A database of subsurface temperature in Japan - Evaluations of the effects of climate changes and groundwater flow -

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Inversions in temperature-depth profiles due to surface warming are found in subsurface thermal regimes in many areas over the world. This is attributed to the recent global warming, urbanization and land cover change. Moreover, there is a regional difference of the effect of surface warming in the groundwater flow system of the basin. The effect of surface warming due to urbanization and land cover changes reaches deeper in the groundwater recharge area and shallower in the discharge area. Therefore, it is necessary to evaluate subsurface flows for reconstructions of the climate change from borehole temperatures, because heat in the aquifers is transported not only by heat conduction but also heat convection due to groundwater flow. The inversion due to surface warming caused by global warming and urbanization could be a good trace to detect the groundwater flow system. Repeated measurements of borehole temperature can also tell us the transient subsurface flow regime. In order to reconstruct climate changes and evaluate groundwater flow system from borehole temperature, we have developed a database of surface and subsurface temperatures in Japan. Three different types of subsurface temperature; (1) temperature-depth profiles (at 500 boreholes, 50m to several hundred meters depth), (2) soil temperature (at 61 meteorological stations, surface to 10 m depth), and (3) deep temperature at the bottom of boreholes (at 1937 boreholes, up to 6 km depth), are combined to develop a new data base of subsurface temperature in Japan. These data can be used for not only reconstructions of climate changes, but also evaluations of subsurface fluid flow and tectonic processes. For instance, the relationships between air temperature, soil temperature and borehole temperature (temperature-depth profiles) may give us a better reconstruction of climate change (change in air temperature) from borehole temperature. The combinations of shallow and deep temperature date to evaluate the thermal gradients may give us information of the lower boundary depth of the earthquake in the crust.