Highlights

In the face of climate change, the assessment of future landslide exposure is of prime importance for maintaining the **free and uninterrupted movement** of persons and freight, especially in mountainous areas.

Rainfall periods exceeding certain thresholds have been used as a **proxy** for landslide occurrences.

Results indicate overall increases of landslide occurrences throughout Europe.

Implications are illustrated at the example of a particularly risk-prone area located at the tripoint of France, Germany and Switzerland in the Upper Rhine Valley.

Landslide-inducing rainfall events

Fig. 1 and 2 show the projected changes in the annual number of periods exceeding rainfall thresholds for the possible occurrence of landslides (RR > 25.6 mm/d and RR > 37.3 mm/3d), based on SRES A1B.

The first row of each figure refers to the **near future (2021-2050)**, the second row displays projection results for the **remote future (2071-2100)**. The three columns represent the **quartiles** in increasing order.

Figure 1: Future landslide exposure for the central European road network

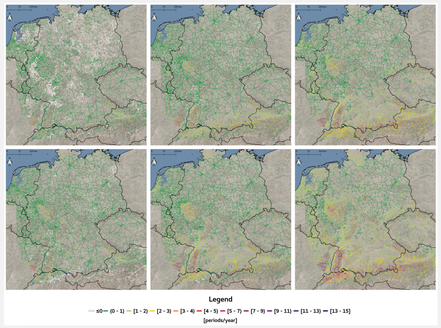
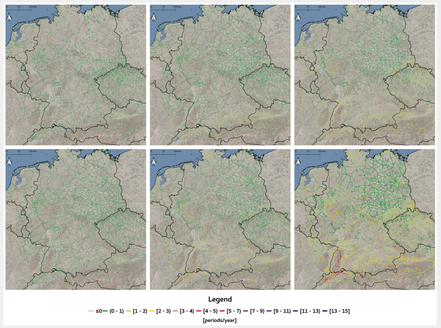


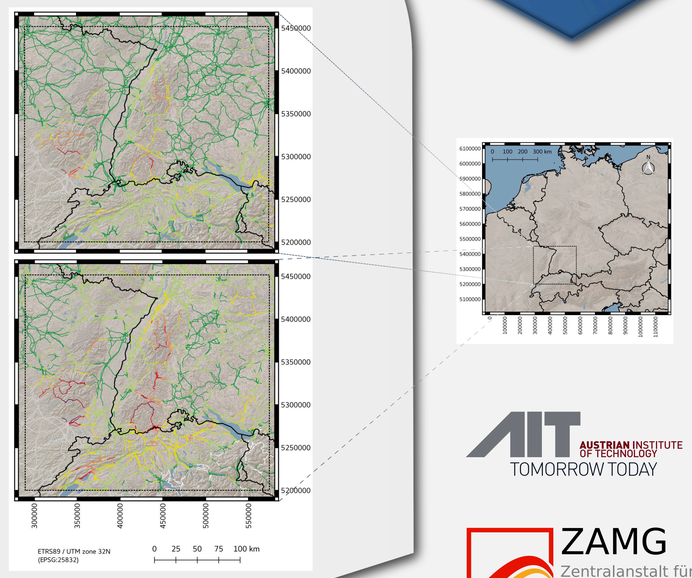
Figure 2: Future landslide exposure for the central European railway nework



Future Landslide Exposure

While flat terrain at low altitudes exhibits an increase of about one more potentially landslide-inducing rainfall period per year until the end of this century, **higher elevated regions are more affected** and show increases of up to 14 additional periods. This general spatial distribution emerges already in the near future (2021-2050) but gets **more pronounced in the remote future** (2071-2100).

Figure 3: Target region: Prediction of landslide exposure in (a) the near future (2021-2050), (b) the far future (2071-2100).



Landslide Exposure of Europe's Road and Rail Infrastructure in a Changing Climate

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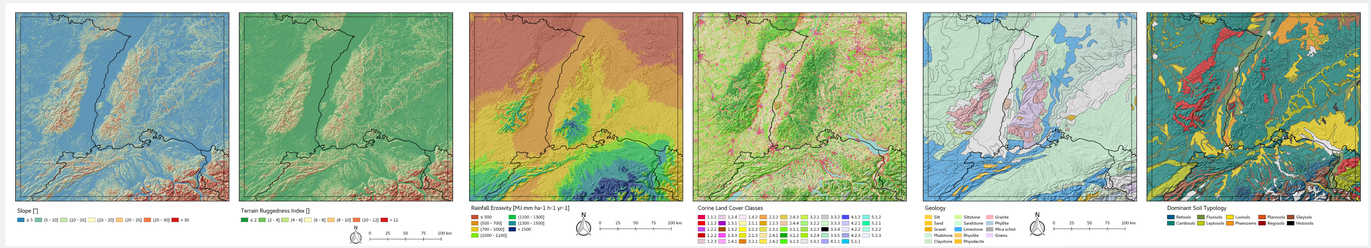
Figure 5:
(a) Slope, (b) Terrain Ruggedness Index, (c) Rainfall Erosivity, (d) Land Cover, (e) Geology and (f) soil in the target region.



Conclusions

Mountainous regions and rolling landscapes – which exhibit the strongest increases in landslide-inducing rainfall periods – are generally particularly **susceptible** to landslides due to their **topographic properties**.

Since land bound transport infrastructure networks in higher elevated regions usually **do not feature redundant elements at comparable economic efficiency**, an increased exposure towards landslide-inducing rainfall events is likely to have **potentially severe impacts on alpine communities** if **appropriate adaptation measures** and precautions are neglected.

Schlögl, M. and Matulla, C. (2018): Potential future exposure of European land transport infrastructure to rainfall-induced landslides throughout the 21st century.
Nat. Hazards Earth Syst. Sci. Discuss., in press.
(revised manuscript accepted for NHESS)
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2017-393/

Geophysical Properties of the Target Area

In order to provide a more expressive landslide susceptibility evaluation, additional static **information on topographic, geologic and landscape properties** is needed. In addition to the increased exposure from a climatological point of view, the respective properties of the target area indicate **preconditions that are favorable for the occurrence of landslides**.

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