EGU22-5859
https://doi.org/10.5194/egusphere-egu22-5859
EGU General Assembly 2022

Fenics_ice framework applied to three West Antarctic ice streams: Smith, Pope and Kohler Glaciers.

Beatriz Recinos[1], Daniel Goldberg[1], James Maddison[2], and Joe Todd[1]
[1]University of Edinburgh, School of GeoSciences, Edinburgh , United Kingdom of Great Britain – England, Scotland, Wales
[2]University of Edinburgh, School of Mathematics, Edinburgh , United Kingdom of Great Britain – England, Scotland, Wales

Fenics_ice is a finite element model framework written in Python that quantifies the initialization uncertainty for time-dependent ice sheet models. Here, we apply for the first time this framework to real ice streams in the Amundsen basin: Smith, Pope and Kohler Glaciers. We quantify the degree to which observational uncertainty translates to parametric uncertainty (posterior uncertainty of inversions for basal drag and ice stiffness fields) and to uncertainty in projected quantities of interest (QoIs) such as sea level contribution. The framework implements the Shallow Shelf Approximation (SSA), and implements a control methods approach to invert for the basal drag and ice stiffness fields. Beginning with a cost function optimization which can allow for either gridded or point-cloud velocities, we generate a low-rank approximation to the posterior covariance of the parameters through the use of the cost function Hessian. In our work, the Hessian is calculated through algorithmic differentiation (AD) using the "complete" Hessian rather than the Gauss–Newton approximation. We then project the covariance on a linearization of the time-dependent ice sheet model (again using AD to generate the linearization) to estimate the growth of QoI uncertainty over time. We then show the model framework and capabilities when applied to these ice streams and our future plans to scale our framework into a larger domain.