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Modelling the behavior of the Jakobshavn glacier since the end of the Little Ice Age

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Current model estimates of the Greenland Ice Sheet (GrIS) are almost entirely based on coarse grids (>10km) and constrained by climate models that span from 60s to present. To improve the projection of future sea level rise, a long-term data record that reveals the mass balance beyond decadal timescale is required. Here, we use a continuous 171 year reconstruction (since the end of the Little Ice Age) by J.E. Box of the Greenland Ice Sheet climatic surface mass balance and its sub-components to study the interaction between climate and the cryosphere originating in changes in the surface mass balance and dynamics of the GrIS over the last 171 years.

Throughout our study, we use the Parallel Ice Sheet Model (PISM) capabilities. The initialization of the ice sheet is performed on a 5 km grid using paleo climatic forcing (-125 ka to present) based on a positive degree day (PDD) model. For a better overview and for the purpose of increasing the resolution to 1 km, our study focuses only on the Jakobshavn glacier. In order to determine the locations of the flow for the regional model, a drainage basin mask was extracted from the surface elevation data based on the gradient flow. While inside the basin mask the full PISM model is applied, outside the basin mask the boundary conditions are taken as captured by the whole Greenland initialization. Considering the surface mass balance reconstruction where the monthly accumulation rates are assumed to be 1/12 of the annual accumulation, a yearly 1850-2010 climatic forcing is applied in the regional run.