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Inverse seismic interferometry: can we observe seismic data at greater depth?

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By the very nature of our planet, seismological recordings are limited to the Earth's surface with some deployments in boreholes and more recently the placement of seismometers on the sea floor. Therefore, only travelling and standing waves that are excited and oscillate at shallow depths can be observed. Seismic waves oscillating at great depth with zero amplitude near the surface, e.g. higher frequency core-mantle boundary Stoneley modes, remain practically invisible to us.

Seismic interferometry based on background noise has become a standard method for obtaining information regarding shallow and more recently also deeper Earth structure. Noise cross-correlations between a set of stations located on the surface of the Earth provide in theory information on the inter-station Green's functions, in case of an equipartitioned wave field or an isotropic source distribution. Using reciprocity, similar techniques can be employed to obtain the Green's function between two events for a distribution of receivers.

In this contribution, we propose to use the concept of inverse interferometry for observing seismic data with only deep non-zero amplitude. As an initial step, cross-correlation measurements between two deep events, recorded at stations over the globe, will be analysed. Numerical wave field simulations will enable us to investigate the sensitivity of these measurements to Earth structure. Important contributing factors are possibly the source mechanisms of the events, inter-source distance and the distribution of receivers over the surface of the Earth.