May 23, 2019

NASA

NOPP
National Oceanographic Partnership Program

NOAA

MBON
Marine Biodiversity Observation Network

Sanctuaries MBON

Monterey Bay,
Florida Keys, and
Flower Garden Banks
National Marine Sanctuaries

Principal Investigators:
Frank Muller-Karger (USF)
Francisco Chávez (MBARI)

BLUE PLANET Oceans and Society

GEO BON

AmeriGEOSS

Intergovernmental Oceanographic Commission

IOOS Integrated Ocean Observing System

MBARI

USF University of South Florida College of Marine Science

MarineGEO The Tennenbaum Marine Observatories Network

OSU Oregon State University College of Earth, Ocean, and Atmospheric Sciences

National Marine Sanctuaries

NOAA FISHERIES

Partners: E. Montes/M. Breitbart/A. Djurhuus/N. Sawaya[1], K. Pitz/R. Michisaki[2], Maria Kavanaugh[3], S. Gittings/A. Bruckner/K. Thompson[4], B.Kirkpatrick[5], M. Buchman[6], A. DeVogelaere/J. Brown[7], J. Field[8], S. Bograd[8], E. Hazen[8], A. Boehm[9], K. O'Keife/L. McEachron[10], G. Graettinger[11], J. Lamkin[12], E. (Libby) Johns/C. Kelble/C. Sinigalliano/J. Hendee[13], M. Roffer[14] , B. Best[15]

[1] College of Marine Science, Univ. of South Florida (USF), St Petersburg, FL;
[2] MBARI/CenCOOS, CA;
[3] Oregon State University, Corvallis, OR;
[4] NOAA Office of National Marine Sanctuaries (ONMS), Washington, DC;
[5] Texas A&M University (TAMU/GCOOS), College Station, TX;
[6] NOAA Florida Keys National Marine Sanctuary (FKNMS), Key West, FL;
[7] NOAA Monterey Bay National Marine Sanct. (MBNMS), Monterey, CA;
[8] NOAA SW Fisheries Science Center (SWFSC), La Jolla, CA,
[9] Center for Ocean Solutions, Stanford University, Pacific Grove, CA;
[10] Florida Fish and Wildlife Research Institute (FWRI), St Petersburg, FL;
[11]NOAA Office of Response and Restoration (ORR), Seattle, WA;
[12]NOAA SE Fisheries Science Center (SEFSC), Miami, FL;
[13]NOAA Atlantic Oceanographic and Meteorol. Lab. (AOML), Miami, FL;
[14]Roffer's Ocean Fishing Forecasting Service (ROFFS™), Melbourne, FL.
[14]Ecoquants, Santa Barbara,CA.

MBON
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Sanctuaries MBON

Monterey Bay,
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The MBON vision:

MBON
Marine Biodiversity Observation Network

Good and timely information on marine biodiversity sustains the long-term health and use of marine ecosystems

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

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

The NOPP Sanctuaries MBON Pilot:
Primary Goals of Cooperative Agreement

- Integrate, synthesize, augment biodiversity information from ongoing programs
- Develop technologies for biodiversity assessments through:
  - Emerging environmental DNA (*eDNA*) molecular methods and autonomous sample collection;
  - Application of remote sensing to evaluate biogeographic *Seascapes*
- Bring biodiversity and environmental data together and serve it using international standards
- Use advanced analyses to link the mean and fluctuating components of biodiversity and ecosystem function to environmental conditions
- Relate information to social-economic context and provide information rapidly to stakeholders
- Seek to do this as an operational system
- Work with other US MBON demonstration projects to develop network concept
- Export the MBON concept globally

NOPP
National Oceanographic Partnership Program

Addressing User Needs

Sanctuary sites engaged with California Current IEA, MBON demonstration projects and Gulf of Mexico IEA

Collaboration of IEA with MBON Marine Biodiversity Observation Network

U.S. MBON PORTAL

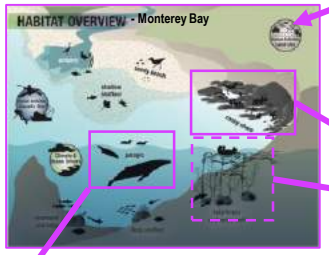
The NOPP Sanctuaries MBON Pilot: Integration of information

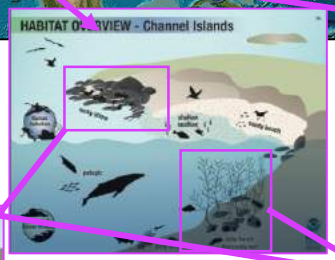
- Multiple, multi-agency, international satellite and in situ datasets
- State data sets
  - GCOOS (FL, Alabama, Mississippi, Louisiana, Texas)
  - CenCOOS (CA)
- Augmented Monterey Bay Time series (eDNA)
- Augmented the South Florida Program (eDNA, plankton)
- NOAA/State Fisheries and Reef surveys
  - Reef Visual Surveys, Rockfish Recruitment & Ecol Assessment, Coral Reef
  - Physical and chemical oceanographic data
- Beach Strandings data
- Many different environmental data
- Contributed to developing the MBON Portal (IOOS) and open source information tools

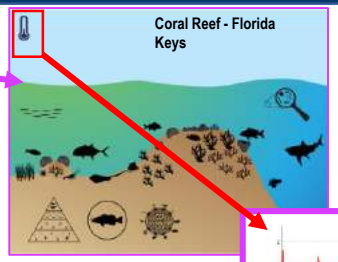
Addressing Sanctuary Needs: data tools

Processes and products being shared across programs and regions

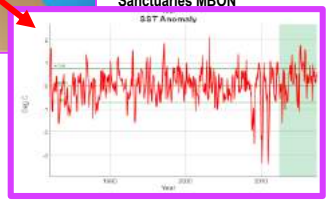
Collaboration between sanctuaries, IEA, MBON expanding to Gulf of Mexico



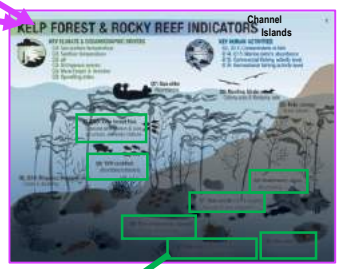


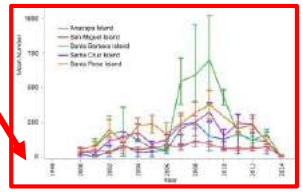


Currently conceptual models and data products under Development by Sanctuaries MBON

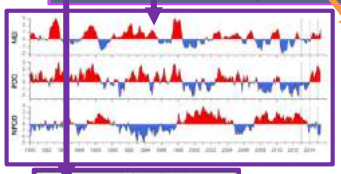


Gulf of Mexico IEA meeting with FKNMS, including Sanctuaries MBON partners, to expand collaboration apply IEA products and processes to the sanctuary.

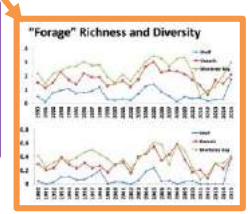




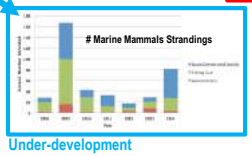
MARINe long-term monitoring data



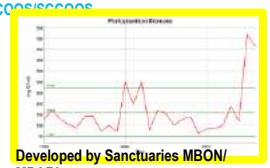
Available through CCIEA



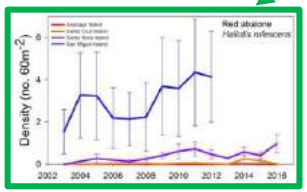
Developed by Sanctuaries MBON



Under-development CeNCOOS/SCCOOS



Developed by Sanctuaries MBON/ MBARI



PISCO / CINP / LTER data

FKNMS Demo: https://marinebon.github.io/info-fk/corals.html

MBNMS Demo: https://marinebon.github.io/info-mb/pelagic.html

Collaboration of

MBON Marine Biodiversity Observation Network

U.S. MBON PORTAL

https://mbon.ioos.us/

Inventories and "Curated data views"!

Outcomes in Information Management:

- Established a framework for operational biological observations, data management, communications
  - Biodiversity Information Standards (TDWG; old Taxonomic Databases WG)
  - Darwin Core / Event Core: data standard; Publish/Harvest data: ERDDAP
- Framework has been adopted by US IOOS RAs, and broadly discussed at NOAA (NMFS, NCEI), DataOne, USGS

MBON Marine Biodiversity Observation Network

NOPP National Oceanographic Partnership Program

In memory of Matt Howard, whose leadership demonstrated the MBON framework for IOOS

The NOPP Sanctuaries MBON Pilot:
Primary Goals of Cooperative Agreement

- Develop technologies for biodiversity assessments through:
  - Emerging environmental DNA (*eDNA*) molecular methods and autonomous sample collection;
  - Application of remote sensing to evaluate biogeographic *Seascapes*

National Oceanographic Partnership Program

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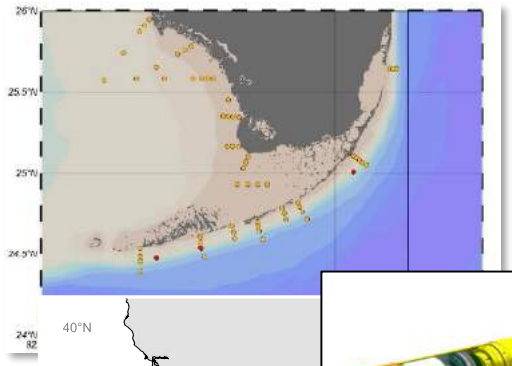
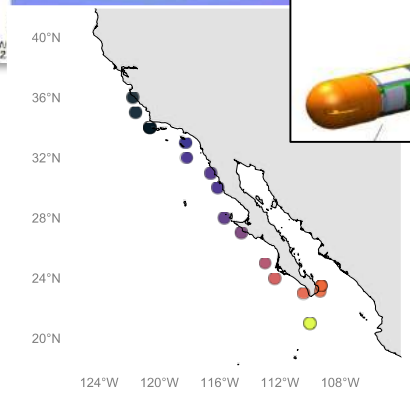
Active Biodiversity Field Programs

Gulf of Mexico / South Florida, Northern Gulf
Monterey Bay / Southern California
Sampling Sanctuaries with big and small boats,
and automated devices (AUVs, etc.)

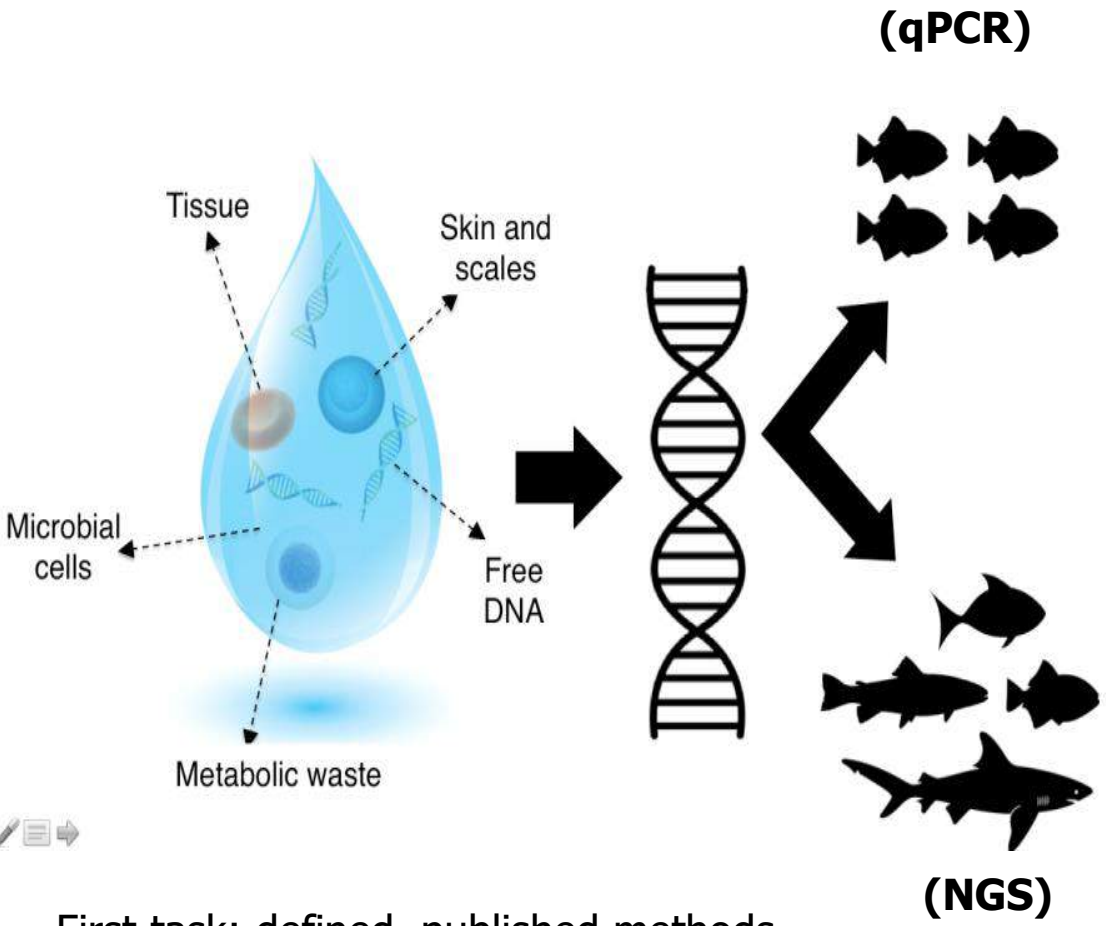




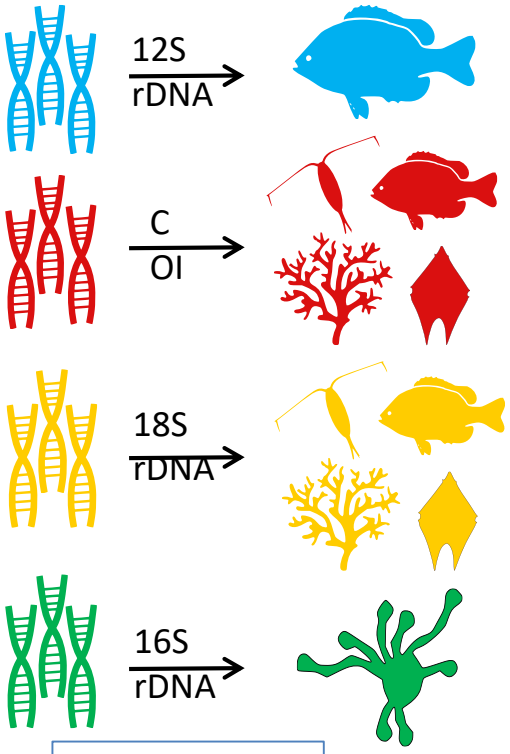
Over 45 expeditions in each FL Keys & MB

Marine environmental DNA (MBON)

A cheaper, less invasive and larger scale strategy to monitor species diversity – two approaches: next generation sequencing (NGS) and species specific primers



Target Gene Markers



Djurhuus et al. 2017

Each marker targets a different group of organisms.

First task: defined, published methods

eDNA summary statistics

Monterey Bay (2013-2019)

- >50 cruises
- Samples collected: >1500

Florida Keys (2015-2019)

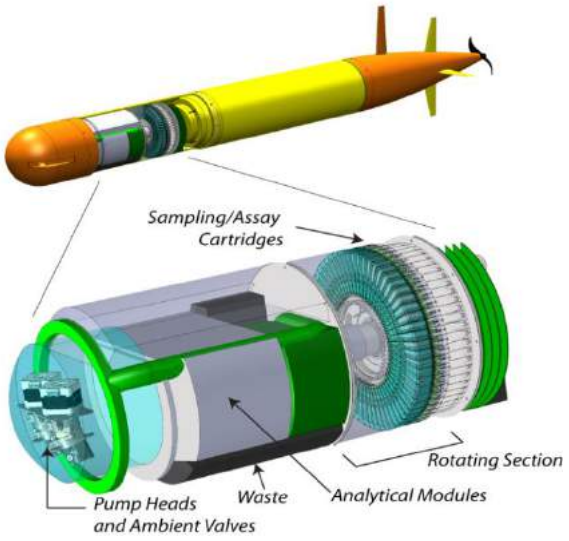
- >20 cruises
- Samples collected: >1300

Santa Barbara (2015-2017)

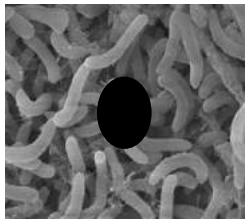
- 11 Diver surveys

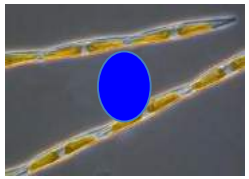
AUV (2015-2018)

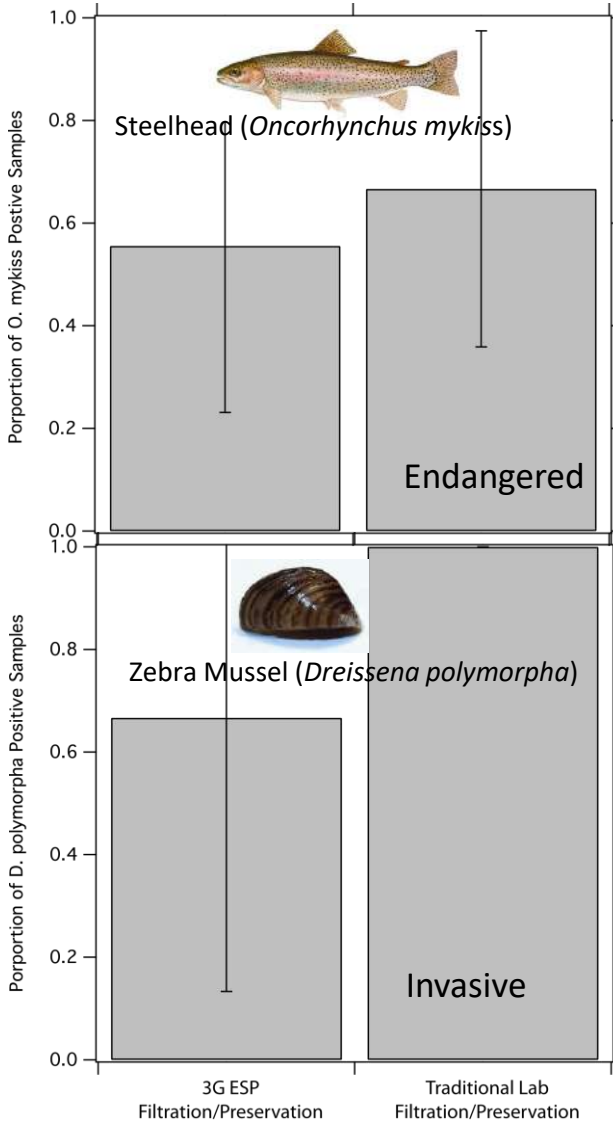
- 26 missions
- Autonomous eDNA samples collected: 366
    - Sequenced for 18S: 5
    - Sequenced for COI: 19



ESP vs Traditional Laboratory Methods







Yamahara et al., submitted

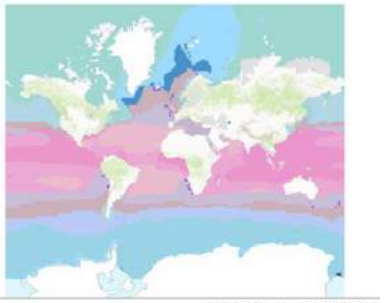
Satellite-derived Seascapes

Kavanaugh (OSU), Doney (UVa), Grebmeier (UMCES), Wright (ESRI), Otis, Montes, Djurhuus, Muller-Karger (USF)

- Regional to global classification of dynamic seascapes
- EMU intercalibration (R. Sayre/USGS, D Wright/Esri)
- Case Studies: Arctic, West Coast, Florida
- Habitat –species relationships
- Operational multiscale products: collaboration with NOAA NESDIS (P DiGiacomo, J Trinanes, G Goni)

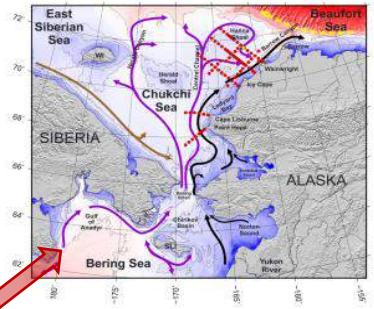
Global classification

Static+3D



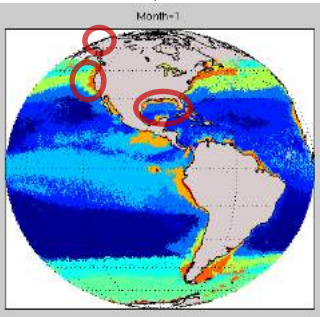
Ecological Marine Units

Regional downscaling

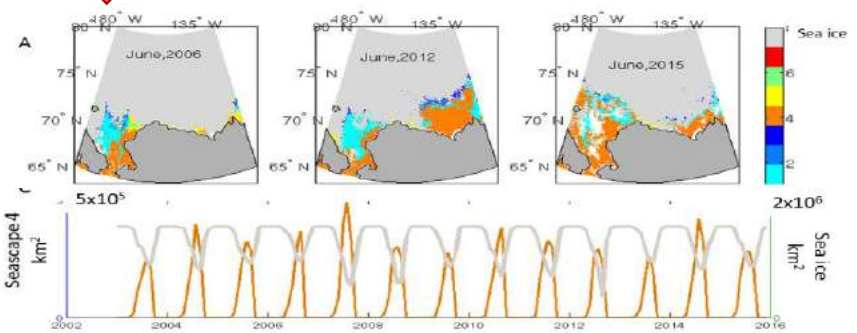


Arctic MBON; Distributed Biological Observatory

Dynamic+2D



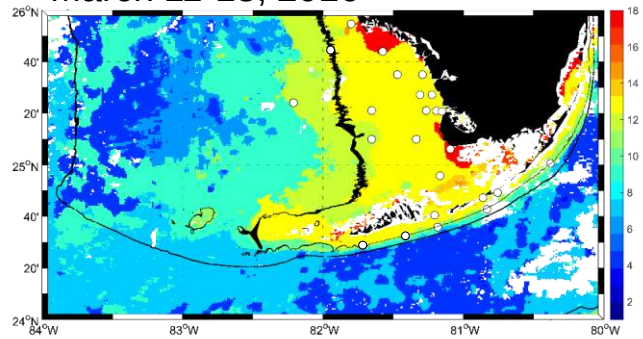
Dynamic Seascapes



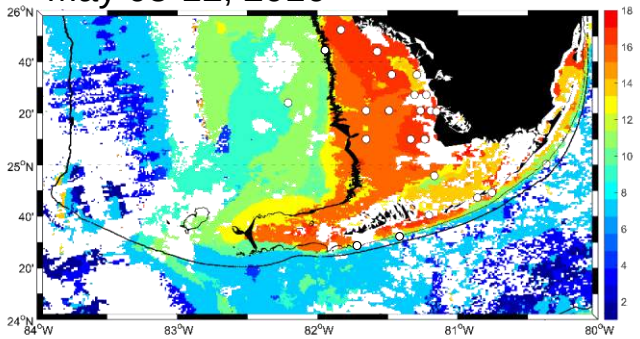
Dynamic habitat maps

Seascape validation in south Florida

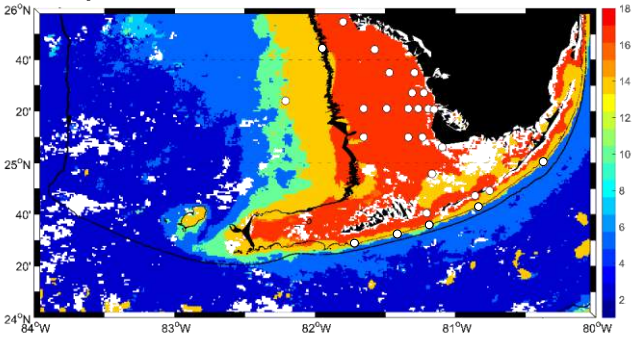
March 11-18, 2016

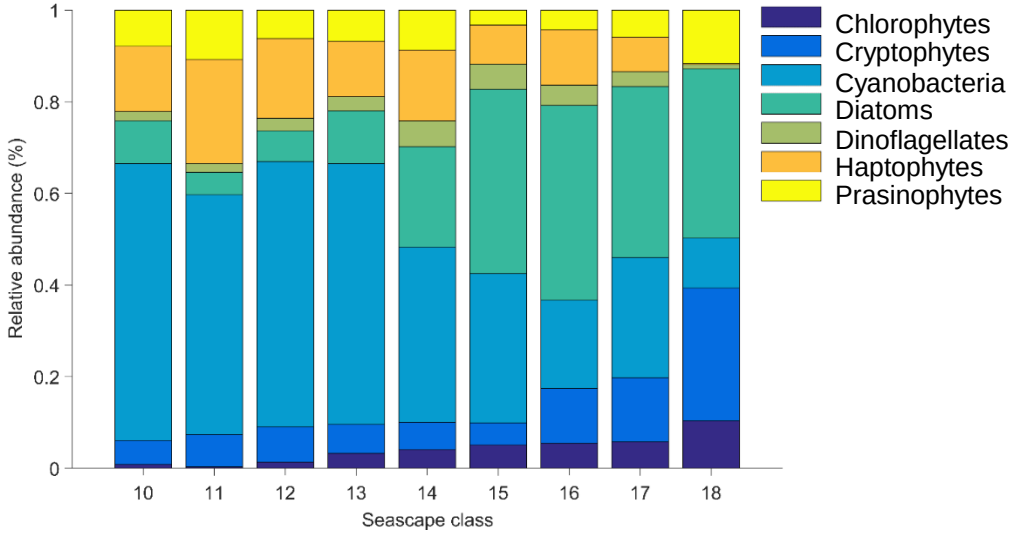


May 05-12, 2016



September 12-19, 2016





In prep: Dynamic satellite seascapes as predictors of seasonal shifts of phytoplankton assemblages in south Florida waters.
Enrique Montes, Anni Djurhuus, Christopher R. Kelble, Daniel Otis, Frank E. Muller-Karger, and Maria T. Kavanaugh

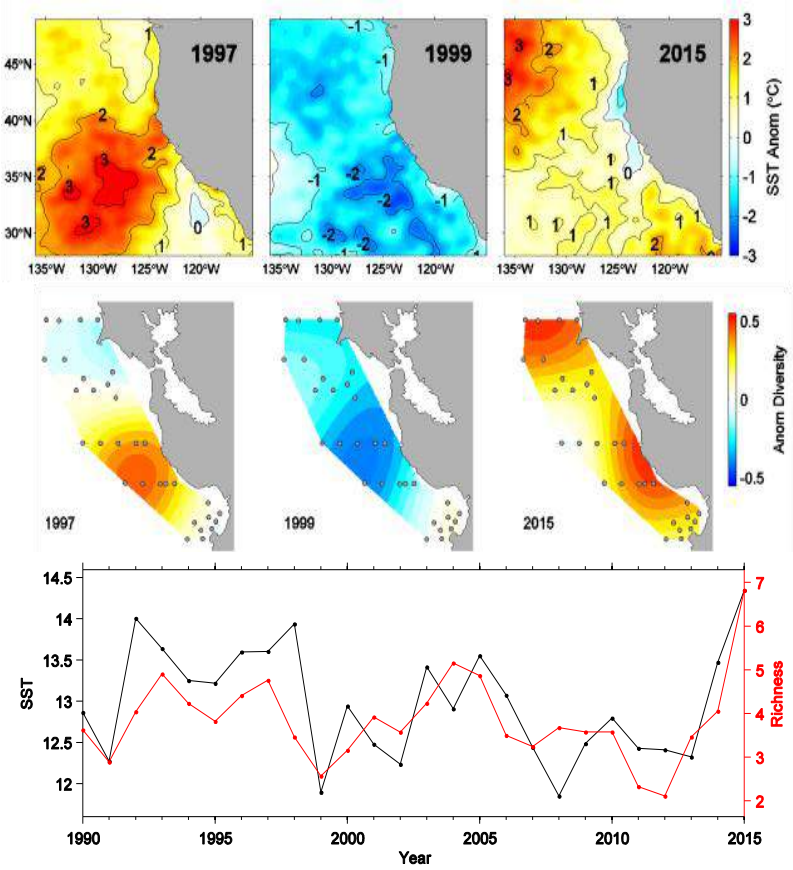
The NOPP Sanctuaries MBON Pilot:
Primary Goals of Cooperative Agreement

- Use advanced analyses to link the mean and fluctuating components of biodiversity and ecosystem function to environmental conditions

National Oceanographic Partnership Program

Ocean climate and biodiversity of pelagic fish (forage species)

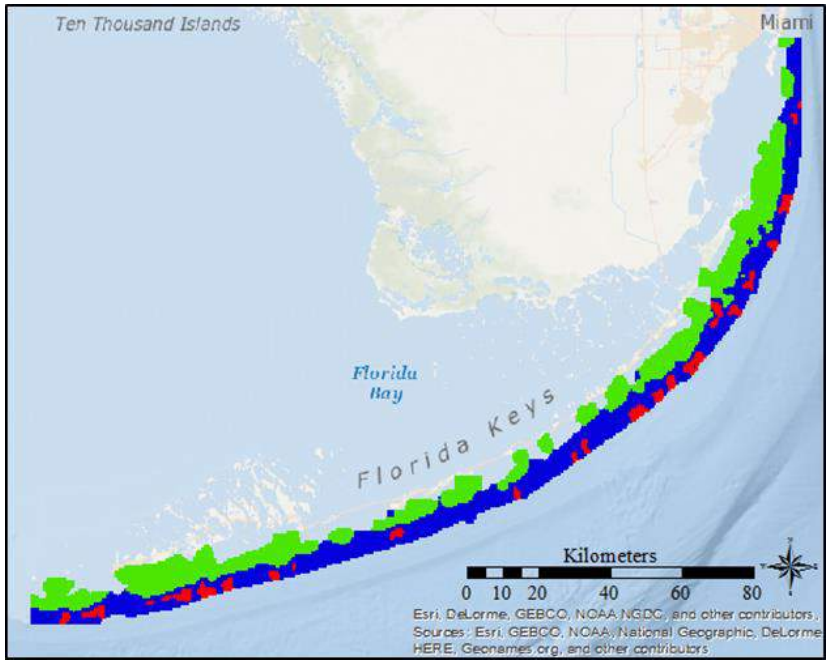
J.A. Santora, E.L. Hazen, I.D. Schroeder, S.J. Bograd, K.A. Sakuma, J.C. Field (2017)
MEPS Vol 580: 205-220, DOI: 10.10.3354/meps12278



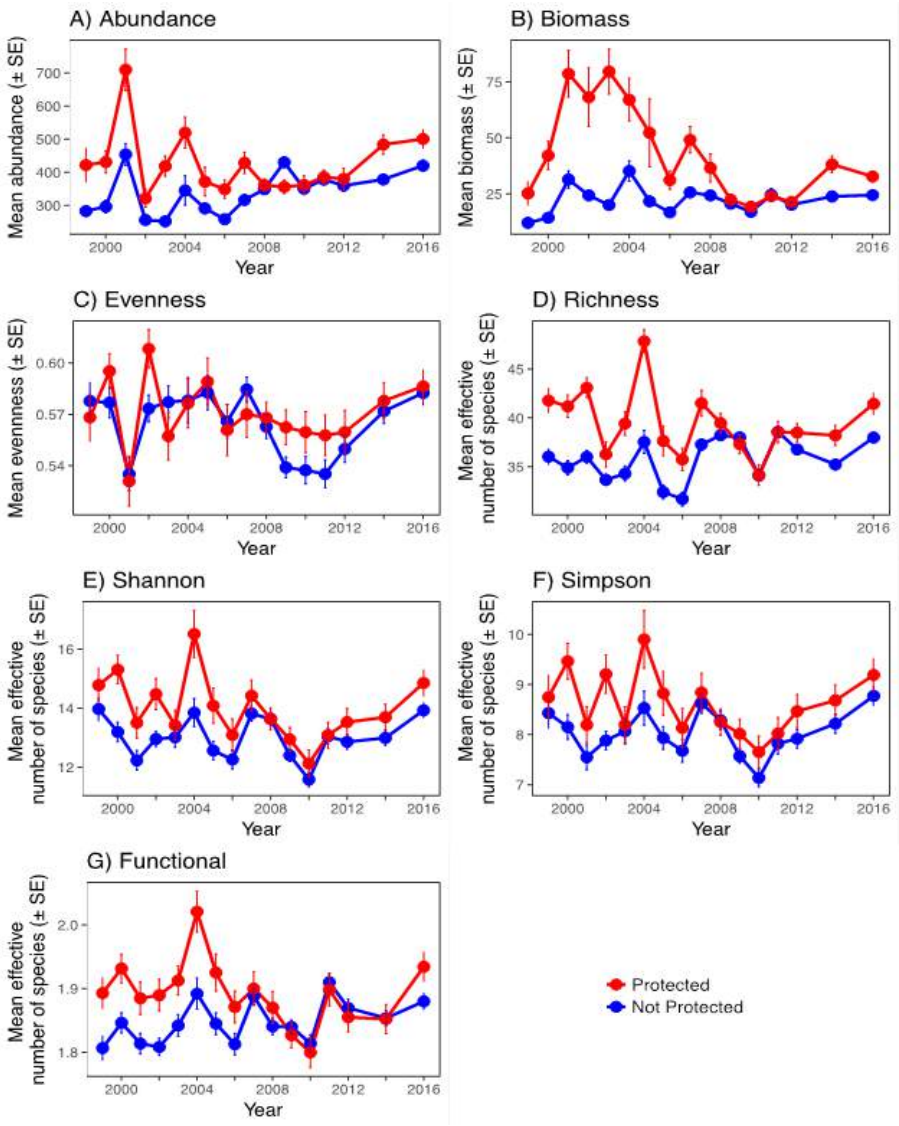
- 1995-97 and 2015 heat waves (ENSO) show high diversity.
- Affects fisheries and coastal water quality.

NOAA FISHERIES
National Oceanic and Atmospheric Administration

Reef Fish Biodiversity by No-Take Marine Zones and Habitat Strata in the Florida Keys National Marine Sanctuary: 1999 – 2016



Protected (no-take) areas have higher biomass and diversity



Megan Hepner et al (thesis and paper in prep)

The NOPP Sanctuaries MBON Pilot:
Primary Goals of Cooperative Agreement

- Seek to do this as an operational system

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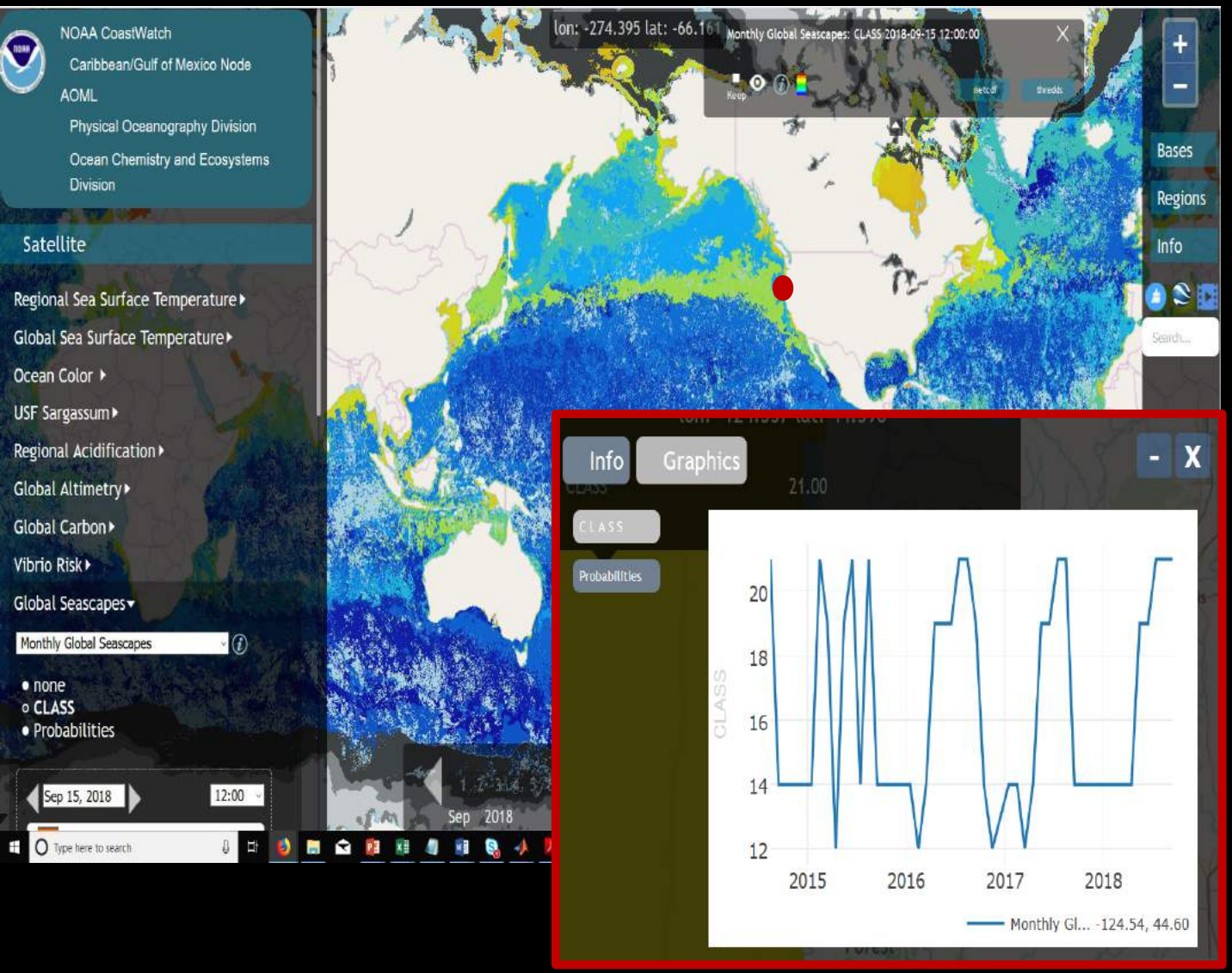
  - Strong partnerships have led to operational MBON elements:
    - US IOOS and RA's are fully engaged in MBON pilot program
      - Established a framework for management of biological ocean observations
      - Training in DMAC framework to all IOOS RA's
      - Early warning tool development
    - DoI USGS / US OBIS program
    - NOAA NESDIS: Global Seascapes now served via CoastWatch
    - Integrated Ecosystem Assessment (CA, FL Keys): indicators, infographics, data visualizations; MBON Portal development
    - National Marine Sanctuaries: Condition Reports
    - Worked with NOAA NMFS to develop eDNA srategy
  - Heavy input to US OSTP ocean policy vision
  - Exercised / demonstrated autonomous collections

NOAA CoastWatch: Operational Global Coverage

Seascape Identity: visualization and analysis



EBVs

Ecosystem Structure Class

- Habitat Structure
- Habitat Extent
- Habitat Function (time dynamics of seascape identity)

Other Classes:
Community Composition
Ecosystem Structure

The NOPP Sanctuaries MBON Pilot:
Primary Goals of Cooperative Agreement

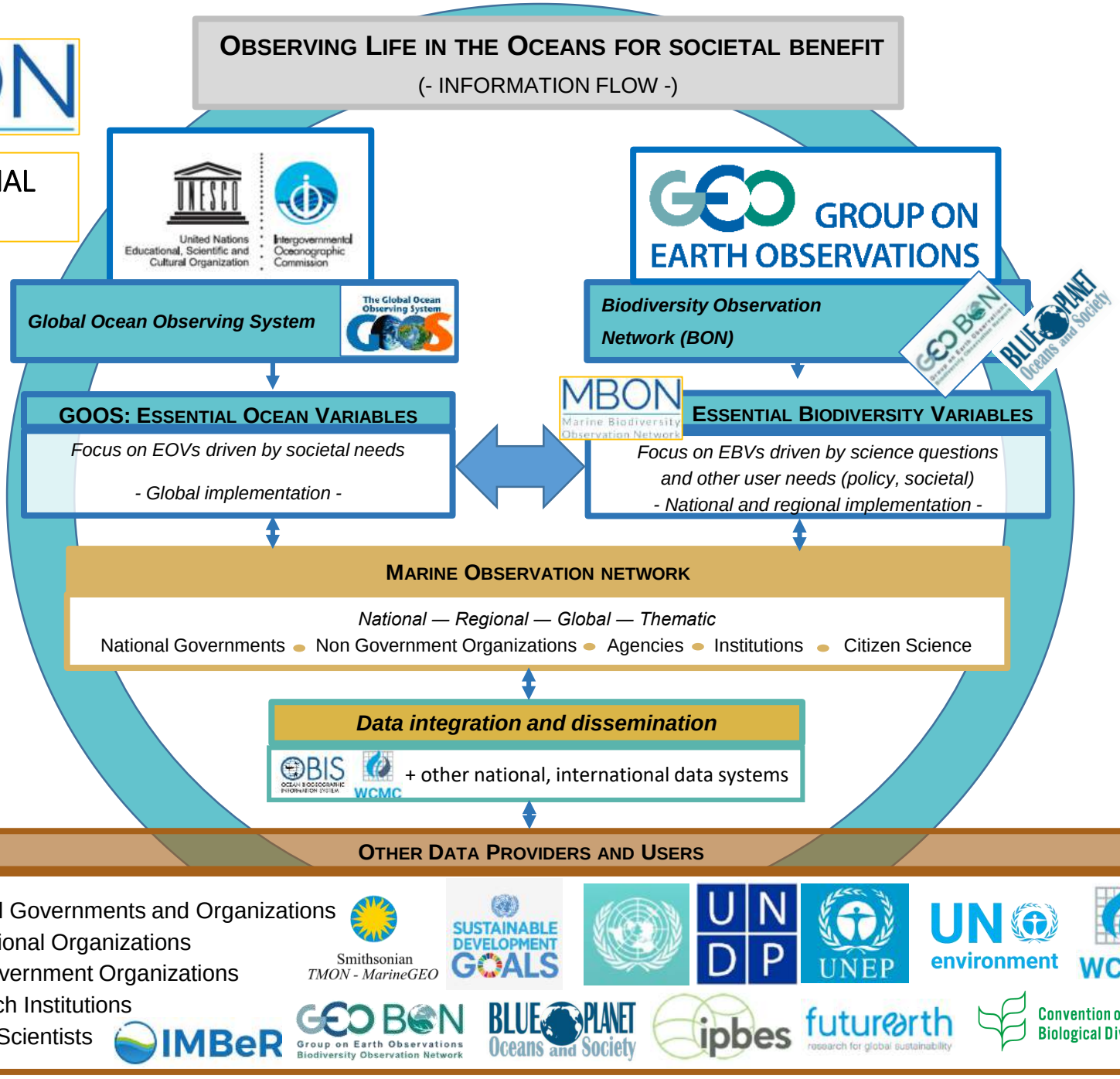
- Export the MBON concept globally

Our Approach:

Networking networking networking

MBON

INTERNATIONAL LINKAGES



Capacity Building – Field sampling

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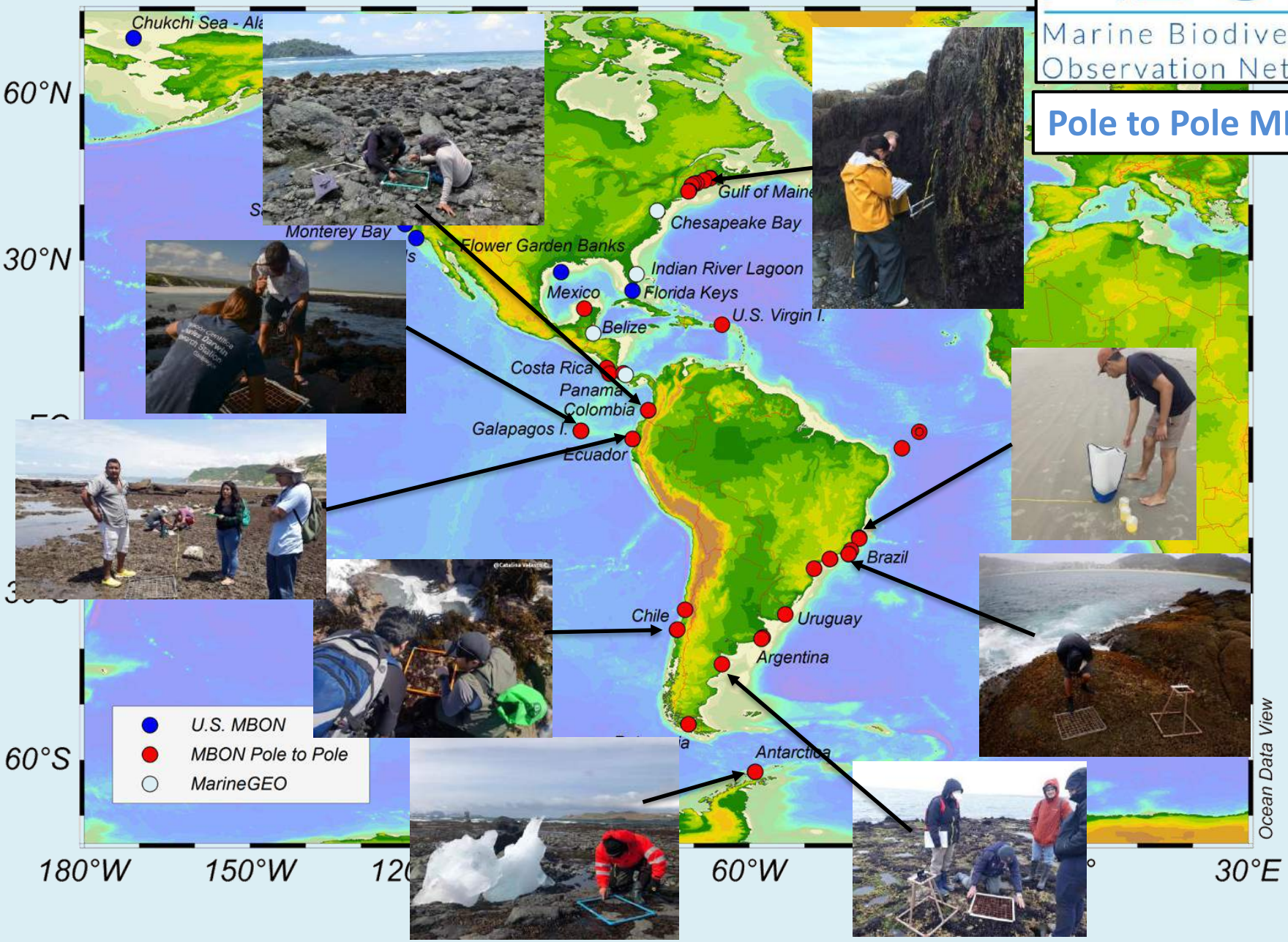
Pole to Pole MBON



Honolulu, Hawaii

MBON
Marine Biodiversity Observation Network

The Global Ocean Observing System
GOOS

BLUE PLANET
Oceans and Society

Substantial MBON involvement

In partnership with

NSF OceanObs RCN:

- ***Intellectual sponsor***
- ***Program Committee***
- Participation:
  - Speakers and panelists
  - Breakout sessions
- **Post OO19 activities** planned
  - AGU fall Meeting
  - Ocean Sci. Meeting

http://www.oceanobs19.net/

SUSTAINABLE DEVELOPMENT GOALS

2030 AGENDA

UN Decade of Ocean Science forSustainable Development (2021-2030)

Biological Diversity/Aîchi Biodiversity targets (CBD)

Law of the Sea (UNCLOS + BBNJ + UNFSA)

SIDS Action (SAMOA Pathway)

Disaster Risk Reduction SENDAI Framework

Climate Change/Paris Agreement (UNFCCC)

A global framework that will ensure Ocean Science can help governments and societies achieve the major goals of our generation

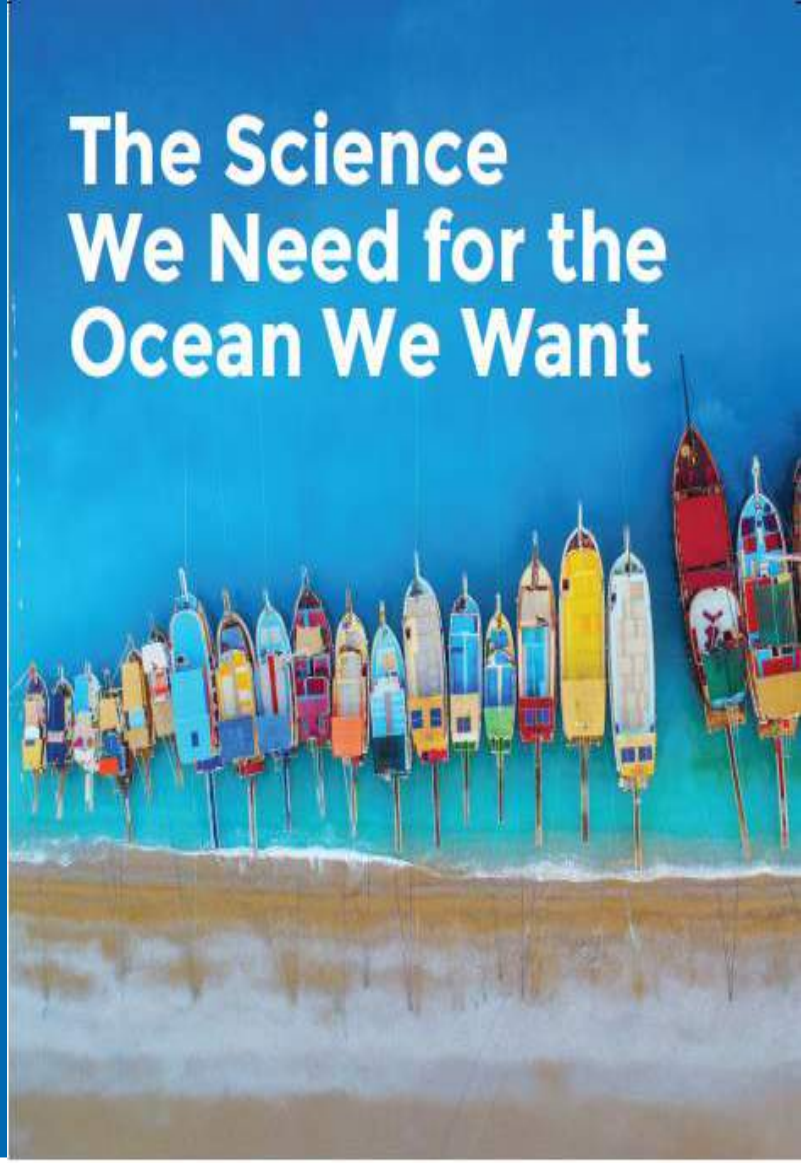
Get in touch

Write to:
oceandecade@unesco.org

Follow all Decade news:
http://oceandecade.org

Social media:

IocUnesco IocUnesco ioc_unesco



United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

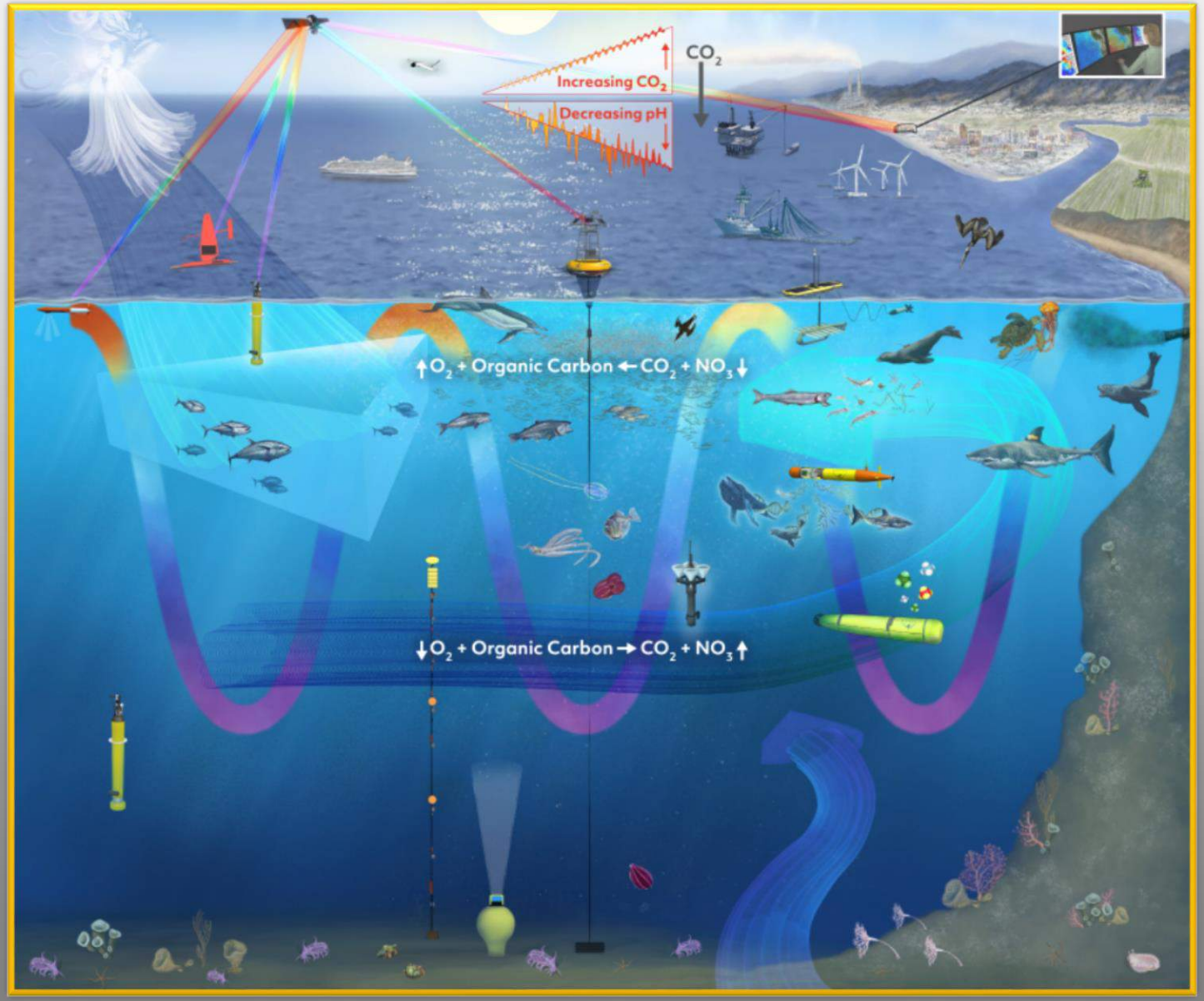
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

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

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Addressing the need for sustained observations of marine ecosystems

MBON
Marine Biodiversity Observation Network



NASA

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE