Session: C15 Poster: T71A

GCOS Reference Upper Air Network: Reference data products derived from Vaisala RS92 radiosoundings

Franz Immler[†]; Holger Vomel; Michael Sommer; Masatomo Fujiwara; Larry Miloshevich
[†] Deutscher Wetterdienst, Germany
Leading author: franz.immler@dwd.de

Data products based on Vaisala RS92 radiosonde measurements of temperature, humidity, wind and pressure have been developed that follow the requirements of the GCOS Reference Upper Air Network (GRUAN) that were described in Immler et al., AMT, 2010. Reference measurements need to be traceable to SI or an accepted standard, involves an uncertainty analysis, are documented in accessible literature, and are validated, i.e. based on intercomparisons. The main feature of RS92 data products is that the profiles are retrieved from raw measurement data (read from the DigiCora III data base files), special correction algorithms are applied, and that a comprehensive uncertainty analysis is made that includes an assessment of the uncertainty of the corrections. For GRUAN soundings, special ground check procedures are carried out before launch to ensure best possible calibration of the sensors ("100 % pot") and traceability to SI. Temperature data are corrected for radiation bias by a correction scheme that is based on lab measurements obtained in Lindenberg, where the effect of sun radiation on the sensors was determined for different insolation, pressure, and ventilation conditions. An uncertainty analysis of these corrections is carried out based on assumptions on how well these conditions are known during ascent and how well the effect on the sensor can be evaluated. It was found that the largest contribution to the uncertainty arises from the fact that the radiation effect depends on the orientation of the cylindrically shaped sensor with respect to the incoming direct solar radiation. The humidity data are also corrected for a bias caused by radiation and additionally need to be corrected for the time-lag of the sensor which has a rather slow response time at cold temperatures. Also an adjustment of the calibration at cold temperature is made that creates an additional contribution to the calibration uncertainty. The total uncertainty of the humidity is about 2 % RH in the lower troposphere and reaches values of 5 % RH and more in the upper troposphere. In order to obtain higher accuracy in this region and for obtaining useful data in the stratosphere, other technologies must be used like the cryogenic frostpoint hygrometer (CFH). Wind data from GPS locating was assumed to be bias free. A statistical uncertainty can be calculated from the noise in the signal that is assumed to arise from the pendulum motion of the radiosonde and from noise created by the GPS receiver itself. Pressure is measured by a Silicon sensor but can also be retrieved from the GPS altitude. The analysis of the uncertainty of each method allows determination of a best estimate of pressure that uses the data from the pressure sensor at lower altitude and the pressure that was derived from GPS at higher altitudes, where this method is more accurate. GRUAN data are reported in NetCDF files that contain for each variable the profile of the total measurement uncertainty, its correlated (systematic) and uncorrelated (random) contributions as well as the time (altitude) resolution. Reference: Immler, F. J.; Dykema, J.; Gardiner, T.; Whiteman, D. N.; Thorne, P. W. and Vˆmel, H., Reference Quality Upper-Air Measurements: guidance for developing GRUAN data products. Atmospheric Measurement Techniques, 2010, 3, 1217-1231, doi:10.5194/amt-3-1217-2010.