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Inhomogeneities in temperature records deceive long-range dependence estimators

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We investigate the effect of inhomogeneities in data temperature records on the estimation of a long-range dependence (LRD) parameter. Short-range dependent processes are characterised by an exponential tail of the autocorrelation function (ACF) and a finite area under the ACF, whereas LRD processes show an algebraic tail and the area under the ACF is infinite. It is crucial to reliably determine this characteristic because these slowly decaying correlations are responsible for an increase in confidence intervals for statistics derived from the data. Furthermore, they alter significance levels for tests, as, e.g., trend tests.

Examples of inhomogeneities in observed temperature data are sudden jumps caused by a relocation of the measurement station, or a new type of shelter. Homogenisation procedures are able to detect and correct for such jumps by considering the signal of multiple nearby measurement stations and can thus reduce the bias in estimating the LRD parameter.

We analyse a set of temperature time series before and after homogenisation with respect to LRD and find that the average LRD parameter is clearly reduced for the homogenised series. In order to test whether the homogenisation artificially reduces LRD, we create sets of simulated data from a LRD stochastic process and artificially introduce jumps. These sets are then corrected using a homogenisation procedure. This test provides evidence that the homogenisation procedure is able to remove biases introduced by artificial changes, leaving the LRD parameters unchanged.