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Additive Covariance Inflation in an operational, convective-scale NWP Ensemble Kalman Filter Assimilation System

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Towards a climatological B-matrix from the LAM COSMO for additive covariance inflation (ACI) in an EnKF

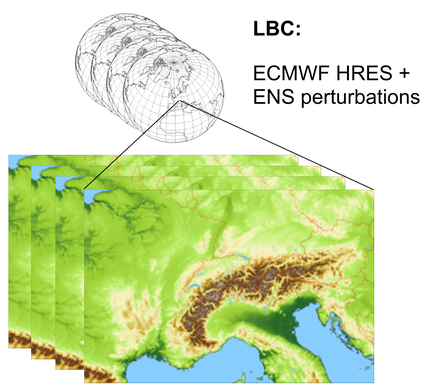
First steps to include additive climatological perturbations to account for systematic model errors in EnKF have been undertaken in the COSMO consortium.

We show results from a test using perturbations from a **B**-matrix derived from the global model ICON in the operational COSMO NWP system of MeteoSwiss

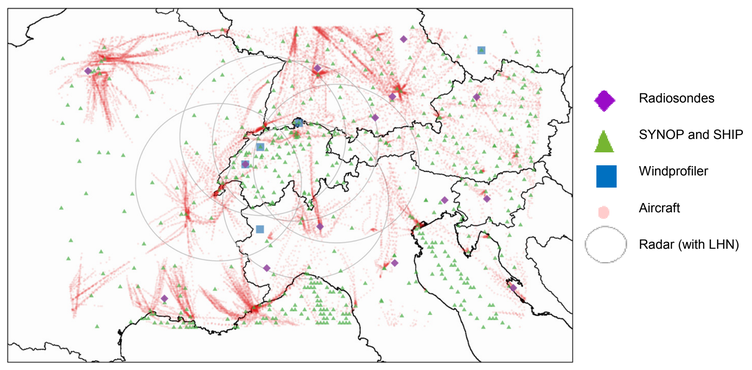
The Operational MeteoSwiss DA System

High-resolution NWP ensemble prediction system for the Alpine area

- KENDA (Schraff et al., 2016) based on LETKF (Hunt et al., 2004)
- Convection-resolving resolution (2.2km mesh-size)
- 40 members
- Hourly cycling
- Treatment of model error
  - Adaptive, multiplicative covariance inflation and RTPP
  - Stochastic Perturbation of Physical Tendencies (SPPT)



Observations



Additive Covariance Inflation

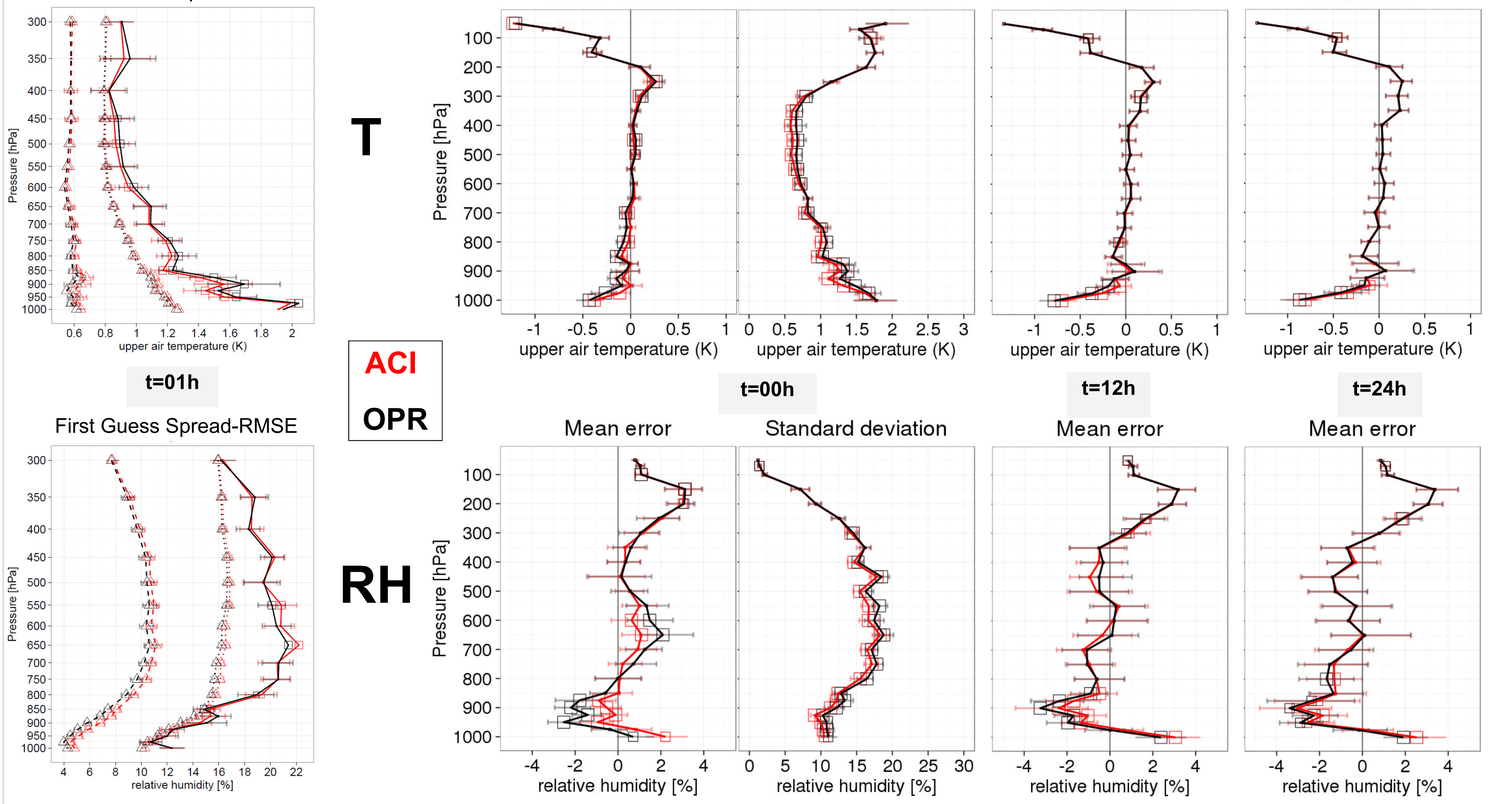
- Perturbations in T, qv, u and v, added to $\mathbf{x}^a$ after the update step
- Drawn from climatological **B**-matrix of the global DWD ICON DA system based on NMC method (Rhodin and Anlauf, 2007)

Experimental Setup

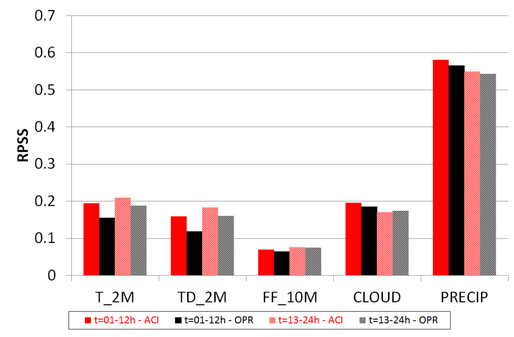
- **ACI** (with Additive Covariance Inflation) vs. **OPR** (operational, without ACI)
- 1 month parallel suite (01.01. - 05.02.2018), analysis and forecasts up to t = 24h
- Identical model, observations and LBC in ACI and OPR analyses

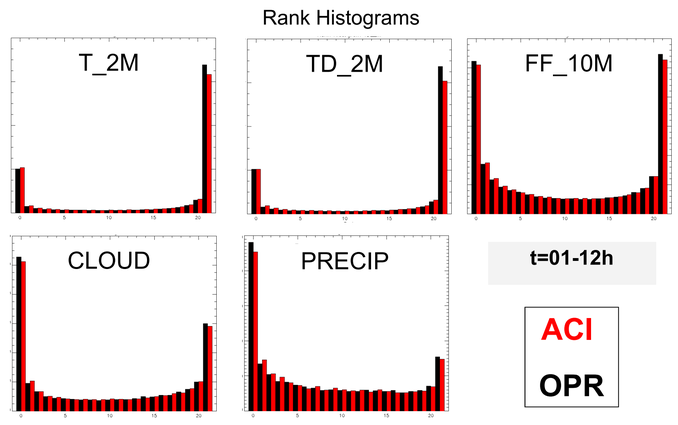
Impact of Additive Covariance Inflation

Verification against Radiosonde Observations

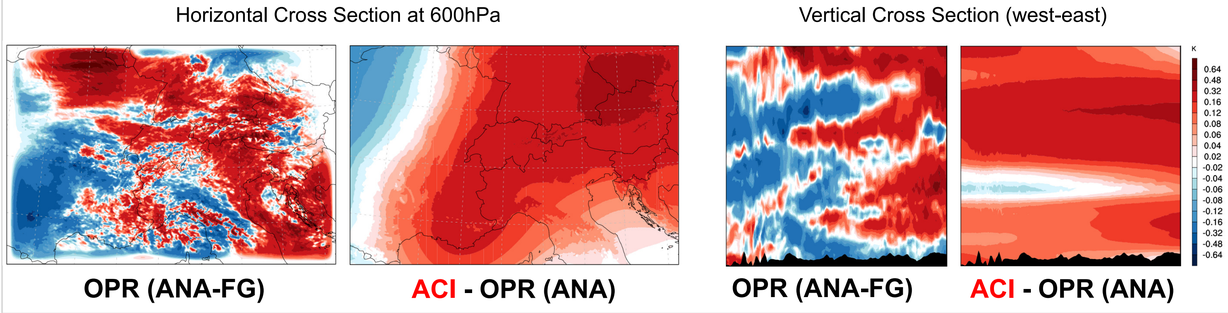


Verification against SYNOP Observations





Temperature Perturbation Structure - LETKF Analysis Increments vs. ACI Increments



- Experiments with identical background state and observations
- Spatial scales of ACI perturbations from the global, climatological **B**-matrix are much larger than those of the flow-dependent LETKF analysis increments
- Shown is one ensemble member out of 40

Conclusions:

- ACI using the global ICON **B**-matrix yields encouraging and consistent improvements in filter performance and consecutive forecasts
- ACI perturbations have larger spatial scales than LETKF analysis increments and are consistent with climatological first guess errors

Future Work:

Derive a climatological **B**-matrix of the regional COSMO model and investigate:

- assumptions made in the global **B**-matrix (NMC method, balances, correlation homogeneity)
- added value of regional compared to global **B**-matrix

References

Hunt, B.R., Kalnay, E., Kostelich, E.J., Ott, E., Patil, D.J., Sauer, T., Szunyogh, I., Yorke, J.A. and Zimin, A.V. (2004), Four-dimensional ensemble Kalman filtering. *Tellus A*

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