Building Ensemble-Based Data Assimilation Systems

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Different strategies for implementing ensemble-based data assimilation systems are discussed. Ensemble filters like ensemble Kalman filters and particle filters can be implemented so that they are nearly independent from the model into which they assimilate observations. In particular, an online coupling strategy is computational efficient. In this coupling strategy, subroutine calls for the data assimilation are directly inserted into the source code of an existing numerical model and augment the numerical model to become a data assimilative model. The online coupling shows an excellent computational scalability on supercomputers and is hence well suited for high-dimensional numerical models, including coupled earth system models. Further a clear separation of the model and data assimilation components allows to continue the development of both components separately. Using the example of the parallel data assimilation framework (PDAF, http://pdaf.awi.de) and the ocean model NEMO, it is demonstrated how the online coupling can be achieved with minimal changes to the numerical model.