Geophysical Research Abstracts
Vol. 16, EGU2014-10819, 2014
EGU General Assembly 2014


# Data assimilation of two-dimensional geophysical flows with a Variational Ensemble Kalman Filter

Zubeda Mussa, Tuomo Kauranne, and the Zubeda Mussa Team
Lappeenranta University of Technology, Lappeenranta, Finland (Tuomo.Kauranne@lut.fi)

The Variational Ensemble Kalman Filter (VEnKF), a recent data assimilation method that combines a variational assimilation of the Bayesian estimation problem with an ensemble of forecasts, is demonstrated in two-dimensional geophysical flows using a Quasi-Geostrophic (QG) model and a shallow water model. Using a synthetic experiment, a two layer QG model with model bias is solved on a cylindrical $40 \times 20$ domain. The performance of VEnKF on the QG model with increasing ensemble size is compared with the classical Extended Kalman Filter (EKF). It is shown that although convergence can be achieved with just 20 ensemble members, increasing the number of members results in a better estimate that approaches the one produced by EKF.

In the second test case, a 2D shallow water model is described using a real dam-break experiment. The VEnKF algorithm was used to assimilate observations obtained from a modified laboratory dam-break experiment of Bellos at al. (1991) with a two-dimensional setup of sensors at the downstream end. The wave meters are placed parallel the direction of the flow alongside the flume walls to capture both cross flow and stream flow. In both test cases, VEnKF was able to predict genuinely two-dimensional flow patterns when the sensors had a two-dimensional geometry and was stable against model bias in the first test case.

In the second test case, the experiments are complemented with an empirical study of the impact of observation interpolation on the stability of the VEnKF filter. In this study, a novel Courant-Friedrichs-Lewy type filter stability condition is observed that relates ensemble variance to the time interpolation distance between observations.

The results of the two experiments shows that VEnKF is a good candidate for data assimilation problems and therefore can be implemented in higher dimensional nonlinear models where other methods proves difficulty.