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Estimation of analysis and forecast errors

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Accurate estimates of errors in numerical analyses and forecasts (i.e. difference between analysis/forecast fields and nature that is being predicted) are critical for the evaluation of analysis/forecast systems and for the proper initialization of ensembles. A number of issues, however, hinder related efforts, such as errors in observations and the difficulty in their estimation; the fact that estimates of analysis errors derived via data assimilation schemes are influenced by the same assumptions as those used to create the analysis fields that we wish to evaluate; and the presumed but unknown correlation between analysis and forecast errors.

In this paper a new approach is proposed for the estimation of analysis and forecast errors. The method is based on a few simple assumptions that are independent of any data assimilation method and provides error estimates with a range of uncertainty, partitioned into initial value and model related components. In a simulated forecast environment the method is demonstrated to reproduce the true analysis and forecast error within the predicted error bounds.

Forecasts from four leading Numerical Weather Prediction centers are evaluated using the new method. Results indicate that synoptic-scale forecast errors over extra-tropical regions are dominated by amplifying initial errors while those in the tropics are strongly influenced by errors associated with the use of imperfect models. Comparing analysis and forecast error estimates from the different centers one can assess the quality of each analysis/forecast system.