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Urban and agricultural contribution of annual loads of glyphosate and AMPA towards surface waters at the Orge River catchment scale (France)

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The general use of pesticides in the Orge Basin, located in the southern part of the Paris suburb (France), is damaging surface water quality. Consequently, an increase in the water supply costs is registered by the water supply agencies that are situated downstream the Orge confluence with the Seine River. In this catchment, high uses of glyphosate are registered for fallow fields (upstream part) and for roadway weed control (downstream part). The proportion of glyphosate coming from these two zones was not well known, along with the double source of its metabolite AMPA originated from the degradation of some detergent phosphonates. The aim of this work was firstly to identify the potential sources of glyphosate and AMPA in urban sectors (such as sewerage system inputs) and in agricultural areas and to quantify the origins of urban pesticides pathways towards surface waters at the basin scale. The new approach of this project was to collect information at three different scales to establish a first step of modeling. At the basin scale, 1 year of surface water monitoring at the outlet of the Orge River was useful to establish the inputs towards the Seine River. At the urban catchment scale, the investigations have permitted to record glyphosate and AMPA loads transferred by storm waters and by wastewaters. Loads were estimated during and out of application calendar, in different hydrological conditions such as rainfall with high intensity or dry conditions. Impact of WWTP on surface water was also demonstrated. The third phase of this work was the interpretation of agricultural inputs from two different agricultural catchments of the Orge River. The results showed the impact of urban uses of glyphosate upon the Orge River contamination with annual loads from 100 times higher from the urban zone than from the agricultural one. Storm sewers were recognized to be the main way for glyphosate transfer towards surface waters. A budget of glyphosate and AMPA inputs and exported amounts was carried out at the River scale. Different origins (agricultural zones, urban areas and wastewater treatment plants) were assessed to determine the contribution of each usage. These investigations showed the high impact of storm waters and wastewaters upon the Orge River contamination (90%), whereas the agricultural zone contributed to only 10 % of the glyphosate contamination of the River. Glyphosate contaminates the river by direct flow of rainfall sewers towards surface waters. AMPA in the Orge river originates from both degradation of glyphosate in agricultural soils (29%) and from urban sewers (79%). Glyphosate amount transferred via overflows between sewers is the main source (more than 95%) in wastewaters during application period and rainfall events, but represents only 50% of the annual load in wastewaters that reach treatment plants (WWTP). AMPA, always detected in wastewaters and WWTP, is partly related to domestic wastewaters (18 to 23% of the total load). A difference between glyphosate and AMPA load inputs in the Orge River and outputs load at the outlet was registered: Glyphosate load is decreasing downstream as AMPA is increasing, suggesting a degradation of glyphosate into the river. The rule of sediments could have a significant influence of the dynamic transport of glyphosate. The results of the budget calculation are supported by a strong and logical data collection, coupled with detailed spatial information and consciousness of estimation accuracy.

Keywords: Catchment, glyphosate, AMPA, inputs, budget