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Soil redistribution in rural catchment: how fifty years old soil survey can help model improvement

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In a context of high urbanization's pressure in rural zones, landscape modelling of erosion opens interesting perspectives in land use planning. In most cases, validation data are the weak point. In this study, we present how fifty years old soil observations can help progressing towards a more accurate validation of such modelling in rural areas.

As of 1947, a comprehensive systematic survey of the Belgian soil cover was initiated. Field observations were done every 75 meters by soil auger to a standard depth of 125cm (if possible). Map units were delineated on cadastral field survey maps at scale 1:5,000, based on auger observations and landscape context, then generalised on the 1:10,000 topographic base map for a publication at 1:20,000 scale. The legend of the map includes more than 6,000 different soil types and variants. More recently, the Walloon part of this map was digitalised to produce the Digital Soil Map of Wallonia (DSMW).

A 10m resolution DEM was build up in 2009. Its RMSE is 0.8m. Soil erodibility and runoff production maps were derived at the same resolution. A land use map exists at 1:10,000 scale since 2005 and is updated yearly.

We applied the USPED model (Unit Stream Power - based Erosion Deposition) (Moore and Burch, 1986) in a small watershed where first soil observations took place in 1956. New soil observations were done in 2010. The watershed is completely included in a cultivated area.

The model was applied considering a transport capacity limitation proposed by Mitasova and Mitas (1996). Furthermore, we slightly modified it, in order to take into account recent advances in RUSLE factors computations like LS computation proposed by Desmet and Govers (1996) and Nearing (1997).

The spatial distribution of erosion and deposition area produced by the model on the basis of the current DEM is consistent with a comparison between old and recent pedological observations. Furthermore, a comparison between horizons' thickness in 1956 and 2010 gives spatially distributed quantitative information on erosion and deposition. Nevertheless, some uncertainties remain since the pedological descriptions are based on thickness classes, due to the variability of soil cartographical units, and since the current DEM is itself affected by an uncertainty on the elevation value. Future research will then focus on more accurate elevation data as starting point and then it will become conceivable to model the evolution of watershed elevation including land use and other local anthropogenic structures like hedgerows, ditches or grass strips.