The Global Ocean Observing System (GOOS) and the U.S. Integrated Ocean Observing System (IOOS); with focus on the National Backbone

GCOOS Meetings
24-27 April 2006
Biloxi, MS
Outline

• Global Ocean Observing System

• U.S. Integrated Ocean Observing System
  - Background
  - The Global Module
  - The Coastal Module
  - The National Backbone
Global Ocean Observing System (GOOS)
Global Ocean Observing System (GOOS)

- GOOS is an end-to-end system of observations, data management, and production and delivery of products/services.

- GOOS is being coordinated by United Nation agencies with the participation of some 100 ocean nations.

The GOOS Modules

The Global Ocean Observing System (GOOS) has been designed and is being implemented in two modules:

- The **global module** is designed to monitor, predict, and understand marine surface conditions and climate variability/change; and

- The **coastal module** is designed to sustain healthy marine ecosystems, ensure human health, promote safe and efficient marine transportation, enhance national security, and predict and mitigate against coastal hazards.

The U.S. contribution to GOOS is called the Integrated Ocean Observing System (IOOS).
U.S. Integrated Ocean Observing System (IOOS)
Background
1998 U.S. Congress Called for an Integrated Ocean Observing System (IOOS)

Provide Data/Info Required for More Rapid Detection & Timely Prediction of State Changes

- Improve the safety & efficiency of marine operations
- Improve homeland security
- Mitigate effects of natural hazards more effectively
- Improve predictions of climate change & their effects
- Minimize public health risks
- Protect & restore healthy ecosystems in coastal environments more effectively
- Sustain living marine resources

1 System, 7 Goals
Framework for IOOS

- Ocean.US formed in 2000
  - Governed by a federal Executive Committee
  - Prepare & maintain IOOS Development Plans
  - Coordinate interagency implementation

- 2004 U.S. Commission on Ocean Policy
  - Implement the IOOS
  - Implement ecosystem-based management approaches to natural resources & water quality
  - Strengthen the Regional Approach

- President’s Ocean Action Plan
  - Enhance Ocean Leadership & Coordination
  - Establish IOOS as part of GEOSS
  - Optimize & Harmonize Use & Conservation of Ocean, Coastal & Great Lakes
  - Manage Coasts & their Watersheds
  - Establish strong partnerships among stakeholders
Integrated Ocean Observing System (IOOS)

An End-to-End System that Routinely Provides Data & Information Specified by

Groups that Use, Depend on, Manage or Study Oceans & Coasts

(1) Analysis, Modeling

(2) Data Management & Communications

(3) Observing In Situ & Remote Sensing

GOOS

End To End
Integrated End – to – End System
Rapid Access to Diverse Data from Many Sources

- Satellites
- Aircraft
- Fixed Platforms
- Ships
- Drifters & Floats
- AUVs

Metadata standards
Data discovery
Data Management
Data transport
Online browse
Data archival

Observations → Data Telemetry ↔ Data Management & Communications ↔ Modeling & Analysis ↔ Products & Services

Maritime Navigational Services
Search & Rescue
Coastal Flooding & Erosion
Beach Closures
Water Management
Nutrient Management
Fisheries Management
Ecosystem-Based, Adaptive Management

- **Rapid & Repeated Detection** of changes
  - over a broad spectrum of time-space scales
- **Timely Predictions** of such changes

**Tune the flow of environmental data & information to the Time scales on which decisions should be made**

**WE DO NOT HAVE THIS CAPABILITY TODAY**
Why?

- Cultural divides
- Inefficient, ineffective data management
- Under sampling in time, space & ecological complexity
- Lack of capacity for rapid data acquisition & analysis
U.S. IOOS
Multi – Scale Hierarchy of Observations

Global Ocean Climate Component
GOOS/GCOS

Coastal Ocean Component

Regional Observing Systems

National Backbone

Low

Resolution

High

H Isl

C Cal

S Cal

NW

GoA

GLs

NE

MAB

SE

Go Mex

Carrib

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The Global Module
Global Component of the GOOS Integrates Remote & In Situ Sensing

An International Collaboration
Broad Objectives of Ocean Component

- Monitoring and detection of climate change
- Seasonal-to-interannual climate prediction
- Marine and weather forecasts
- Short-range ocean forecasts
- Understanding decadal variations
- Support of scientific research
- Routine ocean state estimation

International coordination and oversight of the global ocean component is by the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology; U.S. participation is significant.
Key Actions

• Full implementation of the surface and subsurface observing networks
• Designate and support national agents for implementation and establish research-operational partnerships
• Timely, free, unrestricted data exchange and comprehensive data management procedures
• International standards for metadata for essential climate variables
• Develop more cost effective two-way communication technologies
• Develop integrated global climate product needs
Argo Network, as of February 2005

1671 Active Floats

Australia (44)  Canada (80)  Germany (80)  Mauritius (2)
China (13)  India (39)  Netherlands (3)  New Zealand (5)
European Union (36)  Ireland (1)  Norway (9)  Spain (9)
France (106)  Japan (279)  Portugal (2)  United Kingdom (3)
Korea (55)  Russia (4)  United States (8)

56% complete
GCOS Climate Reference Tide Gauge Stations

54% complete
The Coastal Module
Coastal Component

**Regional COOSs**
- Regional Associations Responsible
- Involve private & public sectors
- Inform Federal Agencies of user needs
- Enhance the backbone based on user needs
- Incorporate sub-regional systems

**National Backbone**
- Federal Agencies Responsible
- EEZ & Great Lakes
- Core variables required by regions & Federal Agencies
- Network of sentinel & reference stations
- Standards/Protocols
11 Groups Funded by NOAA Coastal Services Center to Establish Regional Associations (RAs)
IOOS & Data Management

• Data Management and Communications (DMAC) subsystem - a primary integrating mechanism for IOOS
• Framework to link diverse observing systems into an integrated, interoperable data-sharing network
• DMAC Plan: evolving recommended data and metadata standards, protocols, and operating practices
IOOS Coastal Backbone
Core Variables

• Geophysical
  - Sea surface meteorological variables
  - Land–Sea Stream flows
  - Sea level
  - Surface waves, currents
  - Ice distribution
  - Temperature, Salinity
  - Bathymetry

• Biophysical
  - Optical properties
  - Benthic habitats

• Chemical
  - pCO₂
  - Dissolved inorganic nutrients
  - Contaminants
  - Dissolved oxygen

• Biological
  - Fish species, abundance
  - Zooplankton species, abundance
  - Phytoplankton species, biomass (ocean color)
  - Waterborne pathogens
IOOS Coastal Component
High Priority Research & Pilot Projects

• **Surface current mapping**
  - Product: real-time surface current maps
  - HF-radar, remote & in situ sensing
  - Data assimilation–numerical modeling

• **Space–based remote sensing**
  - Improve chl algorithms for ocean color
  - Increase spatial, temporal, & spectral resolution
  - Sea surface salinity

• **Aircraft remote sensing of near shore environments**
  - LIDAR

• **Coupled physical–water quality/ecosystem models**
  - Ecosystem – Based Management

• **Glider development for *in situ* sensors**

• ***In situ* sensors for core variables**
  - Chemical & biological
IOOS Summary: Current Status

- **1st Annual IOOS Development Plan**
  - Global ocean–climate component being implemented
  - Initial backbone in place
  - Sub-regional coastal ocean observing systems funded
  - DMAC Plan completed

- **Regional groups funded to**
  - Form Regional Associations
  - Engage User Groups: Public & Private Sectors
  - Establish RCOOSs

- **Government support**
  - Current Funding: ~ $125 M
  - Executive order
  - Legislation in Congress to Authorize Additional Funding
The National Backbone
The National Backbone of the IOOS

U.S. IOOS
Multiscale System of Systems

- What is it?
- How will it be specified?
- How will it be implemented?
- How will it be funded?

Based on a Presentation by Tom Malone, Ocean.US Office
Background

• Spatial boundaries are blurred intentionally
  - Global & coastal components overlap.
  - RCOOSs overlap w/ the National Backbone & each other.
  - Fixed boundaries are needed for funding & accountability only.

• At this time, RCOOS development is focused on regional needs (or should be).

• As an integrated component of the IOOS, the Initial National Backbone (NB) exists in concept only.
  - The First IOOS Development Plan recommends
    - Existing operational assets for an initial observing subsystem for the NB;
    - Road map for developing the DMAC subsystem
  - As the DMAC subsystem comes into being, the NB will transition from concept to reality.
  - At this time, the recommended NB assets are funded & operated by federal agencies for the most part.
What is the NB in Concept?

- **Initial** Observing Subsystem Infrastructure
  
  - Measures the core variables in the nation’s Exclusive Economic Zone & Great Lakes
  - Transmits DMAC-compliant data to data assembly centers routinely & reliably
  - Remote sensing: sea surface temperature only
  - *In situ* sensing: Sparse network of sentinel & reference stations
Programs Recommended for NB

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<tr>
<th>Core Variable</th>
<th>NOAA</th>
<th>Navy</th>
<th>USACE</th>
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# Programs Recommended for NB (continued)

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## Societal Goals & NB Programs

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Next Steps

• Initial NB recommended in the 1st IOOS Development Plan
  ➢ Does not include elements of regional or subregional observing systems at this time.

• Phased development of the NB
  ➢ Stage 1: Identify Building Blocks (Today)
    • Initial NB as recommended in 1st IOOS DP & IOOS DP: FY 2006 – 2008
    • Initial DMAC subsystem implemented
    • All elements of the IOOS becoming DMAC compliant.
    • Regional & subregional elements incorporated into the NB based on user needs & recommendations in IOOS Development Plans
  ➢ Stage 3: Transition to a fully user–driven system (2008 – )
    • Must be DMAC compliant & support products & services requiring data integration
    • RCOOSs become integral part of the IOOS as a whole
How Will It Be Specified & Implemented?

- Ocean.US Responsible for Design Specifications & Development Plans
  - IOOS Implementation Conferences
    - Federal Agencies ↔ Regional Associations
  - IOOS Development Plans
    - Ocean.US ↔ Joint Subcommittee on Ocean Science and Technology (JSOST)
- Federal Agencies & RAs responsible for implementation
How Will It Be Funded?

IOOS Funding Model

- Non-Federal Funding
- RCOOSs
- Federal Funding
- RCOOSs
- Federal Funding
- National Backbone
- Federal Funding
- RA Administration
Thank You

• GOOS International
  http://ioc.unesco.org/goos/

• GOOS U.S.
  http://www-ocean.tamu.edu/GOOS/

• IOOS – Ocean.US
  http://ocean.us/