Geophysical Research Abstracts
Vol. 13, EGU2011-13812, 2011
EGU General Assembly 2011

A New Approach to Homogenize Daily Radiosonde Humidity Data

Aiguo Dai (1), Junhong Wang (1), Peter W Thorne (2,3), David E Parker (2), Leopold Haimberger (4), and Xiaolan L Wang (5)

(1) National Center for Atmospheric Research, Boulder, Colorado, USA, (2) Met Office Hadley Centre, Exeter, Devon, United Kingdom, (3) Now at CICS-NC, NOAA's National Climatic Data Center, Asheville, North Carolina, USA, (4) Department of Meteorology and Geophysics, University of Vienna, Vienna, Austria, (5) Climate Research Division, Science and Technology Branch, Environment Canada, Toronto, Canada

Radiosonde humidity records represent the only in-situ observations of tropospheric water vapor content with multi-decadal length and quasi-global coverage. However, their use has been hampered by ubiquitous and large discontinuities resulting from changes to instrumentation and observing practices. Here a new approach is developed to homogenize historical records of tropospheric (up to 100 hPa) dew point depression (DPD), the archived radiosonde humidity parameter. Two statistical tests are used to detect change points, which are most apparent in histograms and occurrence frequencies of the daily DPD: a variant of the Kolmogorov-Smirnov (K-S) test for changes in distributions, and the Penalized Maximal F-test (PMFred) for mean shifts in the occurrence frequency for different bins of DPD. These tests capture most of the apparent discontinuities in the daily DPD data, with an average of 8.6 change points ($\sim$1 change point per 5 years) in each of the analyzed radiosonde records, which begin as early as the 1950s and end in March 2009. Before applying breakpoint adjustments, artificial sampling effects are first adjusted by estimating missing DPD reports for cold (T < -30˚C) and dry (DPD artificially set to 30˚C) conditions using empirical relationships at each station between the anomalies of air temperature and vapor pressure derived from recent observations when DPD reports are available under these conditions. Next, the sampling-adjusted DPD is detrended separately for each of the 4-10 quantile categories, and then adjusted using a quantile-matching algorithm so that the earlier segments have histograms comparable to that of the latest segment. Neither the change-point detection nor the adjustment uses a reference series given the stability of the DPD series. Using this new approach, a homogenized global, twice daily DPD data set (available from www.cgd.ucar.edu/cas/catalog/) is created for climate and other applications based on the Integrated Global Radiosonde Archive (IGRA) and two other data sources. The adjusted daily DPD has much smaller and spatially more coherent trends during 1973-2008 than the raw data. It implies only small changes in relative humidity in the lower and middle troposphere. When combined with homogenized radiosonde temperature, other atmospheric humidity variables can be calculated, and these exhibit spatially more coherent trends than without the DPD homogenization. The DPD adjustment yields a different pattern of change in humidity parameters compared to the apparent trends from the raw data. The adjusted estimates show an increase in tropospheric water vapor globally. A full paper will soon appear in Journal of Climate and the eproof is available from http://www.cgd.ucar.edu/cas/adai/papers/Dai_etal_JC2011_DPD.pdf.