Atmospheric Temperature and Humidity Measurements of Vaisala Radiosonde RS41

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17th Symposium on Meteorological Observation and Instrumentation

VAISALA

Outline

1. Sensor technology and product overview
2. Stability tests
3. Uncertainty analysis
4. Results in soundings
5. Conclusions

RS41 Temperature measurement

Platinium resistor technology

- Linearity and stability
- No ground check correction needed

Sensor and boom design optimization

- Response time
- Radiation error
- Water repellent treatment

SI-traceable calibration references (NIST)

RS41 Humidity measurement

Capacitive Humicap® technology

- Integrated temperature sensor
- Integrated heating element

Sensor concept features

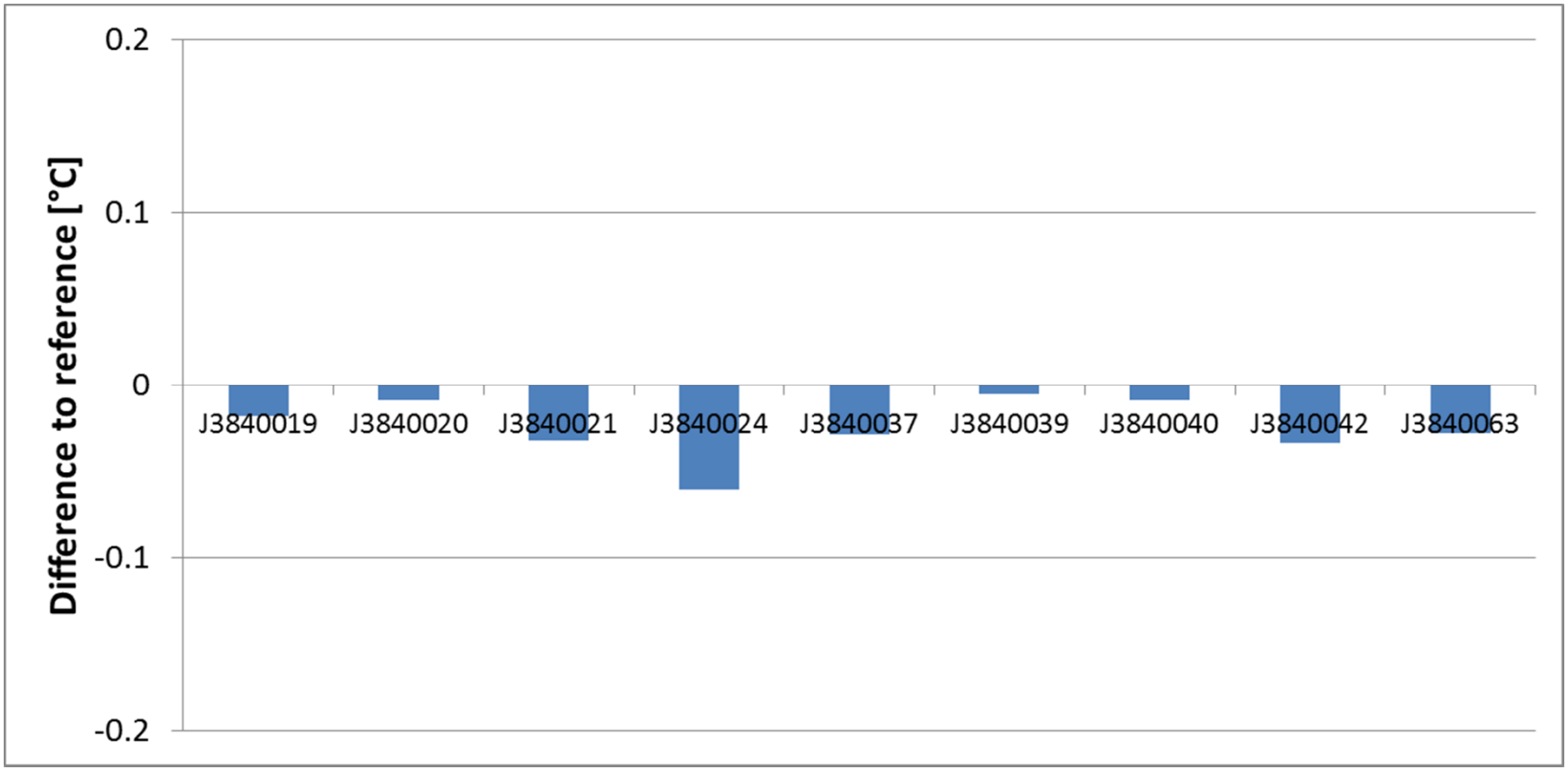
- Accuracy under solar exposure
- Icing prevention
- Reconditioning for contaminant removal
- Zero humidity correction without dessicants

SI-traceable calibration references (NIST)

Stability test results

RS41 Temperature measurement

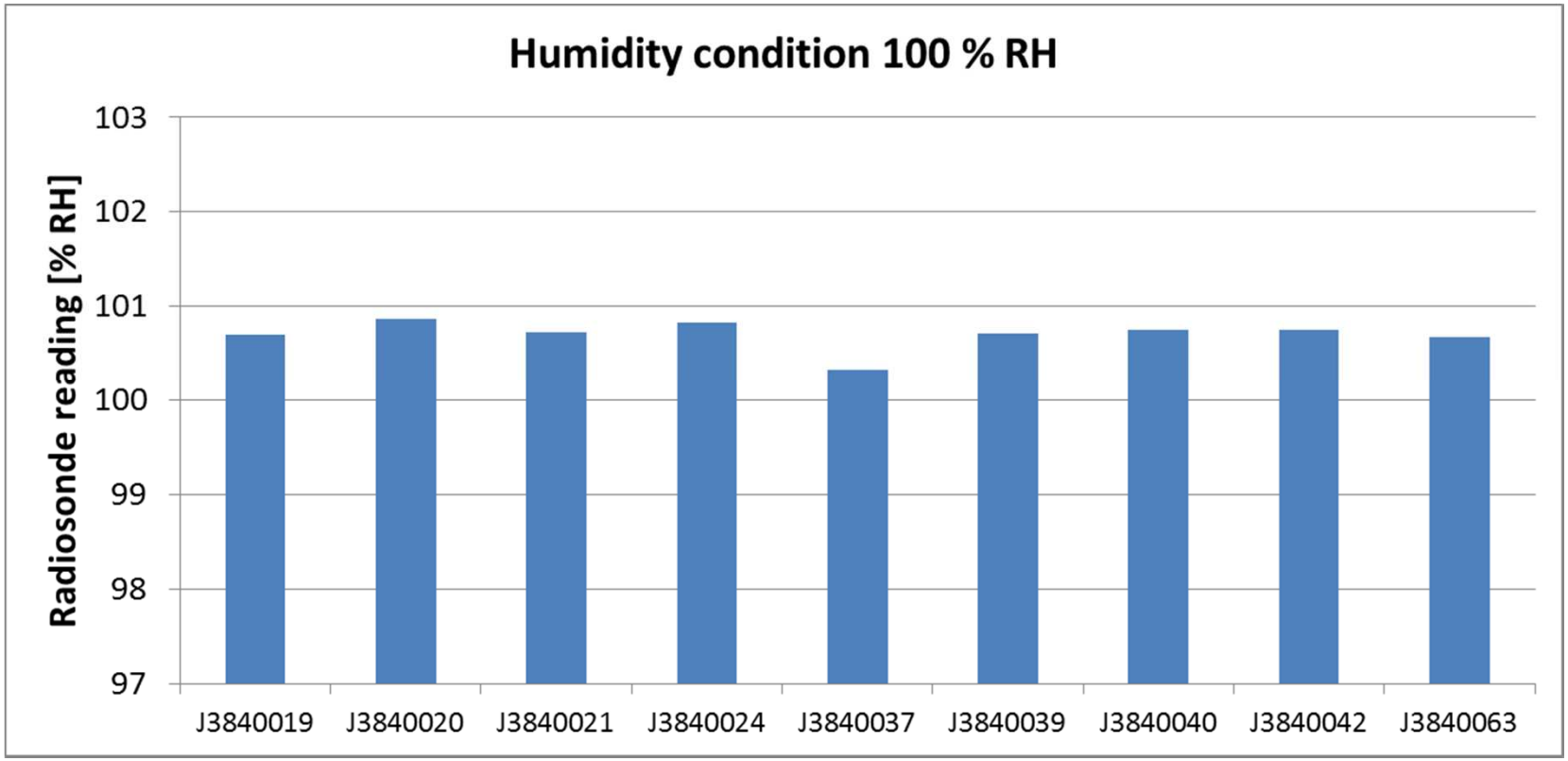
- Storage 6 months, measured at 20°C
- Test equipment uncertainty = 0.07°C (k=2)



Stability test results

RS41 Humidity measurement

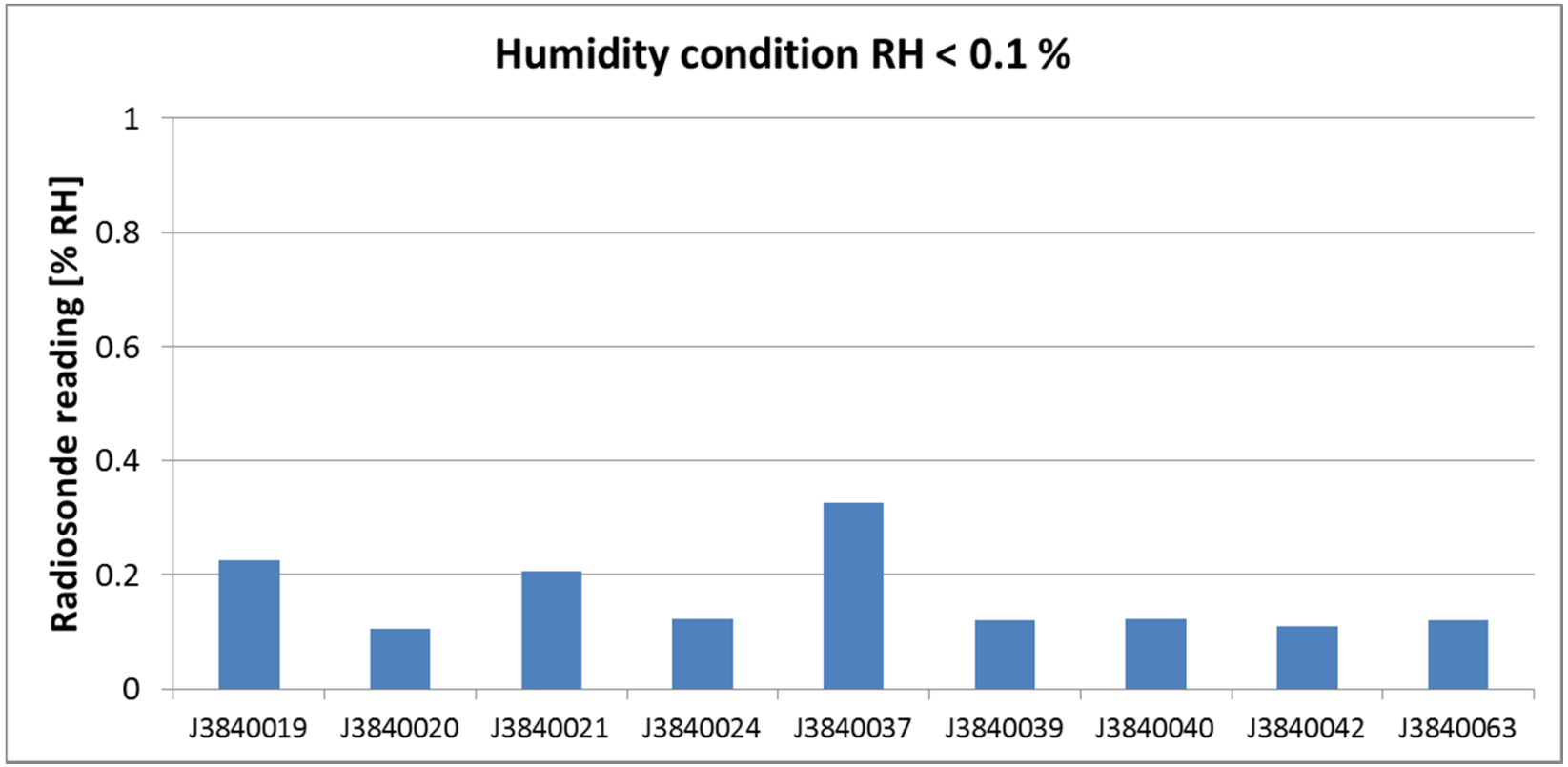
- Storage 6 months & ground check
- Measured in standard humidity chamber SPRH 100



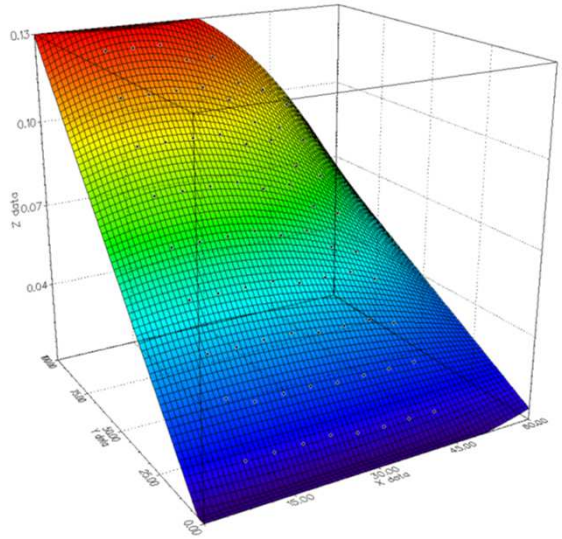
Stability test results

RS41 Humidity measurement

- Storage 6 months & ground check
- Measured in dry conditions (RH < 0.1 %)



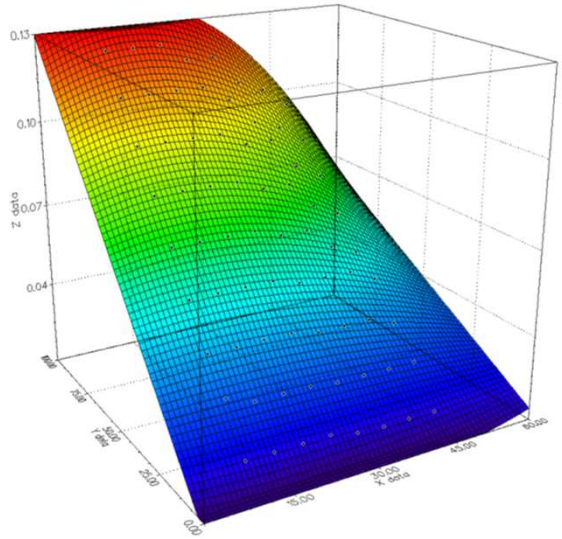
Uncertainty analysis according to GUM 2007



Uncertainty analysis model:

- Calibration
  - Reference measurements
  - Calibration process
  - Unit under calibration
- Sensor models
- Storage (T), Reconditioning & Zero humidity correction (U)
- Sounding
  - Dynamic conditions
  - Solar radiation

Uncertainty analysis according to GUM 2007



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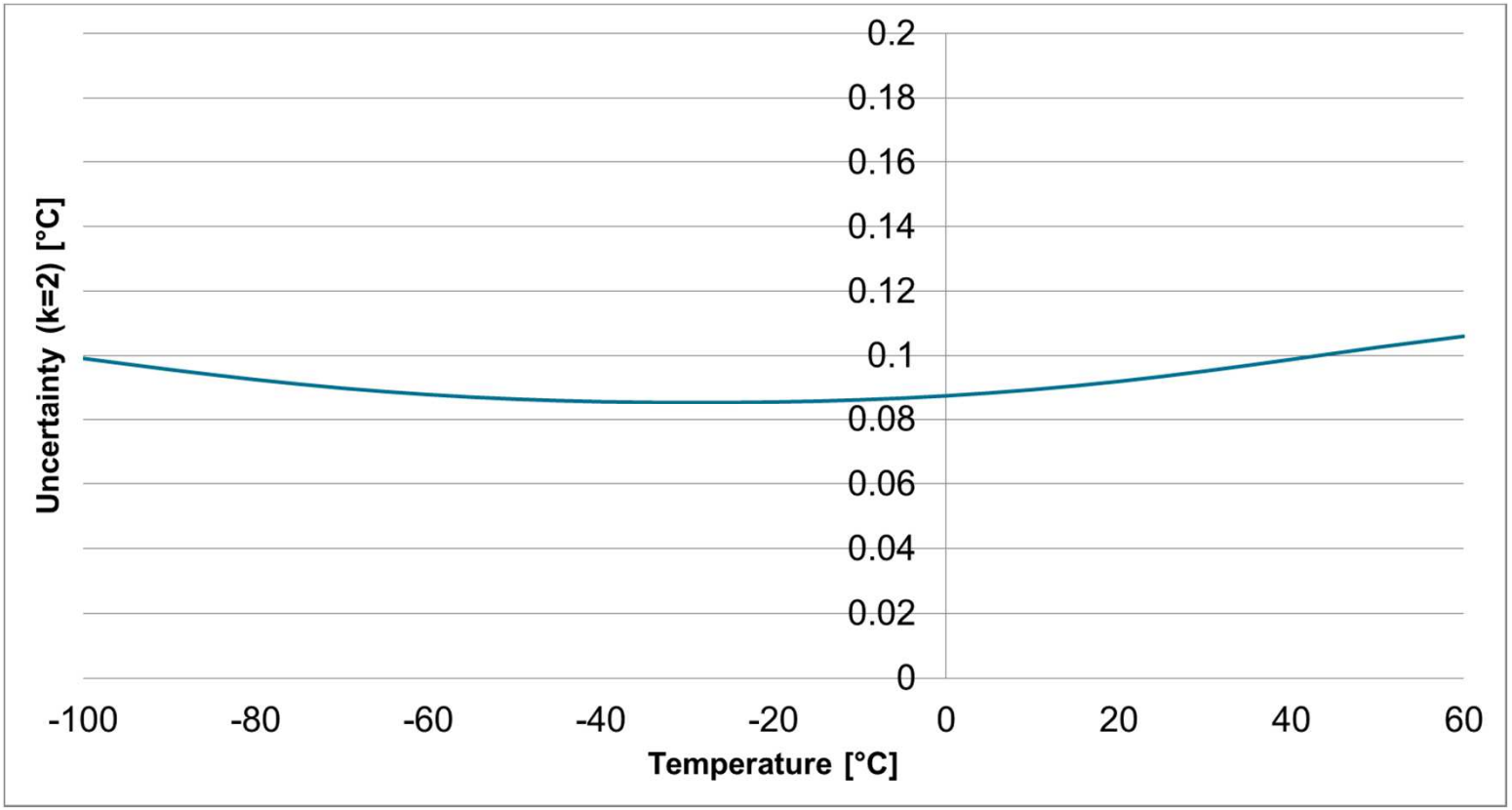
= Accuracy after ground preparations

Accuracy after ground preparations

RS41 Temperature measurement

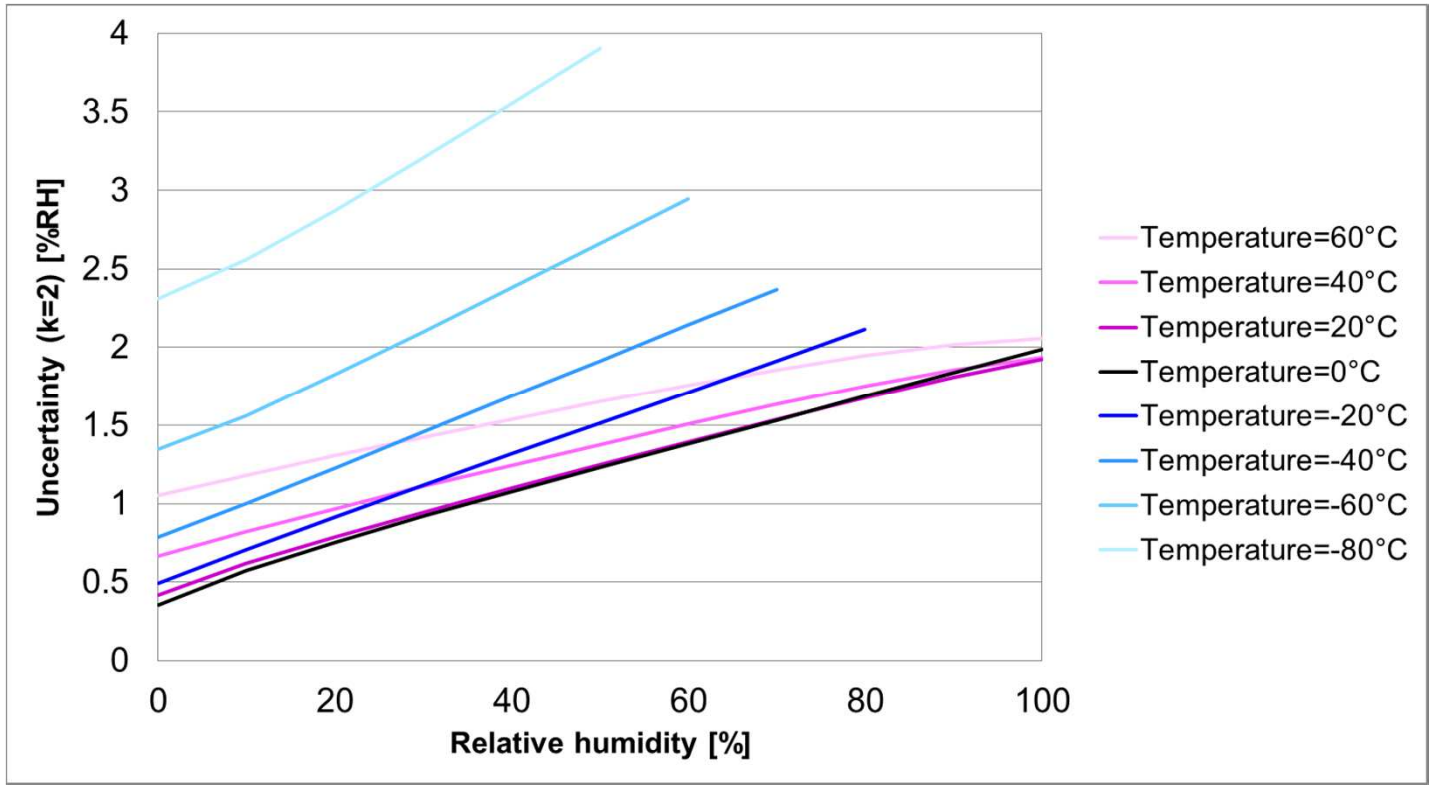
- Stability of Pt-resistor - No corrections applied



Accuracy after ground preparations

RS41 Humidity measurement

- Reconditioning for chemical contamination removal
- Zero humidity correction



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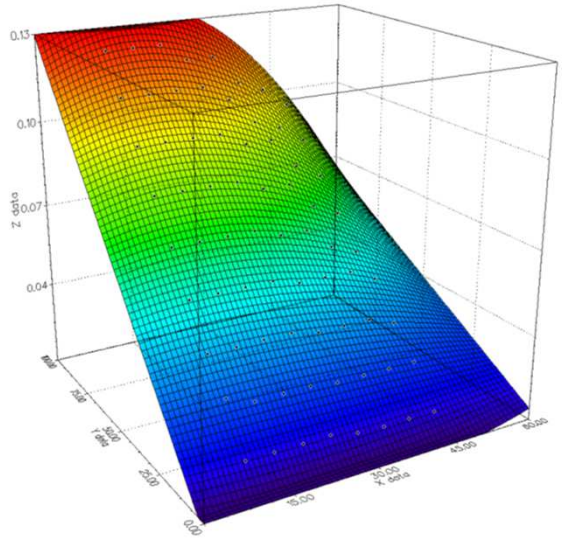

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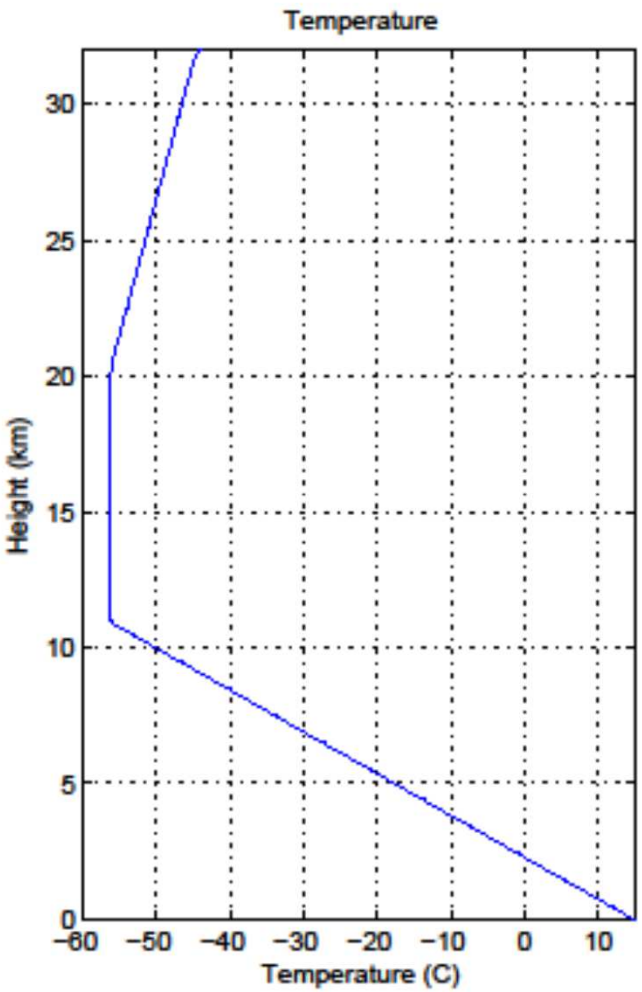
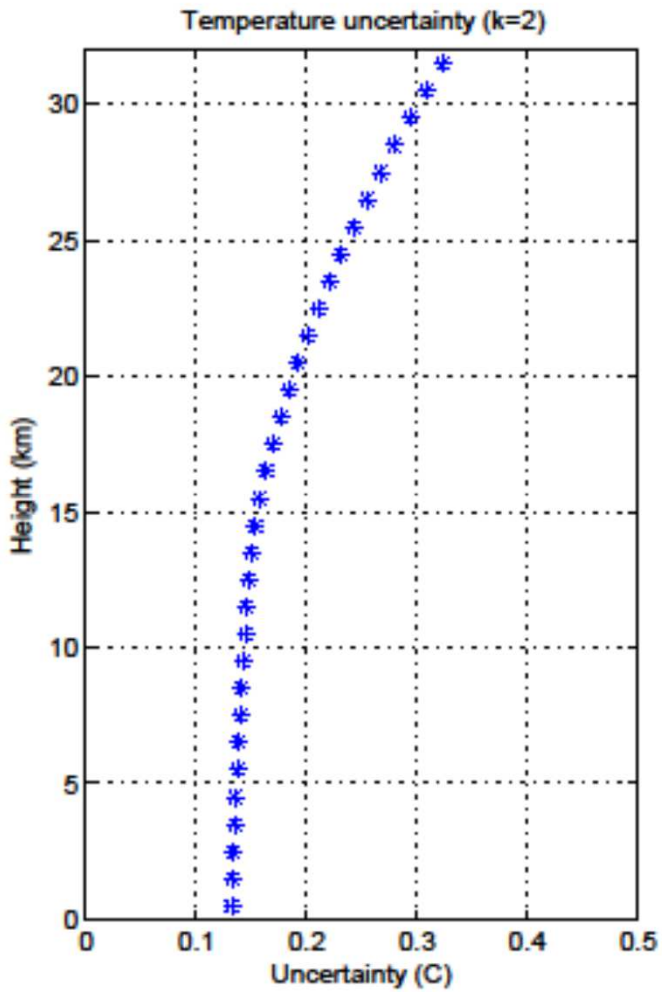
= Accuracy in sounding

Accuracy in sounding

RS41 Temperature measurement

- U.S. Standard Atmosphere 1976
- Solar angle 60°
- Ascend rate 6 m/s
- Coverage factor k=2





Accuracy in sounding

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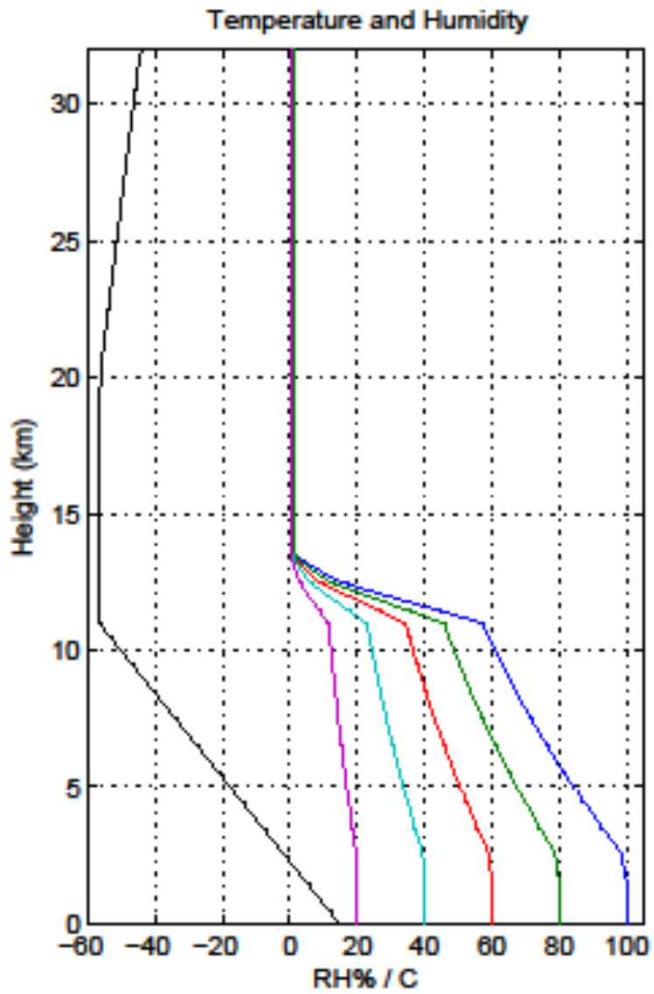
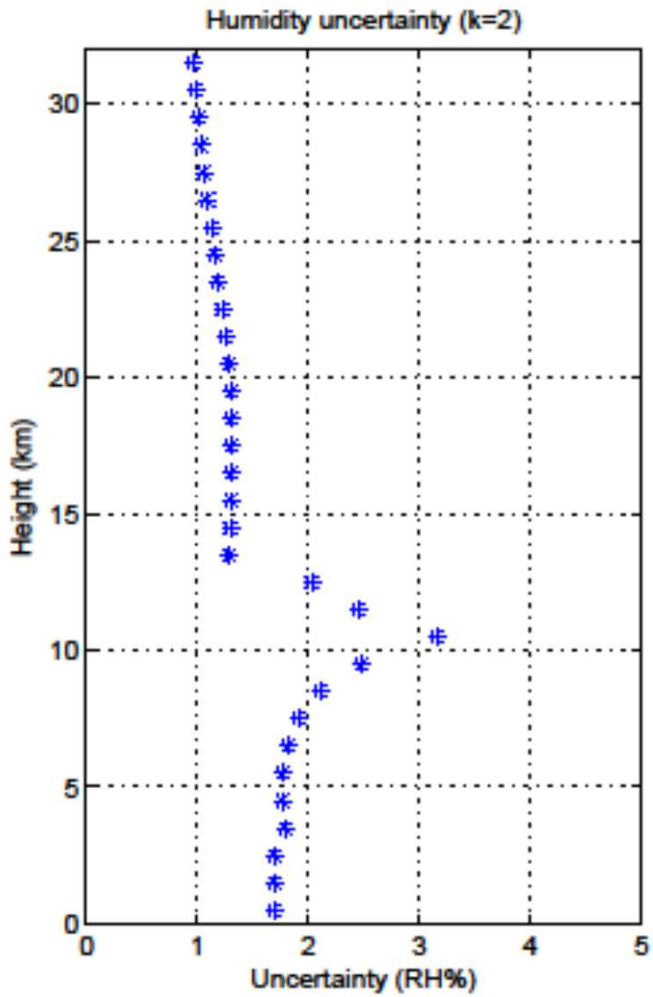
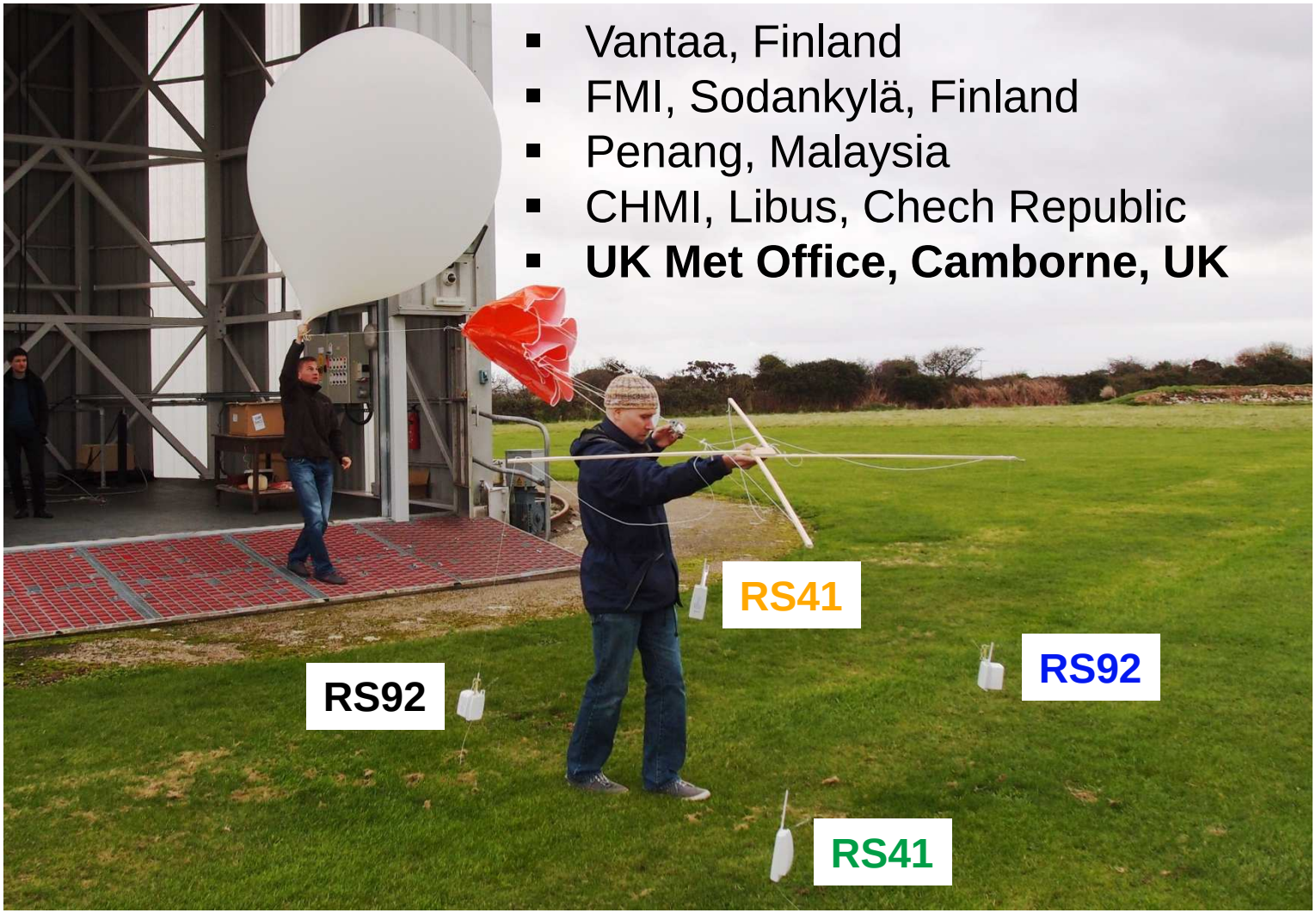




Sounding campaign results

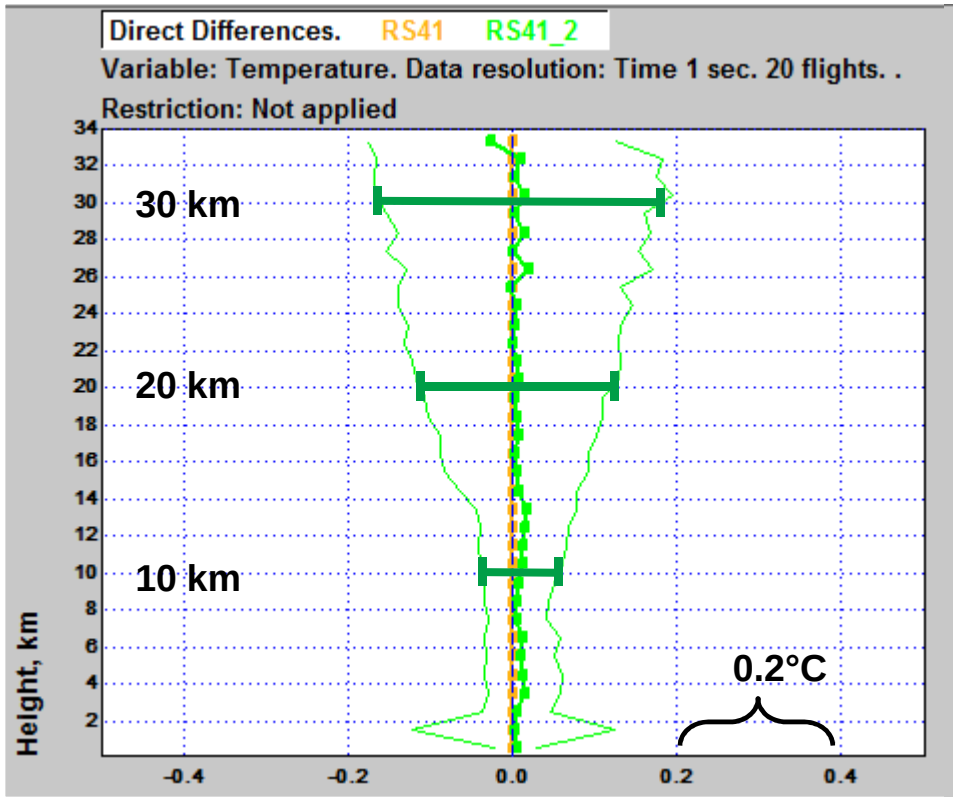


- Vantaa, Finland
- FMI, Sodankylä, Finland
- Penang, Malaysia
- CHMI, Libus, Chech Republic
- **UK Met Office, Camborne, UK**

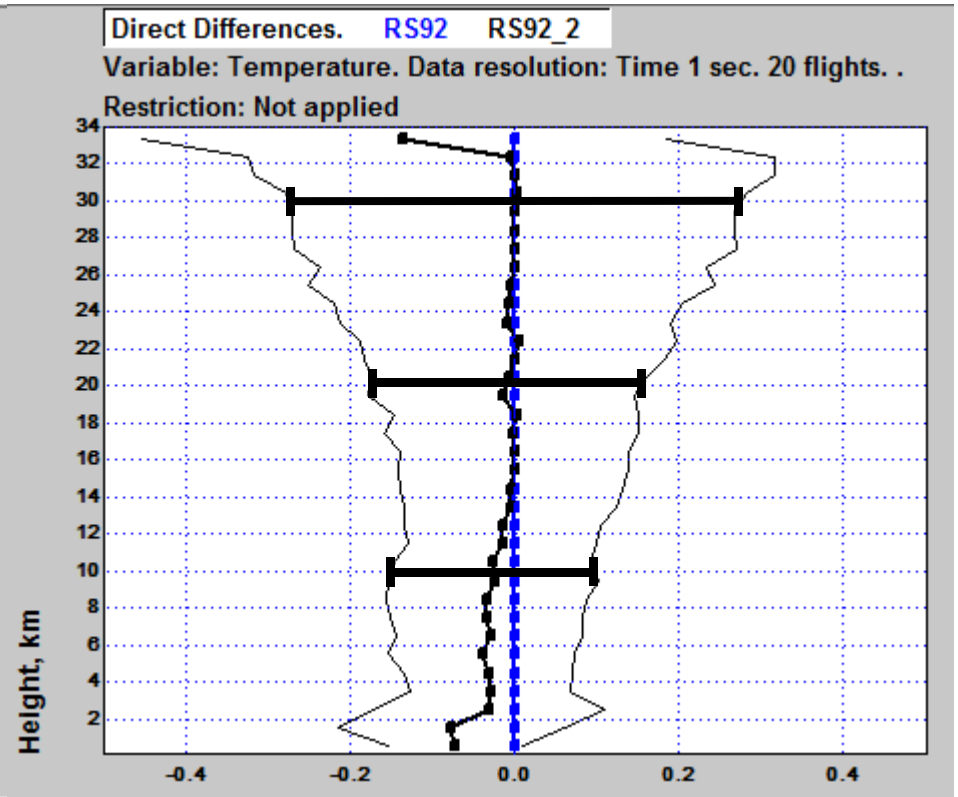
Temperature reproducibility, daytime

Direct differences and standard deviations
20 flights, Camborne UK

RS41 - RS41



RS92 - RS92



Humidity reproducibility, daytime

Direct differences and standard deviations
20 flights, Camborne UK

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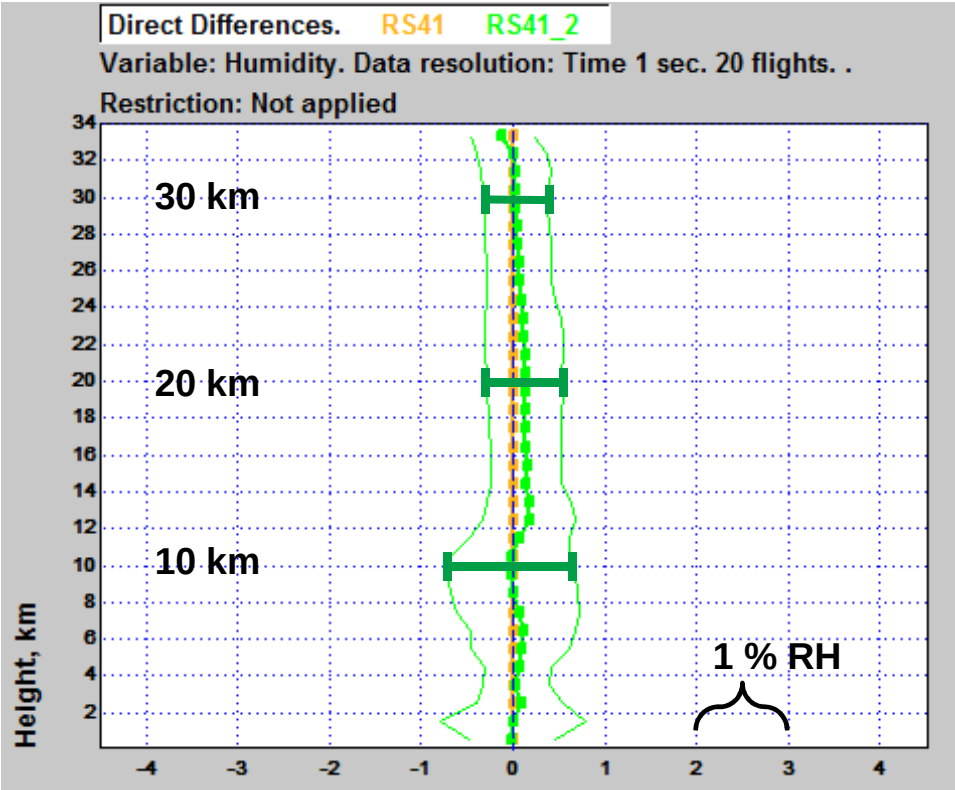

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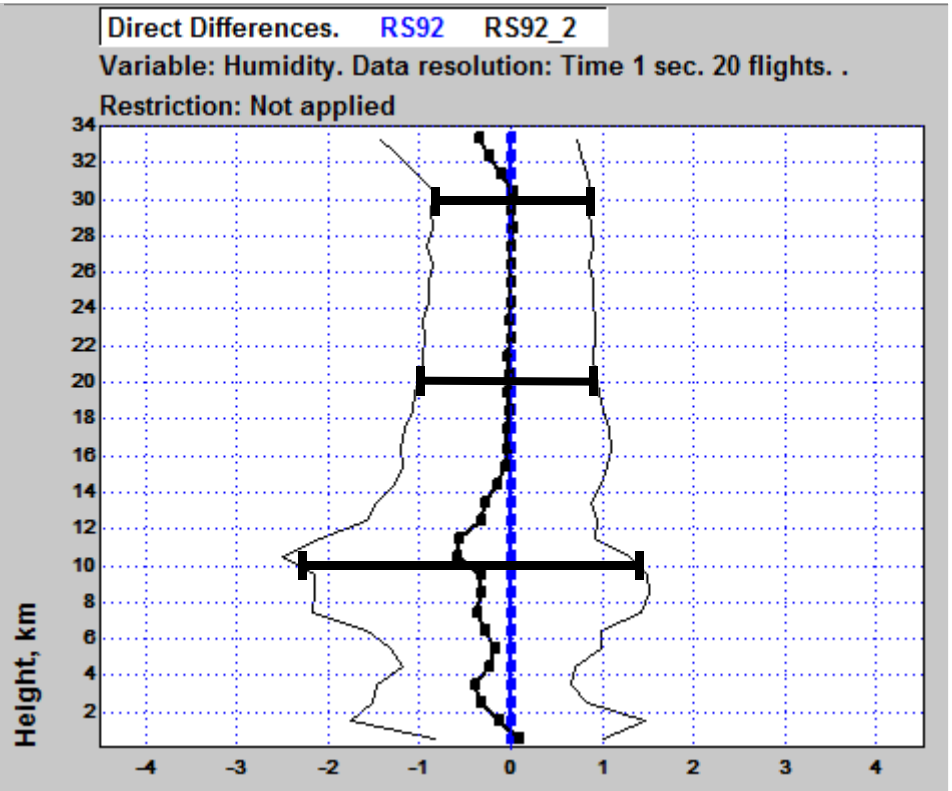
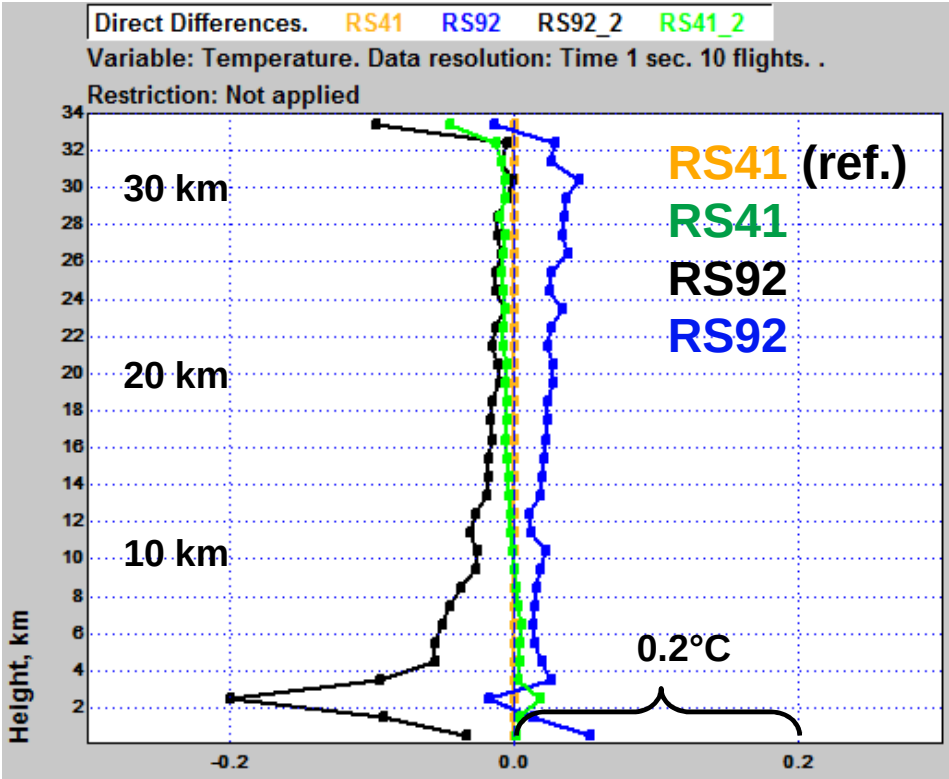


Temperature difference: RS92 – RS41

Camborne UK

Night-time, 10 flights



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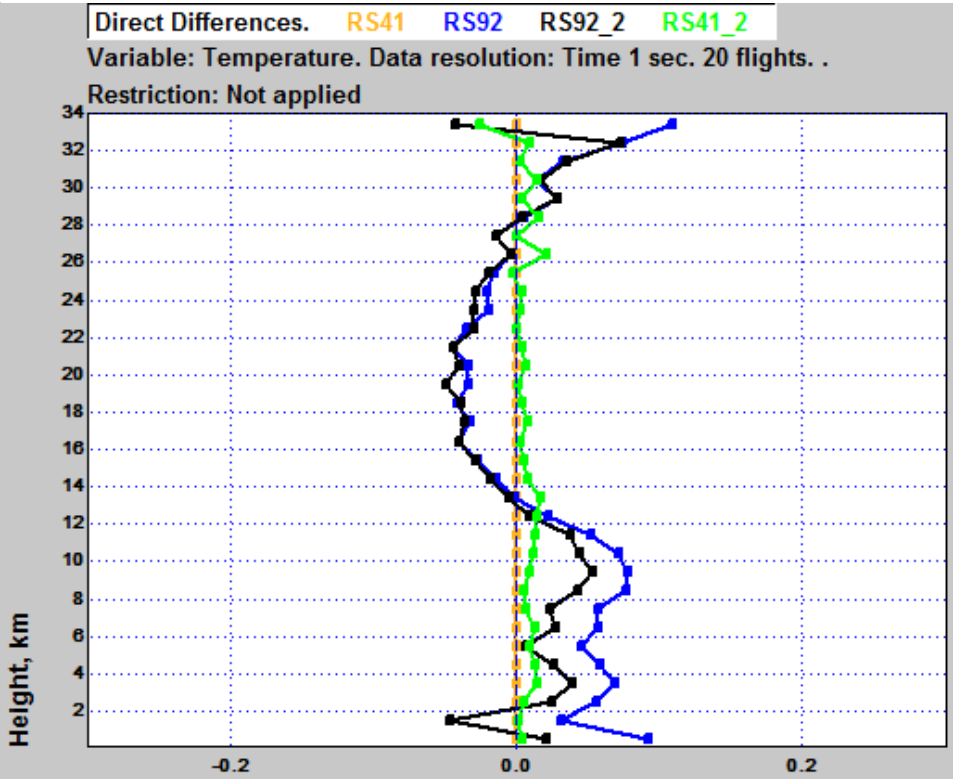

Humidity difference: RS92 – RS41

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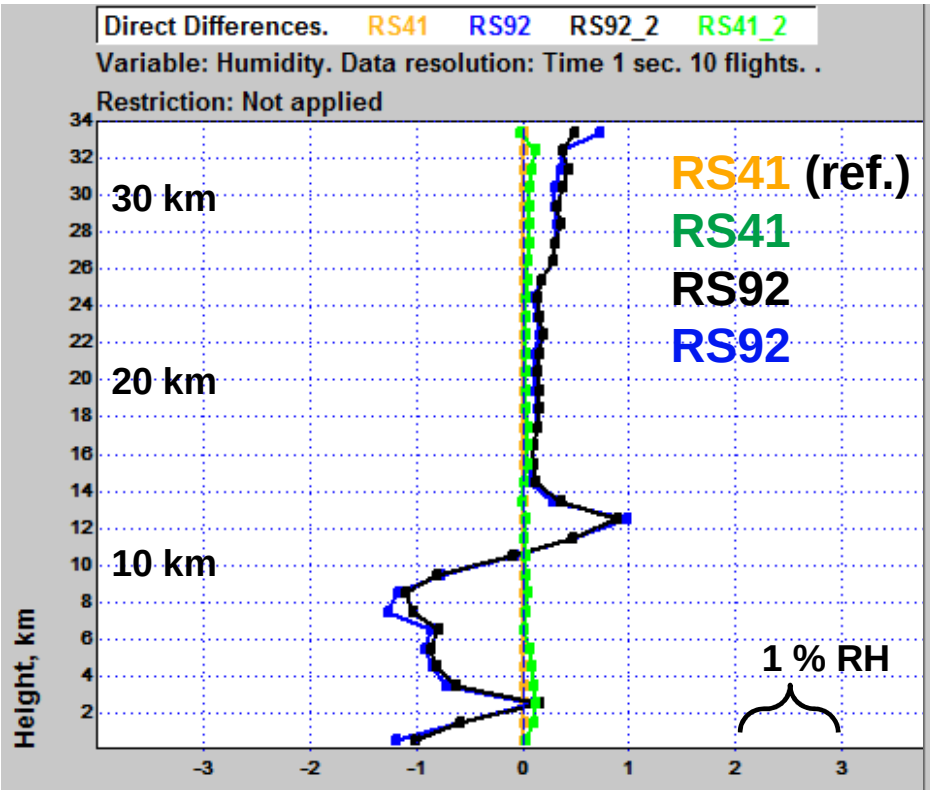
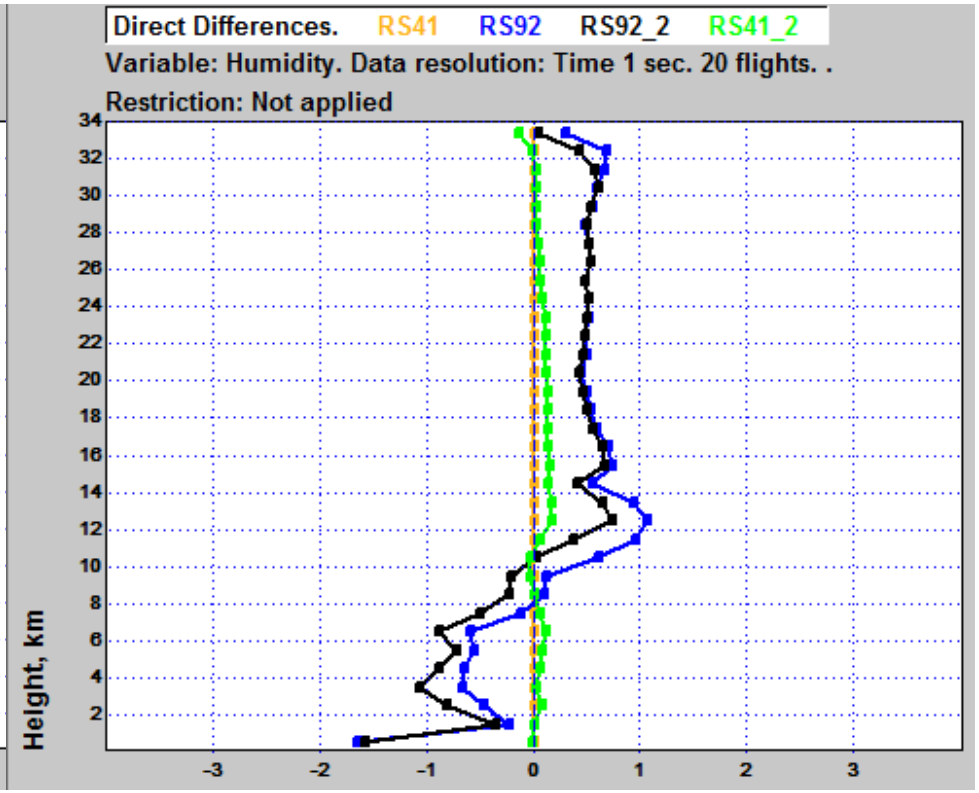
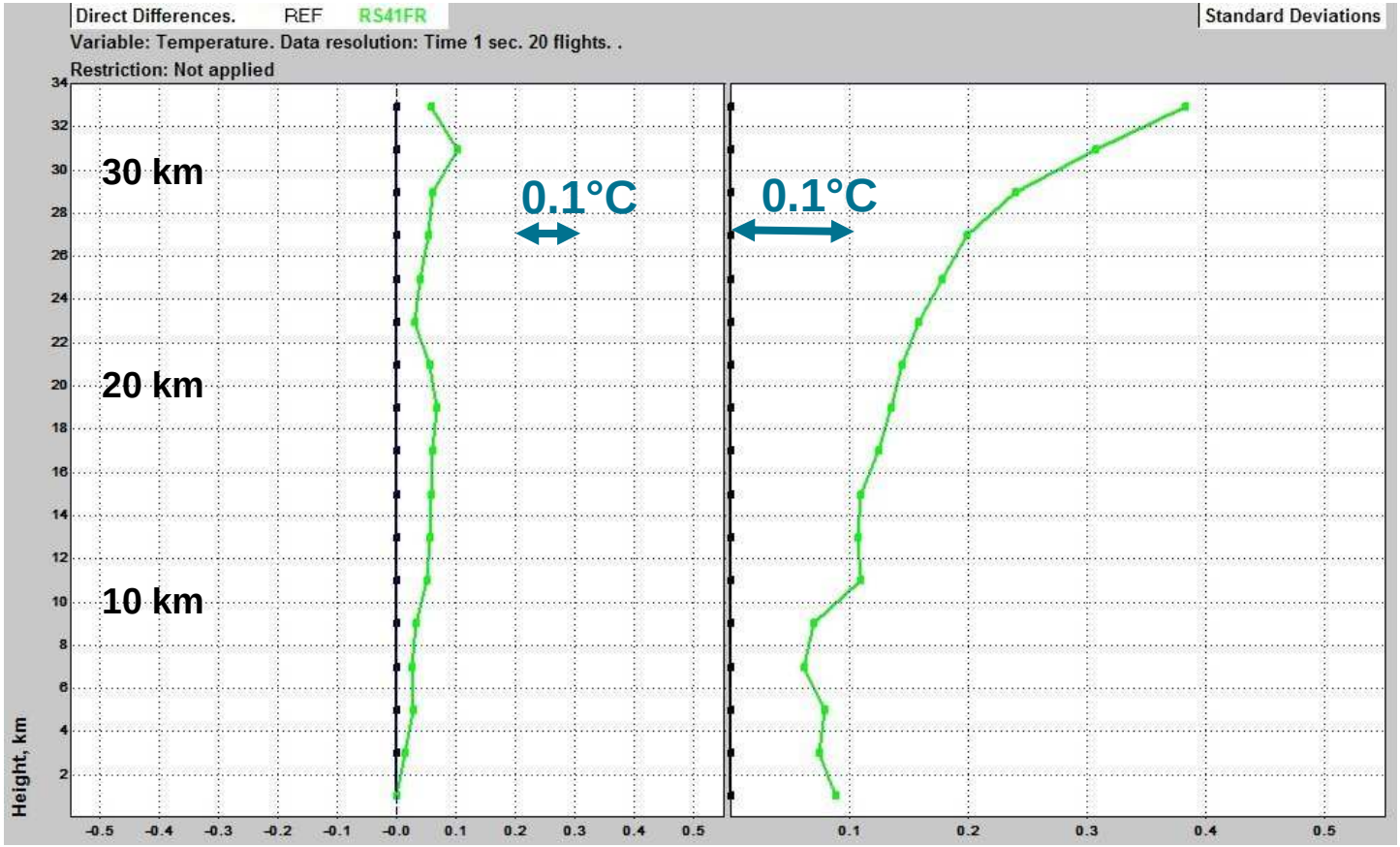


Daytime, 20 flights

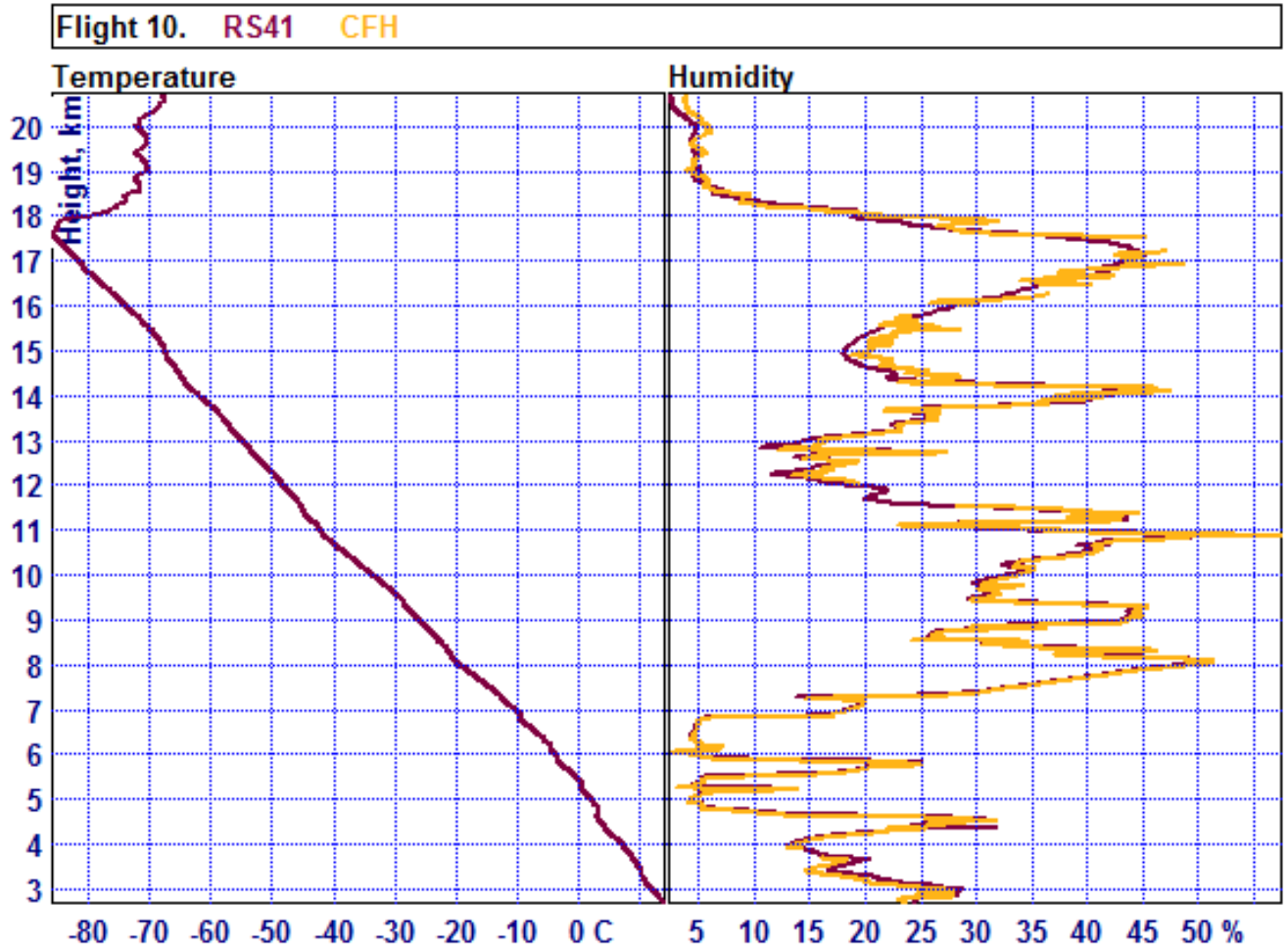


RS41 Temperature measurement vs. multi sensor instrument

Direct differences and standard deviations, 20 flights



RS41 Humidity measurement vs. Cryogenic Frostpoint Hygrometer



Tropical daytime

Conclusions

RS41 introduces new measurement technologies for upper air observations.

A comprehensive uncertainty analysis has been conducted.

RS41 has been tested in various climate conditions and verified against reference instruments and technologies. Compared to RS92, the results demonstrate improved precision and accuracy.

Thank you!