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Intercomparison of Vaisala RS92 and RS41 radiosondes under controlled laboratory conditions

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Atmospheric profiles of meteorological variables measured with radiosoundings are essential for the study of weather, climate and related atmospheric processes, as well as for the validation of satellite observations.
So far, Vaisala RS92 sondes have been widely used within global scale radiosounding networks. In 2014, Vaisala introduced the RS41 to replace RS92, whose production was terminated at the end of 2017. To ensure the homogeneity and the highest quality standard of radiosounding data records, intercomparisons are strongly needed to characterize the relevant differences between RS92 and RS41 in terms of biases, calibration/measurement errors and uncertainties.
In the frame of GRUAN (GCOS Reference Upper Air Network) activities, a joint experimentation between Italian National Research Council's Institute of Methodologies for Environmental Analysis (CNR-IMAA) and National Institute for Metrological Research (INRiM) has been planned and carried out in order to intercompare performances of RS92 and RS41 under laboratory controlled conditions.
The experimentation consisted in three different experiments, to test the behaviour the two sonde types in different controlled temperature, pressure, humidity and wind speed conditions. All experiments were performed with a set of reference thermometers and hygrometers, calibrated at INRiM and traceable to SI national standards.
The first experiment involved testing both sondes in a climatic chamber at different combinations of humidity (5 points between 20 % and 98 %) and temperature (9 points between -40 °C and 40 °C).
The second experiment aimed at the evaluation of the time constant of temperature sensors during steep temperature transients, by quickly moving the sondes from one climatic chamber set at high temperature to another set at low temperature (and vice versa). Repeated transitions between -40 °C and 20 °C, between -30 °C and 30 °C, and between 0 °C and 20 °C were measured.
The third experiment consisted in testing both sondes at different wind speeds and pressures, using INRiM's climatic chamber/wind tunnel EDDIE (Earth Direct Dynamics Investigation Experiment). The sondes were tested at 5 different temperatures (between 30 °C and -20 °C), 4 different wind speeds (between 2 m/s and 15 m/s) and 4 different atmospheric pressures (between ambient and 350 hPa).
A preliminary analysis revealed that RS41 is more stable and accurate than RS92, both in temperature and humidity. Both sondes detect temperature transitions quite fast, without significant differences between them, and show a performance degradation after such transitions, which requires further investigation. At low pressures, both sondes show a good performance in temperature measurements, though they become noisier. A more consolidated metrological analysis, providing a complete uncertainty budget and characterization of both sondes at different environmental conditions, will be presented.