

## PROJECT DESCRIPTION

[S. Schmidt](#); [K. Meusbürger](#); [P. Panagos](#); [C. Alewell](#)

### Soil Erosion Risk Modeling in the Alps –

### ERK<sub>Berg</sub> as a Prototype of ERK2 for mountain zones III, IV and summering grazing zones

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

Grant numbers N° N222-0350 & N° P182-1535

Duration: March 2015 – December 2018

Soil Erosion on grassland is generally neglected due to the protective character of dense grass vegetation on soil loss. However, recent studies by [MEUSBURGER et al. \(2010\)](#), [KONZ et al. \(2012\)](#) and [ALEWELL et al. \(2013\)](#) show that large amounts of topsoil are mobilized also on grassland in the alpine areas (Fig. 1).



Figures 1: Soil Erosion in the Swiss Alps

A soil erosion modeling approach for arable land (Erosionsrisikokarte ERK2; [Prasuhn et al. 2013](#)) was already realized by the *Centre for Development and Environment University Bern* and *Agroscope Reckenholz*. To complement the ERK2-results and to create a **nationwide soil erosion risk map**, a risk assessment for the (alpine) grassland will be realized by geospatial modeling.

According to a comprehensive approach, the model is based on the Revised Universal Soil Loss Equation (**RUSLE**) by [WISCHMEIER & SMITH \(1978\)](#). The general soil-loss-equation of RUSLE is a function of five factors:

$$A = R * K * LS * C * P$$

Where A is the mean long-time soil loss in  $t\ ha^{-1}\ yr^{-1}$ , R the rain erosivity factor, K the soil erodibility and the parameters L and S describe the length and slope of the relief. C is the cover and management factor, P is a factor for protection and soil conservation.

The main task of the ongoing project is the **adaptation of the model parameters** which aren't generally accepted for steep slopes and grassland in alpine areas. Furthermore, the project aims the investigation of **spatial AND temporal** soil erosion patterns by a dynamic soil erosion risk assessment.

The **monthly rainfall erosivity** of Switzerland, based on 87 automated gauging stations and a regression kriging approach, revealed spatial and temporal pattern with highest R-factors in summer (Fig.2; [SCHMIDT et al. 2016](#)). A proportion of 62% of the total annual sum of rainfall erosivity affects soils within a time period of 4 months (June, July, August, and September) (Fig. 3).

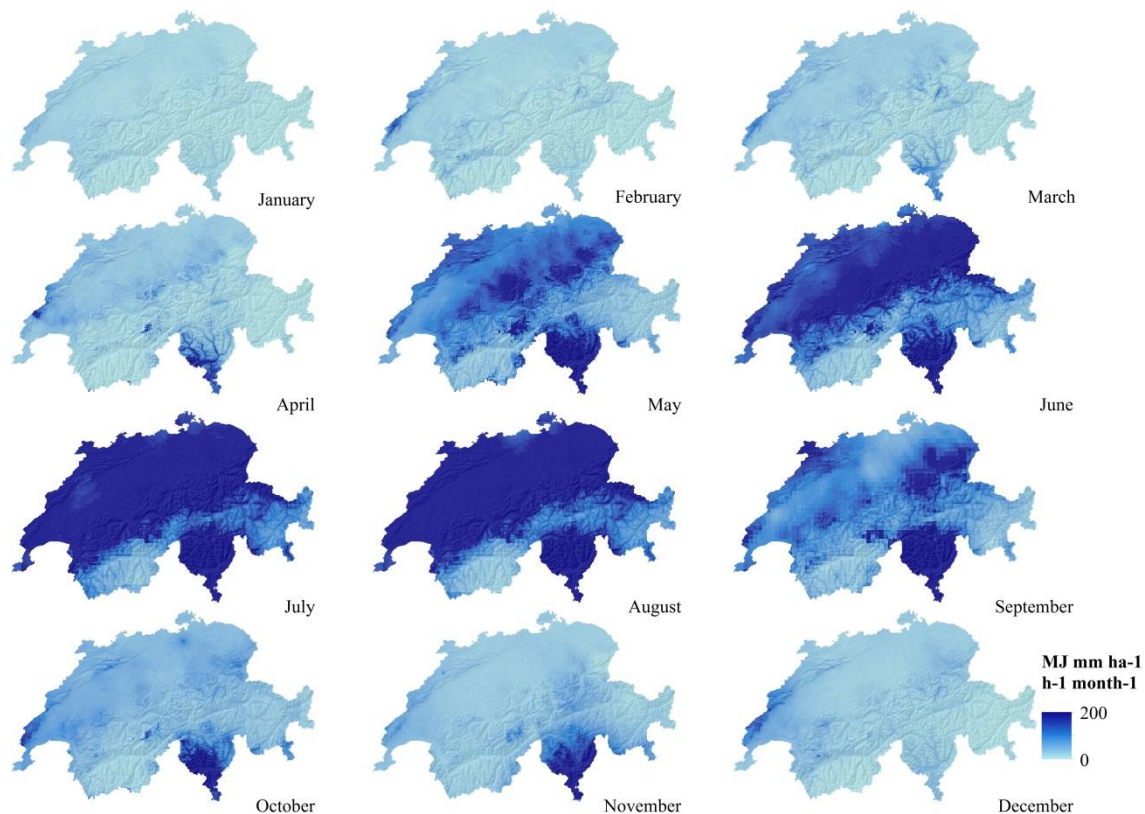


Figure 2: Monthly rainfall erosivity maps for Switzerland derived by regression-kriging ([SCHMIDT et al. 2016](#))

The increase of spatial and temporal resolution of remote sensing datasets enabled the mapping of **C-factors** on a monthly scale. We used an orthophoto with a spatial resolution of 0.25m (Swissimage FCIR) and a time-series of the fraction of green vegetation cover with a temporal resolution of 10-days (FCover) to calculate the dynamics of the C-factor on Swiss grassland. The annual average C-factor of all Swiss grassland is 0.012 (Schmidt et al. in review a). A **national map of Swiss grassland** and Swiss permanent grassland was presented for the first time (SCHMIDT et al. in review b).

The national **soil erodibility** map of Switzerland is based on digital soil mapping with 199 Land Use/Cover Area frame Survey (**LUCAS**) topsoil samples. The mean national K-factor for Switzerland is  $0.033 \text{ t ha h ha}^{-1} \text{ MJ}^{-1} \text{ mm}^{-1}$  (SCHMIDT et al. in prep.).

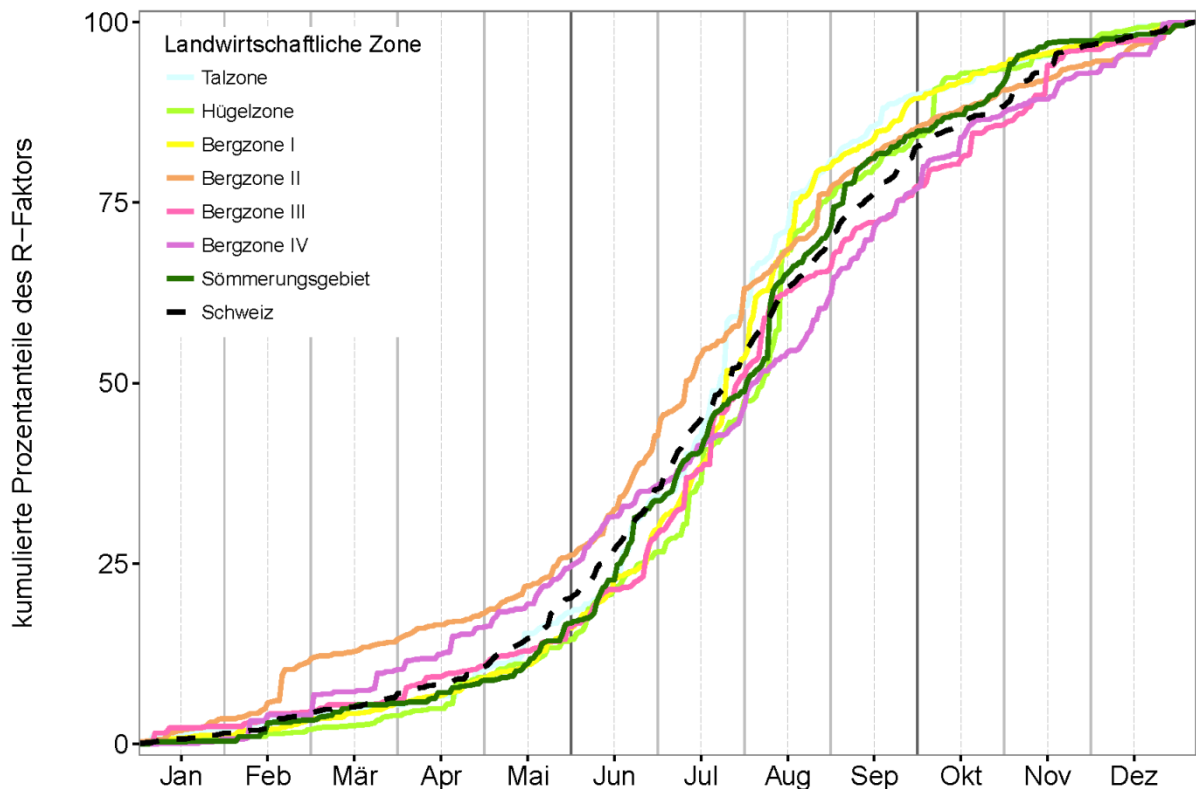


Figure 3: Cumulative daily rainfall erosivity proportion for Swiss biogeographic units, Switzerland and monthly erosivity for Europe (linear smoothed) ([SCHMIDT et al. 2018](#))

**Slope length and steepness** for Switzerland is based on the Multiple Triangular Flow Direction (MTFD) approach ([SEIBERT & MCGLYNN 2007](#)) and was extensively tested on plot scale (BIRCHER et al. in prep.).

Due to the **excellent database of Switzerland**, the model could be used as a **prototype** for risk assessment in the European alpine regions. It is envisaged to present the soil erosion risk map for grassland by the end of the year 2018.

#### Literature:

ALEWELL, C.; MEUSBURGER, K.; JURETZKO, G.; MABIT, L.; and KETTERER, M. (2013): [Suitability of  \$^{239+240}\text{Pu}\$  as a tracer for soil erosion in alpine grasslands](#), Chemosphere, doi: 10.1016/j.chemosphere.2013.12.016.

BIRCHER, P., PRASUHN, V., LINIGER, H.-P. (in prep.): Comparison of different multiple flow algorithms for RUSLE slope-length factor (L) and slope steepness factor (S) calculation in Switzerland.

KONZ, N.; PRASUHN, V.; and ALEWELL, C. (2012): [On the measurement of alpine soil erosion](#), CATENA, 91, 63-71, 10.1016/j.catena.2011.09.010.

MEUSBURGER, K.; KONZ, N.; SCHAUB, M.; and ALEWELL, C. (2010): [Soil erosion modelled with USLE and PESERA using QuickBird derived vegetation parameters in an alpine catchment](#), International Journal of Applied Earth Observation and Geoinformation, 12, 208-215, 10.1016/j.jag.2010.02.004.

PRASUHN, V., LINIGER, H., GISLER, S., HERWEG, K., CANDINAS, A., CLÉMENT, J.-P. (2013): [A high-resolution soil erosion risk map of Switzerland as strategic policy support system](#), Land Use Policy 32, 281–291. 10.1016/j.landusepol.2012.11.006.

SEIBERT, J., MCGLYNN, B.L. (2007): [A New Triangular Multiple Flow Direction Algorithm for Computing Upslope Areas from Gridded Digital Elevation Models](#), Water Resources Research 43, 10.1029/2006WR005128.

SCHMIDT, S., ALEWELL, C., MEUSBURGER, K. (in review a): Mapping Spatio-Temporal Dynamics of the Cover and Management Factor (C-Factor) for Grasslands in Switzerland.

SCHMIDT, S., ALEWELL, C., MEUSBURGER, K. (in review b): Swiss National Grassland Map and Change (1996-2015) of Permanent Grasslands Extent in Switzerland.

SCHMIDT, S., ALEWELL, C., PANAGOS, P., MEUSBURGER, K. (2016): [Regionalization of monthly rainfall erosivity patterns in Switzerland](#), Hydrol. Earth Syst. Sci. 20, 4359–4373. 10.5194/hess-20-4359-2016.

SCHMIDT, S., ALEWELL, C., PANAGOS, P., MEUSBURGER, K. (2018): [Saisonale und räumliche Variabilität der Niederschlagserosivität in der Schweiz](#), BGS Bulletin 38.

SCHMIDT, S., BALLABIO, C., ALEWELL, C., PANAGOS, P., MEUSBURGER, K. (in prep.): Mapping soil erodibility (K-factor) and its seasonal variability in Switzerland.

WISCHMEIER, W. H.; and SMITH, D. D. (1978): [Predicting Rainfall Erosion Losses – A Guide to Conservation Planning](#), U.S. Dep. Of. Agriculture, Handbook No. 537.

## **SHORT PROJECT DESCRIPTION**

[S. Schmidt](#); [K. Meusbürger](#); [P. Panagos](#); [C. Alewell](#)

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

N° N222-0350 & N° P182-1535

Duration: March 2015 – December 2018

Soil Erosion on grassland is generally neglected due to the protective character of dense grass vegetation on soil loss. However, recent studies by MEUSBURGER et al. (2010), KONZ et al. (2012) and ALEWELL et al. (2013) show that large amounts of topsoil are mobilized also on grassland in the alpine areas.

A soil erosion modeling approach for arable land (Erosionsrisikokarte ERK2; Prasuhn et al. 2013) was already realized by the Centre for Development and Environment University Bern and Agroscope Reckenholz. To complement the ERK2-results and to create a nationwide soil erosion risk map, a risk assessment for the (alpine) grassland will be realized by geospatial modeling.

For a detailed description follow this [link](#)

## CURRICULUM VITAE

### **Contact:**

**Simon Schmidt**

<http://www.simonschmidt.de>  
[si.schmidt@unibas.ch](mailto:si.schmidt@unibas.ch)

Telephone: +41 (0)61 267 04 83

University Basel  
Department of Environmental Science  
Bernoullistrasse 30 – Room 204  
CH-4056 Basel  
Switzerland



### **Research:**

PhD student funded by the Federal Office for the Environment (FOEN)

Project title: “Erosionsrisikokarte für das Berggebiet: ERK-Berg – Prototyp der ERK2 für die Bergzonen III, IV und die Sömmerungsgebiete“

### **Curriculum Vitae:**

#### ***Education:***

2015 – today  
PhD Student, University of Basel, Switzerland

2011 – 2015  
M. Sc. Physical Geography / Geoecology, University of Leipzig, Germany  
Thesis: “Developing of a wind erosion screening-model to estimate the potential susceptibility of soil loss on agricultural fields in Western Saxony”

2011 – 2013  
Studies in Soil Science, Martin-Luther-University Halle-Wittenberg, Germany

2010 – 2011  
Studies in Geography and GIS, University of Lisbon, Portugal

2008 – 2011  
B. Sc. Geography, University of Hamburg, Germany  
Thesis: “Implication of deforestation on geomorphological processes – a GIS- based analysis of the spatial dimension of Soil Erosion in Mato Grosso, Brazil”

### ***Employment Information:***

2014 – 2015

Internship at German Development Cooperation (GIZ) and Ministry of Environment and Natural Resource Protection Tbilisi, Georgia

2013 – 2014

Employment at Scholz Engineering-Survey GmbH Leipzig, Germany

2013

Internship at the State Office for Geology and Mining Saxony-Anhalt, Germany

2010

Internship at the University of Applied Science of Bragança, Portugal

### **Publications:**

#### ***Paper***

**SCHMIDT, S., BALLABIO, C., ALEWELL, C., PANAGOS, P., MEUSBURGER, K.:** Mapping soil erodibility (K-factor) and its seasonal variability in Switzerland. in prep.

**SCHMIDT, S., ALEWELL, C., MEUSBURGER, K.:** Mapping Spatio-Temporal Dynamics of the Cover and Management Factor (C-Factor) for Grasslands in Switzerland. in review a.

**SCHMIDT, S., ALEWELL, C., MEUSBURGER, K.:** Swiss National Grassland Map and Change (1996-2015) of Permanent Grasslands Extent in Switzerland. in review b.

**SCHMIDT, S., ALEWELL, C., PANAGOS, P., MEUSBURGER, K.:** [Saisonale und räumliche Variabilität der Niederschlagserosivität in der Schweiz](#). BGS Bulletin, 38, 2018.

**SCHMIDT, S., MEUSBURGER, K., de FIGUEIREDO, T., and ALEWELL, C.:** [Modelling Hot Spots of Soil Loss by Wind Erosion \(SoLoWind\) in Western Saxony, Germany](#), Land Degradation & Development, 28, 3, 1100-1112. doi:10.1002/ldr.2652, 2017.

SCHMIDT, S., ALEWELL, C., PANAGOS, P., and MEUSBURGER, K.: [Regionalization of monthly rainfall erosivity patterns in Switzerland](#), Hydrology and Earth System Sciences, 20, 4359-4373, doi:10.5194/hess-20-4359-2016, 2016.

HELBIG, H., SCHMIDT, S., and KÖTHE, R.: [Gefährdung von Autobahnen durch Wassererosion in Sachsen-Anhalt](#), Straße & Autobahn 12/2015, 851-860, 2015.

### *Conference Paper*

SCHMIDT, S., ALEWELL, C., BORRELLI, P., and MEUSBURGER, K.: [Seasonal dynamics and spatial patterns of the cover management factor for Swiss grassland](#), Swiss Geoscience Meeting 2017, Davos (CH), 17.11.-18.11.2017.

SCHMIDT, S., MEUSBURGER, K., de FIGUEIREDO, T., and ALEWELL, C.: [SoLoWind: Ein GIS-basiertes Winderosionsmodell zur Kartierung von Risikogebieten](#), DKG Deutscher Kongress für Geographie 2017, Tübingen (DE), 29.09.-02.10.2017.

SCHMIDT, S., ALEWELL, C., and MEUSBURGER, K.: [Die Erweiterung der Schweizer Erosionsrisikokarte für alpines Grasland](#), DKG Deutscher Kongress für Geographie 2017, Tübingen (DE), 29.09.-02.10.2017.

SCHMIDT, S., MEUSBURGER, K., de FIGUEIREDO, T., and ALEWELL, C.: [Soil loss by wind \(SoLoWind\): a new GIS-based model to identify risk areas](#), Jahrestagung der Deutschen Bodenkundliche Gesellschaft 2017, Göttingen (DE), 03.09.-06.09.2017.

SCHMIDT, S., MEUSBURGER, K., and ALEWELL, C.: [Die Erosionsrisikokarte ERK-Berg für das Schweizer Berggebiet | Carte du risque d'érosion ERK-Berg pour les régions de montagne suisses](#), Aussprache zum Bodenschutz in der Schweiz 2017, Bern (CH), 01.06.2017.

SCHMIDT, S., MEUSBURGER, K., de FIGUEIREDO, T., and ALEWELL, C.: [SoLoWind - Soil Loss by Wind Erosion Model](#), Erosion Modelling Workshop 2017, Ispra (IT), 21.03.-22.03.2017.

SCHMIDT, S., MEUSBURGER, K., PANAGOS, P., and ALEWELL, C.: [Identification of Spatiotemporal Patterns of Rainfall Erosivity as Decision Support to Erosion Control in Switzerland](#), SSSS Annual Meeting/BGS Jahrestagung 2017, Bern (CH), 09.02.-10.02.2017.

SCHMIDT, S., MEUSBURGER, K., de FIGUEIREDO, T., and ALEWELL, C.: [Soil Erosion Risk Modeling in the Alps - Modeling Approach and Importance for a Soil Erosion Risk Assessment in Swiss Alpine Grassland](#), Mountains 2016 - I International Conference on Research for Sustainable Development in Mountain Regions, Braganca (PT), 3.10.-7.10.2016.

SCHMIDT, S., MEUSBURGER, K., and ALEWELL, C.: [Monthly Rainfall Erosivity Assessment for Switzerland](#), EGU General Assembly 2016, Vienna (AT), 17.04.-22.04.2016.

SCHMIDT, S., MEUSBURGER, K., de FIGUEIREDO, T., and ALEWELL, C.: [A Multidirectional Wind Erosion Model for Western Saxony](#), EGU General Assembly 2016, Vienna (AT), 17.04.-22.04.2016.

SCHMIDT, S., MEUSBURGER, K., PANAGOS, P., and ALEWELL, C.: [Seasonal variability of rainfall erosivity across Europe and Switzerland](#), Swiss Geoscience Meeting 2015, Basel (CH), 20.11.-21.11.2015.



**SCHMIDT, S.:** [Entwicklung eines Winderosionsmodells zur potentiellen Gefährdungsabschätzung des Bodenabtrags in Westsachsen](#), DKG Deutscher Kongress für Geographie 2015, Berlin (DE), 01.10.-06.10.2015.

**SCHMIDT, S.:** [Development of a wind erosion model to assess the susceptibility to soil loss on agricultural land in Western Saxony](#), 12. Mitteldeutsches GEOforum, Leipzig (DE), 01.10.2015.

**SCHMIDT, S.:** [Developing of a wind erosion screening-model to estimate the potential susceptibility of soil loss on agricultural fields in Western Saxony](#), 8. Marktredwitzer Bodenschutztag, Marktredwitz (DE), 08.10.-10.10.2014.

### ***Thesis***

**SCHMIDT, S.:** Entwicklung eines Winderosionsmodells zur potentiellen Gefährdungsabschätzung des Bodenabtrags auf landwirtschaftlichen Nutzflächen in Westsachsen, Master thesis, University of Leipzig, 2014

**SCHMIDT, S.:** Implikation der Waldkonversion für das geomorphologische Prozessgefüge – eine GIS-gestützte Analyse der räumlichen Verbreitung von Bodenerosion in Mato Grosso (Brasilien), Bachelor thesis, University of Hamburg, 2011