Imaging noise sources: comparing and combining a matched-field processing technique with finite-frequency noise source inversions

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Imaging the spatio-temporal variations of ambient seismic noise sources can provide important information to improve near real-time monitoring and noise tomography. Various methods have been developed to tackle this problem. For example, Matched-Field Processing (MFP) offers an efficient data-driven approach by testing different noise source locations and subsequently correlating and stacking. A more rigorous approach is treating it as a finite-frequency full-waveform inversion problem. In contrast to the MFP technique, an inversion framework allows for the incorporation of prior information and subsequent iterative updates of the noise source distribution by numerically modelling correlations and source sensitivity kernels. Bowden et al. (2020) discuss the similarities between these two methods and how one can be derived from the other.

We aim to compare and contrast the two methods using real data from a regional to a global scale to locate the secondary microseismic sources in the ocean. Igel et al. (2021, in prep) use a logarithmic energy ratio as measurement for the sensitivity kernels, which is chosen due to its robustness with respect to unknown 3D Earth structures. However, some disadvantages of this type of measurement are not considering absolute amplitudes and discarding information outside of the expected surface wave arrival time window. By combining the two methods and first using MFP to create an initial model for the inversion, we are able to steer the inversion in the right direction, allowing us to use a more elaborate full-waveform measurement in the inversion and hence increasing the resolution and quality of the final model.

Results for noise source inversions in the ocean on a daily basis using the combination of the two methods will be presented. This work paves the way for publicly available, daily, multi-scale ambient noise source maps.