Geophysical Research Abstracts
Vol. 12, EGU2010-2413, 2010
EGU General Assembly 2010

Comparison of Ensemble Data Assimilation methods for the shallow water equations with nonlinear observation operators

Ionel Michael Navon
Florida State University, Dept of Scientific Computing, Tallahassee, United States (inavon@fsu.edu, 850-644-0098)

Amongst most challenging problems remaining
for EnsDA applications in geosciences is the problem of assimilating highly nonlinear and non-differentiable observations. Examples are cloud, aerosol and precipitation processes, as well as remote sensing (e.g.,satellite and radar) observations. Unfortunately, for EnKF, the typical EnsDA analysis equation is linear, being based on the Kalman filter equations. This fundamentally
prevents EnsDA from extracting maximum information from such observations, and ultimately limits its applicability to outstanding geosciences problems such as hurricane prediction and high-resolution climate simulation.
In order to overcome the limitation of existing EnsDA methodologies
applied to highly nonlinear and nondifferentiable geoscience problems,a new strategy is required. We present here a new comparison of three frequently used sequential data assimilation methods, illuminating their strengths and weaknesses in the presence of linear and nonlinear observation operators . They consist of the ensemble Kalman filter (EnKF), the particle filter (PF) and the Maximum Likelihood Ensemble hybrid Filter (MLEF) methods applied
to the spectral shallow water equations model in spherical geometry
using the Rossby-Haurwitz Wave no 4 as initial conditions.

Conclusions are drawn as to the performance of these filters for the above test case with both linear and nonlinear observation operators. Numerical tests conducted reveal that all the three methods perform satisfactorily for a linear observation operator for 12 days of model integration, whereas the
EnKF filter, even with the Evensen fixture [Evensen 03] with nonlinear observation operator, failed. Both particle filter and the hybrid filter (MLEF) performed satisfactory in presence of nonlinear observation operator with a slight edge for the PF.