INTEGRATED OCEAN OBSERVING SYSTEM

Status report on
IOOS® DMAC & OOI Cyberinfrastructure

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1201 New York Avenue, Washington, DC
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Objectives for today…

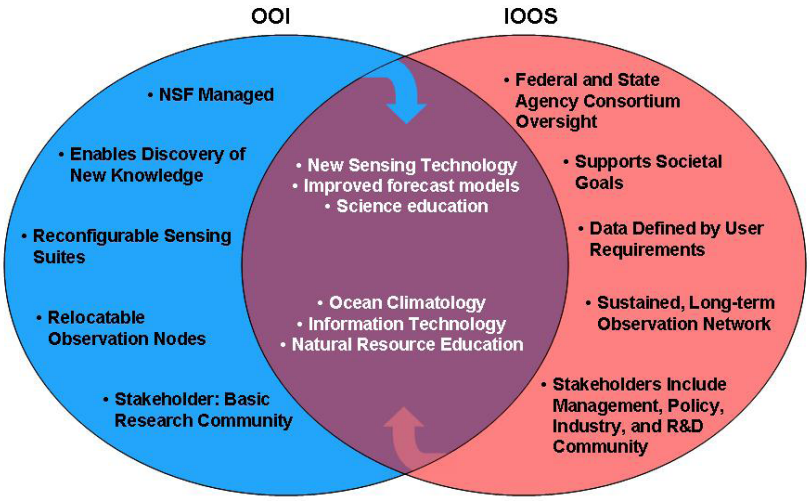
Update on IOOS DMAC and OOI-CI implementation

Report current DMAC-CI collaboration

Anticipated next steps

Potential role for ORRAP Observing Sub-panel

OOI and IOOS



from July 2007 response to ORRAP

OOI and IOOS

	IOOS	OOI
Data	Driven by societal goals and must **routinely and continuously deliver data and data products** of known quality **in real time** to decision makers.	Governed by the needs of the research community, with **experimental data delivery in near-real time** ultimately leading to improved predictability of ocean processes in areas of societal need.
Sensors	Will depend on **highly reliable sensors** and data telemetry to ensure that critical data streams are not interrupted, as well as on operational models for making predictions with known levels of uncertainty.	Will provide the motivation and capability to try out **new, experimental sensors** and to develop new observing strategies that may eventually be adopted by the IOOS system once their reliability for routine operation is established.
Design	**Primarily stationary operational system**, designed to provide reliable operational data streams.	**Highly adaptive**, allowing scientists to respond to ocean events and control and adapt observatory assets and data streams to address new events.

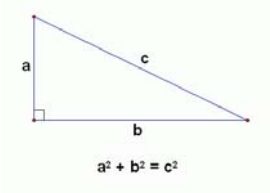
Our Challenge – why is DMAC so important?

standards-based approach or <u>common language</u> is essential

example: **mathematics as the language of science**

*"Philosophy is written in this grand book, the universe which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles and other geometric figures without which it is humanly impossible to understand a single word of it; **without these, one wanders about in a dark labyrinth**."*

Galileo
(on the book of "Nature")



$E = mc^2$

This "language" is emerging

OGC® Open Geospatial Consortium, Inc.

ISO International Organization for Standardization

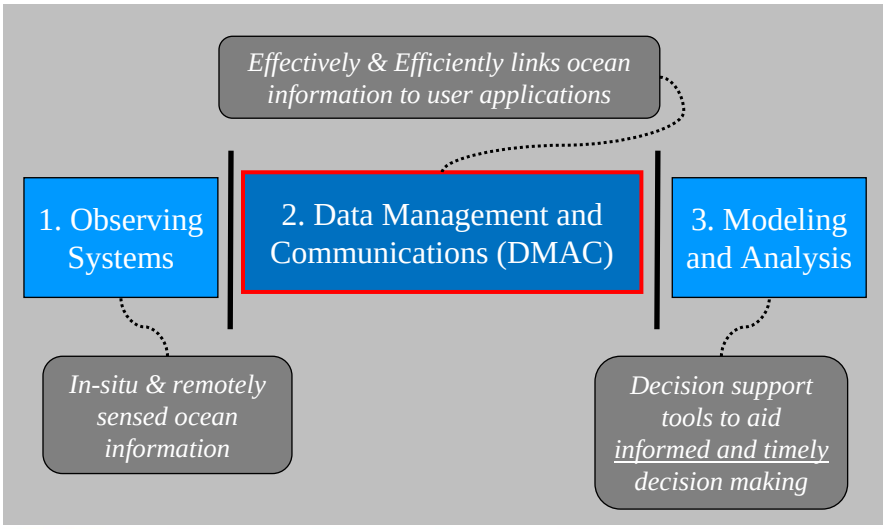
OPeNDAP

unidata

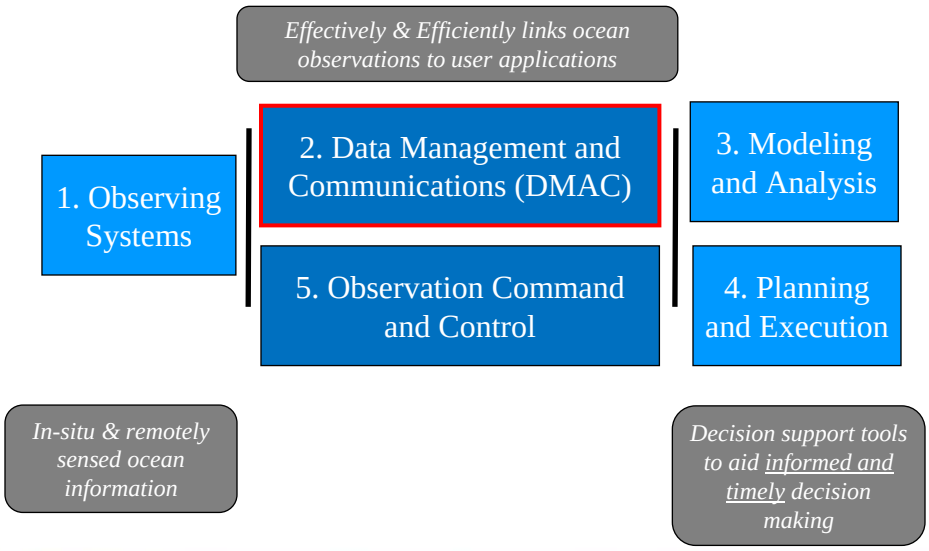
W3C® WORLD WIDE WEB consortium

QARTOD Quality Assurance of Real-Time Oceanographic Data

IOOS® Subsystems



Ocean Observing Subsystems



IOOS DMAC

History
Composition
Accomplishments
Plans

A brief history of IOOS® DMAC

2002 **Ocean.US forms DMAC Steering Committee**

2004 **First IOOS Development Plan Highlights importance of DMAC**

2005 **DMAC Steering Committee Publishes DMAC "plan" and DMAC Steering "Team" is formed to guide execution**

2003-2005 **NOAA/Navy IOOS Interoperability Demo (with Boeing and Northrup Grumman)**

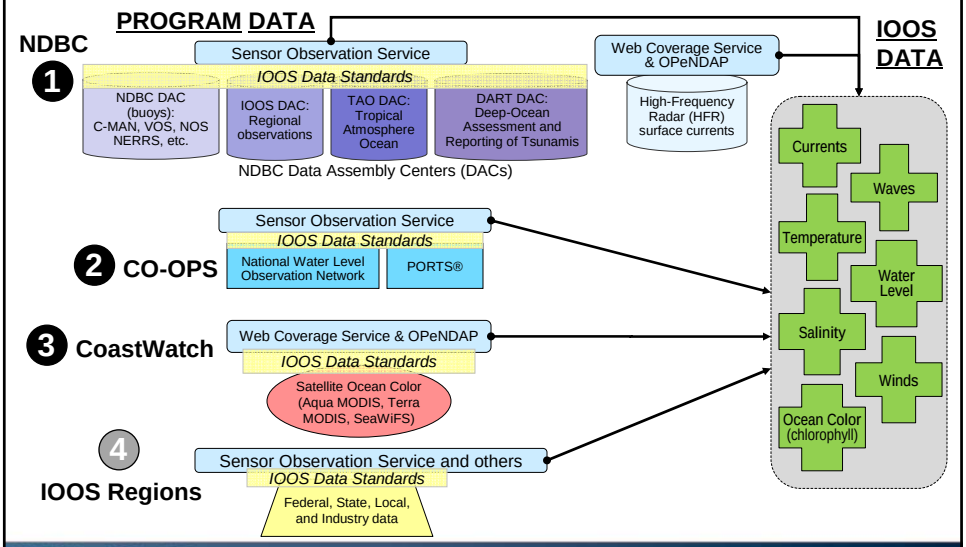
2006 **IOOS Conceptual Designs (Raytheon & Lockheed)**

Data Integration Framework project

Months 0-12 2007	Month 18 2008	Month 24 2009	Month 36 2010
Integration	Model Ingest	Benchmark	Performance Assessment
1. Temperature 2. Salinity 3. Water Level 4. Currents 5. Winds 6. Waves 7. Ocean Color	• requirements • data standards • protocols	• Coastal Inundation • Harmful Algal Bloom Forecast • Hurricane Intensity Forecast • Integrated Ecosystem Assessment	• Lessons learned • technical assessment • customer assessment • write/publish final report

Completed Completed Completed Completed

DIF Observation Systems - Partners



Data Integration Framework Report

#	Metr	DIF impact	
1	Increased efficien reliability of acces water level data fo model initializatio improvement)	ositive	More efficient access to data for TPC operators.
2	Graphic display of observation data, t predictions, and st external audiences events)	ositive	New capabilities were used operationally.
3	Enhanced GIS disp briefings to extern via SDP. (# events	ositive	New capabilities were used operationally.
4	Improved commun local emergency n storm time frame assessment)	eutral	Very little opportunity to test; seems positive but addl enhancements desired.
5	Improved HLS for DIF data integratic (qualitative assess	sufficient ta for aluation	Not enough storms during test period for evaluation

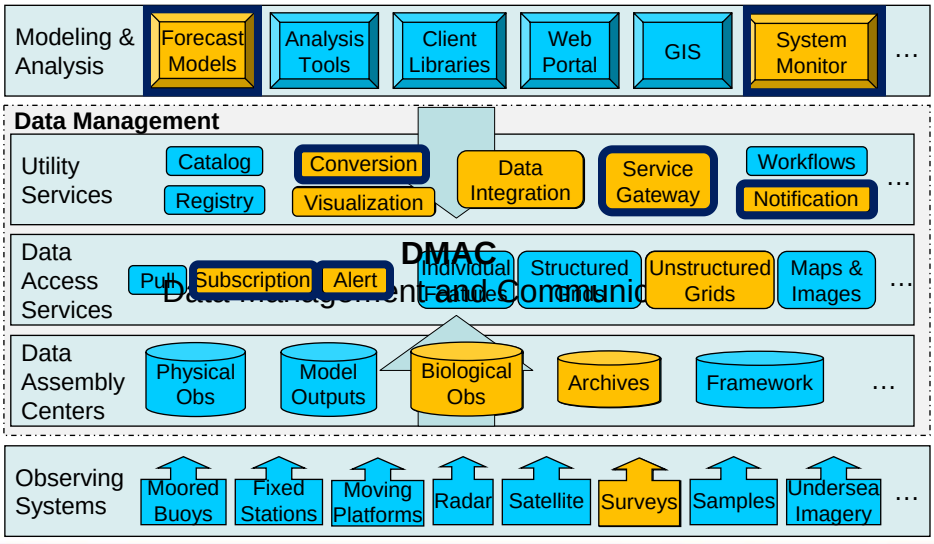
INTEGRATED OCEAN OBSERVING SYSTEM

Data Integration Framework (DIF)
Final Assessment Report

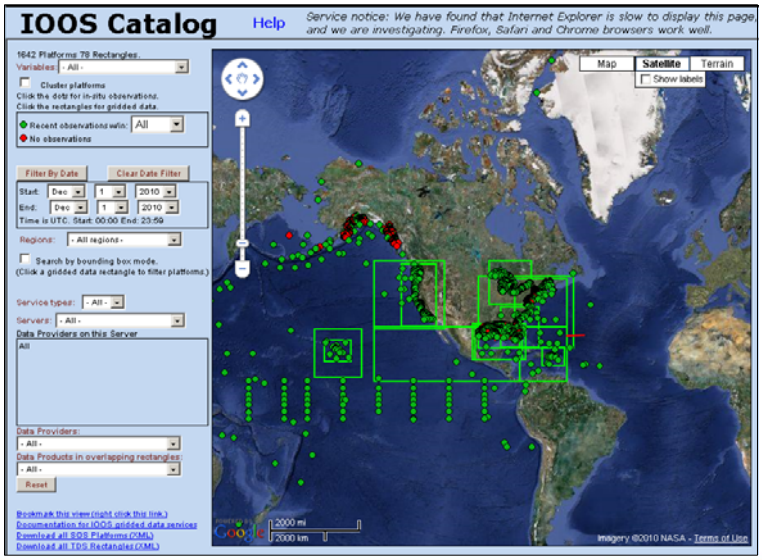
November 22, 2010

Component types needed for IOOS

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



IOOS Catalog – v1.0



IOOS® Core Variables

1. Temperature
2. Salinity
3. Water level
4. Currents
5. Surface Waves
6. Surface Winds
7. Ocean color
8. Dissolved oxygen
9. pH
10. pCO_2
11. Heat flux
12. Bottom character
13. Pathogens
14. Bathymetry
15. Ice distribution
16. Contaminants
17. Stream flow
18. Dissolved nutrients
19. Optical properties
20. Total suspended matter
21. Colored dissolved organic matter
22. Fish species
23. Fish abundance
24. Zooplankton species
25. Phytoplankton species
26. Zooplankton abundance

2010 (7)
2011 definite (15)
2011 maybe (16)

IOOS Biological Observations Project

Goal: standard data representation & standard access

Customer: fishery stock assessments

Data: fishery independent surveys (pres/abs/abund – reef fish)

Products: data content standard, web services

Partners: NOAA Fisheries, NOAA Marine Sanctuaries, Univ. of Hawai'i, Census of Marine Life, USGS/OBIS, State of Hawai'i

IOOC & DMAC

- **IOOS Data Partners Criteria Working Group**
- **IOOC (new) DMAC Steering Team**

OOI

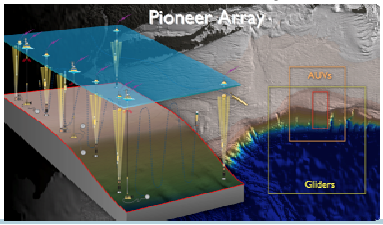
History
Objectives
Composition
Plans

Marine Network Configurations

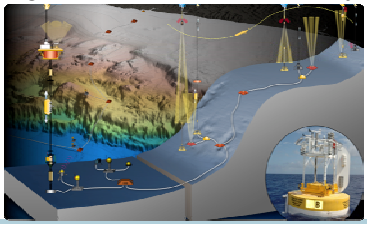
Global Array

Regional Node

Coastal Array



Regional Node + Coastal Array

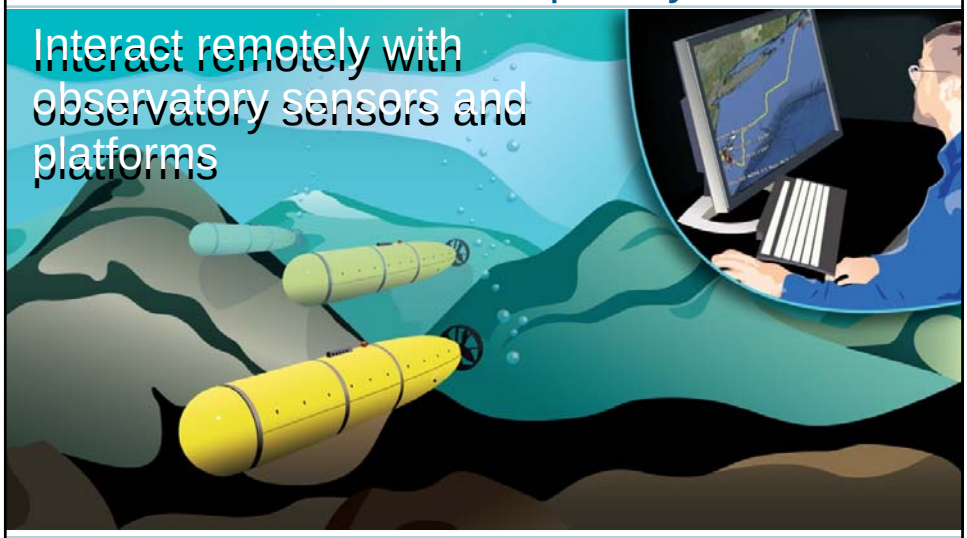


Role of Cyberinfrastructure

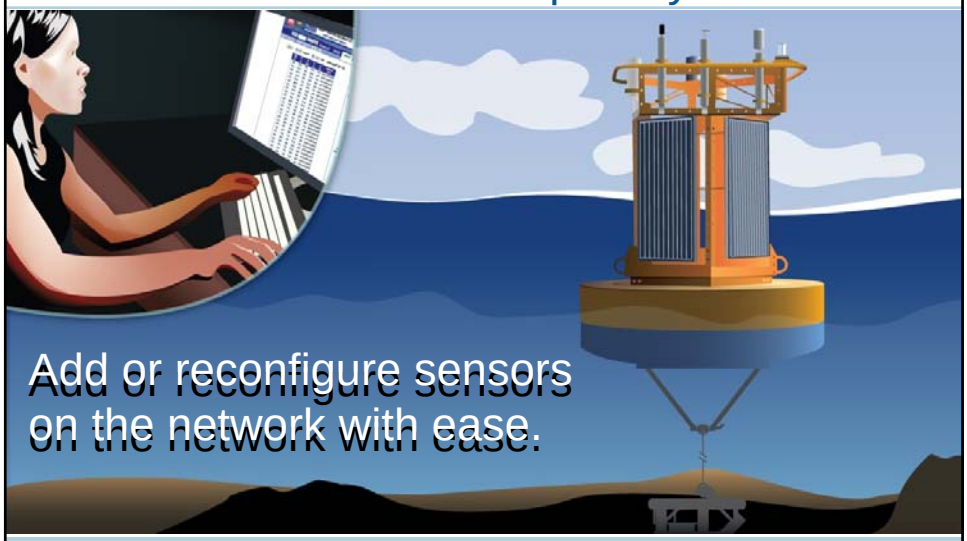
Functional Capability

Collaborate with others in virtual labs to analyze and model data, test ideas and modify the observatory

Functional Capability



Functional Capability



Functional Capability

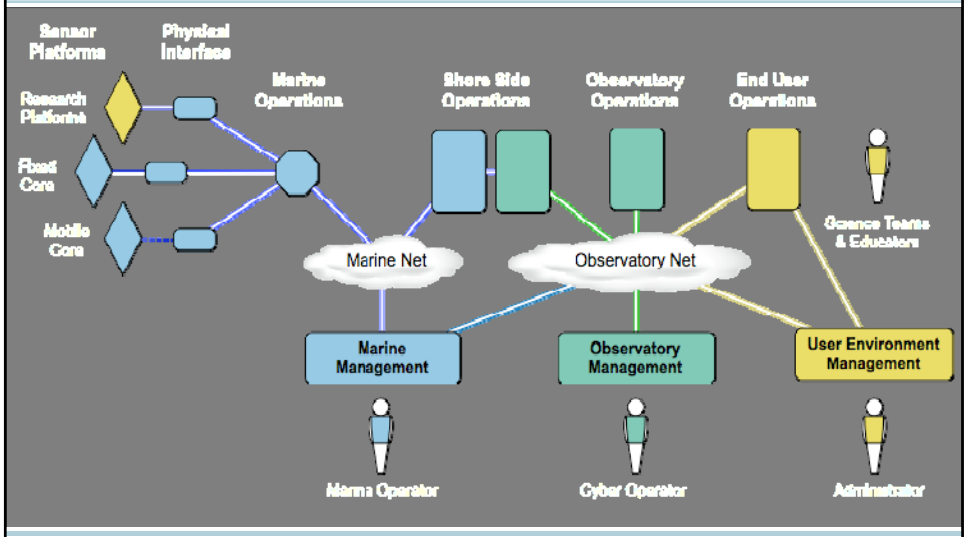
Freely and openly access near real-time data

Functional Capability

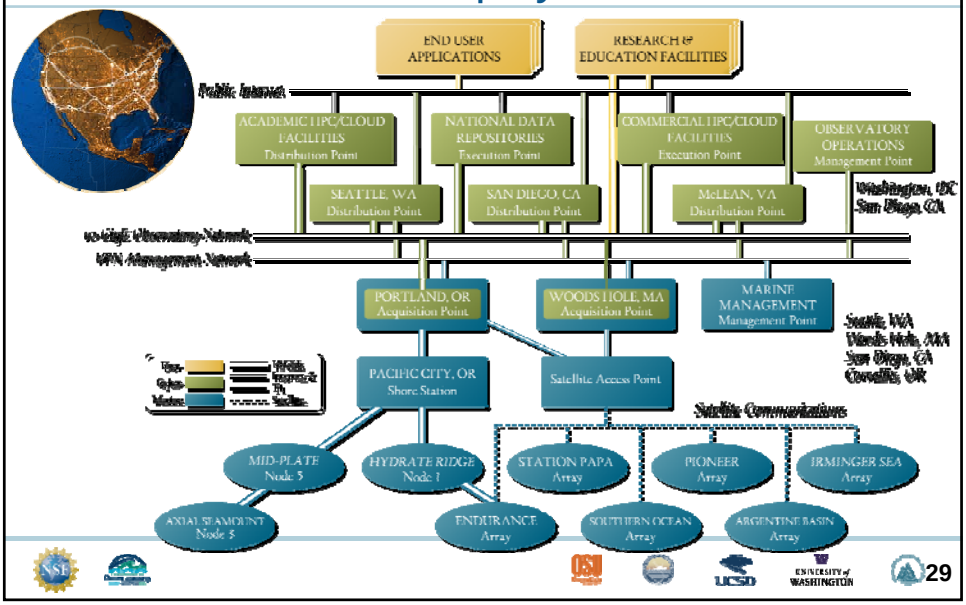
Easily publish and subscribe to data from the observatory

Functional Capability

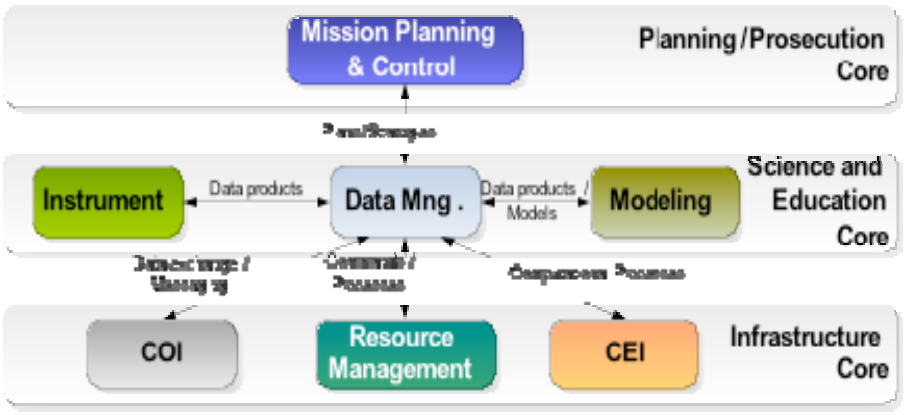
Federated Observatory Network



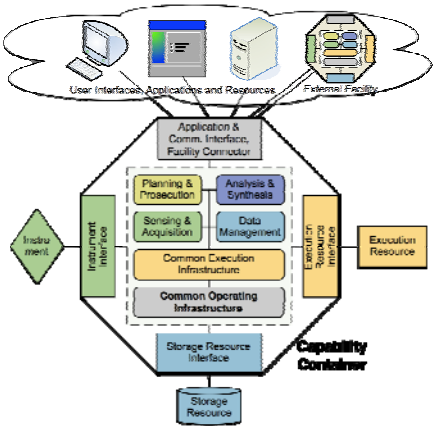
Network Deployment

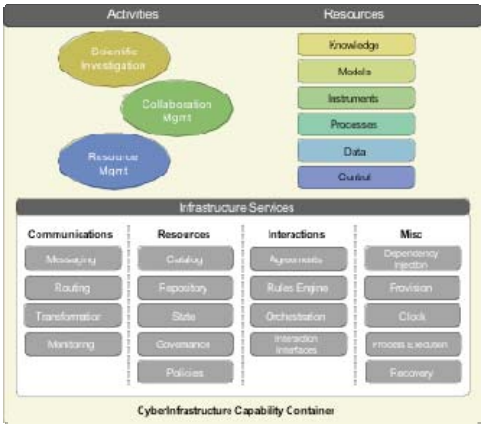


Functional Architecture

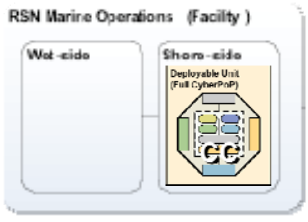


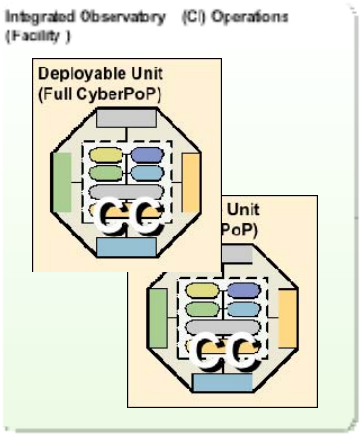
Composable Functional Unit of Deployment

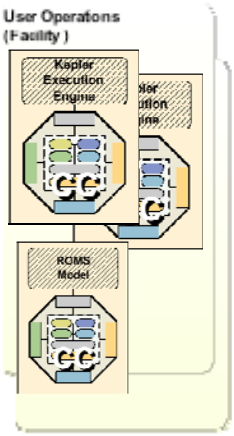




Distributed Functional Deployment



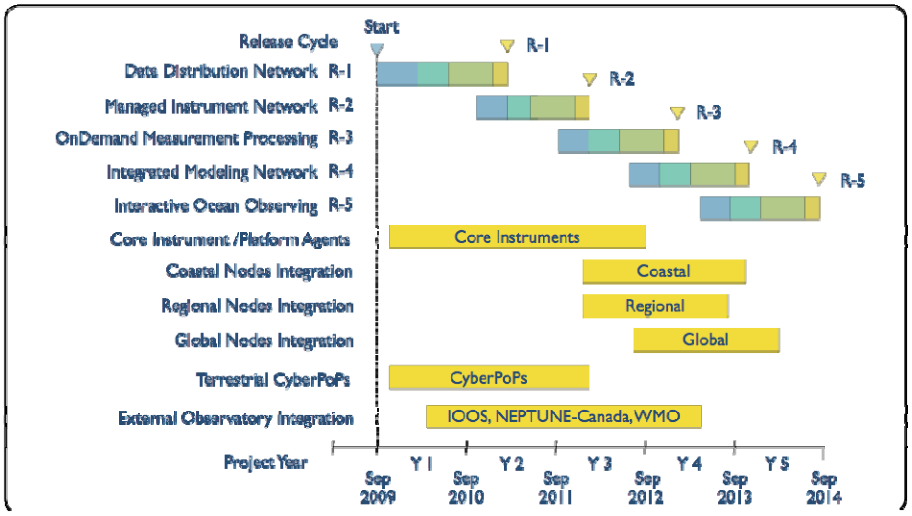




Cyberinfrastructure Plan

Release 1: Data Distribution Network

Cyberinfrastructure Schedule



OOI – IOOS Collaboration

History
Composition
Accomplishments
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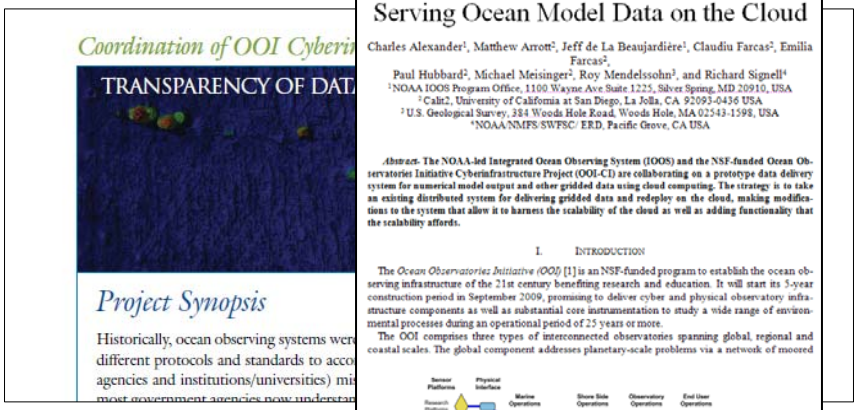
Initial OOI –



Orcutt/Vernon – 2007 grant prop

Serving Ocean Model Data on the Cloud

Charles Alexander[1], Matthew Arrott[2], Jeff de La Beaujardière[1], Claudiu Farcas[2], Emilia Farcas[2],
Paul Hubbard[2], Michael Meisinger[2], Roy Mendelssohn[3], and Richard Signell[4]
[1]NOAA IOOS Program Office, 1100 Wayne Ave Suite 1225, Silver Spring, MD 20910, USA
[2]Calit2, University of California at San Diego, La Jolla, CA 92093-0436 USA
[3] U.S. Geological Survey, 384 Woods Hole Road, Woods Hole, MA 02543-1598, USA
[4]NOAA/NMFS/SWFSC/ ERD, Pacific Grove, CA USA

Abstract- **The NOAA-led Integrated Ocean Observing System (IOOS) and the NSF-funded Ocean Observatories Initiative Cyberinfrastructure Project (OOI-CI) are collaborating on a prototype data delivery system for numerical model output and other gridded data using cloud computing. The strategy is to take an existing distributed system for delivering gridded data and redeploy on the cloud, making modifications to the system that allow it to harness the scalability of the cloud as well as adding functionality that the scalability affords.**

I. INTRODUCTION

The *Ocean Observatories Initiative (OOI)* [1] is an NSF-funded program to establish the ocean observing infrastructure of the 21st century benefiting research and education. It will start its 5-year construction period in September 2009, promising to deliver cyber and physical observatory infrastructure components as well as substantial core instrumentation to study a wide range of environmental processes during an operational period of 25 years or more.

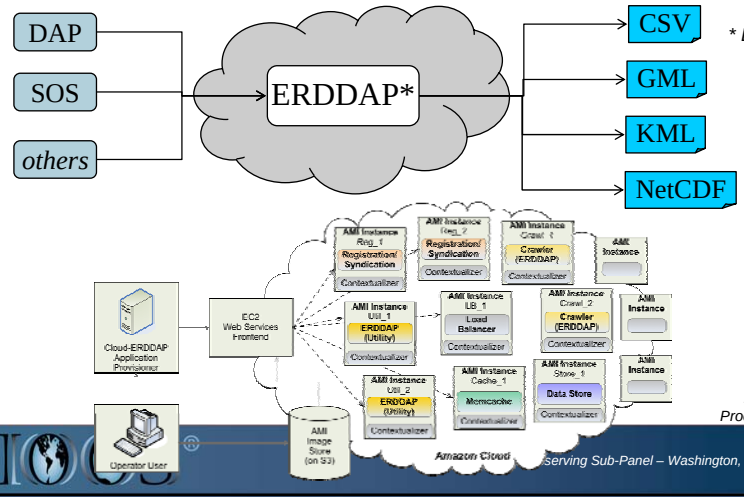
The OOI comprises three types of interconnected observatories spanning global, regional and coastal scales. The global component addresses planetary-scale problems via a network of moored

Fig 1. OOI Data Distribution Network spanning multiple authority domains

2008 OOI – IOOS Collaboration

Scalable translation/visualization service in the cloud

Input formats & services ⇨ *translator* ⇨ *Output formats & services to meet user needs*



* ERDDAP = NOAA Environmental Research Division Data Access Program

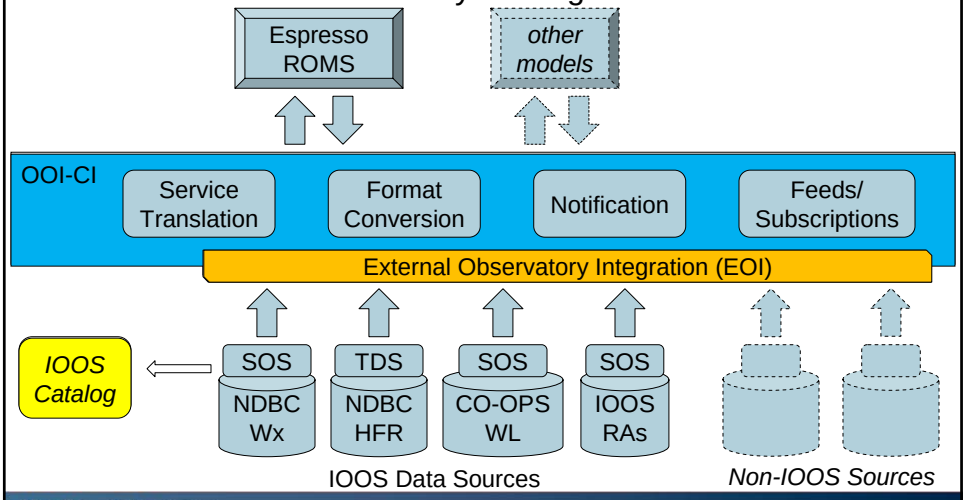
Figure from M. Arrott et al., Proc. MTS/IEEE Oceans 2009

2009 OOI – IOOS Collaboration

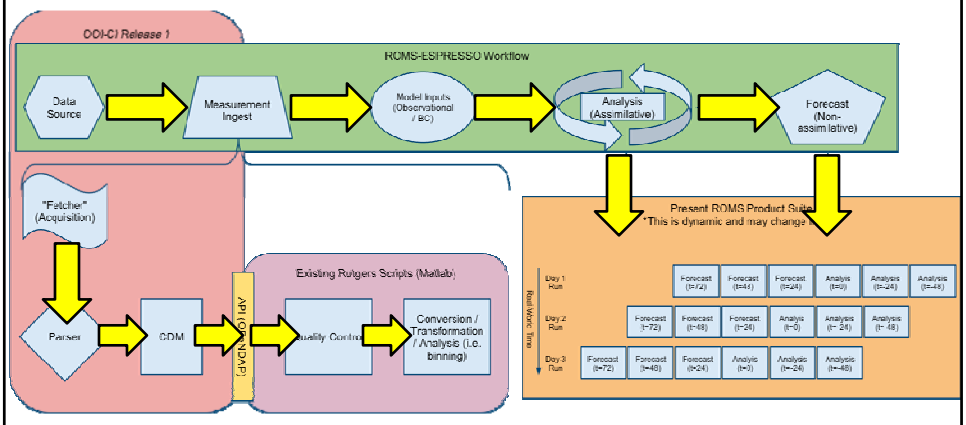
Scalable translation/visualization service in the cloud

2010 OOI – IOOS Collaboration

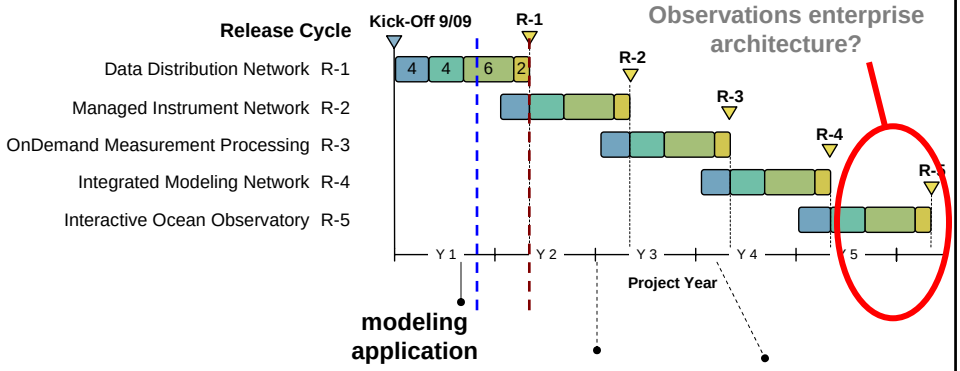
IOOS as external observatory feeding model customer via OOI



MARACOOS Integration Design



Next Steps



OOI-CI – IOO-DMAC collaborations for R1-3

DISCUSSION

1. **Pros/cons for increased IOOS/DMAC collaboration/development with OOI-CI?**
   - *sharing code*
   - *IT security*
   - *alternative architecture*
   - *maintaining identities*
2. **CMSP, Ocean Acidification and other National "themes" as customer drivers for DMAC delivery and evolution?**
3. **Potential role(s) for ORRAP Ocean Observing Sub-panel?**

Thank You

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