SUMMARY OF U.S. REGIONAL OCEAN OBSERVING SYSTEMS AND PLANS
February 2003*

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I. Preface

The following summary is a synthesis of reports provided to the Ocean.US Office by groups who are currently undertaking, or plan to undertake, ocean observing activities in coastal U.S. areas. This document has been prepared as background material for the national effort underway to create a formal structure for the development and operation of regional observing systems.

II. Overview

A National Federation of Regional Associations (RAs), guided by national and regional priorities, is being established to oversee the development of regional observing systems for the provision of data and data-products tailored to the requirements of an increasing number of user groups in each of their respective regions. Enhancements will include increases in the time-space resolution of variables measured as part of the National Observing Network, as increases in the number of variables measured, or both. The National Observing Network will be implemented and operated by federal agencies, federally funded operational centers, and RAs as appropriate. RAs, composed of representatives from both data providers (scientists and technicians) and users groups, will be responsible for the design and implementation of regional observing in accordance with guidelines promulgated by Ocean.US; these Associations will help guide the development of the National Observing Network through the National Federation.

* Regional categorizations of some programs may be ambiguous. Classifications are used only as indicators of general geographic location.

While the current focus is on efforts already underway in particular regions, it is important to note that most, if not all, of these efforts depend on the maintenance or expansion of nation-wide continuous physical ocean measurement activities such as the Marine Observation Network (a variety of real-time data acquisition platforms including coastal buoys and voluntary observing ships), the Physical Oceanographic Real-Time Systems (PORTS), and the National Water Level Observation Network of tide gauges. In addition, programs such as the National Estuarine Reserve System's System-Wide Monitoring Program, the Coral Reef Early Warning System, and the National Water-Quality Assessment Program should be thoroughly incorporated and leveraged.

Not described here are the many sub-regional systems that are spatially more intensive and cover relatively small geographic areas. These systems are largely estuarine and retain their own identity and sets of user groups. Each region is responsible for maintaining coordination, as needed, among the groups operating these systems. In addition, the technologies and communications networks that need to be fostered in order to integrate components and reliably transmit, distribute and manage the unprecedented amounts of data that will be collected are not addressed here. The bulk of this work is to be undertaken by industry partners in the National Federation.

III. Present Regional Observing Systems

Arguably there are only two of ten regions[†] that have portions covered by formalized systems now disseminating products: the Gulf of Maine Ocean Observing System and the Gulf of Alaska Ecosystem Monitoring Program.

A. Gulf of Maine Ocean Observing System, Inc. (GoMOOS): a (non-profit) sub-regional system covering an area from the Bay of Fundy to the Massachusetts Bays. GoMOOS includes a system of buoys and shore-based radar transmitting data in near real-time both above and below the ocean surface for a wide range of user groups. An economics study in 2001 examined five sectors that could benefit from GoMOOS: maritime transportation, commercial fishing, recreational fishing and boating, search and rescue operations, and pollution management (e.g., oil spill response). Economists estimated the potential annual benefits of GoMOOS to be over $33M per year.

Contact: Philip Bogden, CEO, bogden@gomoos.org
www.gomoos.org

B. Gulf (of Alaska) Ecosystem Monitoring and Research Program (GEM): Funded by an endowment from *Exxon Valdez* oil spill settlement funds, GEM is a core monitoring program supplemented by ongoing activities and research efforts to improve understanding of the physical and biological components of the Gulf of Alaska ecosystems and habitats.

Contact: Philip Mundy, Science Director, Exxon Valdez Oil Spill Trustee Council
Phil_mundy@oilspill.state.ak.us; www.oilspill.state.ak.us/gem

[†] For purposes of this paper ten regions are defined. Draft Ocean.US plans define regions a bit differently, as follows: The Great Lakes; the Gulfs of Alaska, Maine, and Mexico; the Southern California, Middle Atlantic, and South Atlantic Bights; the Pacific NW; and Hawaii and the Pacific Territories.

IV. Coastal Observation Technology System

The Coastal Observation Technology System (COTS) is an alliance of programs located along the Pacific, Gulf of Mexico, and south and north Atlantic coasts that focus on coastal ocean observation, research, technology and prediction. The COTS project grants, directed by Congress and funded by NOAA, are designed to further the development of integrated coastal ocean observing systems on a regional basis. These projects are listed elsewhere in this summary in their respective regions.

COTS participants are utilizing data standards, protocols, and guidelines that will allow coastal researchers from different disciplines and areas of the country to greatly increase their effectiveness as they combine and share their knowledge, expertise and data. Partners will be able to share information on techniques and methods they are employing, and work to create a seamless flows of data, information and products. Interoperability will be the primary goal as the COTS partners strive to create a model of integrated observing systems that will serve to advance the national agenda as well address regional needs.

NOAA's Coastal Services Center serves as the lead federal coordinating partner for the COTS awards and strives to facilitate information exchange among the COTS partners, Ocean.US, and other regional observing systems. Learn more about the Coastal Observation Technology System at www.csc.noaa.gov/cots.

The Coastal Observation Technology System (COTS) project grants are designed to further the development of integrated coastal ocean observing systems on a regional basis. COTS will focus on creating an environment to share data and information collected by, and technology useful to, coastal observing systems. Partners will be able to share information on techniques and methods they are employing, and work to create a seamless flows of data, information and products. Interoperability will be the primary goal as the COTS partners strive to create a model of integrated observing systems that will serve to advance the national agenda as well address regional needs.

The COTS project consists of seven grants from Congressionally-directed funds, with five of the seven being administered by NOS, and two by OAR. The grantees have formed a federation that may serve as a model for the larger Integrated Ocean Observing System (IOOS) effort. The federation has agreed to focus initially on data management, and it will work as a unit to ensure that national data standards and protocols are followed. NOAA's Coastal Services Center will serve as the lead federal coordinating partner and will provide a website for communication among the seven separate projects. Partners will be able to share information on the techniques and methods they are employing, and to work to create a seamless flow of data, information and products. Depending on project needs, possible additions to the COTS website may include a bulletin board, data portal and metadata node. COTS may also serve as a model for data management in the IOOS effort, and discussions with IOOS Data and Communications Sub-Committee (DACSC) members indicate a mutual willingness to develop a plan to move forward. The Coastal Services Center will also provide additional leadership for the federation, including facilitating communications, reporting and workshops as

necessary. To date, two workshops have been convened, including 1) an organizational meeting for principal investigators, held in Washington, D.C.; and 2) a focused data management workshop for project scientists and information technology specialists, held in Charleston, SC.

V. Other Present and Planned Activities - Northeast Region

A. Southern New England Bight: Under development (Steering Committee formed); to be coordinated with GoMOOS, LEO 15 and the larger Northeast Ocean Observing System.
Contact: Malcolm Spaulding, University of Rhode Island,
Spaulding@oce.uri.edu,

B. Martha's Vineyard Coastal Observatory: Meteorological and sub-surface measurements; shore lab transmitting data in real-time.
Contact: Rocky Geyer, Woods Hole Oceanographic Institution, rgeyer@whoi.edu
http://mvcodata.whoi.edu/cgi-bin/mvco/mvco.cgi

C. Coastal Ocean Observing and Analysis (COOA): The UNH center of excellence will develop and implement new methodologies and approaches for coastal ocean observing across the spectrum from data acquisition, analysis, integration and synthesis. COOA will, as its primary mission, generate new information and understanding. Supporting activities will include model-data assimilation and design of data and information products. COOA is a COTS partner.
Contact: Janet Campbell, University of New Hampshire, janet.campbell@unh.edu
www.cooa.unh.edu

D. **NorthEast Observing System (NEOS):** Formed to coordinate, integrate and seek support for a network of ocean observing systems throughout the northeast. Objectives of NEOS include establishing a network of integrated ocean observing systems, developing uniform approaches for data management that enable diverse users to retrieve and interpret data easily, and fostering collaborative research programs on coastal issues.
Contact: Fred Grassle, Rutgers, The State University of New Jersey,
grassle@ahab.rutgers.edu; http://marine.rutgers.edu/neos

VI. Other Present and Planned Activities - Mid-Atlantic Region

A. New Jersey Coastal Monitoring Network: Three coastal monitoring stations providing real-time observations of shallow water (5m) and meteorological conditions, in addition to and digital photos of the beach.
Contact: M.S. Bruno, Stevens Institute of Technology, mbruno@stevens-tech.edu
www.dl.stevens-tech.edu/davidson/soon.html

B. Chesapeake Bay Observing System (CBOS): Seven buoys reporting in real time; monthly aircraft remote sensing, with plans for additional instrumentation.
Contact: William Boicourt, University of Maryland Center for Environmental Science boicourt@hpl.umces.edu; www.cbos.org

C. Coastal Ocean Research and Monitoring Program (CORMP): The Coastal Ocean Research and Monitoring Program (CORMP) is research program and observing system in the coastal ocean off the Carolinas designed to: 1) improve weather forecasting, 2) predict climate change and related impacts on coastal populations, 3) improve safety and efficiency of marine operations, and 4) sustain healthy coastal ecosystems. CORMP is a COTS partner.
Contact: Marvin Moss, University of North Carolina at Wilmington, mmoss@uncwil.edu; www.uncwil.edu/cmsr/comp

D. Chesapeake Bay Mouth Survey: The bay mouth survey is comprised of a hydrographic section consisting of 20 stations, just inside the mouth of the Chesapeake Bay. Since 1992, these surveys have been performed once per month, at spring high tides. Parameters measured include temperature, salinity, oxygen and various optical properties; nutrient and chlorophyll analysis will soon be added to the survey. Data collected since the inception of the survey is posted to a website.
Contact: Jay Austin, Old Dominion University, jay@ccpo.edu www.ccpo.odu.edu/chesbaymouth.html

VII. Other Present and Planned Activities - Southeast Region

A. Southeast Atlantic Coastal Ocean Observing System (SEA-COOS): An organization established to develop a system for North Carolina, South Carolina, Georgia and Florida that will enhance and integrate existing sub-regional systems such as SABSOON (see below), Caro-COOPS (part of COTS) and others.

B. South Atlantic Bight Synoptic Offshore Observation Network (SABSOON): Instrumented offshore platforms 50-110 km off the Georgia coast.
Contact: Harvey Seim, University of North Carolina, Harvey_seim@unc.edu www.unc.edu/~hseim/shelf/sabsoon/sabsoon.htm

C. South Florida Ocean Measurement Center: Physical oceanographic instruments from mid-Florida to the Bahamas to the Florida Keys.
Contact: Garth Jensen, Naval Surface Warfare Center, JensenGA@swccd.navy.mil; www.sfomc.org

D. Carolinas Coastal Ocean Observing and Predication System (Caro-COOPS): The Carolinas Coastal Ocean Observing and Prediction System (Caro-COOPS) initiative is based upon an instrumented array of coastal and offshore moorings, which are being deployed off of the coast of the Carolinas. The information from this observing system will be used to monitor and model

estuarine and coastal ocean conditions, as well as develop predictive tools and ultimately forecasts for coastal managers. Caro-COOPS is a COTS partner.
Contact: Madilyn Fletcher, University of South Carolina, fletcher@sc.edu
www.carcoops.org

VIII. Other Present and Planned Activities - Caribbean Region

A. Network of Automated Environmental Monitoring Stations (SEAKEYS): Seven satellite-linked stations located in the Florida Keys National Marine Sanctuary.
Contact: John Ogden, Florida Institute of Oceanography,
jogden@seas.marine.usf.edu; http://coral.aoml.noaa.gov/cman

B. Caribbean Coastal Marine Productivity (CARICOMP): A network to monitor long-term variation in ecosystem structure and function in coral reefs, seagrasses and mangroves, involving 18 countries.
Contact: John Ogden, Florida Institute of Oceanography,
jogden@seas.marine.usf.edu; www.ccdc.org.jm/caricomp_main.html

C. Caribbean Community (CARICOM) Network: A sea level and meteorological network at 18 sites with two satellite ground stations.
Contact: George Maul, Florida Institute of Technology, gmaul@fit.edu

D. Intra-Americas Sea Tsunami Warning Network: A planned system for the Caribbean and Western Atlantic coasts.
Contact: George Maul, Florida Institute of Technology, gmaul@fit.edu

IX. Other Present and Planned Activities - Gulf of Mexico Region

A. Texas Automated Buoy System (TABS) and Texas Coastal Ocean Observation Network (TCOON): Current measurement buoys at nine sites and 50 water level platforms.
Contact: Robert Martin, Texas General Land Office, buzz.martin@glo.state.tx.us;
TABS: http://tabs.gerg.tamu.edu/Tglo
TCOON: www.cbi.tamucc.edu/projects/tcoon

B. Harmful Algal Bloom Ocean Observatory: A planned operational activity for monitoring coastal ecosystems.
Contact: Gary Kirkpatrick, Mote Marine Laboratory, gkirkpat@mote.org

C. Coastal Ocean Modeling and Prediction System (COMPS): Offshore buoys, moorings, and fixed platforms from Pensacola Florida to Northwest Florida Bay.
Contact: Mark Luther, USF, luther@seas.marine.usf.edu or Bob Weisberg, USF, Weisberg@marine.usf.edu

http://comps.marine.usf.edu/

D. Wave Current Surge Information System (WAVCIS): The objective of WAVCIS (wave-current information system) is to provide wave information (sea state) including wave height, period, direction of propagation, water level, surge, near surface current speed and direction and meteorological conditions on a real time basis around the entire Louisiana coast. WAVCIS is a COTS partner.
Contact: Greg Stone, Louisiana State University, gagreg@lsu.edu
http://wavcis.csi.lsu.edu

E. Gulf of Mexico Coastal Ocean Observing System (GCOOS): A group of organizations and individuals concerned with sustained observations and/or products and services based on such observations have formed the GCOOS as part of a U.S. Federation of such systems.
Contact: Worth Nowlin, Texas A&M University, wnowlin@tamu.edu
www.gcoos.org

F. Northern Gulf of Mexico Hypoxia Studies. Detailed observations of hypoxia and related physical and biological parameters have been studied at a single mooring in 20 m water depth off Terrebonne Bay, Louisiana since 1989. Measurements include dissolved oxygen, conductivity, temperature at multiple depths, bottom-mounted upward pointing ADCP, selected nutrient experiments. These meters, with increased capabilities of turbidity and in vivo fluorescence, will be merged with the WAVCIS CSI-6 site in 2003 for real-time transfer of hypoxia-related data.
Contact: Nancy N. Rabalais, nrabalais@lumcon.edu

G. LUMCON's Environmental Monitoring Stations: Five fixed platforms located along the coast of Louisiana providing long term meteorological and hydrographic data.
Contact: Mike Dagg mdagg@lumcon.edu; http://weather.lumcon.edu

X. Other Present and Planned Activities - Great Lakes Region

A. Great Lakes Instrumented Ecosystem Initiative: A buoy-mounted observing system platform.
Contact: Val Klump, University of Wisconsin, vklump@uwm.edu

XI. Other Present and Planned Activities - Pacific Northwest Region

The following activities are among those identified as potential contributors to a Pacific Northwest Regional Observing System:

A. Alliance for California Current Ecosystem Observation (ACCEO):
Planned program for observing the entire California current pelagic ecosystem,

building on existing time series such as CalCOFI; will include Mexico and Canada
Contact: John Hunter, Chair, ACCEO, NOAA Southwest Fisheries Science Center, john-hunter@noaa.gov;
http://swfsc.nmfs.noaa.gov/FRI/acceo/acceo1.htm, and
Olympic Region Harmful Algal Bloom
Puget Sound Ambient Monitoring Program
Puget Sound Regional Synthesis Model
Columbia River Estuary Real-Time Observation and Forecasting System
Joint Effort to Monitor the Strait of Jaun de Fuca
Salmon and Steelhead Inventory and Assessment Program

B. Northern California systems: Moored CTDs and biological sensors in San Francisco Bay, monitoring systems in the Gulf of Farallones and Cordell Bank National Marine Sanctuaries, e.g.
Contact: Newell Garfield, San Francisco State University, garfield@sfsu.edu

C. Oregon State University observing systems: A research network of coastal video cameras, a coastal RF system for hourly maps of surface currents, moored arrays of physical and biological sensors, and plans for autonomous vehicle sampling.
Contact: Jack Barth, Oregon State University, barth@coas.oregonstate.edu
Mike Kosro, Oregon State University, kosro@coas.oregonstate.edu

XII. Other Present and Planned Activities – Central California Region

A. Monterey Bay systems: Moorings, sensors, HF radars, integrated sanctuary monitoring, fiber optic cables and multi-disciplinary surveys, with plans for autonomous ocean sampling.
Contact: Francisco Chavez, Monterey Bay Aquarium Research Institute
chfr@mbari.org
Steven R. Ramp, Naval Postgraduate School, sramp@nps.navy.mil

B. Partnership for the Interdisciplinary Study of the Coastal Ocean (PISCO): 5-year research program to increase understanding of west coast marine ecosystems.
Contact: Margaret McManus, University of California at Santa Cruz,
Margaret@es.ucsc.edu, www.piscoweb.org

C. Network for Environmental Observations of the Coastal Ocean (NEOCO): Instrument packages deployed along the coast of California from La Jolla to Bodega Head (700miles).
Contact: Margaret McManus, University of California at Santa Cruz
Margaret@es.ucsc.edu, www.es.ucsc.edu/~neoco

D. Center for Integrated Marine Technologies (CIMT): The proposed CIMT project will combine emerging technological approaches that will allow the determination of the processes underlying dynamics of the coastal upwelling ecosystems along the California coast, and thereby help to establish the scientific basis for the effective monitoring and management of endangered marine mammals and sea turtles, the National Marine Sanctuaries, and fisheries resources of the California Coast and other similar oceanic regimes. CIMT is a COTS partner.
Contact: Gary Griggs, Director, Institute of Marine Science, griggs@cats.ucsc.edu

E. California Center for Integrative Coastal Ocean Research (CI-CORE): The *CSU CI-CORE* program represents an applied coastal research alliance dedicated to the development of nationally relevant solutions to the challenges facing our marine and estuarine environments. CI-CORE was established in 2002 through the NOAA Coastal Observation Technology System (COTS) in partnership with six other institutions/programs nationwide. Unique to CI-CORE's approach to delivering timely, indispensable and appropriate environmental data to the regulatory agencies responsible for coastal management policies will be the development of web-based, geo-referenced time series of environmental observations.
Contact: Kenneth Coale, Moss Landing Marine Laboratories,
coale@mlml.calstate.edu; www.mlml.calstate.edu/cicore

F. Innovative Coastal-Ocean Observing Network (ICON): ICON as established with 2-year funding from NOPP in FY1998 and involved eight partner institutions. ICON's observational array includes many methods of collecting real-time measurements, including both in-situ and remote sensing. Data collected us is used to create predictive models for forecasting ocean conditions for a variety of users.
www.oc.nps.navy.mil/~icon

G. Simulations of Coastal Ocean Physics and Ecosystems (SCOPE): The goal of SCOPE is to model the coastal upwelling ecosystem withing the Monterery Bay National Marine Sanctuary (MBNMS) with high spatial and temporal resolution. The model includes the interconnected physical, chemical and biological processes; it is capable of assimilating data from satellites and in-situ sensors.
www.mbari.org/bog/nopp

H. Sanctuary Integrated Monitoring Network (SIMoN): SIMoN was designed to identify and track natural and human-induced changes to the MBNMS and is a fundamental element in the Sanctuary's conservation and management plan. It's goals include integrating existing Sanctuary monitoring efforts as well as well as initiating new long-term monitoring efforts.
www.mbnms.nos.noaa.gov/research/simon.html

I. **Autonomous Ocean Sampling Network (AOSN):** AOSN is a Navy-funded effort to develop a real-time adaptive and predictive observational/modeling system. The development of the system will be carried out in Monterey Bay and the contiguous waters of the California Current during 2003 and 2004.
http://graham.princeton.edu/~auvlab/aosnii_page/index2.htm

J. Monterey Accelerated Research System (MARS): MARS will deploy an underwater cable in 2005 with power and high bandwidth communication for instrument testing and scientific research in deep ocean waters.

K. Central Coast Environmental Prediction Initiative (CCEPI): CCEPI will plan, coordinate and execute the development of a "natural laboratory" along the Central California coast using and building upon the existing scientific and technical infrastructure.

L. Tagging of Pacific Pelagics (TOPP): The TOPP program is a collaboration of scientists around the world aimed at understanding the migration patterns of large, open-ocean species in the North Pacific Ocean. The microprocessor-based satellite tagging technologies will produce valuable ocean observations as a by-product.
www.toppcensus.org

M. Bodega Marine Laboratory Coastal Observing System: The BML Coastal Observing System continuously monitors meteorological and oceanographic conditions on the Bodega Marine Reserve and adjacent coastal waters. Data sets from the system describe the climatological context for all field studies at the site and are a central element of many research and resource management programs.
Contact: Susan Williams, Bodega Marine Laboratory, slwilliams@ucdavis.edu
www.bml.ucdavis.edu/envdata

XIII. Other Present and Planned Activities - Southern California Region

B. Southern California Coastal Ocean Observing System – a variety of physical , biological, and water quality observations.
Contact: John Orcutt, Scripps Institution of Oceanography, jorcutt@ucsd.edu

XIV. Other Present and Planned Activities - Alaska Region

A. Coastal Alaska Observing System (CAOS): A consortium planning to provide connectivity among existing systems and enhance those activities to form an Alaska regional (or multi-region) observing system; includes Gulf of Alaska/Southeast Alaska, Bering Sea/Aleutian Islands and Arctic.
www.ims.uaf.edu/caos

The following activities are among those identified as potentially contributing to CAOS**:**

1. Sea-Air-Land Modeling and Observing Network (SALMON): A plan to provide continuous real-time or near real-time observations of ocean circulation and ecosystems using HF radar at four sites and two sub-surface bio-physical moorings.
www.ims.uaf.edu:8000/salmon/index.html

2. Deep-ocean Assessment and Reporting of Tsunamis (DART): Six systems utilizing bottom pressure recorders, acoustic links and satellite telemetry.
http://tsunami.pmel.noaa.gov:88/examples/jsp/wavewatcher/wavespan2.jsp

3. Prince William Sound Nowcasting/Forecasting: Currents, tides and meteorological measurements with sampling of nekton and plankton.

4. Gulf Ecosystem Monitoring – (see above)
Contact: Craig Dorman, Chair, University of Alaska,
craig.dorman@alaska.edu

XV. Other Present and Planned Activities - Hawaii and Pacific Islands Region

- Many ongoing observational activities, particularly off the Hawaiian Islands, but not yet coordinated at a regional or sub-regional level.
  Contact: Roger Lukas, University of Hawaii, rlukas@hawaii.edu

APPENDIX

DEFINITIONS

National Federation of Regional Observing Systems – A nationally coordinated union of Regional Associations formed to promote and implement regional observing systems for U.S. coastal waters. Regional observing systems are designed to contribute to and benefit from the National Observing Network by producing and disseminating ocean data and products that benefit the nation and user groups within the respective regions.

National Observing Network – The national system of observations, data management and analysis required to achieve national goals and provide data and information required by all regional observing systems. The Network is also the U.S. contribution to the ocean-climate module of the GOOS.

Operational – An activity in which the provision of needed data streams and data products are routine, guaranteed, and sustained (in perpetuity) at rates and in forms specified by user groups.

Regional Association (RA) – A partnership or consortium responsible for the development, operation and improvement of regional observing systems. An RA consists of representatives of user groups that specify data requirements and products and data providers responsible for the design, implementation, operation and improvement of a regional observing system. See Appendix V for more details.

Regional Observing System – A system linking the needs of users to measurements of the coastal oceans and the Great Lakes on regional or sub-regional scales. Similar to the National Ocean Observing Network, a regional observing system consists of the infrastructure and expertise required to efficiently link all three subsystems. Development, operation and improvement of the system are conducted under the auspices of a Regional Association. The RA's duties include oversight, evaluation, and the development of evolution mechanisms. Such a system will insure the continued and routine flow of data and information, the evolution of a system that adapts to the needs of the user groups, and the development of new technologies and understanding.