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Airborne thermal data reveal groundwater discharge at the north-western coast of the Dead Sea

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The vicinity around the Dead Sea heavily relies on groundwater as water resource for the increasing population and agricultural demands. Exact locations and volume of groundwater discharge at the western Dead Sea coast are only partly known and concern terrestrial springs only. Yet, a complete picture of the discharge including increasingly mentioned but unlocalised submarine springs is essential for a sustainable groundwater management of that area.

In order to fill this gap we conducted an airborne thermal campaign in 01/2011 over the north-western section of the Dead Sea coast. Based on the thermal contrasts between warmer groundwater and cooler Dead Sea water at that time we identified 72 discharge sites along the north-western coast where thermal data are currently available. We compared these high-resolution thermal data to previously derived thermal satellite-based results and concluded that both show the same discharge characteristics, encompassing two sections in which different spatio-temporal consisting processes occur (1. momentum force of discharging water, 2. local southward directed current or Coriolis force).

The high spatial resolution of the airborne thermal data (0.5 m GSD) allowed refining the so far unknown abundance of submarine springs to 6 sites with varying diameters and distances to the coast. More striking were 24 sites, where the thermal data revealed seeping springs. We assumed groundwater discharge from this spring type to be higher than from submarine springs and hence imperative to account for. The main groundwater contribution to the Dead Sea stems from terrestrial springs that we identified at 42 sites.

For this main spring type we were able to develop a linear ordinary least square model between in-situ measured spring discharge data and the resulting thermal discharge plume area. This quantitative approach explained 93 % of the observed spring discharge with a coefficient of determination of 0.88 underlining both parameters to have a significant relationship. Based on these results unmonitored discharge sites can now be quantified and can provide a complete quantitative picture of terrestrial groundwater discharge amount from the western coast of the Dead Sea.