



Climate Change

# Access to in-situ Reference and Baseline Observations: status

C3S2 311 2

Lead contractor:



Consiglio Nazionale delle Ricerche  
Istituto di Metodologie per l'Analisi Ambientale





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## NEW COP2 PROPOSAL: C3S2 311 LOT2

### **Title: Comprehensive Upper-Air, Baseline and Reference in situ observations**

The new contract widens the efforts spent within the C3S 311a Lot3 (“Access to observations from baseline and reference networks”) and C3S 311c Lot2 (“Historic In Situ Upper Air Database”) contracts of Cop1 to facilitate the access to and the homogenization of comprehensive upper-air, baseline and reference observations for a subset of GCOS relevant ECVs.





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# NEW COP2 PROPOSAL: C3S2 311 ITT

## **Title: Comprehensive Upper-Air, Baseline and Reference in situ observations**

The contract is led by CNR-IMAA. The contract will implement an intensive work plan with the support of 5 subcontractors:

- University of Wien (UNIVIE)
- Royal Belgian Institute for Space Aeronomy (BIRA-IASB)
- BK Scientific GmbH (BKS)
- National University of Ireland, Maynooth (NUIM)
- Tallinn University of Technology (TUT)

TOTAL BUDGET: **1.8 MEuro**





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C3S2 311 Lot 2

Rationalize

Harmonize

Improve

Comprehensive Upper-Air, Baseline  
and Reference in-situ observations.

Quality control

Homogenization

Uncertainties

Data Policy

**GNSS repository**  
Global data sources

**T, RH, wind, radiation**  
Upper-air radiosoundings,  
E-PROFILE, BSRN

**Aerosol and trace Gases**  
NDACC CO<sub>2</sub>, HCOH, PGN,  
EARLINET

CDS backend





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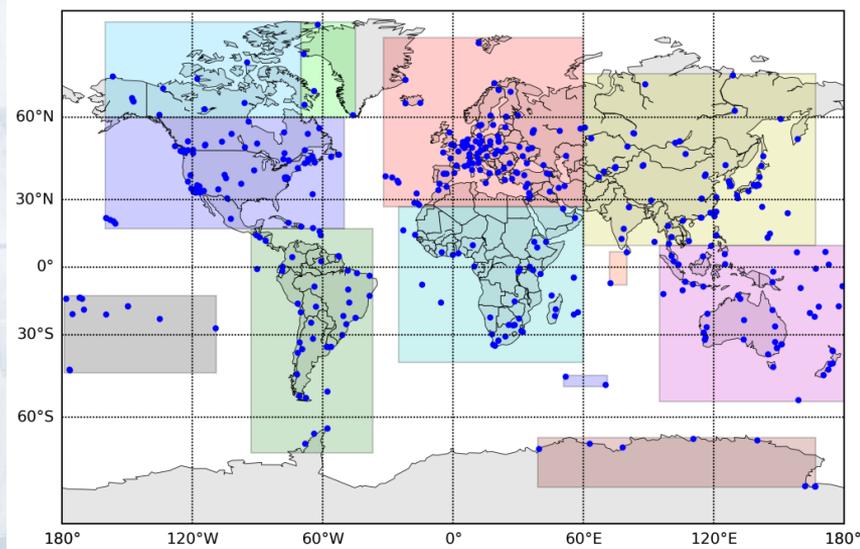


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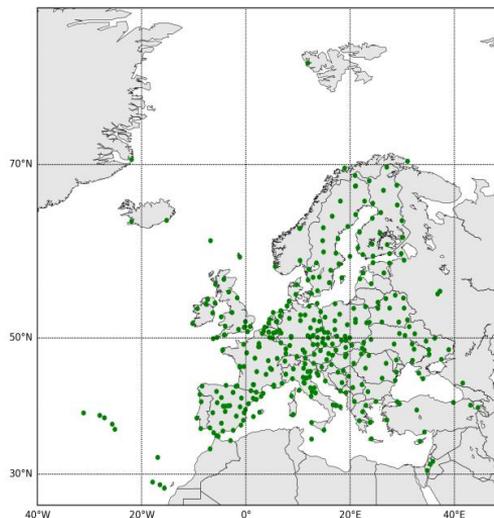
# GNSS global data repository

The repository for Global Navigation Satellite System (GNSS)-Precipitable Water will be established starting from what is already available in the CDS. Both GNSS raw data (RINEX) and products (SINEX) will be stored in the repository.

Current status of the dataset submitted to the CDS is shown in the maps below.



Map of the global distribution of IGS sites (509 in total) and sub-sectioning (optimized since January 2021) for the data requests from CDS.



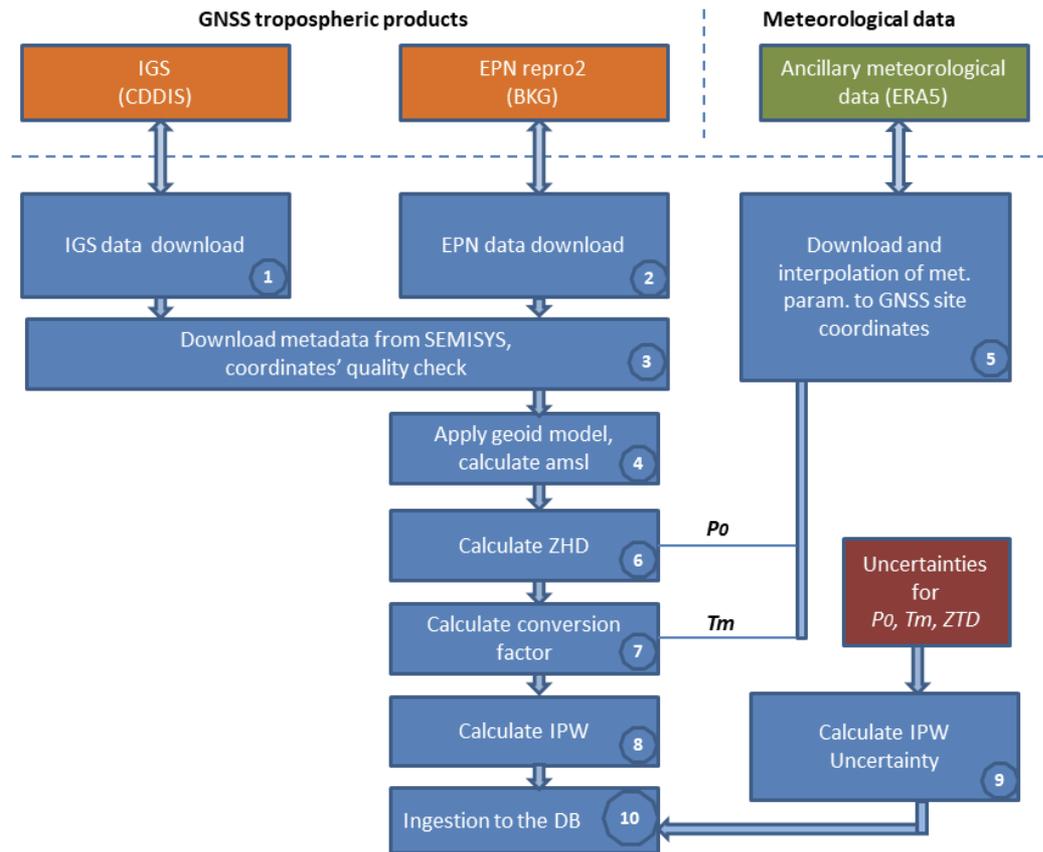
Map of the EPN stations, 89 out of these sites also belong to the IGS network.





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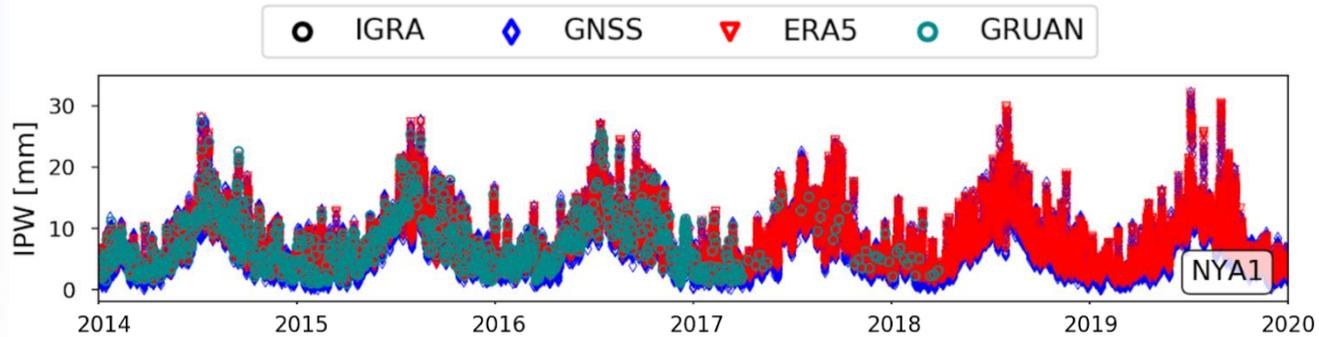
# GNSS IPW + UNCERTAINTY: RETRIEVAL





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# IGS: COMPARISONS



Comparison of the **IPW** estimated by **GNSS**, **ERA5** and radiosondes (**GRUAN** and **IGRA**) at the Ny-Alesund station (NYA1) in the period 01.01.2014-31.12.2019.



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## UPPER-AIR DATASET: CUON AND RHARM

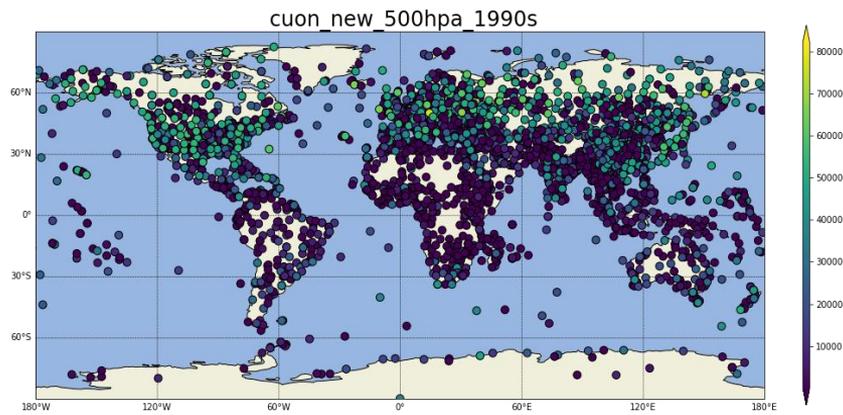
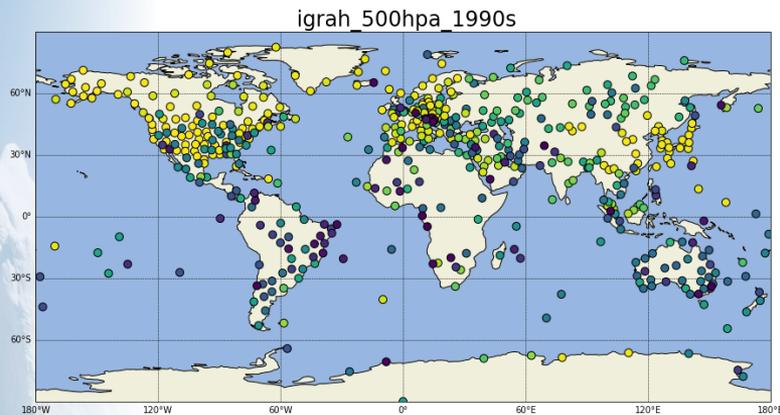
- Improve the bias-adjusted radiosounding datasets delivered in two contract during Copernicus 1.0, i.e. in the C3S 311a Lot3 (RHARM) and in the C3S 311c Lot2 (CUON).
- Merge CUON and RHARM
- Intercomparison of upper-air datasets with satellite data and with new homogenized data sets that have been published recently (e.g. Zhang et al. 2021).
- Expose the adjustments to international peer review, before ERA6 production by ECWMF.





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# UPPER - AIR DATASET INTERCOMPARISON



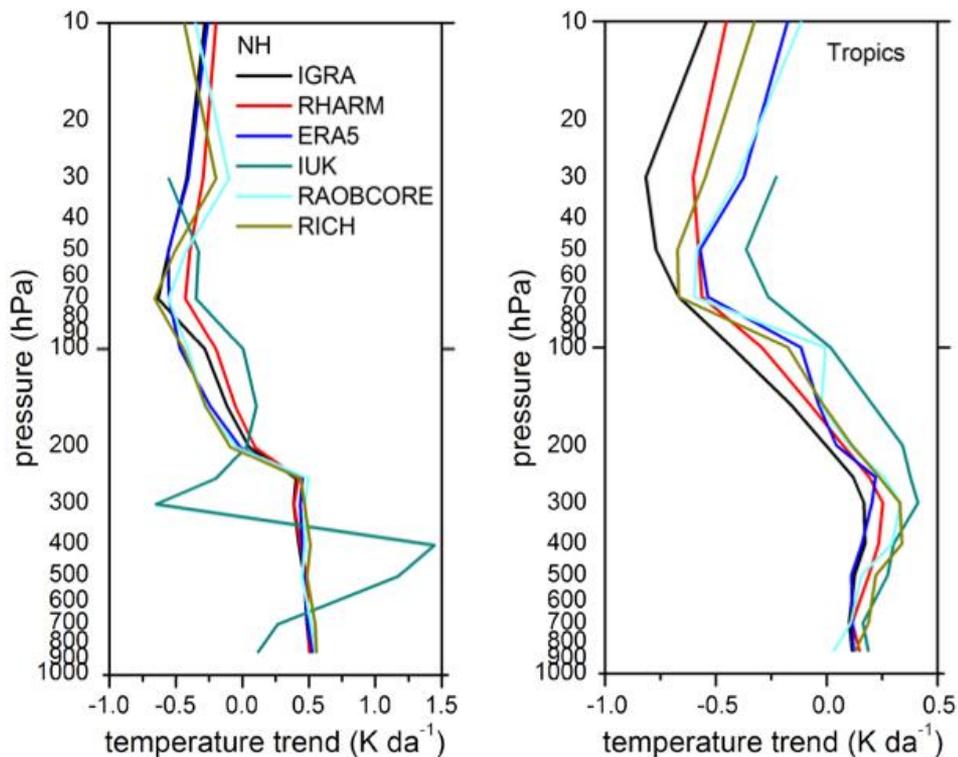
Distribution of RHARM (IGRAH) and CUON stations with data (even if it is only one ascent) in the period 1990-1999.

- RHARM, less stations than CUON (from IGRA), no buddy checks from neighbouring stations, deeper uncertainty characterization (1978-present).
- CUON, more comprehensive, more data sources, using ERA5 fc and neighbouring stations (1950-present).
- Scientific criteria to «merge» the two datasets must be identified.



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# TRENDS



Madonna et al. 2021, JGR in  
review

Profiles of temperature decadal trends at mandatory pressure level between 850 and 10 hPa for the period 1979-2015, in the northern hemisphere and in the tropics for unadjusted IGRA, RHARM, ERA5, and IUKv2, RAOBCORE, and RICH datasets.



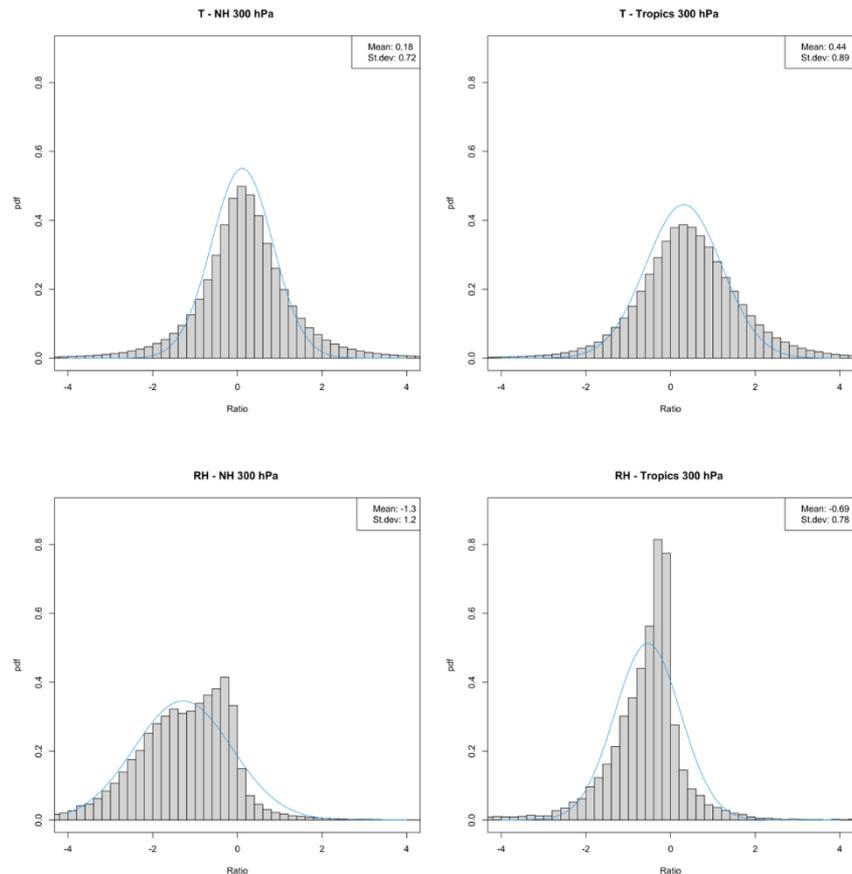
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# UNCERTAINTY VALIDATION

Uncertainty validation based on Merchant et al., 2017 calculated using O-B data (RHARM-minus-Background) in the NH and in the tropics at 300 hPa for T and RH, using the RHARM approach.

Period 2004-2019.

Background data are from the ERA5 6-hours forecast model.





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# OZONE RATIONALIZED DATASETS

Rationalize and create unified ozone datasets from the data networks (NDACC, SHADOZ, WOUDC and Eubrewnet) available for the CDS through the C3S 311a Lot3 contract.

- 14 SHADOZ stations (ozonesoundings)
- 34 NDACC stations (total ozone content+ozonesoundings)
- 95 WOUDC stations (total ozone content+ozonesoundings)
- 57 EUBREWNET stations (total ozone content)
- This will be provided in addition to the original data sets.
- Duplication will be removed by selecting the most mature data sources, keeping full traceability to the corresponding data source.

WOUDC

Metadata	Documentation	Uncertainty characterization	Public access, feedback and update	Usage	Sustainability	Software (optional)
Standards	Formal Description of Measurement Methodology	Traceability	Access	Research	Siting environment	Coding standards
Collection level	Formal Validation Report	Comparability	User feedback mechanism	Public and commercial exploitation	Scientific and expert support	Software documentation
File level	Formal Measurement Series User Guidance	Uncertainty Quantification	Updates to record		Programmatic support	Portability and numerical reproducibility
		Routine Quality Management	Version control			Security
			Long term data preservation Legend			
1	2	3	4	5	6	Not applicable

NDACC

Metadata	Documentation	Uncertainty characterization	Public access, feedback and update	Usage	Sustainability	Software (optional)
Standards	Formal Description of Measurement Methodology	Traceability	Access	Research	Siting environment	Coding standards
Collection level	Formal Validation Report	Comparability	User feedback mechanism	Public and commercial exploitation	Scientific and expert support	Software documentation
File level	Formal Measurement Series User Guidance	Uncertainty Quantification	Updates to record		Programmatic support	Portability and numerical reproducibility
		Routine Quality Management	Version control			Security
			Long term data preservation Legend			
1	2	3	4	5	6	Not applicable

SHADOZ

Metadata	Documentation	Uncertainty characterization	Public access, feedback and update	Usage	Sustainability	Software (optional)
Standards	Formal Description of Measurement Methodology	Traceability	Access	Research	Siting environment	Coding standards
Collection level	Formal Validation Report	Comparability	User feedback mechanism	Public and commercial exploitation	Scientific and expert support	Software documentation
File level	Formal Measurement Series User Guidance	Uncertainty Quantification	Updates to record		Programmatic support	Portability and numerical reproducibility
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1	2	3	4	5	6	Not applicable

SMM approach (Thorne et al., 2017 GI)