Analyses of Tsunami Events using Simple Propagation Models

ASHWITH KUMAR CHILVERY, ARJUN TAN, MOHAN AGGARWAL, Alabama
A&M University — Tsunamis exhibit the characteristics of "canal waves" or "gravity waves" which belong to the class of "long ocean waves on shallow water." The memorable tsunami events including the 2004 Indian Ocean tsunami and the 2011 Pacific Ocean tsunami off the coast of Japan are analyzed by constructing simple tsunami propagation models including the following: (1) One-dimensional propagation model; (2) Two-dimensional propagation model on flat surface; (3) Two-dimensional propagation model on spherical surface; and (4) A finite line-source model on two-dimensional surface. It is shown that Model 1 explains the basic features of the tsunami including the propagation speed, depth of the ocean, dispersionless propagation and bending of tsunamis around obstacles. Models 2 and 3 explain the observed amplitude variations for long-distance tsunami propagation across the Pacific Ocean, including the effect of the equatorial ocean current on the arrival times. Model 3 further explains the enhancement effect on the amplitude due to the curvature of the Earth past the equatorial distance. Finally, Model 4 explains the devastating effect of superposition of tsunamis from two subduction event, which struck the Phuket region during the 2004 Indian Ocean tsunami.

Ashwith Kumar Chilvery
Alabama A&M University

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