Geophysical Research Abstracts
Vol. 15, EGU2013-848, 2013
EGU General Assembly 2013

Data assimilation based on Ensemble Kalman filtering for ice sheet initialisation

Bertrand Bonan (1), Maëlle Nodet (1), and Catherine Ritz (2)

(1) Inria / UJF - Grenoble 1, Laboratoire Jean Kuntzmann, Grenoble, France, (2) CNRS/ UJF - Grenoble 1, Laboratoire de Glaciologie et Géophysique de l'Environnement, Grenoble, France

A hot topic in ice sheet modelling is to run prognostic simulations over the next 100 years to investigate the impact of Antarctica and Greenland ice sheets on sea level change. Such simulations require an initial state of ice sheets which must be as close as possible to what is currently observed. Large scale ice sheet dynamical models are mostly governed by the following input parameters and variables: basal dragging coefficient, bedrock topography, surface elevation, temperature field. But we do not have satisfying initial states for simulations. Fortunately, some observations are available such as surface and (sparse) bedrock topography, surface velocities, surface elevation trend. The use of advanced inverse methods appears to be the adequate tool to produce satisfying initial states.

We develop ensemble methods based on Ensemble Kalman Filter (EnKF) to infer optimal actual states for ice sheet model initialisation thanks to available observations. EnKF is an efficient Monte-Carlo method based on a Gaussian approximation. Contrary to variational approach or traditional Kalman Filter, EnKF does not require full or reduced state error covariance matrices but represents them by a large stochastic ensemble of model realisations. Furthermore, the size of ensembles are generally smaller than other stochastic methods. EnKF has been successfully used in a large community, including ocean and atmospheric sciences.

As we first want to assess the validity of the method we begin with twin experiments (simulated observations) with a simple flowline large scale model, Winnie, as a first step toward data assimilation for a full 3D ice sheet model, GRISLI. Winnie (as GRISLI) is an hybrid SIA/SSA ice sheet model and, as a flowline model, is a good prototype to valide our methods. Here we try here to retrieve the prescribed following input parameters and variables: basal sliding coefficients, bedrock topography and ice thickness thanks to our simulated observations of surface elevation, surface velocities and sparse bedrock topography. We also run several diagnostics to assess the quality of the recovered parameters.