Geophysical Research Abstracts
Vol. 13, EGU2011-427, 2011
EGU General Assembly 2011

To which extent can global ice volume records provide information on past ice sheets evolution and the climate that drove them?

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

(1) INRIA / University of Grenoble, France, (2) CNRS / Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble, France

We use advanced data assimilation methods to assess the feasability of retrieving climate scenarios from past ice sheets data such as global ice volume and/or extent.

Some of the questions we would like to answer are: Is the knowledge of ice-sheet volume evolution sufficient to infer a unique climate scenario? If not, are ice-sheet extent observations a sufficient complement to ensure uniqueness?
And subsequent question: how to extract relevant information from extent observations within an ice-sheet model where the extent is not a state variable?

Data assimilation covers all mathematical methods that allow us to blend, as optimally as possible, information included in numerical models and observations, in order to identify poorly known parameters. In the study presented here, we first try to infer climate scenario from volume observations. To do so, a so-called cost function is defined, measuring the difference between the observed volume and the model-computed volume, as a function of the climate scenario parameters. We then want to find the minimizer of the cost function, that is the climate scenario which would cause the best fit between the observed volume evolution and the one produced by the model.

The implementation of a variational data assimilation system is a very heavy task, as it requires the derivation of the adjoint model, and a very fine tuning of the optimization procedure. As we first want to assess the validity of the method we begin with a simple flow-line model, Winnie, as a first step toward adjoint data assimilation for a full 3D ice sheet model, GRISLI. Despite its simplicity, Winnie flow line model is strongly non-linear and not auto-adjoint, and is a good prototype to validate the methods.

In particular, we will closely study the question of uniqueness: can two different climate scenarios produce similar observed volume evolution? And we will also examine the question of data assimilation of ice-sheet extent observations, as extent is not a state variable.