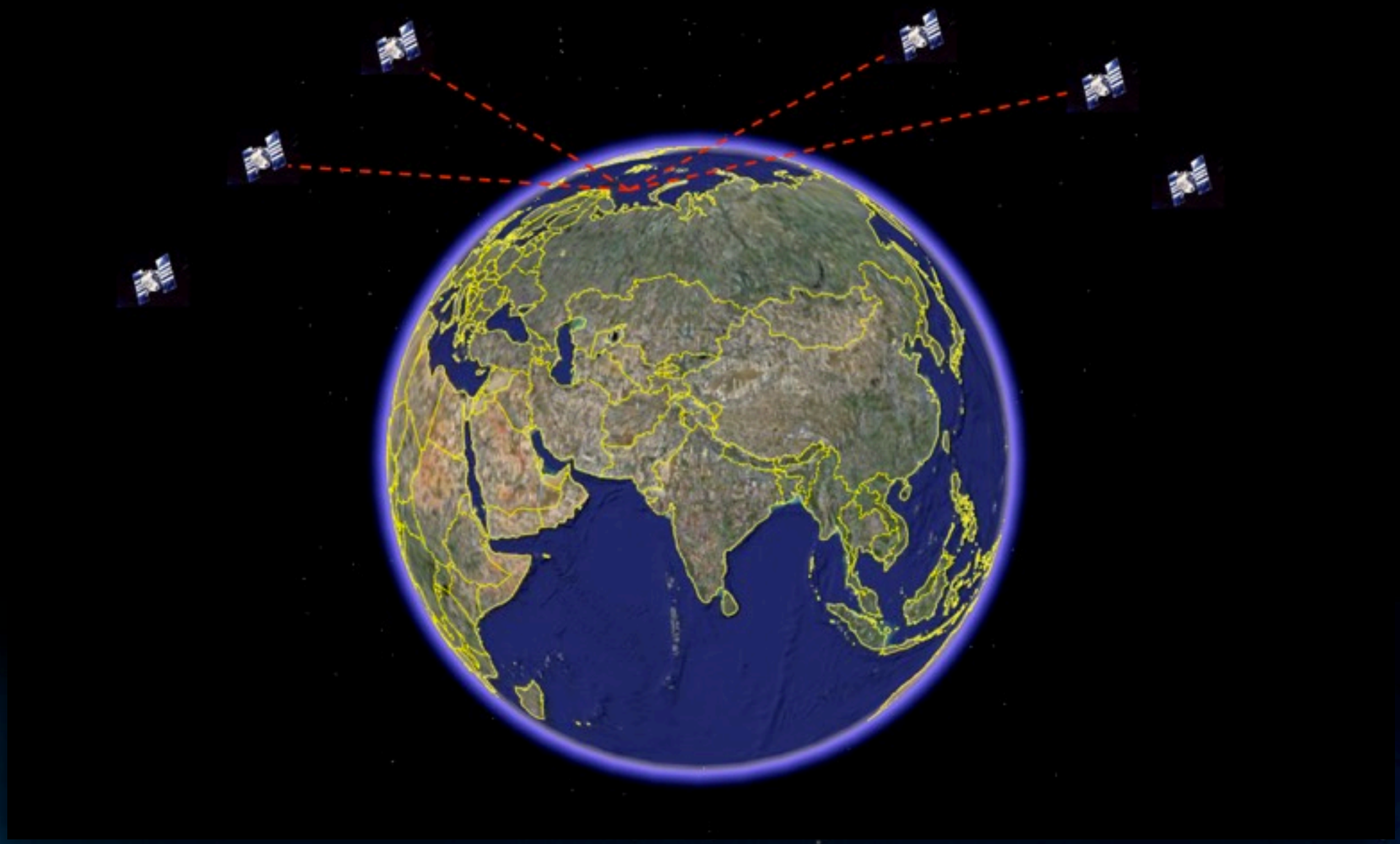
Norwegian Space Activities for the Arctic



Pål Brekke

Senior Advisor

Paal@spacecentre.no

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1 979 179 km²

OCEAN

to survey/manage

(corresponds to half EU)

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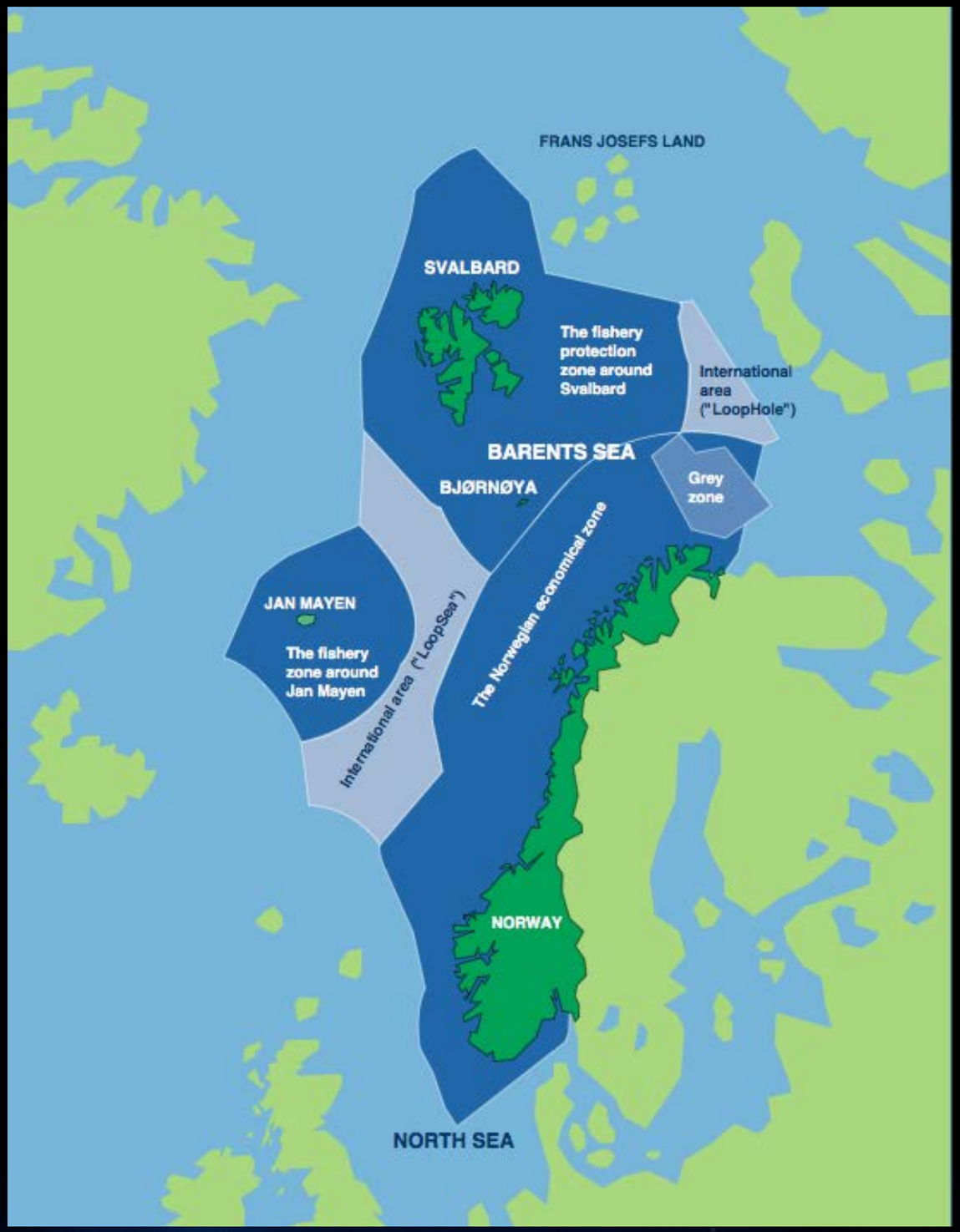
Maybe not so small after all?



- Extensive land/ocean areas
- Large distances
- Few people
- Far north including arctic islands
- Fish, oil and gas
- Fragile environment
- Large shippinge fleet
- Strategic geopolitical location

→ Tailormade for space applications

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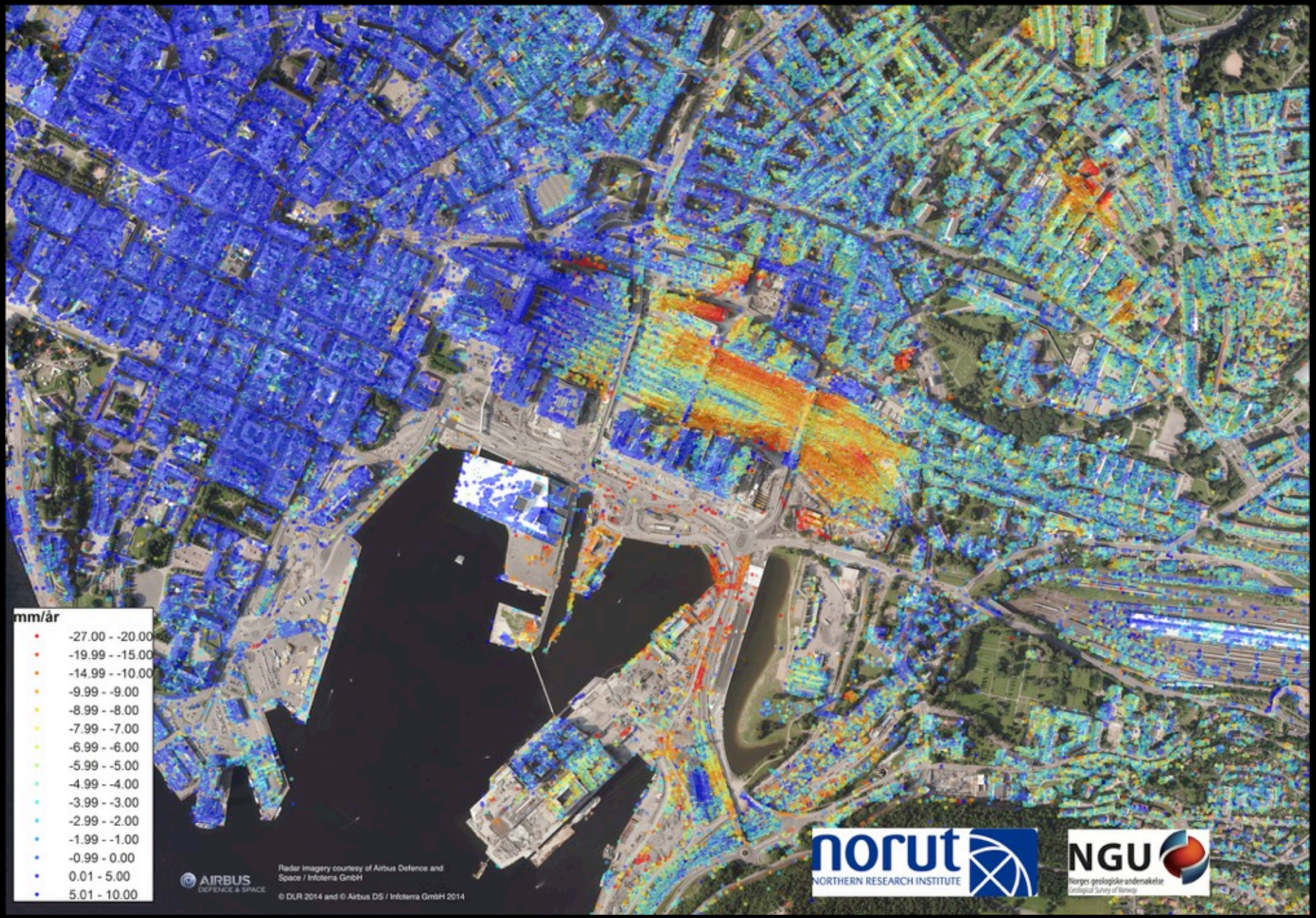
The Norwegian Space Centre

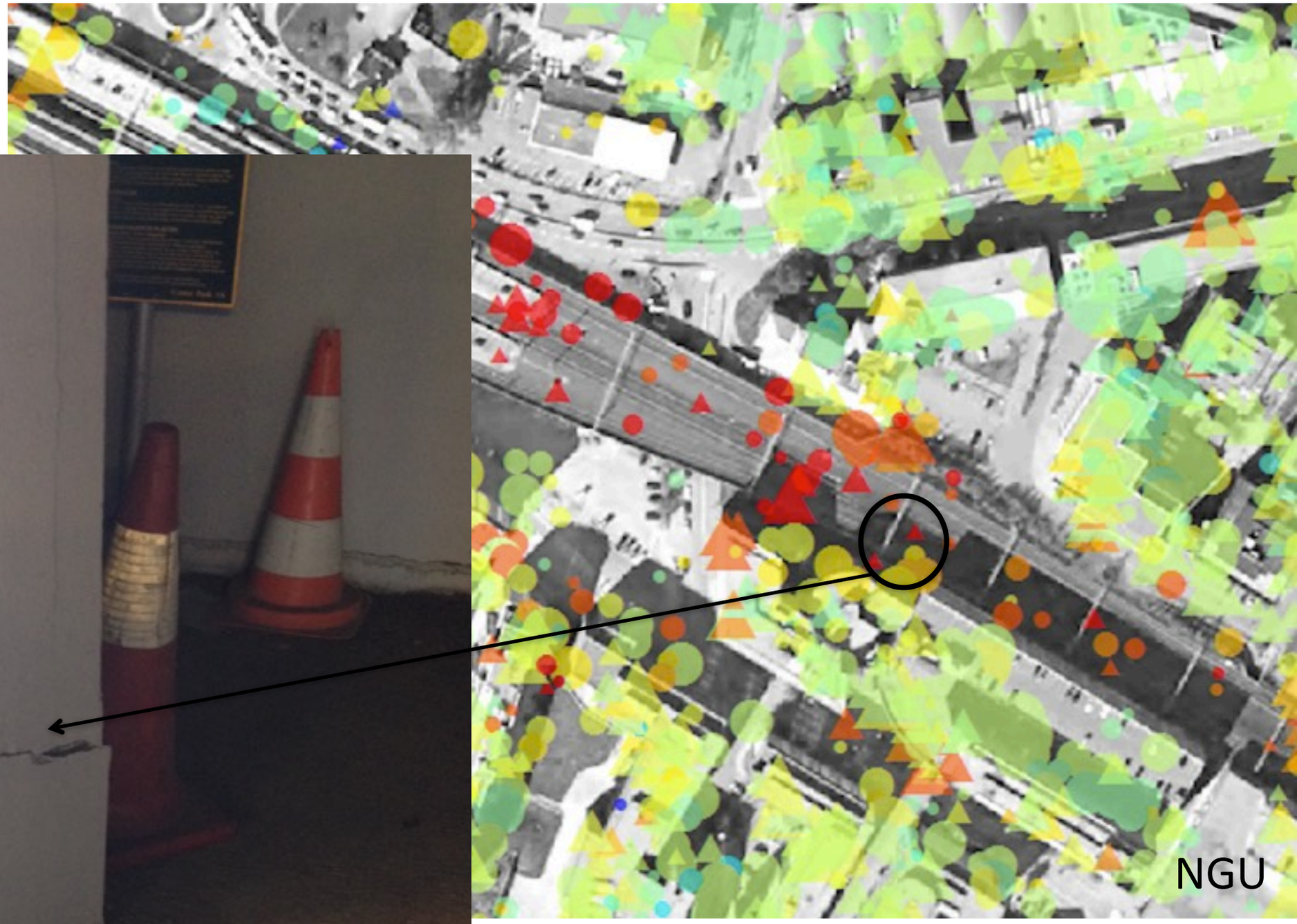
In brief

- The Norwegian Space Centre is a government agency under the Ministry of Trade, Industry and Fisheries
- Established in 1987 when Norway joined the European Space Agency
- Coordinates Norwegian space activities internationally, with focus on ESA and the EU
- Coordinates national space activities
- 38 employees at Skøyen, Oslo
- Budget 2014: NOK 850 million
- Administers government ownership in
  - Andøya Rocket Range AS (90%)
  - Norsk Romsenter Eiendom AS (100%) which owns
    - Kongsberg Satellite Services AS (50%)

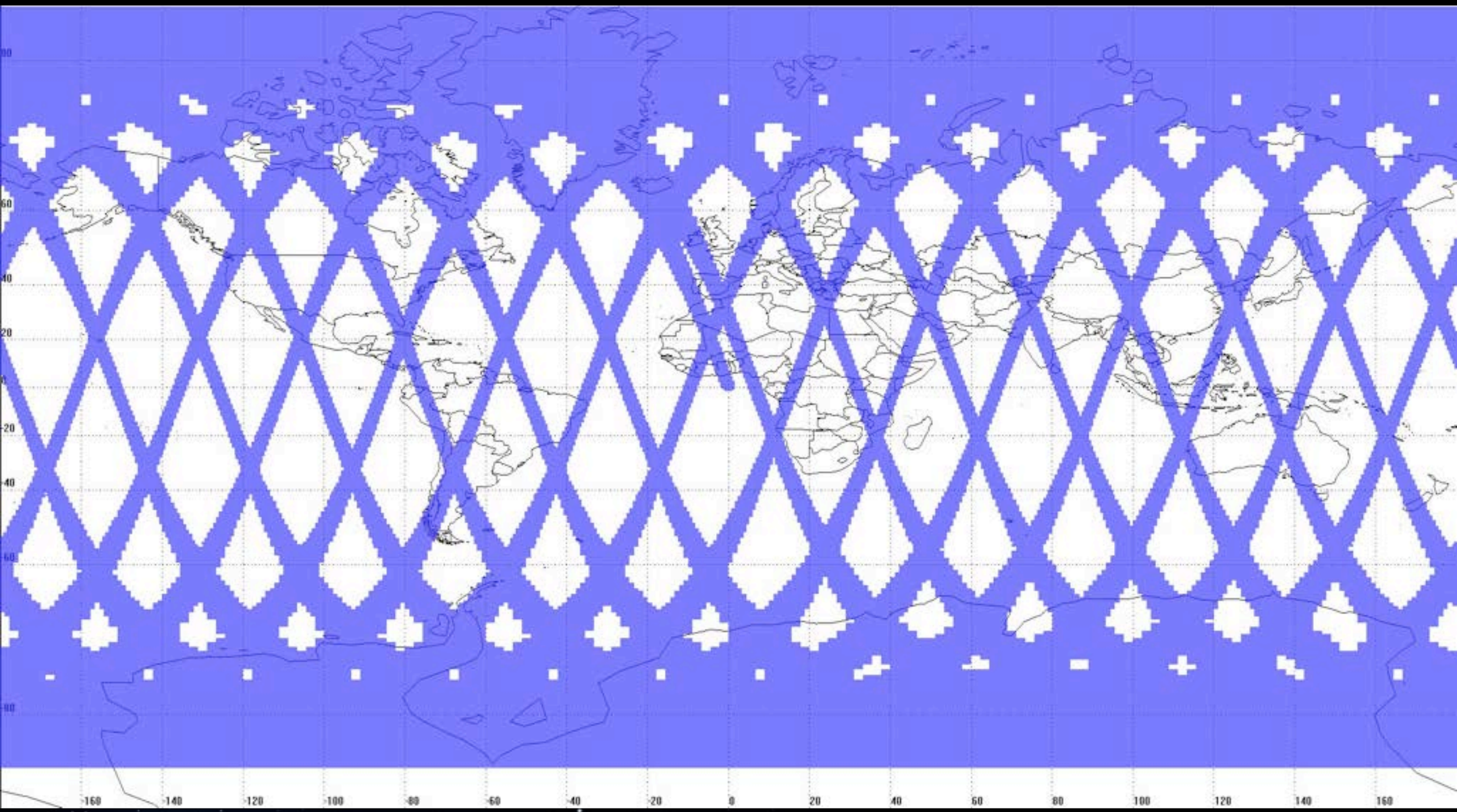
Surface Displacement using inSAR observations



Surface Displacement using inSAR observations



Why Space in the Arctic?



Norway has best coverage over own areas

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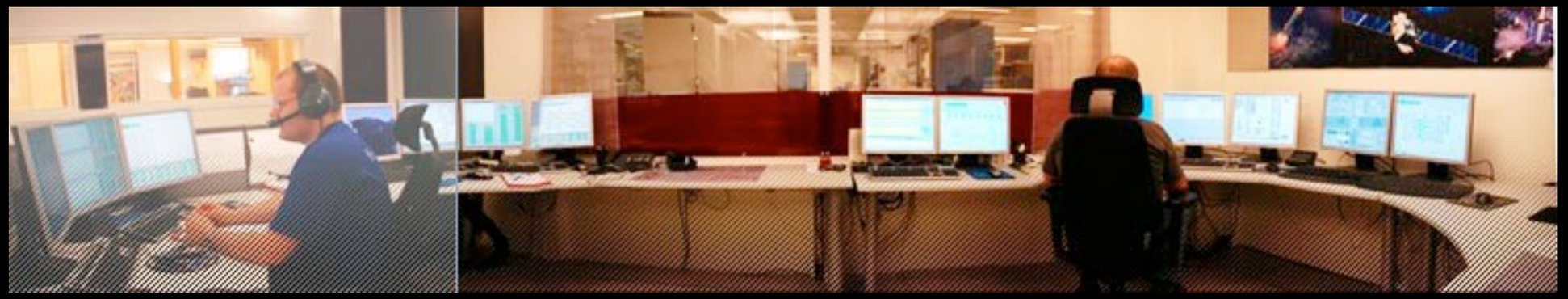
Largest satellite station (LEO) in the world

Kongsberg Satellite Services AS

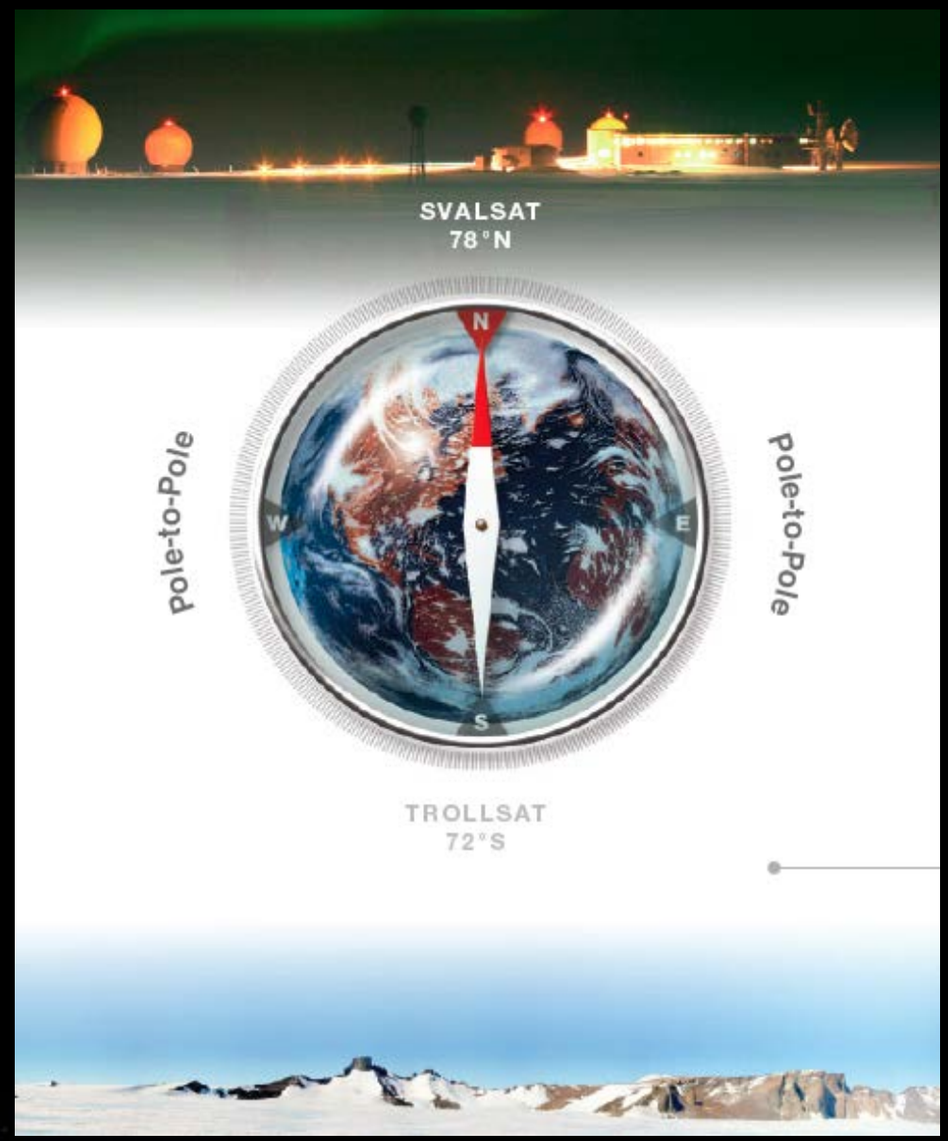


- Owned 50% by the Space Norway og 50% by Kongsberg Defence & Aerospace AS

- Satellite stations in Tromsø, Grimstad, Svalbard (SvalSat) and in Antarctica (Troll station), Bangalore, Mauritzius, Alaska ++

  Total about 50 antennas

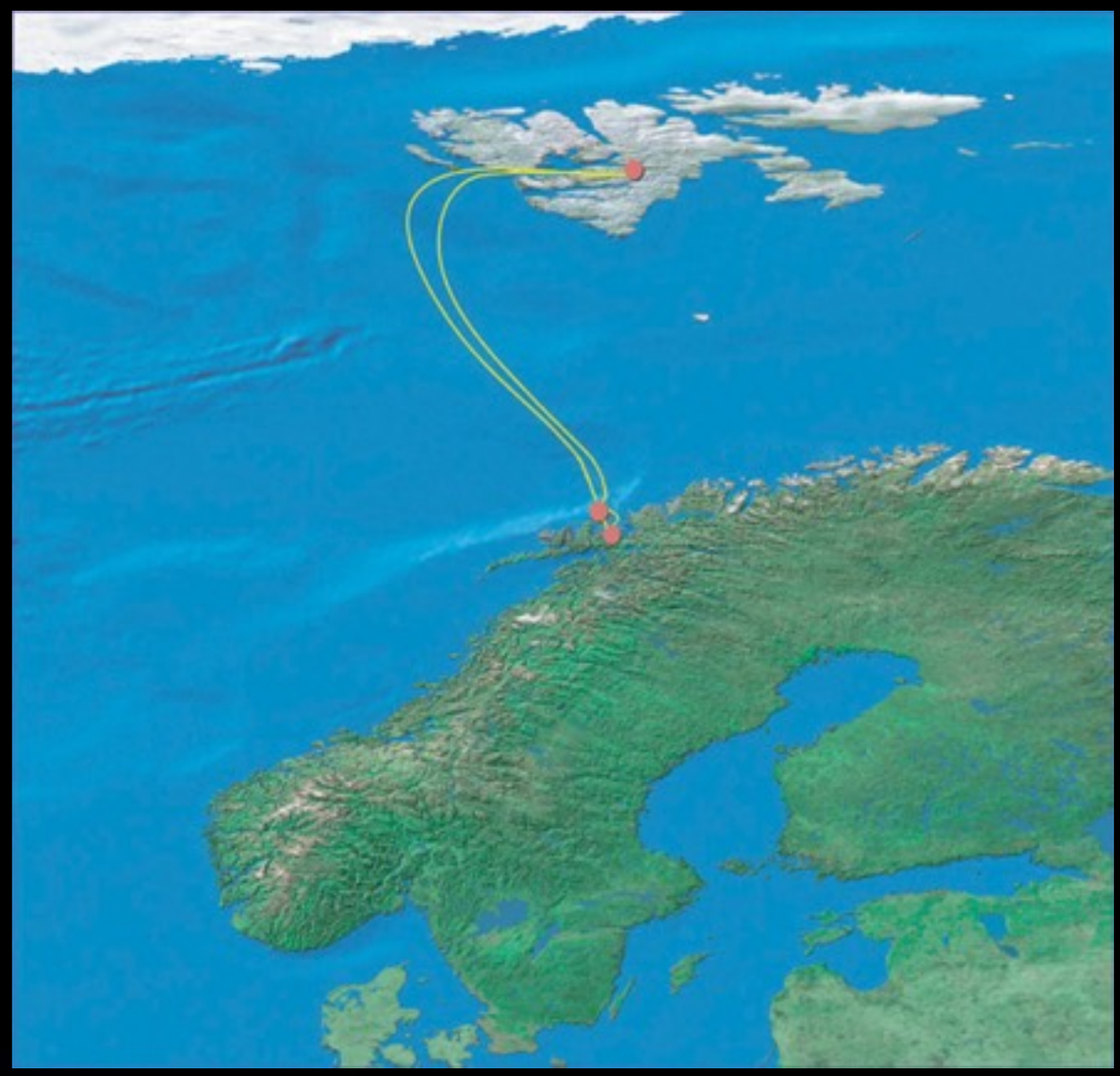
  Supports 85 satellites - 18.000 passes per month



World largest satellite station for polar orbiting satellites

NASA/CSOC missions supported at SvalSat

- LANDSAT-7
- QuickScat
- AM-1 (Terra)
- SAC-C
- ERS-2
- Acrimsat
- Champ
- Grace
- EO-1
- Kompsat
- Cobe
- Aqua
- Quicktoms



20 Gbit Fiberoptical cabel, 1,400 km lang,
Price: NOK 300 millioner.
FInaced by NASA og NOAA/IPO

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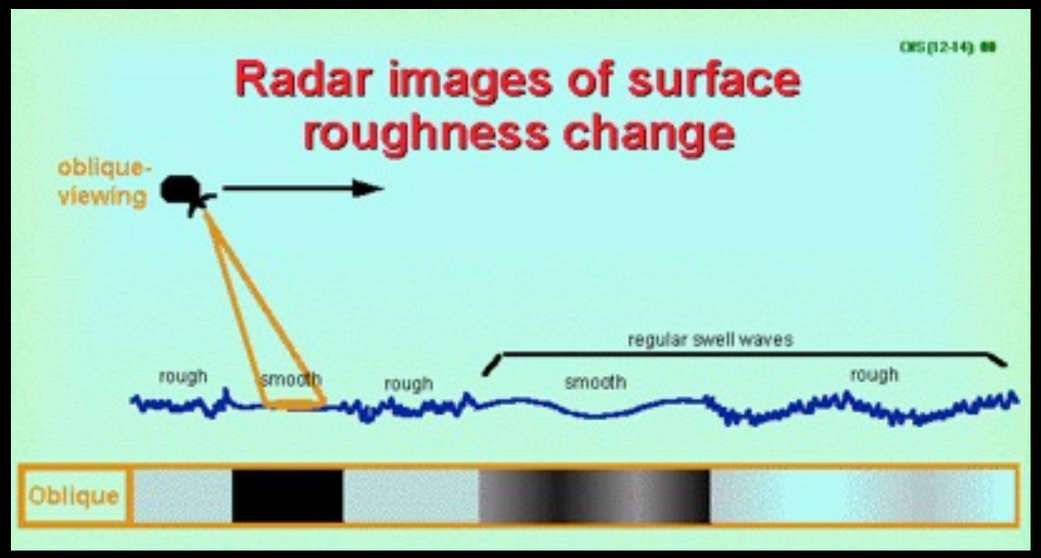
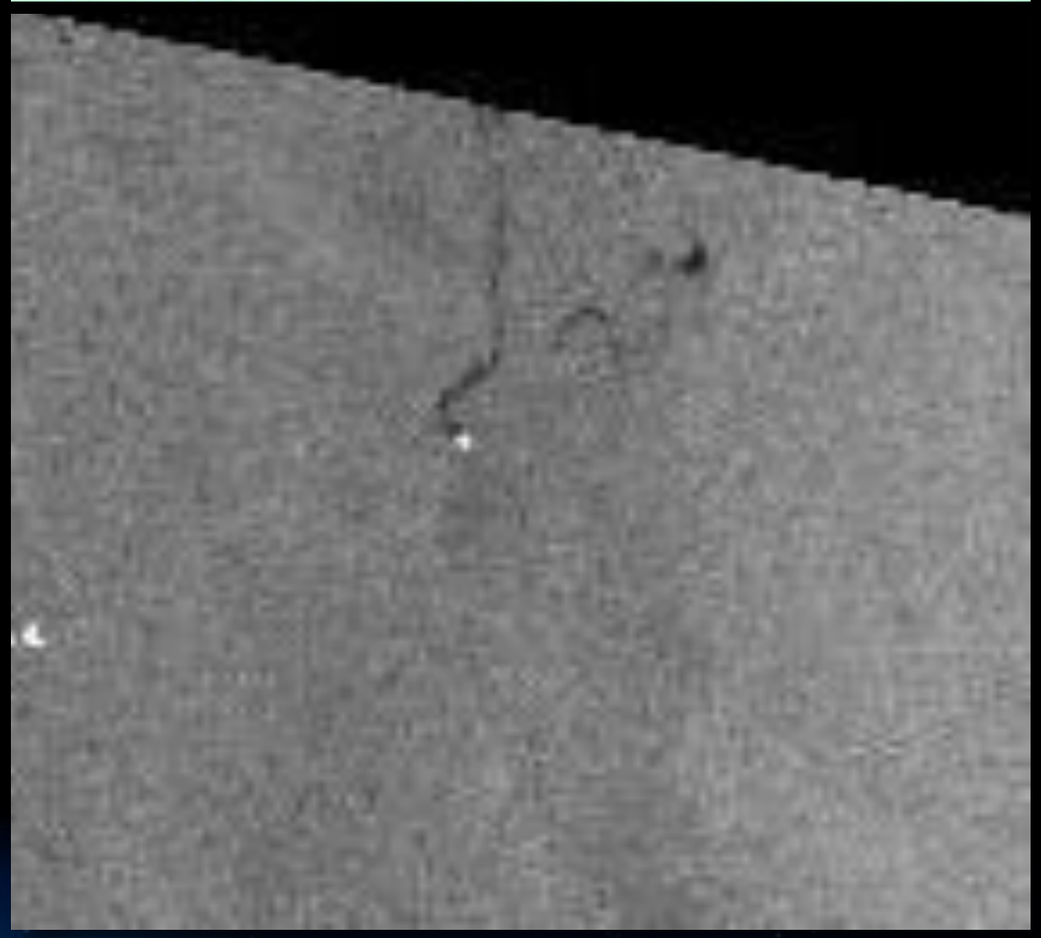
First operational oil spill detection from satellites

Radar satellites can “see” oil spills day and night and through clouds





Oil spill from a Norwegian platform in 2004

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KSAT detects oil-spills in the British Channel

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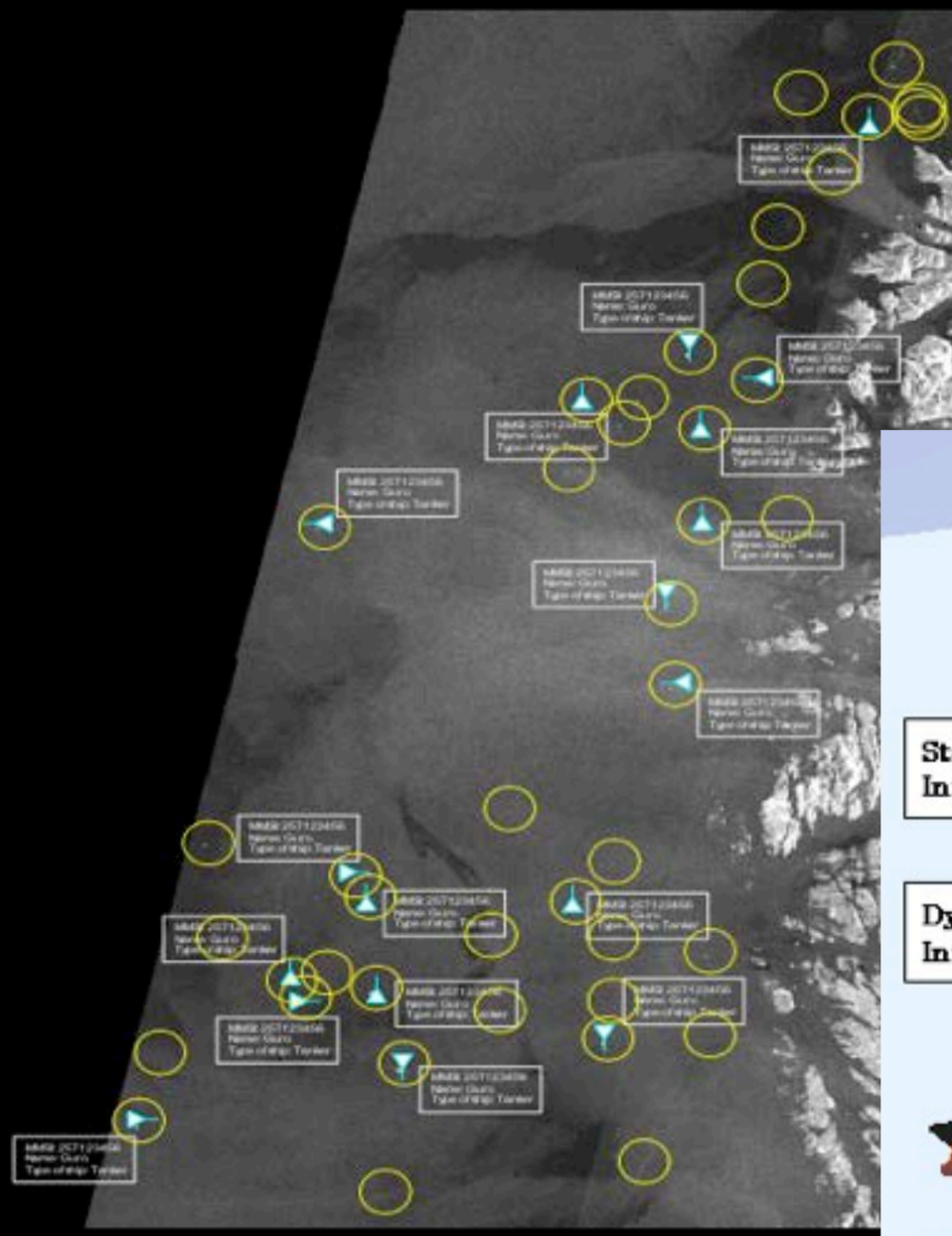
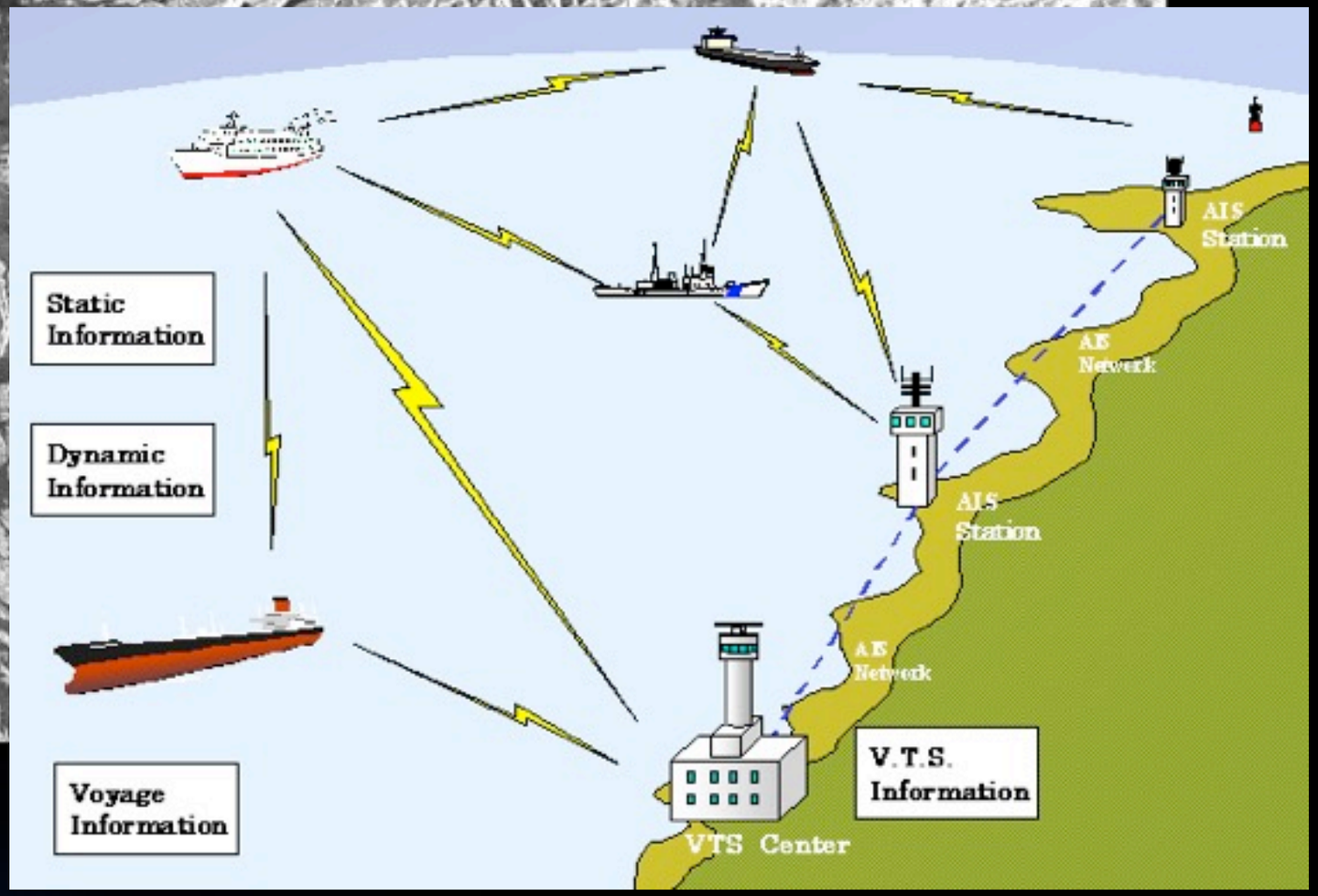
Identification of ships using AIS signals





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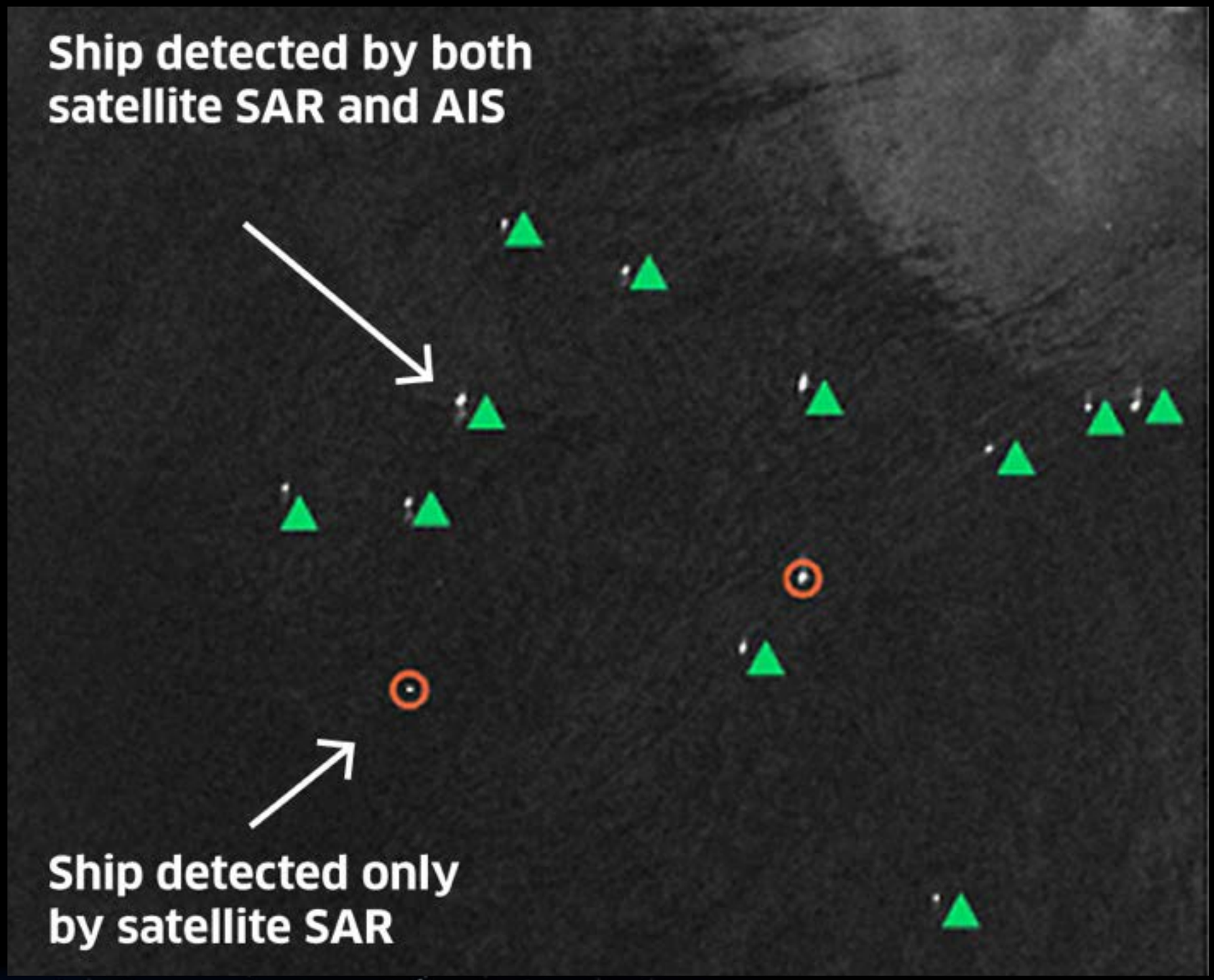
RADARSAT-2 can see ships - but not identify them



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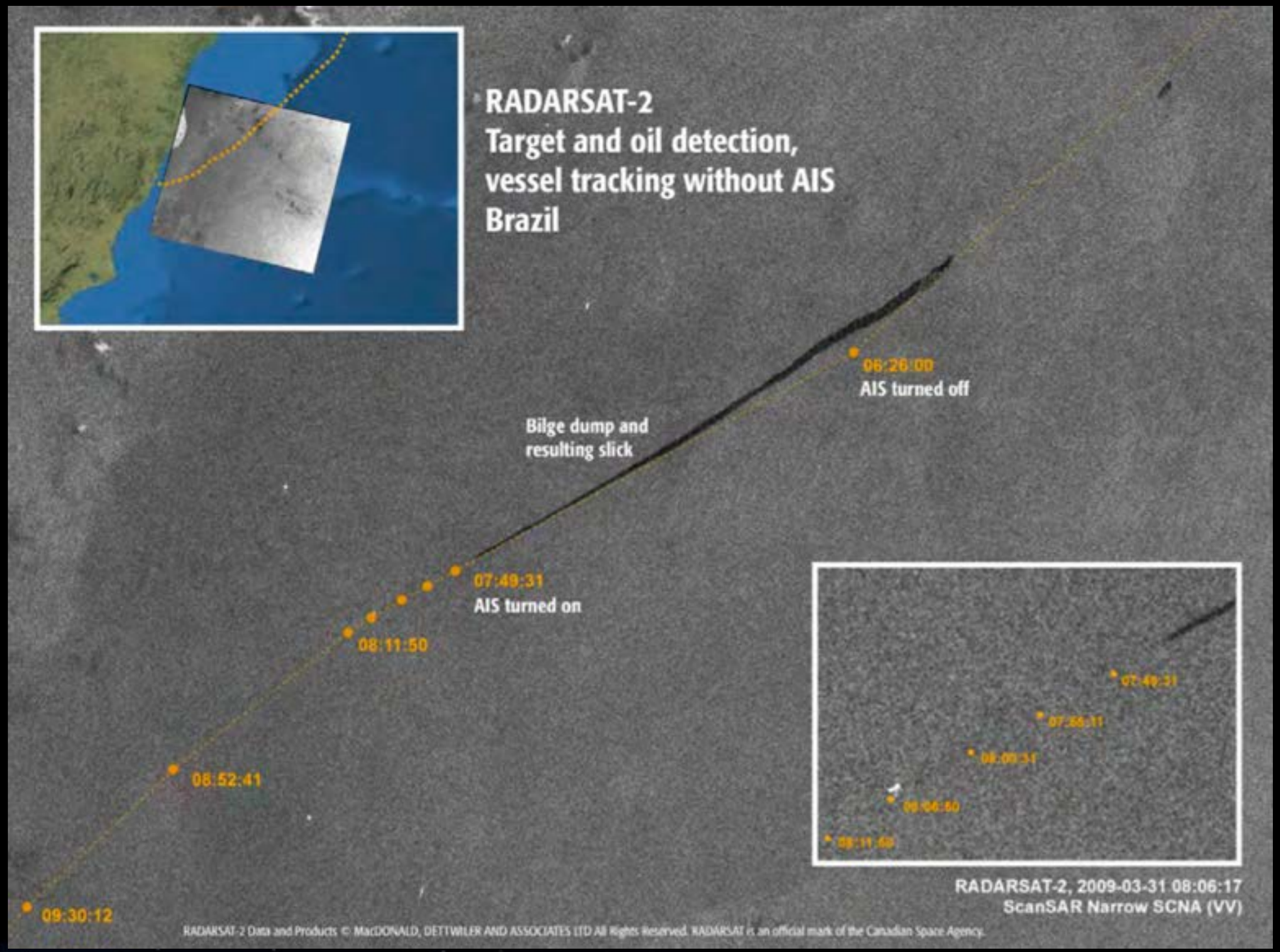
Combining RADARSAT-2 and AIS signals



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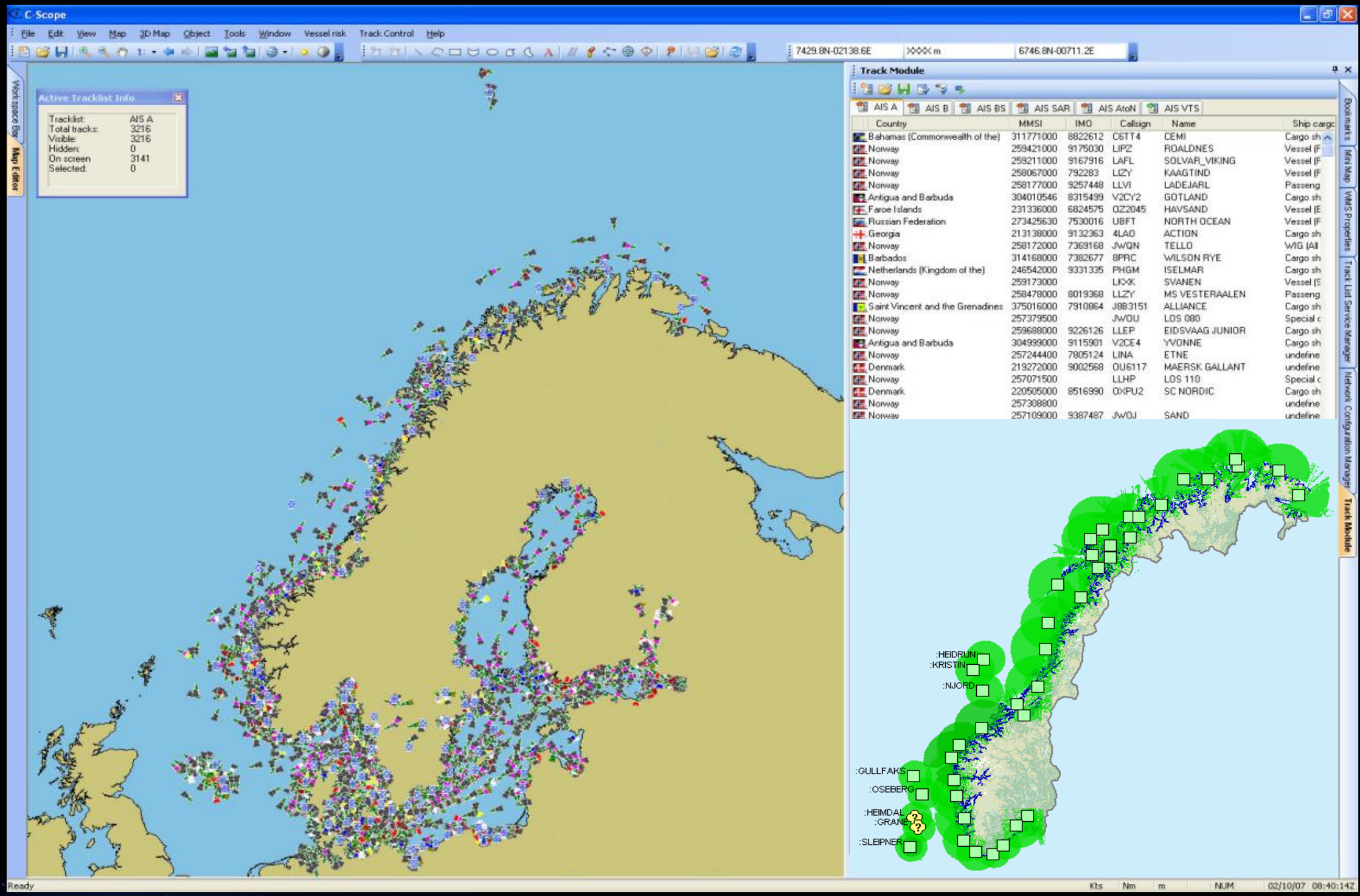
Coast guards AIS monitoring system



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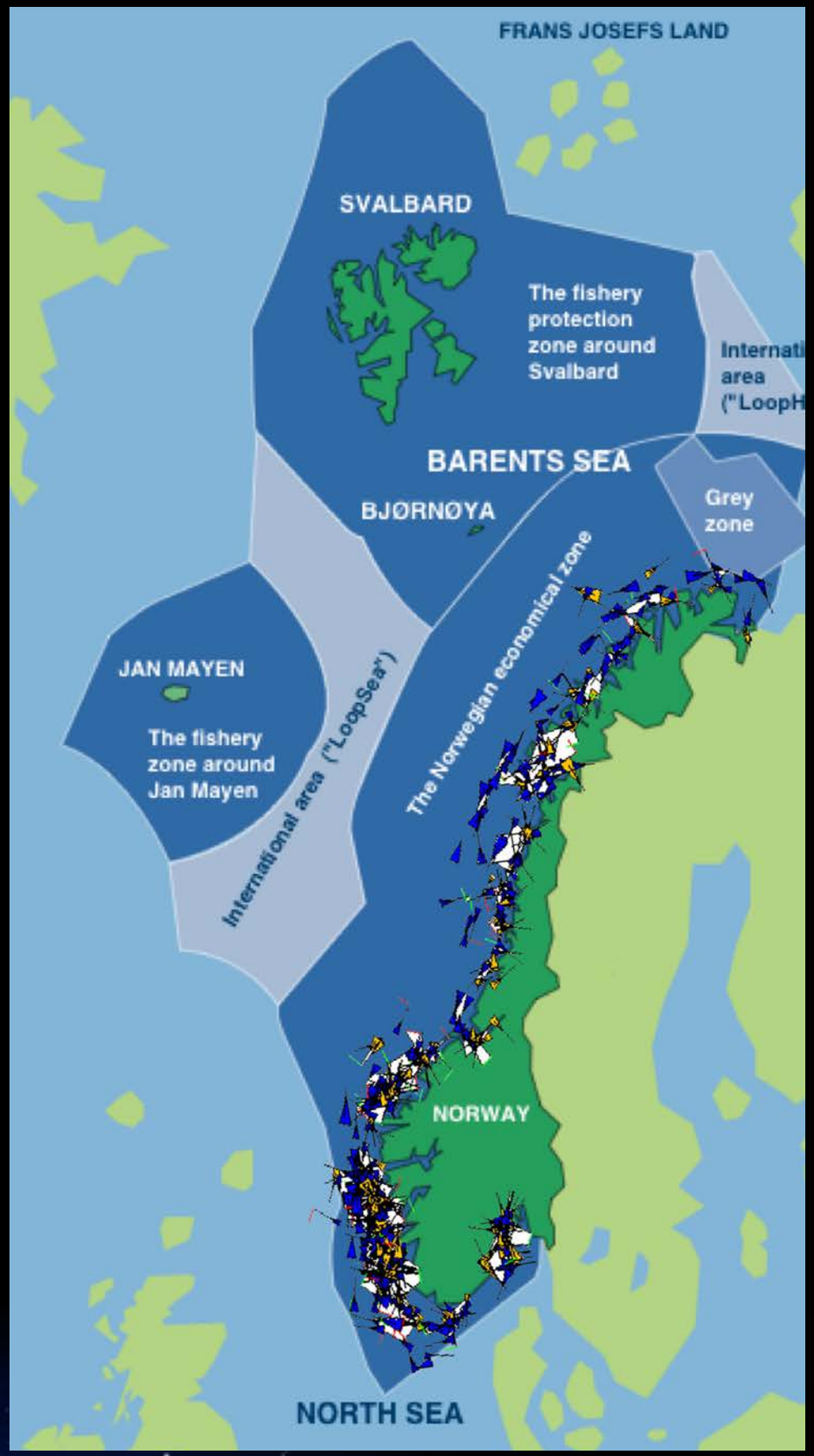
Coast guards monitoring system not enough!



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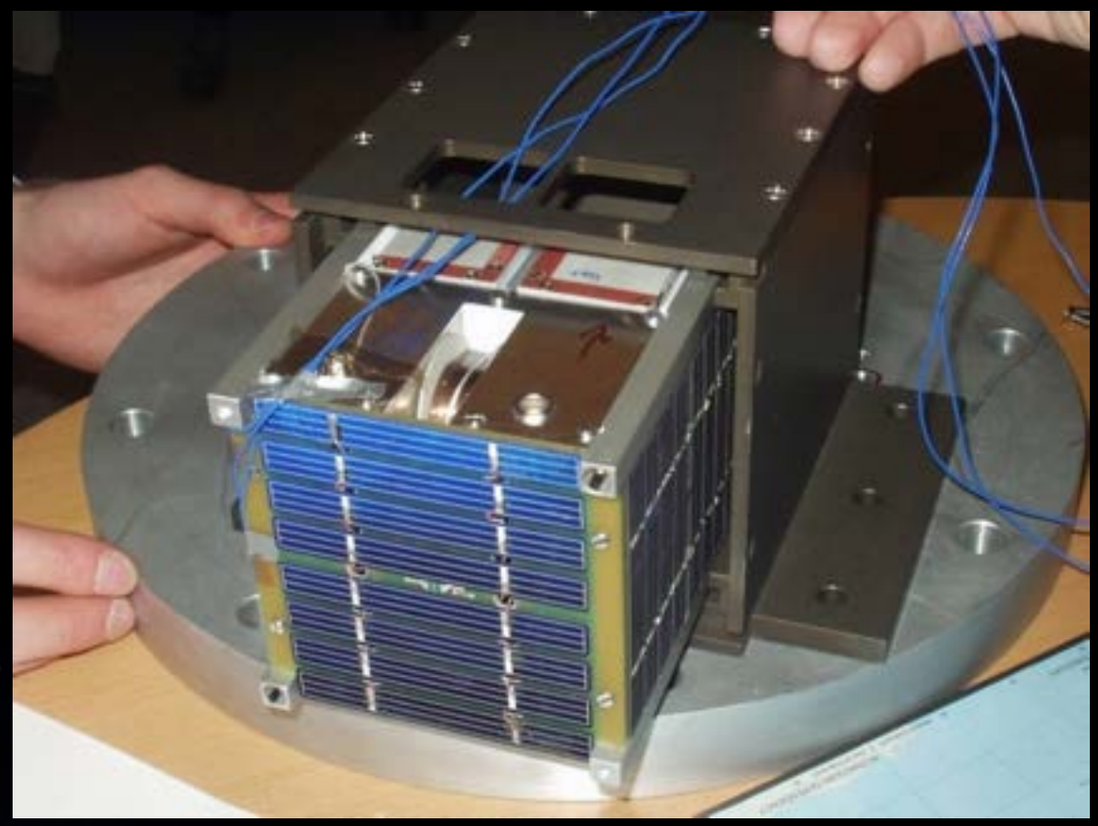
The Rudolf-satellite (NCUBE)

Can AIS signals be received from space?
Can we track a reindeer?



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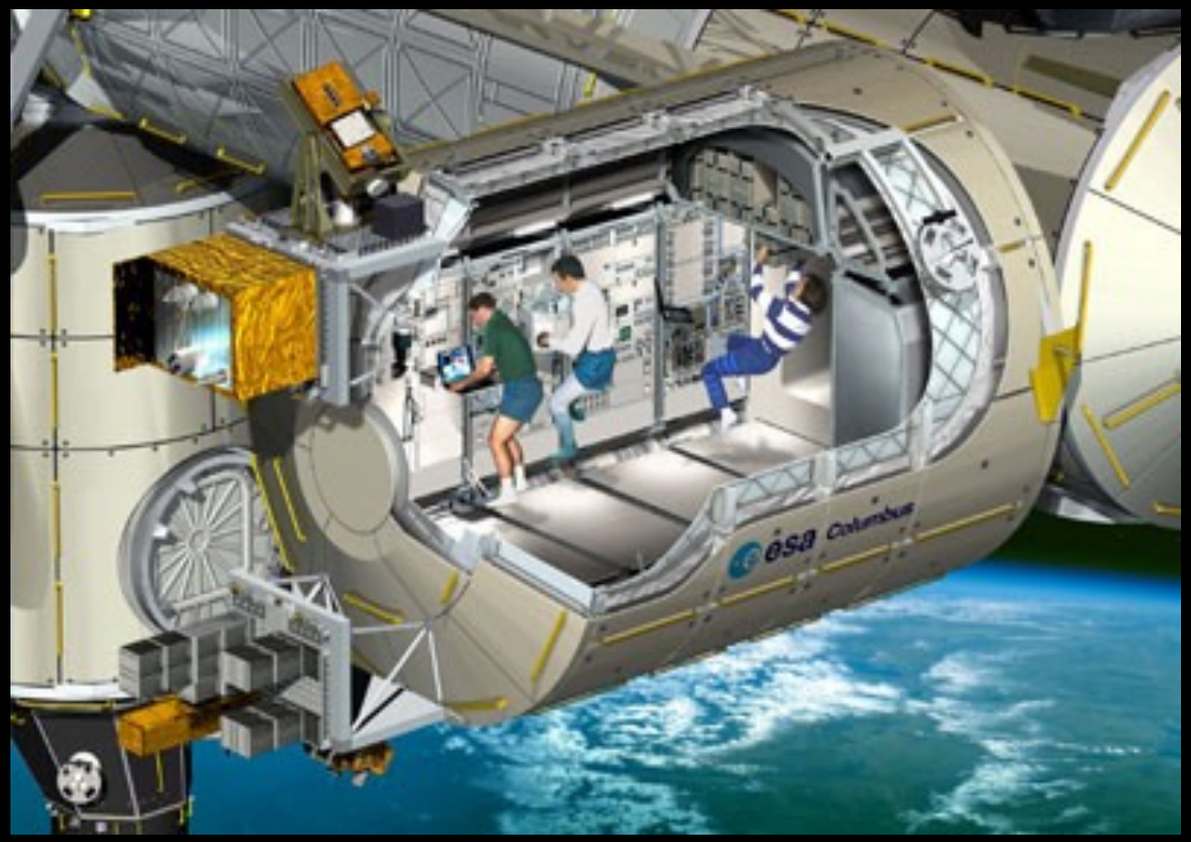
Test version of AISsat (NORAIS) was installed at ISS

- Launch: NORAIS was launched in September 2008, antenna late 2009
- Start of experiment: Early 2010
- Main goal: AIS signal tests in crowded areas



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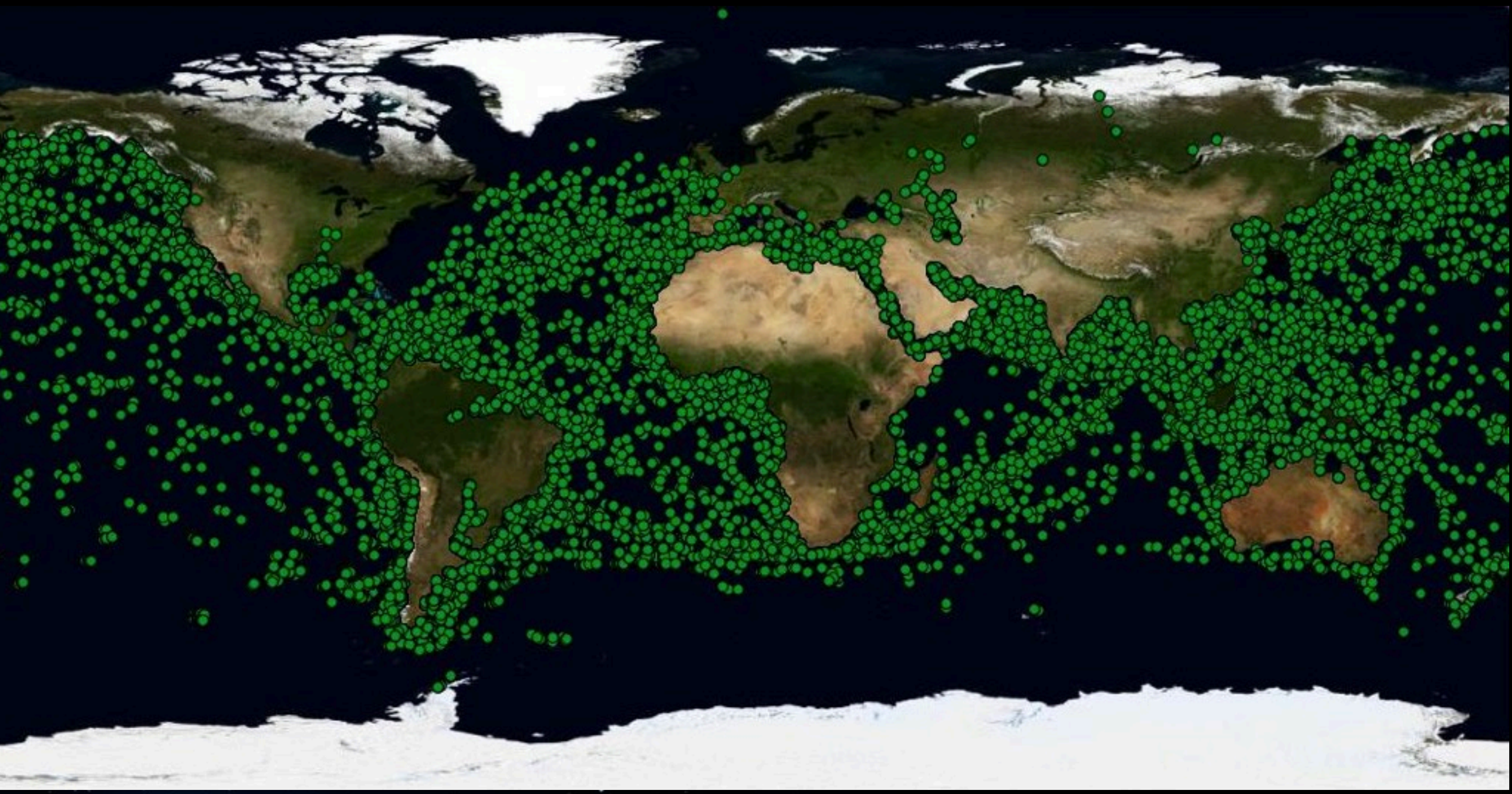
Technology testing on iSS



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Norwegian AIS satellite - AISSat-1

- Total cost ca. 30 million NOK.
- Launched summer 2010 from India
- Norwegian Space Centre and includes funding from NHD.
- Developed by Forsvarets Forskningsinstitutt (FFI), with contribution from Kongsberg Defence & Aerospace og Kongsberg Seatex

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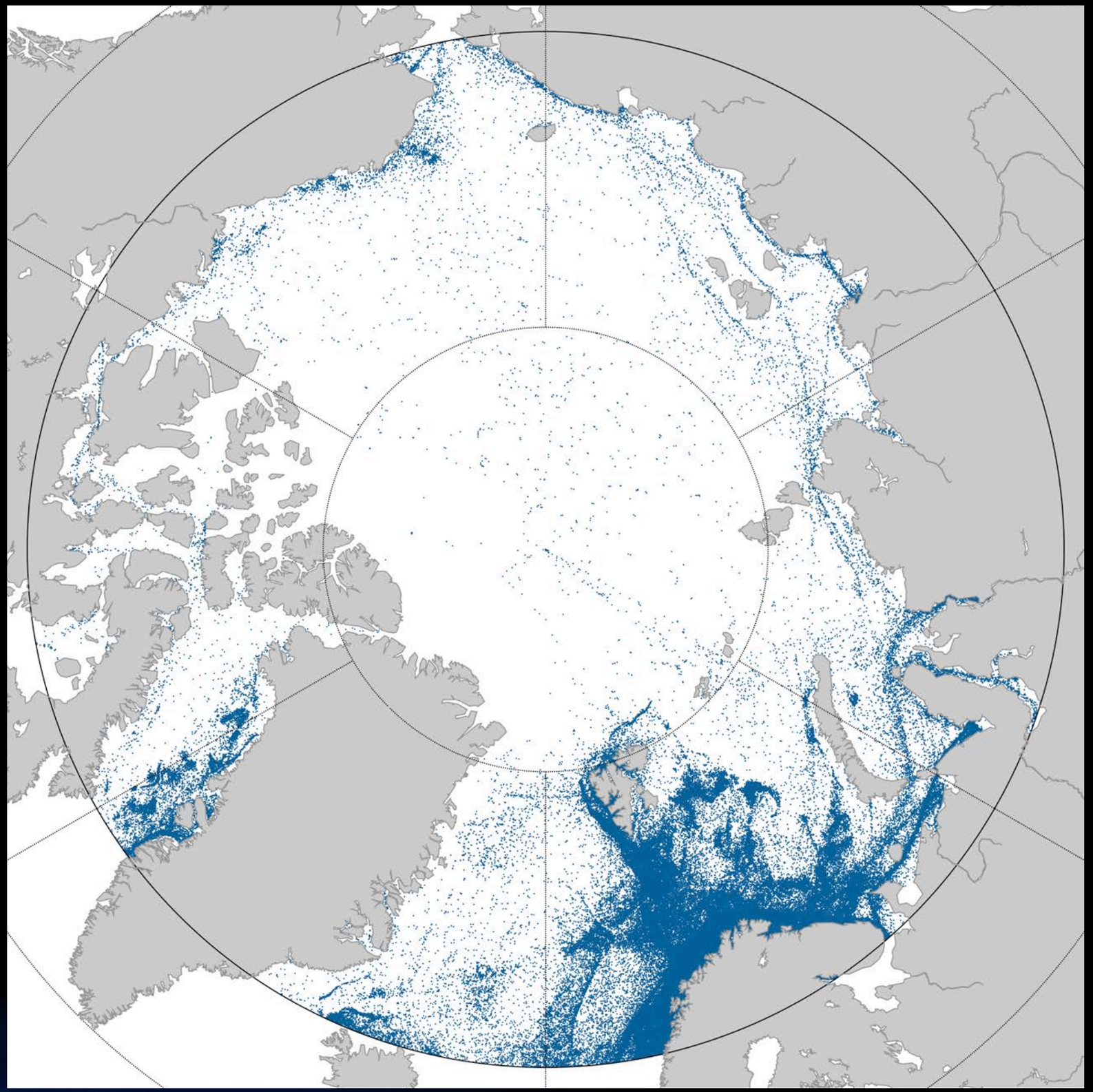
Where is the Arctic Marine Traffic?



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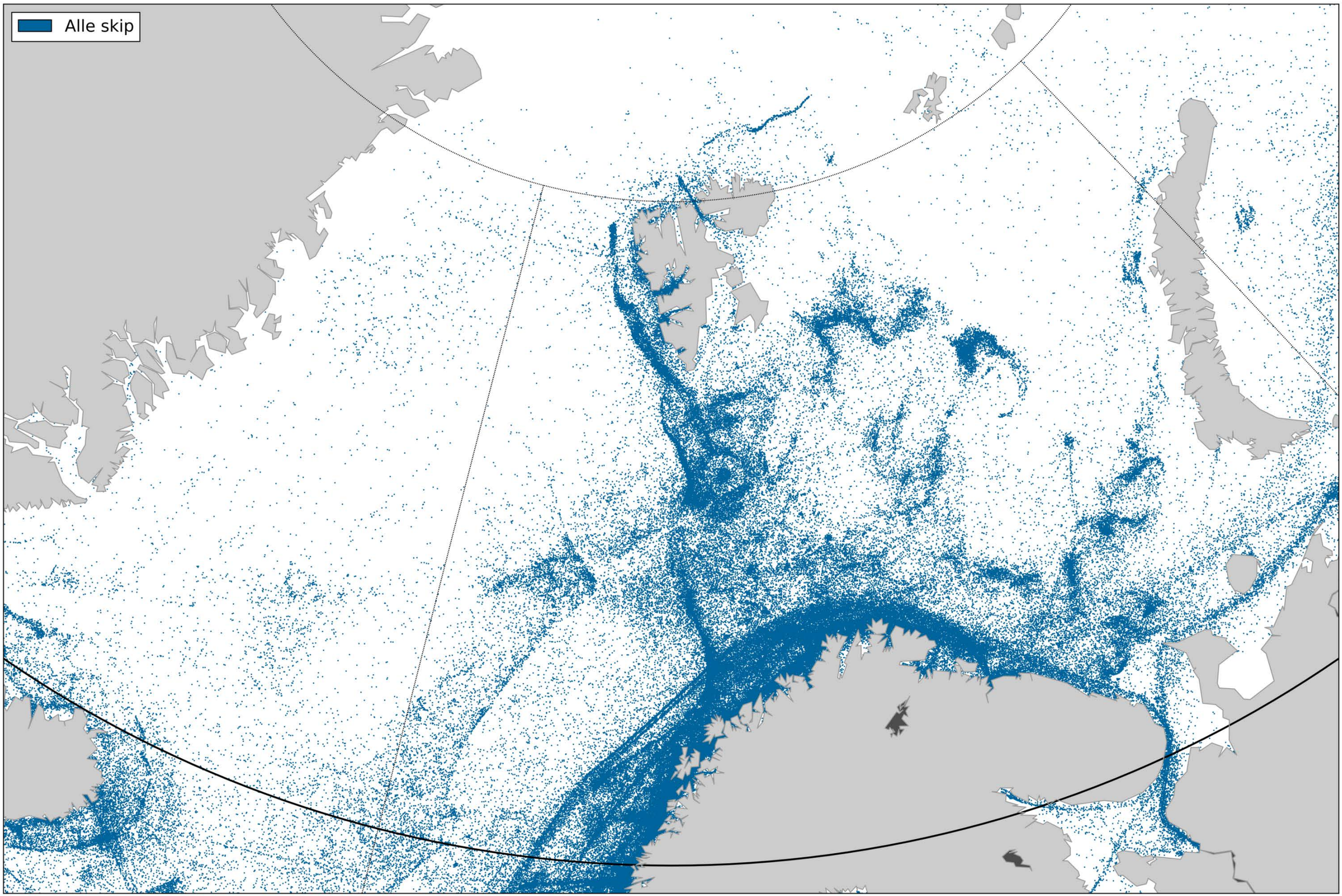
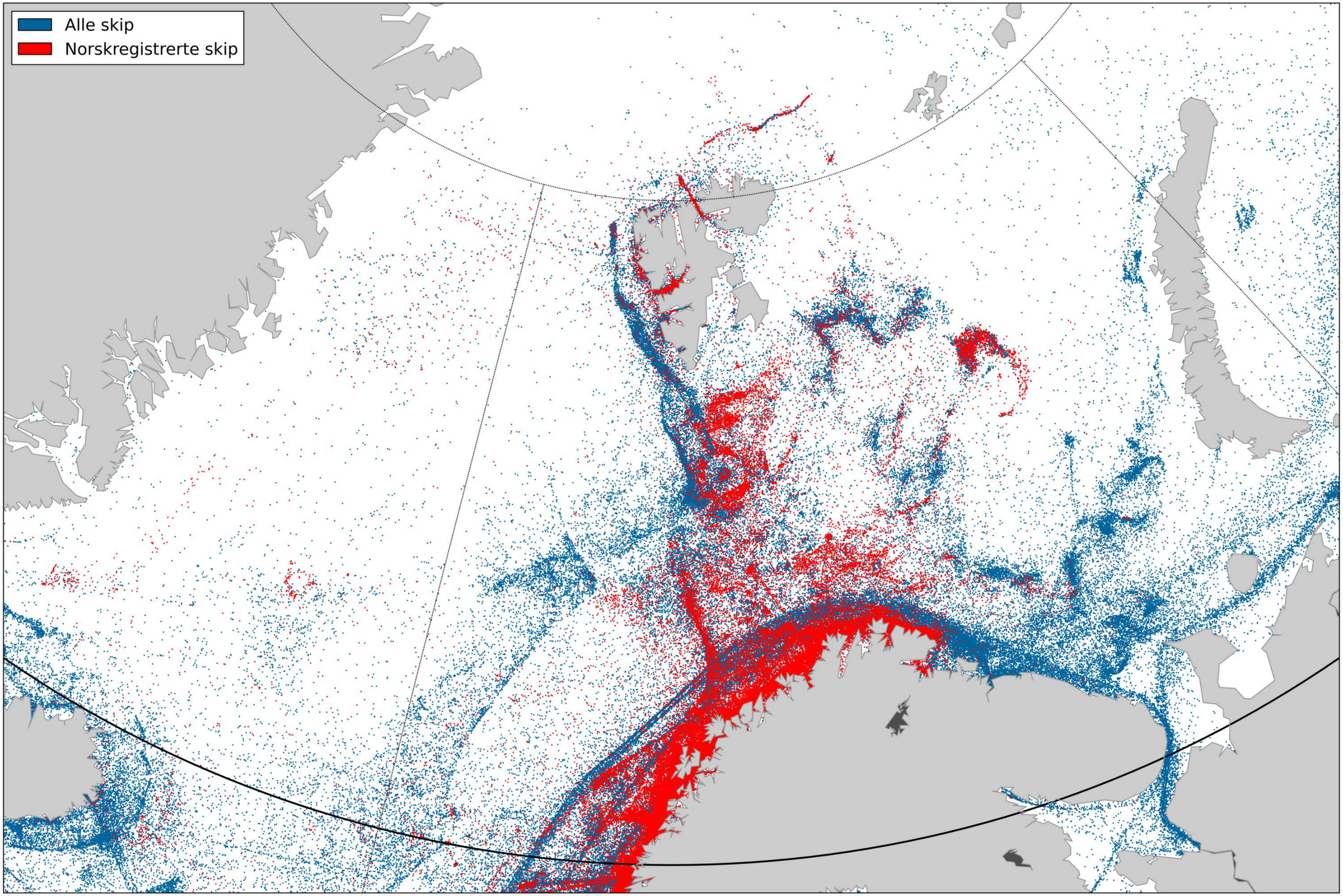
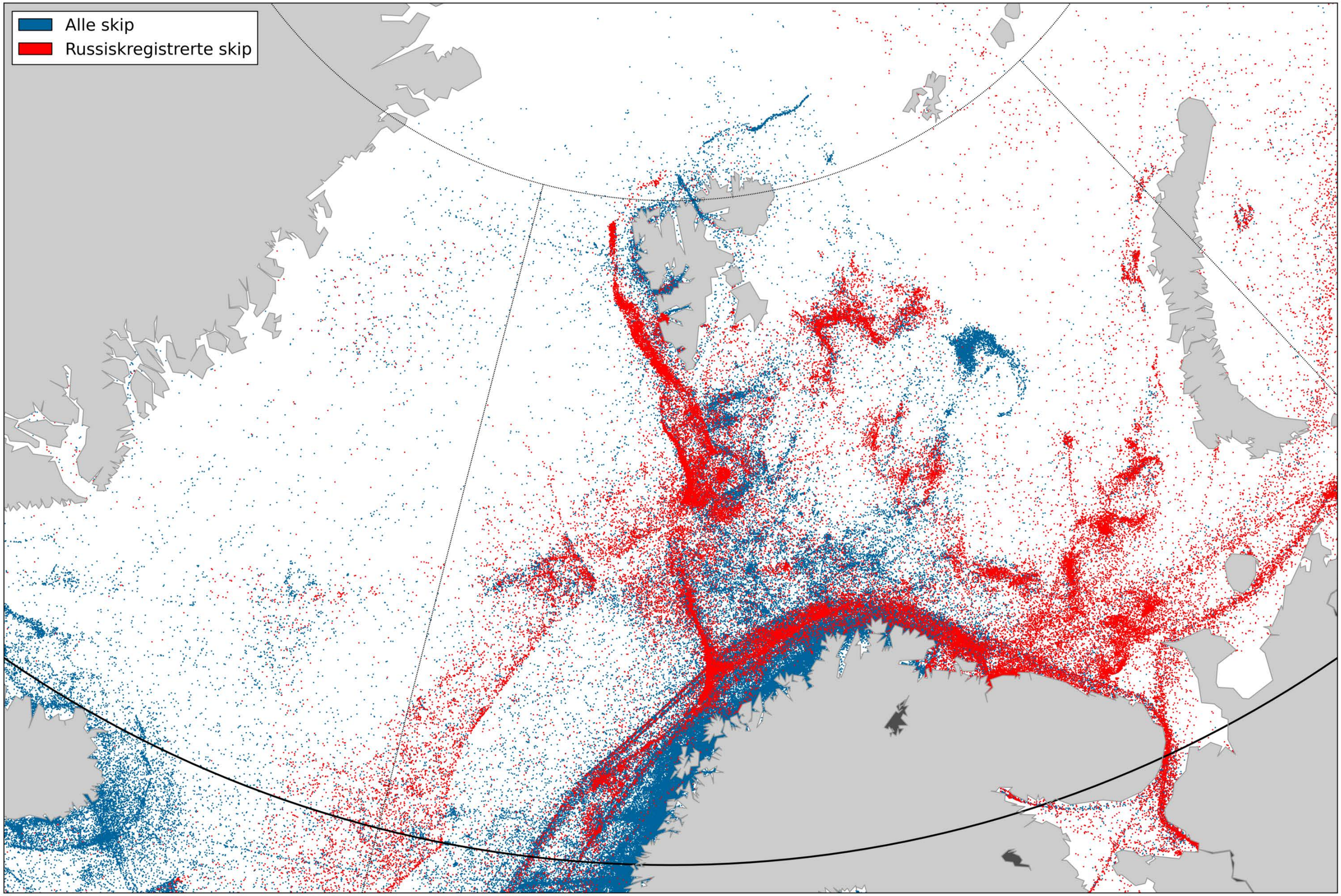
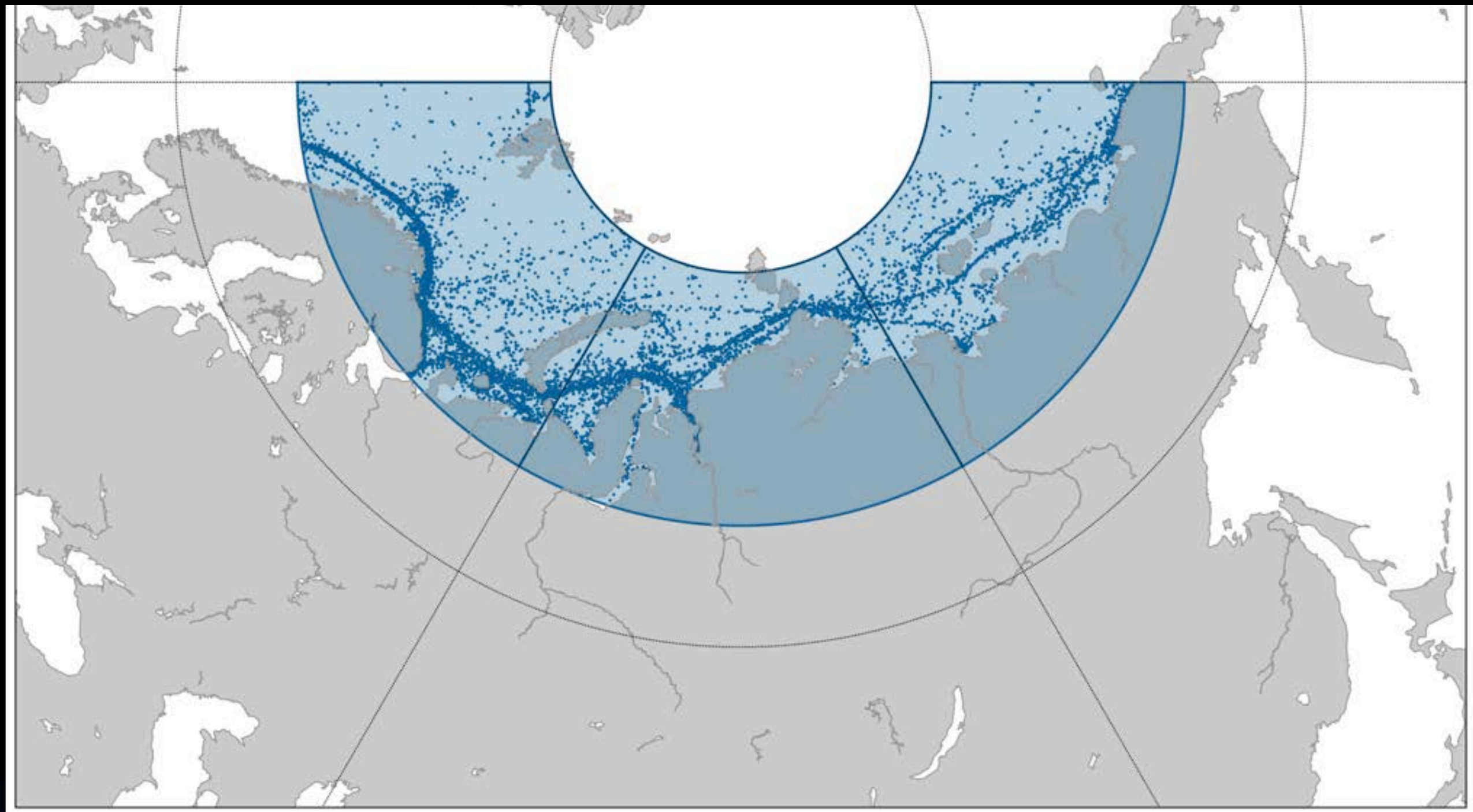

Alle skip

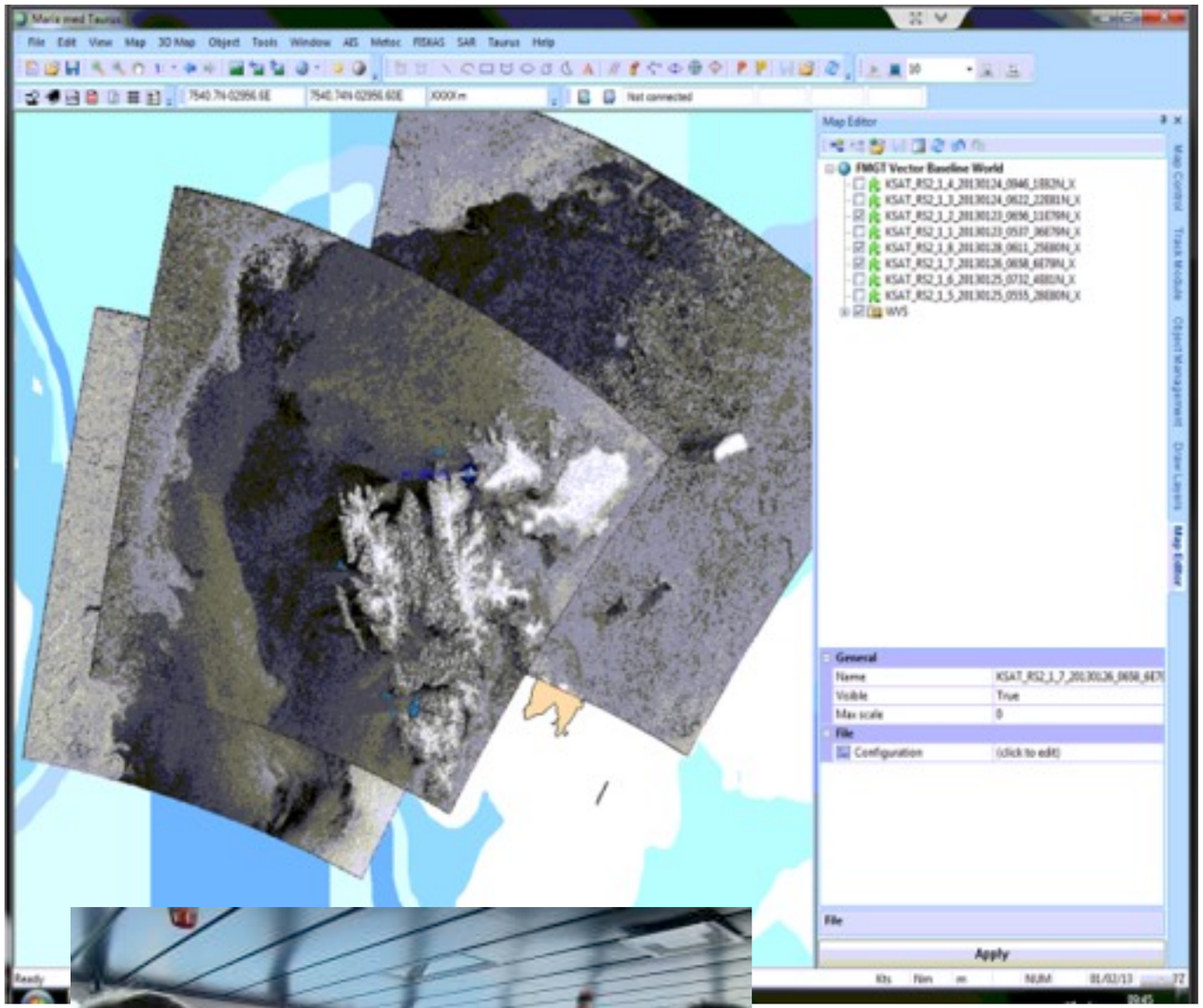

Alle skip
Norskregistrerte skip

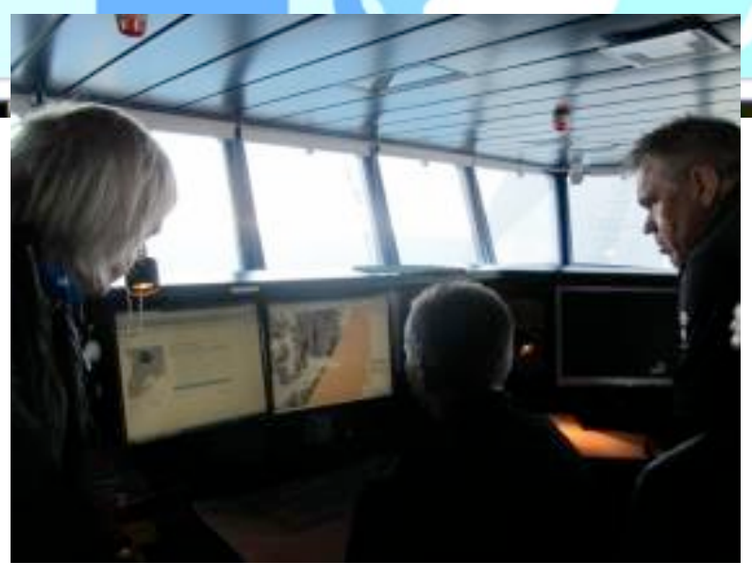

Alle skip
Russiskregistrerte skip

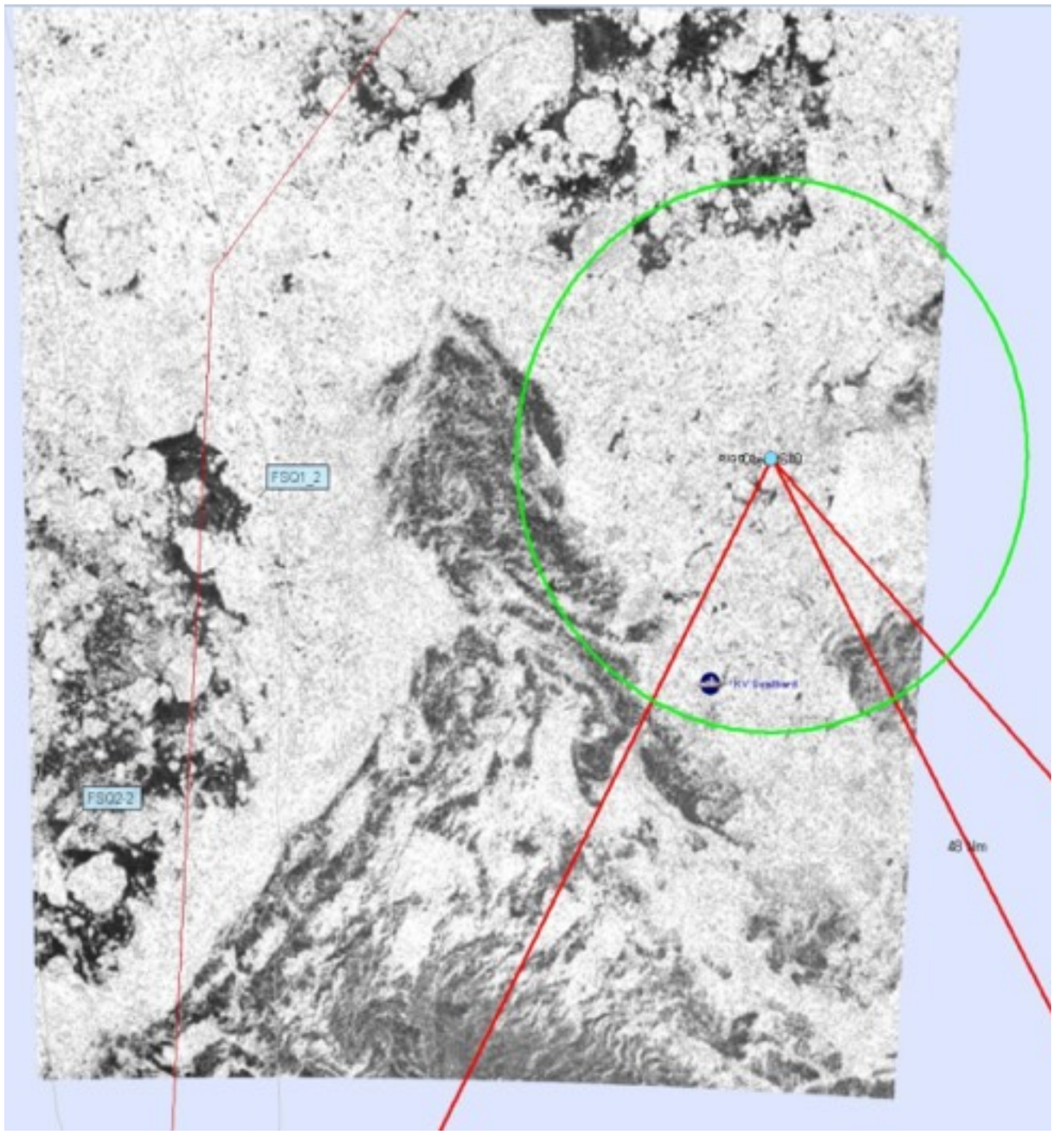
Northern sea route (46 vessels in 2012)



Ice information and operational use





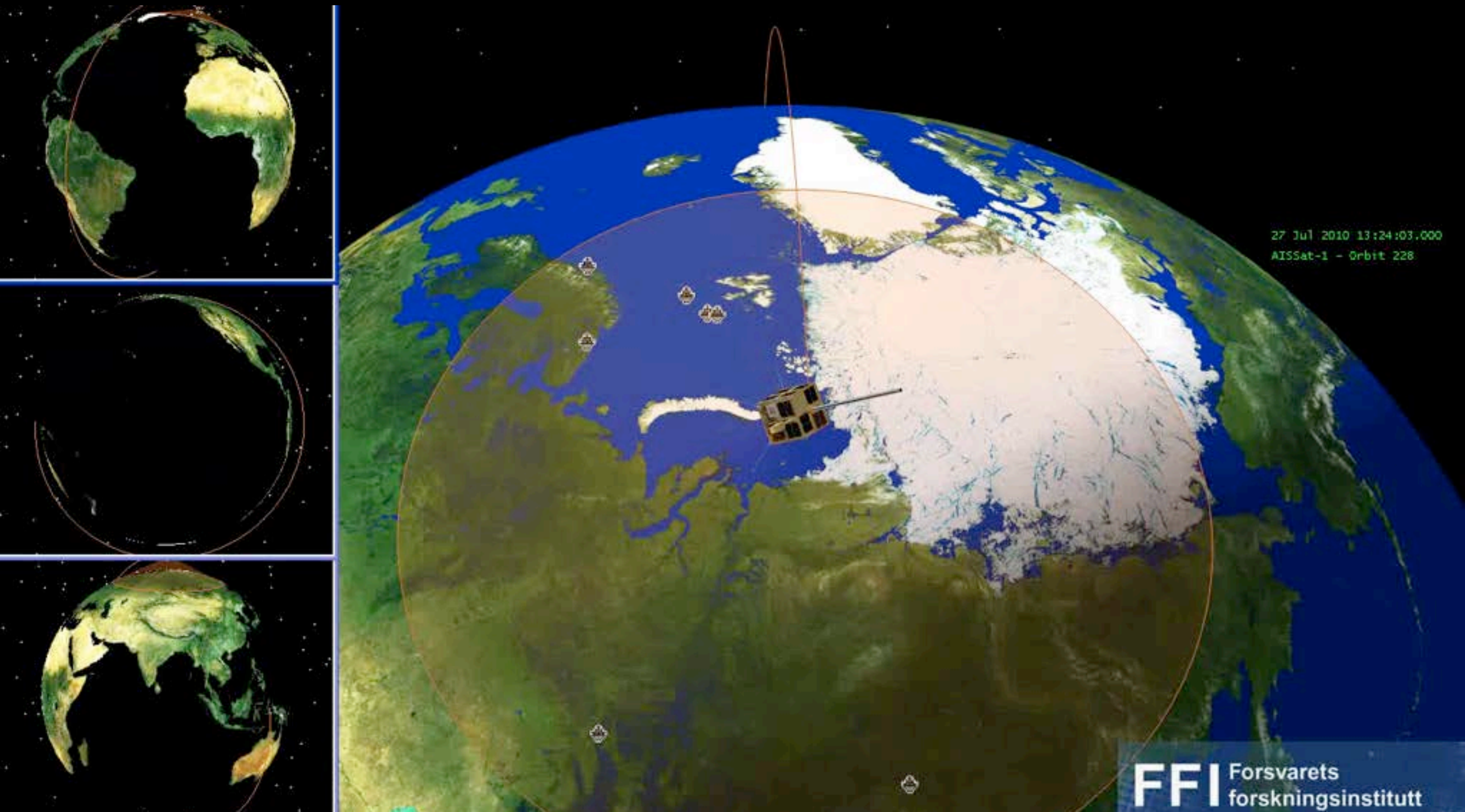


Integration satellite image into vessel navigation systems
Image radar example14.10.2014 (right)

Data for tactical operational use

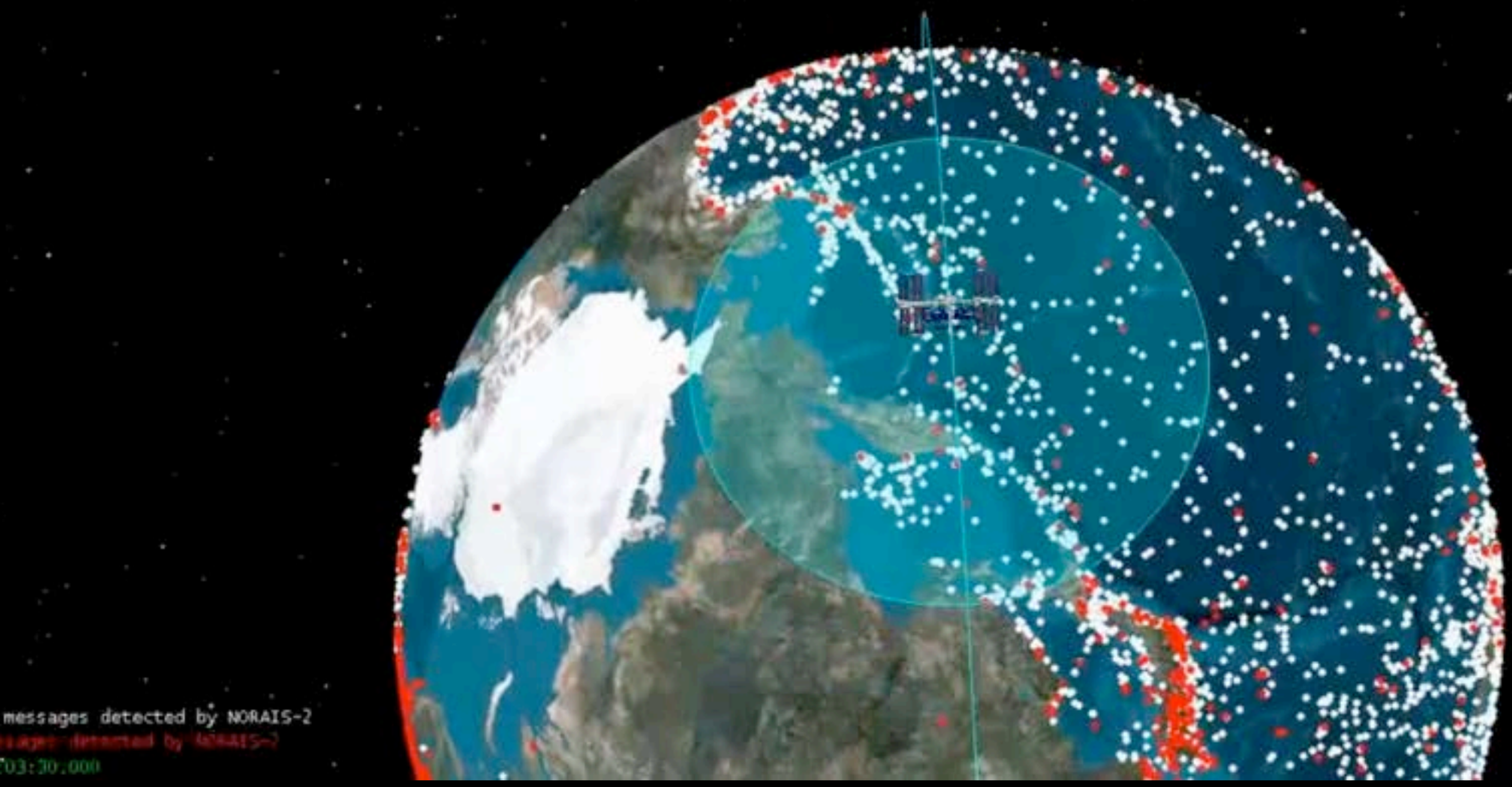
AisSat-2 & 3

Today, the Norwegian Coastal Administration and other governmental institutions are using the data from AISat-1 for a variety of purposes, including monitoring fisheries, oil spills, and maritime traffic, to support anti-piracy operations along the coast of Africa, and other areas of interest to Norway.



NORAIS-II

An increase in number of ships tracked daily from roughly 26 000 to 33 000.



FFI Forsvarets forskningsinstitutt

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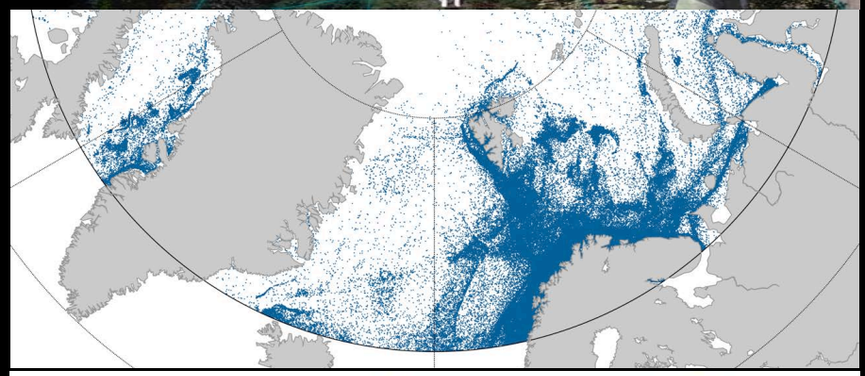
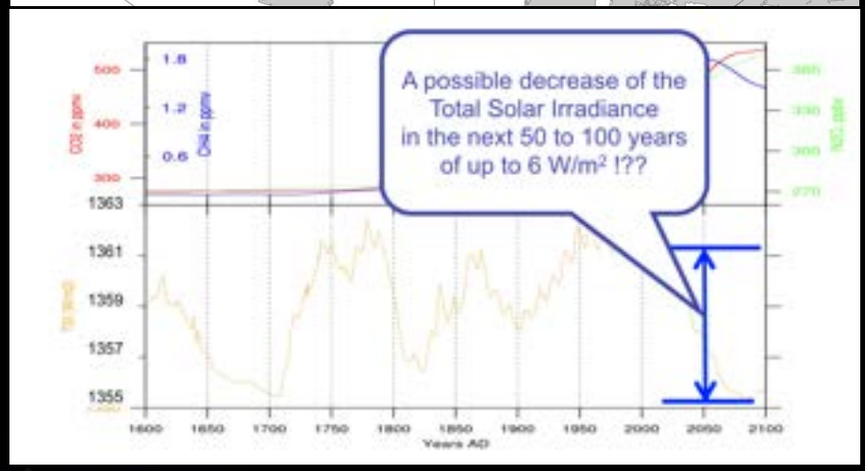
NORSAT-1

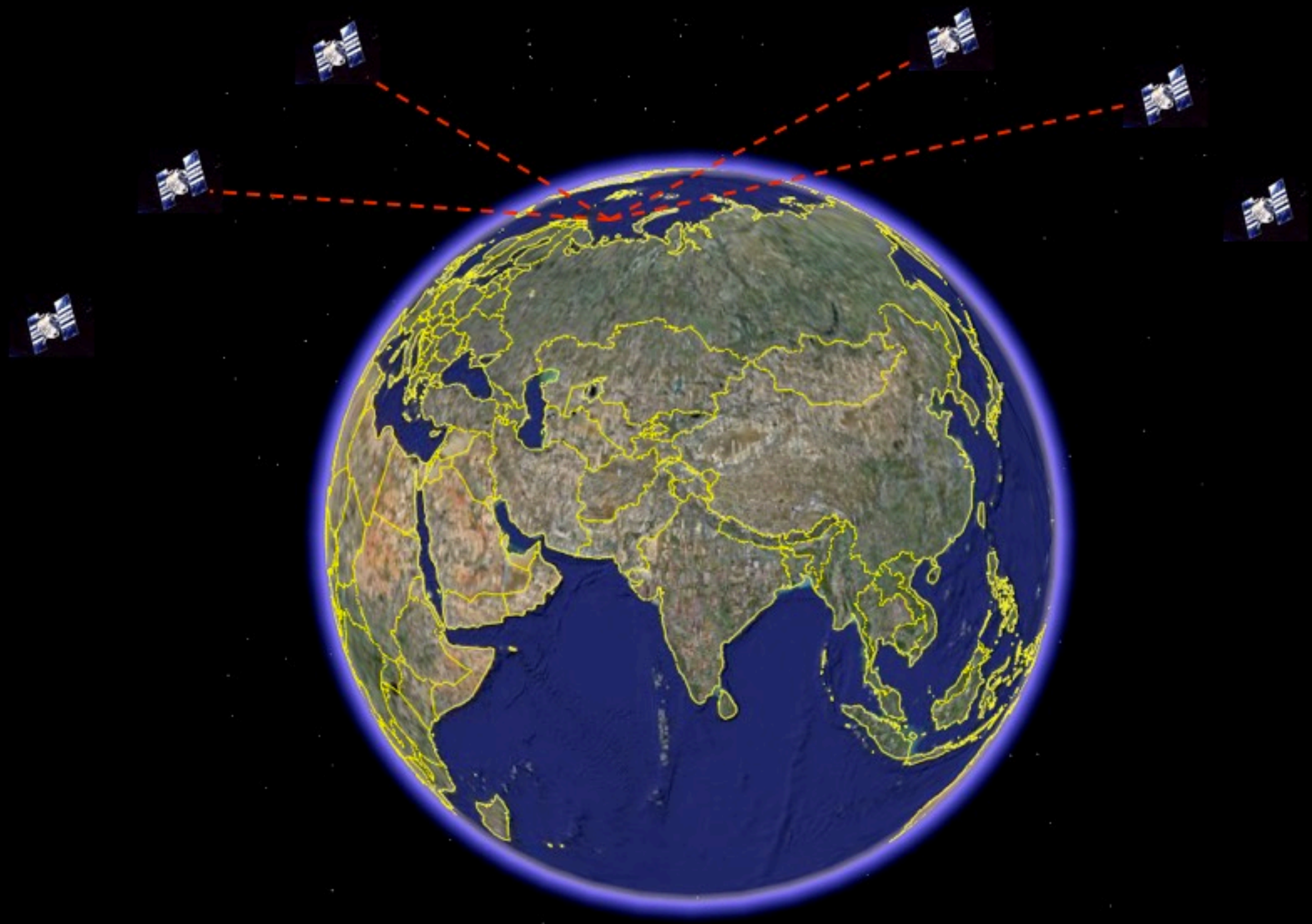
NORSAT-1 will be a small Norwegian satellite designed to carry three scientific payloads

- AIS-receiver - Ship detection - to test new algorithms
- CLARA - Solar Total Irradiance monitor (Sun-Climate)
- Mini-Langmuir probes (Space Weather)





Challenges in the Arctic



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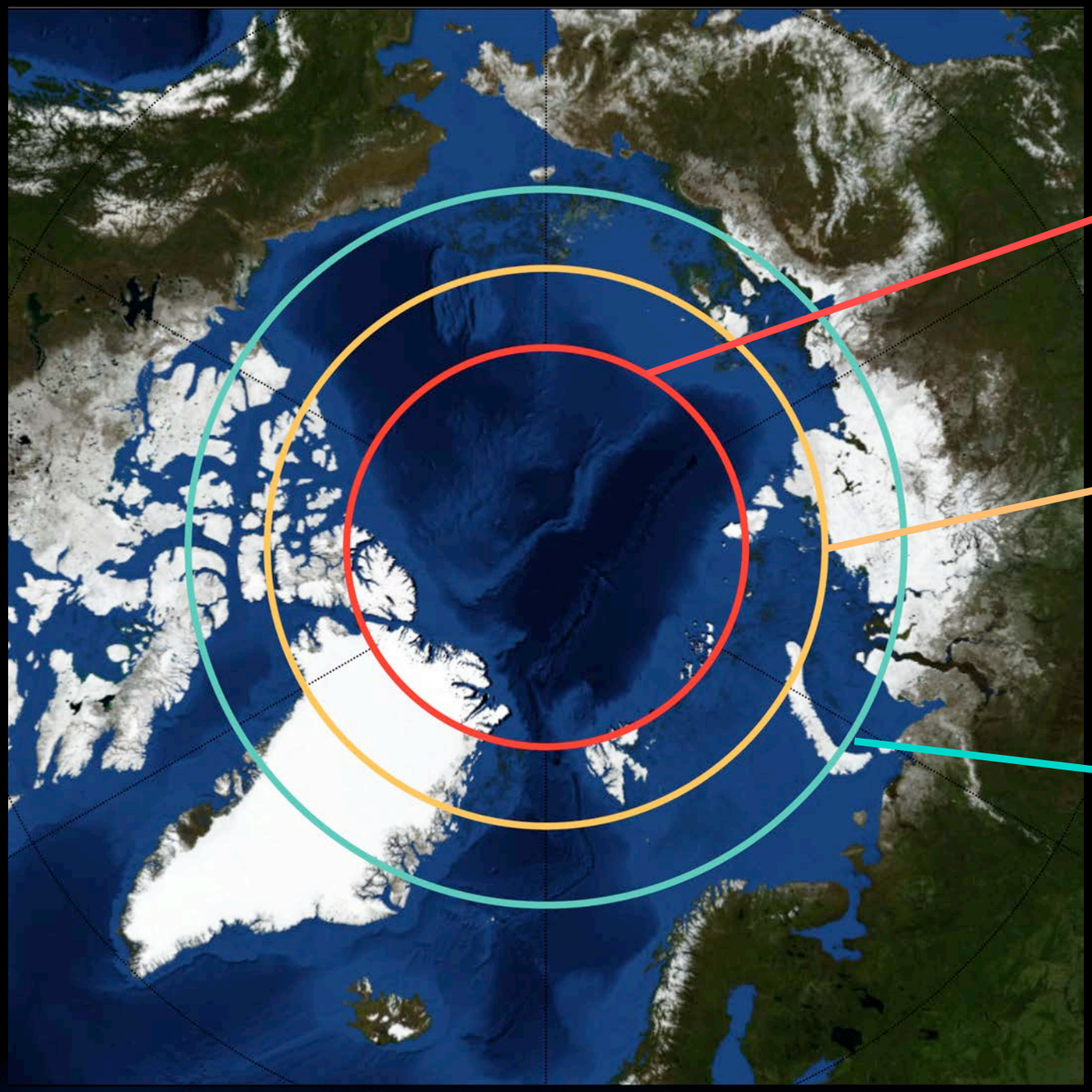
Limited Broadband and radiocommunication in the North



Theoretical (80º)

Practical (76º)

Problems Occur (72º)

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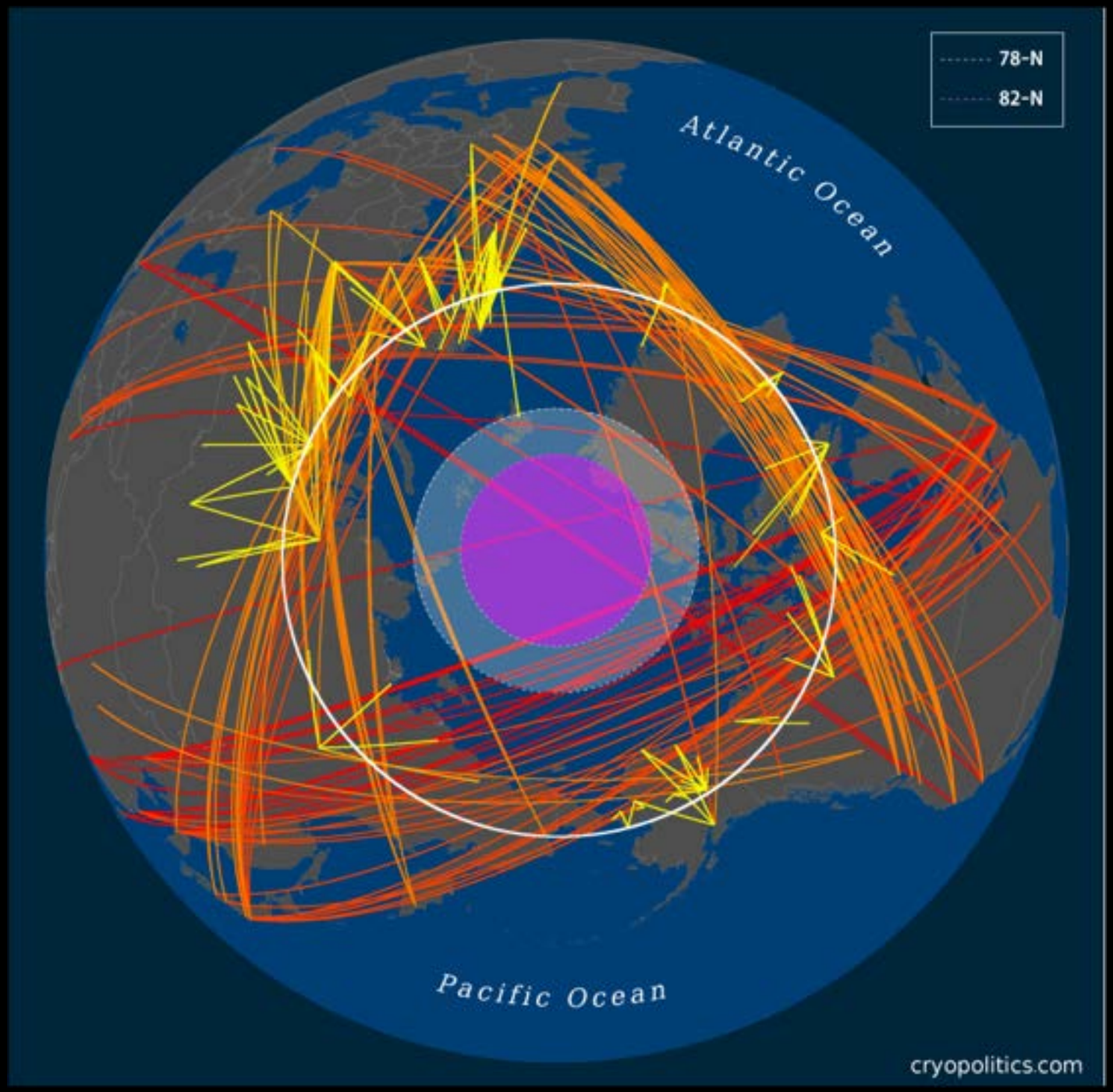
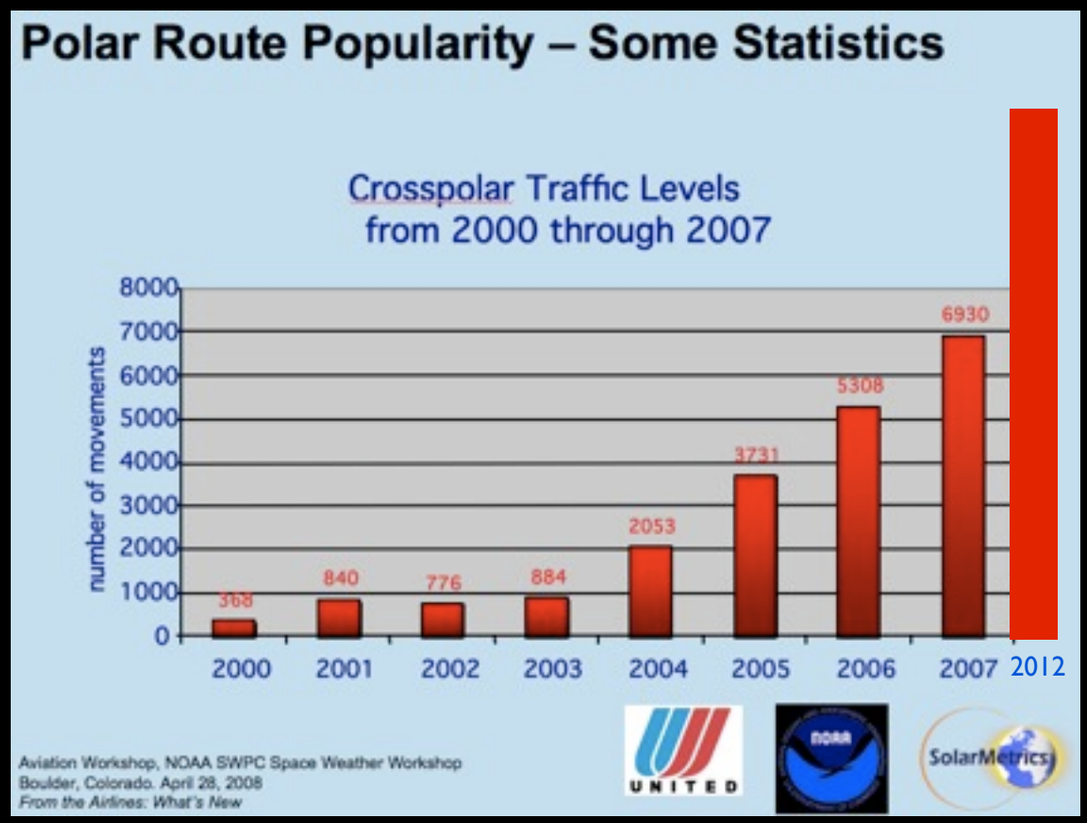
Polar routes

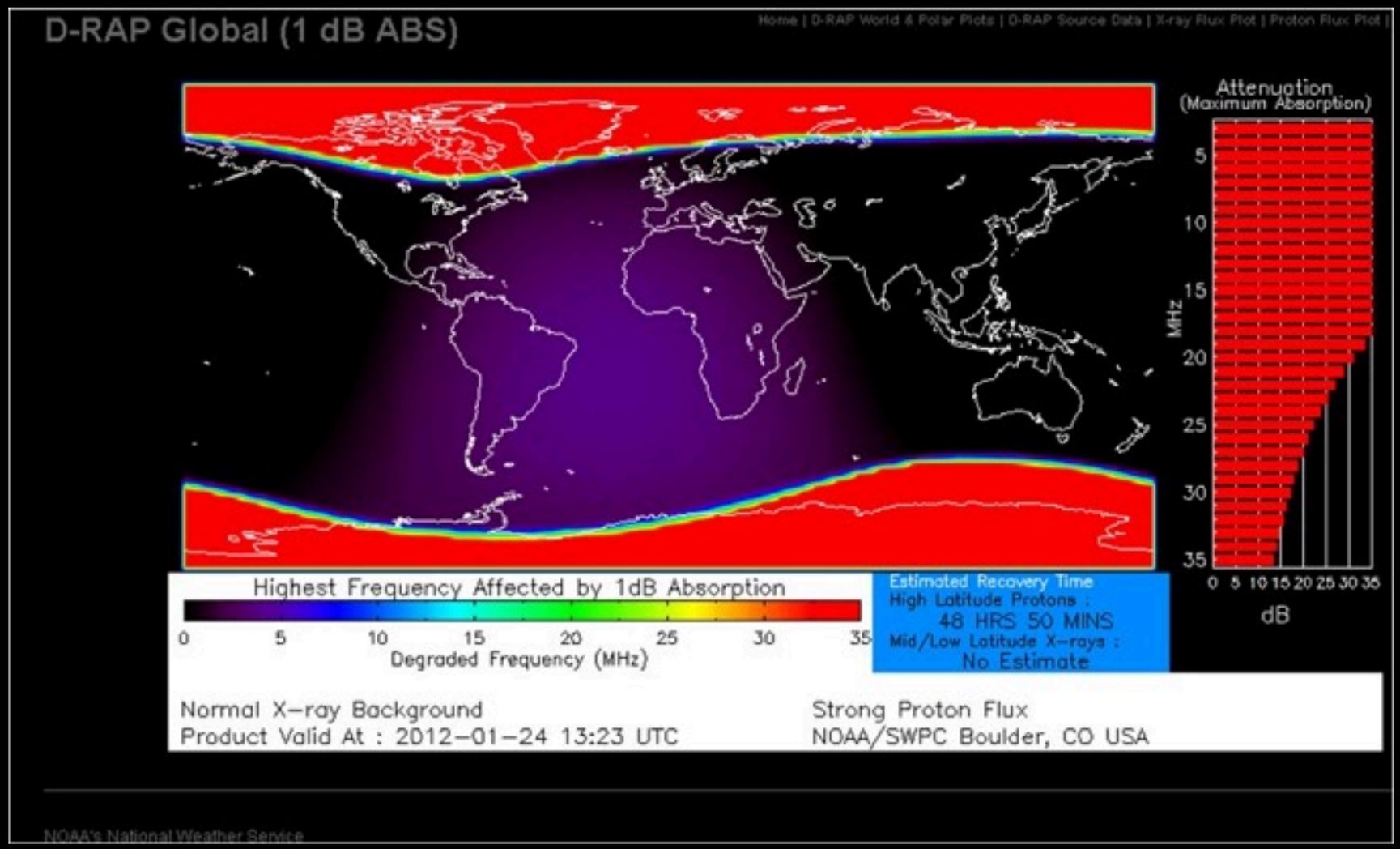
- Polar routes : 11.214 flights in 2012 (3,365,000 passengers)
- No satellite communication north of 82 degree





Flights were diverted due to Space

- Delte Airlines and United diverted some of their polar flights to avoid radio communication problems and increased radiation doses for the crew.
- The South pole was without radiocommunication for two days (where satellite communication is unavailable).



This graphic shows the energetic particles entering the D-region of the ionosphere. SWPC forecasters use this product to show where the energetic particles are entering and to give a visual to what is currently happening here at Earth. The red that can be seen at the poles is where the energetic particles enter and where airliners and spacecraft, should try to avoid.

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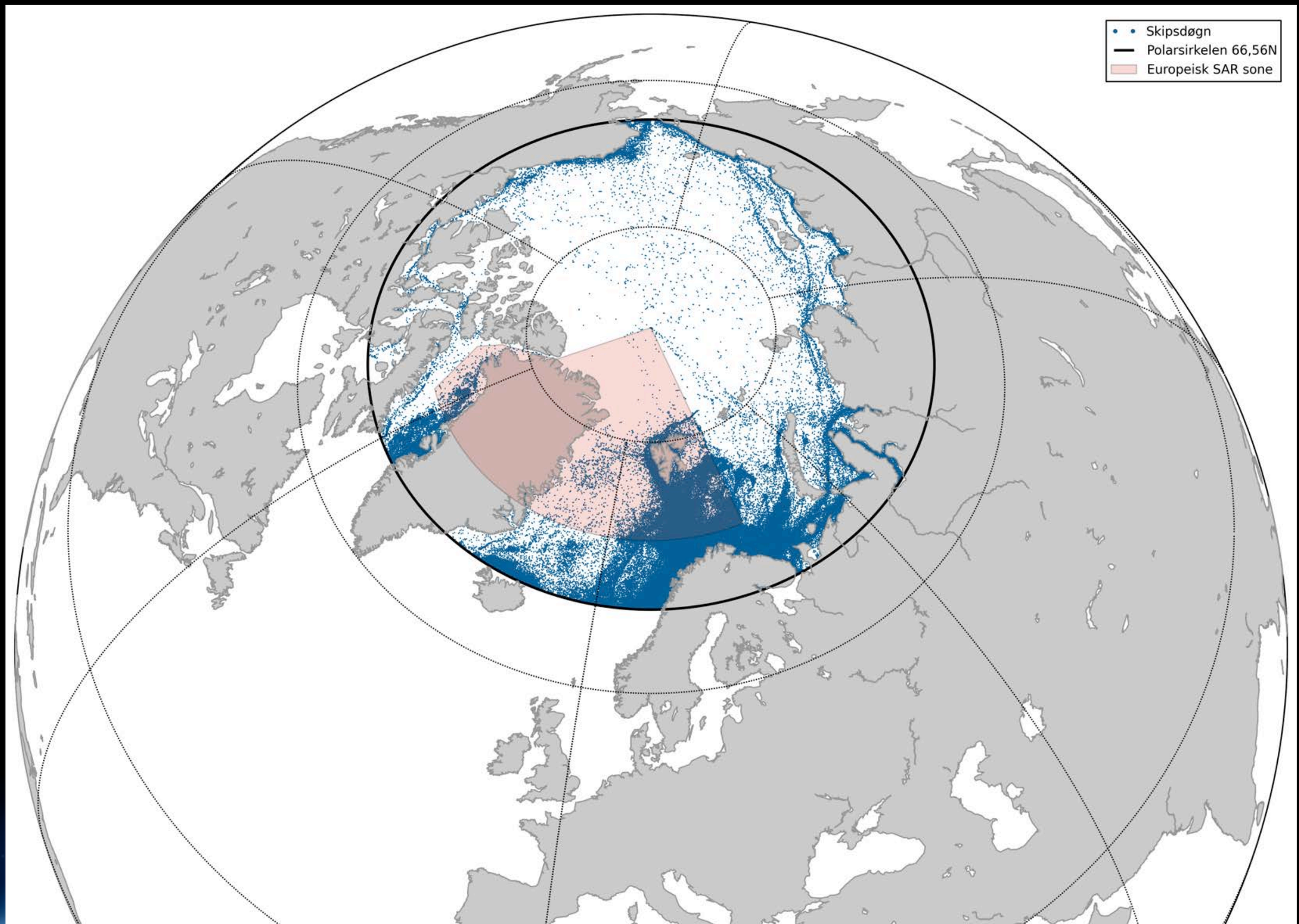
The European SAR area



Satellite communication in the Arctic

”Existing satellite communication systemes have little or no coverage north of 75 degree. The Norwegian Space Centre is exploring possible concepts for satellite communiction north of 75 degree.”

Kilde: Regjeringens statusrapport nordområdene (2014)

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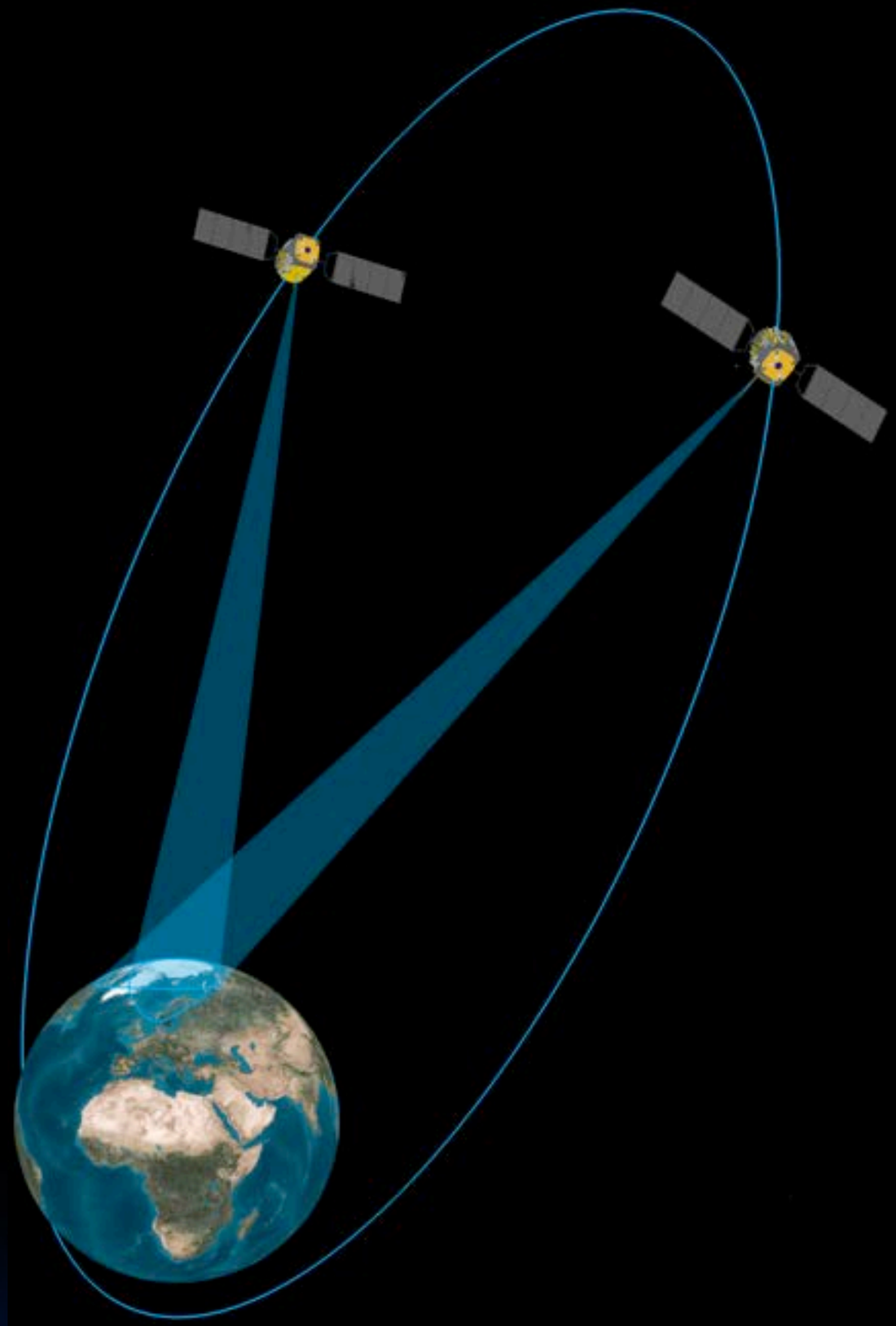
Broadband - Telecom in polar regions

Highly Elliptical Orbit (HEO)



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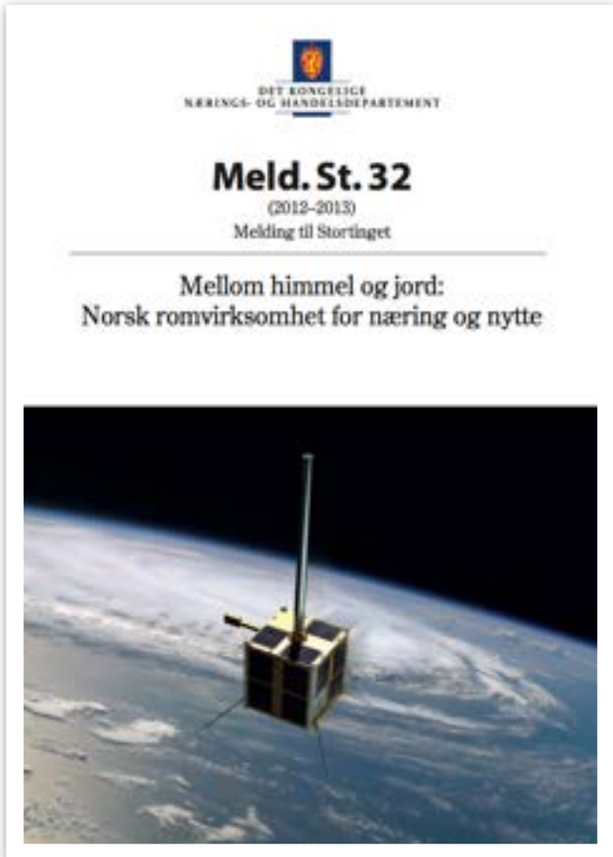
Wy Space Activities in the Arctic

Space technology is perfect for use in the Arctic since satellites can cover vast areas with relatively small amount of infrastructure and without harming the environment.

- Earth observations
- Navigation
- Communictaion
- Research



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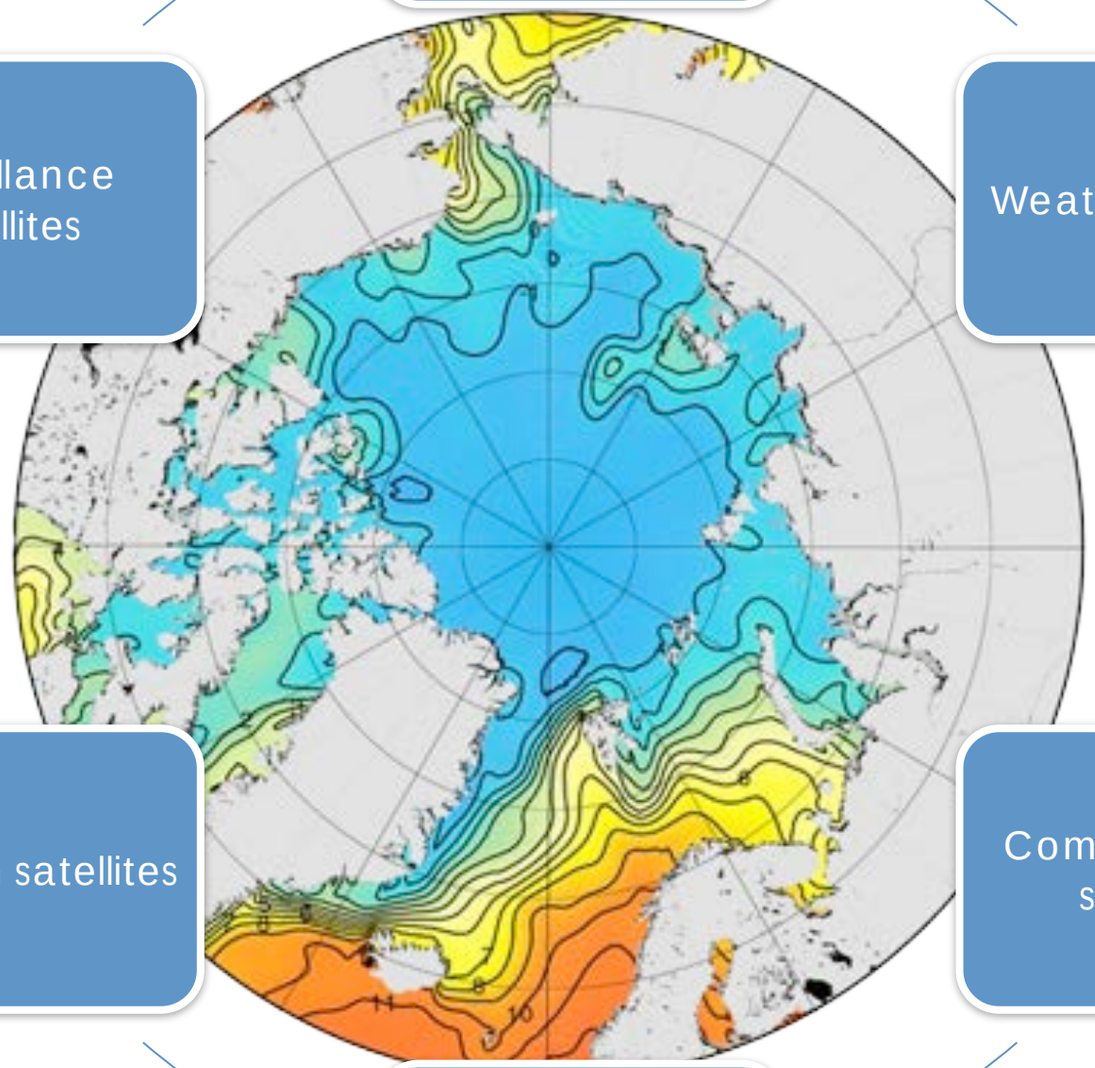
Arctic – an new Space Arena

Earth observing satellites

Surveillance satellites



Weather satellites

Research satellites

Communication satellites

Navigation satellites

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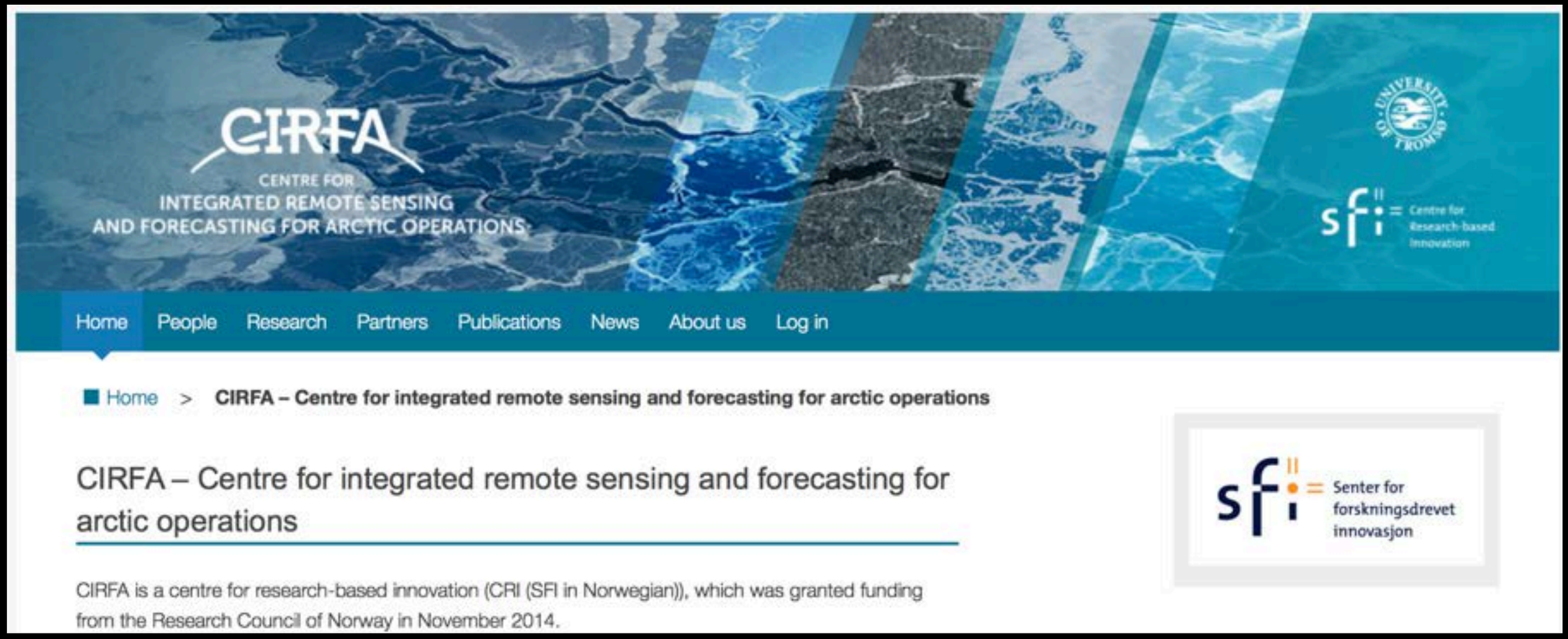
CIRFA - inaguration today



The Centre shall do research on methods and technologies that can reliably detect, monitor, integrate and interpret multi-sensor data describing the physical environment of the Arctic

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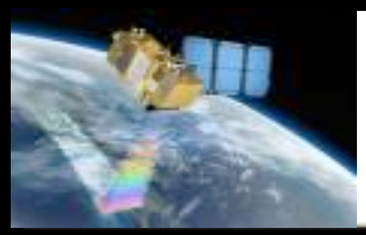
Copernicus, formerly **Global Monitoring for Environment and Security** (**GMES**), is a programme of the European Commission which aims at achieving an autonomous, multi-level operational Earth observation capacity.

Sentinel 1 – SAR imaging

2013 / 2015



Sentinel 2 – Multi-spectral imaging

Land applications: urban, forest, agriculture,..

2014 / 2016

Sentinel 3 – Ocean and global land monitoring

Wide-swath ocean color, vegetation, sea/land

2015 / 2016

Sentinel 4 – Geostationary atmospheric

Atmospheric composition monitoring, trans-

2020

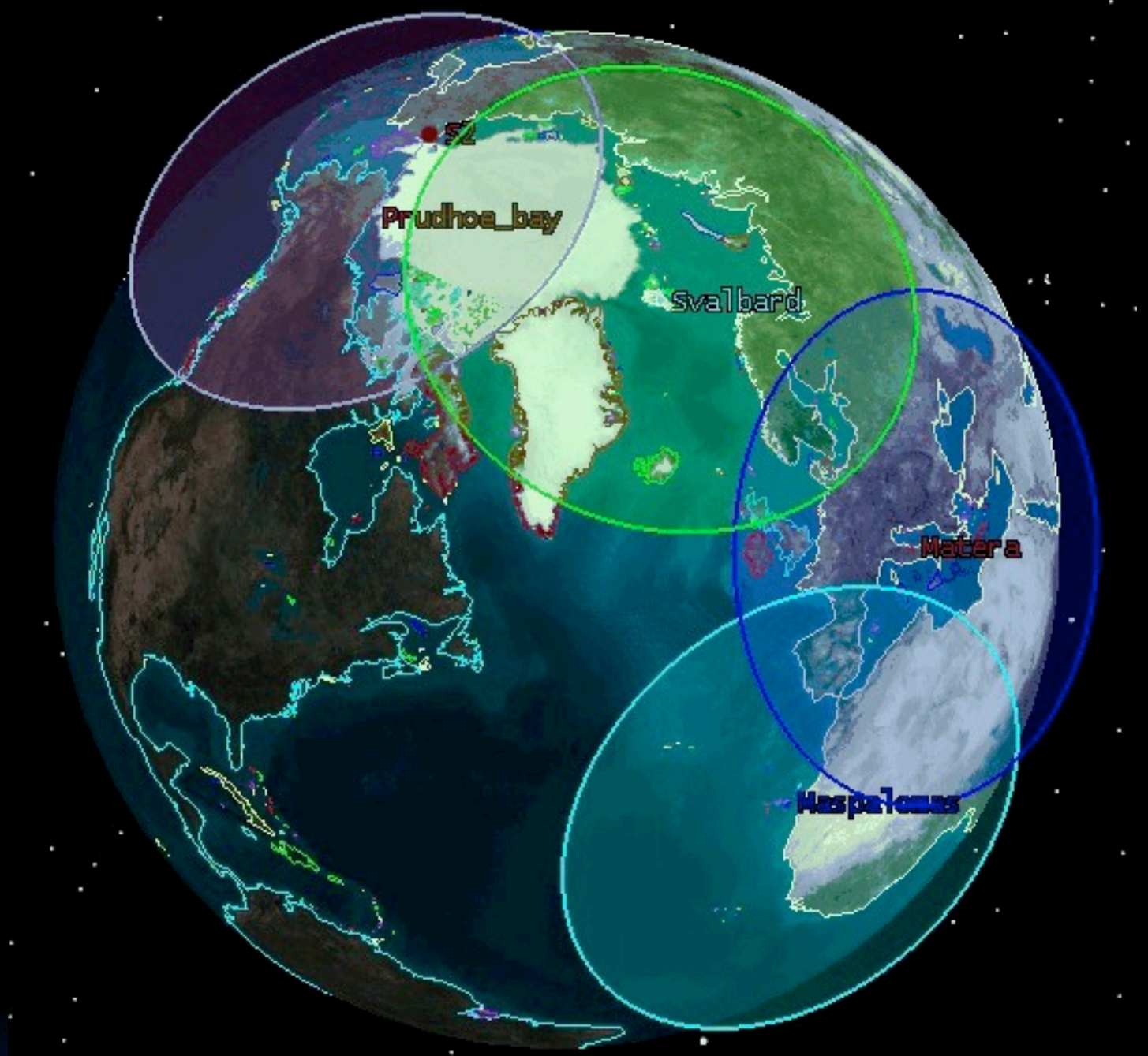
Sentinel 5 – Low-orbit atmospheric

Atmospheric composition monitoring

2020+

Copernicus

Norway is particpating and plays a central role



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Space is not the solution to all our challenges

But few - or none - of our challenges in the Arctic can be solved without secure access to satellite systems

Norsk Romsenter
NORWEGIAN SPACE CENTRE

Our Bold Vision

The vision of the Norwegian Space Centre is that Norway shall be the country in the world to benefit most from space activities.

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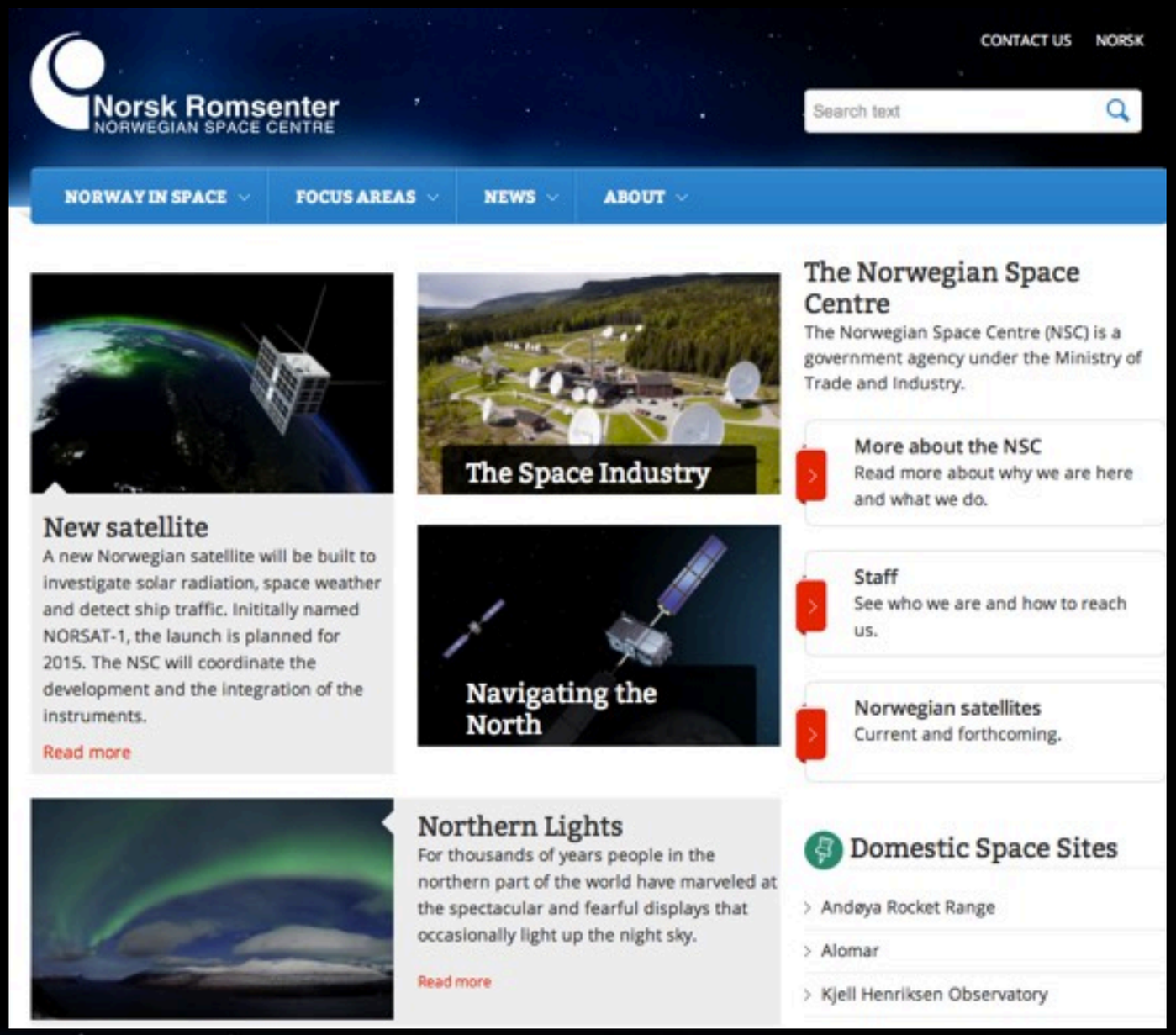

http://www.romsenter.no/eng

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Pål Brekke paal@spacecentre.no