Geophysical Research Abstracts, Vol. 8, 02830, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02830

An empirical comparison of the effect of model non-linearity on state of the art data assimilation methods

R. Barillec, D. Cornford

Neural Computing Research Group, Aston University, Birmingham, UK (barillrl@aston.ac.uk)

Data assimilation combines two sources of information: a sequence of observations of a system in time and a numerical model of a system to produce optimal estimates of the state of the system under consideration. The ideal solution, in the presence of non-linear system and observation models would be a full Monte-Carlo approach, however the computational complexity of implementing such an approach for real problems is prohibitive. In previous work we compared several data assimilation methods on the well know Lorenz 40-variable system, to provide benchmarks for a novel variational algorithm we are developing. The extended Kalman filter, the ensemble Kalman filter, the particle filter and a strong-constraint version of 4D VAR were tested over a range of parameters such as the observation noise and the assimilation frequency (i.e. model non-linearity) in a perfect model setting. The ability of each method to capture the true state of the system was then analysed. Results showed that the particle filter, although supposedly optimal, exhibited some weaknesses in strongly non-linear environments. In this talk we present the extension of that work to weak-constraint 4D VAR and a particle filter with improved, continuous resampling. We will focus on the impact of observation frequency, which is related to the degree of non-linearity over the assimilation window, something that is very important in the application of data assimilation to higher resolution NWP, such as being developed in the UK Met Office with their 1km unified model. The effect of dimensionality will also be considered, by running similar experiments on the simpler Lorenz 3-variable system. We show the relative merits of the various approaches, which represent the state of the art in data assimilation at the present time, discussing the strengths and weaknesses and also the computational cost.