Supplementary information to:

Effects of upper mantle heterogeneities on lithospheric stress field and dynamic topography

immediate

Correspondence to: Anthony Osei Tutu (oseitutu@gfz-potsdam.de)

Contents

Introduction

The main text show the model input and results from our series of calculations with the lithosphere-asthenosphere code coupled to the mantle flow code to evaluate the influence of the mantle flow and lithosphere density anomalies on lithosphere stress and topography. Here we show additional figures of model input and results which did not go into the main text but are referred to in the main text, e.g. modeled stress and topography with other upper mantle thermal structures. In this current study:

1. We evaluate the influence of shallow and deep Earth thermal-and-density heterogeneities on global lithospheric stress field and dynamic topography.

2. We compare the modeled stress field to the World Stress Map 2026 and the corresponding dynamic topography to two independent observation-based residual topography models.

3. Upper mantle thermal structures inferred from the S-wave velocity model fit the observed topography much better when continental depletion are corrected for, but there is almost no improvement in the respective stress field.

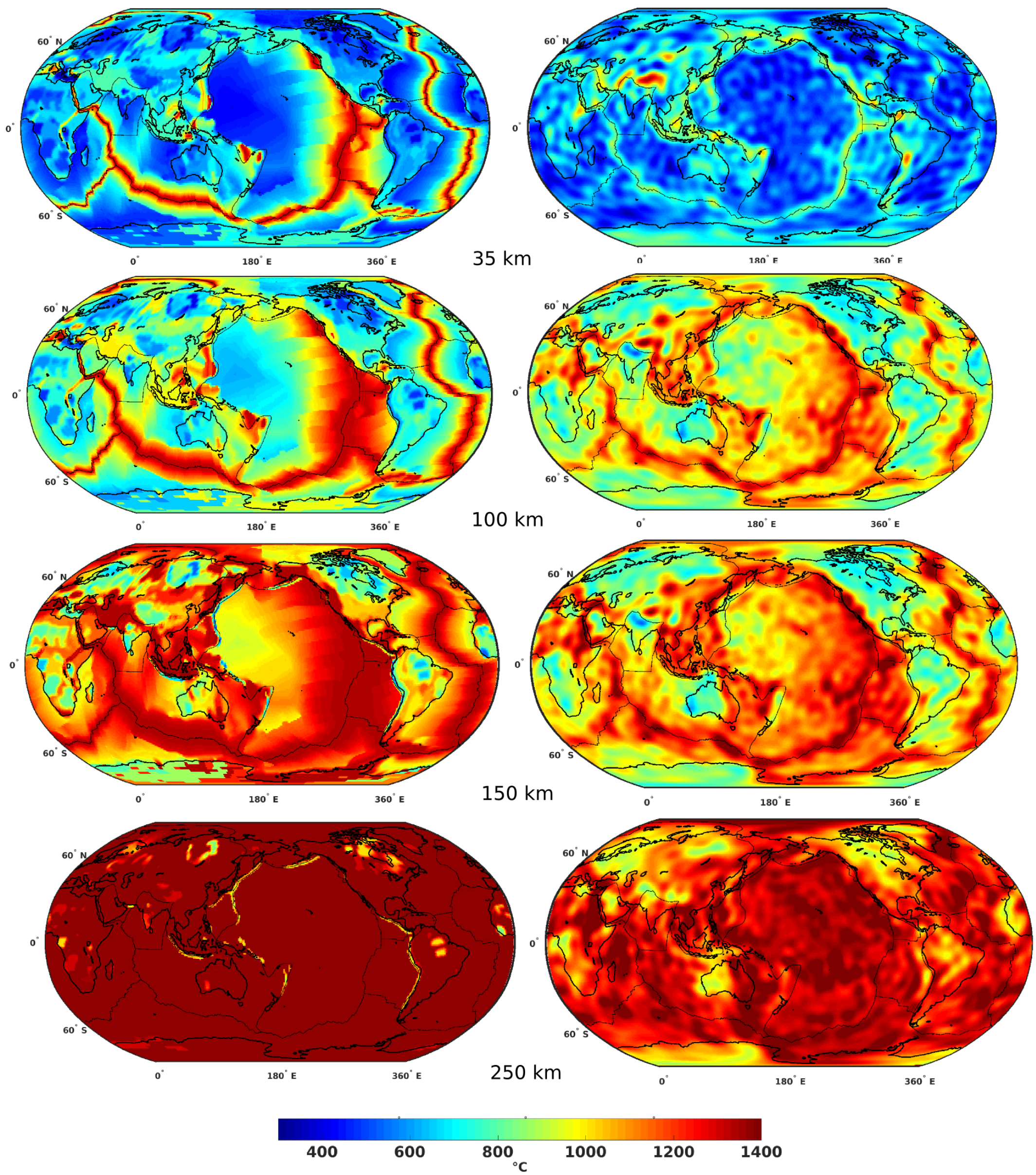

Figure S1. The thermal structure of the upper mantle at a depths of 35, 100, 150, and 250 km from the two reference thermal models adopted in this study, TM1 (left column) and TM2 (right column). TM1 is derived from the thermal structure TC1 of Artemieva (2006) in the continents and the sea floor age model of Müller et al. (2008) in the oceanic areas, while the TM2 model is based on the S-wave tomography-model SL2013sv from Schaeffer and Lebedev (2013) for inferring thermal structure in the upper 300 km. A detailed description is given in the main text

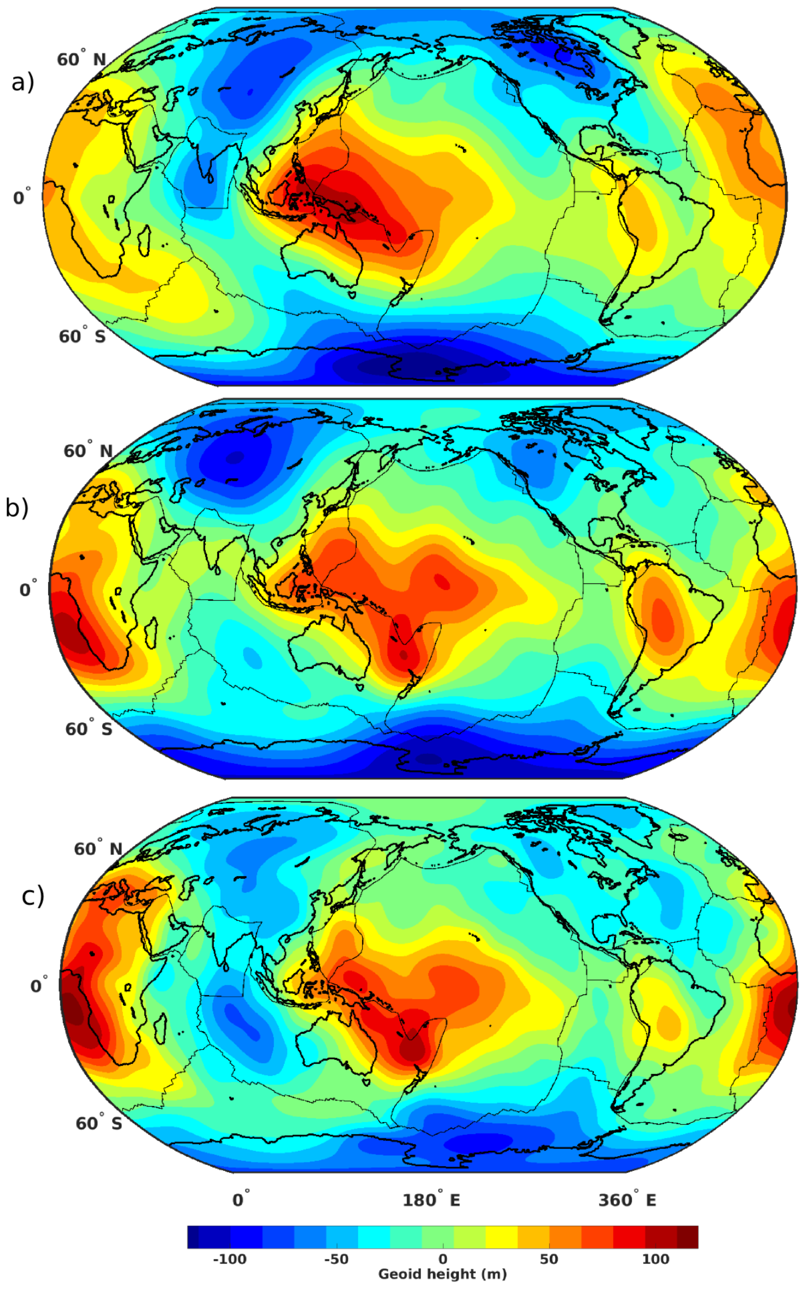

Figure S2. Comparing (a) the observed geoid from GRACE (with the effect of hydrostatic equilibrium removed) to our modeled geoid (b) using LVVs in the upper 300 km with only radial viscosity variation below and (c) with only radial viscosity variation below (Steinberger and Calderwood, 2006) for all depths. The modeled geoid is estimated with the density distribution from Becker and Boschi (2002) and TM1 thermal density structure in the top 300 km

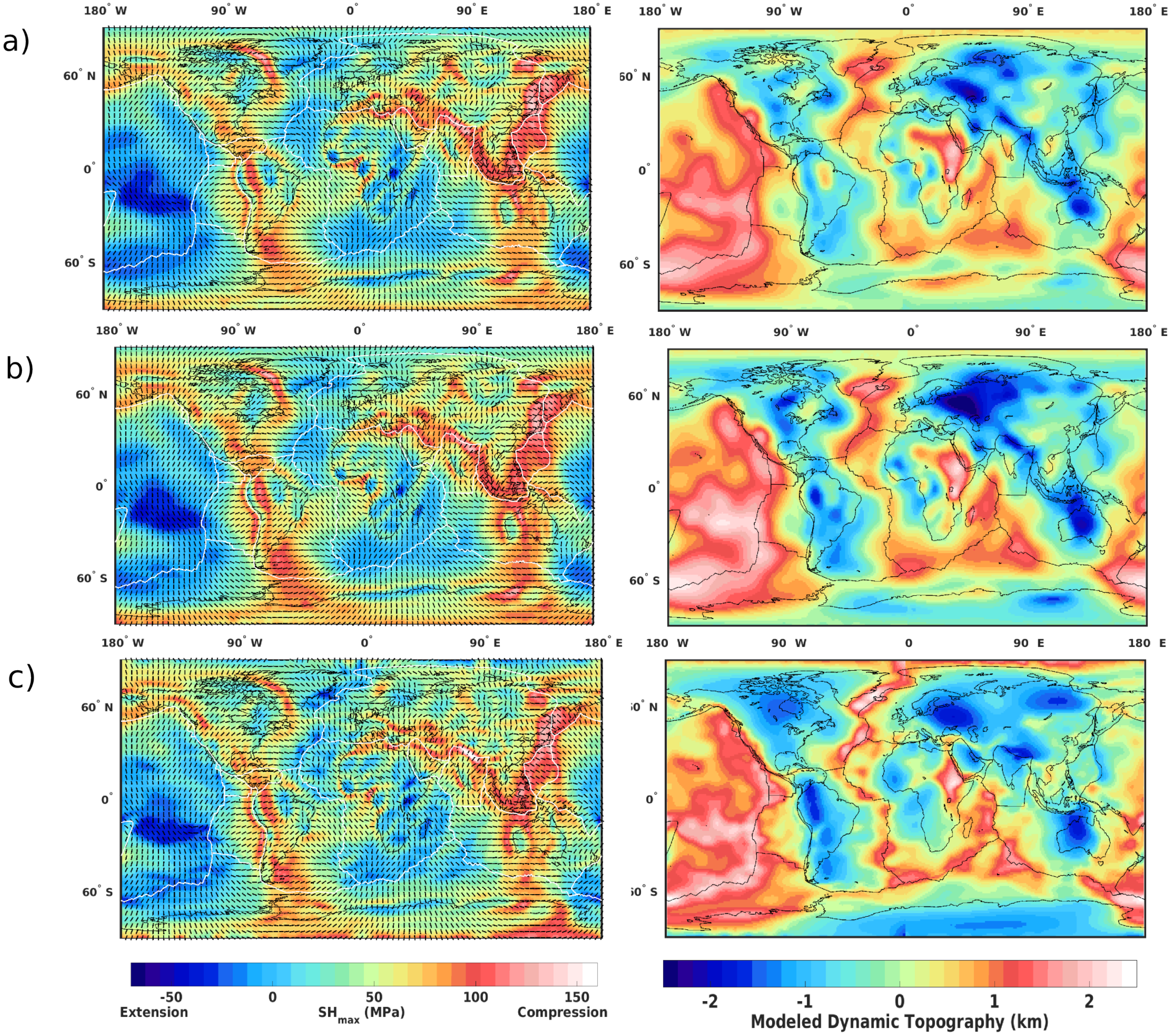

Figure S3. (left column) modeled lithospheric stress field without the effect of crustal thickness variations and (right column) corresponding dynamic topography for (a) TM2 (100 K additional temperature converted to density in crations to account for chemical deplection), (b) SAW24B16 with realistic treatment of cratonS using $Perple_X$ after Cammarano et al. (2011) and same with (c) S20RTS for the upper mantle thermal and density structures.

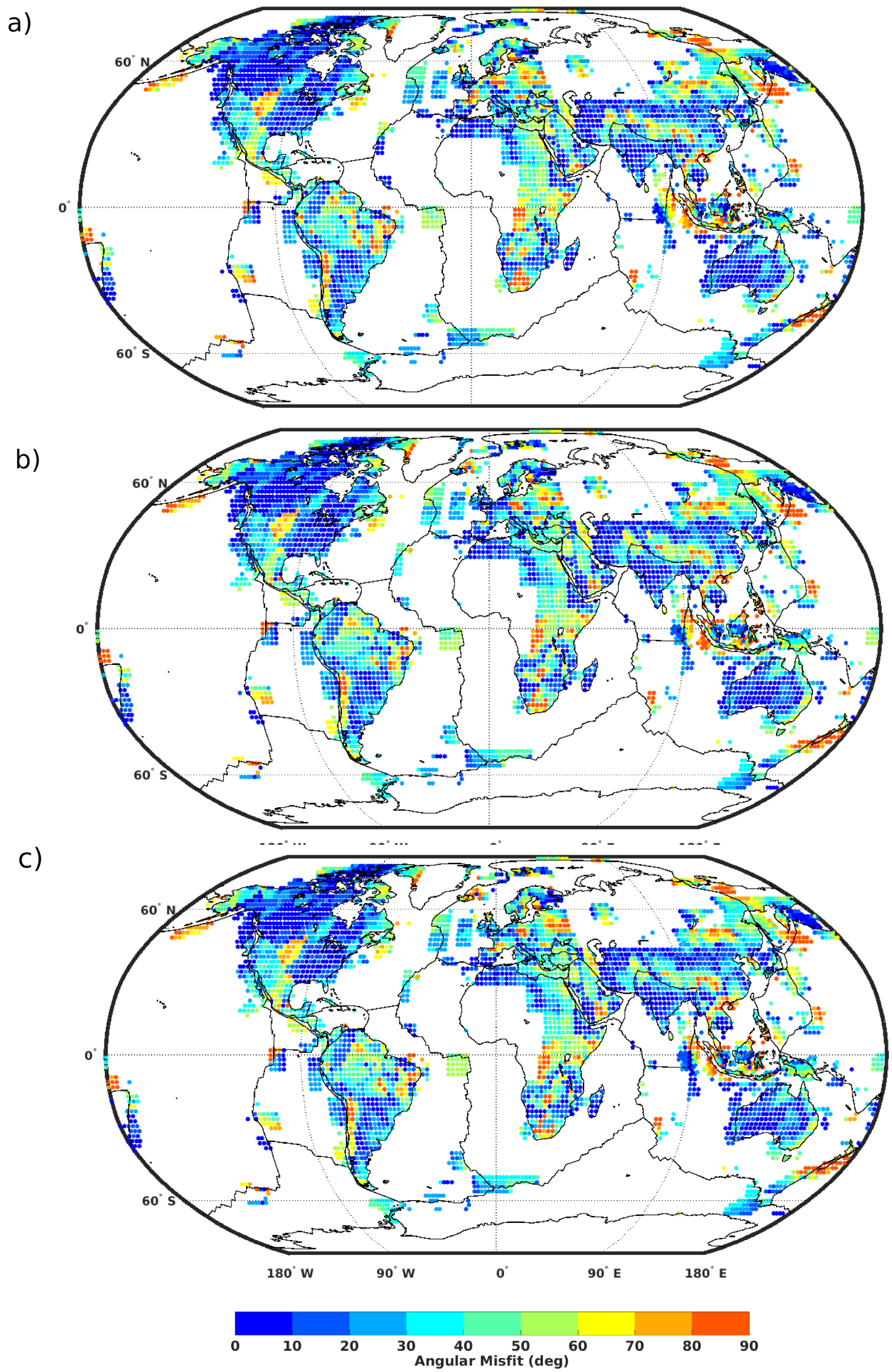

Figure S4. Angular misfit between the observed (WSM 2016) and total modelled stress direction with (a) TM2 with cratonic regions having added constant temperature of 100 K and (b) SAW24B16 with realistic treatment of cratonS using $Perple_X$ after (Cammarano et al., 2011) and same with (c) S20RTS for the upper mantle thermal and density structures.

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