Potential assessment for the use of near surface geothermal energy in the Alpine region within the GRETA project

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GRETA – Geothermal REsources in the Territory of the Alpine space

The project GRETA aims to foster Near-Surface Geothermal Energy (NSGE) in the territory of the Alpine space. Main goals are to assess potentials of NSGE, exchange knowledge and best practices on a transnational basis and to integrate NSGE into policy instruments. 12 partners from six countries (Germany, France, Italy, Switzerland, Slovenia and Austria) are participating in this project, co-financed by the European Regional Development Fund (ERDF) through the Interreg Alpine Space programme. The start of this three years lasting project was in December 2015, first results are accessible via the project homepage http://www.alpine-space.eu/projects/greta/en.

Potential assessment of the use of NSGE

In Austria, the focus within the project is set on the potential of NSGE in the Alpine space, thus, mainly addressed to winter tourism in high altitude regions. In the course of the assessment on the current status of high altitude NSGE installations, so called "best practice examples" were identified. These examples show the broad applicability of NSGE systems in the Alpine space. Examples include different types of NSGE systems like horizontal collectors, groundwater heat pumps or borehole heat exchanger fields. They show how operators run a valuable NSGE installation in high altitudes (e.g. the Hotel Crystal, Ötztal, 1,905 m altitude). They also show how in areas with so-called rough climate, conditions can be unexpectedly well (e.g. the company Euroclima, Sillian, 1,083 m altitude). From these examples, challenges as well as relevant operational criteria and constraints can be derived in a qualitative approach.

In the first year of the project, challenges of high altitude regions and remote areas were assessed in the course of this best, but also "bad" practice example evaluation. Challenges identified are mainly related to underground temperatures – e.g. cold underground temperatures at very high altitude locations or below-average temperatures of groundwater aquifers in low altitude locations due to drainage from mountainous areas.

This assessment made clear that underground temperature is a key parameter for NSGE potential assessment. This parameter is usually calculated based on outside air temperature under consideration of elevation. It can be assessed more precise under consideration of e.g. solar radiation, snow cover and underground properties. This method is not used as a standard because multiple parameters are needed which are not easily available. Thus, calculations tend to get more complex and special software is required. The University of Natural Resources and Life Sciences in Vienna (BOKU) has developed a software called SoilTempSim, allowing complex simulations of underground temperatures (Grabenweger, 2015).

For validation of these simulated values, measurement stations are necessary – those were missing in the Austrian case study area (Leogang and Saalbach-Hinterglemm). That is why, in autumn 2016, monitoring stations were installed in the municipality of Leogang. Two stations were realised in the valley at about 800 m, two were installed further up the mountain at 1,250 m (south-slope) and 1,400 m (north-slope). Drillings for the burial of measurement chains were carried out using an electric hammer. Dependent on underground properties, the drillings reached depths of 1 to 3 m. Samples were taken from the drilling cores in order to perform soil analyses. The remaining material was used to backfill the drillings, mixed with bentonite pellets. The measurement chains are in-house developments and consist of single digital thermometers (Ds18b20) measuring the underground temperature. They are attached to a data cable in depths of 10 cm, 20 cm, 50 cm, 1 m, 1.5 m and 3 m below surface. The data loggers connected to the measurement chains are based on an Arduino Micro controller. Lead accumulators and a solar panel supply pow-

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er. Data is collected every two hours and stored on an SD card. One sample per day is transmitted via SMS protocol and can be downloaded in csv format.

First results of the ground temperature monitoring

The first analysis of the monitoring data show interesting results. Different than expected not the sensors in the valley (~800 m altitude) show the highest underground temperatures but the sensors located in the mountains at an altitude of 1,250 m (station Sonnberg, heading southwards). This might be due to an early snow cover acting as thermal insulation. The earliest and thickest snow cover is at the north-facing station 4 (Bergbahn). Here, the temperature drop is the least significant. These first results show, how much influence parameters like the snow cover or the exposition do have on the underground temperature and that altitude as such is not reliable to predict underground temperatures.

References

Grabenweger, P. (2015): SoilTempSimV3C – A model to calculate soil temperatures accounting for frozen soil conditions (user manual). – 8 S., University of Natural Resources and Life Sciences, Vienna.