Norwegian Meteorological Institute

The use of ASCAT winds in NWP model systems at MET Norway

Teresa Valkonen

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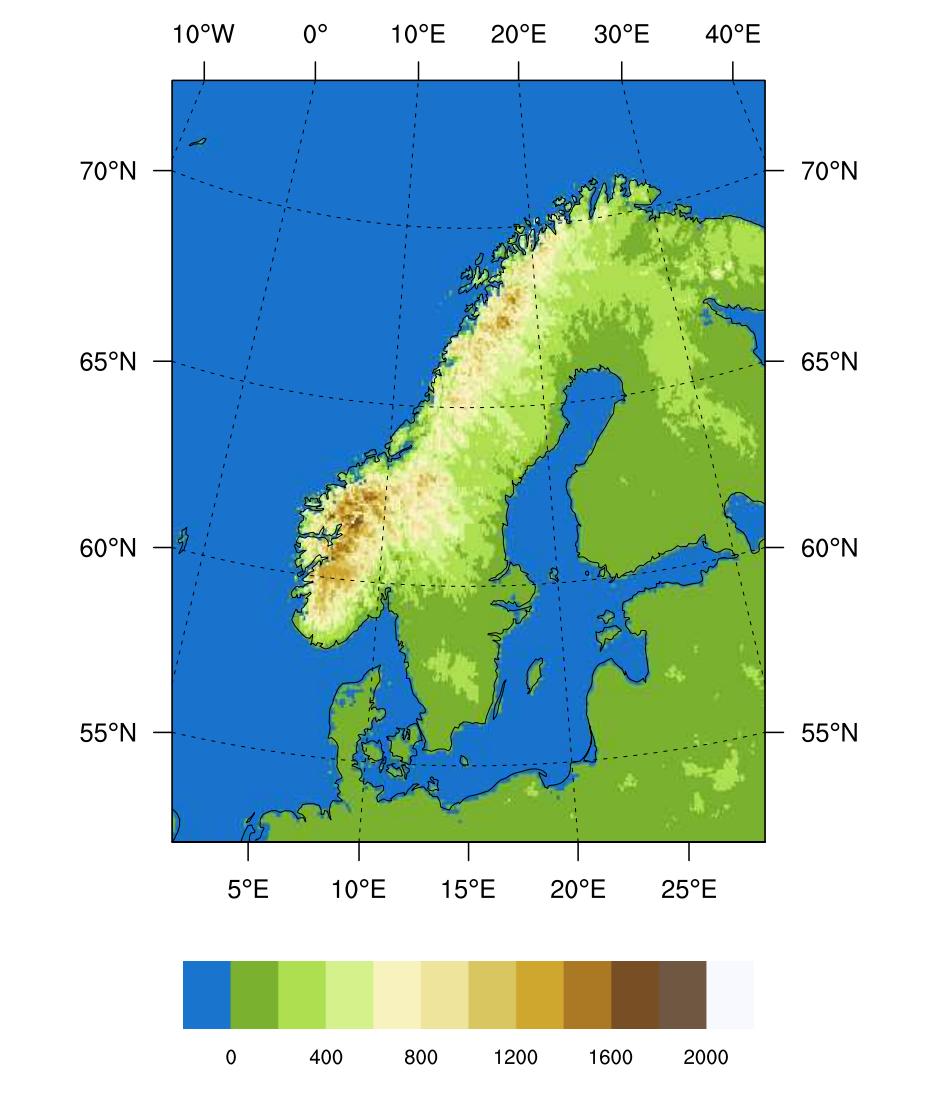
Outline

- Model systems at MET Norway
- Learned from impact experiments
- Choice of ASCAT settings in the model systems
- Data monitoring of operational systems
- Impact on forecasts

Model systems at MET Norway

AROME-MetCoOp - Main forecasting system, operational since 2014

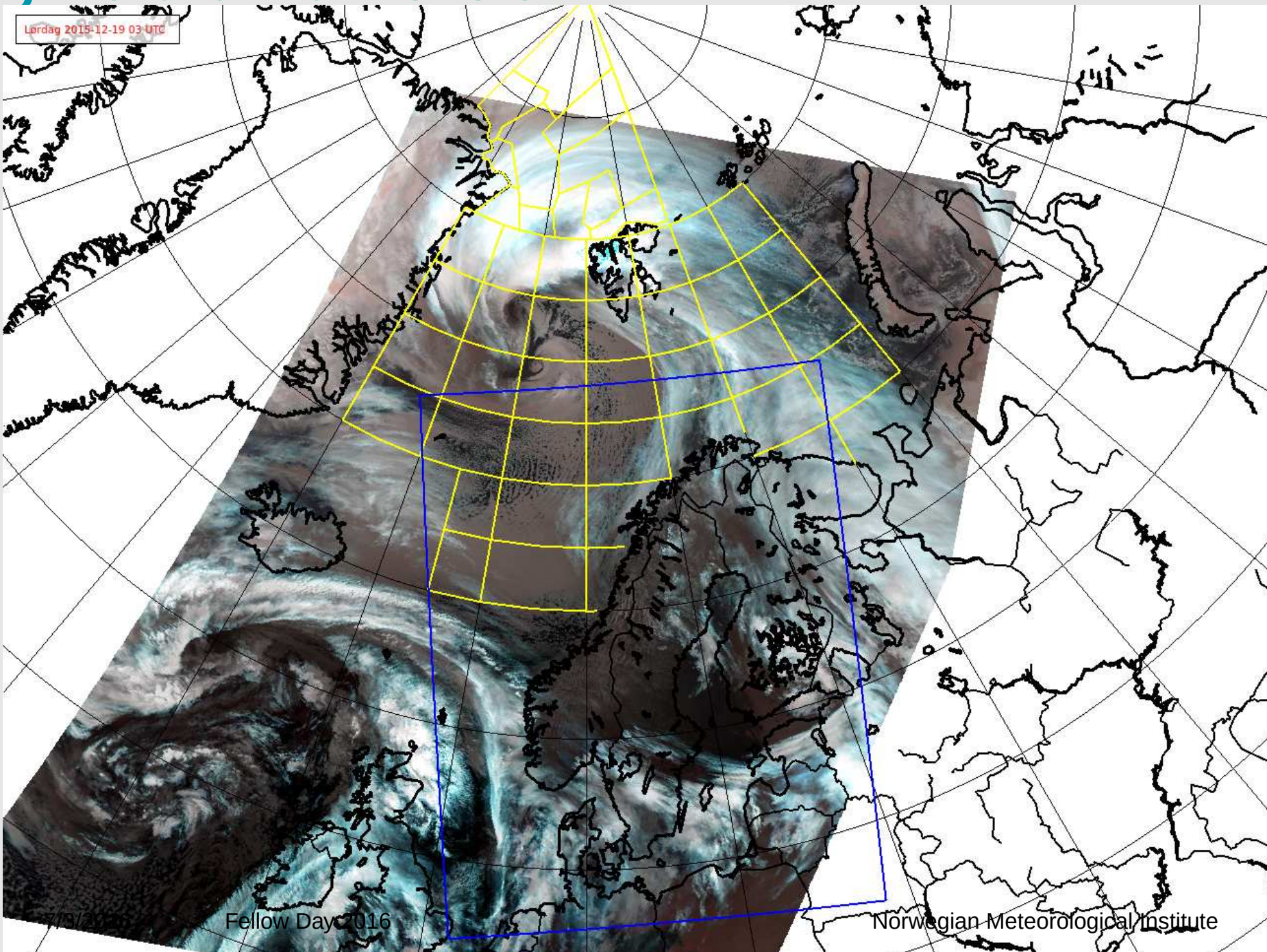


- 2.5 km grid spacing
- 61 vertical levels
- 3D-Var assimilation with 3-hourly cycling
- 66-h forecasts four times a day

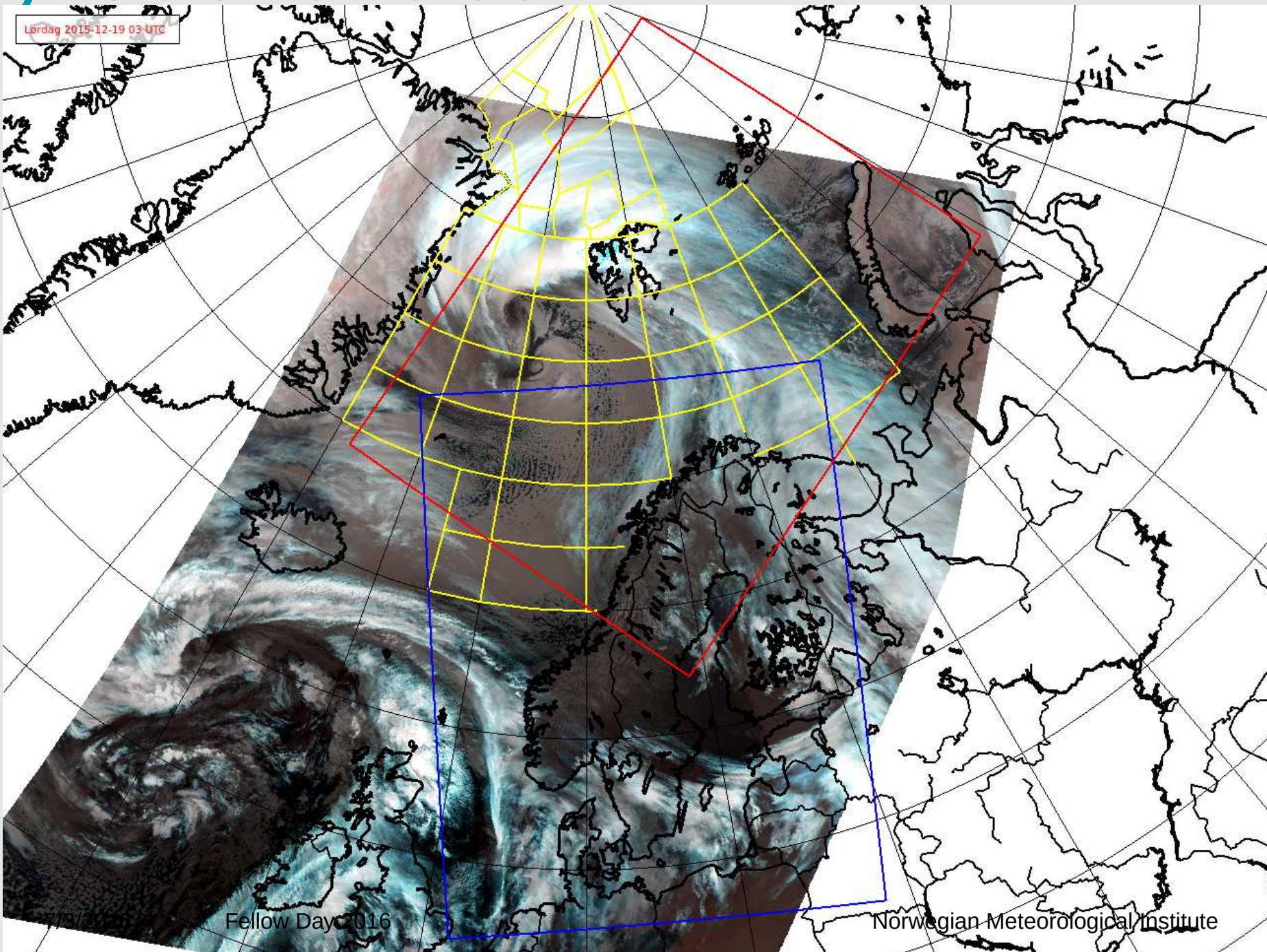
Observations to assimilate

- Conventional
- AMSU
- GPS
- Radar
- OSI-SAF ASCAT Coastal A & B (pre-operational)

Very Northern dimension



Very Northern dimension



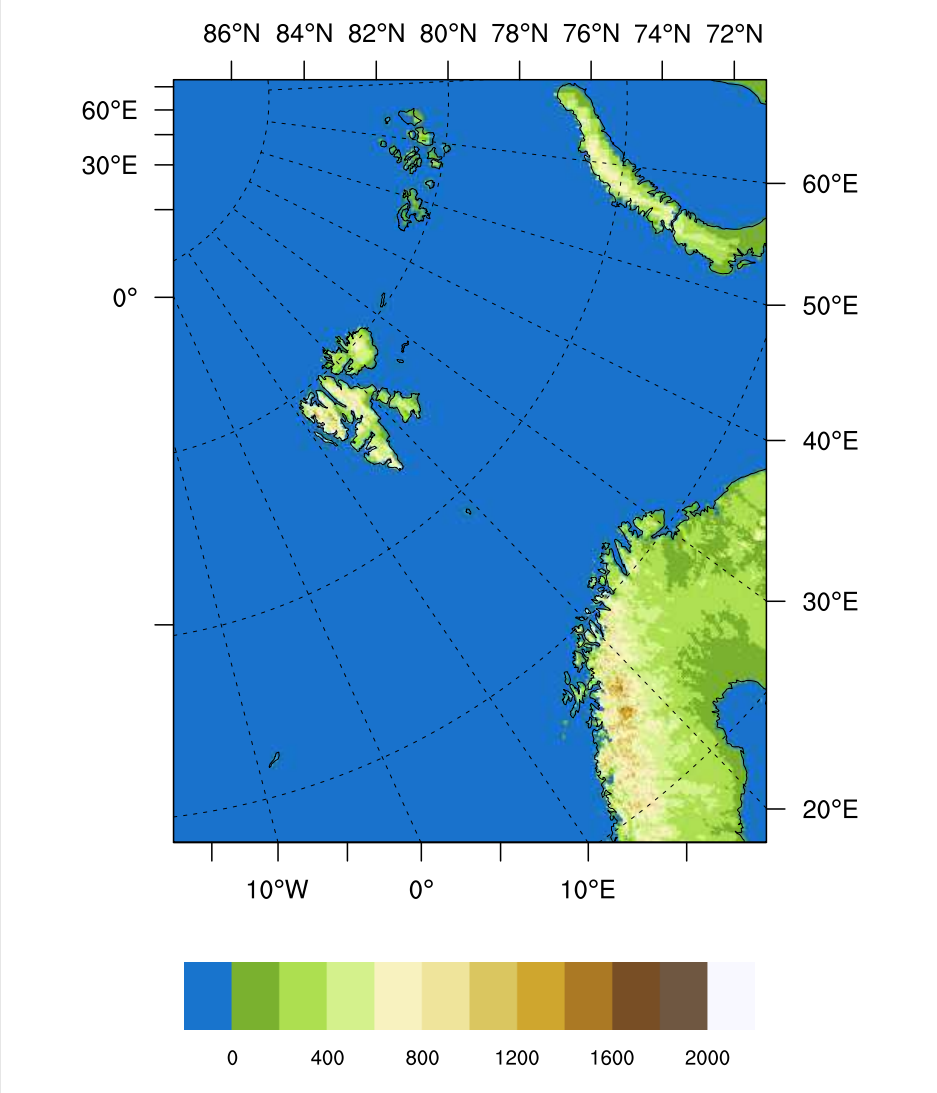
Model systems at MET Norway

AROME-Arctic - Operational since November 2015

- Same domain size and grid spacing
- Same model physics and dynamics
- Same assimilation strategy

Observations to assimilate

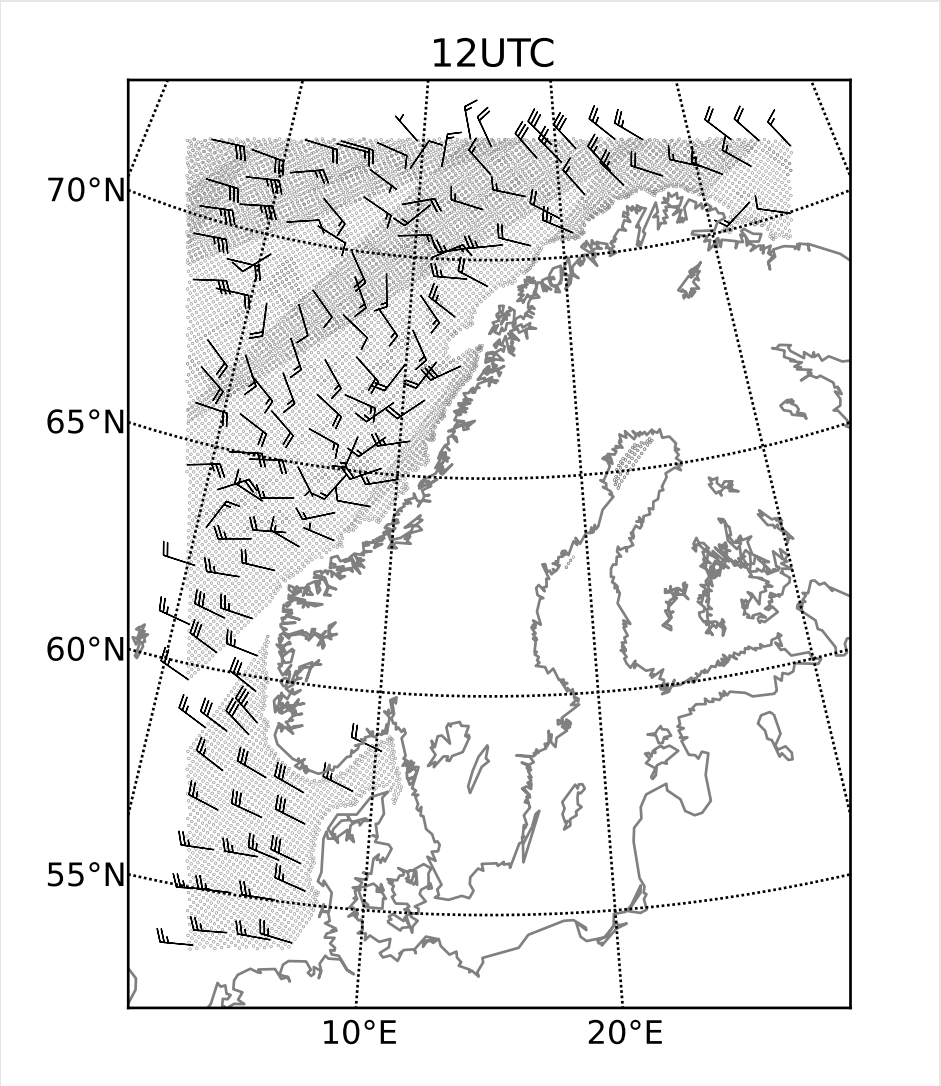
- Conventional
- AMSU
- OSI-SAF ASCAT Coastal A & B



ASCAT in the model systems

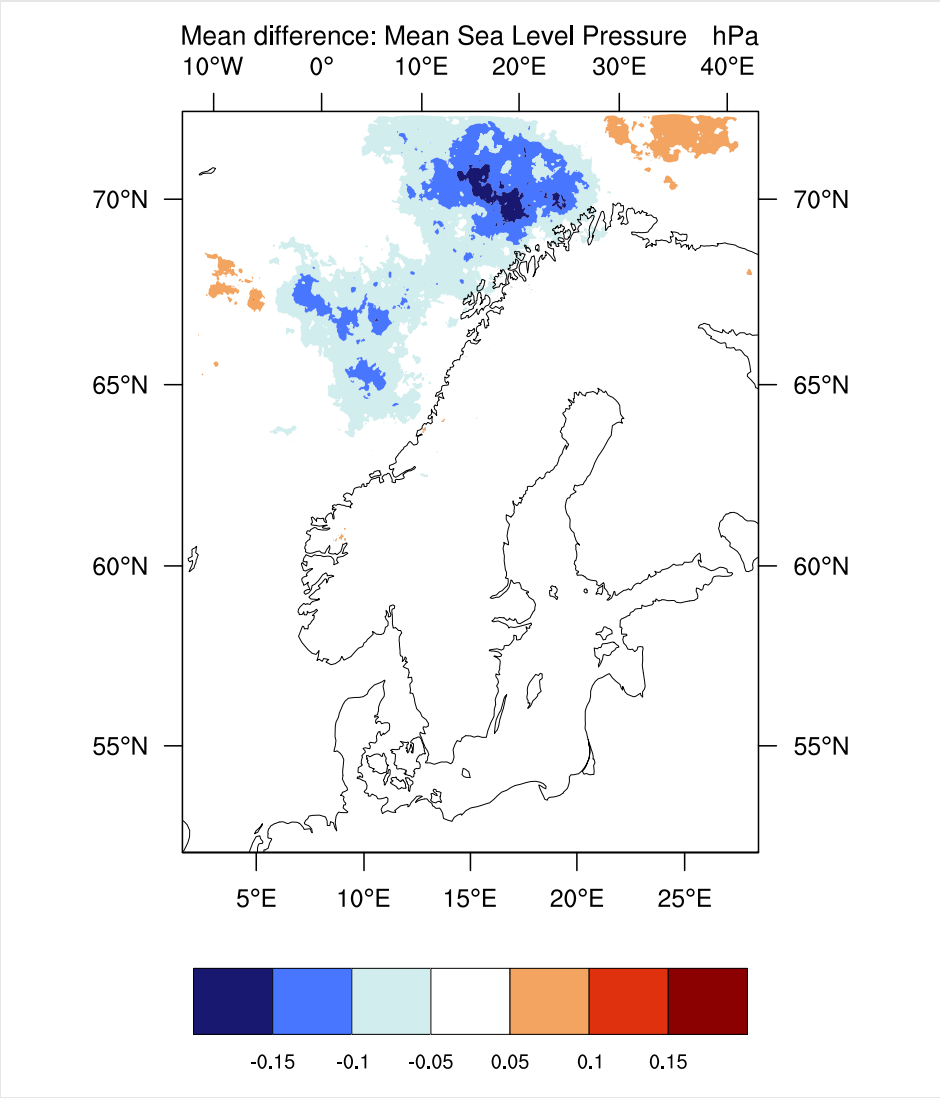
Settings *i*nherited from the model systems of Meteo-France and ECMWF

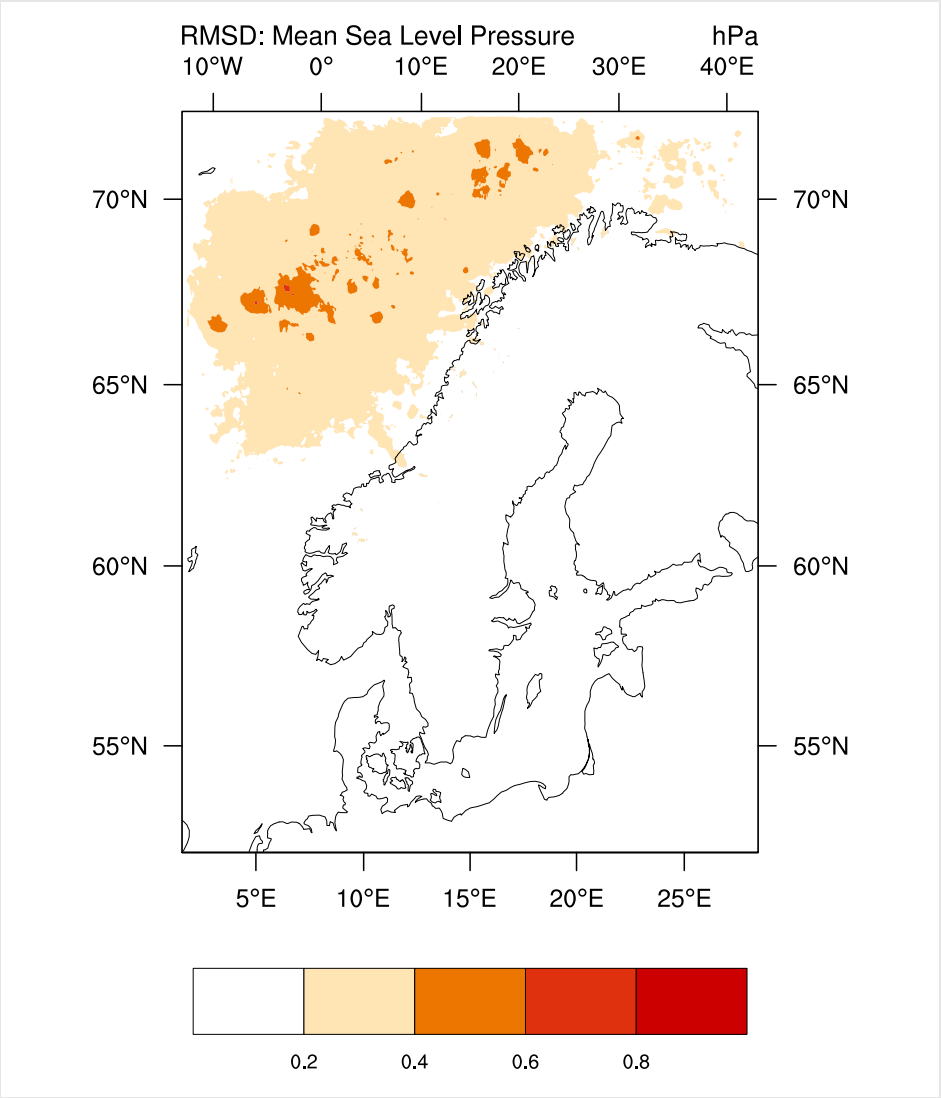
- Data thinning:
  - Every 4th WVC selected across the satellite track
  - Thinning distance of 100 km
- ASCAT-A & ASCAT-B handeled together.
- All ambigious wind solutions are considered
- Wind direction closest to the background is chosen
- Observation errors 1.39 m/s and 1.54 m/s



Learned from impact experiments

ASCAT has the largest impact over the ocean and near the Norwegian coast





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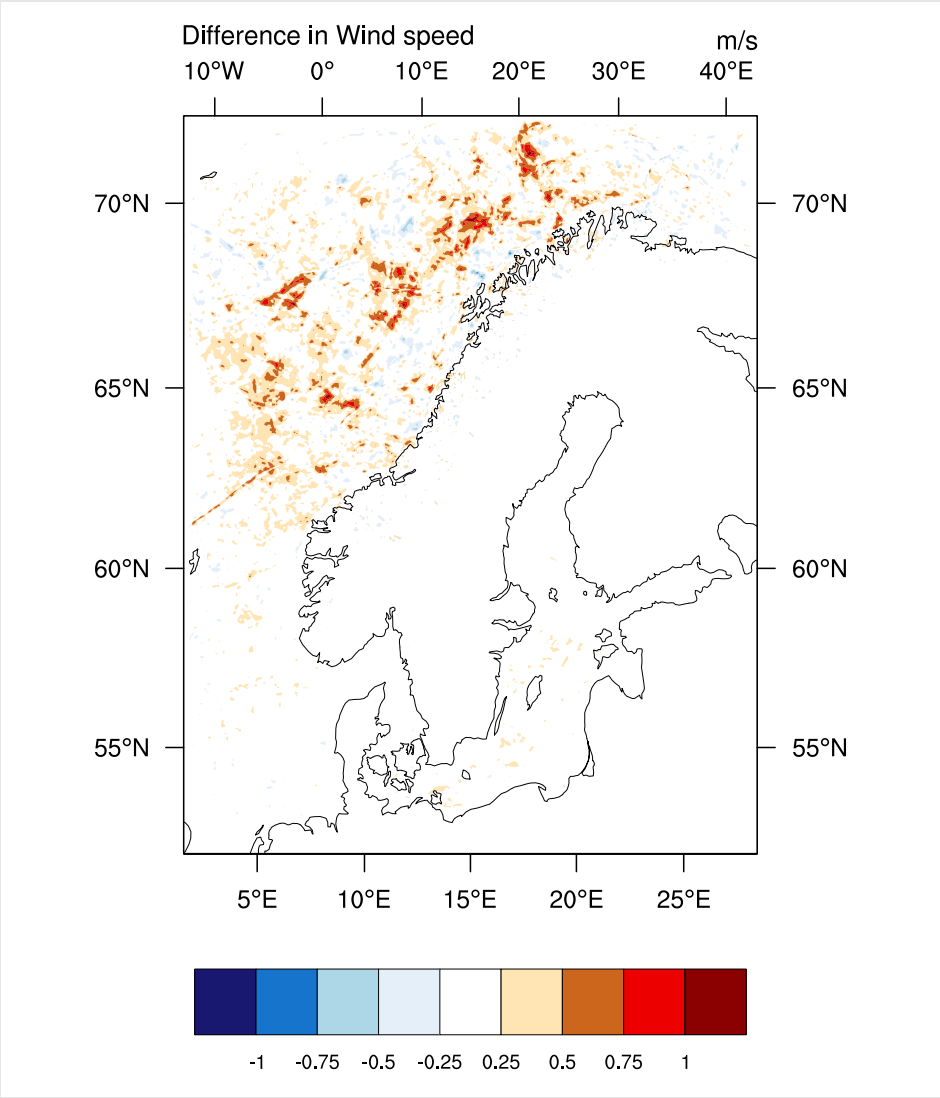
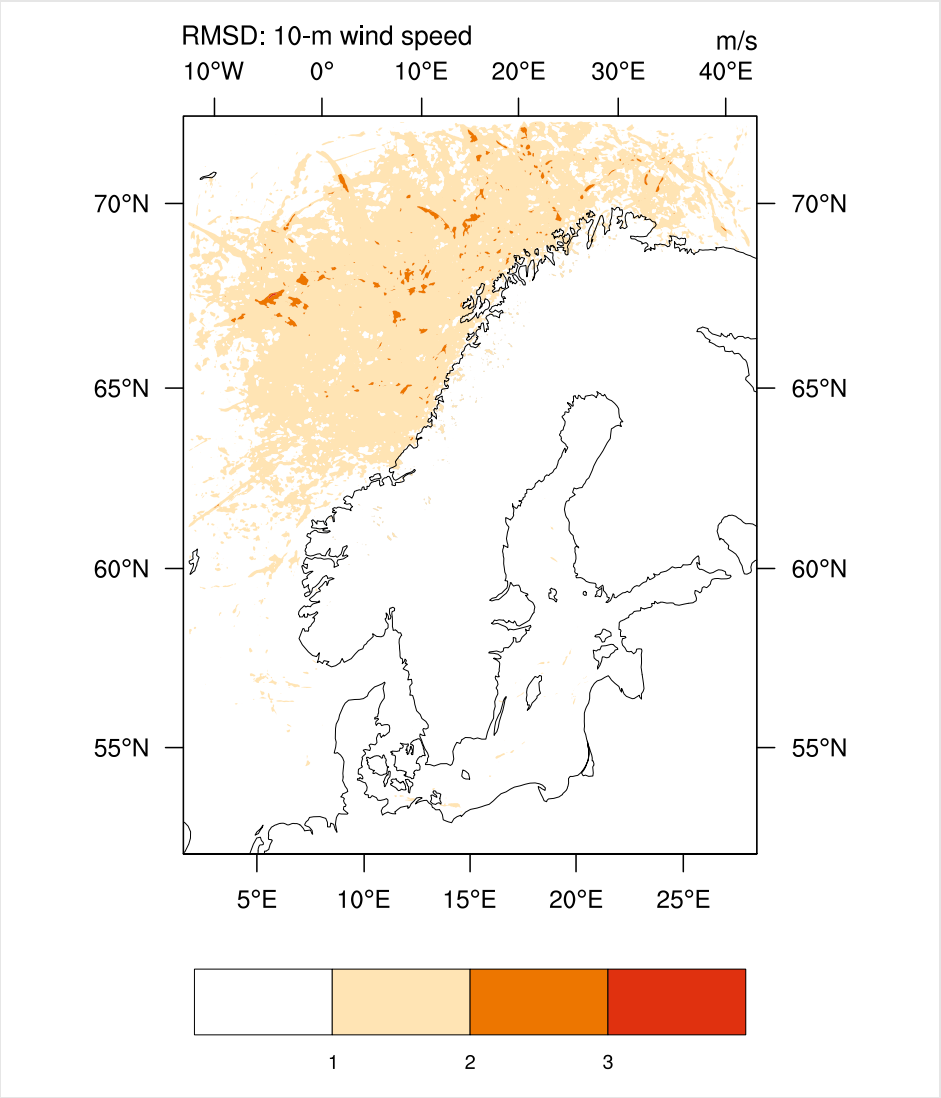
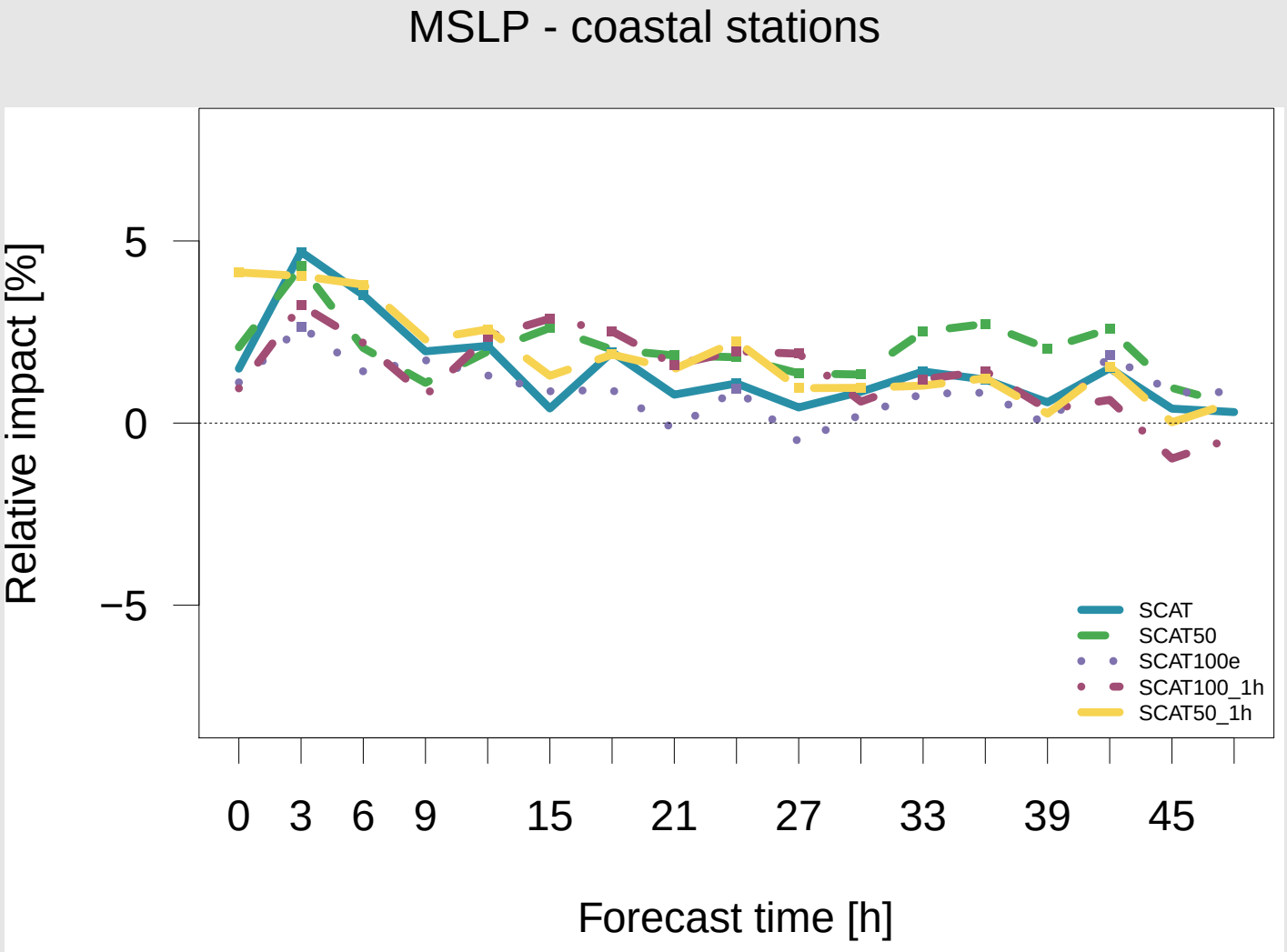




Learned from previous experimentation

ASCAT has slightly positive impact on mslp and wind speed



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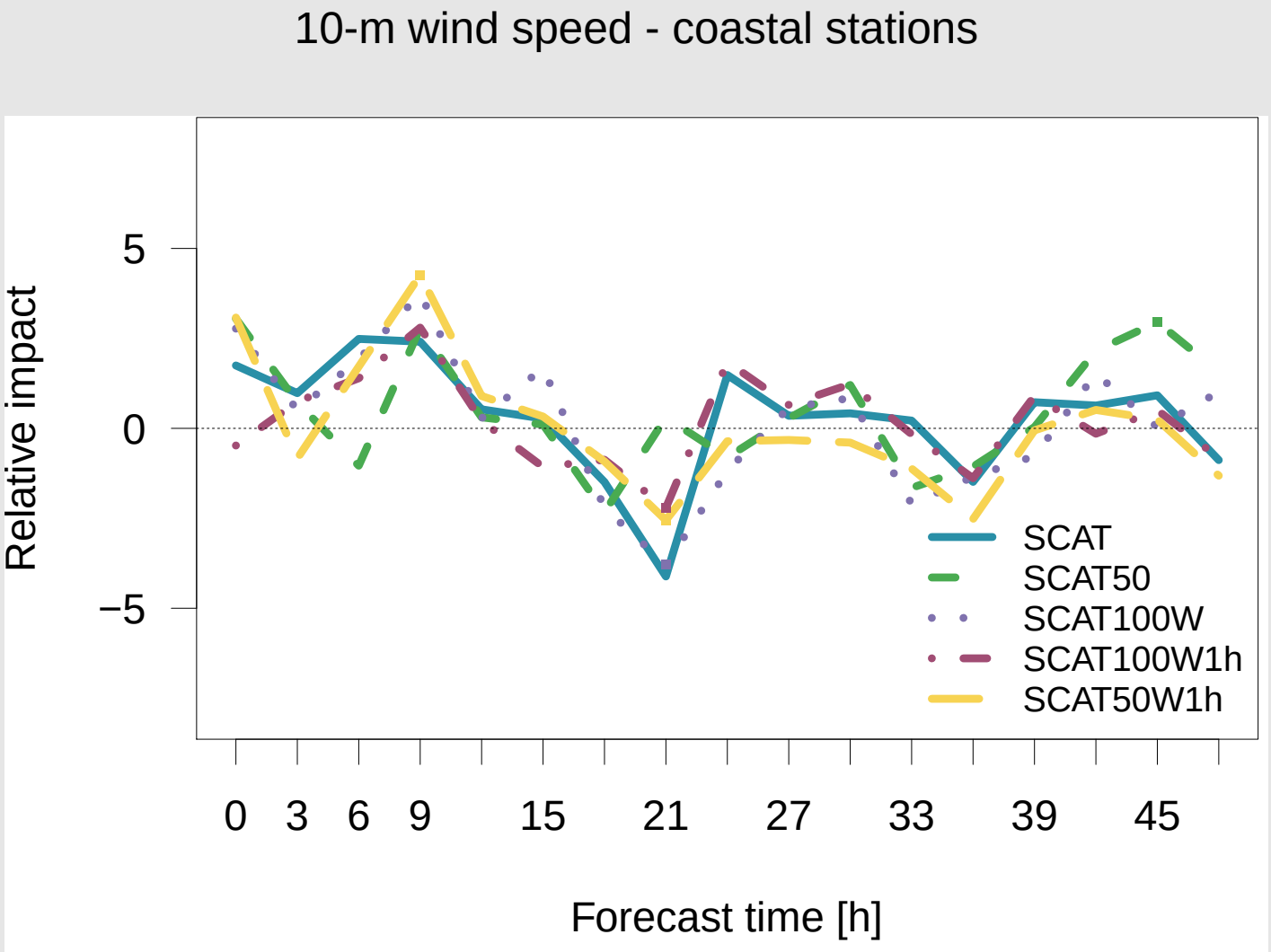

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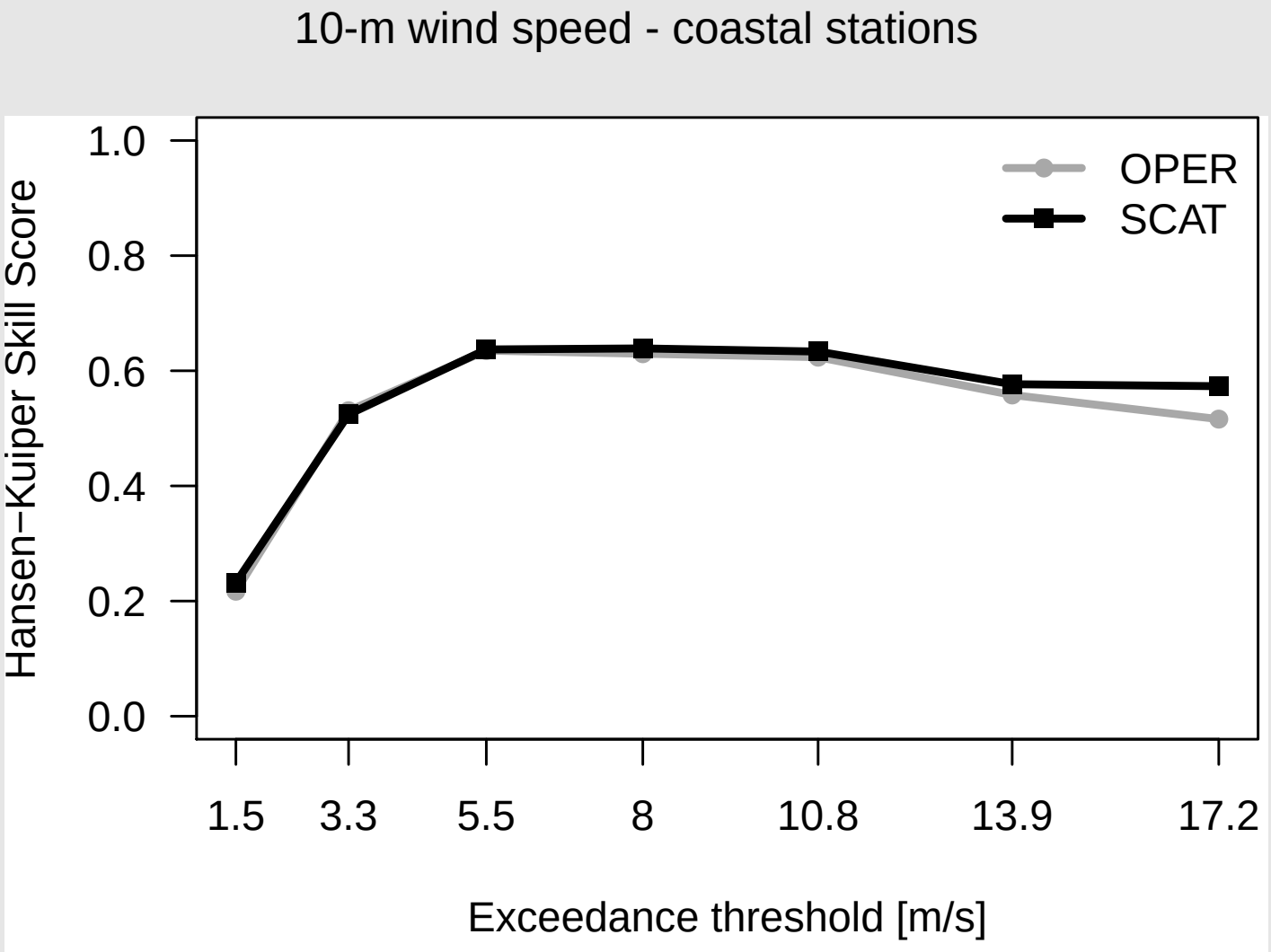
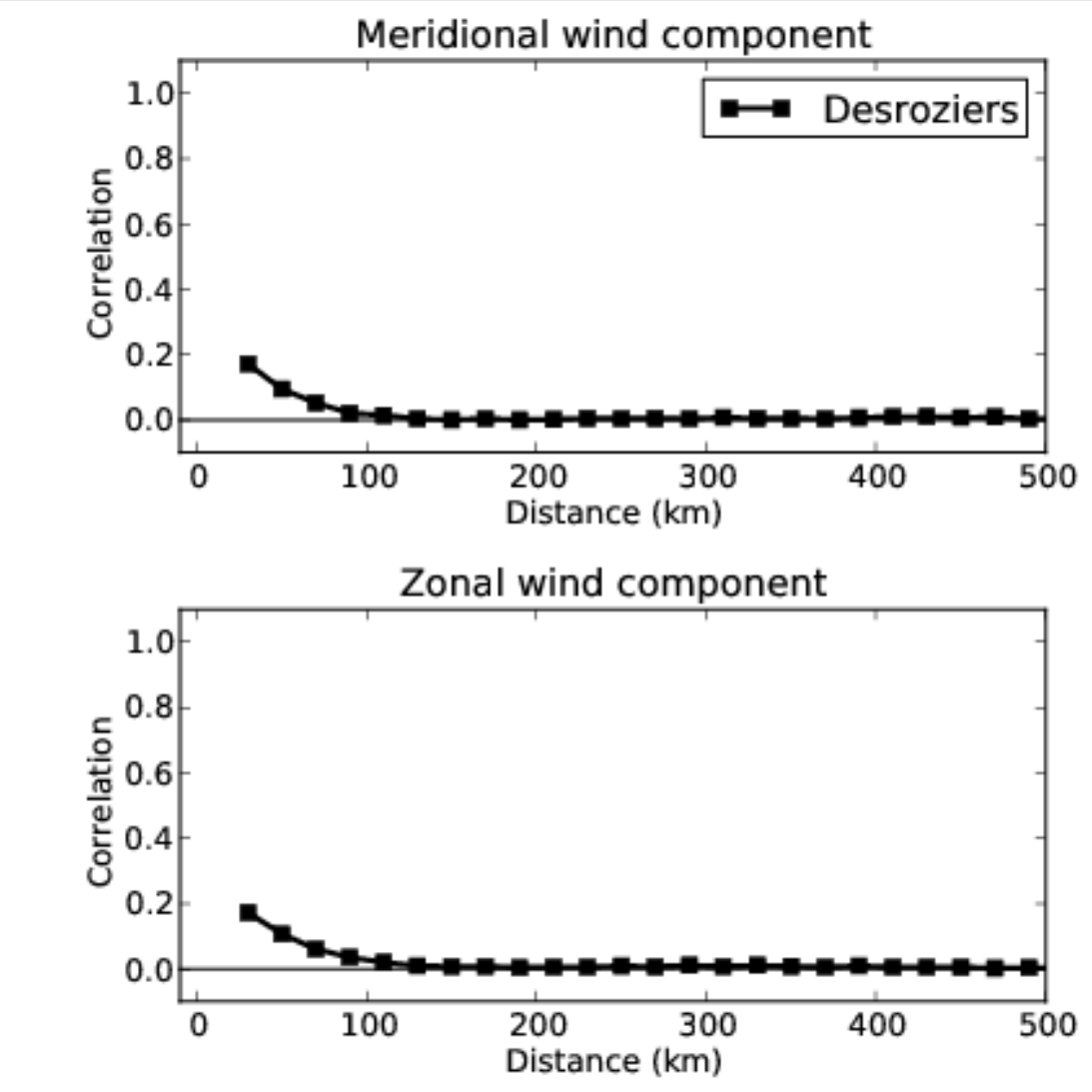


Learned from previous experimentation

No spatial-error correlations on 50 km distance



Choice of ASCAT settings in the model systems

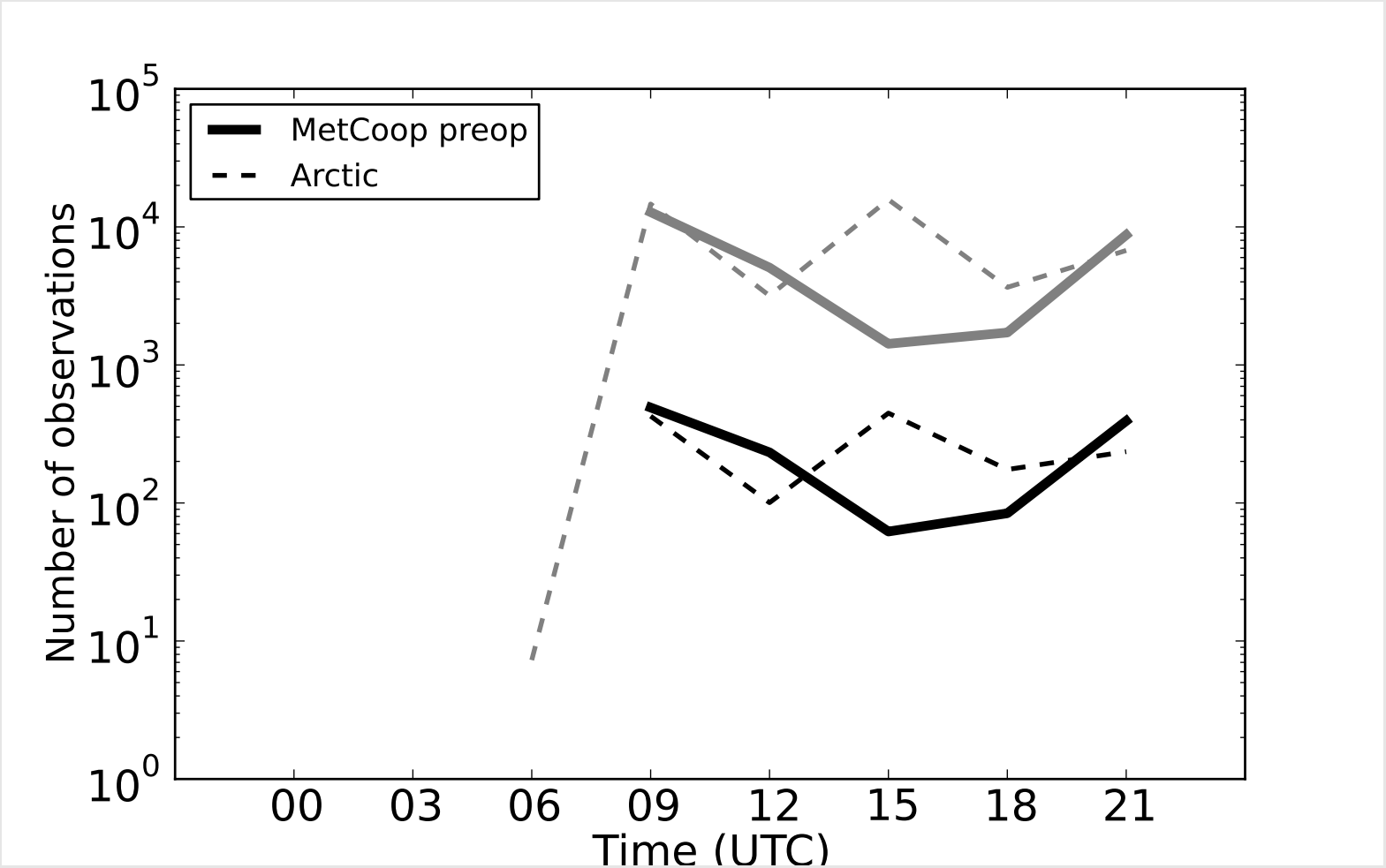
- every 4th wvc selected and then 50 km thinning
- obs errors 1.39 m/s & 1.54 m/s
- assimilation window of 3 hours

ASCAT data in the operational model systems

- operational in AROME-Arctic since Nov 2015
- pre-operational in AROME-MetCoop since Dec 2015
  - going operational March 2016

Data monitoring of operational systems

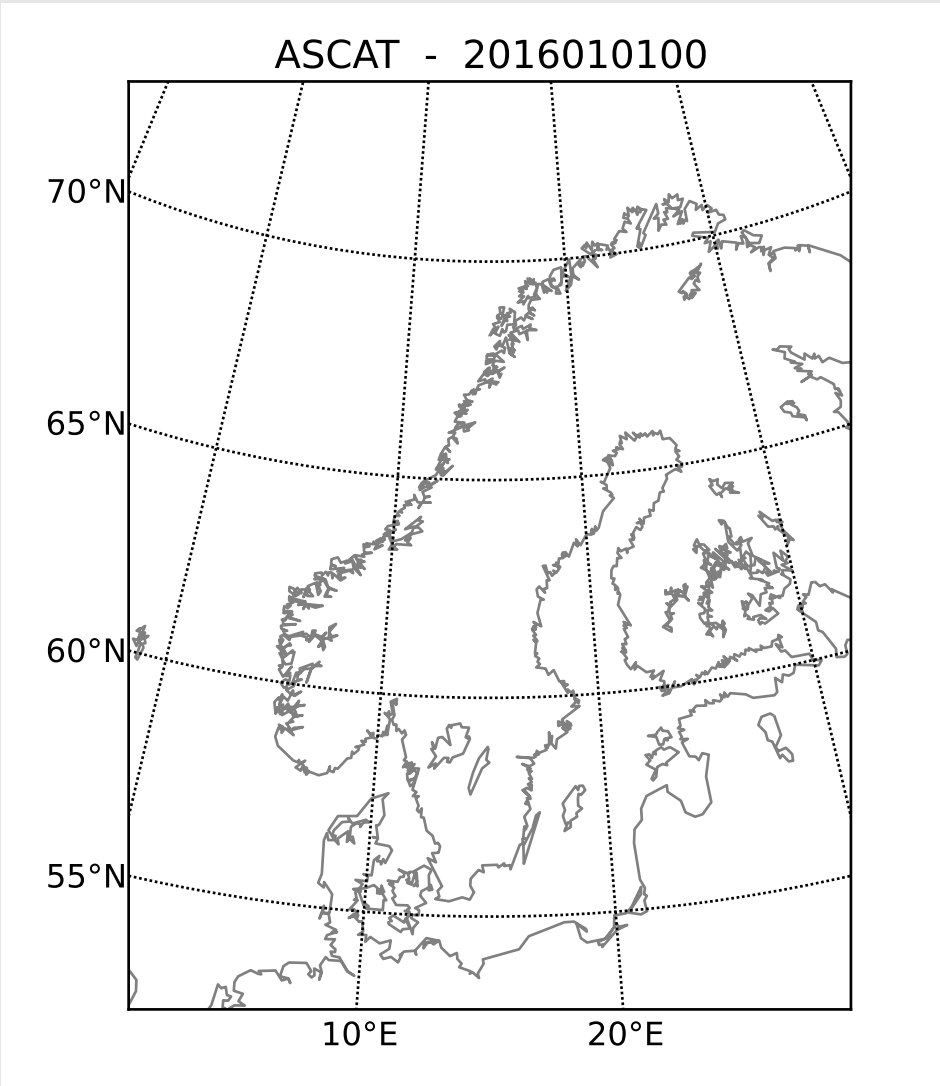
Data usage



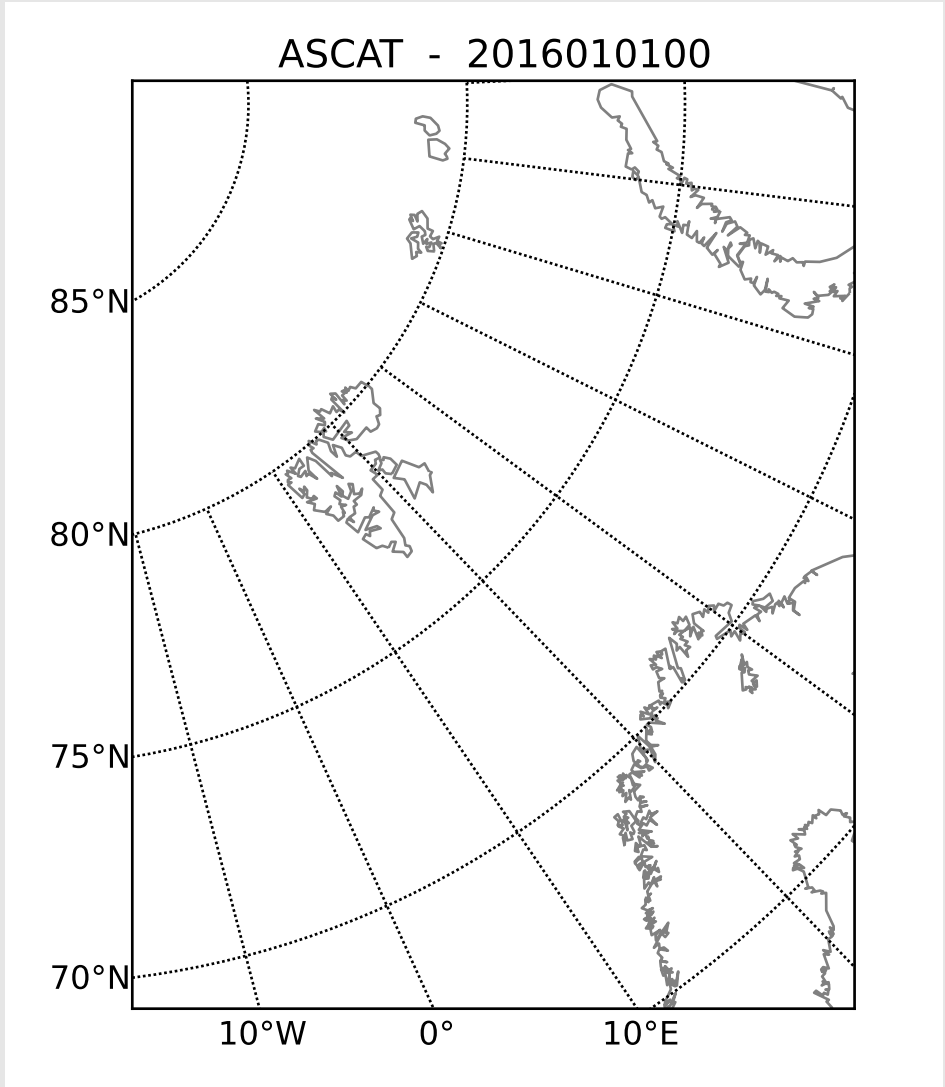
Data monitoring of operational systems

Data usage

MetCoOp 00UTC



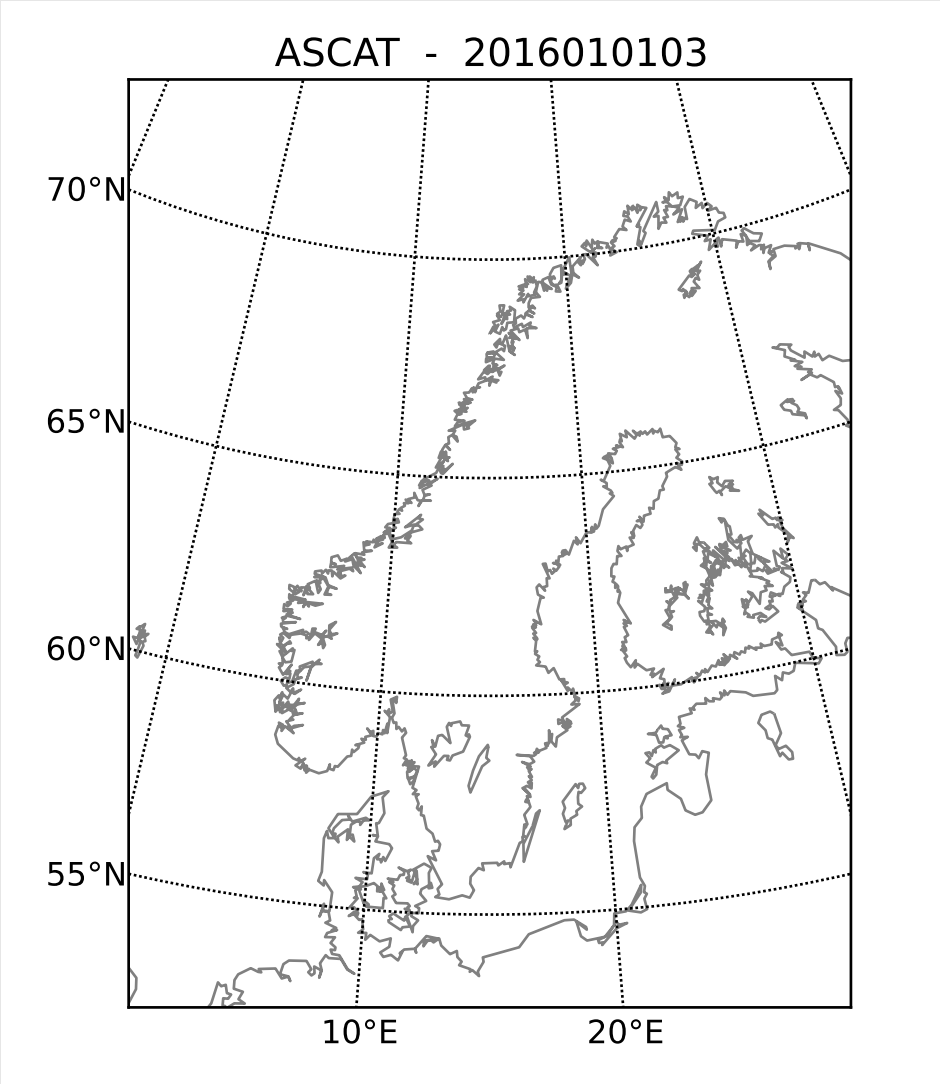
Arctic 00UTC



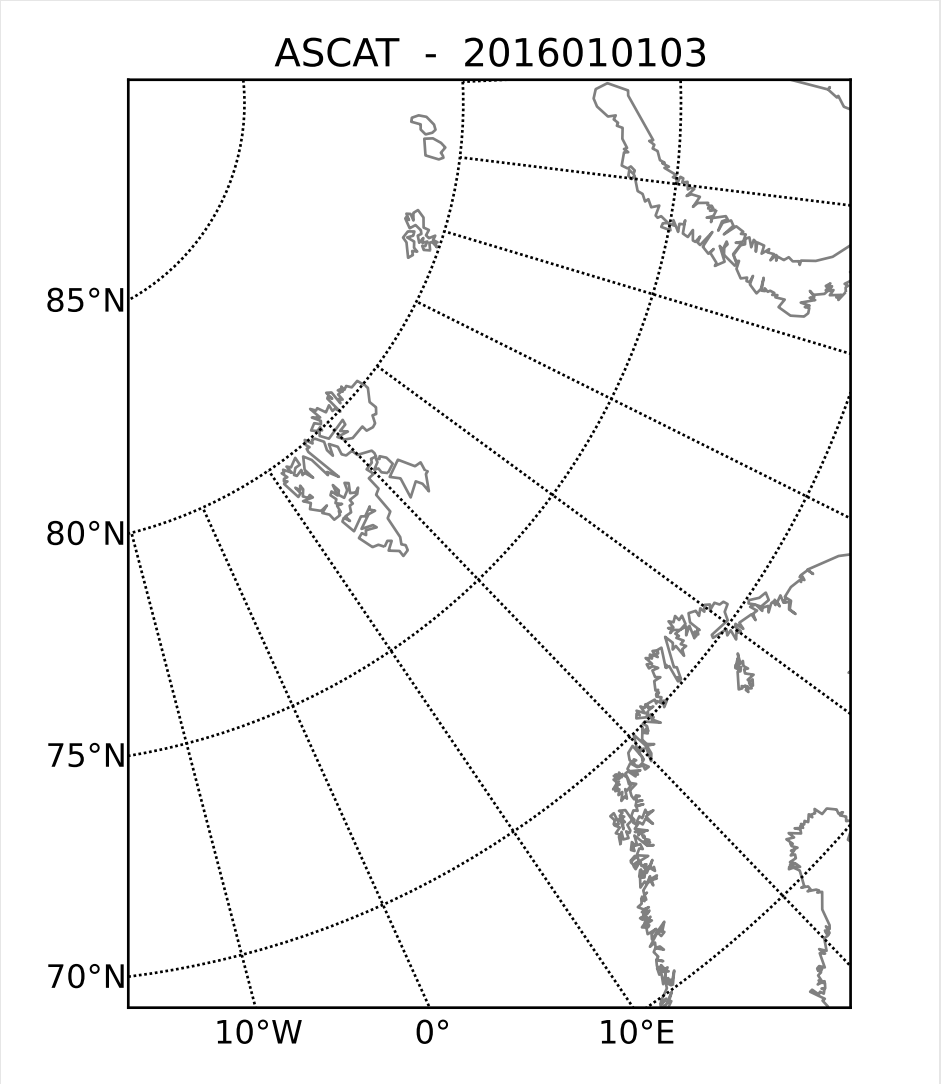
Data monitoring of operational systems

Data usage

MetCoOp 03 UTC



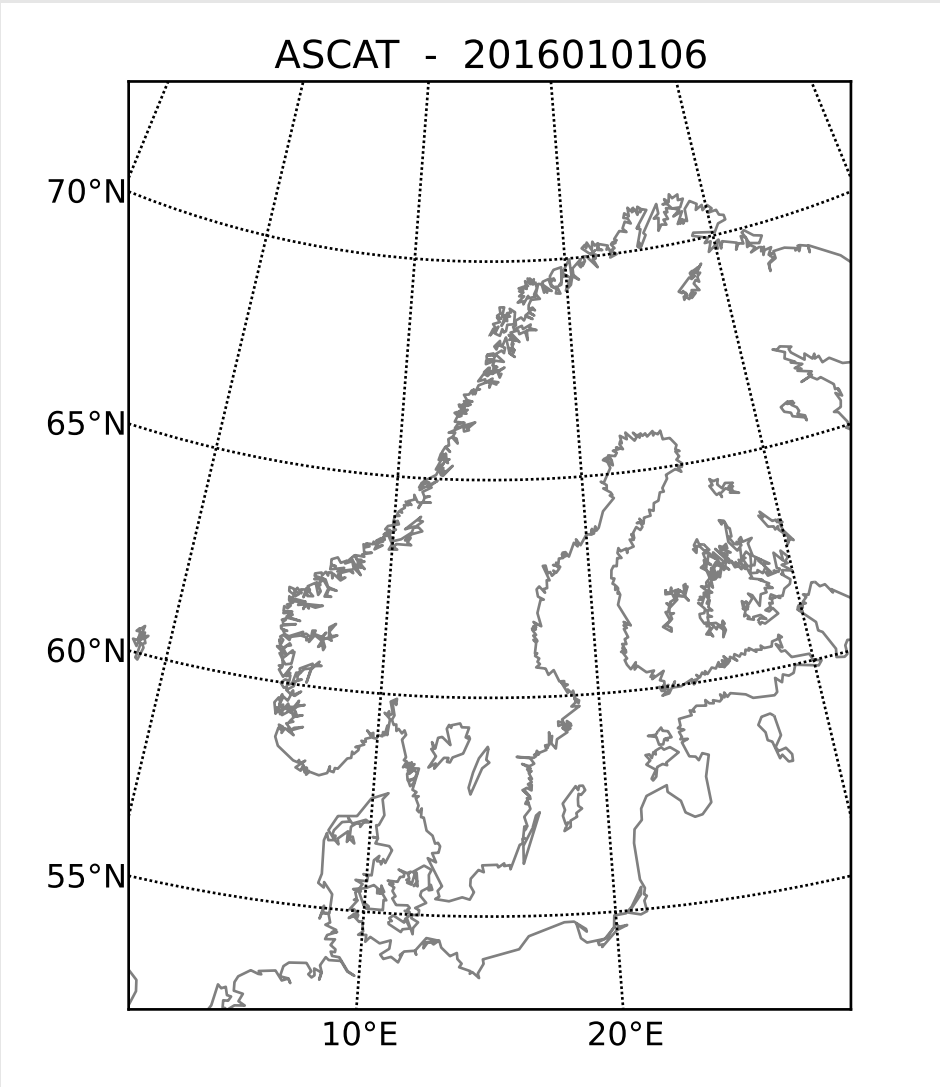
Arctic 03 UTC



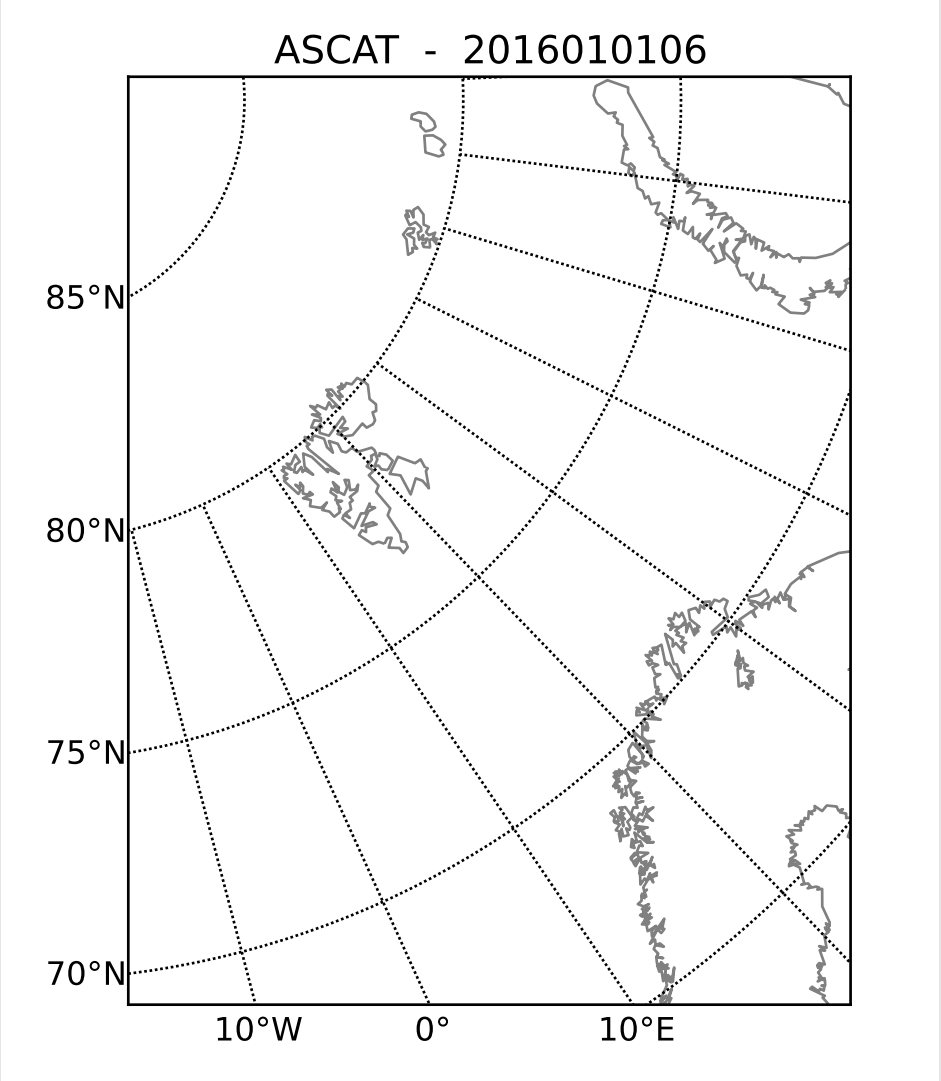
Data monitoring of operational systems

Data usage

MetCoOp 06UTC



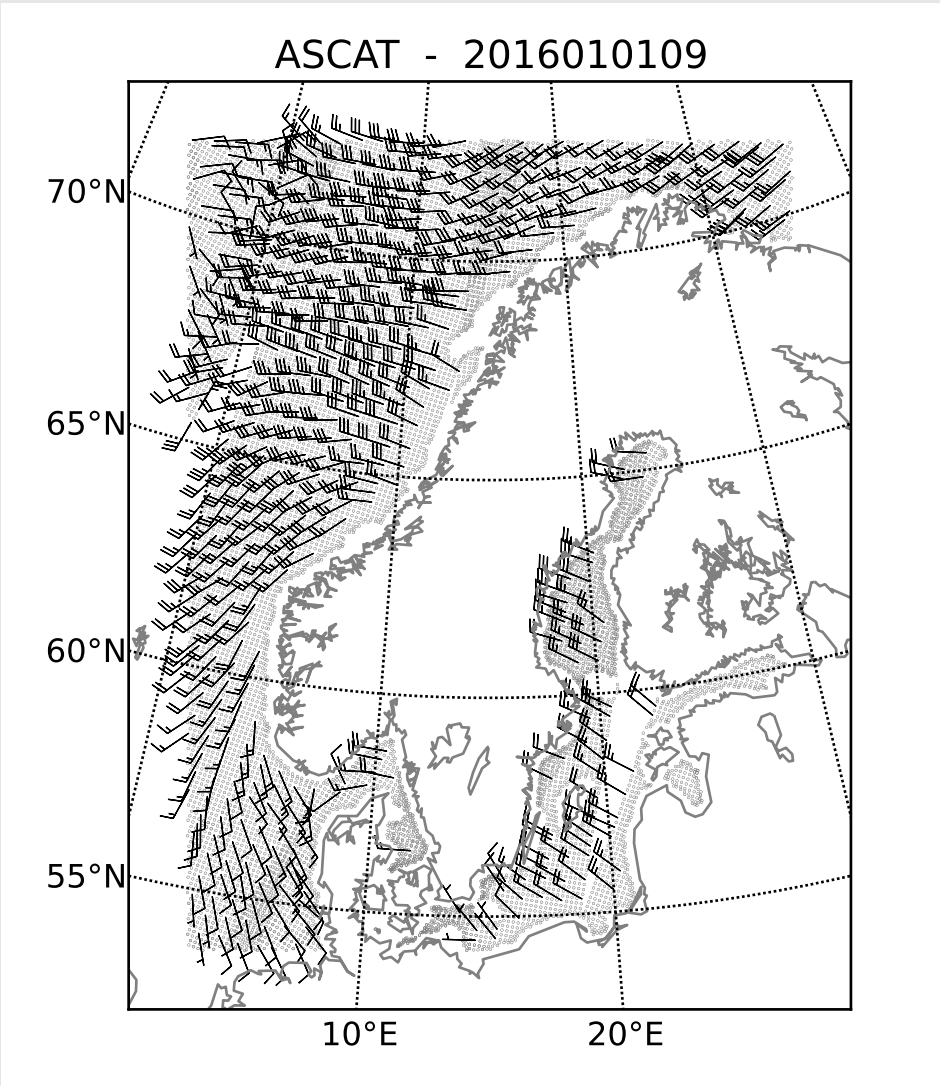
Arctic 06UTC



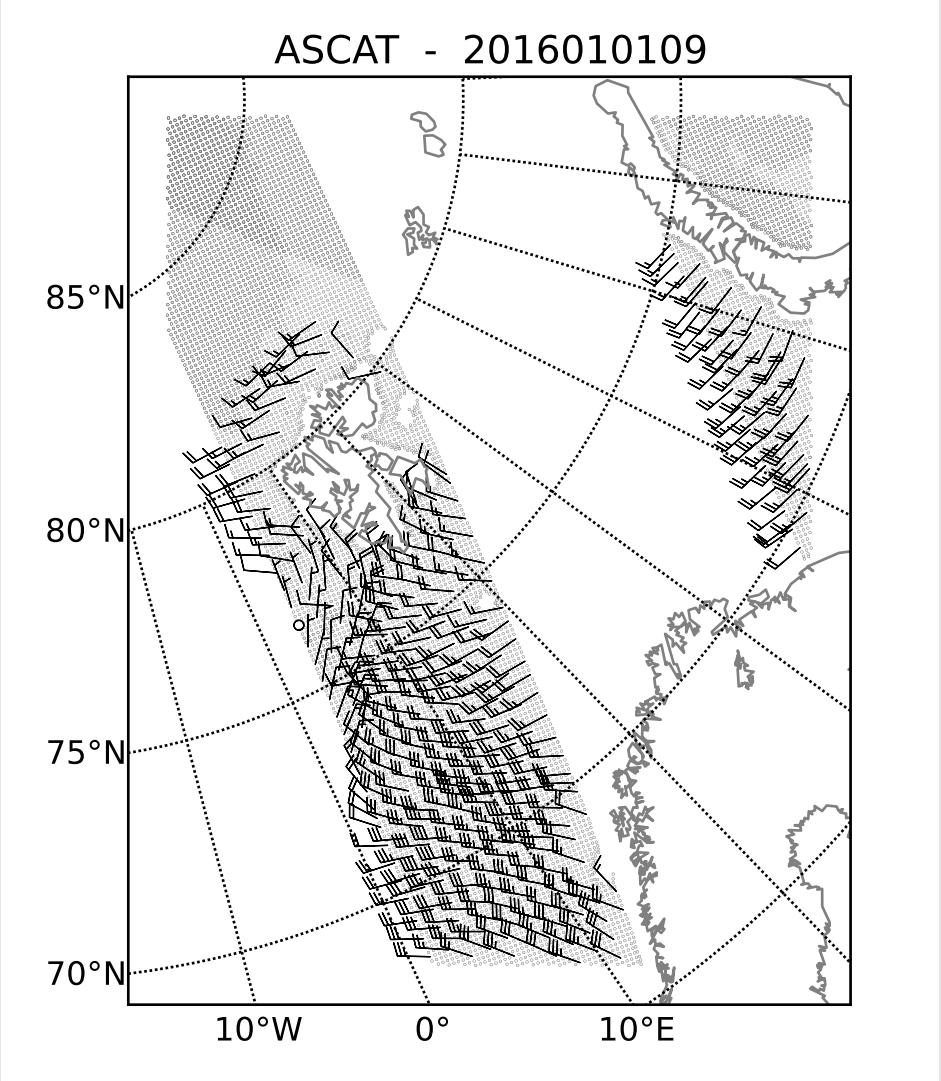
Data monitoring of operational systems

Data usage

MetCoOp 09UTC



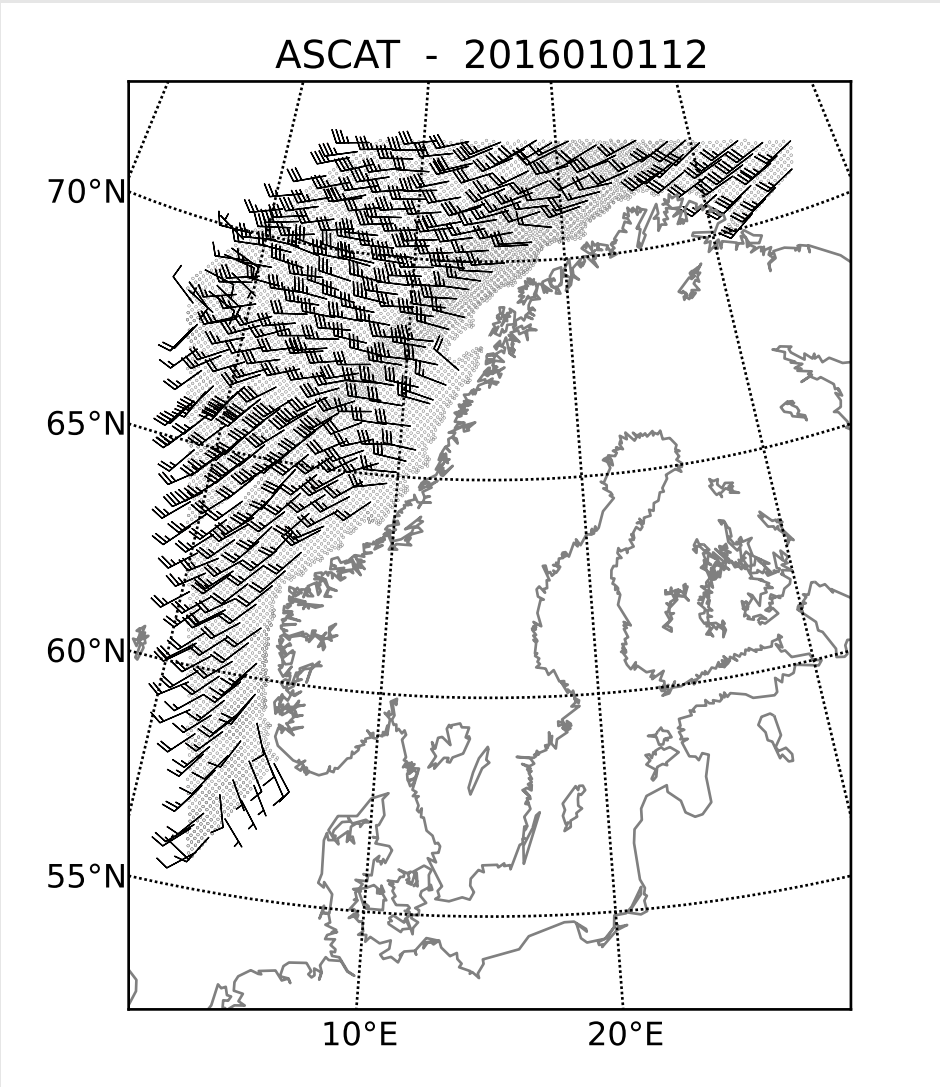
Arctic 09UTC



Data monitoring of operational systems

Data usage

MetCoOp 12UTC



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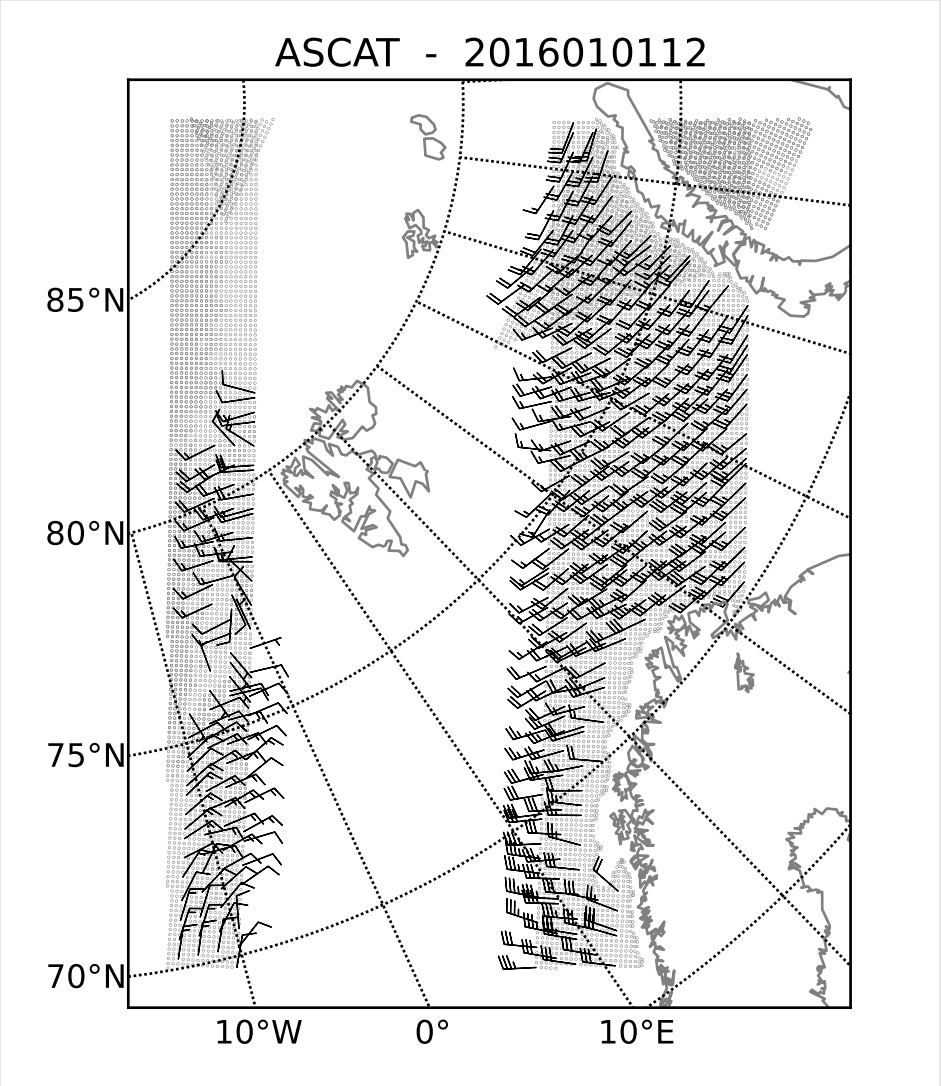

Data monitoring of operational systems

Data usage

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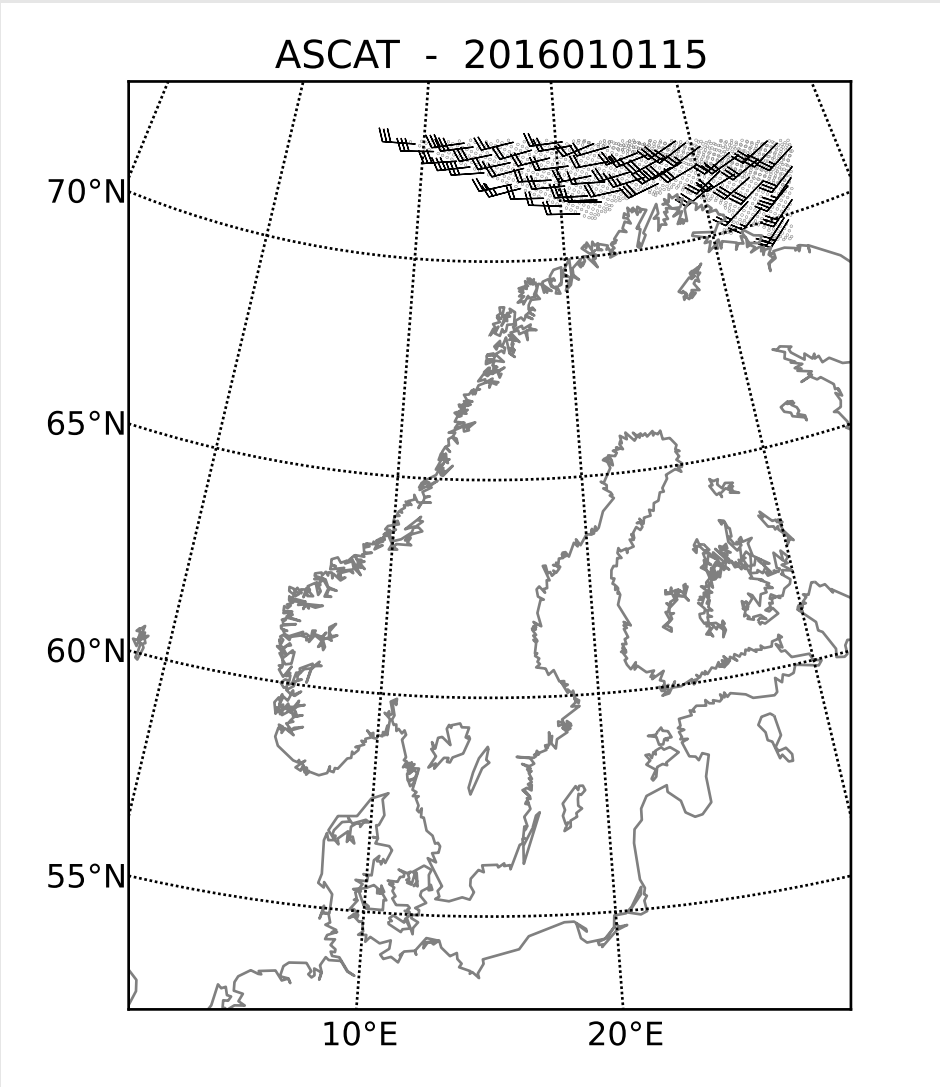
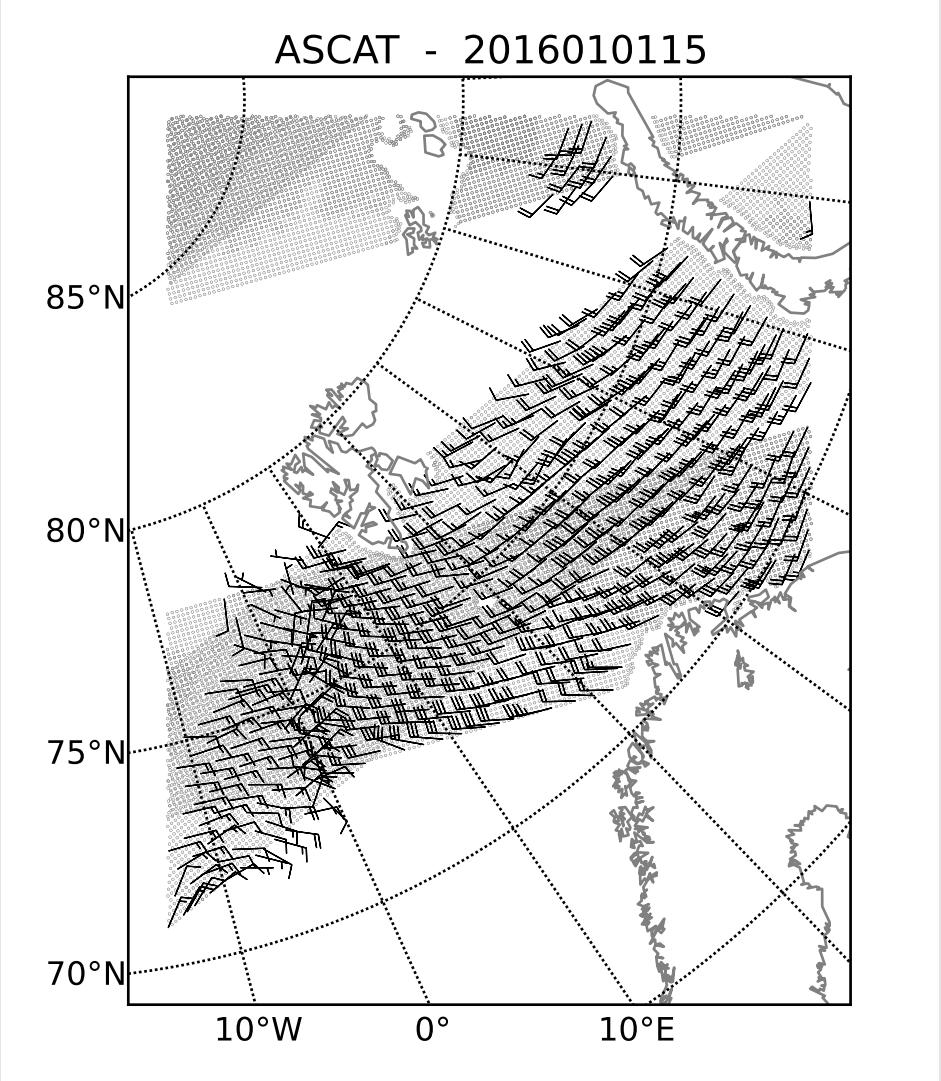


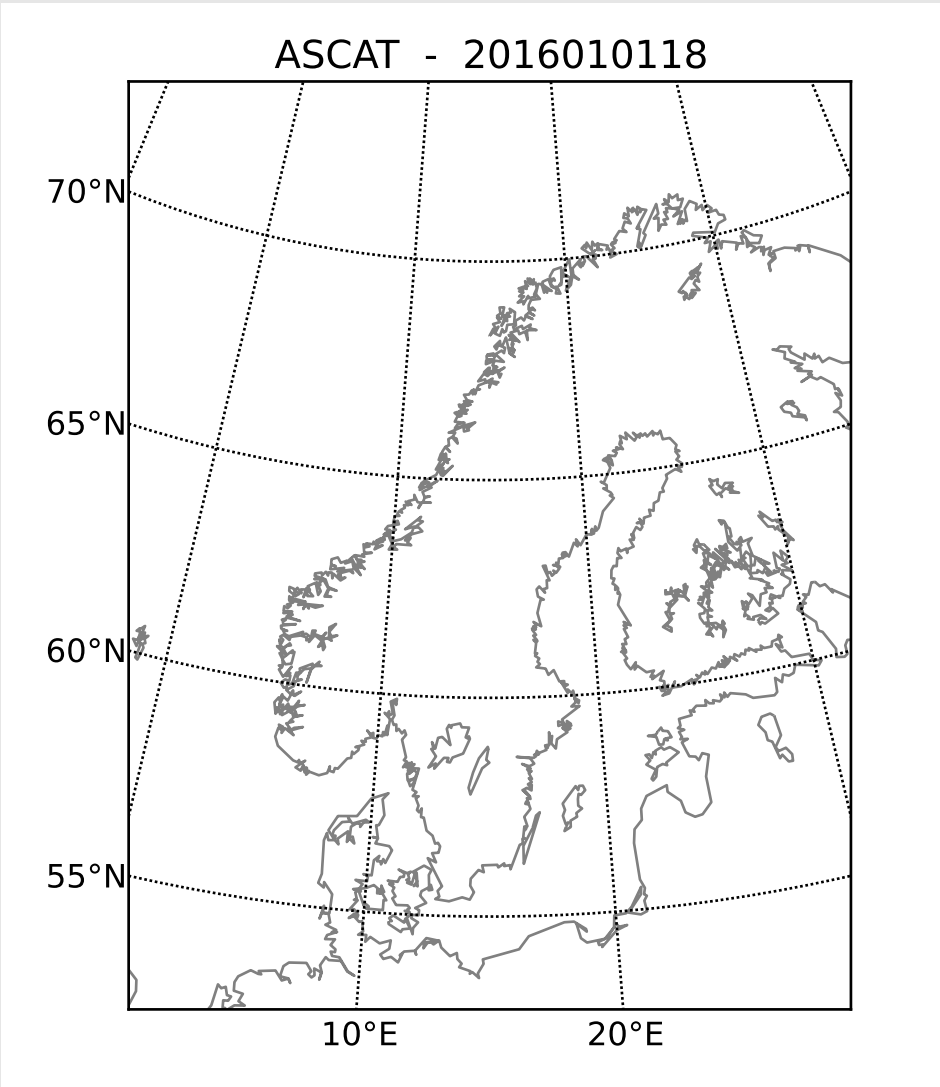
Arctic 15UTC



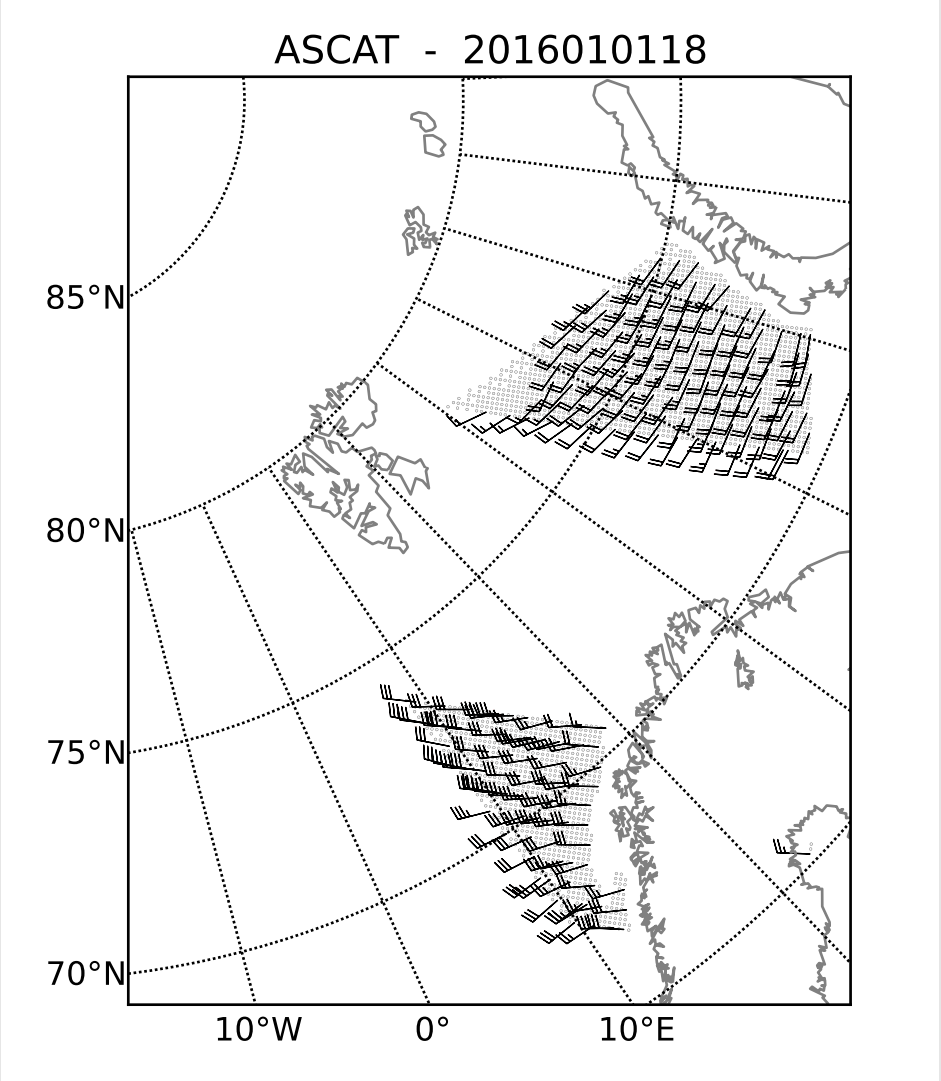
Data monitoring of operational systems

Data usage

MetCoOp 18UTC



Arctic 18UTC



Data monitoring of operational systems

Data usage

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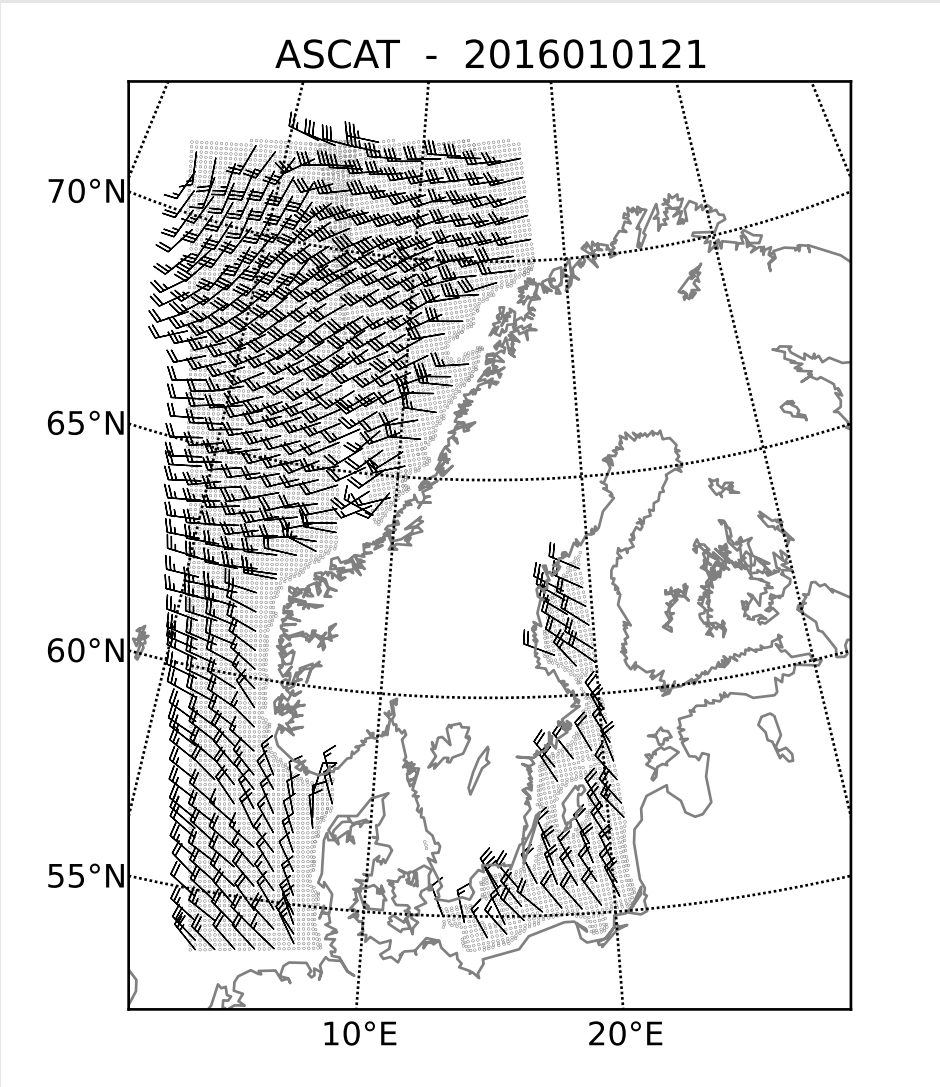
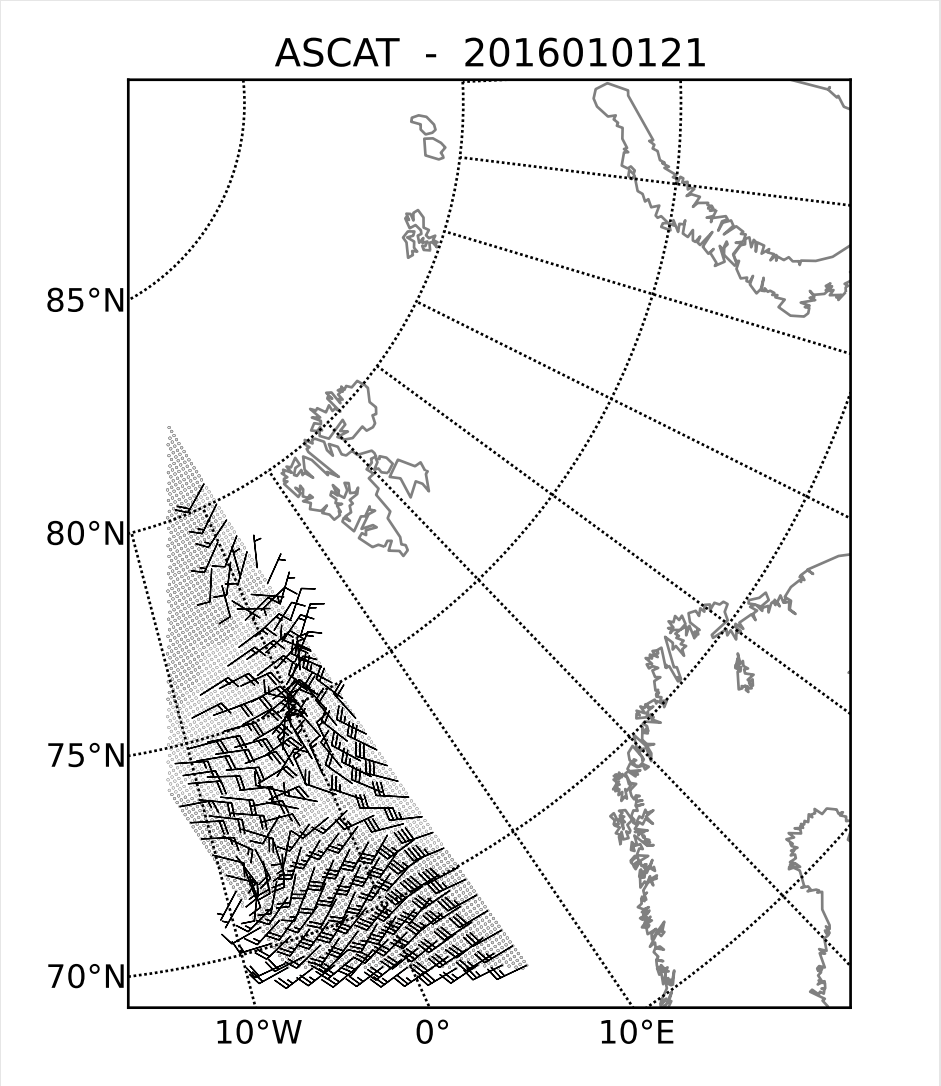
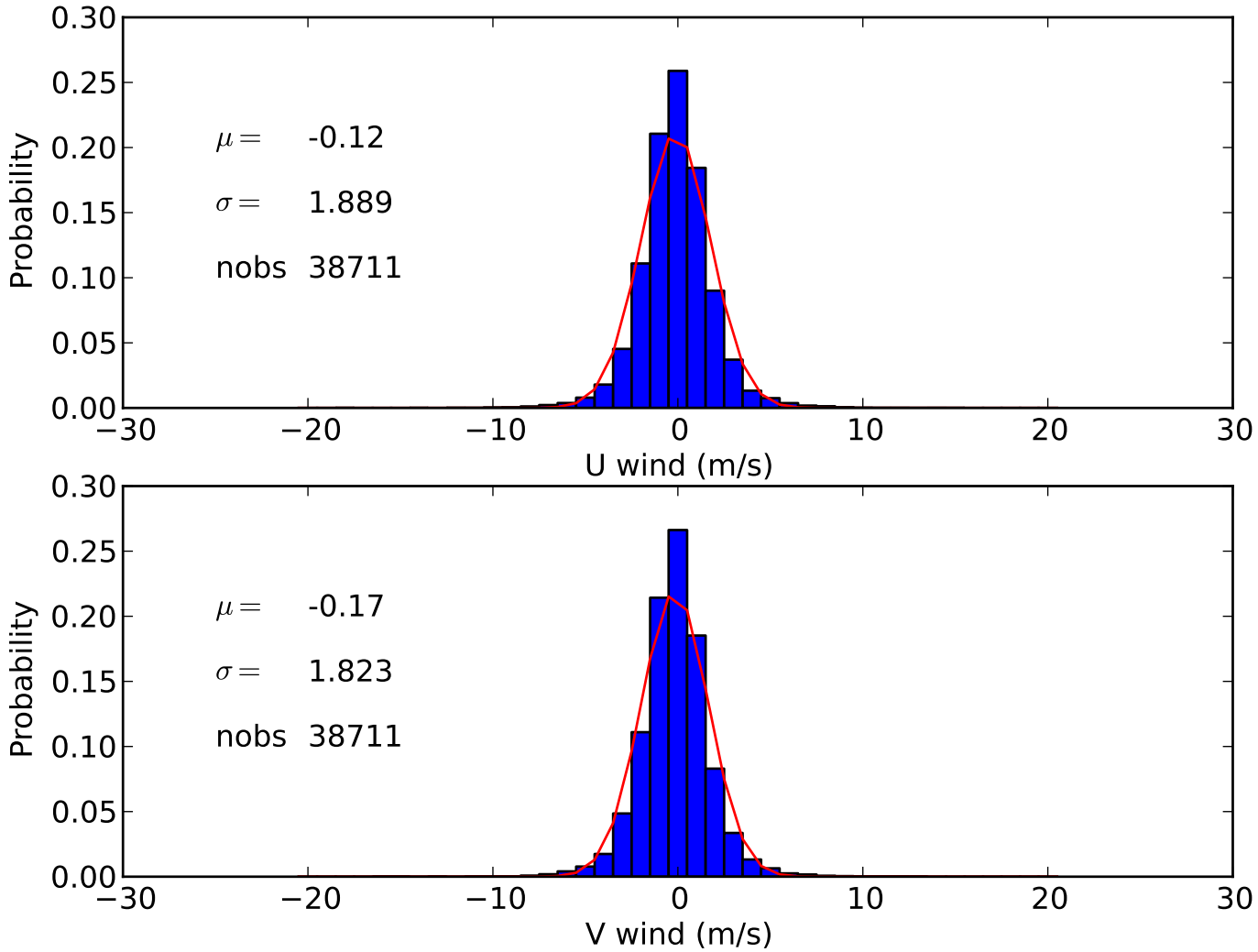


Arctic 21UTC



Data monitoring of operational systems

Departure statistics



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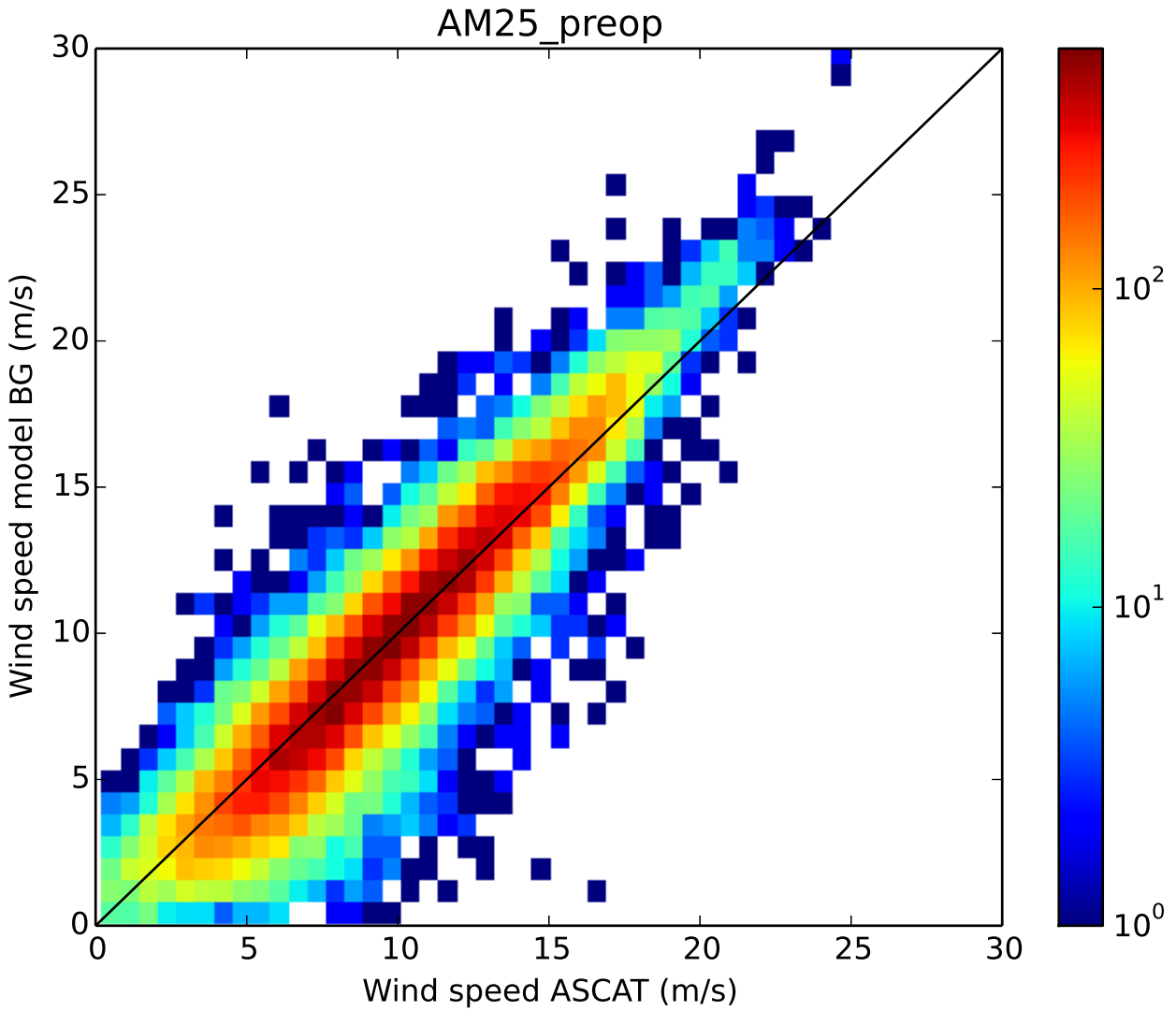

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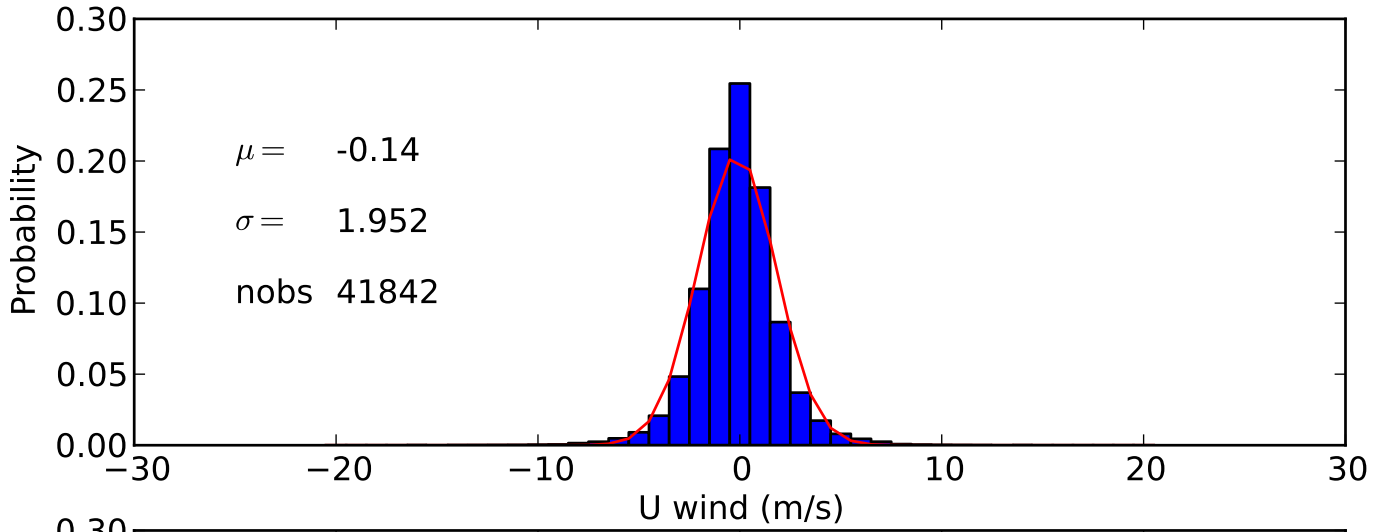

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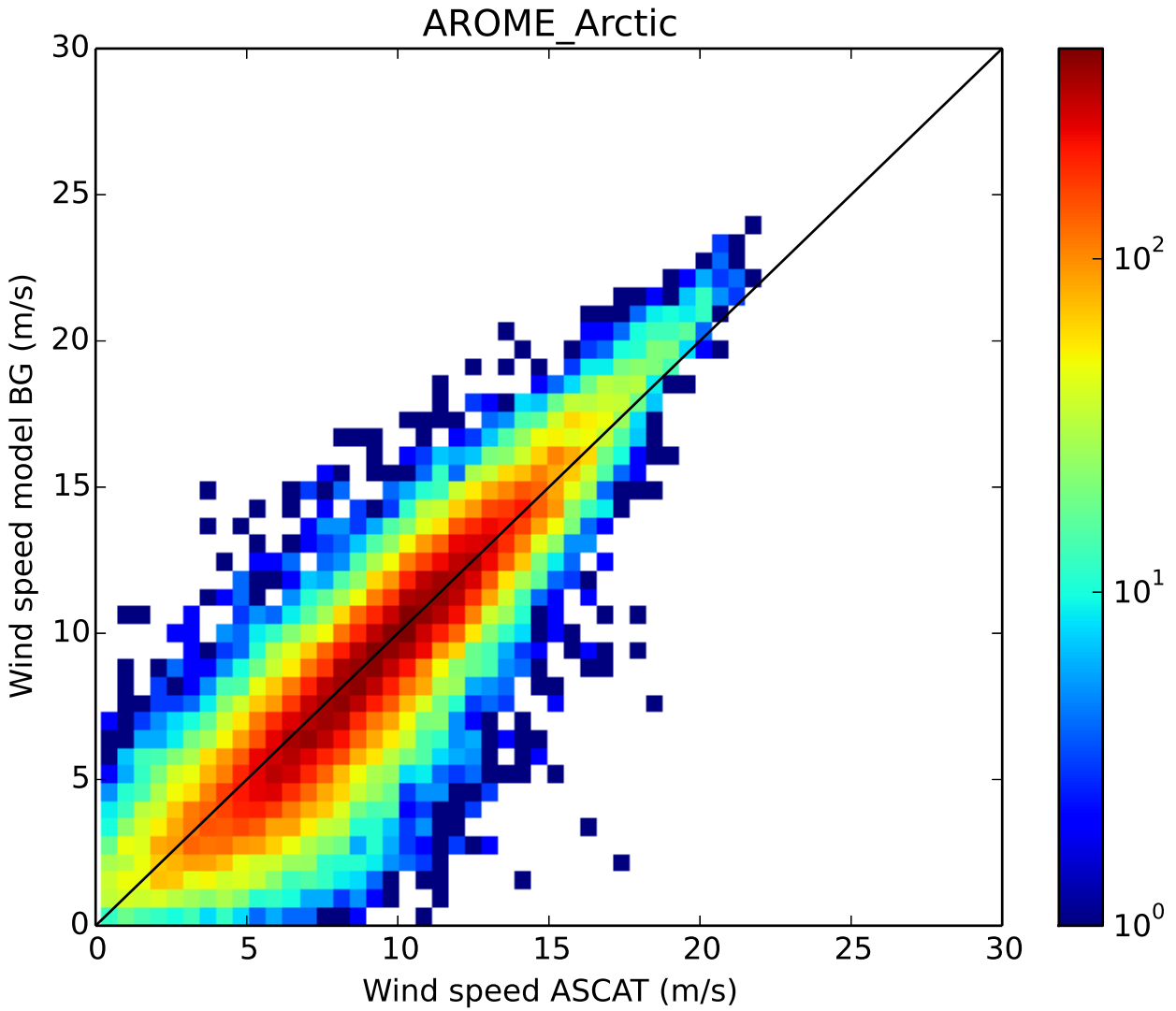
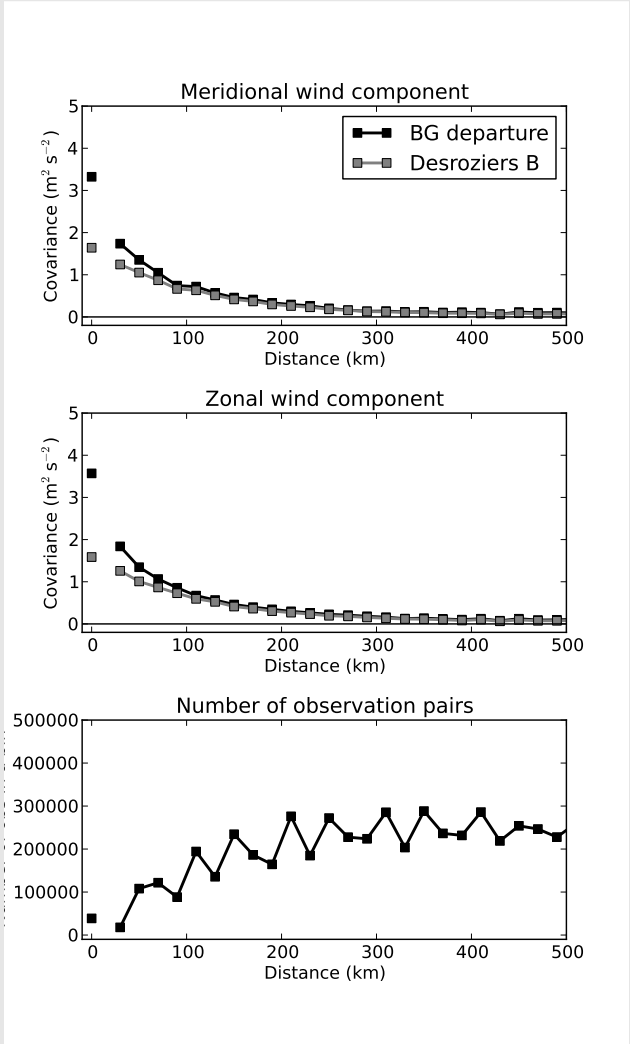


Error diagnostics

MetCoOp January 2016



The relationships by Desroziers *el al.* (2005):

$$\mathbf{R} = E[\mathbf{d}_a \mathbf{d}_b^T]$$

$$\mathbf{HBH}^T = E[\mathbf{d}_b \mathbf{d}_b^T] - E[\mathbf{d}_a \mathbf{d}_b^T]$$

- **R** is the diagnosed observation-error covariance matrix,
- **B** is the diagnosed background-error covariance matrix,
- **H** is the linearised observation operator,
- $E[\,]$ is the expectation operator,
- $\mathbf{d}_b$ is background deparature, and
- $\mathbf{d}_a$ is analysis departure from observations.

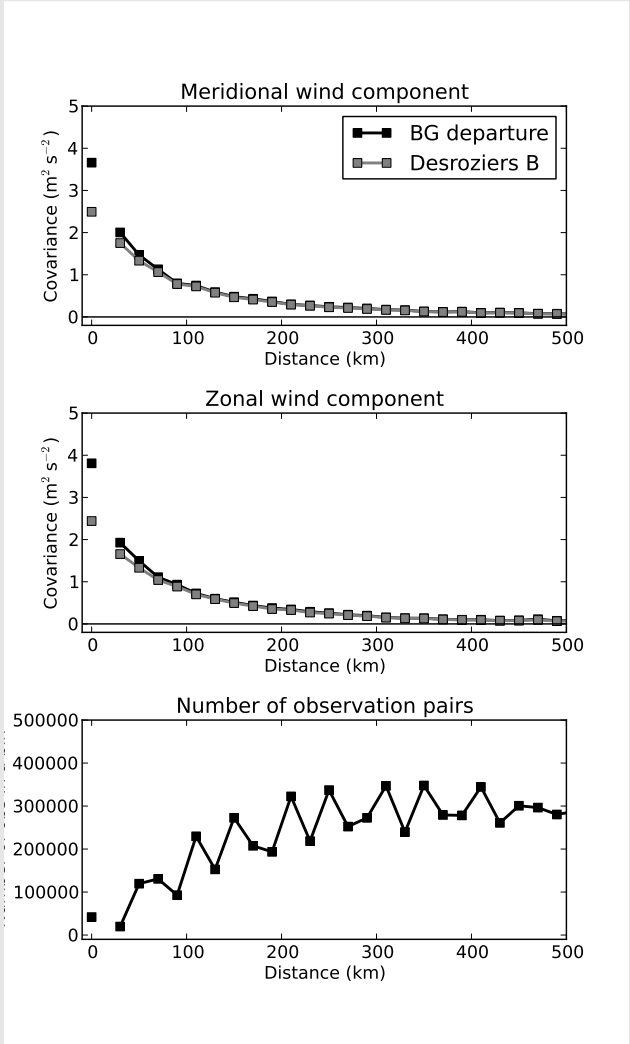
Error diagnostics

MetCoop - January 2016

Estimated error	U [m/s]	V [m/s]
Assumed observation error	1.39	1.54
Std(BG departures)	1.89	1.82
Hollingsworth/Lönnberg	1.32	1.26
Desroziers	1.41	1.31

Error diagnostics

Arctic January 2016



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Error diagnostics

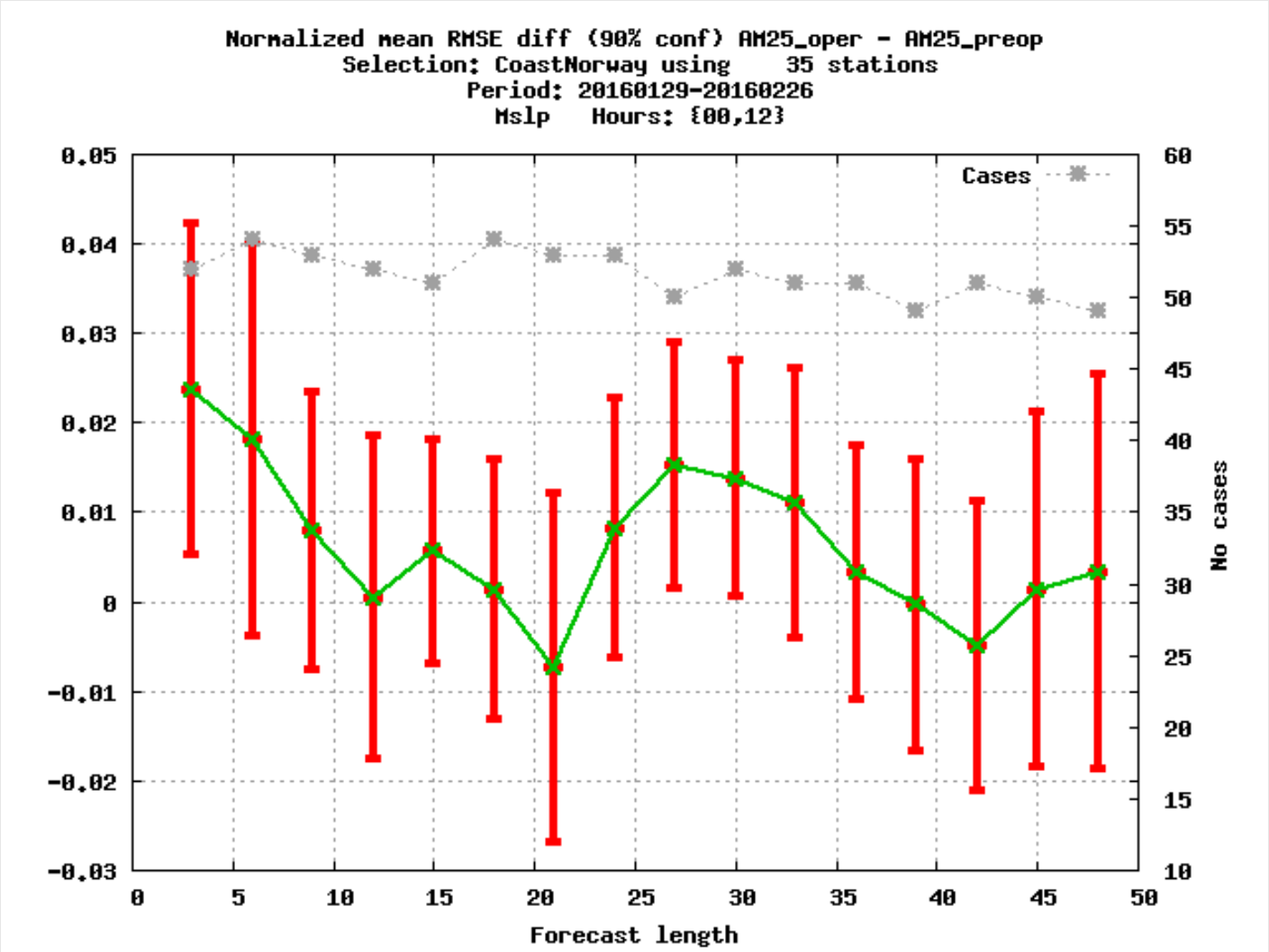
Arctic - January 2016

Estimated error	U [m/s]	V [m/s]
Assumed observation error	1.39	1.54
Std(BG departures)	1.95	1.91
Hollingsworth/Lönnberg	1.37	1.29
Desroziers	1.18	1.08

Impact on forecasts

Verification MetCoop vs. MetCoop-preop

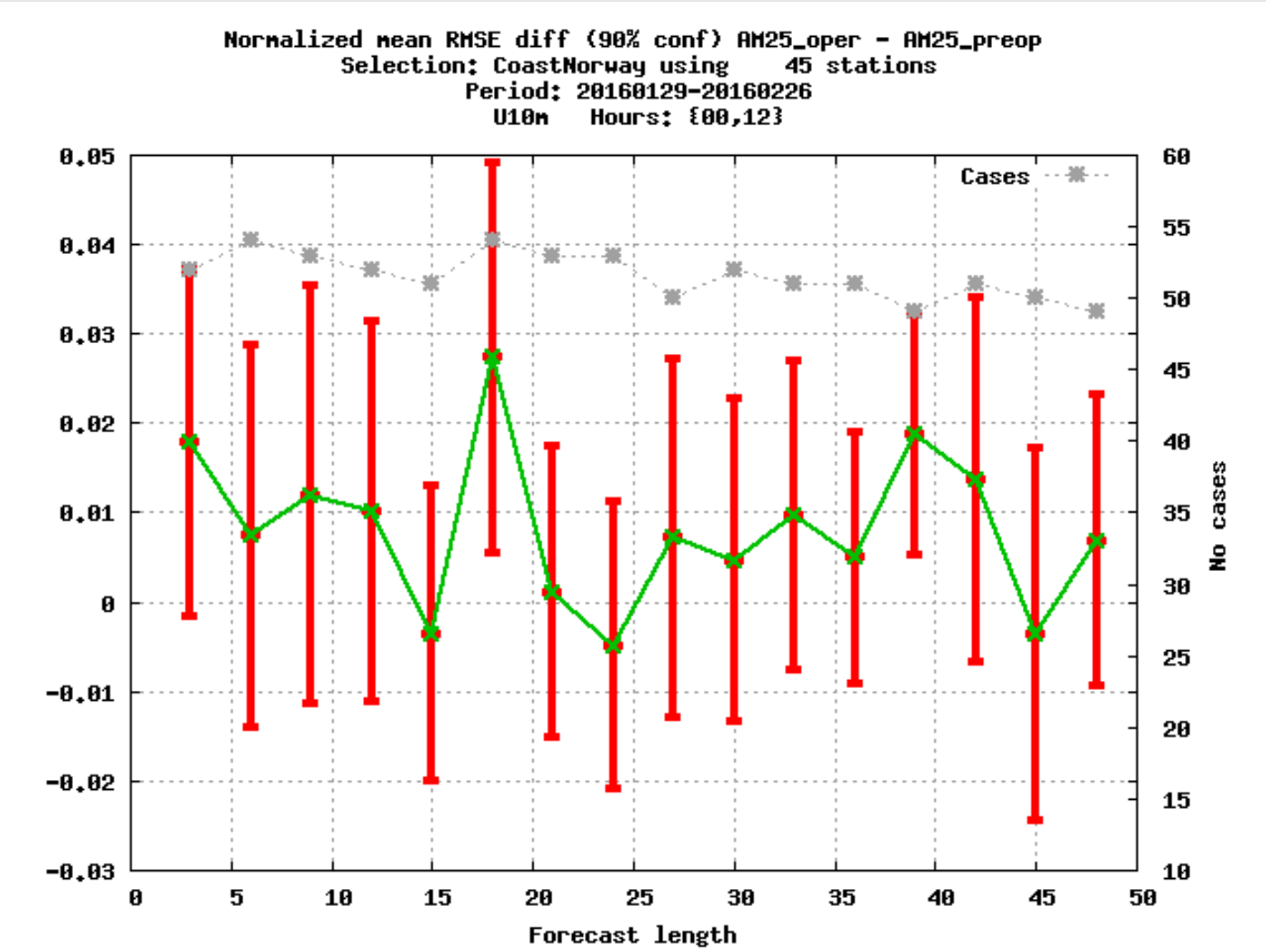
MSLP - coastal stations



Impact on forecasts

Verification MetCoop vs. MetCoop-preop

10-m wind speed - coastal stations



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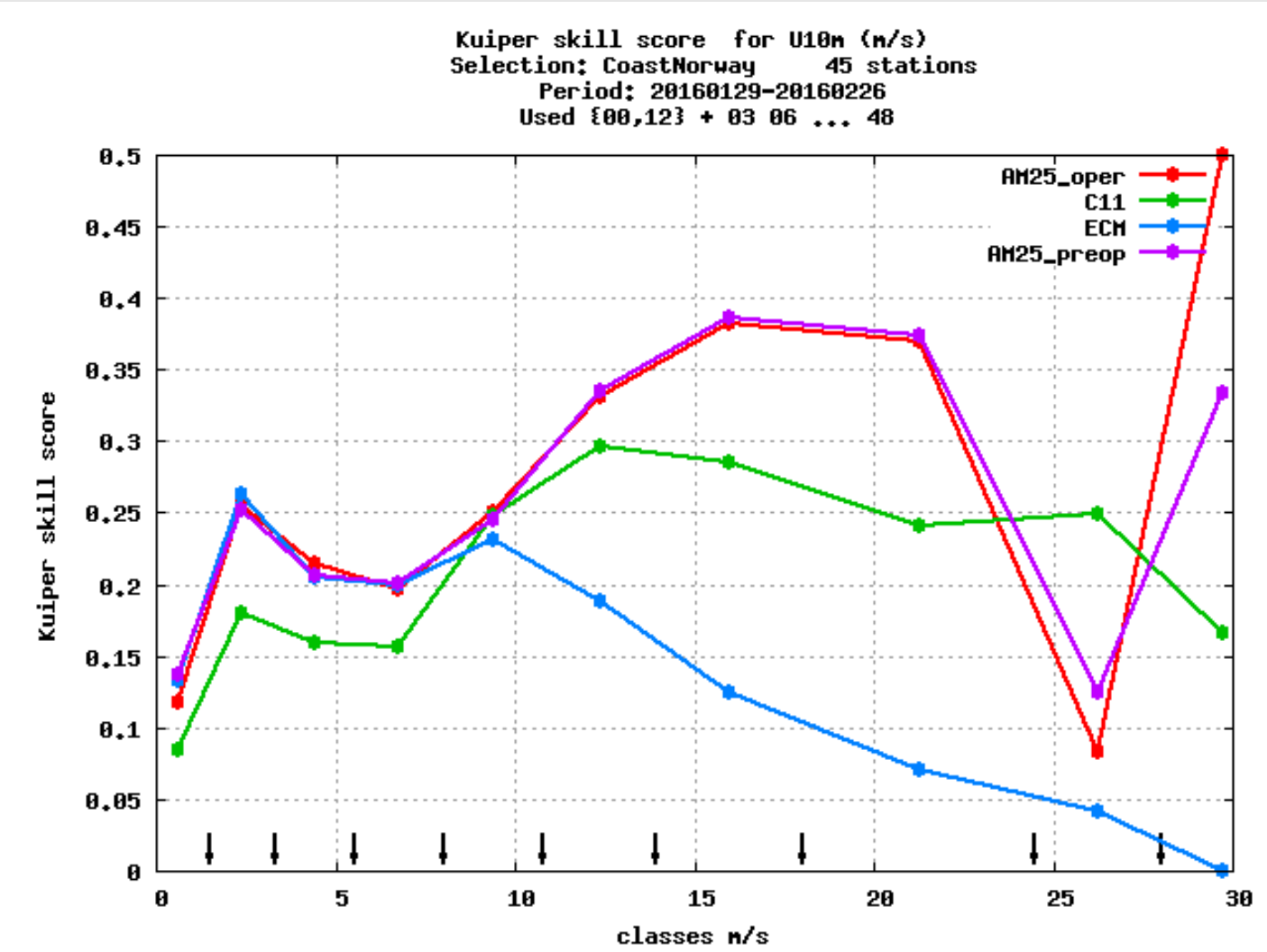
10-m wind speed - coastal stations



Summary

- Impact experimentation showed largest impact of ASCAT over ocean in MSLP and wind speed
- Thinning distance of 50 km for ASCAT improves MSLP forecasts. No spatial error correlations were found on these distances.
- ASCAT 12.5 km Coastal winds assimilated in AROME-MetCoop pre-operationally since Dec 2015 and AROME-Arctic operationally since Nov 2015.
- No problems with the ASCAT data streams and assimilation in the operational environment.
- (Marginal) positive impact on MSLP and wind speed with ASCAT assimilation compared to the operational forecast without ASCAT.

Thank you EUMETSAT!