Losses of glyphosate and AMPA via drainflow in a typical Belgian residential area

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Urban hard surfaces are considered as important facilitators for pesticide transport into urban streams. To obtain concurrent high-resolution data for a detailed investigation on the losses of pesticide runoff from hard surfaces, a monitoring campaign was performed in a typical Belgian residential area (9.5 ha) between 7 May and 7 August, 2013. The campaign yielded a concurrent dataset of rainfall (1-mm rainfall interval), discharge (1-min interval), glyphosate application by the residents and the occurrences of glyphosate and its major degradation product - aminomethylphosphonic acid (AMPA) in the separated storm drainage outflow during 12 rainfall events. In addition, detailed information was obtained on the spatial characteristics of the study area. The resulting dataset allows us to investigate the relevance of catchment hydrology, urban surface properties and pesticide application to the transport and losses of glyphosate in a residential environment.

During the campaign, glyphosate was only applied by local residents, mainly on their private driveways. As a result of their continuous use, both glyphosate and AMPA were detected in all analysed outflow samples, with maximum concentrations of 6.1 μg/L and 5.8 μg/L, respectively. Overall, the storm drainage system collected 0.43% of the applied amount of glyphosate. However, this loss rate varied considerably among rainfall events, ranging from 0.04% to 23.36%. According to statistical analysis of the 12 rainfall events, the loss rate was significantly correlated with three factors: the application amount prior to a rainfall event ($p < 0.005$), rainfall amount during the event ($p < 0.02$) and the weighted lag time between glyphosate application and the start of the rainfall event (negatively, $p < 0.05$). A regression analysis showed that these three factors can explain more than 85% of the variation in the loss rate of glyphosate. Furthermore, three types of glyphosate runoff were classified by a clustering analysis based on these factors: events dominated by runoff availability (runoff-limited), dominated by glyphosate availability (pesticide-limited) and controlled by both runoff and glyphosate availability. To sum up, proper management of the amount and timing of glyphosate application can greatly help to control its losses from urban impervious surfaces.