Modeling past and future landslide occurrences after extreme weather events in the Styrian basin, Austria

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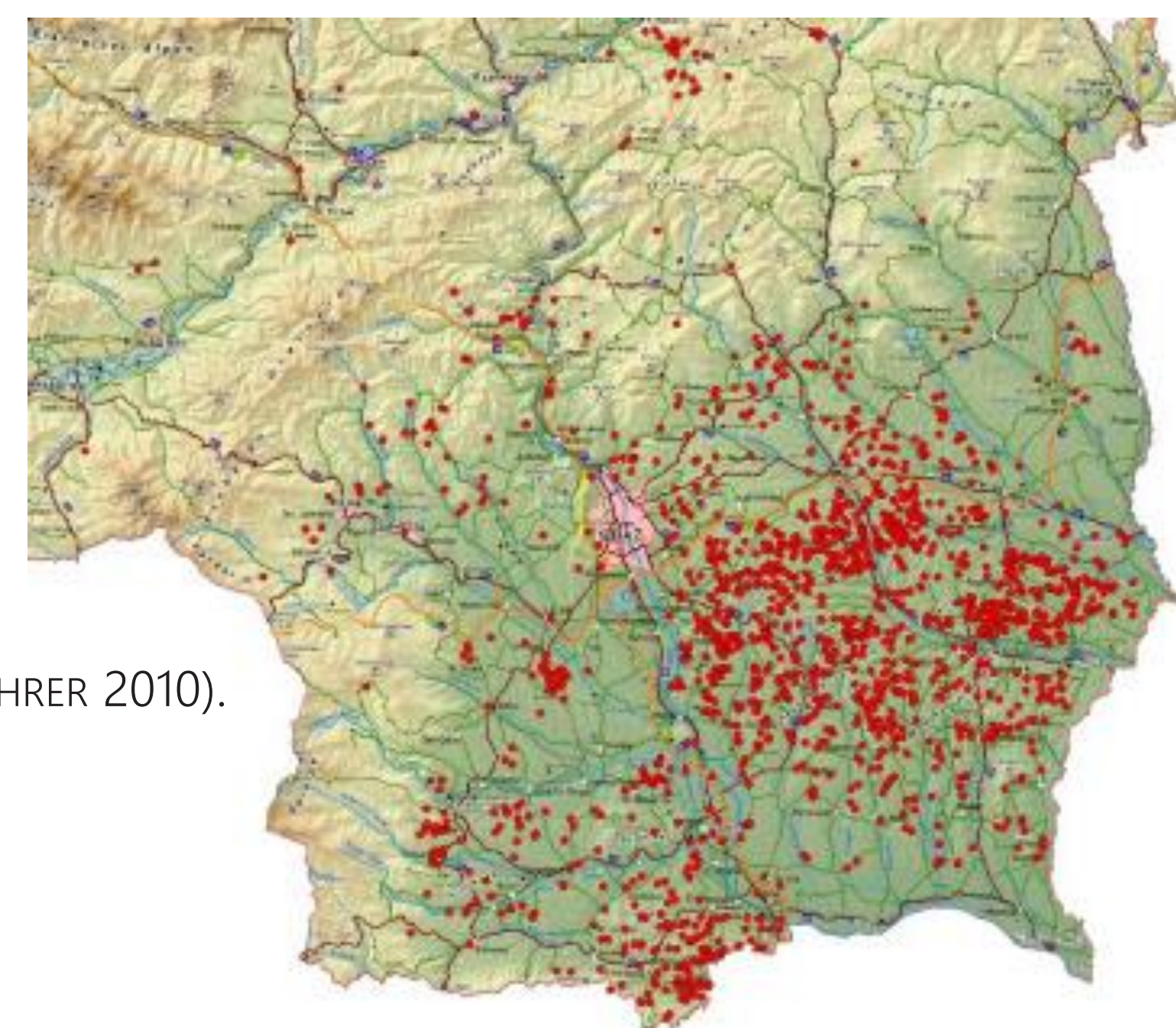
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Landslides in the Styrian basin, Austria

In June 2009 an extreme event of heavy thunderstorms happened in the Styrian basin, Austria, triggering thousands of landslides. Detailed field mapping of the landslides executed by the Geological Survey of Austria, focused on the 730 km² region of Feldbach where more than 3000 landslides could be recorded. In September 2014 after a similar but less severe event, again a high number of landslides occurred in the Styrian basin.

Our **objective** in the ongoing project is to analyse the impact of the extreme weather events on the probability of landslide occurrences in the Styrian basin by developing a statistical model linking meteorological variables to slope failure.

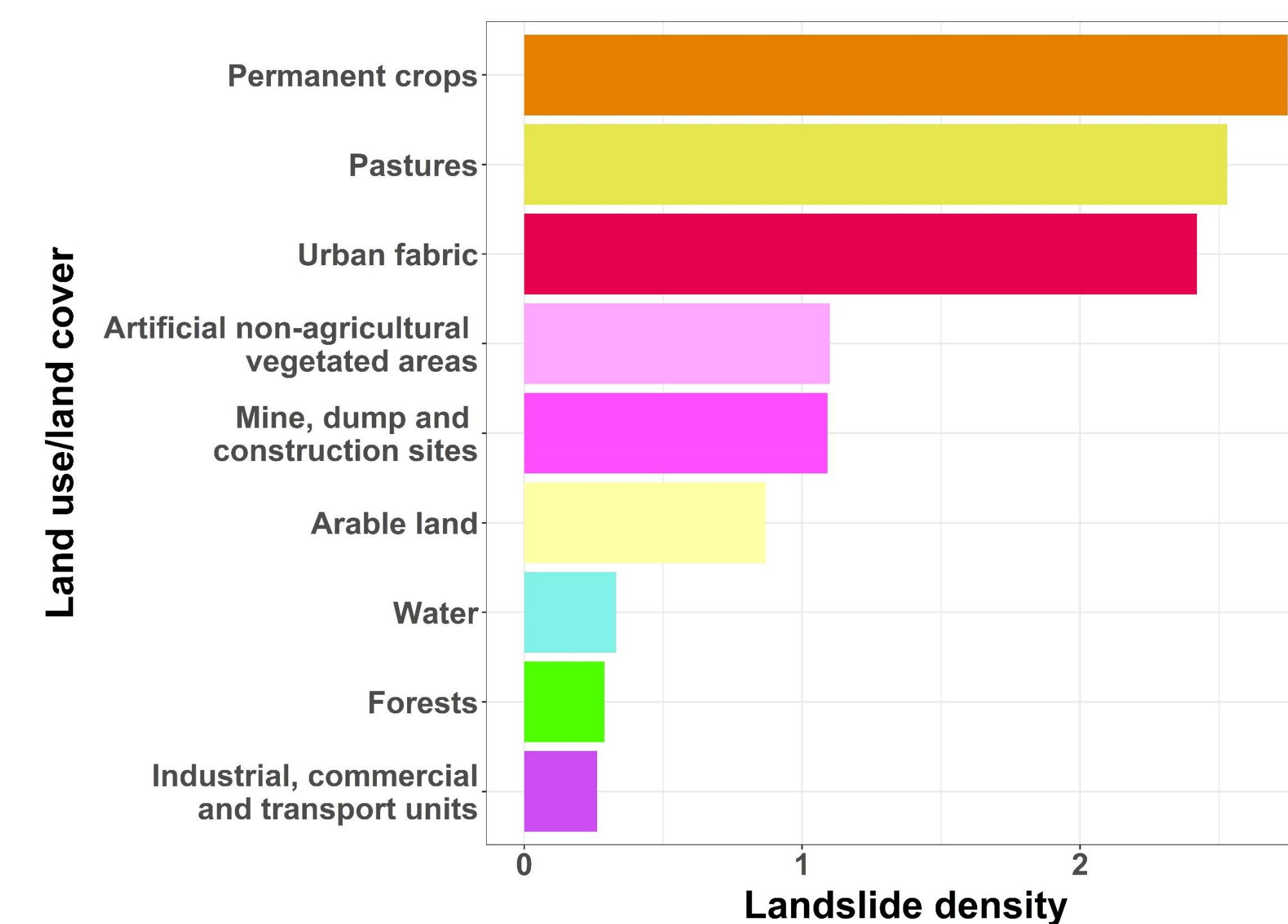Source: Geological Survey of Austria.

Study area
(Hornich & Adelwöhrer 2010).

Data

- event-based inventory (2009: 759 points, 2014: 176 points)

- local land-surface parameters derived from LiDAR-DTM

- hourly precipitation data, INCA, Zentralanstalt für Meteorologie und Geodynamik (ZAMG), Austria
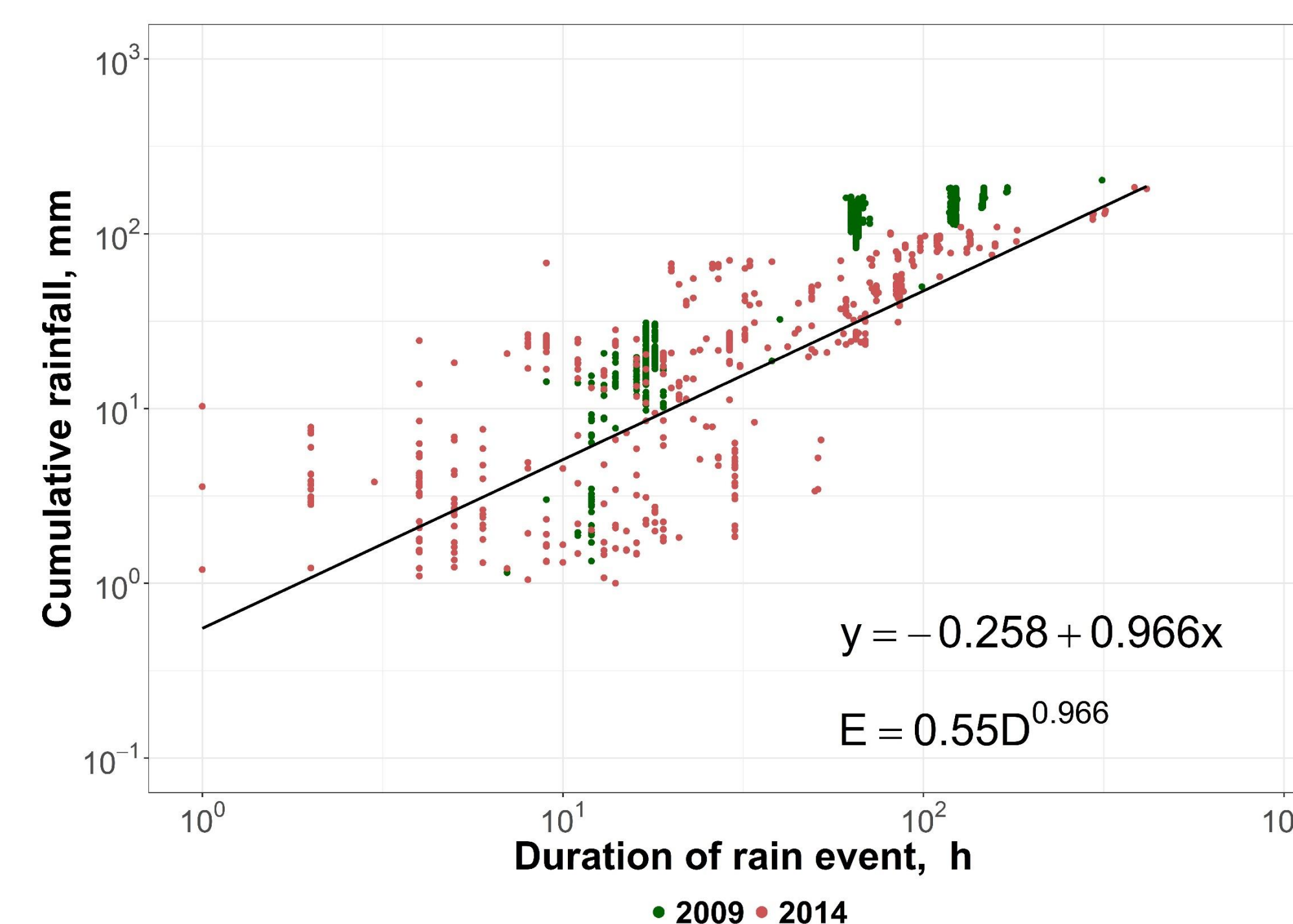
Exploratory data analysis

Landslide density

Landslides were recorded when economic damage arose. Therefore, inventory shows anthropogenic footprint. Land use/land cover data is aggregated according to CORINE Land cover nomenclature.
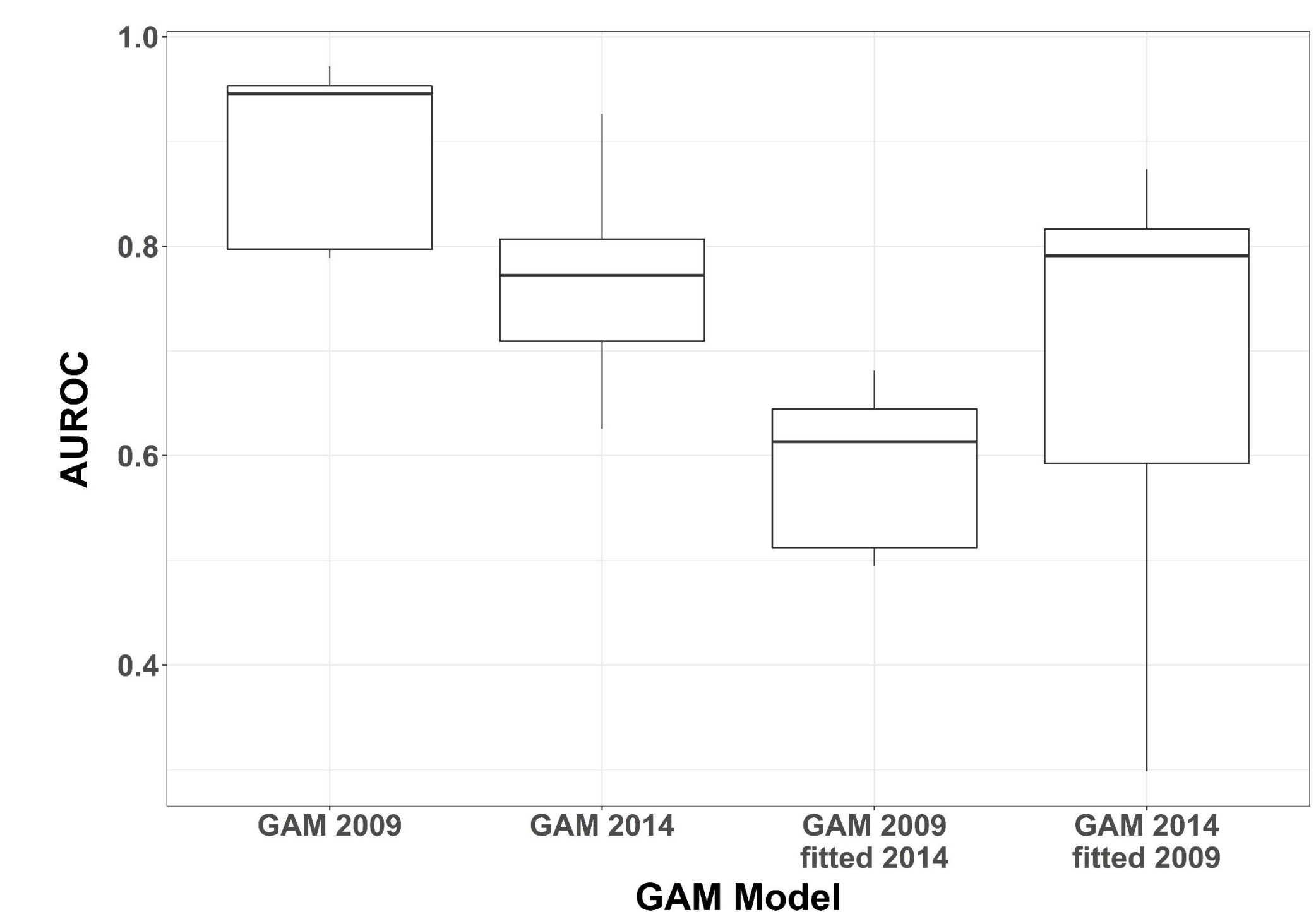
Landslide rainfall event and threshold

$$y = -0.258 + 0.966x$$

$$E = 0.55D^{0.966}$$

• 2009 • 2014

Rainfall events are extracted according to Melillo et al. 2015. Rainfall threshold shows 5% non-exceedance probability level, and is computed using frequentist method with least square fit (Rossi et al. 2017). Computation is automatized and available in the open-source R-package *Lslide* (Knevels 2017).

Preliminary modeling

The landslide occurrence probabilities are assessed using generalized additive model (GAM) (Petschko et al. 2014). To estimate the model performance we apply spatio-temporal cross-validation, and calculate the area under the receiver operating characteristic curve (AUROC).

AUROC model results computed by 5-fold spatial and spatio-temporal cross-validation using 50 repetitions. Explanatory variables are land-surface parameters (slope, curvature, SAGA wetness index) and rainfall event characteristics (sum, max, intensity).

Outlook

- differentiation between shallow and deep-seated landslides

- exploration of further meteorological variables, such as antecedent precipitation index (API)

- implementation of further variables (geological, soil, land cover/land use)

- integration in future storylines of slope instabilities based on climate and land cover/land use scenarios

References

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