GRUAN Implementation in Xilinhot and Certification Report

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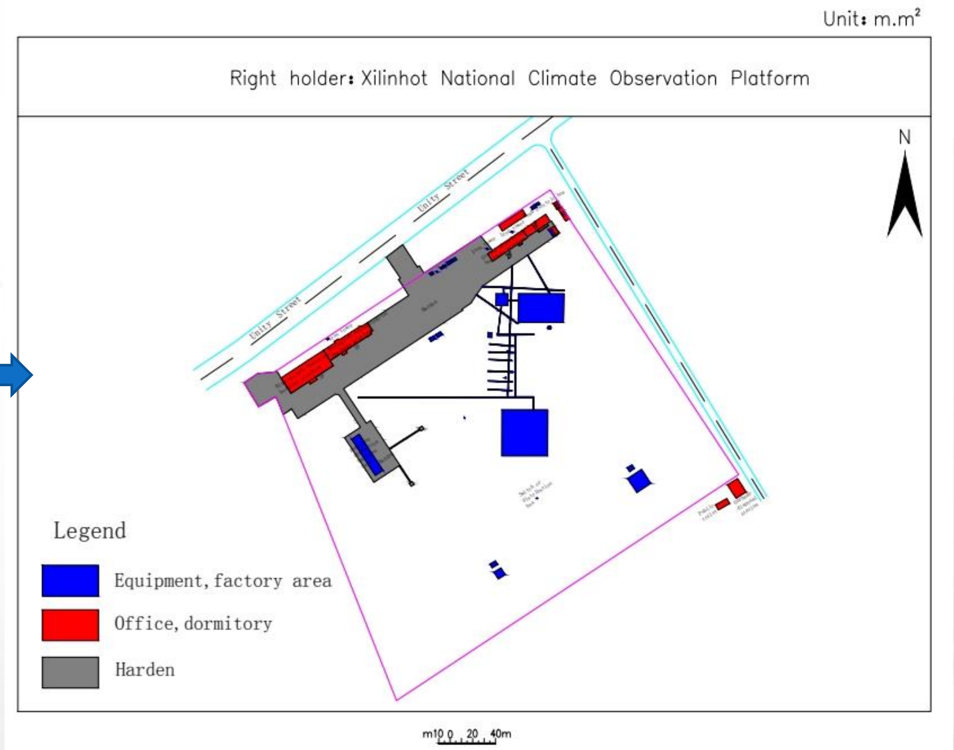
Tenerife Spain November 17, 2025

Outline

I. Site Profile & Strategic Position



- **location**： Located in north-central Asia, It is the only GRUAN global station in Chinese mainland;
- **representativeness**： mid-temperate semi-arid continental monsoon grassland climate in Asia;
- **observation**： Ground measurements, Upper-air measurements, GNSS-IWV **(priority 1 of ECVs)**
  Ground-based remote sensing measurements, Atmospheric composition measurements and Ozone measurements. **(priority 2 of ECVs)**

Outline

- Ⅰ Site profile & Strategic Position
- Ⅱ Key Progress & Milestones
- Ⅲ Observational Capabilities & Technical System
- Ⅳ Data Products & International Contribution
- Ⅴ Future Plans & Cooperation Outlook

II. Key Progress & Milestones

2008

Strategic Foresight

At the invitation of WMO, XIL joined the GRUAN program as one of the first 15 candidate site in the world

2022

Infrastructure Solidified

The site construction has passed the acceptance of high quality

2023

Observation Launched

The XIL site launched the first GRUAN benchmark observation test

2024

System Operational

Prepare certification reports and share data streams globally

2025

Authority Certified

Successfully obtained GRUAN certification, becoming the 15th certified site globally.

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- Ⅲ Observational Capabilities & Technical System
- Ⅳ Data Products & International Contribution
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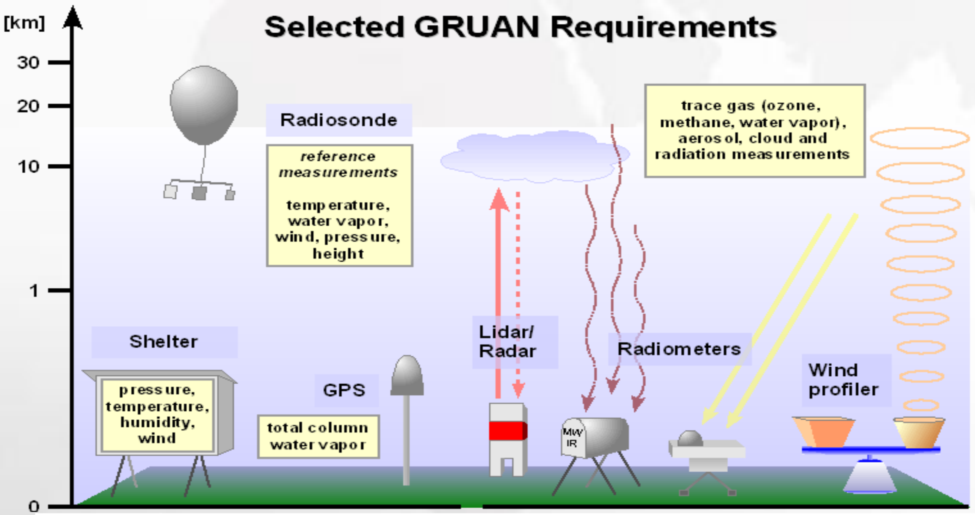
III. Observational Capabilities & Technical System



- **priority 1 of ECVs:** Ground & upper-air measurements, remote sensing of water vapor
- **priority 2, 3 and 4 of ECVs**: Sounding and vertical, surface (radiation), and atmospheric composition measurements, the vertical observation of cloud radar and atmospheric composition, Cloud radar vertical observation

No	GRUAN priority 1 and 2 ECVs	Observation equipments	Xilinhot Implement
1	Vertical profiles of temperature, pressure, water vapour, wind speed and direction, and ozone.	RS41 radiosonde as reference	The RS41 is compared with the GTH3 twice a week, Tuesday at 00 UTC, Saturday at 12 UTC
		sounding	The GTH3 is launched once a day at 00,12UTC
		Ozone sounding	CYT-1 ECC ozone sounding sensor was connected, releasing once a week on Wednesday or Thursday
		Cryogenic Frost-point Hygrometer(CFH)	It has been played twice in November and December 2023, and once a month after June 2024, with RS41 and GTH3
		Surface weather station	The automatically operation is in good condition, the data is uploaded normally, and the GDP is to be formed.
		GNSS/MET	
		Microwave radiometer	
2	Other target variables of lower priority comprise vertical profiles of aerosol attributes including optical depth, total mass concentration, chemical mass concentration, scattering, and absorption; methane columns; surface net radiation, shortwave downward radiation, shortwave upward radiation, longwave downward radiation, longwave upward radiation, and radiances; cloud properties including cloud amount/frequency, base height, layer heights and thicknesses.	Vertical profiles of aerosol attributes	The automatically operation is in good condition, and resolution of observation data is hourly.
		Surface net radiation	The microwave radiometer is used to make online real-time observations
		Cloud properties	Millimeter wave cloud radar

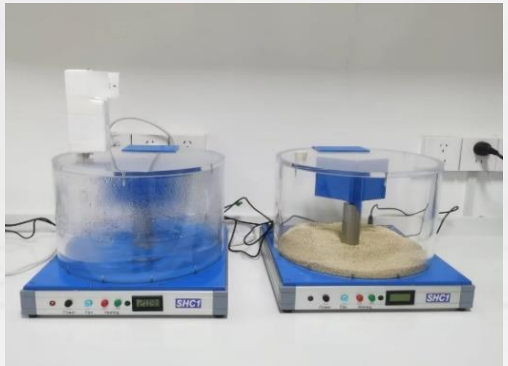
III. Observational Capabilities & Technical System

3.1 High-Standard Observation Operations

Observation Schedule Overview

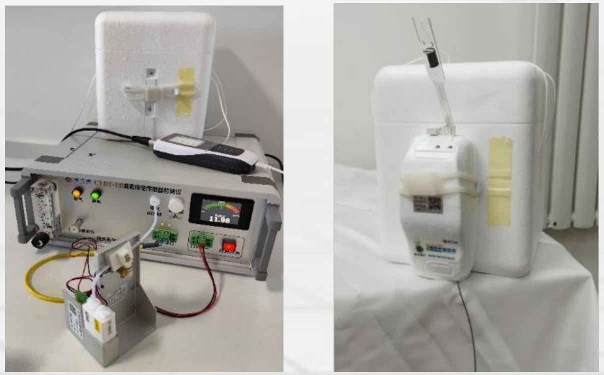
	Routine Upper-air Obs.	High-standard Comparison	Special Observation
Observation Frequency	Daily at 08:00 & 20:00 LT	Tue 08:00 & Sat 20:00 LT	Wed 14:00 LT
Observation equipment	GTS11, 13, and GTH14	RS41 and GTH3	ECC CYT-1 ozone detector

GTH3 Radiosonde



Standard humidity chamber

RS41&GTH3 Radiosonde

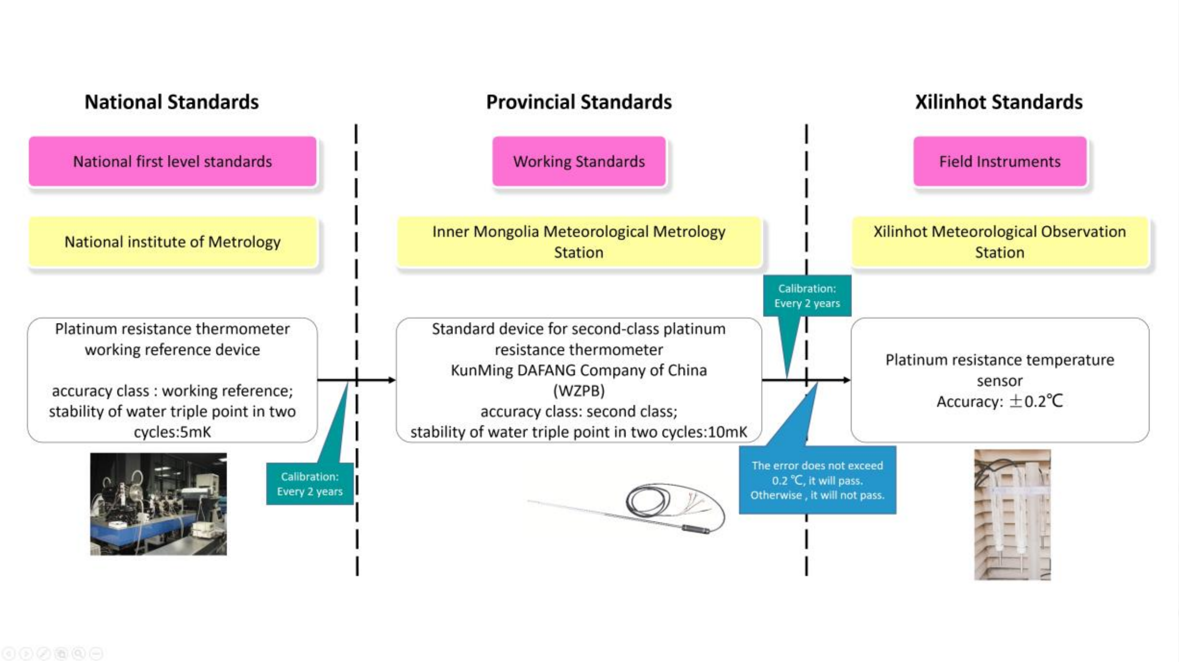


Ozone sounding sensor detector

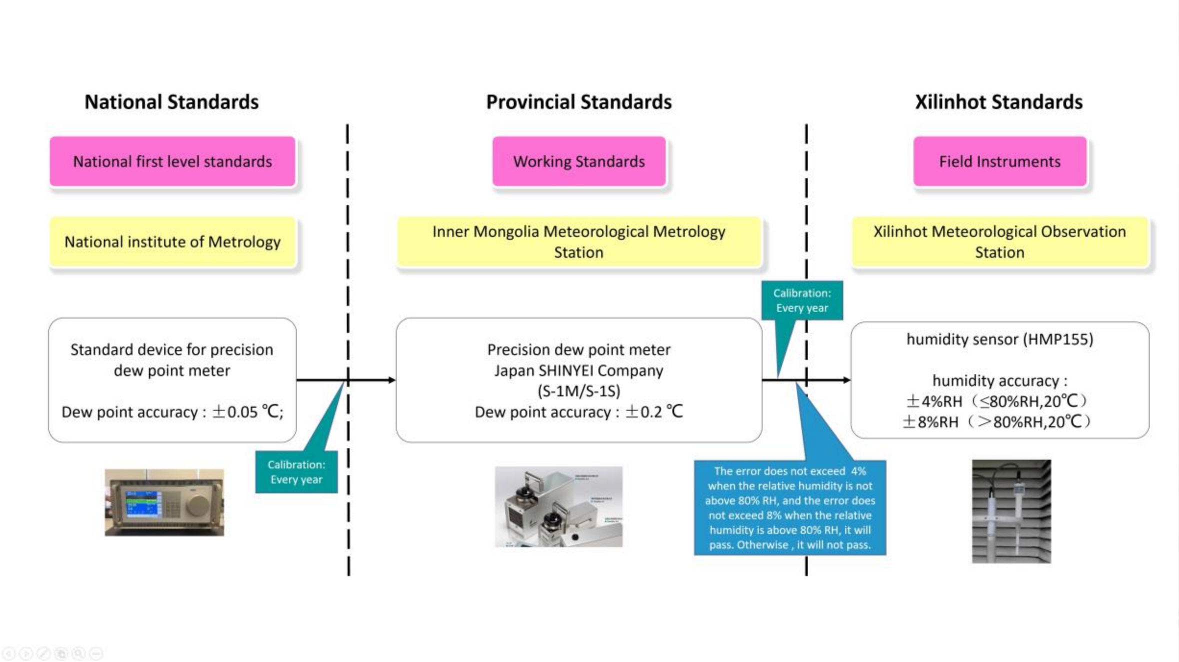
III. Observational Capabilities & Technical System

3.2 Traceability of ground measurements

- **manufacturer traceability:** Before ex-factory, the manufacturer is required to calibrate T, U, P, R, WIN_D and WIN_S sensors.
- **instrument traceability:** Sensors are calibration traceable to CMA provincial standard instruments



The calibration traceable process of temperature

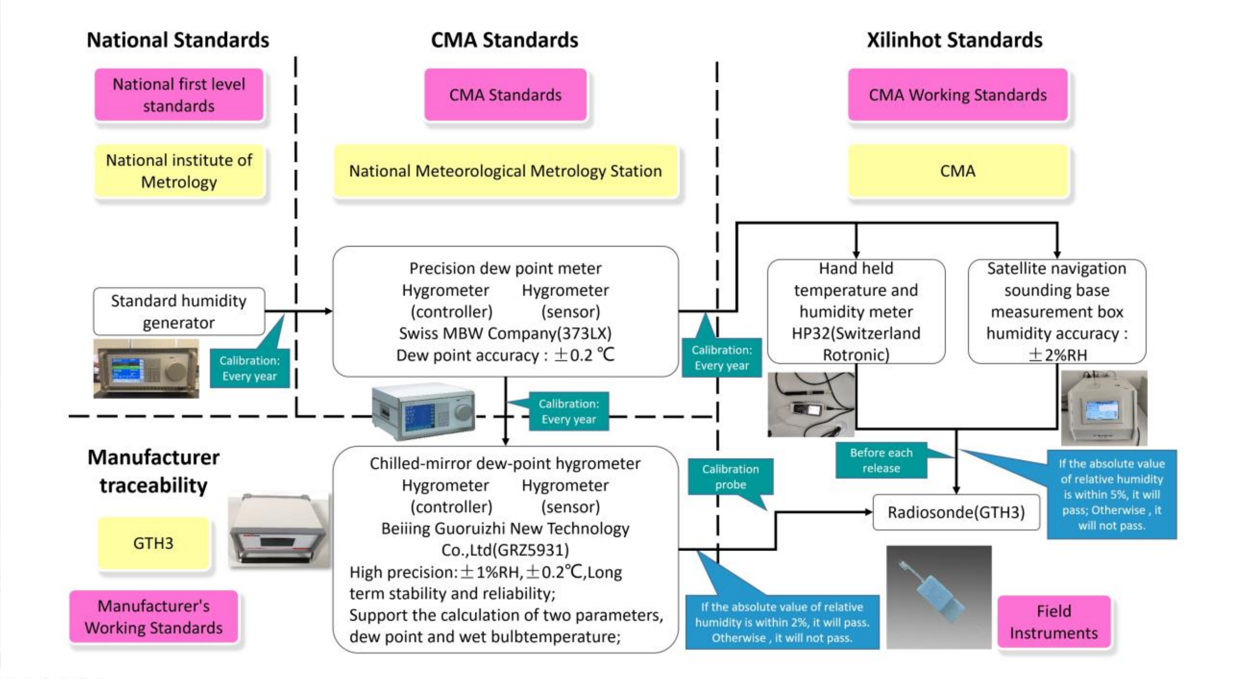


The calibration traceable process of humidity

III. Observational Capabilities & Technical System

3.3 Traceability of Upper-air measurements

- **manufacturer traceability:** Before ex-factory, the manufacturer is required to calibrate T, U and P sensors
- **site traceability:** Site technicians compare GTH3 with the HC2A-S probe of Rotronic HP32 in 0% and 100% standard humidity room check (SHC) for 10 mins before releasing GTH3 and RS41
- **instrument traceability:** The HC2A-S probe of Rotronic HP32 are calibration traceable to an SI unit every year



The calibration traceable process of GTH3

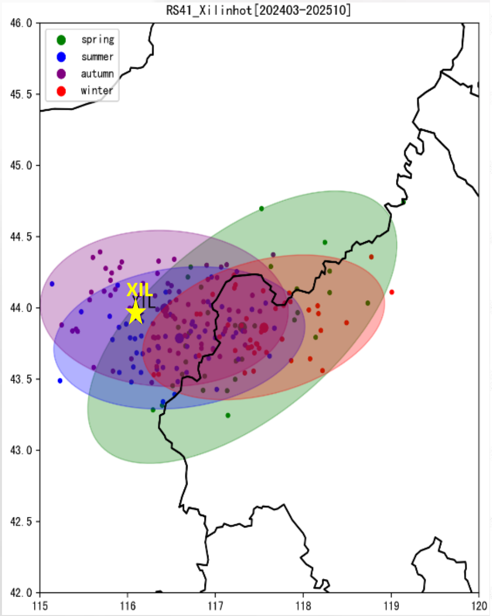
SHC

The HC2A-S probe of Rotronic HP32

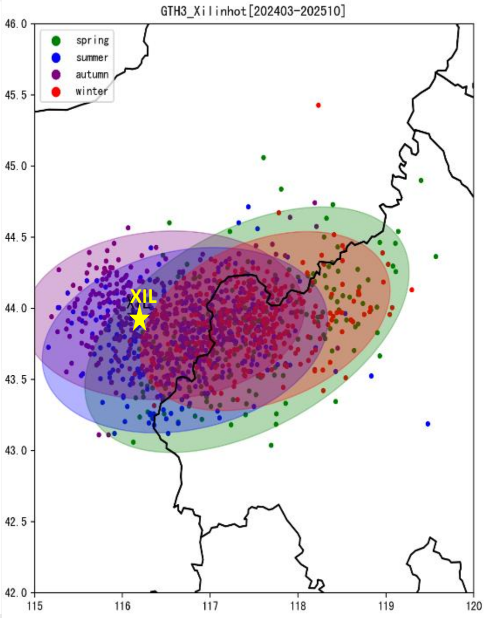
Outline

IV. Data Products & International Contribution

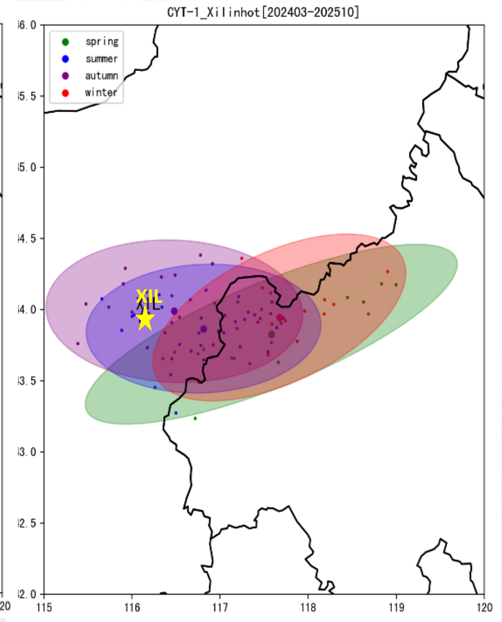
4.1 GTH3,RS41 & CYT-1 radiosonde landing area



RS41 landing point

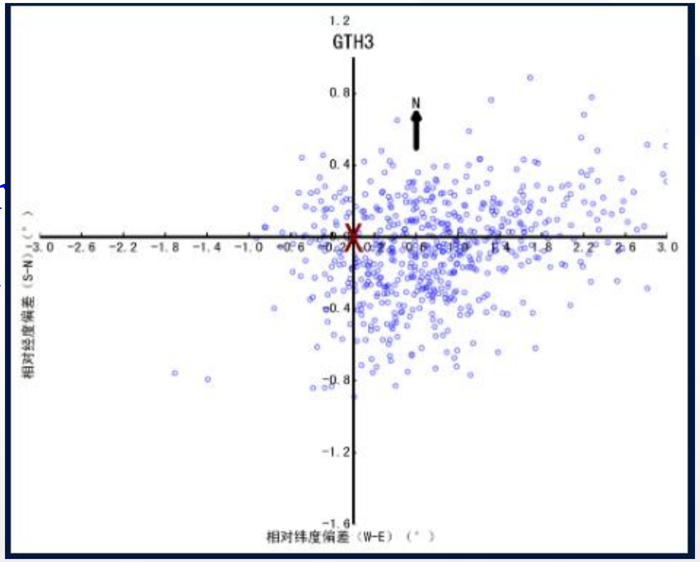


GTH3 landing point



CYT-1 landing point

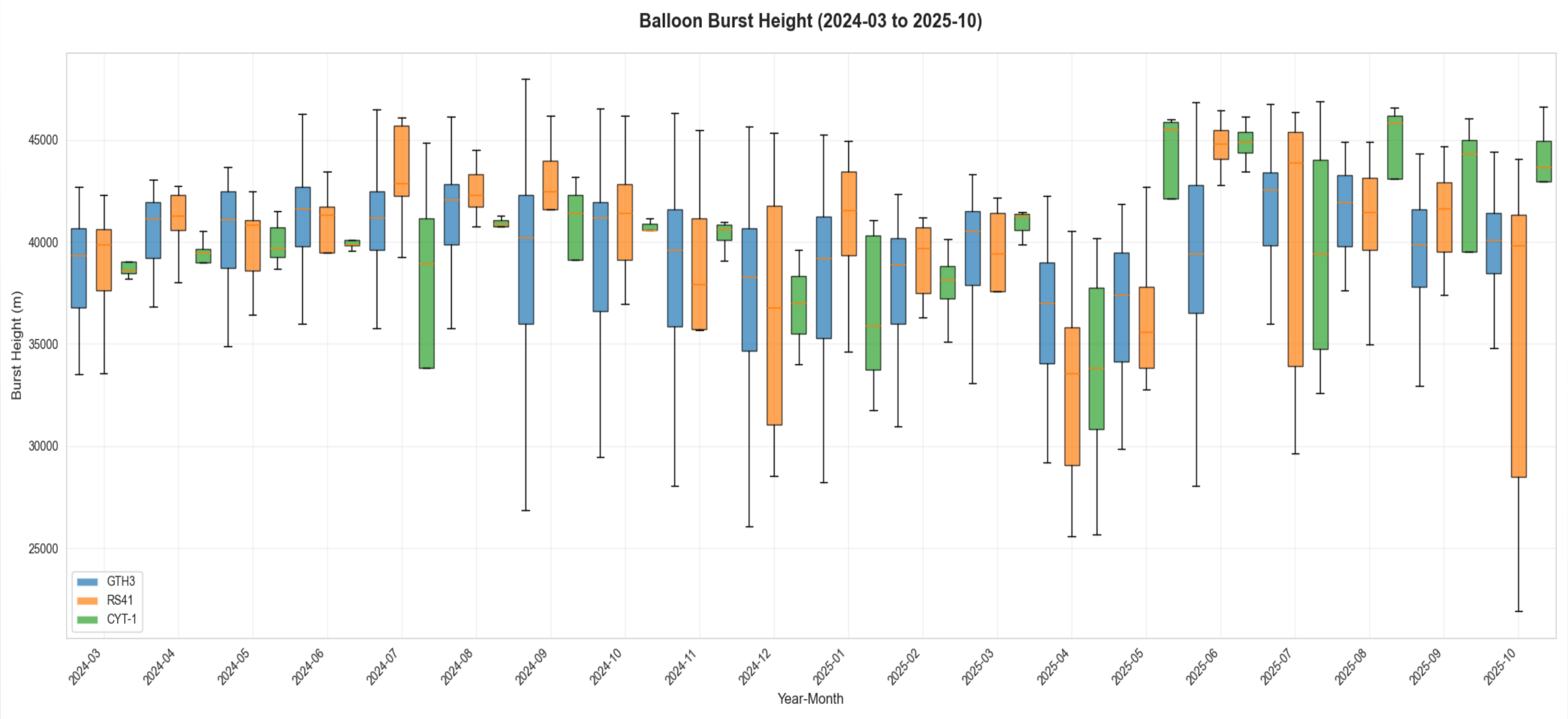
Spring
Summer
Autumn
Winter

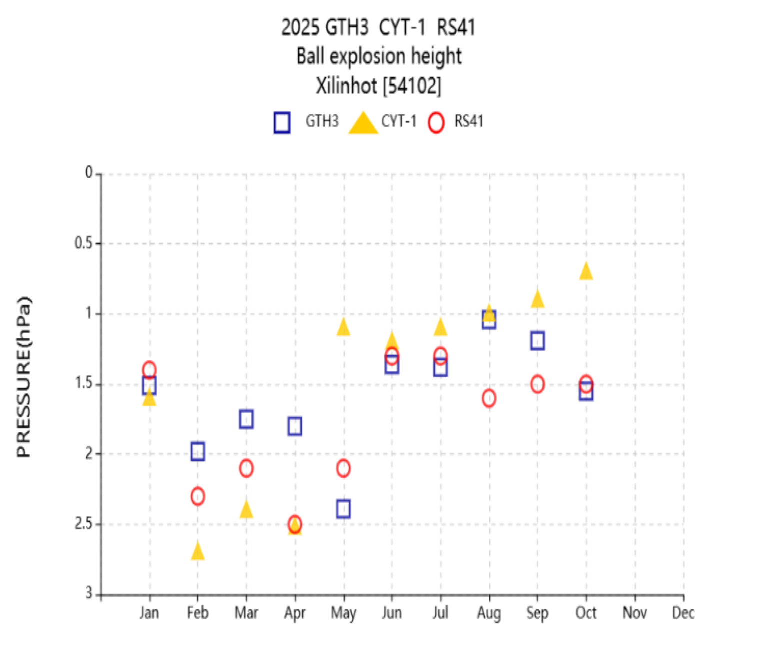


The landing area of spring, summer, autumn and winter in the radiosonde is drawn with a 95% significance test, with the green area being spring (March-May), the blue area being summer (June-August), the purple area being autumn (September-November), and the red area being winter (December-February).

IV. Data Products & International Contribution

4.2 GTH3,RS41 & CYT-1 Sounding altitude statistics



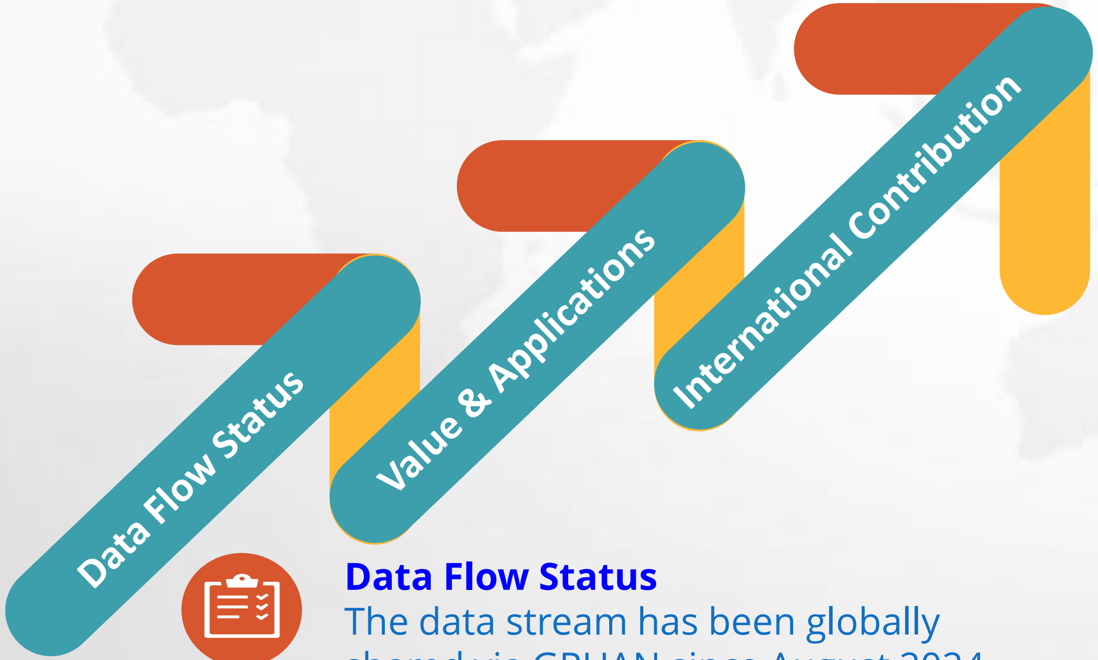


"In terms of flight altitude, our data performance is excellent and stable:

- The GTH3 sonde achieves an average burst altitude of approximately 38200.84 meters(8.05hPa).
- The RS41 sonde, serving as our high-standard comparison instrument, stably around 38478.16 meters(10.77hPa).
- The Ozone sonde also consistently reaches an average burst altitude of about 39102.69meters(8.93hPa).

IV. Data Products & International Contribution

4.1 Available GRUAN data: Vaisala RS41 & GTH3



The data stream from the XIL site has been stably and globally shared in near-real-time. Through the GRUAN network, we are continuously exchanging this metrologically traceable data with the other 14 certified elite sites globally, making a tangible contribution to global climate science, together.

Data Flow Status

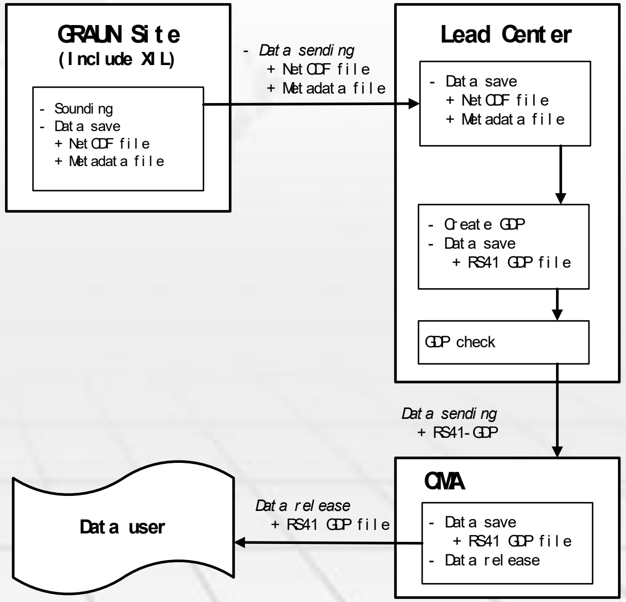
The data stream has been globally shared via GRUAN since August 2024.

Value & Applications

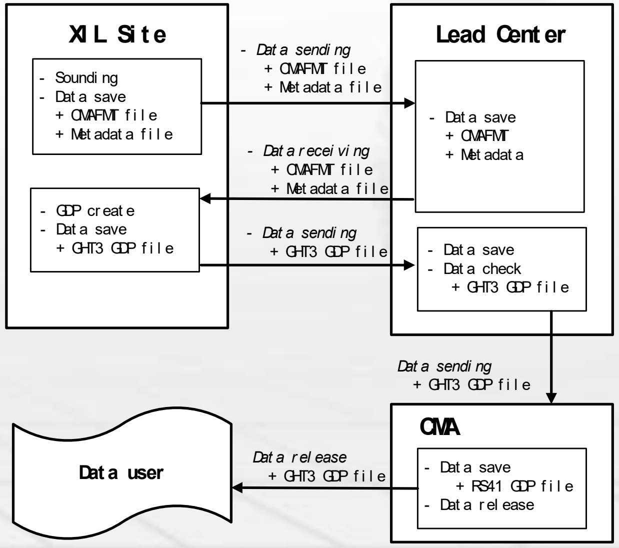
Providing the highest precision upper-air data for satellite validation, climate change research, and numerical weather prediction.

International Contribution

Exchanging highest-quality data with the other 14 globally certified GRUAN sites.



RS41 data flow



GTH3 data flow

IV. Data Products & International Contribution

4.4 Potential Data Products

- **GNSS_IWV**

XIL's GNSS data is scheduled to be converted to a GRUAN data product in NetCDF format and made available to the processing center via GRUAN-LC.

- **ECC Ozone sounding and GTH4**

The ozone sonde used at the XIL site is observed every Wednesday at 06 UTC, saving the raw ECC ozone data in the CMAFMT file format along with other meteorological data obtained at GTH4. The CMA plans to send CMAFMT data containing ECC ozone data and metadata to GRUAN-LC by using the GRUAN Rs Launch Client. The GDP of the ozone sonde (with the GTH4 radiosonde) will be developed at the XIL station in the near future.

Outline

V. Future Plans & Development Goals

- **Technical Deepening**
  - Advance the certification of GRUAN data products for GTH3 sounding and ground-based vertical remote sensing.
- **Capacity Expansion**
  - Enhance integrated analysis and traceability capabilities using ground-based, upper-air, and satellite observations for the entire atmospheric column.
- **International Benchmarking**
  - Benchmark against the Lindenberg Observatory (Germany), aiming to become a globally recognized site
- **Cooperation Initiative**
  - Seek to deepen collaboration with all GRUAN members in data sharing, technical exchange, and joint research.

That's all. Thanks again

We thank the GRUAN Lead Center, GCOS Secretariat, and all domestic and international experts for their support.