Decision support for the implementation of regional marine spatial planning across the North Atlantic

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Oisín Callery & Anthony Grehan

National University of Ireland, Galway

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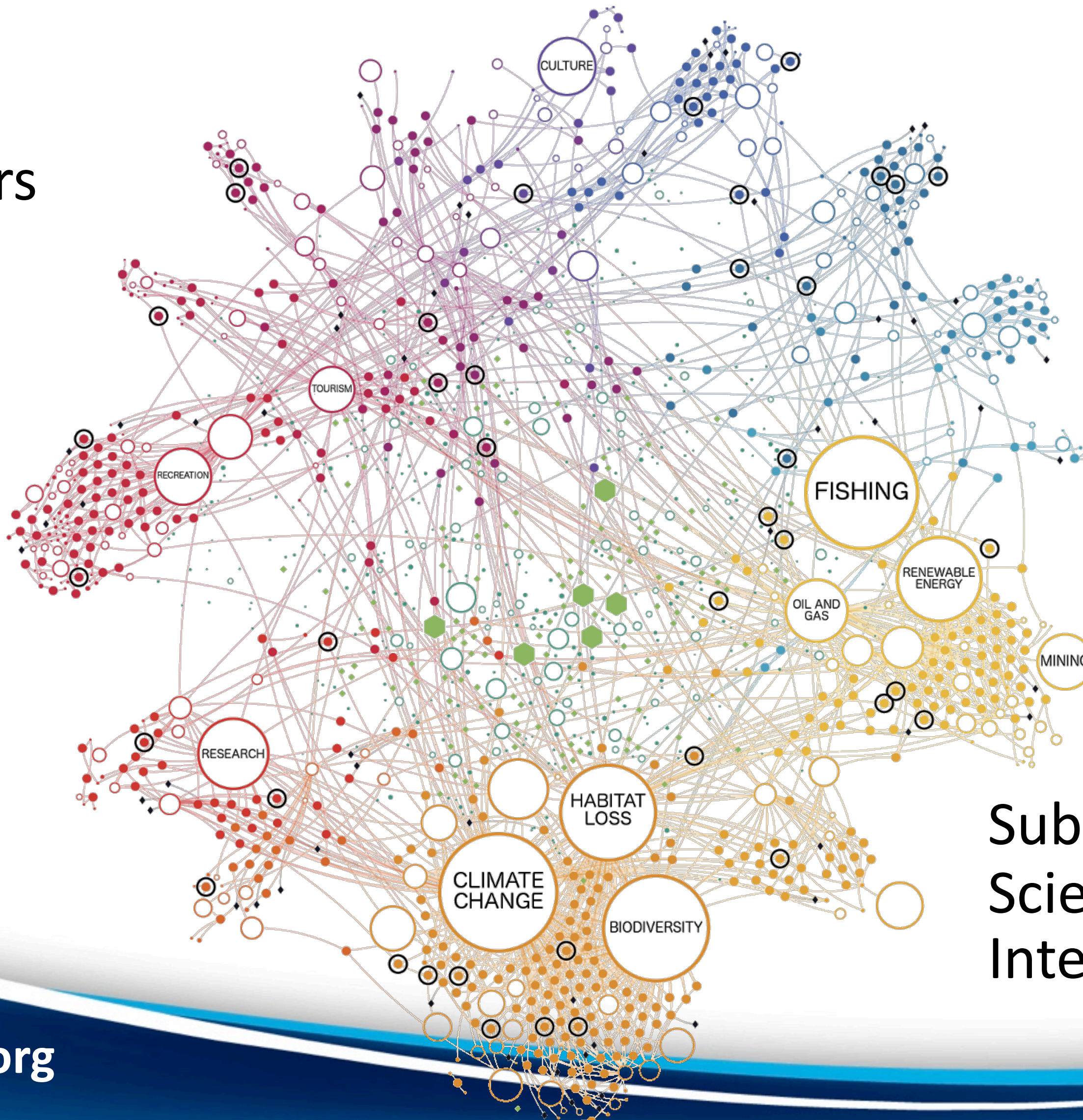
Decision Support Tools for Marine Spatial Planning

Multiple Stakeholders

Too much data & not enough information!



Complex Interactions

Suboptimal Science/Policy Interaction

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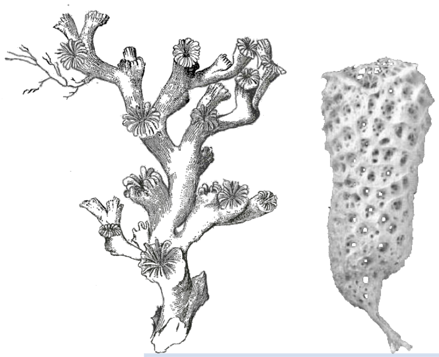
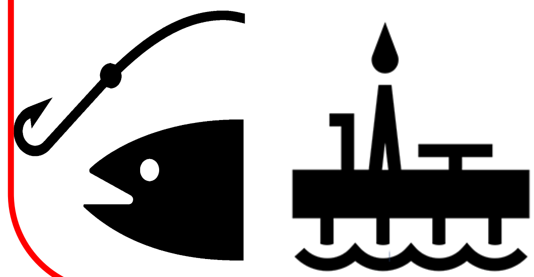
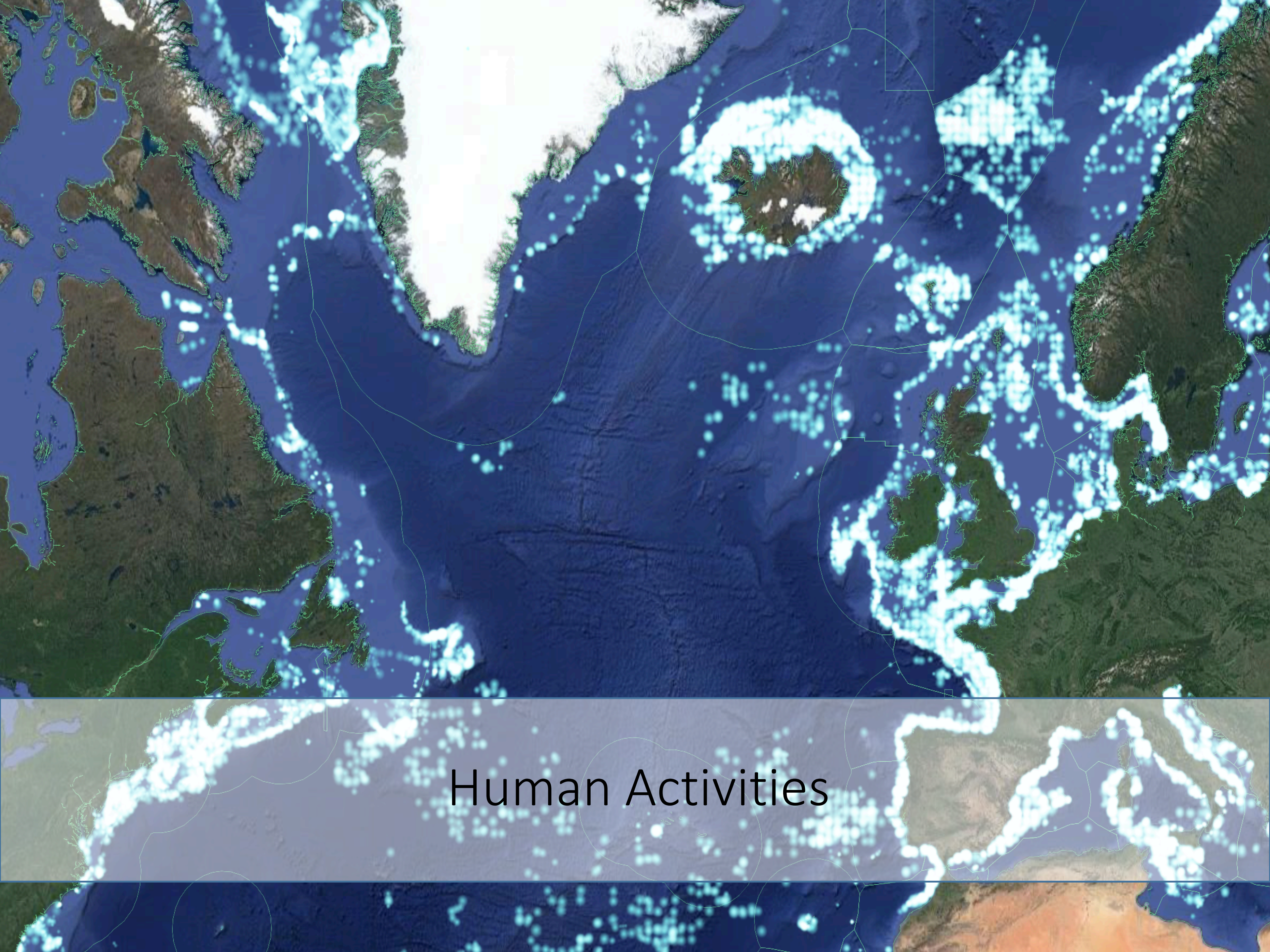
Decision Support Tools for Marine Spatial Planning

Conservation Objectives

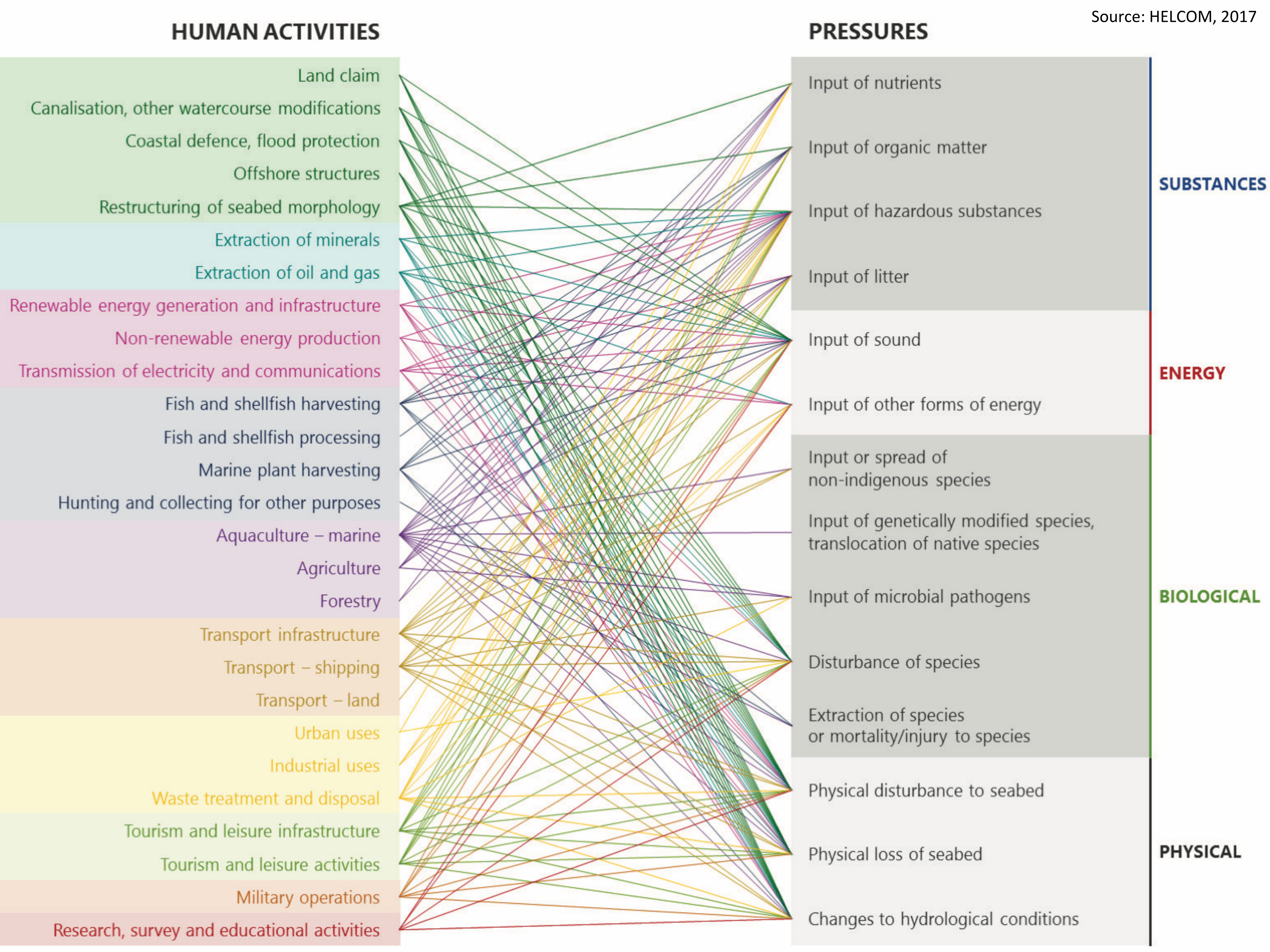
Human Activities







Human Activities



Source: HELCOM, 2017
HUMAN ACTIVITIES
Land claim
Canalisation, other watercourse modifications
Coastal defence, flood protection
Offshore structures
Restructuring of seabed morphology
Extraction of minerals
Extraction of oil and gas
Renewable energy generation and infrastructure
Non-renewable energy production
Transmission of electricity and communications
Fish and shellfish harvesting
Fish and shellfish processing
Marine plant harvesting
Hunting and collecting for other purposes
Aquaculture – marine
Agriculture
Forestry
Transport infrastructure
Transport – shipping
Transport – land
Urban uses
Industrial uses
Waste treatment and disposal
Tourism and leisure infrastructure
Tourism and leisure activities
Military operations
Research, survey and educational activities
PRESSURES
Input of nutrients
Input of organic matter
Input of hazardous substances
Input of litter
Input of sound
Input of other forms of energy
Input or spread of non-indigenous species
Input of genetically modified species, translocation of native species
Input of microbial pathogens
Disturbance of species
Extraction of species or mortality/injury to species
Physical disturbance to seabed
Physical loss of seabed
Changes to hydrological conditions
SUBSTANCES
ENERGY
BIOLOGICAL
PHYSICAL

Pressure Mapping

Source: BioConsult SH, 2013

Activities

Bottom trawling	Offshore installations	Aggregate extraction	Cables and pipelines

Pressures

Definitions		Spatial extent	Temporal extent
Sealing	Permanent loss of marine habitat to land / freshwater or man-made constructions	location of pressure and affected area	rare = 1 event per reporting period
Smothering	Permanent or long-term change to another marine habitat type		occasional = >1-<6 events per reporting period
Selective extraction	Removal of substratum where the exposed sediment is of the same type		regular = 1 event per year
Abrasion	Penetration or disturbance of sediments		frequent = >1-3 events per year
Changes in siltation	Settling out of suspended sediments, accumulation or erosion of sediments		persistent = >3 events per year or permanent installation

5 Pressure maps

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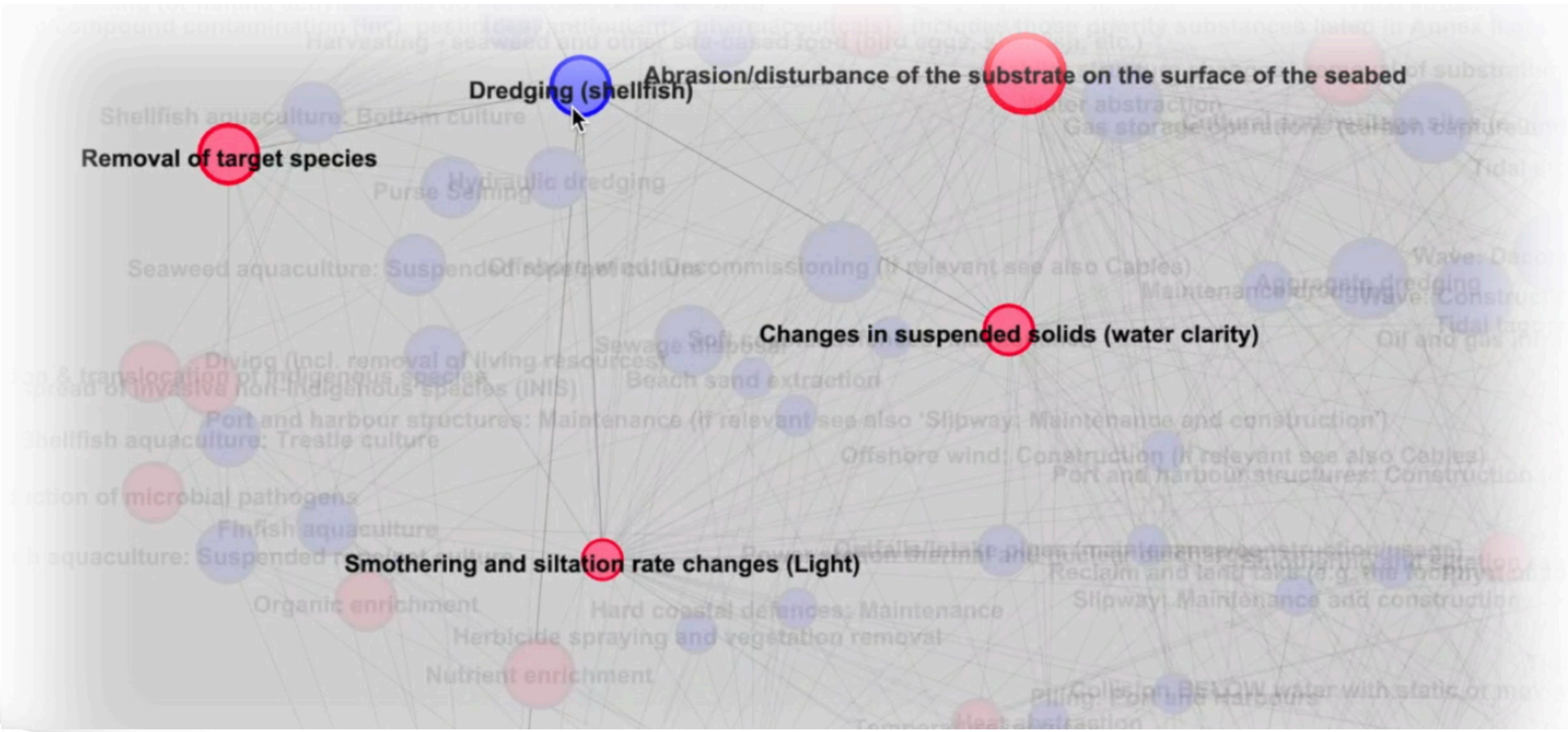
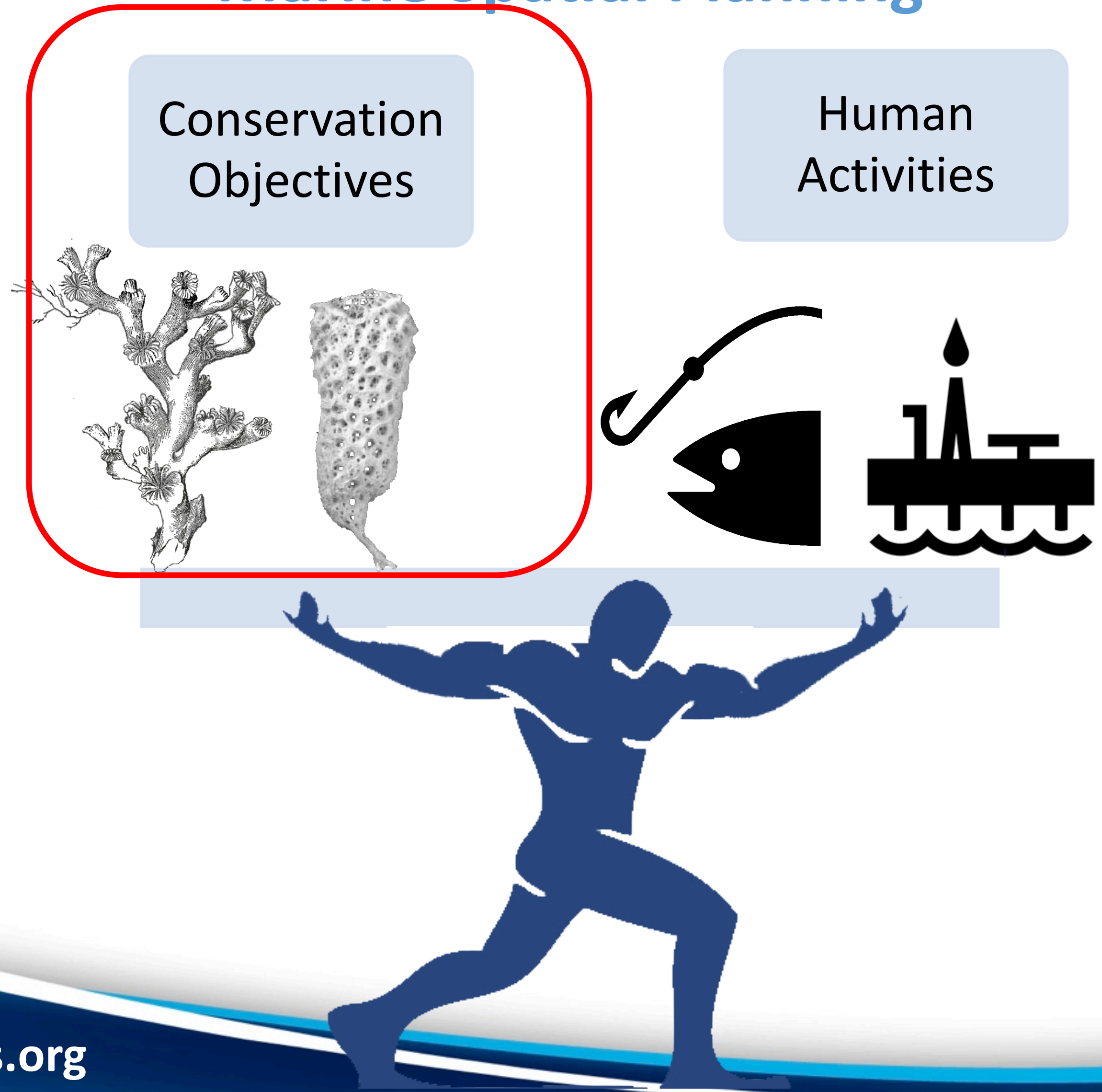
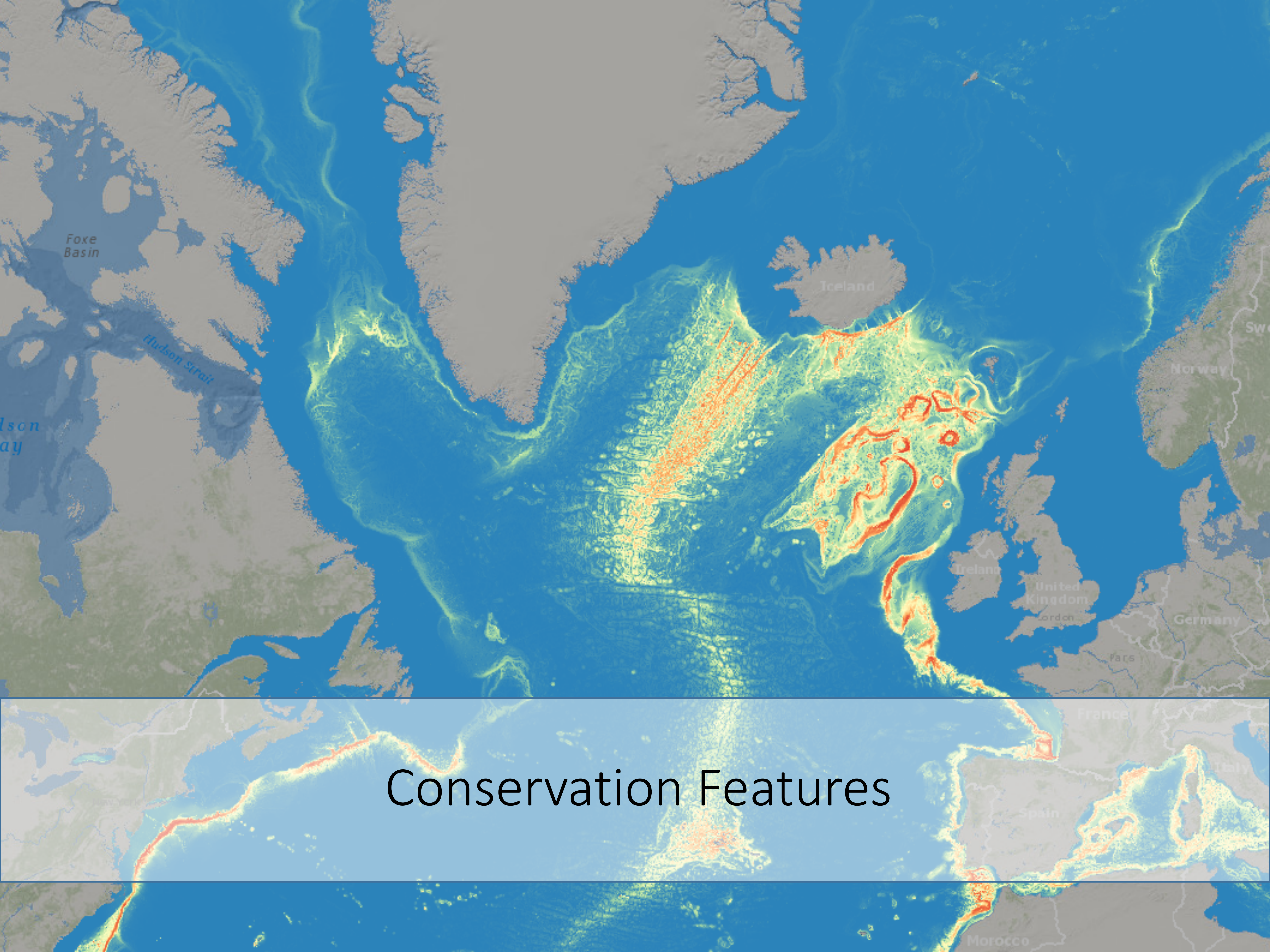
JNCC Marine Pressures–Activities Database

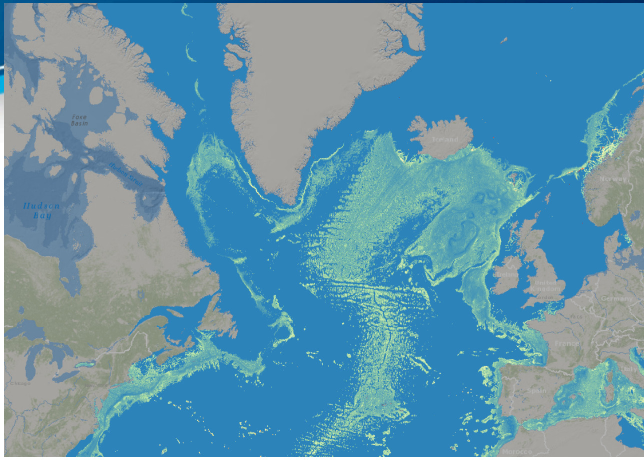


Decision Support Tools for Marine Spatial Planning

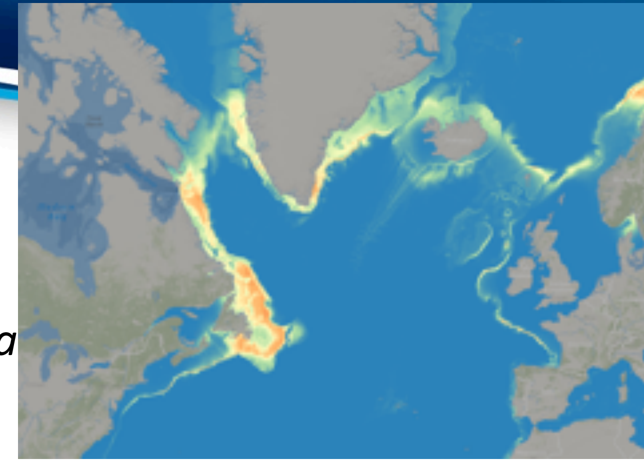


Conservation Features

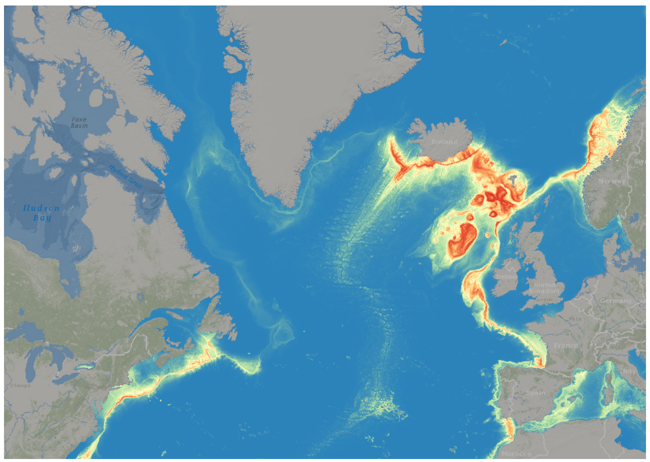




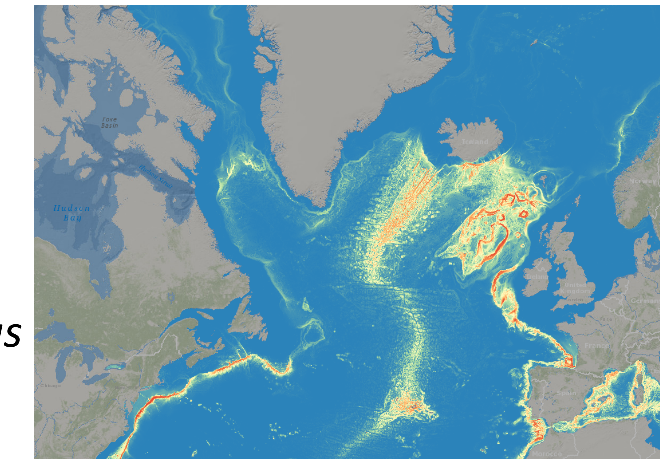
Madrepora oculata



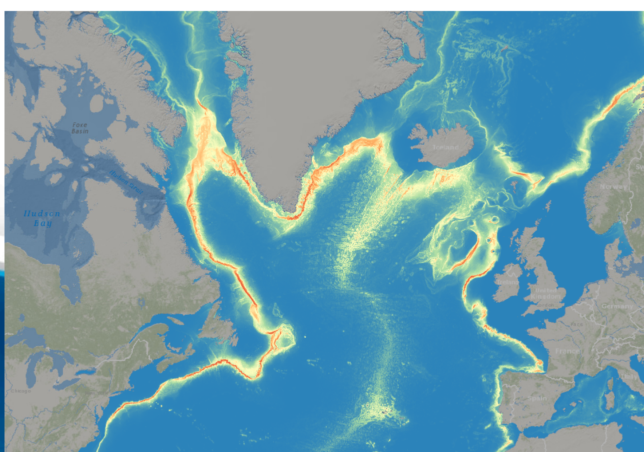
Paragorgia arborea



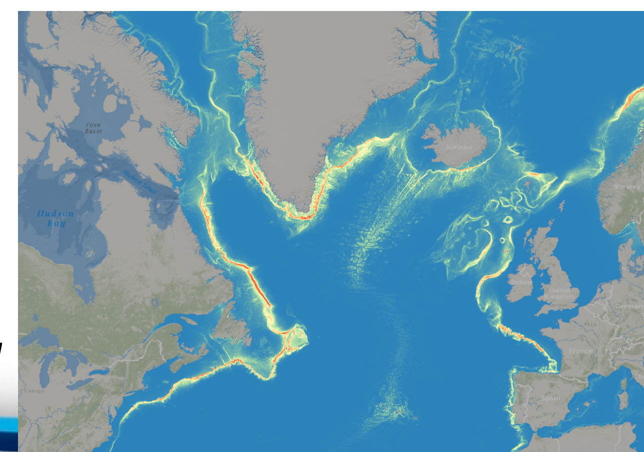
Lophelia pertusa



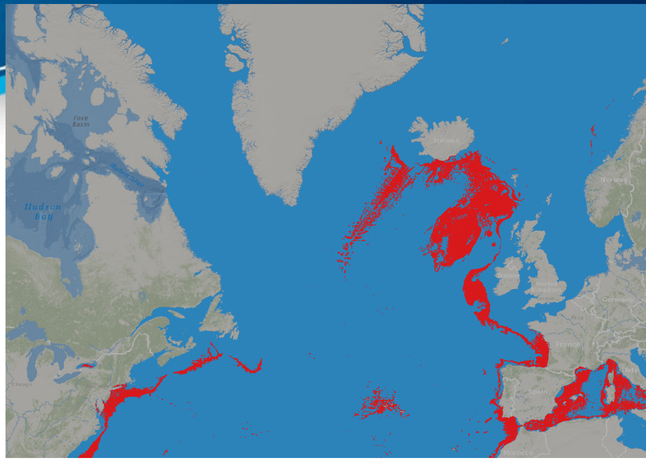
Desmophyllum dianthus

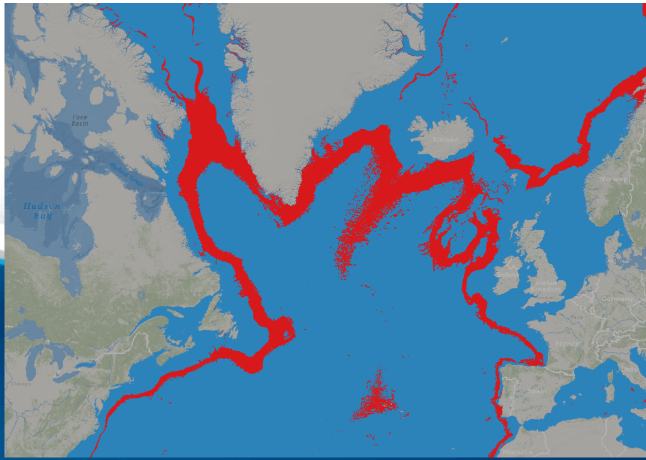


Acanthogorgia armata

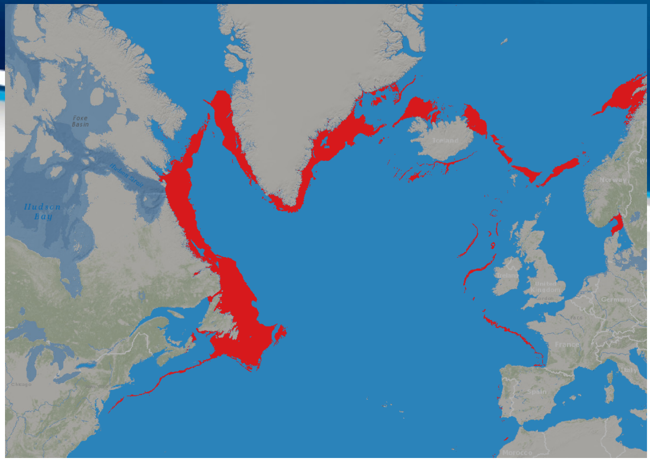


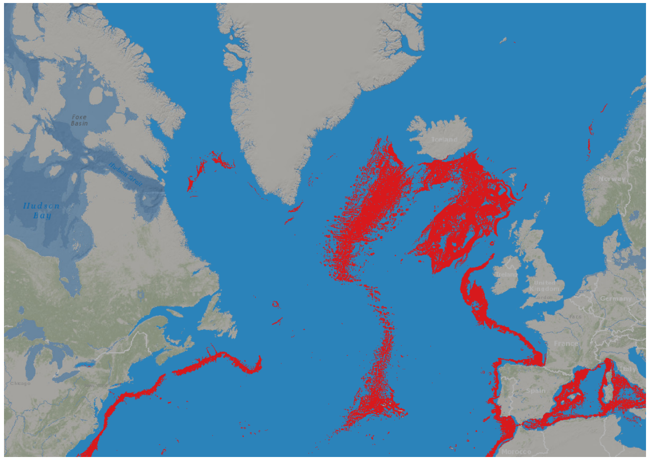
Acanella arbuscula





Convert model outputs to binary presence-absence using Maximum Sensitivity and Specificity (MSS) threshold






Foxe
Basin
Hudson Strait
Hudson
Bay
Iceland
Norway
Ireland
United
Kingdom
Germany
France
Spain
Italy
Morocco
Chicago

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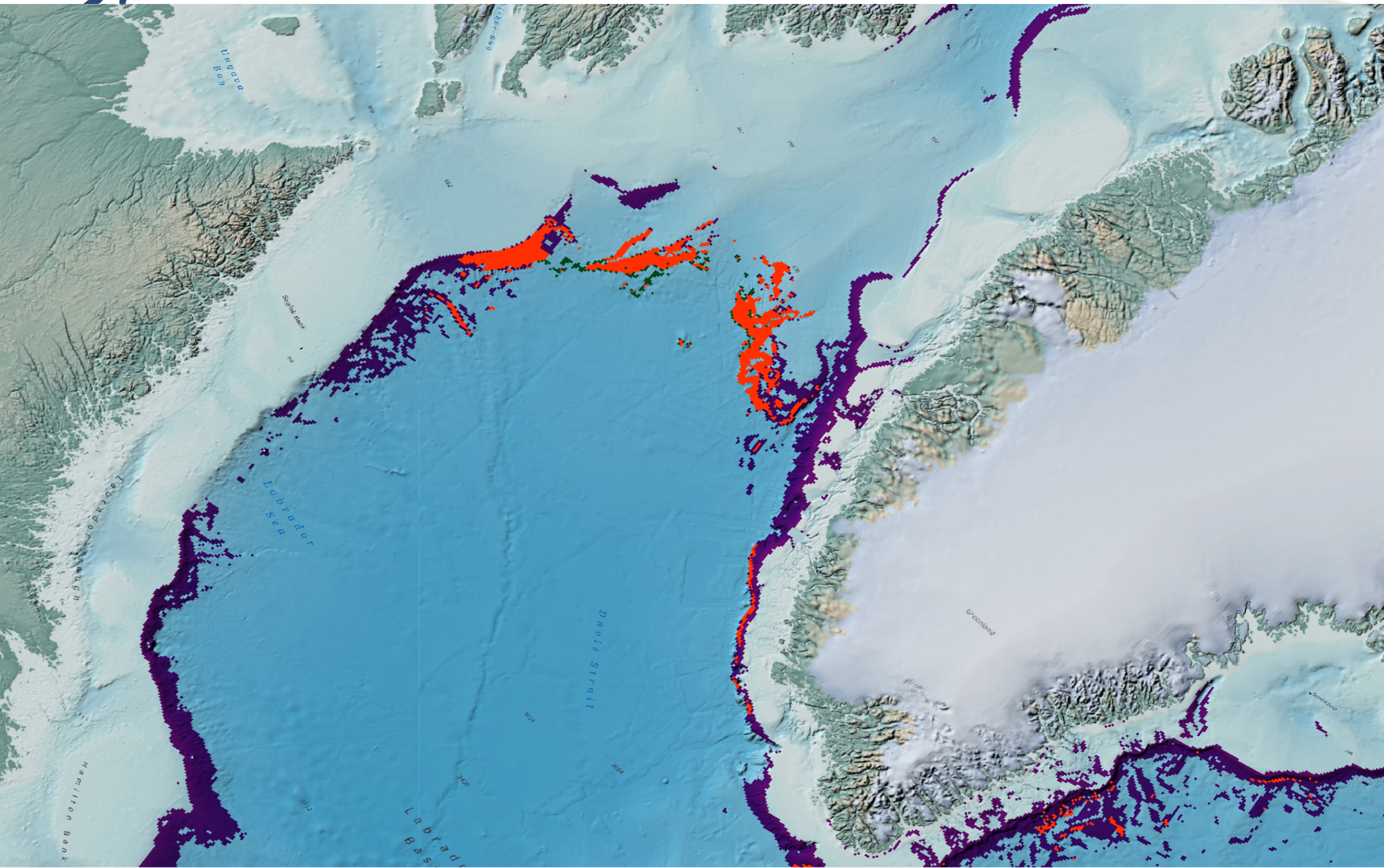
Climate "Refugia"



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Sensitivity Mapping

Source: BioConsult SH, 2013

Habitat types

Predominant habitats

= broadscale habitats based on EUNIS level 3

- Sublittoral coarse sediment
- Sublittoral sand
- Sublittoral mud
- Sublittoral mixed sediments

Special habitats

= habitats protected under EU, regional or national legislation

- sea-pen and burrowing megafauna communities
- species-rich habitats on coarse sand, gravel or shell gravel
- reefs
- sandbanks

Habitats in particular areas

= areas which merit a specific protection regime

- Natura 2000 sites

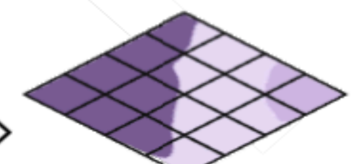
Sensitivity assessment

resistance + recoverability in relation to each pressure

sensitivity of physical habitat and characteristic species

Habitat sensitivity

Sensitivity		Recoverability: very low (>25 yr.)	low (>10-25 yr.)	moderate (>2-10 yr.)	high (1-2 yr.)	very high (<1 yr.)
Resistance	low	very high	high	intermediate	intermediate	low
	intermediate	high	high	intermediate	low	low
	high	intermediate	intermediate	low	low	very low
	tolerant	not sensitive	not sensitive	not sensitive	not sensitive	not sensitive



Pressure-specific sensitivity maps

Ecosystem Sensitivity Data

MarESA/Marlin Approach

Sensitivity		Recoverability				
		very low (>25 yr.)	low (>10-25 yr.)	moderate (>2-10 yr.)	high (1-2yr.)	very high (<1yr)
Resistance	low	very high	high	intermediate	intermediate	low
	intermediate	high	high	intermediate	low	low
	high	intermediate	intermediate	low	low	very low
	tolerant	not sensitive	not sensitive	not sensitive	not sensitive	not sensitive

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Ecosystem Sensitivity Data

Resistance

Rank	Physical habitat	Characteristic species
low	Structure and function of physical habitat characteristics are altered completely or to a large extent.	The species population is likely to be killed / destroyed by single event of anthropogenic pressure.
intermediate	Significant alterations of physical habi-tat characteristics; essential structure and function are maintained.	Some individuals of a species population may be killed / destroyed by single event and the viability of a species population will be reduced.
high	Minor alterations of physical seabed characteristics, low impact on struc-ture and function.	A species population is unlikely to be killed / destroyed by single event. How-ever, the viability of a species population will be reduced.
tolerant	No negative effect detectable or posi-tive effects on structure and function of physical habitat characteristics.	No negative effect detectable or positive effects on survival or viability of a species.

Ecosystem Sensitivity Data

Recoverability

Rank	Definition
very low	recovery not possible or will take over 25 years
low	recovery within 10-25 years
moderate	recovery within 2-10 years
high	recovery within 1-2 years
very high	recovery within 1 year

Ecosystem Sensitivity Data

Sensitivity		Recoverability				
		very low (>25 yr.)	low (>10-25 yr.)	moderate (>2-10 yr.)	high (1-2yr.)	very high (<1yr)
Resistance	low	very high	high	intermediate	intermediate	low
	intermediate	high	high	intermediate	low	low
	high	intermediate	intermediate	low	low	very low
	tolerant	not sensitive	not sensitive	not sensitive	not sensitive	not sensitive

Impact Mapping

Impact		Habitat sensitivity				
		very low	low	intermediate	high	very high
Temporal extent of pressure	rare	very low	very low - low	low	low-medium	medium
	occasional	very low - low	low	low - medium	medium	medium - high
	regular	low	low - medium	medium	medium - high	high
	frequent	low - medium	medium	medium - high	high	high - very high
	persistent	medium	medium - high	high	high - very high	very high

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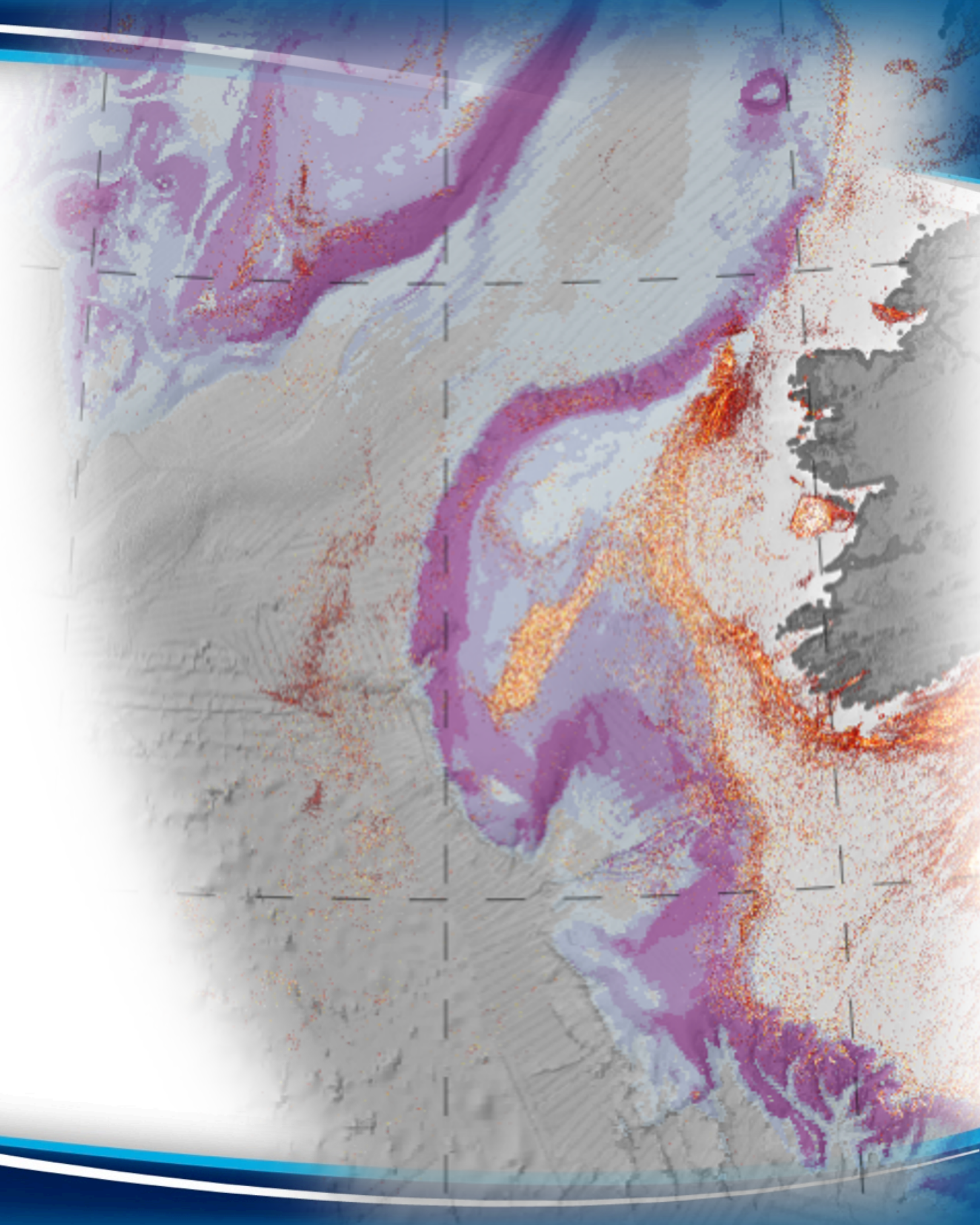
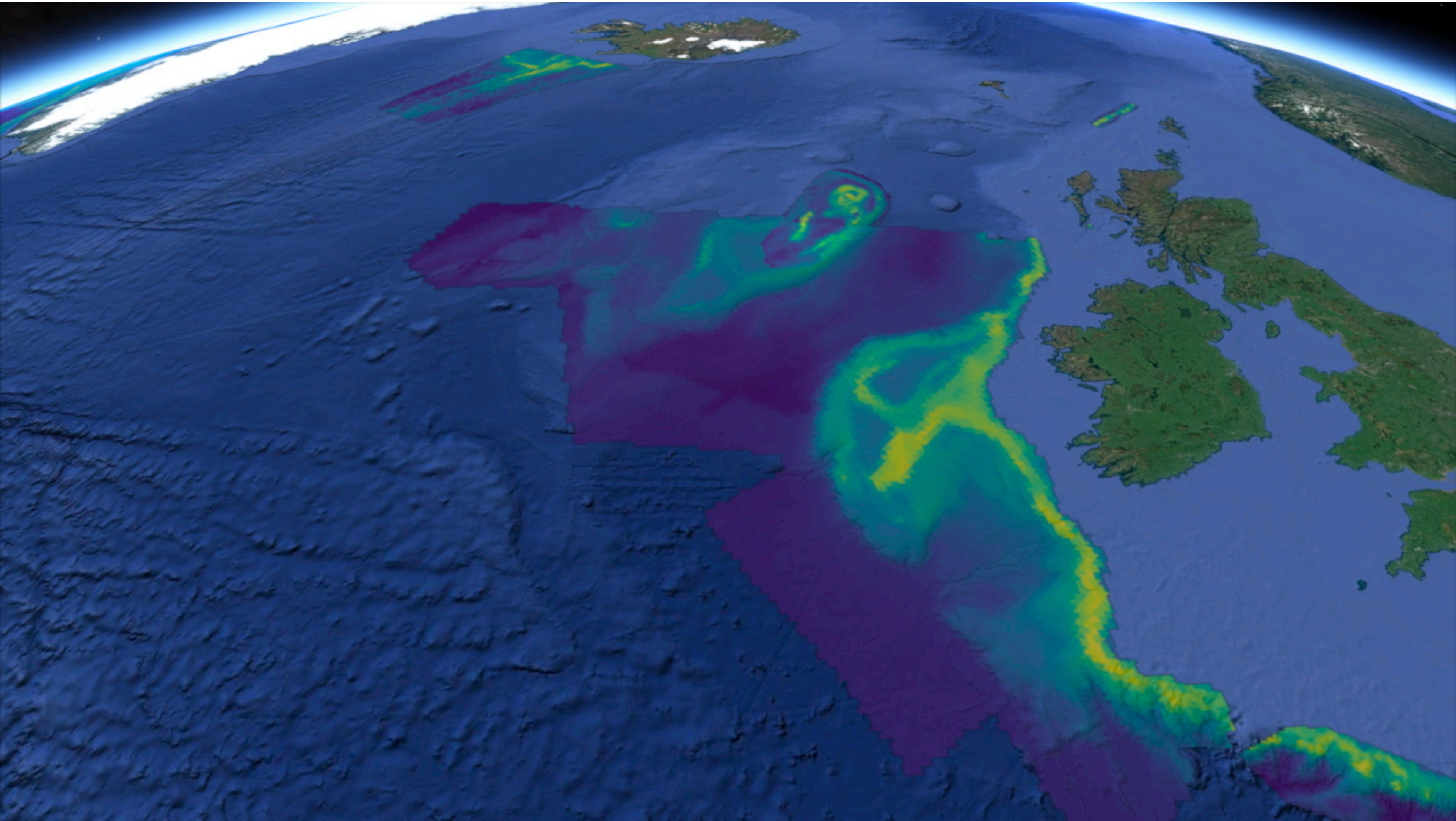
Example Workflow Outputs and Uses



Porcupine Seabight Case Study



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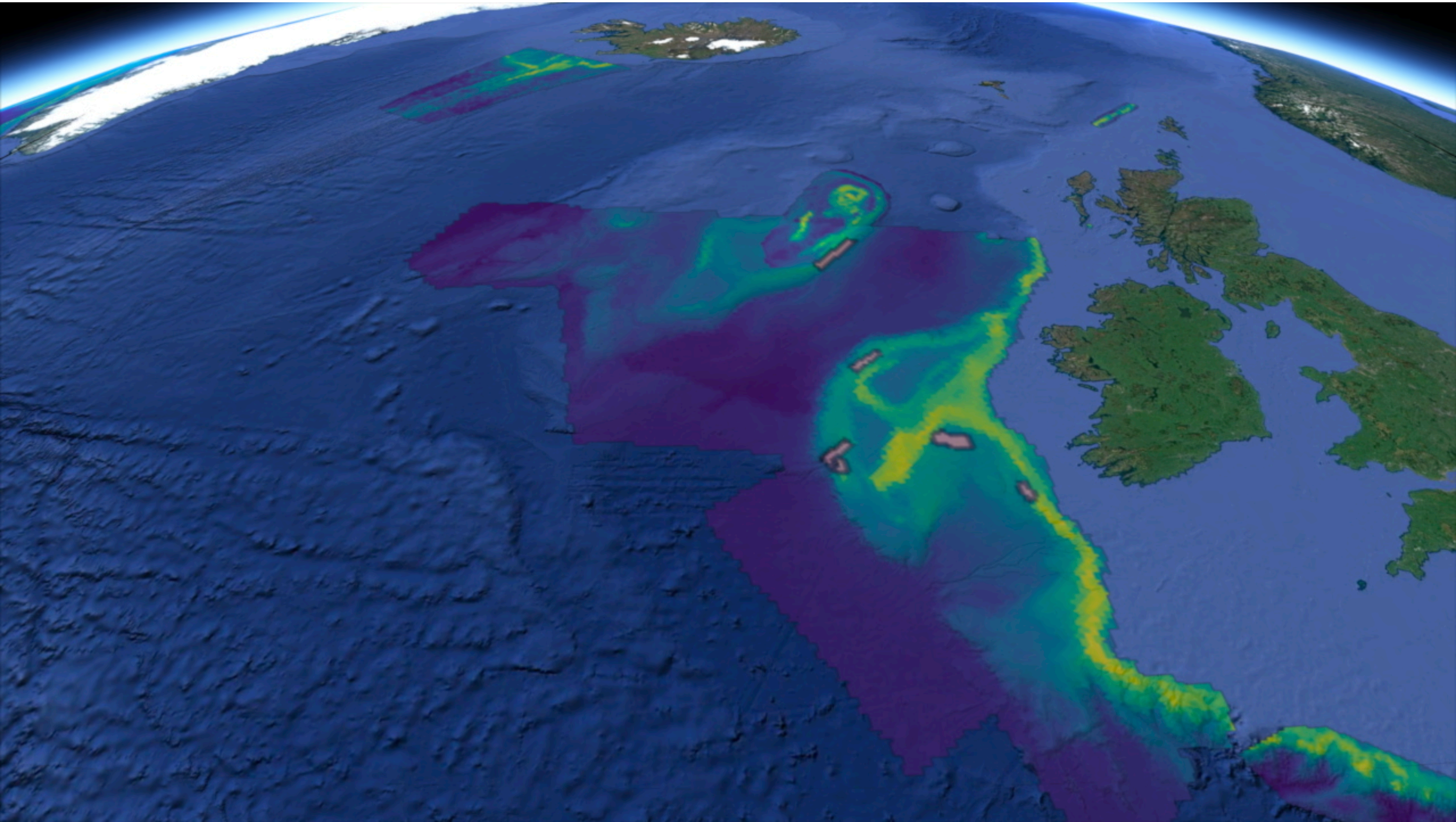
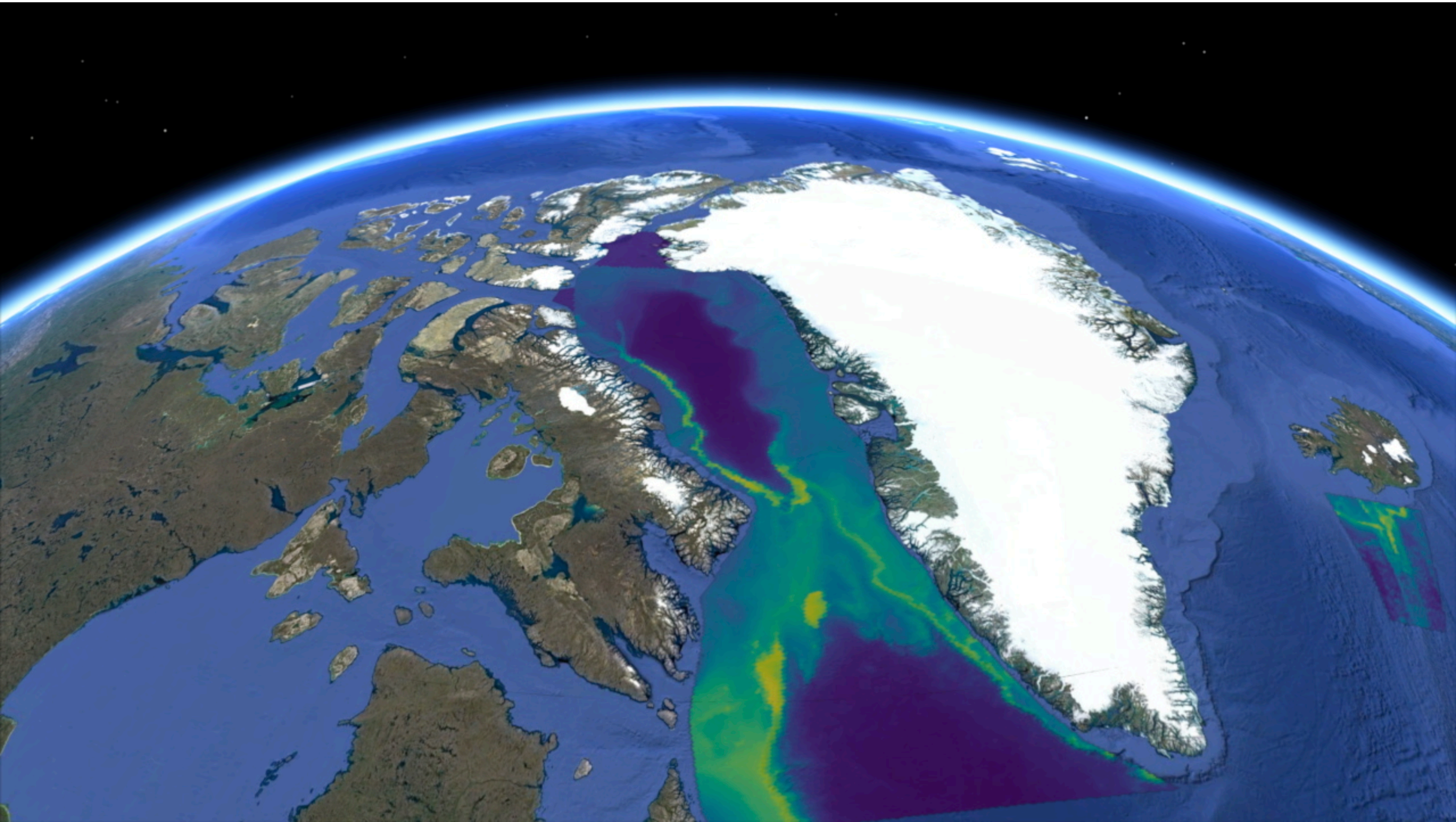
Effectiveness/resilience of existing MPA network



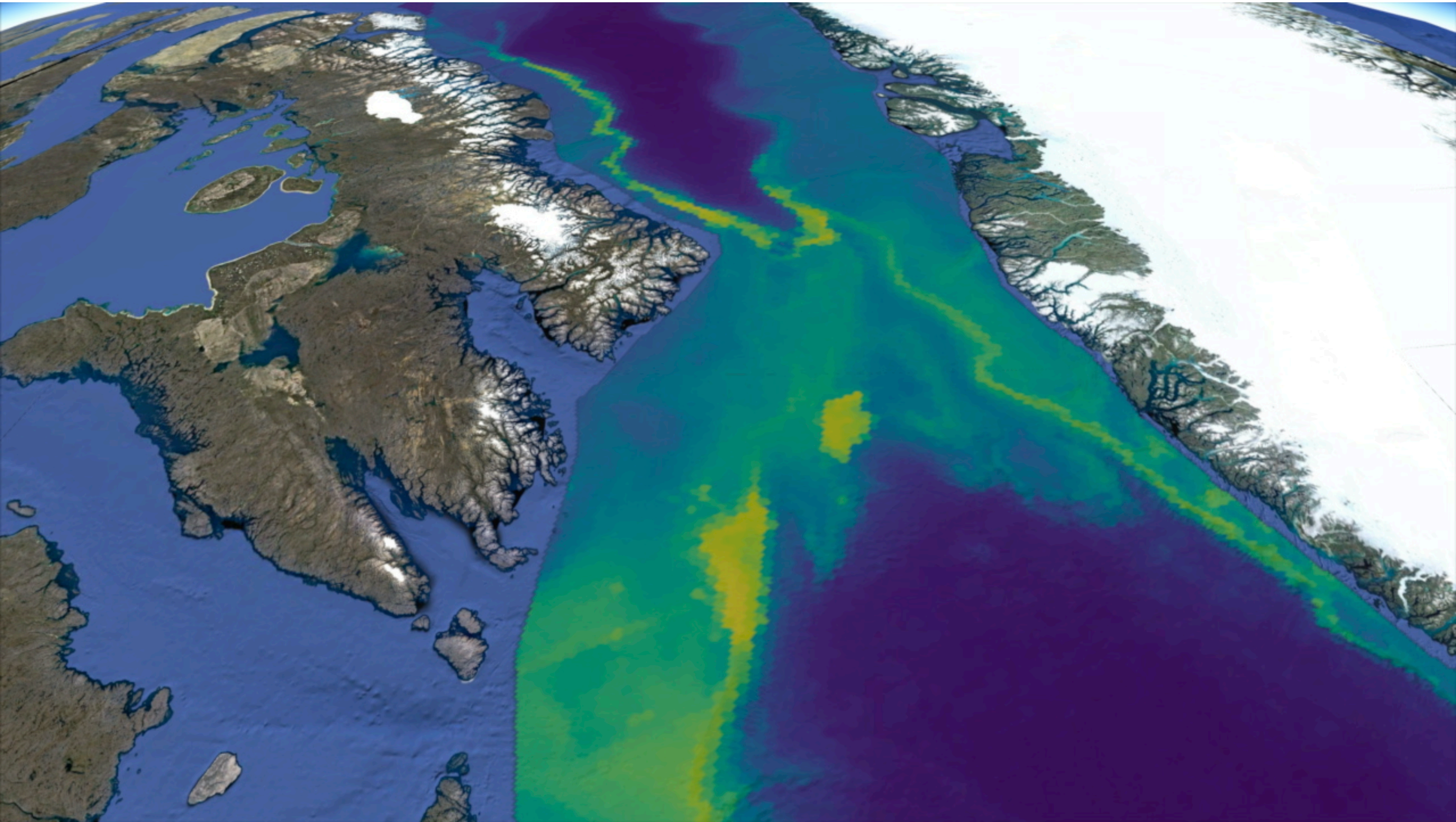
Davis Strait/Baffin Bay Case Study



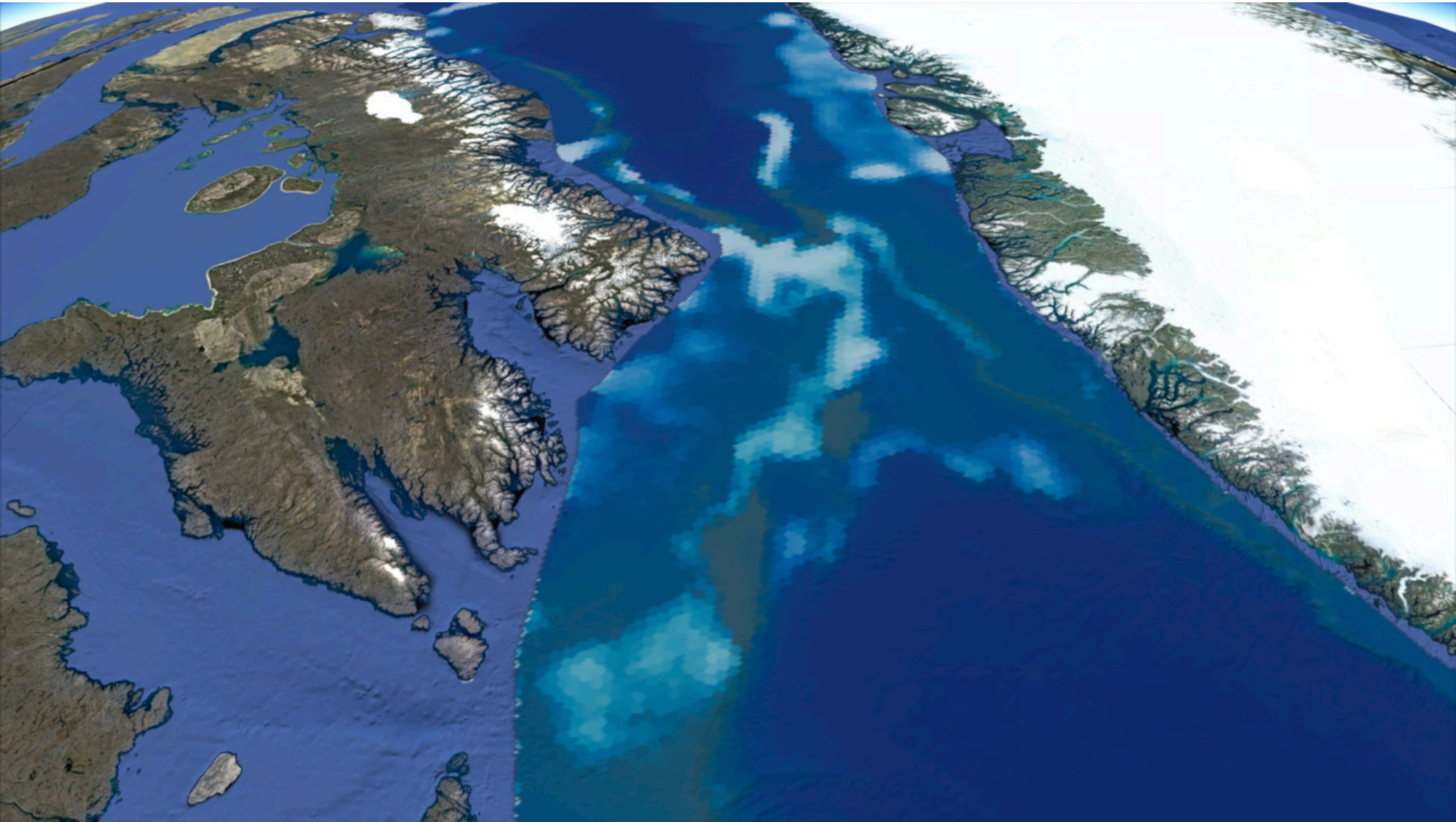
Systematic Conservation Planning Exercise

- Example 1 – Minimal Data Inputs
  - Conservation features:
    - Basin scale model outputs for 6 Coral species
    - Basin scale model outputs for 6 Fish species
  - Conservation targets:
    - 30% of extents of all species’ habitats
  - “Cost” parameter:
    - Cumulative impacts of
      - Demersal trawling
      - Climate change (e.g. temperature increase, deoxygenation…)

Cell cost based on outputs of Cumulative Effects Assessment



Heatmap of cells selected by Marxan for conservation



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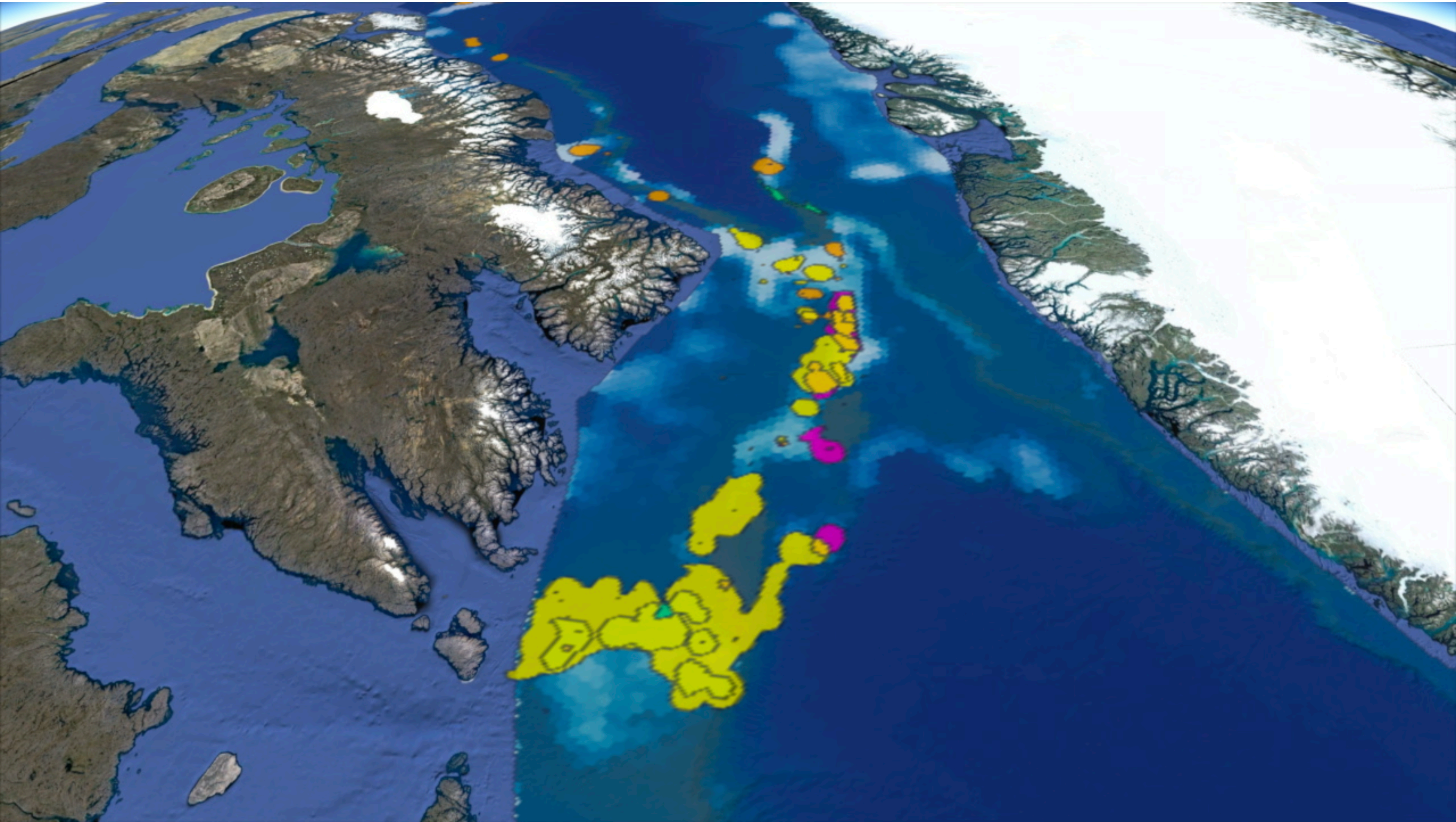
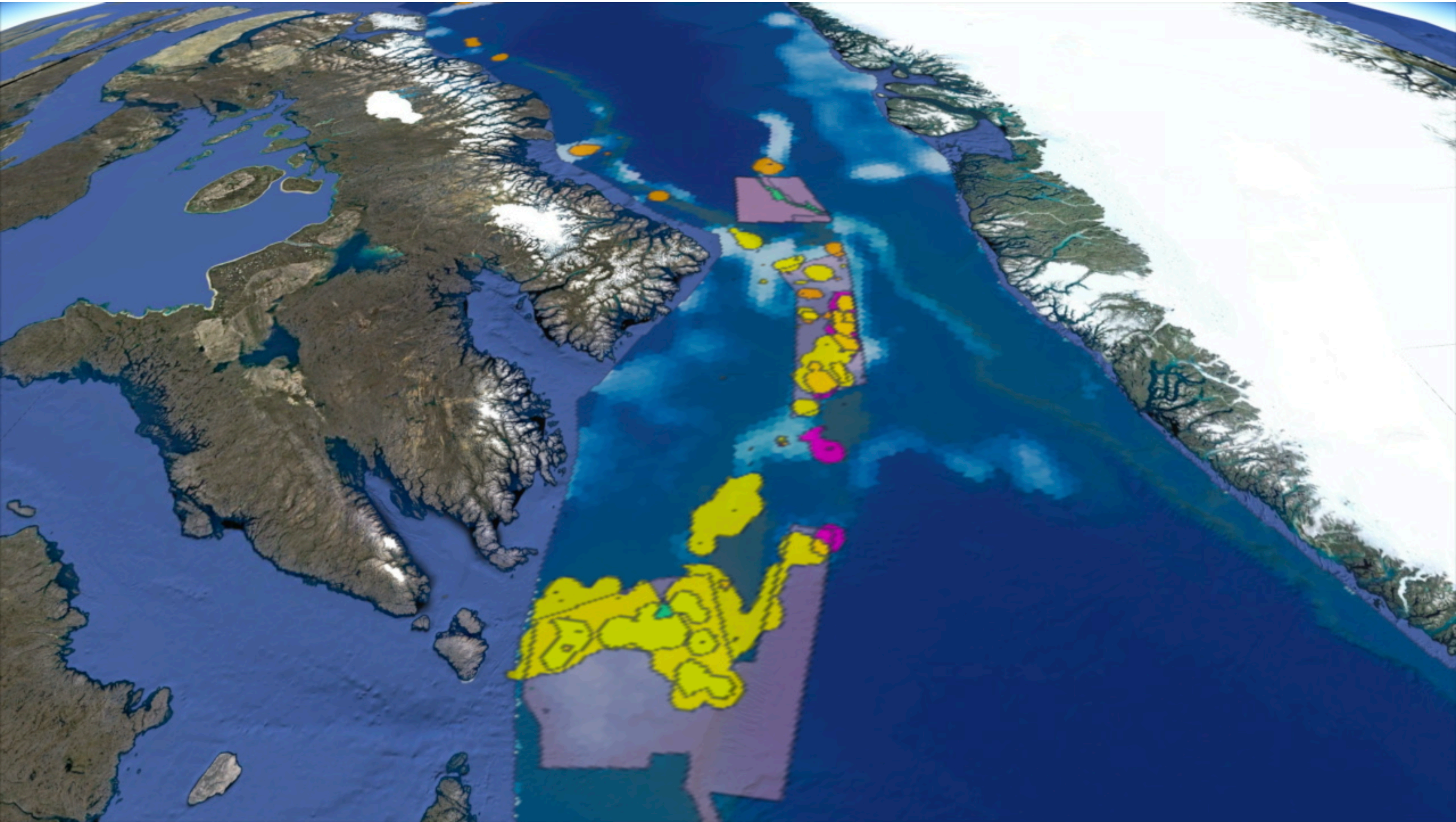
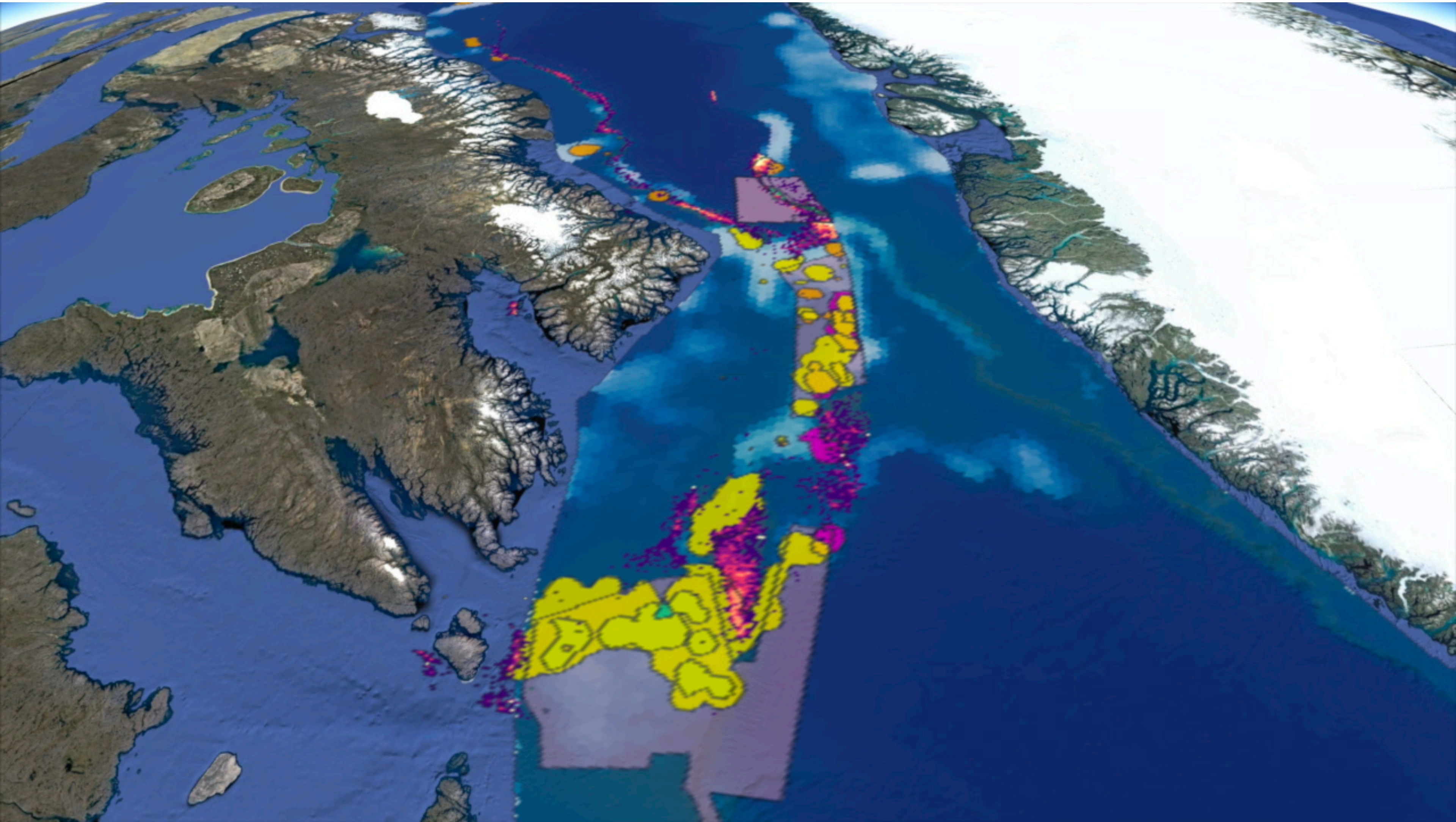
Previously identified Significant Benthic Areas



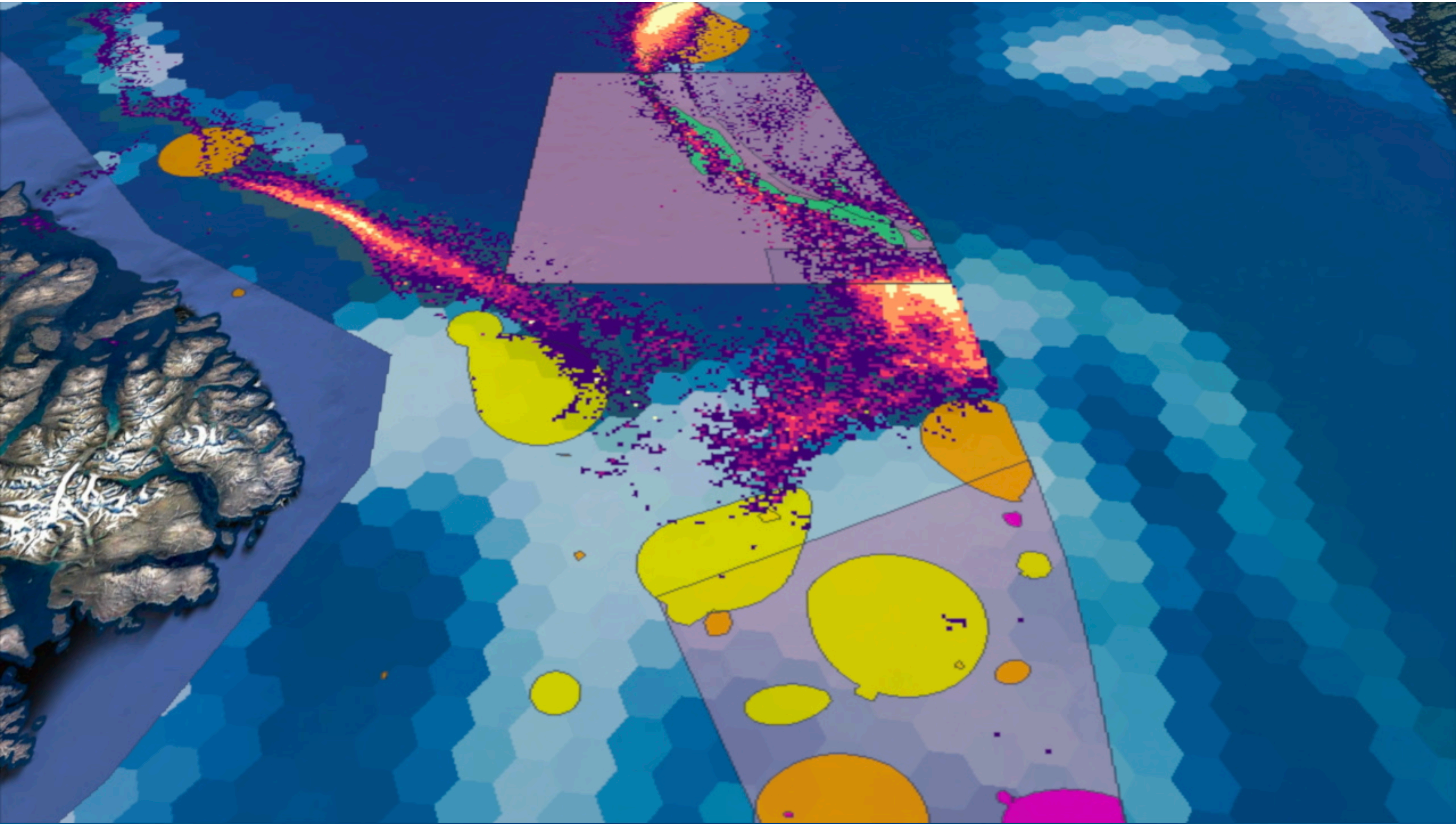
Existing Fisheries Closures



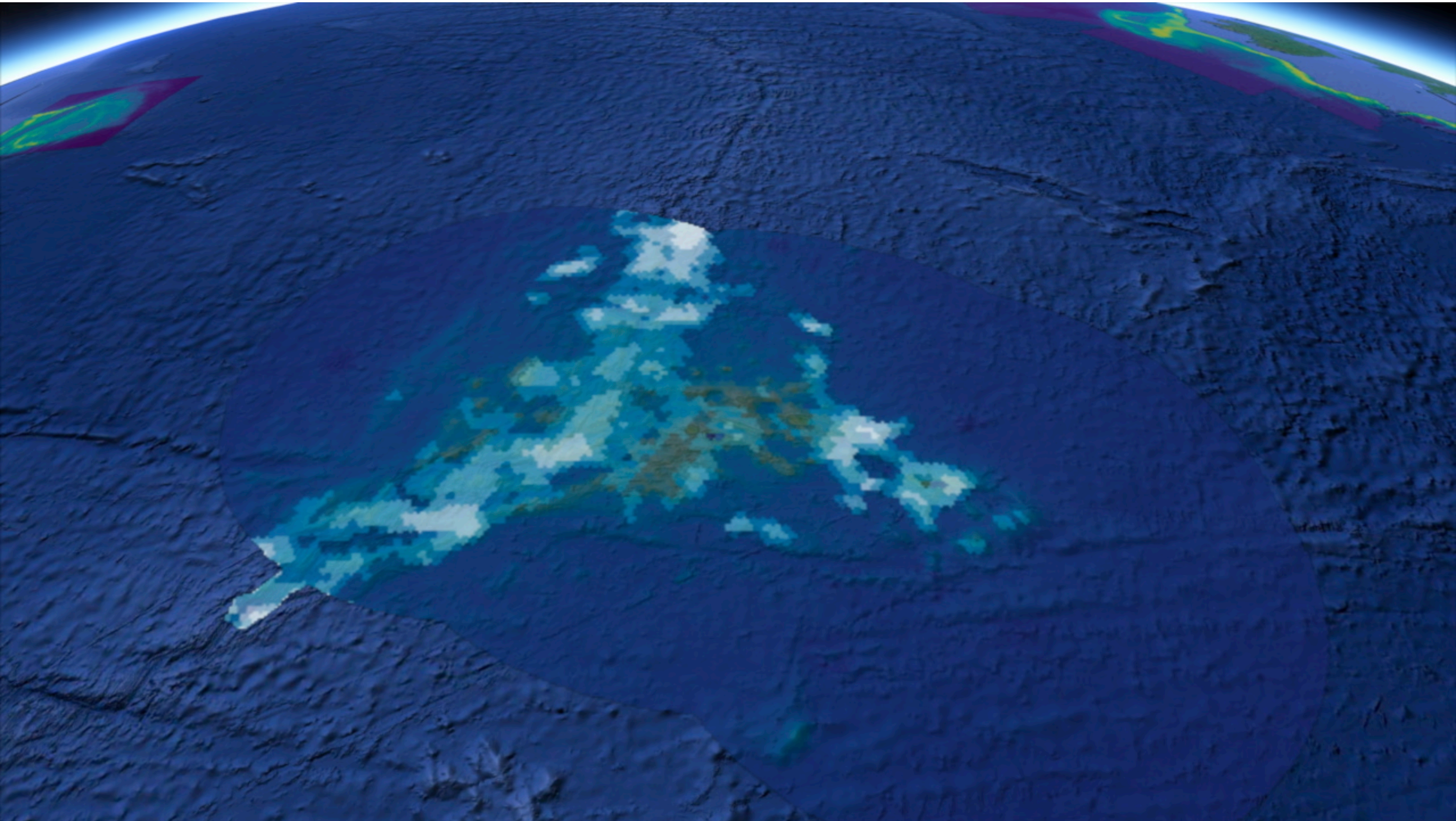
Current Fishing Footprint



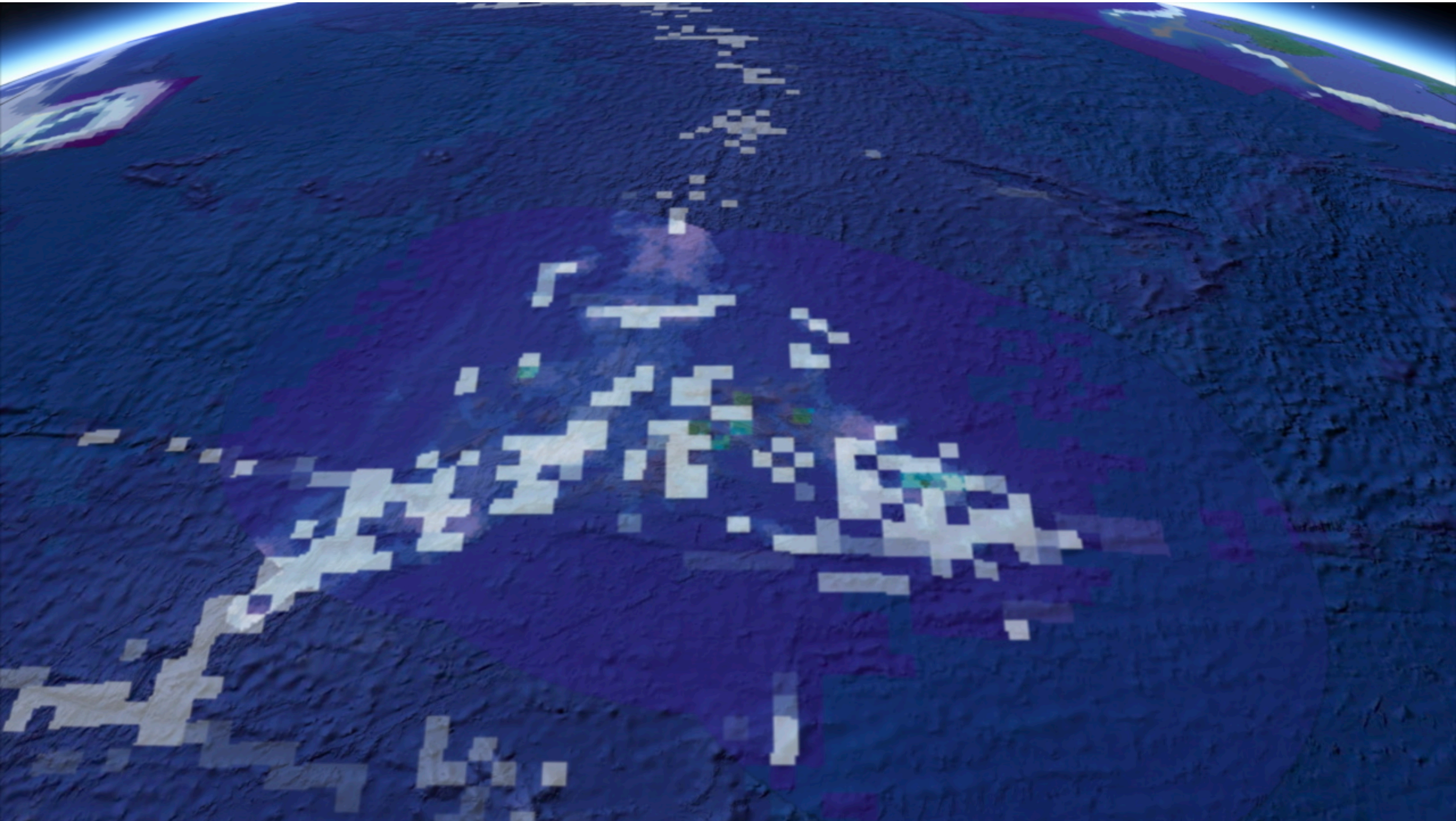
Potential Conservation/Fishing Conflicts Identified



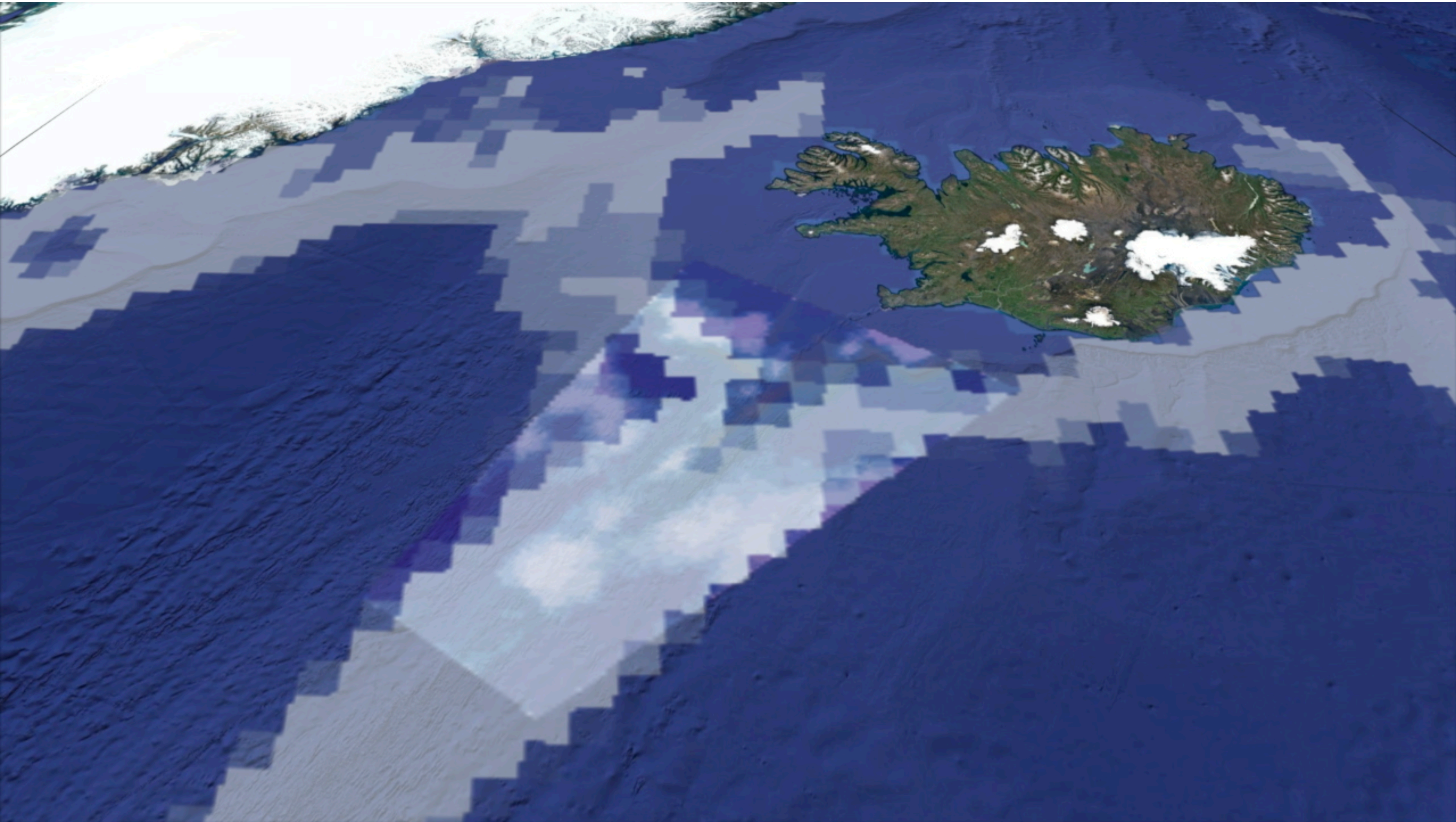
Azores Case Study



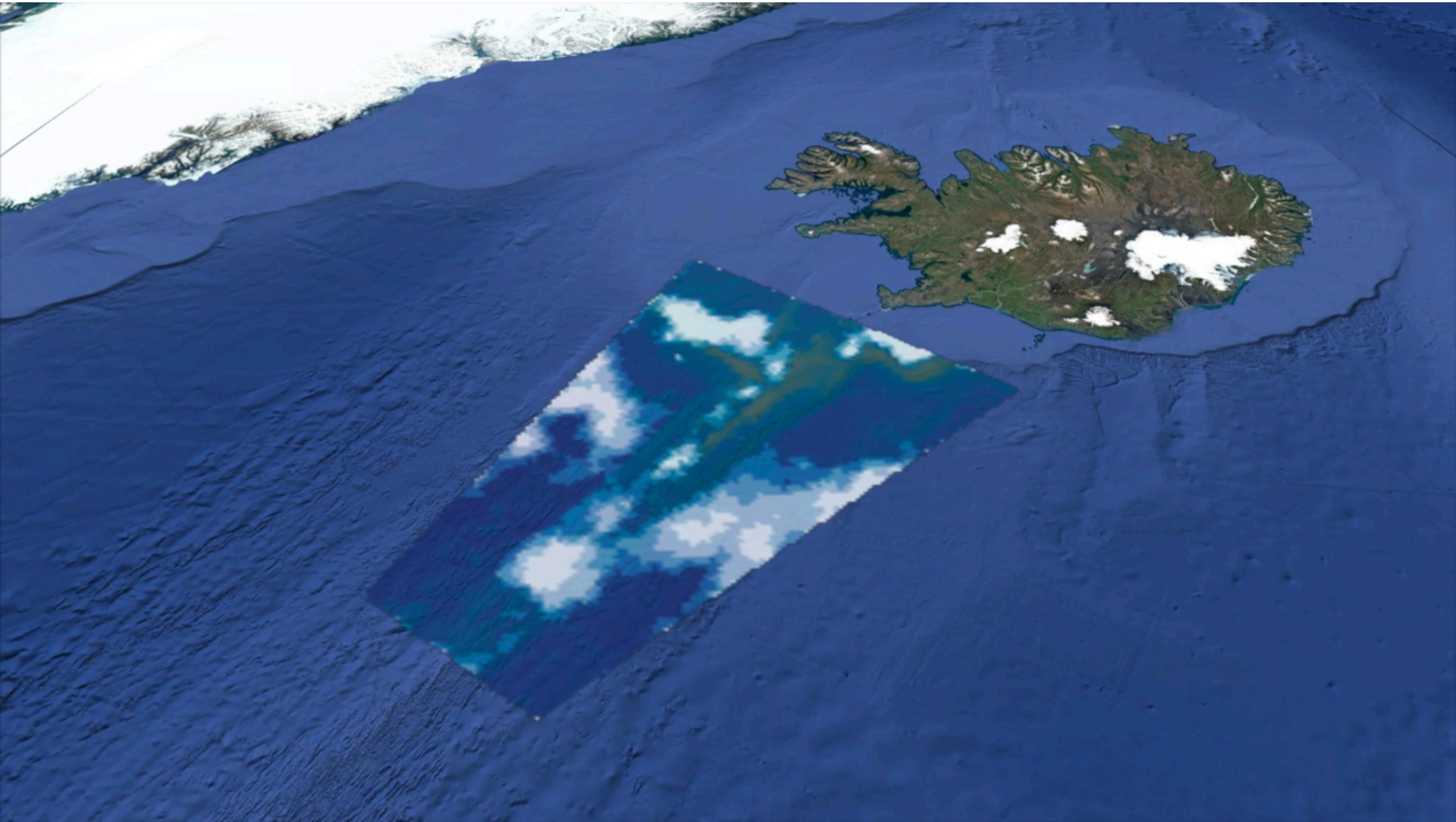
Basin Scale Conservation Planning considering Connectivity



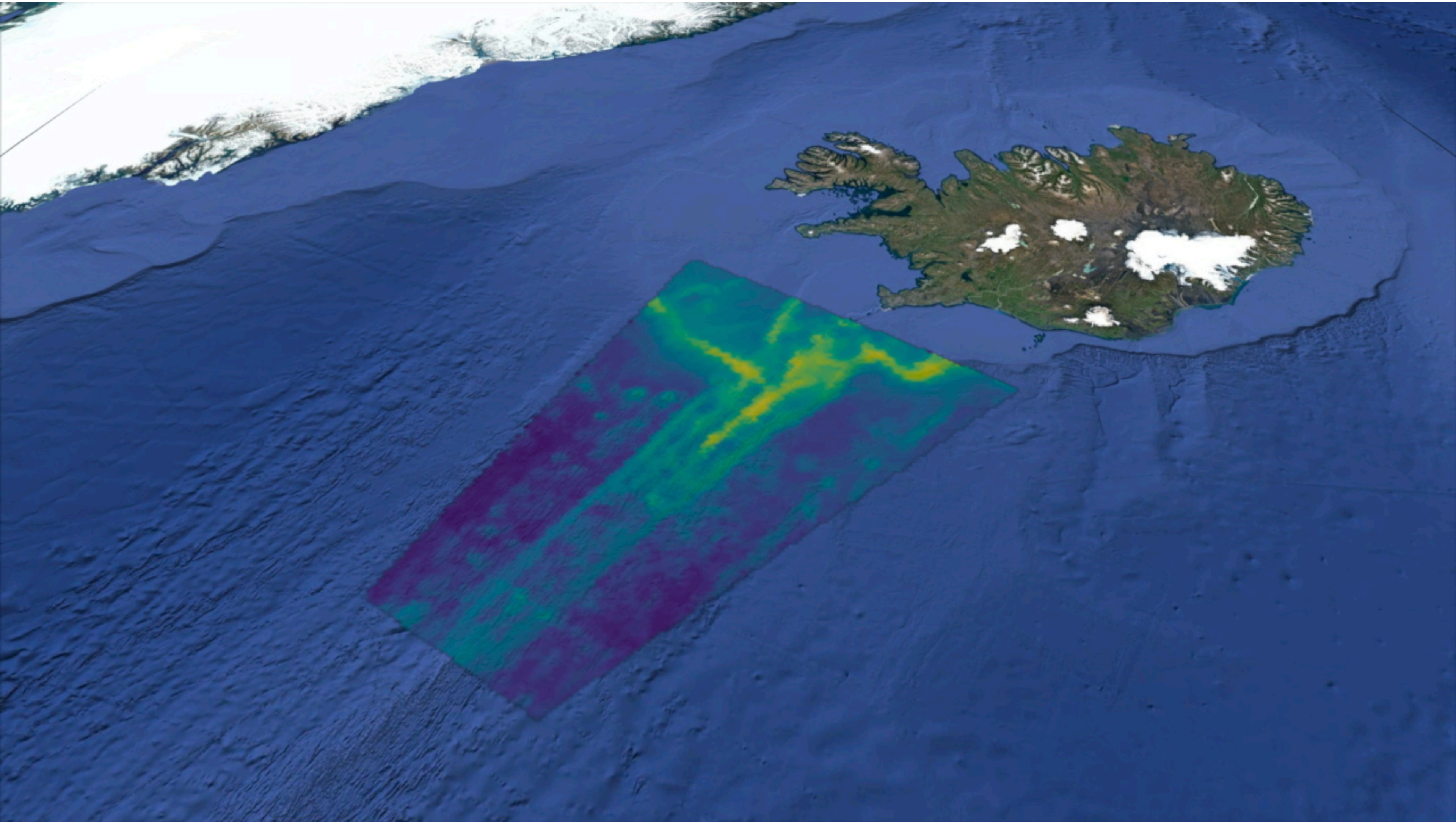
Reykjanes Ridge Case Study



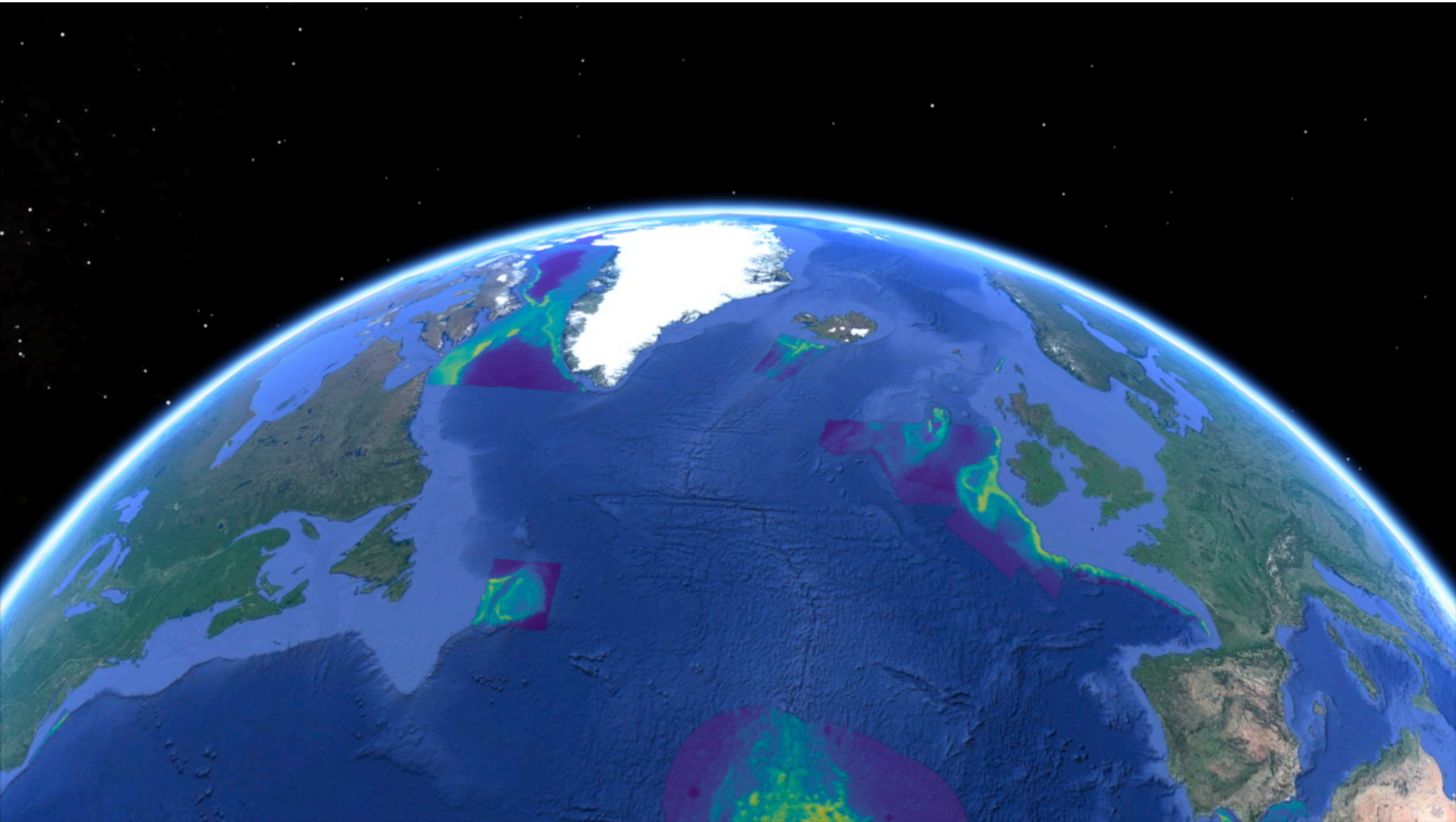
Local Conservation Planning considers Basin-scale Connectivity



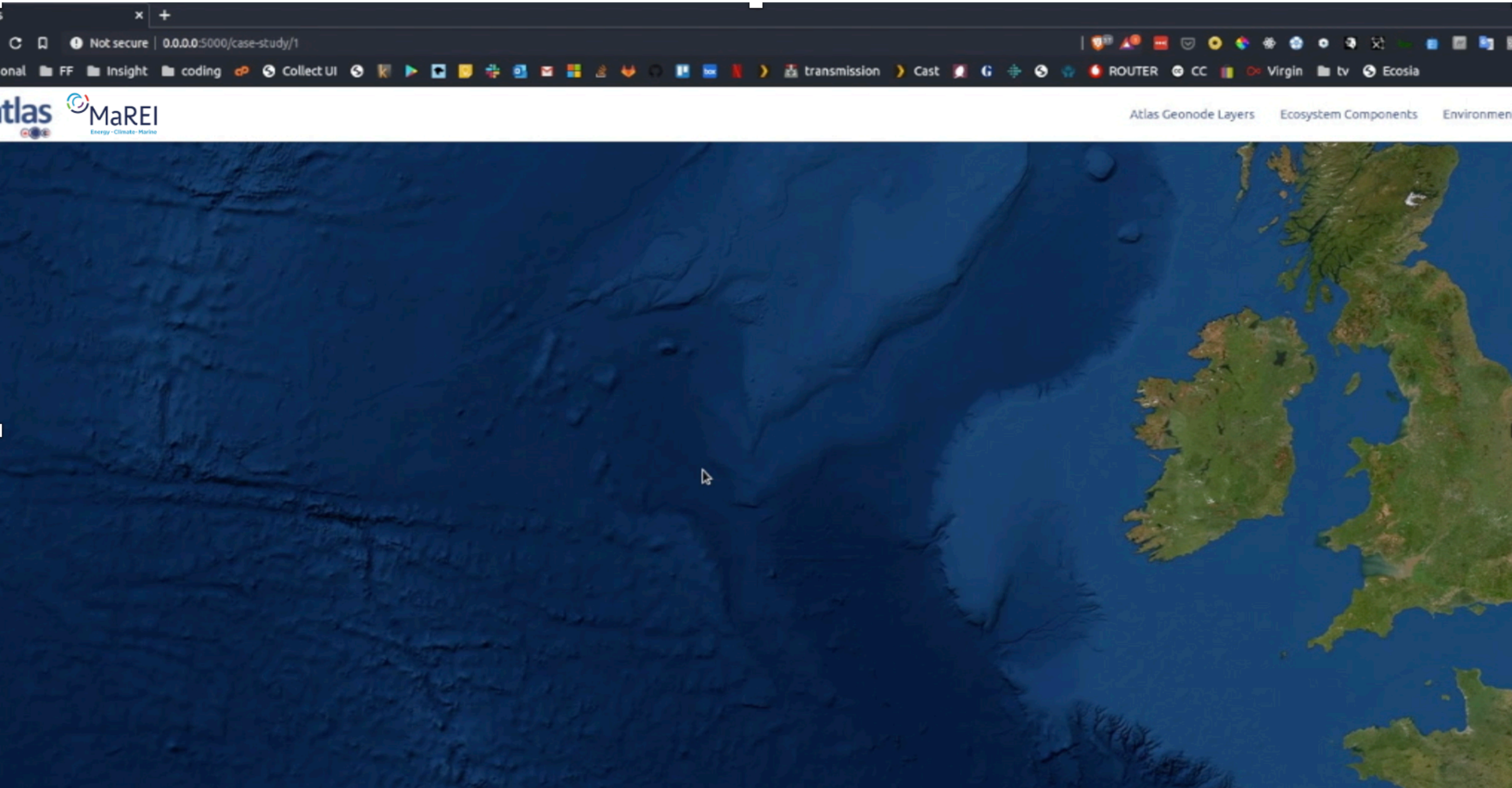
Cell cost based on outputs of Cumulative Effects Assessment



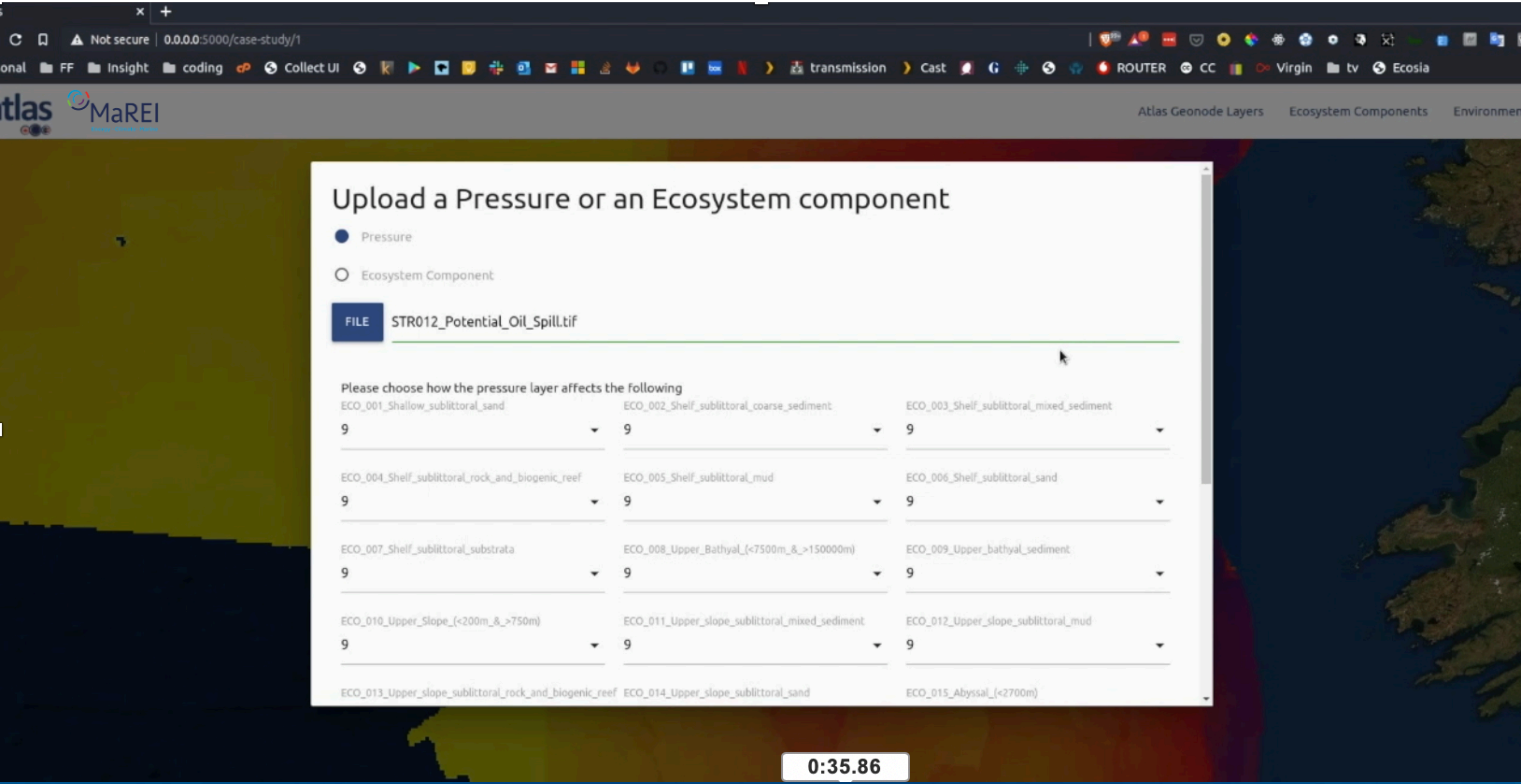
Preliminary CEAs and Marxan Scenarios for 12 ATLAS Case Studies



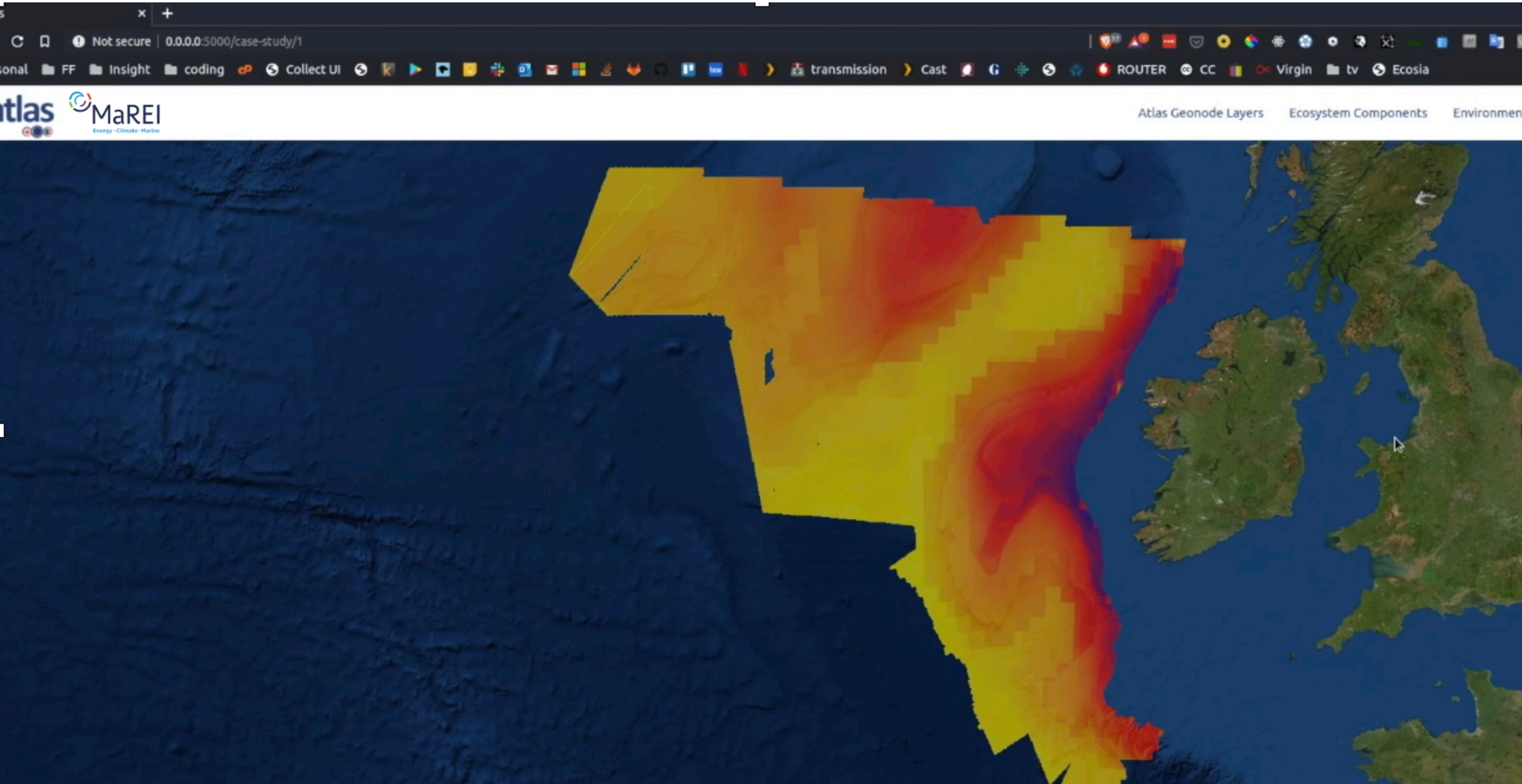
Decision Support Web App



Facilitate CEAs and New Marxan Scenarios



Integrated with ATLAS Geonode



Thank You

Presenter details

Dr Oisín Callery

oisin.callery@nuigalway.ie

Dr Anthony Grehan

anthony.grehan@nuigalway.ie

Project contact details

Coordination: Professor Murray Roberts murray.roberts@ed.ac.uk

Project Office: EU-Atlas@ed.ac.uk

Communication & Press: atlas@aquatt.ie

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