Session: C15 Poster: T76B

SOWER (Soundings of Ozone and Water in the Equatorial Region): Precise observations of the atmospheric temperature profile by fast-response high-resolution tungsten sondes

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The sensor equipped with the radiosonde should observe variables in wide dynamic range (e.g., 40 to -90 deg. in temperature and 1000 to 5 hPa in atmospheric pressure) with certain accuracy. It is well known that there found biases in temperature and humidity measurements by radiosondes. The temperature bias appears more remarkable in the stratosphere, where the time constant for the sensor to reach equilibrium with the environment becomes longer while the solar radiation is stronger. Actually there remain significant differences between temperatures simultaneously measured by radiosondes from different manufacturers due probably to inaccurate radiation correction (Nash et al., 2006). The temperature sensor that can accurately measure the temperature up to the stratosphere is important to improve daily weather forecasts. Highly accurate and reliable temperature sonde is also required for the study of global and regional climate change (WG-ARO, 2008). This study introduces a newly developed temperature sonde that uses the temperature dependence of the electrical resistance of the tungsten wire that was once used for the rocketsonde. It's response time estimated from the result of laboratory experiments is only 46 ms at 10 hPa, and as a result, the bias by solar radiation is estimated to be 0.5 K or less in daytime. In addition, the possible fine temperature structure that has not been discussed so far can be detected by 6 Hz high-speed sampling processing. During the early development stage, numerous pulses are found that are positive in daytime and negative in nighttime. The amplitude increases with height, and reaches 7 K at 10 hPa in daytime. At first, these pulses are interpreted as temperature disturbances generated by short-wave heating on balloon surface in daytime and adiabatic cooling of a balloon internal gas and long-wave cooling on balloon surface in nighttime. However the result of analyzing a pair of GPS positional data at the neck of balloon and the hanging-down sonde, they are interpreted as the thermal contamination arising primarily from radiosonde package box with some additional effect from the launching balloon. This influence from radiosonde package box has been eliminated by modifying the mount of the sensor. On the other hand, the balloon effect could be avoided by using the long suspension lines. However, some small fluctuations with the magnitude of less than 0.5 K, that still remain after successful elimination of artificial perturbations, are interpreted as those brought about by the solid angle modulation of the illumination against the sensor body. They are removed by applying some filtering procedure to the observed data. As a result, the tungsten sonde has become a kind of a reference for a precise observation of the vertical temperature profile. The results from some of the preliminarily analysis on the fine scale temperature structures, together with those from special 16-Hz model, will be discussed.