METHOD FACTSHEET

RUSLE (Revised Universal Soil Loss Equation)

Introduction

The Revised Universal Soil Loss Equation (RUSLE) is an empirical erosion model recognised as a standard method to calculate the average risk of erosion on arable land. It developed from the Universal Soil Loss Equation (USLE) developed in the US Department of Agriculture and has other similar variants such as the Modified USLE (MUSLE) and ABAG (Allgemeine Bodenabtragsgleichung = 'General Soil Loss' in German). As all these models use similar algorithms and produce comparable results, we focus on RUSLE here.

The method is efficient in terms of costs for data provision, model parameterisation and modelling. The results of the RUSLE model can also be coupled with the SITE land use model.

Keywords

Soil loss; Erosion model; Standard method.

Why would I chose this approach?

The method is universally recognized as a standard method for soil loss monitoring. It is relevant for ecosystem services related to soil erosion and protection.

What are the main advantages of the approach?

- RUSLE provides international applicability and comparability of the results and methods, as the method has been adapted to and applied in many world regions.
- The results are plausible in terms of assessing risks of water erosion.
- The algorithms can be implemented based on literature values or adapted to empirical / statistical data by using standard GIS software.
- Required input data are usually available and easy to obtain.

What are the constraints/limitations of the approach?

- RUSLE is used to estimate the *average* long-term risk of erosion on arable land. It is not designed for modeling soil erosion and sediment transport under individual rainfall events.
- Due to the relatively simple empirical approach, the typical erosion processes such as splash erosion, soil transport and soil deposition are not considered as a dynamic process.
- Antecedent soil moisture and soil stratification are not considered.

What types of value can the approach help me understand?

RUSLE is used to identify soil loss, as such it can be used to supply biophysical values related to soil erosion/preservation.

How does the approach address uncertainty?

The model does not explicitly address uncertainty.

How do I apply the approach?

The following input data are required as GIS datasets:

- Average annual precipitation (raster dataset);
- Digital soil map with information regarding the top soil layer;
- Digital Elevation Model (DEM);
- Digital land use data about land use classes and objects that inhibit erosion (barriers);
- Data on crops.

Once provided with this set of data, the RUSLE model links erosion factors influencing soil erodibility (K factor), erosivity (R factor), land cover and management (C factor), slope length (L factor) and slope (S factor). By multiplying these factors, the mean relative soil loss in tons per hectare per year is calculated. The calculation can be based on GIS grid cells or polygons such as crop fields. The factors contributing to erosion risk are location-specific and climate-specific. Due to the countless applications of RUSLE, various nomograms, equations and modelling approaches are available supporting users to determine the individual RUSLE factors (see e.g. the USDA reference below, which provides excellent online support).

Requirements

Data	☑ Data is available ☑ Need to collect some new data ☑ Need to collect lots of new data	This will strongly depend on the case study; all three may or may not apply.
Type of data	☐ Qualitative ☑ Quantitative	
Expertise and production of knowledge	☑ Work with researchers within your own field ☑ Work with researchers from other fields ☐ Work with non-academic stakeholders	
Software	☑ Freely available ☐ Software licence required ☐ Advanced software knowledge required	

Time resources	☑ Short-term (< 1 year) ☐ Medium-term (1-2 years) ☐ Long-term (more than 2 years)	
Economic resources	☑ < 6 person-months ☐ 6-12 person-months ☐ > 12 person-months	
Other requirements		

Where do I go for more information?

Wischmeier, W.H. and D.D. Smith (1978). Predicting Rainfall Erosion Losses: A Guide to Conservation Planning. *Agriculture Handbook No. 537*. USDA/Science and Education Administration, US. Govt. Printing Office, Washington, DC. 58pp.

Schwertmann, U. & Vogl, W. (1987). *Bodenerosion durch Wasser – Vorhersage des Abtrags und Bewertung von Gegenmaßnahmen*. Stuttgart, Ulmer-Verlag.

USDA website: Revised Universal Soil Loss Equation (RUSLE) - Welcome to RUSLE 1 and RUSLE 2. http://www.ars.usda.gov/Research/docs.htm?docid=5971

Factsheet prepared by Jörg Priess, Christian Schweitzer & Christian Hoyer