Preparing for extreme heat events in a changing climate

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Heatwaves are a major global challenge, with serious impacts on human health. Climate change has greatly increased the intensity, duration and frequency of heatwaves in most regions of the world, and climate model projections indicate that such extremes will become even more likely under climate change. In order to reduce the negative effects of heatwaves, it is therefore important to be able to predict the occurrence of heatwaves on time scales of days to months. With the help of such predictions, people at risk and affected sectors can be warned in good time and appropriate measures can be taken.

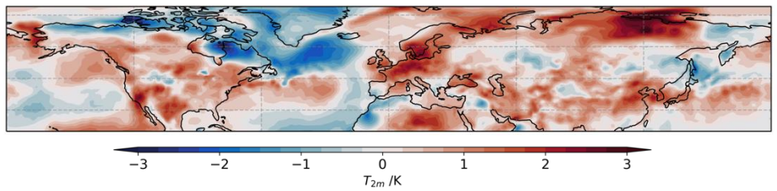

Figure: Temperature anomalies [C] 2m above the Earth's surface for June - August 2018 (Data: ERA-interim). Figure credit: O. Wulff

Heat summers under climate change

Summer temperature distributions have experienced a strong shift towards warmer temperatures in Switzerland, representative of the global temperature increase.

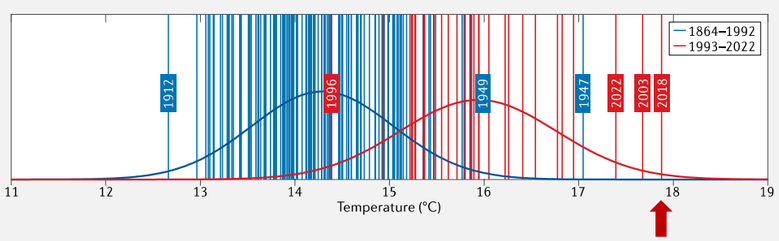

Figure: Distribution of extended summer temperatures (averaged over April–September) for Switzerland, based on four homogenized temperature records from Basel, Bern, Geneva and Zurich. Blue and red bars denote the periods 1864–1992 and 1993–2022, respectively, with normal distributions fitted to the data. From: Domeisen et al, 2023

MAIN MESSAGES:

Heatwaves are some of the most deadly extreme weather events.

Heat extremes can often be predicted 2-3 weeks in advance, which corresponds to a much higher predictability than for other extreme weather events.

Given the high predictability of these extremes and their significant impacts on human health it will be beneficial to explore the potential for early warnings ahead of heat extremes.

Example: Subseasonal predictability of the 2018 summer heatwave

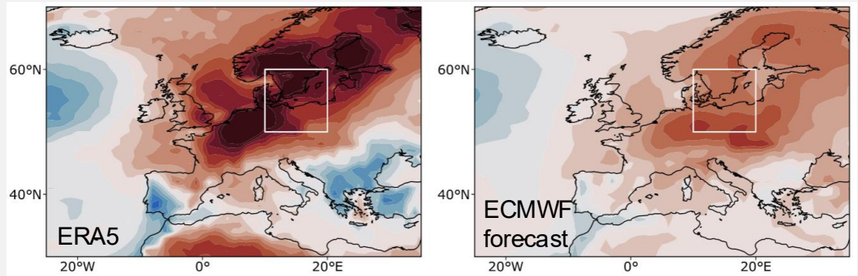

Figure: 2m temperature anomalies for the target week (23 -29 July 2018). Left: Verification. Right: Subseasonal prediction initialized on July 9th, 2018 (3 weeks lead time). From: Domeisen et al, 2022

3 weeks ahead of the peak of the 2018 summer heatwave, the location of the heatwave can successfully be captured. The magnitude was captured starting 2 weeks before the heatwave onset.

Subseasonal predictability of heat mortality during the 2018 heat summer

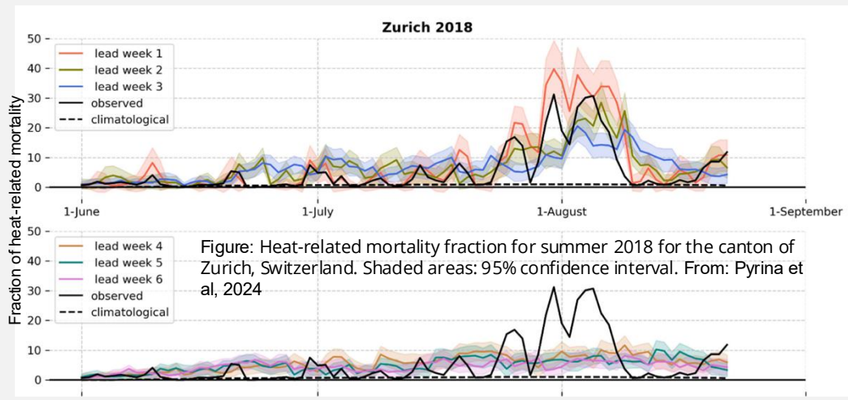

Figure: Heat-related mortality fraction for summer 2018 for the canton of Zurich, Switzerland. Shaded areas: 95% confidence interval. From: Pyrina et al, 2024

Peaks in heat-related mortality are predicted qualitatively well by forecasts of weeks 1, 2 and in some cases week 3.

Longer periods of heat-related mortality (e.g. July/August) are predicted in week 4 and with even longer lead times.

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Pyrina, M., A.M. Vicedo-Cabrera, D. Büeler, S. Sivaraj, C. Spirig, D.I.V. Domeisen (2024): Sub-seasonal prediction of heat-related mortality in Switzerland, GeoHealth, https://doi.org/10.1029/2024GH001199.

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