Research on the current thermal energy budget of land surface by continuous observation of near-surface ground temperature in Kanto Plain, Japan

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We are conducting a study on present-day changes of ground temperature at depths down to 1.0 m from the surface in order to know the physical processes currently occurring on the land surface. In the last few decades there have been many works to obtain by mathematical inversion the past climatic changes based on deep downhole temperature data, which are given as function of depth. But, we think that the relationship between such downhole temperature anomaly signals and the ongoing near-surface processes have not been fully clarified yet. For addressing such an issue we have started a campaign of long-term monitoring of near-surface ground temperature at some locations in the Kanto Plain area, Japan.

Three observation sites are selected in the Kanto Plain: Tsukuba in Ibaraki Prefecture, Toda and Sayama both in Saitama Prefecture. At these sites we have had good records of 1m depth ground temperature (denoted as GT1.0) for more than 4 years, and partly supplementary temperature records at shallower depths such as GT0.3 (those at 0.3 m depth). It is noted that one-year period ground temperature change is the most prominent component at all those sites, and we see longer phase delays and also larger amplitude attenuation of the sinusoidal variation at the deeper part of the same sites, where surface temperature is likely to be the primary driving force. Therefore, to compare with the change of ground temperature we have employed different information, which is time-series of satellite derived land surface temperature for each of the sites. In this study LST (Land Surface Temperature) data from MODIS sensor on Aqua and Terra satellites have been used. The observed LST seasonal change may be controlled by that of solar radiation from above to the particular sites. From the above-mentioned dataset, i.e., MODIS-LST, GT1.0, and GT0.3, we have attempted to estimate the effective thermal properties of the near-surface subsurface layers of the sites, with a result of fairly large variations of thermal properties among our study sites depending on the surface material characteristics.

Keywords: ground temperature, monitoring, thermal energy budget

