Preface

This review volume grew out of THE THIRD INTERNATIONAL WORKSHOP ON LONG-WAVE RUNUP MODELS that took place June 11–12, 2004 at the Wrigley Marine Science Center of the University of Southern California on Catalina Island, California. This workshop and the two previous workshops were sponsored by the Geo-Hazard program of the National Science Foundation of the United States. Dr. Clifford J. Astill was the director of the program.

The first long-wave runup workshop was also held in the Wrigley Marine Science Center, on August 15–17, 1990. Tsunami runup/inundation and the hazard mitigation were the main topics discussed in the first workshop, which brought together researchers from Japan, Russia, England, and the United States. The proceedings of the workshop were reported by Liu, et al. (1991). The workshop revitalized research efforts on long-wave runup, spawning several major research programs on long-wave runup in the United States as well as overseas. The workshop has also facilitated further international research collaborations.

From 1992 to 1994 several major tsunamis occurred, including the Nicaraguan tsunami in 1992; the Flores Island (Indonesia) tsunami in 1992; the Okushiri (Japan) tsunami in 1993. All three tsunamis caused devastating property damages and many deaths. Moreover, in 1994 alone four additional tsunamis, including the East Java (Indonesia), the Shikotan Island (Russia/Japan), the Mindoro (Philippines), and the Skagway (Alaska, USA) tsunamis, occurred around the world. The runup heights along affected coastlines were surveyed and documented by various research teams. Different research groups have performed numerical simulations of all these events with different numerical models. The community felt the strong need to gather researchers together to discuss similarities and dissimilarities among these models and to discuss the issues in modeling coastal effects of tsunami.

Consequently, the Second International Workshop on Long-Wave Runup Models was held at Friday Harbor, San Juan Island, Washington, on September 12–16, 1995. The participants in the workshop were from Japan, Russia, England, Brazil, Australia, Canada, Indonesia, and the United

States. The format of the second workshop was designed to focus more on discussions than on formal presentations. Four benchmark problems were selected before the workshop so that numerical models can be compared, evaluated and discussed among the participants. During the workshop, seven discussion themes were organized as follows: laboratory, analytical, finite-difference, finite-element, vertical-plane models, boundary-integral-element models, and marker-and-cell models. The presentations and discussions were edited and published in a book entitled "Long-Wave Runup Models" (Yeh, et al. 1996).

There was no doubt that the benchmark-problem exercises used in the second workshop proved extremely useful in identifying absolute and comparative modeling capabilities. Overall, in terms of tsunami runup modeling, significant advances had been made between two workshops, due mainly to the advancement of computational capabilities, and because of the generation of a large 2-D and 3-D laboratory data set and the fortuitous field measurements in 1992–1995, all of which have contributed to model calibrations. The tsunami modeling efforts had become more directed towards their implementation for real tsunami predictions and hind-castings than ever before. At the time of the 1990 Catalina workshop, large differences between computed runup results and field measurements might have been attributed to both errors in the seismic estimates of the source motion and to the hydrodynamic calculations. Much advances had been made by the 1995 Friday Harbor workshop; researchers became much more confident in the hydrodynamic calculations, at least for non-breaking waves. It was equally clear that reduction and even elimination of numerical dispersion and numerical dissipation effects would — if not already — soon become reality. At the same time, the workshop participants recognized additional and important problems arising from modeling improvements, such as determination of highly accurate initial wave conditions, modeling the three-dimensional flow effects, and turbulence. Actual tsunami runup motions are turbulent; the runup flow patterns, impacts, scouring effects, and sediment transport are all affected by turbulence in the runup motions.

From 1995 to the summer of 2004, there have been at least six additional large tsunamis resulting in catastrophic loss of life and property. They are the Irian Jaya tsunami (Indonesia) in 1996, the Peru tsunamis in 1996 and in 2001, the Papua New Guinea tsunami in 1998, the Turkey tsunami in 2000, and the Stromboli (Italy) tsunami in 2002. Among these six tsunamis, the Turkey tsunami was definitely caused by land subsidence and slides associated with earthquakes, and the Stromboli tsunami was caused by landslides caused by volcanic eruption. On the other hand, the source of the Papua New Guinea tsunami, which killed more than 2000 people and destroyed completely three villages, remains controversial and has been postulated as due either to co-seismic seafloor dislocation or sediment slump. Because of the occurrence of these tsunamis, research interest and efforts on the modeling of landslide generated tsunamis have been intensified in recent years. The landslide-generated tsunamis have very different characteristics from the tsunamis generated by earthquakes. The traditional depth-integrated shallow water equations are not always adequate for modeling the landslide generated tsunamis. Other noteworthy advances in recent years are the development of several computational fluid dynamics models calculating the nearshore waves and their interactions with structures with the consideration of frequency dispersion and turbulence.

The primary objectives of the third workshop were to provide a platform for discussing both old and new numerical models and their applications to various critical issues concerning tsunami runup and wave-structure interactions. To accomplish this goal, four benchmark problems were selected and posted on the workshop website before the workshop. http://www.cee.cornell.edu/longwave/. The workshop participants were given the solutions, in the form of laboratory data or analytical solutions, a week before the workshop. The workshop participants discussed their numerical model and the comparisons between their numerical results and solutions for the benchmark problems. Their presentations are also posted on the workshop website. The four benchmark problems are as follows:

1. Calculations of the moving shoreline.
2. Tsunami runup onto a complex three-dimensional topography.
3. Landslide generated tsunami.
4. Tsunami forces on a nearshore structure.

This review volume is divided into two parts. The first part includes five review papers on various numerical models. Pedersen provided a brief but thorough review on the theoretical background for depth-integrated wave equations, which are employed to simulate tsunami runup. LeVeque and George describe high-resolution finite volume methods for solving the nonlinear shallow water equations. They have focused their discussion on the applications of these methods to tsunami runup. In recent years, several advanced 3D numerical models have been introduced to the field of Coastal Engineering to calculate breaking waves and wave-structure interactions. These models are still being developed and are at different stage of maturity. Roger and Dalrymple discussed the Smooth Particles Hydrodynamics (SPH) method, which is a meshless method. Wu and Liu presented their Large Eddy Simulation (LES) model for simulating the landslide generated waves. Frandsen introduced the Lattice Boltzmann method with the consideration of a free surface.

The second part of the review volume contains the descriptions of the benchmark problems and twelve extended abstracts submitted by the workshop participants. All these papers compared their numerical results with benchmark solutions.

Professor Synolakis and his staff of the University of Southern California were responsible for the local arrangements. Their efforts are deeply appreciated. The workshop was sponsored by the US National Foundation.

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References

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