Abstract

A dynamic localization method for use with targeted observations and ensemble data assimilation

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One of the major issues in realistic ensemble data assimilation and prediction is the insufficient rank. A common approach used to deal with the issue of insufficient degrees of freedom is the localization of error covariance, usually accomplished using simple geographical sub-domains in model or observation space defined by an equidistant (circular) radius of influence. Although the impact of increasing the degrees of freedom in this manner is positive, there are potentially adverse effects caused by neglecting the model dynamics in the localization procedure. In other words, the uncertainty of the dynamics does not conform to any regular, prescribed patterns. Typical consequence of applying this approach is an imbalance of the initial conditions, as well as a sub-optimal use of ensembles. Given that the number of ensembles is a limiting factor in realistic applications, it is desirable to improve the utility of available ensembles by introducing a dynamics-friendly localization procedure.

We propose a new localization algorithm capable of accounting for the dynamics of the system. The general formulation of the algorithm allows simple adjustment of space and time dimensions. Two components of the new localization algorithm will be discussed in more detail: (i) dynamical correlation structure of the uncertainty matrix, and (ii) neighbor-preserving optimization. The algorithm can be used on a stand-alone basis, in applications to ensemble data assimilation and targeted observations.

The algorithm characteristics will be illustrated in several examples ranging from a simple prescribed error covariance structure to a complex error covariance produced by a non-hydrostatic model.