EMS Annual Meeting Abstracts
Vol. 14, EMS2017-205, 2017

Dynamic Uncertainty: Accounting for Calibration Drift

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The calibration of any meteorological sensor has an associated uncertainty of measurement, resulting from the process of calibration itself, the traceability chain of the reference standards used and the instrumentation employed. This measure of uncertainty is normally recorded in the metadata, associated with the record of observations made with the particular instrument.
However, for any observation made in the field, there are additional sources of uncertainty impacting the representivity of the observed value, due to departures from the ideal environment in which the instrument should be positioned. In addition, the calibration of the instrument is often found to drift over time by an amount which cannot be determined until after the end of the deployment period. At this time, a re-calibration can be made of the instrument, in an “as returned” state. For climate record purposes, this second calibration and the amount of drift revealed, can be recorded in the metadata alongside the observation series. However, if the observations are being used for synoptic purposes, the drift at the time of the observation is not known and, therefore, contributes an additional level of uncertainty to the observed value.
Laboratory calibration records can be used to refine a probabilistic model of drift over deployment, based on Monte Carlo simulation of a large number of possible drift trajectories, from which the probability that drift exceeds a given threshold at any time during the deployment period, can be estimated. This component of the uncertainty will be dynamic. When applied across a complete observing network, it allows for temporal and spatial variability in the total measurement uncertainty of the observed parameter to be estimated.
A process is described by which this process for dynamic uncertainty estimation can be developed and applied to an observing network. The extension of the method to allow the uncertainty estimate to be further refined to account for other factors that may affect the observed measurement is described.