Geophysical Research Abstracts
Vol. 19, EGU2017-17689, 2017
EGU General Assembly 2017

Balanced Atmospheric Data Assimilation

Gottfried Hastermann (1), Maria Reinhardt (2), Rupert Klein (1), and Sebastian Reich (2)
(1) FB Mathematik und Informatik, Freie Universität Berlin, Berlin, Germany, (2) Institut für Mathematik, Universität Potsdam, Potsdam, Germany

The atmosphere's multi-scale structure poses several major challenges in numerical weather prediction. One of these arises in the context of data assimilation. The large-scale dynamics of the atmosphere are balanced in the sense that acoustic or rapid internal wave oscillations generally come with negligibly small amplitudes. If triggered artificially, however, through inappropriate initialization or by data assimilation, such oscillations can have a detrimental effect on forecast quality as they interact with the moist aerothermodynamics of the atmosphere.

In the setting of sequential Bayesian data assimilation, we therefore investigate two different strategies to reduce these artificial oscillations induced by the analysis step. On the one hand, we develop a new modification for a local ensemble transform Kalman filter, which penalizes imbalances via a minimization problem.
On the other hand, we modify the first steps of the subsequent forecast to push the ensemble members back to the slow evolution. We therefore propose the use of certain asymptotically consistent integrators that can blend between the balanced and the unbalanced evolution model seamlessly.

In our work, we furthermore present numerical results and performance of the proposed methods for two nonlinear ordinary differential equation models, where we can identify the different scales clearly. The first one is a Lorenz 96 model coupled with a wave equation. In this case the balance relation is linear and the imbalances are caused only by the localization of the filter. The second one is the elastic double pendulum where the balance relation itself is already highly nonlinear. In both cases the methods perform very well and could significantly reduce the imbalances and therefore increase the forecast quality of the slow variables.