

# Increasing likelihood of heat-related mortality events with global warming: a continental epidemiological extreme event attribution study

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## Supplementary Material

**Table S1:** Medians of return periods of the hottest week and deadliest week in 2022 at 1.2 °C and pre-industrial, and the resulting probability ratios for Catalonia, Spain. Values in brackets are the 95% confidence obtained by bootstrapping and Monte Carlo simulations.

	Return Period 1.2°C (2022)	Return Period pre-industrial	Probability Ratio
Temperature	7.4 (3.8 – 25.4)	33,832 (333.1 – Inf)	4,219.7 (30.7 – Inf)
Mortality	15.2 (6.9 – 46.5)	434.8 (61.0 – 53,578)	28.5 (3.8 – 2,647.3)

**Table S2:** Population-weighted medians of return periods of the hottest week and deadliest week in 2022 at 1.2 °C and pre-industrial, and the resulting probability ratios. Values in brackets are the 95% confidence obtained by bootstrapping and Monte Carlo simulations. Southern Europe comprises Albania, Cyprus, Greece, Spain, Croatia, Italy, Montenegro, Malta, Portugal, Serbia and Slovenia.

	Return Period 1.2°C (2022)	Return Period pre-industrial	Probability Ratio
<b>Temperature</b>	<b>4.5</b> <b>(2.5 – 18.8)</b>	<b>56.8</b> <b>(9.2 – 1,791.1)</b>	<b>12.7</b> <b>(3.6 - 157.3)</b>
Temperature – Southern Europe	7.5 (3.8 – 102.6)	1,292.4 (26.5 – Inf)	92.1 (7.3 – Inf)
<b>Mortality</b>	<b>8.0</b> <b>(3.6 – 20.8)</b>	<b>21.6</b> <b>(9.7 – 140)</b>	<b>3.0</b> <b>(1.02 – 18.6)</b>
Mortality - Southern Europe	10.7 (5.2 – 34.2)	371.8 (62.48 – 49,216.2)	27.5 (3.8-2,354.3)
Mortality - Italy	6.0 (3.1- 27.5)	1,292.5 (131.8 – Inf)	59.9 (7.0 – 70,307.6)

Mortality - Lombardy	9.4 (4.7 – 33.2)	6,356.7 (349.1 – Inf)	677.4 (33.0 – Inf)
Mortality - Calabria	8.3 (3.7 – 23.1)	21.8 (21.8 – Inf)	3.8 (2.4 – Inf)

**Table S3:** Population-weighted medians of return periods of the deadliest week in 2022 for different population groups, and the resulting probability ratios. The last column reports the heat-related mortality rate in deaths per million for the deadliest week of the 2022 summer. Values in brackets are the 95% confidence intervals obtained by bootstrapping and Monte Carlo simulations.

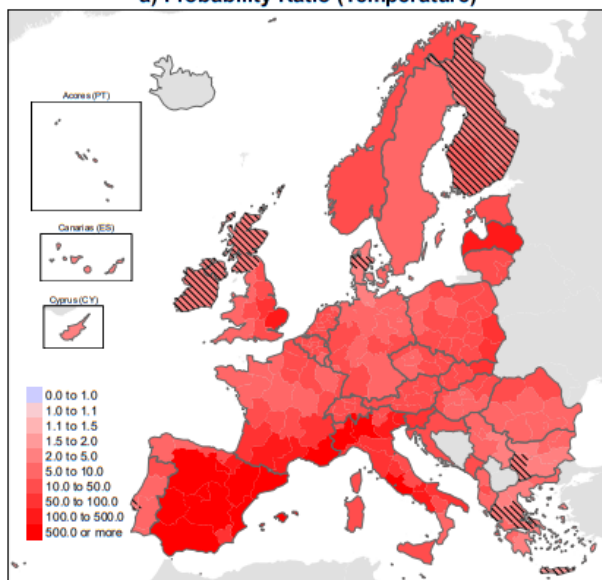
	Return Period 1.2 °C (2022)	Return Period pre-industrial	Probability Ratio	Heat-related mortality 2022
Women	6.0 (2.8 – 13.9)	22.4 (9.3 -136.9)	5.0 (1.3 – 22.2)	23 .3 (9.1 – 34.2)
Men	6.6 (3.2 – 13.8)	18.1 (9.1 – 99.8)	3.5 (1.3 – 18.4)	19.1 (10.9 – 26.8)
Ages < 65	7.2 (2.5 – 23.6)	59.7 (10.5 – 3,049.8)	7.5 (1.4 – 227.6)	3.5 (0.2 – 6.1)
Ages 65 - 79	7.3 (3.2 – 20.3)	54.9 (11.9 – 741.2)	7.5 (1.1- 69.3)	39.7 (11.9 – 65.3)
Ages > 80	8.8 (4.2 – 19.0)	29.6 (10.9 – 242.6)	4 .0 (1.1 – 24.5)	293.1 (101.2 – 483.9)

**Table S4:** Population-weighted medians of return periods for the deadliest week in 2022 at pre-industrial, 1.2 °C, 1.5 °C, and 2°C, and the resulting probability ratios. Values in brackets are the 95% confidence obtained by bootstrapping and Monte Carlo simulations.

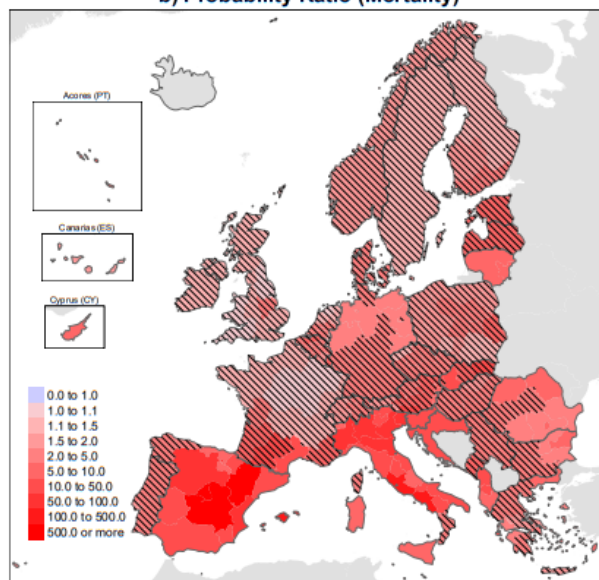
	0 °C	1.2 °C	1.5 °C	2.0 °C
Return Period	21.6 (9.7 – 140.0)	8.0 (3.6 – 20.8)	4.9 (2.0 – 12.7)	2.5 (1.1 – 9.5)
Probability Ratio		3.0 (1.02 – 18.7)	4.8 (1.16 – 38.7)	8.1 (1.24 – 77.2)
Return Period – Spain	422.5 (71.2 – 49,544.5)	13.2 (6.1 – 40.6)	6.2 (2.4 – 21.6)	2.1 (1.1 – 7.7)
Probability Ratio - Spain		29.0 (3.3 – 2,354.2)	59.1 (5.4 – 10,272.3)	141.6 (12.2 – 15,487.7)



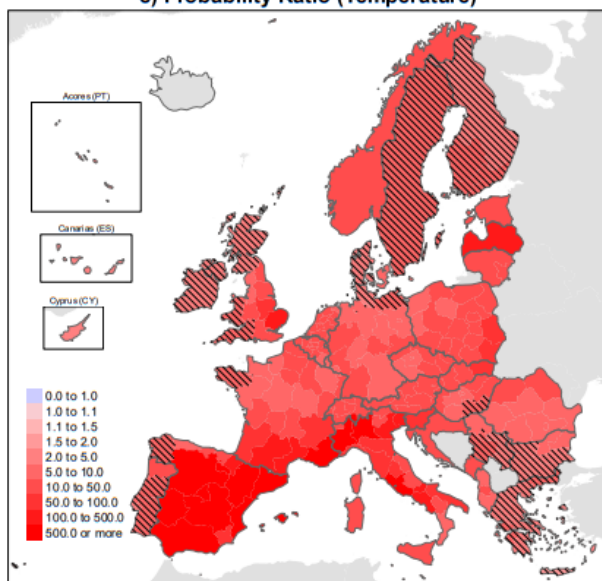
**a) Probability Ratio (Temperature)**



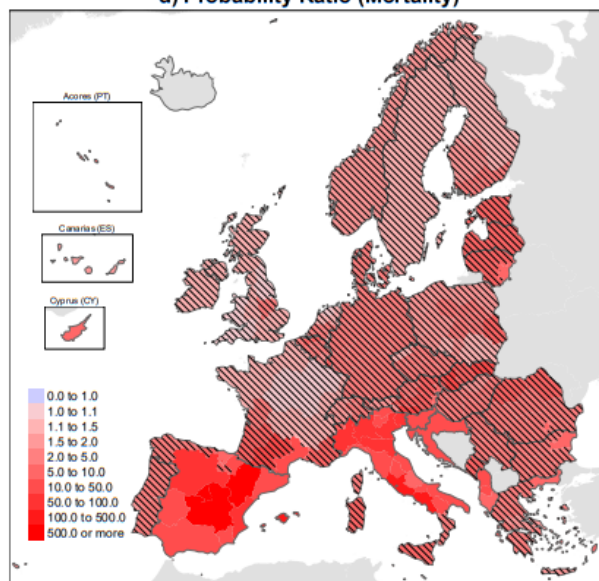
**b) Probability Ratio (Mortality)**



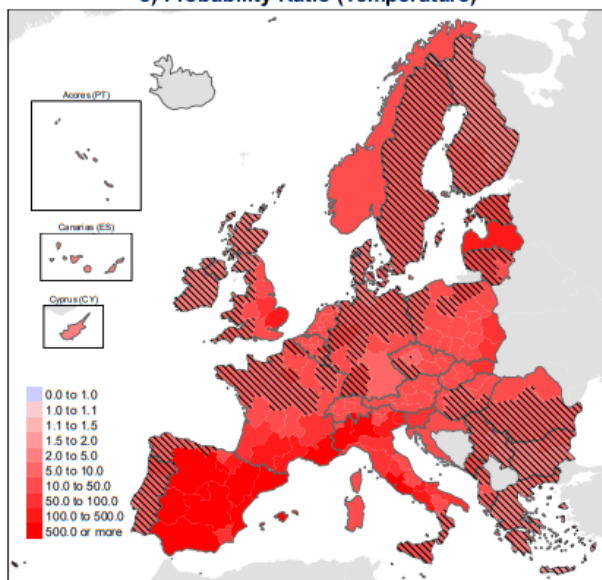
**c) Probability Ratio (Temperature)**



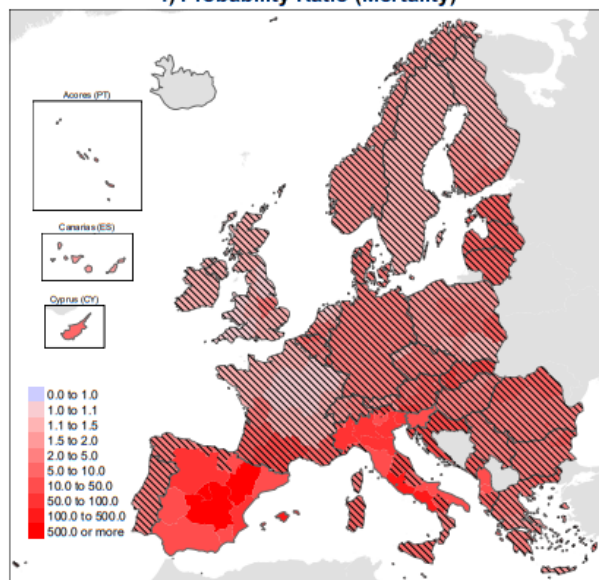
**d) Probability Ratio (Mortality)**



**e) Probability Ratio (Temperature)**



**f) Probability Ratio (Mortality)**



**Figure S1** depicts the median regional probability ratios between 1.2°C and pre-industrial climatic conditions. Hatched areas illustrate regions where the probability ratio is not significantly greater than two (Panels a + b), three (Panels c + d), and five (Panels e + f) at the 0.1 significance level.