Smart sensoring of ground water flow for the management of subsurface assets

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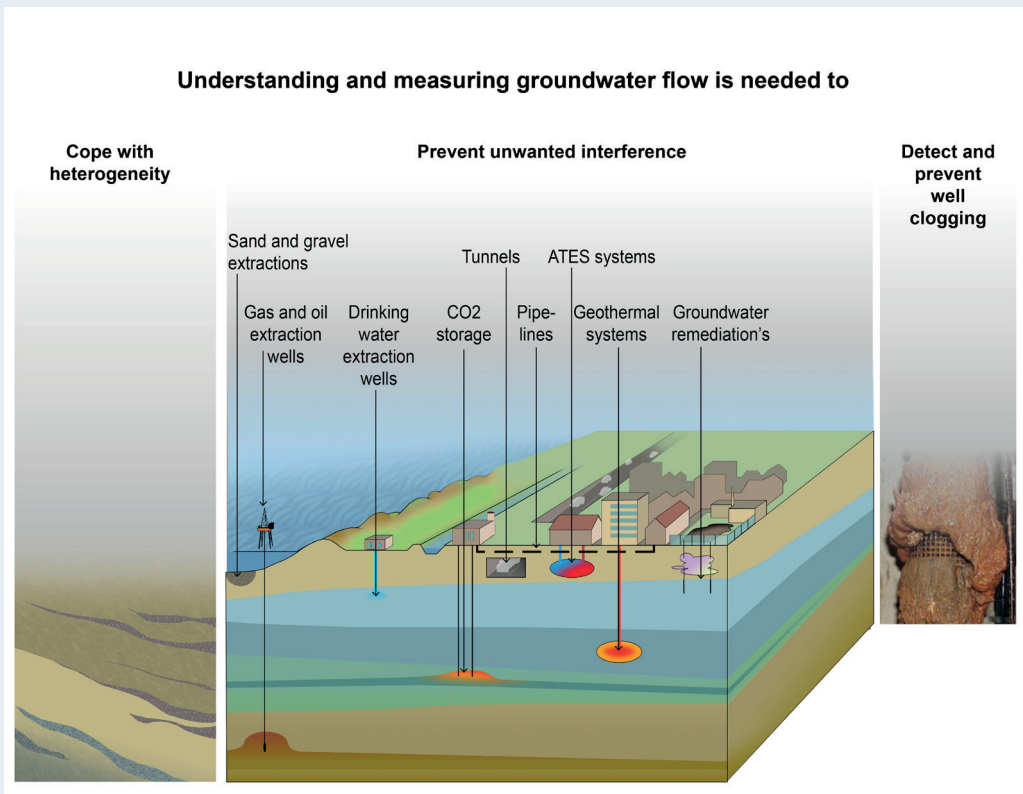
Wiecher Bakx

wiecher.bakx@wetsus.nl wiecher.bakx@arcadis.com

Motivation

For adequate management of groundwater extraction wells, ATES systems, remediation sites, dykes and other subsurface infrastructures, there is a need to improve knowledge of ground water flow (magnitude and direction) on both regional and local scale. Understanding groundwater flow helps to prevent unwanted subsurface interference as a result of the increase of subsurface use, to detect well clogging and to cope with sediment heterogeneity especially in fluvial deposited sediments.

This can be achieved by measuring groundwater flow in detail and in real-time, e.g. by high accuracy measurement using Active Distributed Temperature Sensing (A-DTS) by insertion of optical fiber cables in de subsurface.



Technological challenges

Measuring groundwater flow in detail and in real-time lead to several technological challenges that will be addressed in this research:

- Inserting of fiber optical A-DTS/FBG cables without disturbing subsurface structures
- Translating temperature data (A-DTS, FBG) to groundwater velocity information, separating flow and sediment influence on the cooling of the DTS/FBG cable
- Combining measurement techniques for a spatial and temporal view of groundwater flow including real-time measurements

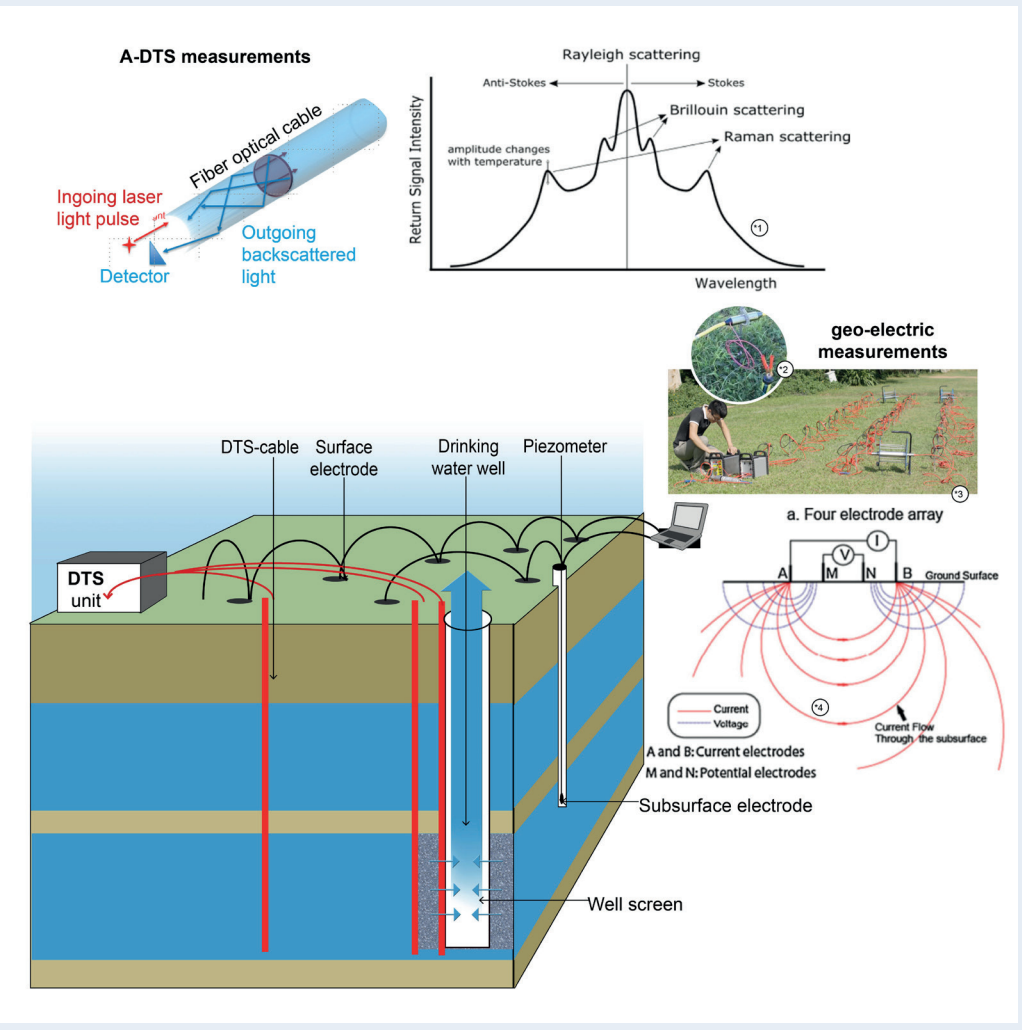
Research goals

- To select sensing techniques for the measurement of groundwater flow in unconsolidated sediments
- To pilot a selection of these techniques in a field situation
- To use these measurements for understanding the influence of subsurface heterogeneity which is essential to improve groundwater modeling
- To build a synthetic/generic predictive groundwater model for subsurface asset management that uses measured data on groundwater flow gathered by the applied sensing techniques

Pilot study

The following groundwater flow sensing techniques will be combined at a drinking water extraction well:

- Active Distributed Temperature Sensing (A-DTS) and Fiber Bragg Grating (FBG) optical fiber cables
- Geo-electrical measurements
- Direct current resistivity
- Self potential (SP)
- Optional: tracer measurements and point-location measurements (using piezometers)



References

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2. picture from www.agiusa.com
3. picture from www.geomative.com
4. Revil, A., Karaoulis, M., Johnson, T., & Kemna, A. (2012). Review: Some low-frequency electrical methods for subsurface characterization and monitoring in hydrogeology. Hydrogeology Journal, 20(4), 617–658. http://doi.org/10.1007/s10040-011-0819-x

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