



iAtlantic

INTEGRATED ASSESSMENT OF ATLANTIC
MARINE ECOSYSTEMS IN SPACE AND TIME

J Murray Roberts

iAtlantic Project coordinator

Science advances at the ocean-climate-biodiversity nexus: Highlights from the Atlantic

2 March 2023, European Parliament



CAGE Max 3
THR: 0
DPT: 4840'
HDG: 090
TRN: 0.5
P: 5
R: 1
TRN: 0.5

Destructive human use

Subsea Slurry Lift
Seafloor Production Tools (SPTs)

Acidification

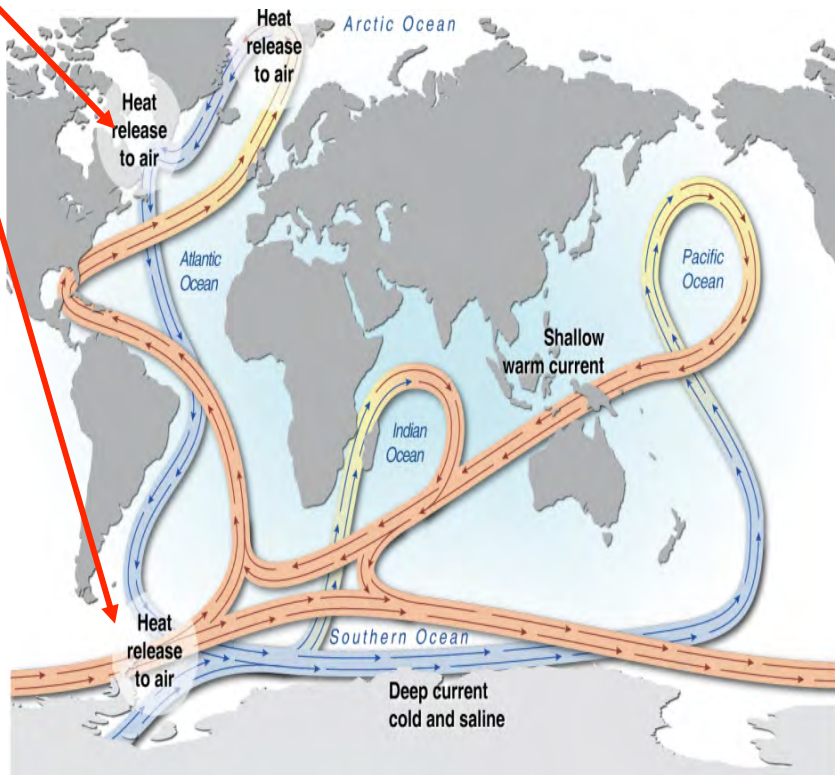


Deoxygenation

Warming

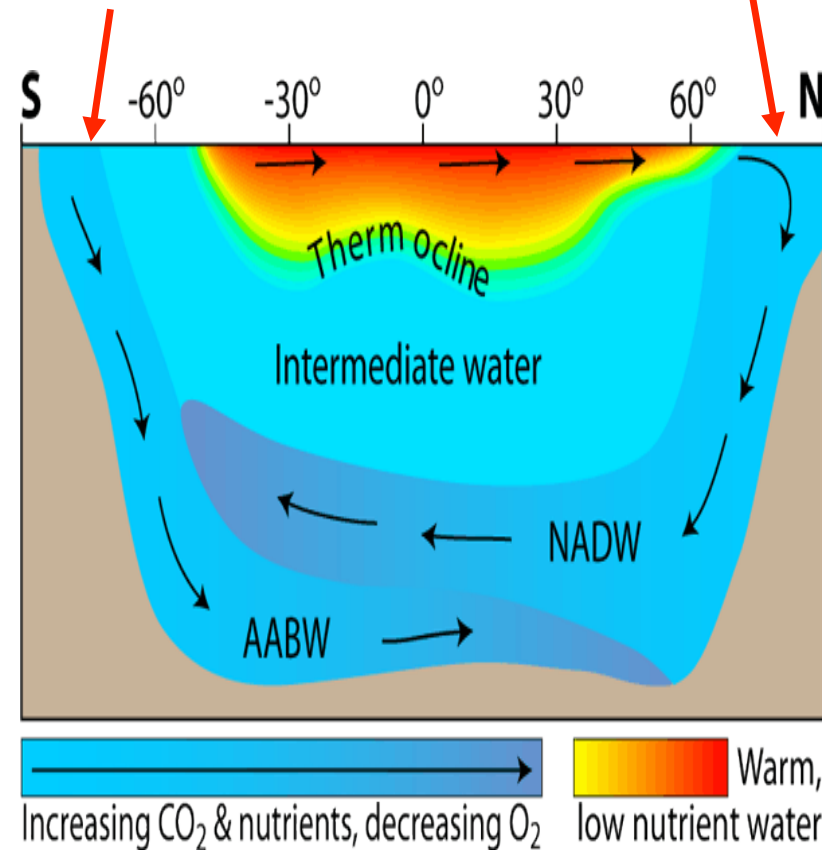
One Ocean: thermohaline circulation

Deep-water formation



https://blogs.egu.eu/geolog/files/2013/09/world-ocean-thermohaline-circulation_79a9.png

Under a warmer climate, warmer, relatively O₂-poor, CO₂-rich seawater will begin to sink into the deep sea at sites of deep-water formation



Simplified water circulation in the Atlantic Ocean (Credit: [SEOS](#))



Crumbling Reefs and Cold-Water Coral Habitat Loss in a Future Ocean: Evidence of “Coralporosis” as an Indicator of Habitat Integrity

Sebastian J. Hennige^{1*}, Uwe Wolfram^{2,3*}, Leslie Wickes^{2,4,5†}, Fiona Murray¹, J. Murray Roberts¹, Nicholas A. Kamenos⁶, Sebastian Schofield², Alexander Groetsch², Ewa M. Spiesz⁷, Marie-Eve Aubin-Tam⁷ and Peter J. Etnoyer^{4,5}

REVIEW

Major impacts of climate change on deep-sea benthic ecosystems

Andrew K. Sweetman¹, Andrew R. Thurber¹, Craig R. Smith¹, Lisa A. Levin¹, Camilo Mora¹, Chih-Lin Wei², Andrew J. Gooday³, Daniel O. B. Jones⁴, Michael Rex^{1†}, Moriaki Yasuhara^{5†}, Jeroen Ingels⁶, Henry A. Ruhl⁷, Christina A. Frieder^{8,9}, Roberto Danovaro^{10,11}, Laura Würzberg¹¹, Amy Baco¹¹, Benjamin M. Grube^{6,12}, Alexis Pasulka¹³, Kirstin S. Meyer^{14,15}, Katherine M. Dunlop¹, Lea-Anne Henry^{16,17} and J. Murray Roberts¹⁸

- Abyssal temp \uparrow 1°C within 84 years
- O₂ declines in areas deep-water formation
- Up to 40-55% \downarrow in POC flux in some regions
- Rapid pH \downarrow at bathyal depths

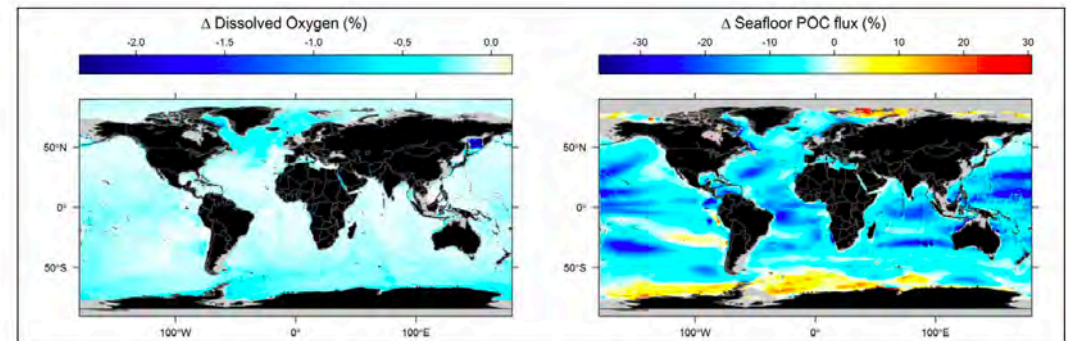
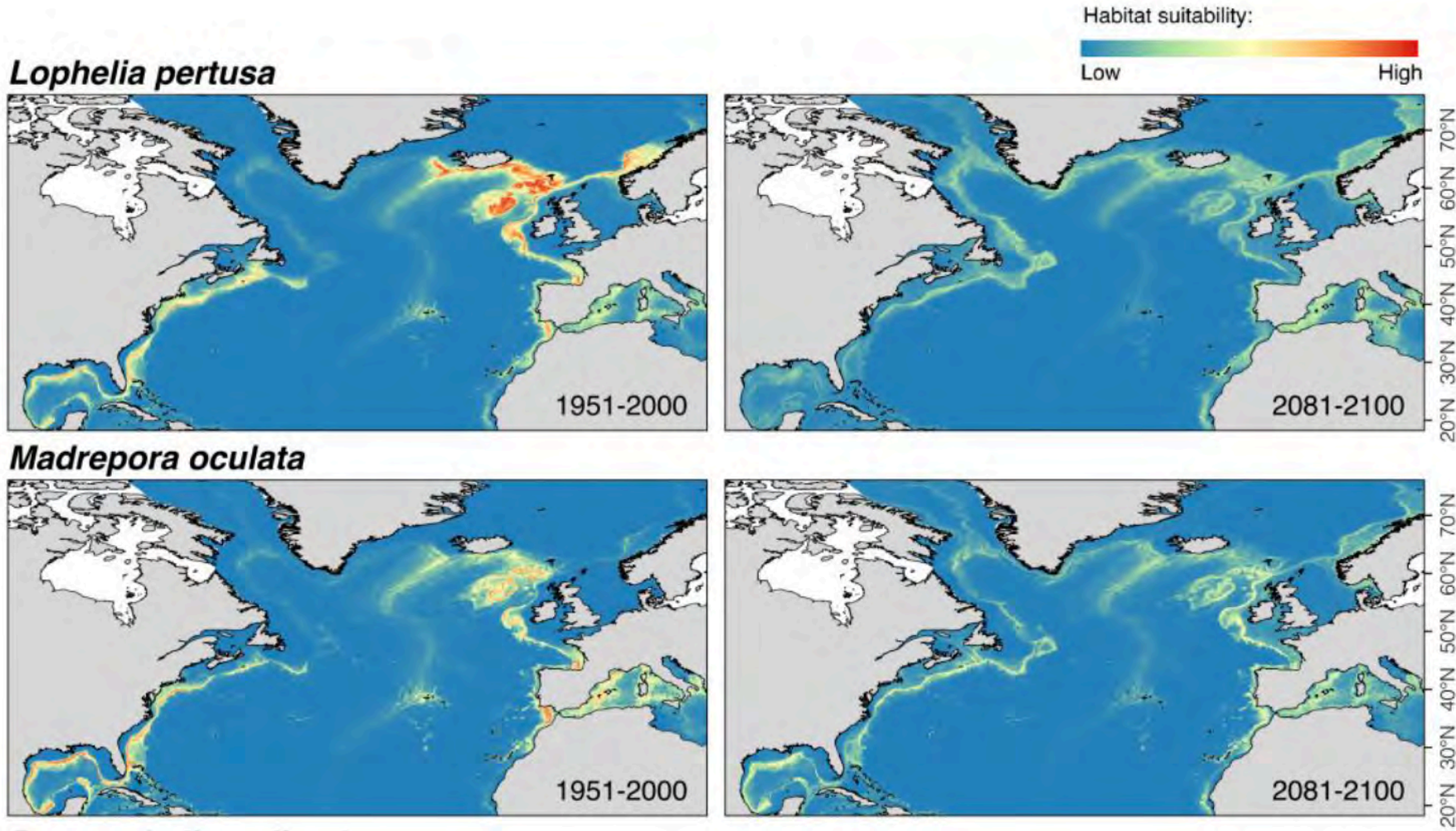


Figure 3: Relative environmental changes at the deep seafloor in the year 2100. Relative change (%) in dissolved oxygen (mL L^{-1}) and seafloor POC flux ($\text{mg C m}^{-2} \text{d}^{-1}$) conditions that could be seen at the deep (> 200 m) seafloor by 2100 relative to present-day conditions. DOI: <https://doi.org/10.1525/elementa.203.f3>

Climate-induced changes in the suitable habitat of cold-water corals and commercially important deep-sea fishes in the North Atlantic

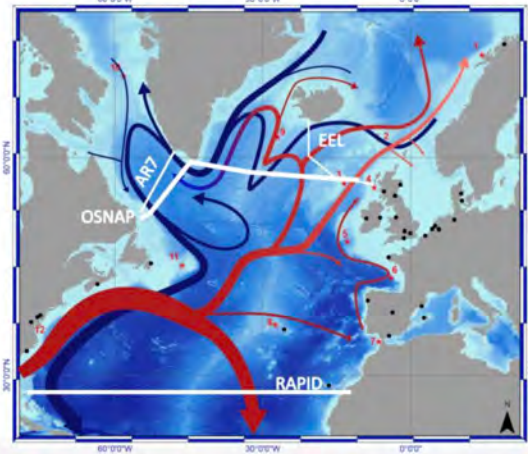
Telmo Morato^{1,2} | José-Manuel González-Irujo^{1,2} | Carlos Domínguez-Carrión^{1,2} | Chih-Lin Wei³ | Andrew Davies⁴ | Andrew K. Sweetman⁵ | Gerald H. Taranto^{1,2} | Lindsay Beazley⁶ | Ana García-Alegre⁷ | Anthony Grehan⁸ | Pascal Laffargue⁹ | Francisco Javier Murillo⁶ | Mar Sacau⁷ | Sandrine Vaz¹⁰ | Ellen Kenchington⁶ | Sophie Arnaud-Haond¹⁰ | Olisín Callery⁸ | Giovanni Chiment^{11,12} | Erik Cordes¹³ | Hronn Egilsdottir¹⁴ | André Freivald¹⁵ | Ryan Gasbarro¹⁹ | Cristina Gutiérrez-Zárate^{1,2} | Matthew Gianni¹⁶ | Kent Gilkinson¹⁷ | Vonda E. Wareham Hayes¹⁷ | Dierk Hebbeln¹⁸ | Kevin Hedges¹⁹ | Lea-Anne Henry²⁰ | David Johnson²¹ | Mariano Koen-Alonso¹⁷ | Cam Lirette⁶ | Francesco Mastrototaro^{11,12} | Lénaïck Menot²² | Tina Molodtsova²³ | Pablo Durán Muñoz⁷ | Covadonga Orejas²⁴ | Maria Grazia Pennino⁷ | Patricia Puerta²⁴ | Stefán Á. Ragnarsson¹⁴ | Berta Ramiro-Sánchez²⁰ | Jake Rice²⁵ | Jesús Rivera²⁶ | J. Murray Roberts²⁰ | Steve W. Ross²⁷ | José L. Rueda²⁸ | Íris Sampaio^{2,15} | Paul Snelgrove⁹ | David Stirling²⁰ | Margaret A. Treble¹⁹ | Javier Urra²⁸ | Johanne Vad²⁰ | Dick van Oevelen³¹ | Les Watling³² | Wojciech Walkusz¹⁹ | Claudia Wienberg¹⁸ | Mathieu Woillez²² | Lisa A. Levin³³ | Marina Carreiro-Silva^{1,2}



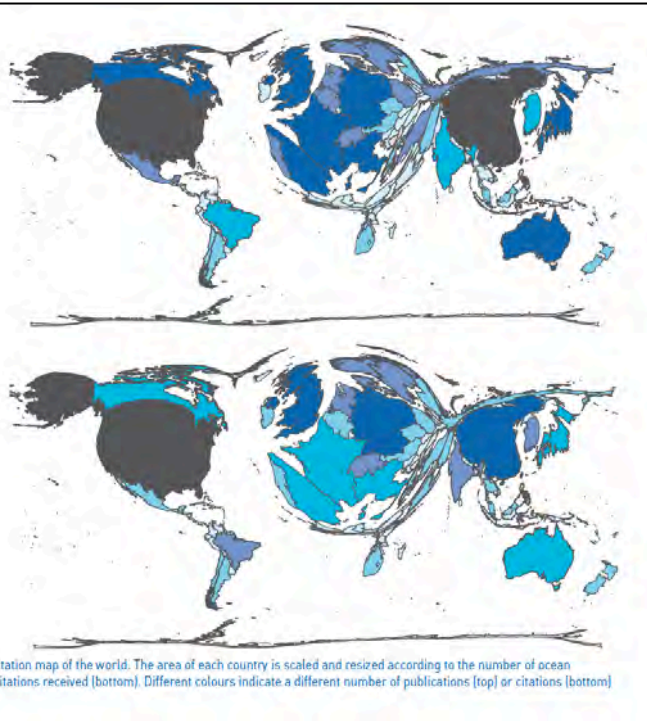


Galway Statement on Atlantic Ocean Cooperation
Launching a European Union - Canada - United States of America
Research Alliance

The Signatories of this Statement meeting on the occasion of the high level event
The Atlantic – a Shared Resource, held on
23 and 24 May 2013
at the Marine Institute, Galway, Ireland

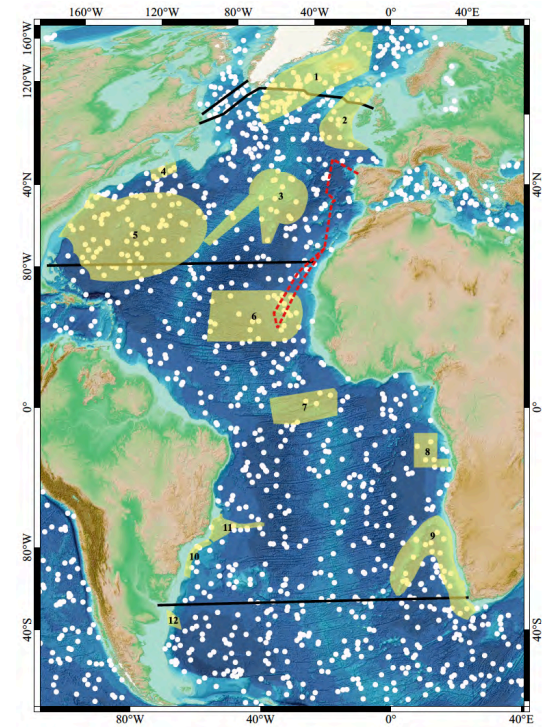


2016-20



2017

Figure ES7. Publication and citation map of the world. The area of each country is scaled and resized according to the number of ocean science publications (top) or citations received (bottom). Different colours indicate a different number of publications (top) or citations (bottom) [Annex F].



2019-23

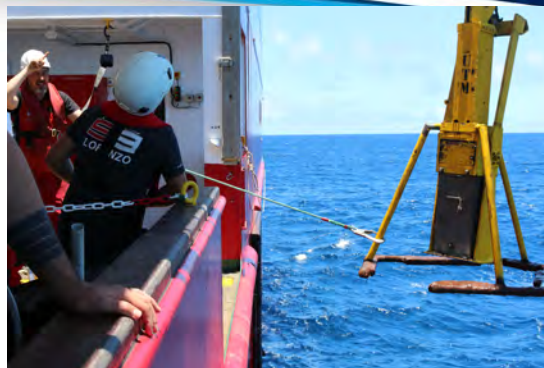


Engage all sectors

- Industry
- Academia
- Policy / Governance
- NGOs
- Public

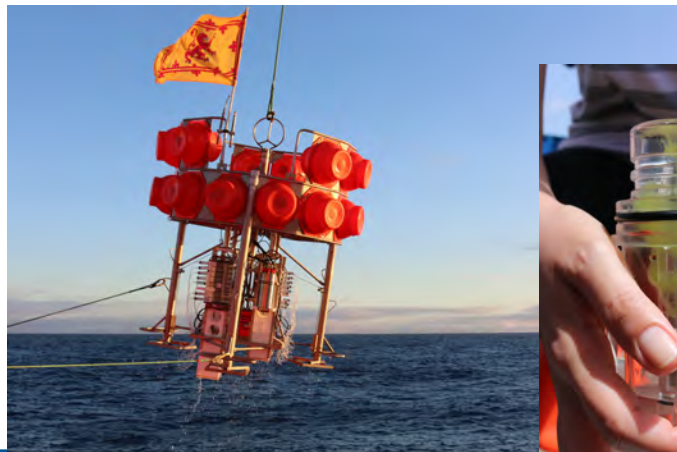
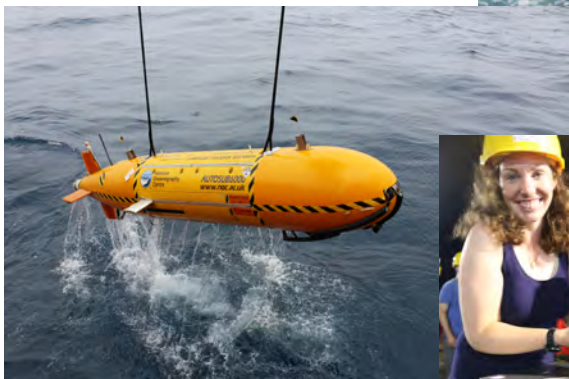
Capacity building and technology transfer integrated across iAtlantic's work

The power of international partnership



The power of International partnership

- 51 expeditions completed
- 10 more scheduled



Hudson2021_048

EX2204

iMirabilis Leg 0 and Leg 1

DECODE Campos Basin
DECODE Sensimar 08_Campos Basin
DECODE Sensimar10_Campo Basin
BIOIL2020_Santos Basin

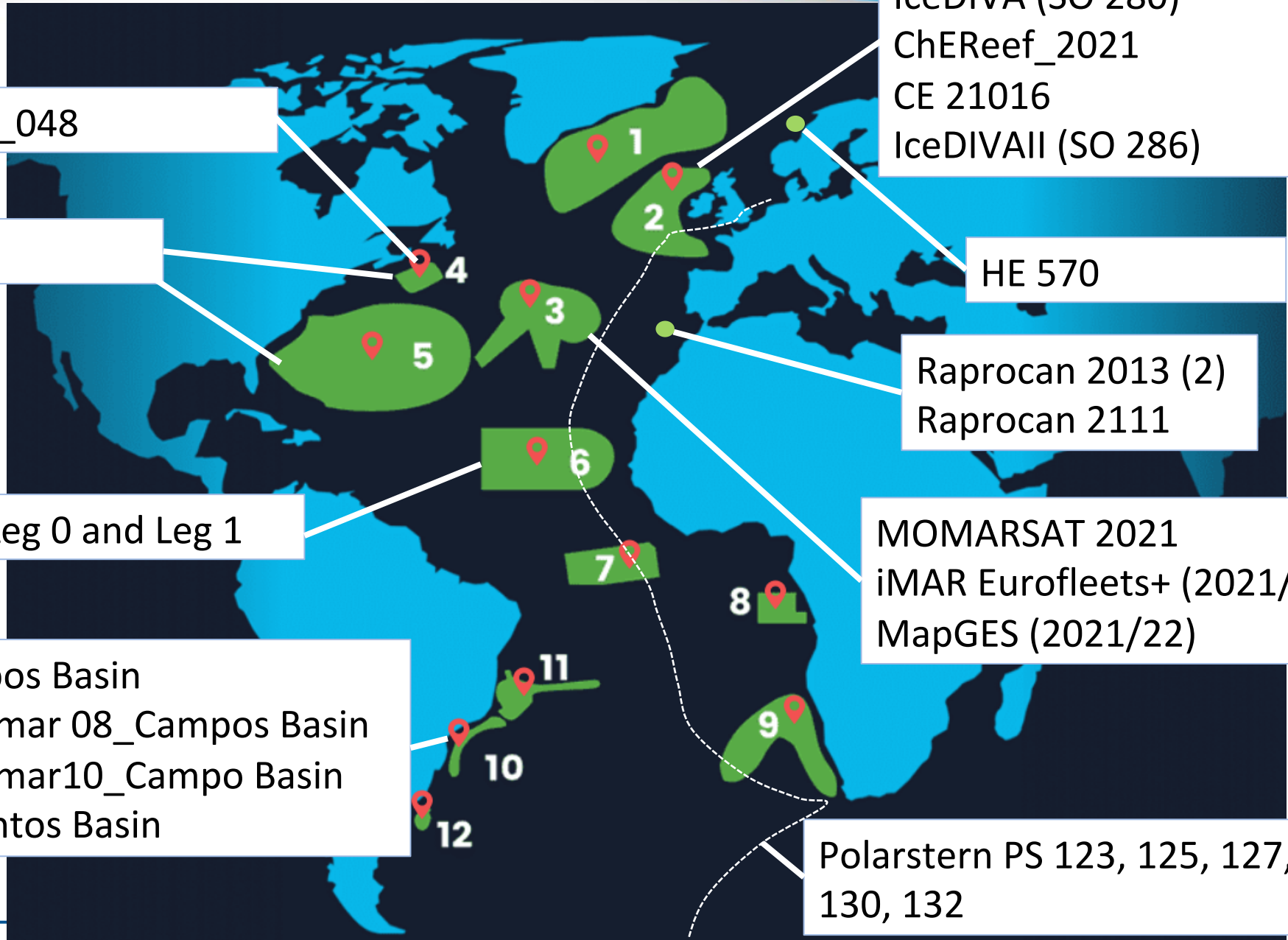
IceDIVA (SO 280)
ChEReef_2021
CE 21016
IceDIVAII (SO 286)

HE 570

Raprocan 2013 (2)
Raprocan 2111

MOMARSAT 2021
iMAR Eurofleets+ (2021/22)
MapGES (2021/22)

Polarstern PS 123, 125, 127,
130, 132





Partners



- 2019-23
- €10.6M budget
- 35 Beneficiaries
- 2 Subcontractors
- 11 Associate Partners

Associate Partners



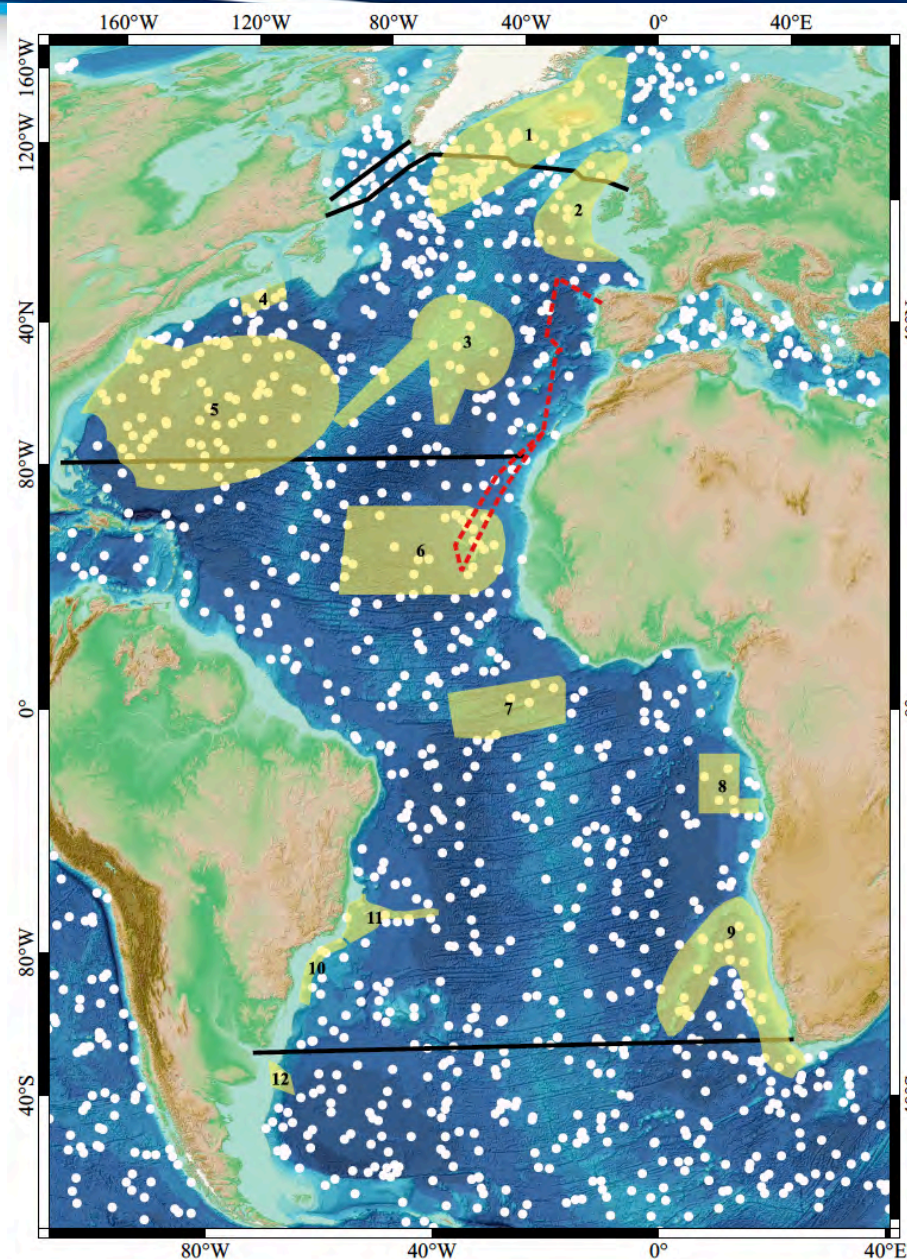
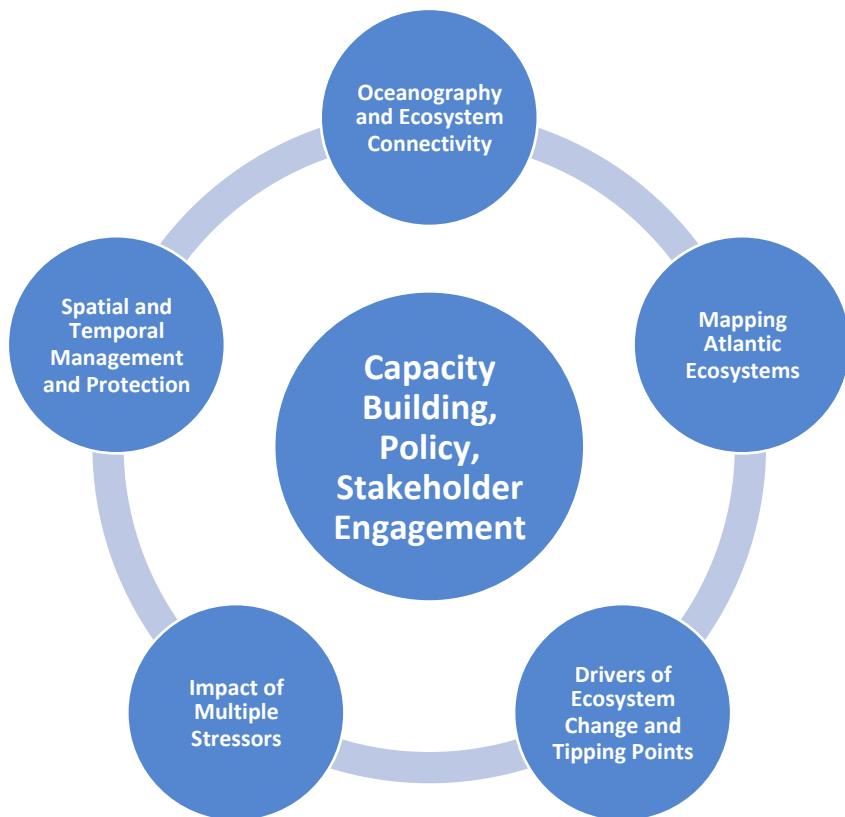
- MoU in progress





- 188 people, including >50 iAtlantic Fellows
- 17 nations
- 6 Priorities
- 1 approach

iAtlantic integrates work across monitoring, experimentation, and modelling



All Atlantic regional study areas

Flagship demonstration and capacity building expeditions

Enhanced transatlantic oceanographic arrays e.g. SAMOC/SAMBA

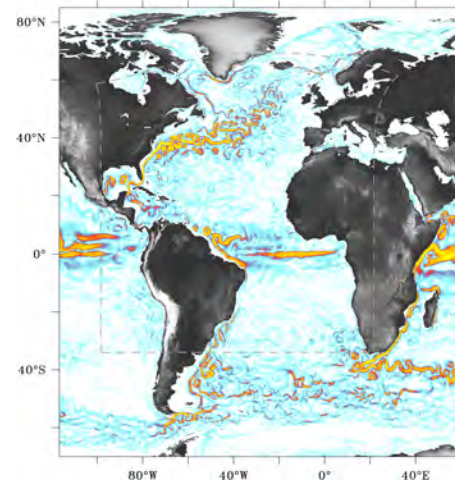




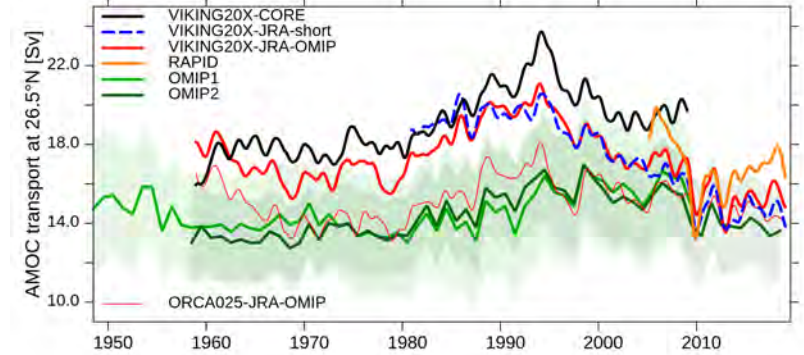
Arne Biastoch
(GEOMAR)



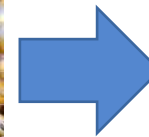
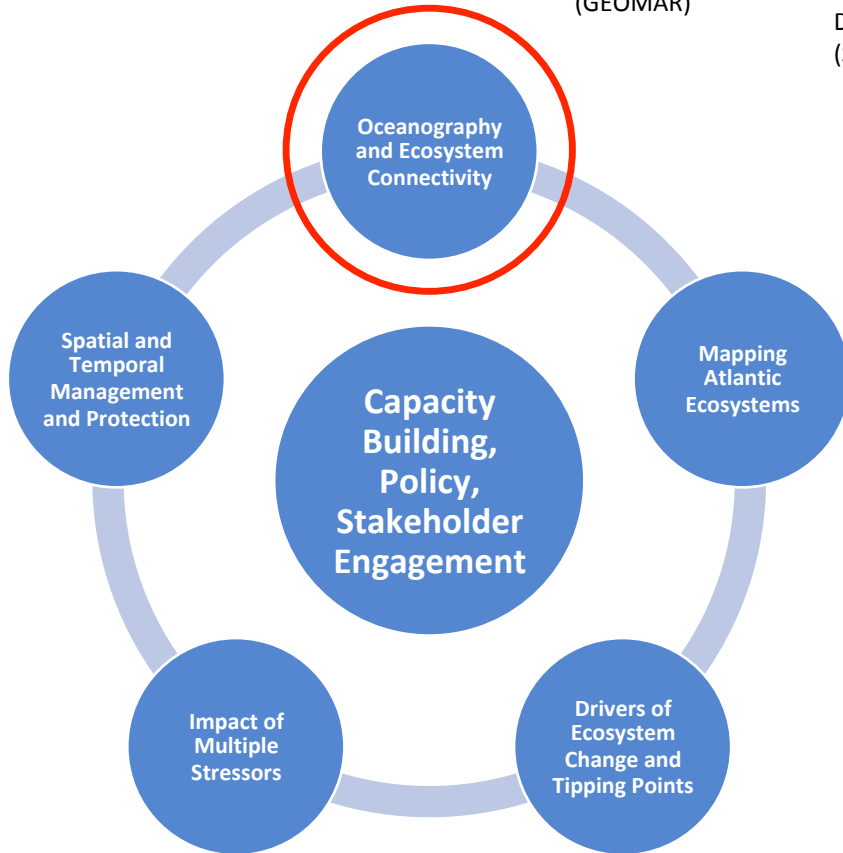
Didier Jollivet
(SU)



Surface speed in VIKING20X



AMOC evolution in series of VIKING20X experiments and observations



- Connectivity **deep-sea coral** populations
- Delineation **mid-Atlantic Ridge vent** populations
- Role Atlantic Equatorial belt connecting **seep fauna**
- How will population connectivity change in the face of AMOC perturbations?



Veerle Huvenne (NOC)

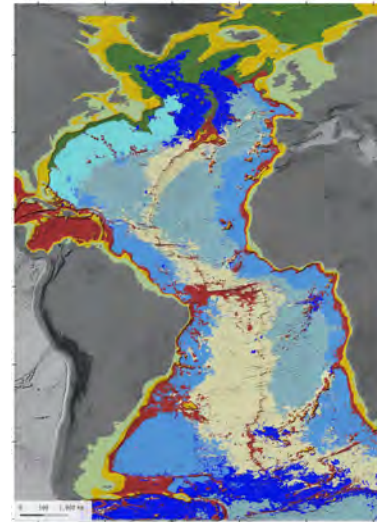


Colin Devey (GEOMAR,
deputy iAtlantic
coordinator)

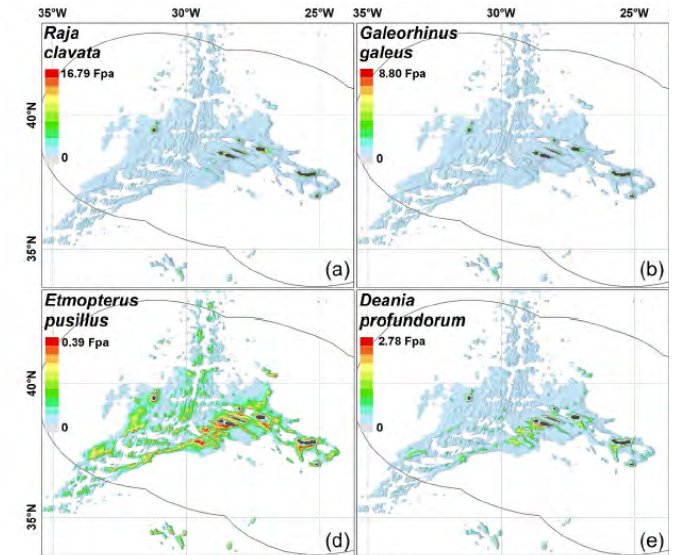


Work at 3
nested scales

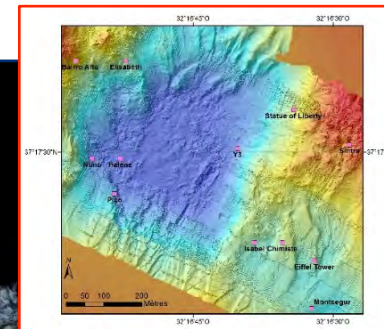
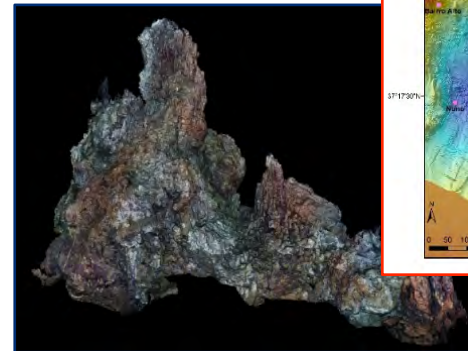
1. Ocean Basin



2. Regional



3. Local





Lea-Anne Henry
(UEDIN)

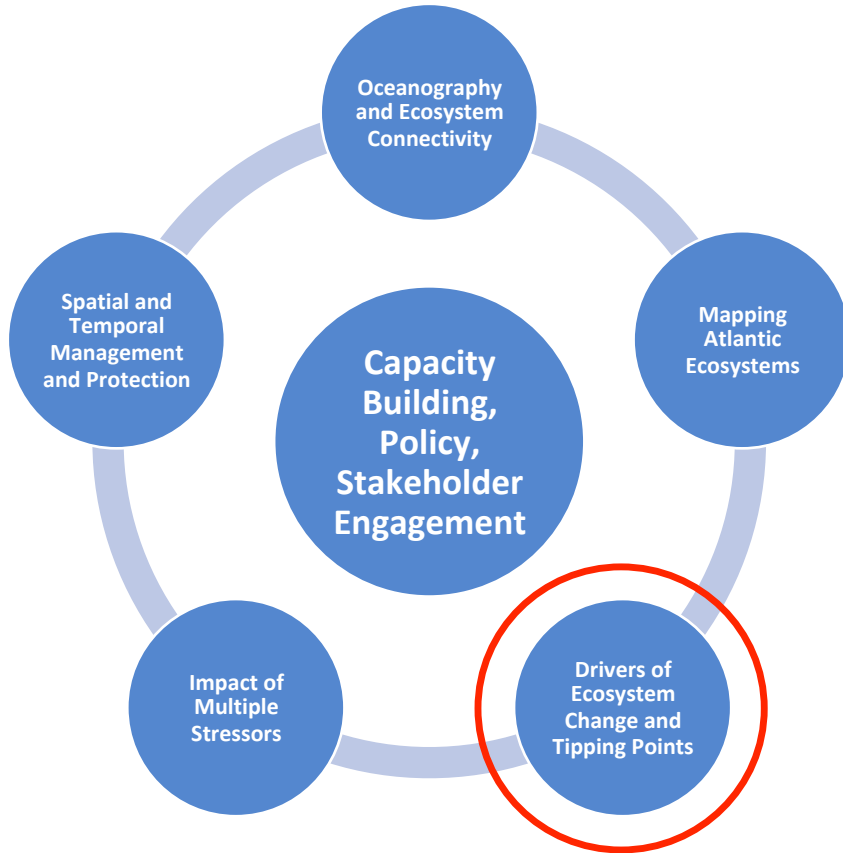


Marjorlaine Matabos
(Ifremer)

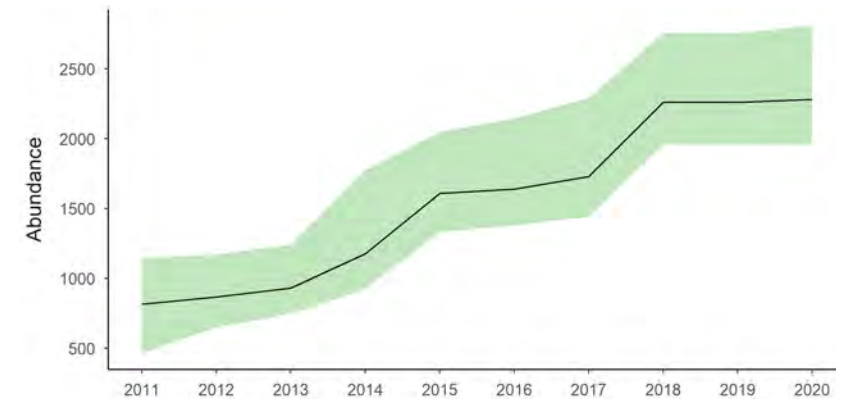


Johanne Vad
(UEDIN)

Brazil's demersal fisheries sector data show a "tropicalisation" of fish fauna since 2014 (Sant'Ana & Perez)



Modelled humpback abundance around Bermuda has nearly tripled over the last decade (Grove, King, Stevenson, Henry)





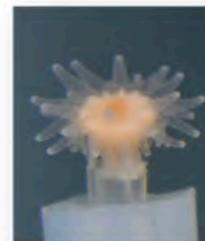
Marina Carreiro-Silva
(IMAR-UAz)



Andrew Sweetman
(SAMS)

3 coral sizes

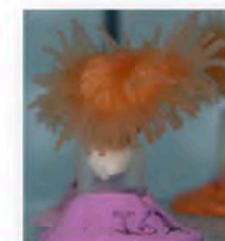
Desmophyllum dianthus
(720 m depth)



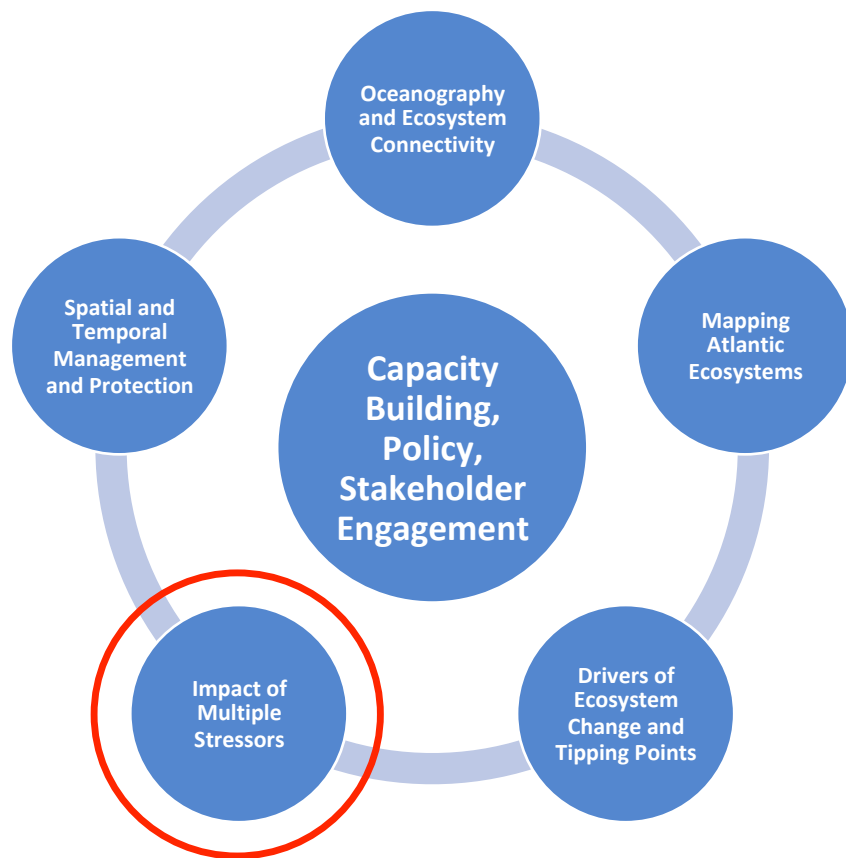
Small – juvenile stages



Medium – early adults



Large – adult



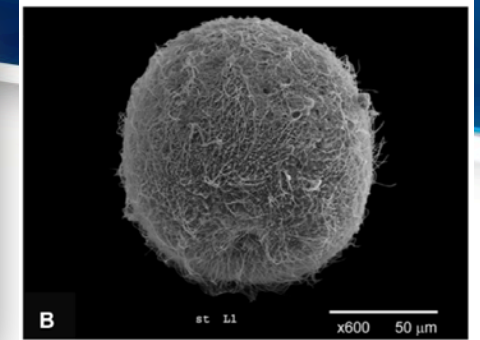
[Unpublished data removed for confidentiality reasons]



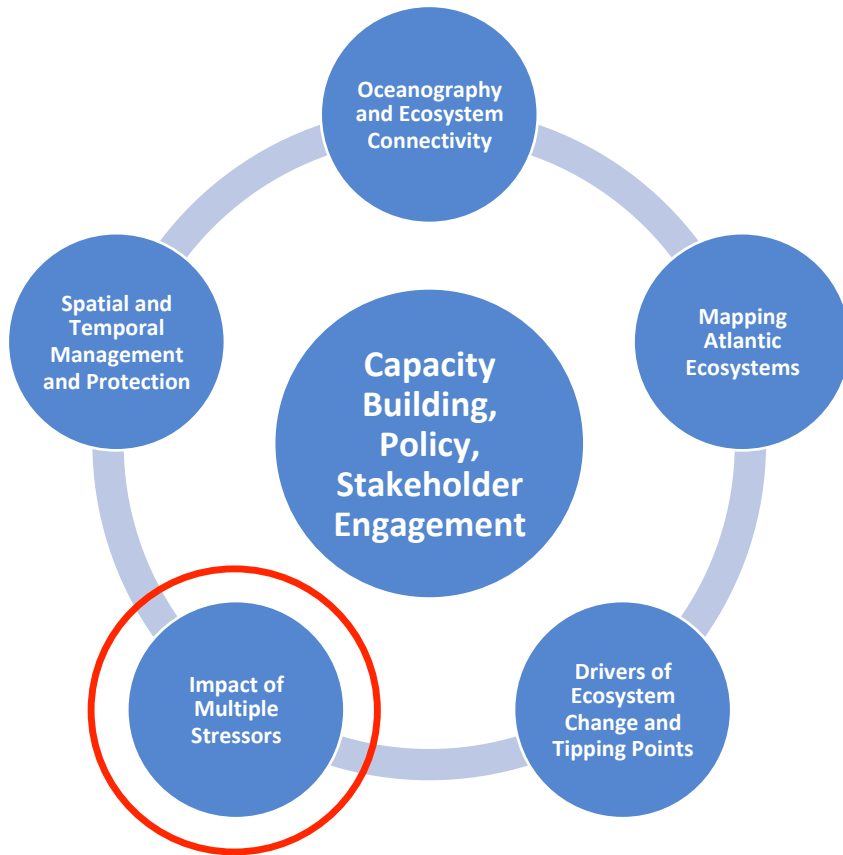
Marina Carreiro-Silva
(IMAR-UAz)



Andrew Sweetman
(SAMS)



Larvae of cold-water coral *Lophelia pertusa*



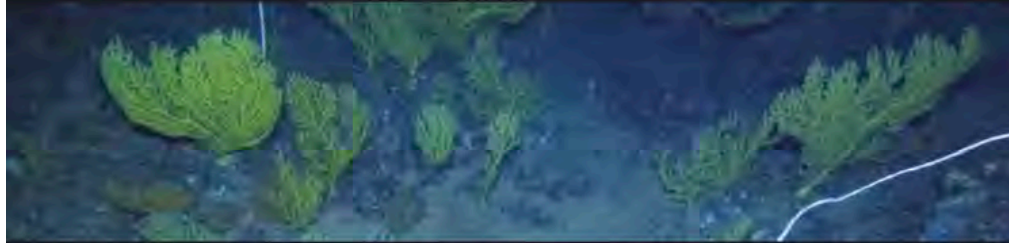
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Policy brief

SCALE AND NATURE OF IMPACTS FROM MINING SEAFLOOR POLYMETALLIC SULPHIDE DEPOSITS

SUMMARY OF LATEST RESEARCH FROM THE iATLANTIC PROJECT

October 2022



Key points:

- Modelling studies in the Azores region project that sediment plumes from seafloor polymetallic sulphide (PMS) mining operations may disperse beyond the licensed mining areas, reaching the flanks and summits of nearby topographic features and extending into the bathypelagic, mesopelagic, and epipelagic environments.
- Sediment particles contained within such plumes can have sub-lethal and lethal effects on benthic sessile suspension- and filter-feeding fauna (such as deep-water corals) by impairing feeding and respiration.
- Toxic metals within this suspended sediment – such as copper – bioaccumulate in coral tissues and skeletons. Subsequent coral death may be due to a combination of the toxic and mechanical effects of PMS particles.
- Delayed mortality in corals exposed even to low concentrations of copper in seawater indicates that some coral species may not recover from the effects of PMS mining plumes. Delayed ecosystem impacts must be considered when predicting the effects of environmental disturbances, such as deep-sea mining, on cold-water coral communities.

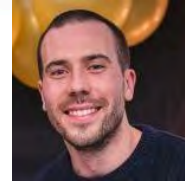
*Image: Cold-water coral garden commonly found on seamount summits of the Azores, comprising *Dentomuricea aff. meteor*, *Acanthogorgia* sp. and *Viminella flagellum*. Image © IMAR/Okeanos-UAz, Azor drift-cam.*



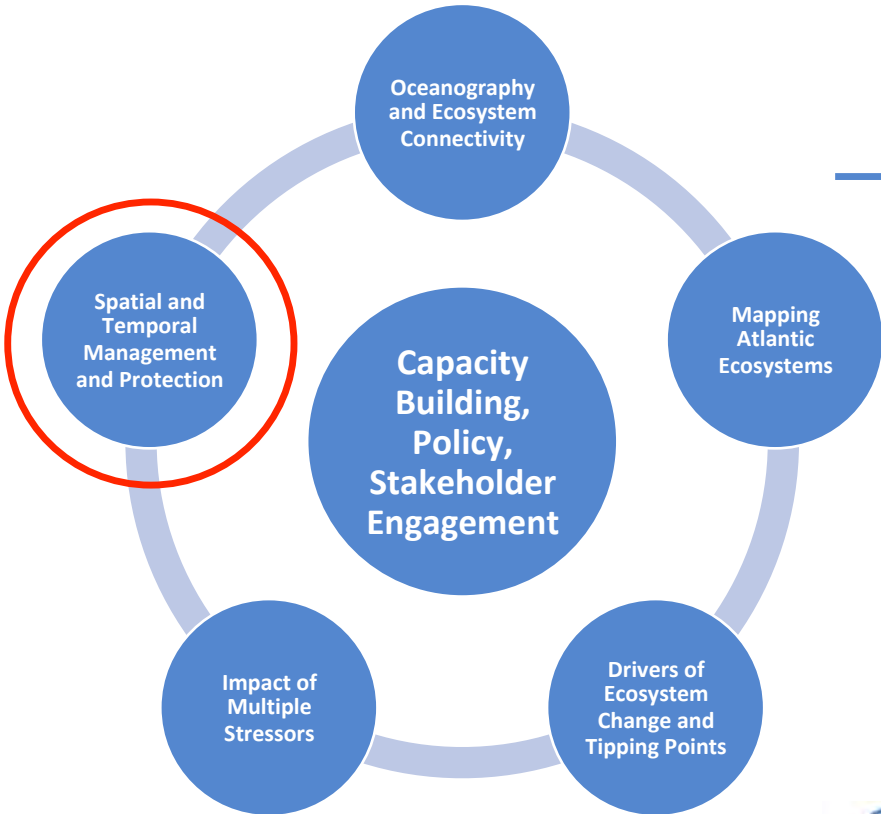
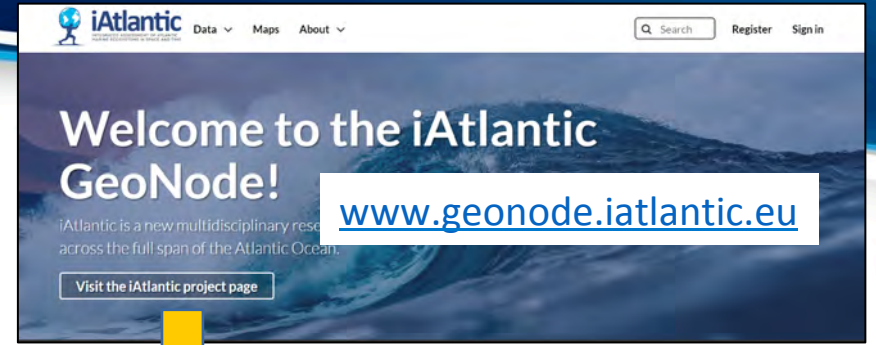
Telmo Morato
(IMAR-UAZ)



Kate Larkin
(EMODnet)



Tim Collart
(EMODnet)



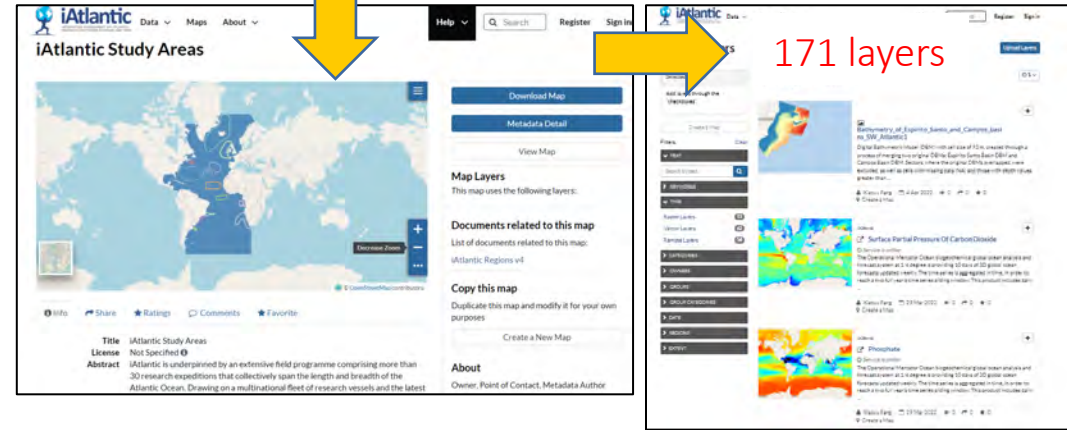
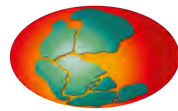
Malik Naumann
(UniHB)



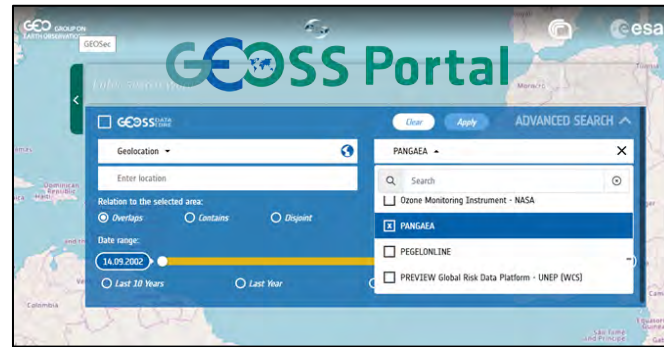
Tina Dohna
(UniHB)



Leo Chiloane
(SAEON)



All-Atlantic Data Community Portal



BUILDING AN ALL ATLANTIC OCEAN COMMUNITY
Implementing the Belém Statement





Vikki Gunn
(Seascope)



Ben Boteler
(TMG)



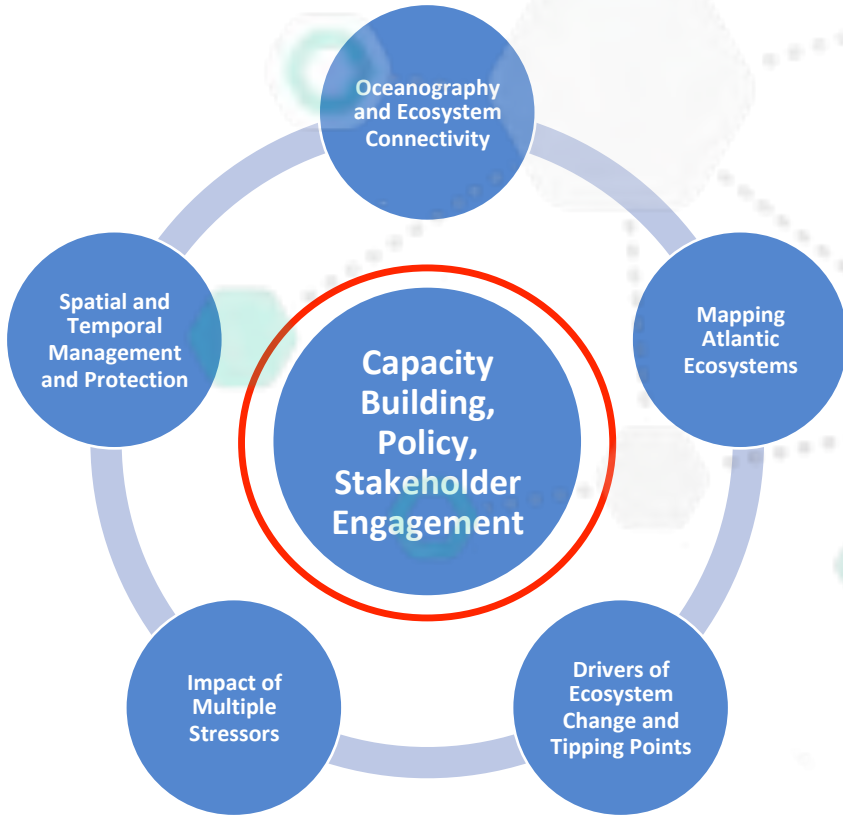
United Nations Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction
Intergovernmental Conference on an international legally binding instrument under the United Nations Convention on the Law of the Sea on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (General Assembly resolution 72/249)



UNITED NATIONS
**OCEAN
CONFERENCE**



Convention on
Biological Diversity



Informing policy processes



Vikki Gunn
(Seascope)



Ben Boteler
(TMG)



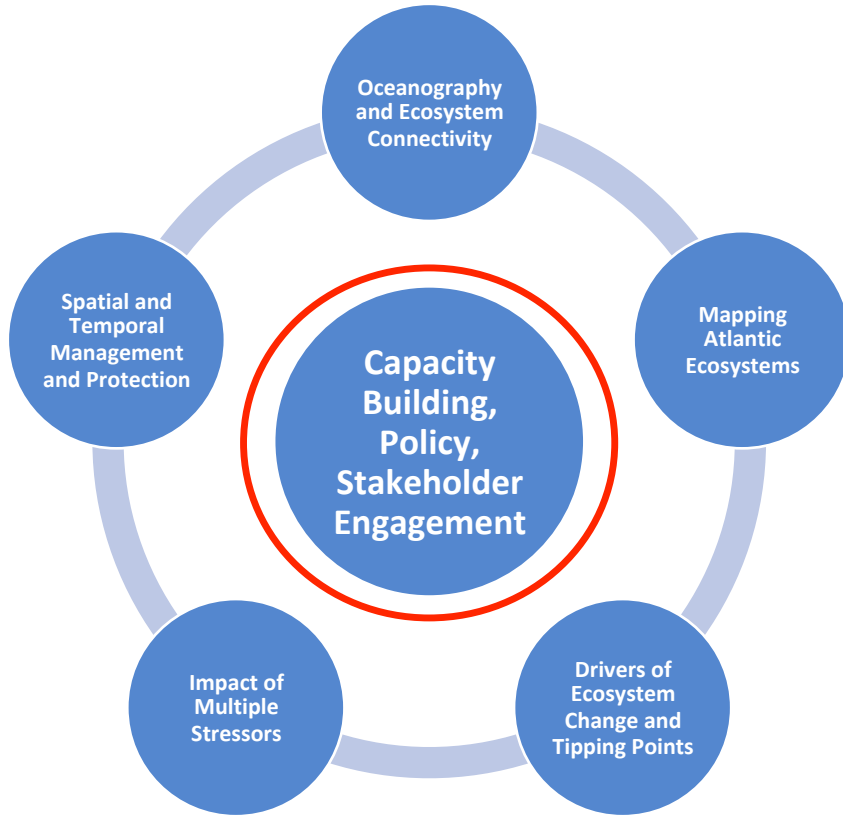
Event opened by:
John Bell (EC)
Lawrence Hanson (Canada)
Jane Lubchenco (USA)

UNOC2022 · Side Event

Scaling up ambition in science partnerships to address challenges at ocean basin scale:
Examples from the iAtlantic project

Wednesday 29 June 18:00-20:00
Tivoli Oriente Hotel

Full details: www.iatlantic.eu/unoc2022-side-event

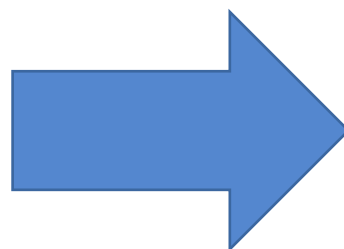
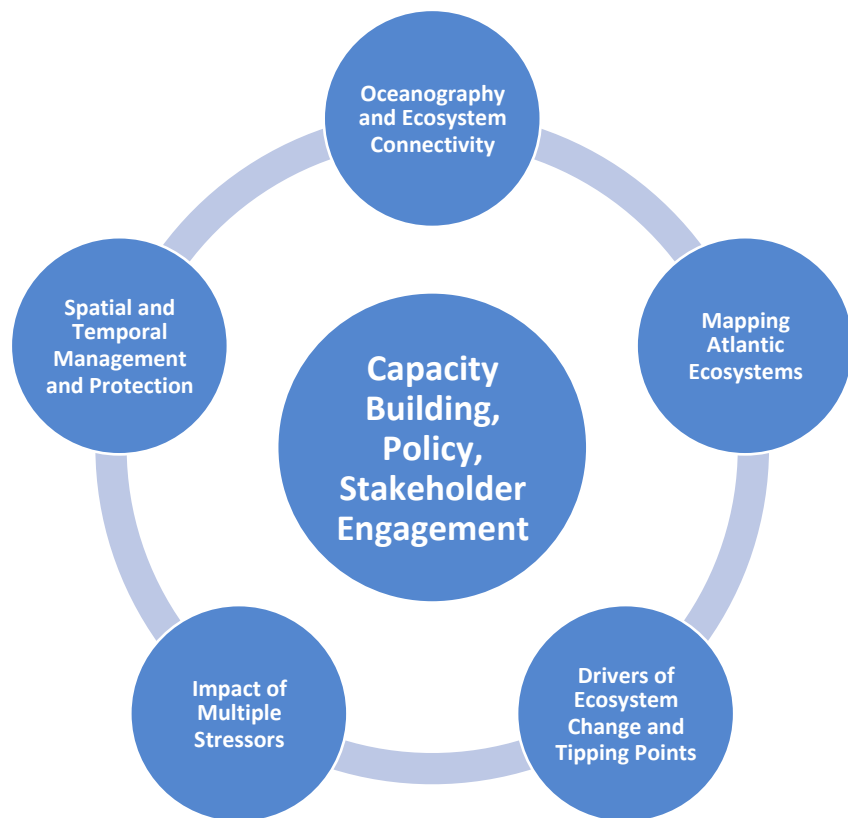


**Cold-water coral taxonomy training school
Florianopolis, Brazil, 15-17 October 2022**



**Ocean governance in the Atlantic
Brazil, 9 October 2022**





A blueprint for integrating scientific approaches and international communities to assess basin-wide ocean ecosystem status

J. Murray Roberts¹, Colin W. Devey², Arne Biastoch², Marina Carreiro-Silva³, Tina Dohna⁴, Boris Dorschel⁵, Vikki Gunn⁶, Veerle A. I. Huvenne⁷, David Johnson⁶, Didier Jollivet⁸, Ellen Kenchington⁹, Kate Larkin^{10,11}, Marjolaine Matabos¹², Telmo Morato³, Malik S. Naumann⁴, Covadonga Orejas^{13,14}, J. Angel A. Perez¹⁵, Stefán Á. Ragnarsson¹⁶, Albertus J. Smit¹⁷, Andrew Sweetman¹⁸, Sebastian Unger¹⁹, Benjamin Boteler¹⁹ & Lea-Anne Henry¹

nature
COMMUNICATIONS

<https://doi.org/10.1038/s43247-022-00645-w>



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MARINE ECOSYSTEMS IN SPACE AND TIME



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Thankyou

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