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Implications of surface water-groundwater interactions in the Sperchios River basin using radioactive and stable isotope tracers

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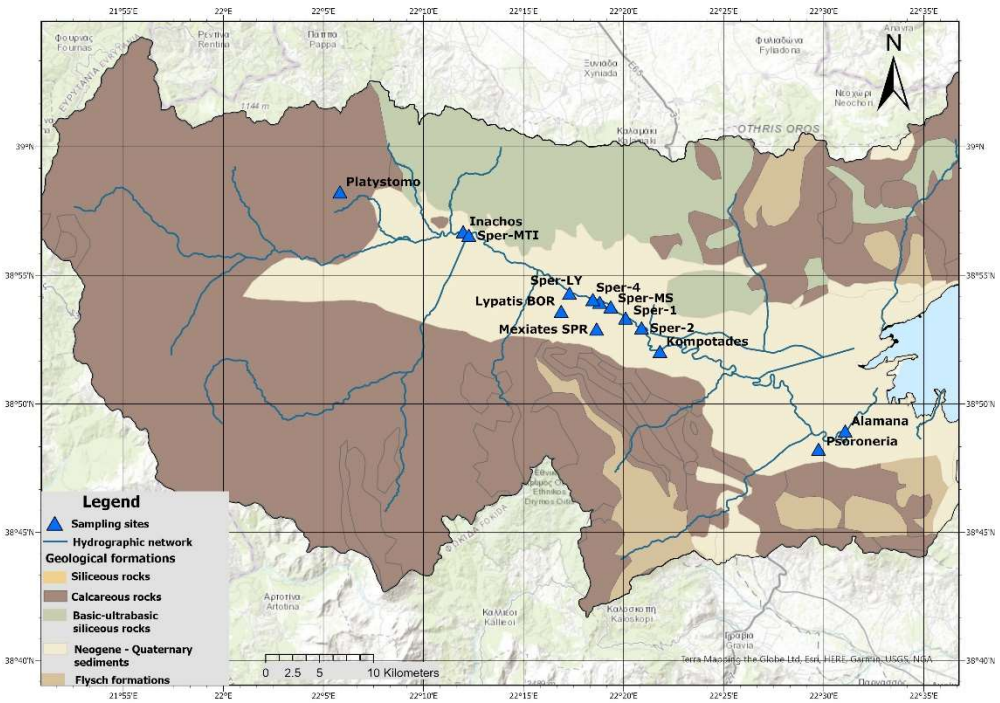


The limestones are among the most permeable formations in the SRB, hosting productive aquifer systems and discharging spring waters (e.g., Mexiates springs).

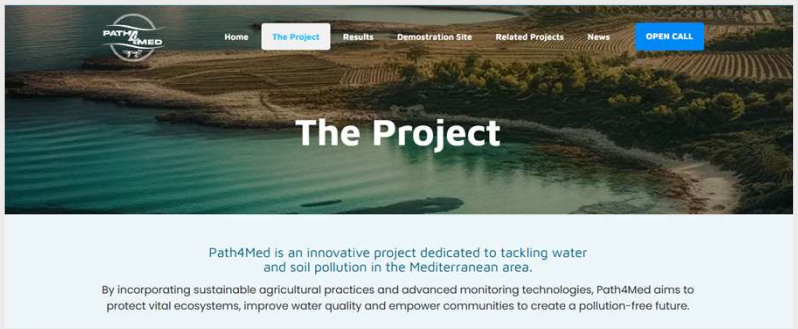
- Sperchios river basin (SRB) is located in in Central Greece, covers an area of ~1,700 km^2, and has a mean altitude of ~640m.
- The total annual precipitation amount averages ~750-850 mm.
- The river flows in a West-East direction, with a mean annual discharge to the Maliakos Gulf typically ranging between 5 and 10 m^3/s.
- The basin is covered by Triassic-Jurassic limestones and dolomites, the ophiolitic complex (basic-ultrabasic siliceous rocks), Cretaceous-Eocene flysch sediments, and Neogene-Quaternary deposits.

Introduction – Study area

Objective

Overall: To identify the contributions and interactions between surface water and groundwater in the SRB by using isotope hydrology techniques.

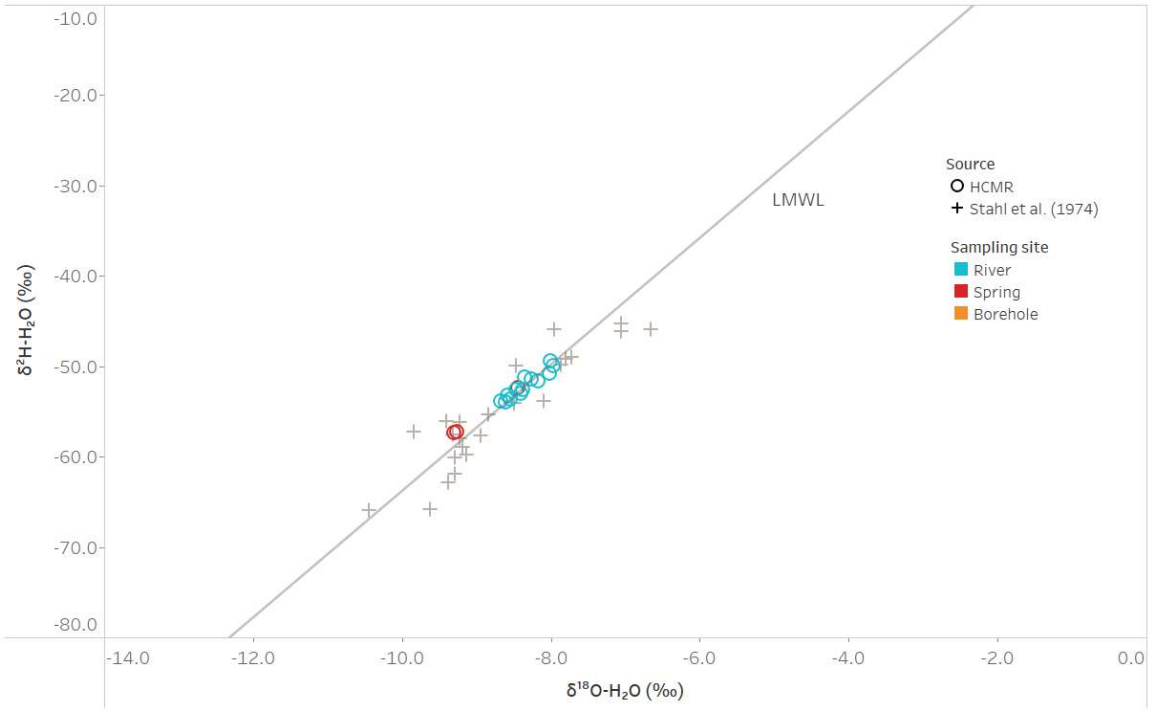
This work was conducted under the auspices of the IAEA CRP project F33207 and the EU project Path4Med.

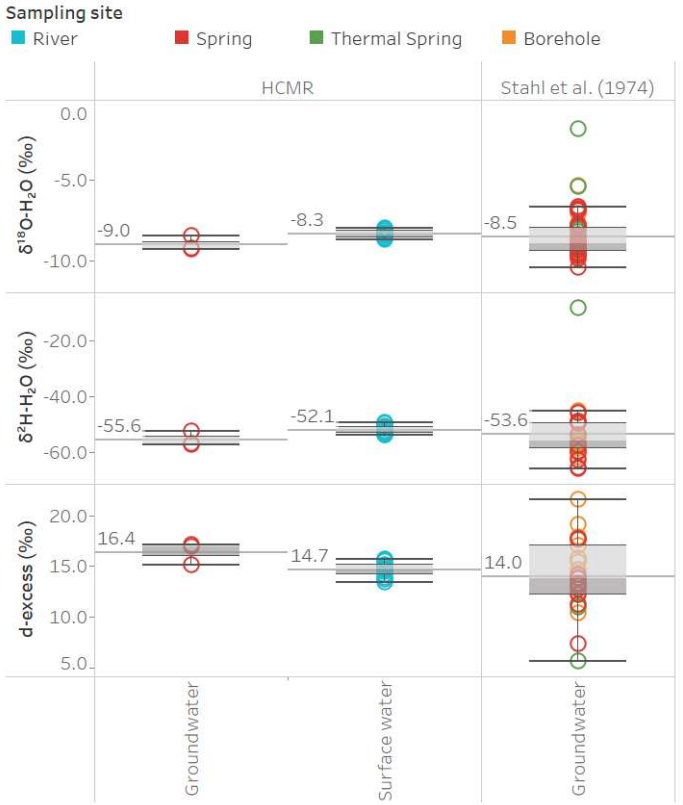


Methods

- **Sampling** (06/2024 and 11/2024) at 12 sites (1 borehole, 3 springs, 8 river waters)
- **In-situ measurements** of pH, electrical conductivity (EC), water temperature, dissolved O_2
- Analysis for **water isotopes** (^{2}H and ^{18}O of H_2O) @ the HCMR
- Analysis of samples for **Radon-222** using a RAD7 instrument.

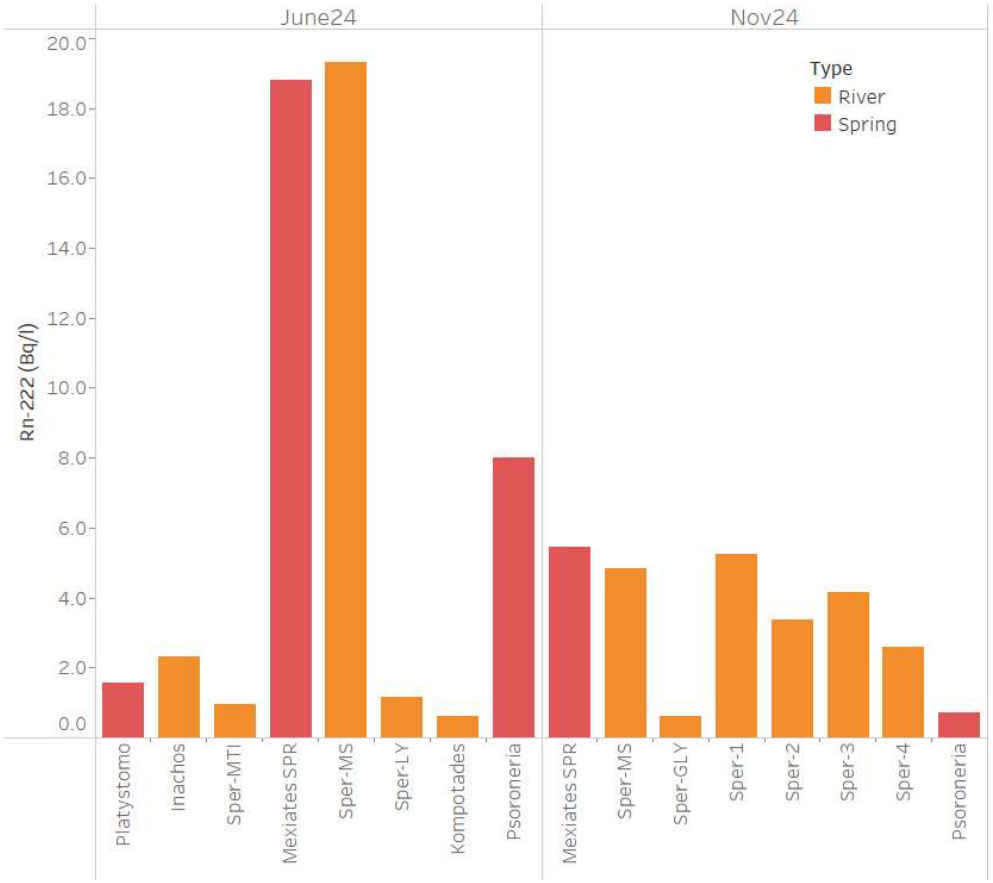
Results – Stable isotope data





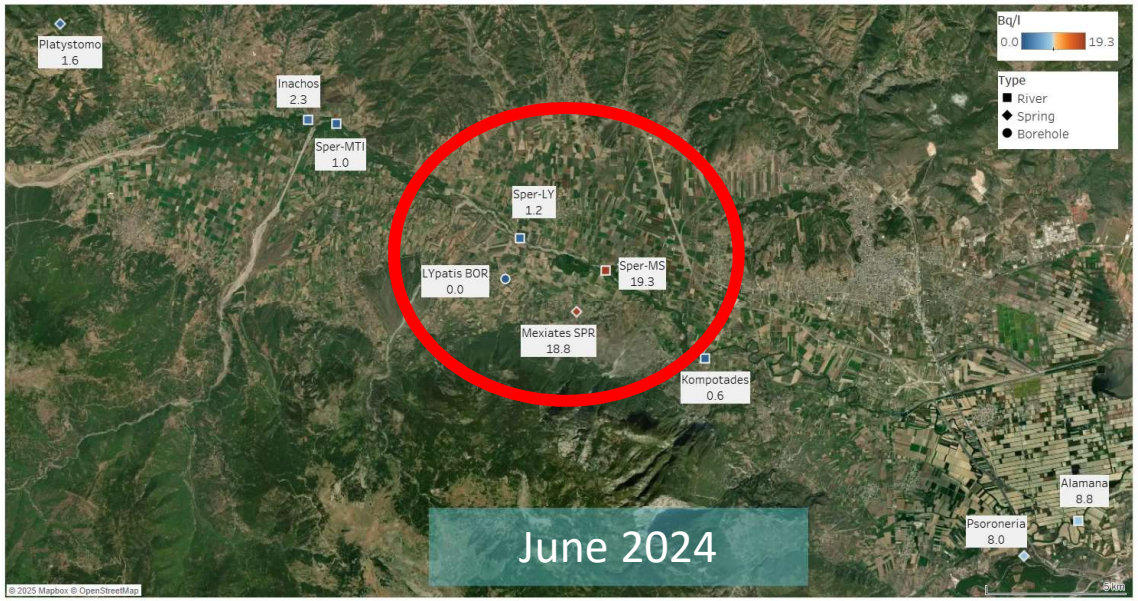
- The river waters of the SRB show similar isotopic values with the groundwater of Mexiates springs and with some groundwater sites representing local boreholes (based on the previous work of Stahl et al. (1974)), which is indicative of same origin of recharge or interaction between them.
- The groundwater sites sampled in the current study show more depleted isotopic values compared to the thermal springs sampled by Stahl et al. (1974) due to fractionation influencing the latter.

Results – Radioactive isotope data



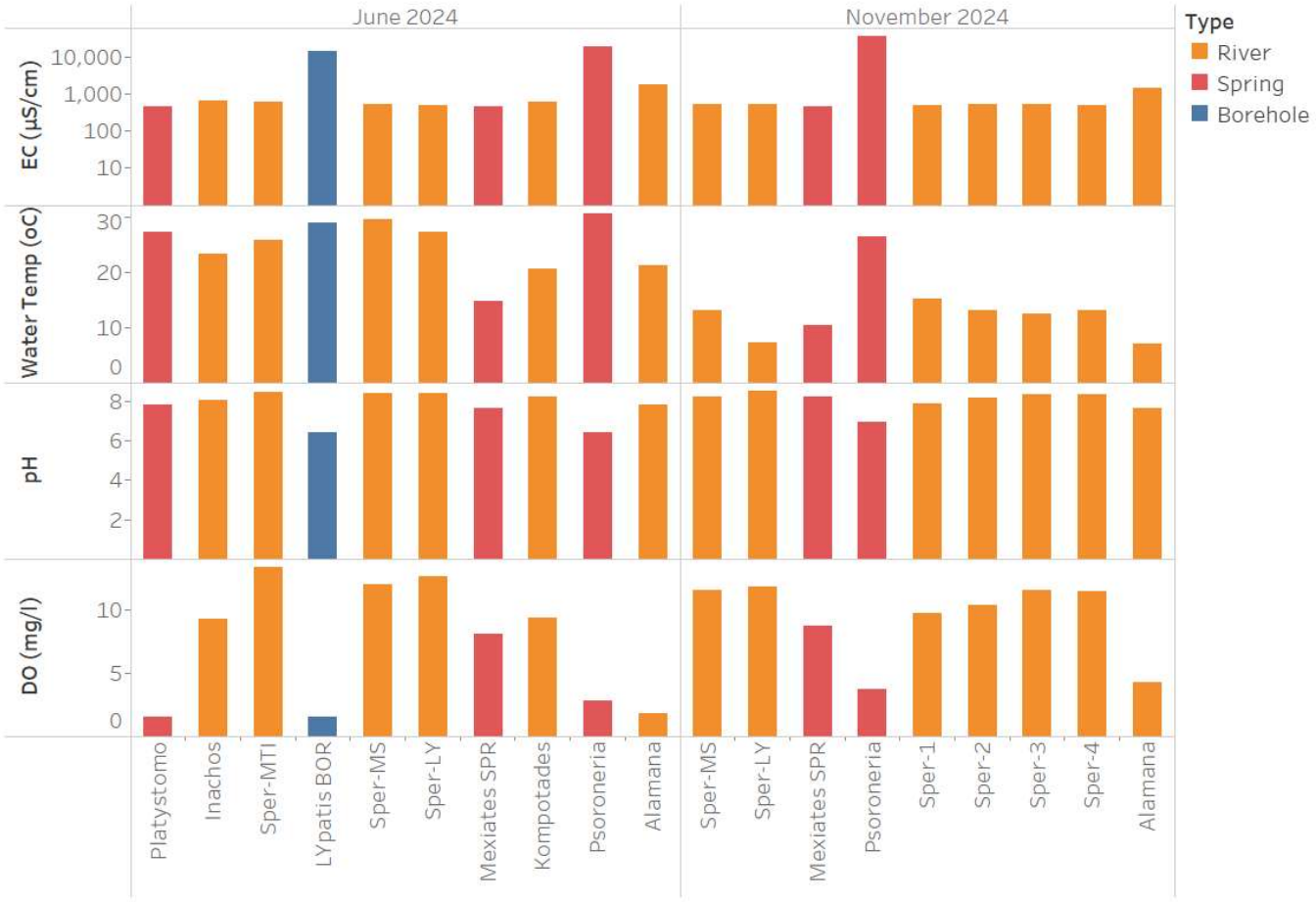
- Among the monitoring sites, Mexiates springs (non-thermal) showed the highest ^{222}Rn activity in both periods.
- The ^{222}Rn activity was overall higher in June 2024 than in November 2024.
- Sperchios River showed a distinct ^{222}Rn activity signal in Sper-MS site in June 2024 and additionally in Sper-1 to Sper-4 sites in November 2024.

Results – Radioactive isotope data



- Radon sampling along the Sperchios River and the main spring waters of the SRB revealed the occurrence of a significant surface-groundwater interaction zone extending approximately from Loutra Ypatis until Kompotades.
- Mexiates springs are one the most important groundwater discharges of Oiti Mt. recharging the river as evidenced by both stable and radioactive isotope values.
- Significant differences in ^{222}Rn per period are attributed to the dilution with rainwater.

Results – Chemical data



- The highest EC and water temperature values were detected in the hydrothermal waters (e.g., Psoroneria springs).
- The lowest pH and DO values were recorded at Lypatis BOR and Psoroneria.
- The DO levels in the groundwater were lower compared to the river waters.

Conclusions

- Surface water–groundwater interactions in the SRB are of great importance for the sustainable management of water resources.
- Stable isotope techniques confirmed earlier findings regarding the origin of the water bodies.
- Radon-222 measurements proved valuable in identifying a zone of interaction where river water is recharged by groundwater.
- The waters of the Mexiates springs are related to river recharge.
- Additional surveys are required to delineate surface water–groundwater interaction zones along the Sperchios River.

Thank you for your attention

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