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Initialising ice sheet model using nudging

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The current global warming has direct consequences on ice-sheet mass loss. In Antarctica, the growing ice discharge is driven by an acceleration of some coastal outlet glaciers. Modelling these high speed glaciers remains very challenging. The construction of an initial state, as close as possible to current observations, is required as a prerequisite before producing any reliable projection of the evolution of ice-sheets. For this step, inverse methods are often use to infer badly known parameter such as the basal friction. Others data fields, such as the surface elevation or bedrock topography, are relatively well known but only locally since the measurement is often made along satellite tracks or flight lines, but usually distributed as gridded product computed using interpolation.

In this work, we present a new data assimilation method based on inverse method and nudging. The method is evaluated on a twin experiment using a synthetical glacier geometry. From this perfectly known geometry, we assume that the surface elevation is only partially known and along some designated lines without measurement errors. Instead of performing a non-physical linear interpolation between each lines, the surface elevation is reconstructed from a nudging experiment consisting in a surface relaxation with a callback of the model to the observations. The comparison of the nudging results to the true surface elevation indicates that the nudging method gives better results than a simple relaxation or, at least, that it allows to considerably decrease the relaxation time. Generalisation of such type of initialisation procedure in ice sheet models points out the necessity of revising data distribution as classical gridded product forbids an optimal use of the model and therefore hampers the quality of its prediction.