IOOC and IOOS Advisory Committee: Integration Challenges

David Legler, IOOC Co-Chair

Wednesday, October 12, 2016

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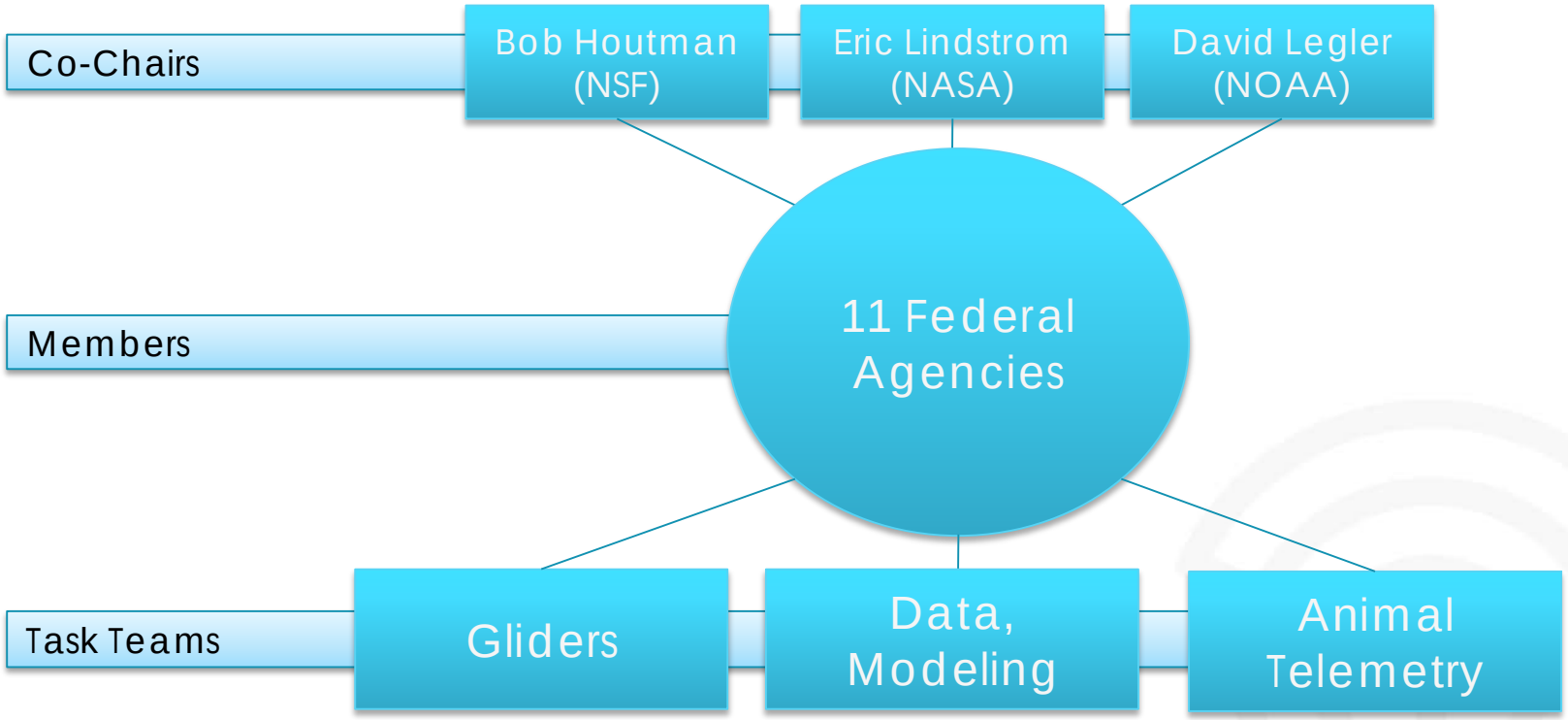
IOOC Overview

The IOOC's mission is to enhance the efficiency of and motivation for multiple-agency contributions to the U.S. Integrated Ocean Observing System (IOOS®), for the purposes of societal applications, education, stewardship, and scientific understanding.



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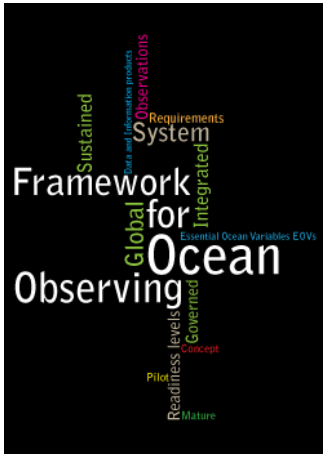
Integration Challenge

Defining integration:

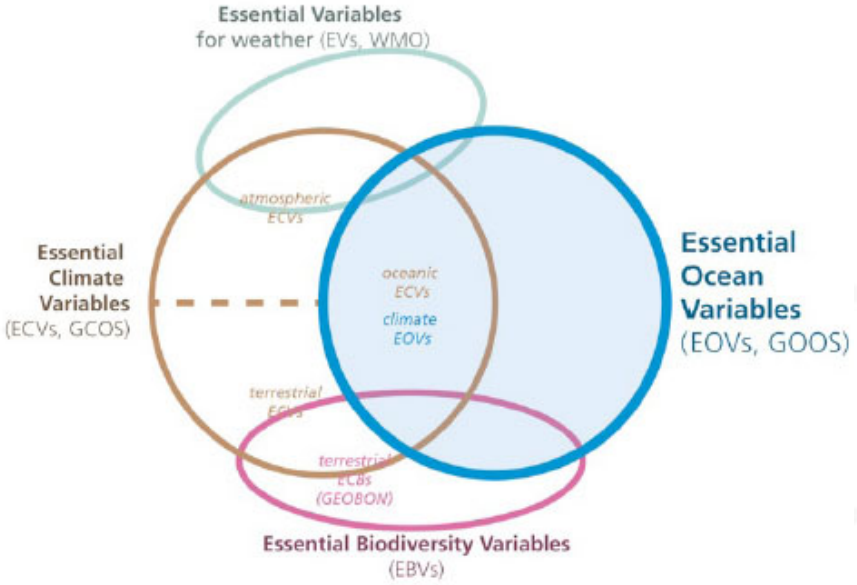
- In-situ and remote
- Global (open ocean) and coastal
- Platform and variable- dependent
- Data access/management (DMAC)



From Oceanobs09:

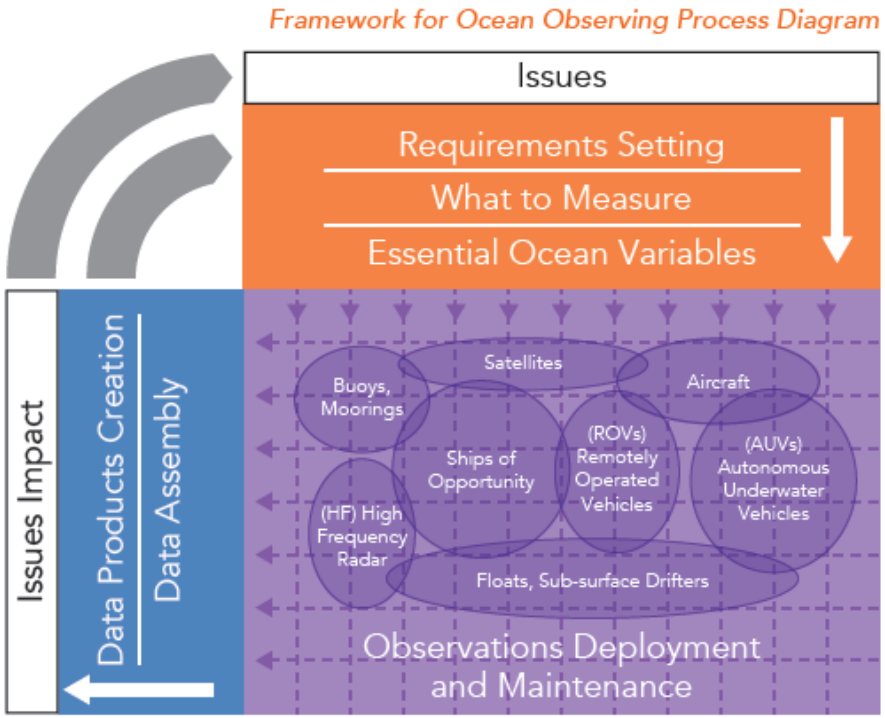
- Framework for Ocean Observing (FOO)

- Global Ocean Observing System:
- Essential Ocean Variables (EOV)



Framework for Ocean Observing

1. Inputs (requirements)
2. Processes (observations)
3. Outputs (data and products)
4. Outcomes (feedback to 1)



Requirements science-driven and informed by societal needs

Could this EOV framing encourage integration within IOOS?

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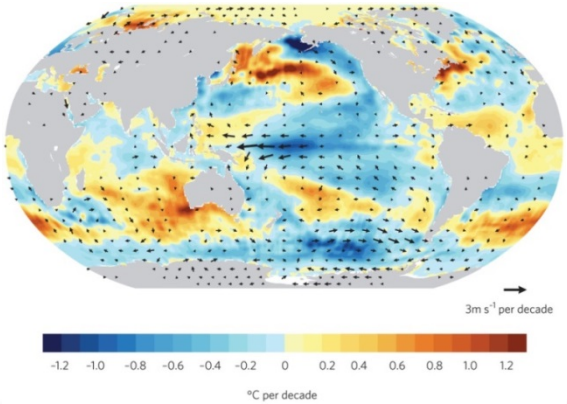
Potential Emerging Areas for EOV integration

1. Ocean Temperature/Heat Content (OHC)
   - Global: OHC calculated based on all ocean temp data from various networks (Argo, XBT, Moorings, etc)
     - Direct evidence of global warming signals; BAMS State of the Climate Report; future USGCRP Indicator; potential future GCOS indicator; contributor to sea-level
   - Regional: emerging evidence of value of regional analyses (e.g. Pacific Anomaly Workshops, GOMOOS, etc)
2. Surface Currents
   - Ocean Observations Panel for Climate (OOPC) Variable Specification for Surface Currents;
   - HF Radar, moorings, Global drifters
   - Altimeters, etc
   - Routine non-integrated products



Sea surface temperature (shading) from NOAA OISST and surface wind velocity (arrows)

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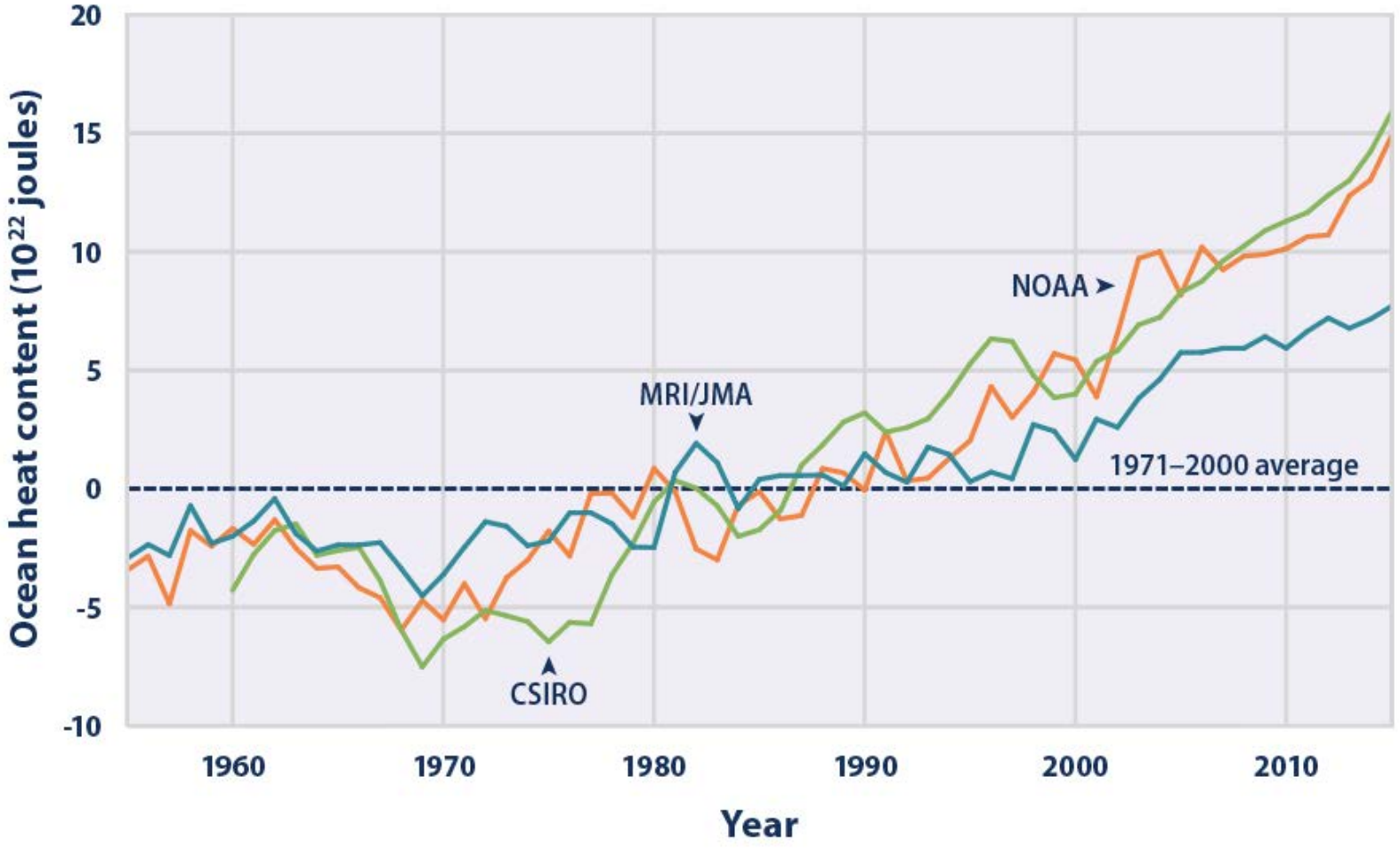
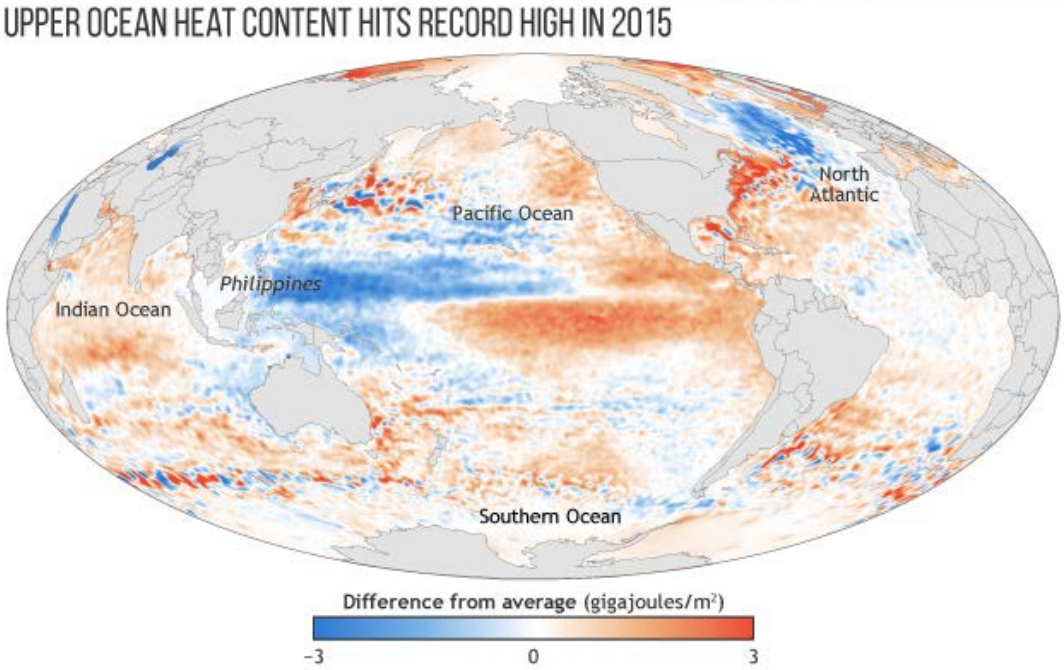
Ocean Temperature/Heat Content

Three different data analyses showing long-term trends of ocean heat content since 1955

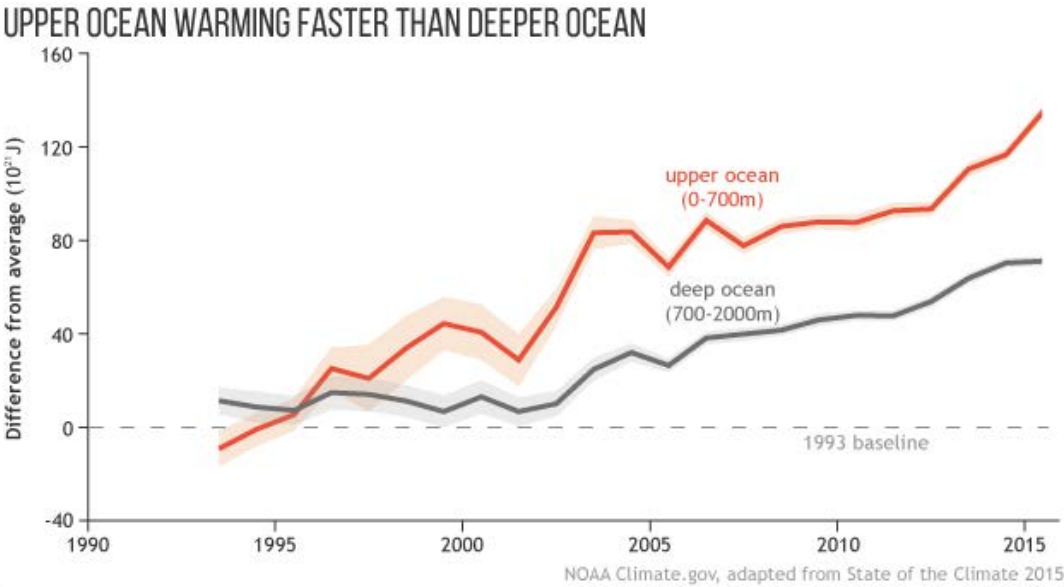


Ocean Temperature/Heat Content

Heat energy in the top 2,300 feet (700 meters, or slightly less than half a mile) of the ocean in 2015 relative to a 1993–2015 average (collected from in situ ocean temperature and sea level data from satellites)



Heat content in the upper 2,300 feet (700 meters) of the ocean (orange) and the deeper ocean (2,300–6,500 feet, gray) relative to a 1993 baseline

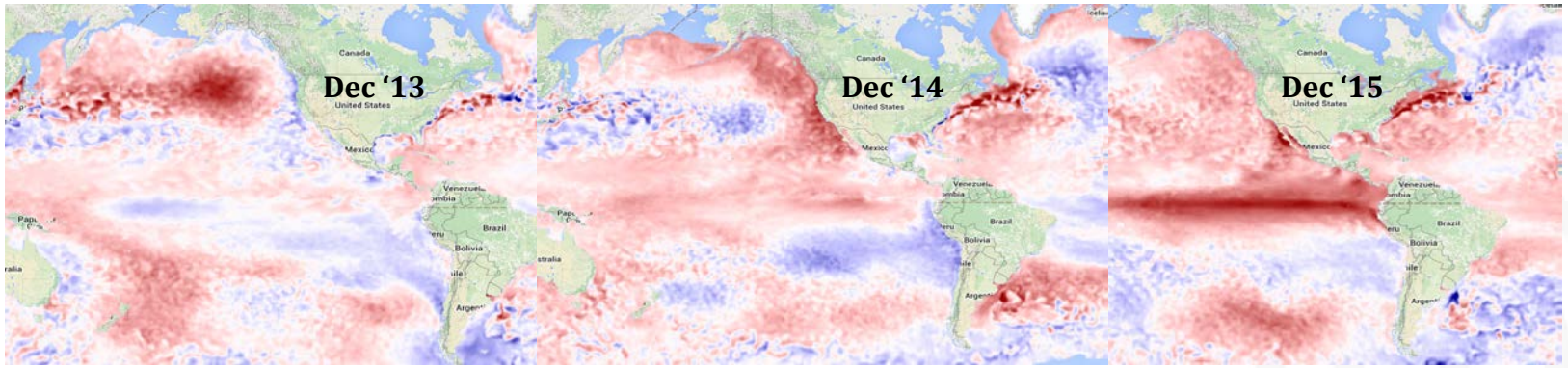


Ocean Temperature/Heat Content

Pacific Anomalies Workshop

- The unusual ocean weather and climate patterns observed during 2014 across the North Pacific basin, earning the nickname the "blob", persisted into 2016 and were accompanied by a strong El Niño during 2015-2016.

- The extreme conditions in physical and biogeochemical parameters appeared to impact the pelagic ecosystem, including fisheries.



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Ocean Temperature/Heat Content

Integrated requirements for temperature/ocean heat content?

- Informed by existing global ocean info and recent PAWS workshops

Data assembly

- Databases exist to assemble subsurface temperature data. Not sure how integrative they are of coastal info

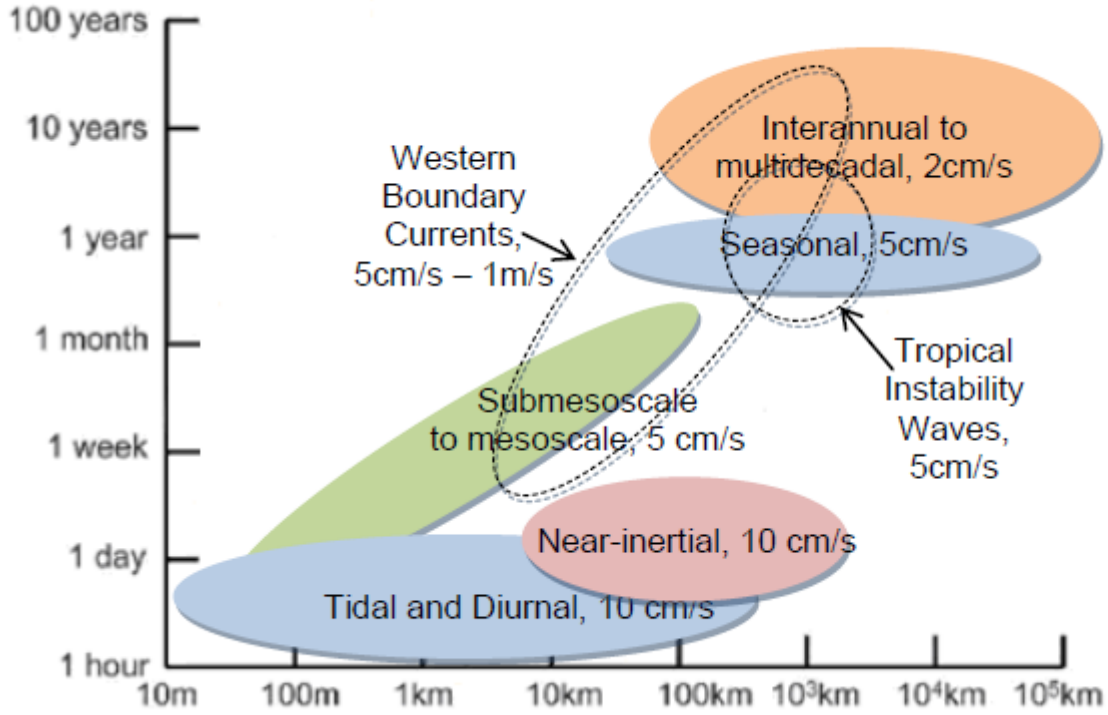
Data and Model Products

- Some global products exist and are routinely updated….
- Many models: not clear which are most suitable…

Surface Currents (example 2)

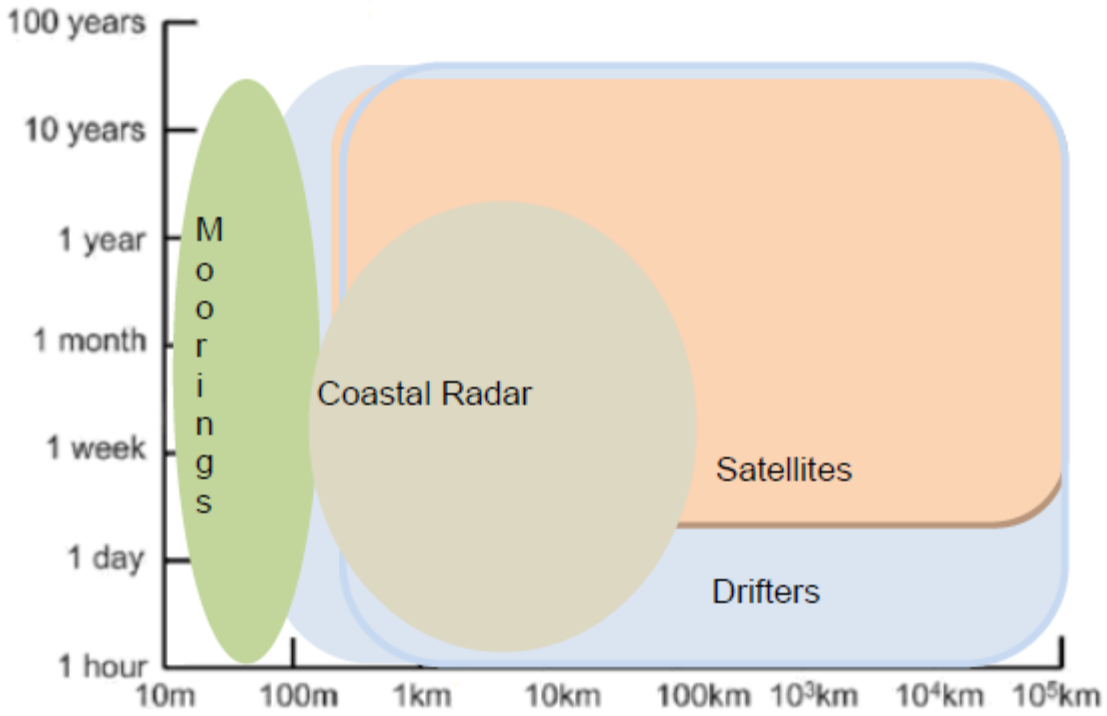
Surface current capacity

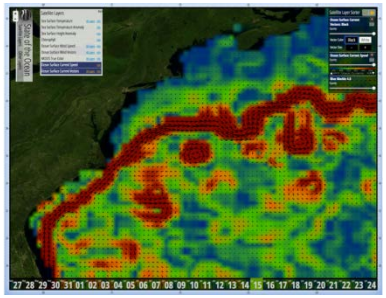
- Scales of surface current velocity phenomena addressed with indications of the magnitude of the signal to capture.

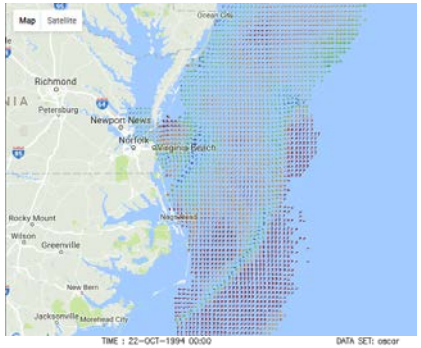


Surface Currents

Surface current networks







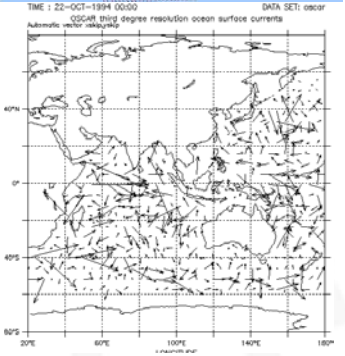


Figure 2. Draw in the well resolved observation scales of the component networks . If these scales are highly dependent on location or time, separate ovals could be drawn to capture this variability (e.g., one for the North Atlantic Ocean, and another for the Southern Ocean). If the capability changes greatly in recent times or will change in the near future (i.e., within five years), provide examples from two times.

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Surface Currents

Integrated requirements for surface velocity?

- Needs to be developed

Data assembly

- Unclear what capabilities could be exploited…

Data Products

- Who are the users?
- What products are needed most and would require integration?

Key Players in EOV Integration

Regional:

- NANOOS
- CeNCOOS
- University of Washington
- Georgia Institute of Technology
- NOAA Southwest Fisheries Science Center
- PacIOOS
- AOOS
- Oregon State University
- Scripps Institution of Oceanography
- DFO Canada
- Farallon Institute
- SCCOOS

National:

- IOOS Program Office
- NOAA Climate Obs Division
- EPA
- NSF
- NASA
- ???

Global:

- Global Ocean Observing System
- Global Climate Observing System
- Ocean Obs Panel for Climate
- WMO/IOC JCOMM

Next Steps

- Areas/EOVs:
  - Ocean Temperature/Heat Content
  - Surface Currents
  - Others?

- Potential activities (integrate users and information providers):
  - Integrated product development/pilot activities
  - Task teams (coordination mechanism…several topics/issues)
  - Sharing technologies/knowledge

Discussion Questions…

- To what extent could EOV and FOO framework help to advance integration of observing activities and delivery of useful information?
  - Which EOVs (if not temperature and currents)?
  - Which facets of integration?
  - Motivation/desired outcomes of such activities (use of integrated information)?
- If not EOV/FOO and these EOVs, what strategies would the IOOS AC advise the IOOC to support to encourage integration?

Thank You

Extra Slides

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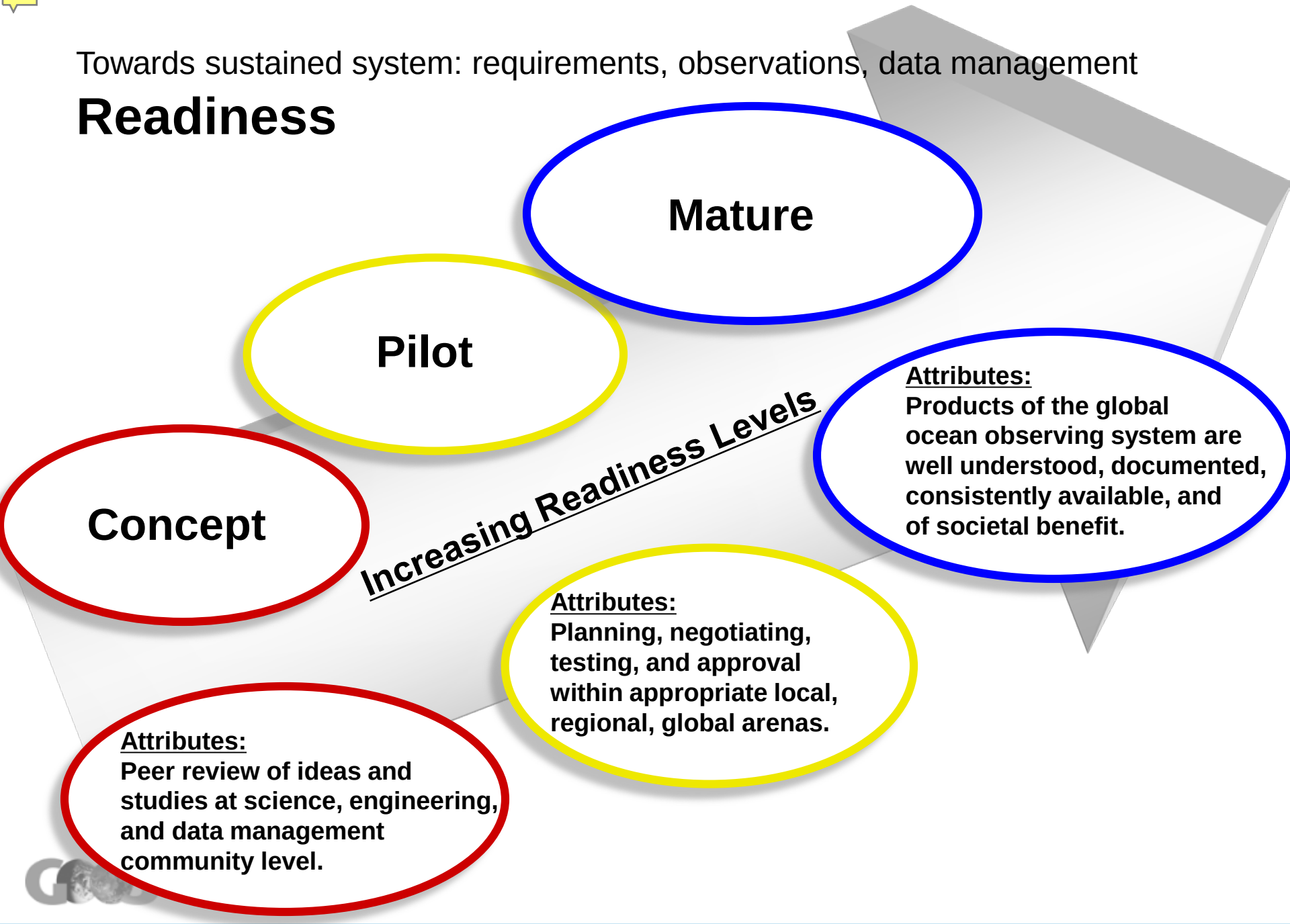
Towards sustained system: requirements, observations, data management

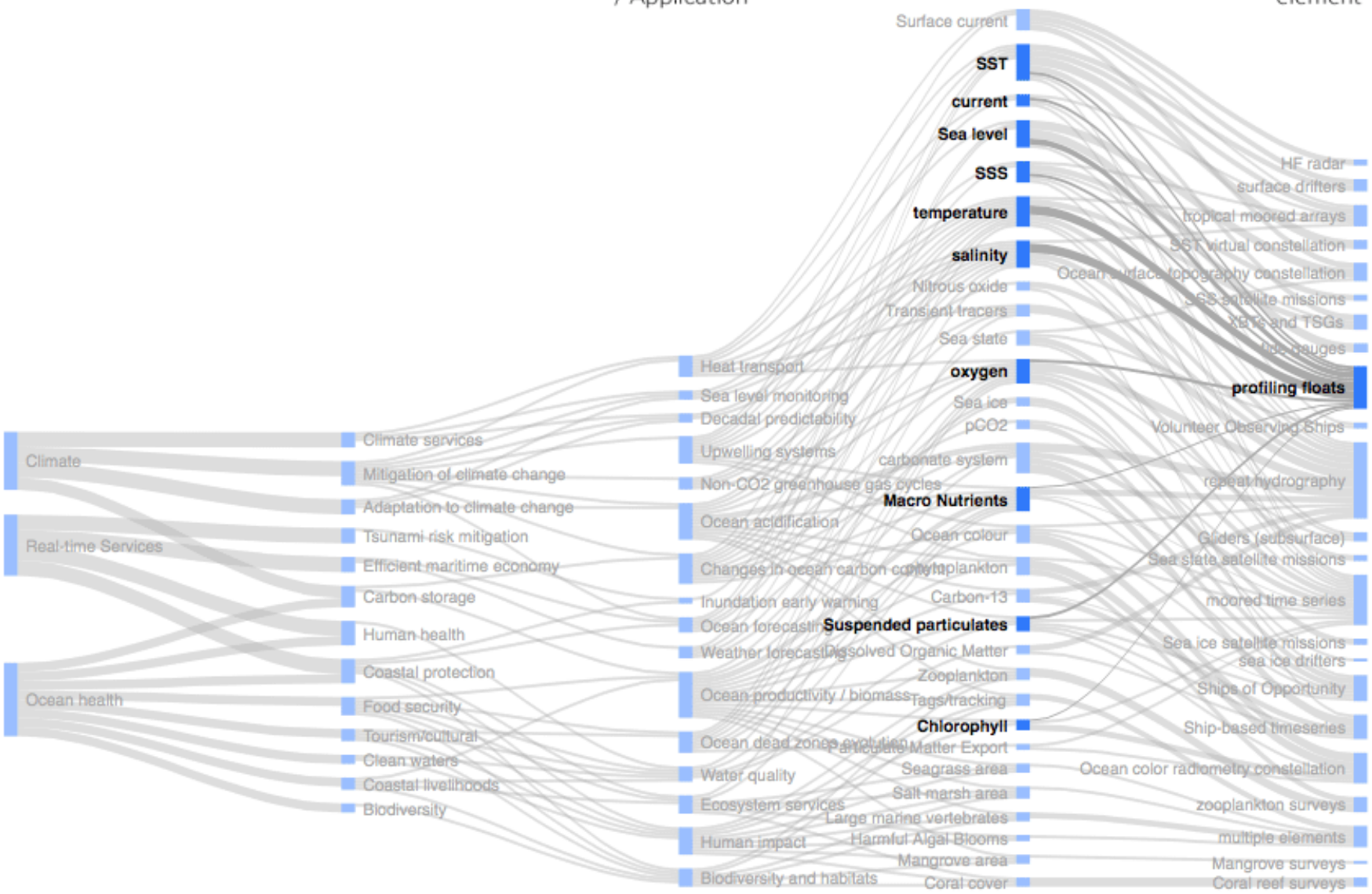
Readiness



Framework for Ocean Observing

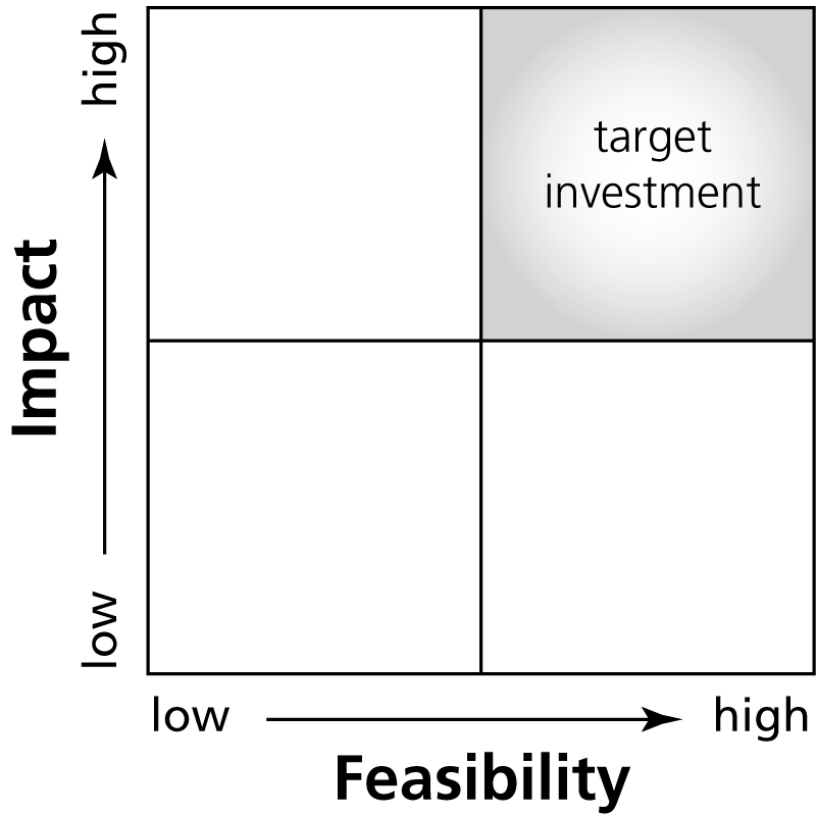
REQUIREMENTS

OBSERVATIONS



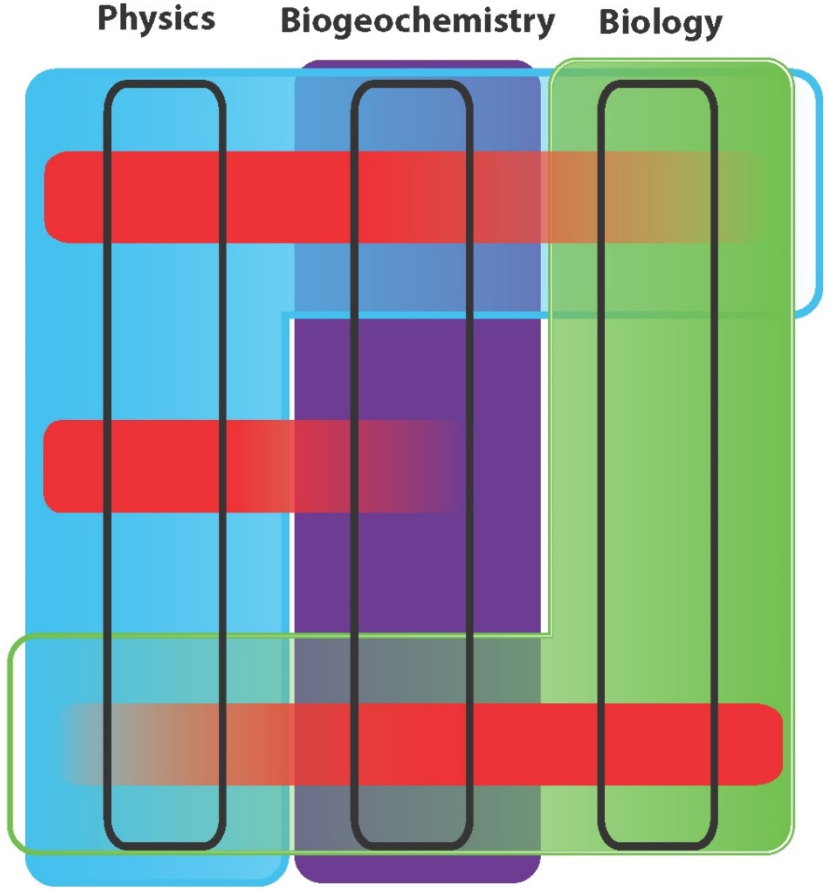
Driven by requirements, negotiated with feasibility

Essential Ocean Variables



- **We cannot measure everything, nor do we need to**
- basis for including new elements of the system, for expressing requirements at a high level
- Driven by requirements, negotiated with feasibility
- Allows for innovation in the observing system over time

GOOS separation of responsibility for disciplines (ocean variables)



GCOS-GOOS-WCRP
OOPC: Panel for Physics variables, and
Climate Theme Lead
RT Services Theme Lead.
Ocean Health Theme Support

GOOS **Biogeochemistry**: Panel for Biogeochemical Variables and
Climate Theme Support
Ocean Health Theme Support

GOOS **Biology**: Panel for Biology Variables, and
Ocean Health Theme Lead
Climate Theme Support

EOVs and readiness level

CONCEPT PILOT MATURE

Physics

- Sea State
- Ocean surface vector stress
- Sea Ice
- Sea level
- SST
- Subsurface temperature
- Surface currents
- Subsurface currents
- SSS
- Subsurface salinity

Biogeochemistry

- Oxygen
- Inorganic macro nutrients
- Carbonate system
- Transient tracers
- Suspended particulates
- Nitrous oxide
- Carbon isotope (^{13}C)
- Dissolved organic carbon

Biology and Ecosystems

- Phytoplankton biomass and productivity
- HAB incidence
- Zooplankton diversity
- Fish abundance and distribution
- Apex predator abundance and distribution
- Live coral cover
- Seagrass cover
- Mangrove cover
- Microalgal canopy cover