



# Update on GRUAN data flow

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10<sup>th</sup> GRUAN Implementation and Coordination Meeting (ICM-10)

Potsdam, Germany

Session 7, 25 April 2018

- Change management
- Ongoing developments
- Statistics & monitoring
- Conclusion

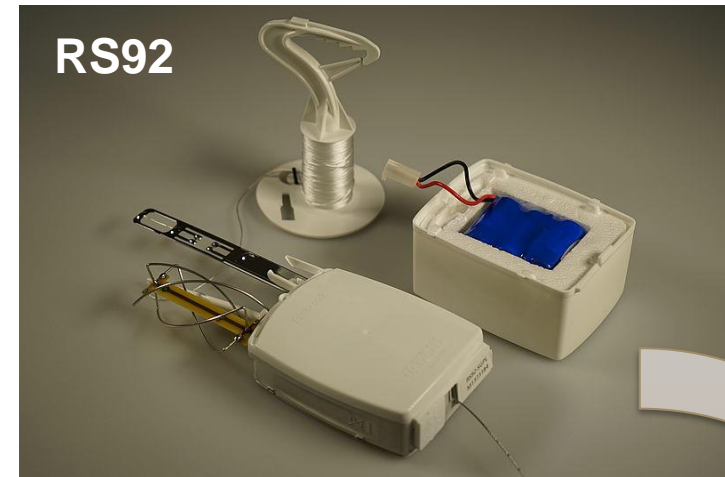
A large white weather balloon is shown floating in a clear blue sky. It is attached to a red fabric streamer, which is connected to a series of instruments and sensors hanging from a thin wire. The instruments include a small red circular device and several rectangular boxes, likely containing electronic equipment for data collection.

# Current activities of **CHANGE MANAGEMENT**

# Transition from RS92 to RS41

## ➤ Change from Vaisala RS92 to RS41 at following sites:

- Lauder (October 2015 – ongoing)  
Lauder (at Invercargill, September 2016)
- Singapore (April 2016, from Graw DFM-09)
- Potenza (May to October 2016)
- Beltsville (December 2016 – ongoing)
- Boulder (January 2017)
- Cabauw (February 2017)
- Lindenberg (March 2017)
- Sodankylä (March 2017)
- Ny-Alesund (April 2017)
- Lamont/SGP (April to December 2017)
- Barrow (September to December 2017)
- Tenerife (December 2017)

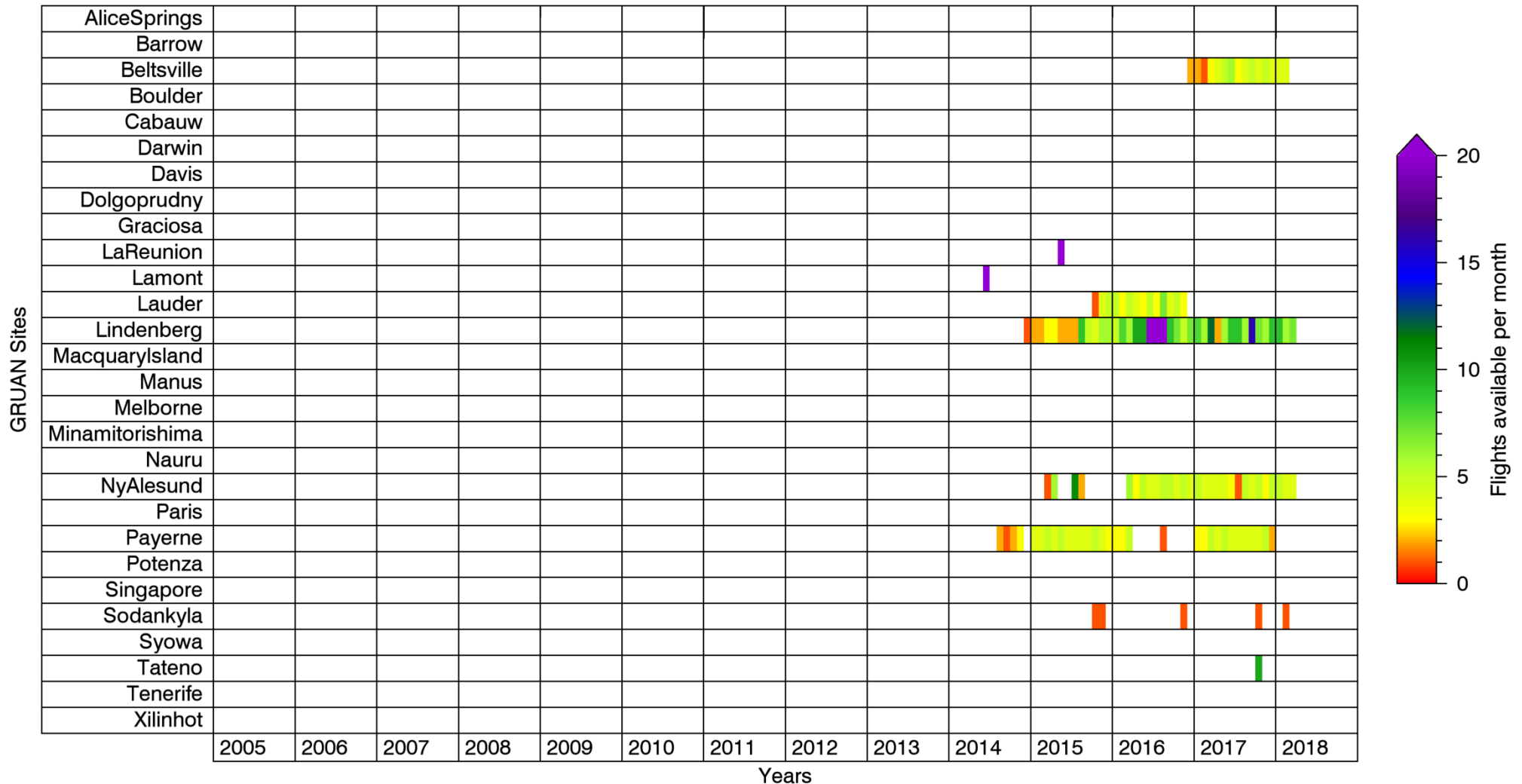


# Dual launches with RS92 and RS41

Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



GRUAN Vaisala RS92 vs. Vaisala RS41 Comparison Launches (total: 730 at 2018-04-11)



→ See start presentation session 5



- Tenerife, TEN (Spain)
  - Site and RS92 as well as RS41 data streams defined
  - RS92 data processed from 2008 to 2017 (with gaps because of missing raw data)
  - RS41 data stream since December 2018 – operational
- Dolgoprudny, DLG (Russia)
  - Site and Modem M10 data stream defined
- Minamitorishima, MTS (Japan)
  - Site and Meisei iMS-100 data stream defined
- Syowa, SYO (Japan)
  - Site and Meisei RS-11G as well as RS-06G data streams defined



RNUM	ID	MS_CODE	SITE_CODE	SITE_NAME	SETUP_CODE	SCHEDULE_DATE	ME_CODE	VERSION	STATUS	INTERNAL_CODE	OP_ALIAS	OLD_VERSION	ISSUE_DATE	DESCRIPTION	MEASURIN
1	85752	TEN-RS-01	TEN	Tenerife	ROUTINE2	2018-04-17T23:00:00.000Z	1	1	2		TEN-AUTO		2018-04-18T06:06:41.693Z	Automatic creation of GMD file by gRai (GruanToolRaLaunch) 0.4.1 (2018-01-04).	85752 <a href="#">info</a>
2	85751	TEN-RS-01	TEN	Tenerife	ROUTINE2	2018-04-17T11:00:00.000Z	1	1	2		TEN-AUTO		2018-04-18T06:06:30.339Z	Automatic creation of GMD file by gRai (GruanToolRaLaunch) 0.4.1 (2018-01-04).	85751 <a href="#">info</a>
3	85750	TAT-RS-01	TAT	Tateno	ROUTINE3	2018-04-17T12:00:00.000Z	1	1	2		TAT-KO02		2018-04-18T05:30:58.093Z		85750 <a href="#">info</a>
4	85749	SNG-RS-01	SNG	Singapore	ROUTINE2	2018-04-16T00:00:00.000Z	1	1	2	SNG-RS-2018041600	SNG-DS		2018-04-18T04:30:31.806Z		85749 <a href="#">info</a>
5	85748	SNG-RS-01	SNG	Singapore	ROUTINE2	2018-04-18T00:00:00.000Z	1	1	2	SNG-RS-2018041800	SNG-DS		2018-04-18T04:18:18.270Z		85748 <a href="#">info</a>
6	85747	LIN-RS-01	LIN	Lindenberg	RESEARCH	2018-04-18T00:00:00.000Z	1	1	2	LG2018_37_rr	LIN-KR		2018-04-18T01:36:59.759Z		85747 <a href="#">info</a>
7	85746	TAT-RS-01	TAT	Tateno	ROUTINE3	2018-04-17T00:00:00.000Z	1	1	2		TAT-S101		2018-04-18T01:12:08.628Z		85746 <a href="#">info</a>
8	85745	SNG-RS-01	SNG	Singapore	ROUTINE2	2018-04-17T12:00:00.000Z	1	1	2	SNG-RS-2018041712	SNG-DS		2018-04-18T00:06:19.943Z		85745 <a href="#">info</a>
9	85744	LIN-RS-01	LIN	Lindenberg	ROUTINE2	2018-04-17T18:00:00.000Z	1	1	2	428	LIN-KR		2018-04-17T20:00:29.385Z		85744 <a href="#">info</a>
10	85743	NYA-RS-01	NYA	NyAlesund	ROUTINE2	2018-04-17T12:00:00.000Z	1	1	2		NYA-MI		2018-04-17T14:18:22.121Z		85743 <a href="#">info</a>
11	85742	LIN-RS-01	LIN	Lindenberg	ROUTINE2	2018-04-17T12:00:00.000Z	1	1	2	427	LIN-TH		2018-04-17T14:12:42.474Z		85742 <a href="#">info</a>
12	85741	LIN-RS-01	LIN	Lindenberg	ROUTINE2	2018-04-17T06:00:00.000Z	1	1	2	426	LIN-TH		2018-04-17T08:30:13.160Z		85741 <a href="#">info</a>
13	85740	TEN-RS-01	TEN	Tenerife	ROUTINE2	2018-04-16T12:00:00.000Z	1	1	2		TEN-AUTO		2018-04-17T06:06:56.206Z	Automatic creation of GMD file by gRai (GruanToolRaLaunch) 0.4.1 (2018-01-04).	85740 <a href="#">info</a>
14	85739	TEN-RS-01	TEN	Tenerife	ROUTINE2	2018-04-16T11:00:00.000Z	1	1	2		TEN-AUTO		2018-04-17T06:06:45.286Z	Automatic creation of GMD file by gRai (GruanToolRaLaunch) 0.4.1 (2018-01-04).	85739 <a href="#">info</a>
15	85738	TAT-RS-01	TAT	Tateno	ROUTINE3	2018-04-16T12:00:00.000Z	1	1	2		TAT-KO02		2018-04-17T05:18:32.611Z		85738 <a href="#">info</a>



```

2018-04-18 06:18:34.795 [I-190] U: # module = modPrepareMetadata (v0.5), config = SpecialConfig_RS41.ini [prep_metadata], function = gruan_gdps_modPrepareMetadata
2018-04-18 06:18:34.796 [I-190] W: # Not recommended usage of special key 'MALL' to have access to all input attributes.
2018-04-18 06:18:34.871 [I-190] W: # Meta-data from GMD are used.
2018-04-18 06:18:34.890 [I-190] I: # processing of step finished with status = Finished
2018-04-18 06:18:34.920 [I-190] I:
2018-04-18 06:18:34.920 [I-190] I: Post-processing...
2018-04-18 06:18:34.943 [I-190] I: > Run post-instruction 'defineBands'
2018-04-18 06:18:35.072 [I-190] I:
2018-04-18 06:18:35.072 [I-190] I: Processing has correctly finished.
2018-04-18 06:18:35.084 [I-190] I:
2018-04-18 06:18:35.085 [I-190] I: S: # output files:
2018-04-18 06:18:35.088 [I-190] I: # file 'OUT1' => out1000f4 (0.1.1)
2018-04-18 06:18:35.204 [I-190] I: # use data file /home/micha/Daten/Processing/temp/pt_929675_compute/result_dummy.nc' is written.
2018-04-18 06:18:35.217 [I-190] I: S: red log messages: errors=0, warnings=4, users=18, info=0, debug=0
2018-04-18 06:18:35.217 [I-190] I: Processing run finished after 12.492 s
2018-04-18 06:18:35.217 [I-190] I: Using file /home/micha/Daten/Processing/temp/pt_929675_compute/dsl_dump.log' is stopped
2018-04-18 06:18:35.318 [I-190] I:
2018-04-18 06:18:35.318 [I-190] I: ... R:
2018-04-18 06:18:35.386 [I-14] < End of ProcessingModule
2018-04-18 06:18:35.386 [I-14] # Log file:
2018-04-18 06:18:35.405 [I-14] # Result:
2018-04-18 06:18:35.405 [I-14] # Create:
2018-04-18 06:18:35.405 [I-14] # Details:
2018-04-18 06:18:37.014 [I-14] > Pack:
2018-04-18 06:18:37.221 [I-14] > Details:
2018-04-18 06:18:37.223 [I-14] * rev00:
2018-04-18 06:18:37.325 [I-14] * com:
2018-04-18 06:18:37.325 [I-14] * All new
2018-04-18 06:18:37.342 [I-14] > 171 d
2018-04-18 06:18:37.544 [I-14] > Upload:
2018-04-18 06:18:38.248 [I-14] * Upload:
2018-04-18 06:18:38.687 [I-14] * File transfer is correct completed.
2018-04-18 06:18:38.689 [I-14] * Delete temporary file gruan_0056.jar
2018-04-18 06:18:38.689 [I-14] * after 1 trials file /home/micha/Daten/Processing/temp/pt_929675_compute/gruan_0056.jar' deleted at 2018-04-18T06:18:38.689Z
2018-04-18 06:18:38.713 [I-14] * 'ArchiveItem 424147' created and uploaded.
2018-04-18 06:18:38.836 [I-14] * Temporary files are deleted.
2018-04-18 06:18:38.837 [I-14] # Task-specific temporary directory '/home/micha/Daten/Processing/temp/pt_929675_compute' is deleted.
2018-04-18 06:18:38.837 [I-14] < End of ProcessingModule 'Start': Module is finished correctly.
2018-04-18 06:18:38.837 [I-14] # Because rule 'Transfer RS41-EDT to products (at HETZNER)' task is created for TRANSFER-PRODUCT-TO-HETZNER v1 with priority NORMAL
2018-04-18 06:18:43.070 [I-14] # Because rule 'Transfer RS41-EDT to RAW file archive (at MLI)' task is created for TRANSFER-PRODUCT-TO-RAW v1 with priority NORMAL
2018-04-18 06:18:43.075 [I-14] # 2 following ProcessingTask's are created:
2018-04-18 06:18:43.093 [I-14] > All new meta-data are being inserted in the GruanDB:
2018-04-18 06:18:43.121 [I-14] > 8 data rows are inserted or changed.
2018-04-18 06:18:43.281 [I-14] * Execute request item '90509' (queue-size=1) .... RTIME: 2018-04-18 06:18:15
2018-04-18 06:18:43.579 [I-14] # ProcessingTask(ProcessingTask 929677, ProcessingVersion 43, NEW, 2018-04-18T06:17:07.698Z, 2018-04-18T06:18:43.321Z, NORMAL, 1, 1, P
2018-04-18 06:18:43.579 [I-14] # ProcessingTask 929677: run task of processing 'CREATE-RS41-EDT.1' (Create RS41 Vaisala Data Product) induced by rule 'Create RS41-EDT.1
2018-04-18 06:18:43.579 [I-14] # Start of ProcessingModule 'Start'
2018-04-18 06:18:43.580 [I-14] # Start of ProcessingModule 'RunIdComputeModule'
2018-04-18 06:18:43.580 [I-14] # Old output files are deleted.
2018-04-18 06:18:43.580 [I-14] > 1 data rows are inserted or changed.
2018-04-18 06:18:43.773 [I-14] # Create new 'ProductItem 363976' for result
2018-04-18 06:18:43.787 [I-14] # Archive file 'TEN-RS-01_0_RS41-Raw_001_20180417T230000-1-000-001_804811.nc' downloaded to temp folder '/home/micha/Daten/Processing
2018-04-18 06:18:44.547 [I-14]

```

Info

User: msommer

Password: [REDACTED]

Session: fae00130d77c

Login Logout



Table and Template

Table: RawPtu

Template: default

Commands: Refresh, Range, Save, Close



- [illegible]

- Heart of GRUAN data flow
- Complex DB, which stores all meta-data
- Running 24/7 at LC

- Graphical user interface for managing general meta-data of sites, measurement systems, ...
- Lead Centre internal use

VEN	ID	MS CODE	SET CODE	SET NAME	SP CODE	SCHEDULE DATE	MS CODE	VERSION	STATUS	INTERNAL CODE	TOP ALIAS OLD VERSION	INSTR. DATE	DESCRIPTION	MEASUREMENT
1	83232	TEN-RS-01	TEN	Tenacite	ROUTINE2	2018-04-17T23:00:00.000Z	1	2			TEN-AUTO	2018-04-18T06:08:41.693Z	Automatic creation of Q6AD file by gtlal (View ToolFile search)	83752
2	83753	TEN-RS-01	TEN	Tenacite	ROUTINE2	2018-04-17T11:00:00.000Z	1	2			TEN-AUTO	2018-04-18T06:08:40.333Z	Automatic creation of Q6AD file by gtlal (View ToolFile search)	83751
3	83720	TAT-RS-01	TAT	Tenacite	ROUTINE2	2018-04-17T12:00:00.000Z	1	2			TAT-RO02	2018-04-18T05:30:18.893Z	Automatic creation of Q6AD file by gtlal (View ToolFile search)	83750
4	83748	SNG-RS-01	SNO	Singapore	ROUTINE2	2018-04-17T12:00:00.000Z	1	2				AdminClient v0.3.0 (2017-05-10)		
5	83748	SNG-RS-01	SNO	Singapore	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
6	83747	LIN-RS-01	LIN	Linsenberg	RESEARCH	2018-04-17T12:00:00.000Z	1	2						
7	83746	TAT-RS-01	TAT	Tenacite	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
8	83745	SNG-RS-01	SNO	Singapore	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
9	83744	LIN-RS-01	LIN	Linsenberg	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
10	83743	NYA-RS-01	NYA	Ny-Almend	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
11	83742	LIN-RS-01	LIN	Linsenberg	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
12	83741	LIN-RS-01	LIN	Linsenberg	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
13	83740	TEN-RS-01	TEN	Tenacite	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
14	83739	TEN-RS-01	TEN	Tenacite	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						
15	83738	TAT-RS-01	TAT	Tenacite	ROUTINE2	2018-04-17T12:00:00.000Z	1	2						

File Help

**Info**

User: msomer

Password: \*\*\*\*\*

Session: fax06130d7fc

Login Logout

---

**Navigation**

Data Analysis

Show chart

Show compare

---

Test pages

Use External files

Show test 'Graph'

Show test 'InstrumentTree'

Show test 'MetaTree'

Show test 'level'

---

Navigation

Back

---

Instruments (loaded) (filtered list)

**Filter Data**

Filter name: default

Run filter

☒ Activate FilterGroup AND Add rule

☒ type.name EQUAL Unwinder U D X

☒ code MATCH UW\* U D X

☒ isType IS\_NULL U D X

ID	Code	Name	Child of
15	UW2	30m Grauw Unwinder	GRAW Unwinder [F]
16	UW1	60m Grauw Unwinder	GRAW Unwinder [F]
17	UW1-V30	Default 30m Vaisala Unwinder (RSx)	Vaisala Unwinder [F]
273	UW1-V15	15m Vaisala Unwinder	Vaisala Unwinder [F]
448	UW-V30-WPB	30m Vaisala Unwinder with paperboard	Vaisala Unwinder [F]
504	UW1-SP	Special Production of UW1 Grauw Unwinder	60m Grauw Unwinder
506	UW1S	15m JMA Unwinder	JMA Unwinder [F]
507	UW-30	30m JMA Unwinder	JMA Unwinder [F]
508	UW-25	25m JMA Unwinder	JMA Unwinder [F]
509	UW-50	50m JMA Unwinder	JMA Unwinder [F]
517	UW5	Grauw Routine Unwinder	GRAW Unwinder [F]
652	UW10	10m JMA Unwinder	JMA Unwinder [F]
660	UW-V30-4	Default 30m Vaisala Unwinder (RS4x)	Vaisala Unwinder [F]
762	UW-VSS-4	New Default 55m Vaisala Unwinder (RS4x)	Vaisala Unwinder [F]
763	UW-VAISALA	Vaisala Unwinder (F)	Unwinder [T]
764	JWA-JMA	JMA Unwinder (F)	Unwinder [T]
765	UW-GRAW	GRAW Unwinder (F)	Unwinder [T]
788	UW-VSS-4-D5	New Default 55m Vaisala Unwinder (RS4x) with Detainer And Stabilizer	New Default 55m Vaisala Unwinder (RS4x)
805	UW-VSS-4-WPB	New Default 55m Vaisala Unwinder (RS4x) with paperboard	New Default 55m Vaisala Unwinder (RS4x)
864	UW15-B	New 15m JMA Unwinder	JMA Unwinder [F]
872	UW-RS41-SGP	null (Auto) [Deprecated]	-

Page 1 of 1

new... view... edit... clone childrow delete load reload close



- GRUAN RsLaunchClient (RLC) – [Java]
  - Graphical user interface for use at GRUAN sites
  - Manual collecting (and uploading) of meta-data and raw data of simple to very complex radiosonde launches
- GRUAN LidarRunClient (LRC) – [Java]
  - Graphical user interface for use at GRUAN sites
  - Manual collecting of meta-data and raw data of LIDAR
- GRUAN Tool RsLaunch (gtRsl) – [Java]
  - Command line tool for (semi-) automatically use at GRUAN sites, e.g. with AUTOLAUNCHER
  - Collecting (and uploading) of meta-data and raw data of **simple** radiosonde launches



```
micha@plgpcsl019:~$ gtRsl -h
usage: gtRsl [OPTION]... [FILE]...
GRUAN tool for automatic creation of GMD files for RsLaunch.
List of options:
-a,--after-slot <PERIOD>      Period defines second part of time slot
                                after schedule date.
-b,--before-slot <PERIOD>     Period defines first part of time slot
                                before schedule date.
--block-formula <FORMULA>     A formula which is used to block files, if
                                the evaluation is true.
-c,--copy-all                Copy all referenced files to defined
                                output directory (see --out-dir).
-d,--delete-all              Delete all referenced files after copying
                                to defined output directory (see
                                --copy-all and --out-dir). Option
                                --copy-all is automatically set, if it is
                                not done yet.
-e,--end-date <DATETIME>     End date defines last schedule date (not
                                included!) for creation of GMD files.
                                The name of FTP connection to use for
                                unloading files to GRUAN. If NAME is
```

## ➤ GRUAN radiosonde file converting tool (gt92) – [Java]

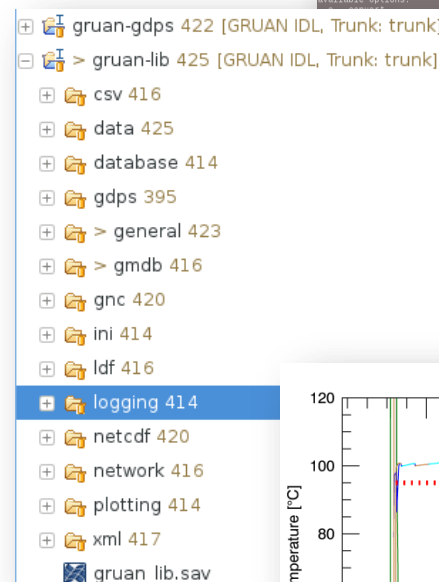
- Command line tool for converting, extracting, formatting, XData decoding and further handling of radiosonde file formats
- Use to prepare data at campaigns and other data analysis

```
gt92 (GruanToolRS92) 0.4.9_02 (2018-04-16)
Written by Michael Sommer (michael.sommer@dwd.de).
Copyright (c) 2011-2018 GRUAN Lead Centre (DWD).
Please do not distribute or share this software without contact to the GRUAN Lead Centre (gruan.lc@dwd.de).
This is free software. There is NO warranty.

Options found:
  -h, --help
Usage: gt92 [OPTION]... [FILE]...

Description: GRUAN tool for converting and extracting data-tables and meta-data from several file formats, e.g. DC308,
GNC-RAW, GNC-DATA, MWX, GFSZ and STRATO-ZIP files. This tool has an included batch mode to process an arbitrary long
list of input files and/or directories. In addition it can be parametrised very detailed with following list of
available options:

Convert all given file(s) to another file format. The possibilities are: DC308,
MWX, GFSZ, STRATO-ZIP to GNC-RAW, GNC-DATA to IDP.
Copy all corrupt source files which cannot be converted.
The directory to copy all corrupt source files.
Prepare all given file(s) for distribution. The possibilities are: MWX.
Extract data tables in addition as binary dump files. Only possible with DC308
files.
Export (write) tables only if they matches the regex filter.
Read only file(s) with this specified file type. If this option is not set,
GNC-DATA is used as default. The possibilities are: DC308, GNC-RAW, GNC-DATA, MWX,
GFSZ, STRATO-ZIP.
Print the help information and exit.
Print a specific information (default is VERSION) and exit. The possibilities are:
VERSION, VERSION NUMBER, VERSION DATE, NAME, NAME SHORT, NAME LONG, COPYRIGHT,
AUTHOR, AUTHOR NAME, AUTHOR EMAIL, FILE TYPES, HISTORY LAST, HISTORY, HISTORY FULL.
Import (read) tables only if they matches the regex filter.
Include source file during converting a file in a NetCDF4 file (version 2) with
compression. Only possible with DC308, MWX, GFSZ and STRATO-ZIP files.
Set result on standard output (STDOUT) as JSON.
Compute checksums for all given file(s).
Set the logging level to another than default (INFO). The possibilities are:
SEVERE, WARNING, INFO, CONFUS, FINE, FINER, FINEST.
Extract meta-data items using original separator in names (not default one).
Extract meta-data only if it matches the regex.
Extract meta-data using this separator for names (not default or original one).
Convert a file in a NetCDF3 file without compression. Only possible with DC308
files. This converts to the old version of GNC-RAW.
Extract no data tables as default csv files.
Do not print NaN values in csv files.
```

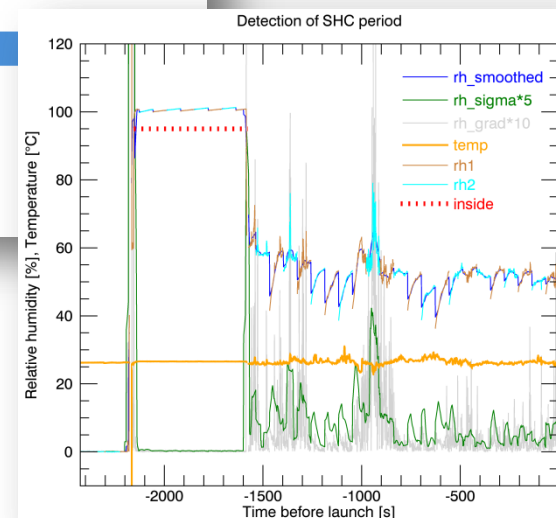


## ➤ GRUAN IDL library – [IDL]

- Software library for data processing, data analysis, logging, reporting, ...
- Base library for GRUAN data processor

## ➤ New GRUAN data processor – [IDL]

- General modular processing system for radiosonde data
- GOAL: RS41-GDP.1, RS92-GDP.3, ... (and more)

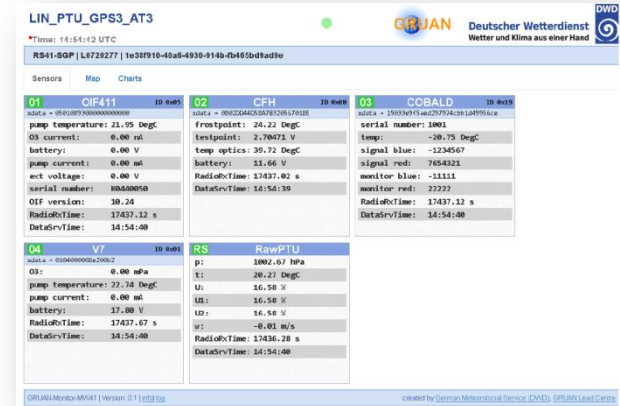


# Software projects at Lead Centre – monitoring and reporting

Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



- GRUAN Monitor MW41 (gm41) – [Python]
  - Live XData decoding during radiosonde launch with MW41
  - Use at sites which launches ECC, CFH, COBALD, PCFH and other XData instruments linked to RS41

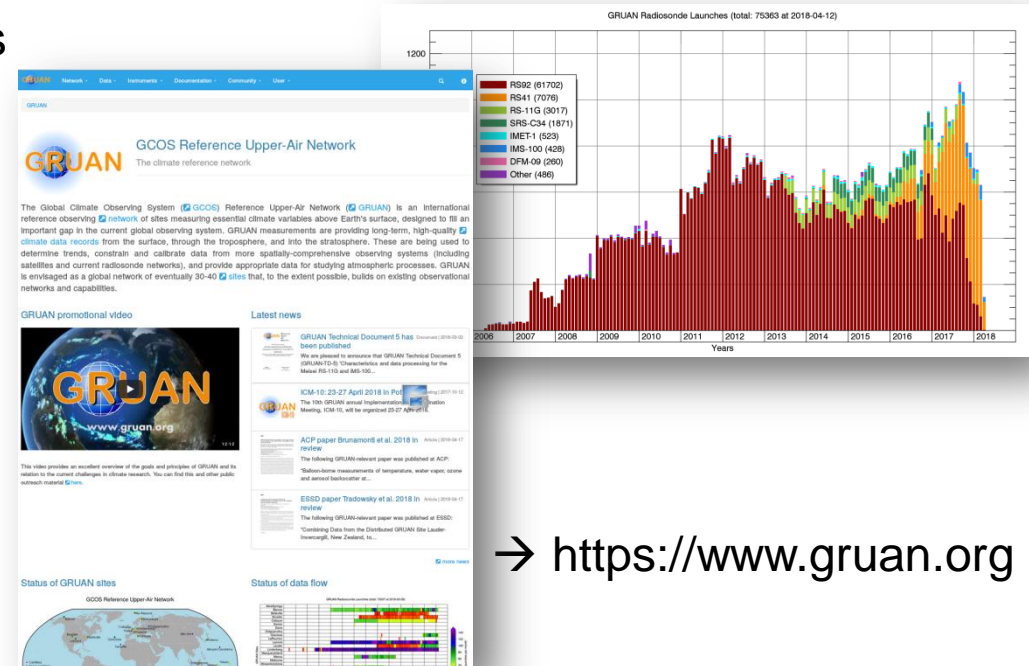


- Collection of monitoring & reporting tools – [Java, IDL, Python]

- Create statistical plots at regular basis
- Create yearly site reports
- Lead Centre internal use

- GRUAN Website – [Typo3, php]

- Platform → documentation, information, communication, ...
- Used by whole community



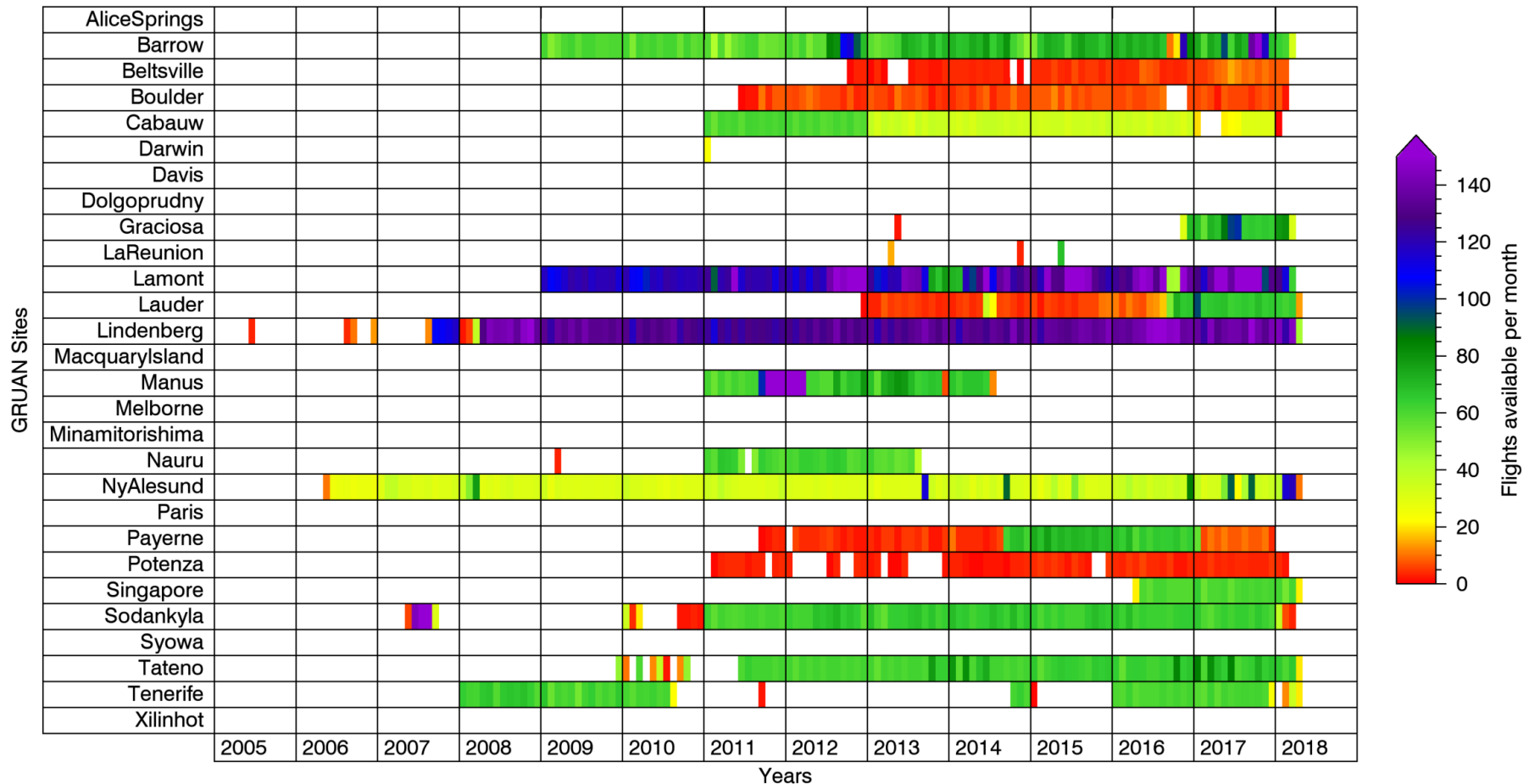
→ <https://www.gruan.org>



Status of data flow

# STATISTICS & MONITORING

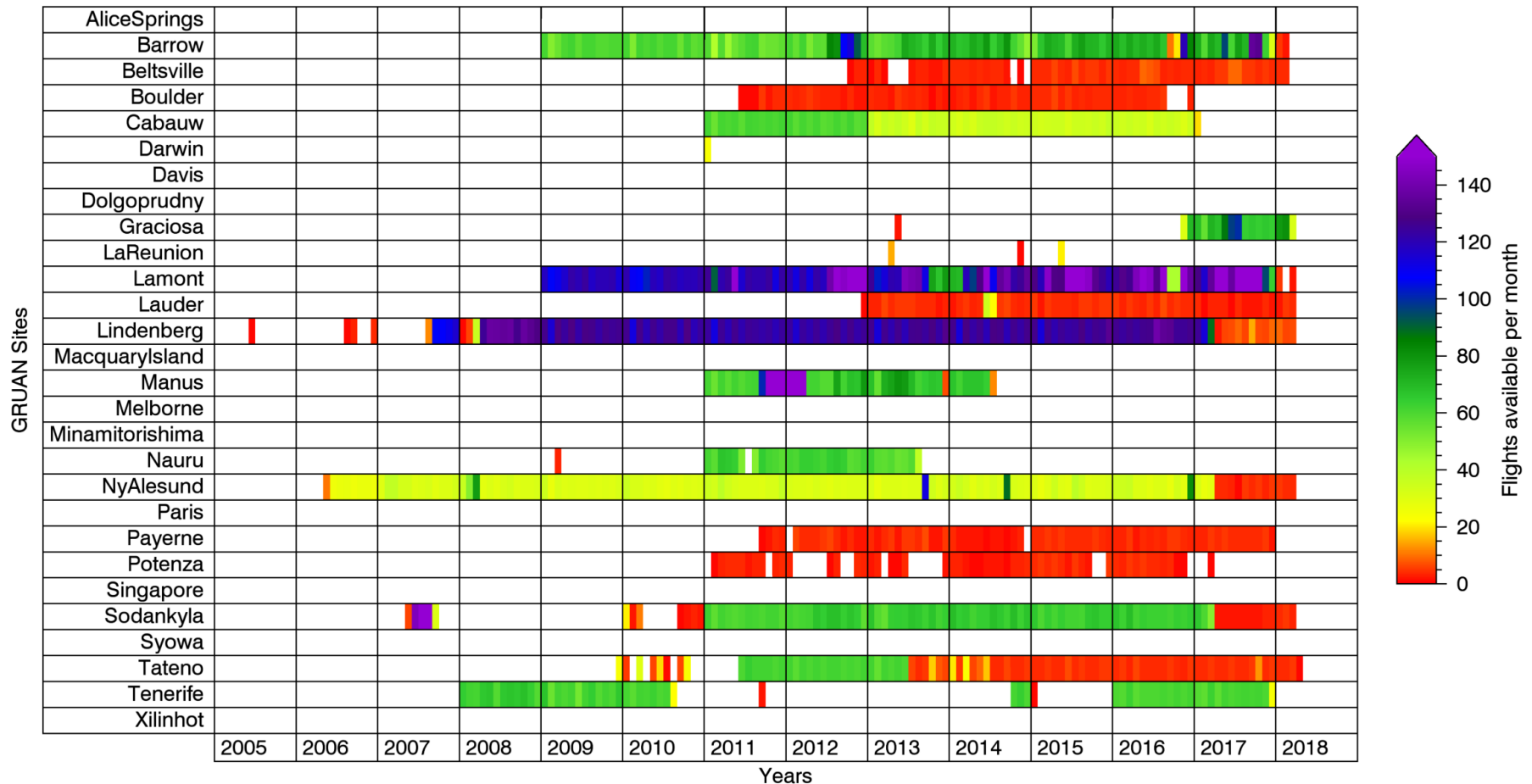
GRUAN Radiosonde Launches (total: 75337 at 2018-04-11)



- Approx. 75,000 launches in GRUAN file archive
  - Much more are performed.
- Some sites have not started data flow yet.



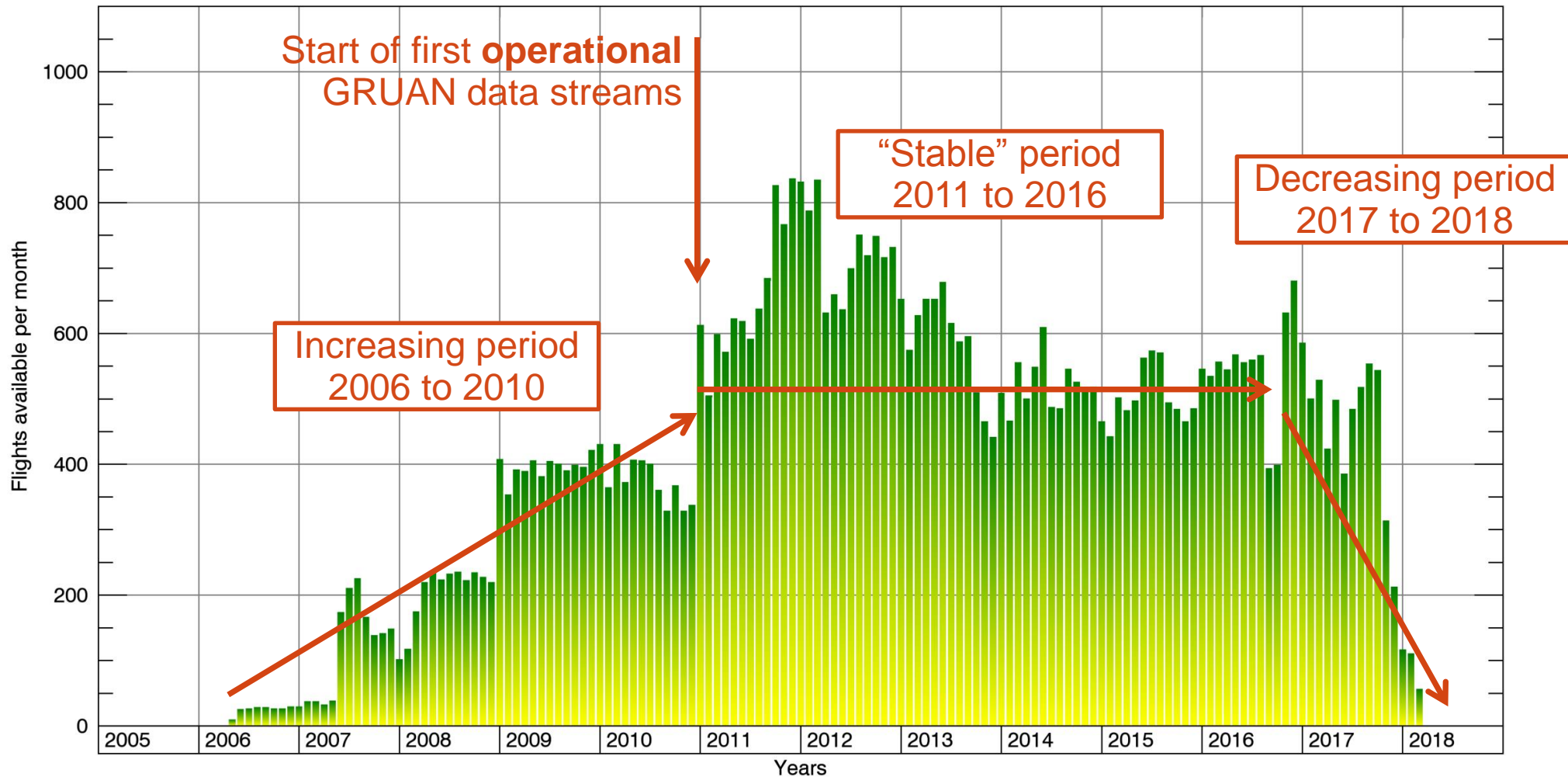
GRUAN Vaisala RS92 Launches (total: 61696 at 2018-04-11)



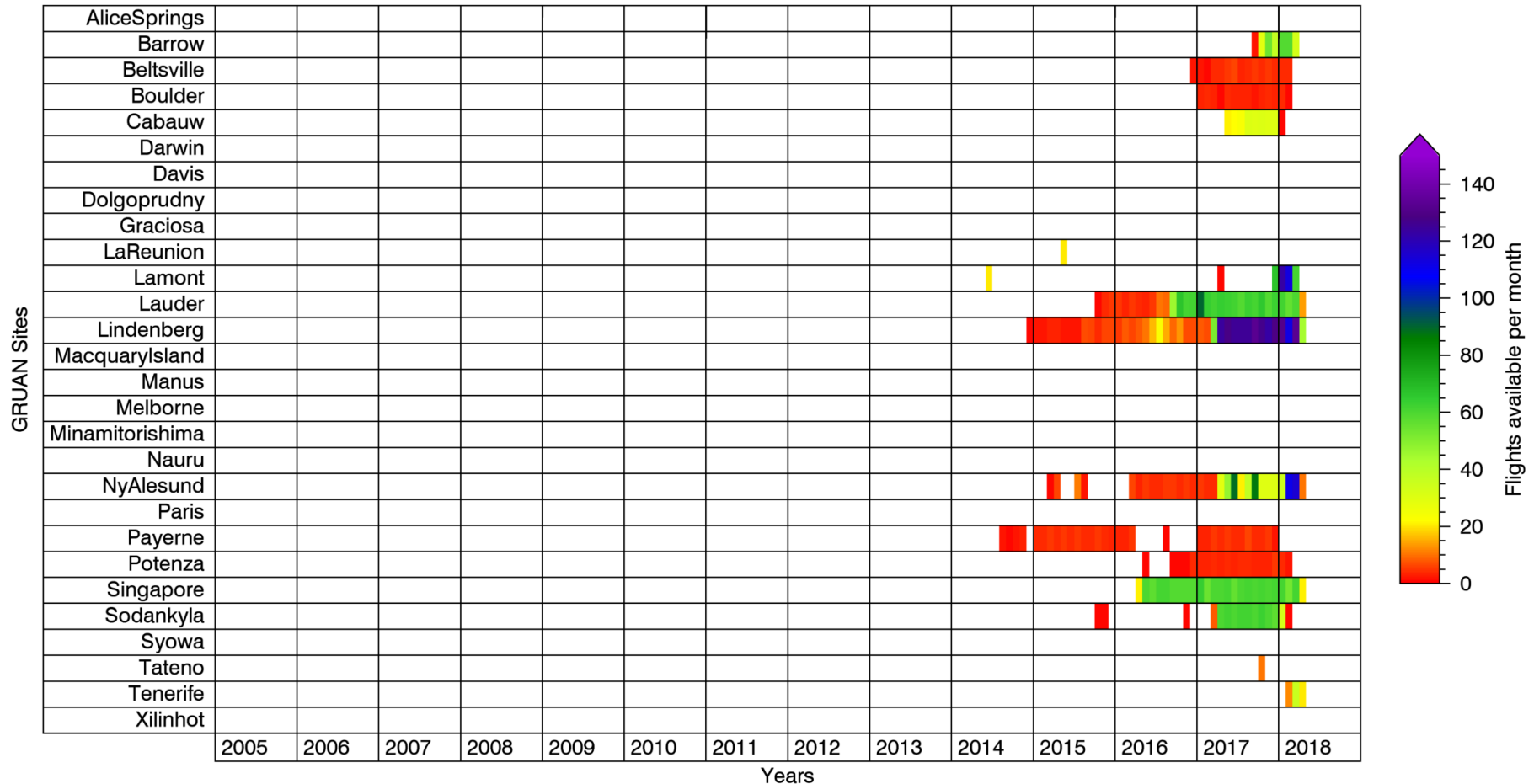
➤ Data flow of RS92 ends at some sites in 2017



GRUAN Vaisala RS92 Launches (total: 61696 at 2018-04-11)



GRUAN Vaisala RS41 Launches (total: 7060 at 2018-04-11)



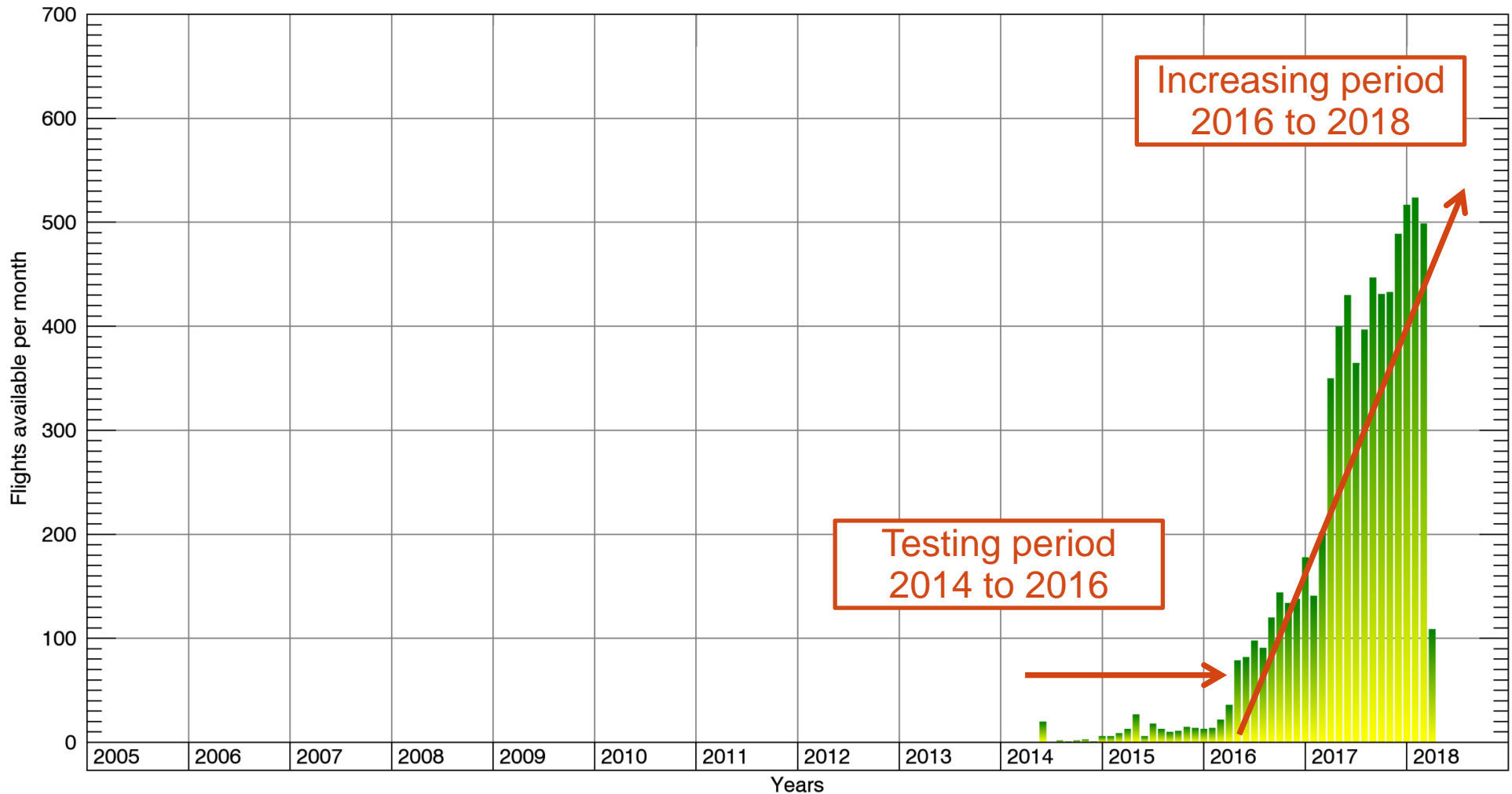
- Data flow of RS41 started in last year(s)
- In addition short campaigns and transition periods with dual launches are available

# Vaisala RS41 – total network

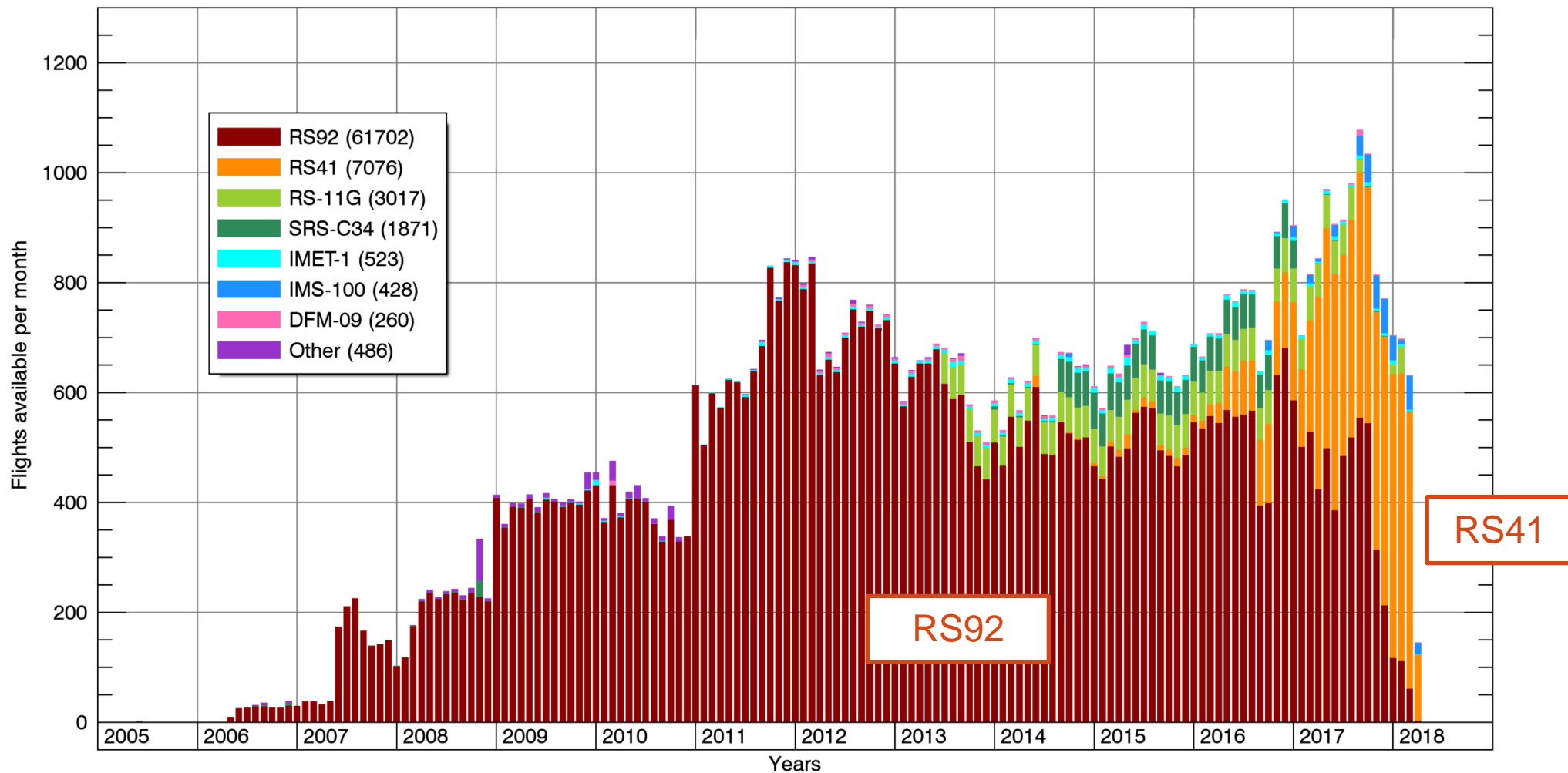
Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



GRUAN Vaisala RS41 Launches (total: 7060 at 2018-04-11)

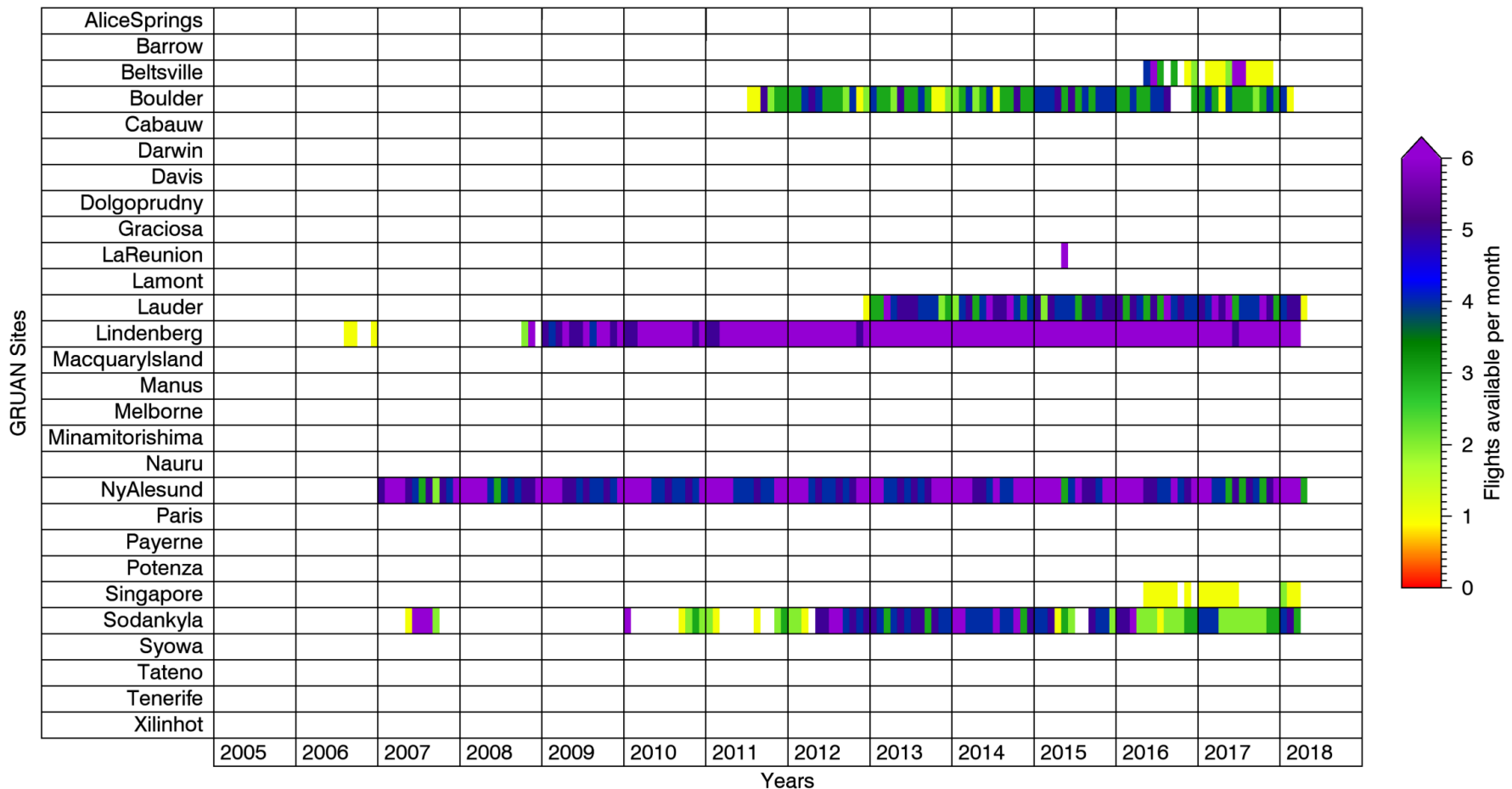


GRUAN Radiosonde Launches (total: 75363 at 2018-04-12)



# Ozone sondes – at sites

GRUAN Ozone Launches (total: 2555 at 2018-04-11)



➤ Approx. 2550 launches in GRUAN file archive  
(plus 500 since last ICM)

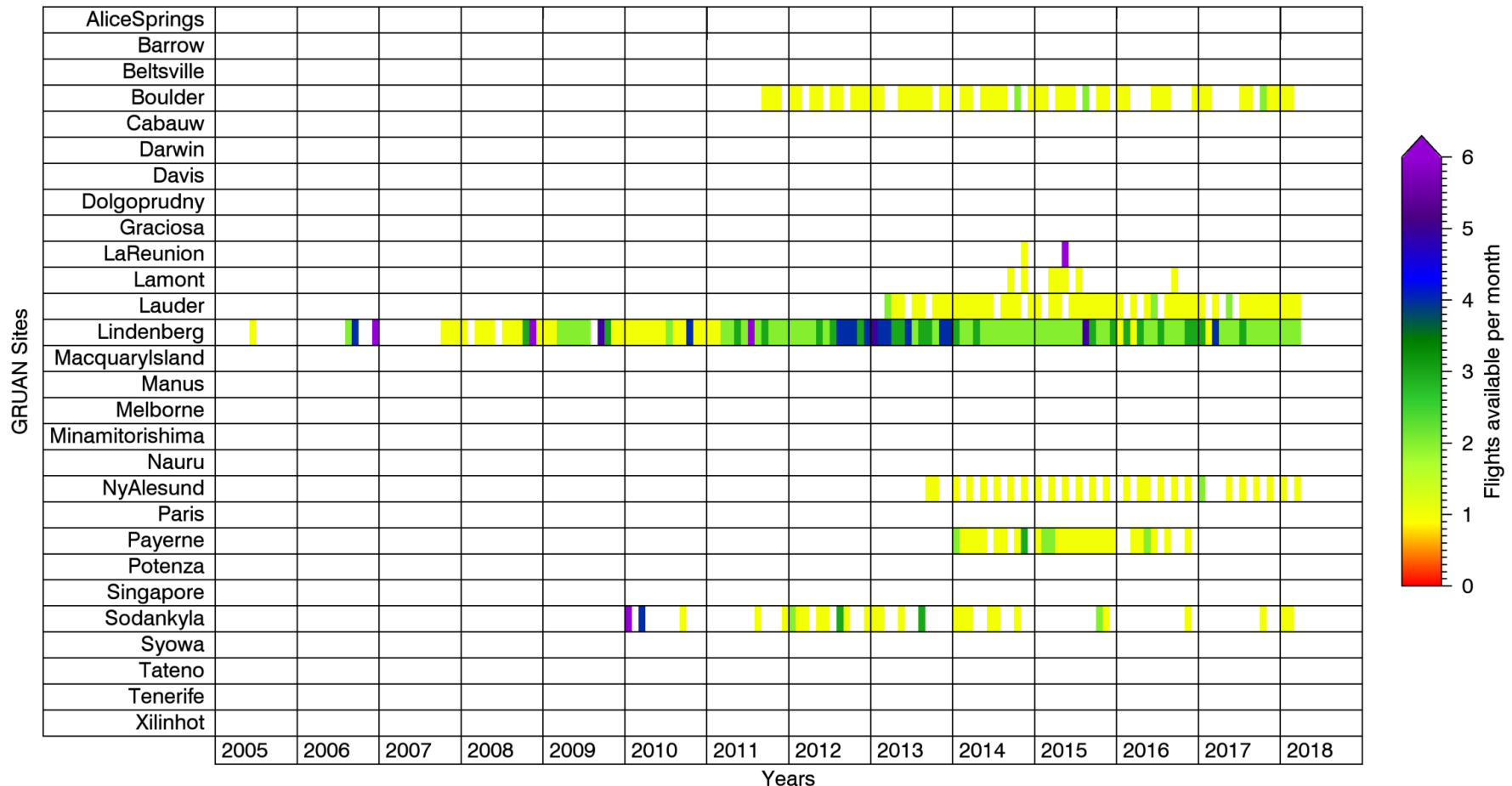
➤ More are performed at sites → Please upload to GRUAN.

# Stratospheric humidity sondes – at sites

Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



GRUAN Stratospheric Humidity Launches (total: 549 at 2018-04-11)



➤ Approx. 550 launches in GRUAN file archive  
(plus 50 since last ICM)

➤ More are performed at sites → Please upload to GRUAN.





Site	Raw	Binary	Rinex	Rinex Meteo	Product	Sinex- Trop	Cost- 716
LDB0 – Lindenberg	2015-10	x	x		2016-07	x	x
LDRZ – Lauder	2015-10		x		2017-08	x	x
NYA2 – Ny-Ålesund	2015-10	x	x	x	2016-07	x	x
SODF – Sodankylä	2015-10	x	x		2017-02	x	x
TMS3 – Boulder	2016-02	x	x		2017-02	x	x
UTQI – Barrow	2017-07	x	x	x	2018-04	x	x
<i>More will be added</i>	<i>soon...</i>						

- Stable running GNSS data stream → 6 sites at moment
- Special near real-time data flow: Site → GFZ (as PC) → LC

- Change management → A lot of **additional** work at sites, LC, PCs
- Software development → A lot of work behind the scenes
- Growing archive → Statistics available at website
- GNSS → Near real-time data flow

Thank you for your attention.