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Abstract: Environmental simulations of pesticide fate and transport can be complex and highly parameterized with uncertain input values. In the face of this uncertainty, many environmental risk models incorporate conservative assumptions in order to avoid false negative decision errors. We examine a regulatory model, the Pesticide Water Calculator (PWC) with a Monte Carlo approach to fully exposure the input parameter space and conduct a sensitivity analysis to rank the parameters that contribute to model prediction error. We quantify the effects of input variability on site-specific model predictions, particularly surface water and sediment outputs and compare the model predictions to field observations to verify the results. For this effort, PWC (version 1.59) was parameterized for three agricultural vernal pool watersheds, located in the San Joaquin River basin in the Central Valley of California, and simulated to estimate exposure concentrations for chlorpyrifos, diazinon and malathion. R scripts were structured to create and load PWC input files in order to bypass the graphical user interface, execute the PWC model components, write input/output files for each Monte Carlo simulation, load the resulting output files and post-process for sensitivity analysis purposes. Partial correlation coefficients (PCC; "sensitivity" R package) were used as a primary linear sensitivity metric for analysing model outputs. The simulations indicate that soil properties (the universal soil loss equation [USLE] soil erodibility factor [USLE-K] and bulk density), degradation half-life, suspended solid and dissolved organic carbon concentrations were critical inputs in simulating pesticide concentrations in the surface water of vernal pools. Depth of benthic region, curve number, soil factors (e.g., bulk density, USLE-K, USLE topographic factor) and suspended solid concentrations in water column were identified as critical parameters to predict pesticide concentrations in the sediment. A focus on improving parameter estimates for these parameters can improve model accuracy while reducing model output-based decision errors.

***Keywords**:* PWC; sensitivity analysis; pesticides; vernal pools; agricultural watersheds