Stochastic Modeling of Uncertainties in Fast Essential Antarctic Ice Sheet Models

Kevin Bulthuis (1,2), Frank Pattyn (2), Lionel Favier (2) and Maarten Arnst (1)
(1) Department of Aerospace and Mechanical Engineering, Université de Liège, Belgium (2) Laboratory of Glaciology, Université Libre de Bruxelles, Belgium

Quantifying the uncertainty in projections of sea-level rise induced by ice-sheet dynamics is a pivotal problem in assessing climate-change consequences. Sources of uncertainty in ice-sheet models include uncertain climate forcing, basal friction, sub-shelf melting, initialization, and other model features. Accounting for uncertainty in ice-sheet models (ISMs) is challenging : (i) the stochastic modeling of sources of uncertainty can be challenged by data scarcity and imperfect representations of physical processes, and (ii) the computational cost of ISMs can hinder their integration in Earth system models and limit the number of simulations available for uncertainty propagation.

In this talk, we address the uncertainty quantification of sea-level rise projections by using the new fast essential ISM f.ETISh that affords computational tractability by limiting its complexity to the essential interactions and feedback mechanisms of ice-sheet flow. After highlighting how simulations require an initialization procedure that precedes their use in predicting climate-change effects, we will discuss the sources of uncertainty in this ISM and the information available for their stochastic modeling. We will show the stochastic modeling of a subset of these sources of uncertainty, followed by a propagation of uncertainty through the ISM and a sensitivity analysis to help identify the dominant sources of uncertainty in sea-level rise projections.