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Possibilities of measuring great tsunamis using GNSS-based ship height positioning

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Offshore measurements of tsunamis are very useful for robust tsunami forecast and its source estimation. The measurements using ocean bottom pressure gauges and GPS buoys with good sensitivities have been established and installed in open oceans. Associated methods based on the on-line offshore data retrievals have been proposed and operated for real-time tsunami source estimation and forecast (e.g., Tang et al. 2012 JGR Oceans; Tsushima et al. 2012 JGR Solid Earth). In terms of extending the skills of the forecast and source estimation, it is useful to exploit further possibilities using other offshore measurements. In the present study we examined an offshore ship-borne GPS height record to evaluate noise level at frequency of the great tsunamis (10^{-2}-10^{-1} cpm). The kinematic PPP (Precise Point Positioning) solution was expected to show possible detection of large amplitudes ($>10^{-1}$ m) of offshore tsunami at the frequency. Such large-amplitude tsunamis seem to be hardly found in low-precision positioning solutions (DGPS (Differential GPS) and single point positioning) because of inherent background noise levels one order of magnitude larger than that in the PPP solution. The low-precision positioning GNSS equipments are, on the other hand, inexpensive and will be widely used as the AIS (Automatic Identification System) by a lot of ships including a larger number of small fishing vessels. The height information is not included in the current AIS data, but may be utilized in future. We are evaluating possibility of large tsunami detection by the low-precision GNSS height time-space series based on spatially-dense distribution from many ships.

Keywords: tsunami, GNSS, ship, height