Finding Land and Water Management Practices to Lessen River Pollutant Concentrations in Irrigated Regions

Christopher D. Shultz, Timothy K. Gates, and Ryan T. Bailey
Department of Civil and Environmental Engineering, Colorado State University

Abstract. Numerous water quality issues related to nutrient and trace element contamination in water systems have been reported worldwide over recent decades. These contaminants have the potential to harm aquatic life, animals, and even humans at high concentrations. This study presents an integrated approach to reasonably represent field conditions in an irrigated agricultural region of the Lower Arkansas River Valley in Colorado using the combination of a coupled flow model (MODFLOW-UZF) to simulate the interaction between surface water and groundwater with a coupled transport model (RT3D-OTIS) to simulate contaminant transport and chemical reactions. RT3D accounts for cycling and transport of species in the root zone, soil zone, and saturated zone of the subsurface, whereas OTIS accounts for species cycles and transport in the river network. Manual and automated calibration of aquifer and stream parameters has been conducted to achieve model predictions of nitrate (NO_3) and selenium (Se) concentrations to match observations in the river-aquifer system. Chemical redox reactions between selenium and nitrate have also been accounted for in the model. Se and NO_3 mass are exchanged between the groundwater and river network on a daily basis according to flow rates simulated by the MODFLOW-UZF model. The aim of the model is to assess alternative best land and water management practices in comparison to baseline conditions to find ways to bring in-stream concentrations down toward compliance with regulatory standards. Preliminary results indicate the potential to lower nitrate and selenium concentrations through reduced fertilization and increased irrigation efficiencies.