The effects of forest cover and disturbance on torrential hazards: Large-scale evidence from the Eastern Alps

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Problem

Human settlements and infrastructure in mountain regions are exposed to destructive natural events.

Large-scale evidence for effects of forest cover and disturbance on torrential hazards is lacking.

Europe’s forest are changing, with intensifying forest disturbances and increasing harvest levels.

Results

Does forest cover reduce the probability of torrential hazard events?

Increasing forest cover decreases torrential hazard probability

One standard deviation increase in forest cover decreases torrential hazard probability by ~ 9 %.

Distributed forest cover decreases torrential hazard probability

One standard deviation increase in patch density (distinct forest patches per km²) decreases debris flow (flood) probability by ~ 8 % (~ 6 %).

Remote sensing

Disturbance data

Natural and human disturbance regimes

National torrential hazard catalogue

Debris flow

Flood

Two processes, causing 877 Million € damage and death to 49 people in Austria (1972-2004)

European countries

A total of 10,885 watersheds in Austria, from 1980 to 2016, 3,768 torrential events recorded

Debris flow increases by 248 %

Probability of debris flow increases by 248 %

Flood is only influenced by disturbance regime

Given a press disturbance regime (high frequency), probability of a debris flow increases by 248 % when moving from 10 to 50 % of the watershed disturbed.

Do forest disturbances influence the probability of torrential hazard events and how do effects change with different types of disturbance regimes?

Do forest disturbances influence the probability of torrential hazard events and how do effects change with different types of disturbance regimes?

Large disturbances or high disturbance frequencies increase probability of debris flows

Given a press disturbance regime (high frequency), probability of a debris flow increases by 248 % when moving from 10 to 50 % of the watershed disturbed.

Flood is only influenced by disturbance frequency

Probability of a flood increases by 183 % when moving from a press (low frequency) to a press (high frequency) disturbance regime.

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