Geophysical Research Abstracts
Vol. 15, EGU2013-14030, 2013
EGU General Assembly 2013

Verifying and Postprocesing the Ensemble Spread-Error Relationship

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With the increased utilization of ensemble forecasts in weather and hydrologic applications, there is a need to verify their benefit over less expensive deterministic forecasts. One such potential benefit of ensemble systems is their capacity to forecast their own forecast error through the ensemble spread-error relationship. The paper begins by revisiting the limitations of the Pearson correlation alone in assessing this relationship. Next, we introduce two new metrics to consider in assessing the utility an ensemble's varying dispersion. We argue there are two aspects of an ensemble's dispersion that should be assessed. First, and perhaps more fundamentally: is there enough variability in the ensembles dispersion to justify the maintenance of an expensive ensemble prediction system (EPS), irrespective of whether the EPS is well-calibrated or not? To diagnose this, the factor that controls the theoretical upper limit of the spread-error correlation can be useful. Secondly, does the variable dispersion of an ensemble relate to variable expectation of forecast error? Representing the spread-error correlation in relation to its theoretical limit can provide a simple diagnostic of this attribute.
A context for these concepts is provided by assessing two operational ensembles: 30-member Western US temperature forecasts for the U.S. Army Test and Evaluation Command and 51-member Brahmaputra River flow forecasts of the Climate Forecast and Applications Project for Bangladesh. Both of these systems utilize a postprocessing technique based on quantile regression (QR) under a step-wise forward selection framework leading to ensemble forecasts with both good reliability and sharpness. In addition, the methodology utilizes the ensemble's ability to self-diagnose forecast instability to produce calibrated forecasts with informative skill-spread relationships. We will describe both ensemble systems briefly, review the steps used to calibrate the ensemble forecast, and present verification statistics using error-spread metrics, along with figures from operational ensemble forecasts before and after calibration.