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Constraining of bedrock friction and rheology in Antarctica and Greenland, using higer order models.

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Spin-up of large scale transient ice flow models of Antarctica and Greenland is an issue that needs to be addressed if sea level rise predictions in the near future are to become reliable. Presently, two approaches are considered: a paleo spin-up, using thermal records provided by ice cores to constrain climate, or inverse control methods to constrain physical properties of ice sheets at present time.
The work we present here engages the second approach, by providing a new way of computing the bedrock properties and the ice rheology of Antarctica and Greenland, constrained using InSAR observations of ice surface motion. We use the newly developed framework ISSM (Ice Sheet System Model) developed at JPL/UCI to model thermo-mechanical steady state and transient ice flow , leveraging parallel architectures.
Using ISSM, we develop a new inverse control method that can take into account internal stress variations due to thermal regime (assuming steady-state), and higher order physics such as MacAyeal's shelfy-stream approach, or Pattyn's higher order approach, or finally, the full Navier-Stokes formulation.
The results provide a detailed map of basal drag for Antarctica, wherever InSAR data is available, for higher order sets of physics. Thermal regime is computed for each of one of the basal drag maps. These results should improve future transient runs as they capture the present properties of ice sheets more accurately, using higher order models that can account for the full stress equilibrium equations, as opposed to shallow ice formulations.

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