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Daily dynamics of emerging pollutants in a sewer network (région Centre, France)

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As any catchment, cities are characterized by important flux of various materials. The specificity of urban socio-ecosystems lies in the nature of these materials that mainly result from human activities or are man-made. An important issue concerns emerging pollutants for which an understanding of their temporal dynamics is crucial to better forecast flux and adapt remediation treatments before waters are released in the environment.
This study aims at better understanding the socio-economic drivers of emerging pollutants temporal dynamics by monitoring, on a daily basis during 85 consecutive days, a series of fifty illicit drugs and pharmaceuticals as well as their metabolites in a sewer network that collects wastewater from 90,000 inhabitants and upstream a wastewater plant. Flow-enslaved composite samples were automatically collected over 24h, then filtered, and target compounds were concentrated by solid-phase extraction before quantitation by HPLC-MS. Concentrations were converted into mass loads per population equivalent by several corrections (i) the flow, (ii) the solid/liquid partition and the molar ratio between target residue and parent-compound (iii) the number of population-equivalent on the catchment and (iv) the excretion rate of target residue.
The large dataset obtained, combined to a literature survey, allows us discussing several issues. (1) Calculated daily mass loads of pharmaceuticals are in agreement with literature data for comparable cities except for to anti-inflammatory drugs: ketoprofen that shows the highest values and ibuprofen that displays the lowest values. This would attest to local therapeutic preference that remains to be explained. Daily mass loads for illicit drugs are lower than those measured in more populated cities, except for tetrahydrocannabinol that exceeds the highest reported values.
(2) Consumption estimates of pharmaceutical based on our approach are very close to theoretical values from the literature. Additionally, ratios of co-consumed antibiotics such as sulfamethoxazole and trimethoprim are constant over the study and afford similar estimates for their consumption. For evident reasons, this comparison between theoretical and calculated consumption could not be achieved for illicit drugs.
(3) Distinction can clearly be made on the temporal pattern of consumptions. Some compounds (e.g. acetaminophen, atenolol) do not exhibit clear week/week-end pattern whereas it is clearly expressed for cocaine and ecstasy. For the first time, some week/week-end patterns were also found for some pharmaceuticals such as metoprolol. Lower values noticed during week-end days could result from the mobility of the population in the catchment.
Our study reveals that monitoring of pharmaceuticals and illicit drugs in wastewaters can bring significant information on the evolution of consumption practices in urban areas. Additional work in engaged to evaluate temporal trends on shorter (hour, minute) and longer (season, year) timescales. Applying this approach to a larger set of cities could reveal useful for developing decision tools for stakeholders and health agencies.