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Body waves from noise correlations: spurious arrivals from the north Pacific Ocean

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Noise correlations are now routinely used for surface wave tomography of the crust and uppermost mantle, while the use of body waves for imaging the deep Earth remains scarce. One of the difficulties is that the conditions of diffuse wave field and/or well distributed sources are only partly met, leading to spurious arrivals and/or anomalous wave amplitudes. We use data from the HI-CLIMB temporary broadband seismic experiment, and study noise correlations between stations of the southern leg of the profile, where the interstation distance is of approximately 5km. In the low frequency range (<10s period), the correlations (ZZ component) are dominated by Rayleigh waves. In the second microseismic peak (∼7s period), the correlations are dominated by a wave with high apparent velocity. The energy on the horizontal components of this wave is small as compared to the vertical component. Small oscillations in the array geometry makes it possible to carry out beamforming; the result of this beamforming indicates that the observed dominant wave corresponds to a P-wave from a source area in the northernmost part of the Pacific Ocean. This noise source is so strong that it appears in most hourly correlations during the (northern hemisphere) winter months. In (northern hemisphere) summer months, body waves still dominate, but are composed of equal contributions from the identified source locations and another location, somewhere south of the array. This situation means that the station cross correlations in the second microseismic peak are not, as would be normally be expected, dominated by waves propagating between the receivers, but rather by wavetrains from specific source regions. The cross correlations are therefore equivalent to time shifted auto-correlations, and deep reflectors are difficult to identify as such correlations also contain cross terms of many different waves.