

## Histories of the subsurface thermal environment in East Asia -Studies in Saitama prefecture and Bangkok area-

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Temperature changes at the ground surface propagate into the underground and disturb the subsurface temperature structure. Analyzing disturbances in the subsurface temperature structure, we can reconstruct the past ground surface temperature (GST) change, which is closely related to the past surface air temperature change. This method can be applied to studies of thermal environment evolution in urban areas such as the development of 'heat islands' and 'global warming'.

We have been investigating the GST histories in and around several large cities in East Asia. In this presentation, we show the measured temperature and results of the GST history reconstruction in Saitama prefecture and Bangkok. We measured temperature profiles in wells for subsidence observation in each area.

In Saitama prefecture, we measured subsurface temperature in groundwater monitoring wells at 25 sites from Jul. to Nov. in 2009. Locations of the wells are eastern part of Saitama prefecture, which is densely populated and considered to be a part of Tokyo Metropolitan area. In Bangkok area, we conducted measurements at 44 sites in 2004, 2006, and 2008. And we are planning to measure in Feb. 2010. Long-term temperature monitoring has been carried out since Jul 2006 at three depths at three stations. We obtained temperature records for about 450 days from 2006 to 2008. The temperature increase rate measured at 45m depth at city center is about 0.005K/year. The temperature increase may be due to the increase of GST.

Reconstruction of the GST history for the last several hundred years was made at two sites in the Saitama prefecture and at six sites in the Bangkok area. We used a multi-layer model that allows layers with different thermal properties, determining layer boundaries based on lithology of the formations around the wells. All of the reconstructed GST histories show surface warming in the last century.

In the Saitama area, the GST increased by more than 2.5 K at both the two sites, which are located in the densely populated part. In the Bangkok area, the amount of the temperature increase ranges from 0.4 to 2.6 K. And the temperature increase in the city is larger than in the area to the west of Bangkok and in the northern rural area. This tendency may reflect difference in the degree of urbanization and/or human activities. We also estimated the amount of heat stored in the subsurface after 1900 based on the reconstructed GST histories.

In this presentation, we also discuss the error of the estimations and effect caused by movement of groundwater flow for the results of GST reconstruction.

**Keywords:** ground surface temperature, climate change, borehole temperature, heat island effect, Bangkok, groundwater flow