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Dual Thermistor Radiosondes for Compensation of Solar Radiation Effects on the Temperature Measurement in Upper Air

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Accurate measurements of air temperature attract more attention because of climate change including global warming. Essential climate variables defined by the Global Climate Observing System (GCOS) include air temperature since temperature provides the primary information to understand the behaviour of atmosphere as well as the energy budget of climate system. One of the challenges in the temperature measurement in upper air using raidosondes is the correction of solar radiation effect which induces radiative heating of temperature sensors during flights at daytime.

Here, the dual thermistor radiosonde (DTR) using different emissivity between two (aluminium and black) sensors will be introduced in order to measure solar irradiance and thereby correct the radiation effect on temperature measurements in upper air. The performance of DTR in terms of temperature measurements and followed by the correction of radiation effect was compared with conventional radiosondes including RS41, RS92, and DFM09 through a campaign held in September, 2017 at Lindenberg observatory in Germany. Intercomparison among four radiosondes has been performed seven times at daytime, two times at nighttime, and once for radiation measurement. Consequently, raw temperature measured by RS41, RS92, and DFM09 shows a collective behaviour at both daytime and nighttime by the difference less than 1 ^{o}C and 0.5 ^{o}C, respectively. However, the raw temperature of two sensors of DTR is significantly higher than those of three other radiosondes at daytime. At nighttime, the raw temperature of black sensor of DTR is lower than those of the rest of other sensors, showing radiative cooling of the sensor due to high emissivity. Correction values of RS41, RS92, and DFM09 are similar at daytime, gradually increasing as a function of altitude reaching about 1 ^{o}C while they are essentially zero at nighttime. In general, the corrected temperature of DTR is lower than those of other radiosondes at daytime but higher at nighttime especially at high altitude. The measurement of irradiance by DTR in the correction process is compared with the measured irradiance by radiometers. The strengths and weaknesses of DTR observed through the intercomparison will be discussed including future plans to improve the correction process of DTR.