Ocean Surveying – Where to Start across the Deep Blue Ocean?

(Mapping the North Atlantic)

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Istanbul, Turkey
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#GordonJHydro

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  - Some selected technical items

Acknowledgements: Jennifer Jencks (NOAA), Anne-Cathrin Wölfl (Geomar), Colin Devey (Geomar), Larry Meyer (Univ of New Hampshire), Margaret Rae (Marine Institute Ireland)

Galway Statement on Atlantic Ocean Cooperation – Overarching Objectives for Research

- Improve ocean health and stewardship
- Promote sustainable management of resources
- Improve ecosystem assessments and forecasts and deeper understanding of vulnerabilities and risks, including climate change
- Generate new tools to increase resilience, conserve rich biodiversity, manage risk and determine social, environmental, and economic priorities

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Galway Statement Implementation
Working Groups - Priority Areas of Cooperation

Formal tri-lateral working groups have been established to advance scientific planning under agreed upon areas of priority research

- Aquaculture
- Ocean Literacy
- Atlantic Seabed Mapping and Characterization
- Ecosystem Approach to Ocean Health and Stressors

Establishment of formal working groups in remaining areas of research cooperation is evolving

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The North Atlantic Seabed Mapping International Work Group

Recommends that all bathymetric data that currently exists is identified and made accessible to the public through the establishment of a North Atlantic Data Portal.

Recommends that an appropriate planning mechanism to gather information from all collaborative seabed mapping network initiatives is developed and resourced, to underpin future plans and activities.

Recommends that a Research Vessel Co-ordinator (RVC) is appointed and resourced, to liaise with the multitude of research institutions and organisations that operate scientific and survey vessels equipped with multibeam echosounder systems.

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Recommends that a an Atlantic Seabed Mapping Pilot Project is scoped, incorporating targeted sites, minimum data requirements, standards and formats, technology & innovation considerations (with industry collaboration), desired products and outputs, and citizen value proposition.

Recommends that high-resolution elevation data made possible by multibeam echosounder systems (MBES) should be collected as the foundation dataset for all others.

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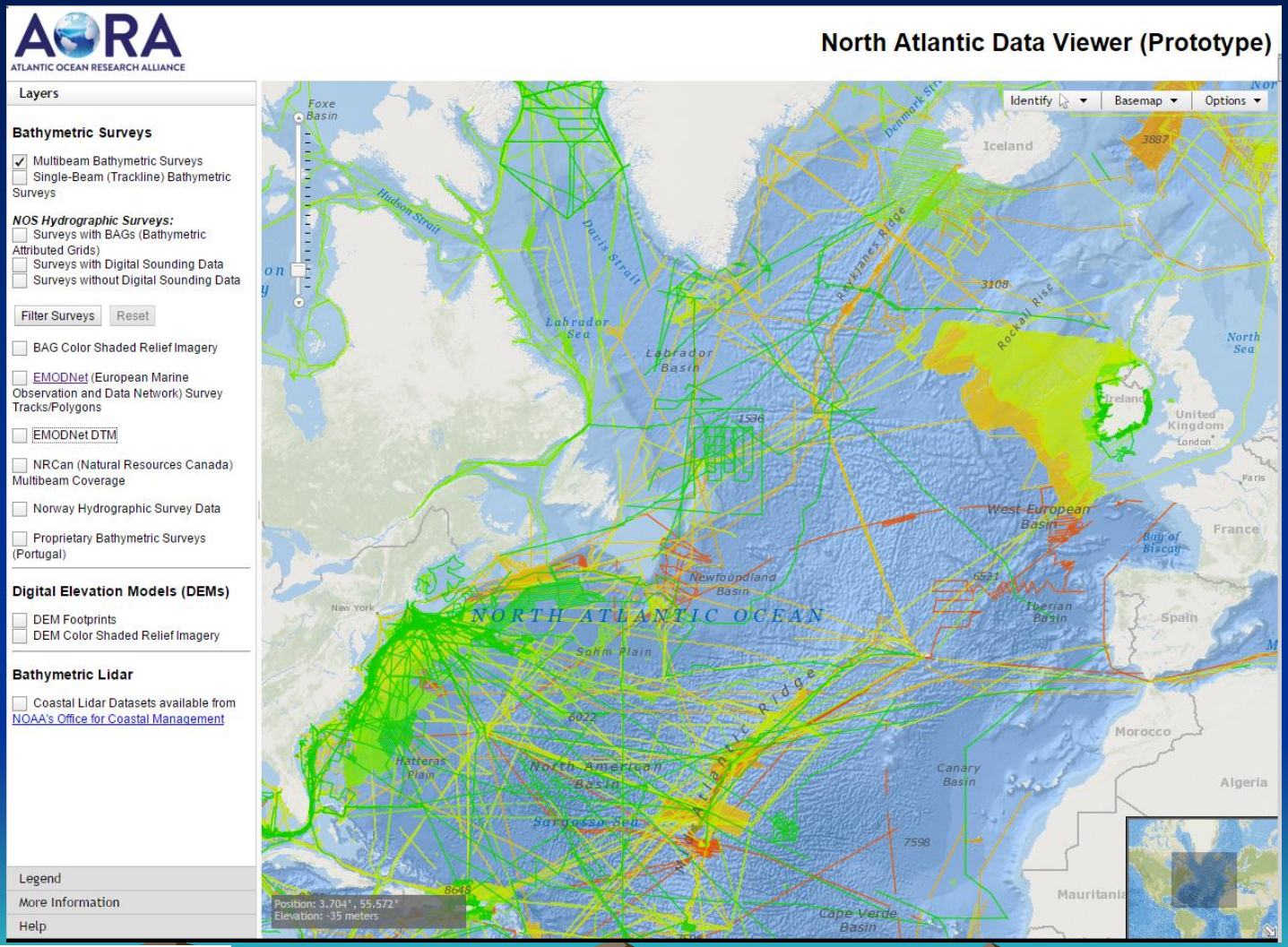
Where is the Bathymetry Data?

- What data exists?
  - EMODNet
  - NOAA
  - GEBCO, IHO etc.
  - “Hidden” (data not online)
- Is it publically accessible?
- Is it presented as maps?

Recommends that all bathymetric data that currently exists is identified and made accessible to the public through the establishment of a North Atlantic Data Portal.



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Recommends that an appropriate planning mechanism to gather information from all collaborative seabed mapping network initiatives is developed and resourced, to underpin future plans and activities.

- Contact the research ships´ operators and Project Leaders pre-cruise to get them to log multibeam underway – **trusted leader needed**
- Keep it simple: no watch standers, only High Seas (or EEZ with permanent permission to work) (e.g. for certain German ships that is Baltic, Cape Verde etc.), minimum data processing
- Start slow: initially just collect data, once that works routinely, move to transit route suggestions & guest operator/scientists
- Get buy-in: For ships´ operators this is visible value-added, for project leaders and crew stress-free, for scientists free data.

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Transits of Opportunity

Transits of Opportunity

	Research Vessel	Dates	Transit	Who on-board for CA/EU/US:	Year
1	Irish Research Vessel *Celtic Explorer*	1-13 July 2015	St. John's Newfoundland Canada to Galway	**CA:** Kirk Regular (MI MUN); **EU:** Marcos Miguel Páscoa Parreira Rosa IPMA	2015
2	Candian Coast Guard *Louis St. Laurent*	23 July - 2 Aug 2015	Halifax, Nova Scotia Canada to Tromsø, Norway	**EU:** David O'Sullian INFOMAR	2015
3	Ifremer Research Vessel *L'Atlante*	29 Jan - 13 Feb 2016	Undertaking a seabed mapping transect (South to North) close to the middle Atlantic Ridge, Zone: 26°N to the limits of Portuguese EEZ South Azores). mobilising at Pointe à Pitre (Guadaloupe) and demobbing at Ponta Delgada (Azores).	**CA:** Troy Manary (Maritime Way Ltd); **EU:** Ifremer team member	2016
4	Irish Research Vessel *Celtic Explorer*	11 May - 21 May 2016	St. John's Newfoundland Canada to Galway	**CA**- Peter MacIntosh (Memorial University NL), **EU** Jamie Maxwell (National University of Ireland Galway), **US** - Rachel Wireman (College of Charleston),	2016
5	Canadian Coast Guard *Louis St. Laurent*	22 July 2016 - 5 Aug 2016	Halifax, Nova Scotia to Tromoso, Norway (parallel line to last year's transect)	**CA:** Darren Hiltz (DFO Canada), **US:** Elizabeth Weidner (Univeristy of New Hampshire)	2016
6	Irish Research Vessel *Celtic Explorer*	19-26 April 2017	St. John's Newfoundland Canada to Galway	**CA:** Riccardo Arruda (Dalhousie University); **US:** Anthony Klemm (NOAA); **EU:** Margot Cronin (Marine iNstitute Ireland)	2017

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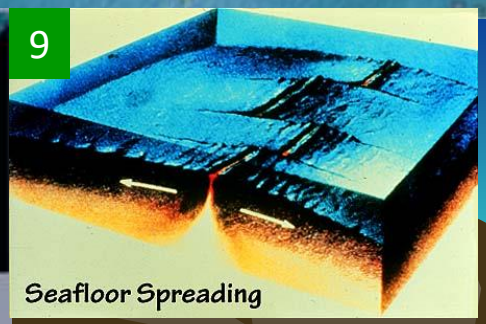
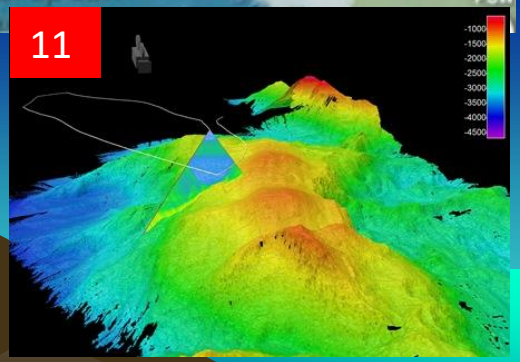
The Atlantic Transect





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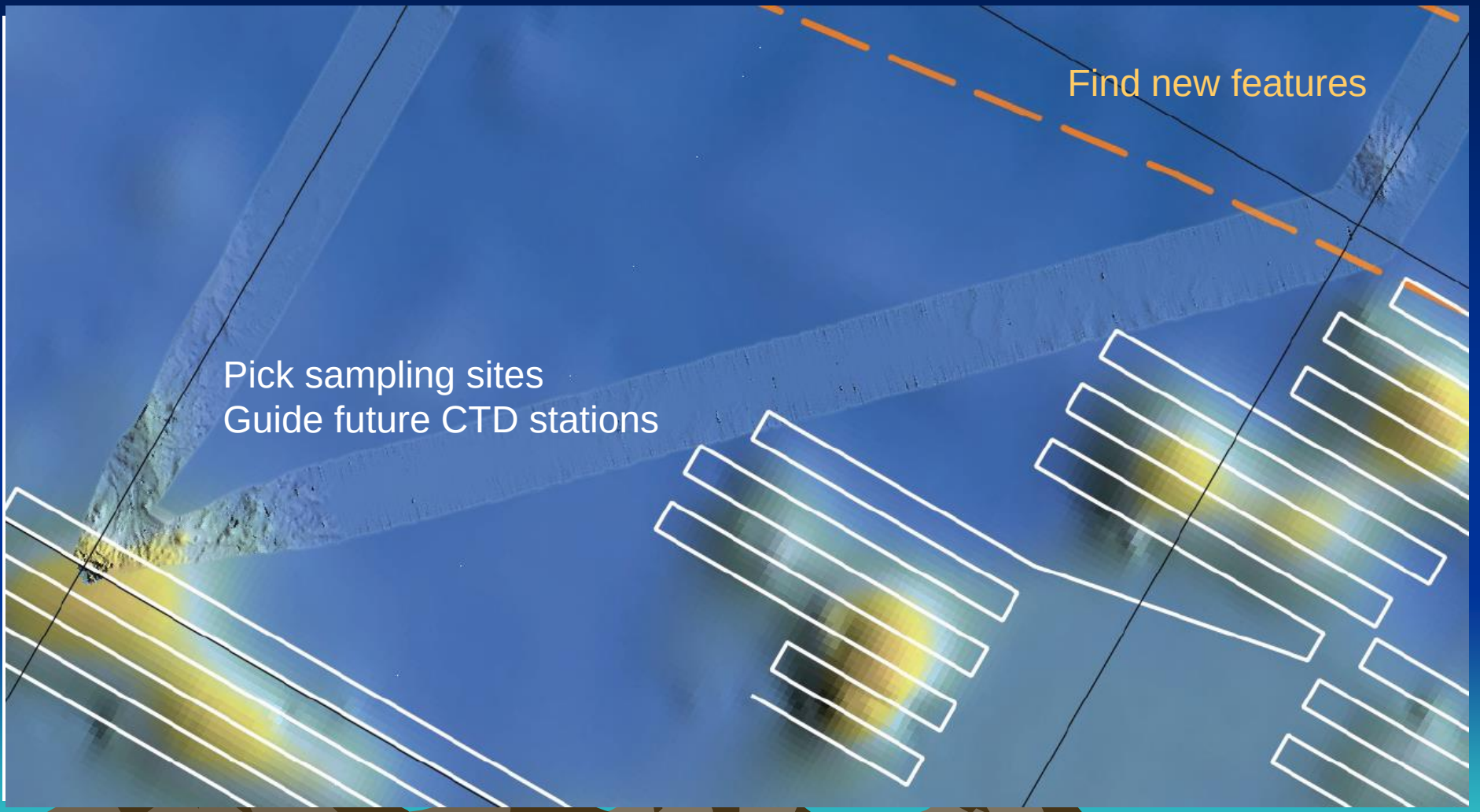
The Consequence



So where do we survey?

Priority Areas identified based upon:

- In relatively sparsely surveyed areas
- In international waters
- Approximately in mid ocean or not too biased east or west
- Ideally, in an area of interest from a recognized user group:
  - Science (exploration of habitat, species and eco-systems) for the lack of data
  - Oceans and weather for the lack of an accurate seabed shape to input for modelling
  - Air transportation as it lies underneath the main north Atlantic flight routes zone.
  - Industry (potential mineral mining)
- Within a nominal 400km x 400km survey area as it was assumed that it would take approximately 100 days to survey the area (~30 days for each Galway signee).

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Parameters included in the suitability analysis

Abbreviation	Name	Description
EBSA	Ecologically or Biologically Significant Marine Areas	EBSAs Regions included: North-west Atlantic, Wider Caribbean and Western Mid-Atlantic
VME	Vulnerable Marine Ecosystems	VME closed areas + VME Bottom fishing areas + VME other access regulated areas have been combined into one single layer. Areas from NAFO (Northwest Atlantic Fisheries Organization) and NEAFC (North East Atlantic Fisheries Commission) included
MPA	Marine Protected Areas Network	MPAs located in possible survey area (from N to S): Charlie-Gibbs North High Seas MPA, Charlie-Gibbs South MPA, Milne Seamount Complex MPA
Flight Lines	Flight Lines	"...sourced their outline from the UK's NATS (National Air Traffic Service)"; 100 km Buffer around flight lines
FM Crusts	Important areas for ferromanganese crust formation	From Petersen et al. 2016, News from the seabed - Geological characteristics and resource potential of deepsea mineral resources, Marine Policy, DOI: 10.1016/j.marpol.2016.03.012
M Nodules	Important areas for manganese nodule formation	From Petersen et al. 2016, News from the seabed - Geological characteristics and resource potential of deepsea mineral resources, Marine Policy, DOI: 10.1016/j.marpol.2016.03.013

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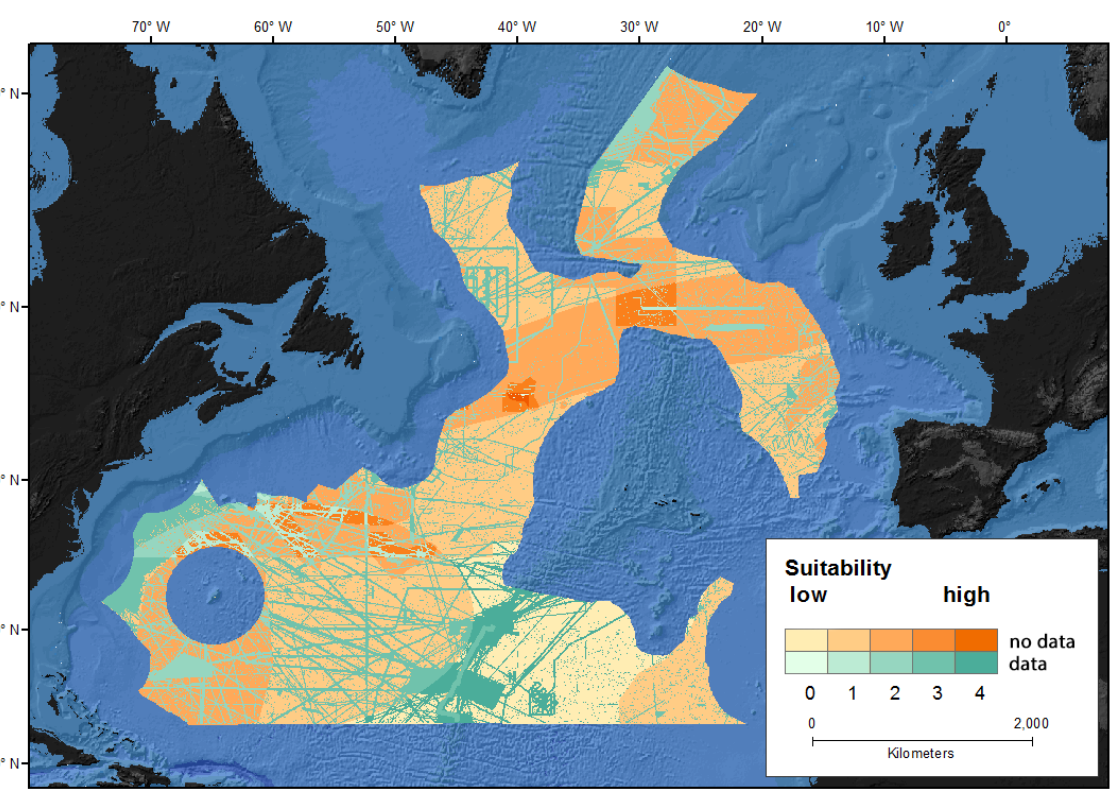

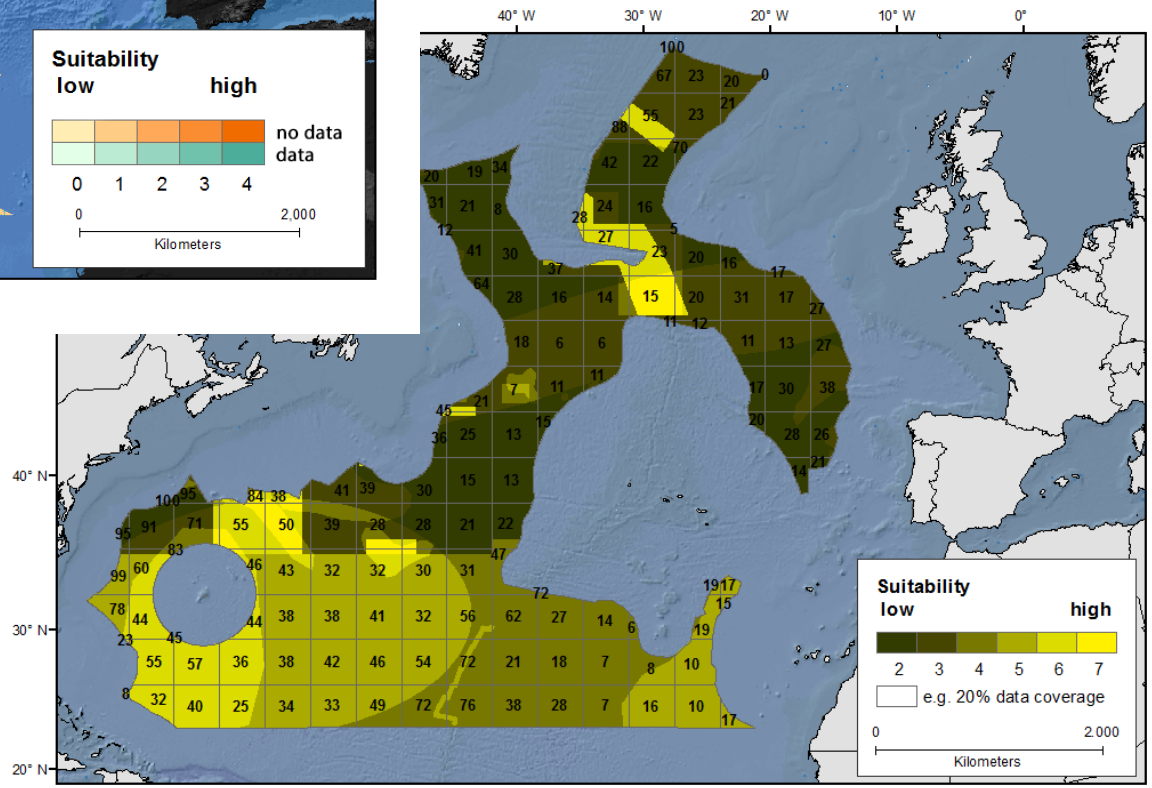

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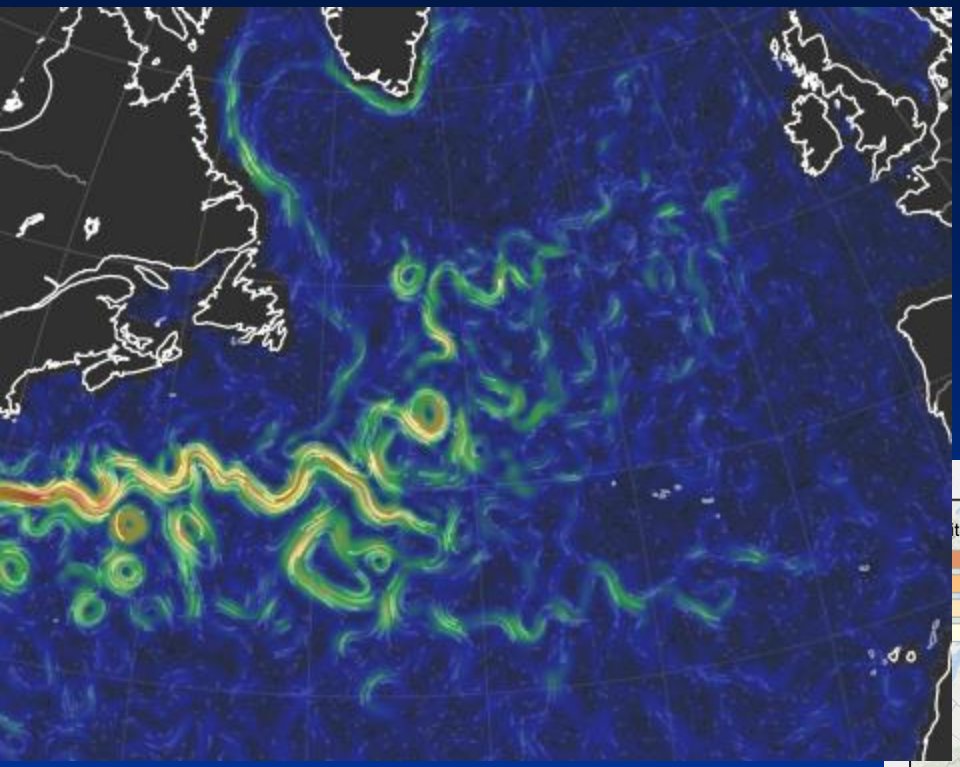

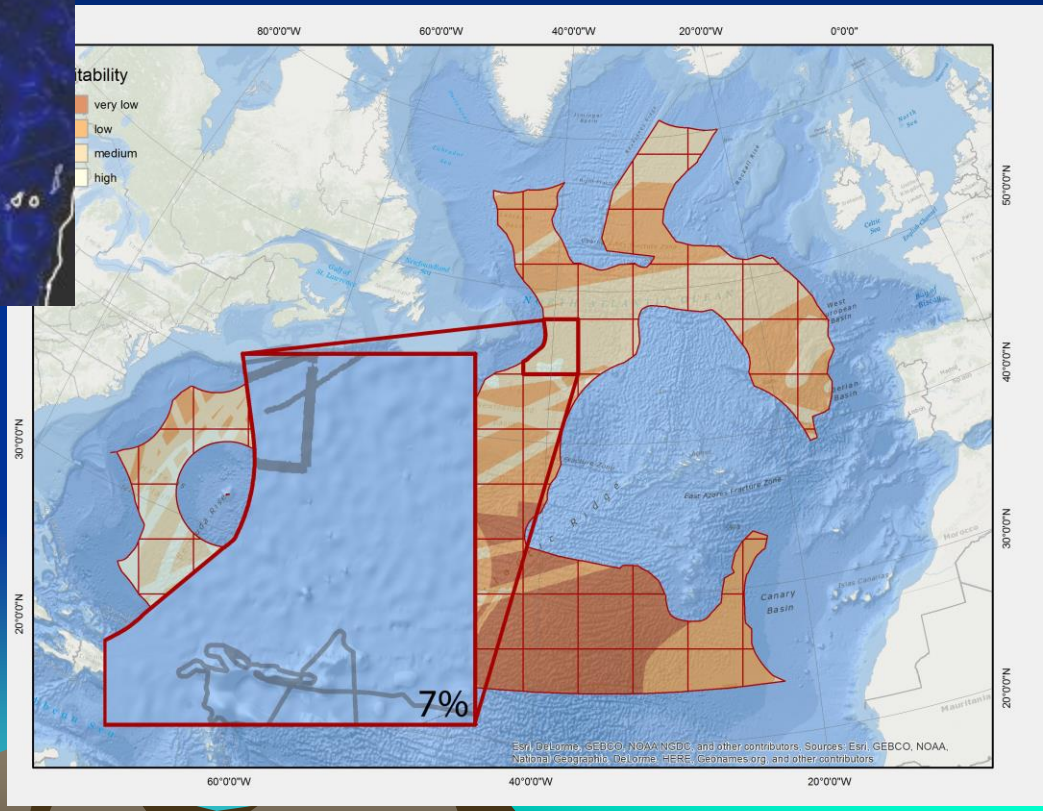

AORA

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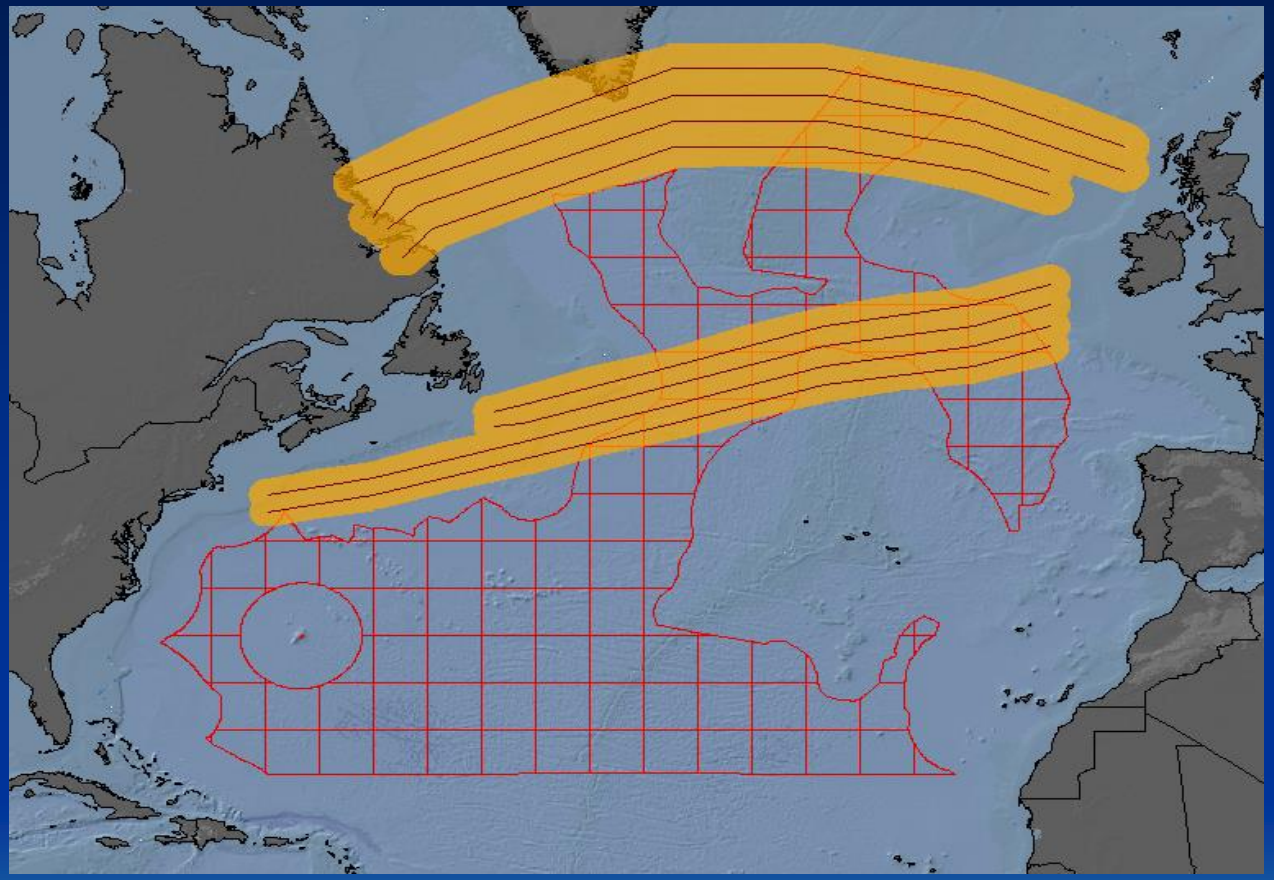
International Flight Paths across the N Atlantic



Over 60% of flight paths over oceans are unmapped *T Schmitt, 2016*

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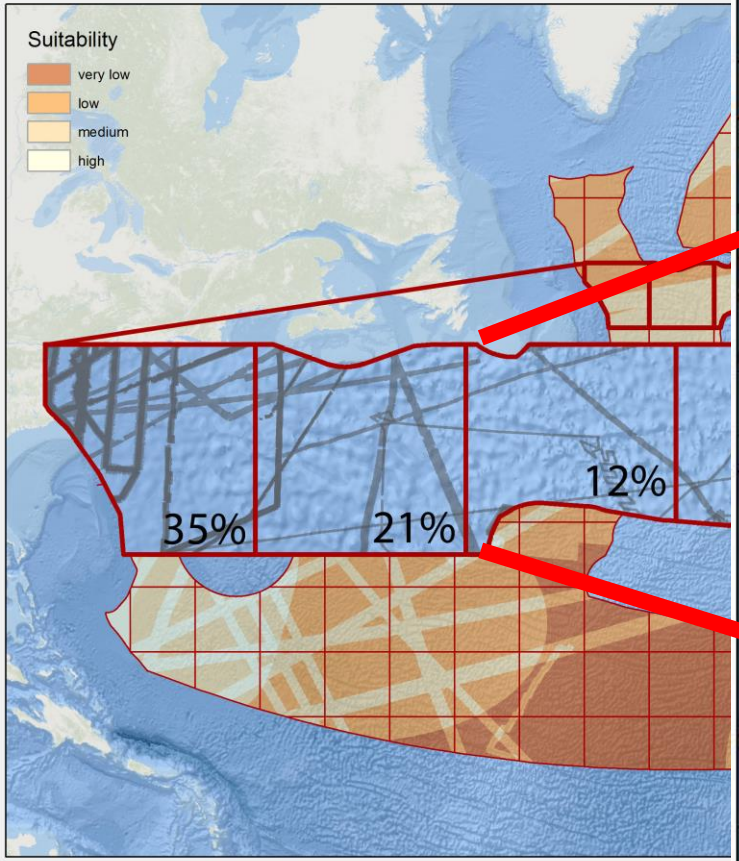
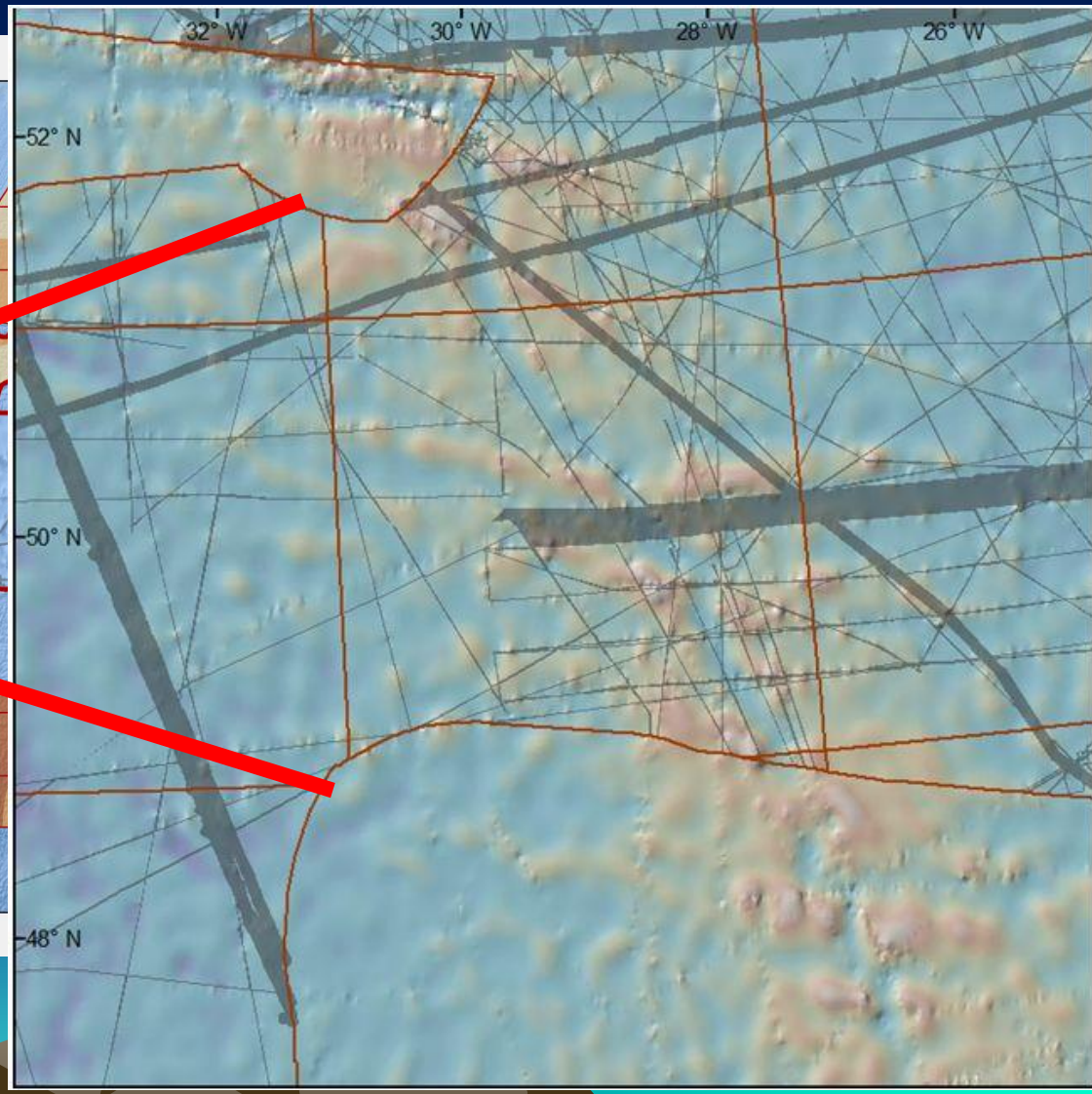
Prime Candidate Areas





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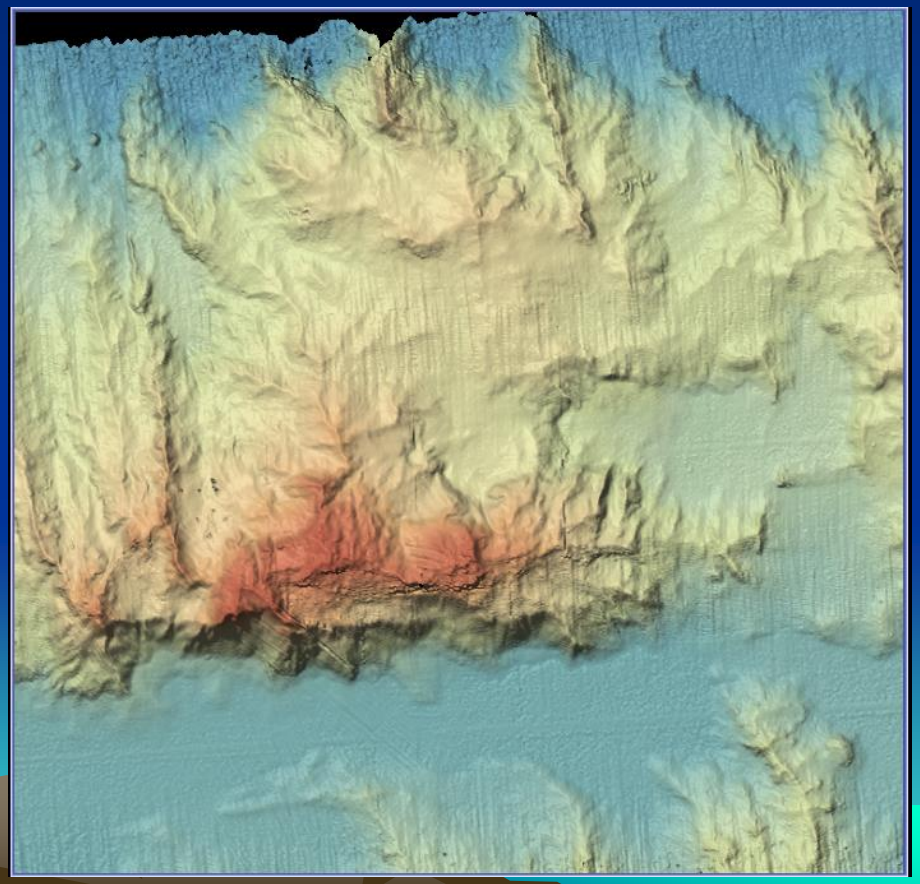
“Slightly improved resolution”

Before

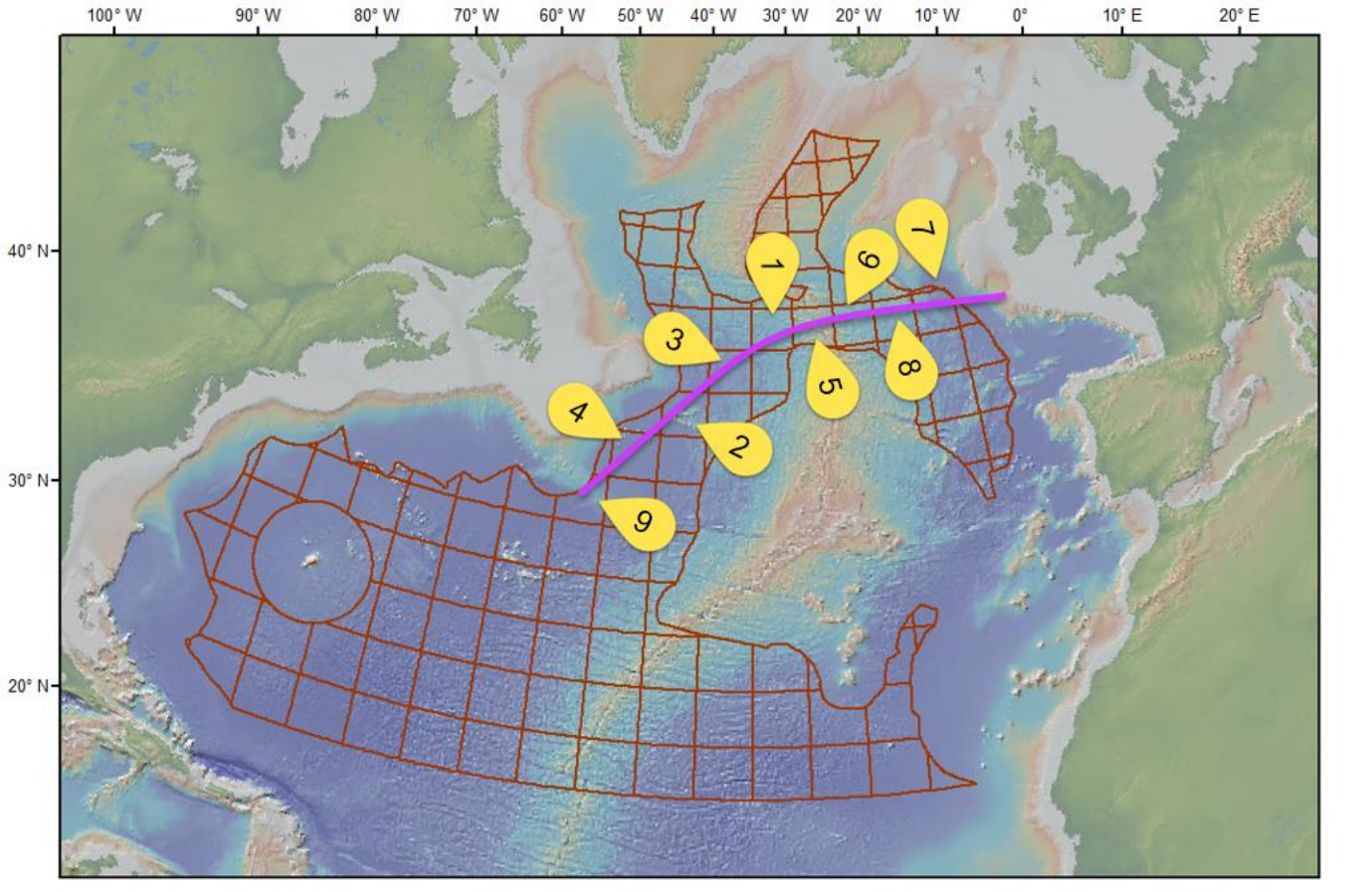
50x50 Km

After



Images courtesy of GeoMAR

The Atlantic Seabed Mapping Initiative



A Canada/EU/USA government funded initiative to develop a survey strategy

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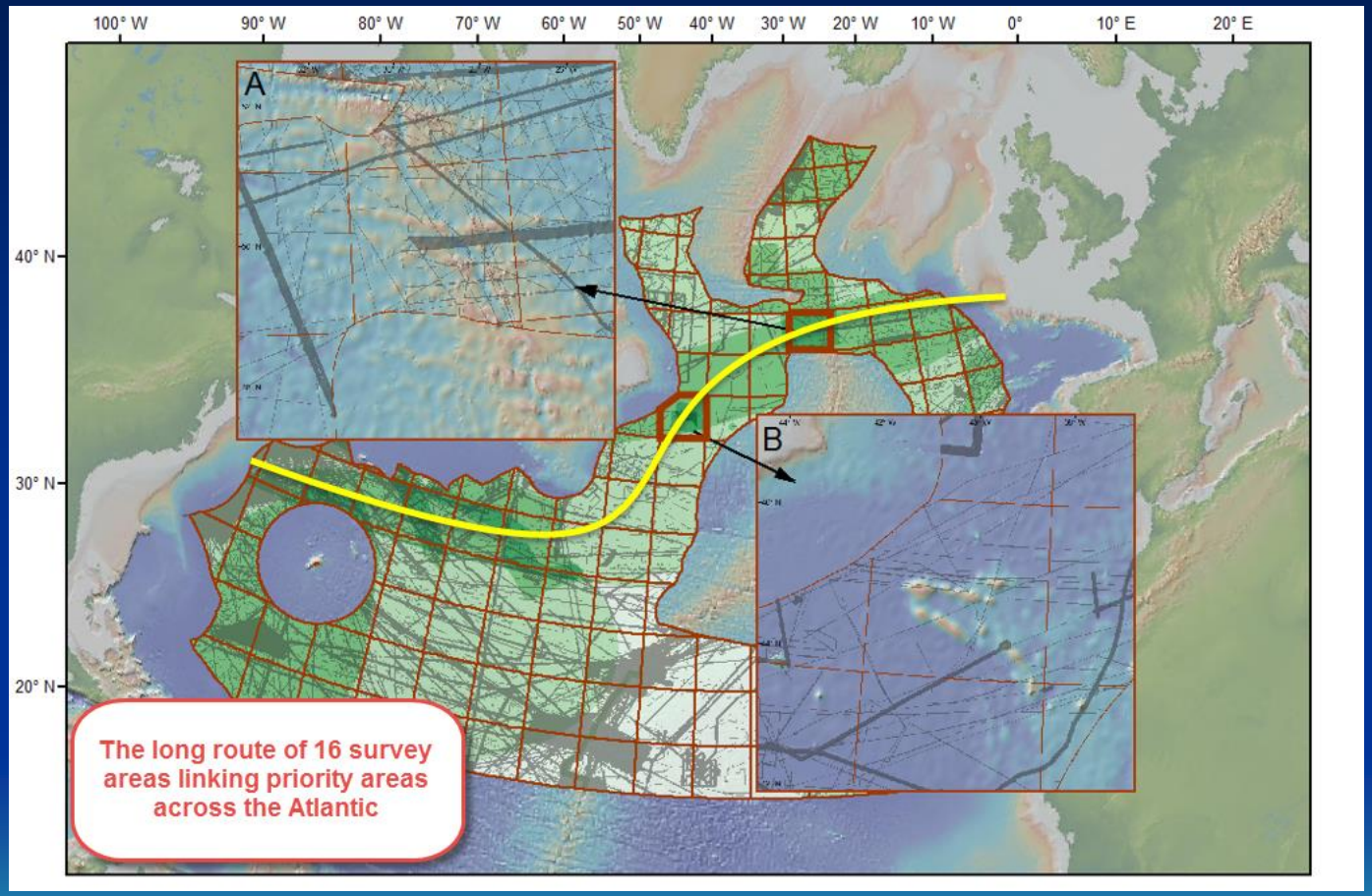

A Canada/EU/USA government funded initiative to develop a survey strategy

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Some Challenges going forward

- Training and retention of skilled personnel
- Adopting the approach for wider use
  - Southern Atlantic, a model for GEBCO
- Technology
  - Remote Automated Data Processing
  - Telecommunication Links – capacity, security
- More cost effective monitoring and collection of data
  - New systems, new platforms

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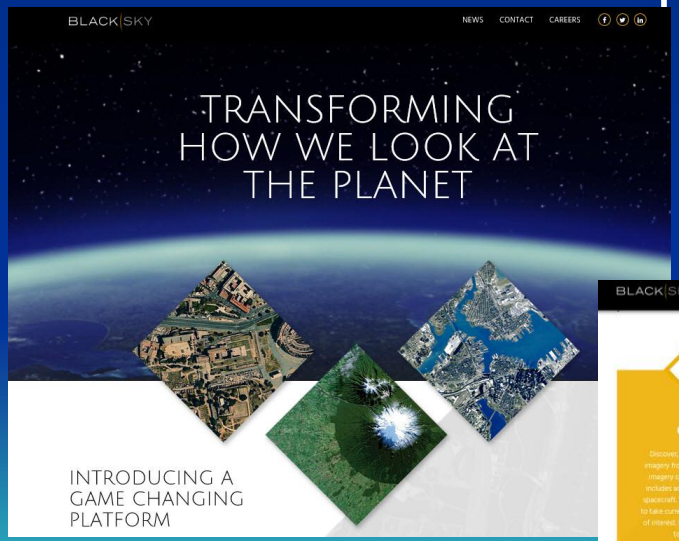
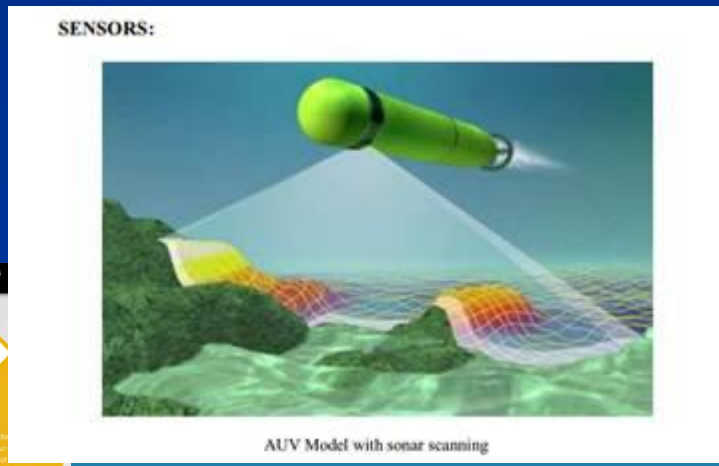
New Technologies

There are over 1000 MBES around the world capable of deep ocean surveying.

Even so these are expensive items installed on relatively expensive ships…….so can we introduce some improvements?





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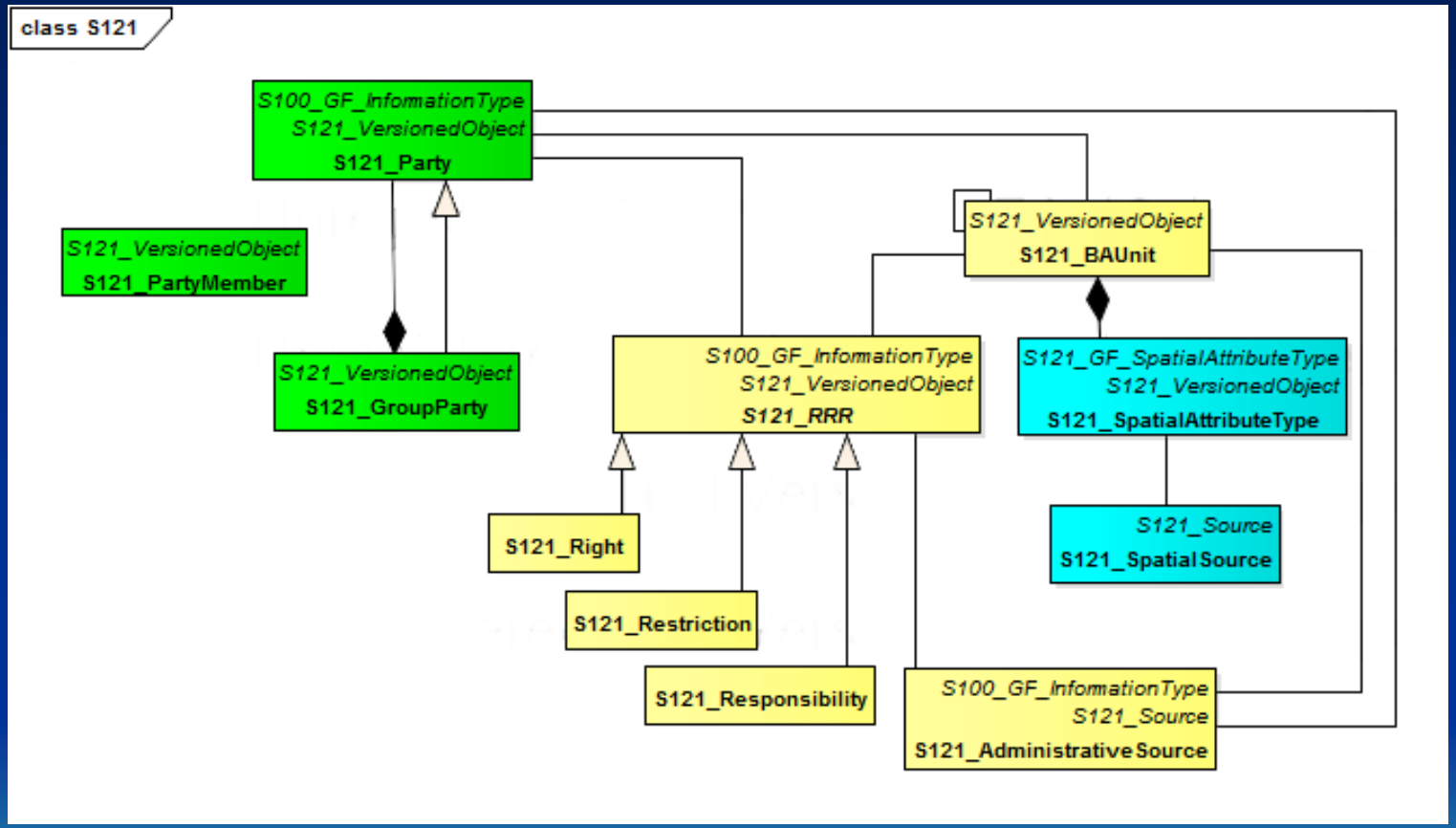
Technical Matters - Schemas



After Athanasiou et al 2016

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UNMANNED MULTIBEAM BARGE

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30 m x 15 m long array → 17 x 34 m resolution in 4000 m water

~1/3 the operating cost of a research vessel (and a lot less to build)

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Force Multipliers

Increase efficiency by:

evolving from the traditional one vessel and one AUV model

utilizing one vessel with up to 8 AUV's & 8 USV's

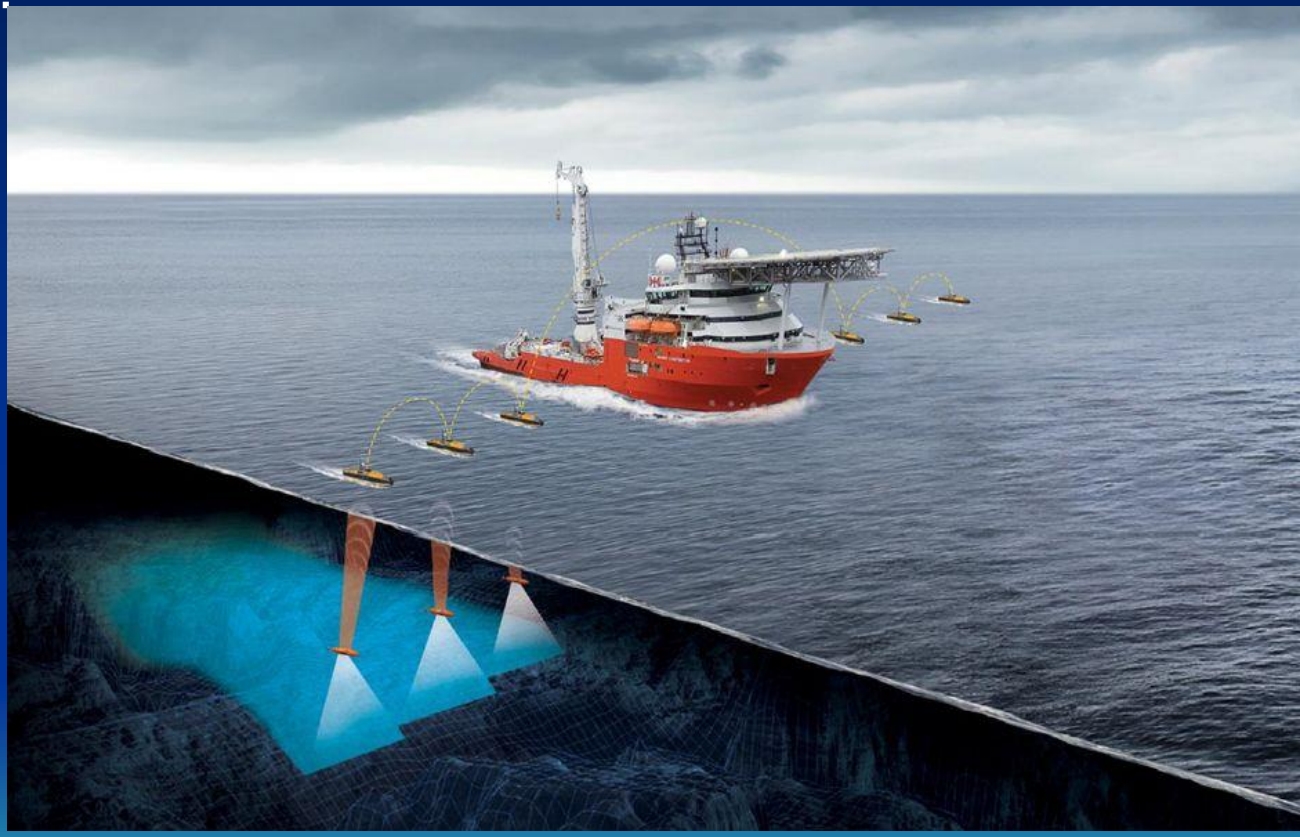

Image courtesy of OceanInfinfty

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Summary

- The North Atlantic Seabed Mapping Work Group has made progress in developing an approach for tackling the larger, deeper un-mapped areas of our oceans. We think we know where to go!
- The collaboration is supported at a high level and is being followed by a South Atlantic initiative.
- New technologies will be the key to a sustainable Ocean programme and ultimately it's success for us all.
- Keep the ideas coming!!

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