

# Role of Ocean Observing Systems in Ocean Research

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Support provided by the National Science Foundation  
Division of Ocean Sciences



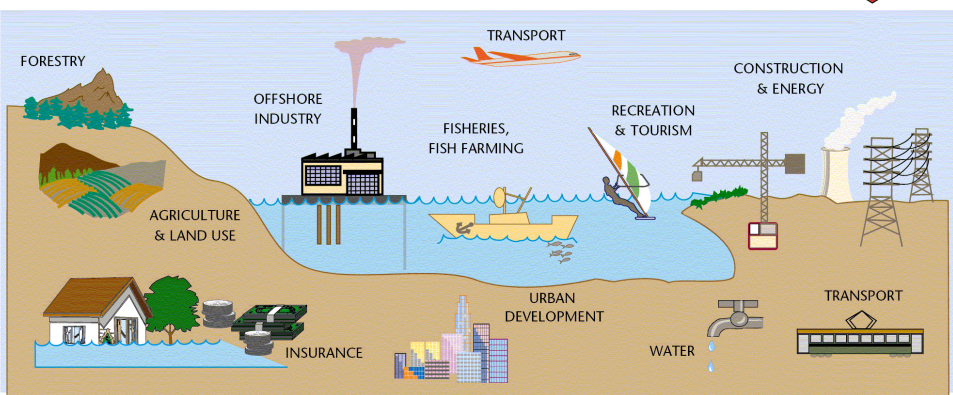
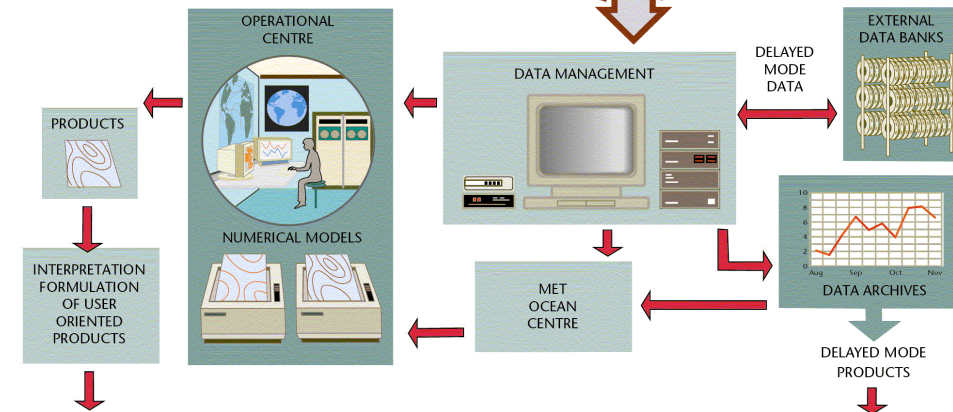
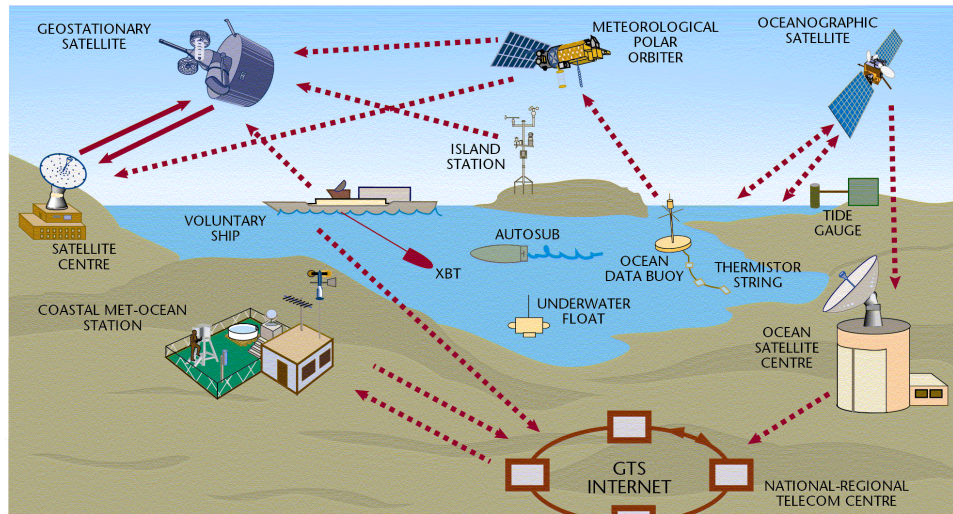
# Bottom Line

- Operational/Sustained ocean observing systems are coming.
- They will allow us to 'see' the ocean
- They will provide
  - Time series data for detecting change
  - 3-D time dependent views of ocean properties at appropriate time and space scales.
  - Predictive capability
- Research is needed to create the system and sustain it.

# Operational/Sustained Ocean Observing Systems

- Serving the ocean community somewhat like the Weather Service serves the atmospheric community. However, more like sustained research observations in many cases.
- International Effort
  - Standards
  - Data Sharing
  - Collaboration

# OPERATIONAL OCEANOGRAPHY



Observing

Data Management and Communications

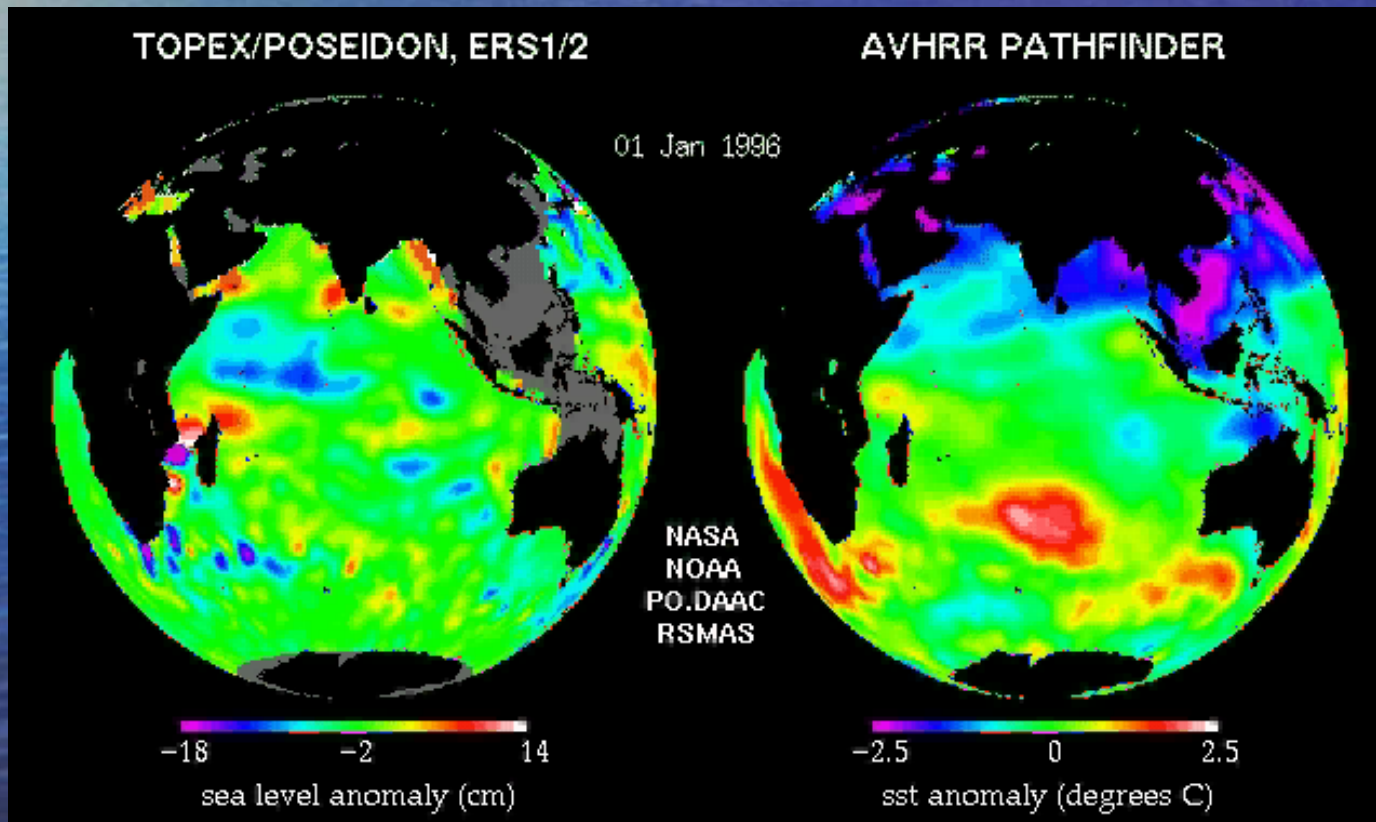
Users

# The Ocean Observing System

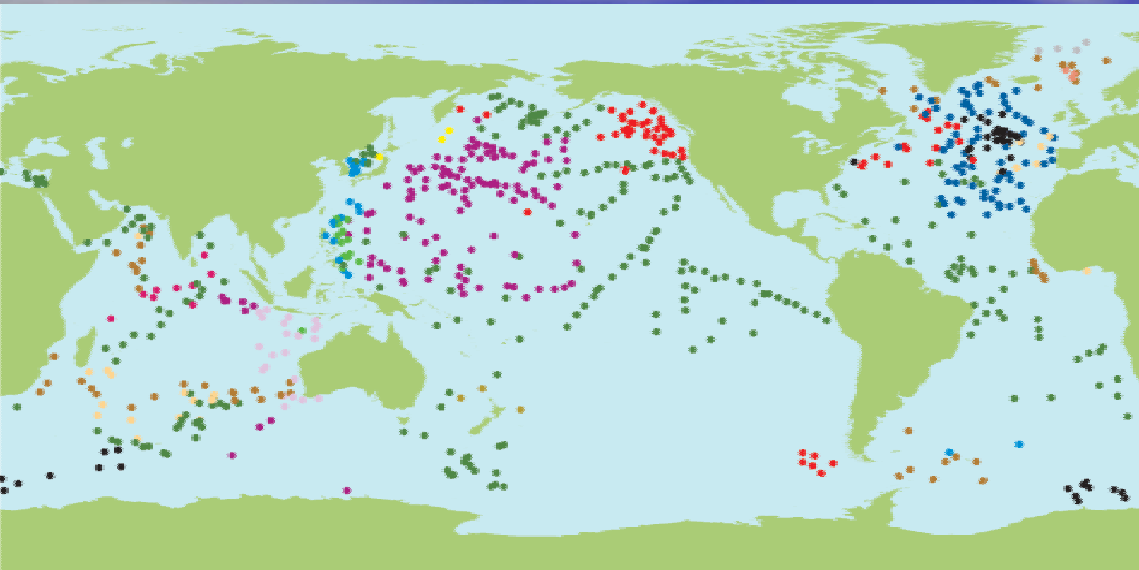
- Global Component
  - TOGA-TAO, Argo, sea level, global remote sensing products, global models
- Coastal Component (US Version)
  - National Backbone
    - Enhanced NBDC Buoys, NWLON, PORTS, remote sensing products
  - Regional Associations
    - Region specific needs (ie. NW – salmon management, Gulf of Mexico – Oil Risk, all areas – recreation, weather, surge, etc.)

# Global Scale Example

## Integrated Product – Sea Surface Height and SST



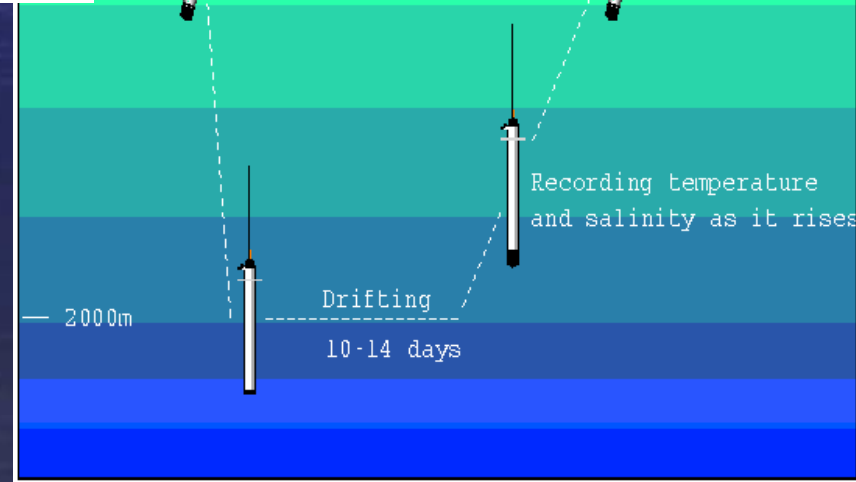
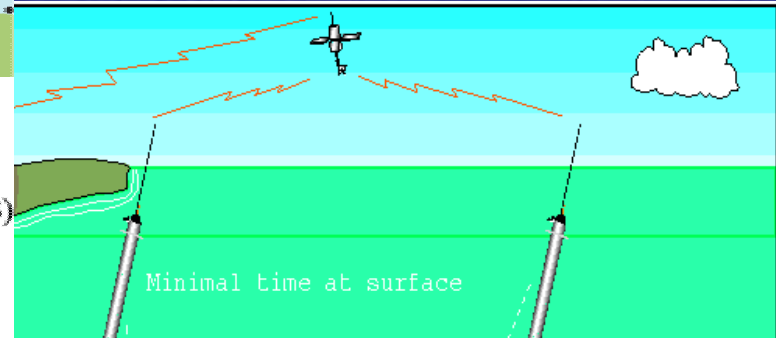
# Argo Floats



Argo Network, as of 11 March 2003 (720 Floats)

● AUSTRALIA (23)	● FRANCE (22)	● NEW ZEALAND (3)
● CANADA (61)	● GERMANY (44)	● NORWAY (3)
● CHINA (14)	● INDIA (9)	● RUSSIAN FEDERATION (3)
● DENMARK (4)	● JAPAN (130)	● UNITED KINGDOM (53)
● EUROPEAN UNION (73)	● KOREA (Rep. of) (26)	● UNITED STATES (252)

+ Mozambique, Mauritius and Pacific Islands

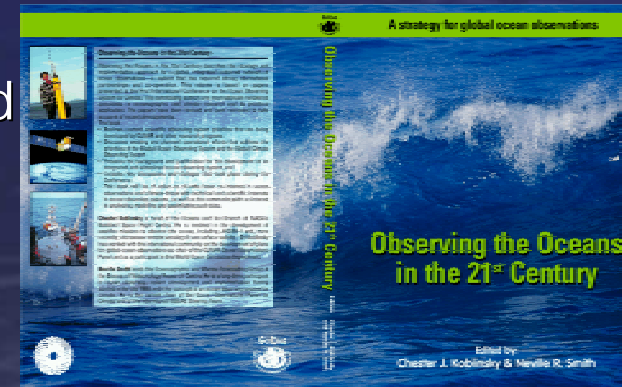


Add bio-optic and other sensors



# Global Ocean Data Assimilation Experiment

- A demonstration of the utility of having timely free and open access to long-term ocean observations (justify ocean observing)
- State-of-the art assimilative ocean models to produce
  - short-range open-ocean forecasts,
  - boundary conditions to extend predictability of coastal and regional subsystems, and
  - initial conditions for climate forecast models.
  - Real-time QA/QC
- Global ocean analyses for
  - Improved understanding of the oceans,
  - Improved assessments of the predictability of ocean variability, and
  - Create a basis for improving the design and effectiveness of a global ocean observing system.





**People**

**People**

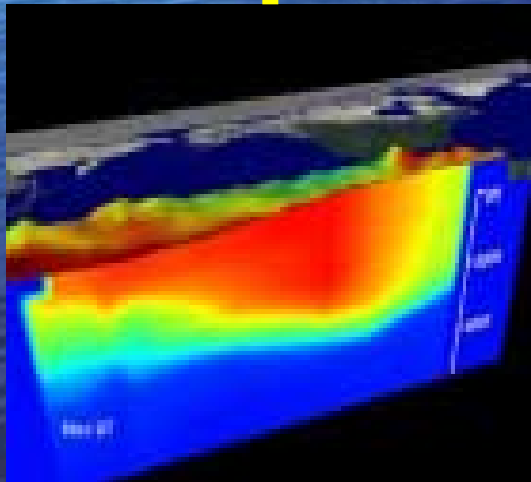


**Airsheds**

**People**

**Ocean Basins**

**Coastal  
Drainage Basins**



**Drivers of Change  
In the Coastal Zone**

# Examples of Regional Ocean Observing Systems

- Euro-GOOS
  - BOOS : Baltic Operational Observing System
  - NOOS: Northwest Shelf Operational observing System\MedGOOS: Mediterranean GOOS
- Black Sea GOOS
- GOOS Africa
- NEAR-GOOS: North-East Asian Regional GOOS
- Pacific Islands GOOS (ex-PacificGOOS)
- The Annual "El Niño" and Measurement of Anomalies in the Pacific (NAYLAMP)
- IOGOOS: Indian Ocean GOOS
- Coastal GOOS initiatives in the Indian Ocean
- The West Indian Ocean Marine Applications Programme (WIOMAP)
- IOCARIBEGOOS: Caribbean GOOS
- SEAGOOS : South-East Asia GOOS
- US Integrated Ocean Observing System

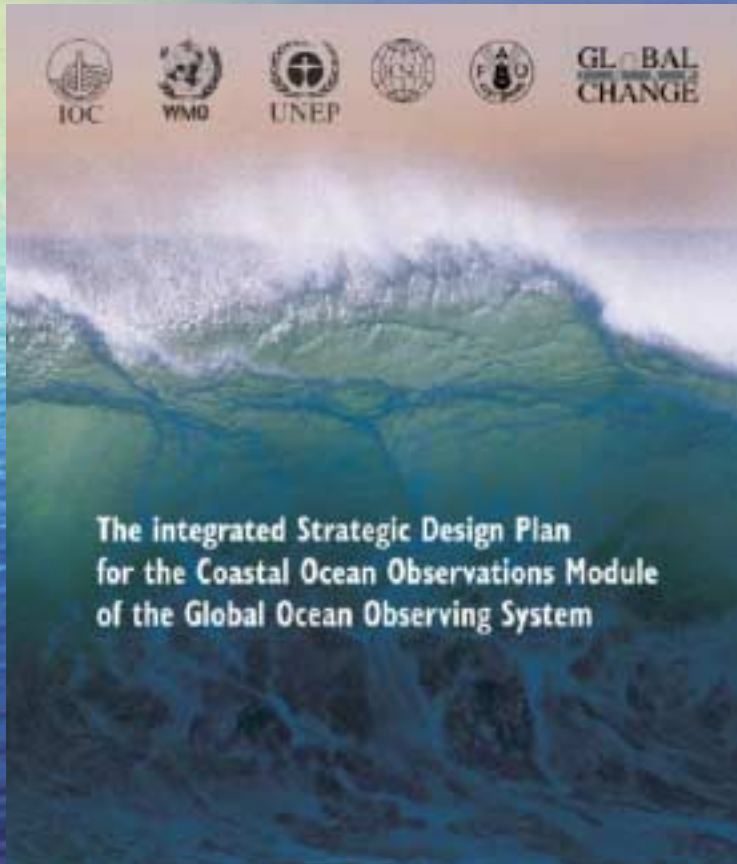
# Identified Needs for Integrated Ocean Observing Systems

- The Easy Ones:
  - Waves, currents, SST, water level, etc.
- The Hard Ones:
  - Operational, **coupled physical-ecological and physical-chemical models** with data assimilation techniques for nowcasting and forecasting changes in conditions of ecosystems.
  - Develop in situ and remote sensing techniques for **ecosystem assessments**
  - Develop techniques for **rapid sensing of biological and chemical variables**, especially human pathogens, harmful algal species, and biotoxins.

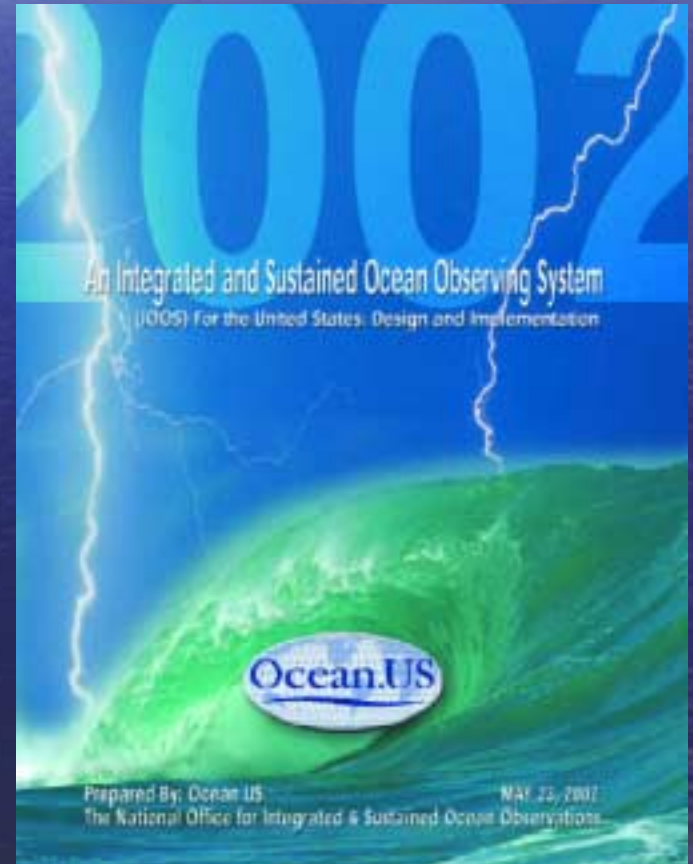
# Data Management and Communications

- Provide integrated products to all users
- 'Seamless' access.
- Free, open and non-proprietary access to data.
- Global communications (eg. Iridium)


# Relation to International Ocean Observing



International Plan



U.S. Plan



Role of Researchers in the  
Operational Ocean Observing  
Systems (global and coastal)

A 3D rendered scene featuring a lighthouse on a rocky island. The lighthouse has a red and white striped body and a red roof. A rainbow is visible in the sky behind the lighthouse. The scene is set on a rocky island with some sparse vegetation, and the lighthouse is reflected in the water.

# Creation

- Sensing Systems
- Sampling Schemes
- Knowledge of Oceanographic Processes



# Rejuvenate

- Reveal new phenomena and lead us towards more complete theories of ocean processes
- New requirements on the observing system
- New instrumentation will be developed to improve on existing systems or meet the new requirements



A 3D rendered scene featuring a lighthouse on a rocky island. The lighthouse has a red and white striped body and a red roof. A rainbow is visible in the sky behind the lighthouse. The water in the foreground reflects the lighthouse and the sky. The overall scene is set against a dramatic, cloudy sky.

# Training

- At-sea operations
- Data and Communications
- Real-time dissemination
- Products
- Forecasting



# Benefiting

- Finally 'See' the ocean in 3-D and time
- Climate data for studies and experimental design
- Predictive modeling of physical environment and ecosystem.
- Supporting data during experiments – enlarge time and space scales.

# What can the research community do?

- Keep up with Ocean Observing System developments
- Participate when appropriate
  - This is an operational system but it requires active and sustained support of the research community: some of it may be operated by researchers (sustained observations)
  - Research -> Pilot -> Pre-operational -> Operational
- Appreciate the challenge of doing this.
  - International, inter-agency, multi-disciplinary, predictive, user oriented.
- Promote free and open access to data
- With unrelenting persistence we will have ocean observing system.
- JGOFS is leaving a legacy of sustained observing systems. We must be sure to take full advantage of what was learned. How will we do that?

# Thomas Jefferson on observing climate change

"Years are requisite for this, steady attention to the thermometer, to the plants growing there, the times of their leafing and flowering, its animal inhabitants, beasts, birds, reptiles, and insects; its prevalent winds, quantities of rain and snow, temperature of fountains, and other **indexes of climate**.

We want this indeed for all the States, and the work should be repeated once or twice in a century, to show the effect of clearing and culture towards **changes of climate**"