Project Fact Sheet

Technische Hochschule Ingolstadt
Institute of new Energy Systems

Project Title	**Past, present and future of subsurface urban heat islands in China and Germany - implications for geothermal develpment**
Keywords	urban heat islands, geothermal energy, groundwater, groundwater modelling, heat transport

Project Details

Project Start	2018	**Duration**	3 years
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Contact Person	Prof. Dr. Peter Bayer (Project Leader) Dr. Ingo Dressel		
Project Partners	Nanjing University (China)sch University (SU)		

Description

The subsurface and its thermal field is strongly affected by human beings. For decades, factors such as cellars, basements, tunnel systems, sewage systems and district heating have delivered continuous heat input into the subsurface. This has resulted in a so-called subsurface urban heat island (SUHI). Measurements of groundwater temperatures in urban areas show on average higher temperatures, ranging from 2-6°C, than in rural areas. In some cases, higher temperatures than 2-6°C occur in some specific areas in city centers.

These higher temperatures in the subsurface can be used for geothermal heating of a city by using, for example, borehole heat exchangers. Utilizing geothermal energy from increased groundwater temperatures has two main advantages: on the one hand, it is an eco-friendly energy supply. On the other hand, this utilization preserves the natural groundwater temperatures and prevents a strong heating of the subsurface, which would have an effect on the entire subsurface ecosystem. However, realizing a sustainable geothermal heating project in the context of a subsurface urban heat island demands a strong knowledge about the factors affecting the urban groundwater temperatures, as well as the processes (e.g., thermodynamic, physical, chemical) that occur in the subsurface. In addition, subsurface urban heat islands can vary from city to city, due to different geological conditions, different evolution of cities and different plans for the future of cities. Accordingly, studies that deal with investigations of subsurface urban heat islands in different cities are worthwhile for a better and more general understanding of the past, present and future subsurface urban heat islands.

Our research project is funded by the German Research Foundation (DFG) and focuses on the cities of Cologne (Germany) and Nanjing (China) and their spatio-temporal evolution of subsurface urban heat islands. We will analyze differences according to the urban planning and the geological conditions of both cities and compare the effects on the urban heat islands. Measurements of groundwater temperatures and other heat island affecting parameters will help to have a spatial resolve to the situation in the subsurface and to build numerical models. These models help in the understanding of the factors responsible for the heat input, as well as the processes that have an impact on the evolution of the temperature in the subsurface. Finally, the results can be used to infer the geothermal potential of the cities.