



## **New insights in the subsurface urban heat island of Cologne, Germany**

Hannes Hemmerle (1), Ingo Dressel (1), Philipp Blum (2), and Peter Bayer (1)

(1) Institute of new Energy Systems (InES), Technische Hochschule Ingolstadt, Ingolstadt 85049, Germany, (2) Institute of Applied Geosciences (AGW), Karlsruhe Institute of Technology (KIT), Karlsruhe 76131, Germany

The subsurface thermal regime in groundwater beneath Western European settlements commonly exhibits a positive thermal anomaly between 2 and 6 K to surrounding rural areas. This phenomenon is usually referred to as a subsurface urban heat island (SUHI) and can also be observed in the air and surface temperatures. While surface urban heat islands are well-known in their spatio-temporal behaviour, temperature records of the subsurface and detailed studies are sparse. Cologne is one of the few cities in Germany where subsurface temperatures have been investigated since the 1970s and the temperature offset is on the upper end of observed anomalies at around +6 K. Based on the measured data, along with dynamically changing land use maps, mechanisms of subsurface heat accumulation, which are relevant for the evolution and process-based modelling of SUHIs, can be examined. The data archive covers almost half a century, which allows for delineation of long-term temperature changes with respect to regional climate variations. SUHIs also represent a large geothermal potential. Utilizing SUHIs for heating – and hereby recycling anthropogenic thermal discharge - offers an eco-friendly source of heat, which can be utilized more cost-efficiently and sustainably when compared to conventional shallow geothermal applications in less disturbed rural areas.