



Sea ice research supporting safe and efficient in the Arctic

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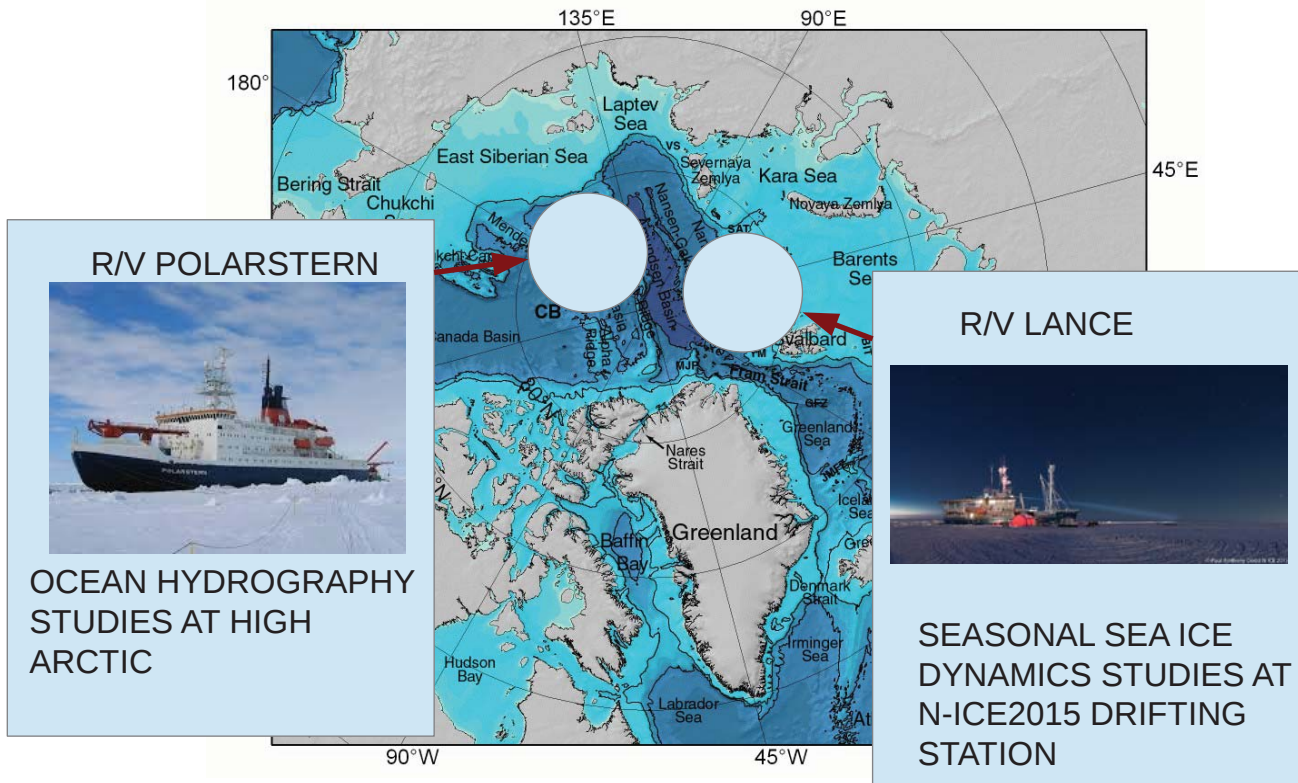


MARINE SCIENCE FOCI AT THE FMI

- Variability and change of the ice covered seas
- Role of sea ice in climate system
- Ocean-atmosphere interactions
- Impact of marine physical changes on ecosystem and society
- Tools for safe and efficient shipping

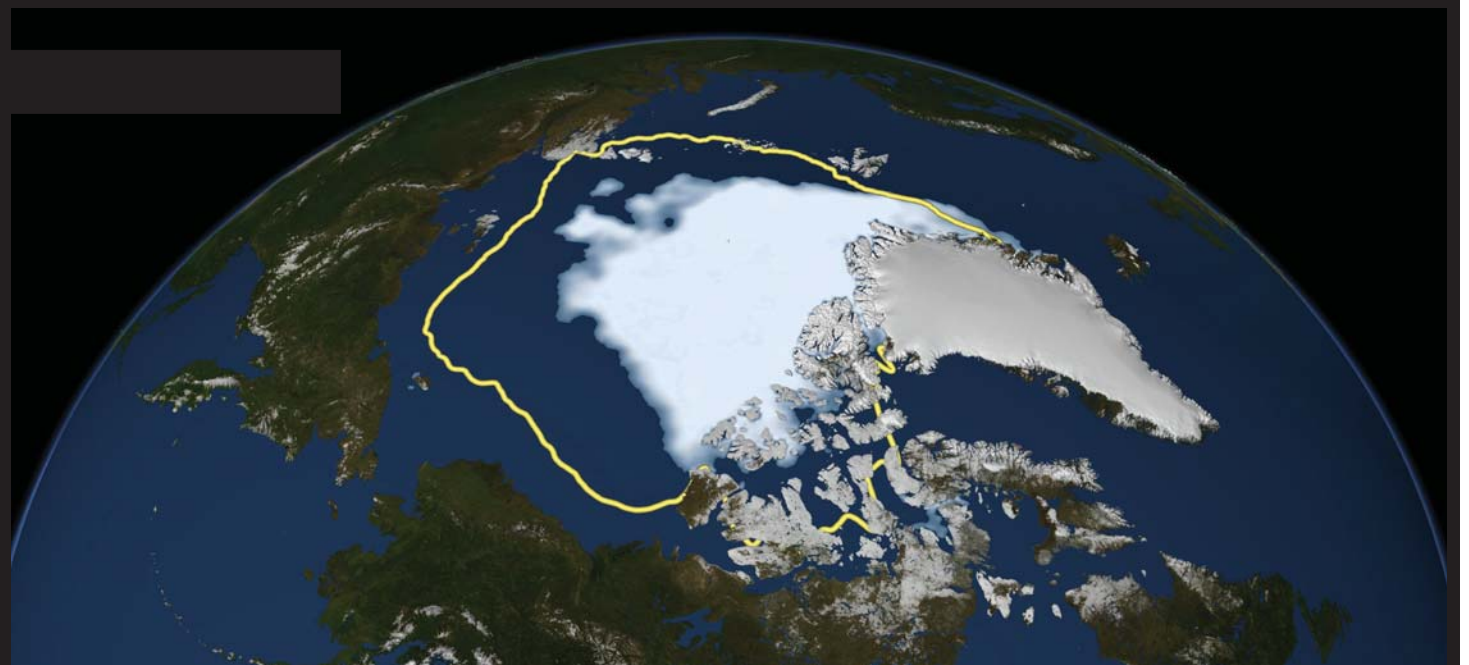


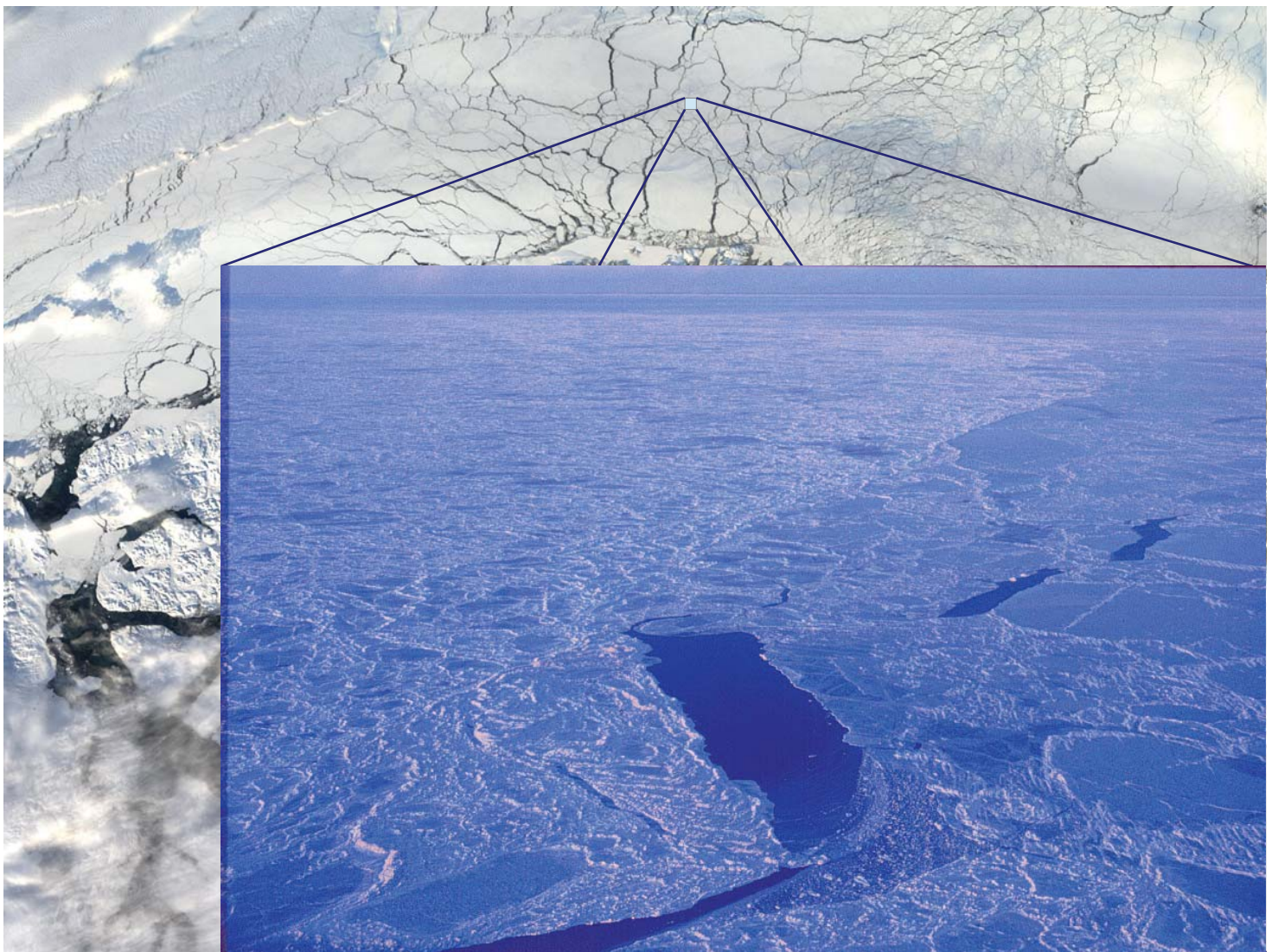
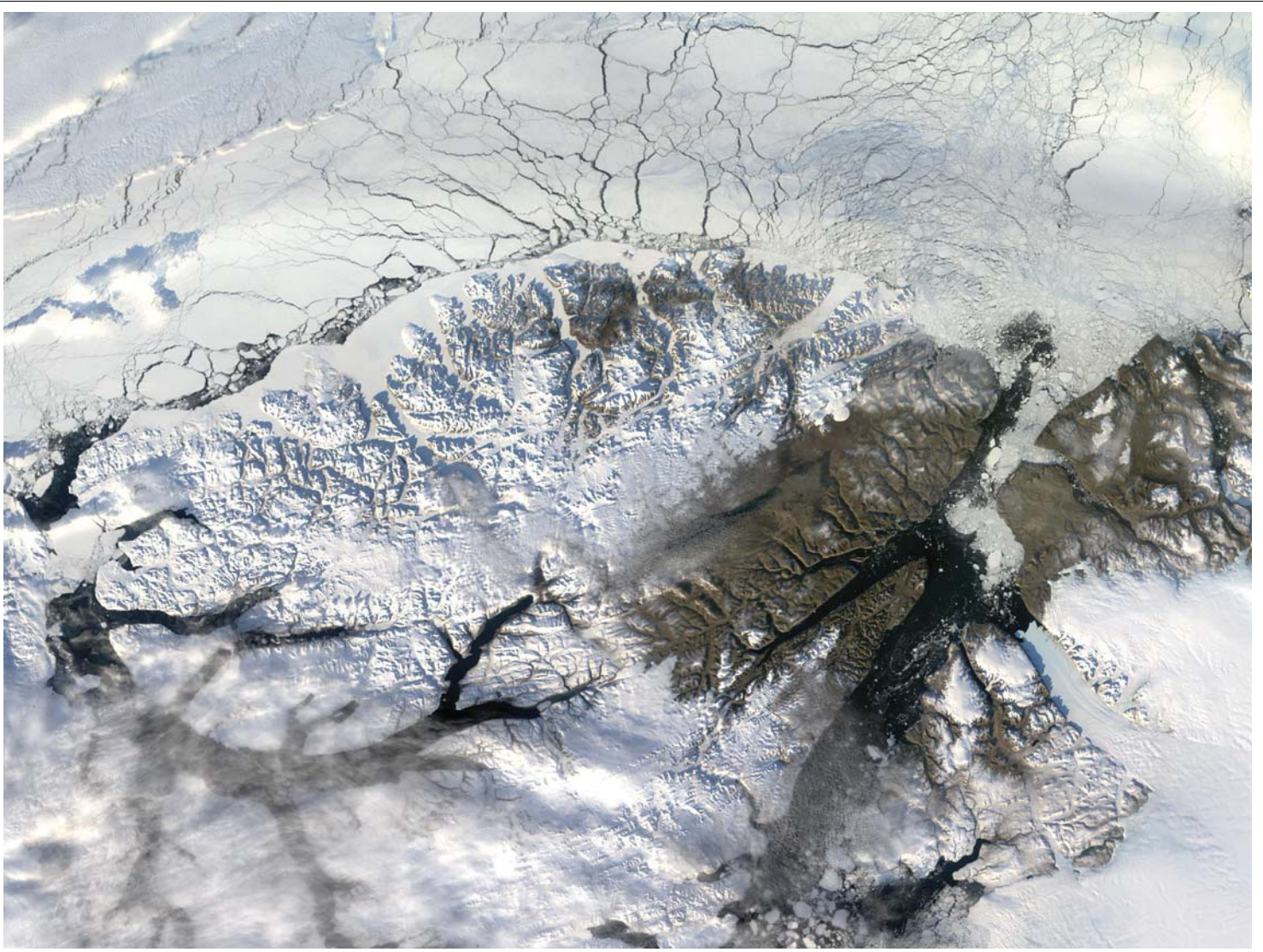
FINNISH ARCTIC OCEAN RESEARCH ACTIVITY 2015 AS PART OF INTERNATIONAL CAMPAIGNS

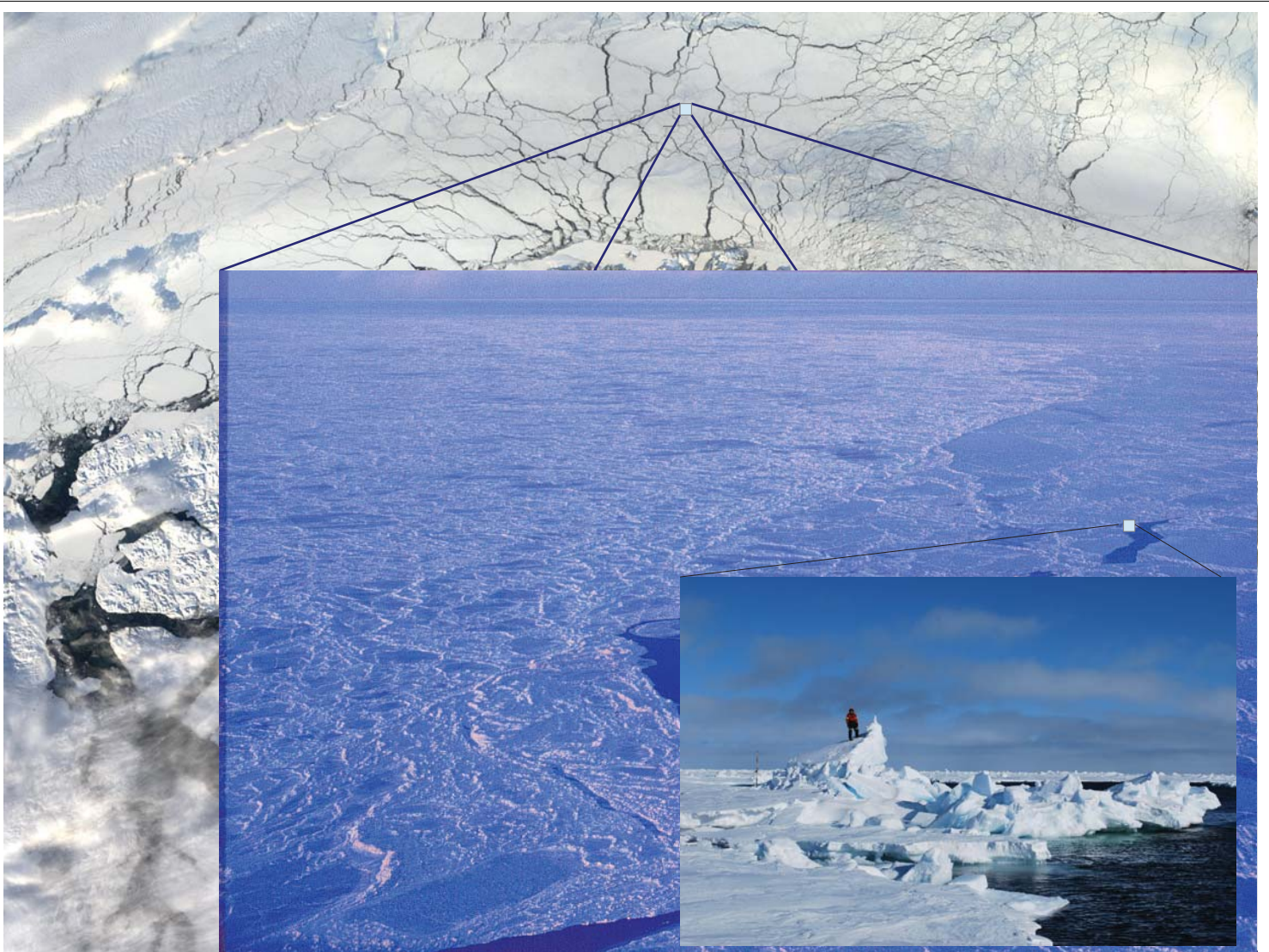


LEADING QUESTIONS OF THIS TALK

- 1) What is important for shipping in ice covered seas ?
- 2) How we can better utilize existing satellite data ?
- 3) How well we can predict sea ice evolution ?







TRENDS IN ARCTIC SHIPPING

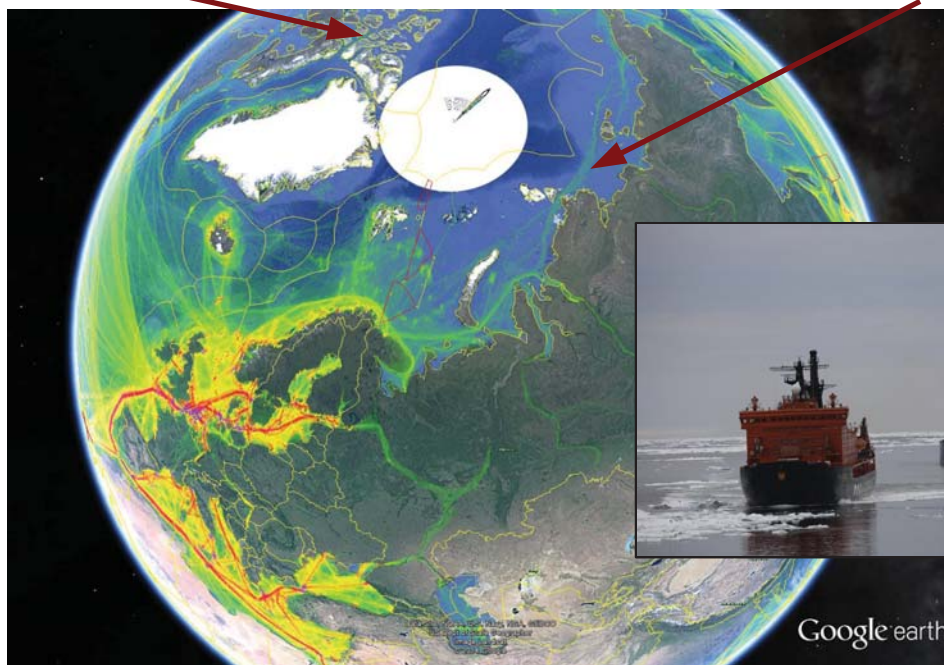
NORTH-WEST PASSAGE

- Very little traffic
- Icebergs and MYI still hazards

NORTHERN SEA ROUTE

- Increasing, but still little traffic (31 ship transits in 2014)
- Russian rules and control
- Rather many damages reported to insurance companies

MARINE TRAFFIC IN 2012

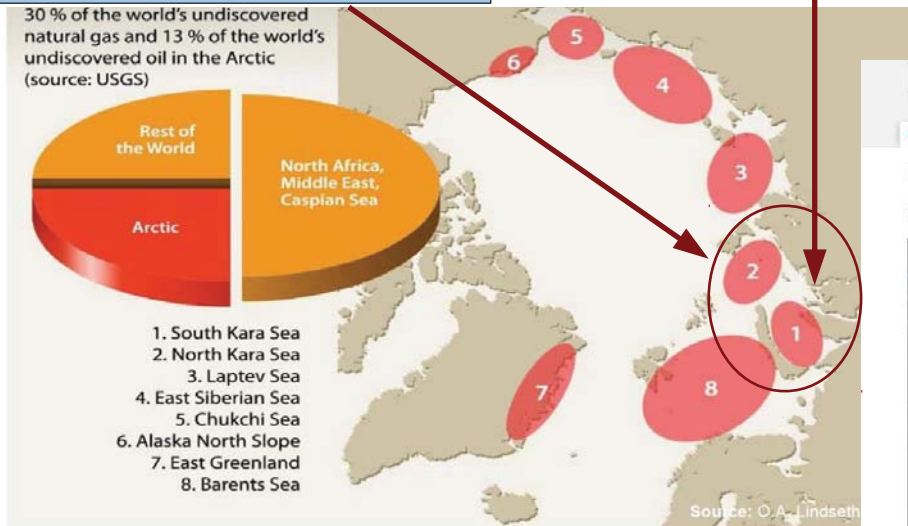


TRENDS IN EXPLOITATION OF OIL AND GAS

KARA SEA DEVELOPMENTS

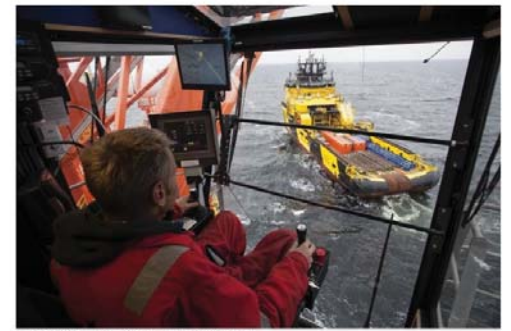
- Opening of the Sabetta LNG terminal will result 24/7/365 shipping in that region as well as will change global LNG transport routes.
- New oil and gas field discoveries, utilization depends on oil price and US/EU/Russia relations.

SABETTA LNG TERMINAL WILL BE IN OPERATION ON 2016/2017



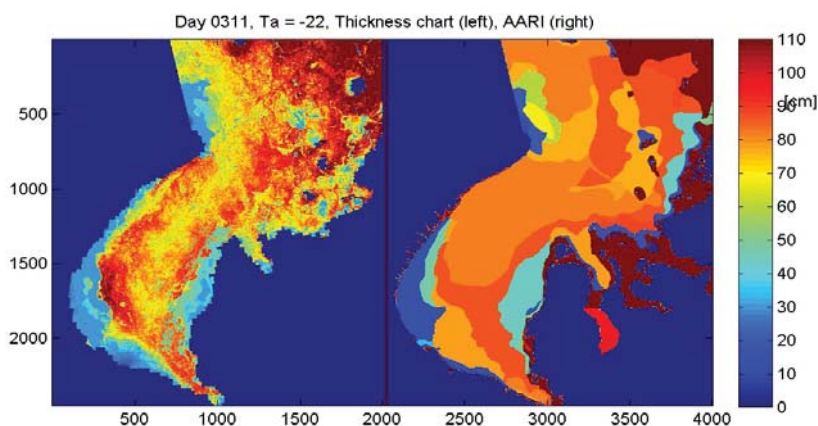
BarentsObserver

Discovers Kara Sea oil a week before sanctions hit



REMOTE SENSING ACTIVITIES

- Development of sea ice motion and classification retrievals methods for SAR satellites
- Utilization of radar altimeter technique (CryoSat-2) for determining sea ice thickness and types
- Focus areas : Baltic Sea, Kara Sea, Arctic & Antarctic



Sodankylä Satellite Data Centre, FMI

Provides Finnish and international customers with extensive satellite data services:

- Data reception
- Data processing and end-product generation
- Data and product delivery and archiving
- In collaboration with Italian company e-GEOS S.p.A. (<http://www.e-geos.it/>)

COSMO-SkyMed satellite data reception and product delivery. Sentinel-1 SAR operational in near future.



COMBINING ULTRA-HIGH RESOLUTION SATELLITE IMAGE AND SHIP RADAR DATA

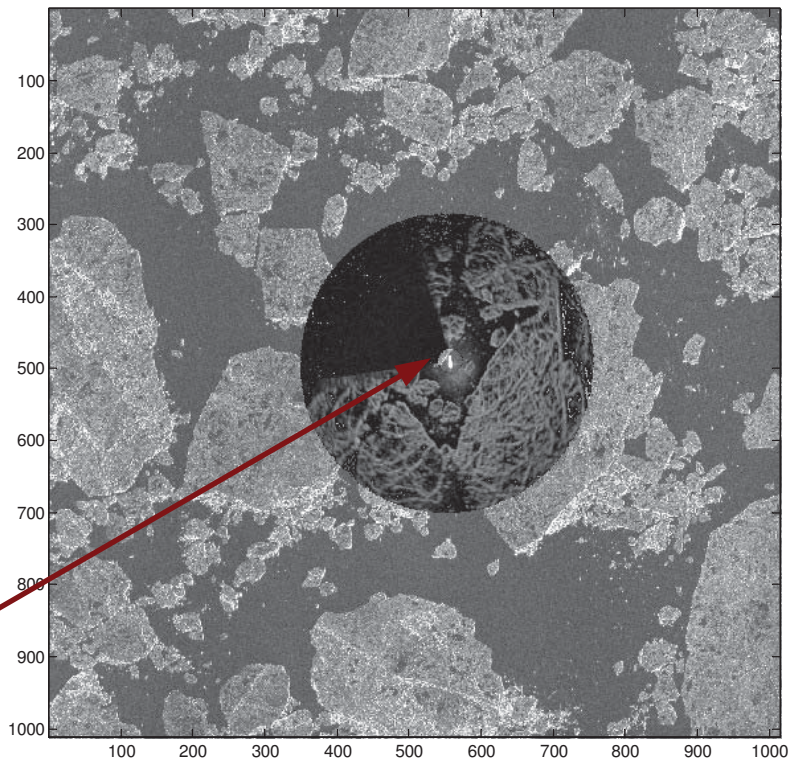
Polarstern ship radar image on a COSMO SkyMed SAR image (both X-band)

2014-07-16 at 19:07

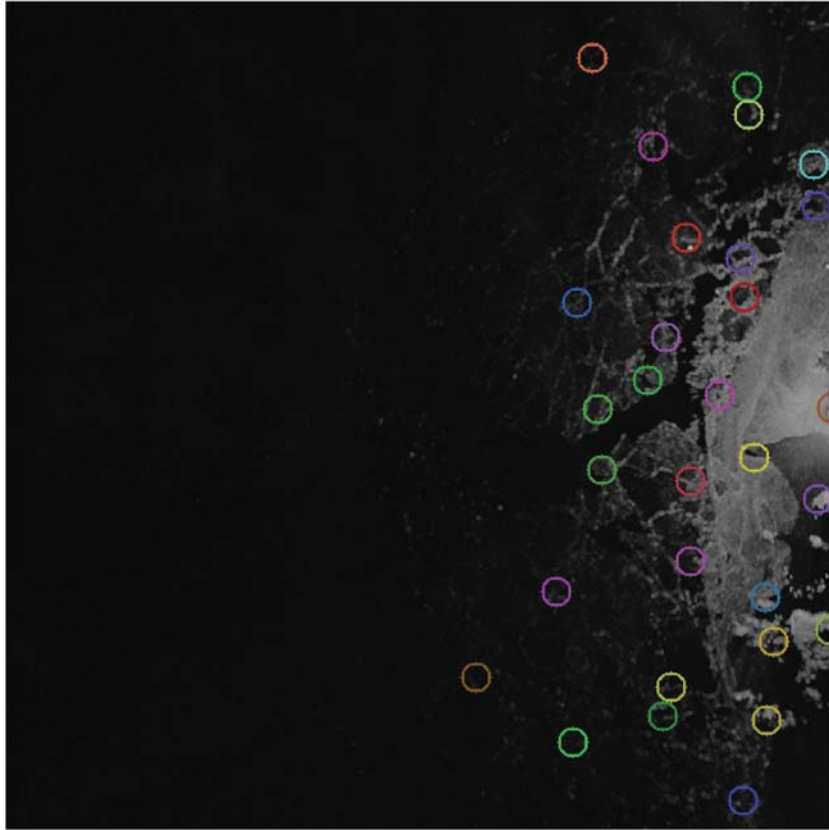
Ship radar and radar satellite images compare well

Due to ice drift (up to 20 km per day) the ship usually cannot be located on a SAR image with position data only

Image matching between ship radar and SAR may do the trick and extend the usefulness of SAR images in tactical navigation

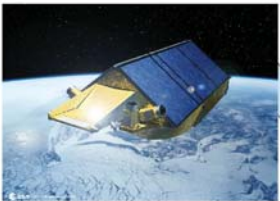


TRACKING OF ICE OBJECTS



FMI SEA ICE FORECASTING SYSTEM

SATELLITE OBSERVATIONS



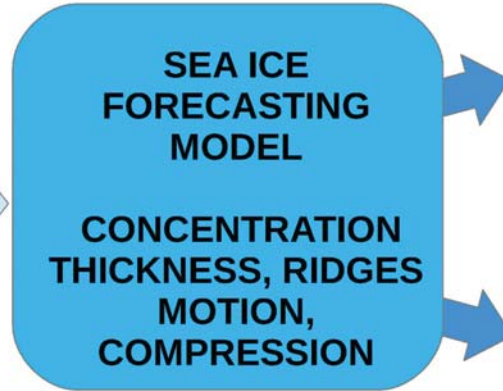
ICE OBSERVATIONS



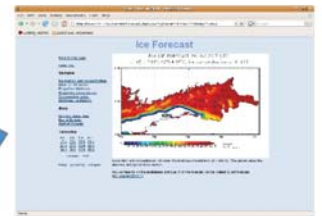
SHIP OBSERVATIONS



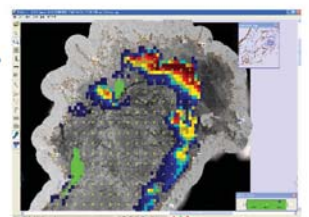
WEATHER FORECAST



PUBLIC WWW-SITE



ICEBREAKERS



BOTHNIAN SEA – QUARK COMPRESSION EVENT (24 FEB 2011 ->)

Dozens of merchant vessels stuck in packed ice in Gulf of Bothnia

Getting ships detached from the ice will take at least a week

Owing to the strong winds and the difficult ice situation, almost all ship traffic to and from harbours has ground to a halt in Northern Finland. The vessels cannot get to the harbour through the packed ice without the help of icebreakers.



at SOURCEY »

60 ships trapped in Baltic Sea Ice on Sunday: 5 icebreakers at work

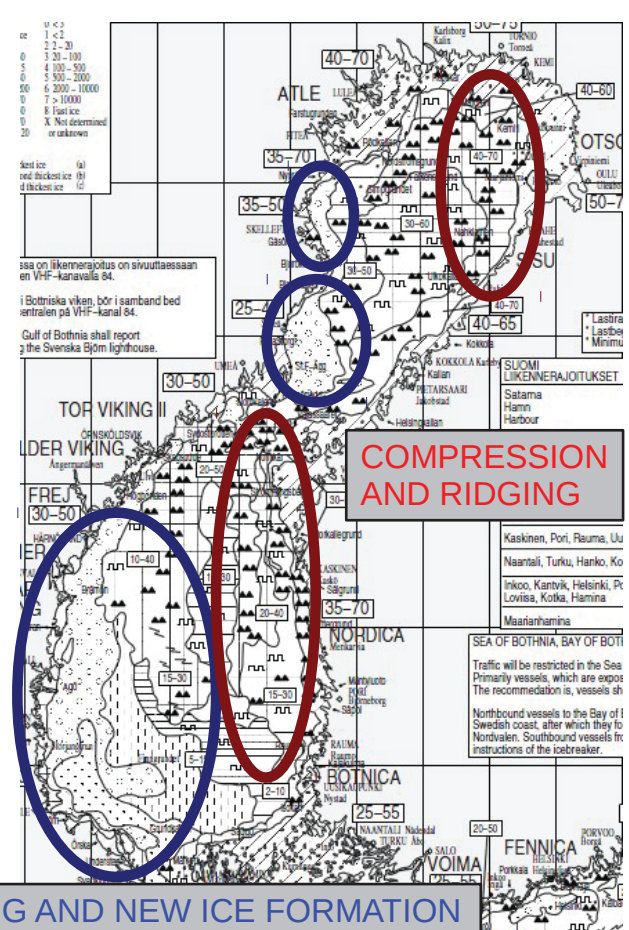
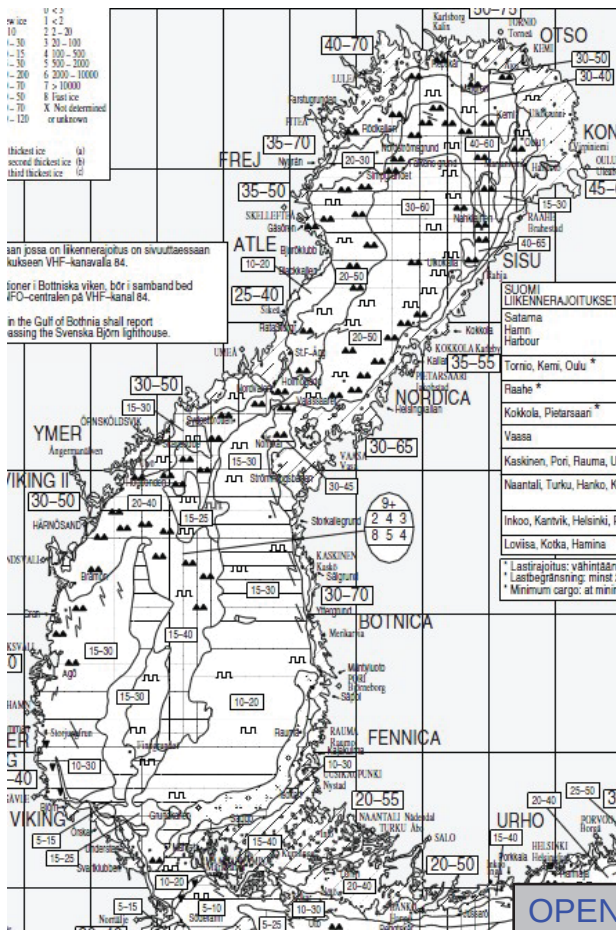
By ktwp

WORLD NEWS

Ships stuck in Baltic Sea ice
05/03/10 07:31 CET

DEVELOPMENT OF ICE CONDITIONS

3 Mar 2011



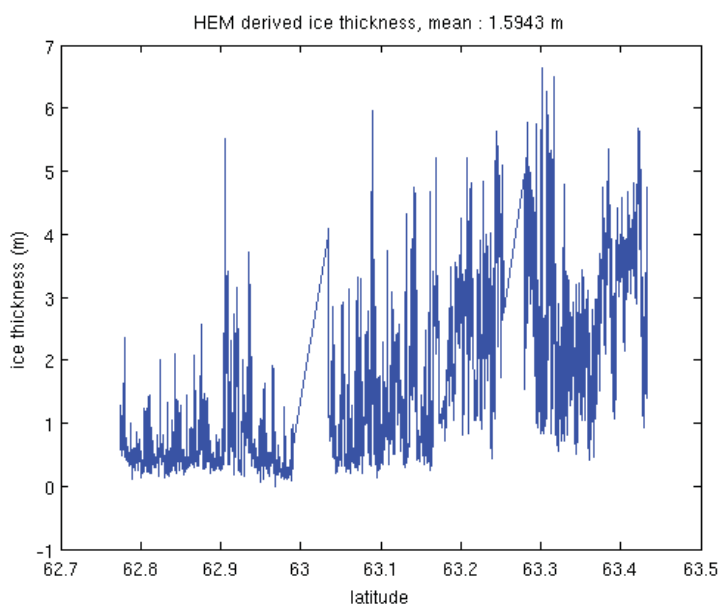
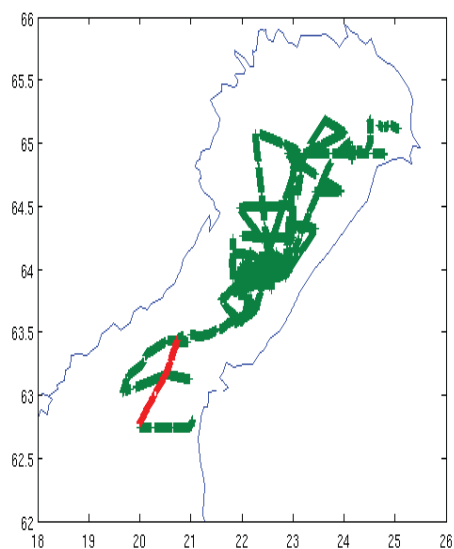


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HEM ICE THICKNESS DATA

ALL FLIGHTS



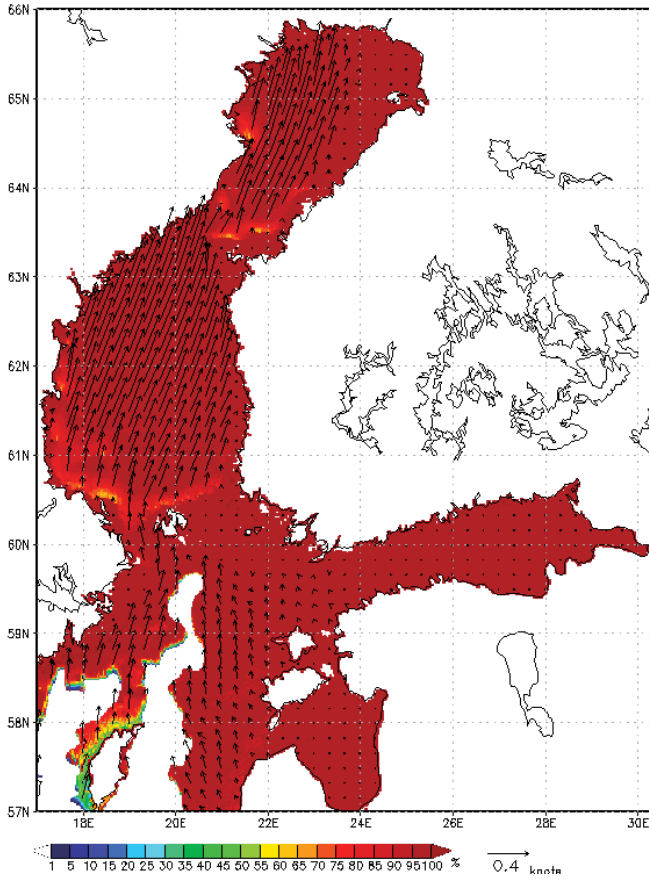
Mean sea ice thickness 1.6 meters !



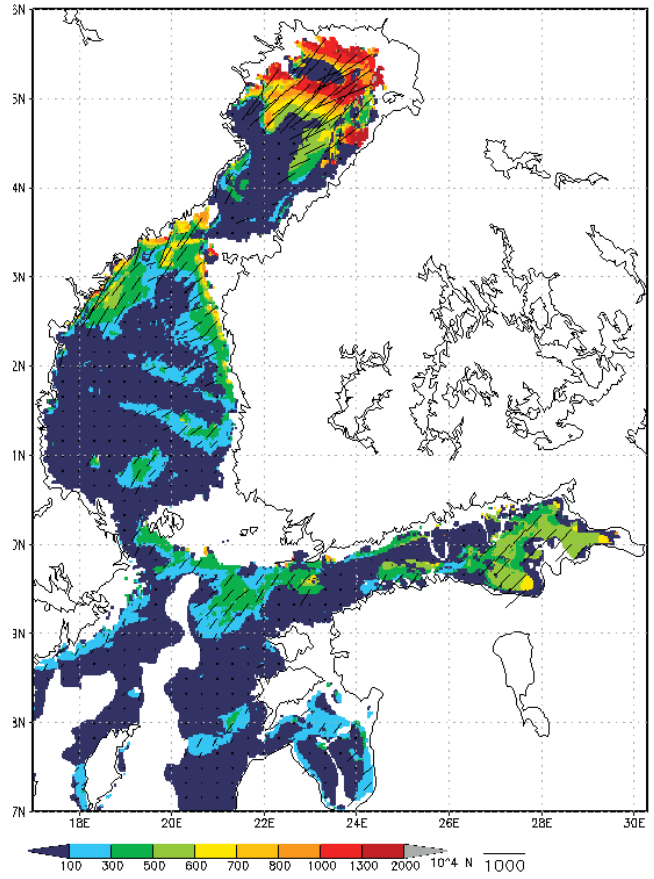
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FMI DETERMINISTIC ICE FORECAST

FMI ICE FORECAST 2011:2:23:7 UTC
t+24 : 2011:2:24:7 UTC, Ice concentration and drift



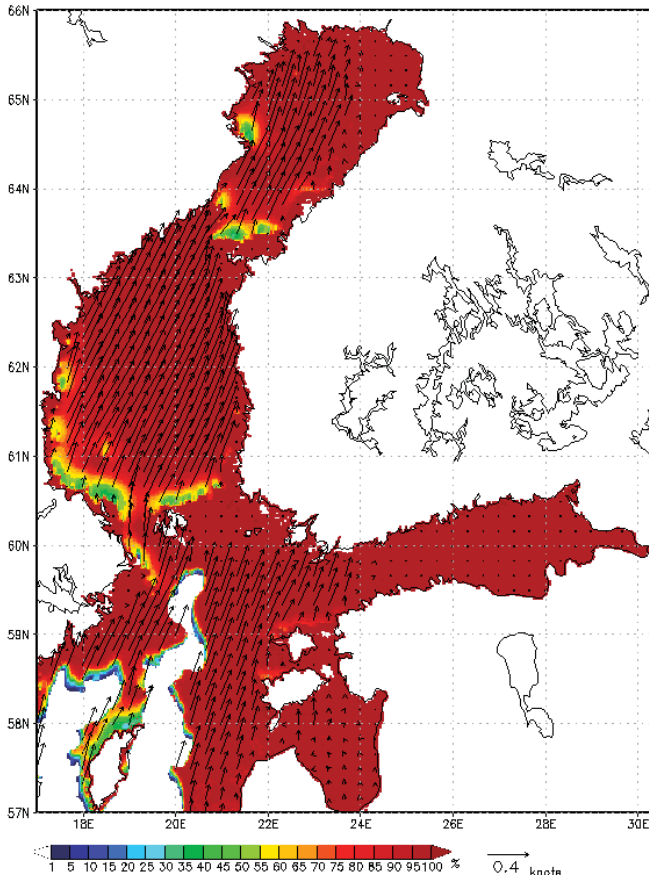
FMI ICE FORECAST 2011:2:23:7 UTC
t+24 : 2011:2:24:7 UTC, Ice pressure



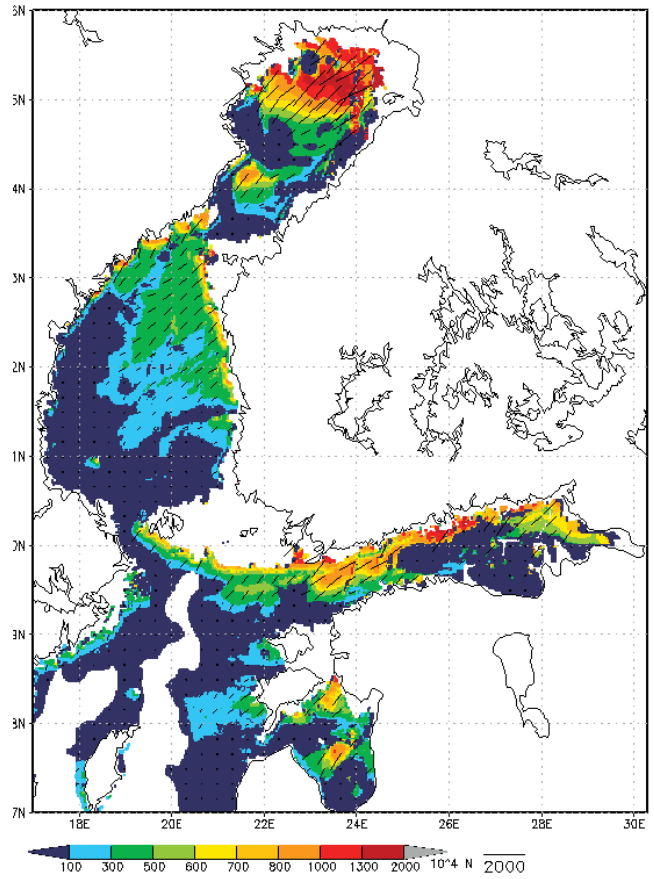
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FMI DETERMINISTIC ICE FORECAST

FMI ICE FORECAST 2011:2:23:7 UTC
t+45 : 2011:2:25:4 UTC, Ice concentration and drift

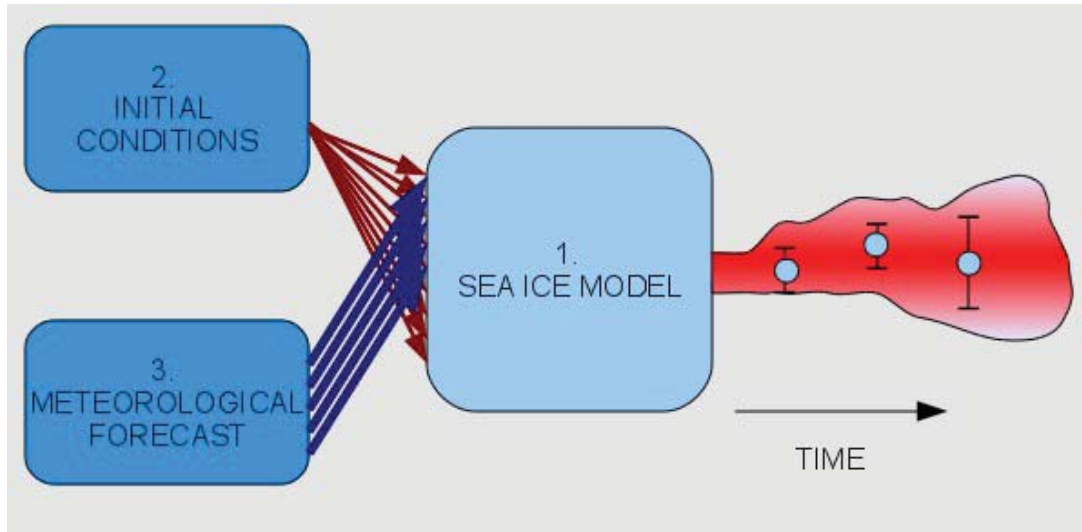


FMI ICE FORECAST 2011:2:23:7 UTC
t+45 : 2011:2:25:4 UTC, Ice pressure





CHANGE IN VIEWPOINT FROM DETERMINISTIC TO PROBABILISTIC FORECAST



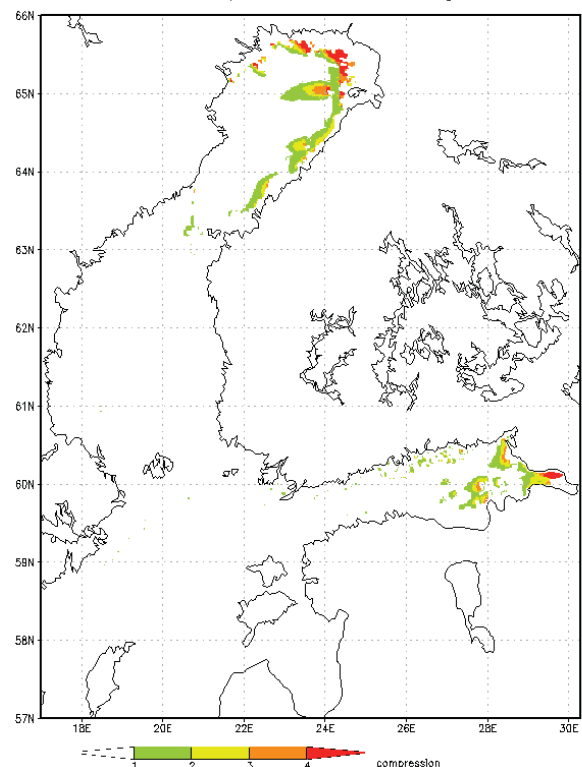
Motivations

- Temporal and spatial variability of ice pressure is large.
- Better control of impact of uncertainties in meteorological forecasts and initial conditions.
- Better estimates of extreme events.



ENSEMBLE AVERAGE

FMI ICE FORECAST for 2013:2:26:12 UTC
Ice compression ensemble average



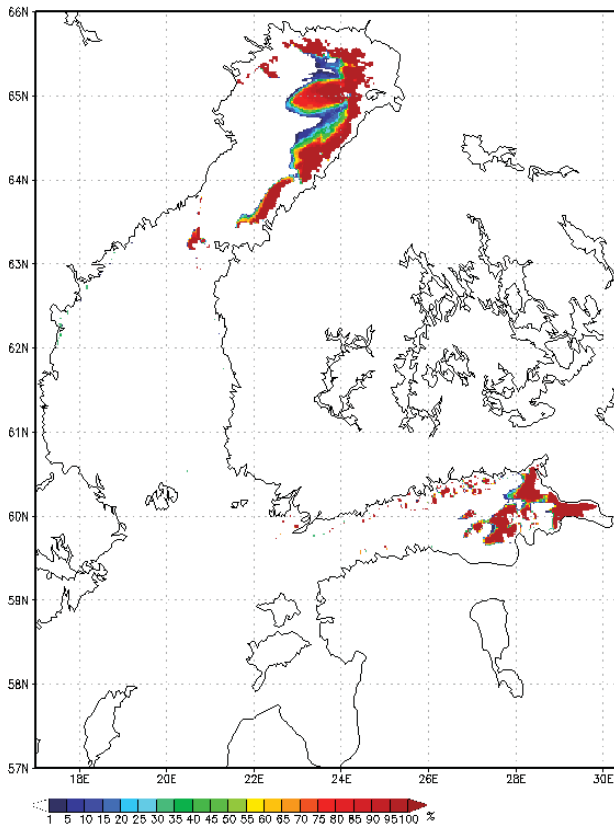
Probabilistic forecasts

- Compression in scale 1-4
- conversion of model unit to 4 scales is based on ship reports
- Available products
 - Average compression
 - Probability of to exceed level 1,2,3,or 4 compression



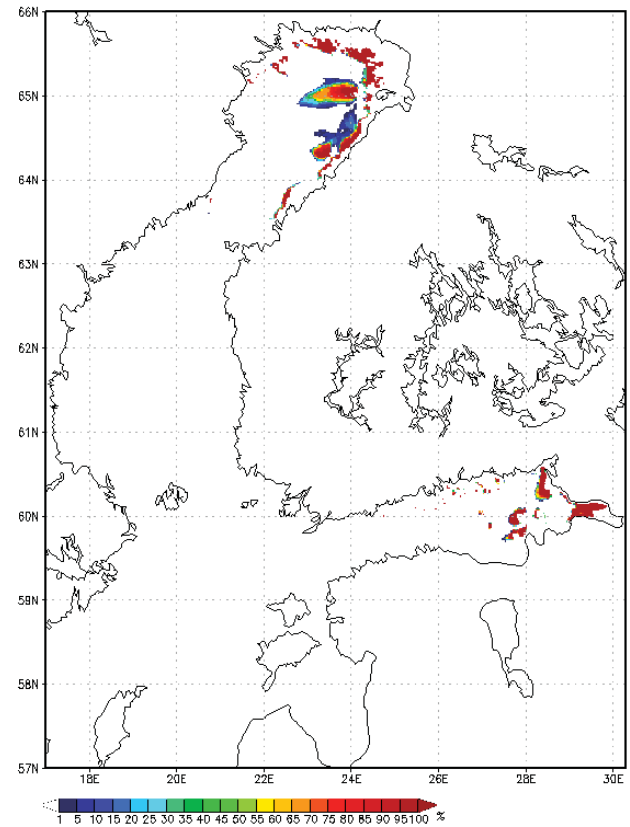
LEVEL 1 COMPRESSION

FMI ICE FORECAST for 2013:2:26:12 UTC
Probability of compression rating 1 or above



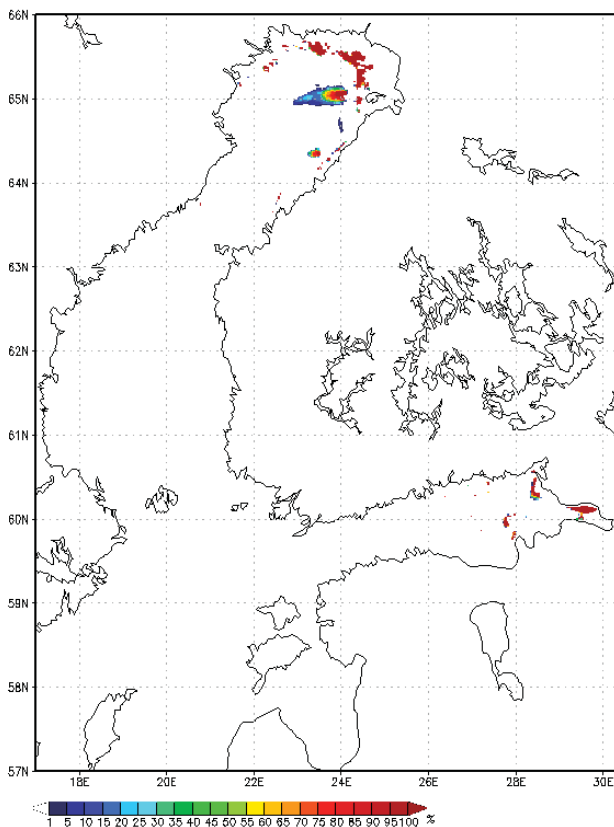
LEVEL 2 COMPRESSION

FMI ICE FORECAST for 2013:2:26:12 UTC
Probability of compression rating 2 or above



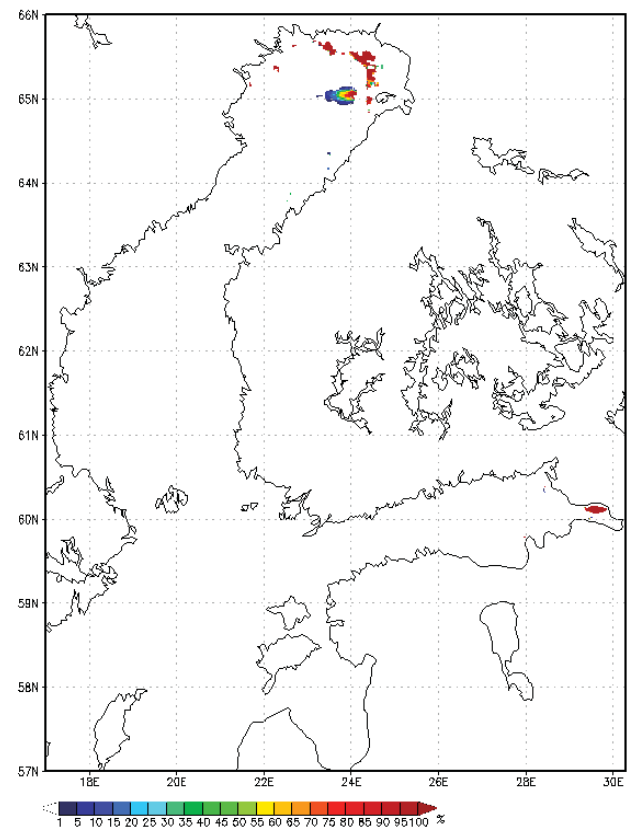
LEVEL 3 COMPRESSION

FMI ICE FORECAST for 2013:2:26:12 UTC
Probability of compression rating 3 or above

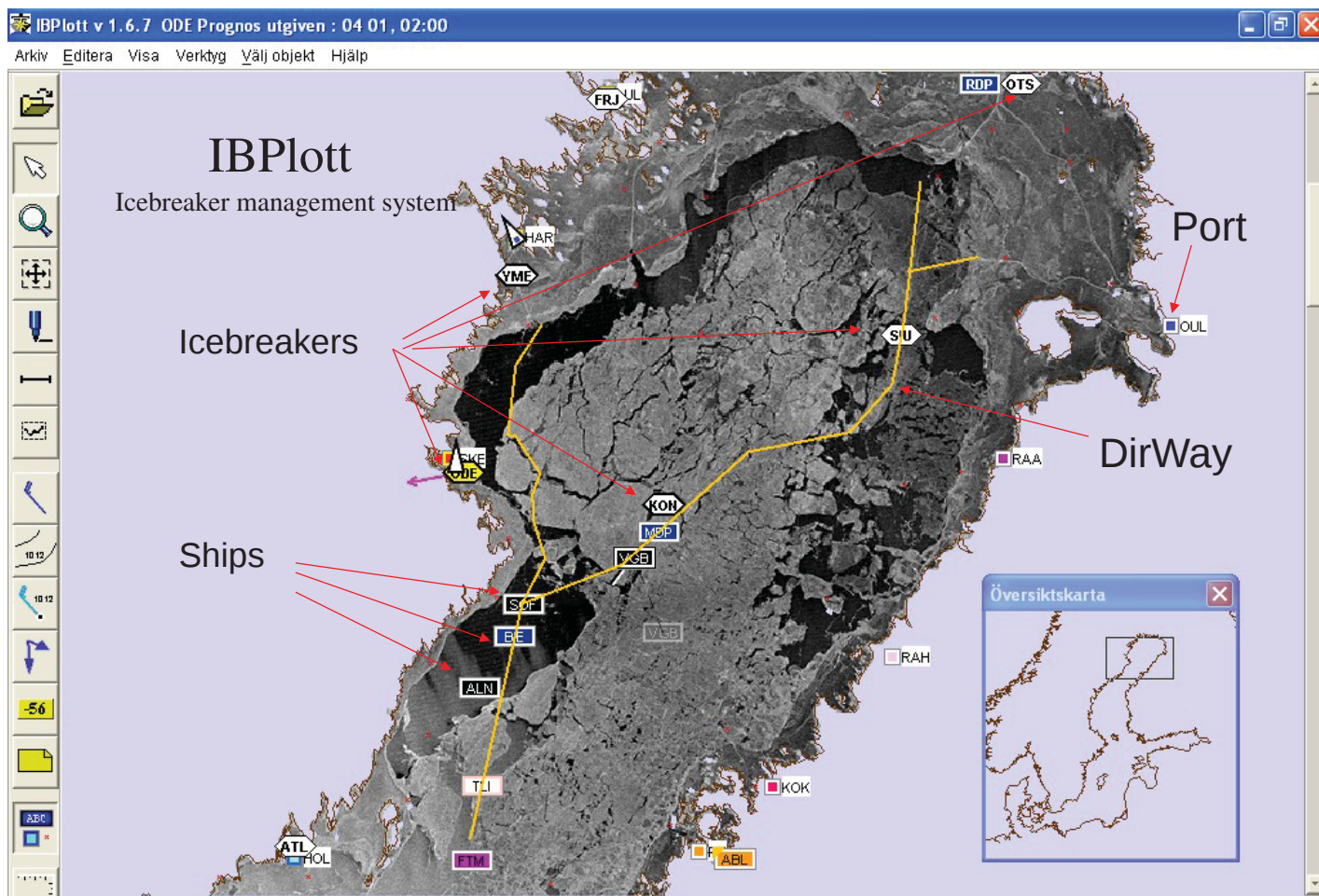


LEVEL 4 COMPRESSION

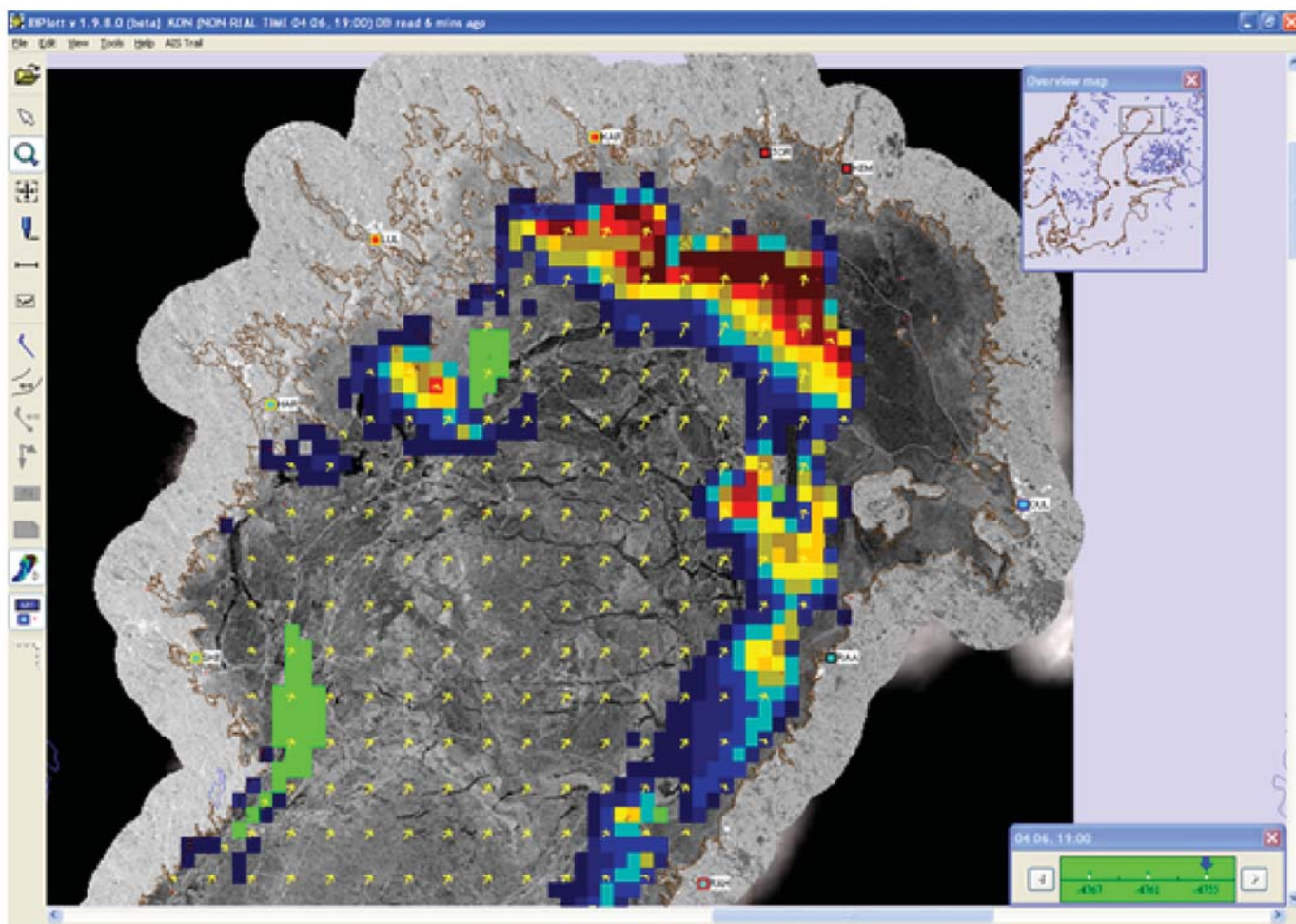
FMI ICE FORECAST for 2013:2:26:12 UTC
Probability of compression rating 4




UTILIZATION OF ICE INFORMATION IN TACTICAL NAVIGATION



UTILIZATION OF ICE INFORMATION IN TACTICAL NAVIGATION



An aerial photograph of a vast, cracked, and dry lake bed, likely a salt flat or a desert basin. The ground is a mosaic of light-colored, polygonal cracks. In the center, a range of rugged, brownish mountains rises above the flat. The sky is a pale, hazy blue. A semi-transparent grey banner is overlaid across the middle of the image, containing the text "THANK YOU FOR YOUR INTEREST!".

THANK YOU FOR YOUR INTEREST !