Simulating interactions of five adjacent Aquifer Thermal Energy Storage (ATES) systems in the Cenozoic and the Cambrian aquifers in Brussels (Belgium)

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Three adjacent shallow open-loop systems (ATES) were studied and installed previously in two overlaying aquifers in the center of Brussels. For two of them, operations started in 2014 and 2017 respectively with pumping and reinjection wells in Cenozoic mixed sandy and silty shallow formations. The third one, a larger ATES system was started in 2020 with 5 doublets of wells in the Cambrian fractured phyllites and quartzites to provide heating and cooling power to a large multi-service building. Now two additional adjacent ATES systems are projected in these Cambrian formations, one for a residential complex, the other one for an office building.

The properties of these two aquifer systems are different and respective potentiometric heads are independent showing the relative disconnection between the two aquifer systems.

The cumulative effect of the three first geothermal installations was previously investigated using Feflow©. In terms of heat interactions, the previous model showed how the first ATES system's thermal imbalance affected the upper aquifer (Bulté et al. 2021) and thus also affected the second ATES system. Then, adding the third system in the deep Cambrian aquifer, relatively small interactions were simulated through the aquitard formed by low permeability Cretaceous base deposits and the weathered top of the bedrock (De Paoli *et al.* 2023).

Now, the research work is extended including the two new ATES systems and their impact and interactions are simulated. Also, the acquisition of recent measured data (i.e., potentiometric heads, groundwater temperatures, detailed pumping, injection flow rate, etc.) has allowed to improve the Feflow 3D model. First results are shown illustrating the sensitivity of the ATES interactions to an adequate hydrogeological characterization. The model results are also very useful to guide the optimized future management of the five adjacent ATES systems to prevent losses in efficiency for some (or all) of them.

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