The September 2010 Mw 7.1 Darfield earthquake may be the best-ever recorded earthquake of its size. Strong-motion data were recorded at 38 sites within 50 km of the epicentre, including eight with accelerations larger than 0.5g. Coseismic displacements were recorded by more than 80 GPS sites, and high-quality coseismic interferograms have been obtained from both Envisat and ALOS synthetic aperture radar data. National seismic network seismometers, together with 13 portable instruments deployed within 24 hours of the earthquake, have allowed detailed mapping of aftershocks using a 3D seismic velocity model. We have used the geodetic data to invert for a static source model of the earthquake, and the strong-motion data to invert for a kinematic source model using both conventional and source-scanning approaches. The kinematic inversions provide a detailed history of the spatial and temporal evolution of the rupture. The earthquake was complex, and we have used both the observed surface rupture of the Greendale Fault and the aftershock distribution to guide the locations of fault surfaces in our models. The earthquake initiated on a steeply dipping reverse fault coincident with the hypocentre. The main moment release began 10-15 seconds later on an east-west trending near-vertical right-lateral strike-slip fault (Greendale Fault) to the south of the epicentre. At least two other fault surfaces were also active during the earthquake. The fault surfaces, final slip distributions and magnitudes are generally consistent between the geodetic and strong-motion inversions.