



State of the art on forest and shallow landslide interactions illustrated by two studies in the French Alps

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The importance of mountain forests in the protection from natural hazards such as landslides was perceived already in ancient cultures. Allusions of these interactions can be found in ancient Greek, Hebrew, Roman and Chinese literature. In modern times, quantitative studies on the role of vegetation on slope stability started flourishing during the 1960's, with particular contributions from the USA, USSR and Japan, followed by Brazil, New Zealand, Canada, Sweden and Taiwan in the 1970's and 1980's.

Forests influence slope stability through mechanical and hydrological effects. Empirical and scientific knowledge agree on the fact that the main effects of forests stands are considered to be:

- Mechanical stabilisation due to the presence of roots
- Soil moisture depletion as a result of transpiration and water interception by the canopy
- Surcharge from the weight of trees

The first two factors are beneficial to slope stability whilst the latter may be beneficial or harmful depending on the slope steepness and the potential failure mode. Roots type and morphology influence the capacity of a tree to stabilise slopes, although the failure surface has to be effectively penetrated by the roots in order to be stabilised. Generally, however, forests are considered beneficial for slope stabilization within the soil depth prospected by the tree's root system. So forest stands, depending on the slope value, the hydrological condition and the soil substrata, could have a positive effect on shallow landslide mitigation.

Much of the research in the European Alps, however, focuses on the protection awarded by forests against avalanches and rockfalls, whilst little has been done to quantify their protection against landslides. This is in contrast with other mountain regions in the world (Oregon, Himalaya, Japan, British Columbia), where the relations between forests and landslides has been and continues to be studied throughoutly.

In order to develop an efficient shallow landslide prevention and mitigation and due to the lack of scientific knowledge on the interaction between forest stands and landslide activities, there is a real need of research axis specifically devoted to the tree main effects cited before. The main objective of these thematically research axis should be an efficient integration of the effect of the forest vegetation in the modelling of shallow landslide dynamic.

This presentation deals with the state of the art on forest and landslide interaction illustrated by two studies conducted in the French Alps. The first one attempts to reduce a gap in the scientific knowledge by quantifying the hazard of landslide occurrence considering vegetation effects, in the Combeloup forest on the French Alps, using a physically based spatial modelling approach. The second one present the added value of dendrogeomorphological analyse to evaluate the past activities of landslide terrain in relationship with the evolution of the forest cover.