Knowledge Discovery of Human Activities at Sea in the Arctic using Remote Sensing and Vessel Tracking Systems

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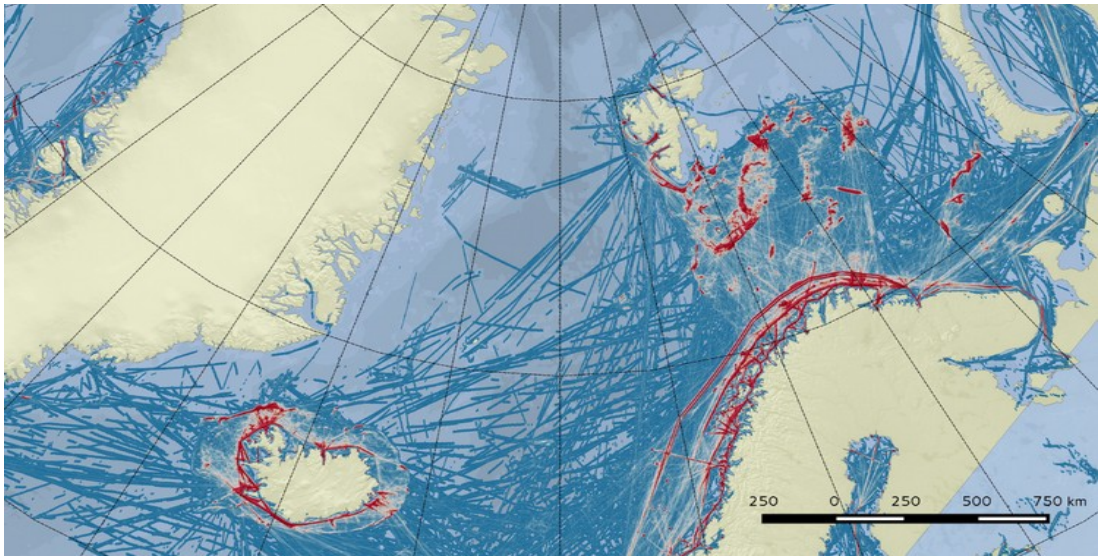
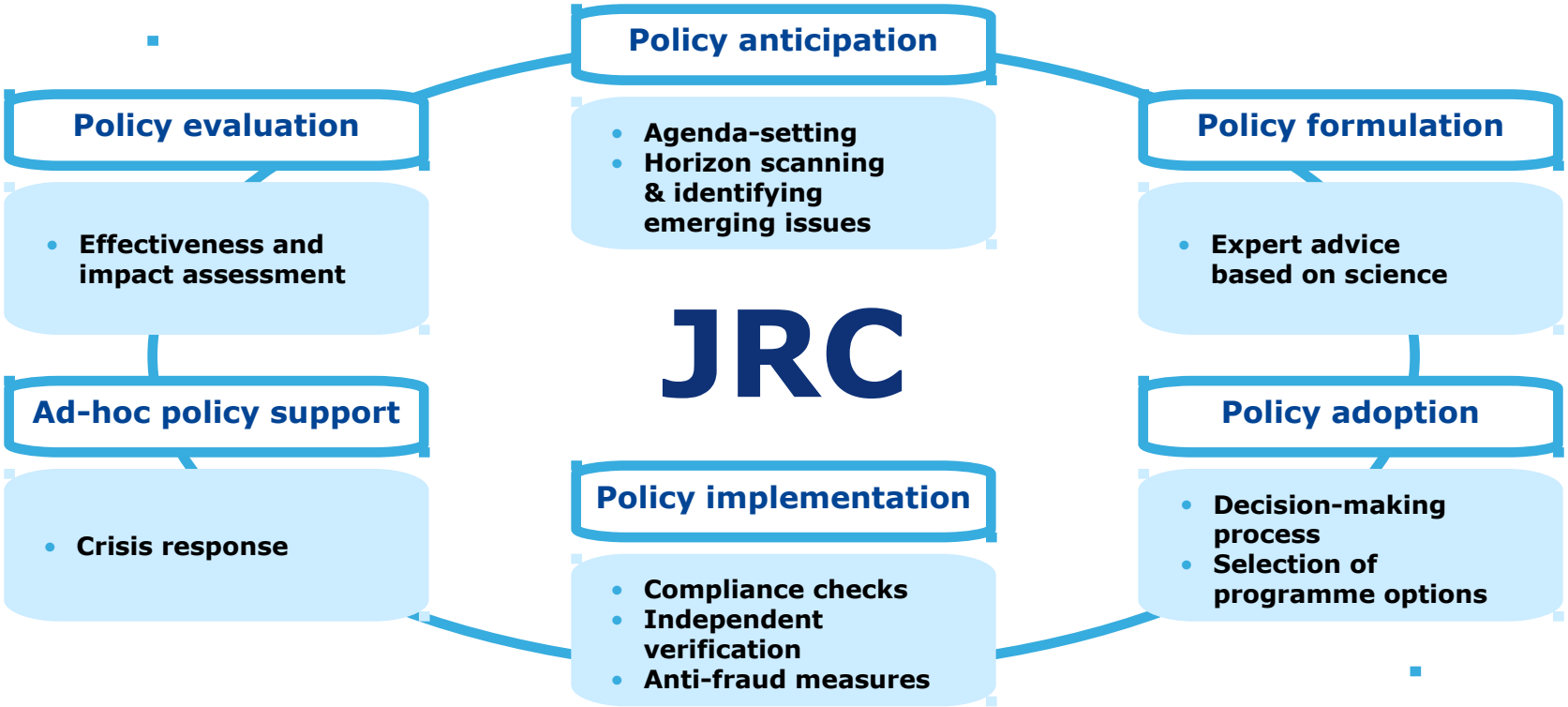


Joint Research Centre

Implementing the European Commission's Joint Research Centre mission in the EU policy cycle



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Maritime Surveillance Data

Categories of data

- Ship reporting data: AIS, LRIT, VMS, …
- Observation systems: Cameras, radars, …;
  from Shore, airplane, satellite, …
- Ship registries, data bases: Fishing fleet, Equasis, blacklists, …
- Intel: Reports, Local knowledge, …
- Supporting: Maps, ENC, weather, oceanographic, …

Integration

- Many applications need a fairly complete picture of what is happening at sea
- No single data source is adequate on its own
- Data of many sources needs to be integrated into a single picture

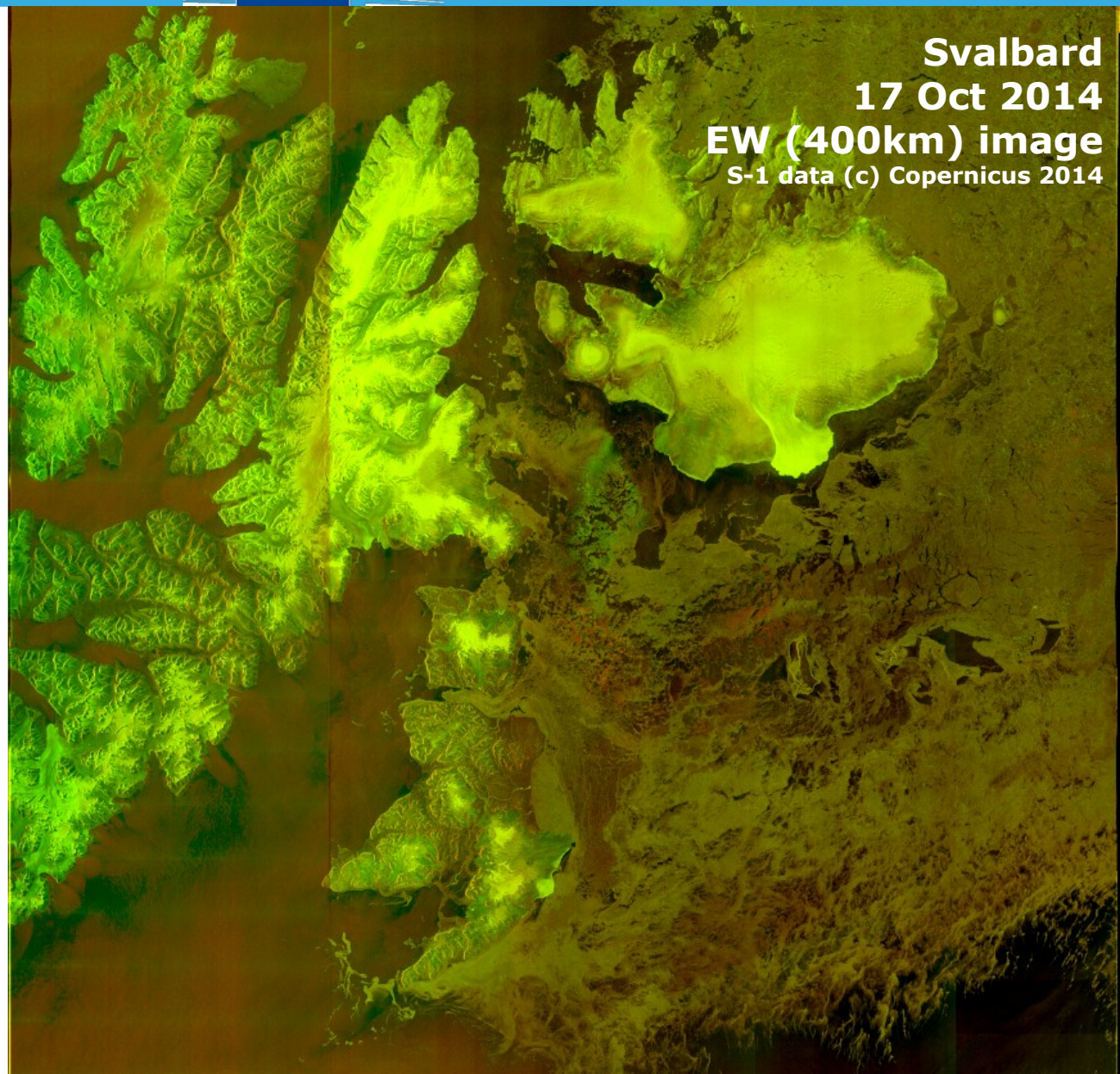
Sentinel -1:

Europe's Earth Observation radar

- Since Oct 2014
- Open data policy
- Routinely acquiring images over the Arctic

Maritime:

- Ice cover
- Oil pollution
- Ship traffic
- Wind, waves



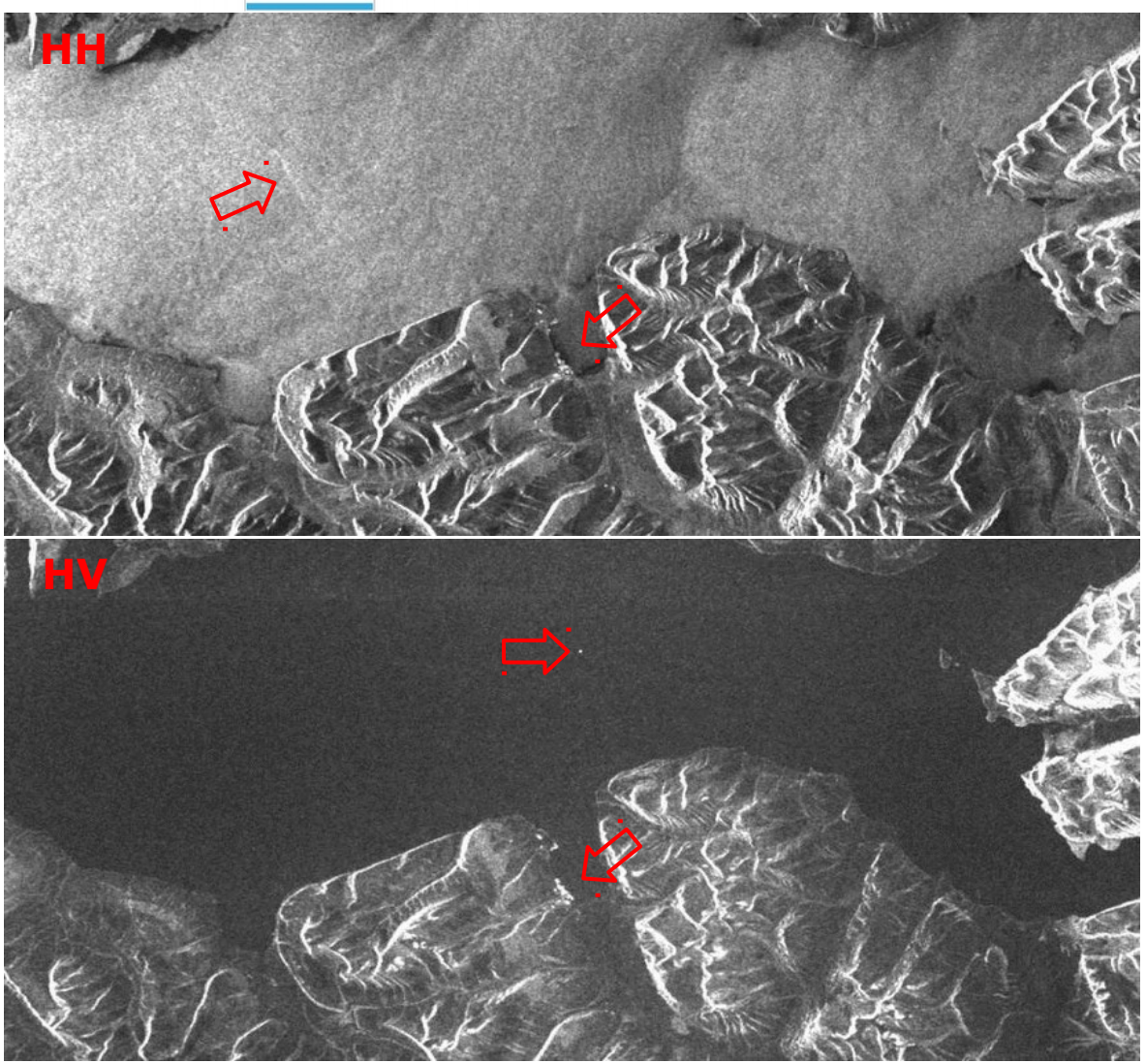
Sentinel -1:

Longyearbyen

Use of two polarisation channels for ship detection

Arctic challenge:

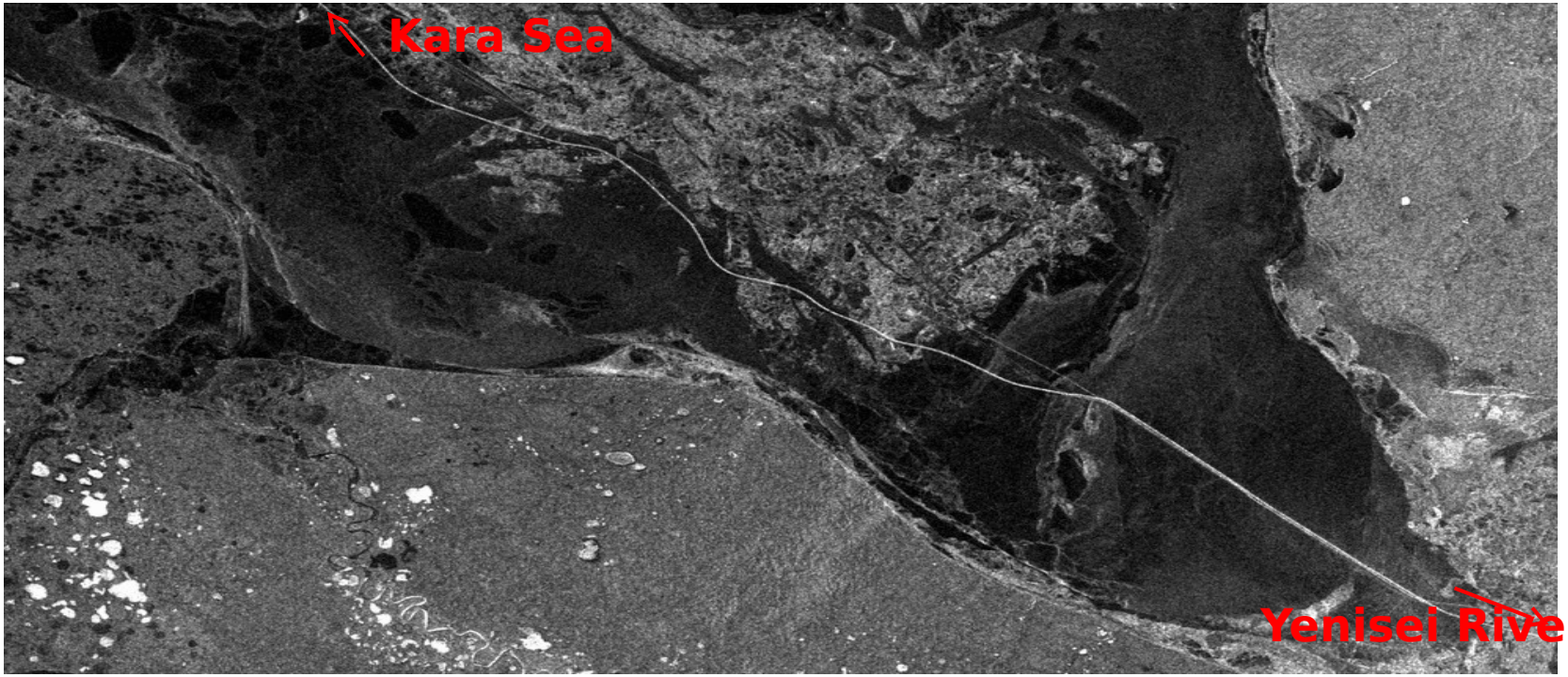
Ship detection in sea ice



17 Oct 2014

Sentinel-1 and AIS ice pathways analysis

Yenisei Gulf (Siberia 72.4N, 79.6E) (120 km E-W x 67 km N-S)



Sentinel-1 image from 2105-04-19 01:28:13 (UTC)

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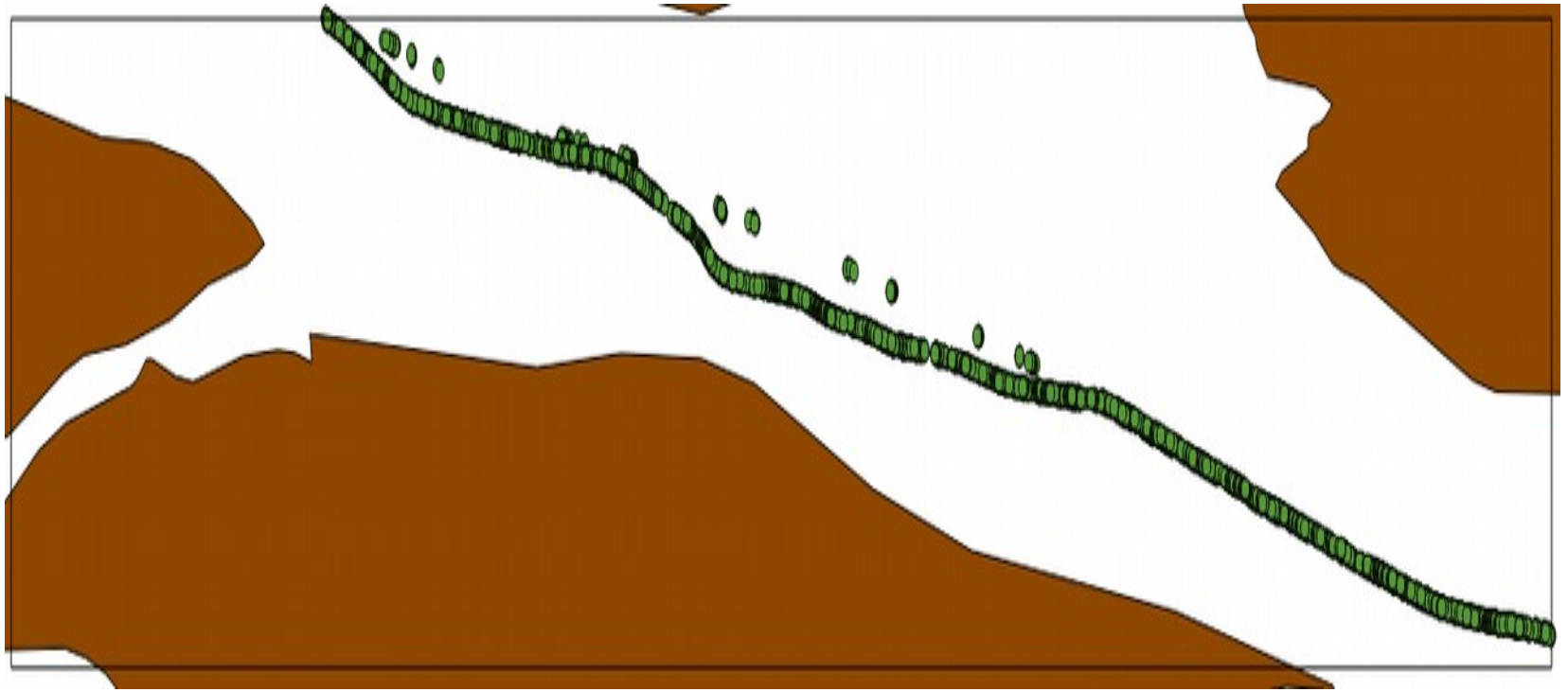
Sentinel-1 and AIS ice pathways analysis

Yenisei Gulf (Siberia 72.4N, 79.6E) (120 km E-W x 67 km N-S)



Sat-AIS from 2105-01-01 to 2015-04-22 (3.5 months): 5088 messa

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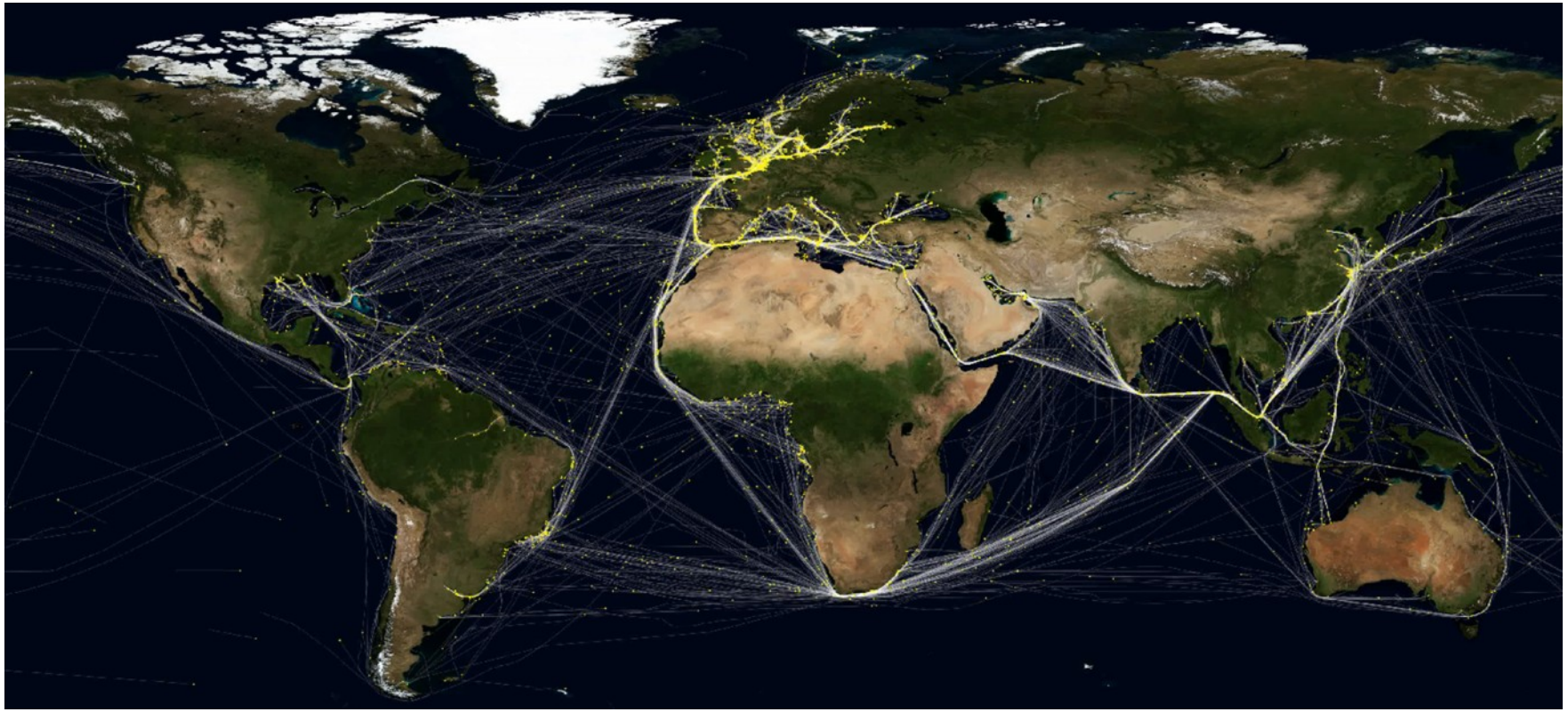
From EU to worldwide tracking and traffic routes



One-month of EU LRIT CDC data, revealing the main global traffic routes and enabling the implementation of innovative decision support tools

→ Video Link

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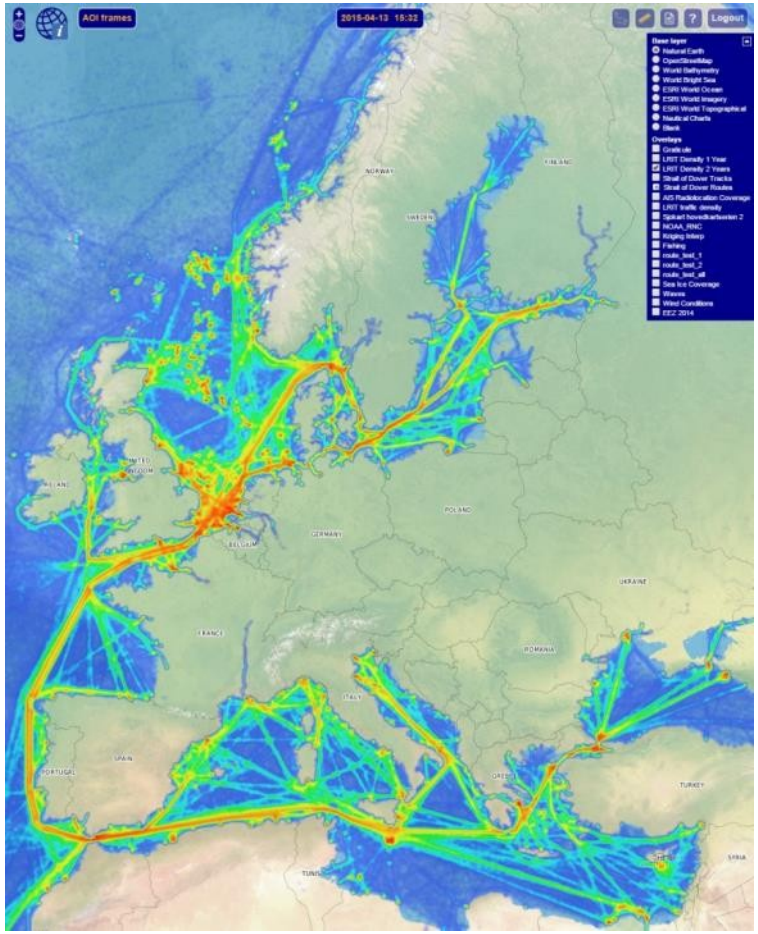
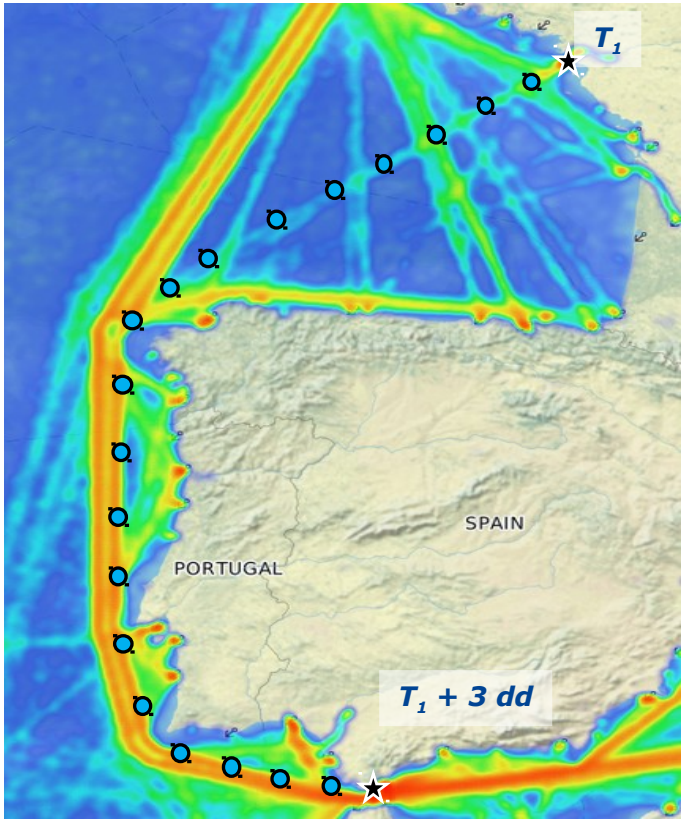
Using density maps to predict vessel routes





Historical LRIT data can be used to predict where a vessel will be up to a few days in advance

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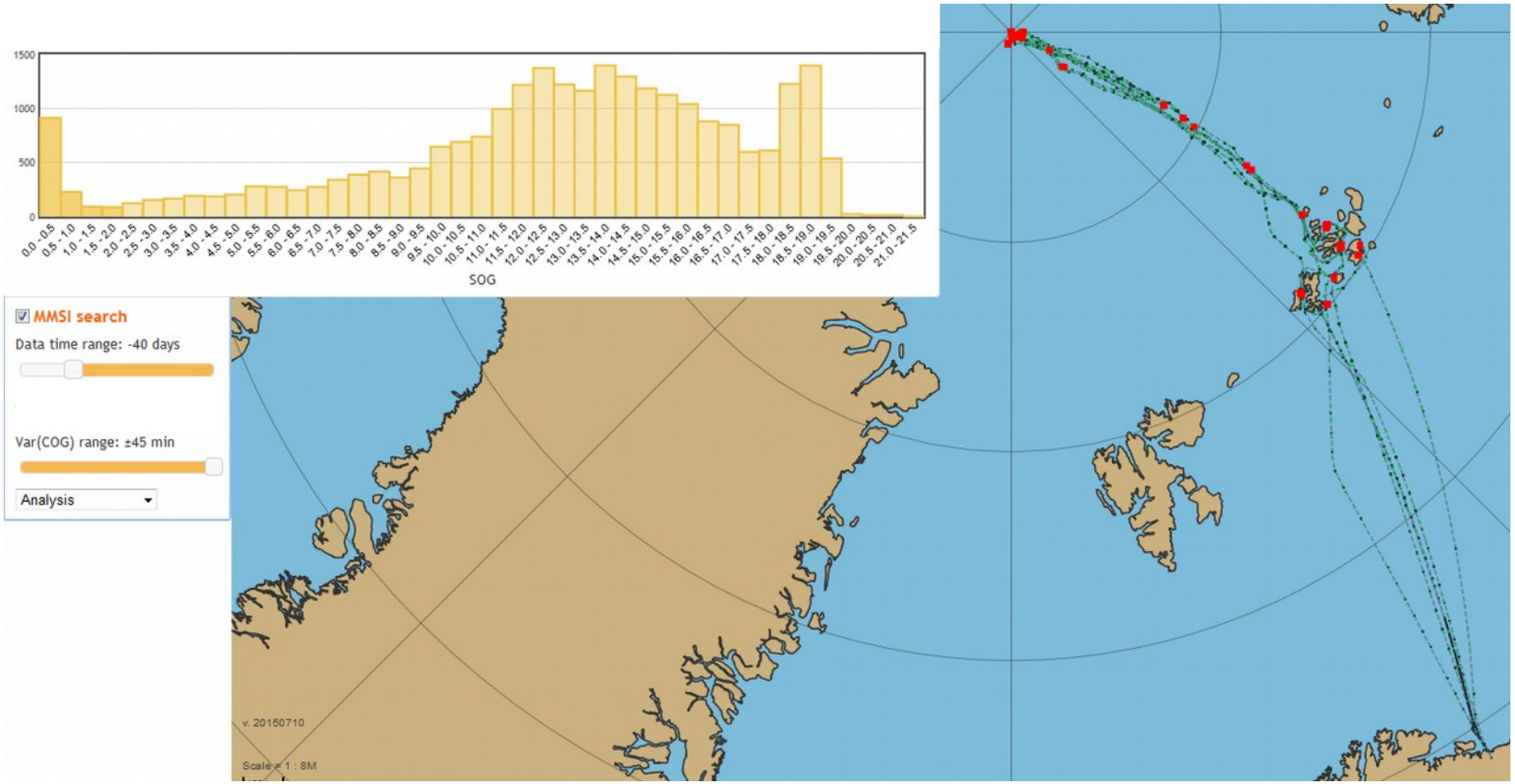
Coding vessel behaviours



Icebreaker

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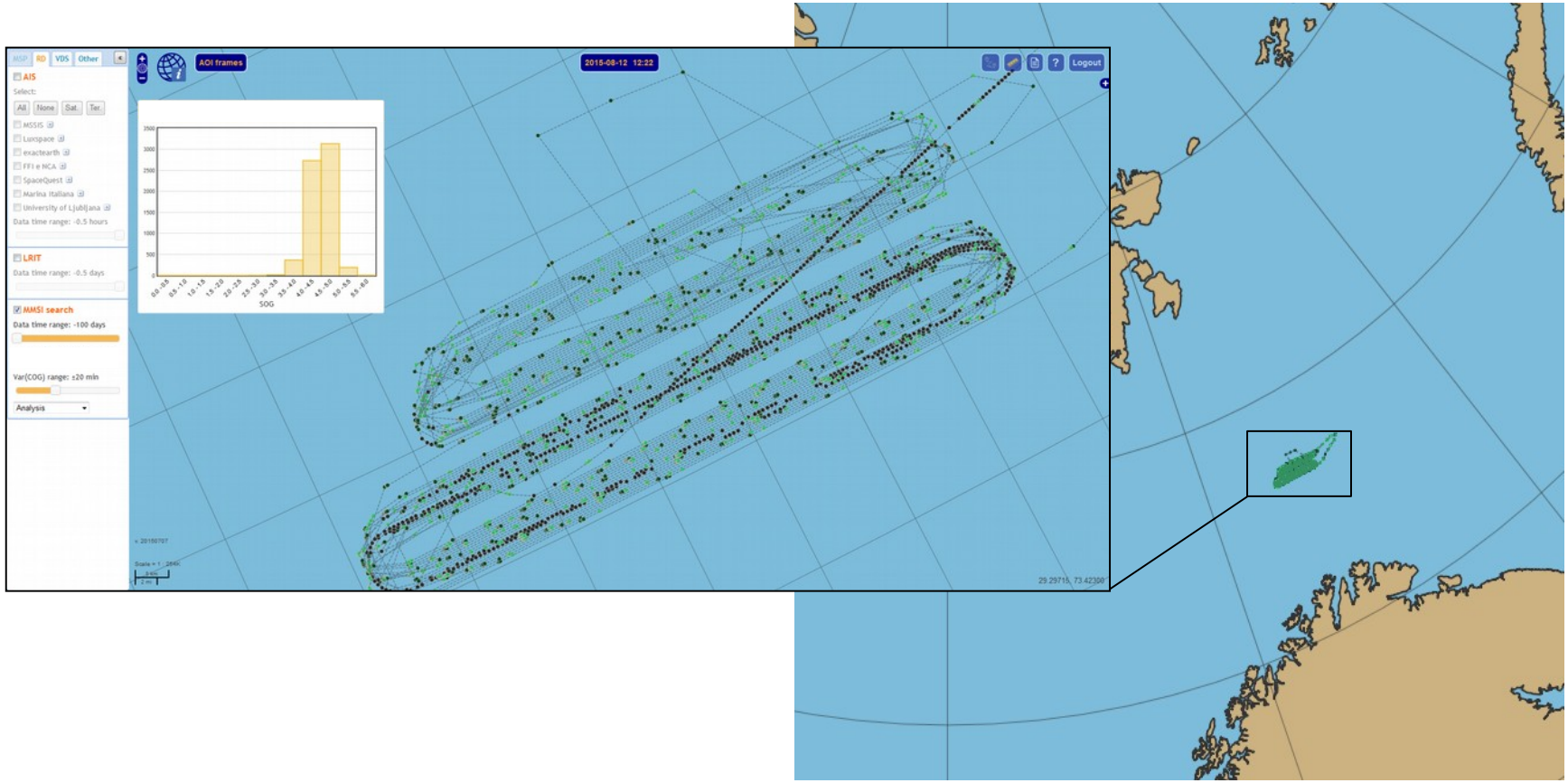

Research and Survey Vessel Behaviour

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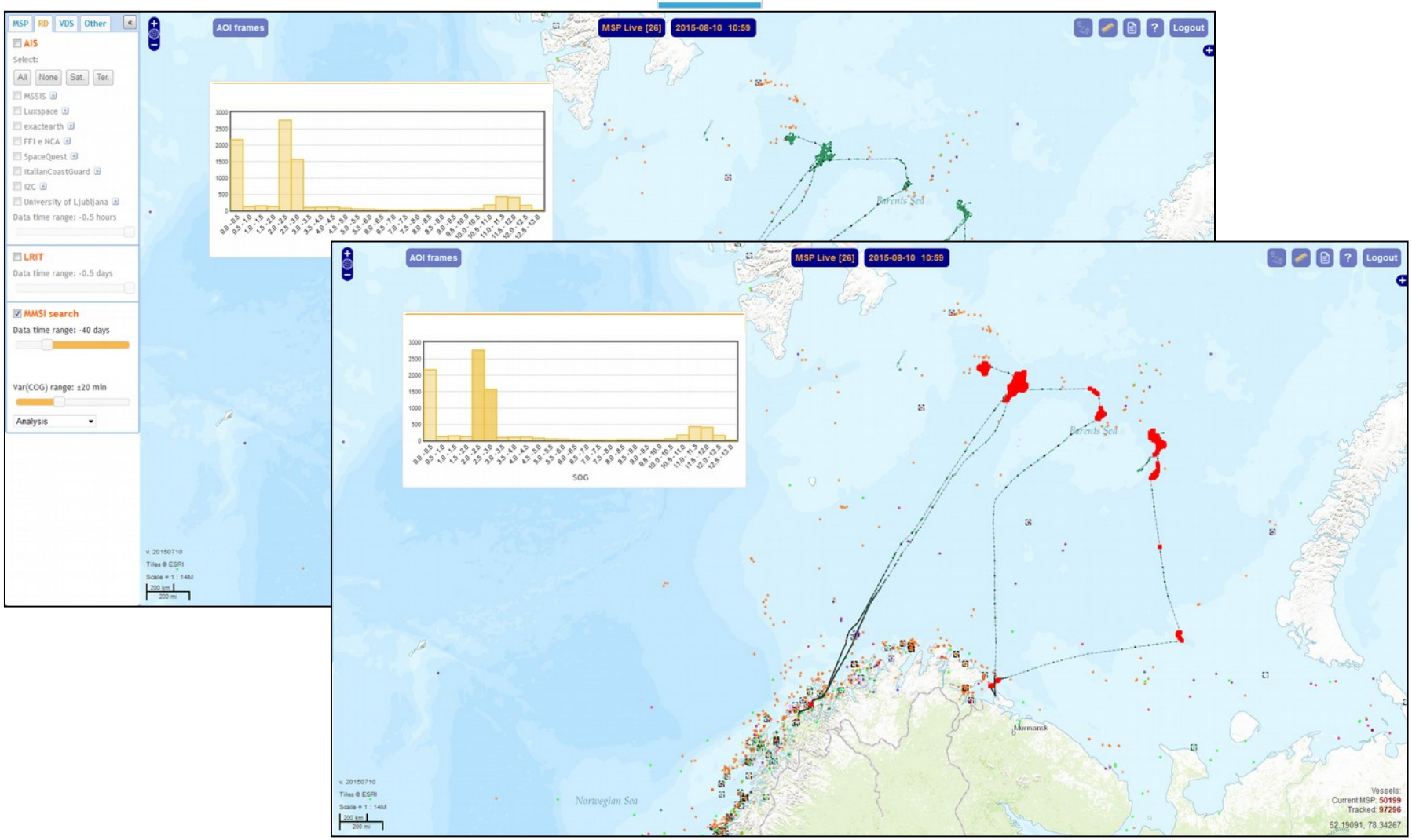

Fishing Behaviour

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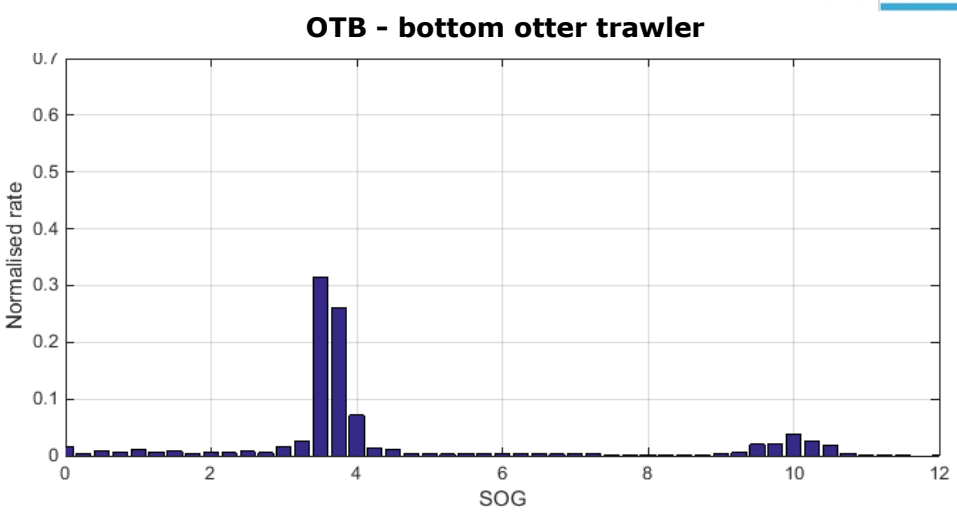
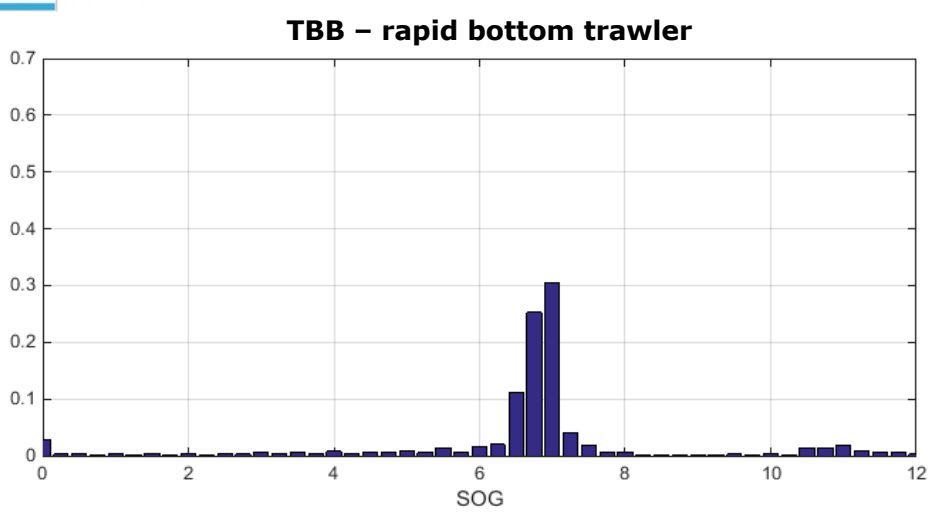
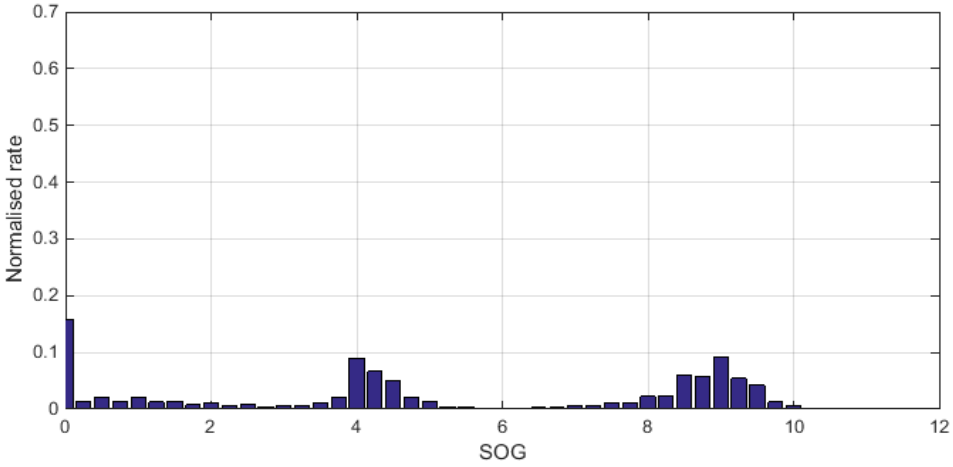
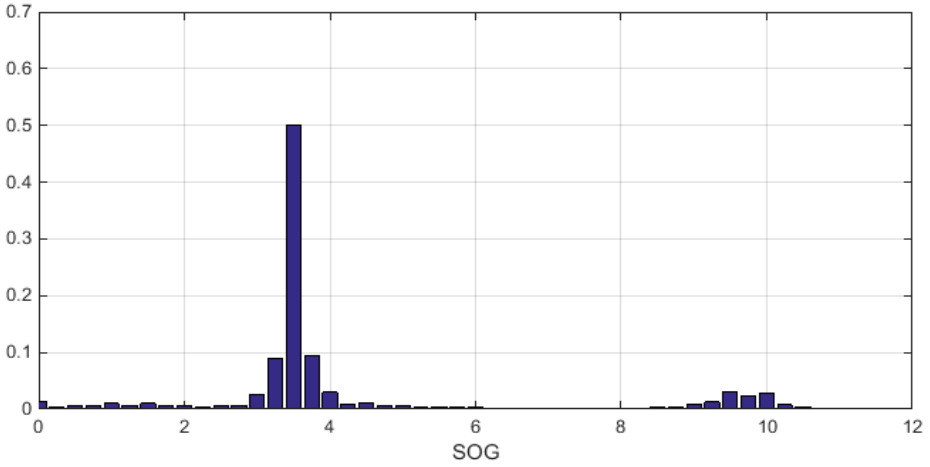
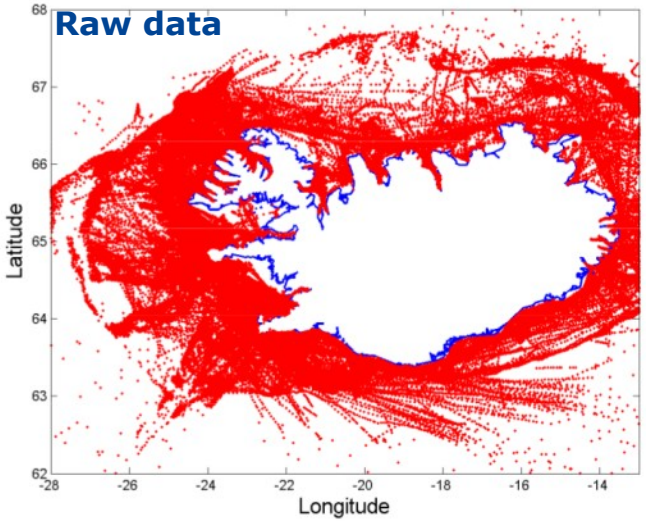


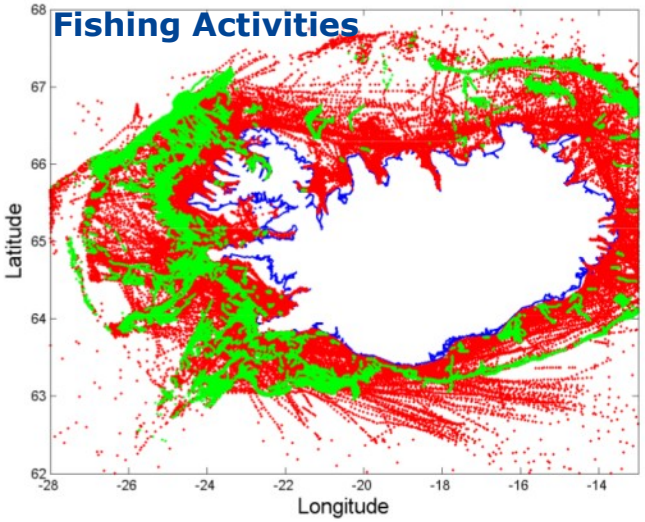




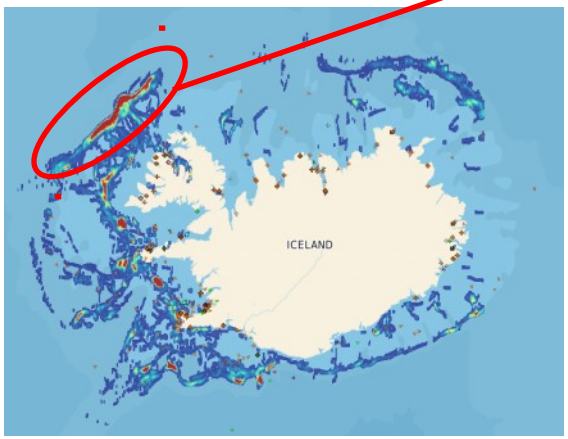


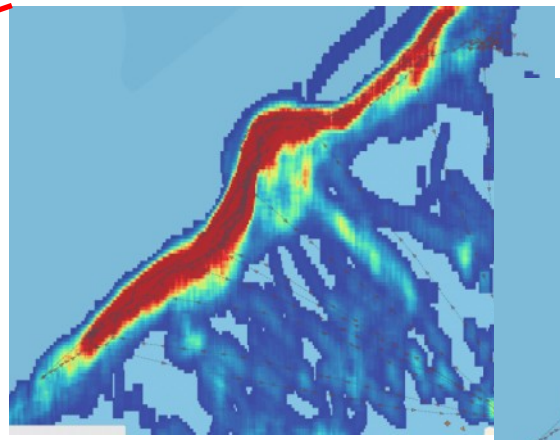
Fishing Behaviour vs gear



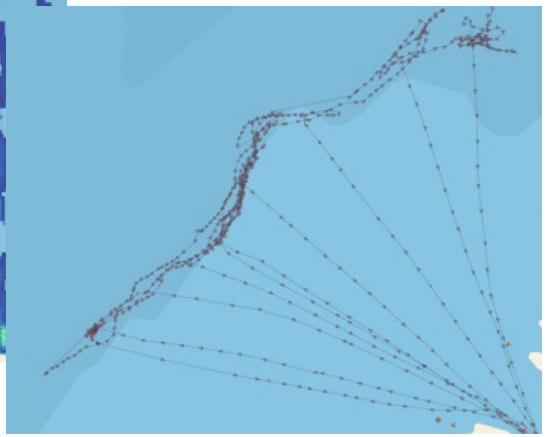


Historical fishing activities





Real time fishing behaviour



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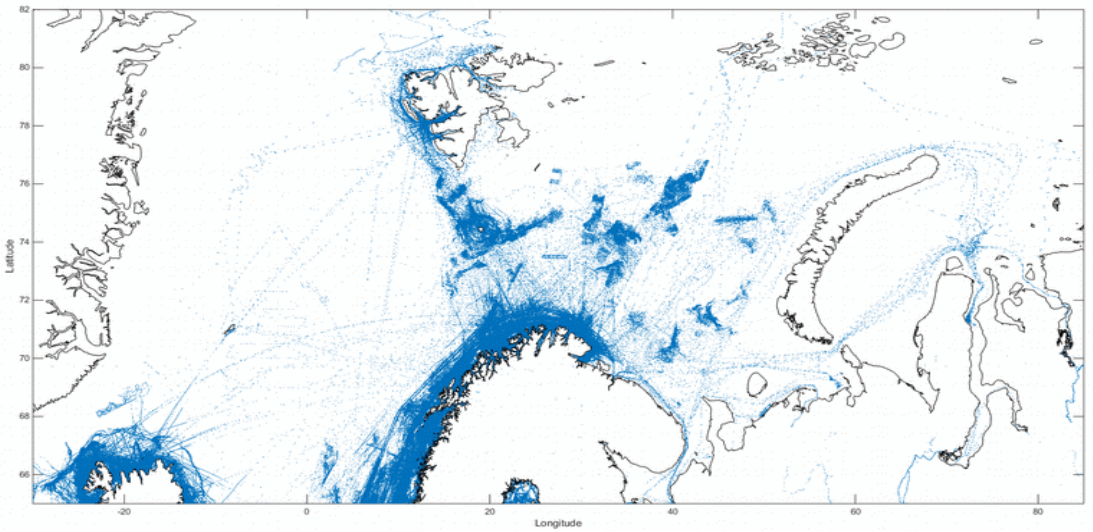
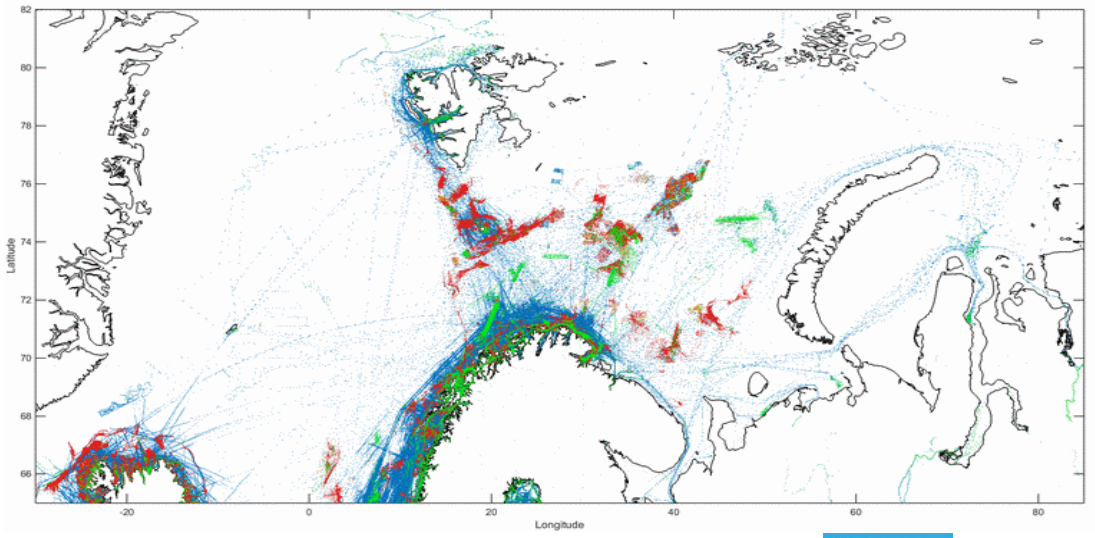
From vessel densities to activities mapping





By coding the relevant behaviours it is possible to isolate shipping (blue), fishing (red) and exploration (green) activities.

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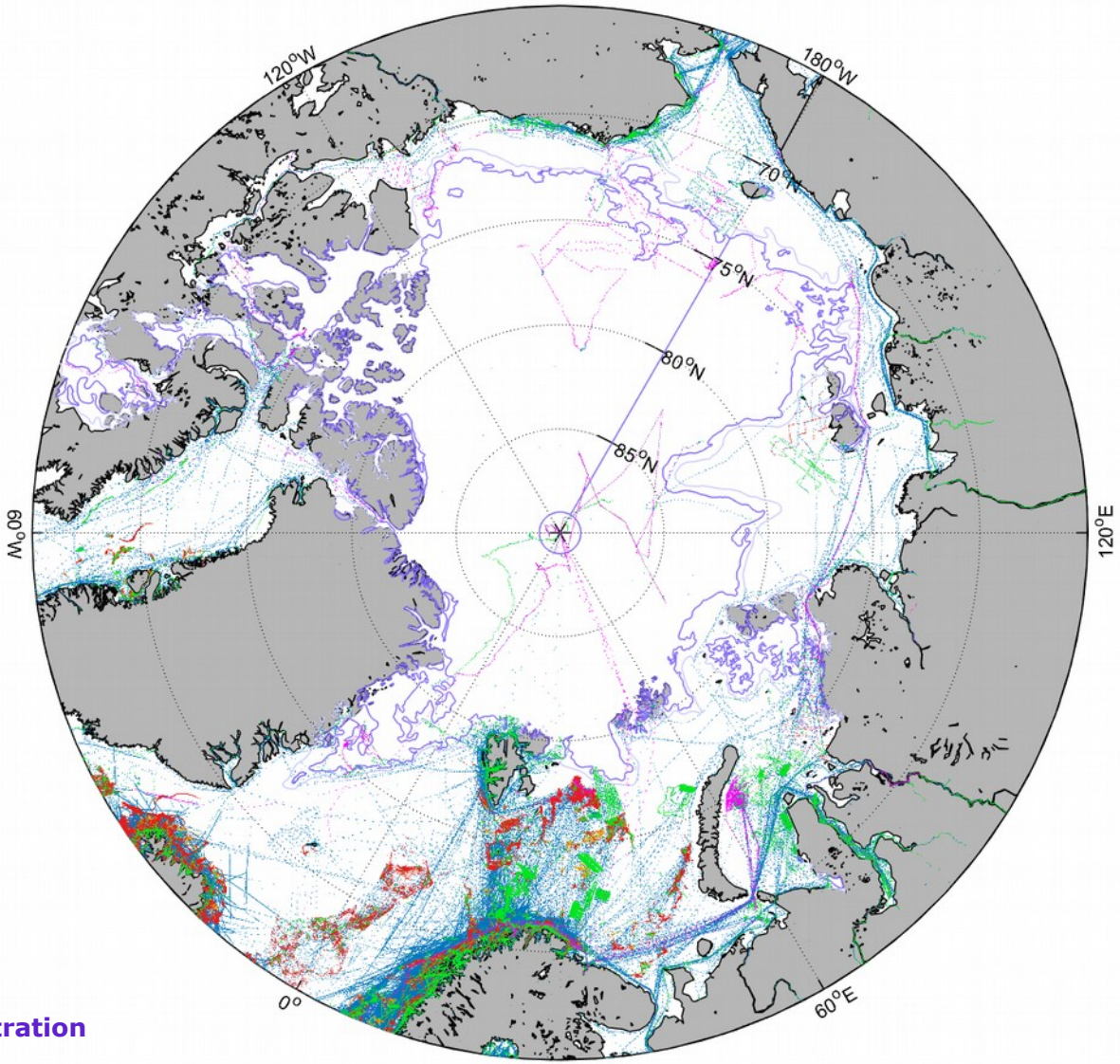
Time period: from 2014-08-01 to 2014-08-30

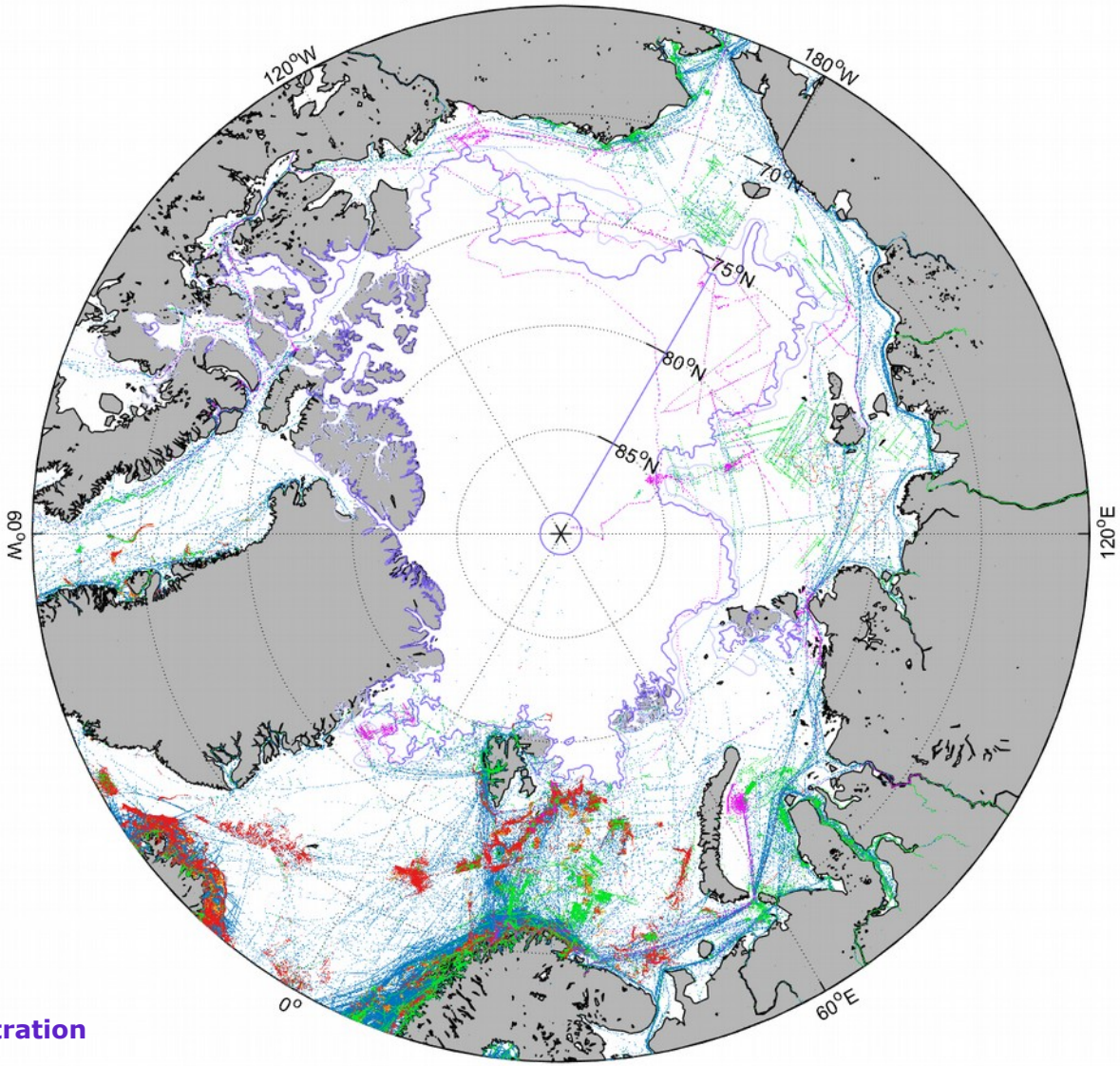


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2014-09-01 to 2014-09-30

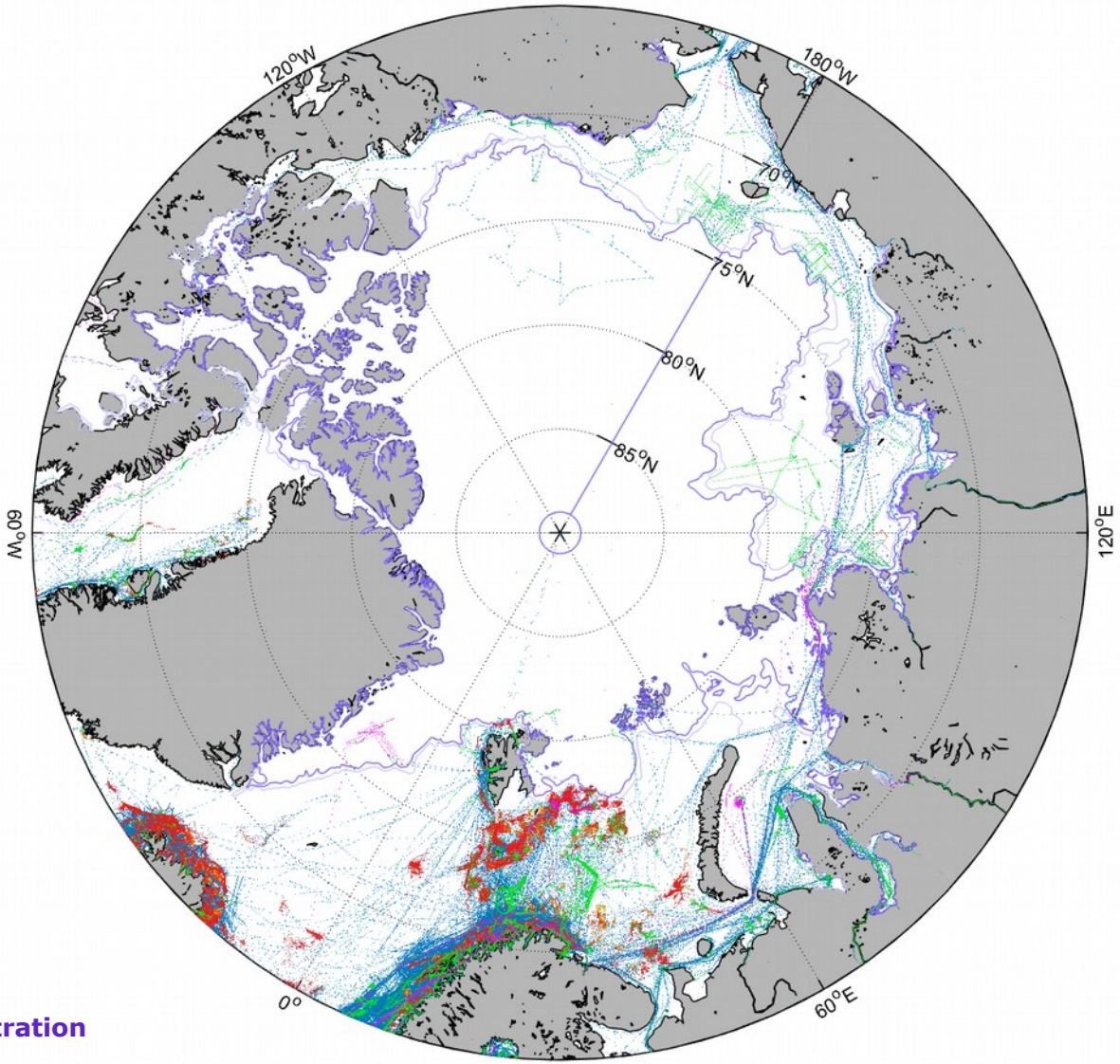


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2014-10-01 to 2014-10-30

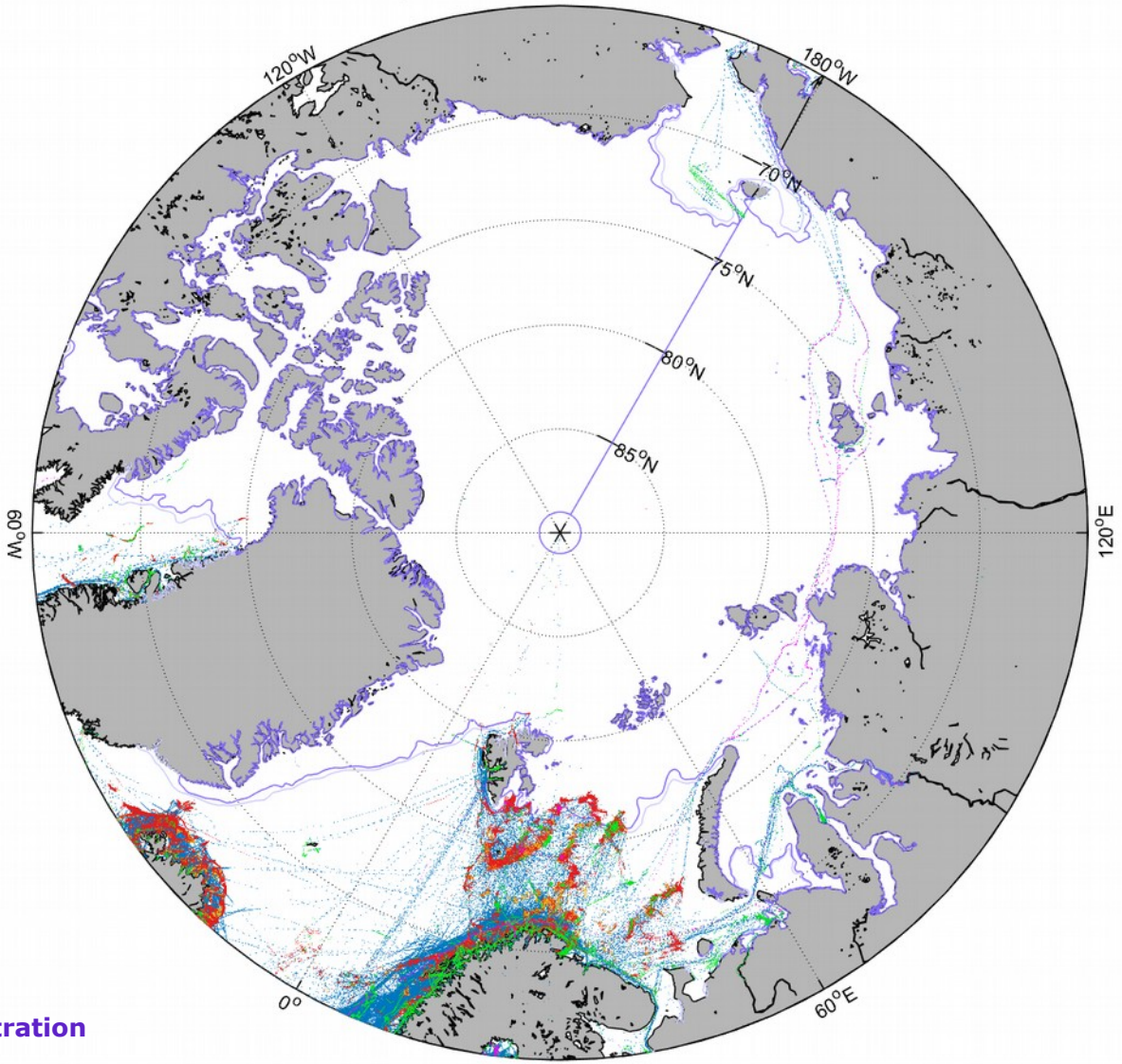


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2014-11-01 to 2014-11-30

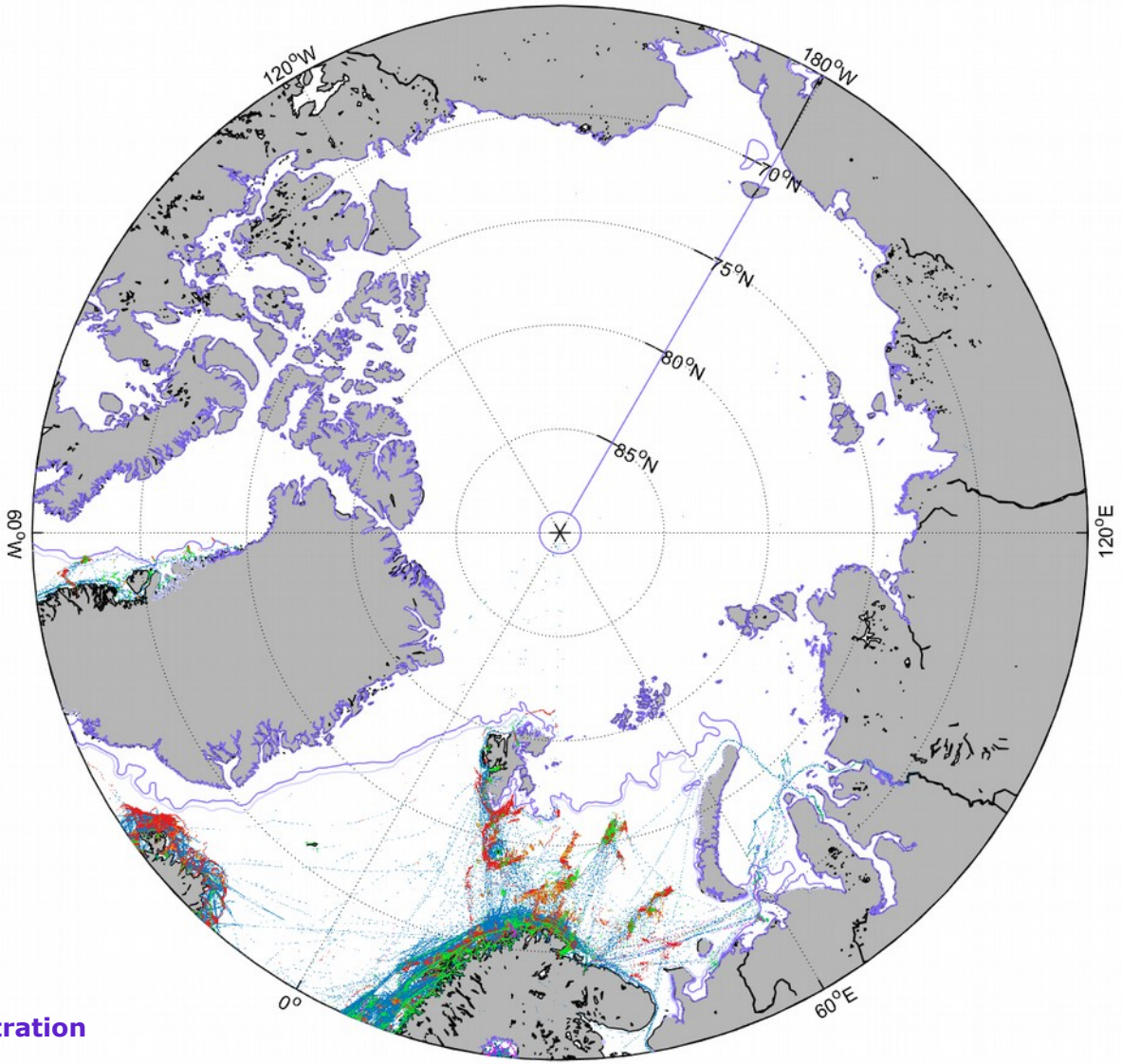


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2014-12-01 to 2014-12-30

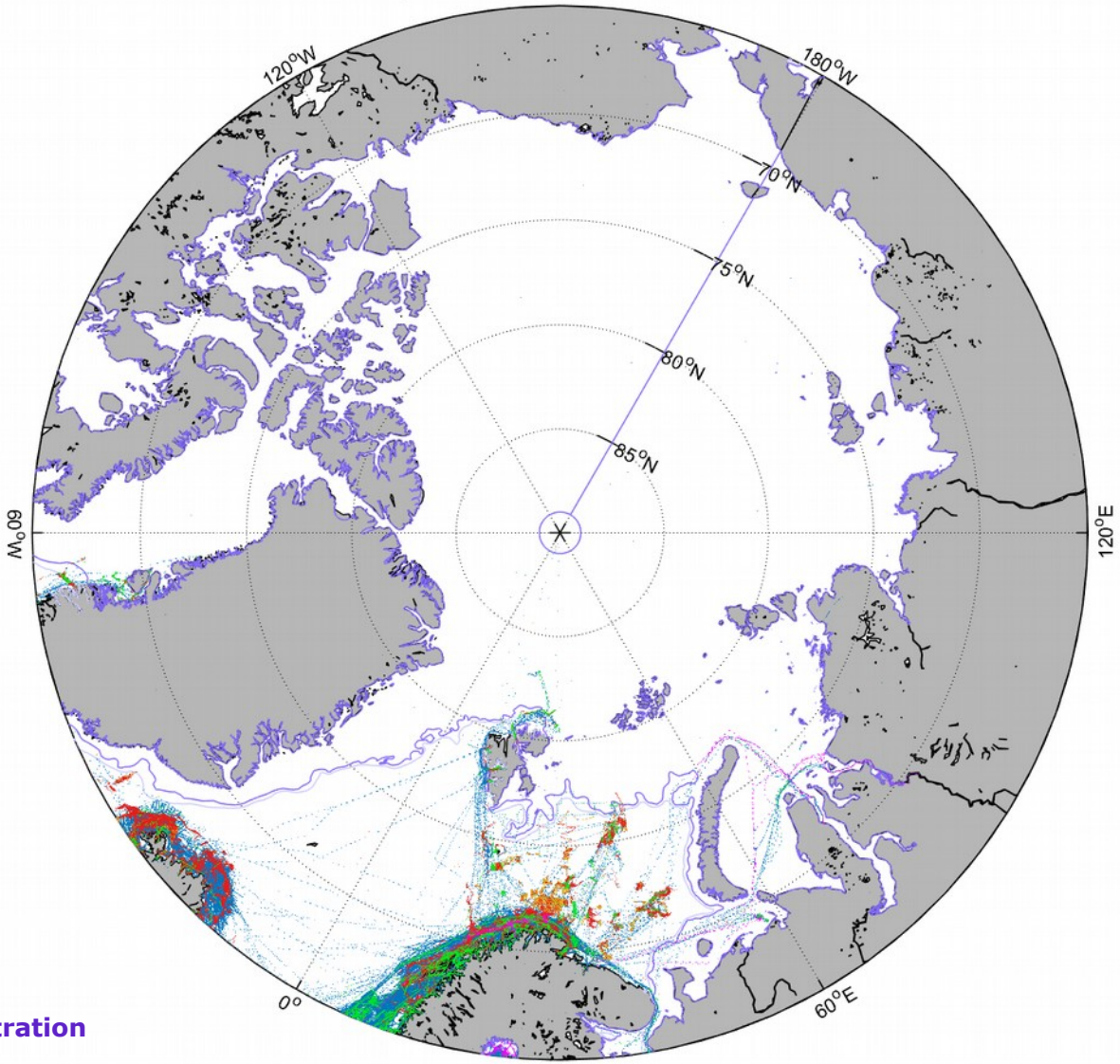


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2015-01-01 to 2015-01-30

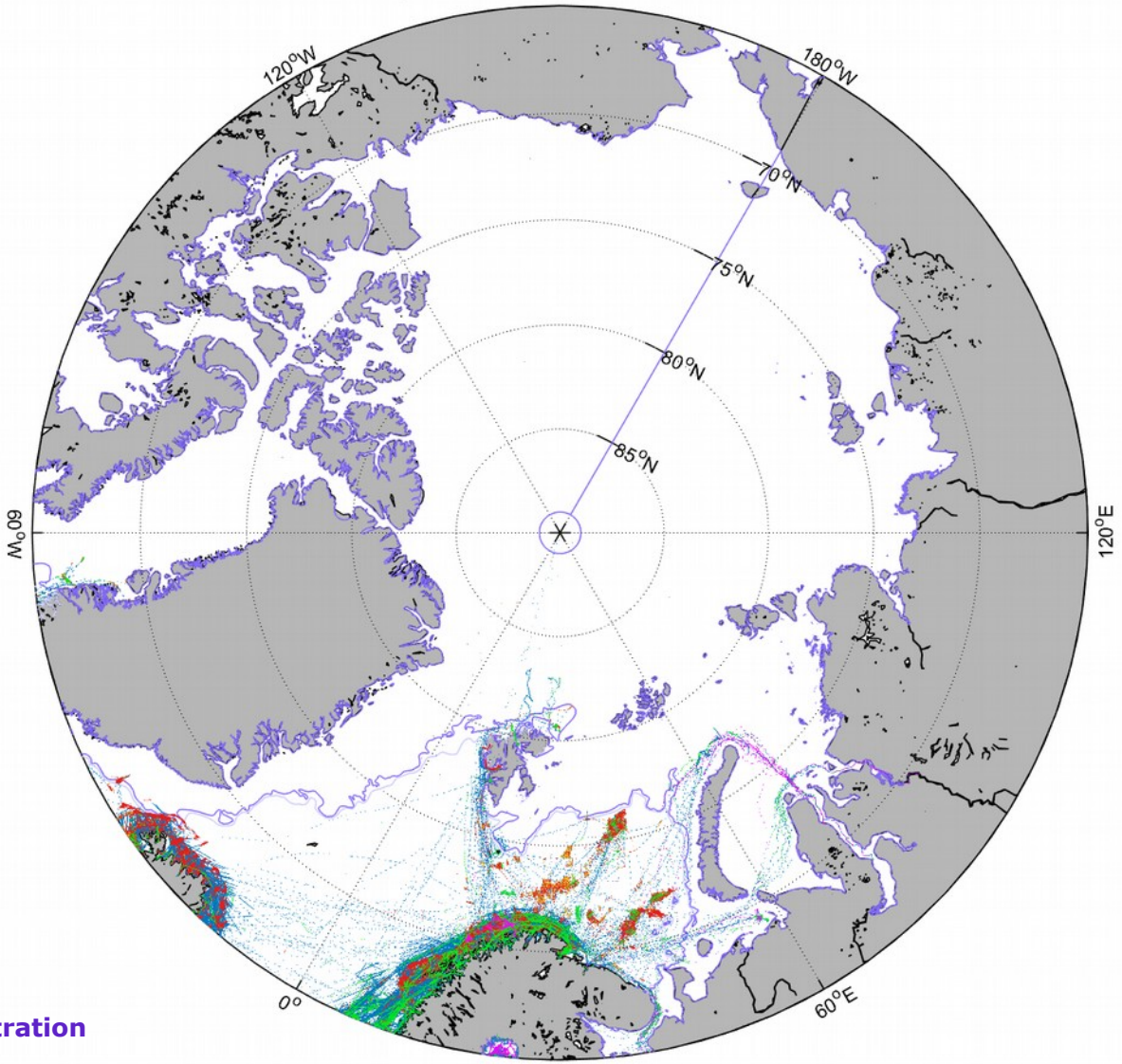


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2015-02-01 to 2015-02-30

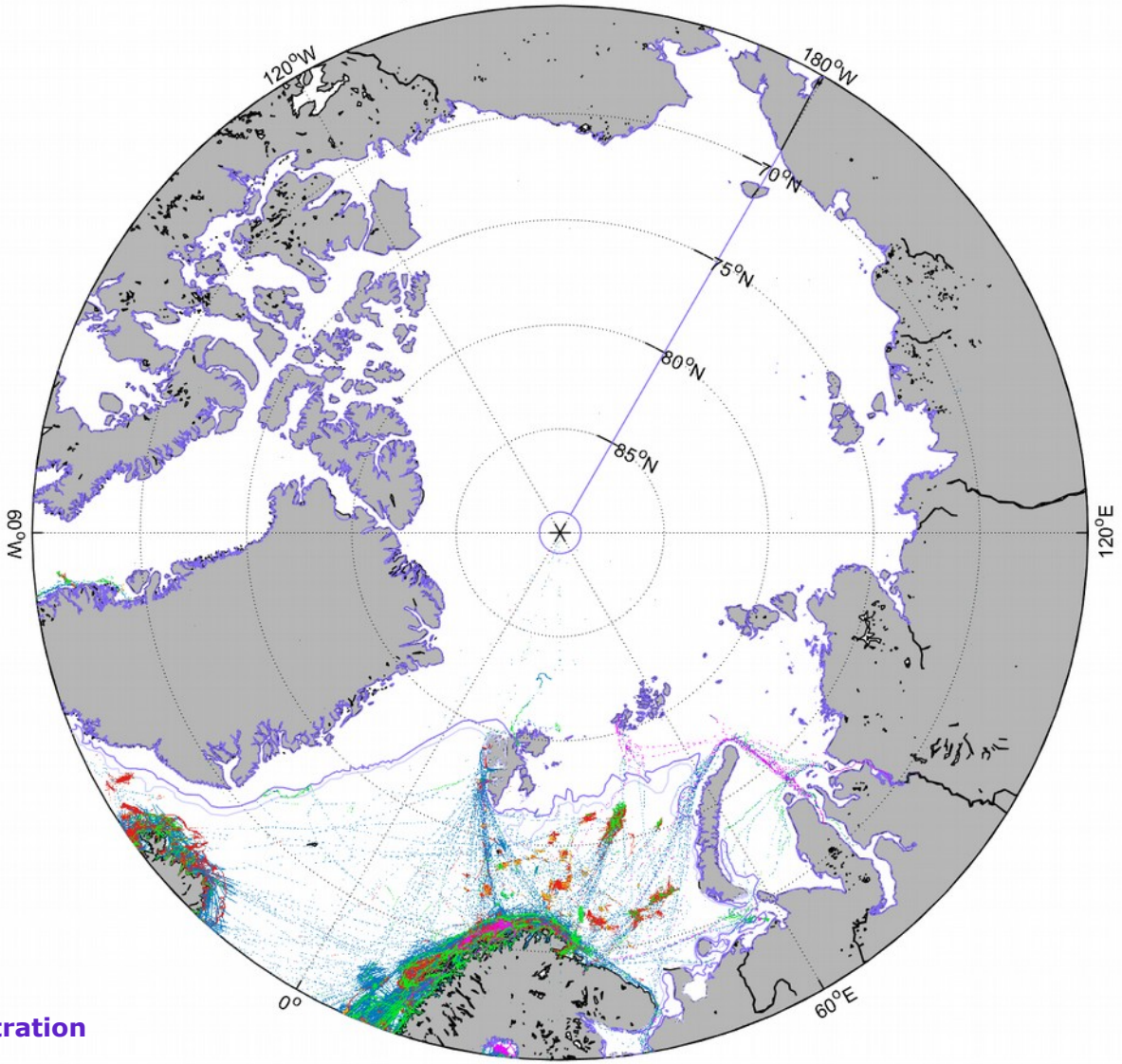


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2015-03-01 to 2015-03-30

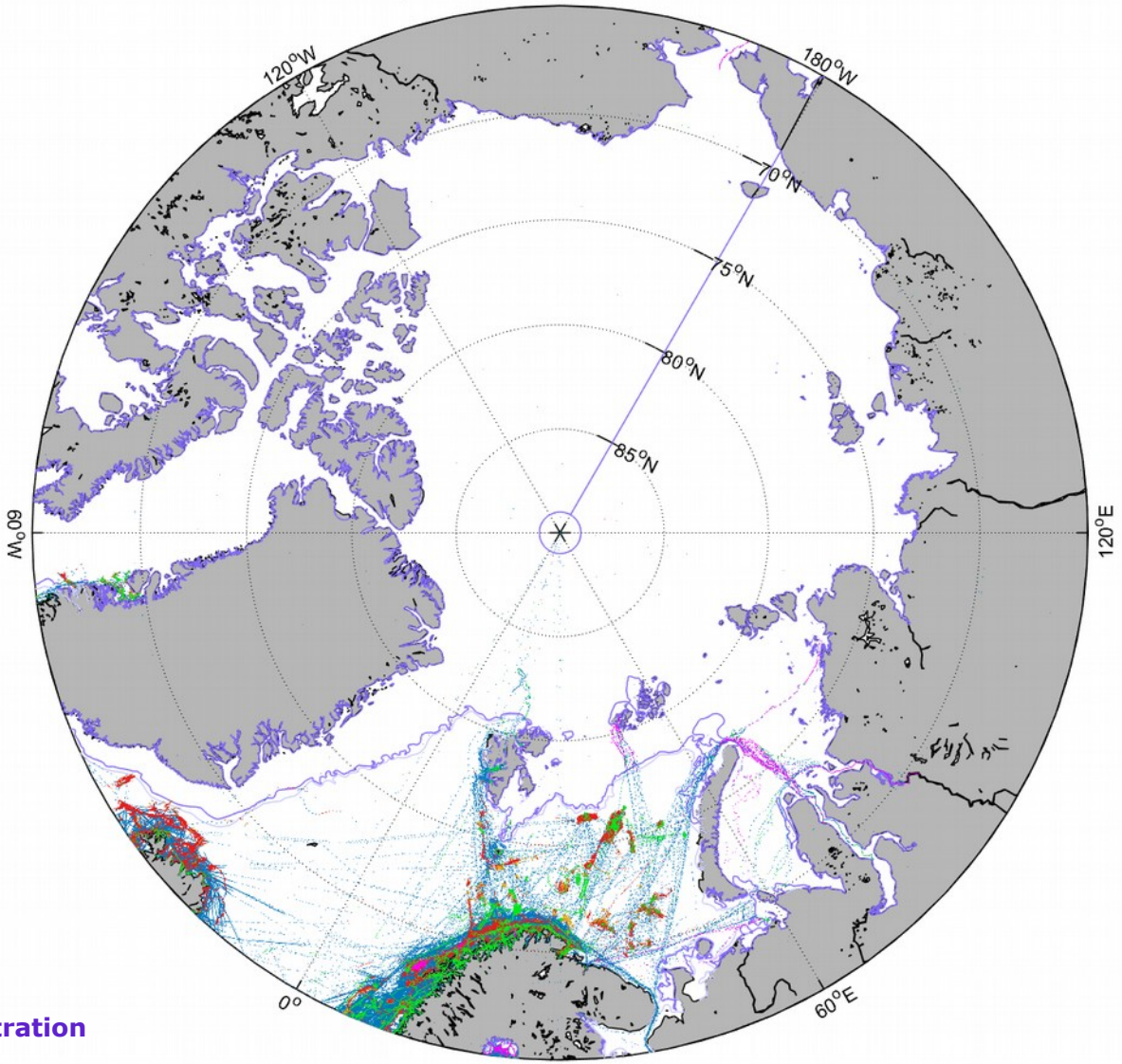


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2015-04-01 to 2015-04-30

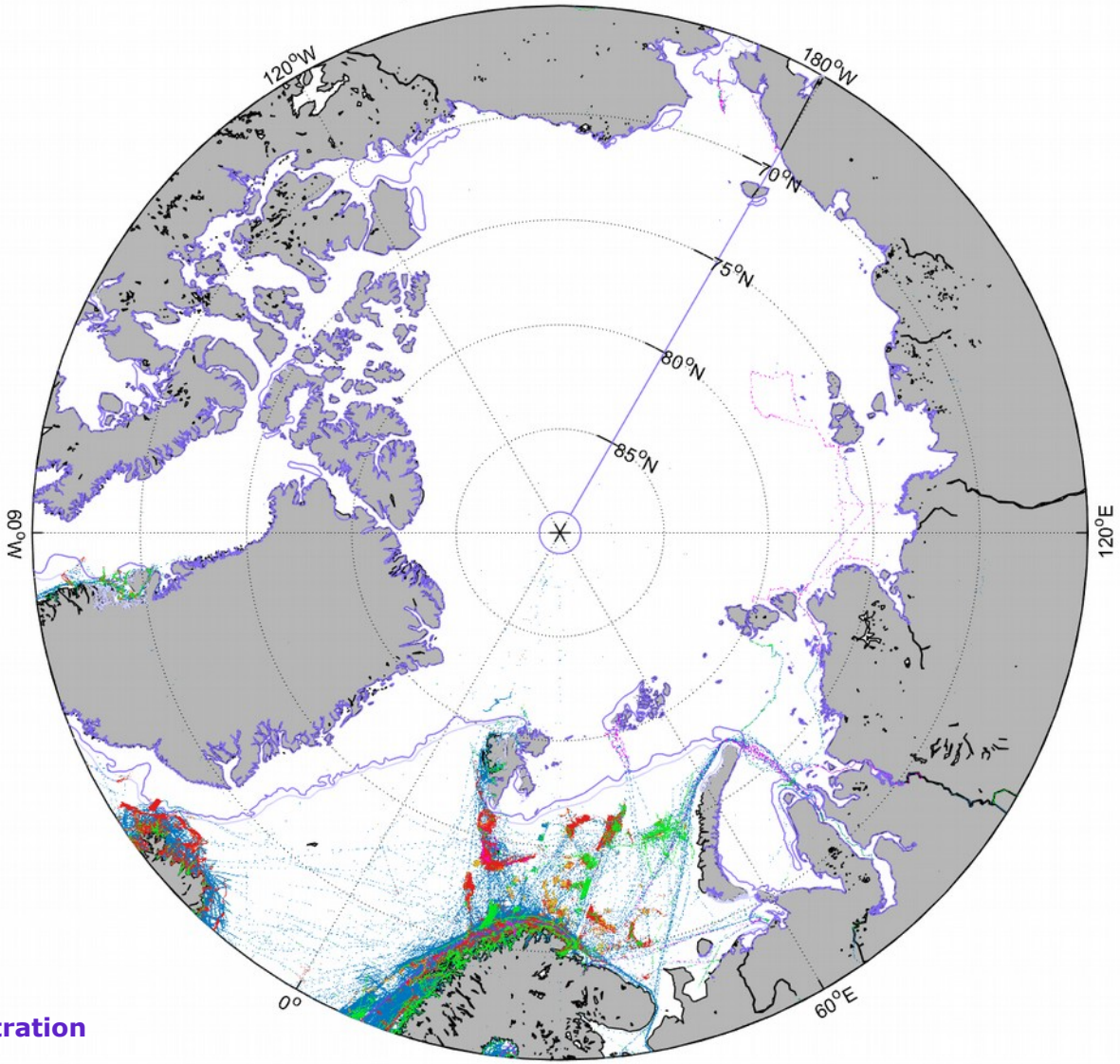


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2015-05-01 to 2015-05-30

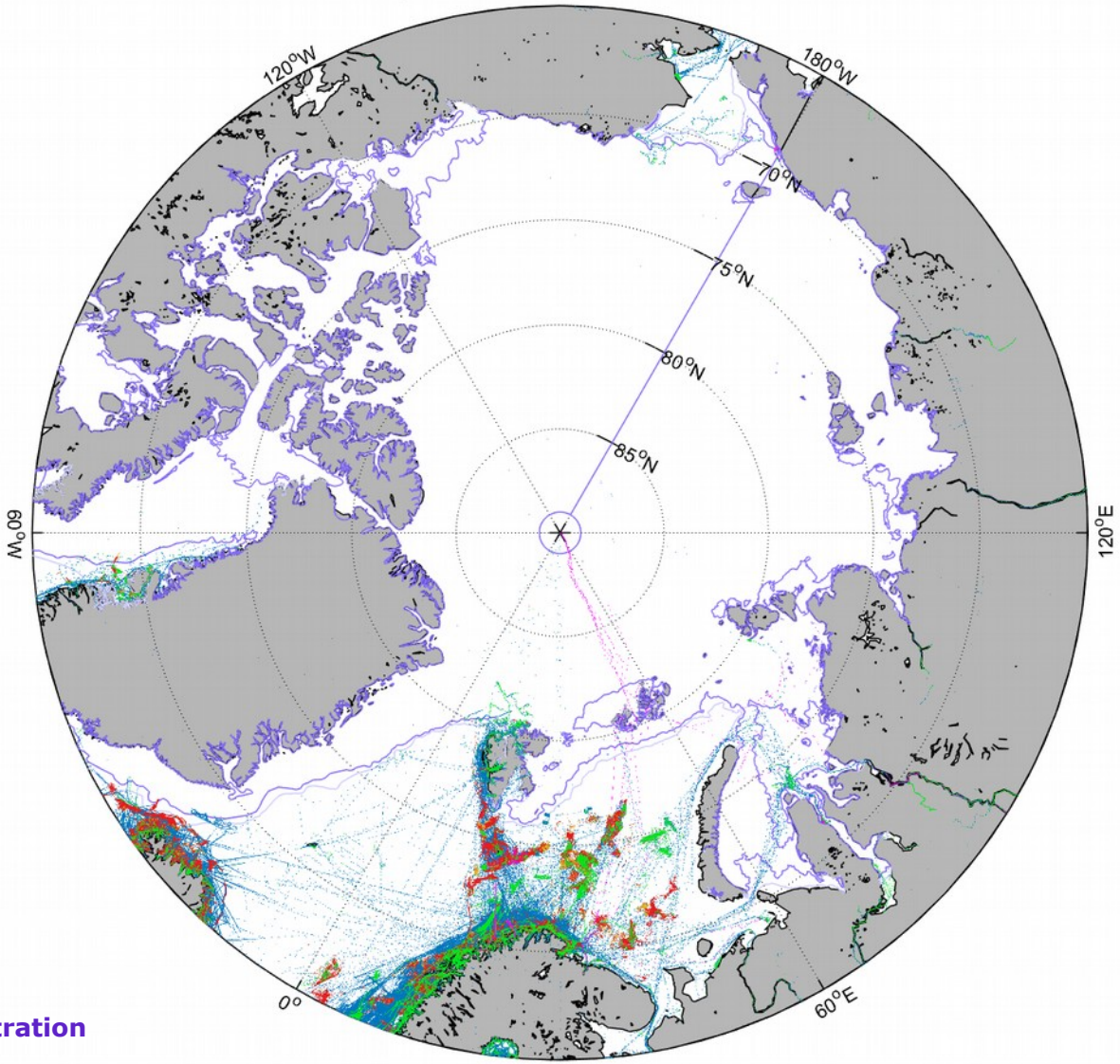


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2015-06-01 to 2015-06-30

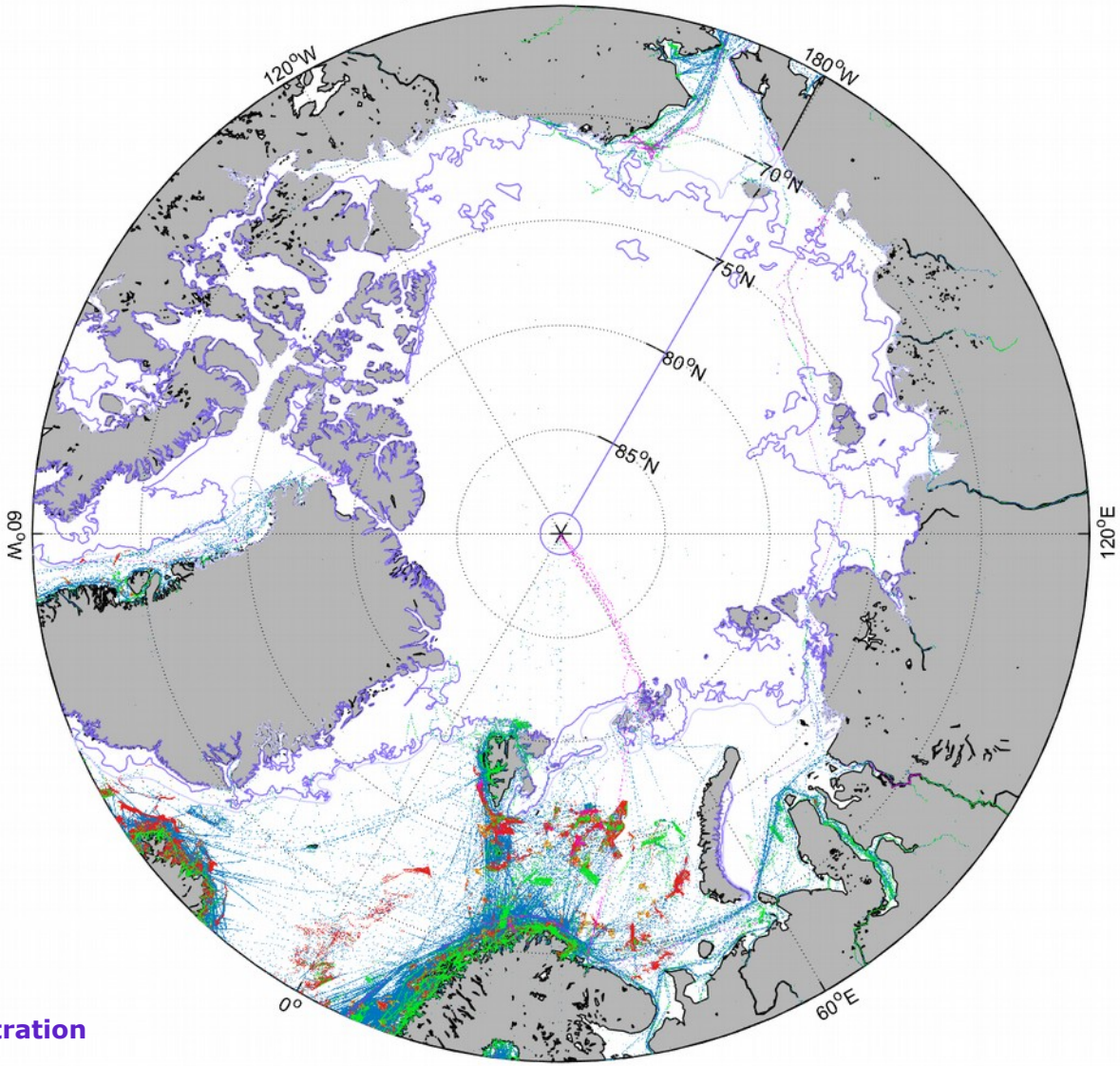


Fishing activity
Research/exploration
Shipping
Service/icebreakers

8/10ths Sea ice concentration
Marginal Ice Zone

European Commission

Time period: from 2015-07-01 to 2015-07-30



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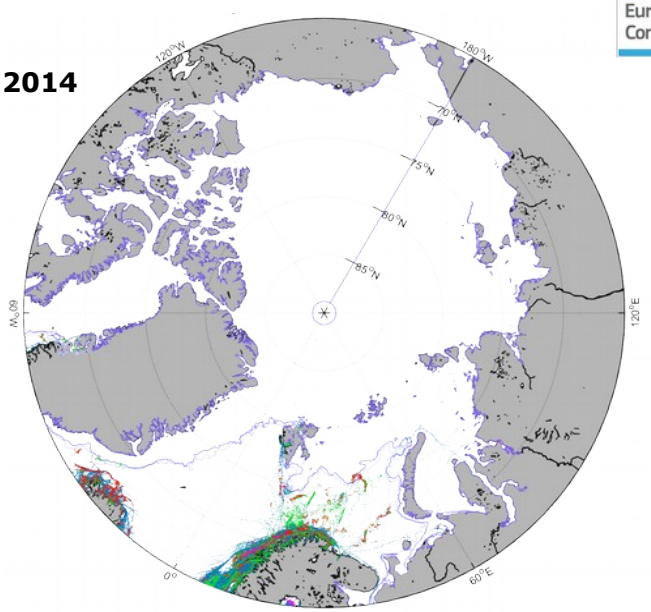
April 2014



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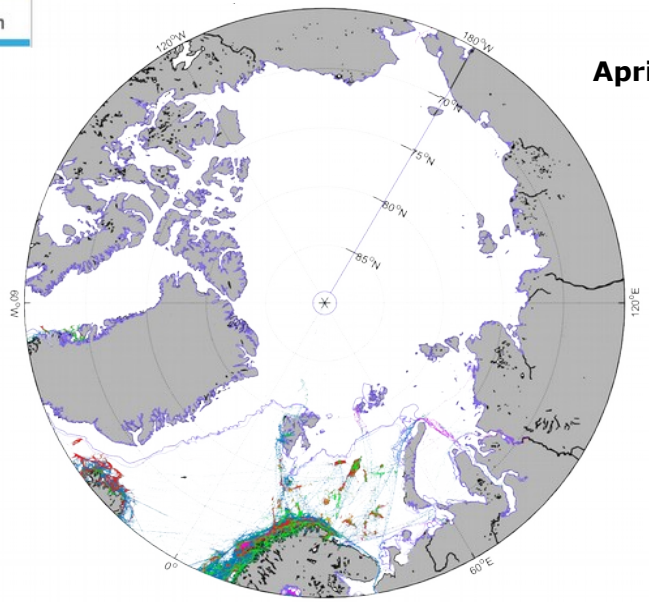

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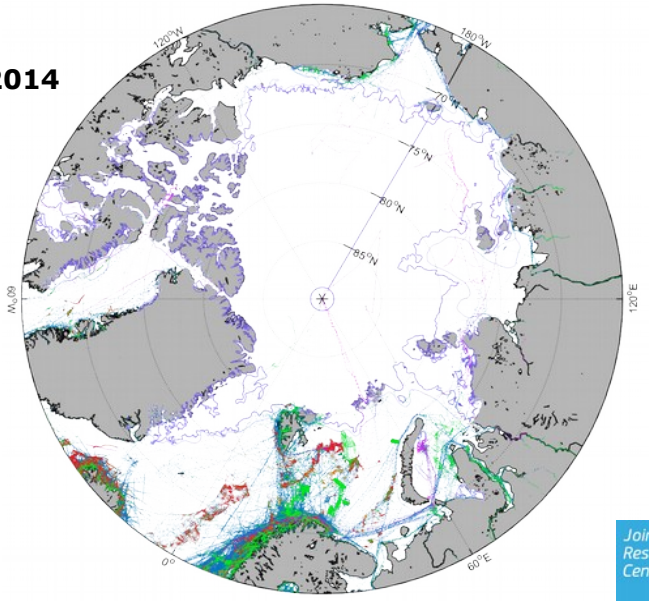

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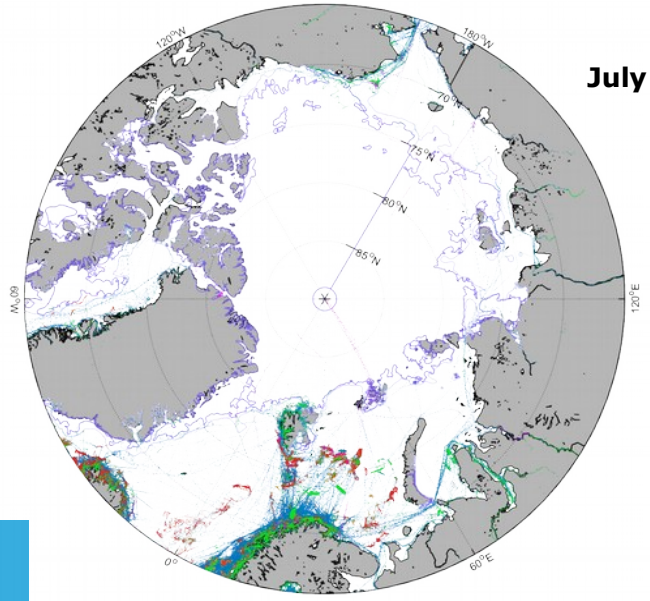

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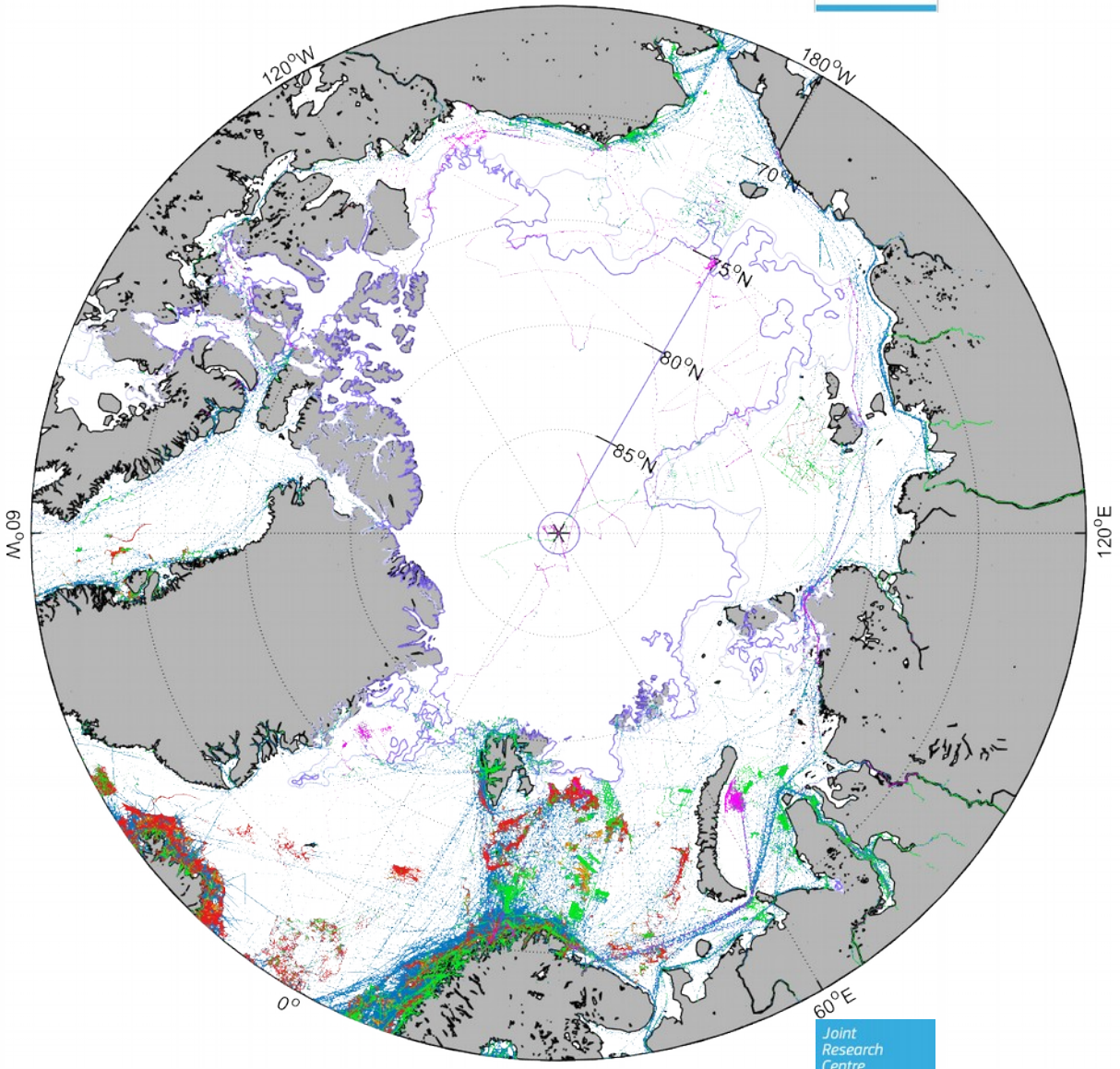
Time period: from 2014-08-15 to 2014-09-15



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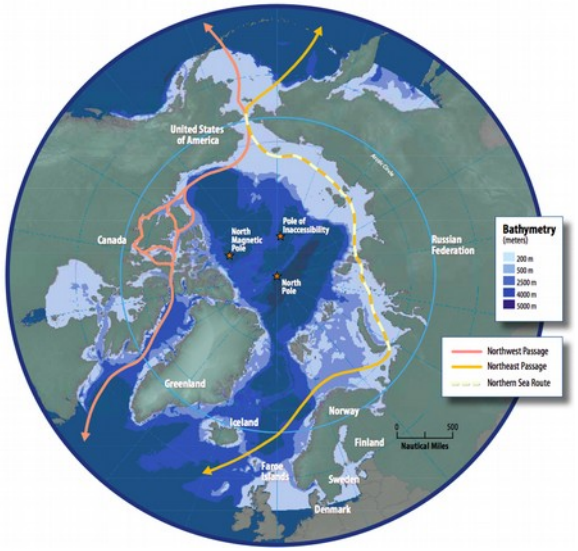
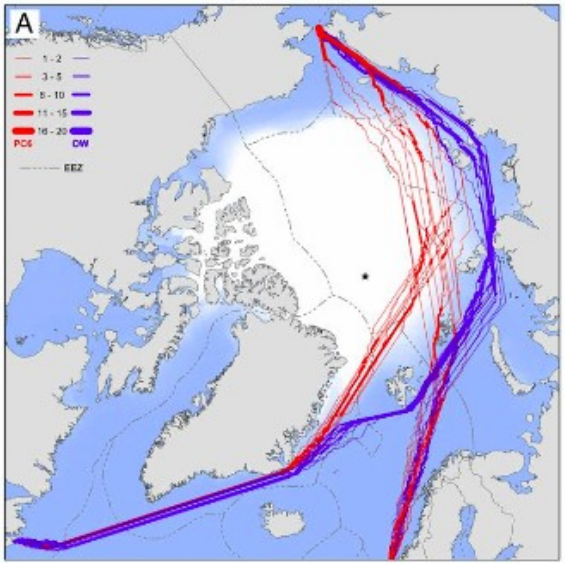


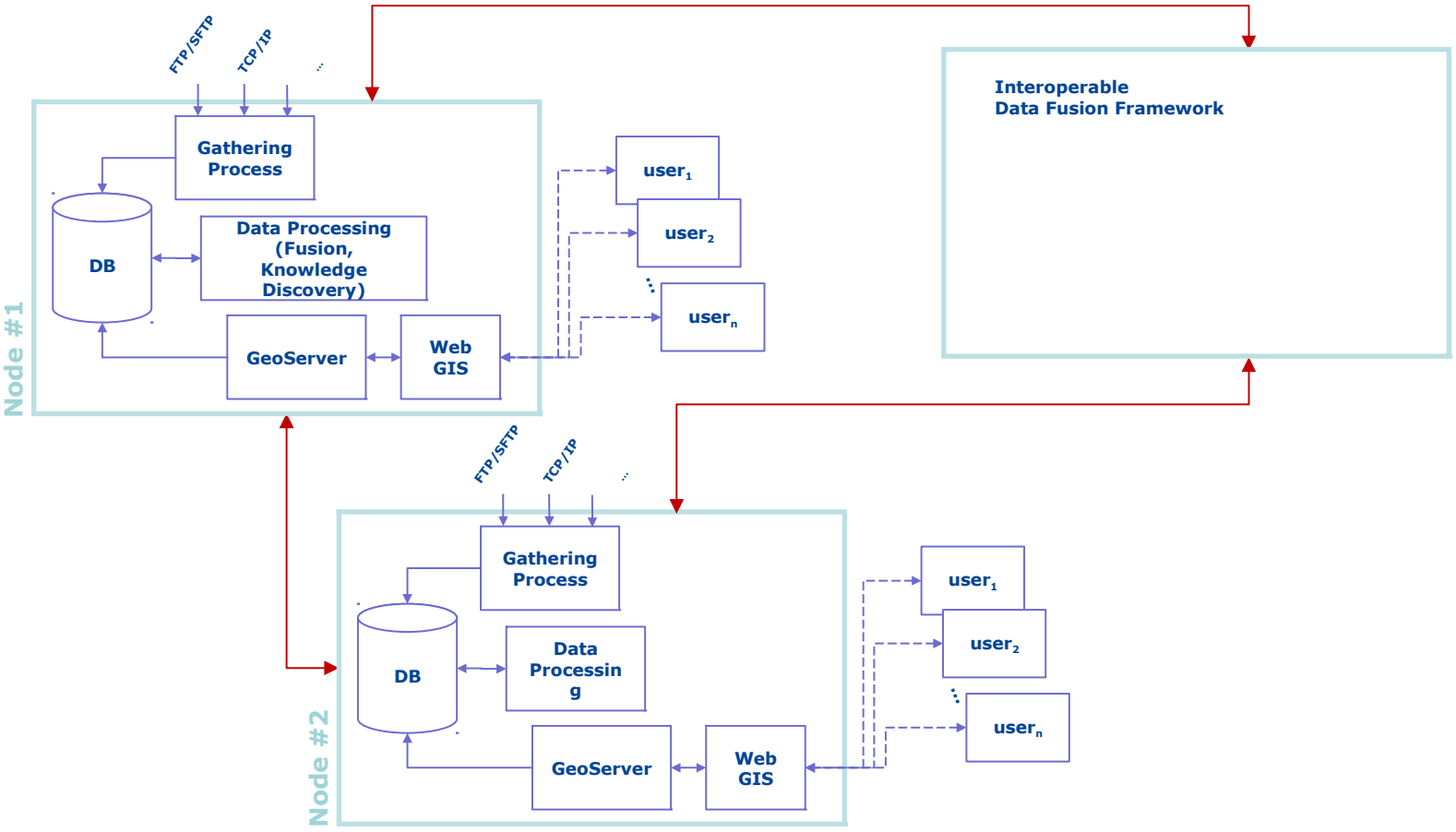
Source: AMSA

2006 - 2015



Source: Smith, L. C., & Stephenson, S. R. (2013).
New Trans-Arctic shipping routes navigable by midcentury

The Arctic Blue Hub: Interoperability and Information Sharing



The Arctic Blue Hub

https://bluehub.jrc.ec.europa.eu/mspArctic/

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Conclusions

- **The Knowledge of human activities at sea and their trends can be enhanced by vessel tracking data.**

- **Such knowledge can support operational authorities (emergency response) and policy makers (impact assessment & planning).**

- **Arctic Blue Hub – a web platform to gather/analyse/share data, enabling a better decision-support product for different applications.**