2024/07/17-19 European Heatwave

High Temperatures in the July 2024 European Heatwave exacerbated by human-driven Climate Change

Press Summary (First published 2024/07/25)

- Heatwaves similar to the July 2024 European heatwave are up to 3 °C warmer than those previously observed in the region
- July 2024 European heatwave was similar to other events in the past.
- We ascribe the high temperatures of the July 2024 European heatwave to human driven climate change and natural climate variability likely played a minor role

ClimaMeter for European July Heatwave
17-Jul-2024 to 19-Jul-2024

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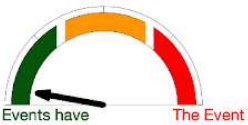

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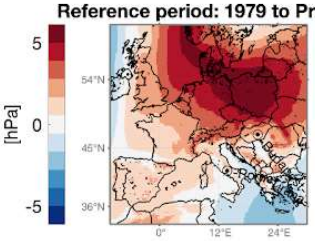
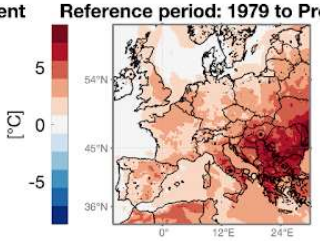
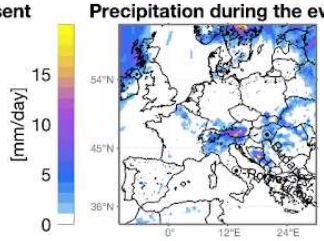
Surface Pressure Anomalies
Reference period: 1979 to Present



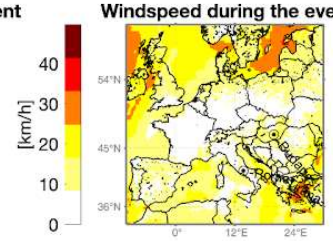
Temperature Anomalies
Reference period: 1979 to Present



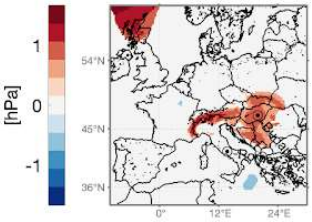
Precipitation Data
Precipitation during the event



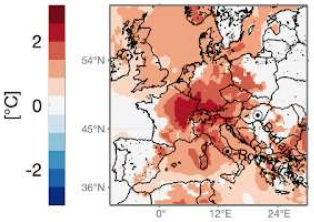
Windspeed Data
Windspeed during the event



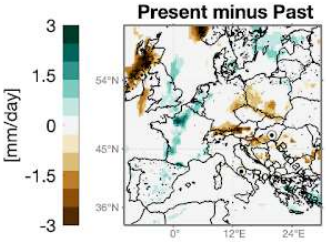
Surface Pressure Changes
Present minus Past



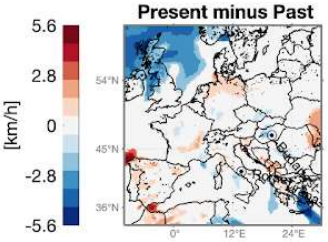
Temperature Changes
Present minus Past



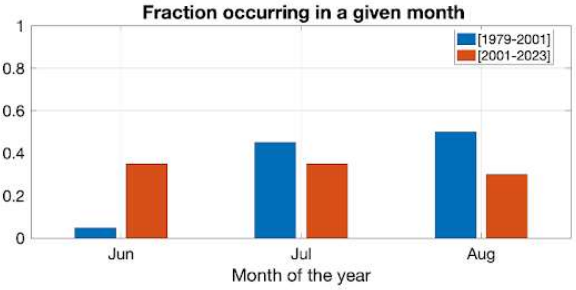
Precipitation Changes
Present minus Past



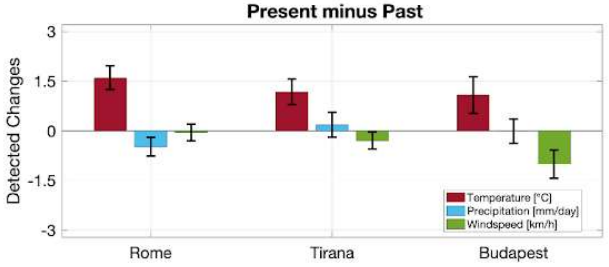
Windspeed Changes
Present minus Past



Similar Past Events
Fraction occurring in a given month



Changes in Urban Areas
Present minus Past



In July 2024, extreme heat has affected several countries in Europe, with a peak intensity of the heatwave between 17 and 19 July 2024. In Hungary, Debrecen's second-largest airport had to close temporarily due to the "thermal stress" on its runways. In an interview, the CEO of Hungarian national railway company MAV said that the railway cars are 40-50 years old and they are not designed for the current climatic conditions. In neighboring Romania, hospitals are experiencing frequent power outages due to exceptional air conditioning demands during the heatwave. A 45-year-old man succumbed to the heat in Botosani, according to the Ministry of Health. Thousands of hectares have burned in North Macedonia, Albania, Greece, and Bulgaria, which was under a "red code" alert. In Greece, some areas have been exceeding 40°C for fourteen days, forcing the Acropolis to close for several hours. Similarly, the Turkish coast and Anatolia experienced temperatures near 40°C. In Sicily, work in agriculture and construction was prohibited between 12:30 PM and 4:00 PM. Fourteen Italian cities were marked on "red alert" due to heat and humidity. The heatwave has caused the return of locusts to regions like Emilia-Romagna. This event compounds other extreme heatwaves witnessed this year in the northern hemisphere, such as the Indian and the US heatwaves, that are exacerbating heat-related problems in communities and ecosystems worldwide.

The *Surface Pressure Anomalies* reveal an anticyclonic anomaly over central-to-northern Europe, that is largely associated with the extreme high temperatures. *Temperature anomalies* indicate warm anomalies reaching up to +7 °C in large parts of the Balkans. *Precipitation data* show absence of precipitation in a large part of the affected region, apart from some localized thunderstorms precipitation (about 15 mm/day) over the Alpine Region and Scotland. *Windspeed data* show light to moderate winds, with the highest values in the Baltic Sea.

Climate and Data Background for the Analysis

It is a fact that the intensity and frequency of heatwaves has increased at the global scale and in 80% of the cases also at the regional scale. It is also a fact that human-induced greenhouse gas forcing is the main driver of this observed trend (Chapter 11 WGI IPCC AR6). In Europe the heatwave frequency has very likely increased in the past decades and the signal has emerged from the natural variability and this is attributable to human induced climate change. An increased trend in heat stress had been detected from 1973 onward and in all future scenarios the frequency of heat extremes will increase, especially in the southern regions. This will exceed critical thresholds for health, agriculture and other sectors (Chapter 12 WGI IPCC AR6).

Warm[illegible]n Europe will rise faster than the global average and this will increase the disparities within Europe, with negative impacts for the southern regions, with increases in cooling needs and losses in agriculture. At 3 °C of GWL the number of deaths for heat stress will triplicate compared to a 1.5 °C GWL with very high confidence (Chapter 13 WGII IPCC AR6).

Our analysis approach rests on looking for weather situations similar to those of the event of interest having been observed in the past. For this event we have high confidence in the robustness of our approach given the available climate data, as the event is very similar to other past events in the data record.

ClimaMeter Analysis

We analyze here (see Methodology for more details) how events similar to the high temperature in the July 2024 European heatwave changed in the present (2001–2023) compared to what they would have looked like if they had occurred in the past (1979–2001) in the region [-10°E 30°E 33°N 60°N]. The *Surface Pressure Changes* show that similar events do not display significant changes in the present climate than what they would have been in the past, except for the Alps now experiencing higher surface pressure than in the past. The *Temperature Changes* show that similar events produce warmer temperatures +1.5 °C (up to +3 °C) in the present climate than what they would have been in the past, with even higher values in France, Germany and Switzerland. The *Precipitation Changes* do not show any significant variations, apart from a decrease (up to -3 mm/day) in the Alpine region and Scotland. *Windspeed Changes* indicate almost 5 km/h less windy conditions in Scotland. We also note that *Similar Past Events* previously mainly occurred in July/August, while in the present climate they are also largely occurring in June. *Changes in Urban Areas* reveal that Rome, Tirana, and Budapest are up to +1.5 °C warmer in the present compared to the past.

Finally, we find that sources of natural climate variability did not influence the event. This means that the changes we see in the event compared to the past may be primarily due to human driven climate change.

Conclusion

Based on the above, we conclude that heatwaves similar to the July 2024 European heatwave are up to 3 °C warmer than the heatwaves previously observed in this part of the world. We interpret the July 2024 European heatwave as an event whose characteristics can be ascribed to human driven climate change.

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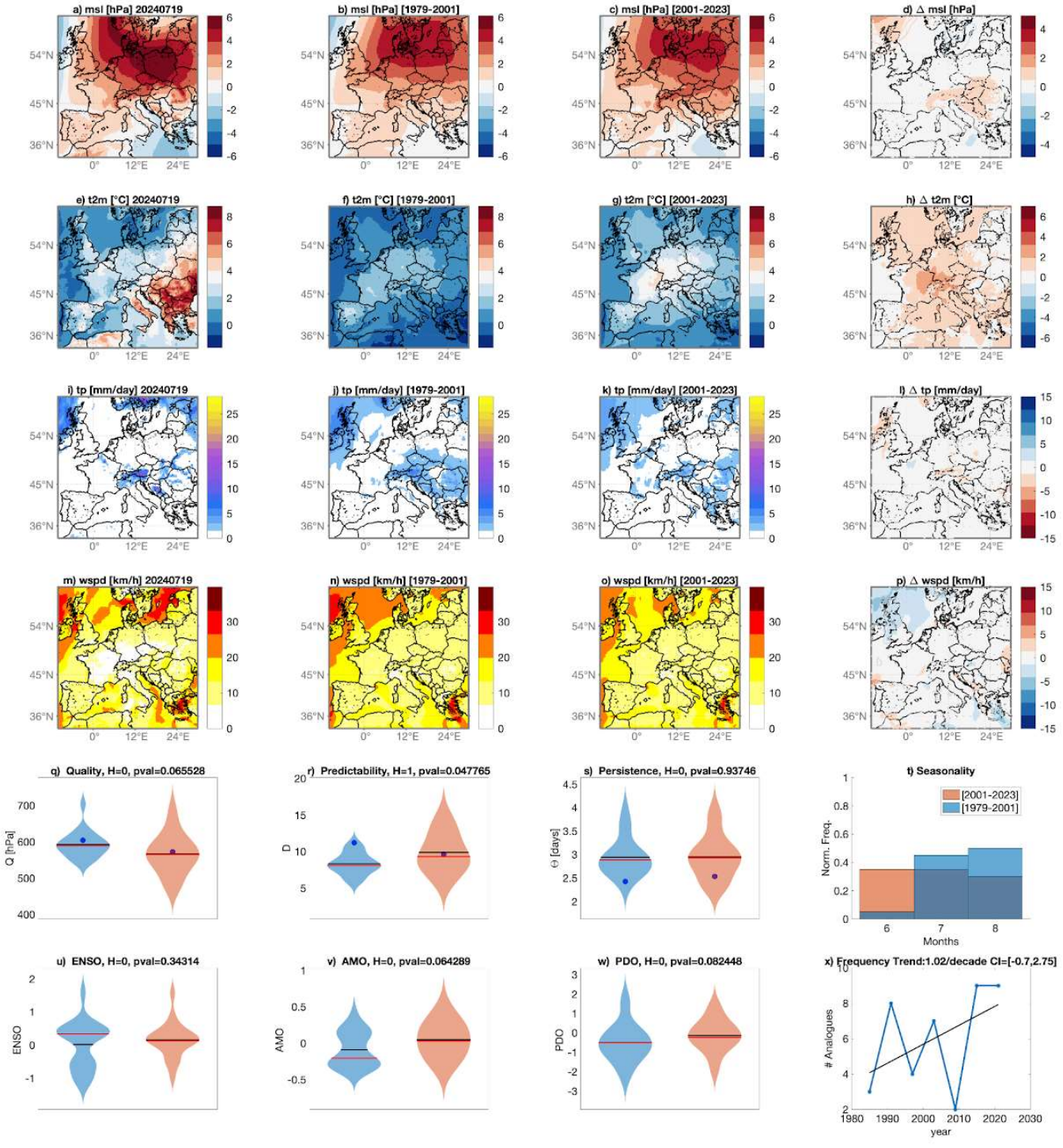
Additional Information : Complete Output of the Analysis

- NB1: The following output is specifically intended for scientists and contain details that are fully understandable only by reading the methodology described in Faranda, D., Bourdin, S., Ginesta, M., Krouma, M., Noyelle, R., Pons, F., Yiou, P., and Messori, G.: A climate-change attribution retrospective of some impactful weather extremes of 2021, Weather Clim. Dynam., 3, 1311–1340, https://doi.org/10.5194/wcd-3-1311-2022, 2022.
- NB2: Colorscales may vary from the ClimaMeter figure presented above.



The figure shows the average of surface pressure anomaly (msl) (a), average 2-meter temperatures anomalies (t2m) (e),

cumulated total precipitation (tp) (i), and average wind-speed (wspd) in the period of the event. Average of the surface pressure analogs found in the counterfactual [1979-2000] (b) and factual periods [2001-2022] (c), along with corresponding 2-meter temperatures (f, g), cumulated precipitation (j, k), and wind speed (n, o). Changes between present and past analogues are presented for surface pressure Δslp (d), 2 meter temperatures Δt2m (h), total precipitation Δtp (i), and windspeed Δwspd (p): color-filled areas indicate significant anomalies with respect to the bootstrap procedure. Violin plots for past (blue) and present (orange) periods for Quality Q analogs (q), Predictability Index D (r), Persistence Index Θ (s), and distribution of analogs in each month (t). Violin plots for past (blue) and present (orange) periods for ENSO (u), AMO (v) and PDO (w). Number of the Analogues occurring in each subperiod (blue) and linear trend (black). Values for the peak day of the extreme event are marked by a blue dot. Horizontal bars in panels (q,r,s,u,v,w) correspond to the mean (black) and median (red) of the distributions.

ClimaMeter *is a rapid weather extreme event framework* 🌩️🌡️🪐

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