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28 November - 02 December 2022

GRUAN Site Report for Lindenberg

(Submitted by Ruud Dirksen)

Summary and Purpose of this Document

Report from the GRUAN site Lindenberg for the period January to December 2021.

Overview

Lindenberg contributes to GRUAN with the following operational data streams: RS41 radiosonde (4 times per day) and GNSS IPW. Other data streams, which are not official GRUAN products yet, include: Ozone, CFH, COBALD, Graw DFM-09 and DFM-17. In March 2017, RS41 replaced RS92 as operational radiosonde. All measurements are performed in accordance with GRUAN operational procedures, which in case of the radiosondes means the application of a manufacturer-independent ground check in an SHC at 100 %RH prior to launch. Data are submitted to the Lead Centre using the RsLaunchClient, generally directly after the sounding has been completed. For extended payloads (research soundings) there may be 1-2 days delay in data submission.

Change and change management

The procedures for the operational RS41 and GNSS data streams have not been altered. In March 2017 the RS92 has been replaced by the RS41 as operational radiosonde. In order to manage this change regular RS92-RS41 twin soundings were performed from 2015 until 2018 as part of the GRUAN-wide effort in the management of the RS92-RS41 transition. From 2019 onwards, soundings with RS92 are performed sporadically as part of a large research payload. For research instruments such as CFH, COBALD and Ozone sonde, the RS41 is employed as carrier sonde.

Resourcing

The resourcing situation at Lindenberg is good: we have stable (financial + personal) resources to perform 4 radiosoundings per day, as well as ozone and research soundings (CFH, COBALD, etc) on a regular basis (O₃-Sonde 1/week, CFH more than 1/month).

In 2019 Tzvetan Simeonov Lindenberg observatory to support the GRUAN Lead Centre for a period of 4 years.

Budget has been approved for a contract on the development of GRUAN dataproducts for Graw radiosondes.

Operations

The impending ban on R23 cryogen for CFH still is a major concern.

The outbreak of African swine flu in Poland complicates the execution of research soundings. Payload recovery is not possible if it lands in an area with access restrictions. More elaborate planning of research soundings is necessary to select favourable trajectories, which on some occasions leads to flights being postponed or cancelled. Nevertheless, in 2021 15 CFH soundings were performed.

As of early 2020 Covid-19 imposes further restrictions (see next item).

Covid-19

Covid-19 did not affect the operational radiosoundings. However, due to Covid-19 related restrictions instrument recovery was not possible, therefore the number of CFH soundings was reduced to once per month.

Covid-19 also led to the postponement of the WMO radiosonde intercomparison campaign, that was originally scheduled for 2020, to 2022.

Site assessment and certification

The Lindenberg site was GRUAN-certified (for the RS92 measurement program) in 2014, and recertified in May 2018.

GRUAN-related research

- DFM-17–RS41 intercomparison.
- Regular soundings with research instruments such as CFH, Ozone, COBALD.
- Support for the development of R23-free strat. Hygrometers.
- Characterization of radiosondes errors and uncertainties under laboratory conditions.
- Characterization of the radiation error of the temperature sensor of RS41, M10 and Graw radiosondes, in support of data product development.
- Development a GRUAN data product for the RS41 (on-going work).

Publications:

- Graf, M., P. Scheidegger, A. Kupferschmid, H. Looser, T. Peter, R. Dirksen, L. Emmenegger, and B. Tuzson, "Compact and Lightweight Mid-IR Laser Spectrometer for Balloon-borne Water Vapor Measurements in the UTLS", *Atmos. Meas. Tech.*, **14**(2), 1365–1378, doi:10.5194/amt-14-1365-2021, 2021.
- Ingleby, B., M. Motl, G. Marlton, D. Edwards, M. Sommer, C. von Rohden, H. Vömel, and H. Jauhiainen, "On the quality of RS41 radiosonde descent data", *Atmos. Meas. Tech. Discuss.*, **2021**, 1–45, doi:10.5194/amt-2021-183, 2021.

- Jorge, T., S. Brunamonti, Y. Poltera, F. G. Wienhold, B. P. Luo, P. Oelsner, S. Hanumanthu, B. B. Sing, S. Körner, R. Dirksen, M. Naja, S. Fadnavis, and T. Peter, "Understanding balloon-borne frost point hygrometer measurements after contamination by mixed-phase clouds", *Atmos. Meas. Tech.*, **14**(1), 239–268, doi:10.5194/amt-14-239-2021, 2021.
- Tu, Q., F. Hase, T. Blumenstock, M. Schneider, A. Schneider, R. Kivi, P. Heikkinen, B. Ertl, C. Diekmann, F. Khosrawi, M. Sommer, T. Borsdorff, and U. Raffalski, "Intercomparison of arctic xh2o observations from three ground-based Fourier transform infrared networks and application for satellite validation", *Atmos. Meas. Tech.*, **14**(3), 1993–2011, doi:10.5194/amt-14-1993-2021, 2021.
- von Rohden, C., M. Sommer, T. Naebert, V. Motuz, and R. J. Dirksen, "Laboratory characterisation of the radiation temperature error of radiosondes and its application to the GRUAN data processing for the Vaisala RS41", *Atmospheric Measurement Techniques Discussions*, **2021**, 1–36, doi:10.5194/amt-2021-187, 2021.

WG-GRUAN interface

GRUAN Lead Centre resides at Lindenberg observatory.

Christoph von Rohden is member of task team radiosondes.

Tzvegtan Simeonov leads the Quality Task Force (QTF).

Other archiving centers

GUAN, NDACC, WOUDC, BSRN.

Participation in campaigns

WMO Radiosonde intercomparison campaign (UAI2022)

Future plans

- Continue RS41-RS92 intercomparison, continue sounding program with research/reference sondes (e.g. CFH).
- Continue measurements with new set-up to assess solar radiation error of radiosondes temperature sensor and use these results in the GRUAN dataproducts for RS92, Modem-M10, Graw.

- Continue development of GDP RS41 v1.
- Collaborative development of GRUAN data product for Graw radiosondes.
- Organize and host WMO radiosonde intercomparison campaign in 2022 in collaboration with MeteoSwiss/Payerne.



GRUAN Site Report for Lindenberg (LIN), 2021

Reported time range is Jan 2021 to Dec 2021

Created by the Lead Centre

Version from 2022-11-15

1 General GRUAN site information

Object	Value
Station name	Lindenberg
Unique GRUAN ID	LIN
Geographical position	52.2100 °N, 14.1200 °E, 98.0 m
Operated by	MOL Meteorologisches Observatorium Lindenberg, part of: DWD Deutscher Wetterdienst
Main contact	Dirksen, Ruud
WMO no./name	10393 LINDENBERG
Operators	currently 22, changes +1 / -0
Sounding Site	1
GNSS	3

1.1 General information about GRUAN measurement systems

System	Name	Type	Setups	Measurements
LIN-GN-01	GNSS Site LDB0	GNSS	1	operational
LIN-GN-02	GNSS Site LDB2	GNSS	0	not operational
LIN-GN-03	GNSS Site LIN0	GNSS	0	not operational
LIN-RS-01	Lindenberg Radiosonde Launch Site	Sounding Site	8	1513

1.2 General comments from Lead Centre

No comments from Lead Centre.

2 System: GNSS Site LDB0 (LIN-GN-01)

Object	Value
System name	GNSS Site LDB0
Unique GRUAN ID	LIN-GN-01
System type	GNSS (GN - GNSS)
Geographical position	52.2096 °N, 14.1185 °E, 160.2 m
Operated by	GFZ Deutsches GeoForschungsZentrum GFZ, part of: HELMHOLTZ Helmholtz-Gemeinschaft
Instrument contact	Dirksen, Ruud
Started at	2007-05-25
Defined setups	1 (HOURLY)
Possible streams	-

2.1 Lead Centre comments

2.1.1 General

This GNSS system was performing measurements until September 2020.

3 System: GNSS Site LDB2 (LIN-GN-02)

Object	Value
System name	GNSS Site LDB2
Unique GRUAN ID	LIN-GN-02
System type	GNSS (GN - GNSS)
Geographical position	52.2091 °N, 14.1209 °E, 159.5 m
Operated by	-
Instrument contact	Dirksen, Ruud
Started at	-
Defined setups	-
Possible streams	-

3.1 Lead Centre comments

3.1.1 Dataflow

No GNSS dataflow to LC has been established yet

4 System: GNSS Site LIN0 (LIN-GN-03)

Object	Value
System name	GNSS Site LIN0
Unique GRUAN ID	LIN-GN-03
System type	GNSS (GN - GNSS)
Geographical position	52.2093 °N, 14.1217 °E, 165.0 m
Operated by	GFZ Deutsches GeoForschungsZentrum GFZ, part of: HELMHOLTZ Helmholtz-Gemeinschaft
Instrument contact	Dirksen, Ruud
Started at	2020-10-01
Defined setups	-
Possible streams	-

4.1 Lead Centre comments

4.1.1 Dataflow

Dataflow of GNSS data to GRUAN LC and to the GRUAN GNSS processing centre at GFZ has started in October 2020. The current dataflow includes manufacturer raw data, converted raw data (RINEX), instrument logs, and processed data.

Meteorological data is available since January 202, therefore the operational processing as GNSS-PW-GDP is also possible since then.

4.1.2 General

This GNSS system is performing measurements since October 2020.

5 System: Lindenberg Radiosonde Launch Site (LIN-RS-01)

Object	Value
System name	Lindenberg Radiosonde Launch Site
Unique GRUAN ID	LIN-RS-01
System type	Sounding Site (RS - Radiosonde)
Geographical position	52.2100 °N, 14.1200 °E, 112.0 m
Operated by	MOL Meteorologisches Observatorium Lindenberg, part of: DWD Deutscher Wetterdienst
Instrument contact	Dirksen, Ruud
Started at	-
Defined setups	8 (ROUTINE, RESEARCH, OZONE, DUAL1, ROUTINE2, OZONE2, DUAL2, UAI12022)
Possible streams	CFH, COBALD, DFM-09, DFM-17, ECC, FPH, M10, RS41, RS80, RS92

5.1 Lead Centre comments

5.1.1 Dataflow

Sonde dataflow to the GRUAN LC operational since January 2008.

Currently, the dataflow includes streams of the Vaisala RS41-SG(P), RS92-SGP, Graw DFM-09, DFM-17, ECC Ozone sonde, and CFH water vapour. All launches are promptly recorded using the RsLaunchClient. The site is used as test bed for the RsLaunchClient.

5.1.2 General

Routine soundings with Vaisala RS41 are performed 4 times per day. Ozone soundings are performed once per week. Research soundings including CFH, ECC, Vaisala RS92 and RS41 are performed once per month. Various sonde combinations have been flown throughout the reporting period.

A regular measurement program for the observation of stratospheric water vapor profiles is performed using CFH.

5.2 GRUAN data products

Product	Version	Soundings received	Available at LC	Distributed by NCEI
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5.2.1 Stream: CFH

CFH		16	16	
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5.2.2 Stream: COBALD

COBALD		15	15	
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5.2.3 Stream: DFM-09

DFM-09		3	3	
DFM-09-RAW	001		3	

5.2.4 Stream: DFM-17

DFM-17		27	27	
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5.2.5 Stream: ECC

ECC		72	72	
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5.2.6 Stream: M10

M10		10	10	
M10-RAW	001		4	

5.2.7 Stream: RS41

RS41		1527	1527	
RS41-RAW	001		1527	
RS41-EDT	001		1527	
RS41-GDP	001		1524	
RS41-GDP-ALPHA	005		4	
RS41-GDP-BETA	002		746	
RS41-GDP-BETA	003		1301	

5.2.8 Stream: RS92

RS92		7	7	
RS92-INT	001		7	
RS92-RAW	002		7	
RS92-EDT	001		4	
RS92-GDP	002		6	

5.2.9 Stream: SRS-C34

SRS-C34		9	9	
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5.2.10 Stream: SRS-C50

SRS-C50		4	4	
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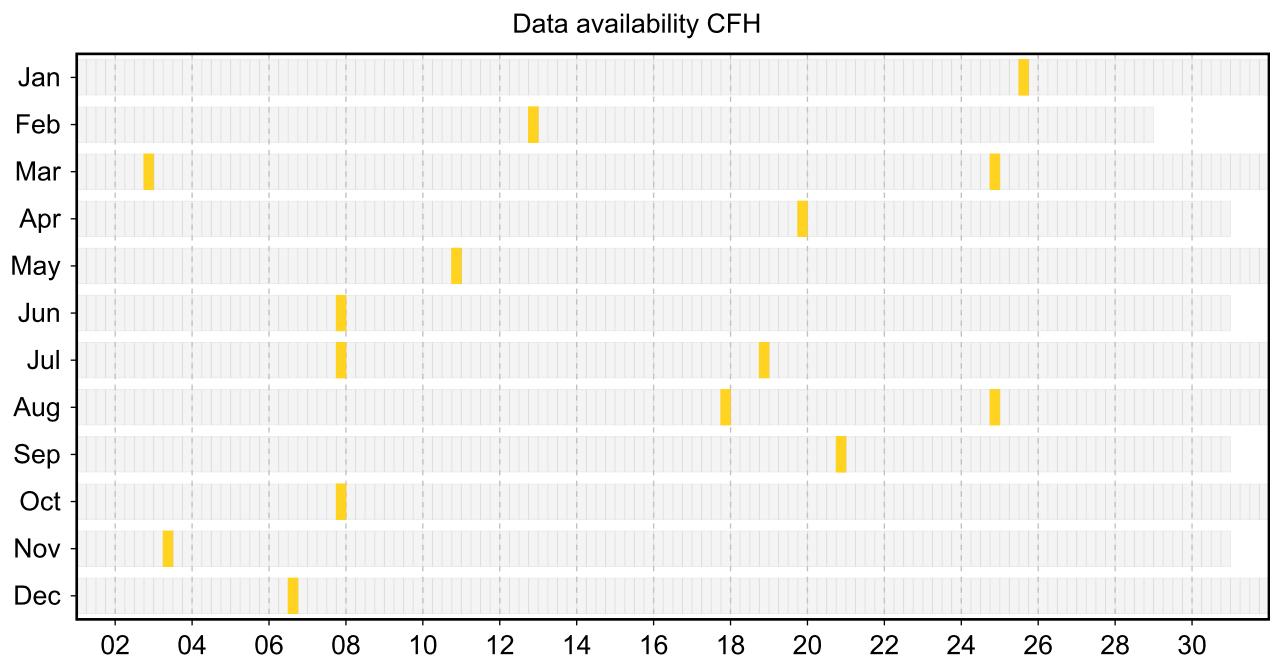
5.3 Availability of data products

Available (green): All steps of data processing have been successfully completed. The data product file is available at LC (e.g. files that didn't pass QA/QC or uncertified GRUAN data products) and/or at NCEI (a certified GRUAN data product file that did pass QA/QC).

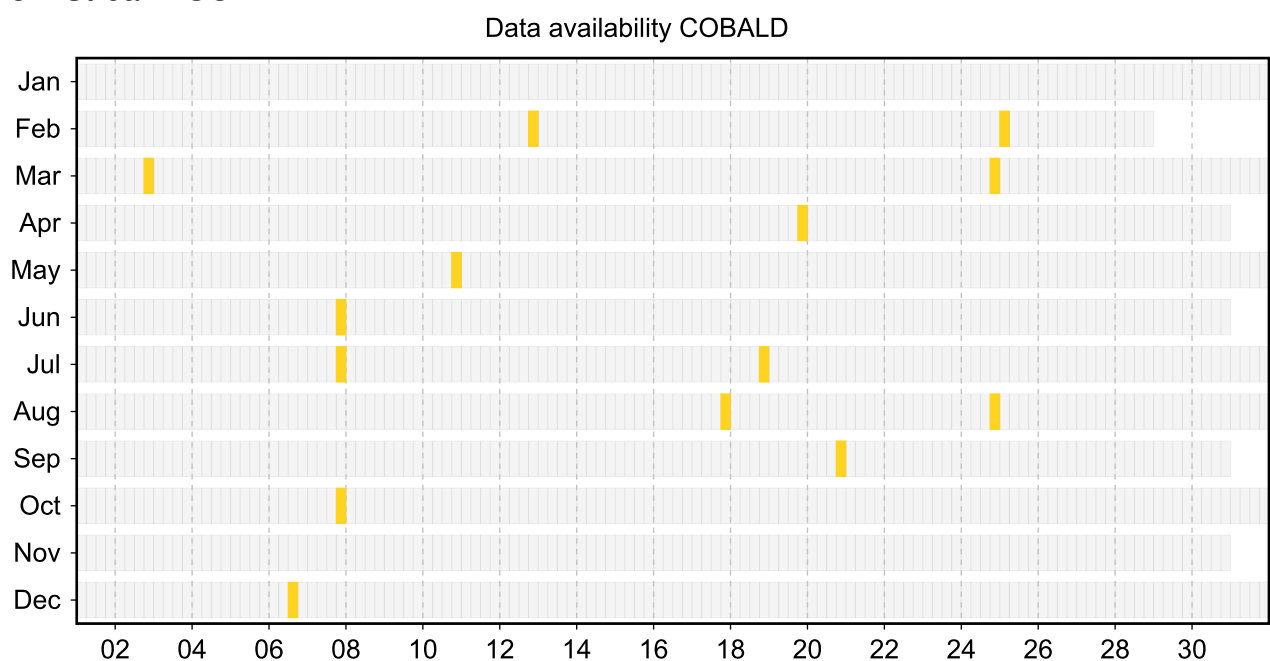
Unprocessed (yellow): The manufacturer-produced file with raw measurement data has been successfully converted into a GRUAN-standardized raw data format (NetCDF). The GRUAN data processing has not been performed or was aborted. Reasons for this may be a still missing GRUAN data processor or a processing-software error.

Original (red): The original, manufacturer-produced, raw data file is available (e.g. MWX data file) but was not converted into a GRUAN-standardized raw data format (NetCDF). Reasons for this may be missing data conversion software, a software error, or a corrupt data file.

5.3.1 Stream: CFH

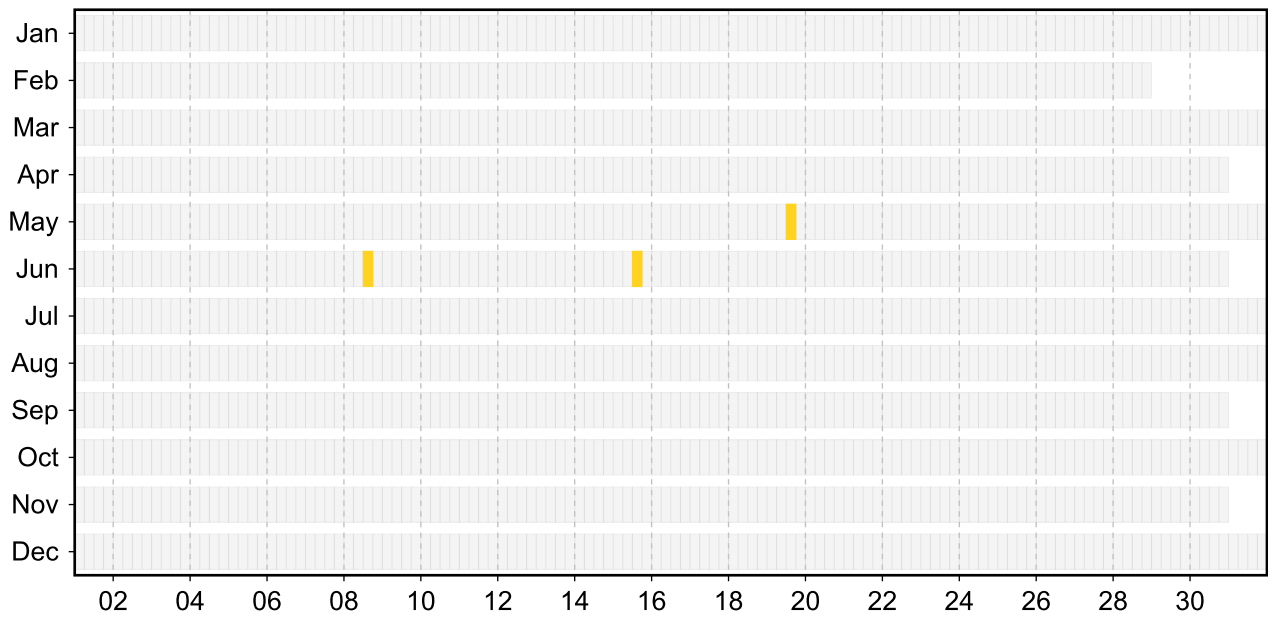


5.3.2 Stream: COBALD



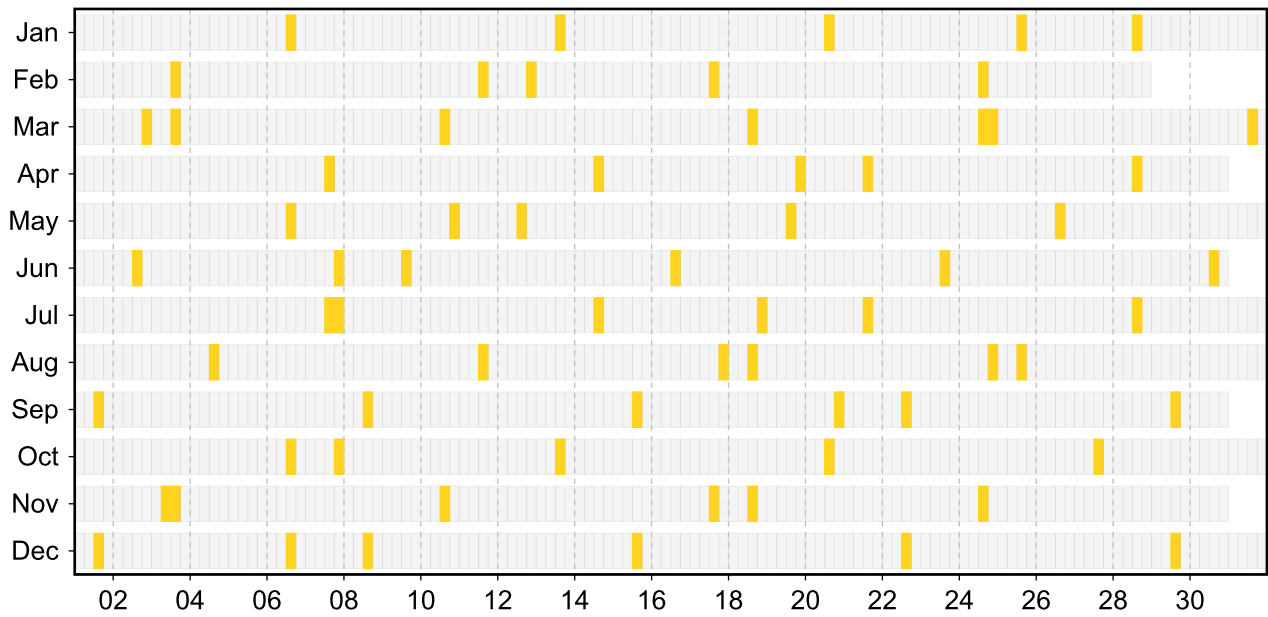
5.3.3 Stream: DFM-09

Data availability DFM-09



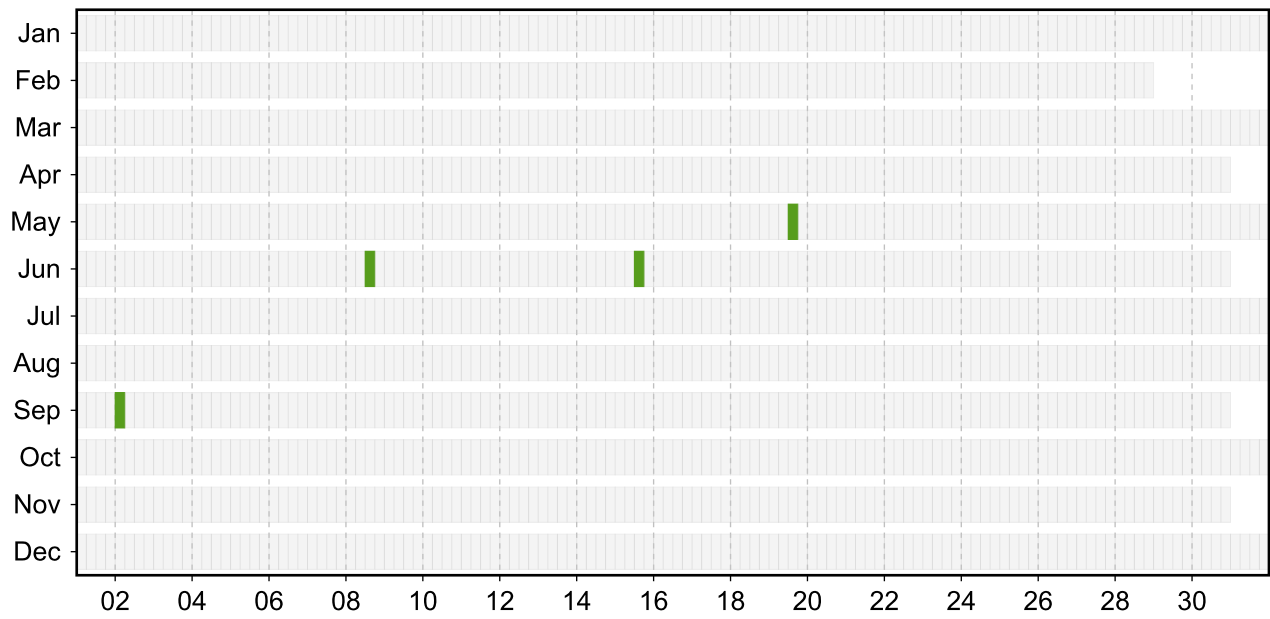
5.3.4 Stream: ECC

Data availability ECC



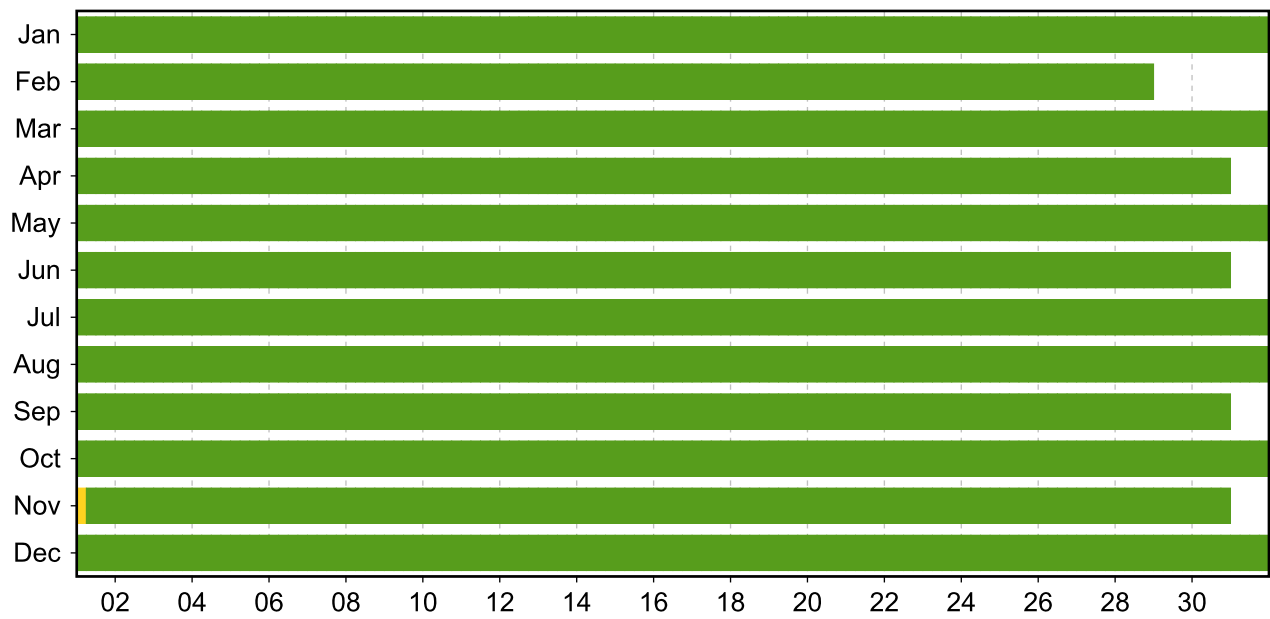
5.3.5 Stream: M10

Data availability M10

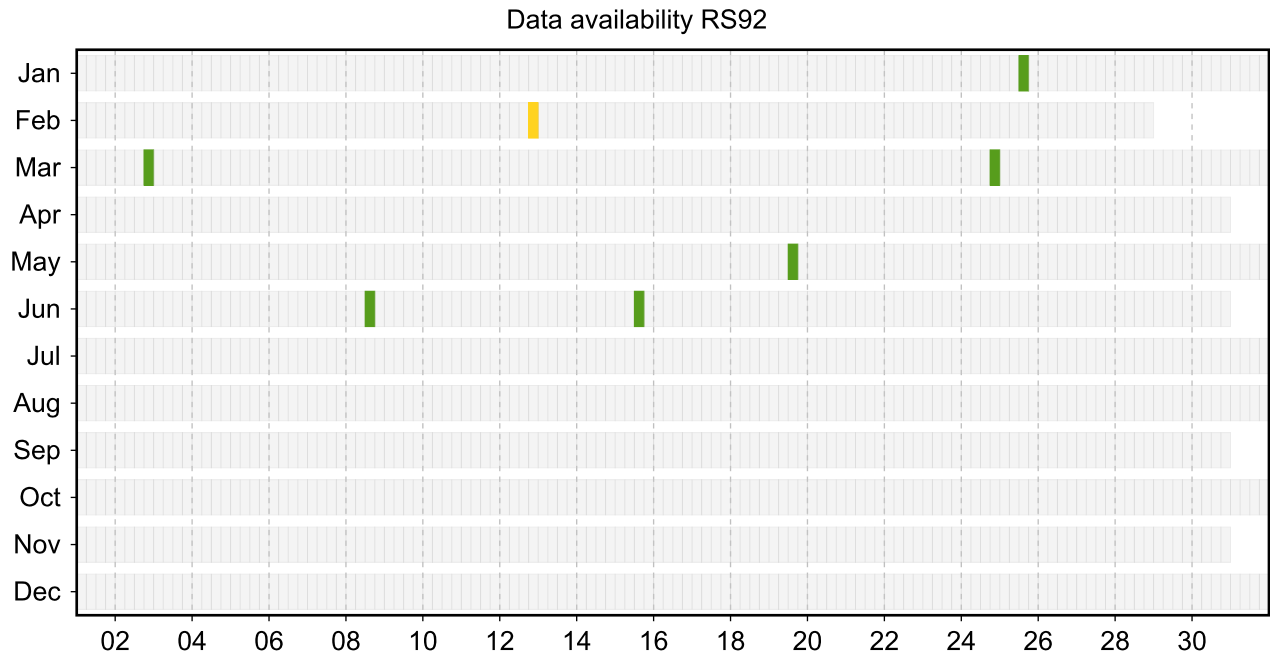


5.3.6 Stream: RS41

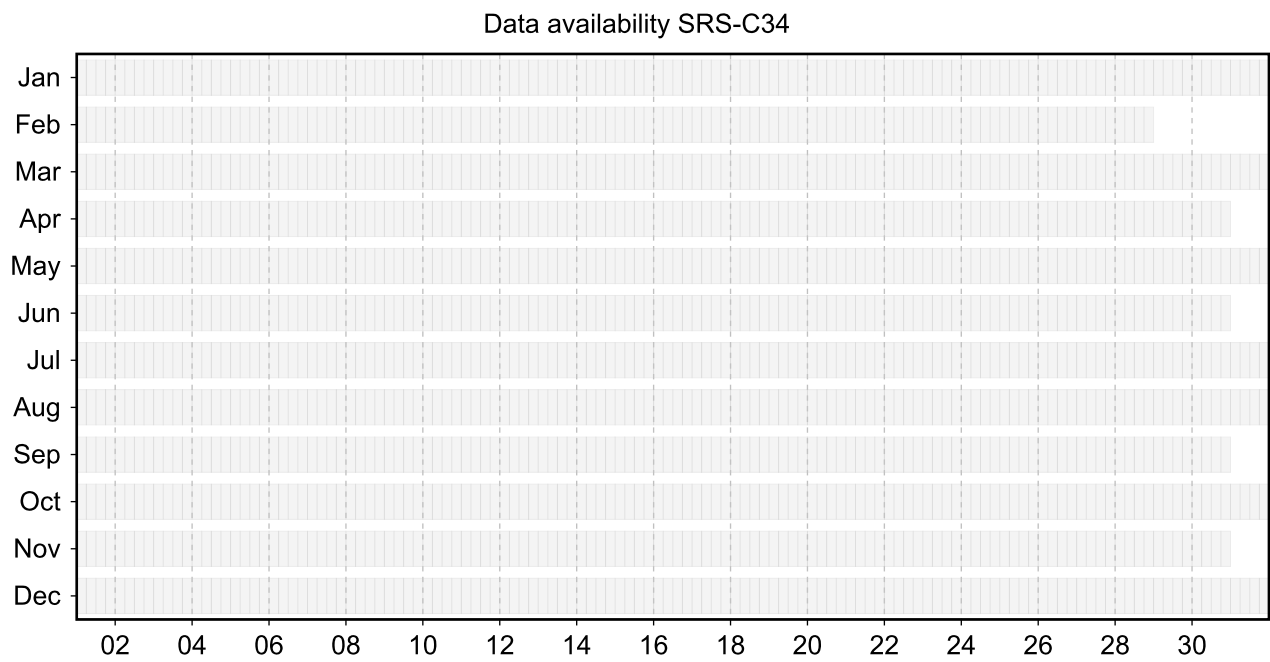
Data availability RS41



5.3.7 Stream: RS92

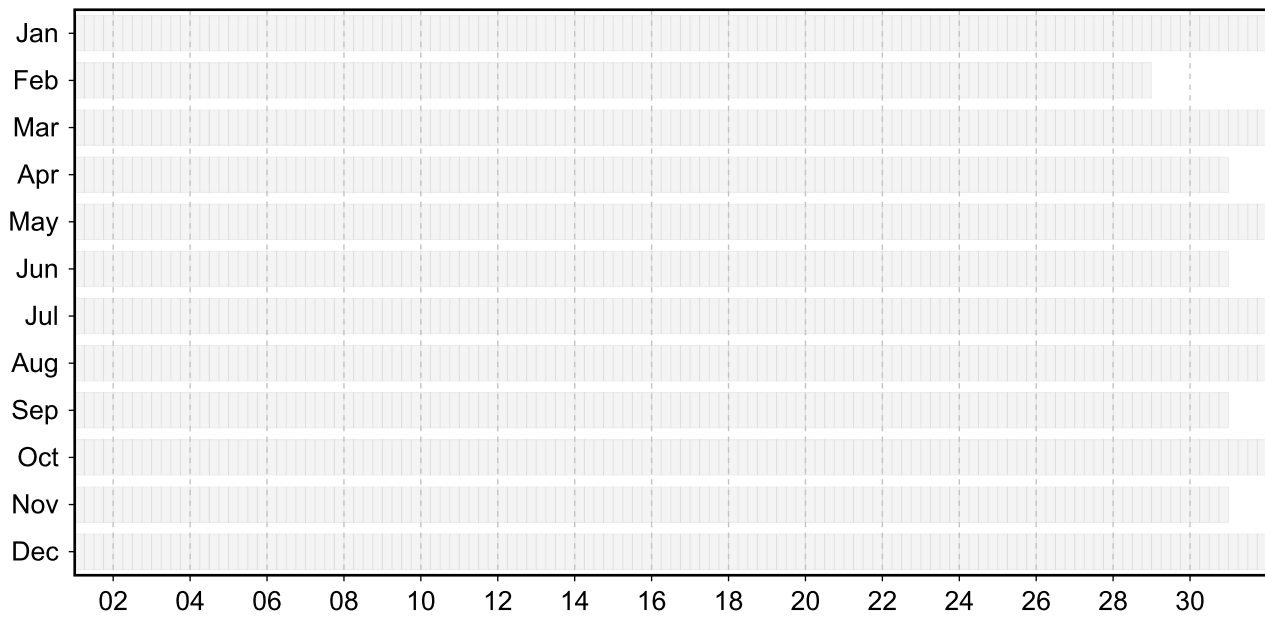


5.3.8 Stream: SRS-C34



5.3.9 Stream: SRS-C50

Data availability SRS-C50



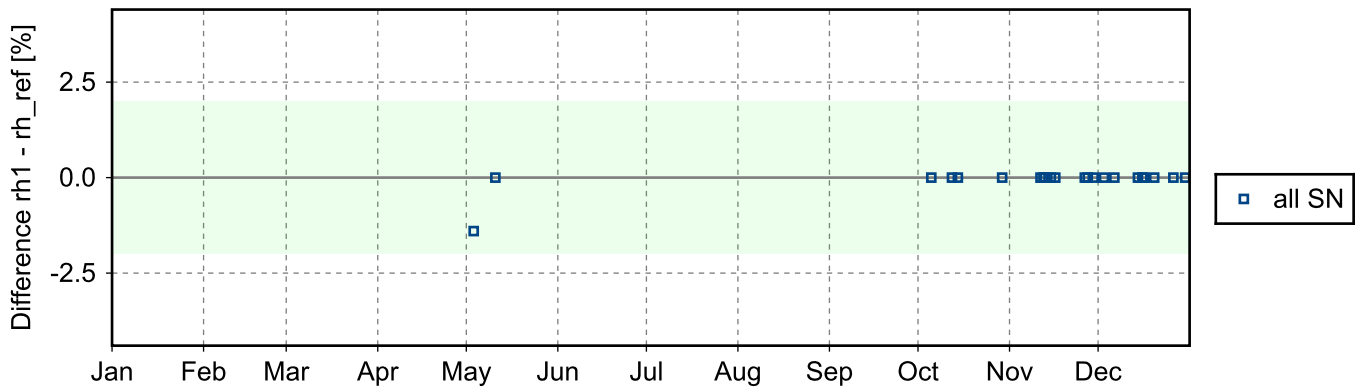
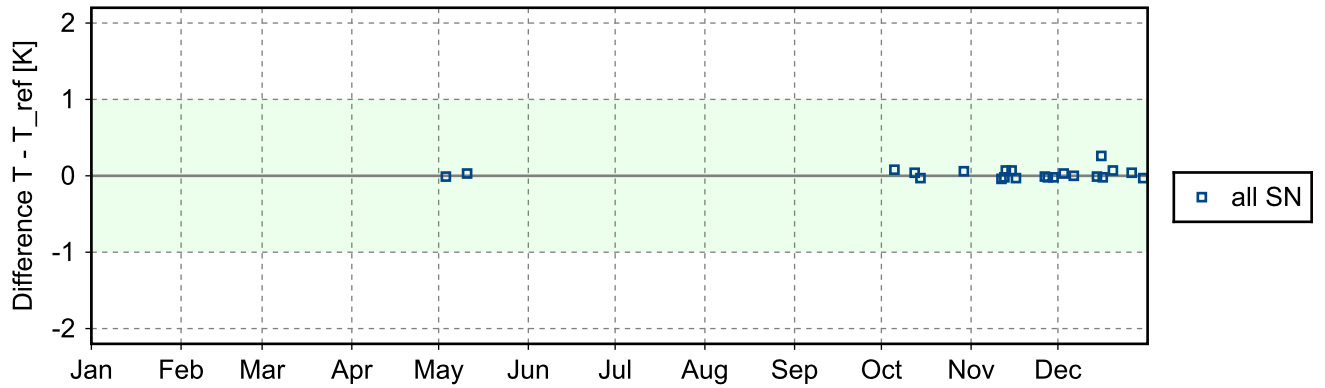
5.4 Instrument combinations of LIN-RS-01

Count	Instrument combination
1	CFH, COBALD, DFM-17, ECC, RS41
4	CFH, COBALD, ECC, 2x RS41
6	CFH, COBALD, ECC, RS41
3	CFH, COBALD, ECC, RS41, RS92
1	CFH, ECC, RS41
1	CFH, ECC, RS41, RS92
1	COBALD, RS41
3	DFM-09, DFM-17, M10, 2x RS41, RS92
1	2x DFM-17, M10, 2x RS41
21	DFM-17, RS41
3	2x ECC, 2x RS41
50	ECC, RS41
3	2x M10, 2x RS41
1401	RS41
1	2x RS41
8	RS41, SRS-C34
4	RS41, SRS-C50
1	SRS-C34

5.5 Instrument ground check

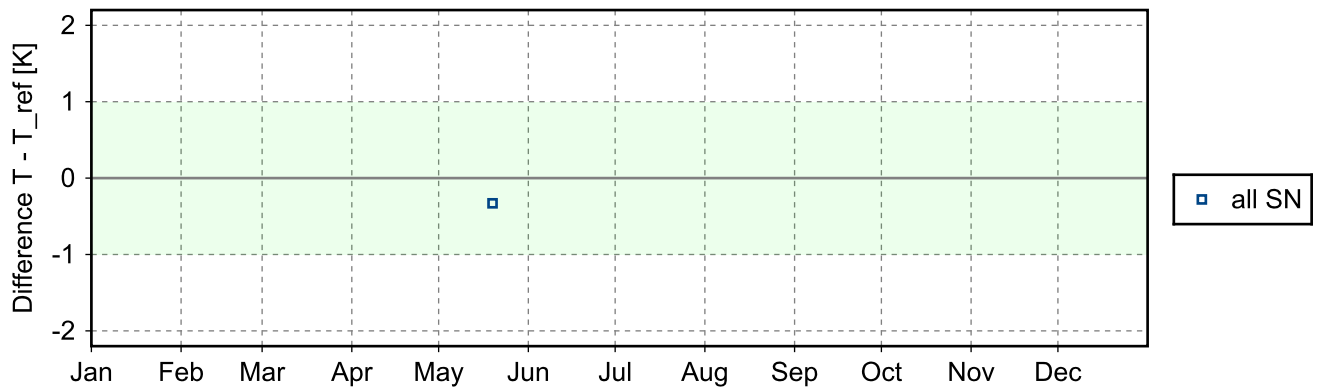
5.5.1 Stream: DFM-17

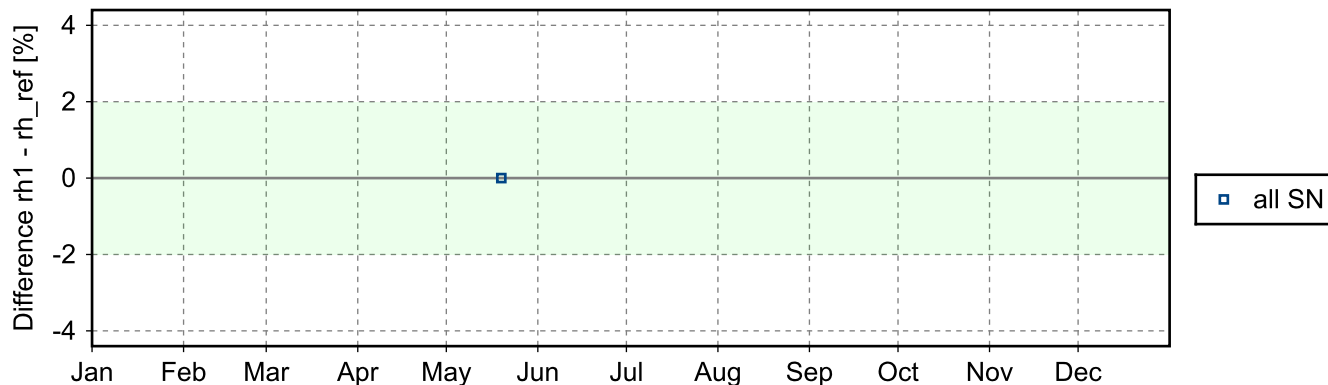
(1) GroundCheck: GC-SHC



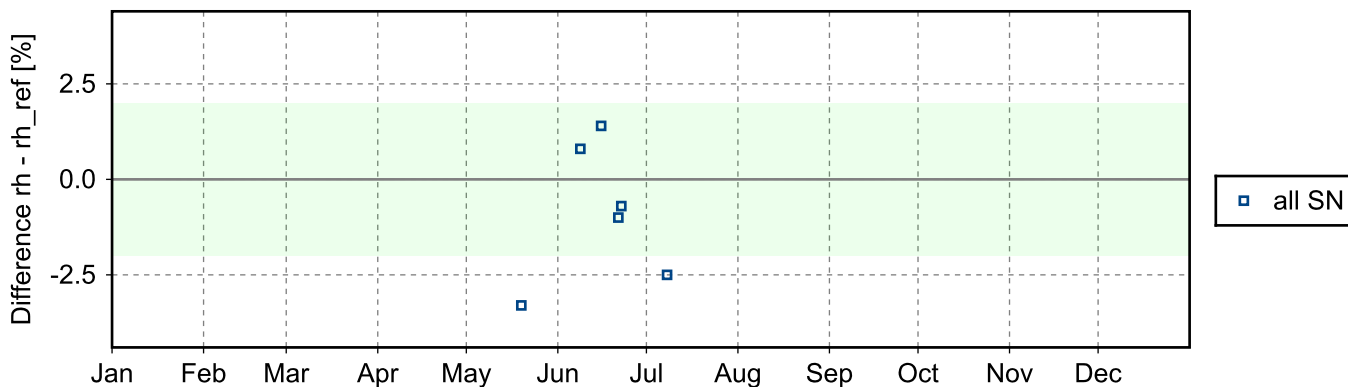
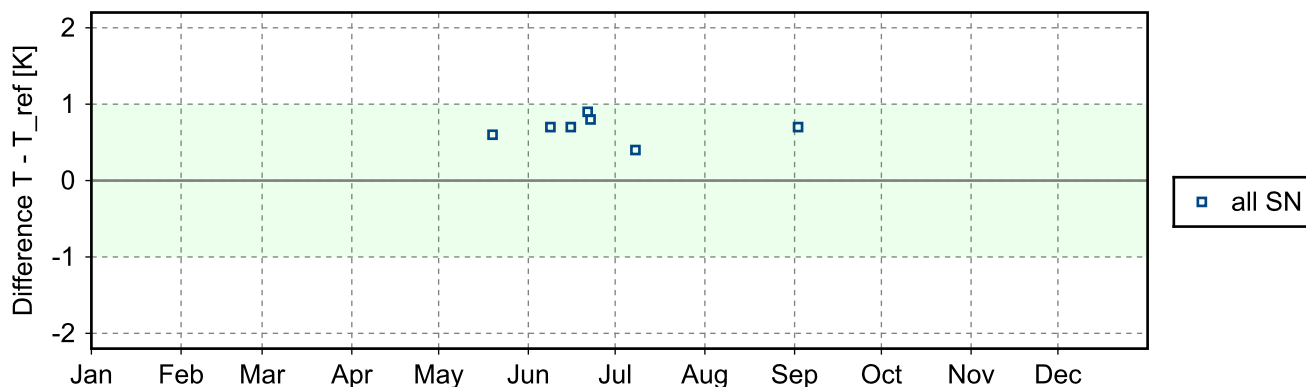
5.5.2 Stream: M10

(1) GroundCheck: GC-SHC



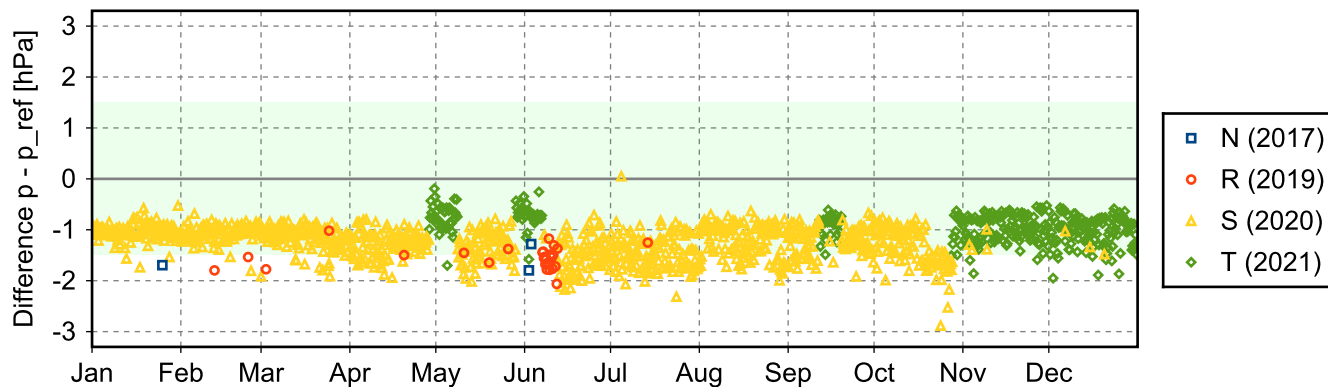


(2) GroundCheck: GC-TU(room)

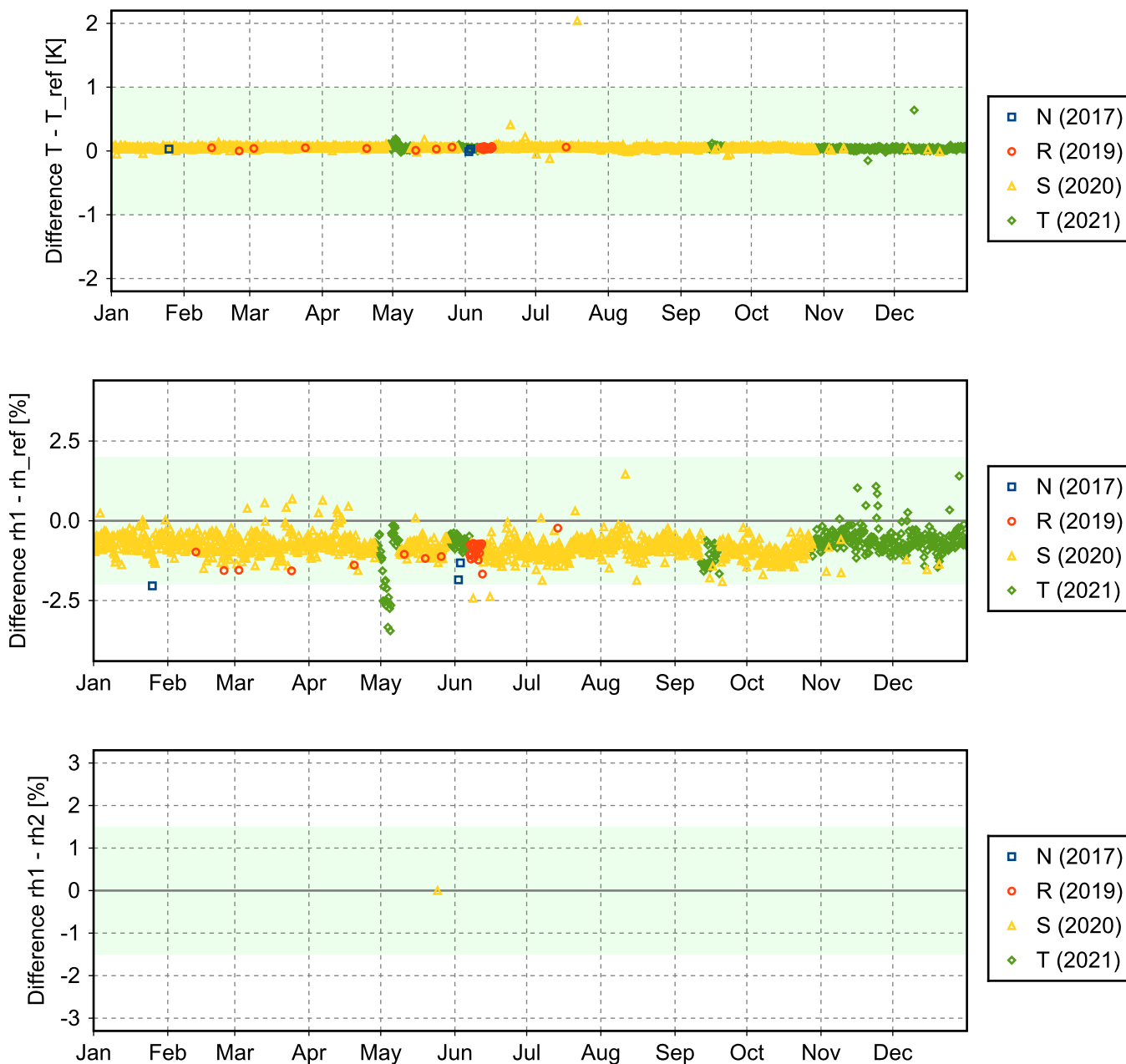


5.5.3 Stream: RS41

(1) GroundCheck: GC-RI41

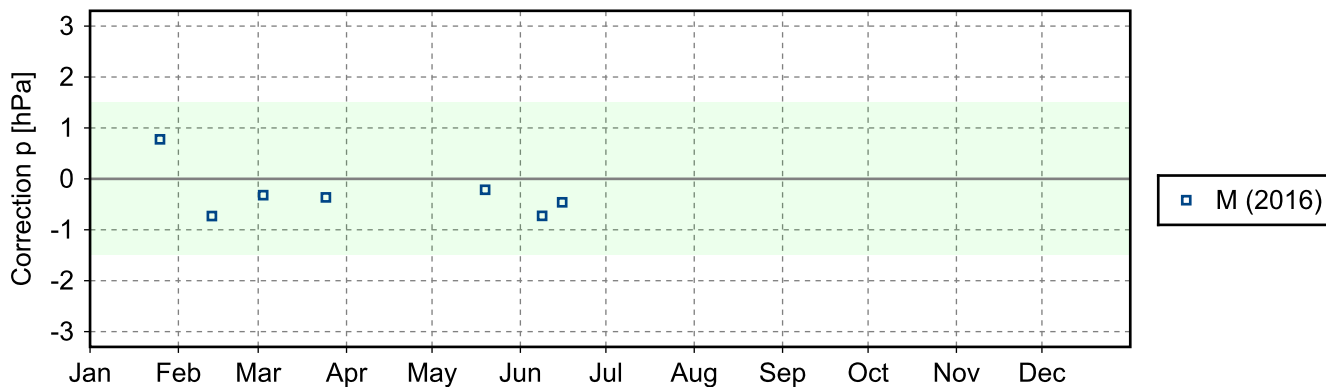


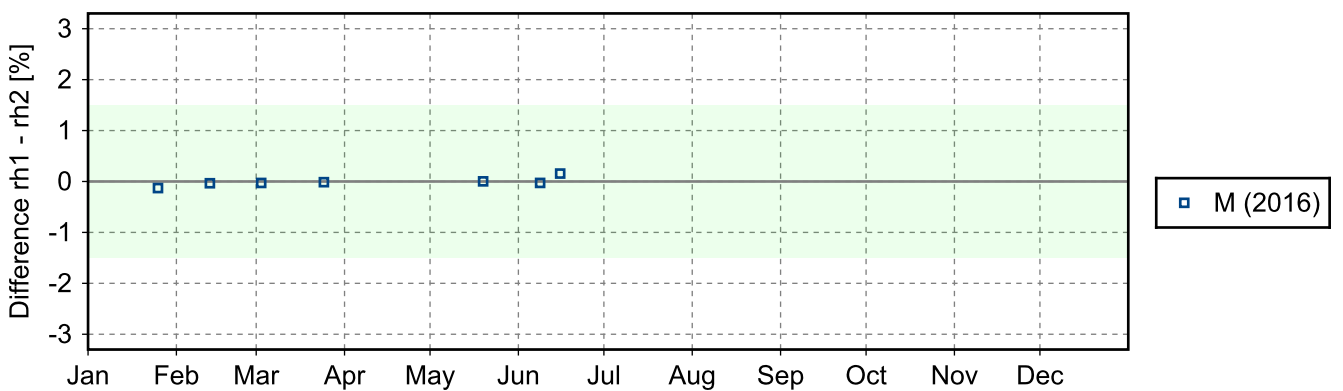
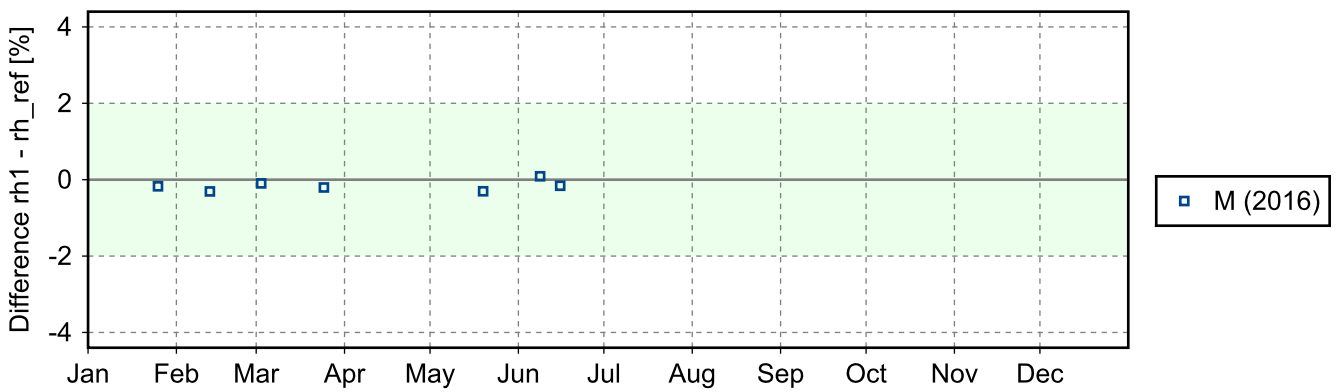
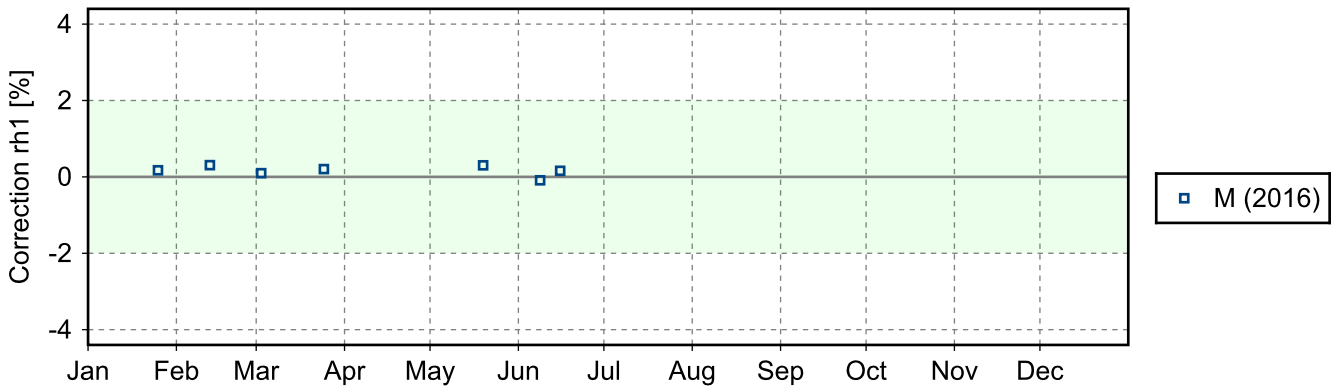
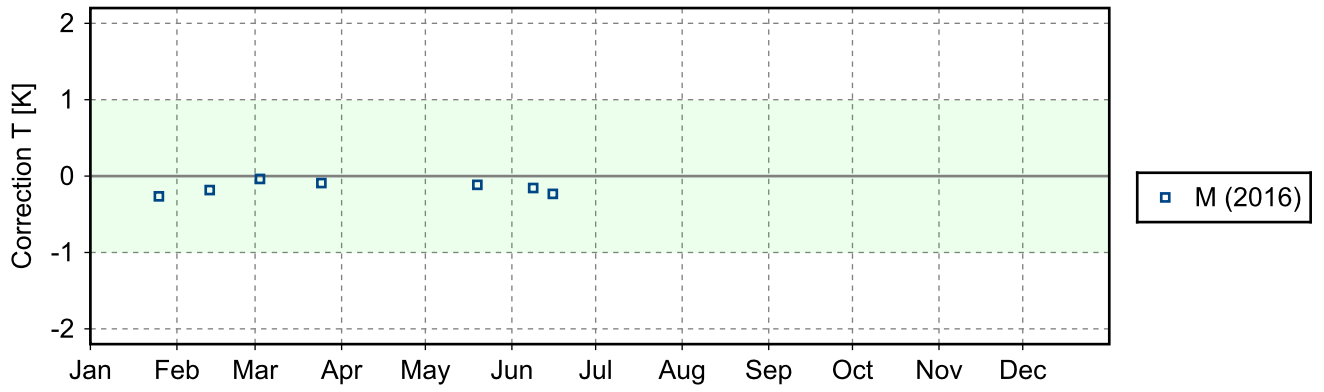
(2) GroundCheck: GC-SHC



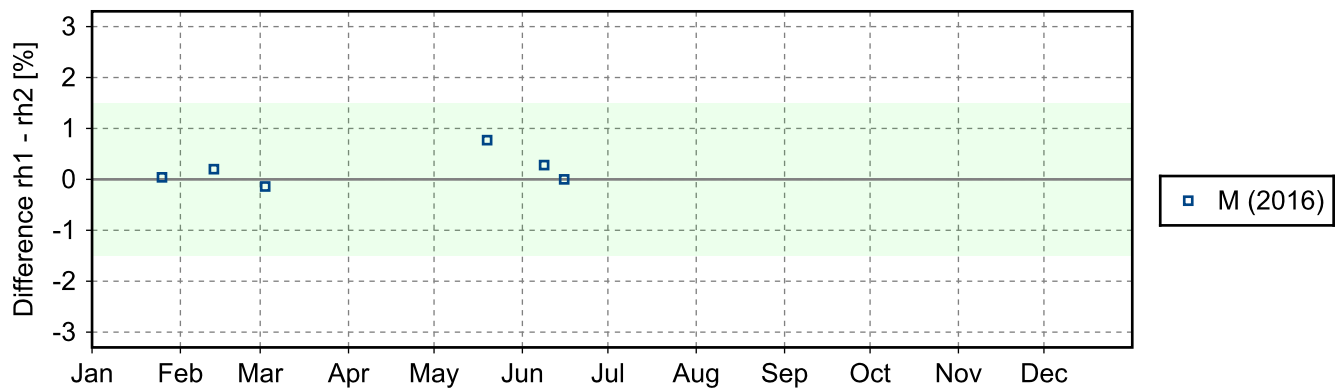
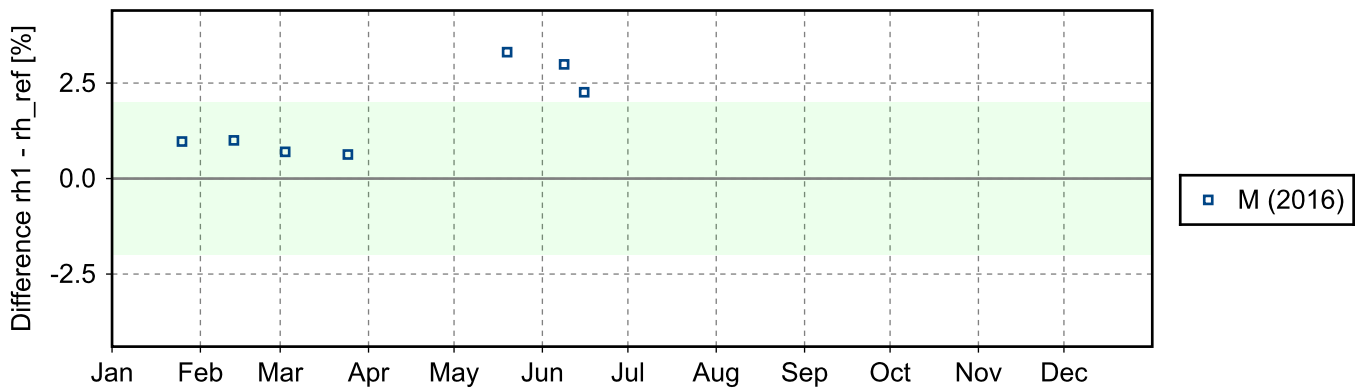
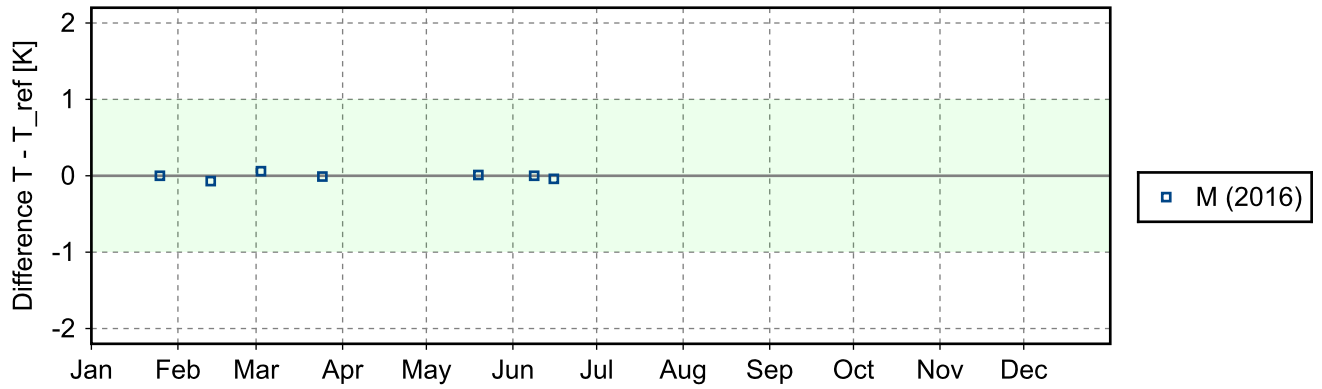
5.5.4 Stream: RS92

(1) GroundCheck: GC-GC25





(2) GroundCheck: GC-SHC



5.6 Measurement events

