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Towards the Next Generation 3D Global Anelastic Mantle Model

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Determining the 3D seismic attenuation structure of the Earth is important for addressing the physical origin of mantle heterogeneities. Being more sensitive to thermal structure, attenuation parameters can provide additional constraints on this issue by distinguishing the heterogeneities caused by thermal variations from the compositional ones. Such an endeavor also has the potential to complement the information provided by elastic tomography by taking the physical dispersion into consideration.

As a methodology, we follow a hybrid approach, using the spectral element method for the forward modeling (Capdeville et al., 2003) and normal-mode based theory (NACT - Li and Romanowicz, 1995) for the kernel computation. The coupled Spectral Element Method allows a complete and accurate description of the 3D wavefield, whereas, NACT based kernel computation takes into account both the effect of horizontally averaged structure along the great circle between the source and receiver and any further correction due to cross-branch modal coupling. This asymptotic approach has proven to be successful in developing high resolution global tomographic models (French and Romanowicz, 2014). We have extended it further to invert for the attenuation (Q_μ).

The major challenge in mapping the attenuation parameters is the separation of anelastic effects, which manifest themselves through dispersion and amplitude decay, from the elastic ones such as (de)focusing and scattering. To address this issue and as a step towards the next generation global attenuation model, we employ a higher resolution elastic model, namely the SEMUCB-WM1 model (French and Romanowicz, 2014), as a starting model. Additionally, we target for a minimum period of 32s by including body wave seismograms, as used in the development of our starting model, and use updated source parameters inverted in our starting elastic model. As our inversion strategy, we follow a joint inversion scheme that addresses the elastic, anelastic (Q_μ) parameters and frequency independent source and receiver terms. Here, we present preliminary results towards the construction of the next generation global anelastic mantle model.