USING REMOTE SENSING AND SPATIAL ANALYSIS TO UNDERSTAND LANDSLIDE DISTRIBUTION AND DYNAMICS IN NEW ZEALAND

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Landslides cause millions of dollars worth of damage to property annually in New Zealand. In a widespread landsliding event (several thousand landslides occurring within a region) remote sensing can be used to map landslide distributions and then combined with other geospatial data to better understand future susceptibility to damage in similar locations around the country. In this study we use high and very high spatial resolution multispectral image data to map rainfall induced landsliding in the North Island of New Zealand. This work follows a large landsliding event in July 2007 where there was an estimated damage cost of $NZD60 million.

To obtain a regional overview of the landslide distribution, SPOT-5 imagery was obtained before and after the event. ALOS AVNIR-2 imagery was acquired a year after the event to evaluate the speed of re-vegetation on the landslides. Quickbird imagery was acquired before the event, and Ikonos after. The latter two very high resolution data sets could only be obtained for a small portion of the region due to cloud cover and financial constraints.

All data were radiometrically calibrated to at-sensor radiance and a dark pixel subtraction was applied for atmospheric correction in the absence of more comprehensive atmospheric measurements. The data were then orthorectified to the New Zealand Map Grid. While manual interpretation of aerial photography has been commonly used in the past for landslide mapping, this technique would be prohibitively slow and costly under the circumstances of a widespread event such as this. After testing numerous image processing techniques, the spectral angle mapper classifier was selected to provide the most accurate landslide map of the region using the SOPT-5 data. The small Ikonos scene (10 x 10 km) was manually digitised for accuracy purposes and revealed 1733 landslides.

The effects of landsliding on the landscape from this event were still evident in the ALOS AVNIR-2 imagery more than a year after the storm. While the landslides that had occurred on pastoral lands had been overgrown somewhat, they could still be detected from their surrounds using the same spectral angle mapper classifier. In particular, those landslides occurring within the areas of woody vegetation showed very little detectable change in the imagery. We intend to obtain imagery over this area on an annual basis to better understand this rate of regrowth in the absence of further disturbance and to also use this knowledge to help estimate the age of other landslide scars.

The relationships between landslide occurrence and other layers of spatial information (landcover, main rock type, slope, aspect) were considered using available geospatial data. Landslides were not found to be confined to any single rock type, landcover or slope category, though generalisations can be made. The number of landslides per unit area increased considerably with a slope greater than 20°, particularly in areas where the main rock type was conglomerate. Landsliding was observed across all slope categories where the main rock type was volcanic breccia or grewacke and consistently more landslides were found in areas of non-woody vegetation, irrespective of the underlying main rock. This information is being combined with rainfall intensity into multivariate predictive models to estimate the future risk of landsliding to properties under given environmental conditions.