EGU2020-21538
https://doi.org/10.5194/egusphere-egu2020-21538
EGU General Assembly 2020

Phase and Amplitude Rayleigh Wave Fields Measured by AlpArray

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Using AlpArray and European networks, it is now possible to resolve the shape and inherent distortion of teleseismic surface waves across the greater alpine area at an as of yet unprecedented resolution. With well over 1500 available broadband stations within a 20° radius around the central Alps we demonstrate our approach for measuring both phase and amplitude distributions of surface wave signals in the space-frequency domain, leading to structural phase velocity information corrected for possible dynamic effects. Knowledge of the amplitude fields is particularly important to understand wave front deformations and to correct dynamic phase velocity measuremnts.

To diminsh the influence of noise, higher modes, coda waves, or adjacent events on our measurement, we analyse correlations with synthetic fundamental mode signals for a spherically symmetric earth model. The resulting wave field parameters are consequently expressed as amplitude and phase perturbations of the synthetic background wave fields. The measurements are explained and examples for phase and amplitude Rayleigh wave fields are shown and discussed.

Examining the wave field properties it becomes apparent that the dynamic contributions to the eikonal phase velocity are indeed significant, caused by both heterogeneities inside and (far) outside the observed region. Smaller local anomalies are for instance frequently observed around Mount Etna and Vesuvius, with the active vulcanism causing noticable reverberations. Surprisingly, large wave field anomalies are often oriented almost parallel to the propagation direction and can potentially span the entire station distribution, manifesting themselves as contiguous stripes of elevated amplitudes from positive interference of off-axis scattered waves.