Surv Geophys (2006) 27:601–602
DOI 10.1007/s10712-006-9014-3

PREFACE

Preface

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Published online: 12 October 2006

At approximately 07:58:53 local time on December 26, 2004, one of the three largest earthquakes since the beginning of global monitoring in the 1890s hit the West coast of Sumatra, Indonesia. Lasting several minutes, this magnitude 9.3 earthquake (moment magnitude scale, Mw) caused a rupture that traveled from south to north along the India–Burma interface with an average slip of ~5 m along the 1200-km-long fault line. Triggered by this event, largely known by the scientific community as the Sumatra–Andaman earthquake, a series of devastating tsunamis followed shortly after that ravaged the shores of the Indian Ocean and eventually left 230,000 dead or missing, and millions homeless in Indonesia, Sri Lanka, India, Thailand and other neighboring countries. The magnitude and scope of this earthquake and its tragic aftermath are unparalleled by any earthquake in the past three decades. Over the ensuing months, waves of aftershocks, including a large Mw 8.5 event on March 5, 2005, continued to reverberate within the various segments along the Sunda trench.

The catastrophic effects of the 2004 Sumatra–Andaman earthquake and the subsequent tsunami were well recorded by global and regional seismic, altimetric, hydroacoustic and tide gauge networks. The availability of these various databases has facilitated ground-breaking research on, for example, earthquake source characteristics, rupture dynamics, short- and long-term gravitational effects, as well as on tsunamigenic observations and modeling. The main objective of this Special Issue is to examine the various important constraints, with a key emphasis on observations and methodologies that could contribute to our future preparedness for and understanding of natural disasters such as the 2004 Sumatra–Andaman earthquake and tsunami. Below is a brief introduction to the five overview papers included in this Special Issue:

- Menke et al. carefully review the tectonic setting, seismic slip, rupture process and, in view of the exceedingly high moment release of the 2004 Sumatra–

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Andaman earthquake, the validity of the various earthquake-magnitude measures. The study primarily focuses on recent results obtained from recordings from global and regional seismic networks.

- Besides generating seismic waves that eventually dissipate, an earthquake also generates a static displacement field everywhere within the Earth. Exceedingly large earthquakes such as the 2004 Sumatra–Andaman earthquake could potentially rearrange the Earth's mass, thereby causing the Earth's rotation and gravitational field to change. The second paper of this issue (Gross and Chao) furthers an earlier study by Chao and Gross (EOS, issue 86, 2005), and carefully compares model-predicted changes to the Earth's rotation and gravitational field caused by the 2004 Sumatra–Andaman earthquake with the present day observations.
- In recent years, the use of tertiary (T) waves from hydroacoustic observations has shown a great potential for earthquake detection and location. In this issue, Tolstoy and Bohnenstiehl analyze data from the International Monitoring System (IMS) of the Comprehensive Test Ban Treaty Organization (CTBTO) and provide critical constraints on the magnitude, rupture process, and aftershocks of the 2004 Sumatra–Andaman earthquake. Their results demonstrate that hydroacoustic analysis could be an effective tool for the rapid assessment of scale, character, and the tsunamigenic potential of large, submarine earthquakes.
- The 2004 Sumatra tsunami was the most extensively observed tsunami in history. In this issue, Rabinovich et al. analyze tide gauge records and examine the amplitude, frequency and wave train structure of tsunami waves recorded at a distance of more than 20,000 kilometers from the source area.
- In the final paper of this Special Issue, Arcas and Titov review novel research results that combine direct, real time tsunami observations (see Rabinovich et al., this issue) with computer models of tsunami propagation and inundation. Their study demonstrates that, through further refinement and validation, computational tsunami forecasting methods could play an important role for both real-time warning and hazard assessment of tsunamis.

The Guest Editor thanks all the referees for their valuable work, and Professor Michael Rycroft, Managing Editor, for his invitation to act in this capacity.