Session: C30 Poster: W113A

Advanced ice sheet modeling: scalable parallel adaptive full Stokes solver and inversion for basal slipperiness and rheological parameters

Noemi Petra[†]; Carsten Burstedde; Omar Ghattas; Tobin Isaac; Noemi Petra; Georg Stadler; Hongyu Zhu
[†] The University of Texas at Austin, USA
Leading author: noemi@ices.utexas.edu

Modeling the flow of polar ice sheets using the nonlinear 3D full Stokes equations requires scalable and efficient solvers as well as the capability to infer uncertain or unknown model parameters from available observations. We present a parallel, adaptive mesh, high-order finite element solver for the 3D full Stokes equations with Glen's flow law rheology. The adaptive mesh capabilities allow for efficiently capturing the wide range of length scales with localized features present in ice sheet dynamics. Numerical results indicate scalability of the algorithm and the implementation for realistic full continent ice sheet simulations. Additionally, we formulate an inverse problem to infer the basal slipperiness and rheological parameters from surface observations. For this purpose, we minimize the misfit between observed and modeled surface flow velocities. The resulting least squares minimization problem is solved using an adjoint-based inexact Newton method. Numerical inversion studies demonstrate the influence of prior knowledge on the model parameters for addressing ill-posedness of the inverse problem and to handling noise present in the observations.