GULF OF MEXICO COASTAL OCEAN OBSERVING SYSTEM
REGIONAL ASSOCIATION
BUSINESS PLAN, Version 2
Revised 08/17/05

Table of Contents

Executive Summary........................................................................................................................................... 1
1. Introduction.................................................................................................................................................. 1
2. Goals and Objectives ................................................................................................................................. 4
   2.1 Ultimate goal and objectives................................................................................................................ 4
   2.2 Initial objectives...................................................................................................................................... 4
   3.1 Introduction.......................................................................................................................................... 6
   3.2 Potential Users ..................................................................................................................................... 6
   3.3 Benefits .............................................................................................................................................. 12
   3.4 Linkages and Product Development and Marketing......................................................................... 14
4. Linking Observations to Models and Other Products............................................................................... 15
   4.1 Introduction.......................................................................................................................................... 15
   4.2 Observations and Data Transmission................................................................................................. 19
   4.3 Data Management and Communications .......................................................................................... 22
   4.4 Data Analysis ..................................................................................................................................... 25
5. Research and Development ....................................................................................................................... 26
   5.1 Development Strategy......................................................................................................................... 26
   5.2 Investment Strategy ............................................................................................................................. 28
   5.3 Priorities ............................................................................................................................................. 28
6. Training .................................................................................................................................................... 31
7. Funding ..................................................................................................................................................... 33
   7.1 Budget ............................................................................................................................................... 33
   7.2 Planning and Budget Development .................................................................................................... 33
   7.3 Income .............................................................................................................................................. 38
8. System Performance .................................................................................................................................. 38
   8.1 Maintaining Operational Continuity ................................................................................................. 38
   8.2 User Satisfaction ............................................................................................................................... 39
   8.3 Gap Analysis ....................................................................................................................................... 39
   8.4 Cost/Benefit ....................................................................................................................................... 40
9. References ................................................................................................................................................ 40
Appendix 1: Southern Association of Marine Laboratories (SAML) 2000 .................................................. 41
Appendix 2: For-Profit Groups from the Private Sector................................................................................ 44
Appendix 3: Organizations Represented in Southern Association of Marine Educators......................... 46
Appendix 4: Gulf Restoration Network Membership.................................................................................. 48
Appendix 5: Environmentally concerned organizations in Louisiana....................................................... 49
Executive Summary
Not yet available.

1. Introduction

The Gulf of Mexico Coastal Ocean Observing System (GCOOS) is a System of Systems. It is comprised of many systems (operational elements) operated by separate entities and funded by a variety of sources. Yet to realize maximum benefit, the whole must operate as one so it must be planned, coordinated, and managed as a system. It is the GCOOS Regional Association (GCOOS-RA) that plans, coordinates, and manages the system of systems that is GCOOS.

The GCOOS produces data and products in response to user requirements. These requirements fall within the seven broad objectives of the U.S. Integrated Ocean Observing System (IOOS):

1. Detecting and forecasting oceanic components of climate variability;
2. Facilitating safe and efficient marine operations
3. Ensuring national security
4. Managing resources for sustainable use
5. Preserving and restoring healthy marine ecosystems
6. Predicting and mitigating against coastal hazards; and
7. Ensuring public health.

The role of Regional Associations (RA) in IOOS is to provide oversight in development and operation of the Regional Ocean Observing Systems (ROOS) subject to the philosophy and guidelines developed by Ocean.US and approved by the NORLC. A regional approach was chosen to provide coherent systems over large scales, yet still be responsive to unique local concerns. The RAs will be established to design, implement, operate and improve their ROOS by increasing the resolution at which variables are measured, supplementing the variables measured by the national backbone with additional variables, providing data and information tailored to the requirements of stakeholders in the region, and by implementing programs to improve public awareness and education.

The GCOOS-RA will coordinate to plan for and manage the GCOOS system of systems; it will coordinate/integrate that system with other elements of the IOOS and ocean observing systems of other nations producing data and products relating to the Gulf of Mexico; and it will represent the GCOOS in the National Federation of Regional Associations (NFRA). GCOOS-RA strongly recommends that the Gulf of Mexico Alliance, which is an alliance of the U.S. Gulf States Governors that plans on crafting a coordinated (i.e., among the state governments) response to the U.S. Commission on Ocean Policy final report, coordinate with the U.S. IOOS effort and in particular with the two Regional Associations in the Gulf of Mexico: GCOOS-RA and SECOORA.

The GCOOS-RA will facilitate the production of products; it will not necessarily produce all of the needed products. Many will be produced by the private sector for profit; many will be produced by the federal government or perhaps even by other nations bordering the Gulf of Mexico.
What are the reasons for establishing GCOOS and its RA? That is, what will GCOOS and its RA bring about that would not happen in their absence?

- It will develop user requirements for the region. Thus, it will identify and serve local and regional user requirements that otherwise would not be provided. This will expand system advocates.

- It will enable easy access to data and model outputs that otherwise would not be readily or easily accessible. The operations center will provide a focus for access, user feedback, and correction of difficulties.

- It will ensure that data obtained via the system are based on calibrated/verified instruments, have been quality controlled, and are accompanied by metadata adequate to allow evaluation and reasonable use.

- It will provide a mechanism to coordinate responses to events.

Having an understanding of what GCOOS and its RA can bring to the community of data and product users, we ask "What are the reasons why operators of observing system elements would wish to join GCOOS?"

- It will facilitate distribution of data from system elements to a much wider group of users than otherwise might have access or be willing to search to find the data.

- It will provide additional data to the primary users of data from the elements.

- It will provide standards and protocols for data management that will provide consistency between elements and that will allow ease of access and utilization of data from the elements.

- It will provide a seal of approval to the data and products produced by the participating observing element.

- For real time data, it can provide QA/QC and possible liability protection for data providers.

- It can provide resources for measurement enhancements or maintenance to elements.

- It can provide to the elements information on what enhancements and expansions their users with.

A key component of the IOOS philosophy is that the planning and implementation involve the complete spectrum of stakeholders of the system. The development to date of the GCOOS has attempted to follow this philosophy in an incremental fashion. The initial planning meetings were composed mainly of data/model providers at the federal and local level. These were followed by a series of workshops, beginning with one mainly focused on state agencies, and then proceeded by an IOOS-Industry workshop, a workshop on underpinning research, and an Educational and Outreach Council workshop. Business Plan and Governance working
committees composed of academics, representatives of state and federal agencies, and the private sector have worked to produce draft Governance and Business Plans. The process is culminating in the open Stakeholders Meeting to be held in New Orleans January 24-26, 2005. The entire sequence of meetings with reports is available via the GCOOS web site (http://www.gcoos.org).

The GCOOS-RA will be formed initially by a Memorandum of Agreement (MOA) which dictates a governance structure schematically shown in Figure 1-1.

Figure 1-1. Schematic of the structure of the GCOOS-RA as specified in the GCOOS Memorandum of Agreement.

The Parties to the MOA will elect a GCOOS Board of Directors. As described in the MOA, the Board shall elect an Executive Committee consisting of 5 members led by the Chair. Stakeholder involvement will be formalized through regular meetings of the Parties, the Board of Directors, the Stakeholders Council, and the Educational and Outreach Council. Technical recommendations and decisions will be made by the Committees. The GCOOS Office will provide staff and logistics support to this structure. The composition and responsibilities of these
entities are all described in the GCOOS Governance Plan. The Operations Center is described in Section 4 of this document and amplification appears in other sections, particularly in Section 8.

The evolution of the GCOOS Business and Governance Plans will be determined by the Board of Directors. The Executive Committee will, based on input and feedback from the various GCOOS committees and councils, provide recommendations to the Board for changes to the Governance and Business Plans.

Ocean.US has developed a rolling 4-year planning cycle for the IOOS that allows for specifying priorities for IOOS implementation and development, formulating a time table for these activities, working within the federal budget process to determine costs, and capitalizing on unplanned developments. In Section 7 a description of how the GCOOS engages the Ocean.US cycle is given.

The first priority of the IOOS is integrating the existing operational elements. For GCOOS these elements include the Gulf of Mexico assets of the national backbone (including the environmental satellites viewing the region) and several modeling and observing systems. A complete catalog and description of these existing elements is given in Section 4. Signatories to the Resolution to develop the GCOOS are given on the GCOOS web site.

2. Goals and Objectives

2.1 Ultimate goal and objectives

The goal of the GCOOS Regional Association is to create a regional coastal ocean observing system serving the users of marine data, products, and services pertaining to the Gulf of Mexico. Ultimately our objectives are to address the seven areas of socioeconomic and environmental concern which are the objectives of the IOOS (described in Section 1). These objectives will be approached in a manner consistent with the current IOOS Development Plan as reflected in the Governance Plan (Memorandum of Agreement) for the GCOOS-RA.

2.2 Initial objectives

Our approach has been, and will continue to be in the short term, to begin GCOOS by identification and integration of extant observing system elements within the Gulf. That identification has resulted in the preparation of an annual inventory of such elements together with current and out year budgets, sources of funds, and users. The integration began with the sharing of data and products as stated in the GCOOS Resolution, first developed early in 2003. Sharing of real time data by extant elements has been exceptionally effective; the data are sent to the NBDC/NOAA where they are quality controlled and distributed in real time and by delayed mode. The sharing of archived data by the OPeNDAP data transfer protocol has been well accepted by the holders of major ocean data archives in the Gulf; most such holders now adhere to this DMAC recommended procedure.

The result has been to integrate the system elements producing primarily physical oceanographic data. However, these data sets are the primary requirements of the IOOS (Airlie House Report,
2002), and are needed to produce the products required for many of our long-term objectives, especially 1, 2 and 6 as listed in Section 1. Physical data underpin essentially all user requirements, although for many requirements biogeochemical measures are essential.

Specific GCOOS actions and objectives achieved to date are:

• Inform potential GCOOS developers and users of actions, plans, and opportunities. We have held four workshops, made many presentations at industry and societal meetings, and established a web site http://www.gcoos.org

  — Gulf of Mexico Regional Workshop on an Integrated Data System for Oceanography, 31 October-2 November 2000, Stennis Space Center, MS.

  — NVODS Workshop for Managers of Coastal Observing System Activities in the Gulf of Mexico, 14-15 January 2003, Stennis Space Center, MS.

  — A Workshop to Explore Private Sector Interests and Roles in the U.S. Integrated Ocean Observing System; Focus on the Southeastern U.S. and Gulf of Mexico, 2-4 March 2004, Marathon Oil Company, Houston, TX.

  — GCOOS Stakeholders Meeting, 24-26 January 2005, New Orleans, LA. The Stakeholders meeting is a crucial event in ensuring that the planning and implementation of GCOOS: 1) meets user requirements for data and information on the Gulf of Mexico coastal and ocean environment, 2) integrates appropriate private sector data and products into the system, and 3) targets appropriate educational and outreach activities.

• Prepare an inventory of extant observing system elements in the region. This was prepared initially in mid 2003. The 2004 revision includes costs over a 5-year period, sources of funds, and users.

• Prepare initial priorities for enhancements to the national backbone of observations in the Gulf of Mexico and for improvements/enhancements to the GCOOS elements. This was submitted to the Ocean.US Office in May 2004 and will be updated annually.

• Encourage release of all real time physical data through the NDBC leading to improved analyses and forecasts of surface winds, sea level, currents, and other maritime services.

• Follow recommendations of the DMAC plan in development of GCOOS data management. We will strive to implement the recommendations of the DMAC Plan within GCOOS. To this end we have established a GCOOS DMAC Committee. This committee will follow the recommendations of the DMAC Plan and thus ensure adherence to the IOOS Development Plan.

• Encourage further development of Harmful Algal Blooms (HABS) detection, tracking, and (in future) prediction for the Gulf of Mexico.
We participated in the planning and execution of a HABSOS-GCOOS workshop in St. Petersburg, FL, in April 2004.

- Encourage cooperative proposals among GCOOS players.

- Encourage release of industry data sets for model evaluation and development as well as physical understanding. We are integrating, as an initial priority, private sector data and products as well as academic and government data and products into the GCOOS system. We have a commitment from the Oil and Gas industry to begin open sharing of real time and delayed mode ADCP data from some 40 sites in the Gulf beginning in 2005.

- Initiate development of a GCOOS Education and Outreach Council. We held an initial meeting (29-30 November 2004) to initiate the formation of the GCOOC Education and Outreach Council to advise on the activities needed to advance education and outreach within the region.

- Attempt coordination with colleagues in Mexico. We have identified the group of personnel who are involved with the establishment of a Global Ocean Observing System in Mexico (GOOS Mexico). We extended an invitation to the co-chairs to attend the GCOOS Stakeholders meeting in January 2005. We also plan to coordinate with The Gulf States Accord, which is an alliance of all U.S. and Mexican states on the Gulf Coast aimed at enhancing the welfare and quality of life of the their citizens.


3.1 Introduction

A Coastal Ocean Observing System would seem to be intuitively valuable, but effort must be made to ascertain the potential users of such information. Education and marketing may be needed in order for potential users to realize the value of the information and products that will be provided by the IOOS. Likewise, the organizations in the IOOS have to actively determine what information and products are most valuable to the range of potential stakeholders. There is no point in creating anything unless there is somebody that wants or needs the products and information. In order to justify the intellectual and financial capital that will be necessary to construct such a system, a rather broad approach to user identification has been and will continue to be pursued. The material presented here is meant to be suggestive of the potential GCOOS users and user requirements and how we intend to develop them further.

3.2 Potential Users

For-profit groups from the private sector The population in the 5 Gulf States is projected by the Census Bureau to increase from a total of 44.2 million in 1995 to an estimated 61.4 million in 2025, nearly a 40% increase. There are many private sector enterprises supporting the needs of this population. The region is the major source of energy and petrochemicals to the entire nation and plans are underway to bring Liquified Natural Gas terminals to the Gulf which guarantees
that this will not change in the foreseeable future. There are 5000 energy-related companies operating in the Gulf region with a total of 200 companies involved in exploration, production, and transportation of oil and gas. The Gulf region produces 1.7 million barrels of oil per day and has 38% of the nation's petroleum reserves and 48% of natural gas. There are 2 large oil refineries and 420 chemical plants. Of the nation’s top 10 ports in terms of cargo tonnage, 6 are located in the Gulf (2003, US Bureau of Transportation). Of the top seven global ports, in terms of total volume, two are located on the Gulf (Houston and South Louisiana; 2003, American Association of Port Authorities). A total of 400 companies are operating along the Houston Ship Channel alone.

Gulf fisheries are some of the most productive in the world. In 2003, the commercial fish and shellfish harvest from the five U.S. Gulf states was estimated to be 1.6 billion pounds (approximately 726 million kg), which represents almost 1/6 (16.8%) of the total domestic landings in the United States. In the same year, commercial catches in the Gulf represented approximately 20% of the total U.S. domestic commercial fishing revenue and were valued at over $683 million. The Gulf also supports a productive recreational fishery. Excluding Texas, U.S. Gulf states accounted for over 40% (>104,000 lbs or >47,000 kg) of the U.S. recreational finfish harvest in 2000. Most estimates of the value of the recreational fishery find it to equal or exceed the economic value of the commercial fishery.

Gulf of Mexico businesses include oil and gas, oil field services, pipelines, chemical, paper-forest resources, insurance, agriculture, utilities, banks, energy, transportation, fishing, recreation and services/consulting. Appendix 2 contains a partial list of different sectors that will benefit from the information generated by the ocean observing system. The appendix lists the sector, the information required, the benefits, the user group, and the time of data requirement. Due to the wide array of protocols and lack of standards, the users in the private sector have been unable to take full advantage of the data and product information already available. A primary objective of GCOOS will be to develop the ability to integrate and standardize the data sets providing information to decision makers on a timely basis.

There are a range of organizations that have entities with direct relevance to GCOOS and the broader IOOS. A listing of these and other organizations is maintained at the GulfBase website (http://www.gulfbase.org) of the Harte Research Institute for Gulf of Mexico Studies at Texas A&M University –Corpus Christi.

Federal Government Entities  There are many federal agencies and departments with direct interest in the Gulf of Mexico and many have offices scattered throughout the Gulf Coast (see the GulfBase website). A concentration of these offices is found at the Stennis Space Center in Mississippi. At its central location with respect to the Gulf Coast States, the NASA Stennis Space Center hosts a number of federal (as well as academic and private sector) entities having direct relevance to GCOOS and the broader IOOS. These are:

- National Aeronautics and Space Administration, Earth Science Enterprise, Applied Sciences Directorate:
  - Applications Research Division
  - Engineering Division
  - Integrations Division
• Department of Defense (DOD):
  o Commander, Naval Meteorology and Oceanography Command (CNMOC)  
    http://www.cnmoc.navy.mil
  o Naval Oceanographic Office (NAVO)  http://www.navo.navy.mil
  o Naval Research Laboratory Detachment (NRLSSC)  http://www.nrlssc.navy.mil
  o U.S. Army Corps of Engineers
• Department of Commerce
  o National Data Buoy Center (NDBC)  http://www.ndbc.noaa.gov
  o National Weather Service (NWS)  http://www.nws.noaa.gov
  o National Coastal Data Development Center (NCDDC)  http://www.ncddc.noaa.gov
  o NOAA National Marine Fisheries Service  http://www.mslabs.noaa.gov
• Department of the Interior
  o United States Geological Survey (USGS) Water Resources Division  
    http://www.hif.er.usgs.gov
  o USGS Geomagnetism Center  http://geomag.usgs.gov/stennis.html
• Environmental Protection Agency
  o EPA/ORD Gulf Ecology Division (GED) Laboratory of Gulf Breze, Florida
  o Gulf of Mexico Program  http://epa.gov/gmpo/

The U.S. Army Corps of Engineers has its major research unit, the Waterways Experiment Station, in Vicksburg, MS. In addition, there are three Army Corps of Engineers Divisions bordering the Gulf states. The USACE makes and uses measurements and could contribute to and benefit from the GCOOS.

The Environmental Protection Agency (EPA) has research laboratories on the Gulf coast, the major one of which is the Gulf Breeze Laboratory, in Gulf Breeze, FL. This Division is responsible for research on the physical, chemical, and biological dynamics of coastal wetlands and estuaries, to determine ecological condition, evaluate rates and causes of declining systems, and predict future conditions under various alternative water quality scenarios. The research program will: (1) Monitor and assess the ecological condition of coastal wetlands, bays, estuaries, and coral reefs of the Gulf of Mexico and evaluate the causes of changes: (2) Develop biological/ecological indicators to (i) classify the ecological status of coastal wetlands, bays and estuaries, (ii) detect significant change in ecological status related to chemical contaminants, biotechnology products, disease, nutrients, energy development, and global warming, and (iii) identify cause(s) of ecological change, using both reactive (diagnostic and epidemiologic) and predictive approaches, and (3) Compare ecological structure and function among microcosms, mesocosms, and field sites to predict relationships between chemical/stressor exposure and changes in biodiversity and ecological function. The Division also provides research and science support to the Gulf of Mexico Program and the Regions and states.

The Gulf of Mexico Program was formed in 1988 by the Environmental Protection Agency as a non-regulatory, inclusive partnership to provide a broad geographic focus on the major environmental issues in the Gulf. The mission of the Program is “to facilitate collaborative actions to protect, maintain, and restore the health and productivity of the Gulf of Mexico in ways consistent with the economic well-being of the Region.” The partnership includes
representation from state and local governments and the citizenry in each of the five Gulf States; the private sector (business and industry); federal agencies responsible for research, monitoring, environmental protection, and natural resource management; and the academic community. This partnership has been very effective in providing: (1) a mechanism for addressing complex problems that cross federal, state, and international jurisdictional lines; (2) better coordination to increase effective and efficient management and protection of Gulf resources; (3) a regional perspective required for effective management decisions; and (4) a forum for affected groups using the Gulf, for public and private educational institutions, and for the general public to participate in the solution process.

Through its partnerships, the Gulf Program is working with the scientific community; policymakers at the federal, state, and local levels; and the public to help preserve and protect the Gulf. It has made significant progress in identifying the environmental issues in the Gulf ecosystem and in organizing a program to address those issues.

The Minerals Management Service (MMS) has its Gulf of Mexico Regional Office in New Orleans, LA. As part of its environmental studies duties, MMS has supported major oceanographic studies in many aspects of the coastal ecosystem and is expected to continue to do so. Additionally, in its role to regulate off-shore federal oil and gas leasing activities, MMS has mandated certain data collection activities by off-shore operators. Thus, MMS is a major provider and user of data sets and products and is expected to contribute important data streams and products to GCOOS through their contractors and regulated industry. In turn, the knowledge generated by the enhanced data base under GCOOS will be of benefit to MMS as it strives to understand the impacts of human oil and gas industry activities on the Gulf ecosystems.

As better correlations between physical parameters and biological resources are articulated, the National Marine Fisheries Service should become more engaged in the products that GCOOS will provide.

The Coastal Zone Management Program is a NOAA-based program that funds many projects within the defined coastal zones of the 5 Gulf states. These are usually state-federal partnerships housed within the state agencies. They are networked through the Coastal States Organization with a Gulf caucus led by Congresswoman Katherine Harris of Florida.

The National Estuarine Research Reserve System is a protected areas program created by the Coastal Zone Management Act, of 1972, to provide a system of representative estuarine ecosystem areas suitable for long-term research, education, and stewardship. More than one million acres of estuarine lands and waters are currently included within the 26 federally designated reserves. A key initiative of the reserve program is the system-wide monitoring program which tracks short-term variability and long-term changes in estuarine waters to understand how human activities and natural events can change ecosystems. It provides valuable long-term data on water quality and weather at frequent time intervals.

The NERR's Coastal Training Program (CTP) provides up-to-date scientific information and skill-building opportunities to individuals who are responsible for making decisions that affect coastal resources. Through this program, coastal decision-makers are provided with the
knowledge and tools they need to address critical resource management issues of concern to local communities. Coastal Training Programs offered by reserves focus on issues such as coastal habitat conservation and restoration, biodiversity, water quality and sustainable resource management. Programs target a range of audiences, including land-use planners, elected officials, regulators, land developers, community groups, recreation users, environmental non-profits and coastal businesses/industry. These training programs provide a range of opportunities for professionals to network across disciplines, and develop new collaborative relationships to solve complex environmental problems.

State Government Entities There are many state agencies with mandated requirements for decision making based on environmental information from the Gulf of Mexico and its estuaries. Many of these agencies already operate observing system elements and provide a basis on which to build the GCOOS. These agencies should be identified, as done for Louisiana in Appendix 5, and approached as potential providers and users of GCOOS data and products.

Academic and research institutions There are 18 academic marine laboratories and 4 government laboratories affiliated with the Southern Association of Marine Laboratories (SAML) in the Gulf of Mexico (Appendix 1). The majority of these institutions are largely engaged with coastal and estuarine systems in contrast to the “open” coastal ocean of the Gulf. This point is raised because the near-coast and estuarine regions represent the most dynamic of coastal ecosystems and is the area of principal concern to many user groups.

In addition, there are major academic and research institutions located on the Gulf coast which are not represented in the SAML. These include such units as Texas A&M University at College Station, University of Texas at Austin, Mississippi State University, Louisiana State University, and Harbor Branch Oceanographic Institution, among others.

Most of these institutions and laboratories are engaged in fundamental research involving physical, geological, chemical, and biological characteristics of their geographic areas of concern in the Gulf. This is the underpinning of the GCOOS. Moreover these institutions are the leaders in the majority of pilot projects leading to observing system elements. Finally many of these institutions are participating in the generation of observational data and production of products.

Most of these institutions have been collecting environmental data for many years with an unfortunately wide array of protocols and a significant lack of metadata. These shortcomings are being addressed through a variety of methods, including implementing the IOOS DMAC Plan with its standards and protocols. This sector would contribute high quality data and information to the GCOOS and in turn would benefit from the availability of the additional data sets and information that would be accessible through GCOOS structures. The overarching goal is to attain the ability to integrate all the various data sets and begin to connect the driving forces and outcomes, particularly in matters that concern the human population.

Sea Grant programs The Sea Grant programs of the 5 Gulf states deserve special mention as they cross over into many areas of our potential users. They fund focused research efforts of the colleges and universities associated with the Sea Grant effort in each state. These research
activities represent a broad spectrum ranging from strictly applied and issue-oriented to fundamental examinations of the processes that drive the Gulf of Mexico ecosystem.

A major commitment of all Sea Grant programs is in extension, including education and outreach. Their efforts in marine extension are legendary and groundbreaking. This will be a significant connection to the user population that drives boats and eats seafood and in general use and enjoy the resources of the Gulf of Mexico. The network of Directors and colleagues is tightly knit and should be a powerful force in developing and justifying the GCOOS, especially in outreach to users and in education.

GCOOS structures would enhance the ability of the Sea Grant programs to provide information and data efficiently to their beneficiaries. In turn, the information network of the Sea Grant programs will provide access to potential users and a ready means for gathering information on how to improve the data and products served by GCOOS.

Education and Outreach Most of the entities previously identified have educational and outreach components which could use GCOOS data and products. Sea Grant Colleges should again be singled out as they have large and elaborate outreach programs. The Centers for Ocean Sciences Education Excellence on the Gulf coast also are important elements when considering education and outreach. The Southern Association of Marine Educators is a subset of the National Association of Marine Education and their network should be included in the user list (Appendix 3). The feedbacks into GCOOS-RA from this user sector would facilitate enhancements to the GCOOS that are responsive to the educational and outreach needs of this sector and the people it serves.

An excellent example of what can be done in the area of educational outreach using the web is the “COOL ROOM” of Rutgers University (http://www.thecoolroom.org/). This effort is a successful example of using the allure of the oceans, a real-time data stream, and a well designed web site, to engage educators to incorporate ocean observing into their curriculums and excite students about science.

Non-governmental organizations (NGO) NGOs encompass a broad spectrum of advocacy interests and range from very local groups to national and international organizations. Advocacy interests can be from opposing groups, such as pro-industry fishery groups to pro-environment, fishery limitation groups. NGOs of all types are represented and active in the Gulf coast states. They form a diverse user group for GCOOS that will be a source of ideas for GCOOS enhancements, a user of a wide variety of the data sets and information served by GCOOS, and in some cases a contributor to GCOOS data sets. NGOs also provide important links to people for education and outreach.

The Gulf Restoration Network is a loose, Gulfwide alliance of many state and local NGOs that focuses on environmental issues. The group is concerned about fish populations in the Gulf and the hypoxic zone off Louisiana. They have carried out a successful and effective educational program as advocates for the “restoration of the Gulf”. This group has could serve as both user and supporter of the goals and objectives of GCOOS.
The Coast Conservation Association has a concern for commercial fishing efforts and has brought about net bans in most of the Gulf States. This group may be interested in the kind of product envisioned for a web-based GCOOS which would provide information on the weather, the ocean “climate”, water quality, the living resource base, and other things that affect their areas of focus.

At the local level, every state has a variety of entities with focus on issues that range from cultural resource degradation to cataclysmic destruction of everything living. GCOOS should develop for the other Gulf states a list such as appears in Appendix 4 for Louisiana.

National Estuary Programs have a committed source of federal funding from the Environmental Protection Agency and are connected through the National NEP Association. There are 7 NEPs in the Gulf of Mexico (Figure 3-1) and most are independent partnerships (IRS Code 502 (c)(3)) of local governments and regional groups. The Barataria-Terrebonne and Mobile Bay NEPs are managed by the marine laboratories in their respective states and are planning to link their Data Information Management Systems This has been discussed as a “brown water” subset of the proposed GCOOS project.

![Figure 3-1. Map of the seven National Estuary Programs in the U.S. Gulf of Mexico.](image)

### 3.3 Benefits

The benefits of the envisioned GCOOS network of coastal ocean observing systems are many. The improved data base that will be available will enhance the basic information available to a wider range of interests and will result in an increase in the commercial, research, and educational products widely available about the coastal ocean and will lead to improved knowledge of how the coastal ocean ecosystem works. The GCOOS-RA, through its board, councils, and committees and supported by the GCOOS Office and Operations Center, will provide for the coordination of the GCOOS network, the broadening and diversification of the stakeholders membership to include new private sector and other members (e.g., Membership Committee, Education and Outreach Council), the identification and development of products...
designed to meet changing needs of the users (Stakeholder Council, Operations Committee, Products and Services Committee, Education and Outreach Council), and the standardization and uniformity of application of protocols for data collection and quality control (Data Management and Communication Committee), among other benefits.

The benefits that can be realized by deploying a network of ocean and coastal observing systems to coordinate response to events, such as hurricanes, violent storms, harmful algal bloom occurrences, oil and chemical spills, damage to oil and gas facilities, damage to crops and utilities, are demonstrated by the following statistics for the Gulf of Mexico:

**Insurance losses** Since 1900, hurricanes in the Gulf of Mexico have killed more than 9000 people and not including the 2004 hurricane season, the cost of damages is more than $30 billion, when dollars are adjusted to 1990. The damage caused by the four hurricanes that struck Florida and other East and Gulf Coast States in 2004 totaled $20.4 billion (2004 dollars).

**Hurricane Evacuation Costs** McAdie and Lawrence (2000) estimated that the approximate cost per mile to warn residents in the coastal US of a hurricane landfall was $600,000. A more recent estimate by FEMA is that is costs $1,000,000 per mile of coastline evacuated for a hurricane. Any information that can improve the landfall forecasts can potentially save millions of dollars and help prevent reluctant evacuees from staying home because of previous experiences with errant forecasts.

**Oil and gas losses due to Hurricane Ivan** With Hurricane Ivan, oil and gas platform operators in the Gulf faced $100 billion in exposure. From 9/11/04 to 12/06/04 shut in oil and gas production (i.e., production that would have occurred if wells hadn't been shut down as precautionary measures) in the Gulf was 33,829,806 barrels of oil (5.592% yearly production) and 134 billion cubic feet of gas (3.014% of yearly production). Eight platforms were destroyed and six had major damage. Twelve large pipelines were damaged.

**Crop losses for the 2004 hurricane season** Structural and crop damage to Florida from hurricanes Charley and Frances was $2.2 billion and for the hurricane season around $3 billion.

**Utilities** The damage for the 2004 hurricane season in Florida was more than $43 million.

**Fisheries, Recreation, Health** Products derived from the Gulf of Mexico Coastal Ocean Observing System (GCOOS) will provide data and information crucial to address questions of importance to fisheries, recreation, and human health. Oceanographic parameters influence fishery development, maintenance of stocks and reproduction. Parameters measurable by instruments provided by GCOOS include nutrient concentrations, salinity, temperature, depth, current speeds and direction, dissolved oxygen, and wave height. Concurrently, meteorological information such as wind speed and direction, air temperature, and rainfall, are also measurable with GCOOS instruments. This data can provide valuable information to better understand fishery parameters such as larval and juvenile fish dispersion. These measurements will aid in the determination of essential habitat requirements for local and global species, thus setting the bar for required water quality conditions.
When written the Magnuson-Stevens Act called for development of procedures and regulations to end the continual loss of fishery habitats. The development of such an act and the following provisions, added in 1996, called for the development of essential habitat requirements (EHR) to be defined for individual species and life stages of each species. The basis of such EHR include physical parameters, which the GCOOS measurements will be applicable and available on a continual, regional, relatively low cost basis, benefiting the fisheries management community.

Harmful algal blooms have been estimated to cost as much as $50 million per year due to closure of fisheries and beaches and treatment of human illness from exposure to toxins.

Economic Benefit Studies

Colgan and Kite-Powell (2004) attempted to estimate the potential of the magnitude of economic benefits for the Gulf of Mexico with the implementation of IOOS. The report provided an “order of magnitude” because the “economic information needed to compile estimates of both the users of the information generated by such systems and the value they placed on such information is only sporadically available and usually incomplete”. Table 3-1 was compiled from this report and illustrates the wide range of sectors that could realize a positive economic benefit from the implementation of the IOOS.

<table>
<thead>
<tr>
<th>User Sector</th>
<th>Users</th>
<th>Estimated Economic Effects ($M/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recreational Activities</td>
<td>Recreational Fishing</td>
<td>$6.7-34.0</td>
</tr>
<tr>
<td></td>
<td>Recreational Boating</td>
<td>$4.0</td>
</tr>
<tr>
<td></td>
<td>Beaches</td>
<td>?</td>
</tr>
<tr>
<td>Transportation</td>
<td>Freight</td>
<td>$30.7</td>
</tr>
<tr>
<td>Health and Safety</td>
<td>Search and Rescue</td>
<td>$28.0</td>
</tr>
<tr>
<td></td>
<td>Oil Spills</td>
<td>$0.8</td>
</tr>
<tr>
<td></td>
<td>Tropical Storm Prediction</td>
<td>?</td>
</tr>
<tr>
<td>Energy</td>
<td>Oil and Gas Development</td>
<td>$14.1-26.3</td>
</tr>
<tr>
<td>Commercial Fisheries</td>
<td>Commercial Fisheries</td>
<td>$2.1</td>
</tr>
</tbody>
</table>

Table 3-1. Order of magnitude estimates of potential economic benefits of the GCOOS to eleven sectors in the Gulf of Mexico as estimated by Charles Colgan and Hauke Kite-Powell (2004). Benefits in areas of beaches and tropical storm prediction not given separately for Gulf; estimates were $105.7M/yr for Florida beaches and $15.6M/yr for tropical storm prediction in SE Atlantic.

3.4 Linkages and Product Development and Marketing

Once the GCOOS-RA is established, work will begin in the various committees and councils to enhance and expand the linkages developed thus far in the various workshops and meetings that have been conducted (see Section 2). The Board, with support of the Committees and Councils, will continue the identification and integration of users, products, and ocean observing system elements. Both the Stakeholder Council and the Education and Outreach Council are suited to assist in this effort. The Board, again with assistance of the GCOOS-RA structural entities, will develop a five-year plan that will include product development in and marketing of GCOOS-RA data and information, as well as consideration of the links between the seven objectives and benefits and product development and identification of the short- and long-term contributions of
the GCOOS-RA planning elements to the IOOS as a whole. Section 4 provides additional information on the linkages of data and products with users, Section 5 considers the strategy for research and development activities, and Section 8 discusses mechanisms for assuring GCOOS System performance.

Workshops for users in specific categories were strongly suggested at the January 2005 Stakeholder Meeting. Perhaps they should be worked into this section.

4. Linking Observations to Models and Other Products

4.1 Introduction

Various in-situ observing stations exist along the United States coastline of the Gulf of Mexico. These stations measure many different ocean and atmospheric parameters and are maintained by a variety of organizations, as illustrated in Figure 4-1. A summary of identified extant observational elements with accompanying information is presented in Table 4-1. The GCOOS-RA is proposed as the central unifying entity to coordinate the development of these disparate elements in an integrated fashion and foster cooperation to achieve the goals of the IOOS as GCOOS as expressed in Sections 1 and 2. As described in Sections 1 and 4.1.b, GCOOS should be considered to be a system-of-systems, with the GCOOS-RA as the governance body as described in Section 1.

Note that this version suggests the creation of a centralized IOOS Operations Center and relies on that center. It is no certainty that IOOS will buy that approach. So, this may need to be reconsidered.

GCOOS-RA proposes a centralized IOOS Operations Center that will be part of the national backbone, and a GCOOS Operations Center Office that will coordinate the communication and interaction between the GCOOS system elements and the OC. The IOOS Operations Center will serve as the central point of contact for any and all issues twenty four hours a day, seven days a week (24/7). The IOOS Operations Center will be responsible for monitoring the system elements in all of the RAs for quality assurance/quality control (QA/QC) issues and inoperative parts of the system. The GCOOS Operations Center Office will provide a local user feedback service and maintain an account of those activities. It will monitor all of the GCOOS observing and modeling elements and require a plan of operations for each element including maintenance schedules, standard operating procedures (SOPs) for repair of malfunctioning observing instruments and data telemetry systems, and Data Management and Communication (DMAC) compliance plans. The GCOOS Operations Center Office will file copies of these plans with the IOOS Operations Center. The DMAC compliance plans will include descriptions of how data and metadata will be transmitted to the data assembly and quality control centers and to archive centers (both regional and national). It will also coordinate data flow to operational modeling efforts.

The GCOOS geographic coverage is illustrated in Figure 4-1. Shown in Table 4-1 are the elements of GCOOS, geographic coverage, purpose of element, primary measurements, station type, and target user groups. Of course, many other classes of entities use these data and products.
in addition to the primary targeted users. These include prominently other governmental agencies, researchers and the private sectors.

**The Gulf of Mexico Coastal Ocean Observing System (GCOOS)**

![Map of GCOOS stations](image)

Figure 4-1: The GC array of in-situ monitoring stations. Groups of stations belong to different governing entities. *This Figure will be revised by mid October 2005.*

The GCOOS-RA will exercise operational monitoring of data collection and transmission, all phases of data management, and modeling and product production through the three committees reporting to the Board of Directors: Observation Systems, DMAC, and Products and Services. These committees will be responsible to the Board of Directors for preparing plans with priorities to meet the user needs of the parties to the GCOOS-RA. Criteria will be established for minimal standards that all GCOOS entities must adhere to.

The subsections to follow identify the strategy by which this operational oversight of GCOOS will be carried out. Within each area (observations and data transmission, data management and communications, and data analysis) a plan will be prepared and maintained by the cognizant GCOOS Committee. The following subsections specify the classes of information which these plans are expected to contain.

With inputs from the Stakeholder Council and the Education and Outreach Council, the GCOOS Office will regularly update compilations of data and product users and user requirements. These requirements will provide the background for the preparation of the plans described in the following sections.
<table>
<thead>
<tr>
<th>Elements of GCOOS (Data Providers)</th>
<th>Geographic Coverage</th>
<th>Purpose of Component</th>
<th>Primary Measurements</th>
<th>Station Types</th>
<th>Target User Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCOON</td>
<td>Texas Gulf of Mexico Coastline</td>
<td>assist local officials with preparations for incoming hurricanes and tropical storms</td>
<td>Water-level and Meteorological at SS</td>
<td>Fixed in water at/near shoreline</td>
<td>Texas State Government Agencies</td>
</tr>
<tr>
<td>COMPS</td>
<td>Florida Gulf of Mexico Coastline and shelf</td>
<td>assist local officials with preparations for storms and flooding</td>
<td>Meteorological at SS, Currents and Salinity</td>
<td>Fixed in water at shoreline and offshore</td>
<td>Florida State Government Agencies</td>
</tr>
<tr>
<td>WAVCIS</td>
<td>Louisiana Gulf of Mexico Coastline and shelf</td>
<td>WAVCIS provides 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</td>
<td>Meteorological at SS, Wave Height/Period, Water-level</td>
<td>Fixed in water at shoreline and offshore</td>
<td>Louisiana State Government Agencies; Industry</td>
</tr>
<tr>
<td>PORTS</td>
<td>Houston and Galveston Bays/Shorelines; Tampa Bay</td>
<td>PORTS is a program of the National Ocean Service that supports safe and cost-efficient navigation by providing ship masters and pilots with accurate real-time information required to avoid groundings and collisions</td>
<td>Physical Oceanographic and Meteorological</td>
<td>Fixed in water at/near shoreline</td>
<td>Maritime pilots/captains, Recreational boaters</td>
</tr>
<tr>
<td>LUMCON</td>
<td>Louisiana Gulf of Mexico Coastline</td>
<td>formed in 1979 to coordinate and stimulate Louisiana's activities in marine research and education. LUMCON provides coastal laboratory facilities to Louisiana universities, and conducts research and educational programs in the marine sciences</td>
<td>Water-level and Meteorological at SS</td>
<td>Fixed in water at/near shoreline</td>
<td>Louisiana Universities</td>
</tr>
<tr>
<td>Elements of GCOOS (Data Providers)</td>
<td>Geographic Coverage</td>
<td>Purpose of Component</td>
<td>Primary Measurements</td>
<td>Station Types</td>
<td>Target User Group</td>
</tr>
<tr>
<td>-----------------------------------</td>
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<td>----------------------</td>
<td>----------------------</td>
<td>--------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>NWLON</td>
<td>GC (CONUS)</td>
<td>The Program provides basic tidal datums to determine U.S. coastal marine boundaries and for nautical chart datums. It also provides support for NOAA's tsunami and storm surge warning programs, climate monitoring, coastal processes and tectonic research. The Program also contributes to safe vessel navigation and the increased efficiency of maritime transportation.</td>
<td>Water-level and Meteorological at SS</td>
<td>Fixed in water at/near shoreline</td>
<td>Government Agencies, Maritime pilots/captains, Recreational boaters</td>
</tr>
<tr>
<td>TABS</td>
<td>Texas Gulf of Mexico Coastline</td>
<td>Real Time Oceanographic Data Supporting Oil Spill Prevention and Response</td>
<td>Physical Oceanographic and Meteorological</td>
<td>Buoys along shoreline and offshore</td>
<td>Government Agencies, Researchers, Industry</td>
</tr>
<tr>
<td>USF IMaRS</td>
<td>Gulf of Mexico (Global)</td>
<td>Provides SERACOOS and GCOOS an understanding of the activities associated with acquisition, processing, archiving, and distribution of real-time satellite data, as well as costs associated with doing this in an operational manner in support of these regional associations.</td>
<td>Remotely sensed Imagery and Infrared and Ocean Color data</td>
<td>Satellite</td>
<td>Researchers</td>
</tr>
<tr>
<td>LSU ESL</td>
<td>Gulf of Mexico (Global)</td>
<td>Receiving station and image processing facility</td>
<td>Environmental data from Earth orbiting satellites</td>
<td>Satellite</td>
<td>Researchers</td>
</tr>
<tr>
<td>NDBC</td>
<td>Gulf of Mexico (CONUS - Coasts and Offshore)</td>
<td>Provide Sea-state for Maritime Safety, Industry, Recreational, Research</td>
<td>Physical Oceanographic and Meteorological</td>
<td>Buoys along shoreline and offshore</td>
<td>Government Agencies, Researchers, Industry</td>
</tr>
<tr>
<td>US ARMY COE</td>
<td>Gulf of Mexico (CONUS - Coasts and Offshore)</td>
<td>Study Shoreline erosion</td>
<td>Physical Oceanographic</td>
<td>Moored stations</td>
<td>Government Agencies, Researchers, Industry</td>
</tr>
<tr>
<td>SEAKEYS</td>
<td>Florida coast and Keys (Global)</td>
<td>Coral Reef Health</td>
<td>Physical Oceanographic and Meteorological</td>
<td>Buoys along shoreline and offshore</td>
<td>Government Agencies, Researchers, Industry</td>
</tr>
<tr>
<td>NAVOCEANO Drifters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MMS DW Current</td>
<td>Deep Water GOM</td>
<td>Loop current observations</td>
<td>ADCP</td>
<td>ADCP surface and seabed</td>
<td>Parties affected by loop current</td>
</tr>
<tr>
<td>Hydrates Monitoring JIP</td>
<td>Deep Water GOM</td>
<td>Hydrate formation</td>
<td>Acoustic primarily</td>
<td>Suspended acoustic array</td>
<td>O&amp;G operators and Regulators</td>
</tr>
<tr>
<td>Elements of GCOOS (Data Providers)</td>
<td>Geographic Coverage</td>
<td>Purpose of Component</td>
<td>Primary Measurements</td>
<td>Station Types</td>
<td>Target User Group</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------</td>
<td>---------------------</td>
<td>----------------------</td>
<td>--------------</td>
<td>------------------</td>
</tr>
<tr>
<td>USM CenGOOS</td>
<td>Central Gulf of Mexico shelf</td>
<td>GPS RTK Research and MS Bight Observations</td>
<td>Physical Oceanographic, Meteorological, and Biological</td>
<td>Moored Buoy</td>
<td>Marine and Hydrographic Scientists, Local and State Government Agencies, Recreational Users, Industry</td>
</tr>
<tr>
<td>SWMP</td>
<td>Apalachicola Bay NERR, FL; Grand Bay NERR, MS; Rookery Bay NERR, FL; Texas NERR (proposed); Weeks Bay NERR, AL</td>
<td>SWMP is the water quality and weather monitoring program network of the NERRS, which is 26 reserves created to support long term estuarine research and education programs</td>
<td>Physical, Meteorological, Water level, Nutrients</td>
<td>Fixed in water at/near shoreline</td>
<td>Researchers, Government agencies, recreational users and decision-makers</td>
</tr>
<tr>
<td>Southeast Environmental Research Center (SERC)</td>
<td>South Florida, Keys</td>
<td>The function of the SERC Water Quality Monitoring Network is to address regional water quality concerns that exist outside the boundaries of individual political entities</td>
<td>APA, CHLA, SODAT, DSIGT, NH4, NO2, NO3, SAL, SRP, TEMP, TNTP, TOC, TON, TP, TURB</td>
<td>Station data</td>
<td></td>
</tr>
<tr>
<td>Florida International University, Seagrass Ecosystems research Laboratory</td>
<td>South Florida</td>
<td>Seagrass species distribution and abundance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Florida Bay Fish Habitat Assessment Program</td>
<td>Florida Bay</td>
<td></td>
<td></td>
<td>Station Data</td>
<td></td>
</tr>
<tr>
<td>NOAA Coastwatch</td>
<td>Gulf of Mexico</td>
<td>Provide notification of potential or actual harmful algal bloom events to state and local coastal managers</td>
<td>Satellite Information Products</td>
<td>State and local coastal managers</td>
<td></td>
</tr>
<tr>
<td>Florida Fish and Wildlife Conservation Commission</td>
<td>Florida Coastal Waters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mote Marine Laboratory, Marine Ecosystem Event Response and Assessment Project</td>
<td>Florida Keys National Marine Sanctuary and surrounding waters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.2 Observations and Data Transmission

The Observing Systems Committee will develop and regularly revise the GCOOS Observing Plan which will:

- Specify a sampling plan to best meet the user requirements in terms of spatial and temporal resolution, sampling frequency, accuracy and precision, delivery time, etc.
- Identify oversight responsibility
• Identify staff to oversee operations and to respond to changes in the system (emergency response plans)
• Specify measurement techniques (platforms, sensors, methods)
• Specify backup sensors (especially - homeland security, safe navigation, and emergency response)
• Identify real-time support and maintenance of observational infrastructure
• Include identification of evaluation mechanisms to ensure that the plan is responsible to user needs
• Contain one- and five-year plans for incorporating and enhancing observing system assets of the national backbone in the Gulf of Mexico and of the GCOOS per se
• Specify for such improvements and enhancements the responsible entity, support costs, and timing

The Observing Systems Committee will utilize this Observing Plan to help identify gaps between requirements and capabilities and to make budgetary recommendations to the Board for closing these gaps.

The GCOOS Operations Center will act as the central ongoing GCOOS point of contact for operational issues with the IOOS Operations Center providing an available 24/7 contact for urgent issues. See Figure 4-2. The specific functions and responsibilities of the proposed IOOS Operations Center are:
• To provide open, efficient, and effective computer access to non-commercial, non-proprietary data sets
• To maintain metrics on the regional coastal observing system operation and use
• To serve as the focal point for receiving information regarding operational problems with the system
• To examine suspected and reported operational problems in terms of data and product flow
• To report operational problems to the subsystem operators
• To maintain records based on RA observing plans of procedures for instrument calibration/validation and routine servicing and to notify operators of subsystems when such work is required.
• To coordinate response to events requiring special vigilance or actions (e.g., hurricanes, harmful algal bloom occurrences, or oil spills)

To carry out these functions will require:
• A Live Access Server (LAS) of the type now supported at NOAA’s Pacific Marine Environmental Laboratory (PMEL)
• Use by all subsystem operators of agreed to standards and protocols for data and metadata models, data transfer, and other matters pertaining to data management.
• 24/7 staffing to respond via email and/or phone to inquiries, complaints, etc.

The specific functions and responsibilities of the proposed GCOOS Operations Center Office are:
• Monitor all of the observing and modeling elements in GCOOS
Together the Operations Center and the GCOOS-RA Committees will manage GCOOS as a system of systems according to the Operational Plan, ensuring that data and products are accessible to a broad range of users.

Figure 4-2. Observational elements of GCOOS
This figure does not seem to be consistent with the text. If the goal is to list observing system elements, Table 4-1 already lists most of those in this figure and more. Also it contains more information. The suggestion is to include missing elements in Table 4-1 and delete this figure.

An Operations Plan is not available at this time. However, we do have inventories of extant observing system elements and we have priorities for improvements and enhancements; these are presented elsewhere in this Business Plan.
4.3 Data Management and Communications

The DMAC Committee will prepare and regularly update the GCOOS DMAC Plan which will conform to standards and protocols developed under the auspices of Ocean.US and as described in the IOOS DMAC Plan (Figure 4-3). The plan will describe how the GCOOS regional efforts interface with the national DMAC program. This plan is expected to address each area in the subsections to follow and should be informed by the user requirements compiled by the GCOOS Office. Figure 4-4 illustrates the data flow as envisioned in the IOOS DMAC Plan.

4.3.1 Data collection

- Individual organizations should continue to collect data.
- Metadata standards will allow identification of the level of quality of the data.
- These metadata standards and levels of quality should be uniformly accepted across GCOOS.

![DMAC Compliant GCOOS Data Management](image)

Figure 4-3. DMAC Compliant GCOOS Data Management

4.3.2 Data verification/validation

- NDBC linking observations to Website
- Verification service – Comparisons with Stations

4.3.3 Metadata management

- Cast-net offers ACET (Automated Cast-net Entry Tool) to give data providers a means of easily creating FGDC compliant metadata and of cataloging the metadata with the FGDC clearinghouse, the NBII Clearinghouse, and Coastal Services Center’s Clearinghouse.
• NCDDC (National Coastal Data Development Center) offers a utility called Mermaid (Metadata Enterprise Resource Management Aid). This tool offers users a more complete metadata creation tool. NCDDC plans to integrate cataloging with this tool.

4.3.4 Data discovery
• In order for data to be retrieved it must be discovered; therefore, a cataloging method must be established. The FGDC metadata standard gives data providers and users a means to catalog data and the clearinghouse offers a method of searching these catalogs for needed data.

![IOOS Data Communications Diagram](image)

Figure 4-4. IOOS Data Communications. GCOOS fits into all aspects of this representation of IOOS communications with the exception of the terrestrial and international portions.

4.3.5 Data transport
• A wide range of telemetry systems, including the World Meteorological Organization’s Global Telecommunication System (GTS), are used to transfer data from the measurement
platforms to and among the locations at which Primary Data Assembly and Quality Control occur.

- OPeNDAP will be the web transfer protocol recommended for GCOOS data.

4.3.6 Data archive and access
Data will be archived at national archive centers if available.

- Several tools allow for integration and retrieval of data from disseminated sites across the region. Although all of these tools allow a user to integrate data from various sites, no “industry” standard is clearly present at this time. Some of the technology is still too new to become a standard.
- LAS (Live Access Server) allows a user to geographically select data they might be interested in by selecting a region on a map. The server will then retrieve the data from disseminated OPeNDAP servers and allow the user to integrate the data. The user can then apply Matlab tools to retrieve, visualize, or analyze the data.
- Esri’s web mapping tool ArcIMS is a server tool that will allow users to integrate data among various sites geographically. This GIS mapping tool allows the user to layer data from various sites through a web browser. The user can simply use the ArcIMS server for analysis or to download the pertinent layers to a local computer and use other tools for visualization and analysis.
- Open Geospatial Consortium, Inc. (OGC) is establishing standards for Web Mapping Servers. These standards allow for developers to design interoperable tools to integrate data, and are becoming widely accepted in the scientific community. A data provider can develop a web mapping service that is compliant with OGC standards and any OGC compliant server can integrate the data as a GIS layer. This technology is state of the art and currently gaining momentum as more people develop web services to comply with these standards.
- DMAC accepts LAS, OPeNDAP, and web services as means of integrating data.
- NCDDC’s Gateway will be a portal integrating data from various sites allowing the user a “one stop shop” to gather data for visualization and analysis.
- NDBC integrates data from various sites into their Weather Buoy System.
- Cooperation among organizations will be the key to integrating data into a common system. Agreement will have to be reached to meet the needs of the region as the data are integrated into the national system, keeping in mind compliance with DMAC as the document is finalized.
- Responsibility for maintaining data will remain with the individual organizations that generate the data until such time as they are delivered to a regional or national archive for long-term archive and access.
- All data will be sent to a national archive. However, individual observing elements will archive their data for a certain amount of time for their specific purposes, but not for an extended period of time. The national archive has to rapidly ingest all data and rapidly make it available for such a scheme to work.

4.3.7 Data dissemination
- Currently, many of the organizations are sending data to the NDBC (National Data Buoy Center) which provides QA/QC of the data and integrates them into the NDBC system. This provides a model for how the region can integrate and disseminate data.
4.4 Data Analysis

4.4.1 Measured data calibration/validation
As discussed in Section 4.3.2:
• The Observing Systems Committee will set standards for calibration and validation.
• All subsystems must use calibrated and validated sensors and techniques.
• Metadata files must specify calibration and validation techniques and results.
• The GCOOS operations center will facilitate user feedback to subsystems.

4.4.2 Model development
There exist a variety of models applicable to the GCOOS objectives; Figure 4-5 shows a representative sample. Although ocean models that predict the state of the ocean are primary, models that couple the physics, biology, chemistry, and geology of the ocean will be required to achieve the seven societal goals of IOOS. The GCOOS-RA will facilitate improved models (faster, better, less expensive). Initially the RA will hold a meeting of Gulf modelers to consider how best to share, compare, and validate models.

Figure 4-5: GCOOS Models
This figure is way too busy. Perhaps we should develop a model inventory table analogous to table 4-1 for observing system elements and drop this figure. However, this figure could be redrawn to show the GCOOS Models in center with 4-8 categories of models surrounding it and that might be a helpful visualization. For example, model types could be depicted by entity--federal govt, state govt, local govt, academic, and private sector--or they could be depicted by type of topic--transportation, environmental monitoring, climate, HABS, fisheries, etc.
The GCOOS provision to modelers of more good data will enable them to greatly improve model capability.

A key objective is to make the modeling process cheaper, quicker, more efficient and effective by
1. Providing better data for models
2. Model comparison from data

4.4.3 Five-year plan for modeling and product development
The GCOOS Products and Services Committee will prepare and annually revise a five-year Data Analysis Plan that is consistent with the GCOOS Observing Plan, GCOOS DMAC Plan, and the compilation of user requirements maintained by the GCOOS Office. That plan will specify:
• Current GCOOS products
• Current GCOOS modeling capability
• Gaps in modeling capability and products needed to meet user requirements
• How capacity will be increased through model development
• Procedures for transitioning research models to operational models
• How new or improved products (including serving of legacy data) will be obtained
• Costs of all proposed actions
• Timelines for all proposed actions.

4.4.4 Products
The Board of Directors with the support from the RA committees and councils will ensure that the data products coming from the RA are made available to the users, and will coordinate with private sector data production.

5. Research and Development

5.1 Development Strategy

Elements within GCOOS will have projects and systems in four developmental stages: 1) Research, 2) Pilot Projects, 3) Pre-Operational, and 4) Operational. The definition of each of these categories, by Ocean.US\(^1\), is as follows.\(^1\)

Research
Research activities include observational (e.g., platforms, sensors, measurement protocols, and data telemetry), data management and communication, and analytical techniques (e.g., numerical models and algorithms) developed by research groups.

Pilot Projects
Techniques that show promise as potential elements of the operational system, or sustained observations for research, are tested repeatedly over a range of conditions. This will illuminate

weaknesses, provide opportunities to address those weaknesses, and permit a better understanding of how they may be applied. Research groups, with involvement of operational groups, are primarily responsible for this stage.

Pre-Operational
Research and operational communities collaborate to ensure that incorporation of new techniques from pilot projects into the operational system are likely to lead to a value added product (is more cost-effective or improves on existing capabilities) and will not comprise the integrity and continuity of existing data streams and product delivery of the operational system. Operational groups, with the involvement of researchers, are primarily responsible for this stage.

Operational
Routine and sustained provision of data and data products in forms and at rates specified by user groups are performed by operational groups with researchers functioning as advisors and users. This stage is improved through the incorporation of elements that are successful in a pre-operational mode. The appropriate federal agency or regional association is responsible for the coordinated incorporation of such elements into the operational system, i.e., successful pre-operational projects, or elements thereof, are transferred to an operational agency, office, center or RA for incorporation into the operational system.

A procedure for transitioning elements along the four-stage process described above is required to ensure orderly development consistent with IOOS goals. The U.S. GOOS Steering Committee has released a draft document outlining a procedure for transitioning GOOS and IOOS elements from one development stage to the next. This document defines criteria to be used in deciding whether to advance developing elements along the four-stage process. GCOOS has adopted this approach that is described below.

Stage One to Stage Two: From Research and Technology to Pilot Project

Selection
1. The element serves an essential purpose or provides an essential product ("essential" means that long term implementation of a successful pilot project is assured).

Evaluation
2. The technology has been proven in concept to be superior and highly advantageous for the purposes intended.
3. (Financial and personnel) Capacities are sufficient to complete a pilot project.

Stage Two to Stage Three: from Pilot to Pre-Operational

Selection
1. The element serves the purposes (provides the product) intended.

---

Evaluation
2. The technology is fully functional under realistic conditions.
3. Capacities for long-term implementation remain firm.

Stage Three to Stage Four: Long-term Deployment of the Observing System Element

Selection
1. The element functions reliably for the purpose intended.

Evaluation
2. The technology is likely to remain superior and highly advantageous at least long enough to amortize the investment.
3. Capacities for long-term implementation are assured.

5.2 Investment Strategy

The GCOOS investment strategy is to allocate 10% of the budget to research projects, 35% to combined pilot and pre-operational projects, and 43% to operations. Administrative costs should be fixed at an inflation adjusted budget of $500,000 (2% of a $30M allocation). The remaining 10% is mandated for education and outreach activities. This strategy is based upon the following reasoning. The core of the IOOS is composed of the operational elements, and so a large fraction of the budget is dedicated to operations. As the IOOS matures and the operational system grows, it is expected that operational expenses will increase as a fraction of the overall budget while pilot and pre-operational efforts decline. Research projects are only allocated 10% because there are other avenues for funding (e.g., the NSF Orion program) and because there are many available instruments, numerical models, etc. that either have not been fully tested for operational use or are underutilized because of funding shortfalls. This is addressed by allocating the remaining 35% to pilot projects and pre-operational projects.

This investment strategy should be viewed as a guide to planning and not a rigid set of mandates for the budgeting process. As resources change, specific opportunities arise, or urgent problems that need more immediate response arise, the planning/budgeting process may deviate substantially from this guide, but in those cases justification should be documented.

5.3 Priorities

The priorities for research and development for GCOOS are broken down into those for the national backbone and those for regional observing system elements within GCOOS.

5.3.1 National Backbone
Along with the entire GOOS endeavor, continuation and expansion of the satellite remote sensing programs is a high priority for GCOOS. This is particularly so of developments that will lead to both better processing algorithms and spatial/temporal sampling in the coastal regime.
1. Efforts to improve DMAC compliance in the Gulf region
• NDBC is working with several Regional Observing Systems and providing a QA/QC and real-time data distribution service using a product called the "MODEM Kit". In the Gulf of Mexico NDBC is working with TABS, COMPS, TCOON, and LUMCON. This activity will be expanded to include other data providers so as to achieve complete integration of real-time measurements in the region.
• NDBC also places these data sets on a DODS server once a month. They will expand this to real-time on an OPENDAP server, using a Live Access Server as a user interface to keep current with the DMAC guidance.
• Transition the NDBC Real-Time OPENDAP server to operational status

2. Enhancement of NDBC buoy and C-MAN networks
   • Add wave directionality to wave height—useful for rip current forecasting and sediment transport estimation
   • Add visibility measurements—needed near the Mississippi River and other areas for biological productivity estimation and for river-ocean connection
   • Add acoustic Doppler current profilers—constraints for models and for HF radar network
   • Add ecosystem measurements, as feasible
   • Add water level measurements
   • Increase the number of stations in these networks by a factor of five, including additional meteorological stations in the near coastal zone for use in forecasting surface currents for HABSOS as well as improved regional models

3. Improve and enhance monitoring of water quality in watersheds, estuaries, and coastal to shelf waters, as well as fluxes between these entities. As recommended in the USCOP report, the Council on Environmental Quality is proposing a federal water quality initiative involving EPA, NOAA, and the USGS. A demonstration project in the Mississippi River watershed and the Gulf of Mexico would focus on nutrient enrichment issues, such as hypoxia. Along these lines, GCOOS would like to see:
   • Monitoring in additional streams
   • Monitoring to include nutrients and other ecosystem indicators, as well as flow rates—uses include monitoring coastal eutrophication

4. Establish long-range HF radar monitoring of surface currents as a part of the national surface current monitoring initiative being planned by Ocean.US.

5. Integration and assessment of numerical circulation models for the region One or more numerical circulation models, utilizing data assimilation, for the Gulf of Mexico should be added to the national backbone. The benefits of having both high density model data (compared to measured data density), which dynamically interpolates the observations, and the capability to forecast the ocean state, will greatly increase the usefulness of GCOOS.
   • Create a portal to outputs from all accessible full Gulf models
   • Assemble and assess the skill of these models
   • Provide boundary conditions for smaller-scale coastal and estuarine models

6. Integrate water level network for Gulf of Mexico.
   • Adjust all water level measurements to a common set of datums
• Analyze all extant water level records for regional trends and assess new requirements
• Expand NWLON (NOS National Water Level Network) as needed based on foregoing activities

7. Development of a deep-ocean, advanced capability sentinel station. Envisioned is a station with a measurement suite capable of characterizing the environment from the sea floor to the troposphere (-3000 m to +3000 m). It would serve both as a sentinel station in the U.S. EEZ but also as a test bed for advanced technology.

5.3.2 Regional Observing System Research Priorities
These priorities are predicated on the assumption that the priority enhancements to the national backbone will be forthcoming. A high priority is a set aside of regional funds for education and outreach. High priority outreach areas are the identification of system users and capacity building between Gulf states (U.S. and Mexican) for harmful algal bloom measurements.

1. Enhance and expand the real-time networks of COMPS, LUMCON, TABS, TCOON, WAVCIS, and other extant observing system elements. [COMPS costs will be budgeted via SERA-COOS.] This will include:
   • Expand LUMCON observing system by one offshore station per year beginning in 2007.
   • Strengthen TCOON platforms against hurricanes.
   • Upgrade TCOON with improved data communication capability to reduce data delay.
   • Place new sensors on COMPS, TABS, LUMCON, and other elements serving data in real-time via MODEM Kit to OPENDAP server.
   • Expand COMPS buoy and HF radar sites, expand types of measurements, and provide adequate auxiliary supplies.
   • Enhance and expand TABS to improve near shore coverage in southwest region and include meteorological packages on all platforms.
   • Expand CenGOOS to improve coverage in the region off eastern Louisiana, Mississippi and Alabama.

2. Technology development for ecological monitoring, particularly for use in HABSOS, and hypoxia study.
   Moored sites will be used to test and evaluate new technology, and proven instrumentation will be added. This will be carried out at sites of TABS, COMPS (budgeted as part of SERA-COOS) and perhaps other elements.

3. Project to develop and improve products and services
   This must be joint public-private venture from the beginning. Some new products may be envisioned as being produced and sold by the private sector. Other new products may be envisioned to be produced for the common good, and those might be handed off to NOAA's Coastal Services Center for routine production and distribution. New products and services may include reanalysis and archiving in web accessible databases of legacy data.

4. Ground support for non-real-time activities, including:
   • Evaluation of developing technology
   • Calibration/validation of satellite remotely sensed measures
5. Expansion of surface current measurement near coasts and in estuaries using short-range HF radar systems.

6. Pilot project demonstrating the use of fiber optic cable for data retrieval and instrument control in the IOOS.

7. Pilot project to retrieve deep current data being collected by oil industry and MMS and to begin selected use of these data
   • Systematic monitoring of deep currents
   • Model improvements

8. Monitoring of effects of river input (e.g., the Mississippi River) on the region.
   This is of very high priority, but design will require time and effort. Sought is the ability to track outflow, spreading, stratification, and effects of river water and constituents. This likely will include:
   • Major densification of present levels of measurements, both spatially and temporally.
   • A concerted modeling effort
   • Coordinated data integration
   • Development of products and reporting

9. Hydrographic science projects to support the IOOS goals. This includes GPS buoys for offshore water level monitoring, surveys to provide high resolution bathymetry and topography across the land-sea interface between 30 m above and 30 m below the mean low water level, and sediment and bottom habitat characterizations.

6. Training
   Two main goals of IOOS education and communications are to 1) develop and sustain a broad educational community that uses IOOS data and information to help achieve their educational objectives, and 2) build the workforce needed to develop and sustain the IOOS as well as providing attendant information products, services and tools (Promoting Lifelong Ocean Education, The National Office for Integrated and Sustained Ocean Observations, Ocean.US Publication No. 4, 2005, hereinafter PLOE2005). Of immediate concern to the RCOOS is the need to create the workforce that will be necessary to develop and sustain the IOOS. The technical capabilities needed for the IOOS ranges from information specialists (e.g., GIS experts) to technicians who can service and maintain a large observational infrastructure. Certification programs do exist for some of these occupations, however, certification is presently not available for oceanographic technicians. Ocean.US recognizes this problem and has plans to encourage professional societies to develop a certification program or programs, but implementation of those plans are projected 7-10 years from now in Phase III of the IOOS educational development plan.

   Two crucial missing pieces of information required to accurately access the needs for both training and certification programs are 1) what are the current workforce needs for oceanographic technicians and 2) how do those needs project into the future? Phase I of the development of education allied with IOOS from PLOE2005 includes performing these studies
over the next 3 years. However, it is clear that we can't afford to wait for the answers to these questions to begin developing plans for training.

Training of technical people for careers related to the IOOS can range from vocational technical training through to graduate degrees. Following general IOOS design principals, the education plan for the IOOS is to:

- build upon the best existing programs
- ensure quality programs are built in a sustainable manner, with scalability of efforts
- foster partnerships among all organizational sectors (PLOS2005). Our first step in this endeavor is to inventory existing relevant technical programs in the Gulf Coast states. Table 6.1 is a first attempt at creating an inventory of such programs.

### Table 6.1 Marine related educational and training programs in the Gulf Coast states.

<table>
<thead>
<tr>
<th>Institution</th>
<th>Department/Division</th>
<th>Degree/Certification</th>
<th>Program</th>
<th>Contact</th>
</tr>
</thead>
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<td>The University of Southern Mississippi</td>
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<tr>
<td>Texas A&amp;M University, College Station</td>
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<td>Coastal and Ocean Engineering</td>
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<td>University of South Florida</td>
<td>College of Marine Science</td>
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<td>Marine Science</td>
<td><a href="http://www.marine.usf.edu/">http://www.marine.usf.edu/</a></td>
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<td>University of South Alabama</td>
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<tr>
<td>University of Mississippi</td>
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<td>Florida Atlantic University</td>
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<td>University of Florida</td>
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Oceanographic Engineering Program  Oceanographic Engineering  http://www.coastal.ufl.edu/

University of Miami  Rosenstiel School of Marine & Atmospheric Science  BS  Marine Science  http://mscserver.cox.miami.edu/newweb/programs.html

         MS  Marine Science  
         MS  Applied Marine Physics  http://www.miami.edu/umbulletin/grad/marine/index.htm#amp

College of Engineering  MSOE  Ocean Engineering

### Associates Degrees

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<td>Alvin Community College</td>
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### Non-degree Programs

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<th>Program</th>
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<td>Certificate</td>
<td>Hydrographic Science Workshops</td>
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<td>Alvin Community College</td>
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<td>Louisiana Technical College</td>
<td>Young Memorial Campus</td>
<td>Certificate</td>
<td>Marine Operations</td>
<td><a href="http://www.ltc.edu/youngmemorial/">http://www.ltc.edu/youngmemorial/</a></td>
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**7. Funding**

**7.1 Budget**

The budgeting process within GCOOS will operate under the guidance of the overall investment strategy (discussed in Section 5) that has been developed to meet the GCOOS objectives and goals. The budget is presented in two tables. Table 7-1 presents the budget for enhancements to the national backbone in the GOM for FT2005-2011. Tables 7-2a and 7.2b present the budget for operations and enhancements to the regional association during the same period.

**7.2 Planning and Budget Development**

The five year budget and planning cycle of IOOS is outlined in Table 1 from the first volume of the Ocean.US implementation plan (reprinted here as Table 7-3).
The annual budget and planning process for GCOOS is synchronous with the Ocean.US process outlined in Table 7-3. Each year GCOOS will develop a detailed budget for the next year, less detailed budgets for the following four years, a status report, annual performance review, requests to migrate elements and/or projects to a higher stage in the sequence of development of the operational IOOS, and a request to enhance or add elements and products. Ocean.US will use all of the submitted reports for their Year N-3 planning. The detailed budget will be used as guidance for the Year N-1 President's draft budget. The previous year's detailed budget will be used as guidance for the present year's appropriations bills.

The GCOOS Board of Directors is responsible for submitting the reports to Ocean.US. Outlined below are the responsibilities within GCOOS to produce reports and submit them to the Board of Directors for approval:

- **Status Report** - GCOOS Regional Coordinator
- **Budget** - Board of Directors
- **Annual Performance Review** - the Board of Directors will submit an annual performance review to Ocean.US. The Regional Coordinator will submit a draft to the Board, using as guidance separate annual performance reviews from each of the following entities: The Regional Coordinator, the Educational and Outreach Council, the DMAC committee, the Observing System Committee, the Products and Services Committee, and the User Council. Additionally, each of these entities will submit, directly to the Board, a separate performance review of the Regional Coordinator.
- **Requests to Migrate Elements** - GCOOS Regional Coordinator will have responsibility to produce this report based on input and feedback from the Observing System Committee and the User Council.
- **Requests to Enhance/Add Elements and Products** - GCOOS Regional Coordinator will have the responsibility to produce this request based upon input and feedback from the Observing System Committee, the Products and Services Committee, and the User Council.
### Table 7-1. GCOOS National Backbone Enhancements

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<td>2. Enhance NDBC buoy &amp; C-MAN</td>
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<td>1520</td>
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<td>400</td>
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<td>5. Advanced capability sentinel station</td>
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## Table 7-2a. GCOOS Operations and Enhancements FY 2005-2008

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<td>Op</td>
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<td>2. Operations Center</td>
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<td>Op</td>
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<tr>
<td>3. Enhancing &amp; expanding extant real-time monitoring</td>
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<td>4. Tech. Develop, Ground Support for sat cal/val, instrument test/evaluation</td>
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<td>6. Integrate &amp; evaluate Gulf models</td>
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<td>260</td>
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<td>1000</td>
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<td>7. Demonstration of use of fiber cable in GCOOS and Sentintel Station(s)</td>
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<td>—</td>
<td>600</td>
<td>475</td>
</tr>
<tr>
<td>8. Use of deep ADCP data for monitoring, model validation, assimilation</td>
<td>—</td>
<td>—</td>
<td>200</td>
<td>600</td>
</tr>
<tr>
<td>9. Monitoring/modeling effects of river input</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>5000</td>
</tr>
<tr>
<td>10. Long-range HF radar surface current monitoring</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1320</td>
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</tbody>
</table>

<table>
<thead>
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<th></th>
<th>%</th>
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</tr>
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<tbody>
<tr>
<td>Total Administrative</td>
<td>237</td>
<td>66</td>
<td>247</td>
<td>43</td>
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<td>Total Education and Outreach</td>
<td>48</td>
<td>13</td>
<td>64</td>
<td>11</td>
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<tr>
<td>Total R&amp;D</td>
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<td>130</td>
<td>23</td>
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<tr>
<td>Total Pilot</td>
<td>0</td>
<td>0</td>
<td>1580</td>
<td>12</td>
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<td>Total Pre-Operational</td>
<td>80</td>
<td>22</td>
<td>130</td>
<td>23</td>
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<tr>
<td>Total Operations</td>
<td>80</td>
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<td>Total</td>
<td>365</td>
<td>100</td>
<td>571</td>
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Table 7-2b. GCOOS Operations and Enhancements FY 2009-2011

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<thead>
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<th>GCOOS RA Enhancements</th>
<th>FY 2009</th>
<th>FY 2010</th>
<th>FY 2011</th>
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<tr>
<td></td>
<td>($1,000)</td>
<td>($1,000)</td>
<td>($1,000)</td>
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<tr>
<td>RA Administration</td>
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<td>500</td>
<td>500</td>
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<tr>
<td>Incl. Education &amp; Outreach</td>
<td>2700</td>
<td>2900</td>
<td>3000</td>
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<tr>
<td>1. Ongoing operational observing elements</td>
<td>4800</td>
<td>4800</td>
<td>4800</td>
</tr>
<tr>
<td>Op</td>
<td>Op</td>
<td>Op</td>
<td>Op</td>
</tr>
<tr>
<td>2. Operations Center</td>
<td>500</td>
<td>500</td>
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</tr>
<tr>
<td>Op</td>
<td>Op</td>
<td>Op</td>
<td>Op</td>
</tr>
<tr>
<td>3. Enhancing &amp; expanding extant real-time monitoring</td>
<td>6375</td>
<td>5355</td>
<td>5360</td>
</tr>
<tr>
<td>Op</td>
<td>Op</td>
<td>Op</td>
<td>Op</td>
</tr>
<tr>
<td>4. Tech. Develop, Ground Support for sat cal/val, instrument test/evaluation</td>
<td>900</td>
<td>800</td>
<td>2300</td>
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<tr>
<td>R&amp;D, Pilot</td>
<td>R&amp;D, Pilot</td>
<td>R&amp;D, Pilot</td>
<td></td>
</tr>
<tr>
<td>5. Ground support for satellite and instrument cal/val</td>
<td>1340</td>
<td>1840</td>
<td>1840</td>
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<tr>
<td>R&amp;D</td>
<td>R&amp;D</td>
<td>R&amp;D</td>
<td>R&amp;D</td>
</tr>
<tr>
<td>5. Development of products and information</td>
<td>2000</td>
<td>2700</td>
<td>2800</td>
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<tr>
<td>Pilot, PreOp</td>
<td>Pilot, PreOp, Op</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Integrate &amp; evaluate Gulf models</td>
<td>1800</td>
<td>1800</td>
<td>1000</td>
</tr>
<tr>
<td>Op, R&amp;D</td>
<td>Op, R&amp;D</td>
<td>Op, R&amp;D</td>
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</tr>
<tr>
<td>7. Demonstration of use of fiber cable in GCOOS and Sentintel Station(s)</td>
<td>750</td>
<td>1000</td>
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</tr>
<tr>
<td>Pilot</td>
<td>Pre-Op</td>
<td>Pre-Op</td>
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</tr>
<tr>
<td>8. Use of deep ADCP data for monitoring, model validation, assimilation</td>
<td>600</td>
<td>1000</td>
<td>1000</td>
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<tr>
<td>Pilot</td>
<td>Pre-Op</td>
<td>Pre-Op</td>
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</tr>
<tr>
<td>9. Monitoring/modeling effects of river input</td>
<td>3000</td>
<td>3000</td>
<td>3000</td>
</tr>
<tr>
<td>Pilot</td>
<td>Pilot</td>
<td>Pilot</td>
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<tr>
<td>10. Long-range HF radar surface current monitoring</td>
<td>1000</td>
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<td>1000</td>
</tr>
<tr>
<td>Pilot</td>
<td>Pilot</td>
<td>Pilot</td>
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</tr>
<tr>
<td>11. Hydrographic Science Support</td>
<td>1400</td>
<td>1700</td>
<td>1900</td>
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<td>R&amp;D, Pilot, OP</td>
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<td></td>
</tr>
<tr>
<td>Total Administrative</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Total Education and Outreach</td>
<td>2700</td>
<td>2900</td>
<td>3000</td>
</tr>
<tr>
<td>Total R&amp;D</td>
<td>3157</td>
<td>3565</td>
<td>3965</td>
</tr>
<tr>
<td>Total Pilot</td>
<td>7267</td>
<td>5725</td>
<td>6558</td>
</tr>
<tr>
<td>Total Pre-Operational</td>
<td>1000</td>
<td>3325</td>
<td>3408</td>
</tr>
<tr>
<td>Total Operations</td>
<td>13042</td>
<td>12880</td>
<td>12568</td>
</tr>
<tr>
<td>Total</td>
<td>27665</td>
<td>28895</td>
<td>30000</td>
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</table>

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Total Administrative</td>
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<td>Total R&amp;D</td>
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<tr>
<td>Total Pilot</td>
<td>7267</td>
<td>5725</td>
<td>6558</td>
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<tr>
<td>Total Pre-Operational</td>
<td>1000</td>
<td>3325</td>
<td>3408</td>
</tr>
<tr>
<td>Total Operations</td>
<td>13042</td>
<td>12880</td>
<td>12568</td>
</tr>
<tr>
<td>Total</td>
<td>27665</td>
<td>28895</td>
<td>30000</td>
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</table>
Table 7-3. Ocean.US four-year planning cycle from IOOS Development Plan.

<table>
<thead>
<tr>
<th>Year N-3</th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>May</td>
<td>Observing system status reports and proposals for improvement compiled by Ocean.US</td>
<td></td>
</tr>
<tr>
<td>July-Sept</td>
<td>Status reports and plans for future operations and development transmitted to government agencies</td>
<td></td>
</tr>
<tr>
<td>Sept</td>
<td>Guidelines for integrated development of the IOOS provided by Ocean.US</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year N-2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-Aug</td>
<td>Guidelines used by agencies to specify budgets for IOOS operation and development</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year N-1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct-Dec</td>
<td>President's budget drafted and reviewed by the OMB. Integrated IOOS plan prepared by Ocean.US. Consolidated multi-agency budget prepared by NOAA</td>
<td></td>
</tr>
<tr>
<td>Feb</td>
<td>President's budget submitted to Congress for approval and appropriation of resources for the IOOS</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year N</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct-Dec</td>
<td>Appropriations finalized for Congress, implementation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year N+1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>Solicitations generated for new starts and renewals (RFPs or BAAAs)</td>
<td></td>
</tr>
<tr>
<td>Mar-May</td>
<td>Performance evaluation and verification</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>New starts/renewals begin</td>
<td></td>
</tr>
</tbody>
</table>

### 7.3 Income

For FY2004-2005 GCOOS has $106,143 in funding from the NOAA Coastal Services Center to help develop the GCOOS-RA. A proposal for funding through FY2005-2008 has been submitted. The requested funding is only for administrative, educational, and outreach activities.

### 8. System Performance

The evaluation of the GCOOS is critical to its continued improvement. This section identifies the methodology to be used in the routine evaluation of the success of the system and its elements.

#### 8.1 Maintaining Operational Continuity

Operational continuity will be monitored on a continuous basis by the IOOS Operations Center with assistance of the GCOOS Operations Center Office.

##### 8.1.1 Monitoring operations

The GCOOS Operations Center Office will adopt and employ metrics to routinely monitor the continuing production of data and products according to plans agreed to by the GCOOS DMAC, Observing Systems, and Products and Services Committees, the operators of the system elements and the IOOS Operations Center. These metrics will enable evaluation of the performance of the extant elements as well as the performance of the whole relative to the system envisioned for the future. To the extent possible, metrics being developed for WMO-IOOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) will be used.
When faulty data or flawed products are discovered, they will no longer be made available to potential users via the IOOS Operations Center’s servers. System element operators responsible for these data or products will be notified immediately. Notice of such problems will be available to potential users via the Center's servers.

8.1.2 Monitoring quality control
Agreed to plans for instrument calibration and validation and for servicing of in situ instrumentation will be provided to and maintained by the GCOOS Operations Center Office and forwarded to the IOOS Operations Center. The IOOS Operations Center will contact operators of system elements to help ensure that such plans are met.

In cases when calibration/validation or servicing are not being performed on schedule, the GCOOS Operations Center Office will forward that information to the IOOS Operations Center so that it can make a note of it when providing the resulting information.

8.2 User Satisfaction

The GCOOS Operations Center Office will serve as a link to receive user comments and suggestions via phone or email. Feedback from users on desired system enhancements will be provided to the GCOOS Office, which will forward the information to the appropriate GCOOS Committee(s) for their consideration and use in making recommendations to the Board. Complaints will trigger immediate transfer of information to system element operators. The information transferred in these exchanges will become part of the system's performance metrics (Section 8.1). This will provide a procedure for obtaining and responding to user feedback concerning timely delivery, quality, and usefulness of products. The GCOOS Operations Center Office will identify the measures taken to improve user satisfaction. Based on this information the GCOOS Office will prepare evaluations of the effectiveness of the measures taken. The Office will maintain a record of complaints, remedying actions, and their success/failures.

A record of success stories and of endorsements of GCOOS by users will be maintained by the GCOOS Office. This information will be shared with other IOOS Regional Associations via the NFRA.

In addition to the passive collection of user comments and suggestions, the GCOOS Office will fund studies that actively solicit user satisfaction, desires for improvements and additions, and information that will for enhancements which will increase the user base. This activity will be part of the education and outreach efforts of the Office that include the activities discussed in the following subsections.

8.3 Gap Analysis

Based on the GCOOS user requirements developed by the GCOOS Office with assistance from the Stakeholder Council and Education and Outreach Council, plans for data, products, and services will be developed by the Observing Systems (OS) Committee and the Products and Services (P&S) Committee. Pending approval by the Board, they will be incorporated into the next version of the GCOOS Business Plan.
It will then be the responsibility of the relevant committees (DMAC, OS, and P&S) to recommend priorities for addressing gaps between the capabilities of the extant system of systems and the required capabilities in the Business Plan. In recommending priorities, the committees will be informed by information from the Operations Center and assisted by the GCOOS Office staff. Recommended priorities for improvements and enhancements will be considered by the Board. Agreed priorities and estimated budgets required to carry out the actions will be included in the Business Plan. Funds will be sought from appropriate sources and awarded to operators of the appropriate system elements.

8.4 Cost/Benefit

An initial order of magnitude of economic benefits to eleven different sectors in the Gulf of Mexico as a result of GCOOS development has been made by Charles Colgan and Hauke Kite-Powell [see Executive Summary at http://ocean.tamu.edu/GOOS/publications.html]. The GCOOS-RA intends to work with economists to produce a more careful estimate of economic benefits likely to result from GCOOS. We have expressed our interest in working with Colgan and associates to refine the potential economic benefits of GCOOS to user sectors in the Gulf.

Once economic benefits have been identified they can be compared with estimated costs of providing the necessary information. This information will be used to justify the system, but also will be useful in identifying priorities for system improvements and enhancements.

9. References


APPENDIX 1
Southern Association of Marine Laboratories (SAML) 2000
Gulf Coastal Laboratories

REGULAR MEMBERS

Center for Coastal Studies
Texas A&M University B Corpus Christi
6300 Ocean Drive; Suite 3200
Corpus Christi, TX 78412
Phone: (361) 825-2736
Fax: (361) 825-2770
jtunnell@falcon.tamucc.edu

Coastal Fisheries Branch
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744
Phone: (512) 389-4651; FAX (512) 389-4388
gene.mccarty@tpwd.state.tx.us

Coastal Studies Laboratory
University of Texas - Pan American
100 Marine Lab Drive
South Padre Island, Texas 78597
Phone: (956) 761-2644; FAX (956) 761-2644
hockaday@panam.edu

College of Marine Science
University of South Florida
140 Seventh Avenue S.
St. Petersburg, Florida 33701
Phone: (727) 553-3940; FAX (727) 553-3968
pbetzer@marine.usf.edu

Conrad Blucher Institute for Surveying & Science
Texas A&M University - Corpus Christi
6300 Ocean Drive
Corpus Christi, TX 78412
Phone: (361)825-2646; Fax: (361) 825-2715
bonner@acs.tamu.edu

Dauphin Island Sea Lab
Marine Environmental Sciences Consortium
101 Bienville Blvd.
Dauphin Island, Alabama 36528
Phone: (251) 861-7505; FAX (251) 861-7506
gcrozier@disl.org

Florida Marine Research Institute
Department of Environmental Protection
100 Eighth Ave. S.E.
St. Petersburg, Florida 33701-5095
Phone: (727) 896-8626; FAX (727) 823-0166
ken.haddad@fwc.state.fl.us
Florida State University Marine Laboratory
Florida State University
Tallahassee, Florida 32306-4032
Phone: (850) 644-4066; FAX (850) 644-8297
marcus@ocean.fsu.edu

Galbraith Marine Science Laboratory
Eckerd College
4200 54th Avenue South
St. Petersburg, Florida 33711
Phone: (727) 864-8991; FAX (727) 864-7964
thompsjb@eckerd.edu

Institute of Marine Sciences
University of Southern Mississippi
703 East Beach Dr., P.O. Box 7000
Ocean Springs, Mississippi 39566-7000
Phone: (228) 872-4211; FAX (228) 872-4279
jay.grimes@usm.edu

Keys Marine Laboratory
Florida Institute of Oceanography
830 First Street South
St. Petersburg, Florida 33701
Phone: (727)553-1100; FAX: (727) 552-1109
jogden@marine.usf.edu

Louisiana Universities
Marine Consortium (LUMCON)
8124 Hwy. 56
Chauvin, Louisiana 70344-2124
Phone: (504) 851-2803; FAX (504) 851-2874
mdagg@lumcon.edu

Marine Biomedical Institute
University of Texas Medical Branch
301 University Blvd., League Hall
Galveston, Texas 77555-1163
Phone: (409) 772-2133; FAX (409) 772-6993
plee@mbian.utmb.edu

Marine Science Institute
University of Texas - Austin
750 Channel View Drive
Port Aransas, Texas 78373
Phone: (361) 749-6730; FAX (361) 749-6777
gardner@utmsi.utexas.edu

Mote Marine Laboratory
1600 Ken Thompson Parkway
Sarasota, Florida 34236
Phone: (941) 388-4441; FAX (941) 388-4312
kumar@mote.org
Coastal Laboratories - SAML

Rosenstiel School, Marine & Atmospheric Science
University of Miami
4600 Rickenbacker Causeway
Miami, Florida 33149-1098
Phone: (305) 361-4000; FAX (305) 361-4711
obrown@rsmas.miami.edu

Seahorse Key Marine Laboratory
University of Florida
122 Bartram Hall
P.O. Box 118525
Gainesville, FL 32611-8525
Phone: (352) 392-1101; FAX: (352) 392-3704
hbl@zoo.ulf.edu

Texas Institute of Oceanography
Texas A&M University - Galveston
P.O. Box 1675
Galveston, Texas 77553-1675
Phone: (409) 740-4937; FAX (409) 740-4754
jonesg@tamug.tamu.edu

ASSOCIATE MEMBERS: (NMFS)

Galveston Laboratory
National Marine Fisheries Service
4700 Ave. U
Galveston, Texas 77550
Phone: (409) 766-3500; FAX (409) 755-3508
roger.zimmerman@noaa.gov

Panama City Laboratory
National Marine Fisheries Service
3500 Delwood Beach Rd.
Panama City, Florida 32407
Phone: (904) 234-6541; FAX (904) 235-3559
herb.kumpf@noaa.gov

Pascagoula City Laboratory
National Marine Fisheries Service
P.O. Box 1207
Pascagoula, Mississippi 39567
Phone: (601) 762-4591; FAX (601) 769-9200
scott.nichols@noaa.gov

Gulf Ecology Division
Environmental Protection Agency
One Sabine Island Drive
Gulf Breeze, Florida 32561
Phone: (850) 934-9208; FAX (850) 934-9201
benson.william@epamail.epa.gov
# APPENDIX 2
For-Profit Groups from the Private Sector

<table>
<thead>
<tr>
<th>Sector</th>
<th>Activity</th>
<th>Information Required</th>
<th>Benefits</th>
<th>User Group</th>
<th>Time of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil and Gas</td>
<td>Exploration, production, and transportation of oil and natural gas</td>
<td>Better, faster, and more valuable weather information to improve forecast</td>
<td>Decision to evacuate or not personnel from oil platforms</td>
<td>Oil and Gas companies operating in the Gulf of Mexico</td>
<td>Need information on a timely basis before severe storms hit specific geographic locations</td>
</tr>
<tr>
<td>Oil Field Services</td>
<td>Provides equipment, maintenance and engineering, and construction to oil and gas companies</td>
<td>Better, faster, and more valuable weather information to improve forecast</td>
<td>Decision to evacuate or not personnel from oil rigs. Forecast damage to facilities. Avoid loss of life or injuries. Ensure continuous technical support by monitoring critical environmental conditions</td>
<td>Oil field services companies operating in the Gulf of Mexico</td>
<td>Need information on a timely basis to monitor weather conditions.</td>
</tr>
<tr>
<td>Insurance</td>
<td>Insurance Premiums Reinsurance brokering Claims Catastrophe Risk Models</td>
<td>More valuable weather data for input to catastrophe models. Storm tracking Historical Records Weather Forecast Flood warnings</td>
<td>Prepare for severe storm conditions Evaluate losses Assess value of properties vulnerable to storm surge and flooding Improve transactions and “due diligence”</td>
<td>Insurance companies operating in Texas, Louisiana, Mississippi, Alabama, Georgia and Florida.</td>
<td>Need information on a timely basis before severe storms hit specific geographic locations? Need historical records.</td>
</tr>
<tr>
<td>Financial Institutions</td>
<td>Financial market (stock assessment) Risk exposure Credit approvals</td>
<td>Better data and more valuable weather information to support financial decisions Historical Records</td>
<td>Short/long term investment analysis</td>
<td>Financial institutions operating in Texas, Louisiana, Mississippi, Alabama, Georgia and Florida.</td>
<td>Need all historical and present information to forecast risk</td>
</tr>
<tr>
<td><strong>Agriculture</strong></td>
<td>Transportation, storing, processing, and merchandising agricultural commodities</td>
<td>Better data and more valuable weather information to predict crop damages and safe, secure, efficient transportation</td>
<td>Improve transactions Prepare for weather severe conditions Reduced loss</td>
<td>Agriculture and food industries operating in Texas, Louisiana, Mississippi, Alabama, Georgia and Florida.</td>
<td>Need weather information on a timely basis to make the right decisions before severe weather hit specific geographic locations</td>
</tr>
<tr>
<td><strong>Fishing</strong></td>
<td>Commercial fisheries</td>
<td>Secure reliable weather information Forecast water levels to avoid damage to fish farms Forecast conditions that trigger in abundance of plankton that produce harmful algal blooms</td>
<td>Prepare for severe weather conditions Reduced loss</td>
<td>Fishing industry in the Gulf of Mexico</td>
<td>Timely data on storms and currents (dispersal of harmful algal blooms)</td>
</tr>
</tbody>
</table>
APPENDIX 3
Organizations Represented in Southern Association of Marine Educators

Alabama 4-H Youth Development Center
Alabama Cooperative Extension
Audubon Aquarium of Americas, LA
Baruch Marine Lab, SC
Big Lagoon State Park, FL
BREC Bluebonnet Swamp Nature Center, LA
Barataria Terrebonne National’ Estuary Program, LA
Camp Timpoochee 4-H Center, FL
Challenger Learning Center, LA
Dauphin Island Sea Lab, AL
Florida Department of Environmental Protection
Florida Park Service
Grand Bay National Estuarine Research, MS
Gulf Islands National Seashore, MS
Henderson State University, AR
J L Scott Marine Education Center, MS
Lake Pontchartrain Basin Foundation, LA
Louisiana Sea Grant
Louisiana Department of Wildlife & Fisheries
Louisiana Department of Education
Louisiana State University
LSU AG Center
Louisiana University Marine Consortium
McWane Center, AL
Mississippi Delta Community College
Mississippi Department of Marine Resources
Monterey Bay Aquarium, AL
MSU Extension Service, Coastal Restoration
Naval Oceanographic Office Stennis, MS
Nunez Community College, LA
Pearl River Community College, MS
Sea Grant Law Center -University of Mississippi
Southeastern Louisiana University
The Nature Conservancy, MS
Turtle Point Science Center, AL
Tuskegee University, AL
University of West Alabama
Weeks Bay National Estuarine Reserve, AL

Alabama Schools Represented in SAME:

Alabama School of Math & Science
Birmingham Public Schools
Curry Elementary
Fairfield High Preparatory School
Fairhope High School
Farley Elementary
Fleeta Junior High
Mobile County Public School System
Mountain Brook High School
Munford High School
Oliver Elementary
Oneota High School
Oxford High School
Robertsdale High School
Russellville High School
Satsuma High School
Sheffield Junior High School
Sidney Lanier High School
Southside Middle School
St. Clair County High School
St. Paul's
Stanhope Elmore High School
Vigor High School

Florida Schools Represented in SAME:

Destin Elementary School
Holley-Navarre Intermediate
St. Michael Interparochial School
Walton High School

Louisiana Schools Represented in SAME:

A. F. Smith Middle Magnet School
Acadian Elementary School
Berwick High School
Capitol High School
DeRidder Junior High
Edgar Martin Middle School
Fellowship Elementary
Grace King High School
Henry Ford Jr. High
Hynes Elementary
McDonogh #35 High School
Northshore High School
Pointe Coupee Central High
St. Charles Parish School Board

Mississippi Schools Represented in SAME:

Bayou View Middle School
Bruce High School
D'Iberville High School
Hancock High School
Long Beach High School
Magnolia Junior High
Meridan Public School System
N. Woolmarket School
Oakland Heights Elementary
Ocean Springs High School
Pass Christian Middle School
St. Joseph High School
Tupelo Middle School
Wesson High School
West Marion Jr. High School
### APPENDIX 4: GULF RESTORATION NETWORK MEMBERSHIP

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
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<tbody>
<tr>
<td>Alabama Environmental Council</td>
<td>Birmingham, AL</td>
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<tr>
<td>Alabama Rivers Alliance</td>
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<td>Alliance for Affordable Energy</td>
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<tr>
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<tr>
<td>Bayou Preservation Association</td>
<td>Houston, TX</td>
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<td>Coalition to Restore Coastal Louisiana</td>
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<td>Hammond, LA</td>
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<tr>
<td>U.S. Public Interest Research Group, Gulf States Field Office</td>
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<tr>
<td>Wetlands Watch</td>
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