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A Bayesian Approach to Statistical Post-Processing

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Weather affects a wide range of individual and institutional activities. Users seek the most skillful and calibrated forecasts available, hence weather agencies must be prepared to provide information on any aspect of future weather, in any form requested. Today, most weather forecasts are based on Numerical Weather Prediction (NWP) model output. Such guidance (e.g., single or ensemble forecasts) is (1) available from multiple sources (with partially independent information); and due to modeling limitations, (2) they suffer from lead-time dependent miscalibration (systematic errors), and (3) are limited to some basic coarser scale variables that may not be of direct interest to most users. Hence the three main objectives of statistical post-processing of NWP output are: (1) Combine all predictive information into a single guidance product; (2) Calibrate such guidance; and (3) Provide additional information beyond that carried in NWP forecasts.

In this presentation, we outline a methodology called the Bayesian Processor of Ensemble (BPE), designed to accomplish the above objectives. BPE follows a theoretically based approach and uses the climatological distribution of the predictand as a prior, significantly reducing demand for the volume of hindcasts. It combines all available independent and skillful guidance products (e.g., unperturbed and ensemble forecasts from multiple centers) to produce, given the input, the most skillful calibrated posterior forecast cdf, pdf, quantile, and alternative scenario (i.e. ensemble) information. A meta-Gaussian distributional approach used in BPE enables the unified processing of all continuous variables and provides an edge in processing extreme values. With an array of output formats, any question about future weather, including those concerning probabilities for aggregated or joint variables, can be answered.