Shallow geothermal systems numerical modelling through a holistic approach: The Canton Ticino (CH) test site

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Shallow geothermal energy can play a valuable role in reducing the amount of greenhouse gas emissions caused by the combustion of fossil fuels. The application of low-enthalpy geothermal technologies in several European countries has been very profitable and has seen a significant growth during the last decades, resulting in emissions and costs saving.

Cantone Ticino, located in the southern part of Switzerland, is greatly affected by the continuous growth of subsurface exploitation through the use of both closed-loop (mostly vertical borehole ground heat exchangers) and open-loop (by using directly groundwater) geothermal systems. Such a density of geothermal systems (approx. 1.5 probe/km^2) will subsequently arise issues regarding short probe distances or adjoining probe fields that will influence ground temperatures and system performances in the long term. Shallow geothermal energy development in Canton Ticino will be very important in the next years, since at least 20% of energy requirements for new buildings will have to be provided from renewable energies, and in particular geothermal systems, as stated in RUEn, 2008.

Starting from these premises, the research project will focus on the estimation of the shallow geothermal potential and environmental impact and potential interference for both closed and open-loop systems using innovative numerical approaches. Then the possible presence of subsurface subsoil urban heat island effect (SUHI) will be assessed.

Subsequently the study will focus on the interference among neighboring shallow geothermal systems, which is an important issue that is often perceived but it is quite difficult to assess and quantify. This happens because it shows up after a few years from the installation of the system and requires costly instrumentations and a large amount of measurements to be evaluated. The study sets as its goal to identify and quantify interference issues among shallow geothermal energy systems, both closed and open-loop. The challenge is to numerically understand how interference issues influence ground/groundwater temperature and energetic performance of the geothermal systems, trying to infer rules or suggestions useful to pre-emptively assess these issues in geothermal systems design phase. At the light of the research output, improvements to the authorization process of new plants will suggest.

International Collaborations:

This study involves a close collaboration with world-class laboratories in Italy (National Research Council), Great Britain (Glasgow University), Swiss (SUPSI), Spain (Valencia University), Germany (FAU) and Canada (Montreal University).

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