Voluntary spring monitoring to make invisible groundwater visible

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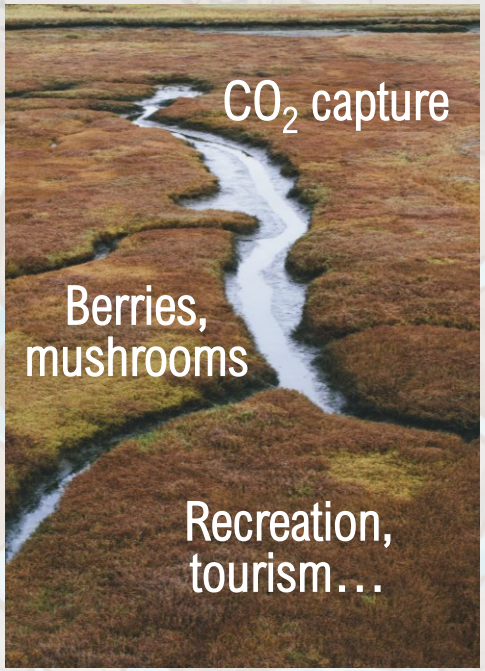
EOS1.4. Science communication and citizen science to increase risk perception and awareness

Groundwater is a crucial resource for human well-being



Provide ecosystems services

Supply groundwater dependent ecosystems

Provide water supply

Supply agriculture

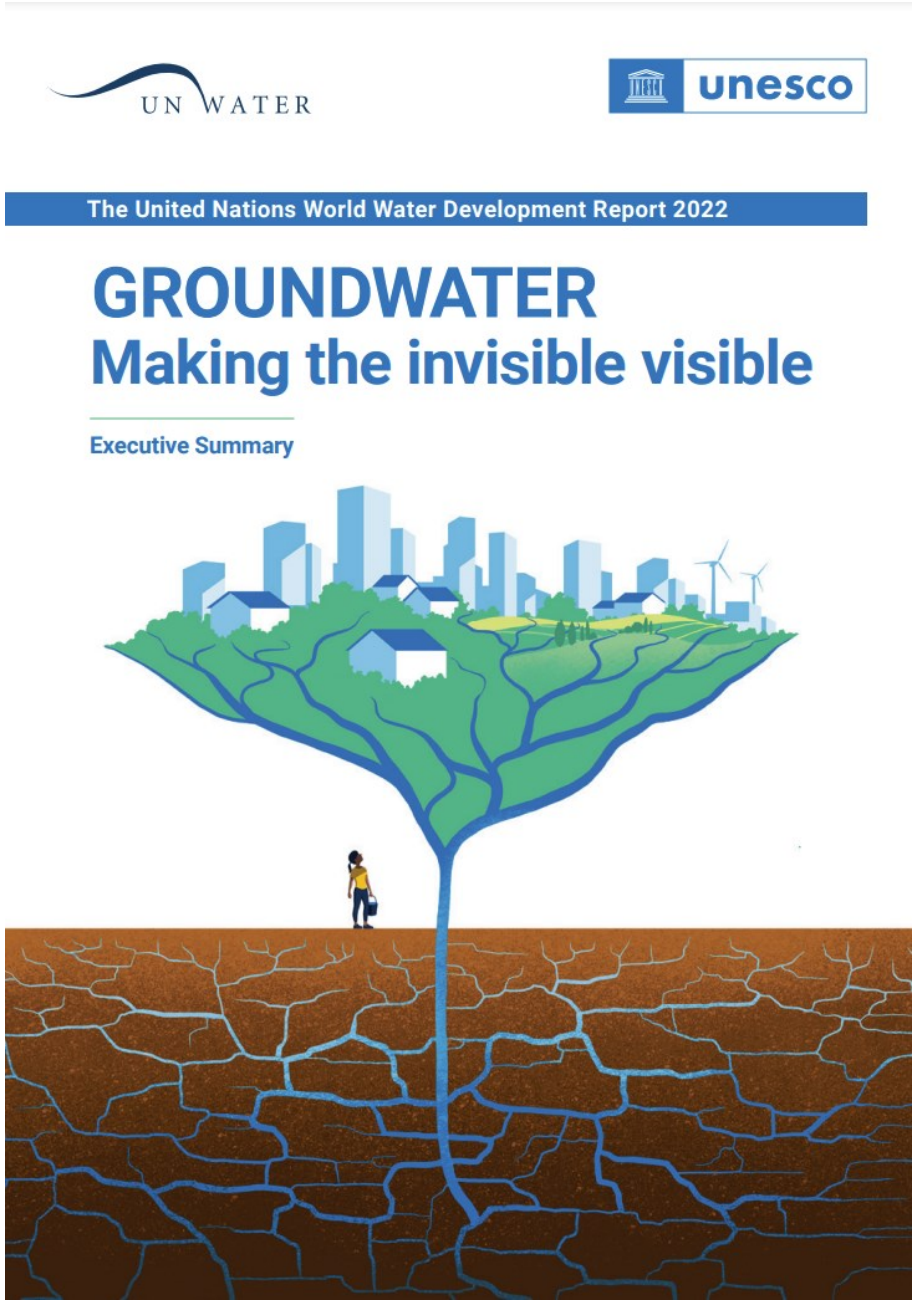
Climate change mitigation

Invisible groundwater

The aim of United Nations World Water Development Report 2022 is to shine a spotlight on groundwater, calling attention to its specific roles, challenges and opportunities.

"As the planet adapts to a changing climate and rising population, **groundwater will play an essential role in meeting the growing demand for food and drinking water.** Yet this essential resource faces serious risks – including inadequate protection and sometimes irreversible pollution."

Audrey Azoulay
Director-General of UNESCO



https://www.unesco.org/reports/wwdr/2022/en

Some qualities of ideal groundwater awareness raising/ citizen science tool…

Familiar to everyone

Must represent majority of issues

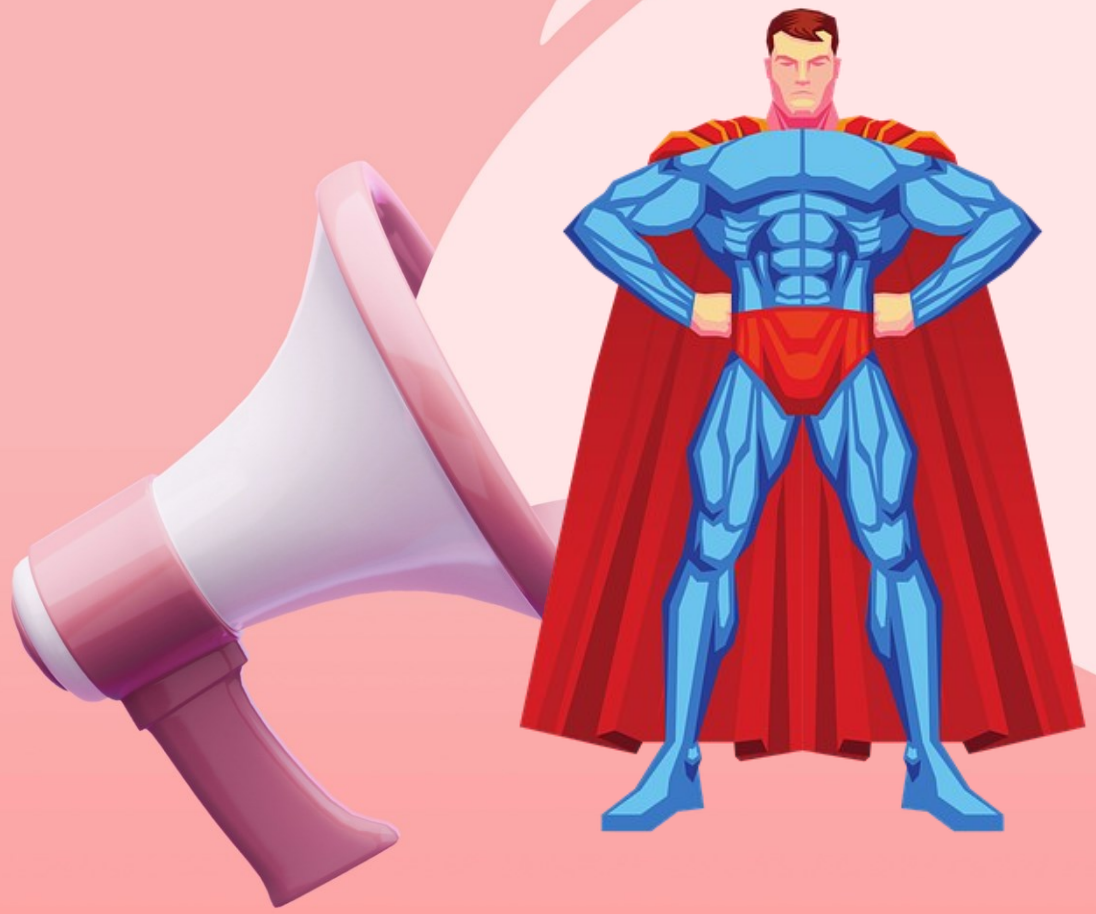
Target groups must care about it

Interesting and beautiful

Added value from monitoring

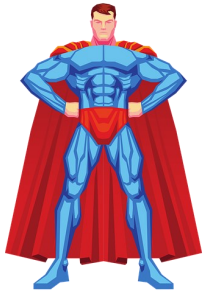
Easy and cheap to find and measure

Some qualities of ideal groundwater awareness raising/ citizen science tool…



- Familiar to everyone
- Must represent majority of issues
- Target groups must care about it
- Interesting and beautiful
- Added value from monitoring
- Easy and cheap to find and measure

Spring – where groundwater becomes visible

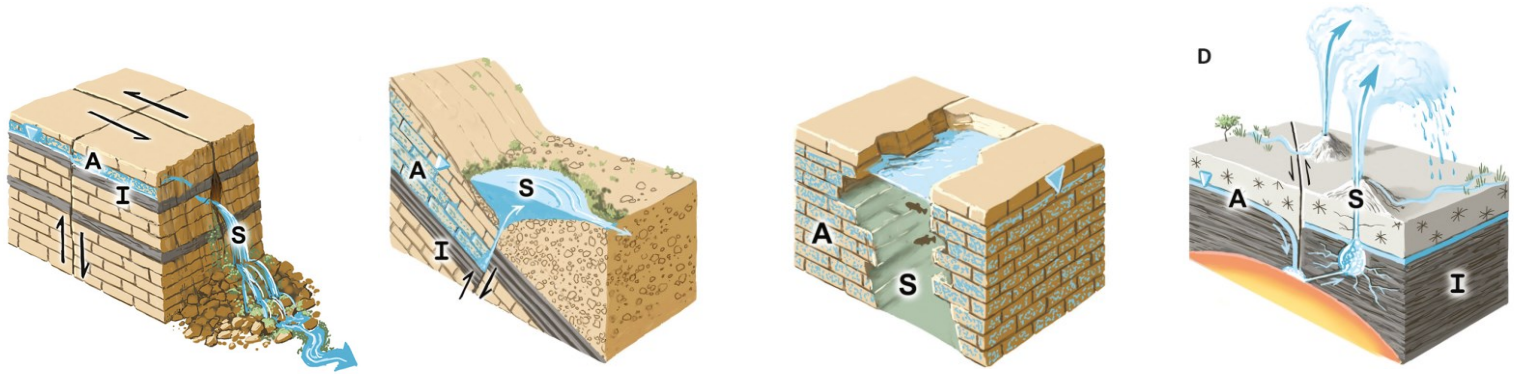


Spring monitoring benefits:

No installation or maintenance costs
Easy to sample and access
Fingerprints of human activities in the watershed
Great (citizen) science object

Limitations:

Should be mapped, screened seasonally
Watersheds needs to be delineated



Stevens, L.E., Schenk, E.R., Springer, A.E., 2021. Springs ecosystem classification. Ecol. Appl. 31, e2218.

«Kazu leja» spring in Vidzeme, Latvia

Why voluntary groundwater monitoring?

General approach for identification and selection of springs to improve transboundary groundwater monitoring network (Estonia-Latvia)

#1 **Mapping of springs**
(location, seasonality indicators, usage)
LOCALS

#2 **Finding representative springs**
(water quality analysis seasonally, watershed modeling and assessment)
SCIENTISTS

#3 **Inclusion into national GW monitoring network**
WATER MANAGERS

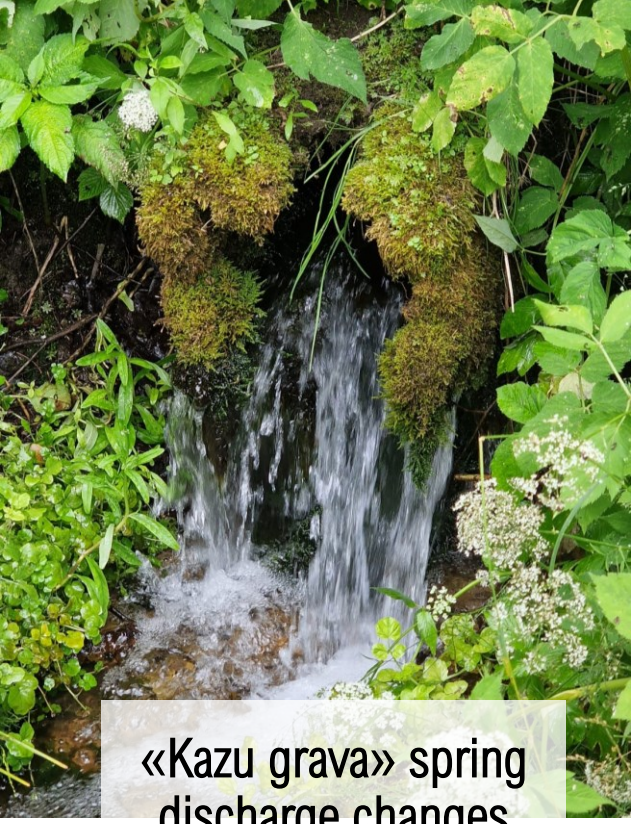
#4 **Funding allocation**
(annual GW monitoring)
POLICY MAKERS

#1 Benefits of citizen science and voluntary spring monitoring

- Increased awareness
- Educational
- Outdoor family activity
- Valuable data sets

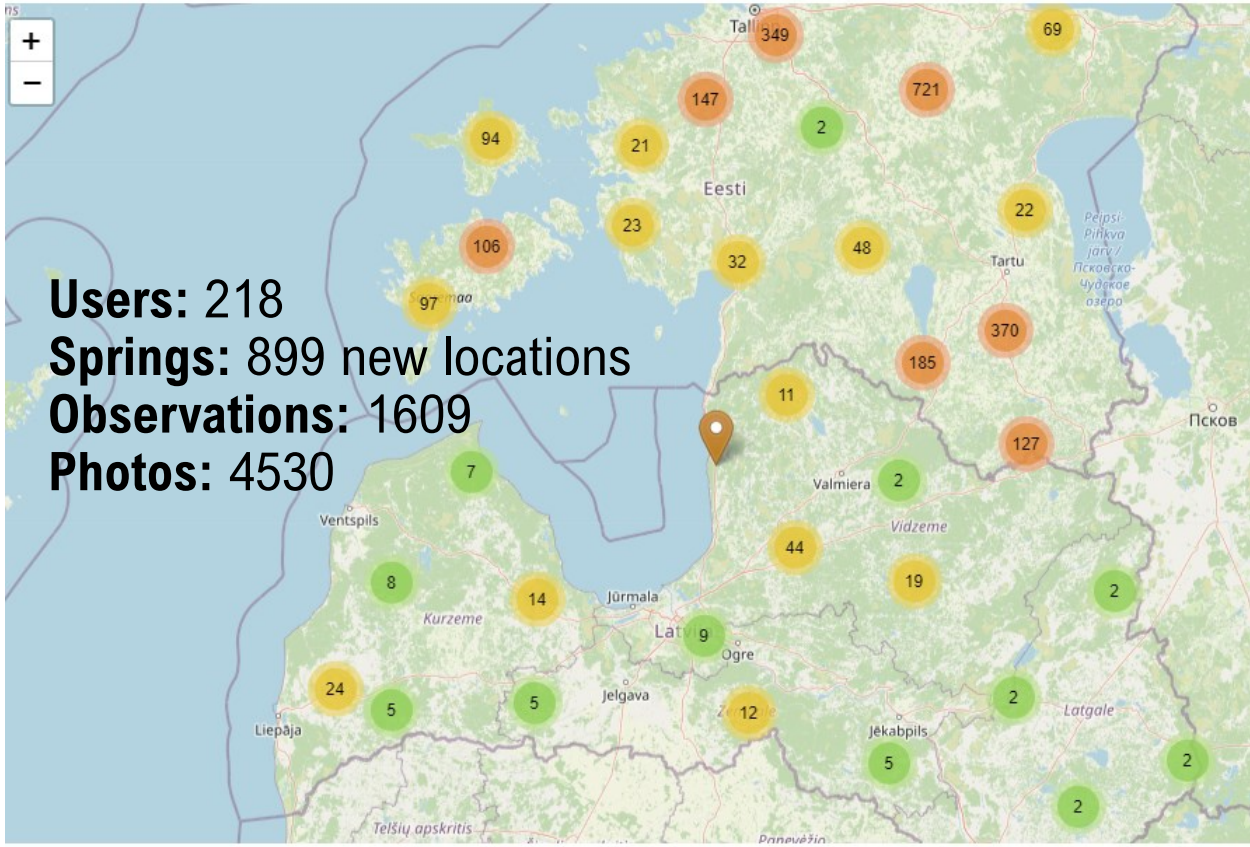
https://avoti.info/
https://allikad.info/

https://avoti.info/instructions



«Kazu grava» spring discharge changes during the seasons

Discharge and temperature/conductivity measurements



Featured springs | Newest springs | Newest observations | Newest analysis

Dzirnavu Kaļķavoti - Beižas avots
Latvia

Classification
Artesian spring

Status
Confirmed

Loonepõllu allikas 2
Estonia Rapla County Loone

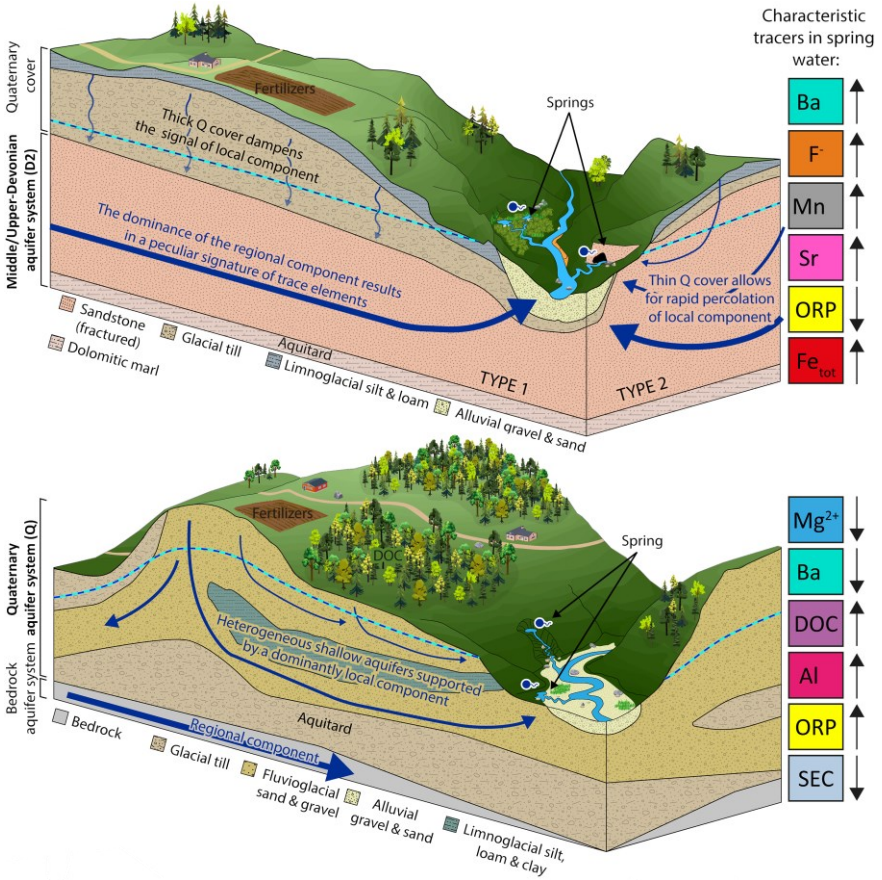
Classification
Artesian spring

Status
Confirmed

Lauri allikas 1
Estonia Lääne-Viru County Kisuvere

Classification
Gravity spring

Status
Confirmed



https://doi.org/10.1016/j.gsd.2023.100927

Number of samples for the quality analysis of one spring

#2 Scientific article published proposing new springs to be included in transboundary groundwater monitoring network.

#3 List submitted to Estonian and Latvian national authorities and are

#4 under consideration to be included into transboundary groundwater monitoring network.

Lessons learned

- Spring mapping works and delivers appropriate, necessary data sets.
- People activity is strongly connected with seasons and social campaigns.
- Long-time series possible to acquire by establishing direct relationships with volunteers e.g., involving educational institutions.
- Long-term success depends on funding and ownership.
- Water managers and policy makers are open to use results, but not to fund the activities (dependence on projects is not a solution).

Thank you!

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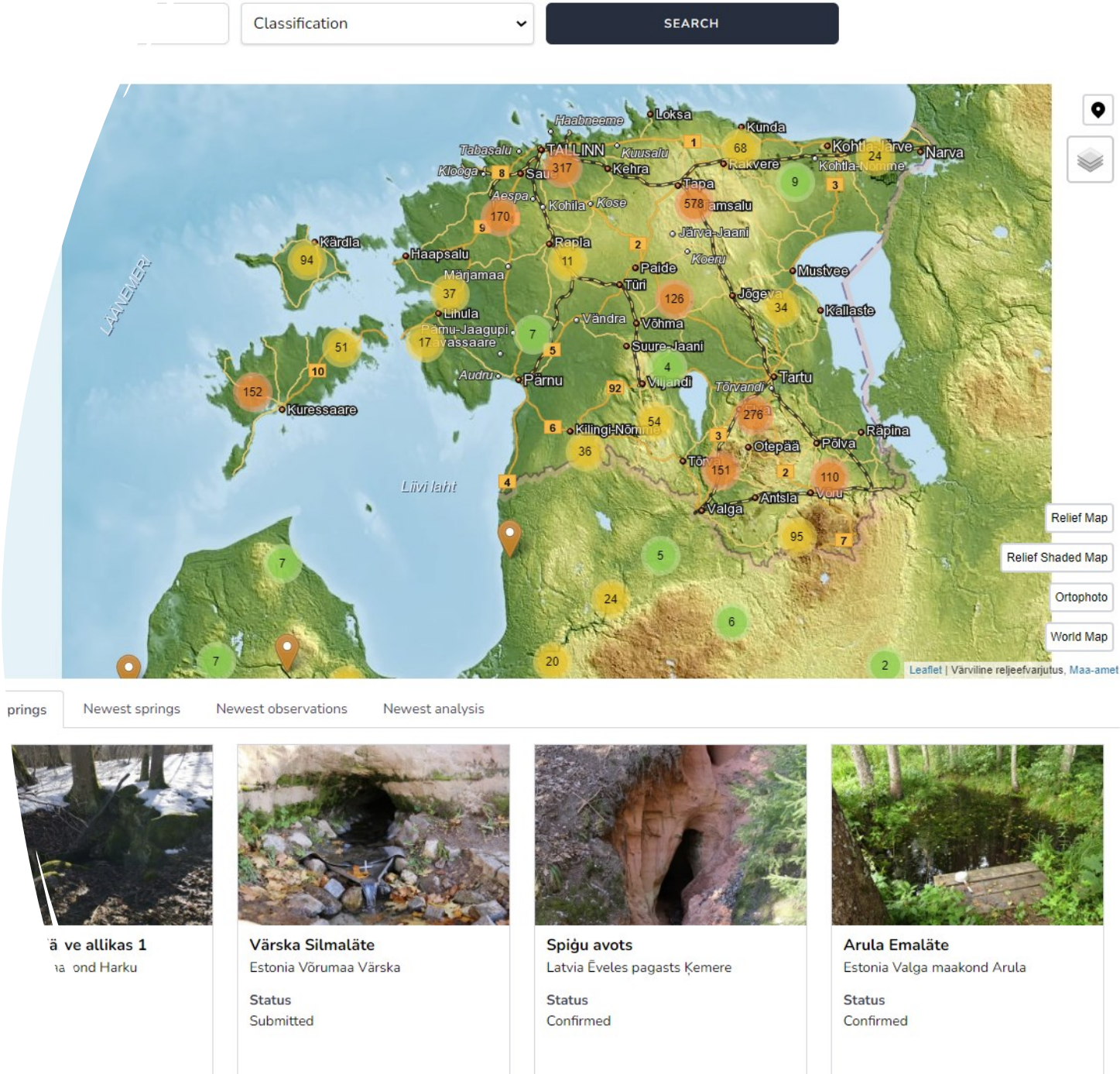
Supplementary

Observation database here:
https://avoti.info/ or
https://allikad.info/



Supplementary

Manual for voluntary spring monitoring here: https://allikad.info/manuals/volunteer_monitoring_manual_ENG.pdf

Contents

Supplementary

Link to scientific article that used citizen provided data to select springs for transboundary monitoring needs: https://doi.org/10.1016/j.gsd.2023.100927

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Research paper

Hydrochemical signatures of springs for conceptual model development to support monitoring of transboundary aquifers

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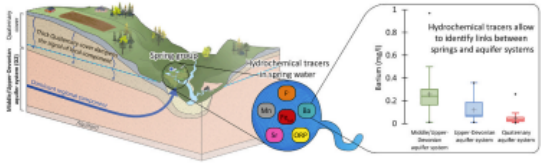
HIGHLIGHTS

- Springs can contribute to transboundary groundwater monitoring networks.
- Three conceptual models describe springs in EE-LV transboundary area.
- Hydrochemical signatures can reveal the source aquifers of springs.

GRAPHICAL ABSTRACT



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Groundwater monitoring
Transboundary aquifers
Springs
Baltic states

ABSTRACT

Neighboring states sharing transboundary aquifers should carry out joint assessment of the common groundwater resources to fulfill the EU Water Framework Directive's and Water Convention's aims. Therefore, the establishment of a representative cross-border groundwater monitoring network is essential. The transboundary catchments of Estonia (EE) and Latvia (LV) are sparsely populated and feature a relatively scarce monitoring network. Springs are natural groundwater outflows that may represent a significantly greater catchment area than monitoring wells, and their monitoring is more cost-effective. But a thorough evaluation is required to select the most representative springs for particular groundwater bodies/transboundary aquifer systems. In this study, 59 springs were investigated in the EE-LV transboundary area for 37 hydrochemical parameters. Additionally, we assessed 32 monitoring wells to define the aquifer system end-members. In total 409 groundwater samples were analyzed. The sampled springs were pre-classified to one of the three aquifer systems: Quaternary (Q), Upper-Devonian (D3) and Middle/Upper-Devonian (D2). Significant differences among the pre-classified groups in terms of spring elevation, Q thickness and discharge were detected. Multivariate and machine learning techniques implementing barium as a tracer, were applied to link the studied springs to their main contributing aquifer systems. This study shows that the application of diverse hydro-chemical and statistical methods help to evaluate the sources of spring water in an area with relatively homogenous groundwater chemistry. The developed conceptual models provide new generalized interpretation of transboundary aquifers, needed to improve groundwater monitoring networks in data-scarce areas using springs.

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