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Surface wave phase velocity maps from multiscale wave field interpolation

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I present a multiscale interpolation scheme for surface wave fields which allows to derive phase velocity maps on regional scale by non-tomographic means. For each observed wave field a multitude of phase velocity maps is calculated based on subsets of the available data and the mean of all maps taken at each interpolation point.

Comparison of different interpolation schemes on synthetic wave fields shows that simple linear bivariate interpolation of phases in a triangulated region is among the most reliable interpolation options. The recovered phase velocity maps are, even in the presence of random noise (which is in practice equivalent to measurement uncertainties or non-planarity of the wave field), largely free of artifacts and restore a synthetic input model reasonably well.

The method is applied to a subset of Rayleigh wave observations at the USArray and to data from southern Norway. Stability of the method can be achieved entirely parameter free in the case of a larger network in a "tectonically smooth" region (USArray case $\sim$85 stations). For a smaller network ($\sim$ 40 stations) in a tectonically heterogeneous environment as in southern Norway with its proximity to the continental margin and the cratonic Baltic shield, a very conservative taper on acceptable velocity anomalies (dVs <= 20%) may be applied in the stacking to stabilize the maps.

In both cases, however, as few as a handful of high-quality recordings of surface wave fields are sufficient to return a reliable estimate of phase velocity within the study region. Comparison with already published results shows very good agreement for periods up to 80s.

Main advantages of the new method are its independency of choice of arbitrary parameters (like regularization in seismic tomography) and its insensitivity to the number and azimuthal distribution of earthquakes. The method is computationally cheap and theoretically simple.