Tree stem shapes derived from TLS data as an indicator for shallow landslides

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Landslides or other forms of mass movement influence slope stability, and are known to have significant effects on vegetation patterns. Observation of such surface patterns may result in valuable information for understanding the kinematics of the landslide. In forested regions, tree growth anomaly is often served as an indicator of shallow landslide activity. Over the past years, remote sensing techniques have been explored to map and assess landslides at regional scales. However, detailed above-ground vegetation characteristics on landside area are less investigated because of low density and quality of observed data. Terrestrial laser scanning (TLS) is able to acquire accurate and dense 3D point cloud which provides the potential of reconstructing forest structure. Thereby, quantification of tree growth anomaly induced by landslide becomes feasible. In this study, we obtained high density TLS data in the northern Walgau in the federal state of Vorarlberg in Austria, where translational mass movement phenomenon exists in a forested region. A novel algorithm was developed to fast and robustly characterize single tree parameters (e.g. height, inclination and shape of the stem and stem volume). Specifically, a point cloud projection density image based method was implemented to identify individual tree stems, followed by a robust cylinder fitting strategy, which models tree stems. Consequently, tree parameters (e.g. shape of the stem, inclination, stem volume) were successfully determined at single tree level. Field measurements will be conducted in order to validate the results from the modelling algorithm. Furthermore, both landslide and non-landslide zones in the same region were studied to compare the tree growth irregularities resulted from shallow landslide with normal trees. The results of this study revealed that characterization of trees (i.e. inclination of the stems) can be used to indicate shallow landslide activities in forested regions. Investigated tree parameters could also contribute to a better understanding of the interaction between landslide and vegetation.