ABSTRACT

It is well known that Earth's surface continuously vibrates in response to natural processes such as ocean waves and anthropogenic activities such as road traffic. Study of this ambient noise is a classic topic in seismology and has been ongoing for more than a century. Because of the recent recognition that ambient seismic noise can be used to image Earth's crust and provide 4D monitoring of important geologic structures such as fault zones and volcanoes, there is renewed interest in locating and describing sources of ambient seismic noise. Characterization of ambient seismic noise also contributes to verification seismology by providing the basis for time- and direction-dependent detection thresholds. In the classic microseismic band of 4-20 s seismic noise consists mainly of fundamental mode Rayleigh and Love waves; however, at shorter periods seismic noise also contains a significant amount of body wave energy and higher-mode surface waves.

In this work we perform a global survey of Earth's short period seismic noise field with the goals of quantifying the relative contributions of these propagation modes, and geographically locating prominent sources of seismic noise. We examined a year's worth of vertical component data from 18 arrays of the International Monitoring System that were sited in a variety of geologic environments. The apertures of the arrays varied from 2-28 km, constraining the frequencies we analyzed to 4.0-0.4 Hz. Using frequency-wavenumber analysis we identified the apparent velocity for each sample of noise and so classified its mode of propagation. The dominant component was found to be Lg, occurring in about 50% of the noise windows. Since Lg does not propagate across ocean-continent boundaries this energy must be created in shallow water areas near coastlines. The next most common component was P wave energy, which accounted for about 28% of the noise windows. These were split between regional P waves (PnP at 6%), mantle bottoming P waves (14%), and core sensitive waves (PKP, 8%). This energy is mostly generated in deep water away from coastlines, with a region of the north Pacific centered at 165W 40N being especially prolific. The remainder of the energy arriving in the noise consisted of Rg waves (28%), and so in contrast to the classic microseismic band of 4-20 s, at shorter periods fundamental mode Rayleigh waves are the least significant component.