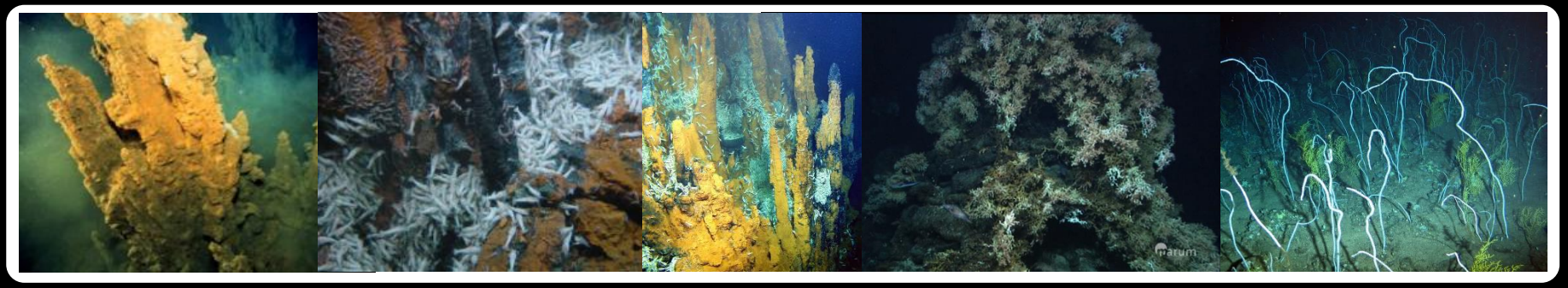
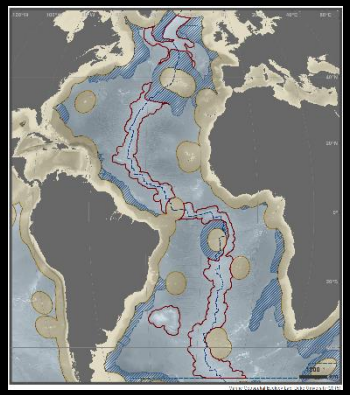
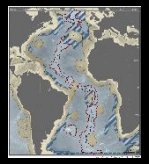


Assessment of knowledge and knowledge gaps in the wide Atlantic Ocean

Telmo Morato, Gerald H. Taranto, Frederic Vandeperre, Christopher K. Pham (IMAR), Daniel Dunn, Jesse Cleary, Patrick N. Halpin (Duke University)





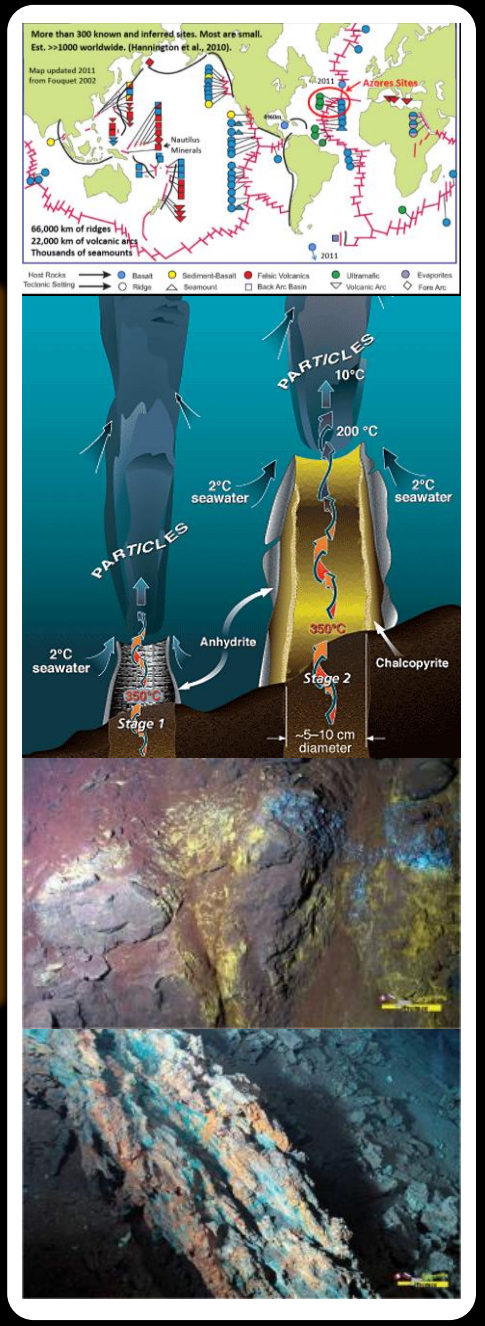
Background – Environmental Management Plan

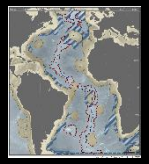
Environmental Management Plan

Growing pressure on **deep-sea minerals** and their associated ecosystems

In 2012, Environmental Management Plan (**EMP**) developed for the **Clarion-Clipperton Zone** (ISBA/18/C/22)

No plan has been formulated for the **Atlantic Ocean** and particularly the Mid-Atlantic Ridge yet





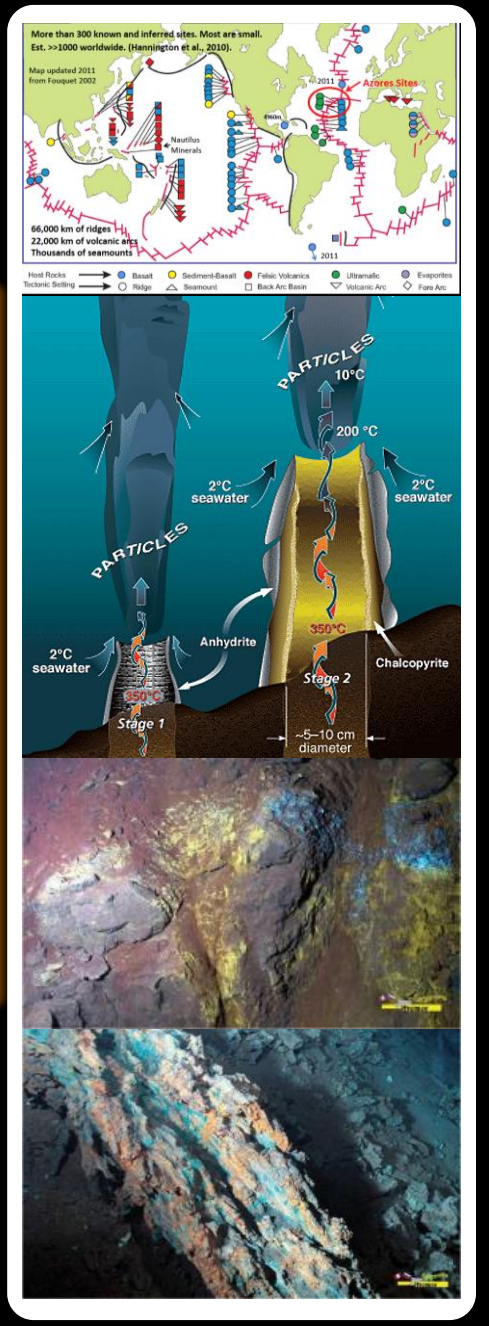
Background – Environmental Management Plan

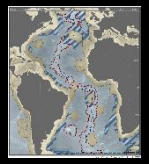
Environmental Management Plan

Drivers for the development of an EMP are the **fragility** and **vulnerability** of species and habitats

Assessed by **data** on the distribution of species, habitats, and stressors or proxies for future stressors

What data exists to support the process of developing an EMP for the Atlantic?





Background – Objectives

Objectives

Gather relevant information to inform any future Strategic Environmental Assessment for the Atlantic Ocean

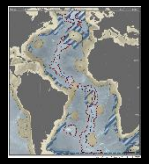
Governo dos Açores
Secretaria Regional do Mar, Ciência e Tecnologia

deepsea conservation coalition

THE PEW CHARITABLE TRUSTS

Geographical area addressed in the report

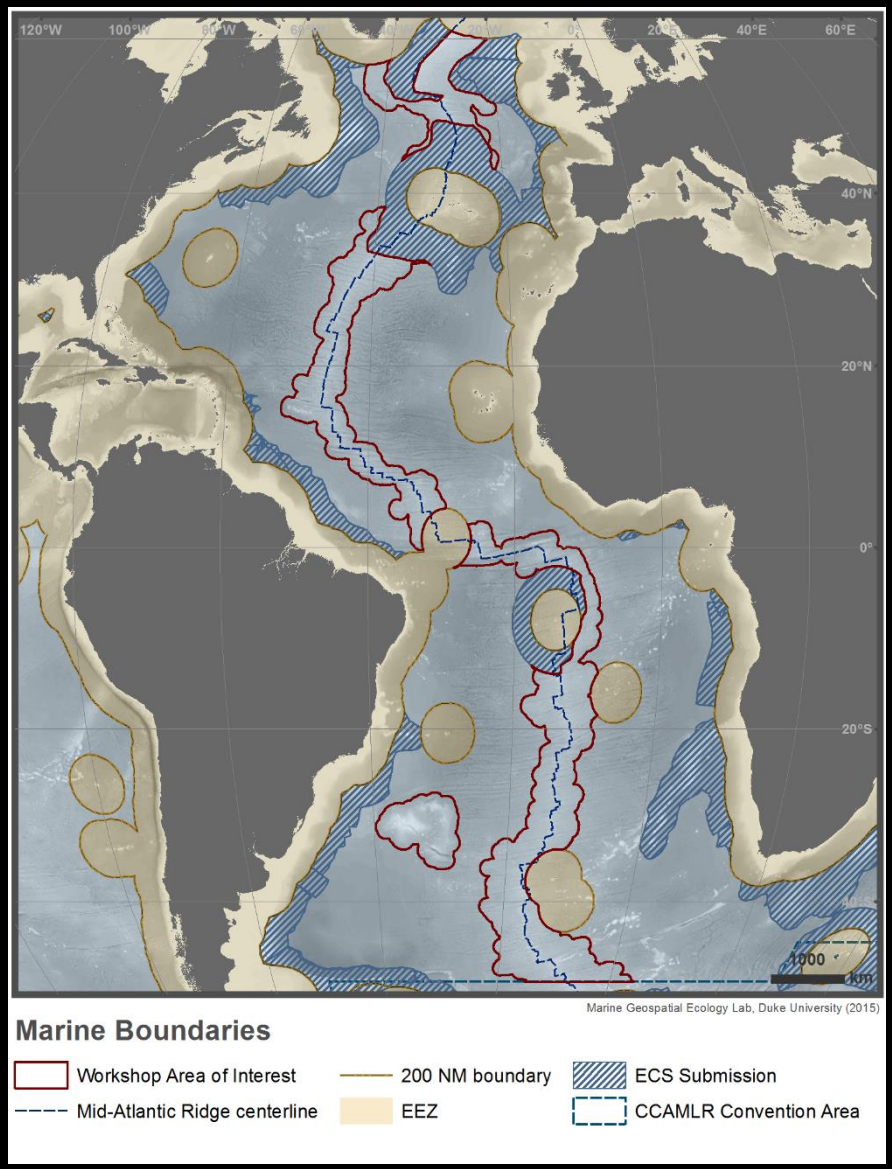
Mid-Atlantic Ridge and Rio Grande Rise



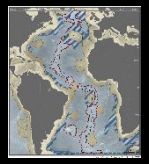
Data report– Geographical area

The Mid-Atlantic Ridge (MAR)

Defined by: (1) a 500km buffer around the MAR; (2) removing areas falling in the GOODS Abyssal provinces (> 3500m); (3) removing areas inside EEZs, extended continental shelf submissions, and the CCAMLR convention



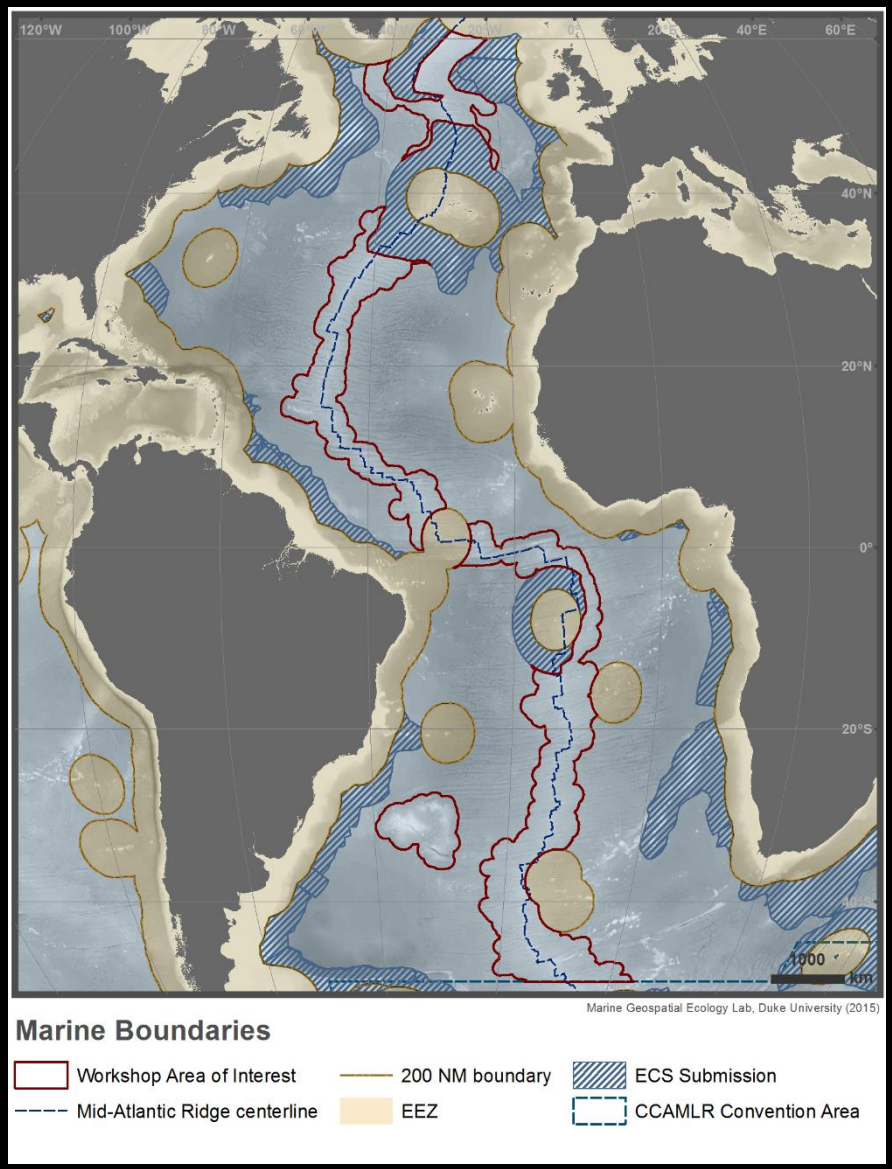
Funded by: DRCT project 2020 & MIDAS Grant Agreement 603418



Data report– Geographical area

Rio Grande Rise (RGR)

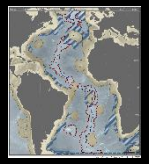
Large ridge rising 5,000 m above the ocean floor of the South Atlantic. Together with the Walvis Ridge it constitutes one of the most prominent bathymetric features in the South Atlantic Basin



Funded by: DRCT project 2020 & MIDAS Grant Agreement 603418

Baseline data mining

Mid-Atlantic Ridge and Rio Grande Rise



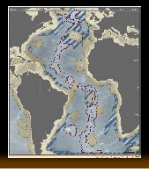
Data report – Data Mining

Data sources

Biogeographic databases, expert consultation, online libraries and habitat suitability models

All the major repositories for biological data in the Atlantic (OBIS, Pangaea and EMODnet) appeared to be interrelated

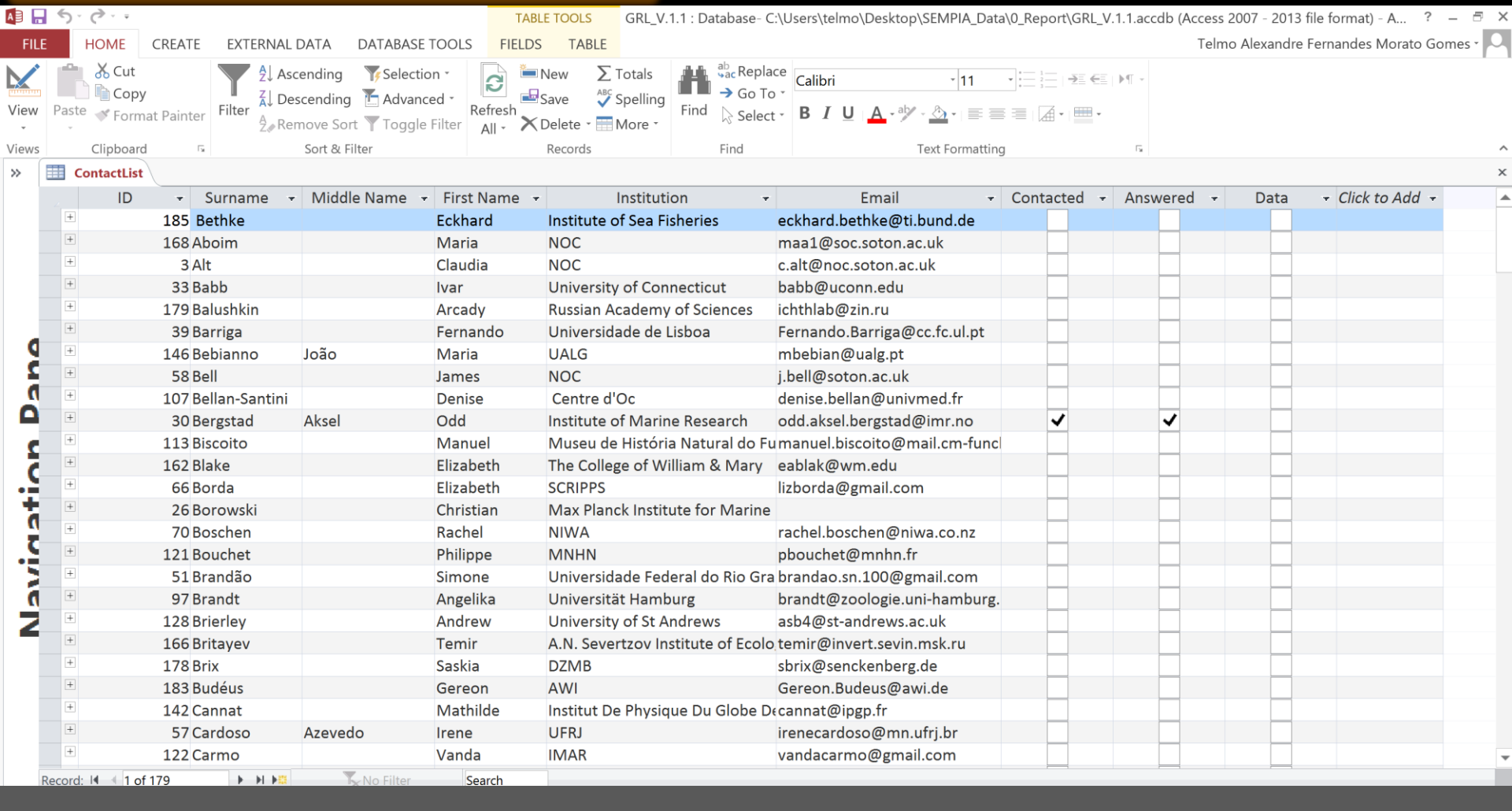
The Ocean Biogeographic Information System (OBIS) (IOC, 2015) harvested data from other portals on a regular basis



Data report – Data Mining

MAR-database

Contact list (n = 179)



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Telmo Alexandre Fernandes Morato Gomes

FILE | HOME | CREATE | EXTERNAL DATA | DATABASE TOOLS | TABLE TOOLS FIELDS | TABLE

Navigation Pane

ContactList

ID	Surname	Middle Name	First Name	Institution	Email	Contacted	Answered	Data	Click to Add
185	Bethke		Eckhard	Institute of Sea Fisheries	eckhard.bethke@ti.bund.de				
168	Aboim		Maria	NOC	maa1@soc.soton.ac.uk				
3	Alt		Claudia	NOC	c.alt@noc.soton.ac.uk				
33	Babb		Ivar	University of Connecticut	babb@uconn.edu				
179	Balushkin		Arcady	Russian Academy of Sciences	ichthlab@zin.ru				
39	Barriga		Fernando	Universidade de Lisboa	Fernando.Barriga@cc.fc.ul.pt				
146	Bebianno	João	Maria	UALG	mbebian@ualg.pt				
58	Bell		James	NOC	j.bell@soton.ac.uk				
107	Bellan-Santini		Denise	Centre d'Oc	denise.bellan@univmed.fr				
30	Bergstad	Aksel	Odd	Institute of Marine Research	odd.aksel.bergstad@imr.no	✓	✓		
113	Biscoito		Manuel	Museu de História Natural do Fu	manuel.biscoito@mail.cm-func				
162	Blake		Elizabeth	The College of William & Mary	eablak@wm.edu				
66	Borda		Elizabeth	SCRIPPS	lizborda@gmail.com				
26	Borowski		Christian	Max Planck Institute for Marine					
70	Boschen		Rachel	NIWA	rachel.boschen@niwa.co.nz				
121	Bouchet		Philippe	MNHN	pbouchet@mnhn.fr				
51	Brandão		Simone	Universidade Federal do Rio Gra	brandao.sn.100@gmail.com				
97	Brandt		Angelika	Universität Hamburg	brandt@zoologie.uni-hamburg.				
128	Brierley		Andrew	University of St Andrews	asb4@st-andrews.ac.uk				
166	Britayev		Temir	A.N. Severtzov Institute of Ecolo	temir@invert.sevin.msk.ru				
178	Brix		Saskia	DZMB	sbrix@senckenberg.de				
183	Budéus		Gereon	AWI	Gereon.Budeus@awi.de				
142	Cannat		Mathilde	Institut De Physique Du Globe D	cannat@ipgp.fr				
57	Cardoso	Azevedo	Irene	UFRJ	irenecardoso@mn.ufrj.br				
122	Carmo		Vanda	IMAR	vandacarmo@gmail.com				

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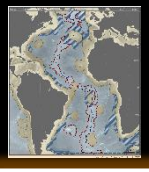
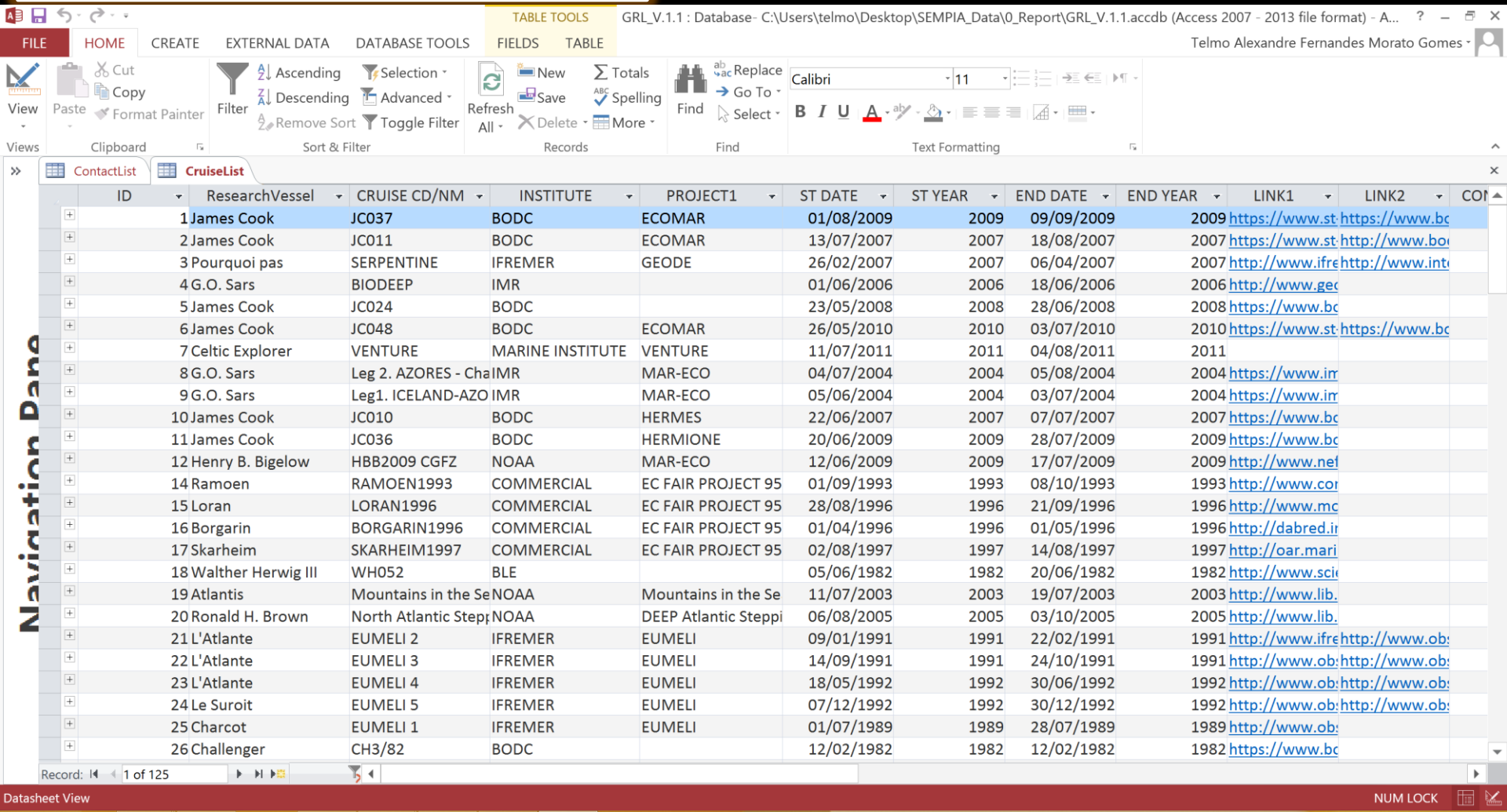


Data report – Data Mining

MAR-database

Cruise list (n = 125)



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Telmo Alexandre Fernandes Morato Gomes

FILE | HOME | CREATE | EXTERNAL DATA | DATABASE TOOLS | TABLE TOOLS FIELDS | TABLE TOOLS TABLE

Views | Clipboard (Cut, Copy, Format Painter, Paste) | Sort & Filter (Filter, Ascending, Descending, Remove Sort, Selection, Advanced, Toggle Filter) | Records (Refresh All, New, Save, Delete, Totals, Spelling, More) | Find (Find, Replace, Go To, Select) | Text Formatting (Calibri, 11)

ContactList | CruiseList

Navigation Pane

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1	James Cook	JC037	BODC	ECOMAR	01/08/2009	2009	09/09/2009	2009	https://www.st	https://www.bc	
2	James Cook	JC011	BODC	ECOMAR	13/07/2007	2007	18/08/2007	2007	https://www.st	http://www.boc	
3	Pourquoi pas	SERPENTINE	IFREMER	GEODE	26/02/2007	2007	06/04/2007	2007	http://www.ifre	http://www.int	
4	G.O. Sars	BIODEEP	IMR		01/06/2006	2006	18/06/2006	2006	http://www.gec		
5	James Cook	JC024	BODC		23/05/2008	2008	28/06/2008	2008	https://www.bc		
6	James Cook	JC048	BODC	ECOMAR	26/05/2010	2010	03/07/2010	2010	https://www.st	https://www.bc	
7	Celtic Explorer	VENTURE	MARINE INSTITUTE	VENTURE	11/07/2011	2011	04/08/2011	2011			
8	G.O. Sars	Leg 2. AZORES - Cha	IMR	MAR-ECO	04/07/2004	2004	05/08/2004	2004	https://www.im		
9	G.O. Sars	Leg1. ICELAND-AZO	IMR	MAR-ECO	05/06/2004	2004	03/07/2004	2004	https://www.im		
10	James Cook	JC010	BODC	HERMES	22/06/2007	2007	07/07/2007	2007	https://www.bc		
11	James Cook	JC036	BODC	HERMIONE	20/06/2009	2009	28/07/2009	2009	https://www.bc		
12	Henry B. Bigelow	HBB2009 CGFZ	NOAA	MAR-ECO	12/06/2009	2009	17/07/2009	2009	http://www.nef		
14	Ramoen	RAMOEN1993	COMMERCIAL	EC FAIR PROJECT 95	01/09/1993	1993	08/10/1993	1993	http://www.cor		
15	Loran	LORAN1996	COMMERCIAL	EC FAIR PROJECT 95	28/08/1996	1996	21/09/1996	1996	http://www.mc		
16	Borgarin	BORGARIN1996	COMMERCIAL	EC FAIR PROJECT 95	01/04/1996	1996	01/05/1996	1996	http://dabred.ir		
17	Skarheim	SKARHEIM1997	COMMERCIAL	EC FAIR PROJECT 95	02/08/1997	1997	14/08/1997	1997	http://oar.mari		
18	Walther Herwig III	WH052	BLE		05/06/1982	1982	20/06/1982	1982	http://www.sci		
19	Atlantis	Mountains in the Se	NOAA	Mountains in the Se	11/07/2003	2003	19/07/2003	2003	http://www.lib.		
20	Ronald H. Brown	North Atlantic Stepp	NOAA	DEEP Atlantic Steppi	06/08/2005	2005	03/10/2005	2005	http://www.lib.		
21	L'Atlante	EUMELI 2	IFREMER	EUMELI	09/01/1991	1991	22/02/1991	1991	http://www.ifre	http://www.obs	
22	L'Atlante	EUMELI 3	IFREMER	EUMELI	14/09/1991	1991	24/10/1991	1991	http://www.obs	http://www.obs	
23	L'Atlante	EUMELI 4	IFREMER	EUMELI	18/05/1992	1992	30/06/1992	1992	http://www.obs	http://www.obs	
24	Le Suroit	EUMELI 5	IFREMER	EUMELI	07/12/1992	1992	30/12/1992	1992	http://www.obs	http://www.obs	
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26	Challenger	CH3/82	BODC		12/02/1982	1982	12/02/1982	1982	https://www.bc		

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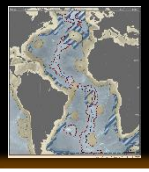
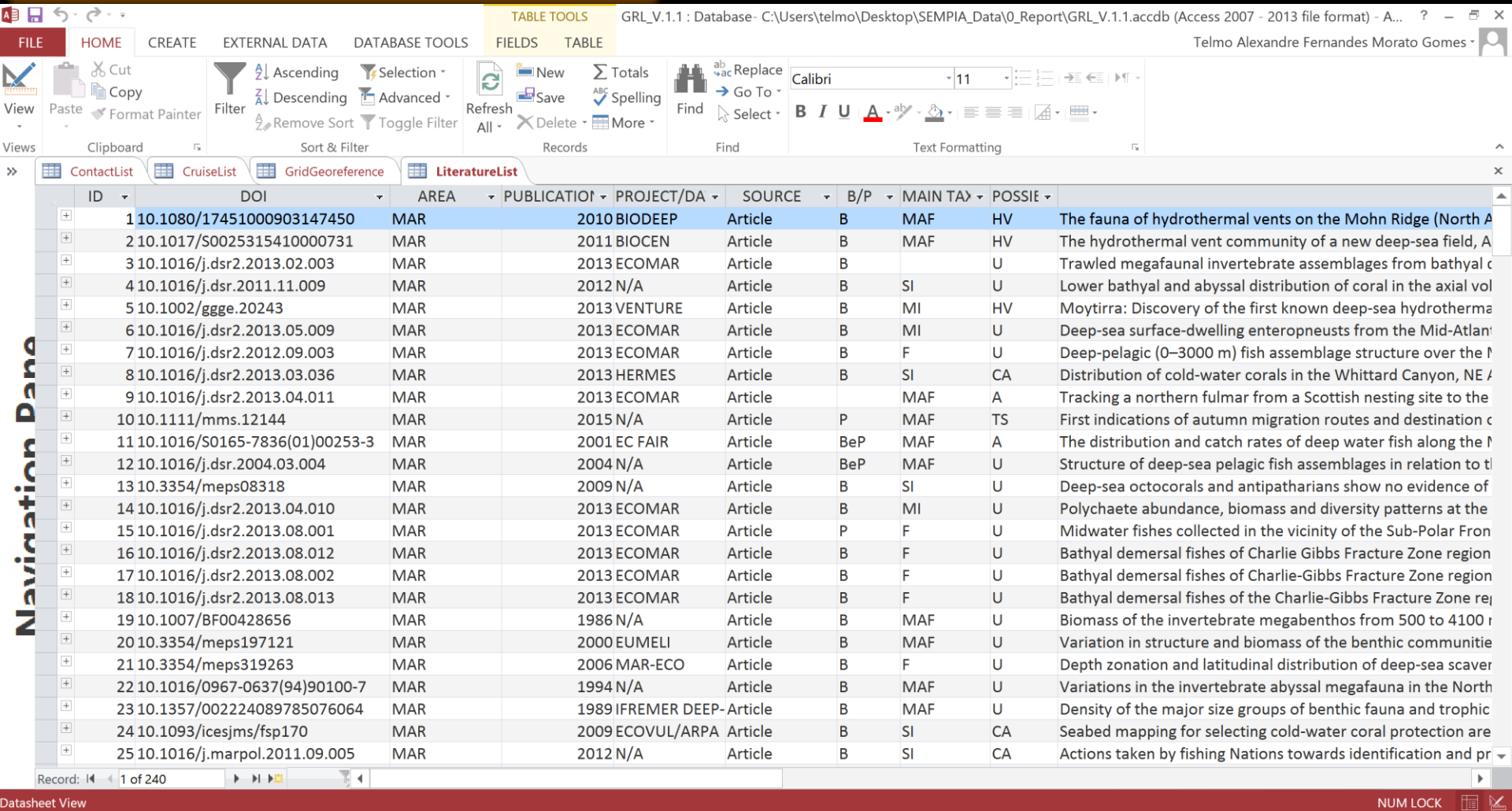
Datasheet View | NUM LOCK



Data report – Data Mining

MAR-database

Publication list (n = 240)



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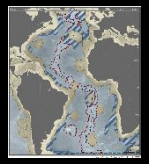
1	10.1080/17451000903147450	MAR	2010	BIODEEP	Article	B	MAF	HV	The fauna of hydrothermal vents on the Mohn Ridge (North A
2	10.1017/S0025315410000731	MAR	2011	BIOCEN	Article	B	MAF	HV	The hydrothermal vent community of a new deep-sea field, A
3	10.1016/j.dsr2.2013.02.003	MAR	2013	ECOMAR	Article	B		U	Trawled megafaunal invertebrate assemblages from bathyal c
4	10.1016/j.dsr.2011.11.009	MAR	2012	N/A	Article	B	SI	U	Lower bathyal and abyssal distribution of coral in the axial vol
5	10.1002/ggge.20243	MAR	2013	VENTURE	Article	B	MI	HV	Moytirra: Discovery of the first known deep-sea hydrotherma
6	10.1016/j.dsr2.2013.05.009	MAR	2013	ECOMAR	Article	B	MI	U	Deep-sea surface-dwelling enteropneusts from the Mid-Atlan
7	10.1016/j.dsr2.2012.09.003	MAR	2013	ECOMAR	Article	B	F	U	Deep-pelagic (0–3000 m) fish assemblage structure over the M
8	10.1016/j.dsr2.2013.03.036	MAR	2013	HERMES	Article	B	SI	CA	Distribution of cold-water corals in the Whittard Canyon, NE A
9	10.1016/j.dsr2.2013.04.011	MAR	2013	ECOMAR	Article		MAF	A	Tracking a northern fulmar from a Scottish nesting site to the
10	10.1111/mms.12144	MAR	2015	N/A	Article	P	MAF	TS	First indications of autumn migration routes and destination c
11	10.1016/S0165-7836(01)00253-3	MAR	2001	EC FAIR	Article	BeP	MAF	A	The distribution and catch rates of deep water fish along the M
12	10.1016/j.dsr.2004.03.004	MAR	2004	N/A	Article	BeP	MAF	U	Structure of deep-sea pelagic fish assemblages in relation to t
13	10.3354/meps08318	MAR	2009	N/A	Article	B	SI	U	Deep-sea octocorals and antipatharians show no evidence of
14	10.1016/j.dsr2.2013.04.010	MAR	2013	ECOMAR	Article	B	MI	U	Polychaete abundance, biomass and diversity patterns at the
15	10.1016/j.dsr2.2013.08.001	MAR	2013	ECOMAR	Article	P	F	U	Midwater fishes collected in the vicinity of the Sub-Polar Fron
16	10.1016/j.dsr2.2013.08.012	MAR	2013	ECOMAR	Article	B	F	U	Bathyal demersal fishes of Charlie Gibbs Fracture Zone region
17	10.1016/j.dsr2.2013.08.002	MAR	2013	ECOMAR	Article	B	F	U	Bathyal demersal fishes of Charlie-Gibbs Fracture Zone region
18	10.1016/j.dsr2.2013.08.013	MAR	2013	ECOMAR	Article	B	F	U	Bathyal demersal fishes of the Charlie-Gibbs Fracture Zone re
19	10.1007/BF00428656	MAR	1986	N/A	Article	B	MAF	U	Biomass of the invertebrate megabenthos from 500 to 4100 r
20	10.3354/meps197121	MAR	2000	EUMELI	Article	B	MAF	U	Variation in structure and biomass of the benthic communitie
21	10.3354/meps319263	MAR	2006	MAR-ECO	Article	B	F	U	Depth zonation and latitudinal distribution of deep-sea scaver
22	10.1016/0967-0637(94)90100-7	MAR	1994	N/A	Article	B	MAF	U	Variations in the invertebrate abyssal megafauna in the North
23	10.1357/002224089785076064	MAR	1989	IFREMER DEEP-	Article	B	MAF	U	Density of the major size groups of benthic fauna and trophic
24	10.1093/icesjms/fsp170	MAR	2009	ECOVUL/ARPA	Article	B	SI	CA	Seabed mapping for selecting cold-water coral protection are
25	10.1016/j.marpol.2011.09.005	MAR	2012	N/A	Article	B	SI	CA	Actions taken by fishing Nations towards identification and pr



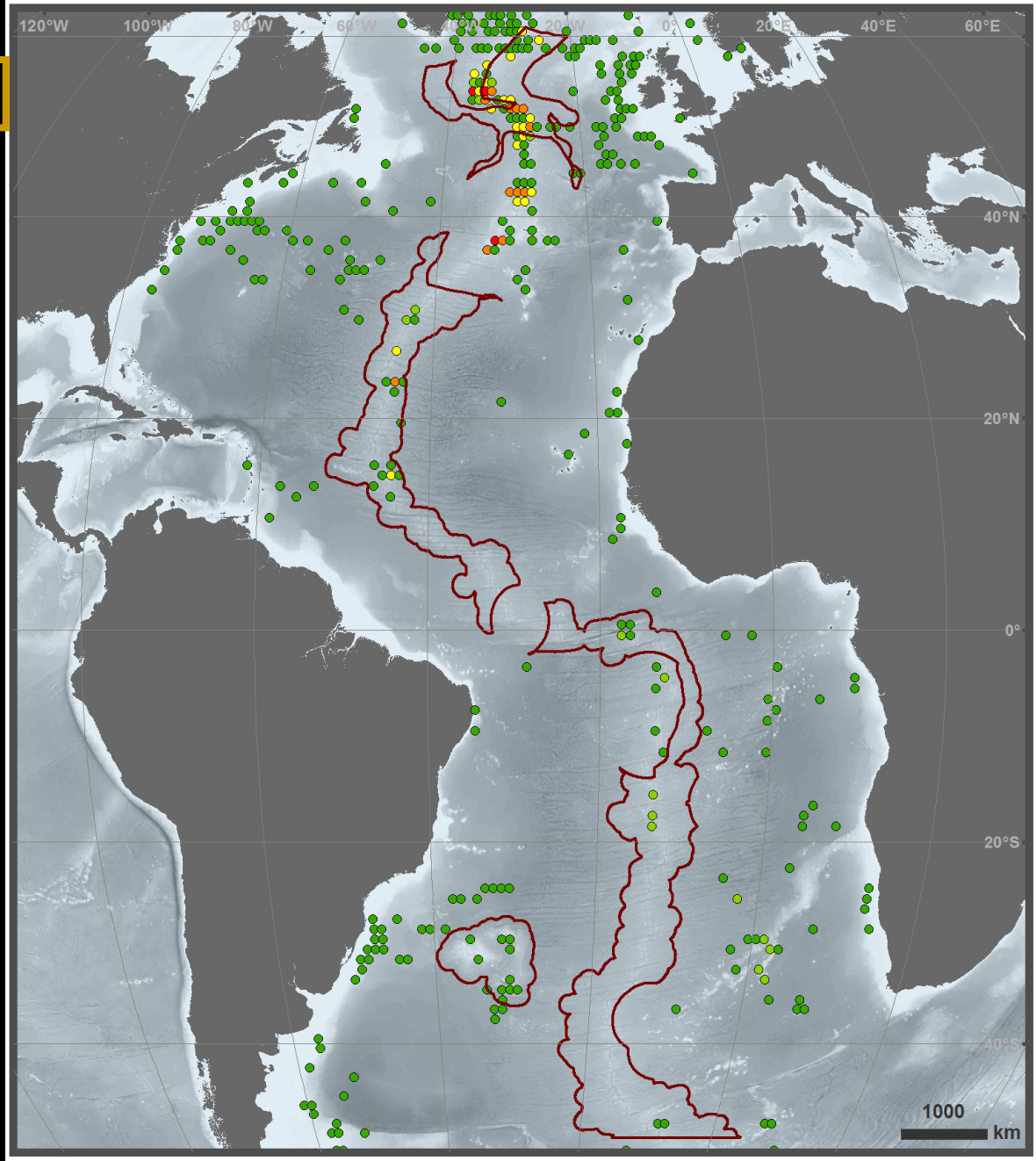
Data report – Data Mining

MAR Database

Publication list (n = 235)

Greater scientific pubs on the northern portion of the MAR

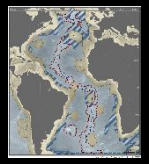
But limited to specific areas (hydrothermal vents; 35%)



Marine Geospatial Ecology Lab, Duke University (2015)

Number of Publications per 1 x 1 degree cell

1 - 4 | 5 - 11 | 12 - 26 | 27 - 38 | 39 - 61



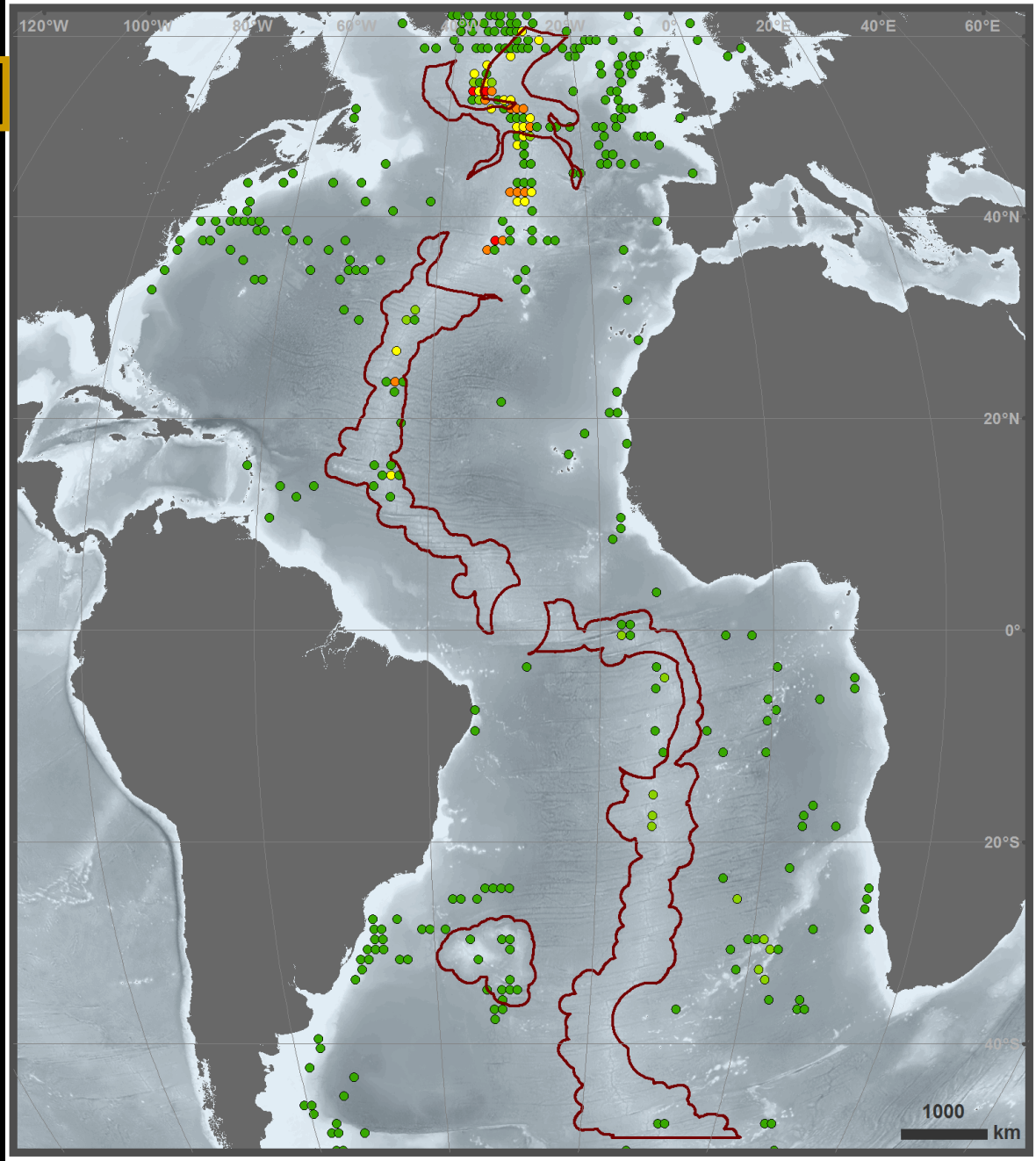
Data report – Data Mining

MAR Database

MAR and RGR remain poorly represented in the literature

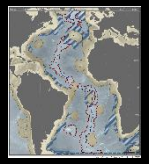
< 10% described the biology of S-MAR and RGR

ca. 5% concerned the benthic environments of these areas

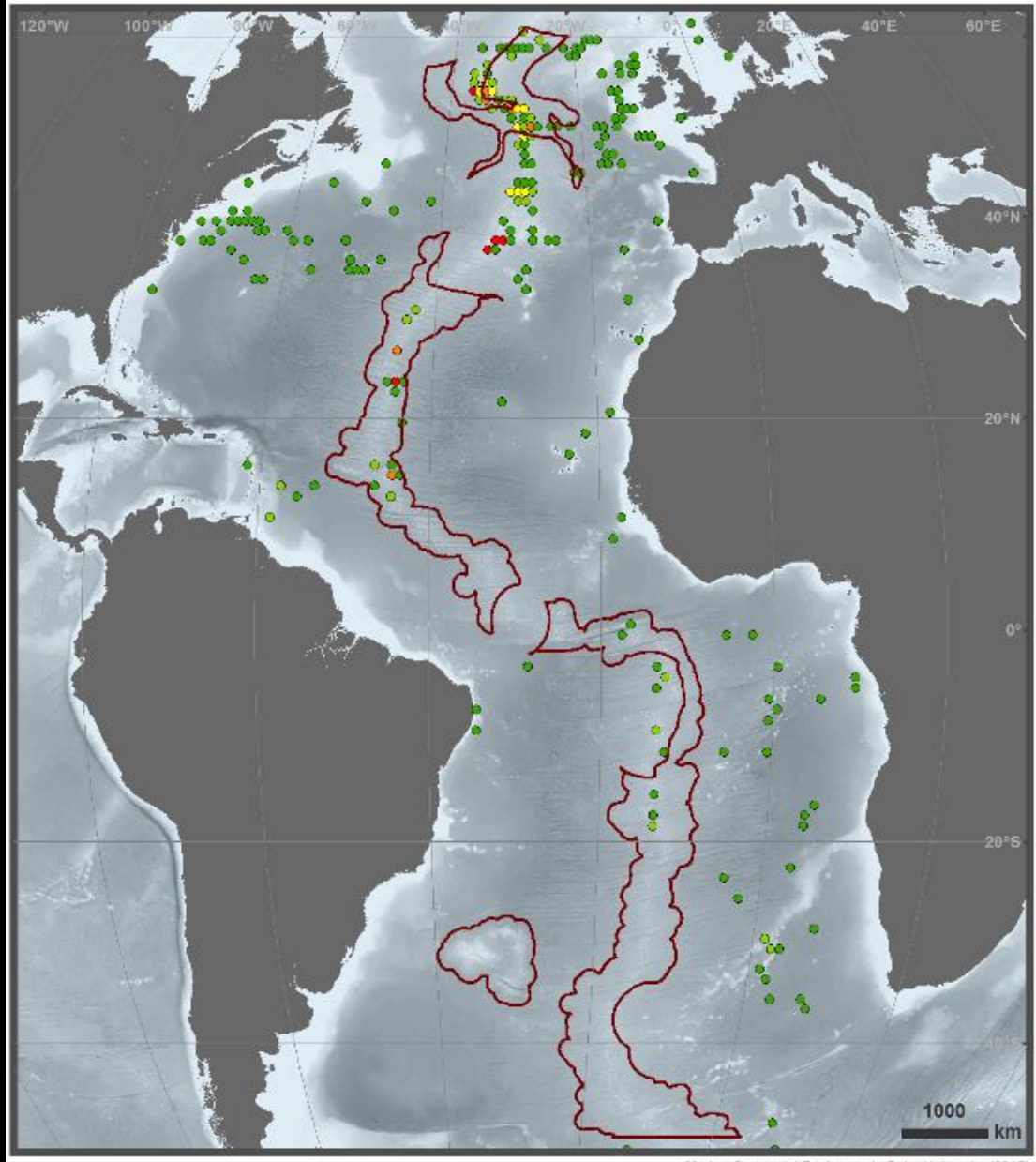


Biological Data

Mid-Atlantic Ridge and Rio Grande Rise



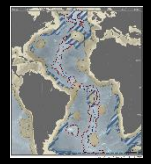
Data report – Biological Data



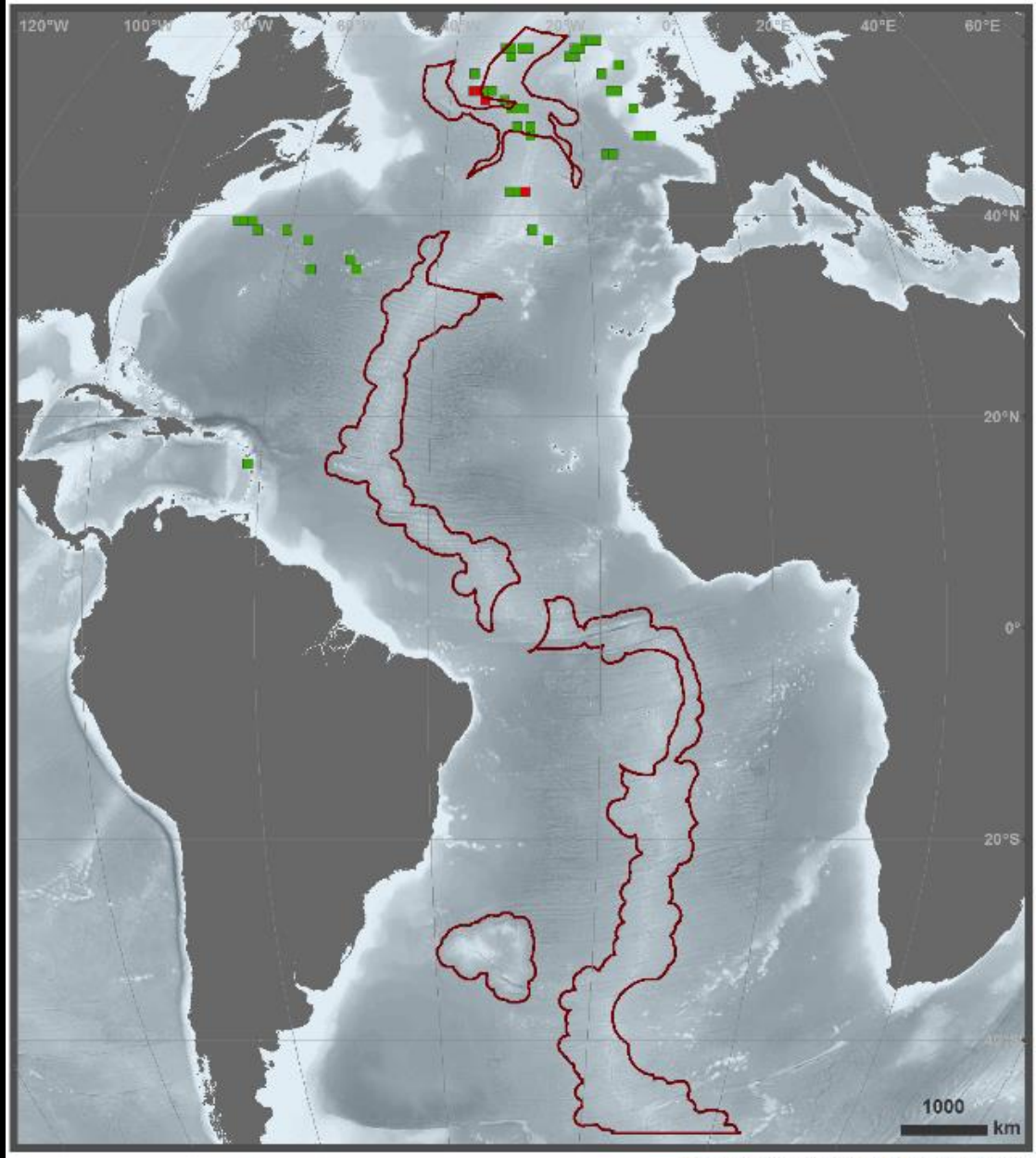
Marine Geospatial Ecology Lab, Duke University (2015)

Number of Publications per 1 x 1 degree cell: Benthic

1 - 2 3 - 8 9 - 17 18 - 23 24 - 50



Data report – Biological Data

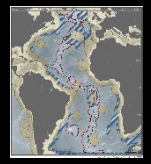


Marine Geospatial Ecology Lab, Duke University (2015)

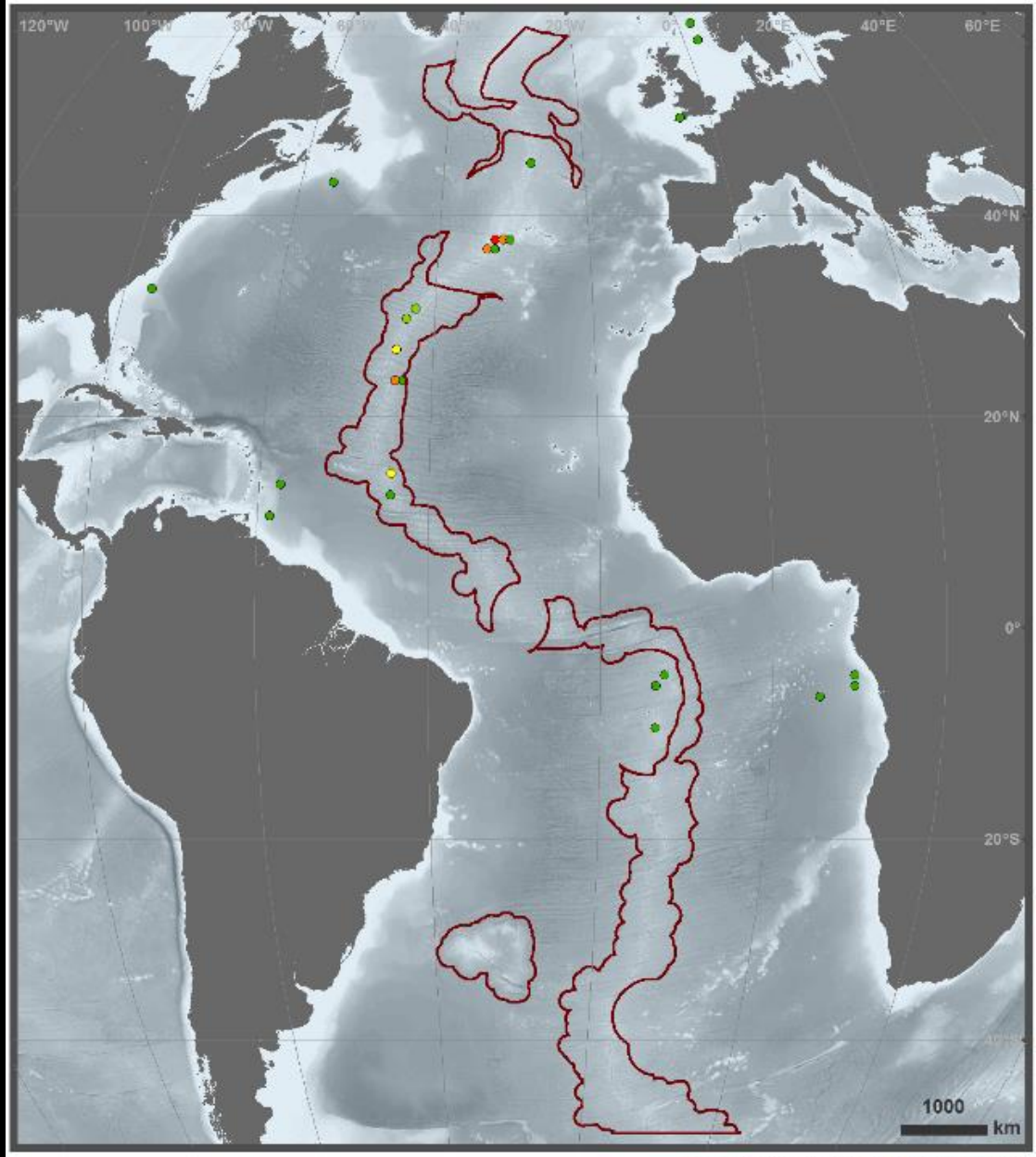
Number of Publications per 1 x 1 deg cell: VME Indicator Taxa

Number of Publications

- 1
- 2



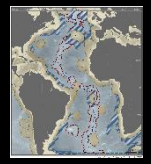
Data report – Biological Data



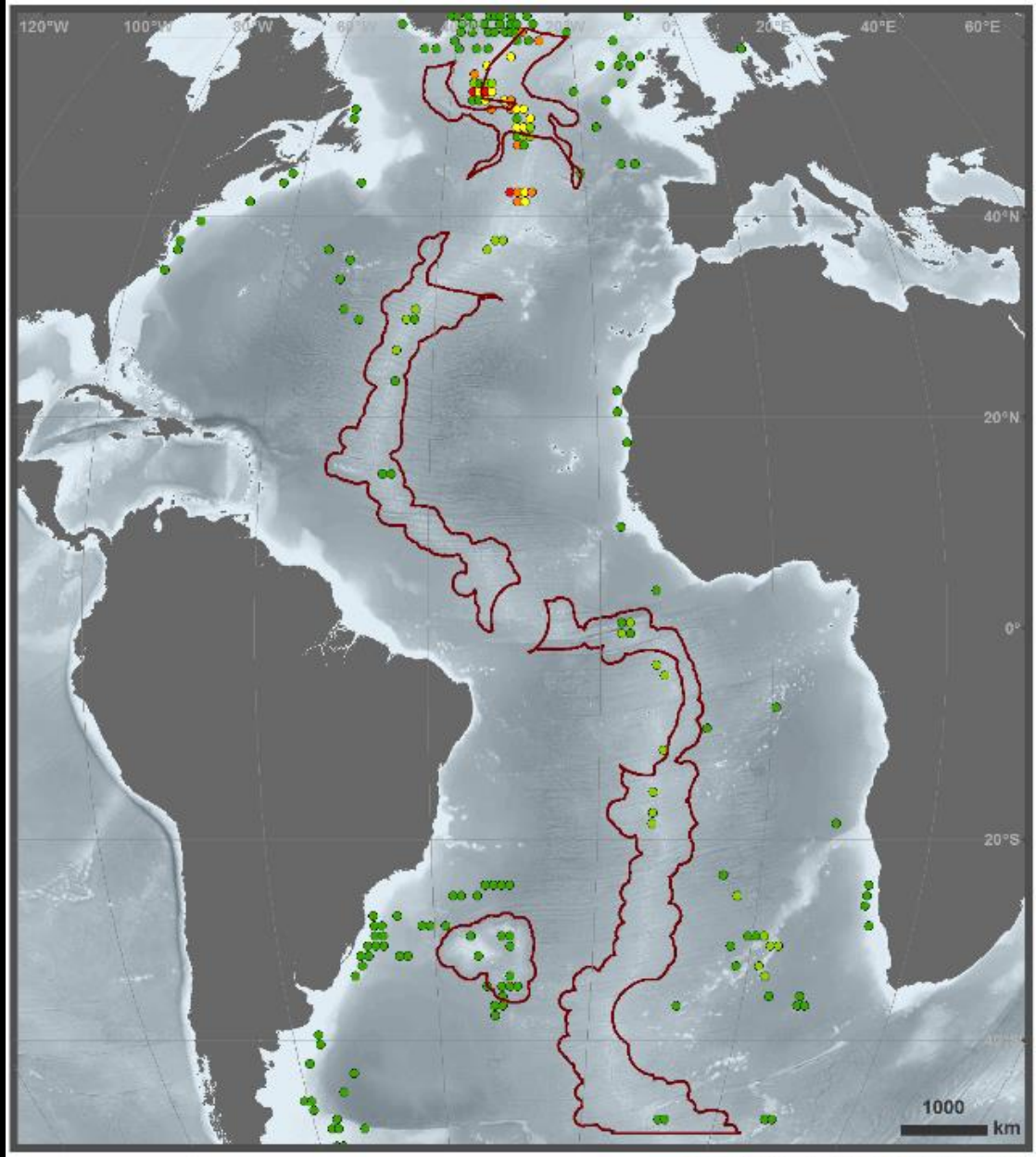
Marine Geospatial Ecology Lab, Duke University (2015)

Number of Publications per 1 x 1 deg cell: Hydrothermal Vents

Number of Publications • 1 - 3 • 4 - 8 • 9 - 16 • 17 - 27 • 28 - 41



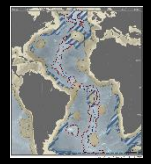
Data report – Biological Data



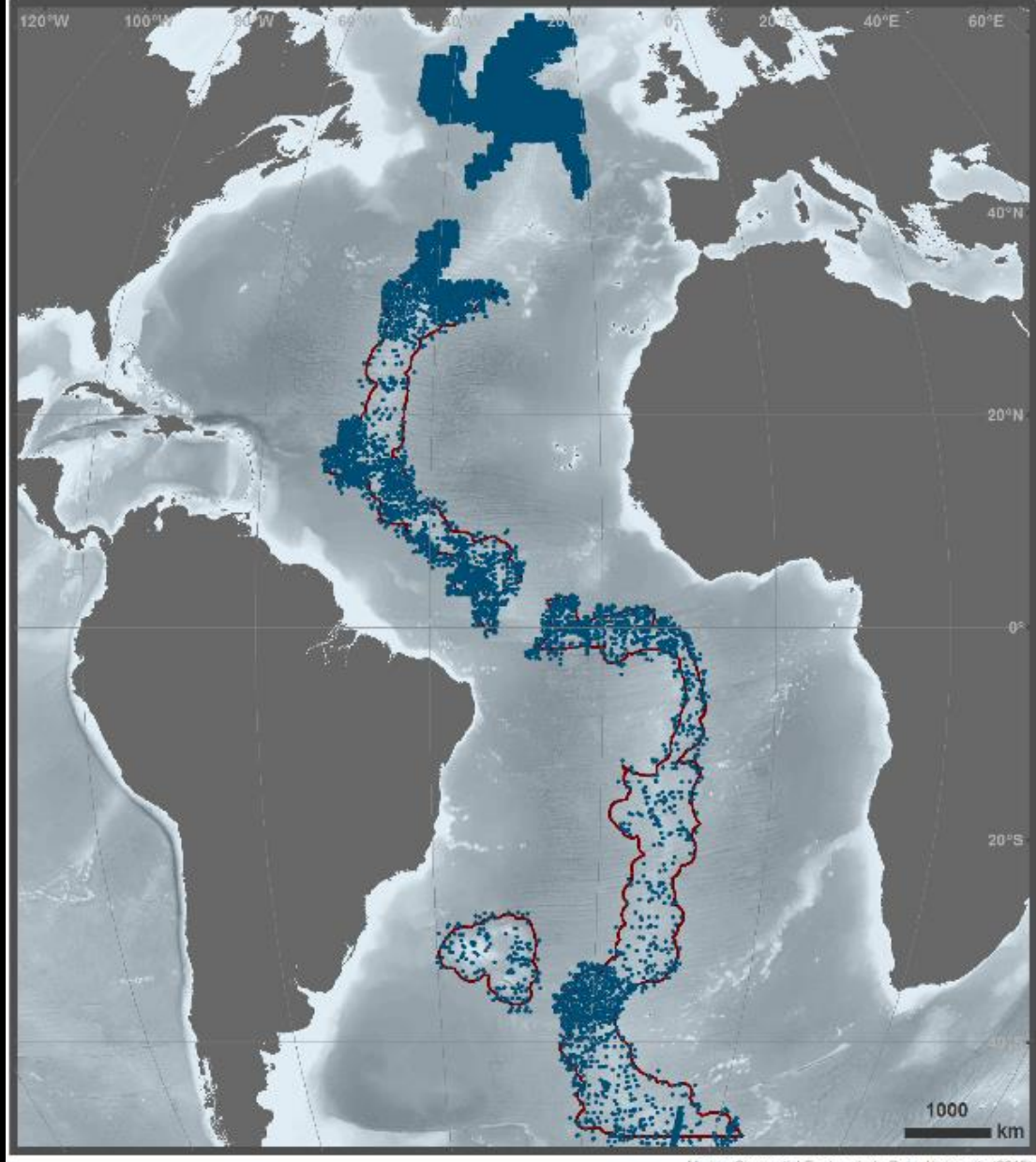
Marine Geospatial Ecology Lab, Duke University (2015)

Number of Publications per 1 x 1 degree cell: Pelagic

1 - 2 3 - 6 7 - 15 16 - 21 22 - 29



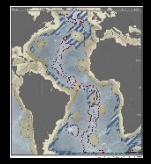
Data report – Biological Data



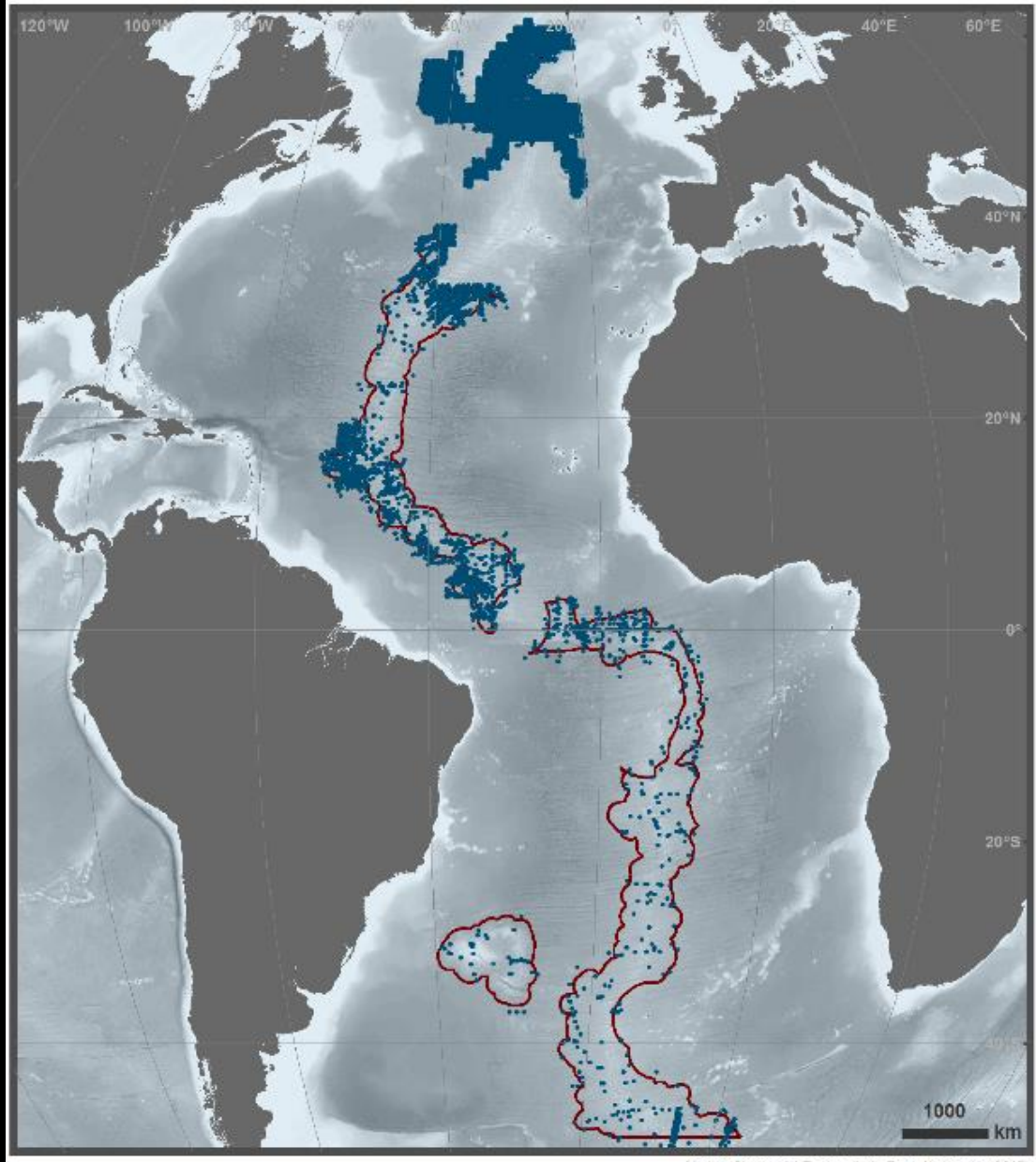
Marine Geospatial Ecology Lab, Duke University (2015)

OBIS Records: Area of Interest

- OBIS record (all, ~316K)



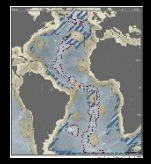
Data report – Biological Data



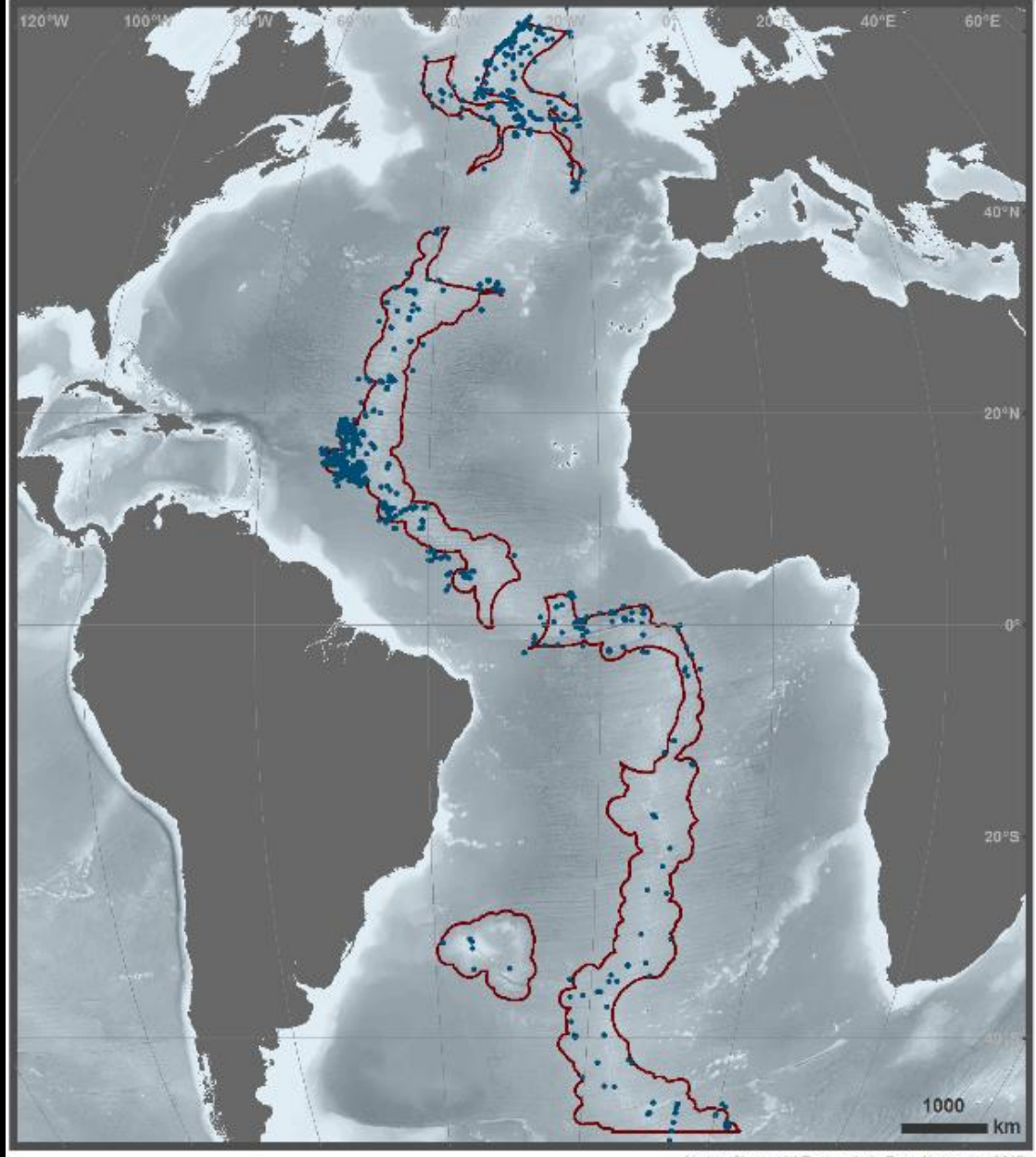
Marine Geospatial Ecology Lab, Duke University (2015)

OBIS Records: Upper Half of Water Column

- OBIS record (upper half water column, ~263K)



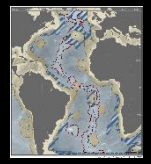
Data report – Biological Data



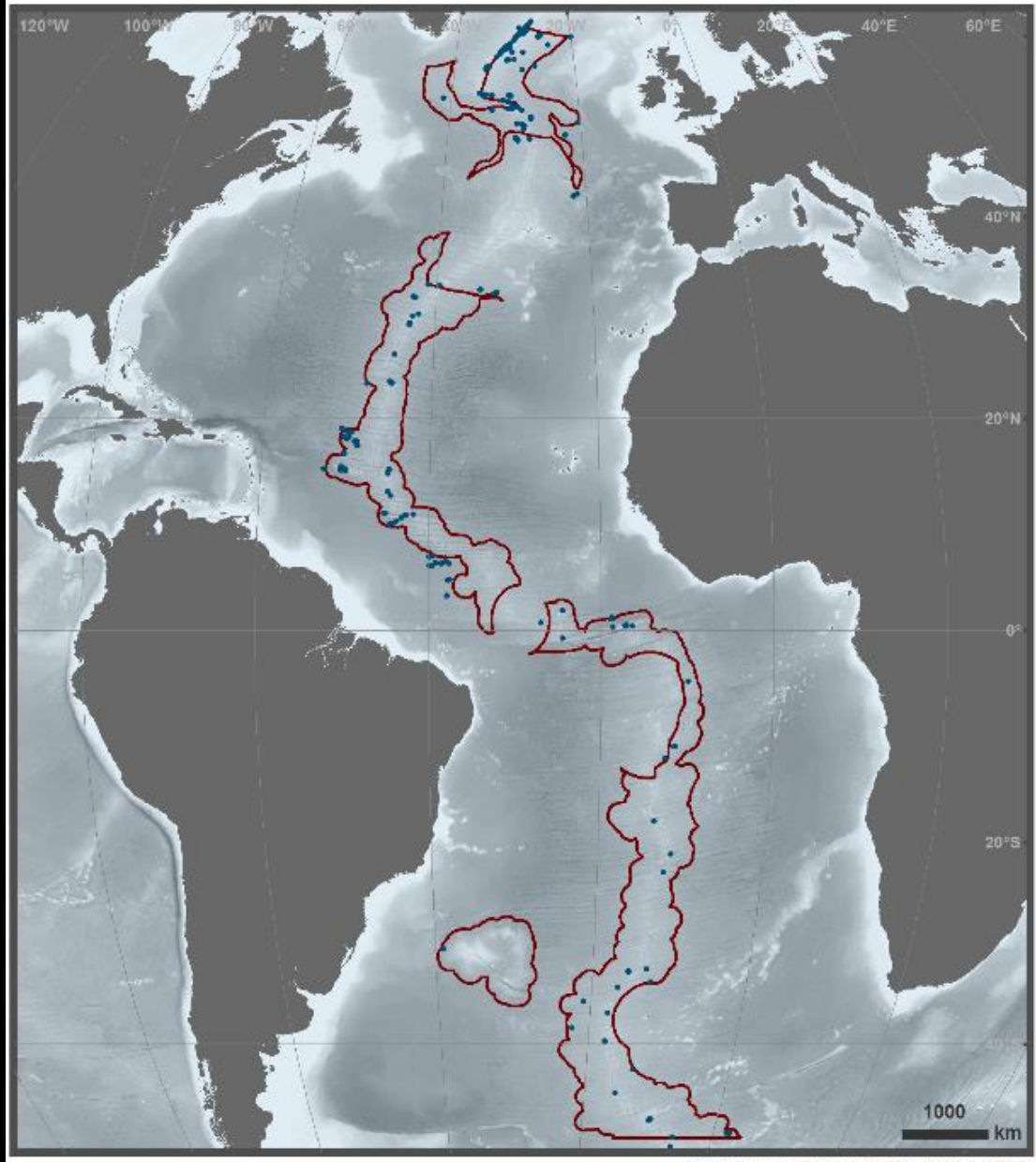
Marine Geospatial Ecology Lab, Duke University (2015)

OBIS Records: Below 200m

- OBIS record (below 200m,~22K)



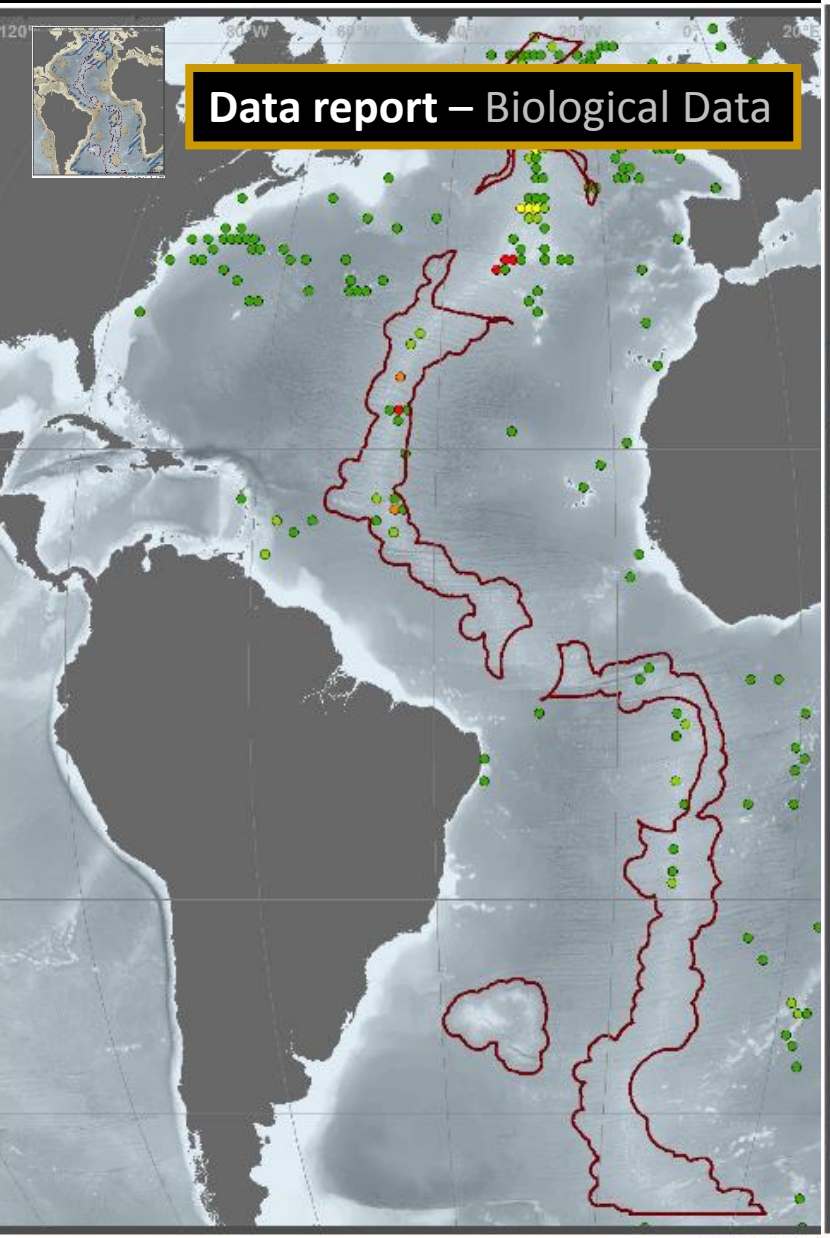
Data report – Biological Data

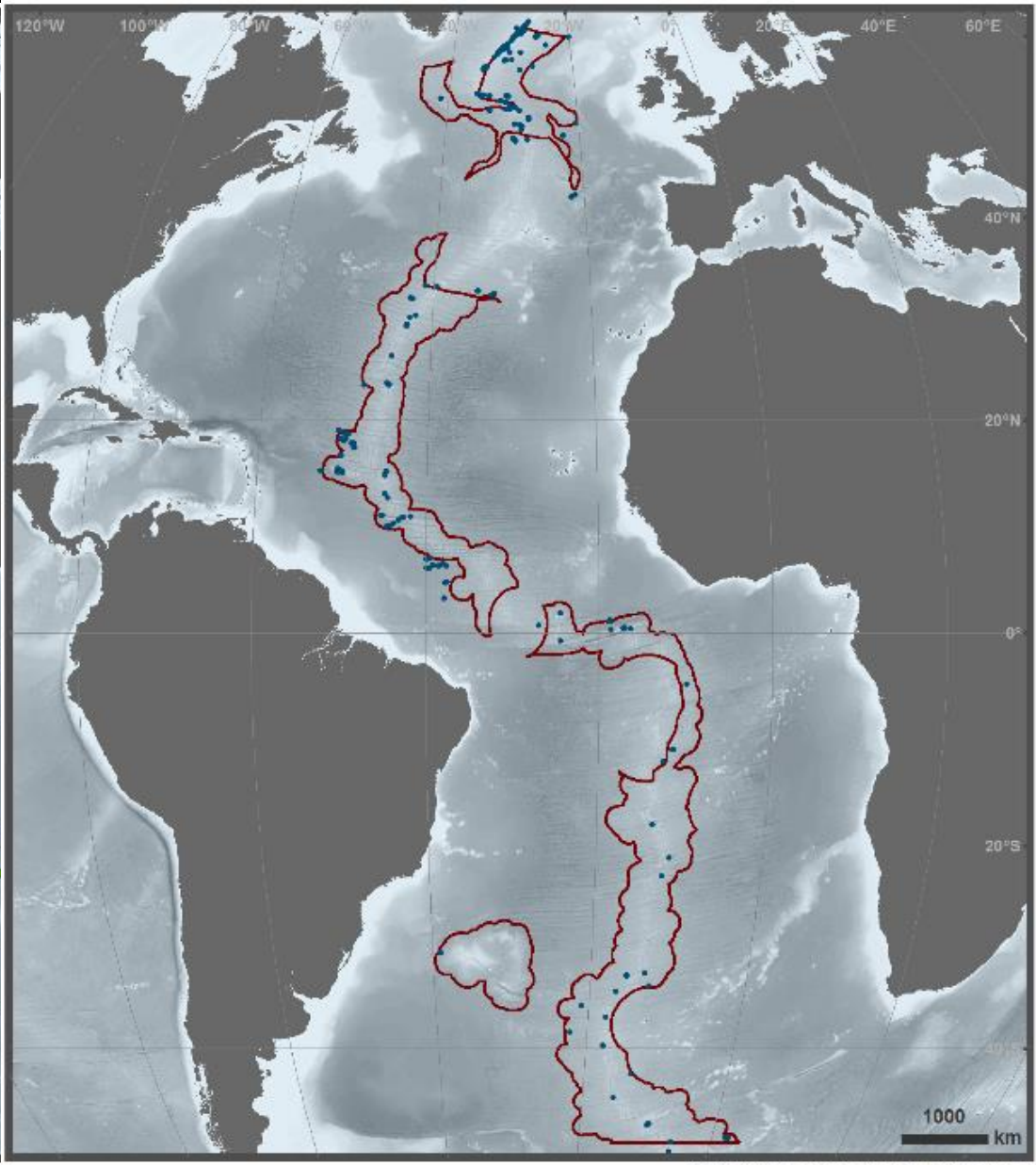


Marine Geospatial Ecology Lab, Duke University (2015)

OBIS Records: Lower Half of Water Column

- OBIS record (lower half water column, ~5K)





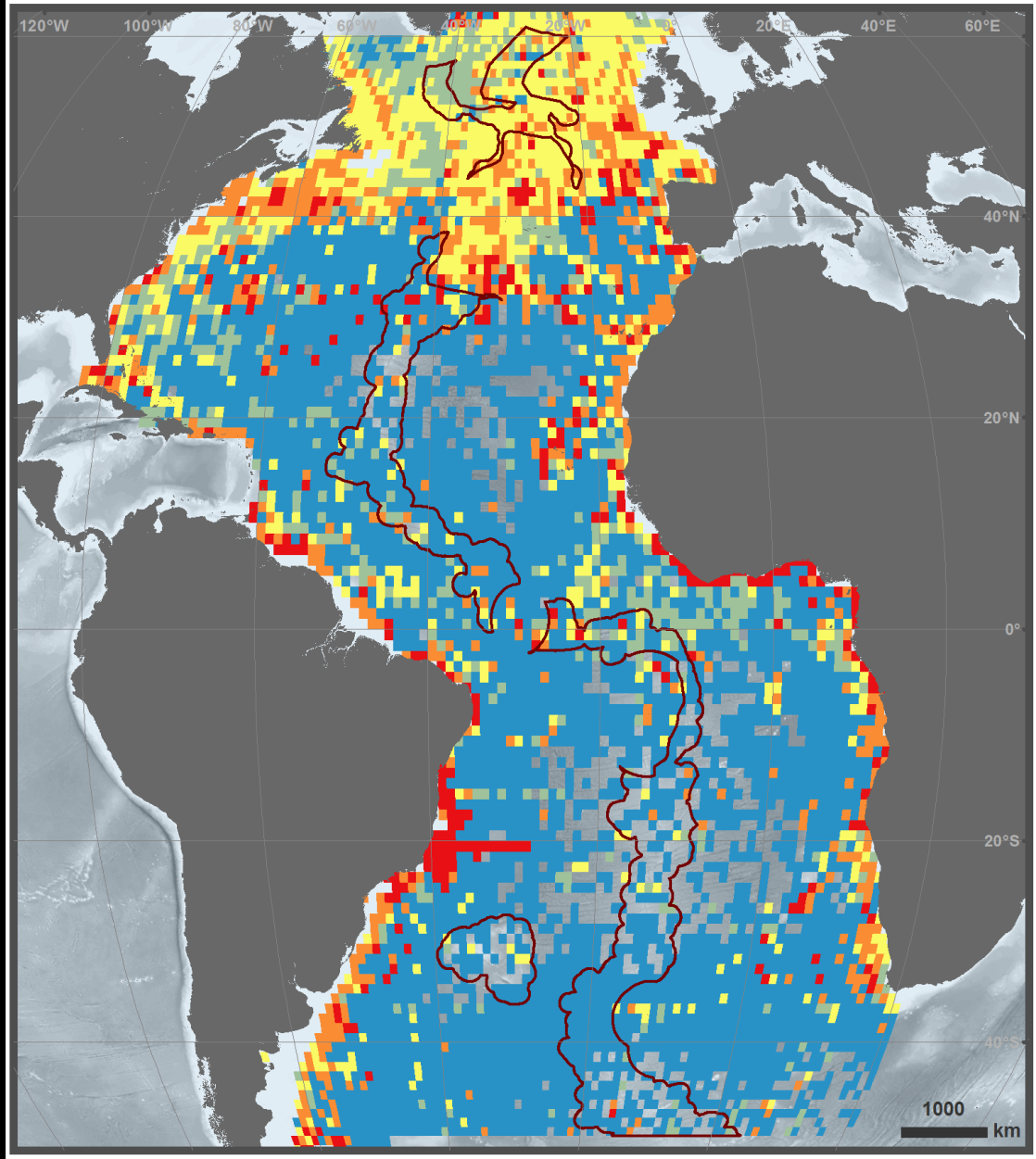
Number of Publications per 1 x 1 degree cell: Ber

1 - 2 3 - 8 9 - 17 18 - 23 24 - 50

OBIS Records: Lower Half of Water Column

OBIS record (lower half water column, ~5K)

Data report – Biological Data



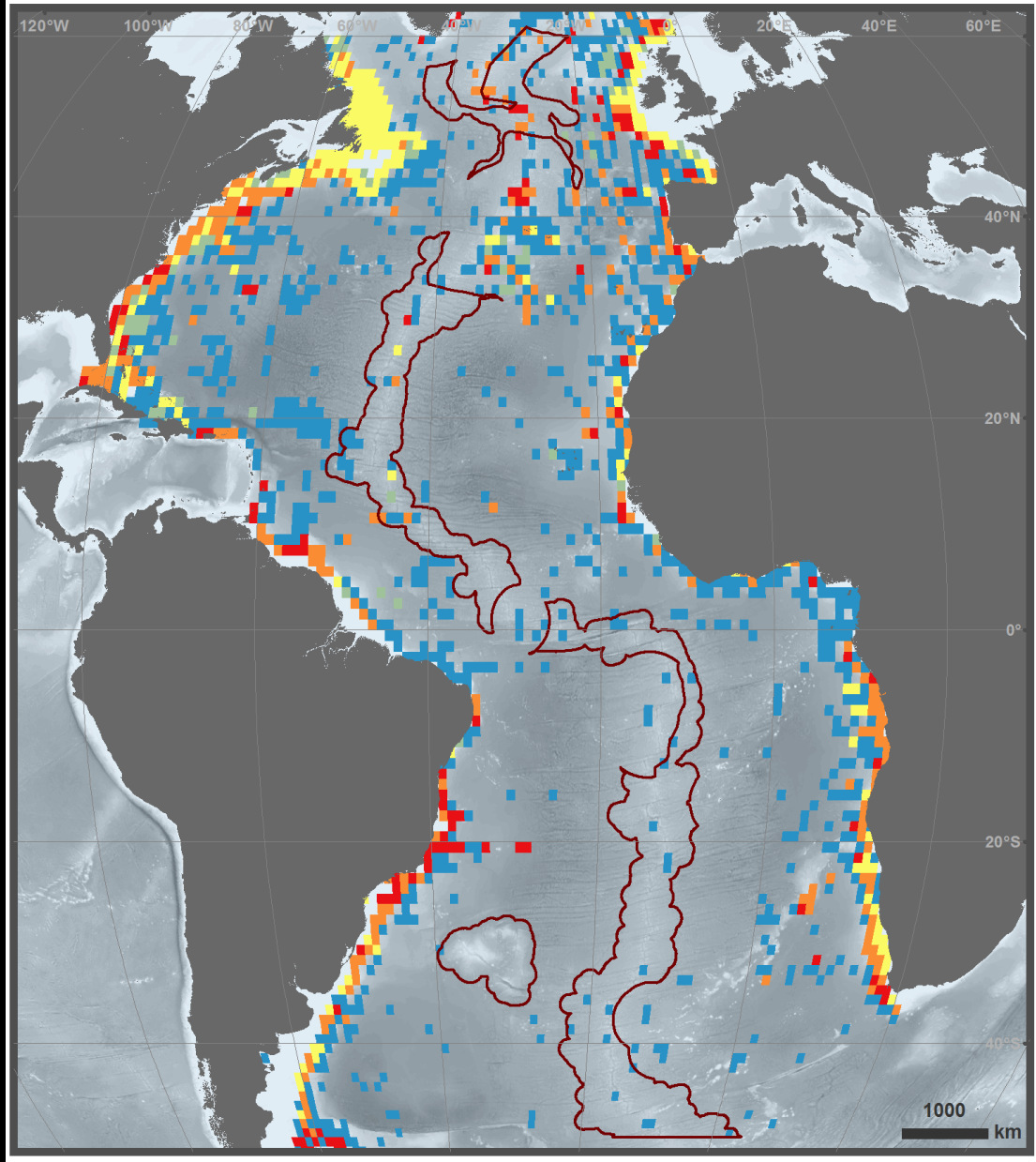
Marine Geospatial Ecology Lab, Duke University (2015)

OBIS Biodiversity: all records

Hurlbert Index - es(50)

- 0.0 - 10.0
- 10.1 - 20.0
- 20.1 - 30.0
- 30.1 - 40.0
- 40.1 - 50.0

Data report – Biological Data



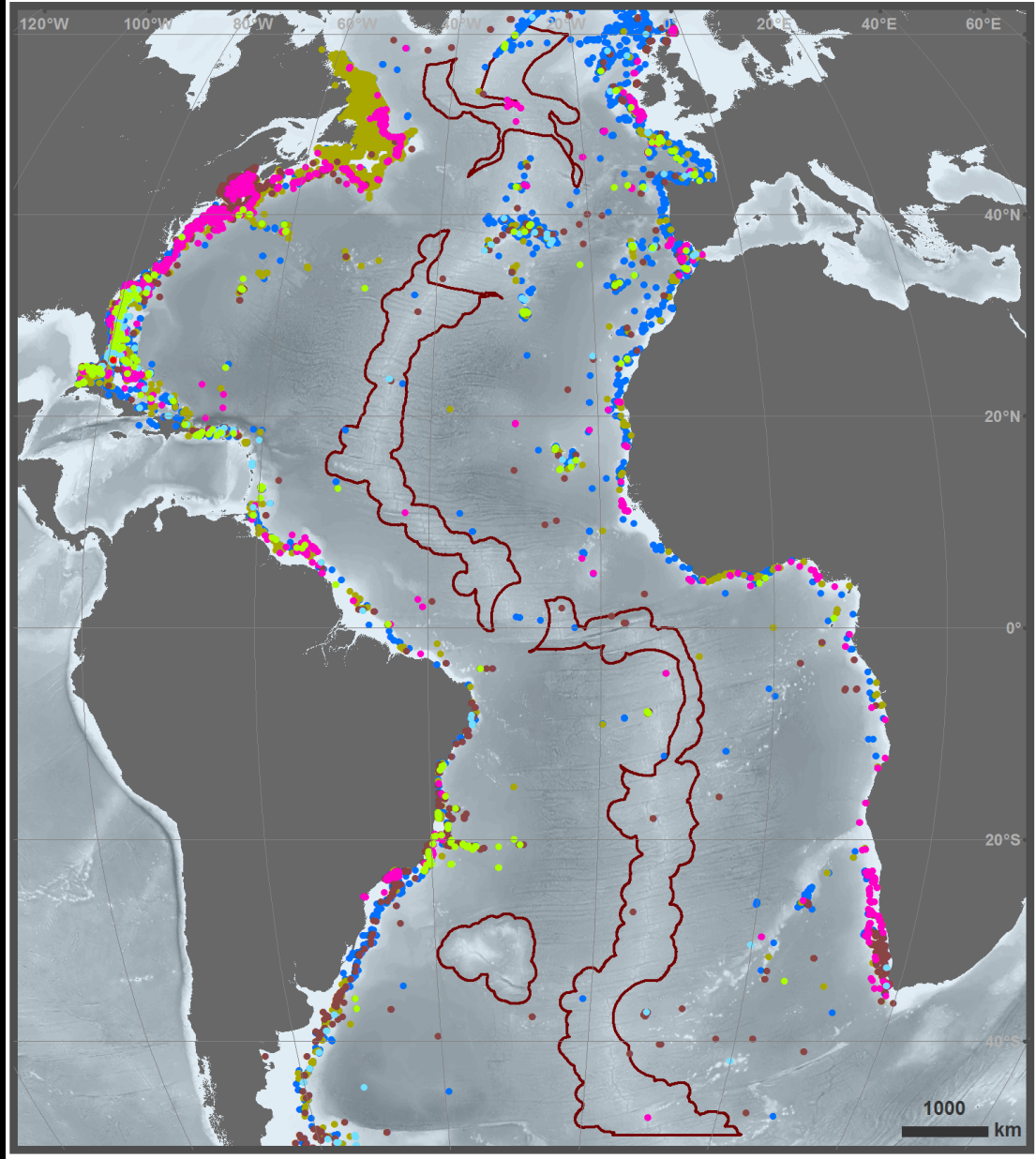
Marine Geospatial Ecology Lab, Duke University (2015)

OBIS Biodiversity: records from lower water column

Hurlbert Index - es(50)

- 0.0 - 10.0
- 10.1 - 20.0
- 20.1 - 30.0
- 30.1 - 40.0
- 40.1 - 50.0

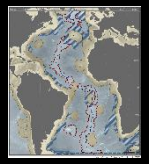
Data report – Biological Data



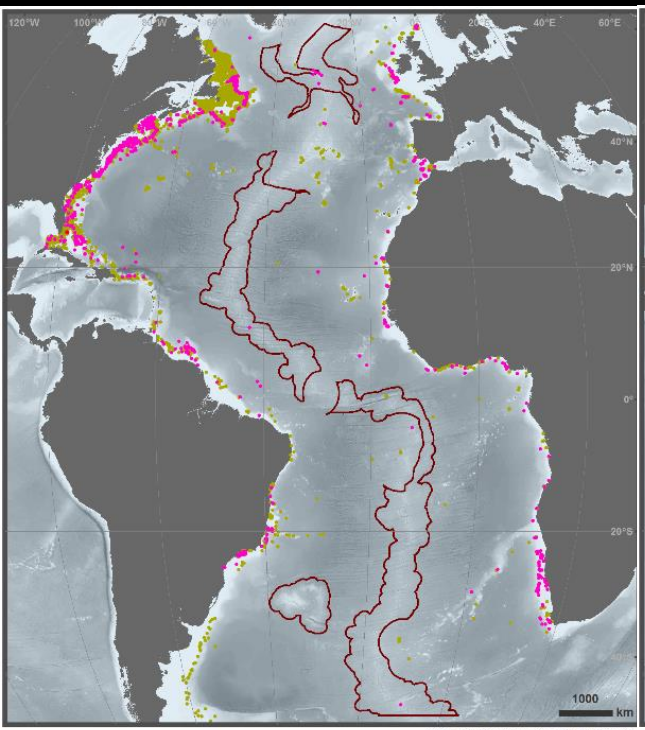
Marine Geospatial Ecology Lab, Duke University (2015)

OBIS Records: VME Taxa

- Order Helioporacea (n=1)
- Order Pennatulacea (n=1821)
- Order Scleractinia (n=36614)
- Order Antipatharia (n=559)
- Phylum Porifera (n=6889)
- Family Stylasteridae (n=811)
- Order Alcyonacea (n=10529)

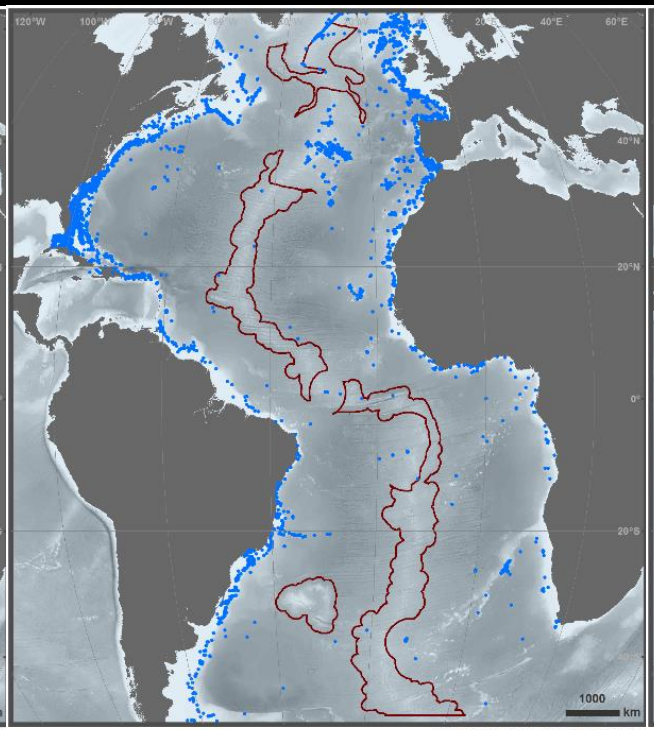


Data report – Biological Data



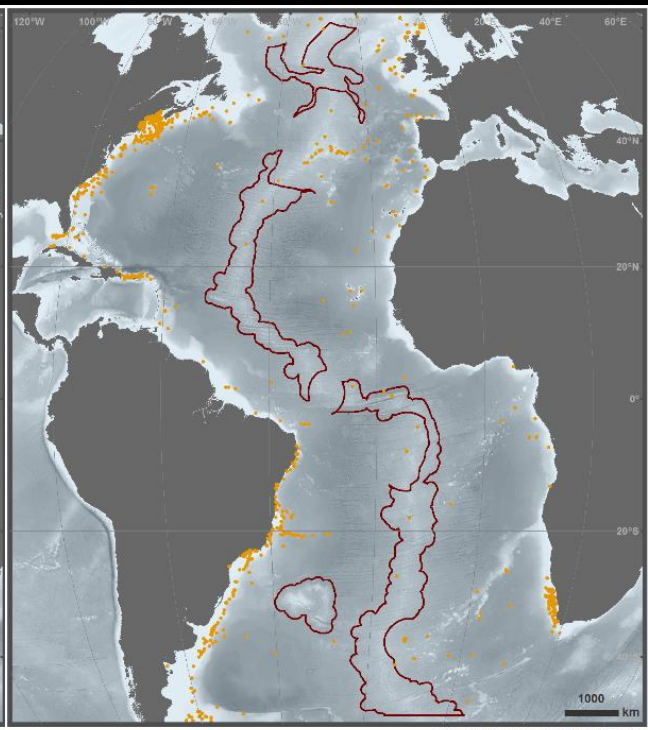
OBIS Records: Octocorals

- Order Helioporacea (n=1)
- Order Pennatulacea (n=1821)
- Order Alcyonacea (n=10529)



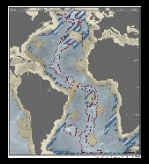
OBIS Records: Order Scleractinia

- Order Scleractinia (n=36614)

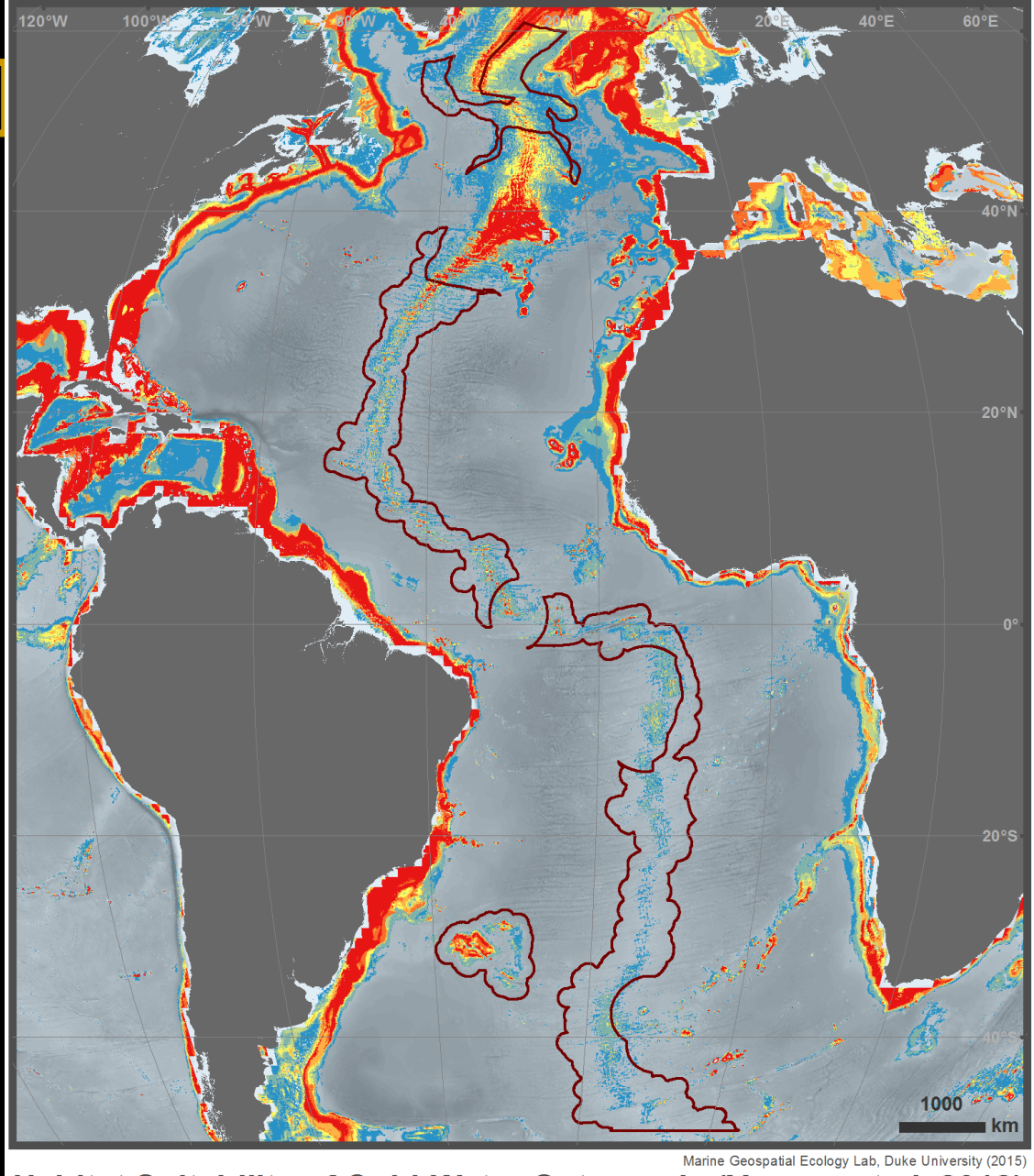


OBIS Records: Sponges

- Phylum Porifera (n=6889)



Data report – Biological Data

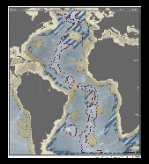


Marine Geospatial Ecology Lab, Duke University (2015)

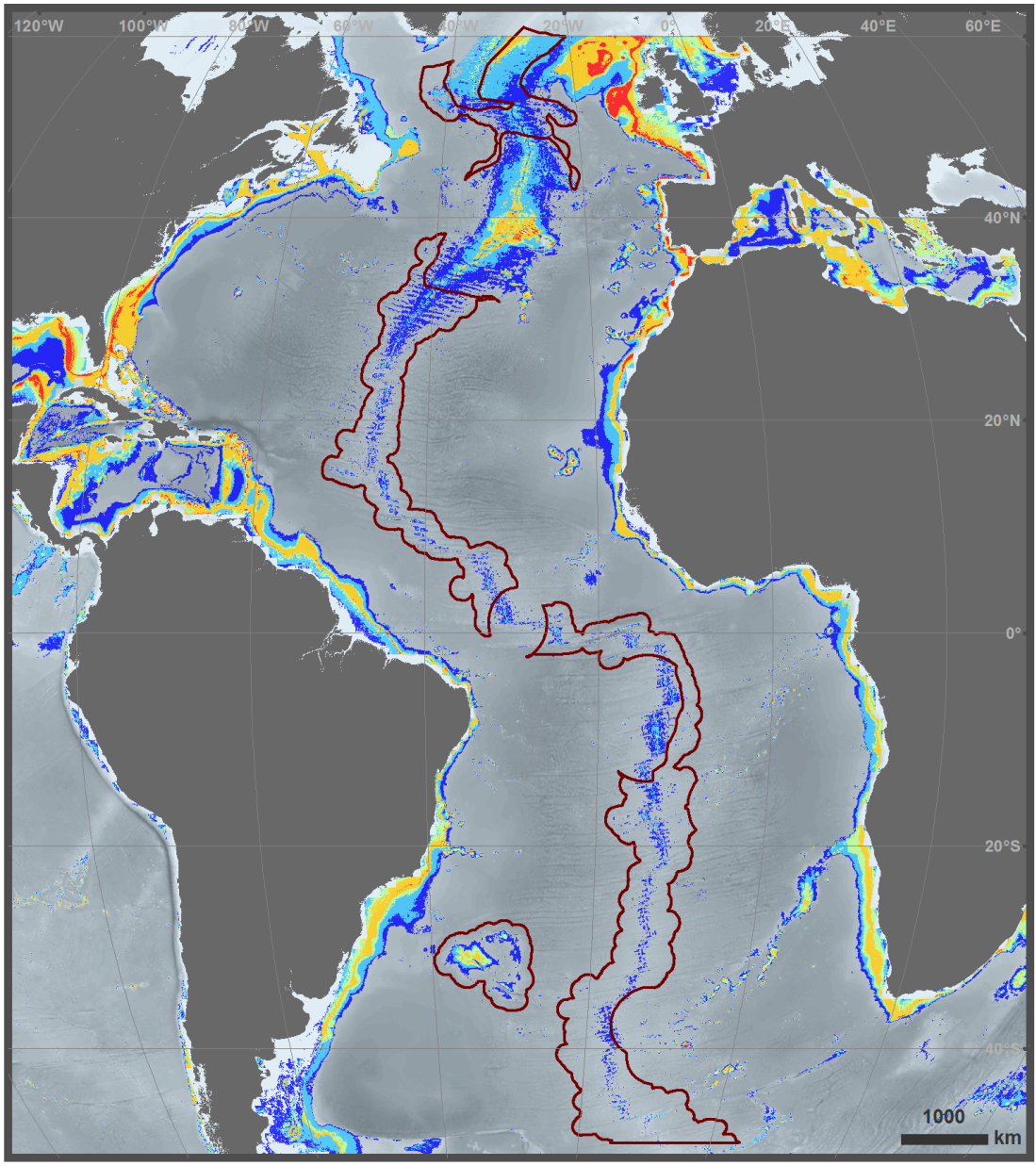
Habitat Suitability of Cold-Water Octocorals (Yesson et al. 2012)

Habitat Suitability (# of Octocoral Species)

1 2 3 4 5 6 7



Data report – Biological Data

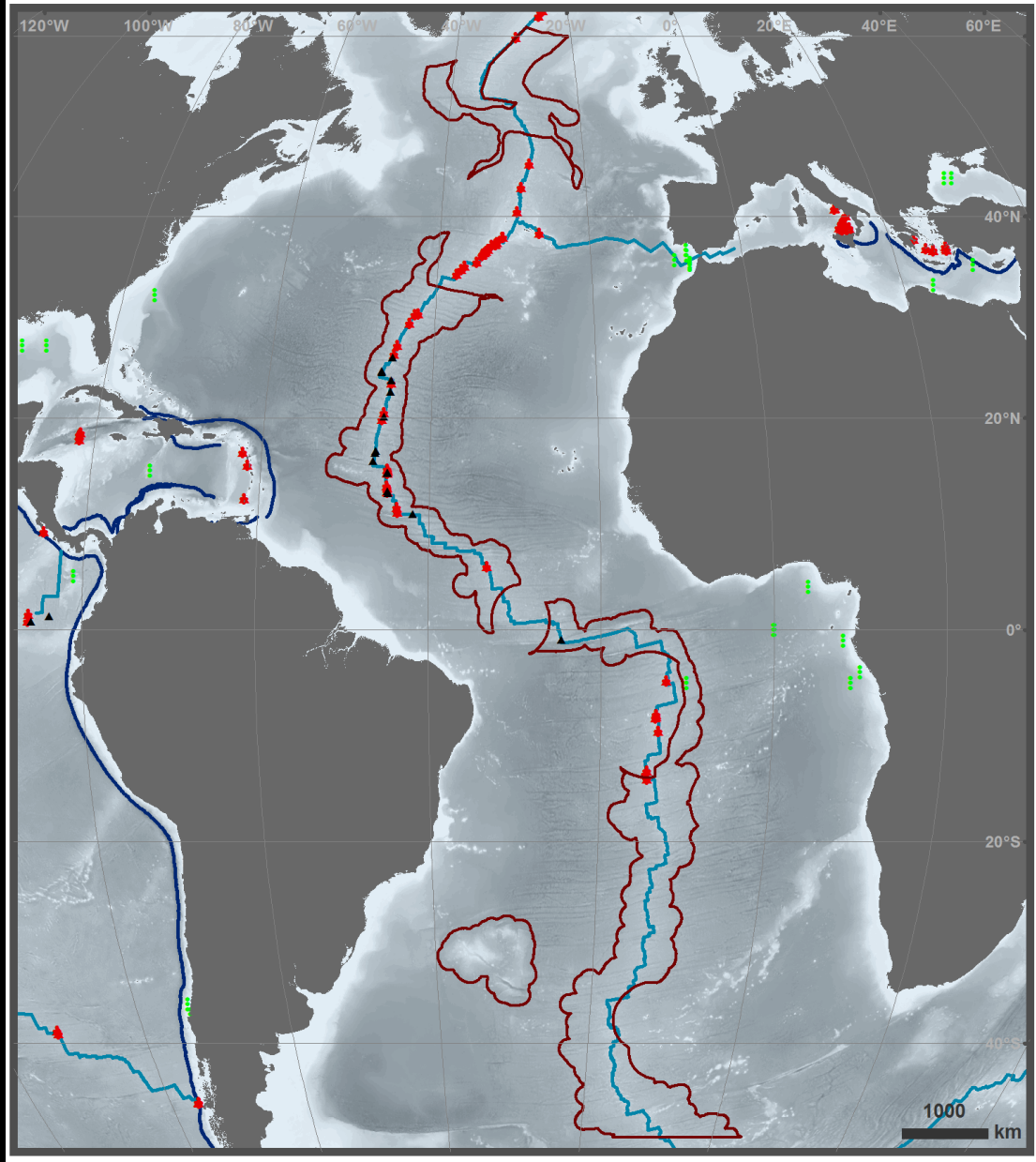


Marine Geospatial Ecology Lab, Duke University (2015)

Habitat Suitability of Scleractinia (Davies and Guinotte 2011)

Suitability

Data report – Biological Data



Marine Geospatial Ecology Lab, Duke University (2015)

Hydrothermal Vents and Cold Seeps

Hydrothermal Vents (InterRidge 2011)

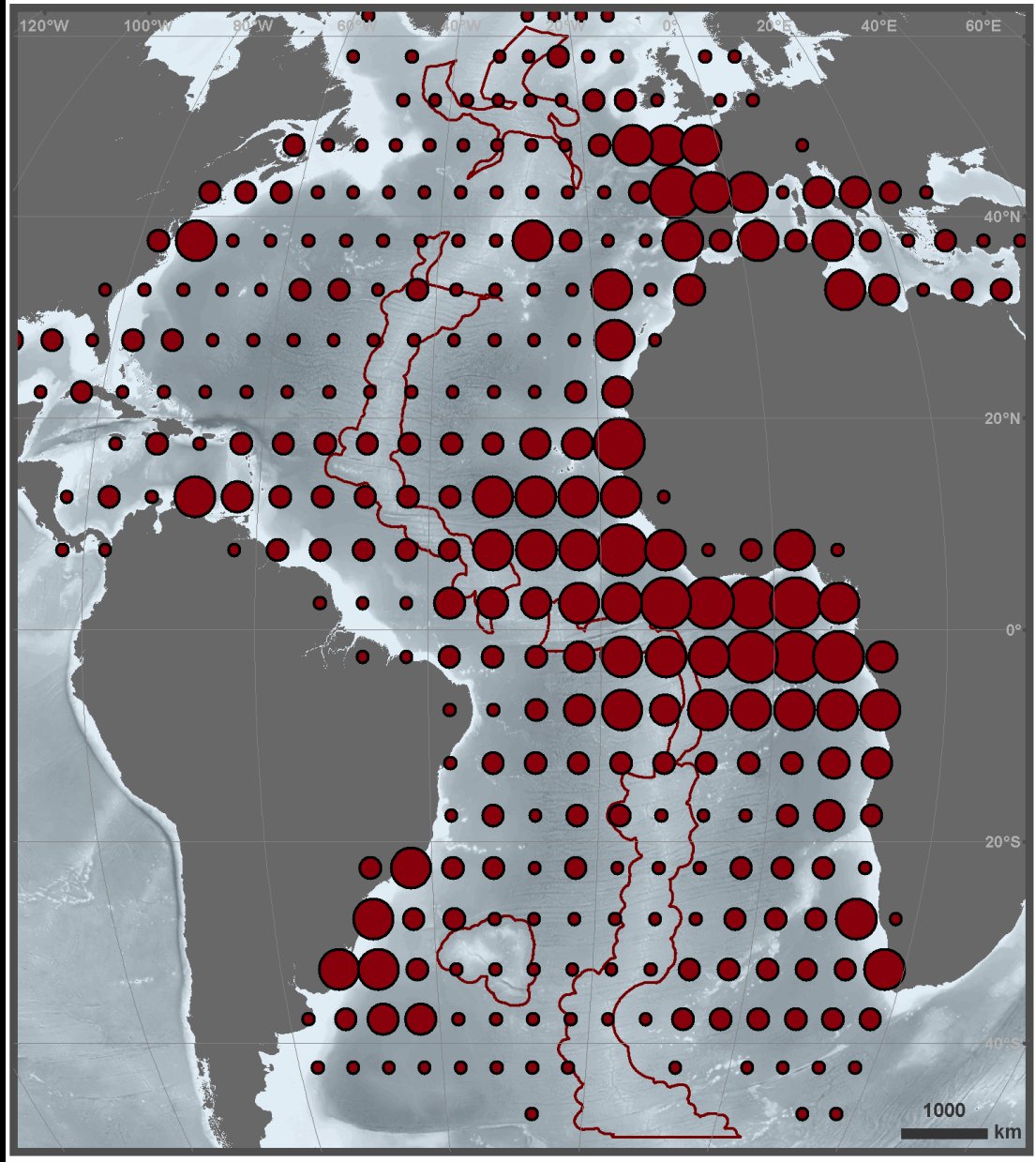
- Active
- Inactive

Cold Seeps (CHESS)

Ridge

Trench

Data report – Biological Data

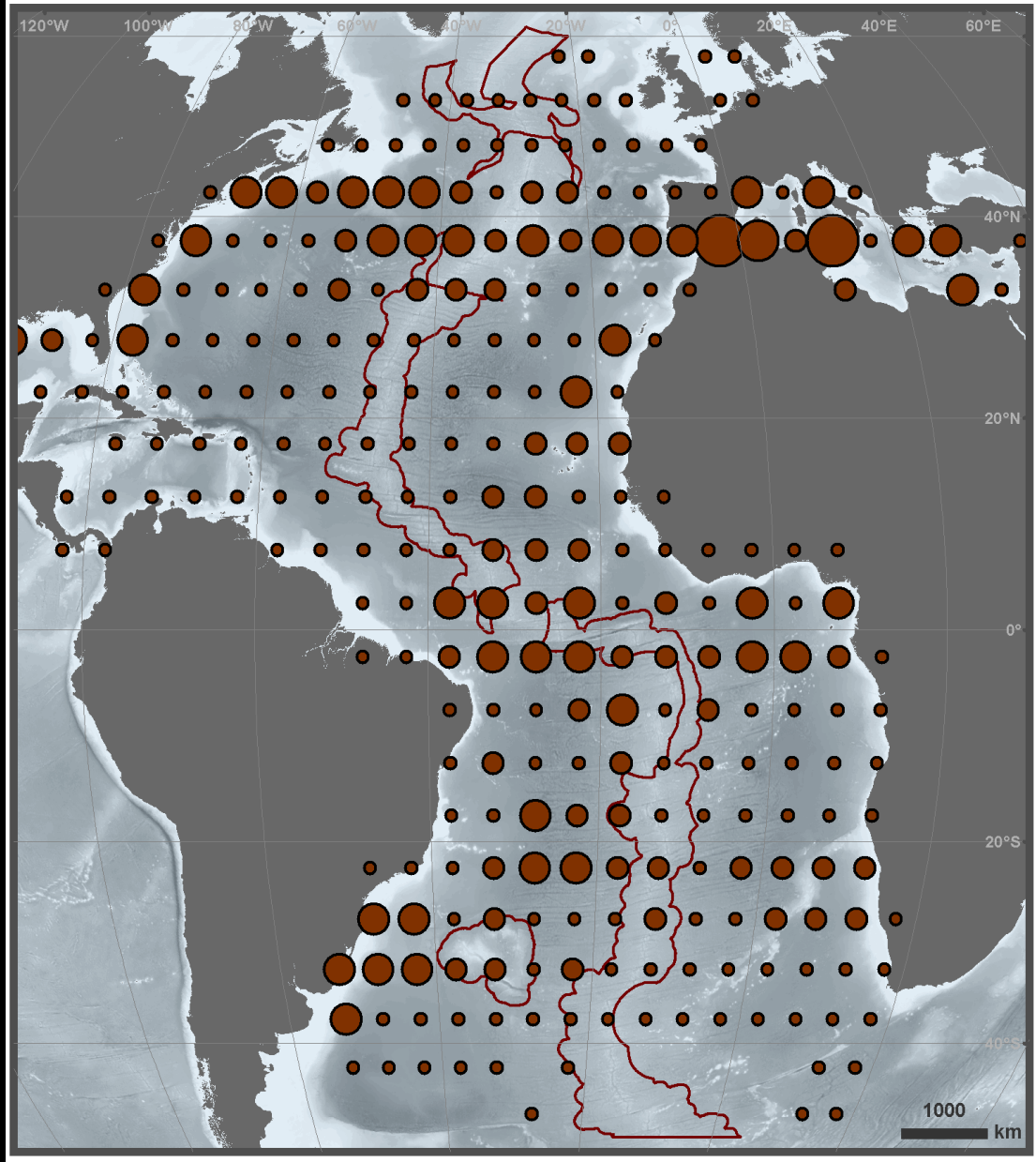


Marine Geospatial Ecology Lab, Duke University (2015)

Aggregated Landings of Tuna between 2005 and 2009 (thousands of kg; source: ICCAT)

< 1000 | 1000 - 5000 | 5000 - 10000 | 10000 - 50000 | > 50000

Data report – Biological Data

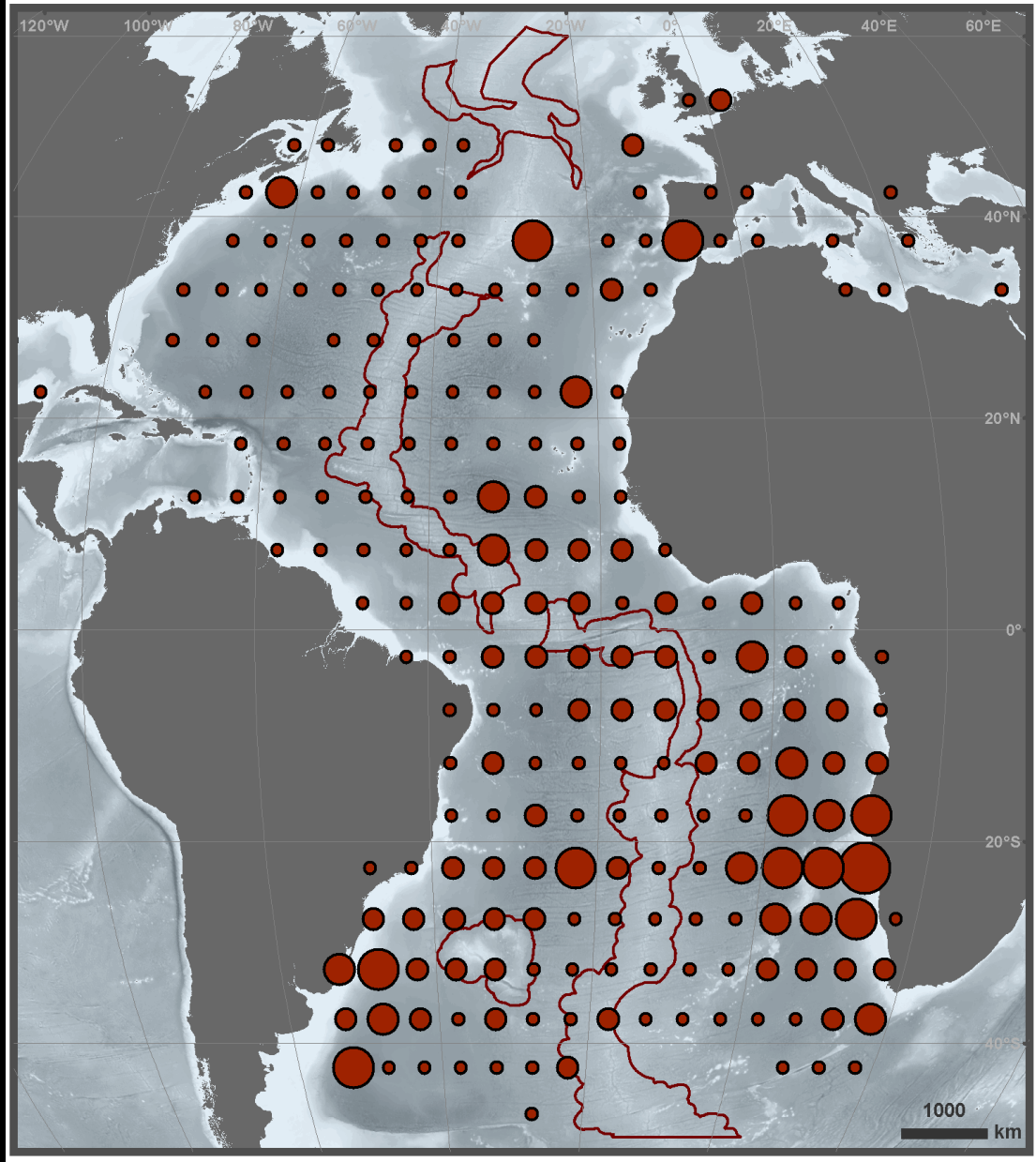


Marine Geospatial Ecology Lab, Duke University (2015)

Aggregated Landings of Swordfish between 2005 and 2009 (kg; source: ICCAT)

< 500 | 500 - 1000 | 1000 - 5000 | 5000 - 10000 | > 10000

Data report – Biological Data

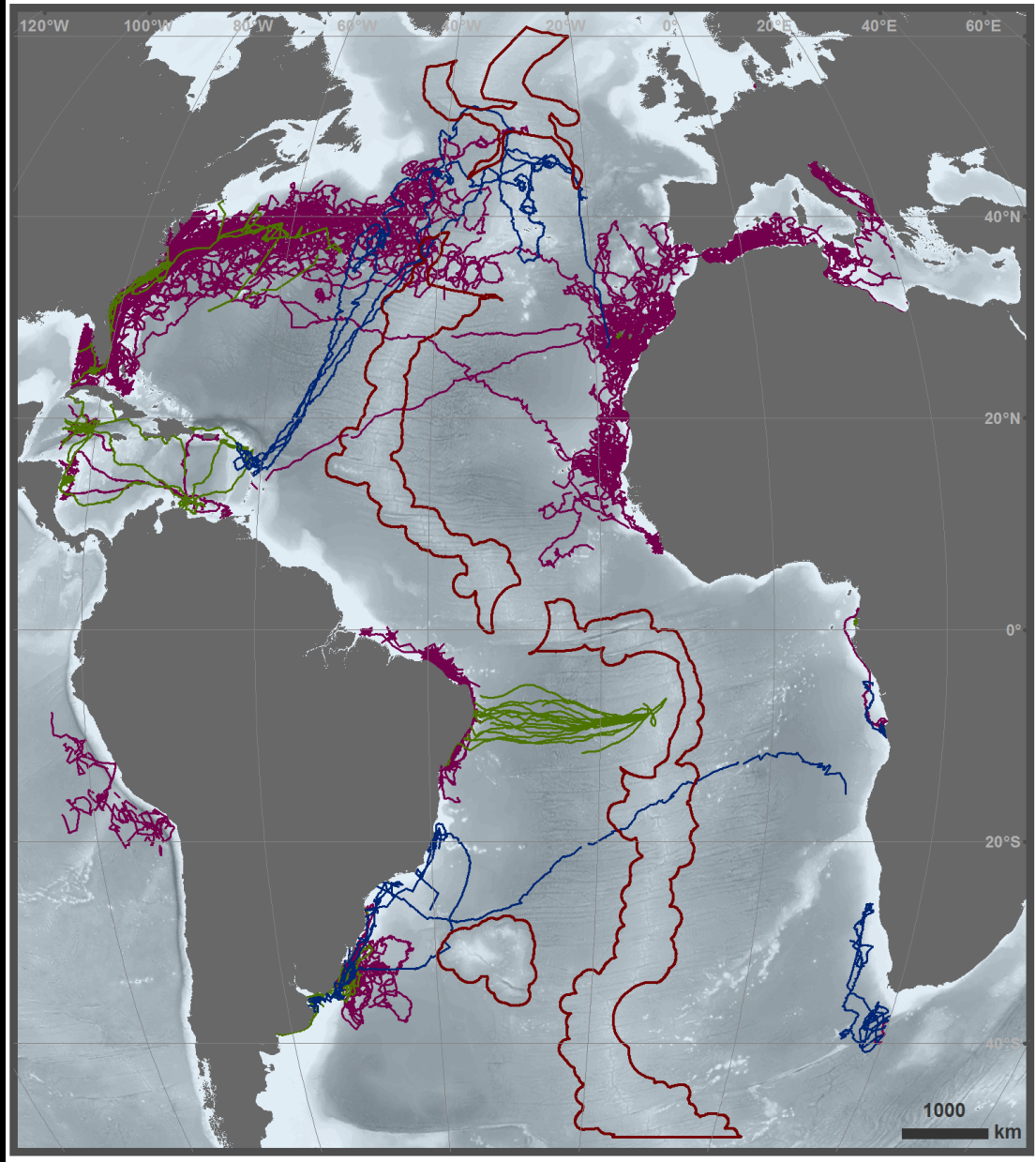


Marine Geospatial Ecology Lab, Duke University (2015)

Aggregated Catches of Sharks between 2005 and 2009 (kg; source: ICCAT)

< 100000 | 100000 - 500000 | 500000 - 1000000 | 1000000 - 5000000 | > 5000000

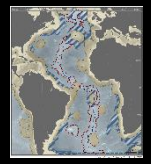
Data report – Biological Data



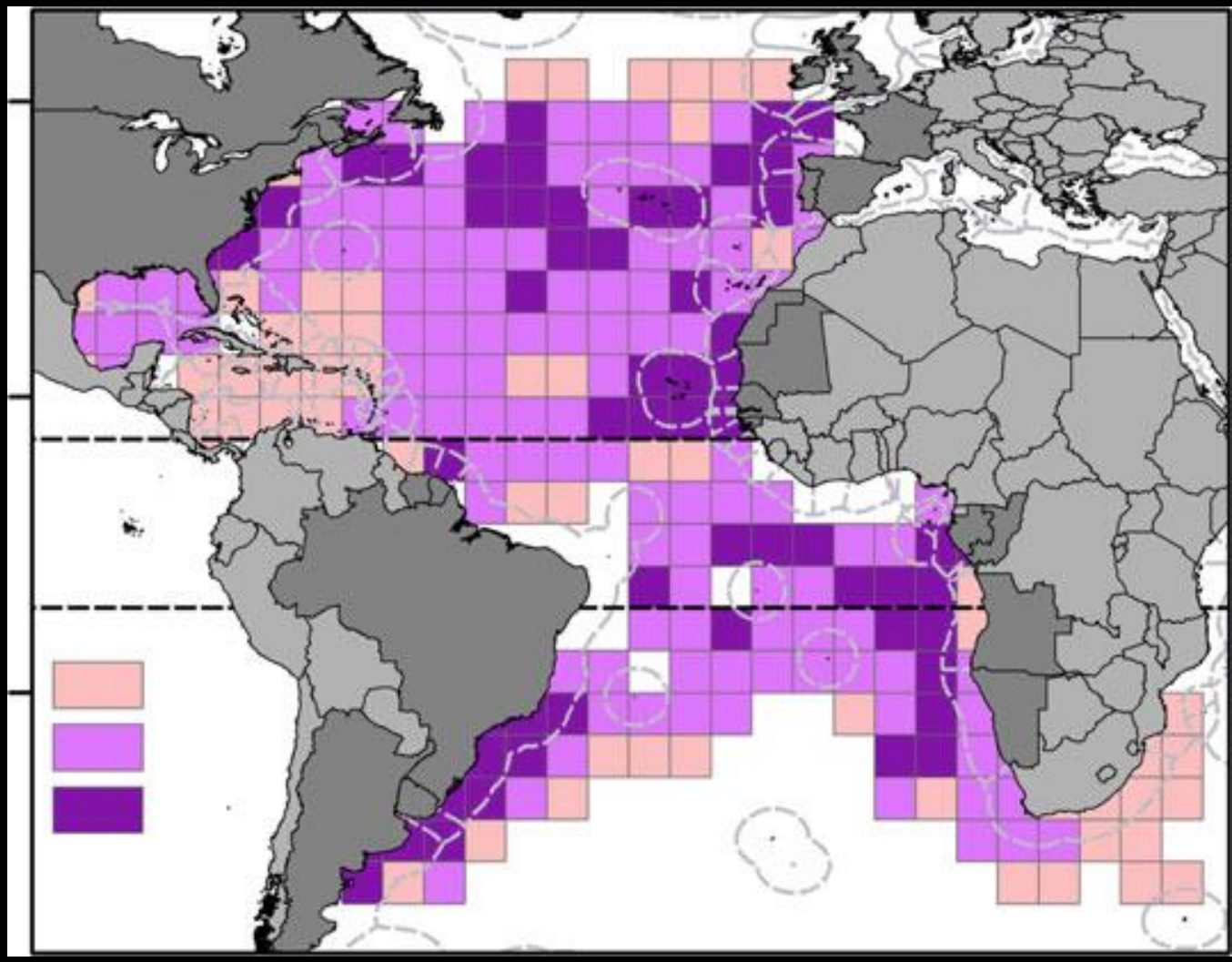
Marine Geospatial Ecology Lab, Duke University (2015)

OBIS-SEAMAP Turtle Tracks

- Leatherback turtle track (17 individual tracks shown)
- Green turtle track (115 individual tracks shown)
- Loggerhead turtle tracks (441 individual tracks shown)

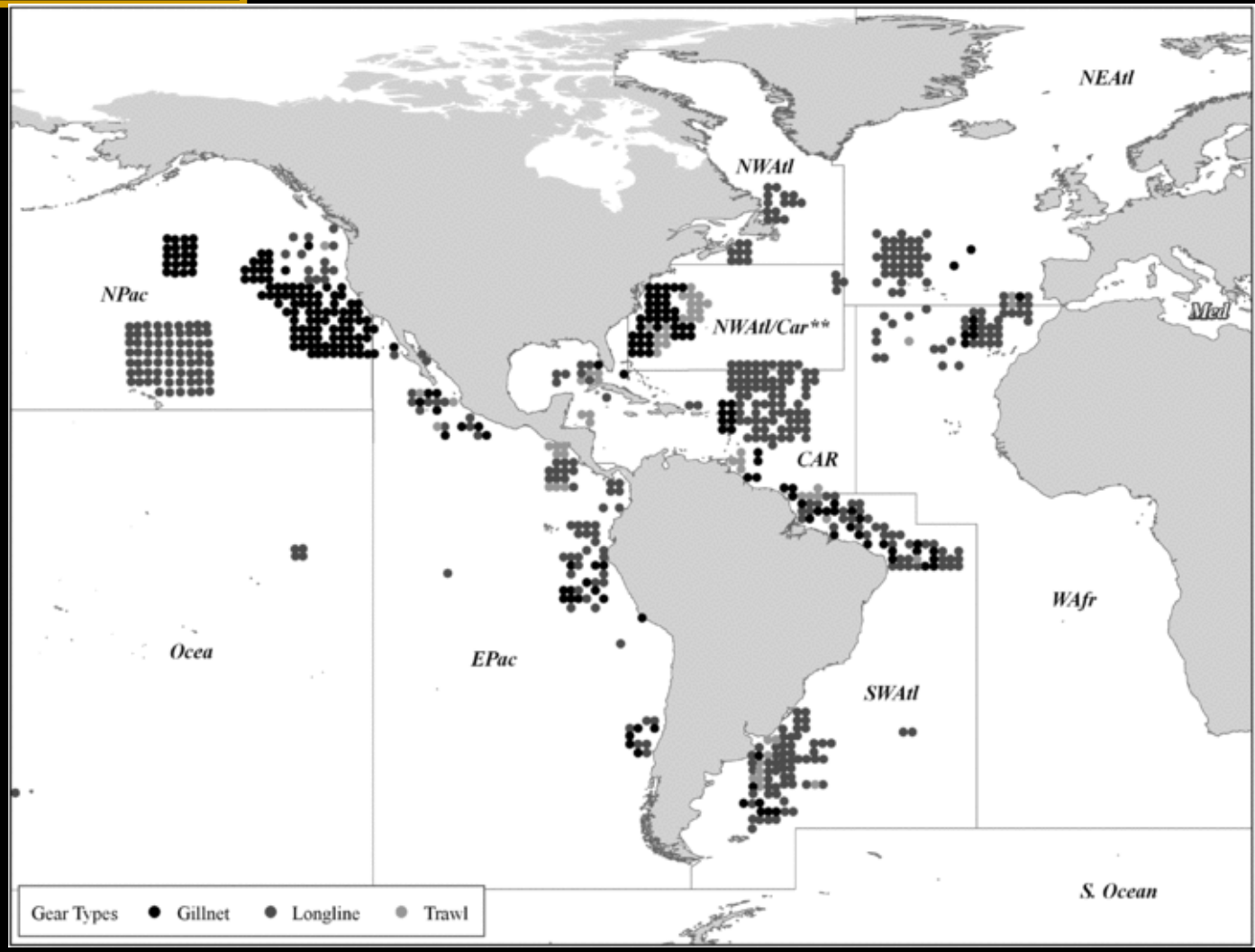


Data report – Biological Data

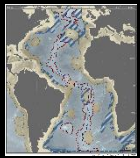


Density distribution of satellite-tracked leatherbacks in the Atlantic Ocean (Fossette et al., 2014)

Data report – Biological Data



Sea turtle bycatch data (Wallace et al., 2010)



Data report – Biological Data

Seasonal blue shark utilisation distributions (Vandeperre et al., 2014)

Orange- Small Juvenile females

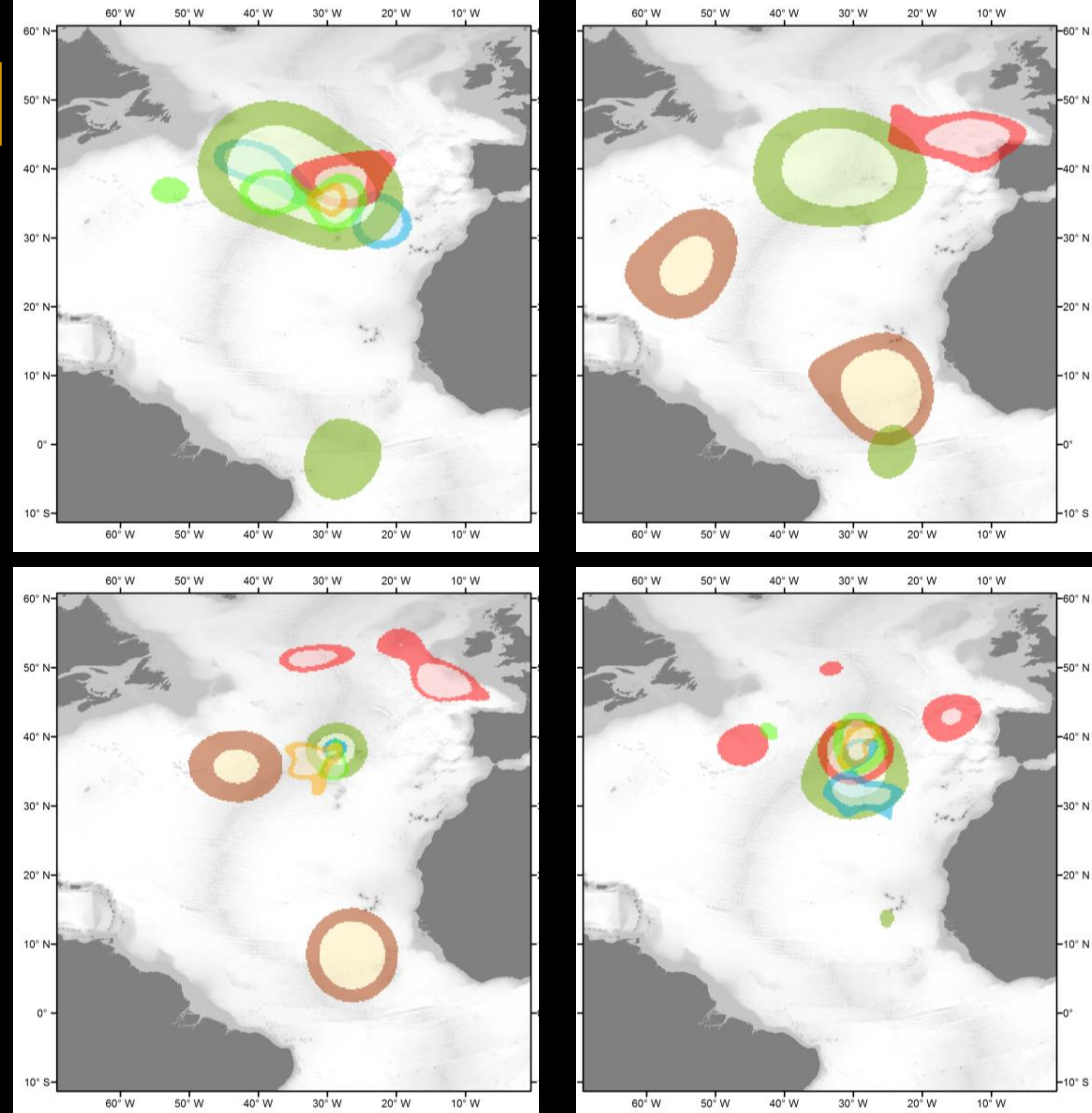
Green- Small Juvenile males

Red- large juvenile and sub-adult females

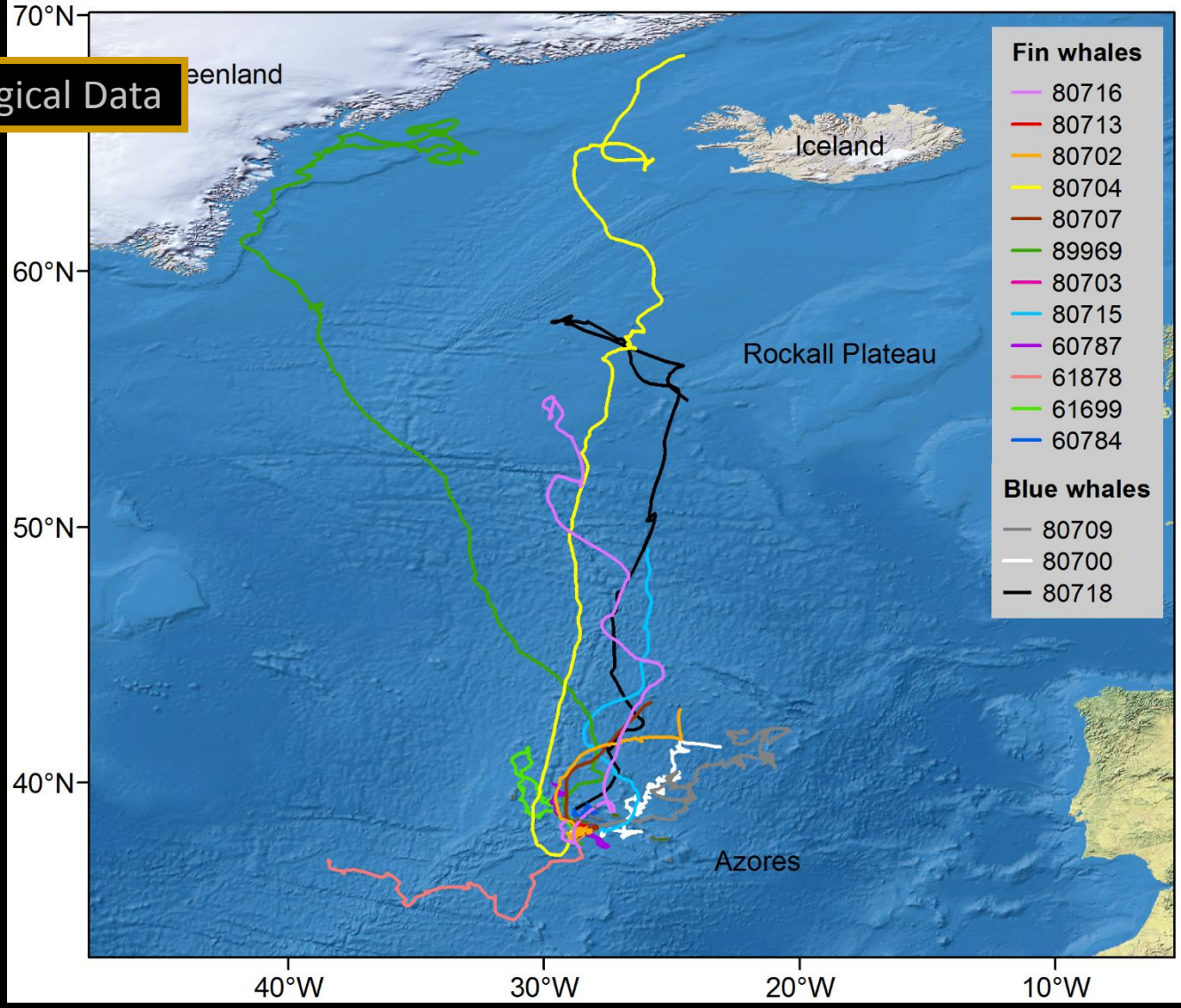
Dark green- Large Juvenile males

Brown – Adult females

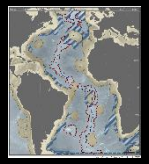
Blue – Adult males



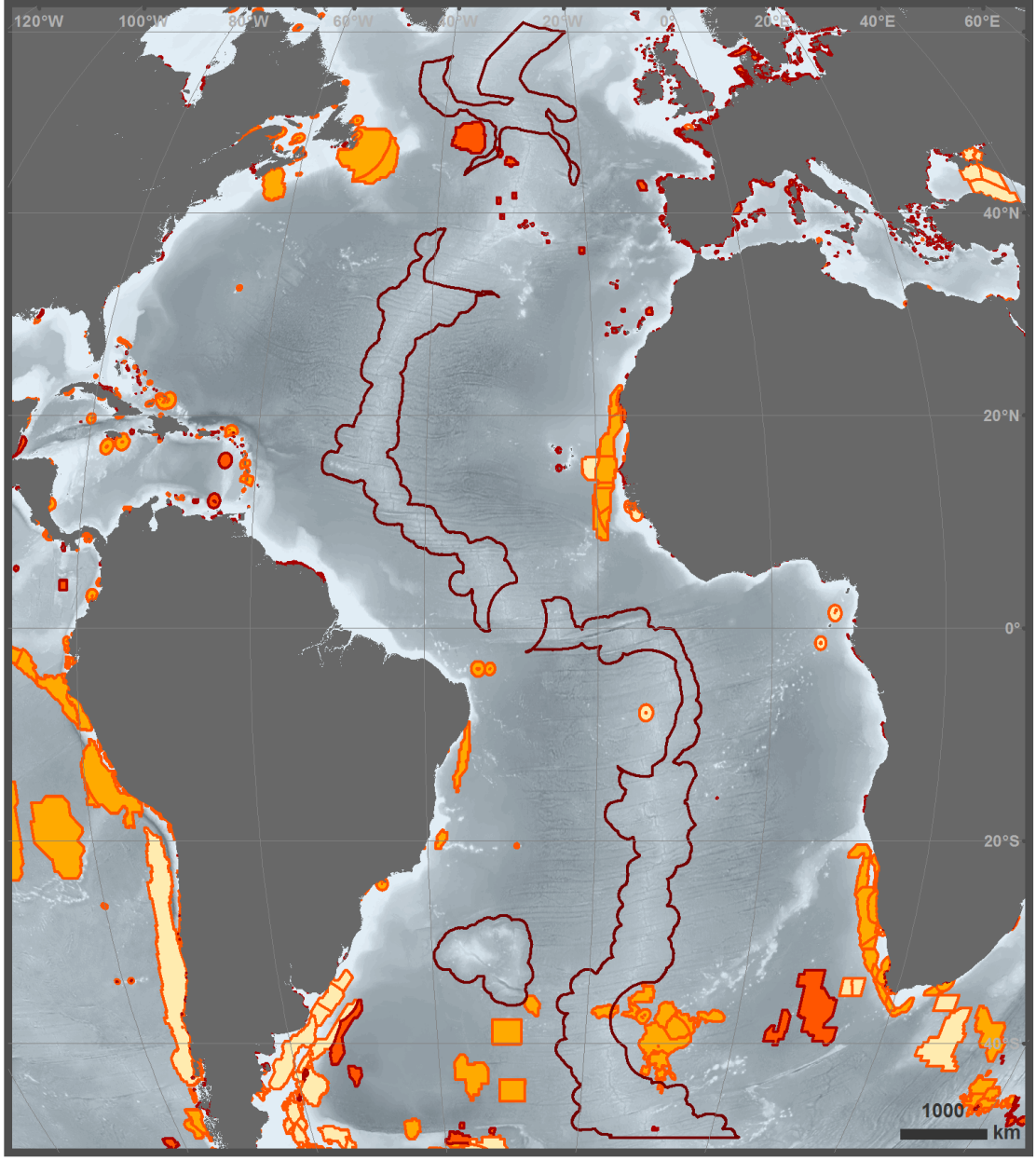
Data report – Biological Data



Blue and fin whale telemetry (Silva et al. 2013)



Data report – Biological Data



Marine Geospatial Ecology Lab, Duke University (2015)

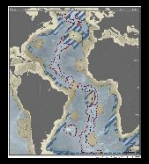
Marine Important Bird Areas (Bird Life)

IBAs

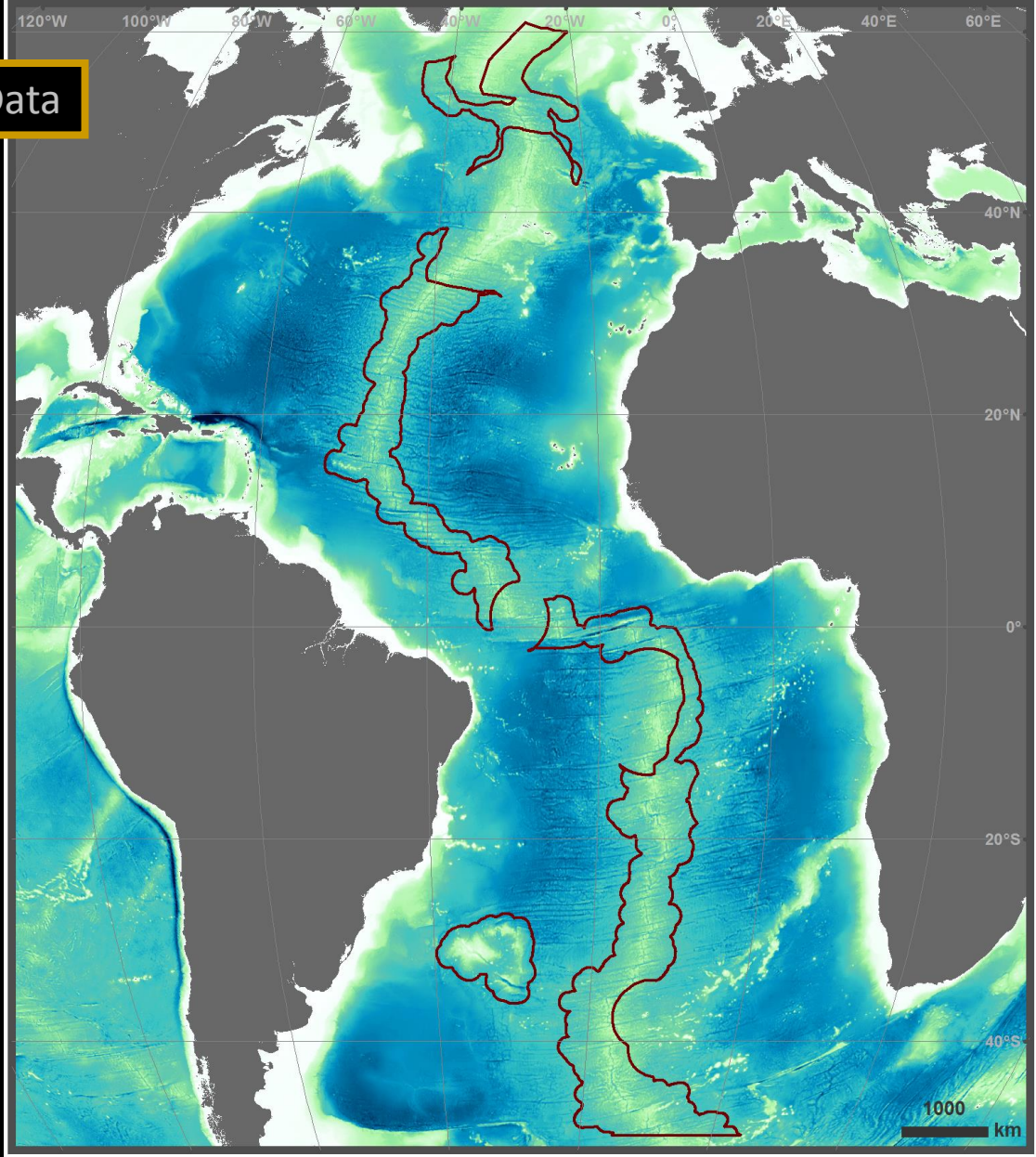
- Confirmed
- Candidate
- Proposed

Environmental Data

Mid-Atlantic Ridge and Rio Grande Rise



Data report – Environmental Data

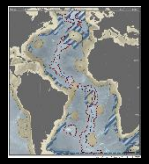


Marine Geospatial Ecology Lab, Duke University (2015)

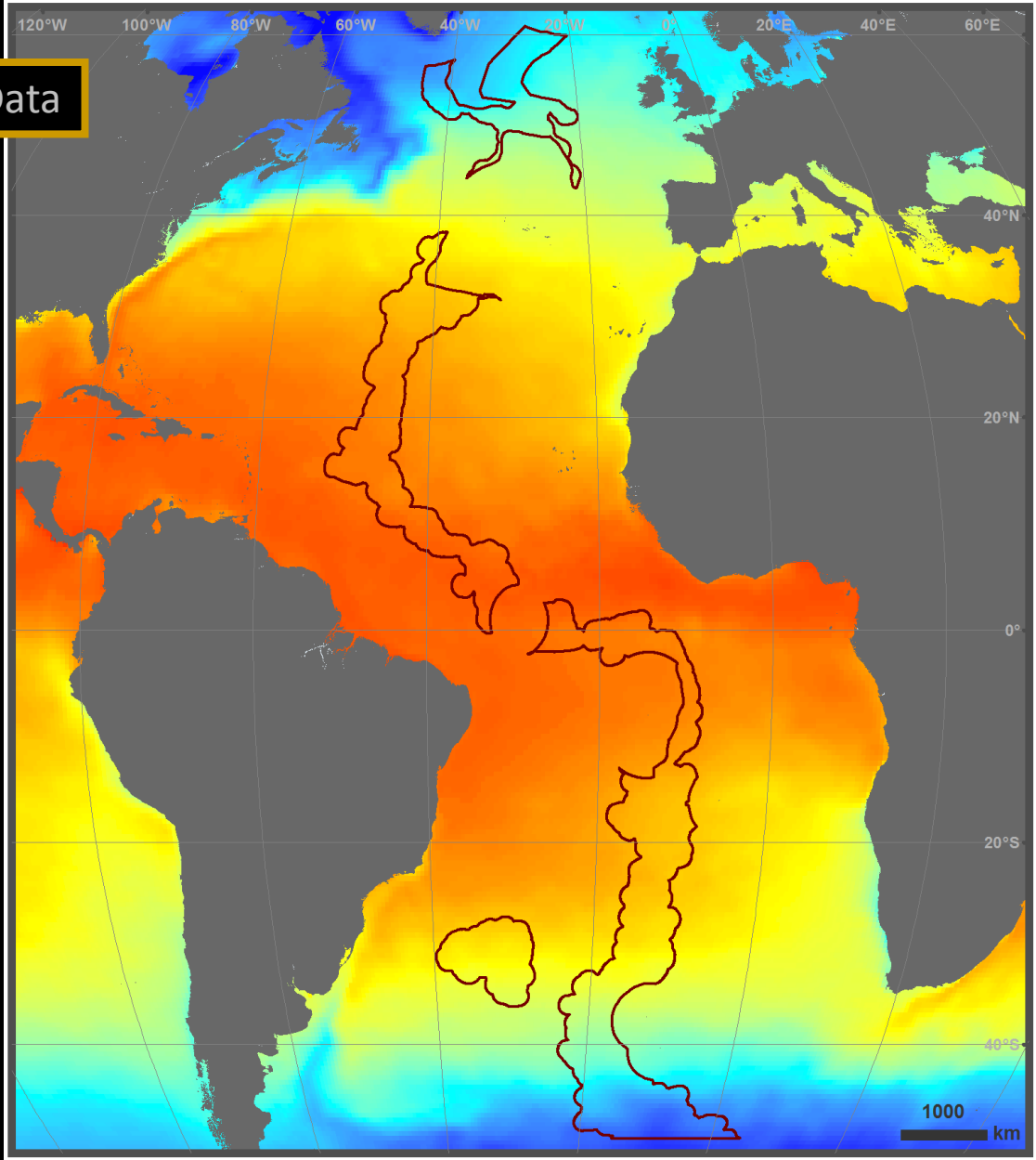
Bathymetry (GEBCO 2014)

Depth (meters)

0 -7500



Data report – Environmental Data

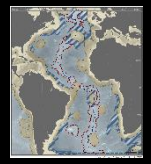


Marine Geospatial Ecology Lab, Duke University (2015)

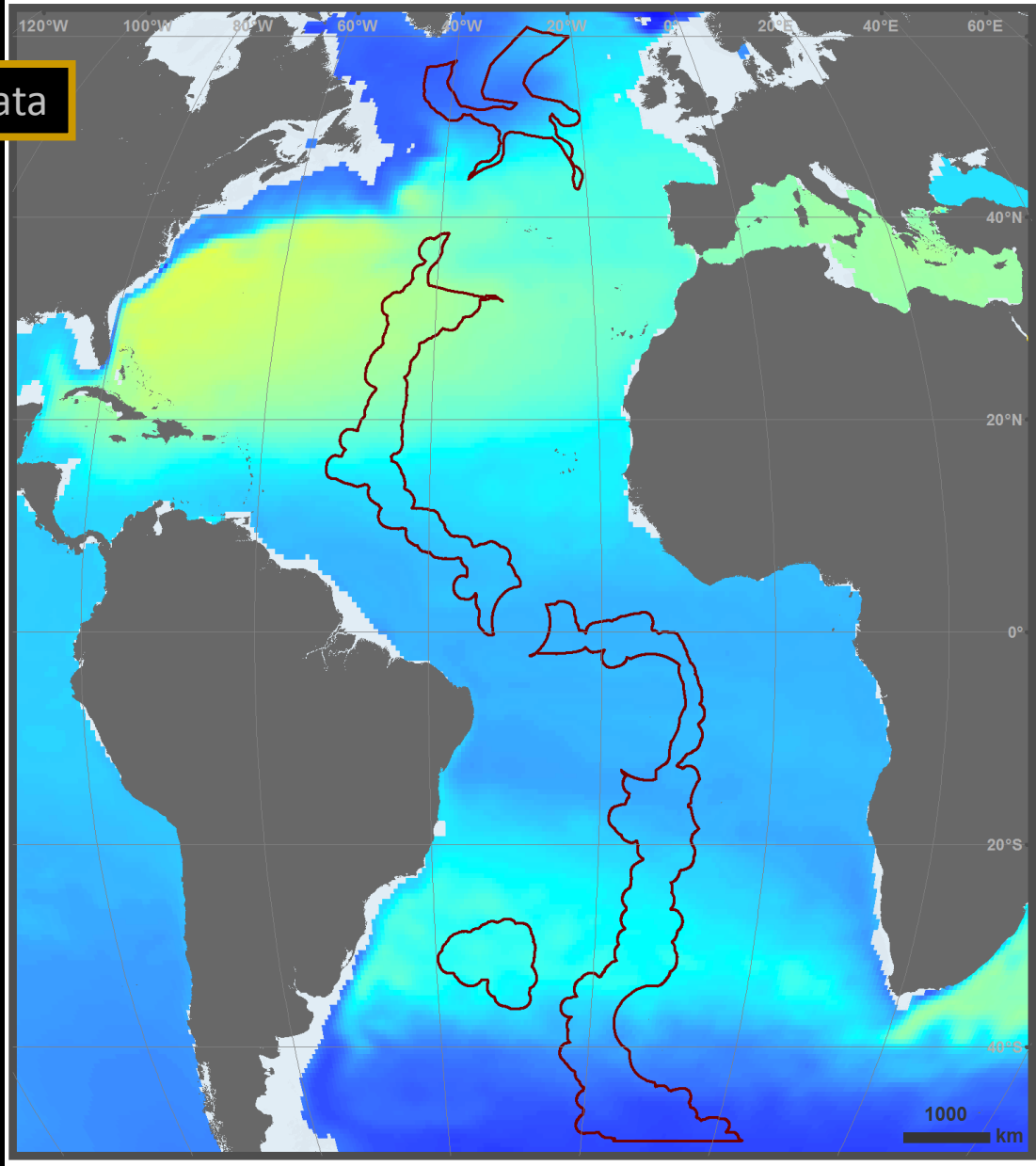
Surface Temperature Climatology (CARS 2009)

Temperature (deg C)

31 -3



Data report – Environmental Data

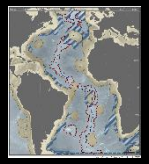


Marine Geospatial Ecology Lab, Duke University (2015)

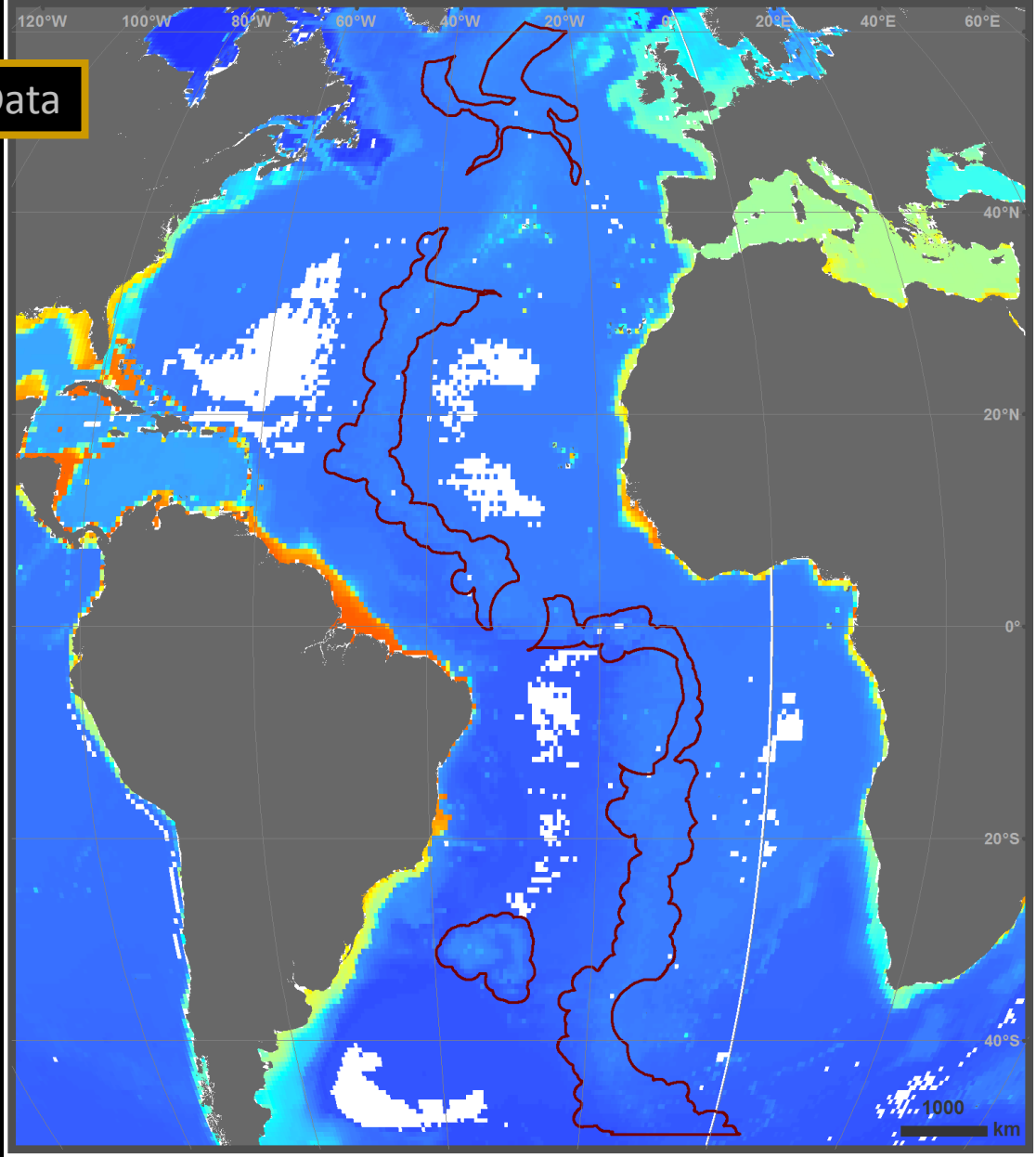
500m Temperature Climatology (CARS 2009)

Temperature (deg C)

31 -3



Data report – Environmental Data

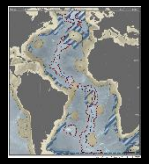


Marine Geospatial Ecology Lab, Duke University (2015)

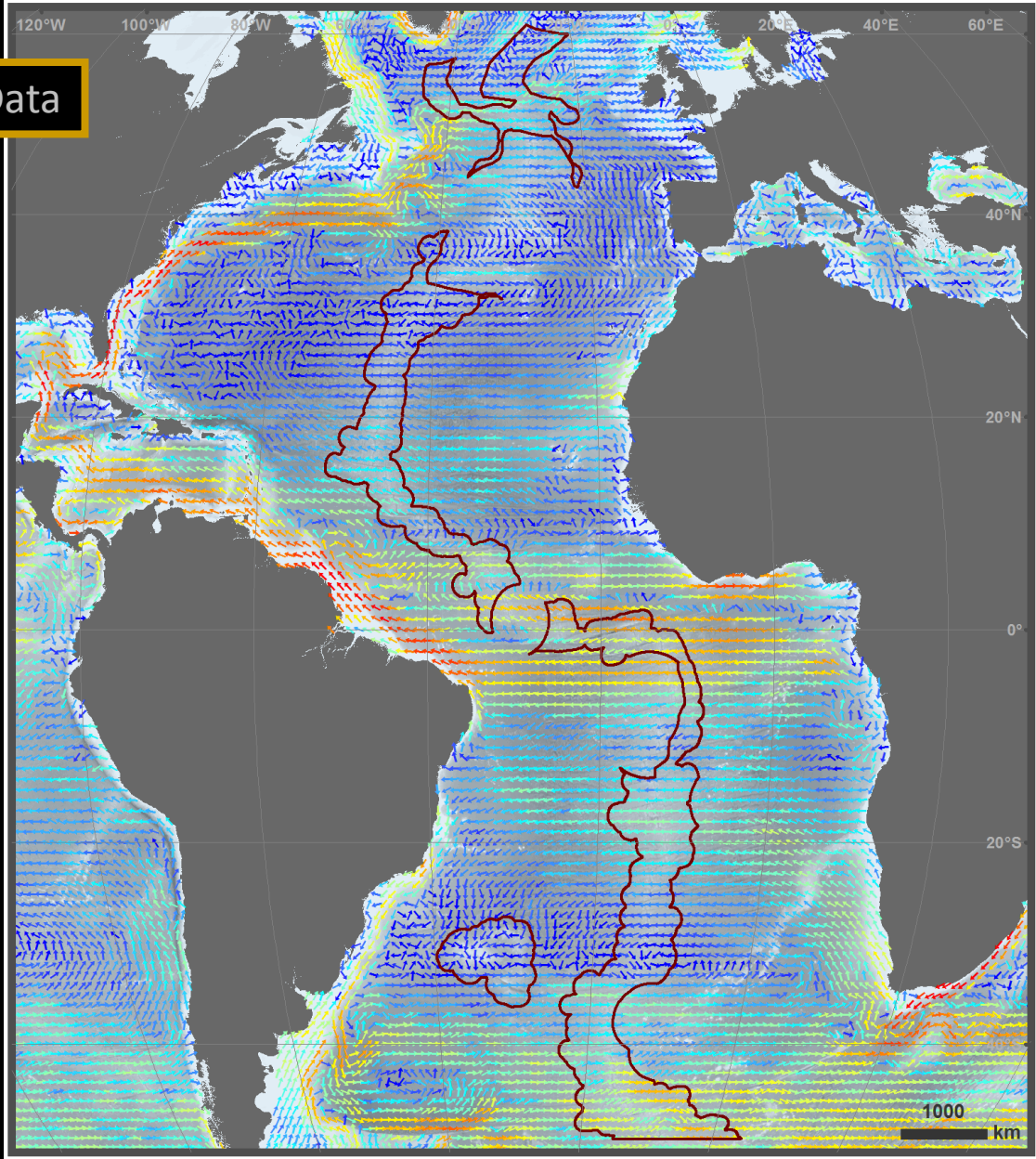
Bottom Temperature Climatology (CARS 2009)

Temperature (deg C)

31 -3



Data report – Environmental Data

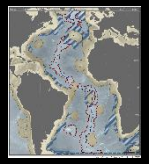


Marine Geospatial Ecology Lab, Duke University (2015)

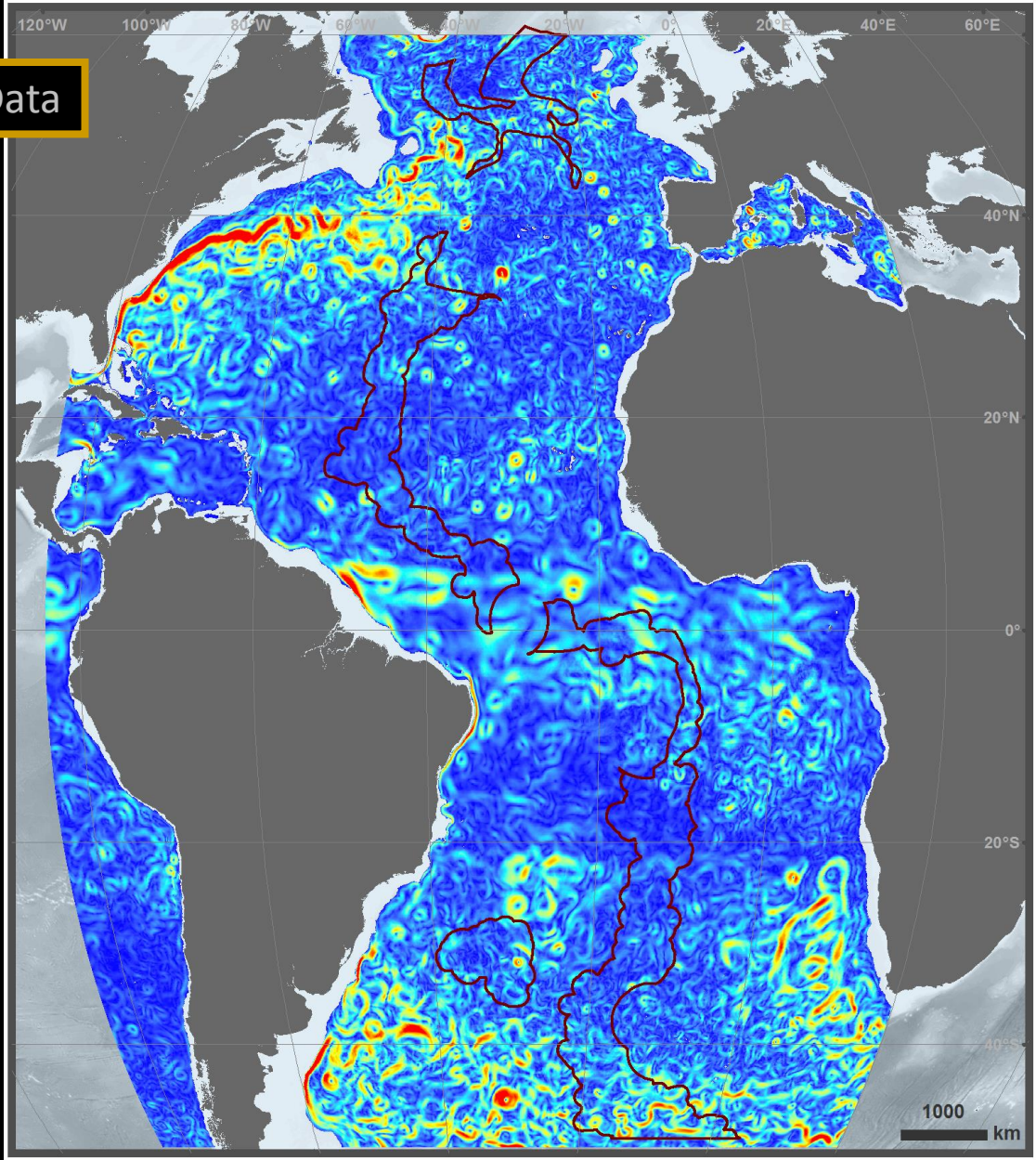
Drifter-Derived Climatology of Near-Surface Currents

Surface Current Velocity (m/s)

- 0.000 - 0.062
- 0.063 - 0.113
- 0.114 - 0.174
- 0.175 - 0.244
- 0.245 - 0.336
- 0.337 - 0.477
- 0.478 - 0.705
- 0.706 - 1.221



Data report – Environmental Data



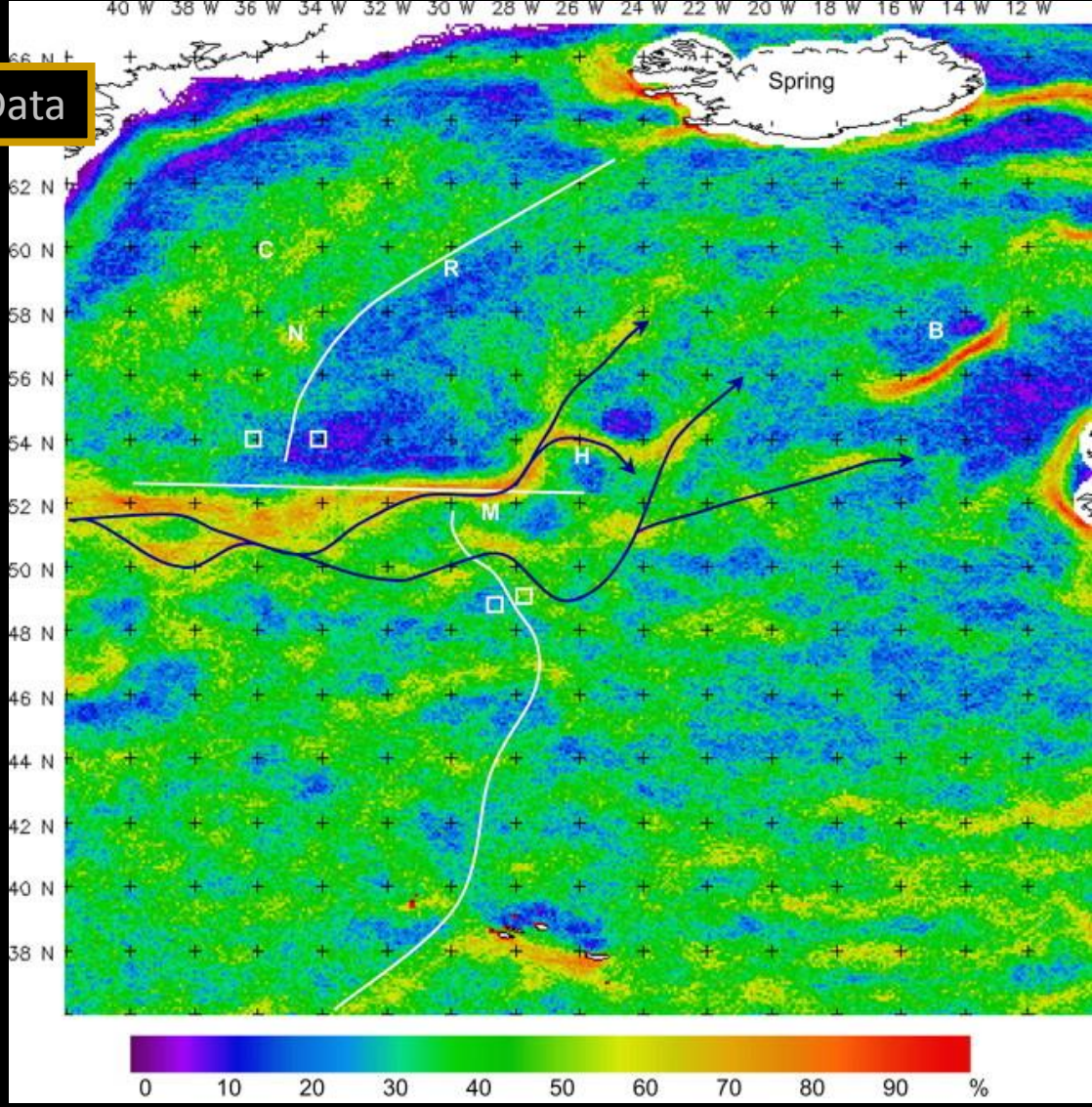
Marine Geospatial Ecology Lab, Duke University (2015)

500m Current Velocity (HYCOM, January 2014)

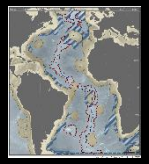
Velocity (m/s)

H: 0.9 L : 0.0004

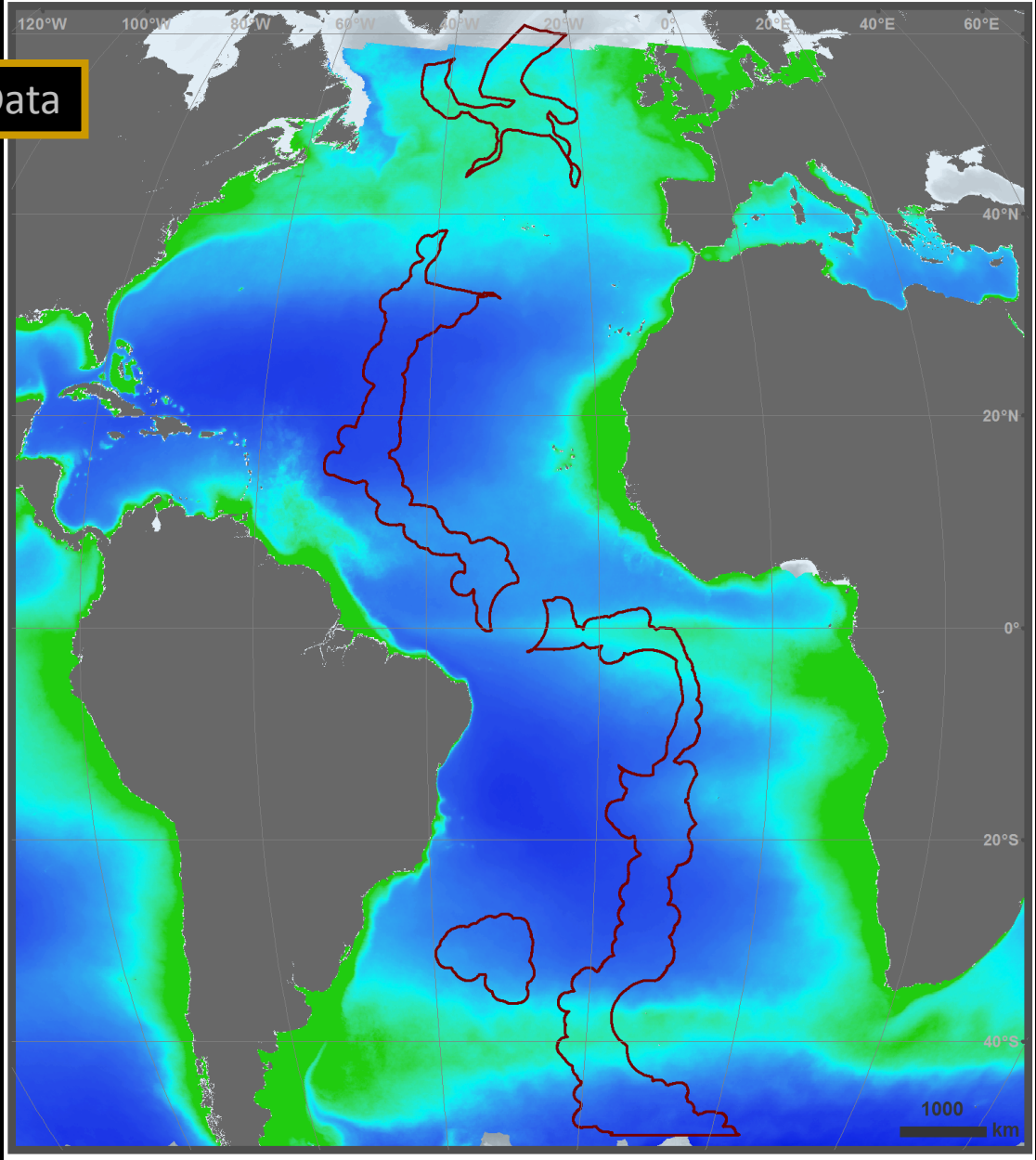
Data report – Environmental Data



Spring oceanic front frequency Miller et al. (2013)



Data report – Environmental Data



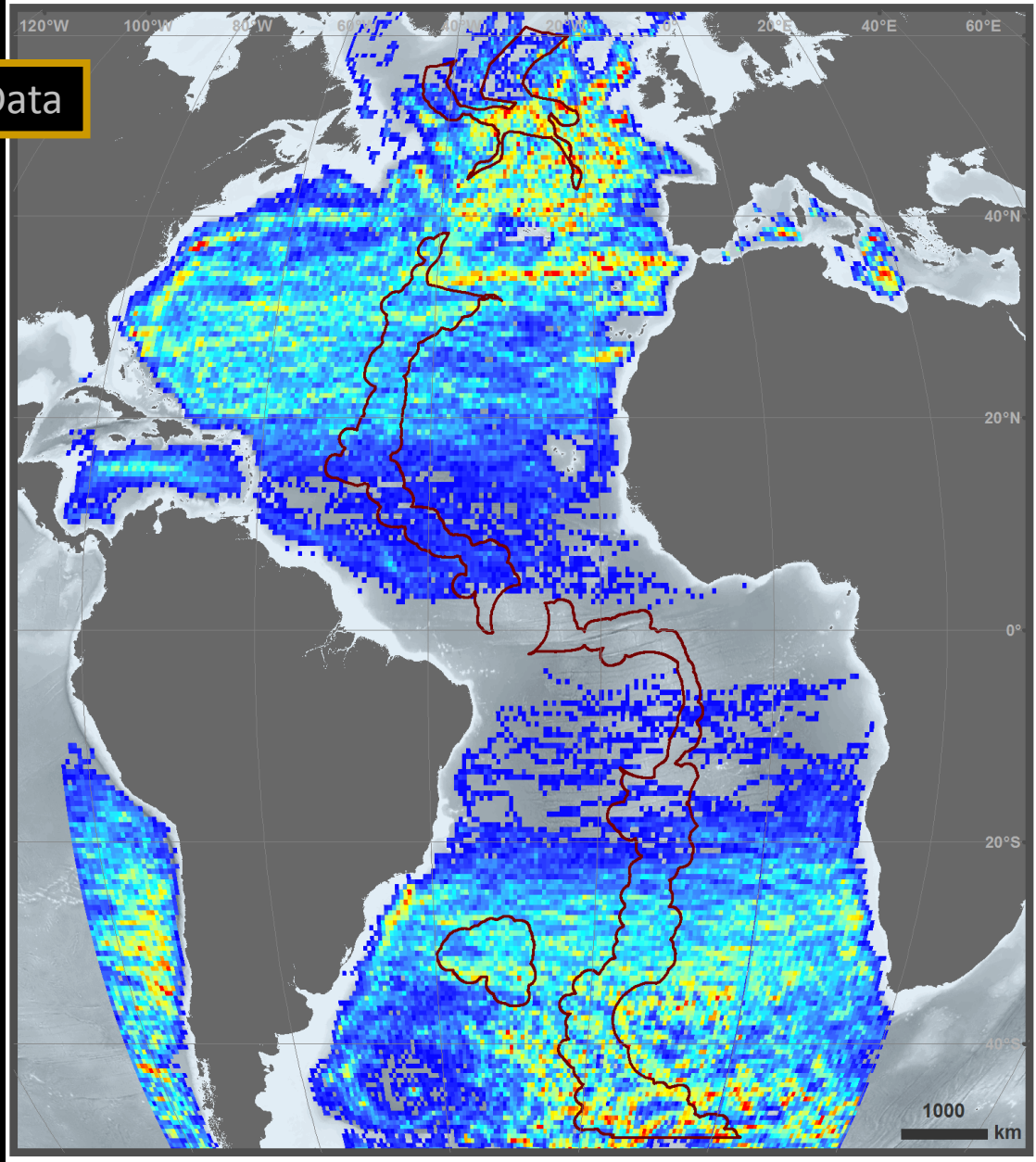
Marine Geospatial Ecology Lab, Duke University (2015)

Standard VGPM Primary Production Climatology

2003-2007 Annual Mean - mg C / m**2 / day

High : 8799.57 Low : 103.861

Data report – Environmental Data

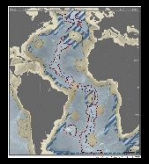


Marine Geospatial Ecology Lab, Duke University (2015)

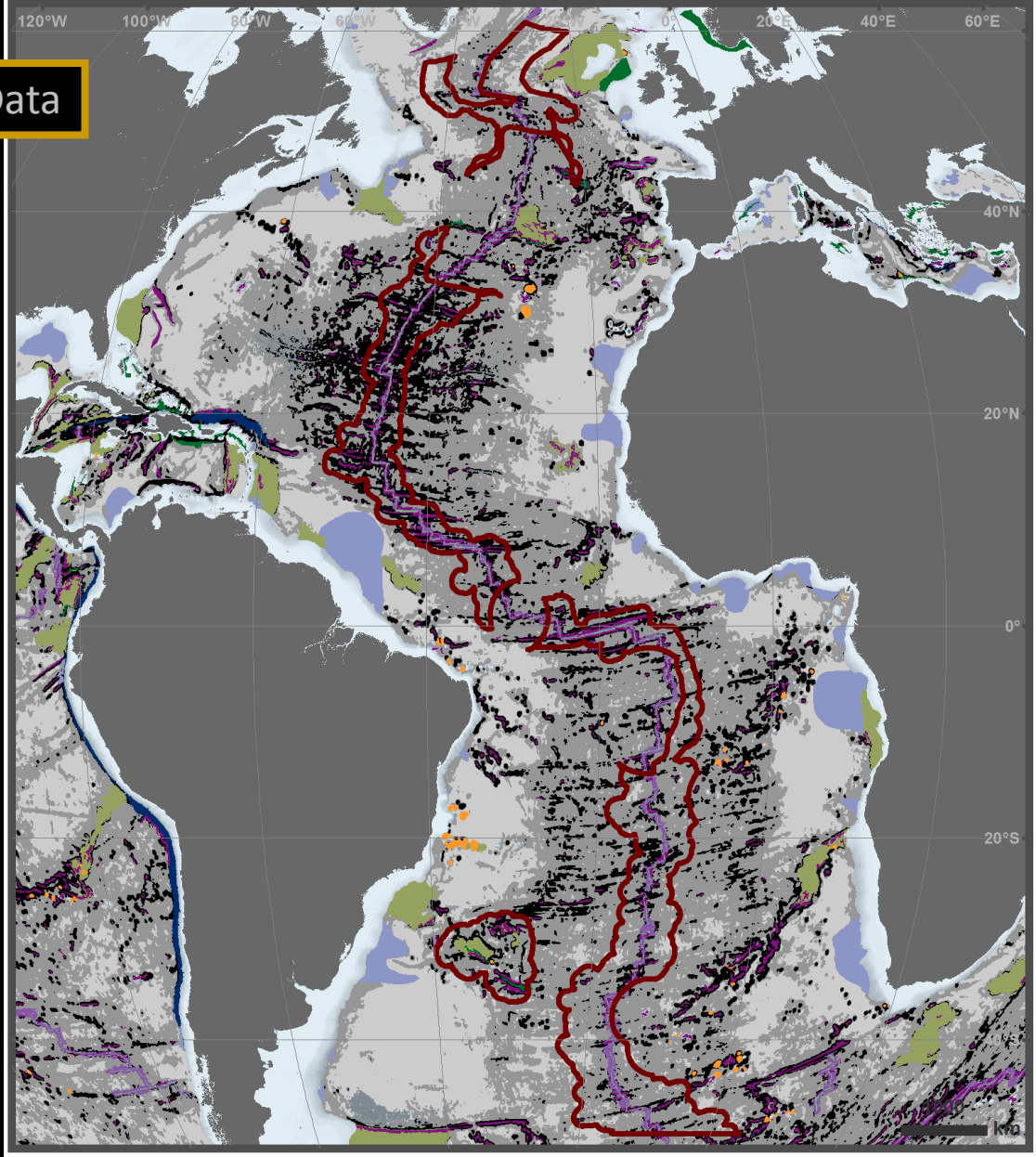
Mesoscale Eddy Density

Eddy density, 0.5 degree cells

High : 452 Low : 0



Data report – Environmental Data



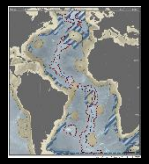
Marine Geospatial Ecology Lab, Duke University (2015)

Global Seafloor Geomorphic Features (Harris et al. 2014)

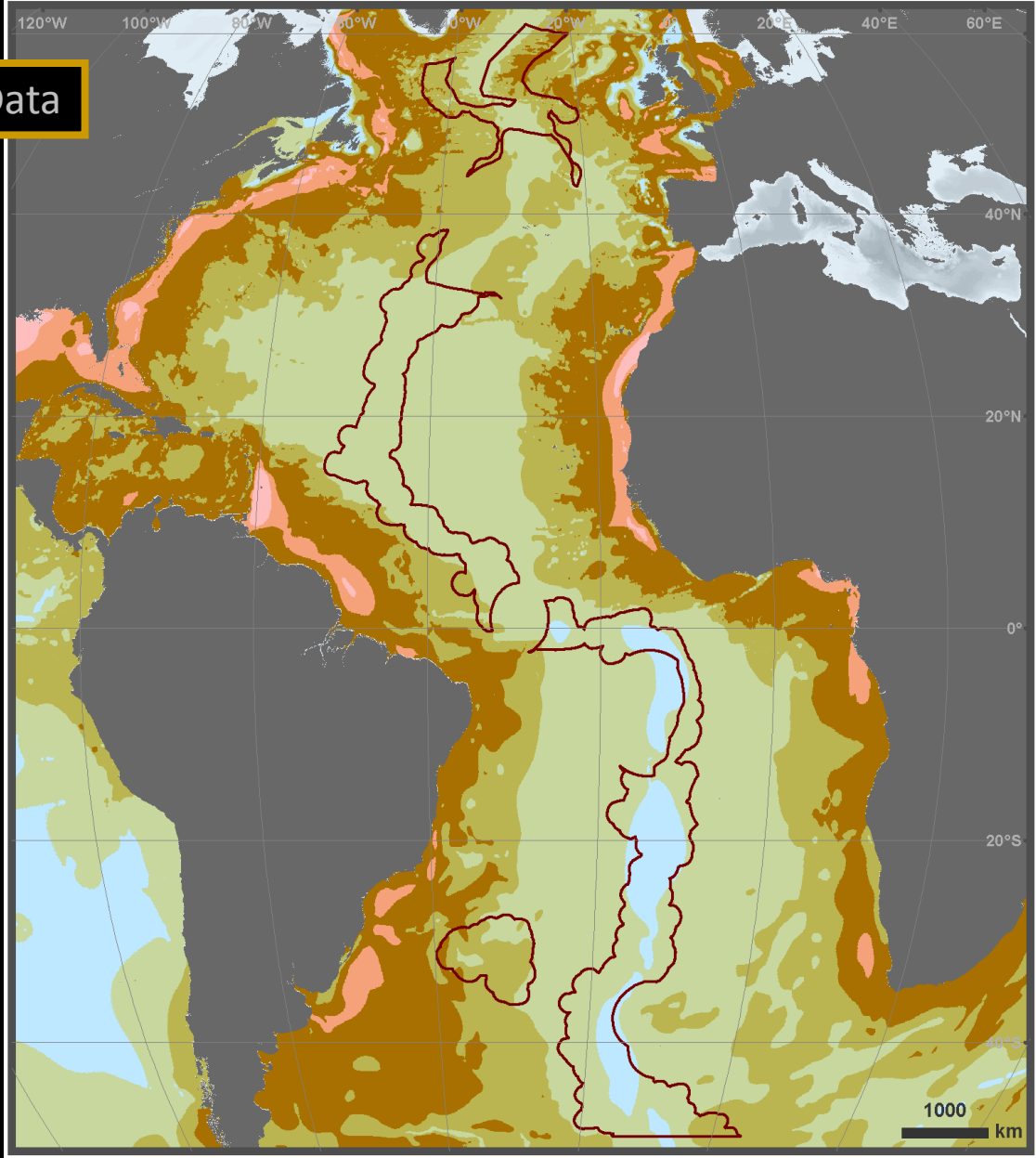
- Guyot
- Bridge
- Sill
- Rift valley
- Trough
- Ridge
- Spreading ridge
- Fan/Apron
- Trench
- Plateau

Abyssal Classification

- Mountains
- Hills
- Plains



Data report – Environmental Data



Marine Geospatial Ecology Lab, Duke University (2015)

Sediment Thickness of the Worlds Oceans & Marginal Seas (Whittaker et al. 2013; Retrieved from NGDC)

0 - 50m	51 - 250m	251 - 1,000m	1,001 - 5,000m	5,001 - 10,000m	10,001 - 20,000m

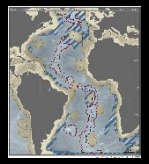
Biogeographic Classification

Mid-Atlantic Ridge and Rio Grande Rise

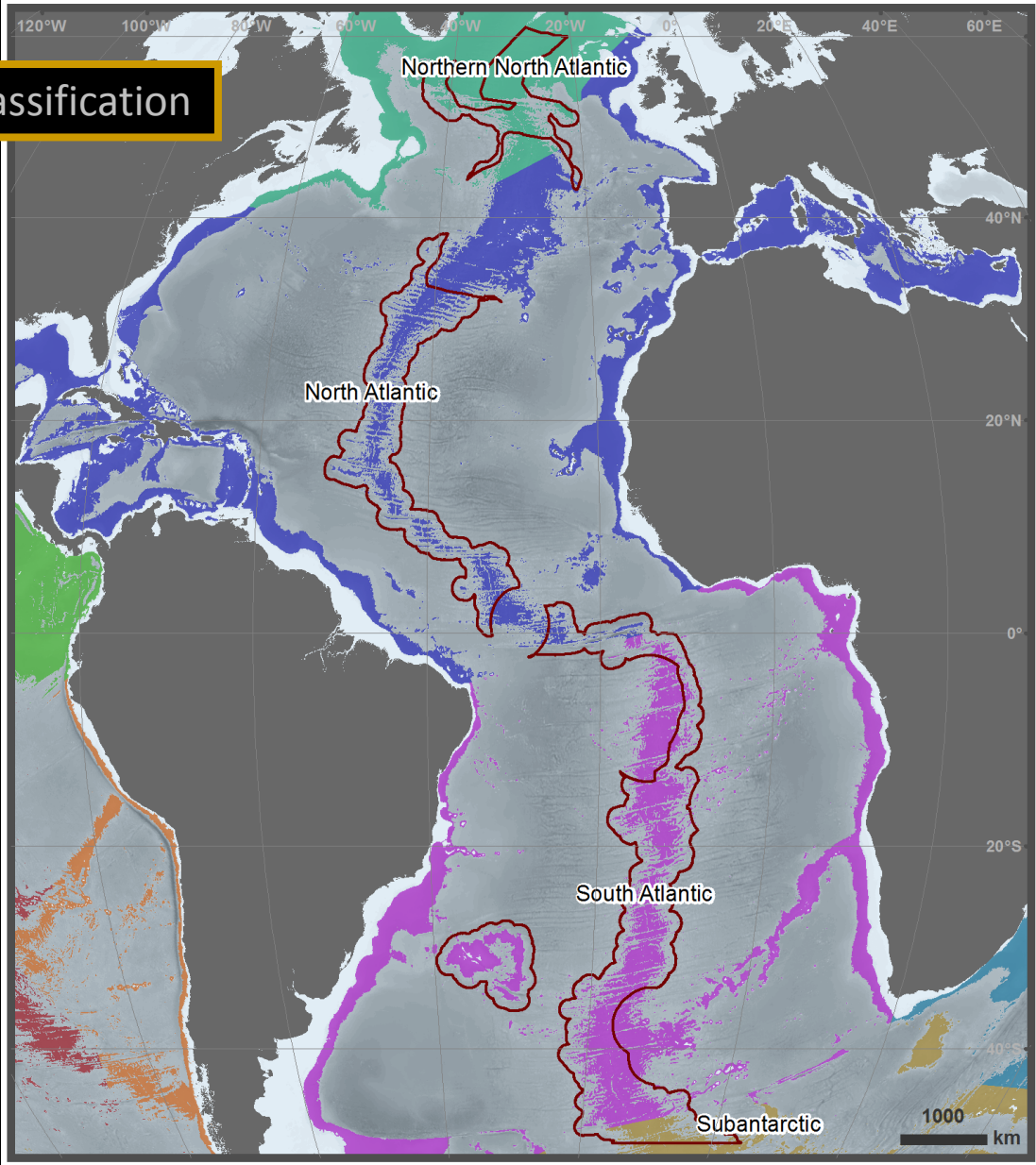
Data report – Biogeographic Classification

Marine Geospatial Ecology Lab, Duke University (2015)

GOODS Abyssal Provinces



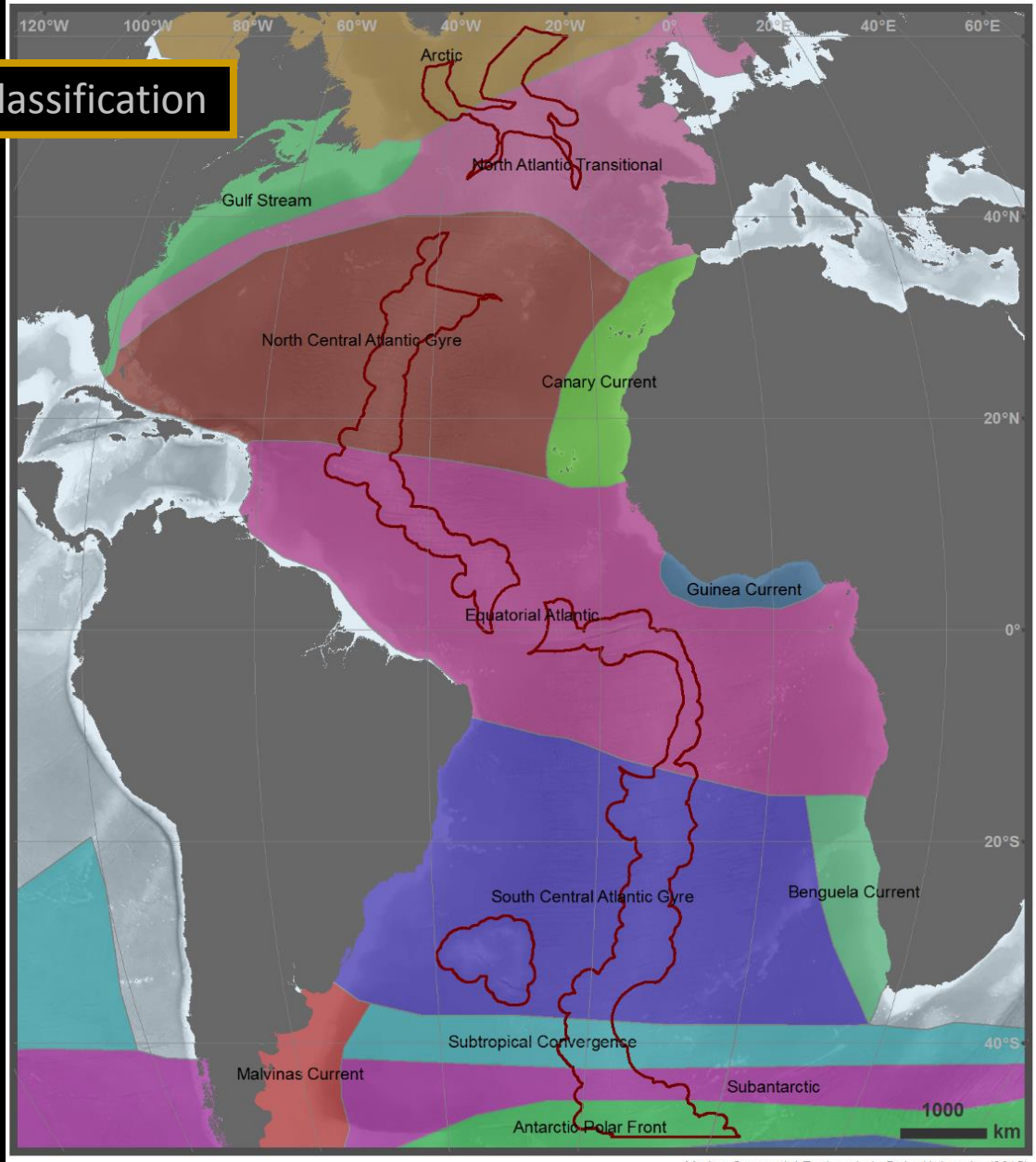
Data report – Biogeographic Classification



Marine Geospatial Ecology Lab, Duke University (2015)

GOODS Bathyal Provinces

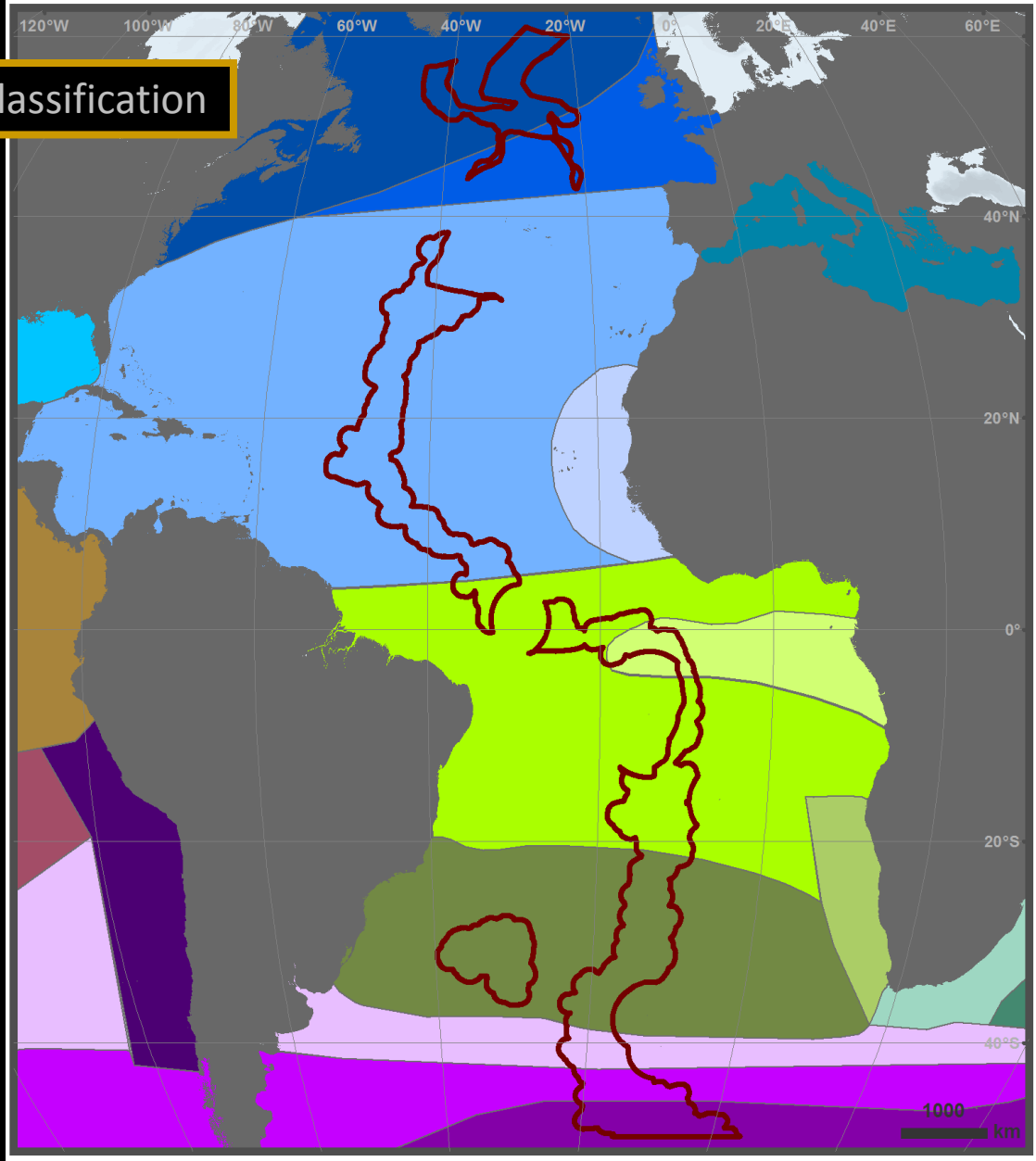
Data report – Biogeographic Classification



Marine Geospatial Ecology Lab, Duke University (2015)

GOODS Pelagic Provinces

Data report – Biogeographic Classification



Marine Geospatial Ecology Lab, Duke University (2015)

Global Mesopelagic Provinces (Sutton et al. In review)

- Arctic
- Eastern Tropical Pacific
- Humbolt Current
- Southern Central PAcific
- Southern Indian Ocean
- Agulhas Current
- Northwest Atlantic Subarctic
- North Atlantic Drift
- Gulf of Mexico
- Central North Atlantic
- Mediterranean
- Mauritania / Cape Verde
- Tropical and West Equatorial Atlantic
- Guinea Basin and East Equatorial Atlantic
- Benguela Upwelling
- South Atlantic
- Circumglobal Subtropical Front
- Sub-Antarctic
- Antarctic / Southern Ocean

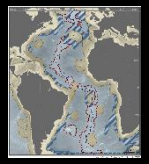
Data report – Biogeographic Classification

Marine Geospatial Ecology Lab, Duke University (2015)

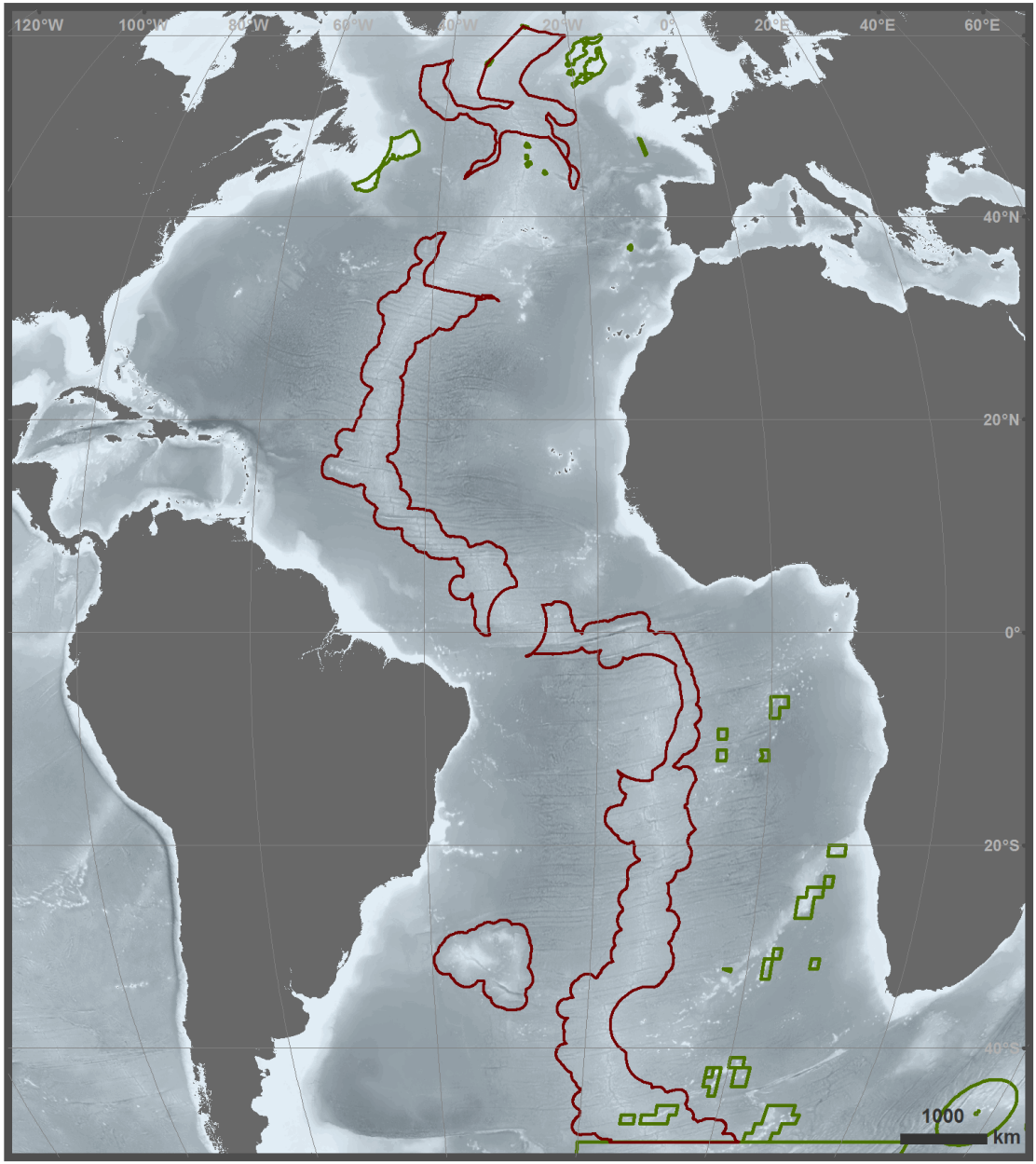
Longhurst Marine Provinces

Human uses

Mid-Atlantic Ridge and Rio Grande Rise



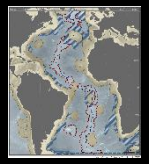
Data report – Human uses



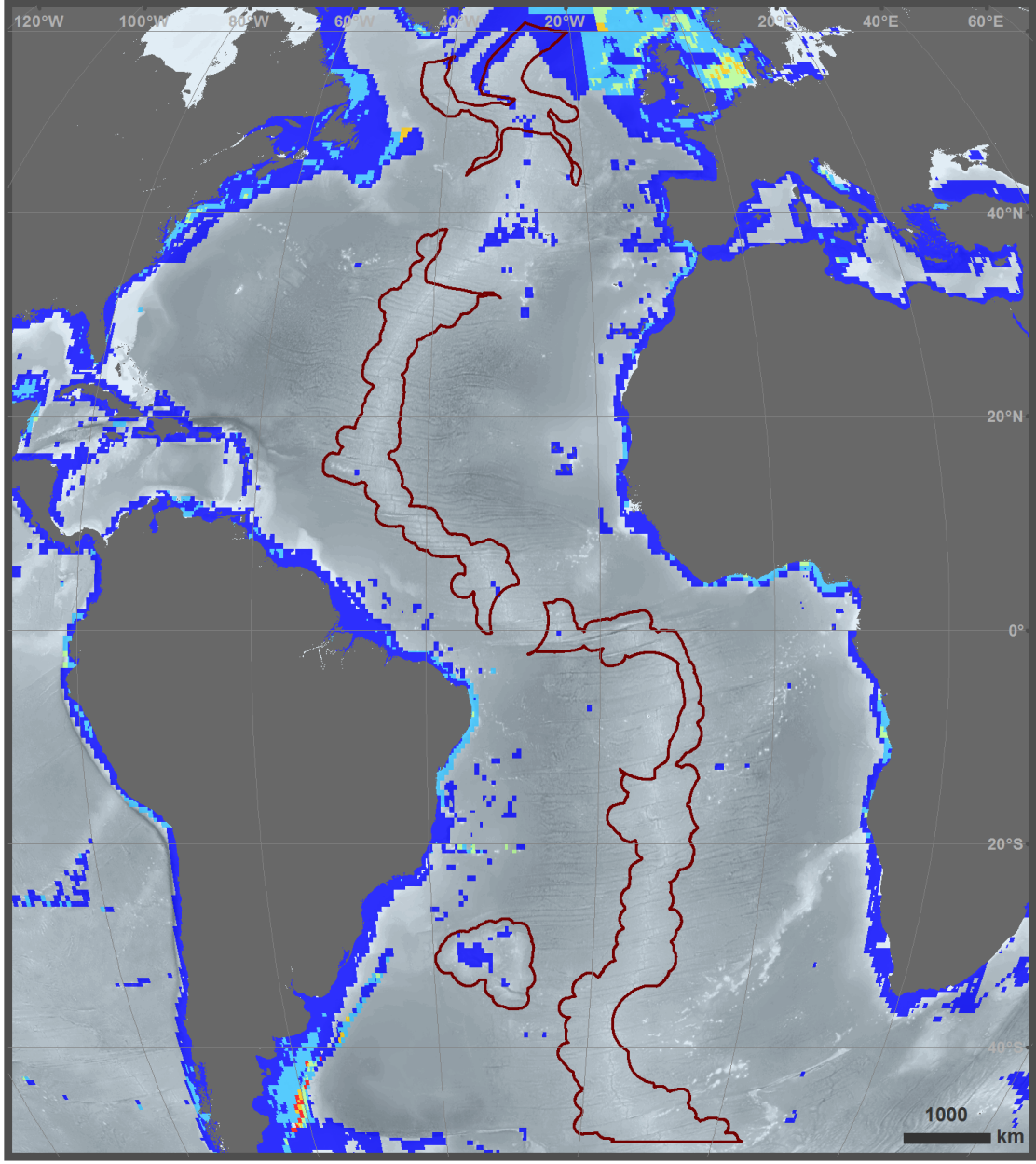
Marine Geospatial Ecology Lab, Duke University (2015)

FAO Bottom Fishing Areas

Bottom Fishing Area



Data report – Human uses



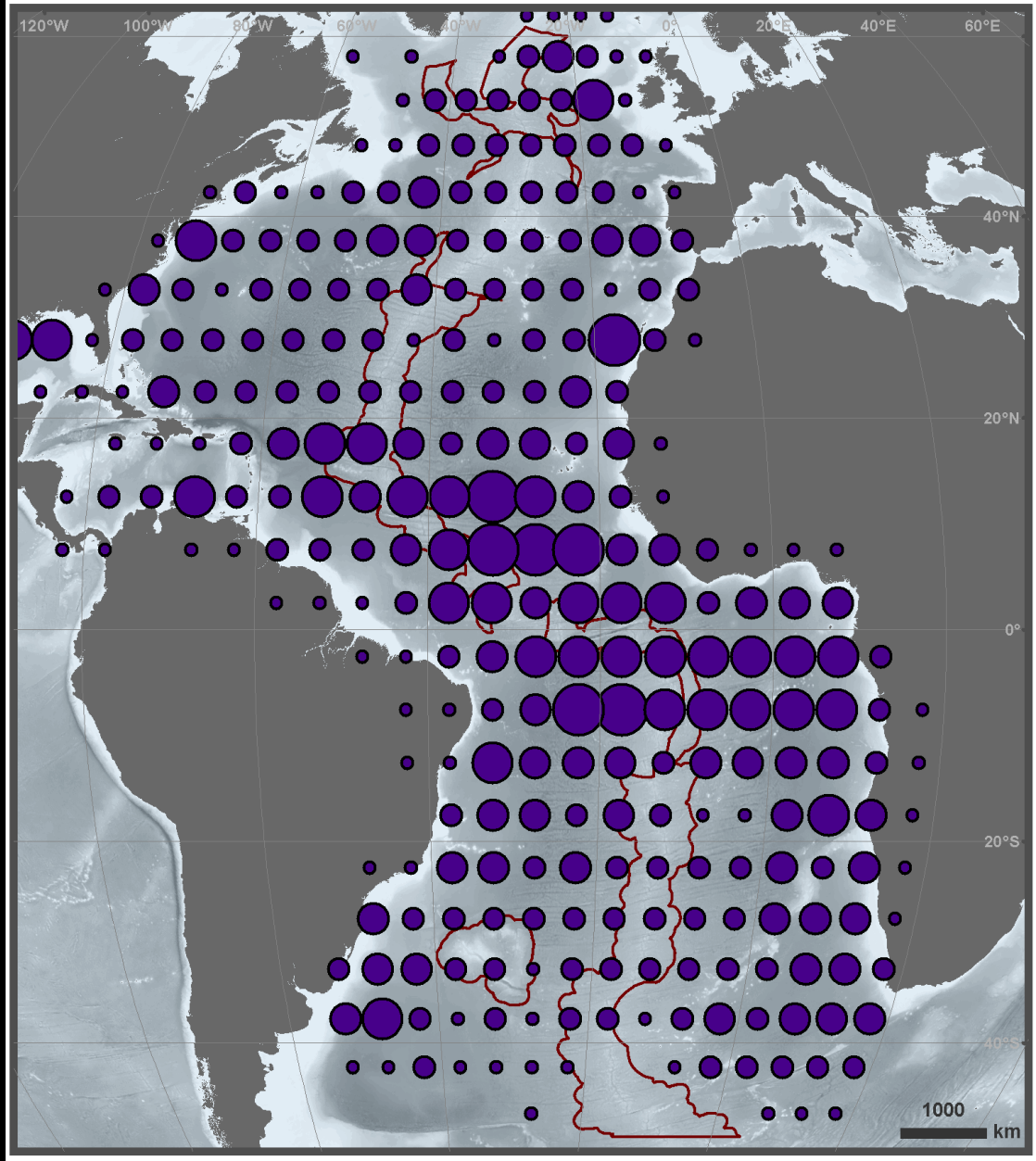
Marine Geospatial Ecology Lab, Duke University (2015)

Demersal Destructive Fishing

Demersal Destructive Fishing (input to Halpern et al. 2008)

Low High

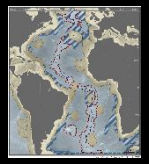
Data report – Human uses



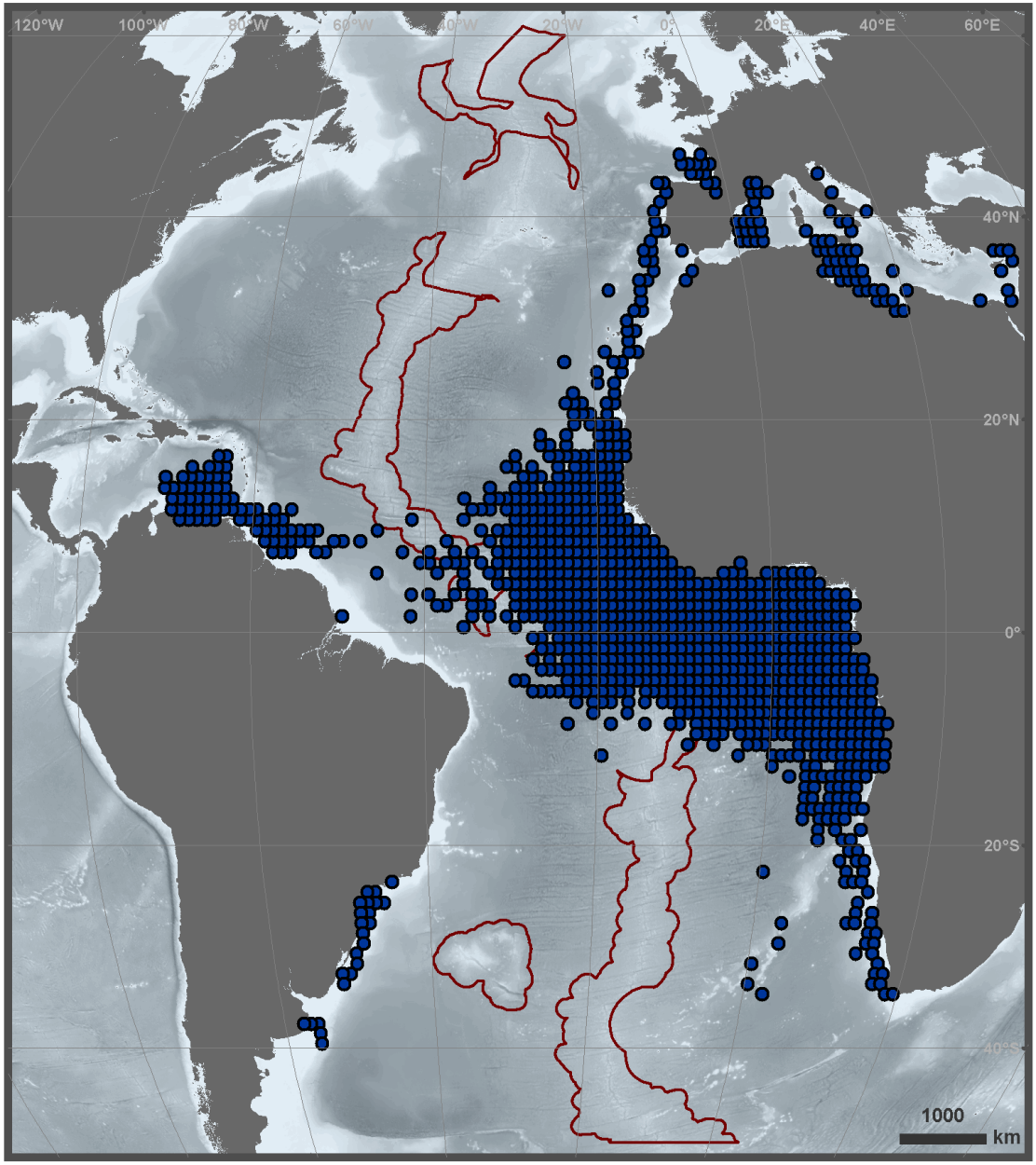
Marine Geospatial Ecology Lab, Duke University (2015)

Aggregated Longline Effort between 2005 and 2009 (thousands of hooks; source: ICCAT)

< 1000 | 1000 - 5000 | 5000 - 10000 | 10000 - 25000 | > 25000



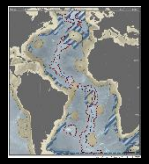
Data report – Human uses



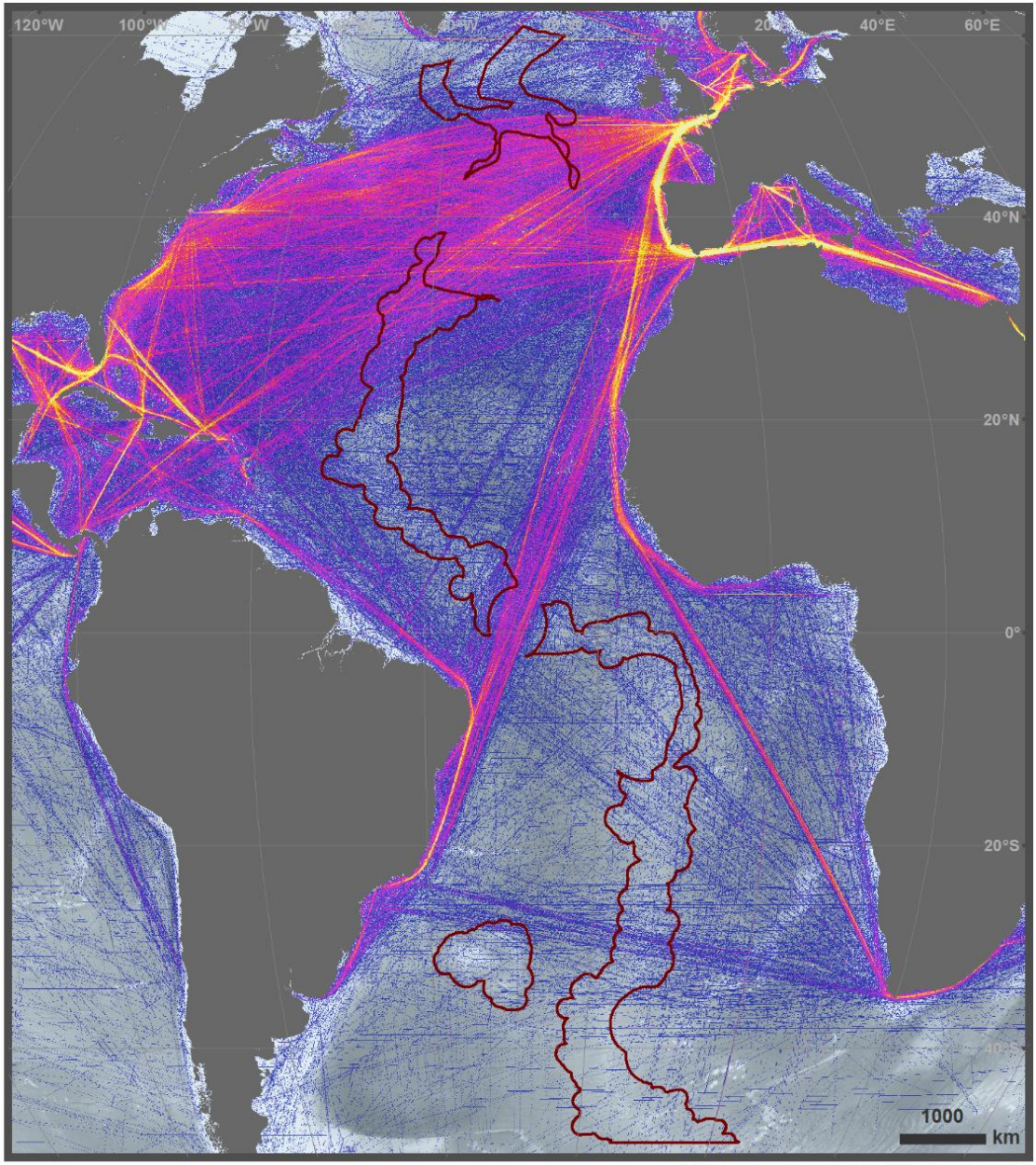
Marine Geospatial Ecology Lab, Duke University (2015)

Areas of Purse Seine Fishing between 2005 and 2009 (source: ICCAT)

- Areas of ICCAT Purse Seine Fishing



Data report – Human uses

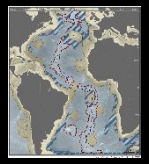


Marine Geospatial Ecology Lab, Duke University (2015)

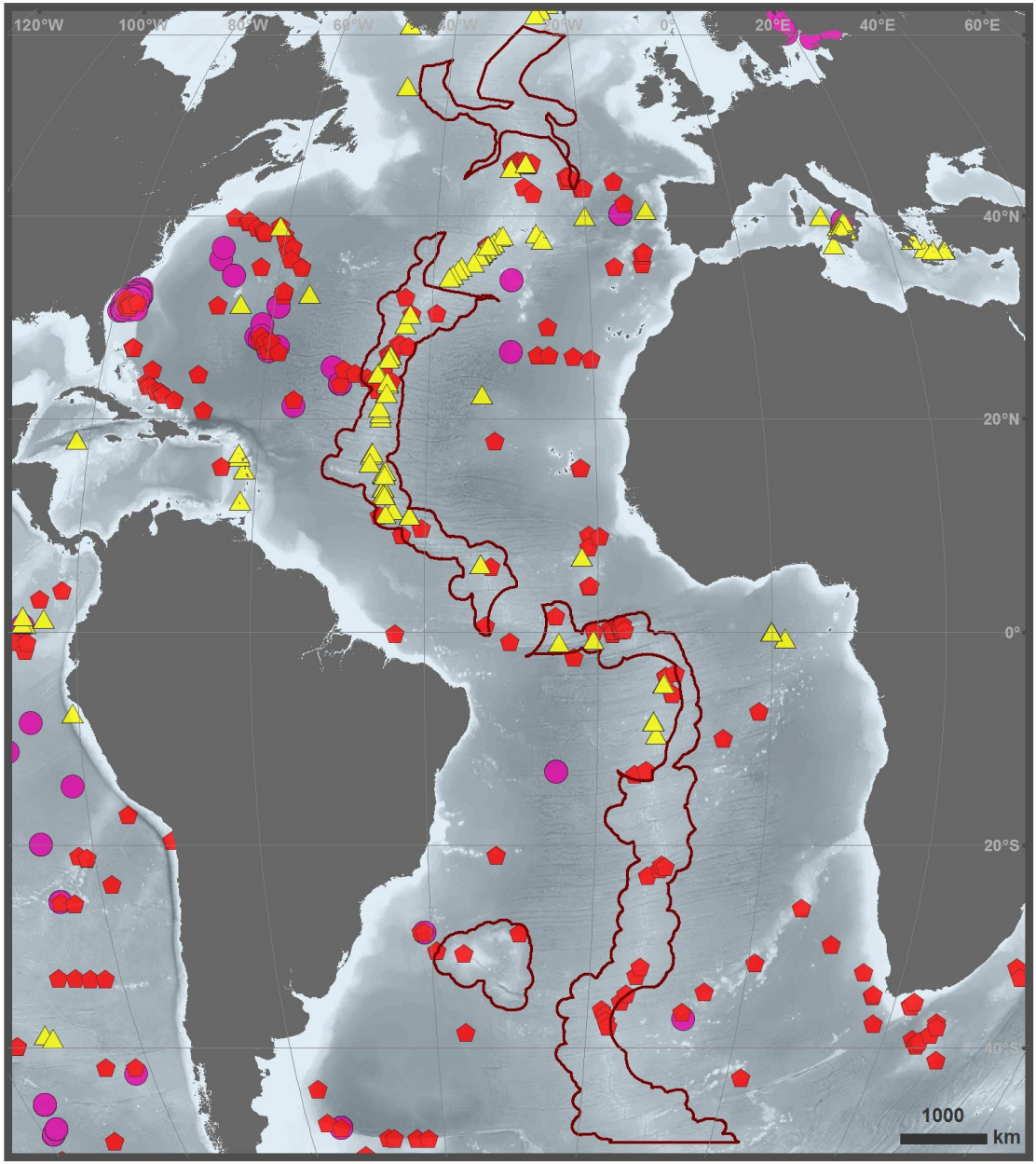
Commercial Shipping

Ship Traffic (Halpern et al. 2008)

High Low



Data report – Human uses

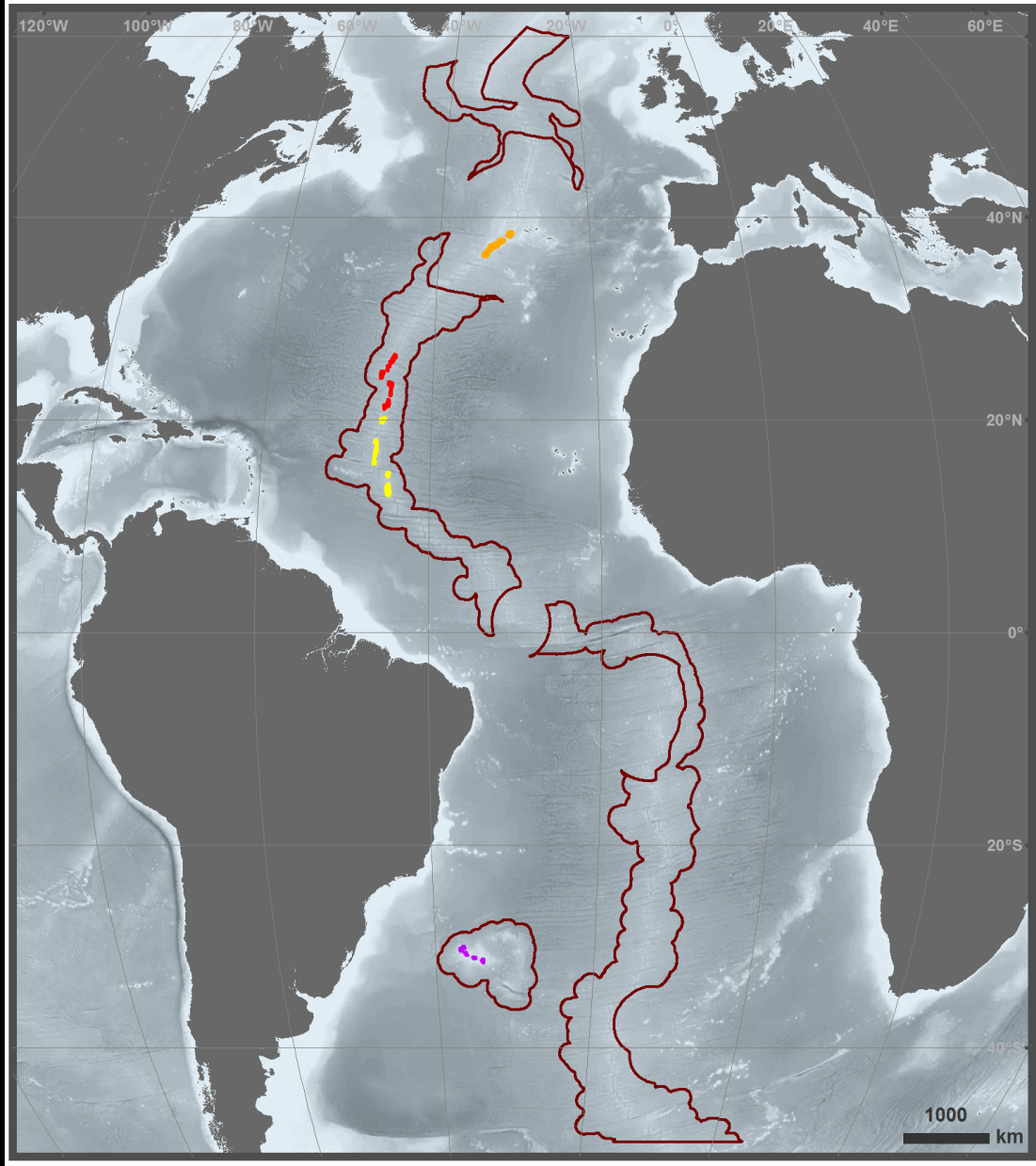


Marine Geospatial Ecology Lab, Duke University (2015)

ISA Resource Distribution

- Polymetallic Sulphides
- Cobalt-Rich Ferromanganese Crusts
- Polymetallic Nodules

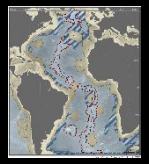
Data report – Human uses



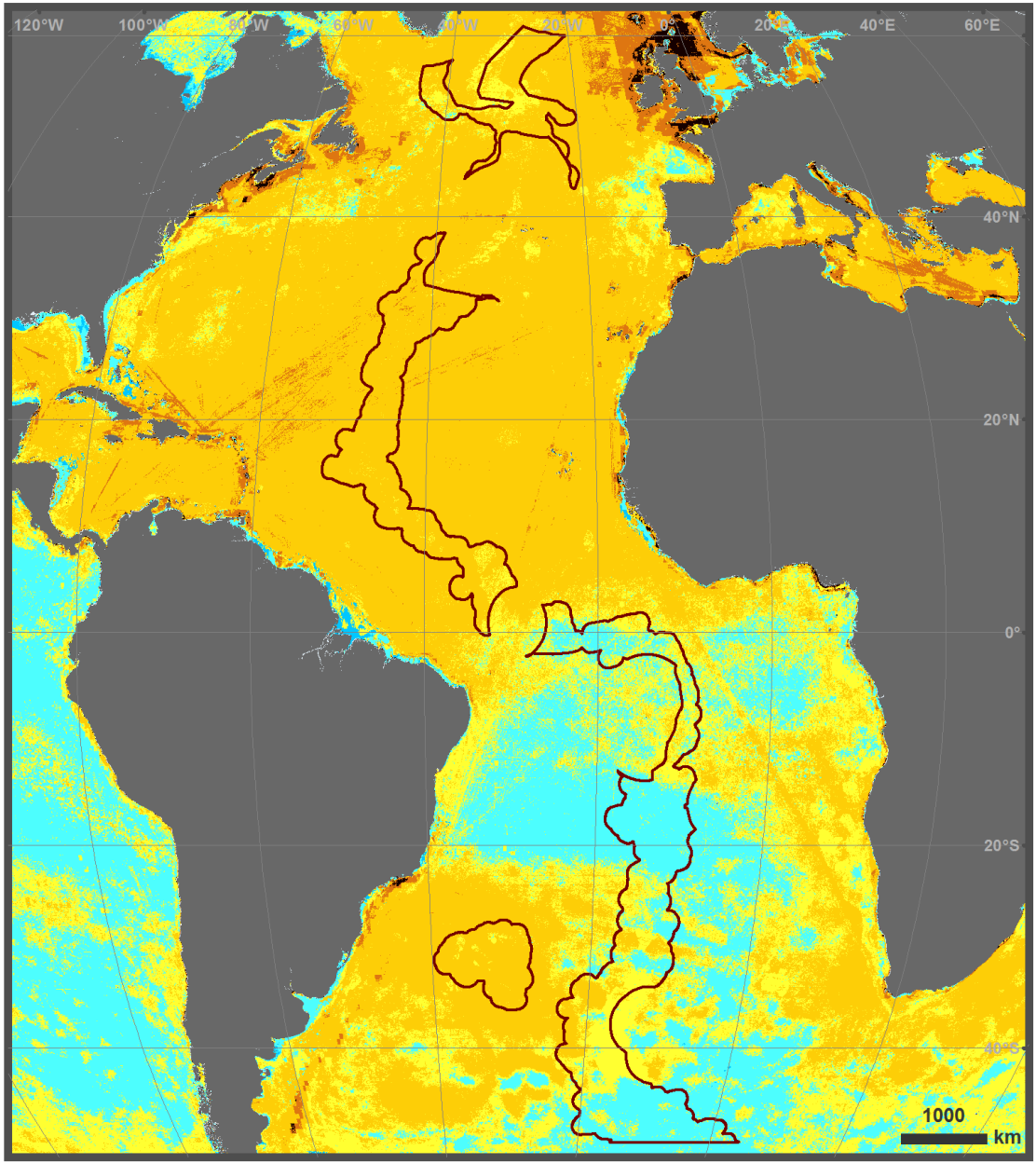
Marine Geospatial Ecology Lab, Duke University (2015)

Exploration Areas

- ISA: France
- ISA: Russian Federation
- ISA: Brazil
- Nautilus Minerals



Data report – Human uses



Marine Geospatial Ecology Lab, Duke University (2015)

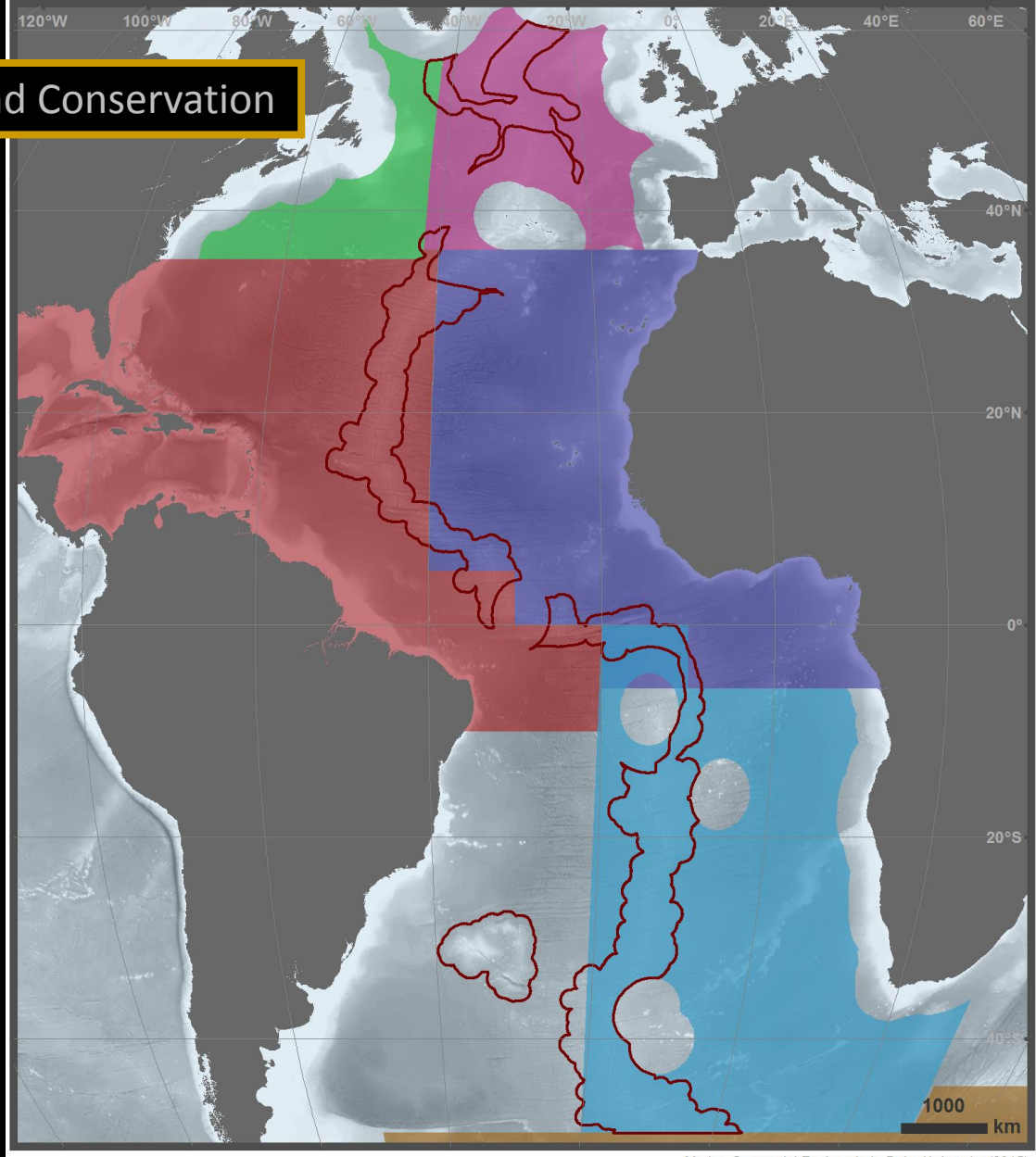
Cumulative Human Impact (Halpern et al. 2008)

- Very Low Impact (<1.4)
- Low Impact (1.4–4.95)
- Medium Impact (4.95–8.47)
- Medium High Impact (8.47–12)
- High Impact (12–15.52)
- Very High Impact (>15.52)

Management and Conservation

Mid-Atlantic Ridge and Rio Grande Rise

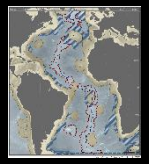
Data report – Management and Conservation



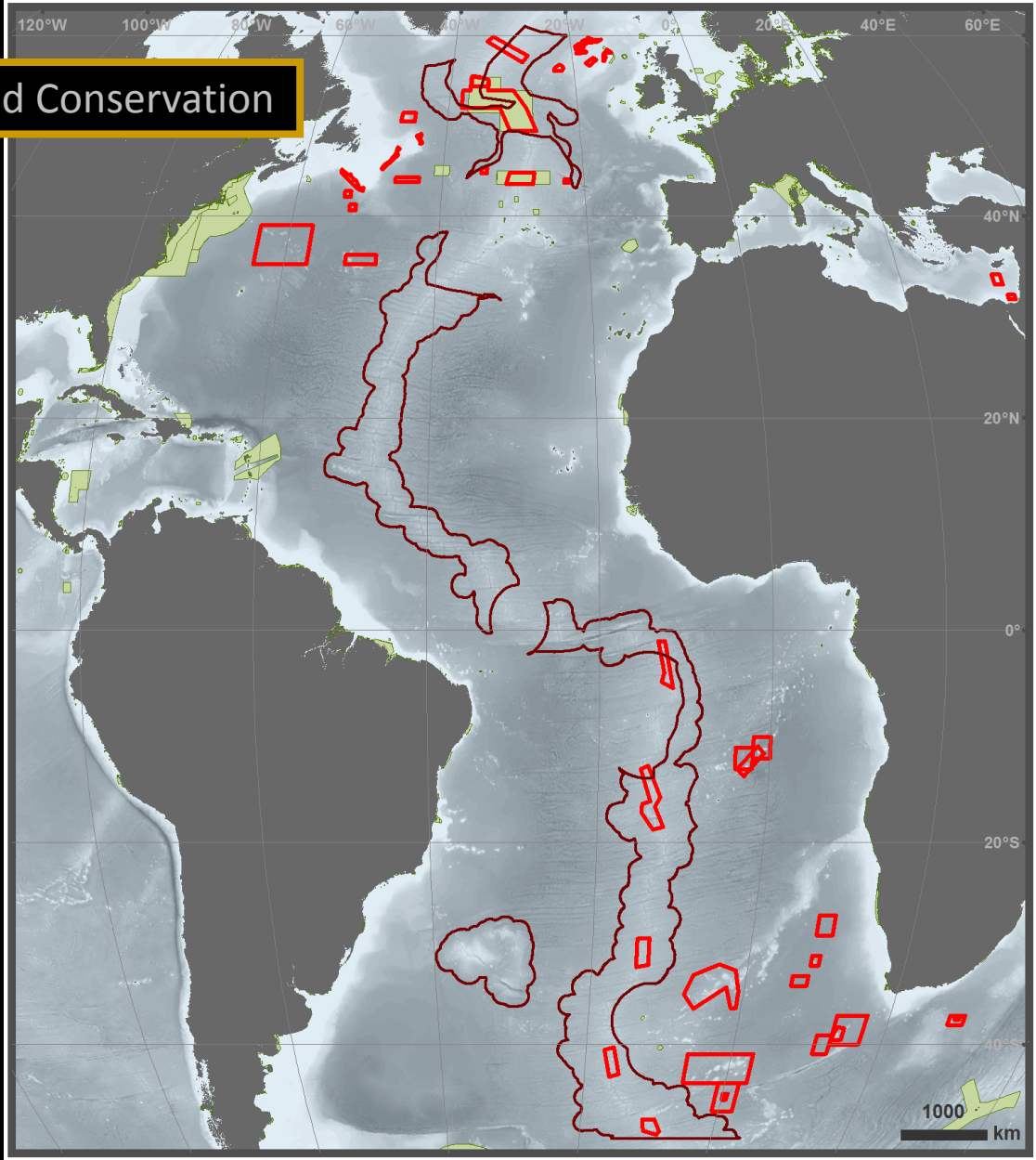
Marine Geospatial Ecology Lab, Duke University (2015)

Regional Fisheries Organizations

RFB	RFMO	
WECAFC	NAFO	SEAFO
CECAF	NEAFC	CCAMLR



Data report – Management and Conservation



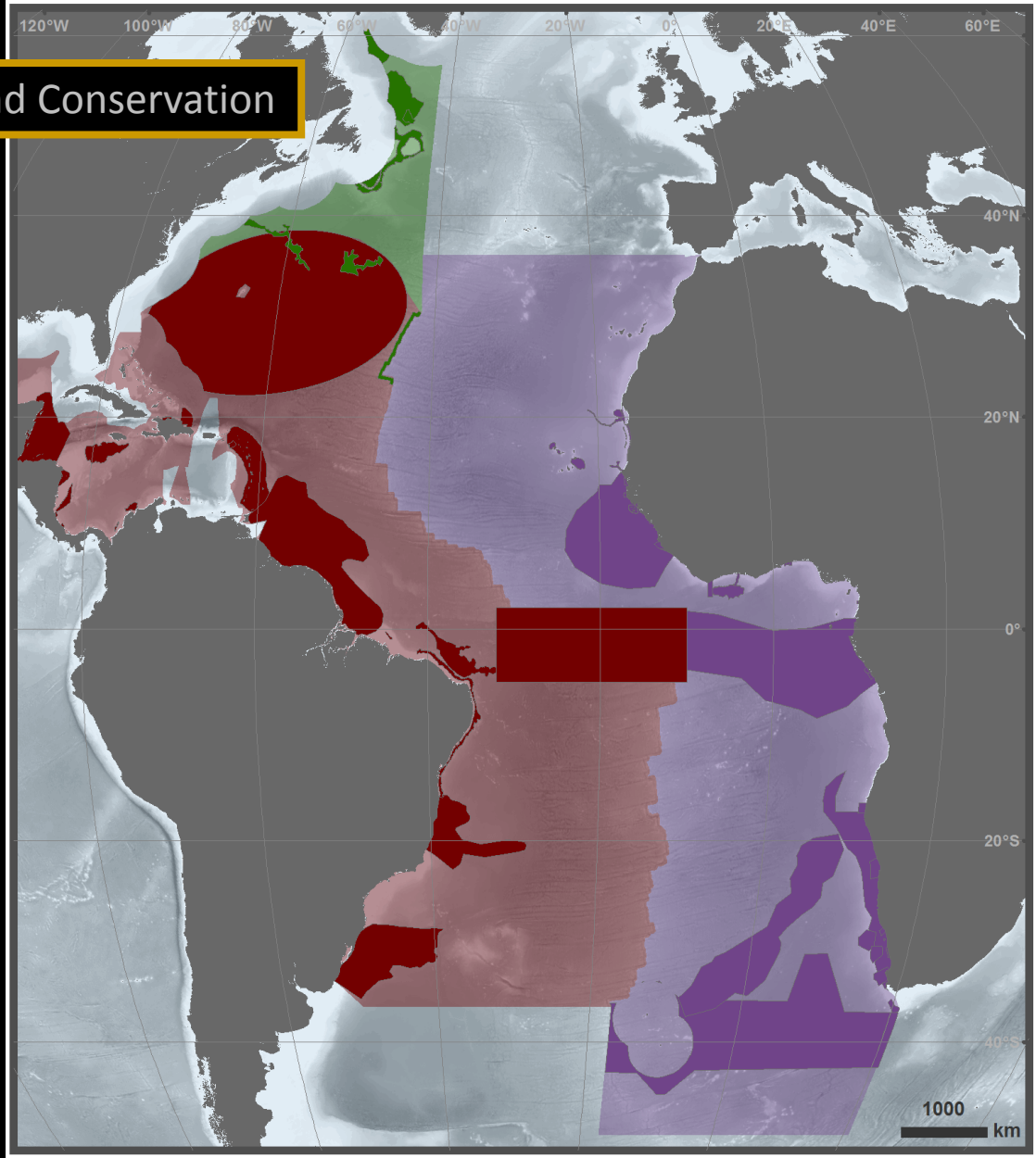
Marine Geospatial Ecology Lab, Duke University (2015)

Marine Protected Areas

Marine Protected Area (WDPA)

VME Closed Area

Data report – Management and Conservation



Marine Geospatial Ecology Lab, Duke University (2015)

CBD Ecologically or Biologically Significant Areas (EBSA)

Workshop Boundary

- North West Atlantic
- South East Atlantic
- Wider Caribbean and Western Mid-Atlantic

Described EBSA

- NWA EBSA
- SEA EBSA
- WC and WMA EBSA

Thanks

Data collection team

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