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Study of Conservation properties of Ensemble-Type Kalman Filter Algorithms with 2D Shallow Water Model

Y. Zeng (1) and T. Janjic (2)

(1) Hans Ertel Centre for Weather Research, LMU, (2) Hans Ertel Centre for Weather Research, German Weather Service, Offenbach am Main, Germany (Tijana.Janjic-Pfander@dwd.de)

Numerous approaches have been proposed to conserve physical properties in the Numerical Weather Prediction (NWP) models. However, to achieve a reliable prediction, adequate initial conditions are also necessary, which are produced by a data assimilation algorithm. If an ensemble Kalman filters (EnKF) is used for this purpose, it has been shown that it could yield unphysical analysis ensemble that for example violates principle of mass conservation and positivity preservation (Janjic et al 2014).

In this work, LETKF (Localized Ensemble Transform Kalman Filter) will be tested in an idealized setup for a nonlinear 2D shallow water model. The model is discretized in a specific way to conserve mass, angular momentum, energy and enstrophy. The effects of the data assimilation on the conserved quantities (of mass, angular momentum, energy and enstrophy) depend on observation distribution, localization radius, observed variable and observation operator. Further, the effects on prediction, depending on the type of errors in the initial condition, are shown. The performance with respect to nonlinear energy cascade is assessed as well (e.g. Janjic et al 2011).