Climate Change

Title

C3S_311a_Lot3”
Baseline And Reference Observations Network for C3S (BARON for C3S)

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C3S CALL FOR TENDER

"Access to observations from baseline and reference networks"

Objective: to rationalise, harmonise and generally improve access to measurements provided by the large variety of existing networks, to facilitate climate monitoring, estimation of ECVs and uncertainty assessments.

Scope of service

Tenders for this Lot shall:

- Prioritise access to observations of ECVs that are not well observed from space;
- Prioritise access to data that can be used and redistributed without restriction;
- Address multiple ECVs within at least one of the physical climate domains: **atmosphere**, land surface, ocean.

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C3S_311a_LOT3: OBJECTIVES

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- To rationalise, harmonise and improve access to open and free observational records and data streams from selected in-situ GCOS-relevant Baseline and Reference observing networks.

CNR is the solely responsible for the implementation of the whole Service.

Nevertheless, CNR will take advantage of the sub-contractors involved and of their specific expertise delegating specific responsibilities in the projects:

- WP0 - Management (lead: CNR)
- WP1 - Access to network data (lead: CNR)
- WP2 - Data harmonization (lead: BKS)
- WP3 - Data dissemination (lead: BIRA-IASB)

The successful implementation of the proposal will allow:

- the development of consistent quality control algorithms for in situ climate data arising from Baseline and Reference networks at various time scales (hourly, daily, monthly, annually).
- the developments of methods to detect and adjust for inhomogeneities due to issues such as, instrumentation changes, calibration drifts, observing station relocations,
- to provide/quantify uncertainty in a consistent and metrologically rigorous manner.

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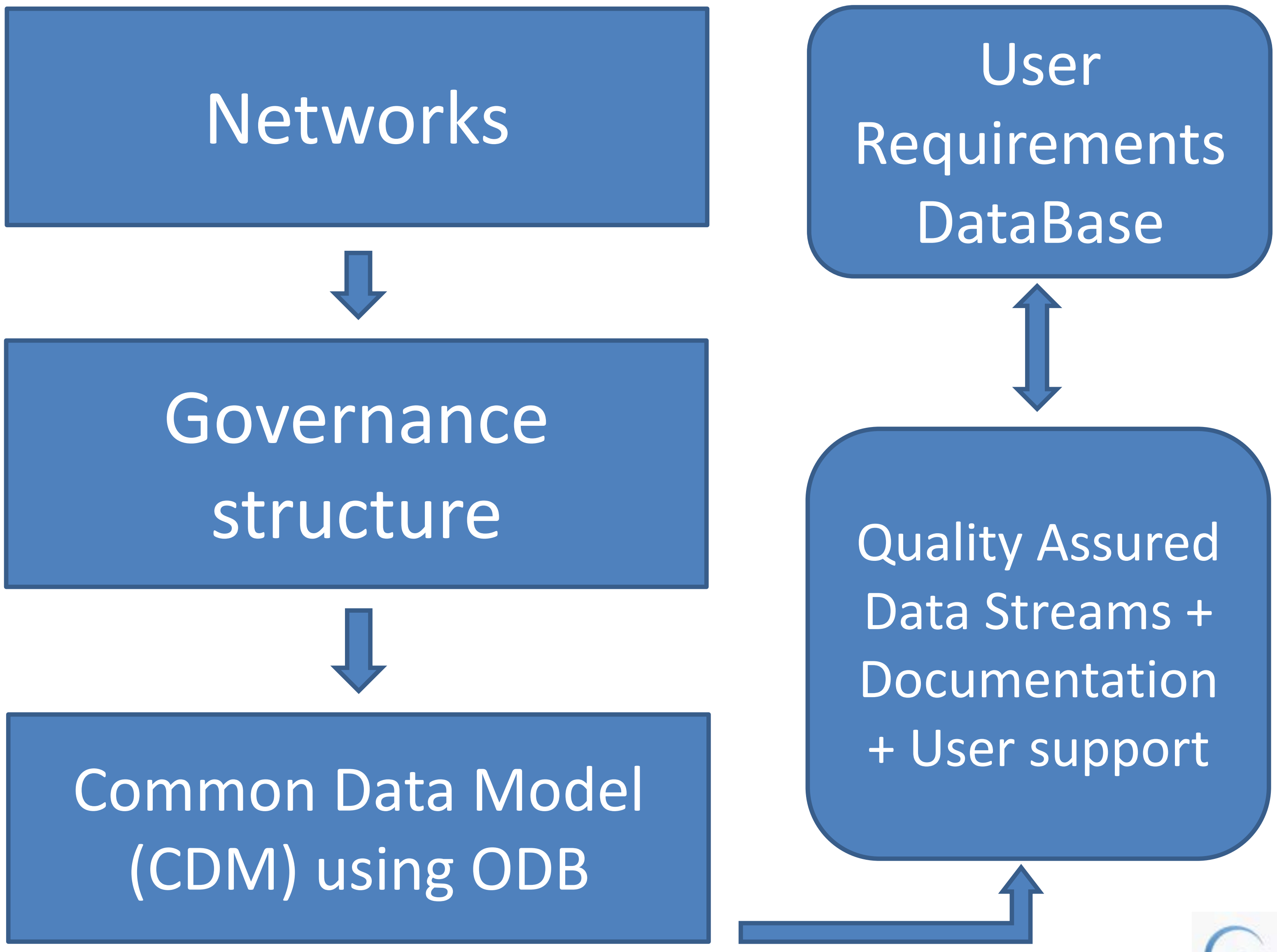
PROJECT GENERAL INFORMATION

- Started 1st March 2017 (duration: 4 years)
- Budget, 2.1 MEuros
- 8 sub-contractors
- 4 EU countries + UK represented + WMO
- Variety of expertise including remote sensing experts, statisticians, ICT experts, metrologists, ….
- Redundancy in the specific expertise to minimize the risks.

NUIM	National University of Ireland, Maynooth	IE - Ireland	Public Sector Organisation
BIRA-IASB	Koninklijk Belgisch Instituut voor Ruimte Aeronomie - Institut royal d'Aéronomie Spatiale de Belgique	BE - Belgium	Public Sector Organisation
BKS	BK Scientific GmbH	DE - Germany	Private Sector Organisation
NPL	NPL Management Ltd	UK - United Kingdom	Public Sector Organisation
TUT	Tallinn University of Technology	EE - Estonia	University
UNIBG	Università degli studi di Bergamo	IT - Italy	University
UNIBRE	UNIVERSITÄT BREMEN	DE - Germany	University
WMO	Organisation Météorologique Mondiale	CH - Switzerland	Other

TECHNICAL APPROACH



NETWORKS AND DATASET

The following networks will be considered:

- Surface Temperature: USCRN, RBSN, GSN, RBCN;
- Temperature/humidity/wind (profiles): GRUAN, GUAN, RAOB;
- Ozone (concentration, columns and profiles): NDACC, SHADOZ, GAW Networks;
- CO, CO2, CH4 (concentration, columns and profiles): TCCON, GAW networks;
- Integrated water vapour (from GNSS zenith tropospheric delay only): IGS, EUREF, all international GNSS networks.

According to the following timeline:

Service year I (03/2017-02/2018): in-situ sounding temperature and humidity profile data products;

Service year II (01/2018-12/2018): column and profile ozone data products, surface temperature, in-situ sounding wind profile data;

Service year III (01/2019-12/2019): column and profile CH_4, CO_2 and CO data products;

Service year IV (01/2020-12/2020): integrated water vapour from GNSS.

Updated on yearly basis.

SERVICE YEAR I: RATIONALE

Several groups have used multiple years of RAOB temperature measurements to construct long-term CDRs (Durre et al., 2005; Free et al., 2004, 2005; Sherwood et al., 2008; Haimberger et al., 2008, 2011; Thorne et al., 2011; Seidel et al., 2009).

- It has long been recognized that the quality of the RAOB observations varies for different sensor types and height.

- Can GRUAN as a Reference network improve the quality of the baseline radiosounding capability?

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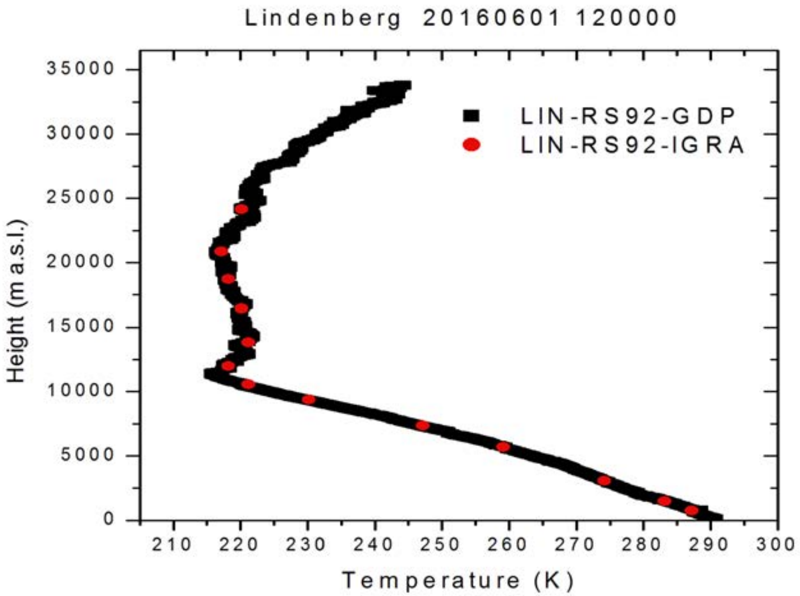
G R U A N V S . B A S E L I N E R A D I O S O N D E S

- Difference in the number of levels
- Several manufactures and sonde types
- Different measurement procedures
- Different data processing
- Different formats/coding, roundings, ……….



- **Objective**: to drain as much information as possible from the comparison of baselline radiosondes with the corresponding GDP.

Background model data information maybe considered as an ancillary if required at a later stage.

HARMONIZATION PROCESSING

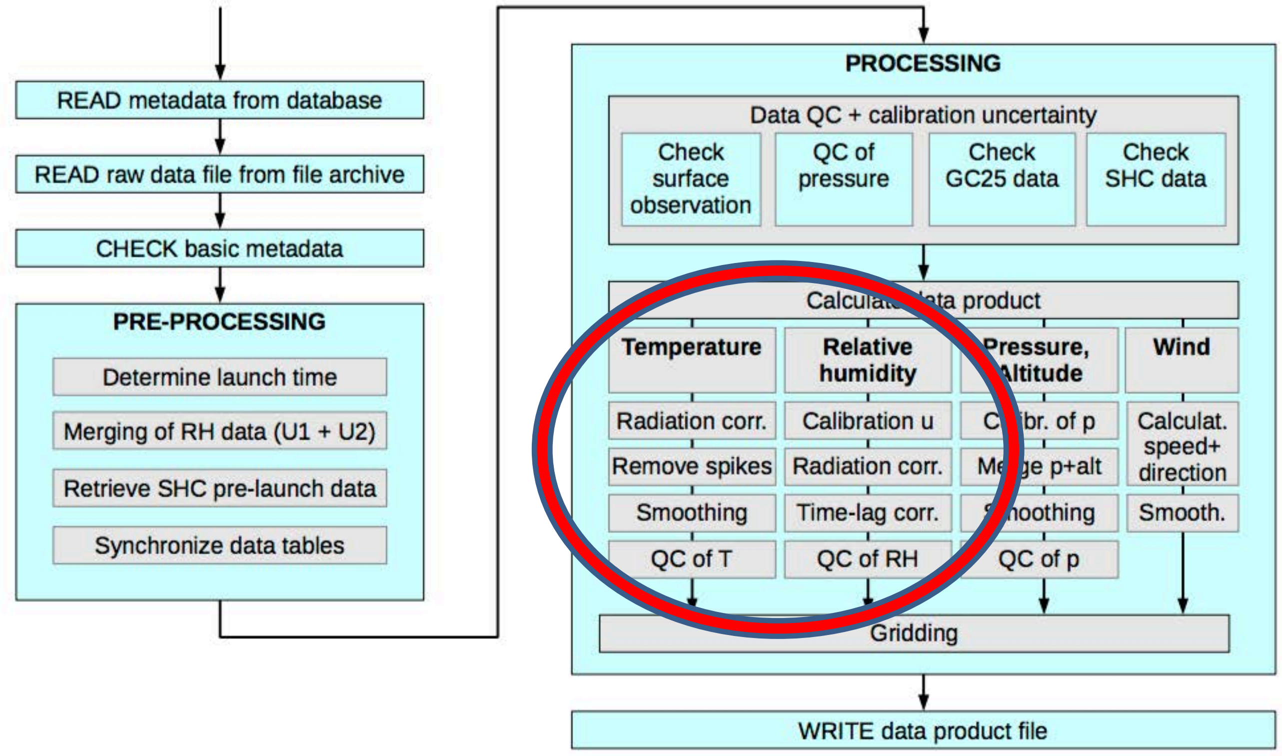
- Use GRUAN as the reference and correct baseline VAISALA RS92 Radiosondes in the GRUAN era (2006-present).

- Harmonize the baseline VAISALA Radiosondes data before the GRUAN era back to 1979 (e.g locally detrending according the step change in the time series and normalization of the anomalies to the GRUAN era values).

- Use the harmonized Baseline VAISALA Radiosondes to extend the harmonization to "neighbours" (*k-nearest neighbors regression*) from other manufacturer (including and uncertainty estimation); **CIMO radiosonde intercomparison datasets** may play an important role.

GRUAN DATA PROCESSING

To harmonize baseline radiosoundings, we considered to apply as much as possible the GRUAN processing: but this is not always feasible.....



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CURRENT APPROACH

- GRUAN Radiation correction will be applied to all the baseline radiosondes in the GRUAN era.

- Time-lag correction cannot be homgeneously applied to the same dataset (time missing at many station of for many time period in the IGRA database, challenges in using the exponential kernel low-pass filtering, ….).

- Similar conclusion for the spike removal and any other kind of smoothing applied in GRUAN.

Therefore, correctons will be statistically modelled exploiting the GRUAN GDP vs IGRA database at a few stations (LIN, BAR, CAB, NYA, SGP, SOD).

In this talk, the following station are considered: LIN, NYA, SGP, SOD.

STATISTICAL APPROACH

- A simplified approach is to model other correction than radiation using a locally linear model at each altitude level:
-
- $(\text{IGRA - RS92-GDP})^2 = \text{Noise}^2 + \text{Bias}^2 + \text{Variance}$

- Calculation of the bias has been performed using the bootstrapping method (i.e. more robust calculation of the mean).
- Attempt to model the timelag correction using an exponential function have been proven to be inaccurate, but this will be explored more intensively.
- Assume noise is the same as those calculated for the GDP.

Comparisons : T, night, 100 hPa

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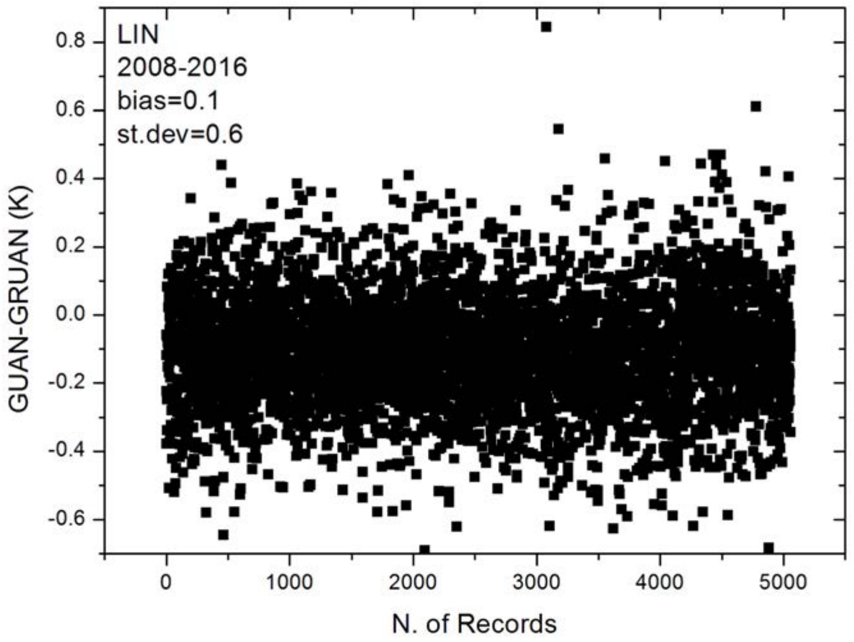

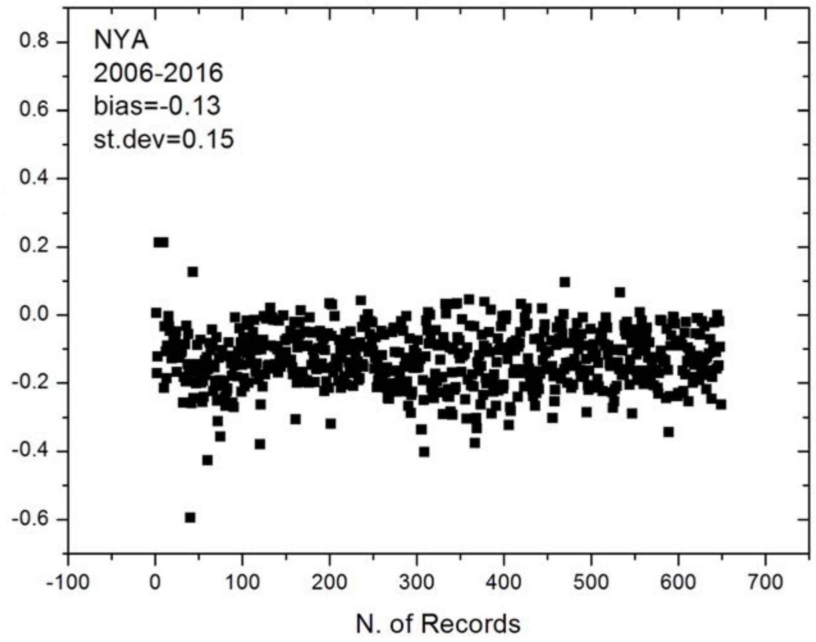

Lindenberg (LIN) show a much larger variability than Ny-Alesund (NYA) though the bias is the same at both the stations.

Please note that NYA data have been reprocessed after the discovery of a mistake related to the attribution of a wrong WMO index in the database.

Comparisons : T, night, 500 hPa

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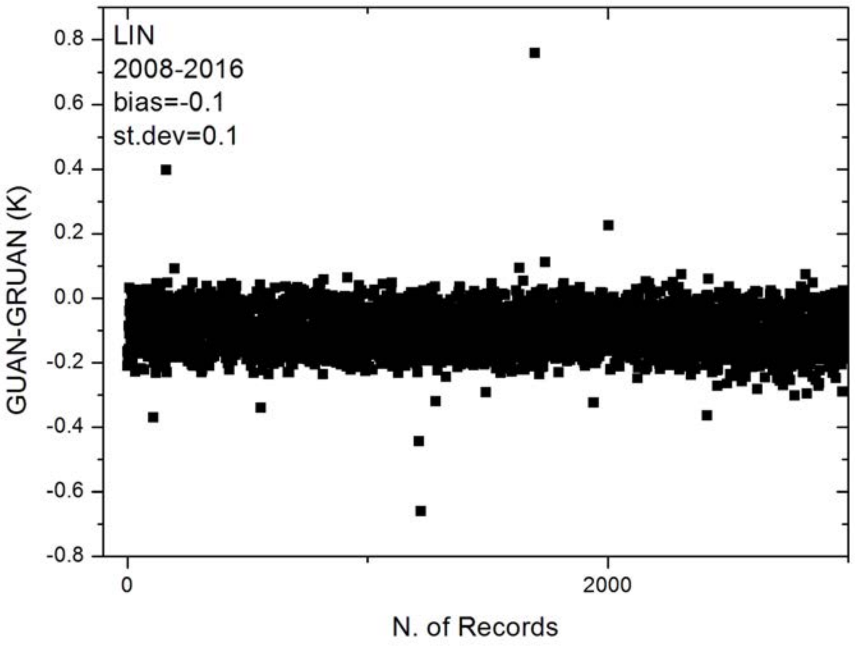

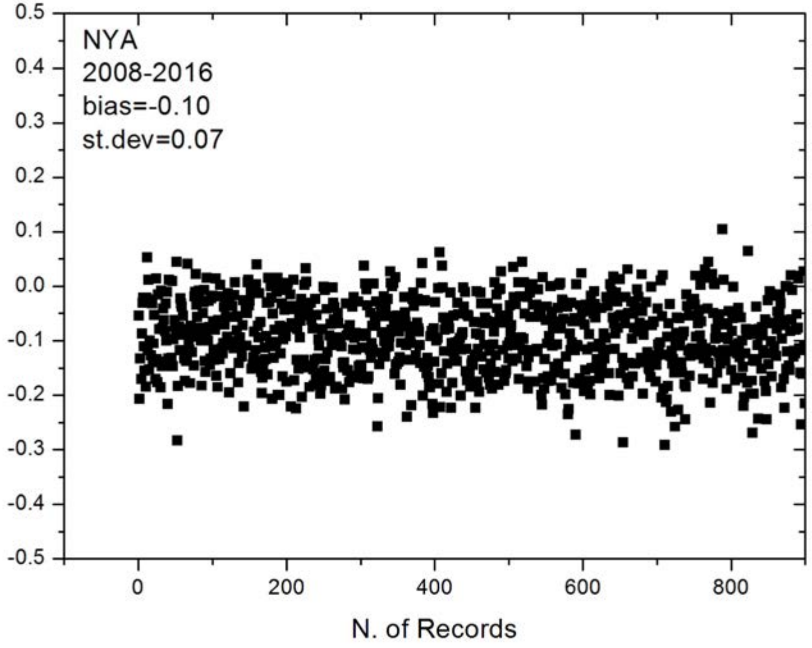

LIN and NYA bias is the same as at 100 hPa.
Same standard deviation.

Comparisons : RH, night, 300 hPa

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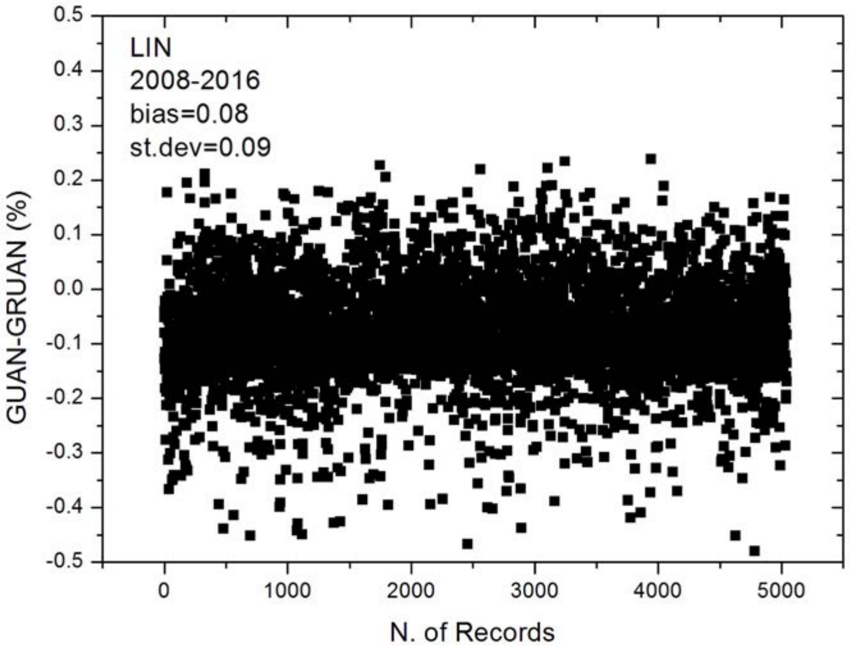
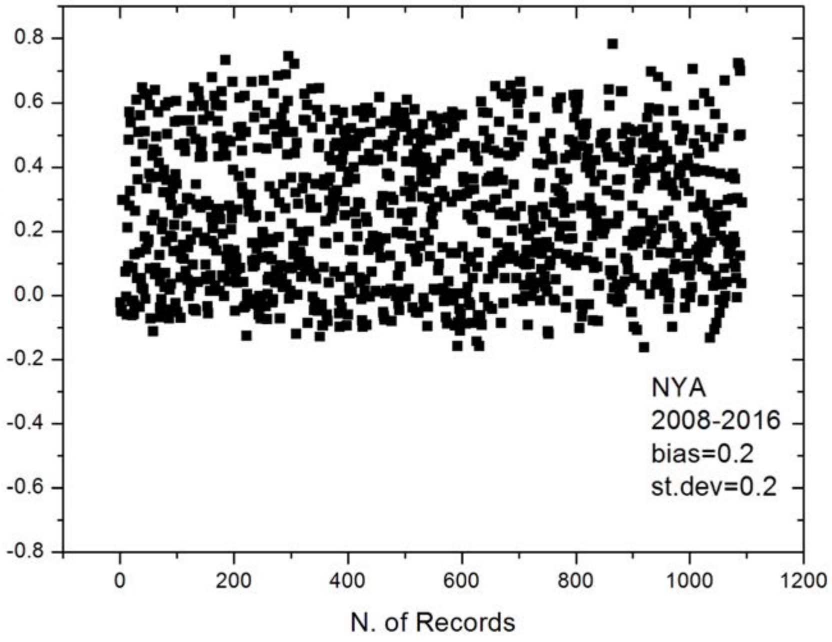
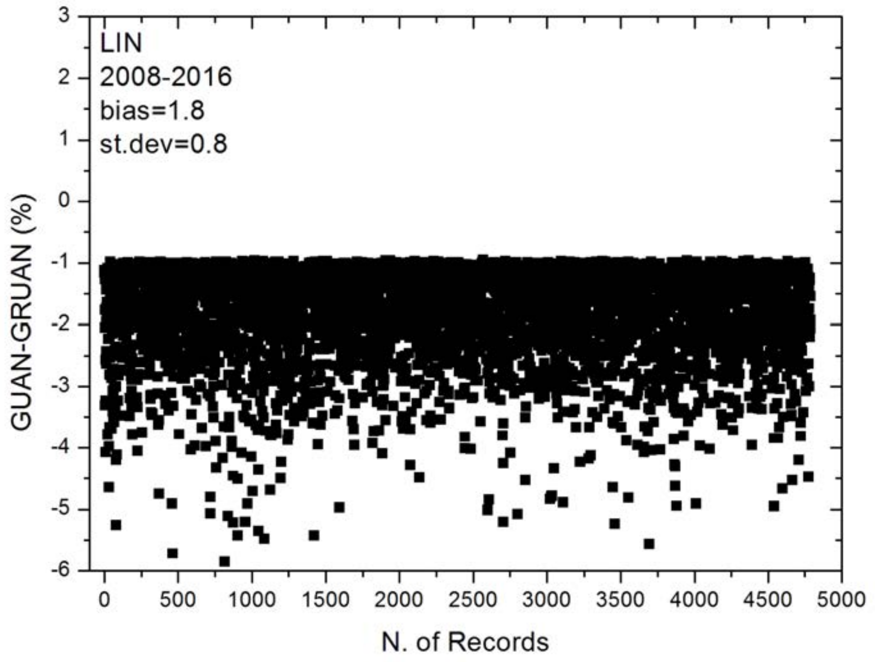
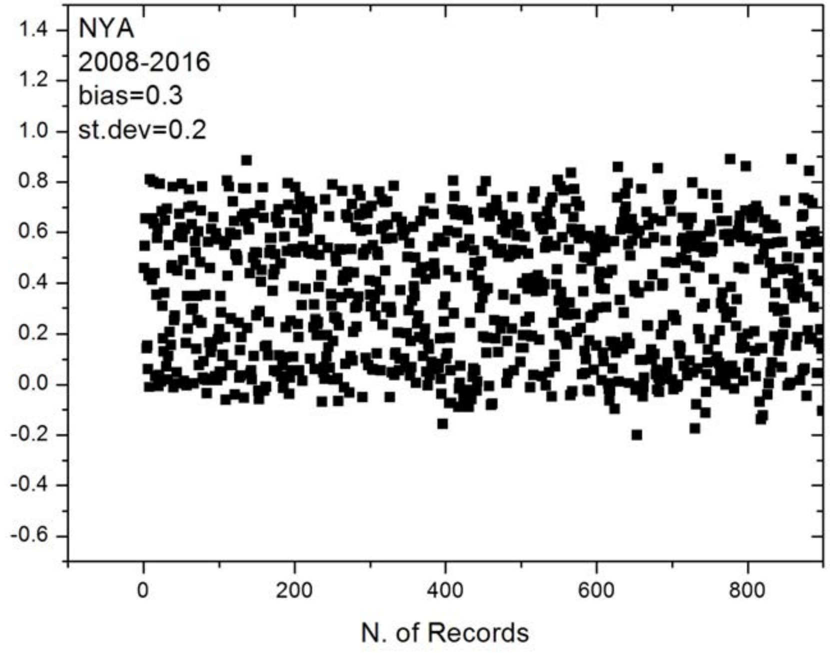




Time series of the RH differences show small discrepancies both at LIN and NYA.
Positive bias for NYA negative for LIN
Small standard deviations.

Comparisons : RH, night, 500 hPa





Small bias and variances for NYA as at 300hPa.

LIN GUAN values are represented by a strange bi-modal distribution and the bias is larger than for NYA.

FOUR STATIONS AT A GLANCE

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T 100hPa	LIN	NYA	SGP	SOD
Bias (K)	-0.1	-0.13	-0.09	-0.08
St.Dev (K)	0.6	0.15	0.37	0.09
T 500hPa				
Bias (%)	-0.10	-0.10	-0.10	-0.09
St.Dev (%)	0.08	0.07	0.09	0.06

RH 300hPa	LIN	NYA	SGP	SOD
Bias (K)	-0.12	0.2	-0.07	-0.06
St.Dev (K)	0.08	0.2	0.09	0.11
RH 500hPa				
Bias (%)	-1.9	0.3	-2.0	-2.1
St.Dev (%)	0.8	0.2	0.9	0.8

Analysis from four GRUAN/GUAN stations.
Good agreement in the T bias, same for RH, expect for NYA where bias is smaller but has an opposite sign compared to the other stations.

All the other GRUAN stations will be investigated to assess the bias and the standard deviations of the differences across the network.

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SUMMARY

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- GRUAN radiation correction will be applied to the baseline radiosondes (and the related uncertainty will be calculated)
- A statistical modelling of the other corrections (and the related uncertainties) will be likely inferred from the GRUAN vs Baseline comparison. More work is needed to define the statistical model.
- Homogenization of past dataset will be based on statistical methods and on the CIMO radiosonde intercomparison datasets.

Next deadlines:

- June 30th: delivery of a sample dataset
- Nov. 30th: delivery of the software and of the processing chain
- Feb. 2018: delivery of the (annually updated) harmonized dataset.

QUESTIONS?