

# Atmospheric Temperature and Humidity Measurements of Vaisala Radiosonde RS41

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**VAISALA**

# Outline

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

# RS41 Temperature measurement

## Platinum 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

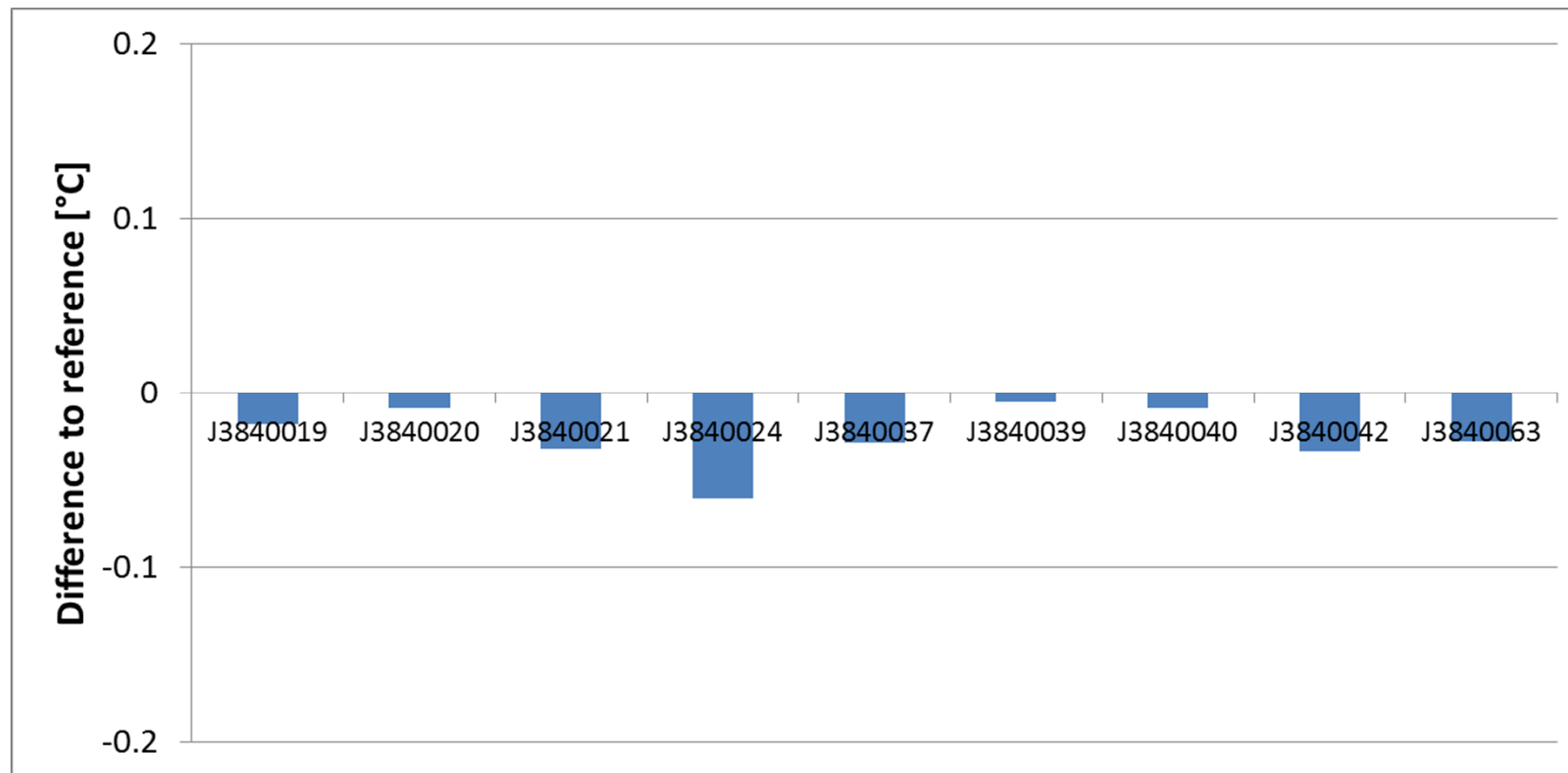
SI-traceable calibration references (NIST)



# Stability test results

## RS41 Temperature measurement

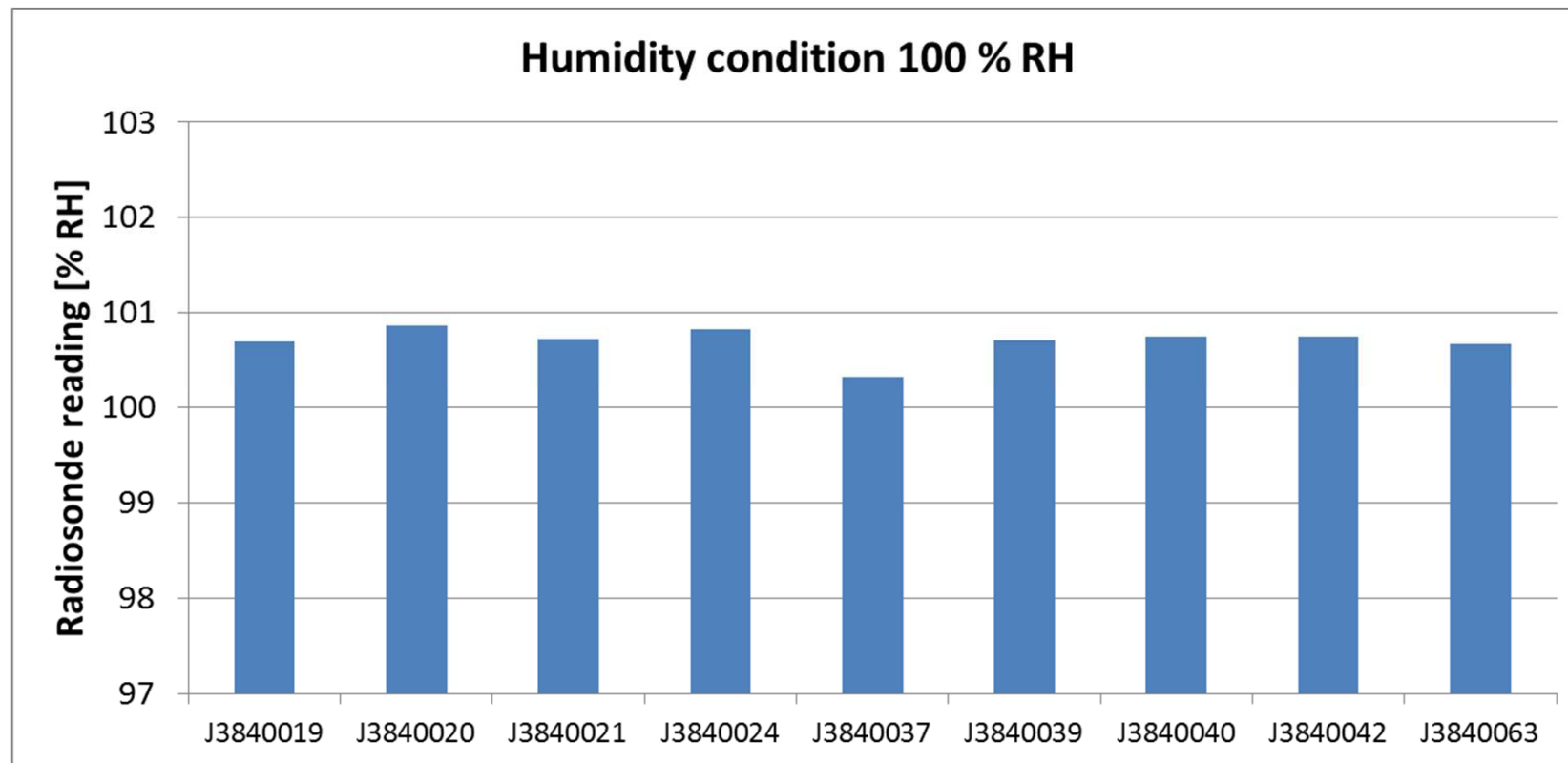
- Storage 6 months, measured at 20°C
- Test equipment uncertainty = 0.07°C (k=2)



# Stability test results

## RS41 Humidity measurement

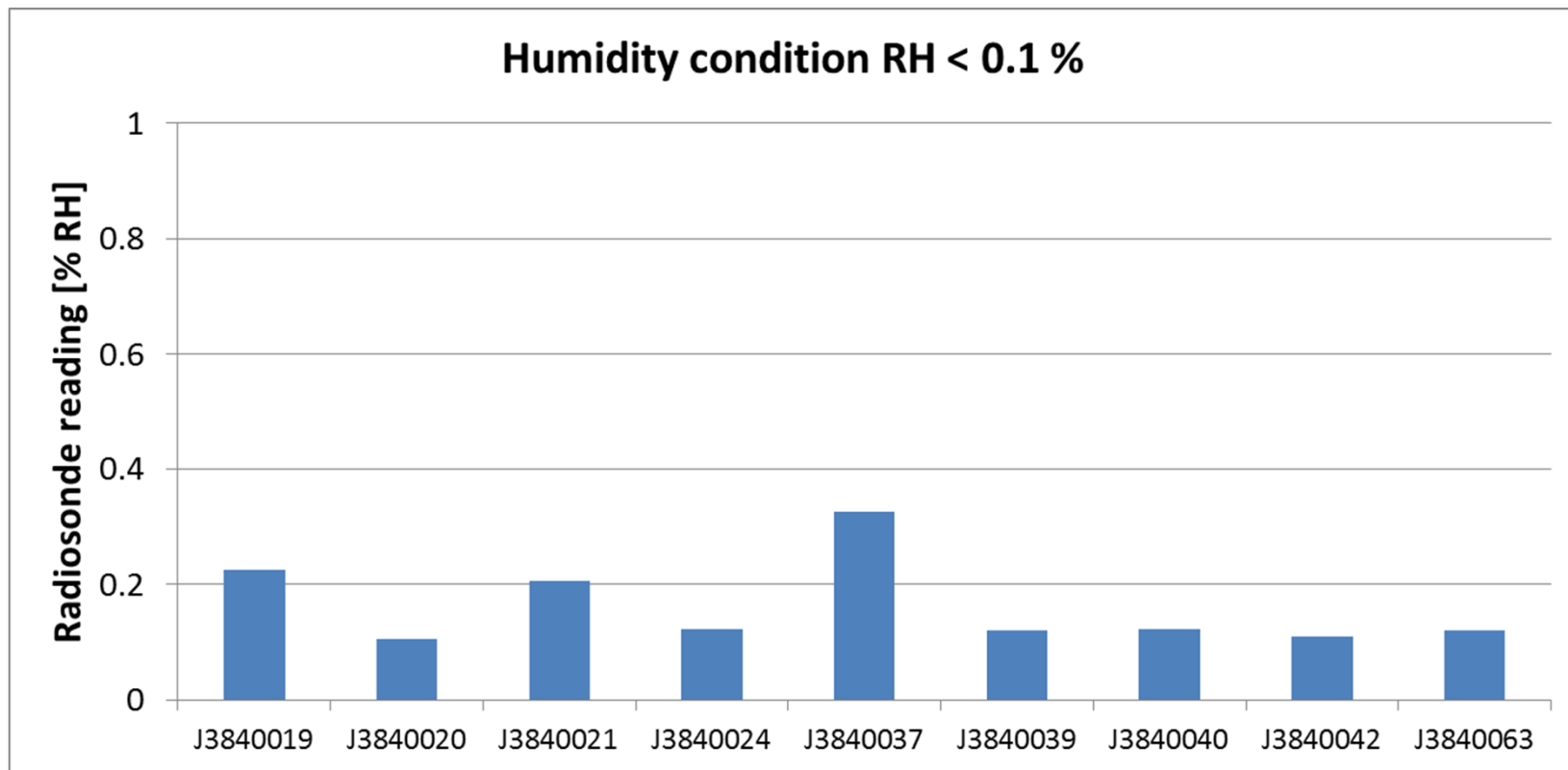
- Storage 6 months & ground check
- Measured in standard humidity chamber SPRH 100



# Stability test results

## RS41 Humidity measurement

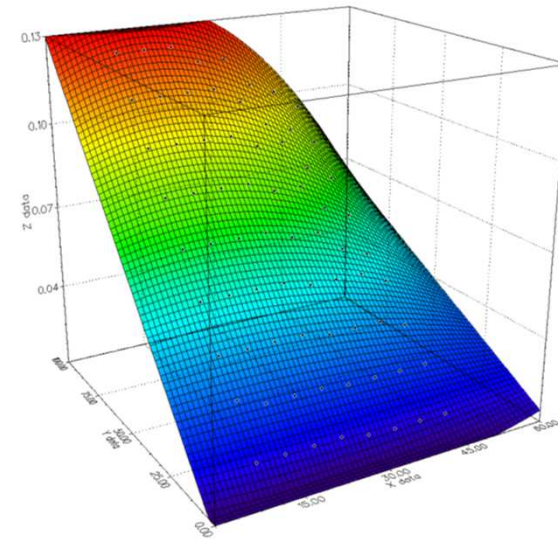
- Storage 6 months & ground check
- Measured in dry conditions (RH < 0.1 %)



# 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

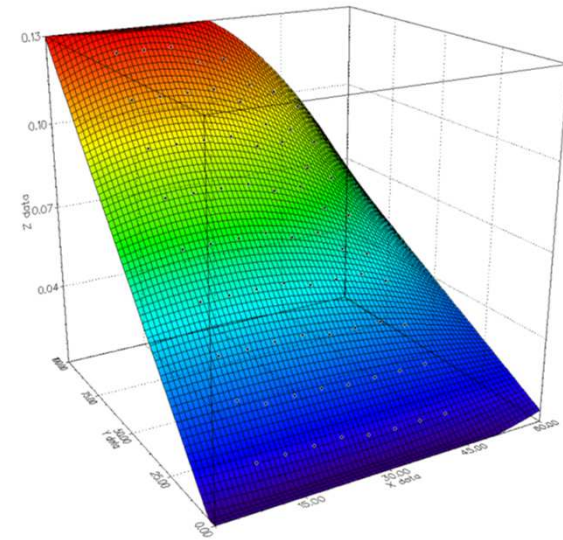




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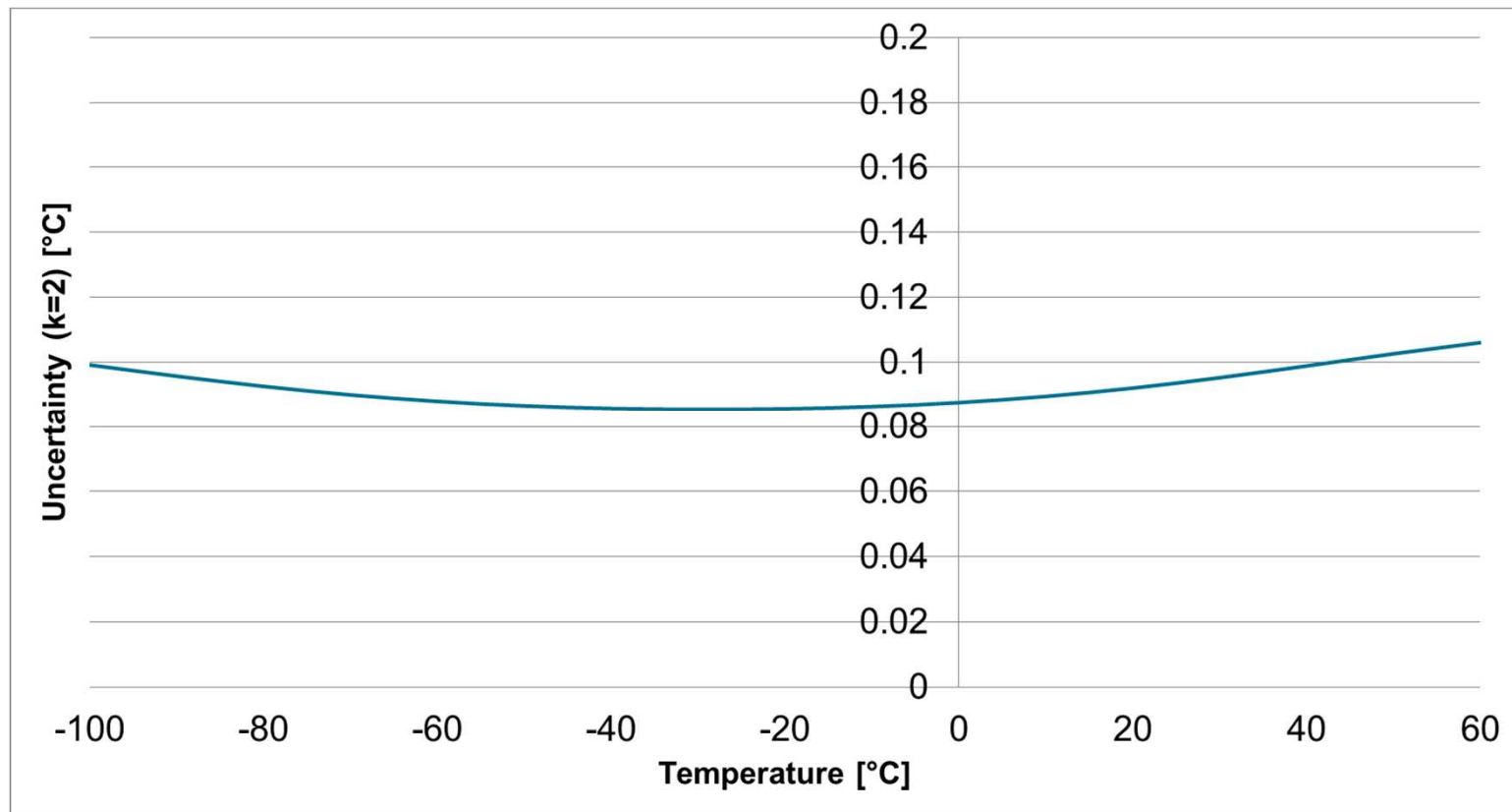


**= Accuracy after ground preparations**

# Accuracy after ground preparations

## RS41 Temperature measurement

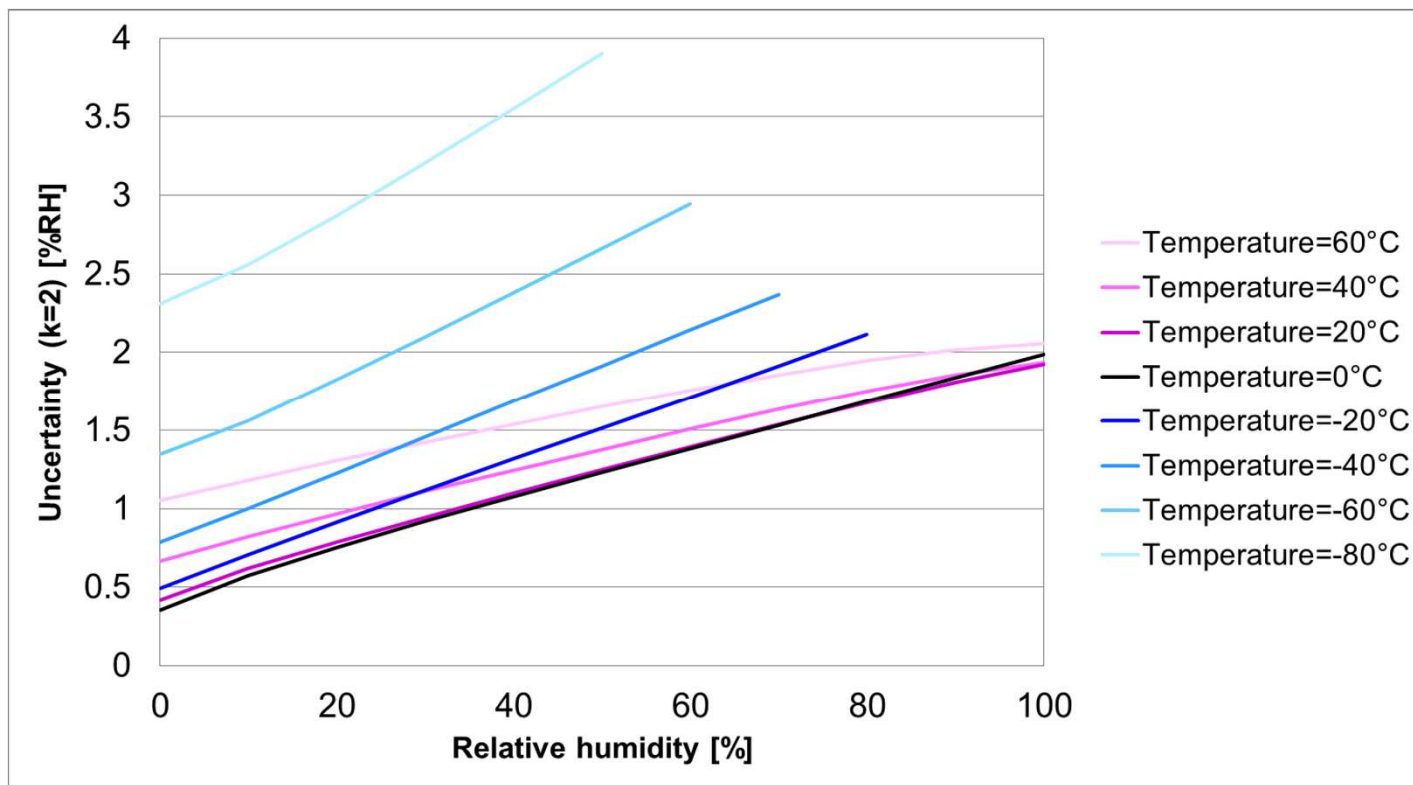
- Stability of Pt-resistor - No corrections applied



# Accuracy after ground preparations

## RS41 Humidity measurement

- Reconditioning for chemical contamination removal
- Zero humidity correction

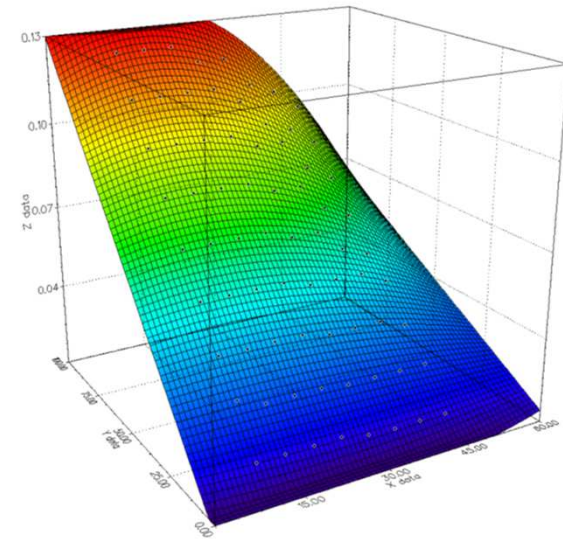


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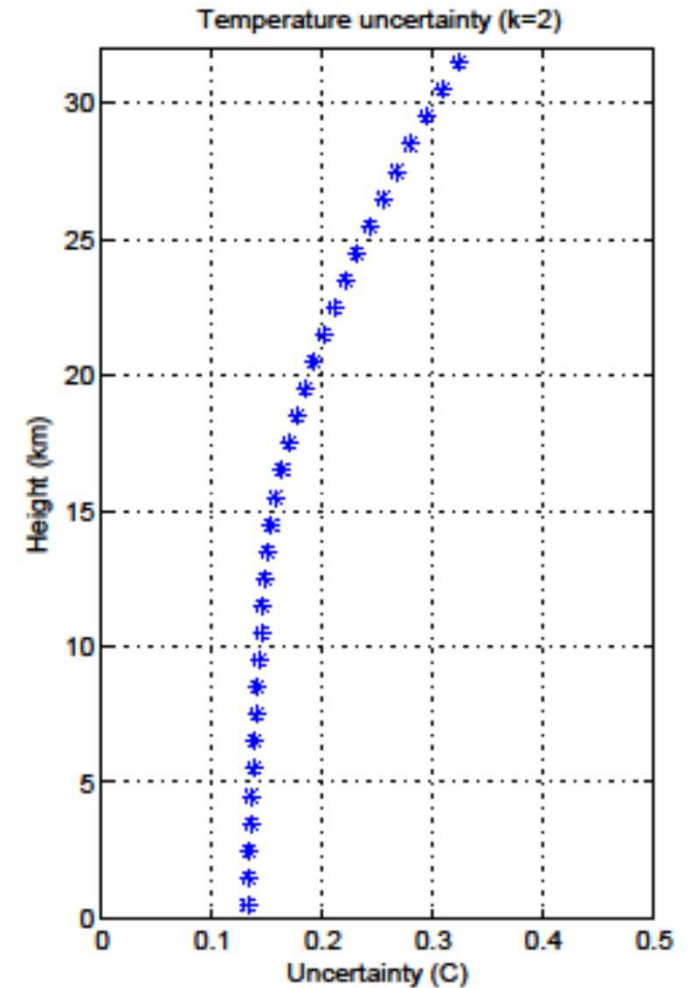
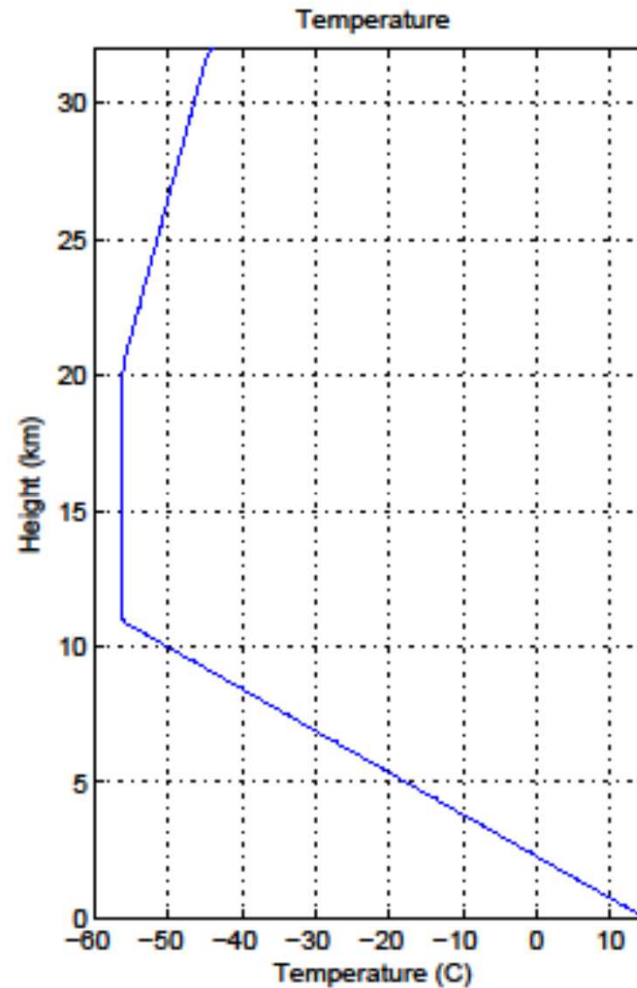
**= Accuracy in sounding**



# Accuracy in sounding

## RS41 Temperature measurement

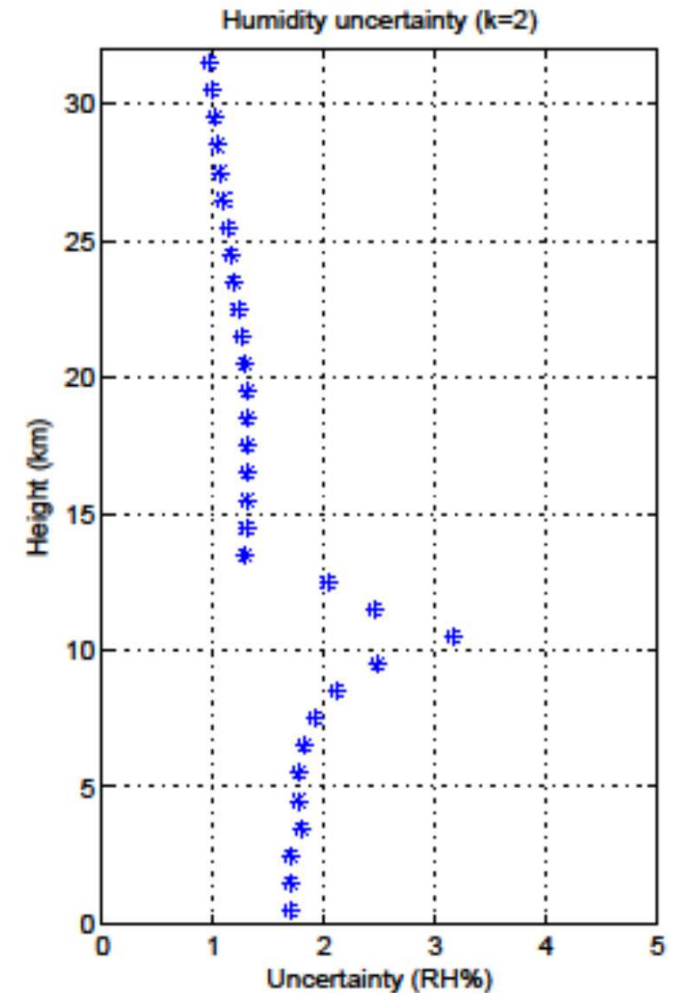
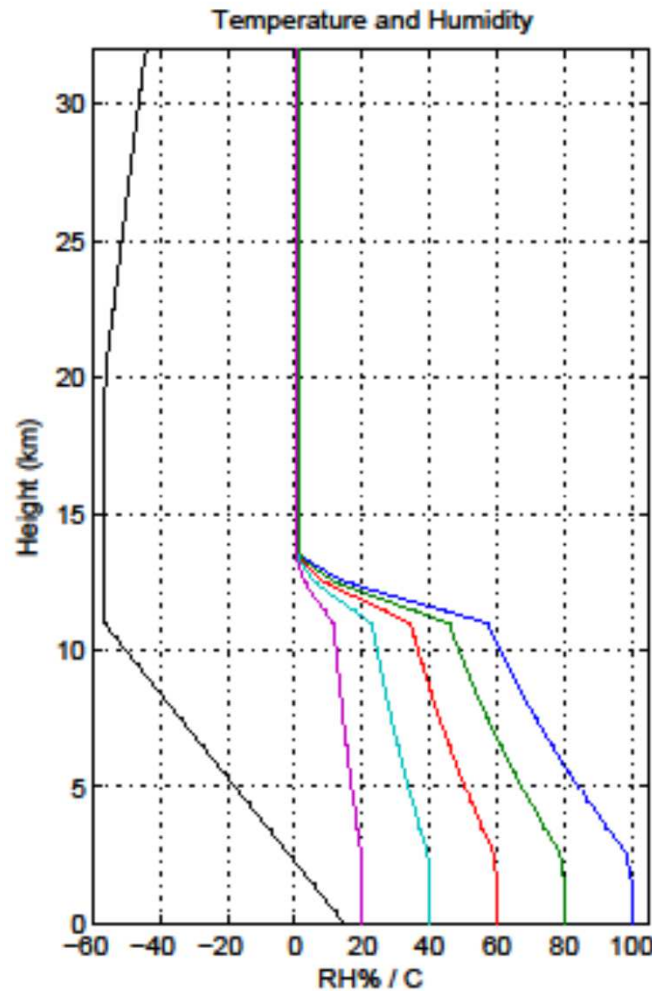
- U.S. Standard Atmosphere 1976
- Solar angle  $60^\circ$
- Ascend rate 6 m/s
- Coverage factor  $k=2$



# Accuracy in sounding

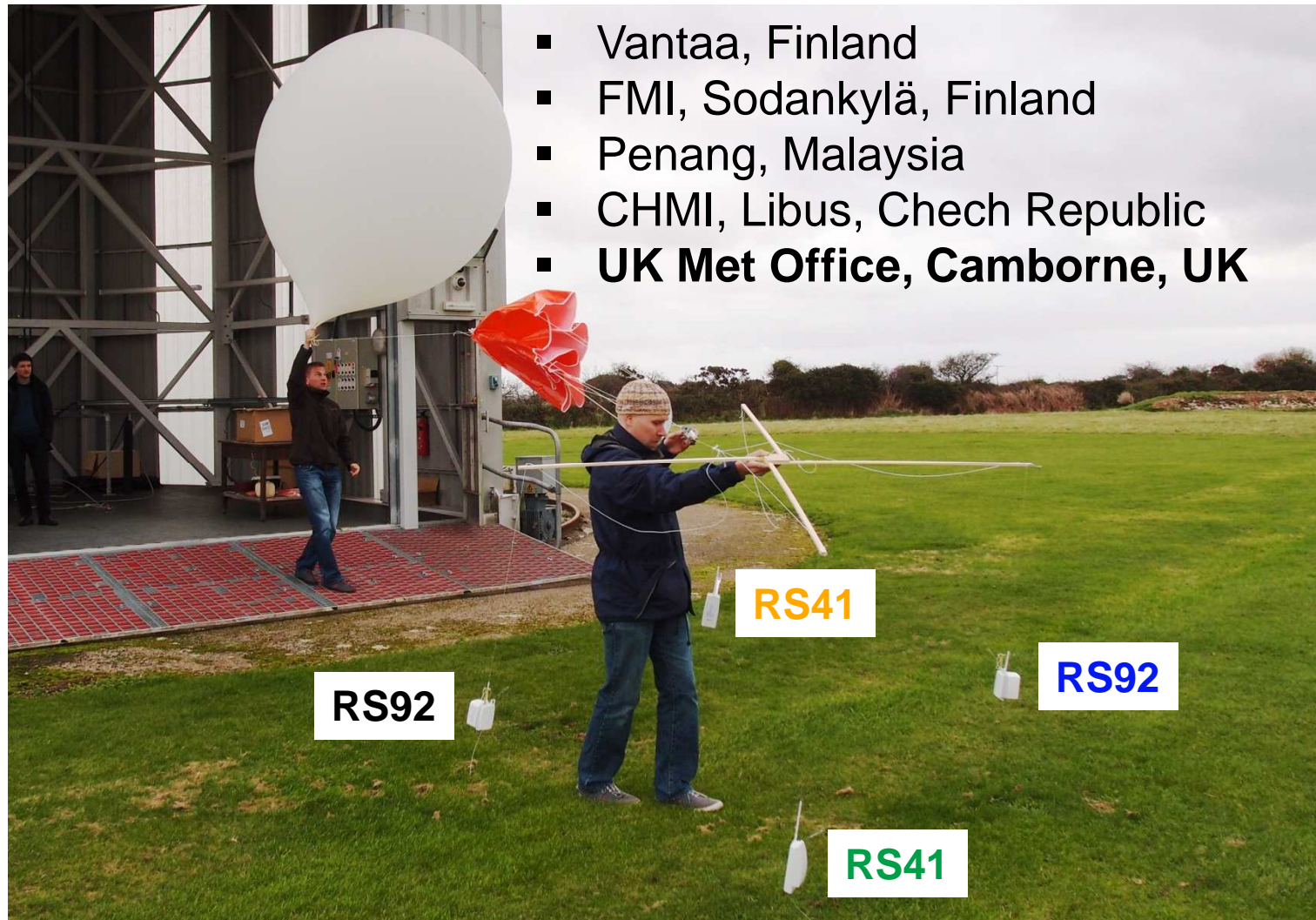
## RS41 Humidity measurement

- U.S. Standard Atmosphere 1976
- Solar angle 60°
- Ascend rate 6 m/s
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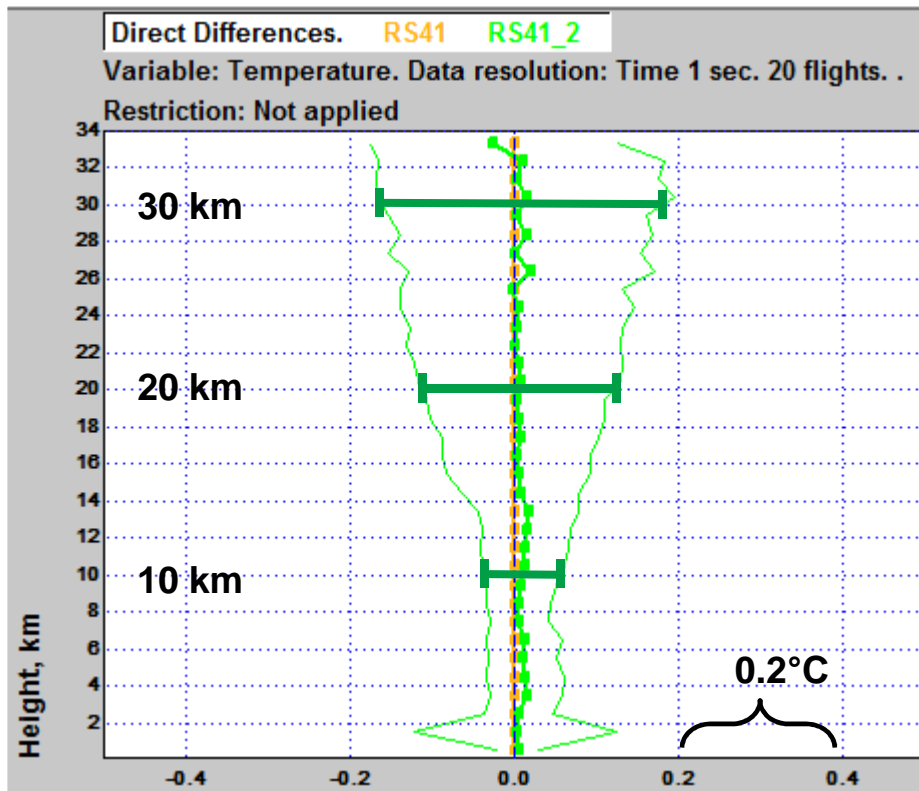
# Sounding campaign results



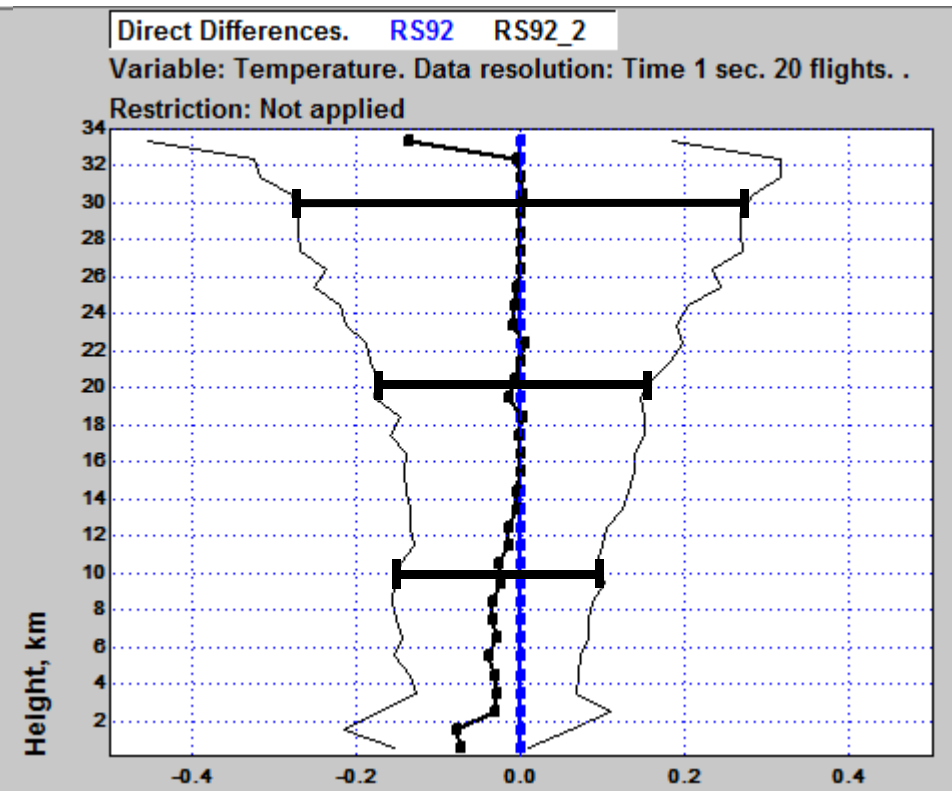
# Temperature reproducibility, daytime

Direct differences and standard deviations  
20 flights, Camborne UK

RS41 - RS41



RS92 - RS92

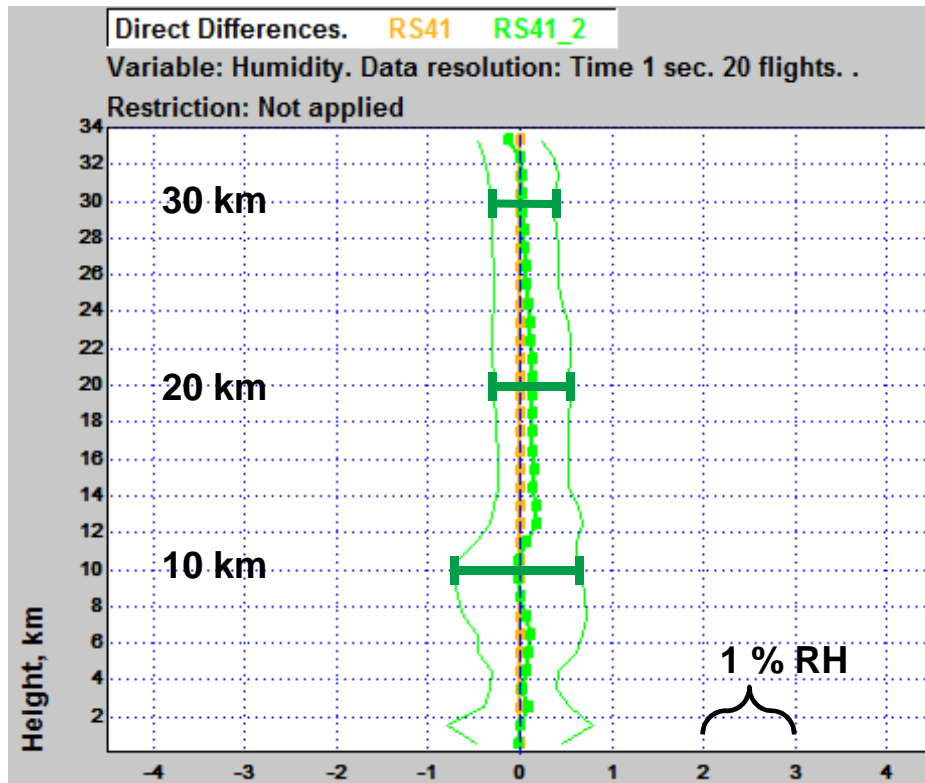




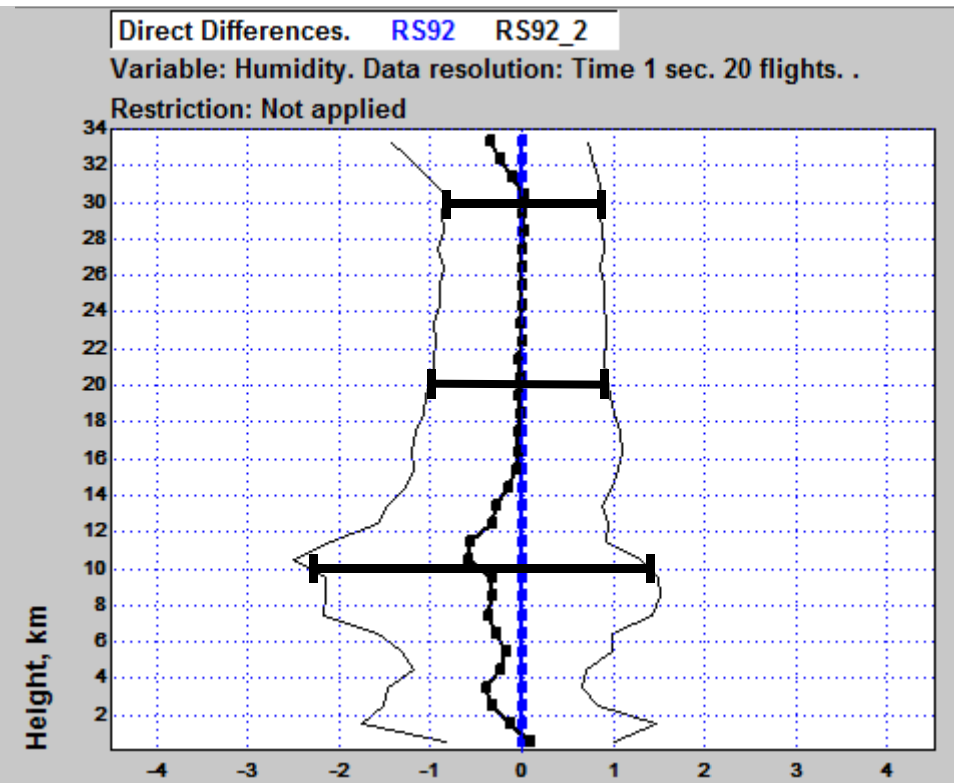
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RS41 - RS41



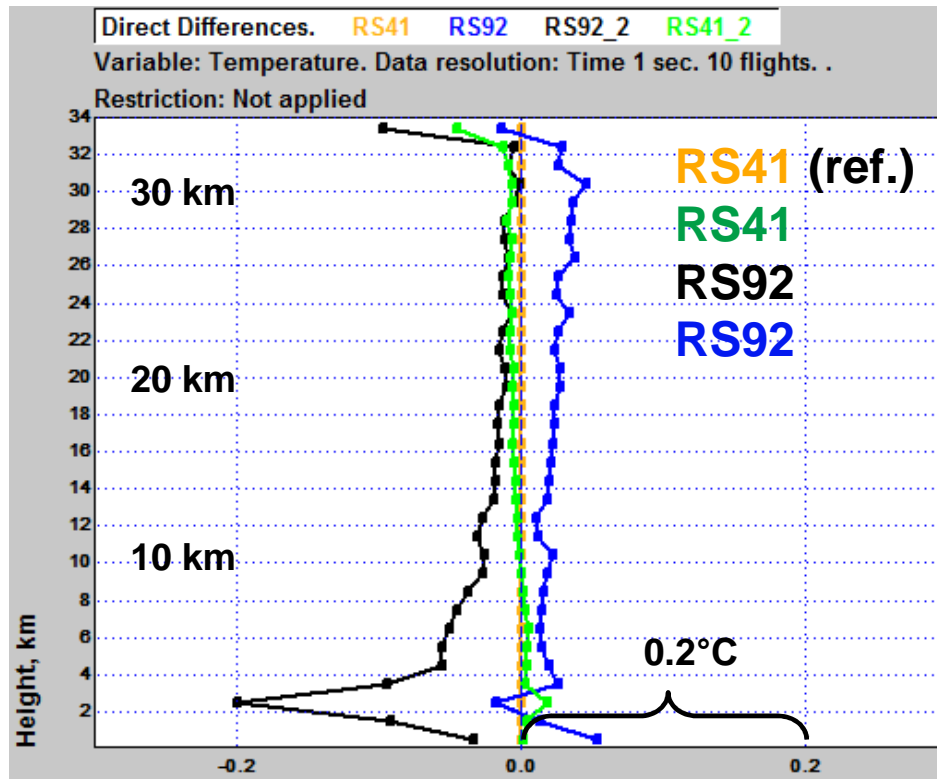
RS92 - RS92



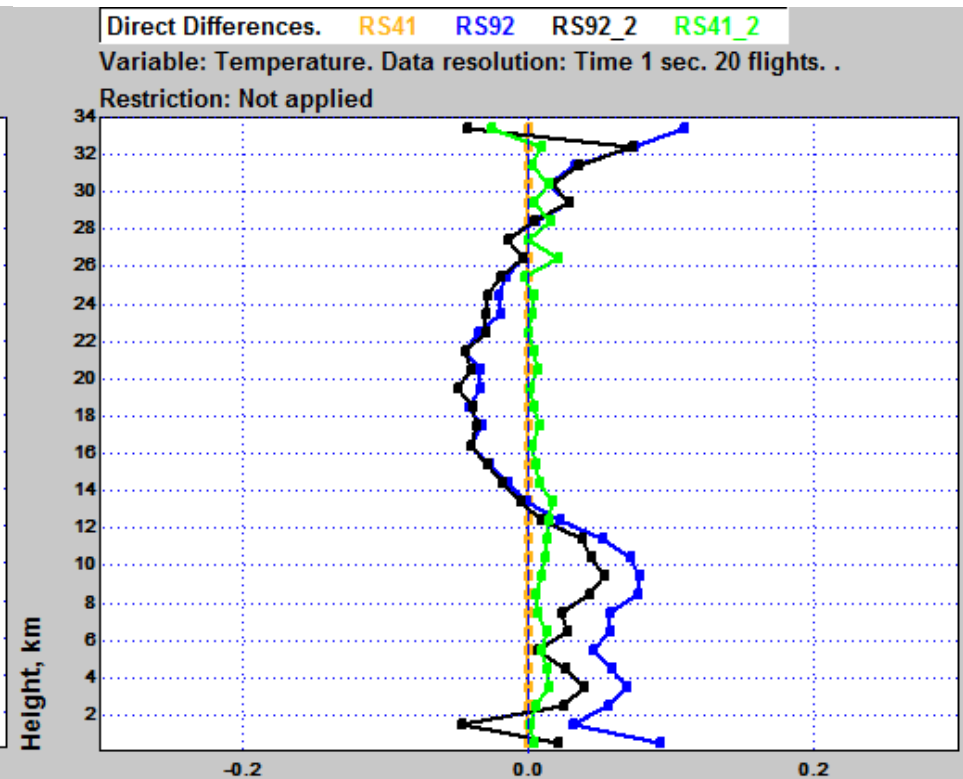
# Temperature difference: RS92 – RS41

Camborne UK

Night-time, 10 flights



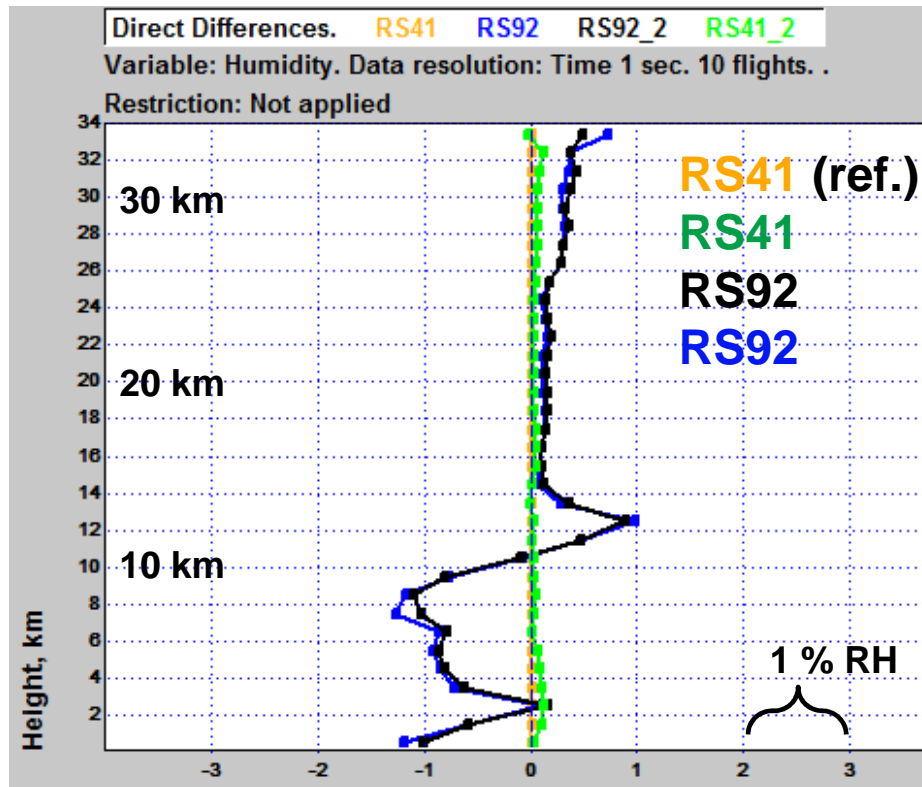
Daytime, 20 flights



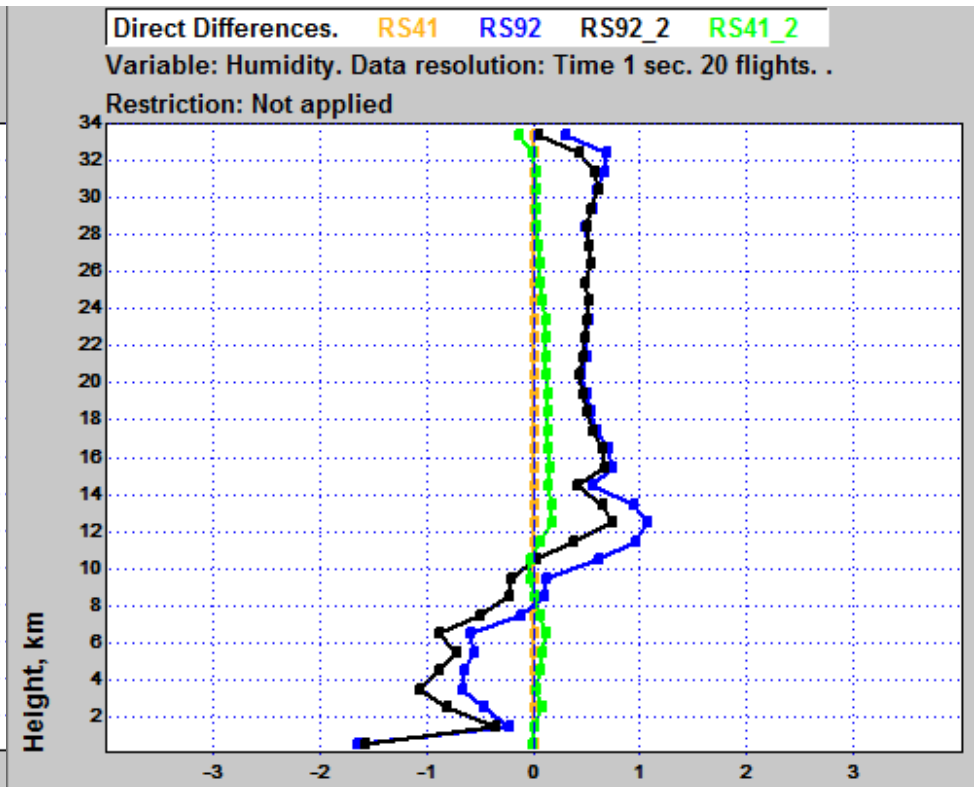
# Humidity difference: RS92 – RS41

## Camborne UK

Night-time, 10 flights

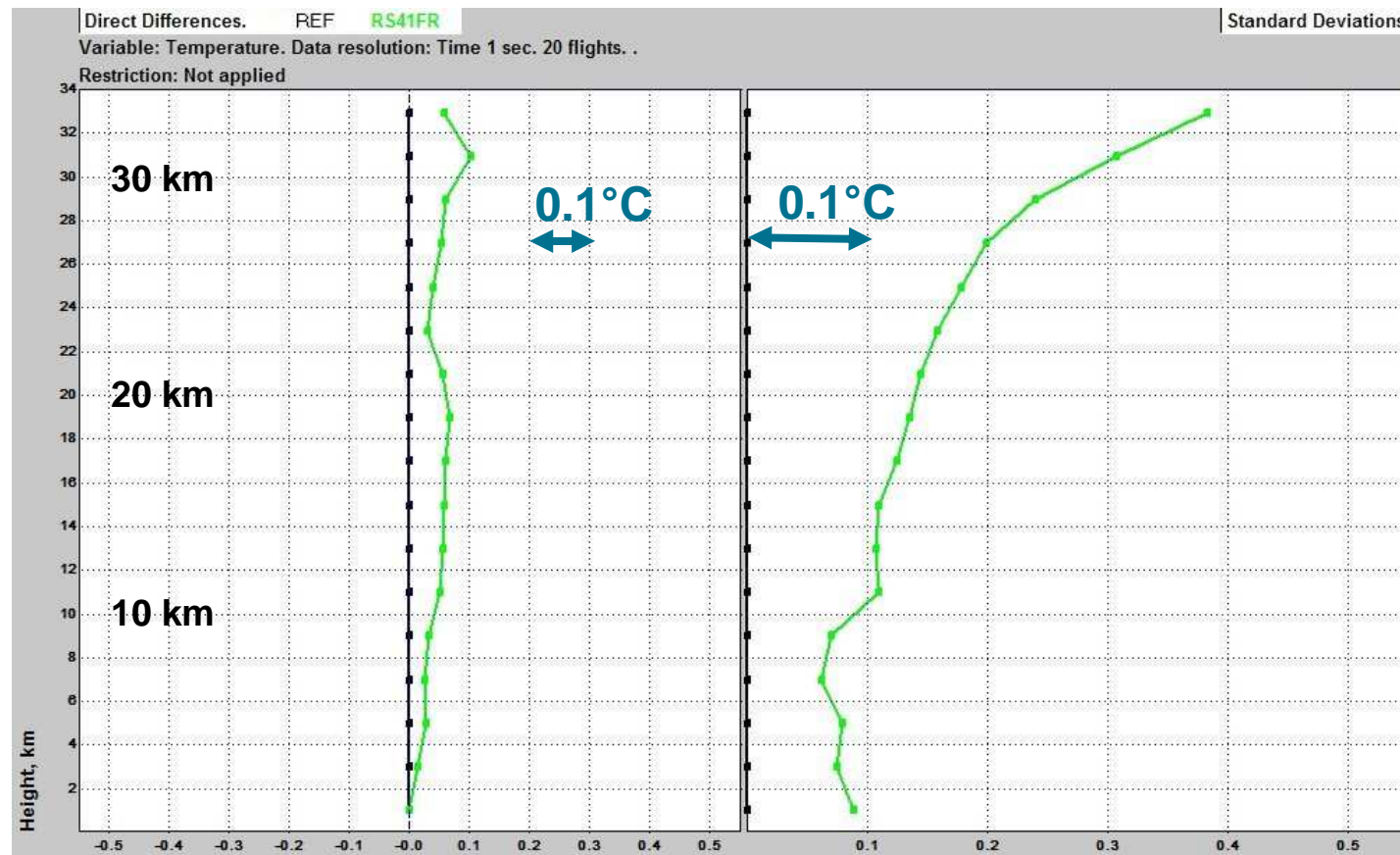


Daytime, 20 flights

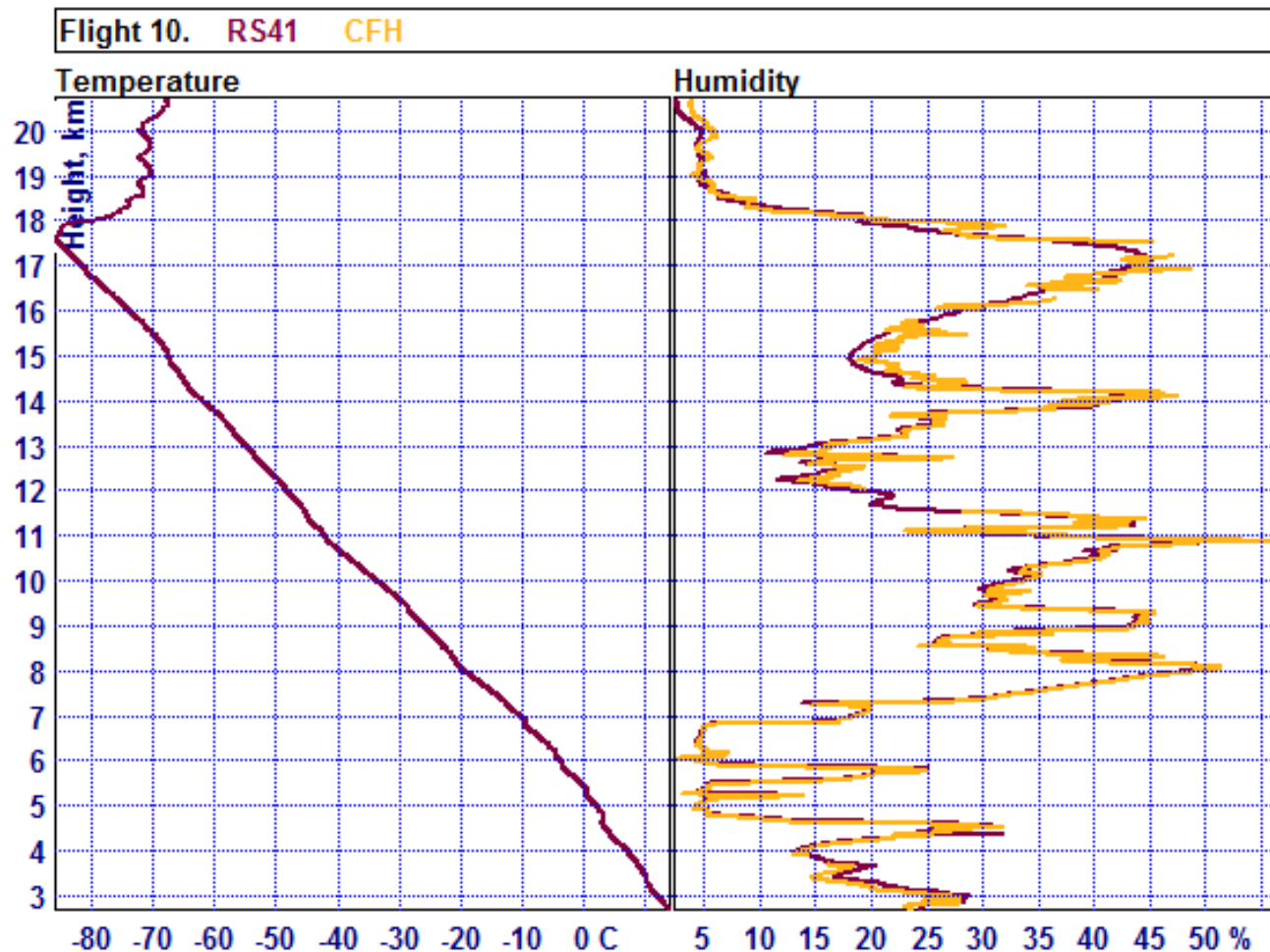


# RS41 Temperature measurement vs. multi sensor instrument

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!

