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Chiral signatures of herbicides and metabolites concentrations as tools to characterize the hydrodynamic of aquifer

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Increasing surveillances demonstrated the presence of pesticides and their metabolites in surface and groundwater, sometimes at concentrations higher than the threshold values admitted. The implementation of programs of measures to improve the groundwater quality may sometimes seem to be ineffective as transfer times of water and solutes are long. Constraining this timeframe between the implementation of measures and the impact on water quality is thus a key point to evaluate the effectiveness of measures.
Many pesticides are chiral. Since some isomers are inactive, plant protection producers try to develop market products with active isomer enrichment in order to decrease the rate of application and as a consequence the impact on water quality. In this context of drastic switch from one chiral form to the other, the use of the chiral ratio of a pesticide appears as a promising tool to characterize the infiltration rate of water from soil to groundwater. However, in order to validate this tool, it is necessary to characterize the evolution of chiral signatures during the degradation process. In that perspective, the more the signature will be conservative, the more the tool will be efficient.
Determining the areas where the infiltration of water is the highest in a catchment is also important for the implementation of programs of measures. Metabolites of pesticides are in many cases very mobile compounds prone to be easily leached into groundwater. Monitoring these metabolites is also useful to better constraint the hydrodynamic functioning of an aquifer. Data on the kinetics of apparition and the kinetics of dissipation of these metabolites are scarce. However, these data are crucial to determine when and how long they can potentially be leached.
Here we present new data based on the determination of chiral signatures of two selected herbicides (metolachlor and dimethenamid). We conducted degradation experiments on 2 different soils using both racemic and isomer enriched molecules. During these experiments, the fate of their metabolites was also characterized. The results allow defining the potentialities of these tools, namely the use of chiral signature and the metabolite occurrence, in the goal of improving the knowledge of aquifer functioning.