Global Assessment of Radiosonde Systematic Temperature Biases in the Lower Stratosphere using COSMIC, CHAMP, and GRACE from 2001 to 2010

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Radiosondes are the only operational instrument for measuring atmospheric pressure, temperature, humidity, and wind profiles directly from near the surface to an altitude of about 20 to 30 km. Radiosonde observations have long been used to validate satellite remote sensing results and are used as the backbone measurements for the global numerical weather prediction. It is well-known that radiosondes suffer from radiation errors in temperature measurements especially in the upper troposphere. Because radiosonde sensor characteristics can be affected by the changing environment, its measurement accuracy varies considerably in times and locations for different sensor types. In this study, we compare temperature profiles derived from multiple years of Global Positioning System (GPS) Radio Occultation (RO) data from the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC, 2006-2010), CHAllenging Minisatellite Payload (CHAMP, 2001-2008), and Gravity Recovery And Climate Experiment (GRACE, 2008-2010) with those from different types of radiosonde systems. The systematic temperature biases from 2001 to 2010 at the height of 12 to 25 km for different radiosonde temperature sensors are assessed. Because the measurements obtained from the GPS RO limb-sounding technique are free of satellite-dependent and geographical-dependent biases, the radiosonde temperature systematic biases from 2001 to 2010 for different instrument types at different geographical locations can be identified.