McGill Computational Science and Engineering Seminar

Friday January 12th at 14:00 in Burnside Hall room 1205

Maintaining dynamical constraints in a variational analysis

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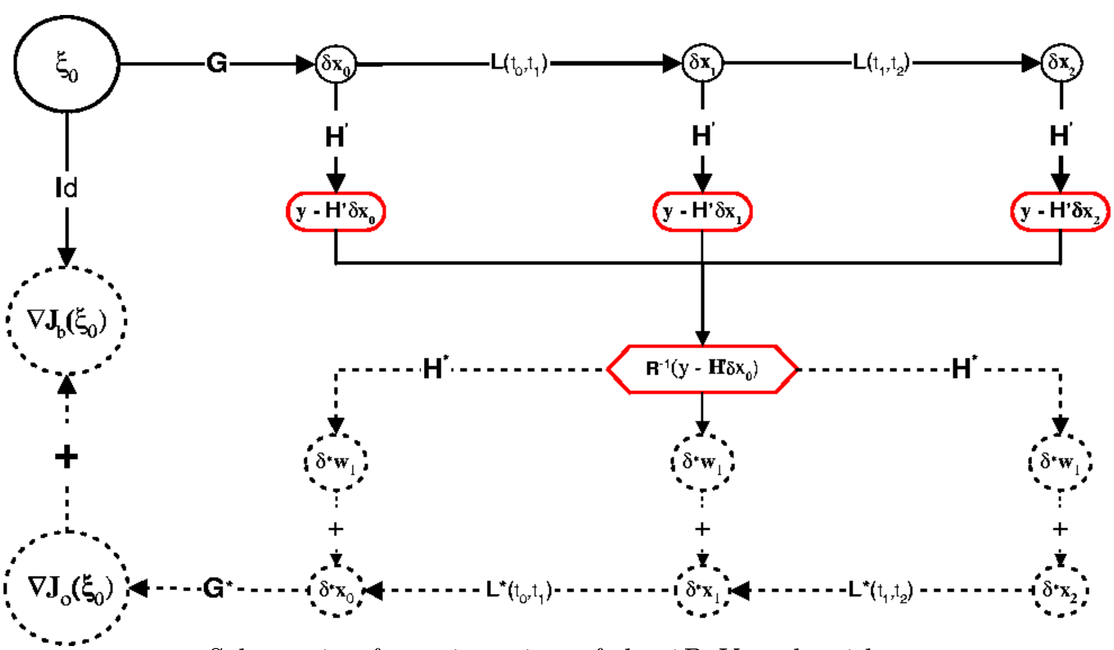
Data assimilation is an essential part of any numerical weather prediction (NWP) system. Its purpose is to blend information contained in observations originating from different sources with information contained in a prior estimate of the state of the atmosphere referred to as the background state. In practice, current operational assimilation systems use a short term forecast from a NWP model as the background state. The last ten years have seen the advent of variational data assimilation first in its 3D formulation, the 3D-Var, which has made possible the direct assimilation of radiances obtained from satellite measurements. This problem can be cast as a statistical estimation problem and it is particularly important to embed dynamical constraints within the background-error covariance model to reduce dynamical imbalances. The variational form of the problem makes it possible to naturally extend the problem from 3D to 4D, the 4D-Var. We then seek to determine initial conditions that will lead to a model trajectory in time that will best fit observations spread over the data assimilation window. This has the ability of extracting information contained in a time series of observations which results in more realistic dynamical balances in the analysis. By using a so-called incremental approach, it is possible to reduce the cost of 4D-Var by an order of magnitude. This approach will be illustrated with results from Laroche and Gauthier (1998) for the barotropic vorticity equation on the β-plane and from Gauthier and Thépaut (2000) for the operational 4D-Var assimilation of Météo-France.



Schematic of one iteration of the 4D-Var algorithm.

Coffee and desserts are served after the seminar at 15:00 in the lounge, Burnside Hall 1024