

## **Rapid mapping of co-seismic landslides using Sentinel-2 images: The case of 2016 $M_w$ 7.8 Kaikoura, New Zealand earthquake.**

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### ***Abstract***

The  $M_w$  7.8 earthquake on 13<sup>th</sup> November 2016 was the largest earthquake onshore in New Zealand since the 1855 Wairarapa event. The event consisted of a complex rupture pattern involving multiple different fault and fault segments totaling over 200 km of length. The earthquake had only minimal casualties and damages to settlements due to the area affected being sparsely inhabited. Most severe damages were on infrastructure (roads, highways, railroad etc) due to the widespread landslide & mass movement phenomena.

The Sentinel-2A multispectral satellite of European Space Agency, launched at May 2015, is a new platform offering multitemporal coverage of high & medium resolution (10, 20 & 60m) and the final products being open-access and available in a short interval since sensing time. Sentinel-2 images offer the advantage of short temporal coverage (5-10 days) and a wide swath of 290 km, enabling a quick and detailed overview of large areas affected by earthquakes and other natural hazards. Sentinel-2 post-event images enabled a complete coverage of the Kaikoura earthquake affected area within 12 days (sensing dates 15, 22 & 25 November 2016) including serious gaps due to cloud cover. Using optical & near-infrared RGB composites at a 10m resolution, a first map of 7300+ landslides was producing, including preliminary mapping of surface ruptures visible even at this resolution. The rapid assessment of the landslides showed an affected area of about 5000 square kilometres with a high number (7300+) of landslides & other mass movement deformation types of considerable size (>10m).

Although a final detailed mapping effort using VHR images will probably result in a ten-fold number of landslides, the Sentinel-2 images provided a satisfactory & thorough coverage of the area affected in a short time and with significant less processing time for mapping the co-seismic landslides and effects. The rapid product of co-seismic landslides for the Kaikoura earthquake from our team was the first release offering a complete and detailed coverage and was integrated in the Kaikoura Earthquake Hazards Data Viewer operated by the Earthquake Commission of New Zealand offering assistance for post-earthquake recovery efforts.

***Key words:*** Earthquake, Landslides, Remote Sensing, Rapid mapping, New Zealand.