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Modeling pesticides in surface runoff: a review of the current status, progress achieved and desirable improvements.

Marco Centanni et al.

The excessive use of pesticides in agriculture poses a threat to water and environmental quality. Under Horizon Europe, considering the priorities of the European Green Deal (EGD), research activities, technological innovation, and investments are needed to contribute to reducing the use of pesticides, fertilizers, and antimicrobials. In this scenario, there is a need to carry out studies on the short and long-term effects of the use of pesticides in the agro-environment and on the effect of mitigation measures. For this purpose, hydrological models are useful tools for the simulation of the fate and transport of pesticides.

Through a critical review, this study aims to: (i) update the status of the use of the hydrological models to simulate pesticides coming from diffuse pollution, (ii) Analyze the spatial and temporal scale of the model applications, (iii) Investigate possible relationships between models and specific pesticides. The ISI papers were selected based on six keywords were used on Scopus: “pesticides, model, watershed, hydrology, water quality, diffuse pollutant”. After removing articles, not in English and articles not related to modeling applications, 37 papers were found and analyzed by constituting a database containing information about the study areas, the pesticides, the model, and the methodology adopted (I.e. warm-up, calibration, and/or validation). Pesticides were classified into three categories: herbicides, fungicides, and insecticides.

Results showed that most of the study areas were localized in Europe (55.5%) followed by North America (22.3%), Asia (13.9%), and South America (8.3%). Soil and Water Assessment Tool was the most commonly used model with a percentage of 45.95%. Regarding the substances investigated, herbicides were the most modeled (71.4%) followed by insecticides (18.2%) and fungicides (10.4%). In particular, among the most commonly modeled herbicides were atrazine, metolachlor, isoproturon, glyphosate, and acetochlor. Among the insecticides, chlorpyrifos and metaldehyde were the substances most frequently modeled. Finally, chlorothalonil and tebuconazole were the most investigated fungicides.

This work will be useful to create an updated guideline to facilitate the water and the landscape managers in selecting a specific hydrological model to assess the transport and fates of pesticides and to simulate the effect of potential mitigation practices.

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