

Soil wetness data for landslide early warning

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Motivation

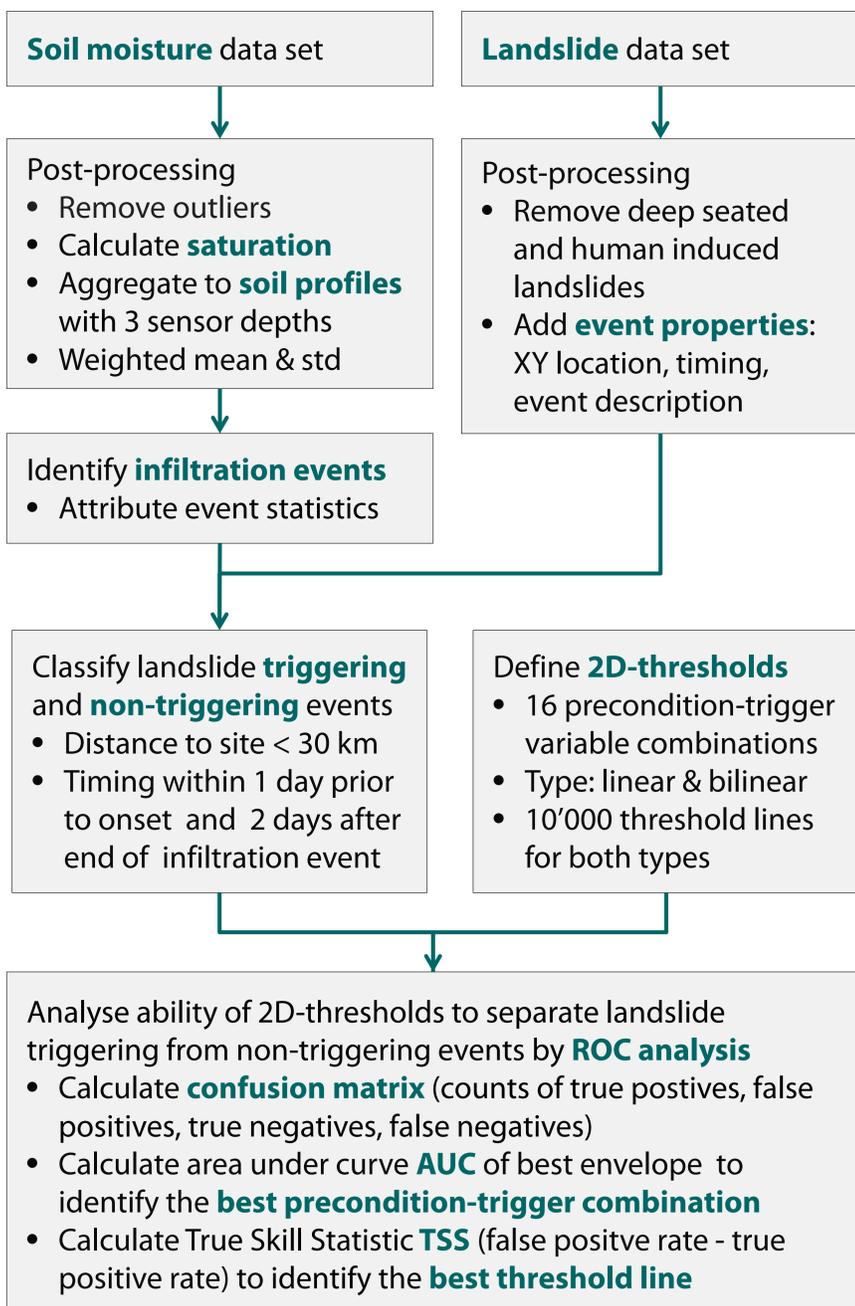


Fig. 1: Shallow landslides and hillslope debris flows in St. Antönien (2005, WSL).

Rainfall triggered landslides pose a risk to people and infrastructure due to their abrupt nature and difficulty to predict. This led to the development of many rainfall based landslide early warning systems (LEWS).

Thresholds based on rainfall only may miss the antecedent wetness state of the soil. Here, the value of **in-situ soil wetness measurements** for their use in a regional LEWS is assessed. A comprehensive set of soil moisture measurements in Switzerland is analysed to find statistical values preceding **observed landslide events**.

Methodology



Data base

Soil moisture: 34 sites, 300 water content sensors, 2 to 10 years of records, 1 hour resolution

Landslides: 441 events since 2008

- Soil moisture sites**
 - ETH - SwissSMEX
 - WSL - LWF
 - UniFr - SOMOMOUNT
 - Cantons
 - Pilot project FOEN
- Landslides**
 - WSL - Damage Database

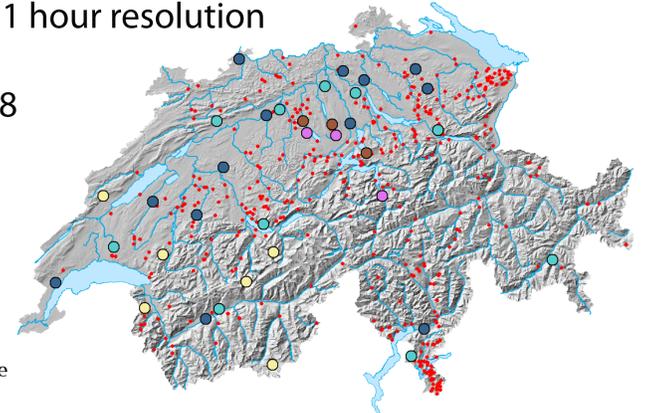


Fig. 2: Map of Switzerland showing the soil moisture sites (filled dots) and landslide events (red dots).

Infiltration events

Infiltration events are delimited by **onset** and **peak** of the weighted mean time series. **Event statistics** (e.g. 2-week/4-week-preceding max, antecedent, peak or delta of mean and std time series) are calculated.

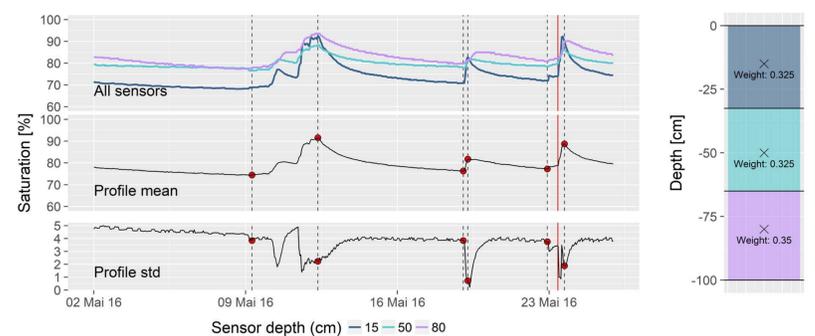


Fig. 3: Saturation time series at Novaggio of all profile sensors (top), profile mean (middle) and standard deviation (bottom), and sensor weighting (right). Red dots show infiltration event limits and the red vertical line shows a landslide event.

ROC analysis

First results show that the semi-automated procedure is capable to identify **meaningful precondition-trigger combinations** for this soil moisture dataset (Fig. 4). To find robust thresholds however, infiltration events will be **combined** to larger units. Further, other thresholds and different classification methods will be tested.

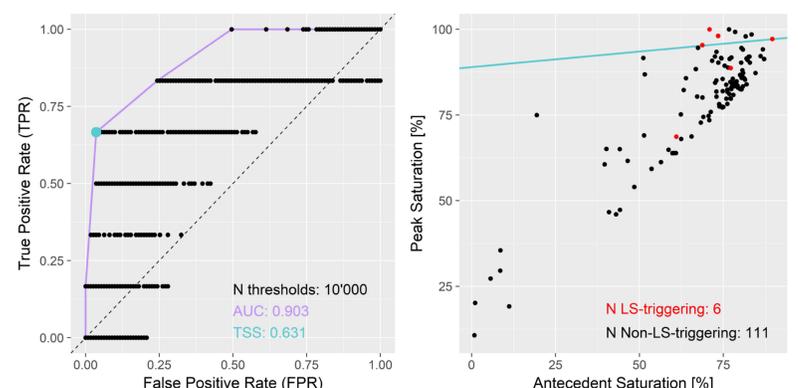


Fig. 4: Results for antecedent vs. peak saturation with a linear threshold at Novaggio. Left: ROC plot (FPR vs. TPR) showing the best envelope (purple) and the best threshold variation using TSS (blue). Right: Scatter plot (antecedent vs. peak saturation) showing the best threshold variation using TSS (blue). Landslide triggering events are denoted in red.

