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Homogenization of Daily Maximum Temperature Series in the Mediterranean

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Homogenization of atmospheric variables to detect and attribute past and present climate trends and to predict scenarios of future meteorological extreme events is a crucial issue for the reliability of results.
Here we present a quality control and new homogenization method (PENHOM) based on a penalized log-likelihood procedure and a nonlinear model applied to 174 daily summer maximum temperature series in the Greater Mediterranean Region covering the last 50 to 100 years. The lack of metadata informing about artificial break points in this area demands for the development of this improved homogenization technique to correct climate series reliably.
After carrying out the homogeneity procedure, 84% of all time series were found to contain at least one artificial break point. Time series of the Eastern Mediterranean (one break point in 24 years on average) show significantly more break points than series of the Western Basin (one break point in 36 years on average). The mean adjustment of all daily summer maximum temperatures is +0.03°C (±0.38°C) for the Western, +0.16°C (±0.52°C) for the Central and +0.19°C (±0.30°C) for the Eastern Mediterranean indicating a reduced increase in mean summer daytime temperature than detected by analyzing raw data. The adjustments for higher order moments were not uniform. Most significant mean changes due to homogenization were detected for both, the hottest (+0.15°C ±0.66°C) and coldest decile (-0.83°C ±1.28°C) compared to the raw data in the Central Mediterranean.
This study demonstrates that homogenization of daily temperature data is necessary before the analysis of all temperature related extreme events such as heat waves, cold spells and their impacts on human health, agriculture and ecosystems.