



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

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**8th GRUAN Implementation-  
Coordination Meeting (ICM-8)**

Boulder, USA

25 April – 29 April 2016

Session 7

## GRUAN Station Report for Lindenberg

*(Submitted by Ruud Dirksen)*

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### Summary and Purpose of Document

Report from the GRUAN station Lindenberg for the period March 2015 to March 2016.

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## GRUAN Station Report for Lindenberg (LIN)

Reporting for the period Mar 2015 to Mar 2016

Date: 6-Apr-2016

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### Overview

Lindenberg contributes to GRUAN with the following operational data streams: RS92 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, RS41. These additional soundings are performed at least once per month, depending on instrument type. All measurements are performed in accordance with GRUAN operational procedures.

### Change and change management

The procedures for the operational RS92 and GNSS data streams have not been altered. In 2017 the RS92 will be replaced by the RS41 as operational radiosonde. In preparation for this upcoming change we have initiated an extensive (> 2 years) intercomparison program to investigate the differences between both radiosondes. This intercomparison program will be part of the GRUAN-wide effort in the RS92-RS41 change management.

In order to be able to fly RS41, we upgraded several Vaisala receiving systems to MW41. The system for the GRUAN/operational radiosounding with the RS92 still is MW31.

For research sondes such as CFH, COBALD and Ozone, the RS41 has replaced the Internet iMet-1 as carrier sonde.

### Resourcing

The situation at Lindenberg is good: we have stable (financial + personal) resources to perform 4 radiosoundings per day, as well as numerous research soundings with CFH, COBALD and alike.

### Site assessment and certification

The Lindenberg site was GRUAN-certified (for the RS92 measurement program) in 2014.

### GRUAN-related research

- RS92-RS41 intercomparison.
- Soundings with research instruments such as CFH, Ozone, COBALD, FLASH.
- Characterisation of radiosondes' errors and uncertainties under laboratory conditions. E.g. characterisation of the time lag of the RH sensor for RS92, RS41, Graw DFM-09.
- Characterisation of the radiation error of the temperature sensor.
- Development a GRUAN data product for the RS41, Graw DFM-09, and for the CFH (all on-going work).
- Development of upgrade for RS92 data product (version 3).
- Cooperation with GFZ Potsdam in development of a GRUAN GNSS IPW data product.
- Participation in MORGANE-2 campaign on La Reunion (7-27 May 2015)

#### Papers:

- Bodeker, G. E. et al., Reference upper-air observations for climate: From concept to reality, Bull. Amer. Meteor. Soc., 97, 123–135, doi:[10.1175/bams-d-14-00072.1](https://doi.org/10.1175/bams-d-14-00072.1), 2016.
- Ning, T., et al., The uncertainty of the atmospheric integrated water vapour estimated from GNSS observations, Atmos. Meas. Tech., 9(1), 79–92, doi:[10.5194/amt-9-79-2016](https://doi.org/10.5194/amt-9-79-2016), 2016.
- Vömel, H., et al., An update on the uncertainties of water vapor measurements using Cryogenic Frostpoint Hygrometers, Atmos. Meas. Tech. Discuss., 2016, 1–26, doi:[10.5194/amt-2016-44](https://doi.org/10.5194/amt-2016-44), 2016.
- Antón, M., et al., Validation of GOME-2/MetOp-A total water vapour column using reference radiosonde data from GRUAN network, Atmos. Meas. Tech., 8(3), 1135–1145, doi:[10.5194/amt-8-1135-2015](https://doi.org/10.5194/amt-8-1135-2015), 2015.
- Yu, H., et al., Evaluation of humidity correction methods for Vaisala RS92 tropical sounding data, J. Atmos. Ocean. Technol., 32(3), 397–411, doi:[10.1175/jtech-d-14-00166.1](https://doi.org/10.1175/jtech-d-14-00166.1), 2015.

#### **WG-GRUAN interface**

Not necessary.

#### **Items for ICM-8 plenary discussions**

Nothing which isn't already on the agenda.

#### **Future plans**

Continue RS41-RS92 intercomparison, continue sounding program with research/reference sondes (e.g. CFH). Develop new set-up to assess solar radiation error of radiosonde's temperature sensor. Participate in and support international measurement campaigns.



# GRUAN Station Report for Lindenberg (LIN), 2015

Reported time range is Nov 2014 to Feb 2016

Created by the Lead Centre

Version from 2016-04-19

## 1 General GRUAN station information

Info	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	current 15, change +0 / -0
Sounding Site	1
GNSS	2

### 1.1 General information about GRUAN measurement systems

System	Type	Setups	Measurements	As scheduled
LIN-GN-01	GNSS	1	0	0.00 %
LIN-GN-02	GNSS	0	0	not scheduled
LIN-RS-01	Sounding Site	3	1991	106.13 %

### 1.2 General comments from Lead Centre

#### 1.2.1 General

The site is requested to establish a GRUAN data product for the cryogenic frostpoint hygrometer.

#### 1.2.2 GTS

This site regularly sends PTU measurements in the GTS (BUFR format, 2s resolution, 4 times per day).

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

Info	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	Bisek, Krispin
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 Lindenberg GNSS station is one of two test sites to implement the GNSS dataflow in GRUAN. The current dataflow includes manufacturer raw data, converted raw data (RINEX) and instrument logs, containing all equipment changes.

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

Info	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	Bisek, Krispin
Started at	-
Defined setups	-
Possible streams	-

#### 3.1 Lead Centre comments

##### 3.1.1 Dataflow

No GNSS dataflow to GRUAN LC as yet.

## 4 System: Lindenberg Launch Site (LIN-RS-01)

Info	Value
System name	Lindenberg 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	3 (RESEARCH, ROUTINE, OZONE)
Possible streams	CFH, COBALD, ECC, FPH, RS41, RS80, RS92

### 4.1 Lead Centre comments

#### 4.1.1 Dataflow

Sonde dataflow to the GRUAN LC operational since January 2008. This dataflow includes streams of the Vaisala RS92-SGP, ECC Ozone sonde, CFH water vapour, and Internet iMet-1. Additional radiosondes are included in dataflow: Graw DFM-09 since 2010, Vaisala RS41-SG(P) since December 2014. All launches are promptly recorded using the RsLaunchClient. The site is used as test bed for the RsLaunchClient.

#### 4.1.2 Data quality

GC25 ground check corrections are largely within expected limits.

A manufacturer independent additional ground check using the Standard Humidity Chamber (SHC) is used for all radiosonde launches.

Very few metadata issues have been identified. Those that were found were corrected.

#### 4.1.3 General

Routine soundings are performed four times per day. Ozone soundings are performed once per week. Research soundings using CFH, ECC, iMet-1, and Vaisala RS92, RS41 are launched twice per month. Graw radiosondes have been used as redundant sonde during weekly dual soundings till July 2015 (after biweekly). Vaisala RS41 have been used as redundant sonde during biweekly dual soundings since December 2014 and weekly since August 2015. Various sonde combinations have been flown through the reporting period.

### 4.2 GRUAN data products

Product	Version	Soundings received	Available at LC	Distributed by NCDC
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#### 4.2.1 Stream: CFH

CFH		33	33	
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#### 4.2.2 Stream: COBALD

COBALD		17	17	
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#### 4.2.3 Stream: DFM-06



Product	Version	Soundings received	Available at LC	Distributed by NCDC
DFM-06		4	4	

## 4.2.4 Stream: DFM-09

DFM-09		52	52	
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## 4.2.5 Stream: ECC

ECC		110	110	
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## 4.2.6 Stream: FPH

FPH		3	3	
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## 4.2.7 Stream: IMET-1

IMET-1		35	35	
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## 4.2.8 Stream: RS41

RS41		58	58	
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## 4.2.9 Stream: RS92

RS92		1992	1992	
RS92-RAW	001		1989	
RS92-GDP	002		1861	1796

## 4.3 Data quality of current GRUAN data products

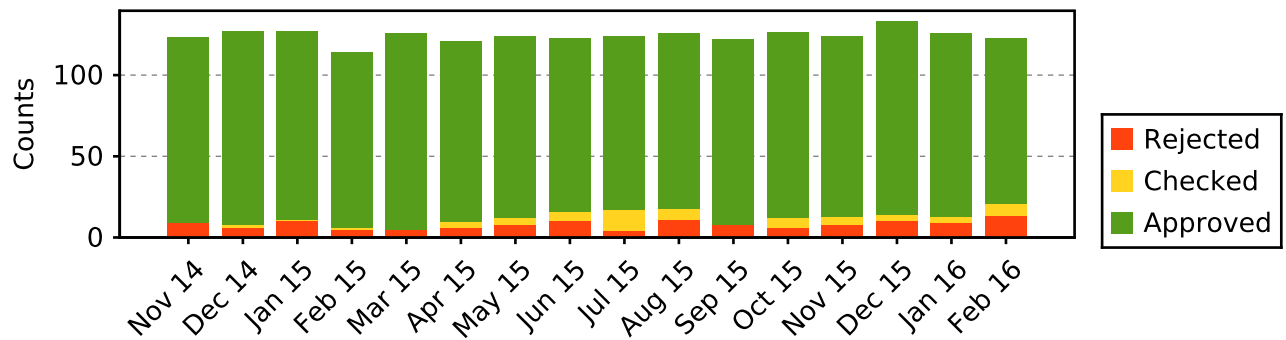
Month	Count	GRUAN Data Quality			Issues				
		Approved	Checked	Rejected	Meta-data	Process.	Press	Temp	RH

## 4.3.1 Stream: RS92 (Product: RS92-GDP-002)

Nov 14	123	114		9	3		2	6	24
Dec 14	127	119	2	6	2		1	4	27
Jan 15	127	116	1	10	5		1	2	22
Feb 15	114	108	1	5	3			5	8
Mar 15	126	121		5	2			6	20
Apr 15	121	111	4	6			6	9	19
May 15	124	112	4	8	3		5	10	15
Jun 15	123	107	6	10	4		8	2	15
Jul 15	124	107	13	4	3		13	11	6
Aug 15	126	108	7	11	8		8	13	16
Sep 15	122	114		8	2		1	12	11
Oct 15	126	114	6	6	1		6	11	17
Nov 15	124	111	5	8	1		6	8	18
Dec 15	133	119	4	10	2		4	8	33
Jan 16	126	113	4	9	4		6	3	31
Feb 16	123	102	8	13	4		5	9	37
	<b>1989</b>	<b>1796</b>	<b>65</b>	<b>128</b>	<b>47</b>		<b>72</b>	<b>119</b>	<b>319</b>

Month	Count	GRUAN Data Quality			Issues				
		Approved	Checked	Rejected	Meta-data	Process.	Press	Temp	RH

Data quality statistic of stream RS92



Schedule data quality of stream RS92



#### 4.4 Instrument combinations of LIN-RS-01

##### Count Instrument combination

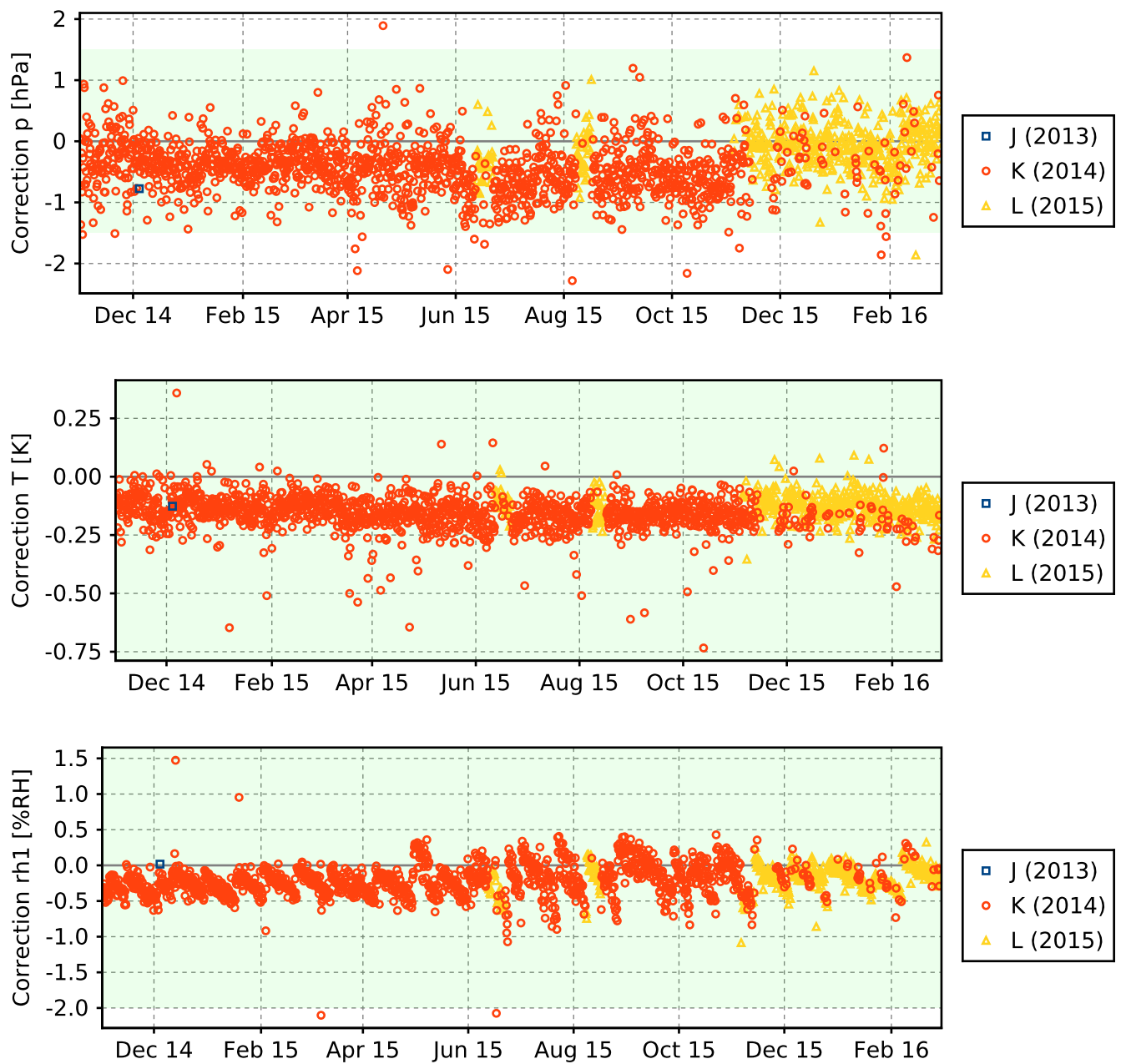
- 11 CFH, COBALD, DFM-09, ECC, IMET-1, RS41, RS92
- 2 CFH, COBALD, DFM-09, ECC, IMET-1, RS92
- 1 CFH, COBALD, DFM-09, ECC, RS41, RS92
- 2 CFH, COBALD, ECC, FPH, 2x IMET-1, RS41, RS92
- 1 CFH, COBALD, ECC, IMET-1, RS41, RS92
- 13 CFH, DFM-09, ECC, IMET-1, RS41, RS92
- 1 CFH, DFM-09, ECC, IMET-1, RS92
- 1 CFH, ECC, FPH, 2x IMET-1, RS41, RS92
- 1 CFH, ECC, IMET-1, RS41, RS92
- 1 DFM-06, DFM-09, RS41, RS92
- 1 DFM-06, ECC, RS92
- 2 DFM-06, RS92
- 2 DFM-09, RS41, RS92

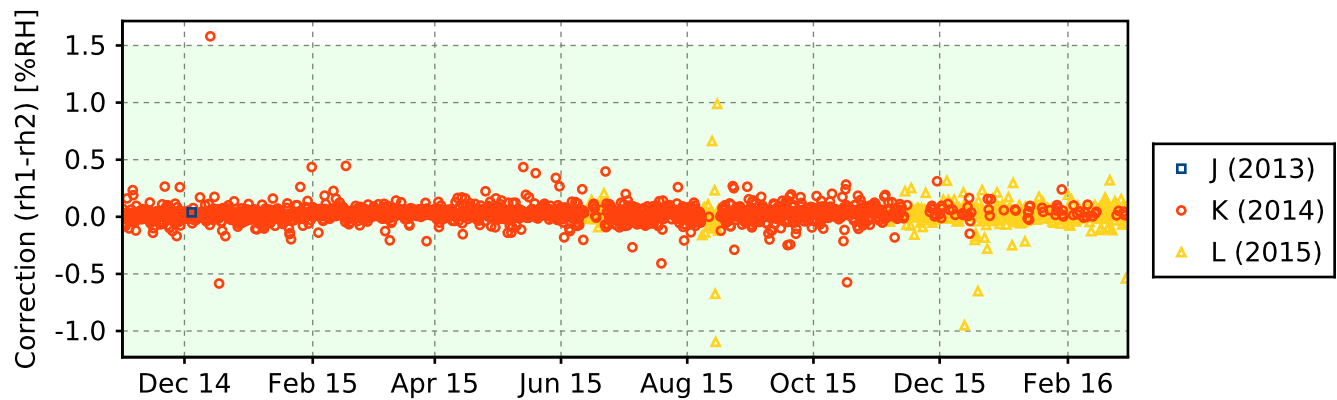
Count	Instrument combination
21	DFM-09, RS92
76	ECC, RS92
23	RS41, RS92
1	2x RS41, 2x RS92
1831	RS92

## 4.5 Instrument ground check

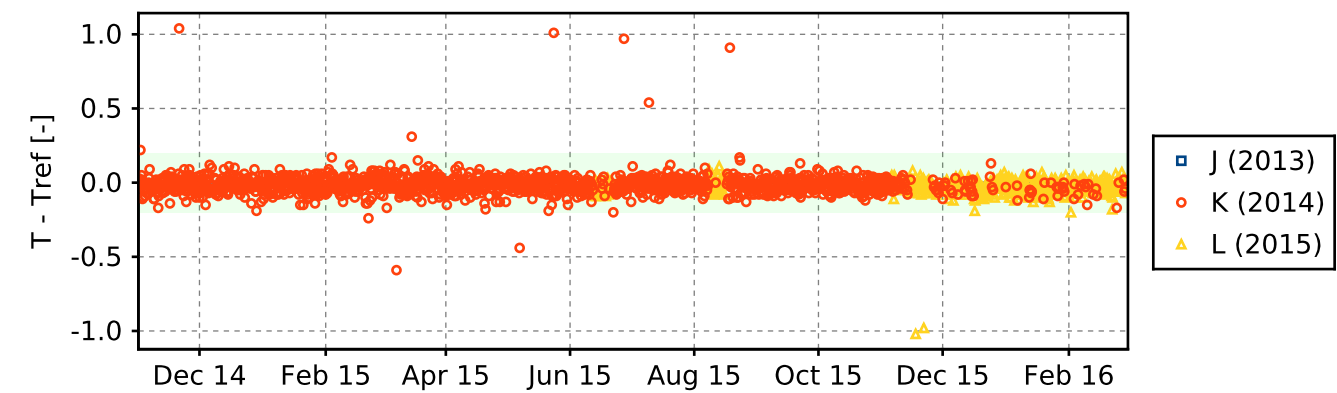
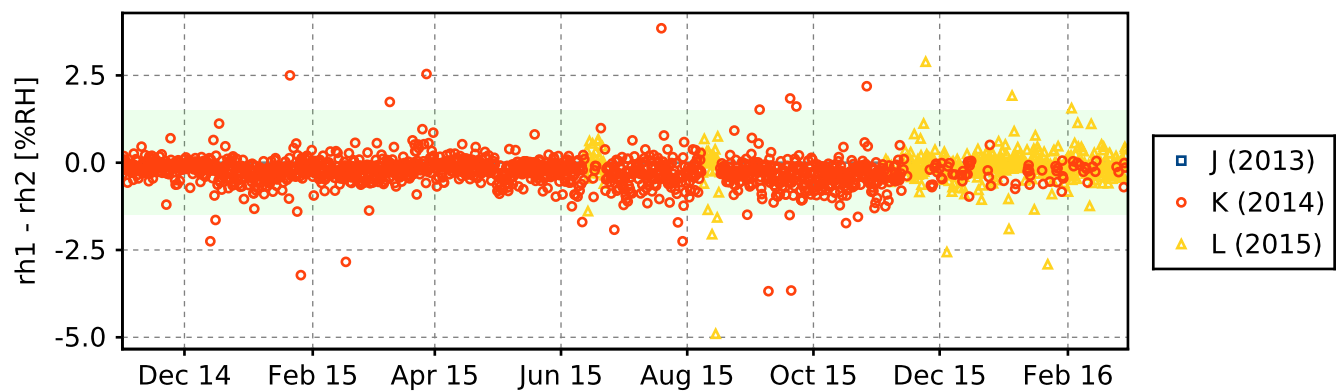
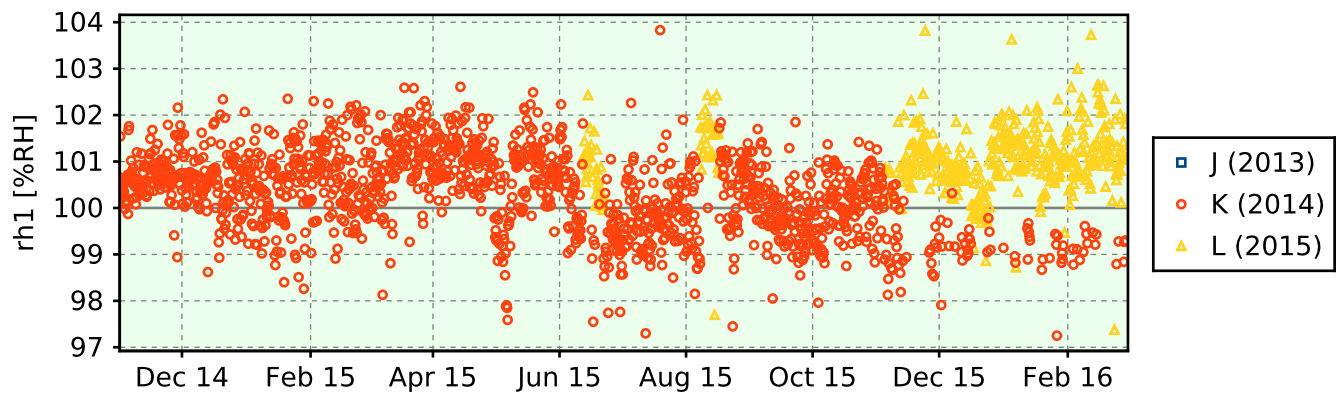
### 4.5.1 Stream: RS92

#### 4.5.1.1 GroundCheck: GC25





4.5.1.2 GroundCheck: SHC



4.6 Measurement events

4.6.1 Stream: RS92

