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Investigation of runoff generation in small catchments with dissolved veterinary and human pharmaceuticals

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This investigation focuses on the analysis of four classes of veterinary and human pharmaceuticals in surface water in Luxembourg. The selected pharmaceuticals include four sulfonamides, two tetracyclines, two analgesics, and three hormones. Solid-phase extraction with liquid chromatography-tandem mass spectrometry resulted in detection limits ranging from 0.3 to 2.0 ng/L, allowing the determination of pharmaceuticals in storm waters. The analysis of pharmaceuticals by liquid chromatography-tandem mass spectrometry is a useful tool to trace their behaviour in the aquatic environment. Application of this method to river concentration and flood events revealed high concentrations of ibuprofen, with highest levels during flood events, while concentrations of estrogens and sulfonamides were comparatively low. So far, the yeast estrogen screen has been applied for some of the samples. The measured steroid values were converted to estrogenic activity by taking into account the relative potency of each chemical compared to the reference, estradiol. This method considers the relative affinity of the steroids for the hormone receptor. The measured estrogenic activity in the surface water is regularly at levels larger than 5 ng/L estradiol equivalents which might be of concern to reproductive success of native fish populations. The concentration and transport of xenobiotics in surface waters depend on hydraulic conditions including rainfall pattern and sewage overflow, on the properties of the substances, including sorption, degradation, and metabolism. The analysis of flood events using the rainfall pattern, the hydrograph, and dissolved pharmaceutical chemographs provides an insight into the temporal structure of flood events. The corresponding anthropogenic sources show a high temporal and spatial variability that is caused by different rainfall patterns and distributions, and the different characteristics (e.g. retention capacities) of the combined sewer systems. We can show that the combined sewer overflows deliver an important part of the dissolved pharmaceuticals into the river network.