Comparing observed and modeled radar reflectivities at different spatial scales

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**Aim of the work**

At the Deutscher Wetterdienst, the SINEXY Project aims at developing a new seamless prediction system for very short range convective-scale forecasting. Products of Nowcasting and Numerical Weather Prediction (NWP) are complemented, further developed and interlocked in such a way that a seamless representation of the atmospheric state and weather phenomena from now until +6h+12 h is possible. Model outputs in observation space, in particular the reflectivities simulated by the Radar Forward Operator EMVORADO (Zeng et al., 2016) included in the COSMO model, allow seamless combination of Nowcasting and NWP into combined products for the forecasters. Furthermore, reflectivity can be used for the verification of the developed products. This method is chosen to be able to compare, and then combine, “apples with apples”. But is the reflectivity simulated by the model really similar to the observed one? Or are they more like “apples and pears”?

Purpose of this work is to analyse the two reflectivity fields and to assess their characteristics and their degree of (dis)similarity, with particular emphasis on the spatial scales represented by the two fields. This analysis aims to contribute to the design of appropriate methods for the combination of Nowcasting and NWP products and for their verification.

**Data used**

Observed reflectivities are obtained from the German radar network, while the simulated ones are from the COSMO-DE-EPS ensemble of DWD, run at 2.8 km over Germany, with 20 members. A period of seven days is analysed, from 27th of May to 2nd of June 2016, when several convective events occurred over Germany. The ensemble was run every day at 15 UTC for 6 hours.

**Frequency distribution of the reflectivity values**

The distributions of the reflectivities observed by the radar (green) and simulated by the model (red) during the events of the 29th (top row) and 31st of May (bottom row) are shown. All the 6 hours contribute to the distributions. For the ensemble, all the members are included (and the frequency is normalised by dividing by 20). The ensemble is run in 2 configurations: COSMO using the 1-moment microphysics scheme (left panels) and using the 2-moment microphysics scheme by Seifert and Beheng (2006) (right panels).

The model tends to produce too many low reflectivity values. Intermediate reflectivity values are sometimes underestimated by the model, also in the 2-moment configuration.

In most cases it is found that the distribution of the high reflectivity values (above 50 dBZ) is better represented by the 2-moment scheme.

**Degree of similarity at different spatial scales**

In order to evaluate the degree of similarity between the modeled reflectivities and the observed ones in dependence of the spatial scale, the Fraction Skill Score (FSS, Roberts and Lean, 2008) was computed for the ensemble, for spatial scales up to about 100 km. The FSS is shown for the event of the 29th of May, for the 2-moment configuration. Three thresholds are considered: 20, 40 and 50 dBZ. The 6 forecast hours are plotted separately (different colours), representing here the evolution of the phenomenon more than the forecast range.

It is not possible to establish an optimal scale of aggregation for all intensities, since the simulated reflectivities have different degree of similarity to the observed one for low, moderate and high intensities.

**References**


