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Protection forest resilience after a fire event: a case study in Vallis, Switzerland

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Forests are well known to protect against natural hazards such as landslides, rockfall and floods. Nevertheless, they are dynamic ecosystems which are exposed to a variety of disturbances such as windstorms, fires, bark beetle and pathogen outbreaks. Catastrophic disturbances like windstorms and fires usually remove large portions of the canopy, starting a succession process which lead to a complete stand regeneration. Disturbances belong to the natural dynamic of forests, however they are highly undesirable in the case where forest protect infrastructure or settlements. Quantifying the decay and recovery of the protection effect of forests after disturbances is therefore important to evaluate risks and implement appropriate management techniques, when needed.
This work analyzes the dynamic of a Scots Pine (Pinus silvestris) protection forests near Visp (Vallis) after a fire event, focusing on root reinforcement, which is the key factor in preventing shallow landslides. Forest cover, root distribution and root mechanical properties were analyzed 4 years after the fire event, and the root reinforcement has been quantified. Furthermore, the contribution of natural regeneration has been evaluated.
Results show that the root reinforcement of Scots pine has declined massively in the forest fire area. At a distance of 1.5 m from the tree stem there is a reduction of 60% compared with the live stand. With increasing distance from the stem, the reduction in the reinforcement is even bigger. At a distance of 2.5 meters it is 12% and at 3.5 meters, only 5% of the original root reinforcement. This decrease is due to the decomposition of roots and associated change in the mechanical properties of the wood. The reinforcement of the dead roots in the forest area is estimated between 0.36 kPa and 2.64 kPa. The contribution of the emerging regeneration is estimated on average 0.01 kPa. Overall the stand provides a reinforcement between 0.37 kPa and 2.65 kPa.
From the results it can be concluded that the dying roots can still provide a certain root reinforcement; however, the contribution of rejuvenation is too little to compensate the continuously decreasing protective effect in the future time.
The time in which a forest can return in the initial state plays therefore a decisive role for contrasting the formation of landslides, which after a forest fire can be triggered at lower precipitation events.
The results obtained need now to be implemented in slope stability analysis to compare the protection effect of vegetation before and after the disturbance.
This work contributes to provide a first framework to evaluate the efficiency of protection forests before and after a catastrophic event, in order to support risk evaluation and plan possible management actions.