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Ambient noise field and temporal changes on ambient noise auto/cross-correlogram at the sea bottom inferred from ocean-bottom seismic and pressure arrays

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The interactions of wind with the ocean surface, ocean wave with acoustic wave, acoustic wave with seismic wave below the sea bottom, and the interplay among them drive important energy flows from the atmosphere to the lithosphere. Uncertainty remains regarding the origin of wind-related noise in the ocean and its coupling to seismic noise below the sea floor. Seismic interferometry is a powerful tool that uses microseisms, or ambient noise within solid earth, to monitor temporal seismic velocity change by referring to the auto/cross-correlation as a Green's function at the sites, and its temporal change. The most important assumption when detecting seismic velocity changes with seismic interferometry is that mutually uncorrelated noise sources are distributed randomly in space and time without any temporal changes in their density and intensity in a fully diffuse wave field. An effect of temporal variation on the ambient noise field to the retrieval of Green's function is, however, not fully understood, nor is how reliable temporal changes in interferogram noise are, especially when accompanied by large earthquakes and slow slip events. Here, we show relationships among the temporal changes of sea surface wave, acoustic wave, and seismic wave fields, which are observed in ocean bottom pressure gauges and seismometer arrays installed in New Zealand. The temporal variation in the power spectrum obtained from continuous ocean bottom seismometer and pressure records near 200 mHz correlates with the temporal variation in wind speed above the sites, particularly during wind turbulence of more than 5 m/s. The temporal fluctuation in the ocean bottom pressure caused by the ocean surface wave field correlates to that of a microseism near 200 mHz. The temporal variations in the power spectrum from both continuous ocean bottom pressures and microseisms in the 200–800 mHz range show a positive correlation. After calculating the auto/cross-correlation functions (ACF/CCF) from ambient noise in a 200–800 mHz pass band every 6 h, the temporal variation in the correlation between the ACF/CCFs is investigated every 6 h. The temporal variation in the ACF/CCFs correlates with the time derivative of the temporal changes in the power spectrum amplitude of both the bottom pressure and the microseism rather than the temporal changes in the amplitude of the power spectrum. This suggests that the temporal change that occurs in the seismic interferogram owing to ambient noise, is mostly controlled by the temporal

change in the ocean wave field undergoing fluctuations by the atmospheric turbulence over the sea surface. The temporal variations in the noise field in space and time may break the assumption on seismic interferometry, and eventually make the apparent temporal change in interferogram noise.