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Interannual variability and sensitivity analysis of manure-borne bacteria transport from irrigated fields.

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Manure application has been implicated in deterioration of microbial quality of surface water utilized in recreation, irrigation, aquaculture, and various household- and agriculture-related processes. The model KINEROS2/STWIR has been recently developed for rainfall- or irrigation event-based simulations of manure-borne overland bacteria transport. Information on uncertainty in the model parameter values is essential for running sensitivity analysis, creating synthetic datasets, developing risk assessment projects, etc. The objective of this work was to analyze data obtained in multiple years when the status of soil surface, soil structure, and weed cover created palpably different conditions for overland microorganism transport. Experiments were carried out at the Beltsville USDA OPE3 site, which is a part of the Lower Chesapeake Long-term Agricultural Research Network Site. Manure was applied at typical Maryland rates and the two-hour irrigation was applied immediately after manure application and one week later. *Escherichia coli* and thermotolerant coliform concentrations in runoff and the bacteria contents in manure and soil before and after application were measured across the application area of about 100 m x 50 m on the 40-point grid. Bacteria contents in manure varied up to six orders of magnitude. No spatial structure in these contents was found at the support and spacing of this work. Parameters sets were substantially different for thermotolerant coliforms and *E. coli*. Bacteria adsorption and straining parameters varied by one order of magnitude over three year trials. Variability of Manning roughness coefficient, saturated hydraulic conductivity, net capillary drive, relative saturation, and solute dispersivity was substantially smaller. The hypothesis of applicability of uniform distributions to simulate the empirical distributions of above parameters could not be rejected at the 0.05 significance level. The Bradford-Schijven model was used to simulate release kinetics; the empirical distribution function of the shape parameter of this model was substantially skewed and could be simulated by the Weibull distribution function. The sensitivity analysis was performed using the fraction of bacteria removed from the field as the target variable. Sobol' indices and complementary regression trees were used to perform the global sensitivity analysis of the model and to explore the interactions between model input parameters and the proportion of bacteria removed from field. Environmental controls such as soil saturation, rainfall duration and rainfall intensity had the largest influence in the simulated bacteria removal, whereas soil and manure properties ranked lower. The shape parameter of bacteria release was an exception, as it appeared to be quite influential. Since the most sensitive model inputs are available in soil and weather databases or can be obtained using soil hydrological models, results of this work indicate the opportunity of obtaining large-scale estimates of manure-borne bacteria transport from fields based on publicly available rather than site-specific information, provided more data on kinetics of bacteria release from manure will become available.