Variational Data Assimilation with Regularization in Meteorology and Oceanography

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Abstract

There is an international focus on the developments on data assimilation systems for meteorology and physical oceanography models and there has been considerable interest in the "inverse problem" of determining poorly known initial boundary conditions and model parameters by incorporating measured data into the numerical model, taking into account both the information about dynamics about a model and the information about the true state which is constrained by a set of measurements.

In the present work, the data assimilation problem in meteorology and physical oceanography is re-examined using the adjoint method in combination with regularization ideas in inverse problem. Here the ocean temperature models in two dimension and one dimension has been taken and the estimation of the initial conditions ,boundary conditions and model parameters are performed simultaneously in the framework of variational data assimilation with global temperature observations and local observations (for instance, observations on surface) respectively. To overcame the difficulty of ill-posedness , especially for the model parameters which are distributed in space and time, additional term is added in the cost functional as a stabilized functional.

Then two sets of twin numerical experiments are performed to examine whether the proposed approach is able to reconstruct the accurate initial boundary conditions and model parameters, one set of which are using global observations and the other one with local observations. Both sets of numerical experiments demonstrate that even with noisy observations the initial conditions, boundary conditions and model parameters were recovered to an acceptable degree of accuracy, which clearly show the efficiency of the proposed approach.

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