Towards Understanding the Effects of Atmospheric Pressure Variations on Long-Period Horizontal Seismic Data: A Case Study

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Incoherent noise generated by seismometer tilt caused by atmospheric pressure variations often limits seismological studies utilizing long-period (>10 s period), horizontal-component seismic records. Several case studies have suggested methodologies for correcting these unwanted signals using collocated pressure records. However, it is unclear if these corrections are applicable to a variety of different geologic settings and installation types (e.g., vault vs. posthole). To better understand how long-period, pressure-induced noise changes with time and emplacement, we examine the coherence of signals recorded on collocated seismometers and barometers at five different Global Seismographic Network (GSN) stations. We also examine three Streckeisen STS-2 broadband seismometers collocated with a barometer at the Albuquerque Seismological Laboratory (ASL).

We calculate the mean magnitude-squared coherence between seismic and pressure signals from collocated sensors to determine the relationship between them as a function of both frequency and time. In addition to these two varying parameters, coherence levels vary greatly even on collocated seismic instruments. This suggests that tilt-generated signals are highly sensitive to very local (<10 m) site effects, making it difficult to apply pressure corrections to horizontal component seismic data unless the effects of the pressure changes are greater than those from the local site. Additionally, the frequency dependence of the coherence suggests that some corrections may only be applicable over a limited range of frequencies. Using this information, we hope to be able to identify locations that are highly susceptible to pressure-induced horizontal noise, identify locations in a vault where tilt effects can be mitigated, and understand the optimal frequency bands for applying pressure corrections.

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