EMS Annual Meeting Abstracts,
Vol. 6, EMS2009-402, 2009
9th EMS / 9th ECAM


9th EMS Annual Meeting
9th European Conference on Applications of Meteorology
High resolution meteorology
- applications and services

# Evaluating multi-scale model forecasts using high resolution analysis

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At the Central Institute for Meteorology and Geodynamics (ZAMG), a variety of numerical weather prediction models is running operationally or in a pre-operational mode covering a broad spectrum of spatial and temporal scales. Beside the operational (reference) limited area model, ALADIN-AUSTRIA, which runs on 10 km up to +72 hours, a non-hydrostatic version on 5 km and an AROME prototype on 2.5 km up to +30 hours are maintained on a quasi-daily basis. During the last few years, the analysis and nowcasting system INCA (Integrated Nowcasting through Comprehensive Analysis) has been developed at ZAMG. The system provides 3D and 2D fields on a very high resolution grid (1 km) up to +48 hours with an update frequency of 15 min and 1 hour, respectively. Beyond the nowcasting range, the precipitation forecast is derived from a statistical combination of both ECMWF and ALADIN-AUSTRIA predictions based on a climatological error weighting. 3D-Temperature and -wind forecasts are generated by bias-corrected ALADIN-AUSTRIA forecasts downscaled to the high-resolution INCA topography.

Illustrating the benefit from high resolution forecasts, especially for precipitation, needs sophisticated verification methods. Using conventional station verification or grid point verification (double penalty problem) it is very difficult to demonstrate that a 5 km or 2 km model generates better precipitation forecasts with respect to a 10 km model.

In combination with the high resolution INCA precipitation analysis, the rather novel verification approach SAL is used to evaluate the quality of quantitative precipitation forecasts (QPF) for different numerical weather prediction models. SAL is an object-based quality measure which allows evaluating QPFs on a given domain according to three quality criteria (Wernli et al. 2008): Structure (S), Amplitude (A) and Location (L). A is a measure for the deviation of the spatial mean QPF with respect to the observed value. S gives information whether the modelled precipitation objects within the domain are too large and/or too flat and too small and/or peaked respectively. Finally L yields information about the displacement of the forecasted objects with respect to the observed objects within the domain.

The advantages and deficiencies of the models with respect to their aimed scale will be shown. Furthermore, the length of the nowcasting range that provides superior QPF compared to high resolution NWP models is discussed.