Radar Assimilation in COSMO-KENDA

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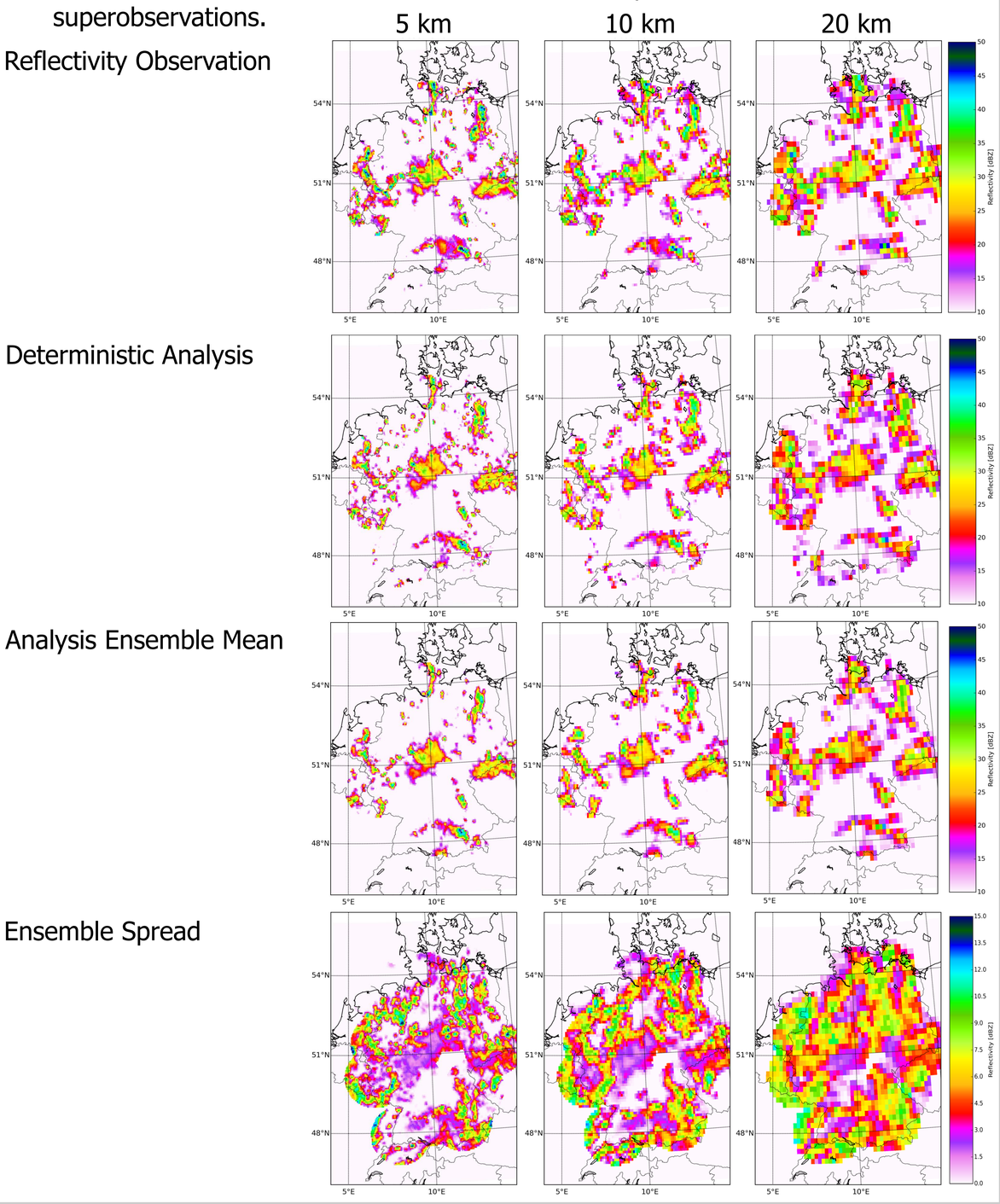
INTRODUCTION

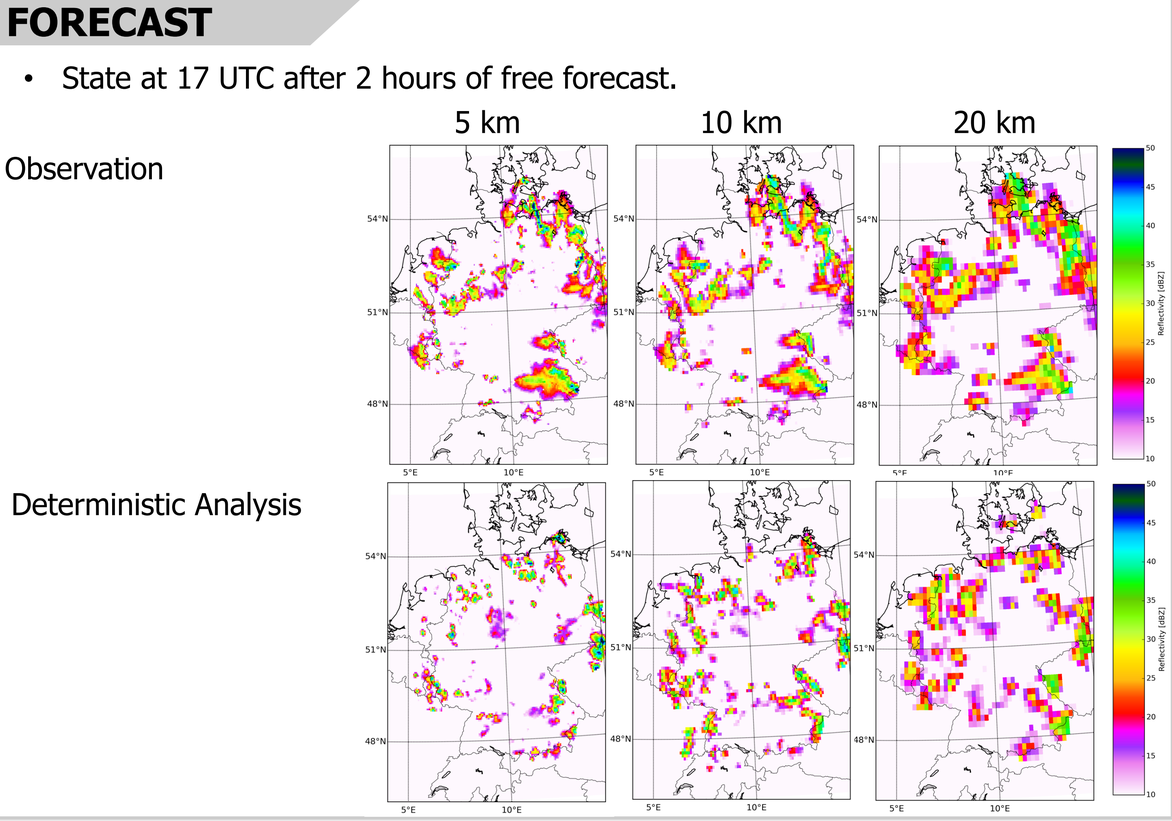
- Simultaneous use of reflectivity and radial wind measurements at full observational resolution has proven difficult.
- The model has difficulties in representing the smallest scales and therefore might not be able to stay close to the radar observations.
- Different localization and averaging techniques have been tested in an idealized environment in Lange & Craig (2014).
- They found an observation resolution of 4 times the model resolution sufficient for a reasonable analysis.
- The LETKF is now being used in the non-hydrostatic COSMO-model to see whether the idealized results can be reproduced in a full model.

REFLECTIVITY ANALYSIS

- State at 15 UTC after 6 hours of assimilation for experiments with different superobservations.



FORECAST



METHODS

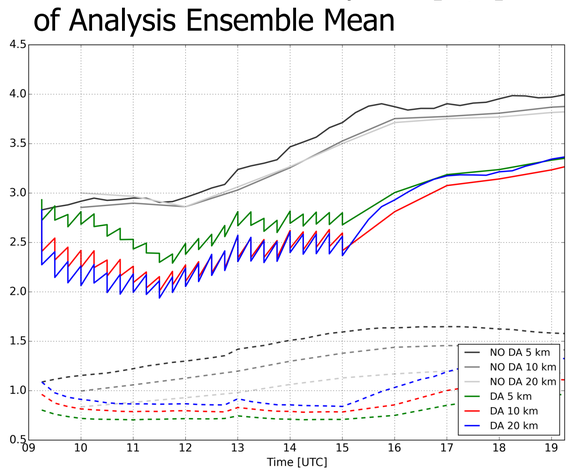
- The Consortium for Small-scale Modeling (COSMO) model is used with a horizontal resolution of 2.8 km in a domain covering Germany (1200 x 1300 km).
- There are 50 vertical layers.
- The LETKF is being used within the kilometre-scale ensemble data assimilation system (KENDA) of the German weather service (DWD).
- 40 ensemble members are used
- The boundary conditions are from a global ensemble (GME).
- Data from 16 operational radars are assimilated every 15 minutes using a radar forward operator (Zeng et al. 2014).
- Radial wind error: 5 m^2s^{-2}; Reflectivity error: 10 dBz^2; Threshold rain/no-rain: 5 dBz.
- Localization radius and superobservations will be varied.
- For a study of different update frequencies see talk of T. Bick.

EXPERIMENTS

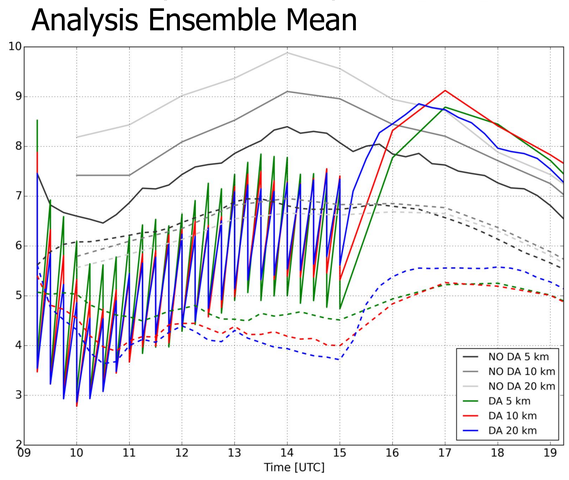
- The experiments are run on 6-6-2011, with spinup from 0 to 9 UTC using only conventional data. Radar assimilation goes from 9 to 15 UTC and a free forecast runs from 15 to 20 UTC.
- The NO-DA experiment runs as a free forecast from 9 to 19 UTC.
- Superobservations are used with a resolution of 5, 10 and 20 km. The horizontal localization radius is kept constant at 20 km.

RMSE

Radial Wind RMS and Spread [m/s] of Analysis Ensemble Mean

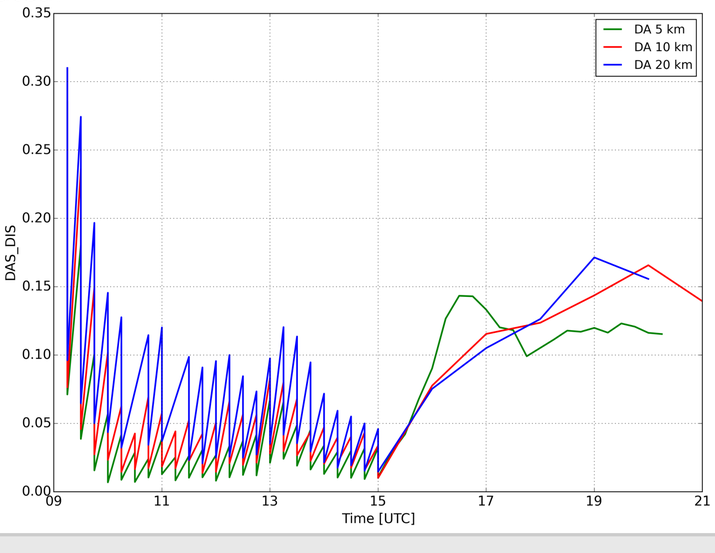


Reflectivity RMS and Spread [dBZ] of Analysis Ensemble Mean



Grey lines show the RMS in the observation space of different averaged observations when no observations are assimilated.

DAS Distance Score of reflectivity objects which are reduced to the same 20 km resolution.



CONCLUSIONS

- A first analysis does not show any advantage of the high resolution observations.
- All thunderstorms are assimilated well in all experiments, although having slightly smaller maximum reflectivities.
- Suppression of spurious convection works well, but wrong cells coming in from the boundaries can still be seen.
- The wind field is being corrected in a consistent and persistent way.
- The reflectivity error grows fast during the forecast and gets even larger than the No-DA experiment.
- The atmospheric profile is not corrected enough to sustain the assimilated thunderstorms for a long time period.

Next Steps

- Distinguish between rain and no-rain pixels in RMS.
- Evaluate unobserved fields.
- Study the behaviour on a longer time period in May 2014 to get robust results.
- Use independent observations for verification.