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Pesticides emitted into the environment may contribute to complex mixtures including the parent molecules, degradates in association with other pollutants. It is of paramount importance to implement suitable monitoring procedures to assess the fate of pesticides, their transfer to groundwater and the potential effects of water quality on aquatic and terrestrial organisms. Diffuse pollution is a significant water management issue in France, imposed notably through the European Water Framework Directive. The effects of past and present land-use practices may take decades to become apparent in groundwater. This is why it remains a challenge to link the current pesticide pressure and observed impact on groundwater quality. In other words, the evaluation of the significance of measured parameters is not trivial.

The alluvial domain of the Ariège River (about 538 km^2) is an unconfined aquifer, the thin thickness of vadose zone making it vulnerable to contamination. Due to intensive agriculture in this area, related to corn cultivation in particular, groundwater quality is affected by pesticides and some of their metabolites.

Monthly monitoring of water quality at 16 water points (wells and springs) in the plain was performed from March 2009 to May 2011 and from March 2012 to November 2014. It includes some 50 organic molecules, major ions such as nitrate and other non-conservative parameters (pH, temperature, redox potential). For each of the sampling point, ground water catchment delineation was performed, based on an existing piezometric map. Land-uses were known thanks to farmer declarations. Regional data on practises were available.

A strong spatial variability of the contamination was demonstrated, with predominance of degradation products over parent molecules in some locations, and also showed a strong temporal variability. Short time transfers from soil into groundwater were observed locally. High transmissivity of the aquifer enabled rapid renewal of the water in the saturated zone. For some parent compounds having a very short presence in groundwater, it is therefore quite easy to link application and presence. Annual variability of concentrations appeared driven by both land-uses and climatic conditions. But, for others molecules and notably metabolites, long-term monitoring illustrated the possible lag-time between application and impact. Thus polar metabolites can be detected not only after application but also during recharge events coming next year and sometimes years after.Metabolites of withdrawn molecules illustrated clearly this aspect. In addition, for a compound recently used close to a well, highest concentrations were quantified after several years and not the first year of uses. As for parent molecules, hydrodynamic affected evidently observed concentrations.

The different concentrations time-series highlighted the importance of long-term monitoring with high frequency of measurements to smooth the impact of climatic conditions from one year to another but also to understand the real fate of molecules.