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Sensitivity of coda correlation wavefields to spatio-temporal variations of microseism noise sources

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Previous research suggests that continuous seismic noise records can effectively extract information about the properties of the Earth's subsurface. The coda of the correlation wavefield between station pairs shows sensitivity to crustal heterogeneity and has been described as a multiple scattering signal. These signals allow to monitor variations in dv/v to detect weak changes in the medium at depth. Oceanic regions, which are highly effective in generating microseisms, play a crucial role in the distribution of seismic energy sources. In Green's function estimates from cross correlations, highly asymmetric correlation wavefields are common due to non-homogeneous source distributions.

This study focuses on the impact of oceanic noise sources on the coda of the correlation wavefield between station pairs. We utilized ambient seismic noise interferometry to retrieve the correlation wavefields between some master stations throughout Europe and the Gräfenberg array located in Germany, in the microseism frequency range. We then applied cross-correlation beamforming to these correlation wavefields. This identifies the source direction for correlation wavefields over a three-year period, allowing us to compare variations in source direction and seasonality with results from raw data beamforming. We find dominant source directions towards the north-northwest of Gräfenberg in winter (with slowness expected for surface waves) and towards the south in summer (with slowness expected for body waves) in the raw data and throughout the coda of the correlation wavefields up to lapse times of one hour. This is in contrast to the diffuse wavefield expected from classical seismic interferometry and demonstrates that higher-order correlations, which are computed during the correlation beamforming of correlation functions, do not improve the degree of scattering in the correlation wavefield coda when persistent, isolated noise sources are present. Additionally, the findings demonstrate notable correlation between the seasonal incidence of microseisms and the very late coda of the correlation wavefields, raising questions about the current understanding of the correlation wavefield coda.