Evaluation of radiative effect on the measurement of the surface air temperature by thermometers using the ground-based microwave radiometer

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Radiative effect is inevitable in surface air temperature measurement by the thermometer. Although thermometer screens/shields are used to reduce this effect, impacts remains affected due to influence of radiation on radiation screens/shields. Their characteristics are different for each type of screens/shields. It is considered that reference temperature measurements have little effect of radiation in principle are effective to evaluate to this characteristics. Very thin resistive wire (ISO 2007) and ultrasonic anemometer and thermometer (Lacombe et al. 2011) have been proposed as candidates for measuring the reference air temperature. Brightness temperature of the atmospheric radiation is examined in this study.
Multi-channel ground-based microwave radiometer (MWR) MP-3000A (Radiometrics) measures brightness temperature 14 frequencies in the band of oxygen resonances between 50 and 60 GHz in multiple elevations. The data of strong atmospheric absorption channel (58.8GHz) at minimum elevation angle (9.45 degree) is compared to surface air temperature measured by two thermometers: the platinum resistance thermometer in the artificial ventilated screen (METIC TD-500) and Rotronic S3 temperature and relative humidity sensor in the air-inlet of MWR with an artificial ventilation. The daily boxplot variation of the difference between them is shown in Figure.
Although they display considerable variation, on average variation is small and almost constant in the night time and quite large in daytime with the maximum on around noon. In addition to radiative characteristics of the instruments, the difference of the observation space is possible cause of the difference.
Brightness temperature of the infrared atmospheric radiation indicating a stronger atmospheric absorption should be examined. Comparison with another measurement methods whose radiative effect is small in principle such as very thin resistive wire and ultrasonic anemometer and thermometer is also necessary.
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Figure
(a) The boxplot variation of the difference between the air temperature measured by the platinum resistance thermometer in the artificial ventilated screen and the 58.8GHz brightness temperature at elevation angle 9.45 degrees measured by MWR (subtracting the latter from the former) measured in May, 2010 at Kagami observation site, Kochi, Japan. Exclude data with one hour precipitation more than 0.5mm. The line inside the box is the median value. The bottom of the box is the first quartile value and the top of the box is the third quartile. The vertical line from the top of the box extends to the maximum value and the vertical line from the bottom of the box extends to the minimum value. The upper (lower) fence is defined as the third (first) quartile plus (minus) 1.5 times the interquartile range.
(b) Same as (a) but for the difference between the air temperature measured by the platinum resistance thermometer in the artificial ventilated screen and Rotronic S3 temperature and relative humidity sensor in the air-inlet of MWR with an artificial ventilation.

References
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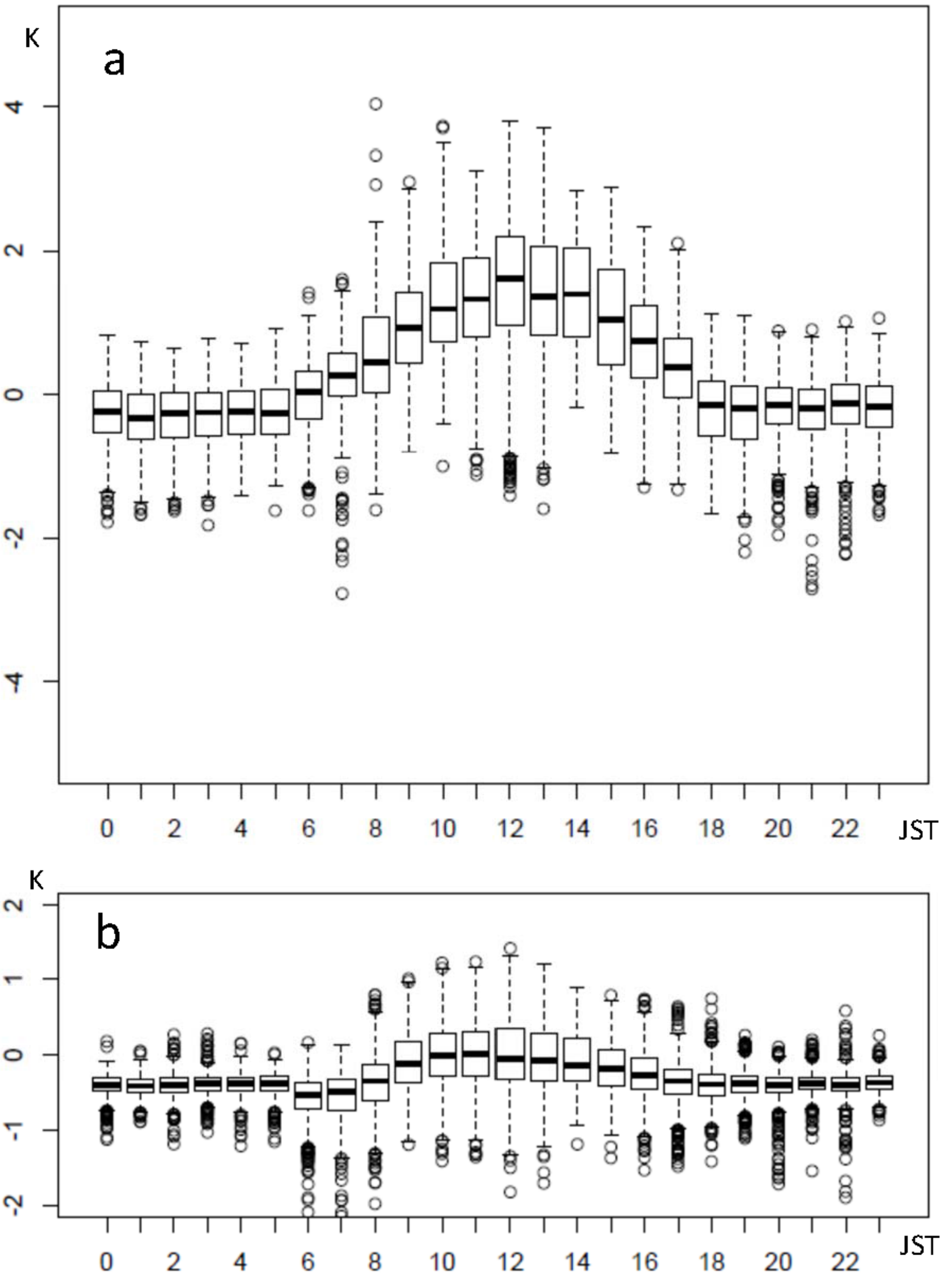
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