Modelling forest effects on snow avalanche runout with the Flow-Py simulation tool

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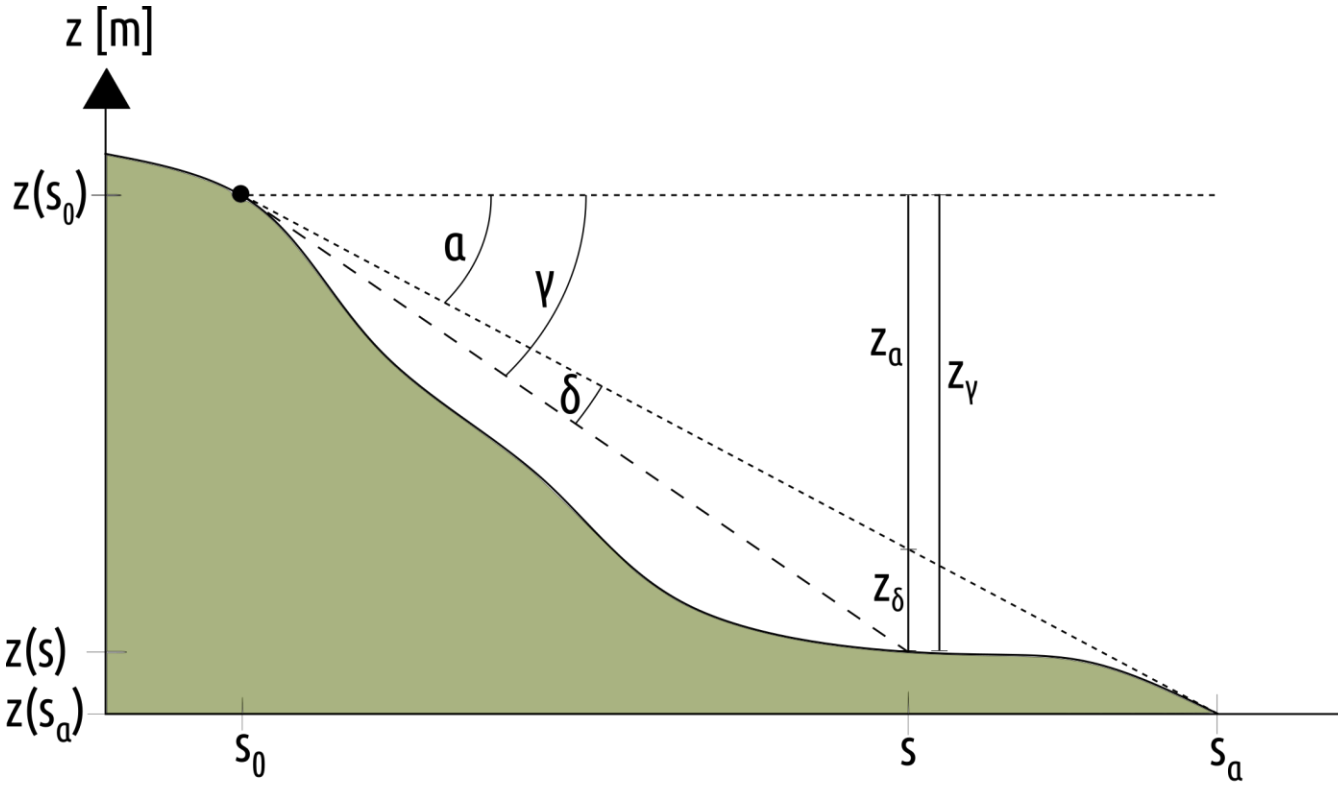
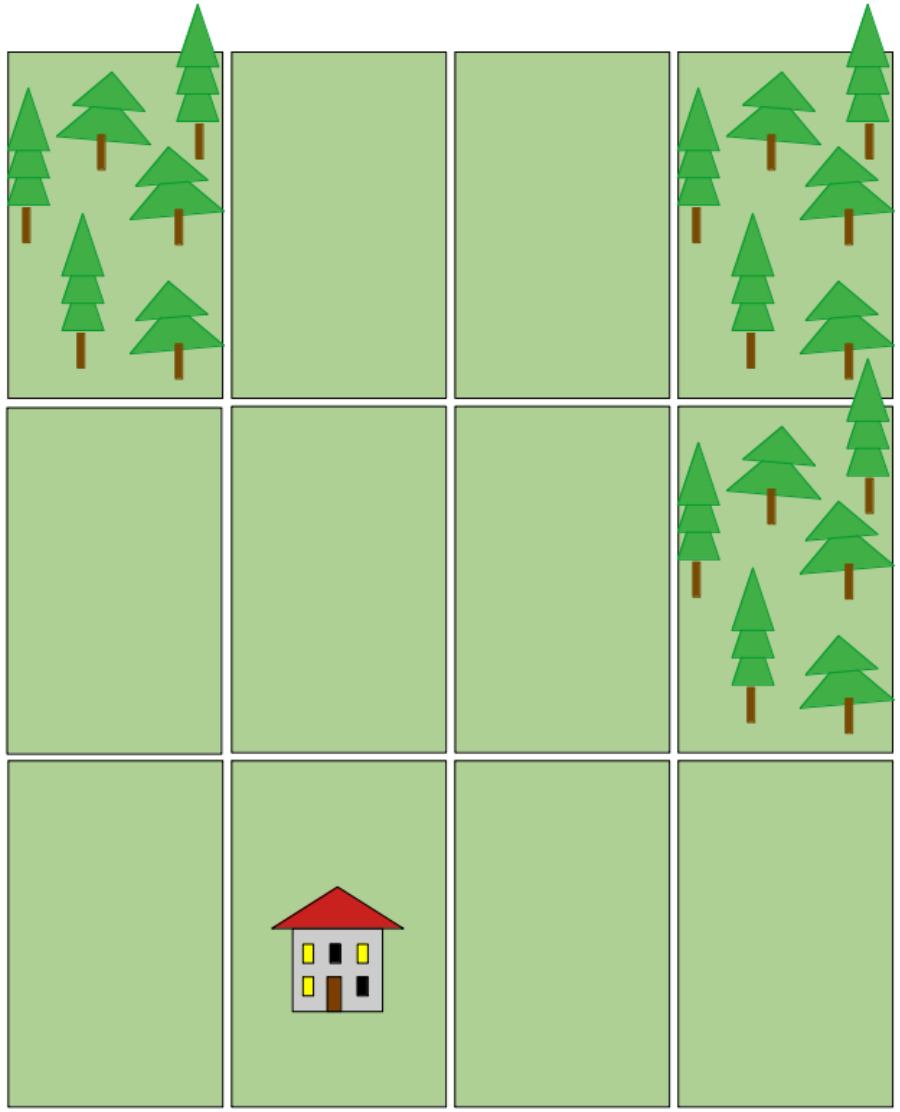
Flow-Py routing and stopping of mass flows

- Routing flux is moved from one raster cell to the next on a spatial iteration.

- Stopping occurs when the flow is too divergent (too little flux) or when the kinetic energy height goes to 0.





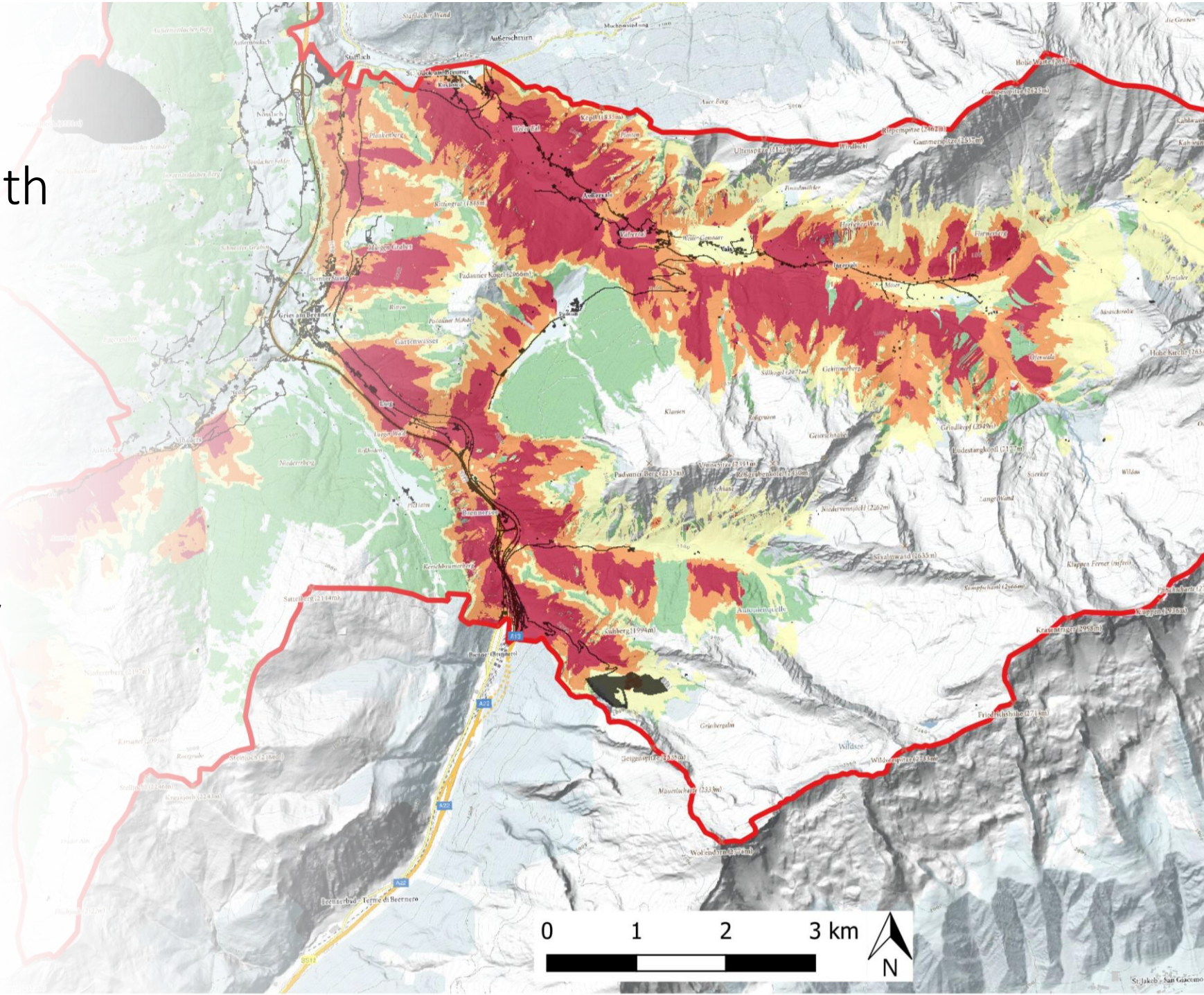
Input data for running Flow-Py with the forest-plugin

3 raster files (.asc or .tiff)

- DEM
- Release layer
- Forest structure layer (0-1)

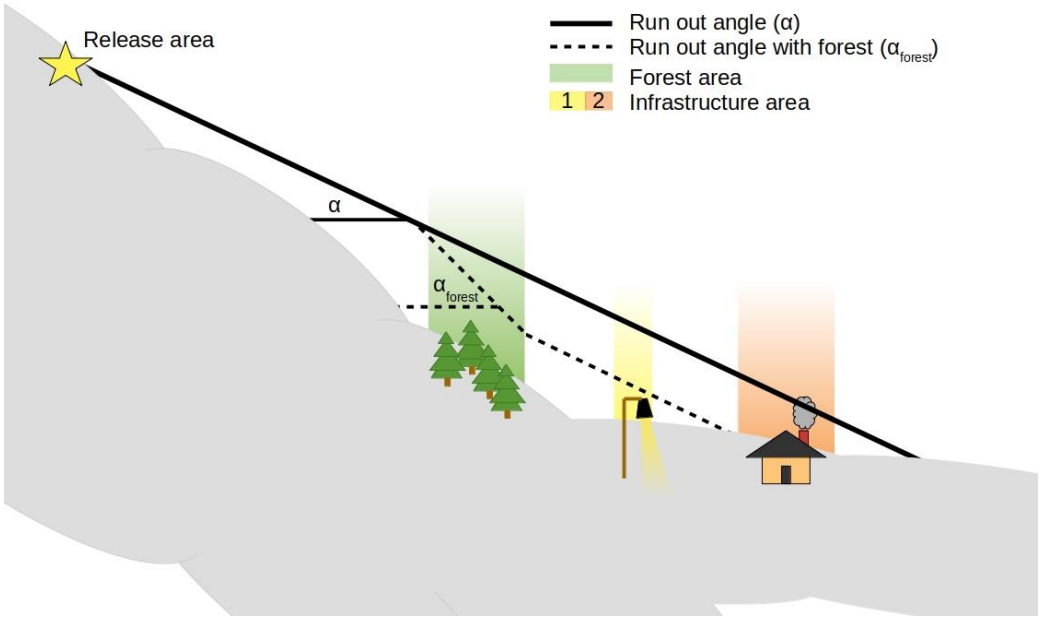
Parameterization for Flow-Py

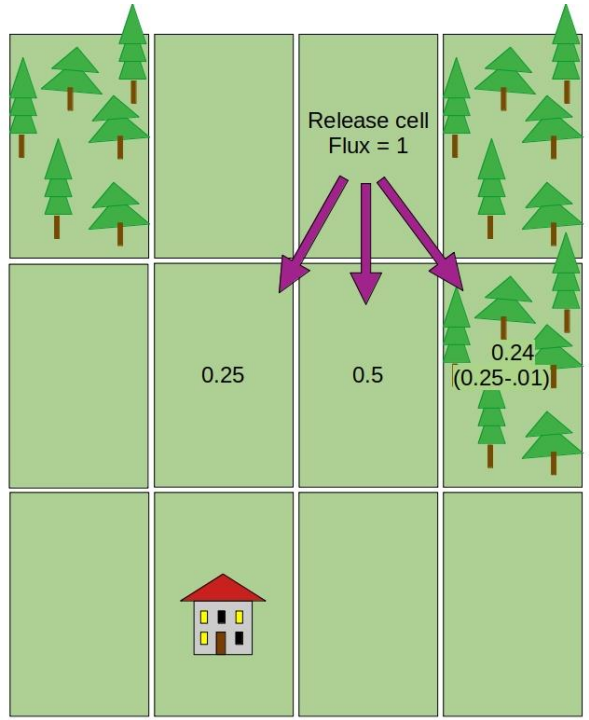
- Runout angle (α angle)
- Divergence exponent
- Max kinetic energy height
- Routing flux cutoff



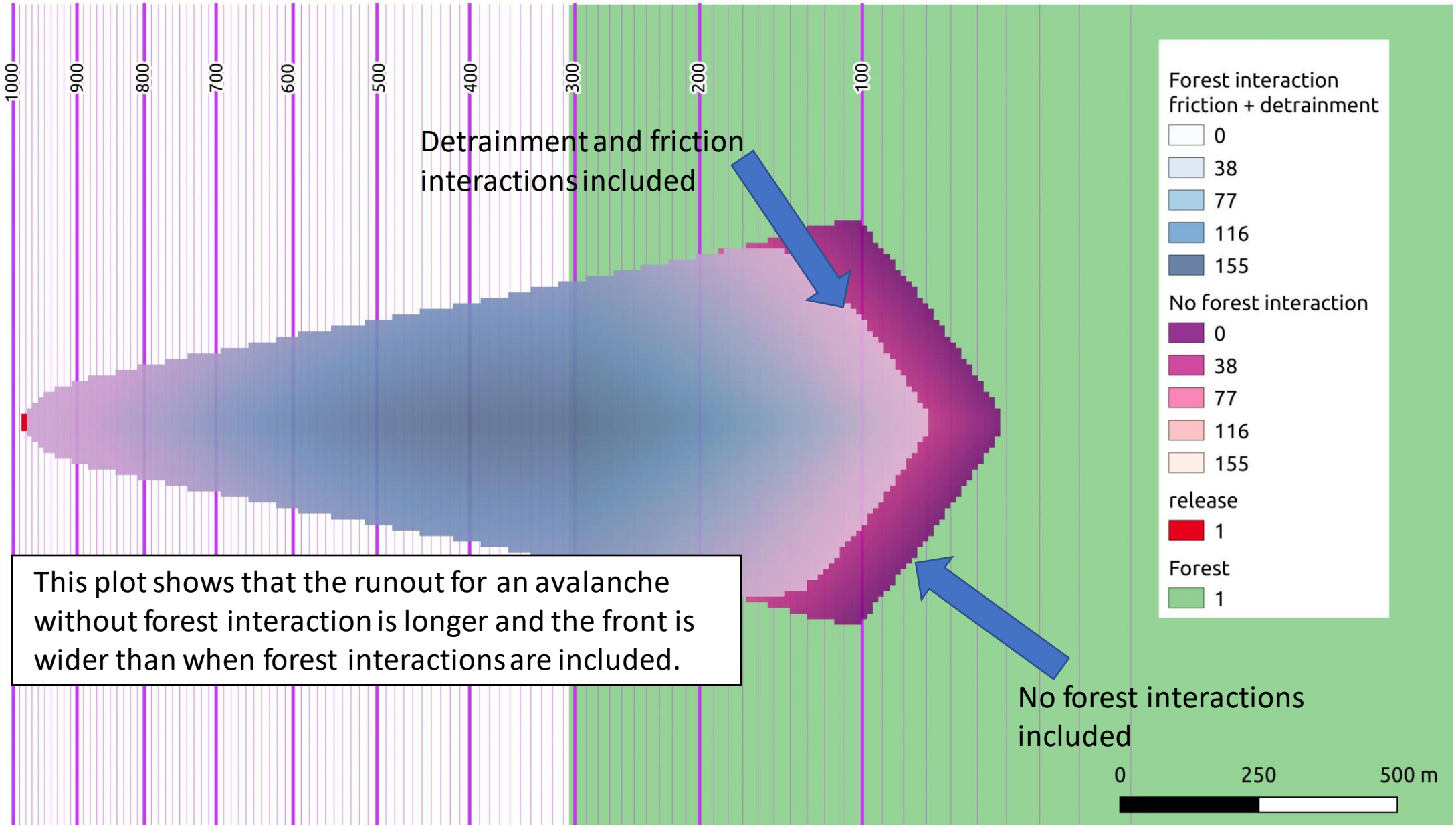
Forest plugin - stopping Criteria

- Friction – increased runout angle in forested terrain. The amount of increase is depended on the **forest structure**, the **kinetic energy height** and the **parameterization of forests**.
- Detrainment – reduced flux propagation in forested area to mimic detrainment. The amount is depended on the **forest structure**, the **kinetic energy height** and the **parameterization of forests**.





Forest interaction vs no forest interactions

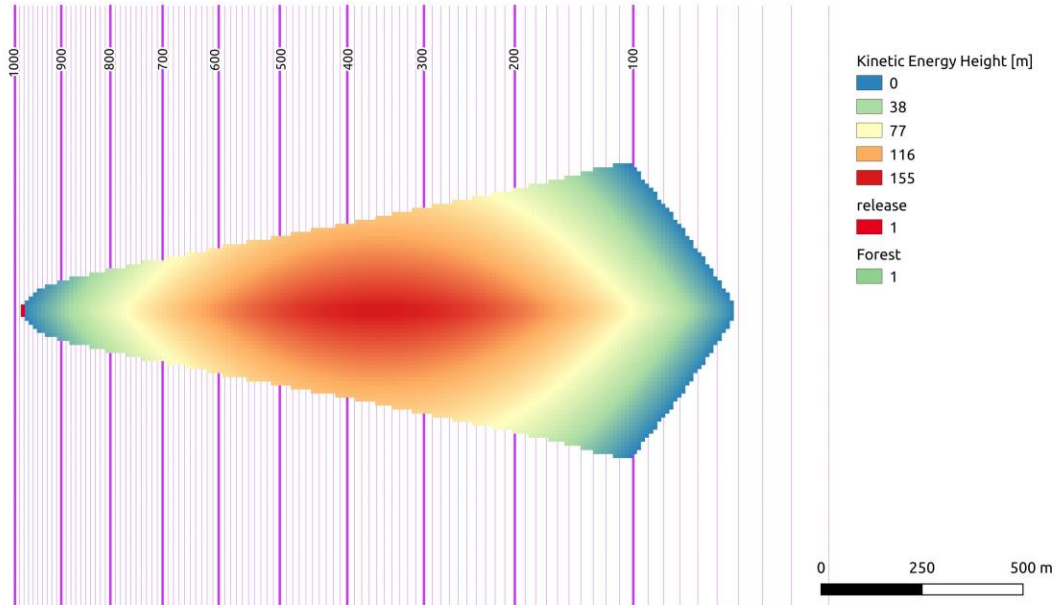


Outlook

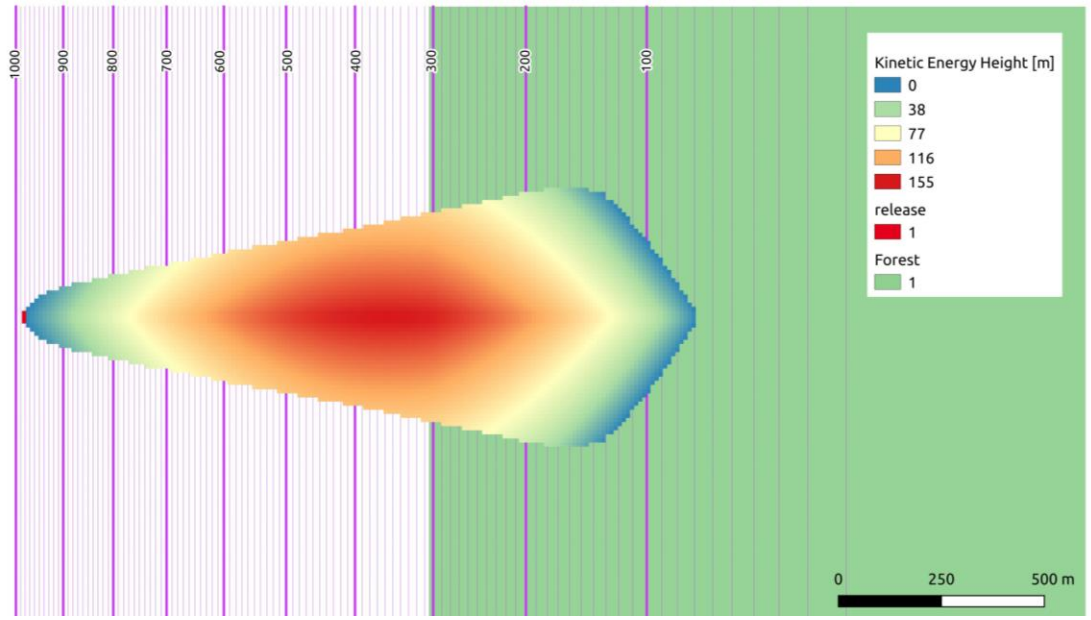
- **Next steps for the Forest-plugin** are to develop parameterizations for the forest-plugin and validate the results
- Flow- py is open source! download Flow-Py at https://github.com/avaframe/FlowPy
- For more information on the Flow-Py simulation tool check out the model description publication (https://doi.org/10.5194/gmd-15-2423-2022)

Backup slides

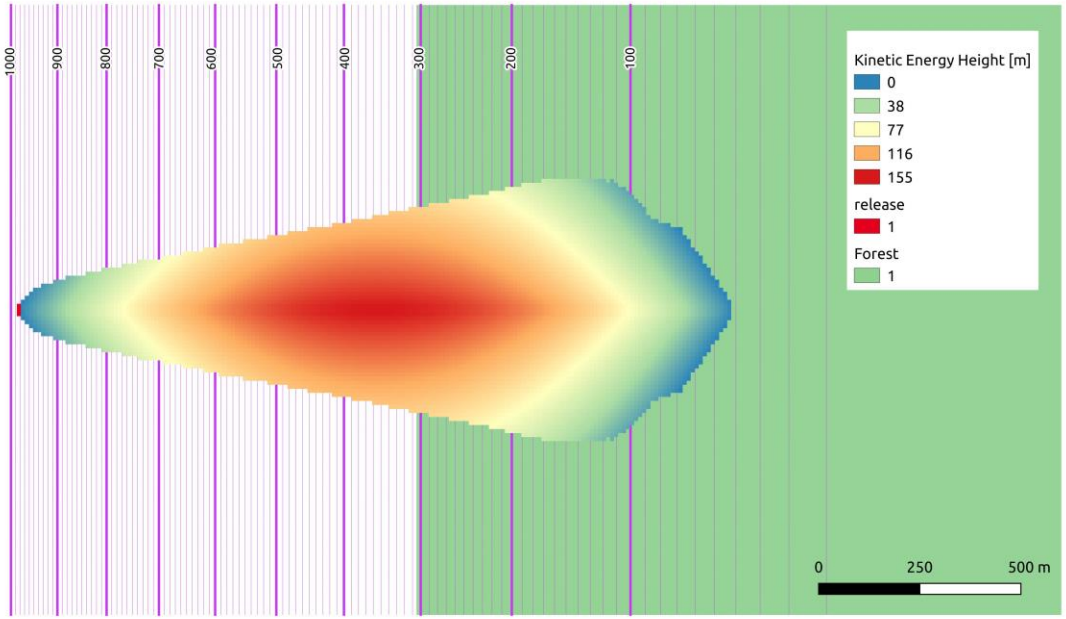
No forest interaction



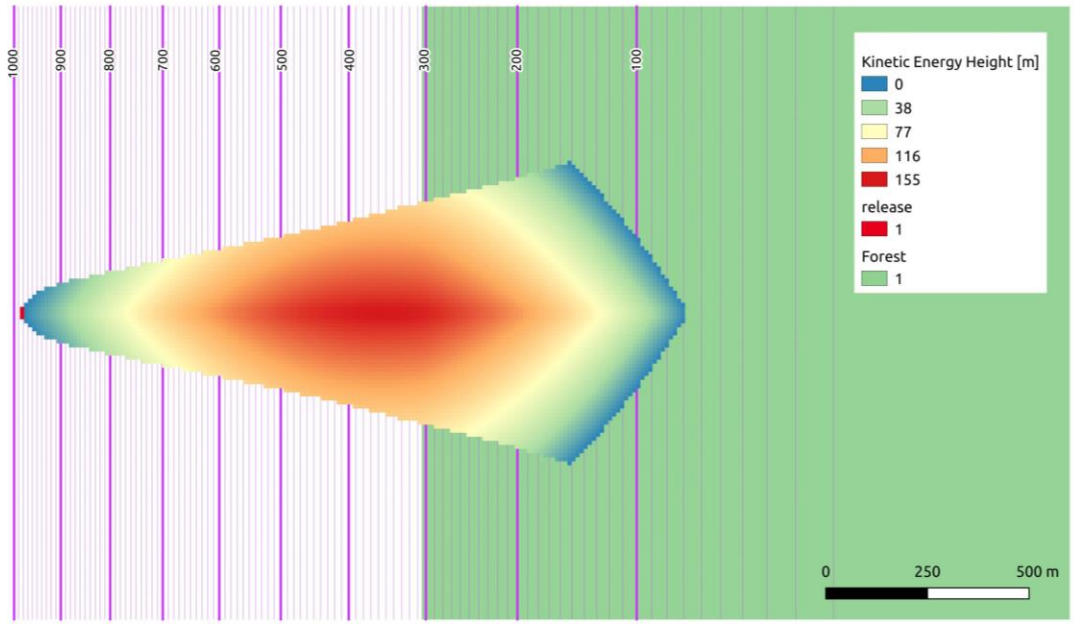
Forest friction + detrainment



Forest detrainment

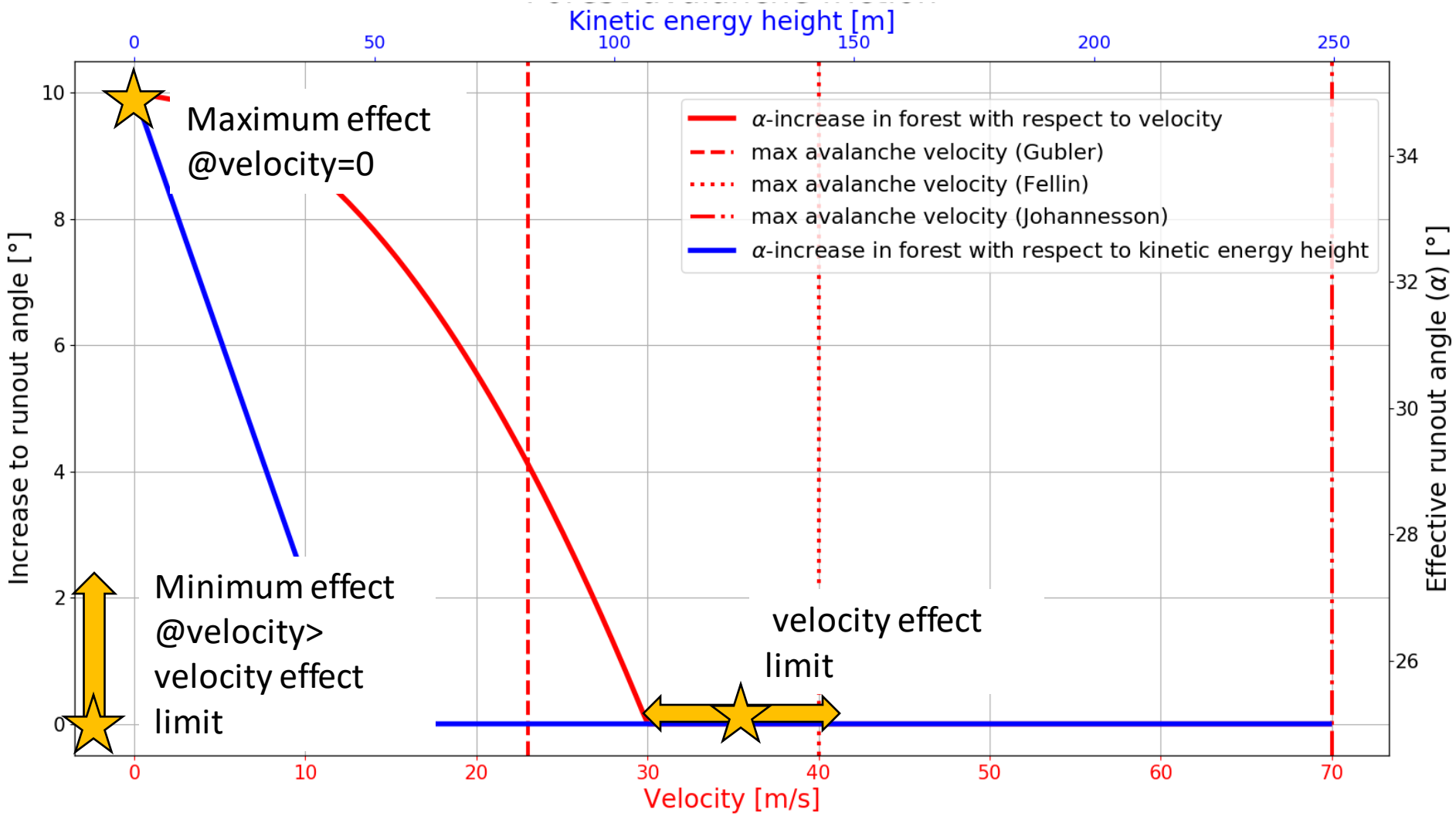


Forest friction



Effect (friction or detrainmnet) is linearly scaled with kinetic energy heigh.

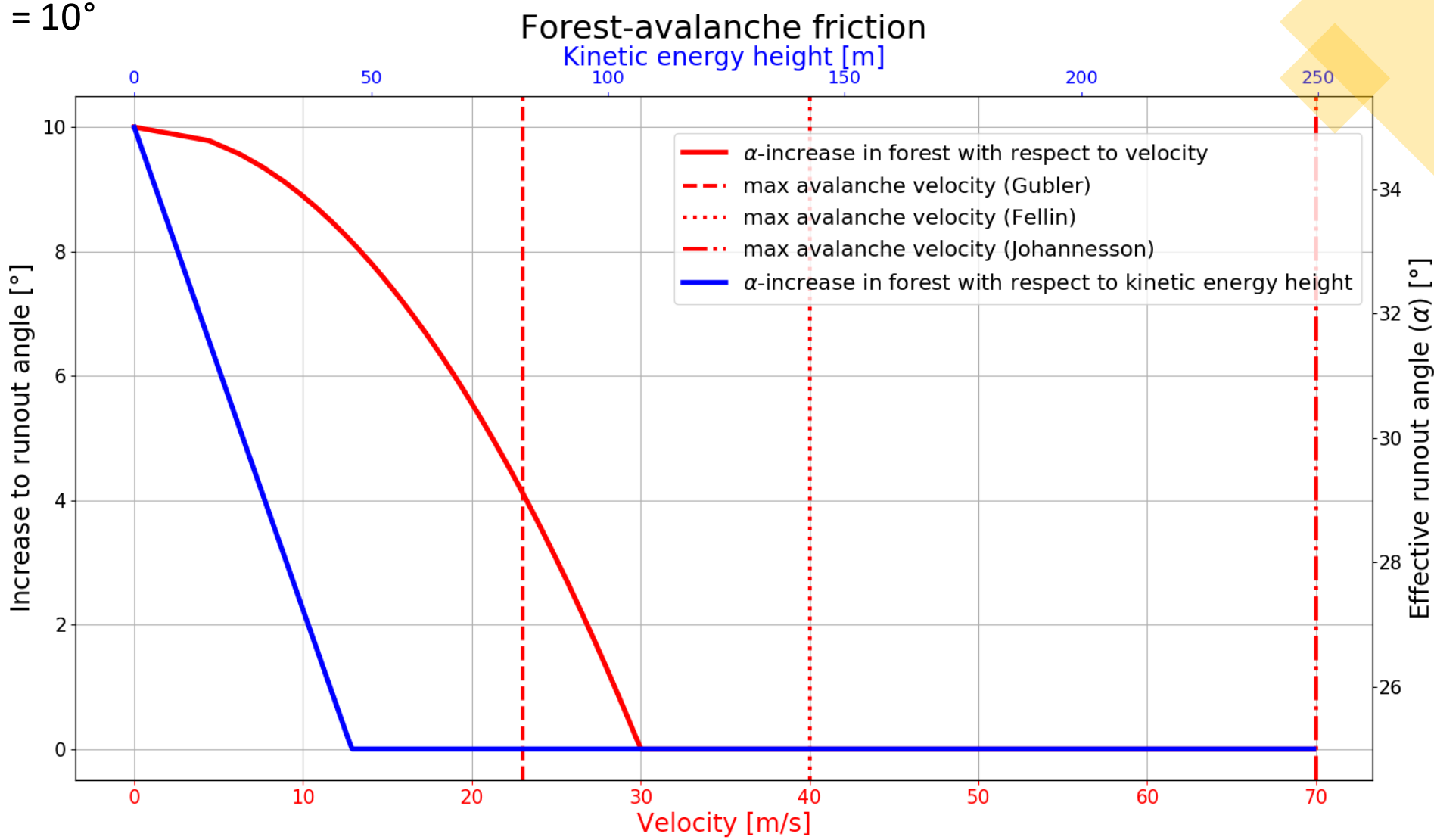
Parameterization for forest effects



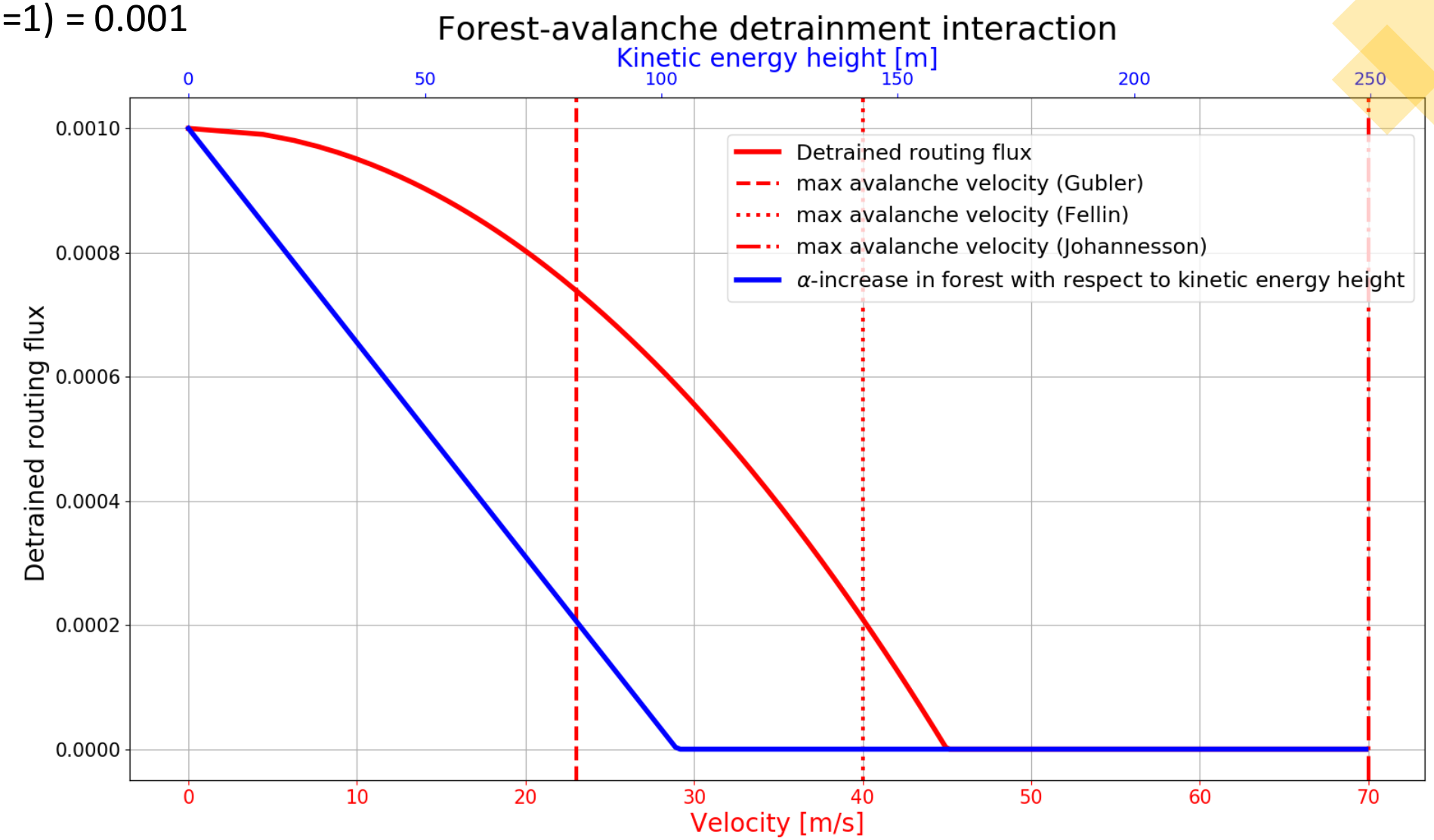
Forest structure index FSI is an index from 0-1 describing how well forest can resist the forces of an avalanche.

Maximum effect is a function of the FSI

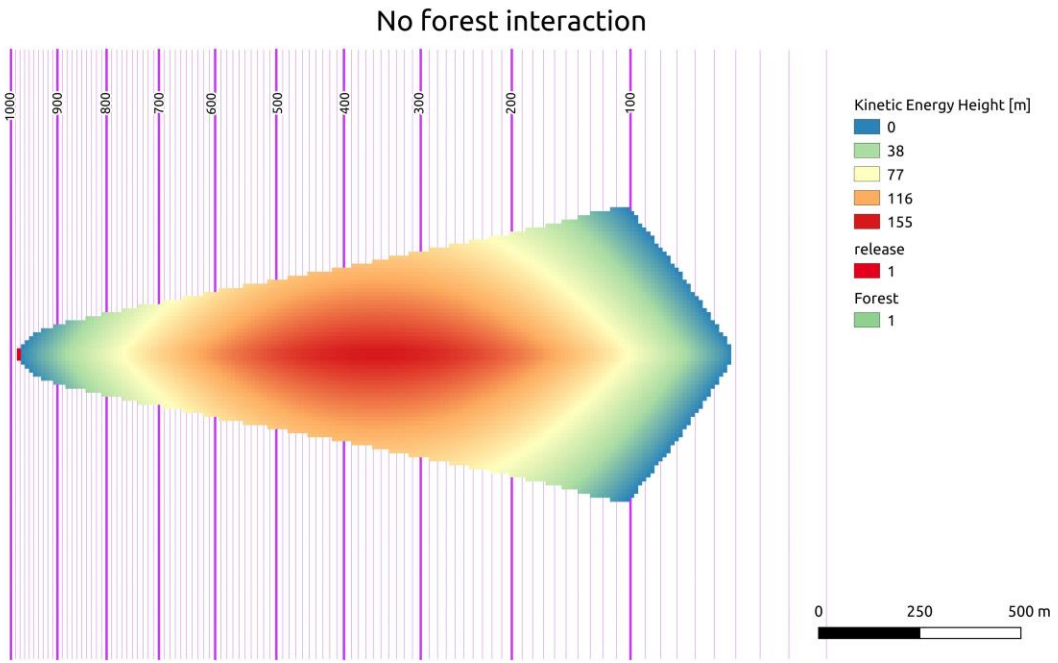
- FSI = 1
- Maximum effect(FSI=1) = 10°
- Velocity effect = 30
- Minimum effect = 0°

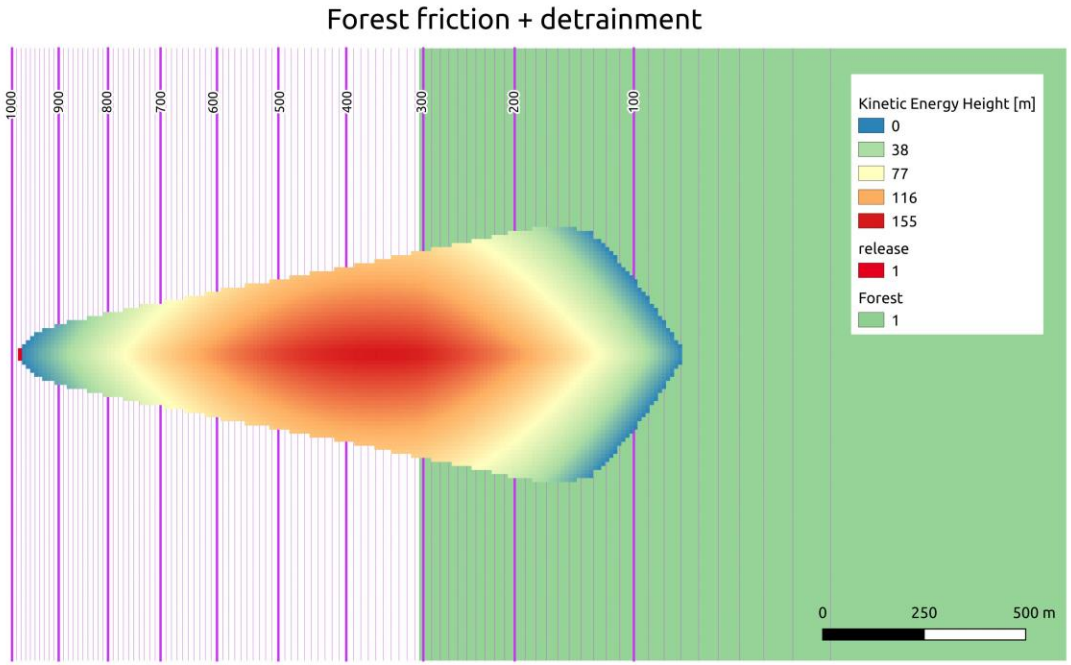


- FSI = 1
- Maximum effect(FSI=1) = 0.001
- Velocity effect = 45
- Minimum effect = 0



Forest interaction





Forest interaction vs no forest interactions