

4TH GEO

BLUE PLANET SYMPOSIUM

4-6 July 2018 – Toulouse, France



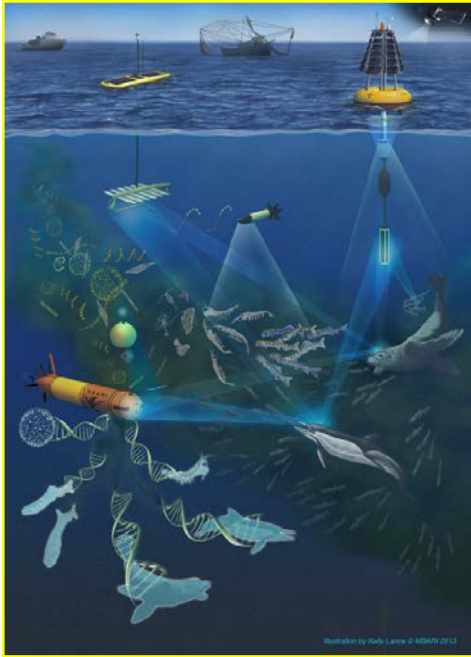
Ocean and coastal observations for management of marine biodiversity

Isabel Sousa Pinto, Frank Muller-Karger and Mark Costello



#GEOBluePlanet4

- Biodiversity means food and other materials for people
- It is our ethical responsibility to prevent species extinctions and have healthy ecosystems
- Biodiversity is key in ecosystem function & resilience, to ecosystem services, (e.g. carbon & nutrient cycles) and ocean health
- Biodiversity is changing and decreasing (IPBES, 2018)
- Marine biodiversity and ecosystem services are a major knowledge gap (IPBES, 2018)





SUSTAINABLE DEVELOPMENT GOAL 14

Conserve and sustainably use the oceans, seas and marine resources for sustainable development



10 targets that require scientific information and capacity building on biodiversity

Acronym	Full name	Key activity
CBD	Convention on Biological Diversity	Aichi Targets
IMO	International Maritime Organisation	Protection of biodiversity and detection of invasive species
IUCN (WCPA, SSC)	International Union for the Conservation of Nature	World Commission on Protected Areas, Species Survival Commission
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora	Protection of biodiversity
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services	Assessments of biodiversity



A global partnership for the systematic study of life in the sea ...from microbes to whales

Operational Objectives:

- Promote a global **community of practice** for the collection, curation, and analysis of marine biodiversity information
- **Promote Best practices** for marine biodiversity observation
 - IOC/IODE Ocean Best Practices repository (field, lab, metadata)/Bon in a Box
- Promote **open-access databases** (e.g. OBIS)
- Promote **integration of biological observations** with observing systems (e.g. GOOS)
- Support **monitoring efforts** in country or region
- Inform government and intergovernmental policies and practices

Scientific Objectives:

- Understand how and why **life in the ocean is changing**, how **local** changes relate to changes taking place over **larger regions**

Community of Practice

Sampling (since 1931)
Globally operated by commercial ships



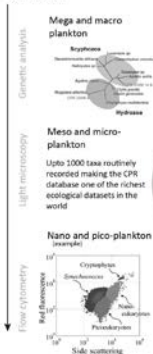
Continuous Plankton Recorder Survey



Illustrations: © Glyn Gorick

What does the CPR record: macroplankton to viruses

SIZE RANGES



BIOLOGICAL MEASUREMENTS 1931-

(a) Continuous Plankton Recorder (CPR)

- (i) Longest sustained marine biological time-series in the world (1931). Routine analysis of ~13000 plankton taxa
- (ii) Multi-decadal sample and molecular archive at ocean-basin scale (1960).



(b) Water and Microplankton Sampler (WaMS)

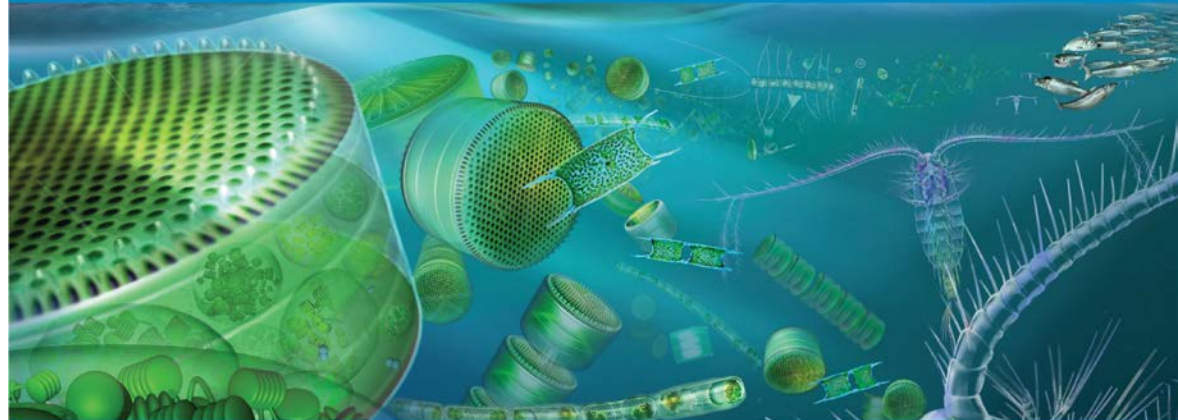
- Aimed at smaller size-fraction nano and pico plankton community.
- (i) Flow cytometry (2010-)
- (ii) Molecular probes and barcoding (2010-)
- (iii) Harmful Algal Bloom microarrays (2010-)

PHYSICAL MEASUREMENTS 1991-

- (i) In situ instrumentation (1991-): Sea surface temperature, salinity, depth and chlorophyll.
- (ii) Marine microplastics (2004-).
- (iii) Other measurements and collaboration with other parties: pCO₂, flowrate, Dissolved Inorganic Carbon, Alkalinity, oxygen content, nutrients.



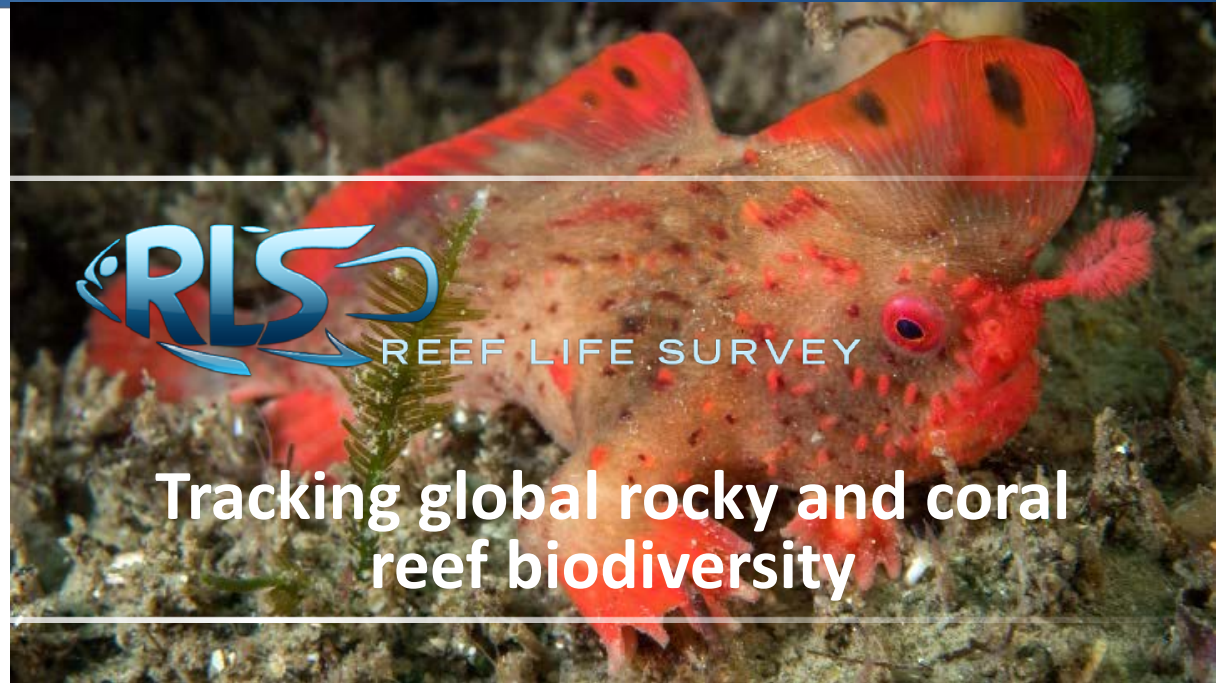
WaMS placed in rear of CPR. Timed water samples and other measurements along CPR route.



Community of Practice

Data collection:

- Long-term monitoring, targeted survey expeditions & voyages of discovery.
- Voluntary divers individually trained and certified.



Community of Practice

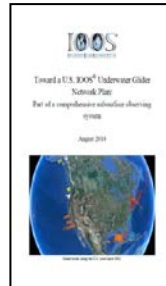
HF
Radar:



Biological Data and
Biological Variables:



Gliders:



Wave
Measurements:



US Marine Biodiversity
Observation Network
(MBON):



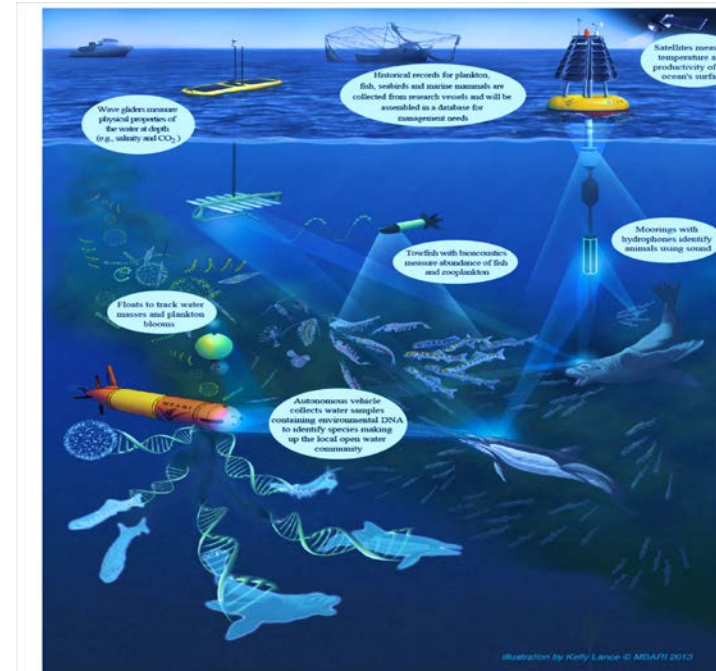
Animal
Telemetry:

US IOOS
11 Regional Associations
17 Federal agencies
Local to Regional to Global



What variables to measure?

- Minimum set of variables already widely measured and captured in open-access databases (Ocean Biogeographic Information System, Global Biodiversity Information Facility)
- Additional variables require R & D to make operational
- National and EU R&D projects (e.g. AtlantOS)



Biodiversity variables

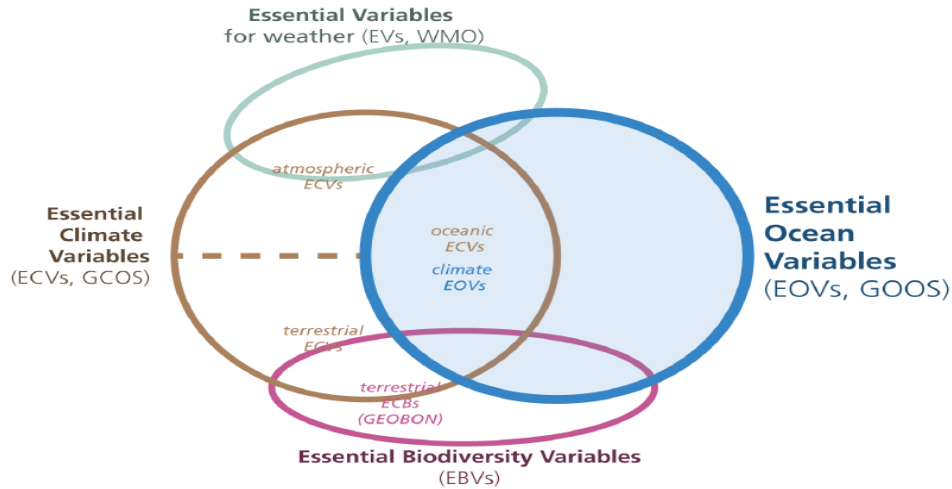
Data	Information value	Cost (* low to high) and availability	Example
Presence only	Occurrence of species of importance to society, e.g. economic, threatened, endemic, pest, ecological (keystone).	* Low for conspicuous and easily sampled species. Maybe reduced by eDNA & RNA techniques in future.	Most data in GBIF, OBIS, WoRMS, biota checklists
Relative abundance	Ecosystem change; change in community structure and food webs	** enables rapid processing of observations and samples into (e.g. log10) abundance scales.	Most ecological surveys
Presence & absence	Extirpation of species e.g. due to extinction, removal of pest, climate change.	*** confidence in absence subject to sampling methods. Difficult to apply to rare species.	Time-series data using standard sampling methods can infer absence
Abundance	Trends in particular populations. Biological productivity.	**** routinely collected for species of economic (e.g. fish stocks), ecological (e.g. land cover, ocean chlorophyll) and conservation importance.	Living Plant Index. Fishery stock estimates.
Population structure	Population health: recruitment, age profile.	***** Limited to populations of species that are easily sampled or of special interest	Fishery stock surveys.

Sources of observations

- National and State surveys
- Marine Protected Area studies
- Fisheries - harvest and landings
- Remote Sensing
- Research
- Advanced technologies: acoustics, video, environmental DNA, autonomous vehicles



GEO BON MBON, GOOS BIO ECO PANEL



Relations between Biological EOVs and Marine EBVs

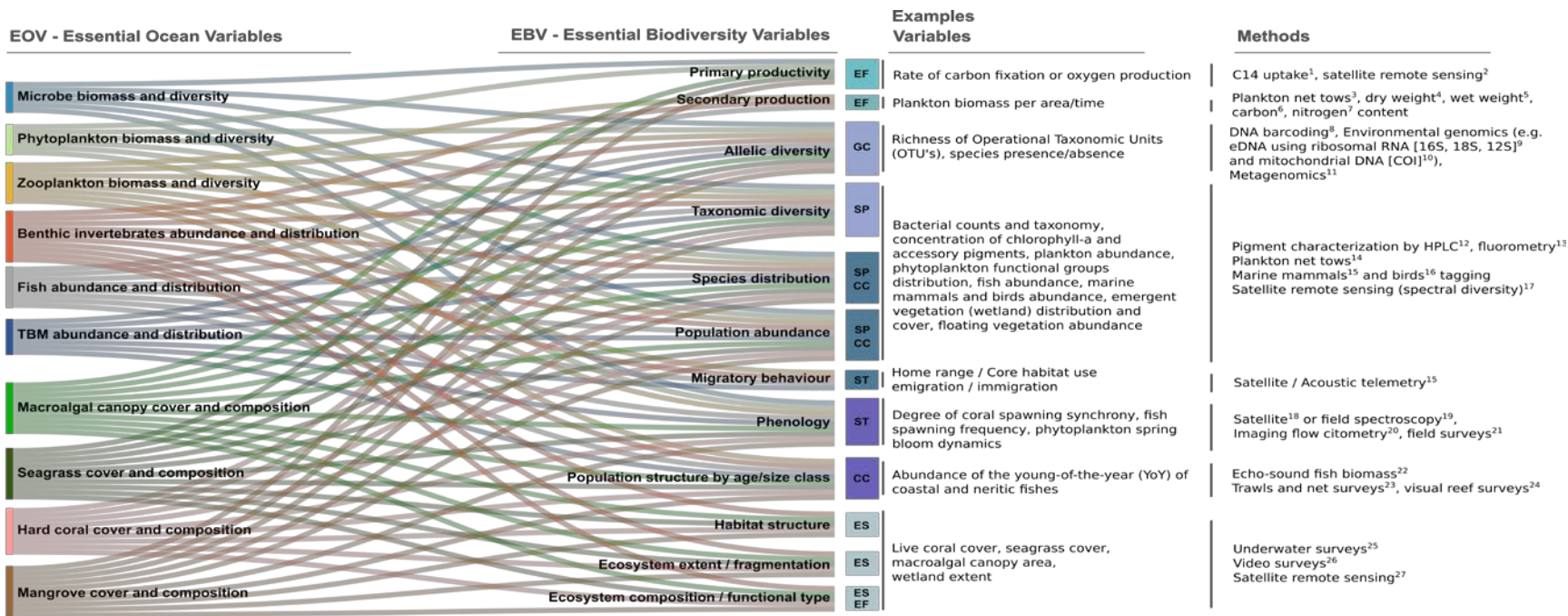


Figure 1. Conceptual relationship between EOVs and EBVs

Relevance, nature and context of biological ocean observation

Overarching goal: identify gaps and recommend priorities for enhancing the current biological ocean observing capacity

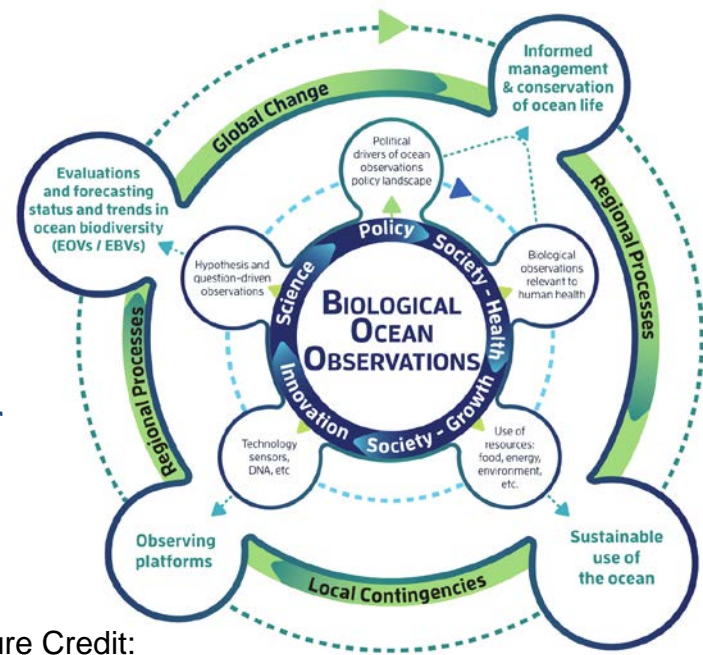
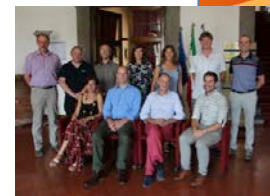


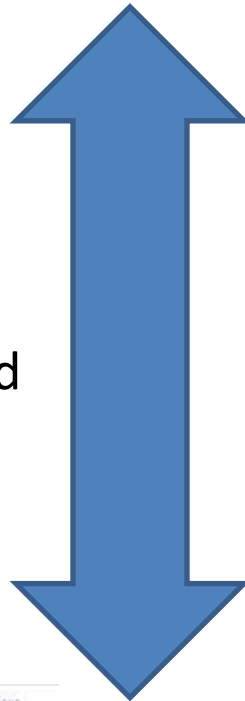
Figure Credit:
Stefi Klein Miloslavich



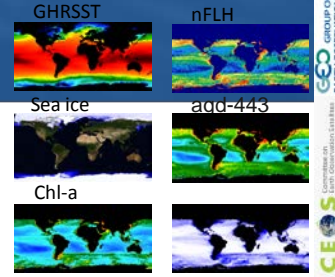
Integration of data

Societally-relevant products need linked data pipelines

At least 5 pipelines need to be linked:



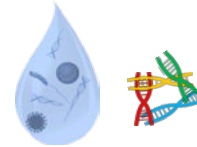
Satellite data (space agencies)



In situ environmental data (NODCs)



Genetic (GenBank/NCBI, RefSeq, Gene Home, SRA, etc.)



Biodiversity (OBIS, GBIF, others)



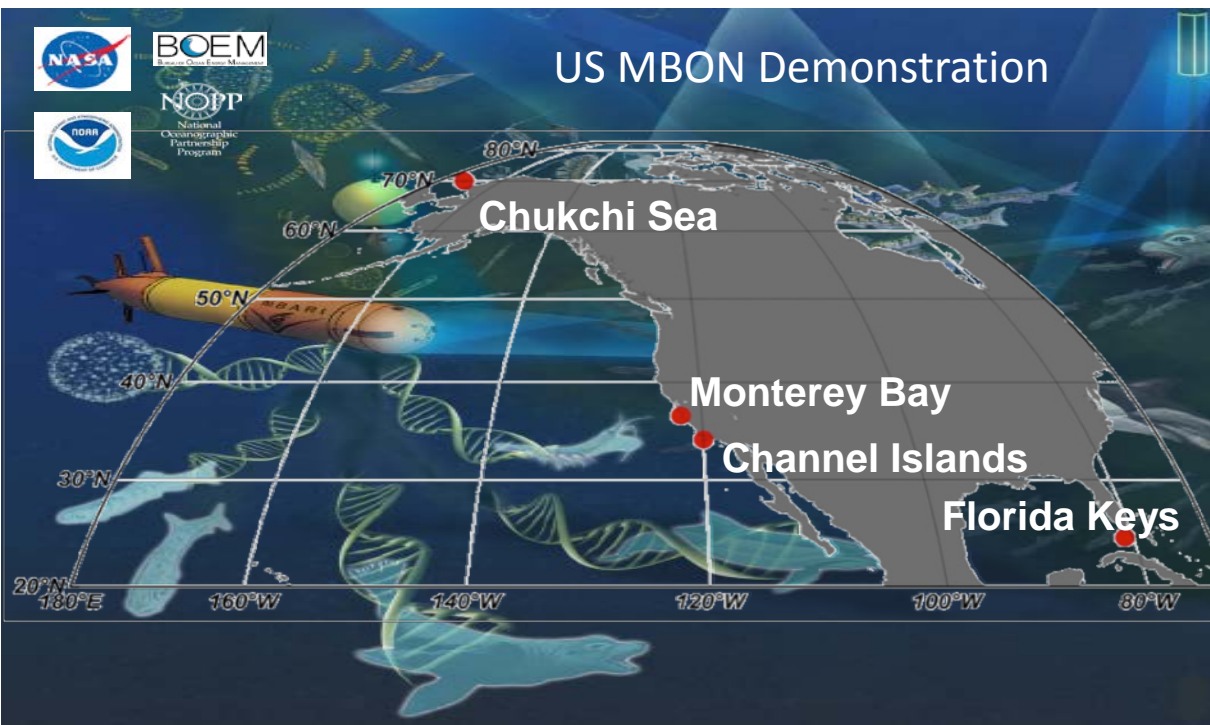
Socio-economic data



Maps, jurisdictions, census, economy

How can this be done in practice?

Pilot studies



IOOS | Integrated Ocean Observing System

Marine Biodiversity Observation Network

MBON Data Portal

EXPLORE MAP SEARCH 270+ DATASETS

Welcome to the Marine Biodiversity Observation Network (MBON) Portal, where you can:

- Search and download real-time, delayed-mode, and historical data for in situ and remotely sensed physical, chemical, and biological observations
- Compare datasets across regions and disciplines
- Generate and share custom data views
- Link to information about protocols, methods and best practices for biological observing
- Access a full suite of tools developed with a broad range of IOOS and MBON partners

How to use the portal

- Documentation
- Demonstration Video (coming soon)
- Release notes

PARTNERS

NASA NOAA IOOS BOEM

Coastal CS Mangroves CS Pelagic CS Seagrass CS

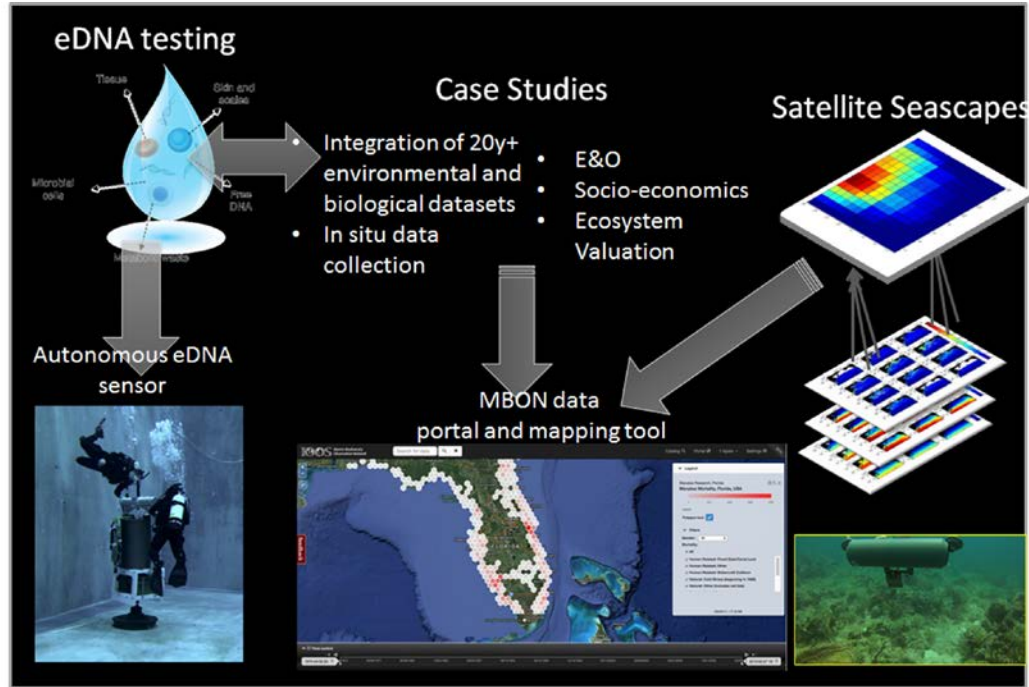
Global MBON Explorer

Create plots of biological and environmental data by region of interest and output to customized reports.

Species Richness CS # of Observations CS Protection metric CS

The screenshot shows the MBON Data Portal website. It features a search bar, navigation links, and a list of data categories. Below the list, there are four small images representing different coastal ecosystems: Coastal CS, Mangroves CS, Pelagic CS, and Seagrass CS. At the bottom, there are three maps showing different data visualizations: Species Richness CS, # of Observations CS, and Protection metric CS.

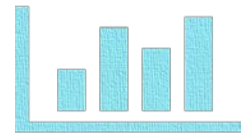
From observations to data to knowledge



Maps



Abundance



Trends



Indicators - Assessments

P2P MBON

Kick-off: September 2016, Mexico

Partners

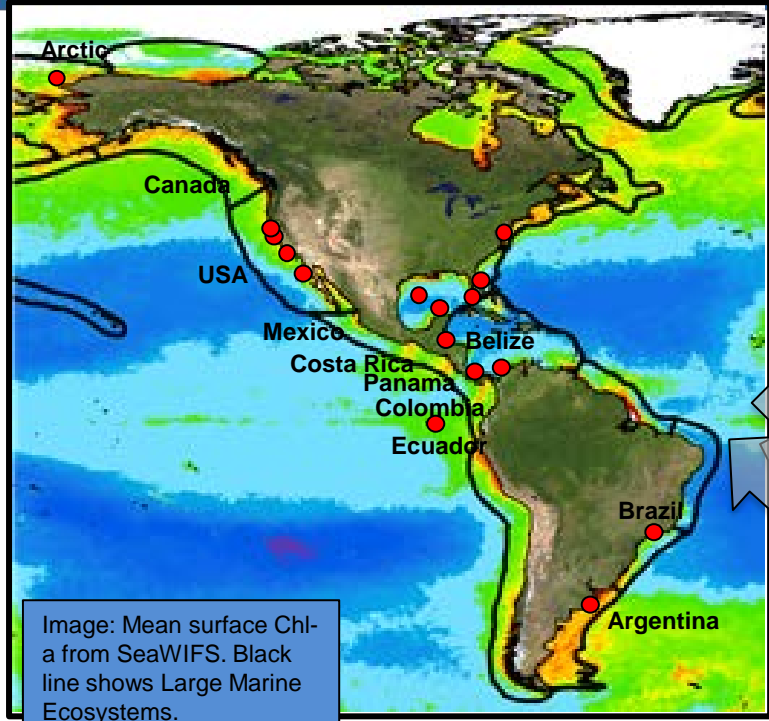
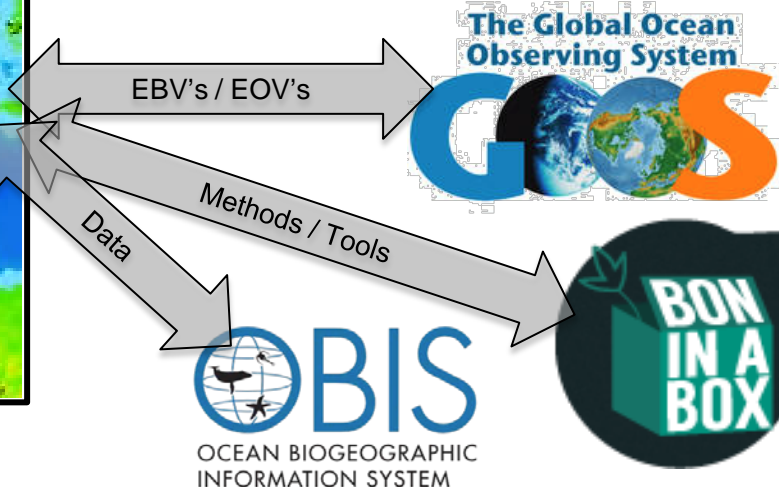


Image: Mean surface Chl-a from SeaWiFS. Black line shows Large Marine Ecosystems.

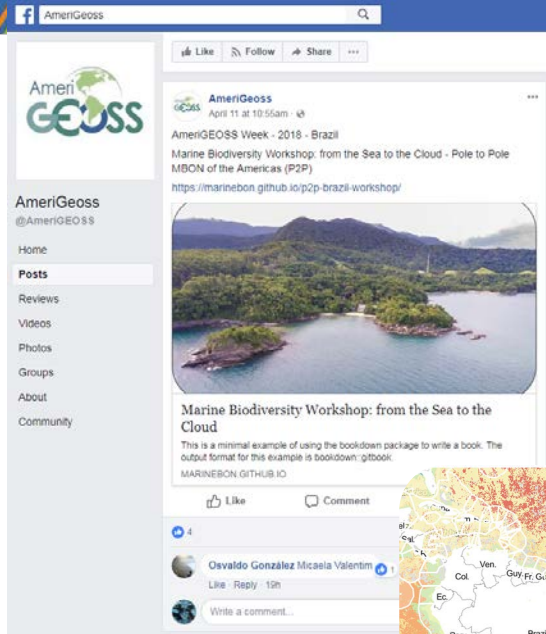


GEO BON

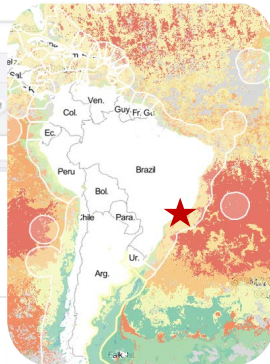


Marine
Best
Practices

Capacity Building and Training Workshops: 2nd Pole-to-Pole MBON Workshop



- **Marine Biodiversity Workshop**
- AmeriGEOSS Week, August 6-10, 2018, São Sebastião, Brazil
- Biodiversity observations in rocky shores and sandy beaches



Thematic implementation



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

AIM: IDENTIFY BEST PRACTICES AND TECHNICAL FEASIBILITY TO INCORPORATE PLANKTON MEASUREMENTS INTO GLOBAL OCEAN OBSERVING PLATFORMS (INITIALLY GO-SHIP AND EXPANSION INTO OCEANSITES).

Organizers/contacts:

Jay Pearlman (jay.pearlman@yahoo.com), Patricia Miloslavich (pmilos@usb.ve), Raphael Kudela (kudela@ucsc.edu), Henry Ruhl (hruhl@mbari.org), Frank Muller-Karger (carib@usf.edu)

Plankton EOVI implementation workshop: Goals

Focus:

- Phytoplankton diversity and biomass EOVI
- Zooplankton diversity and biomass EOVI

Goals:

- **Long-term:** Strategy for a global network of plankton EOVI observations
 - Operational: Justification & Benefits
 - Steps toward implementation (GO-SHIP; OceanSITES, other networks)
- **Short-term** (1-3 years) Define a (regional) pilot project:
 - Who, What, Where, How? (GO-SHIP; OceanSITES, other networks)

cyanobacteria



diatom



dinoflagellate



green algae

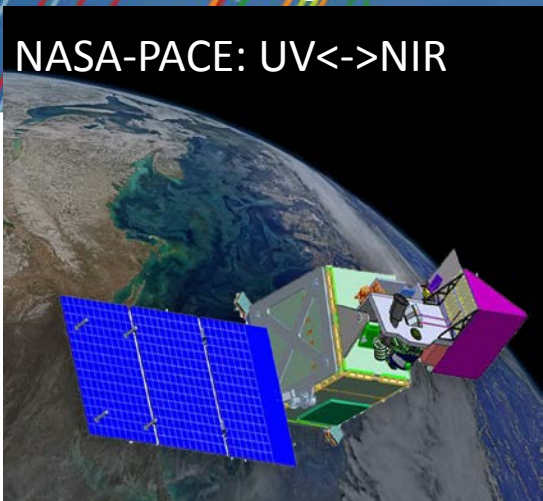


coccolithophore

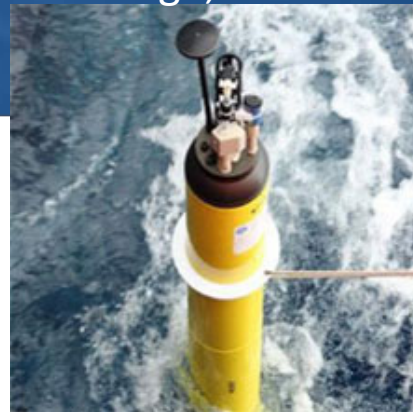


Remote Sensing Ocean Color

NASA-PACE: UV<->NIR

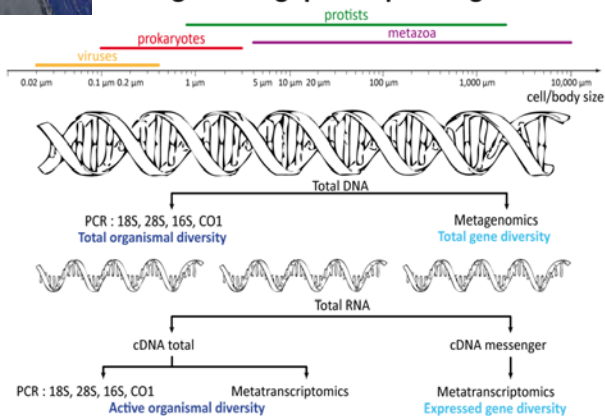


BGC Argo, SOCCOM

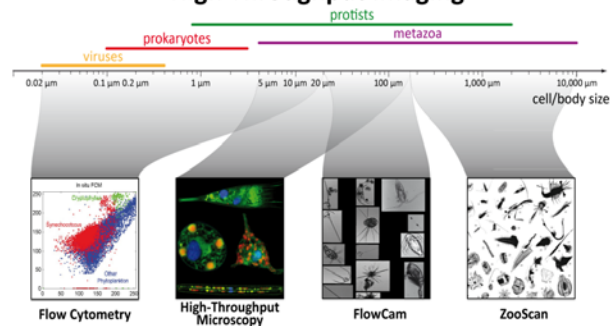


High Throughput Analysis

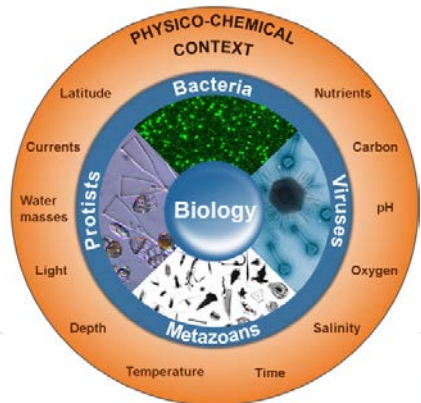
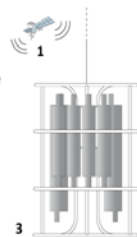
High Throughput Sequencing



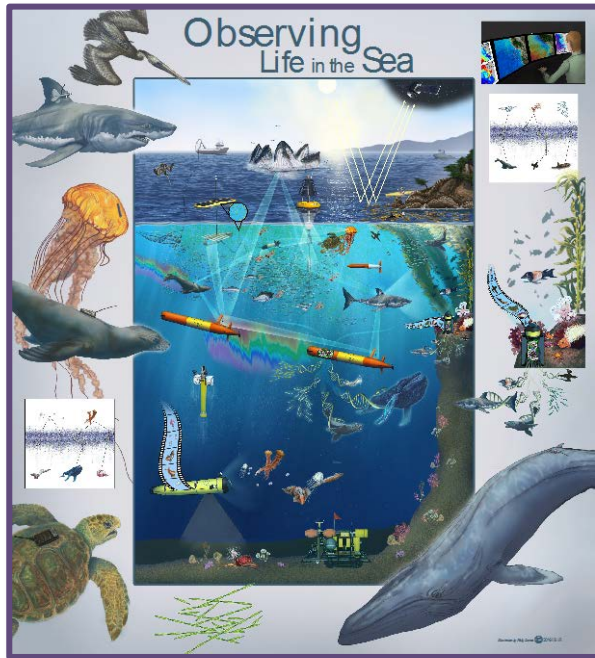
High Throughput Imaging



Physico-chemistry



TARA OCEANS



Marine Network from GEO BON and...the biodiversity arm of Blue Planet

Contacts: (GEO BON / MBON co-chairs)

- Isabel Sousa Pinto (ispinto@fc.up.pt)
- Frank Muller-Karger (carib@usf.edu)
- Mark Costello (m.costello@auckland.ac.nz)