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Ensemble Forecasting: An Enhancer of Information, or an Expensive Filter?

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Realistic Numerical Weather Prediction (NWP) models can well simulate the spatiotemporal variability of weather. Hence with initial conditions closely representing nature, NWP models can be used to predict the future evolution of weather. Predictability, however is limited due to the chaotic amplification of forecast errors. The loss of predictability in NWP forecasts is tied to the spatiotemporal scales of weather phenomena: larger scale features are predictable over progressively longer time periods.

In the late 1950s and 1960s, ensemble forecasting, where a set of NWP integrations are carried out from intentionally degraded initial conditions, was proposed to identify the predictable component in NWP forecasts on a case by case bases. Obviously, the best single forecast is made starting from the best estimate of the state of the natural system (i.e. form the unperturbed "control" analysis). The larger scale, predictable features in such a forecast carry useful information about nature, while the phase and amplitude of finer scale features soon lose their connection with the evolution of such features in nature.

Through theoretical considerations and experimental data, this presentation will revisit the basic premise of ensemble forecasting. Does the mean of an ensemble, for example, enhance the information in predictable forecast features, or only filters out the unpredictable, smaller scale features while leaving the predictable information unchanged or possibly slightly degraded? Since ensemble forecasting is a computationally expensive operation, the answer to this question can have profound implications as to the optimal configuration for NWP forecasting.