

Ocean Climate Observation Annual System Review

Looking toward the Future: OOPC and IOOC Perspectives

Eric Lindstrom, OOPC Chair & IFSOO, IOOC Co-Chair

27 October, 2010 Silver Spring, MD



GCOS
Global Climate
Observing System



GOOS
Global Ocean
Observing System



WCRP
World Climate
Research Programme



jcomm
Joint WMO-IOC Technical Commission
for Oceanography and Marine Meteorology



27 October, Silver Spring, MD

International and US Perspectives on Ocean Observing

- International Perspective – Ocean Observations Panel for Climate (OOPC)
- A Framework for Ocean Observing – An outcome of OceanObs '09 in Venice
- US Interagency Perspective – Interagency Ocean Observation Committee (IOOC)

Ocean Observation Panel for Climate – Serving Multiple Sponsors

- The Ocean Domain team for the Global Climate Observing System (GCOS)
- The Open Ocean team for the Global Ocean Observing System (GOOS)
- Coordination of sustained ocean observation requirements for the World Climate Research Program (WCRP)
- Members: Johnny Johannessen, Robert Keeley, Alberto Piola, Richard Reynolds, Toshio Suga, Robert Weller, Ex officio members from CLIVAR Basin Panels, GSOP, IOCCP

OOPC: Our Foci and Agenda

1. ***State of the Ocean:*** Improve and expand ocean climate indices at OOPC web site.
2. ***Societal Relevance:*** Stories and implications for society from ocean observations and ocean climate indices
3. ***Brief Current Events:*** El Niño, PDO, weather/climate events
4. ***State of the Observing System:*** Up-to-date info for status of satellite and in-situ observing system including data management. Better integration.
5. ***Liaison and Review:*** Continue to interact with the ocean/ climate community and with other programs to advocate for sustaining and enhancing the observing system; reviewing components of the system as necessary.

State of the Ocean Indices and Current/Recent Events

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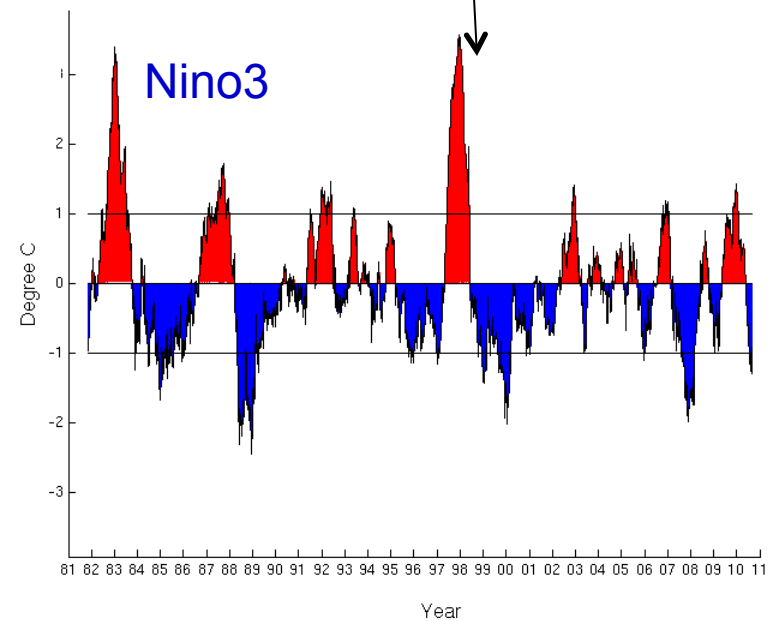
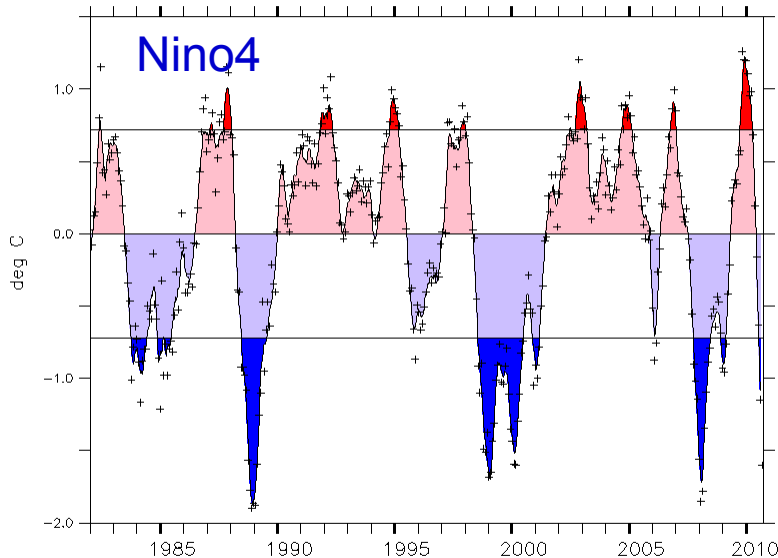
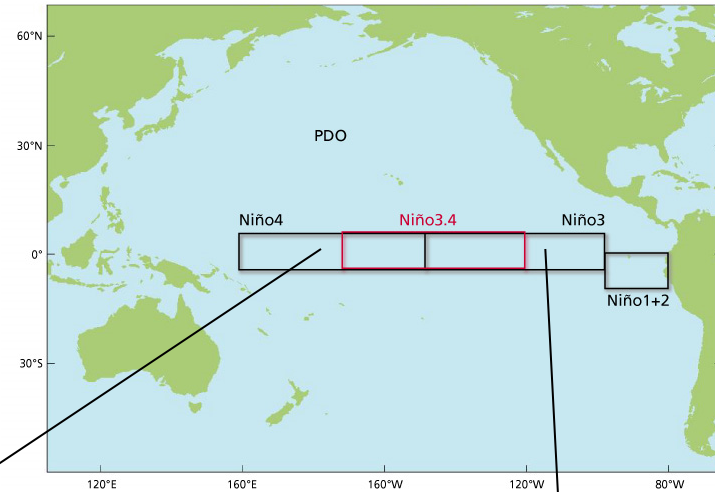
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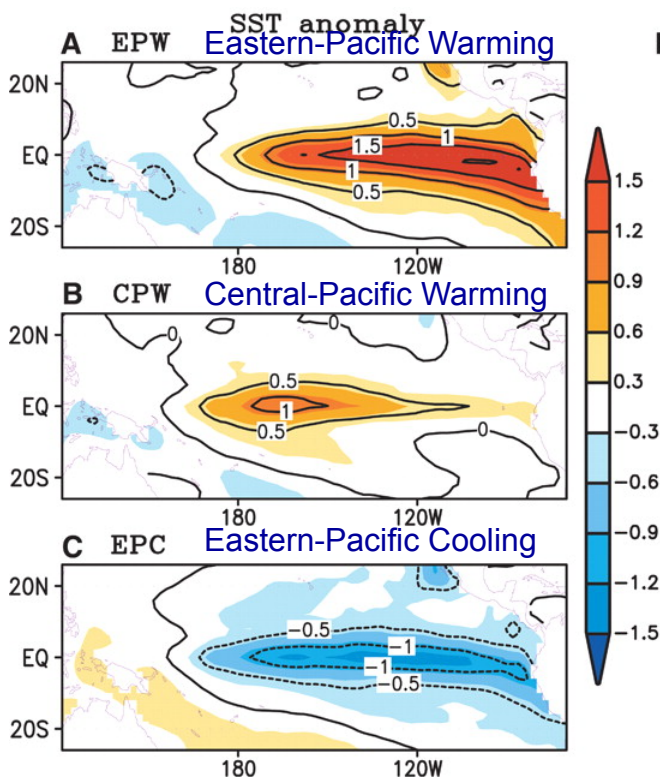
Examples of Existing “State of the Ocean” Indices for the Pacific

Nino3: good for describing classical El Nino with eastern Pacific warming (EPW).

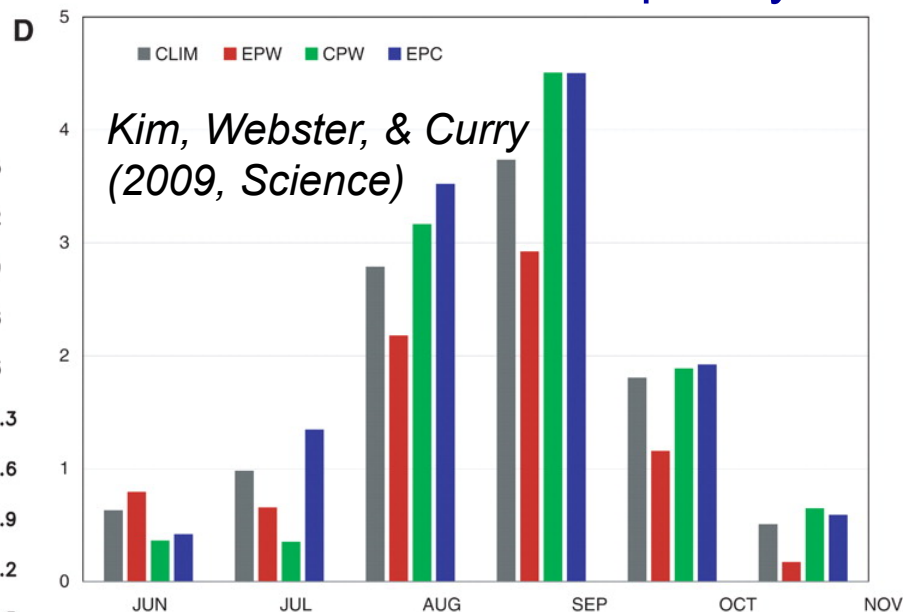
Nino4: suitable to characterizing a new type of El Nino with central-Pacific warming (CPW) (El Nino Modoki).



Different Impacts of EP & CP warming (El Nino) on Hurricanes



Atlantic hurricane frequency



During peak hurricane season (Aug.-Oct.):
 EPW ~ less hurricanes
 CPW ~ more hurricanes (like La Nina)

In the NW Pacific: CP El Nino also associated with more frequent tropical cyclones (*Chen and Tam 2010*).

The 2009-10 El Nino, the strongest central-Pacific El Nino (El Nino Modoki) measured by satellites

SST anomaly at the peak of the 2009-10 El Nino.

May have caused the record warming in S. Pacific & W. Antarctica (Lee et al. 2010), and contributed to heavy snow fall in central US in winter 2009-10 (Seager et al. 2010)

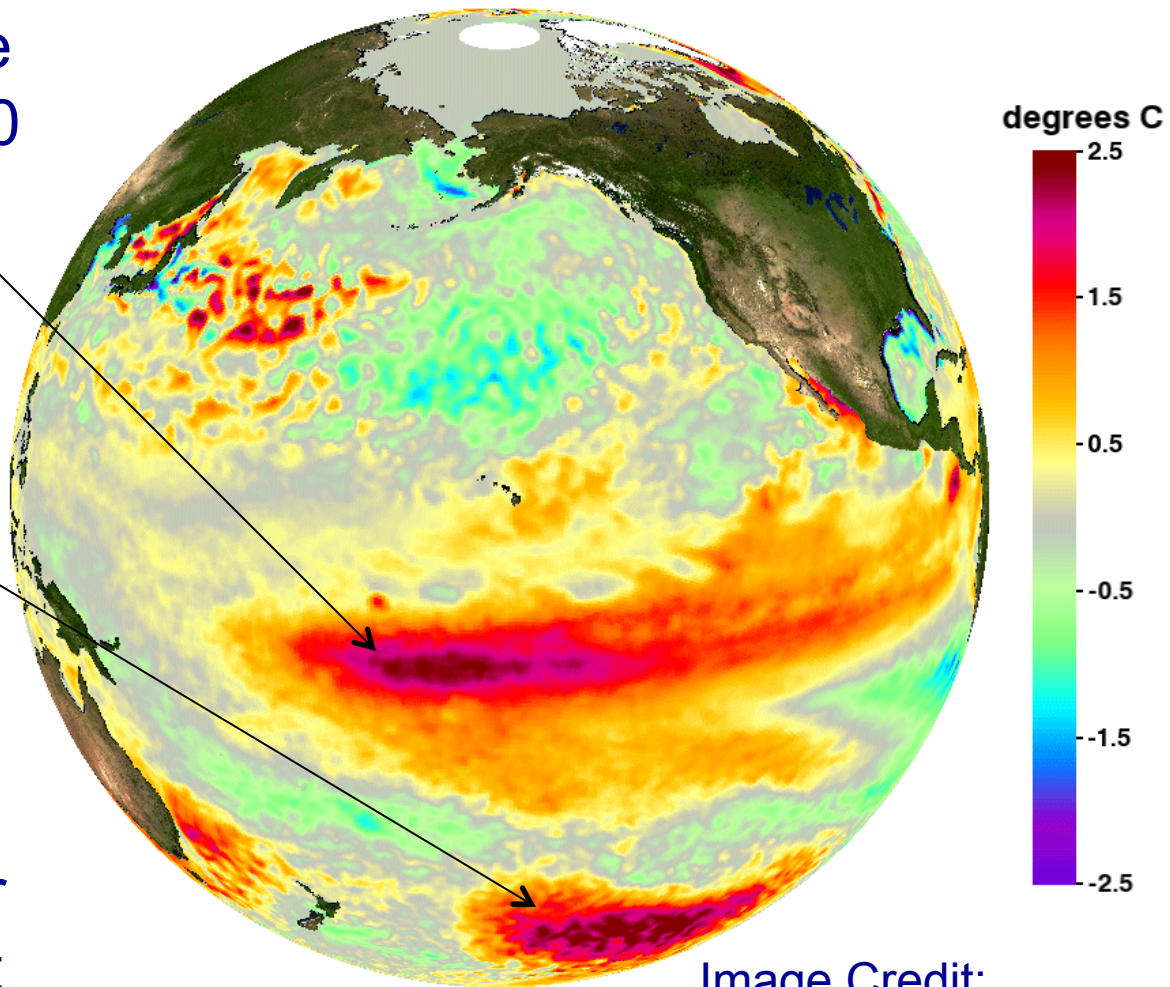
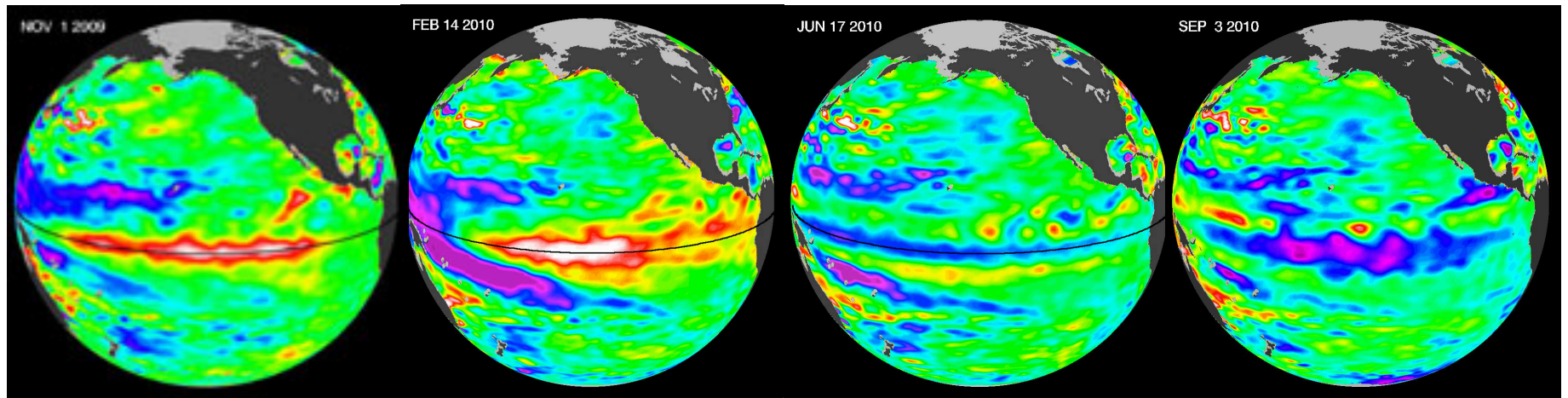


Image Credit:
PO.DAAC, NASA JPL

El Niño-La Niña 2009/2010



The eastward propagation of a warm Kelvin wave (red to white color) is apparent in the late 2009/early 2010 images from OSTM/Jason-2. The September 2010 image, however, indicates that the tropical Pacific has switched from warm (red) to cold (blue) in recent months. Blue regions are 5 to 13 inches below normal SSH.

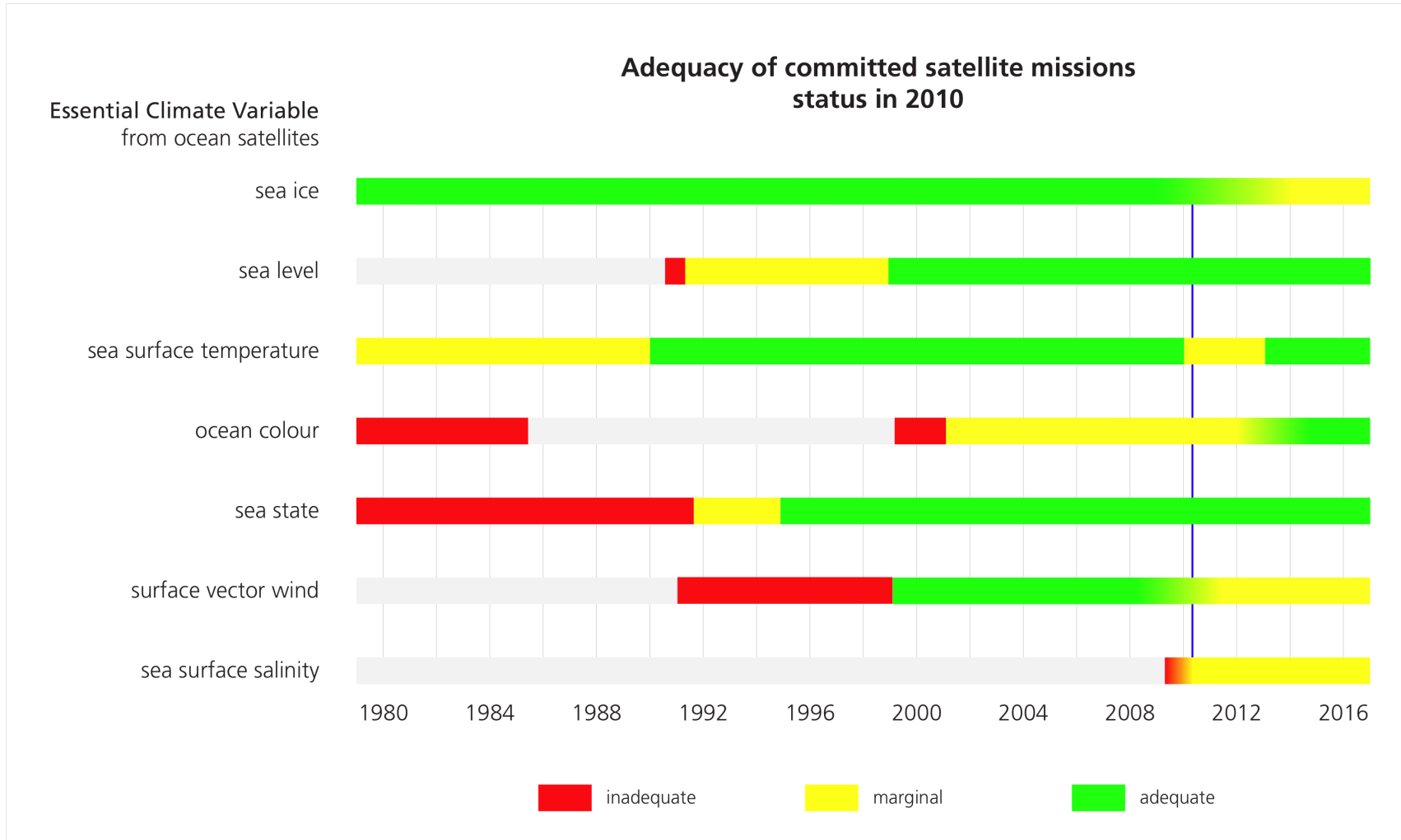
State of the Observing Systems

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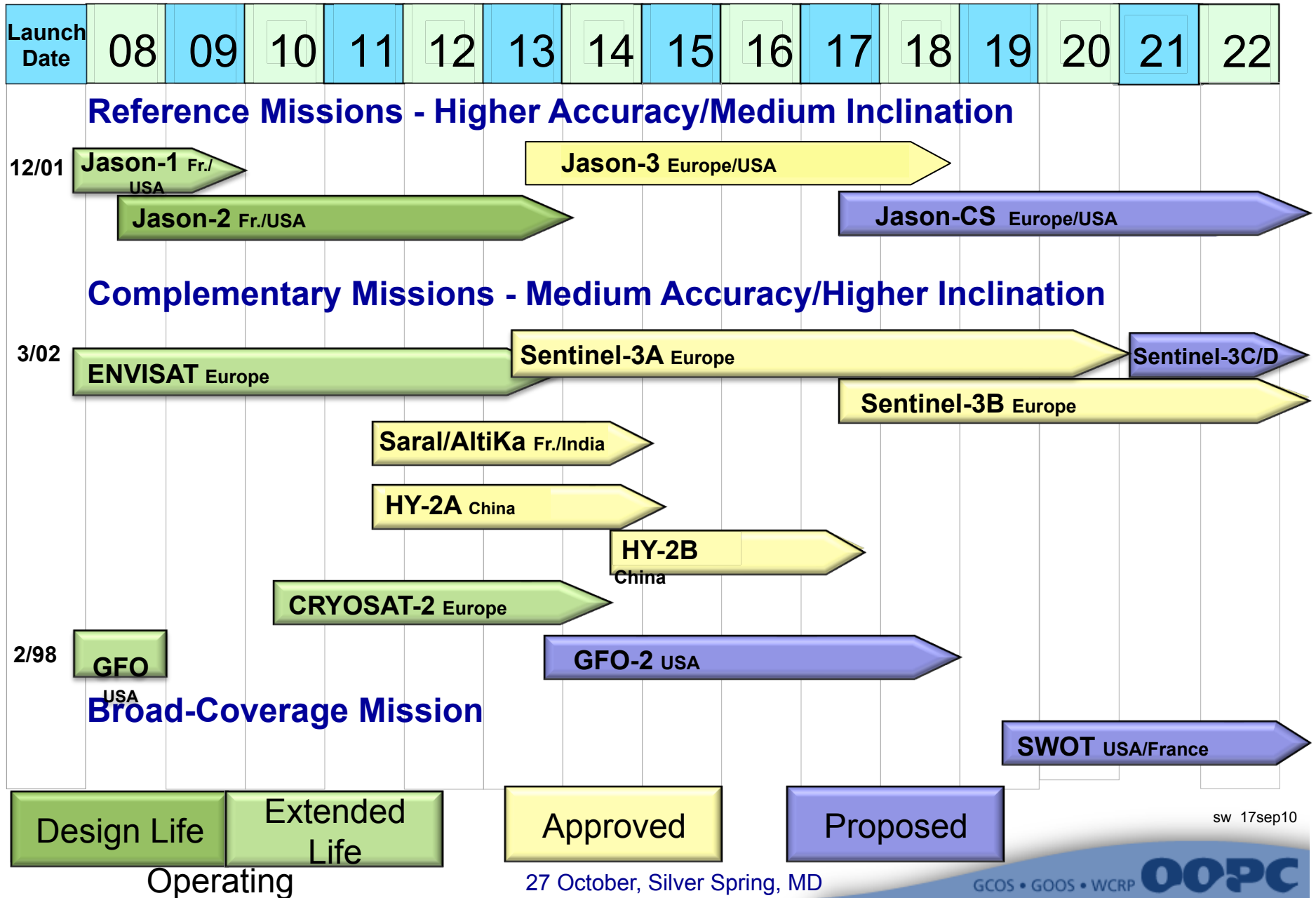
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Observing networks – Improving commitments for satellite observations

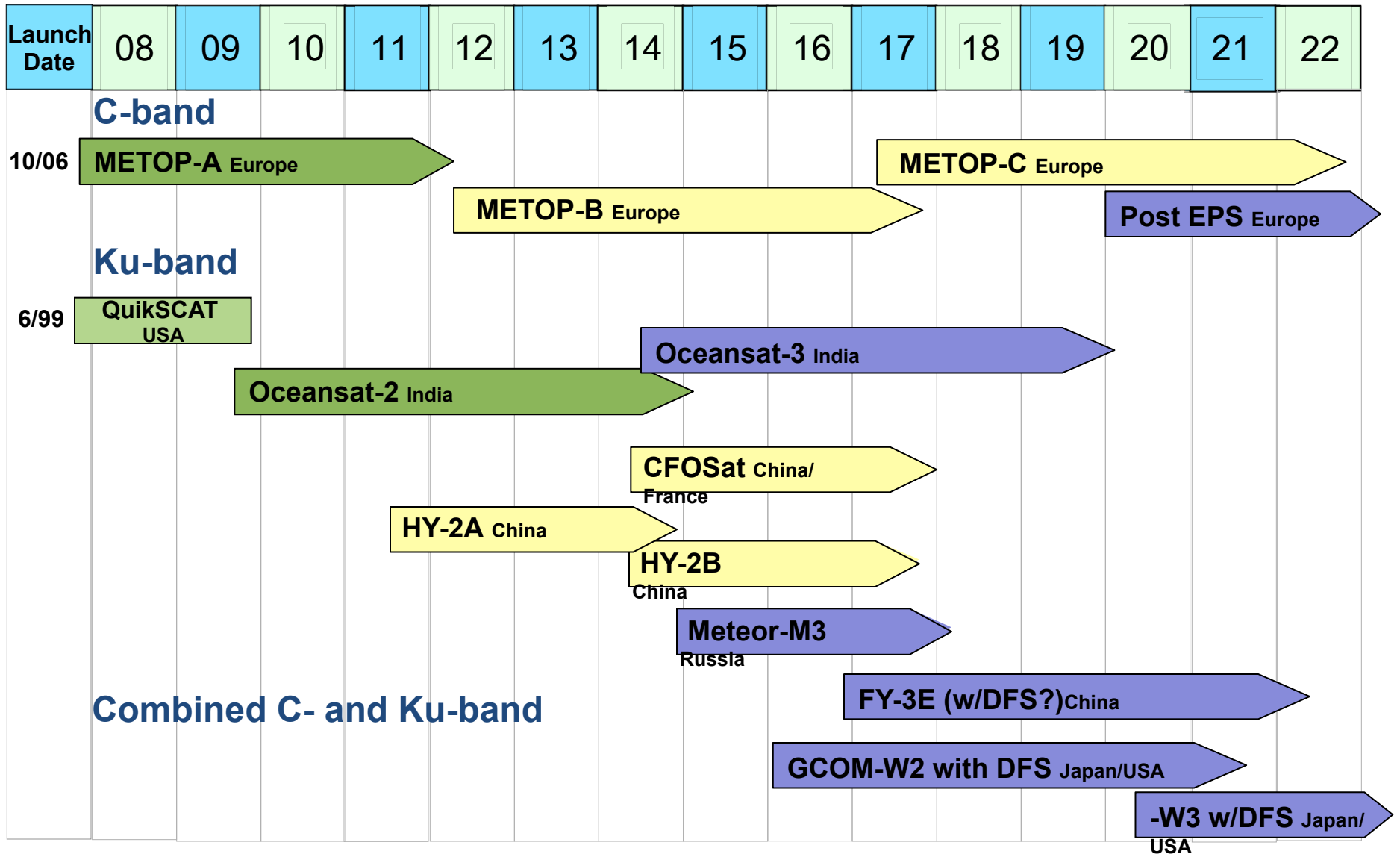


Global Altimeter Missions



sw 17sep10

Global Scatterometer Missions



Design Life
Extended Life
Operating

Approved

Proposed

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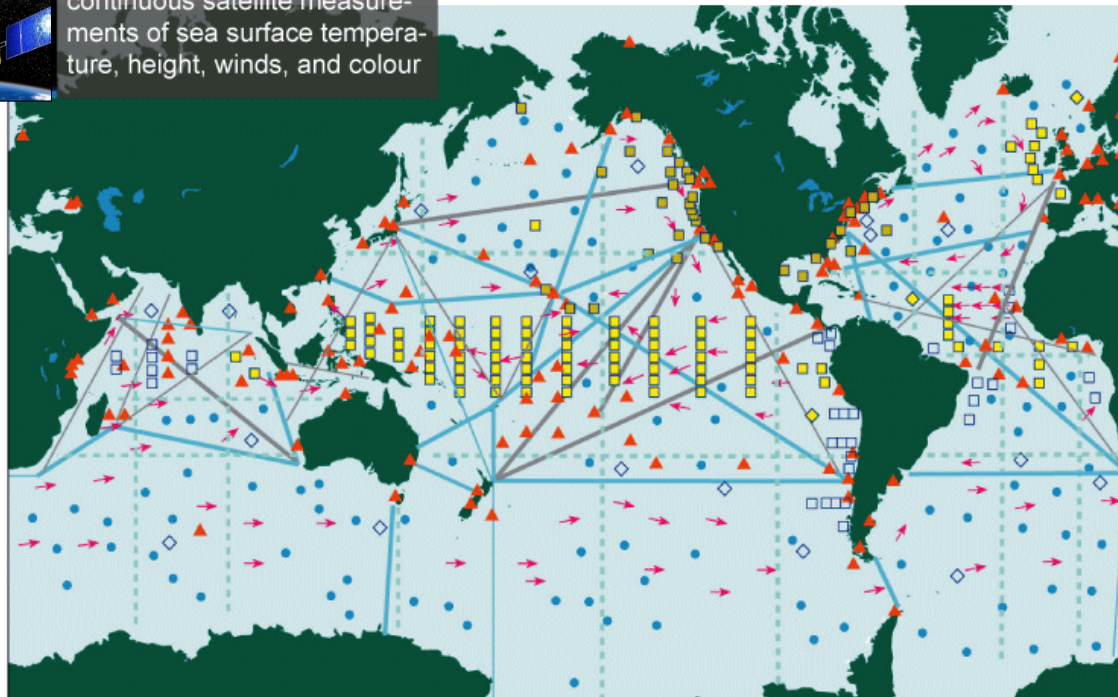
Initial Global Ocean Observing System for Climate

Status against the GCOS Implementation Plan and JCOMM targets

Total *in situ* networks **62%** September 2010

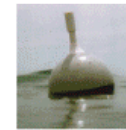


continuous satellite measurements of sea surface temperature, height, winds, and colour



100% **Surface measurements** from volunteer ships (VOSclim)

200 ships in pilot project



100% Global **drifting surface buoy array**

5° resolution array: 1250 floats



59% **Tide gauge network** (GCOS subset of GLOSS core network)

170 real-time reporting gauges



80% **XBT sub-surface temperature section network**

51 lines occupied



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

3° resolution array: 3000 floats



62% **Repeat hydrography and carbon inventory**

Full ocean survey in 10 years

Reference time series **48%**

58 sites



34% **Global reference mooring network**

29 moorings planned



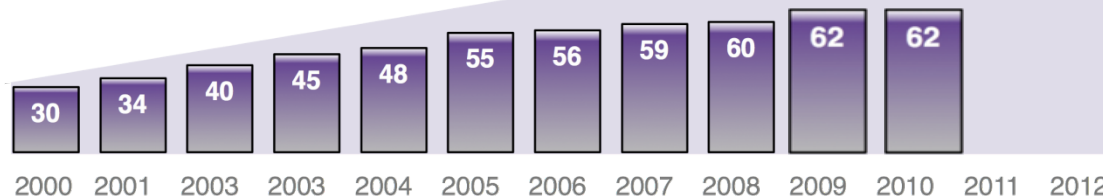
73% **Global tropical moored buoy network**

119 moorings planned



Original goal: Full implementation in 2010

System % complete



Summary 1

Priority for global ocean observing systems

- 100% implementation of initial system by 2015, as called for by OceanObs'09.
- Deep ocean observations to address gap in monitoring of net transports of mass, heat and freshwater.
- Ocean reference stations - surface flux and transport stations in boundary currents to address gaps in understanding air-sea interactions in mid-latitudes and in regions where high spatial resolution is necessary; and for providing data for assimilating into weather, ocean and climate models and for assessing their products.
- Biogeochemical observations for carbon uptake and ecosystems - improve knowledge of dissolved oxygen and sea surface salinity - and the eternal note about improved coordination between satellite and in situ observations of key ECVs.

Summary 2

General goals of OOPC

- OOPC is committed to provide updated information on the state of the ocean, its relevance to climate and society, and liaison with other programs to advocate for sustained ocean observations.
- OOPC will examine the ocean observing system for needed periodic review of component elements, compliance to climate observing requirements, integration of space and in situ components, and addition of new elements.

OOPC Activities in the coming year

- **Complete “Framework for Ocean Observing” and execute “”Roll-out” strategy for the Framework.**
- **Continue support of GCOS IP.**
- **Build outreach and societal relevance.**
- **Initiate review of an observing system component (deep ocean; with upper ocean thermal next...)**

Schedule for next six months

- Nov 2010 – JCOMM Man. Com. (Paris)
- Dec 2010 – I-GOOS (Ivory Coast)
- Jan 2011 – OOPC-14 (Paris), GCOS Sat. Suppl. (Geneva)
- March 2010 – GOOS GSSC (Paris),
- April 2011 – WCRP JSC (UK)
- Others...AGU, WOAP, Framework representation, etc.

OceanObs'09: Vision

Provision of routine and **sustained global information on the marine environment** sufficient to meet society's needs for describing, understanding and forecasting marine variability (**including physical, biogeochemical, ecosystems and living marine resources**), weather, seasonal to decadal climate variability, climate change, sustainable management of living marine resources, and assessment of longer term trends

The conference in one slide...

- 600+ attendees from 36 countries, majority developed countries
- 200+ poster presentations
- **99 Community White Papers** submitted and reviewed before the conference
- **47 Plenary Presentations** - so far 42 submitted/finalized Plenary Papers, peer reviewed as well
- 14 'international coordination' sponsors, 14 additional national/regional agency sponsors
- Interdisciplinary: bringing physics, carbon / biogeochemistry, biology research communities to the same meeting
- Forward-looking / ambitious
- Sets a community action-plan for years ahead

OceanObs'09: calls for action

- (1) Calls on all nations and governments to **fully implement** by 2015 the **initial physical and carbon global ocean observing system** originally envisioned at OceanObs'99, and refined at OceanObs'09.
- (2) Calls on all nations and governments to **commit to the implementation** and international coordination of **systematic global biogeochemical and biological observations**, guided by the outcomes of OceanObs'09, and taking into account regional variations in ecosystems.

OceanObs'09: calls for action

- (3) Invites governments and organizations to embrace **a framework for planning and moving forward with an enhanced global sustained ocean observing system over the next decade**, integrating new physical, biogeochemical, biological observations while sustaining present observations. Recommendations on this Framework, considering how to best take advantage of existing structures, will be developed by an **post-Conference working group of limited duration**.
- (4) Urges the ocean observing community to **increase our efforts** to achieve the needed level of timely data access, sensor readiness and standards, best practices, data management, uncertainty estimates, and integrated data set availability.
- (5) Asks governments, organizations, and the ocean observing community to increase their efforts in **capacity-building and education**.

Converging on a single vision - with many advocates

- IOC Intergovernmental Oceanographic Commission of UNESCO
- GEO Group on Earth Observations
- CEOS Committee on Earth Observation Satellites
- POGO Partnership for Observation of the Global Oceans
- SCOR Scientific Committee on Oceanic Research
- SCAR Scientific Committee on Antarctic Research
- GCOS Global Climate Observing System
- GOOS Global Ocean Observing System
- JCOMM Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
- PICES North Pacific Marine Science Organization
- ICES International Council for the Exploration of the Sea
- CoML Census of Marine Life
- IGBP International Geosphere-Biosphere Programme
- WCRP World Climate Research Programme

Task Team Membership

Name	Expertise	Country	Primary sponsor	Other sponsor Links
Keith Alverson	Paleoclimate/physical/observing systems	Int	IOC	GOOS
Bee Berx	Fisheries	UK	ICES	
Peter Burkill	Biology/plankton	UK	SCOR	
Francisco Chavez	Biogeochemistry/ecosystems	USA	IGBP	
Dave Checkley	Fisheries	USA	PICES	
Candyce Clark	observing systems	USA	JCOMM	
Vicki Fabry	acidification/plankton/biogeochemistry	USA	POGO	
Albert Fischer	secretariat	Int	IOC	GOOS, JCOMM, WCRP
John Gunn*	Biology	Australia	CoML	POGO, SCOR, GOOS
Julie Hall	Biology	New Zealand	IGBP	
Eric Lindstrom*	Satellites	USA	GCOS	GOOS
Yukio Masumoto	Physical oceanography	Japan	POGO	
David Meldrum	Meteorology/Physical/observing systems	UK	JCOMM	
Mike Meredith	Polar regions	UK	SCAR	
Pedro Monteiro	Carbon fluxes	South Africa	GOOS	
José Mulbert	Biology/coastal	Brazil	GEO	GOOS
Sylvie Pouliquen	Real-time data systems	France	JCOMM	GOOS
Carolin Richter	Climate observations	Int	GCOS	
Sun Song	Marine ecosystems	China	POGO	
Rob Koopman	Climate / GEOSS	Int	GEO	
Martin Visbeck	Physical oceanography/climate research	Germany	WCRP	CLIVAR
Stan Wilson	Satellites	USA	CEOS	
* co-chair				

Goals of the Working Group

The WG will consider the outcomes and recommendations from the OceanObs'09 Conference and, in consultation with the international organizations and expert advice, shall:

- Recommend a framework for moving global sustained ocean observations forward in the next decade; integrating feasible new biogeochemical, ecosystem, and physical observations while sustaining present observations; considering how best to take advantage of existing structures,
- Foster continuing interaction between organizations that contribute towards and are in need of sustained ocean observations, and
- Report back to its sponsors and disband by 1 October 2010.

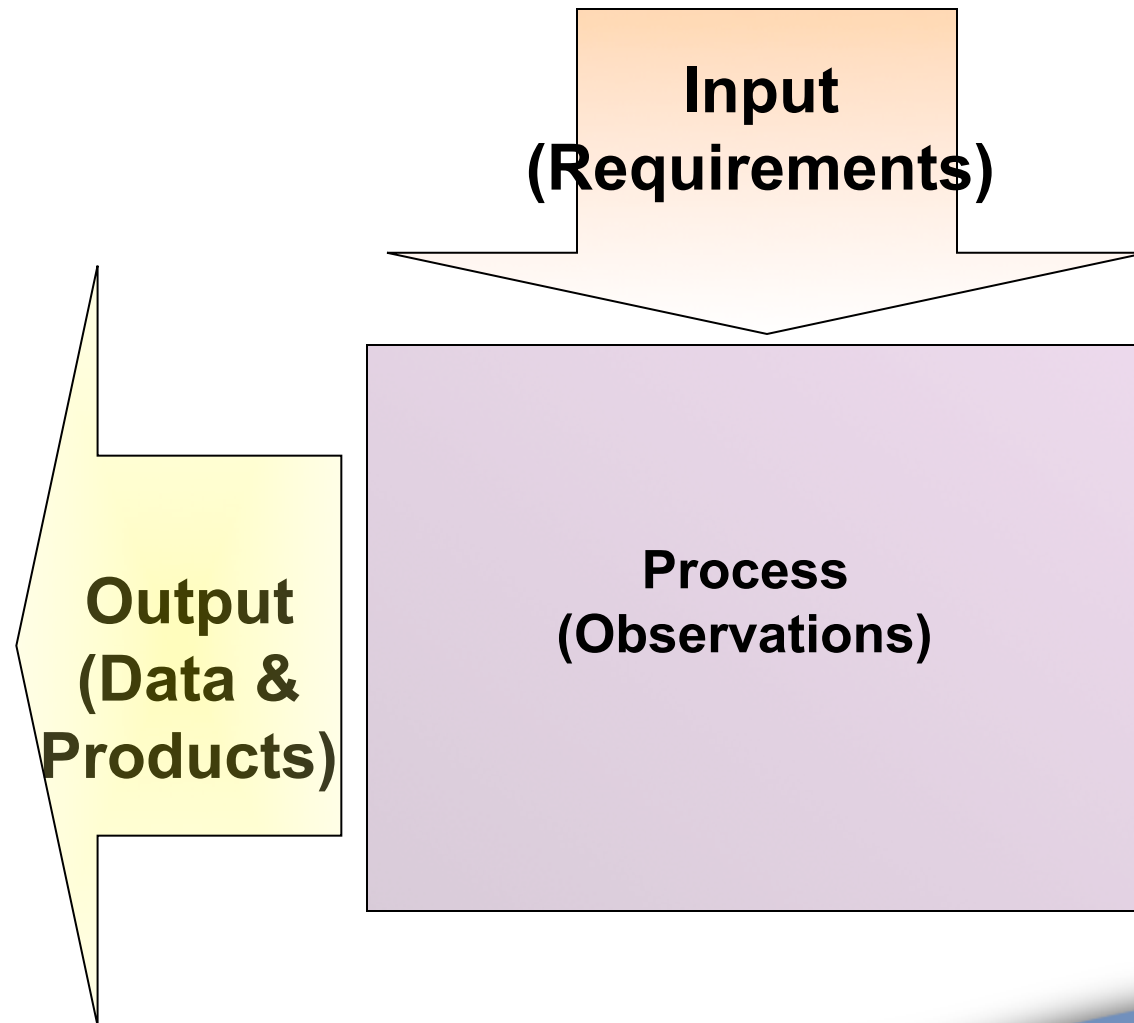
Some Guiding Principles to establish a framework (1)

- We would like the organization to gain strength and international buy-in by being aligned and **responsive to International Framework Conventions and Treaties**. Some obvious examples are:
 - United Nations Framework Convention on Climate Change
 - Convention on Biodiversity
 - Agenda 21 (Sustainability)
- The priority for the organizing (high-level international management) effort and our framework development will be **sustained, global observing systems**.

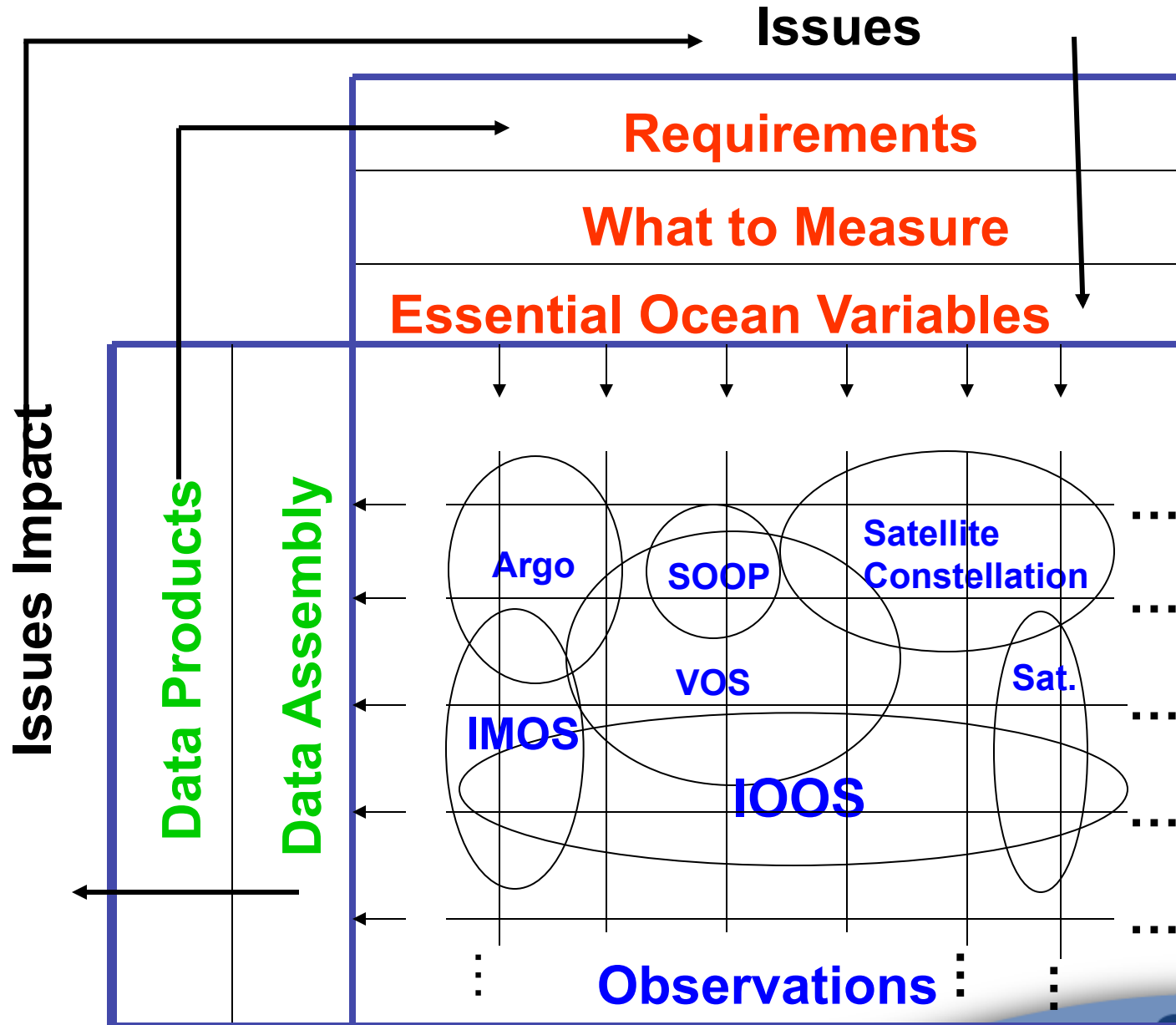
Some Guiding Principles to establish a framework (2)

- **Take advantage of existing organization** and build a new framework for management/development of ocean observing by encouraging new alliances, partnerships, and expanded coordination. New bodies and working groups should be created only to fill uncovered essential functions in the new framework.
- **Expected to deliver a report (a framework with explanation) by 1 October 2010.**

Simple System



A Framework for Ocean Observing



Framework Boundary

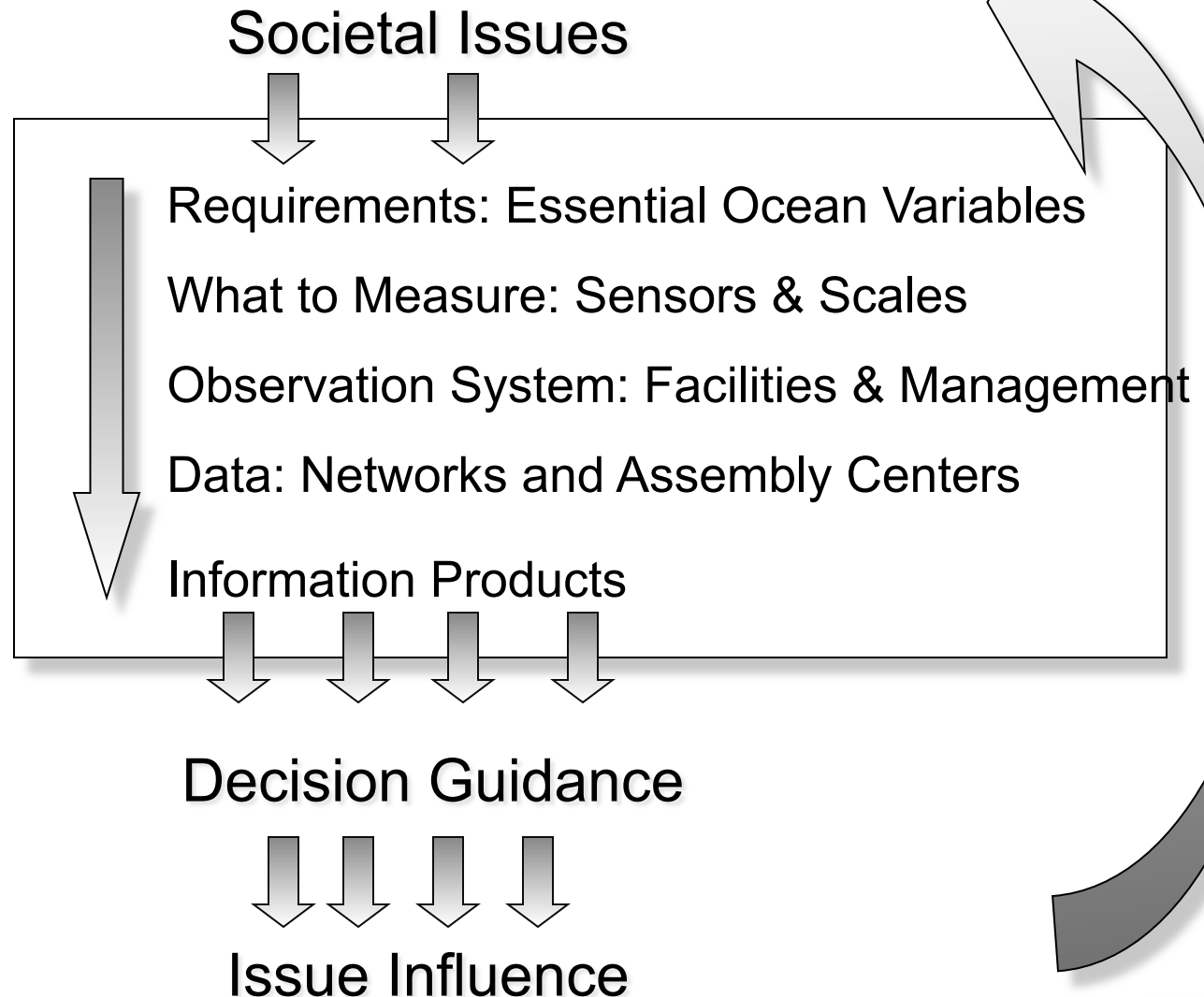
Facilitated by the Framework:

- Quantitative Analysis
- Application of Science to Societal Issues

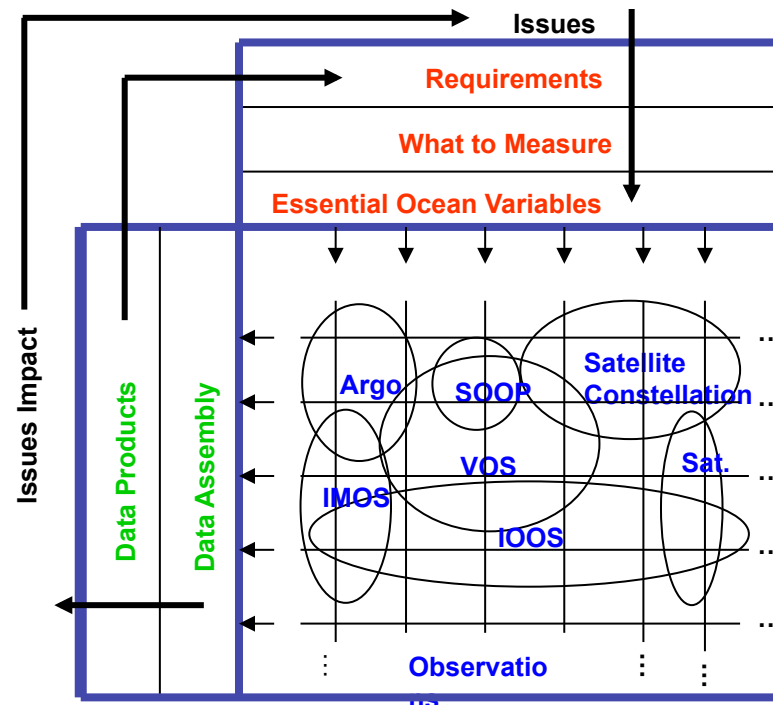
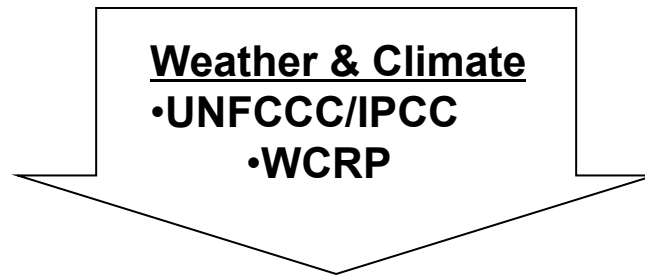


Outside the Framework:

- Qualitative Analysis
- Policy Questions



Framework: Societal Driver 2010



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Framework: Societal Drivers Next Decade

Regional

- Regional Seas
- CCAMLR

Fisheries

- FAO
- RFMOs

Ecosystem services/ Biology

- CBD
- CSD
- WSSD

Assessments

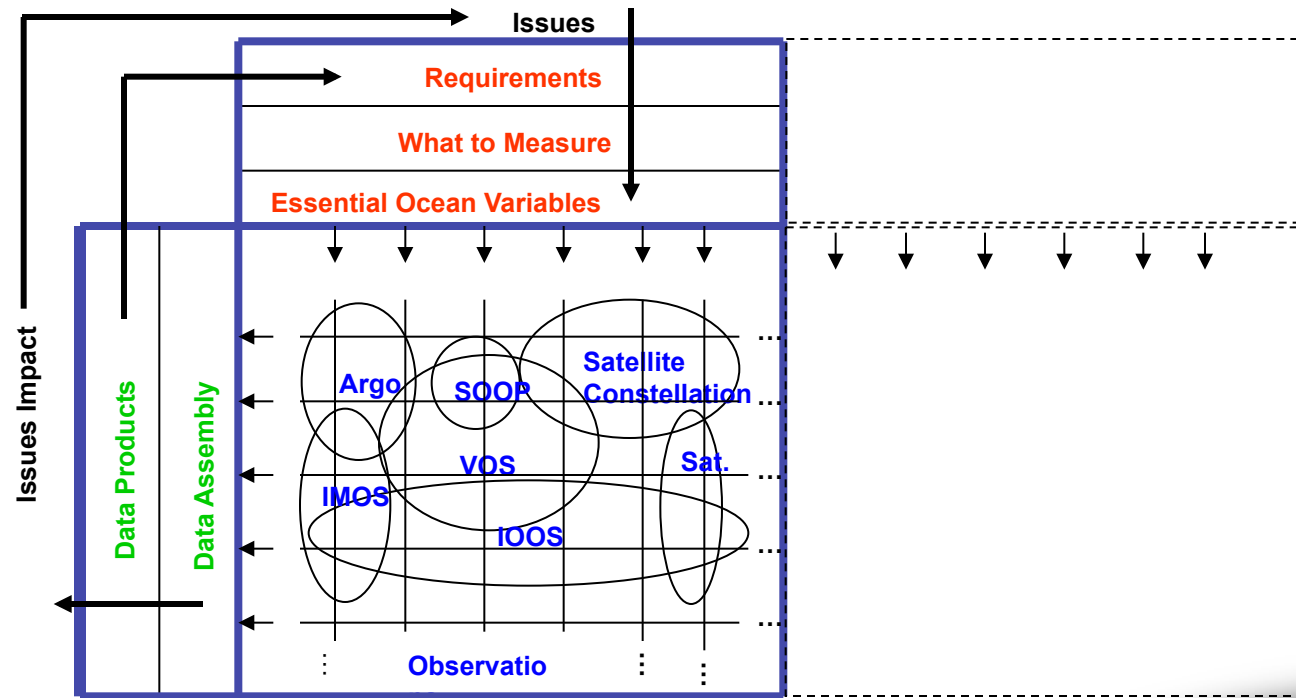
- Global Marine (UN)
- TWAP (GEF)
- Regional

Real-time services

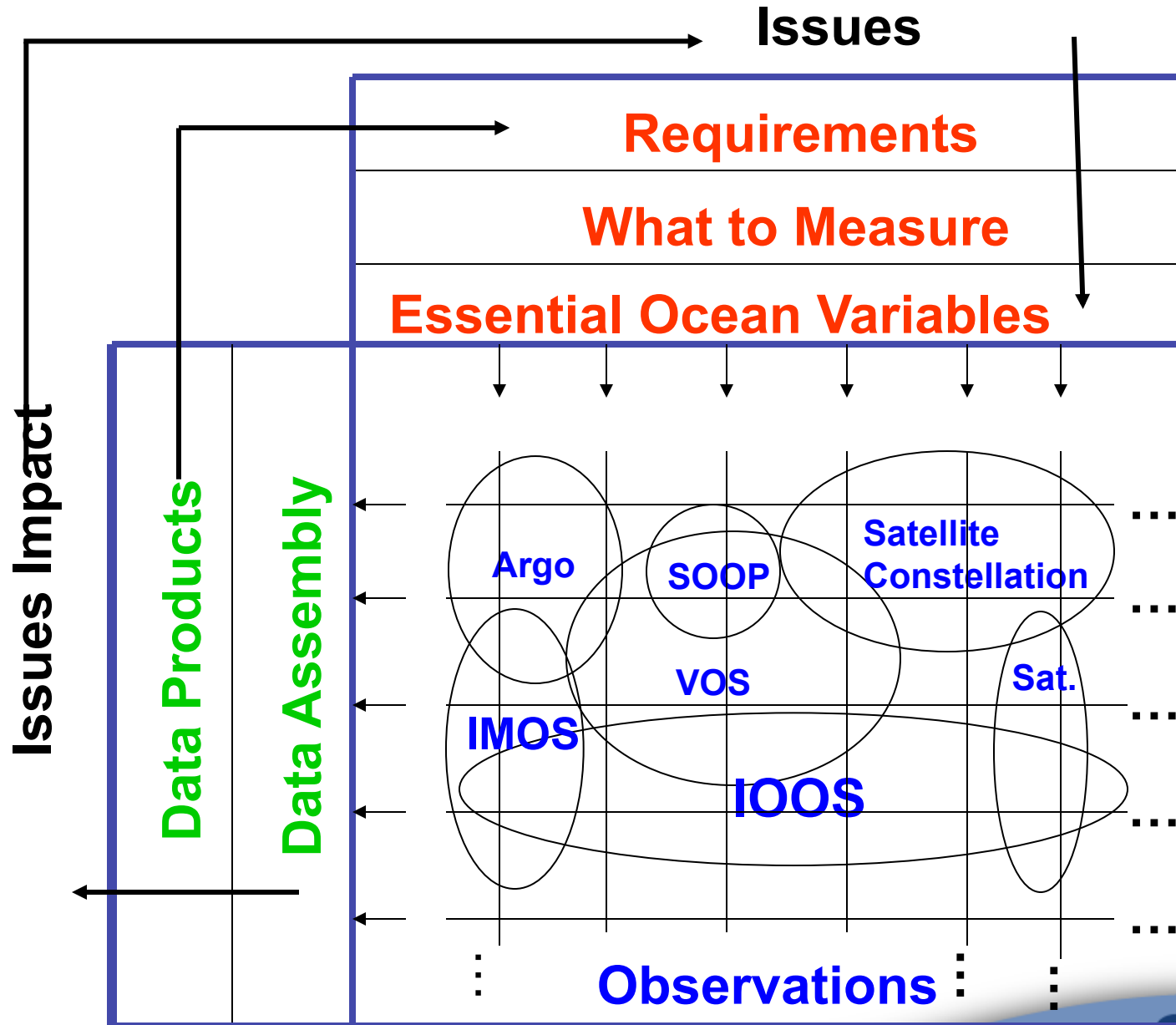
- Emergency support
- Ocean forecasting

Weather & Climate

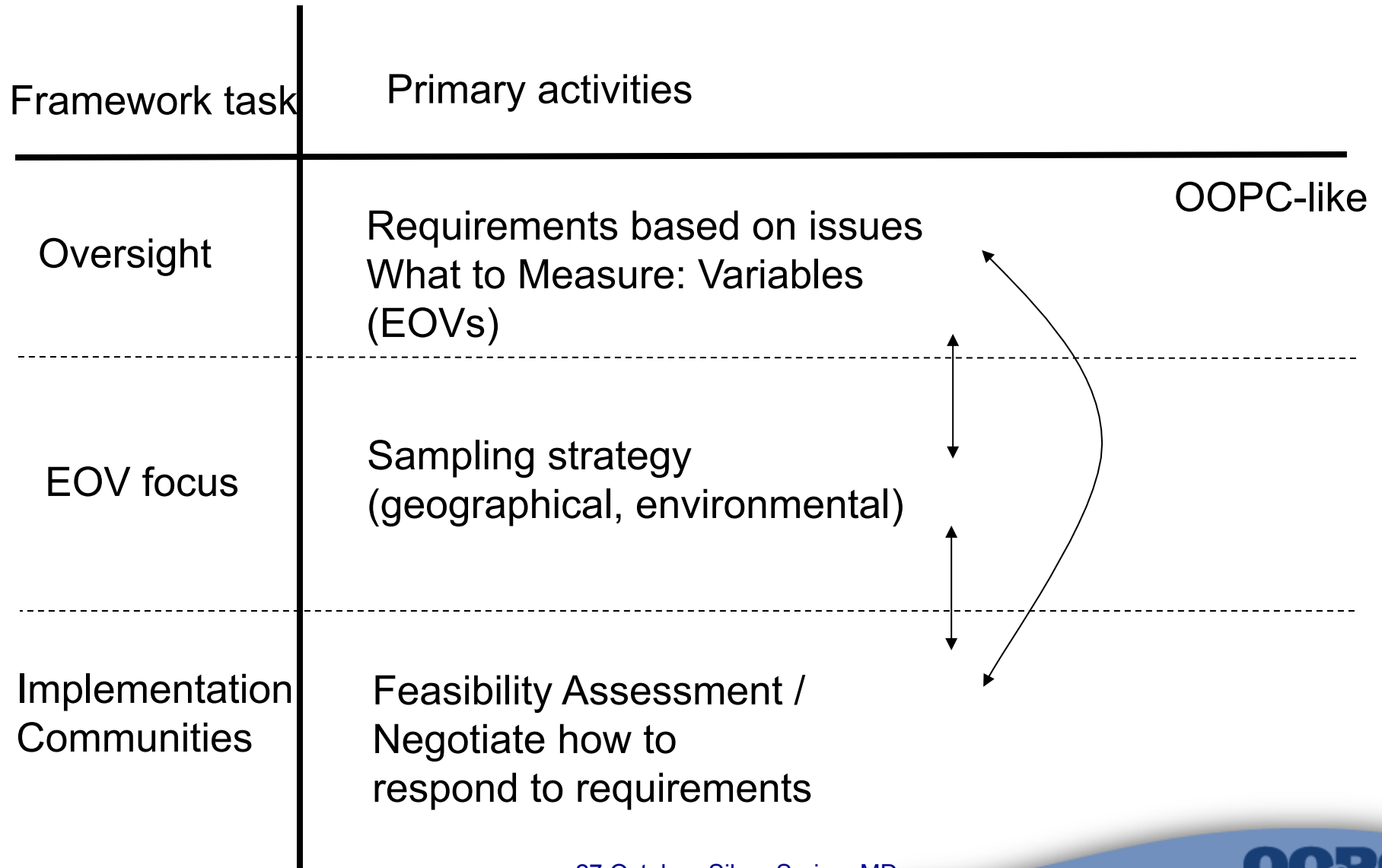
- UNFCCC/IPCC
- WCRP
- Climate services



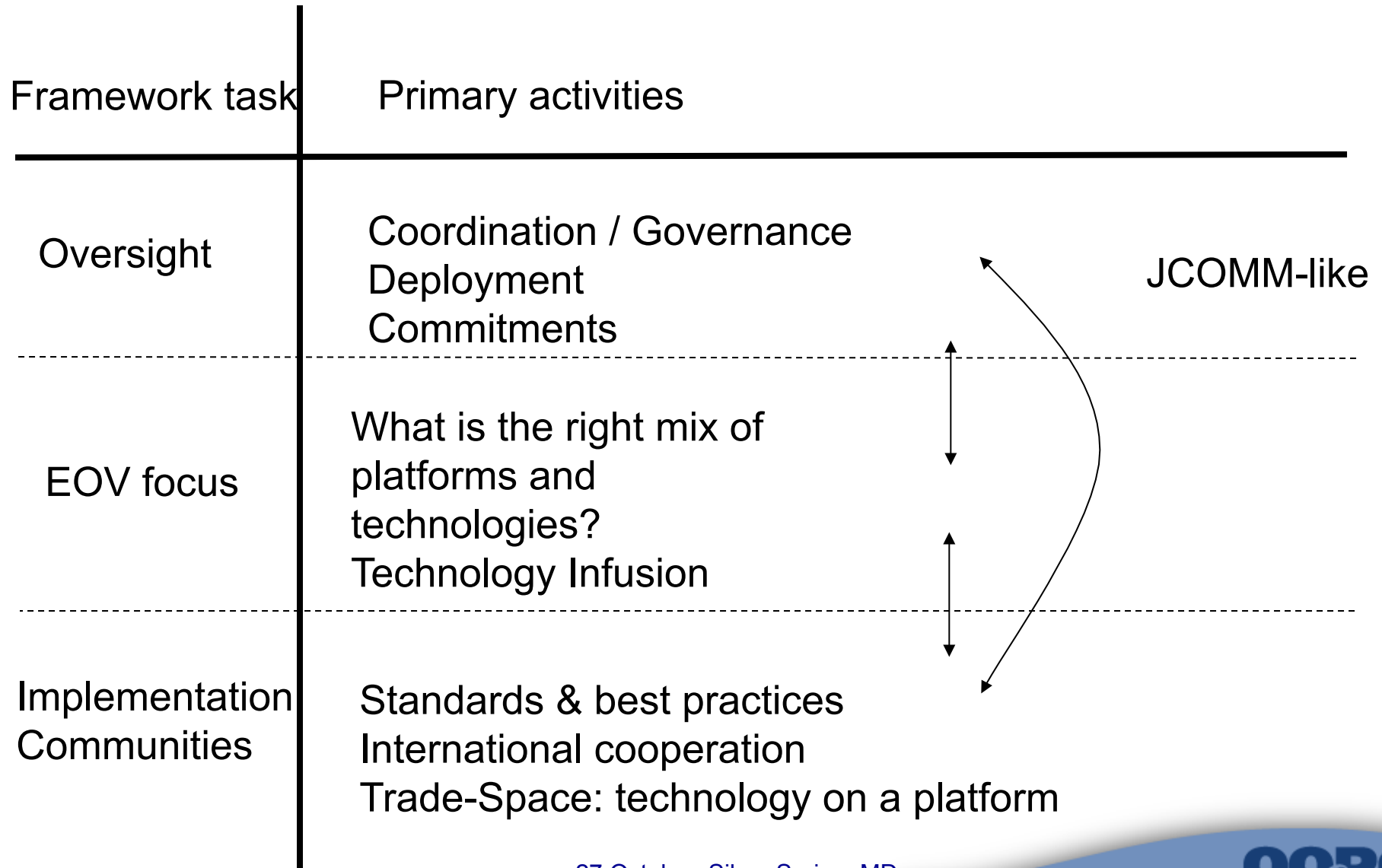
A Framework for Ocean Observing



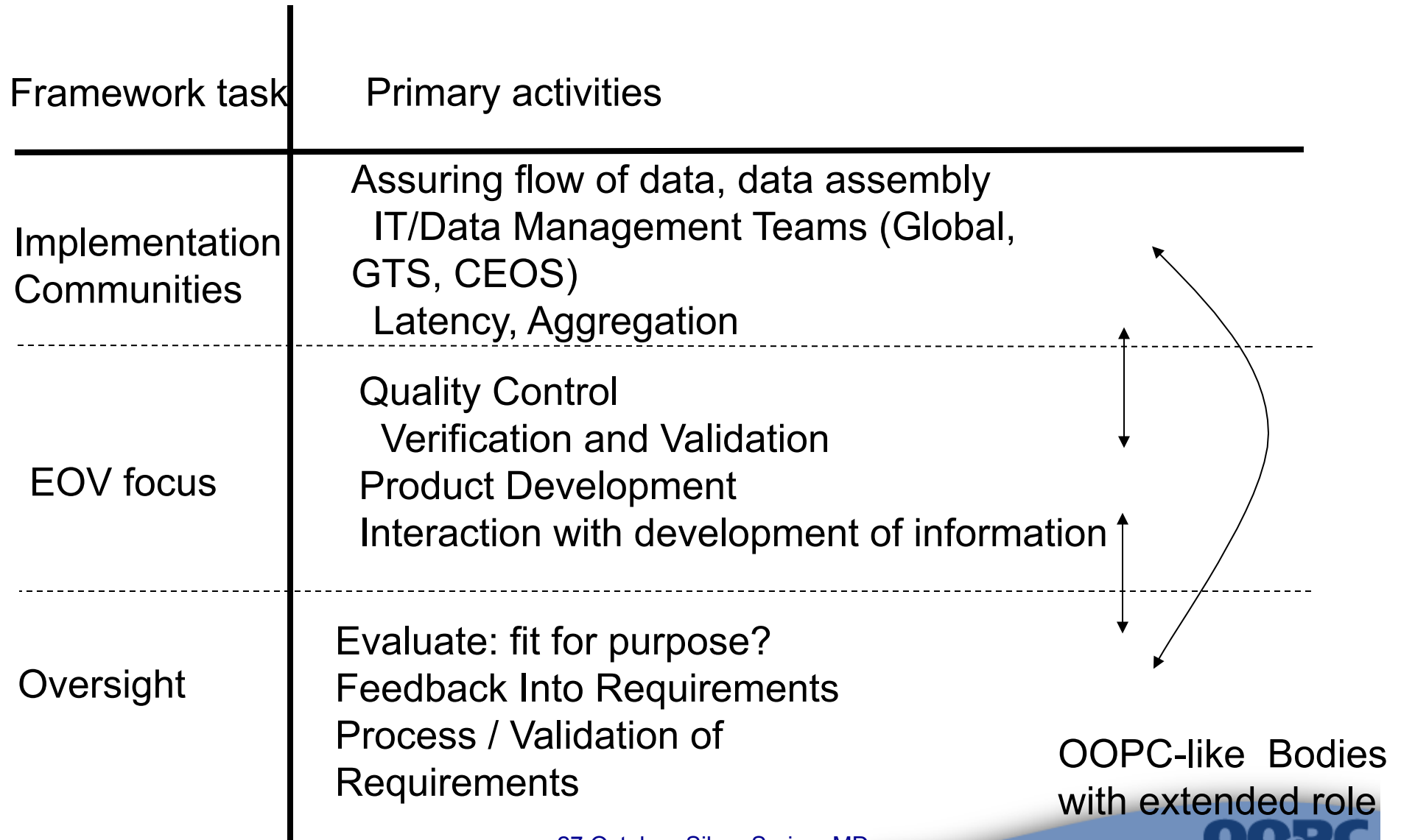
Framework Flow: Requirements



Framework Flow: Observations



Framework Flow: Data and Products



Framework Flow Examples

	Zooplankton	SST	Ocean Acidification Carbon Suite
<p>Framework Flow: Requirements</p> <p>Framework task Primary activities</p> <p>Oversight Requirements based on issues What to Measure: Variables (EOVs) OOPC-like</p> <p>EOY focus Sampling strategy (geographical, environmental)</p> <p>Implementation Communities Feasibility Assessment / Negotiate how to respond to requirements</p>	<p>Individual observing groups - Fisheries research; ICES</p>	<p>GCOS WMO (rolling review)</p>	<p>Origin UNFCCC Biodiversity Conv IOCCP - 4 carbon species pH, TC, Alk, pCO₂</p>
<p>Framework Flow: Observations</p> <p>Framework task Primary activities</p> <p>Oversight Coordination / Governance Deployment Commitments JCOMM-like</p> <p>EOY focus What is the right mix of platforms and technologies? Technology infusion</p> <p>Implementation Communities Standards & best practices International cooperation Trade-Space: technology on a platform</p>	<p>No governance structure</p> <p>- Fisheries surveys (nets, acoustics) - Optical imaging developing - Some common standards and practices</p>	<p>JCOMM-OCG Bodies</p> <p>GHRSSST Science Team Research Community - Scripps - NOAA AOML Many Satellite Teams</p>	<p>- IOCCP and sub-panels</p> <p>Intercalibration Common int Ref Standards (gases and Seawater)</p>
<p>Framework Flow: Data and Products</p> <p>Framework task Primary activities</p> <p>Implementation Communities Assuring flow of data, data assembly IT/Data Management Teams (Global, GTS, CEOG) Latency, Aggregation</p> <p>EOY focus Quality Control Verification and Validation Product Development Interaction with development of information</p> <p>Oversight Evaluate: fit for purpose? Feedback into Requirements Process / Validation of Requirements OOPC-like Bodies with extended role</p>	<p>- Time series of zooplankton abundance, composition, and size structure, e.g., SCOR WG125 on zooplankton time series</p>	<p>-GHRSSST GDAC</p> <p>Research Groups Met Services MISST OI STT Reynolds SST New products: ongoing</p> <p>OOPC WMO GHRSSST ISDM (archive)</p>	<p>CDIAC assembly QC by impl bodies</p> <p>-IOCCP</p> <p>- IOCCP/GCP</p>

“Roll-out” of the Framework

<i>Date</i>	<i>Event</i>	<i>Place</i>	
13-Sep-10	SCOR AGM	Toulouse, France	Peter
27-Sep-10	GCOS Steering Committee	Geneva, Switzerland	Carolin, Eric, Keith, Rob
5-Oct-10	IOCCP Steering Committee	Viterbo, Italy	Pedro, Kathy
12-Oct-10	CEOS Plenary	Rio de Janeiro, Brazil	Stan, Carolin, Rob
18-Oct-10	IGBP Officers	Taiwan	Julie to discuss with Sybill - Eric in
27-Oct-10	PICES annual meeting - MONITOR Committee	Portland OR, USA ?	Dave
27-Oct-10	NOAA Climate Observation Division review	Silver Spring MD, USA	Eric, Candyce, Dave
2-Nov-10	GEO Plenary	Beijing, China	Keith, Rob, Carolin
16-Nov-10	JCOMM Management Committee	Paris, France	Eric, Candyce, Keith, Albert
7-Dec-10	I-GOOS Board	Abidjan, Côte d'Ivoire	Eric, Julie, Keith
24-Jan-11	POGO Annual meeting	Seoul, Korea	John, IOC
10-Feb-11	IGBP IPO Officers meeting	Sweden	
4-Mar-11	WCRP Joint Scientific Committee	Exeter, UK	Martin, Eric, GCOS, IOC
16-Mar-11	IGBP Steering Committee	France	requires invitation and funding
15-Apr-11	documents for IOC Assembly due (approx date)		
2-May-11	CLIVAR SSG	Paris, France	Martin, Albert - after end of process
22-Jun-11	IOC Assembly	Paris, France	

Integrated Ocean Observation Committee



- **The Integrated Coastal & Ocean Observing System Act of 2009**
 - Interagency Ocean Observing Committee
 - Lead Federal Agency (NOAA)
 - Regional Integrated Coordination Entities
- **Committee Members and Staff**
 - Three Co-chairs (NOAA, NASA, NSF)
 - 11 Member Agencies



IOOC Primary Responsibilities



- Establish observation variables.
- Establish DMAC standards.
- Develop contract certification standards.
- Identify coverage gaps.
- Establish competitive grant programs.
- Update the System plan.
- Obtain an independent cost estimate.
- Develop an annual coordinated budget.

National Ocean Policy

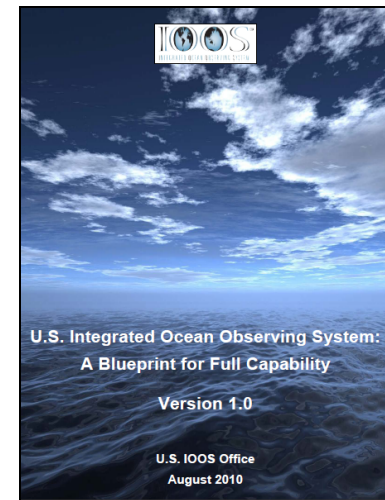


- **OSTP Recommendations**

- Priority Objective #9
- “Strengthen and integrate Federal and non-Federal ocean observing systems, sensors, data collection platforms, data management, and mapping capabilities into a national system, and integrate that system into international observation efforts”

- **Strategic Action Plan**

- Potential joint working group IWG-FI/OCM.
- US IOOS: A Blueprint for Full Capability
 - System Elements
 - Implementation
 - Tracking/Reporting
 - Partnership Roles and Engagement



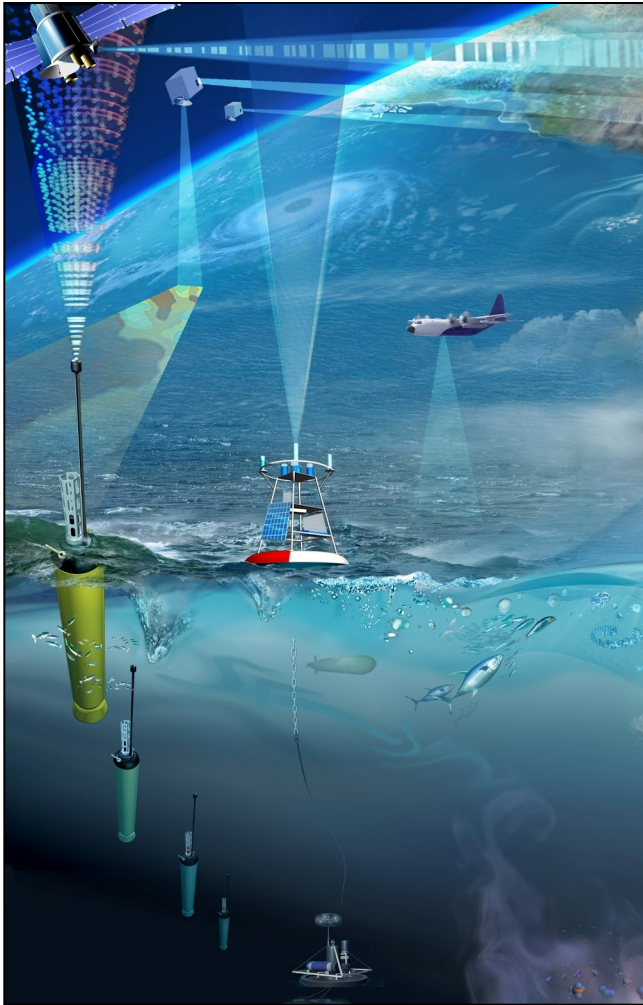
Regional Engagement

- **Collaboration with the National Federation of Regional Associations**
 - Coordinating efforts on the ICOOS Act.
 - Updating each other on activities and priorities.
 - Utilizing community events to meet objectives.
 - Co-hosting workshops to engage experts on technical aspects of building the System.
 - Engaging new stakeholders at industry events.



*****Upcoming Regional Coordination Workshop
November 16 & 17, Washington D.C.**

Federal Agency Involvement



- **Proposed Subcommittees**
 - IOOC Planning
 - Coordinated, Comprehensive Budget
 - Data Variables
 - Certifications
 - Observation Gaps
 - System Plan Review
 - Data Management and Communications Steering Team

- **Federal Experts Needed**

Contact us:
iooc@oceanleadership.org

BACK-UP SLIDES

Goals of the ocean observing system for climate

- Provide data and information products for
 - Climate monitoring and forecasting
 - Climate assessment
 - Climate research
 - Outreach
- Support decision-making in adaptation to climate change
- Serve as a foundation for global oceanography – research and operations.

Decisions and Actions from OOPC-14

19-22 January 2010, NOAA/AOML, Miami FL, USA

- Improve **societal relevance of OOPC ocean climate indices**
<http://ioc-goos-oopc.org>
 - improve suite: indices for tropical cyclones (heat content, storm energy), think about deep ocean indices (high uncertainty from low obs.)
 - reverse presentation for **impacts view**
 - Start with specific examples: SW Australia drought; South Florida rainfall; S. California; E. Africa seasonal rainfall – link to key ocean climate indices
 - Encourage **feedback**: wiki format to allow input, blog with overview
- **OOPC in an integrated framework** for sustained ocean observations including biogeochemistry and ecosystems (post-OceanObs'09)
 - **Climate is central to OOPC**, maintain focus on GCOS IP – UNFCCC
 - Biogeochemistry and ecosystems in OOPC related to climate impacts
 - maintain close link to other parts of framework that might focus on other Conventions and their priorities: Biodiversity CBD, Sustainability of living marine resources CSD, ...
 - improve links to coastal ocean observing systems

Decisions and Actions from OOPC-14

19-22 January 2010, NOAA/AOML, Miami FL, USA

- Review **Deep ocean** observation requirements
 - encourage **clarification of primary scientific goals** of deep ocean observing system at June 2010 GSOP-led workshop
 - sponsor review of **deep ocean observation requirements** end 2010
 - across all relevant ECVs
 - observation and technology development priorities
- 2011 revisit: review of Ocean **Thermal** observation requirements
 - reconciling ocean heat content, sea level, energy imbalances
 - could focus on error budget and sampling requirements
 - high effort in Argo and XBT communities on error – wait for results
- **CLIVAR** and OOPC
 - Basin panel representatives on OOPC
 - help OOPC understand regional *in situ* and *satellite* observing needs
 - help OOPC develop story on *societal relevance* of observations
 - call on research programs to **articulate need for sustained legacy observations in a systematic way**

Decisions and Actions from OOPC-14

19-22 January 2010, NOAA/AOML, Miami FL, USA

- GCOS Implementation Plan
 - develop strategy for joint ECVs key for **air-sea fluxes**
 - encourage and support ongoing **requirements review** process through progress reports
- Encouraging **data sharing** – promote actions for:
 - **regular tracking** of adherence to data sharing policies
 - development of **DOIs for data**
- on the horizon:
 - requirements for western boundary current monitoring

OOPC Activities in the coming year

- **Complete “Framework for Ocean Observing” and execute “”Roll-out” strategy for the Framework.**
- **Continue support of GCOS IP.**
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- **Initiate review of an observing system component (deep ocean; with upper ocean thermal next...)**

Schedule for next six months

- Nov 2010 – JCOMM Man. Com. (Paris)
- Dec 2010 – I-GOOS (Ivory Coast)
- Jan 2011 – OOPC-14 (Paris), GCOS Sat. Suppl. (Geneva)
- March 2010 – GOOS GSSC (Paris),
- April 2011 – WCRP JSC (UK)
- Others...AGU, WOAP, Framework representation, etc.

Ocean Obs '09

Priorities for Ocean Domain

- Provide routine and sustained global information on the marine environment
- Must be sufficient to meet society's needs for useful hindcasts, nowcasts and forecasts of marine variability (including physical, biogeochemical, ecosystems and living marine resources), weather, seasonal to decadal climate variability, sustainable management of living marine resources, and assessment of longer term trends.
- Suitable for scientific research with further processing and calibration
- Multi-national, multi-organizational effort
- Sustained, global observing system
- Accessible, free, easily usable data

Sustained global ocean observing system from Ocean Obs '09 (Details TBD)

Required (physical):

- Extended Argo (full depth highly desired)
- T/P-Jason class altimetry (wide swath mesoscale resolution desired)
- Scatterometry winds (synoptic coverage highly desirable)
- SST (combined system)
- Sea ice (extent and thickness) and under-ice observations
- Gliders and BC measurements
- Sea surface salinity
- Space-borne gravity (bottom pressure) changes
- Argo-mounted nutrient/oxygen/... sensors

Ancillary to the ocean observation problem:

- Land ice volume,
- land hydrology (run-off)
- Land carbon