Metrological characterization of climate reference station thermometers

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Tenth International Temperature Symposium
Anaheim, CA USA
April 3-7, 2023

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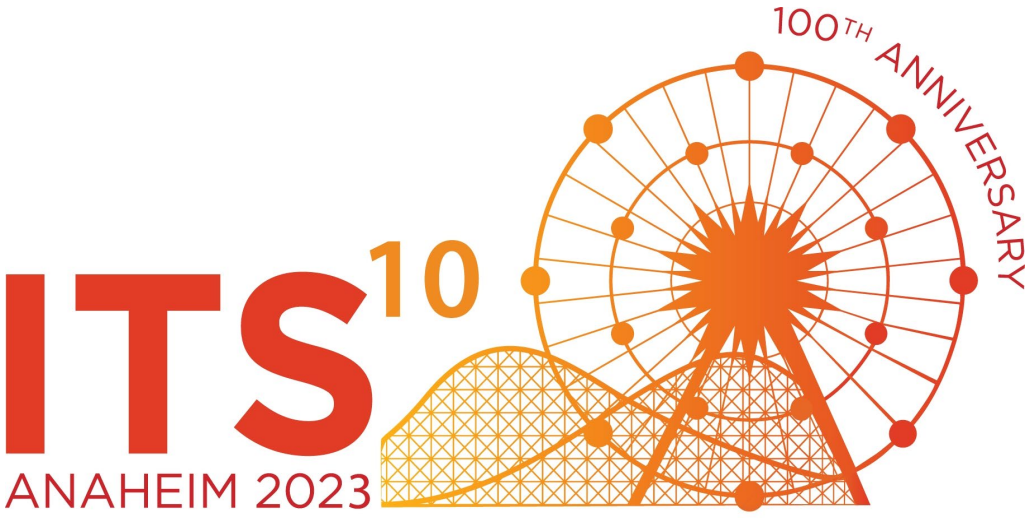

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Metrological characterization of climate reference station thermometers

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Ground-based stations are an essential part of a complex climate observing systems which purpose is to generate data for evaluating local and global climate trends. Measurement traceability in these types of stations is fundamental for generating a robust climate understanding based on comparable data in space and time, both within networked stations and between networks. This importance was expressed by the Global Climate Observing System (GCOS) of the United Nations Environment Programme and WMO (World Meteorological Organization), in its published report 226 that highlights the need for available reference grade observations for accurately detecting of local and global climate trends [1]. As a following action, the GCOS launched in 2022 the implementation plan of its Surface Reference Network (GSRN) where an essential part of the effort is the understanding of instruments performance in field monitoring of temperature, humidity, and pressure. We focused the work here presented on the characterization of resistance thermometers of various types that are candidates to be installed in future prototype reference station. The selection of sensors using resistance measurement principle was motivated by their overall frequent in field use and general superior performance in comparison to other commonly used temperature sensors. The measurements took place under controlled laboratory conditions simulating as close as possible conditions in the field, leading to recommendations on the requirements of instrumentation for a climate reference station. In order to properly determine sensor performance and the components of the measurement uncertainty budget for climate reference stations the metrological parameters as stability, hysteresis and self-heating were determined. These essential parameters were measured in a temperature range typical for air temperature measurements for climate which is from -40 °C up to +60 °C. The characterization of temperature sensors from multiple manufacturers has shown diverging results in all measured parameters which were measured over the whole temperature range. In general, the measurements indicate that from the point of sensor stability the critical temperatures were 20 °C and -40 °C, with indicated highest temperature instability on the level of 0,02 °C. The highest hysteresis effect has been observed at temperatures of 0 °C and -40 °C with a maximum of 0,05 °C. Sensor self-heating exhibits multiple dependencies of the level of supply current that vary with tested sensor and temperature point. This research was made possible thanks to the project (19SIP03- Climate Reference Station) which has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme. This work is part of the opening activities for a future GSRN affiliated research facility.

References

[1] GCOS Surface Reference Network (GSRN): Justification, requirements, siting and instrumentation options – GCOS 226 – WMO February 2019