

GCOS Reference Upper Air Network: Quantifying the value of complementary observations for GRUAN operations

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GRUAN (GCOS Reference Upper Air Network) has the aim to characterize the thermodynamic state of atmosphere using both in-situ and remote observation techniques. GRUAN backbone is represented by 15 highly instrumented observatories with a strong observing capability equipped with GPS, lidars, radiometers, spectrometers, radars. So far, the contribution of ground based remote sensing has been identified as a priority in the frame of GRUAN for providing reference-quality profiling and columnar observations of atmospheric essential climate variables, in particular temperature and water vapour, from the surface into the stratosphere, to enhance the monitoring and the understanding of climate variability and change. To this aim, GATNDOR (GRUAN Analysis Team for Network Design and Operations Research), a research team supporting the development and implementation of GRUAN on scientifically sound foundations, is working for providing a quantification of the value of the so-called "complementary observations", identified as ground based remote sensing techniques available at GRUAN sites. This research aims at estimating uncertainty of vertical profiles of both temperature and moisture using data from highly-instrumented GRUAN sites (e.g., ARM site, Beltsville, Cabauw, Lindenberg, Potenza) and to quantify the error reduction resulting from increasing redundancy of measurements. This requires the assessment of the uncertainty of the temperature and moisture vertical profiles retrieved using each of the considered techniques and then the investigation of possible sensors' synergies to reduce the uncertainty. The investigation is carrying out focusing on the most common instruments available at the GRUAN sites: radiosoundings and microwave profilers, for temperature; radiosoundings, Raman lidars, microwave profilers and GPS receivers, for moisture. The quantification of the value added by complementary observations will be assessed with respect to the following issues: 1. identification of possible biases; 2. representativeness of measurements; 3. sensor calibration/inter-calibration; 4. quality control/assurance with a focus on instrument performance in different meteorological conditions. The aim of the investigation is the provision of recommendations for an optimal observation strategy related to GRUAN phase 1 and 2, increasing accuracy of measured parameters and reducing uncertainties through redundancy. Moreover, recommendations for the equipment to operate/acquire at the GRUAN sites will be also provided. A preliminary assessment of value of complementary observation will be provided showing what are the real advantages in estimating temperature and humidity, along with their uncertainties, from the combination of radiosondes and ground based remote sensing techniques respect to the use of radiosondes only.