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A modified rotating shallow water model for investigating convective-scale data assimilation

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I outline a modified rotating shallow water model to represent an idealised atmosphere with moist convection for use in inexpensive data assimilation experiments. By combining the nonlinearity due to advection in the shallow water equations and the onset of precipitation, the proposed model captures two important dynamical processes of convecting and precipitating weather systems. The model is a valid non-conservative hyperbolic system of partial differential equations and is solved numerically using a shock-capturing finite element framework which deals robustly with the high nonlinearity and so-called non-conservative products.

Assimilations using the ensemble Kalman Filter (EnKF) with perturbed observations are conducted in a twin experiment setting. The "truth" trajectory is determined by high resolution simulations, from which pseudo-observations are generated. The "forecast" model is run at a lower resolution in which small-scale features (such as gravity waves and localised moisture transport) are (i) not resolved, (ii) partially resolved, and (iii) fully resolved, in order to ascertain if and how small-scale dynamics degrade the data assimilation scheme.

The model is currently being integrated into the Met Office's Data Assimilation Modelling framework, a testbed for data assimilation research using idealised models.