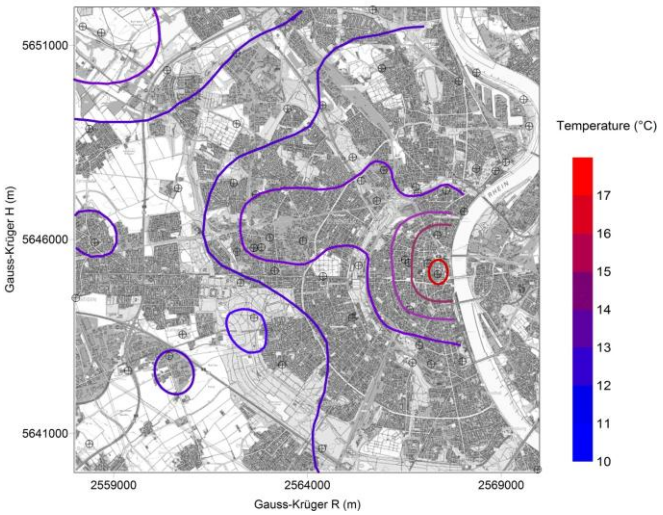
Urban Heat Islands as Heat Sources

Researchers Study the Geothermal Potential of Aquifers in Large Cities



Heat potential of the city of Cologne: Groundwater temperatures at a depth of 15 meters. (Graphics: Zhuh et al.)

In large cities, climate change and the heat island effect have not only given rise to an increase in surface temperatures. Temperature of the groundwater has also increased. Within the framework of a project coordinated by KIT, scientists studied the geothermal potential of close-to-surface aquifers in urban areas. The result: Enormous heat sources are located underneath the cities. In Cologne, for instance, the annual consumption for heating all residential buildings could be covered by heat from the groundwater for at least two and a half years.

Narrow roads, densely arranged buildings, factories, and strong road traffic cause the temperatures in large cities to be far above those of the urban hinterland. Together with climate change, this heat island effect has also caused the temperatures below this surface of conurbations to increase in the past hundred years. Within the framework of a project coordinated by KIT and ETH Zurich, researchers from Germany, Switzerland, and Canada detected significant increases in groundwater temperatures.

KIT Energy Center: Having future in mind

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“These warmer aquifers offer sufficient energy to cover a major fraction of the heating consumption of entire cities,” explains Junior Professor Philipp Blum, Head of the Department of Engineering Geology of the KIT Institute of Applied Geosciences. Blum and his colleagues studied the geothermal potential of groundwater in large cities. The results of their studies have now been published in the journal “Environmental Research Letters”.

Measurements of scientists in Cologne and Winnipeg/Canada revealed an increase in the groundwater temperatures by up to 5°C compared to the urban hinterland. By geothermal heat pumps, this energy might be used efficiently for heating in winter and cooling in summer. If the water in the about 20 m thick layer in the underground would be tapped in Cologne and cooled down by 2 degrees only, annual consumption for heating all residential buildings in the city would be covered by at least two and a half up to a maximum of 20 years, the researchers calculated. In megacities such as Shanghai and Tokyo, the groundwater might even supply heating power for several decades.

Researchers assume that the groundwater temperatures will further increase with increasing urbanization. Use of this geothermal potential would not only contribute to covering the growing needs for energy, but also reduce the emission of greenhouse gases and thus counteract the heating of the cities.

Ke Zhu, Philipp Blum, Grant Ferguson, Klaus-Dieter Balke, and Peter Bayer: The geothermal potential of urban heat islands. Environmental Research Letters, 5 (2010), 044002 http://dx.doi.org/10.1088/1748-9326/5/4/044002

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