Magnitude estimation for Earthquake Early Warning applicable for various seismic networks including OBS

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In JMA EEW system, since source parameters (hypocenter and magnitude) are determined quickly by using real-time data from several stations near the source region, stable observation record near the source area is important for EEW. In recent years, large-scale ocean bottom seismic networks, such as S-net (NIED), DONET1 and DONET2 (JAMSTEC) are currently under construction to make use for real-time monitoring, and it is expected that those OBS systems contribute to rapid EEW issuance. However, several problems were revealed for utilizing OBS data to EEW. One of these problems is acceleration offset caused by slight inclination change of OBS and/or hysteresis of sensors. From the analysis of Off-Kushiro OBS (JAMSTEC) data, it was found that the acceleration offset caused by OBS inclination increases with increasing input acceleration (PGA) when OBS exposed strong shaking (over 100cm/s^2) (Hayashimoto et al, 2015, JpGU). Acceleration offsets from inclination or hysteresis of OBS were also found at DONET1.
Magnitude of JMA EEW is mainly determined from the maximum amplitude of 3-component vector summation of displacement waveform. Here displacement waveforms are obtained from acceleration waveforms using the recursive filter by which waveforms are integrated twice and high-pass filtered at 6s. When acceleration offset appears within an acceleration waveform, EEW Magnitude might be overestimated because acceleration offsets lead to the displacement waveforms with large displacement offsets.
In this presentation, we focus on the characteristics of inclination change of OBS. It is found that the acceleration offsets are larger on the horizontal component (perpendicular to the cable line) than the vertical component and the other horizontal component (along the cable line). We proposed new magnitude estimation for EEW by using the maximum amplitude of vertical component displacement waveform. We found that overestimation of magnitude due to the inclination of OBS is able to reduce by using vertical component. Furthermore, it is found that variance of magnitude estimated at each stations becomes small by using vertical component. These improvements can be confirmed not only OBS network but also land stations. By using vertical displacement waveform, we would be able to reduce the effect of difference of site amplification factor and to estimate more stable magnitude.
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