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Analysis of induced temperature anomalies along borehole heat exchangers

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Over the last years, the thermal use of the shallow subsurface for heat generation, cooling, and thermal energy storage has increased. However, the injection or extraction of heat potentially drives changes in the subsurface temperature regime; especially in urban areas.
The presented case study investigates the intensive use of borehole heat exchangers (BHE) and their potential thermal impacts on subsurface temperatures, as well as thermal interactions between individual BHE's for a residential neighborhood in Cologne, Germany. Based on on-site subsurface parameterization, a 3D subsurface model was designed, using the finite element software FEFLOW (DHI WASY). The model contains five BHE, extracting 8.2 kW, with a maximum BHE depth of 38 m, whereby the thickness of the unsaturated zone is 22 m. The simulated time span is 10 years. This study focusses on two questions: How will different BHE arrangements vary in terms of temperature plume formation and potential system interaction and what is the influence of seasonal subsurface heat storage on soil and ground water temperatures.