Supporting Information for "Early tsunami detection with near-fault ocean-bottom pressure gauge records based on the comparison with seismic data"

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Introduction

In Section 3 of the main text, we introduced a new f'-value that is analogous to the f-value of Wu and Wu (2007) for the correction of acceleration records. The difference between them is the introduction of Δd or the correction term of the static coseismic displacement. This term is available with the ocean-bottom pressure record at the same site, for which many recent ocean-bottom networks have been designed such as DONET stations. The basic idea of this improvement is similar to the combination of a strong-

motion seismogram and a high-rate GPS record at a common site on land, as having been investigated by Bock, Melgar, and Crowell (2011). Figure S1 compares the displacement waveforms corrected by the use of f'-value and f-value.

Figure 3(b) in the main text shows magnitude squared coherences (MSC) between OBP and sea-bottom acceleration records at stations B08, E17, and E18. The MSC is a function of the amplitude of cross-spectral density, so that it represents the agreement of two signals at each frequency. From the cross-spectral density, we can also estimate the phase lag of two signals at each frequency. If the two signals match each other, the MSC becomes close to 1 and the phase lag to 0 (e.g., Nosov et al., 2018). Figure S2 shows the MSCs and phase lags at B08, E17, and E18 (1) between OBP and sea-bottom acceleration and (2) between OBP and sea-bottom velocity.

References

Bock, Y., Melgar, D., & Crowell, B. W. (2011). Real-Time Strong-Motion Broadband Displacements from Collocated GPS and AccelerometersReal-Time Strong-Motion Broadband Displacements from Collocated GPS and Accelerometers. *Bull. Seismol. Soc. Am.*, *101*(6), 2904–2925. doi: 10.1785/0120110007

Nosov, M., Karpov, V., Kolesov, S., Sementsov, K., Matsumoto, H., & Kaneda, Y. (2018). Relationship between pressure variations at the ocean bottom and the acceleration of its motion during a submarine earthquake. *Earth Planets Space*, *70*(1). doi: 10.1186/s40623-018-0874-9

Wu, Y. M., & Wu, C. F. (2007). Approximate recovery of coseismic deformation from Taiwan strong-motion records. *J. Seismol.*, *11*(2), 159–170. doi: 10.1007/s10950-006-9043-x

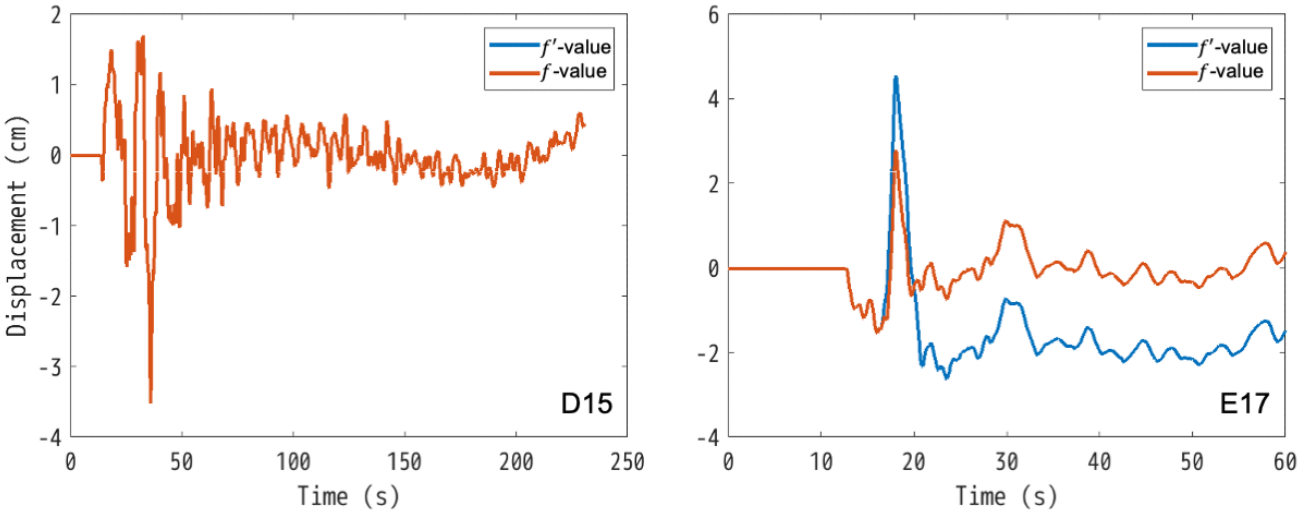

Figure S1. Comparison of the corrected displacement waveforms at stations D15 and E17 between f'-value (blue) and f-value (orange). The residual or static displacements obtained by OBP records for f'-value were 0.2 cm and -1.8 cm at D15 and E17, respectively. The residual displacement can be reproduced by f'-value better than the one with f-value at E17. Because the residual displacement at D15 was negligible, the waveforms with f- and f'-value are nearly identical to each other.

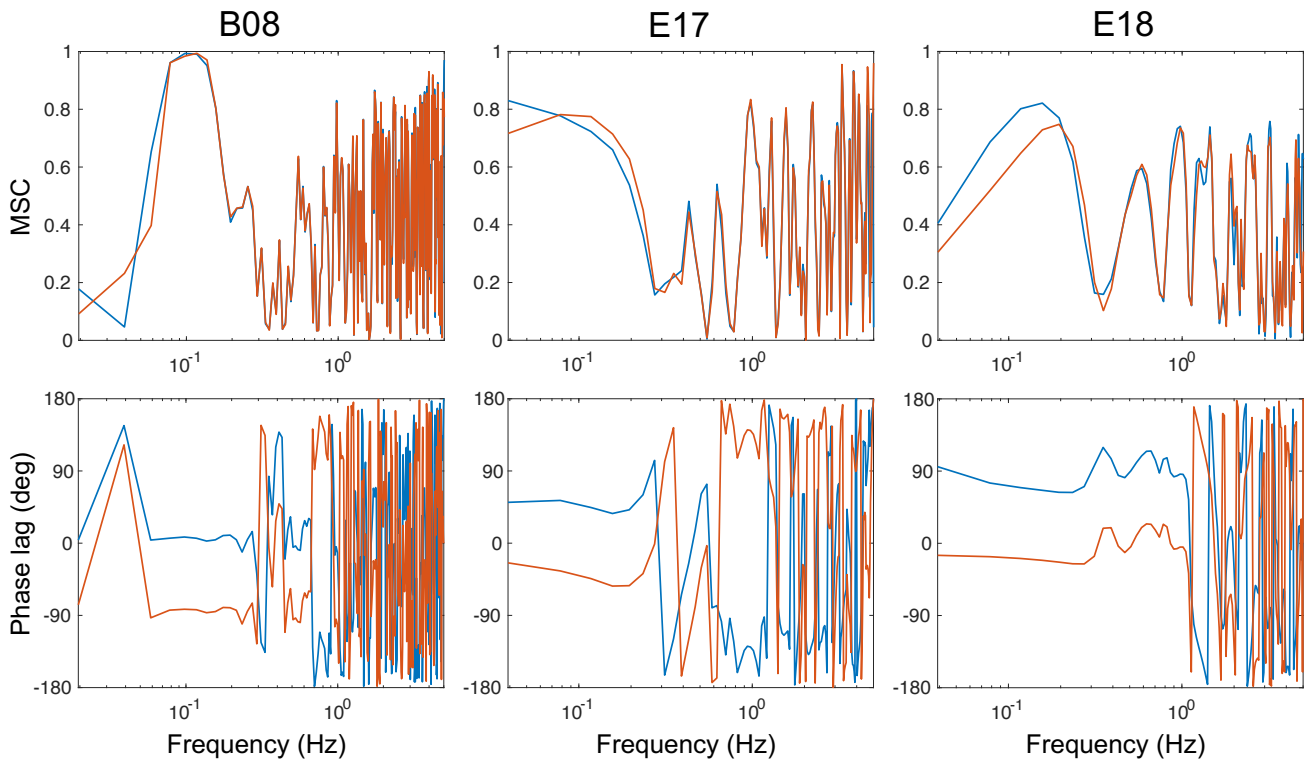

Figure S2. MSCs (top) and phase lags (bottom) at B08 (left), E17 (center), and E18 (right). Blue and orange lines represent the results estimated from the pair of acceleration and OBP and that of velocity and OBP, respectively. Note that the frequency range is the same as Figure 3(a) not 3(b). The MSCs of both acceleration and velocity at B08 are larger than 0.8 at around 0.1 Hz. On the other hand, the phase lag of acceleration is almost 0° at around 0.1 Hz while the one of velocity is about 90°. This result implies that OBP gauges record sea-bottom accelerations at mainly around 0.1 Hz. This relationship does not seem to be maintained at E17 and E18 due to their strong-ground motions in horizontal components (Section 4.2).