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# PRELIMINARY SOURCE MODEL FOR Mw 7.1 DARFIELD, NEW ZEALAND, EARTHQUAKE FROM GPS AND INTERFEROMETRIC SATELLITE RADAR OBSERVATIONS

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The Mw 7.1 Darfield earthquake of 4 September 2010 struck within 40 km of Christchurch, New Zealand's second-largest city (population 300,000), causing extensive damage but no fatalities. Largely right-lateral surface rupture of up to 5 m occurred along a 30-km length of the previously-unrecognised east-west trending Greendale Fault. The well-located epicentre lies ∼3.5 km north of the surface rupture. We surveyed >80 pre-existing GPS marks 3-10 days after the earthquake and created differential interferograms (DInSAR) from pre- and post-earthquake ALOS and Envisat satellite radar images. Resurveys of some of the GPS marks over the next two months showed that major amounts of afterslip are not occurring. We inverted the GPS and DInSAR displacement data using a model consisting of variable slip on several rectangular fault planes in an elastic half-space. The data require at least three faults to be active during the earthquake: the largely right-lateral Greendale Fault and its buried extension that trends northwest for ∼6 km beyond the western end of the mapped surface rupture; a blind reverse fault coincident with the earthquake hypocentre; and a blind reverse fault at the northwest end of the strike-slip fault near the village of Hororata. The main section of the Greendale Fault has slip of up to ∼6 m concentrated between the surface and 8 km depth on a near-vertical plane (Mw ∼6.9). Its northwestern extension has slip of up to ∼3 m on a plane dipping steeply northeast with a component of normal-faulting (Mw ∼6.6). The blind reverse fault near the hypocentre dips southeast, has up to 4-5 m of slip, and ruptures to within 1-2 km of the surface (Mw ∼6.5). Initiation of the rupture sequence on this fault is supported by inversions of seismic data. The buried reverse fault near Hororata has up to ∼3 m of slip and also ruptures to within 1-2 km of the surface (Mw ∼6.2).