The ATLAS and iAtlantic projects

J Murray Roberts

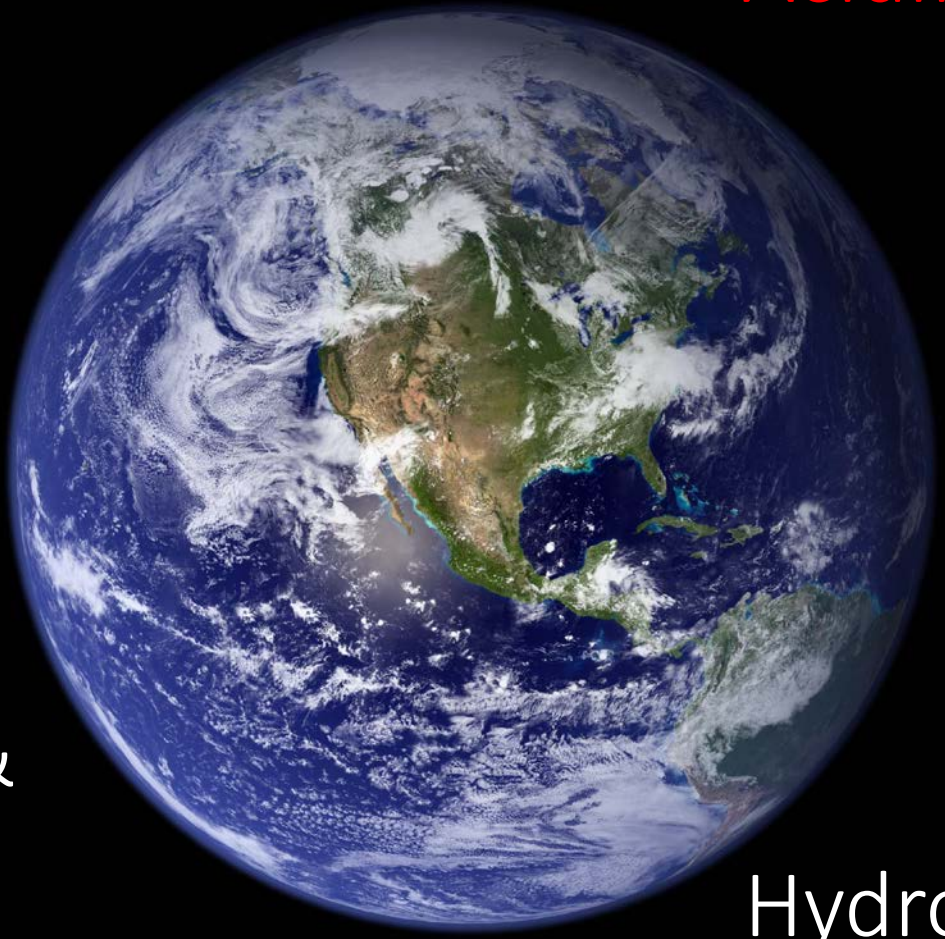
ATLAS project coordinator, University of Edinburgh

Next Steps to Strengthen Stewardship of the Sargasso Sea
Bermuda Institute of Ocean Sciences, 13-14 March 2019

Ocean Warming

Ocean Acidification

Reduced oxygen



Harmful Fishing Practices

Invasive species

Deep-sea Mining

Plastics & Pollution

Hydrocarbon Exploitation

Bioprospecting

ELEMENTA
Science of the Anthropocene

Sweetman, AK et al 2017 Major impacts of climate change on deep-sea benthic ecosystems. *Elem Sci Anth*, 5: 4, DOI: https://doi.org/10.1525/elementa.203

REVIEW

Major impacts of climate change on deep-sea benthic ecosystems

Andrew K. Sweetman*, Andrew R. Thurber†, Craig R. Smith‡, Lisa A. Levin§, Camilo Moral‖, Chih-Lin Wei¶, Andrew J. Gooday**, Daniel O. B. Jones**, Michael Rex††, Moriaki Yasuhara‡‡, Jeroen Ingels§§, Henry A. Ruhl**, Christina A. Frieder§,‖‖, Roberto Danovaro¶¶,***, Laura Würzberg†††, Amy Baco‡‡‡, Benjamin M. Grupe§,§§§, Alexis Pasulka‖‖‖, Kirstin S. Meyer¶¶¶,****, Katherine M. Dunlop*, Lea-Anne Henry†††† and J. Murray Roberts††††

- Abyssal temp ↑ 1°C within 84 years
- O_2 declines in areas deep-water formation
- Up to 40-55% ↓ in POC flux in some regions
- Rapid pH ↓ at bathyal depths

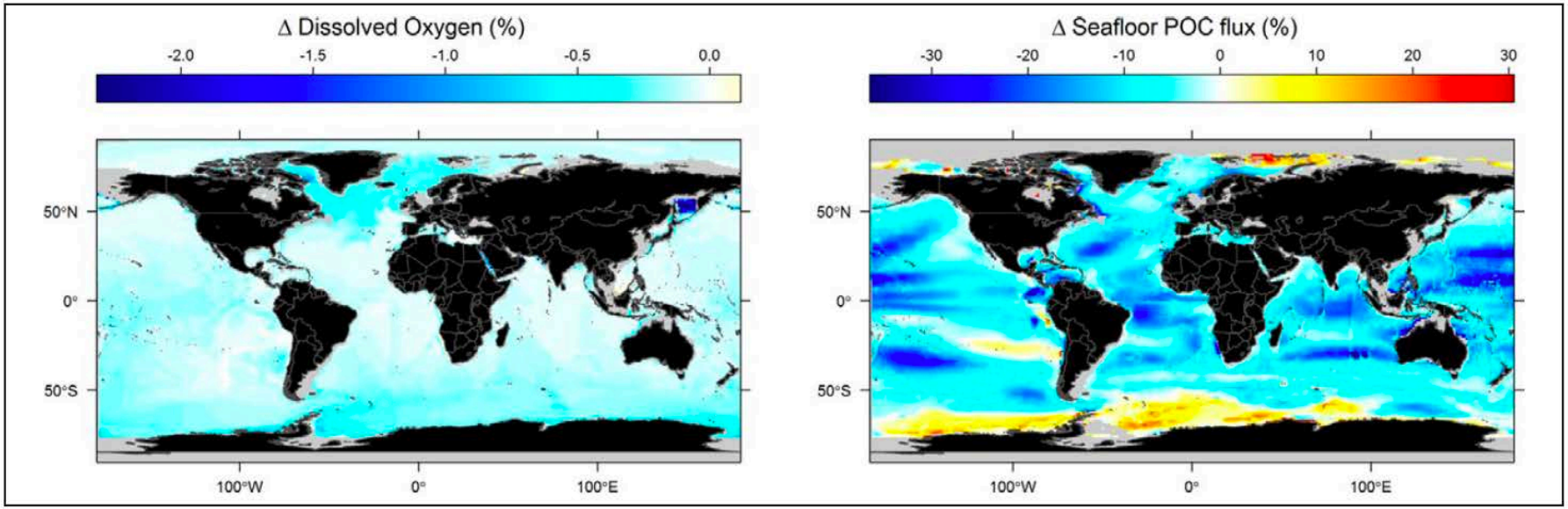


Figure 3: Relative environmental changes at the deep seafloor in the year 2100. Relative change (%) in dissolved oxygen (mL L^{-1}) and seafloor POC flux (mg C m^{-2} d^{-1}) conditions that could be seen at the deep (> 200 m) seafloor by 2100 relative to present-day conditions. DOI: https://doi.org/10.1525/elementa.203.f3

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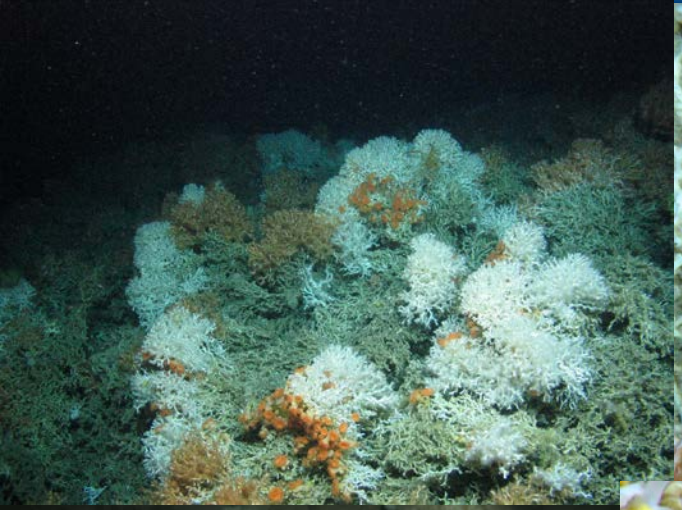
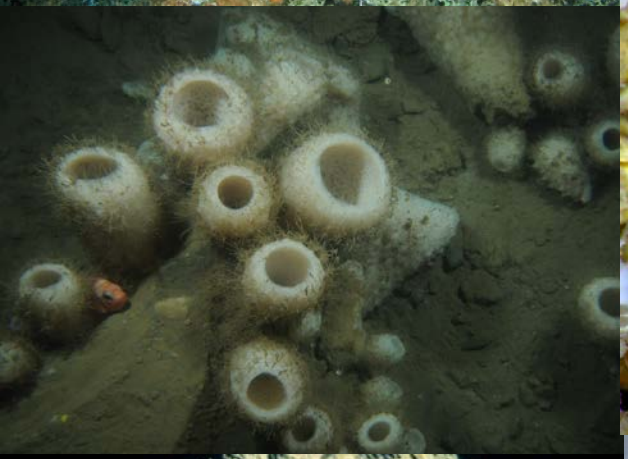
UNDERSTANDING DEEP ATLANTIC ECOSYSTEMS

A trans-Atlantic assessment and deep-water ecosystem-based spatial management plan for Europe

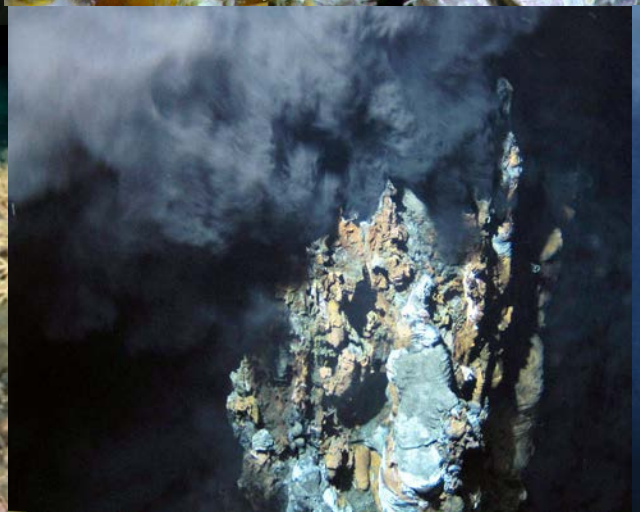
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 678760 (ATLAS). This output reflects only the author's view and the European Union cannot be held responsible for any use that may be made of the information contained therein.

www.eu-atlas.org








At a Glance

A trans-Atlantic assessment and deep-water ecosystem-based spatial management plan for Europe

Call: EU Horizon 2020: BG-2015-2 (Unlocking the potential of seas and oceans)

Duration: May 2016 – April 2020 (48m)

Consortium: 24 partners +1 linked 3rd party, from 12 countries

Budget: €9.3M

Coordinator: University of Edinburgh (UK)

Focus: Providing essential new knowledge of North Atlantic ecosystems through data gathering and synthesis

Impact: Discoveries and outputs will inform and facilitate stakeholder agreement on marine policy and regulation and spur Blue Growth

Core activities: 25+ research cruises investigating 12 case studies across the Atlantic

Galway Statement on Atlantic Ocean Cooperation

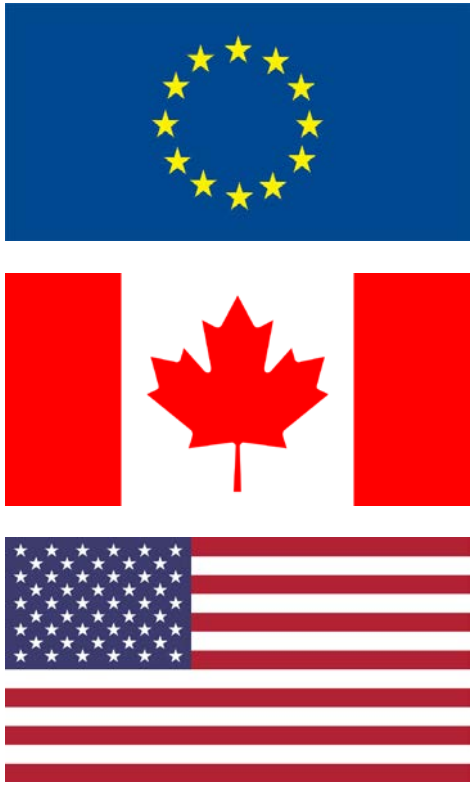
Launching a European Union - Canada - United States of America Research Alliance

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**



Signed in Galway on 24 May 2013 in three originals in the English language.

For the European Union

Máire GEOGHEGAN-QUINN
Commissioner for Research, Innovation and Science

Maria DAMANAKI
Commissioner for Maritime Affairs and Fisheries

For the Government of Canada

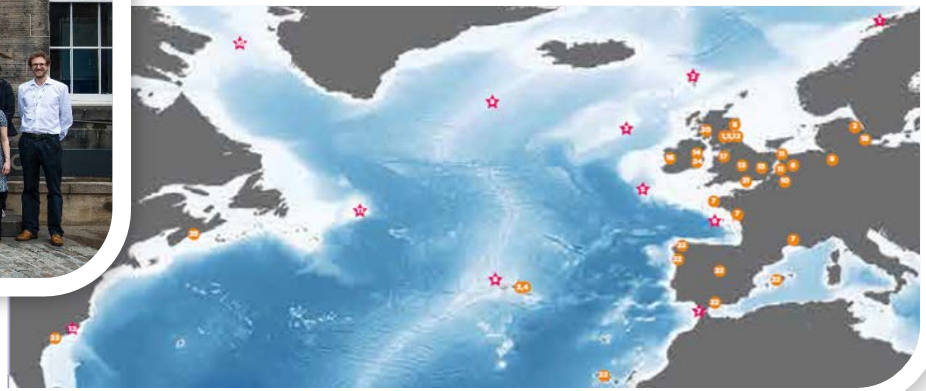
Edward FAST
Minister of International Trade and Minister for the Asia-Pacific Gateway

For the Government of the United States of America

Dr Kerri-Ann JONES
Assistant Secretary of State for Oceans and International Environmental and Scientific Affairs

Trans-Atlantic Collaboration

ATLAS kick-off meeting Edinburgh (June 2016)



★ Case studies ● Project Partners

1 University of Edinburgh (UEDIN)
2 Aarhus Universitet (AU)
3 IMAR - Instituto do Mar (IMAR -Uaz)
4 Secretária Regional do Mar, Ciência e Tecnologia (DRAM)
5 British Geological Survey (BGS/NERC)
6 Gianni Consultancy (GC)
7 Institut Francais de Recherche pour L'Exploitation de la Mer (Ifremer)
8 Marine Scotland (MSS)
9 Universitaet Bremen (UniHB)
10 Iodine (Iodine)
11 NIOZ Koninklijk Nederlands Instituut voor Onderzoek der Zee (NIOZ)
12 Dynamic Earth (DE)
13 University of Oxford (UOX)
14 University College Dublin (UCD)
15 University College London (UCL)
16 National University of Ireland, Galway (NUIG)
17 University of Liverpool (ULIV)
18 Syddansk Universitet (USD)
19 UiT The Arctic University of Norway (UiT)
20 Scottish Association for Marine Science (SAMS)
21 Seascape Consultants (SC)
22 Instituto Español de Oceanografía (IEO)
23 University of North Carolina at Wilmington (UNCW)
24 AquaTT UETP Ltd (AquaTT)
25 Fisheries and Oceans Canada (DFO)

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2017

2018

atlas Advisory & Stakeholder Board

Jake Rice, DFO
Scientist Emeritus

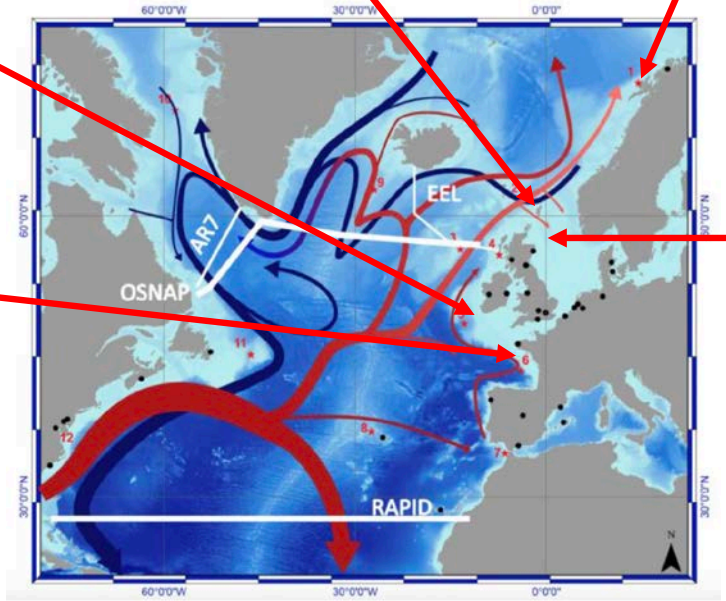
bp

Statoil

equinor

woodside

TOTAL



Canadian Natural

CHOne
CANADIAN HEALTHY OCEANS NETWORK

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

Science Policy Panel

NAFO
Northwest Atlantic Fisheries Organization

NEAFC

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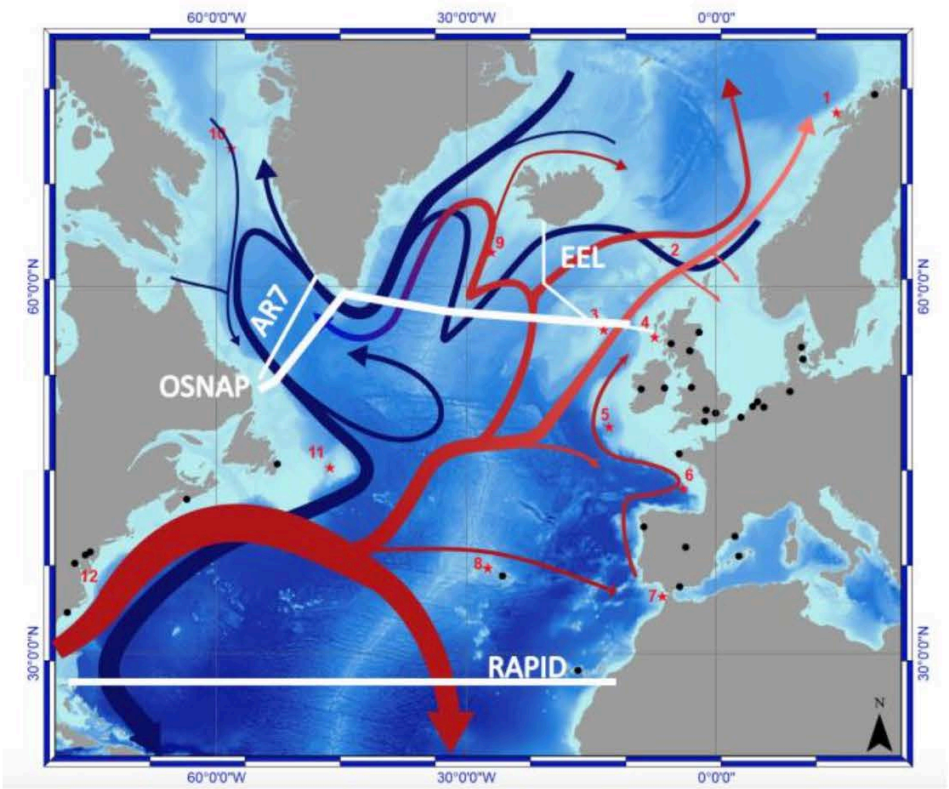
Case Study	Focus Ecosystems (CWC, cold-water coral)	Current and BG Sectors*	Lead & collaborators
1. LoVe Observatory (Norway)	CWC reefs, sponges	F, OG, T	Statoil, NIOZ, UEDIN
2. West of Shetland and W Scotland slope (UK)	Sponge grounds	B, F, OG	UEDIN, BP, OGUK, MSS
3. Rockall Bank (UK & Ireland)**	CWC reefs, coral gardens, carbonate mounds, sponge grounds, cold seeps	B, F, OG	MSS, IEO, OXU
4. Mingulay Reef Complex (UK)	CWC reefs	F, T	UEDIN, MSS
5. Porcupine Seabight (Ireland)	CWC reefs, coral gardens, carbonate mounds, sponge grounds	B, F, OG	NUIG, Woodside
6. Bay of Biscay (France)	CWC on slope and in canyon settings	B, F	IFREMER
7. Gulf of Cádiz/Strait of Gibraltar/Alborán Sea (Spain & Portugal)	CWC reefs, coral gardens, sponge grounds	B, F, OG	IEO, IFREMER, IMAR-UAz
8. Azores (Portugal)**	Hydrothermal vents, seamounts, coral gardens, sponge grounds	B, F, M	IMAR-UAz, IEO
9. Reykjanes Ridge (Iceland)**	Hydrothermal vents, CWC reefs, coral gardens, sponge grounds	B, F, M	UCD
10. S Davis Strait/Western Greenland/Labrador Sea (Canada)	CWC reefs, coral gardens, sponge grounds	B, F	DFO
11. Flemish Cap (Canada)**	Coral gardens, sponge grounds	B, F, OG	IEO, DFO, OXU, NAFO
12. SE USA (Bermuda transect)**	CWC reefs on slope and in canyon settings	B, F, M, OG	UNCW, AP-TU, NOAA

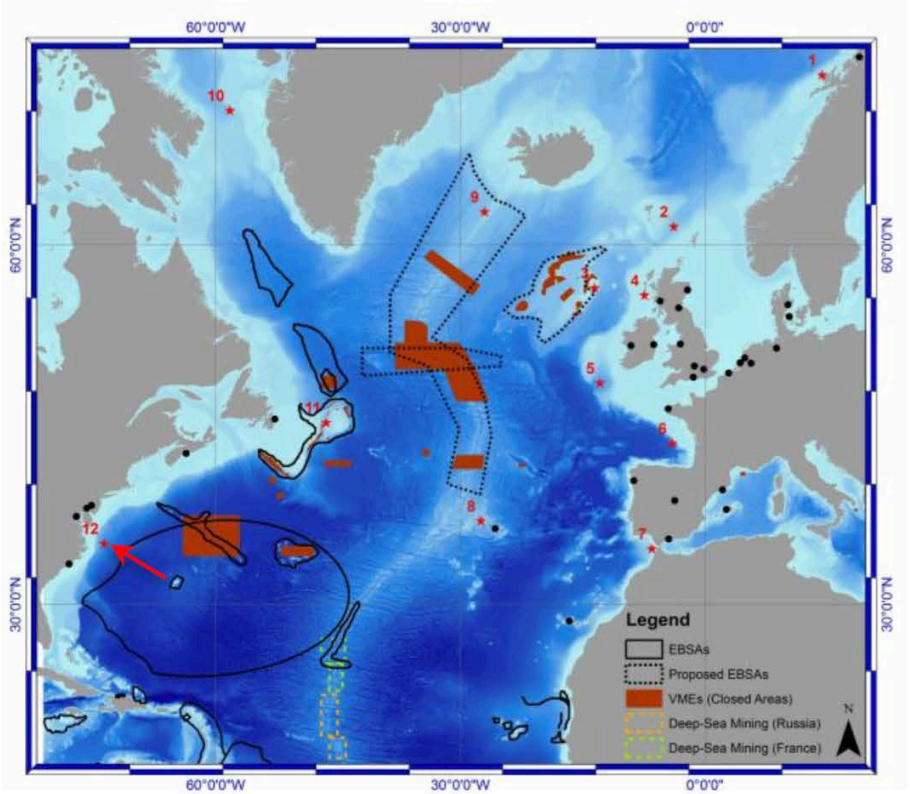
* Blue Growth sectors: **B**iotechnology; **F**isheries; **M**ining; **O**il & **G**as; **T**ourism; ** indicates data include ABNJ

Lea-Anne Henry

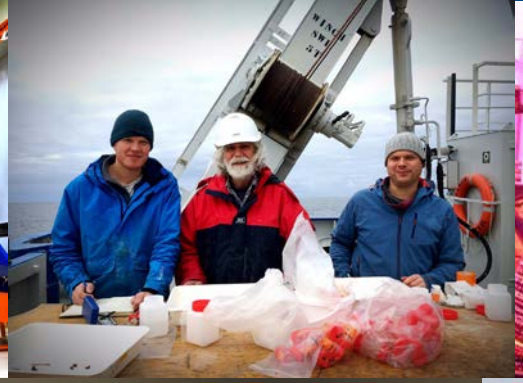
Case Study co-ordinator

Chancellor's Fellow, University of Edinburgh

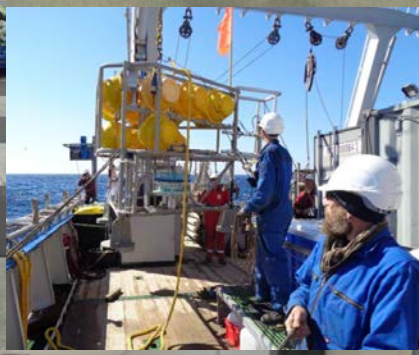




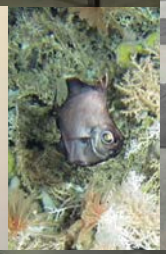
Multidisciplinary Approach



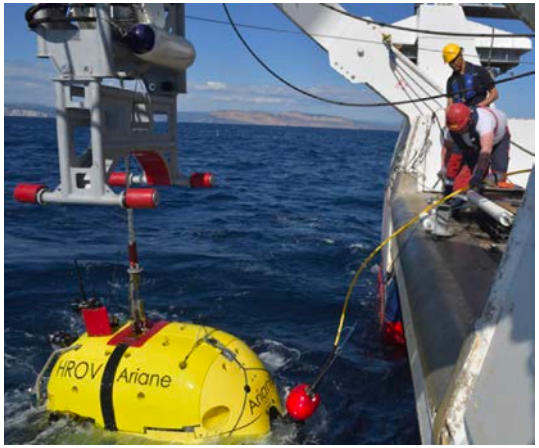

atlas
Deep-Sea Science for Sustainable Development
Monday 5 June
09.00-10.00
United Nations, New York

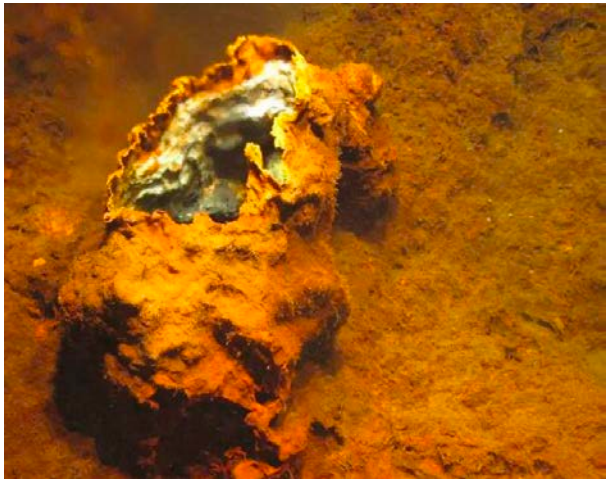


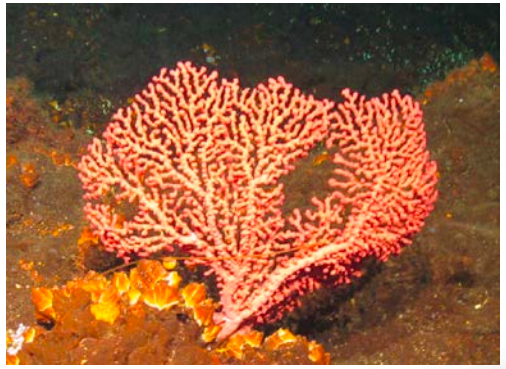

the EU-funded project on deep-sea sponge ground ecosystems of the North Atlantic
SponGES



ATLAS @sea





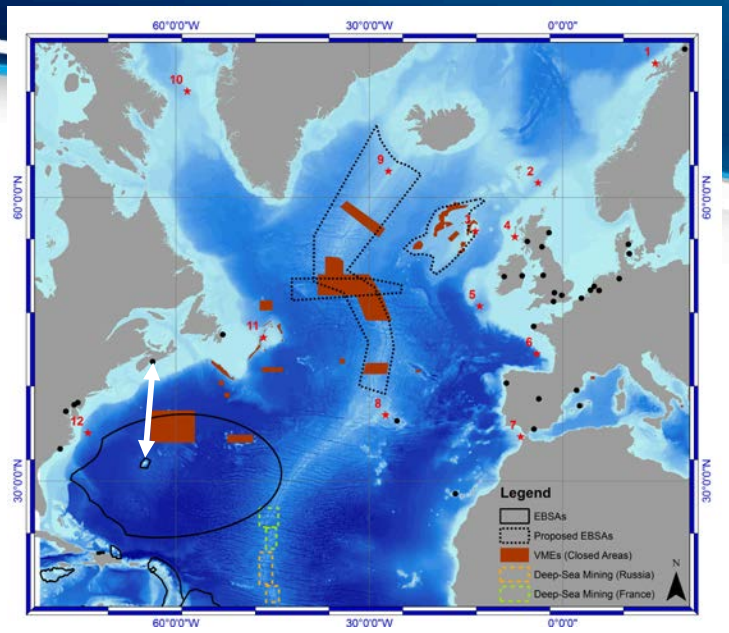


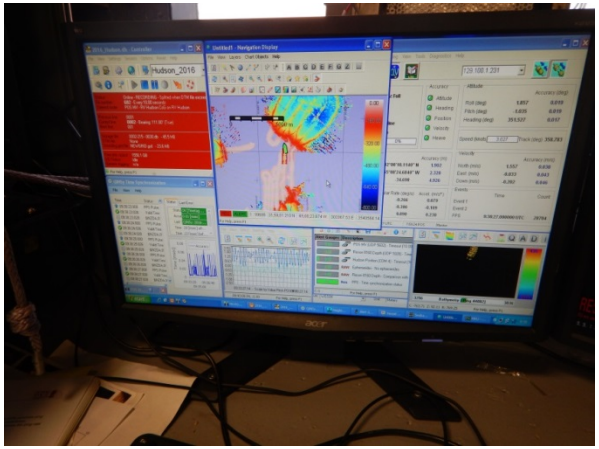
Bermuda to Atlantic Canada
28 July – 8 August 2016

Deep-sea habitat mapping; Oceanographic profiling; Seamounts; Biodiversity; Geology and fossil history

CCGS *Hudson* in St. Georges' Harbour

CTD casts on 3 seamounts (Argus, Challenger and Bowditch)





Oceanographic seamount profiling

Fisheries and Oceans Canada

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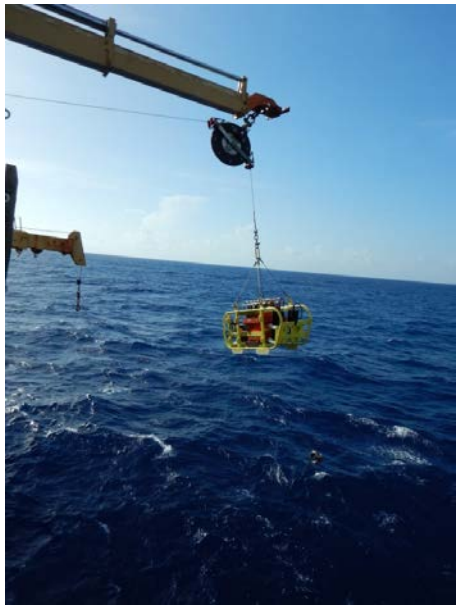
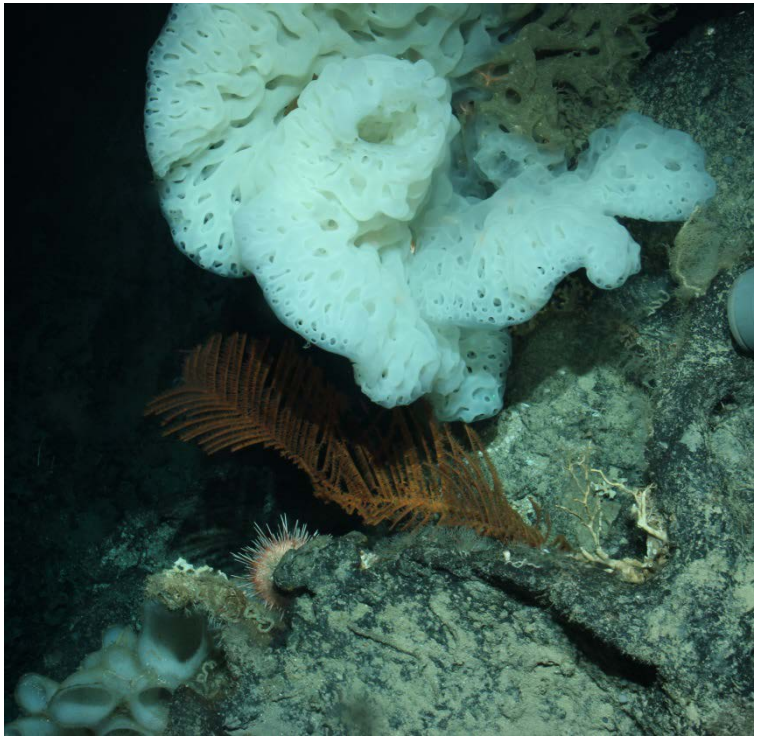


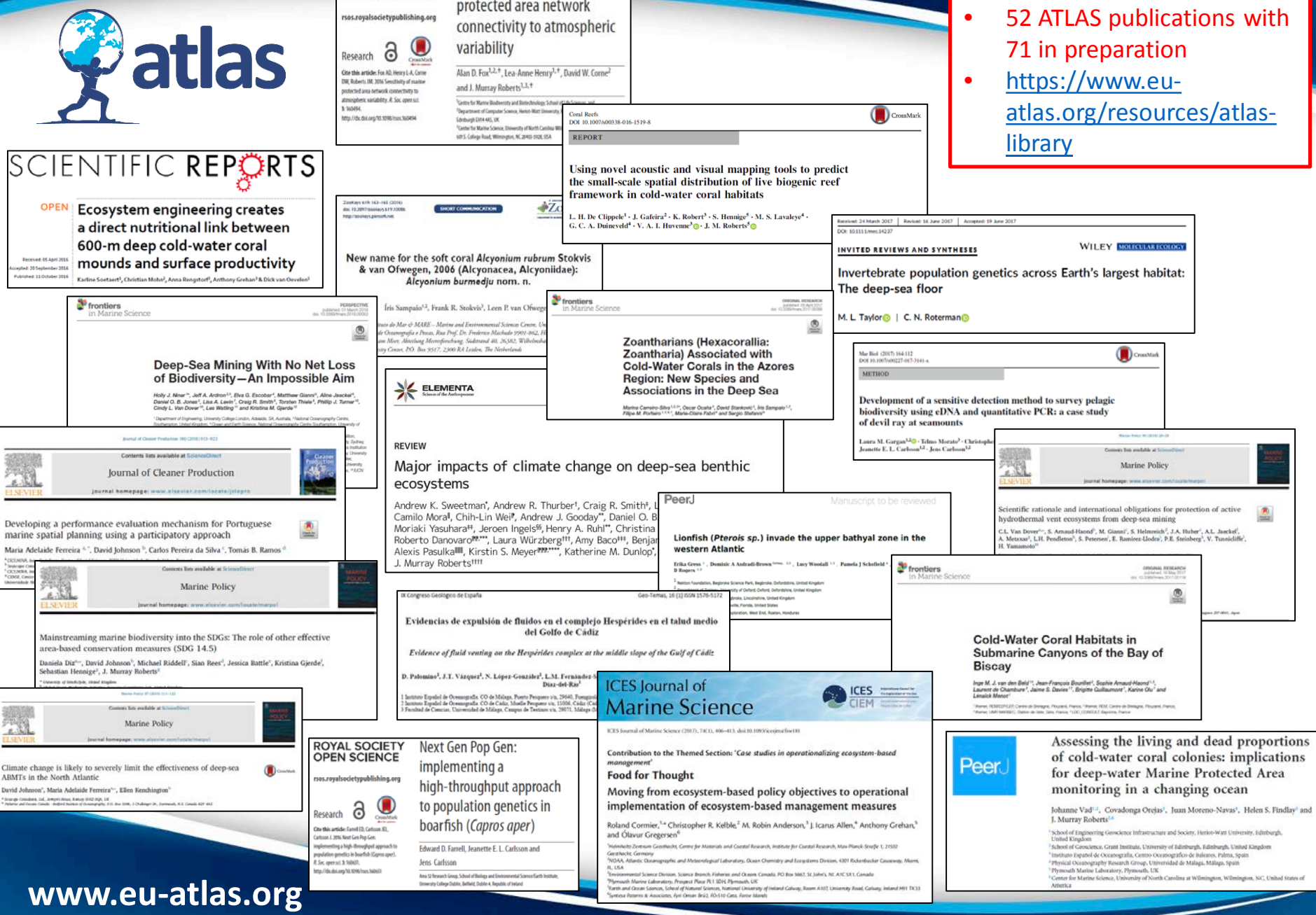
NRCan's 4K dropcamera

Van Veen grabs on seamounts



Seamount biodiversity captured by 4k camera

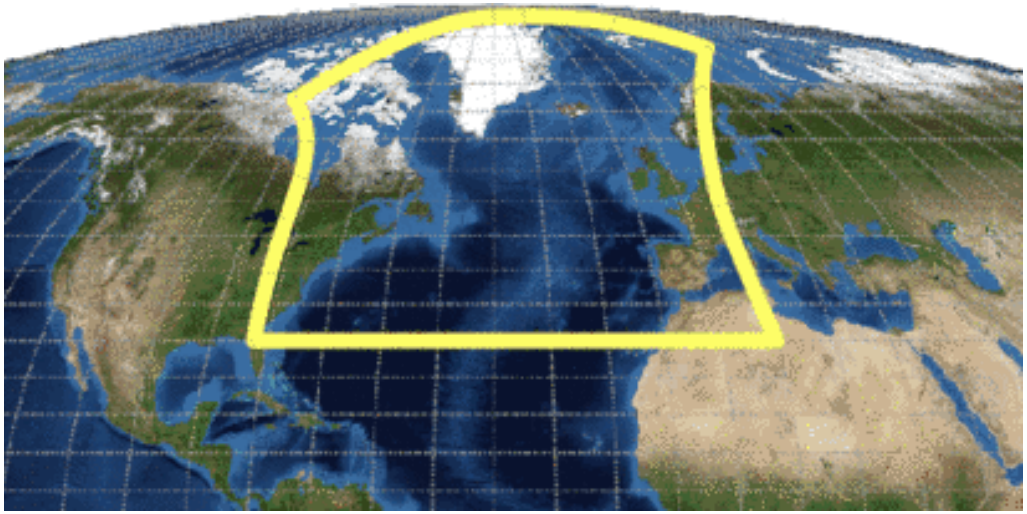
Fisheries and Oceans Canada



- 52 ATLAS publications with 71 in preparation
- https://www.eu-atlas.org/resources/atlas-library

www.eu-atlas.org

Expanding to basin-scale: How do behaviour traits impact deep-sea larval dispersal and population connectivity?



Viking 20 hydrographic model (GEOMAR): Nemo ocean, LIM2 sea ice. 1/20 degree nest within 1/4 degree global ocean. Years 1958-2009.

ARIANE particle tracking. Modified to include ontogenic vertical migration.

Stefan Gary (SAMS)

Arne Biastoch (GEOMAR)

Alan Fox (UEDIN)

Lea-Anne Henry (UEDIN)

Stuart Cunningham (SAMS)

Murray Roberts (UEDIN)

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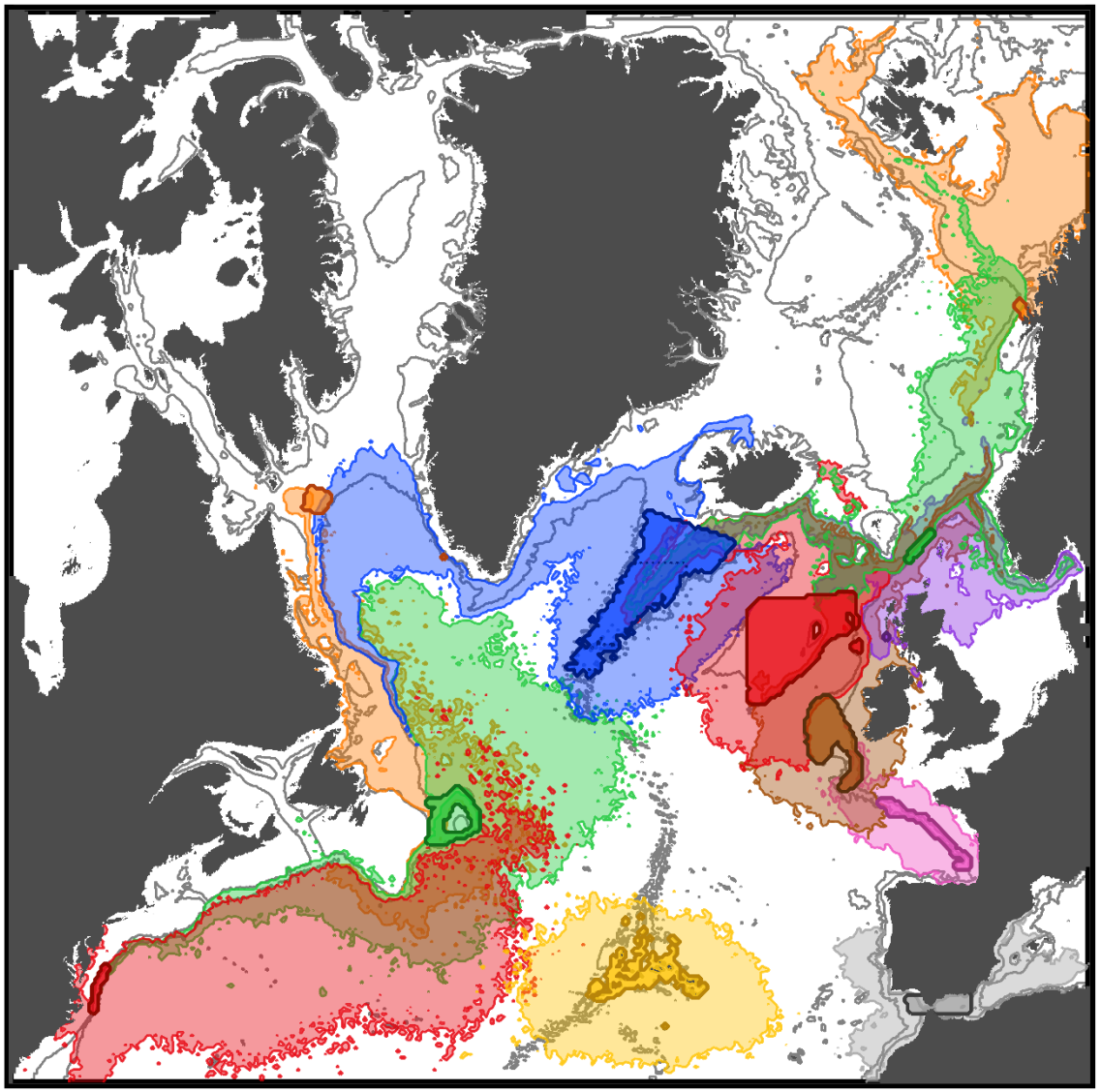
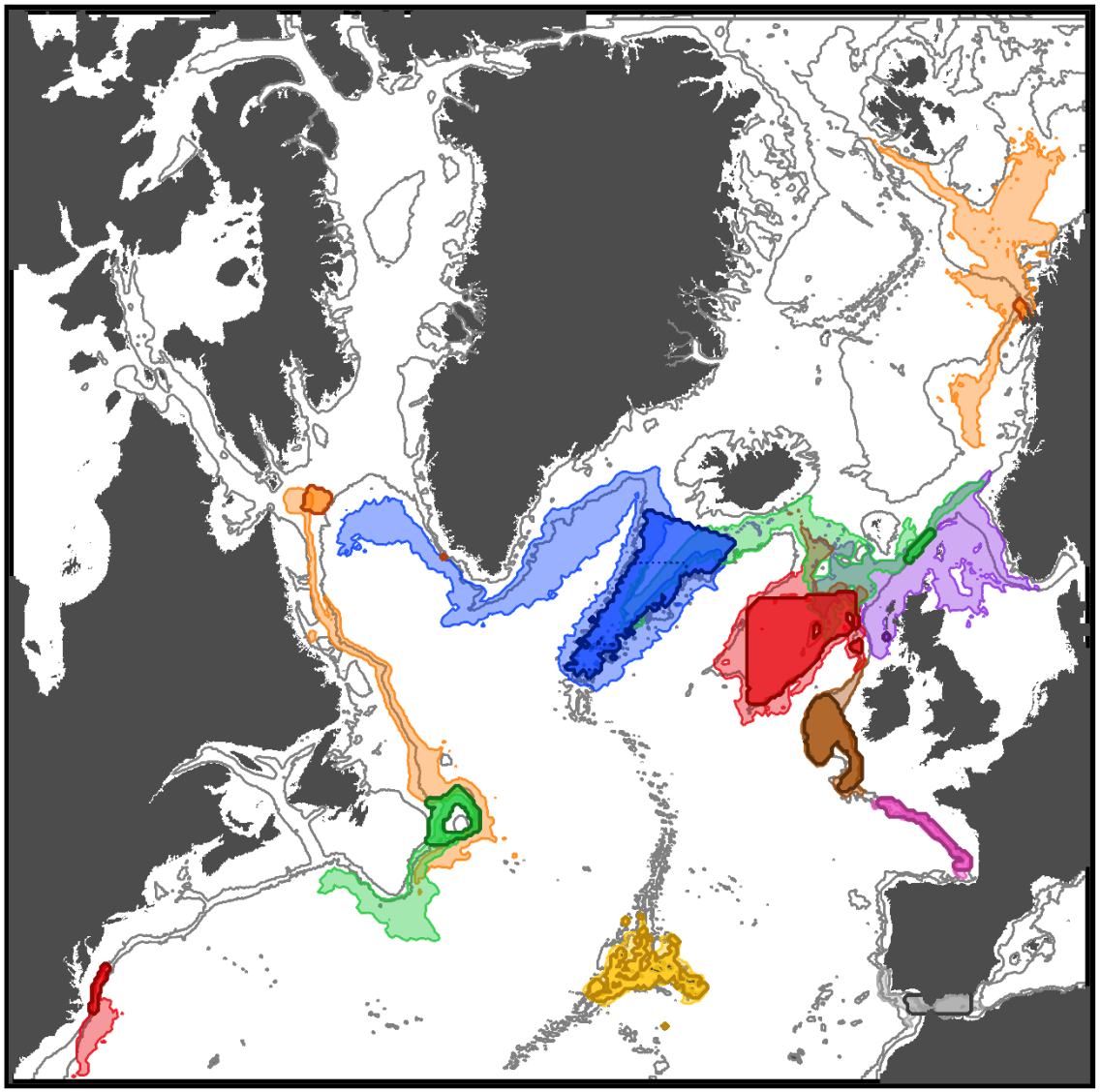
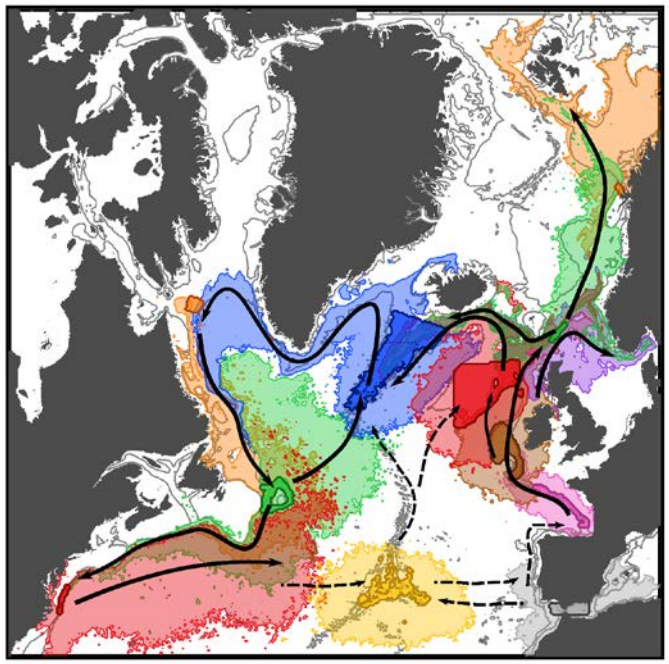
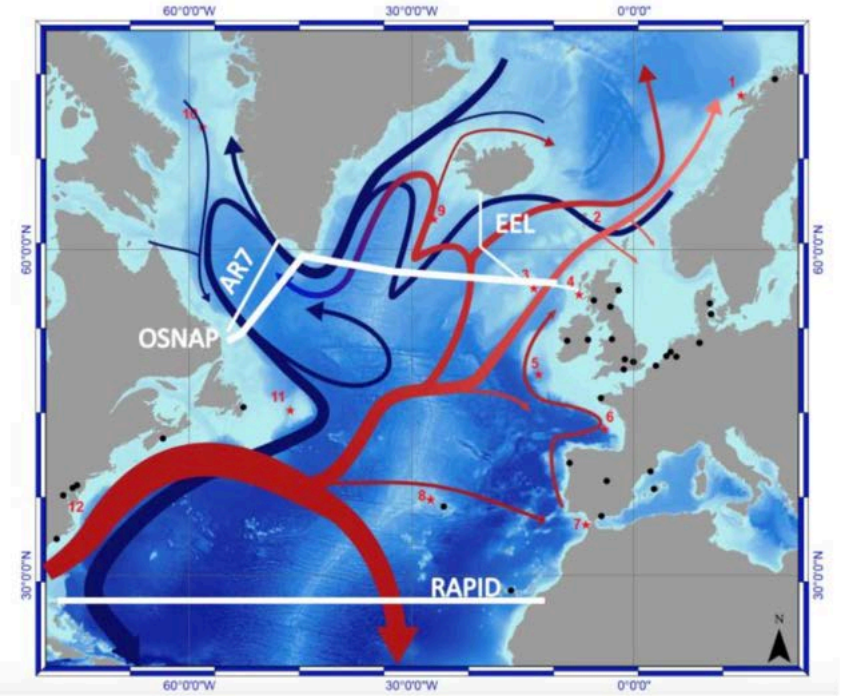
- Particle dispersal after 6 months for our most dispersive case.
- Particles rise to surface, drift there until six weeks old, then descend to bed where they drift until six months old (*Lophelia*-like behaviour).
- Dark shapes are the source regions (ATLAS case studies), pale shapes are the areas of dispersal.
- These are accumulated over 50 years, all seasons.





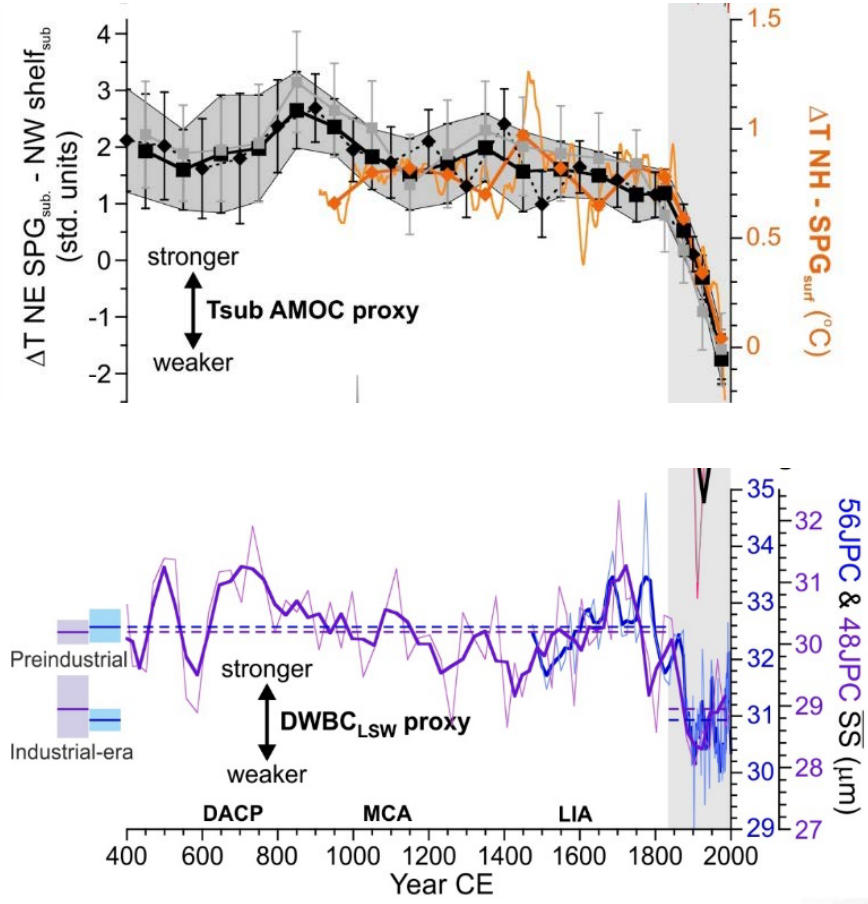



60°0'0"W
30°0'0"W
0°0'0"
60°0'0"N
30°0'0"N
N.D.0.09
N.D.0.30
OSNAP
AR7
EEL
RAPID
N

AMOC strength over last 1600 years

- Proxy-records show anomalously weak AMOC strength over past ~150 years.
- Imply modern circulation atypical of longer term.
- Important when interpreting distribution & functioning of Atlantic ecosystems.

Thornalley et al. (2018) Anomalously weak Labrador Sea convection and Atlantic overturning during the last 150 years. *Nature*.



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Science & Environment

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By Victoria Gill
Science correspondent, BBC News

11 April 2018

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The circulation system plays a "significant role" in regulating the Earth's climate by distributing the globe.

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Climate change

Gulf Stream current at its weakest in 1,600 years, studies show

Warm current that has historically caused dramatic changes in climate is experiencing an unprecedented slowdown and may be less stable than thought - with potentially severe consequences

Damian Carrington
Environment editor
@dpcarrington
Wed 11 Apr 2018 18.00 BST

20,035

from The Day After Tomorrow showing the Statue of Liberty covered
c current causes the temperatures to plummet overnight. In reality th
natic.
aph: 20th Century Fox/Kobal/REX/Shutterstock

arm Atlantic current linked to severe and abrupt
ist is now at its weakest in at least 1,600 years, ne
gs, based on multiple lines of scientific evidence,
ous predictions that a catastrophic collapse of the
ries to occur.

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World faces climate CHAOS because the circulation of the Atlantic Ocean is the weakest it has been in more than 1,500 years, warn scientists

- A key cog in the global ocean circulation system has not been running
- If the system continues to weaken, researchers say it may disrupt weather
- Experts believe the Atlantic began to warm near the end of the Little Ice Age

By PHOEBE WESTON FOR MAILONLINE

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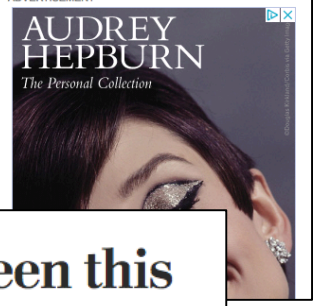

Infact.

Environment

Is the Gulf Stream about to collapse and is the new ice age coming sooner than scientists think?

Josh Gabbatiss Science Correspondent | @josh_gabbatiss | Thursday 12 April 2018 15:47 BST | Click to follow

1. What is the Atlantic Meridional Overturning Circulation?
2. So is The Day After Tomorrow about to become a reality, and are we going to plunge into another ice age?
3. So how likely is it that those ocean currents will collapse?
4. If the Amoc isn't shutting down completely, what is going on?

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INDEPENDENT

Energy and Environment

The oceans' circulation hasn't been this sluggish in 1,000 years. That's bad news.

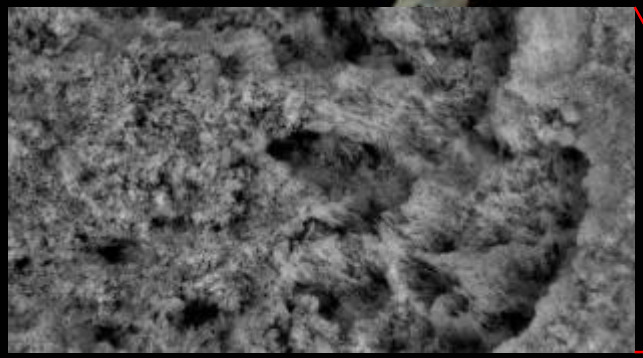
By Chris Mooney April 11 Email the author

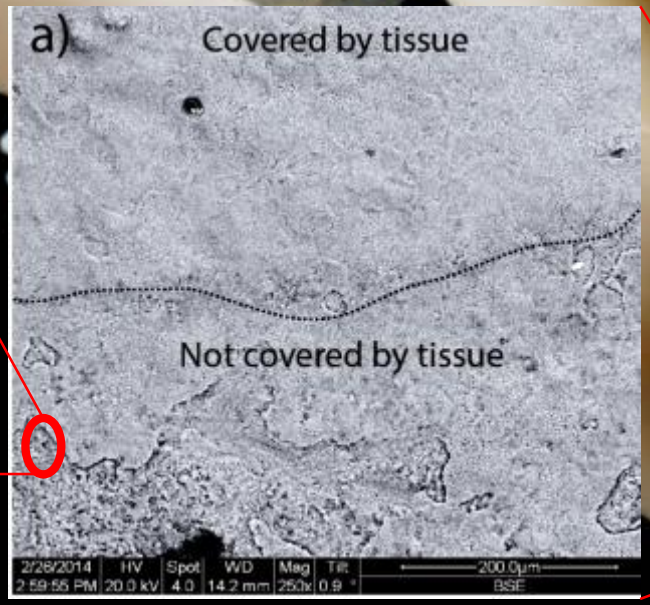
The Washington Post
Democracy Dies in Darkness

www.eu-atlas.org

Skeleton protected by tissue

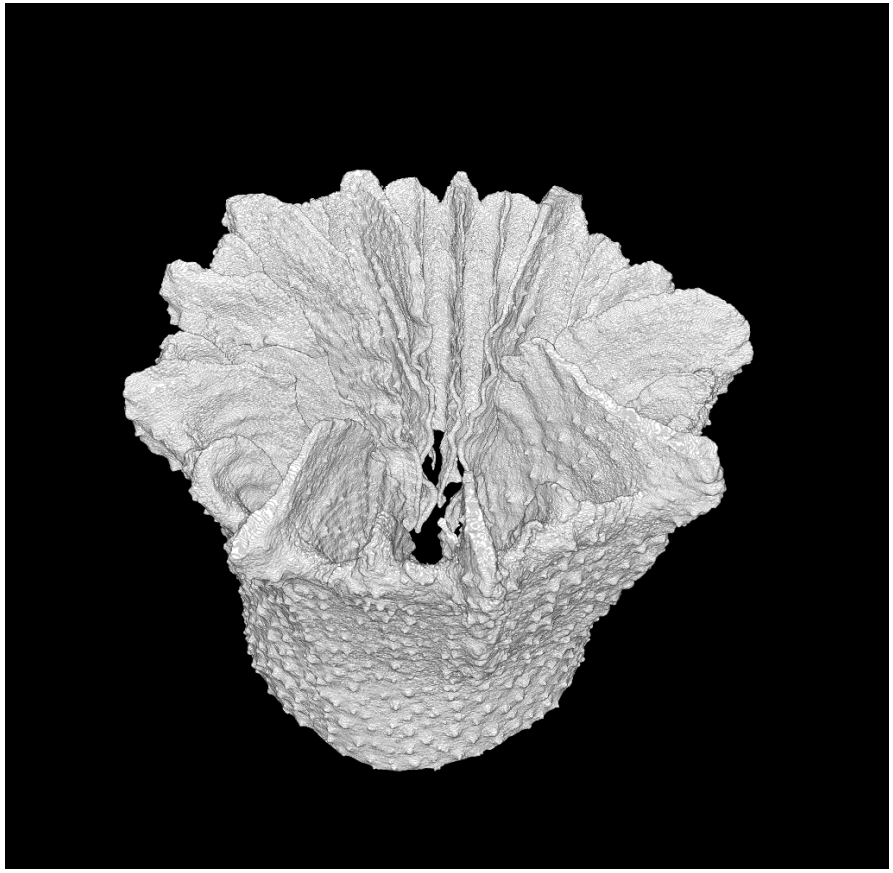
Skeleton exposed to ocean acidification





SEM images: S. Hennige
Coral image: Solvin Zankl, BIOACID

Synchrotron reconstructed images



Skeleton protected by tissue

Skeleton exposed to dissolution

Changing Oceans
Research Group

Changing Oceans
Research Group

Marine Policy 87 (2018) 111–122

Contents lists available at ScienceDirect

Marine Policy

journal homepage: www.elsevier.com/locate/marpol

Climate change is likely to severely limit the effectiveness of deep-sea ABMTs in the North Atlantic

David Johnson[a], Maria Adelaide Ferreira[a,*], Ellen Kenchington[b]

[a] Seascape Consultants, Ltd., Jermyn's House, Romsey SO52 0QA, UK
[b] Fisheries and Oceans Canada - Bedford Institute of Oceanography, P.O. Box 1006, 1 Challenger Dr., Dartmouth, N.S. Canada B2Y 4A2

Impacted

Low impact

No impact

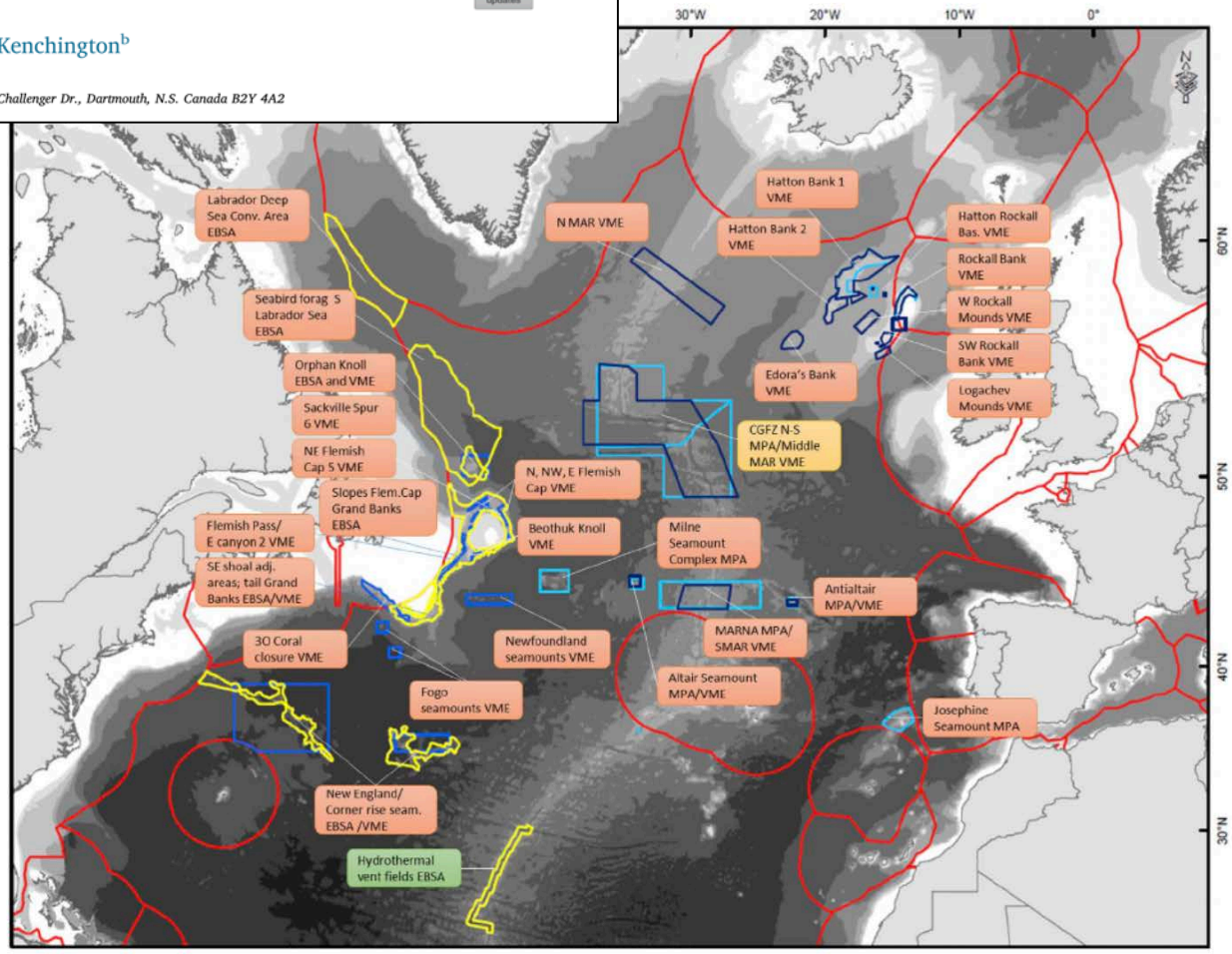


Fig. 2. Expected effect of changing environmental variables on main taxa listed in the conservation objectives for each North Atlantic ABMT in ABNJ. Green: no expected impact; Yellow: low expected impact; Orange: impacted. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

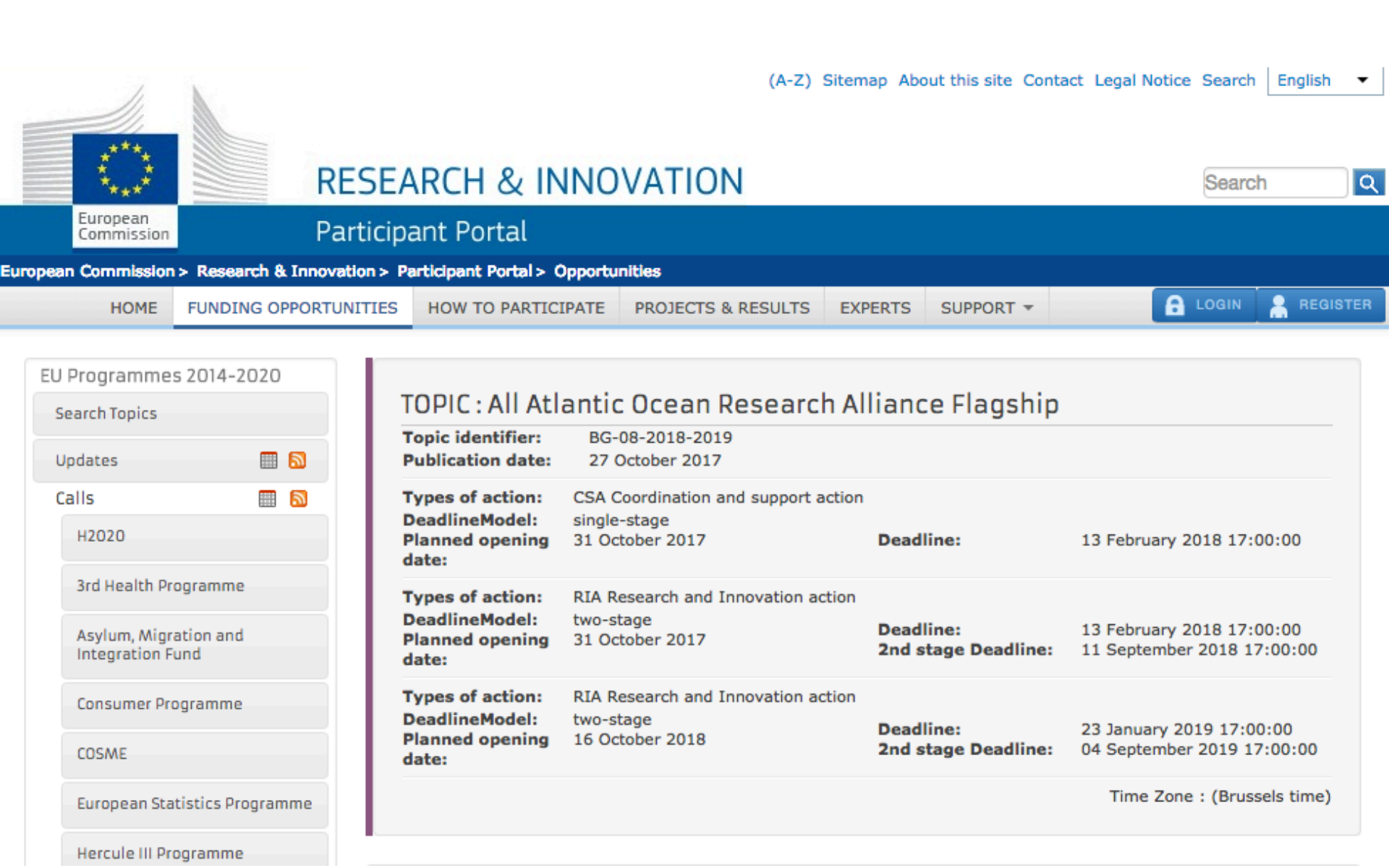
Expected Impacts

- Improve **resource management** (ecosystem approach) and governance
- Improve **cooperation** within EU and transatlantic
- Contribute to the **EU Integrated Maritime Policy**
- Strengthen international **agreements to conserve** Vulnerable Marine Ecosystems and Ecologically & Biologically Significant Areas
- Engage with UN process developing an international legally binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction

Belém Statement on
Atlantic Research and Innovation Cooperation

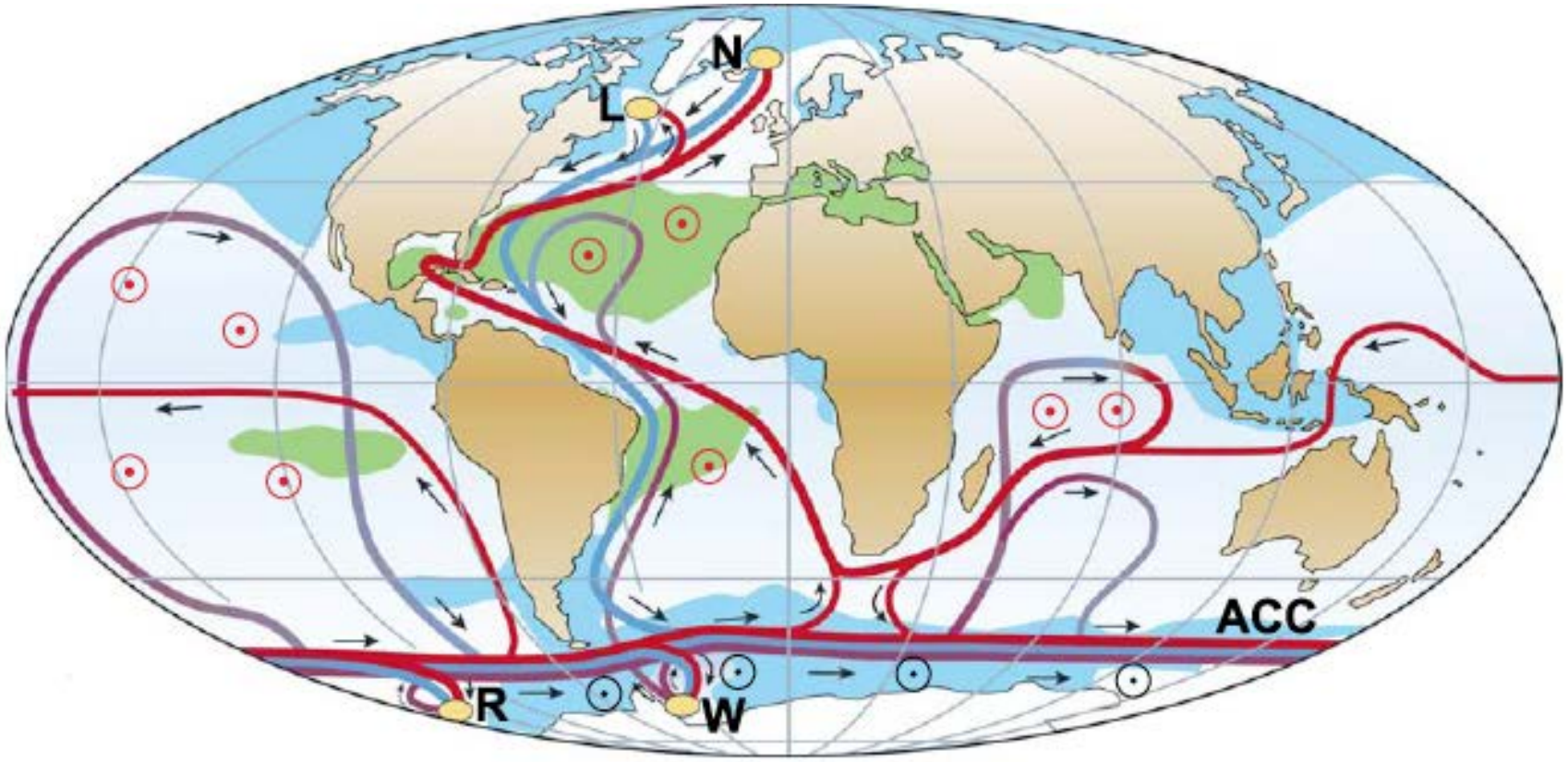
Conference in Lisbon on 13-14 July 2017

FOR THE EUROPEAN UNION	FOR THE DEPARTMENT OF SCIENCE AND TECHNOLOGY, A GOVERNMENT DEPARTMENT OF THE REPUBLIC OF SOUTH AFRICA	FOR THE MINISTRY OF SCIENCE, TECHNOLOGY, INNOVATIONS AND COMMUNICATIONS OF THE FEDERATIVE REPUBLIC OF BRAZIL
Carlos Moedas	**Naledi Pandor**	**Gilberto Kassab**
Commissioner for Research, Science and Innovation	Minister of Science and Technology	Minister of State for Science, Technology, Innovations and Communications



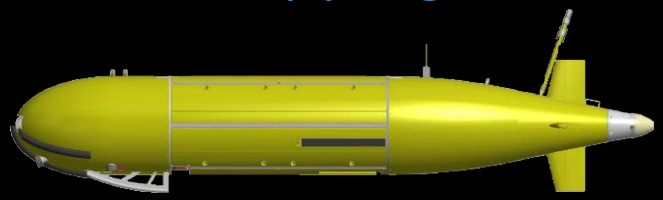
iAtlantic project selected for funding and currently in Grant Agreement Preparation

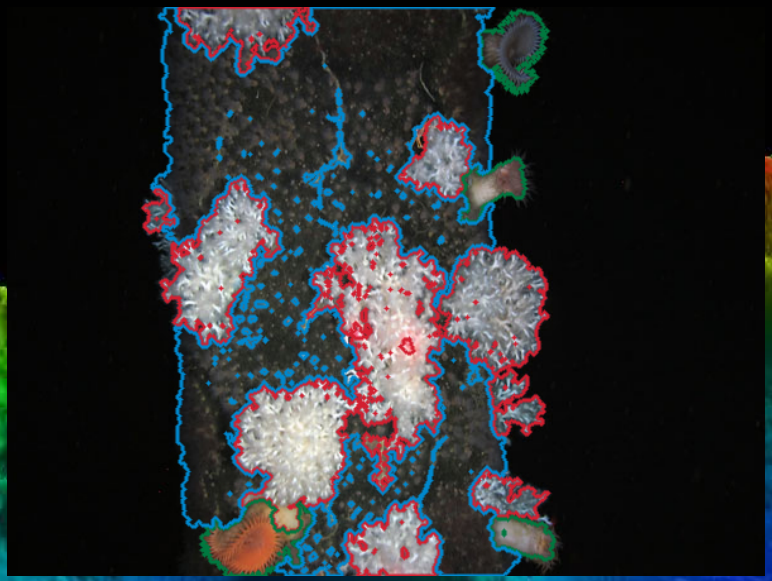
iAtlantic Objective 01
Ocean Observation

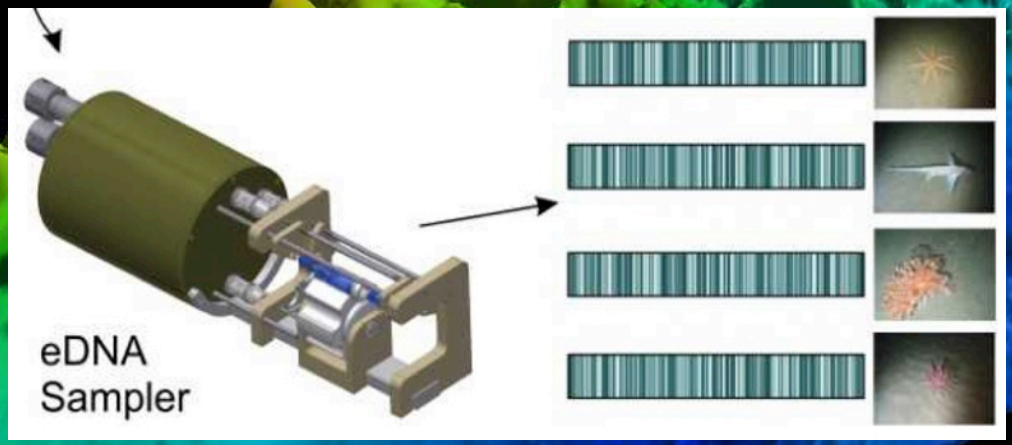


Standardise South and North Atlantic Ocean observations to enable short, medium and long-term assessments of Atlantic Ocean circulation and its physico-biogeochemical environment.

iAtlantic Objective 02
Ocean Mapping







Map deep and open-ocean ecosystems at basin, regional and local scales.

iAtlantic Objective 03
Deep & open ocean ecosystem assessment

Assess the stability, vulnerability, and any tipping points of deep and open-ocean Atlantic ecosystems to changes in ocean circulation, and effects of single and multiple stressors.

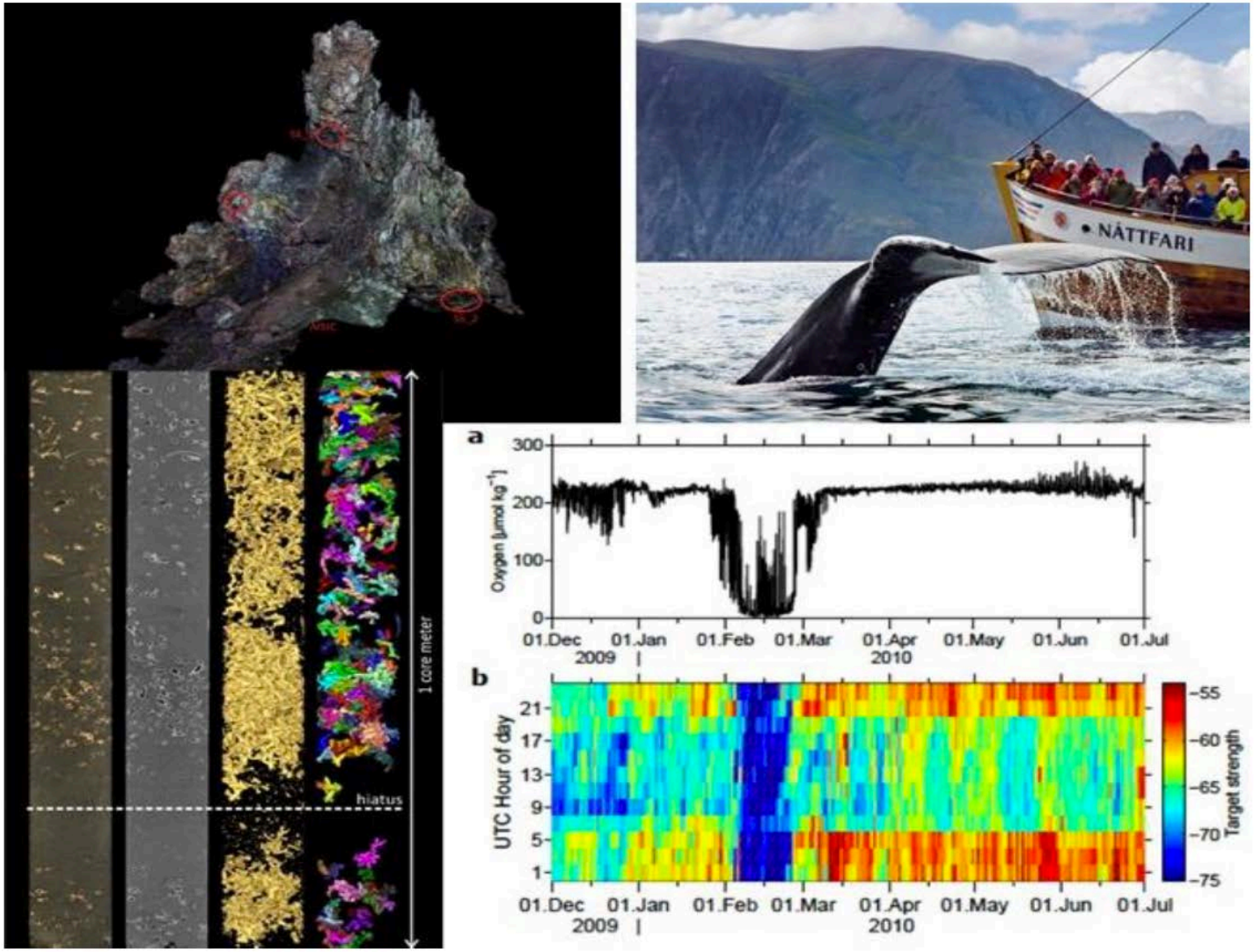
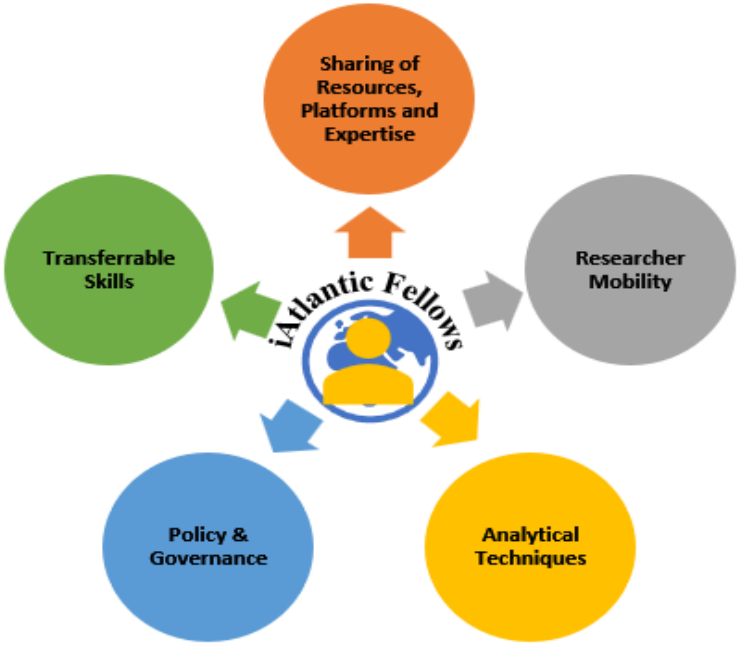


Figure 6: Examples of novel methods to create ecosystem timeseries. Clockwise from top left: 3D reconstruction of benthic communities at the Lucky Strike hydrothermal vent using photomosaics; whale fluke identifications from Iceland and Bermuda to reconstruct temporal changes in population size; inter-annual changes in oxygen (a) and effects on zooplankton (b) derived from ADCP from the CVOO off Cape Verde (Karstensen et al., 2015); sediment core from Mauritania with periods of coral growth and hiatuses from Wienberg & Titschack (2017).

iAtlantic Objective 04
Capacity Building

Agreement in principle for industry sponsorship to enhance iAtlantic fellowship scheme

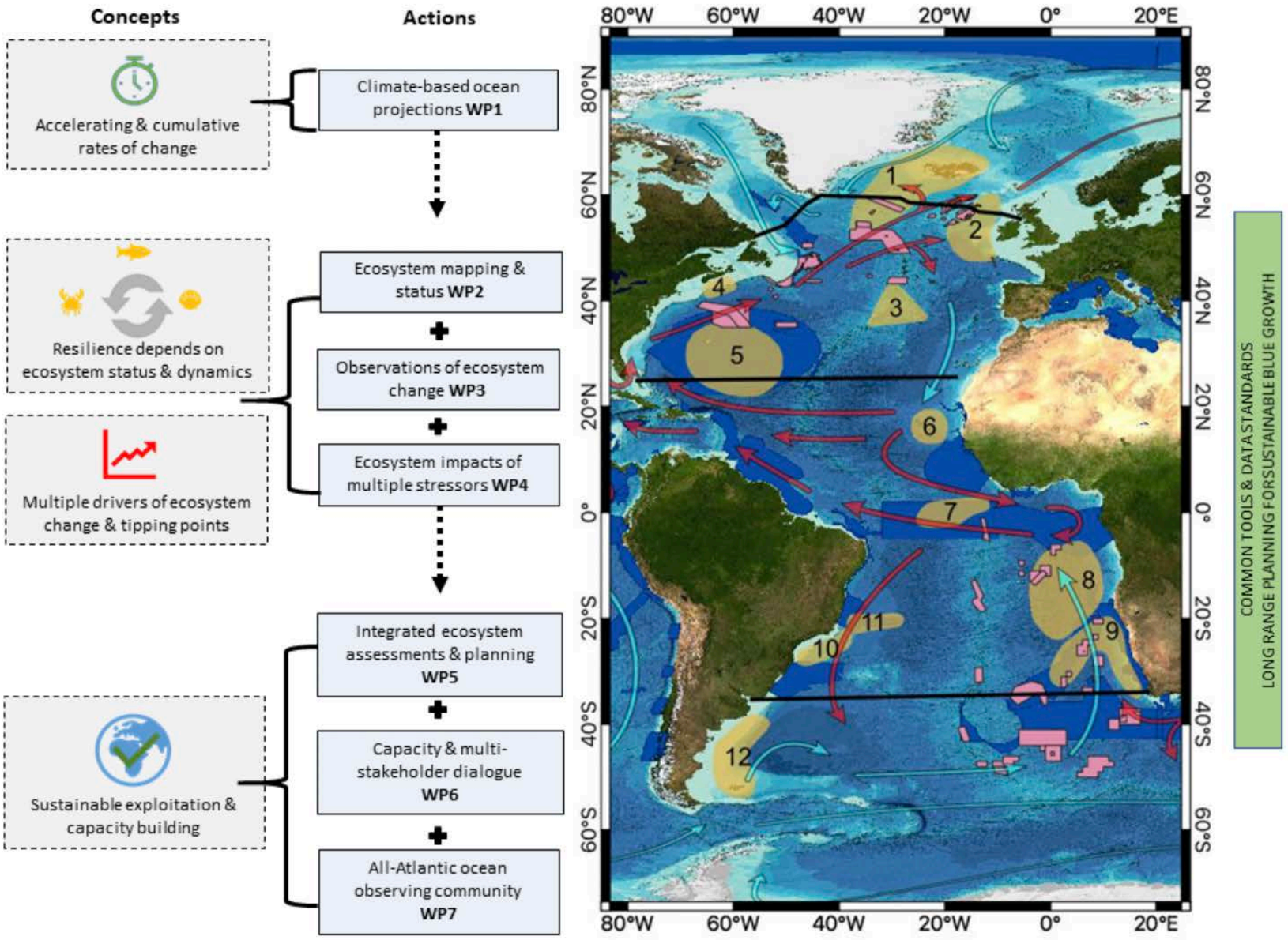


Align and enhance human, technological and data inter-operability capacities for cost-effective cooperation and planning across the Atlantic.

iAtlantic Objective 05
Sustainable Management

Define requirements for sustainable management with industry, regulatory and governmental stakeholders to reflect societal needs and inform policy developments that ensure and encourage a sustainable Blue Economy.

iAtlantic


Concepts
Actions
Accelerating & cumulative rates of change
Climate-based ocean projections WP1
Resilience depends on ecosystem status & dynamics
Ecosystem mapping & status WP2
Observations of ecosystem change WP3
Multiple drivers of ecosystem change & tipping points
Ecosystem impacts of multiple stressors WP4
Integrated ecosystem assessments & planning WP5
Sustainable exploitation & capacity building
Capacity & multi-stakeholder dialogue WP6
All-Atlantic ocean observing community WP7
80°W
60°W
40°W
20°W
0°
20°E
80°N
60°N
40°N
20°N
0°
20°S
40°S
60°S
1
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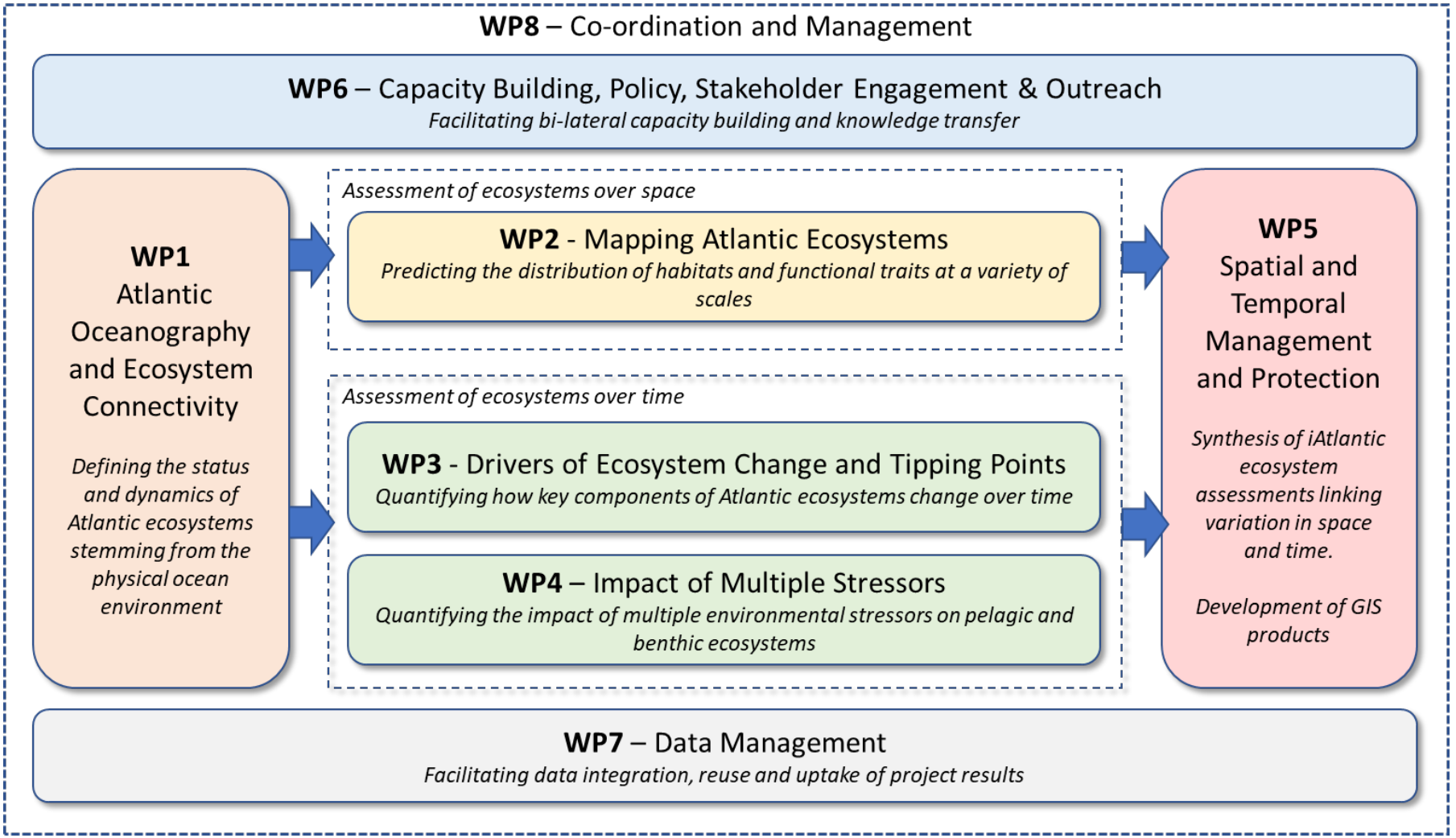
COMMON TOOLS & DATA STANDARDS
LONG RANGE PLANNING FOR SUSTAINABLE BLUE GROWTH

iAtlantic

Integrated assessment of Atlantic marine ecosystems in space and time



iAtlantic Team

Integrated assessment of Atlantic marine ecosystems in space and time

University of East Anglia

Phil Williamson (Chair)

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Lisa Levin

IUCN

Kristina Gjerde

IOGP International Association of Oil & Gas Producers

Wendy Brown

NATURAL HISTORY MUSEUM

Gordon Paterson
(Chair Science Council)

GLOBAL OCEAN TRUST

Thorsten Thiele

iAtlantic Advisors

Integrated assessment of Atlantic marine ecosystems in space and time

iAtlantic

- 34 partners
- €10.6M budget
- 11 international associate partners
- €27M programme of 32 cruises

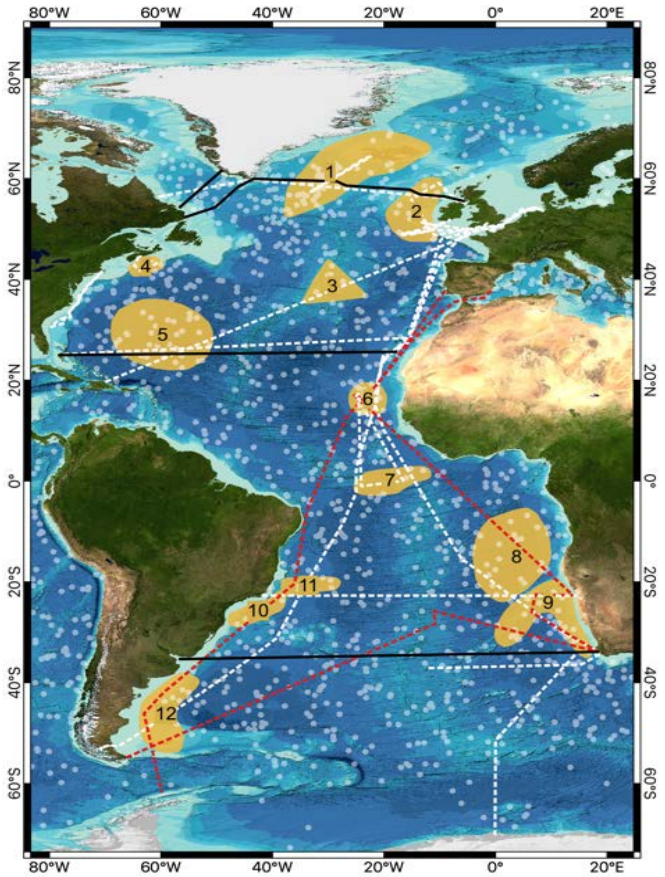


Figure 2: Chart illustrating the density of ARGO floats (grey circles) and positions of transatlantic monitoring arrays (black lines) providing oceanographic data to iAtlantic. Dashed white lines illustrate tracks of iAtlantic cruises with the two ***S Atlantic Demonstrator Capacity Building cruises*** iMirabilis ***and*** iCorsage *shown in red. Led by the Spanish Institute of Oceanography (IEO) and named for iconic plants of W Africa and S America, these cruises are dedicated to the iAtlantic consortium.* iMirabilis *targets Regions 6–9 and will bring the UK Autosub6000 AUV equipped with the MAPS eDNA sampler and the Portuguese Luso ROV to the S Atlantic for the first time. The* iCorsage *cruise primarily targets Region 11 where it will conduct extensive mapping of the Vitória-Trindade Seamounts and provide training in the latest shipboard mapping approaches. iAtlantic will run a third Demonstrator Capacity Building cruise on a UK vessel in Region 2. Equipped with Autosub6000 and science-class ROV, this cruise will be open to iAtlantic fellows with dedicated berths for S Atlantic researchers.*

Take home messages

- Deep & open ocean remains largely unexplored but human activities are expanding rapidly
- Ocean monitoring & ecosystem assessment technologies improving at exponential rate
- Need to work closely with Blue Economy stakeholders from data gathering to sustainable management
- Vital to **invest in the human element** throughout the science-to-policy process

Many thanks!

Project Contact Details:

Coordination: J Murray Roberts
murray.roberts@ed.ac.uk
Project Management: Julia Eighteen
EU-Atlas@ed.ac.uk
Communication & Press: Annette Wilson
annette@aquatt.ie

Follow us: @atlas_eu
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www.eu-atlas.org

Template developed by AquaTT

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Image credit: BGS

ONE OCEAN HUB

- Research team from UK, S Africa, Ghana, Namibia, Kenya, S Pacific, Caribbean
- Led by University of Strathclyde (Scotland)

- UK Global Challenge Research Fund
- £20M budget
- 2019-2024
- 8 UN partners
- 4 regional bodies
- 7 Government Depts
- 4 NGOs
- 3 Think Tanks
- 5 Private sector