Geophysical Research Abstracts, Vol. 9, 04013, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04013

Intercomparison of the primal and dual formulations of variational data assimilation

A. El Akkraoui(1), P. Gauthier(1,2) and S. Pellerin(2)

(1) Department of Atmospheric and Oceanic Sciences, McGill University, Canada (amal.elakkraoui@mcgill.ca), (2) Meteorological Research Division, Environment Canada, Canada.

Two approaches can be used to solve the variational data assimilation problem. The first one, referred here as the primal form, corresponds to the 3D/4D-Var form used now by operational centres like ECMWF, Météo-France, the UK MetOffice, the Japan Meteorological Agency and the Meteorological Service of Canada. An alternative approach consists of solving the problem in observation space, an approach that is used at NASA's Global Modeling and Assimilation Office (GMAO) and at the Naval Research Laboratory (NRL). Both forms use the same basic operators so that once the operators have been developed and tested to build one of the two forms, it should be possible to obtain easily the other form provided these basic operators have a modular form that makes them independent. In Courtier (1997), it was shown that with proper conditioning of the minimization problem, the two algorithms should have similar convergence rates and similar computational performances. The first objective of this work is to present results obtained with the variational data assimilation of the Meteorological Service of Canada which has a modular structure that enabled to first show the equivalence between the 3D-Var and the 3D-PSAS systems in an operational framework. In presence of nonlinearities, the incremental form of 3D/4D-Var extends the equivalence to the so-called 4D-PSAS. This being said, this work focuses on the two quadratic problems that show similar convergence rates and similar analysis results. It is also shown that the Hessians of the two problems are directly related to one another and their singular vectors can be remapped into both spaces which makes it then possible to cycle the Hessian of the PSAS form.