Sensitivity of global and regional ensemble assimilation to initial conditions and lateral boundary conditions

The implementation of ensemble assimilation methods is a fairly recent technique used to simulate the analysis and forecast errors within a data assimilation system. On the one hand, this allows to estimate the spatial covariances of forecast errors, which are an essential component in data assimilation systems, insofar as they are used to filter and disseminate spatially the observed information. The dependence of such error covariances to the weather situation becomes accessible with these ensemble techniques. On the other hand, the ensemble assimilation is a method increasingly used to provide initial perturbations to ensemble prediction systems.

Such approach may be implemented not only in a system modeling the atmosphere throughout the globe, but also in a regional system with limited area using suitable lateral boundary conditions.

The proposed thesis consists on examining some sensitivity properties of these ensemble assimilation techniques in both contexts (global and regional, respectively).

In the first part, the sensitivity of a global ensemble assimilation system to its initialization will be examined. This will be conducted by comparing a "cold" initialization technique (initial perturbations equal to zero) with a method based on initial perturbations drawn from a covariance model.

In the second part, the sensitivity of a regional ensemble assimilation to lateral boundary conditions will be considered. In this context, a comparison between different techniques producing lateral boundaries will be achieved. It involves comparing approaches using lateral boundaries which are equal to zero or drawn from a global ensemble, or generated using a covariance model.

These sensitivity studies will be conducted using experiments using the global and regional modeling systems, ARPEGE and ALADIN respectively. Furthermore, this work will be based on a formalization of the equations governing the evolution of perturbations in an ensemble assimilation.

These studies should help to document the ensemble assimilation properties, and develop strategies for implementing in real scale for data assimilation and possibly for ensemble prediction system.