Latest development related to the 3D-VAR ALADIN at HMS

Roger Randriamampianina

Contributors: Gergely Bölöni, Michal Májek, Alena Trojáková and Zoltán Juhász

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Outline of the presentation

- Assimilation of the AMV data
- A posteriori diagnostics and tuning of background errors
- Assimilation of the Seviri data
- Comparison of the M1QN3 and CONGRAD minimization algorithms

Assimilation of the AMV in the ALADIN/HU 3D-VAR

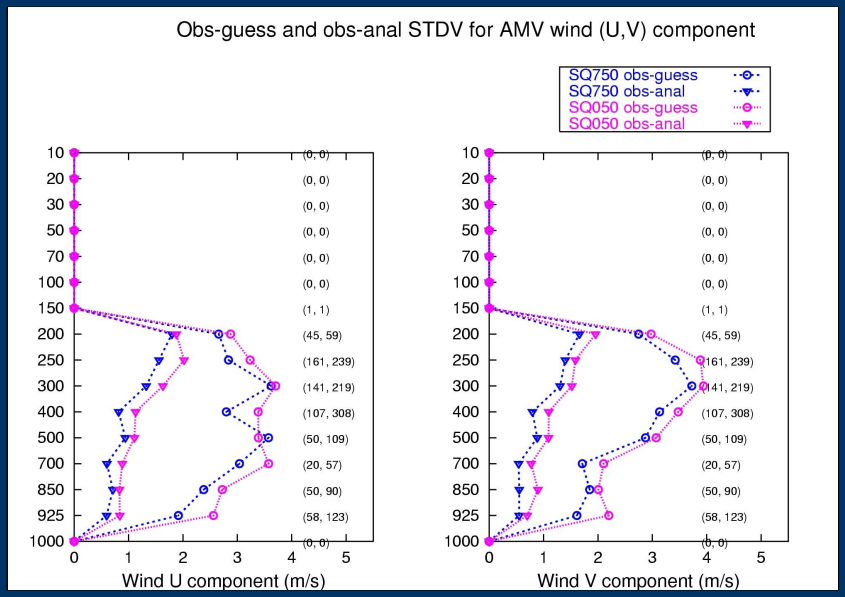
Configuration of the model (CY28T3)

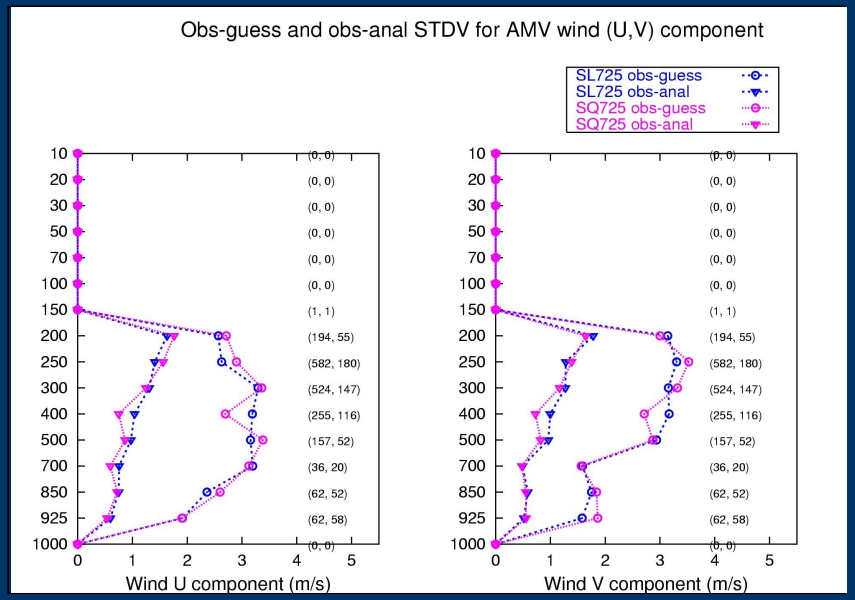
Main Characteristics

- 12 km horizontal resolution
- 37 vertical levels
- 6 hour cycle
- 3D-VAR for the upper air fields
- substitution of the surface fields by the ARPEGE ones
- B matrix: NMC method
- LBC: long cut-off ARPEGE analysis
- 3 hour coupling frequency
- 48 hour production forecast twice a day

➔ AMV and quality indicator (QI) ?

➢ Using data with different QIs ➔





- data with QI ≥ 30%
- data with QI ≥ 70%

- data over sea with QI ≥ 70%
- data over land also with QI ≥ 70%

The tested configurations

a) WDEF	used over sea only		
	P>800hPa	800-350hPa	P<350hPa
HRV	QI>85%	not used	not used
IR	QI>85%	not used	QI>85%
CWV	QI>85%	not used	QI>85%

b) W80P	used over sea only		
	P>800hPa	800-350hPa	P<350hPa
HRV	QI>80%	not used	not used
IR	QI>80%	not used	QI>80%
CWV	QI>80%	not used	QI>80%

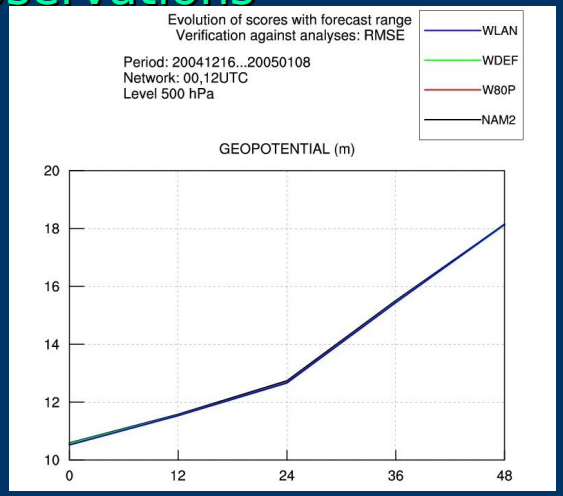
c) WLAN	used over land also		
	P>800hPa	800-350hPa	P<350hPa
HRV	QI>85%	not used	not used
IR	QI>85%	not used	QI>85%
CWV	QI>85%	not used	QI>85%

WDEF- the default settings (QI ≥ 85%)

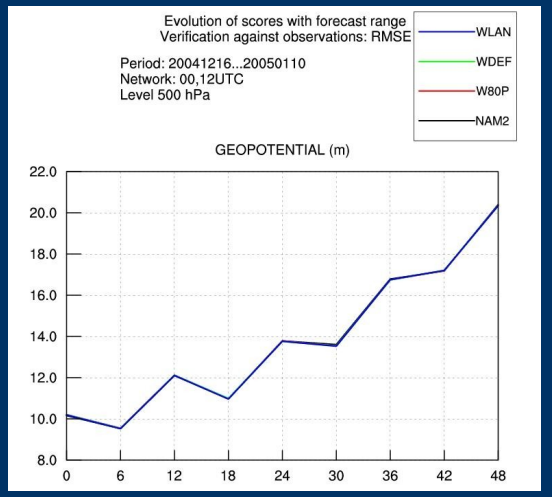
W80P- using data with QI ≥ 80%

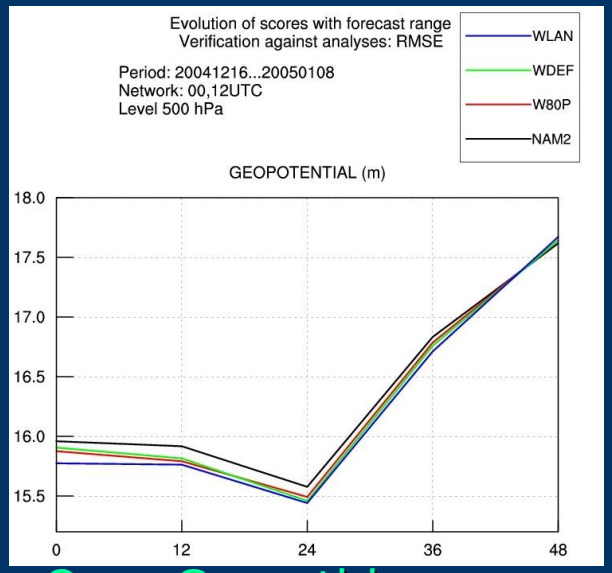
WLAN- using data over land also with QI ≥ 85%

➔Impact of the AMV
➔Comparison against analyses observations



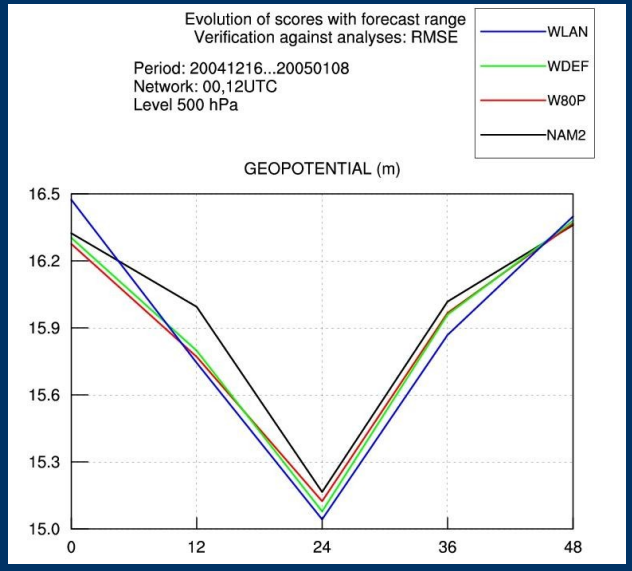
Comparison against





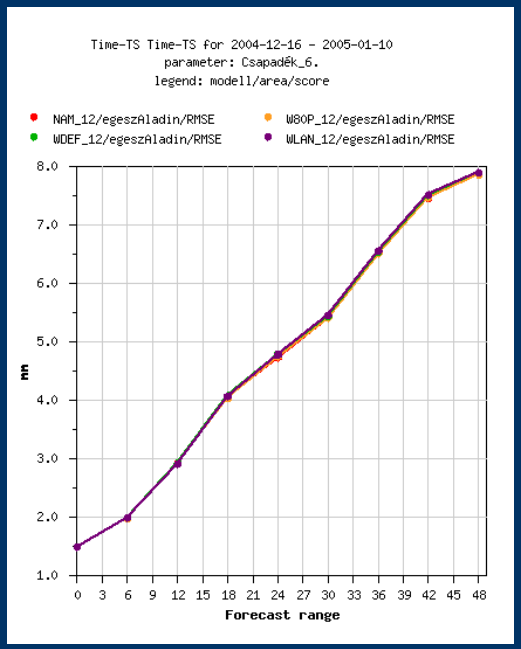
Over Carpathian basin

Comparison against the analyses

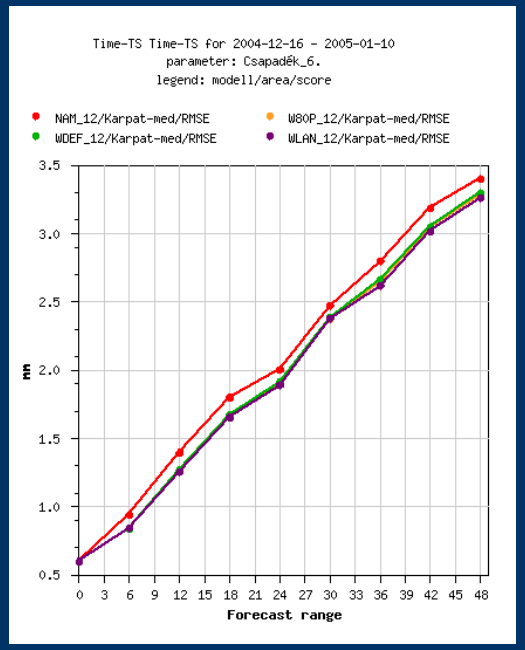


Over Hungary

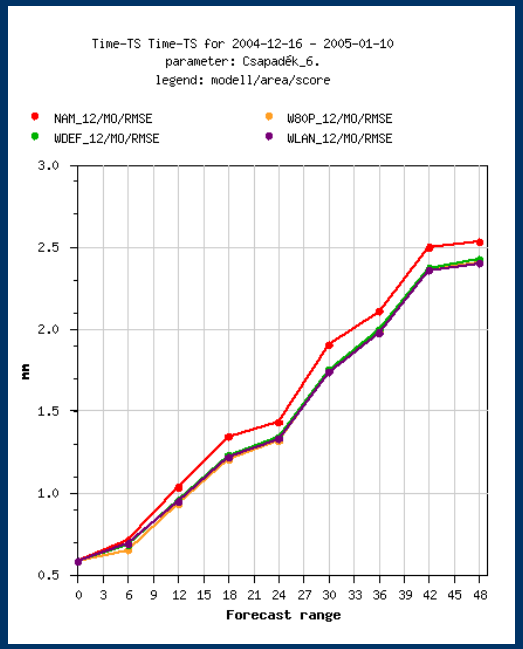
Impact of the AMV on the forecast of precipitation (12 UTC runs)



Over the whole ALADIN/HU



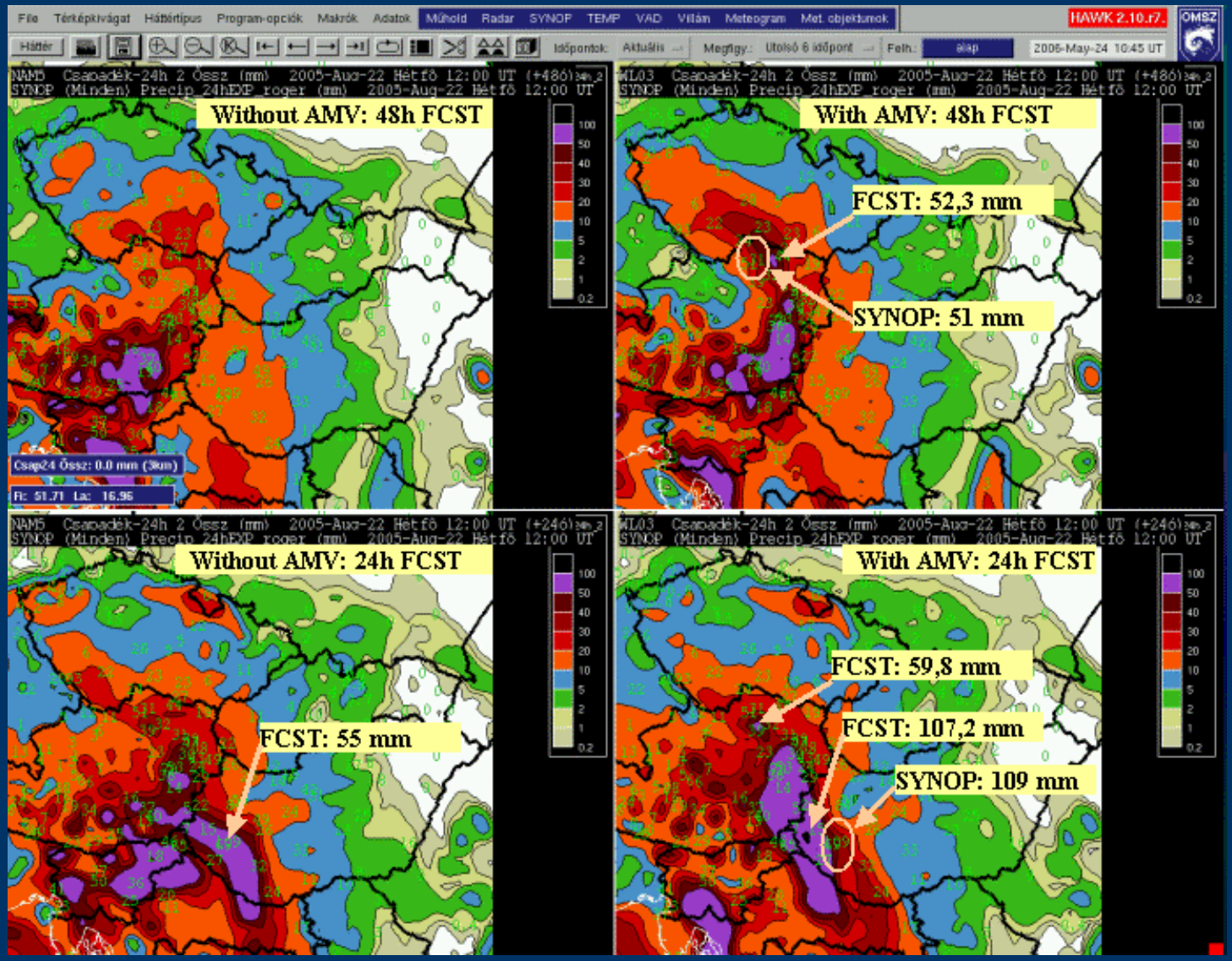
Over Carpathian basin



Over Hungary

Example from the case studies

24-h cumulated precipitation valid for the same verif. time 22 Aug. 2005 at 12 UTC



Conclusions

→ Over the whole ALADIN/HU domain comparison against long cut-off ARPEGE analyses showed slightly positive impact of the AMV on geopotential, wind speed and humidity

→ Zooming over our target areas, we observed a remarkable positive impact of the AMV data

→ We observed a significant positive impact of the AMV on the precipitation over our areas of interest

→ This is true especially for “extreme” weather conditions

→ This leads to the use of the AMV data in operation at HMS

Possible future work:

We think revision of the quality control in the pre-processing is needed to make the analysis system able to use more good data

A posteriori diagnostics and tuning of background errors

$$\hat{\sigma}_b^2 = \frac{1}{P}\sum_{i=1}^{P} d_{bi}^a d_{bi}^o \longrightarrow$$ replace **B** variances

(Desroziers et al, 2005)

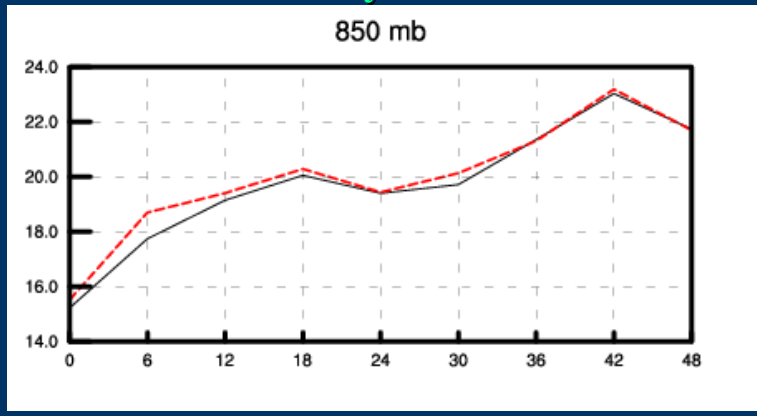
$$d_{bi}^a = H(x_a)_i - H(x_b)_i$$

$$d_{bi}^o = y_i - H(x_b)_i$$

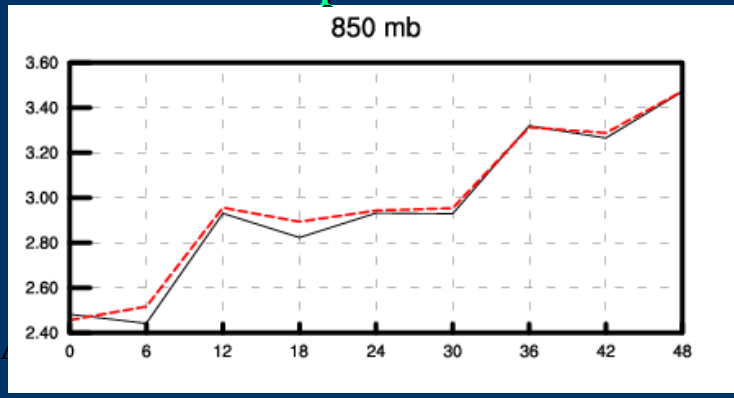
i=1…P: loop over the obs points

- Tuned ensemble B matrix gives better results than the presently operational NMC B matrix (figures on the right)
- The ensemble B has to be recomputed with the most recent model version (CY30T1), more periods to bet tested → goal is an operational use
- More complex tunings to be tried (variable and height dependent) both for sigmao and sigmab

Humidity RMSE



Wind speed RMSE



TES2: OPER with NMC B

ENSE: Tuned Ensemble B

Investigation of the Seviri data

Configuration of the model (CY30T1)

Main Characteristics

- 8 km horizontal resolution
- 49 vertical levels
- 6 hour cycle
- 3D-VAR for the upper air fields
- substitution of the surface fields by the ARPEGE ones
- B matrix: NMC method
- LBC: long cut-off ARPEGE analysis
- 3 hour coupling frequency
- 48 hour production forecast from 00 UTC

→ We use the same pre-processing technique as at Météo-France

→ Local bias correction (Harris and Kelly, 2001)

→ 8 channels are read but only 5 of them are assimilated

→ For more details about the pre-processing, please read Trojáková and Májek' s report, available on LACE webpage

→ or see our poster

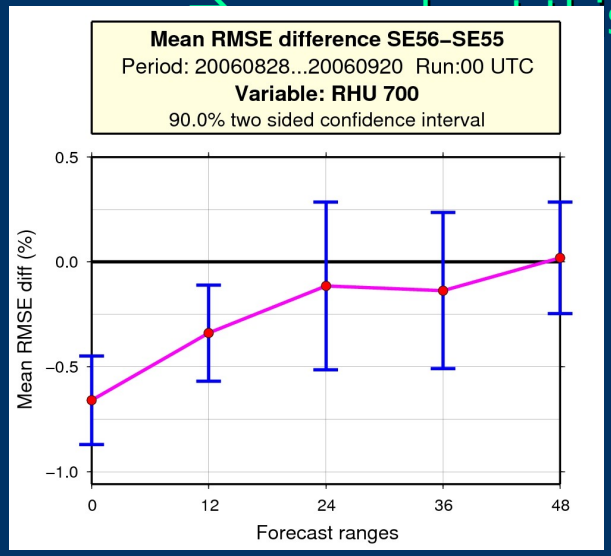
The impact study

→ We presumed a “disbalance” between the observation and background errors statistics

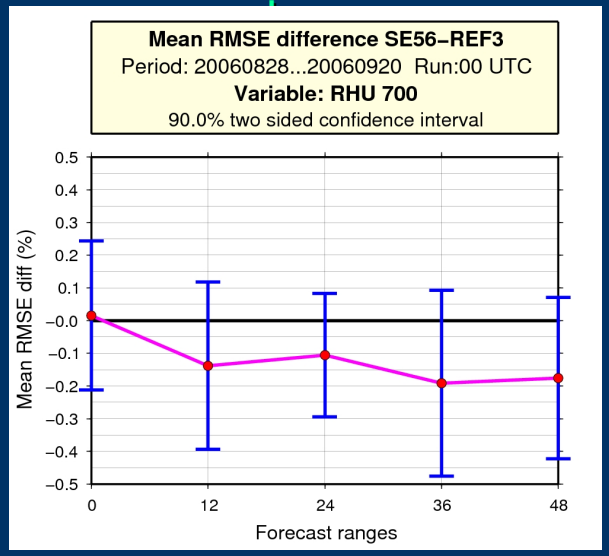
→ The MNC and the tuned ensemble B were tested

→ There was also a tuning of the observation errors stat. (σ_0)

→ [illegible] this tuning you will see [illegible]

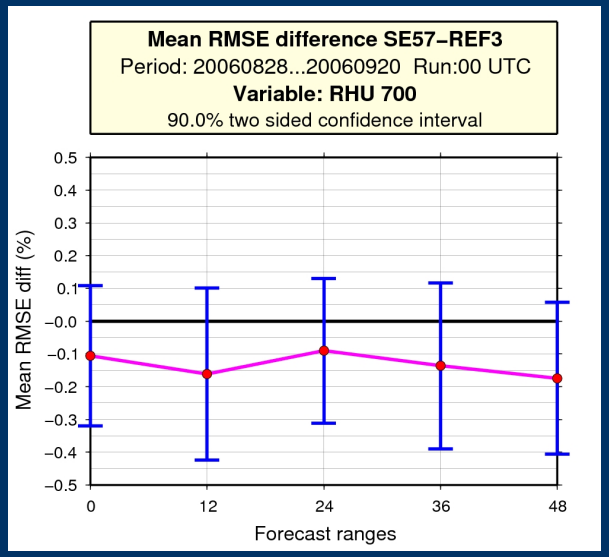


Comparison against ARPEGE analyses

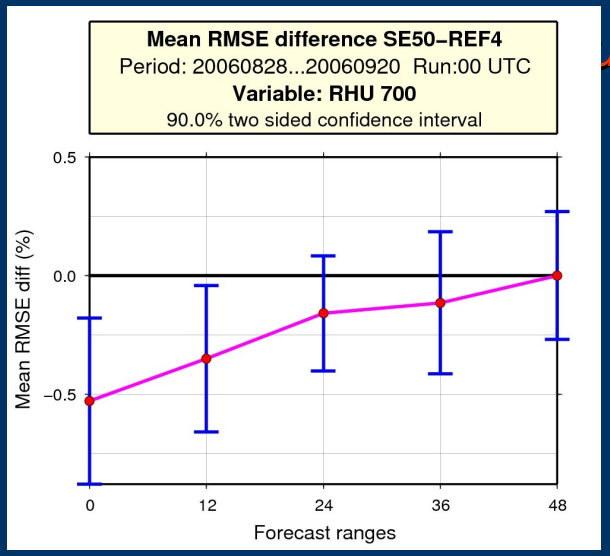


NMC B vs Ens B both runs with Seviri data

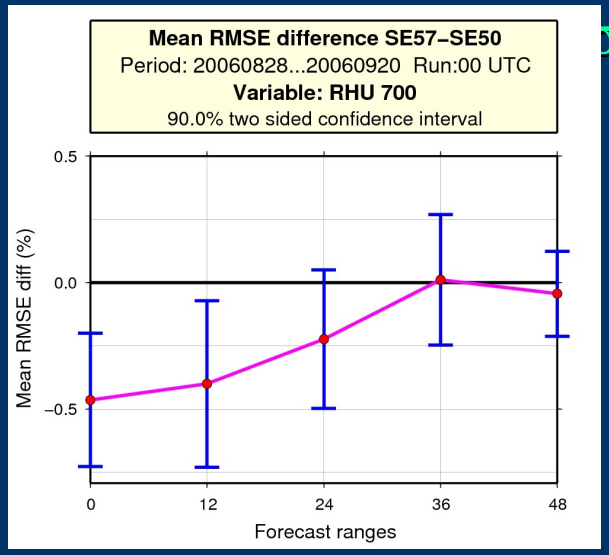
Ens. B: Impact of Seviri data using the default σ_0



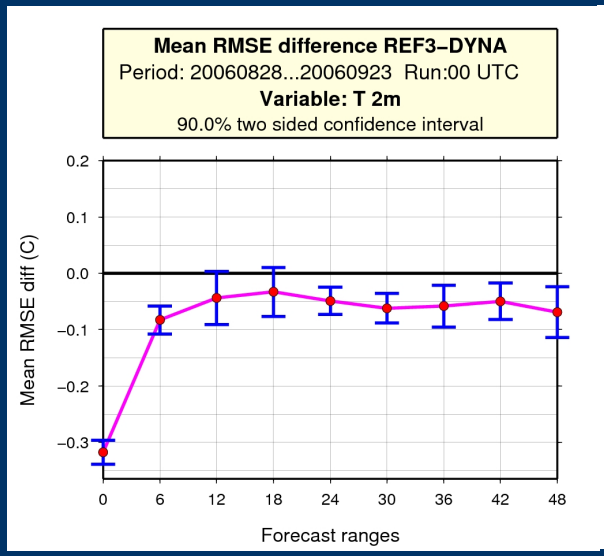
Ens. B: Impact of Seviri data

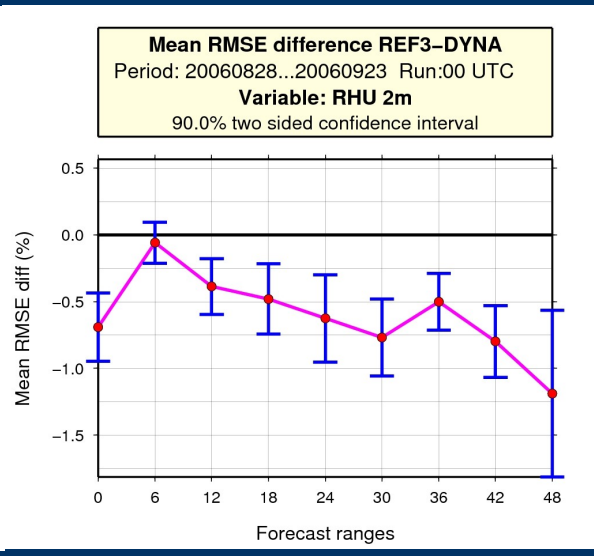


Ens. B: Impact of Seviri data on top of TEMP and SYNOP only

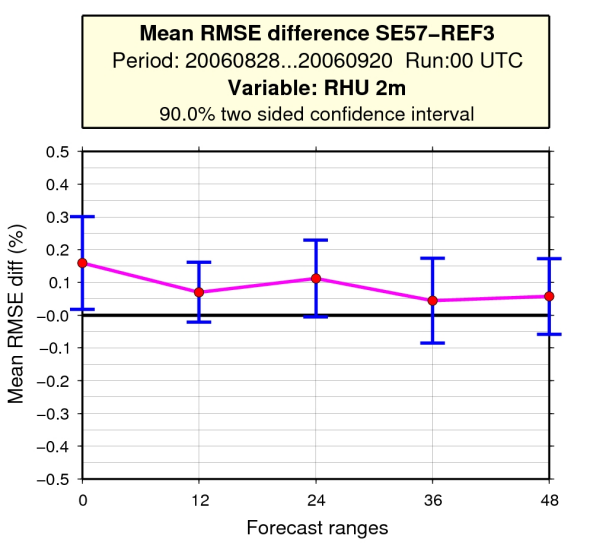


Ens. B: Impact of ATOVS + AMV + AMDAR





Dynamical adaptation vs 3D-VAR



Ens. B: Impact of Seviri data using tuned σ_0

Conclusions

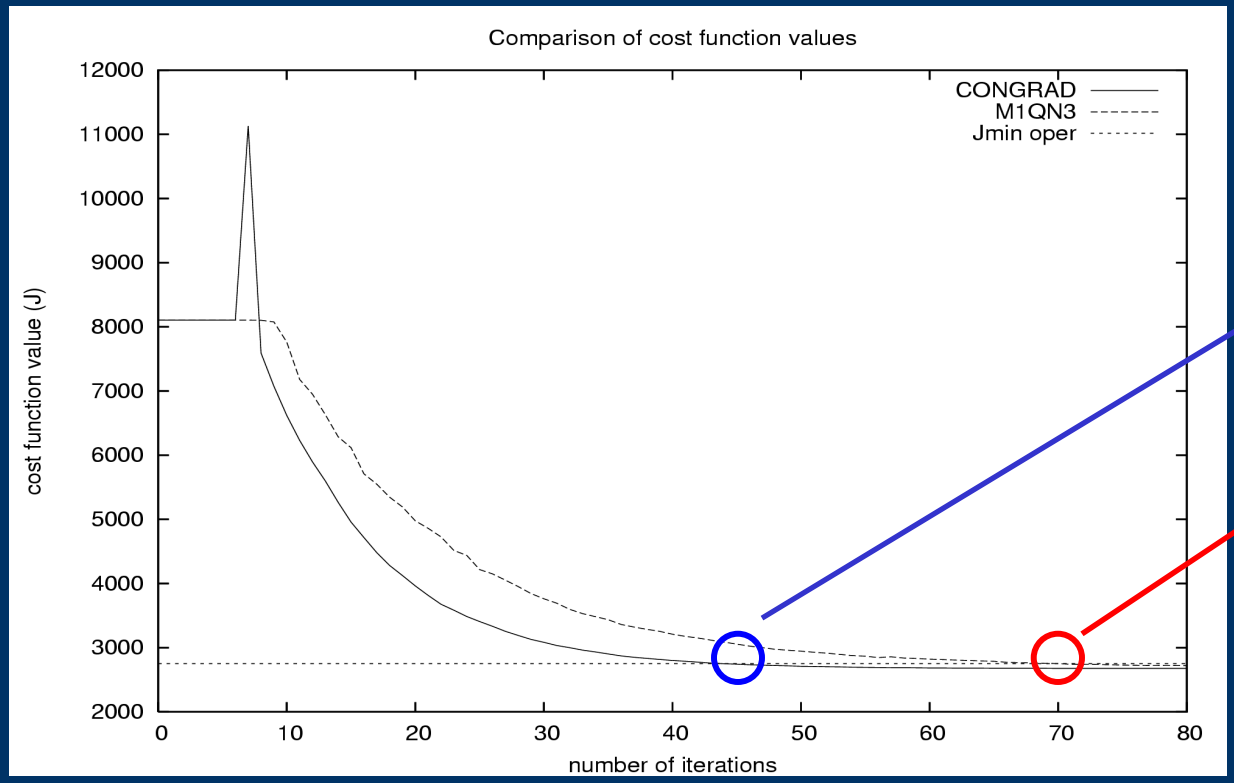
- We observed small impact of the Seviri data when comparing the analyses and forecasts against the observations;
- The impact of the Seviri data in our system was found to be similar to that of ATOVS data (AMSU-A or AMSU-B) assimilated in high resolution;
- We found different impact of the Seviri data depending on the parameters and model levels;
- A remaining negative impact near the surface needs further investigations.

Future plans

- To perform additional experiments using the water vapor channels only;
- Testing the use of more surface measurements (eg. 2-m humidity and/or 2-m temperature) together with the Seviri data;

Comparison of the M1QN3 and CONGRAD minimization algorithms

Comparison of the M1QN3 and CONGRAD minimization algorithms



For the same minimum…

CONGRAD: 45 iterations

M1QN3: 70 iterations

- CONGRAD is more costly than M1QN3 in CPU/iteration
- CONGRAD needs less iterations than M1QN3 to reach the same minimum
- Depending on the required minimum both methods can be more efficient than the other
- The 2 algorithms produce similar analysis from meteorological point of view

Thank you for your attention !