4D-hybrid formulation of 4DEnVar for global data assimilation at Météo-France

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Abstract

There is growing interest for using ensemble information in the formulation of data assimilation, which can be combined with advantages of variational approaches. The 4DEnVar formulation is a variational method based on the use of 4D ensemble non linear trajectories, at relatively high resolution, in order to represent 4D background error covariances, which are localized spatially.
A usual approach in 4DEnVar is also to employ an hybridation with error covariances which are spatially averaged, for representing long-distance correlations. Moreover, these spatially averaged covariances are usually static within the assimilation window. This can be seen as a 3D-hybrid approach, partly relying on 3D static error covariances, which are employed repeatedly for the different time slots of the 4D data assimilation window.
A new (4D) formulation of the hybridation is proposed at Météo-France for 4DEnVar, in order to combine respective advantages of 4DEnVar and of more conventional variational approaches. Its properties will be discussed both in the perfect model framework and also in the case where model errors are taken into account. Preconditioning aspects will be considered too. A preliminary implementation of this 4D-hybrid formulation of 4DEnVar has been made possible thanks to the flexibility offered by the OOPS (Object-Oriented Prediction System) software, and experimental results with the Météo-France global ARPEGE system will be presented.

Keywords: ensemble, variational, 4DEnVar, error covariances, hybrid, global data assimilation.

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