

Identifying object protection forest for natural hazards with the model Flow-py

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Outline

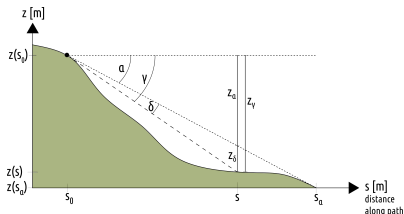
Introduction to Flow-Py and custom extensions

GreenRisk4ALPs Avalanche example, Results from Vals/Gries am
Brenner

Flow-Py run out model

The Flow-py model is a gravitational mass flow (GMF) run out model. The model is open source and customizable.

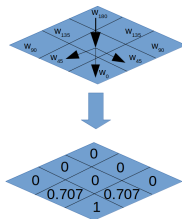
Stopping routine



There are two stopping criteria

- runout angle
- flux cutoff

Routing routine



There are two parts to the routing problem

- Terrain based (steepest descent)
- Persistence base (momentum)

Flow-Py run out model

The Flow-py model uses raster files (.tif , .asc). The model has been tested with 10 m resolution. However it is flexible and will run on any resolution.

Input Data:

Digital elevation model (DEM)

Release area raster

Runout angle α

Spreading exponent

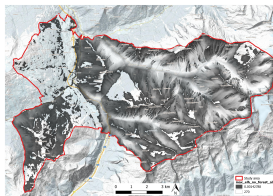
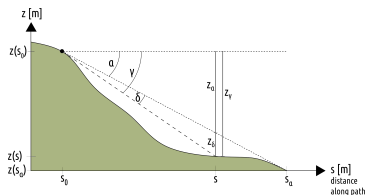
Output Data:

Routing flux

Maximum local travel angle (γ)

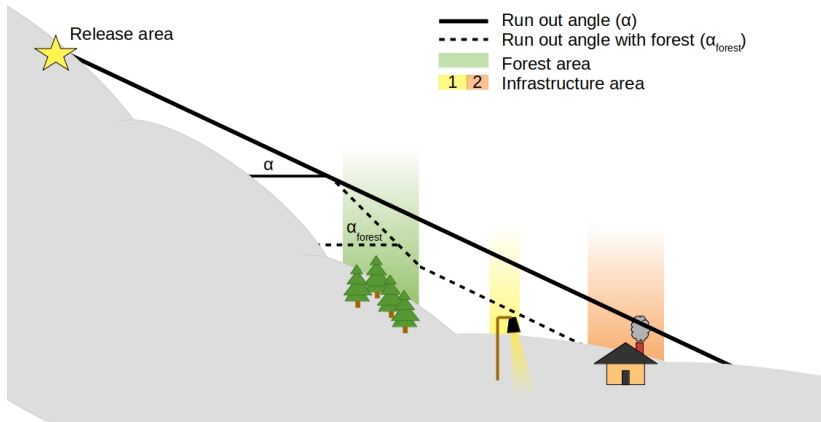
Average z_δ (Cell counts $\sum z_\delta$)

Maximum z_δ



Forest extension

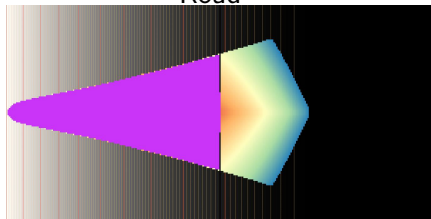
To include forest in the Flow-py model we made a custom extension which adjusts the run out angle in forested areas. The run out angle is dependent on the structure of the forest and the z_δ ("energy") of the GMF.



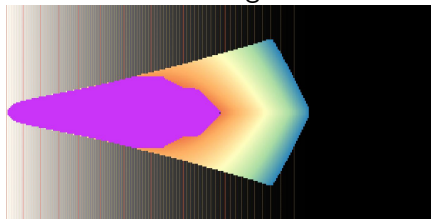
Infrastructure extension

The infrastructure extension identifies release, path and deposition raster cells that are associated with endangering infrastructure. This is done with a back-tracking step in the model.

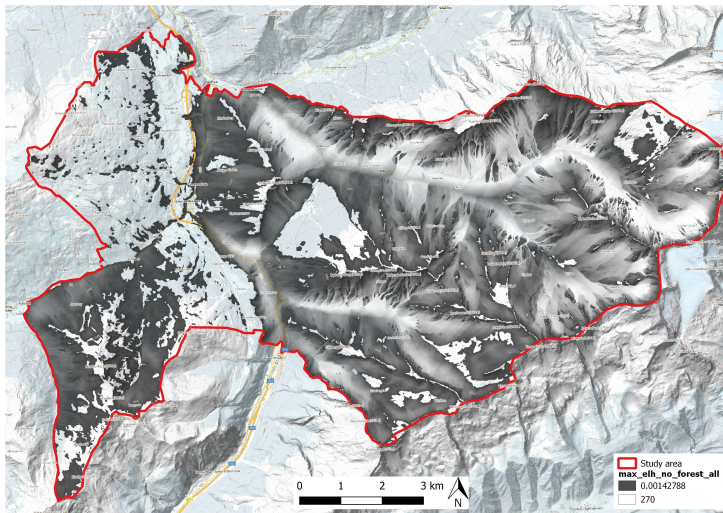
Avalanche on a parabolic slope
Road



Building



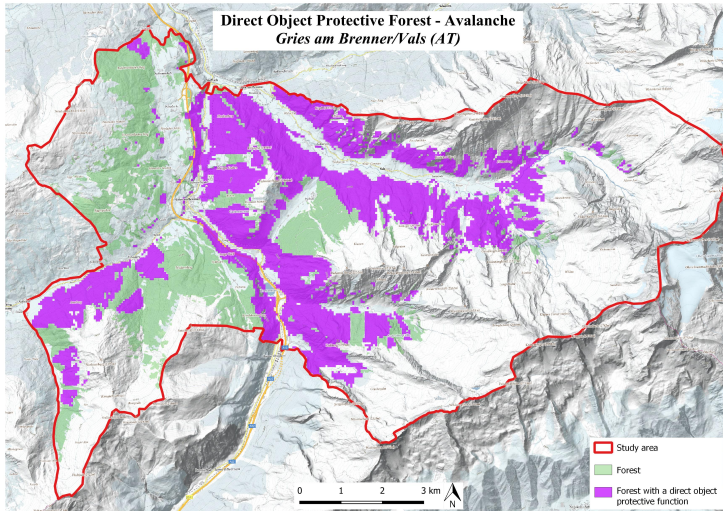
Process path



z_δ which can be interpreted as "energy" of the avalanche.

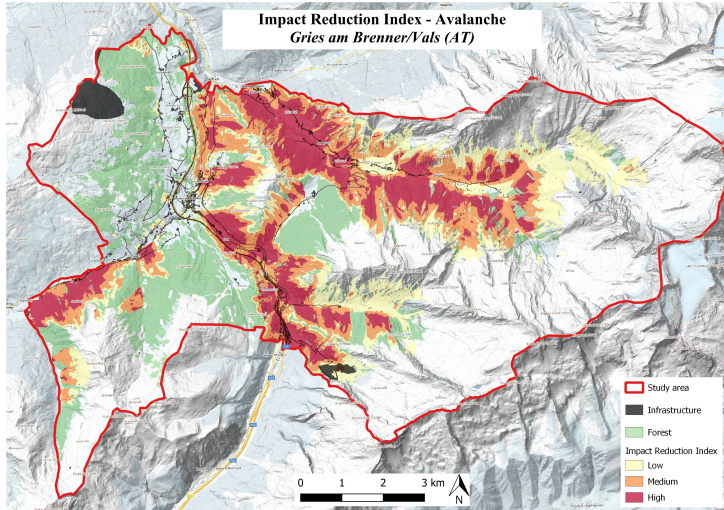
Forest Function Avalanche (infrastructure extension)

Forest that directly protects developed areas from large and very large slab avalanches (with a return period of 100 years or greater).



This is the union between the back-tracking and a forest raster.

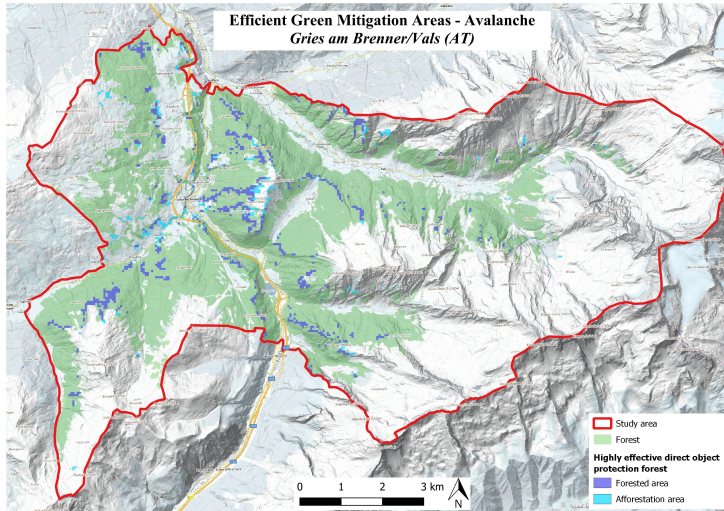
Forest Effect Avalanche (forest extension)



Difference between average z_δ for simulations with and without the forest extension.

Green mitigation areas effect Avalanche

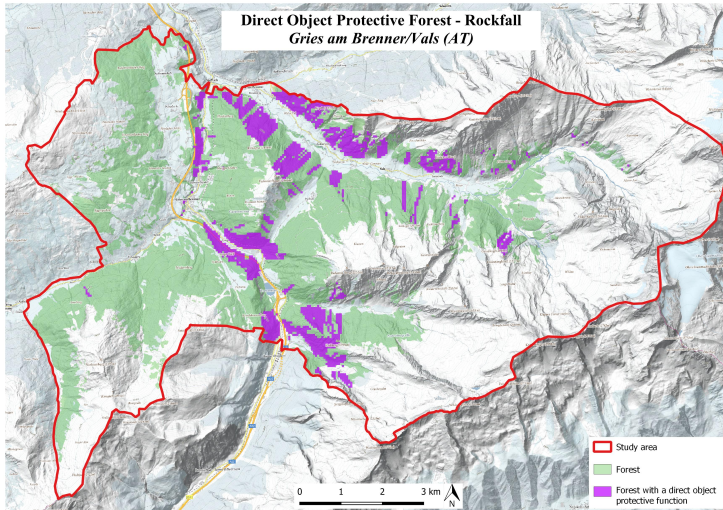
Forest locations highly effective for reducing avalanche energy



z_{δ} "energy" below 10 m and slopes must be below 2000m on slopes less than 45 degrees.

Forest Function Rockfall (infrastructure extension)

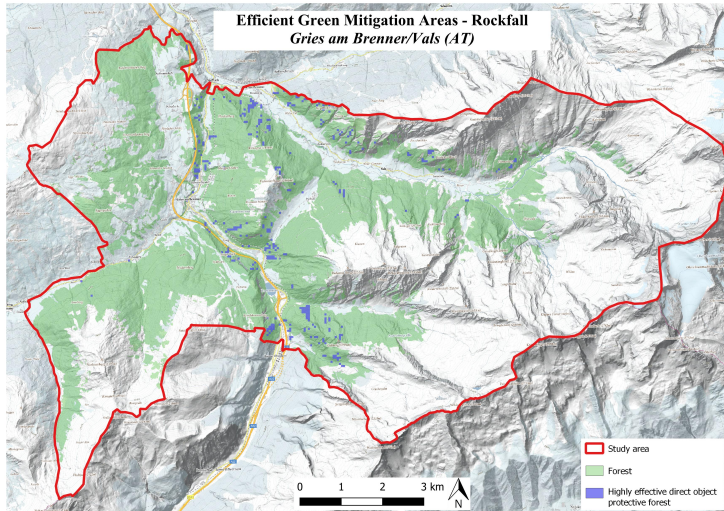
Forest that directly protects developed areas from large and very large slab avalanches (with a return period of 100 years or greater).



This is the union between the back-tracking and a forest layers.

Green mitigation areas effect Rockfall

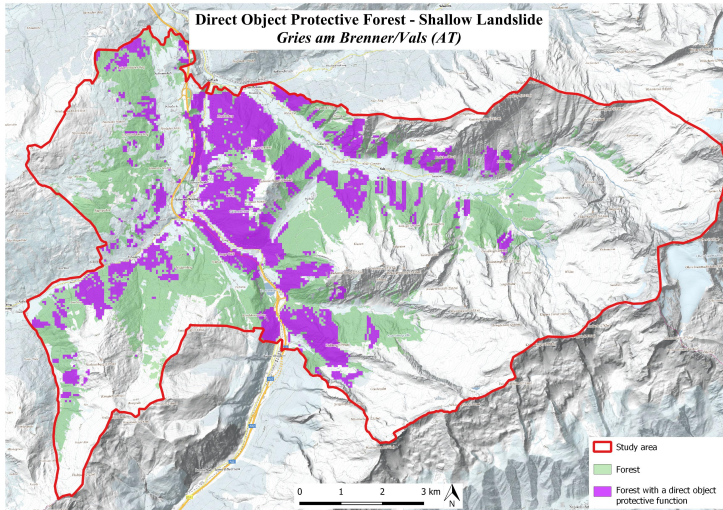
Forest locations highly effective for reducing a rocks energy.



z_δ "energy" below 10 m and slopes must be below 2000m on slopes less than 45 degrees.

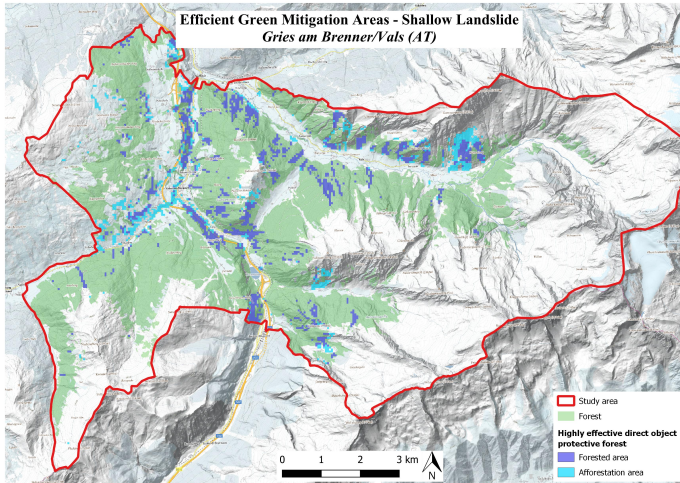
Forest Function Shallow Landslide (infrastructure extension)

Forest that directly protects developed areas from shallow landslides.



Green mitigation areas effect Shallow Landslides

Forest locations highly effective for reducing shallow landslide release probability.



Slopes must be below 2000m on slopes less than 45 degrees and in potential landslide release areas that endanger infrastructure.