WMO/IOC/UNEP/ICSU
GLOBAL CLIMATE OBSERVING
SYSTEM (GCOS)

**16th GRUAN Implementation-
Coordination Meeting (ICM-16)**
Puerto de la Cruz
17 - 21 November 2025

Doc. 3.04
(28.X.2025)

Session 3

GRUAN Site Report for Boulder

(Submitted by Elizabeth Asher)

Summary and Purpose of this Document

Report from the GRUAN site Boulder for the period January 2024 to December 2024.

Overview

RS41, Intermet radiosonde, ozonesonde and NOAA Global Monitoring Laboratory (GML) frost point hygrometer data are submitted on a monthly basis to the GRUAN LC via RSLaunchClient. Our group does weekly ECC ozonesonde launches (both an Intermet radiosonde, and a RS41 radiosonde are regularly part of these payloads), and launches approximately every three weeks with a NOAA GML frost point hygrometer, an ECC ozonesonde, a Portable Optical Particle Spectrometer (POPS) and a RS41. POPS data is collected but is currently not submitted to the GRUAN LC.

Change and change management

No change in GRUAN related operation procedures has occurred. We continue to launch NOAA GML frost point hygrometers and RS41 radiosondes. As the iMet-1 radiosonde is no longer available for purchase, we have begun using iMet-4 radiosondes on ozonesonde launches and iMet-54 radiosondes on our launches with the NOAA GML frost point hygrometer. We will update RSLaunchClient as soon as possible.

Resourcing

Our site is not facing any insurmountable resourcing challenges. However, we are currently in a hiring freeze and are unable to hire additional support staff for ECC ozonesonde or FPH/ECC launches.

Operations

Our site is not facing any operational challenges. We currently launch the R23, Dry Ice and Alcohol, and LN_2 NOAA GML frost point hygrometers.

Site assessment and certification

Our site is certified.

GRUAN-related research

Our group has been involved in a number of GRUAN-related research projects and publications, primarily studying stratospheric water vapor and aerosol. Related publications are listed below.

Peer-reviewed publications

- X. Zhou et al., Antarctic Vortex Dehydration in 2023 as a Substantial Removal Pathway for Hunga TongaHunga Haapai Water Vapor, Geophysical Research Letters, vol. 51, no. 8, p. e2023GL107630, Apr. 2024, doi: 10.1029/2023GL107630.
- C. Li et al., Microphysical Simulation of the 2022 Hunga Volcano Eruption Using a Sectional Aero-sol Model, Geophysical Research Letters, vol. 51, no. 11, p. e2024GL108522, June 2024, doi: 10.1029/2024GL108522.
- R. J. H. Dunn et al., Global Climate, Bulletin of the American Meteorological Society, vol. 105, no. 8, pp. S12S155, Aug. 2024, doi: 10.1175/BAMS-D-24-0116.1.
- E. Asher et al., Balloon Baseline Stratospheric Aerosol Profiles (B2SAP)Perturbations in the Southern Hemisphere, 20192022, JGR Atmospheres, vol. 129, no. 22, Nov. 2024, doi: 10.1029/2024jd041581.

WG-GRUAN interface

At this time, our site does not require any assistance or support from the GRUAN working group.

Other archiving centers

NDACC, NOAA GML

Participation in campaigns

Our group was involved in the following field campaigns, of relevance to GRUAN:

ATMOSFER balloon intercomparison campaign (2024), Kiruna, Sweeden. Our group launched the NOAA GML frost point hygrometer. Other instruments involved in this intercomparison were the Pico-Light H_2O, and the LN_2 CFH on free-flying balloons and the TDLAS on ATMOSFER gondola.

Dual free-flying balloon intercomparison with the NOAA GML frost point hygrometer and CU Boulder TDLAS (PI Darin Toohey) on the same payload. The RS41 and a second NOAA GML frost point hygrometer was flown on a second free-flying balloon launched within 10 minutes.

Future plans

We plan to launch free-flying balloons for intercomparison from our tropical locations (e.g., Paramaribo) during the long endurance super-pressure balloon Strateole 2 campaign. Specifically, our group will aim to launch free-flying balloons with the NOAA GML frost point hygrometer, an ECC ozonesonde and the POPS aerosol instrument and the for intercomparison with the long endurance super-pressure balloons.

GRUAN Site Report for Boulder (BOU), 2024

Reported time range is Jan 2024 to Dec 2024
Created by the Lead Centre
Version from 2025-11-06

1 General GRUAN site information

Object	Value
Station name	Boulder
Unique GRUAN ID	BOU
Geographical position	39.9500 °N, -105.2000 °W, 1743.0 m
Operated by	GMD | Global Monitoring Division, part of: ESRL | Earth System Research Laboratory, part of: NOAA | National Oceanic and Atmospheric Administration
Main contact	Asher, Elizabeth
WMO no./name	-
Operators	currently 6, changes +0 / -0
Sounding Site	1
GNSS	2

1.1 General information about GRUAN measurement systems

System	Name	Type	Setups	Measurements
BOU-GN-01	GNSS Site P041	GNSS	0	not operational
BOU-GN-02	GNSS site TMS3	GNSS	1	operational
BOU-RS-01	Radiosonde Launch Site (Marshall)	Sounding Site	4	42

1.2 General comments from Lead Centre

No comments from Lead Centre.

2 System: GNSS Site P041 (BOU-GN-01)

Object	Value
System name	GNSS Site P041
Unique GRUAN ID	BOU-GN-01
System type	GNSS (GN - GNSS)
Geographical position	39.5658 °N, -105.1139 °W, 1728.8 m
Operated by	GMD | Global Monitoring Division, part of: ESRL | Earth System Research Laboratory, part of: NOAA | National Oceanic and Atmospheric Administration
Instrument contact	Asher, Elizabeth
Started at	2004-02-13
Defined setups	-
Possible streams	-

2.1 Lead Centre comments

2.1.1 Dataflow

No GNSS dataflow to LC has been established yet.

3 System: GNSS site TMS3 (BOU-GN-02)

Object	**Value**
System name	GNSS site TMS3
Unique GRUAN ID	BOU-GN-02
System type	GNSS (GN - GNSS)
Geographical position	40.0748 °N, -105.1358 °W, 1668.7 m
Operated by	GFZ | Deutsches GeoForschungsZentrum GFZ, part of: HELMHOLTZ | Helmholtz-Gemeinschaft
Instrument contact	Bradke, Markus
Started at	2014-06-20
Defined setups	1 (HOURLY)
Possible streams	-

3.1 Lead Centre comments

3.1.1 Dataflow

No GNSS dataflow to LC has been established yet.

4 System: Radiosonde Launch Site (Marshall) (BOU-RS-01)

Object	Value
System name	Radiosonde Launch Site (Marshall)
Unique GRUAN ID	BOU-RS-01
System type	Sounding Site (RS - Radiosonde)
Geographical position	39.9500 °N, -105.2000 °W, 1743.0 m
Operated by	GMD | Global Monitoring Division, part of: ESRL | Earth System Research Laboratory, part of: NOAA | National Oceanic and Atmospheric Administration
Instrument contact	Asher, Elizabeth
Started at	-
Defined setups	4 (RESEARCH, OZONE, FPH-OZONE, FPH)
Possible streams	FPH, IMET-1, IMET-4, IMET-54, POPS, RS41, RS80, RS92

4.1 Lead Centre comments

4.1.1 Dataflow

Operational dataflow of radiosonde measurement data to the GRUAN LC since August 2014.

Currently, the dataflow includes radiosoundings with Vaisala RS41-SG, Intermet iMet-4 & iMet-54, ECC Ozone and FPH. All data are transmitted using the RsLaunchClient.

A regular and intensive measurement program for the observation of stratospheric water vapor was performed using FPH.

4.1.2 Data quality

Ground check (SHC) temperature differences are very large and noisy at -3 to -6 K. There appears to be a fundamental flaw in the reference temperature measurement.

4.2 GRUAN data products

Product	Version	Soundings received	Available at LC	Distributed by NCEI

4.2.1 Stream: ECC

ECC		42	42	

4.2.2 Stream: FPH

FPH		23	23	

4.2.3 Stream: IMET-4

IMET-4		19	19	

4.2.4 Stream: IMET-54

IMET-54		23	23	

4.2.5 Stream: POPS

POPS		17	17	

4.2.6 Stream: RS41

RS41		25	25	
RS41-RAW	001		25	
RS41-EDT	001		25	
RS41-GDP	001		25	

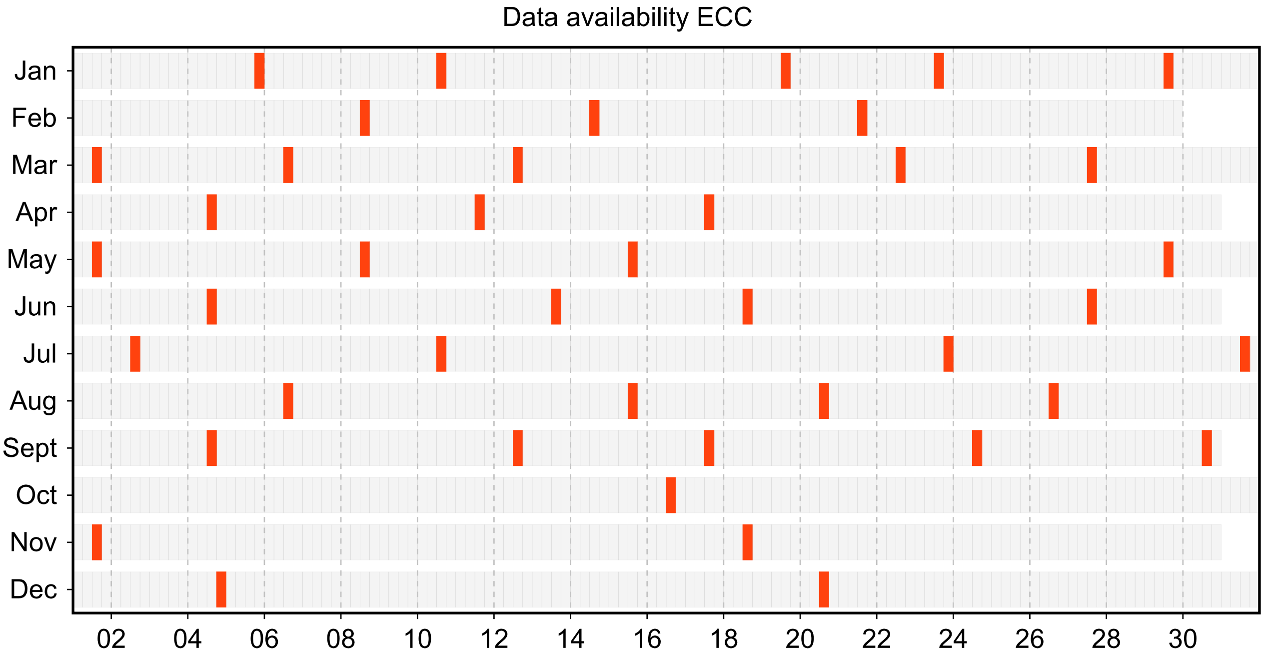
4.3 Availability of data products

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).

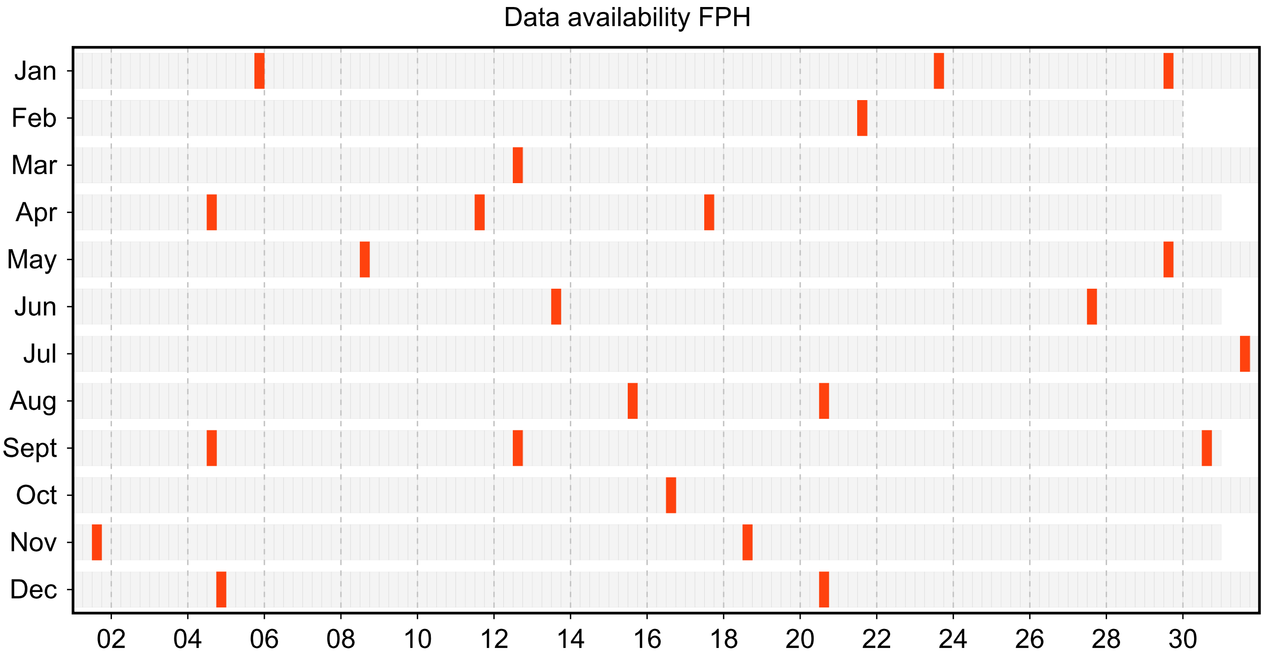
Unprocessed (yellow): The manufacturer-produced file with raw measurement data has been successfully converted into a GRUAN-standardized raw data format (NetCDF). The GRUAN data processing has not been performed or was aborted. Reasons for this may be a still missing GRUAN data processor or a processing-software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

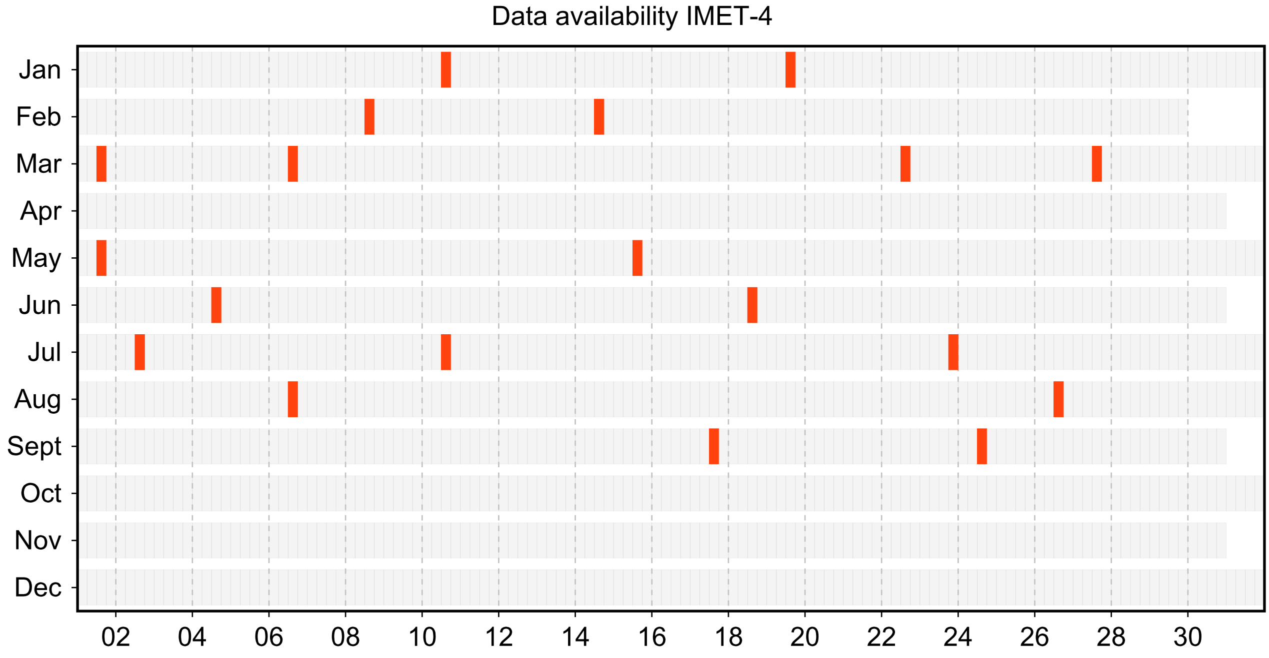
4.3.1 Stream: ECC



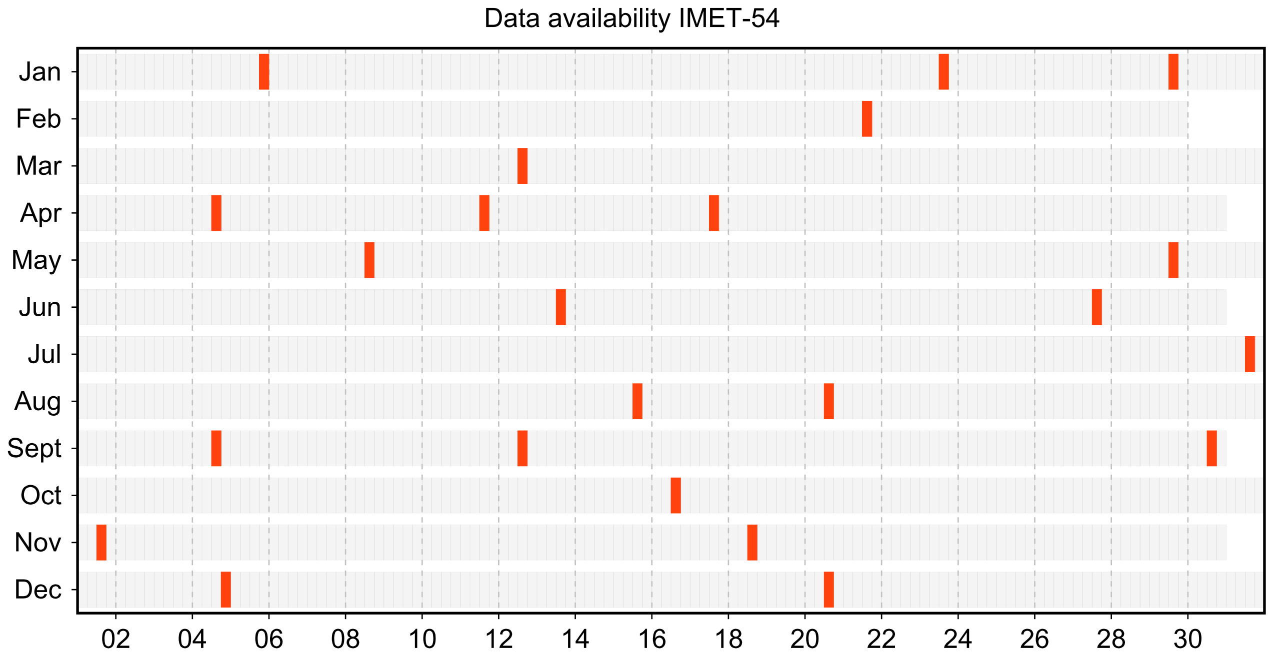
4.3.2 Stream: FPH



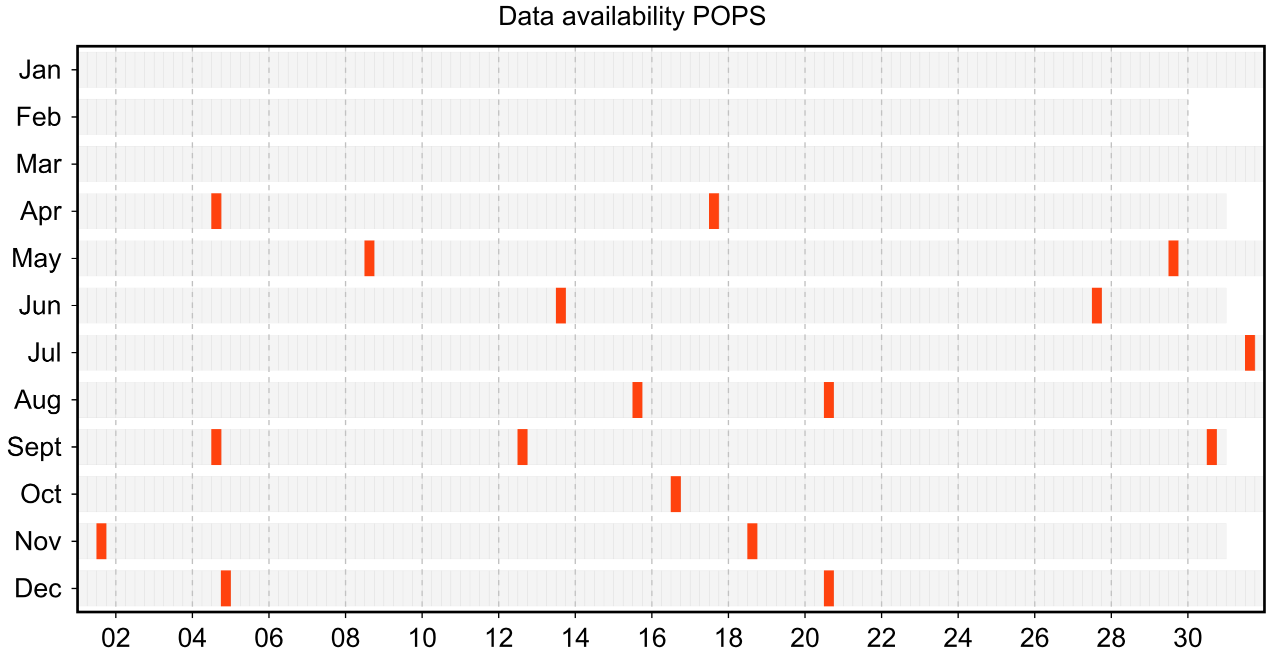
4.3.3 Stream: IMET-4



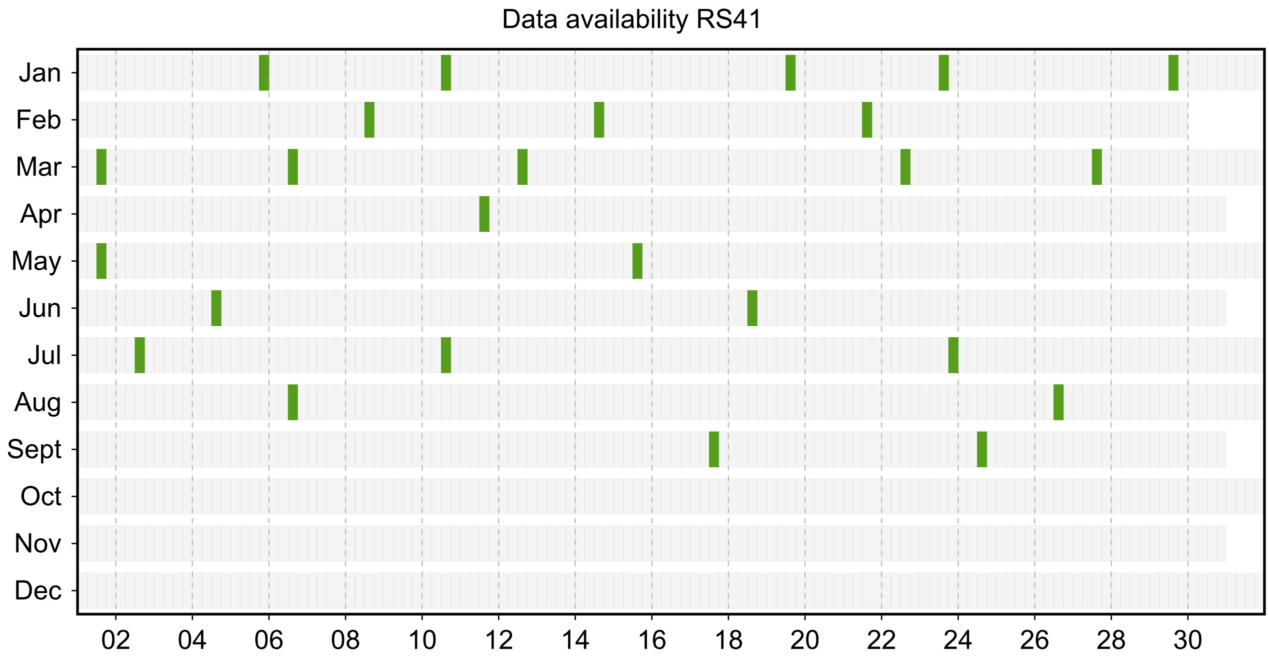
4.3.4 Stream: IMET-54



4.3.5 Stream: POPS



4.3.6 Stream: RS41



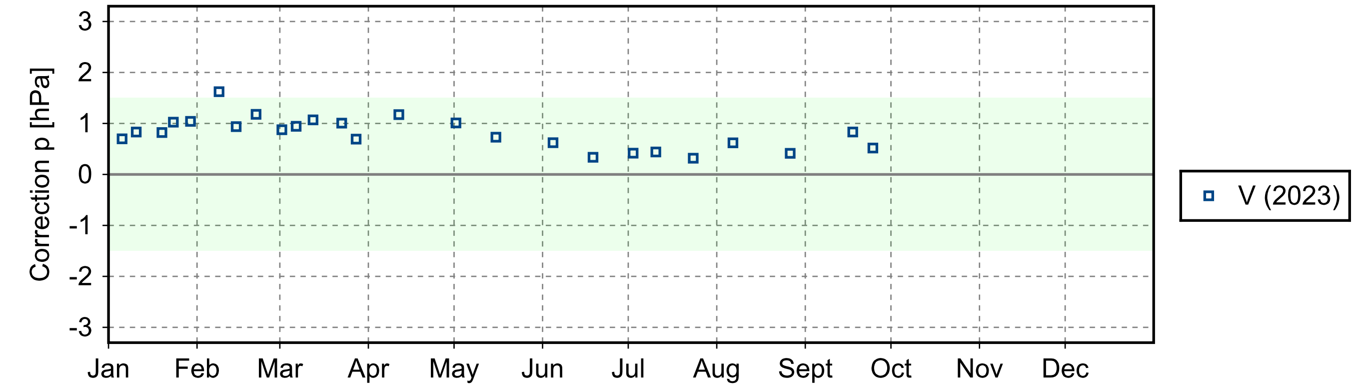
4.4 Instrument combinations of BOU-RS-01

Count	Instrument combination
17	ECC, FPH, IMET-54, POPS
6	ECC, FPH, IMET-54, RS41
19	ECC, IMET-4, RS41

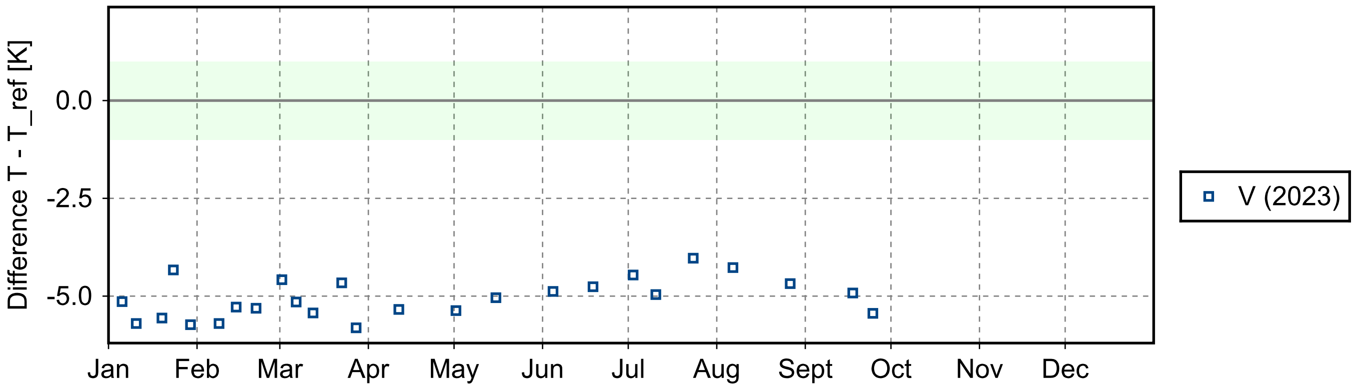
4.5 Instrument ground check

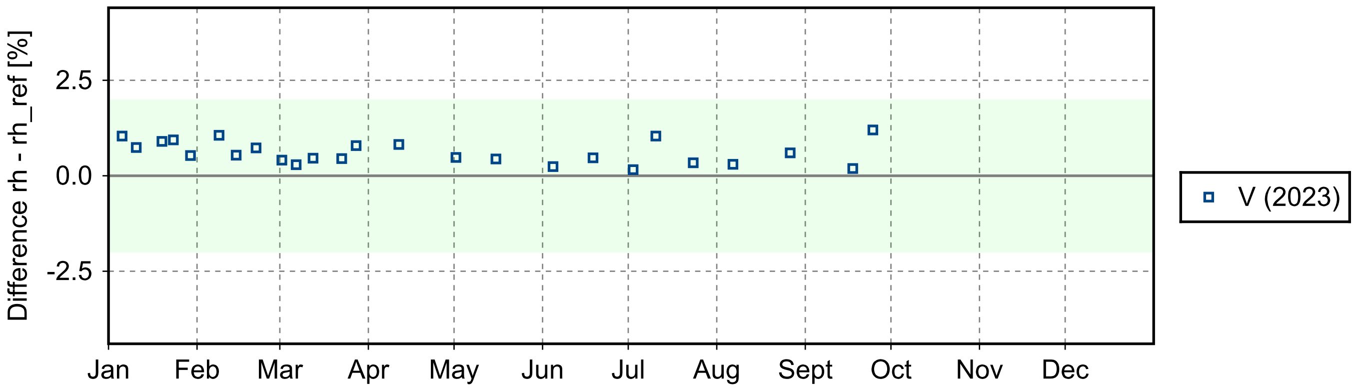
4.5.1 Stream: RS41

(1) GroundCheck: GC-RI41



(2) GroundCheck: GC-SHC





4.6 Measurement events