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

Bentje Brauns (et al.)

British Geological Survey

17 January 2023

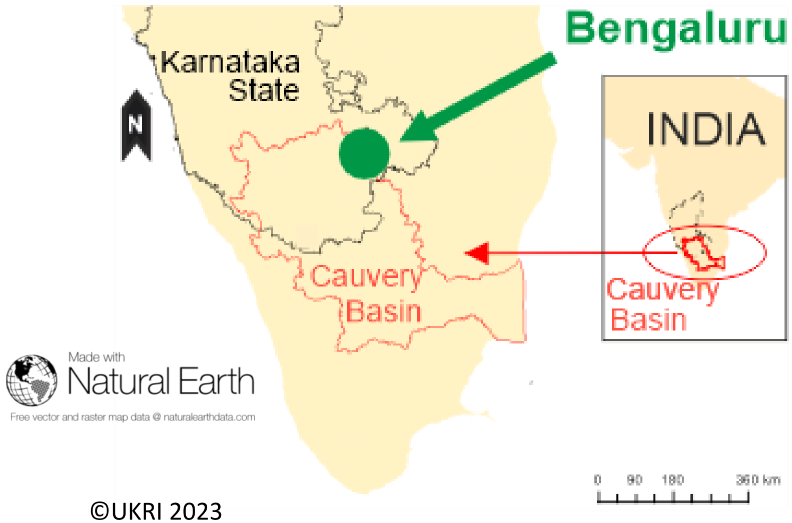
unesco Programme hydrologique intergouvernemental

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 2023

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

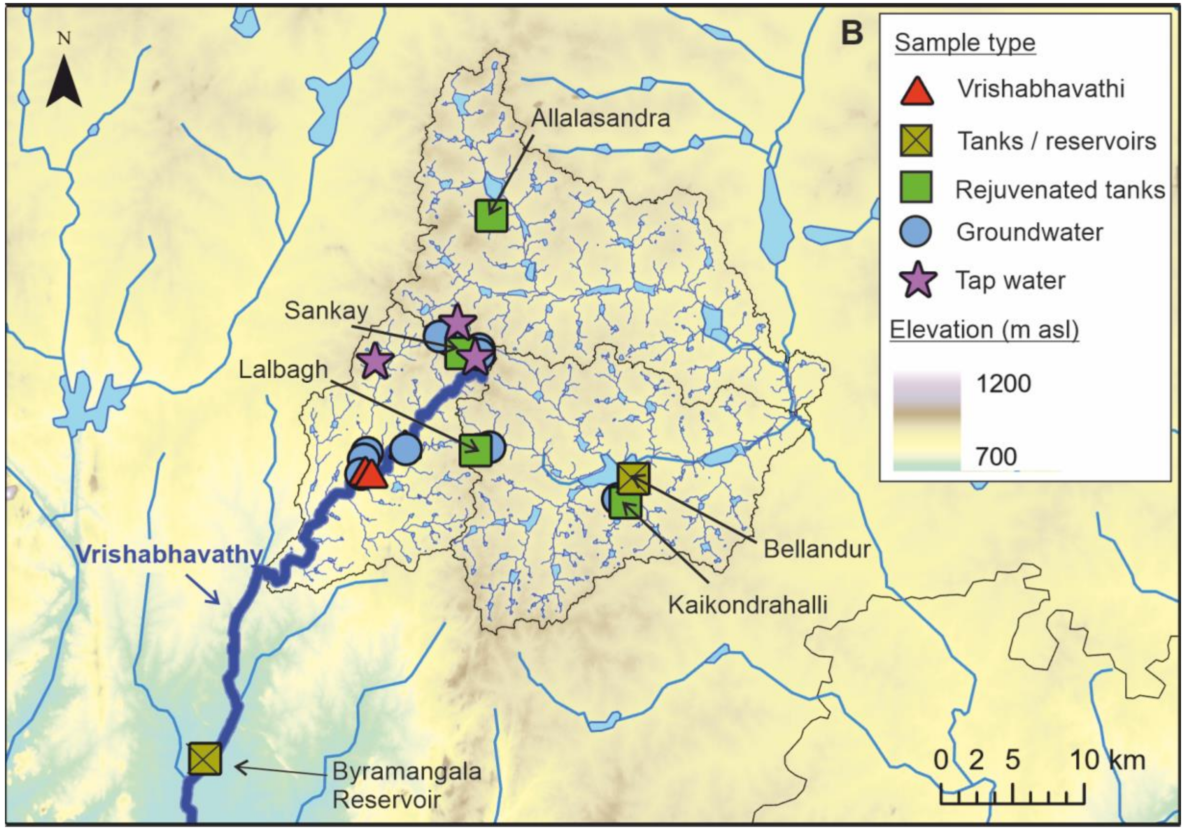
Urban rivers

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



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

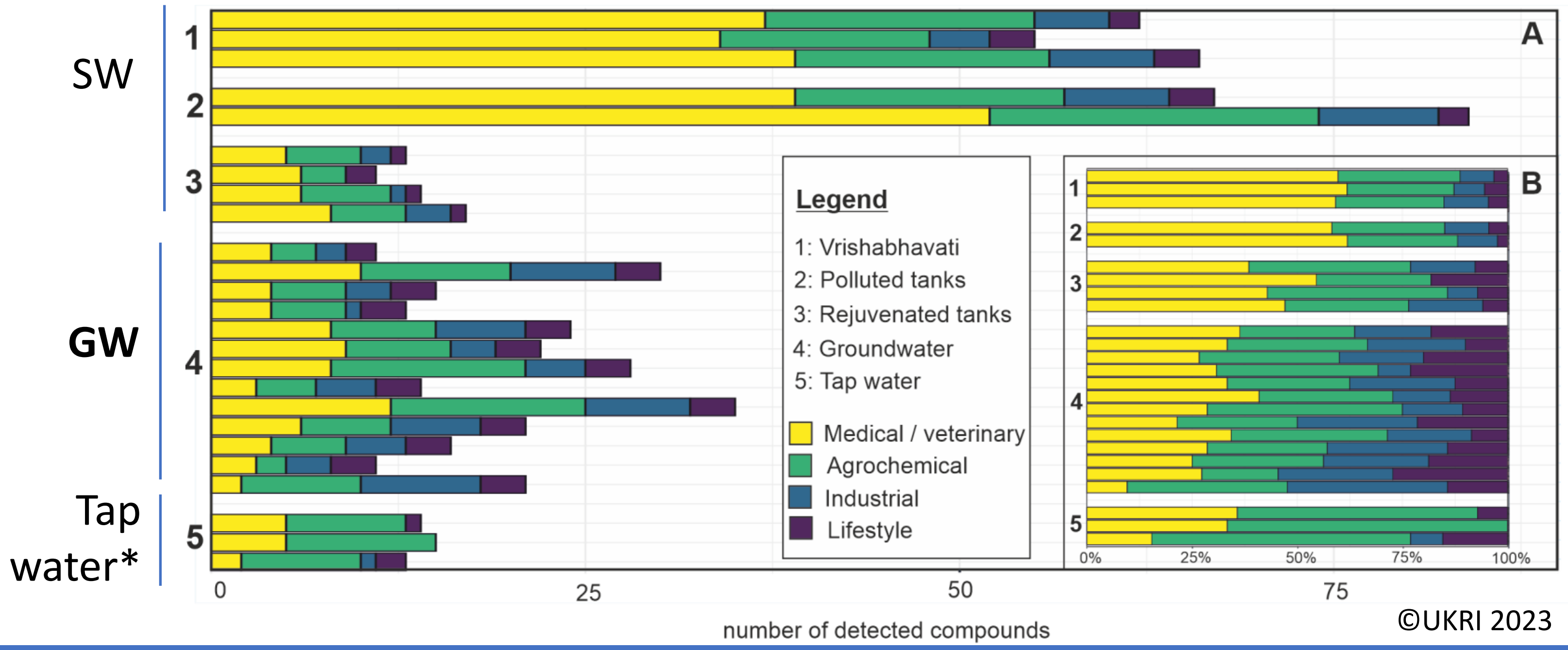
Samples were screened (GC-MS and LC-MS) for a total of **1499 emerging organic contaminants**, **EOC**s, at the UK National Science Laboratories at Starcross Laboratory in Exeter, UK

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

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:

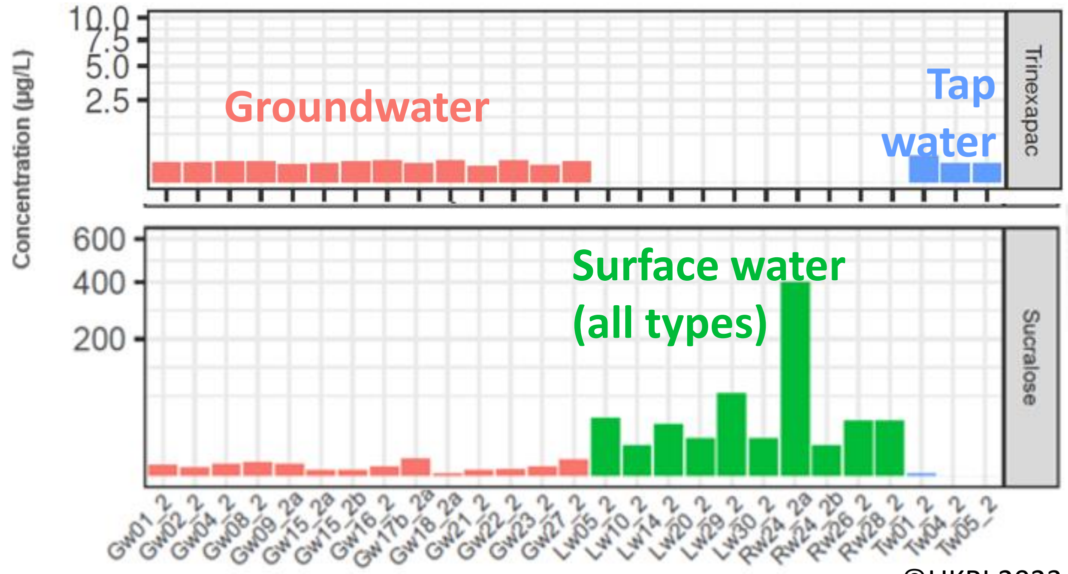
Sucralose, Acesulfame K, Ibuprofen

(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



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

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

Full author affiliations

Bentje Brauns[a,*], Subhash Chandra[b], Dan J. Lapworth[c], Alan M. MacDonald[d], Andrew A. McKenzie[c], Muddu Sekhar[e], Veena Srinivasan[f], Amritha Thankachan[g]

[a]British Geological Survey, Environmental Science Centre, Keyworth NG12 5GG, UK

[b]Department of Mines and Geology, Government of Karnataka, Ramanagara, Karnataka 562159, India

[c]British Geological Survey, Maclean Building, Crowmarsh Gifford, Wallingford OX10 8BB, UK

[d]British Geological Survey, The Lyell Centre, Edinburgh EH14 4AP, UK

[e]Department of Civil Engineering, Indian Institute of Science, Bengaluru, Karnataka 560012, India

[f]Ashoka Trust for Research in Ecology and the Environment (ATREE), Bengaluru, Karnataka 560064, India

[g]University of Visvesvaraya College of Engineering, Bangalore University, Bengaluru, Karnataka 560001, India

Photo credit: all photos used in this presentation were taken and provided by the authors

Funding declaration

The research underlying this work was carried out under the

UPSCAPE project*: Upscaling local water management interventions to inform larger-scale decision-making in the Cauvery basin, India,

Interpretation and write up were funded by the British Geological Survey NC-ODA Grant **Geoscience for Sustainable Futures** [NE/R000069/1] and the BGS International NC programme '**Geoscience to tackle Global Environmental Challenges** [NE/X006255/1].

**part of the Newton-Bhabha programme "Sustaining Water Resources for Food, Energy and Ecosystem Services", funded by the UK Natural Environment Research Council (NERC-UKRI) [NE/N016270/1], and the Indian Ministry of Earth Sciences (MoES) [MoES/NERC/IASWR/P1/08/2016-PC-II (i), (ii)]*