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SEIMS: a Spatially-Explicit Integrated Modeling System for agricultural watershed

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Abstract: Irrigation and drainage engineering changes natural water flow pathways in agricultural watershed, which have not been well characterized in existing hydrological models. This research developed a Spatially-Explicit Integrated Modeling System (SEIMS) for agricultural watershed to represent the water and nutrient migration processes at a fine scale. First, a vector-based data model was proposed to represent spatial simulation units and the flow relationships among them. Polygons were used as simulation units for farmland and ponds considering their irregular shapes, and regular quadrates were used for natural land covers such as forest and grassland. Lines were used to represent irrigation canals and natural rivers. Both static and dynamic flow relationships among simulation units were considered. Static flow relationship was driven by gravity and extracted from elevation. Dynamic flow relationship was driven by irrigation and drainage operations. Both the direction and condition of water movement were expressed. Based on the simulation units and flow relationships among them, a modular modeling framework was designed. Each module implements a specific algorithm for one process (e.g. infiltration). Currently there has been over 30 modules covering hydrological, crop growth and nutrient migration/transformation processes. For a given simulation scenario, related modules would be selected and combined by workflow engine to form a customized watershed model. Taking a rice watershed in South China as example, this system was used for streamflow and non-point source pollution simulation. The results showed that SEIMS was effective and flexible for agricultural watershed modeling.

***Keywords**:* Watershed modeling; spatial discretization; flow path