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Sensitivity of trend estimation to subsampling and estimation algorithms in radiosounding historical time series

Souleymane Sy, Fabio Madonna, Monica Proto, Marco Rosoldi, Emanuele Tramutola, and Alessandro di Filippo

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

The estimation of trend is an important aspect for long-term climate change detection. Trend estimation is a potentially useful technique to help interpretation of data and accurate calculation would urge to support climate projections evaluation and to design efficient mitigation and adaptation strategies. It is still challenging to provide a best estimate for trends of ECVs since several sources may contribute to the trend uncertainties, the trend sensitivity to the fitting methods, the specific nature and features of each dataset, the length and the stability of a data record over long time periods.

In the frame of the Copernicus Climate Change Service (C3S), a study has been carried out with the aim to discriminate among competing estimation methods of decadal trends and to quantify the effect of spatial and temporal subsampling. Trend estimation methods used fall into two main categories: parametric and non-parametric. Given also their quite common use in the climate community, decadal trends as well as performances have been evaluated for the following four fitting methods: simple linear fitting, calculating the linear trend (slope) based in statistical significance; LADFIT robust linear fitting, a robust least absolute deviation method; LANZANTE robust linear fitting, a resistant and non-parametric regression based on the median of pairwise slopes and LMROB robust linear fitting, based on a fast MM-type estimator linear regression models.

The presented work will shortly discuss a comparison among the decadal trends estimated for the period between 1-1-1978 to the present, using the different fitting methods applied to daily (0000 and 1200 UTC) time series of temperature and relative humidity profiles on 16 standard pressure levels (from 1000 to 10 hPa) for a subset of radiosounding stations at global scale (656 stations) among those available from the IGRA data repository.

The differences across the fitting methods become large between 250hPa and 100hPa, with trend difference up to 2°K/decade in the Tropics and in the South Hemisphere for temperature, where less observations are typically available. Differences are within a few percent/decade for relative humidity with a maximum of 6%/decade at all latitudes and pressure levels higher than 850hPa, due to the higher water vapour variability in the boundary layer. These differences show how large is the variability of the trend estimation due to the use of different fitting (linear or robust linear) methods, and this mainly depends on quantity and continuity of the available radiosounding data records.

In addition, a short discussion will be focused on the assessment of the effects of spatio-temporal subsampling variation at different latitudes and at global scale, using the same dataset provided by IGRA.