United States Ocean Observing Initiatives: A Look to the Future

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GODAE Meeting
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INTEGRATED OCEAN OBSERVING SYSTEM

IOOS

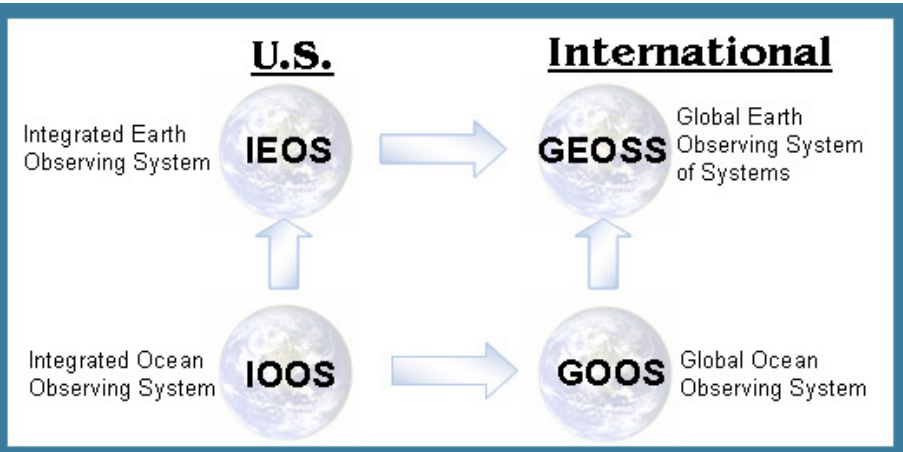
Background: US IOOS®

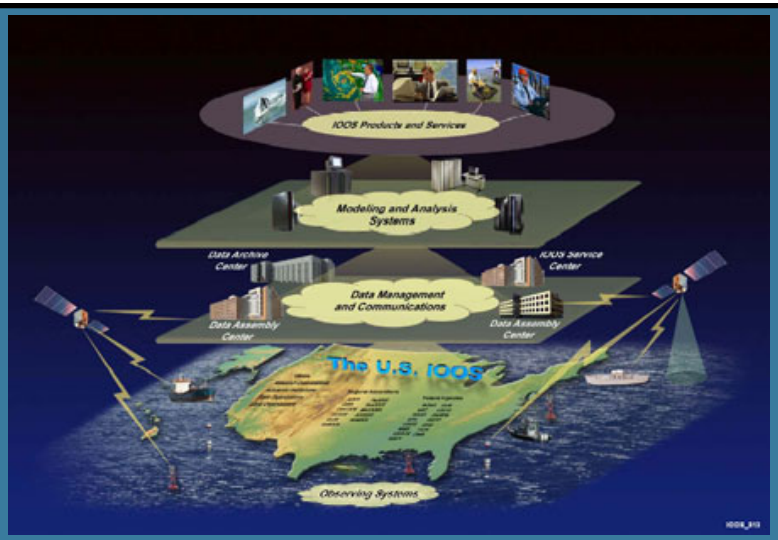
IOOS® Development Plan defines:

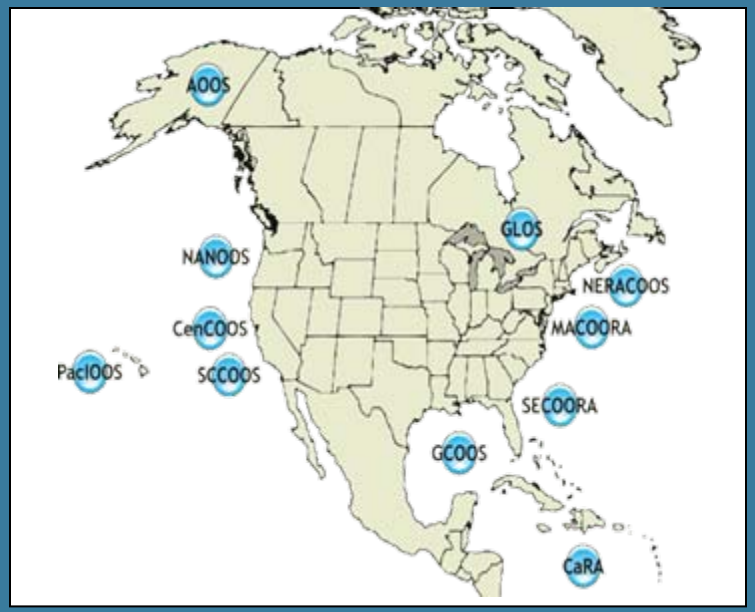
1) **Global Component**
2) **Coastal Component**

17 Federal Agencies

11 Regional Associations





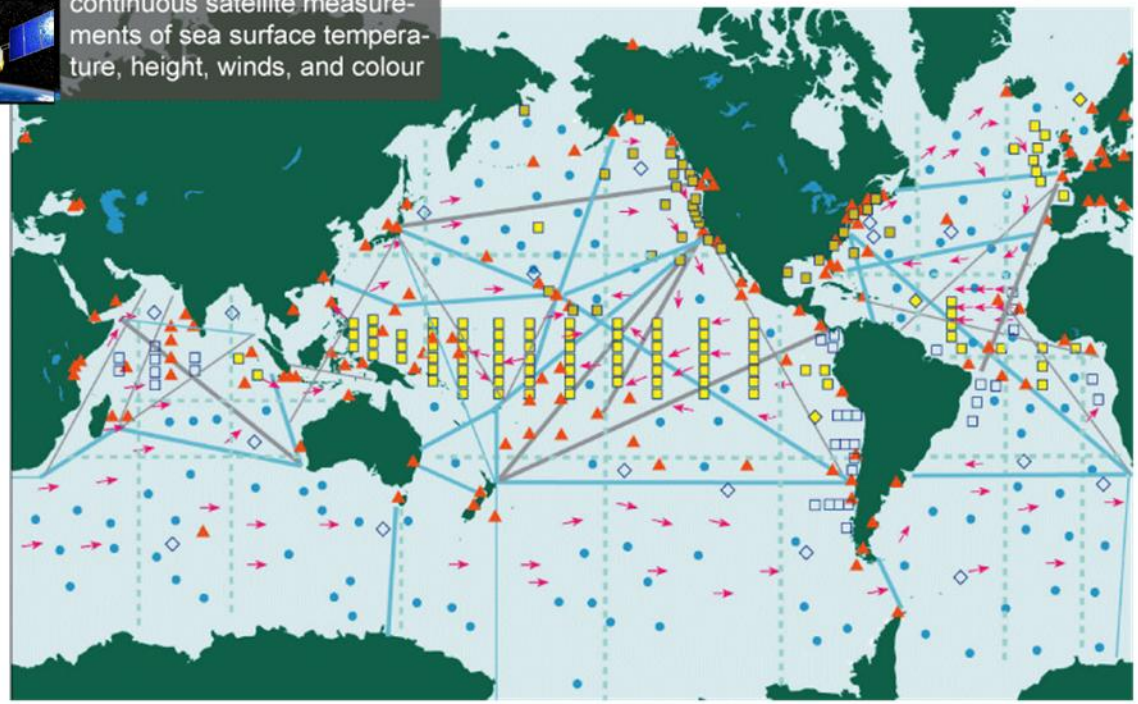


3 Subsystems: Observing, Data Management and Communication (DMAC), Modeling and Analysis;
2 Cross Cuts: Research and Development and Education

Initial Global Ocean Observing System for Climate
Status against the GCOS Implementation Plan and JCOMM targets

continuous satellite measurements of sea surface temperature, height, winds, and colour

Total *in situ* networks **60%** February 2008



87% **Surface measurements** from volunteer ships (VOSclim)

200 ships in pilot project

100% Global **drifting surface buoy** array

5° resolution array: 1250 floats

62% **Tide gauge** network (GCOS subset of GLOSS core network)

170 real-time reporting gauges

81% **XBT** sub-surface temperature section network

51 lines occupied

100% **Profiling float** network (Argo)

3° resolution array: 3000 floats

43% Repeat **hydrography** and **carbon inventory**

Full ocean survey in 10 years

Reference time series 24%

58 sites

48% Global **reference mooring** network

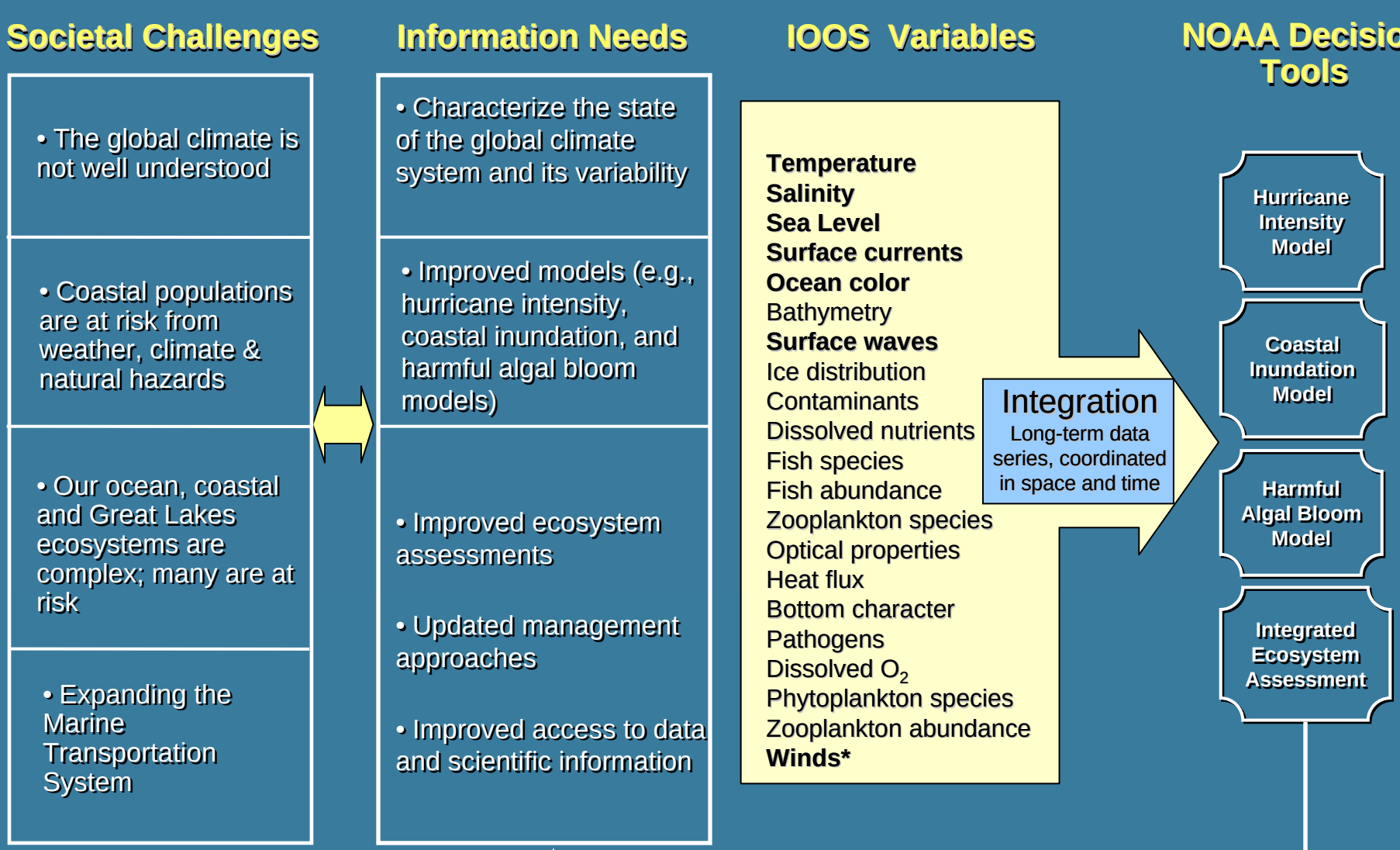
29 moorings planned

79% Global tropical **moored buoy** network

119 moorings planned

Global Climate Observing System (GCOS)
Joint WMO-IOC Commission on Oceanography and Marine Meteorology (JCOMM)

Background: IOOS® – Coastal Component



Data Integration Framework (DIF)

Months 0-12	Month 18	Month 24	Month 36
Integration	Model Ingest	Benchmark	Performance Assessment & Monitoring

Requirements

- Temperature
- Salinity
- Water Level
- Currents
- Winds
- Waves
- Ocean Color

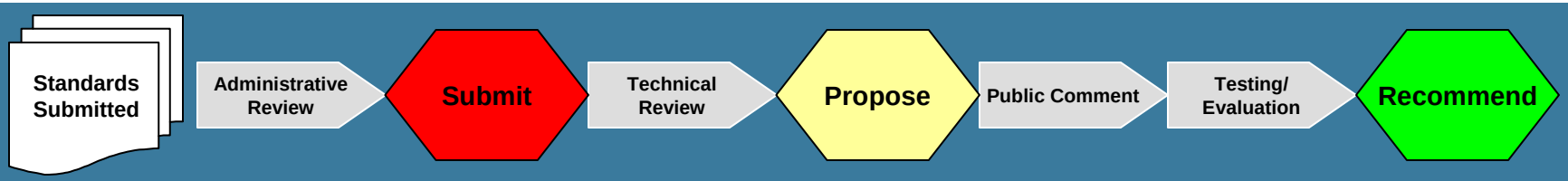
Data Standards

- Coastal Inundation
- Harmful Algal Bloom Forecast
- Hurricane Intensity Forecast
- Integrated Ecosystem Assessment

IOOS Data

http://ioos.noaa.gov/dif/

IOOS® DMAC Standards



- Interagency & Non-Federal, community-based process
  - Approach: Adopt, Adapt, Build new
  - Multiple standards per variable increases complexity
- Process re-initiated October 2007
  - Developed web-based, collaborative tools: http://ioosdmac.fedworx.org
  - 270 day review process: 2 formal cycles per year
- STATUS: 12 standards "submitted"; 4 "proposed"; final "recommended" status still pending

International Standards Coordination

- Forum on Oceanographic Data Management and Exchange Standards was held January 2008
  - Objective: General agreement and commitment to adopt key ocean data standards
  - Who: Representatives from organizations who are extensively involved in ocean data management
  - Way Ahead:
    - Establish a pilot project organized under the IODE
    - Document the standards process and promote it at national and international meetings
    - Website (www.oceandatastandard.org) promotes adoption

Regional Enterprise Partnership

- 11 Regional Associations (RAs) develop and operate the Regional Coastal Ocean Observing Systems (RCOOS)

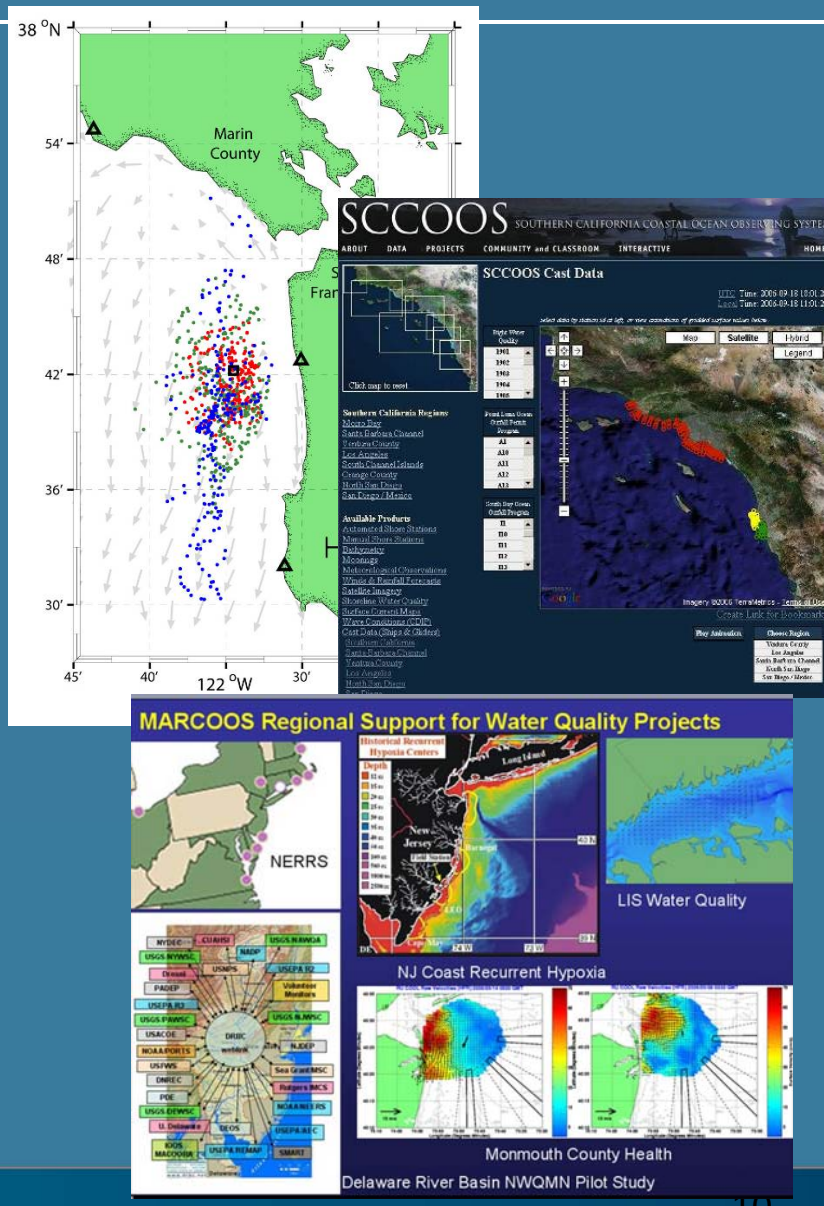
- RAs are the conduit between their local regions and other United States Federal and State agencies
- RAs contribute to the National IOOS® through:
  - Identify user needs at the local level
  - *in situ* observing capability
  - remotely sensed measurements (e.g., HF radar)
  - data management and communication
  - modeling / analytical capability

Regions Meet National Missions

- Oil spill tracking: CeNCOOS spill trajectories and real-time surface current maps within hours of M/V Cosco Busan spill
- Marine Weather Observations and Forecasts: Southeastern Portal, developed by NOAA National Weather Service (NWS) and SECOORA, is a one-stop shop for marine weather.
- Marine Transportation: Ports and Harbor Modeling in 3 Regions; Customized website for the entrance to the Los Angeles and Long Beach Harbor and San Pedro Channel
- Atmospheric Modeling: MACOORA improved local weather forecast model and severe weather alerts, incorporating R/T oceanographic data (transitioned to NWS Weather Forecast Office Mt Holly)
- Harmful Algal Blooms: NERACOOS observing assets support pre-operational, near real time nowcasts in Gulf of Maine
- Aquaculture: NANOOS-NERRS partnership provides real-time water quality information to support shellfish grower industry; CeNCOOS support to Monterey Abalone Company

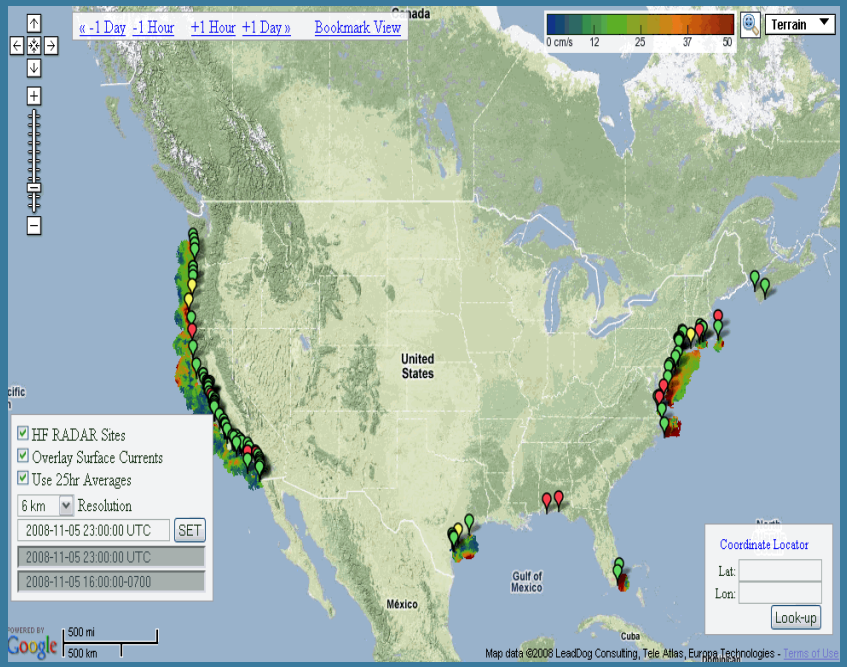
Regions Meet National Missions

- Fisheries - Climate
  - SCCOOS: 50 years of CalCOFI web accessible in ’09
- Water Quality
  - SCCOOS: Hyperion Treatment Plant Diversion
  - CeNCOOS: Effluent trajectories
  - MACOORA: Delaware River Basin NMQWM Pilot Study
  - SECOORA: Surface currents monitoring to mitigate impacts of dredged material on nearby reefs
- Instrument Testing and Validation
  - Alliance for Coastal Technologies



High Frequency Radar (HFR)

- Partners: Federal, State and Local agencies
- Significant non-federal ~$55M investment
- Serves many missions
- Implemented national HFR servers and data management system
- Permanent radio frequency allocations
- Challenge: Funding for operations and maintenance and new systems
- Enhanced data quality control and product development is underway

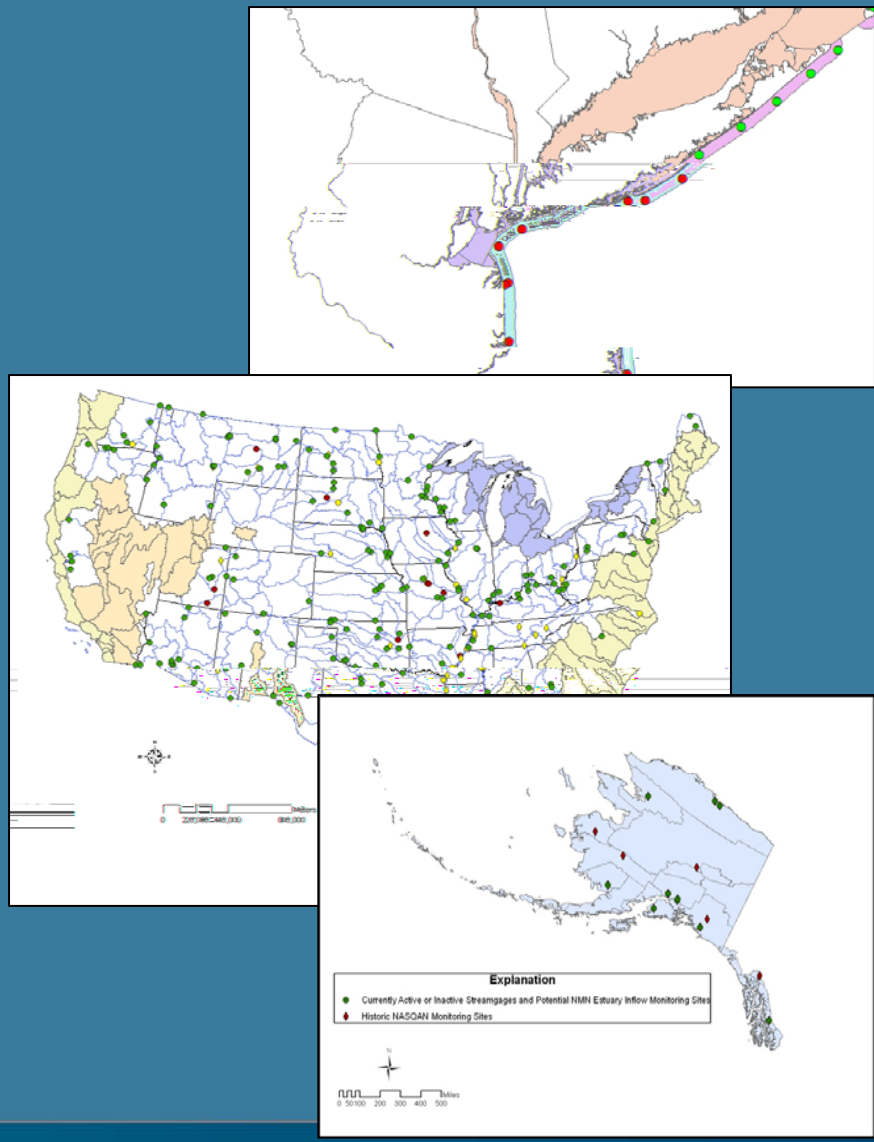


Ocean Observatories Initiative (OOI)

- Major National Science Foundation (NSF) investment
- Constructed over 5 years with expected 25-30 year lifetime
- Multi-scale network-global, regional, coastal
- Multi-disciplinary approach to study complex natural systems and non-linear processes
- Expanded power and bandwidth to the seafloor
- Long time-series
- Ability to investigate short-term episodic events
- Open data policy

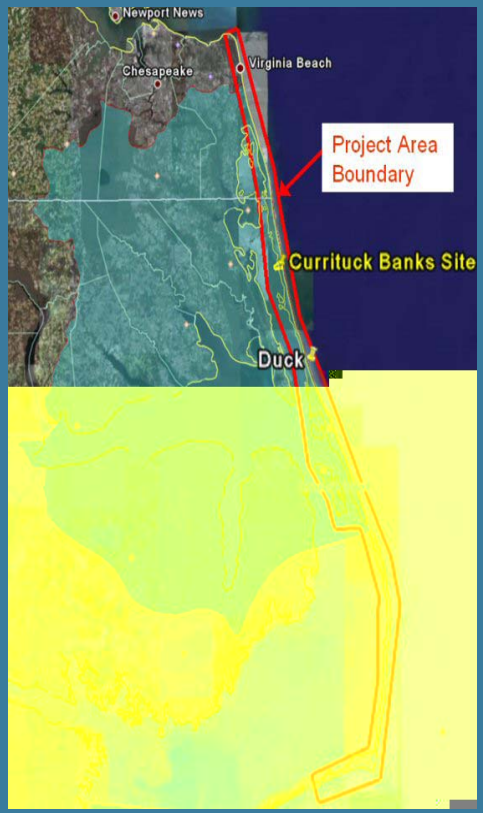
National Water Quality Monitoring Network

- Partners: US Geological Survey (USGS), Environmental Protection Agency (EPA), NOAA
- Network: Water quality data elements (WQDE) selected by working group for comparability, sharing, and value of data.
- 3 Pilot Projects
  - Delaware
  - San Francisco
  - Great Lakes
- Future Plans:
  - Complete demonstration studies
  - Implement network
- Linked to IOOS® through data management and network design



Integrated Ocean and Coastal Mapping (IOCM)

- Acquiring, managing, integrating and disseminating ocean and coastal geospatial data, so data and their products can be easily accessed and used by and for the greatest range of users and purposes - Map Once, Use Many Times
- Involves participation by Federal, State, academic, NGO and private sector partners
- North Carolina Integrated Coastal Mapping Project
  - Location: NC coastal area from Cape Hatteras to Currituck Banks
  - Partnership: 3 Federal agencies and 3 State agencies
  - Data: High-resolution topography and bathymetry, and aerial imagery to characterize habitat
  - Products: Coastal orthophotos, shoreline maps, habitat classification, maps, updated nautical charts
- California Seafloor Mapping
  - Location: CA coast from shoreline out to 3 nautical miles
  - Partnership: State-led with Federal, NGO and industry
  - Data: Bathymetry, acoustic backscatter, geological and biological ground-truthing to characterize habitat
  - Products: Coastal and habitat base maps, updated nautical charts



IOOS® Benefits Business

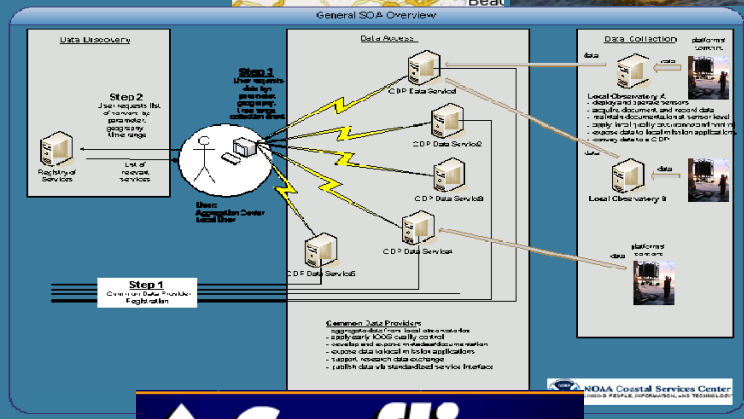
Practical applications of IOOS®

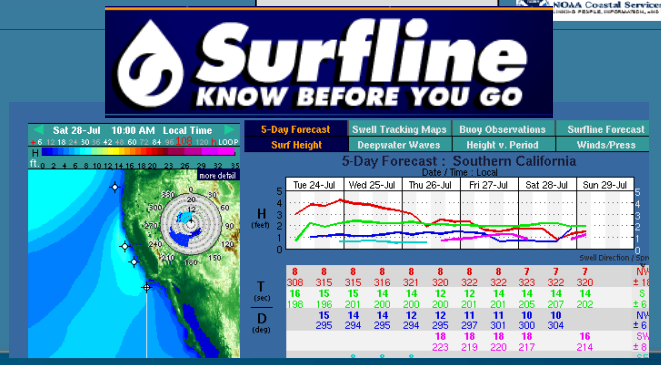
- **All businesses are vulnerable to risks associated with adverse weather and climate change.**
- **Events such as hurricane Katrina and mid-west flooding demonstrated just how much the weather can disrupt business activity.**
- **IOOS® is the key to enhancing, coordinating and connecting information, unlocking improved weather forecasts and climate projections, and providing critical information to businesses far removed from the coast or operations at sea.**

Roles of Industry

Examples of industry partnerships

- Observing
  - Chesapeake Bay Interactive Buoy System (CBIBS)
  - International Tsunami buoys
- DMAC
  - Boeing, SAIC, and ASA working with NANOOS, CeNCOOS and MARCOOS
- Modeling
  - Noblis, Inc. - Chesapeake Bay Inundation Prediction System (CIPS)
- Partnerships
  - Oil and gas companies provide data to the National Data Buoy Center
  - Shell and NOAA
- Value Add Companies
  - Surfline
  - ROFFS™ - Roffer's Ocean Fishing Forecasting Service, Inc.





INTEGRATED OCEAN OBSERVING SYSTEM

Questions?

“Providing information needed to improve safety, enhance our economy and protect our environment”

http://ioos.noaa.gov

IOOS

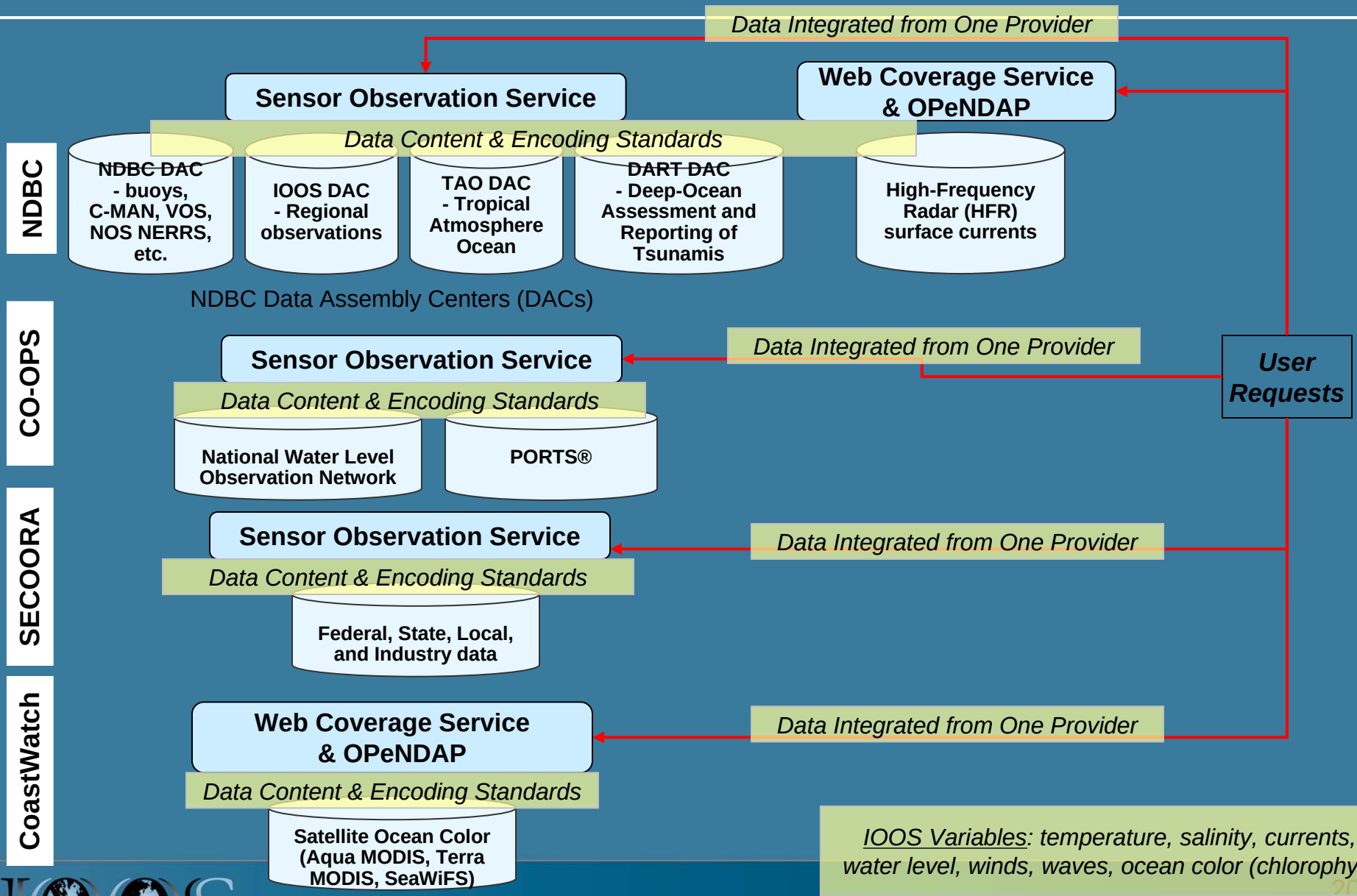
Back Up

Recommended Web Services and Data Encodings

Data Type	Web Service	Encoding
In-situ data (buoys, piers, towed sensors)	OGC Sensor Observation Service (SOS)	XML based on OGC Observations and Measurements (O&M)
Gridded data (model outputs, satellite)	OGC Web Coverage Service (WCS)	NetCDF using Climate and Forecast (CF) conventions
Images of data	OGC Web Map Service (WMS)	GeoTIFF, PNG etc. -possibly with standardized styles

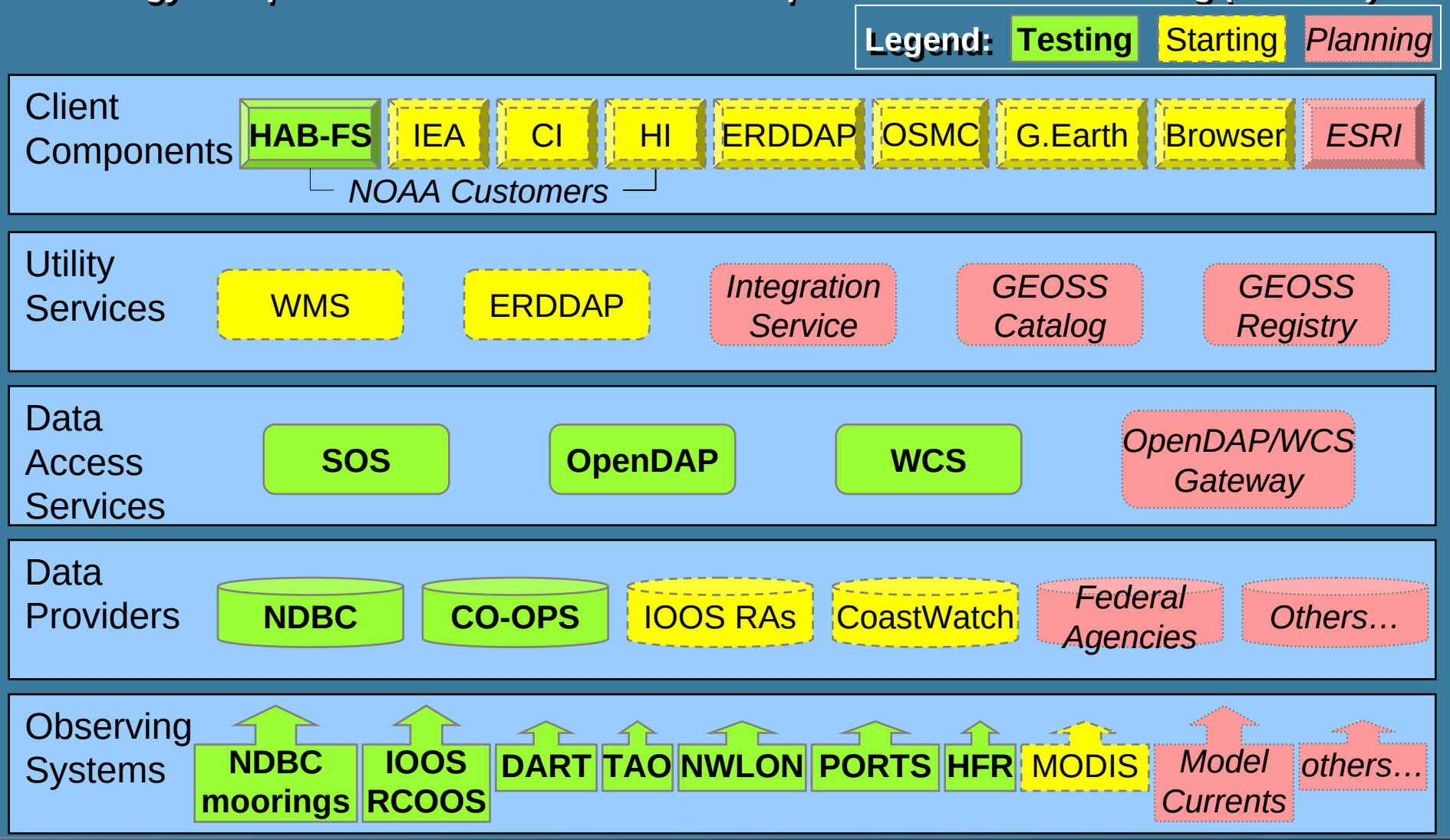
*[*OGC = Open Geospatial Consortium]*

DIF Data Provider Status – end of CY08



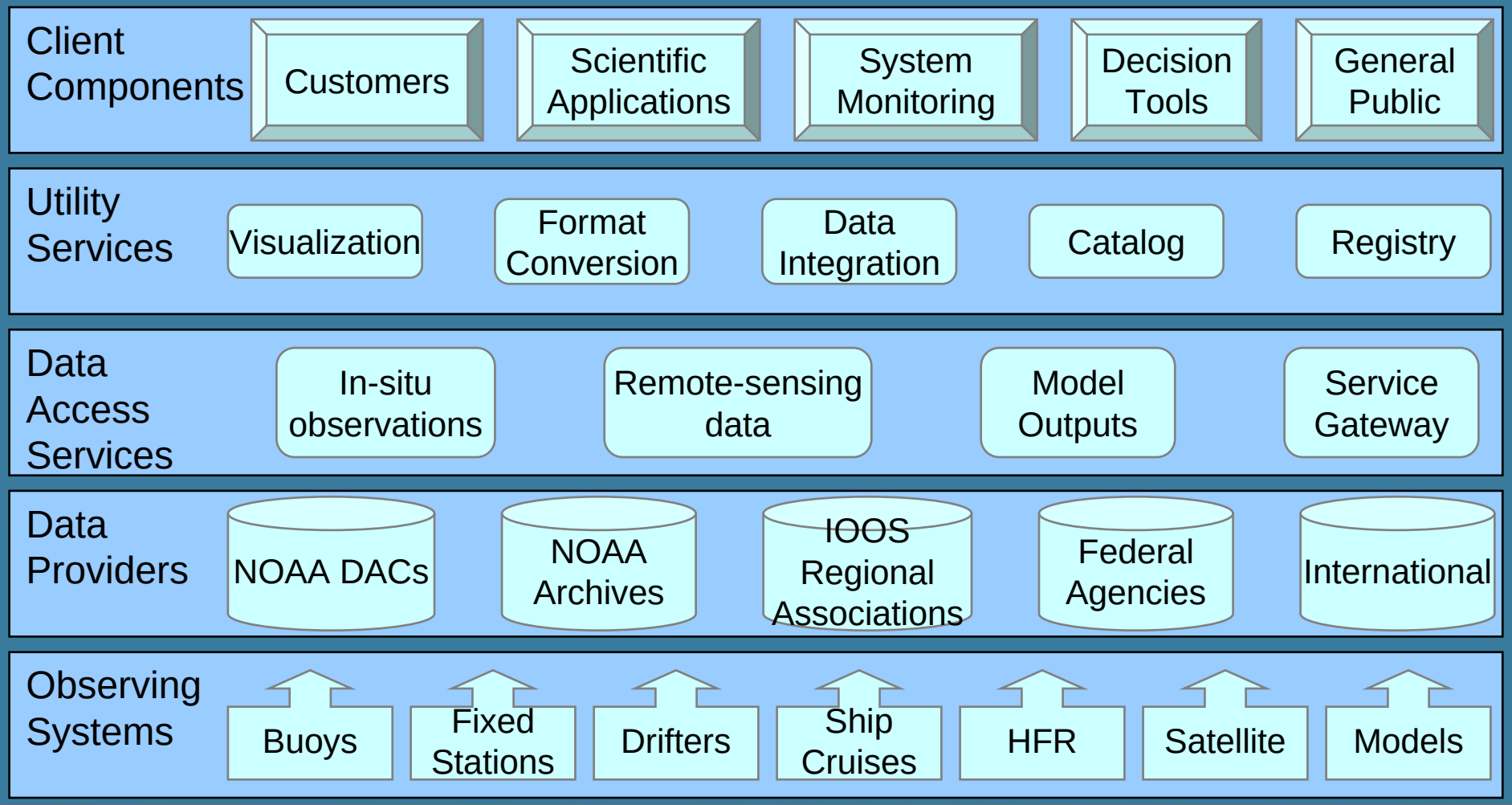
Component Implementations for DIF

Technology Viewpoint from Reference Model for Open Distributed Processing (RM-ODP)



Component Types Needed for IOOS®

Engineering Viewpoint from Reference Model for Open Distributed Processing (RM-ODP)



Geographic Location of Regional Associations

Regional Association	Primary geographic location
Great Lakes Observing System (GLOS)	The Great Lakes, its interconnecting waterways, and the St. Lawrence River
Northeast Regional Association (NERA)	Maine to Massachusetts, including the Canadian provinces of New Brunswick and Nova Scotia
Mid-Atlantic Coastal Ocean Observing Regional Association (MACOORA)	Cape Cod, MA, to Cape Hatteras, NC
Southeast Coastal Ocean Observing Regional Association (SECOORA)	North Carolina to the Atlantic coast of Florida
Caribbean Regional Association (CaRA)	Puerto Rico, U.S. Virgin Islands, and the island of Navassa
Gulf of Mexico Coastal Ocean Observing System (GCOOS)	Gulf Coast of Florida to Texas
Southern California Coastal Ocean Observing System (SCCOOS)	Southern California Bight
Central and Northern California Ocean Observing System (CeNCOOS)	Central and Northern California
Northwest Association of Networked Ocean Observing Systems (NANOOS)	Washington, Oregon, and northern California
Alaska Ocean Observing System (AOOS)	Gulf of Alaska, Bering Sea and Aleutian Islands, and the Arctic
Pacific Islands Integrated Ocean Observing System (PacIOOS)	Hawaii, U.S. territories in the Pacific, and the Freely Associated States in the Pacific