Session: C15 Poster: T70A

GCOS Reference Upper Air Network: Management of changes in GRUAN for better climate trend detection

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The GCOS Reference Upper Air Network (GRUAN) is an international reference observing network, designed to meet climate requirements and to fill a major void in the current global observing system. The primary goal of this project is to provide a rigorous quantitative scientific basis upon which to develop operational practices to better manage instrumentation changes at GRUAN sites and to accurately merge the data segments to create a homogeneous time series. The study makes use of dual-sonde data collected at GRUAN sites in the past either continuously or at times when radiosonde changes were made. We have analyzed the 13-year Lindenberg dual-sonde data record starting in 1998 and explored methods to document, identify and adjust for changes in instrumentation and observing practices made during the period that introduced non-climatic influences. Initial findings were that detailed metadata, 4-times daily sampling and independent dual sonde data proved necessary to document and identify changes. It is found that about 200 dual sonde flights over the course of a year are needed to accurately assess the bias between old and new sondes when this station plans to switch from one type of sonde to another one. These flights should cover day and night and the entire annual cycle. Five approaches show promise to quantify and adjust changes (i.e., homogenize the data record), including using independent and redundant measurements e.g. precipitable water derived from ground-based Global Navigation Satellite Systems measurements or a microwave radiometer, correcting known errors and biases using prior work, developing correction schemes to either old or new sonde data using dual sonde data, and using statistical methods. Some of these could substantially lower the number of required (expensive) dual-sonde launches. The GRUAN Vaisala RS92 correction algorithm (Immler et al. 2011) will be applied to Lindenberg operational radiosonde data from 2004 to 2010. The corrected RS92 data will be used as new reference segment data for statistical bias adjustments for historical Lindenberg radiosonde climatology (1964-2010) following Dai et al. (2011). We will evaluate how this correction affects the trend estimation of Lindenberg radiosonde humidity data. At Tateno, whenever there was a change from one type of sonde to another one, old and new sondes were flown on the same balloons for a period of time. Their correction algorithms have been developed using the dual sonde data to correct radiosonde temperature records and show the promise of improving the temperature trend estimation. We plan to develop similar corrections to humidity data. The homogenized radiosonde data based on these corrections will be compared with that homogenized using statistical methods to show the value of the dual-sonde data in preparing a homogenized radiosonde climate record. 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. Immler, F. and others, 2011: GRUAN data product based on RS92 measurements. GRUAN Technical Documents.