

Automatic Mapping of Soil Erosion on Swiss Grasslands using Deep Learning Methods

«Methodenentwicklung zur automatisierten Kartierung von Bodenerosion auf Dauergrünland»

Project funded by the Federal Office for the Environment (FOEN/BAFU)

Duration: September 2021 – September 2024



Fig. 1 Shallow landslides on grassland slopes

Grassland is the dominant land-use cover in the Swiss Alps and is mainly used for pastures and meadows. The combination of agricultural practices and steep terrain with harsh climate conditions make the fragile alpine soils susceptible to erosion. With changing land-use practices (e.g., more intensely used pastures in some regions versus abandoned sites in other areas) and changing climate conditions (e.g., changing snow dynamics, intense precipitation events, droughts), soil erosion becomes an increasing threat.

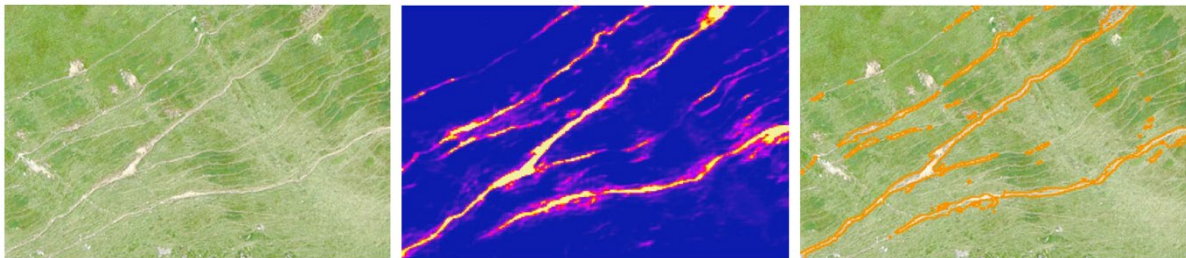


Fig. 2 Example of mapping results for livestock trails (panel 1: aerial image, panel 2: heat map result of deep learning algorithm, panel 3: final mapped livestock trails)

The aim of this project is to develop an automated monitoring tool able to identify and map soil erosion features on aerial images (Swisstopo) based on deep learning algorithms. We locate degraded sites and assign classes to these sites by identifying the most likely erosion form (shallow landslides, sheet erosion) or triggering factors (livestock trails, degradation by land-use management).

The overall goal is to better understand the current state and spatio-temporal dynamics of soil erosion processes in Swiss mountain grasslands (starting from 1998) and identify hot spot areas in need of mitigation. The results of this monitoring tool will be used by national agencies (FOEN) as well as local governmental agencies (cantons) to identify soil erosion issues and develop sustainable mitigation strategies.

Related Publications

Zweifel, L., Meusbürger, K., Alewell, C.: Spatio-temporal pattern of soil degradation in a Swiss Alpine grassland catchment, *Remote Sens. Environ.*, **2019**, 235, 111441

<https://www.sciencedirect.com/science/article/pii/S0034425719304602?via%3Dihub>

Samarin, M., Zweifel, L., Roth, V., Alewell, C.: Identifying Soil *Erosion Processes in Alpine Grasslands on Aerial Imagery with a U-Net Convolutional Neural Network*. *Remote Sens.* **2020**, 12, 4149

<https://www.mdpi.com/2072-4292/12/24/4149>

Zweifel, L., Samarin, M., Meusbürger, K., and Alewell, C.: Investigating causal factors of shallow landslides in grassland regions of Switzerland, *Nat. Hazards Earth Syst. Sci.*, **2021**, 3421–3437

<https://nhess.copernicus.org/articles/21/3421/2021/>

Zweifel, L.: Identifying Soil Erosion Processes in the Alps using Machine Learning Techniques. Doctoral Dissertation, University of Basel, **2021**.

https://edoc.unibas.ch/85227/1/Dissertation_Lauren_Zweifel.pdf