Testing Hybrid-3DEnVar at the convective-scale NWP model AROME over Austria

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12 UTC 22-06-2022 (convection and fronts)

00 UTC 12-08-2022 (local convection and weak pressure gradient)

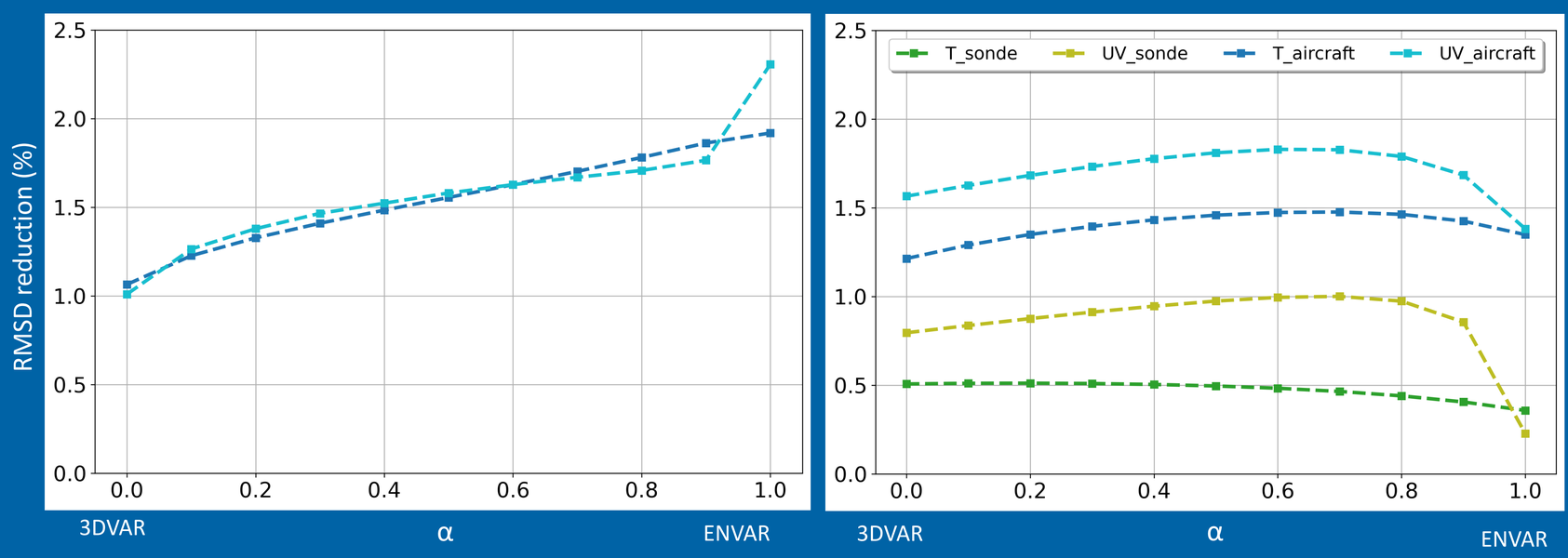


Figure caption: *% reduction in the RMSD of analysis departures with respect to first guess departures. Only one observation (either T or UV) from the aircraft (radiosonde) was assimilated, and RMSD was calculated against non-assimilated radiosonde (aircraft) observation.*

This study tests Hybrid-3DEnVar DA at the convective scale over Austria.

Preliminary results conclude that the inclusion of ensemble-based error statistics in DA in a hybrid-variational fashion can improve ICs.

However, the best combination of climatological and ensemble error estimates for the most accurate estimation of ICs depends on factors like observations assimilated and weather scenarios.

1. Introduction / Research question(s)

Background uncertainties sampled from an ensemble of forecasts can bring convective-scale non-linear error growth and atmospheric daily variations into data assimilation (DA). This is not the case in climatologically sampled error estimates used in variational methods.

3DVAR is operational at GeoShpere Austria. In this study, the Hybrid-3DEnVar DA is used at the convective-scale over Austria to answer the following question:

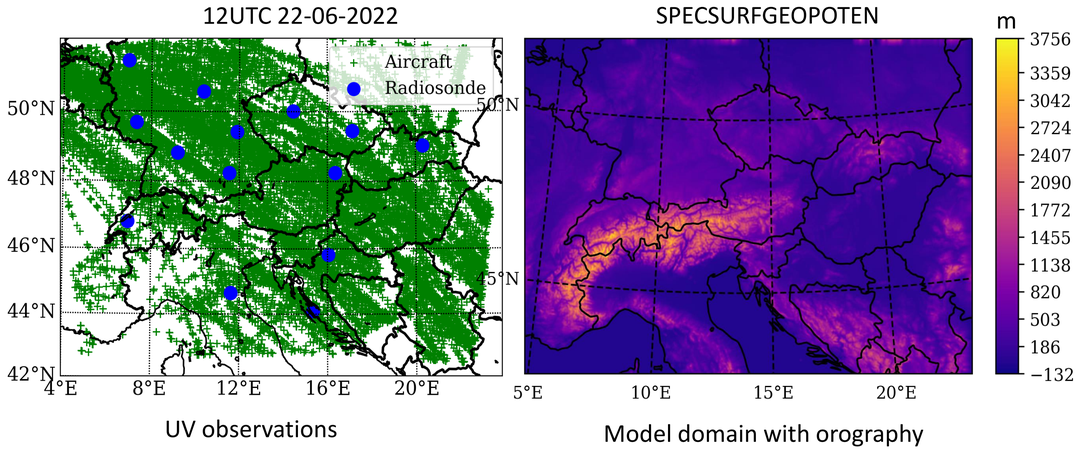
Can initial conditions be improved at the convective-scale by incorporating ensemble error statistics in data assimilation?

2. Approach

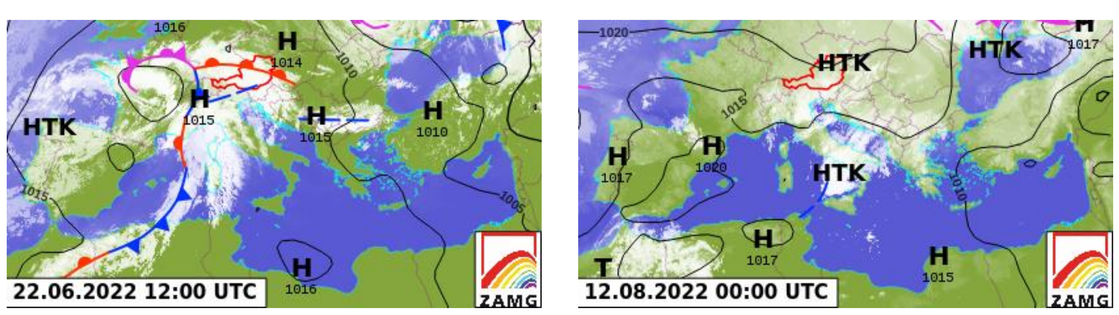
- ❑ AROME at 2.5km, 90 hybrid-pressure coordinates, and 600 X 432 grid-points
- ❑ 50 ensemble members from Convection-permitting Limited-Area Ensemble Forecasting (C-LAEF)
- ❑ Boundary conditions from Global model ARPEGE
- ❑ Radiosonde or aircraft T/UV are assimilated
- ❑ Verification against non-assimilated radiosonde or aircraft T/UV

- ❑ Data assimilation experiments:
  - 3DVAR (α=0)
  - ENVAR (α=1)
  - HYB_XX (α=0.1 to 0.9)
    α [0;1] is weight to ensemble error covariance matrix.

- ❑ Observations and model domain:



- ❑ Test cases:
  - 12 UTC 22-06-2022 (convection and fronts)
  - 00 UTC 12-08-2022 (local convection and weak pressure gradient forcing)



3. Results

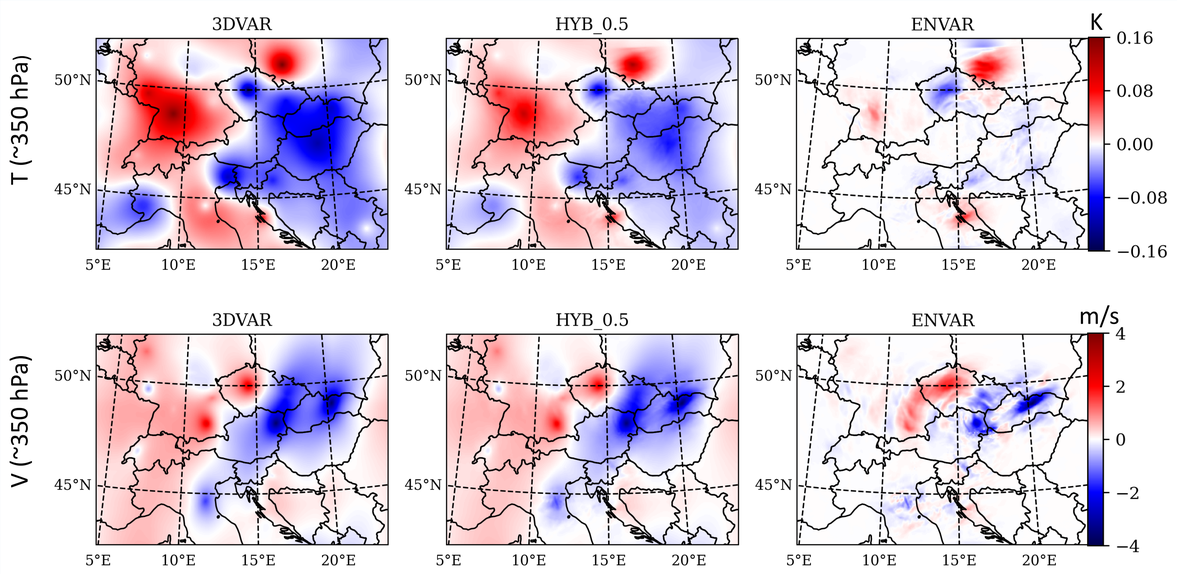


Figure caption: Analysis increments on 00 UTC 12-08-2022 from radiosonde T and V observations at model level S021 (~350 hPa).

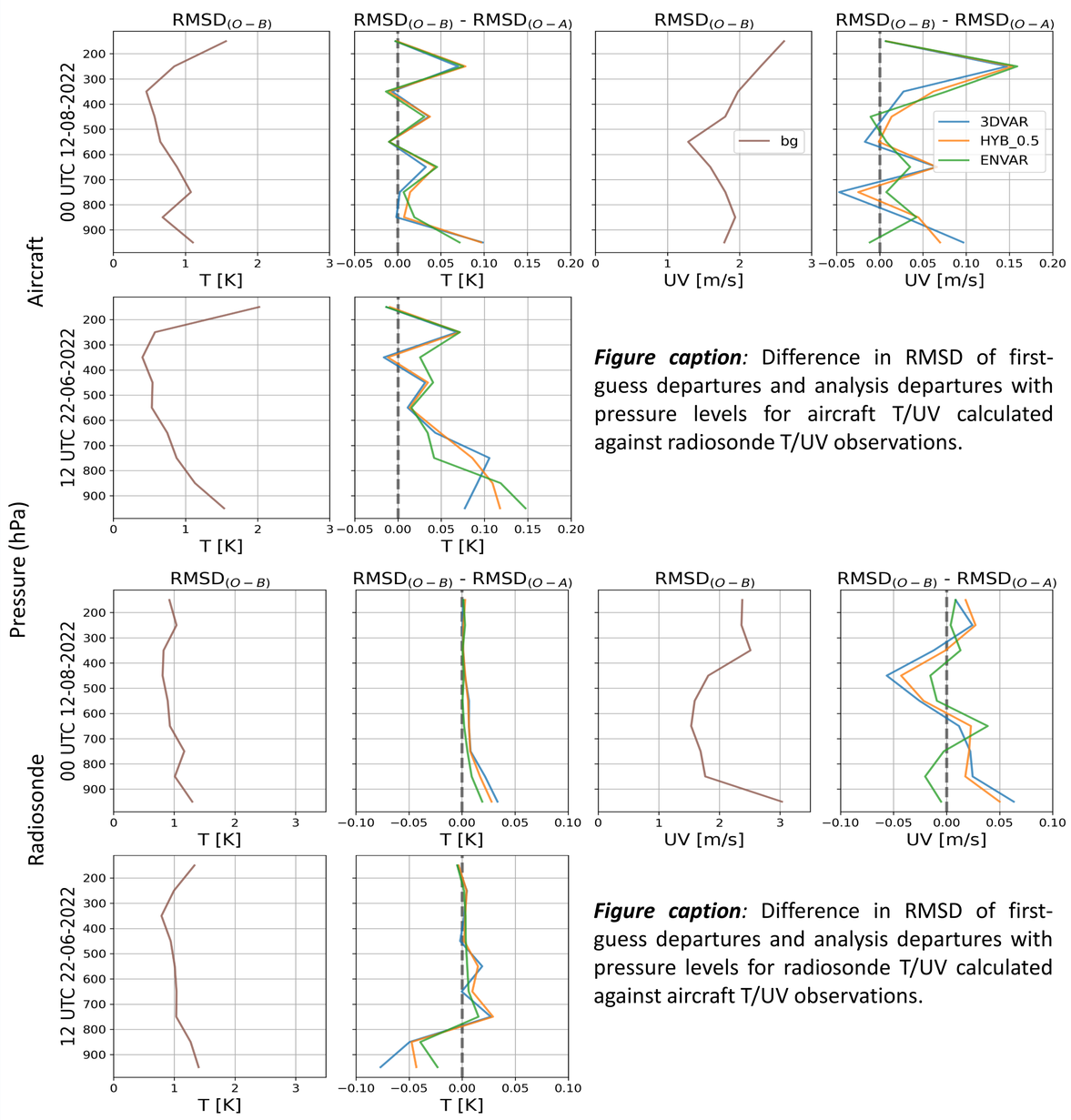


Figure caption: Difference in RMSD of first-guess departures and analysis departures with pressure levels for aircraft T/UV calculated against radiosonde T/UV observations.

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