Geophysical Research Abstracts
Vol. 21, EGU2019-13282, 2019
EGU General Assembly 2019

Statistical optimization and calibration of high resolution ensemble precipitation at DWD

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Precipitation is one of the most important and also challenging parameters in numerical weather prediction. On the one hand, strong precipitation events can cause serious urban as well as regional flooding. On the other hand, verifications of precipitation forecasts with rain gauges for the exact time, location and amount, often reveal essential uncertainties. In order to address these uncertainties and the high variability especially of strong precipitations a number of strategies have been developed and are presented, e.g. aggregation in time and space, ensemble and probabilistic forecasting, and the use of radar precipitation as an area based observation system.
At DWD ensemble forecasts of precipitation amounts and threshold probabilities of the convection-permitting COSMO-DE/2-EPS are downscaled using measurements of synoptic rain gauges. The precipitation amounts are statistically optimized using multiple stepwise linear regressions in a model output statistics approach. Ensemble products as ensemble mean and standard deviation of the most relevant and statistically significant model variables are selected as predictors during training. The resulting optimized precipitation amounts become suitable predictors for the forecasts of probabilities that predefined thresholds are exceeded, which are modeled and calibrated using logistic regressions. In this way the ensemble forecasts are essentially improved and calibrated, respectively. Long time series of currently 7 years of model and observation data are used in order to capture as many strong precipitation events and their error statistics as possible.
Aggregation in time, i.e. the prediction of precipitation amounts during 3-hourly or longer periods and their corresponding threshold probabilities, can be computed straight forward by summing up rain gauge observations and model fields in time. For aggregation in space the situation is more complicated as the statistical optimization with rain gauges normally results in precipitation amounts and probabilities that are related to the sizes of their funnels. Radar precipitation can be used instead in order to provide area related precipitation forecasts. But also methods of stochastic geometry have been applied in order to estimate area precipitation probabilities for arbitrarily chosen areas from point related probabilities.
Larger aggregations in time and space are more predictable and the resulting forecasts can be more accurate. However, the resolution is reduced and details about the exact time and space of the events get lost. The question remains, which is the best compromise in terms of time period and area size and what are suitable statistical products that provide most relevant and valuable input for weather warnings and forecasts their of impacts.
Verification results of different approaches will be presented.