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Adapted Caussinus-Mestre Algorithm for Networks of Temperature series (ACMANT)

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A new homogenisation method (ACMANT) has been developed. Its main properties are: 1) It is for homogenisation of temperature data with monthly resolution, 2) Based on the Caussinus-Mestre inhomogeneity (=IH) detection algorithm, with substantial modifications, 3) Uses relative time series, i.e. differences between candidate and reference series, 4) Before homogenisation applies interpolation for data-gaps, 5) Fulfils outlier-filtering at the beginning and at the end of the homogenisation procedure, 6) The homogenisation is a step-by-step procedure, in one step only 1 series of the network is corrected, 7) Operates in a fully automated way.

Gaps of time series are filled with interpolation relying on the same date values of other series. Spatial correlations are used for the interpolation. When there is no available value with the required date, or when the spatial correlations are low, the monthly mean value of the candidate series is taken into account (partly or wholly) instead of the values of other stations. In the special case of a time series has 30-year-long period with less than 60 original monthly data the procedure stops with error message which indicates that the manual pre-processing of data is needed.

Reference time series are built from component series weighting them with the squares of spatial correlations among first difference series. The minimum requirement is 2 components with at least 0.5 correlation between the component and the candidate series. In case of no sufficient component series neither homogenisation, nor outlier filtering is performed. When different component series are available for various periods of the candidate series, different reference series are applied for different parts of the series. New reference series are built after each step of homogenisation or outlier-filtering.

In the main segment a homogenisation is fulfilled applying a combined analysis of annual means and summer-winter differences, with fitting step-functions to the series of them. The common minimum of the sum of squared errors and the Caussinus-Lyazhri criterion together indicate the timing of IHs. For IH-timings first the year is calculated only, month is calculated later with examining monthly anomalies in 10-month wide windows around the selected year. The IH-search is fulfilled for each time series of the network, but the corrections of mean shifts and that of intensity of annual cycles are fulfilled only for the one that qualified to be the less homogeneous before corrections. Corrections for execution are always calculated relative to the pre-homogenisation values.

When accumulated anomalies of 5-10 months subperiods remained high after correction, a second-type homogenisation is accomplished on 60 months subperiods around the maximum of accumulated anomalies. In this segment series of monthly values are examined. A modified Caussinus-Mestre algorithm is used, i.e. for periods longer than 9 months sinus-curve with natural phase (wavelength = 12 months, extreme values are in January and July) fitted instead of the constant of the period-mean. In this step maximum two IHs are detected for a 60-month period. After fulfilling the second-type homogenisation the corrections for each break of the whole series are recalculated.

The procedure stops when each time series was two times corrected in the main segment or when time series with less than 2 correction-applications are homogeneous or no reference series can be built for them.