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Single best-guess and ensemble forecasts: what is the value of the additional information provided by ensembles?

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One of the main advances in numerical weather prediction of the past 20 years has been the development and operational implementation of ensemble-based, probabilistic systems. To date, ensemble systems provide an estimate of the uncertainty of analysis and forecast states that incorporates our knowledge about the nonlinear dynamics of error growth in the atmosphere and our knowledge about the usage of observational data.

At ECMWF, for example, the combination of the high-resolution 4-dimensional variational assimilation system (4DV) and the lower-resolution Ensemble of Data Assimilations (EDA) system provide an estimate of the most likely initial state and its uncertainty. In forecast mode, similarly, the high-resolution forecast system (HRES) and the Ensemble Prediction System (EPS) provide an estimate of the most likely future states and their uncertainties. We have learned that these combined systems, 4DV+EDA and HRES+EPS, are providing more valuable information than single-forecast based systems that do not explicitly estimate uncertainties.

In this talk, it is argued that the most promising way for the future will be to further develop systems that aim to provide accurate flow-dependent and data-dependent estimates of the uncertainties of analysis and forecast states. ECMWF plans to further progress along this line will also be presented.