UNESCO-IWRA ONLINE CONFERENCE
17-19 JANUARY 2023
3RD IN THE IWRA ONLINE CONFERENCE SERIES

Emerging Pollutants: Protecting Water Quality for the Health of People and the Environment

Emerging contaminants in groundwaters and their relation to recharge sources in Bengaluru City, Karnataka, India

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British Geological Survey

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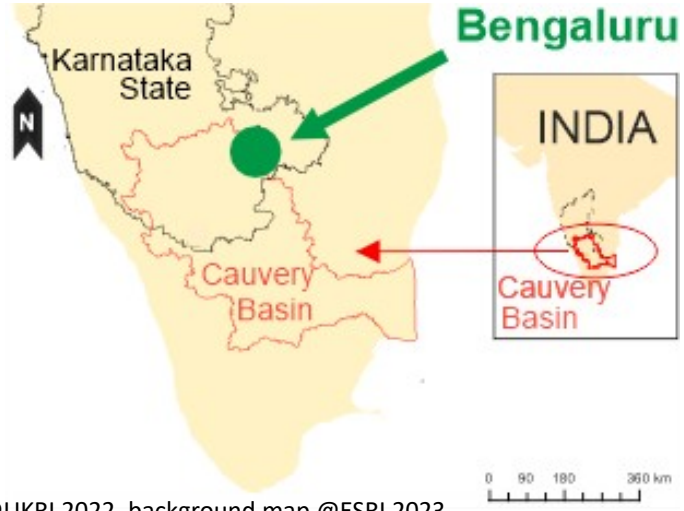
Programme hydrologique intergouvernemental

IWRA International Water Resources Association

Background

- Emerging organic contaminants (EOCs) are becoming more ubiquitous in the environment, particularly Per- and Polyfluoroalkyl Substances (PFAS, e.g. Cousins et al. 2021)
- Despite this, few studies are available on EOCs in Indian groundwaters (GWs), particularly in urban settings with well-documented pollution issues, e.g. the city of Bengaluru, in which GW is recharged from multiple, potentially polluted sources

Study site



@UKRI 2022, background map @ESRI 2023

Groundwater recharge in Bengaluru (hard-rock aquifer) from rainfall, mains leakage and surface waters, such as:

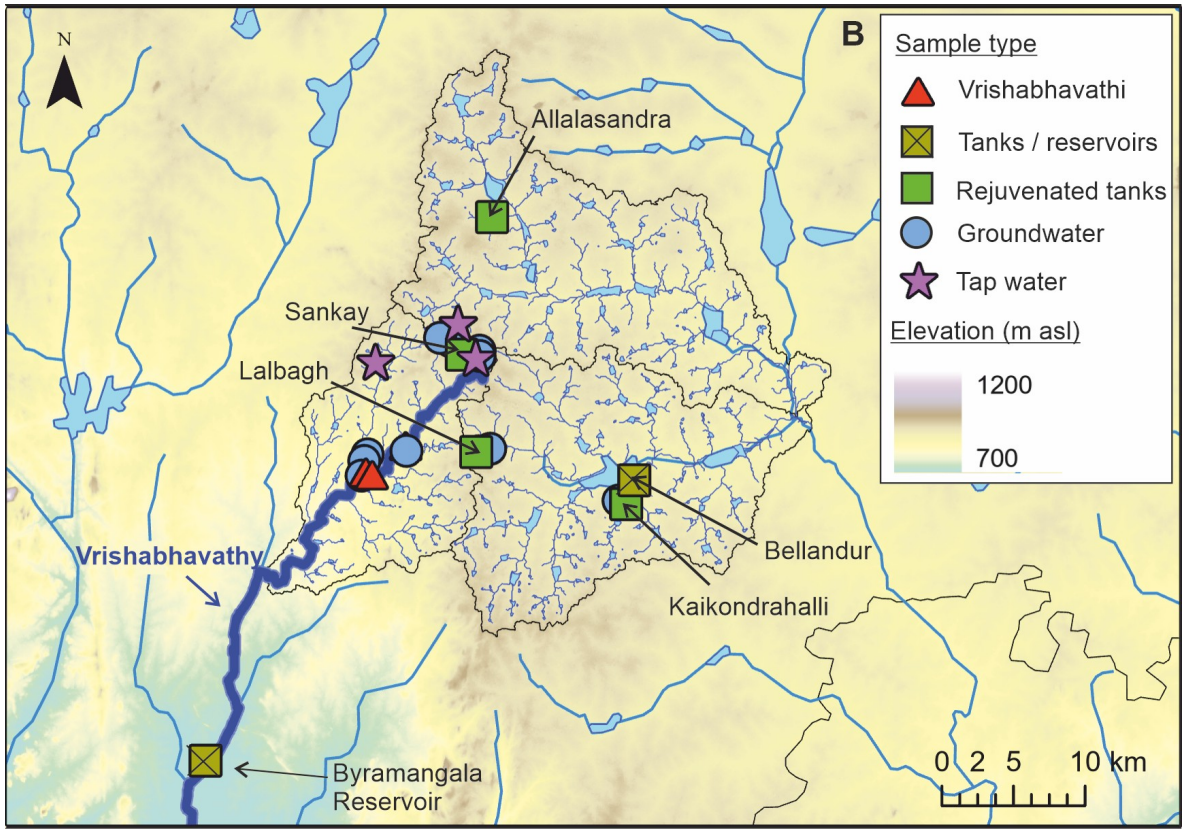
Urban rivers

non-rejuvenated lakes

rejuvenated lakes

Reference: COUSINS, I. T., JOHANSSON, J. H., SALTER, M. E., SHA, B. & SCHERINGER, M. 2022. Outside the Safe Operating Space of a New Planetary Boundary for Per- and Polyfluoroalkyl Substances (PFAS). Environmental Science & Technology.

Study set-up



@UKRI 2023, background map @ESRI 2023, elevation data from USGS SRTM data (http://earthexplorer.usgs.gov)

25 pre-monsoonal water samples were taken within a 9-day sampling campaign in March 2018

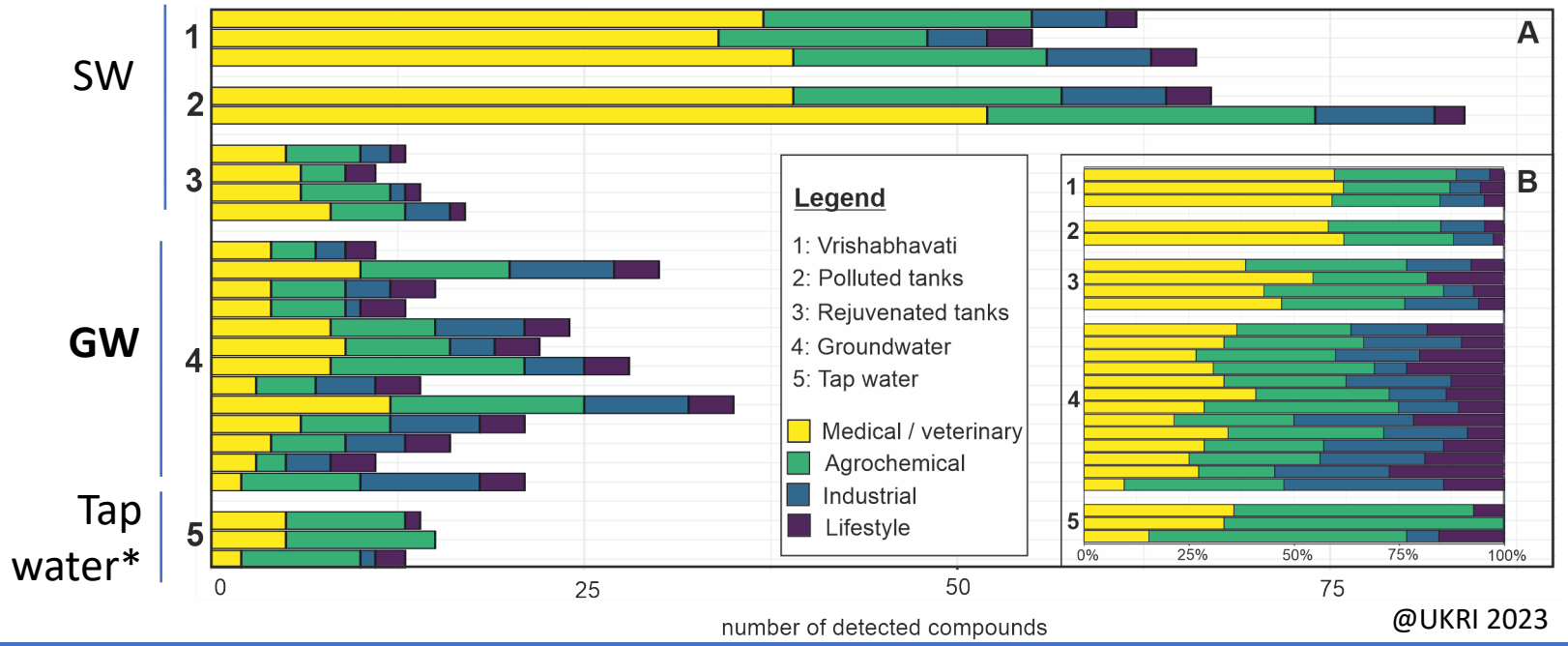
- Vrishabhavathi River n=3
- Non-rejuvenated tanks (lakes) n=2
- Rejuvenated tanks (lakes) n=4
- **Groundwater n=13**
- Tap water n=3

Samples were screened (GC-MS and LC-MS) for a total of **1499 emerging organic contaminants**, **EOC**s, at the UK National Science Laboratories at Starcross Laboratory in Exeter, UK

Results (1)

A total of 126 EOCs were detected, at concentrations between 0.001 and 314 µg/L and most compounds falling into the group of medical/veterinary (n=70) or agrochemical (n=41) products

Surface water (SW) was dominated by medical/veterinary compounds, tap water by agrochemicals (60%)



Groundwater (GW)

- 63 compounds were detected
- 11-35 detections per sample
- concentrations 0.001—3.2 µg/L
- concentrations >1 µg/L only for:

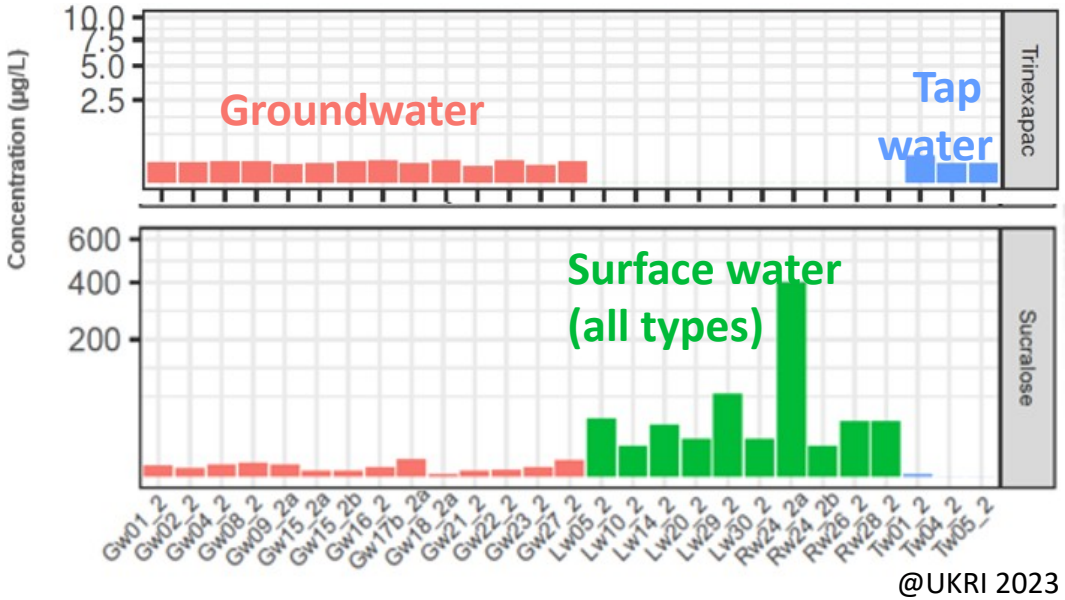
Sucralose, Acesulfame K, Ibuprofen

(max 3.2, 2.8, 1.4 µg/L, respectively)

*tap water is mainly imported water from Cauvery River

Results (2)

- Some compounds, such as the growth regulator trinexapac directly related recharge sources (here tap water) with GW



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PFAS in GW

- 7 of the 11 detected industrial compounds were PFAS
- 3 of the 11 PFAS were only detected in GW, which indicates persistence of legacy compounds
- PFAS concentrations in GW ranged up to 0.9 µg/L*

* higher than currently discussed regulatory thresholds for drinking water in most countries/regions

Conclusions

- The ubiquitous detection of sweeteners gives an indication on groundwater age, since these compounds were introduced recently (~ in 2000)

- Several of the detected compounds could be linked directly to distinct recharge sources.

- Agricultural products, such as the growth regulator Trinexapac and the herbicide Atrazine were only detected in groundwater and piped mains water, indicating a pollution pathway by recharge from mains water leakage

➔ EOCs can be used to trace unique recharge sources in urban settings

➔ Better information on dominant recharge sources can inform GW protection & monitoring efforts

Thank you for listening

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