A DIAGNOSTIC STUDY OF THE BACKGROUND ERROR STATISTICS IN THE ALADIN/HR 3D-VAR DATA ASSIMILATION SYSTEM

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Introduction

- In NWP 3D-Var data assimilation, forecast errors need to be estimated to optimally integrate observations in the initial conditions.
- Estimation methods are generally based on differences among different forecasts which are used to calculate the background error matrix – B matrix.

Objectives

1. **Assess differences between different B-matrix estimates**
2. **Estimate the seasonal dependency of the B-matrix**

Methods

Multivariate B matrices (Berre, 2000)

- Standard NMC – SNMC
- Ensemble – ENSB
- Four seasonal ensemble – ENSB_MAM, ENSB_JJA, ENSB_SON, ENSB_DJF)

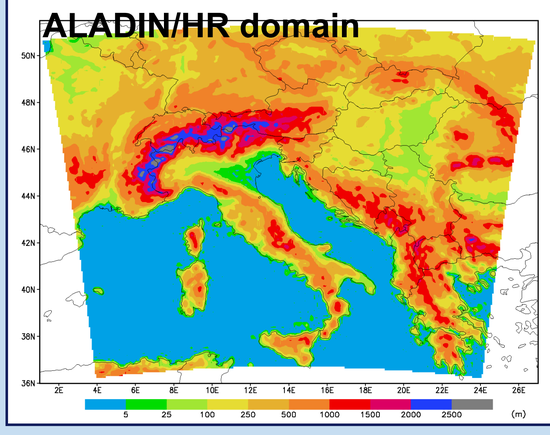
ALADIN/HR model characteristics

- Operational version, hydrostatic, full-physics (Bubnova et al., 1995) at 8 km grid resolution and 37 hybrid vertical levels
- Parametrizations: Louis PBL, Kessler microphysics, modified Kuo convection, Geleyn-Ritter-Hollingsworth radiation schemes

Input data

- ARPEGE deterministic model and four ensmble member forecasts

ALADIN/HR domain



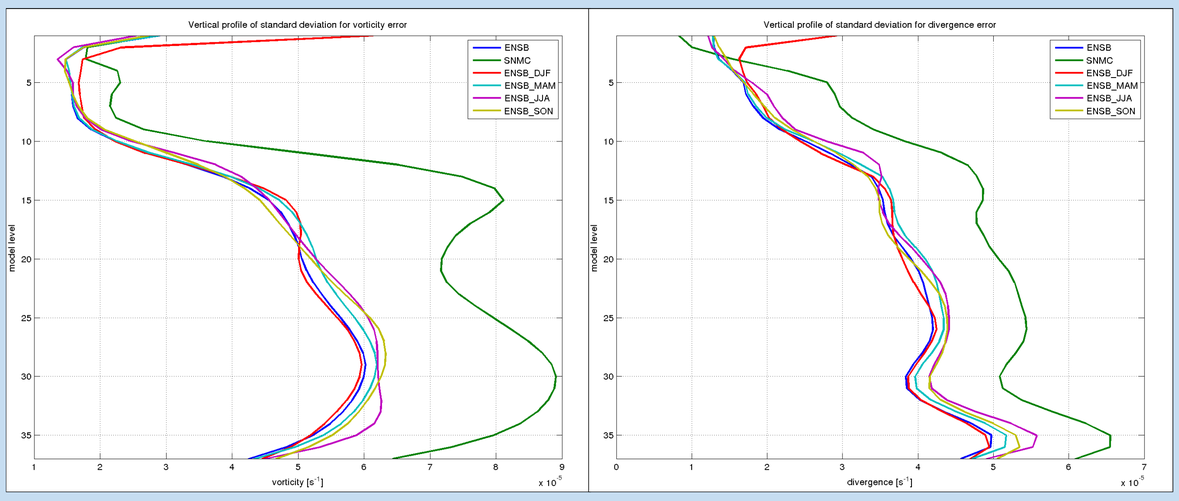
B matrix-calculation periods

1. SNMC (15 Feb – 25 May 2008)
2. ENSB (15 Feb – 25 May 2008)
3. Seasonal ENSB (2008: MAM, JJA, SON, 2008/09: DJF)

Results

Standard deviations of vorticity and divergence errors

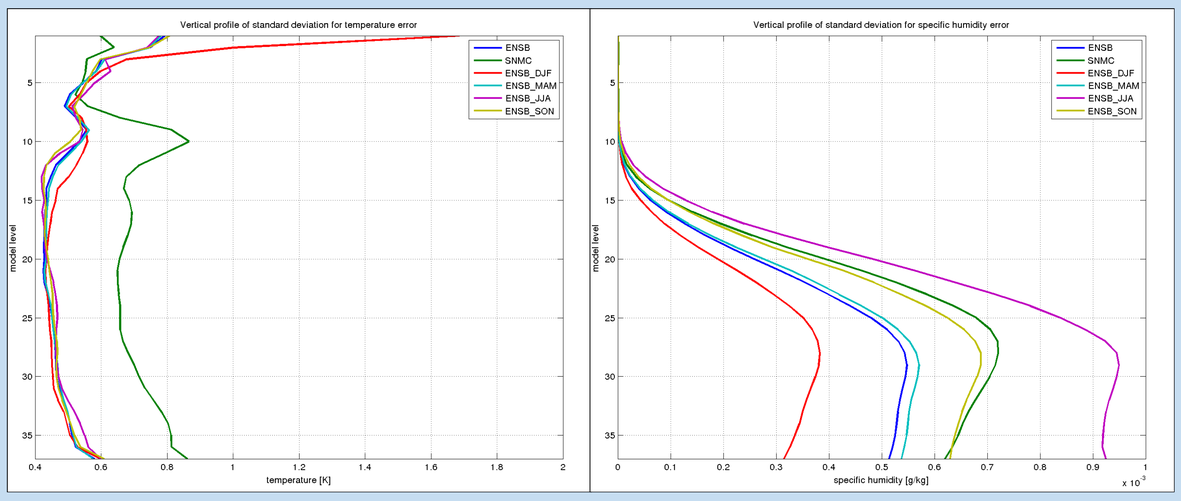
- Smaller magnitude for ENSB with similar shapes in the troposphere
- Small seasonal variability



Results(cont'd)

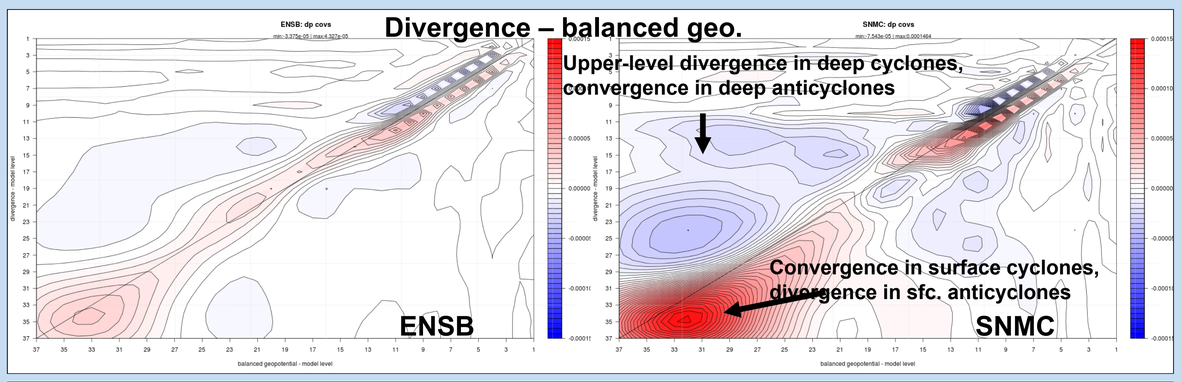
Standard deviations of temperature,ps and specific humidity

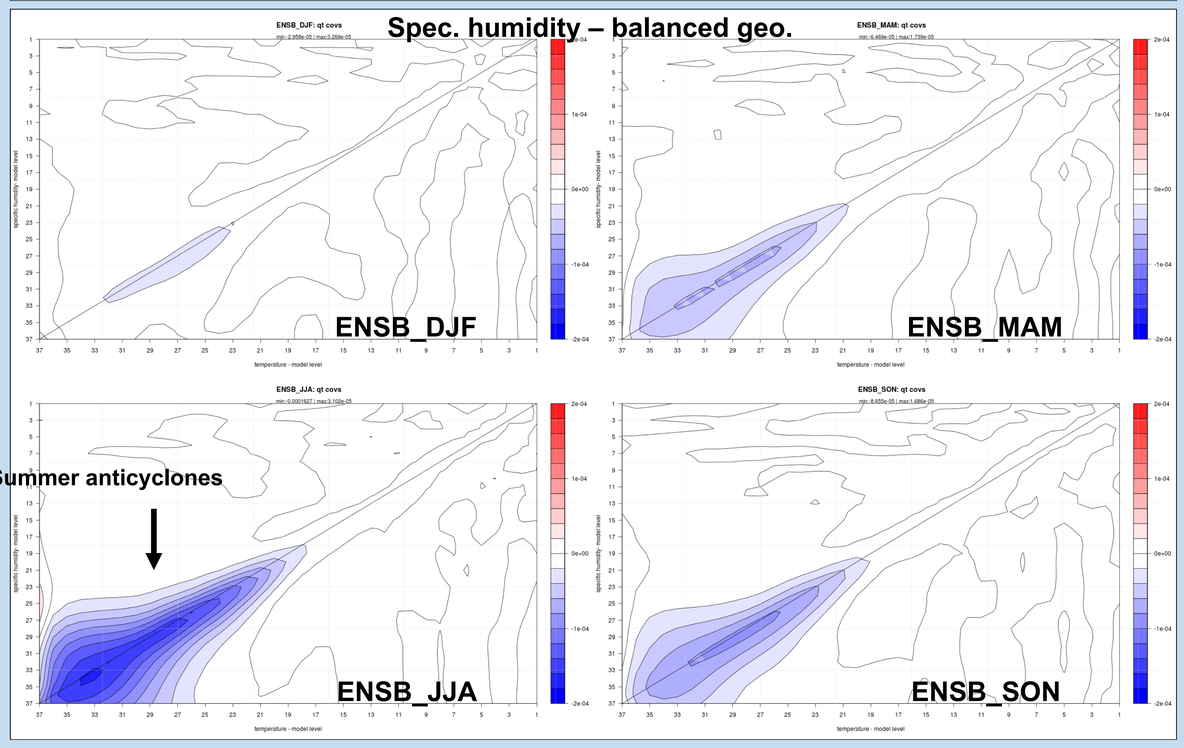
- Smaller standard deviations for ENSB
- Large seasonal variability for specific humidity variable



Multivariate balance operators

- Smaller magnitude of cross-covariances for ENSB
- Weak seasonal variability for divergence-balanced geopotential, T-balanced geop. and T-unbalanced divergence covariances
- Considerable seasonal variability for humidity-related balances





Conclusions

- Ensemble B-matrix generally shows smaller standard deviations and covariances than standard NMC.
- Considerate seasonal dependence exists with respect to humidity-related standard deviations and balances.
- 3D-Var data assimilation could be improved by using seasonal B-matrices.

References

Berre, L., 2000: Estimation of Synoptic and Mesoscale Forecast Error Covariances in a Limited-Area Model. *Mon. Wea. Rev.*, **128**, 644-667.

Bubnova R., Hello G., Benard P. and J. F. Geleyn, 1995: Integration of fully elastic equations cast in the hydrostatic pressure terrain-following coordinate in the framework of ARPEGE/ALADIN NWP system. *Mon. Wea. Rev.*, **123**, 515-535.