Accounting for Model Error in Data Assimilation

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The treatment of model error in Data Assimilation (DA) procedures is still done, in most instances, following simple assumptions. This is in part justified by the fact that on the time scale of NWP, where most of the geophysical DA advancements have occurred, the influence of model is reasonably considered small as compared to the initial condition error that grows in view of the chaotic nature of the dynamics. Nevertheless, the improvement in DA techniques and observational networks on the one hand, and the recent growth of interest in seasonal-to-decadal (s2d) prediction on the other, has placed model error as a main concern and a key priority.

In the present contribution we describe a new approach, referred to as deterministic model error treatment, in which the deterministic evolution of the model error is described based on a short-time approximation suitable for realistic applications and used to estimate the model error contribution in the state estimate, i.e. covariance and correlations. We have distinguished two situations: first assuming that model error originates only from a misspecification of the parameters, and second from the presence of unresolved scales, and has been applied in the context of sequential and variational approach, for state and parameter estimation. The duration of the short-time approximation depends on the type and size of the model error. In the case of uncertain parameters, it scales with the parametric error but also with the functional dependence of the model dynamics on the uncertain parameters. When the error comes from the presence of unresolved scales, the short-time model error evolution in the resolved scales depends on the difference between the truth (unknown) velocity field and the modelled one: a solution to estimate this term in practice has been proposed.

The deterministic model error treatment has been proven competitive in a number of different applications with prototypical chaotic dynamics, in the framework of sequential [1, 3] and variational schemes [2] as well as for parameter estimation [4, 5]. Research is currently undergone for the application of this approach in soil data assimilation where the soil temperature and moisture content is estimated on the basis of atmospheric observations close to the ground.

References

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