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Preface to the Focused Issue on the 22 February 2011 Magnitude 6.2 Christchurch Earthquake

Erol Kalkan
U.S. Geological Survey, Menlo Park

The 22 February 2011 magnitude 6.2 Christchurch earthquake, centered southeast of Christchurch, was part of the aftershock sequence that has been occurring since the September 2010 magnitude 7.1 quake near Darfield, 40 km west of the city. The Christchurch earthquake killed more than 180 people, damaged or destroyed more than 100,000 buildings, and is New Zealand's most deadly disaster since the earthquake that struck the Napier and Hastings area on 3 February 1931.

This special focused issue of *Seismological Research Letters*, which I had the fortune to edit, contains a selected set of 19 original technical papers. These papers cover different aspects of the 2011 Christchurch earthquake from seismological, geodetic, geological, and engineering perspectives.

The first eight papers focus on earthquake source modeling, fault stress variation, and aftershock sequence. The paper by Guidotti *et al.* presents three-dimensional numerical simulations of the Christchurch earthquake by comparing different fault and interface models. Using data from a dense network of strong motion instruments, Holden *et al.* presents the inversion scheme for constraining the source kinematics of the Christchurch event. The constrained geodetic source model is presented next by Beavan *et al.* using a large amount of ground-displacement data. The following paper by Zhan *et al.* concentrates on how applicable the static Coulomb stress triggering mechanism is to the 2011 Christchurch aftershock, and it examines the sensitivity of the stress changes to mainshock slip distribution and aftershock fault orientation. Along the same line, Barnhart *et al.* performs inversions of optical imagery data for spatial distribution of fault slip that occurred during the Darfield and Christchurch earthquakes, and assesses the potential contribution of the static Coulomb stress change during the Darfield event to the eventual rupture of the Christchurch event. The next paper, by Sibson *et al.*, evaluates how the complex earthquake sequence of the region likely has arisen through reactivation under the contemporary tectonic stress field of a mixture of comparatively newly formed and older inherited fault structures. The paper by Fry and Gerstenberger presents apparent stresses of the three largest regional earthquakes, and compares them to global and regional data to improve future seismic hazard estimates due to similar high-stress events. In order to better understand the regional complex fault system, Bannister *et al.* provides relocation analysis of aftershocks that have occurred since the February earthquake through May 2011.

The next three papers concentrate on recorded strong ground motions and their engineering implications. Fry *et al.* investigates characteristics of recorded horizontal and vertical waveforms and their correlation with the observed nonlinear site response. The following paper, by Bradley and Cubrinovski, provides a preliminary assessment of the near-source ground motions recorded in the Christchurch region by examining their spatial distribution including source, path, and site effects. The next paper of this series is by Segou and Kalkan, which evaluates the performance of global ground-motion prediction models using the strong motion data obtained from the Darfield and Christchurch earthquakes in order to improve future seismic hazard assessment and building code provisions for the Canterbury region.

The next set of eight papers focus on observed structural and geotechnical damages associated with strong ground shaking during both the Darfield and Christchurch earthquakes. The paper by Iizuka *et al.* investigates the damage around the seismic stations to determine the relationship between structural damage and strong motions during the Christchurch earthquake. Similarly, Smyrou *et al.* evaluates the strong ground motions of this event in an effort to broadly explain and quantify the observed structural and geotechnical damages. The next paper, by Zupan *et al.*, summarizes the key field observations made following the Christchurch earthquake regarding the effects of soil liquefaction on building performance in the central business district. Along the same line, Orense *et al.* compares the Darfield and Christchurch earthquakes according to the results of the reconnaissance works with emphasis on the geotechnical implications of liquefaction-observed damage in the affected areas. Using the ambient noise measurements following the Christchurch earthquake, Mucciarelli investigates the relationships with previous microzonation studies, liquefaction, and soil nonlinear response. Green, Wood *et al.* compare the observed versus predicted liquefaction occurrence during the Darfield and Christchurch earthquakes using DCP and SASW tests; and Green, Allen *et al.*, summarizes the performance of the levees along the Waimakariri and Kaiapoi rivers during these two events. The final paper of this special focused issue is by Wotherspoon *et al.* and presents a summary of field observations, and subsequent analyses on the damage to some of the bridges in the Canterbury region as a result of the Christchurch earthquake.

The 19 papers presented here meet our goals of covering a wide spectrum of topics related to the strong earthquake sequence and their impacts on the Canterbury region of New Zealand in order to inform and advance our understanding of seismic source mechanism, nonlinear site response, ground motion attenuation, and infrastructure performance, as well as to point out new avenues of investigation for future studies.

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U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025 U.S.A.
ekalkan [at] usgs [dot] gov

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