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Distributed modeling of mean annual soil erosion and sediment delivery rates to surface waters on the upper macroscale

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The European Water Framework directive requires a good qualitative status of surface water bodies by the year 2015. This should be achieved by programs of measures which were set up during the last two years to be ready for implementation from 2009 onwards. As a big number of surface waters is still suffering from eutrophication and high sediment inputs, measures for inland waters have to focus on phosphorus inputs and erosion. Programs of measures have to rely on spatially detailed data on erosion, sediment delivery and phosphorus inputs, if possible on a plot basis. Thus, potential measures and costs can be traced to land owners being in charge.
For investigation areas of the upper macro scale, e.g. the federal state of Hesse in Germany sized 21,115 km^2, the availability of input data for modeling erosion and sediment input at the plot scale is differing strongly. Land use, crop rotation and relief information can be provided at the plot scale or as highly resolved grid data, e.g. with cell sizes of 5•5 m^2, as a general rule. Further input parameters, especially about soil properties, can be provided only at reductionist scales. Therefore, the application of process-oriented erosion models on such investigation areas is not indicated. In their place empirically based approaches have to be applied.
The contribution will demonstrate the application of the phosphate model MEPhos (Tetzlaff et al. 2008) on the German federal state of Hesse. The model uses a variation of the scale-independent Universal Soil Loss Equation for modeling mean annual erosion rates and sediment delivery from eroding arable land to surface waters. Concerning impacts on water quality in streams, the sediment input is of far higher importance than erosion output from arable land. But model approaches to quantify sediment delivery ratios can differ quite strongly in their results and were often developed to represent events instead of mean annual conditions over decades on the macro-scale. Therefore, the sediment delivery function in the MEPhos model was developed to work scale-independent. Making use of the available highly-resolved digital elevation models a relief analysis is performed to delineate flow lines. These relief driven flow lines identify those plots which are connected to streams. This enables modeling the sediment delivery ratio as well as to identify arable lands which are responsible not only for erosion but also for sediment delivery. Measures for tackling phosphorus as well as sediment inputs can then focus on these hydraulically connected plots.
Further details of the MEPhos model approaches for calculating erosion, sediment and phosphorus input will be given in the presentation as well as results from the model application on the federal state of Hesse (Germany).

Reference

Tetzlaff, B., Vereecken, H., Kunkel, R. u. Wendland, F. (2008): Modelling phosphorus inputs from agricultural sources and urban areas in river basins.- Environmental Geology, DOI:10.1007/s00254-008-1293-1.