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Quantifying scale dependencies in the skill of probabilistic precipitation forecasts

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In order to predict floods in small river catchments, we need quantitative precipitation forecasts (QPF) which are highly resolved in space and time. Such QPF could be based on short-term NWP model runs as well as on radar-based nowcasting schemes (or both). However, the native resolution of a QPF does not necessarily coincide with its effective resolution, i.e. the resolution on which we actually trust the QPF to add value to a hydrological forecast. Thus, the hydrological forecaster should be informed how the error of a QPF system might depend on scale. Legitimately, we would assume the forecast error to increase with increasing lead time, decreasing temporal and spatial scale (i.e. increasing resolution) and increasing return period of the event. However, the rate of increase is likely to depend on the QPF system as well as on the regional and synoptic scale meteorological conditions. Altogether, we need a scale-sensitive verification scheme and we would like this scheme to be applicable for ex-post verification of QPF systems as well as for real-time verification of deterministic as well as probabilistic QPF forecasts (see Ebert 2008).

In our approach, we use moving windows to smooth the observed and forecasted precipitation fields in space and time. By successively increasing the size of the moving window, we construct fields which we consider as representative for the distribution of rainfall intensity on a particular scale (assuming that scale corresponds with the size of the window in space and time). The smallest window size (i.e. smallest scale) is imposed by the native QPF resolution while the largest considered scale is limited by the spatiotemporal domain of the forecast. For a spatial domain of 256 x 256 km size and a native resolution of 1 km, we would e.g. apply moving windows with a block length of 1, 2, 4, 8, 16, 32, 64, 128 and 256 km. Analogously, a lead time of three hours and a native resolution of 5 minutes could result into moving windows of 5, 10, 20, 45, 90 and 180 minutes length. We finally use the smoothed fields in order to evaluate the forecast skill as a function of spatial and temporal scale, forecast lead time and event magnitude. In contrast to common verification procedures, the event magnitude is not defined by fixed rainfall intensity thresholds, but by quantiles of the observed rainfall intensity distribution. For each considered scale and lead time, we compute a set of intensity thresholds based on a set of considered quantiles (e.g. the 50%, 75%, 90%, 95% and 99% percentiles). The reason for using quantiles is that a specific rainfall intensity is less likely to extent over large areas (or long time periods) than over small areas (short time periods). In other words: the same rainfall intensity has different return periods on different scales – and thus different levels of predictability. Using quantile thresholds, however, allows us to compare forecast skills on different scales.

Our methodology is applicable for a wide range of skill scores, including measures for both deterministic and probabilistic forecasting schemes. In a case study, we verify forecasts generated by a probabilistic (ensemble) precipitation nowcasting system called STEPS (Bowler et al. 2006). For this purpose, we visualise the scale-sensitive Brier Score and Brier Skill Score for a large range of scales, lead times and precipitation quantiles. The test bed is a storm rainfall event which took place in SW-Germany in June 2008 with rainfall sums exceeding 100 mm within two hours. The spatial domain is a 256 km square region, the maximum lead time is 3 hours. The forecasts have a native spatiotemporal resolution of 1 km and 5 minutes and are verified against radar rainfall estimates with the same resolution.

References:

Bowler, N.E., Pierce, C.E., Seed, A.W., 2006: STEPS: A probabilistic precipitation forecasting scheme which merges an extrapolation nowcast with downscaled NWP. Q. J. R. Meteorol. Soc., 132 (620): 2127-2155.

Ebert, 2008. Fuzzy verification of high-resolution gridded forecasts: a review and proposed framework. Meteorol. Appl. 15: 51–64.