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A multi-model ensemble Kalman filter for forecasting and data assimilation

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Data assimilation (DA) aims to optimally combine model forecasts and noisy observations. Multi-model DA generalizes the variational or Bayesian formulation of the Kalman filter, and we prove here that it is also the minimum variance linear unbiased estimator. However, previous implementations of this approach have not estimated the model error, and have therewith not been able to correctly weight the separate models and the observations. Here, we show how multiple models can be combined for both forecasting and DA by using an ensemble Kalman filter with adaptive model error estimation. This methodology is applied to the Lorenz-96 model and it results in significant error reductions compared to the best model and to an unweighted multi-model ensemble.