Indian Ocean Geoid Low: Unravelling the crustal and upper mantle sources

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Abstract

The Indian Ocean has the largest geoid anomaly, known as the Indian Ocean Geoid Low (IOGL). This long wavelength geoid depression has a magnitude of negative 106 m, and is centered south of India. The nature and depth of the sources causing this characteristic low are poorly constrained and has been the subject of debate. In this abstract, we focus on understanding the density contributions to the geoid low from the crust and upper mantle using joint analysis of geoid and gravity data along with published tomographic models in the region. Decomposition of geoid anomalies in the spectral domain indicate that mass anomalies below the upper mantle ($>$ 700 km) contribute to 90% of the total geoid anomaly. In order to compute the upper mantle contribution to the IOGL, we used the Moho geometry and the crustal density structure from the 3-D gravity inversion, and the SL2013sv tomography model for the upper mantle density structure. The presence of density sources, which was not resolved in the modeling within the sub-lithospheric mantle is confirmed upon comparing the crustal and upper mantle (up to 700 km) geoid response below the IOGL with n=10 residual geoid anomaly. Integrated gravity-geoid 2-D modeling of the geometries of the anomalous sources located at the base of LAB and at a depth of 320-340 km, respectively, confirms that the contribution of density structures up to 700 km explains only the ten percent of the IOGL which matches well with the spectral decomposition results. This suggests that the lower mantle sources, such as paleo-subducted slabs or plume sources from the core-mantle boundary significantly contributes to the IOGL.