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Flow dynamics and temperature regime of the main King George Island ice cap, Antartica.

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King George Island is the largest of the South Shetland Islands and located at the northern tip of the Antarctic Peninsula. It is largely influenced by maritime climate conditions with an observed air temperature of -2.4°C at sea level and an estimated value of -6°C at the summit. However, measured firn temperatures and ground penetrating radar surveys indicate a (partly) temperate ice cap. Hence, from the disagreement between air and ice surface temperature we inferred an unknown thermal state of the ice cap.

To investigate the dynamical regime of the King George Island ice cap we set up a three dimensional full-Stokes ice-sheet model to simulate the flow dynamics. The model is implemented in the commercial FE software package COMSOL Multiphysics. It is based on the balance equations for mass, momentum, and energy and takes rheology properties of polythermal ice masses into account. Additionally, we account for different basal sliding laws. We establish a statistical framework involving ensembles of parameter studies to assess and/or to exclude several coexistent flowdynamical solutions.

The unknown parameters of the numerical ice-sheet model were adjusted by minimization between modeled and ice surface velocities. Here, we rely on an extensive database of ice geometry and ice surface velocities derived by means of ground penetrating radar and differential GPS surveys obtained from several field campaigns. These datasets are used as input (geometry) and validation (velocity) parameters for the numerical simulations. Our purpose is to present a well-validated flow dynamic and temperature regime of the main King George Island ice cap.