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Effectiveness of Vegetative Filter Strips for Mitigation in Higher-Tier Pesticide Exposure Assessments: Mechanistic Analysis with VFSSMOD

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Pesticides high-tier, long-term environmental risk assessments (ERA) are based on the combination of complicated mechanistic models to evaluate regulatory compliance. The modeling framework often involves large sets of input factors (model parameters, initial and boundary conditions, and other model structure options). How can we identify the relative importance of human, chemical, physical and biological drivers on the assessment results? Is there a case for “the right answers for the right reasons”? For the case of pesticide mitigation practices like vegetative filter strips (VFS) for runoff mitigation, what are the important factors controlling or limiting their efficiency under different field settings? We evaluate the combination of the current ERA frameworks (US EPA PWC and EU FOCUS SWAN) in combination with VFSSMOD, an established and commonly used numerical model for the analysis of runoff, sediment, and pesticide transport in VFS. We present a systematic study of the importance of different field conditions that have been proposed in the past as limiting the efficiency of VFS in realistic settings: flow concentration (channelization) through the filter, timing of pesticide application compared to other drivers, assumptions about the degradation and remobilization of pesticide trapped in the filter between runoff events, seasonal presence of a shallow water table near the receiving water body. We identify instances in which the importance commonly assigned to these factors is not supported by the mechanistic analysis, where other factors different than those proposed largely control the results of the assessments.