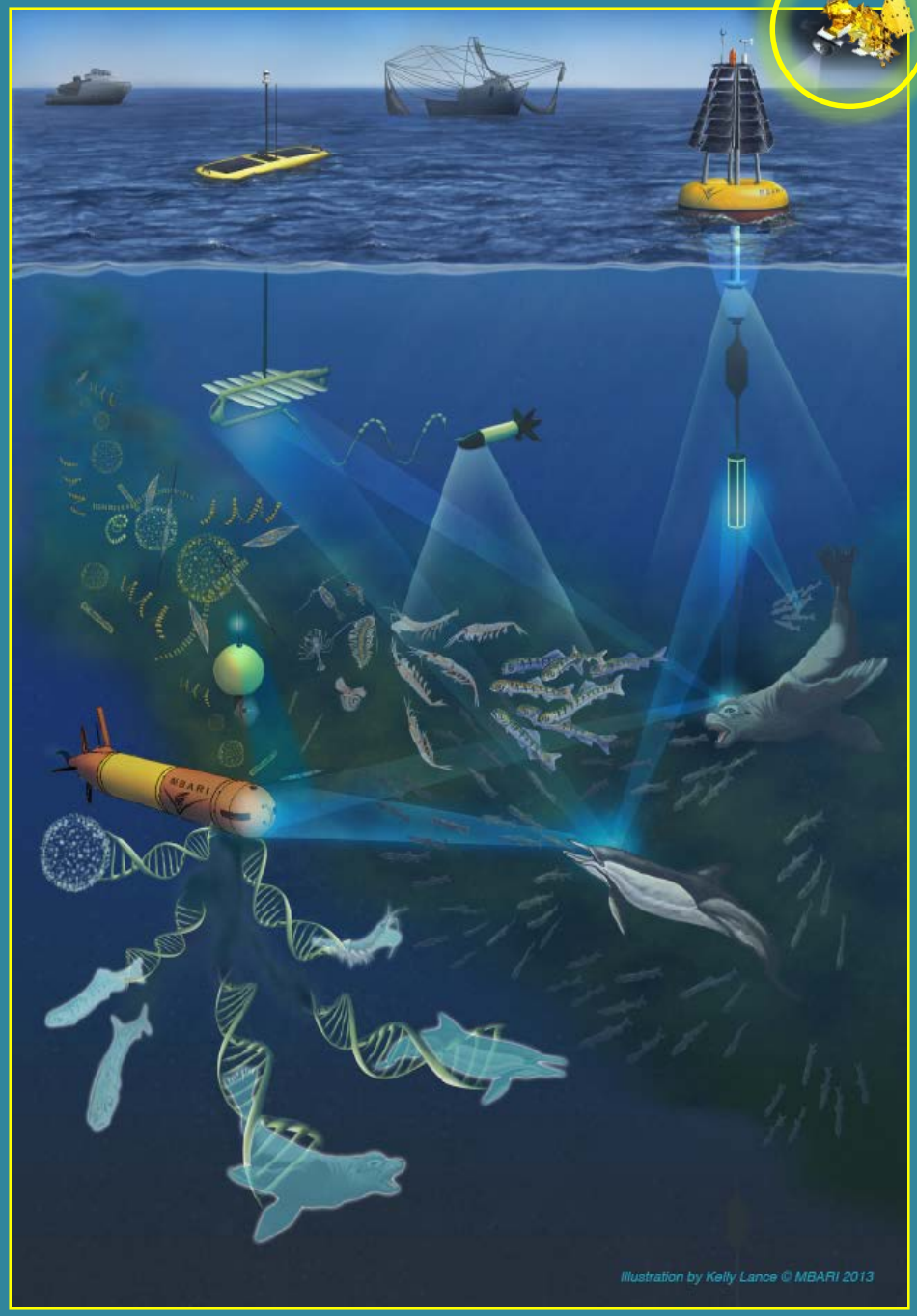


GEO BON

MBON

Marine Biodiversity Observation Network

A global partnership for the systematic study of life in the sea

…from microbes to whales

Illustration courtesy of F. Chavez/K. Lance (Monterey Bay Research Institute/MBARI)

Life in the Sea

MBON
Marine Biodiversity Observation Network

Biodiversity: the variety of life and habitats

- -number of species,
- -abundance, biomass, and distribution
- -interactions (organisms & environment),
- -variability of habitat

*These '**Essential Biodiversity Variables**'*
are really basic, but are very difficult to make

Why measure biodiversity?

MBON
Marine Biodiversity Observation Network

Biodiversity benefits:

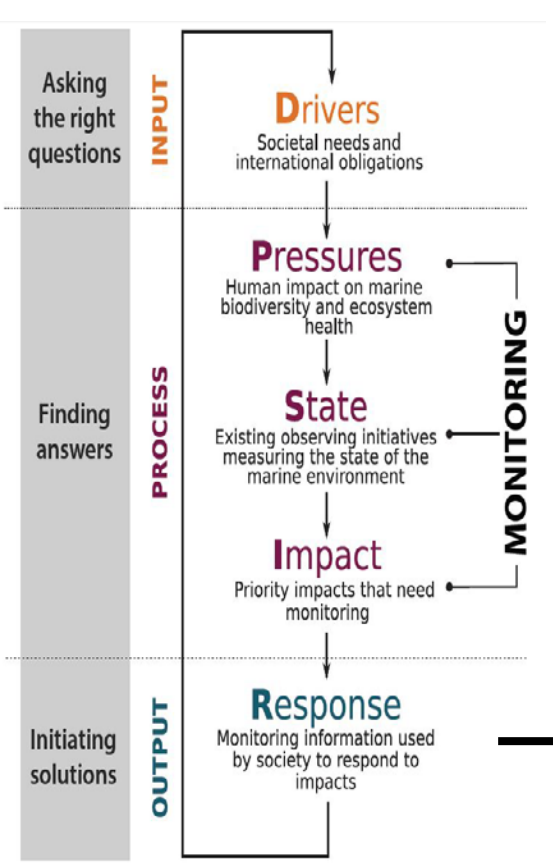
- ecosystem function & resilience,
- chemical cycles,
- human health (food, materials, chemicals, recreation)

Understanding life and why it has evolved on Earth

Defining Essential Ocean Variables: *Biology EOV*

Bio-Eco Panel

Based on the Framework for Ocean Observing (OceanObs '09):



Conventions and National requirements

Observing programs

BLUE PLANET Oceans and Society ?

Courtesy of Nic Bax and Patricia Miloslavich

Organisation for Economic Co-operation and Development (OECD)

OECD 2016
The Ocean Economy in 2030
DOI:10.1787/9789264251724-en

Table 1.1. **Established and emerging ocean-based industries**

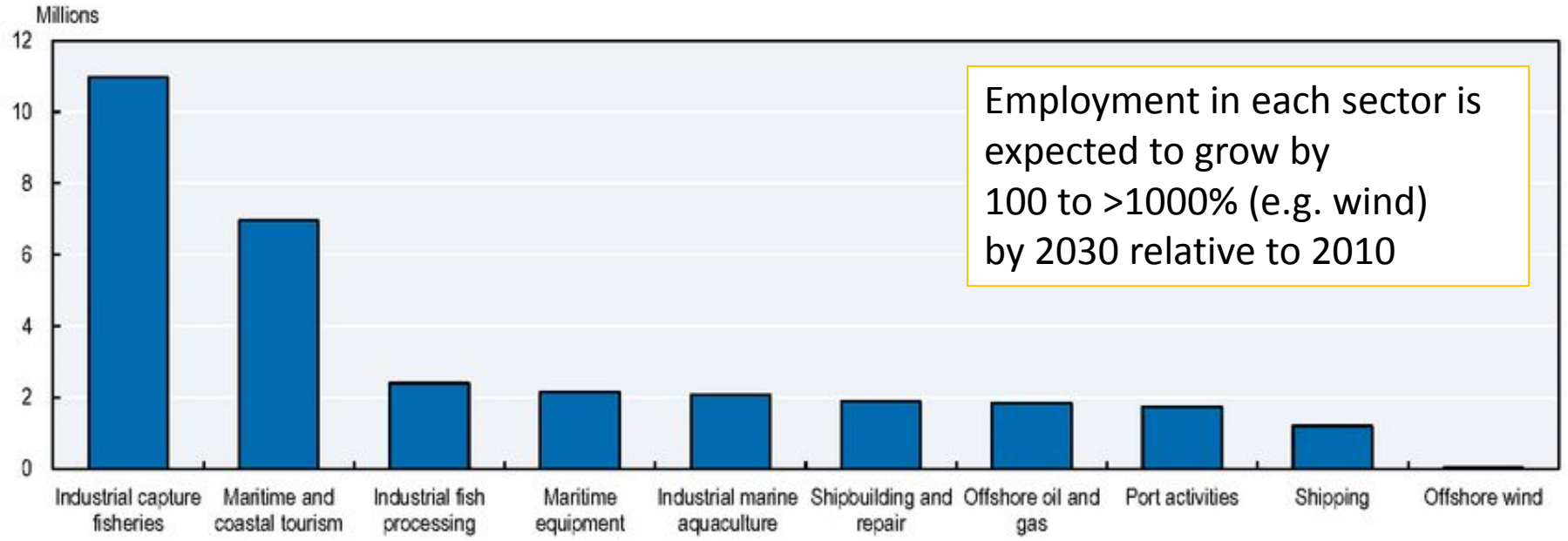
Established	Emerging
Capture fisheries	Marine aquaculture
Seafood processing	Deep- and ultra-deep water oil and gas
Shipping	Offshore wind energy
Ports	Ocean renewable energy
Shipbuilding and repair	Marine and seabed mining
Offshore oil and gas (shallow water)	Maritime safety and surveillance
Marine manufacturing and construction	Marine biotechnology
Maritime and coastal tourism	High-tech marine products and services
Marine business services	Others
Marine R&D and education	
Dredging	

2010: US$ 1.5 trillion

2030 Ocean economy: US$ 3 trillion

OECD 2016
The Ocean Economy in 2030
DOI:10.1787/9789264251724-en

Figure 1.3. **Employment in the ocean-based industries in 2010 by industry**



Employment in each sector is expected to grow by 100 to >1000% (e.g. wind) by 2030 relative to 2010

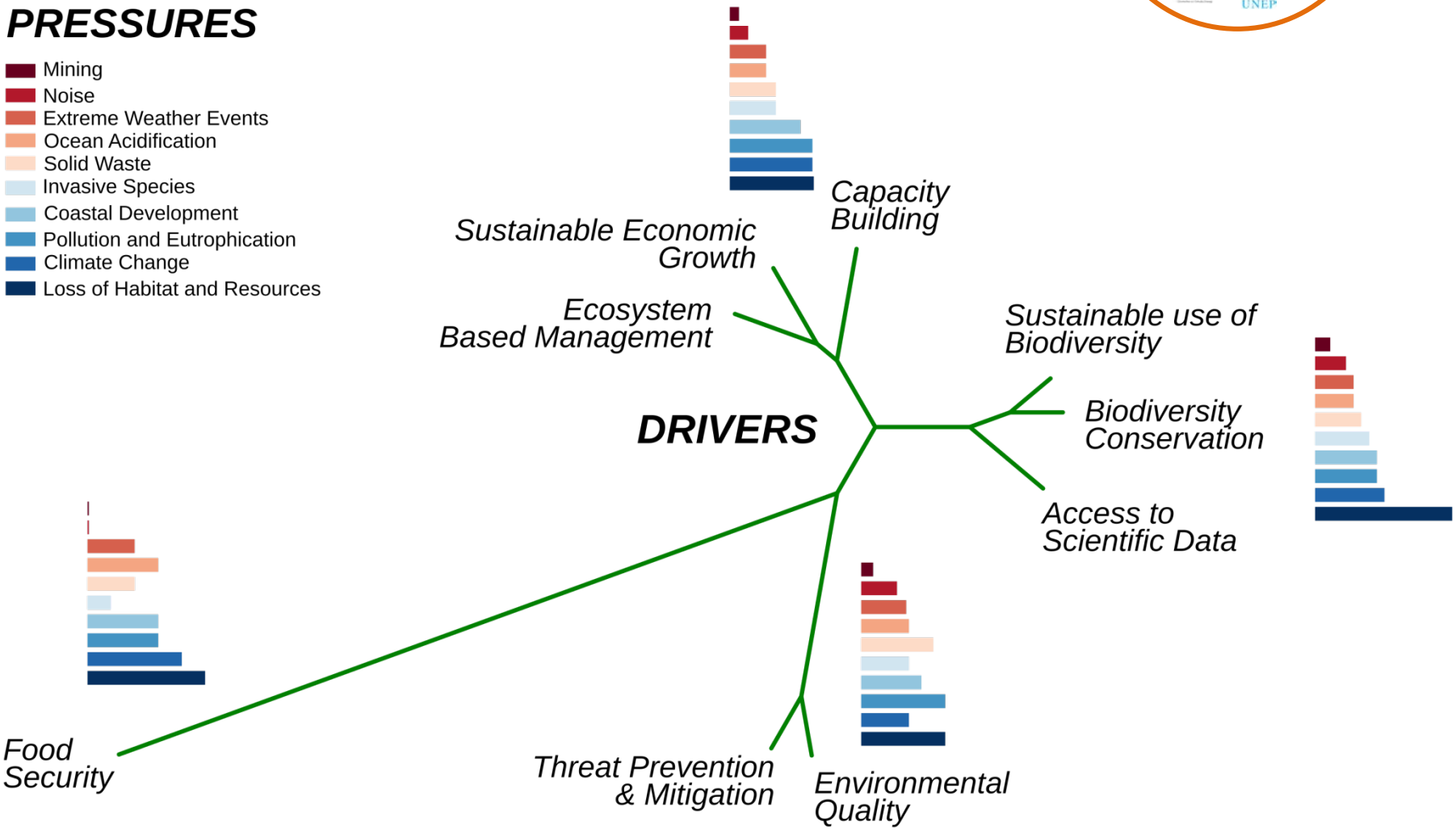
StatLink http://dx.doi.org/10.1787/888933334627

Note: Artisanal fisheries are not included in this overview.

Source: Authors' calculations based on OECD STAN, UNIDO INDSTAT, UNSD, World Bank (2013); IEA (2014); OECD (2014); and various industry reports.

Bio-Eco Panel

Societal drivers and pressures (from international conventions)



Courtesy of Nic Bax and Patricia Miloslavich

Why measure biodiversity?

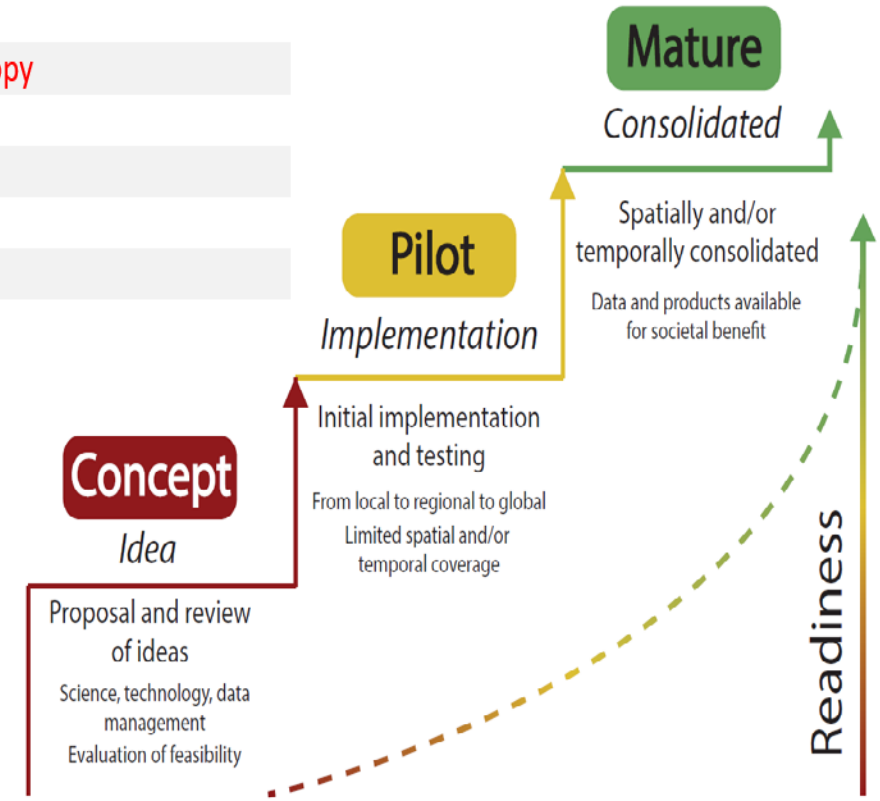
MBON
Marine Biodiversity Observation Network

Everything we do to stimulate the ocean economy affects life in the sea … including our own

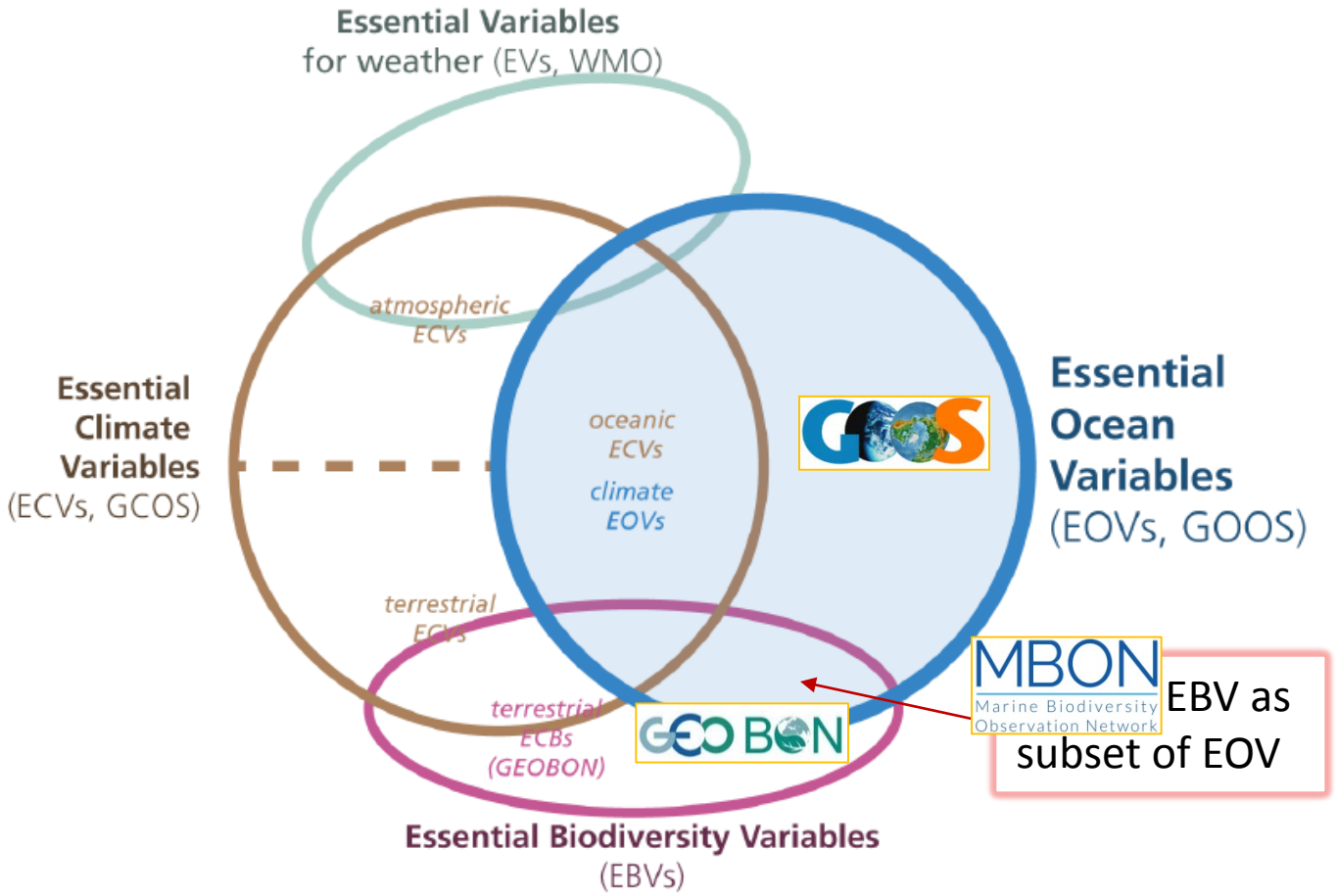
Essential Ocean Variables (EOVs)

PHYSICS	BIOGEOCHEMISTRY	BIOLOGY AND ECOSYSTEMS
Sea state	Dissolved Oxygen	Phytoplankton biomass and diversity
Ocean surface vector stress	Inorganic macro nutrients	Zooplankton biomass and diversity
Sea ice	Carbonate System	Fish abundance and distribution
Sea surface height	Transient tracers	Marine turtle, bird and mammal abundance and distribution
Sea surface temperature	Suspended particulates	Live coral
Subsurface temperature	Nitrous oxide	Seagrass cover
Surface currents	Carbon isotope (^{13}C)	Macroalgal canopy
Subsurface currents	Dissolved organic carbon	Mangrove cover
Sea surface salinity		
Subsurface salinity		
Heat flux / radiation		

Readiness level: CONCEPT | PILOT | MATURE



Essential Biodiversity Variables (EBVs) and EOV

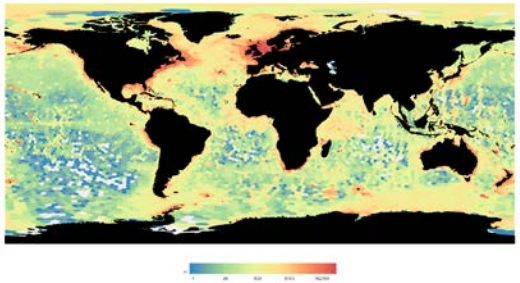


- GOOS: GOOS panels (EOV)
- Group on Earth Observations (GEO): GEOBON – MBON
- National / academic programs

Need to be linked, and enabled to measure life

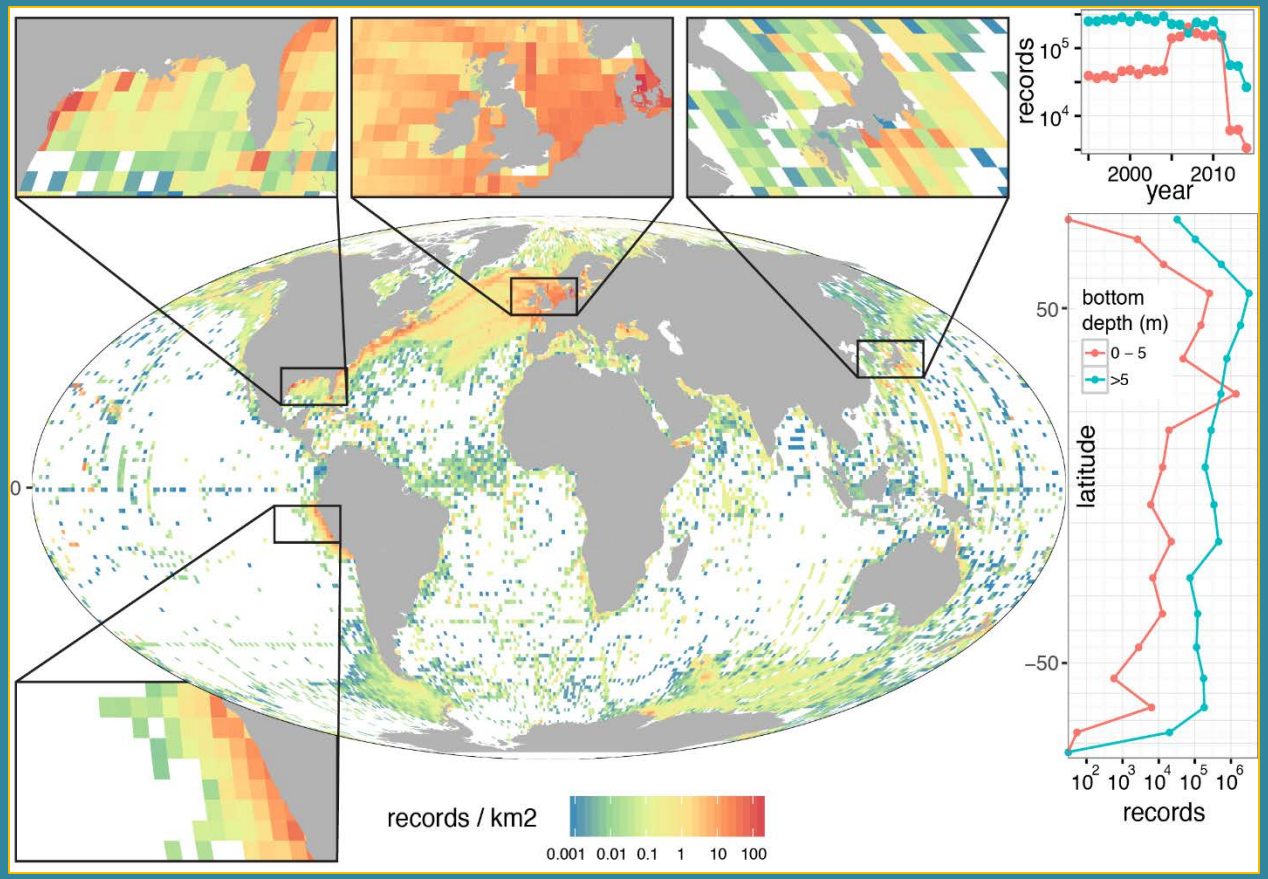
The state of marine biodiversity monitoring

OBIS
OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM



OBIS: 47 million records (water column to benthos)

Data needed to satisfy 'Drivers'



<u>Near-surface</u> taxonomic records (<20 m)

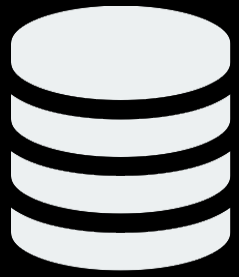
→Many areas have no records

→Less records in last 10 years:
lag in reporting data to OBIS

MBON
Marine Biodiversity Observation Network

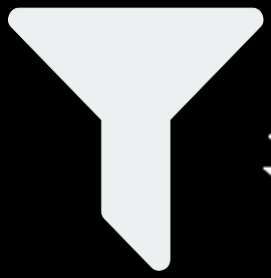
A collaborative NETWORK that links

Data collection



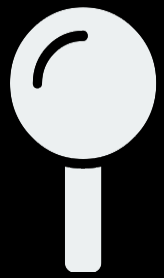
Databases

Datasets

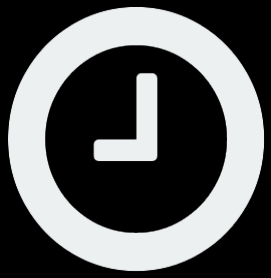


Filters:

Taxa



Space

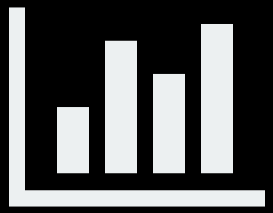


Time

To produce:

Maps

Abundance



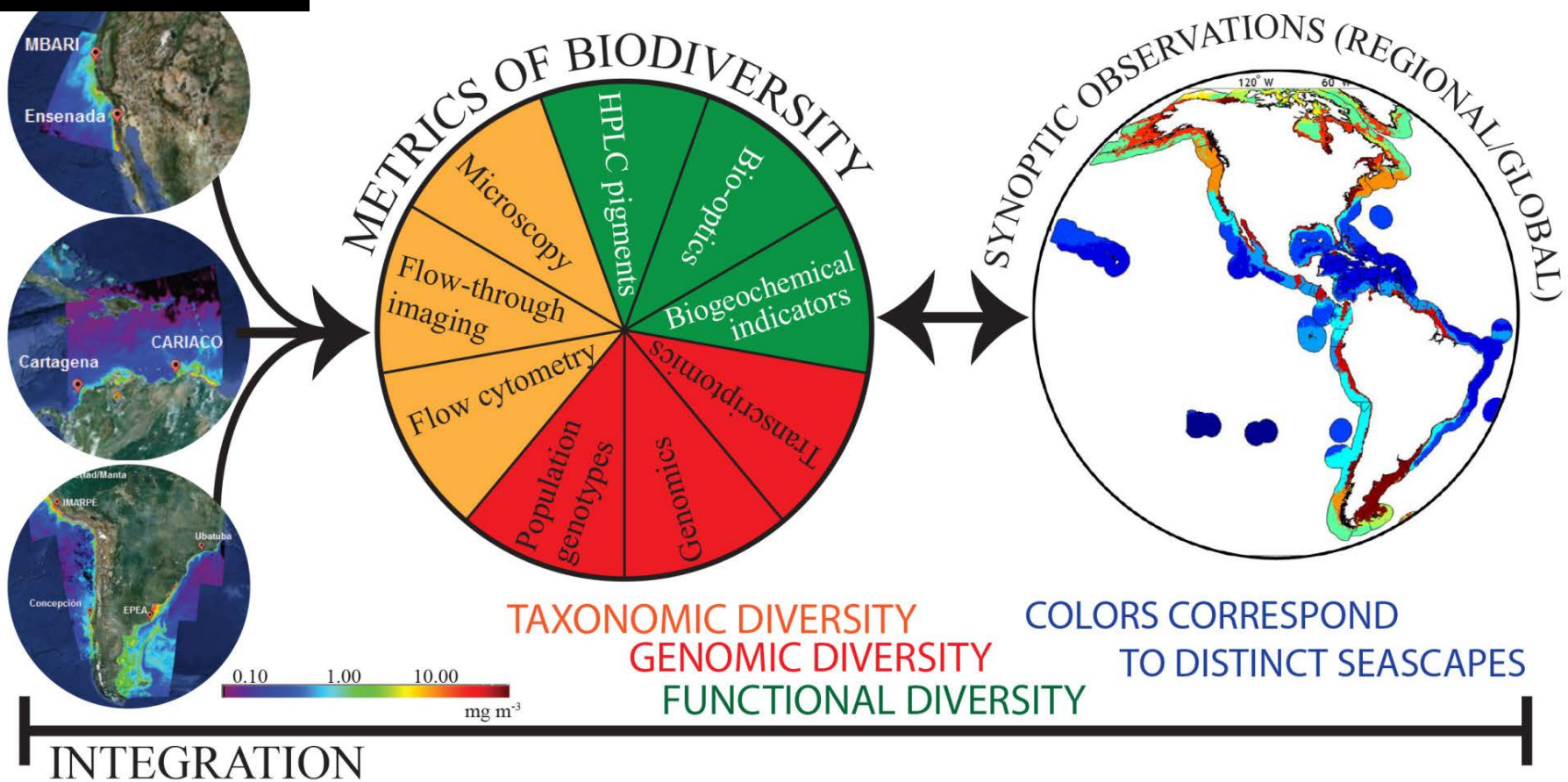
Trends

MBON

STRATEGIES

Time-Series

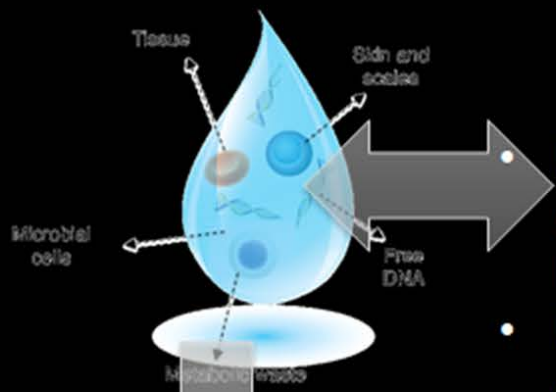
Seascapes



F.E. Muller-Karger, M. Kavanaugh, E. Montes, W.M. Balch, M. Breitbart, F.P. Chavez, S.C. Doney, E.M. Johns, R.M. Letelier, M.W. Lomas, H.M. Sosik, A.E. White. A framework for a Marine Biodiversity Observation Network within changing continental shelf seascapes. In press. Oceanography. September 2014.

Environmental Data Integration

eDNA testing

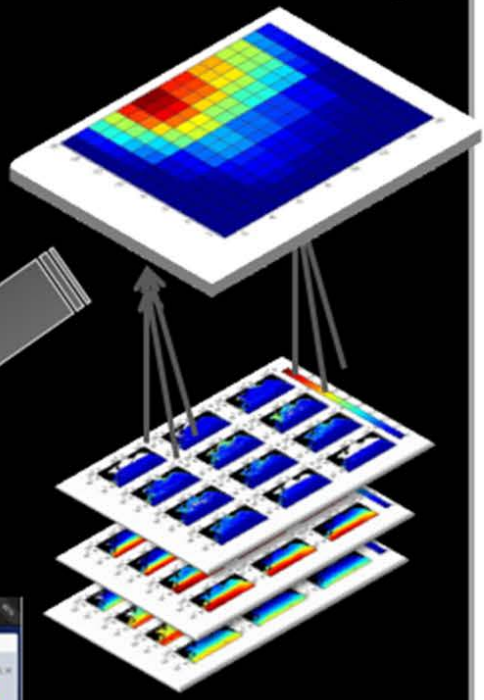


Case Studies

- Integration of 20y+ environmental and biological datasets
- In situ data collection

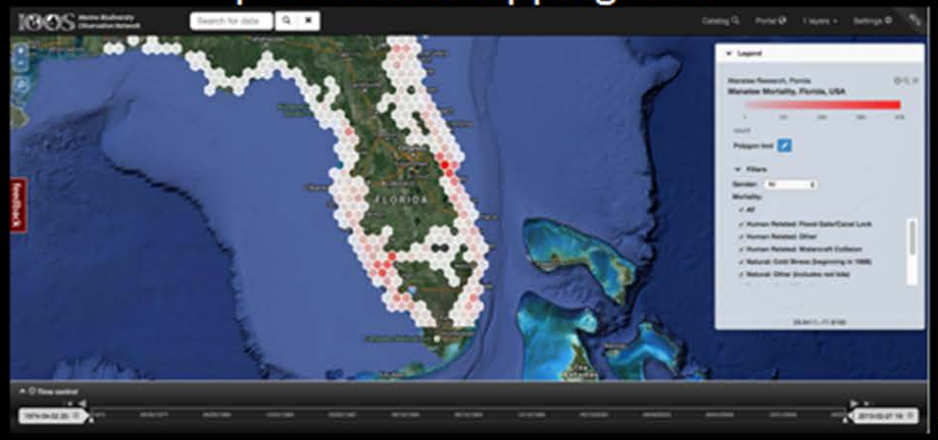
- E&O
- Socio-economics
- Ecosystem Valuation

Ecological Marine Units Satellite Seascapes



Autonomous eDNA sensor

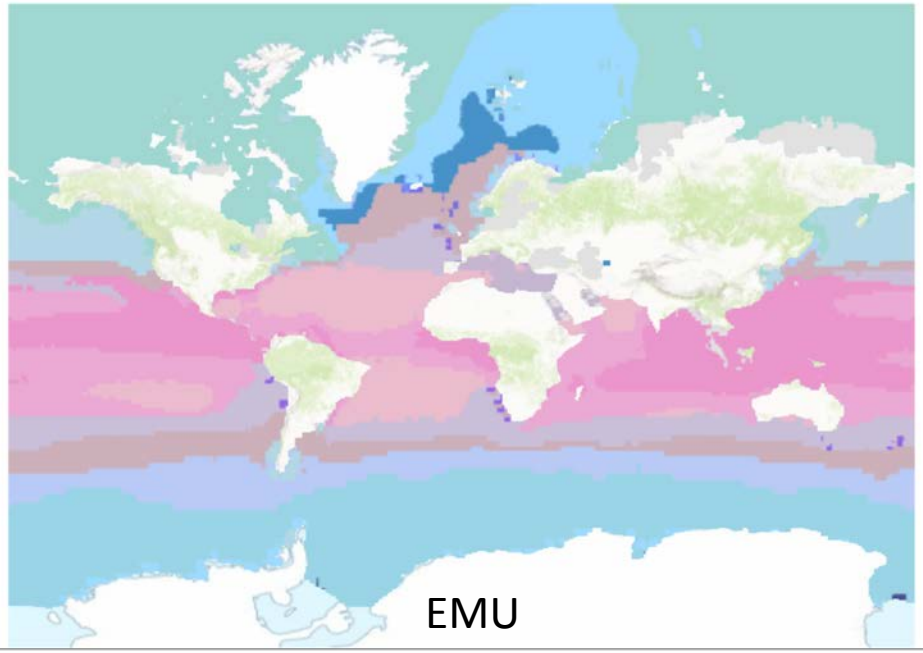
MBON data portal and mapping tool



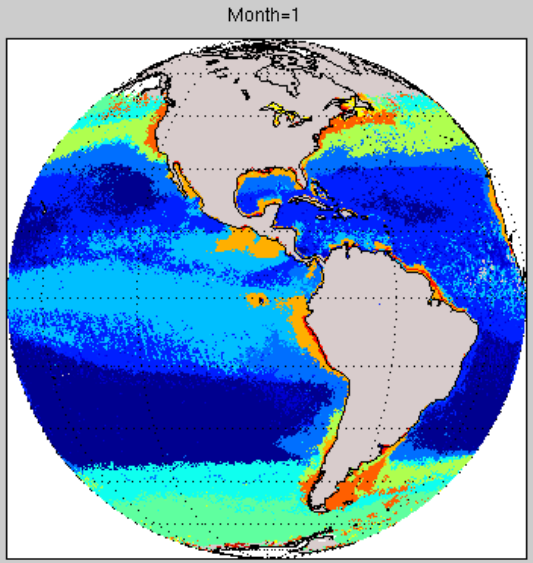
MBON

- A community of practice: share protocols, information, (capacity building)
- Promote development of technologies to observe life (in situ, remote sensing, analysis and synthesis)

GEO Activity: Collaboration with USGS and ESRI
Ecological Marine Units (EMU) and Seascape comparisons



EMU



Seascapes

Esri, FAO, NOAA | Esri, USGS, NOAA, NASA,

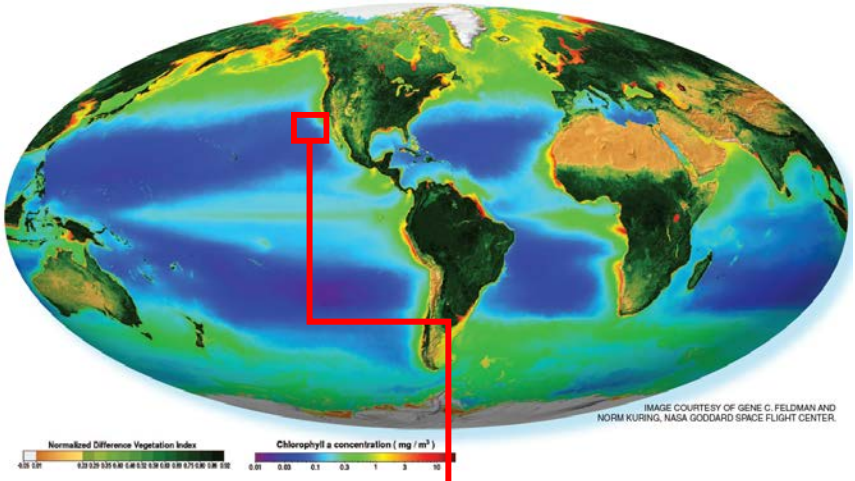
1) Surface EMUs classified from interpolated NOAA WOA data
2) Seascape classified from satellite derived SST, chl-a, NFLH, PAR

Conceptual Models of Major Habitats

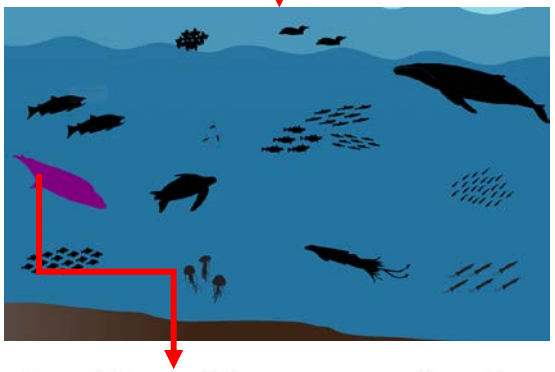
NCEAS Global Marine Ecosystems layers:

Beach
Coral Reefs
Deep Hard Bottom
Deep Soft Benthic
Deep Waters
Hard Shelf
Hard Slope
Intertidal Mud
Kelp
Mangroves
Rocky Intertidal
Rocky Reef
Salt Marsh
Seagrass
Seamounts
Soft Shelf
Soft Slope
Sub-tidal Soft Bottom
Surface Waters
Suspension-Feeder Reef

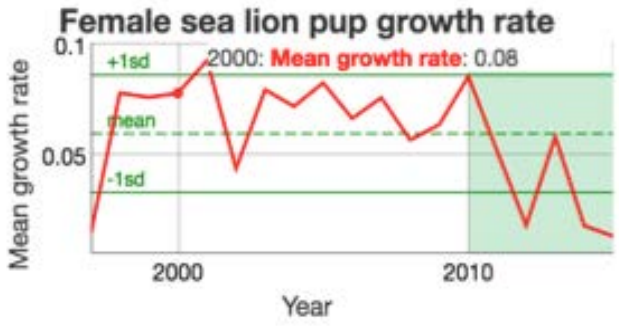
Note: Abyssal-Hadal layers to be created



NASA, other regional/global data



Infographic of local habitats (EEZ, LME)

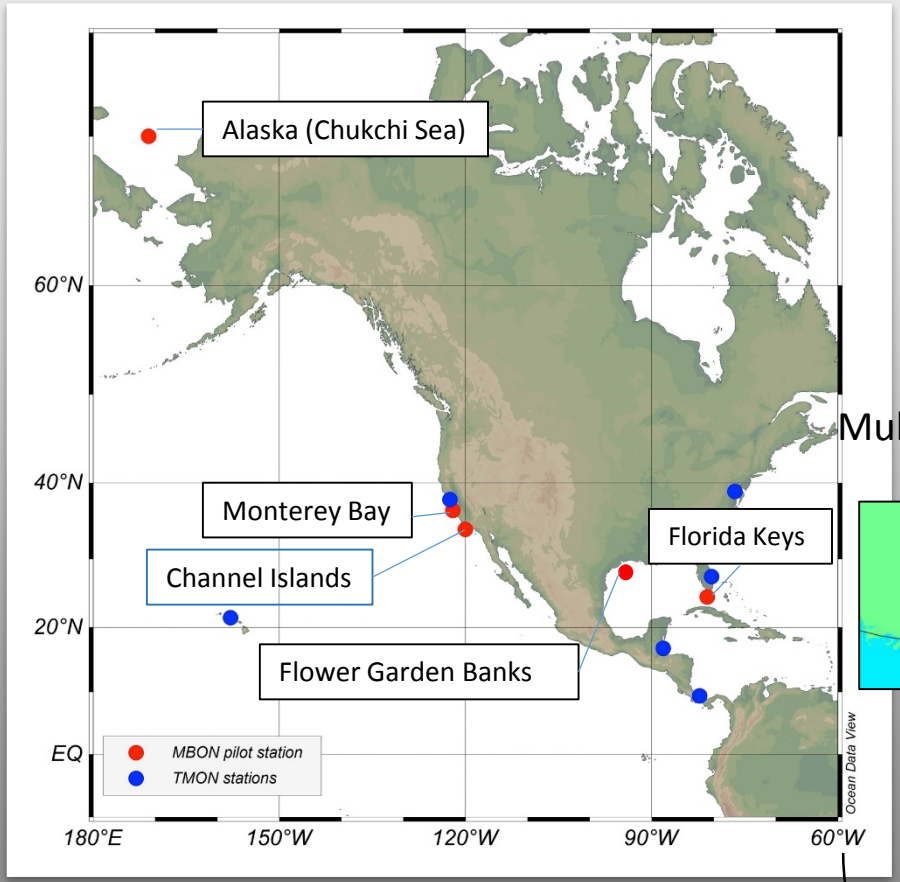


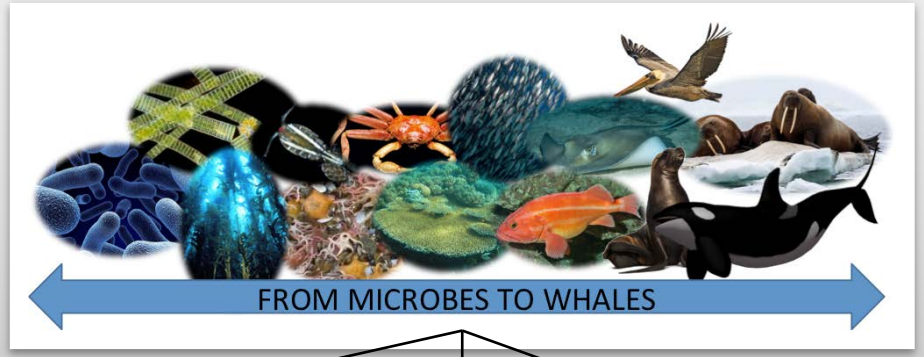
Local data/time series

Collaborators:
B. Best, J. Brown,
L. McEachron,
E. Montes

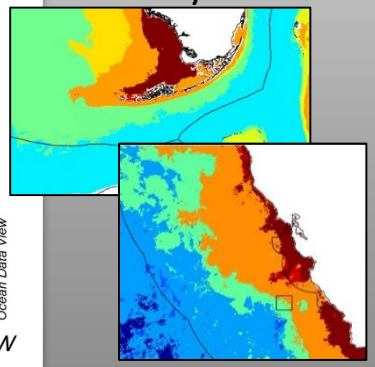
Data collection and aggregation

The U.S. MBON pilot projects





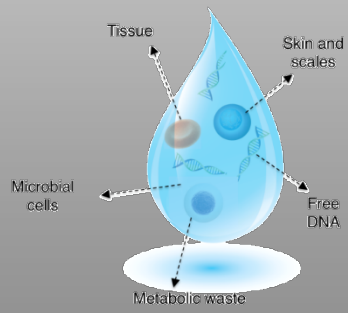
Multivariate seascape analysis



Data Integration:

- IOOS/GOOS
- I-OBIS
- GEO BON

eDNA

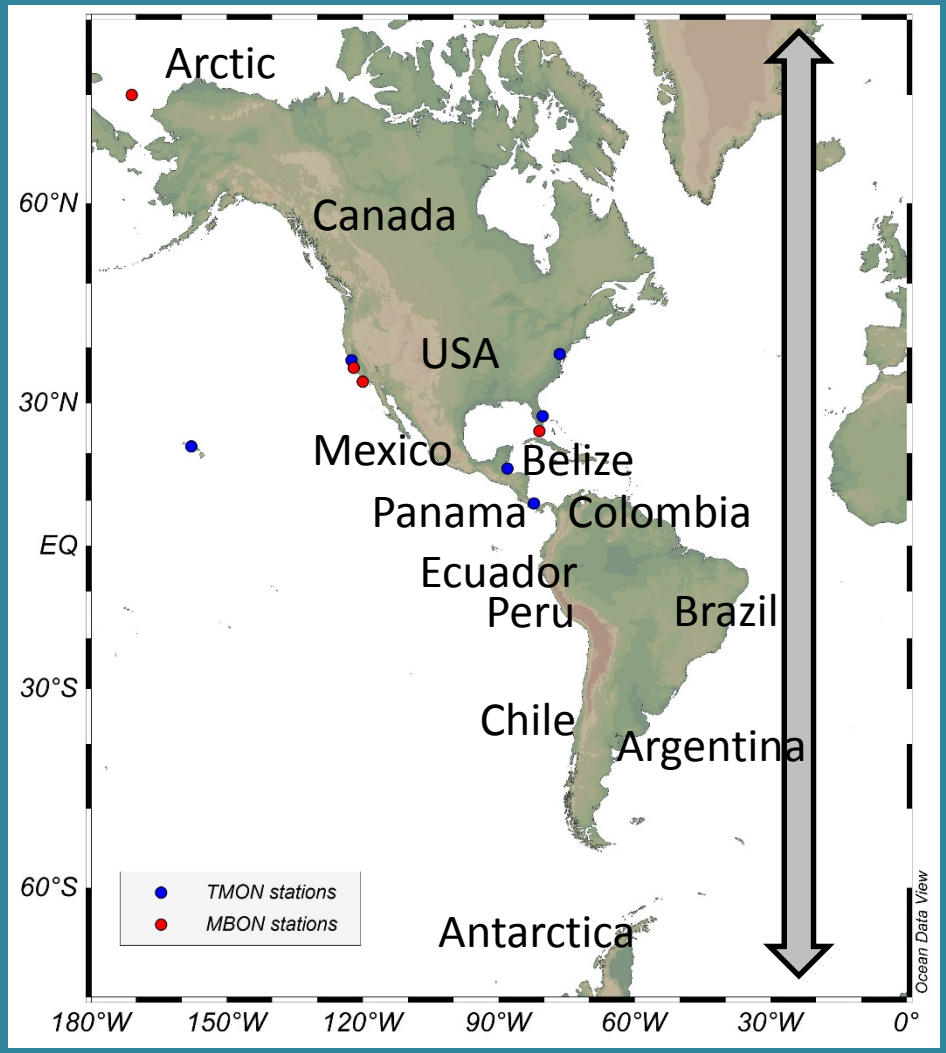


Web-based information system

Supports

- Sanctuary Condition Reports
- Resource managers and policy makers
- Scientists and educators

Pole-to-Pole MBON of the Americas



- GEO Plenary, Mexico (2015)
- Convention of Biological Diversity (Montreal, Apr 24, 2016)
- GEO BON Open Science Meeting (Leipzig, Jul 4-6,2016)
- Pole-to-Pole in the Americas Workshop (Puerto Morelos, Mexico, Sep 26-30, 2016)
- GEO-XIII Plenary (St Petersburg, Russia, Nov 9-10, 2016)
- Animal Telemetry Netw. – Mar'17
- AmeriGEOSS –Jul 2017 Costa Rica
- OBIS Workshops
- GEO Plenary-Oct 2017

Example: Mexico/CONABIO

gef

RESILIENCIA para Áreas Protegidas

CONANP Comisión Nacional de Áreas Naturales Protegidas

PNUD Al servicio de las personas y las naciones

CONABIO Comisión Nacional para el Conocimiento y Uso de la Biodiversidad

Monitoreo Marino

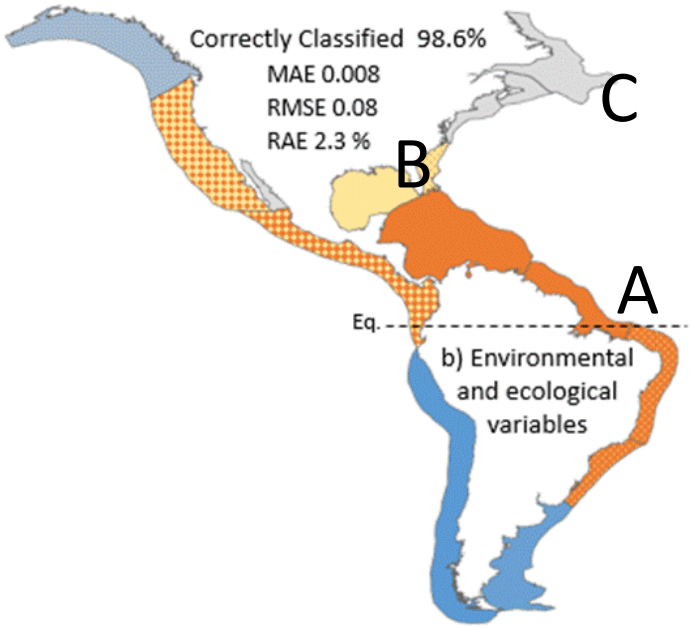
Courtesy of Dr. Sergio Cerdeira (CONABIO, Mexico)

Example: diversity of fisheries and satellite seascapes (SST, CHL, productivity) in Large Marine Ecosystems (LME)

Results:

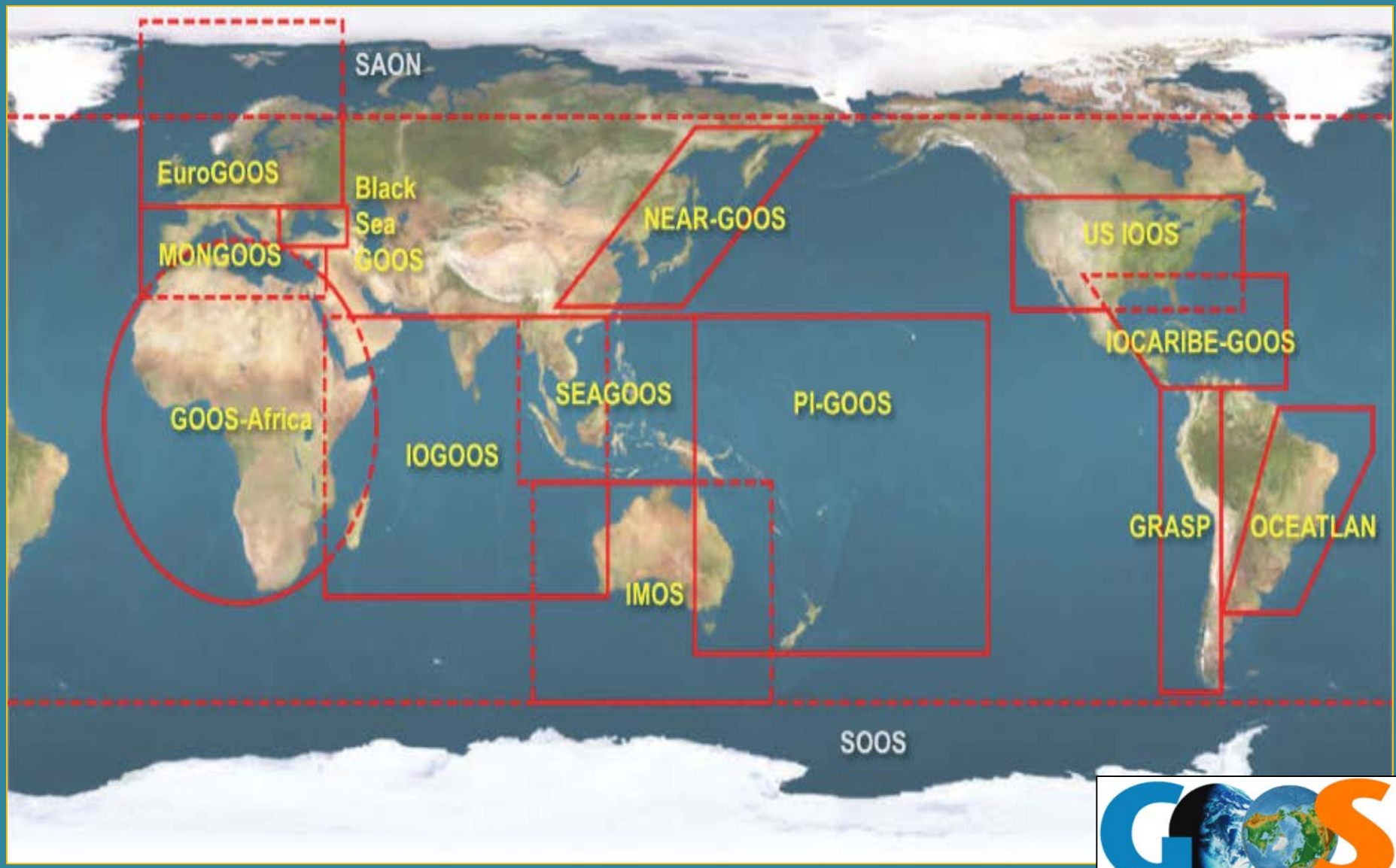
Three megaregions (A, B, C)

Between 1982 and 2010, *seven LMEs diversified their fisheries*



Muller-Karger et al., 2017. Megaregions Among the Large Marine Ecosystems of the Americas. Environmental Development. http://dx.doi.org/10.1016/j.envdev.2017.01.005.

15 GOOS Regional Alliances



A Global Collaboration: OBIS + GOOS (IOC) and MBON

GEO BON/MBON – GOOS BioEco – OBIS partnership

Building a globally coherent, consistent and coordinated sustained global ocean observing system to assess the state of the ocean's biological resources and ecosystems

Requirements

Biology & Ecosystems

- Focus on sustained observations
- Bring selected EOVs from pilot to mature
- Link with platforms and observing systems of GOOS and GRAs

Observations

MBON

- R&D focus
- Bring new EOVs from concept to pilot
- Assist with the establishment of national and regional BONs

Data & Products

OBIS OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM

- Open data sharing
- Data integration
- Data quality control
- Data harmonization
- Tools for data exploration, visualization and analysis

Products, Indicators, Assessments

e.g.: http://iobis.org/2016/12/15/goosgeobonobis/

Ongoing/Developing Collaborations:

OBIS-GOOS-MBON

NSF OceanObs Network RCN

Animal Telemetry Network (ATN)

Ocean Acidification Network

Other IOOS RA's

MarineGEO (Tennenbaum)

...

OBIS-GOOS-MBON Partnership: Belgium, Dec 2016

MBON Workshops – 2016-2017

6 - 7 July, 2016, Leipzig, Germany: All Hands Meeting sessions on the GEO MBON – GEO BON

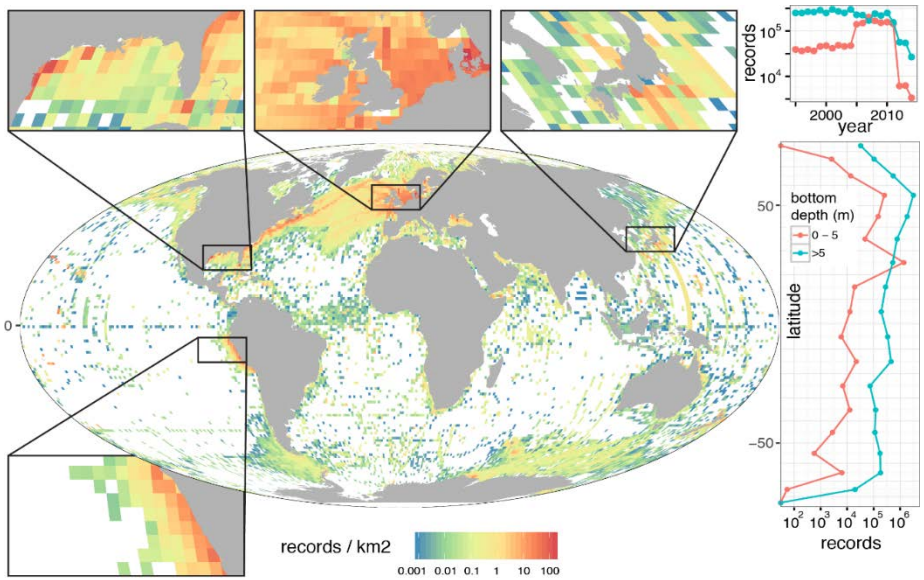
27-29 September, 2016, Playa del Secreto, México: Pole-to-Pole MBON in the Americas Workshop – US MBON

15-17 March, 2017, St Petersburg, Florida: SDG14 product development – US MBON

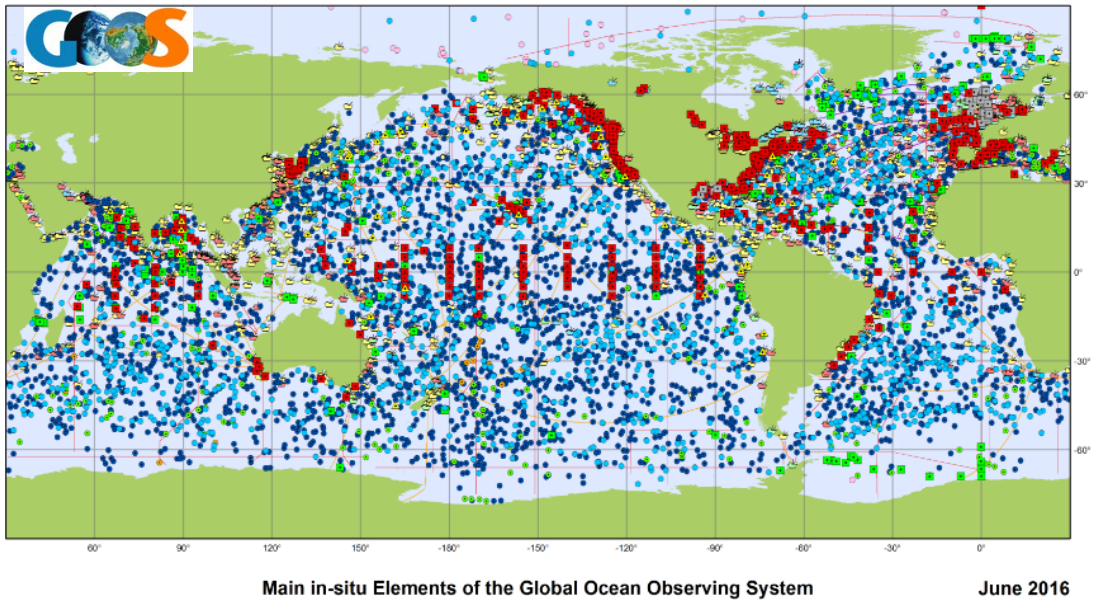
31 Jul-4 Aug 2017
AmeriGEOSS Costa Rica

Aug 2017 – Monterey CA

Oct 2017 GEO Plenary
Washington, DC



Present to Future



MBON

Marine Biodiversity Observation Network

GOAL:

Increase observations of marine life

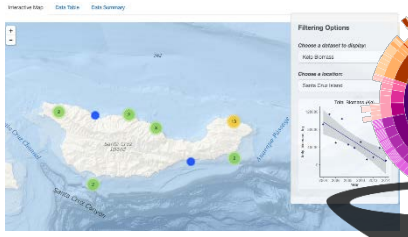
building on GOOS, OBIS, and other networks:

- MarineGEO/Tennenbaum
- UNEP WCMC
- Americas (AmeriGEOSS)
- EuBON
- AsiaPacific
- Coral/GCRMN
- Africa
- CAFF (Arctic)
- National programs
- etc.

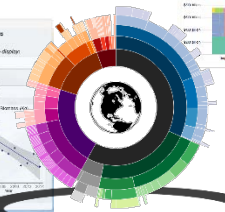
BLUE PLANET Oceans and Society

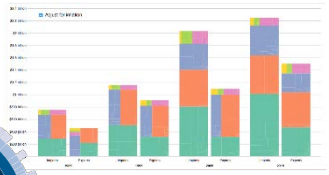
MBON Marine Biodiversity Observation Network

Mapping tools

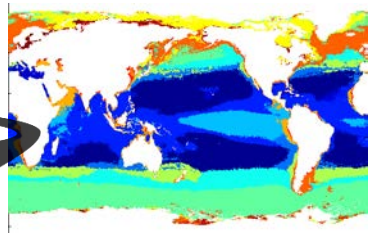


Taxa





Time series



Satellite seascapes

USGEO

14 LIFE BELOW WATER

SUSTAINABLE DEVELOPMENT GOALS

MBON

Marine Biodiversity Observation Network

Contacts: (GEO BON / MBON co-chairs)

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

BACKUP

MBON

Societal Relevance

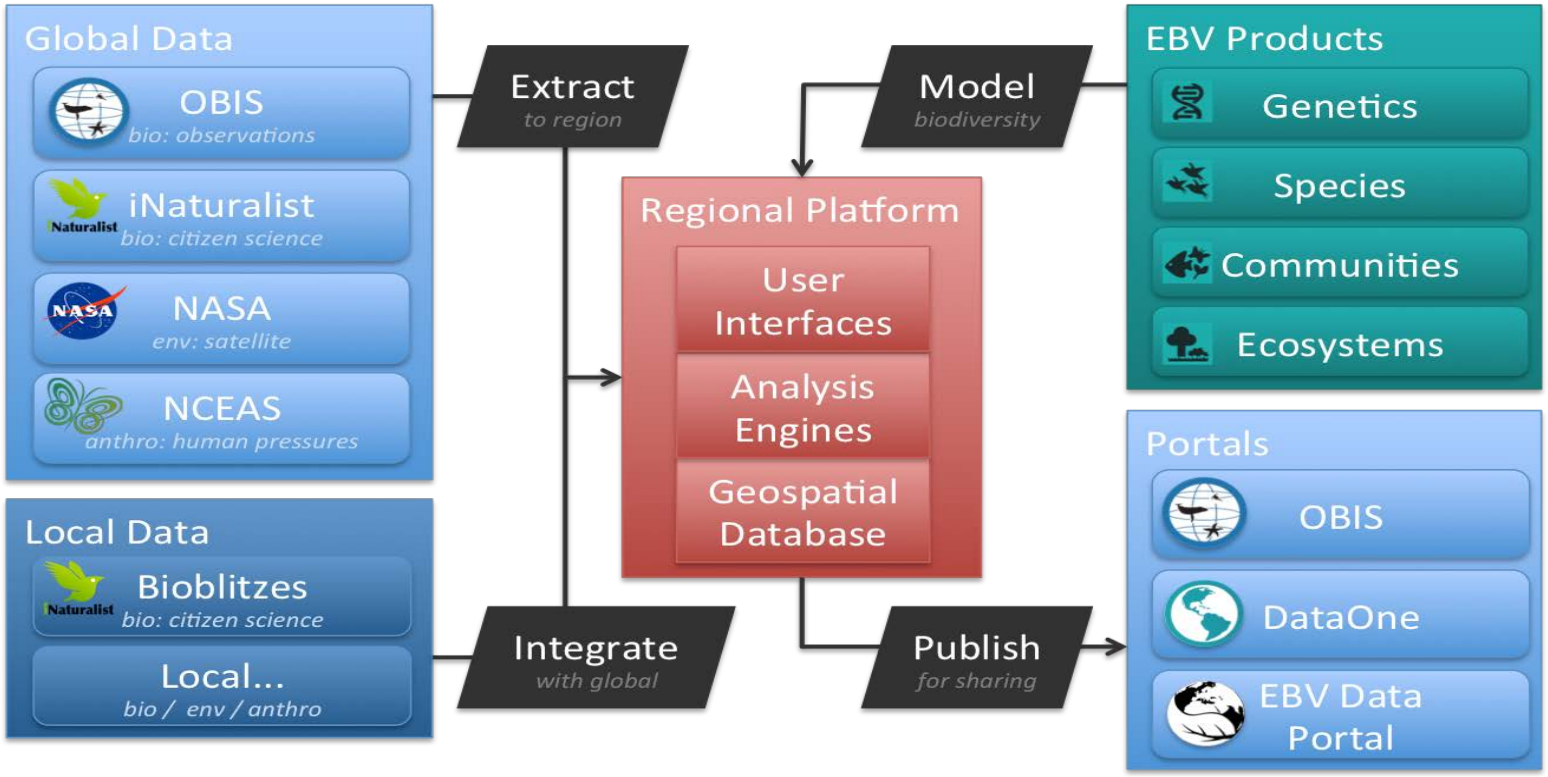
Acronym	Full name	Key activity
CBD	Convention on Biological Diversity	Aichi Targets
IMO	International Maritime Organisation	Protection of biodiversity and detection of invasive species
IUCN (WCPA, SSC)	International Union for the Conservation of Nature	World Commission on Protected Areas, Species Survival 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

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

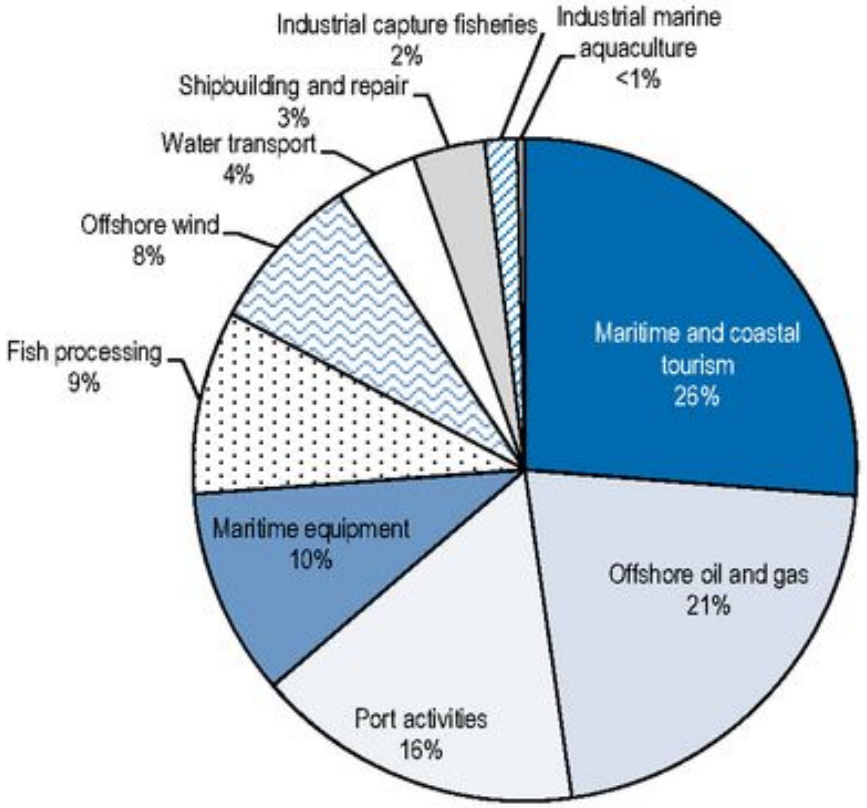
Preliminary concept for Platform for Biodiversity Analyses



- Public global datasets are extracted for a region of interest
- Integrated with local datasets (bio, env, socio-economic…)
- Web-based interfaces
- Interactive geospatial apps (R, Python)

OECD 2016
The Ocean Economy in 2030
DOI:10.1787/9789264251724-en

Figure 1.6. **Value added of the ocean economy in 2030 in the business-as-usual scenario**



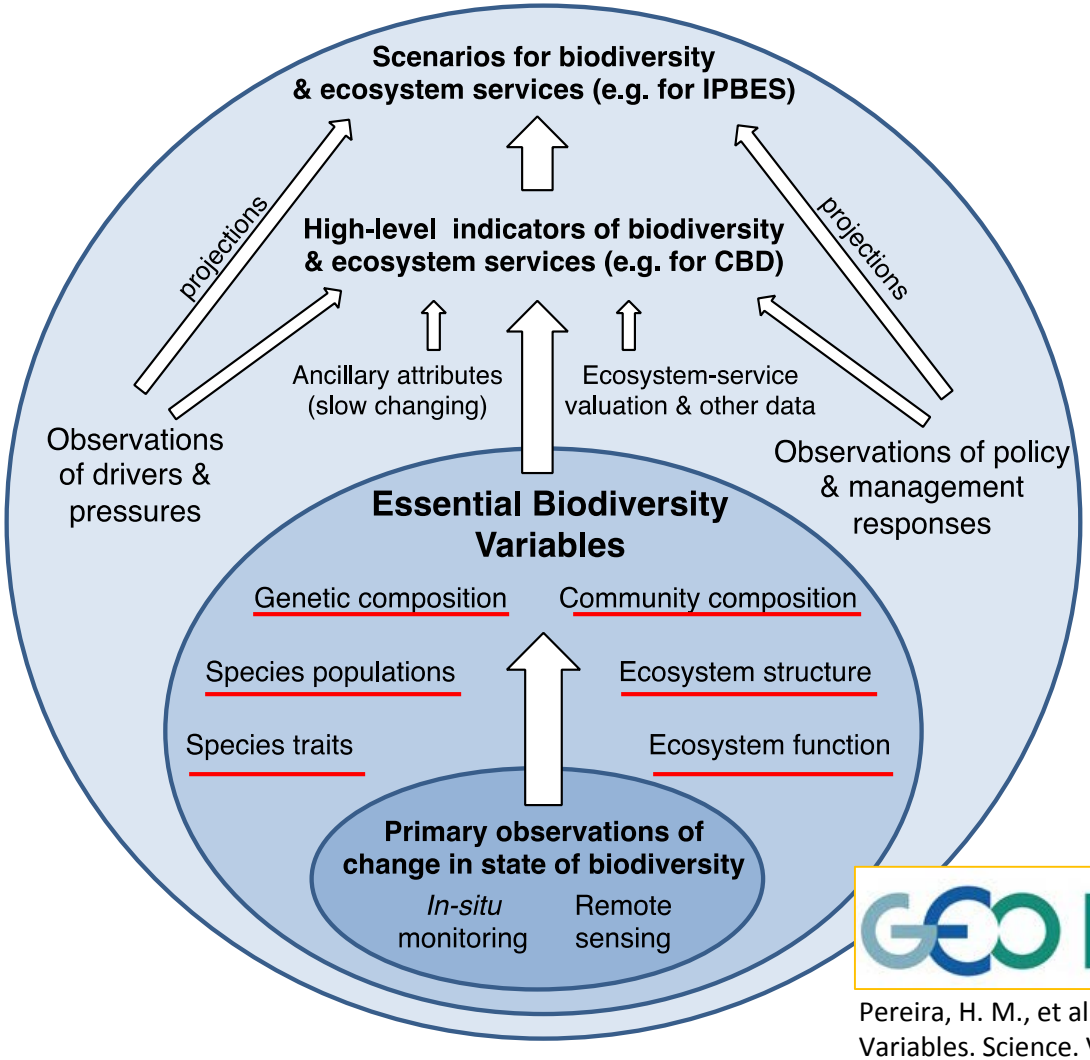
Ocean Economy value:
>US $3 trillion in 2030

StatLink http://dx.doi.org/10.1787/888933334632

Note: Artisanal fisheries are not included in this overview.

Source: Authors' calculations based on OECD STAN, UNIDO INDSTAT, UNSD; Lloyd's Register (2014; 2013); World Bank (2013); IEA (2014).

Essential Biodiversity Variables (EBV)



GEO BON

Pereira, H. M., et al. 2013. Essential Biodiversity Variables. Science. Vol. 339. 277-278.