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The effect of heatwaves and drought on surface wind circulations in the NE of the Iberian Peninsula during the summer of 2003

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Extreme weather situations produce strong impacts on society, infrastructures and ecosystems. The drought and heatwave that affected Europe in the summer of 2003 produced enormous socioeconomic implications. The anticyclonic conditions and a deficit of soil moisture availability led to the extremely high surface air temperatures registered. Several studies have shown that the characteristics of the 2003 European summer will be more frequent, more intense and longer lasting in the future. Therefore, determining atmospheric flow patterns during the heat wave and drought of 2003 is necessary in order to assess potential modifications in the circulations due to associated warmer and drier conditions. However, the effects that the extreme weather situation of the summer of 2003 produced on the surface wind have received little attention. Variations in the diurnal wind pattern associated with the heatwave and drought conditions of the European summer of 2003 are investigated climatologically at a regional level (northeast of the Iberian Peninsula). Our study, based on high-density observational evidence and fine spatial scale mesoscale modeling for the 1992-2004 period, shows that wind speed can decrease up to 22% under situations characterized by extremely high temperatures and severe drought such as the summer of 2003. By examining the role of the different atmospheric scales of motion which determine the wind diurnal variability, we find that the 2003-synoptic conditions are the main driver for changes in the wind speed field. In turn, these changes are modulated by mesoscale circulations influenced by the soil moisture availability. Our results have implications for broad regional modeling studies of current climate and climate change simulations in as much as it demonstrates that a correct representation of local soil moisture conditions impacts atmospheric circulation and therefore the regional climate state.