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Concentration patterns of agricultural pesticides and urban biocides in surface waters of a catchment of mixed land use

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Organic pesticides and biocides that are found in surface waters, can originate from agricultural and urban sources. For a long time, agricultural pesticides have received substantially more attention than biocidal compounds from urban use like material protection or in-can preservatives (cosmetics etc.). Recent studies however revealed that the amounts of urban biocides used may exceed those of agricultural pesticides. This study aims at comparing the input of several important pesticides and biocides into a small Swiss stream with a special focus on loss events triggered by rainfall. A set of 16 substances was selected to represent urban and agricultural sources. The selected substances are either only used as biocides (irgarol, isothiazolinones, IPBC), as pesticides (atrazine, sulcotrione, dichlofluanid, tolylfluanid) or have a mixed use (isoproturon, terbutryn, terbutylazine, mecoprop, diazinon, carbendazim)

The study catchment has an area of 25 km2 and is inhabited by about 12'000 people. Four sampling sites were selected in the river system in order to reflect different urban and agricultural sources. Additionally, we sampled a combined sewer overflow, a rain sewer and the outflow of a wastewater treatment plant. At each site discharge was measured continuously from March to November 2007. During 16 rain events samples were taken by automatic devices at a high temporal resolution.

The results, based on more than 500 analyzed samples, revealed distinct concentration patterns for different compounds and sources. Agricultural pesticides exhibited a strong seasonality as expected based on the application periods. During the first one or two rain events after application the concentrations reached up to several thousand ng/l during peak flow (atrazine, isoproturon). The temporal patterns of urban biocides were more diverse. Some compounds obviously stem from permanent sources independent of rainfall because they were found mostly in the outlet of the wastewater treatment plant throughout the year. The insecticide diazinon for example showed a background concentration in treated waste water of approximately 50 ng/l. Substances like mecoprop, which are used in urban areas (roof protection, private gardens) and agriculture showed a mixed pattern. At the time scale of single events two concentration peaks have been observed. One of them was due to the fast reaction of sewer overflows or rain sewers carrying urban storm water. The delayed peak was caused by fast flow from agricultural soils.

Overall, the study revealed complex concentration patterns for the different compounds. Source identification was only possible by means of a comprehensive approach including different nested measuring sites, a broad range of different compounds that were complemented by tracer substances like caffeine or drugs and their metabolites (sulfamethoxazole, N4-acetylsulfamethoxazole, diclofenac) that can be non-ambiguously attributed to sources like treated or untreated wastewater.