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The outstanding European and Mediterranean heatwave activity during summer 2022

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The European summer of 2022 has been widely recognized as the warmest since mid-19th century. Our updated analyses of instrumental and reconstructed temperature series since 1500 indicate that the European summer (June-to-August) of 2022 was the warmest on record, exceeding the previous hottest summer of 2021 by a large margin. In fact, the past three summers of 2021–2023 have been among the hottest ones of the last five centuries.

By applying a heatwave (HW) detection algorithm to reanalysis data, we identify three large European HW events that affected ample regions of the continent in mid-June, mid-July and August/early September 2022. These episodes were triggered by high-pressure systems with noticeable differences in their characteristics. Additional analyses confirm that high-latitude blocks were largely responsible for the August 2022 HW, whereas subtropical ridges dominated during the June and July 2022 HWs. These HW events were also accompanied by dry soils and warm Sea Surface Temperatures (SSTs) over the Mediterranean. Indeed, summer 2022 displayed the largest marine heatwave activity of the 1982–2023 period due to an unusually high frequency of long-lasting and intense events, particularly over western Mediterranean.

Taking the June 2022 HW over Iberia as an example, we address the role of dynamical (atmospheric circulation) and thermodynamical (regional soil moisture and western Mediterranean SSTs) drivers in the severity of the event. Flow analogues of the June 2022 heatwave are used to reconstruct the expected temperatures under different combinations of these thermodynamical drivers and assess their separate and combined influences on the intensity of the event. Results show a measurable intensification of the heatwave event (of ~1 °C) by both dry land and warm sea conditions. Although these two drivers are significantly correlated, southwestern European HWs are aggravated if dry soils concur with warm SSTs over western Mediterranean. The magnitude of the Mediterranean SST influence could depend on the soil moisture state, being larger for dry than wet conditions, as well as on the atmospheric circulation.

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