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The Evaluation and Quality Control of GRUAN radiosonde data in the Copernicus Climate Data Store

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(ICM-15)

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Aim and content of the presentation

1. the EQC Framework Contract and its structure
2. Work done at ENEA on the EQC of the ***“in situ temperature, relative humidity and wind profiles from 2006 to March 2020 from the GRUAN reference network”***





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The EQC framework contract objectives

The **objectives** of the C3S2_520_CNR service contract are to

- **continue** the Evaluation and Quality Control (EQC) effort addressed in previous EQC contracts (C3S_511 and C3S_512),
- **evolve** the existing EQC concepts and infrastructure already put in place,
- further **consolidate, harmonise** and **streamline** the entire framework, including its methodologies, procedures and outputs.



(in-situ)



(satellite)



(climate
projections)



(seasonal
forecasts)



(reanalysis)

48m: May 2022 to April 2026

SC1: May 2022 to March 2024

SC2: April 2024 to April 2026

**11 Partners (1 Contractor
(CNR)+10 sub-contractors)**





How, and how well, can I use these data for my purpose?

Fitness for purpose (Tier1)

Addressing representative use cases
Relying on quality assessments and/or external publications
Succinct overview with implications for best practice

Quality assurance (Tier2)

Based on explicit requirements *on consistency, information completeness, maturity, etc. depending on the data characteristics in a user-friendly way*
Simple checklist with details on demand

Quality assessments (Tier3)

Addressing specific user questions
highlight potential application/use of the database through and streamlined web application (Jupyter Notebook)



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First outcomes and remarks

GRUAN responds to strict requirements:

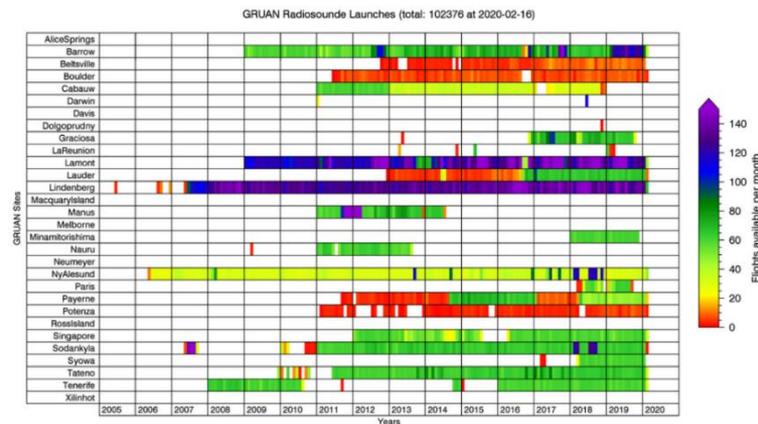
- Homogeneity, long-term stability, traceability and uncertainties provided

- Currently in CDS the GRUAN reference network covers the period May 2006- March 2020.

Specific limitation of the dataset related to coverage:

- ✓ few stations particularly in the SH (no measurements during 2006-2010).
- ✓ number of radiosounding per week/day changes depending on the station.
- ✓ number of stations and data available for all month of the year, often changes from year to year.

Un update was expected in the CDS by the early 2021 but it is still not available.



GCOS Reference Upper-Air Network



Images from the CDS



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First Quality Assessments for GRUAN radiosonde data

the *first Jupyter Notebook*

Quality question: "*which is the seasonal and latitudinal variability of the tropopause at three GRUAN stations?*"

What it has been done:

- for *presenting* the tropopause behavior at three different latitude we have considered the interannual variability and the mean annual cycle;
- by applying a classical decomposition, assuming (reasonably) that the seasonal components repeats from year-to-year, we attempt to estimate the seasonal cycle and "trend" of the Lapse Rate Tropopause, LRT.



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First QAT for GRUAN

Why a JN discussing *the tropopause variability at three stations*.

1. we must provide a standardized scientific assessments pointing out usage of the dataset;
2. “Understanding and monitoring tropopause characteristics” is one of the Scientific imperatives for GRUAN;
3. as typical C3S users of the GRUAN database we considered young researchers (undergraduates, doctoral students, post docs) or non-experts;
4. to highlight the use of the database we use “multiple stations” approach – use the NH for coverage and amount of data;

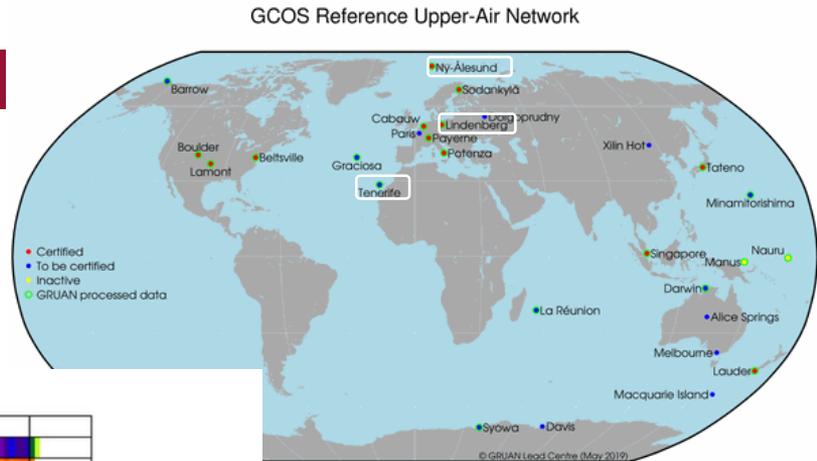
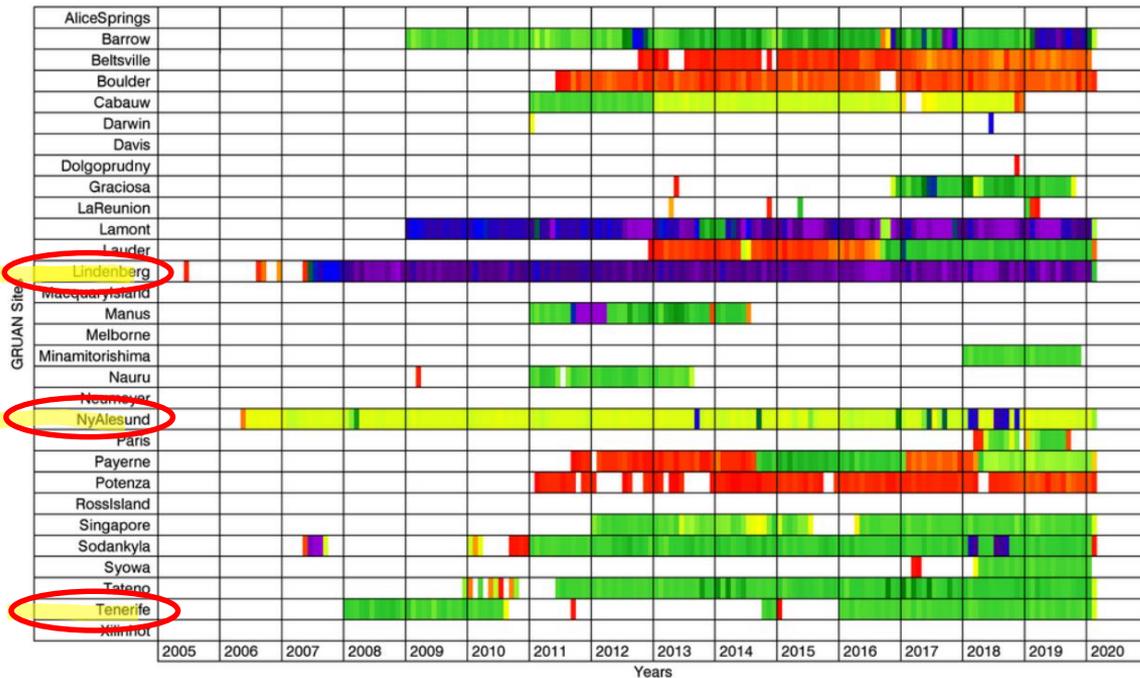


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GRUAN - dataset

Three stations at different latitudes and with longer time series in CDS

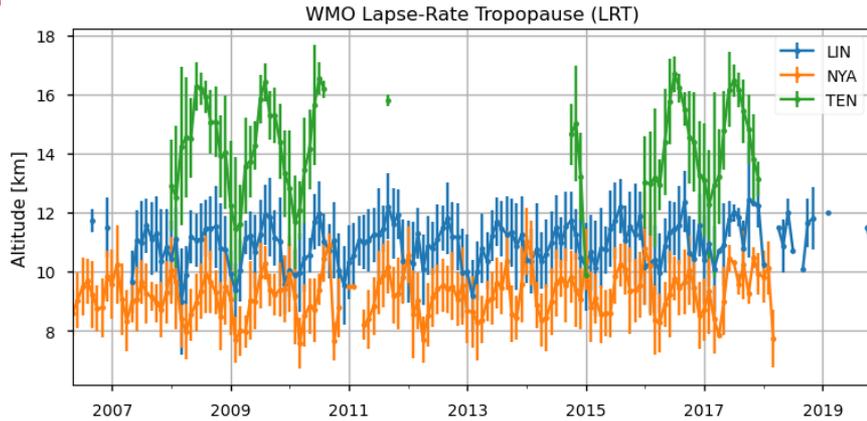
GRUAN Radiosonde Launches (total: 102376 at 2020-02-16)



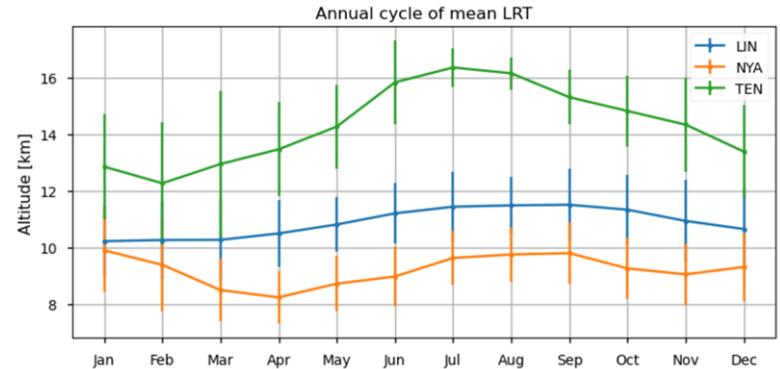


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Lapse Rate Tropopause time series (monthly values) and mean annual cycle



Altitude and amplitude of the LRT is more pronounced at lower latitude and decrease at higher latitude



The annual cycle is more pronounced in the subtropics
At NYA the mean annual cycle shows a two-waves pattern with maximum in summer and in winter and minima in spring and fall.

Lapse Rate Tropopause: WMO (1957), the tropopause is defined as the lowest level at which the lapse rate decreases to 2 C km^{-1} or less....



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Trend and Seasonality of LRT

Lindenberg:

Equation: $+0.0045x - 0.3875$

R^2 : 0.59

p -value (95%): < 0.001

slope: $+0.0045 \pm 0.0006$

Intercept: -0.3875 ± 0.0556

Ny Alesund:

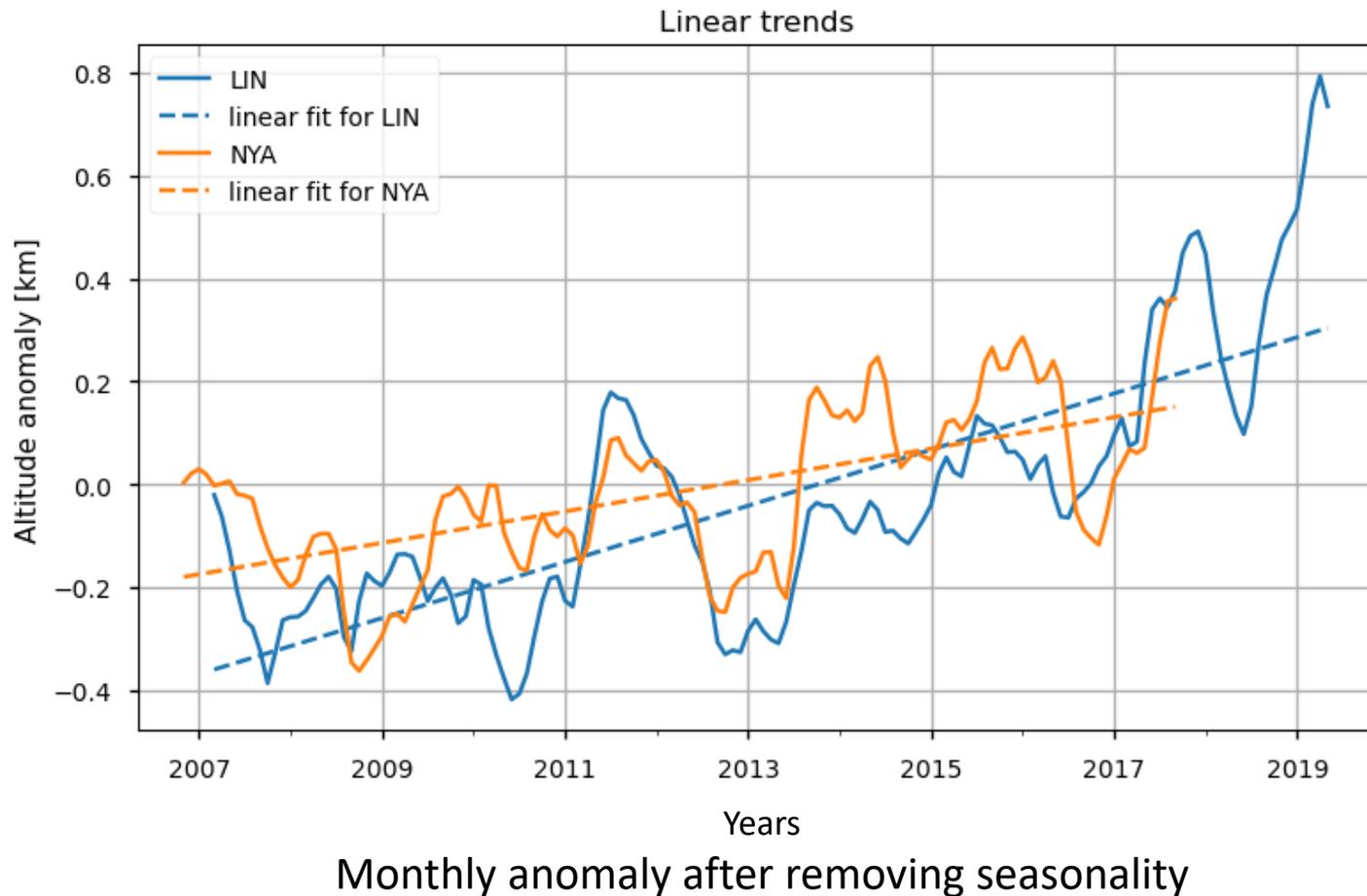
Equation: $+0.0025x - 0.1955$

R^2 : 0.37

p -value (95%): < 0.001

slope: $+0.0025 \pm 0.0006$

intercept: -0.1955 ± 0.0468





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P r e l i m i n a r t a k e - h o m e m e s s a g e s

- GRUAN provides reference measurements and uncertainties, and it is ***suitable and suggested*** to analyzed the tropopause characteristics
- ***Limitation*** are related to the number of stations available and their spatial distribution and, in some cases, to the still limited temporal coverage.
- ***Preliminary results*** presented in the Jupyter Notebook are in accordance with previous findings based on a wider data availability and in deep analysis. Further analysis are needed to verify the results.



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Outlook

- ✓ Ongoing work on
 - fitness for purpose
 - update of the Quality Assurance based on new requirements
 - revision of the JN

- ✓ Second phase of the contract (2024-2026) to start in april 2024 on more detailed quality assessment focused on validated user requirements.



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Thanks for the attention

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