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Pesticide use on urban hard surfaces potentially leads to long-term exposure in urban aquatic environment

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Urban runoff from hard surfaces (e.g., concrete, asphalt, ballast) can be a significant source of pesticides in urban surface water. Estimating pesticide runoff dynamics from hard surfaces is becoming increasingly relevant for urban water management due to global urbanization. In this study, we used the recently developed urban pesticide runoff model, WetSpa-PST (Water and Energy Transfer between Soil, Plants and Atmosphere model for PeSTicides) to quantify glyphosate (a frequently-used herbicide) and AMPA (aminomethylphosphonic acid, main metabolite of glyphosate) in runoff via a storm sewer from a typical Belgian residential area (Meerhout). WetSpa-PST was extended from a spatially-distributed modular flexible dynamic hydrological model WetSpa-Python. WetSpa-PST is the first catchment-scale distributed model that accounts for the physico-chemical interactions between pesticide and hard surfaces, which is essential given the high pesticide wash-off potential from urban hard surfaces.

According to the modeling results after calibration, a large fraction of glyphosate and AMPA (>85 % of total inputs) was still stored in the study area after the simulation period of three months (the weed growing season). Glyphosate was mainly stored in the hard-surface matrix, which has limited mobility or degradation. Hard surfaces therefore act as reservoirs for the strongly-adsorbing glyphosate. The result suggests glyphosate and AMPA occurrence would persist throughout the year in the receiving water. Such persistence raises the question whether chronic or acute risks to the aquatic ecosystems are of higher importance for urban pesticide uses. This question is particularly relevant for hydrophobic pesticides such as pyrethroids due to their stronger sorption capacity. It is therefore advised that regulatory exposure modeling and regulatory risk assessment for urban pesticide uses should include their chronic and long-term effects to the aquatic ecosystems.