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Simulation of lateral flow with SWAT

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Abstract:

Calibration of the SWAT model for the Goodwater Creek Experimental Watershed (GCEW) showed that percolation through the restrictive claypan layer, lateral flow above that layer, and redistribution of excess moisture up to the ground surface were not correctly simulated. In addition, surface runoff and lateral flow were not sensitive to the claypan hydraulic conductivity, which is the main reason these soils are poorly drained and experience a perched water table in early spring. A revised algorithm was proposed for reducing percolation from one layer when the layer below is close to saturation, for estimating lateral flow under saturated conditions, and for redistributing excess moisture above a restricting soil layer anywhere in the soil profile. The revised model was tested on the 72-km² GCEW in northeast Missouri. The Nash-Sutcliffe efficiency and the Pearson correlation coefficient calibration statistics were slightly improved at the 3 gauging stations of the watershed for the calibration and validation periods. More importantly for the simulation of pollutant transport, the separation of surface runoff and groundwater flow was significantly improved: surface runoff and groundwater average differences were less than 15% and 75%, respectively, compared to 25% and 275% with the original algorithm. The improved simulation of surface runoff and lateral flow should allow a more accurate simulation of pollutant transport when soils have a restrictive layer that results in lateral flow or poor drainage and soil saturation. For watersheds in which lateral flow is a significant component of the water balance, the revised model should significantly improve confidence in model's results.

Impact Statement:

The current SWAT model was not simulating lateral flow properly. The improved simulation of surface runoff and lateral flow should allow a more accurate simulation of atrazine, sediment, and nutrient transport in the Goodwater Creek Experimental Watershed. For watersheds in which lateral flow is a significant component of the water balance, the revised model should significantly improve confidence in model's results.

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