Evaluating space-based and in-situ observations of tropospheric humidity

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Space-based microwave satellite observations measured at the frequencies close to the water vapor absorption line at 183 GHz as well as global operational radiosonde data are the main sources of tropospheric humidity in data assimilation systems. Radiosonde data are available for a long-period and have a high vertical resolution compared to the microwave satellite data. On the other hand, satellite data provide global coverage, but radiosonde stations are very sparse. Both space-based and radiosonde observations are prone to different errors. Radiosonde data are affected by several factors including sensor contamination, daytime radiation bias, sensor icing in mid-upper troposphere, and discontinuity in the data because of the difference between observations from different sonde sensors. Microwave satellite data are also prone to several errors including calibration drift, geolocation error, sensor degradation, and inter-satellite biases.

We present the results of evaluating observations from microwave instruments aboard recently launched the Suomi National Polar-orbiting Partnership (NPP, ATMS instrument) and Megha-Tropiques (SAPHIR and MADRAS instruments) satellites. The study includes inter-comparison and inter-calibration of observations of similar channels from the two satellites, evaluation of the satellite data using high-quality radiosonde data from Atmospheric Radiation Measurement Program, as well as geolocation error correction.

In addition, we present the results of a comprehensive study on quantifying different biases in the current operational radiosonde databases. The study investigates different biases in operational radiosonde data in different layers of the troposphere, i.e., lower-, middle-, and upper-troposphere. The study indicates very large discrepancy between current operational radiosonde sensors that cause large temporal and spatial discontinuity in the current radiosonde archives. The results show that current radiosonde data have very large biases throughout the troposphere especially in mid-upper troposphere, so that the data need to be corrected before being assimilated into reanalyes or numerical weather prediction models.