Tsunami forecast for the 2003 Tokachi-oki earthquake (M8.0) using the cabled ocean bottom tsunami-meters

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We applied the tsunami forecast method based on the offshore tsunami observation [Tsushima et al., S142-006, 2007] to the tsunami caused by the 2003 Tokachi-oki earthquake (M8.0) to evaluate how our method works in the case of real tsunami event. In the tsunami forecast method, we inverted tsunami waveforms recorded by cabled offshore ocean bottom tsunami-meters (OBTMs) for the coseismic vertical displacement distribution of the sea-floor. Using the estimated tsunami source, we calculate tsunami waveforms along coastal region to forecast arrival times and amplitudes.

In this study, we estimated the sea-floor deformation using the tsunami waveform records at two OBTM stations deployed in the off-Sanriku area, about 300 km away from the source region of the 2003 earthquake. When we use the waveforms of 50 min length from the origin time of the earthquake, the inverted seafloor uplift distribution shows the good agreement with that calculated from the fault model obtained by a modeling of on- and offshore tsunami waveform records [Tanioka et al., 2004]. By using the inverted sea-floor uplift distribution, tsunami waveforms are synthesized for the coastal tide stations along the Pacific coast of the Hokkaido and Honshu Islands, to be compared with the observed waveform records obtained at these stations. Owing to the reliable estimation of the tsunami source parameters, the forecasted arrival times and the first peak amplitudes of the tsunami match well to those at most of the coastal tide stations in the Honshu Island and at several tide stations in the Hokkaido Island. Since the inversion and waveform synthesis can be finished immediately after the acquisition of the offshore tsunami data, we could obtain these accurate forecasting about 51 minutes after the occurrence of the 2003 Tokachi-oki earthquake, if our procedure had been put into use at that time.

The results of the forecasting can be obtained before the arrival of the first peak of the tsunami at most of the tide stations in the Honshu Island. However, the first peak of the tsunami arrives most of the tide stations in the Hokkaido Island before the tsunami forecasting is completed. For example, the tide station Tokachi, about 30 km away from the tsunami source area, recorded the first peak of the tsunami wave with half amplitude of 2.6 m 34 minutes after the earthquake occurrence, 17 minutes earlier than we obtained the forecasting results. To overcome this situation, we need to carry out the tsunami source inversion using only the beginning part of the OBTM records or using the tsunami records of other OBTMs closer to the source region of the earthquake.

In this study, we used tsunami waveform data obtained by the offshore cabled ocean bottom tsunami observation systems operated by the University of Tokyo and Japan Agency for Marine-Earth Science and Technology. We also used tsunami waveform data at coastal tide stations which are provided by Japan Meteorological Agency and Port and Airport Research Institute.