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Regional subsurface temperature profiles and the temporal variations in Saitama prefecture

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Ground heat exchanger system is spreading as the promising system as natural energy system in Japan. Subsurface environmental basic information (subsurface temperature , geological feature, hydraulic property) is essential for a design of ground heat exchanger system and an estimation of the energy efficiency. The final purpose of the study is to be useful for spreading of ground heat exchanger system through investigation of subsurface environmental information. In the presentation, we mainly talk about investigation method about subsurface temperature measurements and the result in Saitama prefecture.

We conducted to measure at 24 stations in 2009 (Jul 2009- Oct 2011) and 15 stations in 2010(Oct 2010- Jan 2011) using subsurface water observation well located in the plains of Saitama.

The observation well measured in 2010 is same as 2009, but the seasons are different (Summer season in 2009, and Winter season in 2010. Thermal gradient due to heat from deep part is about 20-30mK/m in Saitama area. The values are consistent with past reported results. Most stations have temperature inflection point at about 50m depth and rise toward ground surface. This temperature rises may be caused by global warming and/or the heat island effect of the city for a last century. Most temperature profiles are stable in time in the deeper than 100m depth. On the other hand, several profiles change. The stations are located in the agricultural region. The large amount of groundwater is pumped up in summer season. As one interpretation, seasonal pumping affects groundwater flow, and it may change subsurface temperature. For the understanding of temperature change, it is effective to perform temperature monitoring in the depth. We have a plan such a monitoring.

On the other hand, it is general known that the ground surface seasonal temperature variations are propagated into subsurface by thermal diffusion. As the propagated depth depends on subsurface thermal properties, and the depths are different in region For the measurements of the propagated depth, we made observation wells of 15m depth and 30m depth in CESS (Center for Environmental Science in Saitama). The 15m observation well made in March, 2010, and the 30m observation well made in January, 2011). We measured the temperature distribution of the 15m observation well in October, 2010 and January, 2011. As a result, seasonal temperature variation propagate shallower than about 8m at the station.

It is important that the regional characteristic of subsurface temperature distribution and subsurface temporal temperature variation for understanding of subsurface environment.

Our study is significant model case for applying to other areas.

Keywords: Subsurface temperature, Seasonal temperature variations, thermal gradient, Kanto plain, Saitama