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0.1 Quantifying the protective function of a forest against rockfall for past, present and future scenarios using two modelling approaches

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Following a major rockfall event in 1987, in Saint Martin le Vinoux (French Alps), two types of protection measures were taken. Protective structures using civil engineering were installed (a rockfall dam and rockfall nets) and a forest restoration plan for optimising its protection was developed. This study aimed at investigating the evolution of the role of protection offered by the forest according to various scenarios over a 100-year period (1987-2086). To achieve this aim, two simulation tools, being Rockfor$\cdot^{NET}$ (ww.rockfor.net) and RockyFor were used. Rockfor$\cdot^{NET}$ is an efficient, one- dimensional rockfall-forest evaluation tool, using simple slope and forest characteristics. RockyFor is a process based 3-dimensional rockfall simulation model that takes the barrier effect of individual trees explicitly into account. Within the scenarios, the rockfall events remained unchanged. However, the stand characteristics, in particular the diameter distribution and the stand density, changed over time. This has been done on the basis of a reconstruction of the growth dynamics of the forest stand using tree cores and an assessment on the tree mortality rate. The results show that both models reproduce the historical rockfall events of 1987 in the sense that the forest at the time was not capable of stopping the falling rocks (largest rocks were about 1.5 m^3). Both models also indicate an increase of the number of rocks reaching the foot of the forested slope, the so called residual hazard from 1987 onwards. Rockyfor shows an increase of the residual hazard of 10% in 1987 to 19% in 2086. Rockfor$\cdot^{NET}$ shows an increase of 26% in 1987 to 54% in 2086. The difference between the two models is mainly explained by their different spatial dimensions, which makes that

Rockfor.NET is much more sensitive to a change in the mean tree diameter and the number of trees in the stand. Terrain characteristics, which are often important for stopping rocks, are not taken into account in Rockfor.NET, in contrast to Rockyfor. Regarding the decreasing protective effect of the forest, protection should continuously be provided by civil engineering protective structures. The analyses showed that optimal protection by a forest at the study site would be provided by a coppice stand.