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Comparison of three pesticide fate models based on a long term lysimeter experiment in a crop rotational system with repeated application of s-metolachlor

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A variety of pesticide fate models has been developed to assess the transport of pesticides from the soil surface to the groundwater. Previous evaluations of these models have shown that the models do not always perform well, and model comparisons frequently revealed discrepancies between results obtained from different models. Furthermore model comparisons revealed a user-dependent variability of model parameterisation and often lacked proper quality and quantity of experimental data. In this work, the three different and commonly used pesticide fate models PELMO, PEARL and MACRO are compared with regard to their ability to simulate the transport of the pesticide s-metolachlor and its metabolites metolachlor oxanilic acid and metolachlor ethane sulfonic acid. As opposed to most of the existing studies, here the models are based on equivalent parameter sets and modelling is performed by one modeller. The simulation results are compared with high quality data from a long term lysimeter experiment in a crop rotational system (maize, triticale, oil pumpkin) in Wagna, Austria with a repeated application of s-metolachlor in three following years.

Regarding water flow, all models simulated the monthly leachate amount quite well, with lowest leachate amounts simulated by capacity-based flow model implemented in PELMO followed by PEARL and MACRO, where water flow is simulated based on the Richards equation. Regarding water dynamics, PELMO was not able to properly represent water dynamics, whereas PEARL and MACRO simulated the water dynamic satisfyingly. Discrepancies between measured and simulated data were observed during dry periods for all models. Discrepancies between the models might be explained by different descriptions of certain processes within the models.

Regarding mass flow, it was possible to simulate the leaching of s-metolachlor and its metabolites in similar appearance time but mass flow was over- or underestimated with all models in different years. It was not possible to find a parameterisation to represent mass flow for a repeated application over several years.