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Application of the changepoint detection to daily temperature series with the MAC-D procedure

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Artificial inhomogeneities often affect climate timeseries. A common approach to solve this problem is to perform a change point detection (CPD) on the yearly series and use the results for the homogenization of the daily series. As the CPD suffers of statistical uncertainty in the identification of the position of the changepoints, even the better homogenization procedures when applied to daily timeseries suffer of severe limitations due to the possible misplacement of the changepoints that can easily be of some years, depending on to the time step used in the CPD phase.
Moreover, subsequent changepoints occurring within short time intervals can be erroneously joined or even not detected at all by the analysis of the yearly series. Indeed, in the case of a platform-like inhomogeneity, where two contrasting changepoints lay within a short time interval (say less than 1-2 years), this will turn out in an outlier data in the yearly series, preventing a consistent homogenization of the corresponding daily series.
Obviously those limitations could be overcome by performing the CPD phase directly on the daily series. Unfortunately, the application of CPD methods on daily data series is hindered by the fact that generally daily series do not comply with the requirements of the most widely used methods, such as seasonality and autocorrelation. Only recently, new CPD techniques, that can be reliably applied to daily series, have been introduced for rain (Lund et al., 2012) and temperatures (MAC-D, Rienzner & Gandolfi, 2012).

In this contribution the MAC-D procedure for the CPD in daily temperature series is applied to 12 daily maximum temperature series recorded by rural stations in the Lombardy plain (northern Italy). The data series cover the period from 1/1/1993 to 31/12/2008 with an overall amount of missing data close to 25% due to delayed activation of the station or to station breakdowns. The application of MAC-D identified a number of changepoints much higher than those commonly found in climatic series. Nevertheless, a comparison with the results of the application of CPD on the same series with yearly and monthly time step gives a much lower amount of changepoints, due to the loss of resolution (i.e. the range between subsequent changepoints in the original series is shorter than 1 year) and to the insufficient sensitivity of the CPD test (the sensitivity usually decreases with the series length). These results show that the direct application of CPD to daily series can identify breaks and platform-like inhomogeneities that simply cannot be detected for yearly/monthly series.