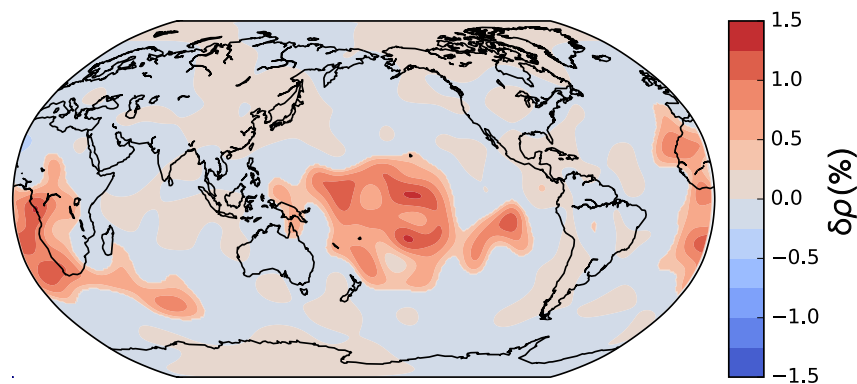


Investigating Earth's deep mantle buoyancy and frequency dependent behavior using Earth tides.

Earth's mantle is a key component of the Earth system: its circulation drives plate tectonics, the long-term recycling of Earth's volatiles, and as such, holds fundamental implications for the Earth's surface environment. In order to understand this evolution, two aspects of the mantle must be known: its buoyancy and how it dissipates energy. For the former, I will discuss how Earth's body tide can provide fresh and independent constraints on deep mantle buoyancy through a newly developed technique called *Tidal Tomography*. This comes at a time when other interesting and exciting data sets sensitive to deep mantle buoyancy, e.g., Stoneley modes, have been brought to bear, and we will explore our conclusions in the context of other recent finds.

As a complement to this, tidal data also stretch the frequency band across which we can analyze dissipation of the lower mantle. By combining a selection of normal mode and tidal attenuation data – while implementing the recent advances in anelastic theory relevant to phenomena – we can examine dissipation spanning six orders of magnitude in frequency (from 7 minutes to 18.6 years). We compare these observations with predictions from a laboratory-based model of intrinsic dissipation and our modeling approach incorporates mantle parameters inferred from mantle convection studies. We find our macroscopic result is consistent with experimental data and resolves a recent discord between wide band attenuation derived from seismic versus geodetic data. We discuss the implications of these results on grain-scale mechanisms of dissipation. To arrive at these conclusions, theoretical and observational insights from a wide range of spatio-temporal data (from the micro- and planetary-scale; from minutes to decades) and disciplines (rock physics, seismology, and geodynamics) have been combined.



One model of deep mantle density (2800 km depth) consistent with GPS measurements of Earth's body tide deformation (Lau *et al.*, 2017; doi:10.1038/nature24452)