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Towards a global-scale ambient noise cross-correlation data base

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We aim to obtain a global-scale data base of ambient seismic noise correlations. This database – to be made publicly available at ORFEUS – will enable us to study the distribution of microseismic and hum sources, and to perform multi-scale full waveform inversion for crustal and mantle structure.
Ambient noise tomography has developed into a standard technique. According to theory, cross-correlations equal inter-station Green's functions only if the wave field is equipartitioned or the sources are isotropically distributed. In an attempt to circumvent these assumptions, we aim to investigate possibilities to directly model noise cross-correlations and invert for their sources using adjoint techniques. A data base containing correlations of 'gently' preprocessed noise, excluding preprocessing steps which are explicitly taken to reduce the influence of a non-isotropic source distribution like spectral whitening, is a key ingredient in this undertaking.
Raw data are acquired from IRIS/FDSN and ORFEUS. We preprocess and correlate the time series using a tool based on the Python package Obspy which is run in parallel on a cluster of the Swiss National Supercomputing Centre. Correlation is done in two ways: Besides the classical cross-correlation function, the phase cross-correlation is calculated, which is an amplitude-independent measure of waveform similarity and therefore insensitive to high-energy events. Besides linear stacks of these correlations, instantaneous phase stacks are calculated which can be applied as optional weight, enhancing coherent portions of the traces and facilitating the emergence of a meaningful signal.
The _STS1 virtual network by IRIS contains about 250 globally distributed stations, several of which have been operating for more than 20 years. It is the first data collection we will use for correlations in the hum frequency range, as the STS-1 instrument response is flat in the largest part of the period range where hum is observed, up to a period of about 300 seconds. Thus they provide us with the best-suited measurements for hum.