Alertness

Impact study of scatterometer observations with improved spatial representativeness in an Arctic data assimilation system

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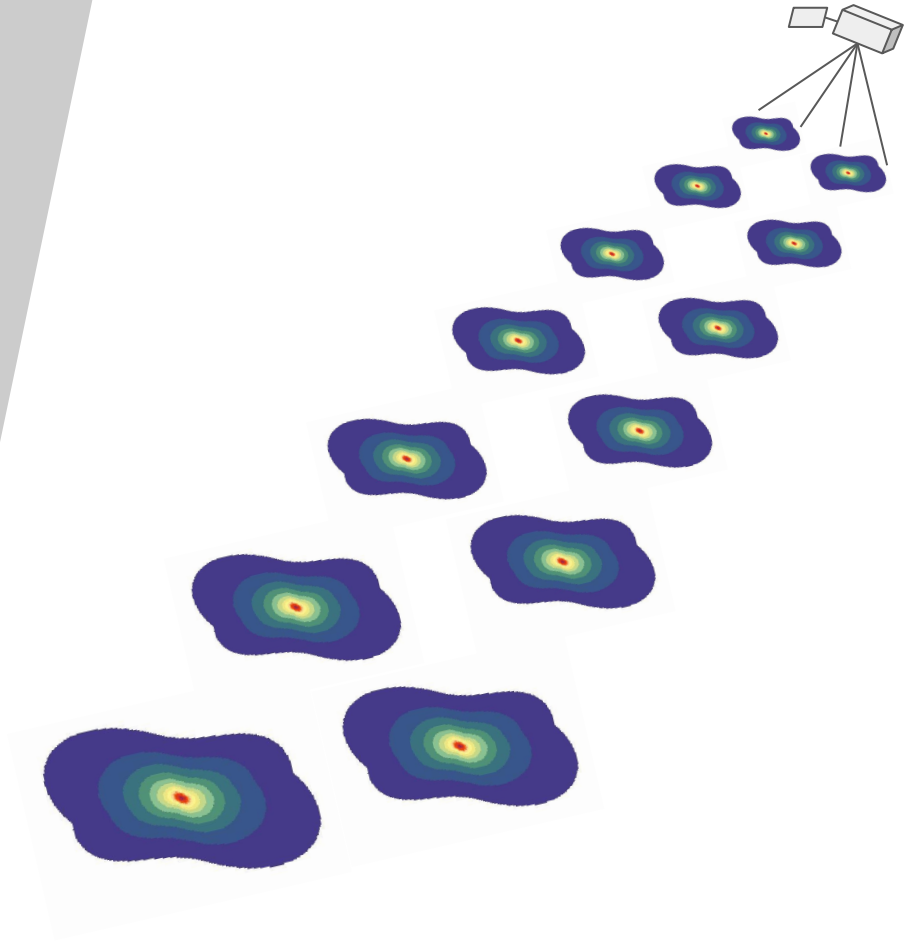
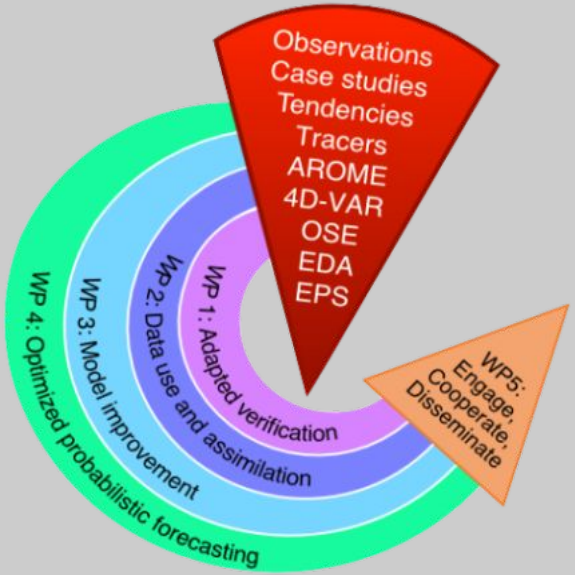


The project:

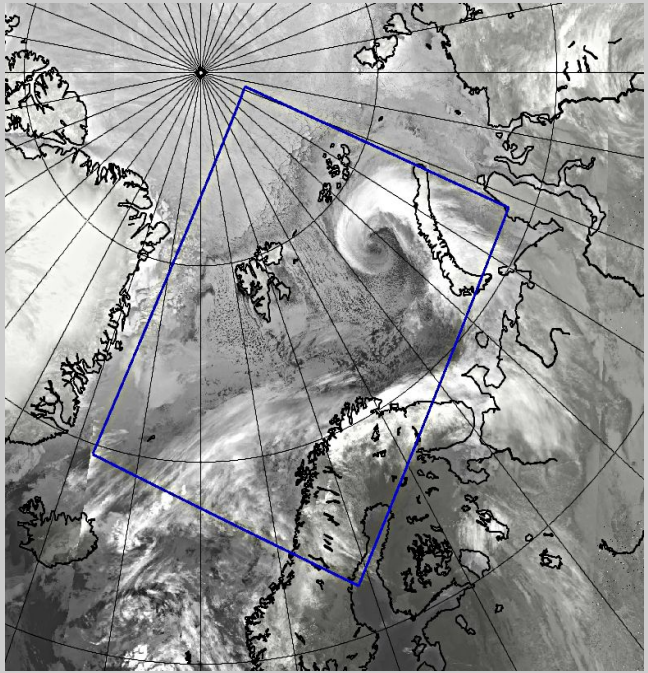
ALERTNESS (Advanced models and weather prediction in the Arctic: Enhanced capacity from observations and polar process representations)



To develop world leading capacity for the delivery of reliable and accurate Arctic weather forecasts and warnings for the benefit of maritime operations, business, and society.

Project lead: Jørn Kristiansen (MET)
Partner institutions: Norwegian Meteorological Institute (MET), University of Bergen (UiB), Uni Research (UNI), University of Tromsø (UiT), The Royal Netherlands Meteorological Institute (KNMI), Nansen Environmental and Remote Sensing Center (NERSC), and University Centre in Svalbard (UNIS)

The model: **AROME-Arctic** (high-resolution limited-area model)



AROME-Arctic domain (Horizontal resolution: 2.5 km)

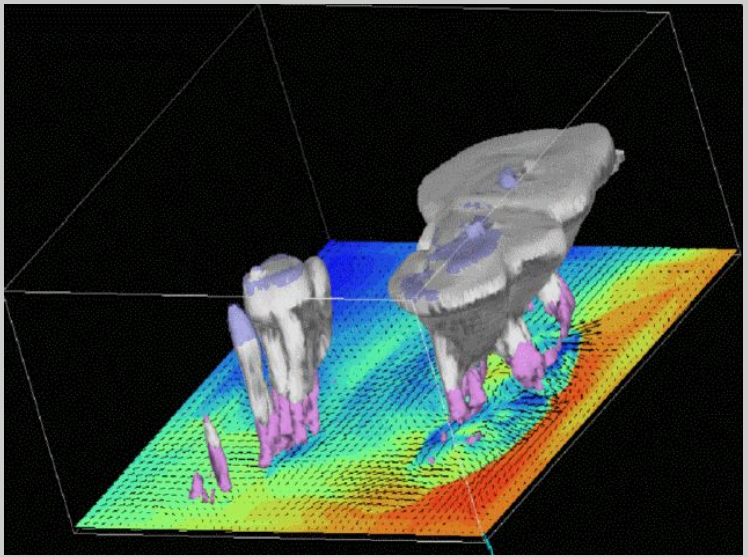


Image: AROME model *Meteo-France*

The observation: ASCAT scatterometer ocean surface winds

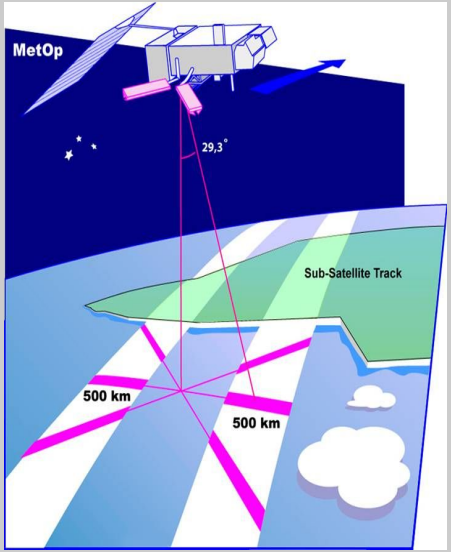


Image credit: EUMETSAT

ASCAT: sampling: 12.5km
effective resolution ~25 km

Motivation

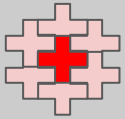
Observation

(instrument error)

(representativeness error)

Observations resolve spatial scales that the model cannot

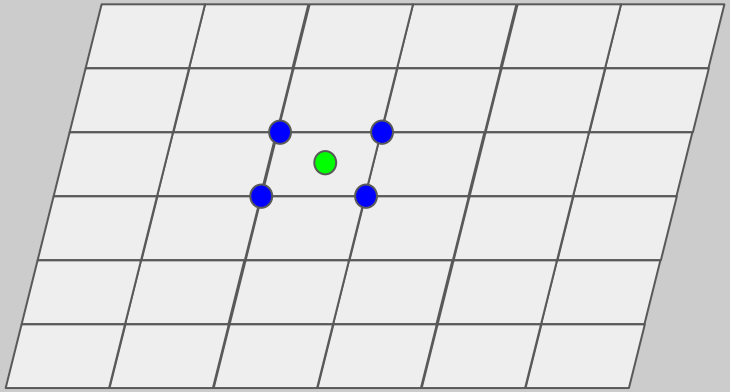
(operator error)



Observation thinning or superobbing

Observation equivalent

NWP background (model error)



Motivation

Observation

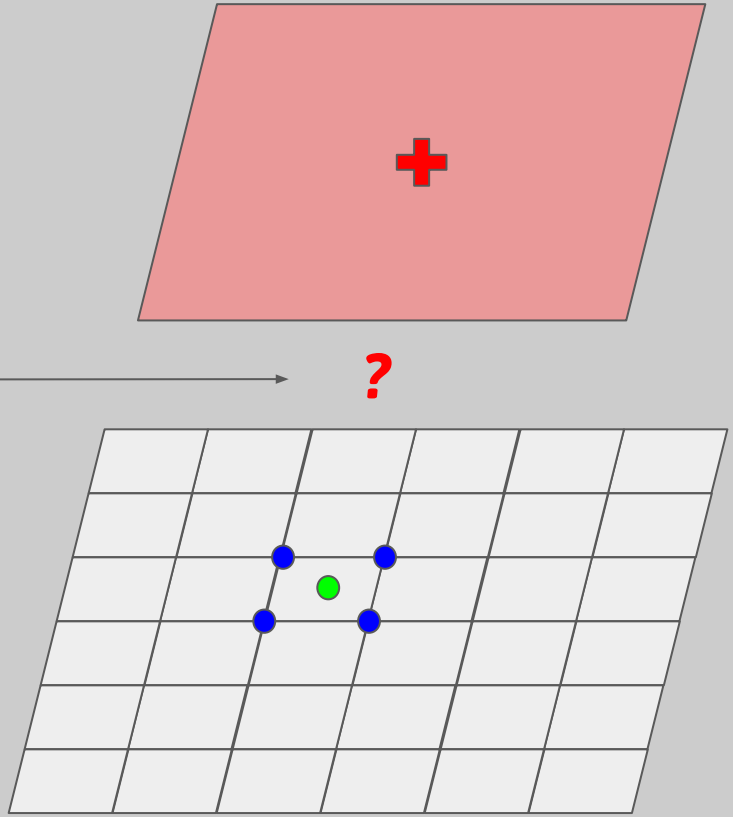
(instrument error)
(representativeness error)

Obs. eff. resol.
<<
Model eff. resol.

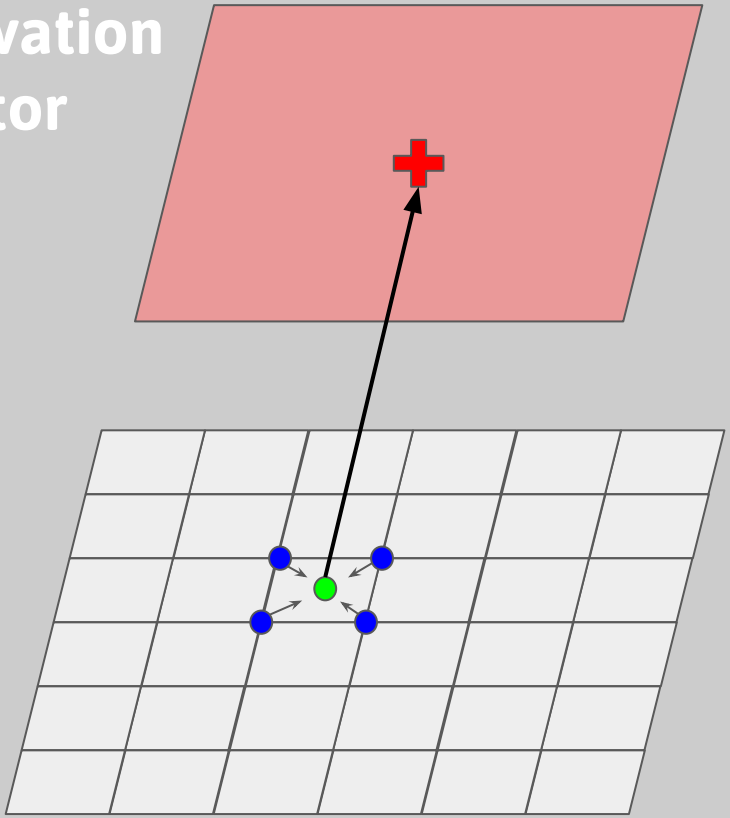
Observation equivalent

(operator error)

NWP background (model error)

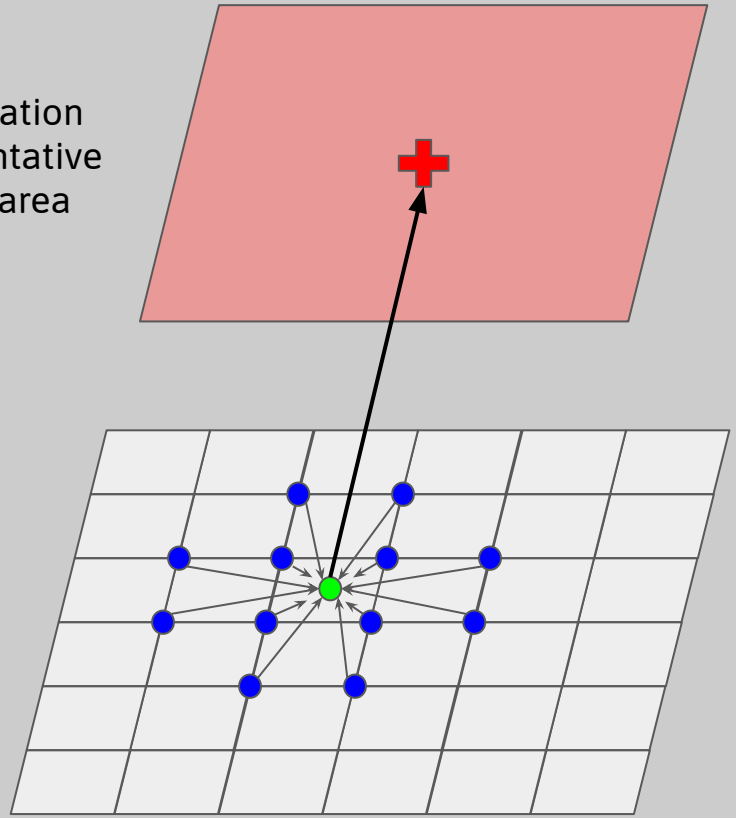


Observation operator



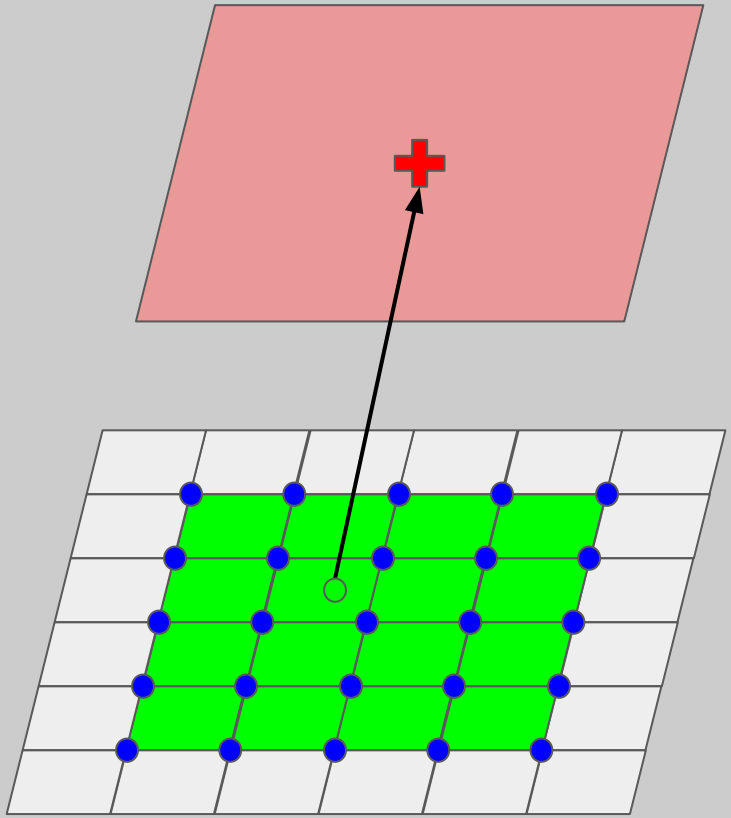
4 points horizontal interpolation

Observation representative on an area



12 points horizontal interpolation

Observation operator



Supermodding

Small-scale data assimilation:

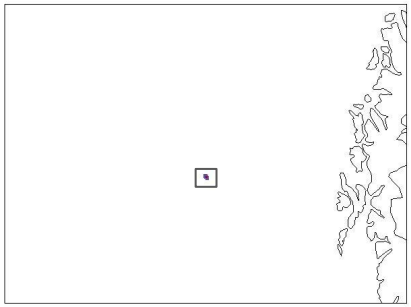
Over the ocean, there are no forcing, no orography, and hardly any observations to constrain small-scales of the high-resolution limited-area model.

Therefore, model noise contaminates data assimilation analyses and scales well analysed are more in the order of 150 km as in the hosting global model (ECMWF IFS).

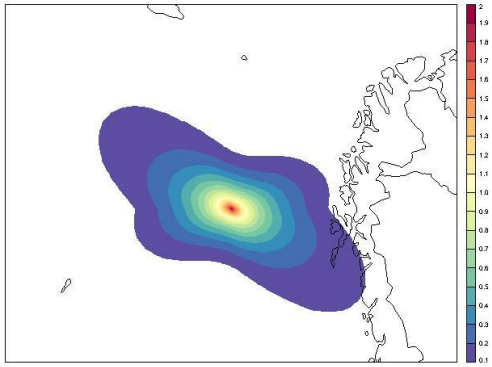
Supermodding aims **to represent the footprint** of scatterometer observations, but also **to remove model noise** from the model background fields.

Single observation experiment

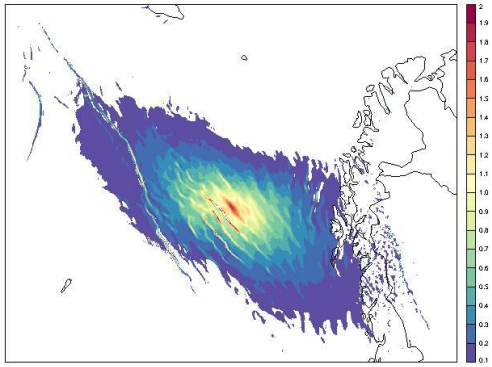
10km supermodding size



AROME-Arctic
3D-Var increments
(Wind U-component)

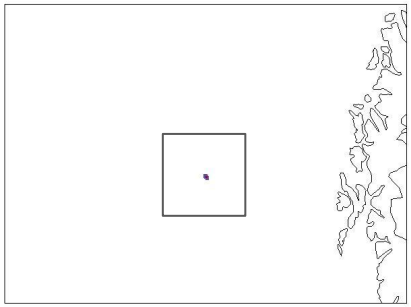


AROME-Arctic
4D-Var increments
(Wind U-component)

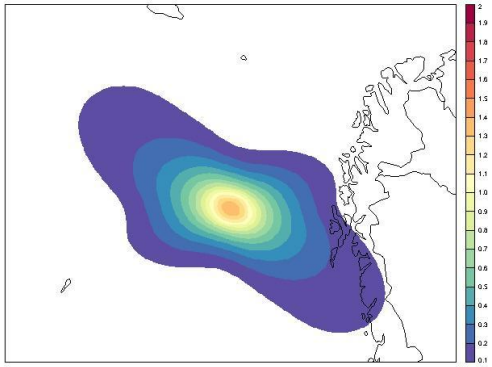


Single observation experiment

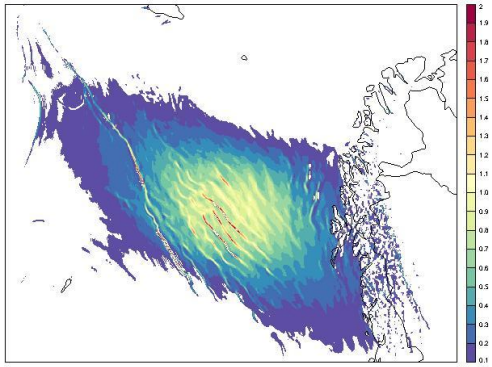
100km supermodding size



AROME-Arctic
3D-Var increments
(Wind U-component)



AROME-Arctic
4D-Var increments
(Wind U-component)



Alertness

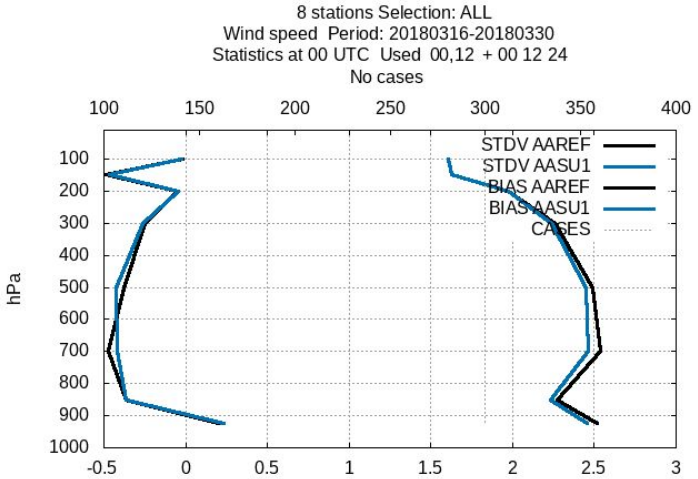
Short observing system experiment SOP1 (15th to 30th of March, 2018)

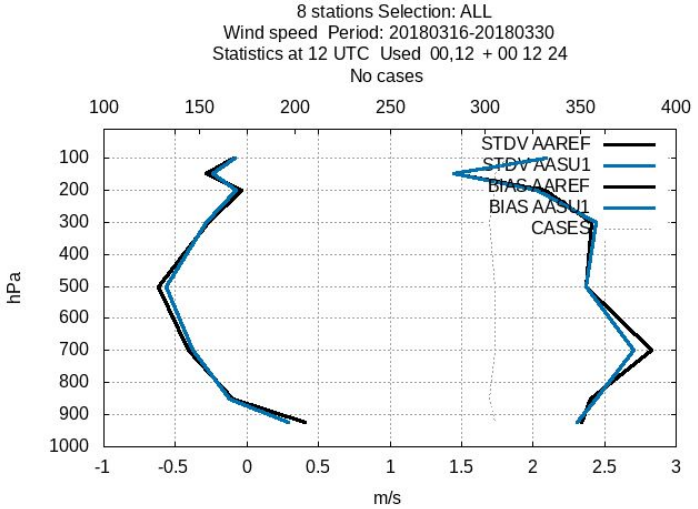
Verification results (STDV and BIAS) for wind speed at 00 and 12 UTC

30 km supermodding size - ASCAT footprint is represented

AAREF - AROME-Arctic operational
AASU1 - AROME-Arctic supermodding 30km

Wind speed forecasts are slightly improved.





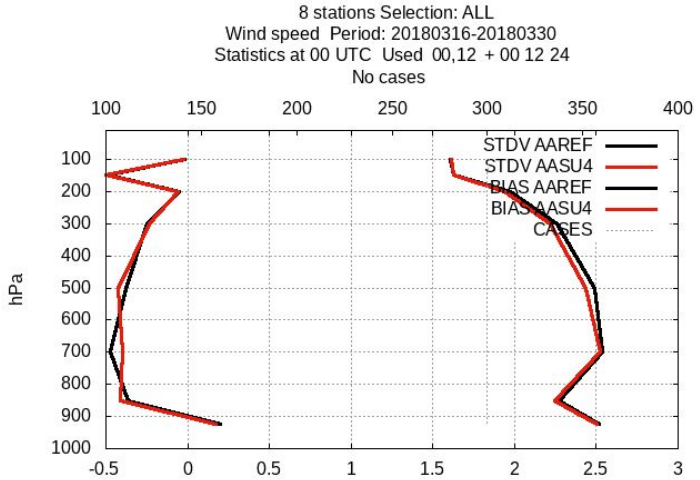
Alertness

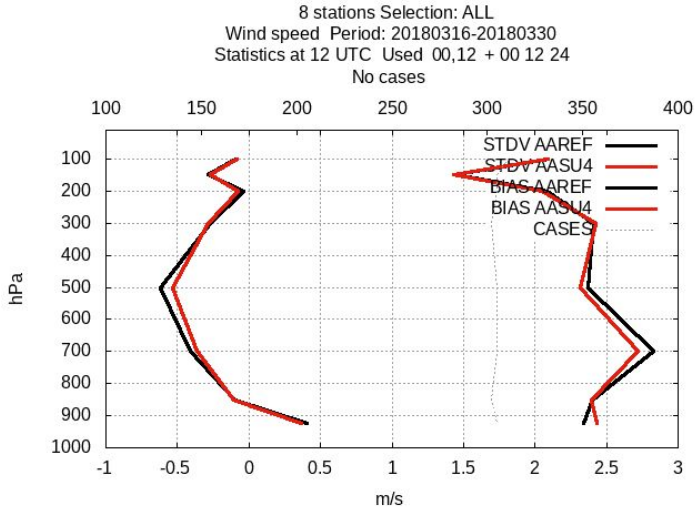
Short observing system experiment SOP1 (15th to 30th of March, 2018)

Verification results (STDV and BIAS) for wind speed at 00 and 12 UTC

60 km supermodding size - +model noise removal

AAREF - AROME-Arctic operational
AASU4 - AROME-Arctic supermodding 60km





Alertness

Short observing system experiment SOP1 (15th to 30th of March, 2018)

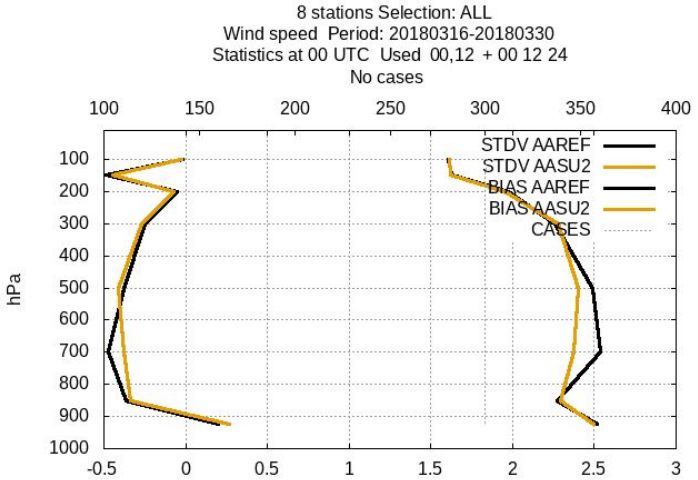
Verification results (STDV and BIAS) for wind speed at 00 and 12 UTC

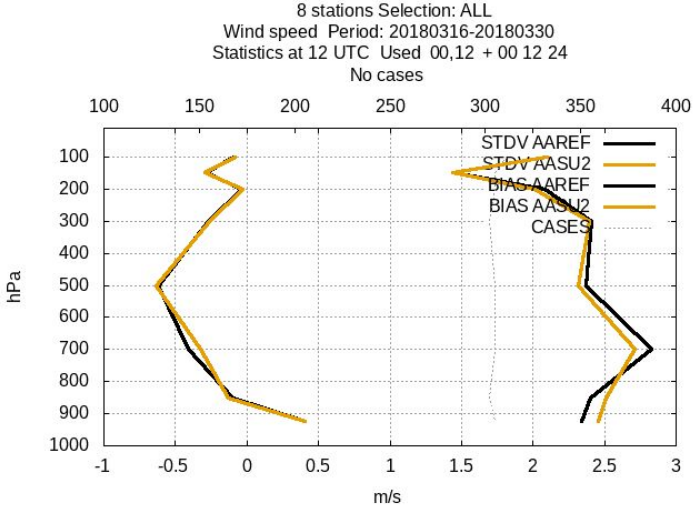
100 km supermodding size - ++model noise removal

AAREF - AROME-Arctic operational
AASU2 - AROME-Arctic supermodding 100km

Wind speed forecasts are further improved in mid atmosphere.

Wind speed near surface is degraded.
- *The tuning of predefined errors is needed.*





Summary

Spatial representativeness of remote sensing observations comes up with different structures in high resolution data assimilation systems

Supermodding approach is trying to take into account the footprint of scatterometer data and to remove unconstrained small-scale model noise through the observation operator

The impact of footprint representation is small, but positive. Further improvement can be gained by larger supermodding sizes (i.e., the removal of model noise), but it requires the tuning of predefined errors in data assimilation

Thank you for your interest!

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Social media: #alertnessarctic