



Using reference radiosounding measurements to improve historical time series

Fabio Madonna, Emanuele Tramutola, Souleymane Sy, Alessandro Di Filippo, Simone Gagliardi, Monica Proto, and Marco Rosoldi

Consiglio Nazionale delle Ricerche - Istituto di Metodologie per l'Analisi Ambientale (CNR-IMAA), Tito Scalo (Potenza), Italy (fabio.madonna@imaa.cnr.it)

Observational records have a key role when assessing long-term changes in our climate, though these are often influenced by residual non-climatic factors which may loosen their reliability to estimate the current state and evolution of the climate. Therefore, it is important to identify and adjust systematic inhomogeneities in measurement time series and quantify measurement uncertainties also in the historical data.

In the frame of the Copernicus Climate Change Service (C3S), a novel approach, named RHARM (Radiosounding HARMonization), has been developed to provide a harmonized dataset of temperature, humidity and wind profiles, along with an estimation of the related uncertainties, for a substantial subset of radiosounding stations globally, among those available from the Integrated Global Radiosonde Archive (IGRA).

The approach comprises of two main stages:

1. The most recent period data records, when modern radiosonde models have been in operation at each station (typically starting between 2006 and 2010, but varying on a station-by-station basis), are corrected using reference datasets from the GCOS Reference Upper Air Network (GRUAN) and the 2010 WMO/CIMO radiosonde inter-comparison.
2. The remaining historical data are scanned to identify structural breaks due to prolonged systematic effects in the measurements at each mandatory pressure level, by using the CUmulative SUMming (CUSUM) method test. Then, an adjustment for each time interval between each pair of structural breaks is calculated to reduce the systematic effects.

Along with the adjustments, corresponding uncertainties are also estimated, taking advantage of GRUAN time series for constraining the estimated values.

The present work will show the benefit of using reference data and the related data processing to improve the quality of global baseline radiosounding capabilities. Decadal trends and anomalies, calculated at different latitudes and at global scale using the source data provided by IGRA, the data harmonized using RHARM and the ECWMF ERA-Interim/ERA5 reanalysis data, will be shown. Results will be framed in the context of the other existing homogenized radiosounding datasets provided through the C3S.