Looking ahead to managing ocean data: CaRA, CarICOOS and DMAC

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Technological Applications for Coastal Protection

"Partnering with our Caribbean and Insular Neighbors"

sponsored by the

Lieutenant Governor of the US Virgin Islands, Federal Emergency Management Agency and the National Oceanic and Atmospheric Administration

The US Integrated Ocean Observing System (IOOS)

Serves national needs for:

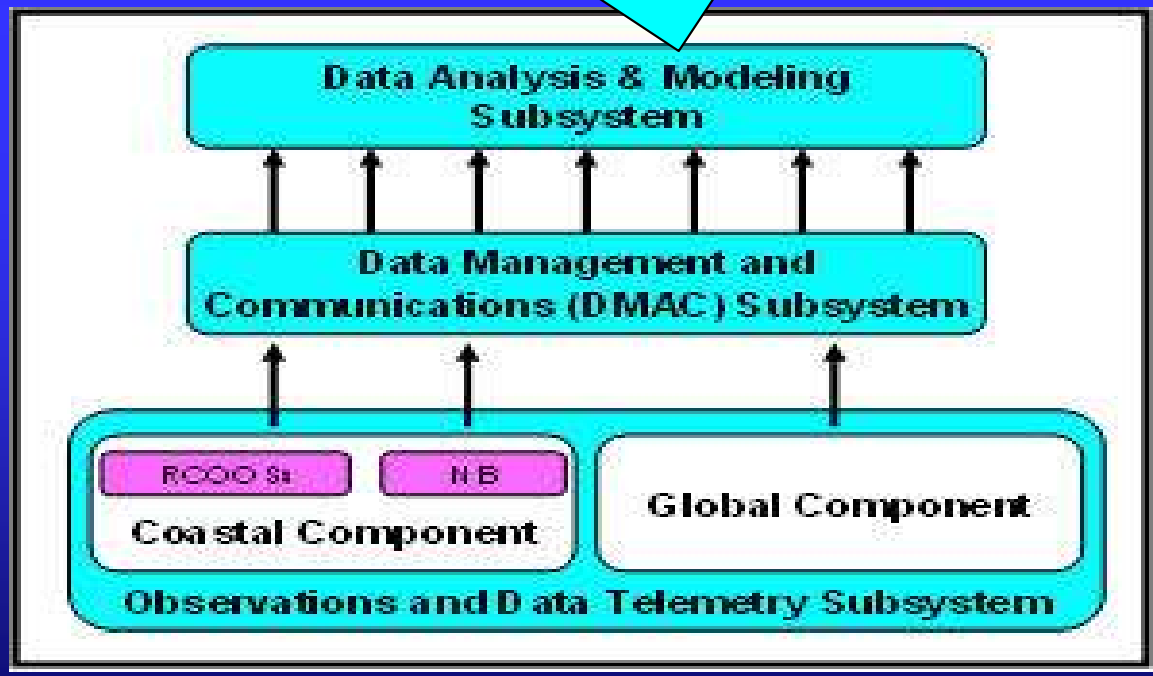
- Detecting and forecasting oceanic components of climate variability
- Facilitating safe and efficient marine operations
- Ensuring national security
- Managing resources for sustainable use
- Preserving and restoring healthy marine ecosystems
- Mitigating natural hazards
- Ensuring public health

The Regional Associations manage the IOOS/ICOOS

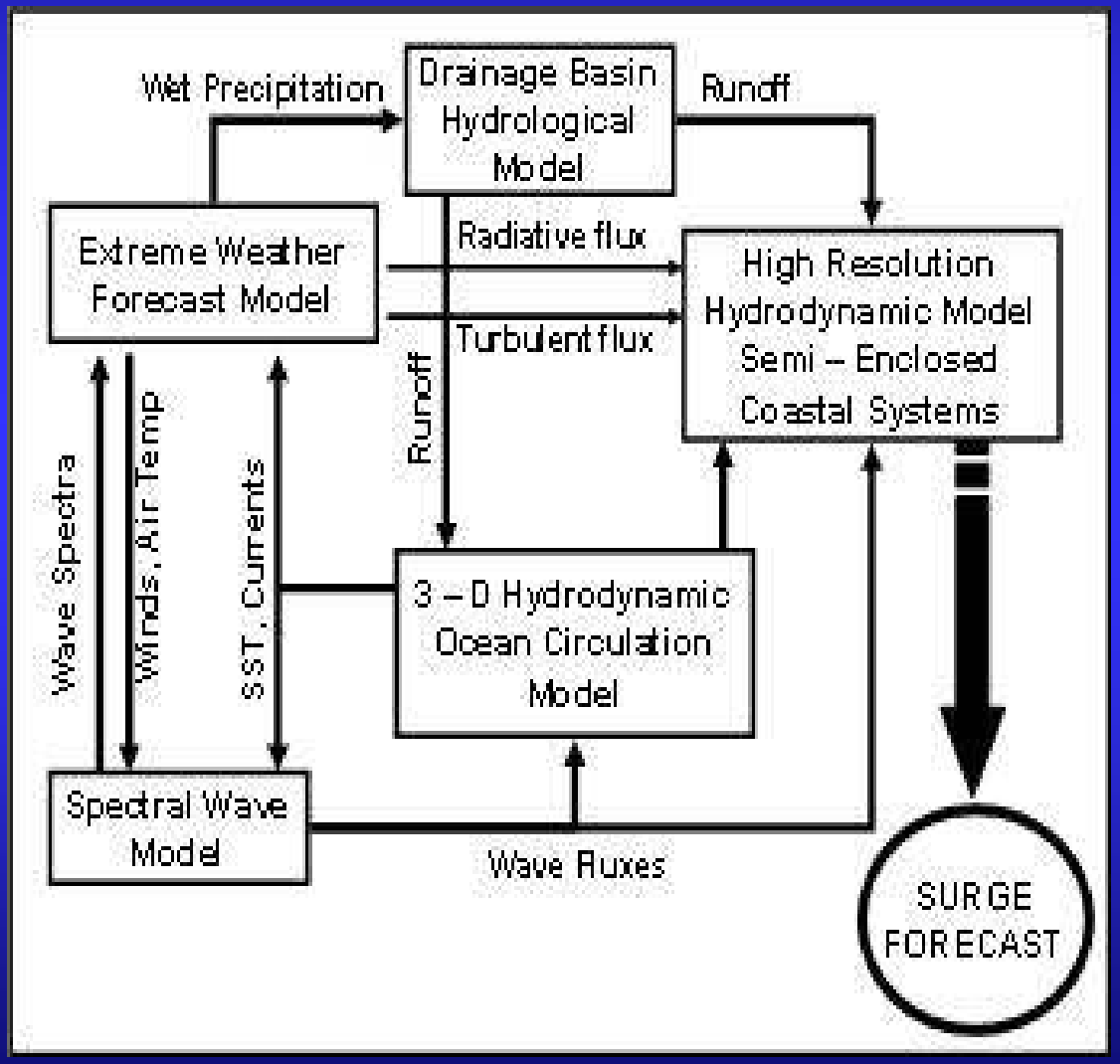
Conceptually, the Integrated Ocean Observing System consists of 3 efficiently linked subsystems:

1. Observing System (*in situ* measurements, remote sensing, and data telemetry),
2. Data Management and Communications (DMAC) subsystem, and
3. Data Analysis and Modeling (DAM) subsystem

COMPATIBLE USERS



Data Analysis and Modeling



Inundation Prediction

Ocean.US
http://ocean.us/Models

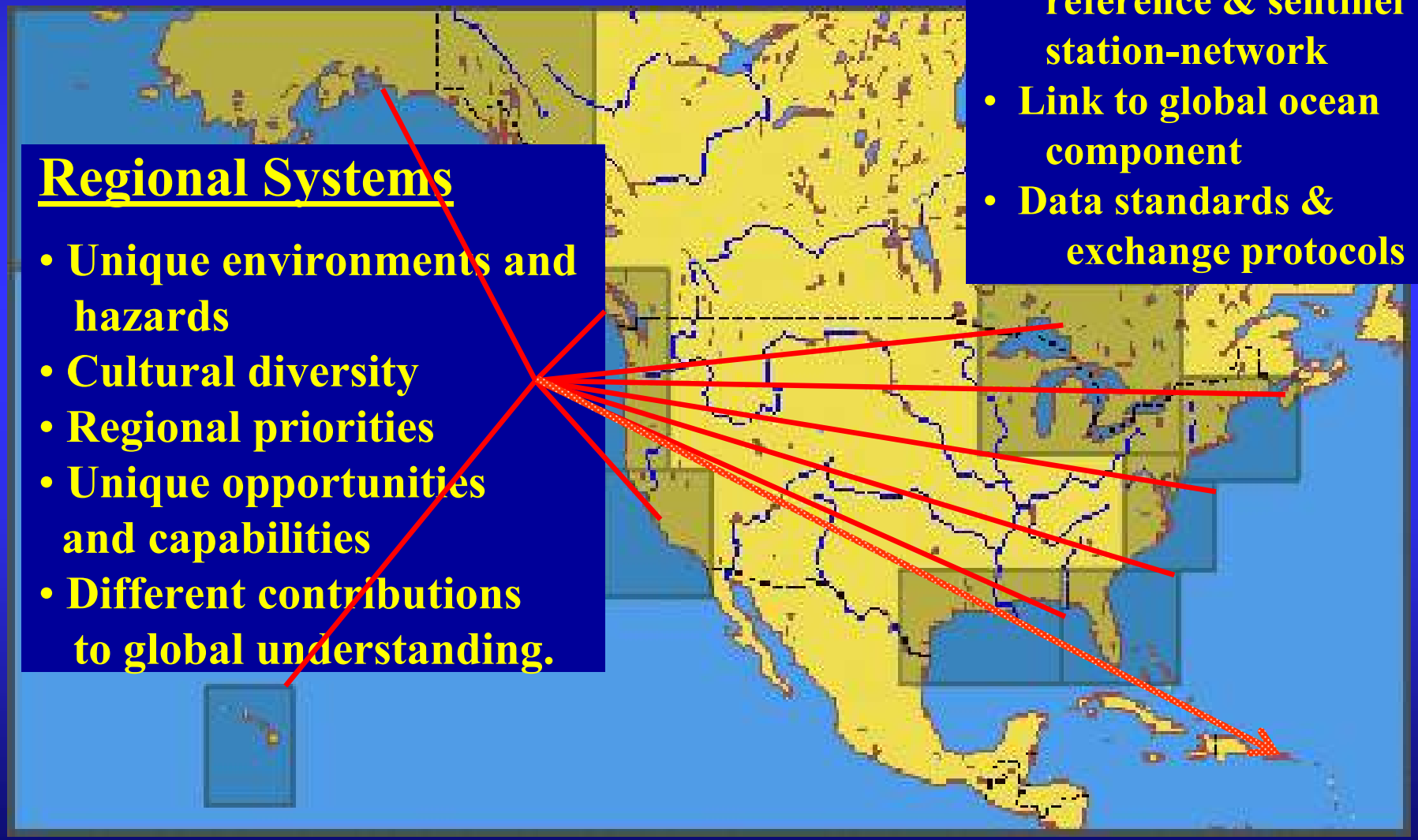
National Federation of Regional Systems (NFRA)

National Backbone

- Satellite remote sensing
- *In situ* sensing reference & sentinel station-network
- Link to global ocean component
- Data standards & exchange protocols

Regional Systems

- Unique environments and hazards
- Cultural diversity
- Regional priorities
- Unique opportunities and capabilities
- Different contributions to global understanding.

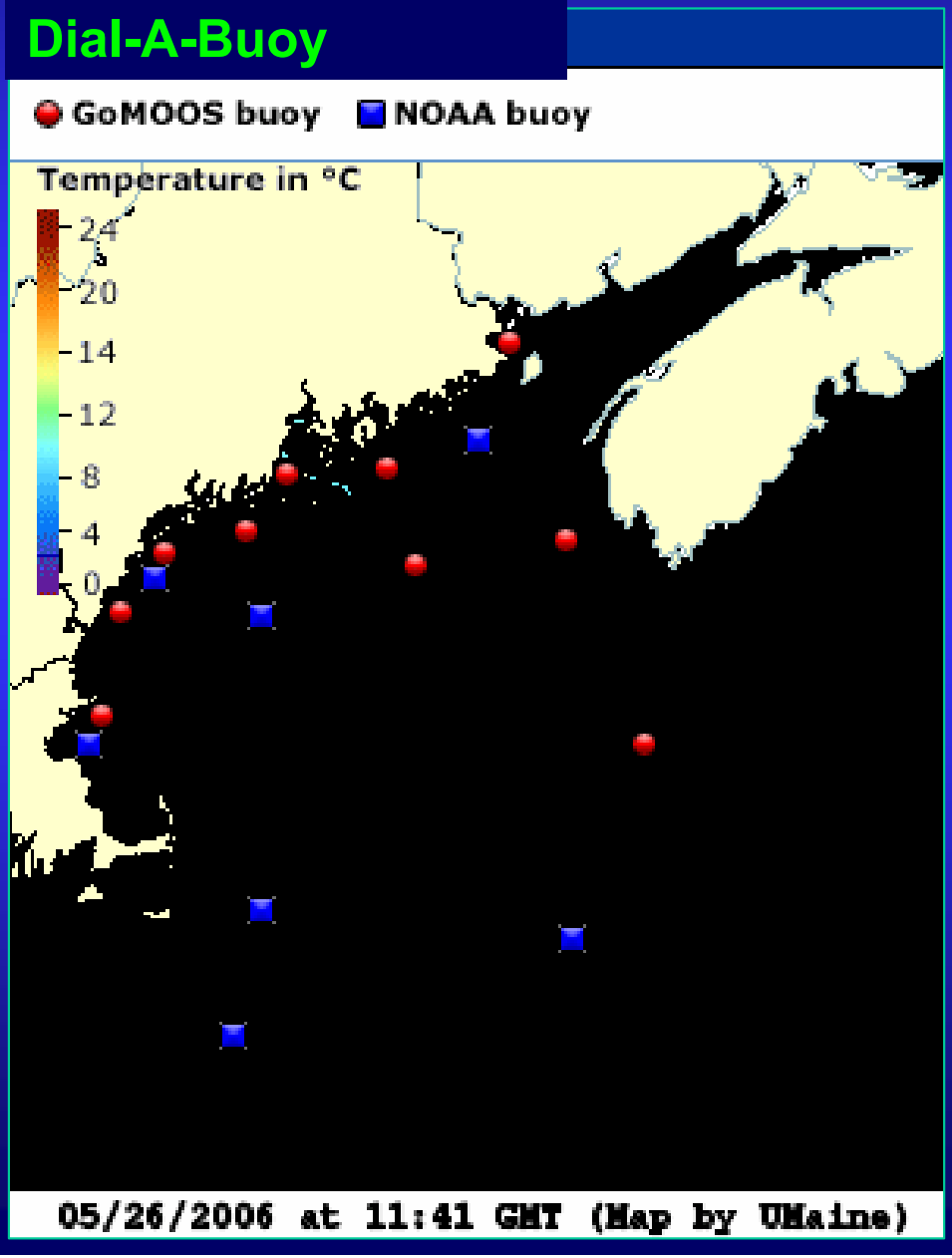


Graphic modified from presentation by SCOOP-SURA, UAH

Example: Gulf of Maine Ocean Observing System

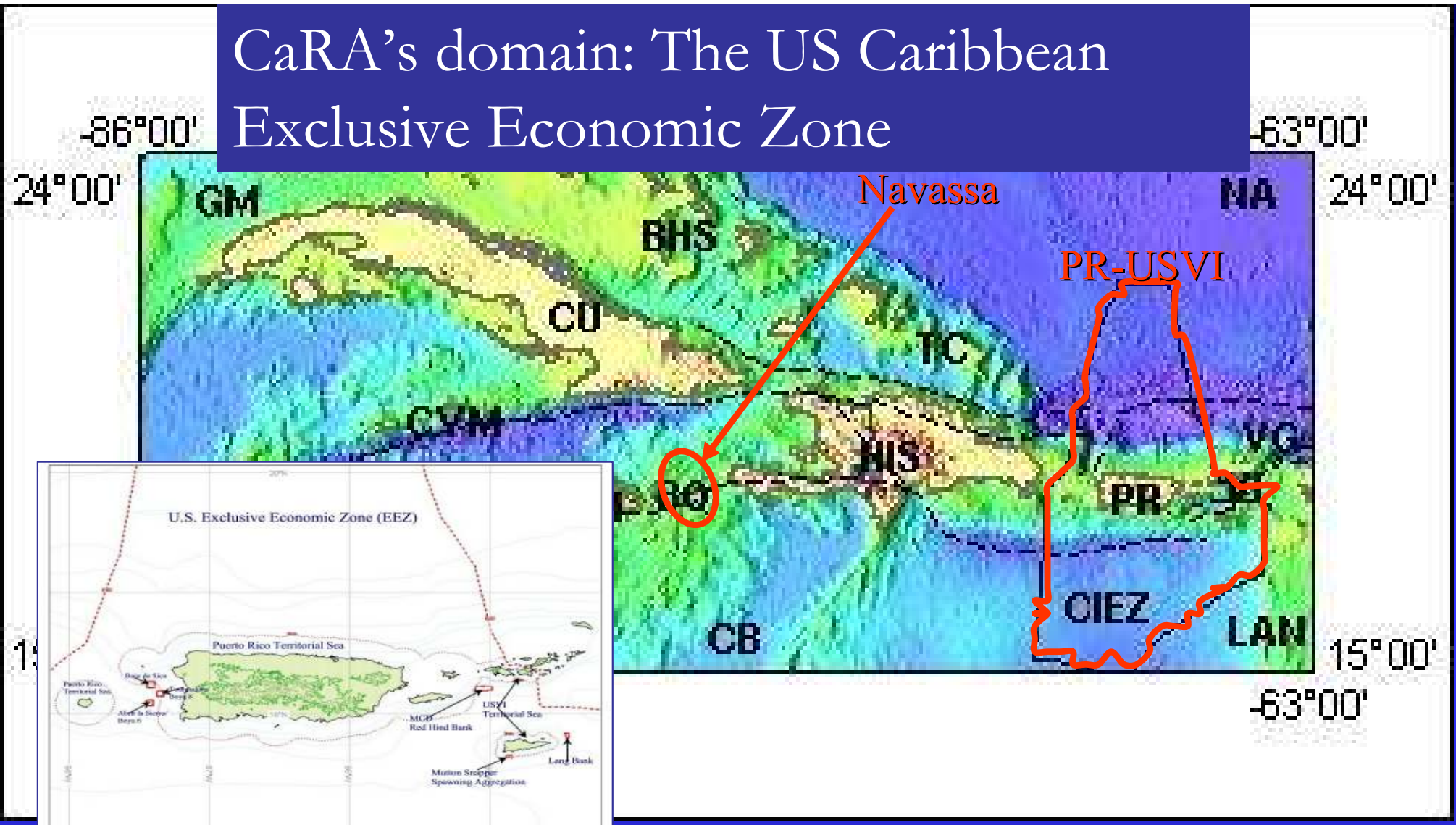
GoMOOS

Dial-A-Buoy

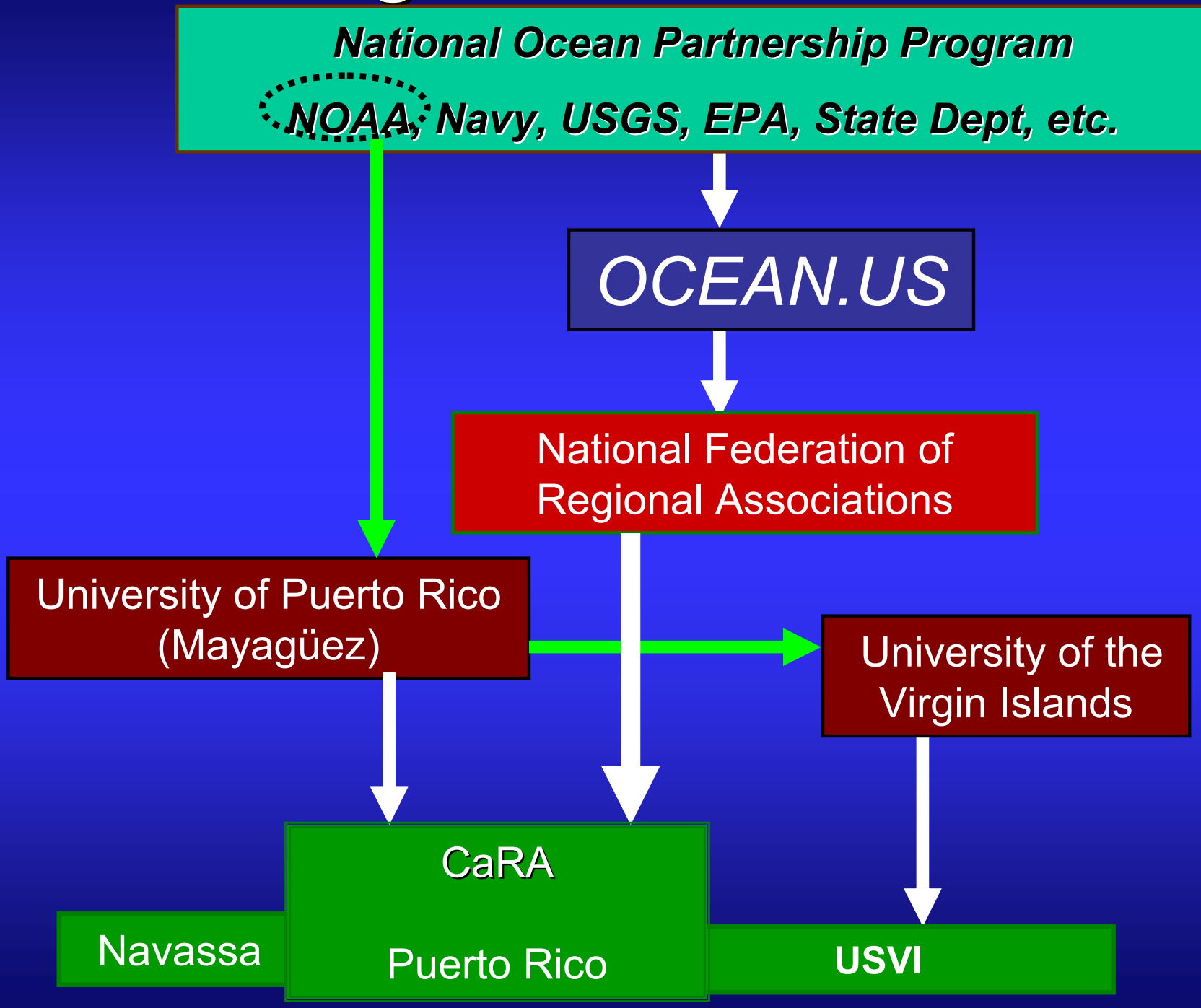


Last update: 05/30 2:00 PM EDT
Wind: E at 10.9 knots
Wind gust: 13.6 knots
Wave height: 2.2 ft
Period: 6.4 sec
Air temp: 50° F (9.8° C)
Visibility: 1.5 nm (1.7 miles, 2.8 km)
Atmospheric pressure: 1023.70 mb

CaRA's domain: The US Caribbean Exclusive Economic Zone

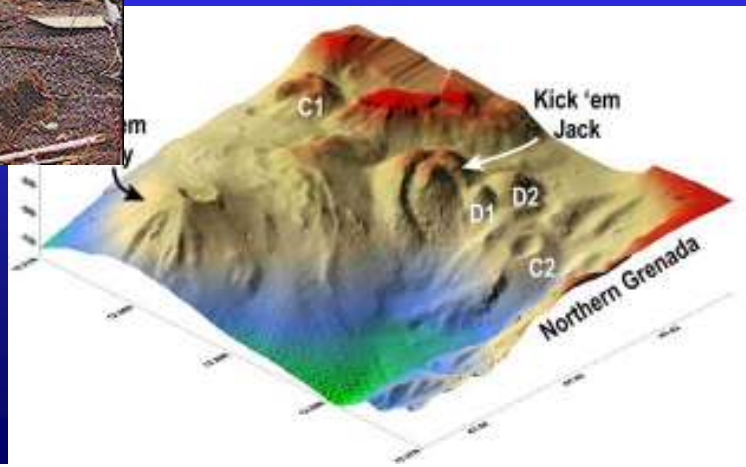


Organizational Structure



For the USVI: focus is on data & information for economic development and natural resource management

Data & observations also essential for coastal protection and natural hazard mitigation



What's needed to make CaRA and CarICOOS operational:

- All potential **stakeholders** (users and providers) should be engaged
- CaRA must be formally organized
  - most likely along the lines of a non-governmental organization (ngo).
  - leadership as much from users as from data providers
  - constitution, bylaws, recognition from NFRA
- Identify data & information **needs** of stakeholders
- Existing data streams identified and accessed
- Expand CarICOOS to meet unmet data/observation needs
- Provide CarICOOS data accessible in databases
  - new databases established as necessary
  - data management and control (DMAC) as per *Ocean.US*
  - user-appropriate accesses to data provided

- Pilot projects for needed observing systems or improved access avenues.

CaRA Progress Report

The goal was… to organize a Caribbean Integrated Coastal Ocean Observing System (CarICOOS) by …

1. fielding proposal for funding from NOAA/CSC to start CaRA [DONE]
2. organizing CaRA to bring data users and producers together [In progress]
3. planning self-funded project [In progress]
4. preparing proposal for funding pilot projects.[Year-2]

Identifying…

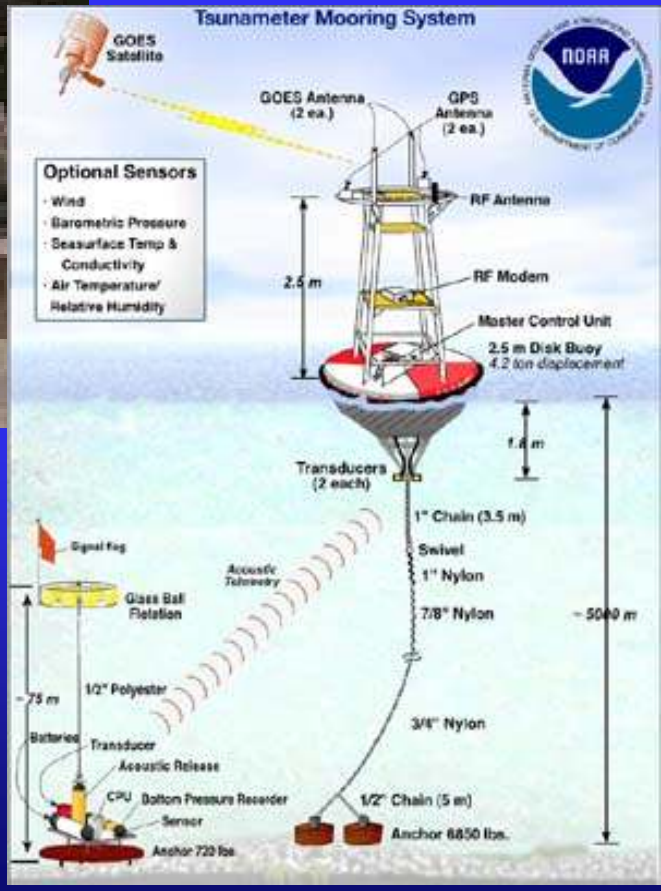
Active NOAA data-transmitting stations in or for the USVI

◄ NOAA C.R.E.W.S. Salt River, St. Croix

CHAV3, St. Thomas

NOAA NDBC Sea Level Stations

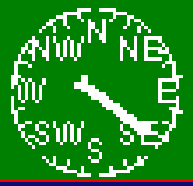
LTBV3, St. Croix



DART tsunami buoys

UVI's Research and Public Service Component

Hourly Weather Report

Jun 11, 2006 5:00 pm	
Temperature	83.8 °F
Relative Humidity	70.1 %
Dew Point	72.2 °F
Atmospheric Pressure	1016 mb
Solar radiation	325.6 W/m^2
Wind Speed	4.4 mph
Wind Gust	8.4 mph
Wind Direction	

WRRI Weather Station And Online Output

Aquadopp™ current profiler such as UVI / BCCR has deployed at key sites.

Other existing programs and/or platforms in/near the CaRA domain

- **Caribbean Atlantic Time Series** (UPRM) – south of La Parguera, P.R. -- full range of hydrographic variables (serial station)
- **Grammanik Bank** Fish population monitoring site (UVI/BCCR) – south of St. Thomas – temperatures, currents, fish counts, other hydrographic variables. (autonomous for currents and temperature, serial for counts).

- National Park Service (– *R/V Nancy Foster*)
- Department of Planning and Natural Resources
- US Geological Service

Next steps

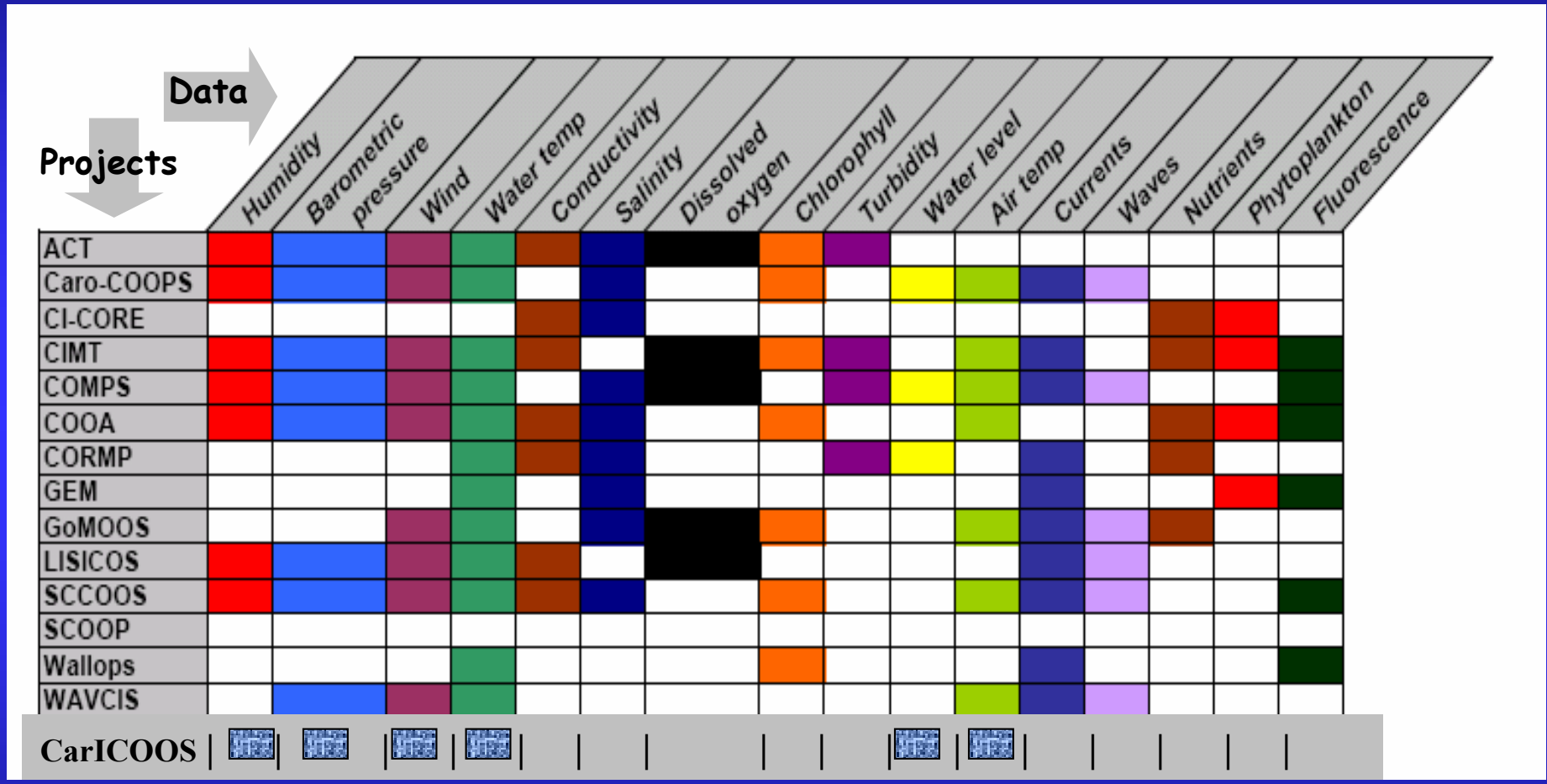
- **Obtain legitimacy and NFRA certification for CaRA by:**
  - **demonstrating its capacity for service to user communities**
  - **identifying its data streams**
  - **establishing the organization's legal charter**
  - **developing data management/sharing plans compliant with DMAC standards.**

More steps

- **continue the identification of existing data streams and capabilities**
- **Establish the existence of historic data sets, assimilating them when appropriate**
- **Inventory existing and anticipated equipment, facilities and technical capabilities**
- **Engage Territorial GIS and data management capabilities**
- **Initiate pilot projects that demonstrate capabilities in**
  - **-- modeling**
  - **-- preferred or optimal access, etc.**

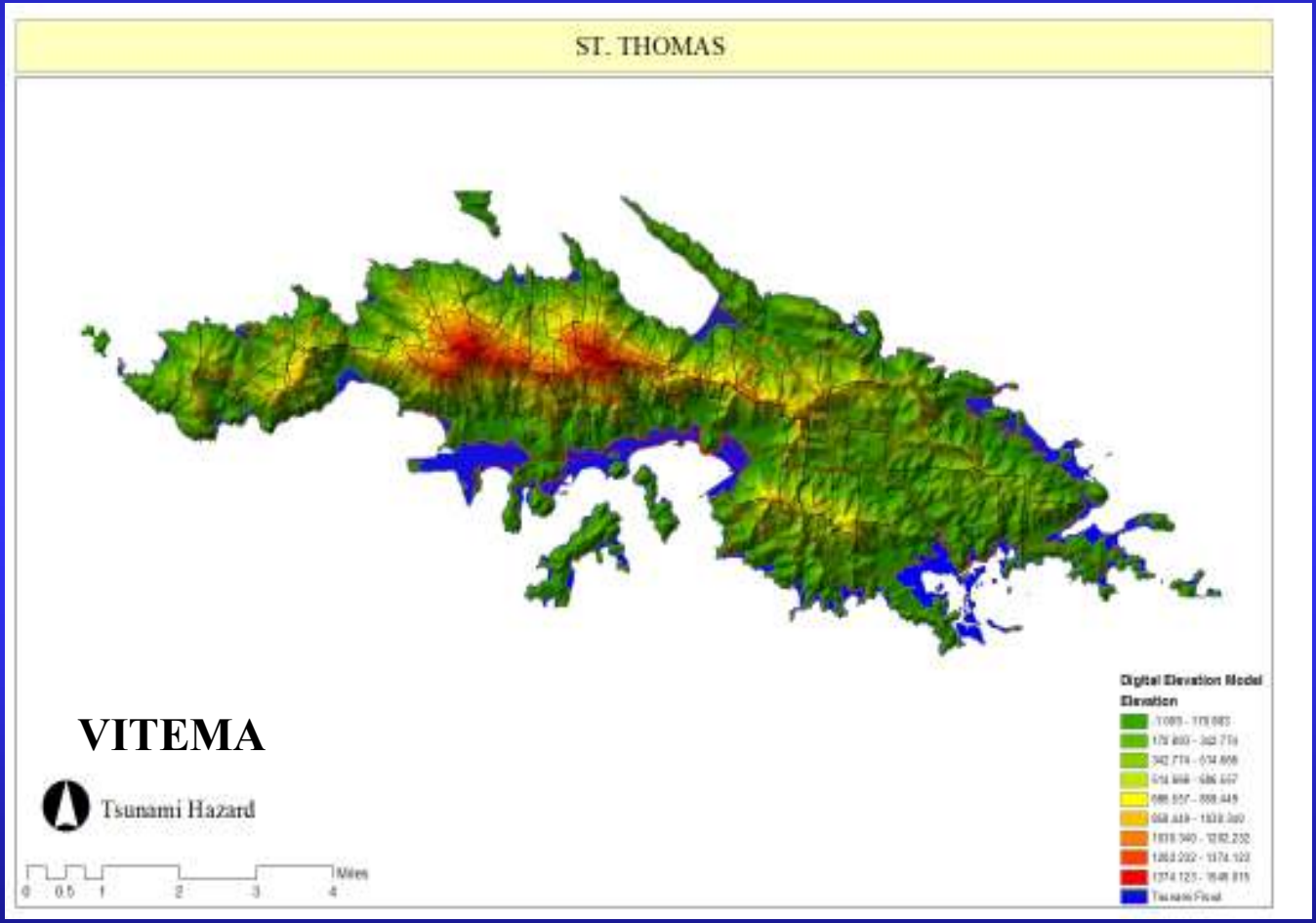
National Sampling of Data Inventory

(CarICOOS potential vs 14 NOAA-COTS projects)



* Note that NOAA-COTS observations typically reflect initial regional emphasis and that not all observations are available in "real-time"

How should data be stored, made accessible, visualized, manipulated?



Decisions about:

- Means of physical storage
- Type of database
- Languages for manipulation
- Software for access

What is DMAC ?

"A community resource [mandated by *Ocean.US*] to identify appropriate standards-based best practices and technical solutions that enable interoperability among IOOS data providers and users."

What is DMAC ?

Key components (and associated standards)

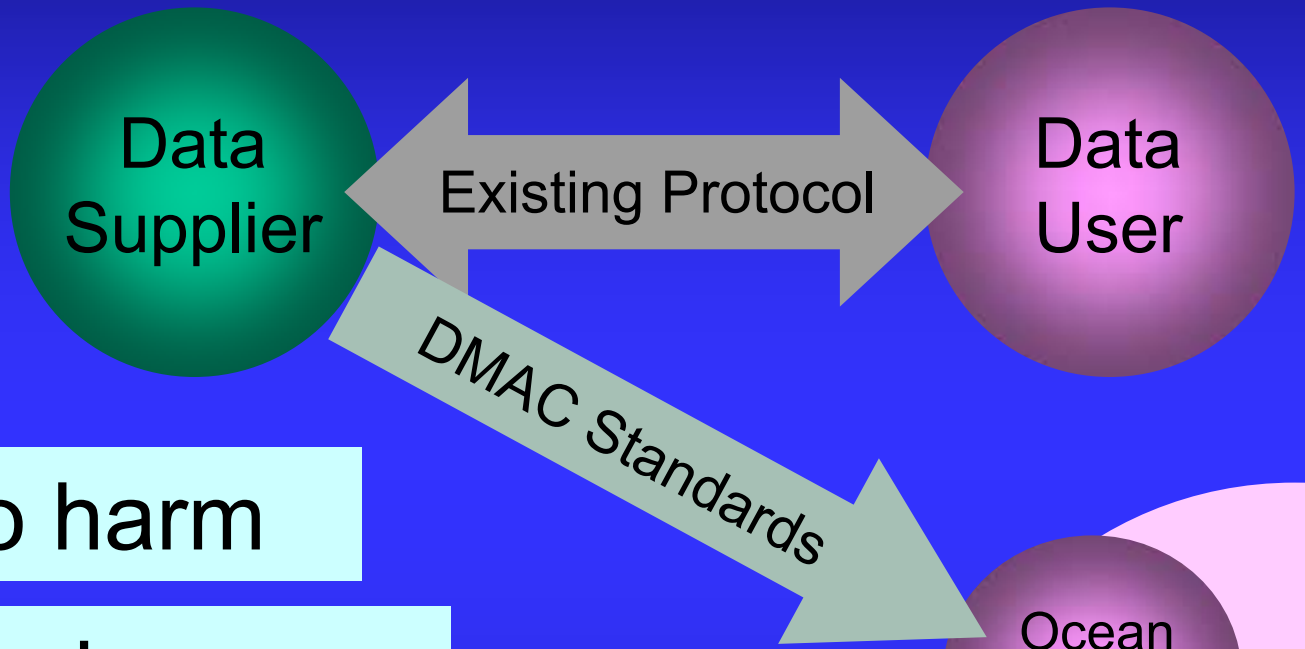
- Data discovery (metadata)
- Data transport and access
- On-line browse
- Archive
- Metrics, feedback and fault correction
- IT security

What is DMAC ?

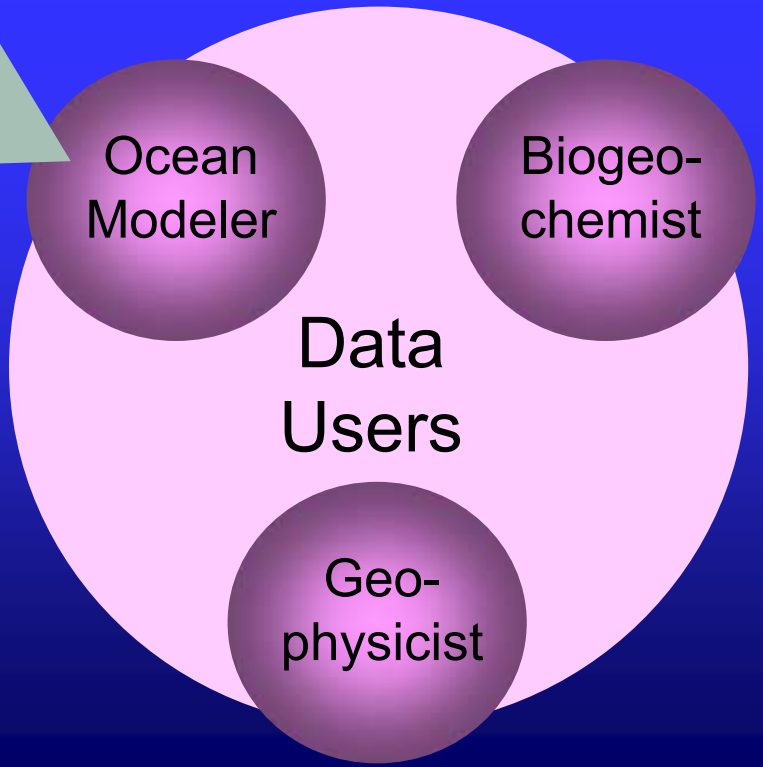
DMAC does not include:

- Observing systems themselves
- Telemetry (sensor-to-collection point)
- QA / QC (for now)
- Modeling and forecasting

DMAC Guiding Principles

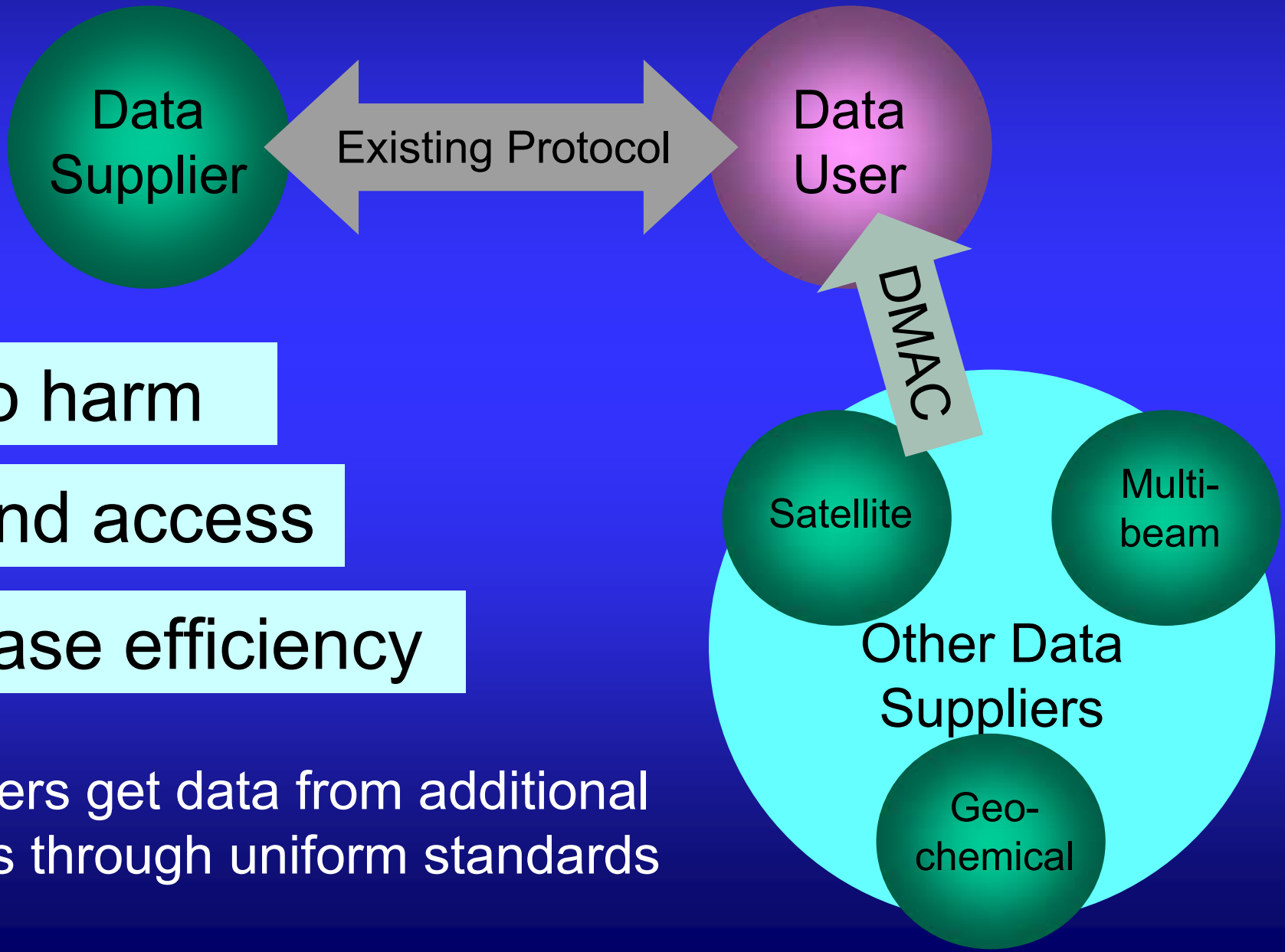


1. Do no harm
2. Expand access



DMAC standards enable data suppliers to reach a wider range of users.

DMAC Guiding Principles



1. Do no harm
2. Expand access
3. Increase efficiency

Data users get data from additional suppliers through uniform standards

Key DMAC Short-term Technical Recommendations

1. DMAC Standards Process – Implement a community-based collaborative, program-bridging, Web-accessible DMAC resource
2. Metadata – Minimum content using standard vocabulary appropriate to marine data
3. Transport and Access – A suite of protocols consistent with eventual IOOS Web Services functionality
4. Archive and Access – Engage major existing infrastructure
5. IT Security – Appropriate to the evolving, diverse IOOS community
6. QA/QC – Not addressed by DMAC – addressed by QARTOD (Quality Assurance of Real-Time Data)

About QA/QC: QARTOD

- **QARTOD** is a continuing multi-agency effort to address the Quality Assurance (QA) and Quality Control (QC) issues of the Integrated Ocean Observing System and broader international community.*

  For example, at the next QARTOD meeting (QARTOD IV) waves and *in situ* currents groups will report on QC definitions and address quality assurance. The CTD group will continue work on QC and begin exploration of international outreach and coordination. Metadata definitions relating to real time data collection will be developed, working with representatives from the *Oceans.US* DMAC metadata team.

After *Marine Metadata Interoperability project

DMAC Details

- Provide a search and discovery capacity with common interface
- Provide long term storage at archive centers and acquire metrics
- Provide a security and data retention strategy and capabilities
- Provide real-time observations to data assembly and modeling units
- Utilize common IOOS data models
- Monitor transport performance
- Provide transport and security using a middleware strategy
- Provide a reliable browse capability that includes time and geography
- Coordinate the national hardware/software/network design and installation
- Connect the OPeNDAP and GIS data infrastructure

OPeNDAP

Open-source Project for a Network Data Access Protocol

- "**OPeNDAP** provides software which makes local data accessible to remote locations regardless of local storage format. OPeNDAP also provides tools for transforming existing applications into OPeNDAP clients (i.e., enabling them to remotely access OPeNDAP served data)…. OPeNDAP software is freely available."

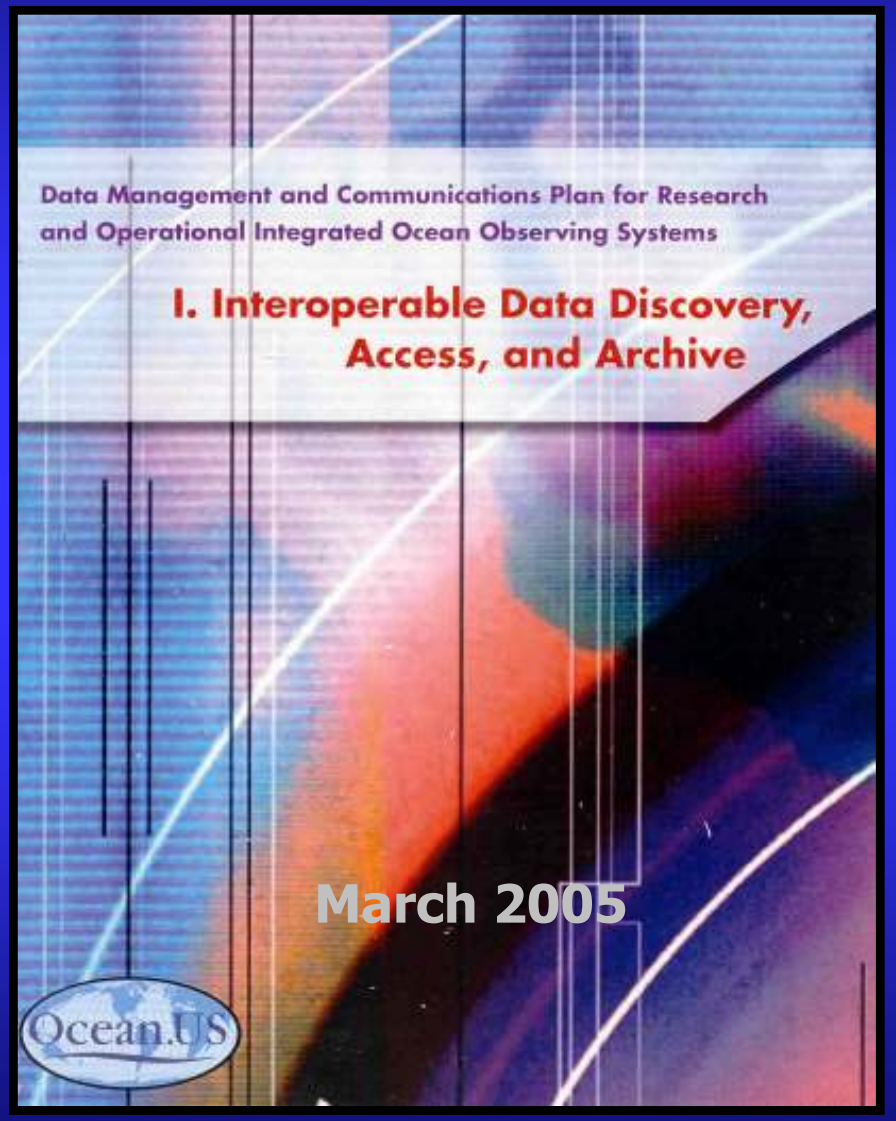
  (*After http://opendap.org*)

- "**The 'OPeNDAP to ArcGIS' Python script suite** accesses data across the Internet via OPeNDAP, a framework that makes local data accessible to remote locations regardless of the particular local data storage format (NetCDF, HDF, text file, etc….). The purpose of these scripts is to provide OPeNDAP data users the ability to download geophysical datasets from OPeNDAP web based data servers and convert the data into a native ESRI datasets (GRID or point shapefile) in one single seamless step. The scripts were designed to work with OPeNDAP servers that are part of the IOOS project and will work with other servers….

  (*After ESRI*)

The IOOS Data Management & Communications (DMAC) Standards Process

- Embodied in DMAC Plan
- 4 levels of review over 2 years
  1. Selected specialists
  2. Public workshops
  3. Wide distribution across community
  4. Formal public comment period announced in ***Federal Register***
- Involving ~150 reviewers
  - 6 Federal Agencies
  - 21 Universities & Institutes
  - 11 Private Sector
  - 11 Regional/State agencies
  - 4 International
- Formally released March 2005



Web Addresses

- **Ocean.US Data Analysis and Modeling (DAM)**
  http://www.ocean.us/Models

- **Ocean.US Data Management and Communications (DMAC) Plan** *provides the framework for interoperability*
  http://dmac.ocean.us/dacsc/imp_plan.jsp

- **Open Geographic Information Systems (GIS) Consortium (OGC)** *an open consortium of industry, government, and academia developing interface specifications to support interoperability*
  http://www.opengis.org

- **Open-source Project for a Network Data Access Protocol (OPeNDAP)** http://www.opendap.org

The End

Thank you

1. DMAC Standards Process

- Create and share inventory & lessons learned & gaps of standards now used
- *Ocean.US* implement community-oriented, Web collaboration resource that would support
  - Consensus building and feedback opportunity
  - Attention and information on current DMAC standards
  - Encourage technical assistance in key standards areas
  - Sharing information among players & programs
- Participate in DMAC Standards Process Expert Team

2. Metadata

- Create in XML-schema and provide style sheet
- Document data dictionary used
- Use FGDC standards
- If FGDC extension(s) not available, use community accepted standard and document what was used
- …

3. Transport and Access

- Gridded data – provide access through OPeNDAP
- Complex data collections that are SQL accessible, either enable with OPeNDAP or use enterprise GIS
- Address Gateway services (protocol conversions) immediately
- Participate in pilot or test-bed activities
- Assume future DMAC interfaces will be SOAP-enabled
- Participate in DMAC Transport & Access Expert Team

4. Archive

- Ensure data are placed with responsible archive, directly or by proxy (e.g., NOAA NDBC)
- Existing archive centers make data accessible using DMAC guidelines
- Participate in DMAC Archive Expert Team

5. IT Security

- Better understanding needed
- Those providing data used in official forecasts & warnings negotiate their use with appropriate federal center who have certified security plan(s) in effect
- All others use prudent IT security measures until guidance is available
- Share information on security measures being taken
- Participate in DMAC IT Security Expert Team

6. QA / QC

- Now lies outside DMAC responsibility…but
- Submit marine buoy data to NOAA NDBC
- Additional guidance may be found elsewhere, such as QARTOD initiative