Probabilistic Precipitation Type Forecasting based on Ensemble Forecasts of Vertical Temperature Profiles

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Abstract: Accurate prediction of precipitation type is one of the major weather forecasting challenges during the cool season. Freezing rain is particularly dangerous; it can cause power outages by forming glaze ice and pose significant threats to air and ground traffic. The prediction of this precipitation type typically comes with substantial forecast uncertainty, thus making a case for probabilistic precipitation type forecasting. In this talk we present a Bayesian classification method for probabilistic forecasts of precipitation type. The method considers the vertical wetbulb temperature profiles associated with each precipitation type, transforms them into their principal components, and models each of these principal components by a skew normal distribution. A variance inflation technique is used to de-emphasize the impact of principal components corresponding to smaller eigenvalues, and Bayes’ theorem finally yields probability forecasts for each precipitation type based on predicted wetbulb temperature profiles. Our approach is demonstrated with reforecast data from the Global Ensemble Forecast System (GEFS) and observations at 551 METAR sites, using either the full ensemble or the control run only. In both cases, reliable probability forecasts for precipitation type being either rain, snow, ice pellets, freezing rain, or freezing drizzle are obtained. Compared to the Model Output Statistics (MOS) approach presently used by the National Weather Service, the skill of the proposed method is comparable for rain and snow and significantly better for the freezing precipitation types.

Michael Scheuerer is a Research Scientist at the Cooperative Institute for Research in Environmental Sciences (CIRES) at CU Boulder and the Earth System Research Laboratory of the National Oceanic and Atmospheric Administration (NOAA). He received his graduate degree in mathematics from Bayreuth University, Germany, and his Ph.D. in mathematical statistics from Göttingen University, Germany. His research focuses on probabilistic weather forecasting with emphasis on statistical calibration of ensemble weather predictions. In addition, he is developing methods for the evaluation of forecast performance.

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