Real-Time GPS Detection of Tsunamis and Requirements

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ABSTRACT

Continuous GPS stations can be used to measure ground motions in real time as often as once every data epoch (typically set in the range of 1-30 seconds). Recent studies [e.g., Blewitt et al., 2006; Song, 2007], though preliminary, have demonstrated that coastal GPS stations could be used to detect tsunami genesis and scales before the waves reach coastal areas. In this study, we have used a coupled three-dimensional earthquake-tsunami model to determine the requirements of such a coastal GPS network for tsunami early warnings. Our approach focuses on directly detecting the seafloor motions that trigger tsunamis and estimating tsunami scales from GPS displacement data. So far, three historical tsunamis caused by the 2004 Sumatra earthquake, the 2005 Nias earthquake, and the 1964 Alaska earthquake, respectively, have been studied and modeled permanent ground displacements were used to infer a "tsunami magnitude". The results were compared with tsunami magnitudes inferred using the conventional seismic solutions, which usually take hours or days to get through inverting seismographs. We have also demonstrated the potential for ultra-rapid IGS orbits to be used for real-time positioning for tsunami warning. Demonstrating the potential of coastal GPS networks for successful determination of tsunami magnitude is a critical step toward a new NASA project for nature hazard mitigation.