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Data assimilation methods for ice-sheet model initialisation.

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A hot topic in ice-sheet modelling is to run prognostic simulations over the next 100 years, to investigate the impact of Antarctica and Greenland ice-sheets on sea-level change. Such simulations require an initial state of the ice-sheets which must be as close as possible to what is currently observed. The use of advanced inverse methods appears to be the adequate tool to produce such an initial state.

Criteria for a good initial state are: an optimal fit to available observations, such as surface and (sparse) bedrock topography, surface velocities, surface elevation trend. Large scale ice-sheet dynamical models are mostly governed by the following input parameters and variables: basal dragging coefficient, bedrock topography, surface elevation, temperature field. We use variational and sequential data assimilation methods to infer these inputs parameters from available observations.

To address this problem we perform identical twin experiments on the realistic flow-line large-scale ice-sheet model GRISLI. Thanks to the model, we simulate observations from a set of given input parameters (bedrock topography, basal sliding field, surface elevation), and we then try to recover these parameters with the generated observations. We also run several diagnostics to assess the quality of the recovered parameters.

In the light of the results of our numerical twin experiments, we will discuss advantages and drawbacks of the state-of-the-art data assimilation methods currently used for the initialization problem of ice-sheet models.