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Application of a statistical downscaling method to detect inhomogeneities in a temperature time series

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In the context of climate studies, the analysis of long homogeneous time series is of the utmost importance. A homogeneous climate series is defined as a series whose variations are caused only by changes in weather and climate (Conrad and Pollak, 1950). Unfortunately, a time series is often affected by one or more artificial inhomogeneities. Regardless of the type and the effect of inhomogeneities, the analysis of a non-homogeneous series can be misleading. Consequently, it is crucial to determine, assign and adjust any discontinuities in the data, especially in those reference series used in climate change studies.

The Twentieth Century Reanalysis (20CR) data can provide an independent estimate of, among other variables, surface temperature. However, the difference in scale affects its potential use as a tool to detect non-climatic inhomogeneities in a local temperature time series. To avoid this limitation, we propose a new approach based on a parsimonious statistical downscaling method to bridge the gap between reanalysis data and the local temperature time series. This method was applied to two high-quality international reference stations in the North-East of Spain (present in the ECA database, http://eca.knmi.nl/) whose temperature series are used, for example, in the report of climatic change in Catalonia, Cunillera et al., 2009: Ebre (Tortosa) and Fabra (Barcelona), for the periods 1940-2008 and 1914-2008, respectively. Both series show an anomalous period which is clearly identifiable by visual inspection. The statistical downscaling model was calibrated for these stations and independently tested over the reliable periods with good results. The model was then applied to reproduce the doubtful years. The results of the study are in agreement with the metadata: for the Fabra series, the method proposed clearly identifies the artificial inhomogeneity; whilst for the Ebre Observatory, there is no documented change in the station and the suspicious period falls inside the error bands.