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The importance of geothermal heat flux in modelling of the Antarctic Ice Sheet

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Ice sheet models are the only physically-based tools that allow us to simulate the future evolution of the Antarctic Ice Sheet, including its contribution towards changes in global sea level. However, due to limitations in our understanding of ice sheet dynamics, modelling is an inherently uncertain exercise. A typical approach towards optimising ice sheet models is to "tune" key physical parameters by finding the values that give the most realistic simulations of the present-day ice sheet, based on criteria such as ice sheet geometry or ice velocity. However, this approach assumes that there are no errors in the boundary conditions being used to drive the models.

Here, we use the Parallel Ice Sheet Model to explore the sensitivity of the simulated Antarctic Ice Sheet to the available geothermal heat flux (GHF) datasets. We find that the choice of GHF is a significant source of uncertainty, leading to basin-wide differences in excess of 1000m in the simulated ice thickness. Using different GHF datasets to drive the model, we then "tune" it by determining the optimal values of key physical parameters. We show that the parameter combinations obtained are sensitive to the choice of GHF.

Our results highlight the importance of GHF in ice sheet modelling. Reliable GHF estimates are critical to optimising numerical models of the Antarctic Ice Sheet and, therefore, to reducing uncertainty in projections of future global sea level rise.