Geophysical Research Abstracts
Vol. 20, EGU2018-5227, 2018
EGU General Assembly 2018

Impact of Ground Source Heat Pump (GSHP) usage on the long-term groundwater temperature changes: A case study in residential area

Boyan Meng (1,2), Thomas Vienken (3), Olaf Kolditz (1,2), Haibing Shao (1,4)

(1) Department of Environmental Informatics, Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany, (2) Faculty of Environmental Sciences, Dresden University of Technology, Dresden, Germany, (3) Department of Monitoring and Exploration Technologies, Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany, (4) Faculty of Geosciences, Geoengineering and Mining, Freiberg University of Mining and Technology, Freiberg, Germany

The thermal effects of shallow geothermal systems are investigated for a suburban neighborhood on the west of Cologne, Germany, where such systems have been densely applied for the heating and cooling of residential buildings. Since the heating demand is much higher than that of cooling, an overall decreasing trend of the local groundwater temperature was observed. Based on the acquired geological data, a layered 3-D subsurface model was formulated. Assuming Richards flow in the unsaturated soil, the open-source simulator OpenGeoSys was applied for the modeling of hydro-thermal processes. The groundwater temperature changes have been simulated over a period of four years considering a typical annual thermal load curve. The simulation results generally agree with the documented temperature profiles. In particular, seasonal fluctuations of subsurface temperature were rather significant for downstream observation points as a result of the alternating heat / cool periods. With the calibrated numerical model, current work focuses on the prediction of future trends for the subsurface temperature, assuming that the GSHP systems will continue to operate in the next decades. Of particular interest is the so-called “worst-case” scenario where the thermal load increases by approx. 20%. The accumulative impact on the groundwater temperature should be within a certain limit so that a sustainable use of the shallow subsurface can be assured.

Keywords: shallow geothermals systems, OpenGeoSys(OGS), groundwater temperature