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Geothermal heat-flux in Antarctica – Linking satellite and seismological models by Bayesian inversion

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The thermal structure of the Antarctic continent is one of the most unknown parameters, but critical for a variety of applications on different scales, e.g. ice-sheet modelling or glacial-isostatic adjustments. Different methods have been applied in recent years to quantify the thermal structure and more specific the geothermal heat flux over Antarctica. Due to the limited amount of direct measurements, estimates are often derived from modelling of satellite data or seismological models, or based on a combination of these. This results in vastly different estimates of geothermal heat flux. Here, we present our efforts to combine data products from the GOCE, Swarm and SMOS satellite missions with seismological results in an integrated inverse framework. For example, SMOS can provide estimates of the sub-ice temperature, while satellite magnetic data are often used to estimate Curie isotherms.
Applying a Bayesian inversion using a hierarchical Monte-Carlo-Markov-Chain approach, we explore model dependencies and how the uncertainties of the different data products are affecting the reliability of the derived models. The results show that the use of a Curie isotherm is heavily influencing the inversion, not necessarily leading to a reasonable distribution of petrophysical parameters (e.g. radiogenic heat production, heat generation). Therefore, reasonable uncertainties have to be defined to avoid a bias. The combination of the different data sets by inverse modelling illustrates the challenges in providing a consistent geothermal heat-flux model for Antarctica.