

The Global Ocean Observing System
www.goosocean.org

The Essential Ocean Variable Framework:

GOOS authoritative guidance on observing system design

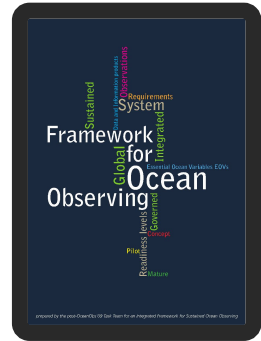
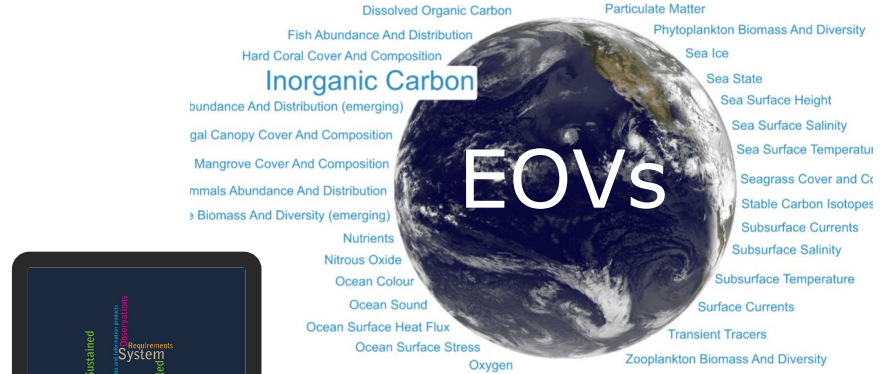
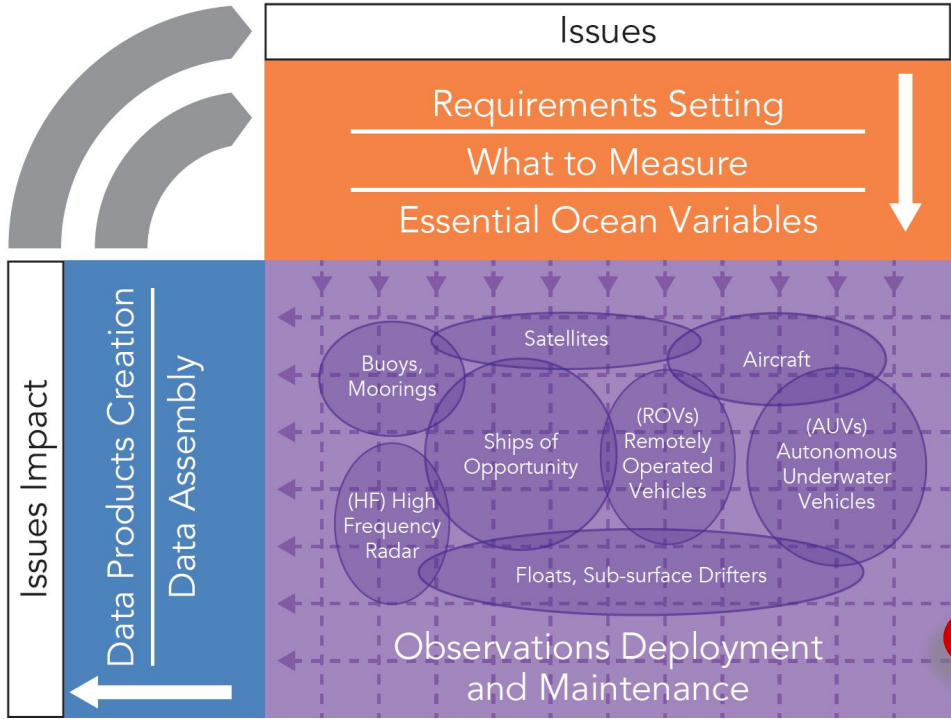


*Artur Palacz, IOCCP Project Officer
Arctic Observing Summit, 31 March 2022*



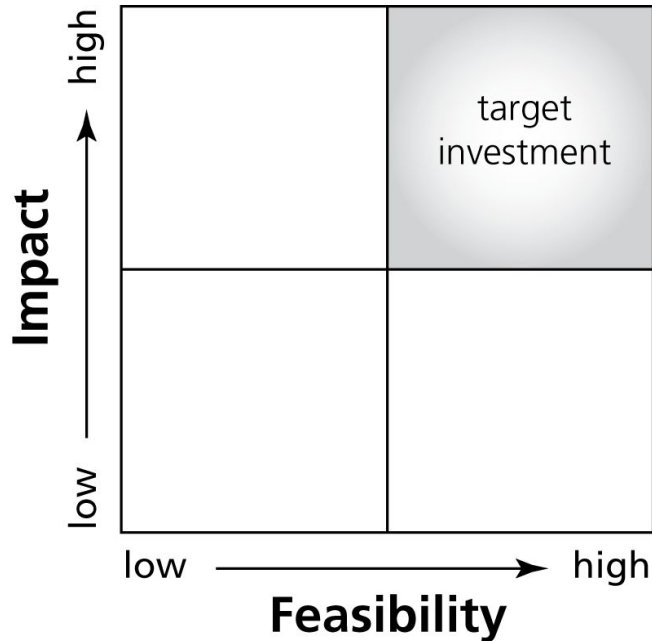
coordinates a large network of ocean observing platforms delivering data for climate, operational services and ocean health applications

Framework for Ocean Observing Process Diagram



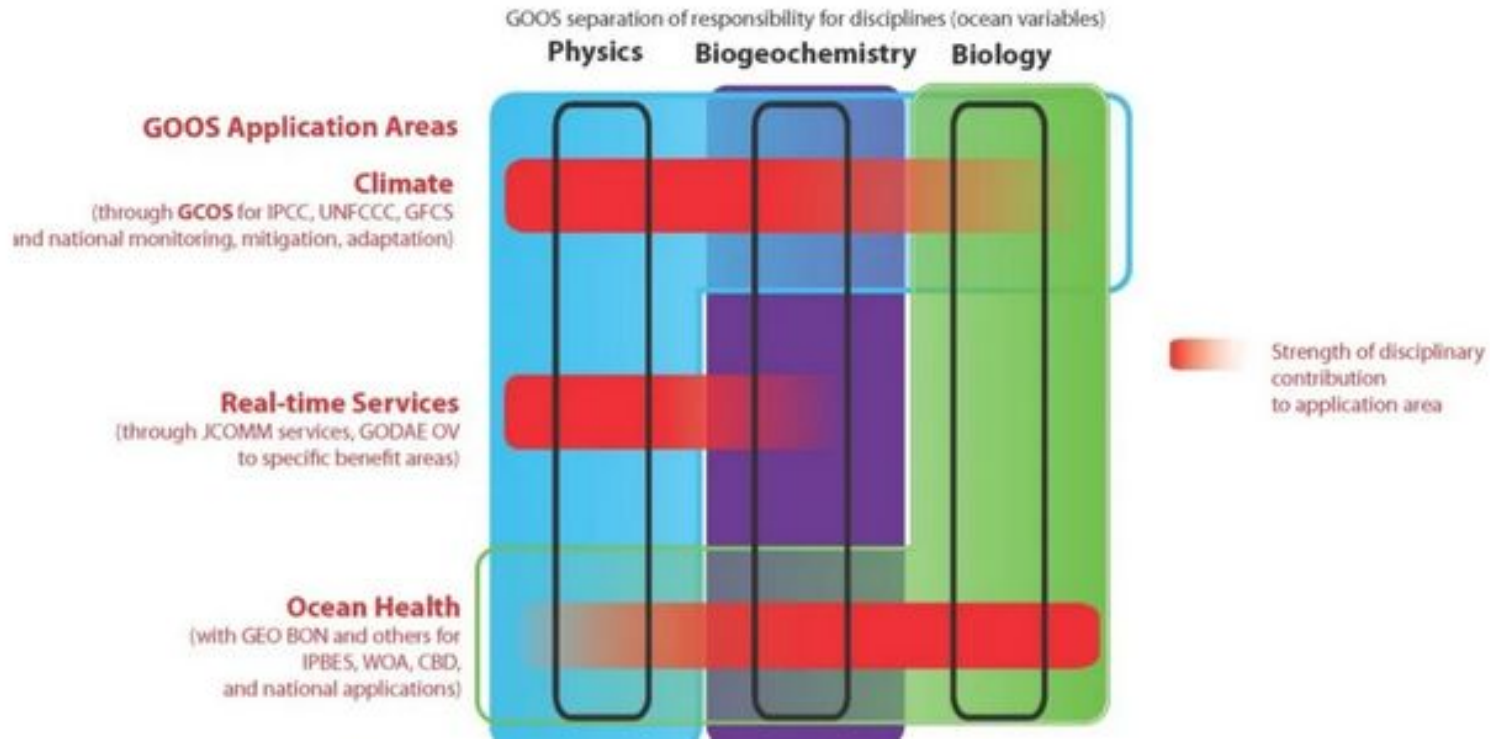
Essential Ocean Variables for **sustained** observations

driven by requirements, negotiated with feasibility



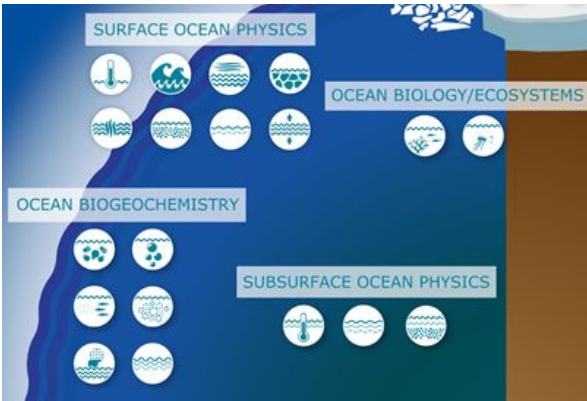
- **We cannot measure everything, nor do we need to**
- Driven by requirements, negotiated with feasibility
- Feasibility assessment includes different criteria: technical, cost, environmental, or ethical
- Basis for including **new elements** of the system, for expressing requirements at a high level
- Allows for innovation in the observing system over time

Establishing EOVs for an integrated GOOS



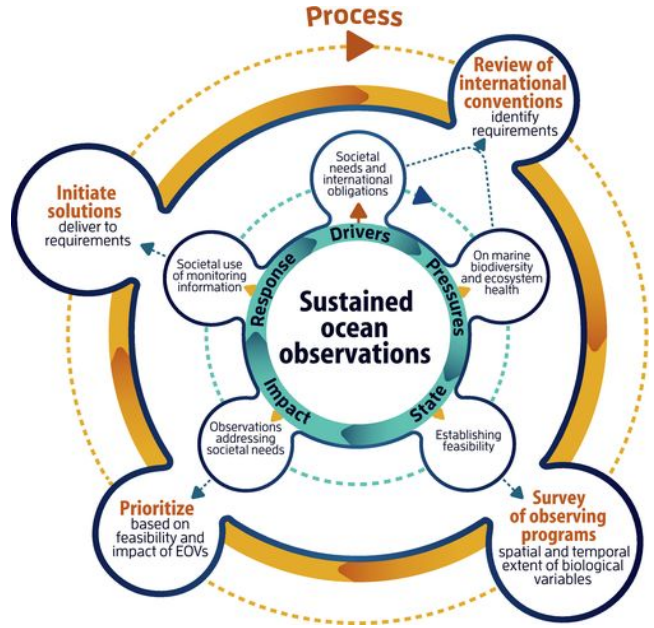
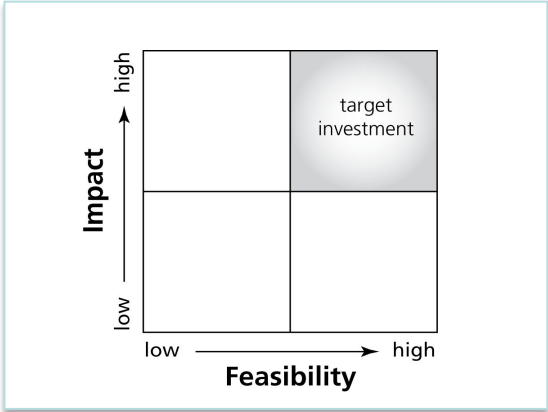
Establishing EOVs for an integrated GOOS

Physics & Climate



Biology & Ecosystems

Biogeochemistry



From Miloslavich et al. (2018)

Physics & Climate

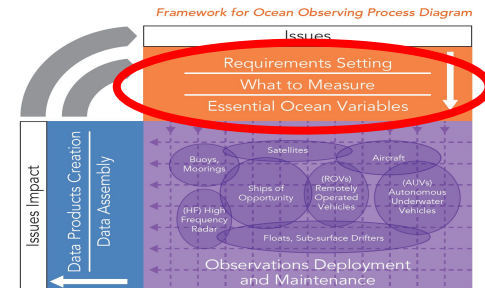
Sea State
Ocean Surface Stress
Sea Ice
Sea Surface Height
Sea Surface Temperature
Subsurface Temperature
Surface Currents
Subsurface Currents
Sea Surface Salinity
Subsurface Salinity

Biogeochemistry

Oxygen
Nutrients
Inorganic Carbon
Transient Tracers
Particulate Matter
Nitrous Oxide
Stable Carbon Isotopes
Dissolved Organic Carbon

Biology & Ecosystems

Phytoplankton Biomass & Diversity
Zooplankton Biomass & Diversity
Fish Abundance & Distribution
Marine Turtles, Birds, Mammals Abundance & Distribution
Live Coral
Seagrass Cover
Macroalgal Canopy
Mangrove Cover



EOV Specification Sheets:

www.goosocean.org/eov

Physics & Climate

Sea State
Ocean Surface Stress
Sea Ice
Sea Surface Height
Sea Surface Temperature
Subsurface Temperature
Surface Currents
Subsurface Currents
Sea Surface Salinity
Subsurface Salinity
Ocean Surface Heat Flux

Biogeochemistry

Oxygen
Nutrients
Inorganic Carbon
Transient Tracers
Particulate Matter
Nitrous Oxide
Stable Carbon Isotopes
Dissolved Organic Carbon

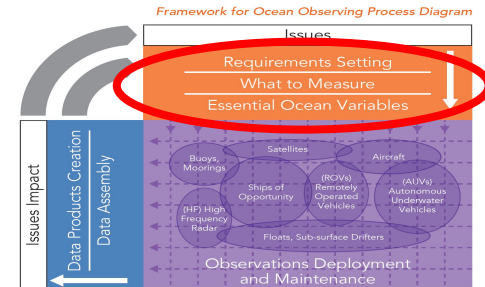
Biology & Ecosystems

Phytoplankton Biomass & Diversity
Zooplankton Biomass & Diversity
FISH Abundance & Distribution
Marine Turtles, Birds, Mammals Abundance & Distribution
Hard Coral Cover and Composition
Seagrass Cover & Composition
Macroalgal Canopy Cover & Composition
Mangrove Cover & Composition
Microbe Biomass & Diversity
Invertebrate Abundance & Distribution

Ocean Colour

Ocean Sound

Marine Plastics Debris



EOV Specification Sheets:

www.goosocean.org/eov

Emerging
EOVs



EOV: “What’s in a name?”

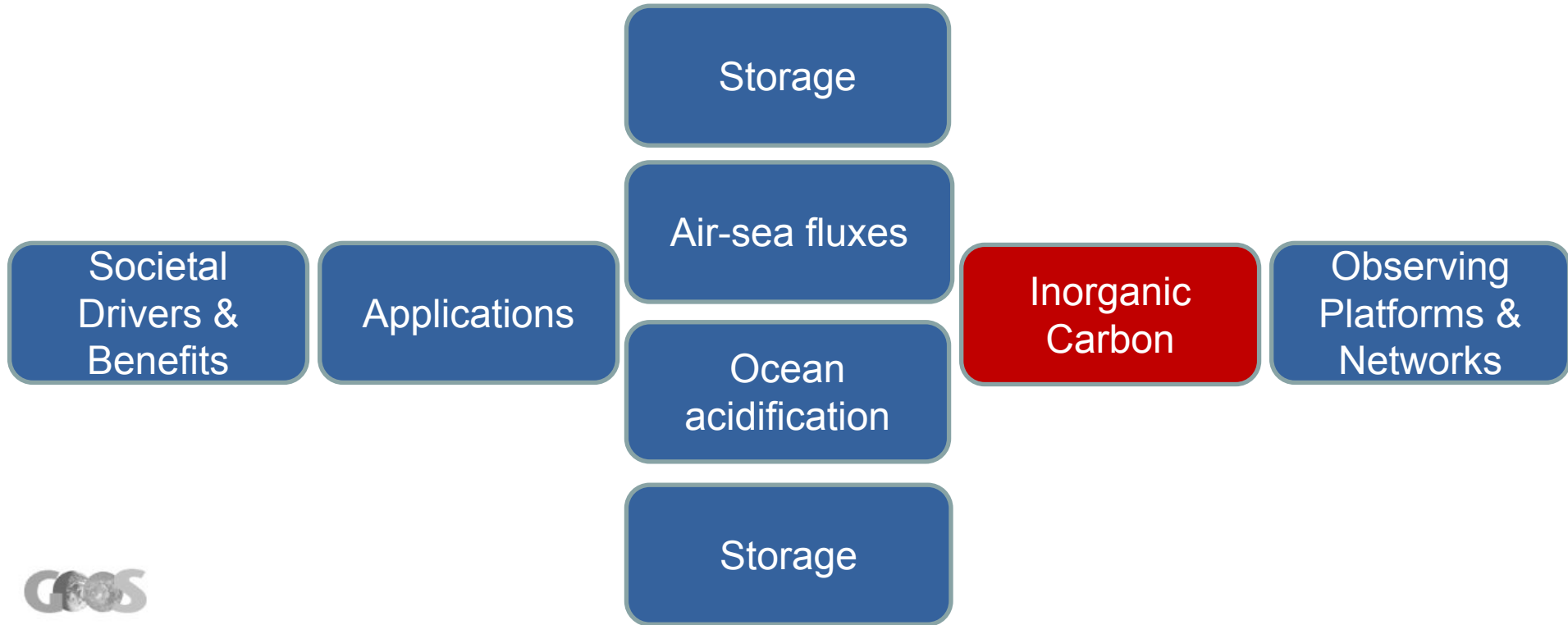
Example - Inorganic Carbon EOV

Phenomena to Capture	1 Air-Sea Fluxes	2 Storage / inventory	3 Ocean Acidification	4 Primary production	5 Export fluxes
Temporal Scales of the Phenomena	Monthly	Annual	<u>Coastal</u> Daily <u>Open Ocean</u> Seasonal	Seasonal to decadal	Seasonal to decadal
Spatial Scales of the Phenomena	1-250 km	100-1000 km	<u>Coastal</u> 0.1-100 km <u>Open Ocean</u> 100-1000km	<u>Coastal</u> 1-100 km <u>Open Ocean</u> 100-1000 km	<u>Coastal</u> 1-100 km <u>Open Ocean</u> 100-1000 km

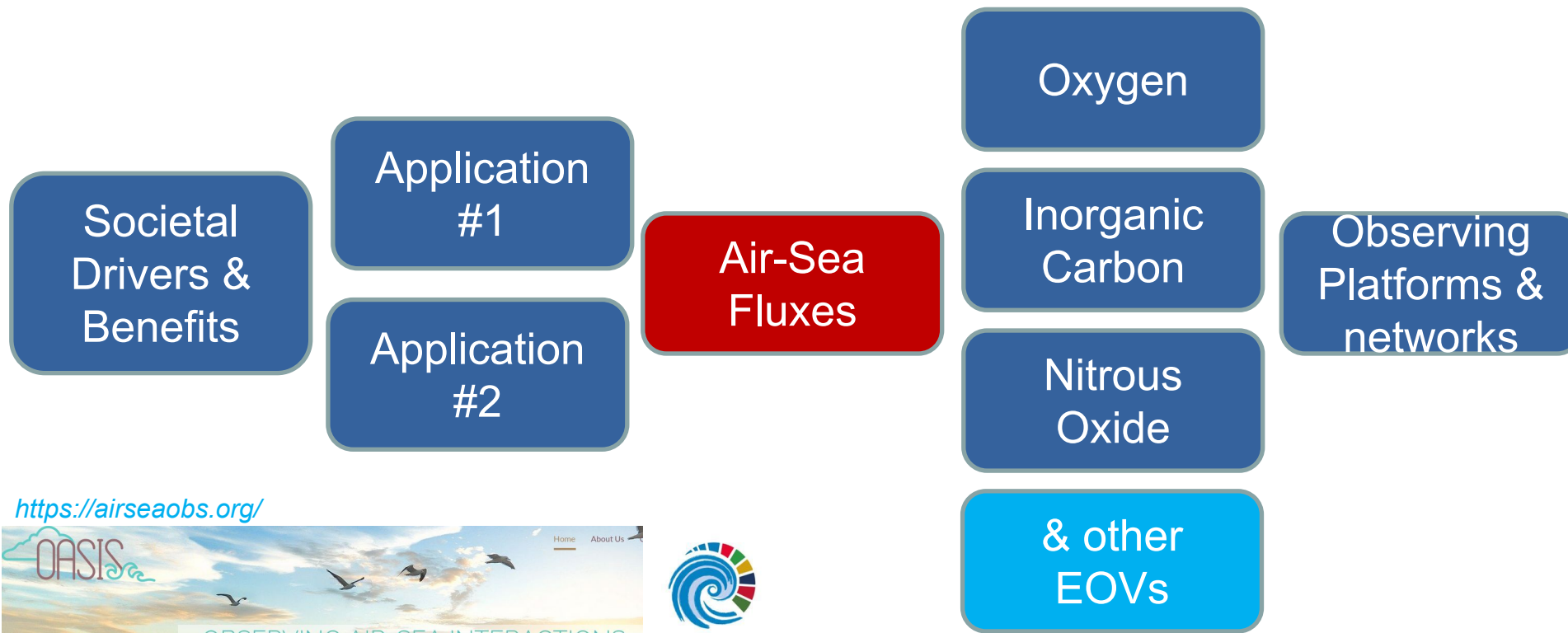
Table 1: EOV Information

Table 1: EOV Information		20 Pg C decade ⁻¹	<u>Saturation states</u> 0.1 decade ⁻¹ pH 0.01 decade ⁻¹	0.5 Pg C yr ⁻¹ decade ⁻¹ (net community production)	1 Pg C yr ⁻¹ decade ⁻¹
Name of EOV	Carbonate System				
Sub-Variables	Dissolved Inorganic Carbon (DIC), Total Alkalinity (TA), Partial pressure of carbon dioxide (pCO ₂) and pH; <i>[At least two of the four Sub-Variables are needed.]</i>				
Derived Products	Saturation state (aragonite, calcite), Dissolved carbonate ion concentration, Air-sea flux of CO ₂ , Anthropogenic carbon, Change in total carbon	±10%	±20%		

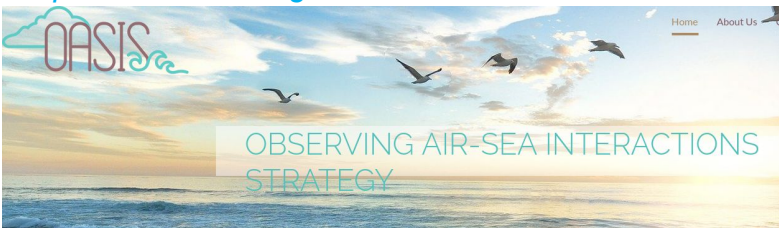
A single EOV informs multiple phenomena operating on very different spatio-temporal scales → *akin to distinct requirements for ECV products*



Multiple applications require measurements of the same phenomenon. Each phenomenon sets requirements for multiple EOVs.



<https://airseaobs.org/>



2021-2030 United Nations Decade of Ocean Science for Sustainable Development

Establishing an EOV places a demand for coordinated action and EOV-based implementation plans

Eos Science News by AGU

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Sustainable Observations of Plankton, the Sea's Food Foundation

Workshop on Developing an Implementation Plan for a Sustained, Multidisciplinary Global Observing System of Plankton Communities, Santa Cruz, California, 25–27 June 2018

By P. Miloslavich, J. Pearlman, and R. Kudela 20 November 2018



Plankton can be monitored in a variety of ways. Zooplankton diversity and biomass can be estimated by deploying collecting devices in the ocean, like the plankton net pictured here. Credit: Carlie Devine, CSIRO

Plankton-mob Workshop Proceedings
Implementation of global, sustained and multidisciplinary observations of plankton communities



Implementation of global, sustained and multidisciplinary observations of plankton communities

Plankton-mob Workshop Proceedings

Seymour Marine Discovery Center, Santa Cruz, California, USA

June 25-27, 2018

GOOS REPORT # 230

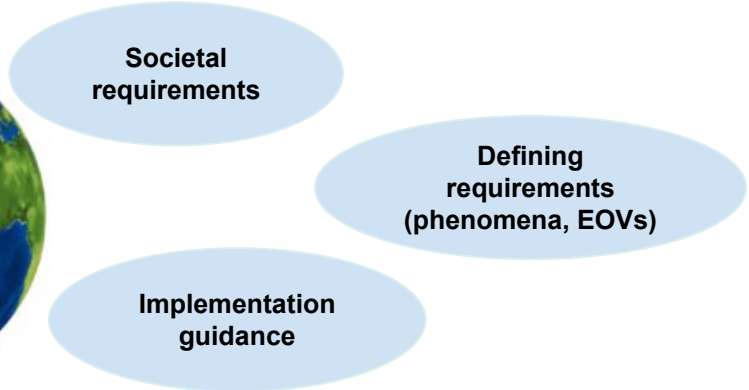
Patricia Miloslavich, Francoise Pearlman, Jay Pearlman, Frank Muller-Karger, Ward Appeltans, Sonia Batten, Raphael Kudela, Ana Lara López, Peter Thompson



EOVs are critical for meeting GOOS 2030 Strategic Objective #5


“Provide **authoritative guidance** on integrated observing system design, synthesizing across **evolving** requirements and identifying gaps.”

“GOOS will enhance its undertaking of **multidisciplinary assessment and synthesis** across a range of **evolving requirements**, in order to **guide and support implementation decisions** from global to regional, and across platforms, networks and technologies (...)”



A Roadmap for the Implementation of the Global Ocean Observing System 2030 Strategy
for an open planning process

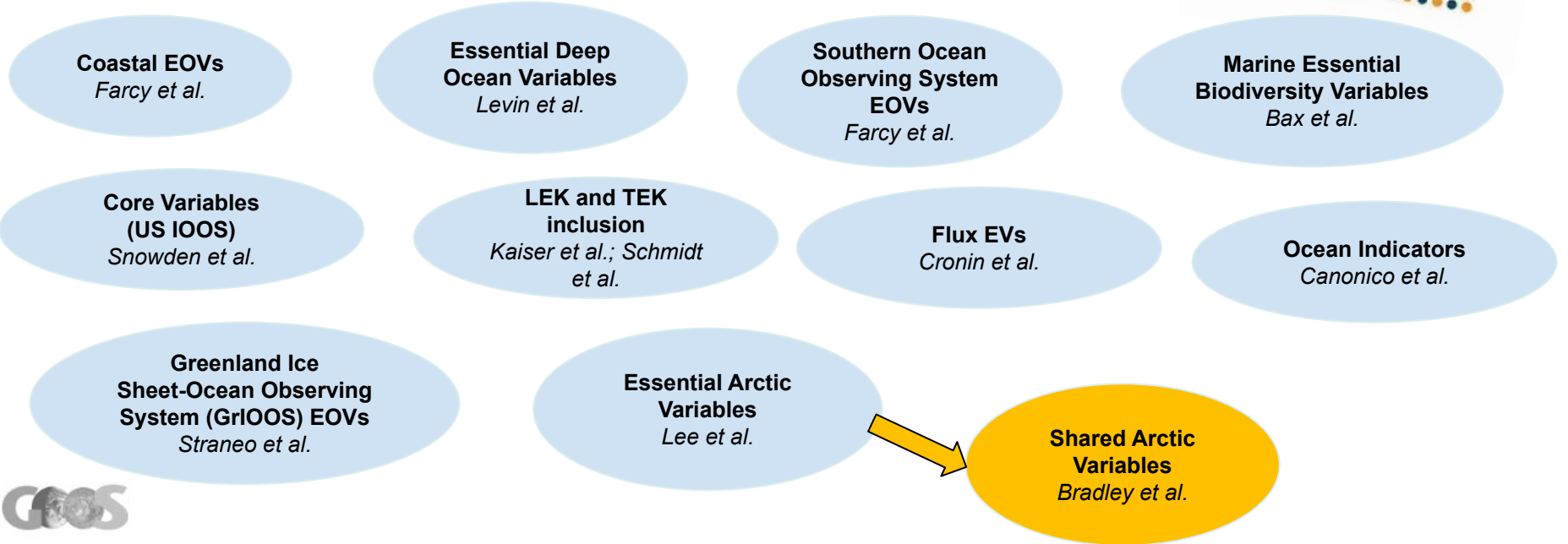
April 2020



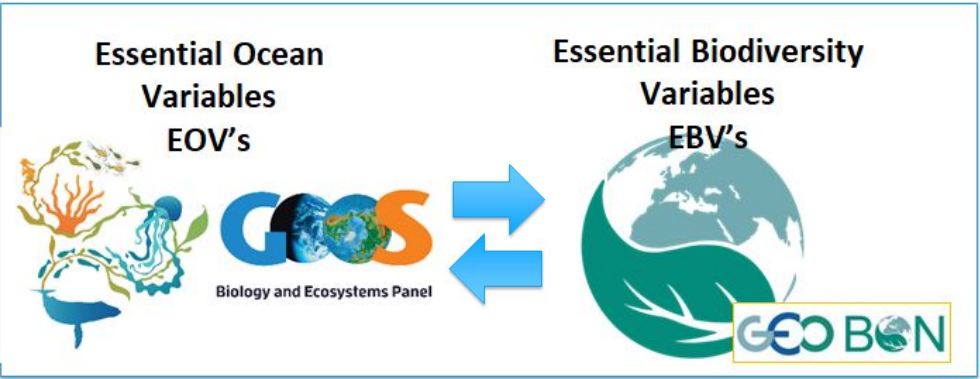
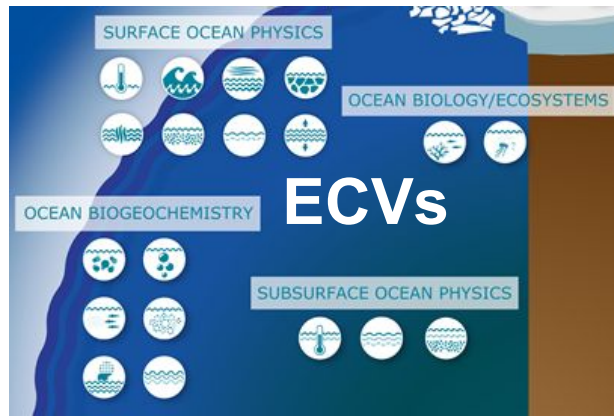
Is the EOV framework fit-for-purpose?

Views from the OceanObs'19 Community White Papers

Comprehensive review of the current and recommended uses of EOVs presented in the OceanObs'19 Community White Papers and recommendations from the Conference breakout sessions.



Interaction between and evolution of requirement setting frameworks



Incorporating regional requirements in the EOVS framework:

- Deep Ocean EOVS
- Essential Arctic Variables (EAVs) → Shared Arctic Variables (SAVs)



H2020 ECOTIP Project

Arctic biodiversity change and its consequences: Assessing, monitoring and predicting the effects of ecosystem tipping cascades on marine ecosystem services and dependent human systems

Includes a task contributing to optimized requirement setting in relevant EV frameworks (EOV, EBV, ECV, SAV?)

- **Reconciling biogeochemical and biological requirements** for carbon sequestration in the ocean → e.g. model needs for data
- Modeling requirements for **(plankton) biodiversity monitoring**
- **Linking regional (Arctic) and global observing requirements**, e.g. invasive species monitoring, incorporation of LEK

ECOTIP-sponsored **community workshop** planned for end of October 2022 - potential venue for joint discussions of interest to GOOS & SAON?



www.ecotip-arctic.eu

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Thank you



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