Zhang et al., 2016

transient quasi-3D entire time scale line source model is proposed - introduces the concept of transient borehole thermal resistance and considers the heat flux profile along the U-pipe as a variable. 🡪 predict the temperature with a relative error less than 5%.

outside ground temperature profile that defines the borehole distance analyzed and compared with the Sandbox experiment result 🡪 prposed model leads to a maximum relative error < 3.85%.

impact of the heat flux profile along the U-pipe on the ground temperature profile prediction investigated 🡪 when the heat flux profile along the U-pipe is considered as a variable, the determination of borehole distance is more accurate.

Therefore, the transient quasi-3D entire time scale line source model is an effective method for the fluid and ground temperature prediction and may offer the theoretical basis for the system control and the borehole distance determination.

Background:

* Many studies proposed to predict outflow temperature of GHE
* Common approach = 2-region model (Yang) = heat transfer process analysed by 2 regions (BHE = line/cylindric source and 3D model for surrounding)🡪 not valid for short term analysis due to thermal capacity of grout, U-pipe and fluid
* Full 3D model efficient but complex to implement 🡪 possibility to use analytical solution in which the pipe wall temperature is used as the reference temperature instead of the borehole wall temperature. Although the transient analytical model (Li et al) offers accurate results, heat flux along the Upipe considered as a constant + thermal interaction between two legs of the U-shaped pipe not considered + only one BHE configuration possible.
* Here, heat transfer of the inlet pipe and the outlet pipe will be considered separately + outside ground temperature profiles calculated by distinguishing the case of constant heat flux and the heat flux profile along the U-pipe.

Results show the temperature profile along the borehole axis after max 50h production