



Jun 25th, 2:00 PM - 3:20 PM

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Bailey, Ryan T. and Neupane, Pratikshya, "Selenium fate and transport module for the SWAT watershed model" (2018). *International Congress on Environmental Modelling and Software*. 8.

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Selenium Fate and Transport Module for the SWAT Watershed Model

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Abstract: Selenium (Se) is an essential micro-nutrient for humans and animals, but can be harmful at elevated concentrations. Se species are present in most soils worldwide, with many regions experiencing toxic Se levels in associated groundwater and surface water. Several groundwater models have been developed in recent years to simulate the fate and transport of Se species in soil-aquifer systems in an effort to investigate best management practices for controlling Se contamination of aquifers and streams. However, none have the ability to simulate the suite of surface and subsurface transport processes that occur in a watershed. In this study, we present a new module for the SWAT (Soil & Water Assessment Tool) model that simulates the fate and transport of principal Se species (selenate, selenite) in a watershed setting. The module accounts for transport in the soil zone, leaching to the aquifer, groundwater transport to streams, stream transport, and transport with runoff water and with mobilized surface sediment. All subroutines are imbedded in SWAT's modeling code. The module also accounts for Se sorption and chemical reduction, with the latter affected by the presence of nitrate. The model is applied to the Big Sandy watershed in southeastern Colorado, which is known to have elevated concentration of Se in Big Sandy Creek and adjacent soils. Preliminary results are shown, with simulated groundwater, soil, and stream water Se concentrations compared to field data. This new module can be used in regions worldwide to assess Se contamination and explore remediation strategies.

Keywords: Selenium, SWAT, watershed model, hydrologic modeling