

Session: Monitoring Essential Variables

**Essential Ocean Variables for Sustained Observations of** Marine Biodiversity and Ecosystems

19 June 2020



Frank Muller-Karger Gabrielle Canonico (1)









#### **GEO VIRTUAL SYMPOSIUM 2020**

#### Frank Muller-Karger

Frank is a biological oceanographer who conducts research on the diversity of life in the sea, factors that drive diversity and production, and the relevance to people. He combines traditional oceanographic methods and satellite remote sensing to study patterns of variation of phytoplankton and of coastal wetlands.

Frank is involved in a number of international working groups including the Marine Biodiversity Observation Network (MBON, as co-chair) of GEO BON, the UNESCO Intergovernmental Oceanographic Commission's (IOC) Global Ocean Observing System (GOOS) Bio-Eco panel, the UNESCO IOC's Ocean Best Practices Steering Committee, and leads the OceanObs Research Coordination Network (RCN).

He holds B.S., M.S. and Ph.D. degrees in marine science and a Master in management. He has authored or co-authored over 250 peer-reviewed scientific publications.



Frank Muller-Karger Professor



#### GEO VIRTUAL SYMPOSIUM 2020

#### Gabrielle Canonico

Gabrielle is a member of the U.S. Integrated Ocean Observing System (U.S. IOOS) Program Office, housed in NOAA. Her professional interests include integration of biological observing data and capability into U.S. IOOS and the Global Ocean Observing System, development of information products to ensure wide use of biodiversity observations by resource managers and the public, and advancing efforts to ensure sustained monitoring of ocean life and biodiversity. Gabrielle led development of the U.S. Marine Biodiversity Observation Network (MBON) - established in 2013 – and is an active participant in development of global MBON and other biological observing efforts.

Gabrielle serves as co-chair of the Global Ocean Observing System (GOOS) Biology and Ecosystem Panel and of the US National Oceanographic Partnership Program Biodiversity Working Group.



Gabrielle Canonico
Biology Lead and MBON Manager

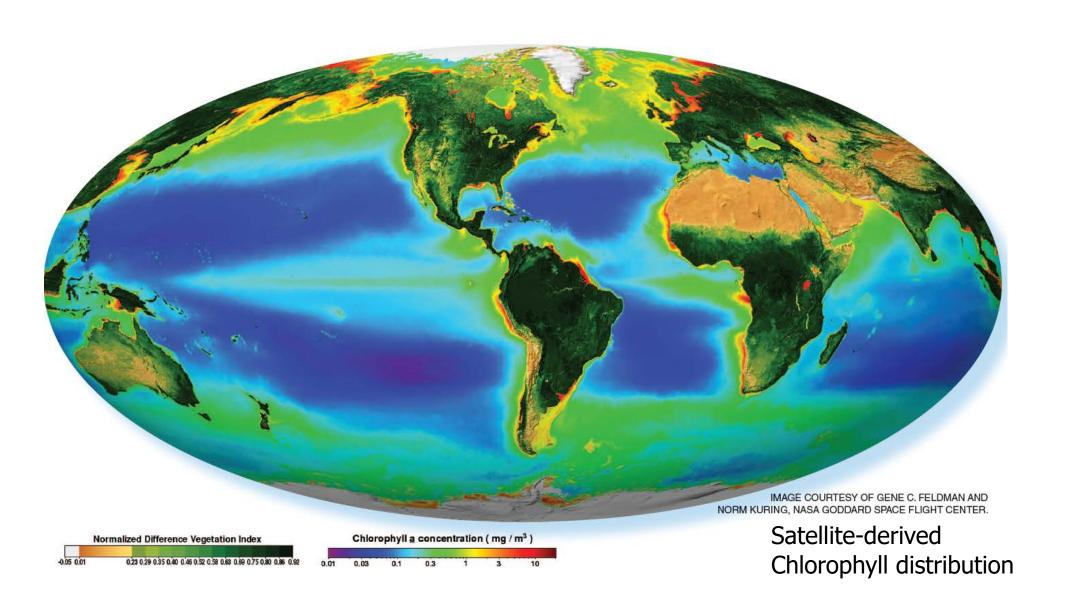




Huge investments have gone into ocean observing systems — But there is no systematic effort to observe <u>life in the sea</u>

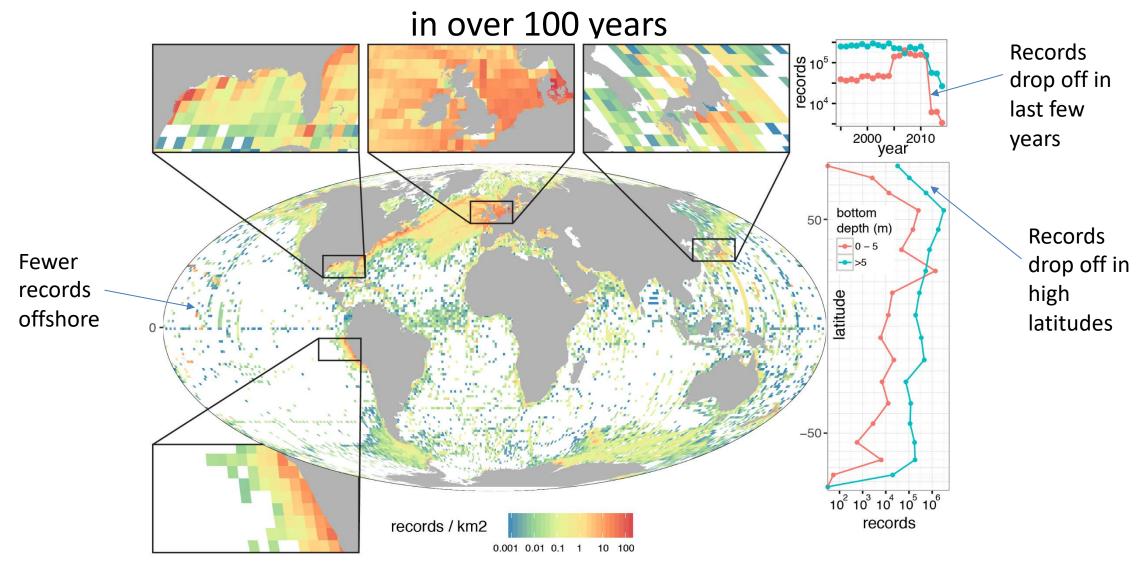
MBON Goal: Enable the effort to characterize how marine biodiversity is changing and how it affects us

## Our best sustained synoptic global biological observations look like this today. But, how do we move 'beyond chlorophyll'?



#### **OBIS** – THE Ocean Biodiversity Information System

The reality: in situ surface ocean records of biodiversity



We need better coverage and baselines to evaluate changing diversity, abundances, ranges, and connectivity

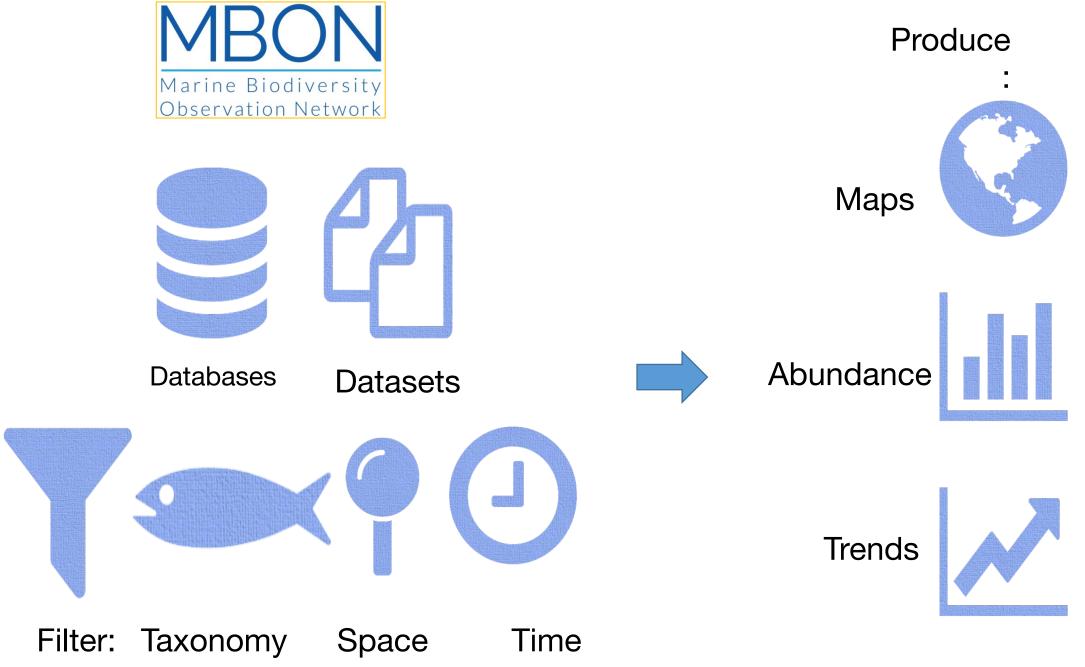


#### **Vision and Goal**

# Develop a community of practice to understand changes in marine biodiversity

#### Focus:

- "Ocean Observing Systems" and networks
- Coastal zones, Exclusive Economic Zones, High Seas
- Marine Protected Areas
- Community resilience and the blue economy



## The Need for Information Leads to Essential Variables:

- -Essential Climate Variables (ECVs)
- -Essential Ocean Variables (EOVs)
- -Essential Biodiversity Variables (EBVs)



#### **OBSERVING LIFE IN THE OCEANS FOR SOCIETAL BENEFIT**

(- INFORMATION FLOW -)

#### **INTERNATIONAL LINKAGES**





**Biodiversity Observation** Network (BON)

#### Data integration and dissemination





+ other national, international data systems

#### OTHER DATA PROVIDERS AND USERS

- ✓ National Governments and Organizations
- ✓ International Organizations

Global Ocean Observing System

- ✓ Non Government Organizations
- ✓ Research Institutions
- √ Citizen Scientists

















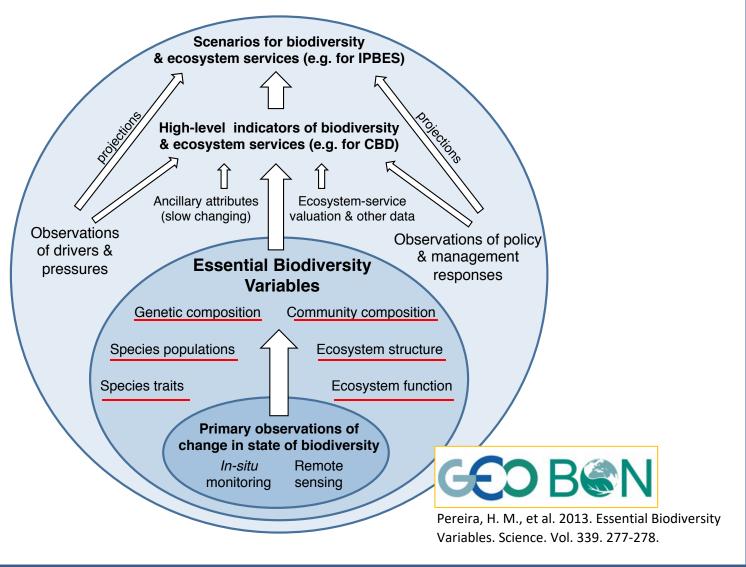








## Essential Biodiversity Variables (EBVs)



#### **BIOLOGICAL EOVS** THE CHAMPIONS Pier Luigi Buttigieg Microbes -Max Planck-Germany Frank Muller-Karger / Raphael Kudela Phytoplankton -USF-USA / UCSC - USA Sonia Batten / Sanae Chiba Zooplankton → MBA-Canada / JAMSTEC-Japan Benthic Looking for a champion! invertebrates Yunne Shin / Valerie Allan Fish IRD-France / SPC-New Caledonia Dan Costa Turtle-Bird → UCSC - USA Mammal **David Obura** Hard Coral → CORDIO - Kenya Lisandro Benedetti-Cecchi Macroalgae -University of Pisa - Italy **Emmett Duffy** Smithsonian - USA Lisa María Rebelo Mangrove → IWMI - Lao

#### THE PARTNERS GL MICON integrated Marine Observing Syste IOOS MBON SCOR MarineGEO GCOS CSIRO **■**IMBeR GLOBAL CORAL REEF soos AUSTRALIAN INSTITUTE Australian Government OF MARINE SCIENCE WESTERN AUSTRALIA **IMAS NCEAS** National Center for Ecological Analysis and Synthesis

#### THE USERS



## Partnerships & Users

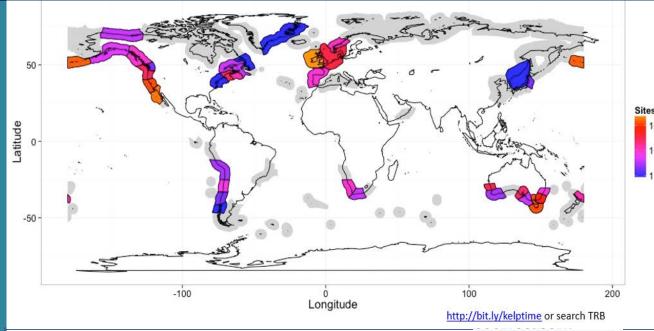
- Science and technology
- Policy and sustainability
- Business and industry
- Civil society and NGOs
- Funders and donors





#### Macroalgae:

- High production, diverse, useful
- Undergoing change
- Data not fully aggregated, collected using different methods
- GOOS and MBON workshops



KelpTime Database 1,454 sites 1954-2012 Krumhansl etal. (2016)

First observation of large quantities of Hypnea sp. in Seychelles – a new arrival or a strong monsoon?





#### **Emmett Duffy Smithsonian-led Tennenbaum Marine Observatories**

## **SeaPlants Cover and Composition**

- Seagrass and Mangroves:
  - Foundational to coastal systems
  - Services include carbon storage
  - Rapid loss of cover
- In situ data fragmented, opportunities to make better use of remote sensing
- GOOS and MBON workshop 2019





Seagrass Watch

## Users & Partnerships

	N. Farantial Bindingsity Variables		Examples
EOV - Essential Ocean Variables EB	V - Essential Biodiversity Variables		Variables
	Primary productivity	EF	Rate of carbon fixation or oxygen production
Microbe biomass and diversity	Secondary production	EF	Plankton biomass per area/time
Phytoplankton biomass and diversity	Allelic diversity	GC	Richness of Operational Taxonomic Units (OTU's), species presence/absence
Zooplankton biomass and diversity			
	Taxonomic diversity	SP	Bacterial counts and taxonomy,
Benthic invertebrates abundance and distribution			concentration of chlorophyll-a and accessory pigments, plankton abundance,
	Species distribution	SP	phytoplankton functional groups distribution, fish abundance, marine
Fish abundance and distribution		CC	mammals and birds abundance, emergent vegetation (wetland) distribution and
TBM abundance and distribution	Population abundance	SP	cover, floating vegetation abundance
		CC	Harris and Constability and
	Migratory behaviour	ST	Home range / Core habitat use emigration / immigration
Macroalgal canopy cover and composition	Phenology	ST	Degree of coral spawning synchrony, fish spawning frequency, phytoplankton spring
			bloom dynamics
Seagrass cover and composition	Population structure by age/size class	СС	Abundance of the young-of-the-year (YoY) of coastal and neritic fishes
			l coastal and heritic lishes
Hard coral cover and composition	Habitat structure	ES	Live coral cover, seagrass cover,
	Ecosystem extent / fragmentation	ES	macroalgal canopy area, wetland extent
Mangrove cover and composition	Ecosystem composition / functional type	ES EF	wedand extent
		-	

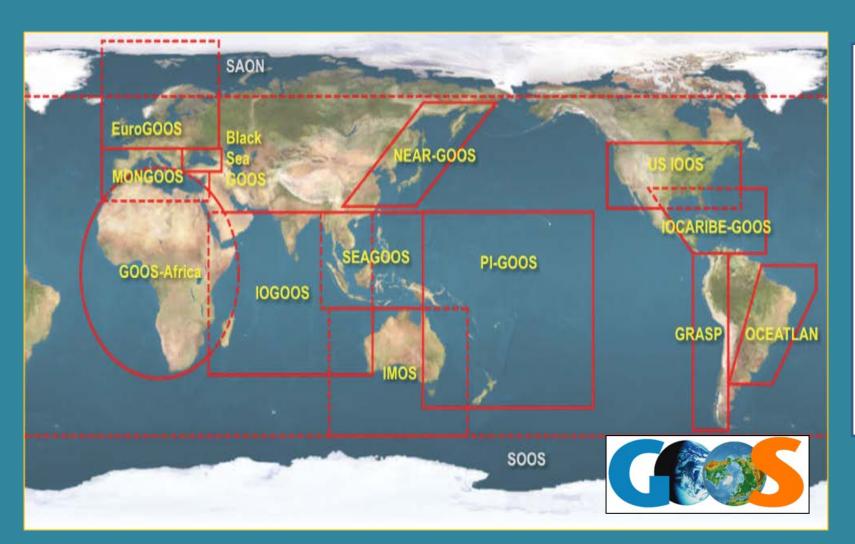
Conceptual, <u>complementary</u> relationship between EOVs and EBVs

(TBM = turtles, birds, mammals)

Muller-Karger et al., 2018. Frontiers in Marine Science, https://doi.org/10.3389/fmars.2018.00211]



#### Building a Global Ocean Biodiversity Observing System



#### **Use existing infrastructure:**

- -GOOS Regional Alliances
- -GO-SHIP
- -OceanSites
- -OBIS
- -Ocean Best Practices System
- -Other global networks

#### The Need: Address Social and Economic Challenges

- Biodiversity time series
- Common methods
- Lower cost of technologies
- Capacity development

### Best Practice Challenges

- Capacity development to link observers and users
- Interoperability
- Multidisciplinary integration
- Open science, open data

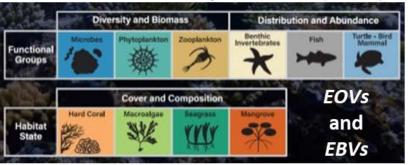


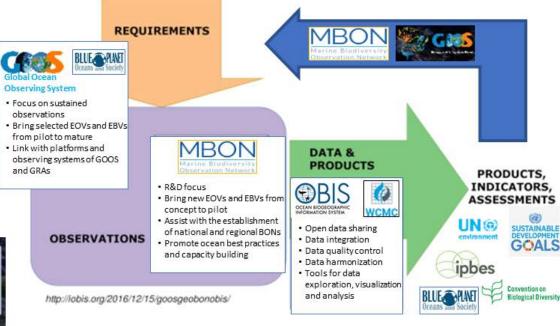
#### Monitoring biodiversity is fundamental to managing ecosystem uses and human health

Join our community of practice to develop a global capacity to collect and use biological observations for conservation and ecosystem-based management



Addressing the challenge and benefits of observing life in the sea, by measuring Essential Ocean Variables (EOVs) and Essential Biodiversity Variables (EBVs)





See Canonico et al (2019): <a href="https://www.frontiersin.org/articles/10.3389/fmars.2019.00367/full">https://www.frontiersin.org/articles/10.3389/fmars.2019.00367/full</a> Contacts: <a href="mailto:MBON">MBON</a>: F. Muller-Karger (<a href="mailto:carib@usf.edu">carib@usf.edu</a>), M. Costello (<a href="mailto:m.costello@auckland.ac.nz">m.costello@auckland.ac.nz</a>), and I. Sousa Pinto (<a href="mailto:isabel.sousa.pinto@gmail.com">isabel.sousa.pinto@gmail.com</a>);

GOOS: N. Bax (Nic.Bax@csiro.au); OBIS: W. Appeltans (w.appeltans@unesco.org)

#### GEO VIRTUAL SYMPOSIUM 2020

19 June 2020

### Thank You!

Frank Muller-Karger / carib@usf.edu Gabrielle Canonico / gabrielle.canonico@noaa.gov







#### **#EO4Impact**

Collaborate and communicate with GEO:















http://marinebon.org