

Earth Observation



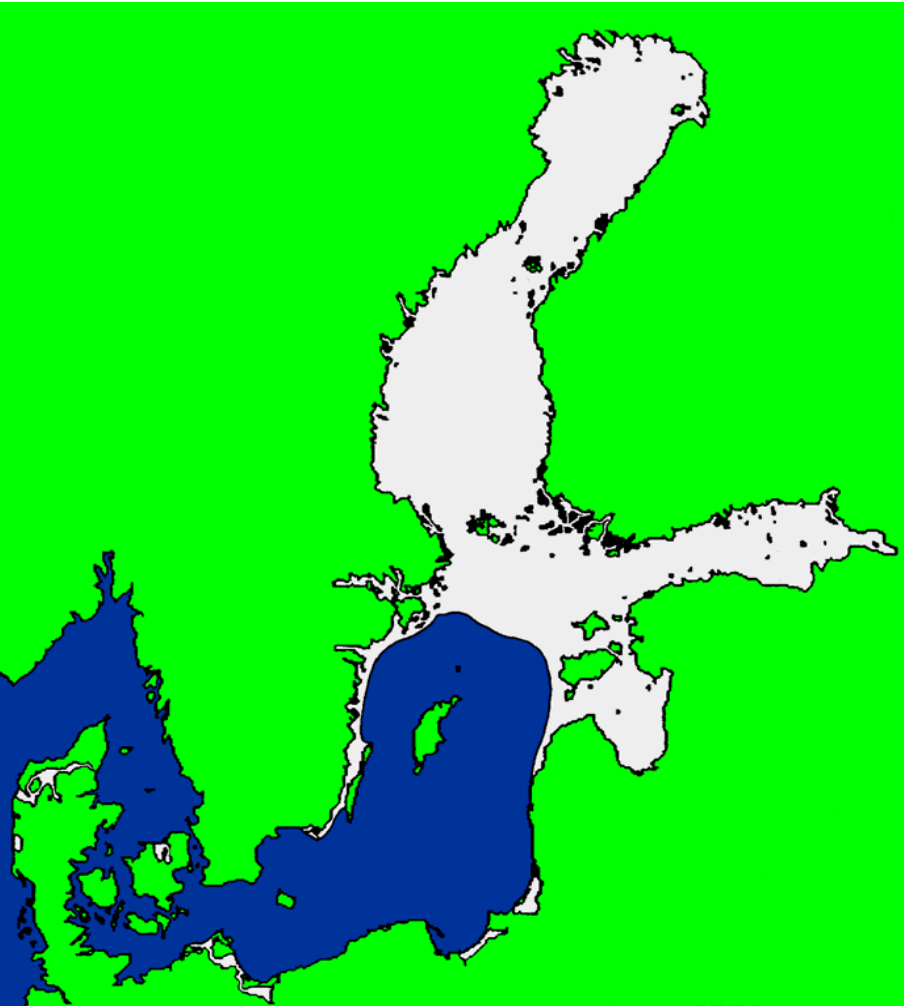
The use of
satellite data
within the Finnish
and Swedish
Ice-breaking
services

Ulf Gullne
Space and the Arctic Workshop in
Stockholm 20-21 okt

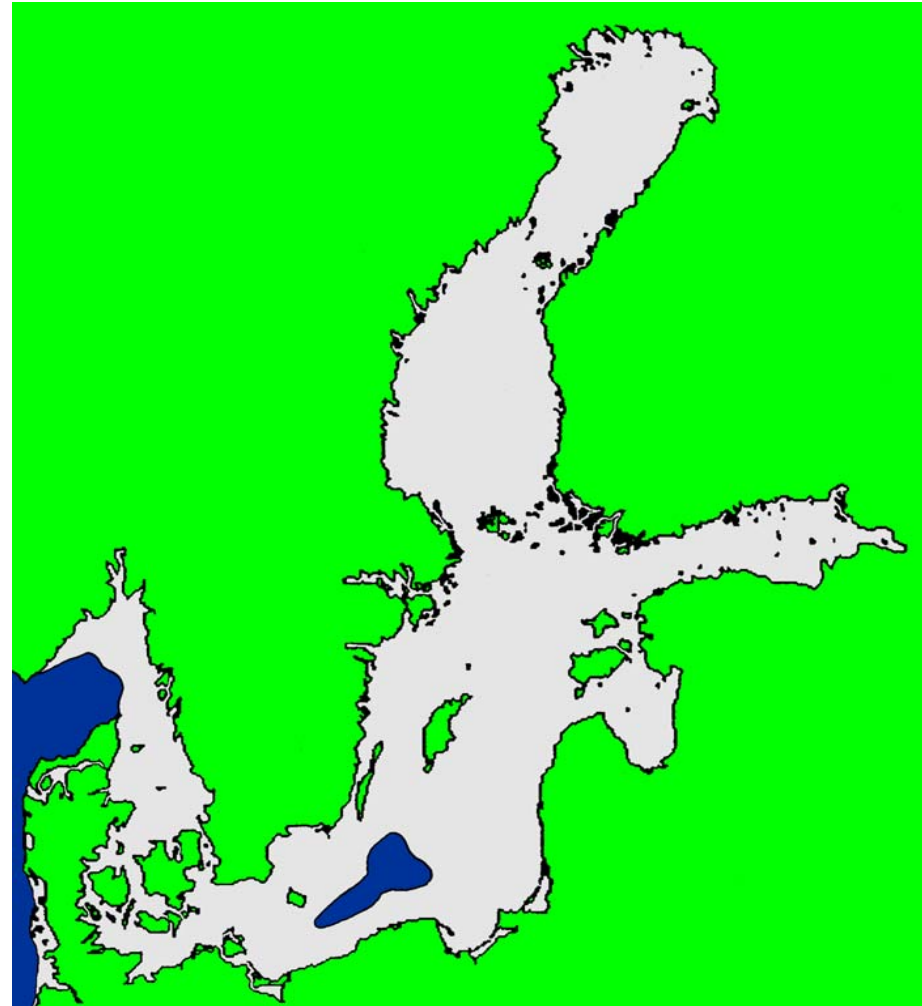
Baltic Sea Marine Transportation

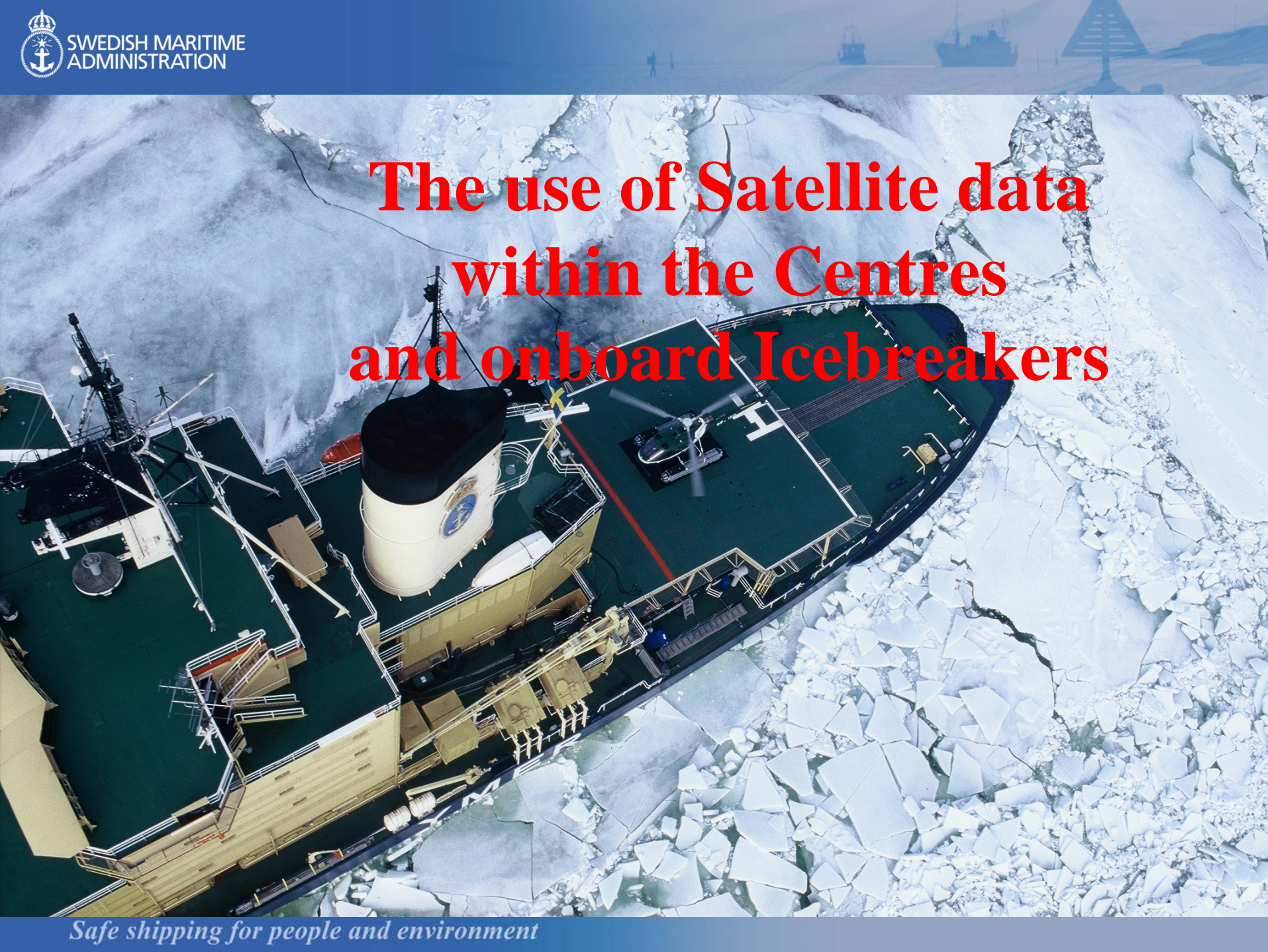
- **Vitally important waterway for dozens of countries**
- **Effects the lives of 85 million people**
- **Annual ice coverage season up to 7 months.**
- **Up to 90% of foreign trade is marine based of which 60-70% is within EU.**
- **2000 large vessels are sailing at any given time**

Average winter

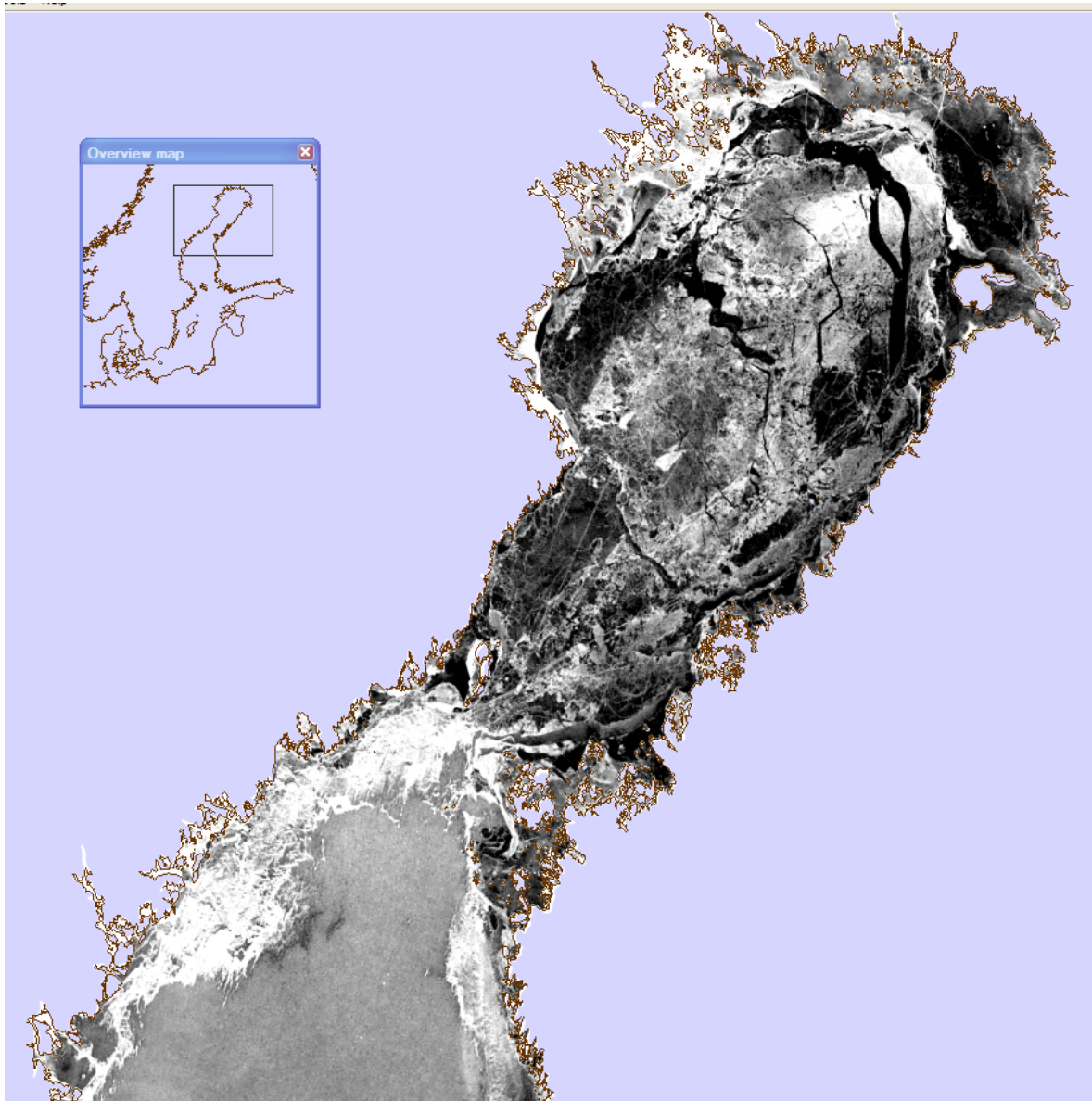


Extremely severe winter



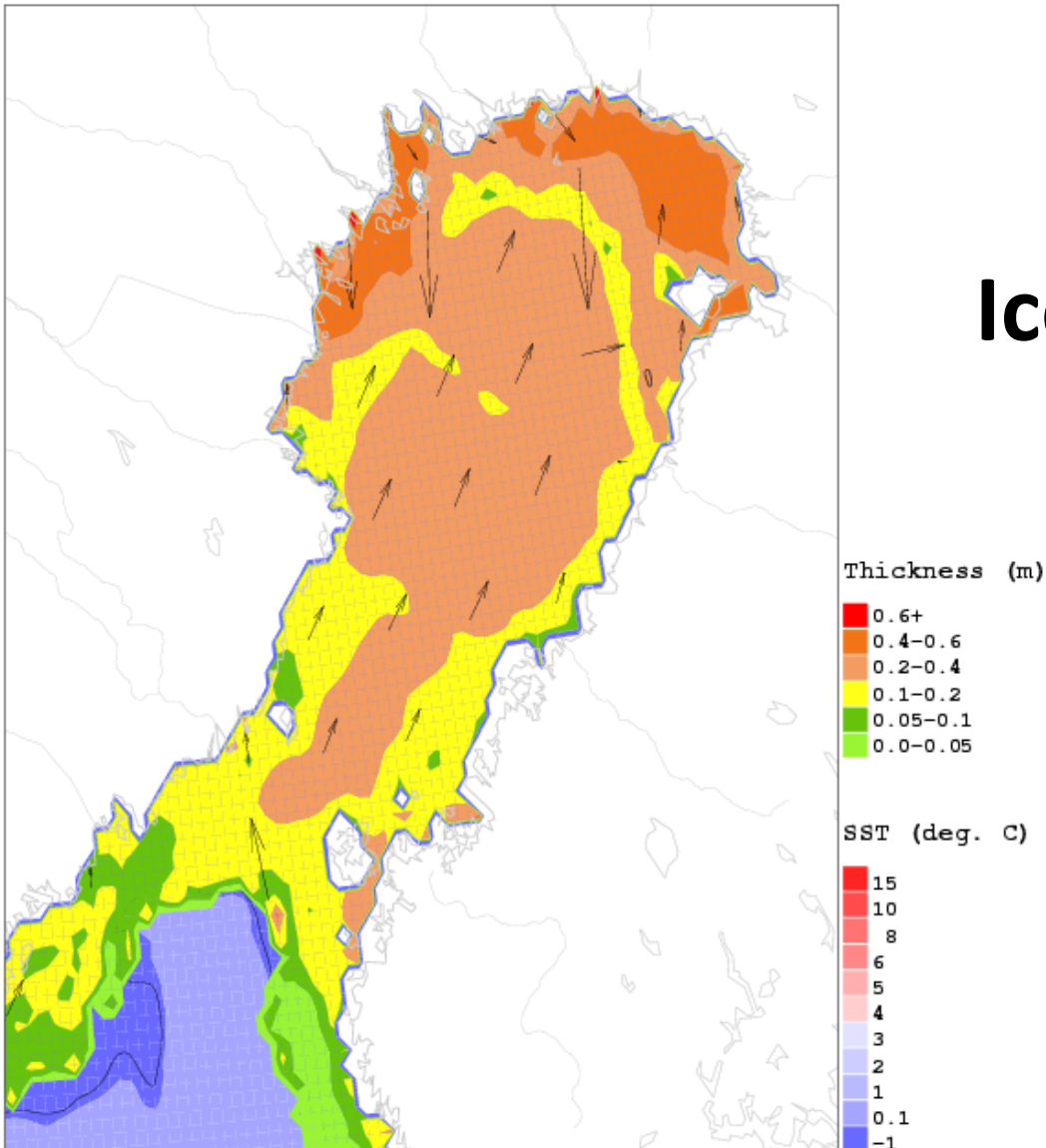


The use of Satellite data within the Centres and onboard Icebreakers



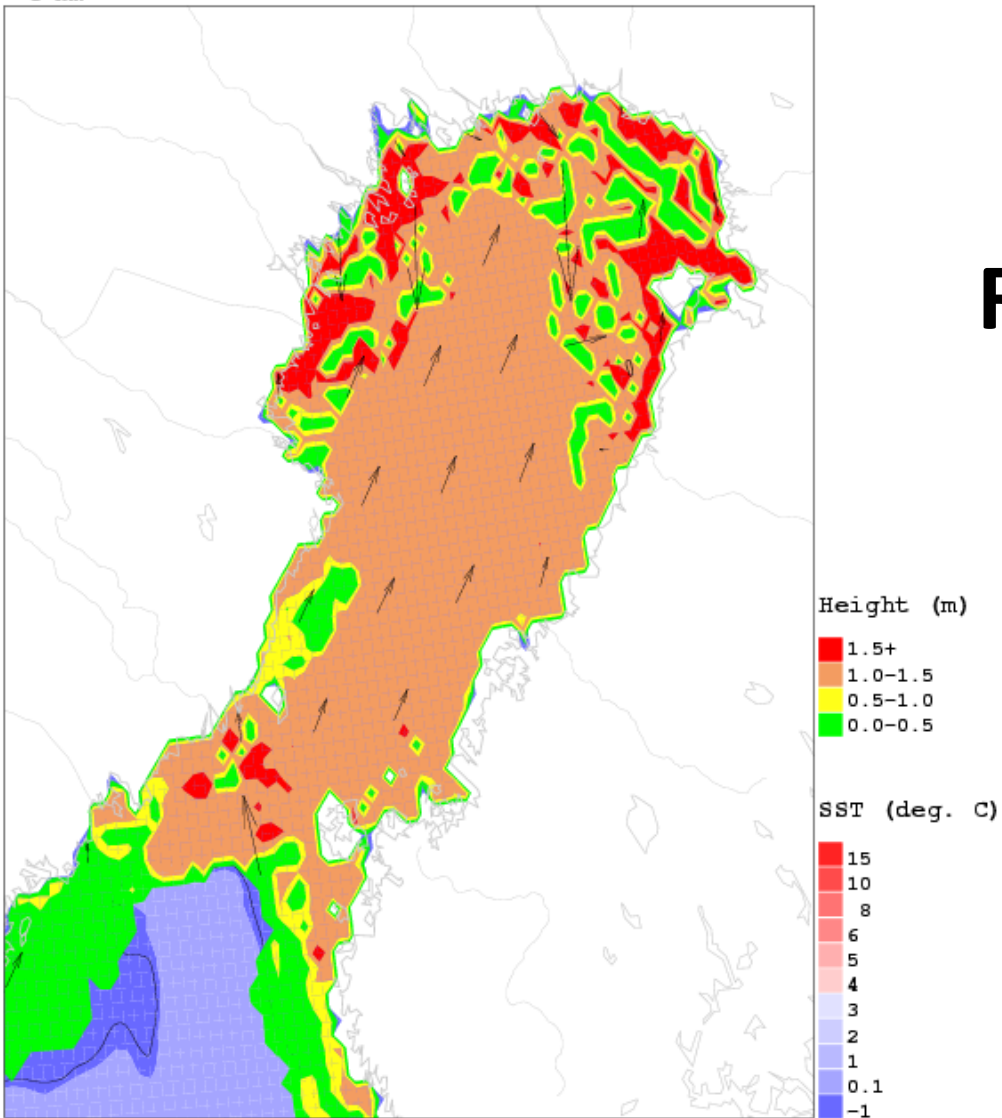
**Satellite
image from
2009-03-03**

Level ice thickness, ice drift and SST
3 nm



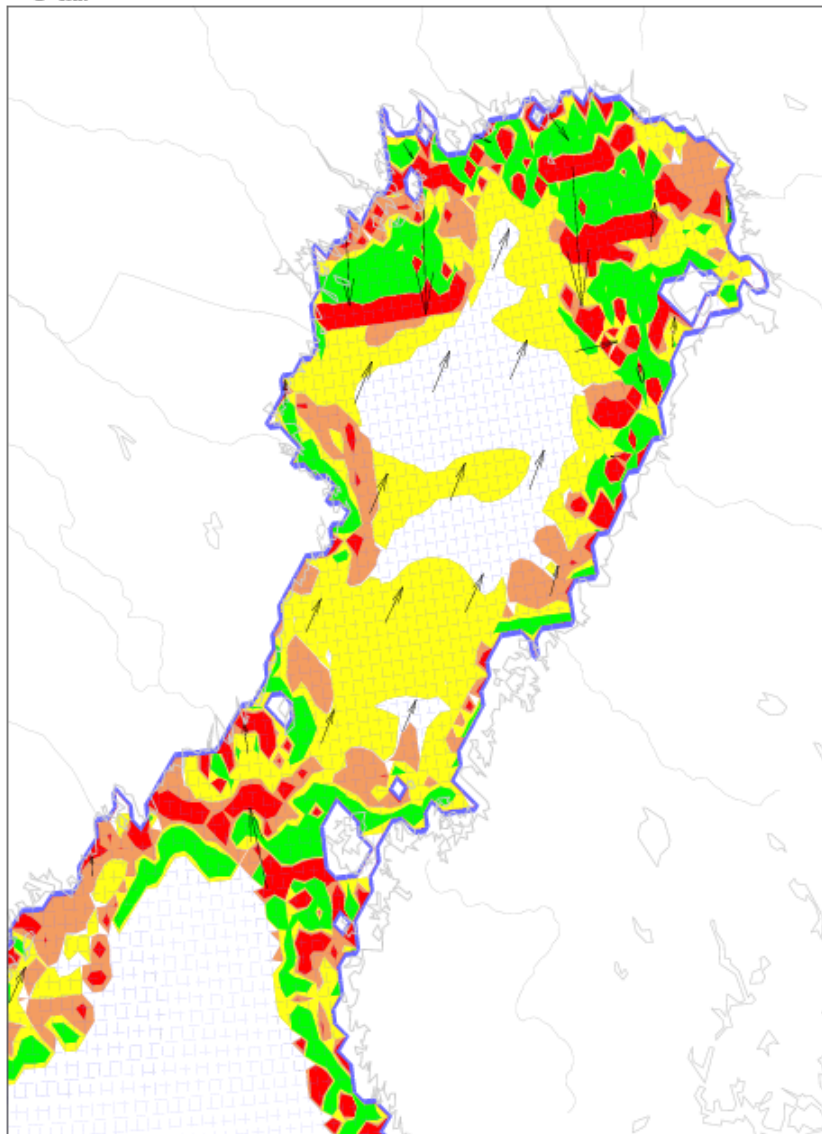
Ice thickness chart

Ridge sail height, ice drift and SST
3 nm



Ridges ice zone

Ice divergence/convergence and ice drift
3 nm



Areas with Ice under pressure

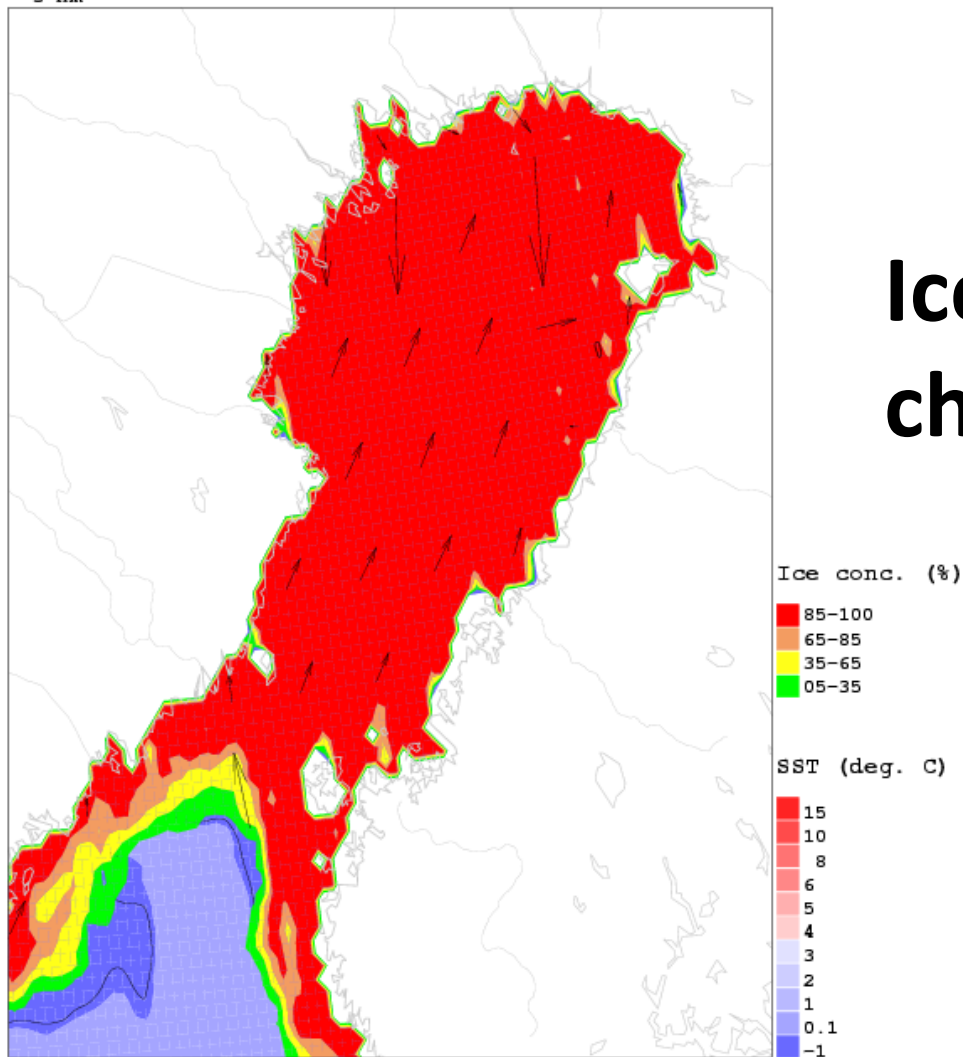
Div./Conv.

div: ++
div: +
conv: 0
conv: +
conv: ++

SST (deg. C)

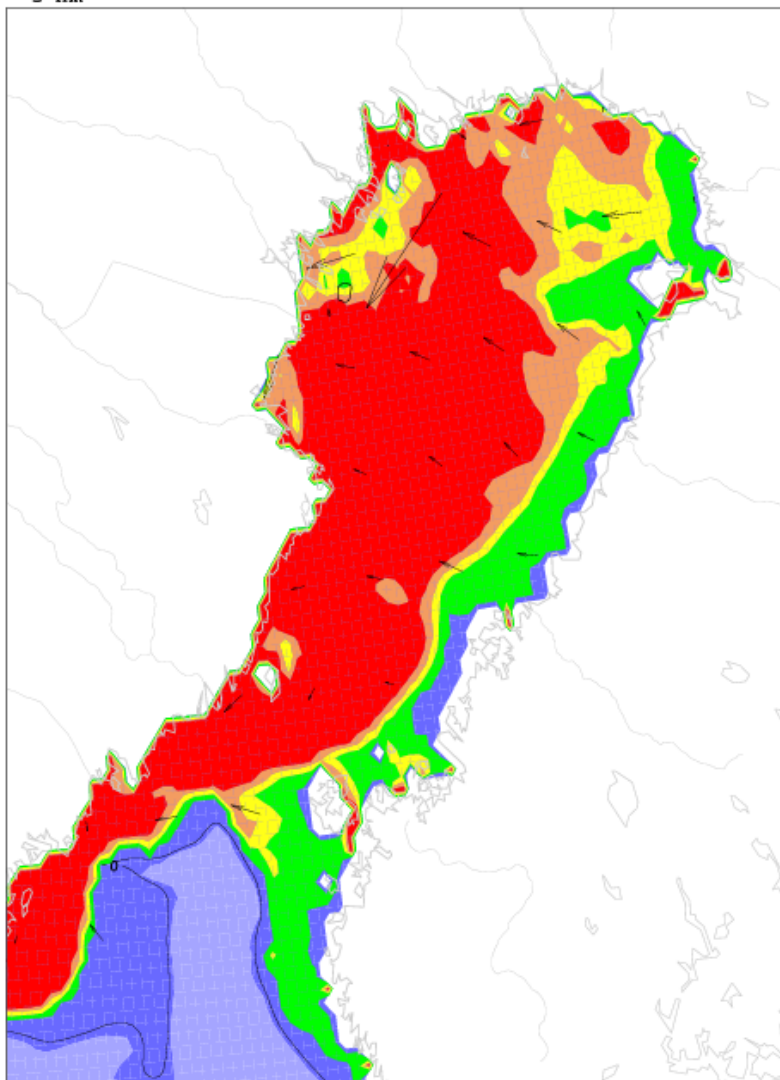
15
10
8
6
5
4
3
2
1
0.1
-1

Ice concentration, ice drift and SST
3 nm

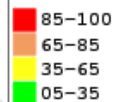


Ice concentration chart

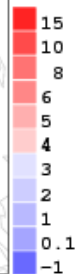
Ice concentration, ice drift and SST
3 nm



Ice conc. (%)



SST (deg. C)

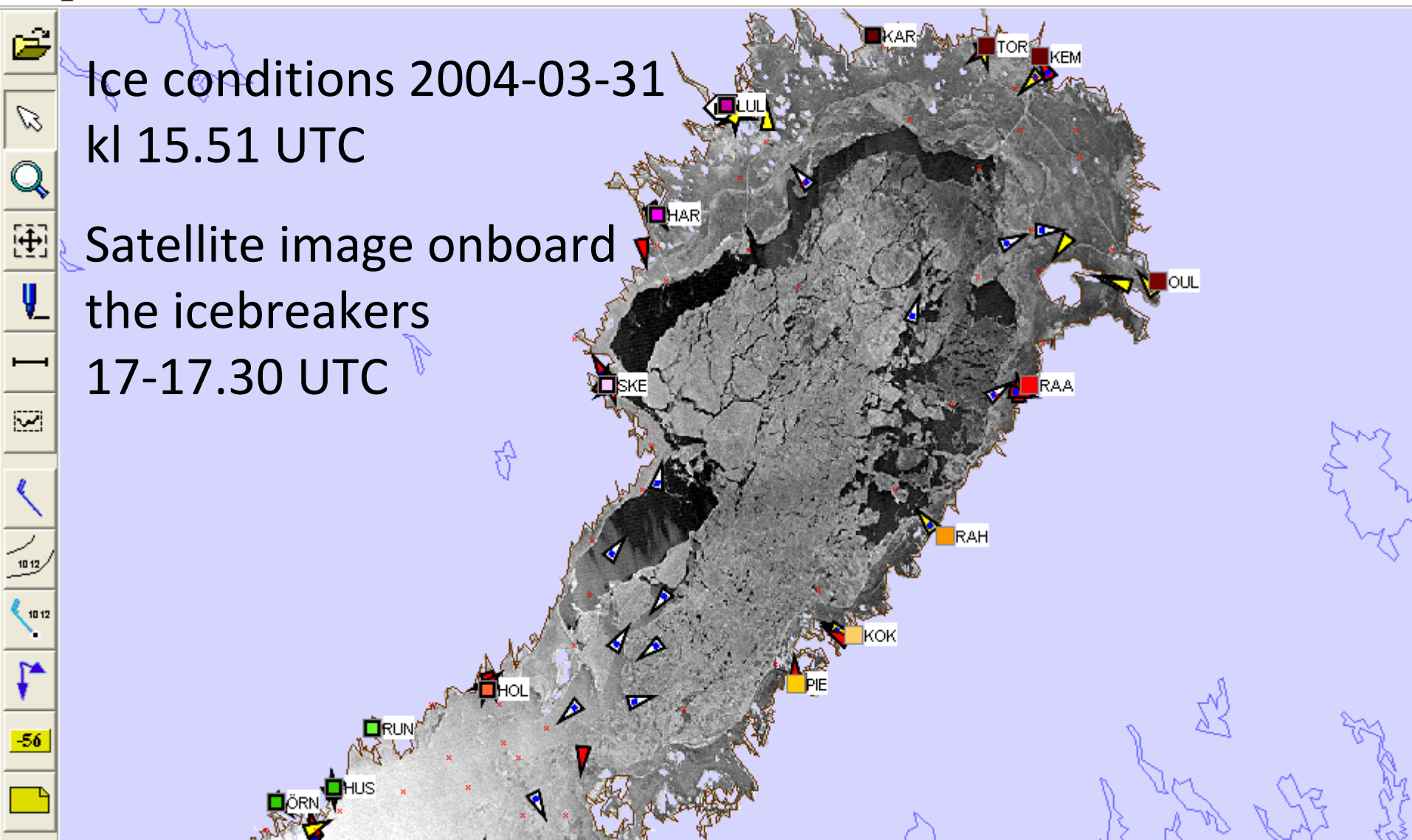


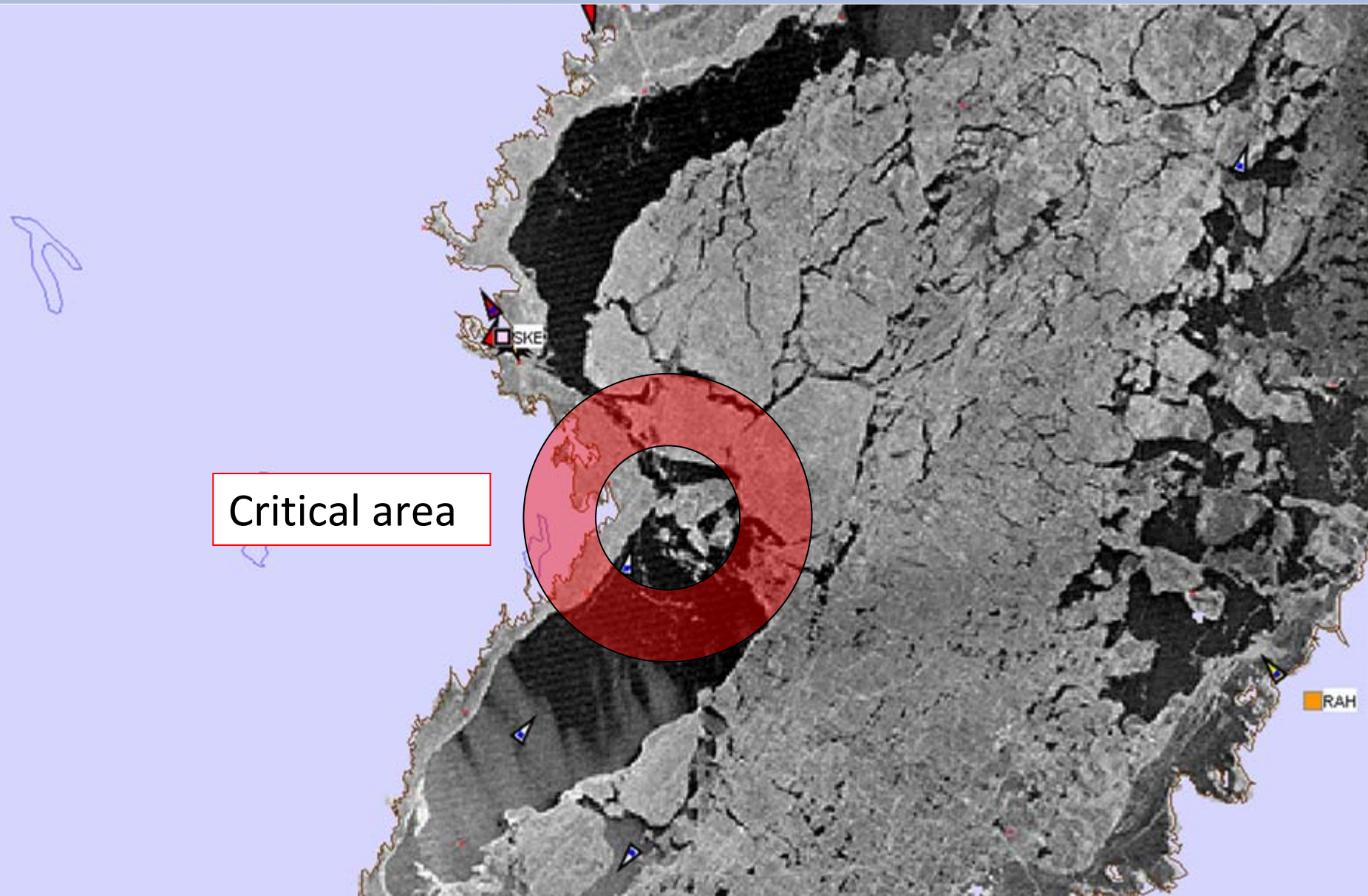
Tue 3 Mar 2009 00Z +168h
valid Tue 10 Mar 2009 00Z

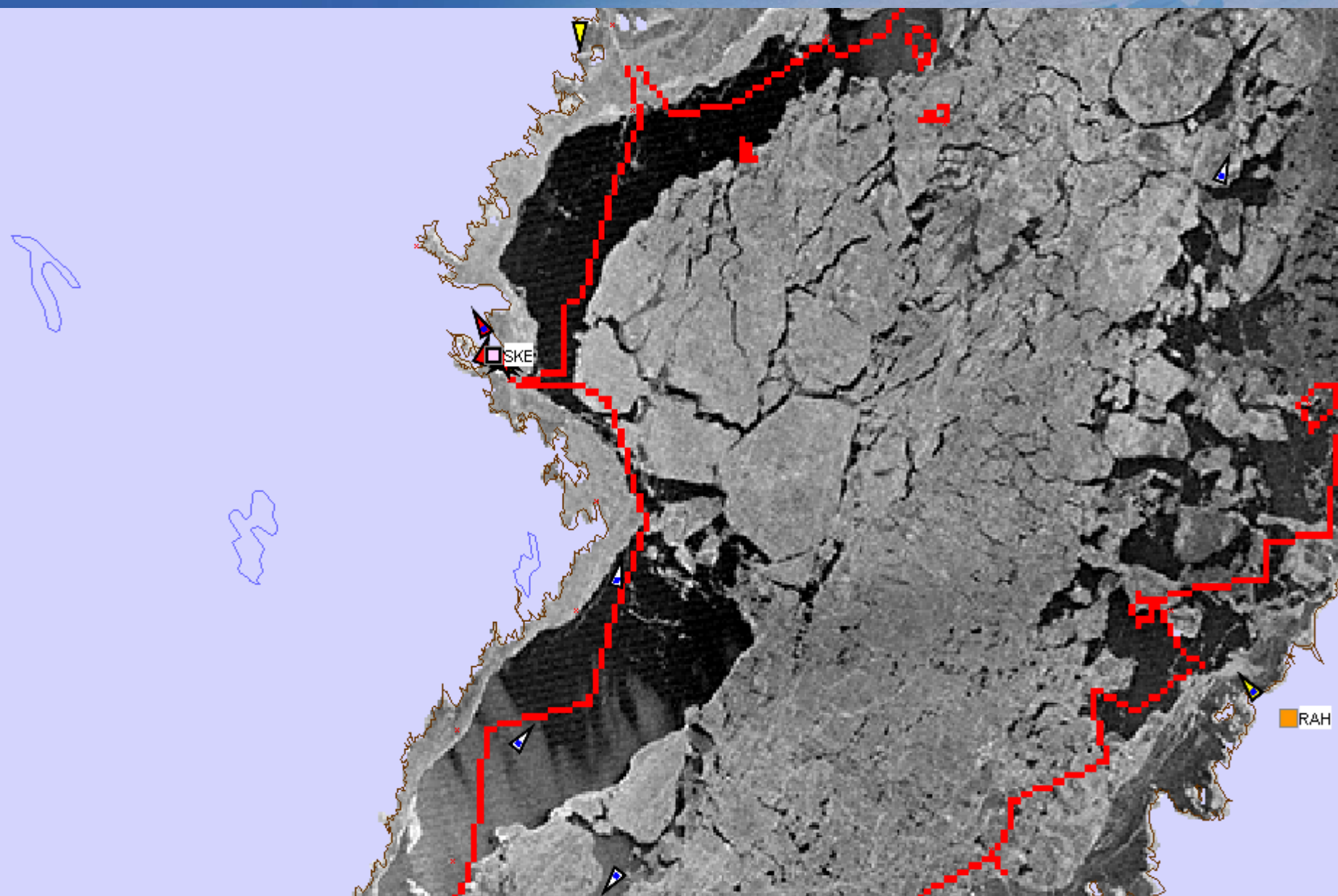
Ice concentration chart, one week later

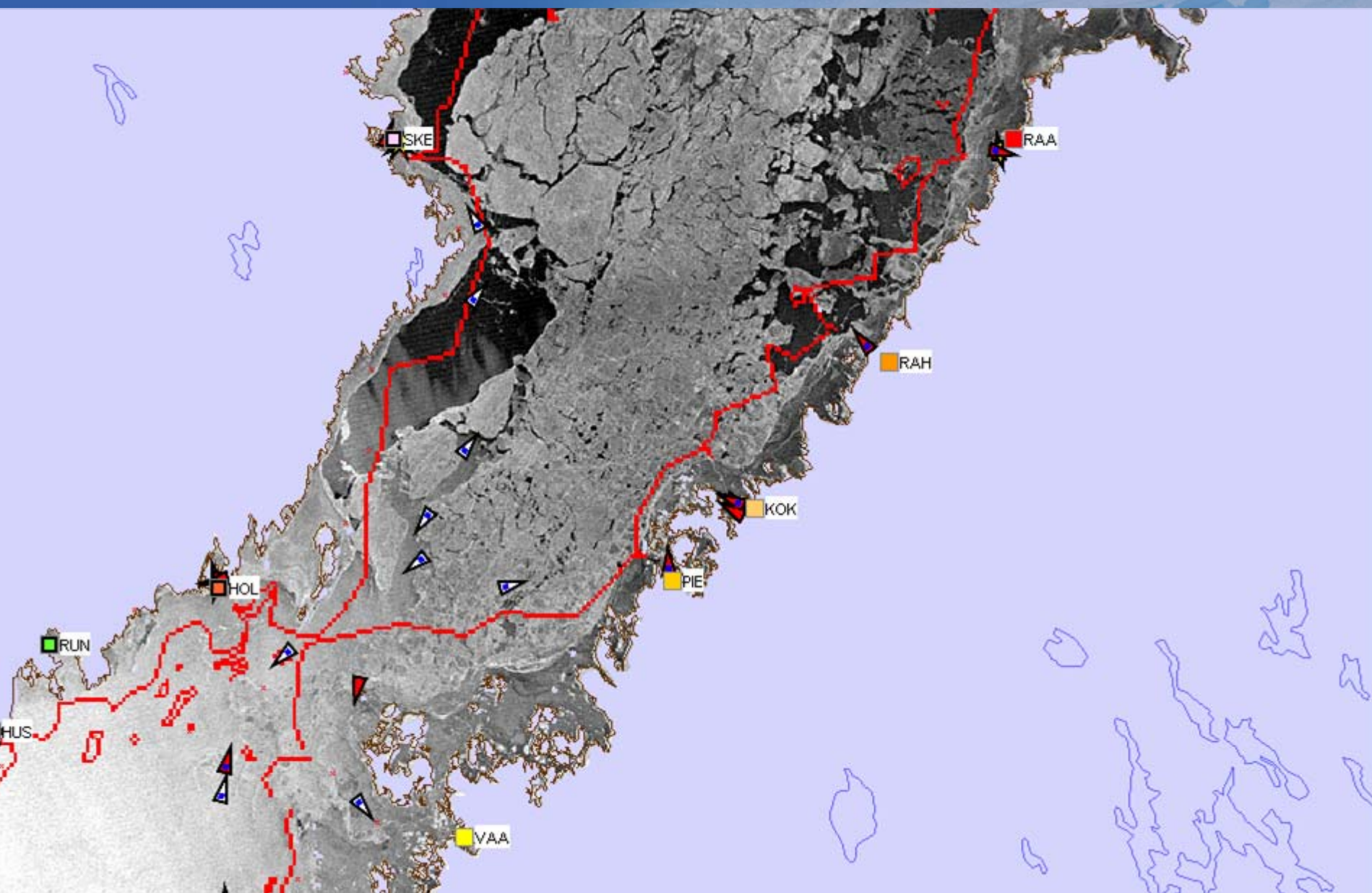
Ice conditions 2004-03-31
kl 15.51 UTC

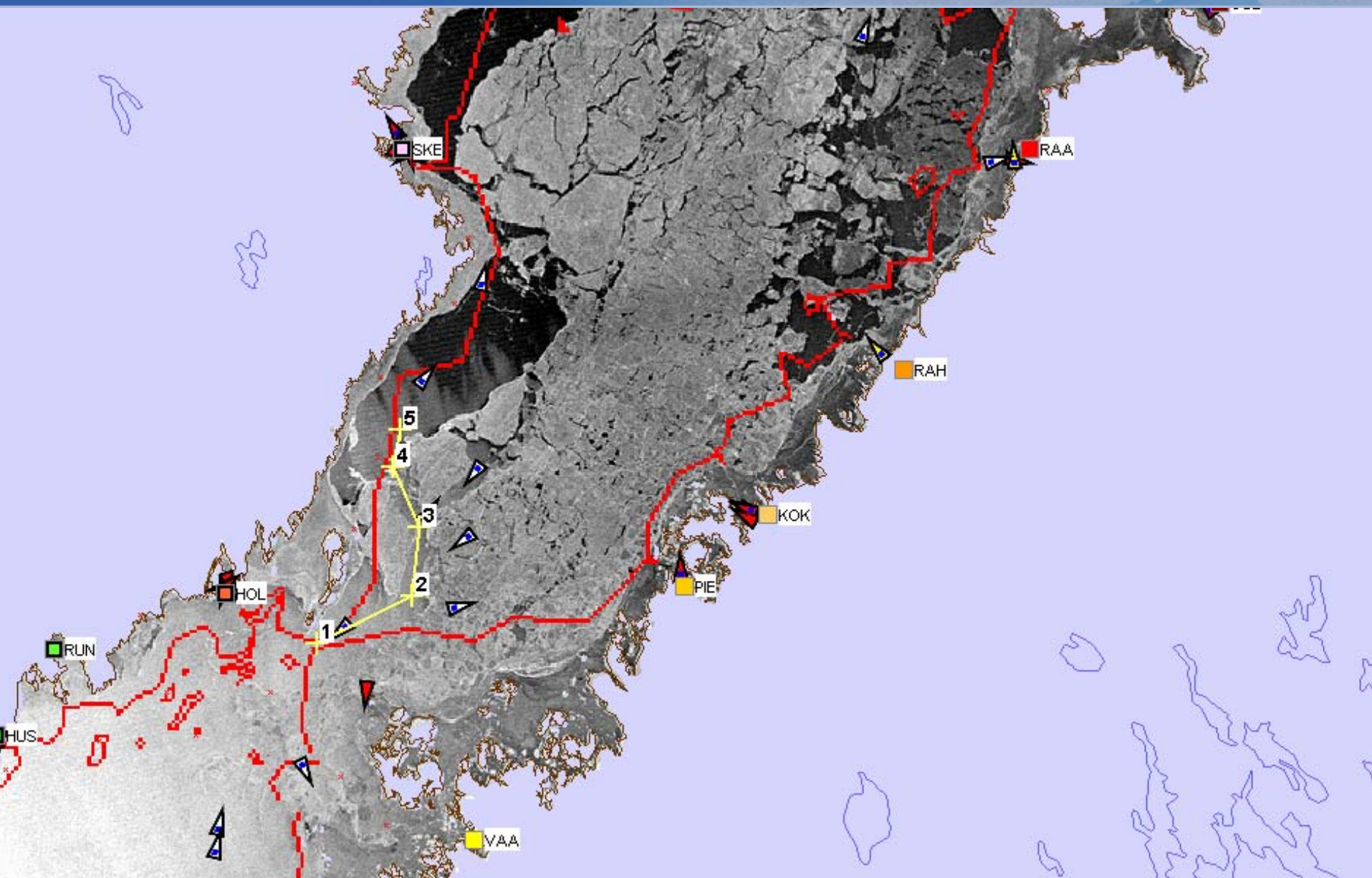
Satellite image onboard
the icebreakers
17-17.30 UTC

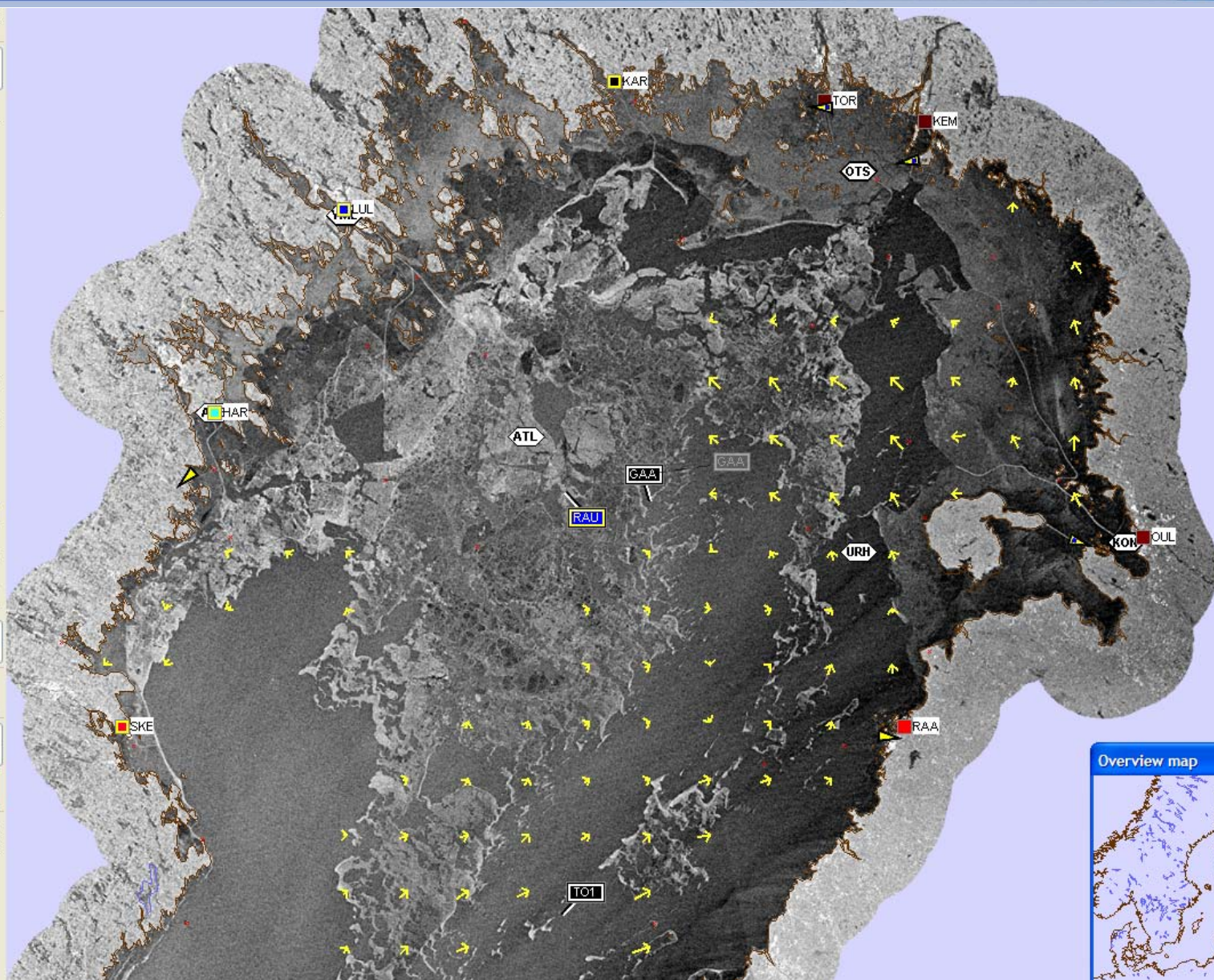




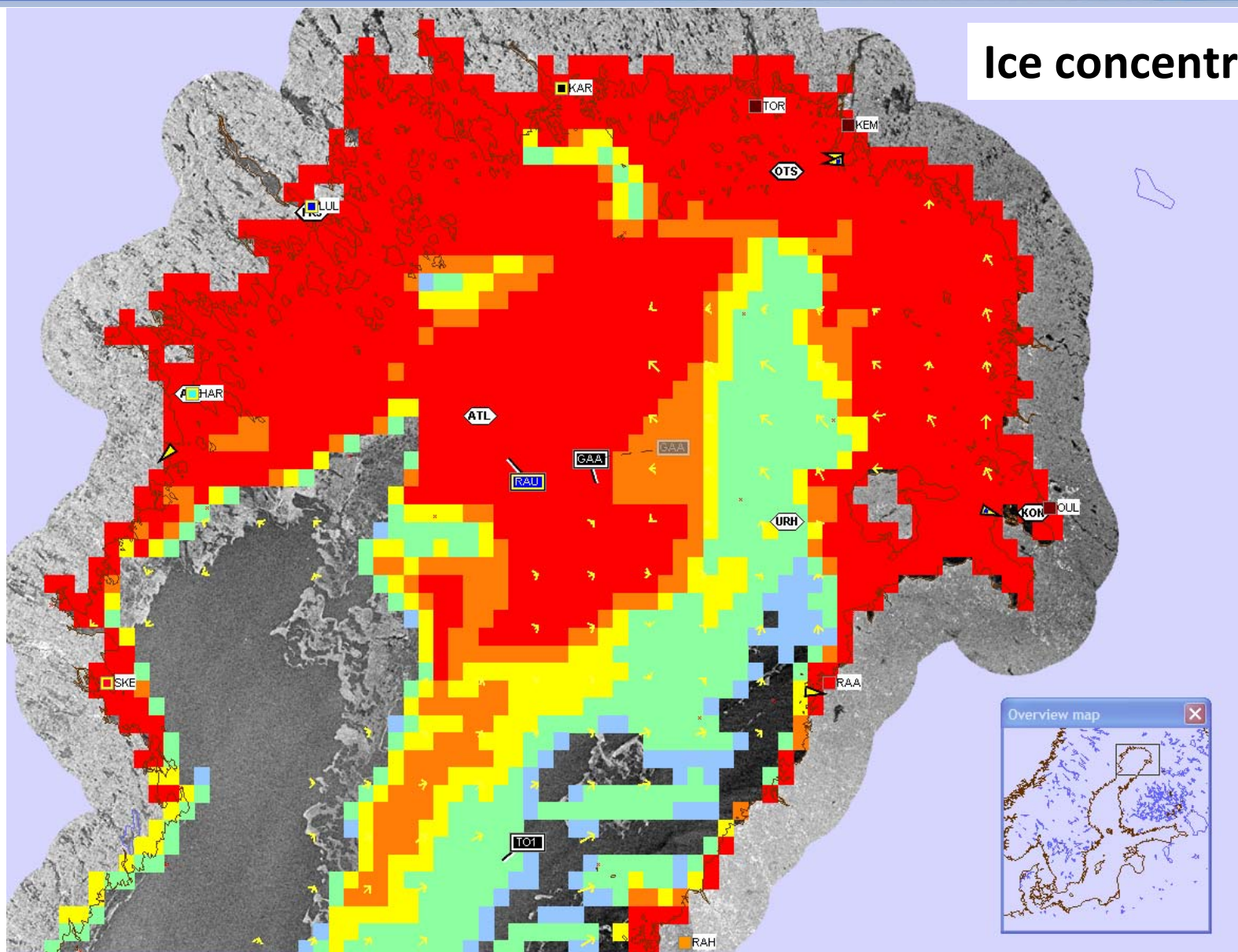




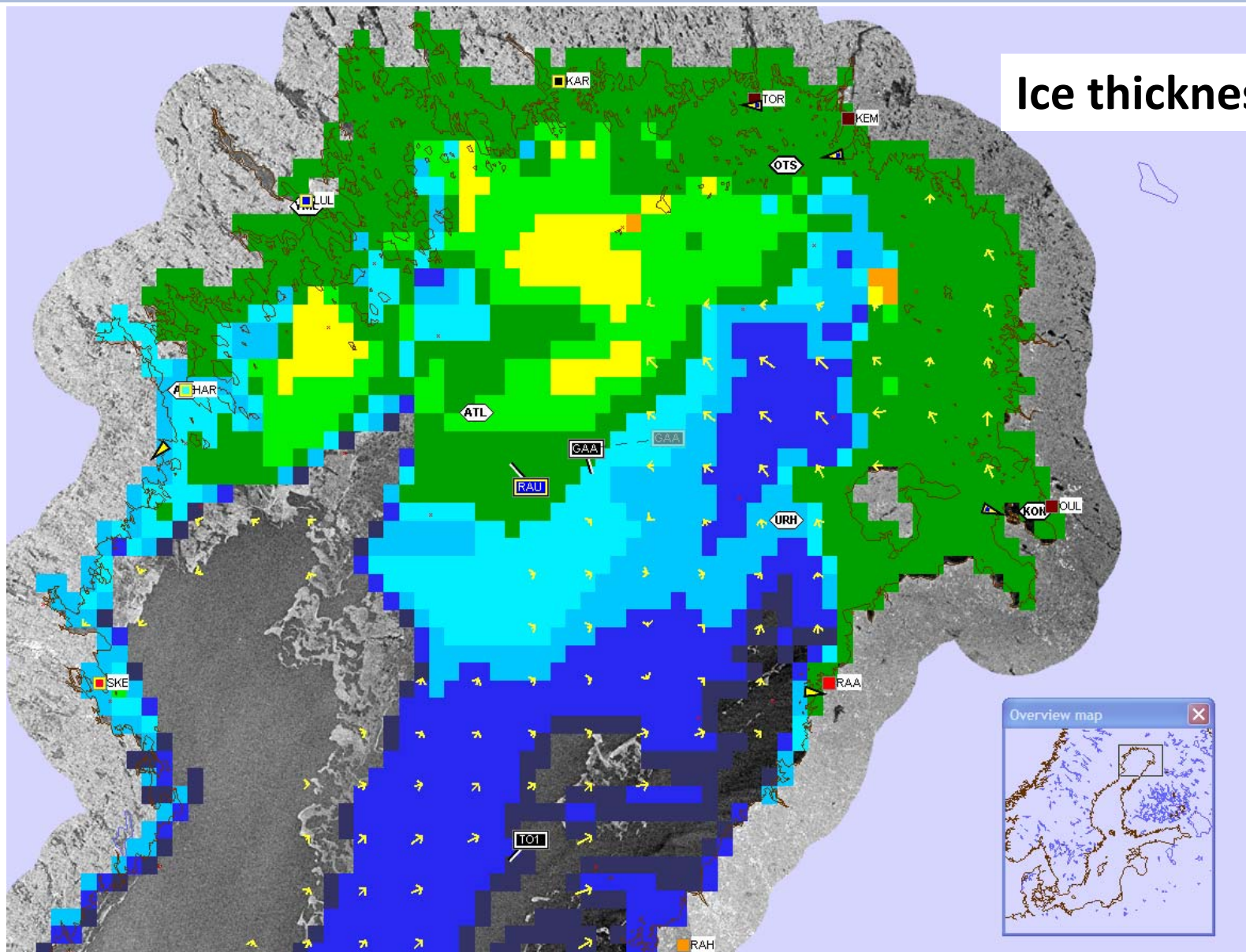




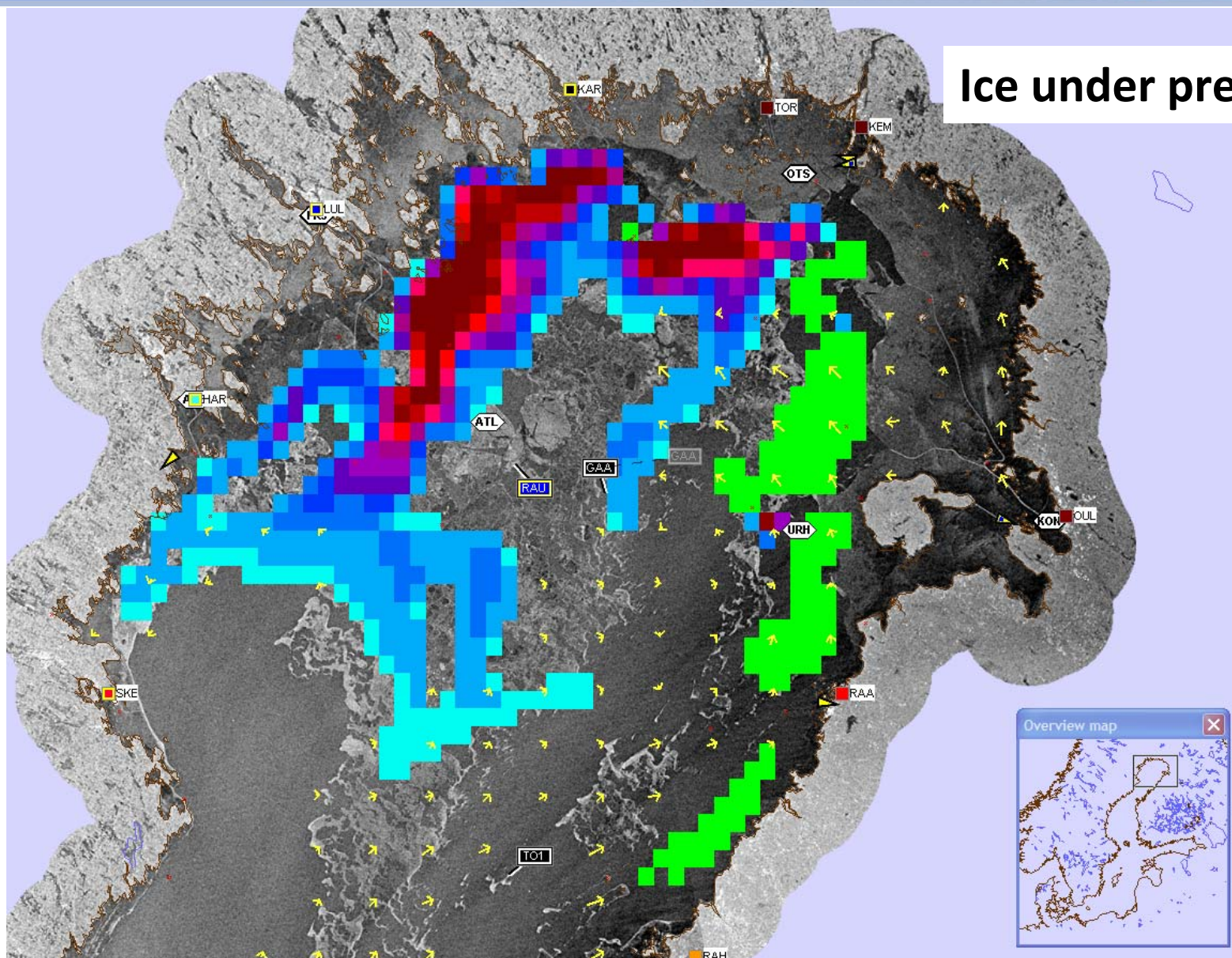
Ice concentration



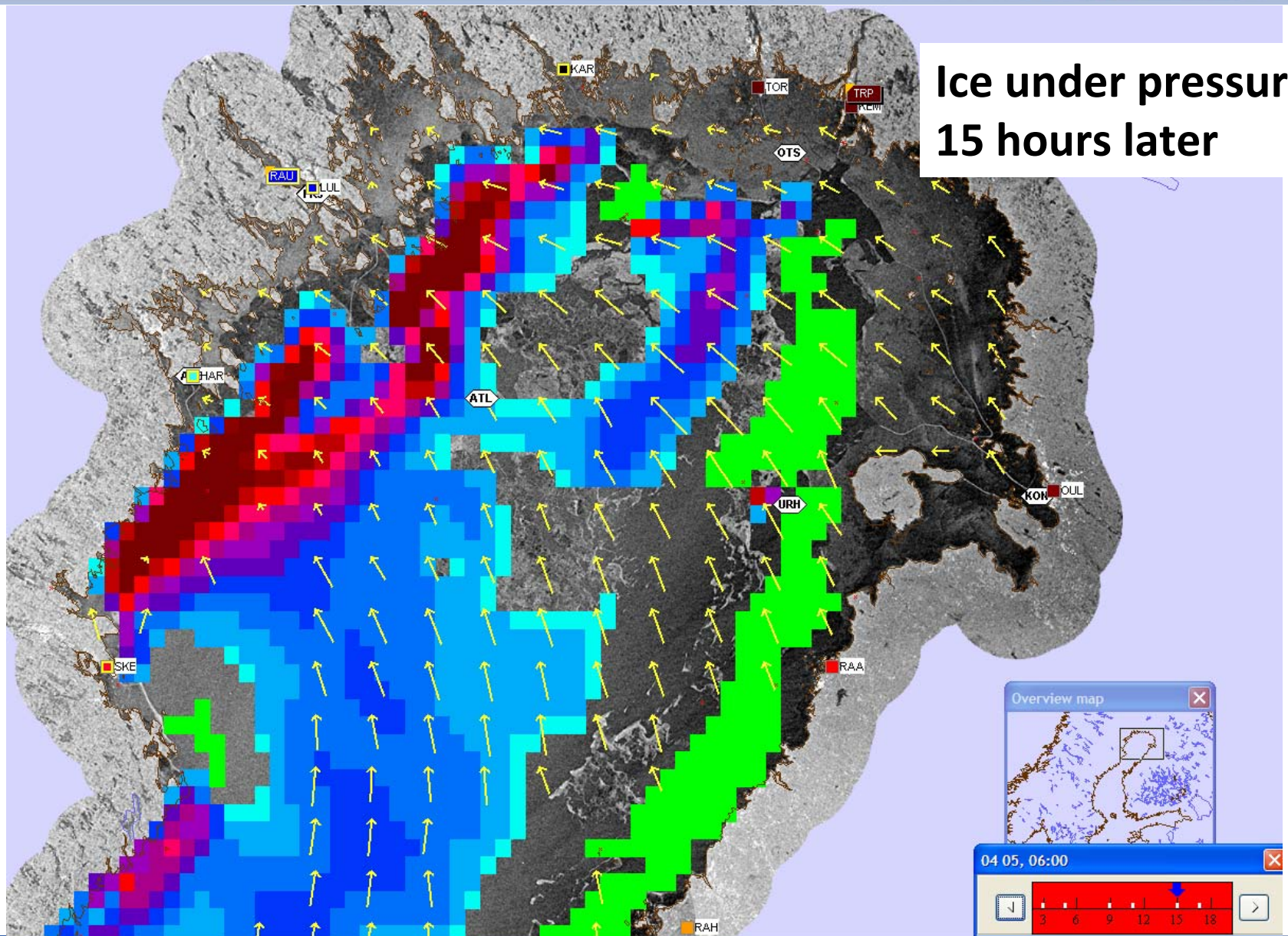
Ice thickness

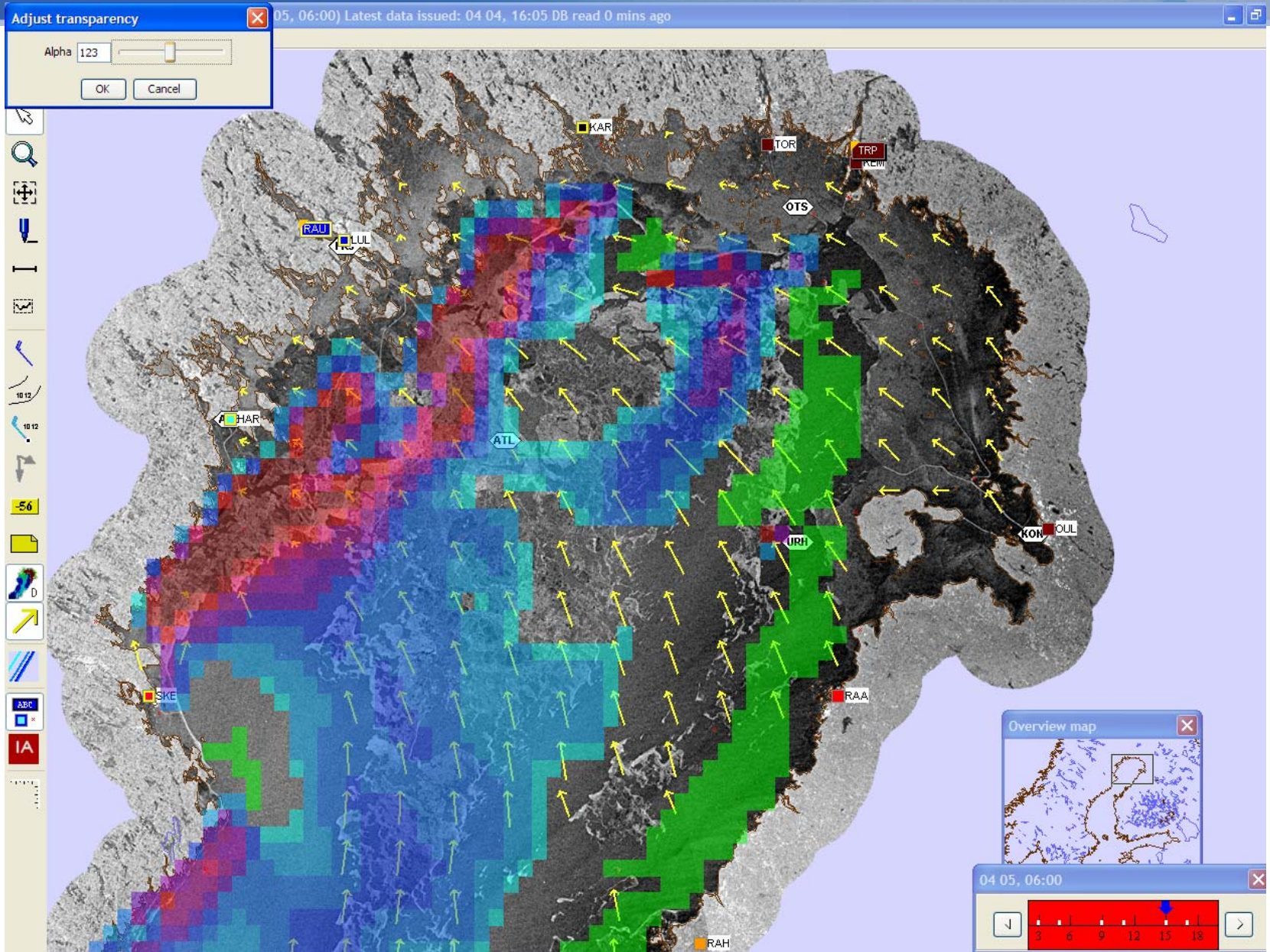


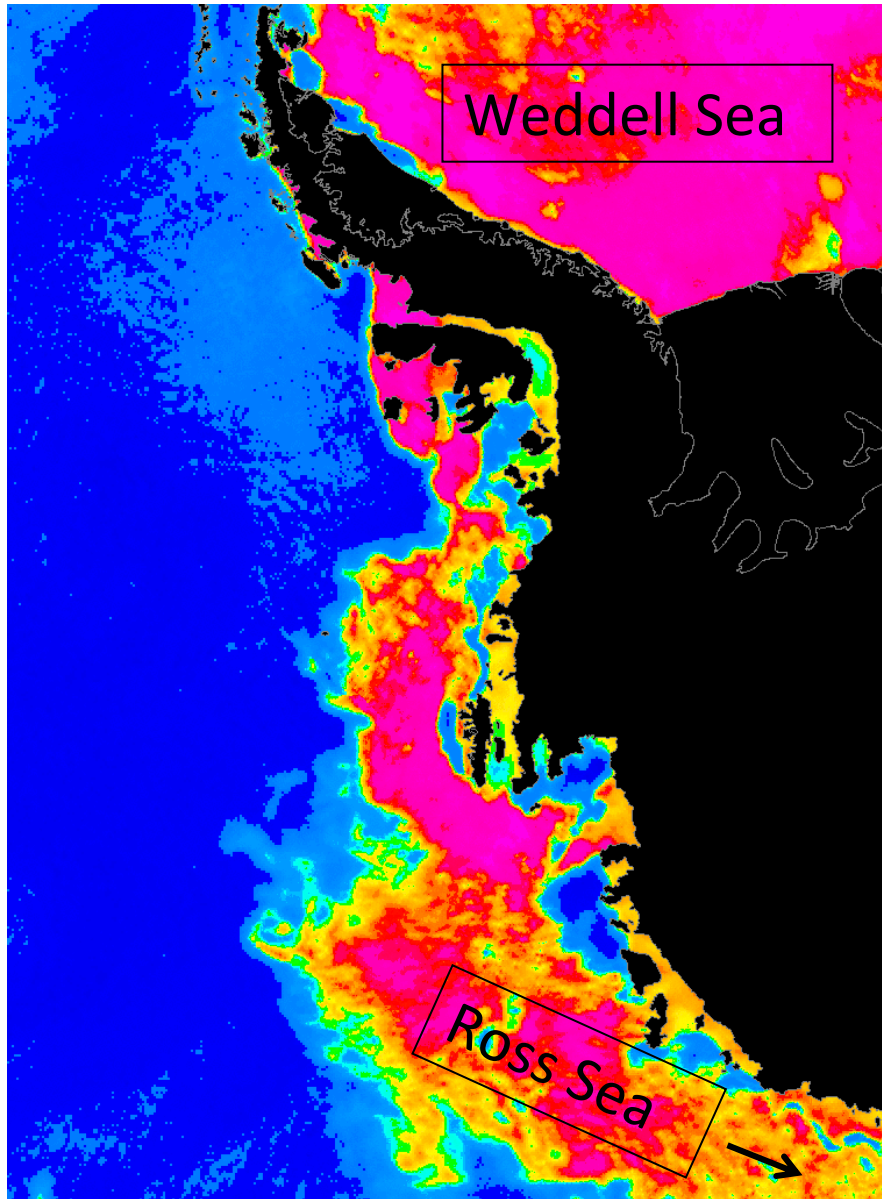
Ice under pressure



Ice under pressure 15 hours later







Further development in the
Arctic and Antarctic

- Ice Thickness Charts
- Forecast
 - Ice-concentration
 - Ice-thickness
 - Compressed areas

SAFEWIN (Safety of winter navigation in dynamic ice) within FP 7 for the Baltic Sea & the Arctic Ocean

- **Observation campaigns, 2010, 2011, 2012**
- **Forecasting methods**
 - Baltic Sea
 - Arctic Ocean
- **Ice dynamics modeling**
 - Description of compression in ice cover
 - Short term forecasting
 - Derivation of parameters applicable in ship scale
- **Operative forecast**
 - Format and transmission of guidance for ship operators
 - Comparison of the predicted influence on ships and observations
 - Assessment of the impact on ship safety
 - Application to ice management schemes

Benefits of Earth Observations

- Ice information
- Early warning changed ice situation
- Improved the safety of navigating in ice
- Better allocation of resources
- Environmental friendly shipping



ICE IS NICE

Ulf Gullne
Swedish Maritime Administration
Ice-breaking Department
418 34 GÖTEBORG
Tph: +46 31-64 77 83
Cellcall: + 46 709-53 47 73
Fax: +46 31-64 77 90
E-mail: ulf.gullne@sjofartsverket.se
Internet: www.sjofartsverket.se