NSF ORION Cyberinfrastructure

Lessons Learned from the NSF ORION CI Architecture

Associate Vice Chancellor - Research

Director, Center for Earth Observations & Applications (CEOA)

Director, UCSD Research Innovation Initiative

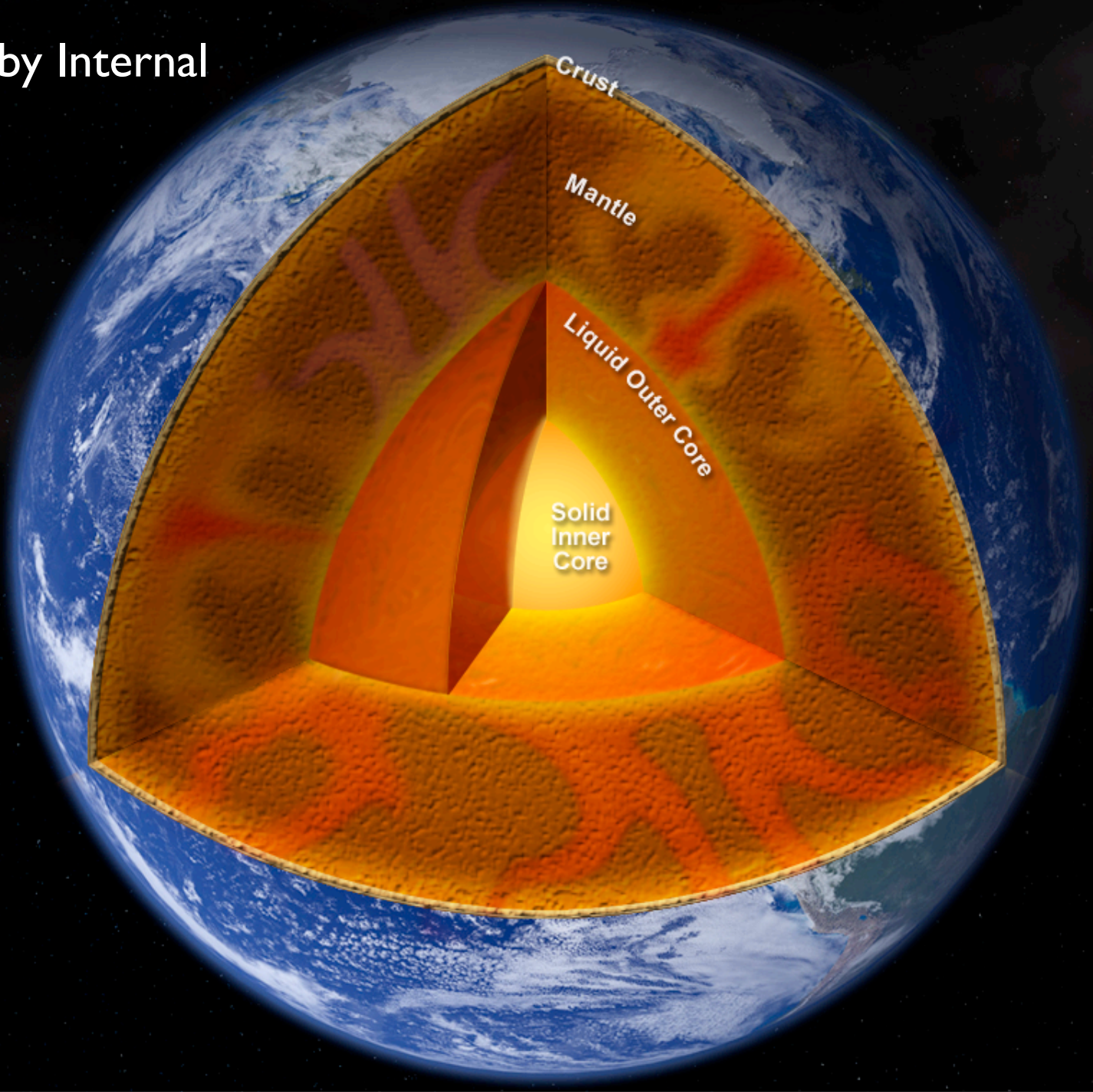
Past President, American Geophysical Union

New Meaning to the Connected Planet

- Beginning of an epoch - **Instrumented Earth**
- A globally accessible **Continuous Signal**
- Representing the **Now State** of the Earth System
- Informing our understanding of its
  - **Past, Present and Predicted Future**
- Signal scales exponentially for the foreseeable future
  - **Quantity, Resolution, Coverage and Utility**

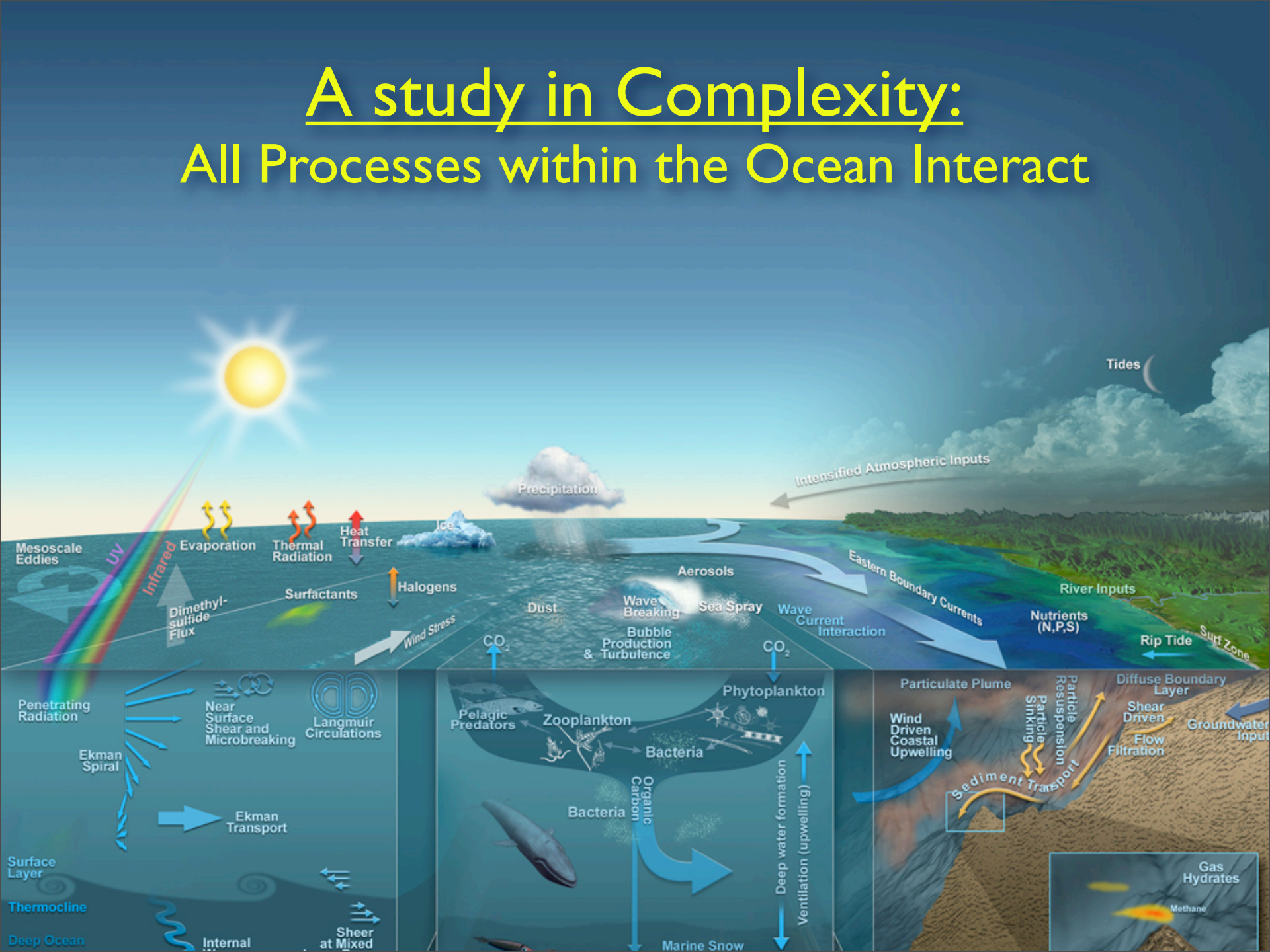
Driven by Solar Energy

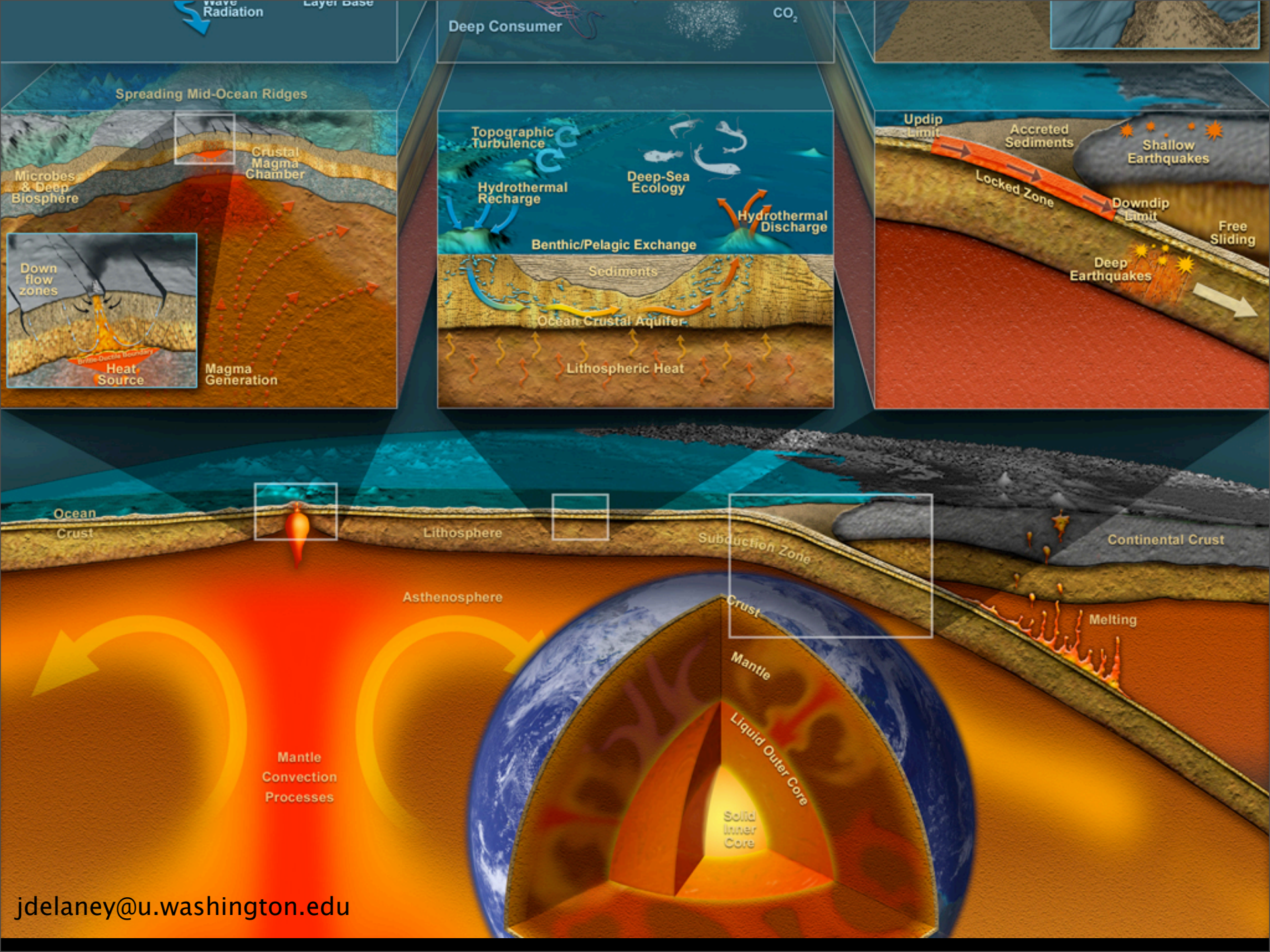
Driven by Internal Heat



A study in Complexity:

All Processes within the Ocean Interact





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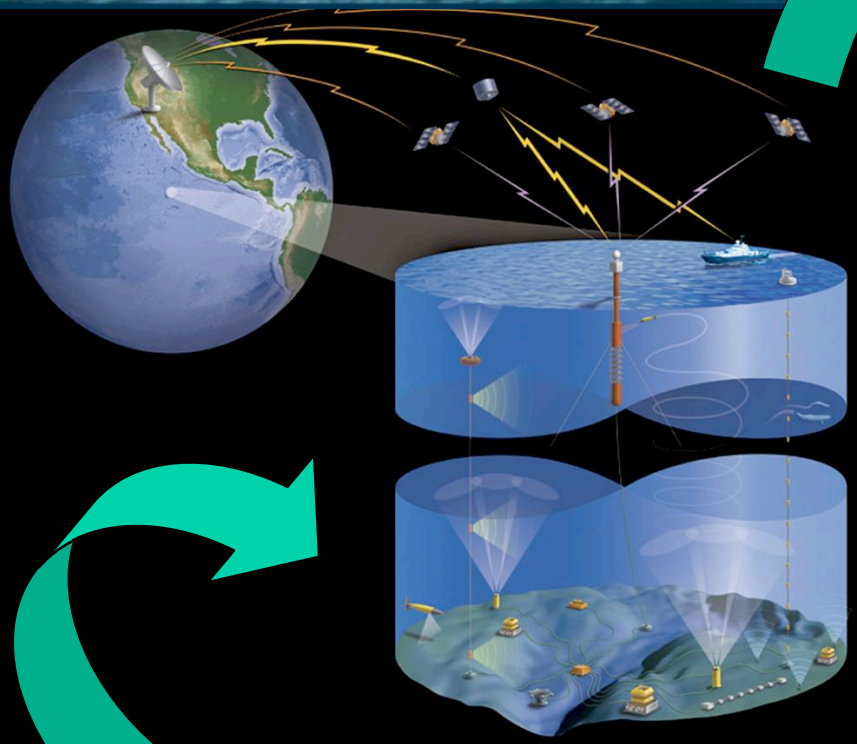
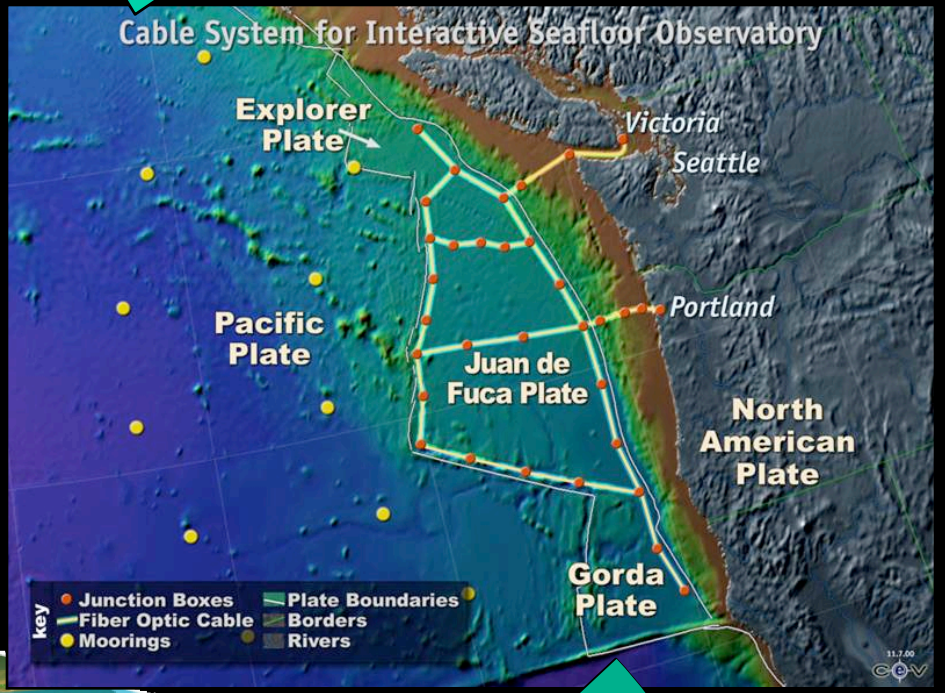
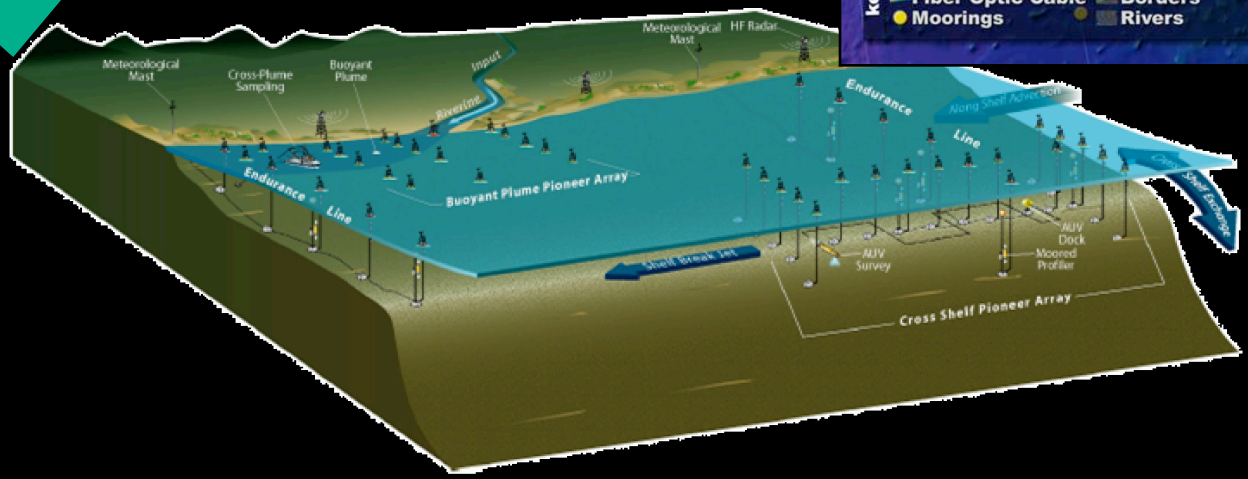
Ocean Research Interactive Observatory Networks







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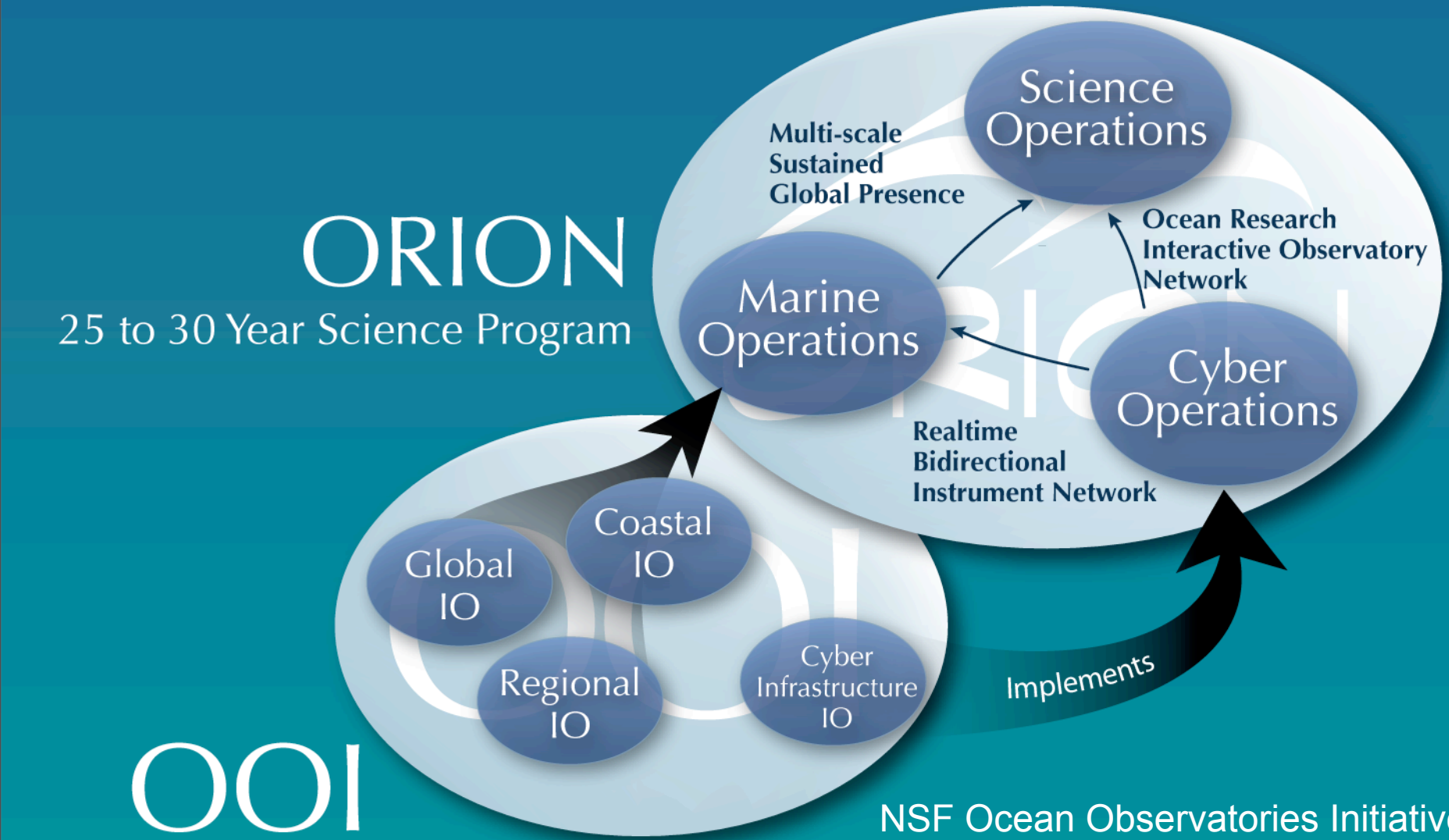
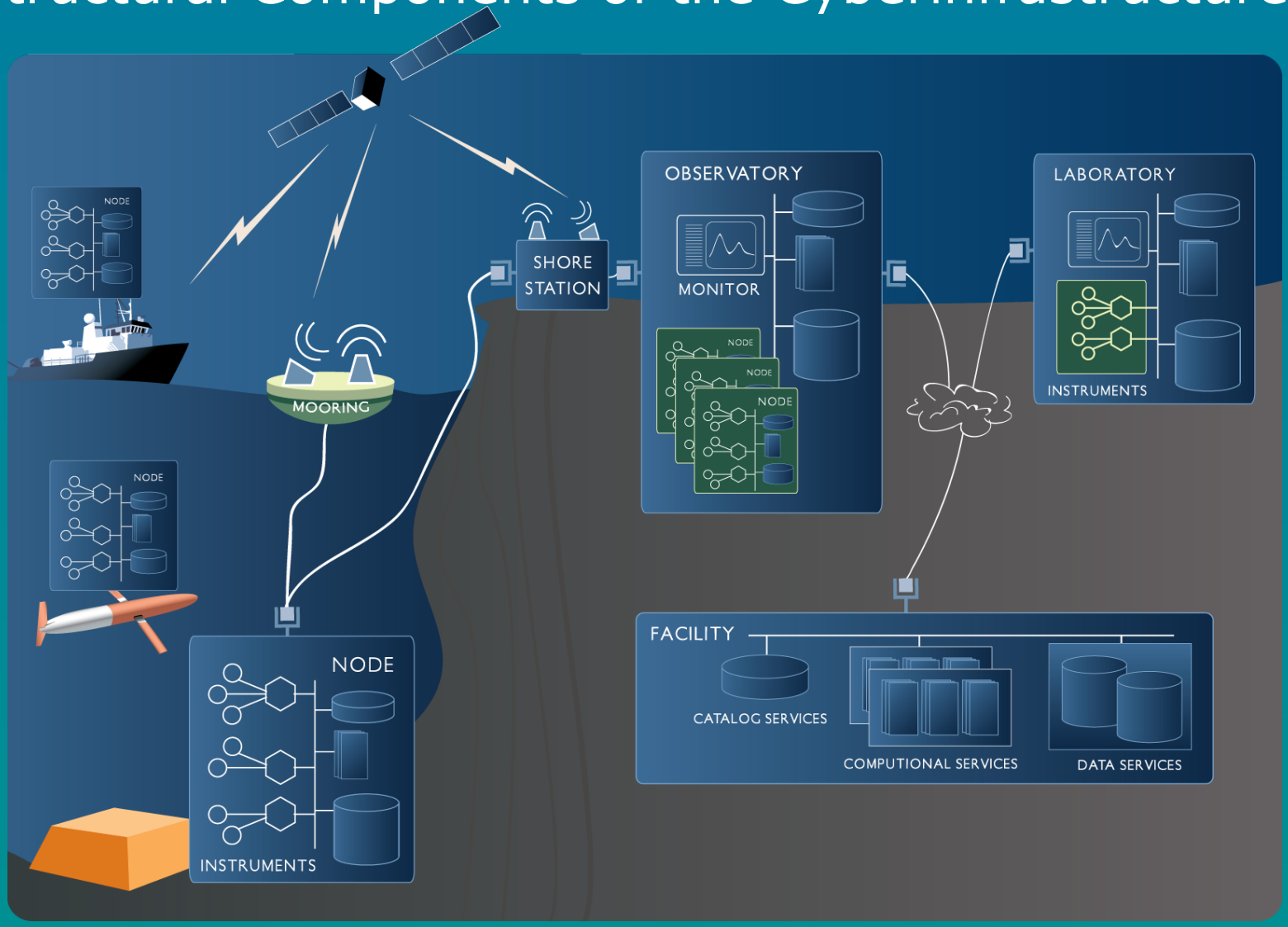


NSF Ocean Observatories Initiative
$331.5M

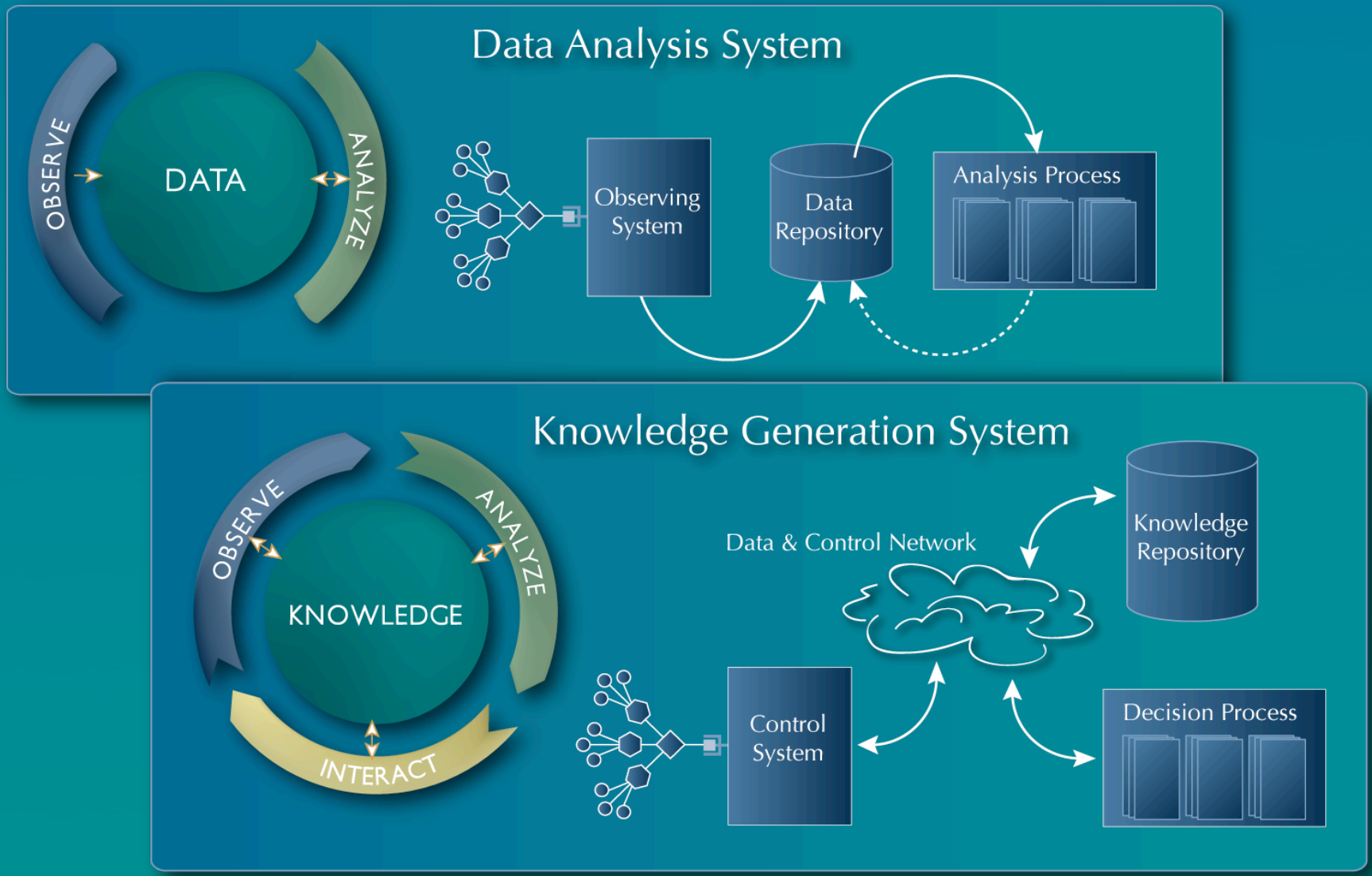
Relevant Experience

- Real-time Observatories, Applications, and Data management Network (ROADNet)
- High Performance Wireless Research and Education Network (HPWREN)
- Storage Resource Broker (SRB) & i Rule Oriented Data System (iRODS)
- Laboratory for Ocean Observatory Knowledge INtegration Grid (LOOKING)
- Southern California Coastal Ocean Observing System (SCCOOS)
- EarthScope Array National Facility (ANF)
- HiSeasNet

Structural Components of the Cyberinfrastructure



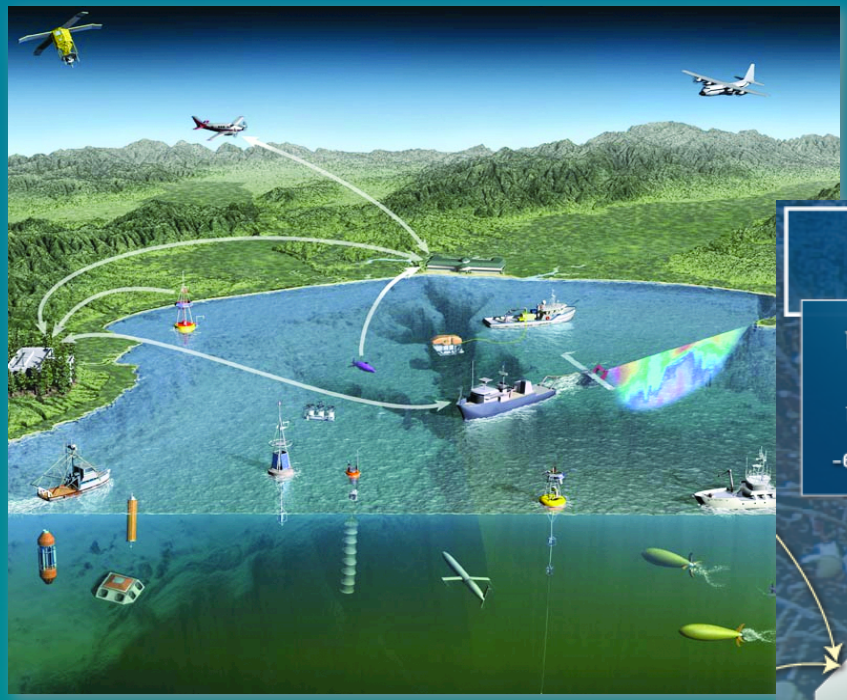
Interactive Observatory

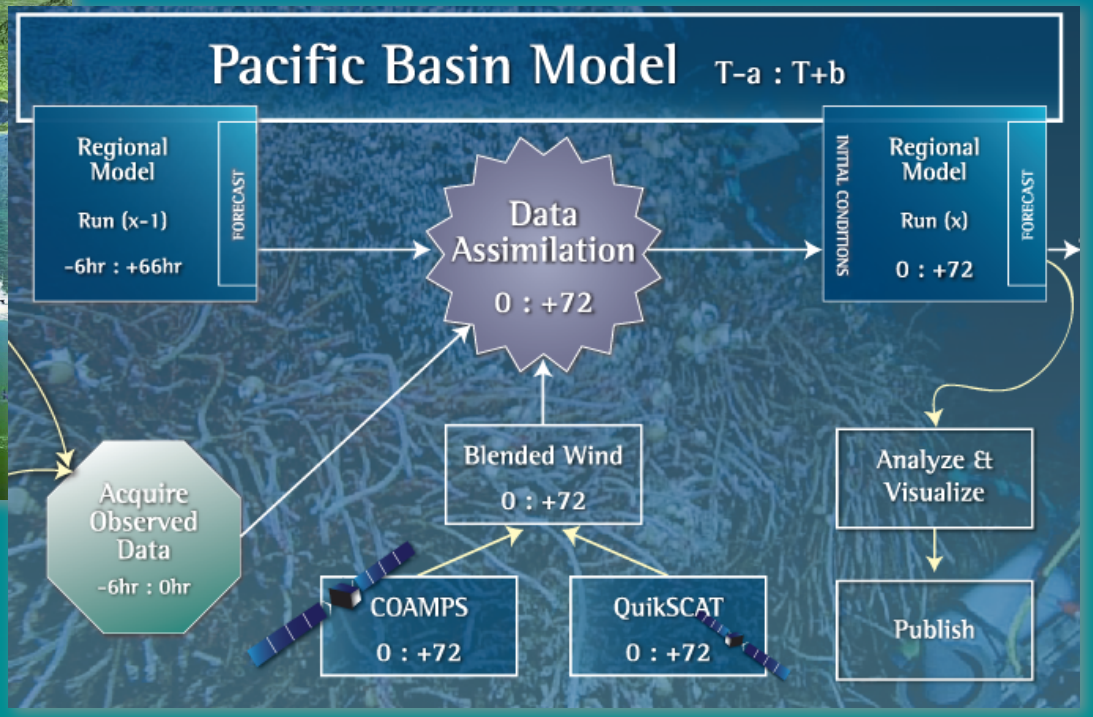


Design Distributed Capabilities

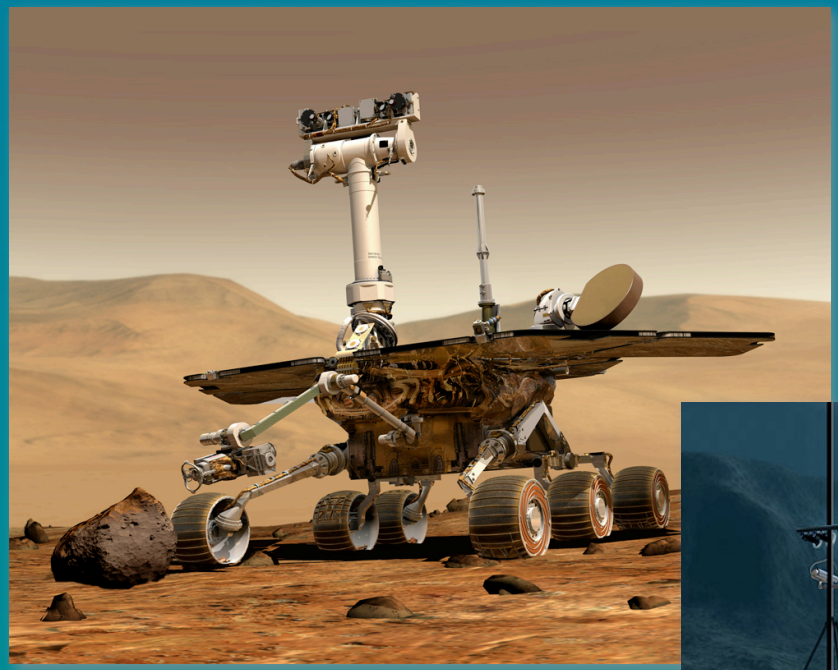
- End-to-end data preservation and access,
- End-to-end, human-to-machine and machine-to-machine control of how data are collected and analyzed,
- Direct, closed loop interaction of models with the data acquisition process,
- Virtual collaborations created on demand that drive data-model coupling and share ocean observatory resources (e.g. instruments, networks, computing, storage and workflows), and
- End-to-end preservation of the ocean observatory process, its outcomes, and automation of the planning and prosecution of observational programs.

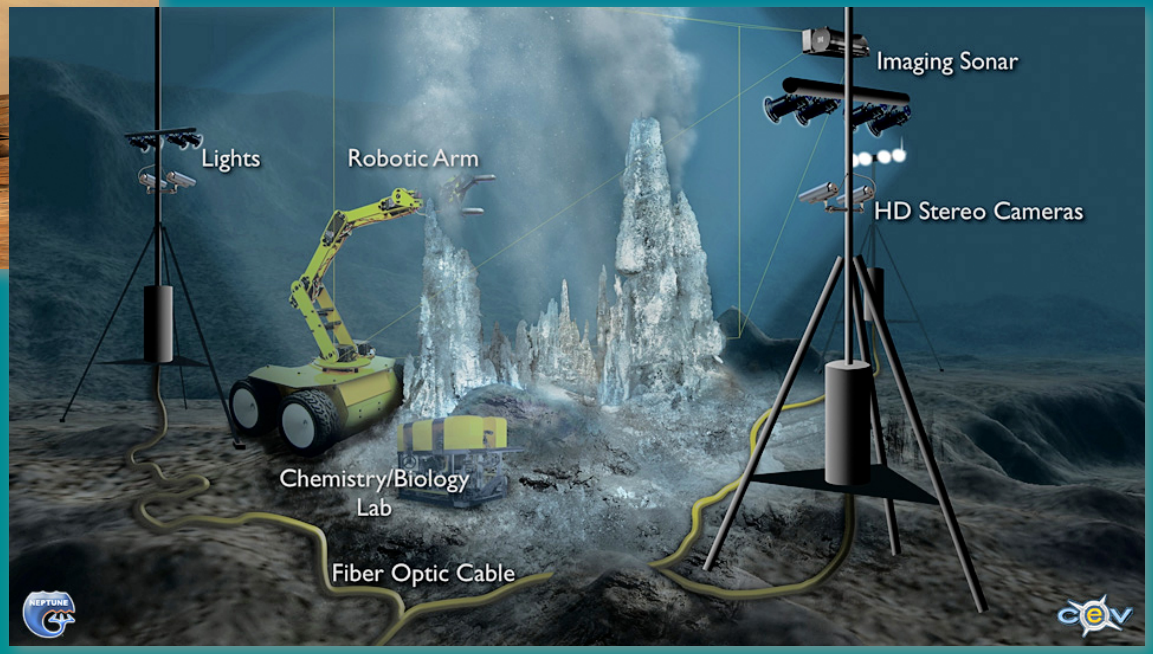
Dynamic Data Driven Assimilation System





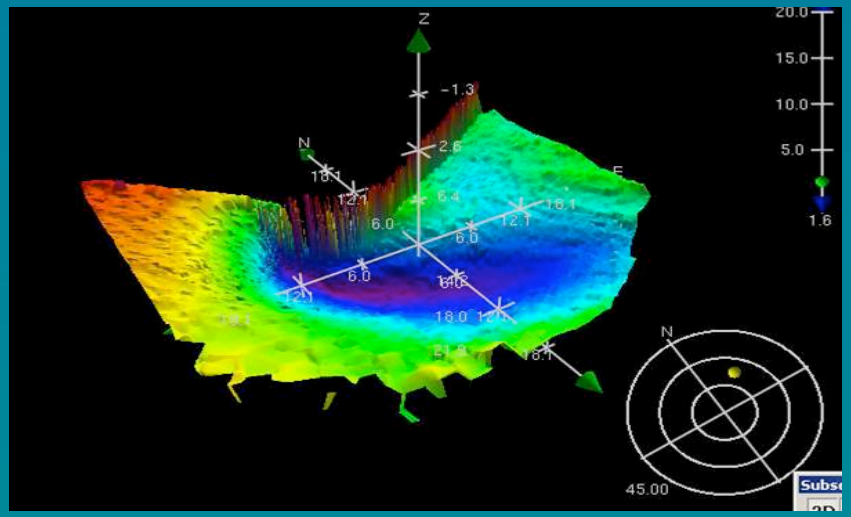
Remote Multi-Mission Autonomous Laboratories

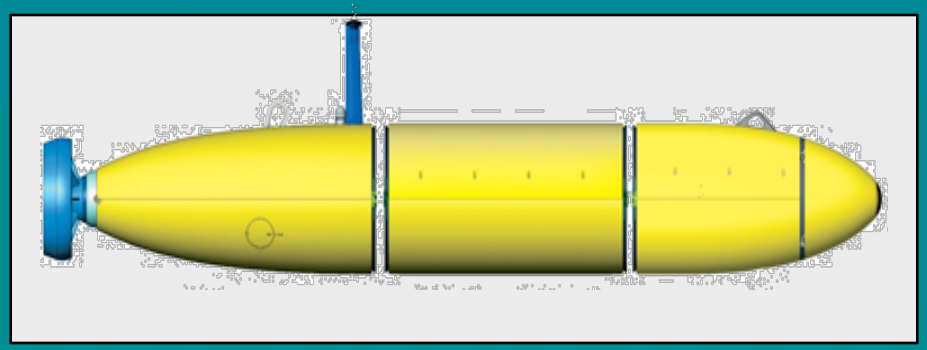




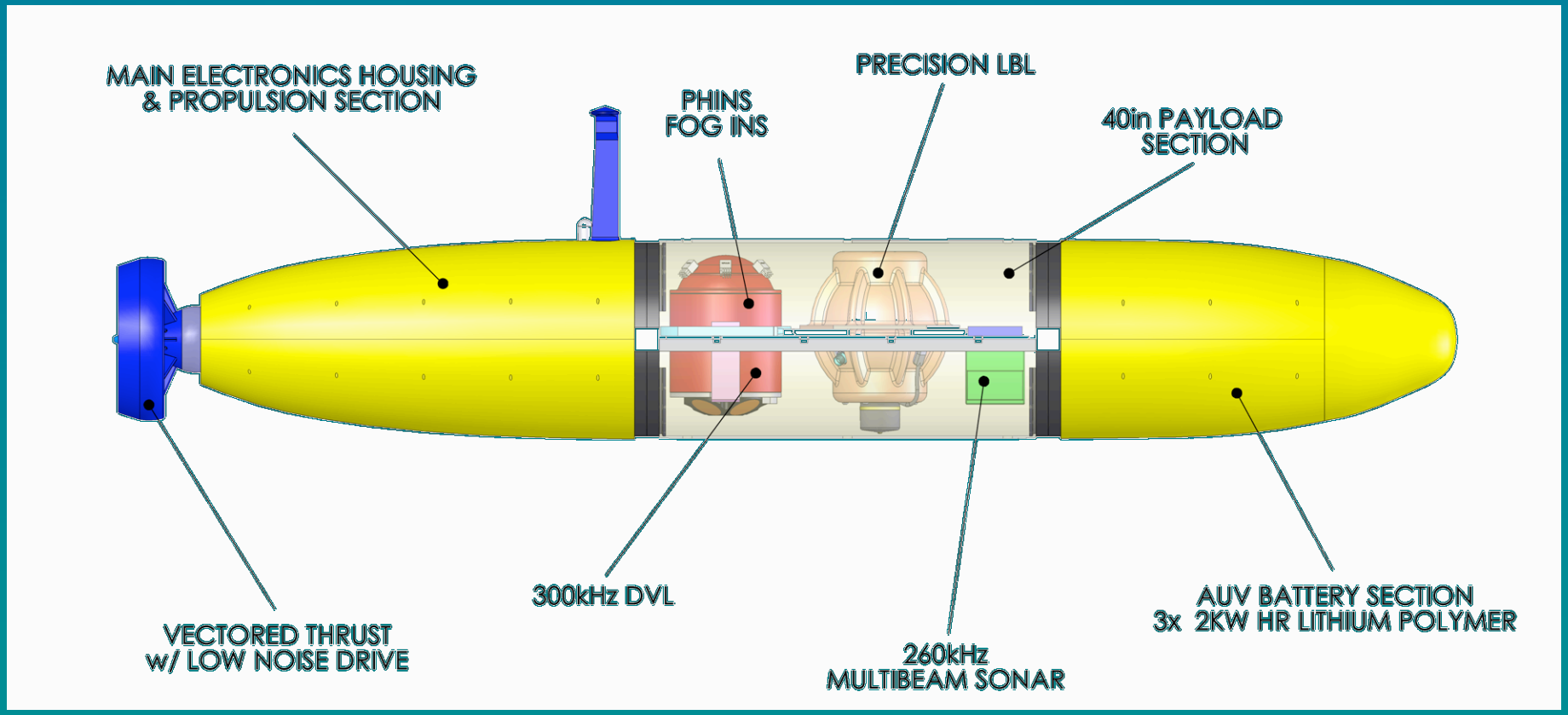
Repeat AUV Bathymetric Mapping

- Extended range
- Decimetric accuracy
- Point measurement in time, but continuous in space
- Surficial seafloor change and deformation
- Queued by FOSS and Acoustic Geodesy
- Expandable sensor payload

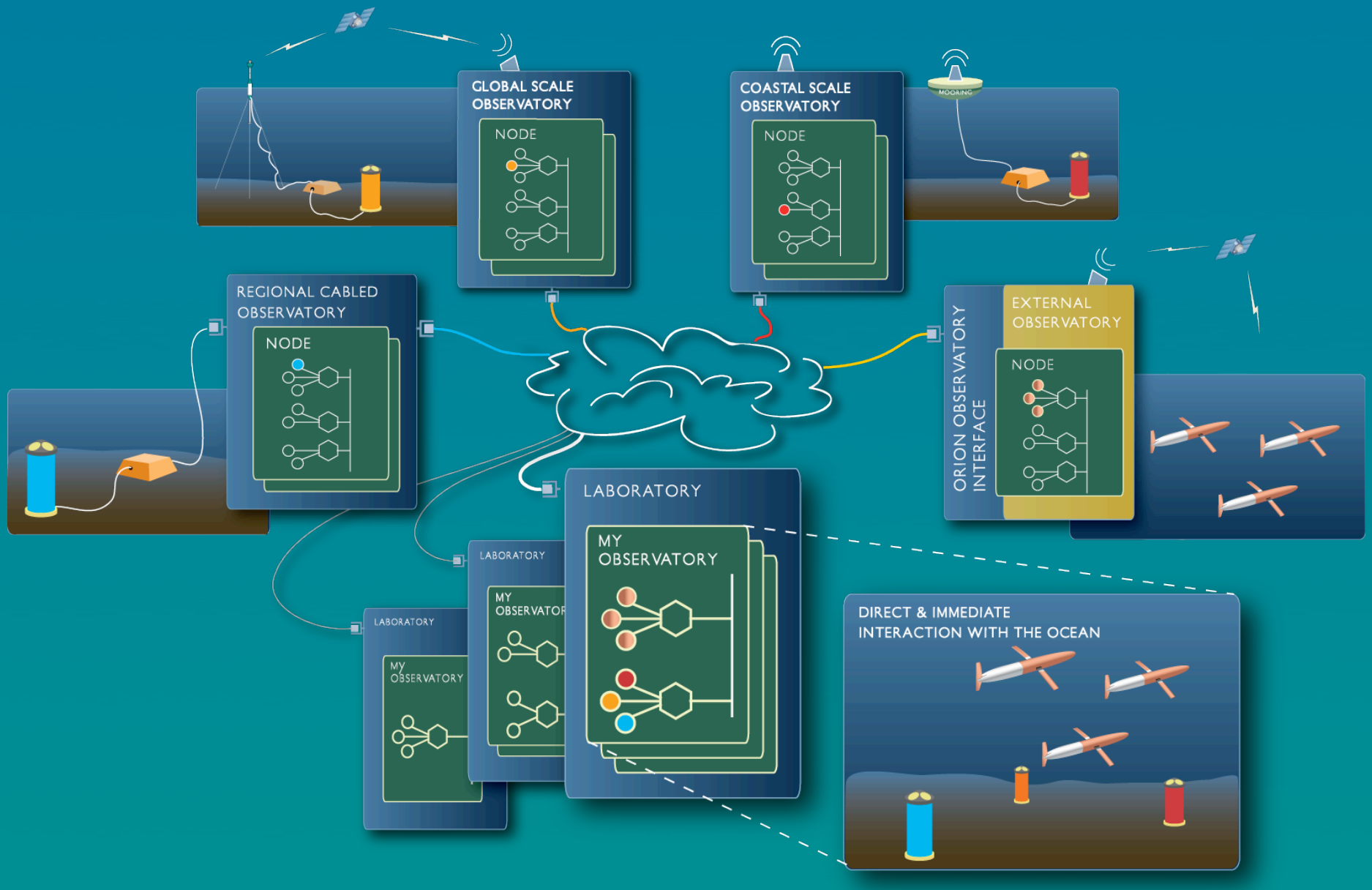




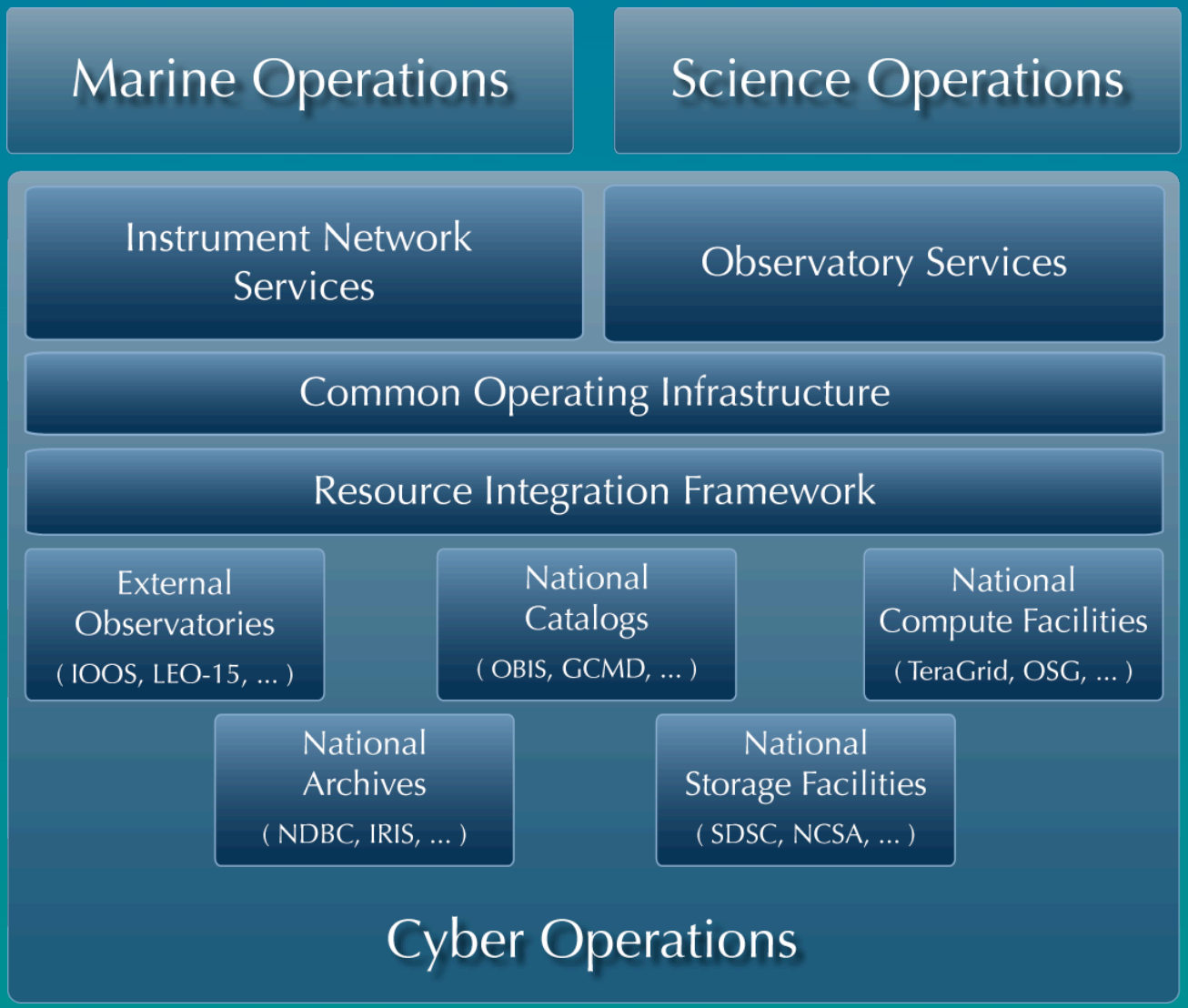
Bluefin 21 Configuration



Ocean Research Interactive Observatory Networks

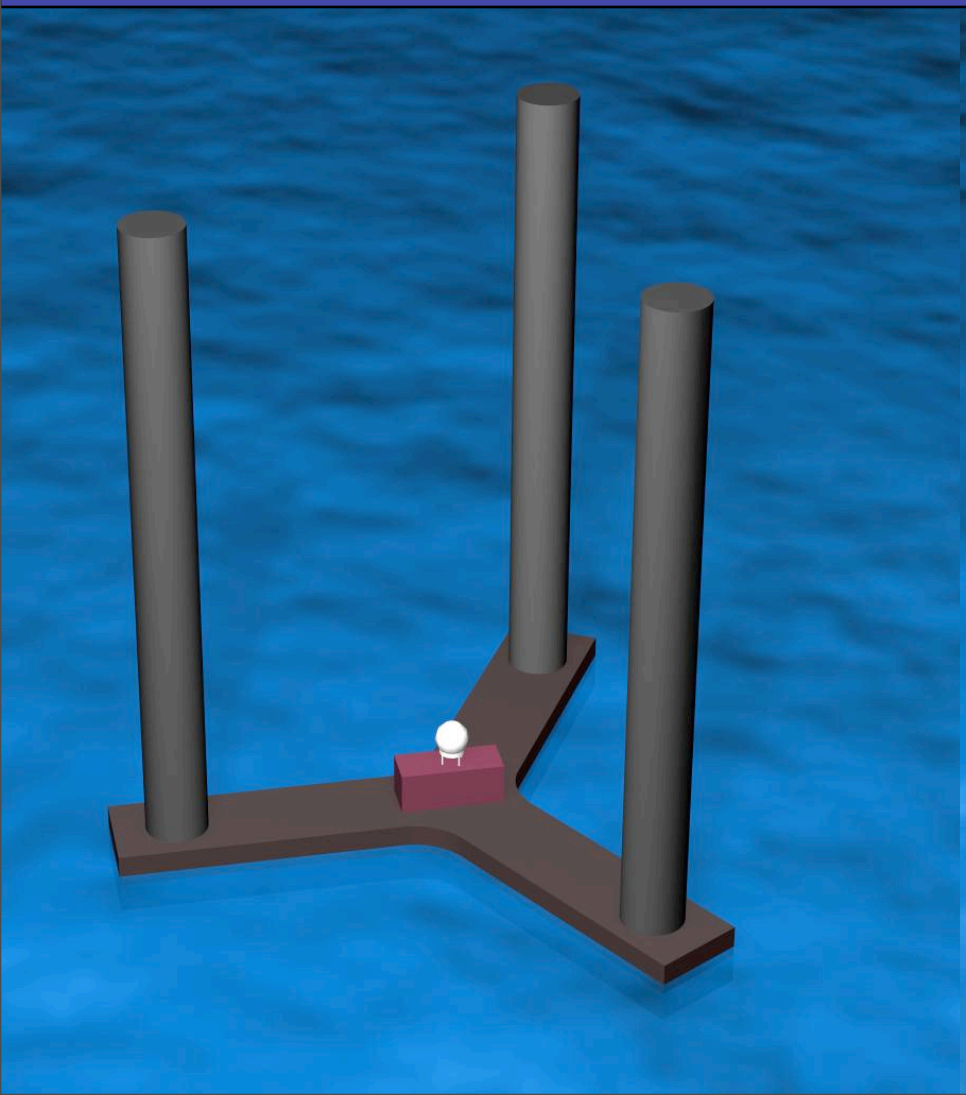


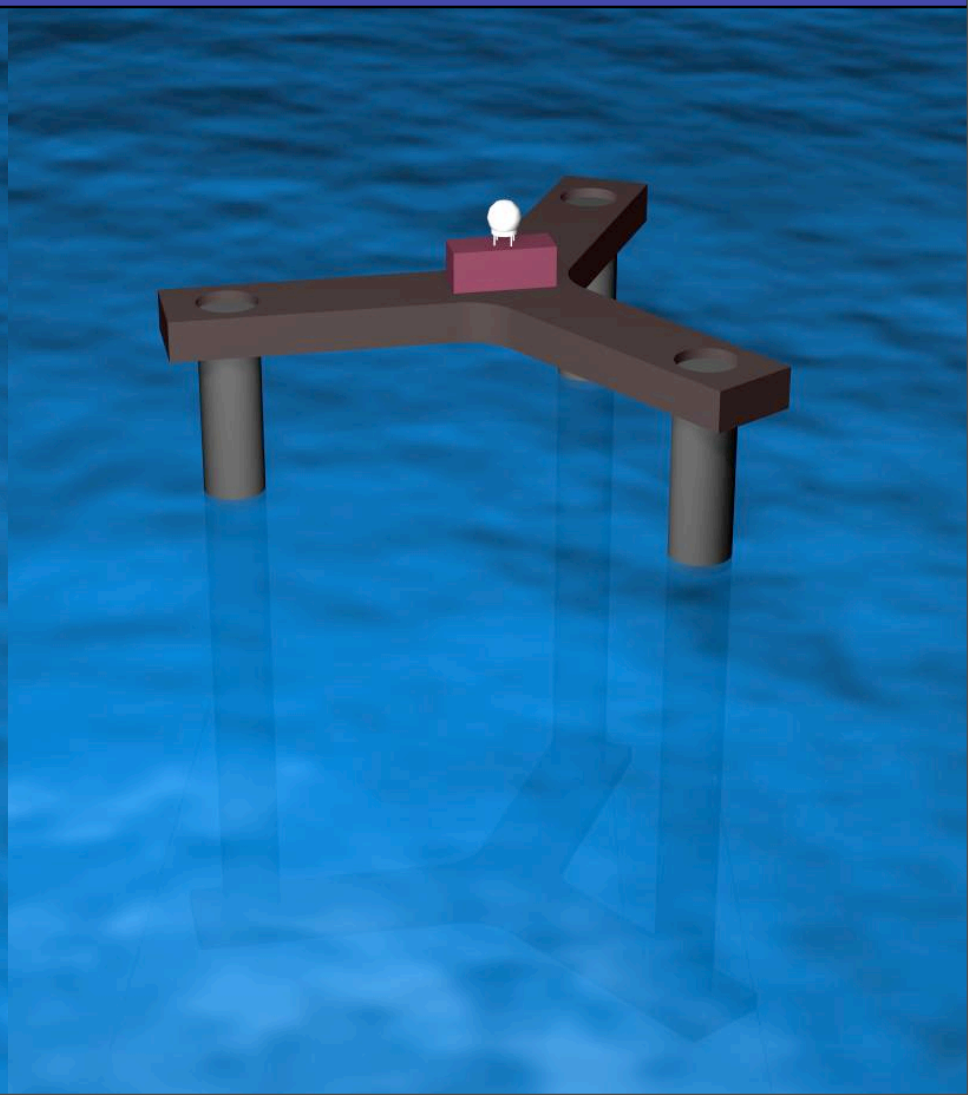
Cyberinfrastructure Service Oriented Architecture

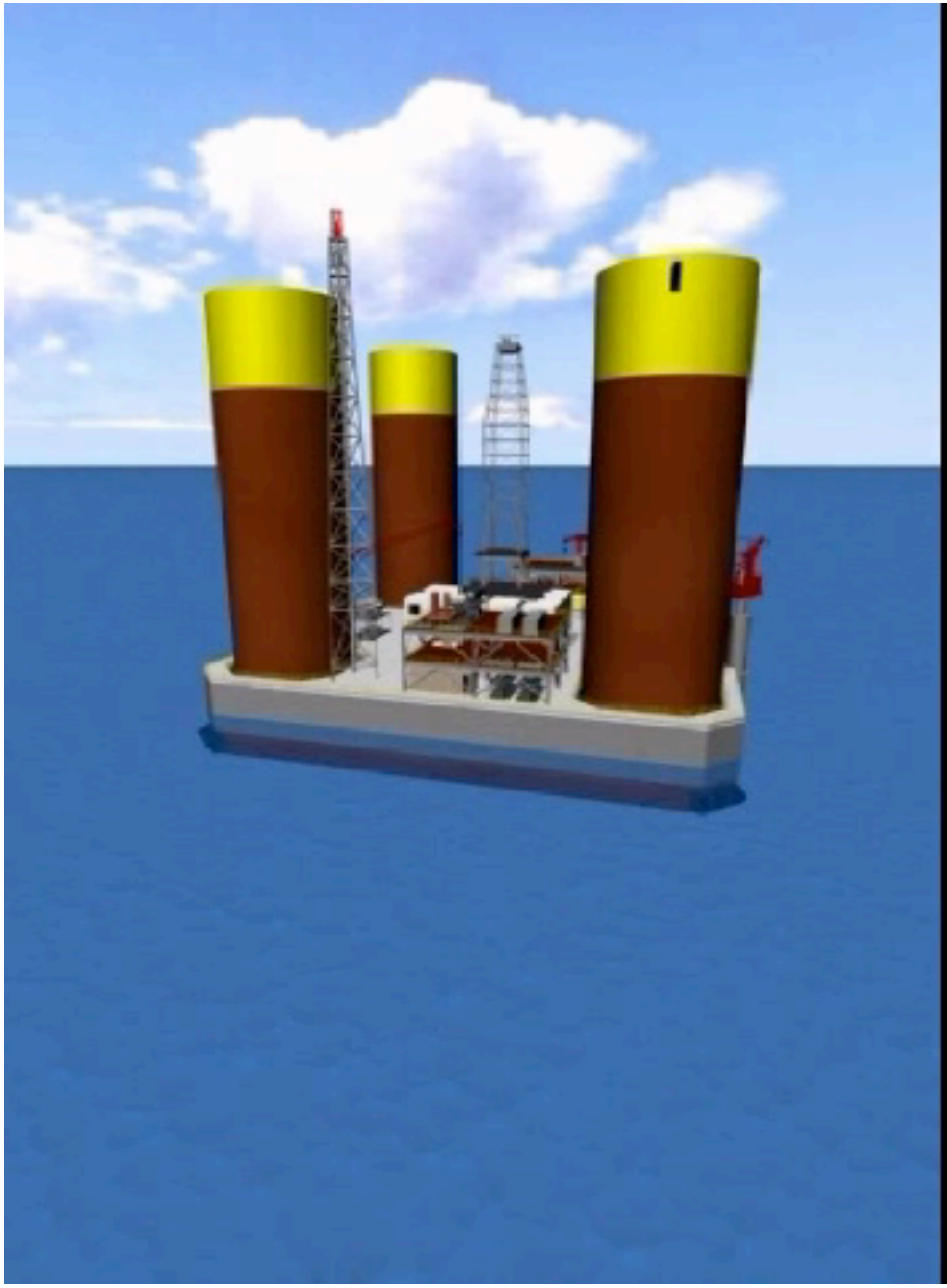


Extendable Draft Platform (EDP) for ORION Global Observatory

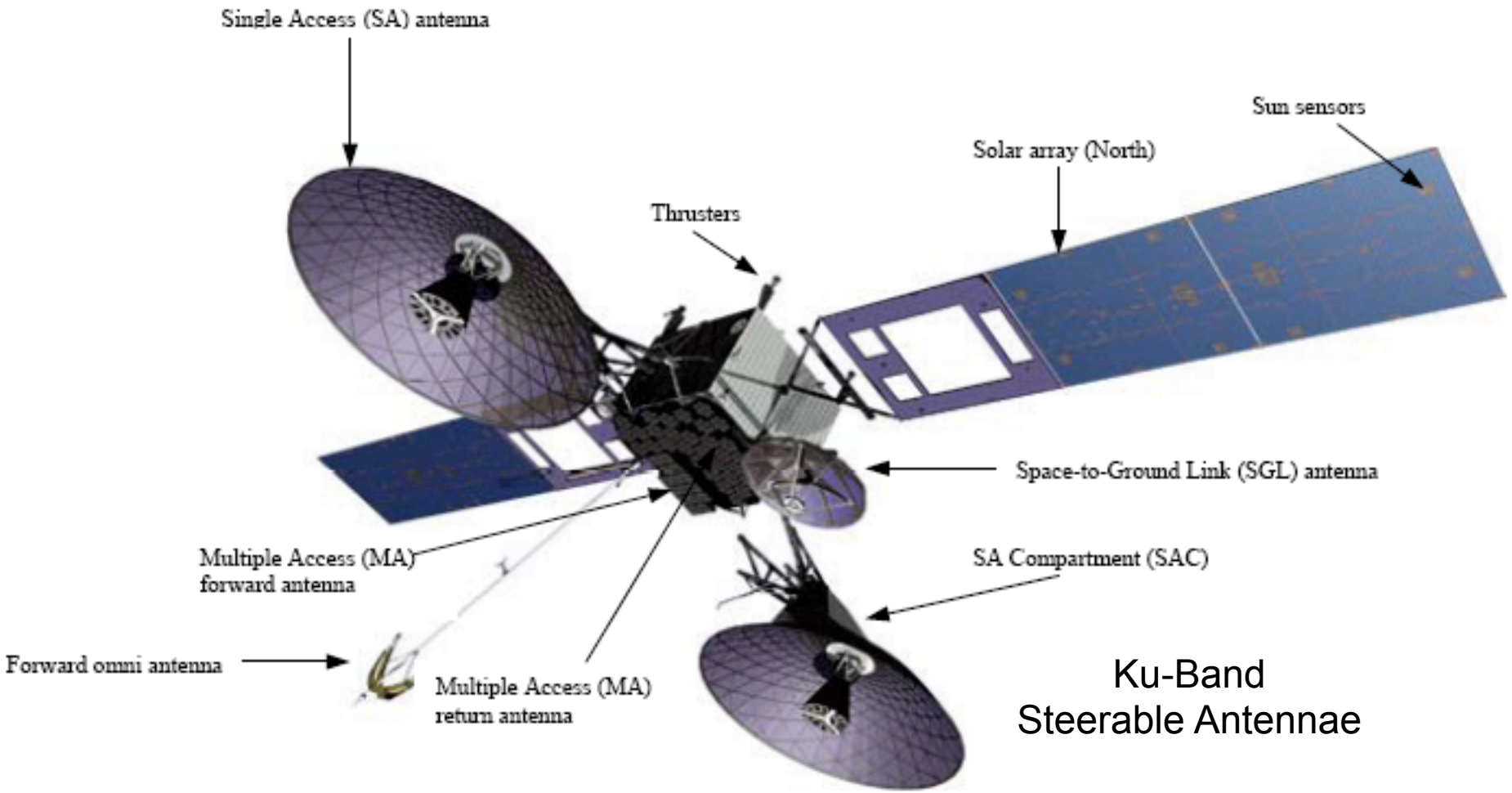
January 2007





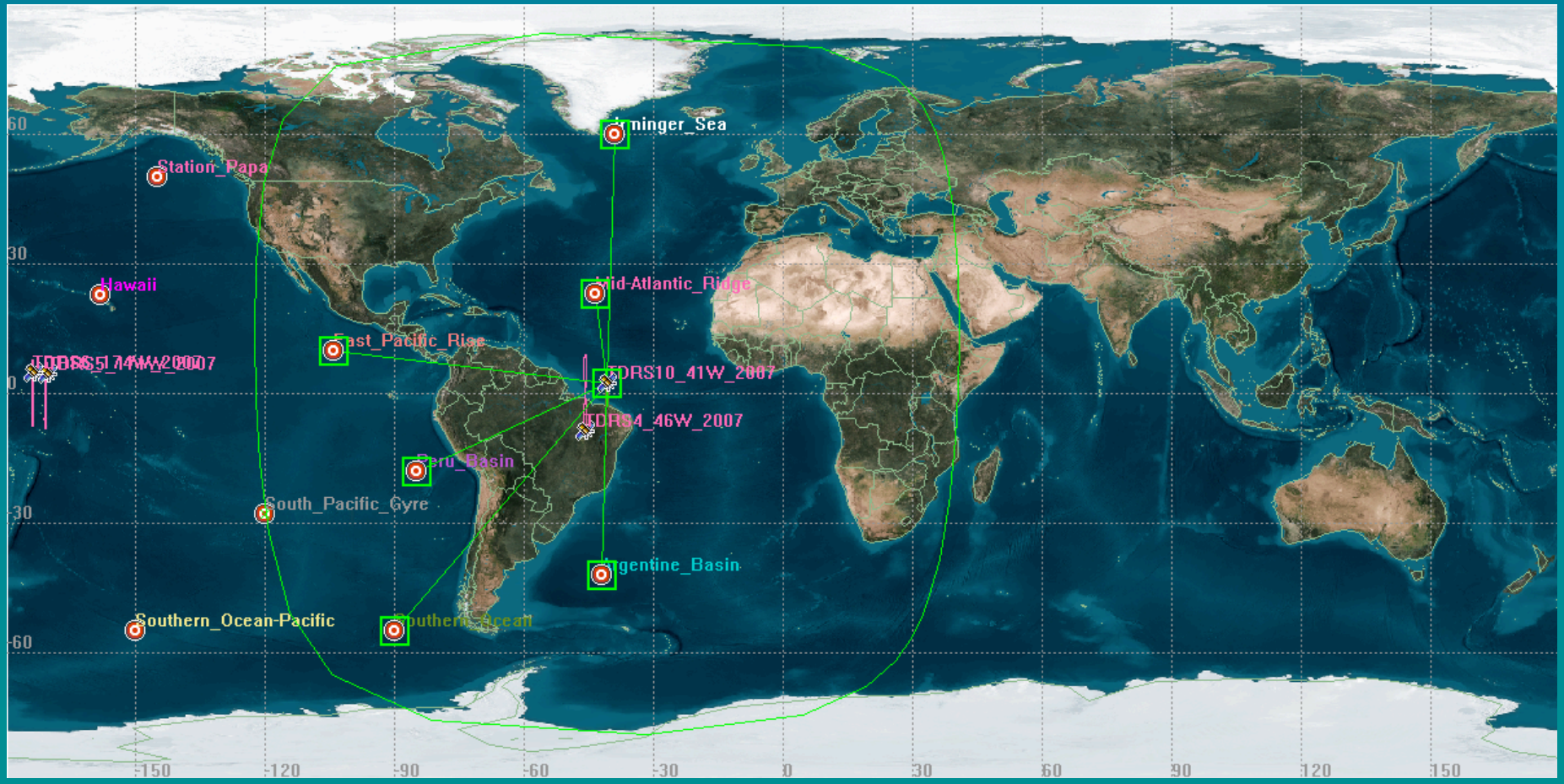


Tracking & Data Relay Satellite - TDRS



Ku-Band
Steerable Antennae

TDRS10 at 41 deg West SA Visibility



Data Rate Comparisons at 500MB/day/platform

XMT Rate	Time Req'd
150kbps	445 min (7 hr 25 min)
300kbps	223 min (3 hr 43 min)
1Mbps	67 min
3Mbps	22 min
5Mbps	13 min

Note: Transmission sessions can be split on a per day basis

Risks

- High
  - Data vocabulary interoperability across disciplines
  - Incorporation of real time streaming data into scientific process
  - Interfacing with external organizations & resources
  - Observatory resource allocation & scheduling
  - Multi-instrument mission planning and control
  - Appropriate level of funding for scope of responsibility
  - Community acceptance
- Moderate to Low
  - Specification & adoption of instrument services
  - Adoption of continuous computing model by NSF computing centers
  - Effective operations that will scale with the anticipated growth