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Modifications to an idealised data assimilation scheme for research in convective-scale satellite data assimilation

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Satellites comprise one of the main sources of observations in data assimilation (DA) and an increasingly efficient use of their data has been of great benefit to the performance of weather forecasts in the last few decades.

An idealised model for convection suitable for data assimilation research has been developed at the University of Leeds in collaboration with the Data Assimilation and Ensemble Research and Development team at the Met Office [1] [2]. As a follow-up to that research, a new project is now focussing on using this model for satellite DA research. In particular, we aim to expand our knowledge of the relative impact of using satellite data to adjust large and small scales in the model. The DA scheme currently in use is an Ensemble Kalman Filter.

In order to achieve our objective by means of an idealised model, it will be essential to retain the fundamental properties and characteristics of satellite observations, acting on both the model and the observation operator. Among many aspects, we consider as crucial: 1) the nature of satellite observations as brightness temperature measurements; 2) their spatially varying character (as in polar-orbit satellites) and 3) the presence of clouds in the atmosphere potentially impacting on them. In this sense, the first version of the DA-model scheme did not offer enough complexity to recreate such conditions, because the observation operator only observed model variable directly, the temperature of the fluid was not a prognostic variable and the atmosphere was treated as a single layer of fluid.

On the one hand, we have revised the first version of the model, moving from the previous isopycnal single layer configuration to an isentropic one-and-a-half-layer model. The numerical implementation of the new model is still underway but preliminary checks on stability and convergence seem promising.

On the other hand, the development of a revised observation operator able to deal with the spatially varying character of satellite observations has been developed in parallel to the model modifications.

[1] T. Kent, (2016): An idealised fluid model of convective-scale NWP: dynamics and data assimilation. *PhD Thesis, University of Leeds.* Available at: http://etheses.whiterose.ac.uk/17269/

[2] T. Kent, Bokhove, O., Tobias, S.M. (2017): Dynamics of an idealized fluid model for investigating convective-scale data assimilation. *Tellus A: Dynamic Meteorology and Oceanography*, **69(1)**, 1369332. DOI. Numerical model available on GitHub