



Forest canopy disturbances increase the risk from torrential hazards in mountain regions

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Global human population growth and limited space for settlements in combination with a booming tourism industry have led to a strong increase of human infrastructure in mountain regions around the globe. This infrastructure is highly exposed to torrential hazards such as debris flow and sediment transport. Theory and local observations suggest that forests play an important role in protecting human infrastructure against torrential hazards a) as their rooting systems stabilize the soil and b) forests buffer surface runoff during precipitation events through canopy water interception and improved soil infiltration. In general, forest cover is increasing in the temperate biome, also increasing the protection effects of forests. At the same time, however, a push towards a bio-based economy increases the pressure on forests, and results in increasing harvest levels. Furthermore, natural disturbances are increasing around the globe as a result of anthropogenic climate change. These two trends lead to an increase in forest canopy disturbance, and are thus hypothesized to reduce the protection effect of forests against torrential hazards. Here we analyzed the occurrence of natural hazards for 10,885 watersheds (with a total area of 4,8 million hectare) in the Eastern Alps in Europe and quantified the effects of forest canopy disturbances deduced from Landsat satellite time series analysis for 1985 to 2018. We found strong evidence that the risk of torrential hazards is significantly lower in watersheds with higher forest share. Furthermore, forest canopy disturbances elevate the risk of torrential hazard events. Our analysis presents the first large scale study on interactions between forest cover, canopy disturbances and torrential hazards, highlighting that growing canopy disturbances increase the risk from natural hazards.