



Evolution and changes in Spanish monthly maximum and minimum temperatures with homogenized data

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The aim of this study is to contribute to the research about regional thermal changes with an analysis of the evolution of monthly maximum and minimum temperatures in Spain over the last 130 years. For the first time, the whole set of 43 available long-term Spanish temperature series has been previously homogenized with a detailed new method, explicitly designed for these data. Therefore, the confidence in the obtained results is considerably higher than before.

The analysis is comparative between the different regions of Spain. Variations in the mean values of several 30-year intervals in the 19th and 20th century and their significance levels are analyzed with several statistical tests, as well as trends, their continuity and the presence of break points in the series. Besides, an empirical correction of the urban heat island is applied to the minimum temperatures.

The principal and regionally robust result is a clear asymmetry between the rather slight rise of the maximum temperatures and a strong and highly significant increase of the minima. As in the global evolution, the warming occurs in parts of the first half of the 20th century, and starts again in the 1970s. In the three recent decades, the asymmetry between maxima and minima is distinctly broken, because the former ascend as strongly as the latter. This remarkable result defines clearly the end of the decrease of the mean daily temperature range, while the Spanish cloudiness shows a slight decrease in the same period, suggesting a possible enhancement of the subtropical characteristics of the Iberian Peninsula.

There are considerable regional and seasonal differences in the temperature evolution, among them a particularly strong warming of the minima in the two main Spanish river valleys: Ebro and Guadalquivir. The warming is generally strongest in winter and weakest in spring. No robust and highly significant changes in variability are found.

The order of the temperature rise since the 1870's is 0.4-0.8°C for the maxima and 0.8-1.5°C for the minima. Only the previous data homogenization, frequently omitted and performed for the first time systematically with Spanish temperatures, allows a detection of these changes with high confidence, because the mean error of the new series is around 0.4°C, whereas the error margin of the raw data is of the order of 1°C or even larger.