EGU21-14502
https://doi.org/10.5194/egusphere-egu21-14502
EGU General Assembly 2021

Building Performance Simulations coupled to Borehole Heat Exchanger Simulations: a tool for realistic monitoring and forecast

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The actual heat demand of a building depends on various building-specific parameters, such as building age, insulation type, housing volume, but also external parameters, e.g. outdoor temperature. Being able to dynamically model the thermal power demand of a specific building can increase the robustness of coupled borehole heat exchanger simulations (BHE-simulations), as the transient heat demand models of a building / consumer can be used to simulate the thermal response of the subsurface to the prescribed consumer demand.

We present results of coupling results of Building Performance Simulation (BPS) with simulations of Borehole Heat Exchangers. BPS are carried out using TEASER (Tool for Energy Analysis and Simulation for Efficient Retrofit) which models the thermal power demand of a building based on parameters, such as year of construction, net-lease area, and outdoor-temperature.

Using annual temperature curves, we model the thermal power demand of buildings from the 1950s, once in original state and in retrofitted state. The thermal response of a connected BHE-field is simulated using SHEMAT-Suite, an open-source simulator for heat- and mass-transfer in porous media. In our BHE simulations, thermal plumes develop as a result of heat-extraction and regional groundwater flow.

To improve the forecast of, e.g. the magnitude of these plumes, realistic knowledge of the heat demand is important, which can be achieved by the presented coupling of BPS- and BHE-modelling.