11th Eastern European Young Water Professionals Conference

Book of Abstracts

Water for All - Water for Nature, Reliable Water Supply, Wastewater Treatment and Reuse

1-5 October 2019, Prague, Czech Republic
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BOOK of ABSTRACTS

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Pollution of Urban Groundwater by Emerging Contaminants

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INTRODUCTION

Groundwater is an important source of drinking water worldwide and its role is growing due to the deterioration of surface water quality and quantity under the impact of climate variability, contamination, and reallocation of surface run-off (WWAP, 2015). There is a high concern regarding the low quality and quantity of available groundwater resources due to ongoing and increasing contaminations in Ukraine (Yakovlev et. al., 2015), and a lack of appropriate regulations (Vystavna et al., 2018a). Organic compounds, particularly pharmaceuticals, have been used to determine the sewage contribution in groundwater (Schaider et al., 2016). The research area is the densely populated Kharkiv city (1.4 M inhabitants), East Ukraine, where locals use groundwater as an alternative to tap water. The study area has limited local runoff and is located in zone under risk of military actions. Therefore, groundwater is considered as an important strategic drinking water source that can potentially replace the tap water in an emergency. We selected five urban (T1, S2, N3, Y4 and P5) and one peri-urban forested (O6) groundwater sites.

METHODS

Groundwater samples (1L amber glass bottles) for analysis of emerging compounds were collected in September 2017. The screening of chemicals was based on an exact mass in an open access library (over 2,000 compounds) by Liquid Chromatography Quadrupole Time-of-Flight Mass Spectrometry coupled to an Accela 1250 LC pump (Thermo Fisher Scientific®) and an HTS XT-CTC autosampler (CTC Analytics AG®, Switzerland), operated using Xcalibur software (Thermo Fisher Scientific®). Because of the nature of the screening analysis, exact concentrations could not be determined.

RESULTS

The identified chemicals were divided into three groups: drugs (caffeine, nikethamide, riluzole, phenazone, pilocarpine, pergolide, ajmaline, carbamazepine, moxonidine, dihydrocodeine, sulfathiazole, papaverine, and aripriprazole), pesticides (DEET (pentedrone), dodine, chlordimeform, atrazine, simazine and butraline) and food compounds (alternariol as a mycotoxin, chanoclavine and kojic acid as additives). All of the studied drugs can be abused and some are illicit drugs. The most frequently detected drug (in 5 out of 6 springs) was the alkaloid pilocarpine which was found even in the forest spring. The chanoclavine and chlordimeform were detected in 4 out of 6 studied springs. Caffeine, phenazone and alternariol were found in 3 out of 6 studied springs. Other compounds were found in 1 or 2 sites. However, each spring was characterized by a distinct group of detected compounds according to the principal component analysis (PCA) ordination (Figure 1) (Vystavna et al., 2019).

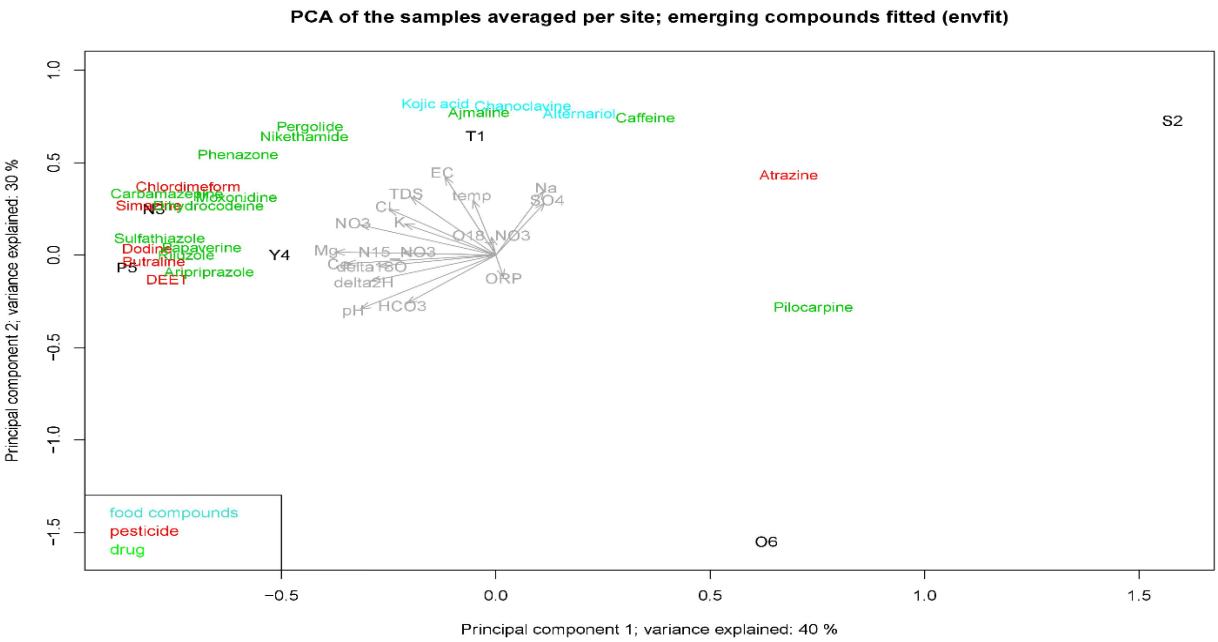

Figure 1. PCA of the samples of emerging compounds averaged per site (Vystavna et al., 2019)

DISCUSSIONS

The impact of anthropogenic land use was reflected also by the presence of drugs and food compounds in urban springs (Figure 1). The highest diversity of drugs and food compounds was found in springs with the high sewage contribution (T1, N3, Y4 and P5). The relation between the non-persistent chemicals caffeine, food compounds and some ions (SO_4^{2-} and Na^+) indicates that these emerging compounds continuously enter T1 with raw sewage likely from mains. However, the positive relation between persistent drugs and pesticides with NO_3^- at N3, Y4 and P5 may point to sewage leakages from pit latrines. Some persistent pesticides and food compounds were detected at sites with negligible sewage contribution (urban S2 and forest O6).

CONCLUSIONS

The chemical (major emerging compounds) analyses was useful to determine and partly quantify hydro chemical processes in the urban subsurface. Our findings clearly indicate strong contamination under the urban impact. High nitrate contamination of urban springs and the presence of potentially toxic emerging compounds indicate the health risk associated with the use of urban springs as drinking water sources.

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