Mountain forests are a valuable defence against snow avalanches. While avalanche-forest interactions are relatively well understood for large avalanches which destroy the forest, much less is known about small avalanches that occur in forest openings or shortly above the tree line. Avalanche flow in forested terrain is strongly influenced by the condition and composition of vegetation in the avalanche path. The decelerating effect of different forest structures has, however, not yet been quantified.

We analysed data sets on avalanches stopped in forested areas, which were collected in different climatic regions and forest ecosystems in the European Alps. For each region, detailed data on forest conditions, terrain and avalanche characteristics were gained during field surveys as well as from aerial photograph and digital elevation model analyses. The relationships between these parameters were quantified using statistical classification methods. Furthermore, we applied the two-dimensional numerical avalanche dynamics program RAMMS to simulate several avalanche events in forests and compared the model output with observed run-out distances in order to estimate the decelerating effects of different forest structures. We found that, combined with terrain conditions, the forests influence on the avalanche flow varies for wet and dry snow avalanches.

Quantifying the effects of forest on the avalanche flow emphasizes the importance of mountain forest as an effective biological protection measure against snow avalanches. Furthermore, implementing avalanche-forest interactions into numerical avalanche simulations will open new fields of application for avalanche models, e.g. for managing mountain forests and by better accounting for forests in natural hazard mapping and landscape planning.