Sensitivity analysis of the modified ICECREAM model to improve parameterization for Swedish conditions

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A modification of the simulation model ICECREAM to which macropore flow was added (Larsson et al., 2007) has been used in national calculations of P loads from Swedish agricultural soils. A need for a model uncertainty measure to report with calculated loads, and a refined parameter set to represent Swedish conditions, has been identified. The overall objective is therefore to carry out an uncertainty analysis of the modified ICECREAM model, and to optimize the parameterization for future national calculations.

The first step, which is presented here, is to get a general view of model sensitivity and to identify the parameters to include in the optimization. A modification of the Morris method (Morris, 1991) was used, where the measure of sensitivity was made dimensionless to allow sensitivity ranking of parameters with different units. The elementary effect as a measure of sensitivity relates the percentage change in the output variable to the percentage change in the input parameter. Results presented include elementary effects where a percentage change in the input parameter results in a larger percentage change in the output variable.

Analyzed response variables can be divided into eight different groups: Partitioning of water between surface runoff, infiltration and macropore flow; partitioning between transpiration and soil evaporation; flow between soil P pools; erosion; particle transport in macropores; P in surface runoff and leached to drains; mineralization of manure; and plant uptake of P. Preliminary results show that input parameters related to the simulated crop (growth and senescence, the partitioning between yield and residues and above-ground/below-ground biomass), and the generation of macropore flow, have a large elementary effect on the first five response groups. This is true even for soil physical parameters such as porosity and field capacity, and for the incorporation efficiency by soil tillage equipment. High elementary effects for the erosion and particle transport in macropores were shown for specific input parameters related to soil loss, and particle generation, respectively. Transport of dissolved and particle-bound P in surface runoff and dissolved P leached to drains, mineralization of manure, and plant uptake of P were not sensitive to changes in any of the input parameters. The high sensitivity and non-linear response of model output for changes in several groups of input parameters indicates a need for further refinement of the parameterization, while the lack of sensitivity of P transport is important to consider in future model development.

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