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GRUAN: reference quality upper air measurements from radiosoundings

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One of the main goals of the GCOS Reference Upper Air Network (GRUAN) is to perform reference observations of profiles of atmospheric temperature and humidity for the purpose of monitoring climate change. Two essential criteria for establishing a reference observation are measurement-traceability and the availability of measurement uncertainties. Radiosoundings have proven valuable in providing in-situ profiles of temperature, humidity and pressure at unmatched vertical resolution. Data products from commercial radiosondes often rely on black-box or proprietary algorithms, which are not disclosed to the scientific user. Furthermore, long-term time-series from these products are frequently hampered by changes in the hardware and/or the data processing. Data provided by GRUAN comply with the above-mentioned criteria for a reference product. Correction algorithms are open-source and well-documented and the data are traceable to SI units and include vertically resolved best-estimates of the uncertainties.

Apart from introducing the principles of GRUAN, this presentation describes the GRUAN processing of RS92 radiosoundings, the correction algorithms that are applied, and the derivation of the vertically resolved uncertainty estimates. Well-known, dominant error sources for the RS92 profiles are related to solar radiation, causing a temperature error and a dry bias, and time-lag of the humidity sensor. The correction for radiation-related errors is based on laboratory experiments to measure the response of the RS92 sensors to solar irradiance. Verification of GRUAN RS92 humidity profiles show good agreement with coincident CFH soundings up to the tropopause, with a relative error smaller than 10%. Comparison of temperature profiles processed by GRUAN and by Vaisala shows negligible differences at night, and daytime differences of less than 0.1 K below 25 km. The bias between both temperature profiles are within the estimated uncertainty. Comparison of the humidity measurements shows moister GRUAN profiles at night. For daytime profiles the GRUAN profiles are up to 15% moister in the upper troposphere, which is largely attributed to the correction for the radiation dry bias.

The major advantages of the GRUAN processing include the availability of uncertainty estimates and the storing of the radiosonde's raw measurement data, which allows for reprocessing when new or improved corrections become available.