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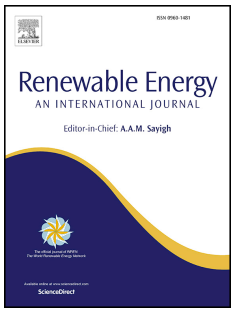

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Geothermal assessment of the Pisa plain, Italy: coupled thermal and hydraulic modeling

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Abstract

This paper explores the possibility of a development project with a geothermal well doublet in the Pisa plain, Italy. The performance of the system has been evaluated with a 3-dimensional field-scale numerical model that simulates the evolution of temperature and pressure conditions in the aquifer, under different exploitation scenarios. Coupled groundwater flow and thermal transport processes in the reservoir are considered together with non-Darcy fluid flow in the wellbores, and heat exchange between boreholes and surrounding rock formations. Calculations are performed with a parallelized version of the wellbore-reservoir simulator T2Well. This code allows for the efficient modeling of coupled hydraulic-thermal processes over a domain about 40 km^2 wide and 1.5 km thick. Simulation results indicate that the energy of the reservoir is sufficient for the designed extraction rate (between 80 and 150 m^3/h), but also suitable for much larger rates, up to 250 m^3/h. Although aimed at assessing the long-term performance of a specific system, this modeling approach could be profitably applied for the design of similar projects elsewhere.

Keywords: Low-enthalpy geothermal system; Geothermal doublet; Numerical simulation; Well flow; Aquifer heterogeneity; Pisa plain

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