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Landscape-Based Modeling of Pesticide Leaching and Runoff Risks

New regional spatial databases are useful for exploring process-level questions and management scenarios across a landscape. Potential pesticide leaching and runoff risks can be mapped using the USDA-NRCS SSURGO (Soil Survey Geographic), USGS and USEPA National Hydrography data sets, and pesticide property data. We used this information to assess pesticide leaching, solution and adsorbed runoff risks in Saunders County, Nebraska. Landscape variables included soil organic matter, clay content, pH, erosivity (K-factor), free water in the soil profile, likelihood of flooding and the ISRO (index surface runoff, derived from saturated hydraulic conductivity and slope). The organic carbon partition coefficient (K_{oc}) and half-life provided the chemical framework for pesticides. The resulting maps demonstrate how environmental risk is strongly impacted by landscape-dependent variables and provide guidance for managing risk at the application level based on county modeled soil properties. Our approach provides more spatial discrimination than the currently used USDA-NRCS model, Windows Pesticide Screening Tool (WIN-PST). Our models differentiate divides, side slopes and drainage ways in the uplands, while WIN-PST only differentiates drainage ways. Similar trends between WIN-PST and our models occur in the flood plains, upland slopes (runoff) and stream buffers, but contrasting results occur at extreme landscape positions (Todd Valley depressions, playas and steep slopes), where free water occurs in the soil profile, and, in the case of adsorbed runoff, in drainage ways. Our model results support landscape-dependent pesticide selection based on pH sensitivity, and demonstrate the impact of K_{oc} and half-life on pesticide leaching and runoff under typical and flooding conditions.

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