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Three component microseism analysis in Australia from deconvolution enhanced beamforming

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Ocean induced microseisms in the range 2-10 seconds are generated in deep oceans and near coastal regions as body and surface waves. The generation of these waves can take place over an extended area and in a variety of geographical locations at the same time. It is therefore common to observe multiple arrivals with a variety of slowness vectors which leads to the desire to measure multiple arrivals accurately.

We present a deconvolution enhanced direction of arrival algorithm, for single and 3 component arrays, based on CLEAN. The algorithm iteratively removes sidelobe contributions in the power spectrum, therefore improves the signal-to-noise ratio of weaker sources. The power level on each component (vertical, radial and transverse) can be accurately estimated as the beamformer decomposes the power spectrum into point sources. We first apply the CLEAN aided beamformer to synthetic data to show its performance under known conditions and then evaluate real (observed) data from a range of arrays with apertures between 10 and 70 km (ASAR, WRA and NORSAR) to showcase the improvement in resolution. We further give a detailed analysis of the 3 component wavefield in Australia including source locations, power levels, phase ratios, etc. by two spiral arrays (PSAR and SQspa). For PSAR the analysis is carried out in the frequency range 0.35-1Hz. We find LQ, Lg and fundamental and higher mode Rg wave phases. Additionally, we also observe the Sn phase. This is the first time this has been achieved through beamforming on microseism noise and underlines the potential for extra seismological information that can be extracted using the new implementation of CLEAN. The fundamental mode Rg waves are dominant in power for low frequencies and show equal power levels with LQ towards higher frequencies. Generation locations between Rg and LQ are mildly correlated for low frequencies and uncorrelated for higher frequencies. Results from SQspa will discuss lower frequencies around the primary and secondary microseism peak.