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Comparison of different multiple flow algorithms for topographic RUSLE factor (LS) calculation in Switzerland

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Soil erosion is a well-known challenge both from a global perspective and in Switzerland, and it is assessed and discussed in many projects (e.g. national or European erosion risk maps). Meaningful assessment of soil erosion requires models that adequately reflect surface water flows. Various studies have attempted to achieve better modelling results by including multiple flow algorithms in the topographic length and slope factor (LS-factor) of the Revised Universal Soil Loss Equation (RUSLE). The choice of multiple flow algorithms is wide, and many of them have been implemented in programs or tools like Saga-Gis, GrassGis, ArcGIS, ArcView, Taudem, and others. This study compares six different multiple flow algorithms with the aim of identifying a suitable approach to calculating the LS factor for a new soil erosion risk map of Switzerland.

The comparison of multiple flow algorithms is part of a broader project to model soil erosion for the entire agriculturally used area in Switzerland and to renew and optimize the current erosion risk map of Switzerland (ERM2). The ERM2 was calculated in 2009, using a high resolution digital elevation model (2 m) and a multiple flow algorithm in ArcView. This map has provided the basis for enforcing soil protection regulations since 2010 and has proved its worth in practice, but it has become outdated (new basic data are now available, e.g. data on land use change, a new rainfall erosivity map, a new digital elevation model, etc.) and is no longer user friendly (ArcView). In a first step towards its renewal, a new data set from the Swiss Federal Office of Topography (Swisstopo) was used to generate the agricultural area based on the existing field block map. A field block is an area consisting of farmland, pastures, and meadows which is bounded by hydrological borders such as streets, forests, villages, surface waters, etc.

In our study, we compared the six multiple flow algorithms with the LS factor calculation approach used in the ERM2. A GrassGis algorithm matches the current erosion risk map (ERM2) best, both statistically and visually; modelling results show water flow accumulation and concentration in areas where a ten year field mapping study documented many erosion events. The same field mapping data were also used to check the validity of soil loss predictions using the six different multiple flow algorithms.