Paper Number: 3399

Satellite gravity gradient and airborne gravity views of the Antarctic lithosphere

Ferraccioli, F.[1], Ebbing, J.[2], Bouman, J.[3], Pappa, V. [2], Kern, M.[4], Forsberg, R.[5], Barletta, V.[5], Martos, Y. [1], Root, B.[6], van der Wal, W.[6]

[1]British Antarctic Survey (NERC), Cambridge, UK ffe@bas.ac.uk
[2]Christian-Albrechts-Universität Kiel, Germany
[3]Technischen Universität München, Germany
[4]European Space Agency, Noordwijk, Netherlands
[5]Technical University of Denmark –Space, Lyngby, Denmark
[6]Delft University of Technology, Delft, Netherlands

The GOCE+Antarctica project, part of the Support to Science (STSE) program of the European Space Agency (ESA) is a new polar geosciences research initiative that aims to investigate the thermal and compositional structure of the Antarctic lithosphere by combing satellite gravity gradients (Bouman et al., 2016), airborne gravity datasets (e.g. Scheinert et al., 2016), seismological (e.g. An et al., 2015) and petrological models in a forward and inverse manner. This approach will shed new light into the fundamental interplays between Antarctic lithospheric architecture, bedrock topography, ice sheet dynamics, and its dynamic relations with Glacial Isostatic Adjustment (GIA).

Despite large-scale aerogeophysical exploration efforts over Antarctica (e.g. Ferraccioli et al., 2011; Aitken et al., 2014), knowledge of the crustal and lithospheric structure of the continent is still limited compared to other continents due to thick ice sheet cover and the paucity of seismic data. Our knowledge of Antarctic subglacial bedrock has improved substantially in recent years (Fretwell et al., 2013). However, it is estimated that the current bed compilation still has in some regions uncertainties larger than 1 km, and if these occur where the bed is beneath sea level, they can also have a significant impact on our ability to derive reliable assessments of ice sheet dynamics/stability.

We evaluate current seismological upper mantle and crustal models with the aid of satellite gravity gradients and discuss trade-offs between the uncertainties of these models and estimates of temperature and composition in the upper mantle. As a specific example, we also present a comparison between satellite gravity gradient, airborne gravity and seismological views of the crustal and lithospheric-scale transition between the West Antarctic Rift System, the Transantarctic Mountains and the Wilkes Subglacial Basin in East Antarctica.

References:

[1] Bouman J. et al. (2016) Scientific Reports 6, Art. 21050.
[2] Scheinert M. et al. (2016) Geophys. Res. Lett. 43: 600-610.
[3] An M. et al. (2015) JGR 120: 359-383.
[4] Ferraccioli F. et al. (2011) Nature 479: 388-392.

[5] Aitken A. et al. (2014) GRL 41(7): 2390–2400.
[6] Fretwell P. et al. (2013) The Cryosphere 7: 375-393.