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# Towards Better Quality Assurance of Upper-Air Observations - Progress Report on the Vaisala Reference Radiosonde Program

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In 2009 Vaisala launched a program to develop a reference grade radiosonde for climate studies, especially targeting the needs of the GCOS Reference Upper Air Network (GRUAN). The program's initial focus is to improve upper-air measurements of water vapor.

To date the project has developed a prototype of an operational reference radiosonde, the Vaisala RR01, which is built around the DRYCAP® advanced capacitive humidity sensor that is capable of measuring extremely low humidites in the upper troposphere and lower stratosphere (UTLS). Conventional Vaisala RS92 radiosonde technology is used for telemetry and measuring pressure, temperature and tropospheric humidity along with GPS wind finding.

During 2011, the moisture measurement performance of the RR01 in the UTLS was substantially improved and now demonstrates good consistency with a cryogenic frost point hygrometer (CFH) that is a widely accepted and well established reference instrument. This year the main focus has been on quality assurance issues. In line with the GRUAN recommendations for reference measurements, the QA task includes defining uncertainty estimates for moisture measurement in the UTLS as well as maintaining the data continuity management of the RS92. As a result, each frostpoint reading measured by the RR01 is now accompanied by an individual uncertainty estimate, which consists of components of uncertainty from all stages of the measurement process: instrument calibration, storage, corrections applied during humidity calculation, and the actual sounding event. According to preliminary results typical uncertainty estimates of the DRYCAP® measurements are around 1.0 °C below an altitude of 20 km and increase gradually to 1.5 - 2.0 °C at 30 km, as expressed in frostpoint temperature (k=2).

A significant error source, which cannot be completely taken into account by the uncertainty estimation algorithm, is condensed moisture on the surfaces of the sensor mechanics. In order to find a sensor shield design that would minimize the unwanted effects of precipitation and supersaturation, a great variety of designs has been studied through CFD modeling and test soundings.

A group of beta test partners involved with the GRUAN program are currently conducting independent tests of the Vaisala RR01 and future development will be focused on feedback gained from these tests. The final target is a reference radiosonde that is considerably easier to operate and less expensive than the current reference grade instruments, thus enabling more frequent and economical climatological soundings.