Moho depth and residual topography of the Antarctic continent

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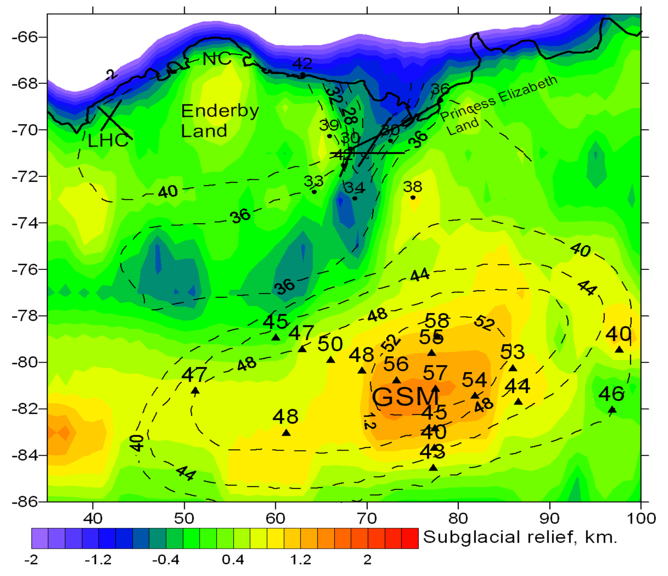
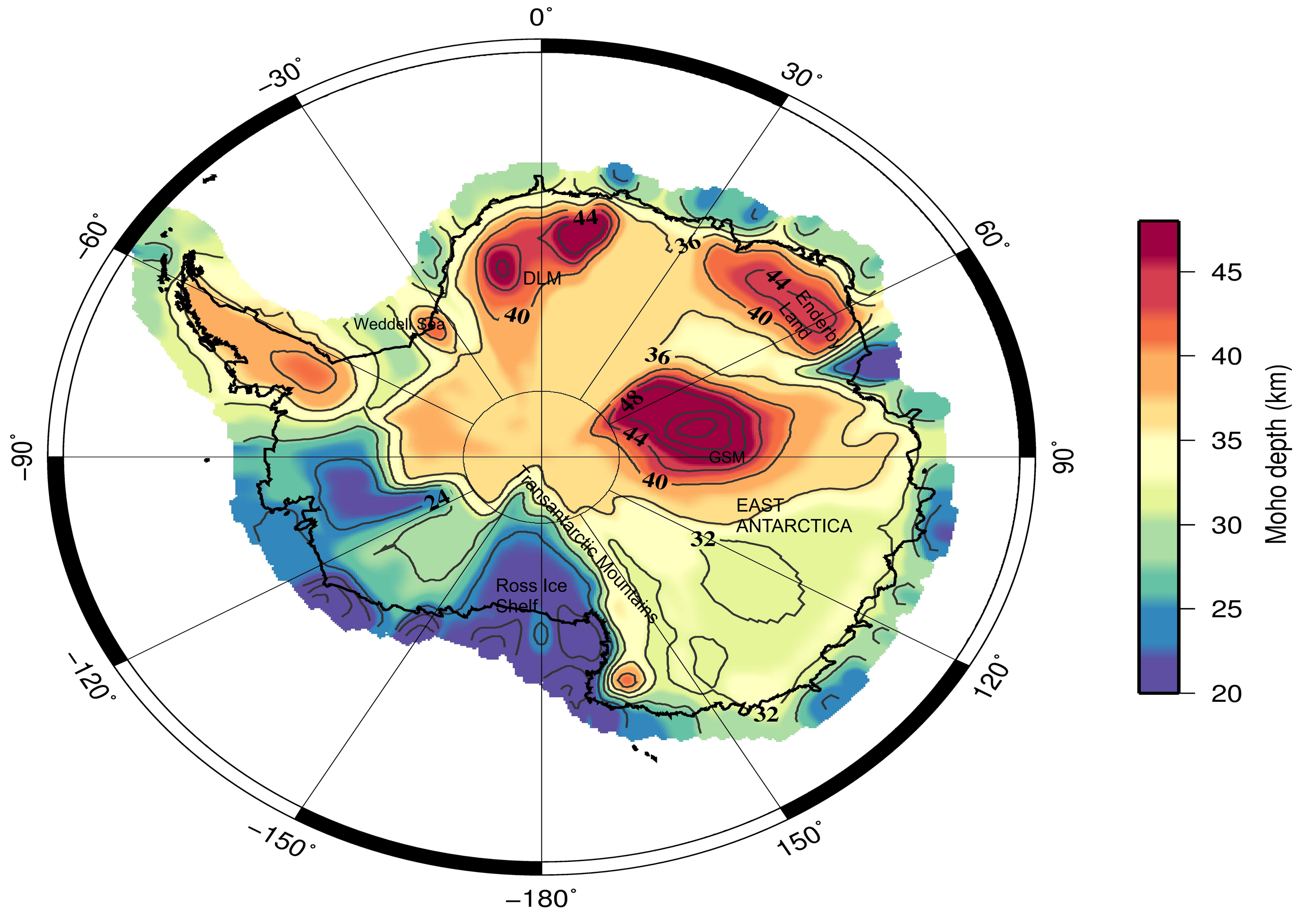
NEW CRUSTAL MODEL

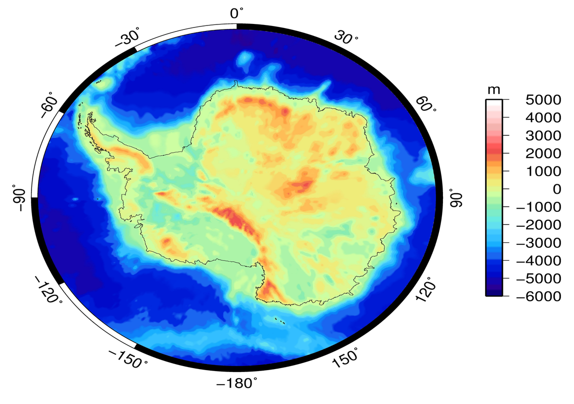
A new Moho depth map for the Antarctic continent has been recently assembled (AntMoho, Baranov and Morelli, 2013), merging copious information from geophysical and geological studies selected from the literature. A large volume of old and new data has been analyzed: mostly seismic experiments, as well as receiver functions and geological studies, ranging from DSS profiles acquired by Soviet Union field experiments, to recent seismic receiver function studies. AntMoho has a reference lateral resolution of 1°x1° and it is available in digital format. The model exhibits differences between CRUST 2.0 that amount up to -10 - +24 km. The crustal structure is divided into 4 layers: sediment, upper, middle and lower crust. In each layer we update the CRUST 2.0 model values integrating new seismic data. VS and density are scaled by VP using the Brocher empirical relations (Brocher, 2006).



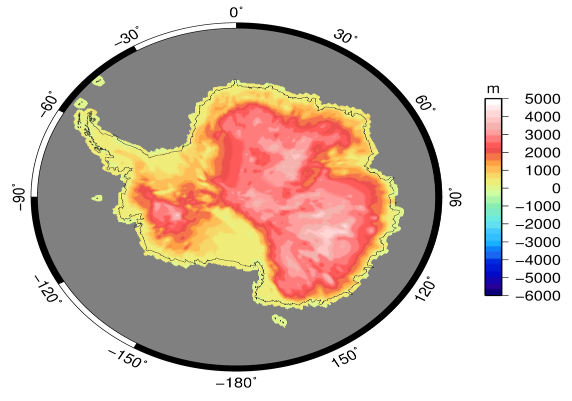
Zoom on East Antarctica region. Distribution of the seismic data used to compile the Moho map: (triangles, crosses and points) receiver functions data, (line) DSS profiles.



Moho depth (km)



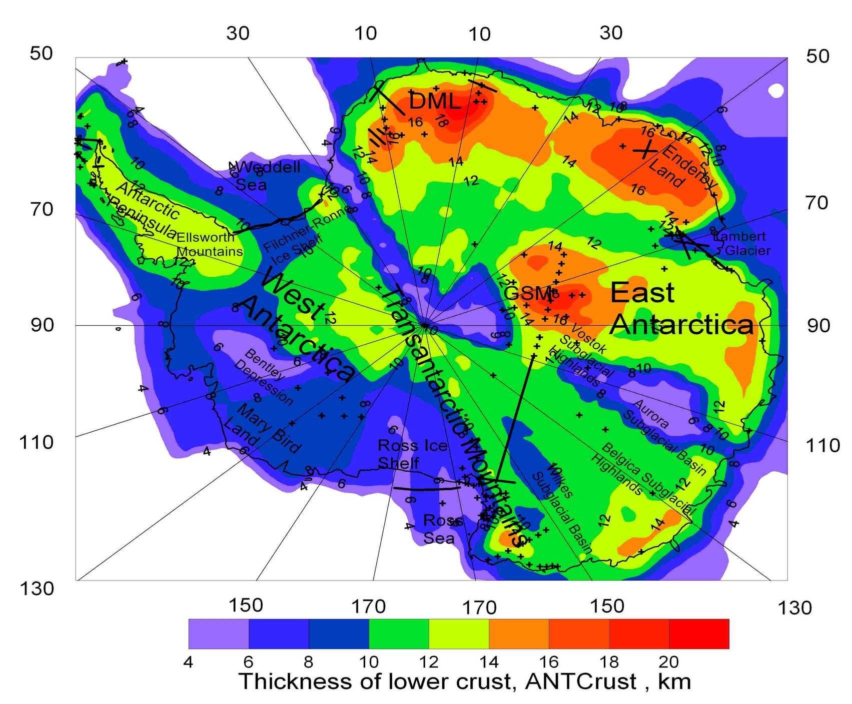
Bedrock elevation



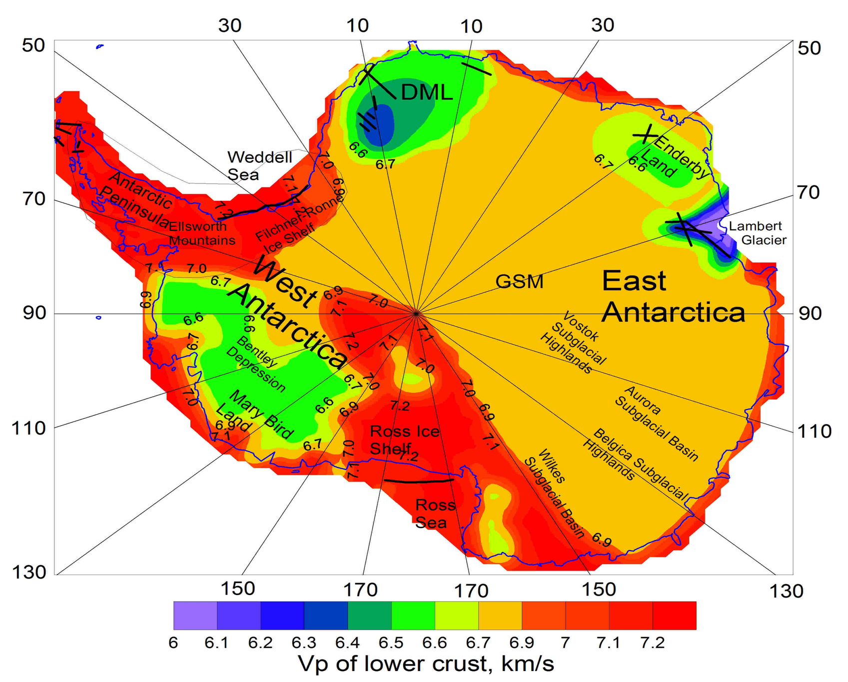
Ice thickness

The model is completed by bedrock elevation, topography and ice thickness taken from BEDMAP 1 (*http://www.antarctica.ac.uk//bas_research/data/access/bedmap/*)

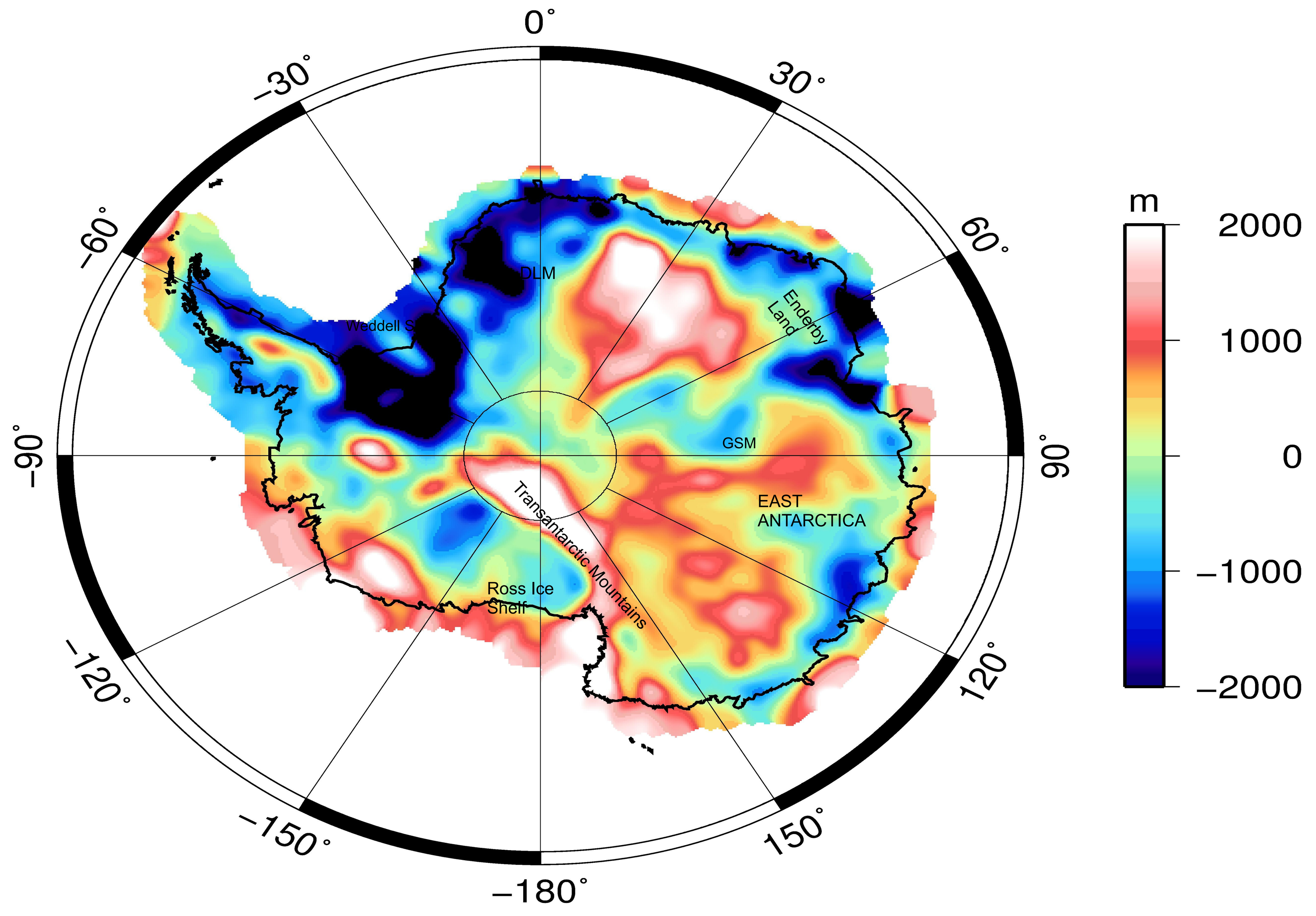
Thicknes of the lower crust (km) in AntModel



VP of the lower crust (km/s) in AntModel

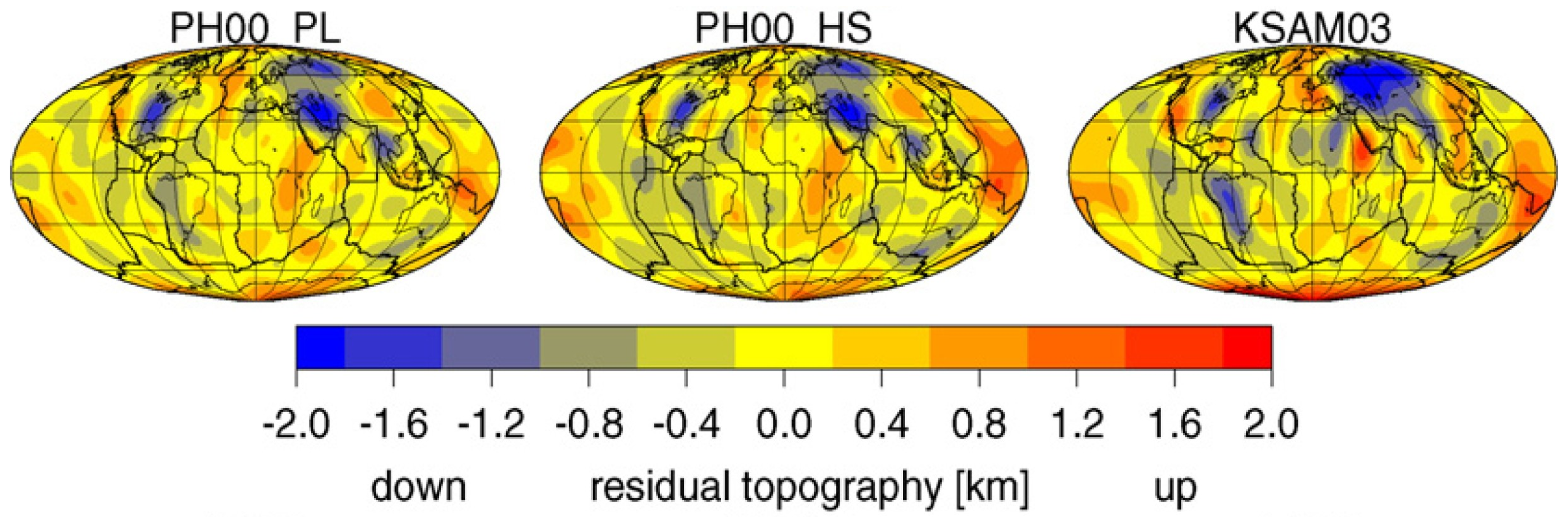


RESIDUAL TOPOGRAPHY



Residual topography is obtained by removing the isostatic contribution of the crust from the observed topography. Long-wavelength residual topography can be interpreted in term of loads that are rigidly supported, hence related to varying lithospheric thickness ("static" contribution), or in term of dynamic response to large scale mantle convection due to density contrasts. We show such residual topography calculated using new AntModel combined with BEDMAP1 data.

Residual topography from AntModel. To ease comparison with deglaciated continents, in this calculation ice thickness has been replaced by an equivalent load of crustal granitic rock.



Comparison with other published global residual topography (Steinberger, 2007). All models show excess topography up 2000 m in Antarctic continent. Note that these maps refer to ice topography rather than equivalent-rock topography as displayed above.

DISCUSSION

We present a new crustal model for the Antarctic continent. The model has the resolution of 1 degree by 1 degree. The structure is parametrized into 4 layers (sediment, upper, middle and lower crust). The values of VP are obtained integrated existing model, results from seismic profiles and available data. The new model exibits remarcable difference with existing model (e.g. CRUST 2.0).

The new crustal model give us the possibility to separate the isostatic and dynamic contribution to the observed topography. In the residual topography map, we can identify a few significant features:

- The Transantarctic Mountains appear not to be isostatically compensated, bordered by the Wilkes Subglacial Basin whose depression is similarly not isostatically compensated. This is consistent with inference derived from recent seismic receiver function studies (Lawrence et al., 2006).
- East Antarctica on a large scale has generally low positive value (300 m) of residual topography. We can also note high positive (2000 m) values in East of Queen Maud Land that is also present in Steinberger (2008).
- Some significant correlation of residual with sub-glacial topography is apparent, but it may be due to lack of sufficient resolution in the Moho map, or lack of a laterally-variable crustal density.

This preliminary study opens new directions that should be followed.
Allowance for compositional variation in the continental mantle (isopycnic condition) will significantly modify the dynamic topography and provide more realistic estimates.
Joint seismic velocity and density inversion in the mantle, fitting seismic and gravity field data (e.g., Tondi et al., 2012) may provide better and more 'direct' information on the dynamics of the mantle. The crustal structure, besides just Moho depth, of the continent should be investigated to provide better resolution, also using the new data that have been collected in the framework of the International Polar Year.

ACKNOWLEDGEMENTS

We thank Thorsten Becker for making his code (HC) freely available and for useful discussion and Dr. A. Cavaliere for helping us with GIS software. This work has been supported by the Italian National Antarctic Program (Programma Nazionale di Ricerche in Antartide) and by the Russian Foundation for Basic Research, grant no. 12-05-33066, 13-05-01123 . Figures has been prepared using GMT (Wessel P. and H.F. Smith).

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