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An improved temperature model of the Antarctic uppermost mantle for the benefit of GIA modelling

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Mass changes in Antarctica's ice cap influence the underlying lithosphere and upper mantle. The dynamics of the solid earth are in turn coupled back to the surface and ice dynamics. Furthermore, mass changes due to lithosphere and uppermost mantle dynamics pollute measurements of ice mass change in Antarctica. Thus an improved understanding of temperature, composition and rheology of the Antarctic lithosphere is required, not only to improve geodynamic modelling of the Antarctic continent (e.g. glacial isostatic adjustment (GIA) modelling), but also to improve climate monitoring and research.

Recent field studies in Antarctica have generated much new data. These data, especially an improved assessment of crustal thickness and seismic tomography of the upper mantle, now allow for the construction of an improved regional temperature model of the Antarctic uppermost mantle. Even a small improvement in the temperature models for the uppermost mantle could have a significant effect on GIA modelling in Antarctica.

Our regional temperature model is based on a joint analysis of a high resolution seismic tomography model (Heeszel et al., forthcoming) and a recent global gravity model (Foerste et al., 2011). The model will be further constrained by additional local data where available. Based on an initial general mantle composition, the temperature and density in the uppermost mantle is modelled, elaborating on the the methodology of Goes et al. (2000) and Cammarano et al. (2003). The gravity signal of the constructed model is obtained using forward gravity modelling. This signal is compared with the observed gravity signal and differences form the basis for the compositional model in the next iteration. The first preliminary results of this study, presented here, will focus on the cratonic areas in East-Antarctica, for which modelling converges after a few iterations.

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