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Tsunami Generation and Propagation

Springer

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Preface

In the study of tsunamis, researchers have traditionally analyzed tide-gauge records and surveyed inundation areas. In addition to these coastal observations, sea-bottom pressure gauges are now widely deployed in deep oceans. Offshore observations can detect tsunamis promptly near the source, and short-wavelength tsunamis can be clearly observed using these records. After the 2011 Tohoku-Oki earthquake, observations were carried out at array stations inside the earthquake focal area in order to detect tsunamis more rapidly. At the stations inside the focal area, tsunami signals are recorded simultaneously with seismic waves.

The tsunami data have changed dramatically as the methods of observation have changed. A theory should also be developed for the effective use of the new records. We can use dispersive theory to analyze offshore records. Seismic-wave theory would be helpful for analyzing the tsunami records inside the focal area. At the forefront of tsunami research, new application studies and numerical methods are advancing greatly, as reported in journals. However, description of fundamental theories and the derivation of basic equations are often skipped in the reports, but deriving the equations is not always straightforward. Textbooks may be a more suitable venue for explaining the fundamental theories.

When I started doing tsunami research, it was difficult for me to find books that explain in detail how to derive fundamental equations and how to apply numerical methods from tsunami generation to propagation, although there are many excellent textbooks about fluid dynamics and tsunamis at present. This book focuses on the quantitative modeling of earthquake tsunamis using real data and mathematical representations. Considering that seismic waves cannot be neglected in tsunami observations, we treat both fluid dynamics and elastic dynamics. I tried to reasonably organize the seismology and tsunami research to construct a theoretical framework for tsunami generation due to earthquakes.

I could not have completed this book without the help and encouraging words of my supervisors and colleagues. Kenji Satake carefully reviewed the draft and gave important comments. I thank Takashi Furumura, Yuichiro Tanioka, Takuto Maeda, Hiroyuki Kumagai, and Eiichi Fukuyama. Their comments and suggestions are very

important in the study of earthquakes and tsunamis. Kentaro Emoto and Tatsuya Kubota helped me very much with their comments about seismic waves and tsunamis. Daisuke Inazu, Toshitaka Baba, Hiroaki Tsushima, Ryota Hino, Takayuki Miyoshi, Satbyul Kim, Shunsuke Takemura, and Nelson Pulido worked with me on tsunami, for which I am very grateful. I express my deepest gratitude to Haruo Sato. His enthusiasm for his research and teaching helped make geophysics enjoyable for me. I thank all those who held discussions with me and provided valuable comments on the research.

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