Waveform tomography in the Mediterranean and Southeast Asia

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In this work, we present results from waveform tomography conducted in the Mediterranean and Southeast Asia. Whilst computationally more expensive than ray-based imaging methods, the advantage of waveform methods lies in their ability to incorporate in a consistent manner all the information contained in seismograms – not just the arrivals of certain, specified phases. We can therefore naturally and coherently exploit body and multimode surface waves, and take into account source effects, frequency-dependence, wavefront healing, anisotropy and attenuation.

Here, we look at applications of this method in two geologically complex regions: the Mediterranean and Southeast Asia. Both are characterised by broadscale convergence and a complicated pattern of interactions between larger and smaller-scale tectonic plates.

The Mediterranean is historically one of the best studied areas in the world, with an impressive density of seismic stations which greatly aids the detailed imaging of the region. We have been able to image the Central and Eastern Mediterranean down to the mantle transition zone, thereby illuminating the complex slab structures and geometries within the domain. We identify several main slabs that correspond to major current and former subduction zones.

In Southeast Asia, we work at a larger scale, with a model domain encompassing the Sunda arc (which gives rise to some of the world's most significant natural hazards), the Banda arc with its spectacular 180° curvature and various smaller-scale features, such as the tectonically complex island of Sulawesi. To date, sparse instrument coverage in the region has led to a heterogeneous path coverage, in particular around Borneo which is located in an intra-plate setting. A recent series of temporary seismometer deployments in Sabah (North Borneo), Kalimantan, Sulawesi and the Celebes Sea allows us to fill the gaps in the publicly available data, thereby providing new opportunities to investigate the region's complexity using waveform tomography.

In this presentation, we will also discuss a number of features and “best practices” that can significantly influence waveform tomography results. In particular, we highlight how we can optimise sensitivity to deep structure by combining long-period data with a window selection approach that specifically targets body wave signals, and we discuss the effect of uncertainties in earthquake source parameters on the seismic inversion process.