Homogenization of Daily Global Radiosonde Humidity Data: Vaisala RS92 Bias Correction and Impact

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A new statistical approach has been developed to homogenize historical records of daily tropospheric dew point depression (DPD) from radiosonde data (Dai et al. 2011). The adjusted-daily DPD using this approach shows no apparent discontinuities and has much smaller and spatially more coherent trends during 1973–2011 than the raw data. One of improvements can be made to the approach with quantitative bias information for specific sonde types. Such information will enable us to identify a segment with the most realistic DPD distribution, remove any biases in the DPD data over this segment, and then use it as the reference segment for the quantile based adjustment for each station.

Vaisala RS92 radiosonde is the most widely used radiosonde type in the current global network ($\sim$30% of the stations), and its data are used as the reference segment for homogenization. One of the most significant biases in RS92 data is its daytime solar radiation dry bias (SRDB) due to the heating of the sensor boom. This study focuses on developing and validating an algorithm (referred as NCAR Radiation Bias Correction, NRBC) to correct the SRDB, which is applicable to operational radiosonde data archive. The method is based on a more complicated approach developed by the GCOS Reference Upper Air Network (GRUAN) community. The NRBC to RHs is a function of measured RH, temperature and solar radiation correction of the temperature sensor. The latter varies with pressure, season and the time of the day. The RH correction has a mean magnitude of $\sim$2-4% in the lower and middle troposphere and increase to 6-8% in the upper troposphere. The uncertainty of the NRBC is also estimated and is within 2% with maximum values in the upper troposphere. The NRBC algorithm is evaluated by comparing with the ground-based GPS estimated precipitable water (PW). The NRBC leads to reduced biases in PW comparing with the GPS data and better agreements with GPS on PW diurnal cycle in phase, magnitude and its seasonal variations. The NRBC is applied to the radiosonde data from 1960 to 2010 at 65 stations. The raw DPD data with and without NRBC are homogenized using the methods in Dai et al. (2011). The NRBC results in consistently smaller DPD values throughout the time record in the homogenized data with NRBC than that without corrections, which would have potential impact on global reanalysis products when the homogenized daily data are assimilated into the reanalysis models. However, it has insignificant effects on the long-term trends.

Dai, A., J. Wang, P.W. Thorne, D.E. Parker, L. Haimberger, and X.L. Wang, 2011: A new approach to homogenize daily radiosonde humidity data. J. Climate, 24, 965-991.