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Thermal influence on the groundwater fluid dynamics of the shallow Santiago forearc basin: 2D numerical simulations

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A thorough understanding of the thermal processes that occur in aquifers is essential to assess local and regional low enthalpy geothermal resources. The relationship between heat convection and heat conduction has been widely studied in basins around the world at a regional scale. However, few studies have focused on smaller, shallower basins containing free aquifers hosted in unconsolidated fluvial-alluvial sediments, like Santiago Basin. We use numerical modeling to simulate the fluid dynamics of the Santiago basin groundwater system under different thermal conditions. Despite the current computational advances, modeling such a complex system with a full 3D approach is still numerically time demanding and unstable. Besides, the basin has irregular geometry and variable hydraulic and thermal features. Thus, we performed a 2D model comprising a thin water saturated slice of sediments beneath the central part of the city, where the basin morphology is well constrained. We simulate coupled groundwater and heat flow throughout this vertical slice and we compare results for different scenarios that comprise different hydraulic, thermal and geometric parameters. Results obtained with certain hydraulic conductivities show that instabilities appear giving rise to free thermal convection in the deepest parts of the basin. If the system is split into several hydrogeological units, the onset of these instabilities is inhibited. Consequently, we suggest that the stratigraphic complexities of a fluvial-alluvial deposit should be considered to better understanding the thermal-driven groundwater fluid dynamics.