Engineering Risk Analysis Group
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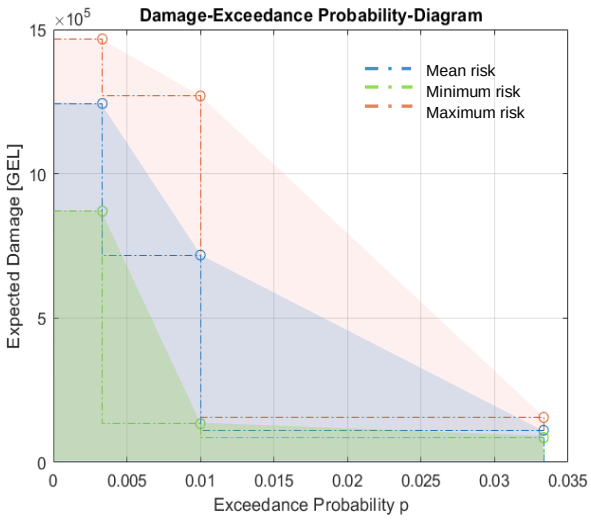
MSc thesis

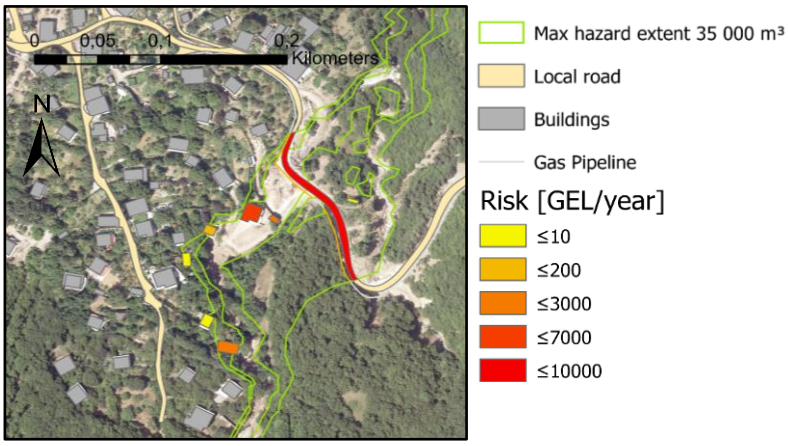
Debris Flow Risk Analysis for Akhaldaba, Georgia

Leena Warmedinger, July 2020

Background

A disastrous landslide event in June 2015 near the village Akhaldaba caused widespread damage to Georgia's capital Tbilisi and the surrounding areas. Rehabilitation works and investigations in the aftermath of the event revealed that the hillside area around the detachment zone and the village are prone to further mass movements and debris flows. The resulting risk potential to Akhaldaba has however not been assessed yet. Thus, the aim of this study is to determine the risk of direct damage to the infrastructure from debris flows.





Left: Damage-Exceedance Probability diagram, where a small, medium and large debris flow with increasing event magnitude and decreasing recurrence period are used to approximate the 'risk curve' in order to quantify the risk. The colored areas correspond to the risk to Akhaldaba in dependence of the minimum, maximum or mean debris flow magnitude defined in each scenario.
Right: Risk map for Akhaldaba indicating the risk as annual expected damage in Georgian Lari per object for the affected buildings, a local street and an above surface gas pipeline.

Methodology

Three scenarios are established based field work and empirical formulas, which each specify a range of plausible debris flow magnitudes and return periods. Using the numerical simulation software RAMMS, the hazard potential is determined. The vulnerability for the exposed infrastructure is derived from vulnerability curves or tabular values. This allows to quantify the damage potential attributed to each scenario and the resulting risk.

Conclusion

The mean risk from the direct damage to the infrastructure amounts to around 20 000 Georgian Lari GEL per year in Akhaldaba. However, through uncertainties in the assessment the risk may deviate by half from the mentioned value. The most sensitive factor is the event magnitude defined in the scenarios, whereas the choice of the calculation mode, the vulnerability curves and the return period of the large scenario are little sensitive to the result.

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