



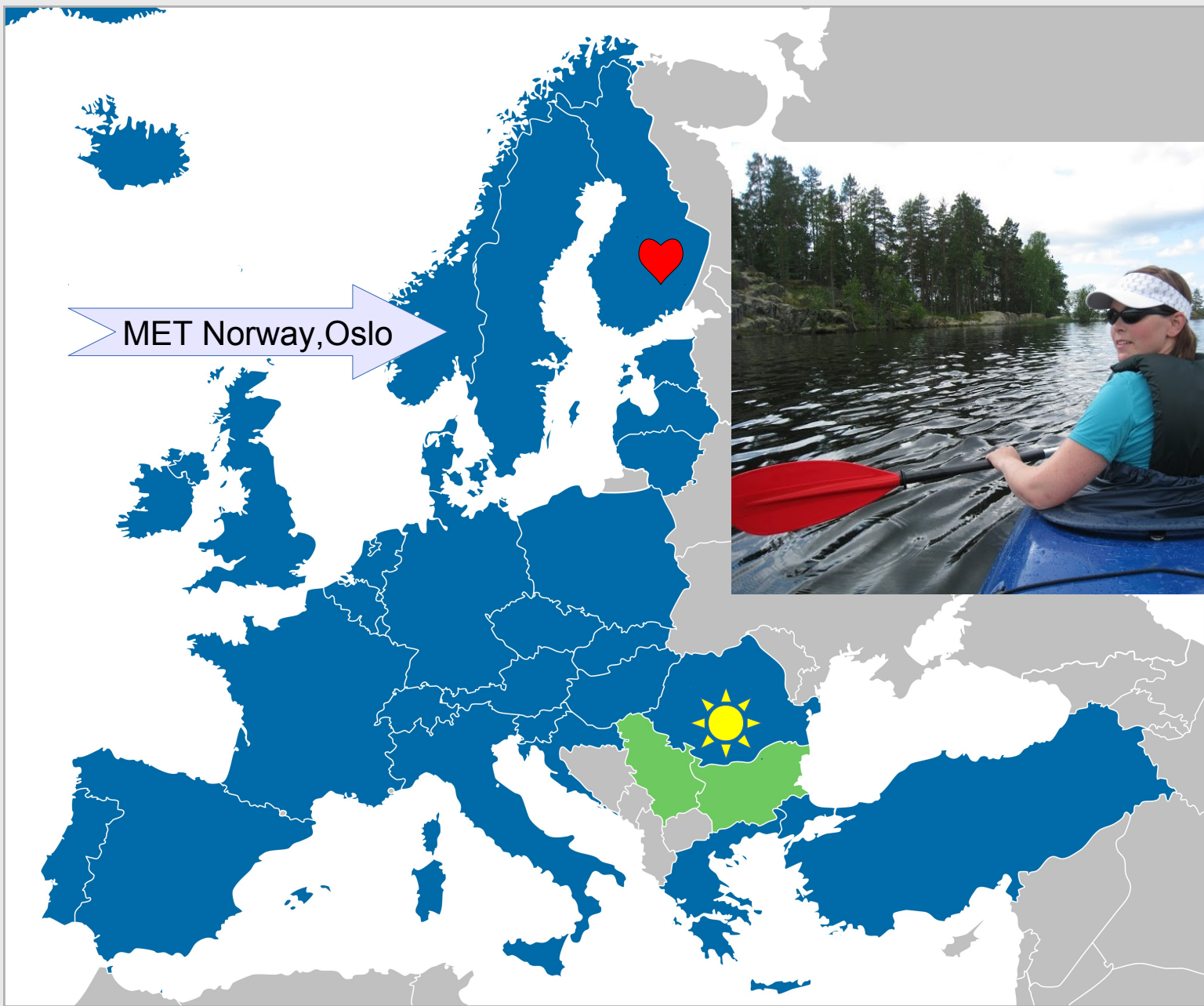
Norwegian
Meteorological
Institute

Scatterometer winds in rapidly developing storms (SCARASTO) – First experiments on data assimilation of scatterometer winds

Teresa Valkonen, EUMETSAT fellow

Norwegian Meteorological Institute

09/04/2014



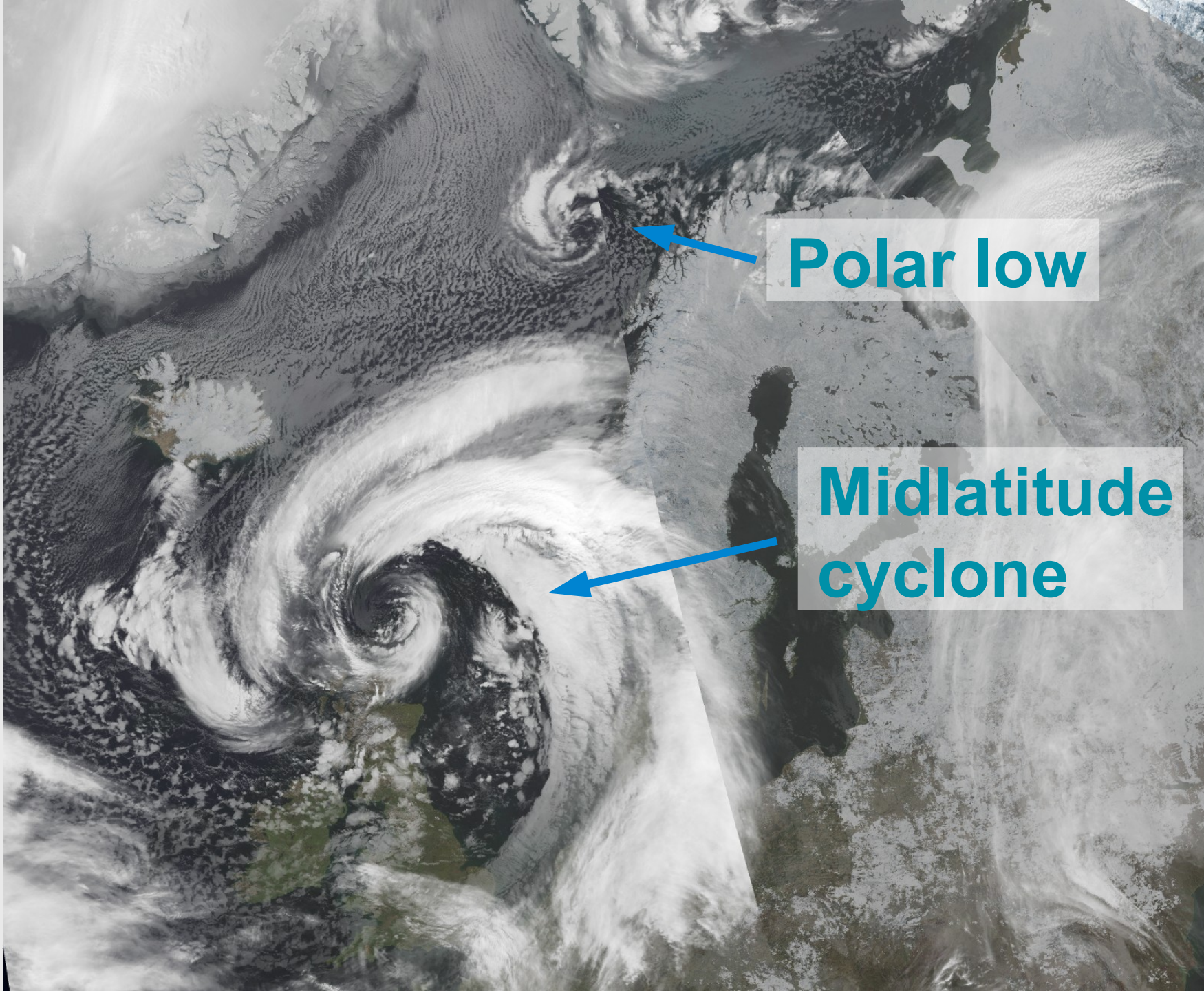
Outline

- Introduction:
 - SCARASTO project
 - Rapidly developing storms
 - Scatterometer winds
- Case study: Storm Hilde in November 2013
 - Data usage
 - Observation departures
 - Forecast impact
- Summary & outlook

SCARASTO – Scatterometer winds in rapidly developing storms



- EUMETSAT fellowship project, May 2013 – April 2016
- The project aims to take better benefit of scatterometer winds in the numerical weather prediction
- The goal of the project is to improve extreme weather forecasting by data assimilation of scatterometer winds

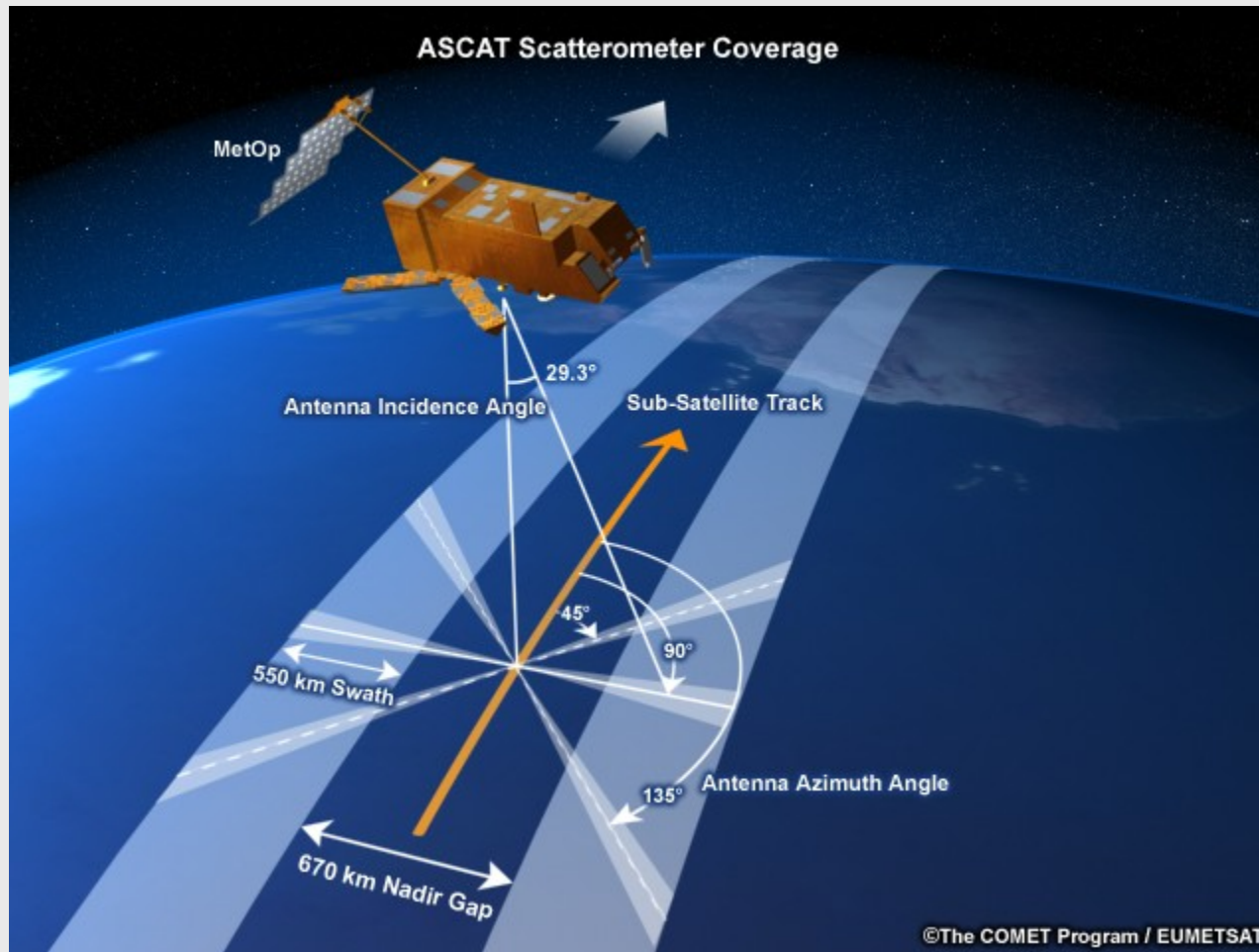


Polar low

**Midlatitude
cyclone**

Scatterometer winds

<http://www.youtube.com/watch?v=kdwWdLE-2el>



Questions

0) Is it possible to run HARMONIE with data assimilation of ASCAT winds?

1) Data usage:

What is the spatial and temporal ASCAT data coverage in the domain used in Norway? Does the wind ambiguity selection work properly, specially close to the fronts?

2) Observation departures:

How are the ASCAT winds compared to the model forecasts (background) and the analysis (initial state)?

3) Forecast impact:

Do ASCAT winds have an impact on the forecast?

Case study: Storm Hilde

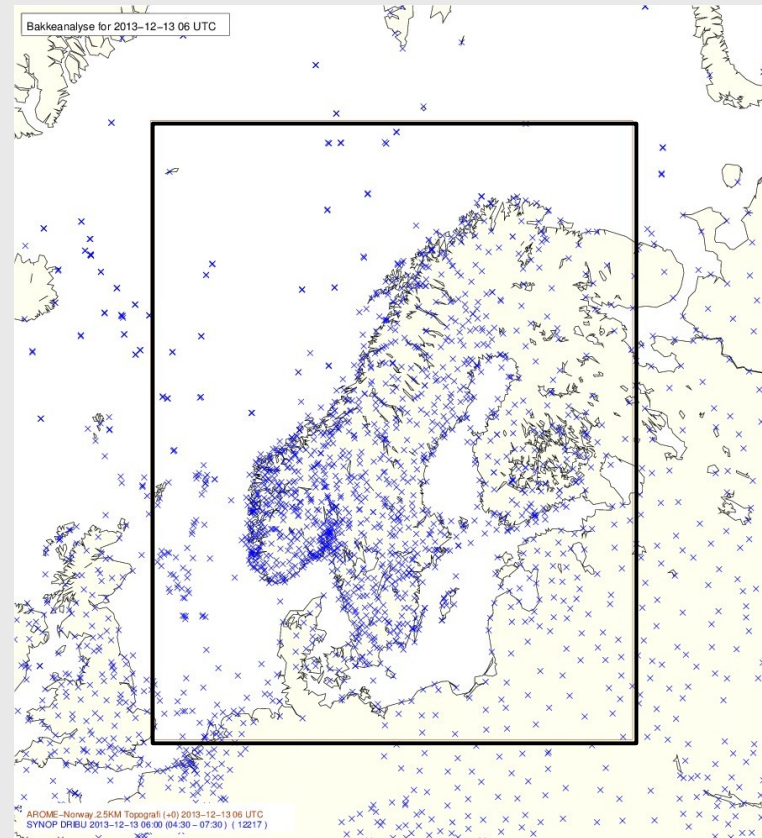
- Strong low pressure system that hit Norway 16-17/11/2013. Continued over Sweden and Finland (called Eino).



Pictures:NRK

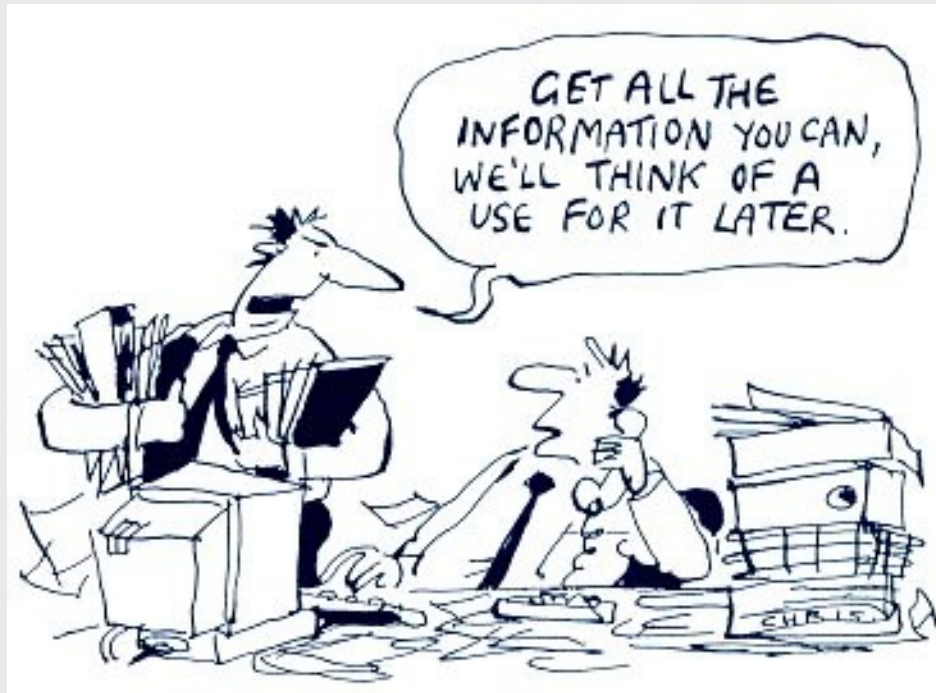
Experimental setup

- 1-week period 11/11/2013 – 18/11/2013
- HARMONIE 37h1.2
- METCOOP25B domain
- Grid size 2.5 km
- ECMWF forecast used at boundaries
- 3-hour assimilation cycle
- 2 experiments:
 - ExpASCAT
(3DVar – CONV + ASCAT)
 - ExpCONV
(3DVar – CONV)



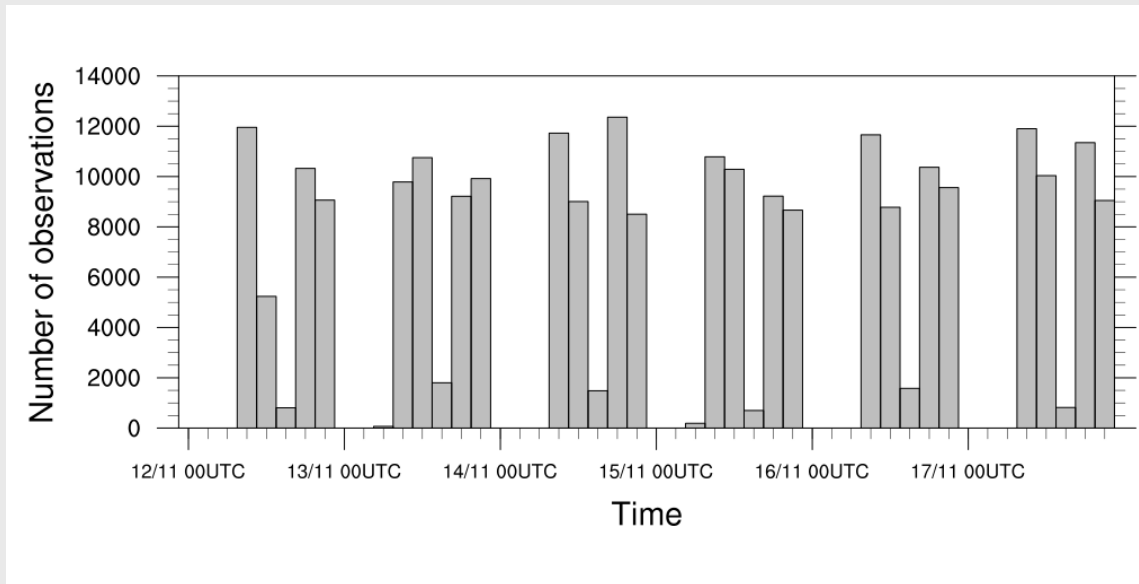
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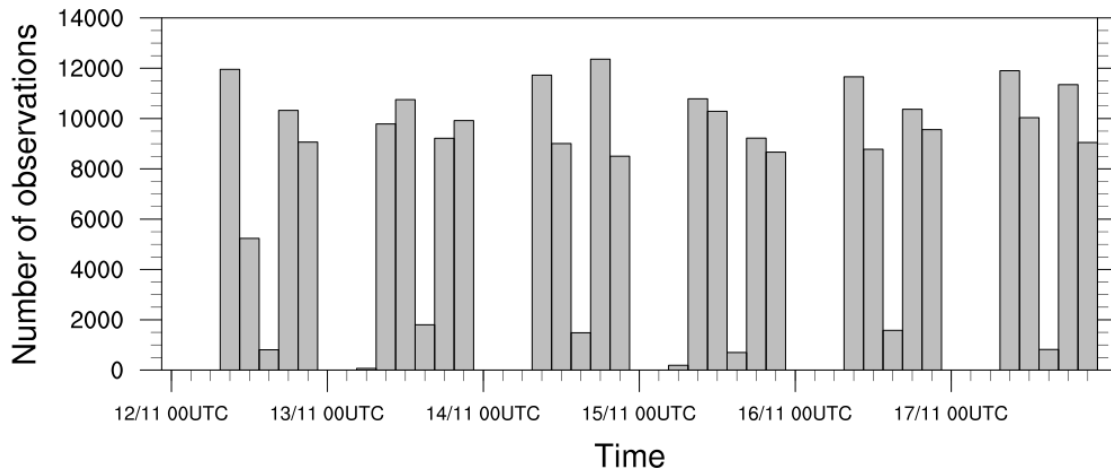
1) Data usage

ASCAT
data in



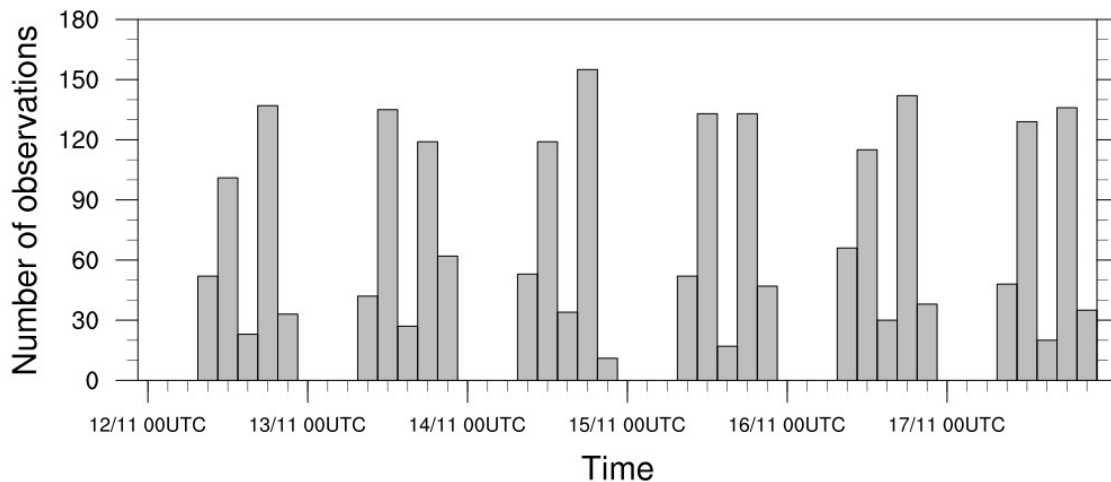
1) Data usage

ASCAT
data in



About 1 %
of data
is used

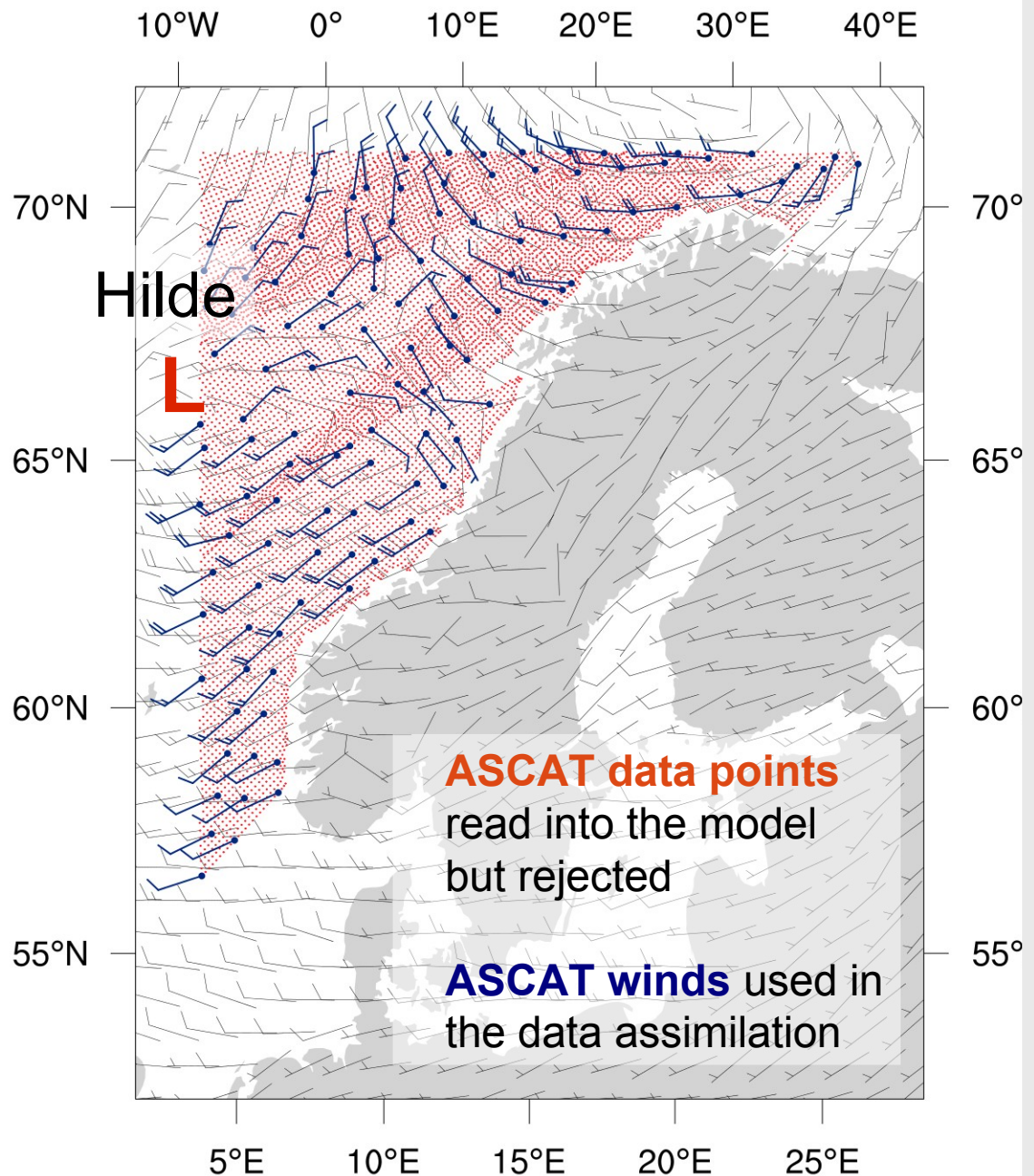
ASCAT
data
used



Good coverage
during day.
No data at
00, 03 &
06 UTC!

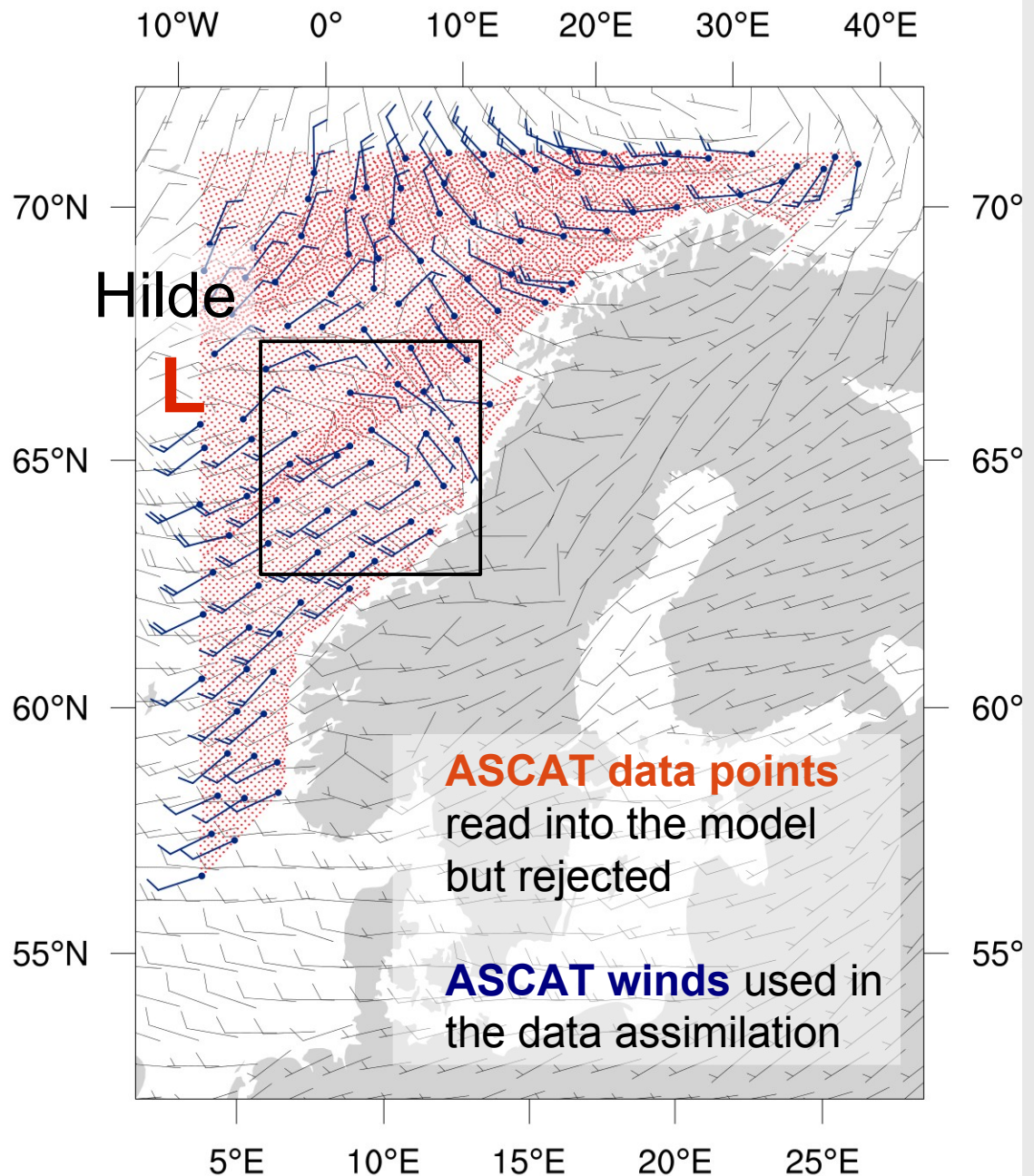
1) Data usage

- Data thinning by factor of 4 is performed to avoid correlated errors.
- Data rejection close to the storm core
- Individual ambiguity selection problems

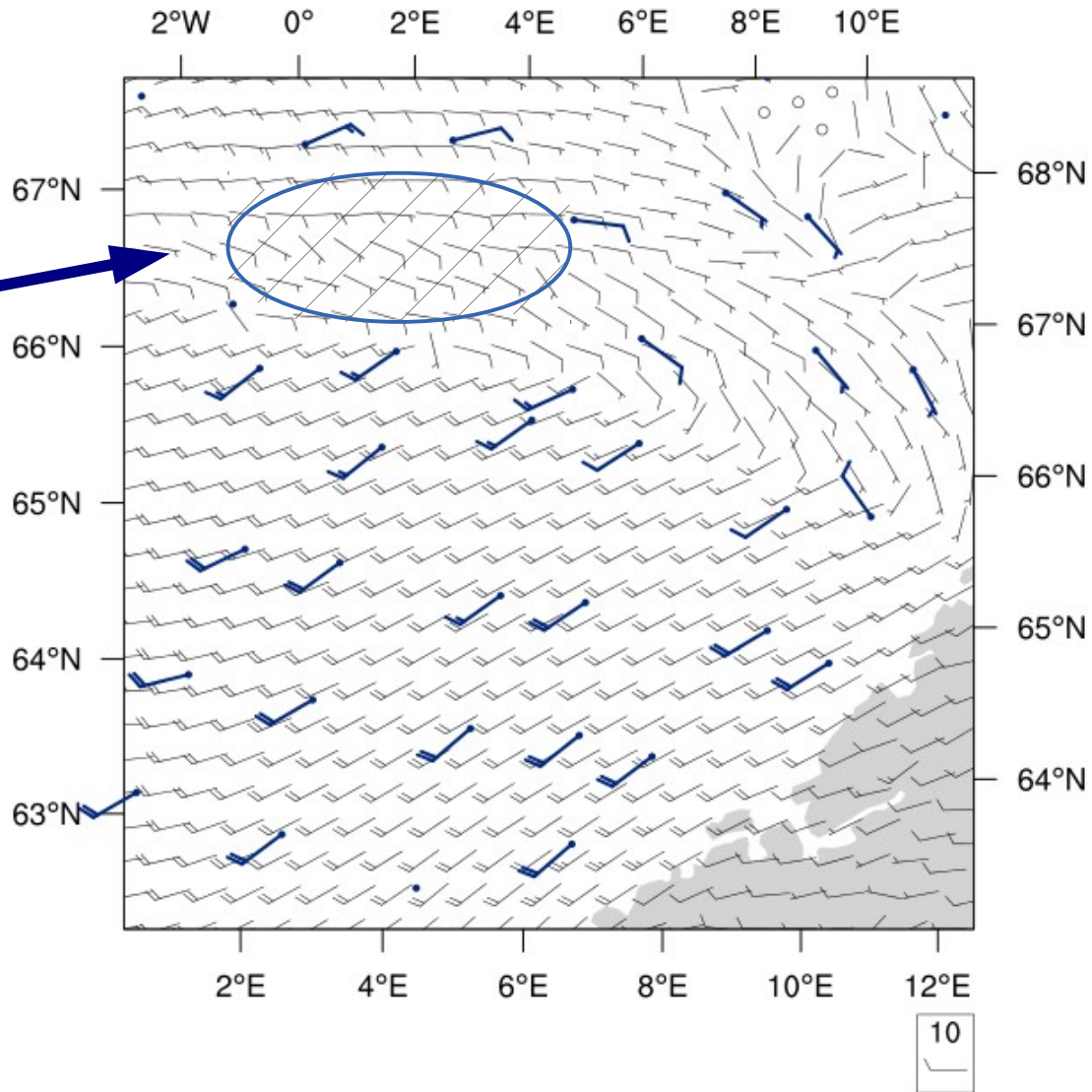


1) Data usage

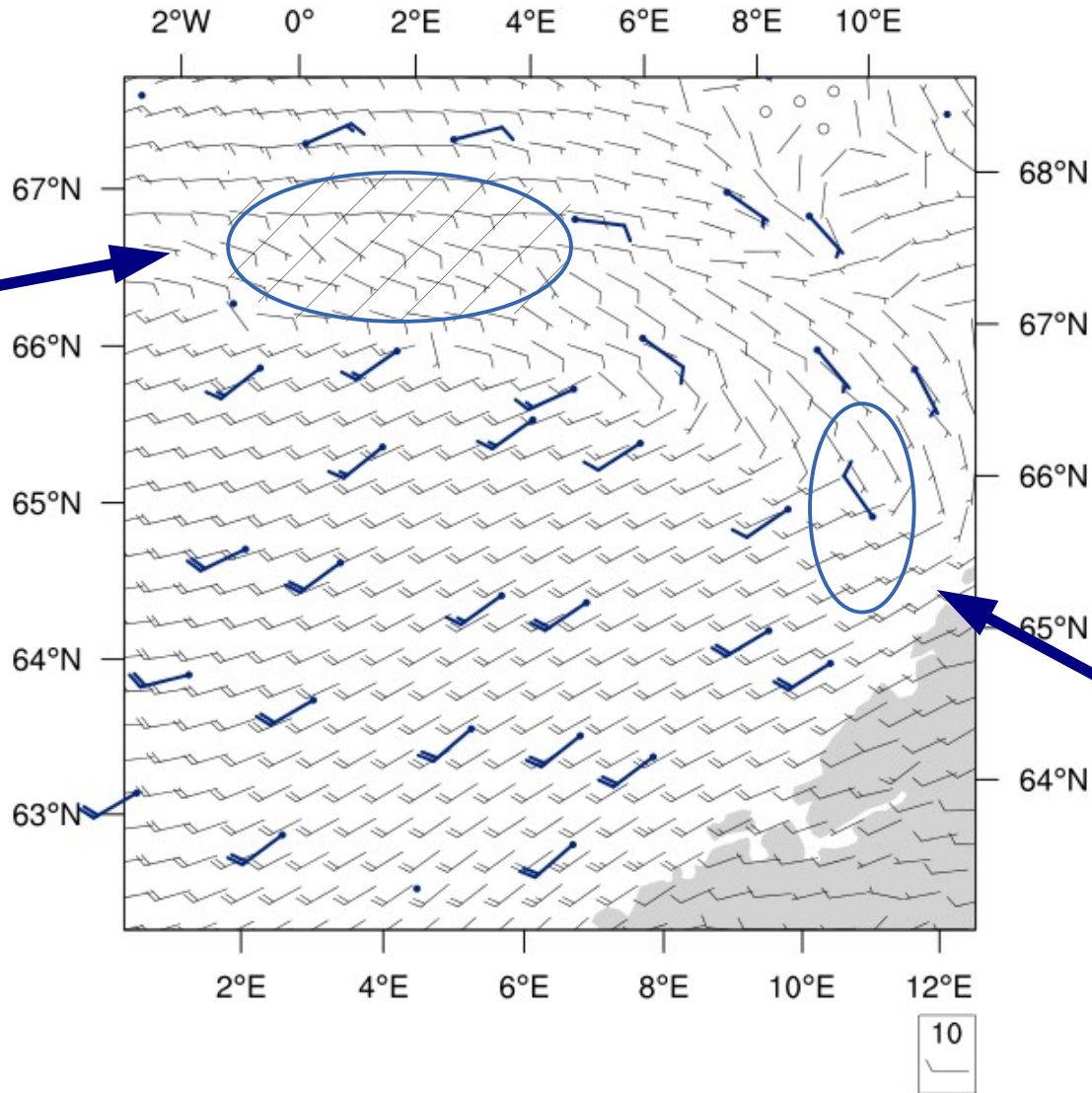
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- Individual ambiguity selection problems



Data rejection close to the storm core



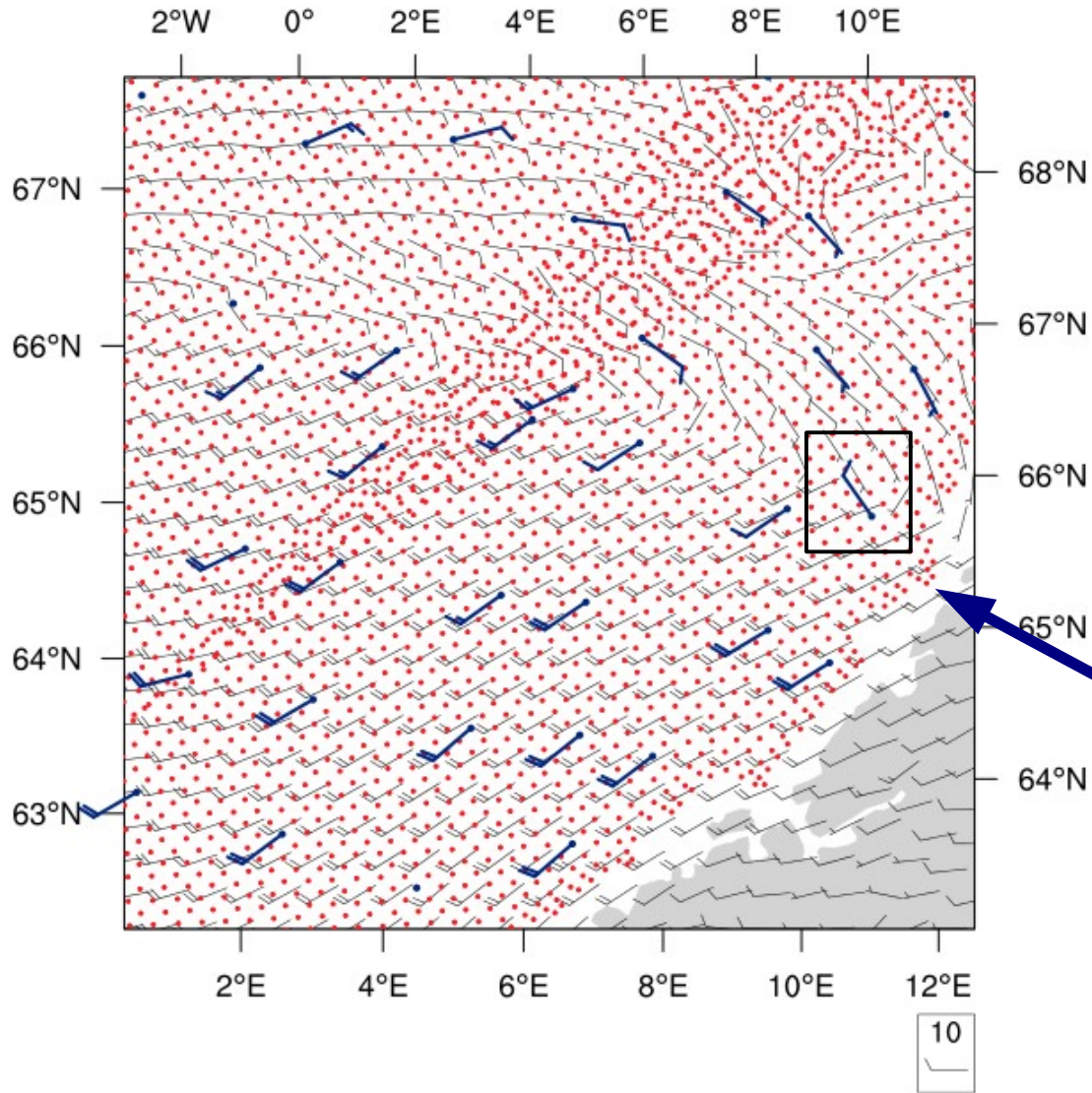
Data rejection close to the storm core



Individual ambiguity selection problems

ASCAT data points read into the model but rejected

ASCAT winds used in the data assimilation

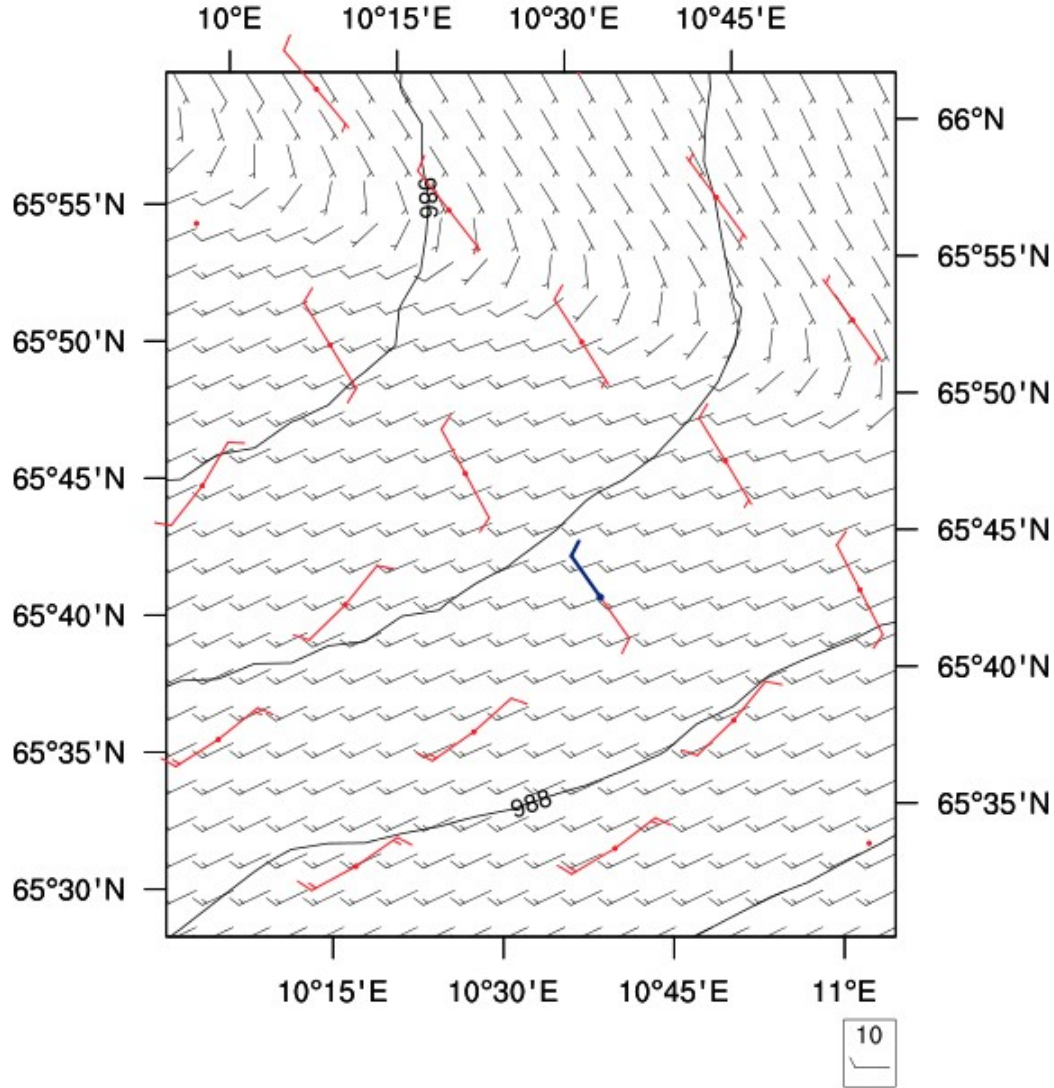


Zoom into the ambiguity selection problem

ASCAT winds
read into the
model but
rejected

ASCAT winds
used in the
data
assimilation

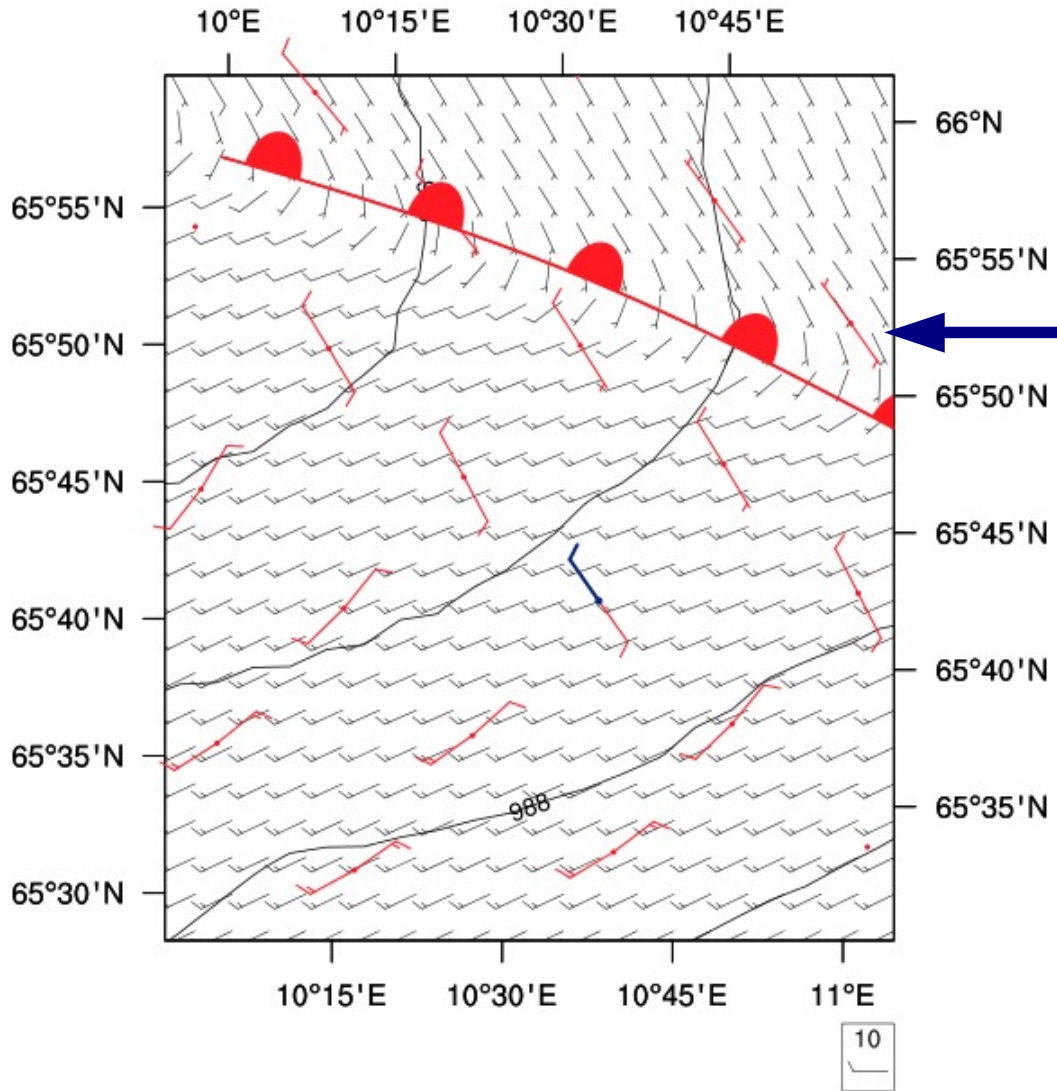
Black wind
arrows
Harmonie
winds in full
resolution



ASCAT winds
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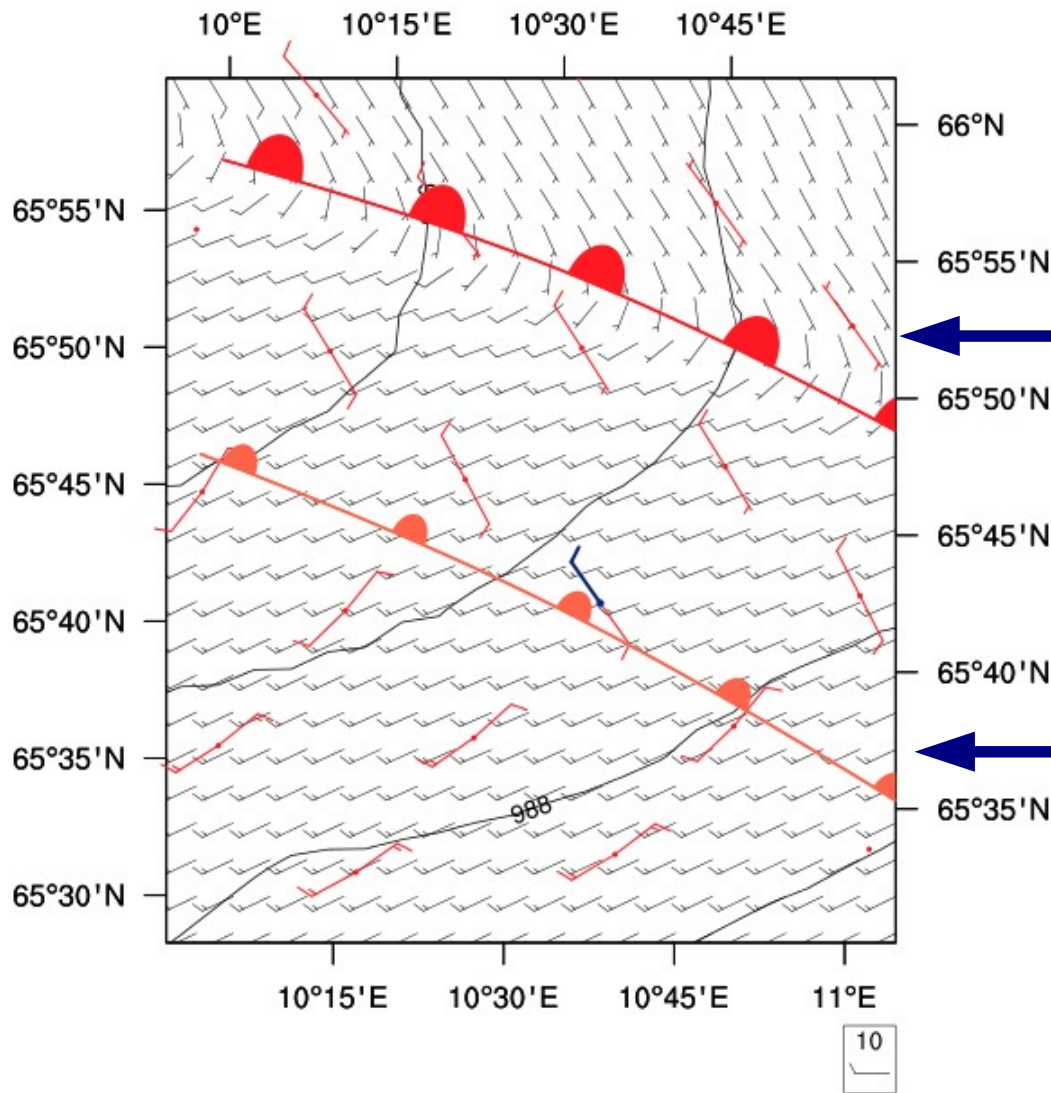


Warm front in
Harmonie

ASCAT winds
read into the
model but
rejected

ASCAT winds
used in the
data
assimilation

Black wind
arrows
Harmonie
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Warm front in
Harmonie

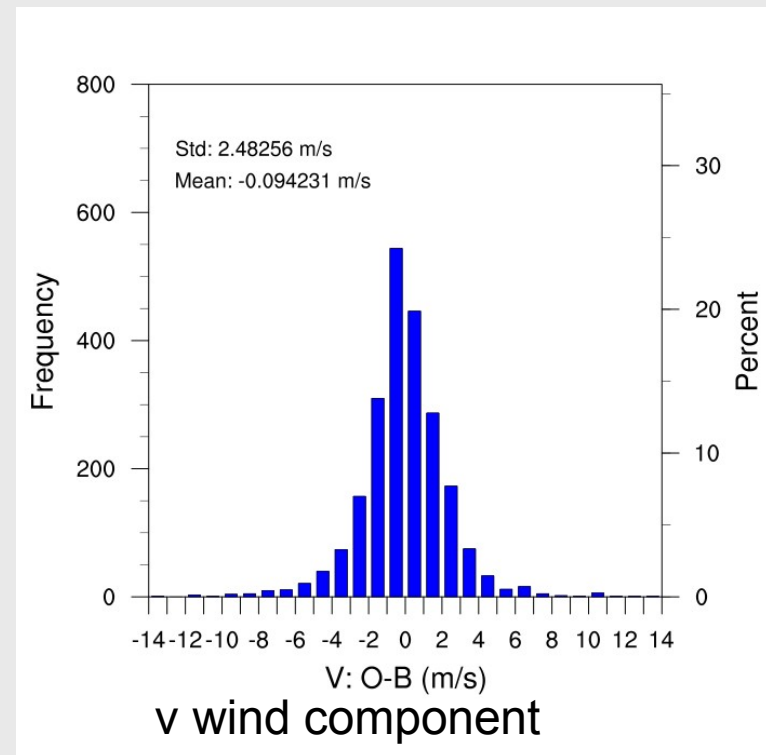
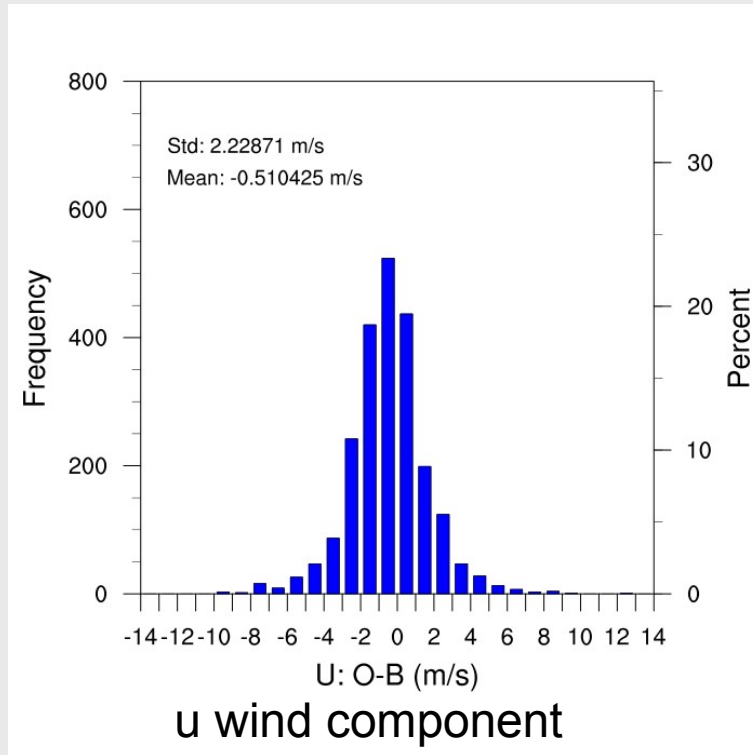
Warm front of
ASCAT winds

2) Observation departures

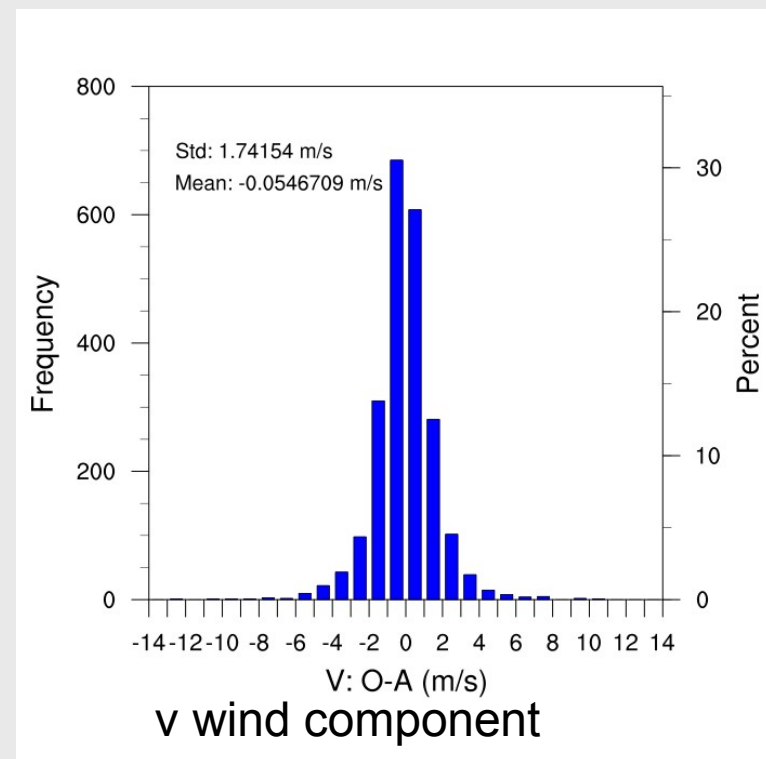
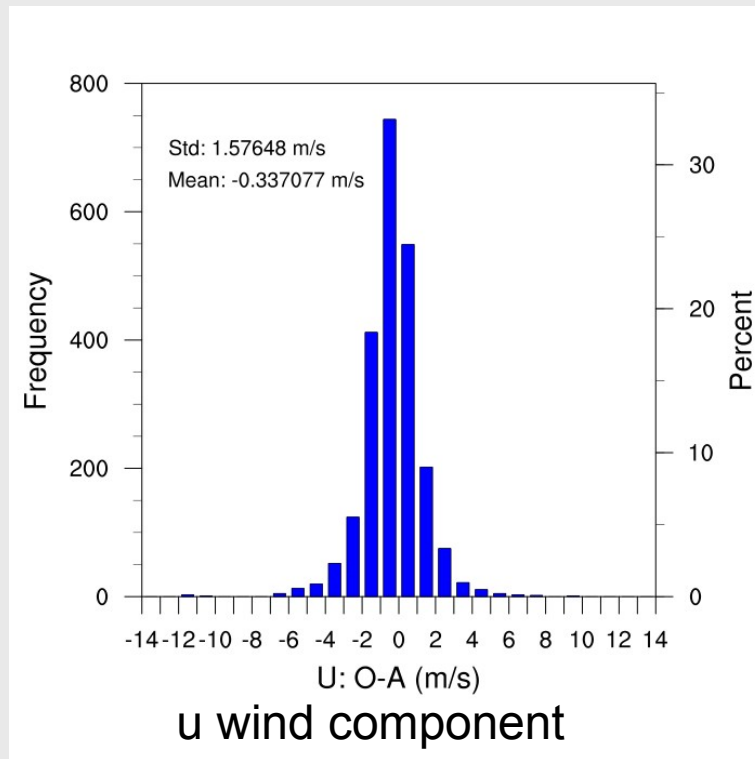
How are the ASCAT winds compared to the model forecasts (background) and the analysis?



2) Observation departures



2) Observation departures



- The standard deviation of the analysis departure is here approximately 30 % smaller than the background departure
- The analysis has been changed closer to the ASCAT wind retrieval
- The standard deviation of background (2.2 m/s, 2.5 m/s) is higher than the observation error set in the system (2.0 m/s)

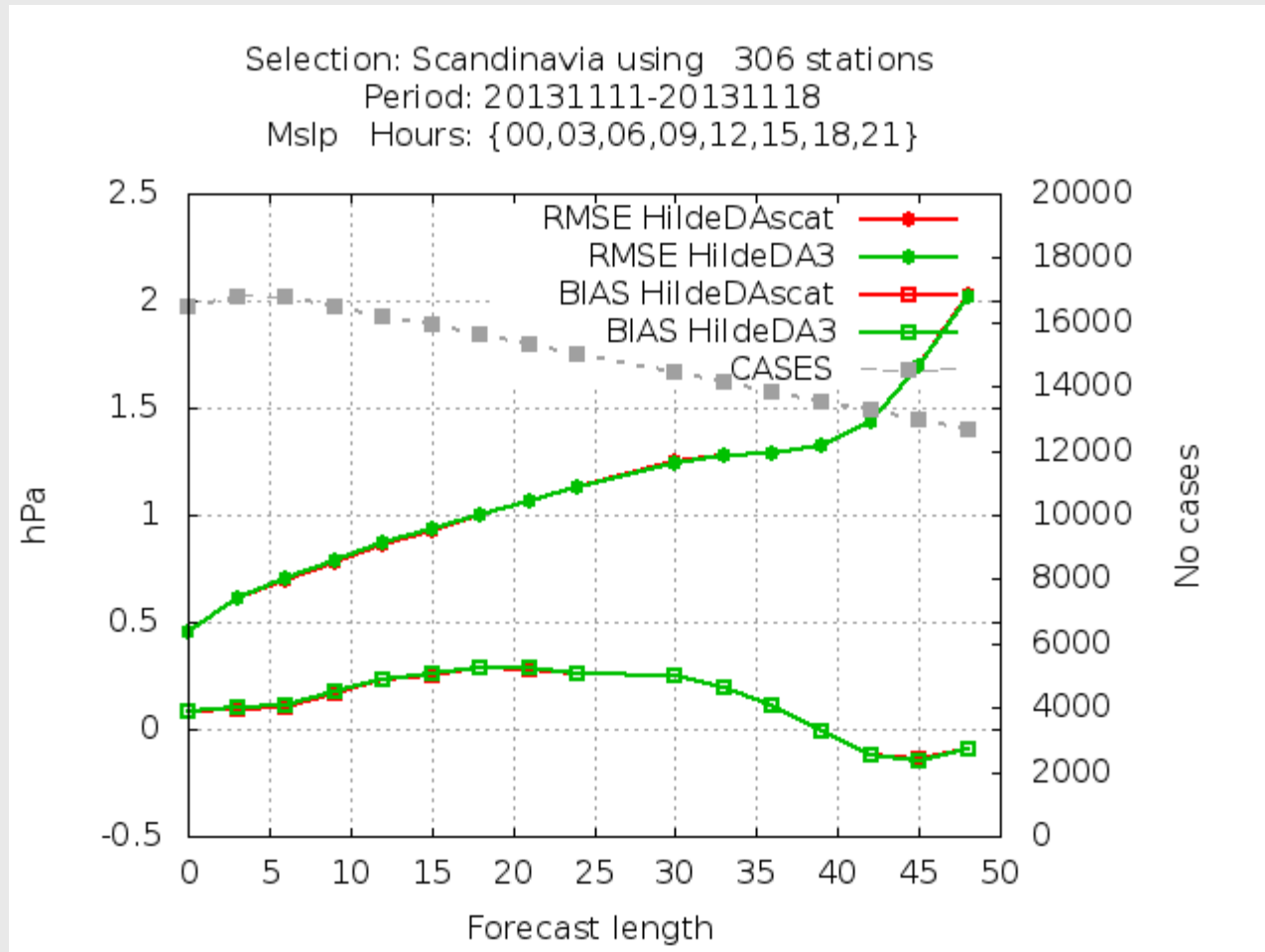
3) Forecast impact

Do ASCAT winds have an impact on the forecast?



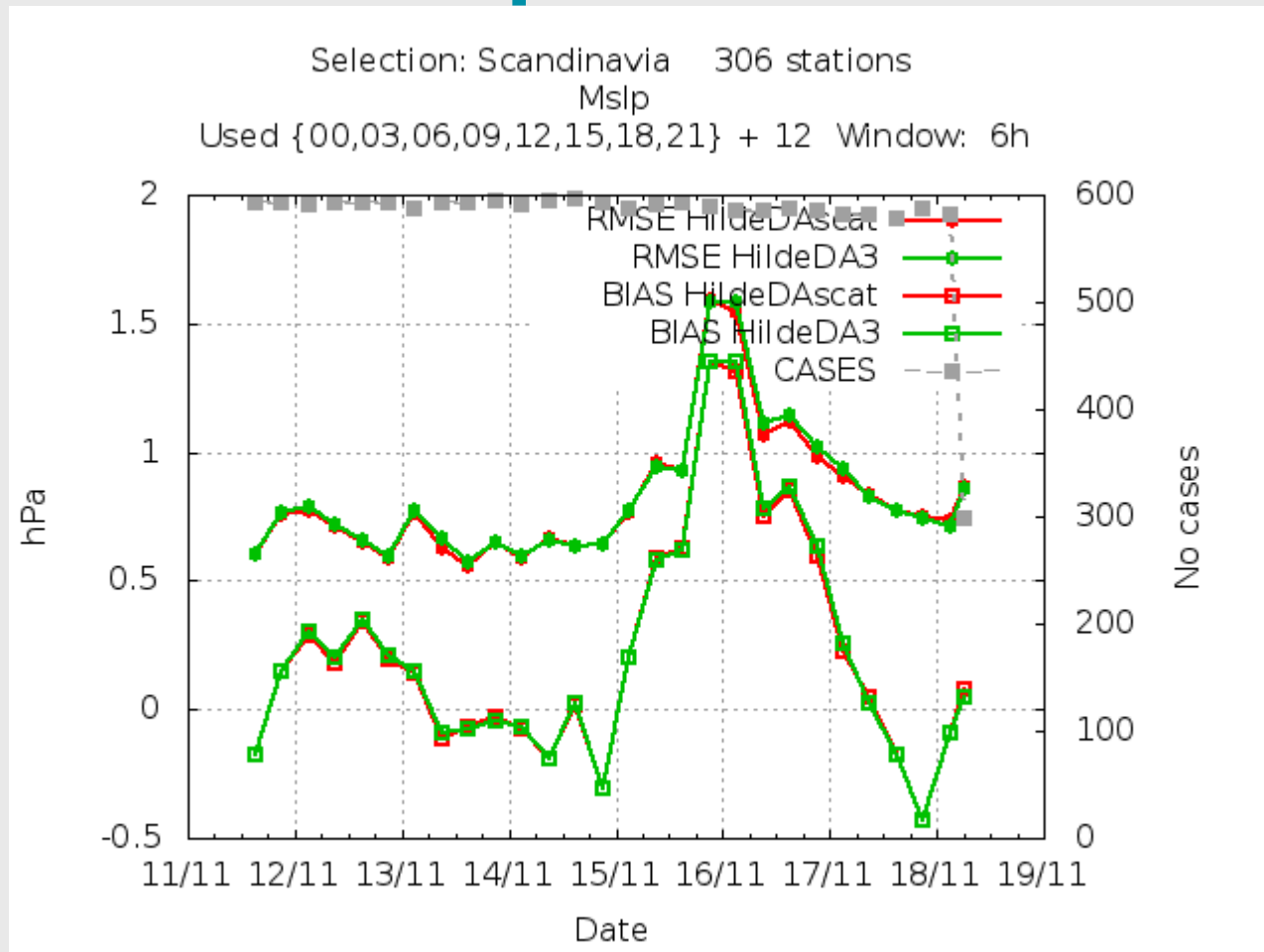
3) Forecast impact: SYNOP

Mean sea level pressure



Assimilation of scatterometer winds cannot show an impact here!

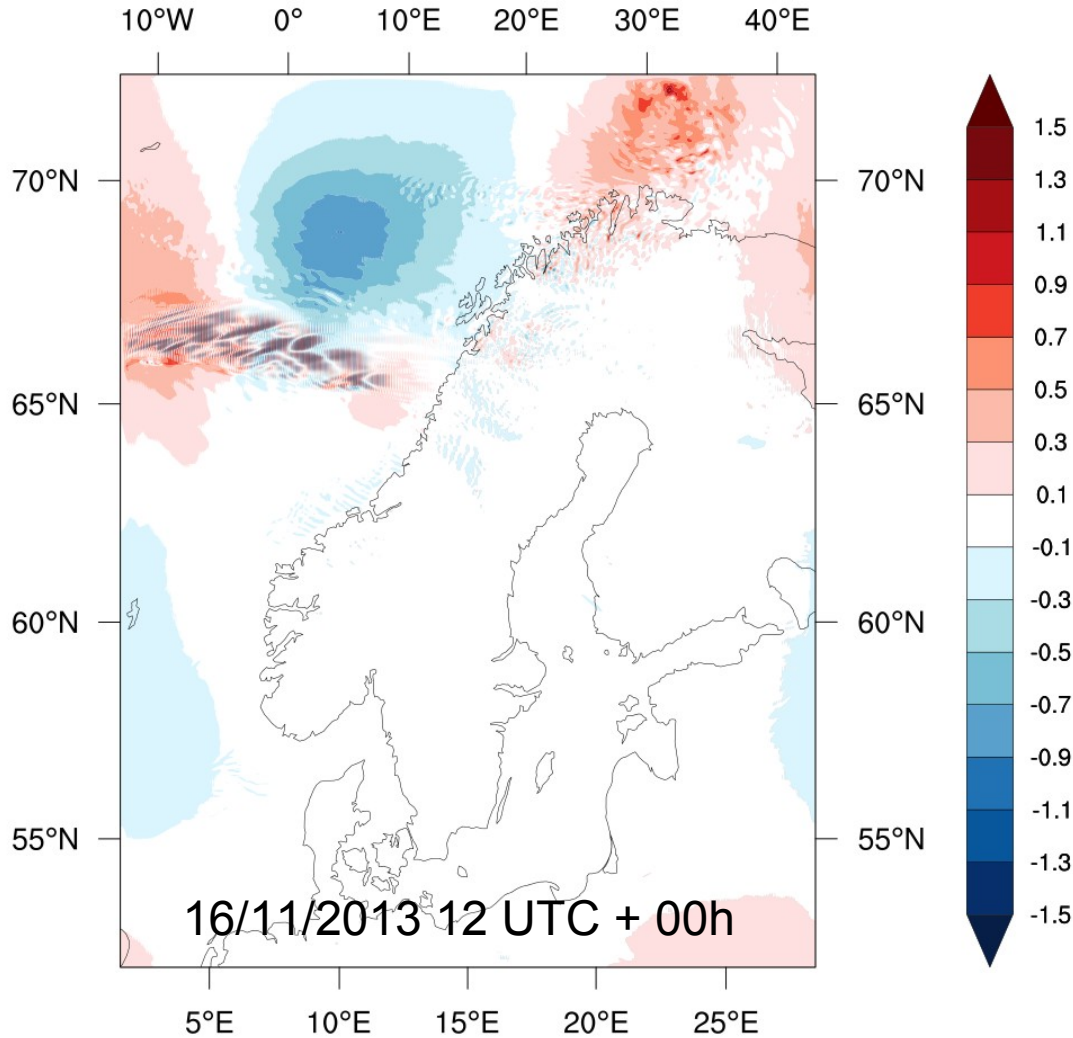
3) Forecast impact: time series



There is a weak positive signal in RMSE and bias during the most intense development of the storm.

3) Forecast impact

Mean sea level pressure: ExpConv - ExpASCAT

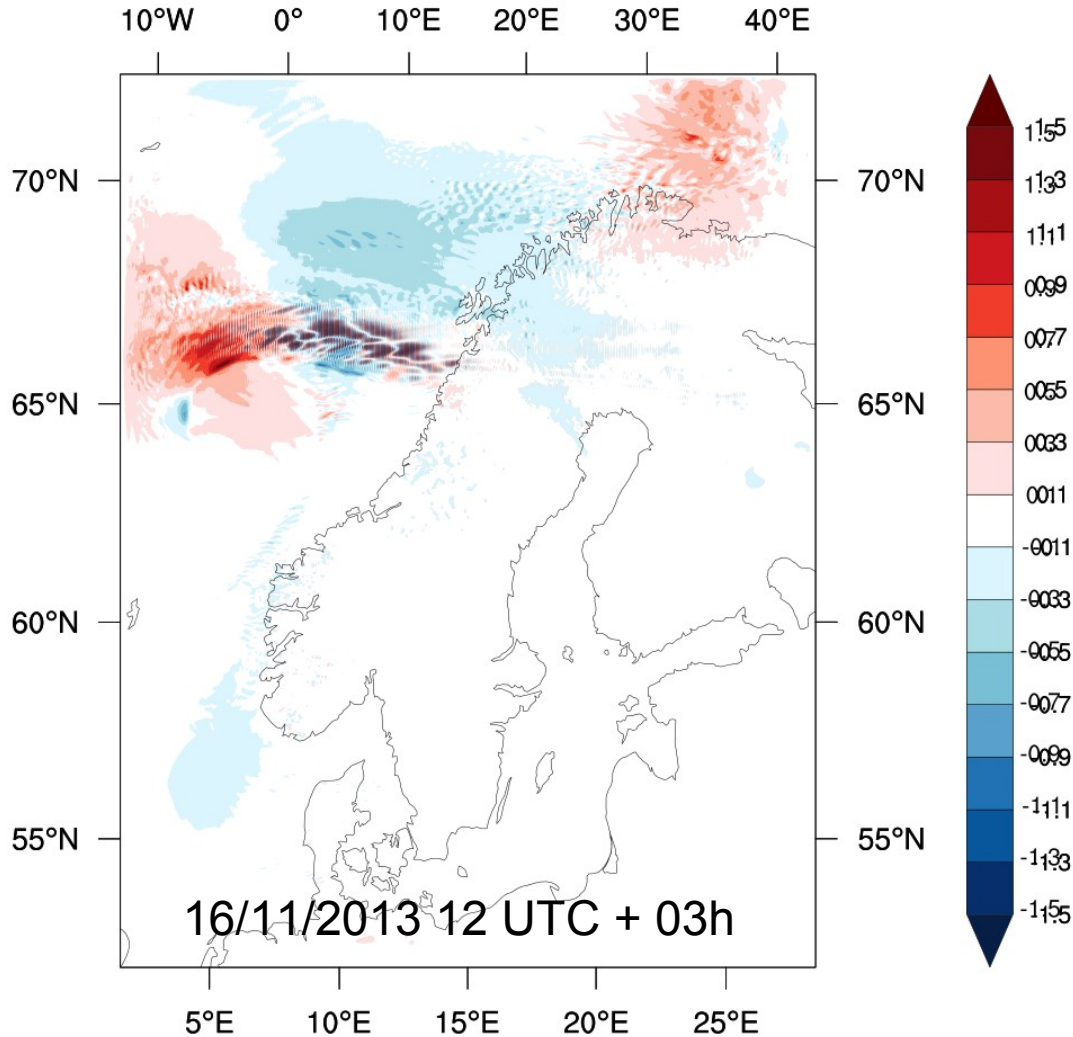


Higher pressures
in ExpASCAT

Lower pressures
in ExpASCAT

3) Forecast impact

Mean sea level pressure: ExpConv - ExpASCAT

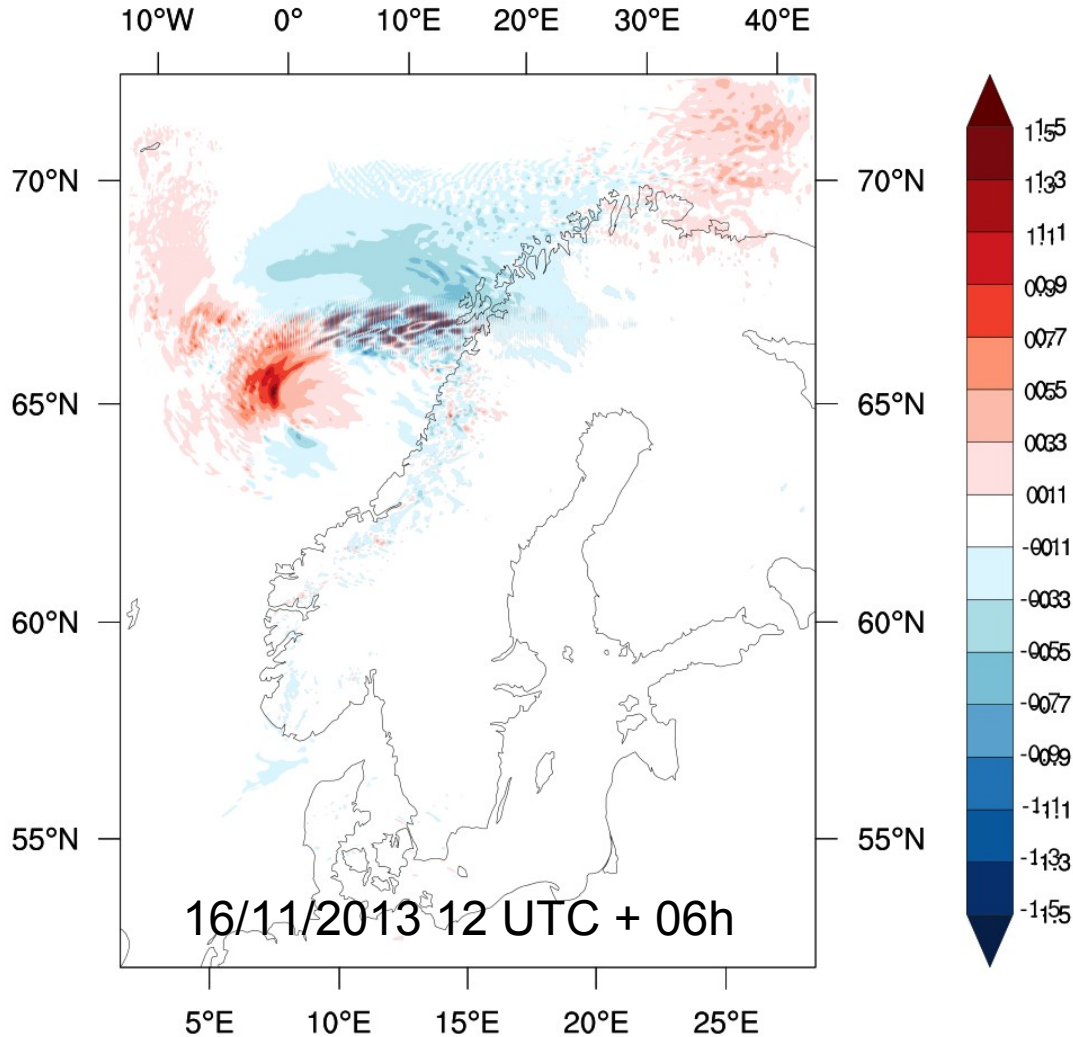


Higher pressures
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Lower pressures
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3) Forecast impact

Mean sea level pressure: ExpConv - ExpASCAT

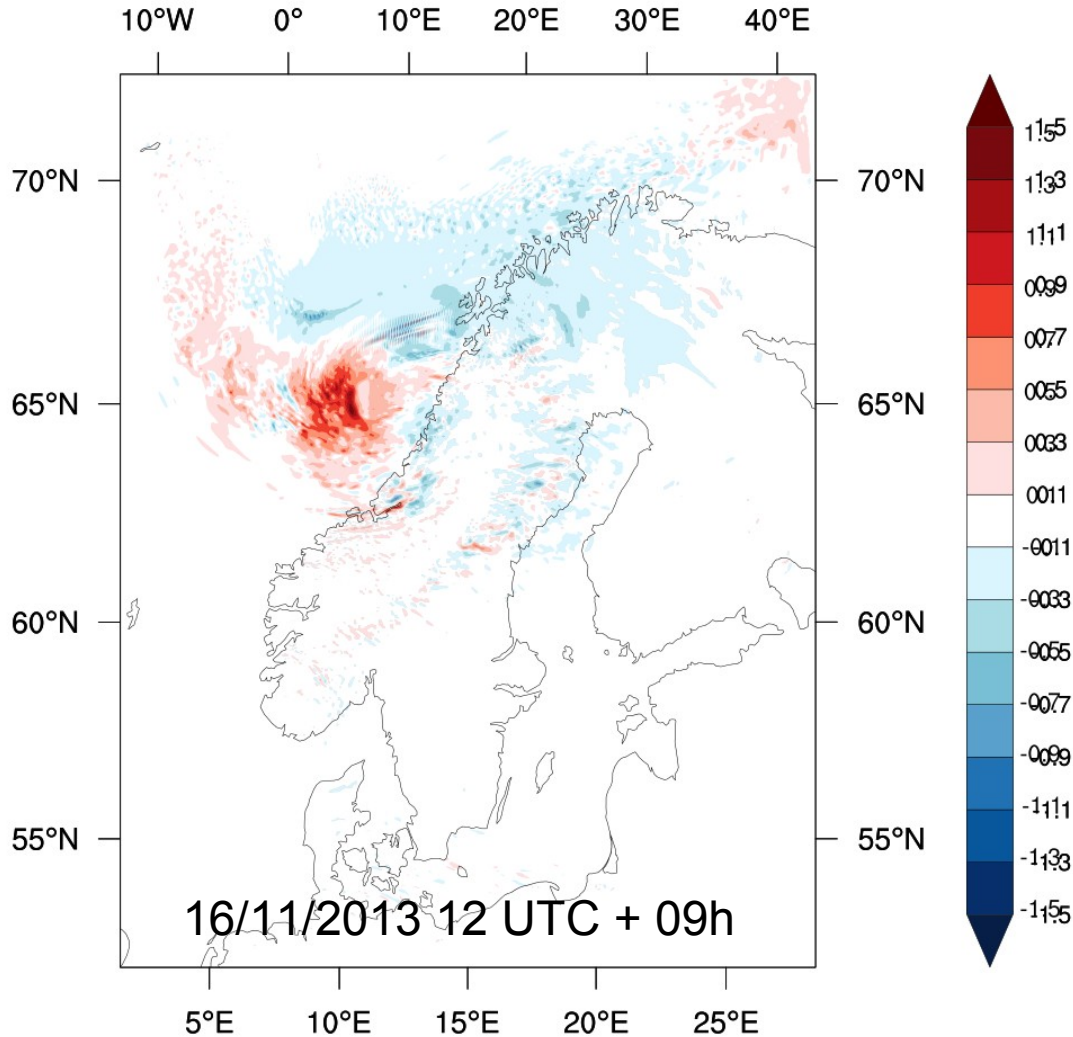


Higher pressures
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Lower pressures
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3) Forecast impact

Mean sea level pressure: ExpConv - ExpASCAT

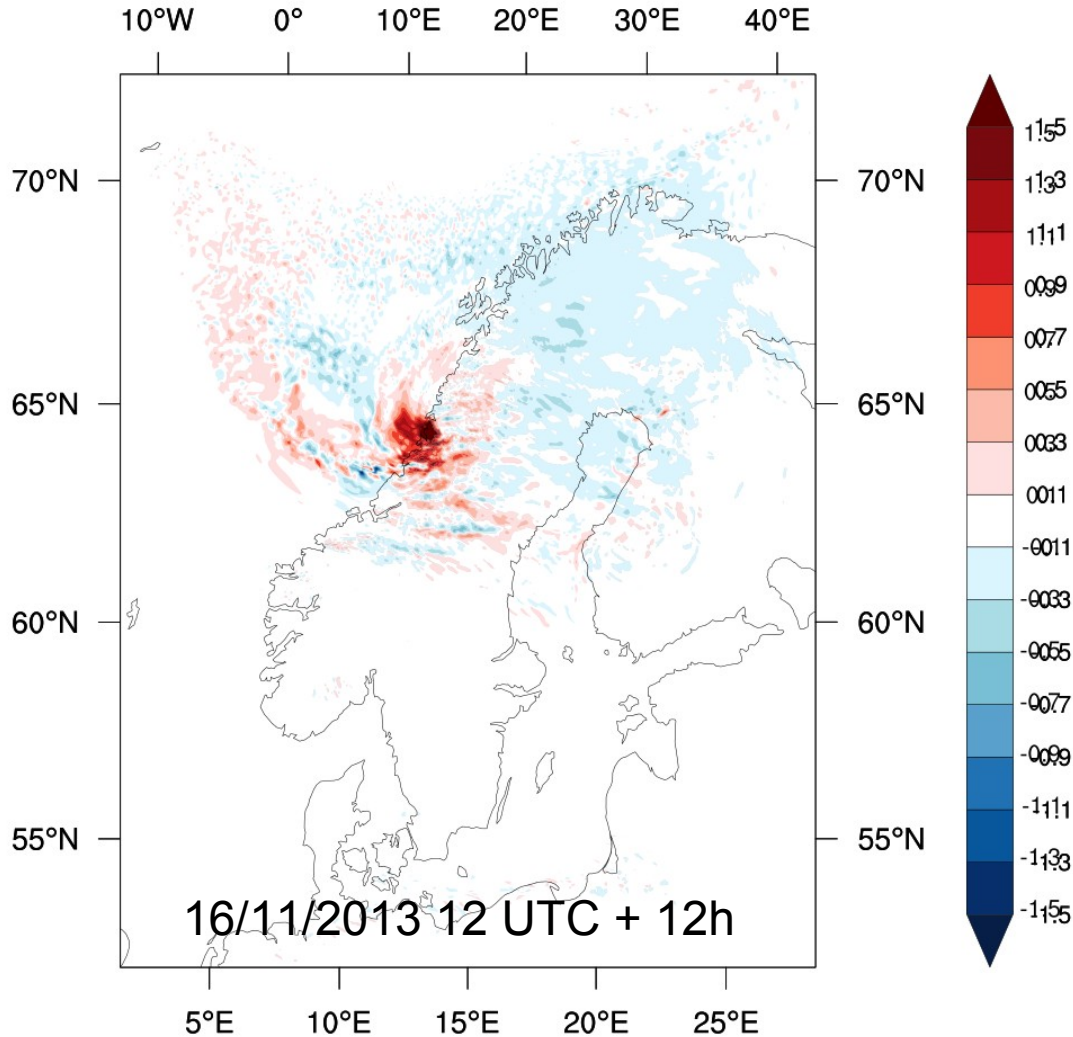


Higher pressures
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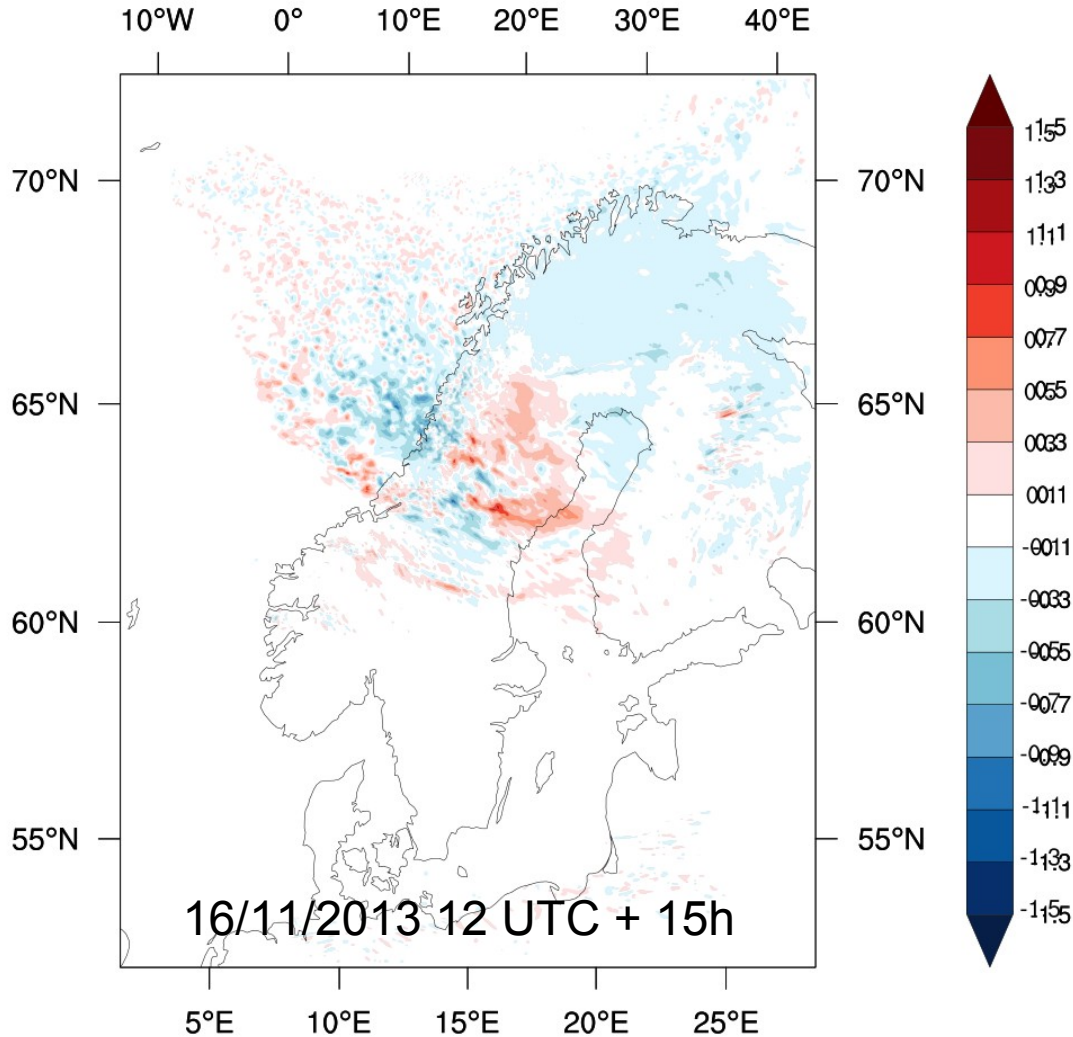


Higher pressures
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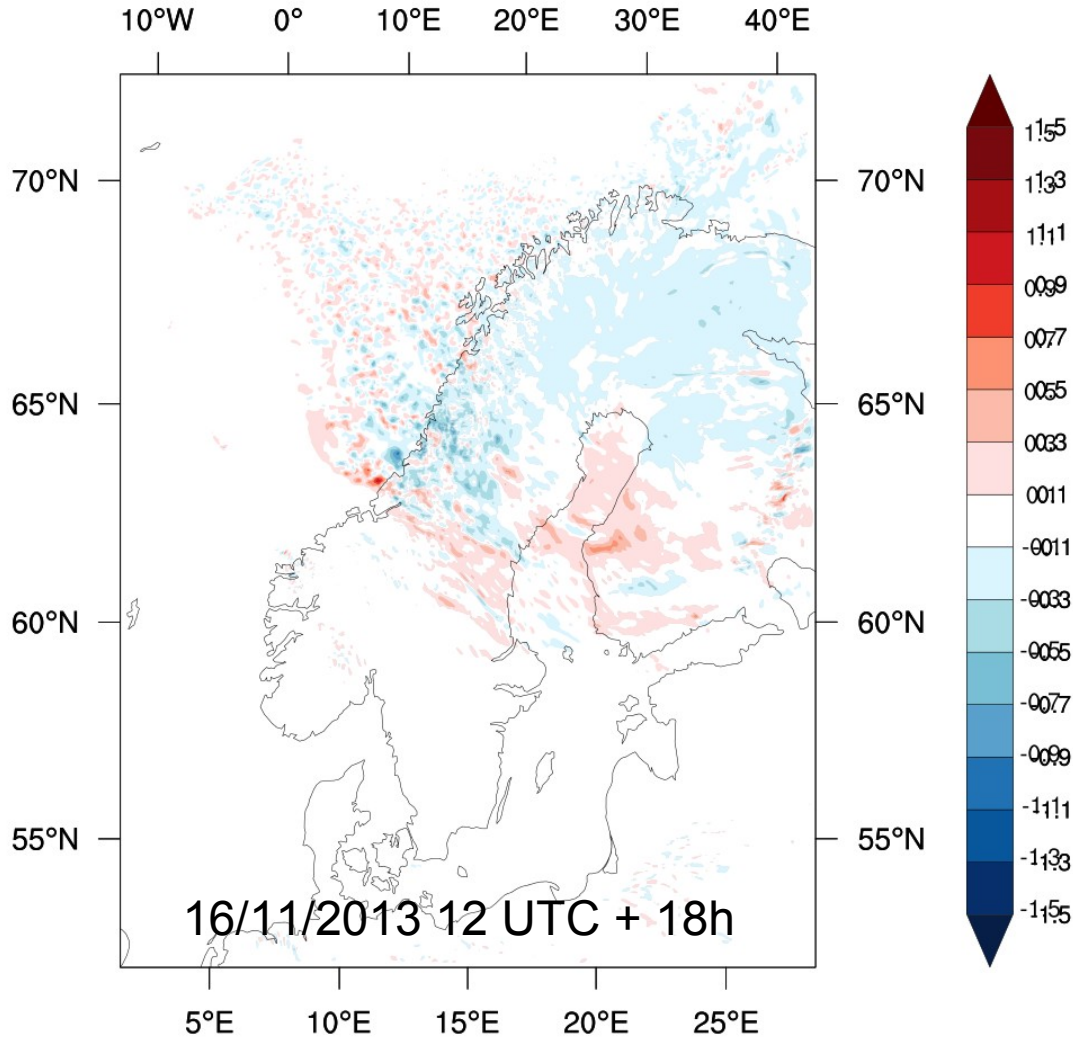


Higher pressures
in ExpASCAT

Lower pressures
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3) Forecast impact

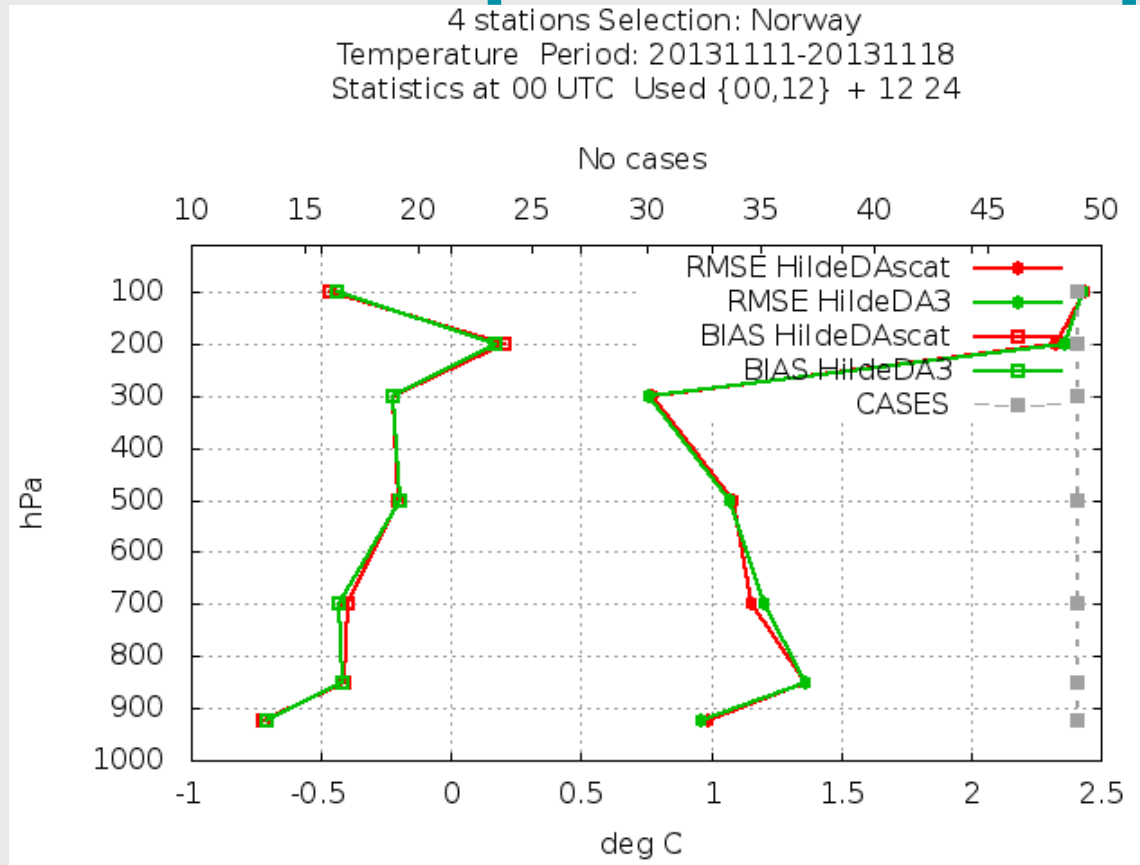
Mean sea level pressure: ExpConv - ExpASCAT



Higher pressures
in ExpASCAT

Lower pressures
in ExpASCAT

3) Forecast impact: vertical profiles



- Temperature and humidity bias slightly decreased around 700 hPa
- Impacts can be seen in upper levels because of improved dynamics. Surface variables (T, U, RH) are locally driven and it is difficult to see impact on them.

Summary

0) Data assimilation of scatterometer winds runs technically in the Harmonie system.

1) Data usage:

- Spatial coverage within the domain is good during daytime though data are strongly thinned in order to avoid correlated errors
- Individual ambiguity selection problems close to fronts and data rejection close to storm cores.

2) Observation departures:

- Wind speeds are drawn from background closer to the observations. (DA works how it is supposed to)
- HARMONIE wind speeds are higher than ASCAT on strong winds

3) Forecast impact:

- There is a weak positive impact of scatterometer winds

Outlook

- Impact studies on Polar lows and other high impact events
- Longer simulation periods for robust verification results
- Work on optimal thinning distance, data rejection procedures and observation weighting
- Operational implementation of scatterometer wind assimilation (?)
- Follow the shorter and longer term developments within the NWP consortium and apply and test new methods when available



Norwegian
Meteorological
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Thank you!

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