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Connecting shallow geothermal resources to the Internet of Things

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Sophisticated numerical models or elaborate groundwater management strategies are of little value without the opportunity to calibrate or verify the estimates. Thus, a reasonable environmental monitoring is the fundamental key to good results. Especially for the dynamic processes, which affect the use of shallow geothermal energy. The desired solution to overcome this lack of knowledge would be a grid of low-cost sensor nodes, which provide online measurements. Continuous measurements in an appropriate spatial density will facilitate a precise calibration of transient thermal groundwater models – laterally and vertically.

The Chair of Hydrogeology currently evaluates the feasibility of establishing a distributed sensor network for groundwater monitoring in Munich. In cooperation with the Leibniz-Rechenzentrum (LRZ), pilot sites have been equipped with the required sensor and transmitting infrastructure. Hereby, a real-time data collection with a secure cloud storage was in the focus. In addition, the monitoring data is visualized and accessible via ThingSpeak. Up to now, monitoring activities comprise the measurement of extraction and injection temperatures of a GWHP system, grout temperature and heat meter measurements of a GSHP system and soil temperature measurements from distributed sensor nodes.

The major challenge in distributed measurements of soil and water temperatures or groundwater levels is a long-term power supply and a wireless data communication. Those essential properties should be present in an inexpensive sensor node. Therefore, the LoRaWAN (Low Power Wide Area Network) protocol is used. A programmable microcontroller (ATmega328) reads the sensors and a radio transceiver module (RFM95W) transmits the data to a LoRa Gateway. The gateway is connected to the Internet and uploads the sensor readings to the LRZ compute cloud, where they are stored in a database. The hardware setup of the sensor node is very cost-efficient and further field tests are foreseen to evaluate a larger application of this monitoring approach.

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