HIGH DENSITY AIRBORNE LIDAR ESTIMATION OF DISRUPTED TREES INDUCED BY LANDSLIDES

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ABSTRACT

Airborne laser scanning (ALS) data has revolutionized the landslide assessment in a rugged vegetated terrain. It enables the parameterization of morphology and vegetation of the instability slopes. Vegetation characteristics are by far less investigated because of the currently available accuracy and density ALS data and paucity of field data validation. We utilized a high density ALS (HDALS) data with 170 points m^{-2} for characterizing disrupted vegetation induced by landslides by means of a variable window filter and the SkelTre-skeletonisation. Tree analyses in landslide areas resulted in relatively low height, small crown and more irregularities, whereas these peculiarities are not so obvious in the healthy forests. The statistical tests unveiled the clear differences between the extracted parameters in landslide and non-landslide zones and supported the field evidences. We concluded that HDALS is a promising tool to geometrically retrieve disrupted woody vegetation structures and can be good bioindicator to landslide activity.

INTRODUCTION

> Modern remote sensing have revolutionized the landslide hazard and risk assessment.

> Few attempt has been made to utilize the ALS data to represent tree structures that may be indicative of landslides, mostly due to the point density, and limited capability of passive remote sensing instruments to detect variability of forest structure.

> The performance of ALS for assessing the physical presence of disrupted trees and its relation to landslides remains unexplored.

> This study aims at providing better insight into the use of HDALS data to characterize disrupted trees induced by landslides.

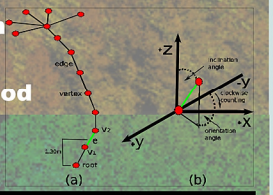
MATERIALS AND METHODS

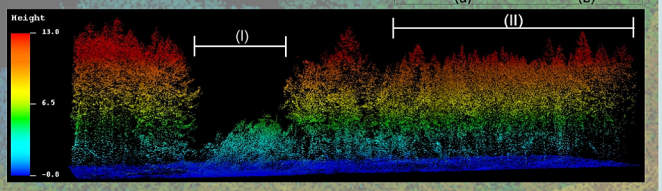
>Hand-held airborne laser scanning system was used to capture an HDALS data in July 2009.

> 214 million points with a mean density 170 points m^{-2}

>560 field-trees: Pinus uncinata (75%), Pinus sylvestris (15%)& Larix decidua (10%) collected at tree stand in June 2009, 2010, and September 2011.

> Variable window filter algorithm to extract single tree attributes and SkelTre-skeletonisation method to determine landslide-tree irregularity from 3D point clouds.

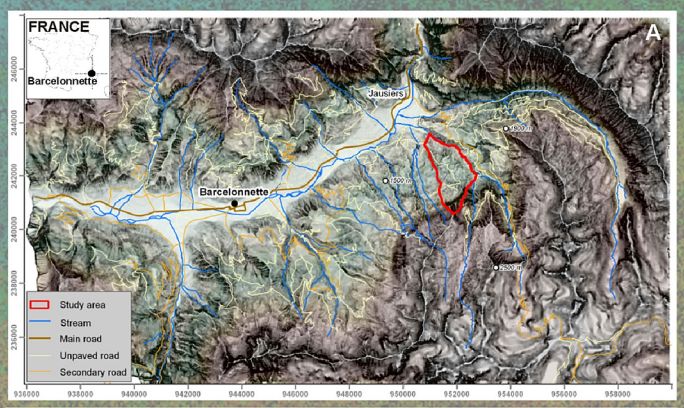




STUDY AREA

> Bois Noir catchment is situated in the dry intra-Alpine zone with a Mediterranean environment

> It is characterized by Callovo-Oxfordian marls in the Barcelonnette Basin (Southern French Alps)



RESULTS AND DISCUSSIONS

> 80000 trees with an average detection of 84.8 %

> Estimated tree height R^2 0.84 RMSE 1.426 m

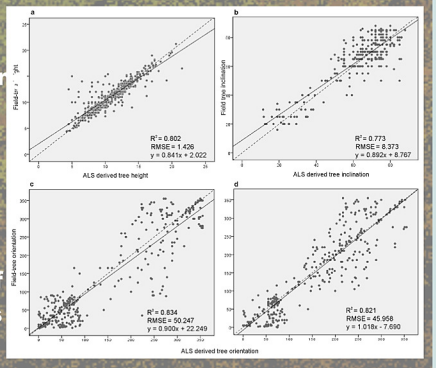
> SkelTre method was mostly over-predicting tree inclination (R2=0.77) and orientation (R2=0.83)

> Statistical tests showed all parameters have significant different in landslide and non-landslide zones, ranged from 0.001 and 0.015 p-values.

> Pinus uncinata had better estimation of tree irregularity due to species competitive

> Results are promising given the complexity of earth surface and landform processes

> HDALS data is state-of-the-art for geometric retrieval of vegetation structures subjected to forest disturbances in mountainous regions.



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