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Geothermal heat flux and basal melt rate in the Dome C region inferred from radar reflectivity and thermal modelling.

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Basal melt rate is the most important physical quantity to be evaluated when looking for an old-ice drilling site, and it strongly depends on the geothermal heat flux, which is poorly known under the East Antarctic ice sheet. The wetness of the ice-bed interface can be assessed from radar echoes on the bedrock, considering that a wet bedrock has a stronger reflectivity than a dry one. But, as the basal conditions depends on the climatic forcing lagged by the thick ice, the basal ice may be cold today whereas it was in average temperate in the past. Accordingly, the risk of mismatch between present and past conditions must be evaluated, and more generally the geothermal heat flux and basal melt rate in the Dome C region. Here, we run a 1D heat model over the last 800 ka in inverse mode to constrain the value of geothermal heat flux by assessing a critical ice thickness, i.e. the minimum ice thickness that would allow the local melting distribution at present. A regional map of the geothermal heat flux is then inferred on a 80 km$\times$130 km area, and shows a N-S-oriented gradient, with a value range of $48 - 60$ mW m^{-2}. The forward model is then emulated by a polynomial function, to compute a time-averaged value of the basal melt rate, spatially variable over the region. Two main subregions appear to be free of basal melting because of the thin overlying ice, and a third one, north of Dome C, because of a low geothermal heat flux.