Standard Humidity Chamber (HP3)

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15th GRUAN Implementation and Coordination Meeting (ICM-15)
11 Mar - 15 Mar 2024

- HP3:
  Finalise the activity to justify the use, and document the procedures, for SHC

  Submit paper to **justify** the use of the SHC in terms of the data quality and the **benefits** and including need for **standardisation** of operating procedures. (Dec. 2023)

  Outline

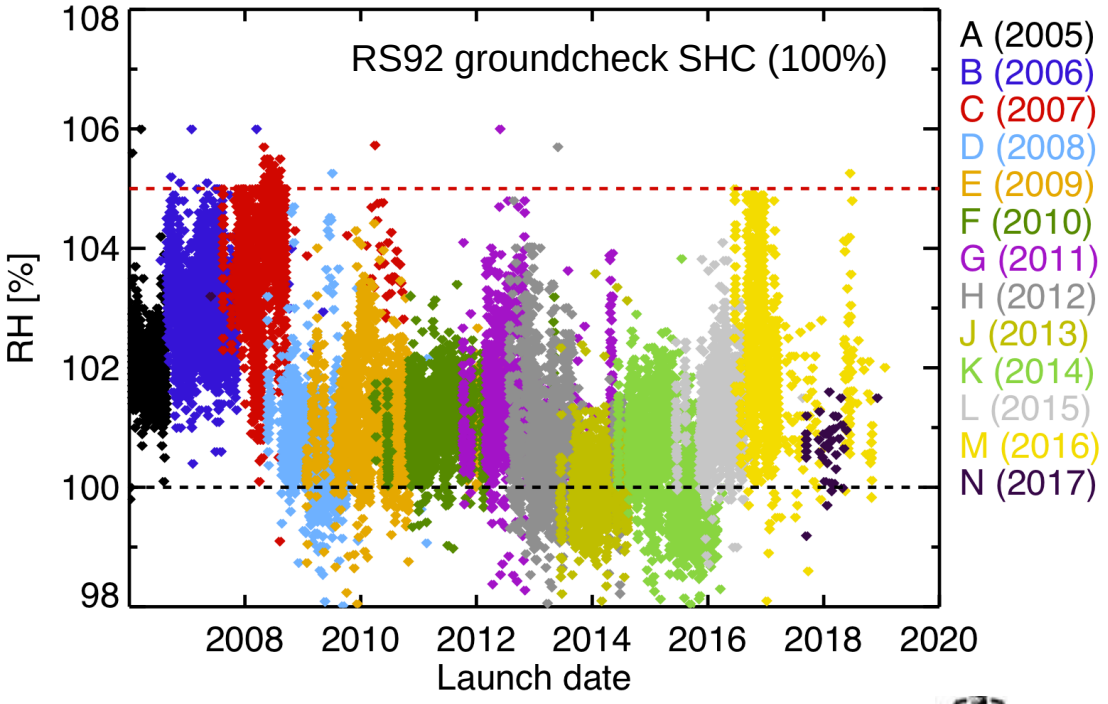
  Complete TN to describe **procedural requirements** (e.g. operational procedure; quality of the applied references in the SHC). (Mar 2024)

  not yet started

- Who: TT-sites (Richard Querel); Lead Centre

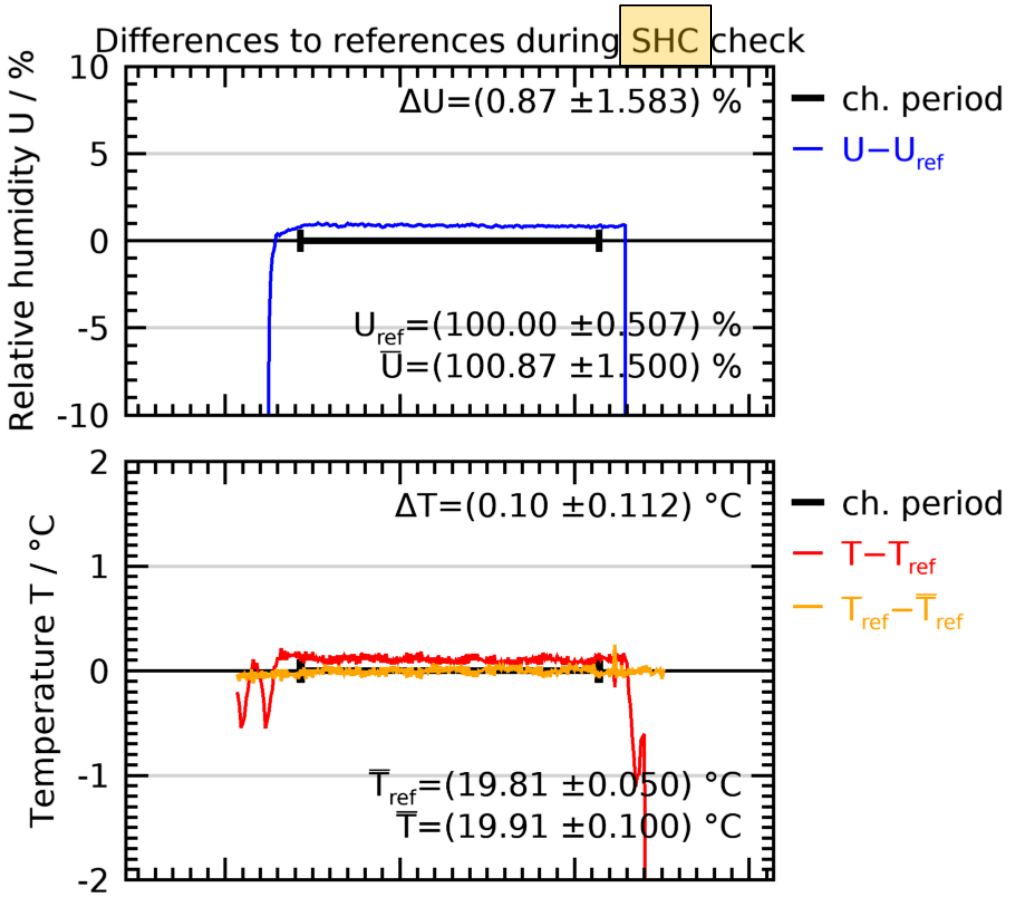
Why SHC?

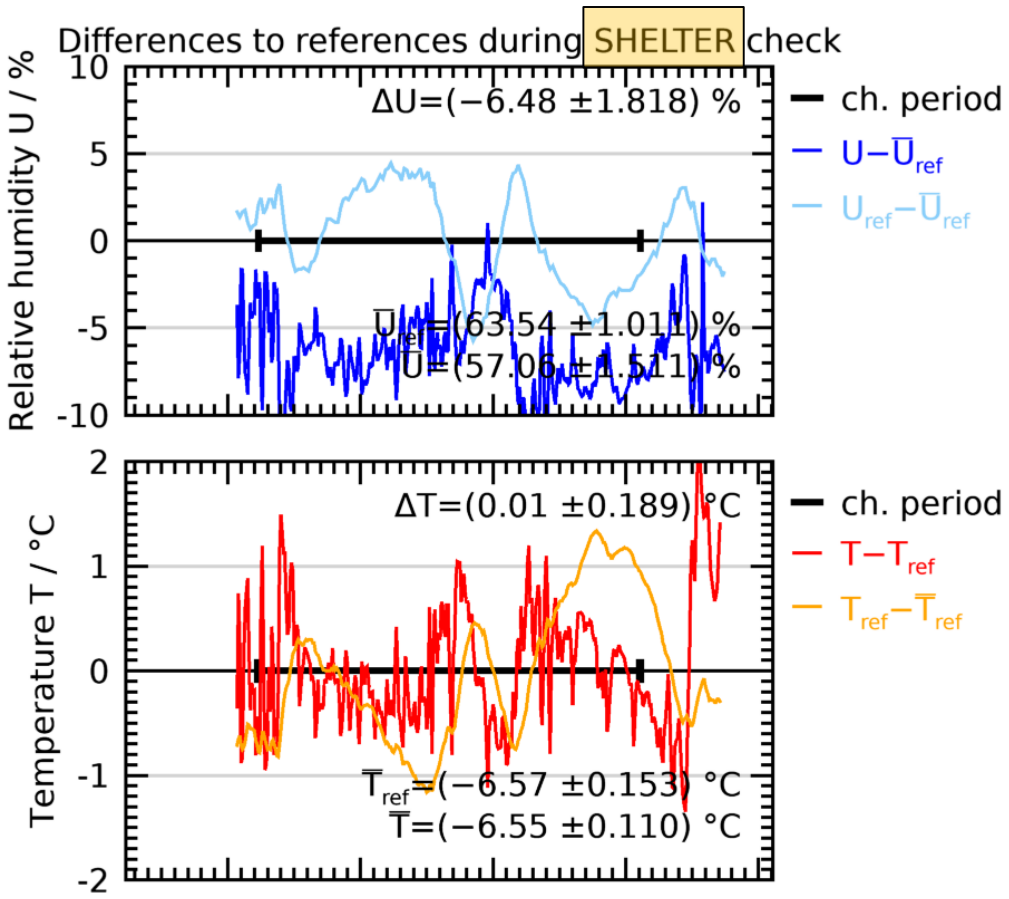
- A manufacturer-independent ground check should be a mandatory part of a GRUAN radiosounding
  → Otherwise, we rely entirely on the manufacturer's traceability claims.
- SHC proved to be a good implementation of a controlled test environment
- helps identifying 'bad' radiosondes
- check result may lead to a contribution to uncertainty of actual sounding (RH and T)
  (current practice for RS41-GDP.1)
- Time series of routine SHC checks represent valuable metadata:
  - Variability
  - Long-term stability:
    Identification of discontinuities (e.g. changes in production or calibration) and drift



SHC vs. weather shelter

- Example: Pre-launch check in 100% SHC and weather shelter
  1) Data recorded during check period (RH, T)





Site effort to implement 100% SHC check

- Requirements/efforts for the implementation of the 100% RH SHC check in a routine radio-sounding program:

  ‘Manual’ sites:

  - Acquisition, installation, training (~once)
  - Additional time and attention for actual check with each launch
  - Maintenance and cleaning of SHC
  - Maintenance and calibration of reference sensors (T)

  Sites using autolaunchers:

  The same as above +

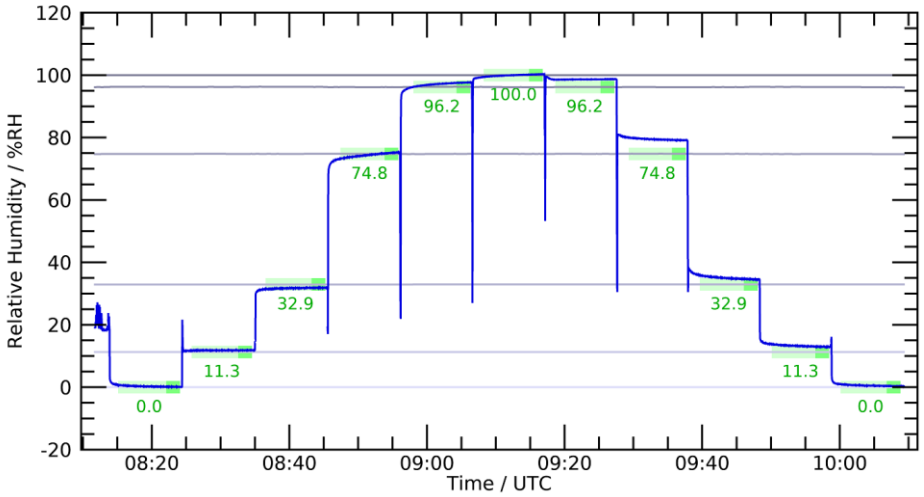
  - SHC-check for the number of RS belonging to a load before each autolauncher reload
  - Extra file management (RS, reference sensors)

SHCs used for multi-point calibration (0% to 100% RH)

- SHCs for six fixed points (no reference sensors):
  0 %RH: Desiccant
  (11, 33, 75, 96) %RH: Saturated salt solutions
  100 %RH: Pure water

- LC regularly performs calibration test series on subsamples of radiosondes purchased for routine and research use

- Motivation:
  - Detailed overview on calibration quality; potential changes with time/batches
  - Maintain the ability to apply a calibration correction as part of the GDP



- To be continued for any (future) GDP radio-sonde, as distributed effort at selected sites

Manuscript outline

1) Introduction
   - GRUAN principles — **Reference** data for climate monitoring; **Stable**, **traceable** data; **Independent** check; **Redundancy**; "Trust, but verify“
   - Discuss existing ground check methods — Manufacturer checks; Miloshevic’s THREF; AWI’s weather shelter method
2) Theoretical background — RH polymer **sensors**; **Calibration** curve / range of RH sensors; Reference salts (Greenspan), **uncertainties**
3) SHC
   - 3.1 Design — Vessel, heater, ventilator, desiccant/water/reference salt, adapter, additional thermometers to record air/liquid temperature; Well mixed
   - 3.2 Operational aspects
     - Pros: **Easy** to use; **Stable** environment for RH & T; Ref. T-sensor can be installed; **High stability** of test conditions (e.g. compared to weather shelters); Wide choice in **humidity levels**; Versatile tool: fast checks as well as more elaborate characterisation
     - Demanding: Operational **mistakes** (duration of test, no ventilation, no heating, no distilled water, leaking in of ambient air); **Additional work**: duration of measurement; RS **specific peculiarities** (e.g. orientation of RS41 sensor); Regular **maintenance/cleaning**; Concerns of manufacturers about **saturation** of RH sensors at 100%; Additional efforts when using **autolauncher**
   - 3.3 Achievements with SHC — SHC in use at **18 GRUAN sites**

Manuscript outline

- RS92: - Detection of long-term **drift** in instrument calibration
  - **Malfunctioning** radiosonde passing Vaisala GC
- Incentive to manufacturers for product improvement: **customer feedback**
- Application in WMO UAII-2022
- Part of **GDP development** (laboratory assessment of RH sensors)
- Input to **uncertainty** budget (RH and *T*) (RS41-GDP.1)
- Other radiosonde models (M10, DFM-09, DFM-17, RS-11G, iMS-100, FN-method RS80)

- 4 Discussion
  - Current and potential future applications of SHC

    Uncertainty estimate in GDP; **Correction** of RH profile using SHC measurement; **Other SHCs** (Meisei, Modem); **Quality control** (systematic checking of samples from a new batch); Share information within the network
  - Benefits

    For: Individual sounding, a site's time series, Network (GRUAN), Global networks
- 5 Conclusions

Contributions:
- Ruud (text)
- Michael, Peter O., Christoph (text, data evaluation)
- Peter O., Tatjana N. (laboratory work)
- Richard (text, language, site perspective)