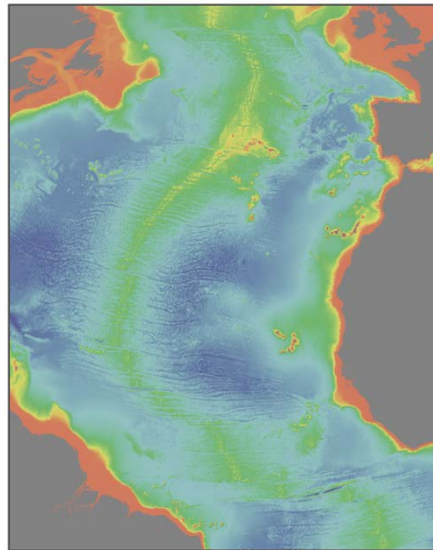


Review of regional scientific data/information/maps compiled

WORKSHOP ON THE REGIONAL ENVIRONMENTAL MANAGEMENT
PLAN FOR THE AREA OF THE NORTHERN MID-ATLANTIC RIDGE

25 November 2019
Evora, Portugal



Patrick Halpin, Jesse Cleary, Sarah DeLand, Elisabetta Menini, Sena McCrory, Kharia Ismail
Marine Geospatial Ecology Lab, Duke University, USA

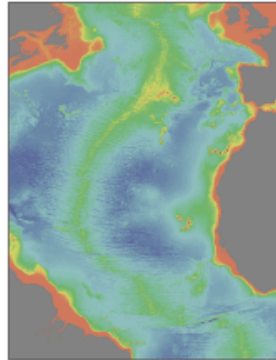
Workshop Data Report

DRAFT: This draft will be further refined based on the comments from the workshop participants.

**DRAFT Data Report:
Workshop on the Regional Environmental Management Plan for
the Area of the Northern Mid-Atlantic Ridge**

**Evora, Portugal
25-29 November, 2019**

Jesse Cleary, Sarah DeLand, Elisabetta Merini, Sena McCrory, Khaira Ismail, Patrick N. Halpin
Marine Geospatial Ecology Lab, Duke University



Supported by



This work was supported by the Atlantic REMP project, funded under Service Contract EASME/EMFF/2017/1.3.1.1 - SI2.775068 to the European Commission.

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Funding

This work was supported by the Atlantic REMP project, funded under Service Contract EASME/EMFF/2017/1.3.1.1 - SI2.775068 to the European Commission.

The project is executed by a consortium of scientists and scientific organisations:

- Seascope Consultants Ltd, UK
- Deep Seas Environmental Solutions Ltd, UK
- Instituto do Mar (University of the Azores), Portugal
- Institute for Advanced Sustainability Studies, Germany
- Duke University Marine Geospatial Ecology Lab, USA
- Environmental Resources Management Ltd, UK
- Jose Angel Alvarez Perez, Universidade do Vale do Itajaí – UNIVALI, Brazil
- Alexander Turra, Universidade de São Paulo, Brazil

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Acknowledgements

The data collection team gratefully acknowledge contributions from:

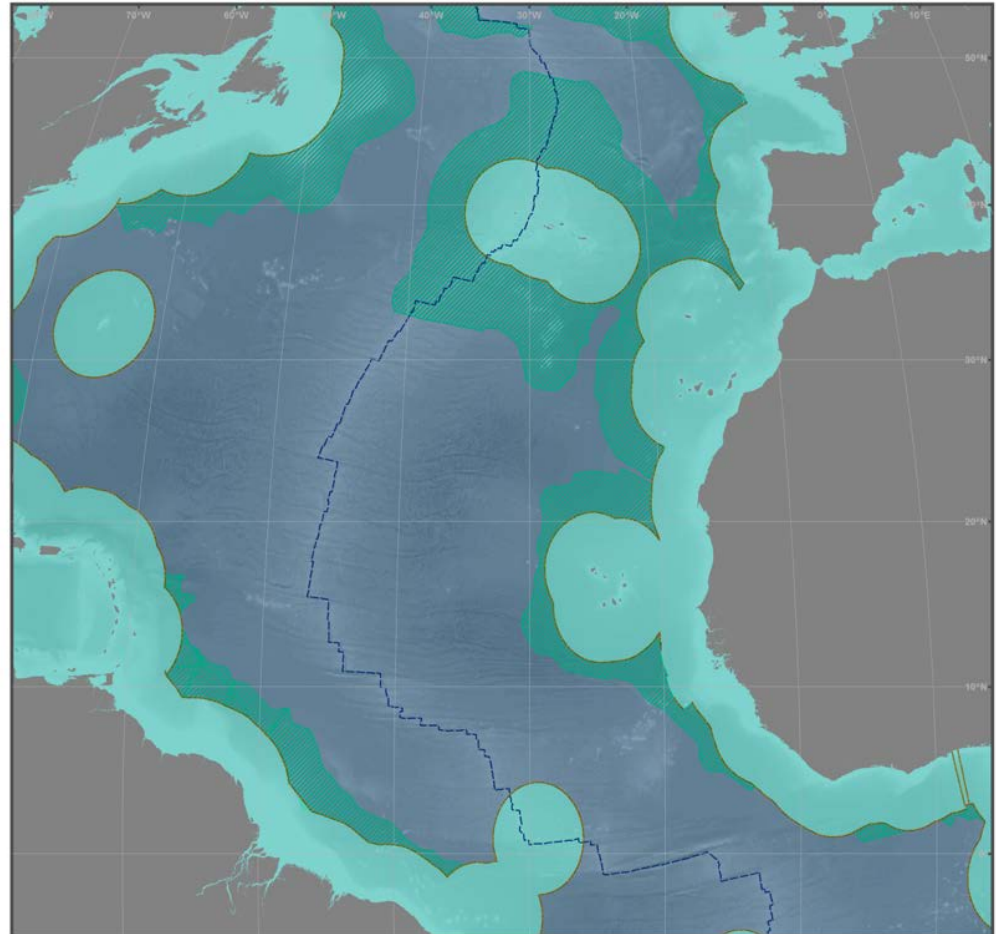
- Phil Weaver, Rachel Boschen-Rose - Seascope Consultants
- Ward Appletans, Pieter Provoost - Ocean Biogeographic Information System
- Cindy Van Dover - Duke University
- Daniel C. Dunn - University of Queensland, Duke University
- Jihyun Lee, Luciana De Melo Santos Genio, Sheldon Carter - ISA Secretariat
- Telmo Morato, Gerald H. Taranto, Frederic Vandeperre, Christopher K. Pham, Daniel C. Dunn, Ana Colaço - SEMPIA workshop data collection team
- Piers Dunstan, Skip Woolley - CSIRO Australia

Workshop Data Report

Data collection scope:
Mid Atlantic Ridge and
surrounding ocean areas

- Southern end of Icelandic ECS submission ($\sim 57^\circ \text{N}$)
- South of the Romanche Fracture Zone ($\sim 9^\circ \text{S}$)

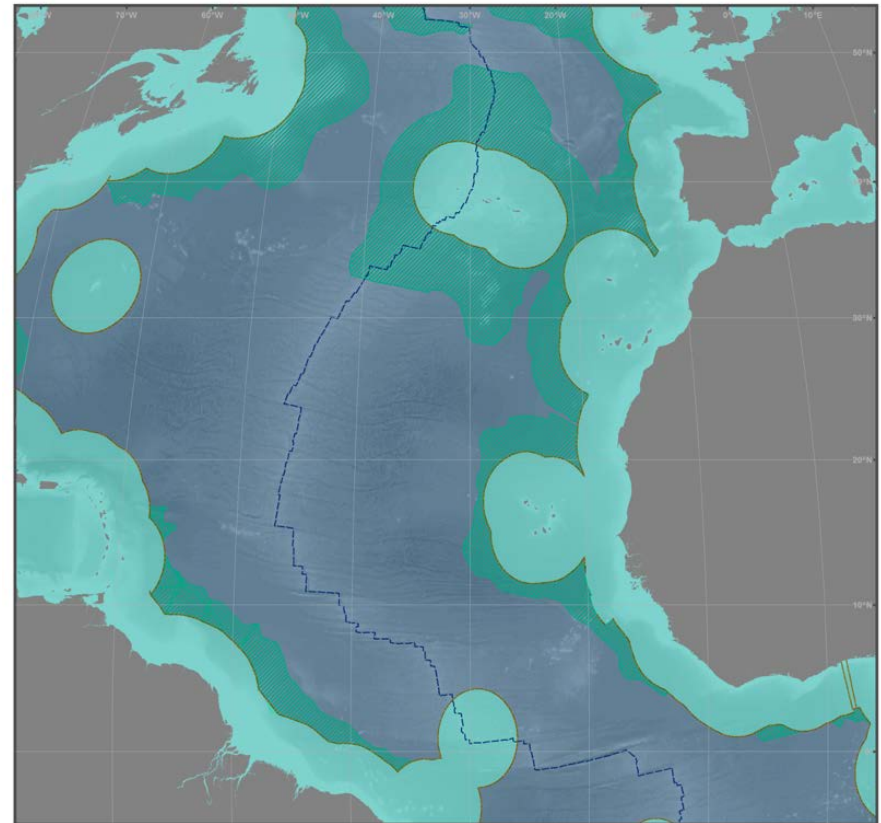
Area inclusive of the broader region to provide regional context and does not represent the REMP planning area.



Workshop Data Report

Purpose

- Aid in understanding of available data
- Help identify data gaps
- Discovery of datasets that could be used during the workshop process



Compilation of scientific data & information

Describe the data
~100 GIS data layers

Consider possible analyses to support
the workshop...

Overlay & Analysis

DRAFT: This draft will be further refined based on the comments from the workshop participants.

DRAFT Data Report:
Workshop on the Regional Environmental Management Plan for
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Evora, Portugal
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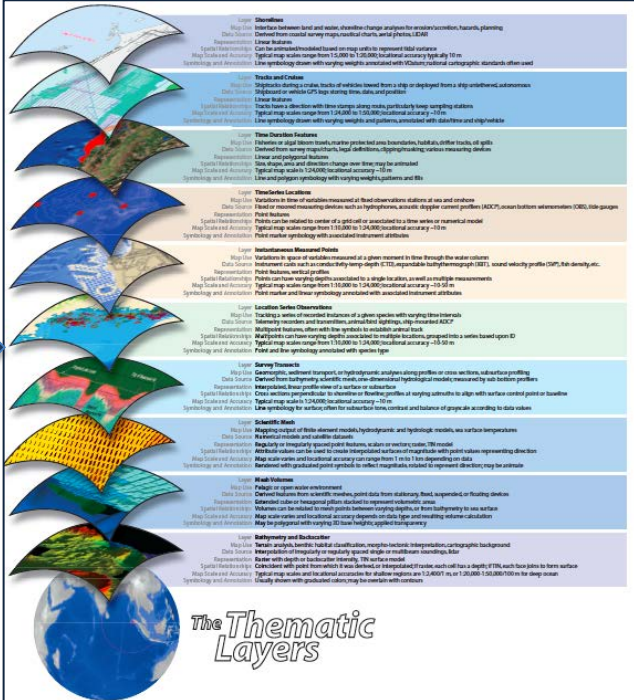
Jesse Cleary, Sarah DeLand, Elisabetta Merini, Sera McCrory, Khajra Ismail, Patrick N. Halpin
Marine Geospatial Ecology Lab, Duke University




Supported by

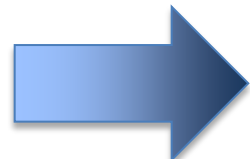
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The Thematic Layers

- Oceanography**
 - Depth: Bathymetry, seafloor topography, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Bathymetry, seafloor topography, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Geology**
 - Depth: Seafloor geology, sediment distribution, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Seafloor geology, sediment distribution, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Biology**
 - Depth: Marine life distribution, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Marine life distribution, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Chemistry**
 - Depth: Chemical composition, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Chemical composition, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Physics**
 - Depth: Physical properties, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Physical properties, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Meteorology**
 - Depth: Meteorological data, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Meteorological data, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Seismicity**
 - Depth: Seismic activity, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Seismic activity, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Geomorphology**
 - Depth: Seafloor morphology, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Seafloor morphology, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Geology**
 - Depth: Geological data, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Geological data, hydrographic profiles, water column profiles, oceanographic profiles
- Marine Biology**
 - Depth: Biological data, hydrographic profiles, water column profiles, oceanographic profiles
 - Scale: Global, regional, local
 - Resolution: 100m to 1000m
 - Accuracy: 10m to 100m
 - Metadata: Biological data, hydrographic profiles, water column profiles, oceanographic profiles



Workshop Data Report

Northern Mid-Atlantic Ridge

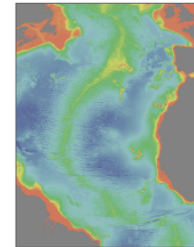
- Environmental Data
- Biological Data
- Biogeographic Classifications
- Human Uses
- Areas Defined for Management and/or Conservation Objectives

DRAFT: This draft will be further refined based on the comments from the workshop participants.

DRAFT Data Report:
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Marine Geospatial Ecology Lab, Duke University



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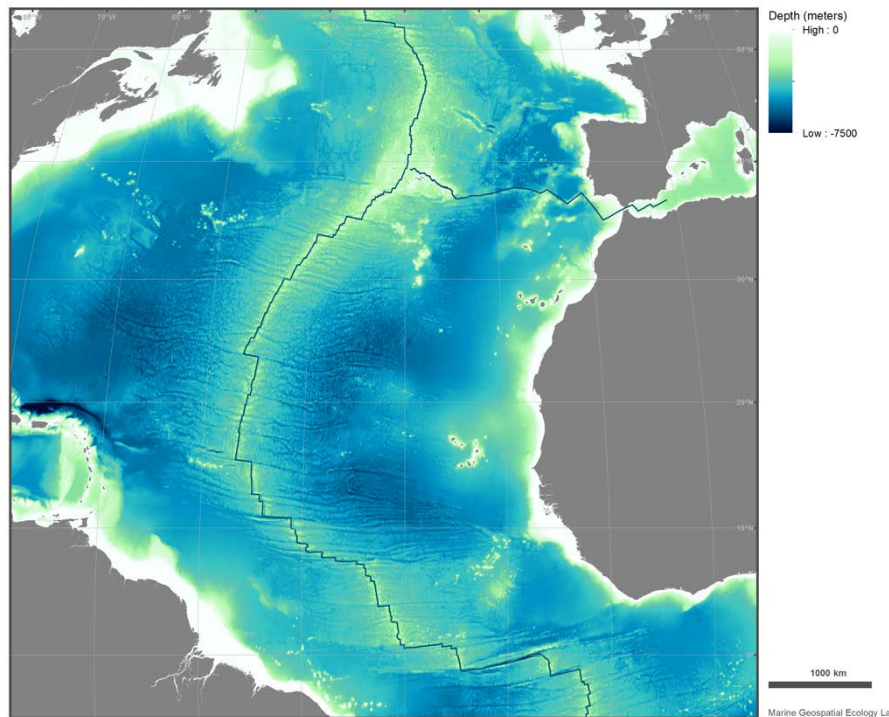
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Environmental Data

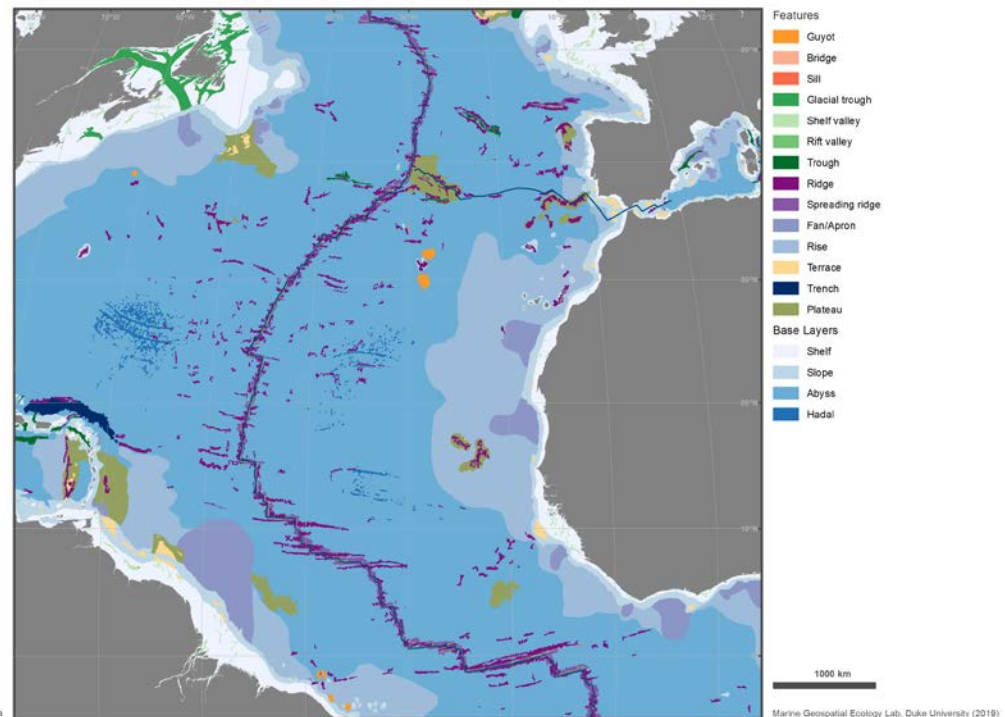
GEBCO Bathymetry

Bathymetry (GEBCO 2019)



Seafloor Geomorphic Features

Global Seafloor Geomorphic Features (Harris et al. 2014)

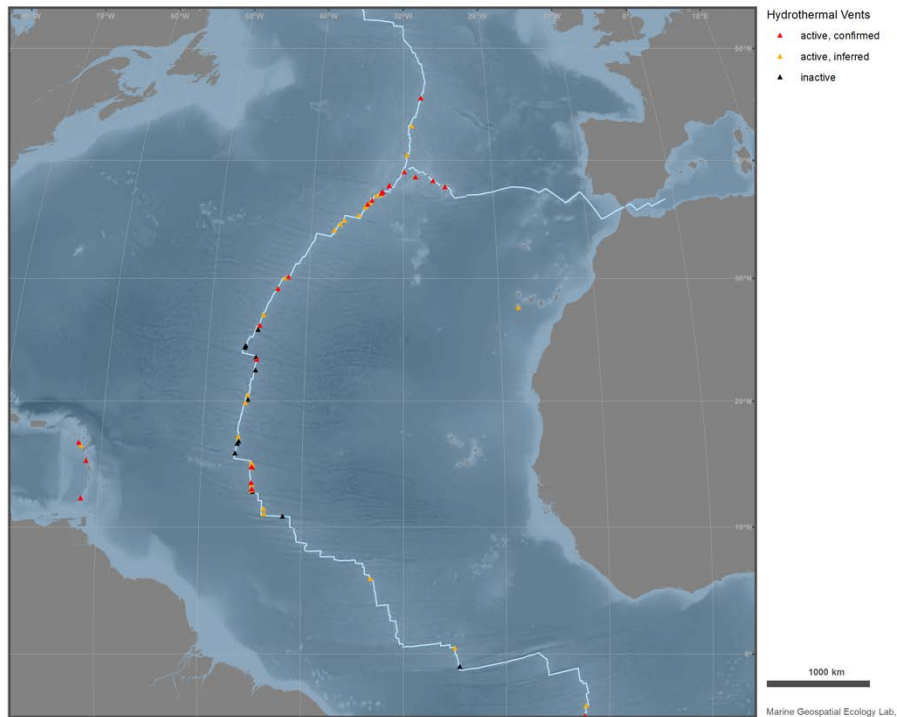


Environmental Data

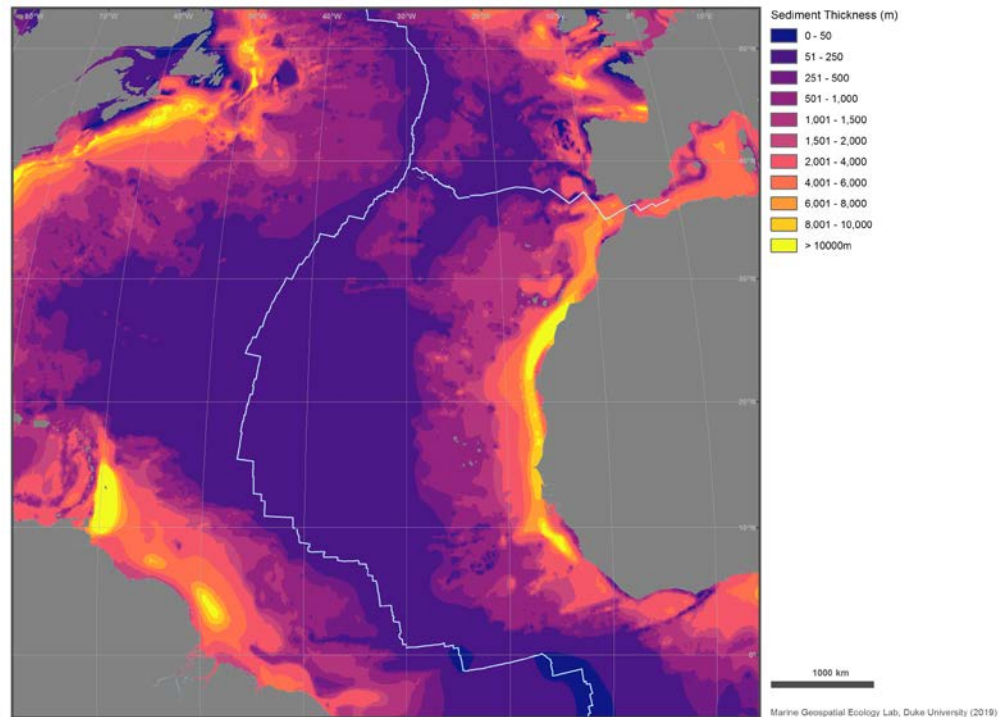
Interridge Vent Database

Sediment Thickness

Hydrothermal Vents (InterRidge database v3.4)



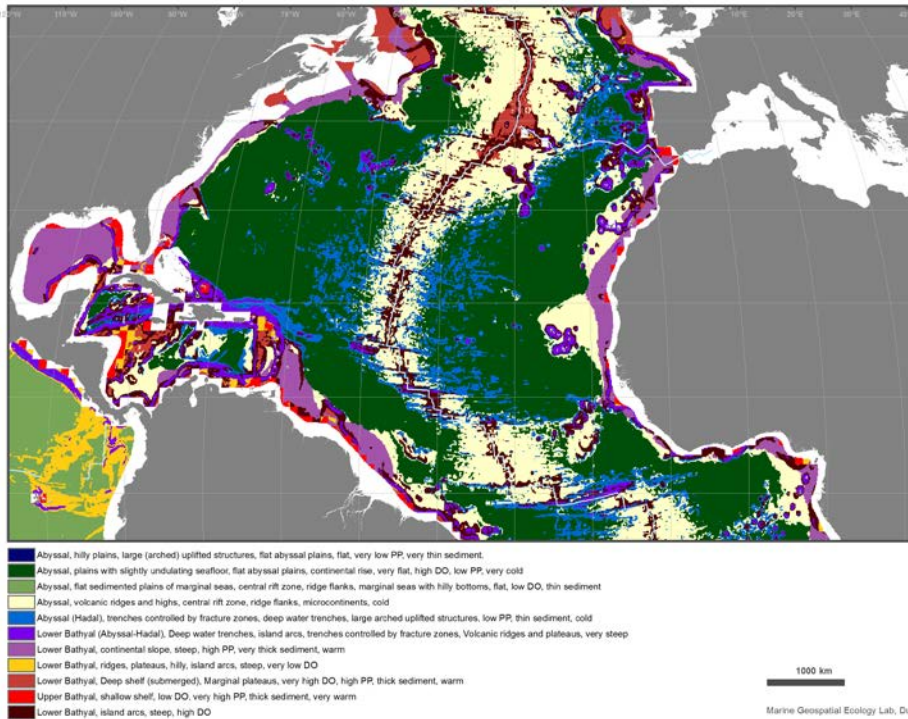
Sediment Thickness of the Worlds Oceans & Marginal Seas (Straume et al. 2019)



Environmental Data

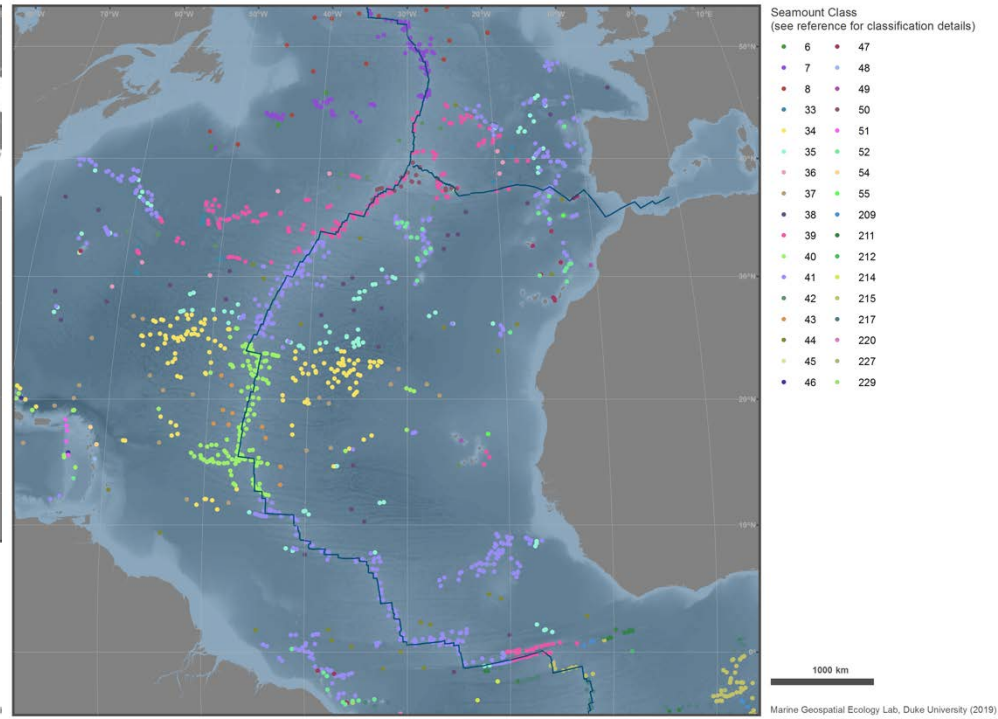
Global Seascapes

Global Seascapes (Harris and Whiteway 2009)



Seamount Classification

Global Seamount Classification (Clark et al. 2011)

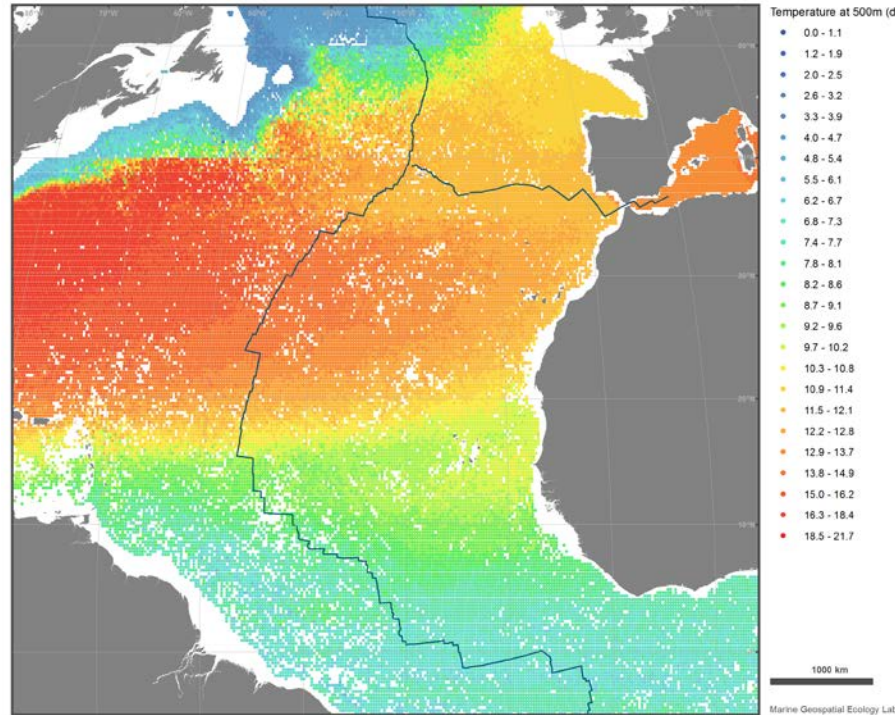


Environmental Data

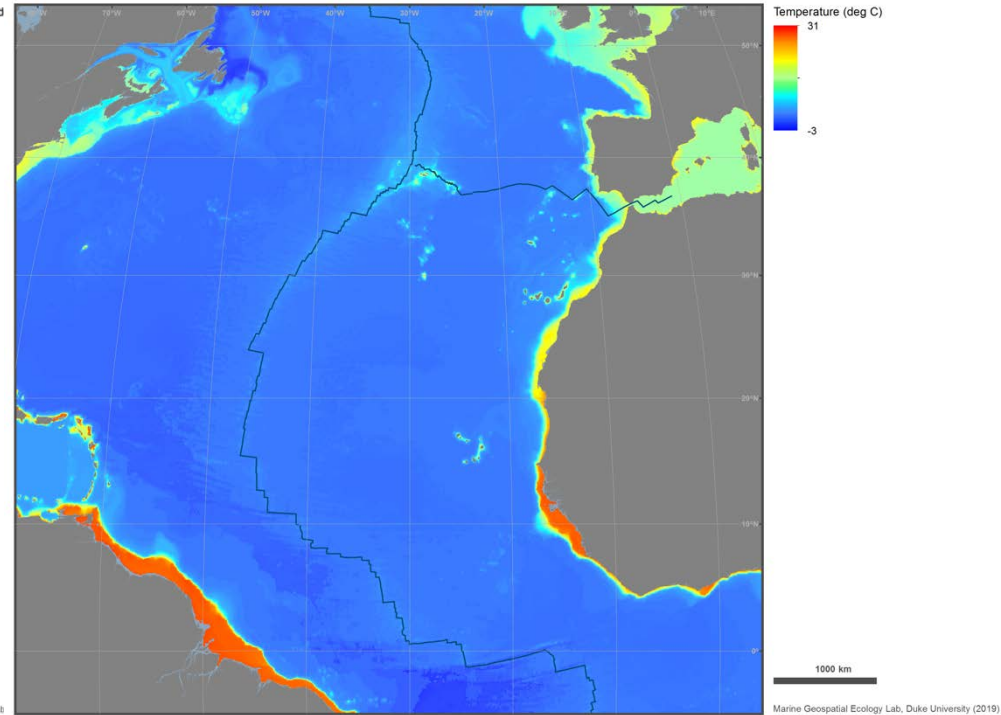
World Ocean Atlas Temperature
Climatology - multiple depth zones

HYCOM modeled temperature -
multiple depth zones

Temperature Climatology, 500m (World Ocean Atlas 2018)



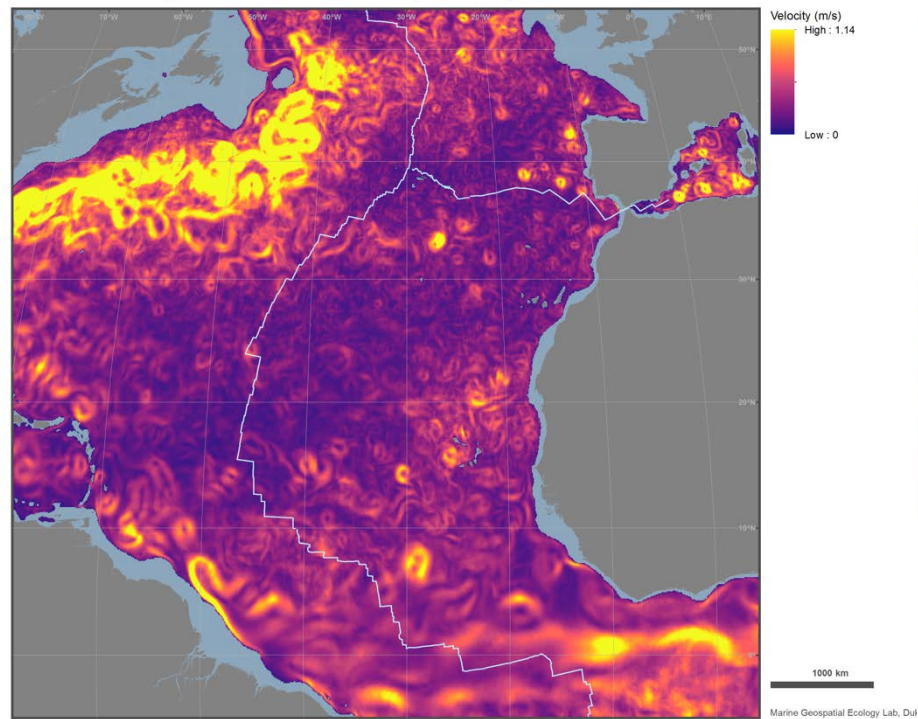
Bottom Temperature, January 2018 (HYCOM)



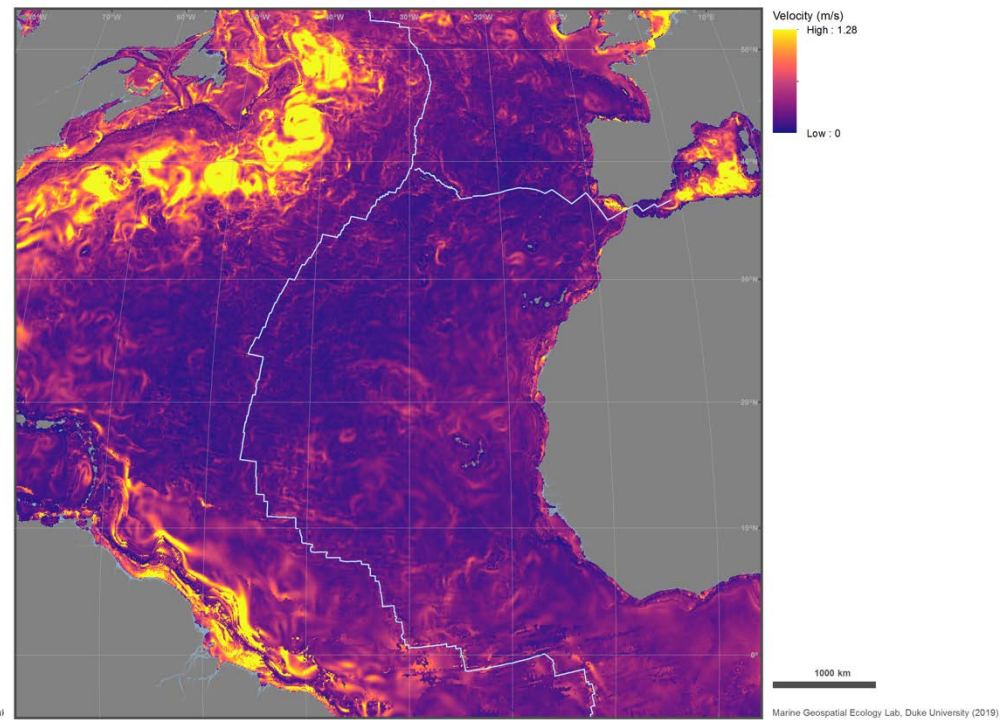
Environmental Data

HYCOM Current Velocity – multiple depth zones

Current Velocity, 500m, January 2018 (HYCOM)



Current Velocity, Bottom, January 2018 (HYCOM)

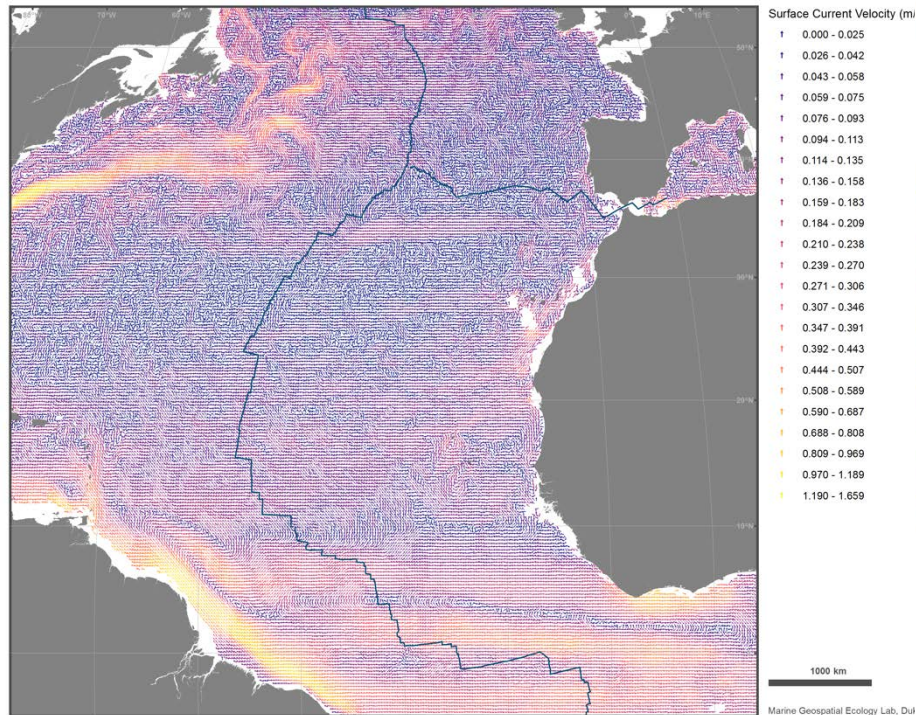


Environmental Data

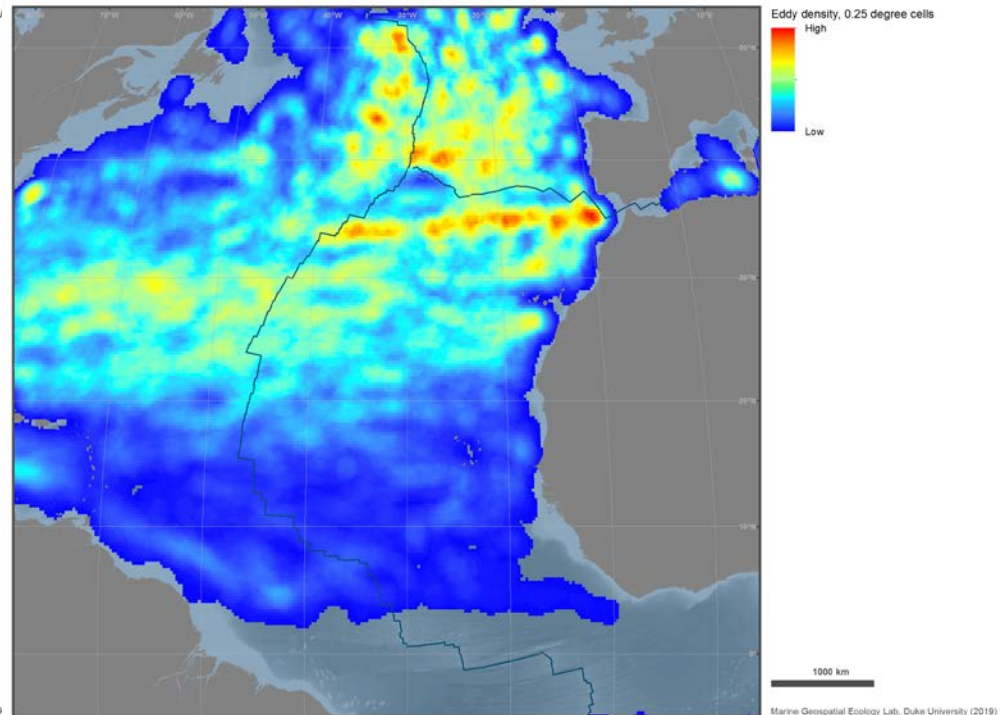
Drifter-derived Surface Currents

Mesoscale Eddy Density Climatology

Drifter-Derived Climatology of Near-Surface Currents



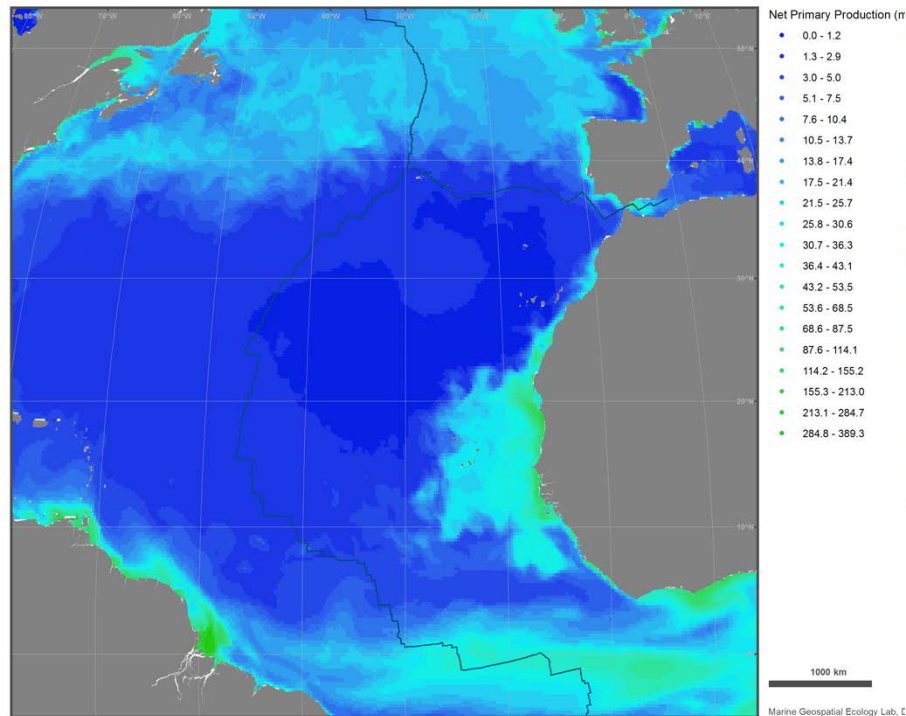
Mesoscale Eddy Density



Environmental Data

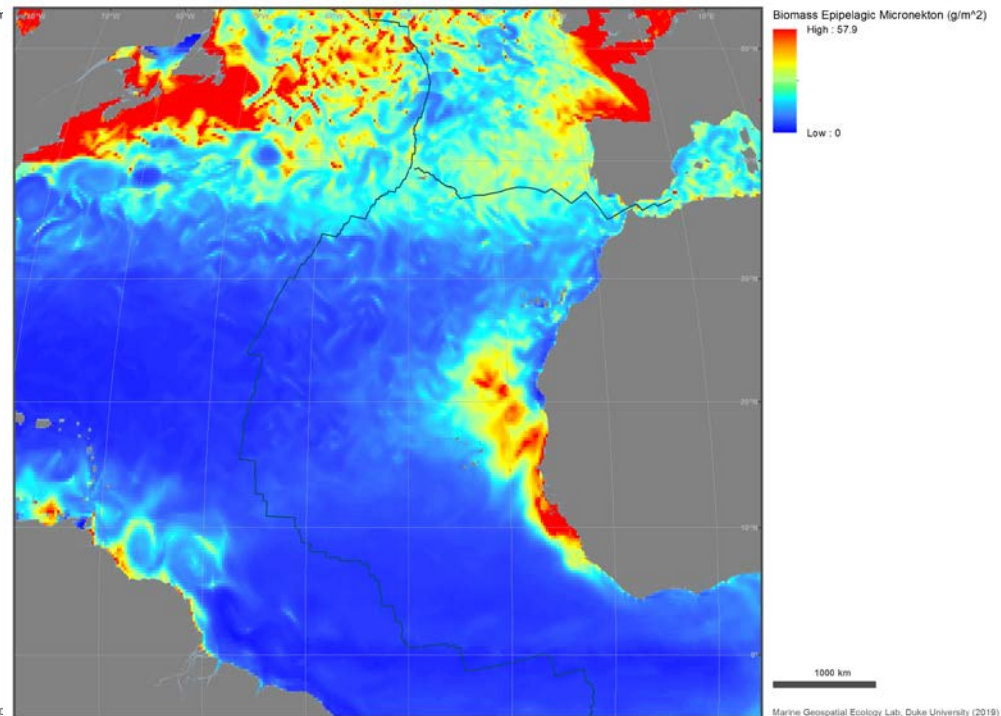
Net Primary Productivity

Net Primary Production of Biomass, June 2018 (Mercator Ocean model)



Epipelagic Micronekton Biomass

Epipelagic Micronekton Biomass, June 2016 (low and mid-trophic levels reanalysis model)

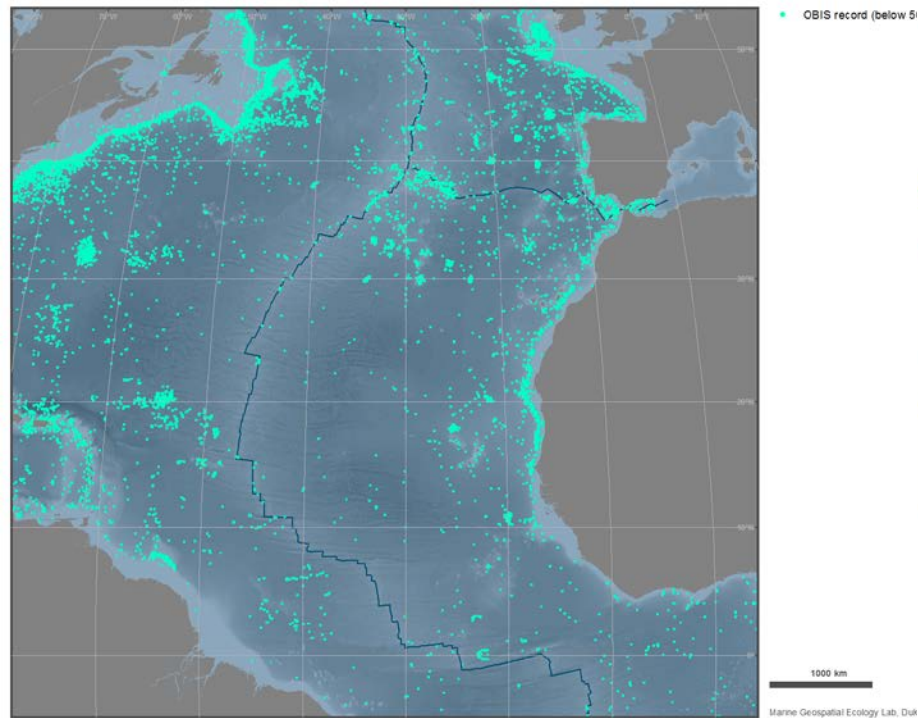


Biological Data

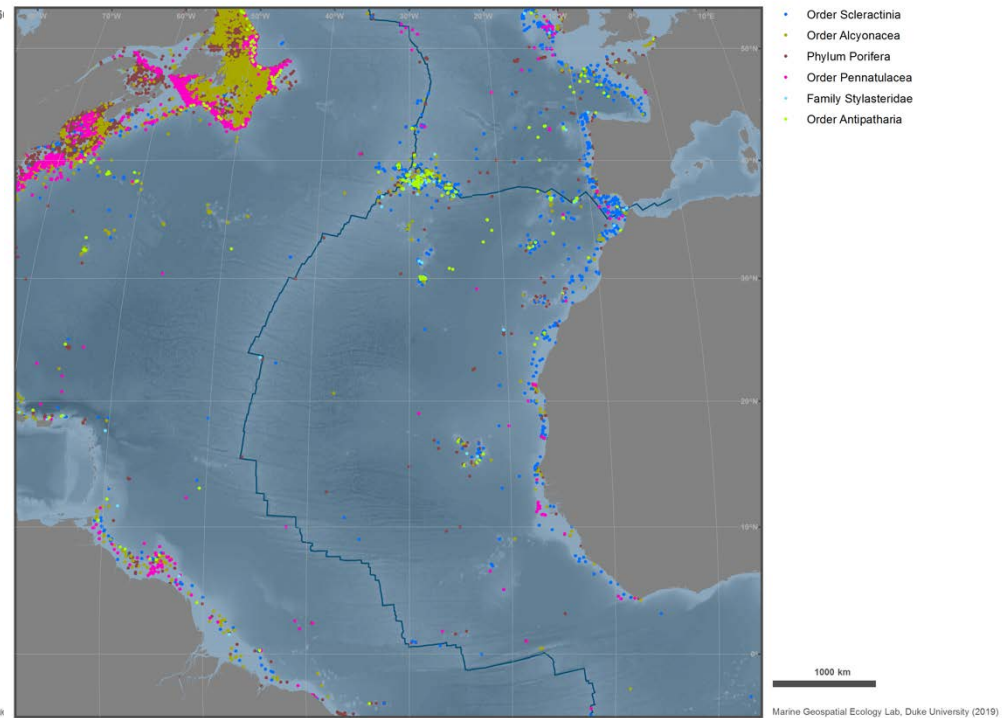
OBIS Observations: below 500m

OBIS Observations: VME Taxa

OBIS Records: Below 500m



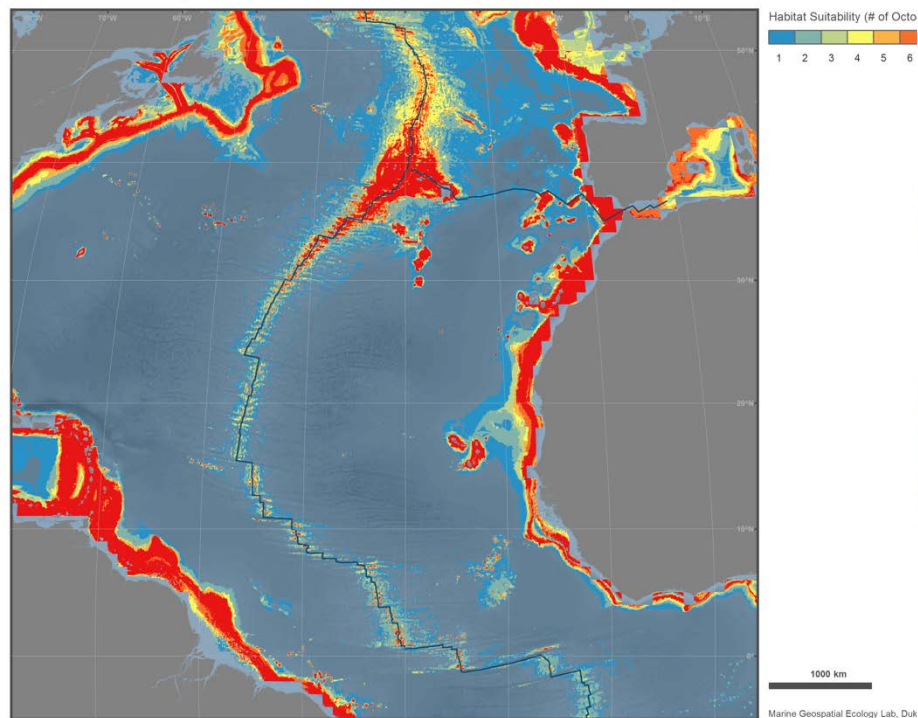
OBIS Records: VME Taxa



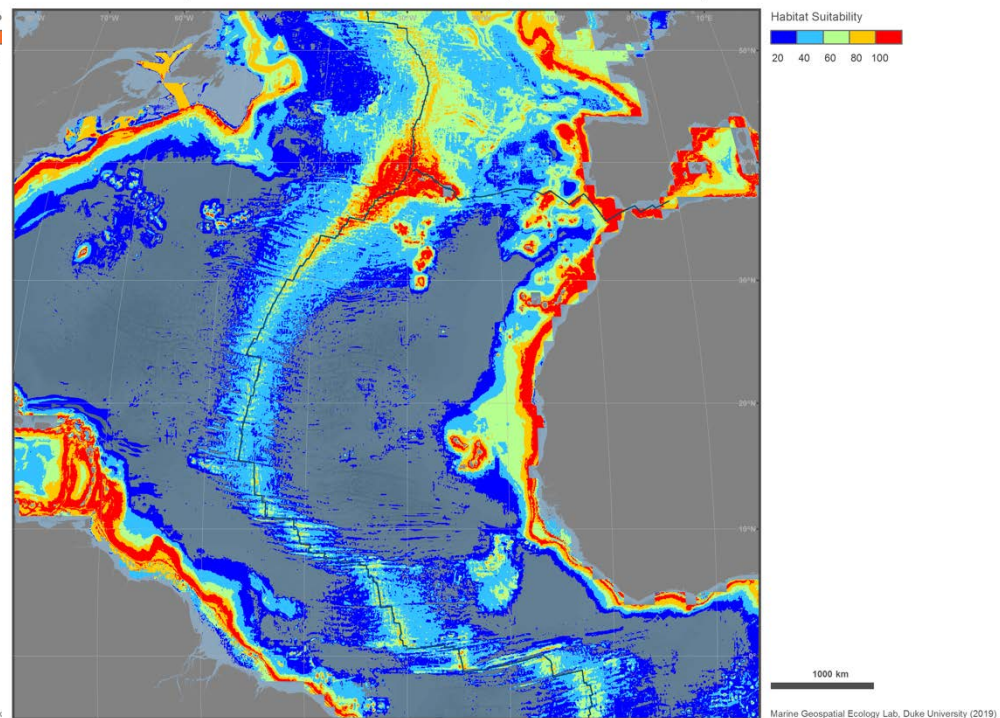
Biological Data

Habitat Suitability for Cold-water Octocorals

Habitat Suitability of Cold-Water Octocorals (Yesson et al. 2012)



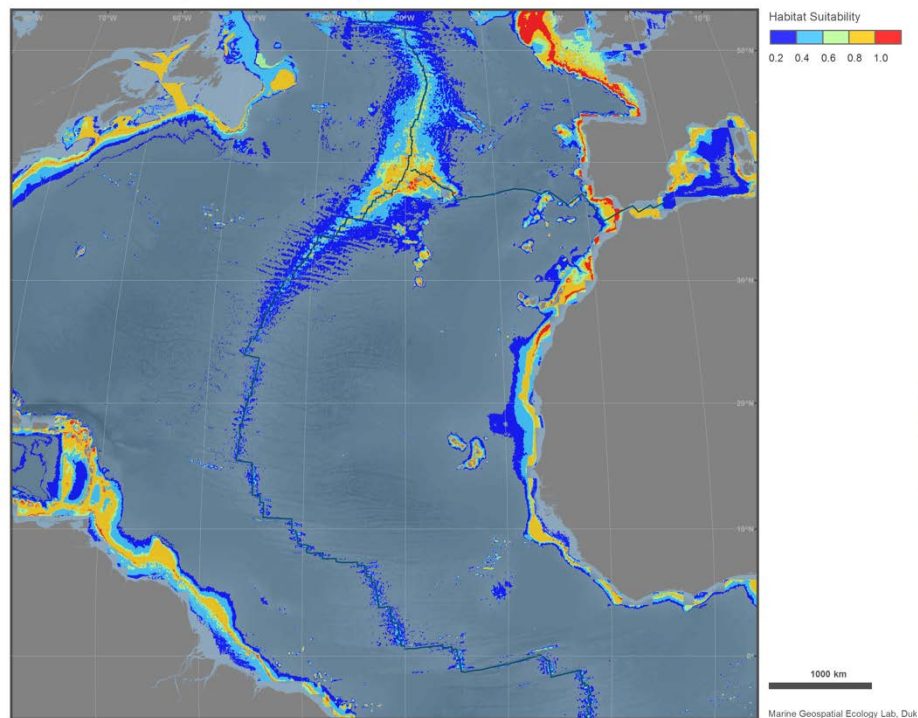
Habitat Suitability of the suborder Sessiliflorae (Yesson et al. 2012)



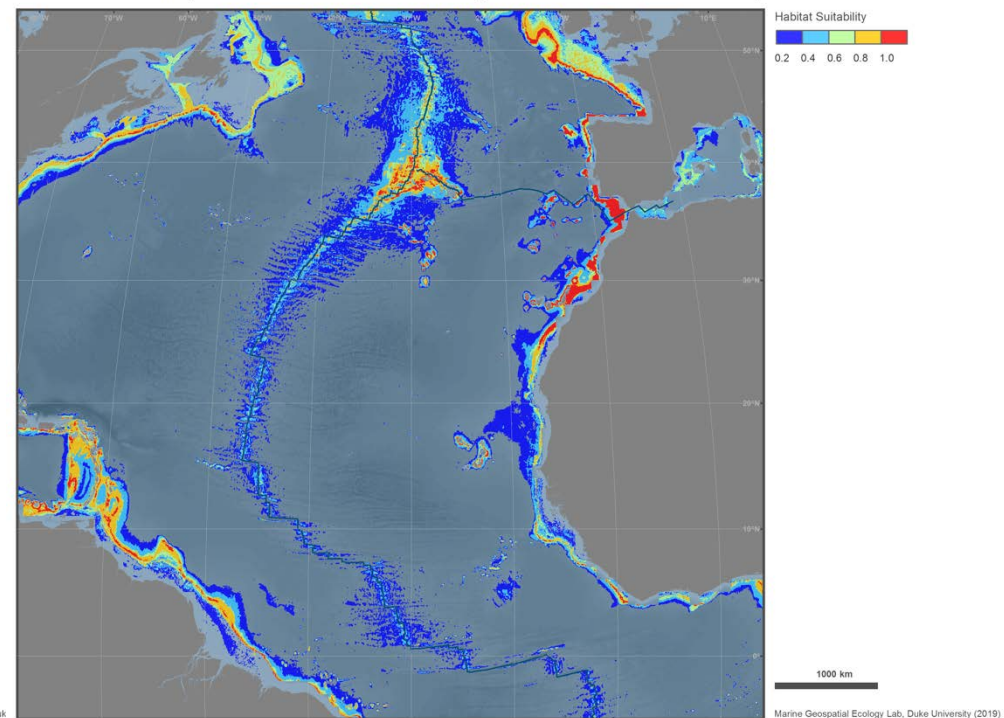
Biological Data

Habitat Suitability for Framework-Forming Cold-water Corals

Habitat Suitability of Scleractinia (Davies and Guinotte 2011)



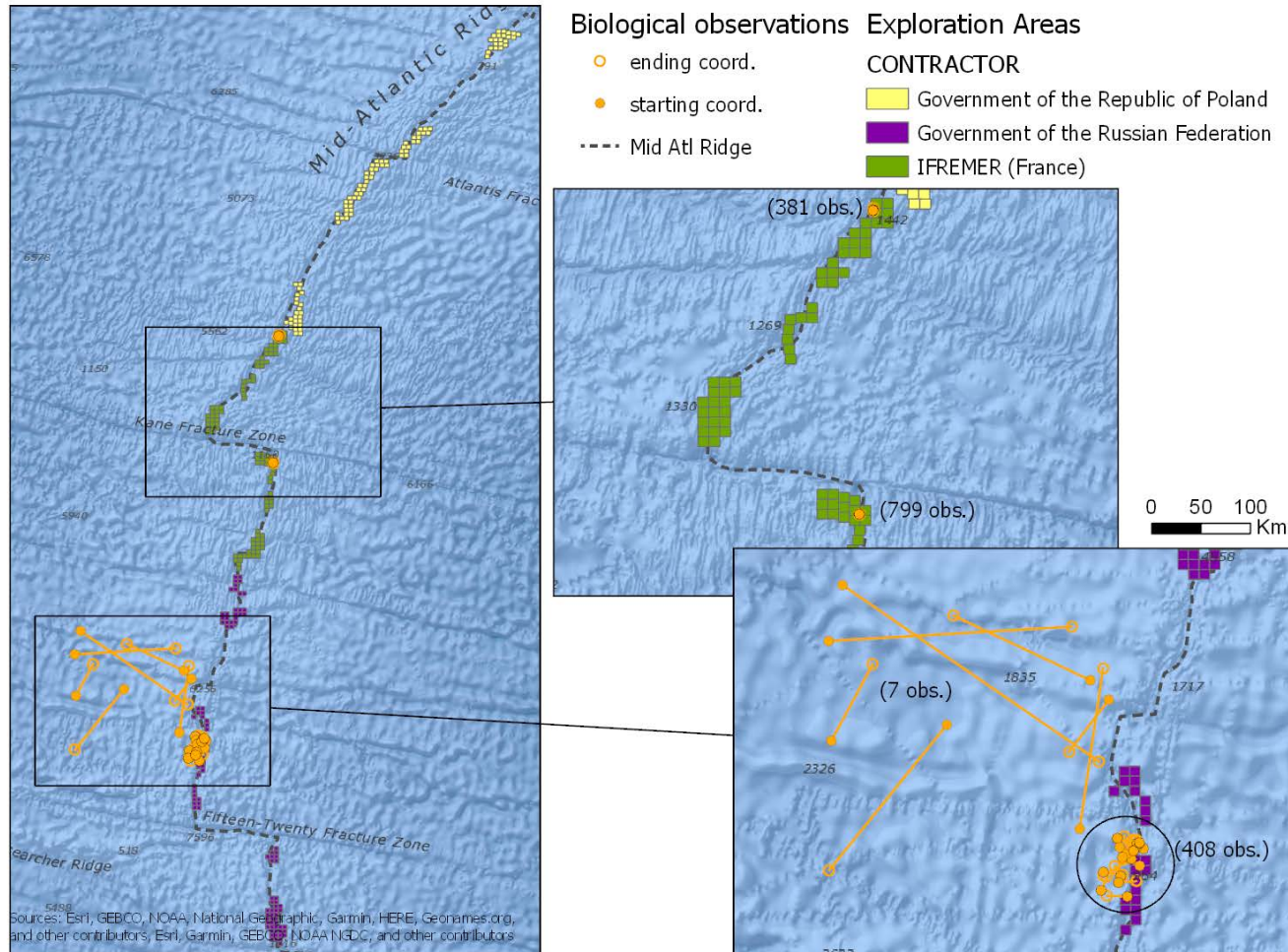
Habitat Suitability of *Solenosmilia variabilis* (Davies and Guinotte 2011)



Biological Data

ISA Deep Data

Deep Data - All observations



Biological Data

Taxonomic resolution

	FR (n=1180)		RUS (n=416)		ALL (n=1597)	
	count	%	count	%	count	%
Phylum	740	62.7%	409	98.3%	1150	72.0%
Class	718	60.8%	392	94.2%	1111	69.6%
Order	630	53.4%	295	70.9%	926	58.0%
Family	575	48.7%	333	80.0%	909	56.9%
Genus	469	39.7%	335	80.5%	805	50.4%
Species	412	34.9%	134	32.2%	547	34.3%

Biological Data

Number of unique taxa

	FR	RUS	Total
Phylum	8	12	12
Class	14	22	25
Order	21	57	65
Family	22	97	114
Genus	18	139	156
Species	9	84	93

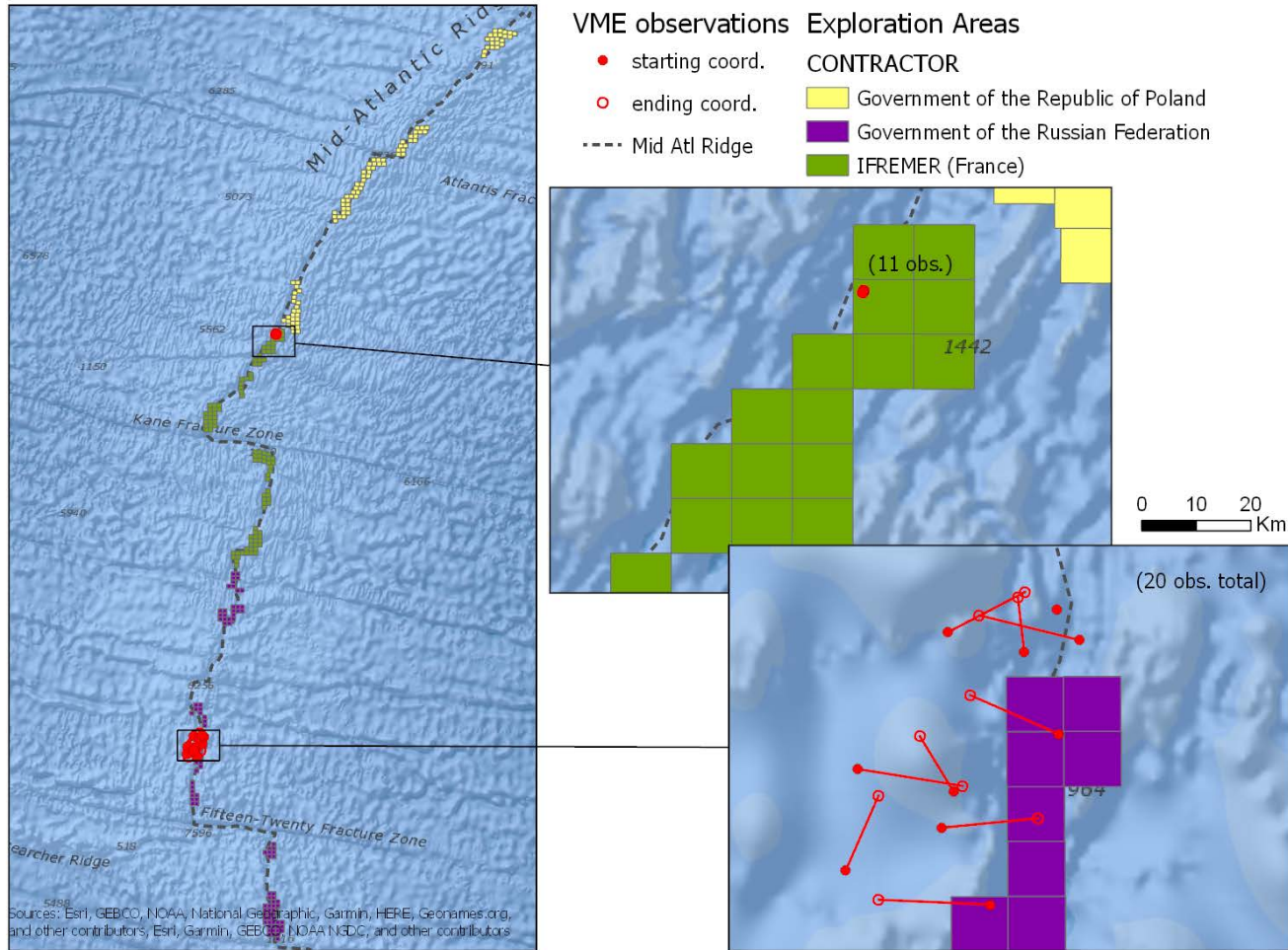
Biological Data

VME taxa observations

VME taxa	FR (n=11)	RUS (n=20)	Total (n=31)
Phylum Porifera	8	4	12
Order Scleractinia	-	9	9
Order Alcyonacea	-	4	4
Order Antipatharia	3	1	4
Order Pennatulacea	-	1	1
Family Stylasteridae	-	1	1

Biological Data

Deep Data - VME observations

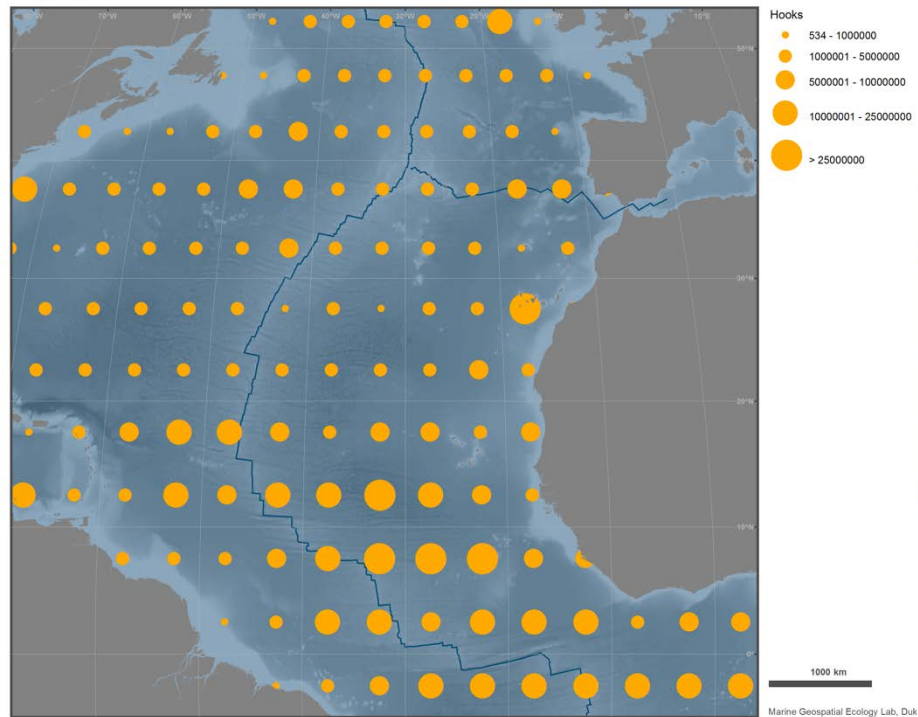


Biological Data

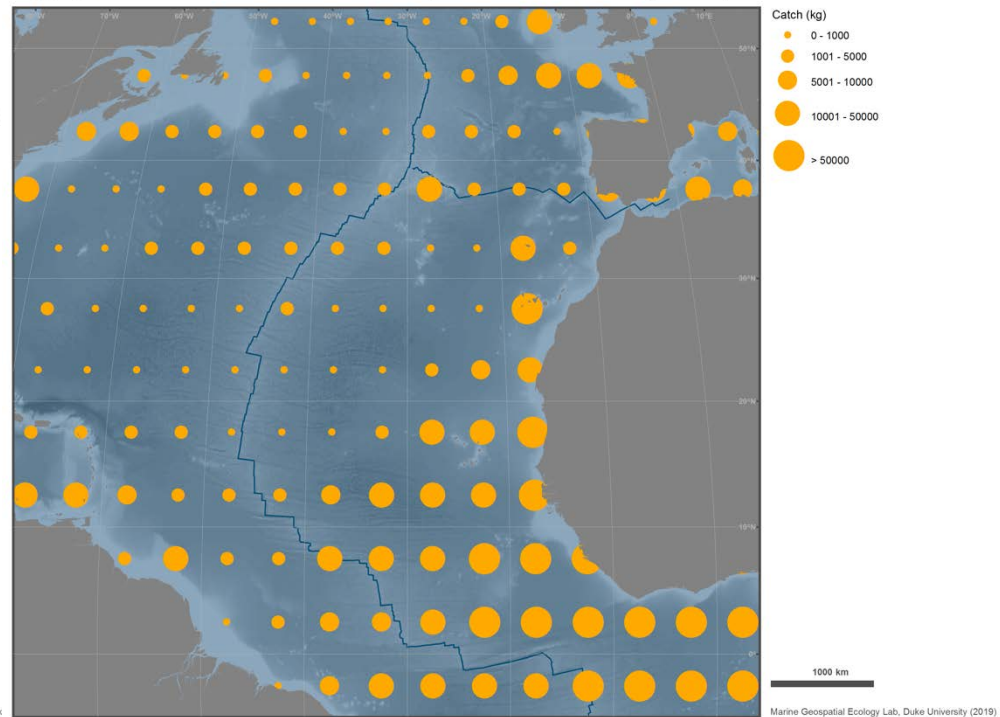
Longline Fishing Effort

Tuna and Billfish Catch

Aggregated Longline Effort, 2005 - 2009 (ICCAT)



Aggregated Catch of Tuna and Billfish Species, 2009 - 2016 (ICCAT)



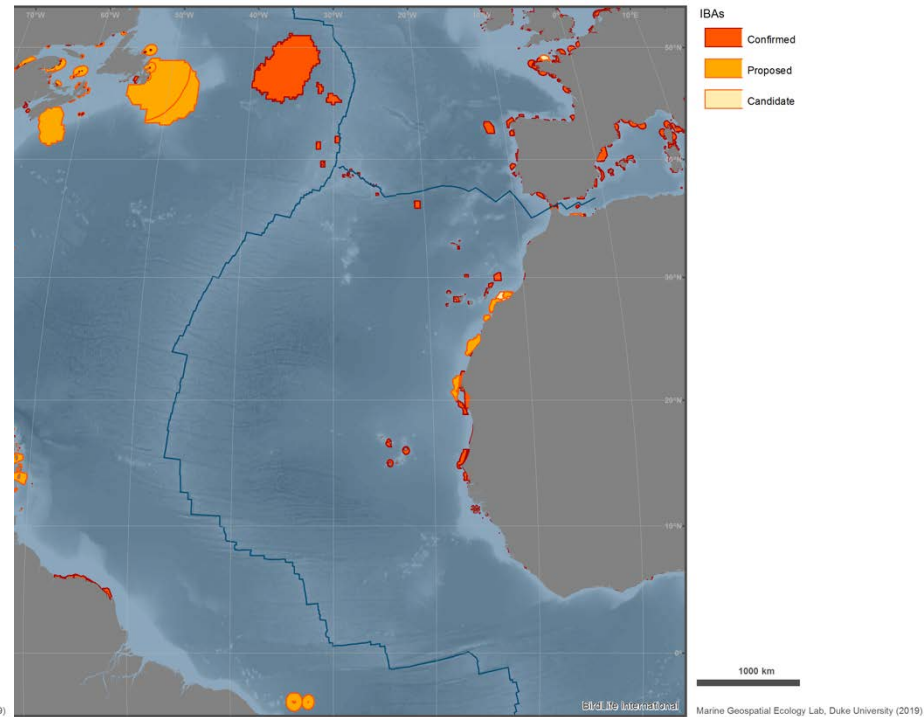
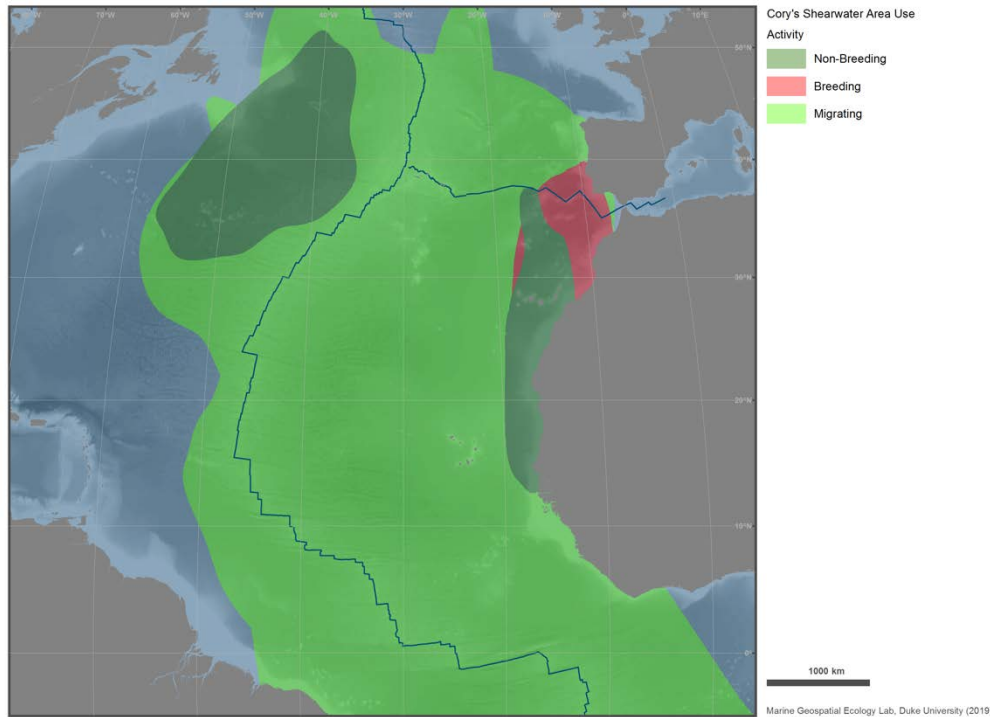
Biological Data

Cory's Shearwater Area Use

BirdLife Important Bird Areas (IBAs)

Cory's Shearwater Area Use (MiCO 2019)

Important Bird Areas (BirdLife International)



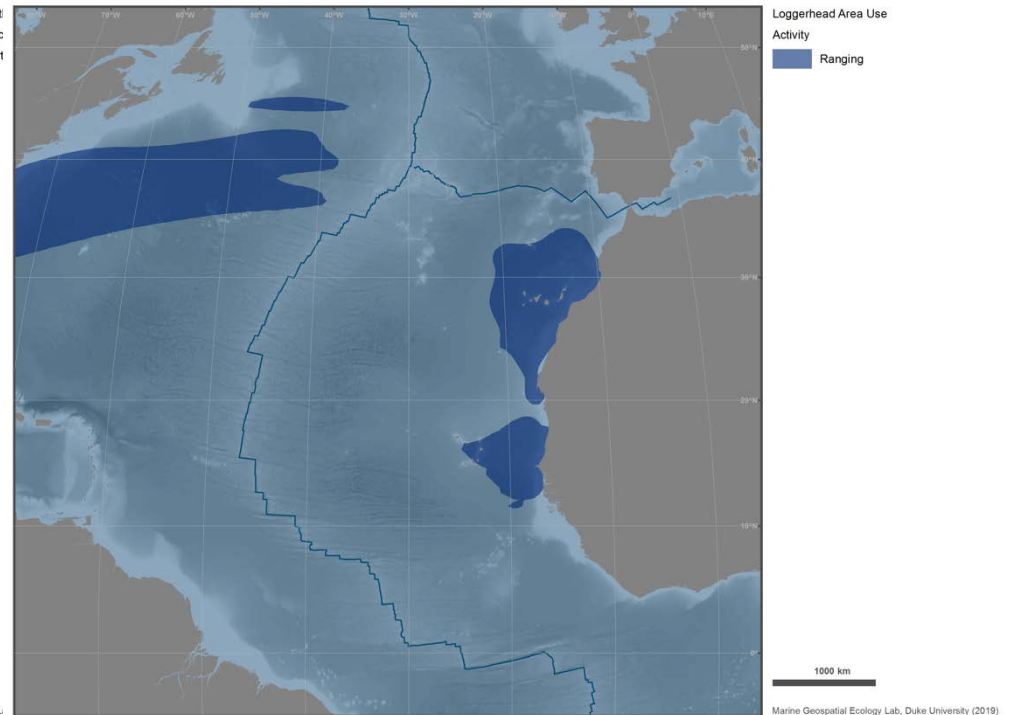
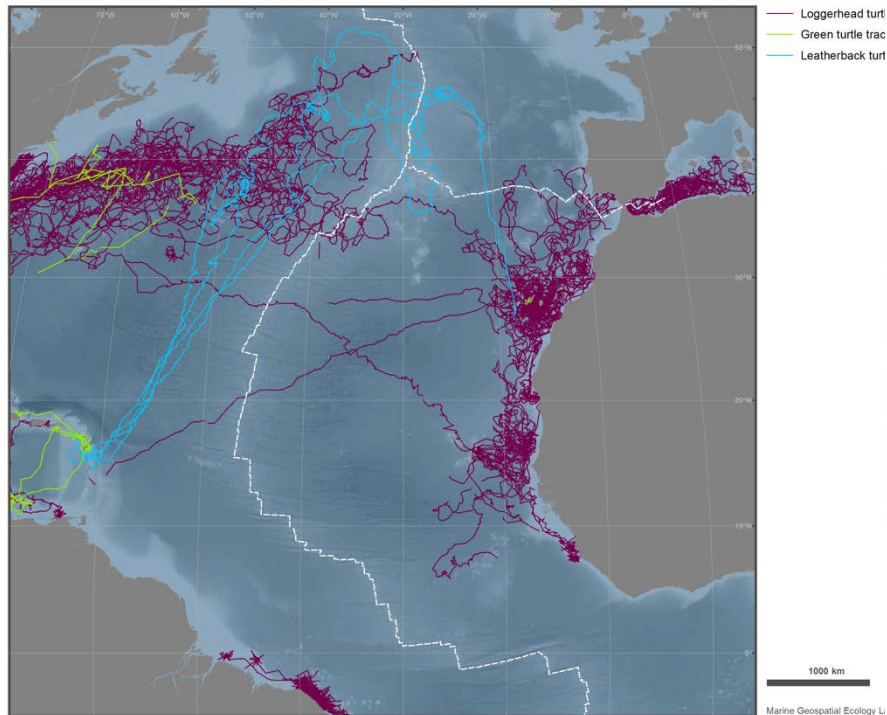
Biological Data

Turtle telemetry - OBIS-SEAMAP

Loggerhead Area Use

Turtle Tracks (OBIS-SEAMAP)

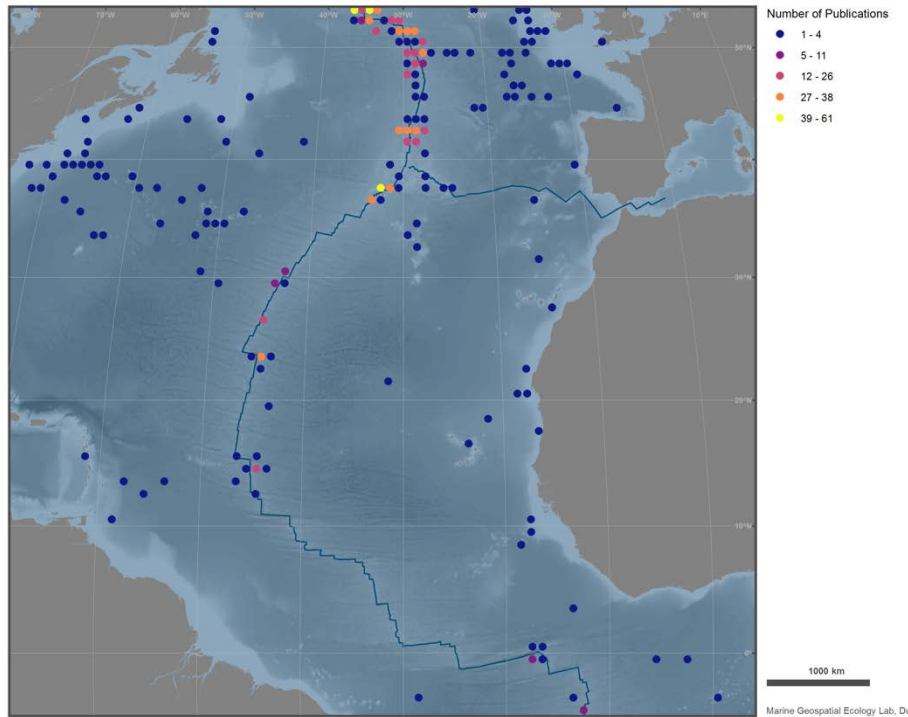
Loggerhead Area Use (MiCO 2019)



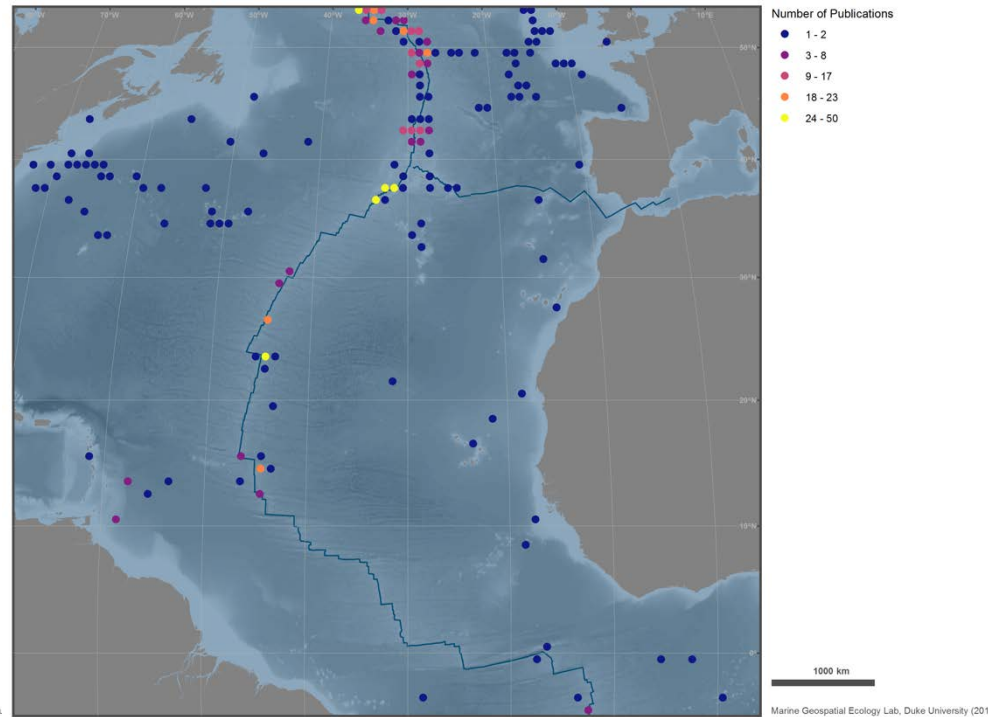
Biological Data

Geo-referenced Publications

Number of Publications per 1 x 1 degree cell (through 2015)



Number of Publications per 1 x 1 degree cell: Benthic

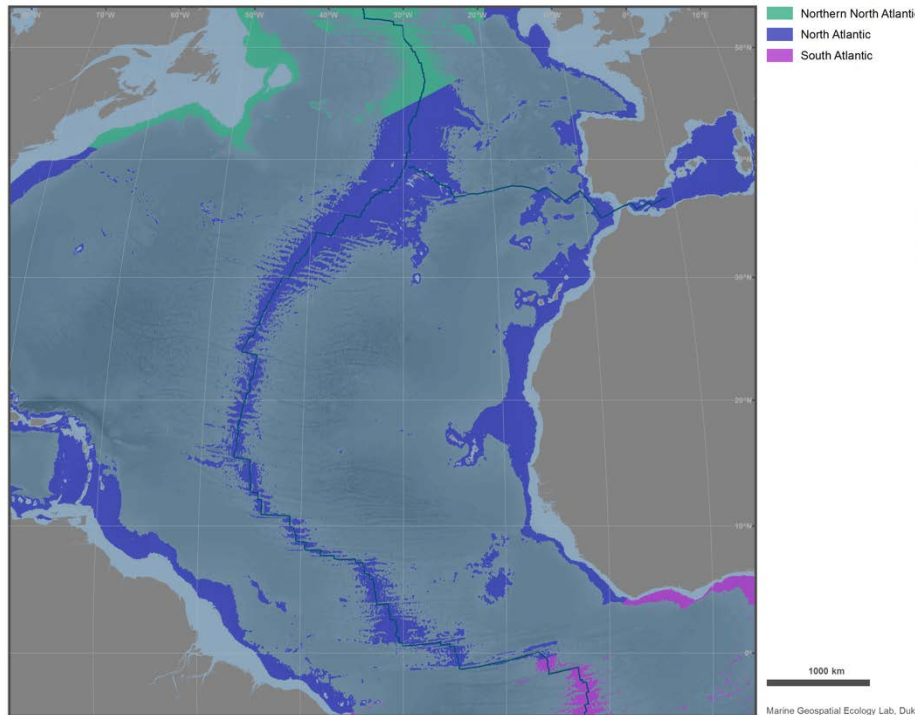


Biogeographic Classifications

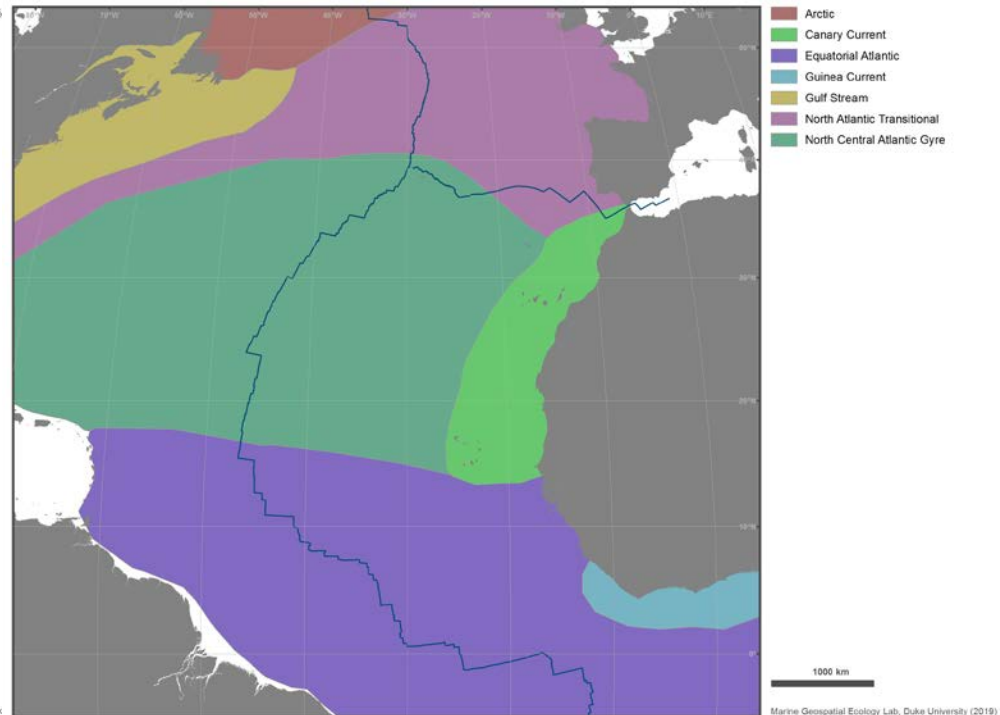
GOODS Bathyal Provinces

GOODS Pelagic Provinces

GOODS Bathyal Provinces (GOODS 2009)



GOODS Pelagic Provinces (GOODS 2009)



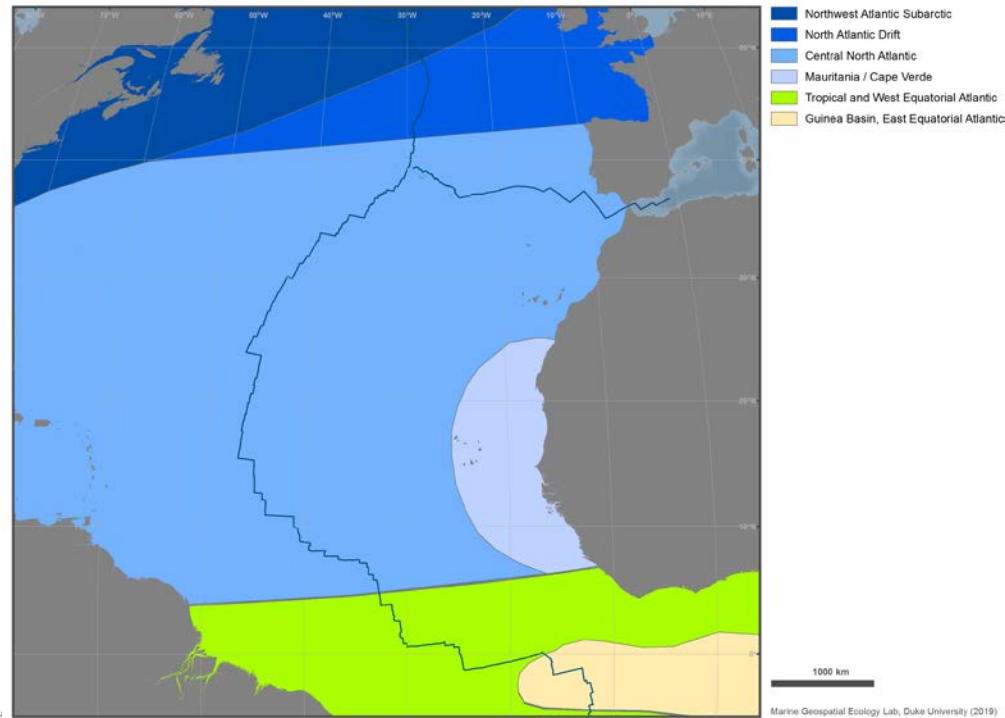
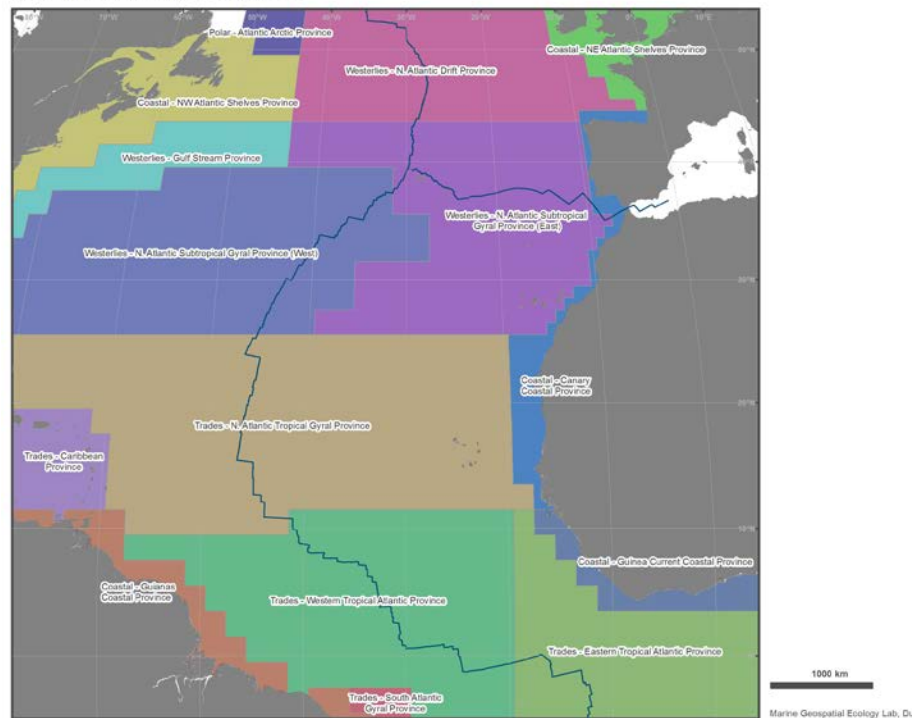
Biogeographic Classifications

Longhurst Provinces

Mesopelagic Provinces

Longhurst Marine Provinces

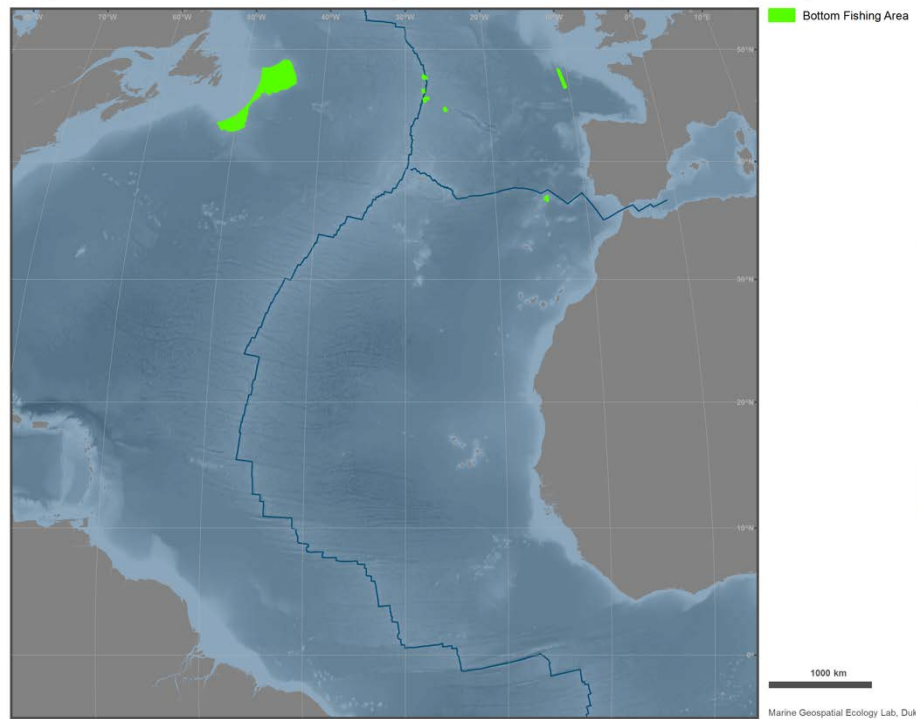
Global Mesopelagic Provinces (Sutton et al. 2017)



Human Uses

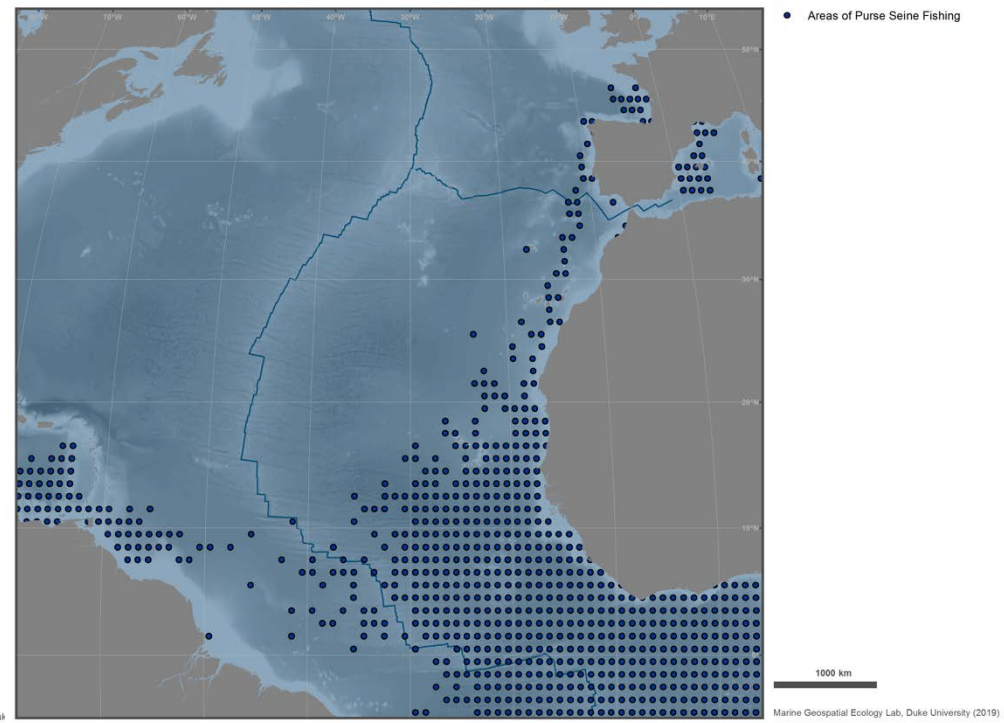
RFMO Bottom Fishing Areas

Regional Fisheries Management Organizations, Bottom Fishing Areas (FAO)



Areas of Purse Seine Fishing

Areas of Purse Seine Fishing, 2005 - 2009 (ICCAT)



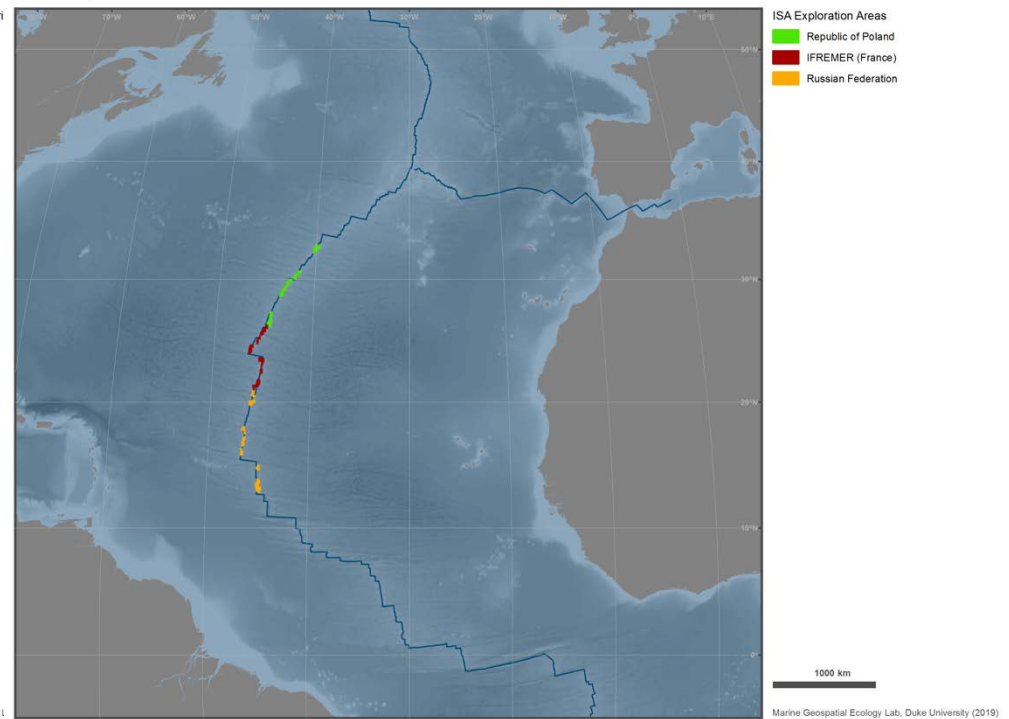
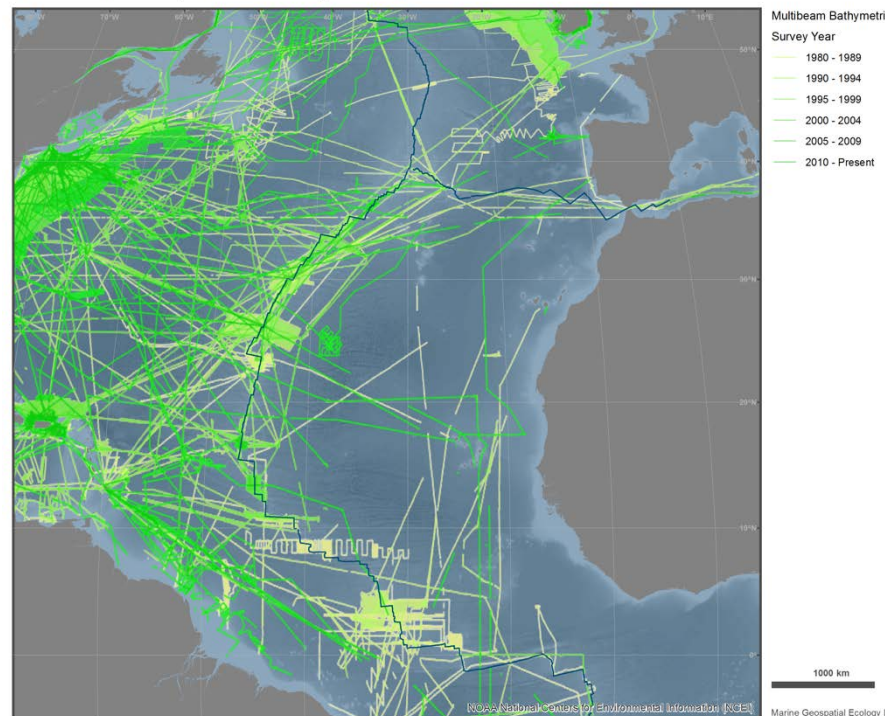
Human Uses

Multibeam Survey Tracklines

ISA Exploration Contract Areas

Multibeam Bathymetric Survey Tracklines

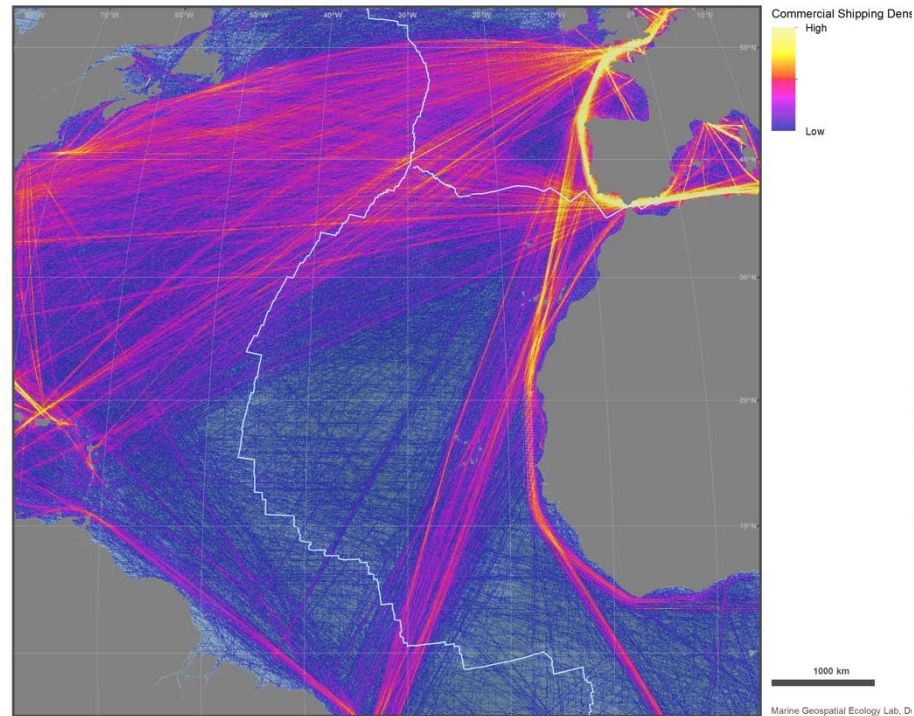
ISA Exploration Contract Areas



Human Uses

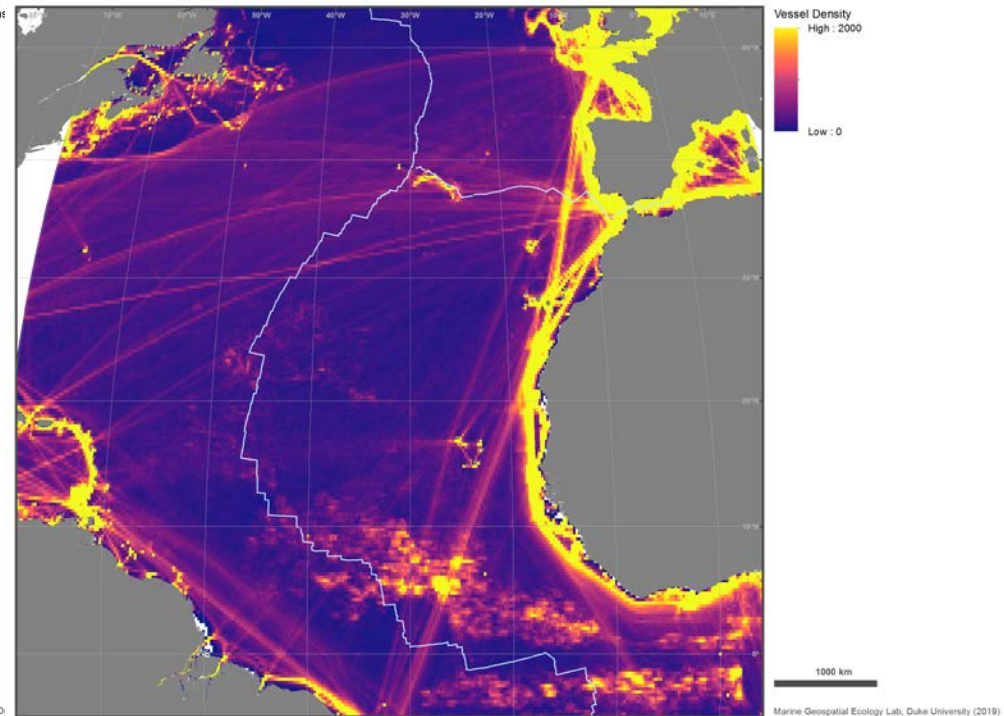
Commercial Shipping

Commercial Shipping (Halpern et al. 2008)



Vessel Density

Vessel Density - all AIS-instrumented vessels (2018)



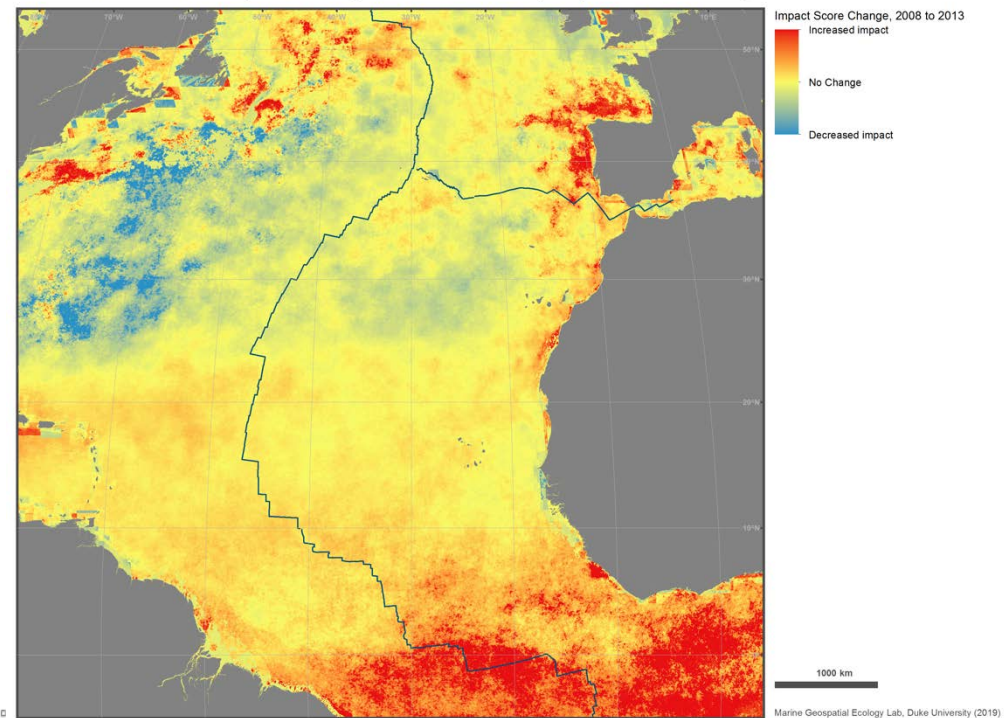
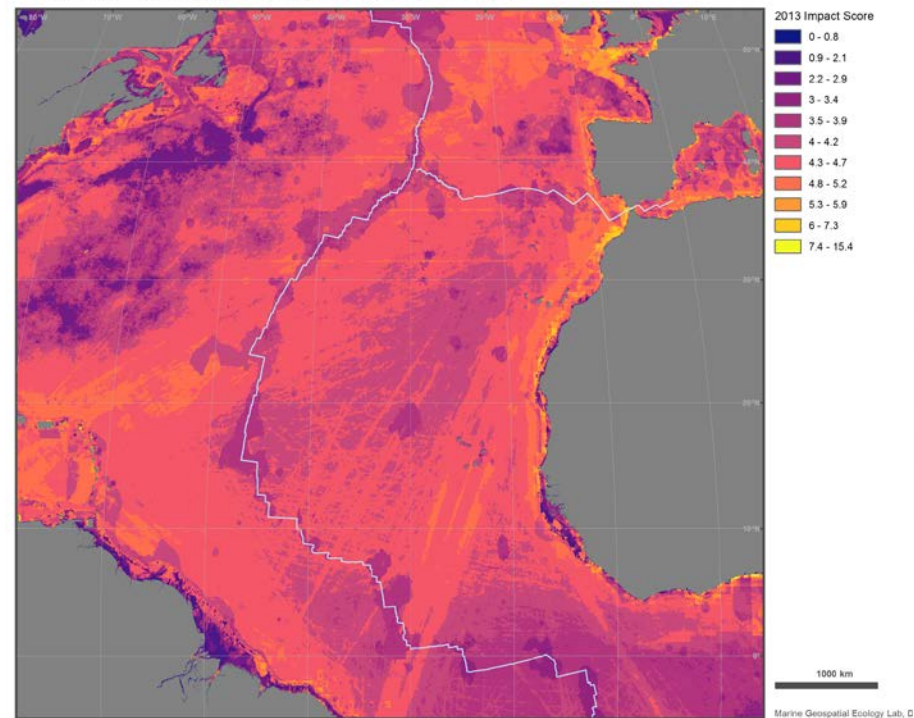
Human Uses

Cumulative Human Impact

Cumulative Human Impact Change

Cumulative Human Impact (Halpern et al. 2015)

Cumulative Human Impact Change, 2008 to 2013 (Halpern et al. 2015)

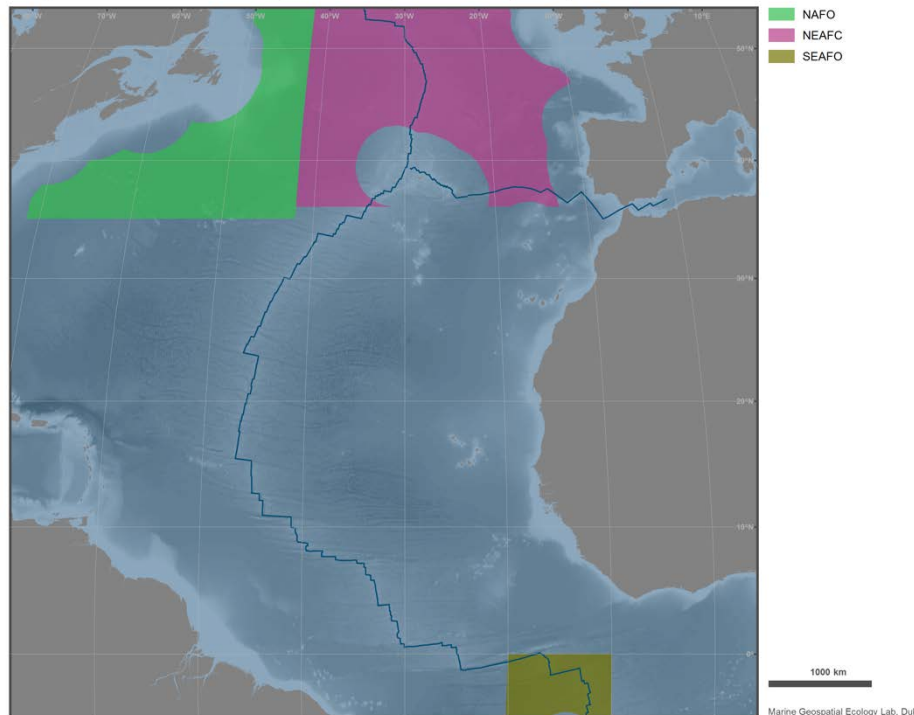


Areas Defined for Management and/or Conservation Objectives

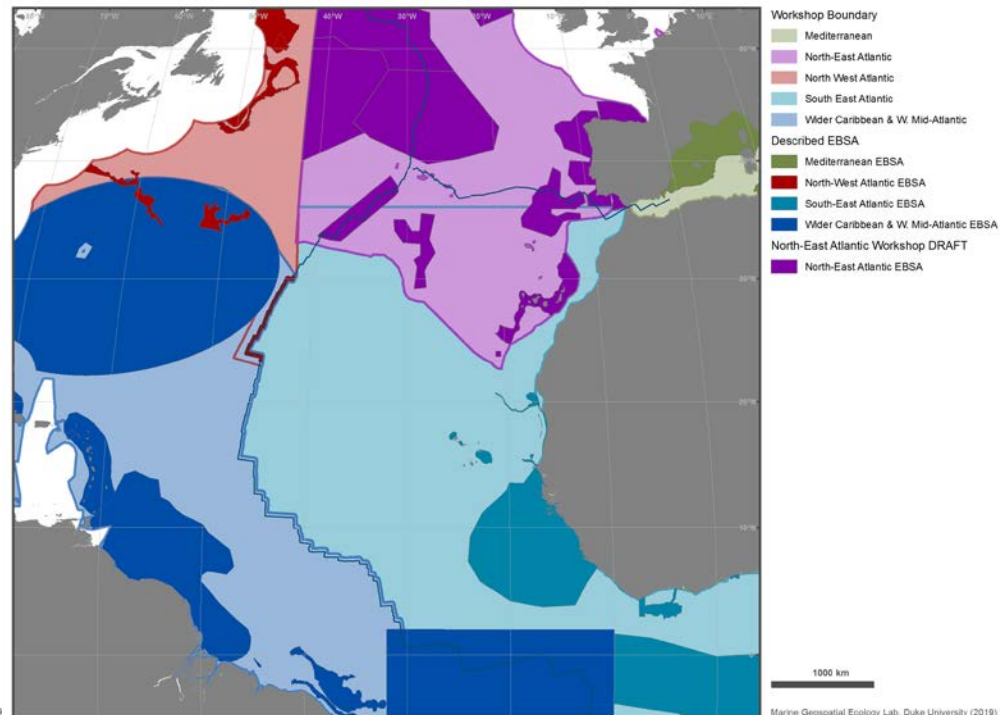
Regional Fisheries Management Organizations (RFMOs)

CBD Ecologically or Biologically Significant Areas (EBSAs)

Regional Fisheries Management Organizations (FAO)



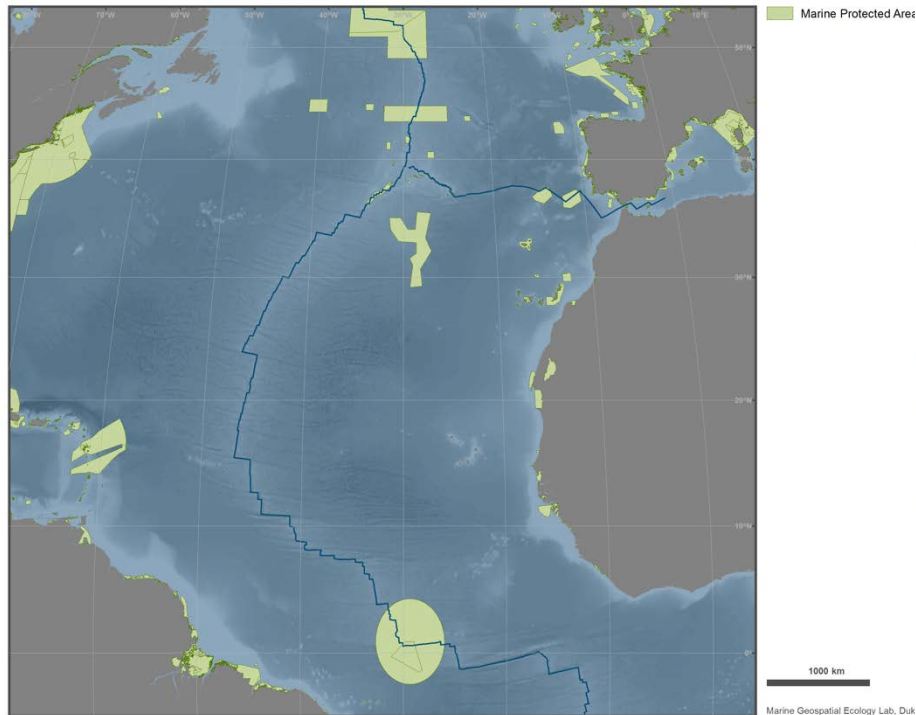
CBD Ecologically or Biologically Significant Areas (EBSA)



Areas Defined for Management and/or Conservation Objectives

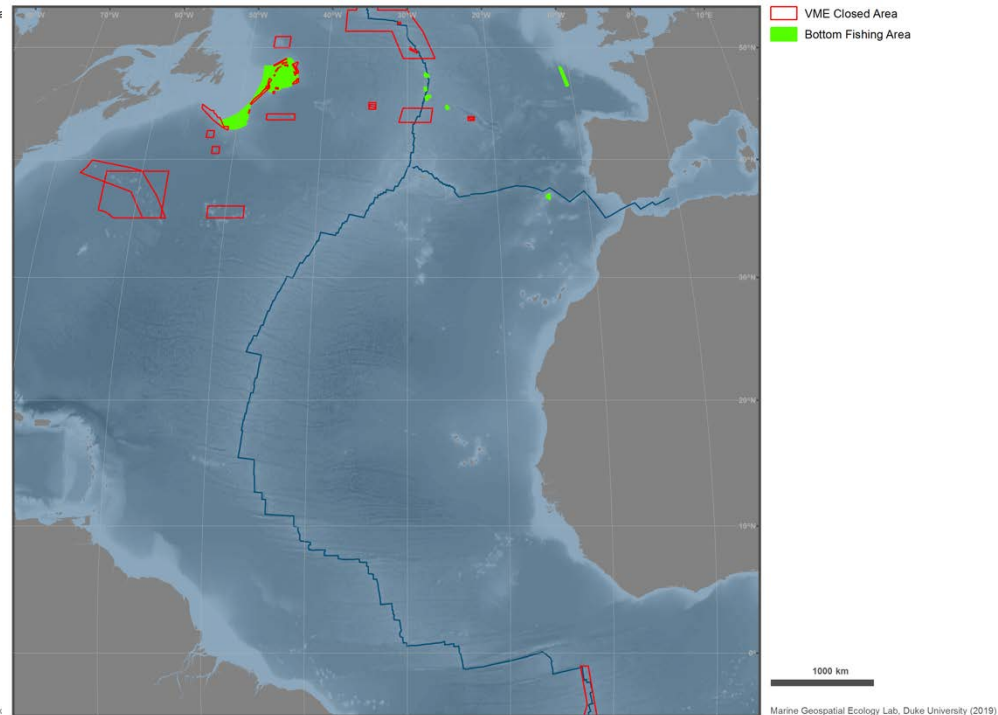
Marine Protected Areas (MPAs)

Marine Protected Areas (WDPAs 2019)



Vulnerable Marine Ecosystem (VME) Closed Areas

Regional Fisheries Management Organizations, VME Closed Areas (FAO)



Review of regional scientific data/information/maps compiled

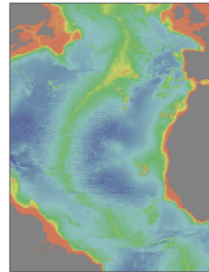
Questions and Discussion

DRAFT: This draft will be further refined based on the comments from the workshop participants.

**DRAFT Data Report:
Workshop on the Regional Environmental Management Plan for
the Area of the Northern Mid-Atlantic Ridge**

Evora, Portugal
25-29 November, 2019

Jesse Cleary, Sarah DeLand, Elisabetta Menini, Sena McCrory, Khaira Ismail, Patrick N. Halpin
Marine Geospatial Ecology Lab, Duke University



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