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A method for correcting and determining uncertainties of measurements by the EE-33 humidity sensor for climate reference measurements in Germany

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The German weather service (DWD) operates 10 climate reference stations for surface observations of meteorological standard parameters. Since 2008 parallel measurements of traditional instruments and automatic sensors are performed at these stations. For temperature and relative humidity different housings are used: the manual instruments are installed in a Stevenson screen whereas a ventilated LAM-630 screen is used for automated instruments. The measurements of these two parameters also include parallel observations with identical sensors and with different types of sensors.
In a research project, these comparative measurements are used to identify and correct possible inhomogeneities at the transition of different measuring systems. Furthermore, measurement uncertainties are characterized using the climate reference data, laboratory analyses and other comparative field experiments. A third objective of this project is the development of tools for a real-time quality monitoring.
In this presentation, we show a method for subsequent processing of relative humidity data measured with the heated polymer sensor EE-33. In the first step corrections for known systematic errors due to radiation, nonlinearity and long-term sensor drift are applied. We find that the dominant error is radiation. Under specific, unfavorable conditions the radiation-induced dry bias can be as large as 10%RH. In the second step of the data processing the uncertainty for each data point is estimated by evaluating five different uncertainty components:

(1) calibration/nonlinearity
(2) drift
(3) radiation/temperature
(4) stochastic effects
(5) response time

Overall uncertainties are then calculated by addition of the components according to error propagation. The overall uncertainty after correction is usually in the range of ±2-3 %RH, with highest contributions of typically 1%RH from components (1) to (3).