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Automatic homogenization packages comparison: results of the MULTITEST project

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After the successful intercomparison of homogenization methods carried out in the COST Action ES0601 (HOME), many methods kept improving their algorithms, suggesting the need for performing new intercomparison exercises. However, manual applications of the methodologies to a large number of testing networks cannot be afforded without involving the work of many researchers over an extended time. The alternative is to perform automatized comparisons, which is the approach followed in the MULTITEST project, funded by the Spanish Ministry of Economy and Competitiveness.

The basic procedure consists in the repeated random sampling of synthetic homogeneous master networks of 100 series of monthly values of temperature and precipitation, introducing different types of inhomogeneities in each sample, and homogenizing them with different software packages. The homogenized results can then be compared with the original homogeneous series to compute statistics such as Root Mean Squared Errors and differences in the trends, means and standard deviations of the series. In order to make these evaluations statistically robust, all tests were repeated 100 times.

The homogenization packages tested were ACMANT 3.0, Climatol 3.0, MASH 3.03, RHtestsV4, USHCN v52d and HOMER 2.6. They were chosen because they participated in the COST Action ES0601 (except HOMER, which was the main deliverable of the Action), are commonly used and could be run in automatic mode, even when some of them are intended to be run manually.

Different master networks have been used for the tests: i) three with temperatures with different cross-correlation values, 60 years long; ii) three with precipitations with characteristics of the Atlantic temperate, Mediterranean and monsoonal climates, also 60 years long; iii) one with 100 years of temperatures. And different inhomogeneities were applied to the series to study the behavior of the tested methods when confronted with different problems.

In a first stage, inhomogeneities were applied to samples of 10 synthetic temperature series with five different settings with increasing difficulty: i) big shifts in half of the series; ii) the same with a strong seasonality; iii) short term platforms and local trends; iv) random number of shifts with random size and location in all series; and v) the same plus seasonality of random amplitude. Random multiplicative biases were also applied to the precipitation series.

A second stage was dedicated to study the impact of the number of series in the networks, seasonalities other than sinusoidal, and the occurrence of simultaneous shifts in a high number of series.

Finally, tests were performed on the longer temperature master series, including all kinds of realistic inhomogeneities and adding a varying number of missing data along time, thus becoming a similar benchmark to that used in the COST Action ES0601.

These intercomparisons will be valuable both to the users and to the developers of the tested packages, who can see how their algorithms behave under varied climate conditions. These results can be found at http://www.climatol.eu/MULTITEST/index.html, together with links to the master networks and the scripts used along the project, in order to allow full transparency and reproducibility.