



Extreme temperature events in Portugal: recent trends and future scenarios

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The last few years have been characterized by an extraordinary frequency of extreme temperature events in Portugal. One of the most intense heat events in Portugal (and western Europe) occurred in the summer of 2003, notably during the first two weeks of August (Trigo et al., 2005). This outstanding event had major socio-economic impacts in continental Portugal, namely on excessive mortality (about 2000 extra deaths) and wildfire activity (Trigo et al., 2006). Despite the uniqueness of the 2003 event, it has been detected that the following three summers also had heatwave record breaking characteristics. The Southern Portugal province of the Algarve was hit by an intense heatwave (albeit short lived) in July 2004, with an all time new national record for minimum temperature (32.0°C). The number of extreme hot days (above the 90th percentile) during summer 2005 reached a record breaking duration for several stations located in the interior of Portugal. Finally, the summer of 2006 was characterised by the largest number of heatwaves that took place in a single summer season, with 5 distinct events occurring between May and September.

In order to study changes in temperature extremes in Portugal, daily maximum and minimum temperatures (Tmax and Tmin) from 23 climatological weather stations covering the country were analysed for the period 1941-2006. Here we have used indices corresponding to days above or below the 90th and 10th percentile for both Tmax and Tmin. Trends were computed for the entire period (1941-2006) as well as

for two consecutive 31-year periods (1945-1975 and 1976-2006). The most striking results are related with the last period (1976-2006) that reveal a significant increase in extreme heat events for both spring and summer seasons, and a decrease in extreme cold events in winter.

In the second part of this work we present an analysis of climate change over Portugal simulated by the Hadley Centre regional climate model (HadRM3). Maximum and minimum temperatures for 2 IPCC emission scenarios (A2 and B2) are discussed for the 2071-2100 period and compared with the control simulation (1961-1990). In these 2 scenarios, Portugal undergoes a substantial warming, with the highest values of Tmax increase in summer reaching 7°C (A2) and 6°C (B2). In winter, Tmax increases range between 2.5°C and 5.5°C (A2) and 2°C and 4.5°C (B2). For Tmin in winter, there is an increase of approximately 3°C (A2) and 1.5°C (B2).

Seasonal percentiles of extreme episodes (10th and 90th) for both Tmax and Tmin were computed for present and future periods, in order to evaluate changes of extreme events for the two distinct future climate scenarios. Additionally we have also computed the number of days per season (in 2071-2100) with temperatures higher than the 90th percentile (hot events) and lower than the 10th percentile (cold events) based on the 1961-1990 reference period. The ratio between the number of days with Tmax in the summer higher than the 90th (61-90) percentile in the future and the present climate shows an increase of hot events for both scenarios. As expected, this increase is milder for the B2 scenario (ranging between 1.5 and 4 times more), being more intense for the A2 scenarios (ranging between 2 and 5 times more). The steepest increases were always obtained in the interior regions of Portugal. In winter, the number of days with Tmin below the 10th (61-90) percentile decreases substantially for B2 and becomes virtually zero in the A2 scenario.

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