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Normal mode models of the mantle using Backus-Gilbert tomography

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Seismic tomography is a powerful tool to study the deep Earth, given the lack of direct observations. Seismic structures can be interpreted together with constraints from other disciplines, such as geodynamics and mineral physics, to provides valuable information about the structure, dynamics and evolution of the mantle. Nevertheless, a robust physical interpretation of seismic images remains challenging as tomographic models typically lack uncertainty information and may have biased amplitudes due to uneven data coverage and regularisation.

We aim to build tomographic models of the mantle with associated uncertainties and unbiased amplitudes. For this, we use the SOLA method (Zaroli, 2016) applied to normal mode data, the Earth's free oscillations. SOLA is based on a Backus-Gilbert approach, which explicitly constrains the amplitudes to be unbiased and inherently computes the model uncertainty and resolution. This approach enables us to perform meaningful physical interpretations of the imaged structures. By applying this method to normal modes, we obtain valuable insights on the long wavelength structure of the mantle. The use of normal modes also has several advantages: these data are sensitive to multiple parameters, including both Vs and Vp anisotropy as well as density, and they provide global data coverage.

Here, we report on our progress towards a new 3-D mantle model based on the inversion of normal mode splitting function data. We discuss initial results from synthetic tests and isotropic inversions in terms of model estimates, uncertainties and resolution.