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Linear and Nonlinear Computations of the 1992 Nicaragua Earthquake Tsunami

KENJI SATAKE[1]

Abstract—Numerical computations of tsunamis are made for the 1992 Nicaragua earthquake using different governing equations, bottom frictional values and bathymetry data. The results are compared with each other as well as with the observations, both tide gauge records and runup heights. Comparison of the observed and computed tsunami waveforms indicates that the use of detailed bathymetry data with a small grid size is more effective than to include nonlinear terms in tsunami computation. Linear computation overestimates the amplitude for the later phase than the first arrival, particularly when the amplitude becomes large. The computed amplitudes along the coast from nonlinear computation are much smaller than the observed tsunami runup heights; the average ratio, or the amplification factor, is estimated to be 3 in the present case when the grid size of 1 minute is used. The factor however may depend on the grid size for the computation.

Key words: Tsunami, numerical computation, finite-difference method, Nicaragua earthquake.

1. Introduction

Numerical computation has become a powerful and popular tool to study tsunamis. In this topical issue, a number of papers are found on modeling recent tsunamis for various purposes such as to reproduce the observed tsunamis, to estimate unobserved offshore tsunami heights or the effects on coastal structures, or to study earthquake source processes. SHUTO (1991), in a review of tsunami numerical computations, mentioned that numerical computations can predict runup heights with errors smaller than 15%. Tsunami runup heights of the recent tsunamis such as the 1992 Nicaragua tsunami, however, seem to be much larger than those predicted using numerical computations from seismological fault models.

In this paper, I describe a numerical computation method of tsunamis with the 1992 Nicaragua earthquake tsunami as an example. I discuss various factors that affect the computations: the governing equations, linear and nonlinear shallow water equations; bottom frictional values; bathymetric data and the grid size. The

[1] Department of Geological Sciences, University of Michigan, Ann Arbor, MI 48109-1063, U.S.A.