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Distributed sub-field erosion modelling for the southern half of Sweden

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Eutrophication is one of the main environmental challenges in many rivers and lakes as well as in the brackish water of the Baltic Sea. Erosion, even at moderate rates, enhances phosphorus transport from land to water recipients. Recently, use of high resolution elevation data made possible modelling of the erosion risk maps at sub-field scale, enhancing possibilities to properly place suitable countermeasures. However, due to high data demands and complexity, high-resolution modelling has so far been done for relatively small catchments and areas. Here we present results from distributed, high-resolution (2x2m) erosion modelling for the whole southern Sweden (202279 sq km), covering 90.4 % out of 3.2 million hectares of Swedish agricultural land. Beside elevation data, input data consisted of maps of land use and soil texture classes as well as modelled water discharge data. Digital elevation maps were used to calculate flow direction, flow accumulation, slope and slope length, as well as profile and plan curvature to describe the form of the slope across and along the slope direction. Soil textural maps were used to describe soil permeability and erodibility, whereas the influence of vegetation cover was approximated from land use maps. Agricultural land was divided in pasture and arable land. All arable land was modelled as winter wheat crop to get relative comparison of the erosion risk independent of the actual annual crop. The influence of climate was described by a sum of monthly water discharge during the erosion sensitive spring flow period (February, Mars, April) for each of 7587 sub-catchments. Two main set of results were produced by the modified Unit Stream Power-based Erosion Deposition (USPED) model: i) gross erosion rates expressed as kg per ha, to illustrate the mobilization areas of soil particles, and ii) flow-accumulated erosion rates, expressed in tons per sq km, to show how water and in water suspended soil particles accumulate and transport in the landscape. The latter set of results was compared to the long-term measured values of the transport of suspended material in 17 small catchments (2-33 sq km) dominated by agricultural land and spread across the modelled area. In this case, considering the modelled worst-case scenario, the 90th quantile of measured monthly values was compared to modelled erosion values. The Pearson correlation coefficient for this relationship between modelled and measured values was 0.80, with a linear regression line very close to 1:1 line. The possibilities and limitations of the use of modelled maps and results are discussed.