TT Measurement Scheduling and Combination

Fabio Madonna

Possible topics

- Climate trends: can we use homogenized radiosonde and the related T and RH decadal trends to study measurement sampling strategies?
  - Previous work by Seidel et al., 2005 using reanalysis data, few stations; Whiteman et al., 2012, using a statistical model with information inferred from the data.

- Measurement redundancies and synergies: can we use two different techniques estimating the same parameter in a redundant way? How?

Measurement scheduling and climate data

There are numerous caveats that should be kept in mind when analyzing trend, for example:

- Measurement sampling and spatial correlation in the data.
- Time series are not stationary and not homogeneous;
- The Reanalysis assimilate a different observational mix over time, and this may introduce discontinuities in the time;
- Temporal correlation in an observation time series.

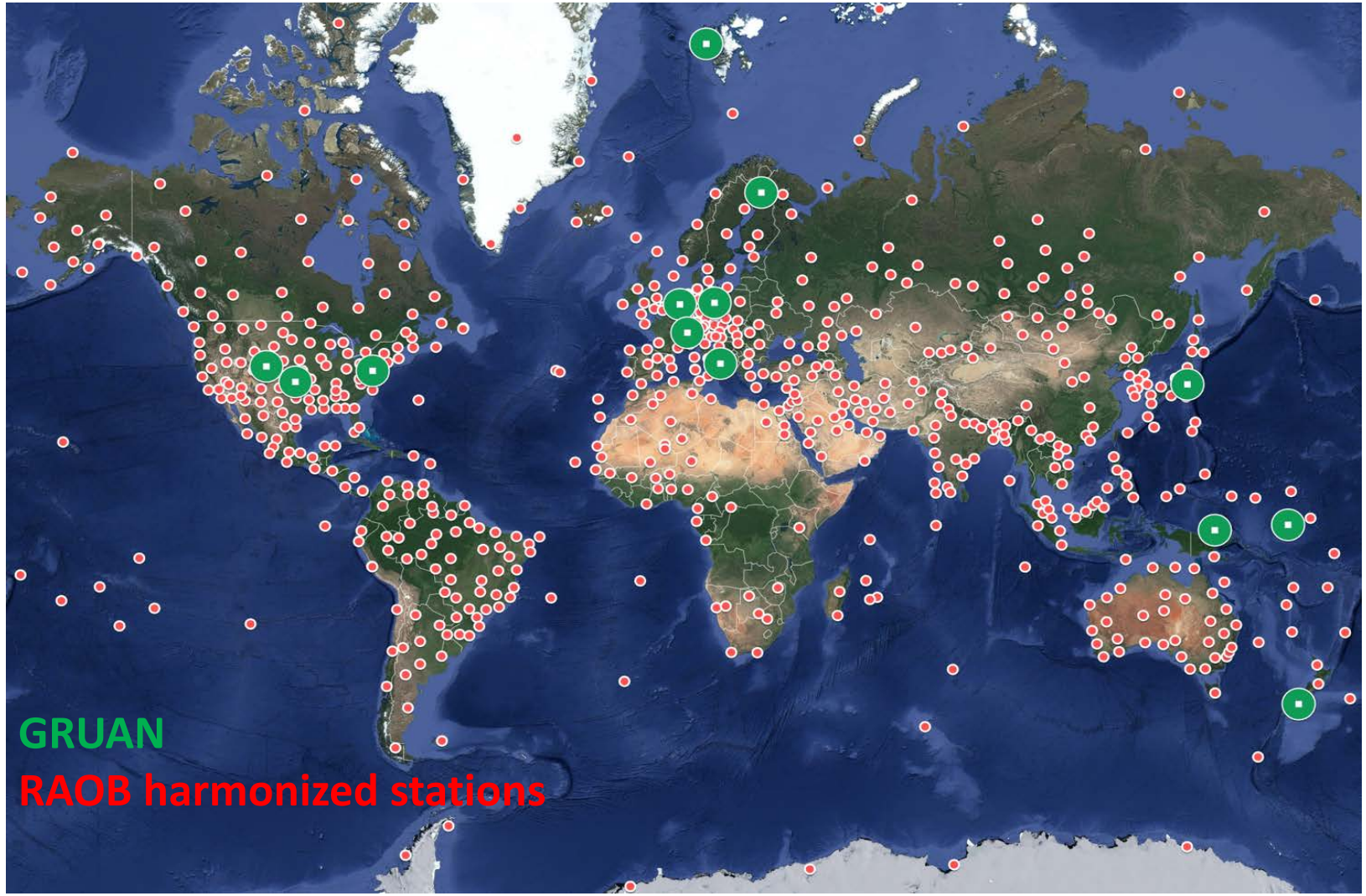
C3S Homogeneization

The homogeneization approach developed within Copernicus C3S 311a Lot3 contract, named RHARM, is based on two steps.

First step: Physical harmonization using GRUAN data processing and WMO intercomparison data. Calculation of measurement uncertainties.

Second step: estimation of uncertainties, identification of breaks and adjustment for historical data back to 1979 (only for station having metadata since 2000).

Radiosounding: homogenized stations



Global distribution of GRUAN Reference station (green large dots) and of a subset of IGRA stations harmonized using RHARM approach (red dots). Many of them have long data records (about 40 yrs).

All the data and metadata will be provided to C3S users by 2018.

Potential work

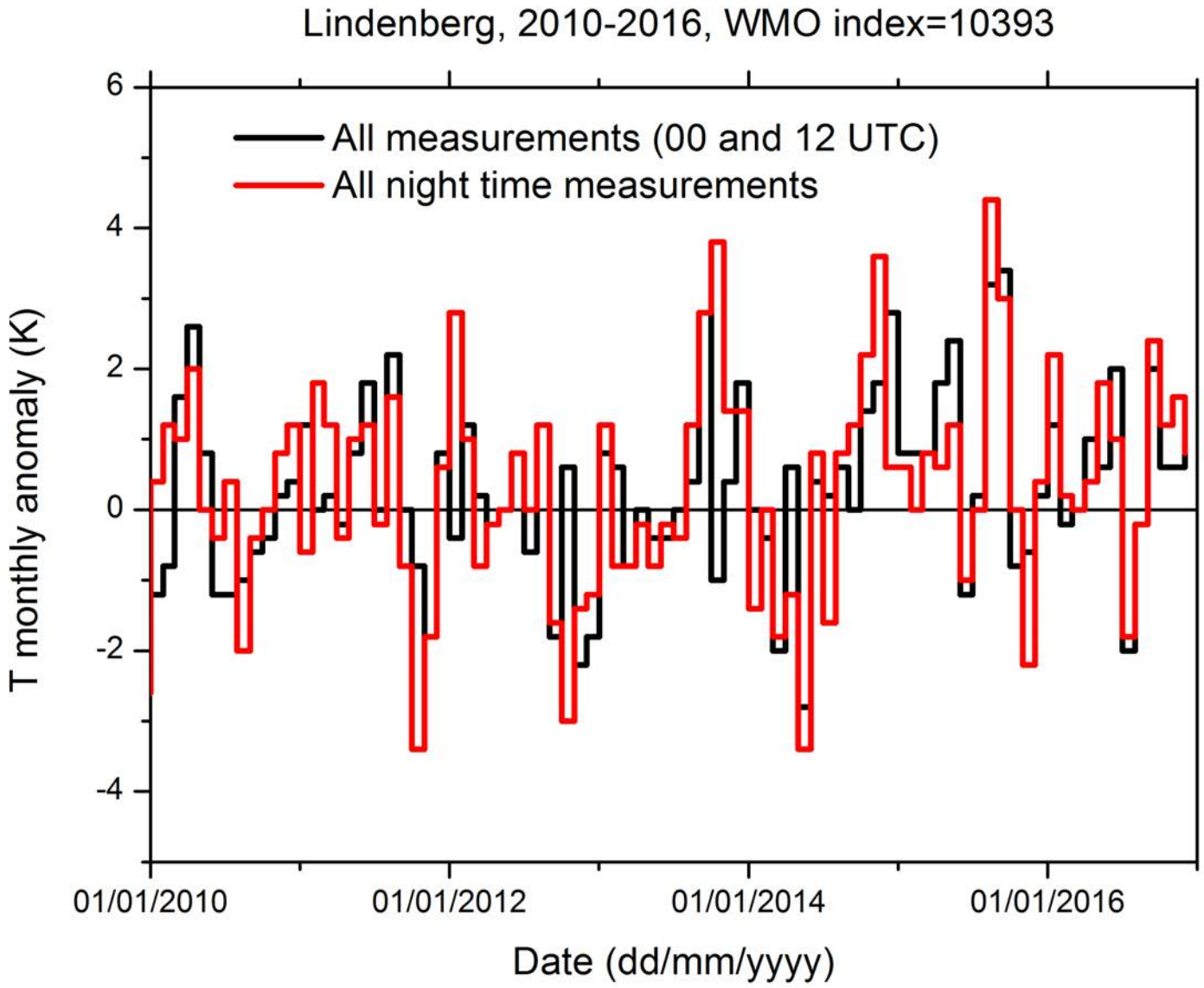
- Sensitivity of break detection in time series to the different sampling: i.e can we easily detect systematic effects when time sampling decreases?

- Estimate sampling effects also on RH decadal trends and correlate with T trend rates.

The work will benefit from a large dataset than in previous studies: a “regionalization” of the approach will be considered.

Autocorelation and uncertainties (estimated in the C3S dataset) will be used.

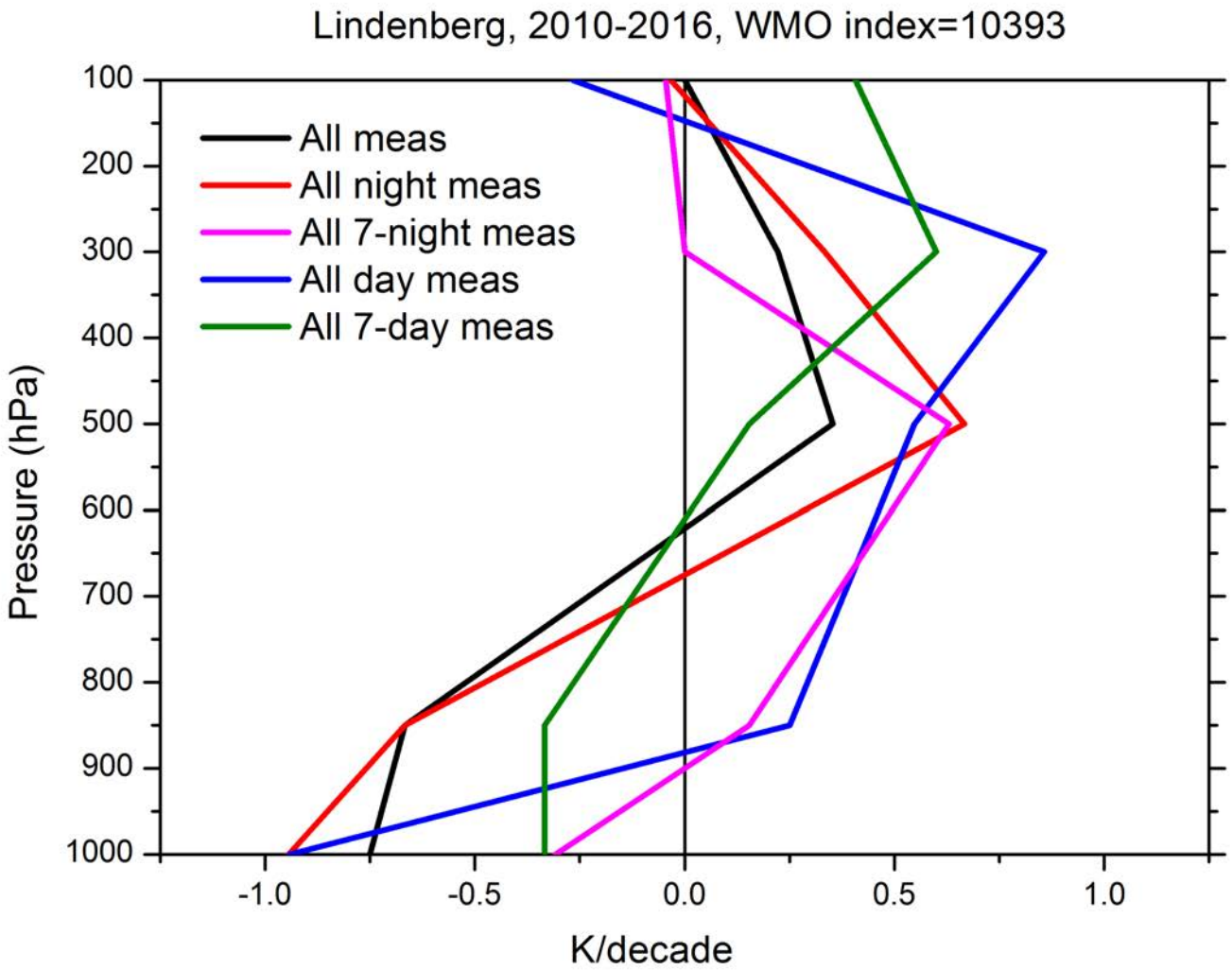
Monthly anomalies: temperature



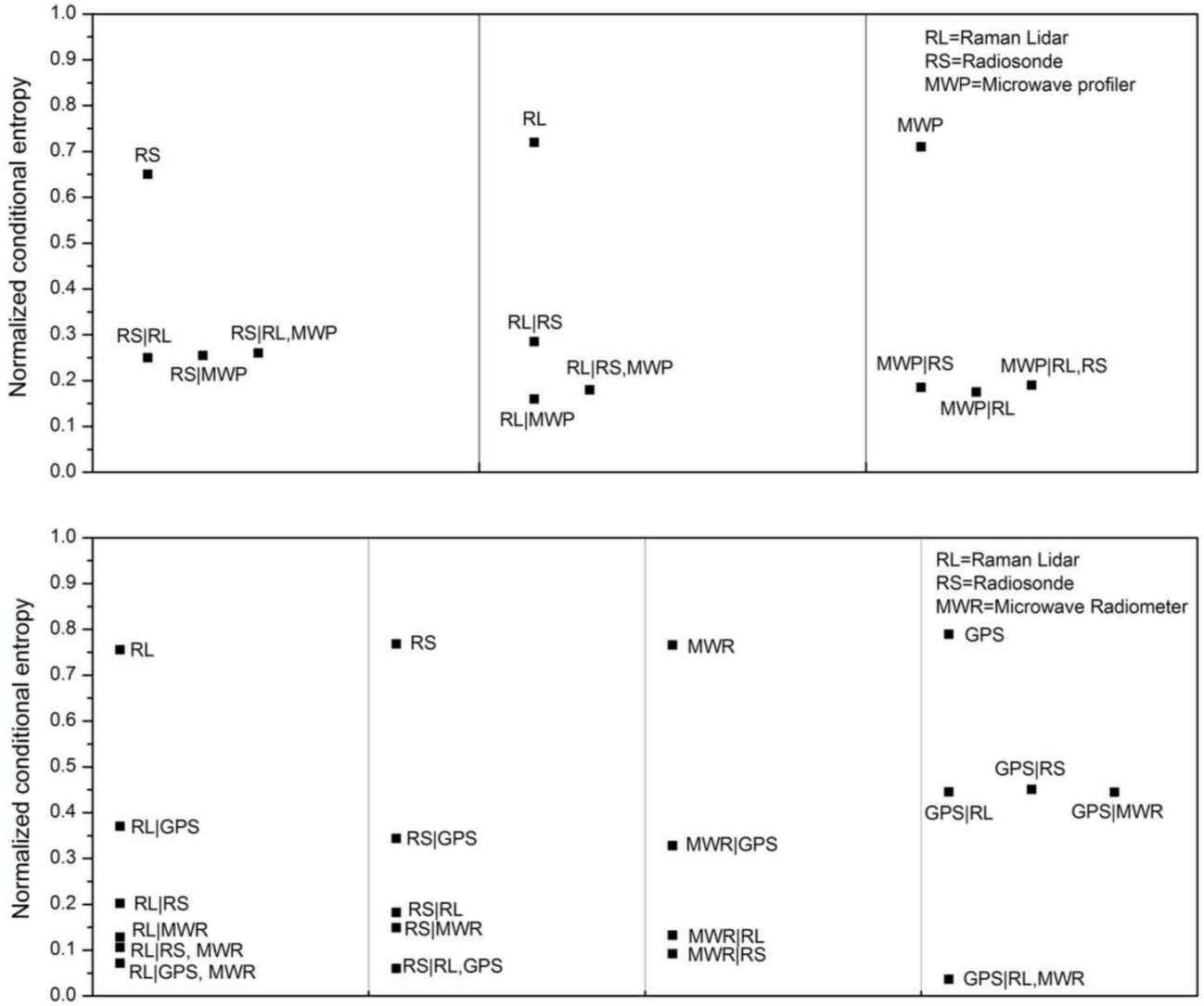
Climate trends: temperature

Trends are calculated at five mandatory pressure using a median of pairwise slope estimation technique which is robust to the presence of outliers [Lanzante et al., 1996].

In the example shown for Lindenberg station, decadal trends calculated for all the night time radiosoundings available are the closer to the trends obtained considering all the available radiosoundings.
Autocorrelation must be added to the calculation in future.

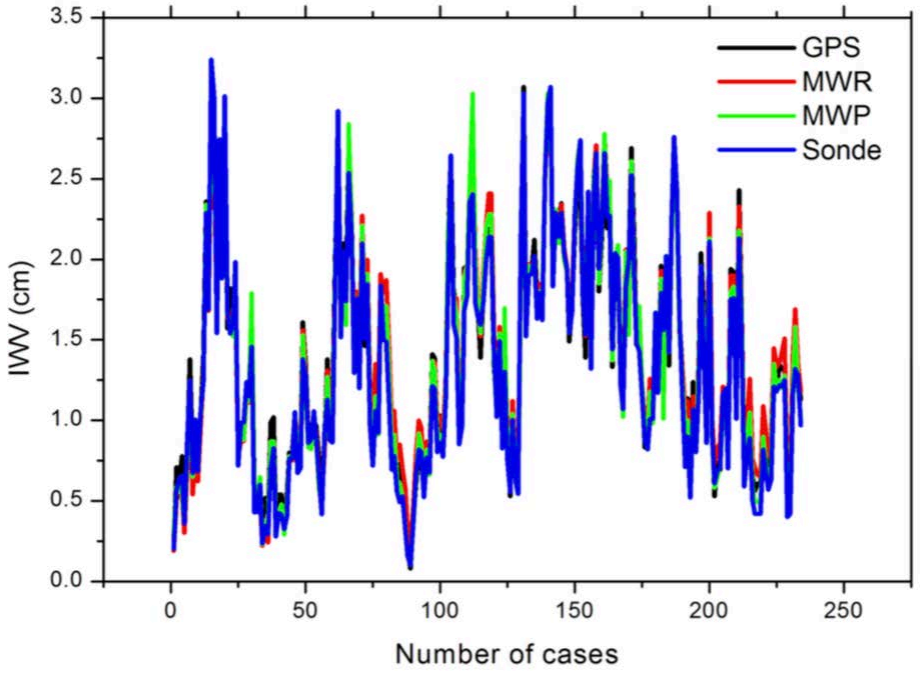


Measurement redundancy and synergy



Madonna et al., 2014 AMT and Bodeker et al., 2016 BAMS

Lindenberg, 52.21 °N, 14.12 °E, 98 m a.s.l.



Can we combine time series of different in a smart way to improve the accuracy of climate trend rates?

Ideas for 2018-2019 work

- Combination of two time series simulating missing data in one of the two time series. A subset of stations may be left out for validation.
  - Radiosonde-lidar for WVMR profile
  - Radiosonde GNSS for IWV

- Investigation of combined time series of simultaneous measurements (using a Bayesian approach or creating sort of “ensembles”(?))

Proposal for other studies relevant for TT

- Any proposal?
- Anyone already investigating these aspects?
- Anyone interested in a cooperation with CNR?