GLOBAL OCEAN OBSERVING SYSTEM
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GLOBAL OCEAN OBSERVING SYSTEM

U.S. NATIONAL IMPLEMENTATION AND PLANNING ACTIVITIES - HIGHLIGHTS

The National Office for
Integrated and Sustained Ocean Observations
Ocean.US Publication No. 11

Country	**U.S.A.**
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Mechanism for national coordination of GOOS	**Executive Committee of Ocean.US, the National Office for Integrated Ocean Observations www.ocean.us**
Membership in GOOS Regional Alliances	**The U.S. encourages the development of all Regional Alliances. US GOOS has been recognized as one Regional Alliance. Because of its geographic situation, the U.S. also especially promotes the activities of IOCARIBE-GOOS and coordinates closely with Canada on both Atlantic and Pacific programs. Pacific Islands GOOS is also a priority.**

"Were it not for the hard work of governments worldwide, we would not be where we are today -- on the cusp of a new era in Earth observations."
Nancy Colleton, Executive Director, Alliance for Earth Observations
March 10, 2005, in testimony before the U.S. House of Representatives Committee on Energy and Commerce Subcommittee on Oversight and Investigations

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1. National contributions to core *in situ* elements of the global observing system

***In situ* observing element**		2003	2004	2005 plans	2006+ plans	2003 total	GOOS goal
DBCP	Surface drifting buoys	751	820	900	900	913	1250
	with barometer	32	32	300	300	84	600
	Sea ice buoys (IABP, IPAB)	17	25	28	31	24	
	Global tropical moored buoy network	55	55	69	71	79	119
	Coastal moorings	83	88	94	95	113	
Ocean SITES	Global reference mooring network	5	5	5	5	6	29
	Total time series sites including above	8	8	8	9	28	58
GLOSS	stations committed to GLOSS	42	24	24	24	233	290
	GLOSS real-time reporting stations	34	19	29	41	95	170
	GLOSS geolocated stations	14	8	10	12	52	170
SOT	High-density XBT lines occupied	11	11	12	17	16	64
	Frequently-repeated XBT lines occupied	4	4	5	6	11	25
	Number of XBTs deployed	9444	11248	13000	14000	18337	23000
	VOS AWS ships	*	*	*	*	80	
	VOSClim ships	12	12	24	36	107	200
	ASAP ships	*	*	*	*	27	
	ASAP sondes deployed	*	*	*	*	5319	
IOCCP	Carbon survey (lines completed since 2001)	2	4	6	7	13	31
	VOS Carbon	8	8	9	10	30	
Argo	Floats operational	474	810	1150	1500	1023	3000
Sustained and repeated ship hydrography lines		*	*	*	*	*	
Data Centers		4	4	4	4	12	

Table 1 - Contributions to GOOS in situ measurements, 2003-2006

Explanatory notes:
2003 figures are for December 2003
2004 figures are for October 2004
2005 and 2006 figures are subject to change based on funding availability
Figures for the moored buoy network do not include buoys jointly maintained in the Atlantic with France and Brazil
*No. undetermined

The First Annual IOOS Development Plan (http://ocean.us/ioosplan.jsp) describes the current U.S. contributions to the global ocean and coastal modules of GOOS.

2. Contributions to Core Satellite Ocean Observations

(** Updates to the 2002 CEOS Handbook)

Sea surface temperature (incl. microwave):

- Present
  - POES AVHRR (NOAA) and GOES Imager (NOAA) provide operational SST observations.
  - MODIS (NASA, NOAA) provides SST data as a developmental data stream.
  - ** The Aqua Atmospheric InfraRed Sounder is used to obtain hyperspectral SST observations
  - ** Microwave sea surface temperature (SST) observations are available from both the TRMM (NASA, NOAA) microwave imager (TMI) and WindSat (NOAA, NASA, DoD).
- Planned
  - VIIRS will provide SST data in conjunction with development on NPP (NASA, NOAA, DoD) and operationally on NPOESS (NOAA, NASA, DoD)
  - ABI will provide SST data when launched on GOES-R (NOAA)

Ocean color/biology:

- Present
  - MODIS (NASA, NOAA) currently provides developmental ocean color observations.
  - SeaWiFS (Commercial - OrbImage, NASA, NOAA) currently provides developmental ocean color data, some of which are used for operational harmful algal bloom detection.
- Planned
  - VIIRS will provide developmental ocean color observations on NPP (NASA, NOAA, DoD) to extend MODIS observations and will provide operational ocean color observations on NPOESS (NOAA, NASA, DoD).
  - ** The GOES-R Hyperspectral Environmental Suite (HES) – Coastal Waters (CW) imaging capability will provide high-resolution ocean color observations (NOAA). The planned launch for GOES-R is in 2012

Ocean topography/currents (high-resolution altimetry):

- Present
  - TOPEX/Poseidon (NASA), currently in a tandem mission with Jason-1, continues its long time series of observations.
  - Jason-1 (NASA), having assumed the original TOPEX/Poseidon ground track, is the source for extending the exact-repeat radar altimetry time series.
  - ** GeoSat Follow-On (GFO) (NOAA, DoD) also provides a continuing source of altimetry data.
- Planned
  - ** NOAA will be partnering to provide Jason-2 satellite altimetry observations (planned launch in 2008) to extend the Jason-1 and TOPES/Poseidon time series (NOAA, NASA).

- ** Plans for NPOESS include an altimeter on at least one platform (NOAA, NASA, DoD).

Surface vector winds:

- Present
    - QuikScat (NASA, NOAA) provides surface vector winds data through scatterometry for operational use.
    - ** WindSat is now providing developmental surface vector winds data using passive polarimetry techniques (NOAA, NASA, DoD).
- Planned
    - CMIS (NOAA, NASA, DoD) will use passive polarimetry to provide operational surface vector winds for NPOESS.

Sea ice cover, edge and thickness:

- Present
    - AVHRR (NOAA) and RadarSat-1 SAR (NOAA, Canada) provide ice cover data.
    - QuikScat (NASA, NOAA) and SSM/I (DoD, NOAA) provide operational ice edge data.
- Planned
    - VIIRS (NOAA, NASA, DoD) will provide ice cover data developmentally on NPP (NASA, NOAA, DoD) and operationally on NPOESS (NOAA, NASA, DoD).
    - ** WindSat is expected to provide observations of ice edge when the algorithms have been developed and validated (NOAA, NASA, DoD).
    - CMIS (NOAA, NASA, DoD) will provide ice edge data operationally on NPOESS (NOAA, NASA, DoD).

3. GOOS Regional Contributions

Section 4, Table 3, summarizes ongoing coastal observing programs that support the US GOOS Regional Alliance. Progress since the last national report has been particularly notable in the organization of US GOOS. Eleven regions of the United States have been identified as potential areas for the establishment of "Regional Associations (RAs)"and the Regional Coastal Ocean Observing Systems (RCOOSs) they will operate. Nascent RAs are currently funded in each region to prepare business and governance plans required to become eligible for sustained funding. Each group is working to identify stakeholders (data providers and users) from all sectors (federal, state, local, and tribal governments; academia; and the private sector) and engage them in the process of creating RAs and developing RCOOSs. High initial priorities are the establishment of an integrating data management and communications system that provides rapid access to diverse data from many sources and ensures interoperability among RAs and GOOS as a whole. At the same time, key members of the eleven regional groups are working to form a "National Federation of Regional Alliances", the NFRA. Development of a mission statement, terms of reference, and by-laws is underway.

For more information, visit http://usnfra.org. For more details on the coastal component of the U.S. Integrated Ocean Observing System (IOOS) see http://ocean.us/ioosplan.jsp.

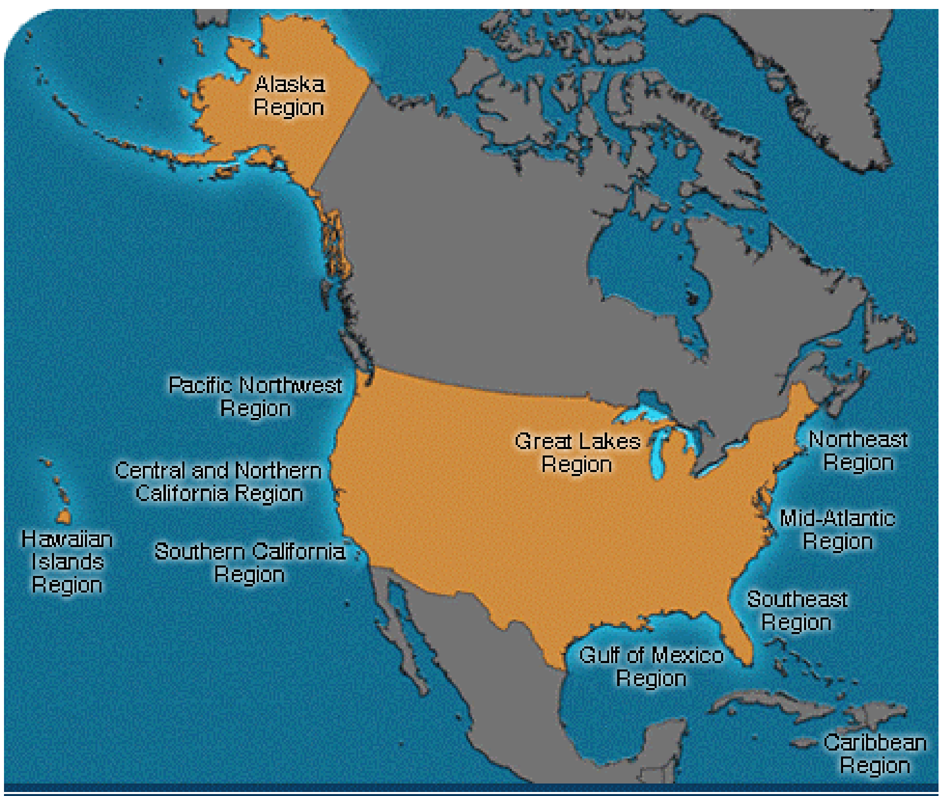

Figure 1. US GOOS Regional Alliance**.**
Regional groups are currently being organized as well as a National Federation of Regional Associations.

In 2004 a national study was completed that outlined potential economic benefits that can be realized by deploying a network of ocean observing systems in U.S. coastal areas. The data indicated that observing systems will have the largest benefits where the information from such systems is used by the largest possible groups. Recreation benefits are consistently the highest generators of benefits because of the very large numbers of people who use beaches, go boating, or enjoy fishing.

User Sector	**Uses**	**Magnitude of potential annual benefits (m$/yr)**	**Areas with greatest expected benefits**
Recreational Activities	Recreational Fishing	100s	Great Lakes, Gulf of Mexico
	Recreational Boating	100s	Great Lakes, Gulf of Mexico, Atlantic
	Beaches/Shore Recreation	100s	Florida, California
Transportation	Transportation-Freight	10s	Florida, Mid Atlantic
	Transportation-Cruise Ships	10s	Florida
Health and Safety	Search & Rescue	10s	All
	Oil Spill Response	10s	All
	Tropical Storm Prediction	10s	Atlantic, Gulf of Mexico
Energy	Electricity Load Planning	10s to 100s	Great Lakes, California, Atlantic
	Ocean Structures	10s	Gulf of Mexico
Commercial Fishing	Commercial Fishing	100s	Alaska, New England

Table 2 - Orders of Magnitude of Possible Economic Benefits from Ocean Observing Systems

4. Other Sustained *in situ* Observations

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The U.S. maintains a large number of monitoring systems for physical, biological, chemical, hydrographic, and marine geological data. The Integrated Ocean Observing System (IOOS), the U.S. contribution to GOOS, is divided into a global component and a coastal component. Tables 3 and 4 below list initial activities comprising each component; additional activities are being added. A few can be highlighted, as illustrations of the U.S. commitment to GOOS:

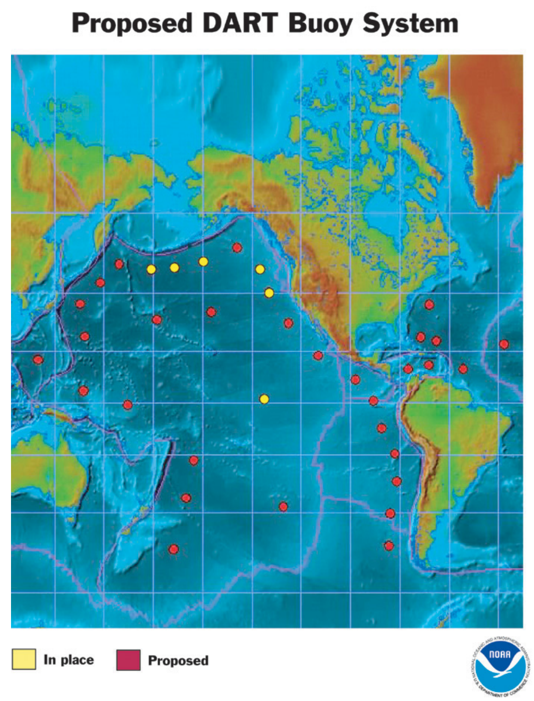


Figure 2. Proposed Buoys for Deep-Ocean Assessment and Reporting of Tsunamis (DART)

The U.S. is working quickly to enhance tsunami warning capabilities in the Pacific and Atlantic Oceans, and the Caribbean Sea, as part of an International Tsunami Warning System. At the recent International Coordination Meeting for the Development of a Tsunami Warning and Mitigation System for the Indian Ocean, the U.S. promoted a detection, forecasting and warning network as a component of an "all hazards" warning system. Such a network should include improved hazard assessment, real-time monitoring, forecasting and warning, rapid responses/remediation, cost-effective mitigation measures, and outreach and education for all relevant communities. The U.S. encouraged partner nations to engage in full and open exchange of publicly-funded, unclassified data, and enhance mechanisms for real-time data sharing, both of which are key principles of the Global Earth Observation System of Systems.

The NOAA Coral Health and Monitoring Program (http://www.coral.noaa.gov/) contributes to the Global Coral Reef Monitoring Network. The U.S. plans to install meteorological and oceanographic monitoring stations at all major U.S. coral reef areas by 2010. These stations consist of a basic suite of sensors, plus additional ones, depending upon local research the stations hope to support, and upon available funding. The basic suite of meteorological and air-based sensors measure air temperature, wind speed and direction, barometric pressure, photosynthetically available radiation (PAR) and ultraviolet radiation (UVR). The basic suite of oceanographic sensors measure salinity, sea temperature, PAR (at 1m nominal) and UVR (at 1m nominal). In addition to these sensors, a data acquisition system gathers and averages the data, then transmits the hourly averages via a GOES satellite to NOAA's National Environmental Satellite, Data and Information Service (NESDIS) data download facility at Wallops Island, Virginia, where the data are then acquired in turn via automated procedures for saving and processing at NOAA's research laboratory in Miami, Florida.

The U.S. (NOAA) contributes maintains two Northwest Atlantic lines to obtain synoptic plankton data using a continuous plankton recorder: between Boston and Nova Scotia and between New York and Bermuda. The U.S. National Science Foundation also contributes to the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) to maintain the Continuous Plankton Recorder (CPR) survey from the North Atlantic and the North Sea on biogeography and ecology of plankton since 1931. The Exxon Valdez Oil Spill Trustee Council contributes to a North Pacific survey. (http://192.171.163.165/index.htm).

Core Variable	NOAA	Navy
Temperature	GOES[a] POES[b] Voluntary observing ships Ships of opportunity Dedicated Ships Moored Buoys (Tropical Array) Drifting Buoy Array Arctic flux & sea ice NWLON[c]	Integrated buoy program Ocean Survey Ships
Salinity	Voluntary observing ships Ships of opportunity Dedicated Ships Drifting Buoy Array Moored Buoys (Tropical Array) Arctic flux & sea ice	Integrated buoy program Ocean Survey Ships
Waves		Geosat[d] Follow-on Ocean Survey Ships Integrated buoy program
Currents, Sea surface topography	Drifting Buoy Array Moored Buoys (Tropical array)	Ocean Survey Ships
Winds	Dedicated Ships Drifting Buoy Array Arctic flux and sea ice Tide Gauge Network	WindSat[e] Integrated buoy program Ocean Survey Ships
Sea Level	Global Sea Level Network, NWLON	Geosat Follow-on

Table 3- Some pre-operational and operational programs of the global ocean component of the initial IOOS, listed by core variable and by the responsible federal agency. From the First Annual IOOS Development Plan (http://ocean.us/ioosplan.jsp)

[a] Geostationary Operational Environmental Satellites
[b] Polar Operational Environmental Satellite
[c] National Water Level Observation Network
[d] Geodetic Satellite
[e] Ocean Surface Vector Winds from Space

Core Variable	NOAA	Navy	USACE	USGS
Sea surface winds	C-MAN[a], NWLON[b] NDBC[c], PORTS®[d], NERRS[e]	Integrated buoy program		
Stream flow				Stream gauging NSIP[f] NSQAN[g]
Temperature	GOES, POES, NDBC, CoastWatch, C-MAN NWLON, PORTS®, LMR-ES[h], NERRS	Integrated buoy program		
Salinity	LMR-ES, PORTS®, NERRS	Integrated buoy program		
Coastal Sea Level-Topography	NWLON, PORTS®	ADFC[i]		NSIP GSN[j]
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			
Chlorophyll	LMR-ES, NERRS			
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	Coral reef mapping & mtrg Coastal change mapping Benthic habitat mapping
Plankton Abndce	LMR & Ecosystem Surveys			

Abundance & distribution of LMRs & protected species	LMR Surveys Ecosystem Surveys Protected Resources Surveys National observer			
Population Statcs[k]	LMR-ES, Nat'l Observer			
Fish Catch	National observer Recreational fisheries Commercial statistics			

Table 4 – Some pre-operational and operational programs of the national backbone of the coastal component of the initial IOOS listed by core variable and by the responsible federal agency. Two are non-ocean variables (winds and stream flows) that are critical drivers of changes in core variable distributions. From the First Annual IOOS Development Plan (http://ocean.us/ioosplan.jsp)

[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]Altimeter Data Fusions Center, [j]Global Seismographic Network, [k]Population statistics = sex, weight, length, and stomach contents of fish species.

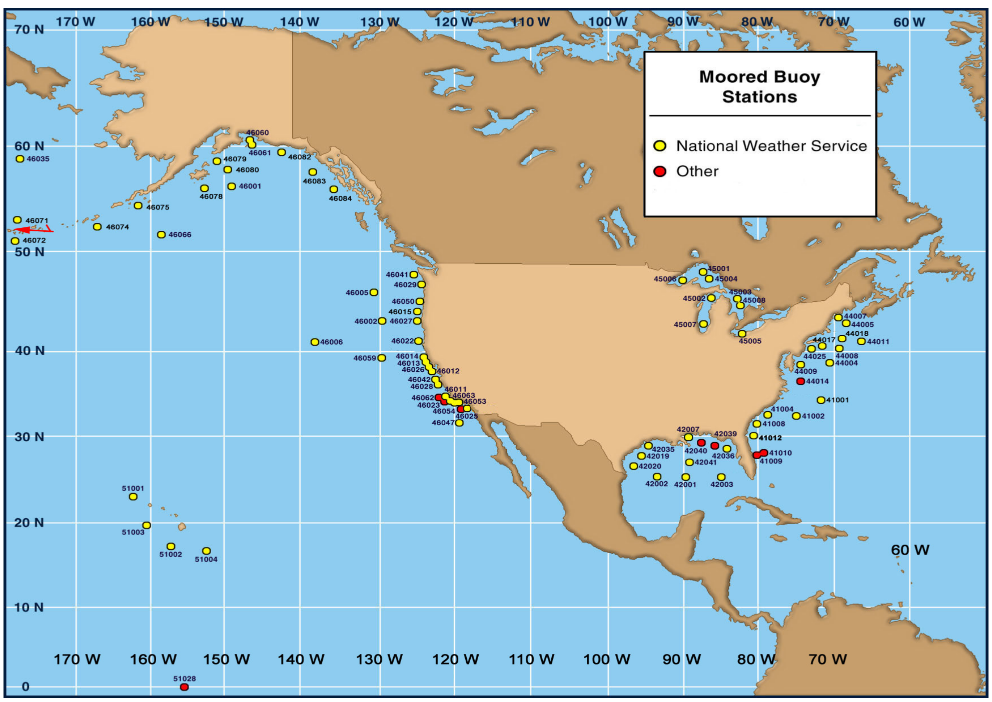


Figure 3. The network of US. National Weather Service buoys, equipped with meteorological sensors for the provision of real-time data critical to weather forecasting, are a high priority for the IOOS backbone.

5. Contributions to GOOS Services and Products and GOOS Synthesis

The U.S. supports a wide variety of GOOS services and products. Examples and some key initiatives are highlighted below.

NOAA supports the Global Observing Systems Information Center (GOSIC) which provides information and facilitates access to data and information produced by GCOS, GOOS and GTOS and their partner programs. GOSIC is a single entry point for users. GOSIC explains the data systems and provides integrating overviews of the programs and on-line access to their data, information and services. GOSIC offers a search capability, across data centers to facilitate access to a worldwide set of observations and derived products. The Center is located at the College of Marine Studies of the University of Delaware. For more information, see http://www.gos.udel.edu.

The Global Ocean Data Assimilation Experiment (GODAE) (http://www.usgodae.org/) is a practical demonstration of near-real-time, global ocean data assimilation that provides, regular, complete descriptions of the temperature, salinity and velocity structures of the ocean in support of operational oceanography, seasonal-to-decadal climate forecasts and analyses, and oceanographic research. The GODAE Monterey Server, sponsored mainly by the Office of Naval Research, is intended to be a principal node in the GODAE architecture. The server contains:

a. Real-time and historical oceanographic observations

b. Real-time and historical surface atmospheric forcing fields from Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC) and NOAA's National Centers for Environmental Prediction (NCEP) suitable for driving GODAE ocean models

c. A full suite of real-time surface and upper-air fields from FNMOC's Navy Operational Global Atmospheric Prediction System (NOGAPS) model sufficient to meet the needs of the Cooperative Opportunity for NCEP Data Using Internet data distribution Technology (CONDUIT) program

d. Selected U.S. Navy operational ocean products

e. Ancillary data sets, such ocean climatology and bathymetry, important to GODAE ocean modeling efforts

f. GODAE demonstration products from various GODAE modeling groups.

GOOS-related products produced by U.S. agencies are too numerous to list. One recent example of a comprehensive report resulting from sustained ocean data is the second National Coastal Condition Report, issued in January 2005 by the Environmental Protection Agency. Assessments of all estuaries in the contiguous 48 states and Puerto Rico are included and are based on four years of coastal data, offshore fisheries data, and human health advisory data. Ecological assessment of the data shows that the nation's coastal waters are in fair condition, with the coastal condition in the Southeast good, Gulf of Mexico and the West fair, the Great Lakes fair to poor and the Northeast and Puerto Rico poor. No overall assessments were completed for Alaska, Hawaii, American Samoa, the Northern Mariana Islands, or the U.S. Virgin Islands, although surveys of Alaska and Hawaii have been completed, samples are being analyzed, and data will be available in 2005.

The U.S. National Oceanographic Data Center (NODC) (http://www.nodc.noaa.gov/) maintains the world's largest unclassified oceanographic data base. Over half of NODC's archived data are obtained through international exchange agreements. NODC operates the World Data Center (WDC) for Oceanography, Silver Spring, under which data exchange agreements are in place with over 40 countries engaged in marine research. Data submitted to the WDC that are amenable to processing and incorporation into NODC's data files thus become part of NODC's global data bank. The NODC also actively participates in the Global Temperature Salinity Profile Program (GTSPP), one of seven countries maintaining a continuously managed data base (http://www.nodc.noaa.gov/GTSPP/gtspp-home.html). The U.S. NODC performs four functions for the GTSPP:

a. Maintains the global database of temperature and salinity data and provides online access to the data.

b. Adds real-time data supplied by MEDS to the database.

c. Processes delayed mode copies of data by performing the same data quality tests as MEDS, then adds data to the database.

d. Prepares monthly data sets and transfers them by network to participants in the U.S., Australia and France, as well as to requestors.

Two U.S. science centers participate in the program by independently evaluating the delayed-mode data sets for the Indian, Pacific, and Atlantic Oceans: the Scripps Institution of Oceanography for Pacific data and NOAA's Atlantic Oceanographic & Meteorological Laboratory for Atlantic data.

The cornerstone of the Integrated Ocean Observing System is Data Management and Communications (DMAC) (http://dmac.ocean.us/index.jsp). The completed plan addresses issues of interoperability and data discovery, data access, and archival. Table 5 lists present activities included.

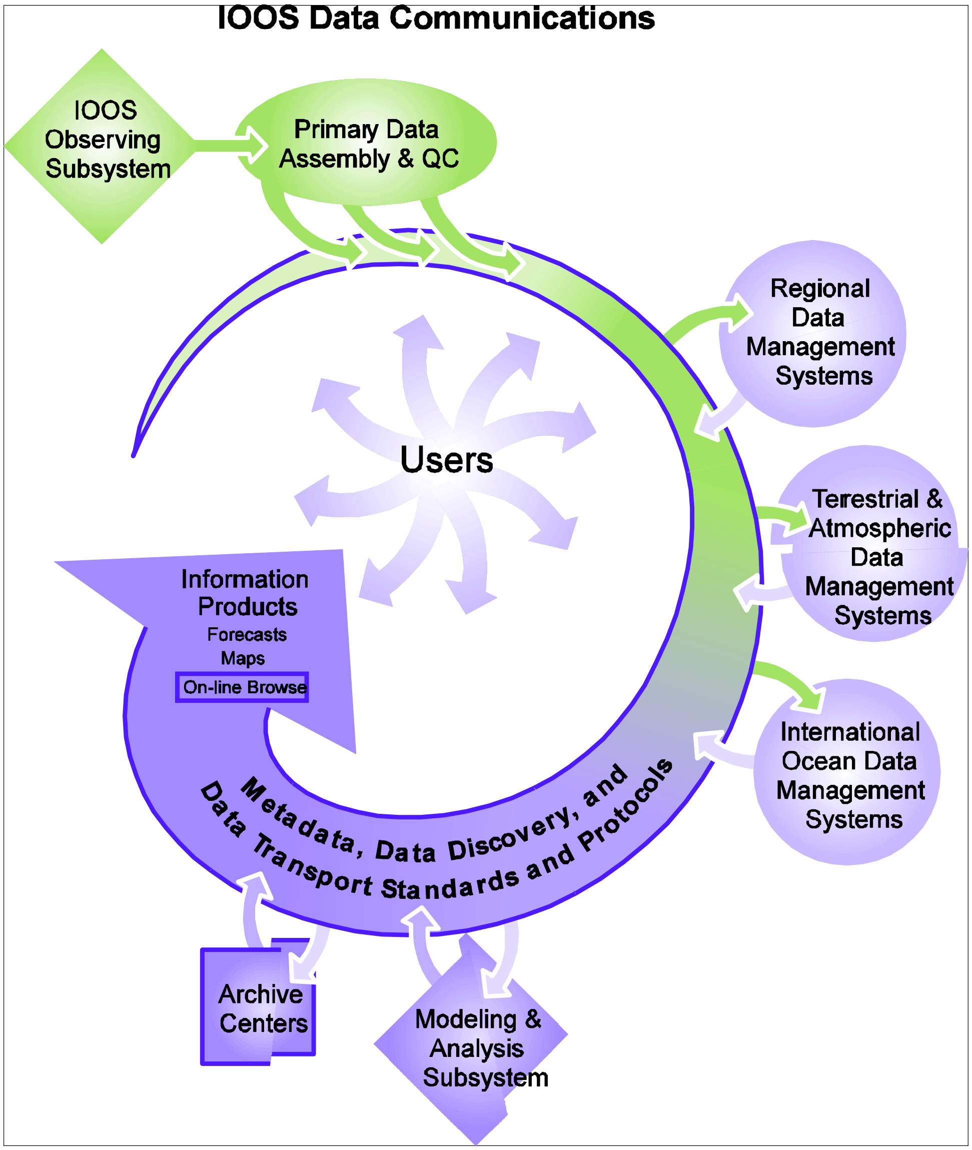


Figure 4. Schematic of the DMAC subsystem of the IOOS. Solid outlines indicate the elements of the IOOS Data Communications framework, detailed in the DMAC Implementation Plan (http://dmac.ocean.us/index.jsp).

The arrows flowing outward from the users indicate the feedback and control mechanisms through which users ultimately direct the functioning of all parts of the system.
Note that the National Data Management Systems are included in the concept of Primary Data Assembly and Quality Control.

DMAC Component	Existing Element	Sponsoring Agency	URL
Metadata	FGDC[a] and GOS[b]	USGS	http://www.fgdc.gov/metadata/metadata.html http://www.geo-one-stop.gov/index.html
Data Discovery	GCMD[c] NCDDC[d] CSC[e]	NASA NOAA	http://gcmd.gsfc.nasa.gov/ http://www.ncddc.noaa.gov http://www.csc.noaa.gov
Data Transport	OPeNDAP[f] Enterprise GIS	Navy, NASA, NOAA, NSF NOAA, Navy, USGS, EPA	http://www.unidata.ucar.edu/packages/dods/ http://www.opengeospatial.org/
On-Line Browse	LAS[g] Enterprise GIS	Navy, NOAA, NASA NOAA, Navy, USGS, EPA	http://www.feret.noaa.gov/LAS/ http://www.opengeospatial.org/
Data Archive	NSF[h]	NOAA, DOE	http://www.nsf.gov/pubsys/ods/getpub.cfm?ods_key=nsf94126
Data Comm'ns	GTS[i]	WMO and NOAA	http://www.wmo.ch/web/www/TEM/gts.html

Table 5 - Candidate standards and protocols-related activities identified in the DMAC Plan

[a] Federal Geographic Data Committee: The FGDC steering committee is composed of representatives from nineteen Cabinet level and independent federal agencies including: Department of Commerce, Department of the Interior, Department of Defense, NSF, NASA, EPA, Department of Transportation, Department of Energy (DOE), Department of Agriculture. Funding for FGDC is appropriated through Department of the Interior/USGS.

[b] The Geospatial One-Stop (GOS) is sponsored by the OMB to streamline access to geospatial information for users. Both GOS and FGDC support the National Spatial Data Infrastructure (NSDI) and the E-Government initiative. NSDI focuses on the technologies, policies, and people necessary to promote sharing of geospatial data. E-Government emphasizes the use of Internet-based technology to simplify interactions with the Government.

[c] NASA Global Change Master Directory

[d] NOAA National Coastal Data Development Center

[e] NOAA Coastal Services Center

[f] Open Source Project for a Network Data Access Protocol

[g] Live Access Server

[h] The NSF policy statement is under revision.

[i] The Global Telecommunications System (GTS) is the worldwide terrestrial satellite telecommunications network that serves data to WMO member nations for forecast operations under the international World Weather Watch.

The WMO has committed to a single coordinated, distributed data distribution and dissemination global infrastructure, the Future WMO Information System (FWIS). FWIS will be used for the collection and sharing of data and information for all WMO and related international programs. FWIS will build on the present GTS. The FWIS and the IOOS DMAC face common data management and communications challenges. Progress made by the U.S. on interoperability-enabling data management policies and standards was shared with the Geneva meeting of the WMO Inter-Commission Coordination Group on the Future WMO Information System. Agreement was reached to continue close U.S. collaboration with the FWIS standards process and to participate on the FWIS metadata standards expert team.

The U.S. is one of four co-chairs of the Group on Earth Observations for the Global Earth Observation System of Systems (GEOSS) established in 2003. GOOS is the ocean component of the GEOSS, which is an effort to link the world's networks of surface, airborne and space-based Earth-observing instruments currently scattered around the globe, with the goal of providing the data needed for more accurate forecasts of natural disasters, better management of water and energy resources, and improved monitoring of public health, among many other potential benefits. In February 2005 nearly 60 countries and the European Commission agreed to a 10-year implementation plan.

The first Earth Observation Summit was held July 31, 2003, in Washington, D.C., and interest has accelerated since the recent tsunami tragedy devastated parts of Asia and Africa. "By adopting an implementation plan for the GEOSS, we have accomplished the first phase of realizing our goal of developing a comprehensive, integrated and sustained Earth Observation System so that the world can better predict weather and climate, prepare for natural hazards and protect people and property," said U.S. Commerce Secretary Carlos M. Gutierrez, head of the U.S. Delegation to Earth Observation Summit III.

The U.S. is increasing the involvement of the private sector. In conjunction with the Third Earth Observations Summit in 2005, an Earth Observation Industry Summit was held with European and U.S. private sector representatives discussing the role of industry in the development and use of Earth observations. An Alliance for Earth Observations has been formed as a publicly and privately funded initiative of the nonprofit Institute for Global Environmental Strategies to strengthen the role of the private sector -- industry, academia and non-government organizations -- in Earth observations. In March 2005 an IOOS Industry Day was held to provide information on Federal plans to design, develop, fabricate, install and operate the Integrated Ocean Observing System. All interested parties were invited to provide input, ideas, concepts and suggestions toward ensuring effective IOOS development.

6. Research Activities Contributing to GOOS

Design and implementation of the IOOS is based on sound science. One initiative that particularly complements the IOOS is the Ocean Observatories Initiative (OOI) of the National Science Foundation (http://www.orionprogram.org/). The OOI will enable constructive and timely synergy between research, modeling and monitoring, ensuring access for the research community to the basic infrastructure required to make sustained, long-term and adaptive measurements in the ocean. The OOI is an outgrowth of several years of community-wide scientific planning efforts, both nationally and internationally. OOI builds upon recent technological advances, experience with existing observatories, and is underpinned by several successful pilot and testbed projects. As these efforts mature, the research-focused observatories enabled by the OOI will be networked, becoming an integral part of the IOOS.

	Integrated Ocean Observing System (IOOS)	**Ocean Observing Initiative (OOI)**
NEEDS	Driven by societal needs and must routinely and continuously deliver data and data products of known quality to decision makers.	Governed by the needs of the research community and will be responsive to the demands of scientists.
SENSORS	Will depend on highly reliable sensors and data telemetry to ensure that critical data streams are not interrupted,	Will provide the motivation and capability to try out new sensors that may eventually be adopted by the IOOS system once their reliability for routine operation is established.
MODELS	Will rely on proven operational models for making predictions with known levels of uncertainty.	Will rely on research models to better understand fundamental interactions and dynamics and to design / adapt new observing strategies which may be adopted by IOOS.
COVERAGE	Will employ a diverse mix of platforms including satellites, aircraft, drifters, floats, moorings, gliders and land based remote sensing such as HF radar, to enable a hierarchy of observations on global to local scales, with regional associations covering the 10 distinct US coastal regions.	Comprised of a global array of ~20 moorings, a cabled regional observatory network on the Juan de Fuca plate, and a large coastal array, all of which will focus on specific processes of interest

Table 6 - Complementary Capabilities between the IOOS and the OOI

Since 1997 the National Oceanographic Partnership Program (NOPP) has funded 93 projects at a cost of over $150M. An average project lasts three years. Subject areas include operational/routine observations, research observatories, observational technique development, a “commons” for ocean information, and outreach/education. The primary purpose of NOPP is to promote partnerships among Federal agencies and with other sectors including academia, industry, and non-governmental organizations. Annual funding has increased significantly since the program’s inception. Part II of the IOOS Development Plan (http://www.ocean.us/ioosplan.jsp) contains a complete listing of NOPP projects that directly support the IOOS.

Innumerable ongoing research programs are essential to the integrity of the IOOS. An example is the Long-Term Ecological Research (LTER) Network, a collaborative effort involving more than 1800 scientists and students investigating ecological processes over long temporal and broad spatial scales. The Network promotes synthesis and comparative research across sites and ecosystems and among other related national and international research programs. The National Science Foundation established the LTER program in 1980 to support research on long-term ecological phenomena in the United States. The 26 LTER Sites represent diverse ecosystems and research emphases.

7. Training, Education, and Mutual Assistance for GOOS

In 2000, the U.S. Congress established the Commission on Ocean Policy. Public hearings were held throughout the country to gather information. A thorough report, "An Ocean Blueprint for the 21st Century", was issued in September 2004 (http://www.oceancommission.gov/), which contains over 200 recommendations. This report strongly emphasizes the importance of education and recommends strengthening ocean education programs to provide better ocean stewardship.

In December 2004 the Bush Administration issued a response in the form of a U.S. Ocean Action Plan (http://www.pub.whitehouse.gov/uri-res/I2R?urn:pdi://oma.eop.gov.us/1998/6/16/5.text.1). This document calls for the U.S. to play a lead role in "an integrated, comprehensive, and sustained global earth observing system of systems that includes a substantial ocean component, known as the Global Ocean Observing System (GOOS)." Ocean research and education are also emphasized. For example, the Plan calls for U.S. leadership in building capacity in key countries for installing and operating tide gauges for IOC's Global Sea Level Observing System (GLOSS). The document also establishes a process for coordinating and expanding the sharing of U.S. ocean expertise with other countries.

At then national/regional level an implementation plan is being finalized for developing education, training, and public awareness networks that will:

1. Enhance the supply of science and technology professionals essential to the nation's economic prosperity
2. Enhance lifelong science and technology learning with an improved understanding of the ocean's role in man's life support system
3. Provided the educated and skilled workforce needed by ocean observing systems and allied enterprises

Research institutions within regions and networks of research institutions nation-wide function as incubators for the development of new technologies and knowledge that will enable and improve regional observing systems and the IOOS as a whole. To this end, NOAA has established the Coastal Observation Technology System (COTS). Goals are to build regional and national capacity by (1) supporting the research and development required to create infrastructure (e.g., sensors, data telemetry) and methods for collecting, sharing, and integrating data (data management and communications) and (2) developing regional associations required to design, implement, operate and improve regional coastal ocean observing systems.

8. Impediments to Progress

During this intercessional period, some previous impediments have been reduced, notably a historic lack of attention to ocean issues. This success has largely been due to the work of the U.S. Commission on Ocean Policy, described in the above section. The conclusions and recommendations of the Commission are provocative, eliciting widespread interest and visibility. Nevertheless, the large amounts of new funding required for the IOOS are expected to remain difficult to obtain due to competing national priorities and budget pressures.

Progress toward full implementation of the IOOS and coordination among Federal agencies is being fostered at a greater rate due to the establishment of Ocean.US, a national focal point, described below. The approval of the *First Annual IOOS Development Plan* by the Ocean.US Executive Committee (EXCOM) was the culmination of several years' efforts. Ocean.US staff worked with the federal agencies to identify observing programs to be considered as a part of the IOOS National Backbone. With that information and the identification of both regional and agency priorities for improving the National Backbone, a draft of the plan was developed and circulated to the regional groups and federal agencies. Enhancements to the National Backbone were one of the foci of the First Annual IOOS Implementation Conference in 2004 that resulted in development of consensus on the enhancements and the approval of the final plan. At that conference, the Federal agencies agreed, in part, to support the development of the RAs and NFRA and to use recommendations from the conference for FY07 and beyond to guide agency-specific contributions to establishing the IOOS. The conference also considered a list of priority research areas needed to address gaps in the technology needed for the IOOS and to develop better data products for use by stakeholders.

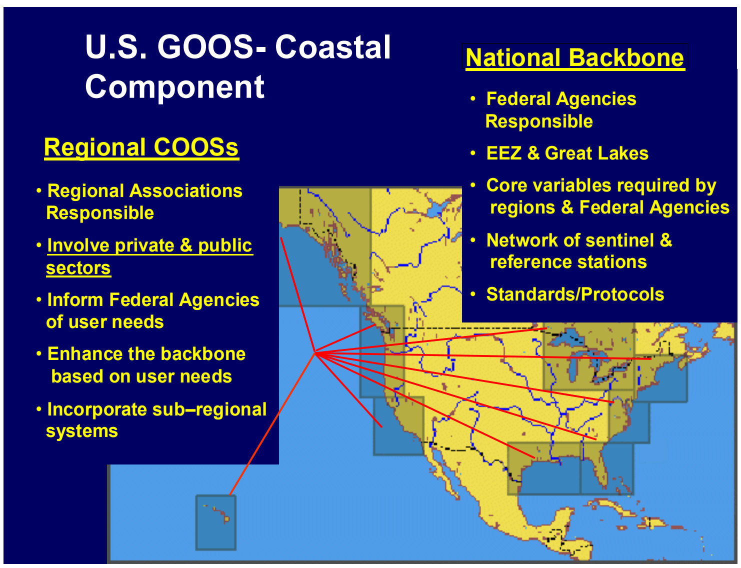
9. Indications of Financial Contribution to GOOS

a. Investment in national activities – an extensive effort has been made within the past year to document the initial IOOS, as described in the above sections, and to estimate the present investment. Annual Federal expenditures for IOOS activities total to approximately $750M. Of this investment, 12% is for Data Management and Communications, 5% is for Education activities. One-quarter is committed to the IOOS global component; three-quarters is assigned to the coastal component.

b. Investment in national coordination - the Ocean.US Office, the National Office for Sustained and Integrated Ocean Observations, has an annual budget of approximately $2M, including 12 staff. This Office does not fund projects but facilitates cooperation and collaboration among its nine sponsoring Federal agencies in the joint effort to implement the IOOS.

The U.S. GOOS Steering Committee (http://ocean.tamu.edu/GOOS/sw.html) is composed of representatives from academia, industry, government, and environmental organizations providing regular guidance for the IOOS. Linkages to international activities are facilitated by several Committee members who lead GOOS planning and implementation activities.

c. Investment in international coordination - international (GOOS) coordination is a responsibility of the Ocean.US Office. The Director of Ocean.US is the U.S. Representative to the Intergovernmental Committee on GOOS.



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