



*Meteorologisk
institutt
met.no*



Radar data assimilation at met.no and OMSZ

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met.no: Christoffer A. Elo, Martin S. Grønsleth

Outline of the presentation

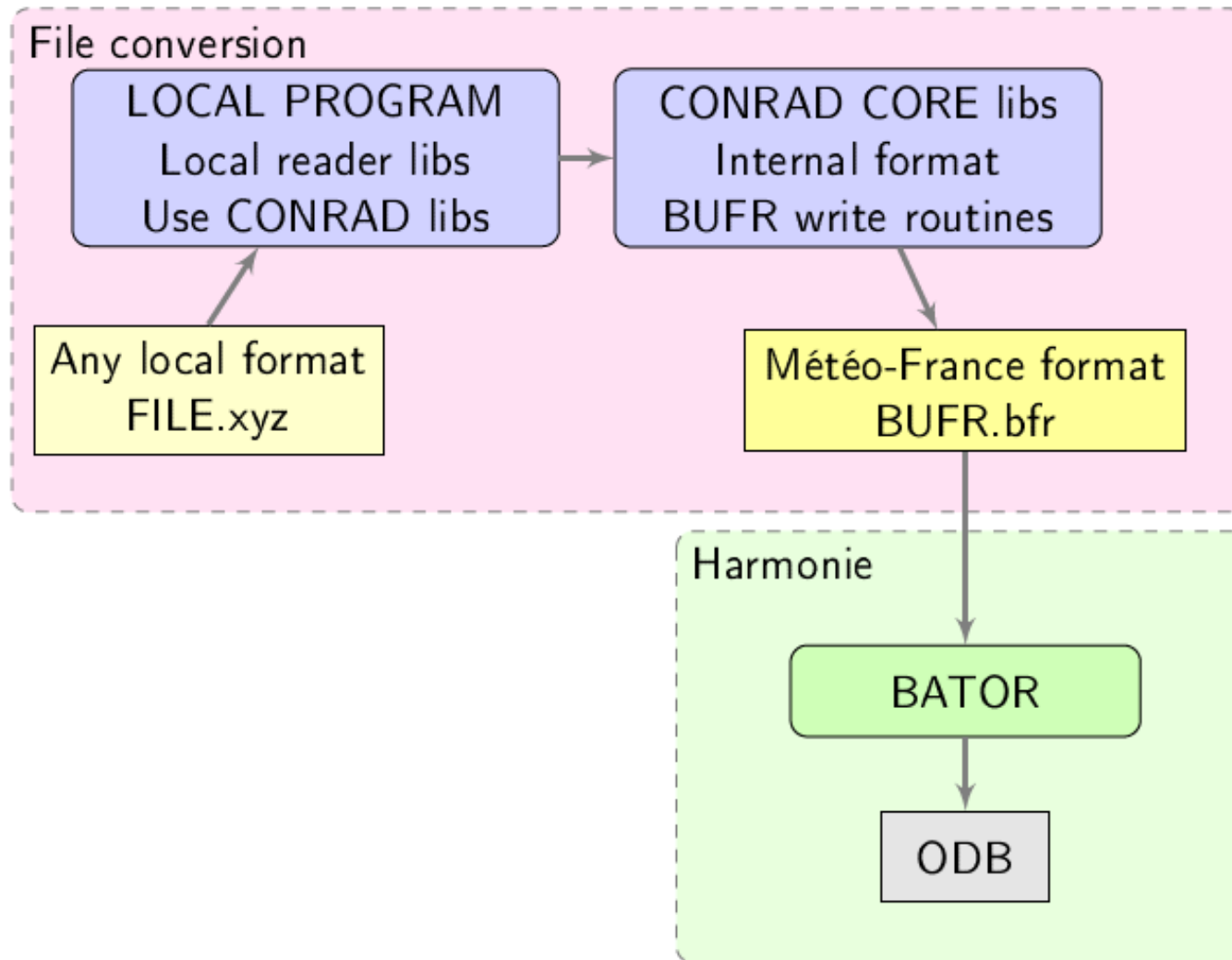
- ❑ The radar data pre-processing
- ❑ The applied assimilation technique
- ❑ The assimilation trials and the impact study
- ❑ Concluding remarks and future plans

The radar data pre-processing - a reminder

- met.no with Martin S. Grønsleth, started a radar project in 2009.
 - We have proposed to Hirlam community first, then to the Aladin, to follow the Météo France solution for the radar BUFR encoding.
- We had taken a decision to build a common convert - CONRAD (CONversion of RADar data)
- The first version of CONRAD was developed by Martin S. Grønsleth
 - Thanks to many contributors from different centres CONRAD have today few available “plugins” for BUFR and even HDF5;
 - today, CONRAD is used in different centres as radar data converter.

The radar data pre-processing - a reminder cont'd

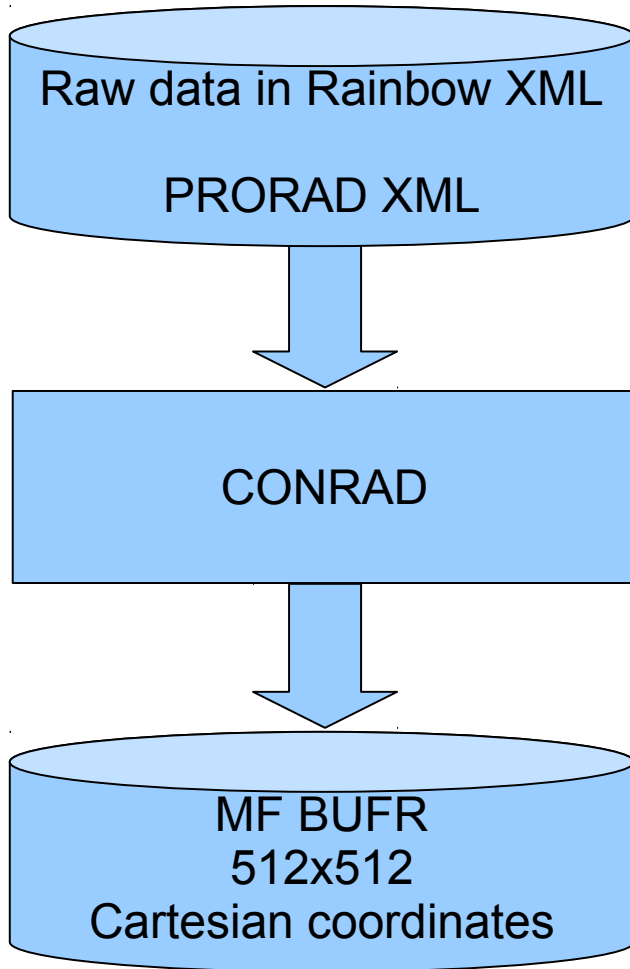
CONRAD data flow



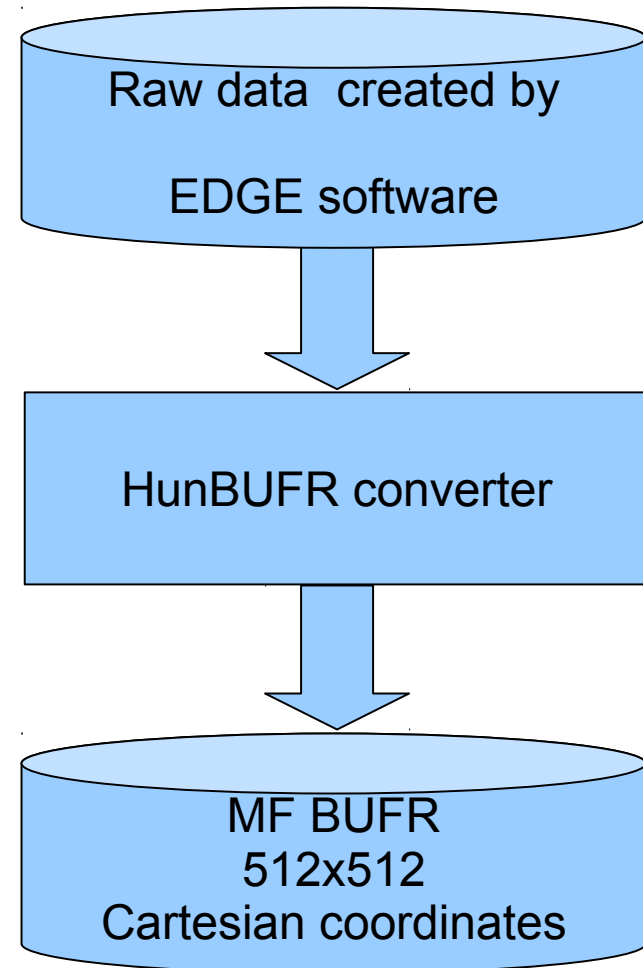
The radar data pre-processing at both centres

BUT!

met.no



OMSZ



The radar data pre-processing - technical details

met.no radars:

- Doppler Radar type:
SELEX Gematronik DP
- Scan frequency:
Northern Norway 7.5 minutes
Southern Norway 15 minutes
- Number of elevations differ between
Southern and Northern Norway.
- Radar range:
Reflectivity: 240km
Doppler data: 120km

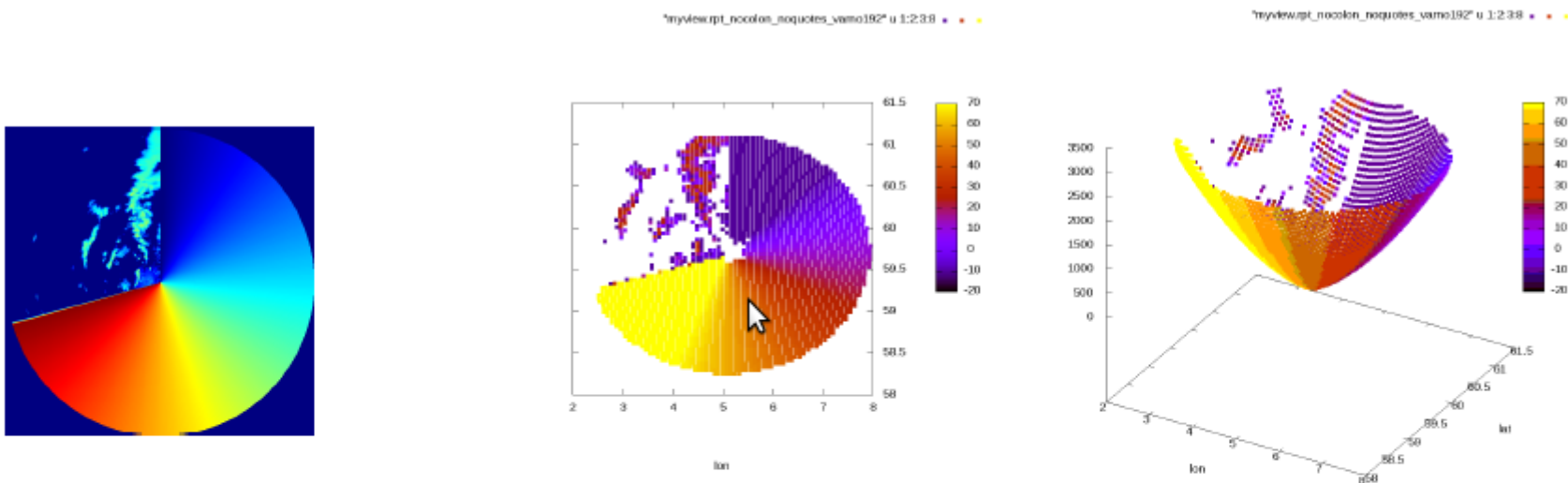
OMSZ radars:

- Doppler Radar type:
EEC
- Scan frequency:
All radar 15 minutes
- Same number of elevations for all radars
(10x)
- Radar range:
Reflectivity: 240km
Doppler data: 120km

→ In both cases we read separately the reflectivity and radial wind in bator

The radar data pre-processing - PPIs verification

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(a) Pixel values in raw data (radial range ~ 240 km) (b) dBZ values retrieved from ODB, seen from above (radial range ~ 160 km) (c) dBZ values retrieved from ODB, 3D view (radial range ~ 160 km)

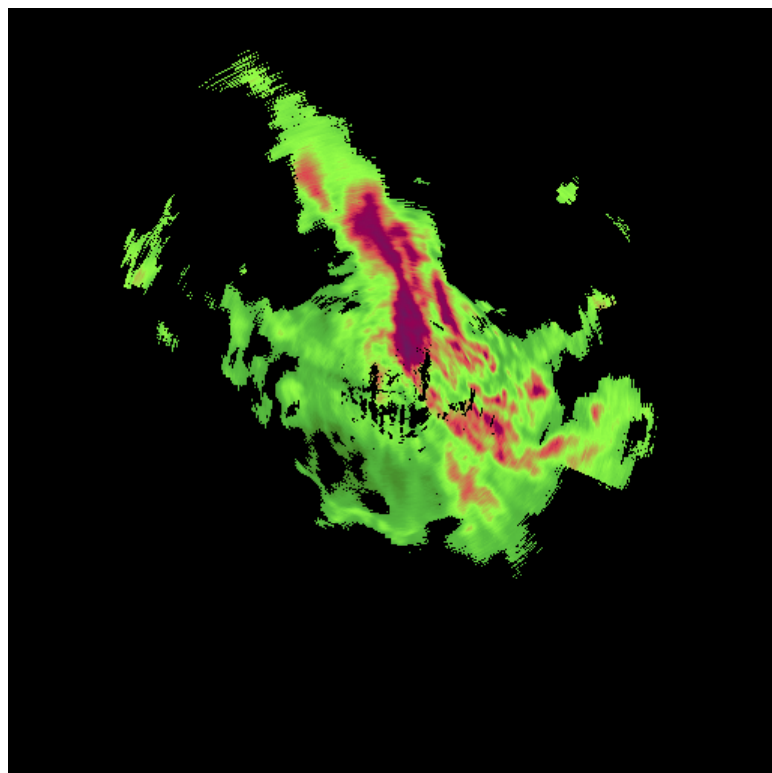
Figure 3.1: Verification of picture orientation, comparing PPIs (Plan Position Indicator) of (a) raw input data and (b,c) as obtained from the ODB (Observational database). Note that the color maps do not correspond, and that the radial range is different in (a) and (b,c).

(Grønsløth and Randriamampianina, 2012)

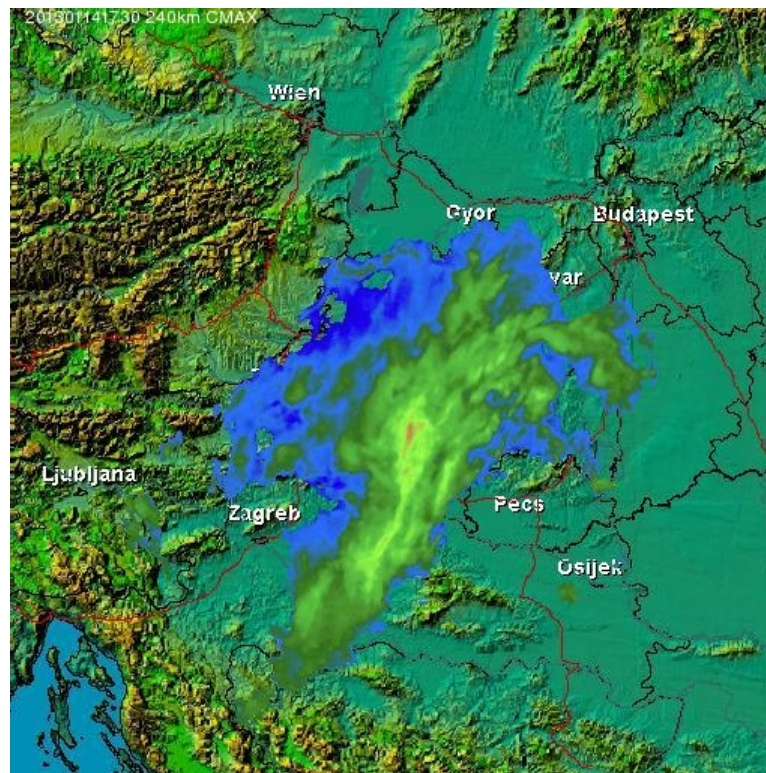
http://www.met.no/Forskning/Publikasjoner/Publikasjoner_1995_-_2012/Publikasjoner_2012/?module=Files;action=File.getFile;ID=4584

The radar data pre-processing - possible problem

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Wrongly created observation file



The observation

→ filling out the fields from upper left and not from the lower left corner.

The applied assimilation technique

Use of Météo France method for both reflectivity and radial wind assimilation

- For reflectivity we apply 1D Bayesian + 3D-VAR (*Caumont et al., 2010*)
More presentations about the applied methods can be found on web.
- For radial wind see *Montmerle and Faccani, 2009*

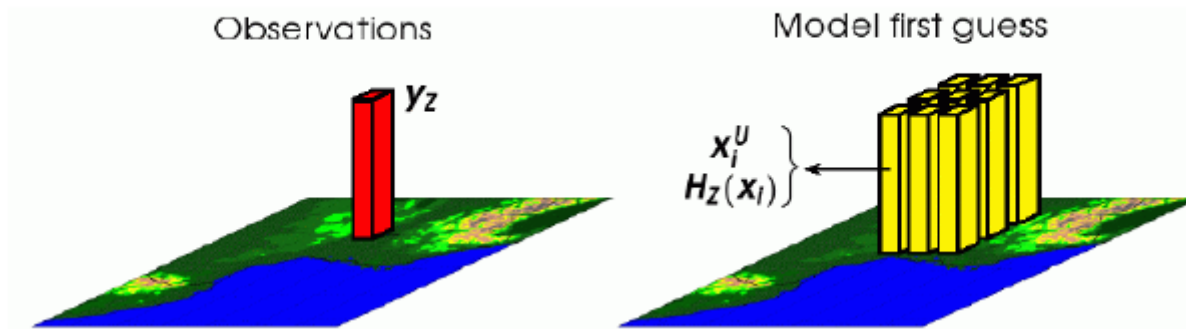
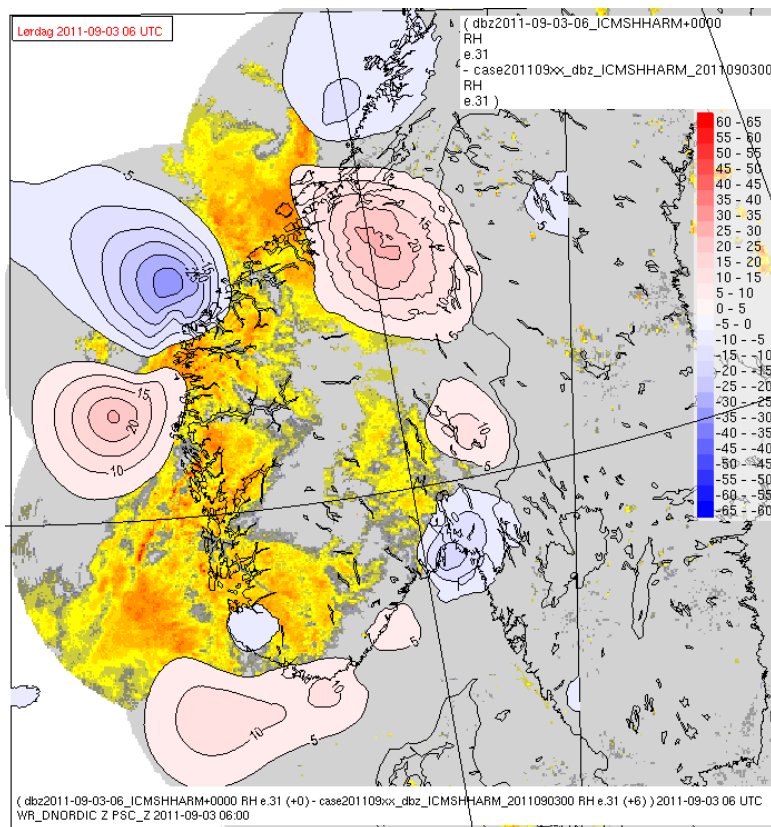
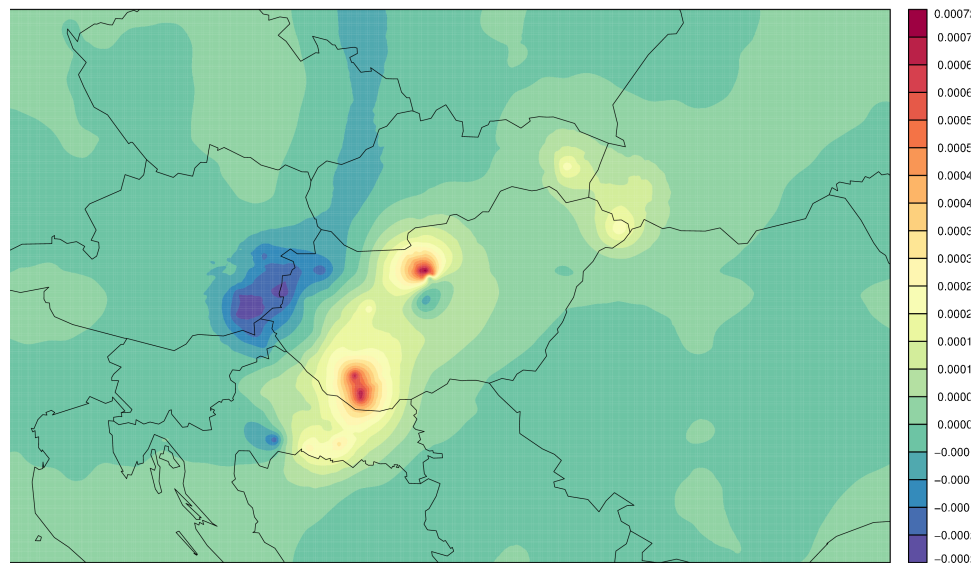


Illustration – Olivier Caumont

The assimilation trials and impact study - the AROME systems



See Máté's presentation about the design of the Hungarian 3h RUC



To be considered when analysing the results

AROME-met.no test domain: using 5 radars

Only reflectivity

Test period:

20110901 - 20110915

Verification:

without warming period

Tested with:

6-hourly cycling

AROME-Hungary domain: using 3 radars

Both refl. and wind

Test period:

20110501 – 20110425

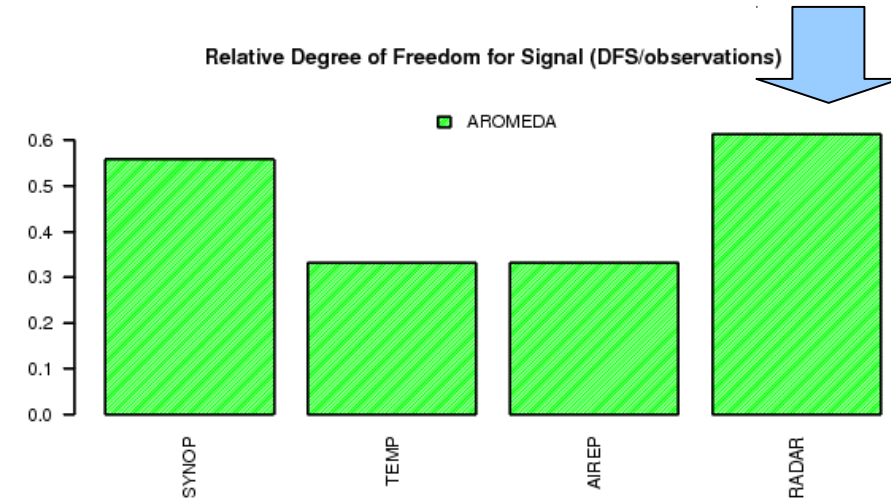
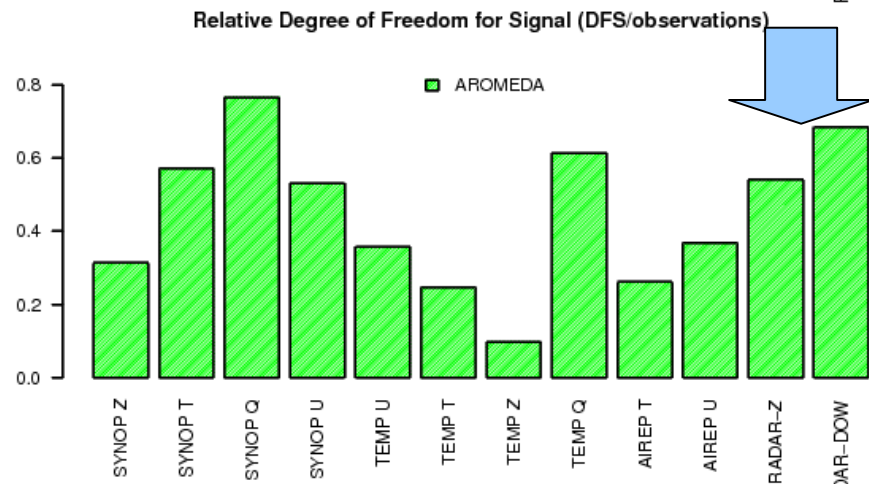
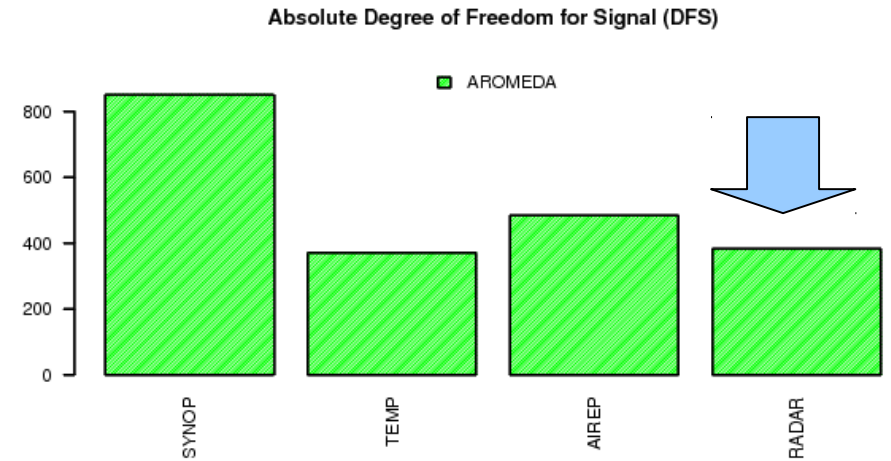
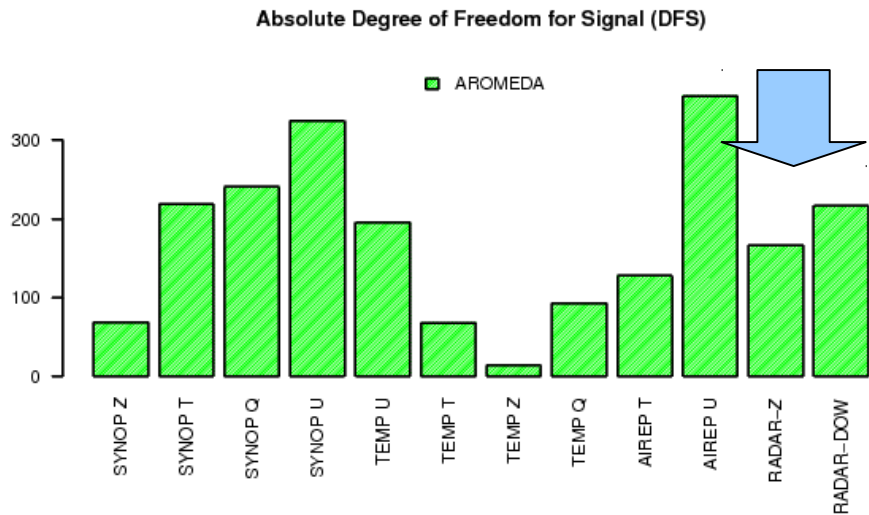
Verification:

5 days warming period

Tested with:

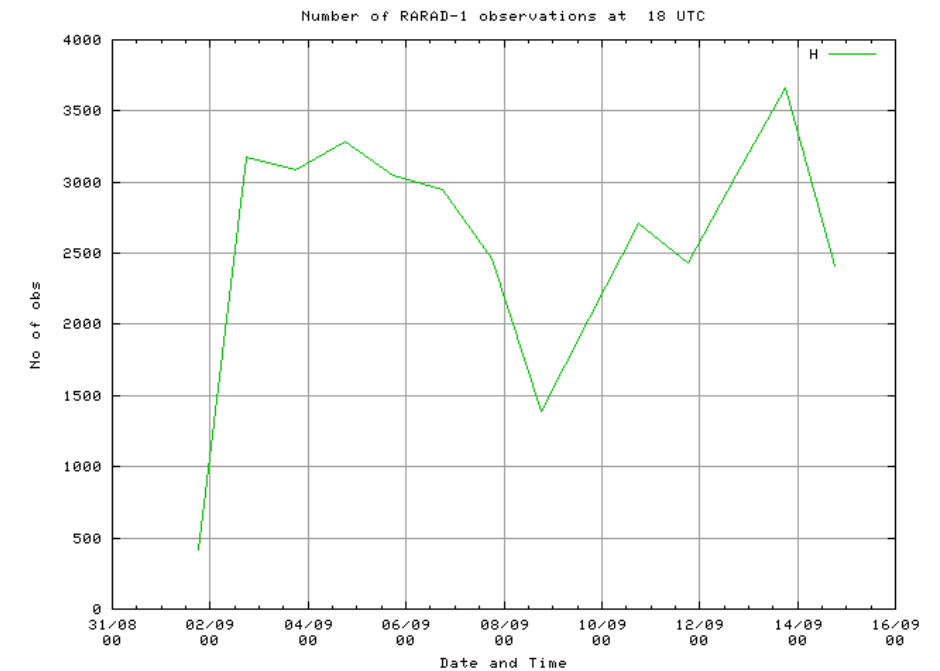
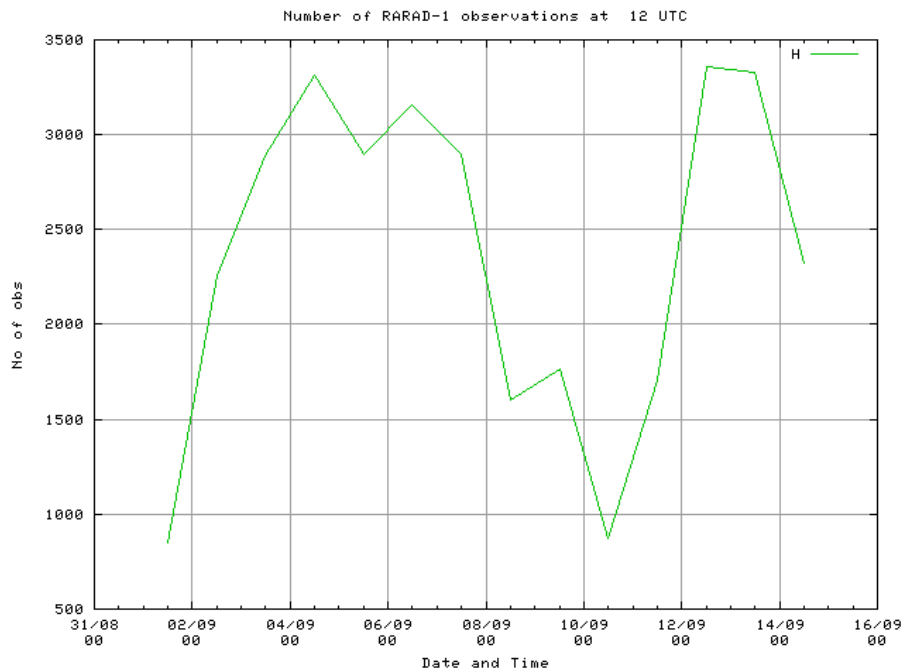
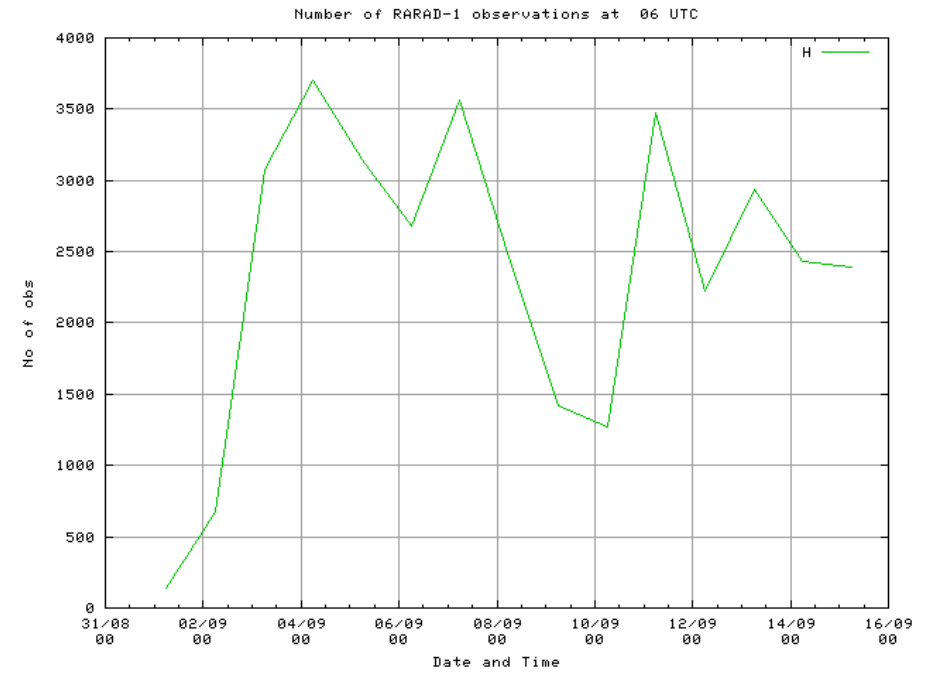
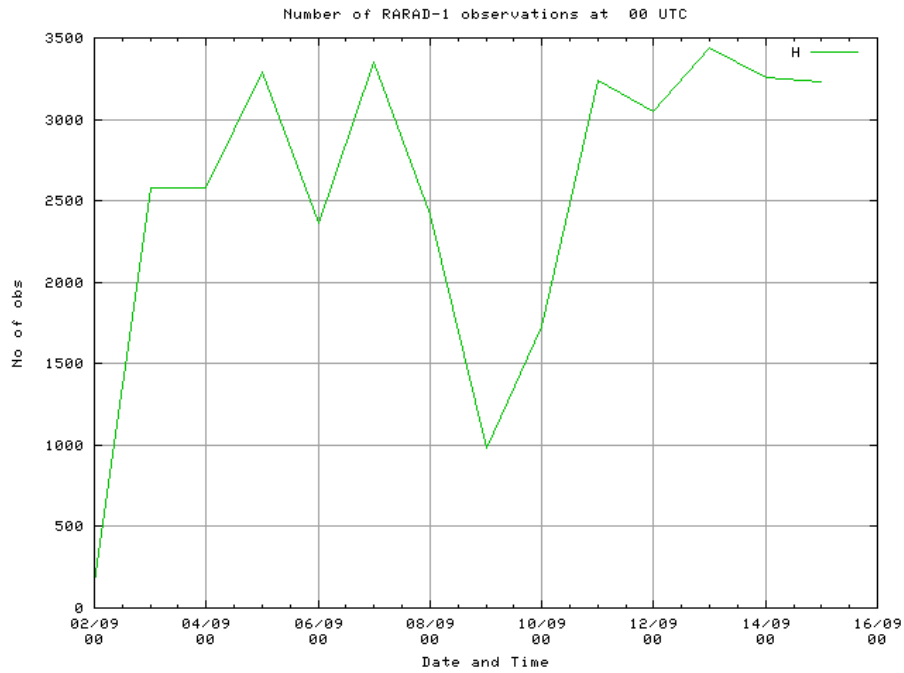
3-hourly cycling

The assimilation trials and impact study - the impact on the analysis system - OMSZ



Impact of different observations on the AROME-Hungary data assimilation system

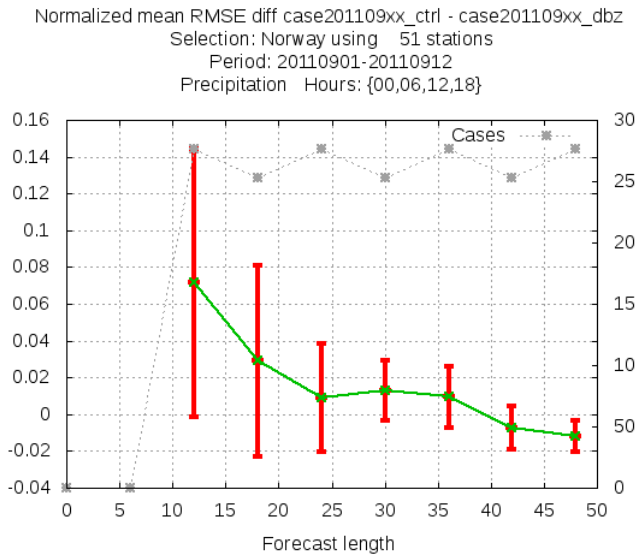
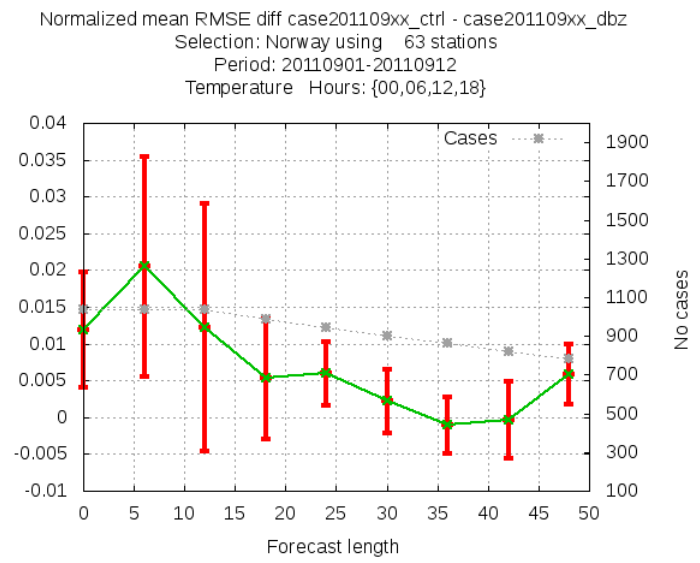
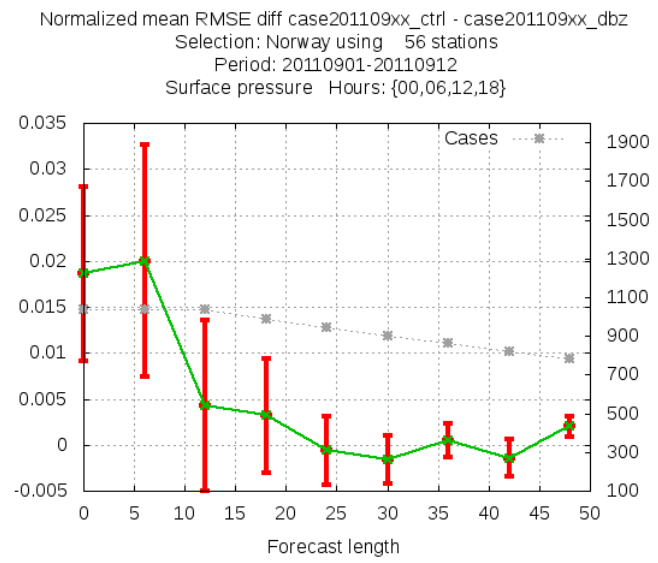
The assimilation trials and impact study - Radar observation usage - met.no



The assimilation trials and impact study

- impact on the forecasts - met.no

Clear improvement in forecast skill for surface parameters and precipitation.



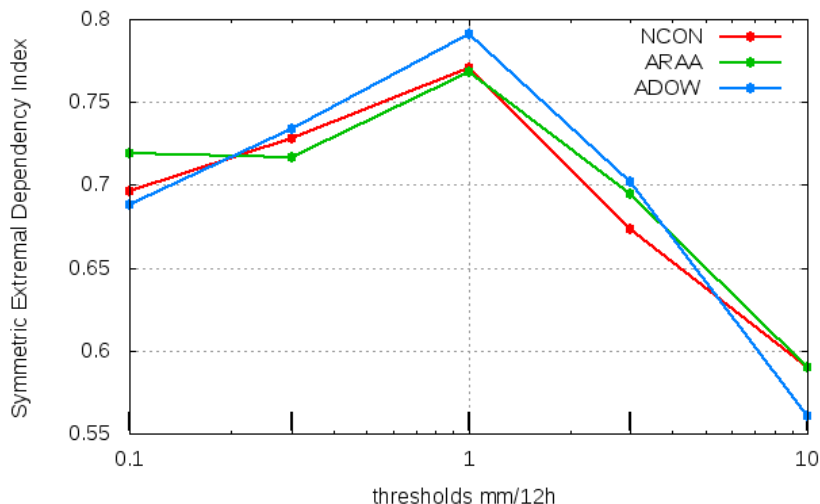
The assimilation trials and impact study - impact on the forecasts - OMSZ

Symmetric Extremal Dependency Index for Precipitation (mm/12h)

Selection: Hungary_ALL 31 stations

Period: 20120405-20120425

Used {00,12} + 18-06

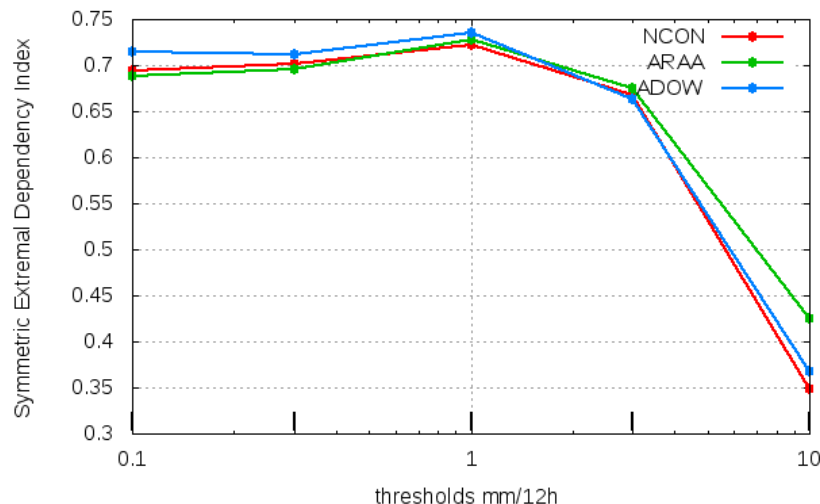


Symmetric Extremal Dependency Index for Precipitation (mm/12h)

Selection: EWGLAM_ALL 42 stations

Period: 20120405-20120425

Used {00,12} + 18-06

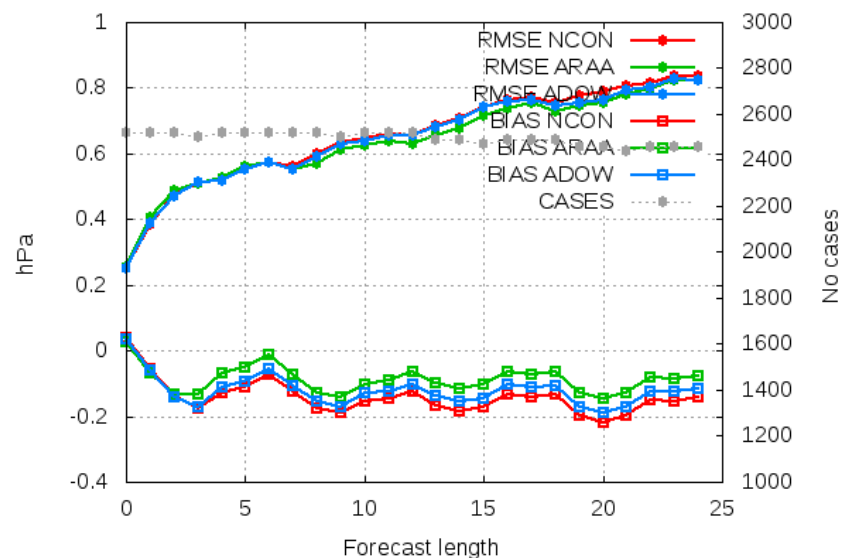


Red (NCON) : RUC with conventional observations
Blue (ADOW) : RUC with radial wind and conventional data
Green (ARAA) : RUC with reflectivity, radial wind and conventional data

Selection: Hungary_ALL using 30 stations

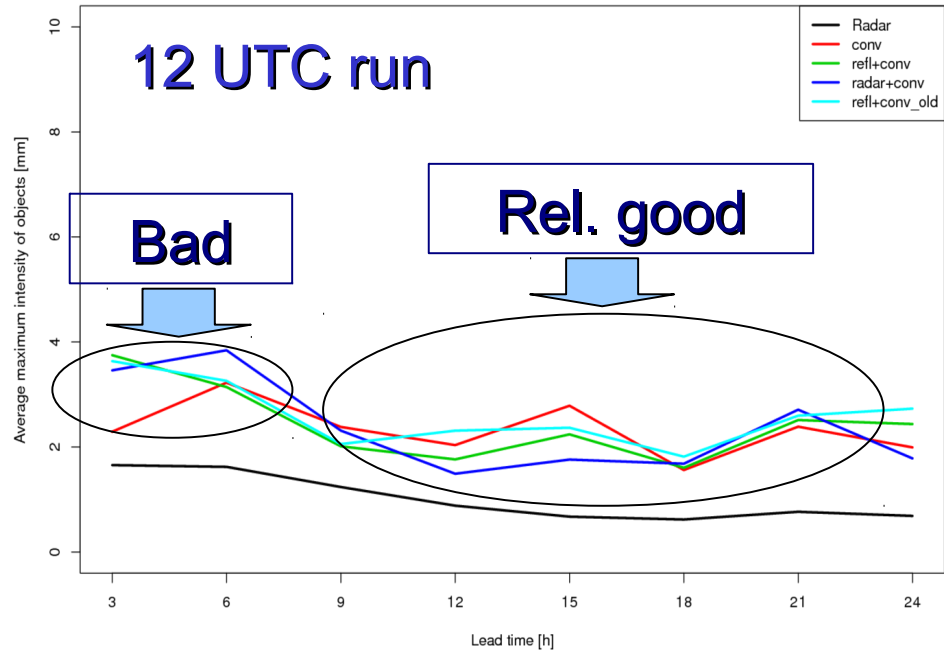
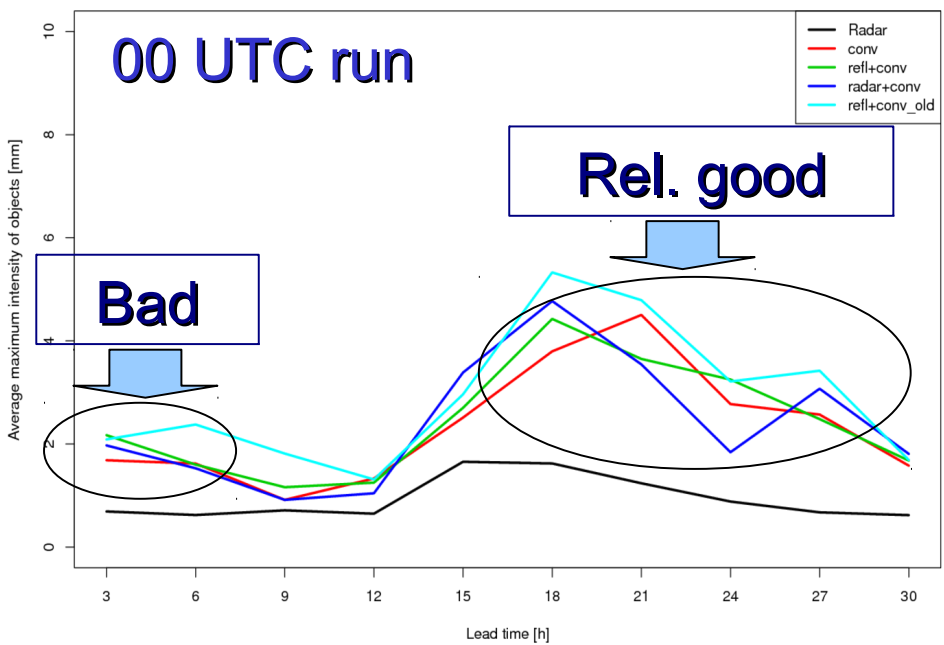
Period: 20120405-20120425

Mslp Hours: {00,06,12,18}



The assimilation trials and impact study - impact on the forecasts - OMSZ

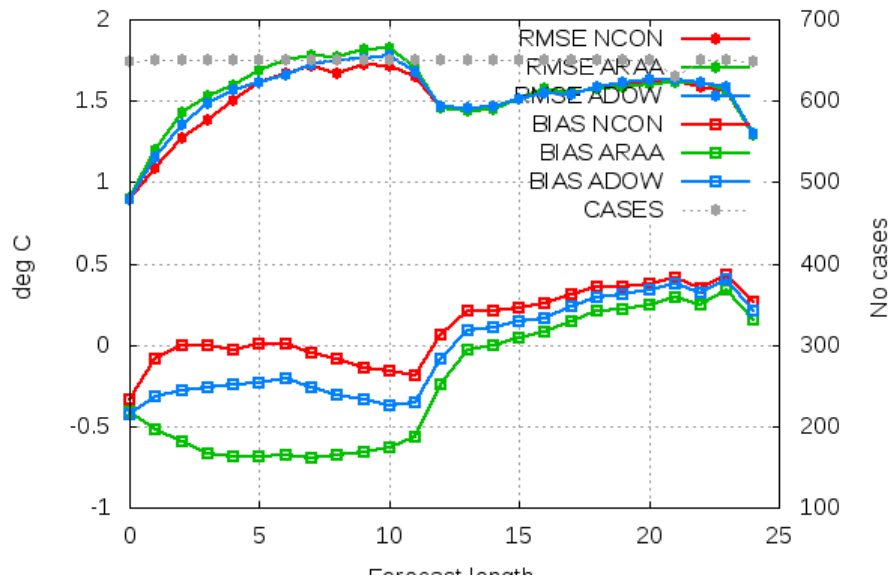
Average maximum intensity of 3h cumulated precipitation (mm)



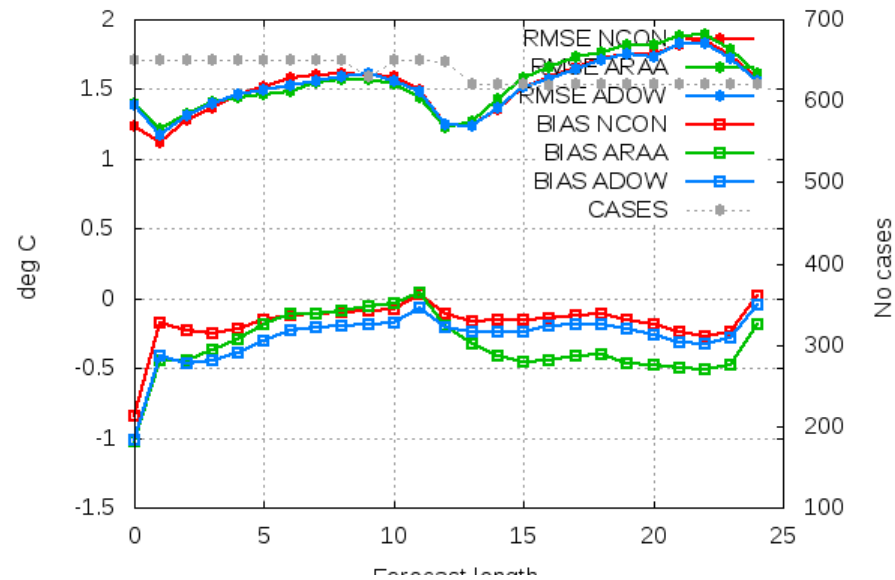
- Black : Radar observation
- Red : RUC with conventional observations
- Blue : RUC with reflectivity and radial and conventional data
- Green: RUC with reflectivity and conventional data

The assimilation trials and impact study - impact on the forecasts - OMSZ

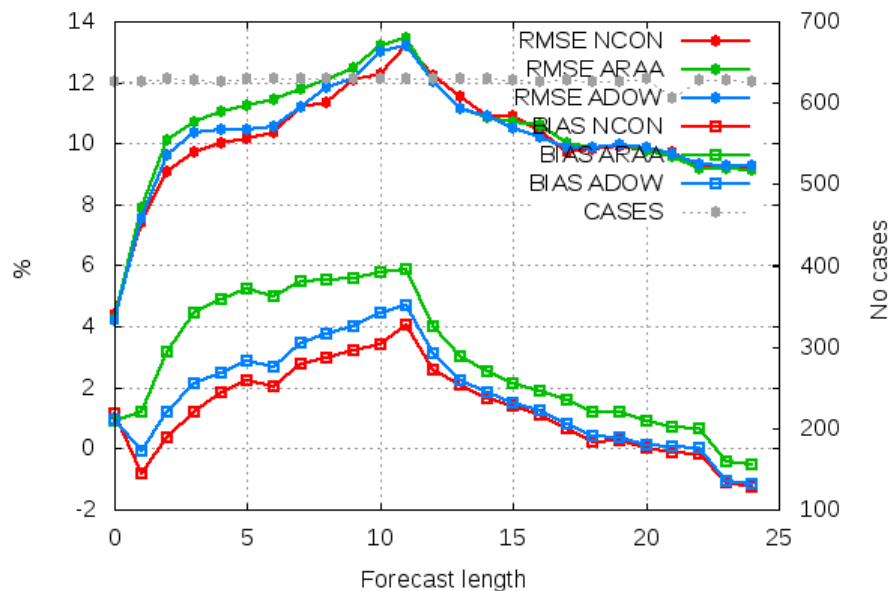
Selection: Hungary_06 using 31 stations
Period: 20120405-20120425
T2m Hours: {06}



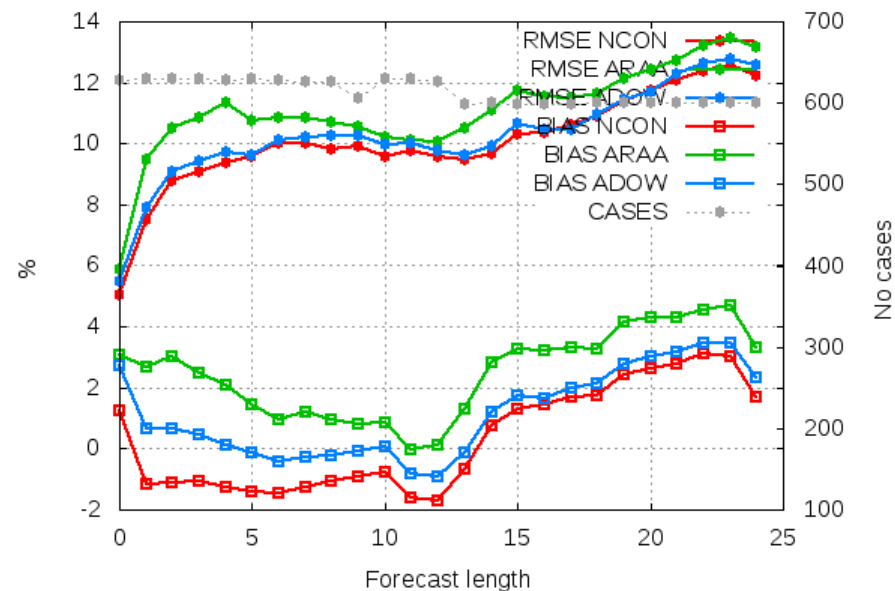
Selection: Hungary_18 using 31 stations
Period: 20120405-20120425
T2m Hours: {18}



Selection: Hungary_06 using 30 stations
Period: 20120405-20120425
Rh2m Hours: {06}



Selection: Hungary_18 using 30 stations
Period: 20120405-20120425
Rh2m Hours: {18}



Concluding remarks and future plan

- The MF BUFR with 512x512 size was used in both studies
- Clear positive impact of radar reflectivity was found in the Norwegian study.
 - Using more radar and relatively small domain and short period
- Encouraging results was found in the Hungarian study.
 - positive impact on longer forecast ranges;
 - but, non-negligible spinup was also observed
 - due to overestimation in the humidity analysis;
- Possible solution:
 - We are trying to skip the lowest 3 elevations measurement
 - Météo France skips 2 elevations in their system
 - We need to understand why Norwegian results were not affected by the RHU overestimation. The radar data assimilation work is restarted at met.no.
- We are interested in the ongoing work, which aims at using flexible sized BUFR data and using the HDF5 as input data format.

Thank you for your attention