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Application of the GFLOW model for hydrological assessment of the South Fork watershed in Iowa

A two-dimensional, steady-state, analytic element (AE) model, GFLOW, was applied to the South Fork (CEAP) watershed in Iowa to simulate the hydrology at the watershed and regional scale and to refine SWAT simulations for the watershed. In contrast to “lumped-distributed” water-quality models such as SWAT, GFLOW solves the governing equation for hydraulic head using the superposition of analytic functions and can simulate the groundwater flow system, streamflow, baseflow, and tile flow. The topography and geology of the South Fork watershed and the surrounding region provides a good test of the GFLOW model for simulating the water-table and streamflow. Four, late Wisconsinan, end moraines cross through the watershed from north to south, providing relief up to 25 m above till plain and outwash sand areas. Twenty-four nested piezometers were installed in these materials in summer and fall 2005 for hydraulic head (water table) measurement and model calibration. The model domain consists of a 78,000 ha near-field (the watershed), a 679,085 ha far-field area, and a thickness of 136 m. Till is the predominant material, however inhomogeneities consisting of alluvium occur along streams near the mouth of the watershed. Initial simulations used a recharge (R) value of 180 mm/yr and a hydraulic conductivity (K) value of 1.25 m/d. These values produced good correlation with stream baseflow data (202,743 m3/d) from a USGS gaging station, but produced a large mean absolute error of 4.7 m at the water table. The largest errors are constrained to the area between the Altamont and Bemis moraines and may be related to complexities in subsurface geology. Future simulations to improve model calibration will include zones (inhomogeneities) of differing K or R associated with the moraines and inclusion of more outwash/alluvium along streams.

Author: William Simpkins
Coauthor(s): L.O. Macalister and W.W. Simpkins Department of Geological and Atmospheric Sciences Iowa State University, Ames, IA