Master's thesis proposal:

Adapting the heat and water model SOIL to represent surface runoff as indata in the phosphorus model ICECREAM

Background

ICECREAM is a simulation model to predict phosphorus leaching from arable land. The model estimates losses of particulate and soluble phosphorus in surface runoff and drainage pipes for individual fields at daily resolution. ICEREAM is amongst other applications used in calculating leakage coefficients of phosphorus from arable fields over Sweden, via the shell program ICECREAMDB and model system NLeCCS. NLeCCS additionally include the shell program SOILNDB, used to calculate leakage coefficients of nitrogen from arable land.

While the two programs ICECREAMDB and SOILNDB are used for the same application -estimating nutrient leakage at field scale, they use different models to estimate soil hydrology within the field. SOILNDB uses the heat and water model SOIL. SOIL describes water flow through the soil profile by Darcy's law and by the law of mass balance. Heat flow is derived from Fourier's law [1]. ICECREAM on the other hand uses a modification of the Soil Conservation Service curve number method for partitioning rainfall between surface runoff and infiltration. Percolation and vertical flow between soil layers is determined by a "bucket-type" model, where downward flow occurs if the water storage in layer *y* gets larger than the field capacity minus the wilting point[2].

The settings for SOIL for the application in SOILNDB are currently not optimized to represent surface runoff, that is an important pathway for phosphorus losses. However, there is a benefit of using the same description of soil profile water flow for both ICECREAMDB and SOILNDB when calculating the national leakage coefficients.

Tasks

Set up ICECREAM and SOIL hydrological shares for a selected field (suggested Mellby, part of SLU field trials) and optimize the SOIL model to represent surface runoff for use in ICECREAM.

Evaluate the differences in model setup and suitability of using a common version of SOIL for both ICECREAMDB and SOILNDB.

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References:

[1]. Jansson, P-E. (1991). *Simulation Model for Soil Water and Heat Conditions – Descpription of the SOIL model.* Department of Soil Sciences, Swedish University of Agricultural Sciences. Report 165. ISSN 0348-1816

[2] Larsson, M., Persson, K., Ulén, B., Lindsjö, A.& Jarvis, N.J. (2007). A dual porosity model to quantify phosphorus losses from macroporous soils. *Ecological modelling.* Vol. 205, 1-2. https://doi.org/10.1016/j.ecolmodel.2007.02.014