Geophysical Research Abstracts
Vol. 15, EGU2013-255, 2013
EGU General Assembly 2013

Potential geomorphic consequences of a future Great (Mw 8.0+) Alpine Fault earthquake, South Island, New Zealand

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The Alpine fault in New Zealand's South Island has not sustained a large magnitude earthquake since c. AD 1717. The time since this rupture (295 years) is close to the average inferred recurrence interval of the fault (∼300 years) and the Alpine fault is therefore expected to generate a large magnitude earthquake in the near future. Previous ruptures of this fault are inferred to have generated Mw 8.0 or greater earthquakes and to have generated, amongst other geomorphic hazards, large-scale landsliding and landslide dams throughout the Southern Alps. There is currently 85% probability that the Alpine fault will cause a Mw 8.0+ earthquake within the next 100 years. While the seismic hazard is fairly well understood, that of the consequential geomorphic activity is less well-studied, and these consequences are explored herein. They are expected to include landsliding, landslide damming, dambreak flooding, debris flows, river aggradation, liquefaction, and landslide-generated lake/fiord tsunami. Using evidence from previous events within New Zealand as well as analogous international examples we develop first-order estimates of the likely magnitude and possible locations of the geomorphic effects associated with earthquakes. Landsliding is expected to affect an area >30,000 square kilometres and involve >1 billion cubic metres of material. Landslide dams are expected to occur in many narrow, steep-sided gorges in the affected region. Debris flows will be generated in the first long-duration rainfall after the earthquake and will continue to occur for several years as rainfall (re)mobilises landslide material. In total more than 1000 debris flows are likely to be generated at some time after the earthquake. Aggradation of up to 3 m will cover an area >125 square kilometres and is likely to occur on many West Coast alluvial fans. The impact of these effects will be felt across the entire South Island and are likely to continue for several decades.