

FMI

First results from the Vaisala RS-41

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Outline

- RS41 sensors and MW41 sounding preparations
- Comparisons of RS41/RS92/CFH based on flights at Sodankylä and other locations.

Vaisala Radiosondes



http://www.vaisala.com/en/products/soundingsystemsandradiosondes

RS41-SG Radiosonde

T measurement

Platinum resistor

- Stability and linearity
- ground correction not needed
- measurement noise reduced
- evaporation cooling effects reduced

U measurement

Humidity sensor with integrated features

- Humicap[®] polymer, thin film capacitor
- Active de-icing method
- On-chip temperature measurement
 - removes solar radiation effect
- Physical 0 %RH check

Jauhiainen et al., 2014, AMS



DigiCORA[®] Sounding System MW41

- Real time remote access
- Data in XML format
- Easy operation



Radiosonde ground check device RI41

 Wireless short range link between sonde and system



- Automatic sensor preparation
 - Humidity sensor reconditioning
 - Humidity sensor 0%RH check and correction without use of drying dessiccant material
 - Temperature sensor check

Test Campaigns

Test campaign locations:

- Vantaa, Finland
- FMI Sodankylä, Finland
- FMI Jokioinen, Finland
- Penang, Malaysia, Tropics
- CHMI, Libus, Chech Republic
- UK Met Office, Camborne, UK
- Other sites

Test flight configuration:

Multiple RS41 and RS92 sondes on one rig, to perform direct comparisons and sonde reproducibility tests;

CFH/RS41 comparisons were made under Arctic and Tropical conditions.



Sounding at Sodankylä, August 2013

RS41, RS92 Sodankylä, February 2014



RS41, CFH Sodankylä , January 2013



RS41, RS92 Tropics, Malaysia

Tropics/ Malaysia



Jauhiainen et al., 2014, AMS

RS41, CFH Tropics, Malaysia



Jauhiainen et al., 2014, AMS

GRUAN ICM-6



Edwards et al., 2014, UK Met Office

Uncertainty estimates

Temperature		RS41-SG	RS92-SGPD
Combined uncertainty in sounding	< 16 km > 16 km	0.3 °C 0.4 °C	0.5 °C 0.5 °C

Humidity	RS41-SG	RS92-SGPD
Combined uncertainty in sounding	4 %RH	5 %RH

Pressure reproducibility

GPS based pressure

Sensor based pressure RS92

RS41



Conclusions

- RS41 has been tested against RS92 at several sites. RS41 test flights have been performed against CFH frost point hygrometer at a high latitude site Sodankylä and also at a tropical site.
- In general RS41 RS92 temperature difference seems to be small, according to test campaign results the difference is below 0.2 C.
- RS41-RS41 pair temperature and humidity deviation is smaller than in case of RS92-RS92 pairs.
- RS41 and RS92 humidity differences have been 1 3 %RH. In tropical daytime conditions RS41 measured higher humidity than RS92 at the tropopause region
- In some tests RS41 has demonstrated better performance around clouds relative to the RS92, this is related to the reduction in moisture contamination on the temperature measurements
- RS41 GPS based height and pressure measurement is improved at altitudes above 20 km.
- Limited number of RS41 vs CFH comparison flights have been performed so far, showing relatively good agreement between RS41 and CFH. More soundings and analysis are needed to make further conclusions.

References

Edwards, David, Graeme Anderson, Tim Oakley, Peter Gault (2014), Met Office Intercomparison of Vaisala RS92 and RS41 Radiosondes Camborne, United Kingdom, 7th – 19th November 2013, UK Met Office.

Jauhiainen H., J. Lentonen, P. Survo, R. Lehtinen, T. Pietari, 2014: The implications of Vaisala's new Radiosonde RS41 on improved in-situ observations for meteorological applications, IOAS-AOLS, 94th American Meteorological Society Annual Meeting

Other related materials at <u>http://www.vaisala.com/en/products/soundingsystemsandradiosondes</u>

-Data sheets, Vaisala News/Czech trial., etc

Additional material (please see the next pages)>>>



Figure 15 - Night-time temperature comparison between the RS92_1 and the RS92_2 and RS41 radiosondes – flight-by-flight direct differences.

Edwards et al., 2014, UK Met Office

Met Office Intercomparison of Vaisala RS92 and RS41 Radiosondes *Camborne, United Kingdom, 7th – 19th November 2013* David Edwards, Graeme Anderson, Tim Oakley, Peter Gault



Figure 16 - Daytime temperature comparison between the RS92_1 and the RS92_2 and RS41 radiosondes – flight-by-flight direct differences.



Figure 32 - Night-time humidity comparison between RS92 and RS41 sondes - flight-by-flight direct differences.



Figure 33 - Daytime humidity comparison between RS92 and RS41 sondes - flight-by-flight direct differences.



Figure 47 - Daytime humidity - average RS92_1 vs. RS92_2 flight-by-flight direct differences with direct difference 2σ lines (left) and standard deviations (right) across temperature ranges.



Figure 49 - Daytime humidity - average RS41_1 vs. RS41_2 flight-by-flight direct differences with direct difference 2σ lines (left) and standard deviations (right) across temperature ranges.

Temperature	RS92-SGPD	RS41-SG
Sensor type	Capacitive wire	Platinum Resistor
Combined uncertainty in sounding 1)	0.5 °C < 16 km 0.5 °C > 16 km	0.3 °C < 16 km 0.4 °C > 16 km
Reproducibility in sounding 2)	0.2 °C > 100 hPa 0.5 °C < 100 hPa	0.15 °C > 100 hPa 0.3 °C < 100 hPa
Repeatability in calibration 3)	0.15 °C	0.1 °C
Response time (63.2%, 6m/s flow, 1000hPa)	0.4 s No time lag correction.	0.5 s Time lag correction applied, negligible residual errors.
Ground Check	Corrected against Pt100 reference.	No correction needed. In-built temperature check to find faulty units.

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Humidity	RS92-SGPD	RS41-SG
Sensor type	Thin-film capacitor, heated twin sensor	Thin-film capacitor, integrated T sensor and heating functionality
Combined uncertainty in sounding 1)	5 %RH	4 %RH
Reproducibility in sounding 2)	2 %RH	1.5 %H
Repeatability in calibration 3)	2 %RH	2 %RH
Response time (63.2%, 6m/s flow, 1000hPa)	< 0.5 s, +20 °C, < 20 s, -40 °C	< 0.3 s, +20 °C < 10 s, -40 °C
Ground Check	Corrected against 0%RH humidity generated by desiccants.	Corrected with RS41 in-built Physical Zero Humidity Check.

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