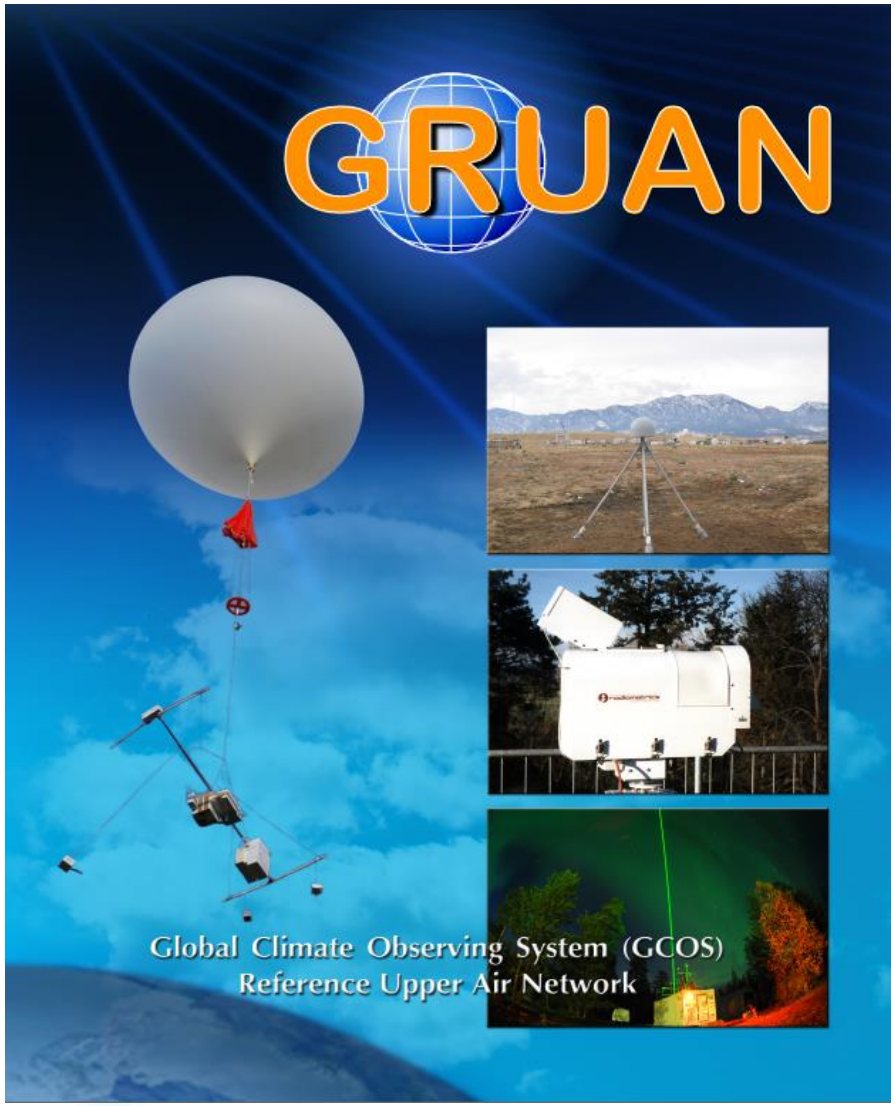


Achievements, developments and GDP Status

Fabio Madonna[1] and Masatomo Fujiwara[2]

[1]University of Salerno, Italy

[2]University of Hokkaido, Japan

Why this talk?

- Assessing our alignment with GCOS expectations and with the needs of the climate-research community is essential for maintaining GRUAN's credibility and for ensuring that the network continues to meet the requirements of the climate-data user community.
- Every year, we must report to the GCOS AOPC.
- The GCOS IP 2022 states under Action B1: Development of reference networks (in situ and satellite Fiducial Reference Measurement – FRM – programmes): "*Continue the development of GRUAN. … Although GRUAN has been successfully implemented since 2005, it remains far from being globally well distributed.*"

Why this talk? (2)

Moreover, the GCOS IP 2022 says:

«Status of GRUAN

- GRUAN is planned as a global network of 30–40 sites.
- As of August 2021, the network officially includes 33 sites, of which 14 are certified.
- Major geographical gaps remain (e.g., Africa, South America).
- Significant work is still needed to expand the suite of GRUAN Data Products, from both balloon-borne systems and ground-based remote sensing.
- GRUAN should be more fully integrated into WIGOS operations.

Assessing Progress (metrics):

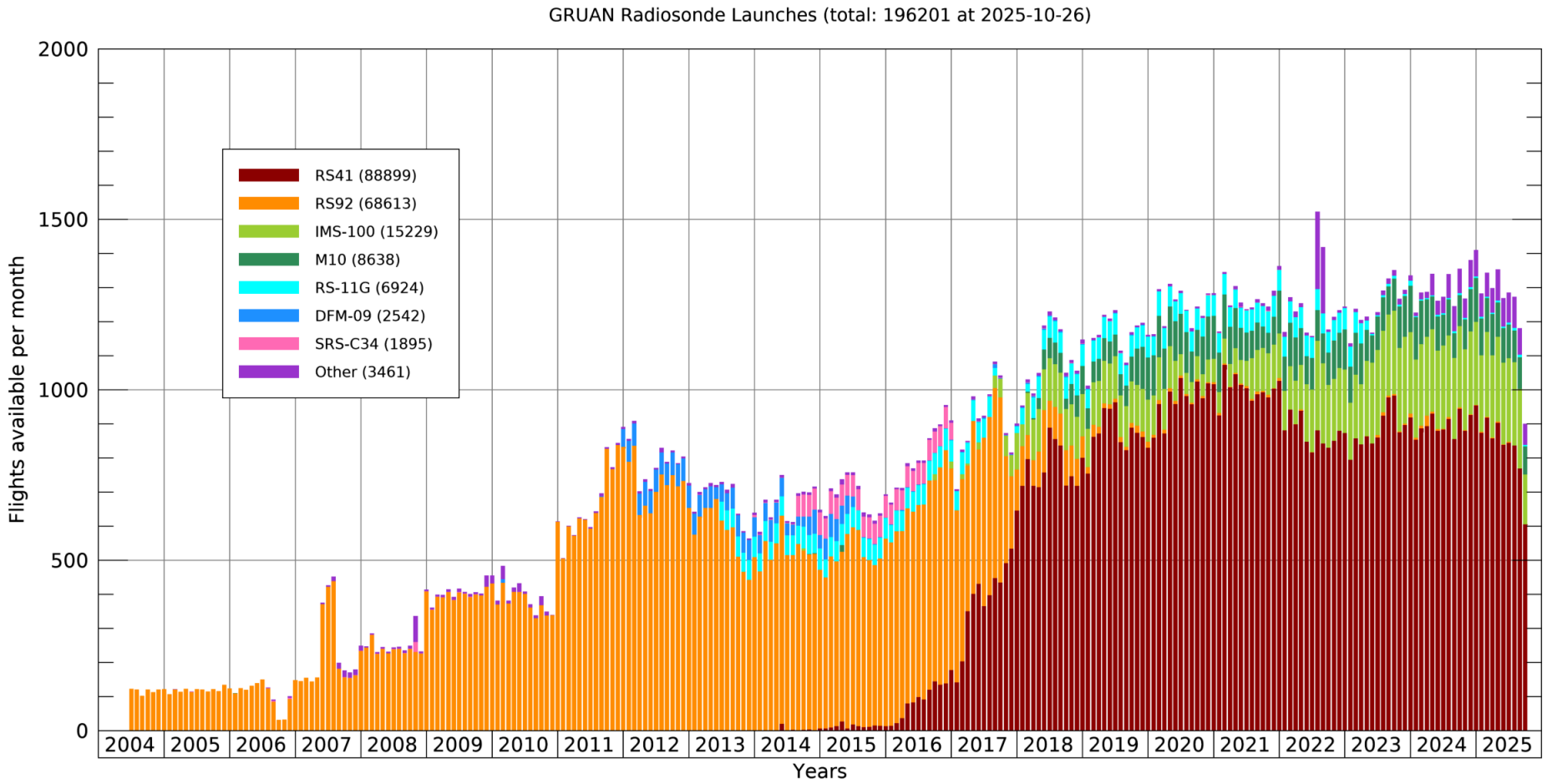
1. Number and geographical distribution of certified GRUAN stations
2. Number of data products
3. Data usage, measured through «citations»

GRUAN Implementation Plan

Main actions in the IP 2024–2030 for monitoring GRUAN performance are:

- Certification of new GRUAN Data Products (GDPs): minimum target should be of at least one new GDP per year.
- Expansion of the certified site network to achieve the goal of 30–40 sites by 2030, implying 1–2 new site and 3-4 certifications per year.
- Maintaining an active and engaged WG GRUAN, with strong participation at each WG meeting.
- Timely publication of key scientific outputs, including major reference papers (e.g., the SHC paper).
- Efficient day-to-day management of the network, ensuring coordination, responsiveness, and operational continuity.

GRUAN data flow - RS



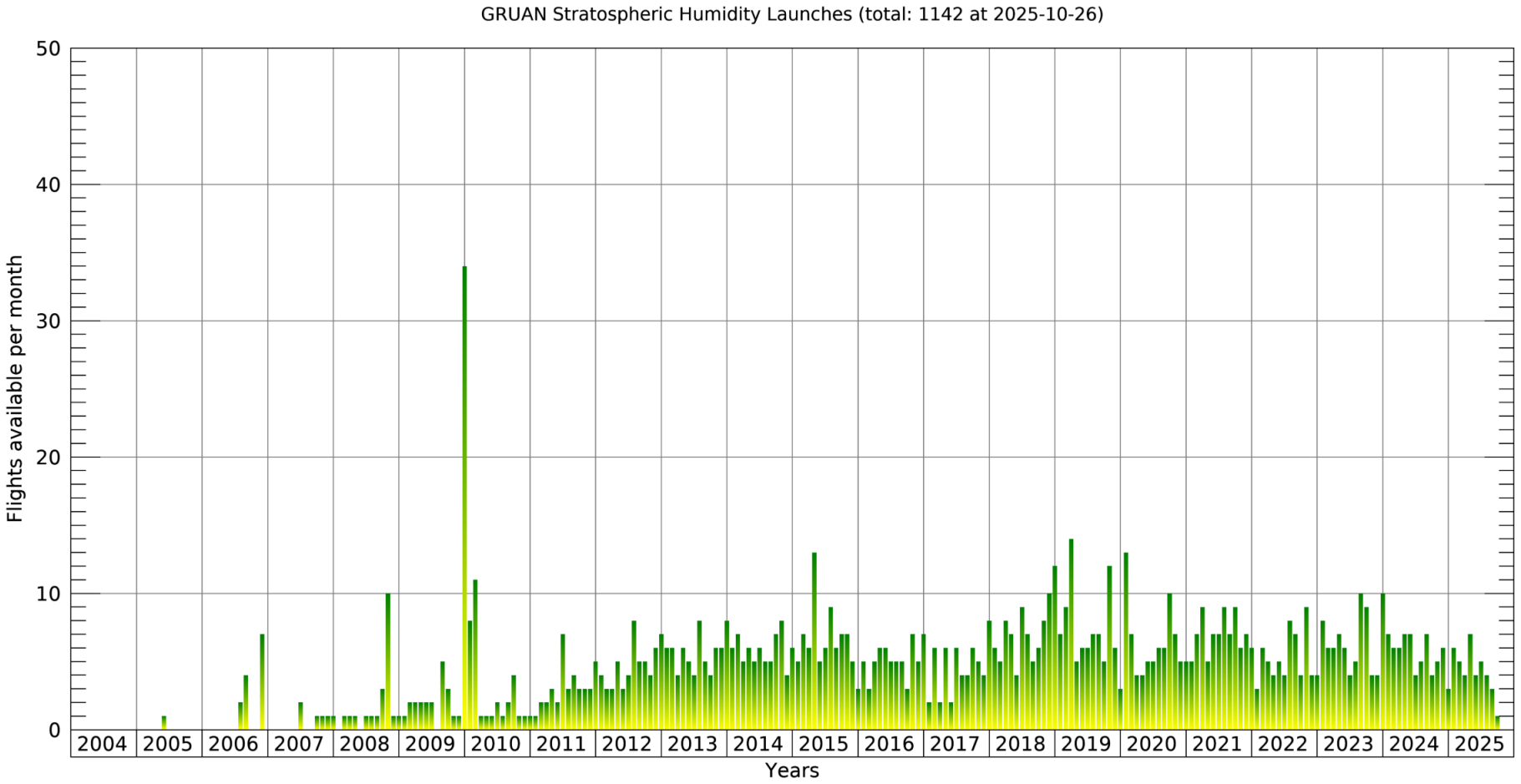
Amount of data flowing to the LC and the developed GDPs are definitely a huge achivement and success of GRUAN.

GDP status

GDP	Begin	Published	Paper+TD available
RS92 v2	2010	2012	2016
RS92 v3	2018	-	-
RS41 v1	2016	2022	2023
RS-11G	2015 (?)	2019	2019
iMS-100	2019 (?)	2022	TD under update
CFH/FPH GDP	> 5 years	-	-
O3 SONDES	> 5 years	-	-
GNSS GDP	> 5 years	-	-
Lidar GDP	> 5 years	-	-
MWR GDP	> 5 years	-	-
FTIR GDP	> 5 years	-	-

- GDP development remains slow, with unclear timelines for many products. Limited resources and reliance on single institutions further constrain progress.
- Shared effort could improve efficiency.
- A central question is whether we should target at least one new GDP per year through 2030.

GRUAN data flow - CFH



StratoWV GDPs are still pending although big progress have been made. This is an HP action since at least 3 years.

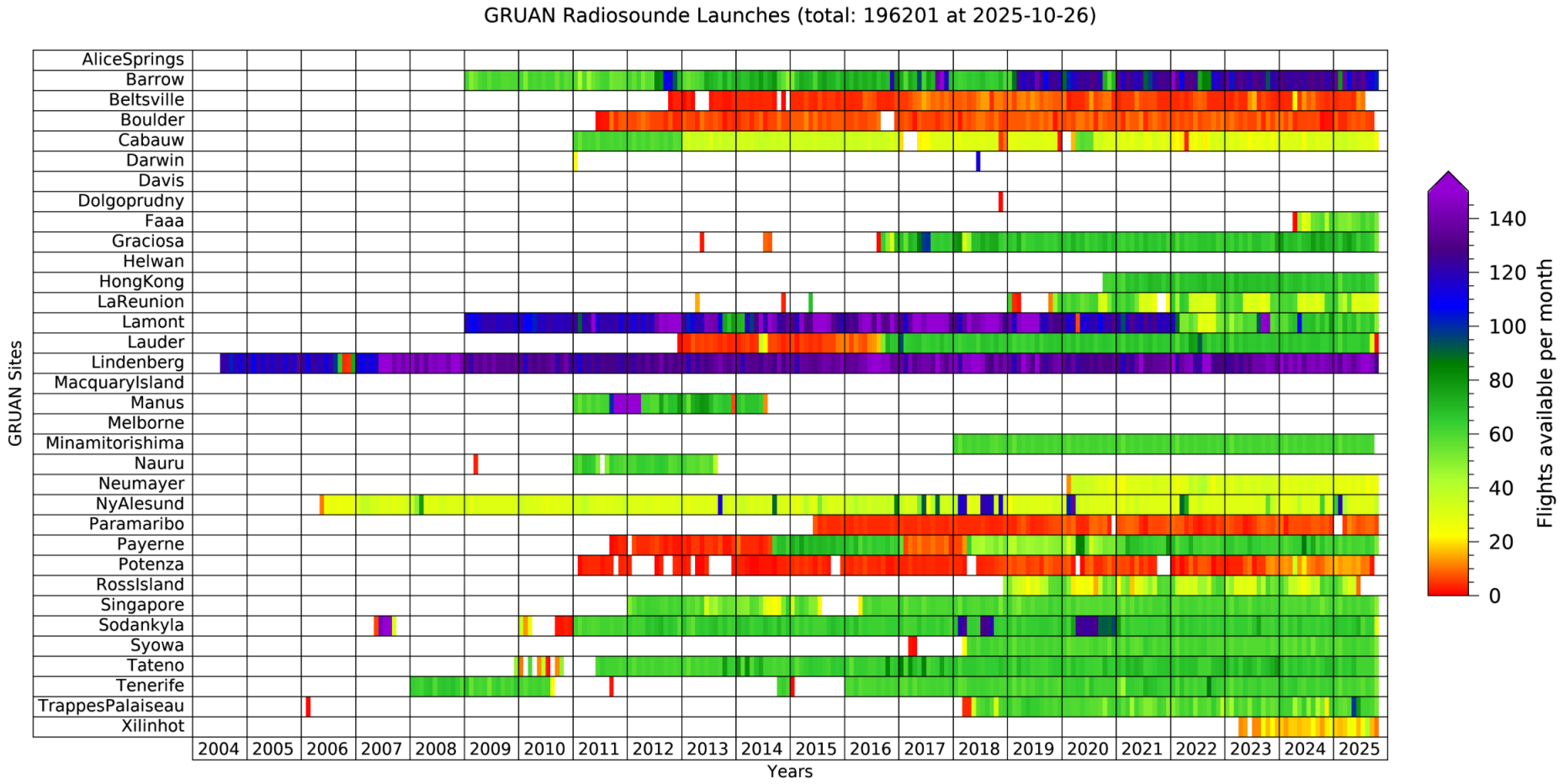
New ECVs covered (priority 1 and 2)

Pressure, temperature, water vapour and wind since 2014 ….

….. and then?

For example, discussion had at the NDACC SC meeting revealed how a first version of the ozonesonde GDP is doable.

Network expansion



25 sites with an active data stream (23 with a GDP), goal 30-40 sites

Progress with the certification: past and future

Abbreviation	Name	Certification date
NYA	Ny Alesund	ott-12
LIN	Lindenberg	giu-13
BOU	Boulder	set-14
LAU	Lauder	nov-14
PAY	Payerne	feb-15
POT	Potenza	apr-15
SOD	Sodankyla	apr-15
CAB	Cabauw	gen-16
BEL	Beltsville	ott-16
TAT	Tateno	apr-18
SGP	Lamont	apr-19
SNG	Singapore	mag-19
ROS	Ross Island	apr-21
BAR	Barrow	set-22
TEN	Tenerife	nov-25
XIL	Xilinhot	nov-25
HKG	Hong Kong	ongoing (2026)
GVN	Neumayer	ongoing (2026)
REU	La Reunion	expected 2026
PAR	Paramaribo	Expected 2026
FAA	Faa'a	expected 2026
TRA	Trappes	expected 2026
HEL	Helwan	expected 2026-2027
GRA	Graciosa	expected 2026-2027
DOM	Dome-C	Under discussion

Certification of new sites is proceeding slower than planned

Progress with the certification: past and future

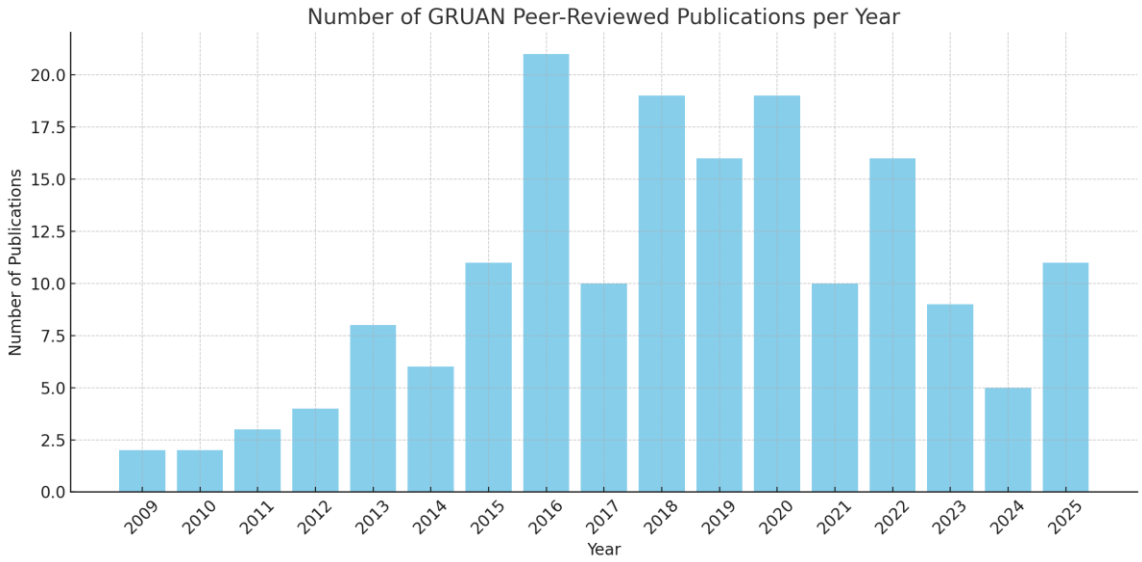
Abbreviation	Name	Certification date
NYA	Ny Alesund	ott-12
LIN	Lindenberg	giu-13
BOU	Boulder	set-14
LAU	Lauder	nov-14
PAY	Payerne	feb-15
POT	Potenza	apr-15
SOD	Sodankyla	apr-15
CAB	Cabauw	gen-16
BEL	Beltsville	ott-16
TAT	Tateno	apr-18
SGP	Lamont	apr-19
SNG	Singapore	mag-19
ROS	Ross Island	apr-21
BAR	Barrow	set-22
TEN	Tenerife	nov-25
XIL	Xilinhot	nov-25
HKG	Hong Kong	ongoing (2026)
GVN	Neumayer	ongoing (2026)
REU	La Reunion	expected 2026
PAR	Paramaribo	Expected 2026
FAA	Faa'a	expected 2026
TRA	Trappes	expected 2026
HEL	Helwan	expected 2026-2027
GRA	Graciosa	expected 2026-2027
DOM	Dome-C	Under discussion

Certification of new sites is proceeding slower than planned

Clear gaps in the planned certification of new sites

Recertification continues on a regular basis.

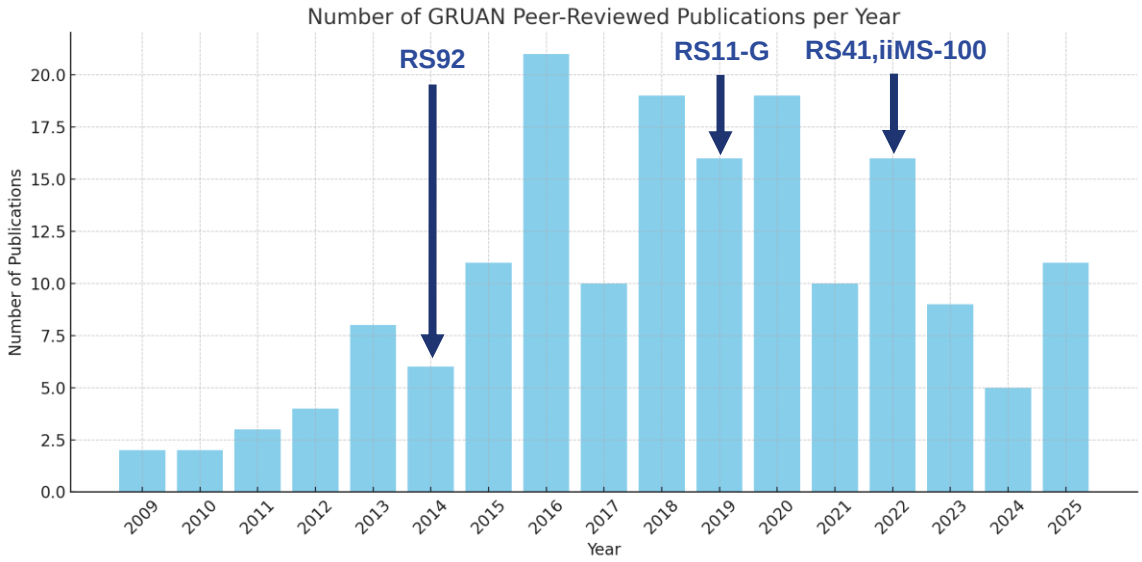
Publications and web «popularity»



Number of publication per year had a maximum in 2016, while now slowly decreasing (2025 promising?)

Number of people searching on Google GRUAN has similar trends

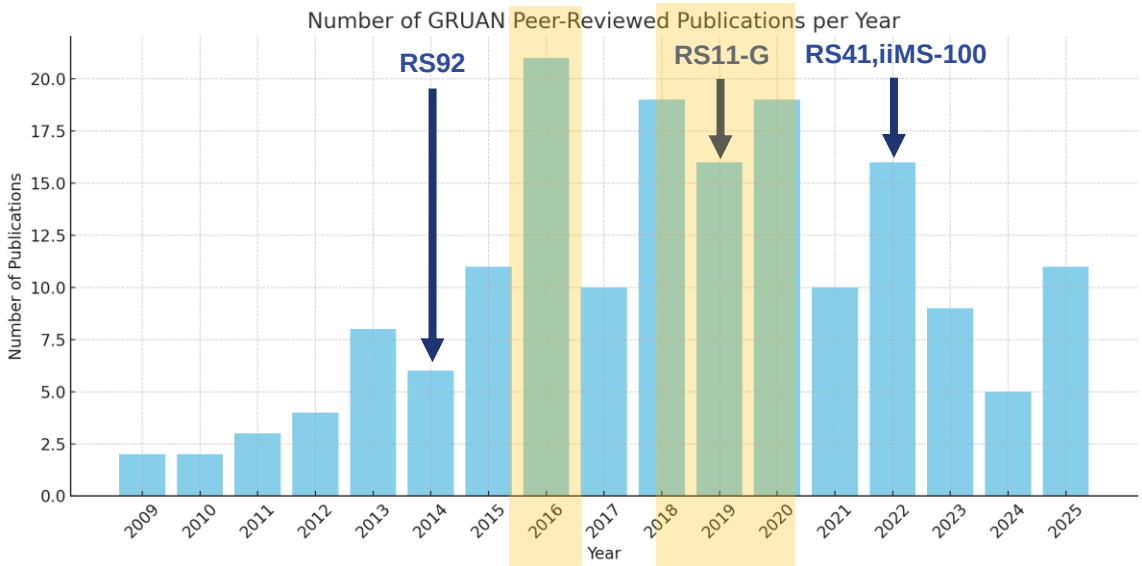
Publications and web popularity



Number of publications per year not necessarily driven by the availability of new GDPs, but from the capability of the community to show their performance and impact in peer-reviewed publications

Participation in conferences has also likely decreased over the years. We are not bringing GRUAN to the global community as effectively as we should.

Publications and web popularity



Number of publications per year not necessarily driven by the availability of new GDPs, but from the capability of the community to show their performance and impact in peer-reviewed publications

Web search are likley driven by publications.

Number of GRUAN documents from TTs

- TT Radiosonde: 5
- TT GB & satellite (formerly ancillary): 1
- TT GNSS: 1
- TT Sites: 1

TTs are groups of expert stimulating discussion and ensuring link with international activities. However, is this what «task» teams should do? Is this structure with task teams efficient and productive?

WG GRUAN & involvement of sites in GRUAN

WG GRUAN members (23) attending the quarterly meetings:

- 11-18 attendees, average 14 (last two years)

Among the stations with an active data streams:

- N. of site involved in TTs (excluding TT sites, last 5 years): **7**
- N. of stations leading a «GRUAN» related paper (last 5 years): **5**

We need to …

- **Expand the network** and improve global coverage.
- **Accelerate and simplify** the station certification process.
- **Prioritize the development of GRUAN Data Products (GDPs)** and improve their **timeliness**
- **Distribute scientific responsibilities** more evenly among WG members.
- **Enhance cooperation** across networking activities.
- **Improve communication with sites**, making them active contributors, not just data providers.
- **Intensify outreach activities** to build visibility and engagement.

GRUAN actions

- Properly select action owners within Task Teams or the WG.
- Ensure that resources are allocated efficiently.
- Let’s make GRUAN effective with the resources we have.
- GRUAN provides high-quality reference measurements and global value to the climate community.
- **Your contribution strengthens the network and supports its long-term success.**

GRUAN sets the bar, and we raise the discussion!