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Homogenization of Portuguese long-term temperature data series: Lisbon, Coimbra and Porto

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Three long-term temperature data sets were studied to detect and correct non-climatic homogeneity breaks and are now available for future studies of climate variability.

Series of monthly minimum (Tmin) and maximum (Tmax) temperatures measured in the three Portuguese meteorological stations of Lisbon (from 1856 to 2008), Coimbra (from 1865 to 2005) and Porto (from 1888 to 2001) were treated. These series, together with monthly series of mean temperature (meanT) and temperature range (DTR) derived from them, were tested in order to detect homogeneity breaks, using, firstly, a visual analysis and, secondly, four widely used homogeneity tests: von Neumann ratio test, Buishand test, Standard Normal Homogeneity Test and Pettitt test. We considered the Tmin, Tmax and DTR series as most informative for the detection of homogeneity breaks due to the fact that Tmin and Tmax could respond differently to changes in position of a thermometer or other changes in the instrument's environment. MeanT series have been used, mainly, as control.

The homogeneity tests show strong inhomogeneity of the original data series, which could have both internal climatic and non-climatic origins. Homogeneity breaks which have been identified by the last three mentioned homogeneity tests were compared with available metadata containing data, such as instrument changes, changes in station location and environment, observing procedure, etc. Significant homogeneity breaks (significance 95% or more) that coincide with known dates of instrumental changes have been corrected using standard procedures. It was also noted that some significant homogeneity breaks, which could not be connected to the known dates of any changes in the park of instruments or stations location and environment, could be caused by the large volcanic eruptions. The corrected series were again tested for homogeneity: the corrected series were considered free of non-climatic breaks when the tests showed no significant (significance 95% or more) homogeneity breaks that coincide with dates of known instrument changes.