Swiss Danger maps practical course: Rockfalls in Frenières-sur-Bex (Canton de Vaud, Switzerland)

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Study area

The study area is the small village of Frenières-sur-Bex (Bex Community, Canton of Vaud; fig. 1), which is located below a cliff composed of massive Flintstone-bearing limestone (Malm) and thin-bedded quartzitic limestone and marls intercalations (Cretaceous). Several blocks are visible in the fields around the houses (fig. 2 and 3, location on figure 5)

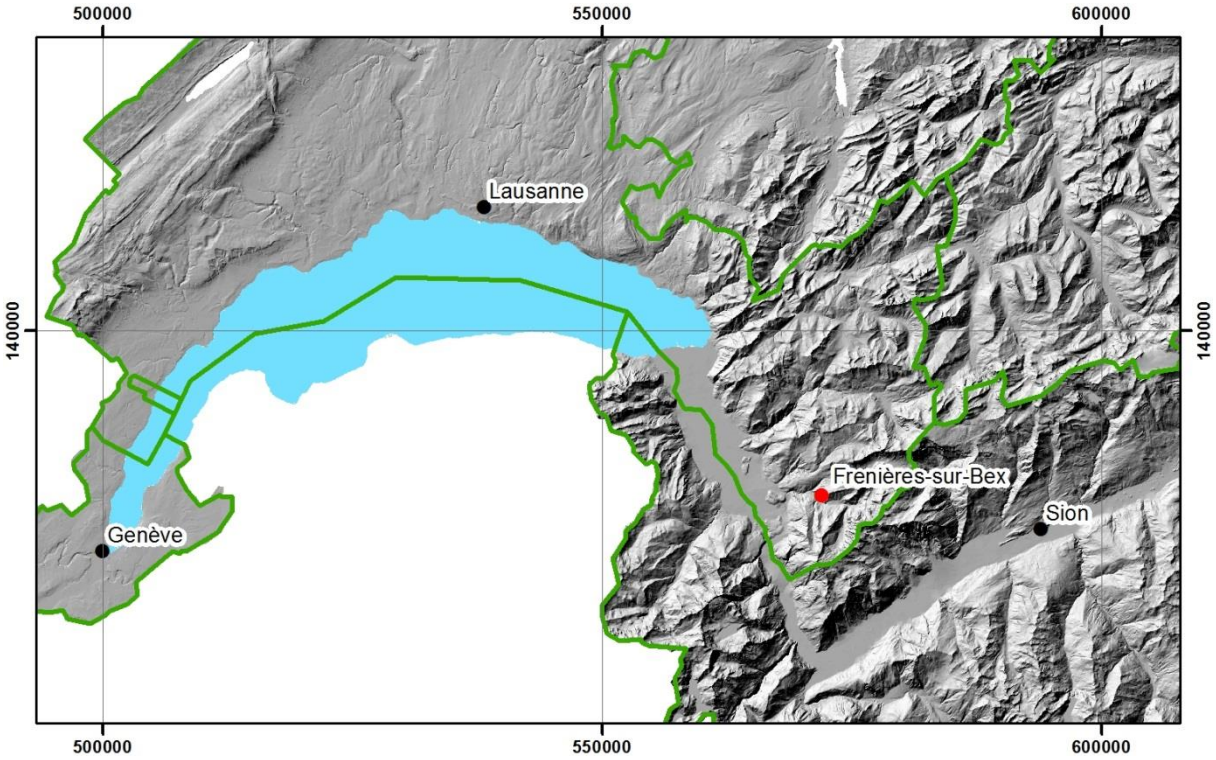


Figure 1: Localization of the study area (coordinates: Swiss metric grid, data: ©Swisstopo)

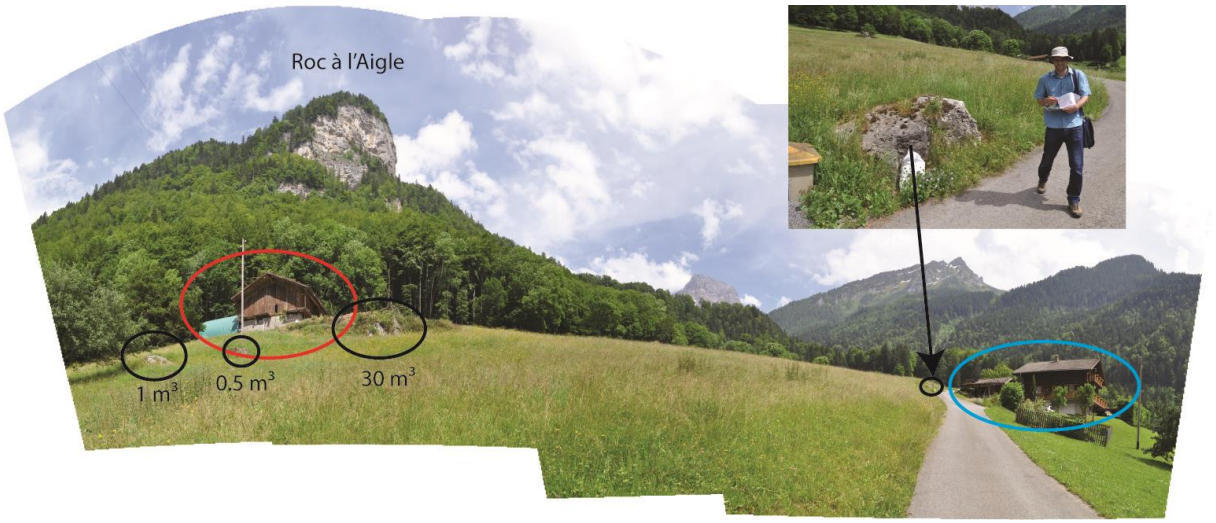


Figure 2: Panoramic view towards the East (picture 1). All blocks are massive limestone

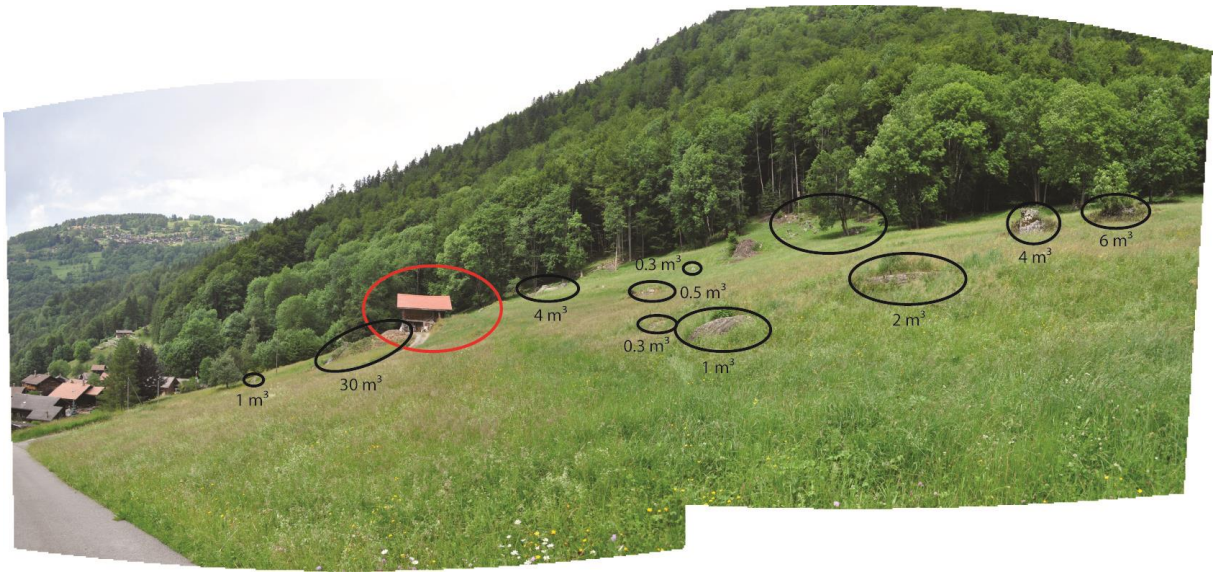


Figure 3: Panoramic view towards the North (picture 2). All blocks are massive limestone

Figure 4: Examples of massive limestone (on the left) and thin-bedded quartzitic limestones and marls intercalations (on the right)

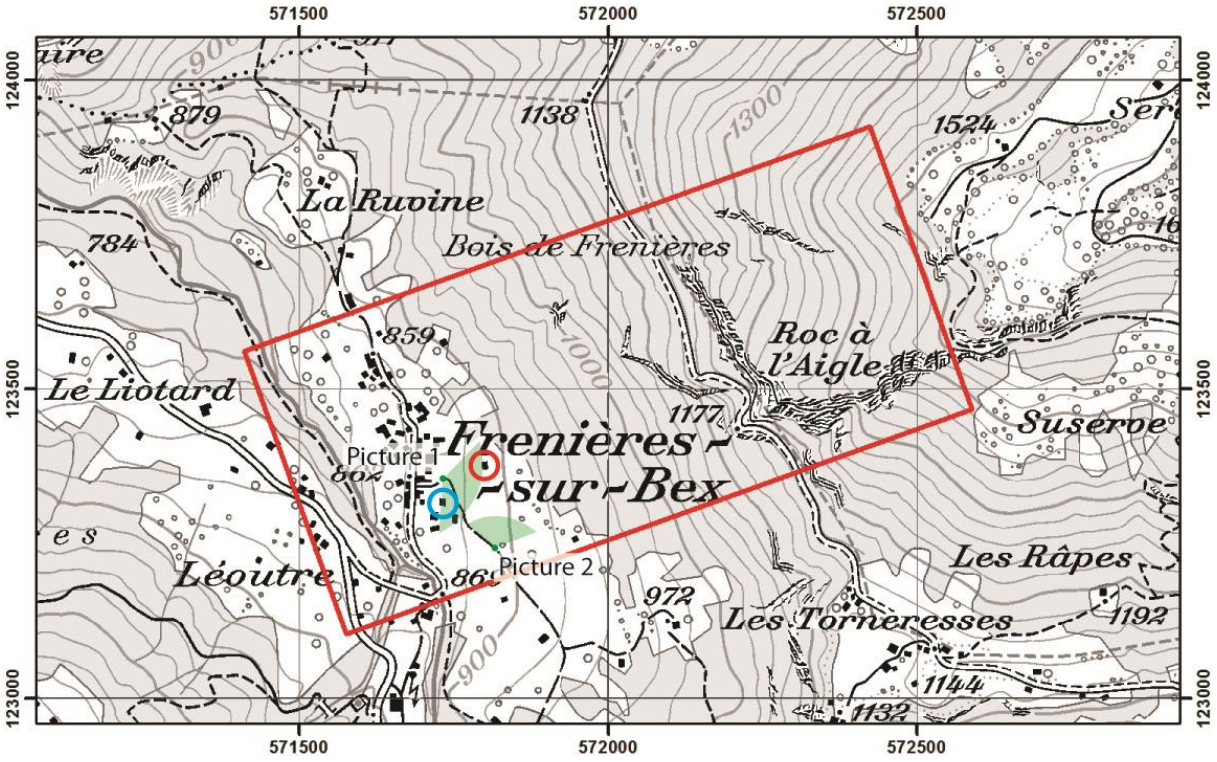


Figure 5: Study area and localization of pictures 1 (fig. 2) and 2 (fig. 3). Red and blue circles are placed around the houses visible on the pictures (coordinates: Swiss metric grid, data: ©Swisstopo)

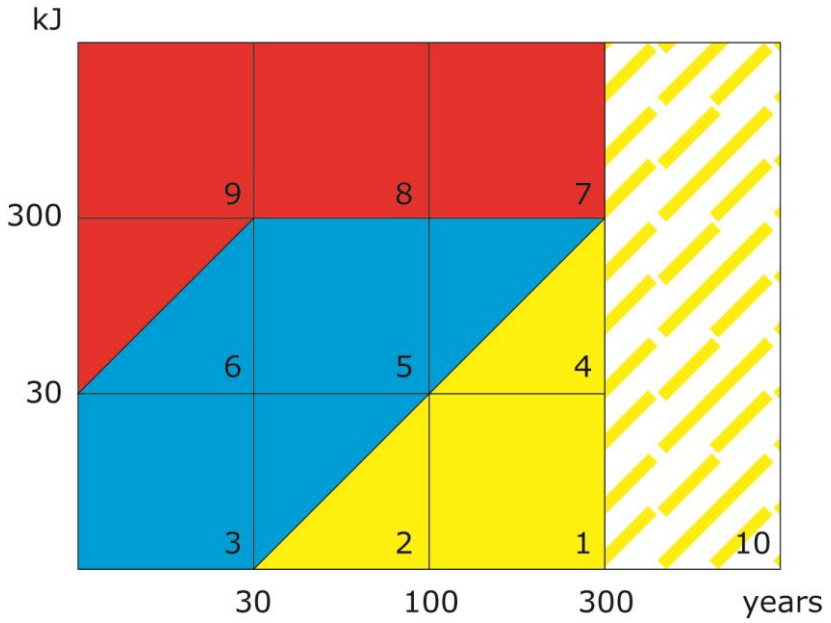
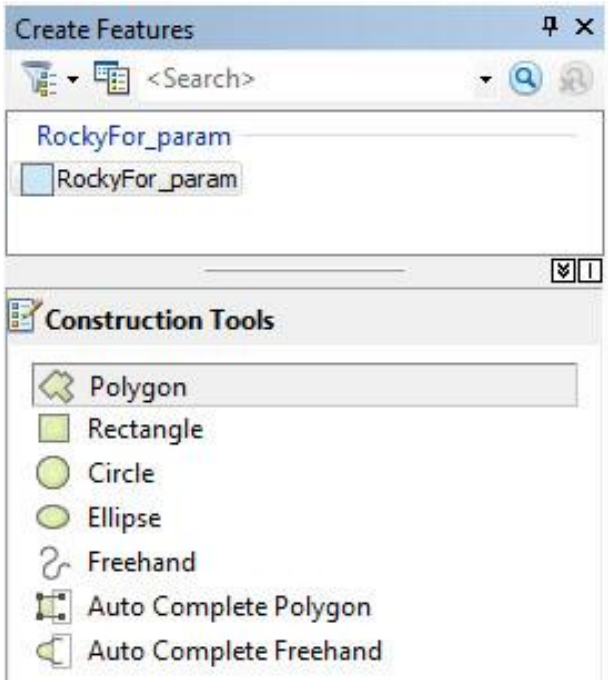


Figure 6: Swiss danger matrix (modified from Lateltin, 1997)

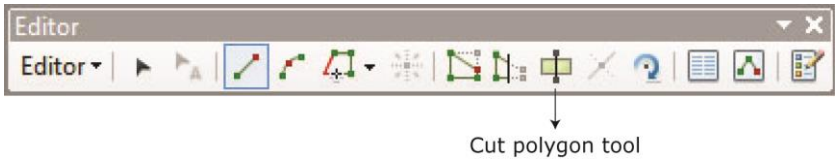
Procedure

1. Estimate the characteristic blocks with 30, 100 and 300 years return period for both lithology based on the field observation (see pictures above), which means the bigger blocks falling with a return period in the considered class. You can use the exponent of the power law given in the course if you want.

2. Prepare a shapefile for *Rockyfor3D* by dividing the area in homogeneous zones (e.g. pasture, outcrop,…). Use the given shapefile for this step (it already contains the study area and the required fields). Fill then the fileds regarding the terrain characteristics in the attribute table with help from *Rockyfor3D* documentation. To edit a shapefile, right-click on the shapfile, then :
    - To add a new polygon, select the layer's template and the desired shape (if the template doesn't exist, right-click on the layer and select Edit features > organize feature template)

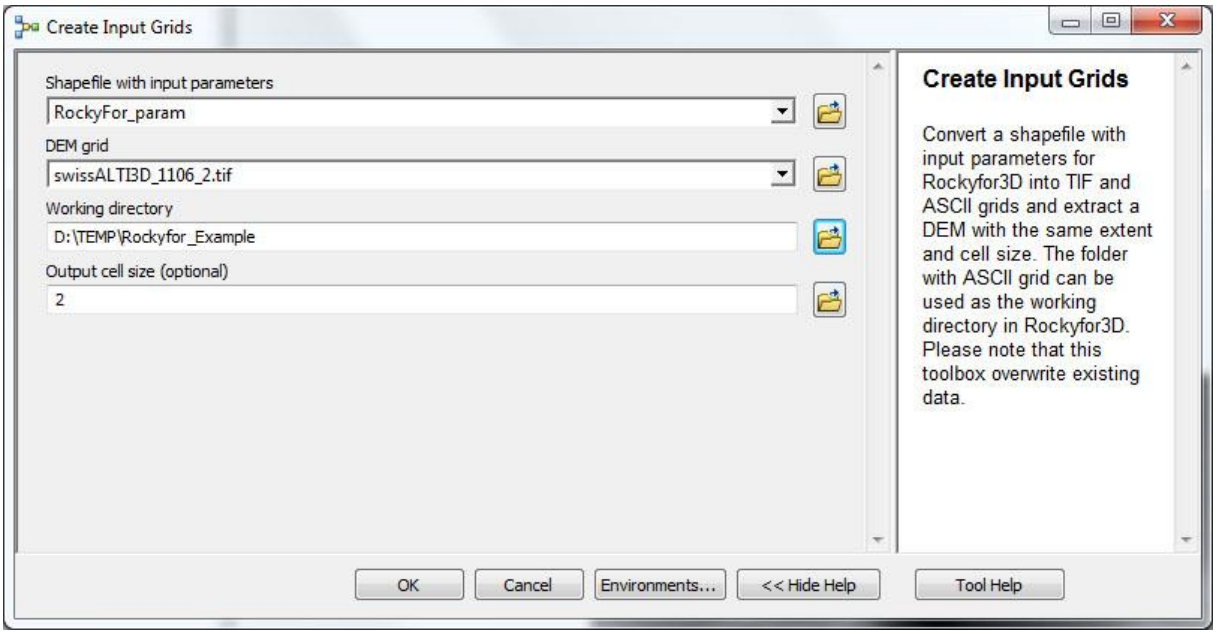


    - To cut a polygon, use the *cut polygon* tool in the *Editor* toolbar. It is recommended that you first create a square polygon of the study area and then divide it into zone according to the ground properties.

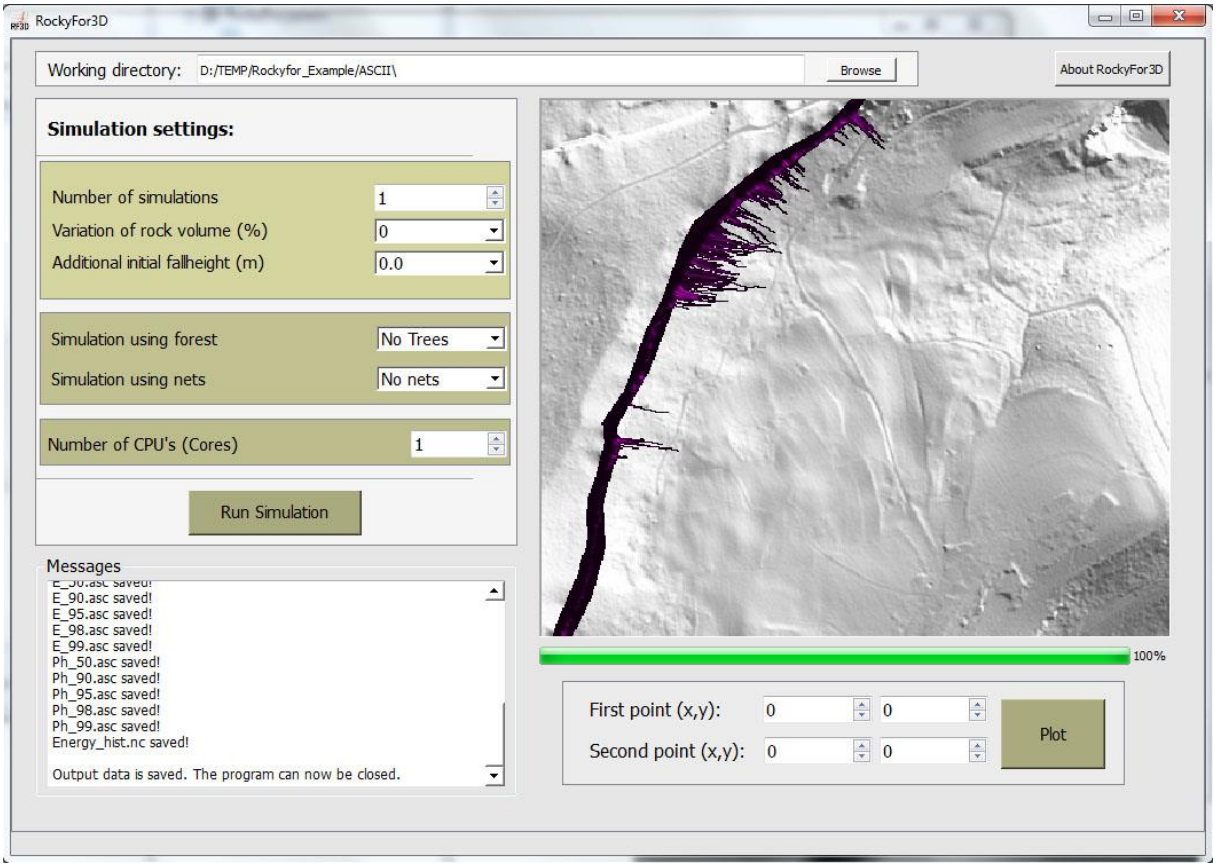


3. Make two copy of the shapefile, then edit the block characteristics (one shapefile for each scenario)
4. Transform the three shapefiles in ASCII grids with help from *Pimp My Rockyfor* toolbox (*Create Input Grids* tool)[1]. A DTM file is also prepared by the toolbox. Make one working directory for each scenario.

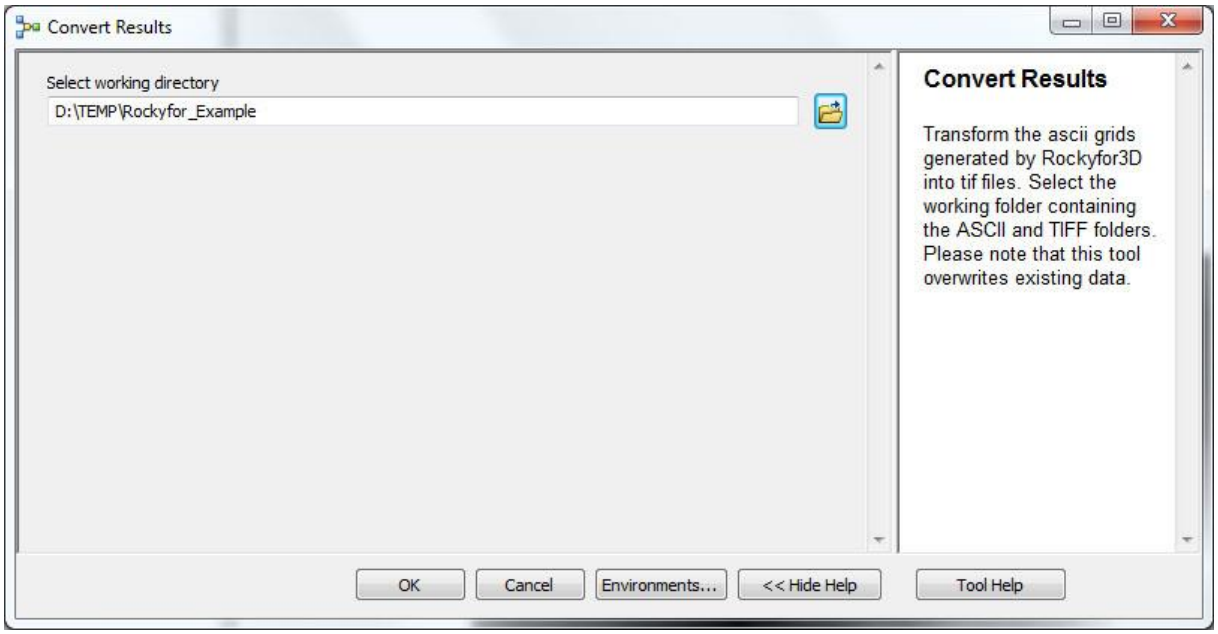
[1] To add the toolbox in ArcMap, open the toolbox window, right-click and select Add toolbox…



5. Perform a trajectographic study in *Rockyfor3D* for each scenario and compare the results with the observed blocs. Modify the parameters if needed.



6. Import the results in ArcGIS using the *Pimp my Rockyfor*'s *Convert Results* tool (opening arcii grids directly in *ArcMap* is possible, but not recommended)



7. Classify the energy grids "E95CI" according to the thresholds of the Swiss methodology (0-30 kJ, 30-300 kJ, >300 kJ)
8. Draw an intensity map for each scenario For this step, you have to simplify the "E95CI" result grid by smoothing the limits and removing (if necessary) outlying trajectories. Use the existing shapefiles (IntensityMap_T30,…) and fill the attribute table with the corresponding intensity (0=null, 1=low intensity, 2=medium intensity, 3=high intensity).
9. Draw a hazard map by combining all intensity maps. For this step, you can use the *AutomaticDangerMap* tool in the *DangerMap* toolbox. You can add manually a Yellow-white zone, if you want, based on the Conefall maps (Geometric methods)
10. Discuss the results in terms of implications for the element at risk. You can use the Siegfried map, drawn between 1870 and 1926 to discuss the evolution of the village.