Norwegian Meteorological Institute
met.no

Use of SAR in observing polar lows

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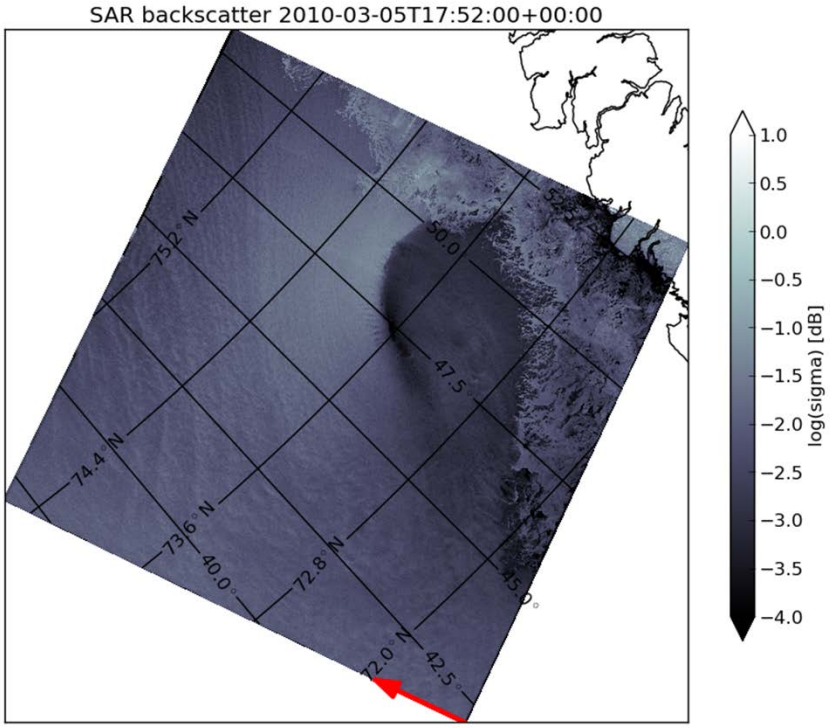
Observing polar lows in 2012

- AVHRR Polar orbiting satellite imagery
  - Primary source of info
  - Observations at cloud tops
- Synoptic observations
  - Isolated spot observations
  - Contaminated by topography at the coast
- ASCAT/Oceanscat:
  - Good at absolute wind speed, but lacking detailed info

Added information from SAR images in observing polar lows?

- Absolute wind speed
- Surface details
- Time span of wind increase
- A tool for early warning

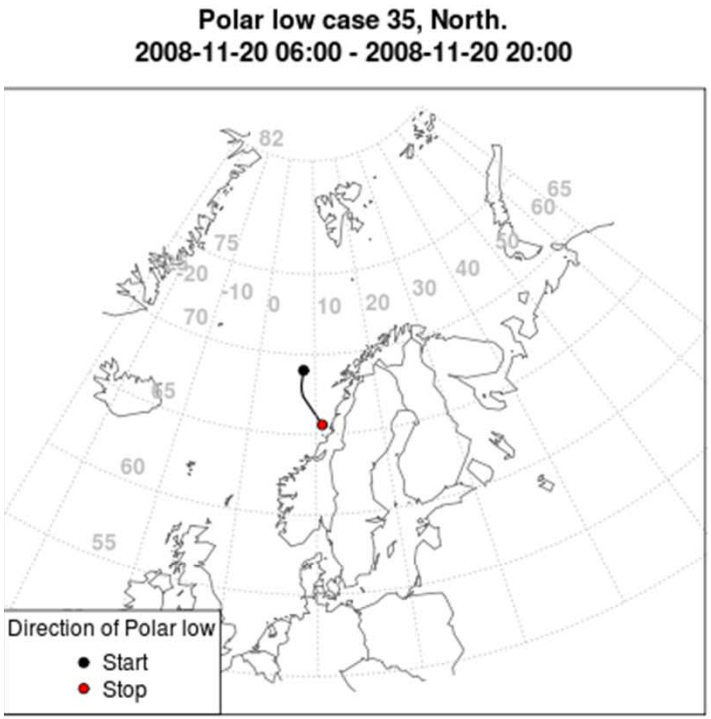


Polar Lows registered at met.no

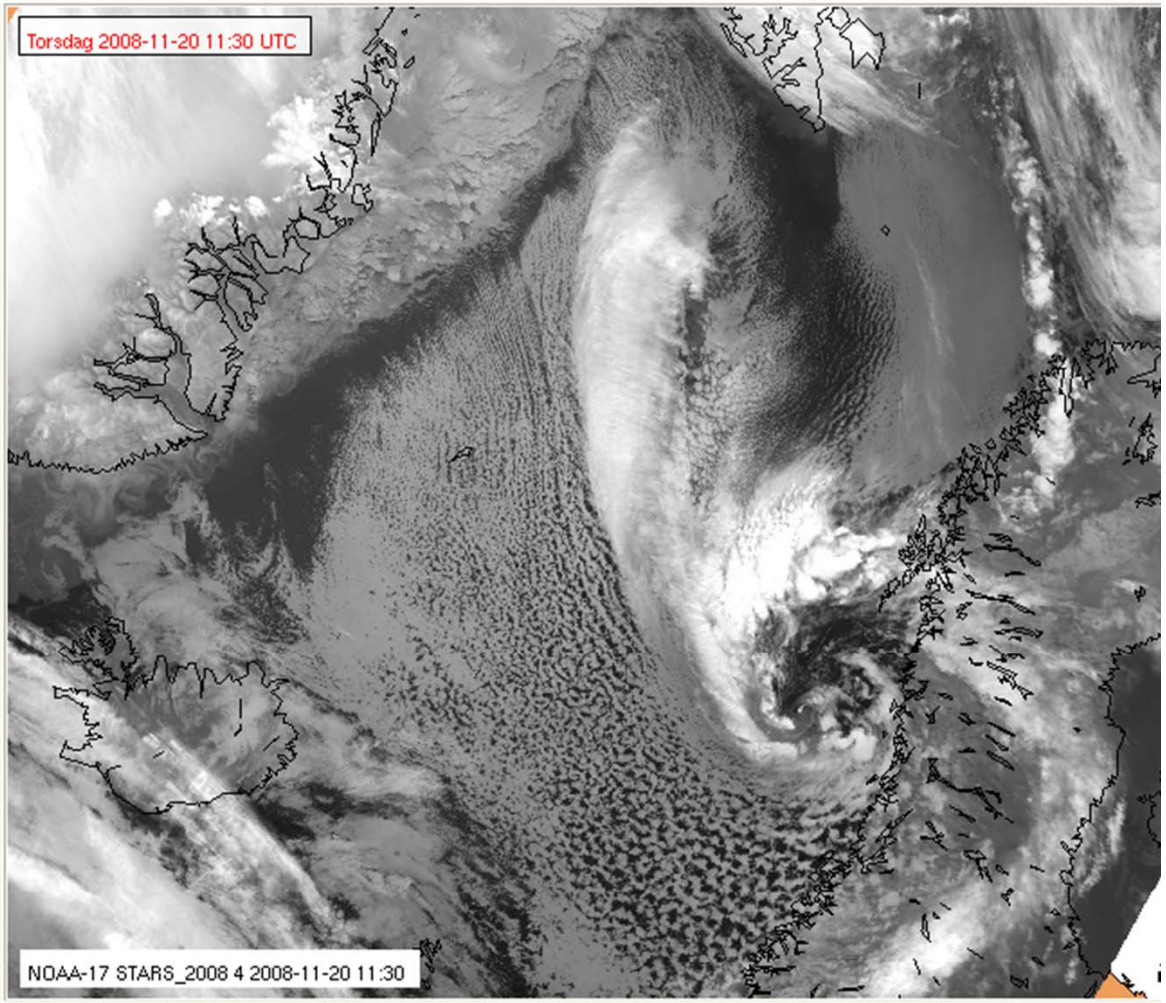
- met.no area
  - 2002-2011
  - 141 polar lows
  - Tracks and dates
- Southern Greenland
  - 2007-2010
  - 41 polar lows

STARS (Sea Surface Temperature and Altimeter Synergy for Improved Forecasting of Polar Lows)

olar low event from observed start to end.



AVHRR IR image of polar low event at one selected time.

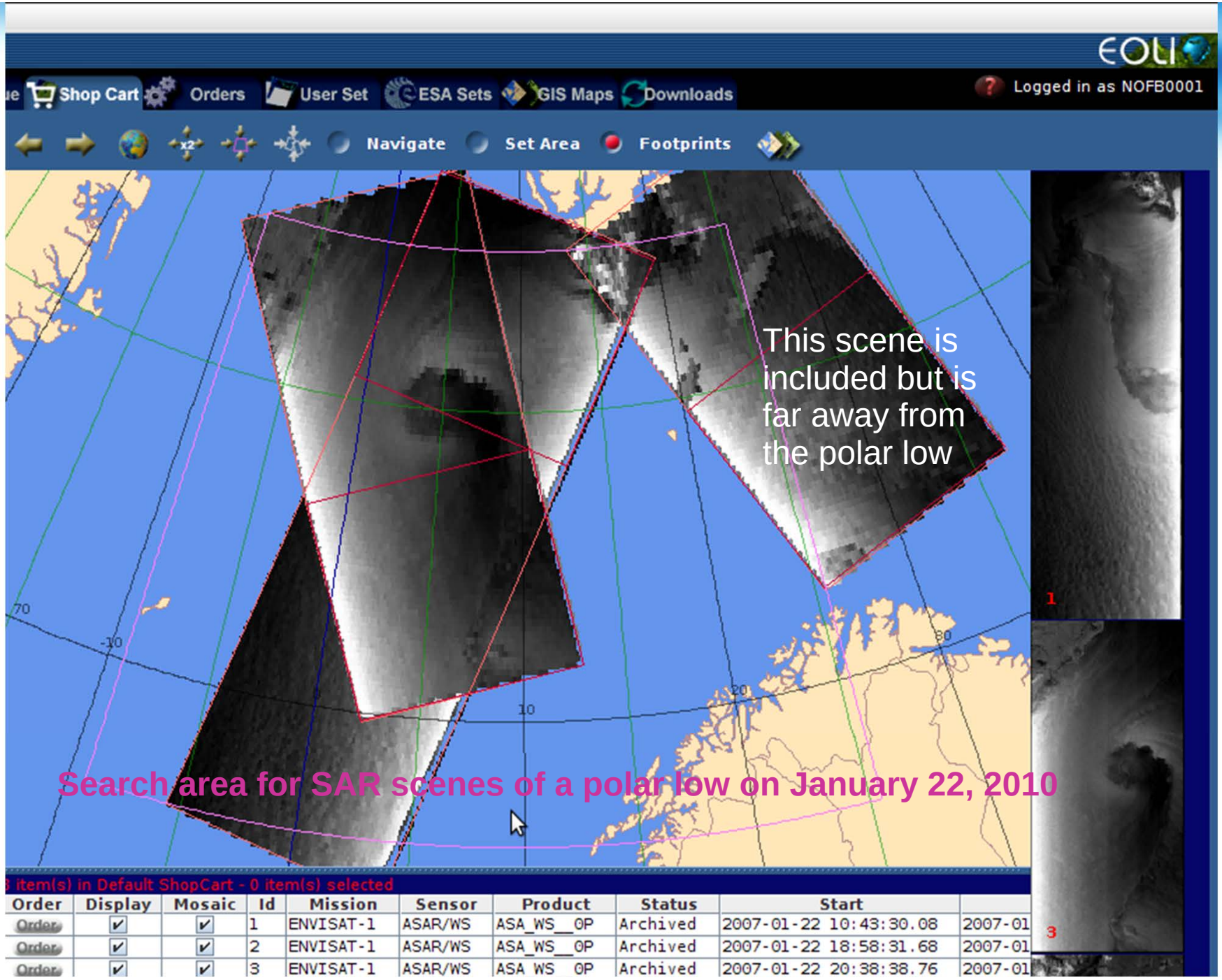


http://projects.met.no/stars/view_stars-dat.php

Workshop on polar lows 21.-22. May in Oslo.

STARS Phase II

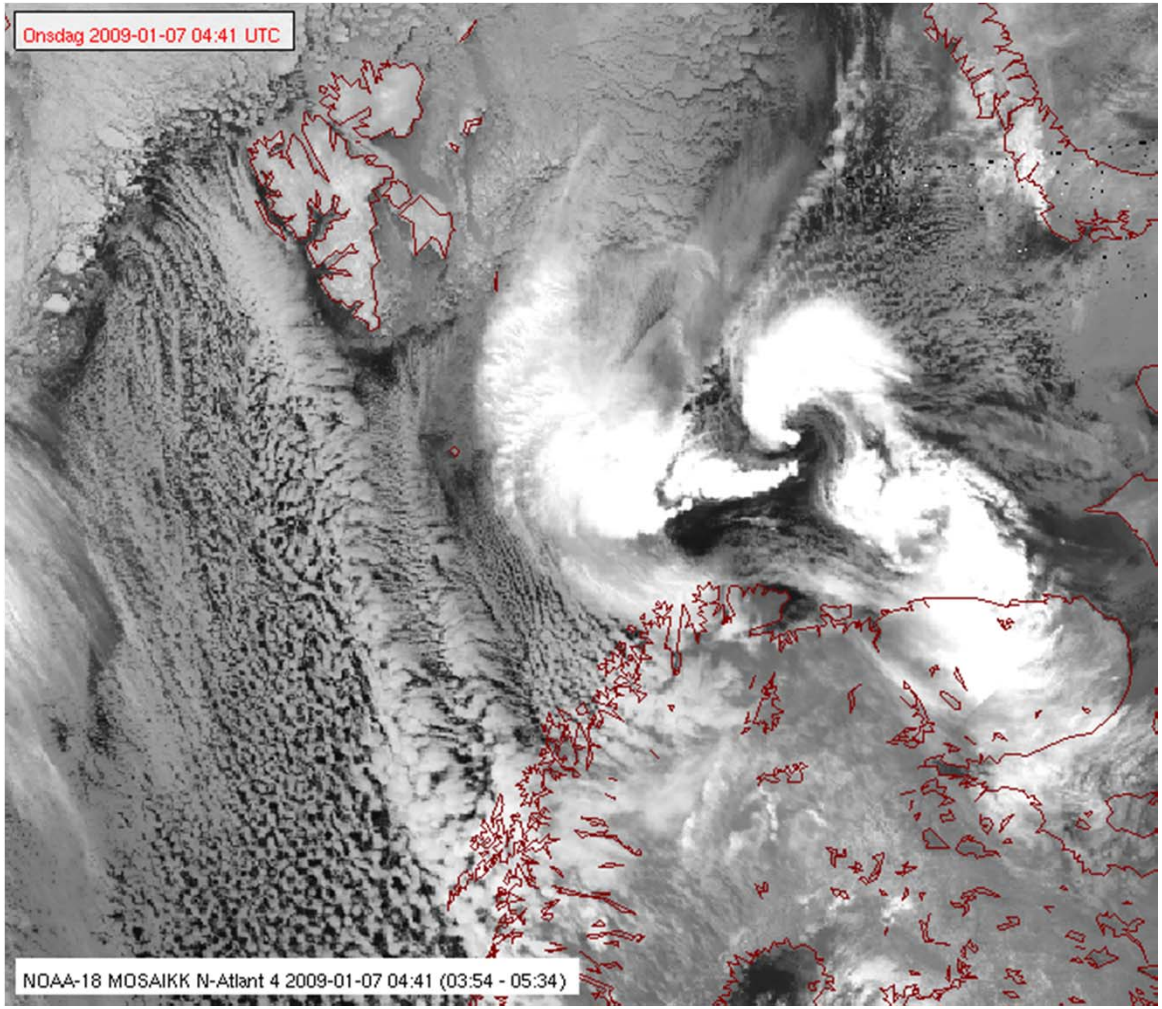
- One objective: To include SAR images of polar low situations in the STARS database
- Envisat ASAR WSM, GM and PRI (about 200 WSM are included in the database by now) +/- 1 day from the PL
- Wind retrieval using CMOD5 and wind directions from HIRLAM and/or ASCAT


EOLI
Shop Cart
Orders
User Set
ESA Sets
GIS Maps
Downloads
Logged in as NOFB0001
Navigate
Set Area
Footprints
This scene is included but is far away from the polar low
Search area for SAR scenes of a polar low on January 22, 2010
item(s) in Default ShopCart - 0 item(s) selected
Order | Display | Mosaic | Id | Mission | Sensor | Product | Status | Start
Order | ✔ | ✔ | 1 | ENVISAT-1 | ASAR/WS | ASA_WS__0P | Archived | 2007-01-22 10:43:30.08 | 2007-01
Order | ✔ | ✔ | 2 | ENVISAT-1 | ASAR/WS | ASA_WS__0P | Archived | 2007-01-22 18:58:31.68 | 2007-01
Order | ✔ | ✔ | 3 | ENVISAT-1 | ASAR/WS | ASA_WS__0P | Archived | 2007-01-22 20:38:38.76 | 2007-01

Polar low cases

The Honningsvåg case

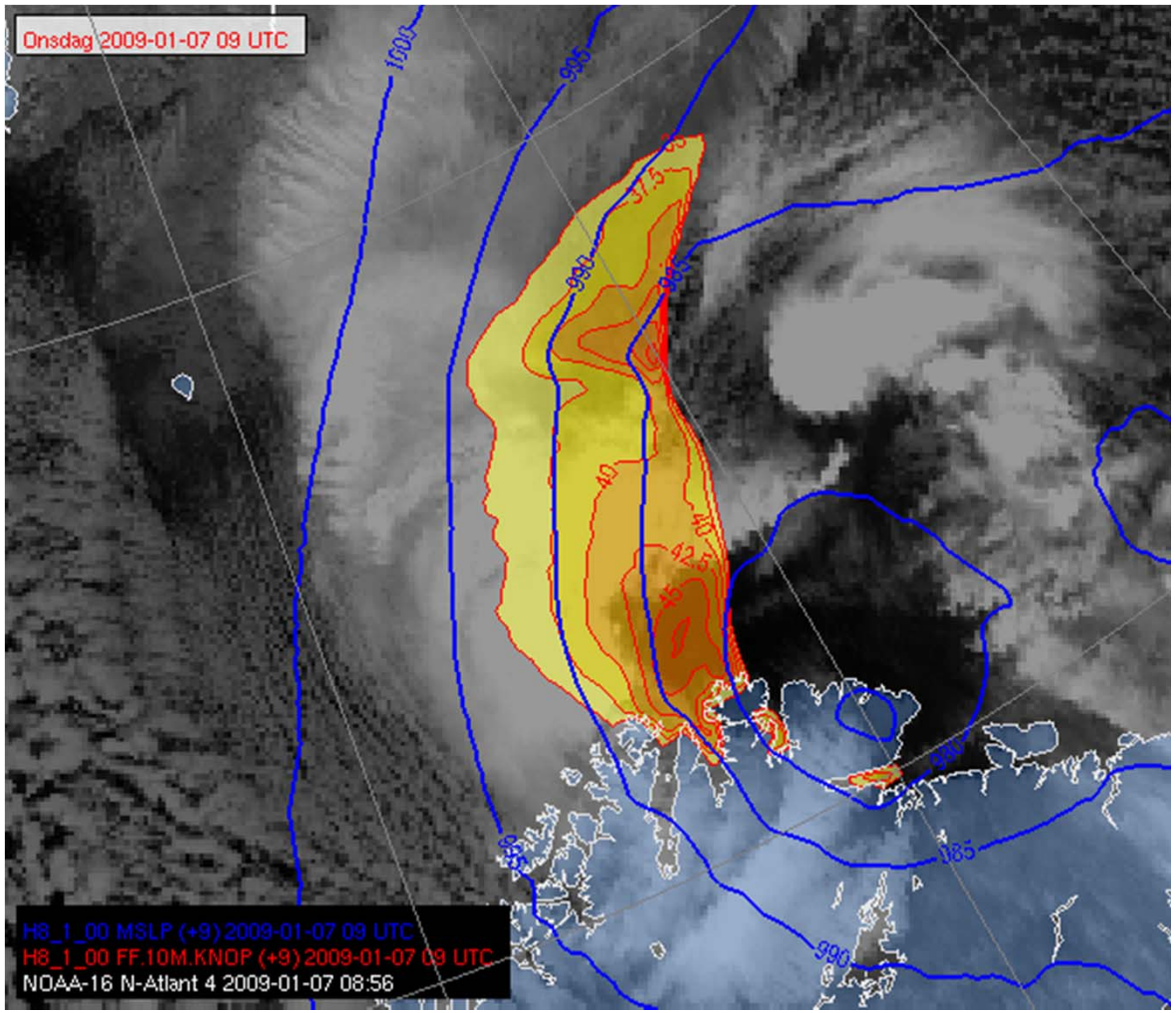
7.th January 2009



Model wind vs. reality

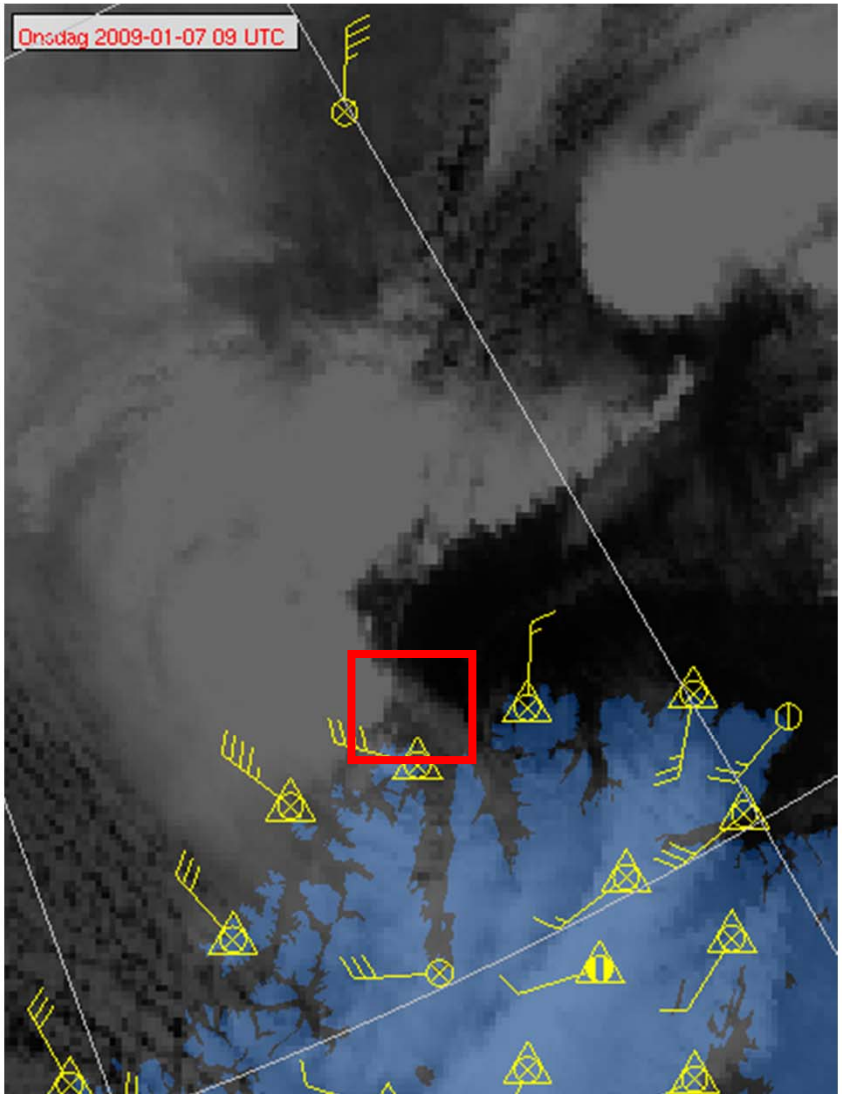
Model positional error:
- up to 150km @ +9 hrs

Large error in wind strength and direction in area of strongest wind

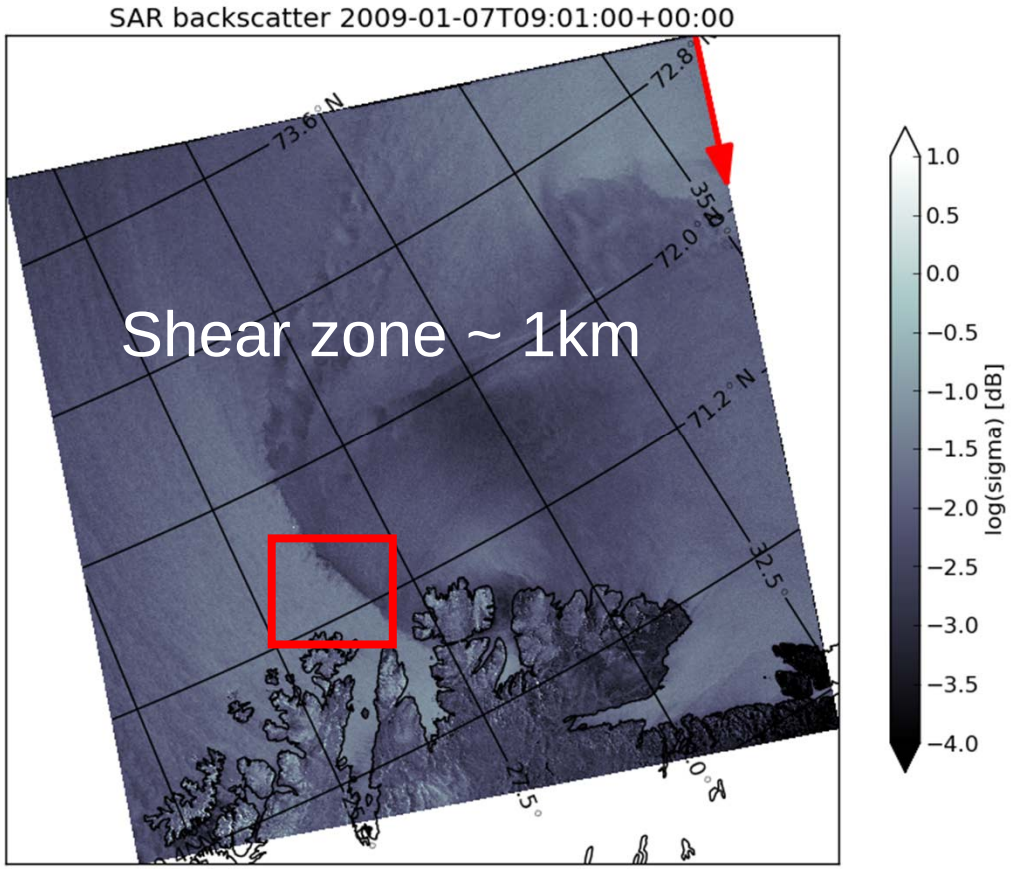


The Honningsvåg case:
January 7, 2009, 09UTC

SAR details

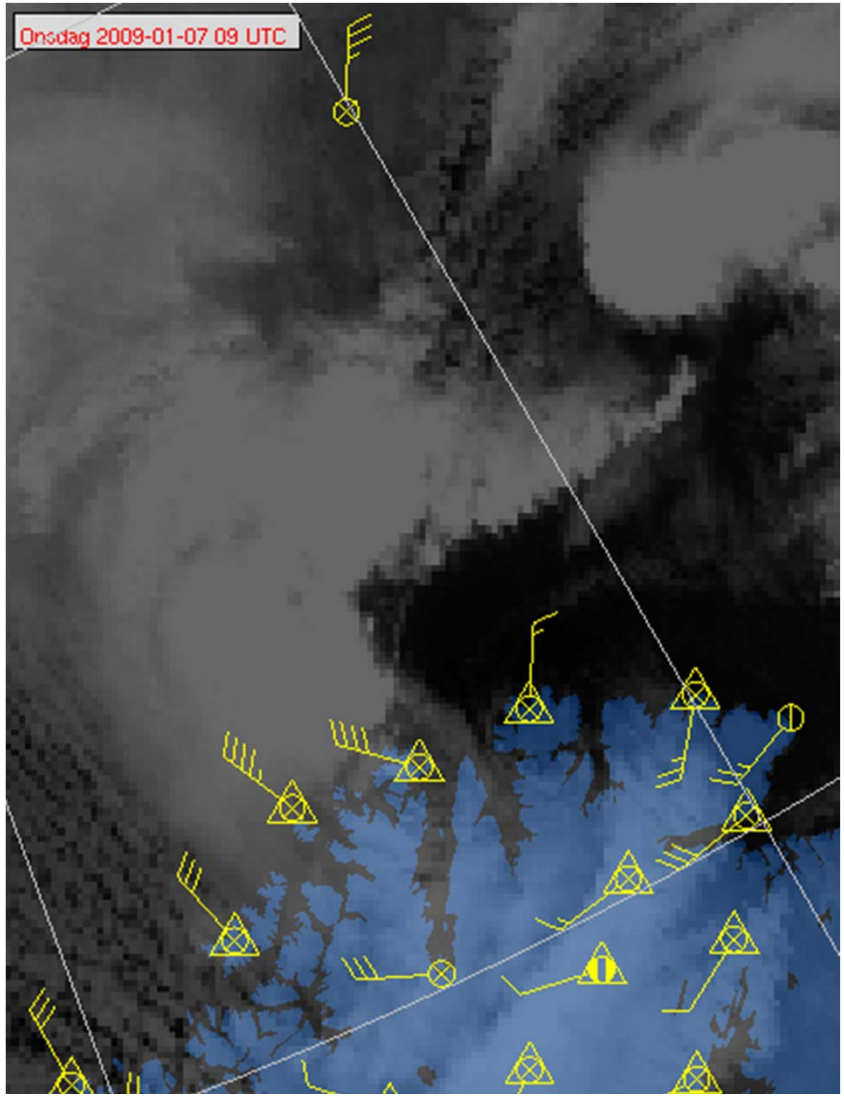


The Honningsvåg case: January 7, 2009, 09UTC

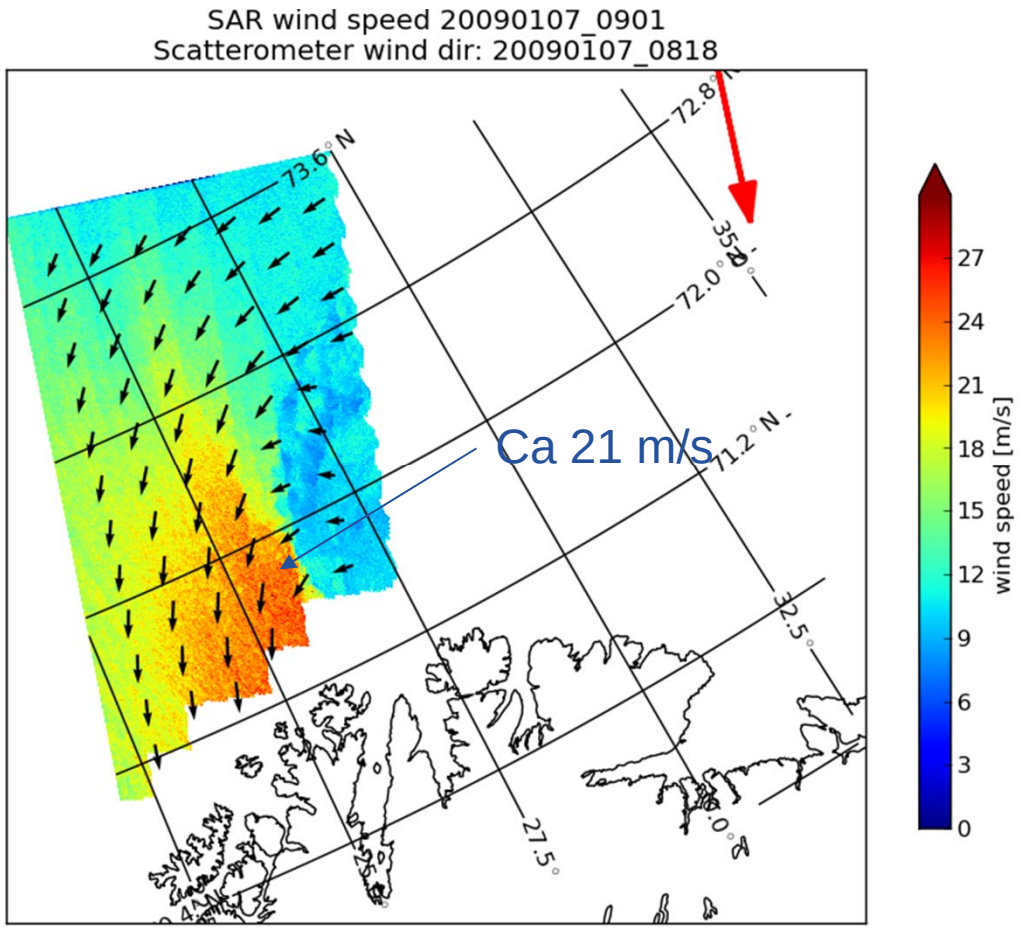


Absolute wind speed?

The Honningsvåg case: January 7, 2009, 09UTC

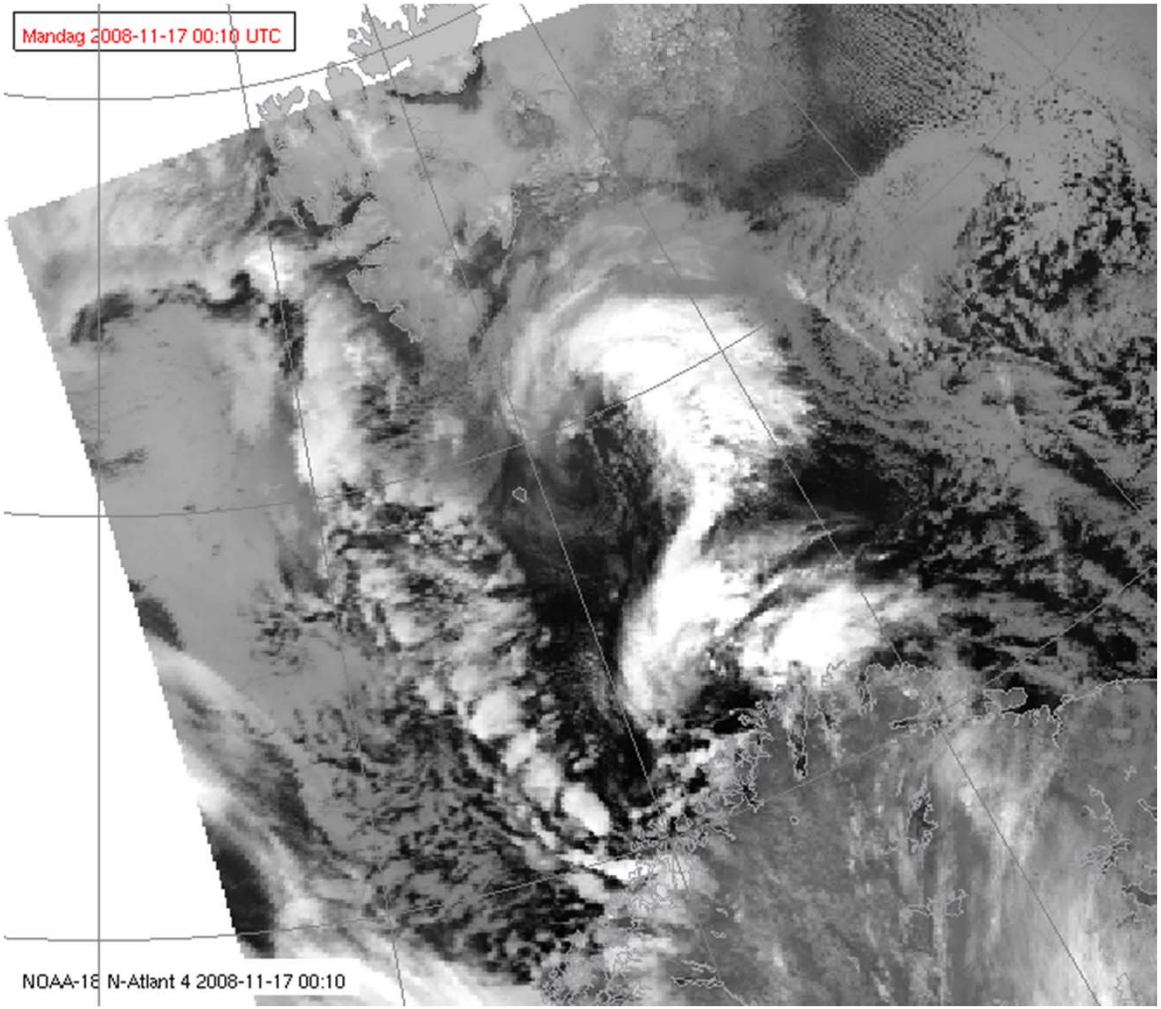


ASCAT wind directions

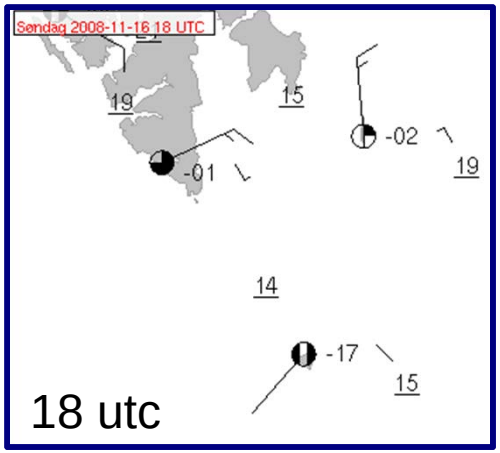


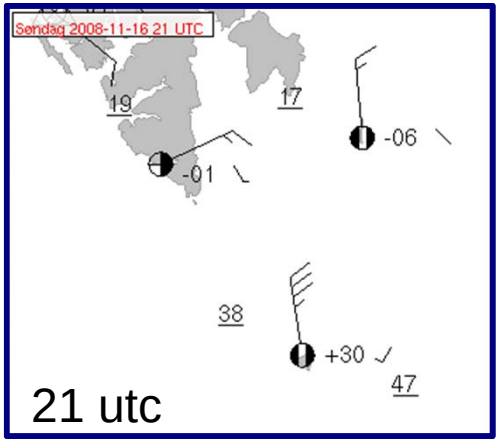
The Bjørnøya lows

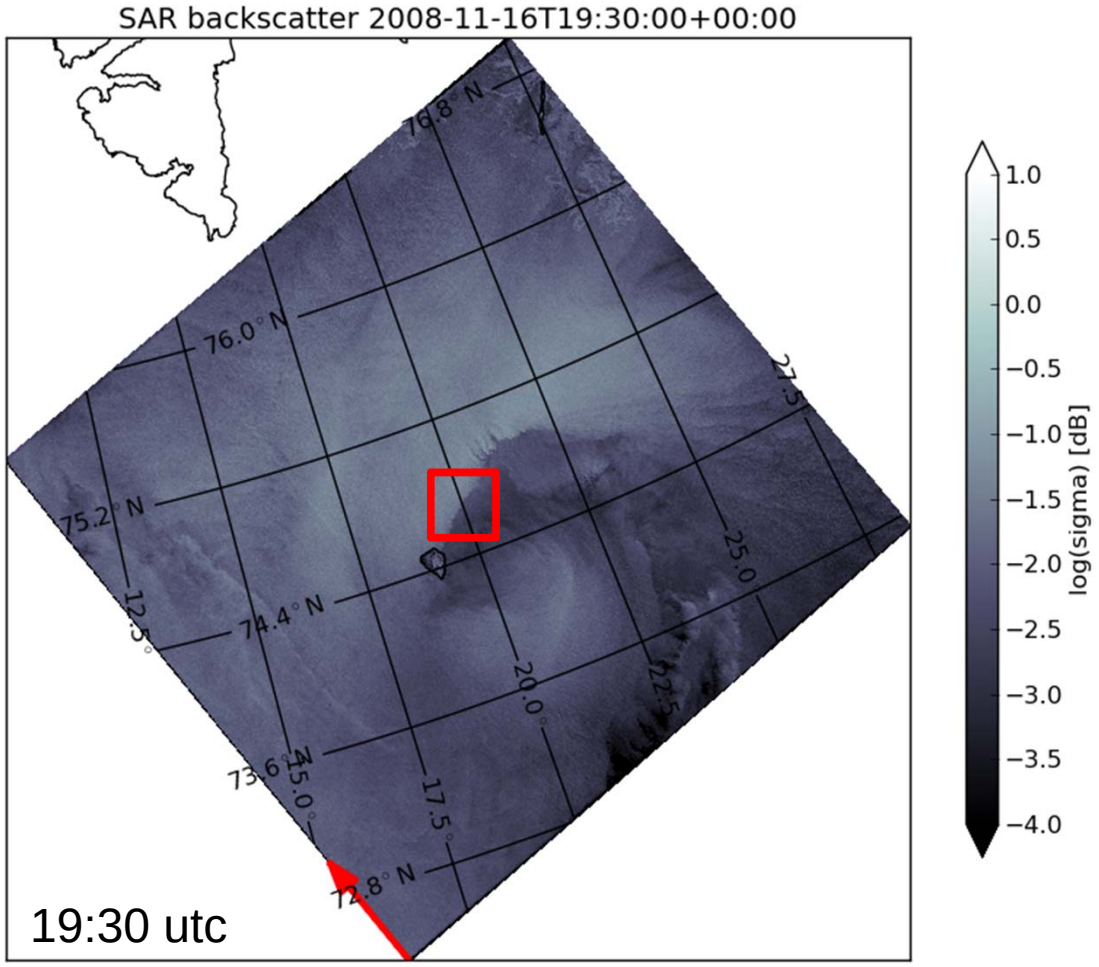
16.th to 18.th November 2008



The Bjørnøya low



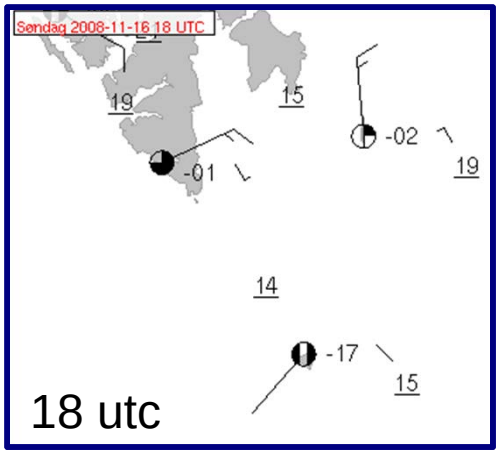


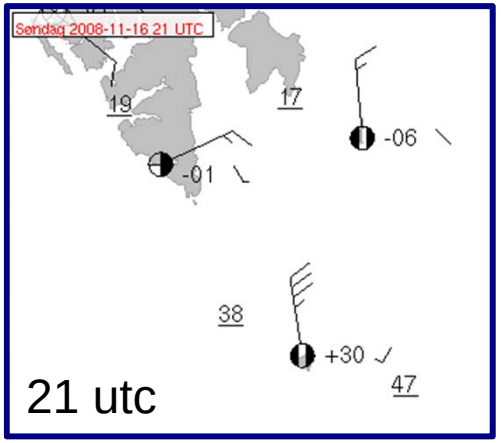


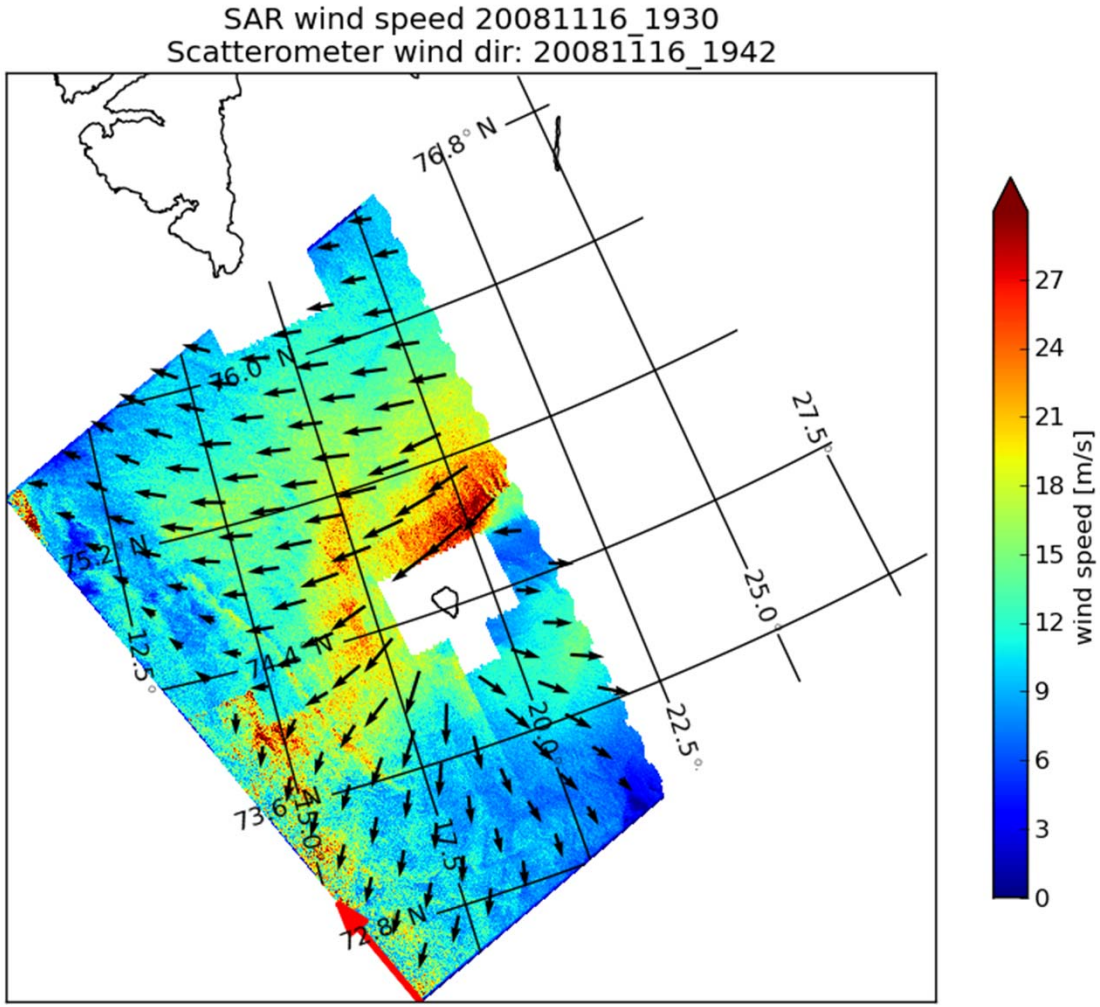
Shear zone ~ 2-3 km, increase time ~ 5 minutes

The Bjørnøya low

ASCAT wind directions



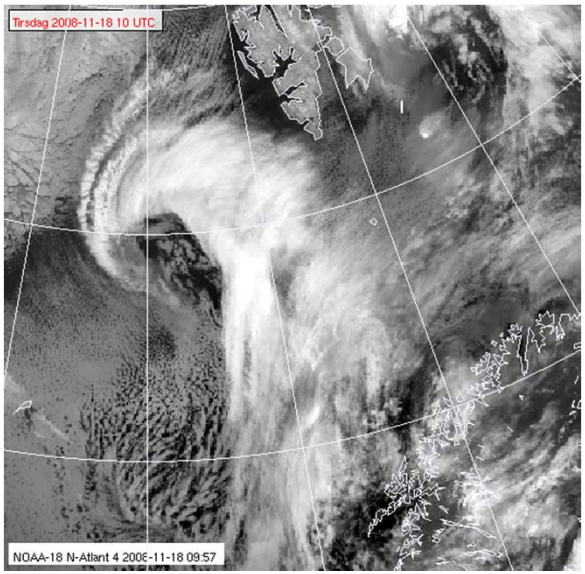




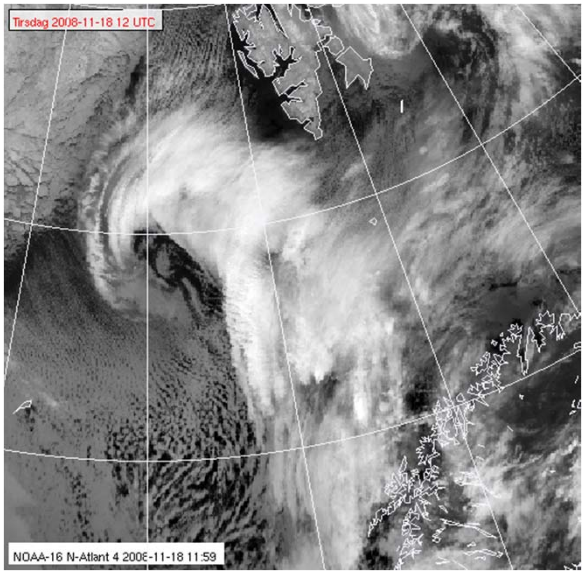
Bjørnøya synop: 38kt (19,5m/s). SAR winds: 25+ m/s

The 18.Nov. 2008 low: Early detection?

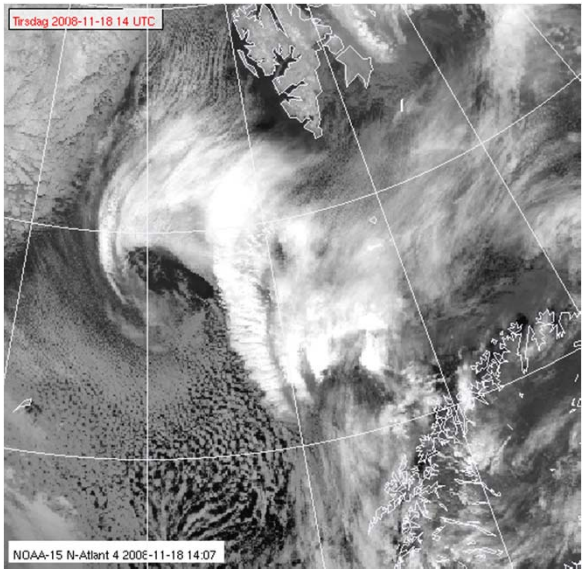
10 utc



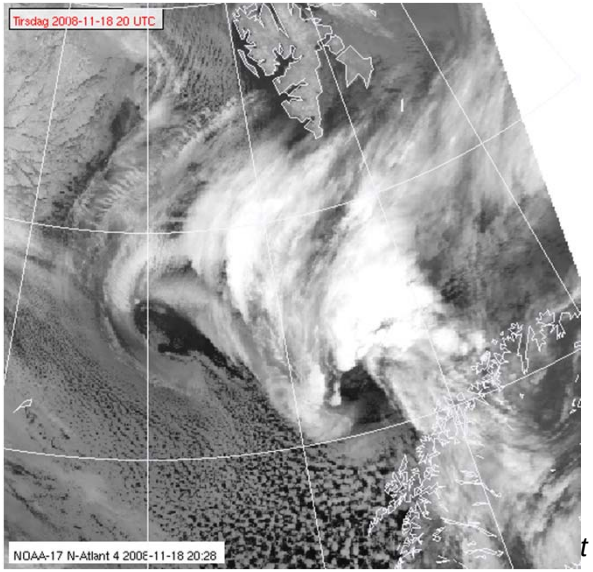
12 utc



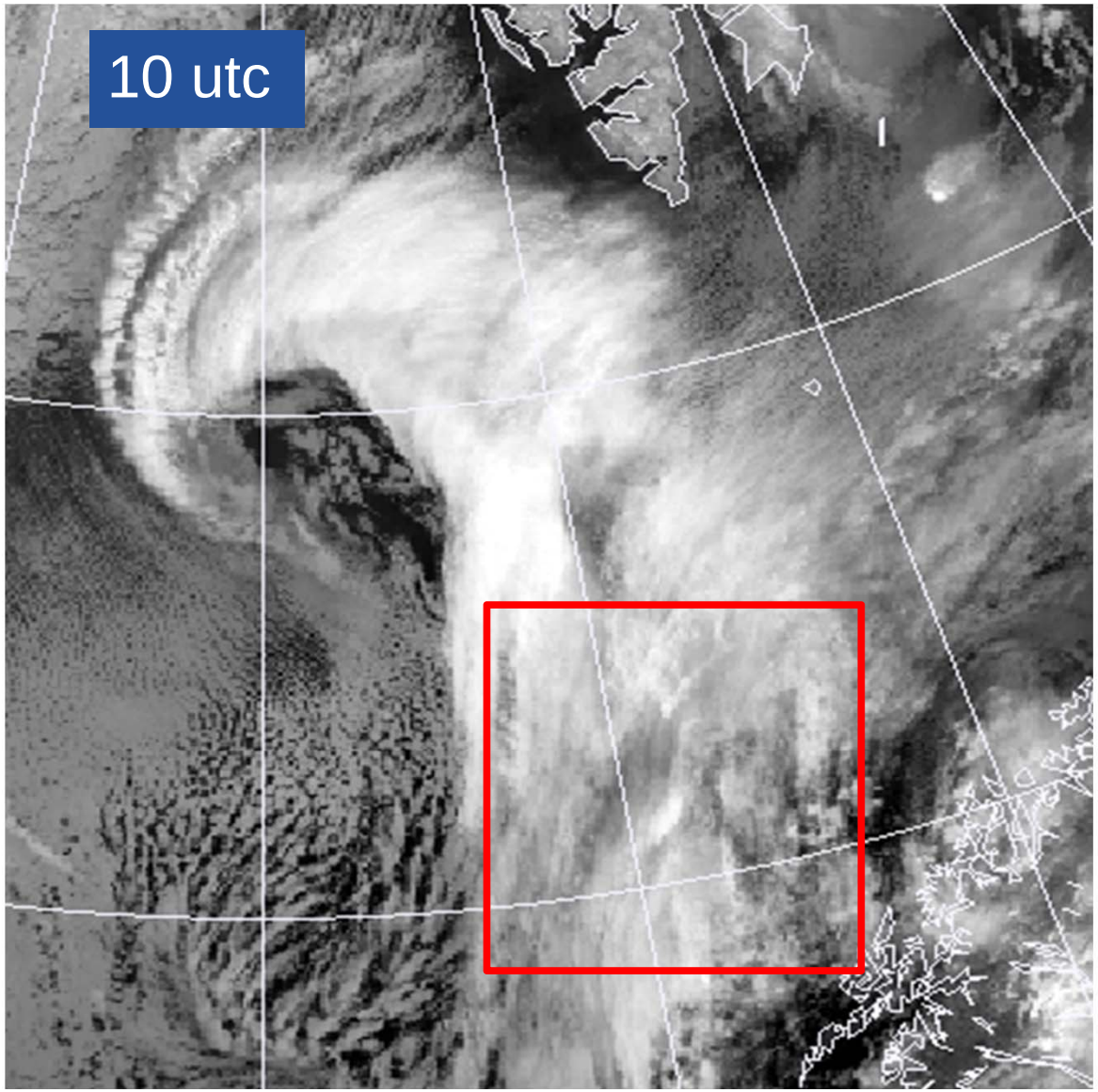
14 utc

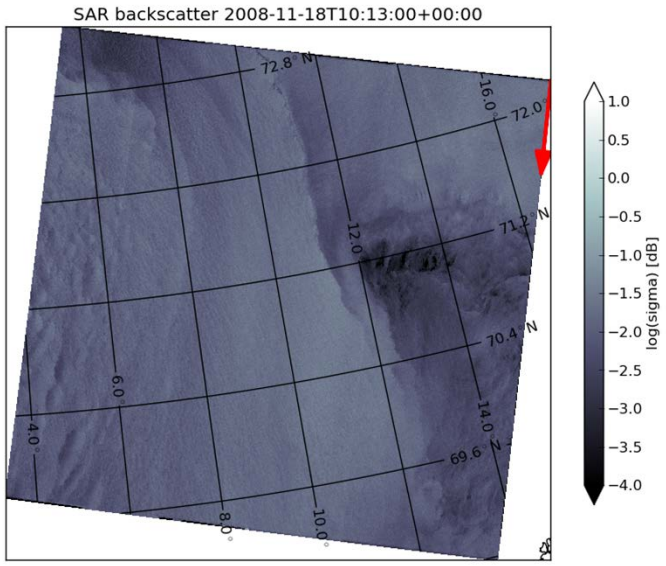


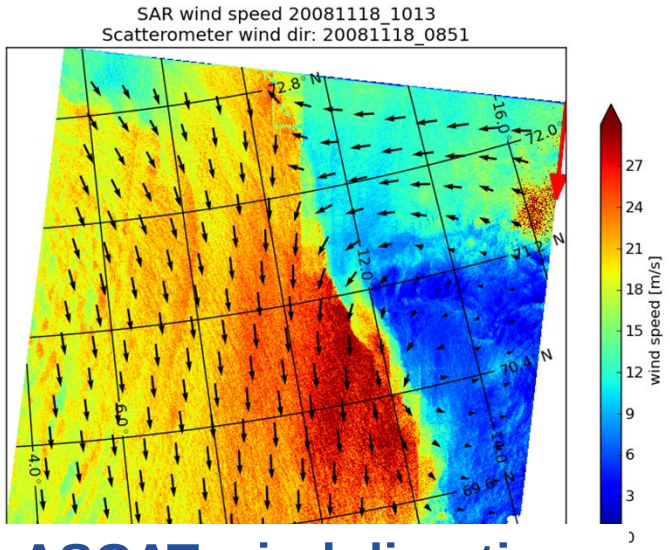
20 utc



Surface signature in the SAR?

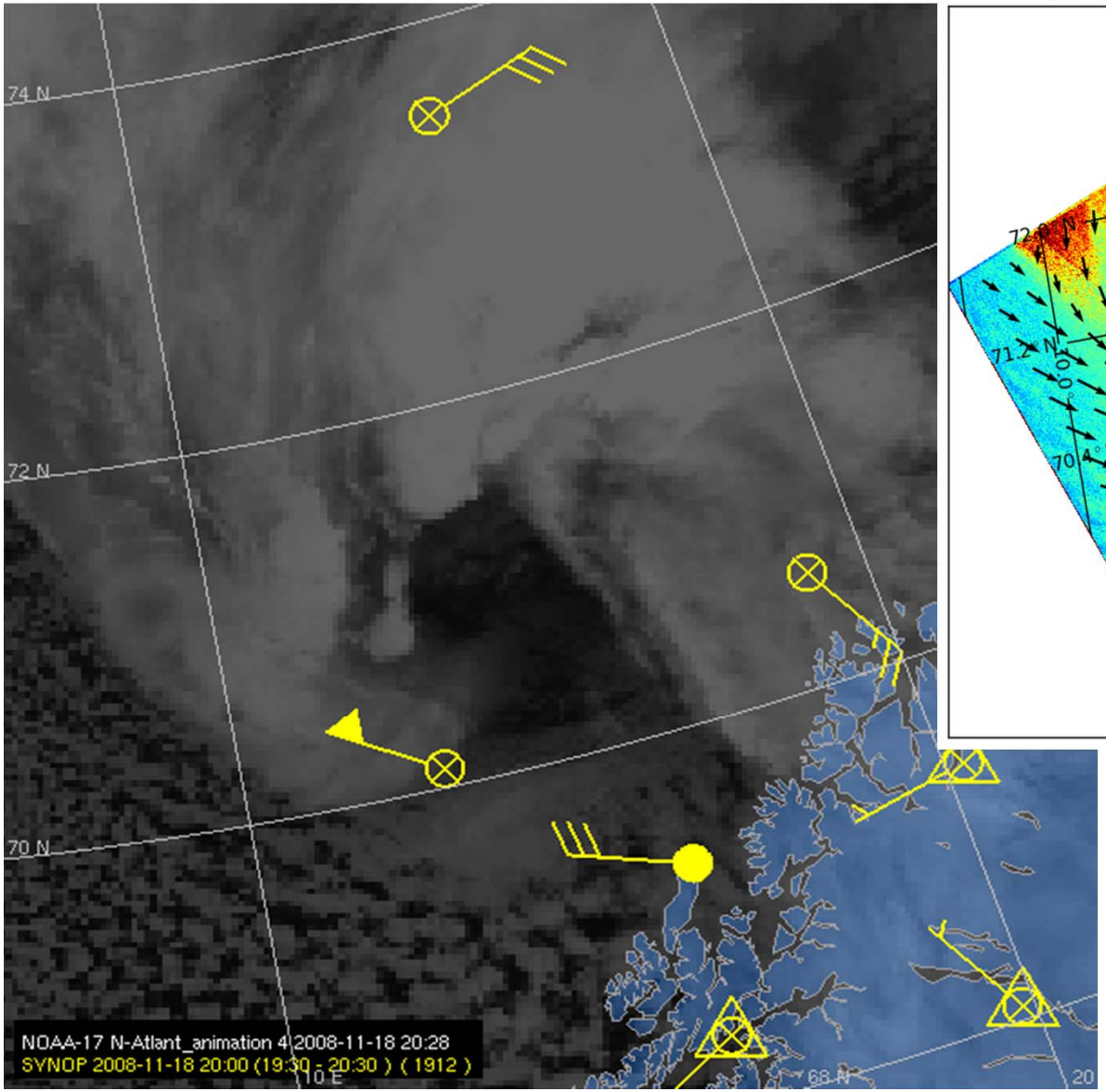


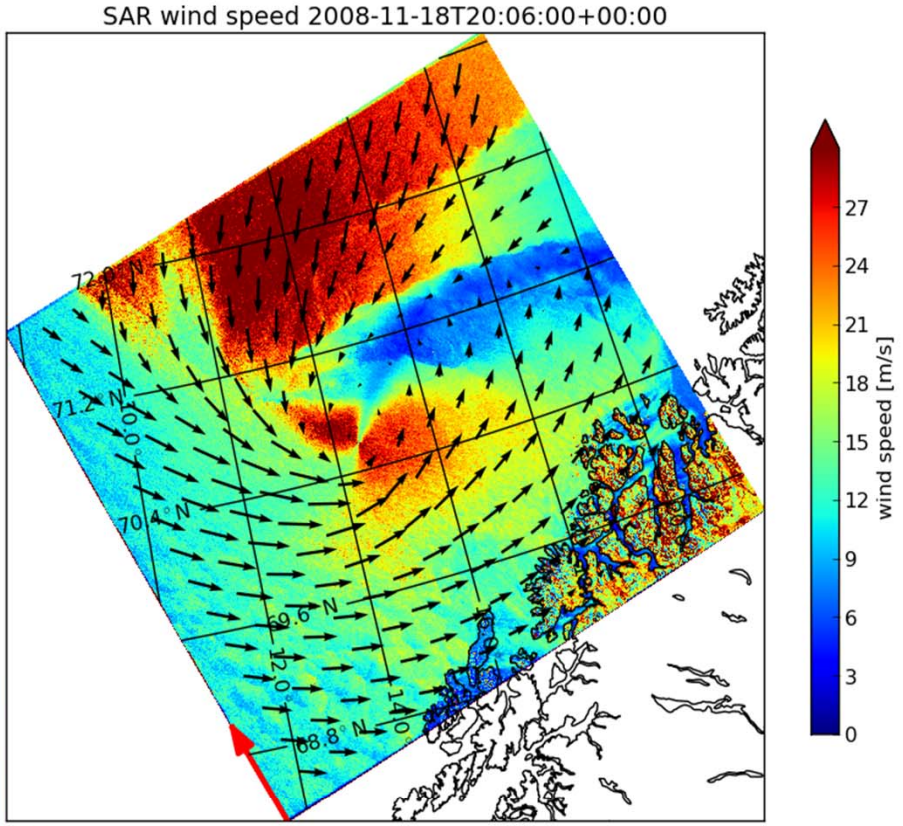




ASCAT wind directions

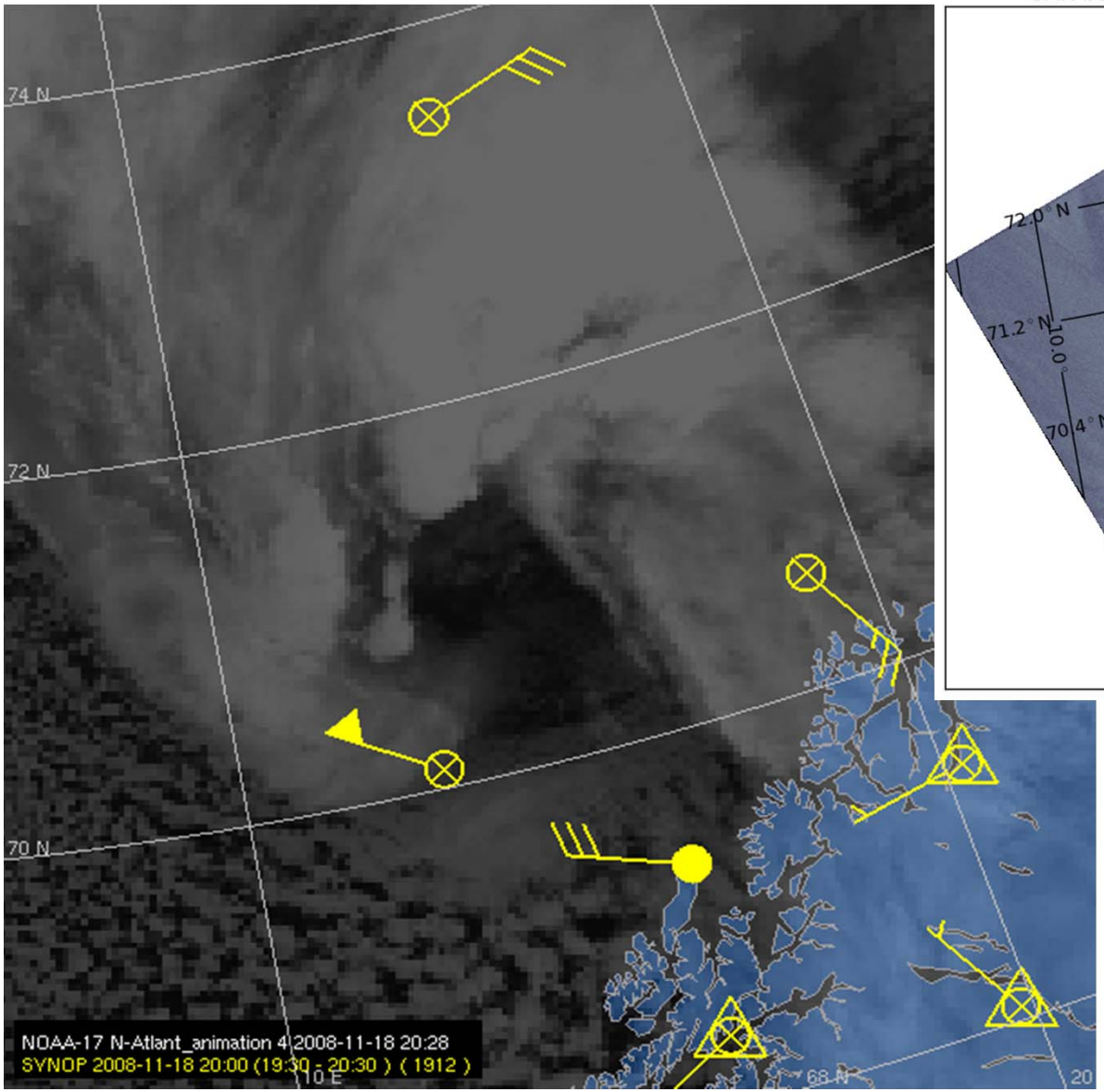
How about absolute wind speed?

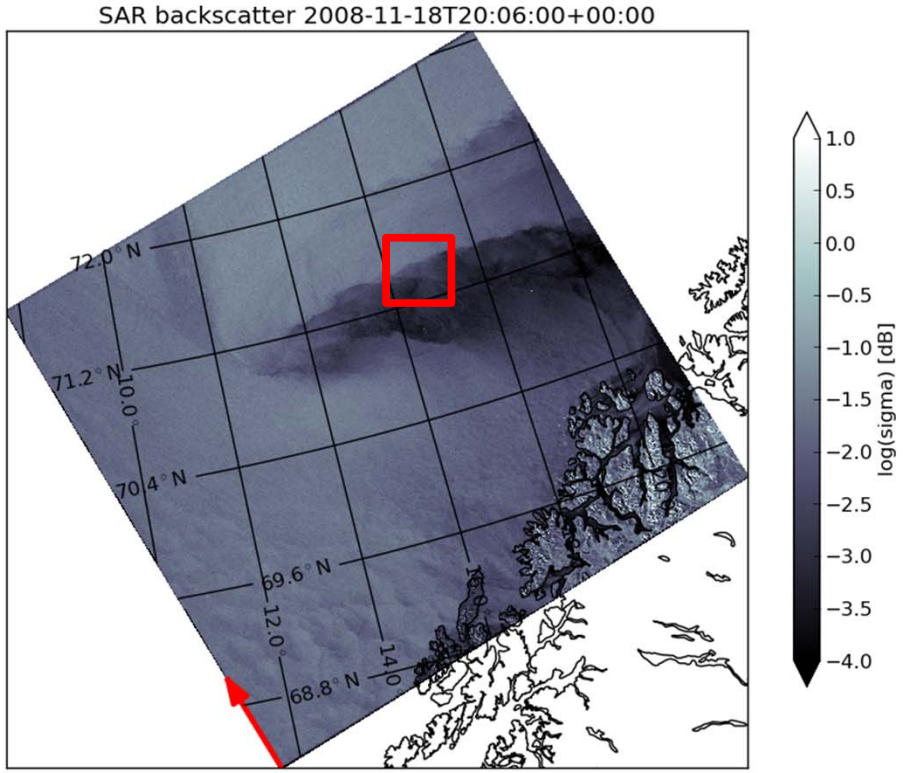




No ASCAT coverage
for this scene

Rapid increase in winds?



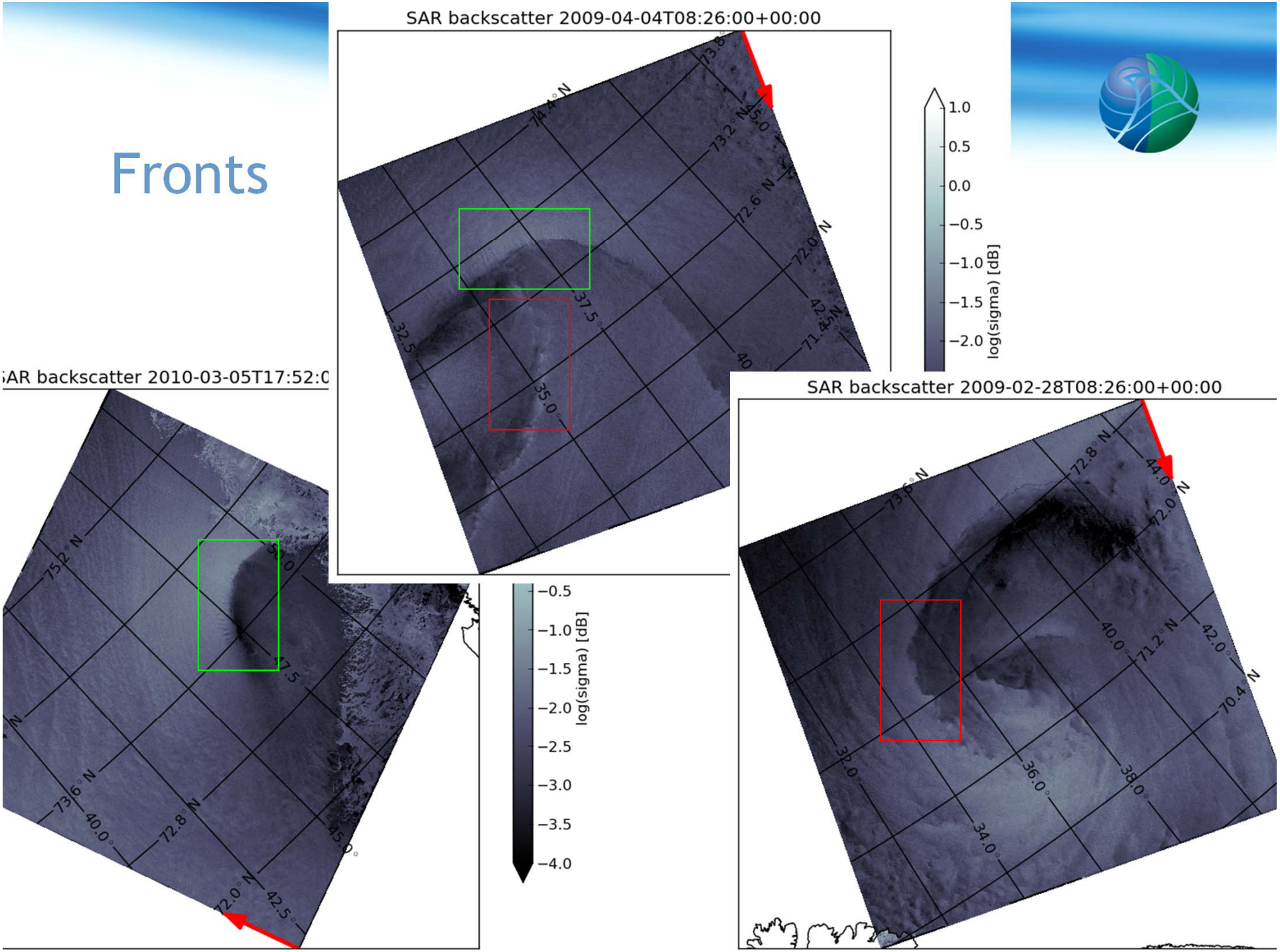


Distance ~ 5 km
Frontal speed ~ 10 m/s

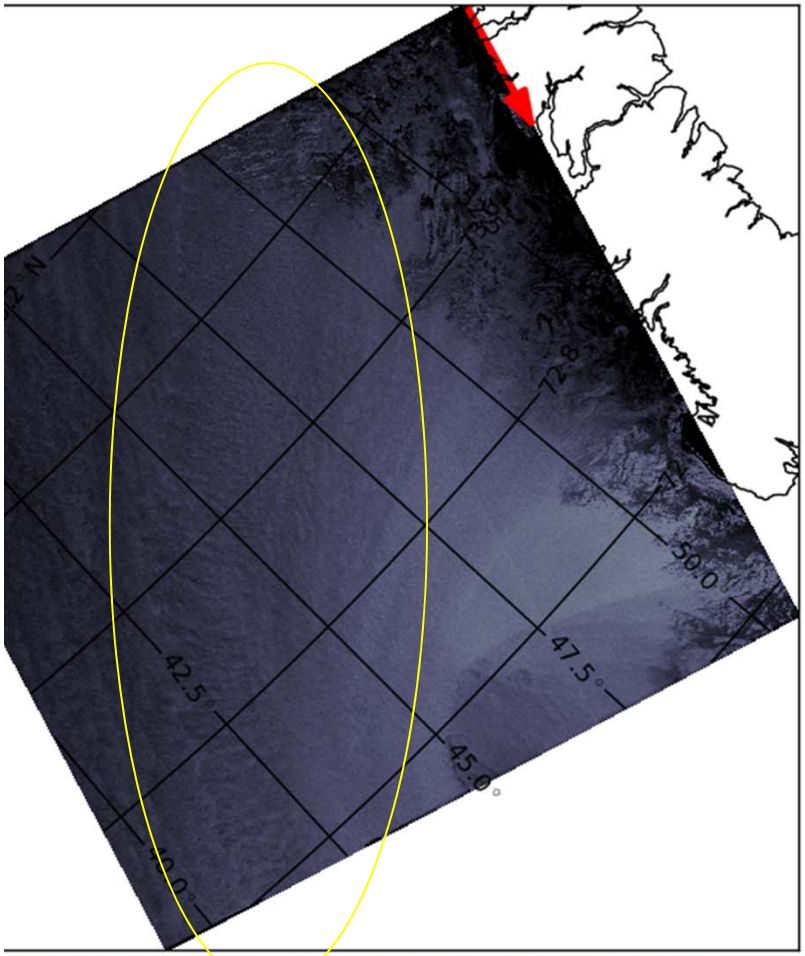
Increase in 7 minutes !

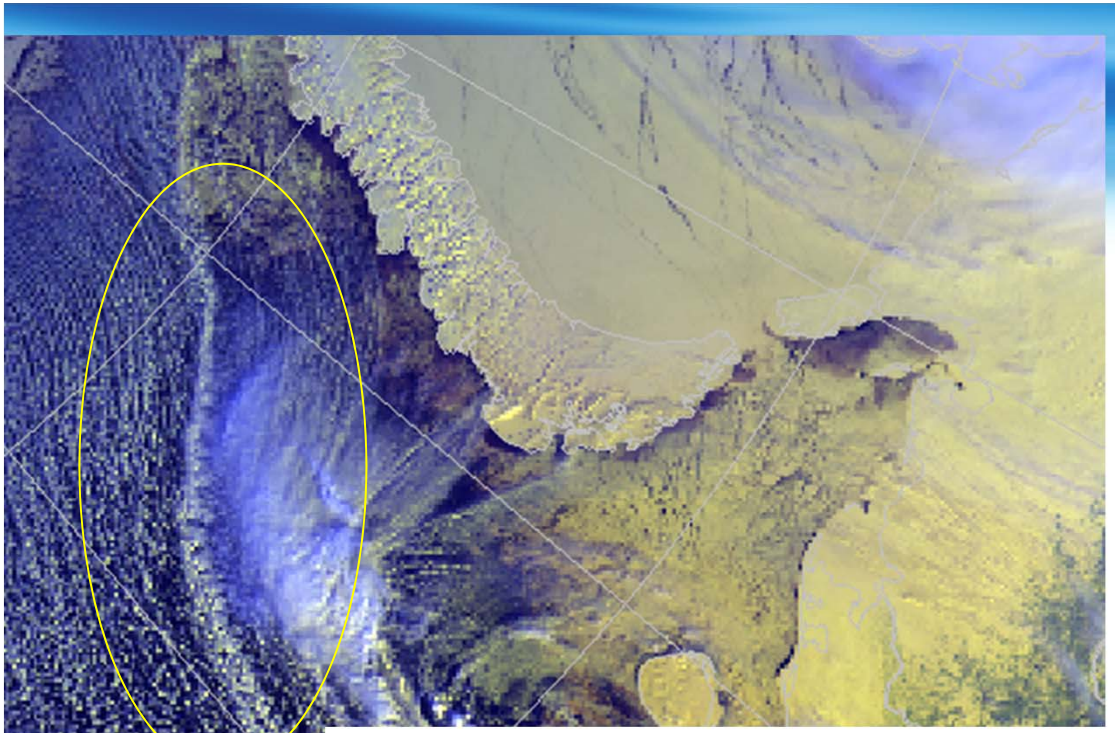
Features

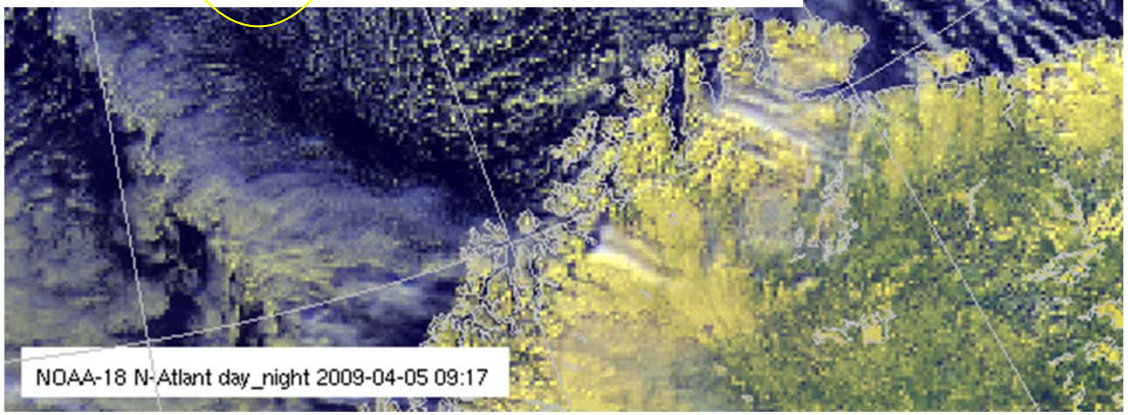
Fronts


SAR backscatter 2009-04-04T08:26:00+00:00
SAR backscatter 2010-03-05T17:52:0
SAR backscatter 2009-02-28T08:26:00+00:00
log(sigma) [dB]
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
−2.5
−3.0
−3.5
−4.0

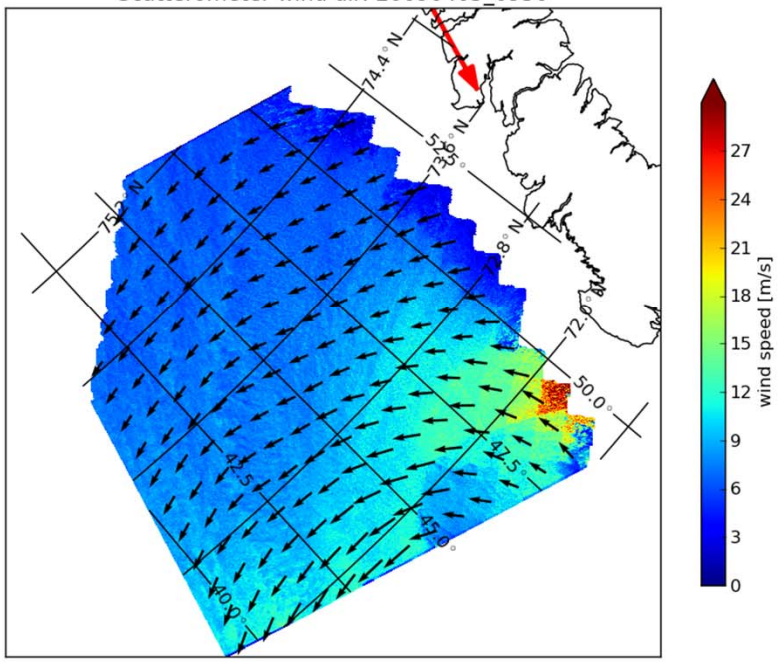
R backscatter 2009-04-05T07:54:00+00:00







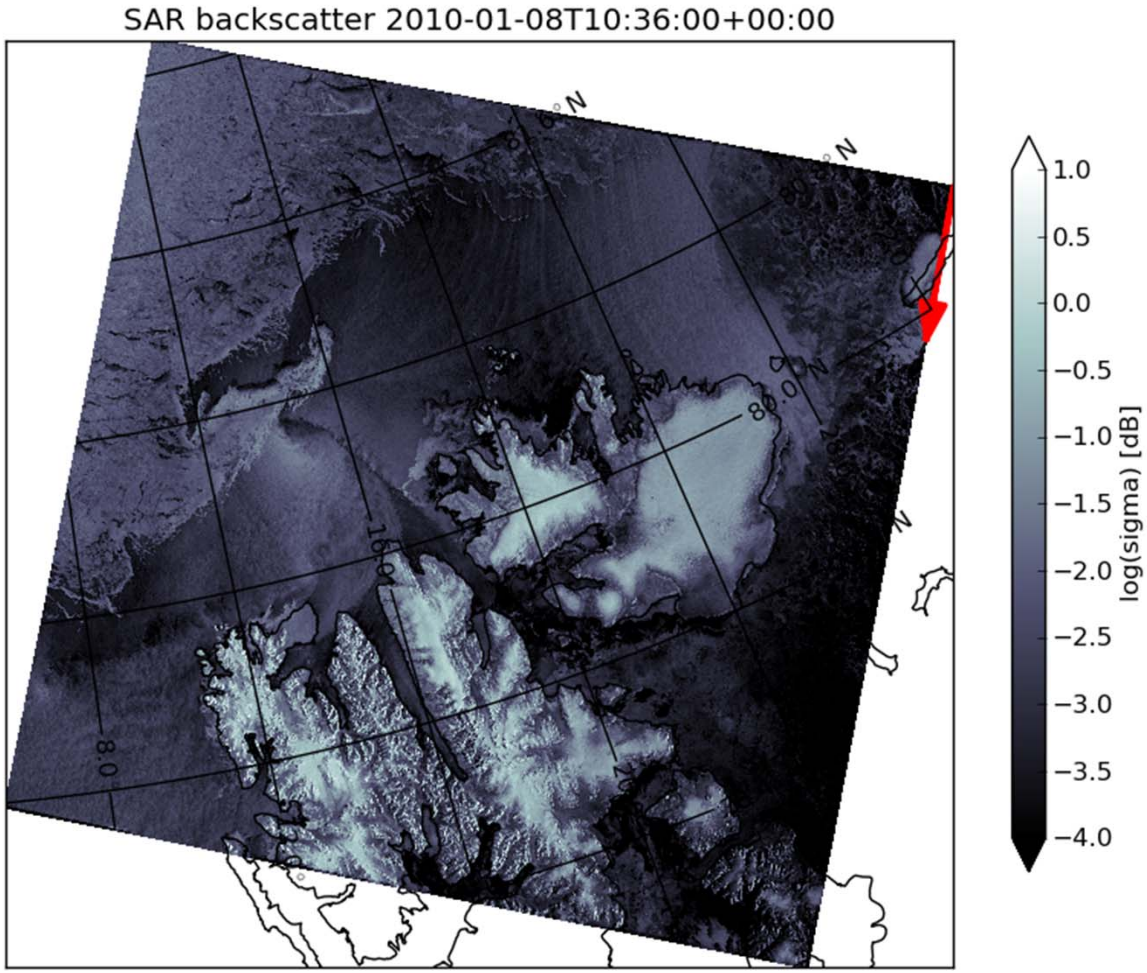
SAR wind speed 20090405_0754
Scatterometer wind dir: 20090405_0936



Summary: SAR imaging of Polar Lows

- Important supplement to existing observational data
  - Excellent source of information on surface wind pattern
  - Absolute wind uncertain
  - Input wind direction maximum +/- 1 hour from SAR
- Imprints on the sea surface (as opposed to AVHRR)
  - Earlier detection ?
  - Polar low dissipation ?
- As of 2012 not sufficient coverage for operational use
  - Sentinel 1, 2 and 3 (2013-14)

Sea ice retreat: First polar low observed north of Svalbard



http://projects.met.no/stars/view_stars-dat.php

Foto: Gunnar Mellem