Call for BSc/MSc Thesis

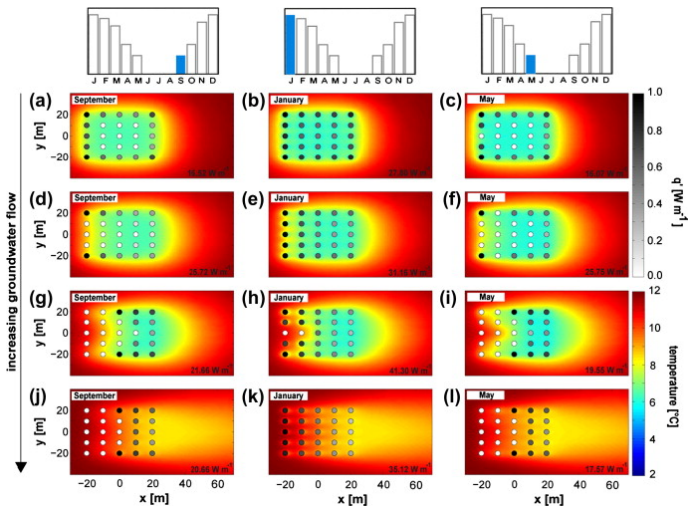
Applied Geology
University of Halle-Wittenberg

Optimization of geometric arrangement and operational parameters in low-enthalpy geothermal borehole fields

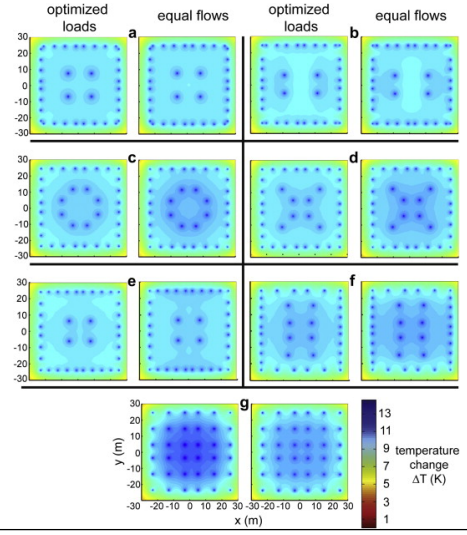
Case Study: Heidemensa

About

Ground-source heat pumps (GSHPs) systems are by far the most common geothermal technologies. A unique component of a GSHPs system is the heat exchanger implemented into the subsurface, which extracts heat from the ground or injects heat into it. They operate within small temperature ranges and feed an aboveground heat pump connected to a heating and/or cooling system of a building. Mostly, so-called borehole heat exchangers (BHEs) are installed, where a heat carrier fluid is circulated in closed tubes installed in the boreholes. Depending on the energy demand, either single BHEs are used or multiple BHEs are operated in borehole fields. If heat extraction/injection is not seasonally balanced or the operational parameters are not tuned appropriately, thermal anomalies grow in the ground which could cause economic and environmental issues. The main objective of this project is to apply mathematical optimization and novel computational techniques for optimal design and operation of GSHPs systems to increase the efficiency of the system and reduce the environmental impacts.



Temperature distribution and BHE extraction rates for the optimized selected scenarios for 3 months of the entire last heating period (9th year) at a depth of 50m. Each circle represents a BHE, with its corresponding normalized load in grayscale.



Distribution of temperature changes in the depth of 50m after 30 years of simulation (different BHE arrangements) for the optimized load and the equal flow case.

Tasks

- Literature review and gathering/measuring data
- Implementing available simulation-optimization procedures in the context of BHEs
- Comparison of the results and making a critical discussion

Requirements

- Good mathematical skills and basic knowledge in hydrogeology
- Good programming skills (preferably Python or MATLAB)
- Enthusiasm for problem-solving and dealing with scientific challenges

Supervisors

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Oct. 2021