

Attenuation structure of North America using USArray: A two-station approach for surface-wave amplitude analysis

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Anelastic attenuation of seismic waves provides us with an insight into the distributions of temperature and water in the Earth's mantle. While seismic velocity models have been investigated by many researchers, anelastic attenuation (or Q) models have yet to be investigated in detail mainly due to the intrinsic difficulties and uncertainties in the amplitude analysis of observed seismic waveforms.

In this study, we developed a new method of non-linear waveform fitting to measure inter-station phase velocities and amplitude ratios simultaneously, working with a fully non-linear inversion scheme. We employed the neighborhood algorithm (NA) that enables us to explore the model parameter space so as to fit the two observed waveforms on a common great circle by perturbing both phase and amplitude of the fundamental-mode surface waves.

This method has been applied to observed waveform data from the high-density transportable seismic network in USA (USArray) to collect a large-number of inter-station amplitude and phase speed data in a period range from 25 to 200 seconds. Our preliminary results indicate good correlation with the conventional tomographic results of surface-wave phase speeds and attenuation in North America on a large-scale; e.g., significant slow velocity anomaly and high attenuation in the western United States.

Our measurements also suggest the limitations in the amplitude measurements between two stations; i.e., estimated amplitude ratios are fairly sensitive to some uncertain factors such as the site effects and employed sensor types, despite all the instrument responses have been deconvolved using the response information provided by the IRIS data center. The effects of station correction factors will need to be carefully considered to compensate for the large uncertainties in the observed amplitude data, when we construct tomographic maps of surface-wave attenuation.

The current measurement technique enables us to gather a number of phase and amplitude data at short distances less than 1000 km in an efficient manner, which is of great help in improving the horizontal resolution of the current tomographic models with intermediate/long period surface waves.

Keywords: anelastic attenuation, non-linear waveform fitting, surface-wave amplitude, two-station approach