

Tsunami Data Assimilation with Sparse Observation: A Study on Tsunami in the Bay of Bengal

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Tsunami data assimilation has been proposed for tsunami forecast. It estimates the tsunami waveforms by assimilating offshore observed data into a numerical simulation, without the need of calculating initial sea surface height at the source (Maeda et al., 2015). The Optimum Interpolation method is adopted in data assimilation. It has been successfully applied to Seafloor observation network for earthquakes and tsunamis along the Japan Trench (Maeda et al., 2015), and the Cascadia Initiative in North America (Gusman et al., 2016). However, this approach depends on dense observation network. Whereas this is not available in some regions under the threat of tsunamis.

Here, we propose a modified approach of tsunami data assimilation, which can be applied to regions with relatively sparse tsunami observations. The method consists of a two-step interpolation. The first step is a linear interpolation. We set the points of virtual stations between two existing observation stations. Then, the arrival time and the tsunami height of virtual waveforms are linearly interpolated from the real waveforms of two observations. The second step is the Optimum Interpolation during the data assimilation process. We employ the method to both the real observations and virtual stations, in order to construct a complete wavefront of tsunami propagation.

We apply our approach to a hypothetical earthquake off the west coast of Sumatra Island similar to the 2004 Sumatra-Andaman Earthquake. In the Bay of Bengal, currently there are only 6 (5 maintained by India, 1 by Thailand) observations available. Based on our approach, we add virtual stations to build a dense hypothetical network, and forecast the tsunami in India, Sri Lanka, the Maldives by data assimilation. The result shows that the method is able to provide a reliable tsunami forecasting for these countries, and the tsunami early warning can be issued within half an hour before the tsunami arrival to reduce the damage along the coast.