

# Application of Vaisala DRYCAP® Sensor in Upper Troposphere and Lower Stratosphere Humidity Measurements

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## Introduction

Vaisala has launched a program to develop an operational reference grade radiosonde for climate change studies, targeting especially the needs of the planned GCOS Reference Upper Air Network. The program first focuses on humidity measurement in upper troposphere and lower stratosphere, for it is a challenging task for present humidity instruments. Humidity is known to be one of the most abundant and most important greenhouse gases in Earth's atmosphere.

## Vaisala Reference Radiosonde RR01 prototype



- RS92 radiosonde + DRYCAP® sensor module
- DRYCAP® capacitive thin film sensor
  - Frost point temperature range -30...-90° C
  - Sensor operated at a constant temperature
    - Response time not temperature dependent
    - Improved accuracy: no temperature correction needed
  - Autocalibration reduces sensor drift

## LAPBIAT2 measurements

- International upper-air humidity measurement campaign at Arctic Research Center in Sodankylä, Finland, in January-March 2010
- RR01 tested with three different wind shield designs and a radiation shield



Figure 2. Wind shield types 1...3 and a radiation shield

Table 1. RR01 results compared to CFH (Cryogenic Frost point Hygrometer) in the frost point range -80...-86° C

Date	Time	CFH data	RRD100	wind shield	radiation	day/night	Difference	Difference	Difference	Difference
2010	UTC	from sounding	ID	type	shield		at -80°CTf	at -82°CTf	at -84°CTf	at -86°CTf
17.01.	19:47	the same	F0160005	1	no	night	1.9	1.9	2.0	2.1
22.01.	19:08	the same	F0160015	1	no	night	1.9	1.7	1.6	1.3
23.01.	17:30	the same	F0160013	1	no	night	1.4	1.2	0.8	1.2
24.01.	23:58	the same	F0160001	1	no	night	1.2	1.0	0.7	0.6
25.01.	18:13	the same	F0160011	1	yes	night	2.3	2.6	2.4	2.8
28.01.	16:44	the same	F0160019	1	yes	night	5.4	4.8	3.5	4.1
02.02.	12:27	the same	F0160009	2	no	day	2.3	2.3	2.0	2.0
02.02.	12:27	the same	F0160010	3	no	day	2.6	2.6	2.3	2.0
23.01.	9:42	night 22.01.	F0160012	1	no	day	1.5	1.3	1.4	1.2
23.01.	9:42	night 22.01.	F0160016	1	yes	day	1.7	1.6	1.5	1.5
28.01.	9:07	night 27.01.	F0160017	1	yes	day	1.7	1.9	1.8	2.4
28.01.	9:07	night 27.01.	F0160018	1	no	day	1.9	2.1	2.1	2.6
Average							2.2	2.1	1.8	2.0
StDev.							1.1	1.0	0.8	0.9
StDev. when F0160019 excluded							0.4	0.5	0.6	0.7

## LAPBIAT2 measurements (cont.)

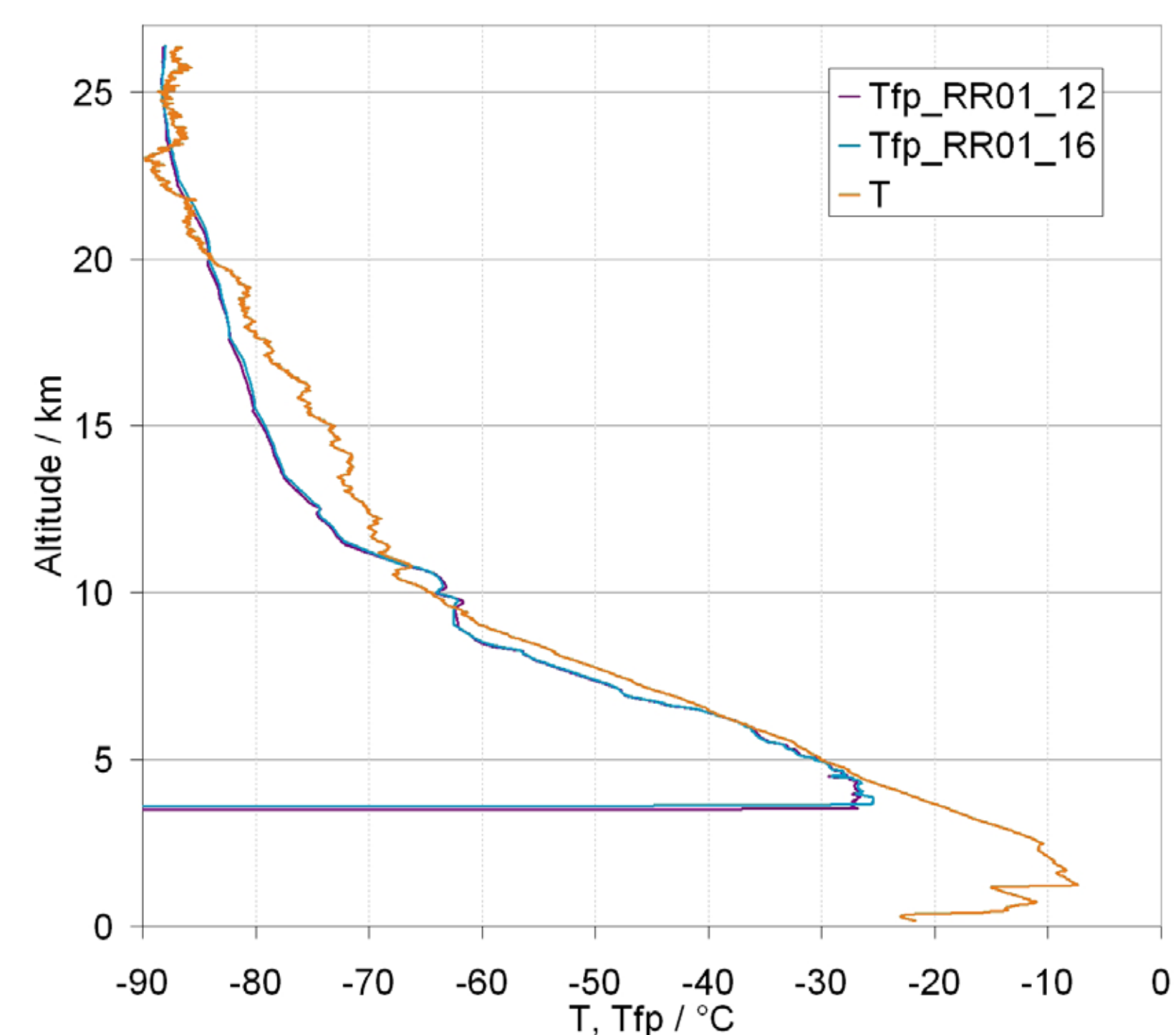


Figure 3. Results of a sounding with two RR01, with (16) and without (12) a radiation shield. Temperature of RS92 is drawn with an orange line.

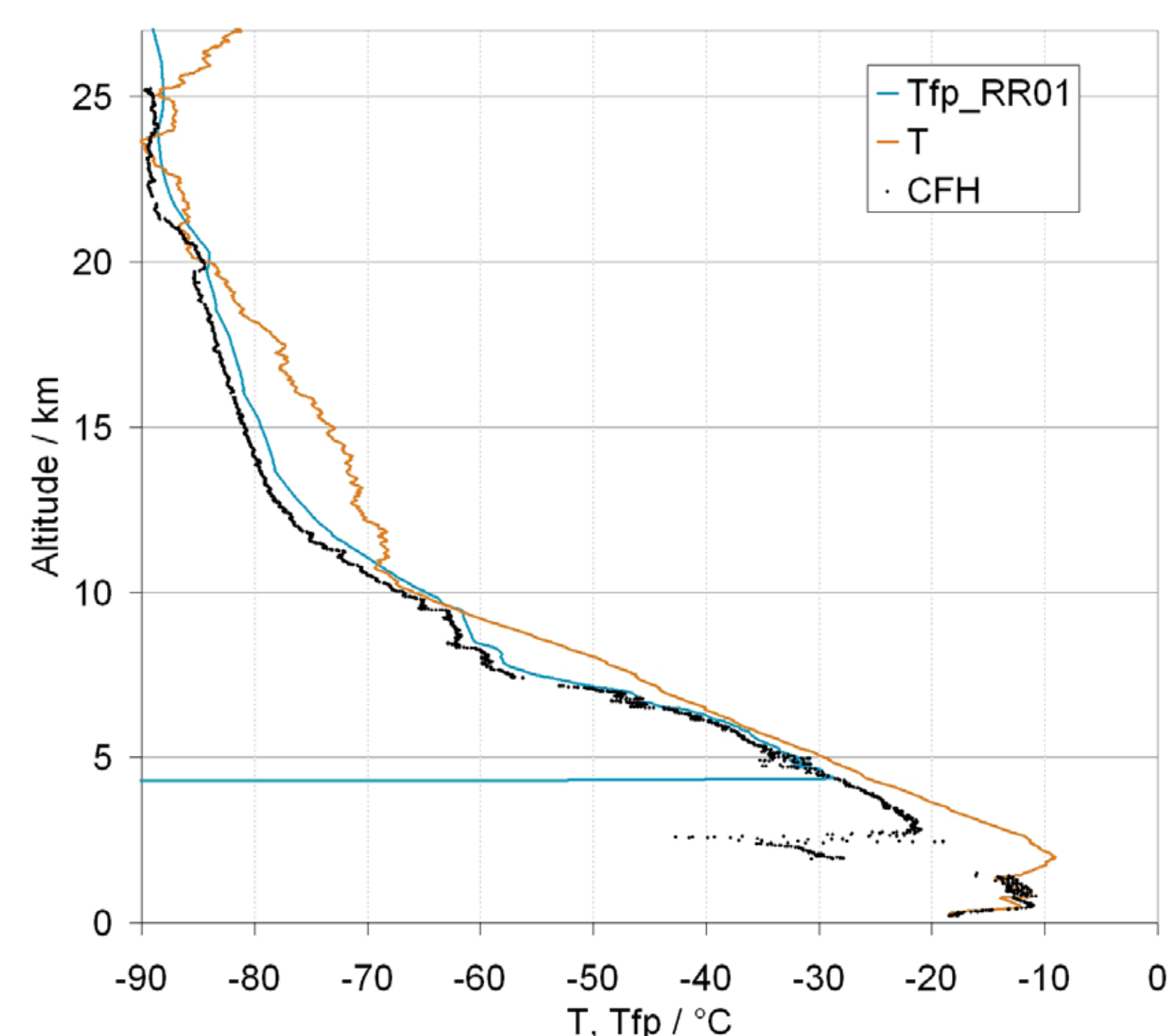


Figure 4. Results of RR01 (blue line) and Cryogenic Frost point Hygrometer (black dots). Temperature of RS92 is drawn with an orange line.

## Conclusions

- Radiation induced error of DRYCAP® is negligible
- Twin soundings with two RR01 exhibit excellent repeatability
- 1...3° C difference between RR01 and CFH results
- Test results demonstrate the potential of DRYCAP® as a new humidity measurement technology for upper troposphere and lower stratosphere
- After finalizing the design and verifying performance with research partners, Vaisala intends to make RR01 available for wider use.