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

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Upper-air radiosounding observations of temperature, relative humidity and wind are a of the primary data source for climate studies. Nevertheless, historical radiosounding time series are affected by several systematic uncertainties due to change in the measurement sensors.

In the frame of the Copernicus Climate Change Service (C3S), a novel approach, named RHARM (Radiosounding HARMonization), has been developed to homogenize temperature, humidity and wind radiosounding profile time series available from the the Integrated Global Radiosonde Archive (IGRA) and provide an estimation of the total uncertainty for each single profile. RHARM is an alternative to the few existing approaches.

RHARM is applied to daily (0000 and 1200 UTC) radiosonde data on 16 standard pressure levels (10, 20, 30, 50, 70, 100, 150, 200, 250, 300, 400, 500, 700, 850, 925, 1000 hPa) for the IGRA data from 1978 onward. Relative humidity (RH) adjustments is limited to 300 hPa owing to pervasive sensor performance issues at greater altitudes. The bias adjustments are estimated at mandatory levels only but they are also interpolated to the significant levels reported within each individual ascent profile.

This paper discusses the comparison of the monthly anomalies and trends estimated at different latitudes and pressure levels for ERA5, IGRA and RHARM. Trends are esitmated using a robust least absolute deviation method. ERA5 is the latest climate reanalysis produced by ECMWF providing hourly data on on regular latitude-longitude grids at 0.25° x 0.25° resolution, with atmospheric parameters on 137 pressure levels (available on https://cds.climate.copernicus.eu).

Differences in the comparisons among the three datasets will be discussed along with the analysis of the trends observed in the considered time series. To evaluate its homogeneity and stability, the uncertainty estimation provided in RHARM will be also compared with O-B field obtained using the to ECWMF operational forecast model as the background.