Probabilistic Weather Forecasting

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A major human desire is to make forecasts for an uncertain future. Consequently, forecasts ought to be probabilistic in nature, taking the form of probability distributions over future quantities or events. Over the past two decades, the meteorological community has been taking massive steps in a reorientation towards probabilistic forecasting. This is typically done using a numerical weather prediction model, perturbing the inputs to the model, such as initial conditions and physics parameters, in various ways, and running the model for each perturbed set of inputs. The result is then viewed as an ensemble of forecasts and is often interpreted as a sample from the joint probability distribution of future states of the atmosphere. However, forecast ensembles typically are biased and uncalibrated. These shortcomings need to be addressed by statistical postprocessing, with ensemble Bayesian model averaging and nonhomogeneous regression being state of the art approaches. Many challenges remain, both theoretically, methodologically and computationally, and there is ample scope for an increased involvement by statisticians.

Key Words: Ensemble forecast, calibration, Bayesian model averaging, nonhomogeneous regression