Significantly large rotation and tilt motion of cabled seismic stations off Sanriku, northeastern Japan

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Deployments of cabled stations in ocean-bottom areas enhance the effectiveness of earthquake early warnings for suboceanic earthquakes in terms of early signal detections and improvements of accuracy for hypocenter analyses. We investigated strong-motion data for rapid magnitude estimations at cabled ocean-bottom stations deployed in the source area of the 2011 Tohoku earthquake (M9.0) in the northeastern Japan. We found DC offsets in accelerations due to movements of the cabled stations during strong motions. Our waveform analyses on the offset data showed that the stations are rotated and tilted in proportion to input motions. The analysis results also showed that the orientation angle around the cable direction is more affected by the motion at earthquakes than the angle along the direction, because of the cylindrical shaped station housing in the long cable. At the 2011 Tohoku earthquake (Mw 9.0), the cabled sensor is rotated up to 57.7˚ around the cable direction and tilted 1.4˚ along the cable. If we apply double integrations for such data, the large rotation causes anomalous displacement waveforms with significantly large amplitudes in the two components perpendicular to the cable direction, which would contribute to the overestimation of displacement magnitudes.
In this presentation, we show schemes of magnitude estimations that can suppress the anomalous amplifications by using the single component data along the cable or by squared root of sum of squares of three components at ocean-bottom stations. We compare the estimated magnitudes with those listed in a hypocenter catalog which is estimated by using land station data.

Keywords: Earthquake Early Warning, ocean-bottom seismic observation, seismic amplification, acceleration offset

