MID-OCEAN-BOTTOM AND LAND-BASED MICROSEISM CORRELATIONS

Peter D. Bromirski • Scripps Institution of Oceanography, UCSD
Fred K. Duennebier • University of Hawaii, Honolulu
Ralph A. Stephen • Woods Hole Oceanographic Institution

Inversion of the double-frequency (DF) microseism band for ocean wave heights from archived seismic data can provide an important diagnostic of climate change (Bromirski et al., 1999; Bromirski et al., 2005a). The usefulness of such inversions requires knowledge of the source areas and propagation attributes of microseisms. The Hawaii-2 Observatory (H2O) is an excellent site for studying microseism characteristics since it is located far from shorelines and shallow water. The DF microseism band can be divided into short period and long period bands, SPDF and LPDF, respectively. A strong correlation of seismic amplitude with wind speed and direction is observed at H2O in the SPDF band from about 0.20 to 0.45 Hz (Bromirski et al., 2005b), implying that the energy reaching the ocean floor is generated locally by ocean gravity waves. Near-shore land seismic stations see similar SPDF spectra, also generated locally by wind seas. Correlation of swell height above H2O with the LPDF band from 0.085 to 0.20 Hz is often poor, implying that a significant portion of this energy originates at distant locations. The LPDF microseism signals recorded at the H2O correlate with signals at other seismic stations around the North Pacific, clearly shown by comparing difference spectrograms (Figure 1). Comparison of relative amplitudes gives an indication of the source region, e.g. higher relative amplitudes at COLA and LLLB compared with JCC, H2O, and KIP implies a Pacific Northwest coastal source region. The times of low relative microseism energy correlate across the stations, indicating that there is little energy being coupled into LPDF microseisms anywhere in the North Pacific during these times. Most of the LPDF energy at H2O appears to be generated by high amplitude storm waves impacting long stretches of coastline nearly simultaneously, and the Hawaiian Islands appear to be a significant source of LPDF energy in the North Pacific when waves arrive from particular directions. The highest DF levels observed at mid-ocean site H2O occur in the SPDF band when two coincident nearby storm systems develop. This extreme event at H2O is not observed at continental sites, indicating high attenuation of these signals. At near-coastal seismic land stations, both SPDF and LPDF microseism levels are generally dominated by local generation at nearby shorelines (Bromirski and Duennebier, 2002). High relative SPDF levels are generally not observed concurrently at JCC and H2O (Figure 1), indicating that DF microseisms generated near H2O do not propagate well, consistent with low effective Q, and also indicating that open-ocean generated DF microseisms will not significantly affect the statistics of ocean wave parameters determined from inversion of land microseismic spectra.