example of a science question it can help answer.

B. Create a scientific question and design a project using the ocean observing sensor/ sensors that will allow you to answer it (e.g. commercial, military or recreational maritime operations, education, water safety, public health, red tide, shore erosion, fisheries management, etc

Be prepared to share your group's idea with the class.

Note: prior to this assignment, students did a research project on deepsea submersibles, so they had background information on how some sensors work and the parameters they measure

Slide 27

Questions? simo@marine.usf.edu