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The extreme heat wave of 2021 in Greece: intensity, duration, cumulative heat and all-time records on centennial scale

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Heat waves (HWs) rank among the most dangerous weather phenomena, with catastrophic impacts on societies and ecosystems. Since the beginning of the 21th century, many regions worldwide have been experiencing unprecedented extreme heat episodes. The Mediterranean countries in particular, are very prominent and vulnerable to climate change and heat-related risk. During summer 2021, Greece faced one of the worst HWs in its modern history, with exceptionally high temperatures prevailing from July 28th to August 6th. The special characteristics and the rarity of this event have been highlighted and evaluated through the historical climatic record of the National Observatory of Athens (NOA), dating since the mid 19th century.

The study analysed daily maximum (T_{max}), mean (T_{mean}) and minimum (T_{min}) air temperatures of the historical record, and estimated several indices of all HW episodes detected during the study period. The analysis showed that the HW of 2021 (HW2021) exceeded all previous records in a number of indices concerning the persistence, amplitude, mean intensity of HWs (based on T_{mean} and T_{min} thresholds), but also 'cumulative heat' (an index combining both intensity and duration of a HW). Specifically, HW2021 was found to be the longest HW ever recorded at NOA (since the mid 19th century), with a total duration of 10 days. The amplitude of HW2021 (maximum temperature of the hottest day) was 43.9 ^{0} C, representing the second highest temperature ever recorded at NOA, following the absolute record value of 44.8 ^{0} C observed on June 26th 2007.

The most prominent features of HW2021 include the maintenance of very high temperatures throughout the whole 24-hour period and especially the elevated nighttime temperatures, inherent to the additive effect of the urban heat island in the city of Athens. The values of 31.6 and 36.5 ^{0}C for the daily minimum and mean temperatures respectively, represent the highest values ever recorded at NOA. National all-time temperature records were observed in other Greek stations, with maximum temperatures reaching up to 47 ^{0}C. The prolonged hot and dry conditions triggered the ignition of catastrophic wildfires in Greece, with dramatic environmental and economic loss.