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Mapping erosion at field scale in Wallonia

Nicolas Feltz (1), Alexandre Maugnard (1), Hélène Cordonnier (2), Charles Bielders (1), and Abdel Ilah Mokadem (2)

(1) Earth and Life Institute, Université catholique de Louvain, Belgium (nicolas.feltz@uclouvain.be), (2) Direction Générale Opérationnelle Agriculture, Ressources Naturelles et Environnement, Service Public de Wallonie, Belgium

According to the European legislation, each country must identify fields at high risk of soil erosion in order to fight against this land degradation process. The aim of this study was to assess the actual erosion rate for every agricultural field in Wallonia (Belgium). For this purpose, the Revised Universal Soil Loss Equation (RUSLE) was selected given its ability to be integrated in a geographical information system (GIS) and its simplicity, which makes the results easy to understand by non-scientific end-users.

In RUSLE, the mean long term annual soil loss E [t.ha^{-1}.y^{-1}] is estimated as the product of 5 factors (Eq. 1, Wischmeier and Smith, 1978)[1]:

$E = R \cdot K \cdot LS \cdot C \cdot P$ **[Eq. 1]**

Three of these factors (rainfall erosivity R [MJ.mm.ha^{-1}.h^{-1}.y^{-1}], soil erodibility K [t.h.mm^{-1}.MJ^{-1}], topography LS [-]) are available as GIS data or easily derived from existing data. Cover management factor C [-] was determined from field measurements for the most common rotations in Wallonia. In this study, specific practices that aim at limiting erosion aren't considered and the P factor (support practice factor [-]) is assumed to be equal to 1.

Experimental determination of the C factor (Eq. 2, Yoder *et al.*, 1997)[2] requires measuring many field characteristics.

$C = \frac{\sum (SLR \cdot EI_n)}{EI_{tot}}$ with $SLR = PLU \cdot CC \cdot SC \cdot SR \cdot SM$ **[Eq. 2]**

where EI_n is rain erosivity for the period of interest.

In this study, only parameters affecting the canopy cover (CC [-]), surface cover (SC [-]) and soil roughness (SR [-]) sub-factors were determined, since prior land use (PLU [-]) and soil moisture (SM [-]) sub-factors include too many parameters that are virtually impossible to determine at a regional scale. Plant height, leaf cover, residue cover and soil roughness were measured once every two weeks for Wallonia's main crops (sugar beet, potatoe, maize, flax, wheat, barley, spelt and rapeseed) during an entire crop cycle. On average, five fields of each crop were monitored in each of 4 agro-pedological regions of Wallonia. These data were then aggregated to compute average soil losses on every agricultural plot of Wallonia.

Without considering land use (C = 1), the north of our study area shows lower erosion rates than the south. This can be explained by both rainfall erosivity, that can be more than 4 times higher in the south, and topography, which is quite flat in the north but hilly in the south. LS factor is thus higher in the south, even though average plot size is lower, because the slope has an important weight in its calculation.

Experimental determination of the C factor reveals major differences between crop rotations but very few differences between agro-pedological regions. Values range from 0.33 (barley – sugar beet – wheat rotation) to 0.55 (continuous maize). These differences highlight the important impact of crop rotations, and hence of agricultural practices, on actual erosion rate. Grassland C factor was assumed to be equal to 0.01 (Morgan, 1995)[3].

Taking into account the actual land use leads to make more homogenous soil loss rates between north and south. Indeed, northern agriculture is intensive and based on crop production on very large plots while, in the south, it is based on meat production and thus mainly uses smaller grassland plots, which offsets the topographical effect.

[1] Wischmeier W. H., Smith D., *Predicting rainfall erosion losses, a guide to conservation planning*, Agriculture Handbook 537, Washington D. C., 1978.

[2] Yoder D. C., Porter J. P., Laflen J. M., Simanton J. R., Renard K. G., McCool D. K., Foster G. R., *Cover-Management Factor (C)* in Renard K. G. *et al.*, *Predicting soil erosion by water : A guide to conservation planning with the Revised Universal Soil Loss Equation (RUSLE)*, Agriculture Handbook 703, Washington D. C., 1997.

[3] Morgan R. P. C., *Soil Erosion and Conservation*, 2nd *ed.*, Longman Group Limited, UK, 1995.

At present, RUSLE soil loss estimates only consider rill and interrill erosion. On cropland, gully erosion may, however, also be a major form of erosion. Next steps would be to integrate gully erosion and practices that aim at limiting erosion.