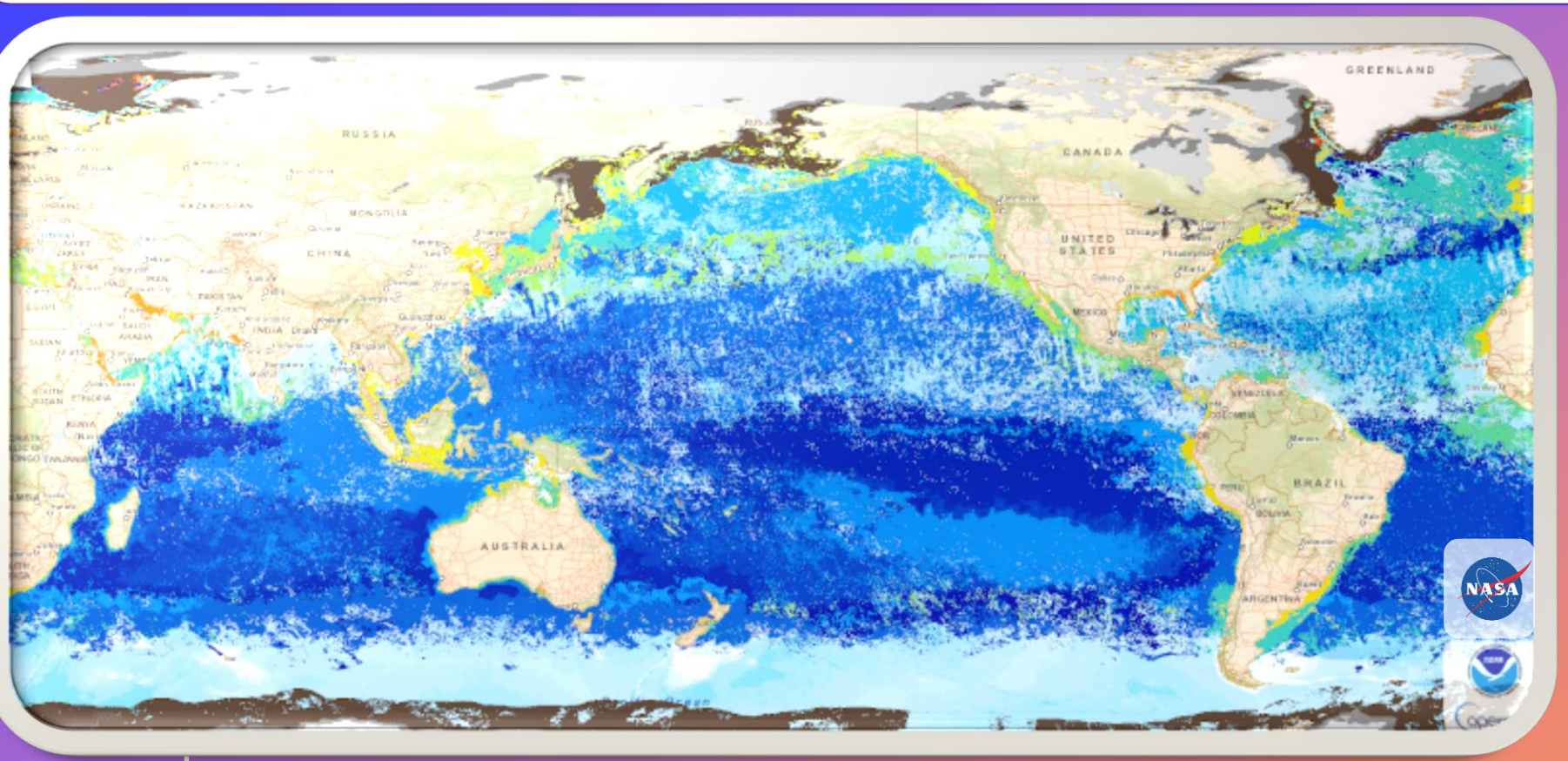
Scientific Applications and MODIS to VIIRS Continuity of Biogeographic Seascape Pelagic Habitat Classifications

(A.33 2020 The Science of Terra, Aqua, and Suomi-NPP projects. Period: 2023-2025)



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CoastWatch

NOAA NESDIS STAR Center for Satellite Applications and Research SMCD CORP SOCD

NASA

NOPP National Oceanographic Partnership Program

NOAA

BOEM

ONR

IOOS Integrated Ocean Observing System

GEO BON

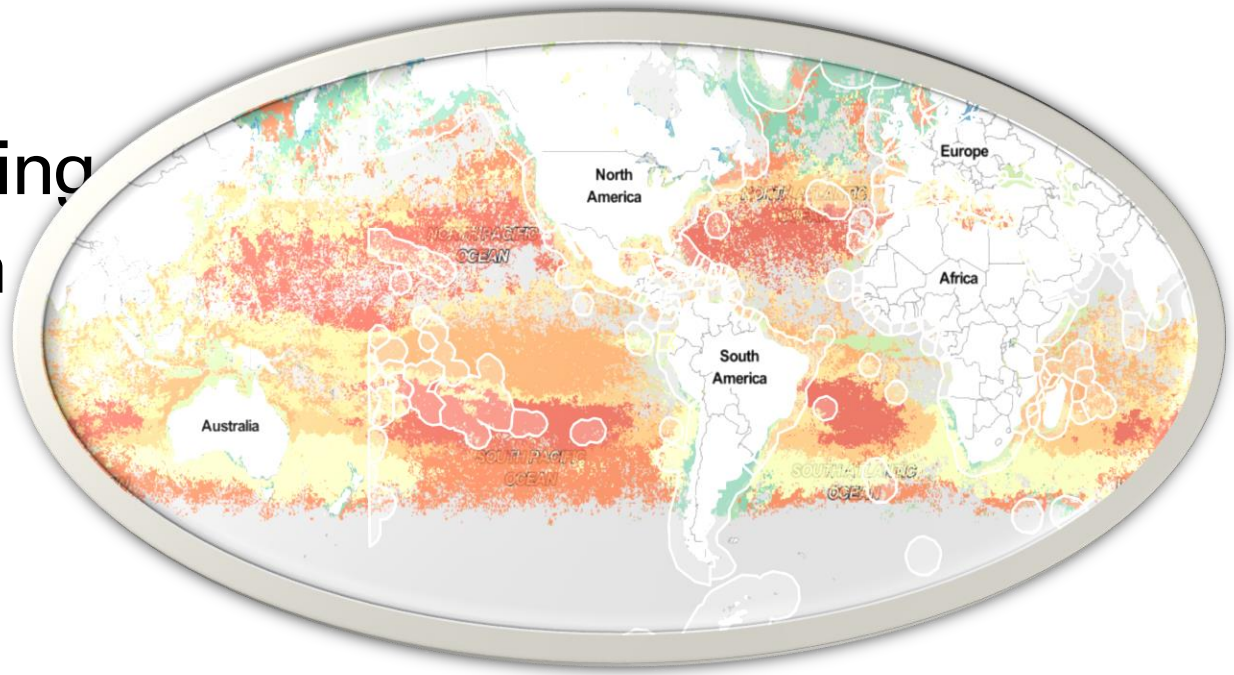
MBON Marine Biodiversity Observation Network

Marine Life 2030

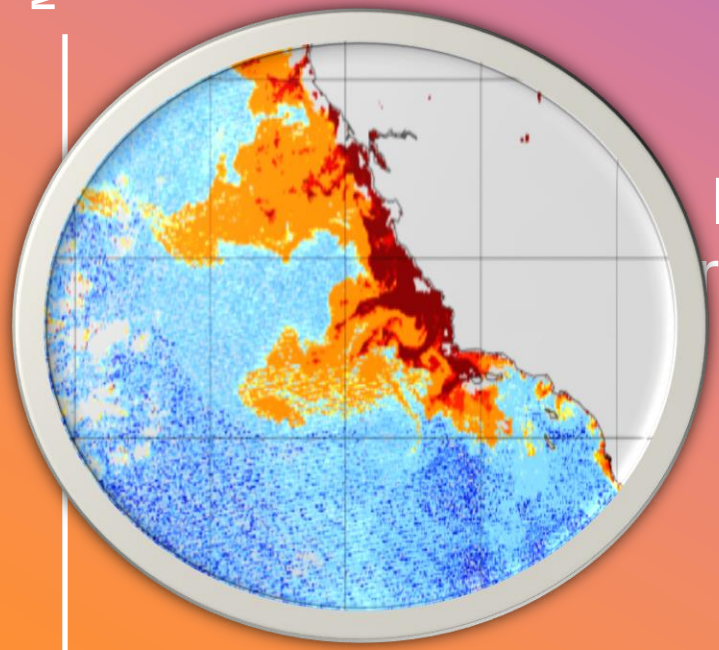
2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Introduction

Seascape pelagic habitat classifications combine data from multiple sensors to map the changing biogeography of the surface ocean



SCIENCE OBJECTIVES

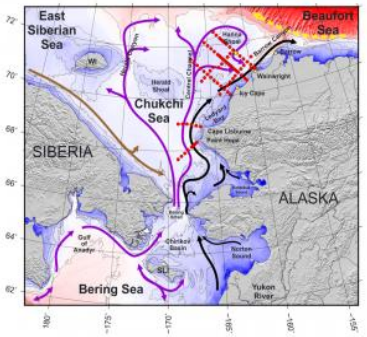


H1 (oceanographic): Biogeographic seascapes have predictable phenology (is it changing with time? Why?)

H2 (remote sensing science): Seascape identity emerges around fronts or submesoscale features (information useful for local management)

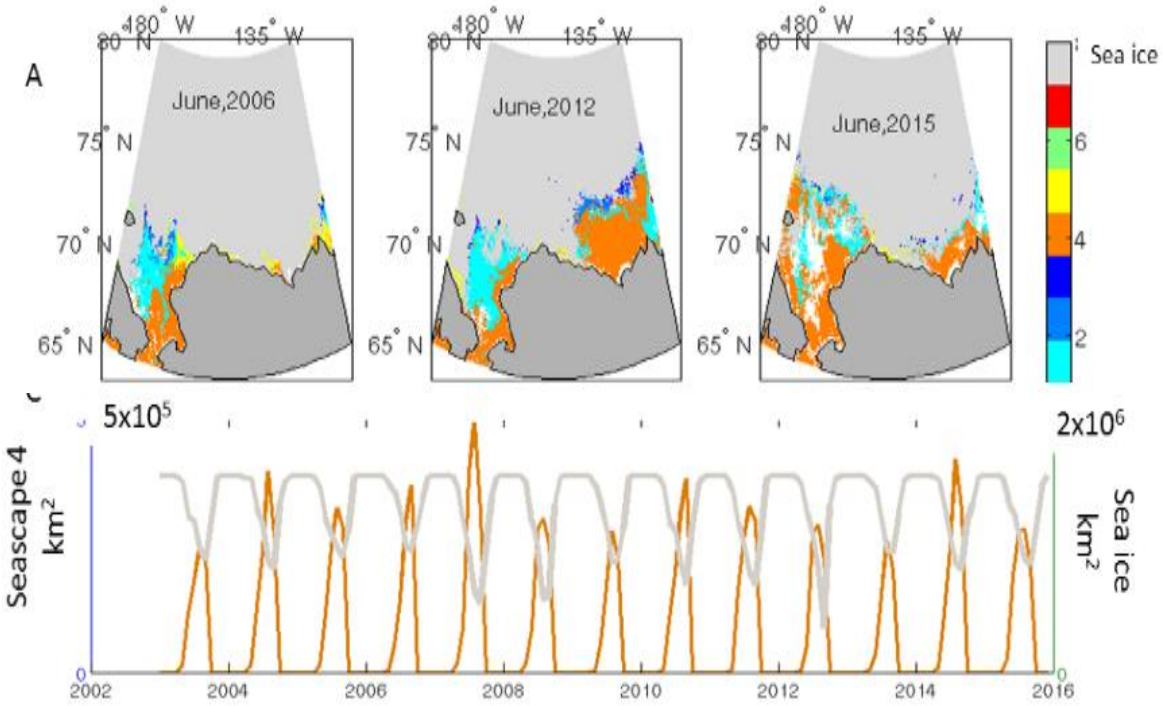
H3 (remote sensing science): There are no differences between seascapes derived from the MODIS and VIIRS/OLCI

Justification



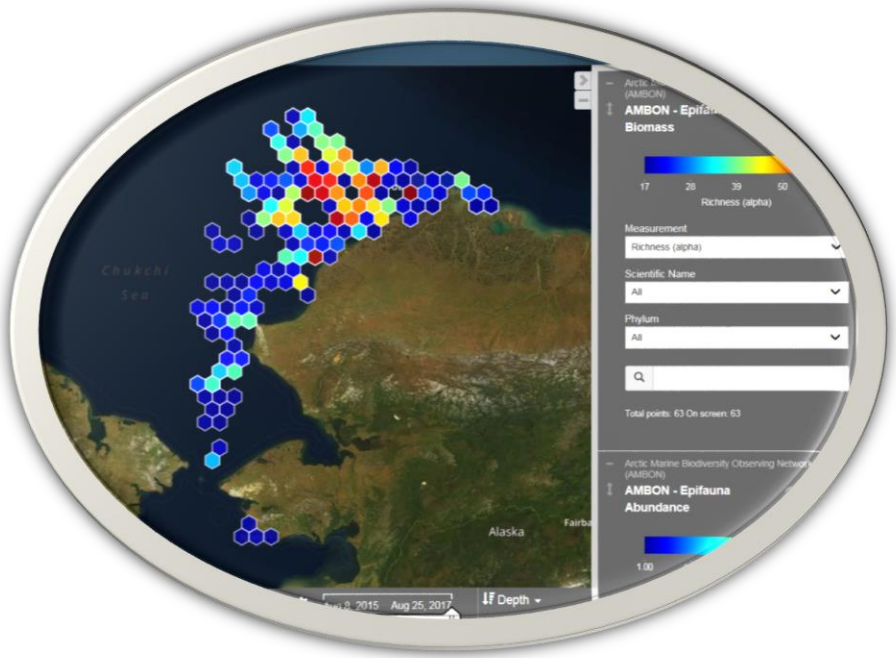
Alaska/Arctic MBON

- **Quantifying change** in biogeographic patterns is fundamental to ecology and to enable forecasting biodiversity and ecosystem functioning
- **Informing** research, applications (MBON, Marine Life 2030, SDG…)
- **Sustained observations** post-MODIS



Approach

1. Test hypotheses
2. Continue to improve Aqua-MODIS seascapes
3. Validate with field data (OBIS, GBIF, MBON)
4. Ensure continuity from MODIS to VIIRS (SNPP, NOAA-20; OLCI/Sentinel 3A-3B); compare products
6. Scientific interpretation of seascapes
7. Utility case studies



Methods

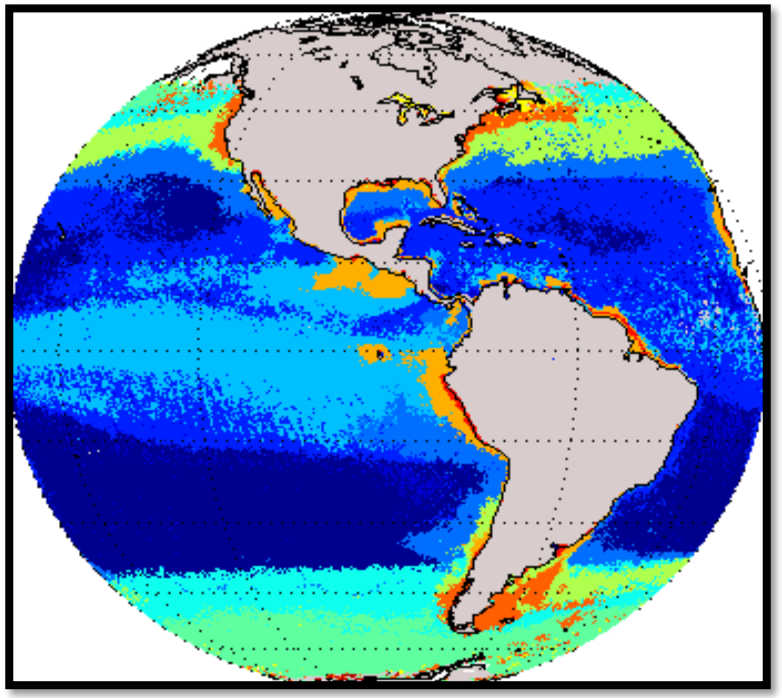
Seascape classifications methodology: Kavanaugh et al. (2014, 2016, 2018)

Classified with a combination of a probabilistic self-organizing map and agglomerative clustering which groups multivariate pixels into a neural map and preserves space-time hierarchical relationships

Inputs: time series of
sea surface temperature, salinity, sea surface height, wind stress, sea-ice, chl-a, phytoplankton fluorescence, and colored dissolved organic matter

8-day, monthly, climatology maps (5 km; limited regional 1 km downscaled)

Uncertainty analyses (water mass, statistics, MODIS vs. VIIRS/OLCI)



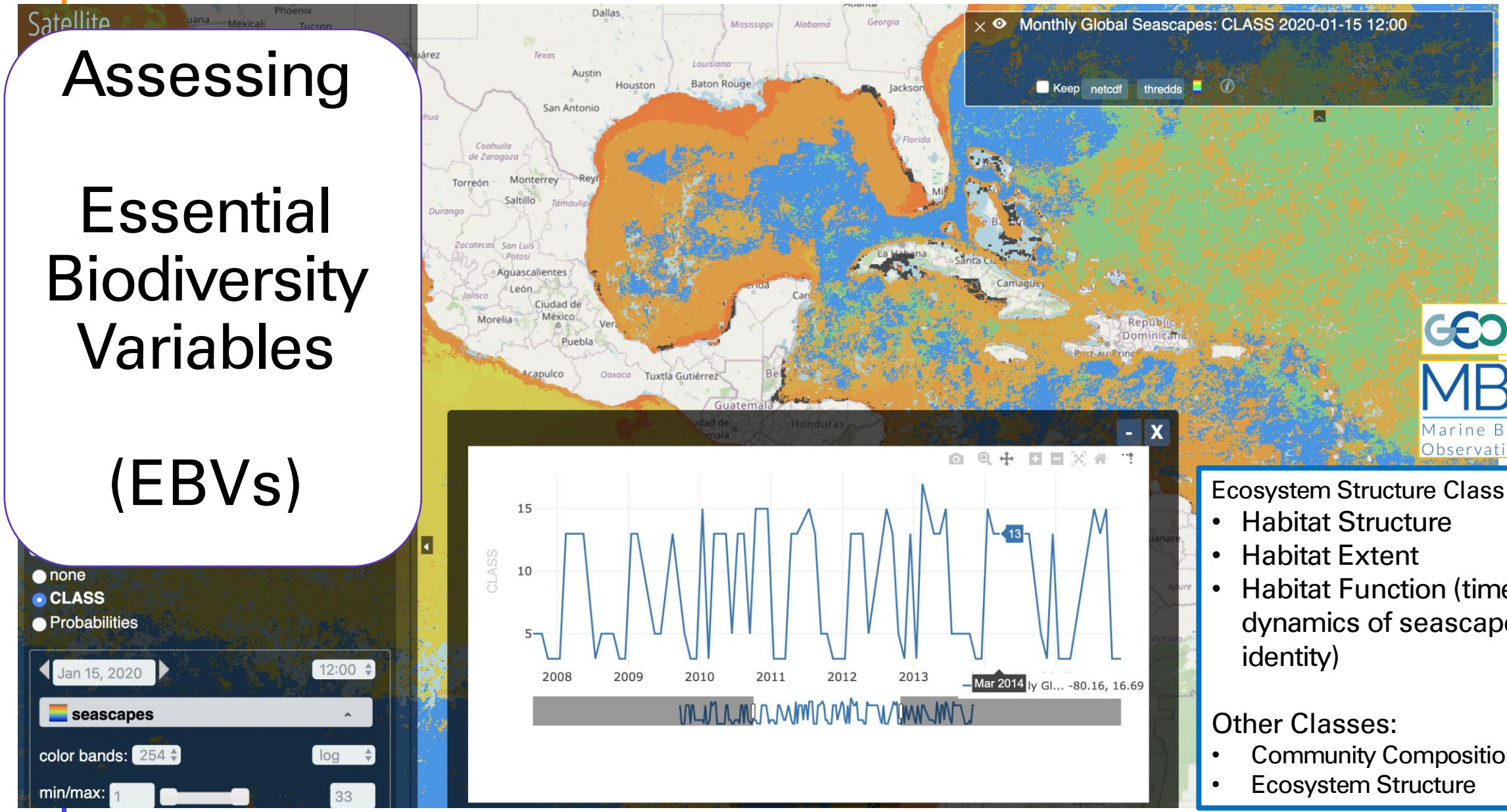
Kavanaugh, et al., 2014. Progress in Oceanography, 120, pp.291-304.
Kavanaugh, et al., 2016. ICES Journal of Marine Science 73 (7), 1839-1850
Kavanaugh, et al., 2018. Front. Mar. Sci. https://doi.org/10.3389/fmars.2018.00130

EXAMPLES

Assessing

Essential Biodiversity Variables

(EBVs)



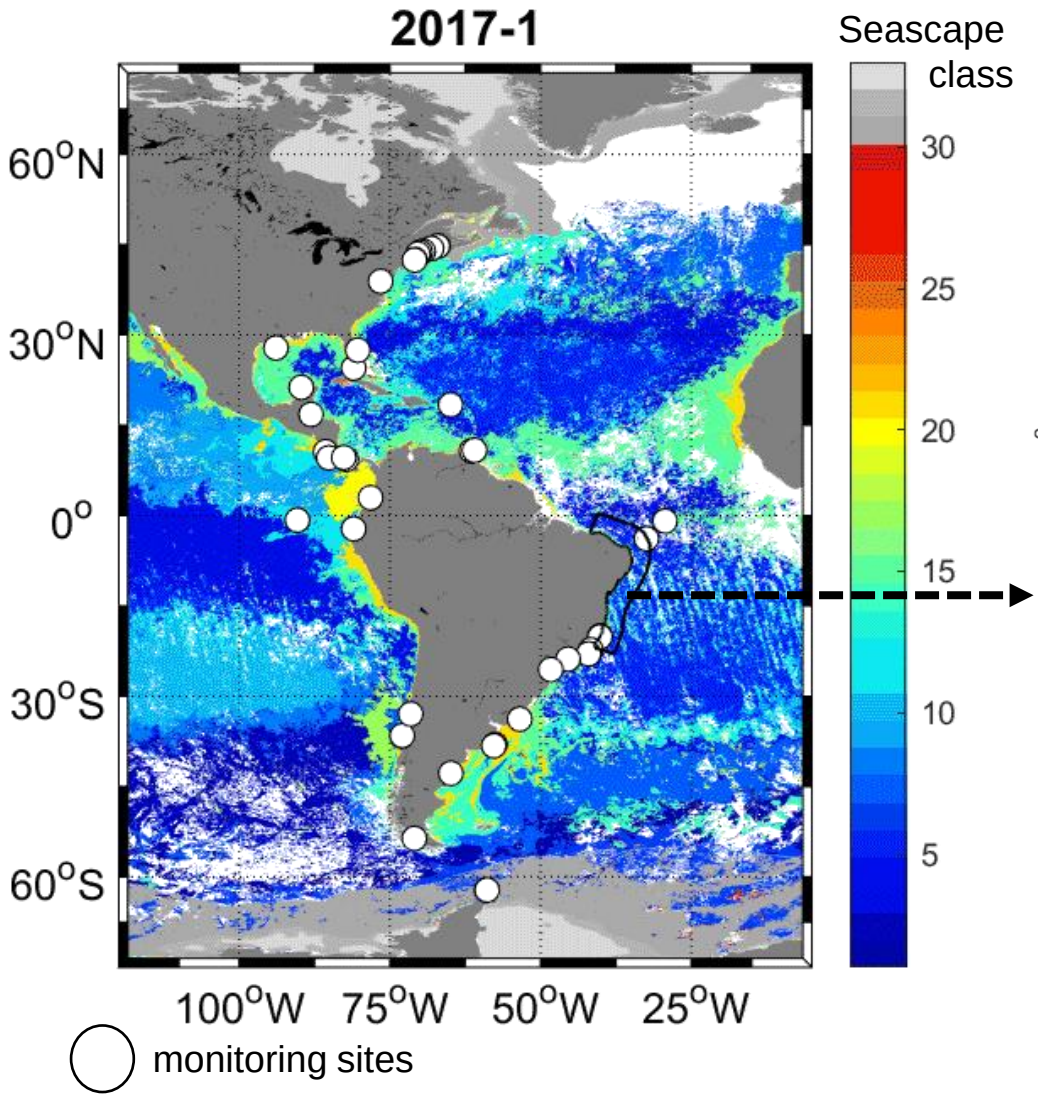
GEO BON
MBON
Marine Biodiversity Observation Network

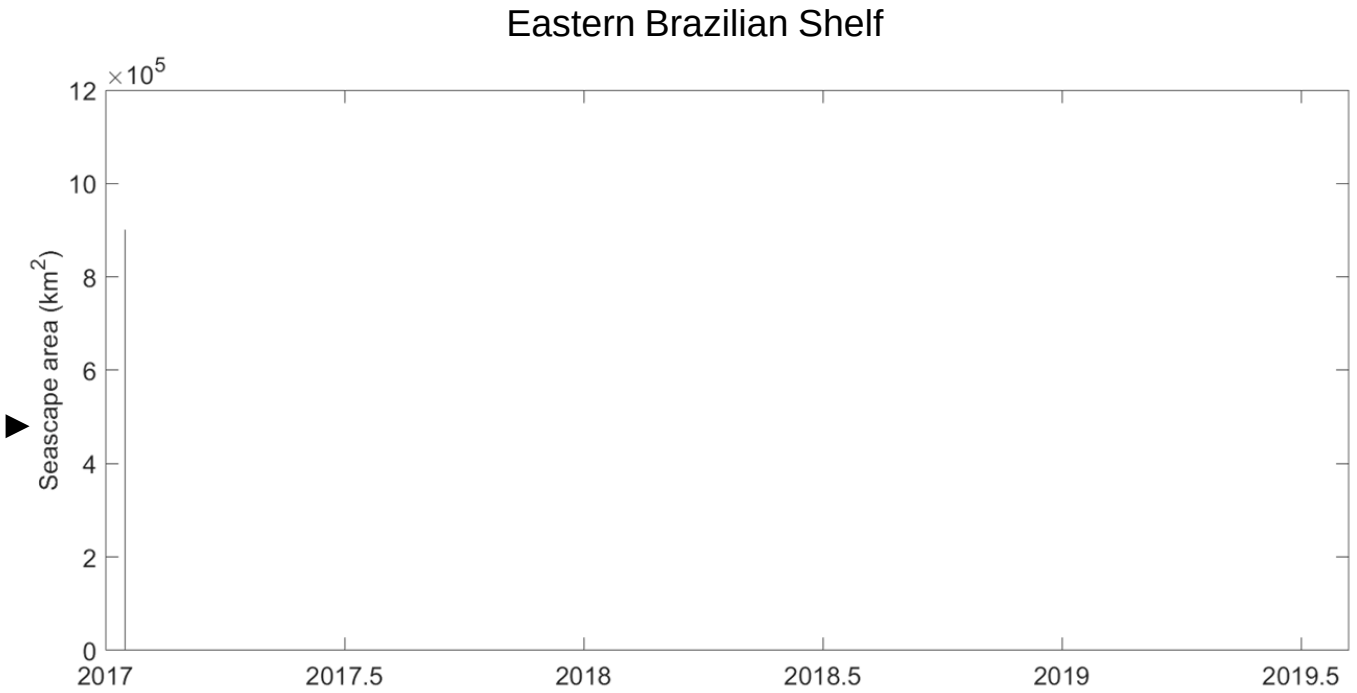
Ecosystem Structure Class
- Habitat Structure
- Habitat Extent
- Habitat Function (time dynamics of seascape identity)

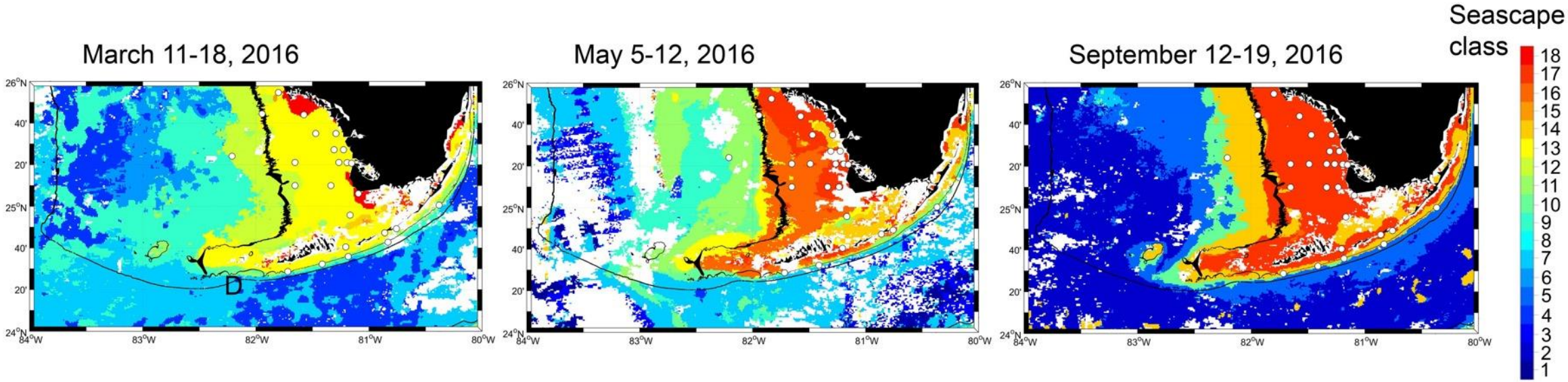
Other Classes:
- Community Composition
- Ecosystem Structure

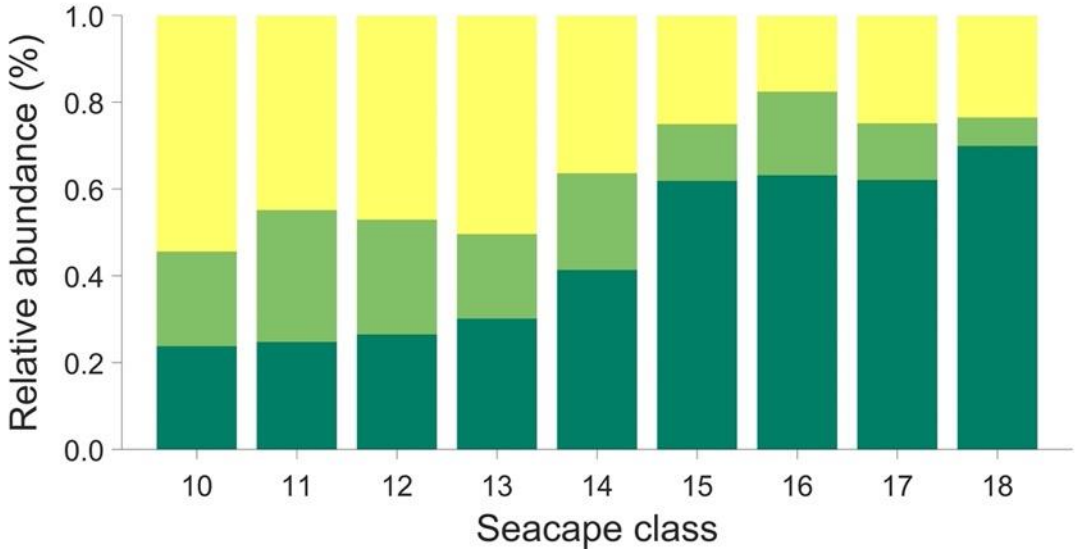
Capacity Building and regional coastal assessments:
Use of dynamic seascape maps in the MBON Pole to Pole in the Americas

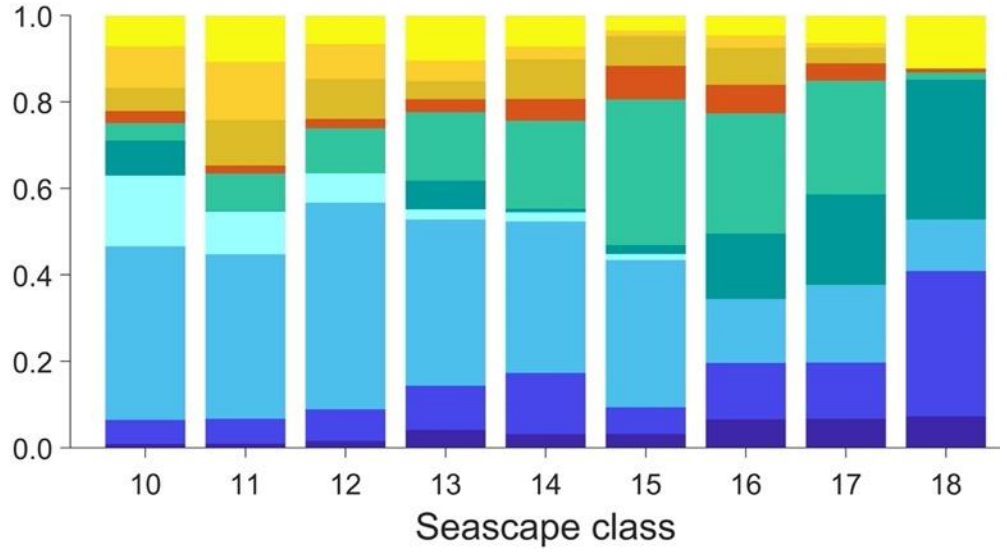
Global classification of surface waters at 5 km pixel res.

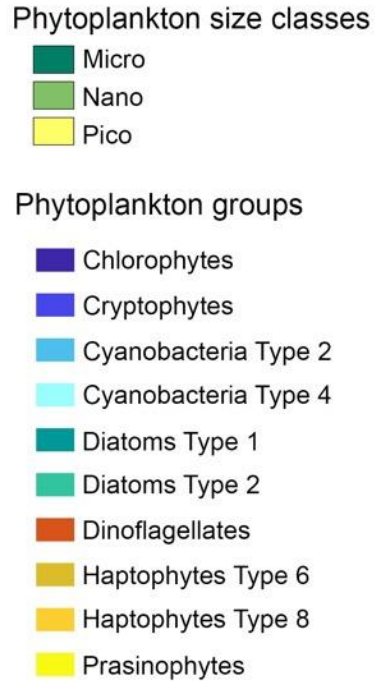




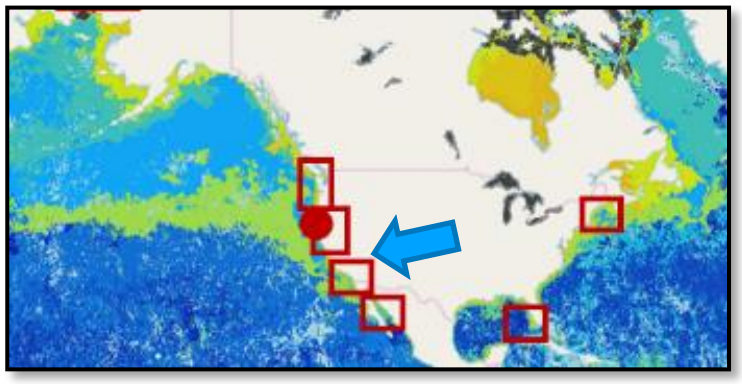

March 11-18, 2016
May 5-12, 2016
September 12-19, 2016
Seascape class
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
26°N
25°N
24°N
40'
20'
84°W
83°W
82°W
81°W
80°W
D


Relative abundance (%)
1.0
0.8
0.6
0.4
0.2
0.0
10
11
12
13
14
15
16
17
18
Seacape class


1.0
0.8
0.6
0.4
0.2
0.0
10
11
12
13
14
15
16
17
18
Seascape class


Phytoplankton size classes
Micro
Nano
Pico
Phytoplankton groups
Chlorophytes
Cryptophytes
Cyanobacteria Type 2
Cyanobacteria Type 4
Diatoms Type 1
Diatoms Type 2
Dinoflagellates
Haptophytes Type 6
Haptophytes Type 8
Prasinophytes

Continuity of products: from MODIS to VIIRS/OLCI



Comparison of seascape identity and boundaries using products derived from MODIS, VIIRS, and Sentinel-3 sensors.

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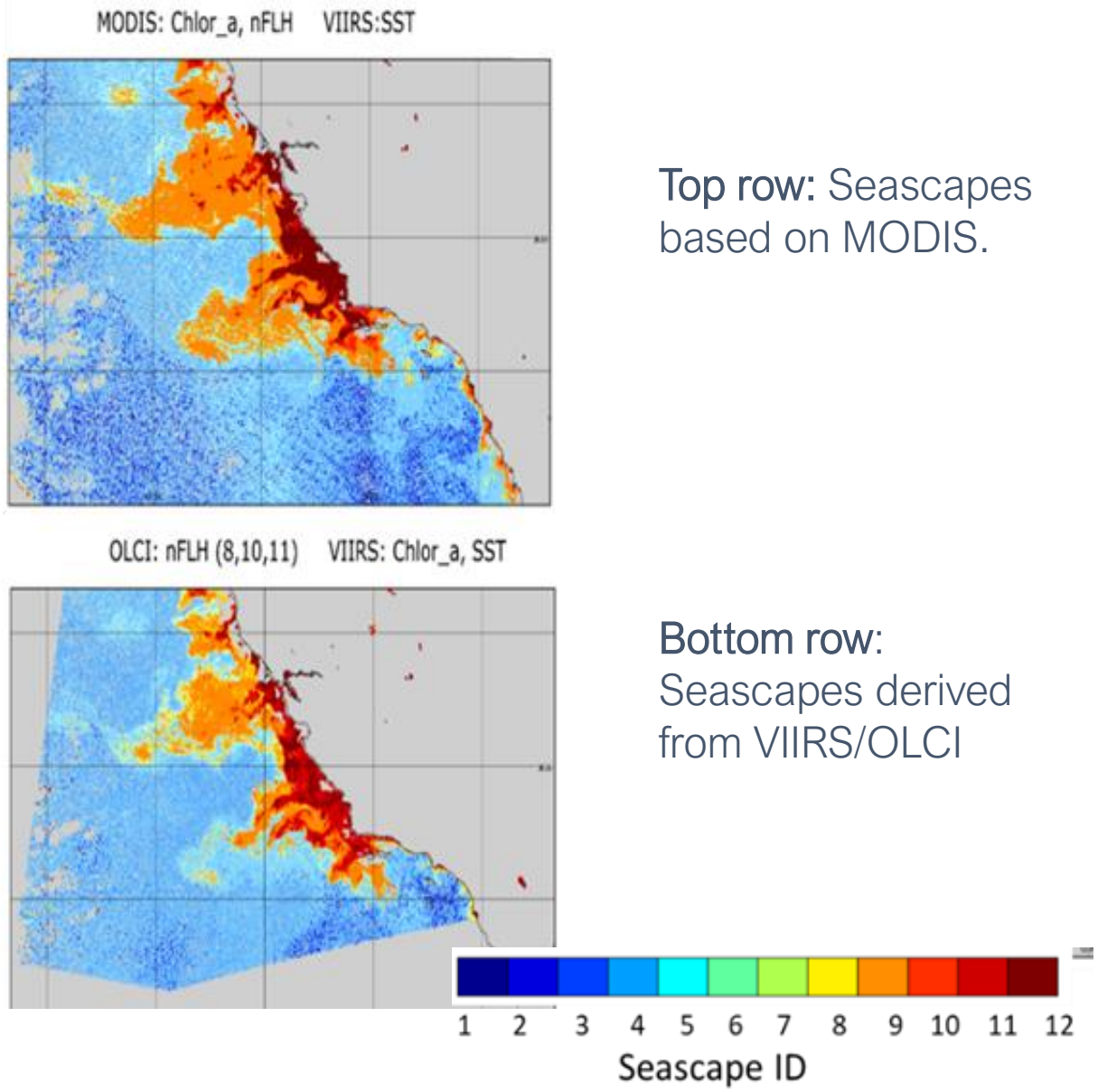


Top row: Seascapes based on MODIS.

Bottom row: Seascapes derived from VIIRS/OLCI

Timeline

Science and Technology:

Outcome 1: Phenology (Aqua-MODIS)

Outcome 2: VIIRS/OLCI seascape classifications; validation

User Engagement:

MBON Seascapes Working Group

Year 1

Science and Technology:

Outcome 3: Downscaling seascapes (higher spatial/temporal resolution)

VIIRS/OLCI product phenology

User Engagement:

Workshops / seascape demonstrations

Year 2

Science and Technology:

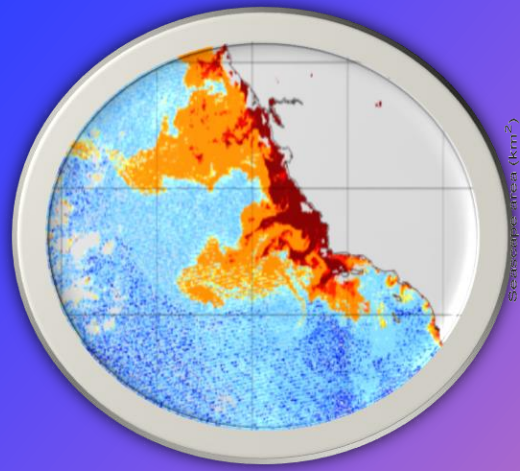
Synthesis

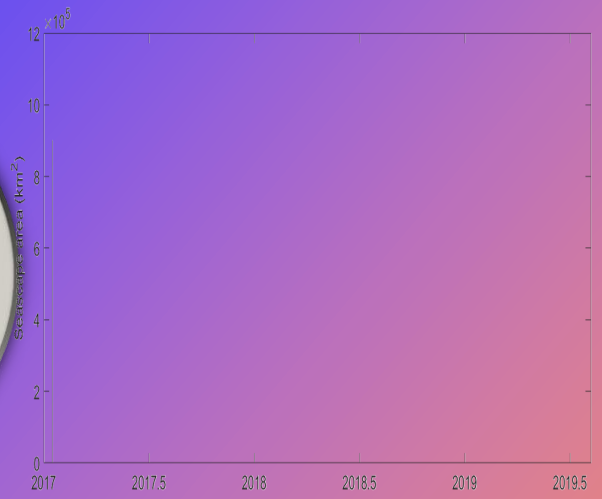
Full transition of global and regional seascape products to CoastWatch

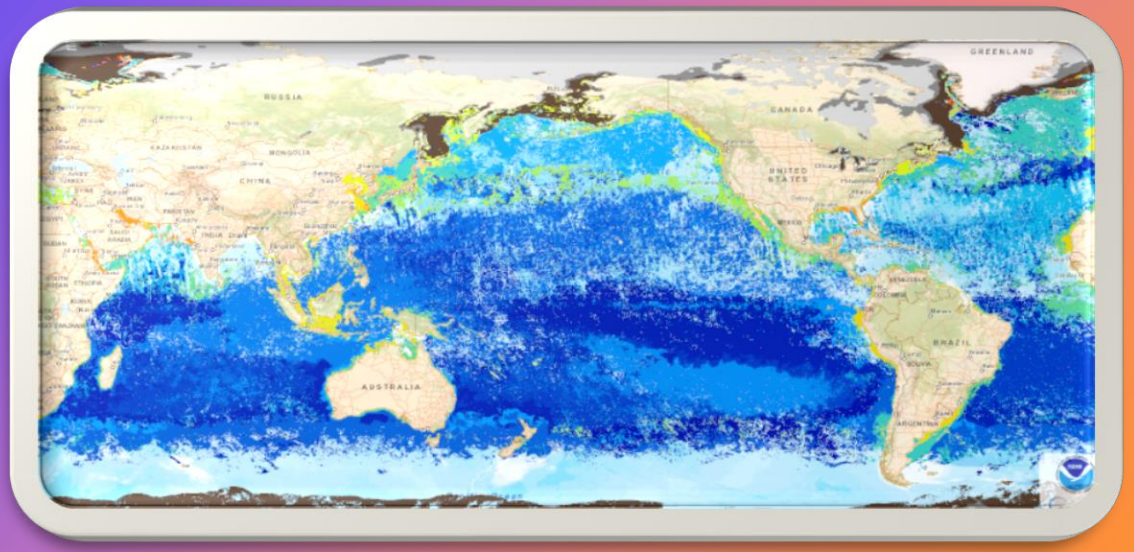
User Engagement:

Training workshops: access and use of the CoastWatch products

Year 3







Summary

- Continuity of biogeographic seascapes (MODIS to VIIRS/OLCI)
- Validated EBVs and ecosystem change analyses
- Research to operations transition with NOAA/NESDIS CoastWatch
- Collaboration among federal, state, academic partners
- National and international scope

MODIS TO VIIRS CONTINUITY OF SEASCAPES

THANK YOU

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