GLOBAL OCEAN OBSERVING SYSTEM
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U.S. GOOS NATIONAL REPORT

U.S. NATIONAL IMPLEMENTATION AND PLANNING ACTIVITIES - 2005 HIGHLIGHTS

The National Office for
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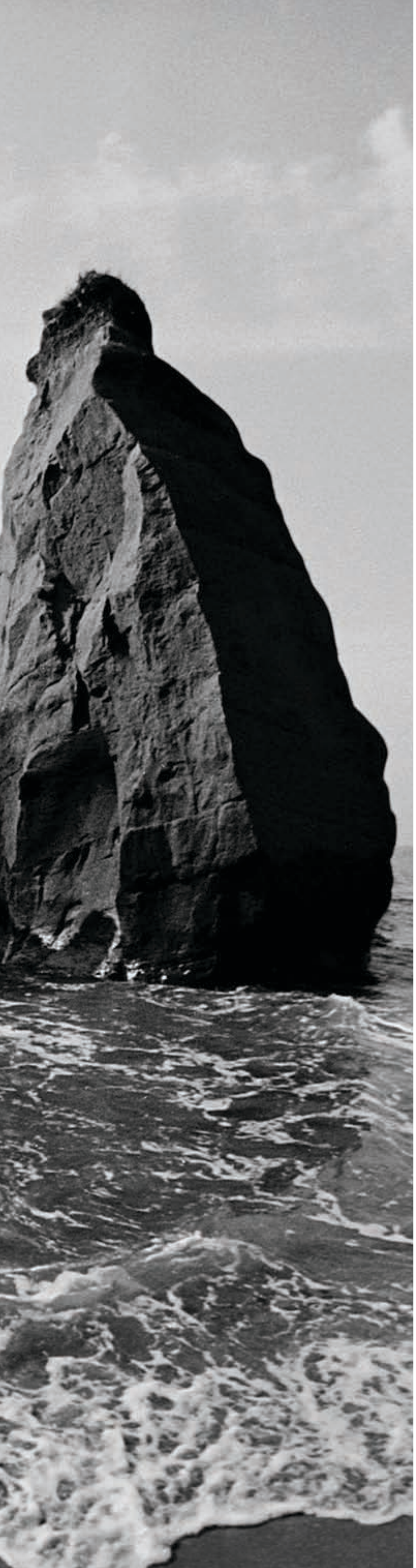


I. Introduction

This annual progress report reflects the status of the Integrated Ocean Observing System (IOOS), which is *the U.S. contribution to the Global Ocean Observing System (GOOS)*, five years into the 21st century. The design plan for the initial IOOS, which includes both global ocean and coastal components, was transmitted to Congress in 2003. Implementation of the initial global ocean component began in the late 1990s and is now approximately 50% completed. Plans for the initial national network (or "backbone") and regional coastal ocean observing systems have been completed The implementation plan for the national network is nearing completion and will be submitted to the National Ocean Research Leadership Council before the end of 2006.

II. IOOS Goals

The Integrated Ocean Observing System is a system of systems that routinely and continuously provides quality controlled data and information on current and future states of the oceans and Great Lakes from the global scale of ocean basins to local scales of coastal ecosystems. It is a multidisciplinary system designed to provide data in forms and at rates required by decision makers to address seven societal goals:

(1) Improve predictions of climate change and its socio-economic consequences;
(2) Improve the safety and efficiency of marine operations;
(3) more effectively mitigate the effects of natural hazards such as tropical storms;
(4) Improve national and homeland security;
(5) Reduce public health risks;
(6) More effectively protect and restore healthy marine ecosystems;
(7) Enable ecosystem-based management of natural resources;

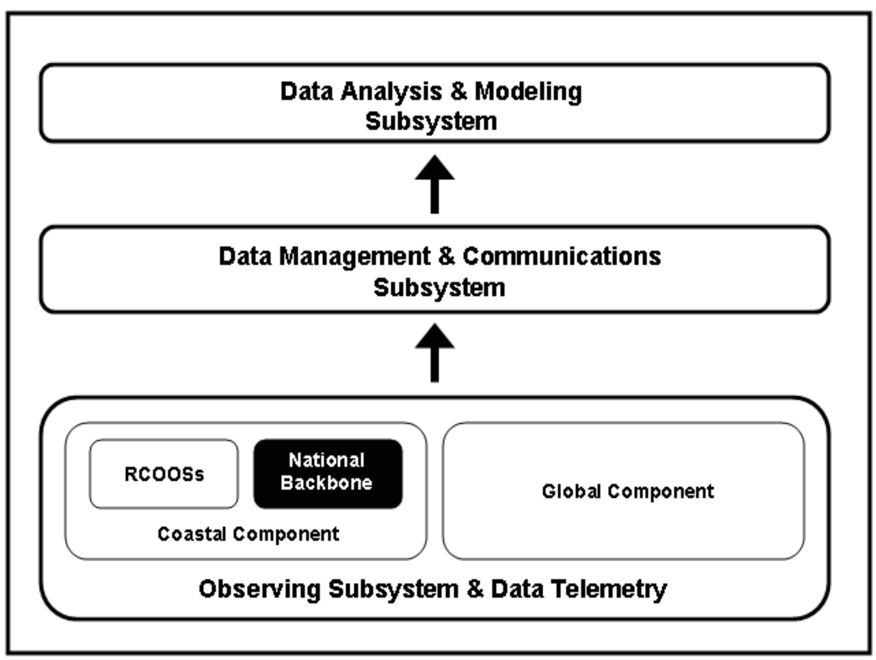


Figure 1. IOOS is an "end-to-end" system that efficiently links three subsystems (observations and data telemetry, data management and communication, and data analysis and modeling) for the provision of data and information required to address the seven societal goals.

The report of the U.S. Commission on Ocean Policy, the Ocean Action Plan[1], called for the implementation of a sustained and Integrated Ocean Observing System to increase our knowledge of the ocean, and the National Ocean Research Leadership Council has called for full implementation by 2010. The system will efficiently link regional, national and international networks of observations, data management and analyses to provide information needed to better understand and predict how changes will impact the nation's oceans, coasts, estuaries and Great Lakes – and the people who live and work in, use and enjoy the coastal zone. Integrating these will enable more efficient access to data and information, shared use of infrastructure, and more effective education and outreach.

III. Coordination among the IOOS, GOOS and the Global Earth Observation System of Systems

The IOOS is the U.S. contribution to the Global Ocean Observing System. Oversight of the IOOS is the responsibility of Ocean.US, the National Office for Sustained and Integrated Ocean Observations. The current Director of Ocean.US is the Vice Chair of the Intergovernmental Committee for GOOS (I-GOOS). The IOOS benefits from the guidance of a U.S. GOOS Steering Committee, composed of representatives from academia, industry, government, and environmental organizations.

The IOOS is also the marine, estuarine, and Great Lakes component of the U.S. Integrated Earth Observing System, whose national strategy is being developed in parallel with the international Global Earth Observation System of Systems (GEOSS). The U.S. plan was submitted at the third Earth Observation Summit in 2005 as the U.S. contribution to GEOSS. The intergovernmental Group on Earth Observations (GEO), now 60 countries strong, is working to integrate energy and environment research initiatives that are critical for achieving sustained global economic growth while ensuring a healthy environment. The Director of Ocean.US represents I-GOOS at the GEO Plenary and serves on the GEO Architecture and Data Committee and the User Interface Committee. Ocean.US's current Deputy Director for Research represents the Partnership for Observations of the Global Ocean (POGO, a member of GEO) at the GEO Plenary and on the GEO User Interface Committee.

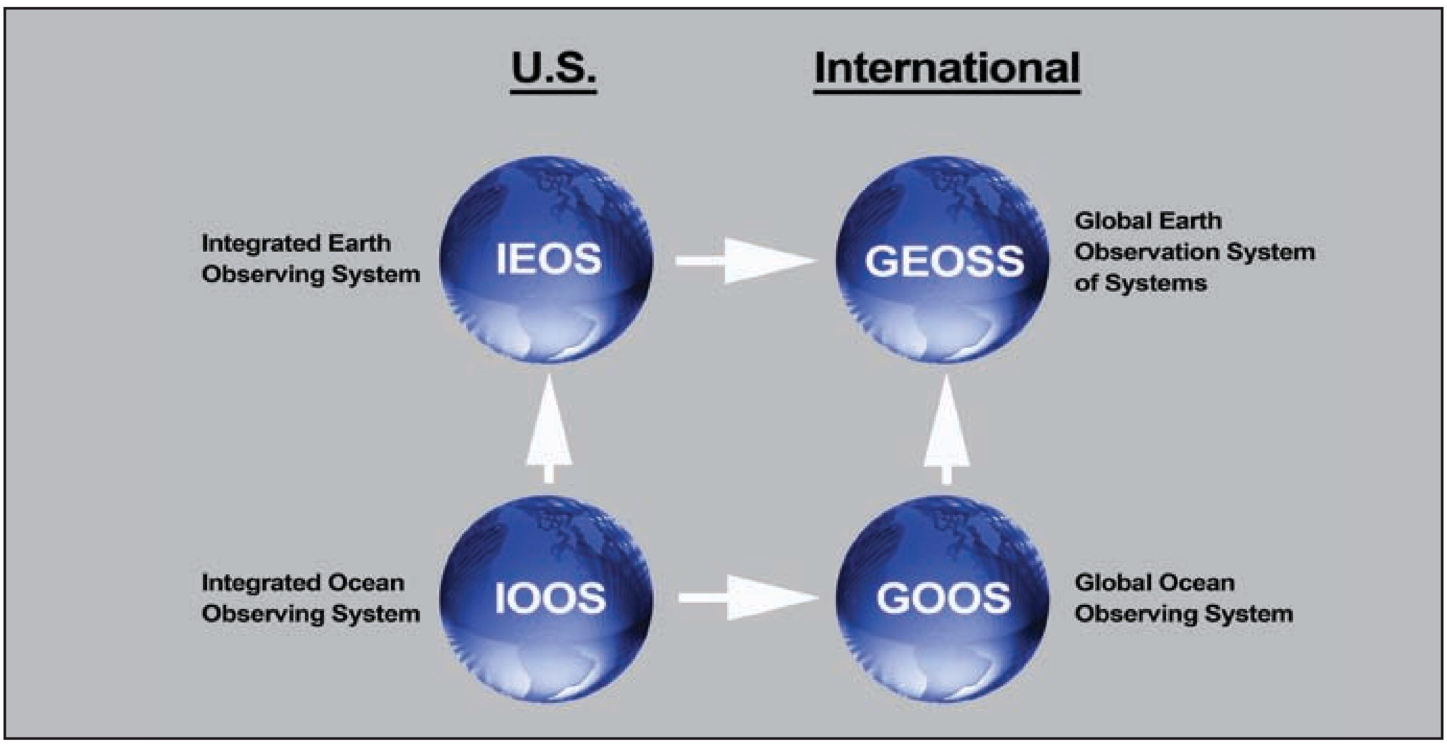


Figure 2. Ocean and Earth Observing Organization. IOOS is only one part of the global earth observing efforts. These efforts are organized into ocean and full-earth focuses, as well as national and international components.

[1] The President's Ocean Action Plan. (http://ocean.ceq.gov/)

IV. Observing Sub-System

The observing sub-system consists of two modules---global and coastal. Appendix A describes the conceptual design of the IOOS. Design Principles are given in Appendix B. The section below summarizes the status of implementation.

A. Global Module

Continued implementation of the global ocean component of the IOOS will improve the safety and efficiency of maritime operations, forecasts of natural hazards, and predictions of climate change. High priorities include the provision of data and information required to document seasonal to decadal scale trends in (1) sea level, (2) ocean carbon sources and sinks, (3) ocean storage and transports of heat and fresh water, and (4) air-sea exchange of heat and fresh water. The required data products needed to achieve these goals can be found in the "Implementation Plan for the Global Ocean Observing System for Climate".[2]

Progress on establishing the global component continues at a consistent pace, with approximately 50% of the *in situ* system now in place (Table 1). As *in situ* networks are needed to fully characterize the three-dimensional structure of the ocean, full deployment of the Argo float array is a high priority. The number of subsurface ocean profiles of temperature and salinity has increased dramatically over the last two years due in large part due to the growth of the Argo array of profiling floats (Figure 3) with 1,928 floats reporting in June 2005, of the required 3,000 needed for global 3° resolution coverage (to be achieved by 2007). In some parts of the world ocean, Argo floats have now contributed more vertical profiles of temperature and salinity to the historical record than all other previous measurements combined. Critical satellite missions (research and operational) supporting the provision of products and services by government agencies and other organizations in the U.S. are summarized in Table 5.

In Situ Observing Element		U.S. Total 2005	GOOS Goal
DBCP[a]	Surface drifting buoys	1316	1250
	with barometer	295	600
	Sea ice buoys (IABP[b], IPAB[c])	12	
	Global tropical moored buoy network	55	119
	Coastal moorings	70	
Ocean SITES	Global reference mooring network (GRMN)	5	29
	Total time series sites including GRMN	6	58
GLOSS[d]	Stations committed to GLOSS	28	290
	GLOSS real-time reporting stations	26	170
SOT[e]	High-density XBT[f] lines occupied	12	64
	Frequently-repeated XBT lines occupied	6	25
	Number of XBTs deployed	10535	23000
	VOS[g] Clim ships	12	200
IOCCP[h]	Carbon survey (lines completed since 2001)	2	31
	VOS Carbon	6	
Argo floats, operational		1163	3000
Sustained and repeated ship hydrography lines		2	
Data Centers		4	

Table 1. Implementation status of the core *in situ* elements of the observing subsystem
[a] Data Buoy Cooperation Panel, [b]International Arctic Buoy Program, [c]International Program for Antarctic Buoys, [d]Global Sea Level Observing System, [e]Ship Observations Team, [f]Expendable Bathythermograph, [g]Volunteer Observing Ship, [h]International Ocean Carbon Coordination Project

[2] The Ocean Observing System Development Panel (OODSP) 1995. "The scientific design for the common module of the Global Ocean Observing System (GOOS) and the Global Climate Observing System (GCOS): An ocean observing system for climate." Report of the OOSDP, publ. U.S. World Ocean Circulation Experiment (WOCE) Office, Texas A&M University, College Station Texas, 285 pp.; United Nations Educational, Scientific and Cultural Organization (UNESCO). 1999. Global physical ocean observations for GOOS/GCOS: an action plan for existing bodies and mechanisms. GOOS Rpt. No. 66, 50 pp. <http://ioc.unesco.org/goos/docs/GOOS_066_act_pl.htm>; Implementation Plan for the Second Adequacy Report. GCOS. 2004. Implementation Plan for the Global Ocean Observing System for Climate in Support of the UNFCC. http://www.wmo.ch/web/gcos/gcoshome.html

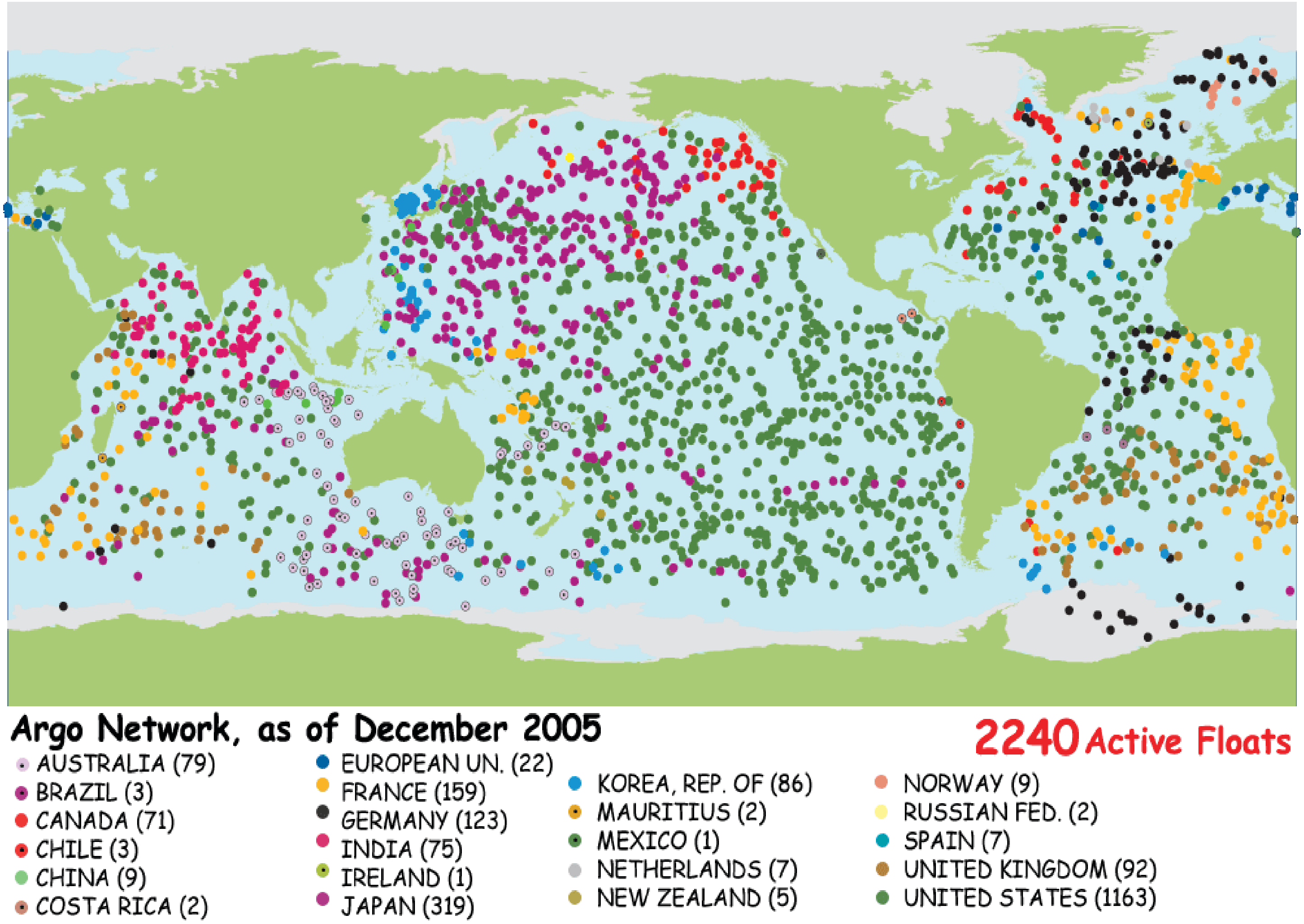


Figure 3. Status of deployment of Argo profiling float network as of December 2005. Argo floats measure temperature, salinity from the surface to 1,000 - 2000 m depth every 10 days depending on the instrument and water mass characteristics. The Argo network is now 64% complete, and the goal is to seed the ocean with 3,000 floats by 2007, yielding a 3° global resolution of sub-surface temperature and salinity. The colors denote the country responsible for the float.

In addition, a major milestone was achieved in September 2005. With support from the U.S., the 1250th global surface drifting buoy was deployed near Halifax Harbor, Nova Scotia, Canada. With this deployment, the global drifting buoy array achieved its initial design goal of 1250 buoys in sustained service, and has become the first component of GOOS to be completed. A special ceremony was held aboard the Tall Ship *Silva* near Halifax, Nova Scotia to commemorate this historic event. The ceremonial deployment of Global Drifter 1250 symbolized the filling of the final 500x500 kilometer box. The number 1250 is based on the requirement for buoy measurement of sea surface temperature in combination with satellite measurements.

B. Coastal Module

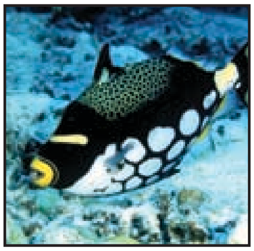
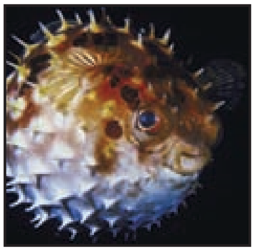
1. The National Backbone

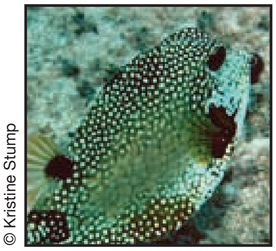
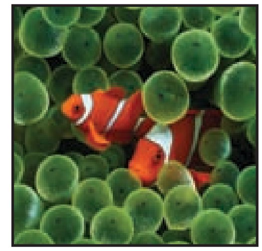
The National Backbone (NB) of the IOOS is the suite of operational observing subsystem elements whose functions are described in Appendix C. Recommendations for the initial observing subsystem of the NB focus on using existing assets to improve estimates of sea surface meteorological conditions and changes in the geophysical, biological and chemical states of pelagic and benthic environments. The following table summarizes the recommended pre-operational and operational *in situ* building blocks for the initial observing subsystem based on recommendations from participating federal agencies and participants in the Second Annual IOOS Implementation Conference.

Table 2. The Elements of the National Backbone. *In situ* pre-operational and operational programs that monitor core variables.

Core Variable	NOAA	Navy	USACE	USGS	EPA
Sea surface winds	C-MAN[a], NWLON[b] NDBC[c], PORTS®[d], NERRS[e]	Integrated buoy program			
Stream flow				Stream gauging NSIP[f] NASQAN[g]	
Temperature	NDBC, CoastWatch, C-MAN NWLON, PORTS®[d], LMR-ES[h], NERRS	Integrated buoy program			
Salinity	LMR-ES, PORTS®, NERRS, NDBC, C-MAN	Integrated buoy program			
Coastal Sea Level-Topography	NWLON[b], PORTS®, DART			NSIP[f] GSN[i]	
Waves	NDBC	Integrated buoy program	Coastal Field Data Collection Program		
Currents	NDBC, PORTS®, National Current Observation Program				
Dissolved Inorganic Nutrients	LMR-ES Habitat assessment, NERRS NCAP[j]				NCAP
Water Quality/ Pollution	BEACHES[k] NCAP			Beaches NAWQA[l]	Beaches NMDMP[m] NCAP
Chlorophyll	LMR-ES, NERRS, NCAP				NCAP
Habitat & Bathymetry	Hydrographic Survey Coral reef mapping Coral reef monitoring Coastal mapping Topographic change mapping Benthic habitat mapping Habitat assessment Coastal change assessment mapping		Hydrographic Surveying Shoreline Mapping	Coral reef mapping & monitoring Coastal change mapping Benthic habitat mapping	
Plankton Abundance	LMR Surveys Ecosystem Surveys				
Abundance & distribution of LMRs & protected species	LMR Surveys Ecosystem Surveys Protected Resources Surveys National observer NCAP				NCAP
Population Statistics[n]	LMR-ES National observer NCAP				NCAP
Fish Catch	National observer Recreational fisheries Commercial statistics				

[a]Coastal-Marine Automated Network; [b]National Water Level Observation Network; [c]National Data Buoy Center (moored meteorological sensors, DART mooring systems); [d]Physical Oceanographic Real-Time System; [e]National Estuarine Research Reserve System; [f]National Streamflow Information Program; [g]National Stream Quality Accounting Network; [h]Living Marine Resources-Ecosystems Survey; [i] Global Seismographic Network; [j]National Coastal Assessment Program, [k]Beach Environmental Assessment and Coastal Health, [l]National Water Quality Assessment Program, [m]National Marine Debris Monitoring Program, and [n]Population statistics = sex, weight, length, and stomach contents of fish species.

Programs	Societal Goals						
	Weather Climate	**Maritime Operations**	**Natural Hazards**	**Homeland Security**	**Public Health**	**Ecosystem Health**	**Living Resources**
C-MAN	X	X	X	X	X	X	X
NWLON	X	X	X	X		X	X
NDBC	X	X	X	X	X	X	X
PORTS	X	X	X	X	X	X	X
Integrated Buoy Program	X	X	X	X			
NSIP			X		X	X	X
NSQAN			X		X	X	X
GSN			X	X	X	X	X
CFDCP	X	X	X	X	X	X	X
National Current Observing Program	X	X	X	X	X	X	X
Hydrographic Surveying	X	X	X	X	X	X	X
Coastal Mapping, Shoreline change		X	X	X	X	X	X
Benthic Habitat Mapping & Monitoring		X	X		X	X	X
Coastal Change Assessment Mapping		X	X	X	X	X	X
Coastwatch	X	X	X	X	X	X	X
GOES	X	X	X	X			
POES	X	X	X	X	X	X	X
ADFC	X	X	X	X	X	X	X
NERRS					X	X	X
LMER-ES					X	X	X
Protected Resource Surveys						X	X
National Observer Program						X	X
Recreational Fisheries						X	X
Commercial Statistics						X	X

Table 3. Programs recommended for integration into the initial IOOS National Backbone and the societal goals they contribute to. See the table above for a definition of acronyms.

2. Regional Development

Eleven Regional Associations (RAs) are being established in the U.S. to oversee the development of regional coastal ocean observing systems for the Nation's EEZ, estuaries and Great Lakes (Figure 4).

System (GLOS) are coordinating with the former, and the organizers of the Gulf of Mexico Coastal Ocean Observing System (GCOOS) are working with the newly formed Gulf of Mexico Alliance to coordinate these efforts with regional IOOS development.

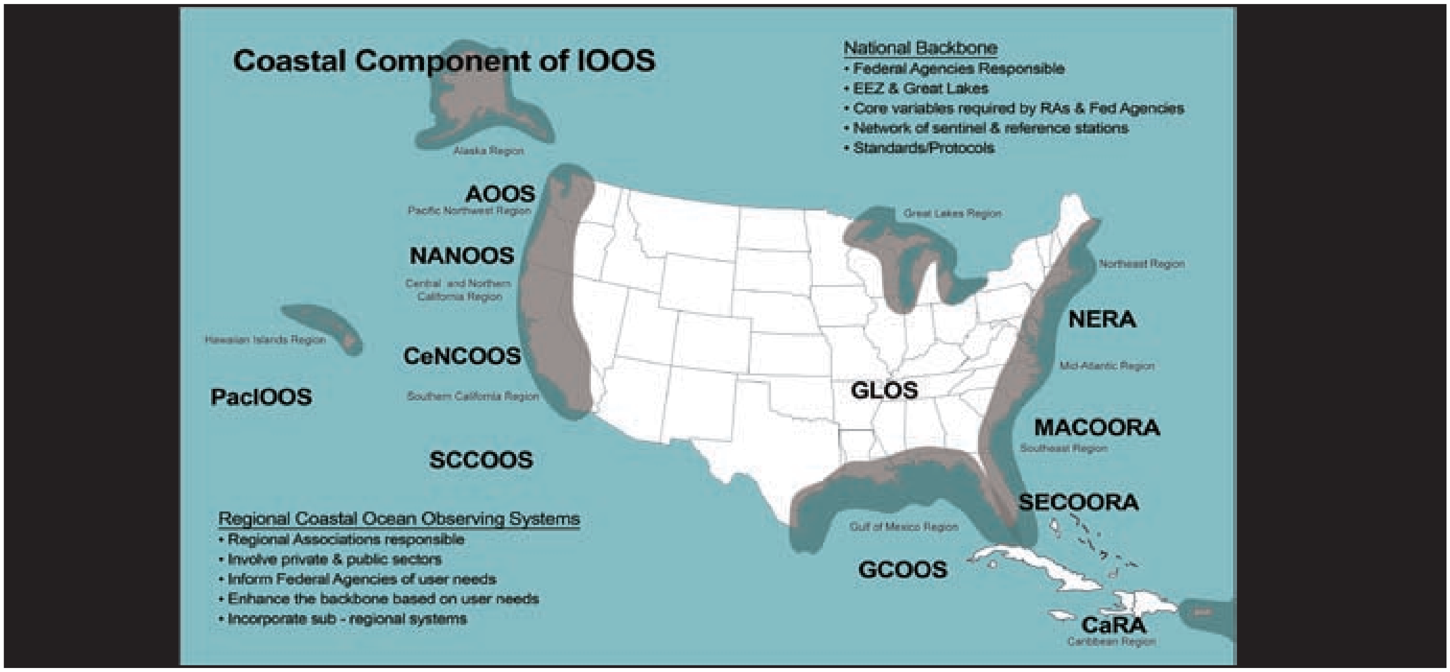


Figure 4. The coastal component of the IOOS consists of a National Backbone with eleven Regional Coastal Ocean Observing Systems embedded in it. Appendices C and D further describe the structure.

All eleven groups have engaged user groups from both public and private sectors in the initial stages of RA development, have initiated or will soon begin inventories of observing system assets in their respective regions, and are assessing or have plans to assess needs (gap analysis). Progress can be summarized as follows:

- Nine have established interim governing bodies;
- Ten have hired full or part-time staff;
- Eight have established websites;
- All eleven are coordinating with adjacent regions and five with neighboring countries;
- Ten are in the process of incorporating active sub-regional observing systems and seven are serving some data in real-time;
- Six have initiated pilot projects;
- Nine are engaged in DMAC activities;
- Nine have initiated education and/or outreach activities, and two are forming education and outreach councils to oversee these activities;
- Six have draft governance plans in review, and two have governance plans that have been approved by stakeholders; and
- Three have draft business plans in review.

In addition to these efforts, the President's Ocean Action Plan calls for supporting the Great Lakes Interagency Task Force and for establishing state-federal partnerships in the Gulf of Mexico. Operators of the Great Lakes Observing

Major accomplishments of the nascent Regional Associations (RAs) in 2005 are summarized in Table 4.

At a 2003 Ocean U.S. Regional Ocean Observing Systems Summit, it was proposed that a National Federation of Regional Associations (NFRA) be established to:

- Coordinate the development of RAs to insure interoperability;
- Represent the RAs at the federal level; and
- Provide a forum for coordinating inter-regional activities.

The goal of NFRA is to promote a robust and sustained national presence for Regional Associations (RAs). As a means of attaining this goal, the NFRA will work to accomplish the following objectives:

- Initiate key actions to enable effective coordination, integration, and implementation of regional coastal ocean observing systems in close collaboration with Ocean.US, applicable federal agencies, and other bodies as appropriate;
- Establish, when requested, collective agreements between and among RA's to promote more effective inter-regional collaboration;

- Develop and advocate coordinated views of coastal ocean observation, prediction, and science to the Congress, the federal government, program sponsors, international bodies, and others;

- Facilitate linkages between Regional Associations and national organizations representing industry, education, and scientific enterprises in relation to their goals, plans, and programs;

- Serve as a venue for the exchange of policy and technical information between and among Regional Associations;

- Facilitate the education and outreach programs of Regional Associations;

- Encourage and foster Regional Association responsiveness to user communities;

- Promote capacity building;

- Promote sharing of facilities, infrastructure and other resources; and

The NFRA Governing Committee is comprised of two members from each of the regional groups.

Category	Activity	Gulf of Mexico	Southeast	Alaska	Northwest	CeN. & No. ca	Great lakes	So. CA	Mid Atlantic	Northeast	Pac islands	CARibbean
Funding	Funding Year	3	3	3	3	3	3	2	2	1	1	1
Organization	Governing Body	X	X	X	X	X	X	X	X	X		
	Website	X	X	X	X	X	X	X	X			
	Staff	P	P	F	F	F[a]	F	P	P	F		P
	Stakeholders	X	X	X	X	X	X	X	X	X	X	X
	Inventory	X	X	X	X	X[b]	X	X	X	X	X	X
	Gap analysis	X	X	X	X	X	X	X	X	X	X	X
	Regional Coordination	X	X	X	X	X	X	X	X	X	X	X
	International Coordination	X		X	X		X	X		X	X	
Infrastructure	Subregional OS	X	X	X	X	X	X	X	X	X	X	
	Real-time	X	X	X	X	X	X	X	X	X	X	
	Pilot Project		X[c]	X[d]	X[e]	X[f]		X[g]		X		
	DMAC	X[h]	X	X[i]	X	X	X[i]	X		X	X	
Education	Implementation	X	X	X	X	X	X	X	X	X		
	Council	X	X				X[j]					
Governance	Plan in Review		X	X	X		X	X	X			
	Approved by Stakeholders	X				X						
	Incorporated								X			
Business Plan	In Preparation			X		X		X				
	In Review	X	X				X					
	Approved by Stakeholders											
TOTAL		**15**	**15**	**15**	**14**	**14**	**15**	**15**	**12**	**12**	**8**	**5**

Table 4. Summary of regional activities as of 12/31/05 with nascent RAs listed according to the number of years of funding received (years 1, 2, and 3). (P- part time, F- full time; GCOOS - Gulf of Mexico Ocean Observing System, SECOORA - SouthEast Coastal Ocean Observing Regional Association, AOOS - Alaska Ocean Observing System, NANOOS - Northwest Association of Networked Ocean Observing Systems, CeNCOOS - Central and Northern California Ocean Observing System, GLOS - Great Lakes Observing System, SCCOOS - Southern California Coastal Ocean Observing System, MACOORA – Mid- Atlantic Coastal Ocean Observing Regional Association, NERA - NorthEast Regional Association, PacIOOS - Pacific Integrated Ocean Observing System, CaRA - Caribbean Regional Association) .

[a] Added two ½ time positions – Oceanographer and Product Development Lead and Outreach Specialist; [b]Geo-referenced database on ongoing ocean observing activities that allows map-based queries via a public web site; [c] Developing manuals for best data management practices (funded by SURA-SCOOP); [d] Prince William Sound Observing System (an AOOS subsystem); [e] A pilot coastal ocean observatory for the estuaries and shores of Oregon and Washington; [f] Currents demonstration project; [g] California Coastal Current Monitoring; [h] Uses the NDBC modem kit that enhances data access for modeling and product development at minimal cost; [i] Hired a data manager; [j] Together with Sea Grant, established the Great Lakes Center for Ocean Science Education Excellence

Sub-regional observing systems, the building blocks for the Regional Coastal Ocean Observing Systems (RCOOSs), exist in ten of the eleven regions. Efforts to integrate these systems have begun. Considerable data are available from these sub-regional systems and from the national backbone activities located in the regions. Sub-regional systems are identified below. Many of them can also be accessed through NOAA's Coastal Services Center website at http://www.csc.noaa.gov/coos/.

The Alaska Region (http://www.aoos.org/) has a number of sub-regional systems that are collecting and distributing data. These are a mix of federal and state systems and include observations from non-federal systems such as the Gulf of Alaska Global Ocean Ecosystem Dynamics Monitoring Program, Prince William Sound Nowcast-Forecast System, and the Gulf of Alaska Ecosystem Monitoring and Research Program.

- Southeast Alaska - http://ak.aoos.org/op/maps?region=SE
- Yakutat - http://ak.aoos.org/op/maps?region=YAK
- Prince William Sound Observing System - http://ak.aoos.org/pws/observing_system_components.html
- Cook Inlet - http://ak.aoos.org/op/maps?region=COOK. There are also
- Kodiak - http://ak.aoos.org/op/maps?region=KOD
- Alaska Peninsula - http://ak.aoos.org/op/maps?region=KOD
- Aleutians - http://ak.aoos.org/op/maps?region=ALEUT
- Pribilof Islands - http://ak.aoos.org/op/maps?region=STP
- Bering Strait - http://ak.aoos.org/op/maps?region=SEW
- Chukchi Sea - http://ak.aoos.org/op/maps?region=CHUK
- Arctic - http://ak.aoos.org/op/maps?region=ARC
- Sea-Air-Land Modeling and Observing Network (SALMON)- http://www.ims.uaf.edu/salmon/CODAR/CODAR.html

In addition to the surface current measurements being made using high frequency (HF) radar in the SALMON network, there are three additional HF radar sites located in Cook Inlet.

The Caribbean Region is early in its development and has no sub-regional observing systems. National Backbone programs provide their only data.

The Central and Northern California Region (http://www.cencoos.org/) includes a number of active sub-regional observing systems. Data from each of the systems may be accessed through the sites listed below:

- Bodega Ocean Observing Node - http://www.bml.ucdavis.edu/boon/
- California Cooperative Oceanic Fisheries Investigations - http://www.calcofi.org/newhome/data/data.htm
- California Sea Otter Survey - http://www.werc.usgs.gov/otters/ca-surveyspr2005.htm
- Center for Integrated Marine Technologies - http://cimt.ucsc.edu/
- Center for Integrative Coastal Observation, Research, and Education - http://cicore.org
- Central Coast Long-term Environmental Assessment Network – access multiple data sites through http://www.oceanobs.org/secure/public_data_record.php?programID=13&projectID=66&regionID=1&PHPSESSID=7e7016b171d8c54c96e21532c0a001eb
- CoastWatch West Coast Regional Node - http://coastwatch.pfel.noaa.gov/
- Humboldt Bay Harbor, Recreation and Conservation District - http://www.humboldtbay.org/
- Innovative Coastal-Ocean Observing Network - http://www.oc.nps.navy.mil/~icon/index.html
- Land/Ocean Biogeochemical Observatory in Elkhorn Slough - http://www.mbari.org/lobo/
- Network of Environmental Observations of the Coastal Ocean - http://www.es.ucsc.edu/~neoco/
- Pioneer Seamount Acoustic Observatory - http://www.physics.sfsu.edu/~seamount/
- Rapid Environmental Assessment Laboratory - http://www.oc.nps.navy.mil/~stanton/miso/misohome.html
- San Francisco Public Utilities Commission Beach Monitoring Program - http://sfwater.org/Custom/LIMS/beachmain1.cfm
- Monterey Bay Aquarium Research Institute Ocean Observing System - http://www.mbari.org/data/
- Monterey Inner Shelf Observatory - http://www.oc.nps.navy.mil/~stanton/miso/
- San Francisco Bay Surface Currents - http://norcalcurrents.org/COCMP/SF%20Bay.html
- Pacific Coast Ocean Observing System - http://www.pacoos.org/

The Gulf of Mexico Region (http://www-ocean.tamu.edu/GCOOS/) includes the following sub-regional observing systems:

- Dermowatch - http://www.dermowatch.org/
- SAIC's DODs Server for the Gulf of Mexico - http://www.saicocean.com/
- Texas Automated Buoy System - http://tabs.gerg.tamu.edu/Tglo/
- Texas Coastal Ocean Observation Network - http://lighthouse.tamucc.edu/TCOON/HomePage
- Gulf of Mexico Distributed Ocean Data System - http://seawater.tamu.edu/NOPPDODSGOM/
- Galveston Bay Estuary Program - http://www.gbep.state.tx.us/solutions-partners/data-mapping.asp
- Louisiana Universities Marine Consortium Environmental Monitoring - http://weather.lumcon.edu/
- Wave Current Surge Information System - http://wavcis.csi.lsu.edu/
- Mississippi Department of Marine Resources Data - http://ms.water.usgs.gov/rt/biloxi/
- Mississippi Beach Monitoring Program - http://www.usm.edu/gcrl/msbeach/index.cgi
- NEGOM Hydrographic Data - http://seawater.tamu.edu/NOPPDODSGOM/data/hydro/negom/
- West Florida Coastal Ocean Monitoring and Prediction System - http://comps.marine.usf.edu/
- Florida Inshore Marine Monitoring and Assessment Program - http://www.floridamarine.org/features/category_sub.asp?id=3448
- Florida Marine Research Institute Red Tide Monitoring - http://www.floridamarine.org/features/view_article.asp?id=9670
- Northern Gulf of Mexico Littoral Initiative - http://128.160.23.41/
- SEAKEYS/C-MAN Project - http://www.coral.noaa.gov/seakeys/index.shtml

The Great Lakes Region(http://www.glos.us/) includes sub-regional systems associated with the Lakes and connecting waterways. These systems have been brought under the umbrella of the Great Lakes Information Network (http://glin.net/), where their data can be found.

The Mid-Atlantic Region (http://www.macoora.org/) includes a number of mature sub-regional observing systems from Long Island Sound to the Outer Banks.

- Martha's Vineyard Coastal Observatory - http://mvcodata.whoi.edu/cgi-bin/mvco/mvco.cgi
- My Sound - http://www.lisicos.uconn.edu/
- Sound Science - http://www.sunysb.edu/soundscience
- New York Harbor Observing System - http://onr.dl.stevens-tech.edu/webnyhos3/
- New Jersey Shelf Observing System - http://www.marine.rutgers.edu/cool/
- Coastal Ocean Observation Lab CODAR Surface Current Maps - http://www.marine.rutgers.edu/mrs/codar.html
- Weatherflow - http://www.iwindsurf.com/support.iws?topic=About+Us
- Delaware Bay Observing System - http://www.udel.edu/dbos/
- Chesapeake Bay Observing System - http://www.cbos.org/
- NASA/Goddard Space Flight Center Wallops Flight Facility Coastal Ocean Observation Laboratory - http://www.nasa.gov/centers/goddard/home/index.html
- US Army Corps of Engineers, Field Research Facility - http://frf.usace.army.mil/
- Chesapeake Bay Mouth Monthly - http://www.ccpo.odu.edu/~jay/cheshome.html
- Alliance for the Chesapeake Bay Citizen Monitoring Program - http://www.acb-online.org/project.cfm?vid=87
- Maryland Department of Natural Resources – Eyes on the Bay - http://www.eyesonthebay.net/
- New Jersey Coastal Monitoring Network - http://cmn.dl.stevens-tech.edu/
- Long Island Sound CODAR data - http://nopp.uconn.edu/CODAR/index.html

The Northwest Region (http://www.nanoos.org/) has only a few sub-regional observing programs.

- NANOOS Pilot Project – Pacific Northwest Estuaries and Shores - http://www.ccalmr.ogi.edu/nanoos/
- Experimental Products Describing Ocean Conditions - http://www.nanoos.org/oconditions/
- Surface Currents of the Oregon Coastal Ocean - http://bragg.oce.orst.edu/ORCoast/
- Bodega Ocean Observing Node - http://www.bml.ucdavis.edu/boon/
- Columbia River Estuary Real-Time Observation and Forecasting System - http://www.ccalmr.ogi.edu/CORIE/
- Oregon State University Coastal Observations - http://ltop.coas.oregonstate.edu/~ctd/index.html and http://damp.coas.oregonstate.edu/coast/
- Pacific Coast Ocean Observing System - http://www.pacoos.org/

The largest observing component of the New England Region is the Gulf of Maine Ocean Observing System (http://www.gomoos.org/) but the larger RCOOS will include at least one additional system.

- Gulf of Maine Ocean Observing System - http://www.gomoos.org/
- Martha's Vineyard Coastal Observatory - http://mvcodata.whoi.edu/cgi-bin/mvco/mvco.cgi

The Pacific Islands Region (http://research.eastwestcenter.org/PacIOOS/) is in the early stages of its development and has few sub-regional systems established. There are, though, access to regional data through federal and international programs, in addition to those associated with National Backbone programs.

- Hawaii Surface Current Data - http://radlab.soest.hawaii.edu/hfradar/
- Asia-Pacific Data-Research Center - http://apdrc.soest.hawaii.edu/w_data/data3.html
- Asia Pacific Natural Hazards Information Network - http://www.pdc.org/mde/explorer.jsp
- Global Ocean Data Assimilation Experiment - http://www.usgodae.org/cgi-bin/datalist.pl?generate=summary
- Global Change Master Directory - http://gcmd.gsfc.nasa.gov/KeywordSearch/Keywords.do?Portal=GCMD&KeywordPath=Parameters%7COCEANS&MetadataType=0&homepg
- National Virtual Ocean Data System - http://ferret.pmel.noaa.gov/NVODS/servlets/dataset
- NESDIS/NODC/NCDDC Hawaii/Pacific Islands Liaison - http://ilikai.soest.hawaii.edu/HILO/
- NOAA Coral Reef Information System - http://www.coris.noaa.gov/metadata/map-search/viewer.htm
- Oceanographic In-situ Data Access - http://www.epic.noaa.gov/epic/access/index.html
- OceanSITES Deep Water Reference Stations - http://www.whoi.edu/virtual/oceansites/trish/data/index.html
- Pacific ENSO Applications Center - http://www.soest.hawaii.edu/MET/Enso/data/data.html
- Pacific Region Ocean Data and Information Portal - http://www.nodc.noaa.gov/PRODIP/
- Permanent Service for Sea Level - http://www.pol.ac.uk/psmsl/datainfo/
- Physical Oceanography Distribute Active Archive Center - http://podaac.jpl.nasa.gov/catalog/
- Research Vessel Surface Meteorological Data Center - http://www.coaps.fsu.edu/RVSMDC/html/data.shtml
- Tropical Ocean Global Atmosphere Coupled Ocean-Atmosphere Response Experiment Data Information System - http://www.ncdc.noaa.gov/oa/coare/
- U.S. Pacific Islands Near-Real-Time Meteorological and Oceanographic Data - http://crei.nmfs.hawaii.edu/ocean_data.html
- Western Pacific Fisheries Information Network - http://www.pifsc.noaa.gov/wpacfin/
- World Seabed Data - http://instaar.colorado.edu/~jenkinsc/dbseabed/goseabed/interactive/
- Hawaii-Pacific Regional Ocean Observing System - http://kela.soest.hawaii.edu/HI-POIS/index.html
- Hawaii Ocean Time-series Program - http://hahana.soest.hawaii.edu/hot/hot_jgofs.html
- Coral Reef Ecosystem Investigation (CREI) Monitoring Network - http://www.nmfs.hawaii.edu/cred/

The Southern California Region (http://www.sccoos.org/), like Alaska, displays its sub-regional data geographically and then by type of station or measurement rather than by program. Access to those data is available by using the interactive map on their website (http://www.sccoos.org/interactive-map/). The stations and measurements shown are:

- Automated Shore Stations
- Manual Shore Stations
- Bathymetry
- Moorings
- Meteorological Observations
- Winds and Rainfall Forecasts
- Satellite Imagery
- Shoreline Water Quality
- Surface Current Maps
- Wave Conditions
- Cast Data
- Chlorophyll and HABS

Additional program information is provided from the NOAA Coastal Services Center (http://www.csc.noaa.gov/coos/southwest.html) for the Southern California region:

- California Cooperative Oceanic Fisheries Investigations - http://www.calcofi.org/newhome/data/data.htm
- Center for Integrative Coastal Observation, Research, and Education - http://cicore.org
- Southern California Coastal Water Research Project Authority - http://www.sccwrp.org/

Finally, the Pacific Coast Ocean Observing System (http://www.pacoos.org/) also provides information in the region.

The Southeast Region (http://www.secoora.org/) has a number of sub-regional observing systems.

- Southeast Atlantic Coastal Ocean Observing System - http://www.seacoos.org/
- Coastal Ocean Research and Monitoring Program - http://www.cormp.org/indexreal.php
- FerryMon - http://www.ferrymon.org/
- Carolinas Coastal Ocean Observing and Prediction System - http://nautilus.baruch.sc.edu/carocoops_website/index.php
- South Atlantic Bight Synoptic Offshore Observational Network - http://www.skio.peachnet.edu/research/sabsoon/
- West Florida Coastal Ocean Monitoring and Prediction System - http://comps.marine.usf.edu/
- East Florida Shelf Information System - http://efsis.rsmas.miami.edu/
- Explorer of the Seas - http://www.rsmas.miami.edu/rccl/index.html
- SEAKEYS/C-MAN Project - http://www.coral.noaa.gov/seakeys/index.shtml
- South Florida Ocean Measurement Center - http://www.sfomc.org/SFOMC_Start.htm
- Florida Inshore Marine Monitoring and Assessment Program - http://www.floridamarine.org/features/category_sub.asp?id=3448
- Florida Marine Research Institute Red Tide Monitoring - http://www.floridamarine.org/features/view_article.asp?id=9670

A number of the sub-regional systems report their data through NOAA's National Data Buoy Center (NDBC). During the first half of fiscal year 2006 (October 2005 – March 2006), the total volume transmitted from NDBC on to the Global Telecommunications System was 2,395,545 observations, or 38% of the total of 910,307 observations.

Criteria for the certification of regional groups as Regional Associations (RAs) have been drafted and are currently under legal review by NOAA counsel. There will be two levels of certification. Level one focuses on the creation of a legal governance structure. Level two focuses on defining system requirements and inventorying observing system assets by the RA.

3. National Water Quality Monitoring Network

A national water quality monitoring network (NMN), recommended by the U.S. Commission on Ocean Policy, is now being planned. The Advisory Committee on Water Information (ACWI) was tasked by the Council on Environmental Quality (CEQ) and the National Science and Technology Council (NSTC) to provide advice and recommendations for the design of the NMN that integrates watershed, coastal waters and ocean monitoring based on common criteria and standards. To these ends, a NMN Design Working Group was established by the National Water Quality Monitoring Council (of the ACWI) to design the NMN. Ocean.US is represented on this Working Group to ensure that the coastal component of the IOOS satisfies requirements for the coastal marine and oceans component of the NMN. As recommended in the First IOOS Development Plan, the National Backbone will measure, manage and analyze a set of core variables that include those required for the NMN (extent and condition of habitats, concentrations of nutrients, suspended sediments, chlorophyll, dissolved oxygen, harmful algae and waterborne pathogens) and used by the National Coastal Assessment Partnership (NCAP). The NMN will contribute to assessments prepared by the NCAP and will contribute to and benefit from IOOS development. The design plan for the NMN has been drafted and is in the final review process. Once it is approved, it will be used by Ocean.US to help guide coordinated implementation of the water quality elements of the coastal IOOS.

A key coastal water quality concern is exposure to pathogens and harmful algal blooms that threaten human and animal health. More timely public health, closure or advisory decisions are needed, which require more rapid methods of data collection and analysis. In 2005 U.S. researchers completed a study of new test methods to predict health effects associated with swimming in contaminated water. Using the polymerase chain reaction method to quantify two types of bacteria (*enterococci* and *bacteroides*) in Great Lakes waters, researchers accurately predicted gastrointestinal illness in beach goers.

C. Current and Planned Satellite Missions

The U.S. is concerned that the long-term sustainability of satellite measurements is in jeopardy, in particular, altimetry, scatterometry, and ocean color.

Core Variable	NASA	NOAA	DOD	Foreign
Sea Surface Temperature	MODIS on Aqua TMI on TRMM	AVHRR on GOES-Imager ABI on GOES-R[a]	WindSat	
Ocean Color	MODIS on Aqua SeaWiFS[b]	HES on GOES-R[a]		
Sea Surface Height	Altimeters on Jason-1, OSTM[a,d]			
Surface Vector Winds	Sea Winds on QuikScat		WindSat	
Sea Ice	Sea Winds on QuikScat AMSR-E on Aqua		SSM/I on DMSP	SAR on RadarSat-1[c]

Table 5. Current and planned satellite based earth observing capabilities (research and operational) that are observing core variables and supporting the provision of products and services by U.S. government agencies and organizations (AVHRR – Advanced Very High Resolution Radiometer, GOES – Geostationary Operational Satellite, MODIS – Moderate Resolution Imaging Spectroradiometer, TRMM – Tropical Rainfall Measuring Mission, TMI – TRMM Microwave Imager, SeaWiFS – Sea-viewing Wide Field-of-view Sensor, HES – Hyper-spectral Environmental Suite, ABI – Advanced Baseline Imager, CMIS – Conical image: rain rate scanning Microwave Imager/Sounder, OSTM – Ocean Surface Topography Mission, AMSR – Advanced Microwave Scanning Radiometer, SSM/I – Special Sensor Microwave Imager, DMSP – Defense Meteorological Satellite Program, SAR – Synthetic Aperture Radar).

[a] Planned Missions
[b] Commercial provider, Orbital Sciences Corporation
[c] Operated by Canada (Instrument and satellite have the same name)
[d] France (CNES) is international partner

V. Data Management and Communications

The Ocean.US DMAC Plan[3] provides a road map for implementing a DMAC infrastructure that seamlessly links elements of IOOS partner organizations with relevant systems in disciplines outside of the marine environmental sciences. The First IOOS Development Plan recommends a process to develop the DMAC Subsystem, identifies high priority near-term activities, and presents time-lines for their implementation. When implemented, this DMAC framework will support the identification of IOOS DMAC standards and protocols required to enable interoperability across the IOOS. Without this framework, present incompatibilities among existing observing systems arising from the lack of shared standards will be propagated into the future.

Implementing an integrated DMAC infrastructure is critical to the development of the IOOS and is *the highest priority for IOOS implementation*. The strategy for designing and implementing the IOOS DMAC Subsystem is being closely coordinated with IEOS design and implementation. Coordination is also occurring with related activities in the federal agencies and regional, national, and international Earth observing systems including the GEOSS, the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM), the World Meteorological Organization's Future WMO Information System initiative (FWIS), and Ocean Research Interactive Observatory Networks (ORION).

[3] Data Management and Communications Plan for Research and Operational Integrated Ocean Observing Systems http://dmac.ocean.us/dacsc/imp_plan.jsp

VI. Education

In 2005 the IOOS education initiative began to address priority areas outlined at a national workshop held in 2004 and refined at the Second IOOS Implementation Conference held in 2005. This effort concurrently supports the goals of the American Competitiveness Initiative in science, math, and workforce education and training. Accomplishments in 2005 according to the top four priority areas are as follows:

(1) Build a community by developing a national education network

Outreach activities highlighted formal education (students and professional development for educators) in elementary through Masters of Science curricula; technology education; and informal and non-formal education at aquaria, research reserves, and sanctuaries. Coordination and collaboration were substantially strengthened between the operationally-focused IOOS and the research-focused Ocean Research Interactive Observatory Networks (ORION) education planning and implementation efforts. In particular, an Education and Public Awareness Strategic Plan was developed for ORION that is consistent with the IOOS education and public awareness strategy. A special issue of the Marine Technology Journal was prepared titled "Promoting Lifelong Ocean Education-Exemplary Ocean and Aquatic Education Efforts that Promote Science Literacy for All Americans." Articles illustrate the array of ocean education programs that exist today and some of the specific challenges that ocean educators face.

(2) Engage educators in the governance of IOOS

An example of regional activities is the formation of an Education and Outreach Council for the Gulf of Mexico Coastal and Ocean Observing System. Nationally the NOPP Ocean Research and Resources Advisory Panel formed an Education Sub-Panel, emphasizing its concern with ocean education.

(3) Pursue planning activities including data management, key messages and themes, and research into the workforce and the public's knowledge of the ocean

A key accomplishment in 2005 was the solicitation of bids for a NOPP research project to examine the ocean science and technology workforce and to project future workforce needs. The ocean sciences, technology, and operations workforce is of special interest because of growing issues related to the ocean, aging of the current workforce, dropping enrollments in the physical sciences and engineering, and the prospect for expanded career opportunities as ocean observing systems become operational. Although the need is recognized, little quantitative research has been done to characterize the current and predict the future ocean sciences, technology and operations workforce, identify gaps in education and training, and consider alternatives to fill those gaps. This research sought here is the initial step in a long-term research effort to remedy this situation.

(4) Design learning materials to meet regional needs within a national IOOS framework

Consideration is being given to the merit and feasibility of a national framework for ocean observing system learning materials for kindergarten through grade 12 classrooms (students and educators).

VII. Industry Outreach

The first IOOS Industry Day was held in March 2005 in Washington, D.C., with more than 175 registrants representing Fortune 500 companies and small businesses alike. Fifteen speakers from Federal agencies, Congress and the private sector laid out the plans for the IOOS. Strategies for private sector involvement in its design, development, deployment, operation, maintenance and products were also provided. Regional IOOS Industry Days were also held in Houston, Seattle, and Chicago. These workshops were held to more directly engage local industry interests with academia, state and federal agencies involved with IOOS.

The IOOS has many characteristics that call for a formalized systems engineering approach: (1) a geographically distributed infrastructure and communities of data providers and users; (2) requirements for interoperability across scales from local, coastal ecosystems to the global ocean (e.g., internationally and nationally accepted standards and protocols for metadata and data discovery, browsing, transport and archival); (3) the need to serve virtual products with geographic information layers on-the-fly; (4) demand for continuous data analysis and modeling; and (5) a diversity of organizational, management and funding structures involving government agencies, academia and private sectors. Mitretek Sytems, Inc., a systems engineering firm, has completed a preliminary Systems Engineering Management Plan, Federal Enterprise Architecture and Concept of Operations to serve as the basis for the conceptual design for the IOOS. With these preliminary systems engineering documents and other IOOS workshop proceedings as reference material, a formal Request For Quotation for the Development of a Conceptual Design for the IOOS was developed for award during the first quarter of Calendar Year 2006.

VIII. The Federal Oceanographic Fleet

Oceanographic research and survey ships are fundamental tools needed to advance our understanding of the oceans. The National Oceanographic Partnership Program (NOPP) Federal Oceanographic Facilities Committee is preparing an update to the December 2001 document "Charting the Future for the National Academic Research Fleet: A Long-Range Plan for Renewal." Currently in draft, the update expands the original Fleet Plan to include all research and survey ships in the Federal Oceanographic Fleet. It provides a detailed description of current Fleet capacity and addresses plans by the federal agencies for renewal and transition to ensure a diverse, capable and technologically advanced fleet of oceanographic ships remains available to meet the needs of the nation well into the future.

IX. Ocean.US Planning Activities

IOOS planning and coordination are carried out by a full-time staff at an interagency office, Ocean.US. On behalf of the National Ocean Research Leadership Council (NORLC), the Ocean.US Office and its Executive Committee completed the First Integrated Ocean Observing System (IOOS) Development Plan[4] in December 2004 following the First IOOS Implementation Conference. The plan was approved at the Cabinet level by the Interagency Committee on Ocean Science and Resource Management Integration (ICOSRMI) in January 2006. The First IOOS Development Plan addresses many of the recommendations of the U.S. Commission on Ocean Policy, including those for establishing an IOOS with an emphasis on regional development, developing capacity for ecosystem-based management and linking IOOS data and information to applications. The Plan recommends pre-operational and operational federal programs for building the global component and the initial National Backbone of the IOOS. The global component of the plan is drawn from international plans developed under the auspices of the Intergovernmental Oceanographic Commission (IOC). A brief description of the Conceptual Design and National Backbone are given in Appendices A and C. In addition, the plan provides a road map for implementing Data Management and Communications for the IOOS as a whole and provides a framework and guidelines for developing Regional Associations and the Regional Coastal Ocean Observing Systems that RAs will develop.

4 http://www.ocean.us/documents/docs/IOOSDevPlan_kiw-res.pdf

The second IOOS plan, IOOS Development Plan: FY 2006 – 2008, is in draft form. It updates and prioritizes recommendations in the first plan by focusing on requirements for improving forecasts of coastal inundation and mitigating the ecological and socioeconomic impacts of coastal inundation. This plan is based on recommendations by the U.S. Commission on Ocean Policy; the Ocean Action Plan (released after the completion of the first IOOS plan); results of the Second IOOS Implementation Conference; the U.S. Integrated Earth Observing System (IEOS) Strategic Plan; reports of the NSTC (Natural Disaster Reduction: A Plan for the Nation, 1996; Grand Challenges for Disaster Reduction, 2005); and guidance from the Ocean.US Executive Committee.

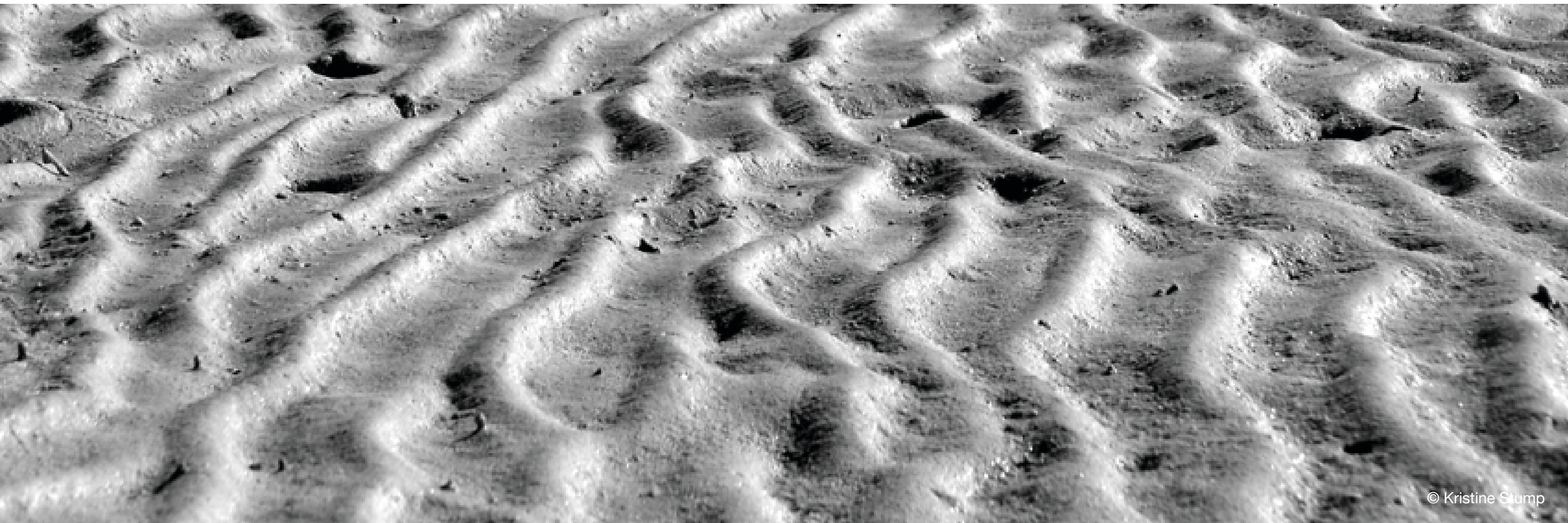
Emphasizing the implementation of the observing subsystem for the National Backbone of the coastal component and the DMAC and modeling subsystems for the IOOS as a whole, recommendations in the IOOS Development Plan: FY 2006 – 2008 plan focus those of the First IOOS Development Plan on to phased implementation of multi-hazard forecasting and mitigation capabilities.

X. The U.S. Investment in the IOOS

The table below represents the present investment in the IOOS, listed by Federal agency. Figures include the costs of all programs, office support, and personnel supporting the IOOS.

Agency	Operations and Pre-operational	Research and Pilot	Total	Notes
EPA	32.17		32.17	
MMS		4.61	4.61	
NASA		93.60	93.60	FY06 Requested
Navy		185.11	185.11	FY06 Requested
NOAA	569.01	169.19	738.21	
NSF		13.62	13.62	
USACE	9.95		9.95	
USCG	5.50		5.50	
USGS	142.53	46.65	189.18	Additional federal funds of $25.70 and non-federal funds of $46.30
TOTALS	$759.17	$512.78	$1,271.95	

Table 6. Total investment in IOOS by agency ($millions)



XI. Looking Ahead

The goal over the next decade is to integrate existing and planned elements to establish an IOOS that meets common research and operational agency requirements for data and information on oceans, coasts and the Great Lakes. As that integration process begins, the focus turns to the development of an “end-to-end” enterprise architecture for IOOS based on a “systems engineering” approach to implement the conceptual design. Such a system calls for collaboration among a number of different sectors: the research/academic community, local, state, and Federal government agencies, the private sector, and non-governmental organizations.

For IOOS to remain at the “cutting edge”, the science, technology, infrastructure, (hardware, software and cyber), and decision support tools must continuously be “refreshed” and processes must be developed to enable and foster that innovation. Ocean.US will continue to develop the IOOS “Concept of Operations” aligned to GEOSS as one of the system component in the Global “system of systems” serving societal needs. As the U.S. component of GOOS and IEOS, the international standards and protocols which have been developed will be taken into account in the design phase so as to “seamlessly integrate” with the global partners. Certain principles such as free and open exchange of data through interoperability will guide the U.S. protocol development.

A priority for 2006 is the establishment of a Modeling and Analysis Steering Team, which will begin by creating a multi-hazard community modeling network. This group will improve existing models for ensemble forecasts of coastal inundation, develop new models for mapping susceptibility (risk) and for better predicting impacts on coastal communities and ecosystems.

For the IOOS to be deemed a success by the American people, it must be demonstrated that it is responsive to user needs whether that customer be a mission (applied) agency, the academic community, a regional manager, a business entity, or the average citizen. As such, it must develop through continuous feedback from the American “customer.” Regional Associations will play an important role in the development of products and services, including the provision of optimal access to and distribution of decision support tools. Regional pilot projects will be implemented and coordinated to demonstrate the utility of observing system information in critical management issues such as coastal inundation and disaster response. Education and training is an important part of the process and Ocean.US will continue to expand its outreach to industry, policy makers, managers and the general public through Regional Industry Days and the production of briefing documents for individual states and regions.

Ocean.US will establish the Certification Criteria necessary for the Regional Associations to become an “official” component of the IOOS. As each of the regional systems currently performs at a different “readiness” level, stages of “maturity” will be defined in terms of technology, networking, operational status and end-user applications and codified in manuals and guidebooks. Ocean.US will work with the Regional Associations to help in the development of annual performance targets and the development of performance metrics to document their success in meeting their objectives of progressing to the next “readiness” level. Performance criteria will include “compliance” metrics for sensors and sampling, data management and communications, modeling and forecasting, and informed decision making. These criteria and metrics will be based on recent national efforts including DMAC and internationally approved standards.

In the following year, results are anticipated from the NOPP research project to examine the ocean science and technology workforce. Projections of future workforce needs will be a start on a long-term effort to strengthen capacity to address ocean observing challenges locally, regionally, nationally, and globally.

Ocean.US also recognizes that the development of the IOOS should be more closely coordinated with similar efforts by other countries, including Canada, Mexico and Caribbean nations. Actions planned include initiating joint planning and implementation activities and the establishment of North America as a GOOS Regional Association.

In order to make the transition from a disconnected series of regional observing systems and associated data management practices to a system which can readily be identified as a national. system, as well as foster a North American Regional GOOS, ensuring sustained funding of the system is critical. Ocean.US will continue refining, validating and verifying the budgetary requirements of a sound fiscal management plan Developing a long term investment strategy that takes into account the changing roles of the sponsoring agencies and partners over time as the system progresses to maturity is essential. Ocean.US will help construct such a profile which reflects the diversity of the funding portfolio so as to ensure a fully operational system of maximum value to the Nation.

APPENDICES

APPENDIX A - IOOS Conceptual Design

The IOOS is being established to routinely and continuously provide data and information required to address seven societal goals: (1) Improve predictions of climate change and weather and their effects on coastal communities and the nation; (2) Improve the safety and efficiency of maritime operations; (3) More effectively mitigate the effects of natural hazards; (4) Improve national and homeland security; (5) Reduce public health risks; (6) More effectively protect and restore healthy coastal ecosystems; and (7) Enable the sustained use of ocean and coastal resources. Achieving these goals requires data and information on the global ocean as well as on the Nation's EEZ, Great Lakes, estuaries, bays, beaches and tidal wetlands.

Conceptually, the IOOS consists of three efficiently linked subsystems: an observing subsystem (*in situ* measurements, remote sensing, and data telemetry), a data management and communications (DMAC) subsystem, and a data analysis and modeling (DAM) subsystem (Figure 1).

DMAC and DAM are integrating tools that cross cut the entire IOOS. The **observing subsystem** (Figure 2) is designed to monitor changes on global, national and regional scales. Global scale observations are the U.S. contribution to the global ocean module of the Global Ocean Observing System (GOOS). National and regional scale measurements are provided by a National Backbone (NB) and Regional Coastal Ocean Observing Systems (RCOOSs), respectively.

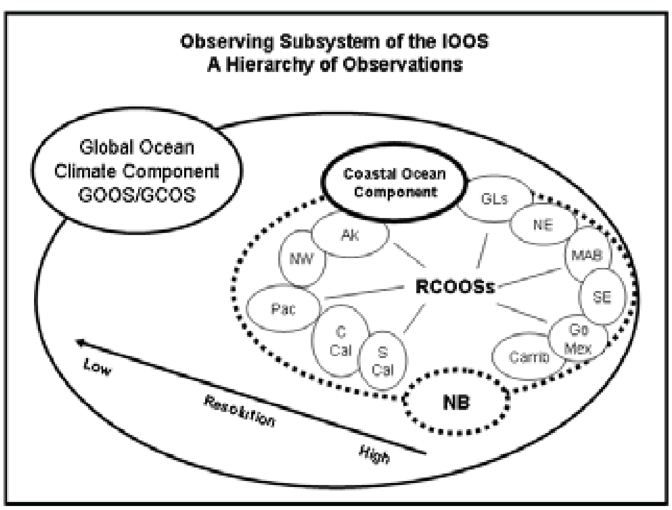
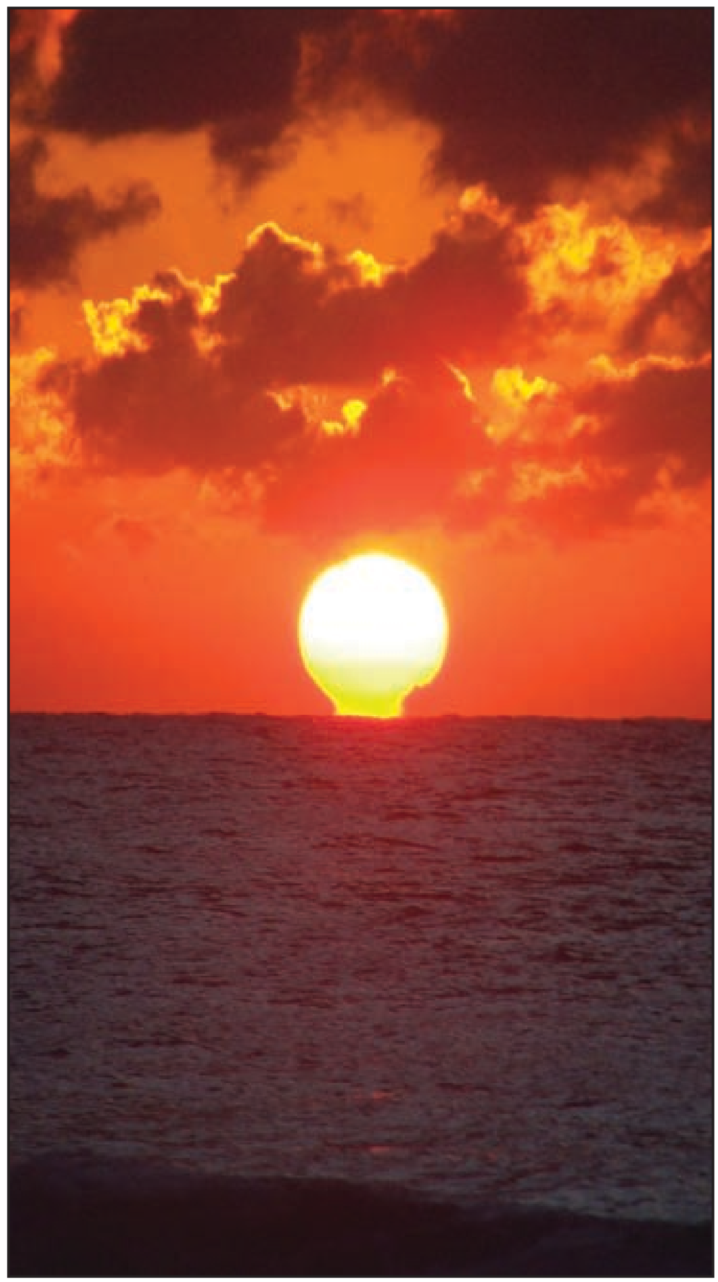


Figure 5. The IOOS is a multi-scale system with observing subsystem elements dedicated to observations of the open ocean (Global Ocean-Climate component) and Nation's coastal waters. The latter consists of a National Backbone (NB) that targets the EEZ (as defined by the U.N. Convention on the Law of the Sea) and Great Lakes and a network of eleven Regional Coastal Ocean Observing Systems (RCOOSs) that enhance the Backbone in the EEZ and Great Lakes and observe near-shore waters (e.g., the Territorial Sea) and semi-enclosed bodies of water (estuaries, bays, tidal wetlands, etc.) within their respective regions
.

Observations on the scale of the ocean basins are needed for predicting and mitigating the effects of changes in climate, weather, and natural hazards on national and regional scales. Regional contrasts in the characteristics of coastal systems and in the data and information needs of user groups require the development of a multi-scale observing system linking changes occurring on global and national scales to more local changes that impact coastal communities, ecosystems and resources (Figure 2). Since data and information needs vary regionally, RCOOSs are critical for using observations on global and national scales to support the provision products and services that are tuned to the needs of user groups within each region (Figure 3). Elements of RCOOSs are currently operational, and Regional Associations (RAs) are developing to coordinate their incorporation into regionally integrated observing systems that will contribute to IOOS development as a whole.



APPENDIX B- IOOS Design Principles

To achieve the IOOS vision, its development must adhere to the following principles:

- Enable user groups from both private and public sectors to achieve their missions and goals more effectively;
- Develop the system with guidance from both data providers and users from public and private sectors that is based on sound science and encompasses a continuum of research to operational activities;
- Judiciously integrate existing assets to provide data and information needed to address the seven societal goals as specified by decision-makers, educators and scientists;
- Improve IOOS operational capabilities by enhancing and supplementing the initial system selectively over time;
- Routinely, reliably, and continuously serve data and information for multiple applications that provide social and economic benefits both to the nation and to a broad spectrum of users from public and private sectors that use, depend on, manage, or study marine and estuarine environments and the natural resources within them;
- Openly and fully share data and information produced at the public expense in a timely manner, at no more than the cost of dissemination;
- All elements of the IOOS must meet federally approved standards and protocols for observations, data telemetry, and DMAC in order to ensure data quality and interoperability;
- Establish procedures to ensure reliable and sustained data streams, to routinely evaluate the performance of the IOOS and assess the value of the information produced, and to improve operational elements of the system as new capabilities become available and user requirements evolve;
- Improve the capacity of all states and regions to contribute to and benefit from the IOOS through training and infrastructure development nationwide; and
- Demonstrate that observing systems, or elements thereof, that are incorporated into the operational IOOS either benefit from being a part of an integrated system or contribute to improving the integrated system in terms of the delivery of new or improved products that serve the needs of user groups.

APPENDIX C - The National Backbone

The IOOS as a whole consists of three closely linked subsystems (Figure 1). The observing subsystem of the IOOS consists of global, National Backbone (NB) and regional and regional elements. The data management (DMAC) and modeling subsystems are the IOOS integrators and cannot (and should not) be "stove piped" specifically to any given observing subsystem element or exclusively to the global ocean component, the NB or to RCOOSs. Thus, the NB is the suite of operational observing subsystem elements that support the following functions:

- Monitor core variables in the nation's EEZ and Great Lakes using both remote sensing and *in situ* measurements;
- Make *In situ* measurements at a sparse network of sentinel sites[1] using federally approved methods;
- Transmit DMAC-compliant data on core variables to national data assembly centers continuously, routinely and reliably (real-time or delayed mode as needed); and
- Link larger scale changes occurring in the oceans and on land to changes occurring within the regions. The sparse network of sentinel sites is designed to provide early warnings of the effects of ocean-basin scale changes (e.g., ENSO events, earth quakes) and land-based inputs (e.g., fresh water runoff and associated inputs nutrients and contaminants) on the coastal ocean.

The First IOOS Development Plan, approved at the Cabinet level by the Interagency Committee on Ocean Science and Resource Management Integration (ICOSRMI) in January 2006, specifies existing operational assets (federal programs) that are the building blocks of the initial observing subsystem for the NB (Appendix B).[2] These initial building blocks represent contributions to the NB in that they contribute to data for functions (1) and (2) above. All of these building blocks were implemented by Federal Agencies to achieve their missions and goals. Integrating data from them represents the value added derived from implementing the coastal component of the IOOS.

The plan also provides a road map for implementing DMAC for the IOOS as a whole. The second IOOS development plan (The IOOS Development Plan: FY 2006-2008) being completed in 2006 prioritizes recommendations in the first plan by focusing on requirements for improving forecasts of coastal inundation and mitigating the ecological and socioeconomic impacts of coastal inundation.[3] The initial NB does not include elements of regional or sub-regional observing systems at this time. This may change with time based on the development of well defined user requirements for data and information that are needed on a national scale.

Phased Development of the NB

The initial NB is a starting point that will evolve and grow over time. It is the cornerstone of the observing subsystem infrastructure for the Nation's EEZ and Great Lakes (Appendix B). As the DMAC subsystem comes into being, the building blocks of the NB will become an integral part of the IOOS with data streams that support the provision of blended products. Evolution of the NB will be driven by user needs and the development of new operational capabilities. Next steps are as follows:

- 2006-2008 – Integrate data streams on core variables to provide new or improved products[4] as the initial DMAC subsystem is implemented and elements of the NB become DMAC compliant;
- 2007-2009 – Begin to incorporate elements of regional and sub-regional observing subsystems into the NB based on user needs and recommendations in IOOS development plans; and
- 2008-2010 – Transition the IOOS into a fully user-driven system as RCOOSs become integral parts of the observing system.

Planning and Implementing the NB

The NB will evolve with time based on data and information needs of user groups and the development of new operational capabilities. IOOS Implementation Conferences provide the primary mechanism for RAs and federal agencies to collaborate on the development of a federally funded NB that meets both national needs and the collective needs of the regions. IOOS Development Plans are based on the results of Implementation Conferences and ongoing input from federal agencies, RAs, and other stakeholders. Development Plans identify the building blocks of the NB that federal agencies have committed to support subject to the availability of funds. IOOS Implementation Conferences are held during the spring every two years, and IOOS Development Plans are revised and updated following each conference. These plans are then used by federal agencies and RAs to guide implementation of the NB. Much of the NB will be implemented and operated by Federal Agencies and some by RAs, state agencies, private enterprise, and other qualified bodies via contracts. As the Backbone matures, the diversity of implementing bodies may increase.

APPENDIX D- Funding Model for the Coastal Module

The funding model described below (Figure 3) is intended to provide both long-term stability for regional operations as well as flexibility that reflects regional differences in observing system requirements for both the National Backbone and RCOOSs. Since funding for the global component of the IOOS is not broken down by region, this should be considered a cross-cutting cost that applies to the system as a whole and is not considered here.

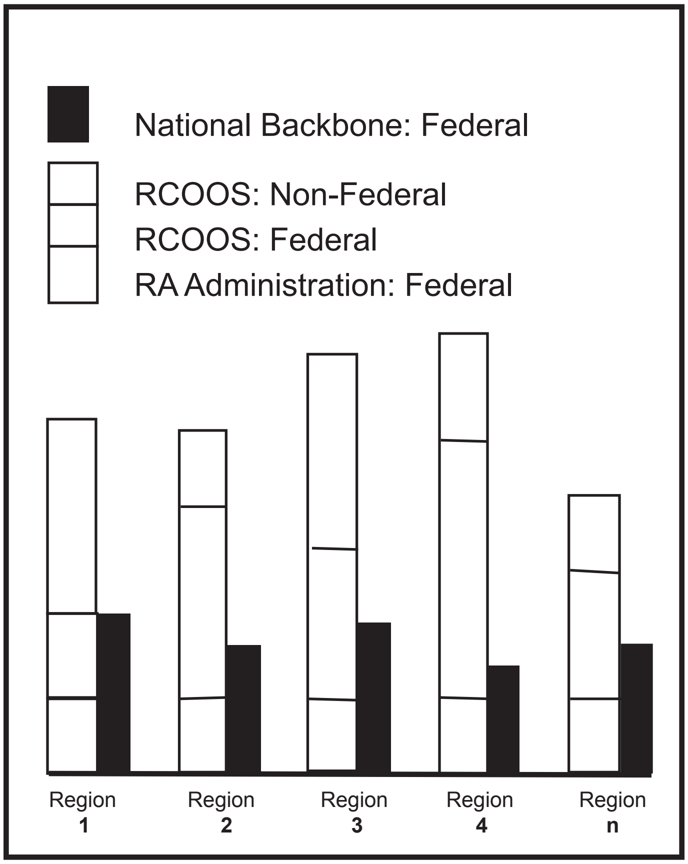


Figure 6. The IOOS funding model for the coastal component includes (1) federal support for the National Backbone (observing subsystem infrastructure) that encompasses all IOOS regions; (2) RA administration (oversight, governance, and management activities); (3) implementing, operating and improving RCOOSs as an integral part of the IOOS (regional observing subsystem infrastructure, DMAC and modeling); and (4) non-federal funding for RCOOSs (regional observing subsystem infrastructure, DMAC and modeling). Currently, eleven regional groups (n = 11) have been funded to establish RAs to oversee the development of eleven RCOOSs.

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In interpreting this simplified conceptualization, the following should be kept in mind:

- It does not include funding for the global component of the IOOS.
- The NB includes elements of the observing subsystem only. The DMAC and modeling subsystems cannot (and should not) be "stove piped" specifically to any given observing subsystem element or exclusively to the global ocean component, the NB or to RCOOSs.
- Although federal agencies are responsible for establishing the NB and will be the primary source support for it, there are and will be exceptions, e.g., the USGS NASQAN Program and the NOAA PORTS Program.
- Elements of the NB may be operated by federal agencies, RAs, state agencies, industries, or other bodies that are certified and conform to national standards and protocols.
- The lines between boxes will be fuzzy to the extent that distinctions are often not black and white, but the exceptions will be small relative to total funding for each category.
- There are additional dimensions that scale funding for research and education (research to improve both the NB and RCOOSs, education networks considered to be part of the NB versus networks that are part of regional development, etc.).

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APPENDIX E - Ocean.US Publications completed

(available at www.ocean.us)

Report No. 1 - Building Consensus: Toward an Integrated and Sustained Ocean Observing System, May 2002

Report No. 2 - An Integrated and Sustained Ocean Observing System for the United States: Design and Implementation, May 2002

Report No. 3 - Regional Ocean Observing Systems, an Ocean.US Summit, March 2003

Report No. 4 - Proceedings of the National IOOS Education Workshop, March 2004

Report No. 5 - Proceedings of the Regional Organization Workshop March 2004

Report No. 6 - Data Management and Communications Plan for Research and Operational Integrated Ocean Observing Systems: Interoperable Data Discovery, Access, and Archive, March 2005

Report No. 7 - Surface Current Mapping in U.S. Coastal Waters: Implementation of a National System, June 2004

Report No. 8 - Proceedings of the First Annual IOOS Development Workshop, August 2004

Report No. 9 - First Integrated Ocean Observing System (IOOS) Development Plan, January 2006

Report No. 11 - Global Ocean Observing System: U.S. National Implementation and Planning Activities and Highlights, April 2005

Report No. 12 - Proceedings of the Second Annual IOOS Development Workshop, May 2005

APPENDIX F - Acronyms

ABI	Advanced Baseline Imager
ACWI	Advisory Committee on Water Information
ADFC	Altimetry Data Fusion Center
AMSR	Advanced Microwave Scanning Radiometer
AOOS	Alaska Ocean Observing System
AVHRR	Advanced Very High Resolution Radiometer
BEACH	Beaches Environmental Assessment and Coastal Health
CaRA	Caribbean Regional Association
CEQ	Council on Environmental Quality
CeNCOOS	Central and Northern California Ocean Observing System
CFDCP	Coastal Field Data Collection Program (of the U.S. Army Corps of Engineers)
C-MAN	Coastal-Marine Automated Network
CNES	Centre National d'Etudes Spatiales
CREI	Coral Reef Ecosystem Investigation
DAM	Data Analysis and Modeling
DART	Deep-Ocean Assessment and Reporting of Tsunamis
DBCP	Data Buoy Cooperation Panel
DMAC	Data Management and Communications
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
EEZ	Exclusive Economic Zone
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Agency
FerryMon	Ferry-based Monitoring (of Surface Water Quality in North Carolina)
FWIS	Future WMO Information System
FY	Fiscal Year
GCOOS	Gulf (of Mexico) Coastal Ocean Observing System
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GLOS	Great Lakes Observing System
GLOSS	Global Sea Level Observing System
GOES	Geostationary Operational Environmental Satellites
GOOS	Global Ocean Observing System

GSN	Global Seismographic Network
HES	Hyper-spectral Environmental Suite
HF	High Frequency
IEOS	Integrated Earth Observing System
IABP	International Arctic Buoy Program
IPAB	International Program for Antarctic Buoys
ICOSRMI	Interagency Committee on Ocean Science and Resource Management Integration
I-GOOS	Intergovernmental Committee for GOOS
IOC	Intergovernmental Oceanographic Commission
IOCCP	International Ocean Carbon Coordination Project
IOOS	Integrated Ocean Observing System
J-COMM	Joint (Technical) Commission for Oceanography and Marine Meteorology
LMR-ES	Living Marine Resources- Ecosystems Survey
MACOORA	Mid-Atlantic Coastal Ocean Observing Regional Association
MMS	Minerals Management Service
MODIS	Moderate Resolution Imaging Spectroradiometer
NANOOS	Northwest Association of Networked Ocean Observing Systems
NASA	National Aeronautics and Space Administration
NASQAN	National Stream Quality Accounting Network
NAWQA	National Water Quality Assessment Program
NB	National Backbone
NCAP	National Coastal Assessment Partnership
NCDC	NOAA/National Climatic Data Center
NCDDC	NOAA/National Coastal Data Development Center
NDBC	NOAA/National Data Buoy Center
NERA	NorthEast Regional Association
NERRS	National Estuarine Research Reserve System
NESDIS	NOAA/National Environmental Satellite, Data, and Information Service
NFRA	National federation of Regional Associations
NMDMP	National Marine Debris Monitoring Program
NMN	National (Water Quality) Monitoring Network
NOAA	National Oceanic and Atmospheric Administration
NOPP	National Oceanographic Partnership Program
NORLC	National Ocean Research Leadership Council
NSF	National Science Foundation

NSIP	National Streamflow Information Program
NSQAN	National Stream Quality Accounting Network
NSTC	National Science and Technology Council
NWLON	National Water Level Observations Network
ORION	Ocean Research Interactive Observatory Networks
OS	Observing System
OSTM	Ocean Surface Topography Mission
PacIOOS	Pacific Islands Integrated Ocean Observing System
POES	Polar Operational Environmental Satellites
POGO	Partnership for Observations of the Global Ocean
PORTS	Physical Oceanographic Real-Time System
QuikSCAT	Quick Scatterometer
RA	Regional Association
RCOOS	Regional Coastal Ocean Observing System
SALMON	Sea-Air-Land Modeling and Observing Network
SAR	Synthetic Aperture Radar
SCCOOS	Southern California Coastal Ocean Observing System
SECOORA	SouthEast Coastal Ocean Observing Regional Association
SEAKEYS	Sustained Ecological Research Related to Management of the Florida Keys Seascape
SeaWiFS	Sea-viewing Wide Field-of-view Sensor
SITES	Sustained Interdisciplinary Time Series Environmental Observation System
SOT	Ship Observations Team
SSM/I	Special Sensor Microwave Imager
TMI	TRMM Microwave Imager
TRMM	Tropical Rainfall Measuring Mission
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USGS	United States Geological Survey
VOS	Volunteer Observing Ship
WindSAT	(Satellite-based Wind Speed and Direction System)
WMO	World Meteorological Organization
XBT	Expendable Bathythermograph