Comparison of anomalies and trends in IGRA, RHARM, and ERA5 temperature and humidity time series

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DATASETS

- Radiosoundings: IGRA v2 (Durre et al., 2018) data. Available from NOAA (https://www.ncdc.noaa.gov/data-access/weather-balloon/integrated-global-radiosonde-archive).

- Radiosoundings: RHARM (Madonna et al., 2020, in review), IGRA bias adjusted dataset, developed in the frame of C3S 311a Lot3 contract.

- Renalysis ERA5 (0.25° x 0.25° resolution, 137 pressure levels, Hersbach et al. 2018). Available from Copernicus Climate Data Store (CDS, https://cds.climate.copernicus.eu).

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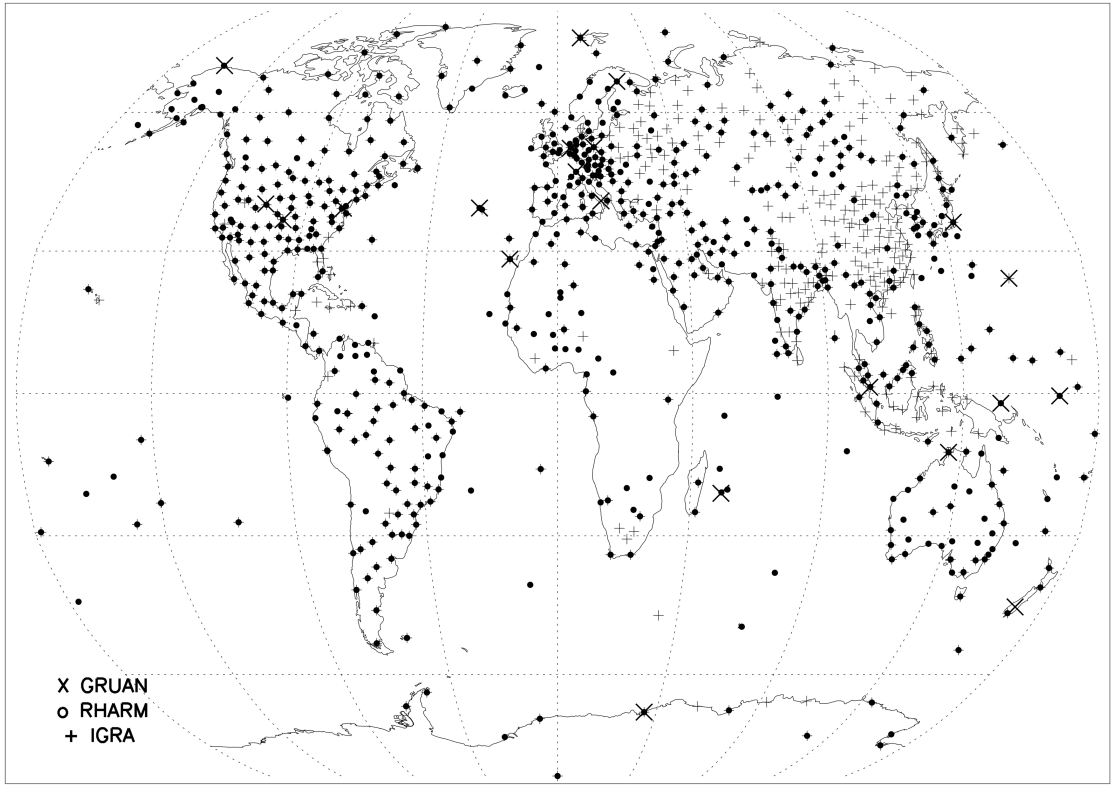
OBSERVATIONS



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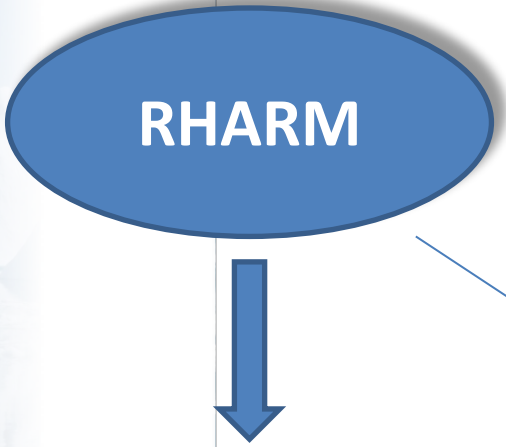
RATIONALE

In the frame of the Copernicus Climate Change Service (C3S), a novel approach, named RHARM (Radiosounding HARMonization), has been developed.



Use of **Reference and international intercomparison datasets** to adjust non-climatic effects of documented radiosonde types (since 2004) using a GRUAN-like data processing

Use of statistical techniques to **constraint historical data** on the most recent data.

Use of statistical techniques to quantify **uncertainties** in historical data using a data model tested on GRUAN reference data.

Homogenized **temperature, humidity and wind sub-daily profiles** since 1-1-1978 for 600 radiosounding stations globally taken from the Integrated Global Radiosonde Archive (IGRA).

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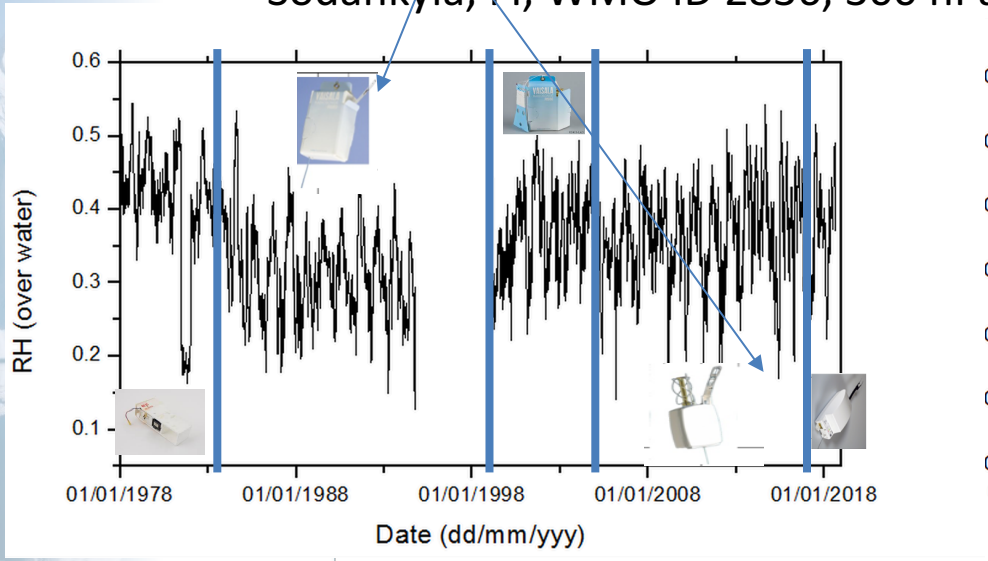
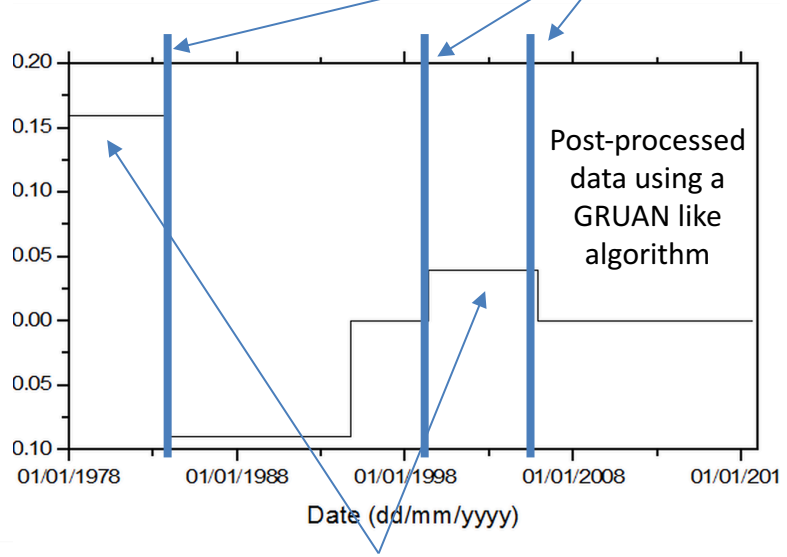
RH ADJUSTMENT: DATA SINCE 1978

Radiosonde type available in the metadata

Detected breaks

Sodankyla, FI, WMO ID 2836, 300 hPa 00:00 UTC (dark only)





Metadata provided by Rigel Kivi (FMI)

Adjustment of the mean (to subtract)

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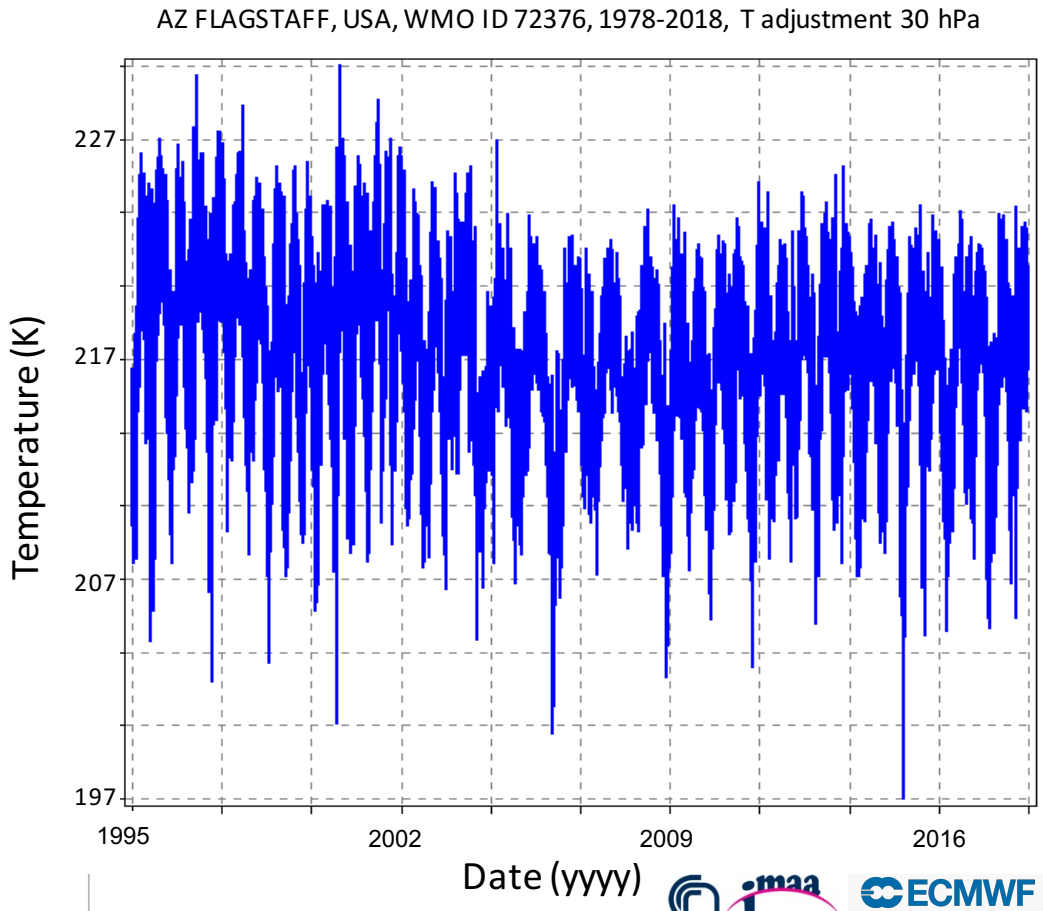
EXAMPLE: IGRA vs RHARM TIME SERIES



IGRA in blue
RHARM in red

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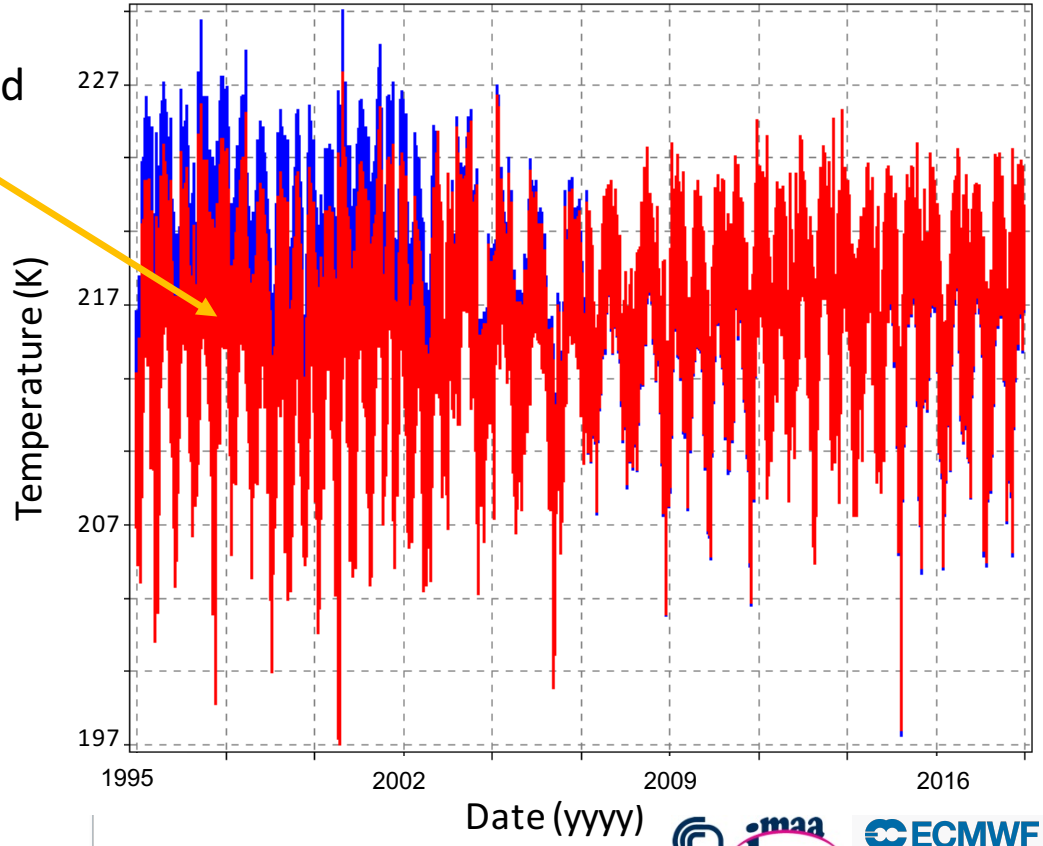
EXAMPLE: IGRA vs RHARM TIME SERIES

AZ FLAGSTAFF, USA, WMO ID 72376, 1978-2018, T adjustment 30 hPa

Bias adjusted



IGRA in blue
RHARM in red

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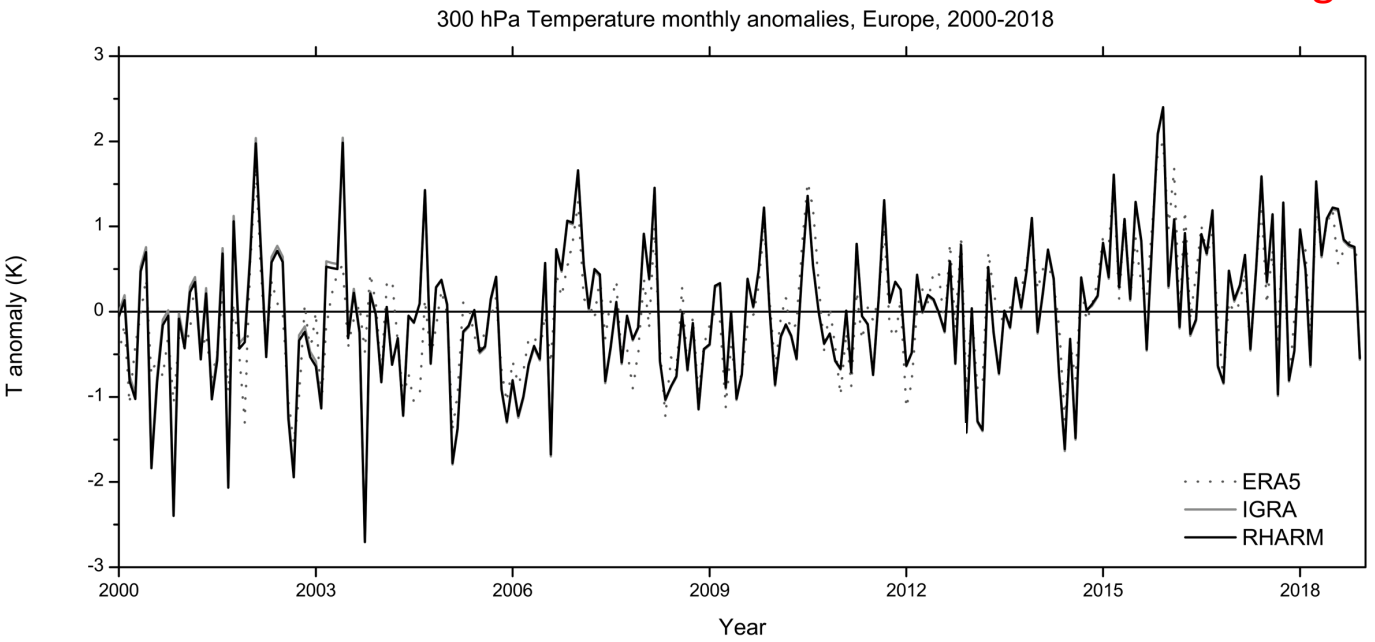
OBSERVATION vs REANALYSIS: T in EUROPE

Good agreement



Dataset	K/da
ERA5	0.35
IGRA	0.30
RHARM	0.32

IGRA (grey), RHARM (dark grey), and ERA5 (black, nearest grid point) at 300 hPa

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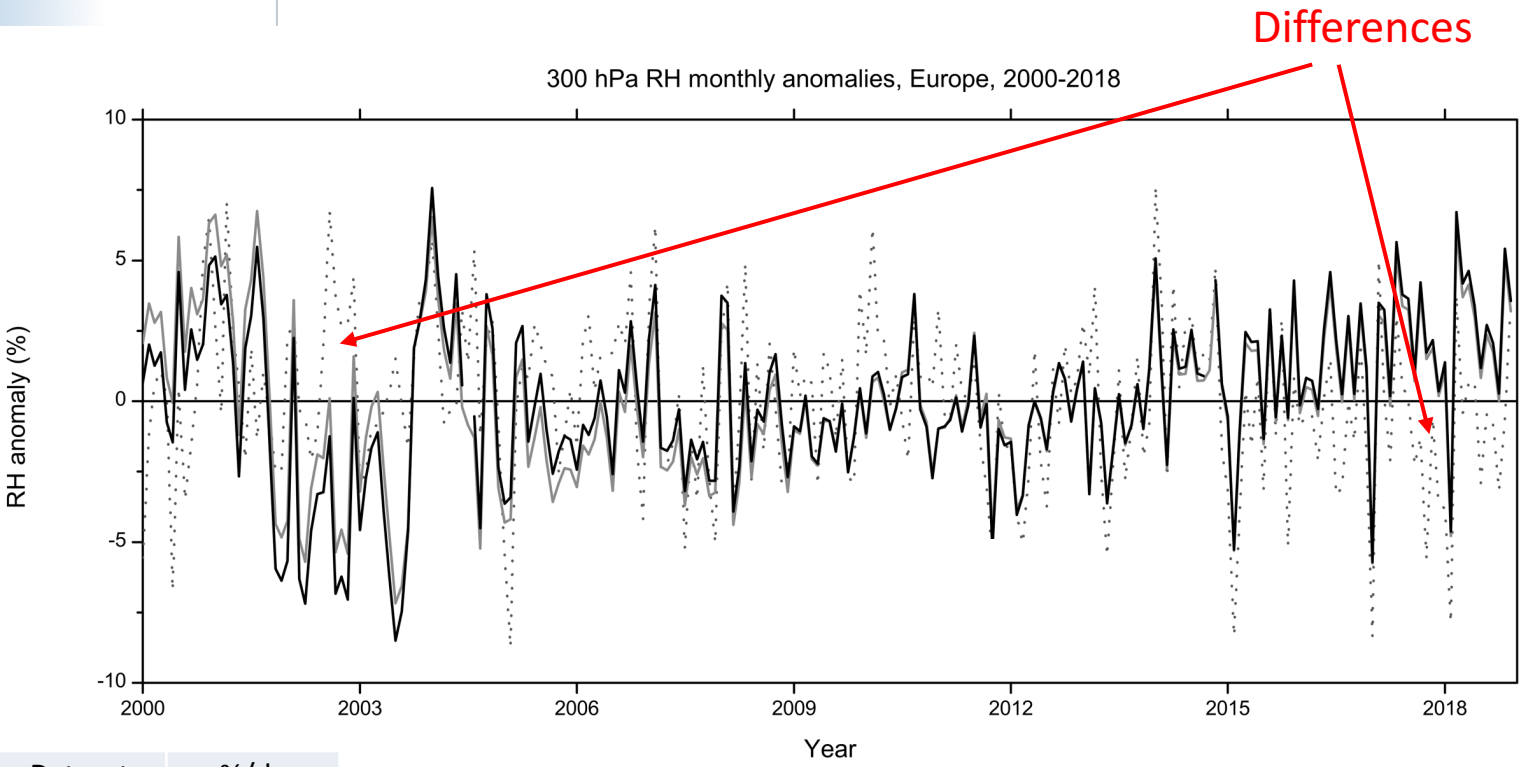
OBSERVATION vs REANALYSIS: RH in EUROPE



Dataset	%/da
ERA5	-0.8
IGRA	0.5
RHARM	0.8

IGRA (grey), RHARM (dark grey), and ERA5 (black, nearest grid point) at 300 hPa

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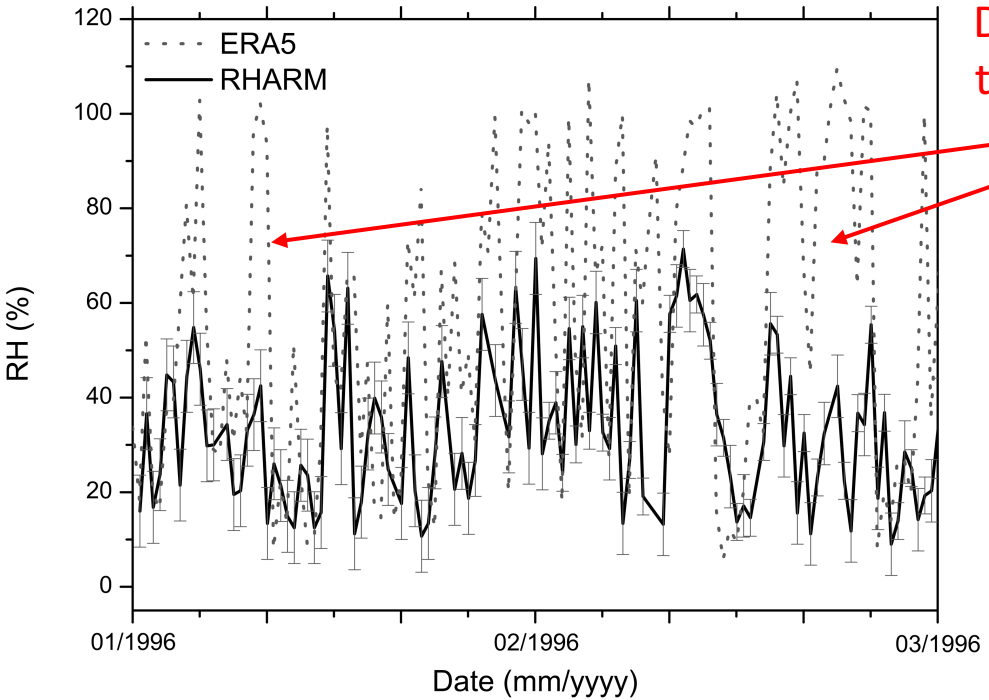
OBSERVATION vs REANALYSIS: 1 STATION



Differences exceeding the obs. uncertainties

Comparison of a relative humidity time series obtained using RHARM (dark grey), shown with its uncertainty (vertical error bar), and ERA5 (black, nearest grid point) at 300 hPa for the Flagstaff station, US (35.23N, 111.82W, WMO index=72376) in the first two months of 1996.

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CONCLUSIONS

- Comparison between ERA5 and observations on the European domain shows a very good agreement in the anomalies and trends calculated for temperature.

- Comparison for RH shows, instead, significant differences both in the estimated trends as well as in the monthly anomalies.

- There is a clear need to estimate the uncertainty budget for ERA5 to complete the comparison with the observations.

- Wind anomalies and trends are currently under investigation

- The RHARM dataset should become available within a couple of months in the CDS. Dataset is currently under a final reprocessing.