A Global Map of Renormalised Mantle Dynamic Topography

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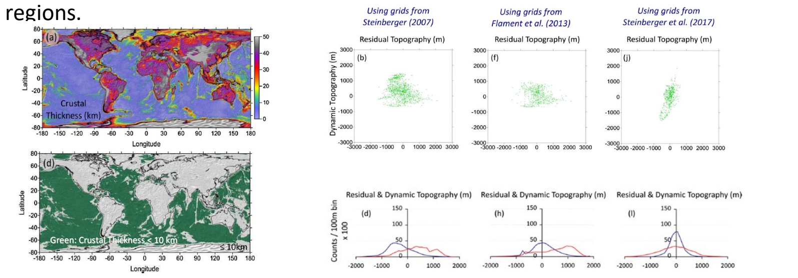
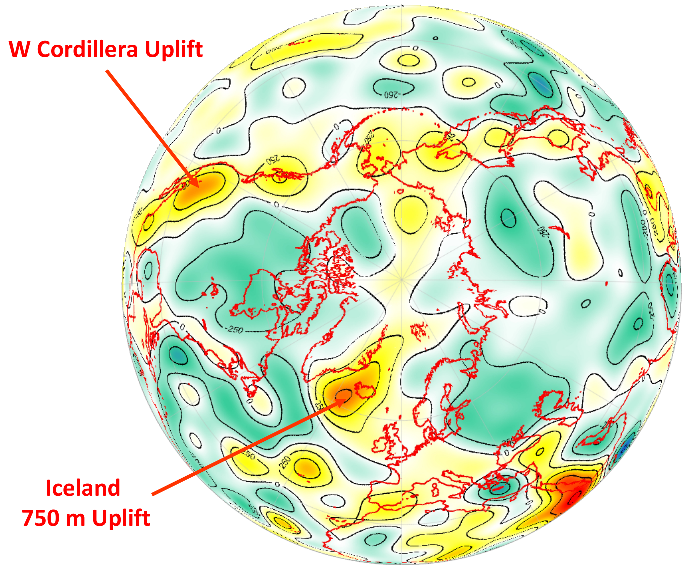
1.Background

- Dynamic topography generated by mantle flow is an important planetary phenomena generating km-scale uplift and subsidence of the Earth's surface.
- While there are several different ways of calculating mantle dynamic topography from 3D mantle convection models, these methods give very different results in terms of amplitude, wavelength and polarity.
- While residual topography measurements provide good constraints on dynamic topography for oceanic regions, residual topography measurements for the continents are very inaccurate.
- As a consequence we know little about dynamic topography for continental regions.



Above: Comparison of 3 different dynamic topography predictions with observed residual topography (on right) for global regions with crustal thickness < 10 km (on left) from Cowie & Kusznir, EPSL, 2018.

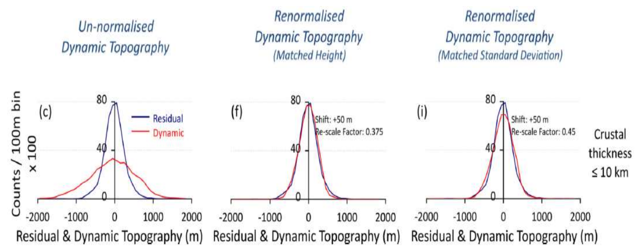
- Oceanic regions with crustal thickness less than 10 km (excluding continental margins, oceanic plateaux and micro-continents) provide the most accurate observations of residual topography and have been used to test several different mantle dynamic topography predictions (Cowie & Kusznir, EPSL, 2018).
- The dynamic topography predictions of Steinberger et al. (2017), which includes seismic tomography information shallower than 220 km, show the best correlation with residual topography measurement. However comparison shows that the amplitude of predicted dynamic topography is too great by a factor of x2.5.

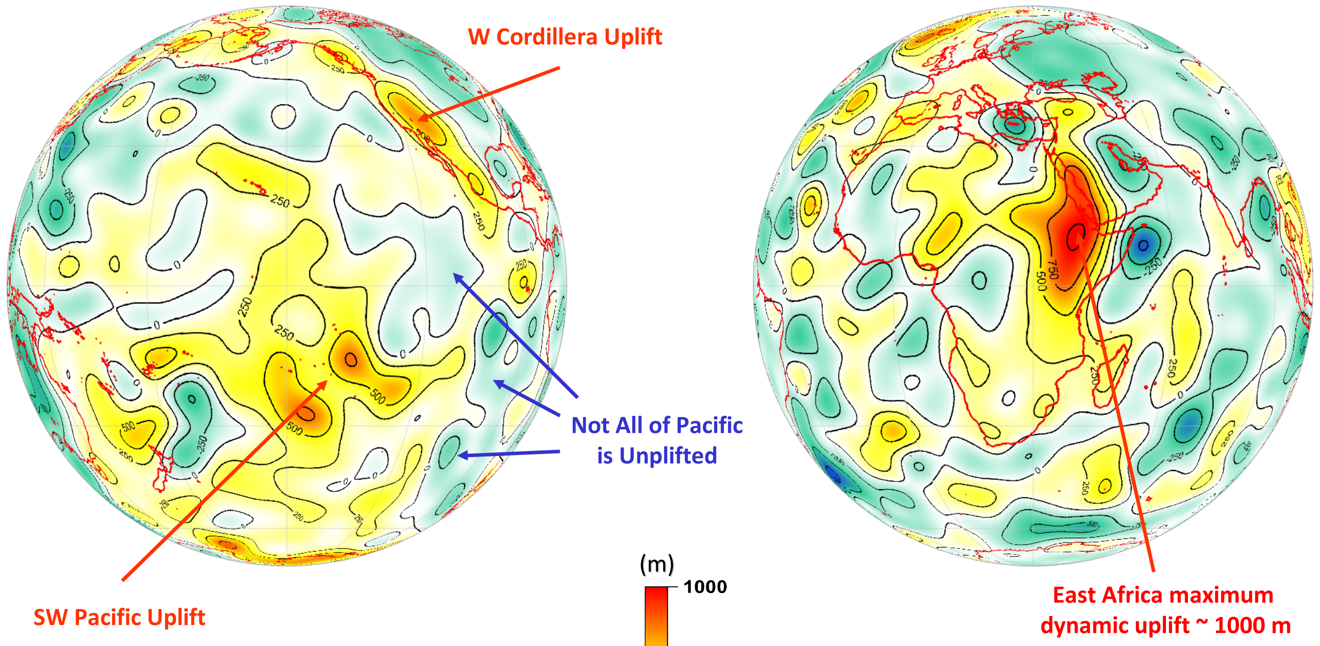


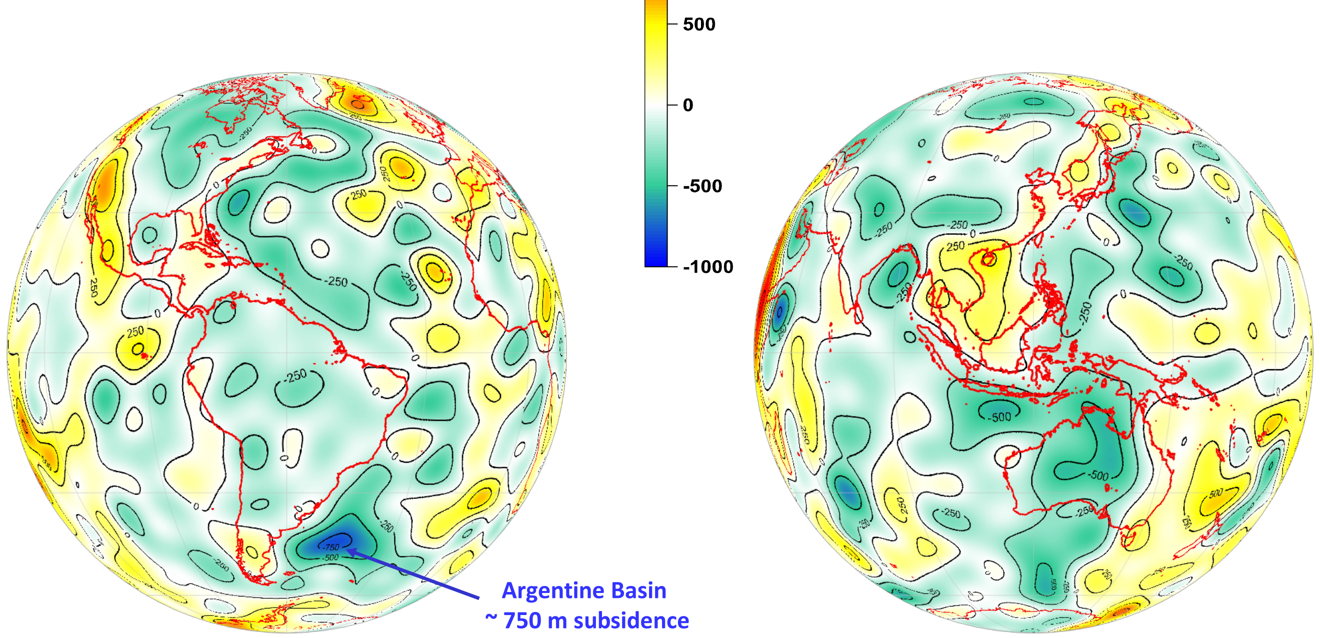
2. Renormalisation

•Renormalisation of the dynamic topography predicted by Steinberger et al. (2017), consisting of rescaling (~ x 0.4) and shifting is required to match observed residual topography for regions with crustal thickness less than 10 km (on right).

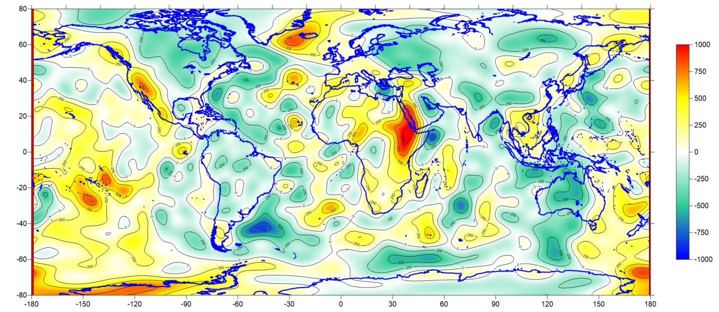
•Renormalisation has been applied globally to generate an improved map of dynamic topography for the continents, other remaining oceanic areas, and the Antarctic and Arctic polar regions.







3. Renormalised Global Dynamic Topography



Above: Renormalised Dynamic Topography of Steinberger et al. (2017)

•Renormalised maximum amplitudes of mantle dynamic topography uplift for East Africa are slightly more than 1000 m.

•Dynamic uplift for Iceland has a maximum value of approximately 750 m.

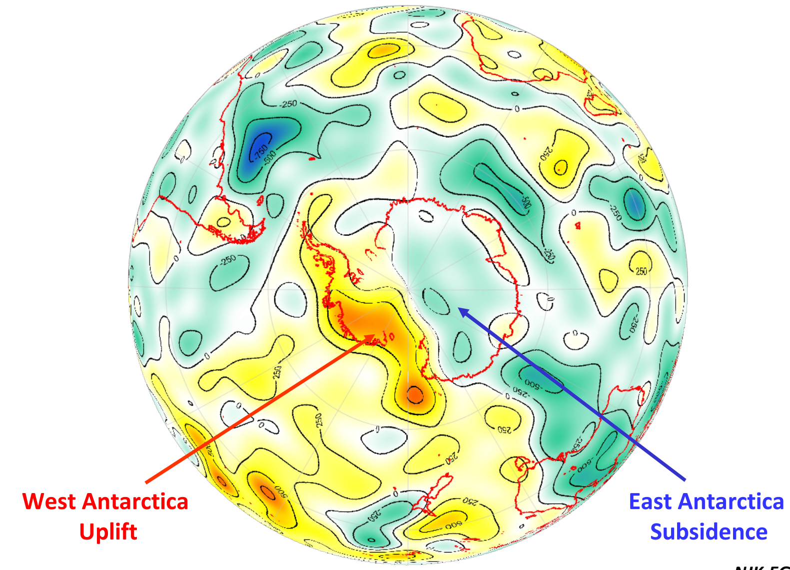
• The S.W. Pacific shows a large area of dynamic uplift reaching a maximum of approximately 750 m.

•In the contrast with many other dynamic topogrpahy predictions, Steinberger et al. (2017) show that not all of the Pacific is uplifted. The E. Pacific shows regions with dynamic subsidence locally reaching -500 m.

•For mantle dynamic subsidence in the Argentine Basin of the S. Atlantic, the maximum amplitude is approximately -750 m.

•West and East Antarctica show contrasting dynamic topography. West Antarctica shows uplift while East Antarctica shows subsidence.

•Both the Western Cordillera of North America and West Antarctica show elongated regions of mantle dynamic uplift with maximum values of 500 and 750 m respectively.



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