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The Asymmetric EDA

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The ensemble data assimilation system used at ECMWF (ensemble of data assimilations, EDA) is a Monte Carlo simulation of the 4D-Var reference assimilation system accounting for observation, forcing and model uncertainties. The EDA is capable of handling non-Gaussian posterior Probability Density Functions for large ensembles. Its maintenance cost is low, as there is no need to support a separate data assimilation system for the ensemble component. Hence, it is straight forward to propagate new developments in the high resolution 4D-Var to the EDA. The EDA scales perfectly with the ensemble size, but compared to an EnKF system, its computational cost is high since the Kalman Gain needs to be computed only once in the latter and not separately for each ensemble member. In the operational EDA setup the control member and the perturbed members are run with two outer loops. Here, we propose an asymmetric EDA configuration: the unperturbed control analysis is calculated using three outer loops and the perturbed member analyses are calculated with only a single minimization. The perturbed members are then re-centred on the control member. We demonstrate that such a configuration allows to reduce the computational cost of the EDA, retain many of its attractive properties and markedly improve its forecast skill. The Asymmetric EDA would allow ECMWF's strategy towards a seamless approach to ensemble data assimilation and forecasting to advance, in particular by enabling more EDA members in future.