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Use of high resolution Airborne Laser Scanning data for landslide interpretation under mixed forest and tropical rainforest: case study in Barcelonnette, France and Cameron Highlands, Malaysia

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Airborne Laser Scanning (ALS) is the state of the art technology for topographic mapping over a wide variety of spatial and temporal scales. It is also a promising technique for identification and mapping of landslides in a forested mountainous landscape. This technology demonstrates the ability to pass through the gaps between forest foliage and record the terrain height under vegetation cover. To date, most of the images either derived from satellite imagery, aerial-photograph or synthetic aperture radar are not appropriate for visual interpretation of landslide features that are covered by dense vegetation. However, it is a necessity to carefully map the landslides in order to understand its processes. This is essential for landslide hazard and risk assessment.

This research demonstrates the capabilities of high resolution ALS data to recognize and identify different types of landslides in mixed forest in Barcelonnette, France and tropical rainforest in Cameron Highlands, Malaysia. ALS measurements over the 100-years old forest in Bois Noir catchment were carried out in 2007 and 2009. Both ALS dataset were captured using a Riegl laser scanner. First and last pulse with density of one point per meter square was derived from 2007 ALS dataset, whereas multiple return (of up to five returns) pulse was derived from July 2009 ALS dataset, which consists of 60 points per meter square over forested terrain. Generally, this catchment is highly affected by shallow landslides which mostly occur beneath dense vegetation. It is located in the dry intra-Alpine zone and represented by the climatic of the South French Alps.

In the Cameron Highlands, first and last pulse data was captured in 2004 which covers an area of up to 300 kilometres square. Here, the Optech laser scanner was used under the Malaysian national pilot study which has slightly low point density. With precipitation intensity of up to 3000 mm per year over rugged topography and elevations up to 2800 m a.s.l., mapping the landslides under tropical rainforest which are highly vegetated and rapidly re-vegetated still remains a challenge.

With the advancement of point clouds processing algorithm, high resolution Digital Terrain Models (DTMs) are becoming a very valuable data source for the production of landslide related maps. In this study, two filtering algorithms, which are based on least square interpolation and progressive TIN densification, are used to extract the bare earth surface. Quantitative and qualitative assessment that was carried out under ISPRS Working Group III/3 shown that those algorithms performed well in terms of discontinuity preservation, vegetation on the slope and high outlier influence in the point clouds. Hence, they are capable to extract ground points under difficult scenarios, especially for application under rugged forested terrain.

The optimal terrain information has been exploited from ALS point clouds, particularly to preserve important landslide characteristics and to filter out unnecessary features. Morphological characteristics and geometric

signatures of landslides are taken into consideration for the derivation of high-quality digital terrain model. Furthermore, ALS-derived DTMs are investigated at different spatial scales for suitable hillslopes morphology representation. Hence, appropriate 2D and 3D visualization methods are presented in such a way to help the image interpreters to detect landslides and classify them according to type, movement mechanism and activity status in forested mountainous terrain.