

# GRUAN



Global Climate Observing System (GCOS)  
Reference Upper Air Network

## GRUAN update

**Fabio Madonna**

University of Salerno, Italy

[fmadonna@unisa.it](mailto:fmadonna@unisa.it)

# GRUAN since last ICM-15 in a nutshell



Masatomo Fujiwara (co-chair since 03-2024), Hokkaido University, JP

Fabio Madonna (co-chair since 12-2022), University of Salerno, IT

GRUAN WG membership has been revised in 2023 as well as terms of reference for the Task Teams.

A list of several actions has been agreed with the stations and experts to carry on a faster implementation of the network and improvement of the performance.

Highest priority actions are on: certification of new radiosonde GDPs; measurement of water vapour in the stratosphere; GDP reprocessing; publishing of peer-reviewed papers showing value of GRUAN as a reference network.

# GCOS Action B1: Continue development of GRUAN



The means of assessing progress for this action is:

- Number of certified GRUAN stations and geographical distribution of stations
- Number of data products
- Data usage measured through citations



# GRUAN performances

GRUAN comprises of 31 sites, 14 of which have been GRUAN certified, 24 site with an active data stream.

GCOS Reference Upper-Air Network



Objective: 30-40 sites, adding 2-3 sites per year

# GRUAN performances

In the last year, two new sites have been added, but not yet certified.

Silent sites policy has been approved and we are currently in touch with two stations (**Dolgoprudny** and **Dakar**) to restart the certification process in the short term or apply the policy.

GCOS Reference Upper-Air Network



# 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
PAR	Paramaribo	ongoing (2025)
TEN	Tenerife	ongoing (2025)
GVN	Neumayer	ongoing (2025)
REU	La Reunion	ongoing (2026)
FAA	Faa'a	expected 2026
TRA	Trappes	expected 2026
HEL	Helwan	expected 2026-2027
GRA	Graciosa	expected 2026-2027
HKG	Hong Kong	expected 2026-2027
DOM	Dome-C	Under discussion

Recertification will continue on a regular basis.

Potential new sites under consideration:

- Australian sites
- European Southern Observatory, Chile
- Punta Arenas, Chile
- US NWS site in the Caribbean

# GRUAN Data Products (GDPs)



## Product certified so far:

RS92 GRUAN Data Product Version 2 (RS92-GDP.2)

IMS-100 GRUAN Data Product Version 2 (IMS-100-GDP.2)

RS-11G GRUAN Data Product Version 1 (RS-11G-GDP.1)

RS41 GRUAN Data Product Version 1 (RS41-GDP.1)

## Period 2024-2025

GNSS GRUAN GDP (minor issues to solve)

RS92 GRUAN Data Product Version 3 (RS92-GDP.3)

GDP for Modem M10/M20

GDP for Lidar temperature and water vapour measurements, data flow to the LC setup already at the 3 sites (**Priority 2 GDP**)

GDP for Meisei SKYDEW (stratospheric water vapour)

## Period 2026-2027

GDP for Graw DMF-07

GDP for CFH/FPH (two separate products)

GDP for ozone concentrations profiles from ozonesondes (**Priority 2 GDP**)

GDP for microwave radiometer, temperature profiles and precipitable water vapour (**Priority 2 GDP**)



# GRUAN data serving

It was agreed to serve the GRUAN in the next years through:

- NCEI: Discussion ongoing to enhance visibility in the NCEI webpage for the dataset.
- GRUAN website: data download available but, not currently considered for a massive data download.
- Copernicus Climate Data Store (CDS): data are available and updated irregularly, with the possibility agreed with C3S to publish data in NRT, although data are reformatted.
- PANGEA: AWI and LC discussing details of a contract to publish the GRUAN data, funded by AWI.



# GRUAN data usage from Copernicus (C3S)



	GNSS	GRUAN	IGRA/RHARM	WOUDC	Tot
N. accesses	167	<b>489</b>	393	160	1209
N. requests	557	<b>3345</b>	6606	499	11007
Volume Mb	21.625,37	<b>21.966,75</b>	114.254,47	4.977,66	162.824,25
Average N. requests per user	3,34	<b>6,84</b>	16,72	3,12	9,09
n. Users	85	<b>305</b>	239	94	723

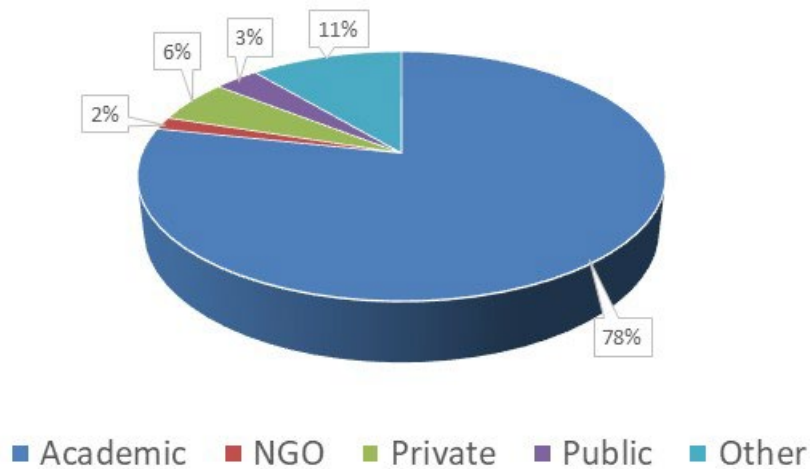
GRUAN data were published in CDS on 27/04/2020

Active users in 2023: 305

# GRUAN data usage from Copernicus (C3S)



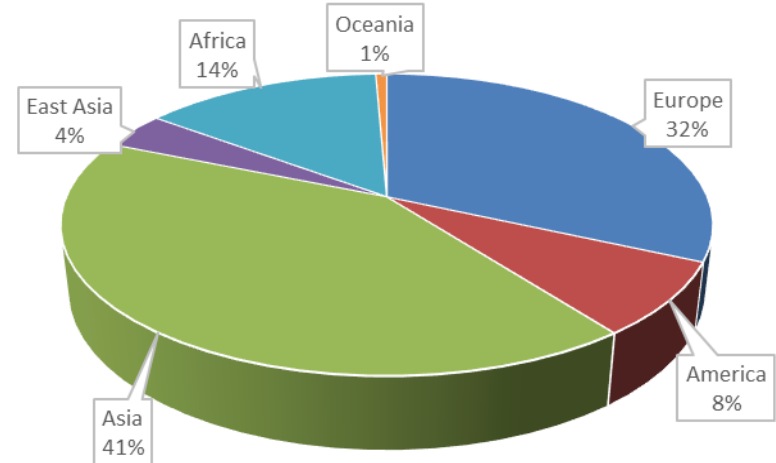
GRUAN users per sector



Distribution of GRUAN users per sector

Most of the users belong to the academic sector (78%), followed by other (11%), private (6%), public (3%) and finally by NGOs (2%)

GRUAN users per continental area



Distribution of GRUAN users per continental area

Most of users come from Asia, in particular from China (57% of the Asian users) and India (14% of the Asian users), followed by Europe, out of which most from Italy (21% of the EU users), France (15%) and UK (13%), from Africa (with a homogeneous territorial coverage), America, East Asia and Australia

# GRUAN GDPs citation



Citation for two paper describing GDPs:  
For Meisei iMS-100 GDP

<https://amt.copernicus.org/articles/15/5917/2022/>

For Vaisala RS92 GDP

<https://amt.copernicus.org/articles/7/4463/2014/amt-7-4463-2014-metrics.html>

# Cooperation BSRN-GRUAN-GSRN



- A discussion was opened with BSRN and GSRN to implement such products.
- A document aiming to outline the requirements for establishing reference data products for essential climate variables was submitted to the attention of BSRN by GRUAN and complemented by the GSRN related documentation.
- The aim is agree on the requirements for radiation products (Priority 2) planned to be provided at both GRUAN and GSRN stations in future.

The document outlines:

- Reference-observing networks: key scientific requirements
- Requirements for radiation products
  - Net radiation: greater than 5 W/m<sup>2</sup>.
  - Shortwave downward radiation: greater than 3 % or 5 W/m<sup>2</sup>.
  - Shortwave upward radiation: greater than 2 % or 3 W/m<sup>2</sup>.
  - Longwave downward radiation: greater than 2 % or 5 W/m<sup>2</sup>.
  - Longwave upward radiation: greater than 2 % or 5 W/m<sup>2</sup>.
- Time resolution

**News: yesterday, at the BIPM stakeholders' workshop (in Paris), R. Urraca (JRC) introduced a framework for the uncertainty estimation of shortwave radiation products by BSRN.**

# Back-up slides

---





## Other relevant points

- Updating GRUAN guide and manual, review of requirements for GRUAN station.
- Discussion to elaborate a document setting the QA/QC for GRUAN data products
- More active engagement with data users and enhancing outreach activities

# Status of data flow



GRUAN Radiosonde Launches (total: 176893 at 2024-09-15)

