

CLIVAR-SPAIN contributions: The unprecedented character of the 2003 summer heat wave over the Mediterranean coast of the Iberian Peninsula

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The 2003 summer heat wave that affected most of the Central and Western Europe, caused a high toll in heat-related deaths and broke European seasonal temperature records. It also had a remarkable impact over the Iberian Peninsula (IP). In order to assess the unprecedented character of this warm event over the Mediterranean coast of the IP and place it in the long instrumental context (1900-2007), here we assess and present the results of the exploratory statistical analysis carried out by employing daily adjusted maximum (Tx), minimum (Tn) and mean temperature series from 5 representative locations; namely from north to south: Barcelona, Valencia, Alicante, Murcia and Malaga, which take part of the Spanish Daily Adjusted Temperature Series (SDATS). These time series were amalgamated into a single regional time series representative of the entire IP Mediterranean coastal areas. First, we compared the 2003 daily Tx and Tn observed values with their corresponding long-term daily averages and the 90th, 95th and 98th percentiles calculated for the whole period 1900-2007 at each station, in order to initially define the warm episodes that characterised the 2003 summer and assess their departures from the long-term means and upper percentiles. All stations showed daily Tx and Tn values well above from their long-term means and from the upper percentiles thresholds, although the departures were more pronounced at the northern than at the southern locations. Second, we calculated regional and local Tx and Tn summer anomaly with regard to the 1961-1990 reference period for placing the 2003 summer averages in the longer historical context. This assessment returned summer 2003 as one with the highest anomalies over the whole period, both at the regional and local scales and for both variables, except for Tn in Murcia. Also, for addressing the exceptionality of the 2003 summer, we examined the frequency distribution of monthly and seasonal Tm averages. The year 2003 is far off the distribution for summer, June and August Tm averages, while July 2003 also lays along with 2006 as the most extreme tail of the distribution. In terms of standard deviation (s), the Tm was 3.9s from the mean for summer, 3.7s for June, 3.3s for August and 2.9s for July, with the highest departures at the northern stations. Finally, we addressed the persistence of the 2003 summer heat wave by calculating four temperature extreme indices: the number of days with Tx and Tn above the 90th percentile (warm days and nights, respectively) and an adapted Warm Spell Duration Index (WSDI). The results show that the warm days were ranging from 23 (Malaga) to 65 (Barcelona) days out of the 92 summer days, while warm nights were ranging between 33 and 61 days at the same stations. Results from the WSDI adapted indices shows for Barcelona and Valencia four spells exceeding the Tx 90th percentile during at least 6 consecutive days, accounting for an accumulated total of 43 and 42 days in total. In the case of the WSDI applied to the Tn series, Barcelona with 5 spells and 51 accumulated warm nights was the location more severely affected, followed by Valencia (36 days in total) and Murcia and Alicante (33 and 31 days in total, respectively). In summary, the 2003 summer had an unprecedented character when placed it in the long instrumental period over the Mediterranean coastal areas of the IP, being more severe in the northernmost part than in the southernmost. Keywords: CLIVAR-Spain, Climate Variability and Change, Southwestern Europe, 2003 heat wave, instrumental period, temperatures distribution, Mediterranean coast of the Iberian Peninsula.