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Remote sensing application possibilities on groundwater characterization in arid regions at the example of the Dead Sea

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In arid regions like the Dead Sea (DS) water supply mostly relies on restricted groundwater resources, which are in many cases defined by large inaccessible areas with scarce in-situ data. However, particularly in these regions it is essential to obtain detailed information of this precious resource in order to develop a sustainable water management - one of the main aims of the BMBF-funded multilateral SUMAR (Sustainable Management of Arid and Semiarid Regions) project. The usage of remote sensing offers different indicators and directly sensed patterns from different platforms providing important data where practical alternatives or simply spatial data are not available (Becker, 2006).

One application possibility regards the identification of lineaments which are simple or composite linear features of a surface and which have been proven to reflect general groundwater flow-paths (Sander, 1997). In a previous study we derived lineaments using a freely available digital elevation model (30 m spatial resolution) and developed a semi-automatic approach composed of low pass and 2nd order Laplace linear filtering and a subsequent object based classification. Based on these lineaments we could identify general groundwater flow-paths with striking directional trends towards known spring areas along the DS (Mallast et al., 2011).

With the knowledge of both, location of spring areas and a given temperature contrast between ground- and DS water, we derived by using thermal remote sensing from satellite and airborne platforms a second application possibility. Satellite based thermal remote sensing with Landsat ETM+ images allowed us to identify groundwater discharge pattern, which highly correlate in location with the previously derived flow-paths, but also enabled us to relatively quantify also seasonal varying groundwater discharge over a time period of 12 years (2000-2011). The drawback remains in the spatial resolution of 30 m (resampled from United States Geological Survey from 60 m), which hinders to accurately delineate spring-caused thermal plumes or to identify small scale springs or even spring types (terrestrial springs and submarine springs) (Mallast et al., 2012).
As exactly this fact is important for subsequent studies we pursued an airborne thermal campaign in January, 2011 where technical specifications (0.5 m spatial resolution, flight time at night for higher contrast) were chosen to account for any so far observed spring type and scale. The result confirms the delineated areas from the satellite findings but refines these areas showing numerous and differentiable discharge locations. It also reveals unknown submarine spring locations and a third spring type where groundwater diffusely seeps through high saline Dead Sea sediments in contrast to the other spring types, with rather concentrated flow.

The study shows at two application examples how remote sensing can be used for groundwater studies and also points at related advantages and disadvantages. Integrating these information into numerical groundwater modelling or sustainable water management strategies can significantly improve existing approaches and hence, yields a valuable benefits.

References

Becker, M.W., 2006. Potential for Satellite Remote Sensing of Ground Water. Ground Water 44, 306-318.
Mallast, U., Gloaguen, R., Geyer, S., Rödiger, T., Siebert, C., 2011. Derivation of groundwater flow-paths based on semi-automatic extraction of lineaments from remote sensing data. Hydrol. Earth Syst. Sci. 15, 2665-2678.
Mallast, U., Siebert, C., Gloaguen, R., Friesen, J., Rödiger, T., Geyer, S., Merz, R., 2012. How to derive ground-

water caused thermal anomalies in lakes based on long-term medium resolution images in semi-arid regions. Journal of Arid Environments (submitted).
Sander, P., Minor, T.B. & Chesley, M.M., 1997. Ground-Water Exploration based on Lneament Analysis and Reproducibility Tests. Ground Water 35, 7.