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Sensitivity analysis on the performances of a closed-loop Ground Source Heat Pump

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Ground Source Heat Pumps (GSHP) permit to achieve a significant reduction of greenhouse gas emissions, and the margins for economic saving of this technology are strongly correlated to the long-term sustainability of the exploitation of the heat stored in the soil. The operation of a GSHP over its lifetime should be therefore modelled considering realistic conditions, and a thorough characterization of the physical properties of the soil is essential to avoid large errors of prediction. In this work, a BHE modelling procedure with the finite-element code FEFLOW is presented. Starting from the governing equations of the heat transport in the soil around a GSHP and inside the BHE, the most important parameters are individuated and the adopted program settings are explained. A sensitivity analysis is then carried on both the design parameters of the heat exchanger, in order to understand the margins of improvement of a careful design and installation, and the physical properties of the soil, with the aim of quantifying the uncertainty induced by their variability. The relative importance of each parameter is therefore assessed by comparing the statistical distributions of the fluid temperatures and estimating the energy consumption of the heat pump, and practical conclusions are from these results about the site characterization, the design and the installation of a BHE.

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