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Anelastic attenuation structure of the southern Aegean subduction area

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The study of the anelastic attenuation structure plays a very important role for seismic wave propagation and provides not only valuable constraints for the Earth's interior (temperature, relative viscosity, slab dehydration and melt transport) but also significant information for the simulation of strong ground motions. In order to investigate the attenuation structure of the broader Southern Aegean subduction area, acceleration spectra of intermediate depth earthquakes produced from data provided by two local networks which operated in the area were used. More specifically, we employed data from approximately 400 intermediate-depth earthquakes, as these were recorded from the EGELADOS seismic monitoring project which consisted of 65 land stations and 24 OBS recorders and operated during 2005-2007, as well as data from the earlier installed CYCNET local network, which operated during 2002-2005. A frequency-independent path attenuation operator t* was computed for both P and S arrivals for each waveform, using amplitude spectra generated by the recorded data of the aforementioned networks. Initially, estimated P and S traveltimes were examined and modeled as a function of epicentral distance for different groups of focal depths, using data from the CYCNET network in order to obtain the expected arrival information when original arrival times were not available. Two approaches to assess the spectral-decay were adopted for t* determination. Initially, an automated approach was used, where t* was automatically calculated from the slope of the acceleration spectrum, assuming an $\omega 2$ source model for frequencies above the corner frequency, fc. Estimation of t* was performed in the frequency band of 0.2 to 25 Hz, using only spectra with a signal-to-noise ratio larger than 3 for a frequency range of at least 4Hz for P-waves and 1Hz for S-waves, respectively. In the second approach, the selection of the linearly-decaying part of the spectra where t* was calculated, was carried out manually, after a visual inspection by the user for optimal spectral fitting.

The observed t* data from both approaches were examined against hypocentral distance. In general, no significant linear trend, revealing dependence of t* with distance, could be observed on the original data, clearly a result of the significant spatial and depth variations of the anelastic attenuation structure that superimposes the distance effect. In order to further investigate this issue, a spatial variation of t* values for different hypocentral-depth groups was performed. The obtained results show that along-arc stations exhibit very low values of t*, while back-arc stations present much larger values. The observed t* along-arc/back-arc differences becomes more significant as the depth of the earthquakes increases, indicating the effect of the high-attenuation (low-Q) mantle wedge beneath the volcanic arc. For a more detailed view of the spatial variations of the whole path attenuation operator, we performed preliminary spatial interpolation of t* values for different hypocentral depth ranges. For "shallower" hypocentral depths, low values of t*, appear to be sparsely observed mainly in the back-arc area, but as hypocentral depths increase, a much larger area with higher attenuation is identified along the volcanic arc.

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