Regional Cooperation for
Limited Area Modeling in Central Europe

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Appropriate Bmatrix for BlendVar

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Outline and motivation

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- The BlendVar scheme – wanted properties:
  - to compensates lack of information on largest scales
  - to preserves results of advanced ARP 4D-Var
  - to analyze scales not resolved by ARP
- We need special B matrix! Why?
- The way we sample the B matrix
- Comparison to Ensemble based B matrix
- Results of experiments
- Conclusion

BlendVar = DF Blending + 3D-Var

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- **DF Blending combines a large scale analysis with small scales of LAM background. [2, 4]**

$$\mathbf{x}_a = \mathbf{x}_b + T_{L\to H}\{\overline{T_{H\to L}(\mathbf{g}_a)}\} - T_{L\to H}\{\overline{T_{H\to L}(\mathbf{x}_b)}\}, \qquad (1)$$

$\mathbf{x}_b$, $\mathbf{x}_a$ ALADIN background, analysis; $\mathbf{g}_a$ ARPEGE analysis in ALADIN resolution, T denotes change of truncation. Bar is digital filter.

Experimental setup CY38t1tr

- Δx ~**4.7km**, GP 529x421,
- L87, lin. trunc. E269x215,
- $\triangle t$ = 180 s, mean orography,
- 3h coupl. interval,
- CANARI (T2m, RH2m)
- ALARO-0 baseline physics [1]

BlendVar for upper air fields

- **DF Blending cutoff Δx ~30km**
- Obs: SYNOP mslp, TEMP, MSG10 (channels 2, 3, 4, 5, 6), AMV, AMDAR,
- 3h assim. window
- no DFI in 6h assim cycle
- incremental DFI init. in production

Why we need special B matrix?

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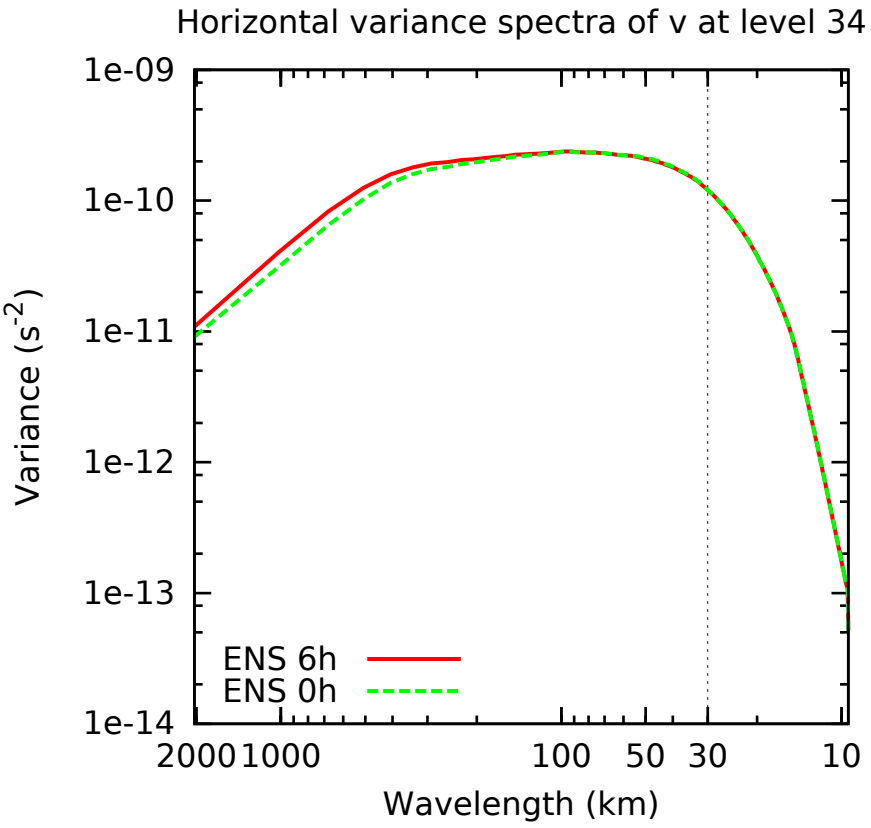
- DF Blending takes large scales from ARPEGE
- 3D-Var reduces also the large scale part of BG error
- We need to force 3D-Var to not reanalyze (distort) scales already taken by DF Blending



ENS Vorticity var. spectra ~500 hPa

Analysis spectra; Background spectra

B matrix for BlendVar

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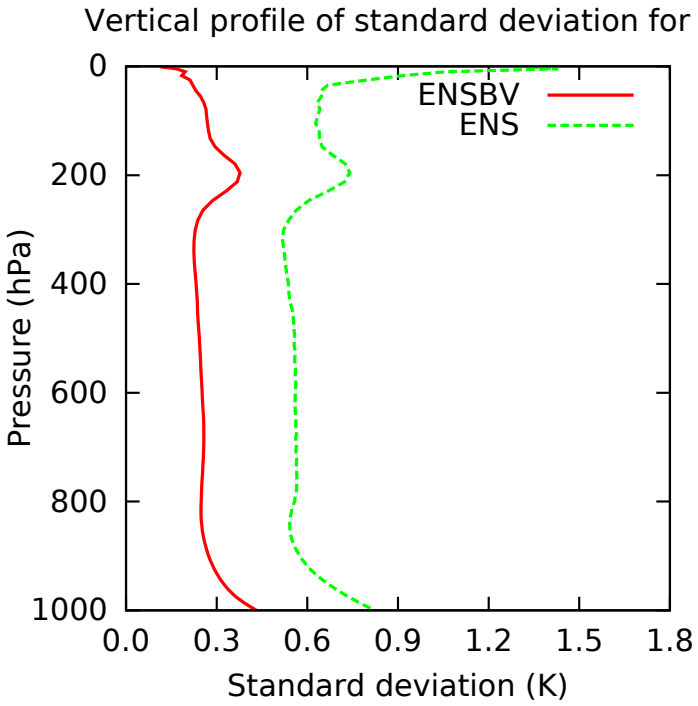
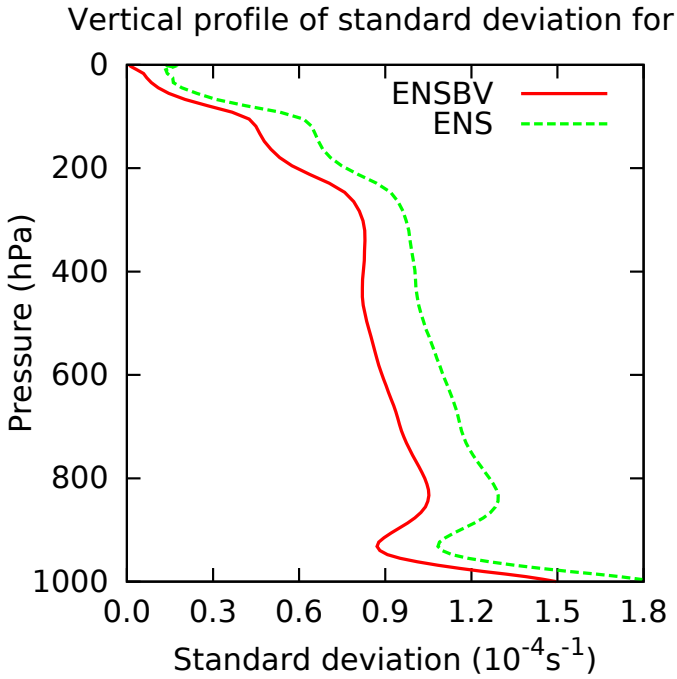
- **LAM BlendVar assimilation ensemble with perturbed observations (ENSBV)**
- **6h assimilation cycle, coupling to ARPEGE**
- **Every member is blended with the same APREGE analysis**
- **B matrix is sampled from differences between 6-hour forecast of ensemble members $\Rightarrow$ much lower differences in large scales**

Comparison ENSBV x ENS (1)





Comparison ENSBV x ENS (1b)

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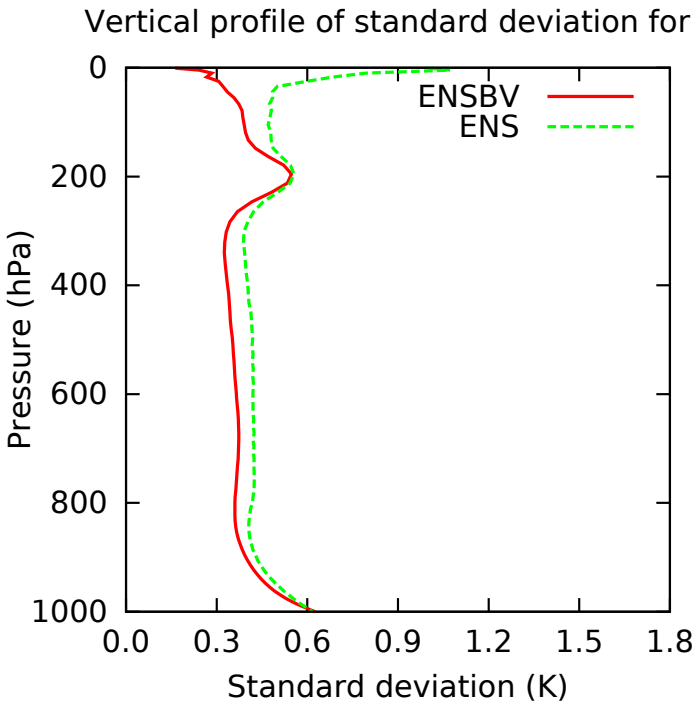
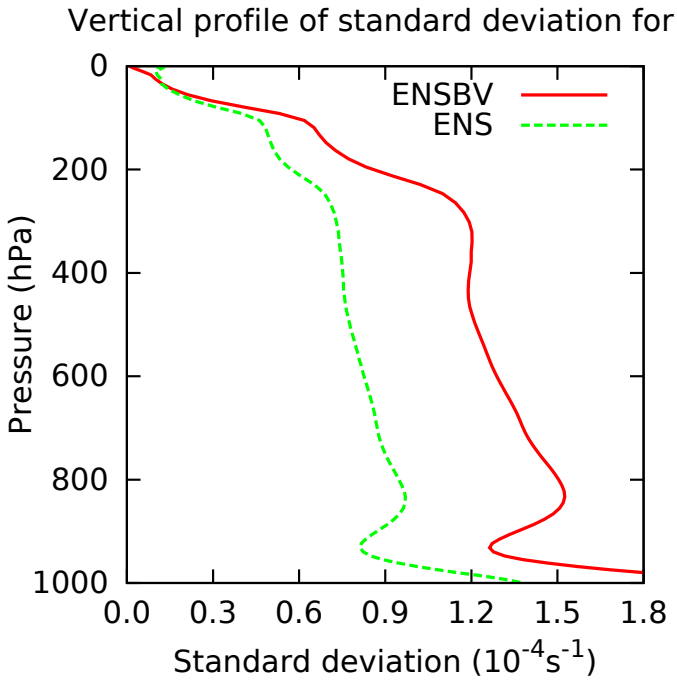
REDNMC(ENSBV)=1.45 **REDNMC(ENS)=0.75**





Comparison ENSBV x ENS (1c)

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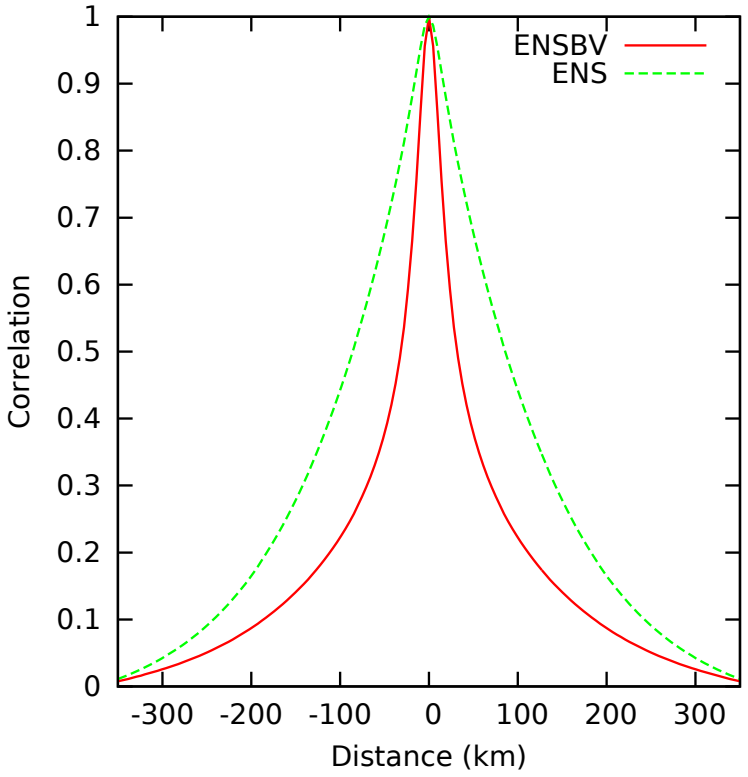
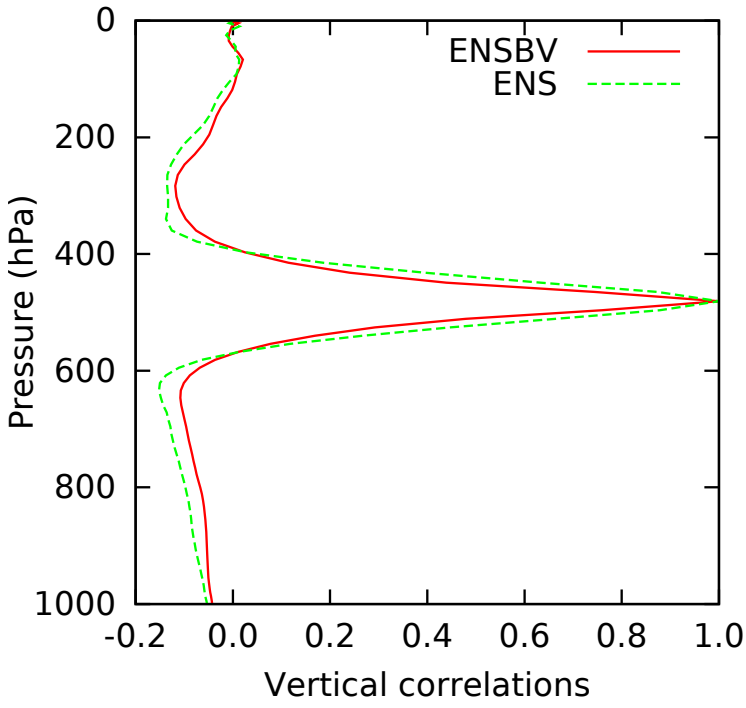
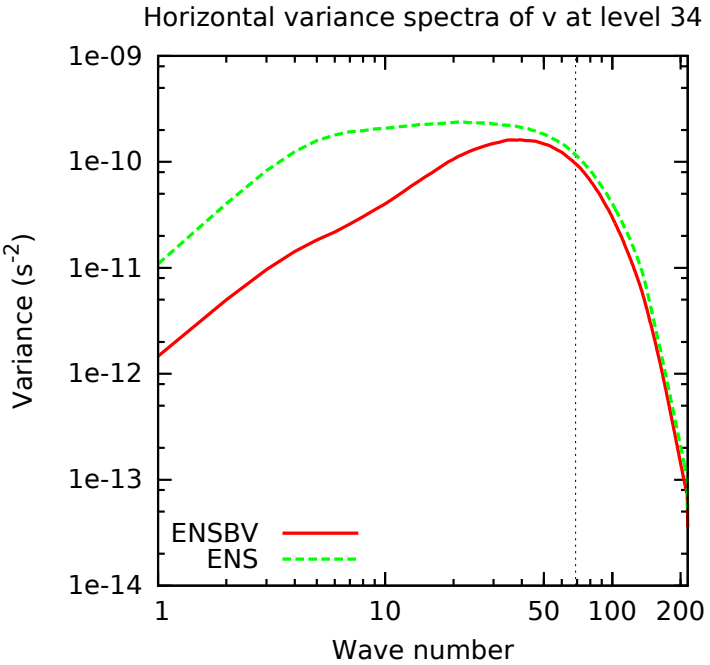
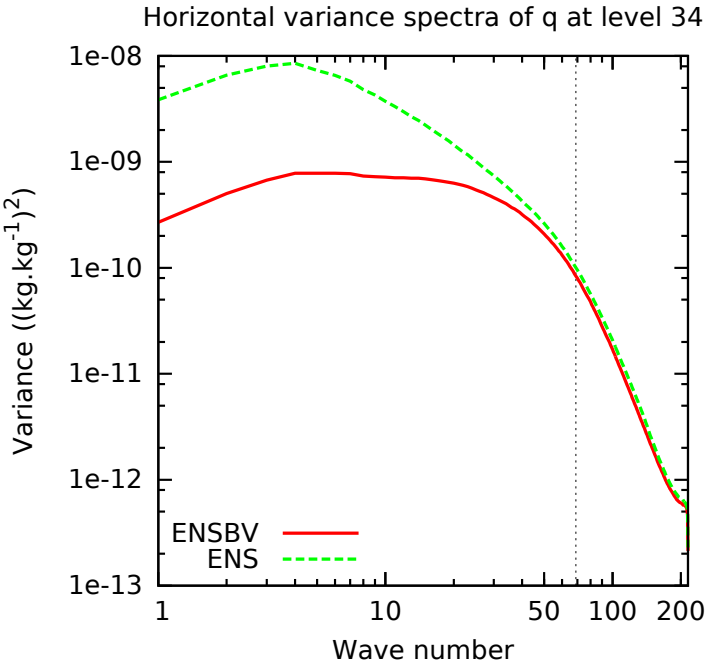
Horizontal and vertical corel. fce ~500 hPa





Comparison ENSBV x ENS (2)





Comparison ENSBV x ENS (3)

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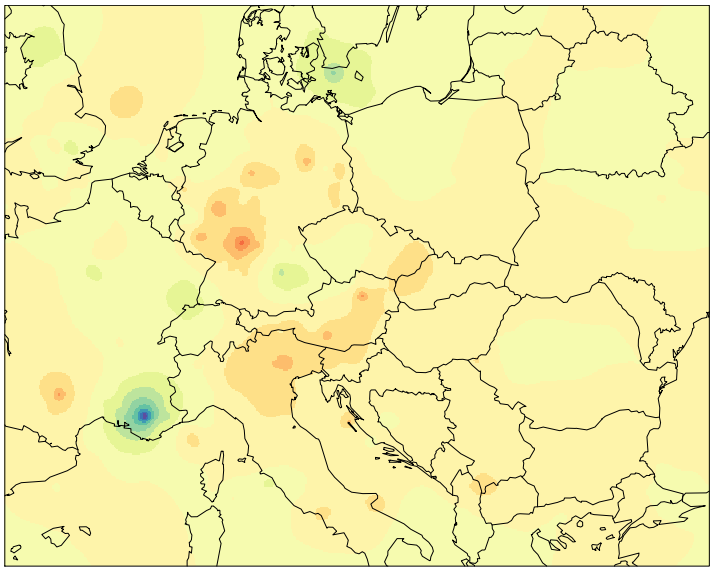
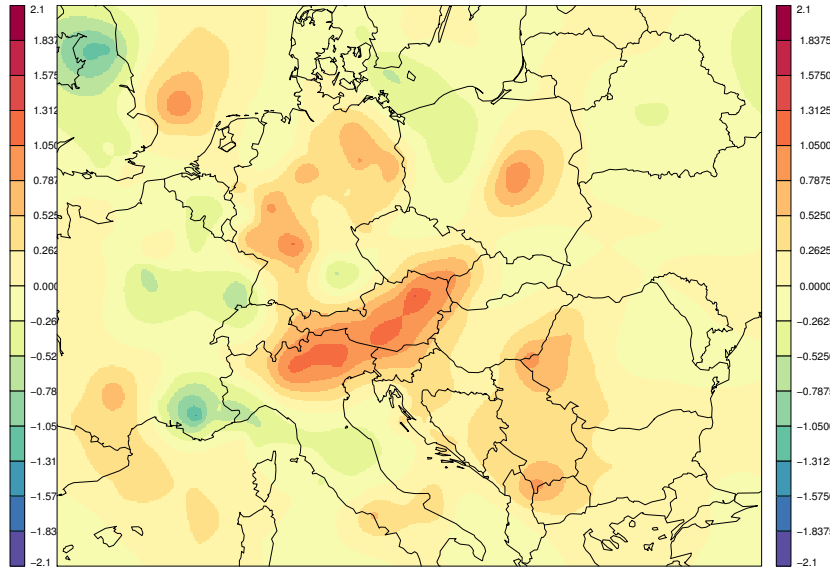
Analysis increment BlendVar_ENSBV
TEMPERATURE ~500hPa

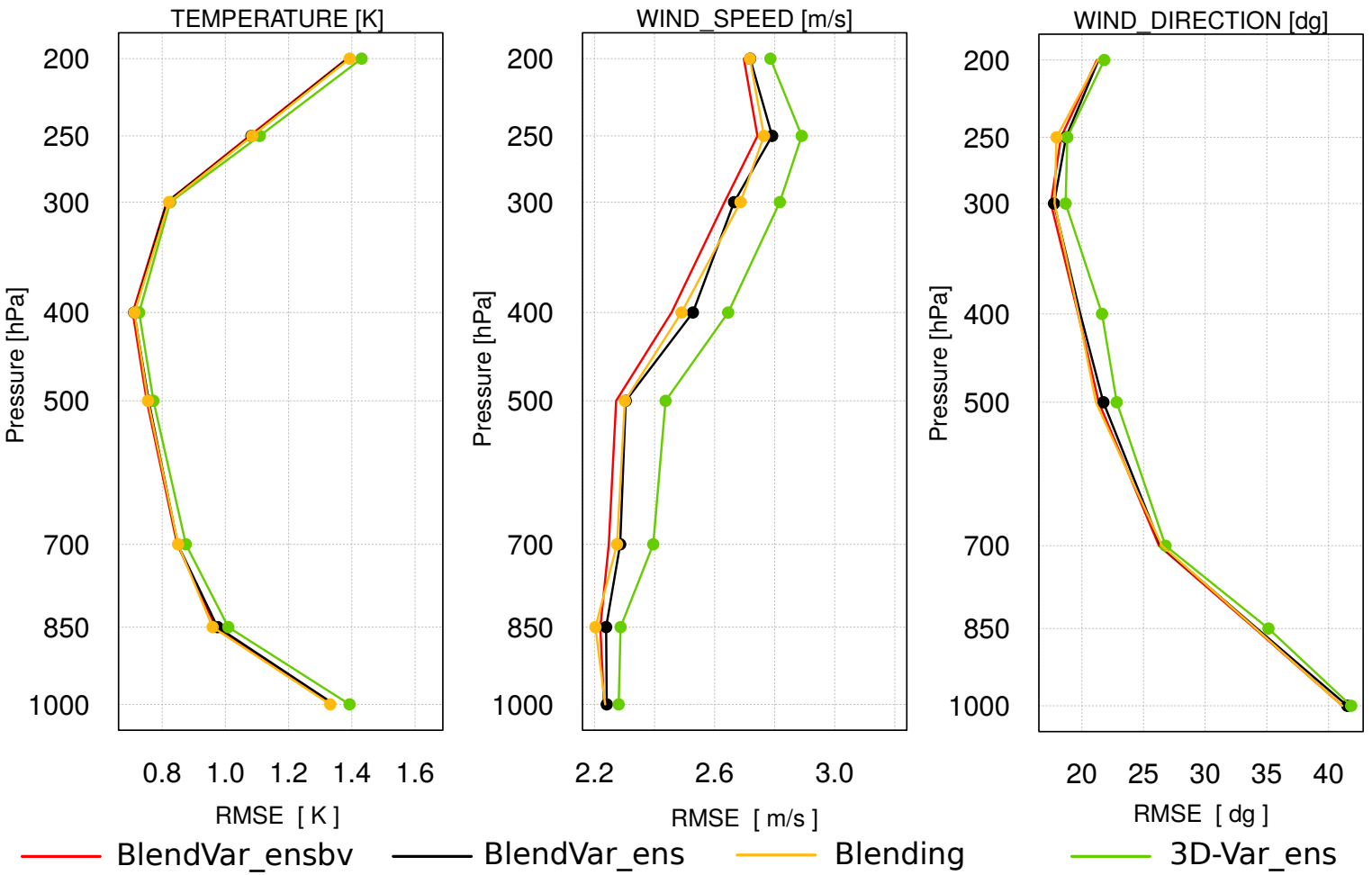


Analysis increment 3Dvar_ENS
TEMPERATURE ~500hPa



Results of experiments (1)

- **RMSE fc +6h assim cycle, against TEMP, AMDAR, 6/2013**



Results of experiments (2)

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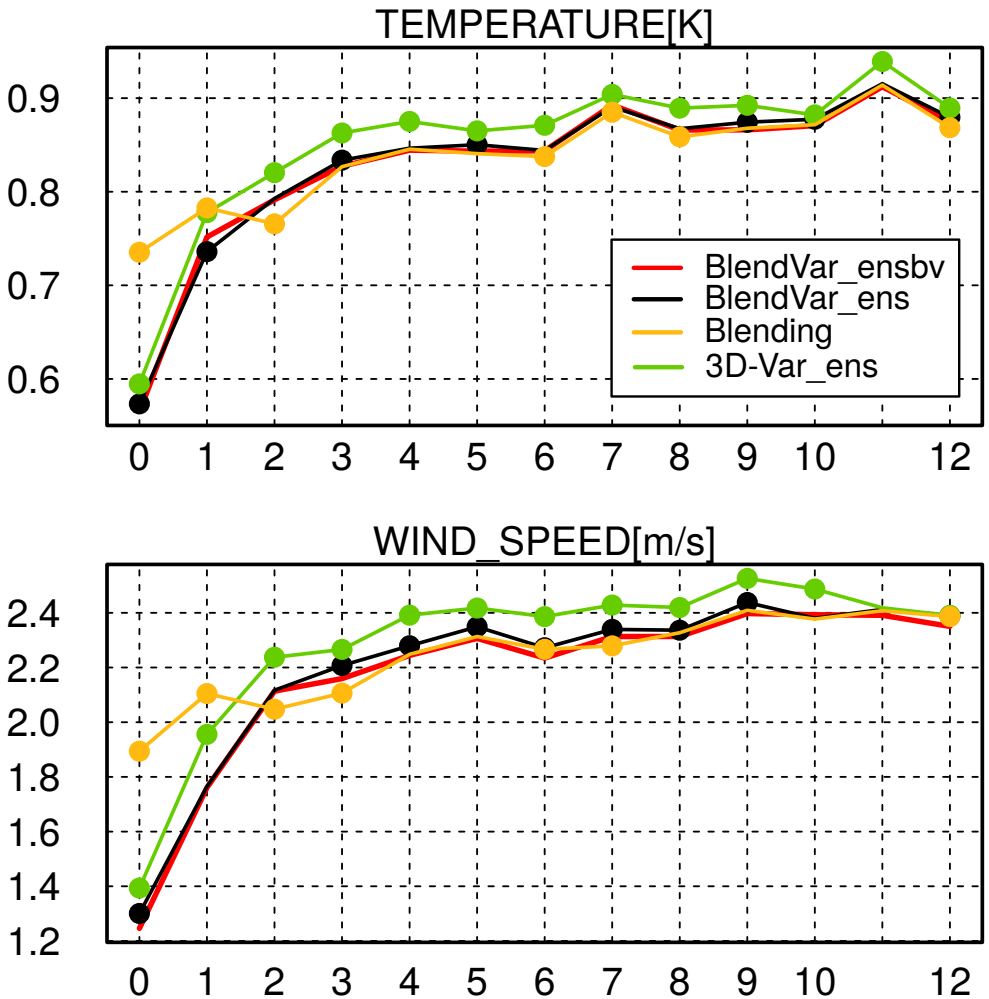
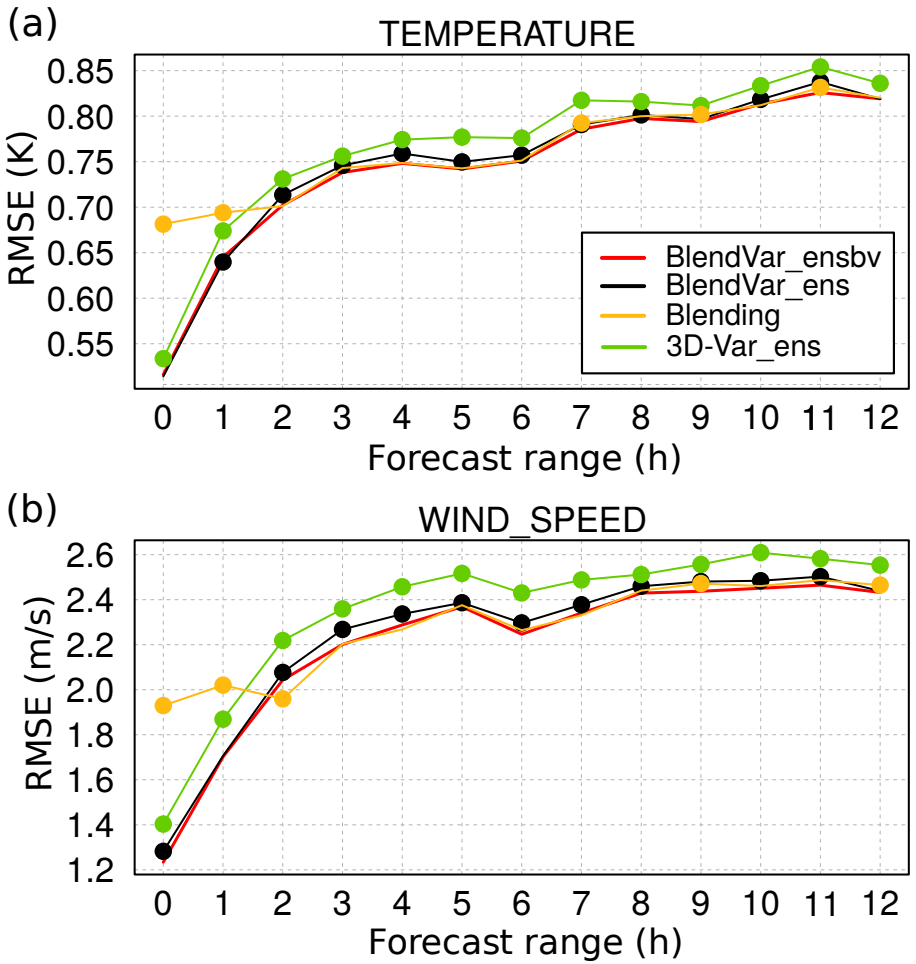
- **RMSE 700hPa production 00,12 utc, against AMDAR, 6/2013**



Results of experiments (3)

- **RMSE 500hPa production 00,12 utc, against AMDAR, 6/2013**



Conclusion

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- DF Blending based schemes clearly outperformed 3D-Var alone
- Appropriate B matrix for BlendVar gives better results than standard ENS.
- The newly sapled B should be used only in BlendVar scheme
- There is space for improving the B matrix for BlendVar since the first derivation in ENSBV was using standard ensemble based B matrix. (second derivation using bg errors of ENSBV)

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Thank You for Your attention !

Antonín Bučánek and Radmila Brožková. Background error covariances for a BlendVar assimilation system. [3]

References

[1] R Brožková. A general description of the “alaro” concept and its realisation. 2014. http://www.rclace.eu/File/ALARO/ALARO_description_Jan2014.pdf.

[2] R Brožková, D Klaric, S Ivatek-Sahdan, J-F Geleyn, V Cassé, M Siroka, G Radnóti, M Janousek, K Stadlbacher, and H Seidl. Dfi blending: An alternative tool for preparation of the initial conditions for lam. *WORLD METEOROLOGICAL ORGANIZATION-PUBLICATIONS-WMO TD*, pages 1–7, 2001.

[3] Antonín Bučánek and Radmila Brožková. Background error covariances for a BlendVar assimilation system. *Tellus A Dyn. Meteorol. Oceanogr.*, 69(1):1355718, jan 2017. ISSN 1600-0870. doi: 10.1080/16000870.2017.1355718. URL https://www.tandfonline.com/doi/full/10.1080/16000870.2017.1355718.

[4] M. Derková and M. Belluš. Various applications of the blending by digital filter technique in the ALADIN numerical weather prediction system. *Meteorol. časopis*, 10(1):27–36, 2007.