Geophysical Research Abstracts
Vol. 21, EGU2019-10421, 2019
EGU General Assembly 2019

Global analysis solution of high-dimensional ensemble data assimilation system

Milija Zupanski

Colorado State University, Cooperative Institute for Research in the Atmosphere, Fort Collins, United States (milija.zupanski@colostate.edu)

High-dimensional ensemble data assimilation applications typically require error covariance localization in order to address the problem of insufficient degrees of freedom. The observation-space covariance localization is generally used, since the alternative, the state-space covariance localization, is currently not feasible in high-dimensional problems. Unfortunately, the observation space localization is not optimal for assimilation of vertically integrated observations, such as the satellite radiances and aerosol optical depth. Another consequence of using observation space covariance localization is that the analysis solution is local: the analysis is calculated at each location using neighboring observations weighted according to their geographical distance from the central point. In other words, only local cost functions defined over a subset of analysis points and neighboring observations are minimized, instead of a single global cost function defined over all analysis points and observations.

Therefore, the use of observation-space localization in high-dimensional ensemble data assimilation has these two undesirable consequences: (1) local analysis solution, and (2) limited ability to assimilate vertically integrated observations.

Attempts to use state-space localization in high-dimensional ensemble data assimilation have been made recently. Unfortunately, a straightforward application of Hadamard product used in covariance localization creates an enormous computational burden in terms of memory and time. This difficulty is limiting such systems to apply the state-space localization only in the vertical, while observation-space localization is used in horizontal, therefore still implying the undesirable local analysis solution.

In this presentation we will describe an ensemble data assimilation system that employs state-space covariance localization and produces a global analysis solution. The new system requires a combination of theoretical improvements and advanced parallel programing. Depending on available processors, the system can handle O(100,000) ensembles in realistic high-dimensional applications. We will also discuss future plans for the development of this system, with emphasis on strongly-coupled data assimilation and non-Gaussian problems.