HIRLAM/LACE

Advances in use of observations

Benedikt Strajnar, Magnus Lindskog & HIRLAM/LACE staff

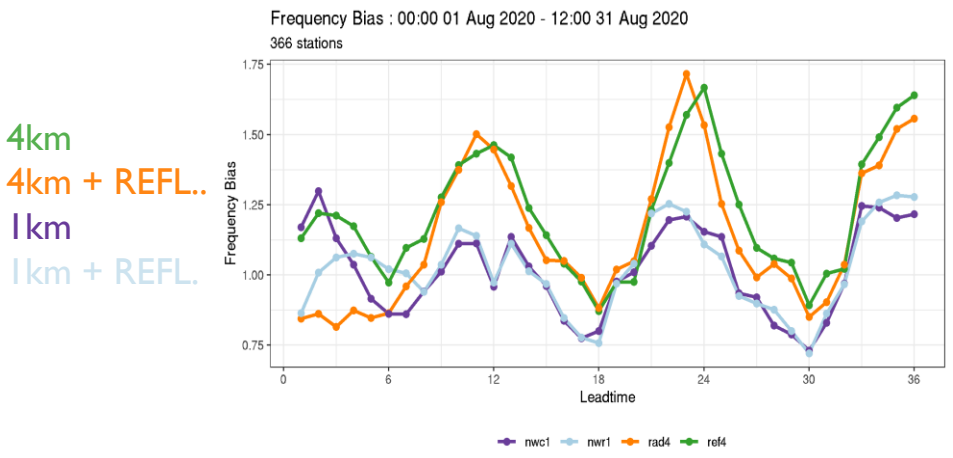
Outline

- Progress in radar DA
- Suppermodding: operator for observations with large footprints
- Improved use of radiances
- Enhanced use of atmospheric motion vectors and scatterometes
- Recent examples with crowd-sourced observations

Progress of radar data assimilation

Reflectivity

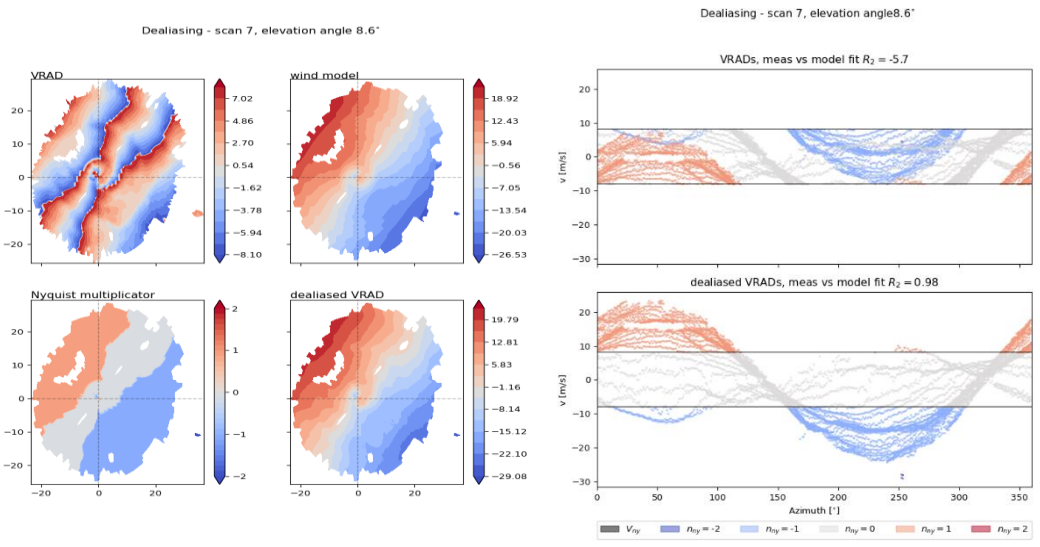
- Impact studies with radar reflectivity (Bayesian inversion) at various resolutions
- Decrease of frequency bias of hourly precipitation up to 9h



2 mm/hour precipitation threshold.

Radial winds

- Ongoing evaluation of impact of Spanish DOW
- Performance of dealiasing improved (torus mapping). Enables use of numerous sites in central Europe



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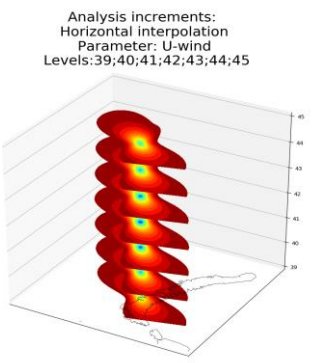
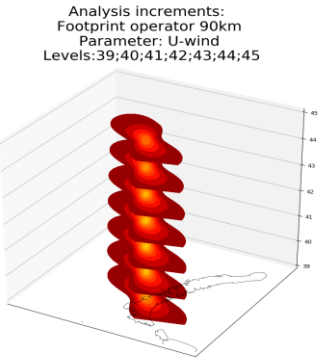
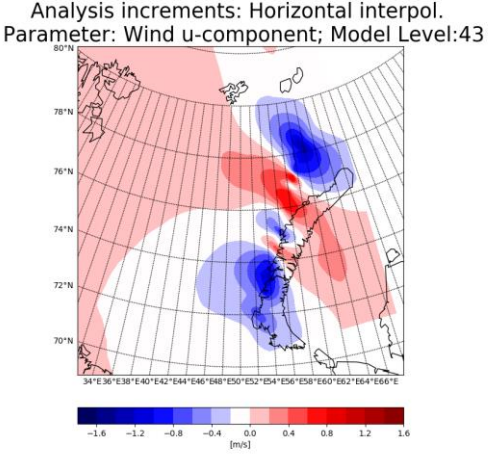
Supermodding

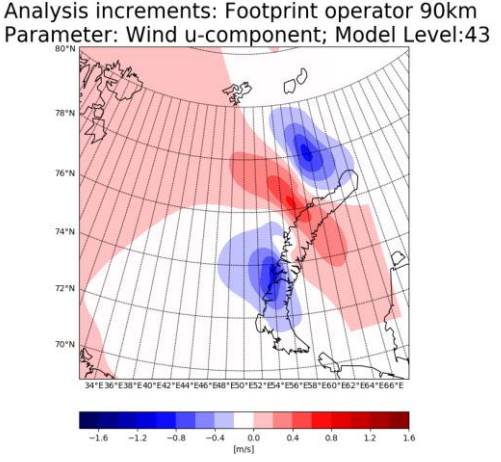
Supermodding: a **footprint operator** to average model within the footprint of observation to better handle the scale differences between observation and model.





- First developed for ASCAT
- Applied to ASCAT, Aeolus and radiance observations
- Less fit to observations and smother analysis increments





Máté Mile et al., QJRMS: 20 January 2021, https://doi.org/10.1002/qj.3979.

M. Mile, R. Randriamampianina, G.-J. Marseille, A. Stoffelen

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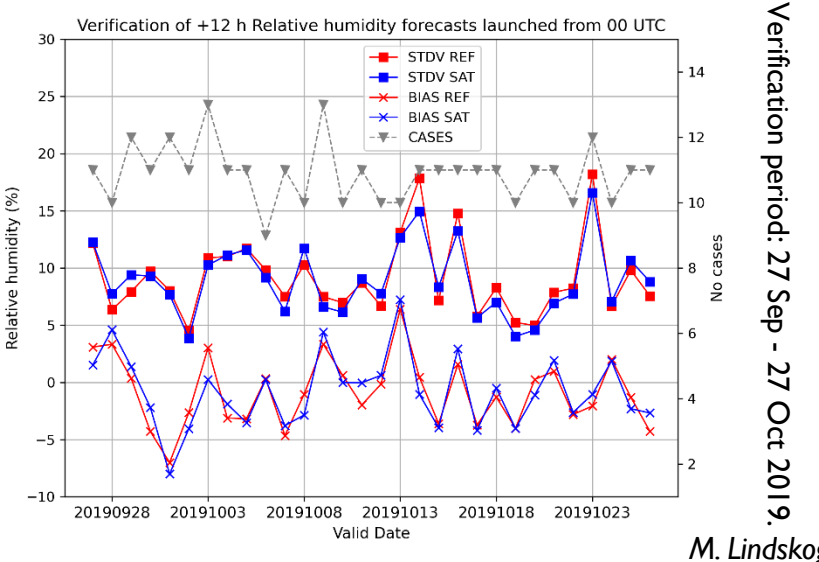
Increased use of clear-sky radiances

FY-3C/D MWHS2 AND METOP-C MHS/AMSU-A

Lindskog, M., A. Dybbroe, R. Randriamampianina. 2021: Use of Microwave Radiances from Metop-C and Feng Yun-3 C/D Satellites for a Northern European Limited-area Data Assimilation System. Adv. Atmos. Sci., https://doi.org/10.1007/s00376-021-0326-5.

Improved use of satellites (Metop-C, FY-3D, SNPP, NOAA20, Meteosat, HY-2B and soon FY3E) and sensors (ATMS, SEVIRI, MWHS-2) at some institutes.

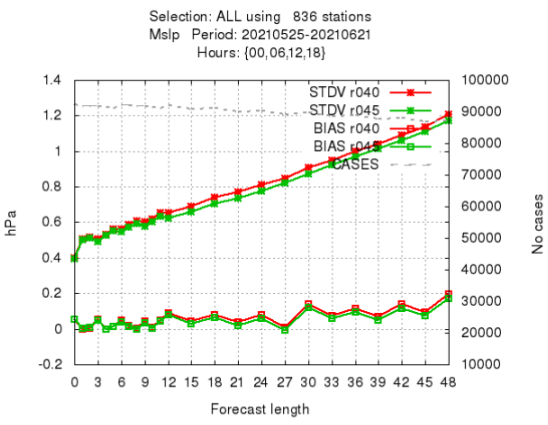
Verification against radiosondes

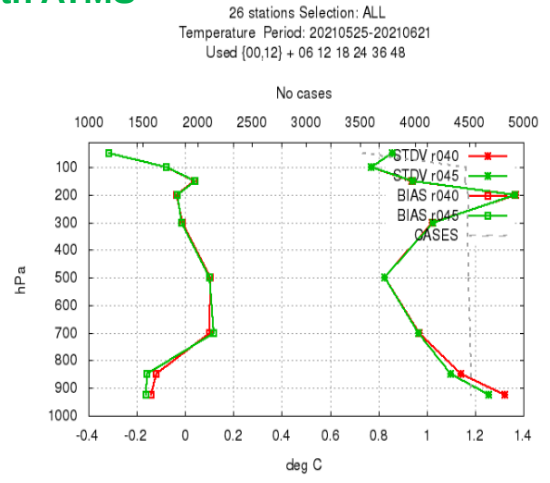


Verification period: 27 Sep - 27 Oct 2019.

Suomi-NPP and NOAA-20 ATMS

REF and **with ATMS**





M. Lindskog, A. Dybbroe, R. Randriamampianina, R. Eresmaa

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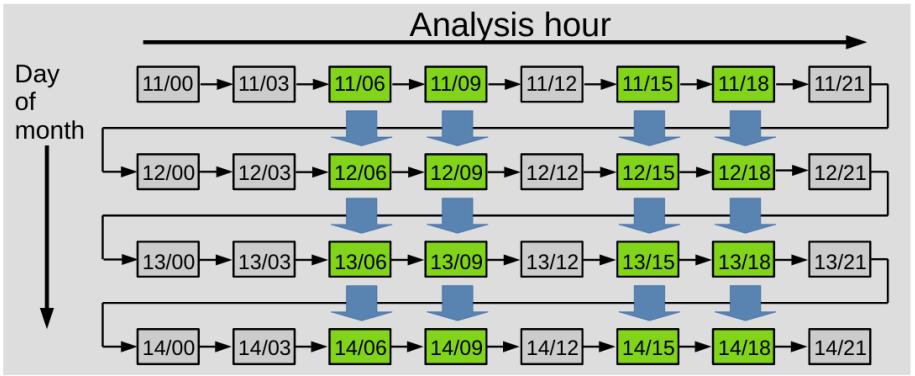
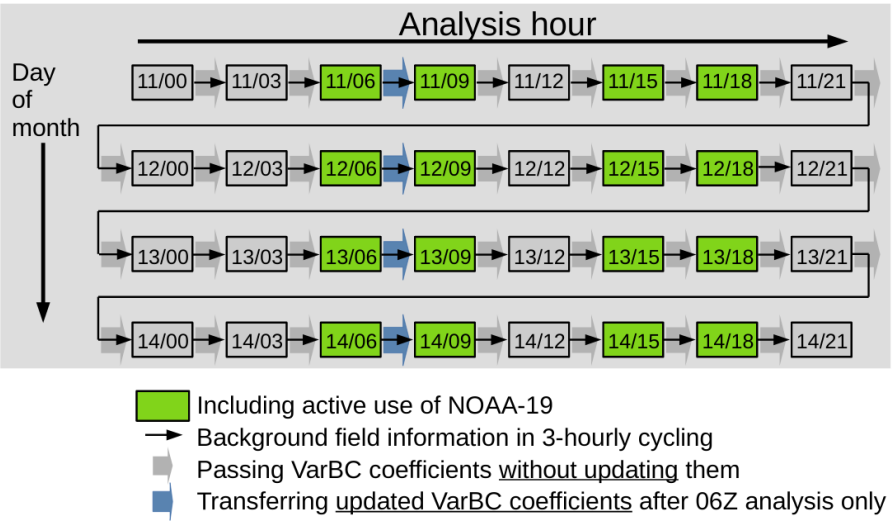
Variational bias correction in LAM

Var-BC cycling

Current



Refined



- New strategy under evaluation
- Update time only when coverage of data is optimal
- Update times for each satellite provided by a namelist to the Var-BC code

R. Eresmaa

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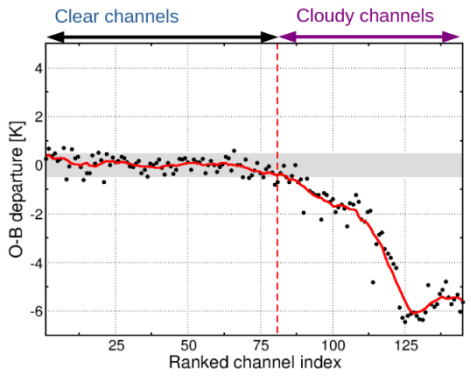
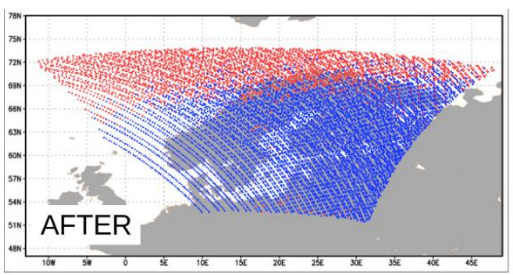
Improved cloud detection for IR radiances

Properly working



Stratospheric channel cloudy
Stratospheric channel clear



General idea

McNally and Watts cloud detection (2003):

– Take a large number of channels from the 15 μm (long-wave IR sounding band

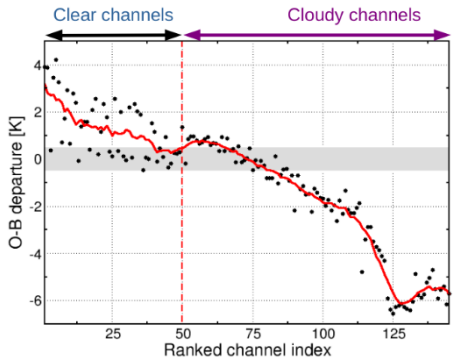
– Rank O-B departures in vertical and apply a smoothing filter

– Find the ”breaking point” that marks the distinction between clear and cloud-affected channels

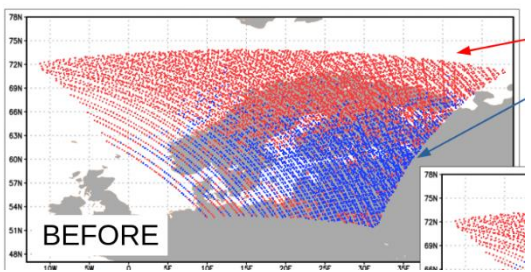
- Carefully select channels to be used in cloud detection
- Let all these data through bias correction (in active or passive mode)

R. Eresmaa

Sub-optimally working



Stratospheric channel cloudy
Stratospheric channel clear



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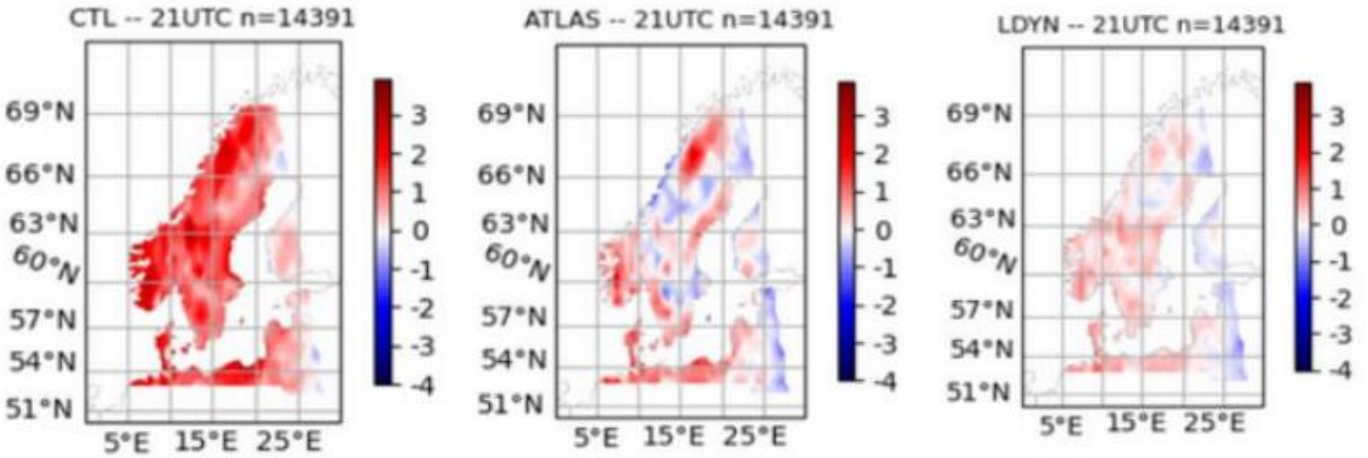
Improved use of low-peaking channels

3. Exploring an improved use of low-peaking channels using emissivity Atlases or dynamical emissivity estimates.

Maps of FGd AMSU-A Channel 4 (52.8 GHz) using different surface schemes - 09/06/2021 (21UTC)



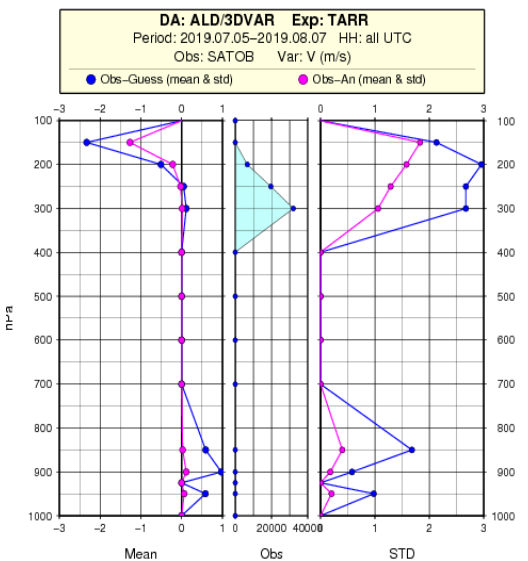
On-going experiments

S. Guedj, R. Stappers, J. Blyverket

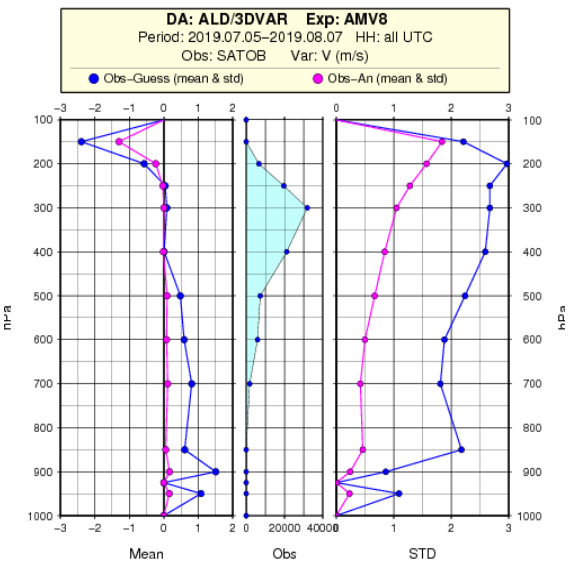
Impact of mid-troposphere AMVs

- Traditionally blacklisted between 350 and 800 hPa (700 hPa over land)
- Passive departure statistics for MSG/AMV show comparable quality
- Additional data with neutral/slightly positive impact

Reference OMG/OMA



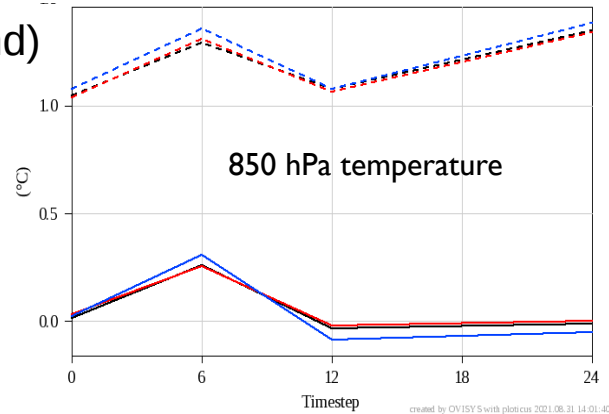
Modified blacklisting OMG/OMA

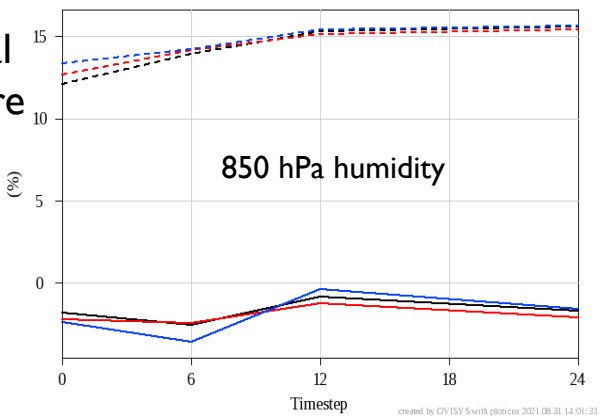


REF

REF + AMV

REF + additional mid. troposphere AMV



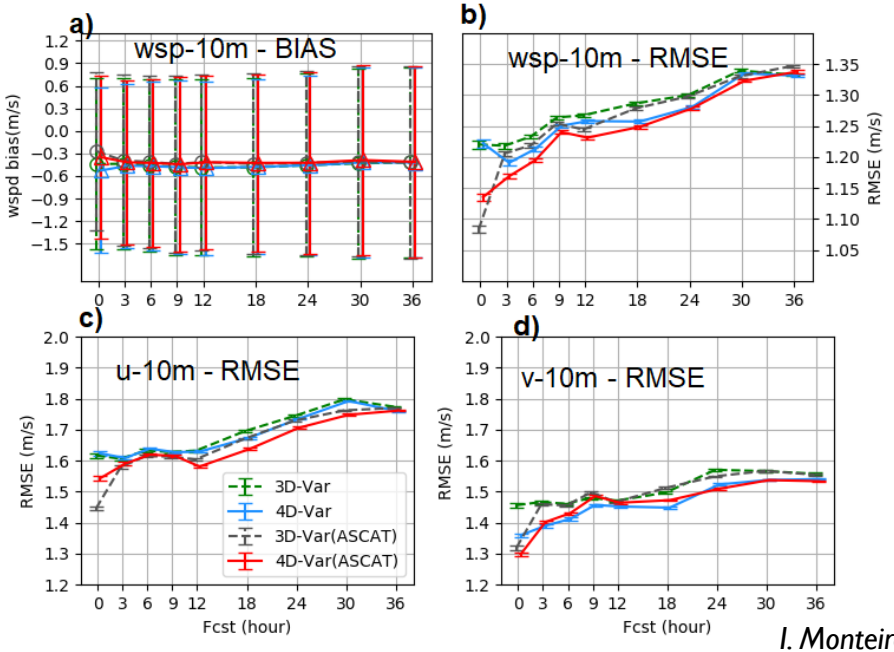


Z. Kocsis

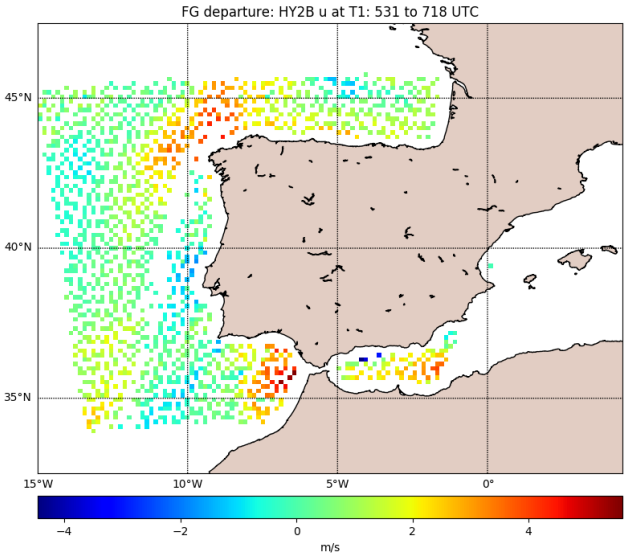
Assimilation of scatterometer winds

- Impact study in 3D-Var and 4D-Var, using ScatSat for independent verification
- Improved scores for Wsp at all lead times (36 h) in 4D-Var
- Additional instrument tested

Impact of ASCAT



HY-2B fg. departure



I. Monteiro, J. Barkmeijer, F. Silva

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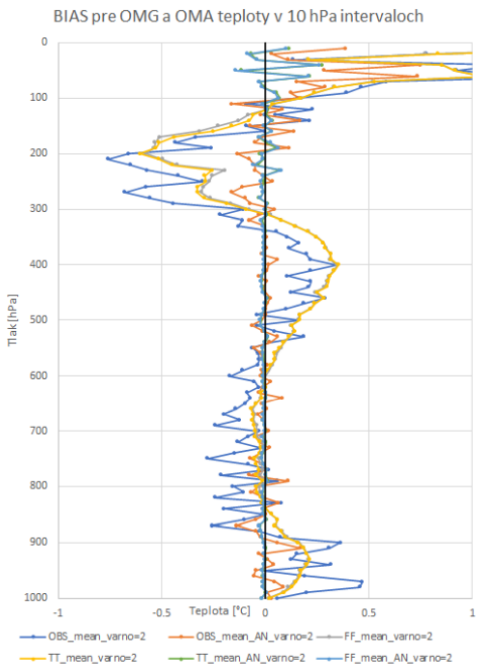
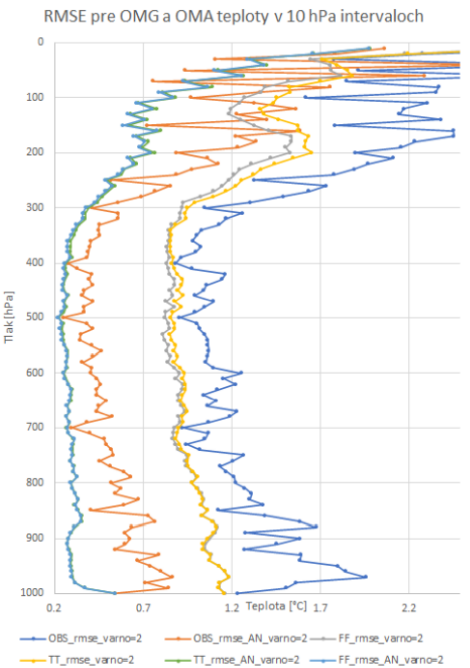
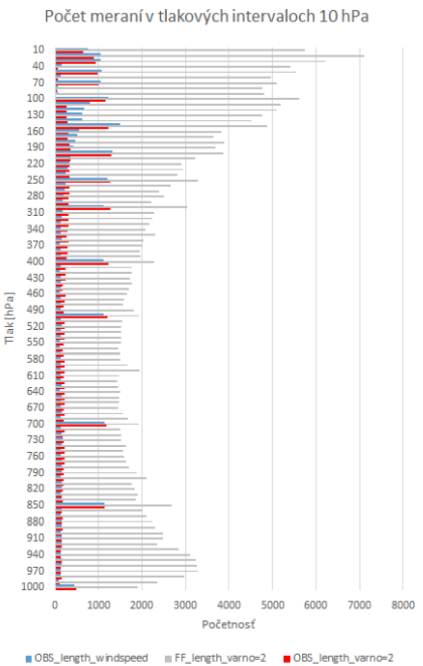
Use of high-resolution radiosondes

Comparison of BUFR-encoded and ASCII radiosonde data

- Improvement mainly by higher resolution (positive impact on short-range forecast)
- drift effect much smaller and increases with height







REF

BUFR

BUFR + drift

M. Derkova, P. Strban

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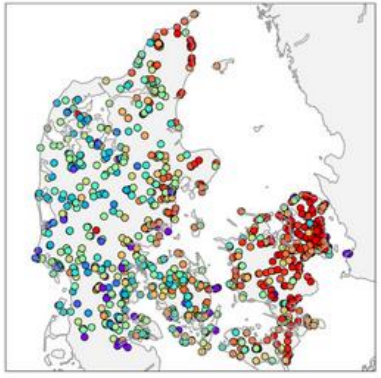
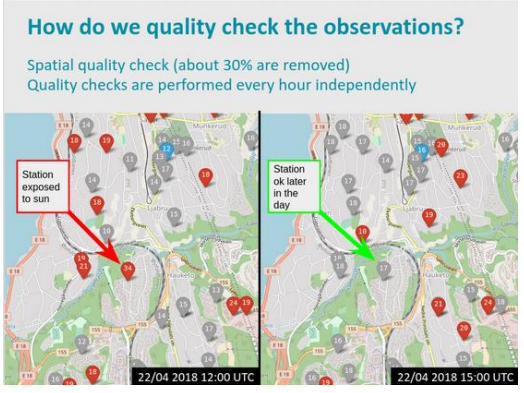
Crowd-sourced observations: smartphones



One hour of data
over Dennmark
10 May, 2018
8.30-9.30 UTC

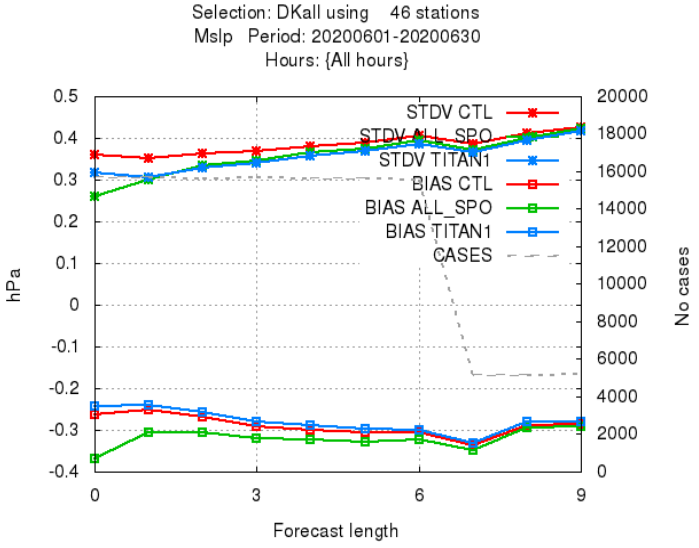
TITAN QC FUNTIONALITY



Checks: Plausibility, FirstGuess, Fraction, Sct, Buddy, Climatology, Redundancy, BlackList, DomainCheck, NoMeta

Surface pressure from smartphones

Verification scores from a one-month parallel exp.

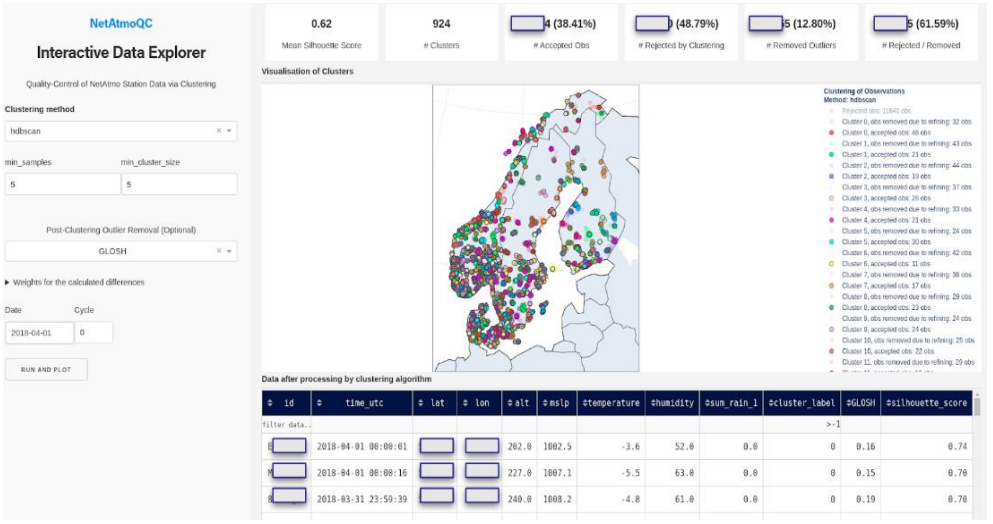


Standard deviation and bias for surface pressure forecasts for three runs. Red is control with no SPOs, green is all SPOs with no QC, blue is QC with TITAN (no thinning, no bias correction but with inflated obs. errors).

K. Hinz, , T. Aspelien, T. Snipen

Crowd-sourced observations: Netatmo

QC using Unsupervised Machine Learning (ML)



Find clusters of similar observations, accept observation with highest degree of confidence within a cluster. Reject obs. that look like outliers or do not belong to any cluster.

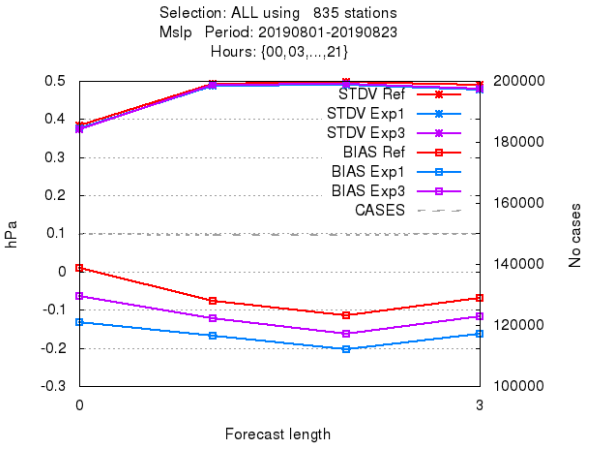
$$d_{i,j} = w_s.d_{s;i,j} + \sum_{\Lambda} \sqrt{w_{\Lambda}^2.(\Lambda_j - \Lambda_i)^2}$$

Distance and data characteristics taken into account.

Surface pressure from Netatmo stations

Verification scores from a three-week parallel exp.

Ref - No Netatmo
Exp1 - Netatmo with basic QC prior to model QC
Exp3 - Netatmo with ML QC



VARBC, thinning and inflation applied to NetAtmo data.
Further tuning and optimisation planned.

E. Gregow, M. Ridal, P. Medeiros, R Stappers, J. Bojarova et al.

Ongoing work and challenges

- Implementation of radar data (in the hourly conv. permitting RUC), superobbing
- Improved use of clear-sky and all-sky use of radiances (e.g., MHS) and other satellite products (winds)
- Application of suppermodding for observations with large footprints
- Exploitation of alternative obs. sources (PWS, smartphones, microlinks, GNNS-related data, including relevant QC)