Idealised satellite data assimilation experiments with clouds and precipitation

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Operational data assimilation (DA) schemes rely significantly on satellite observations with much research aimed at their optimisation, leading to a great deal of progress. Here, we investigate the impact of the spatial-temporal variability of satellite observations for DA: is there a case for concentrating effort into the assimilation of small-scale convective features over the large-scale dynamics, or vice versa?

We conduct our study in an isentropic one-and-a-half layer model that mimics convection and precipitation, a revised and more realistic version of the idealised model based on the shallow water equations in [1,2]. Forecast-assimilation experiments are performed by means of a twin-setting configuration, in which pseudo-observations from a high-resolution nature run are combined with lower-resolution forecasts. The DA algorithm used is the deterministic Ensemble Kalman Filter (see [3]). We focus our research on polar-orbit satellites regarding emitted microwave radiation.

We have developed a new observation operator and a representative observing system in which both ground and satellite observations can be assimilated. The convection thresholds in the model are used as a proxy for cloud formation, clouds, and precipitation. To imitate the use of weighting functions in real satellite applications, radiance values are computed as a weighted sum with contributions from both layers. In the presence of clouds and/or precipitation, we model the response of passive microwave radiation to either precipitating or non-precipitating clouds. The horizontal resolution of satellite observations can be varied to investigate the impact of scale-dependency on the analysis.

New, preliminary results from experiments including both transverse jets and rotation in a periodic domain will be reported and discussed.
References:

