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UAV in combination with a thermal infrared sensor for the use in groundwater research

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Submarine groundwater discharge (SGD) is highly variable in spatial and temporal terms due to interplay of several terrestrial and marine processes. In contrast to discrete in-situ measurements, remotely sensed thermal infrared radiation has proven to reveal horizontal SGD variability in a spatially continuous context. Yet, it lacks temporal information that is crucial to understand highly dynamic systems as represented by many coastal environments.
Here we report the results of temporal continuous Unmanned Aerial Vehicle (UAV)-based measurements of thermal radiances in a highly saline environment - the Dead Sea. Instead of flying over the study area we exploit the UAV ability to observe predefined locations by hovering above a predefined SGD spot to study spatio-temporal characteristics of SGD.
Through hovering and the so obtained high temporal and spatial resolution of thermal radiances, we can show influences of crossflows and interaction of nearby SGDs on the final thermal radiance pattern, horizontal pattern shifts, pattern size variation of up to 600% and a periodic discharge behaviour at intervals of 20-78 seconds. These numbers could not be revealed with classical spatially discrete methods and thus mean an asset for groundwater discharge and process understanding.
Besides the advantages and thus opportunities for groundwater investigation, we will likewise point out limitations during the conduction (flight stability, flight duration, thermal sensor drift) and processing (image registration) but also future improvements that may influence UAV-based groundwater investigations.