

## **Management of geothermal resources – a responsible use of renewable energies as contribution to a sustainable land management**

**Thomas Vienken, Peter Dietrich**

*Department Monitoring and Exploration Technologies, E-Mail: [thomas.vienken@ufz.de](mailto:thomas.vienken@ufz.de)*

### **Abstract**

The increasing use of shallow geothermal energy, especially the rising numbers of geothermal ground source heat pumps that are installed to progressively heat entire residential neighborhoods and the increasing use of groundwater to cool residential building and industrial facilities has led to an emerging need to assess possible effects of the use of shallow geothermal energy and to model subsurface heat transport.

Potential effects include the decline of groundwater quality and depletion of ground water ecosystem services. Heat and mass transport by ground water dispersion and convection may lead to a carryover of effects into groundwater dependent ecosystems. Typically, these underground processes are not directly accessible. Conflicting interests between geothermal energy use and groundwater protection as well as conflicts between geothermal energy users are expected to arise especially in densely populated urban areas, where the highest demand for the use of shallow geothermal energy is located but yet exploitation of shallow geothermal energy is limited and, simultaneously, groundwater vulnerability is highest.

In Germany, for example, awareness of possible effects of the use of shallow geothermal energy has been rising over the last few years, in legislation and the scientific community. A variety of statewide guidelines currently exists concerning the use of shallow geothermal energy in Germany, regulating exploration procedures and the installation of ground source heat pumps (e.g. setting minimum distances between ground source heat pumps). However, the high number of statewide guidelines clearly indicates the problems of setting generally applicable standards. Uncertainty in defining standards is primarily due to a lack of available monitoring data and lack of system understanding that is necessary for the formulation of regulations based on scientifically based thresholds rather than on limited operating experience. Hence, a management of geothermal resources is needed that helps contribute to a sustainable land management by mitigation of conflicts that may arise. This can be achieved by: 1) reliable geothermal exploration and monitoring of effects caused by the use of shallow geothermal energy; 2) developing novel measurement and monitoring technologies; and 3) system understanding, modeling, and development of planning tools.