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GLOBAL CLIMATE OBSERVING  
SYSTEM (GCOS)

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**13th GRUAN Implementation-  
Coordination Meeting (ICM-13)**

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Session 1

Virtual

15 November - 19 November 2021

## GRUAN Site Report for Lindenberg

*(Submitted by Ruud Dirksen)*

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### **Summary and Purpose of this Document**

Report from the GRUAN site Lindenberg for the period January to December 2020.

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## Overview

Lindenberg contributes to GRUAN with the following operational data streams: RS41 radiosonde (4 times per day), RS92, 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 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 In March 2017 the RS92 has been replaced by the RS41 as operational radiosonde.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 we have been performing regular RS92-RS41 twin soundings since 2015 as part of the GRUAN-wide effort in the management of the RS92-RS41 transition. Soundings with RS92 as part of a large research payload are now performed approximately once per month. 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.

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. We have performed test flights with CFH using cooled ethanol.

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. 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 scheduled for 2020.

## **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**

- RS92-RS41 intercomparison.
- Regular soundings with research instruments such as CFH, Ozone, COBALD.
- 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).
- Tests with dry-ice/ethanol as cryogen for CFH.

### **Publications:**

- Dirksen, R. J., G. E. Bodeker, P. W. Thorne, A. Merlone, T. Reale, J. Wang, D. F. Hurst, B. B. Demoz, T. D. Gardiner, B. Ingleby, M. Sommer, C. von Rohden, and T. Leblanc, Managing the transition from Vaisala RS92 to RS41 radiosondes within the Global Climate Observing System Reference Upper-Air Network (GRUAN): a progress report, *Geoscientific Instrumentation, Methods and Data Systems*, **9**(2), 337-355, doi:10.5194/gi-9-337-2020, 2020, <https://gi.copernicus.org/articles/9/337/2020/>.

- Fassò, A., M. Sommer, and C. von Rohden, Interpolation uncertainty of atmospheric temperature radiosoundings, *Atmospheric Measurement Techniques*, 2020, **13**(12), 6445-6458, doi:10.5194/amt-13-6445-2020, 2020, <https://amt.copernicus.org/articles/13/6445/2020/>.
- Gierens, K., L. Wilhelm, M. Sommer, and D. Weaver, On ice supersaturation over the Arctic, *Meteorologische Zeitschrift*, **29**(2), 165-176, doi:10.1127/metz/2020/1012, 2020, <http://dx.doi.org/10.1127/metz/2020/1012>.
- Hanumanthu, S., B. Vogel, R. Müller, S. Brunamonti, S. Fadnavis, D. Li, P. Ölsner, M. Naja, B. B. Singh, K. R. Kumar, S. Sonbawne, H. Jauhiainen, H. Vömel, B. Luo, T. Jorge, F.G. Wienhold, R. Dirksen, and T. Peter, Strong variability of the Asian Tropopause Aerosol Layer (ATAL) in August 2016 at the Himalayan foothills, *Atmos. Chem. Phys.*, **20**(22), 14,273-14,302, doi:10.5194/acp-20-14273-2020, 2020, <https://acp.copernicus.org/articles/20/14273/2020/>.
- 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 cryogenic frost point hygrometer measurements after contamination by mixed-phase clouds, *Atmos. Meas. Tech. Discuss.*, 2020, 1-76, doi:10.5194/amt-2020176, 2020, <https://amt.copernicus.org/preprints/amt-2020-176/>.
- Philipona, R., A. Kräuchi, R. Kivi, T. Peter, M. Wild, R. Dirksen, M. Fujiwara, M. Sekiguchi, D. F. Hurst, and R. Becker, Balloon-borne radiation measurements demonstrate radiative forcing by water vapor and clouds, *Meteorologische Zeitschrift*, **29**(6), 501-509, doi:10.1127/metz/2020/1044, 2020.

## WG-GRUAN interface

GRUAN Lead Centre resides at Lindenberg observatory.

Christoph von Rohden is member of task team radiosondes.

## Other archiving centers

GUAN, NDACC, WOUDC, BSRN.

## Participation in campaigns

N/A

## 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, 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 2021/2022 in collaboration with MeteoSwiss/Payerne.



# GRUAN Site Report for Lindenberg (LIN), 2020

Reported time range is Jan 2020 to Dec 2020

Created by the Lead Centre

Version from 2021-04-27

## 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:<br>DWD   Deutscher Wetterdienst |
| Main contact          | Dirksen, Ruud   |
| WMO no./name          | 10393 LINDENBERG  |
| Operators             | currently 16, changes +1 / -1   |
| 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 | 7      | 1517            |

### 1.2 General comments from Lead Centre

No comments from Lead Centre.

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

| <b>Object</b>         | <b>Value</b>   |
|-----------------------|--|
| 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:<br>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 Dataflow

Dataflow of GNSS data to GRUAN LC and to the GRUAN GNSS processing centre at GFZ has started in September 2013. The current dataflow includes manufacturer raw data, converted raw data (RINEX), instrument logs, and processed data.

Meteorological data is missing, therefore the operational processing as GNSS-PW-GDP is not possible at moment.



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

| <b>Object</b>         | <b>Value</b>                    |
|-----------------------|---------------------------------|
| 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)

| <b>Object</b>         | <b>Value</b>   |
|-----------------------|--|
| 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:<br>HELMHOLTZ   Helmholtz-Gemeinschaft |
| Instrument contact    | Dirksen, Ruud  |
| Started at            | 2020-10-01   |
| Defined setups        | -  |
| Possible streams      | -  |

### 4.1 Lead Centre comments

No comments from Lead Centre.

## 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:<br>DWD   Deutscher Wetterdienst |
| Instrument contact    | Dirksen, Ruud   |
| Started at            | -   |
| Defined setups        | 7 (ROUTINE, RESEARCH, OZONE, DUAL1, ROUTINE2, OZONE2, DUAL2)                              |
| Possible streams      | CFH, COBALD, DFM-09, 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, 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 |
|---------|---------|--------------------|-----------------|---------------------|
|---------|---------|--------------------|-----------------|---------------------|

### 5.2.1 Stream: CFH

|     |  |    |    |  |
|-----|--|----|----|--|
| CFH |  | 18 | 18 |  |
|-----|--|----|----|--|

### 5.2.2 Stream: COBALD

|        |  |    |    |  |
|--------|--|----|----|--|
| COBALD |  | 17 | 17 |  |
|--------|--|----|----|--|

### 5.2.3 Stream: DFM-09

|            |     |   |   |  |
|------------|-----|---|---|--|
| DFM-09     |     | 1 | 1 |  |
| DFM-09-RAW | 001 |   | 1 |  |

### 5.2.4 Stream: ECC

|     |  |    |    |  |
|-----|--|----|----|--|
| ECC |  | 69 | 69 |  |
|-----|--|----|----|--|

### 5.2.5 Stream: RS41

|                |     |      |      |  |
|----------------|-----|------|------|--|
| RS41           |     | 1524 | 1524 |  |
| RS41-GCA       | 001 |      | 1518 |  |
| RS41-RAW       | 001 |      | 1525 |  |
| RS41-EDT       | 001 |      | 1516 |  |
| RS41-GDP-ALPHA | 003 |      | 495  |  |
| RS41-GDP-ALPHA | 004 |      | 380  |  |
| RS41-GDP-BETA  | 001 |      | 1508 |  |
| RS41-GDP-BETA  | 002 |      | 283  |  |

### 5.2.6 Stream: RS92

|          |     |   |   |  |
|----------|-----|---|---|--|
| RS92     |     | 8 | 8 |  |
| RS92-INT | 001 |   | 8 |  |
| RS92-RAW | 002 |   | 8 |  |
| RS92-EDT | 001 |   | 8 |  |
| RS92-GDP | 002 |   | 8 |  |

### 5.2.7 Stream: SRS-C34

|         |  |   |   |  |
|---------|--|---|---|--|
| SRS-C34 |  | 3 | 3 |  |
|---------|--|---|---|--|

### 5.2.8 Stream: SRS-C50

|         |  |   |   |  |
|---------|--|---|---|--|
| SRS-C50 |  | 8 | 8 |  |
|---------|--|---|---|--|

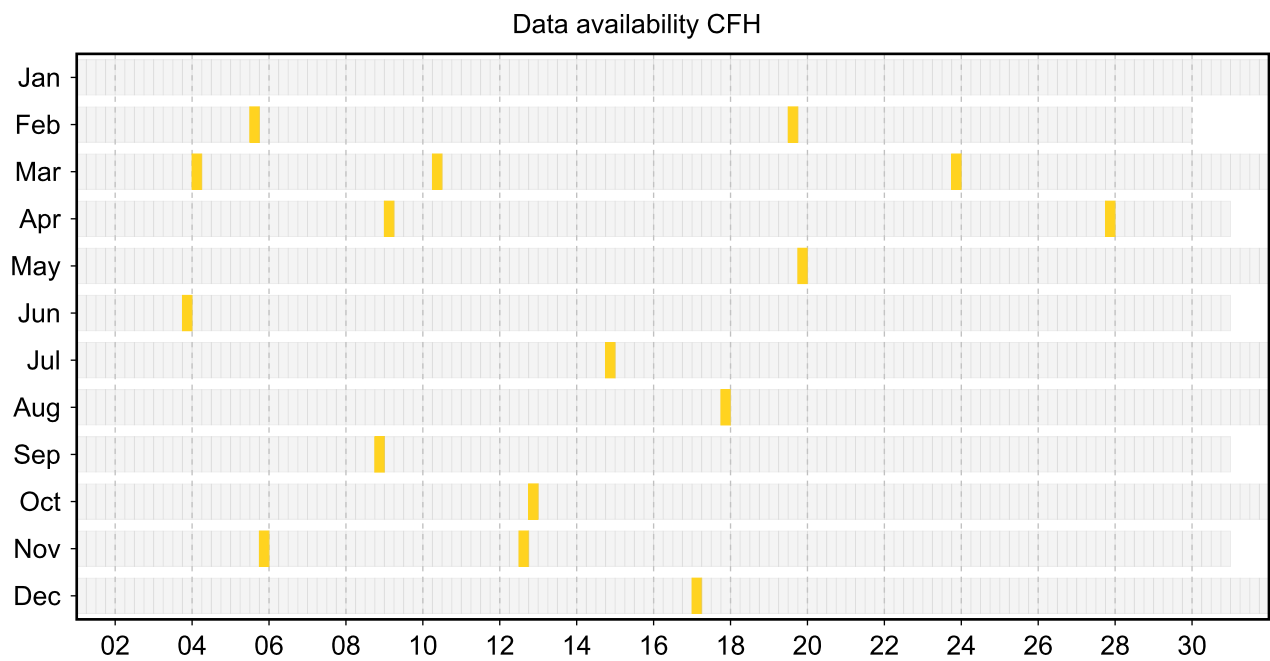
### 5.3 Availability of data products

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).

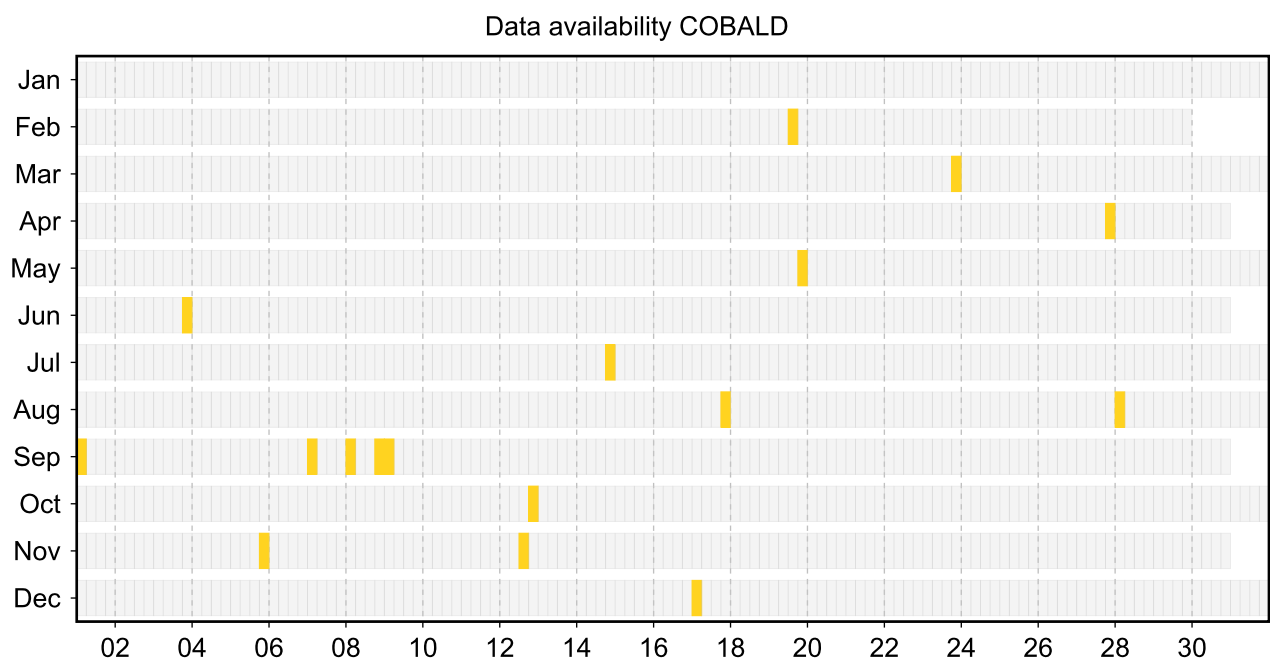
Unprocessed (yellow): The manufacturer-produced file with raw measurement data has been successfully converted into a GRUAN-standardized raw data format (NetCDF). The GRUAN data processing has not been performed or was aborted. Reasons for this may be a still missing GRUAN data processor or a processing-software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

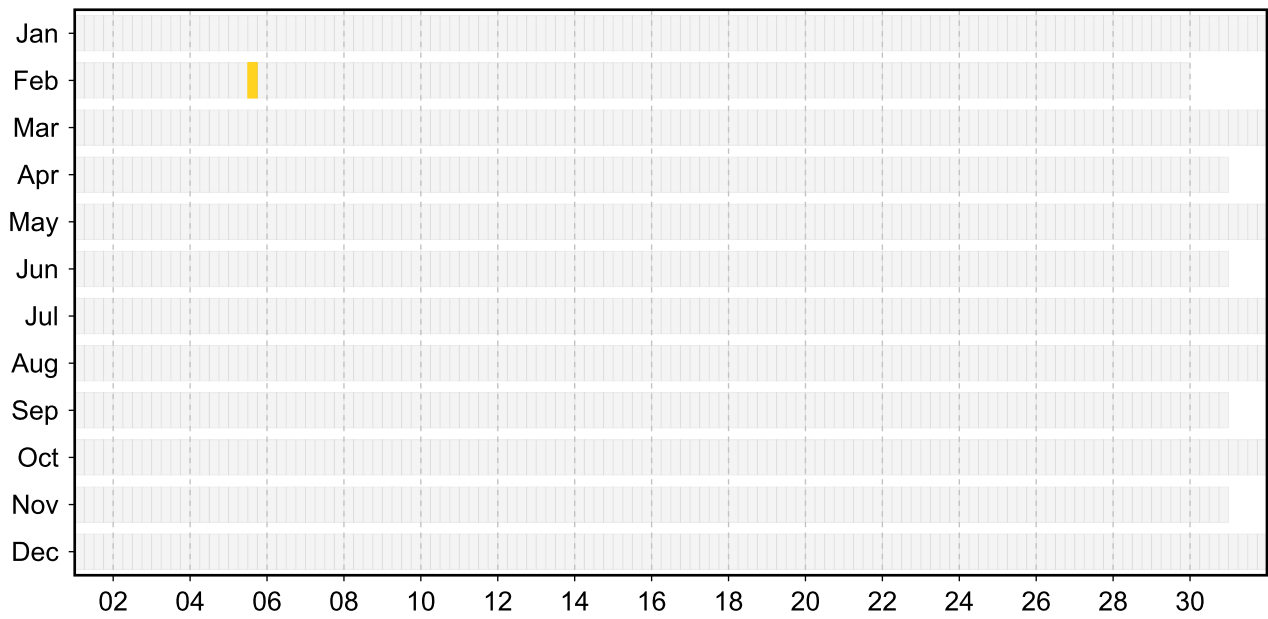


#### 5.3.2 Stream: COBALD



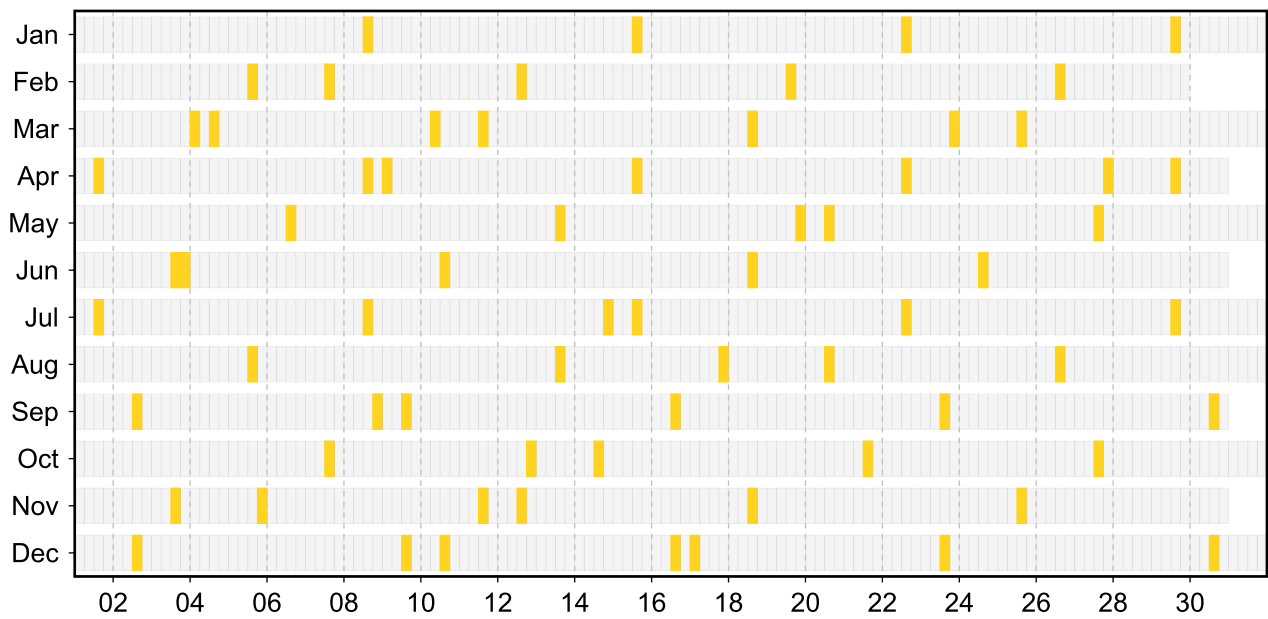
5.3.3 Stream: DFM-09

Data availability DFM-09



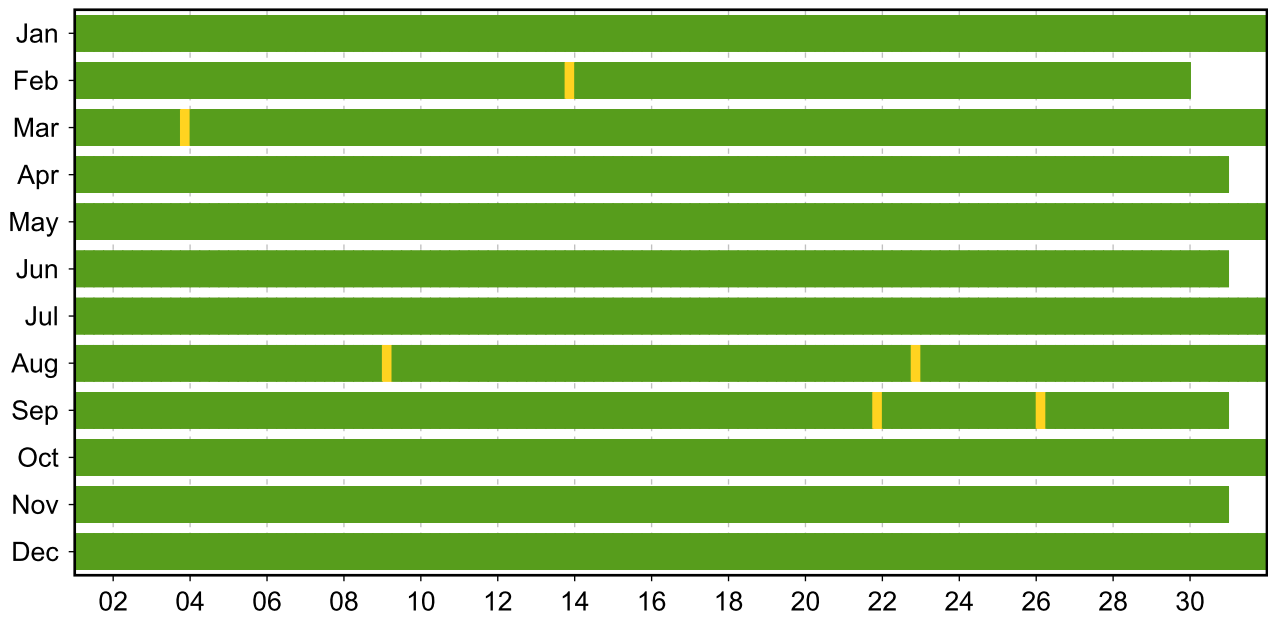
5.3.4 Stream: ECC

Data availability ECC



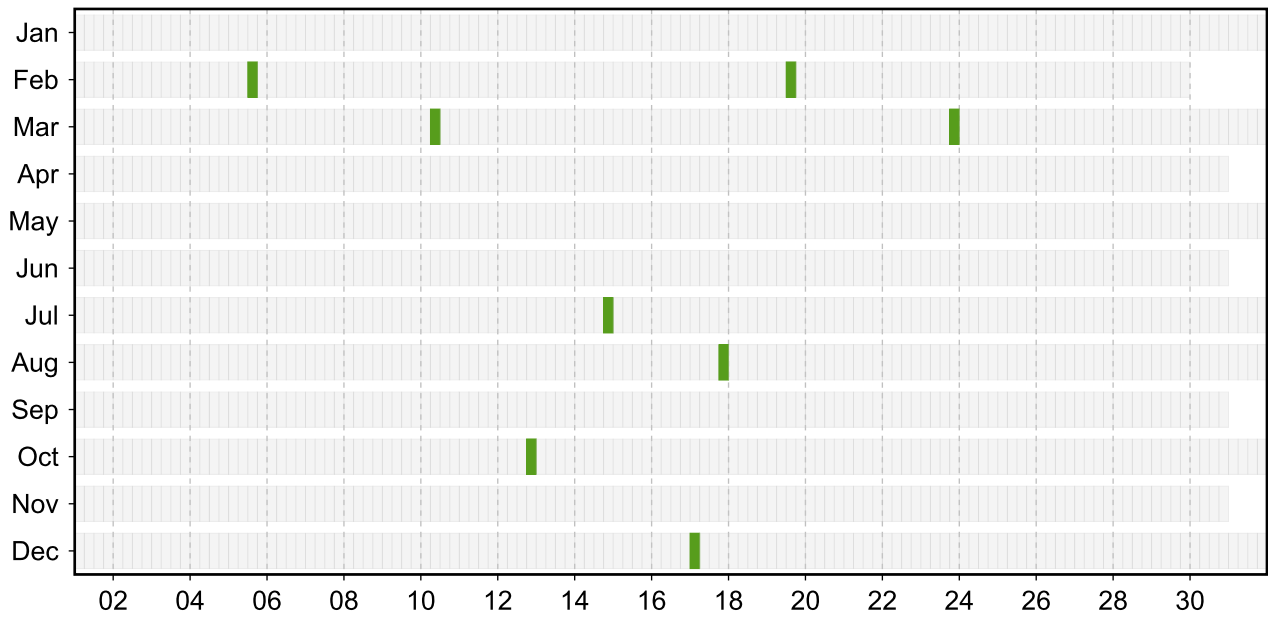
5.3.5 Stream: RS41

Data availability RS41



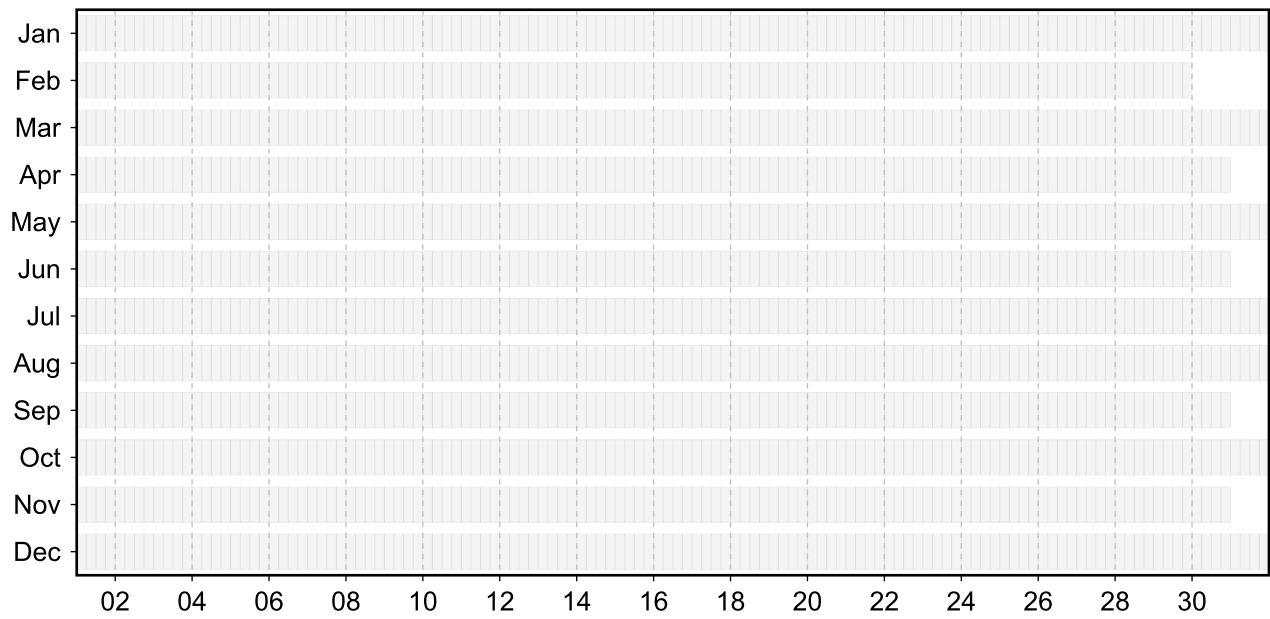
5.3.6 Stream: RS92

Data availability RS92



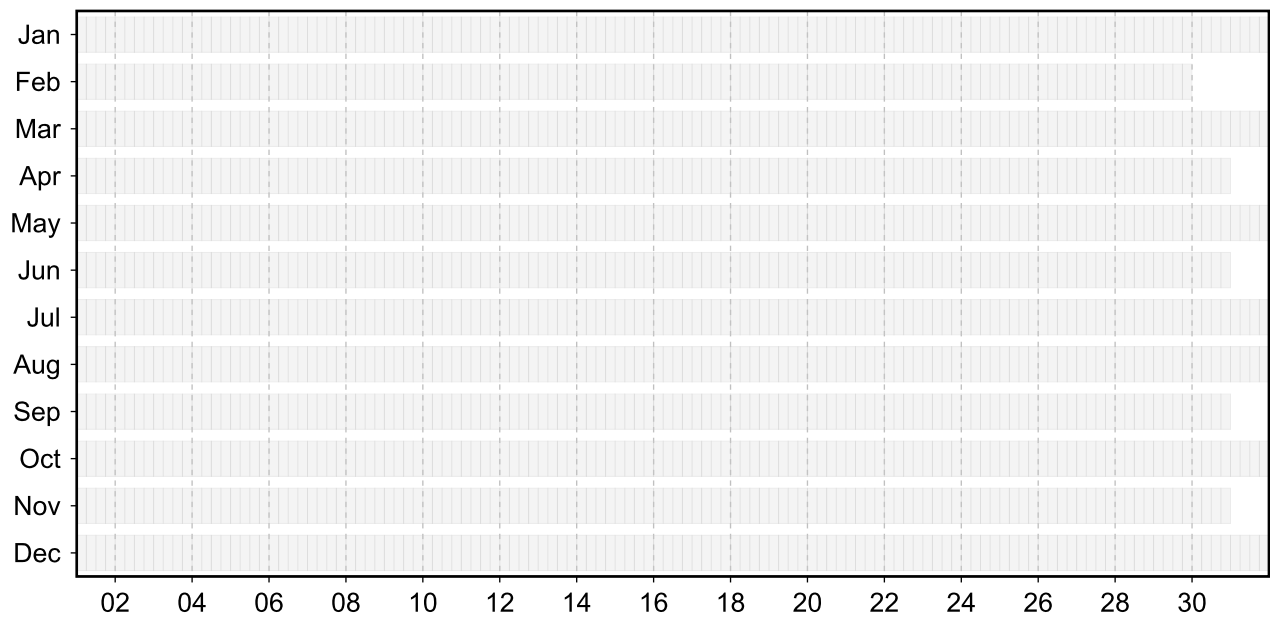
5.3.7 Stream: SRS-C34

Data availability SRS-C34



5.3.8 Stream: SRS-C50

Data availability SRS-C50





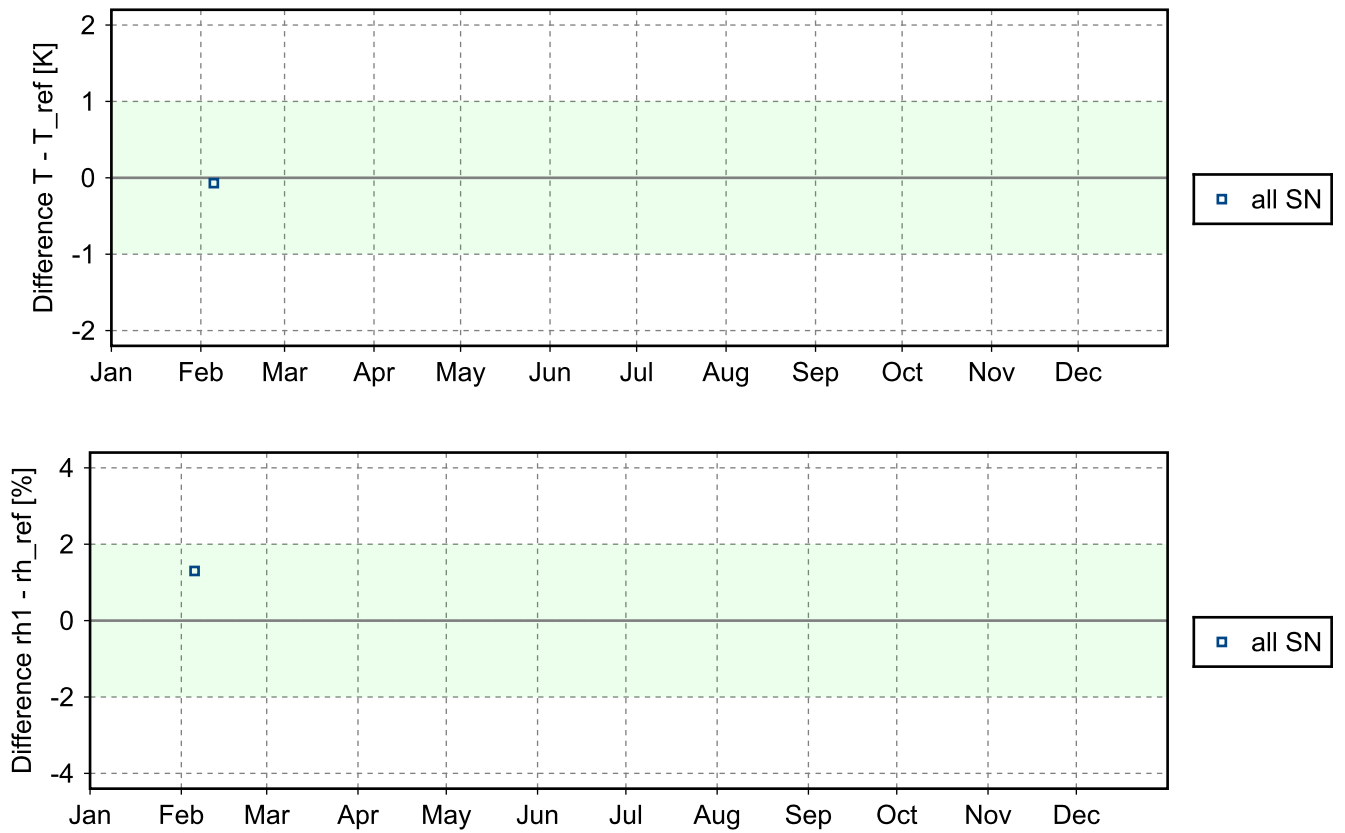
## 5.4 Instrument combinations of LIN-RS-01

| <b>Count</b> | <b>Instrument combination</b> |
|--------------|-------------------------------|
| 4            | CFH, COBALD, ECC, RS41        |
| 2            | 2x CFH, COBALD, ECC, 2x RS41  |
| 6            | CFH, COBALD, ECC, RS41, RS92  |
| 1            | CFH, DFM-09, ECC, RS41, RS92  |
| 1            | CFH, ECC, 2x RS41             |
| 1            | CFH, ECC, RS41                |
| 1            | CFH, ECC, RS41, RS92          |
| 5            | COBALD, RS41                  |
| 53           | ECC, RS41                     |
| 1            | 5x RS41                       |
| 1428         | RS41                          |
| 3            | 2x RS41                       |
| 1            | RS41, SRS-C34                 |
| 7            | RS41, SRS-C50                 |
| 2            | SRS-C34                       |
| 1            | SRS-C50                       |

## 5.5 Instrument ground check

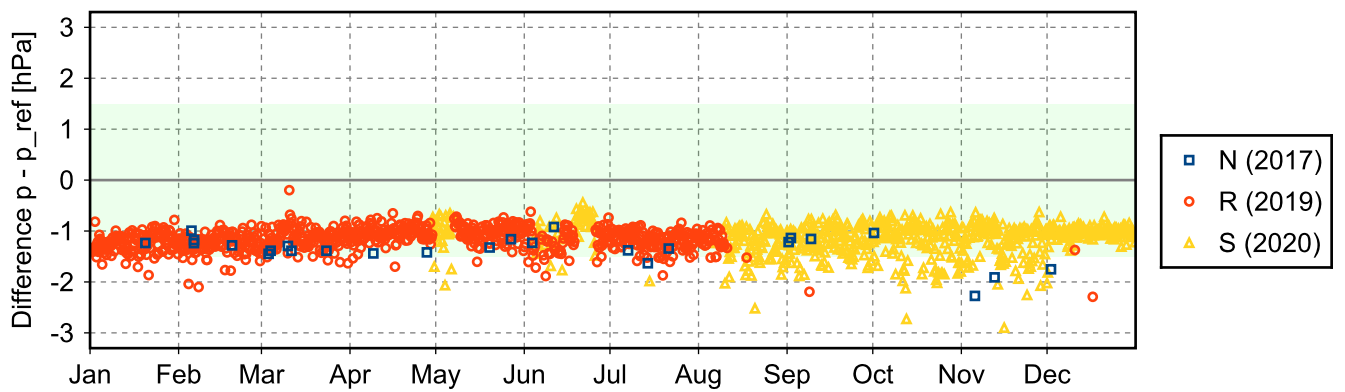
### 5.5.1 Stream: DFM-09

#### (1) GroundCheck: GC-SHC

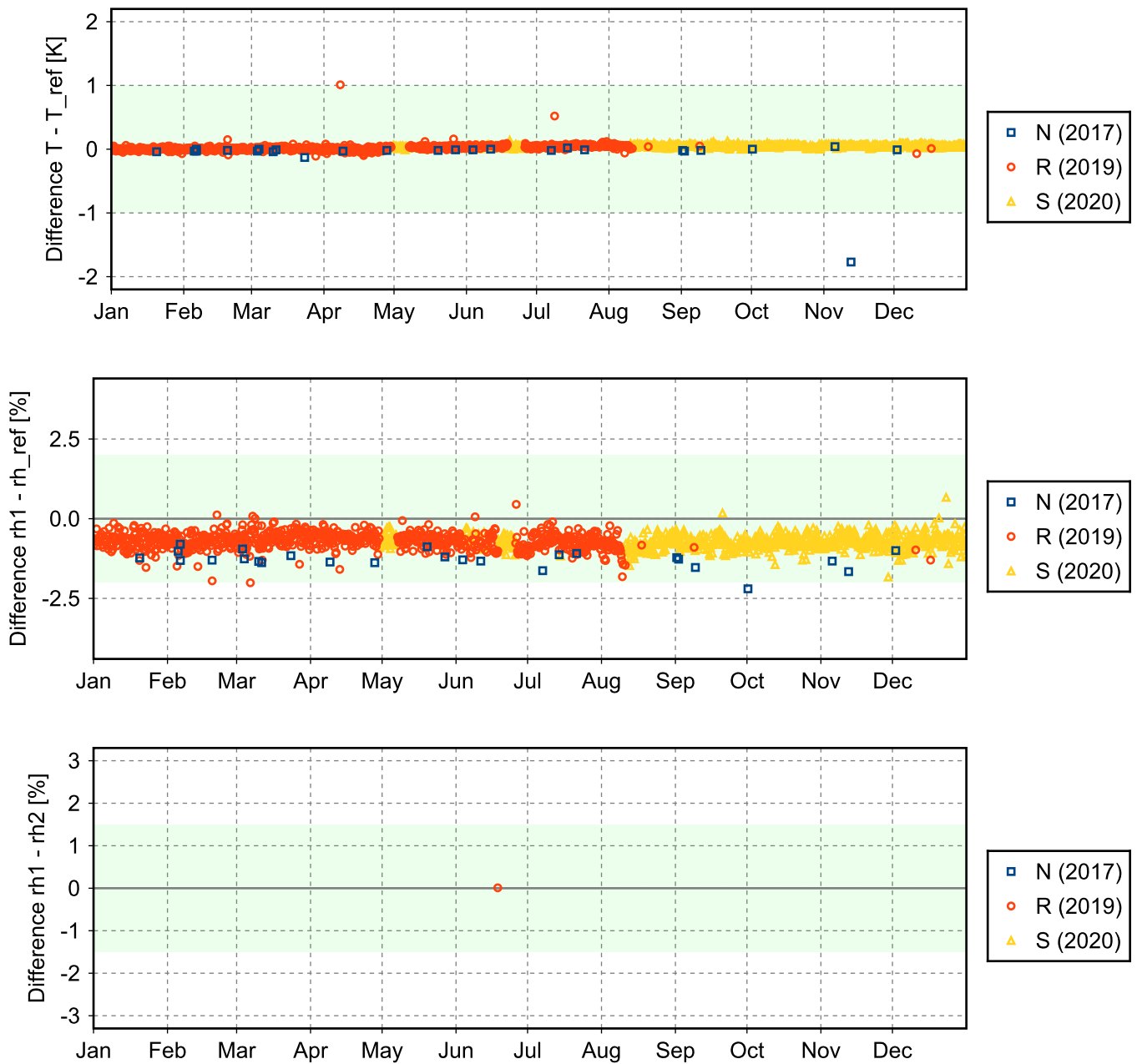


### 5.5.2 Stream: RS41

#### (1) GroundCheck: GC-RI41

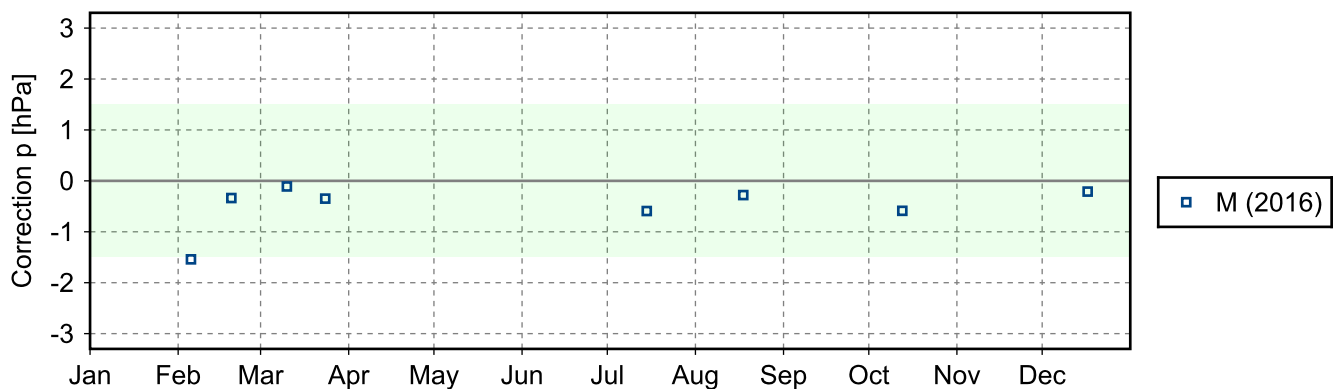


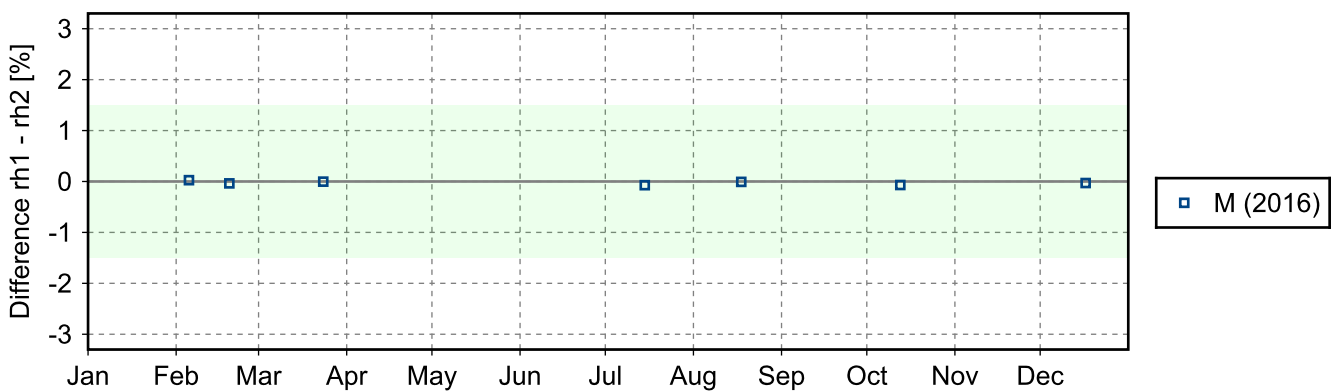
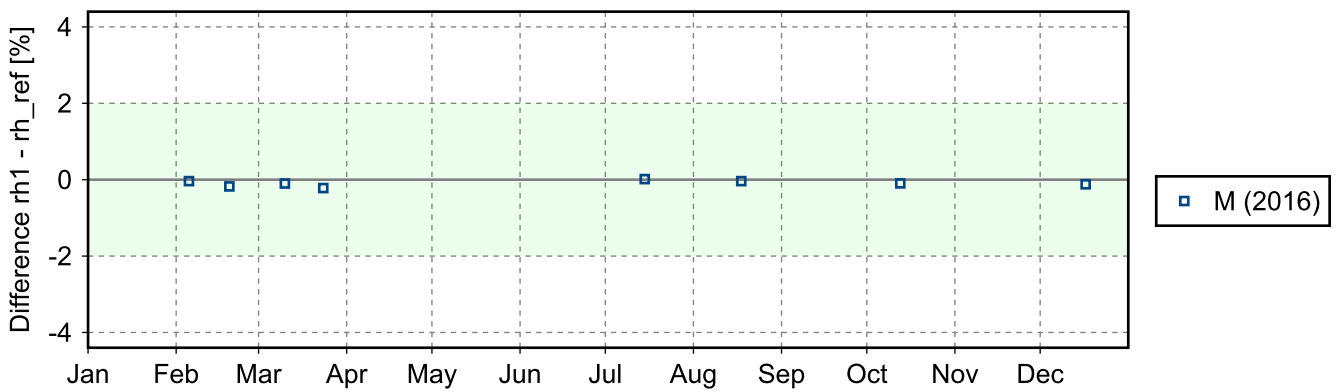
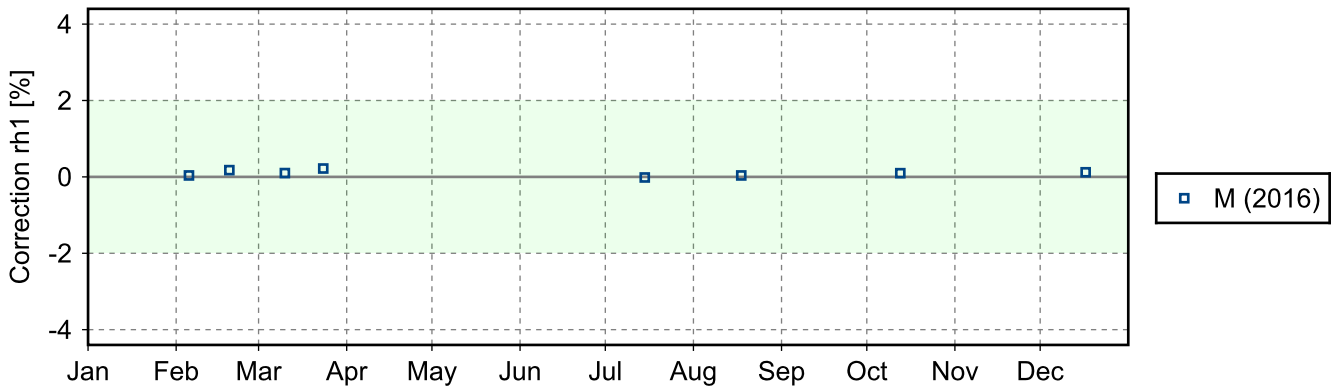
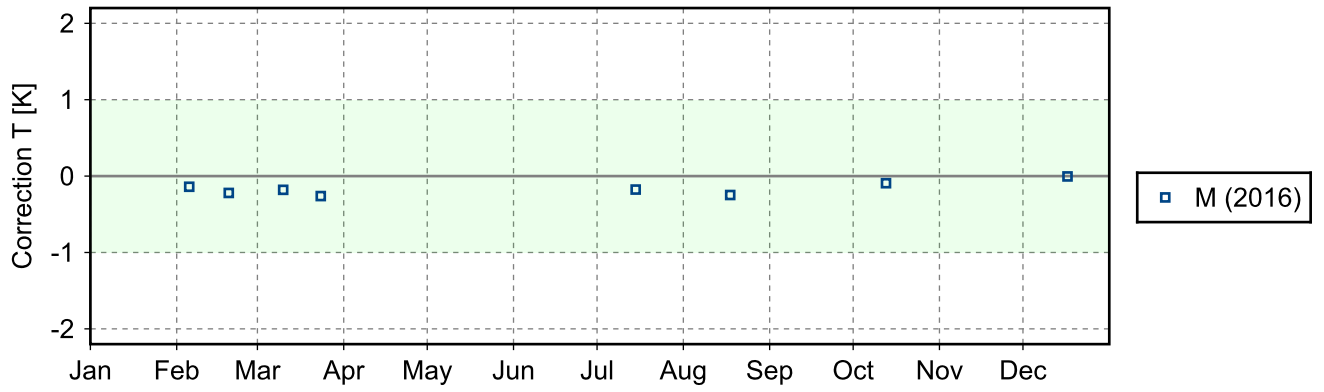
**(2) GroundCheck: GC-SHC**



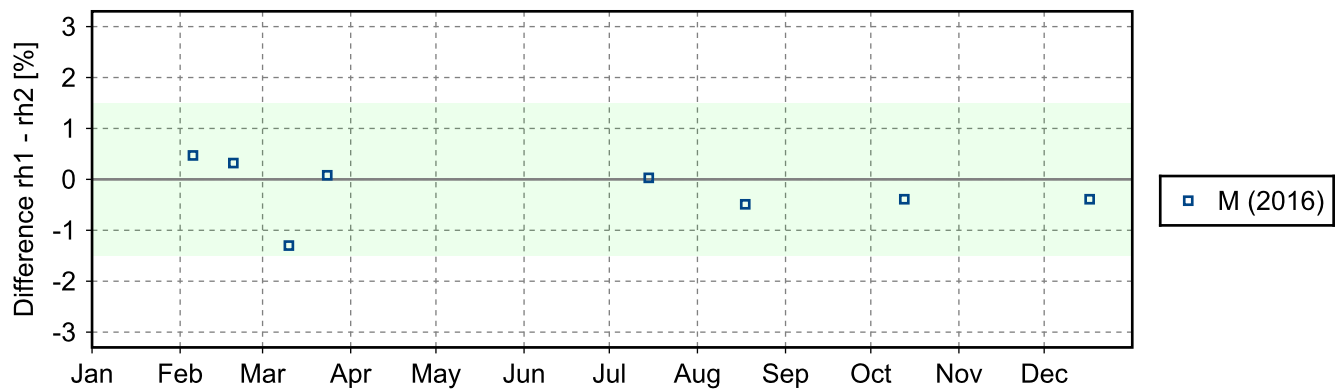
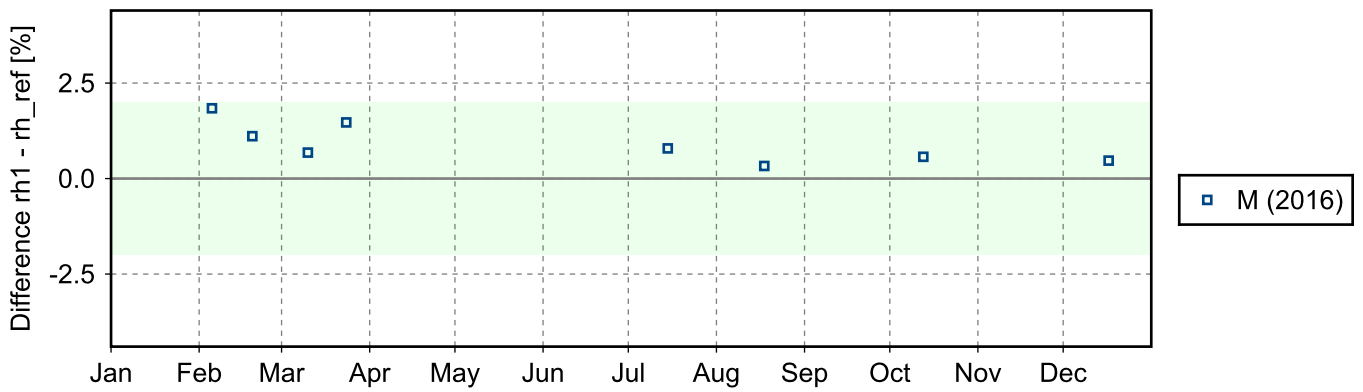
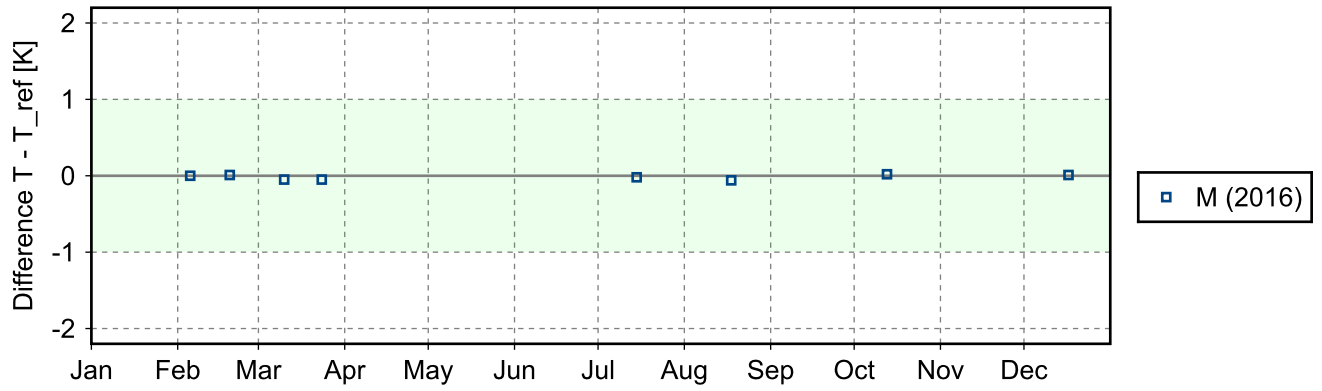
**5.5.3 Stream: RS92**

**(1) GroundCheck: GC-GC25**





(2) GroundCheck: GC-SHC



5.6 Measurement events

