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A Geothermal Energy Concept based on Heat Storage in Geological Media

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Aquifer Thermal Energy Storage (ATES) can help to balance energy demand and supply to make better use of infrastructures and resources. ATES consists of a pair or more wells that simultaneously inject or extract thermal energy into aquifers. The aim of ATES is to store the excess of energy during summer and to reuse it during winter, when there is an energy deficit. High-temperature Aquifer Thermal Energy Storage (HT-ATES) provides a good option to store water over 50°C, but it requires facing some problems, such as low efficiency recoveries and the uplift of the surface. Coupled thermo-hydro-mechanical (THM) modelling is a good tool to analyze the viability and cost effectiveness of the HT-ATES systems and understand the interaction of processes, such as heat flux, groundwater flow and ground deformation. We present the 3D THM modelling of a pilot HT-ATES system, inspired by one of the projects of HEATSTORE, which is a GEOTHERMICA ERA-NET co-funded project. The model aims to simulate the injection of hot water of 90°C in a central well and the extraction of water in four auxiliary wells during summer. In winter, the auxiliary wells inject water of 50°C and the central well extract water. The loading lasts longer than the unloading (8 months versus 4 months) and overall more heat is injected than extracted. We found that the system is more efficient in terms of energy recovery, the more years the system is operating. In the aquifer, both thermal loads and hydraulic loads have an important role in terms of displacements. At the surface, the vertical displacements are only a consequence of the hydraulic strains generated by the injection of water in the aquifer.