Geophysical Research Abstracts
Vol. 16, EGU2014-10731, 2014
EGU General Assembly 2014

Sensitivity and initialisation of a moving mesh ice sheet model

Bertrand Bonan, Michael J. Baines, Nancy K. Nichols, and Dale Partridge
University of Reading, United Kingdom (b.c.bonan@reading.ac.uk)

One of the most important issues in marine ice sheet modelling is tracking accurately the evolution of the snout and the grounding line. Here we present a moving mesh method that is well-suited to tracking moving phenomena accurately. We study the behaviour of the method for a flow line version using the Shallow Ice Approximation. The solution procedure uses the conservation of mass fractions to define a deformation velocity that generates movement of the support of the ice. The ice thickness is recovered using the conservation principle. In order to initialise the moving mesh model, we apply advanced inverse data assimilation techniques to the system. We develop particularly an Ensemble Kalman Filter (EnKF) approach in this context. EnKF is an efficient Monte-Carlo method based on Gaussian assumptions. Contrary to variational methods, it does not require the development of the adjoint of the model.

The data assimilation procedure treats both the mesh point positions and the ice sheet thickness as unknown state variables and updates both of these at each assimilation step. The advantage of the ensemble approach is that it enables the sensitivity of the system to be understood and, more importantly, provides information on the correlations between the variables, in particular between the grid and the ice thickness. We demonstrate the success of the technique for noisy, infrequent, partial measurements of ice thickness, both with and without noisy measurements of the terminus position.

The moving mesh and EnKF methods can be extended to coupled models of grounded ice sheets and floating ice shelves. The covariances between the states of the system at the grounding line derived by the method will provide valuable information on the coupled system. The techniques presented here can also be extended to include the estimation of parameters, such as the basal sliding coefficient and the bedrock topography, and to two dimensional ice sheets.