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Data assimilation in the rotating annulus experiment using analysis correction

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We present results from a study of data assimilation in the rotating annulus laboratory experiment. The Met Office analysis correction method is used to assimilate irregularly-distributed laboratory observations into a model of the thermally-driven baroclinic rotating annulus over a range of regular and chaotic flow regimes. The annulus is firmly established as a good testbed for atmospheric methods and dynamics, and the laboratory setting allows baroclinic flow to be studied in a reproducible manner in a system where the complexity of the flow can be controlled.

By comparing the analyses with independent laboratory data, we show that a range of flow regimes with varying complexity can be accurately assimilated using this method. Analysis correction is shown to be accurate in both regular and chaotic regimes, with residual velocity errors about 3–8 times the observational error. Specific assimilation scenarios studied include information propagation from data-rich to data-poor areas, assimilation of vortex shedding observations, and assimilation over regime and rotation rate transitions. Now that a range of observations have been assimilated onto a regular model grid from raw data irregularly spaced and intermittent in time, these analyses will also allow further detailed study of the dynamics of annulus flow in these regimes.