Geophysical Research Abstracts
Vol. 16, EGU2014-4659, 2014
EGU General Assembly 2014

A surprise result of geothermal numerical simulation - Persistent drawdown of ground water table may reduce local climate warming rate

Fengling Yin, Yaolin Shi, and Huai Zhang

University of Chinese Academy of Sciences,Key Laboratory of Computational Geodynamics of Chinese Academy of Sciences,100049,Beijing,China

Due to persistent groundwater over-exploitation since the 1970s, groundwater level has been found significantly declined in a large area of more than 70,000 km^2 in Beijing, Tianjing and Hebei Provinces in North China. Consequently, a series of geo-environmental problems have emerged and drawn widely public attentions, such as land subsidence, groundwater contamination, sea water invasion, etc. We found that decline of water table can result in significant reduction in geothermal heat flux density, and this effect has never been discussed in literatures. Thermal properties, such as thermal conductivity, specific heat, are different for layers of water saturated sediment beneath the water table and layers of dry sediments above the water table. When the water table declines, due to the variation of thermal properties, transcend changes of underground geotherm occurs. Our numerical simulation indicates that surface heat flow density may reduce 40%, about 25mW/m^2 in ground water drawdown zone in North China after more than 40 years over-exploitation, and the surface heat flow density cannot return to normal state for hundreds of years even if the water table does not decline any more from now on. The amount of reduction of heat flow density is small, but it can last for long period of hundreds of years, and cover a large area of 70,000 km^2, its effect on climate may not be negligible. It is estimated that this reduction of surface heat flow may reduce an air column temperature 0.08°/a if it is adiabatic with surroundings, while the actual air temperature warming rate is only 0.03°/a in the depress zone and 0.05C/a outside the depression zone in North China. Meteorological subsurface temperature (up to 3.2m depth) records show similar trend. Although air temperatures are influenced by many factors, but the decline of surface heat flow density should be one of the factors to be studied. We suggest that more attention should be paid to this effect, and systematic monitoring of geotherm at tens to hundred meters depth should be carried out.