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What will Europa sound like? Modelling the seismic response of an icy moon.

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Seismology is a powerful tool for illuminating internal structure and dynamics in planetary bodies. With a Europa lander concept being studied for the next decade, we have the opportunity to place a seismometer on the surface and greatly increase our knowledge of internal structure of an ocean world. In order to maximize the return from such an instrument, we need to understand both the predicted signals and noise. Previous studies showed that the seismic wavefield in an icy moon will be considerably different from that in the terrestrial planets studied so far.

We use the fast spectral-element solver AxiSEM to simulate the seismic wavefield on Europa between 0.005 and 1 Hz and use the results to identify wavetypes that constrain important parameters of the interior, like the ice layer thickness, ocean depth and the potentially hydrated crust under the ocean. We compare these observables with a noise model based on tidal cracking. We estimate a range of cumulative moment releases based on tidal dissipation energy, and then create an assumed Gutenberg-Richter relationship (e.g. Golombek et al., 1992). We then use this relationship to generate random realizations of event catalogs with a length of 1 day, including all events down to a moment magnitude of -1, and generate continuous 3-component seismic records from these catalogs. The seismic data are calculated using a range of thermodynamically self-consistent layered models of Europa structure, varying ice shell thickness and attenuation (e.g. Cammarano et al., 2006). The noise records are then used to define overall spectral characteristics of the noise and to test methods to take advantage of the ambient noise, such as autocorrelation techniques. The ambient noise characteristics are also compared with candidate instrument noise models which may be included in future Europa missions.

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