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Thin-layer resolution from multiscale analysis of teleseismic P-to-S converted waves: the oceanic nature of the African slab subducted under Peloponnesus.

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In Greece, receiver-function processing of teleseismic P-waves in the standard frequency band results in the image of a low-velocity layer at the top of the Hellenic slab twice thicker than expected for an oceanic crust. The objective of this work is to assess if this result could be due to a lack of resolution of the standard processing.
A multiscale approach with the receiver-functions is developed in order to quantify the resolution. It is based on the wavelet-response of the medium, akin to the wavelet-transform of the velocity-depth function. The synthetic response in conversion of multiscale singularities, like that formed by two opposite velocity-steps at the boundaries of a crust embedded in mantle material, leads to quantify the domain of non-interaction between the signal wavelength and the heterogeneity thickness. Only at the shortest periods can the low-velocity layer (LVL) between upper plate and slab mantle be simply characterized in term of thickness and velocity contrast at its boundaries. For a 7 km thick oceanic crust, only wavelet periods shorter than about 0.8 s will allow to identify clearly this thin LVL. Going to longer periods will first lead to underestimate the time-thickness of the LVL, then overestimate it increasingly such that for a band-pass commonly used in data processing, it will thus appear twice thicker than it is. The amplitudes also vary, increasing from the short period non-interaction domain where their values only depend on the velocity contrast, to the resonance period, then decreasing in the thin-layer domain. The analysis of the response in conversion from full waveform synthetic seismograms in a dipping slab model allows to validate a multiresolution approach to real observations. This approach involves building the wavelet response of the slab top as the scalogram of receiver-functions for P-wavelets of different scales extracted from observations through application of band-pass filters to the seismograms.
We present the first results of the application of this analysis to examples of a real dataset recently collected in the frame of the European Union THALES WAS RIGHT project. A tight-array teleseismic receiver-function network was dedicated to resolve at depth the heterogeneity at the top of the African slab under the Hellenic region and its variations along-dip and along-strike. With earthquakes of broad-enough spectrum towards the short periods yielding energy to provide wavelet periods significantly shorter than 1s, the P to S conversions obtained beneath the eastern coast of Peloponnesus allow resolving for the first time a standard oceanic crust at the slab top. This result is consistent with the fast trench retreat model, attested by the southwestward fast motion of the edge of the Aegean upper plate domain documented from GPS. Indeed, if this occurred since 4-5 million years ago, the slab underlying now eastern Peloponnesus to about 180 km from the backstop tip should be the most reduced buoyancy oceanic slab of the Ionian sea basin.