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On the robust relative traveltime measurement of noise-based surface waves across asynchronous networks - application to dense arrays in Taiwan

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Ambient noise tomography (ANT), has become a well-established technique for characterizing the structures of the crust and upper mantle. In Taiwan, ANT has significantly improved the lateral resolution of the shallow crust (3-25 km) over the past decade. To further explore near-surface structures, recent efforts involve deploying cost-effective and easily installable geophone nodes and Distributed Acoustic Sensing (DAS), focusing on high-frequency surface waves in small aperture arrays. However, the computational challenges posed by traditional ANT for large-N seismic arrays persist. Additionally, the impact of noise source distribution on long-period surface waves, coupled with measurement precision limitations dictated by the long-wavelength criteria, substantially restricts the capability to investigate deep structures beneath small, dense arrays using noise-based techniques. This study presents a novel approach employing beamforming to evaluate relative travel time fields for long-period surface waves across three asynchronous dense arrays in Southern Taiwan. The resulting beamforming not only provides valuable insights into the complex nature of wave propagation in Taiwan but also addresses the computational intensity associated with traditional ANT. Leveraging the Eikonal equation, we derive phase velocity maps for multi-mode surface waves from the obtained relative travel time fields.

Keywords: ambient noise, Beamforming, Eikonal tomography