Effects of surface warming and groundwater flow on subsurface temperature

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Inversions in temperature-depth profiles due to surface warming are found in subsurface thermal regime of many areas in over the world. This is attributed to the recent global warming, urbanization, and land cover change. However, a little attention has been paid to both effects of heat conduction and convection caused by groundwater flow on the temperature-depth profiles under the condition of surface warming. The purpose of this study is to evaluate the effects of surface climate-change and groundwater flow on the subsurface thermal regime in Osaka and Kumamoto, Japan

Groundwater flow systems estimated from observed subsurface temperature agreed well with the systems evaluated from hydraulic potentials in Osaka and Kumamoto. Subsurface temperature could be a good trace to detect the groundwater flow systems. Furthermore, the subsurface temperature may be a god tracer for evaluating regional groundwater flow system rather than the local groundwater flow system.

According to the comparisons of subsurface temperature observed in 1986 and 2001, subsurface temperature increased due to surface warming in the groundwater recharge area, but decreased in the discharge area because of decreasing in groundwater flow and recharge rates. The effect of surface warming on the subsurface temperature is larger at the center of the city Osaka than that in the suburban area. Therefore, the effect of the urbanization on the subsurface temperature is much larger than that of global warming.