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Predicting ocean activity from seismic data using machine learning techniques

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The most pervasive seismic signal recorded on our planet – microseismic ambient noise -results from the coupling of energy between atmosphere, oceans and solid Earth. Because it carries information on ocean waves (source), the microseismic wavefield can be advantageously used to image ocean storms. Such imaging is of interest both to climate studies – by extending the record of oceanic activity back into the early instrumental seismic record – and to real-time monitoring – where real-time seismic data can potentially be used to complement the spatially dense but temporally sparse satellite meteorological data.

In our work, we develop empirical transfer functions between seismic observations and ocean activity observations. We start by following the classical approach of Bromirski et al (1999), who computed an empirical transfer function between ground-motion recorded at a coastal seismic station and significant wave height measured at a nearby ocean buoy. We explore further developments by considering other seismic data observations – such as the polarization of seismic ambient noise – and other indicators of ocean activity observations, including the spectra of ocean waves.

In addition to employing the classical approach of empirical transfer functions, we further present preliminary tests using machine learning techniques to: 1) infer which seismic and ocean activity observables are better predictors of each other, and 2) to predict ocean activity given observed ground motion.

The analysis is made using selected datasets around the North Atlantic, namely using seismic data from North America (west Atlantic), the Azores (central Atlantic) and Portugal (east Atlantic).

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References:

Bromirski, P. D., Flick, R. E., & Graham, N. (1999). Ocean wave height determined from inland seismometer data: Implications for investigating wave climate changes in the NE Pacific. *Journal of Geophysical Research: Oceans*, *104*(C9), 20753-20766.