Extremes and record-breaking events in a warming climate

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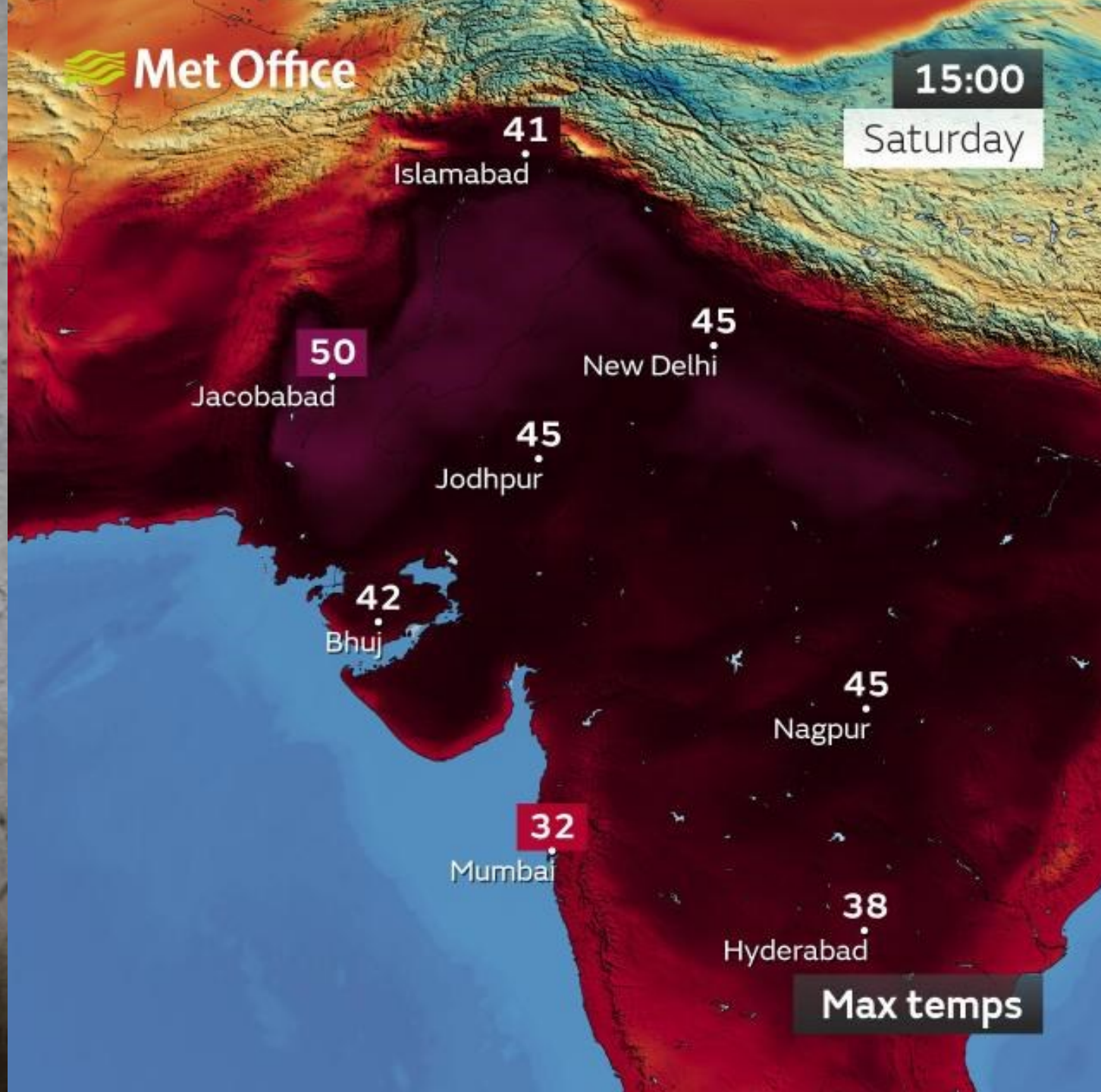

Met Office
15:00
Saturday
41
Islamabad
45
New Delhi
50
Jacobabad
45
Jodhpur
42
Bhuj
45
Nagpur
32
Mumbai
38
Hyderabad
Max temps

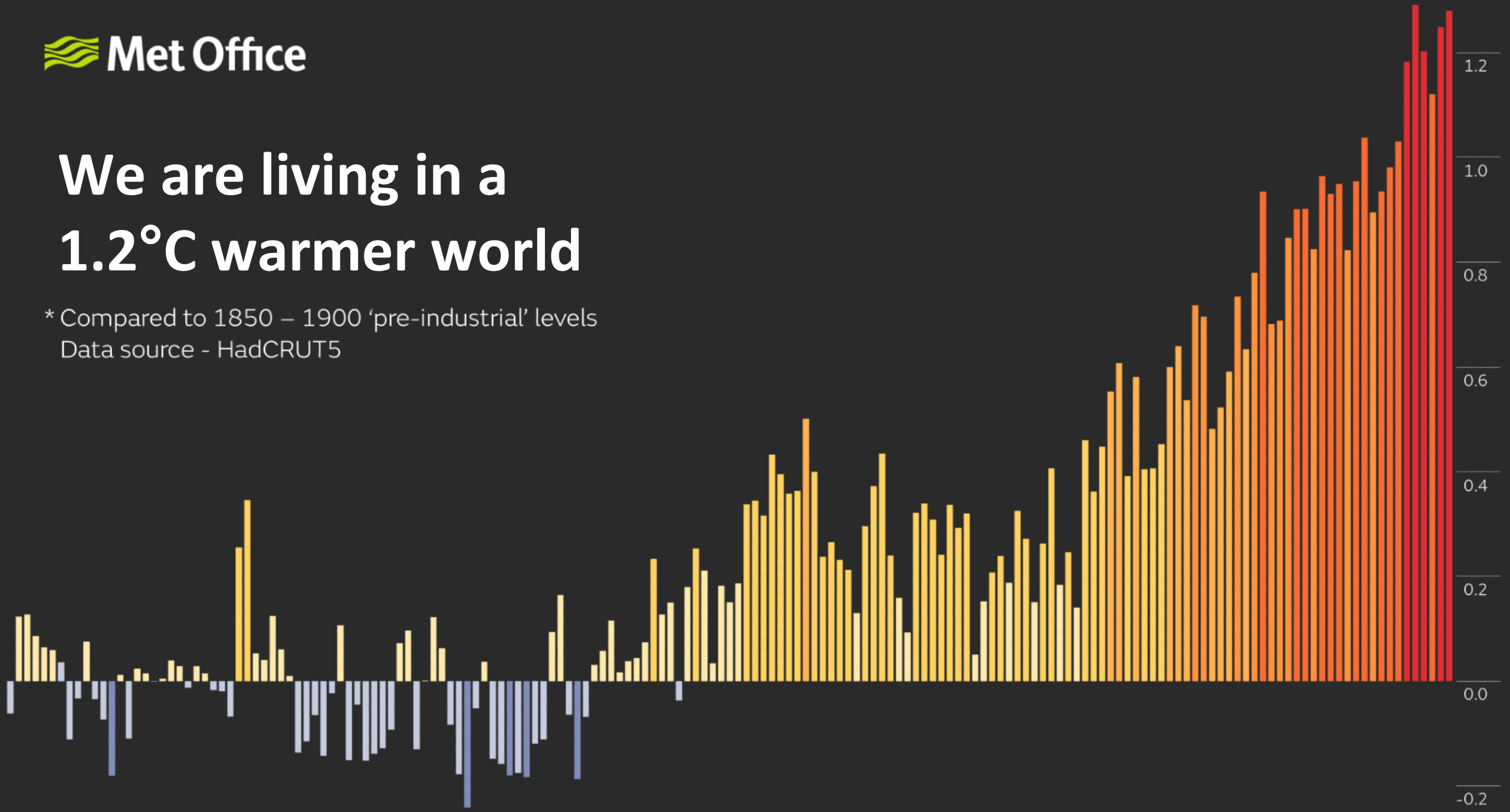

>40°C in UK

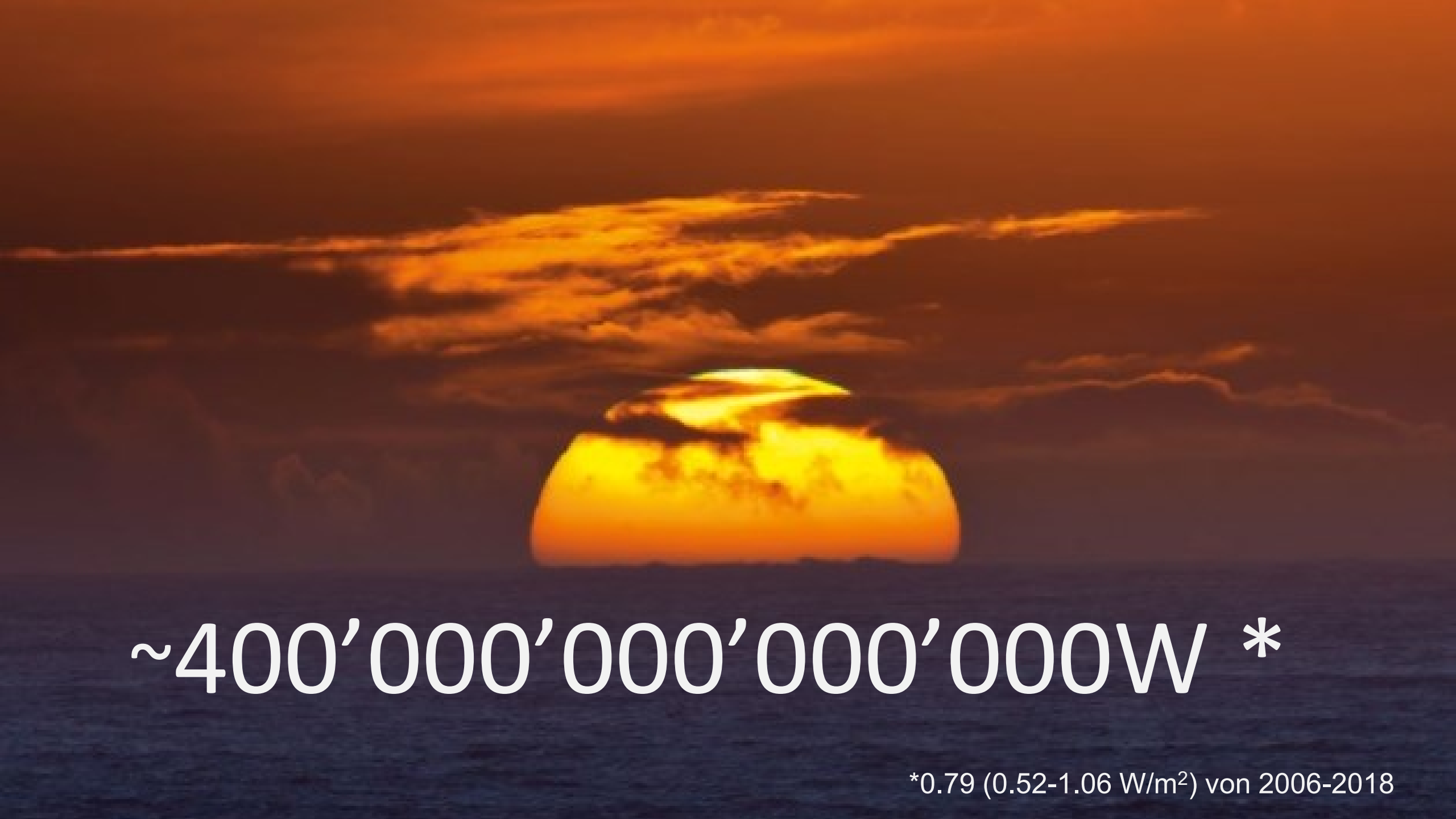
Do weather extremes change in a warming climate?

Met Office

We are living in a 1.2°C warmer world

* Compared to 1850 – 1900 ‘pre-industrial’ levels
Data source - HadCRUT5

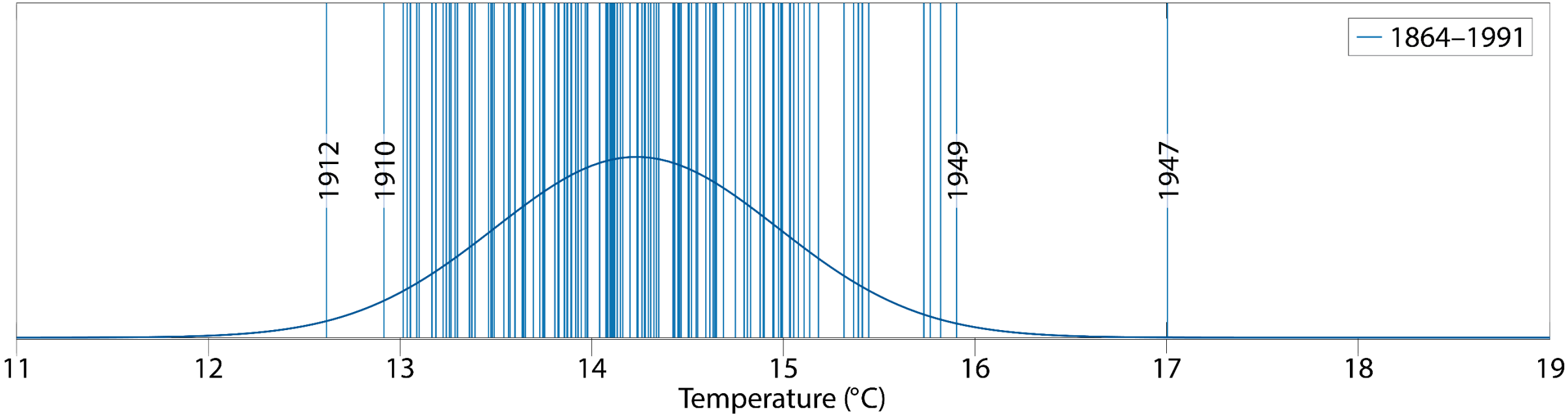




~400’000’000’000’000W *

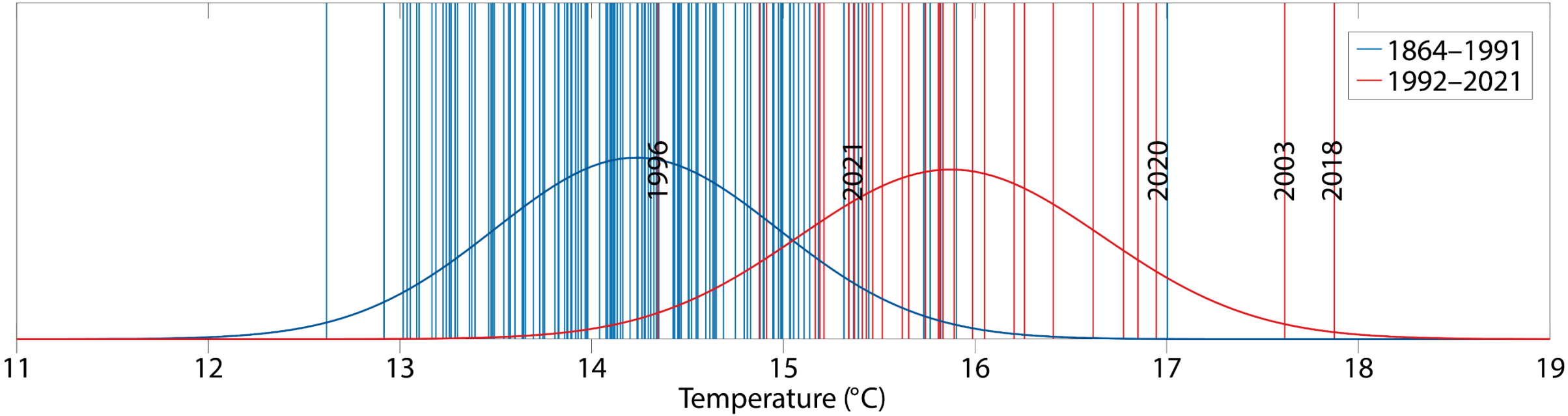
*0.79 (0.52-1.06 W/m^2) von 2006-2018

Heatwaves used to be rare…



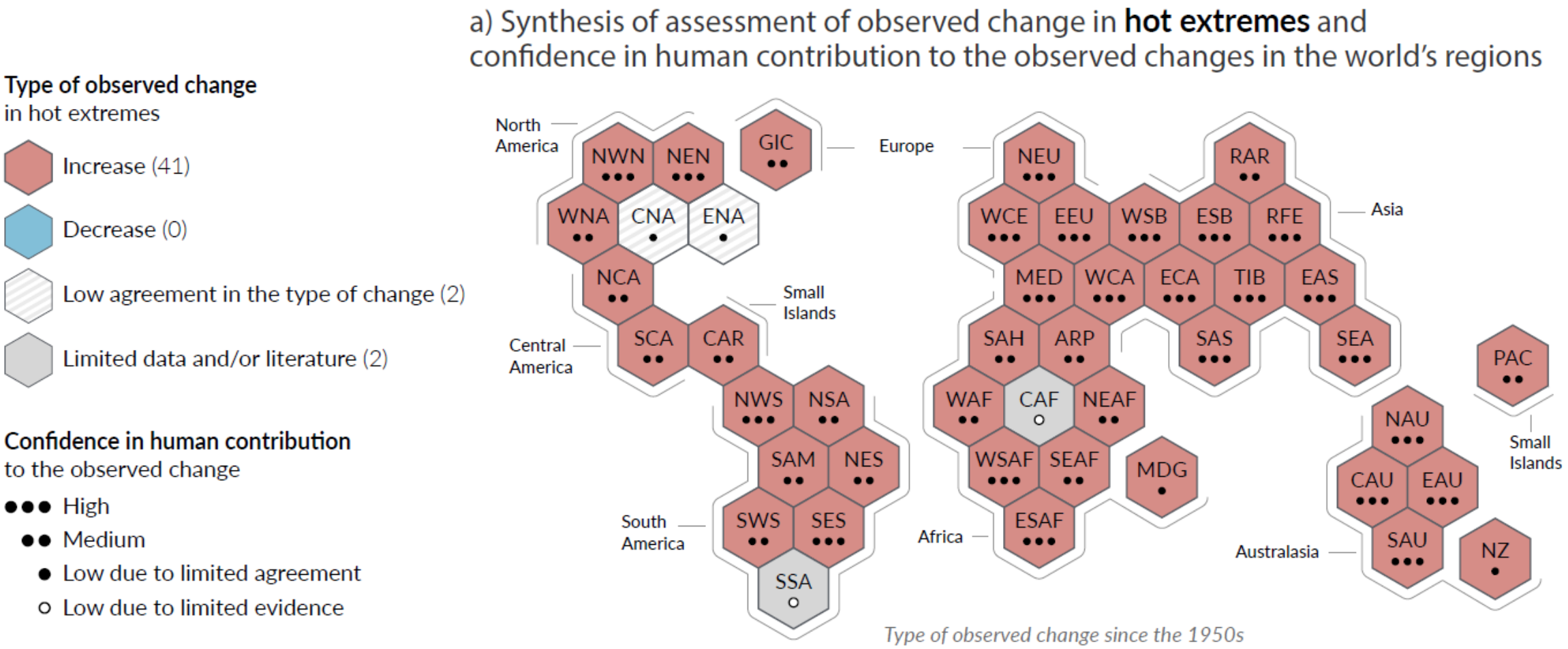
Domeisen et al. (2022)

but have become more frequent and intense



Domeisen et al. (2022)

More frequent and intense heat extremes



IPCC AR6 (2021), *Figure SPM.3b*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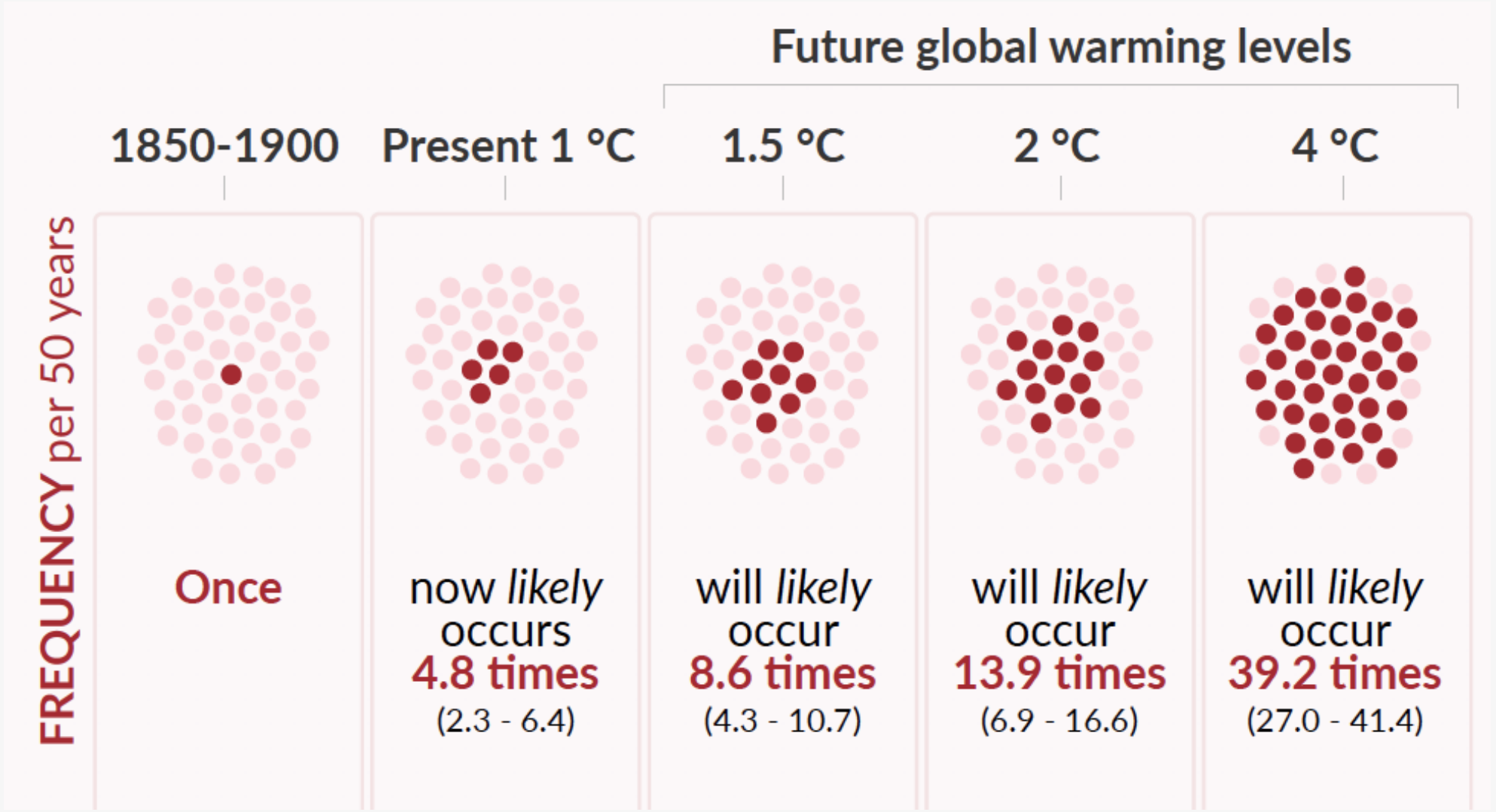
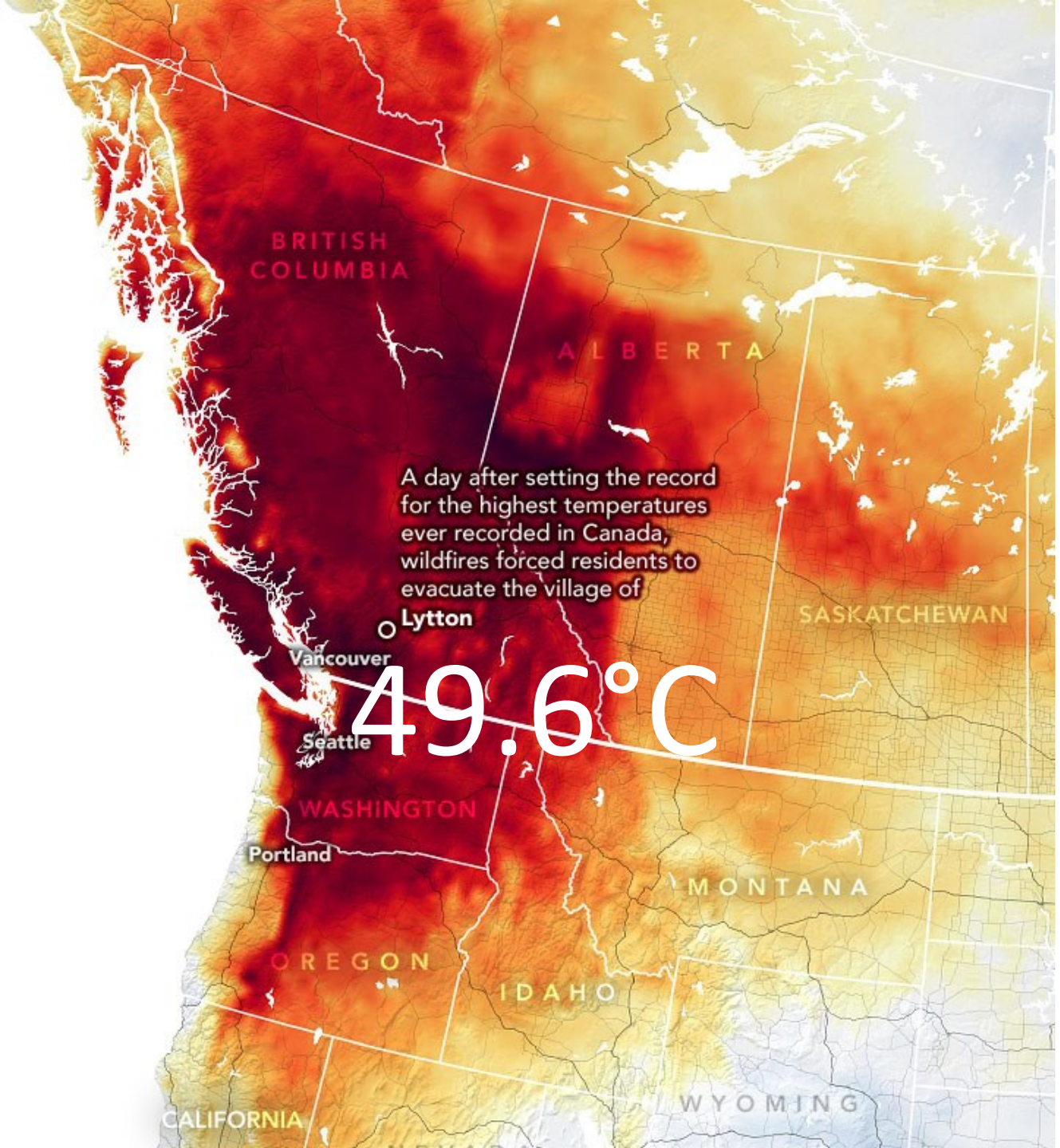
11 Feb 16:15

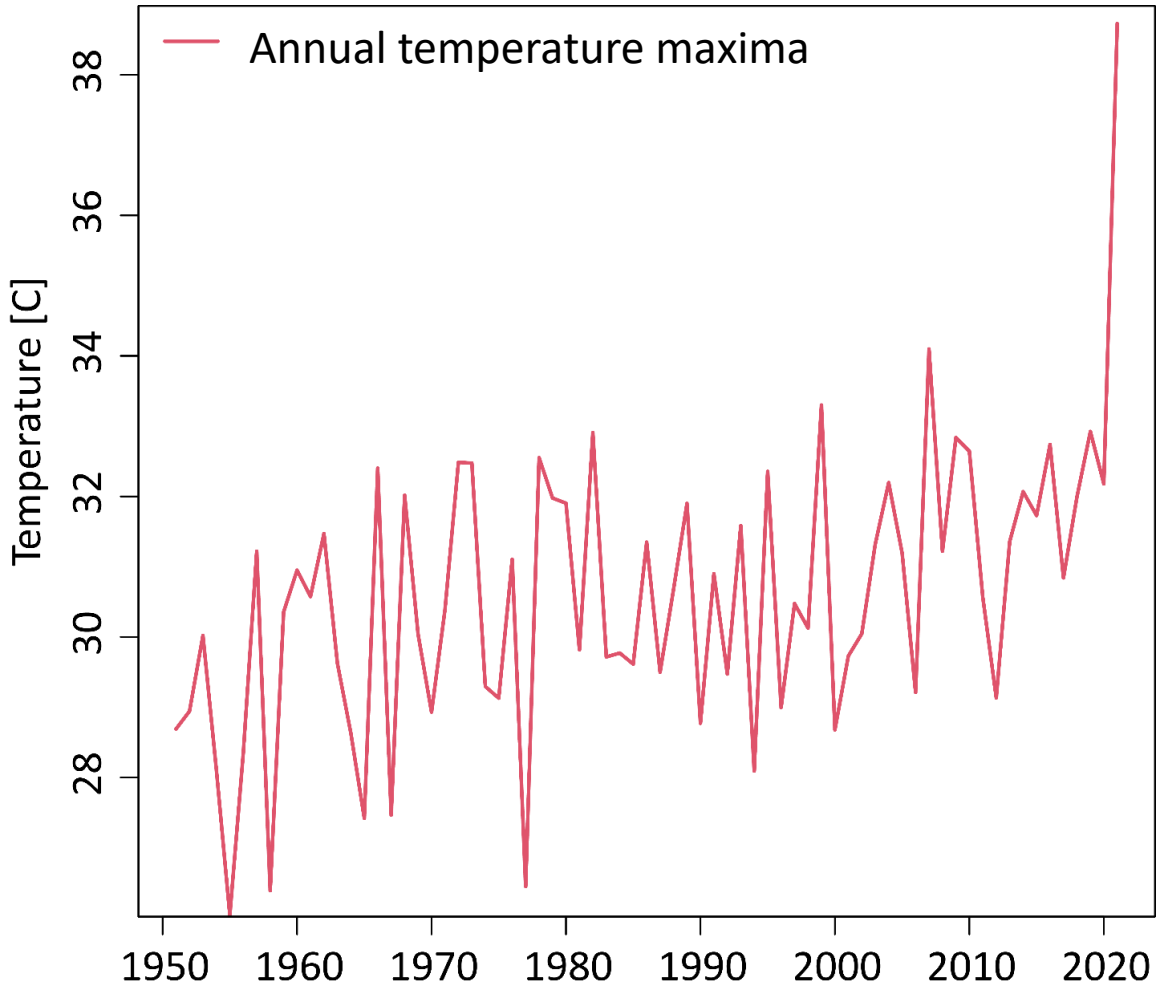
Rare heat extremes become the norm



(IPCC AR6 WG1, Fig. SPM.6)

2021 Pacific Northwest heatwave





The New York Times

July 26, 2021 Updated Sept. 15, 2021, 5:08 a.m. ET

Extreme Weather and Climate Updates

The world can expect mo… waves, research sh…

nature climate change

ARTICLES

https://doi.org/10.1038/s41558-021-01092-9

Check for updates

Increasing probability of record-shattering climate extremes

E. M. Fischer, S. Sippel and R. Knutti

Recent climate extremes have broken long-standing records by large margins. Such extremes unprecedented in the observational period often have substantial impacts due to a tendency to adapt to the highest intensities, and no higher, experienced during a lifetime. Here, we show models project not only more intense extremes but also events that break previous records by much larger margins. These record-shattering extremes, nearly impossible in the absence of warming, are likely to occur in the coming

SRF

Wir n… Ereign…

Schweizer W… …matische Extremst-Ereignisse

THOMSON REUTERS FOUNDATION NEWS

…rd-smashing heat extremes may become … more likely with climate change -study

…59 GMT

THE TIMES | Today's sections | Past six days

Scientists warn of more killer heatwaves

Neue Zürcher Zeitung

ETH-Studie: Je schneller sich das Klima verändert, desto deutlicher können alte Hitzerekorde übertroffen werden

Forbes

SCIENCE

Climate On Steroids Is Going Full 'Hulk Smash' On Weather

…an …s

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'Record-shattering' heat becoming much more likely, says climate study

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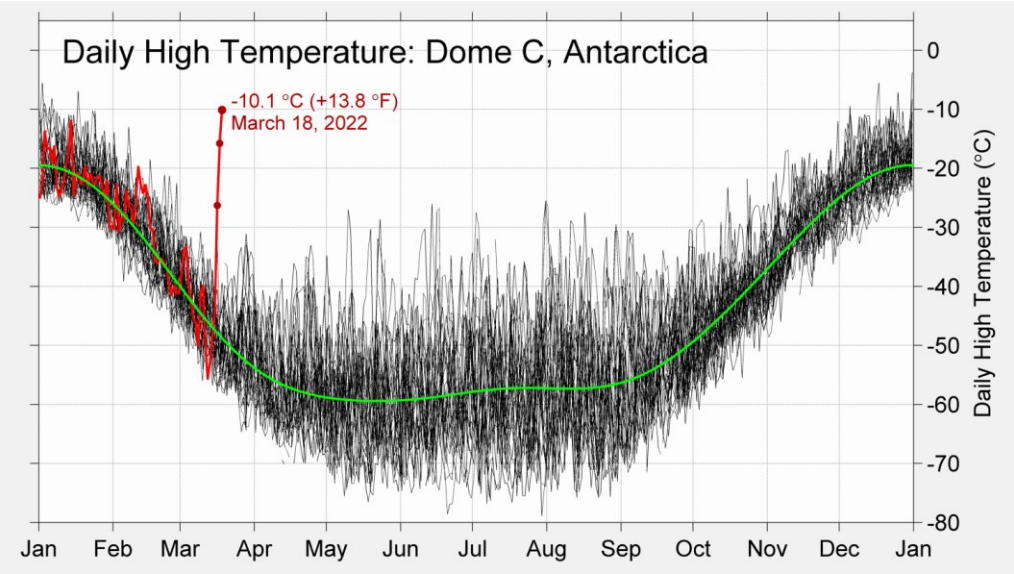
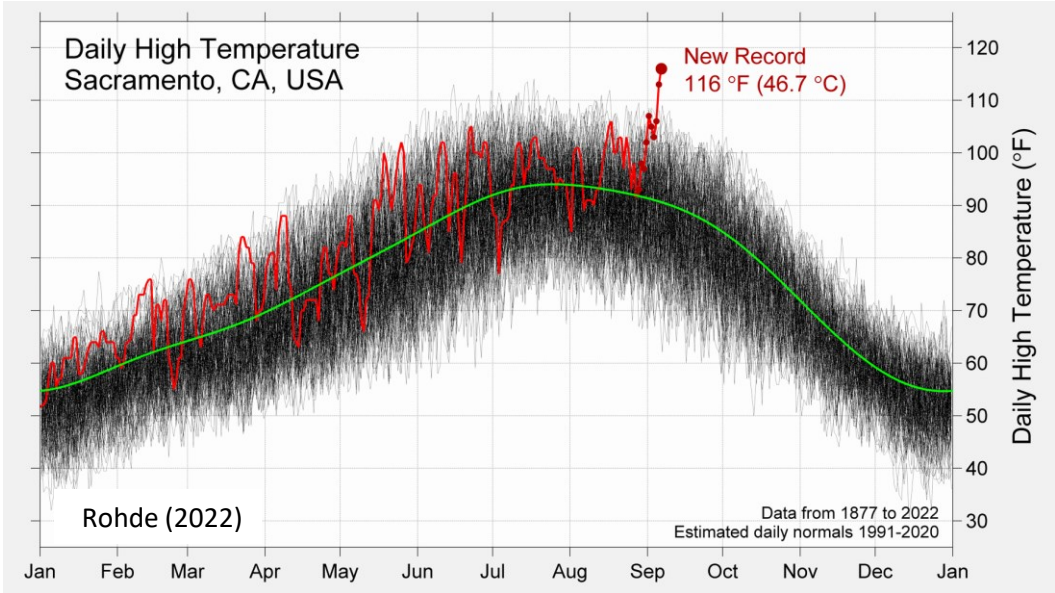
Climate > News

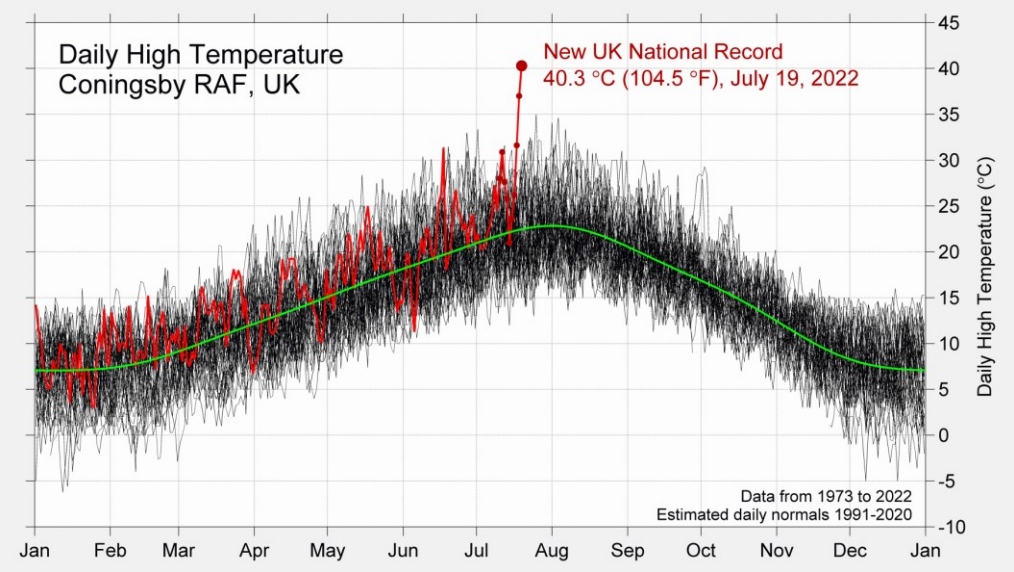
'Record-shattering' heatwaves to become far more likely without urgent climate action, research warns

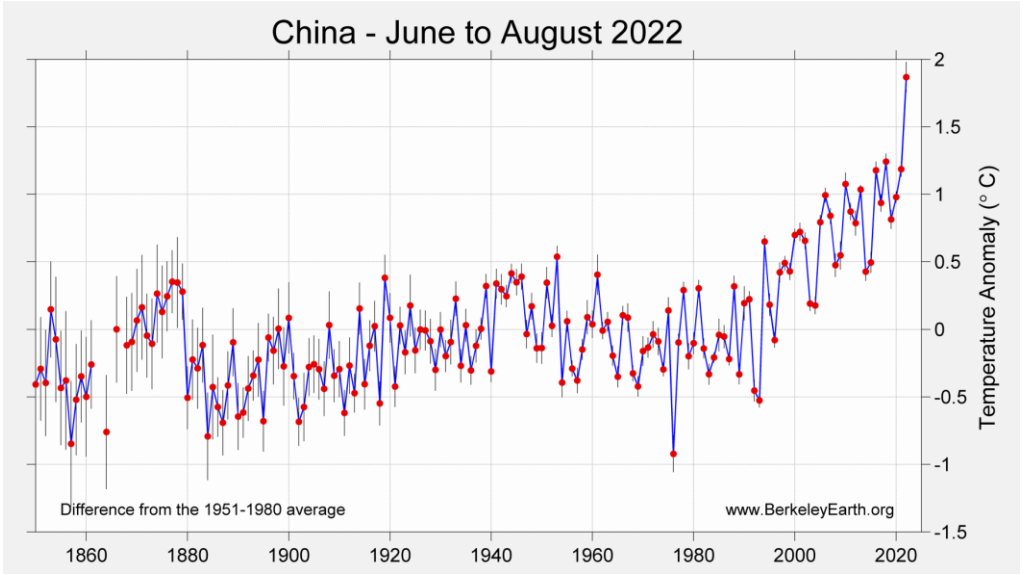
More evidence for record-shattering extremes

Seasonal records shattered

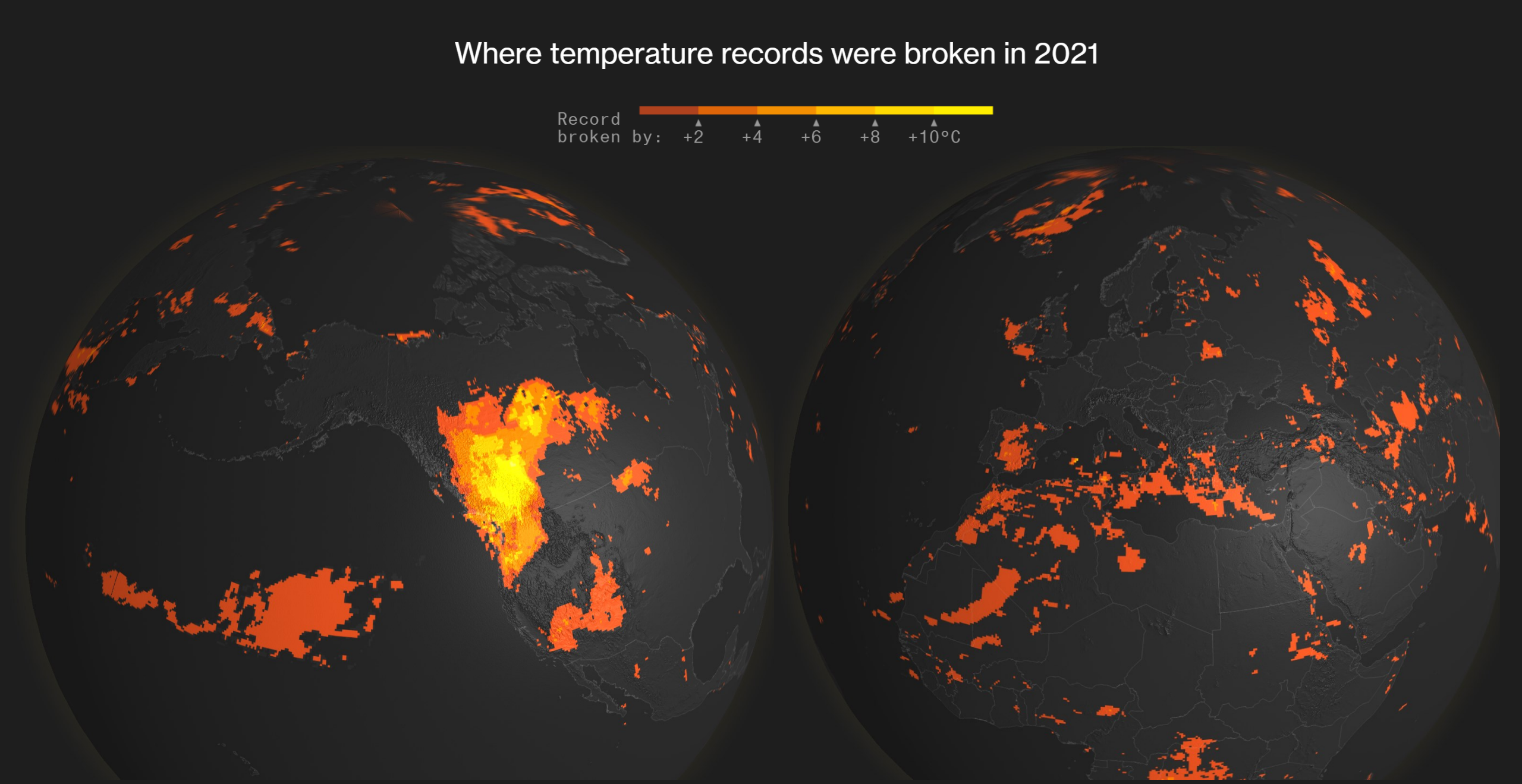








Source: Rohde (2022), Twitter



Bloomberg (2022)

Records should become rarer but they don’t

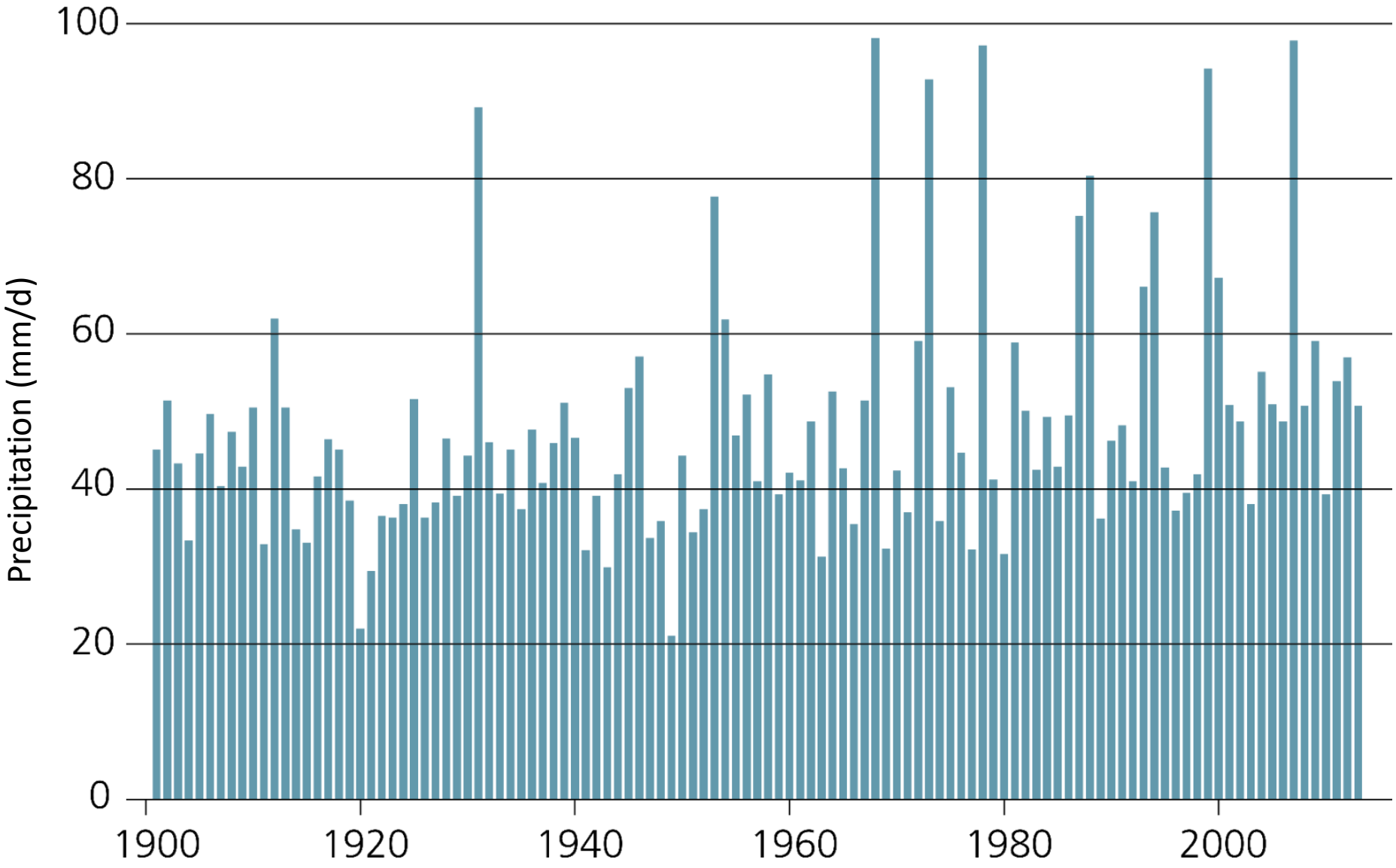

Boulogne forest
Paris
Eiffel Tower
Paris Expo
500 m
Land surface temperature
18 June 2022
32
40
48 °C

Marine heatwaves have doubled over the last decades

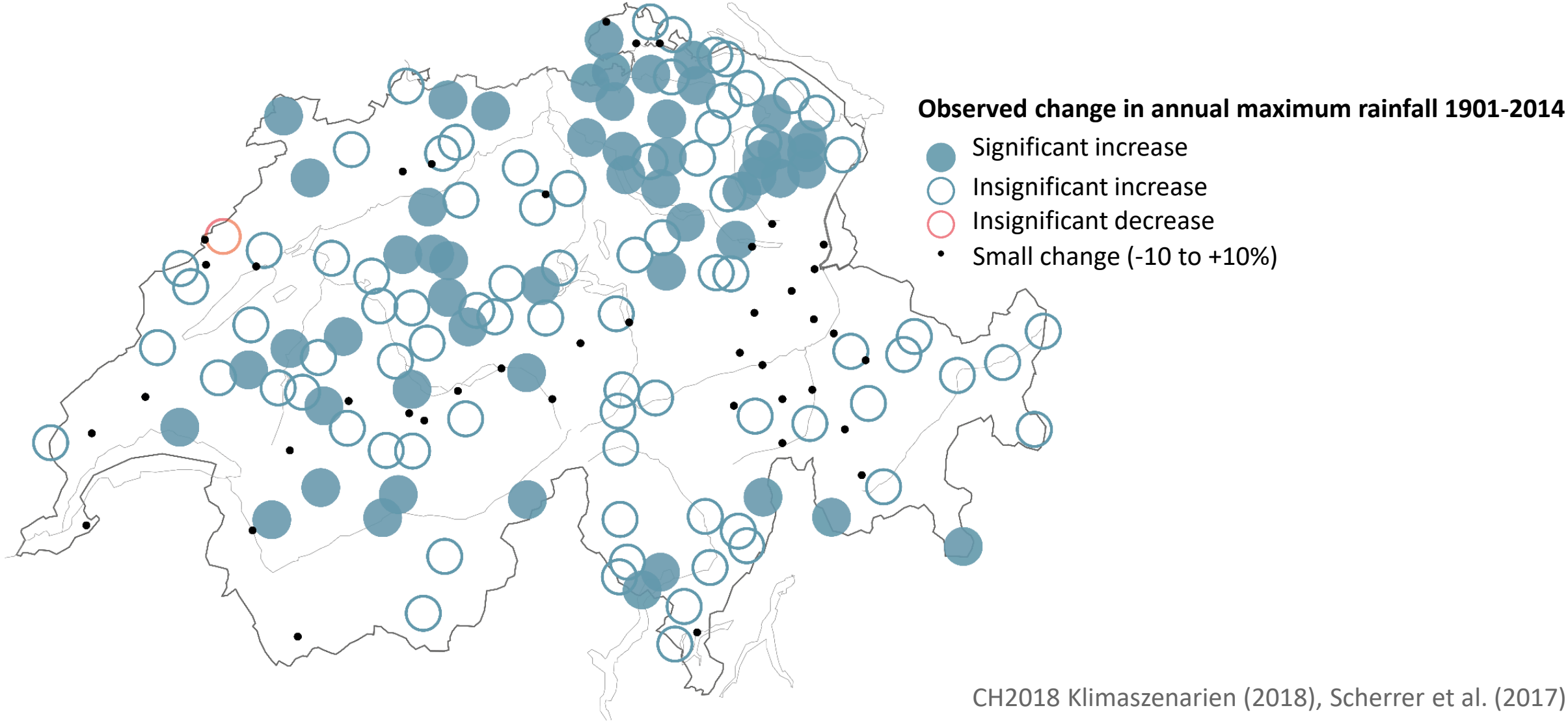
?

Heavy rainfall – variability or change?

1-day precipitation maxima
1901-2017 (Zurich)



A clear signal across Switzerland: The score is 32 to 0



CH2018 Klimaszenarien (2018), Scherrer et al. (2017)

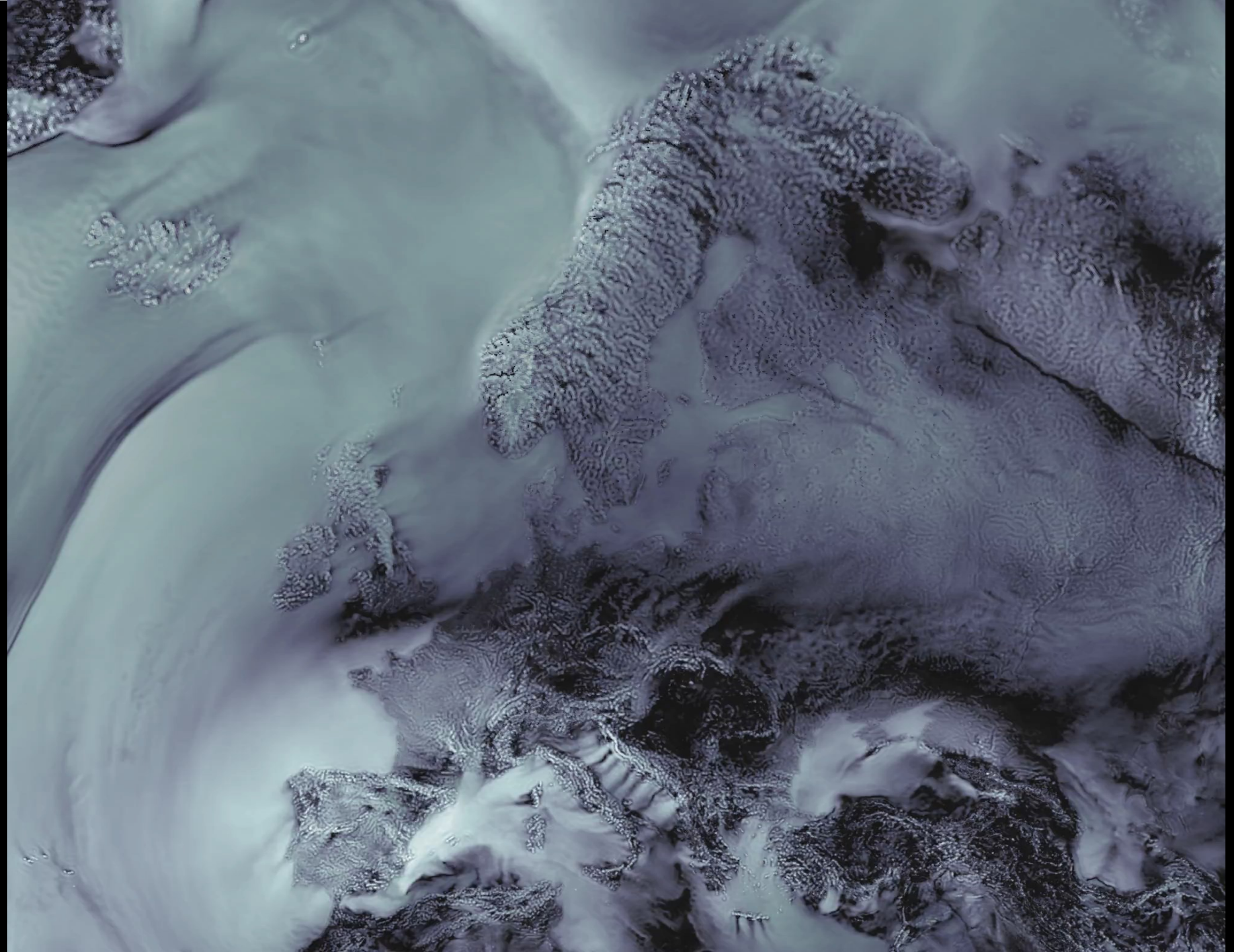
$$\frac{de_s}{e_s} = \frac{L_v \cdot M_{H_2O} \cdot dT}{R \cdot T^2} \approx 0.065\,K^{-1} = 6.5\,\%/K$$

$L_v = 2.5 \cdot 10^6\,J\,kg^{-1}$

$M_{H_2O} = 0.018\,kg/Mol$

$R = 8.314\,J\,K^{-1}\,Mol^{-1}$

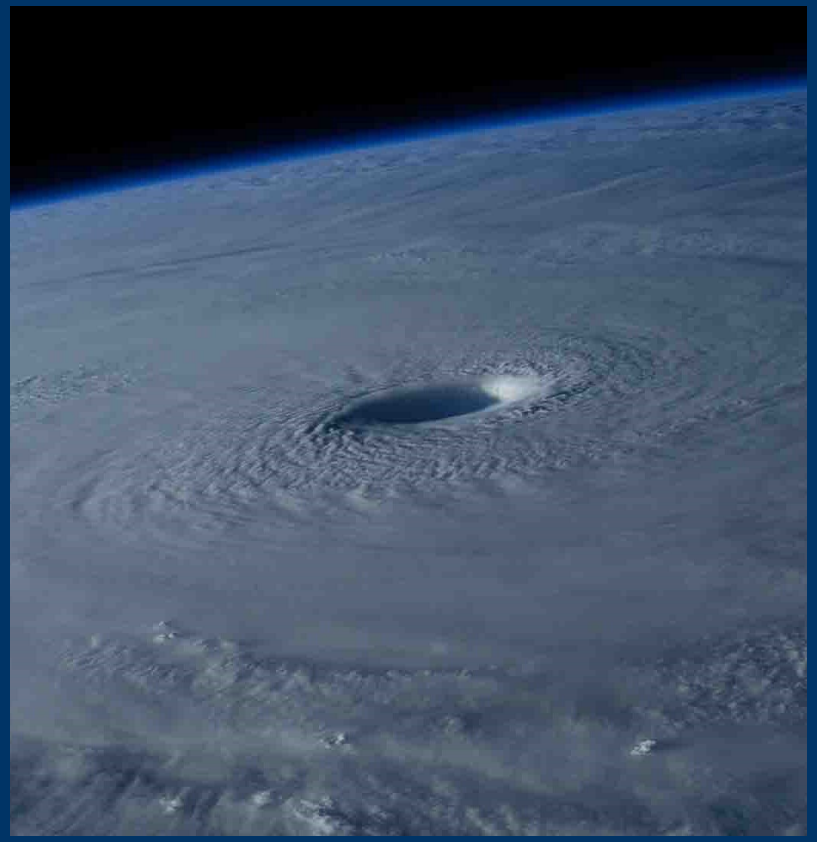
$T = 288\,K$




PHARMACY

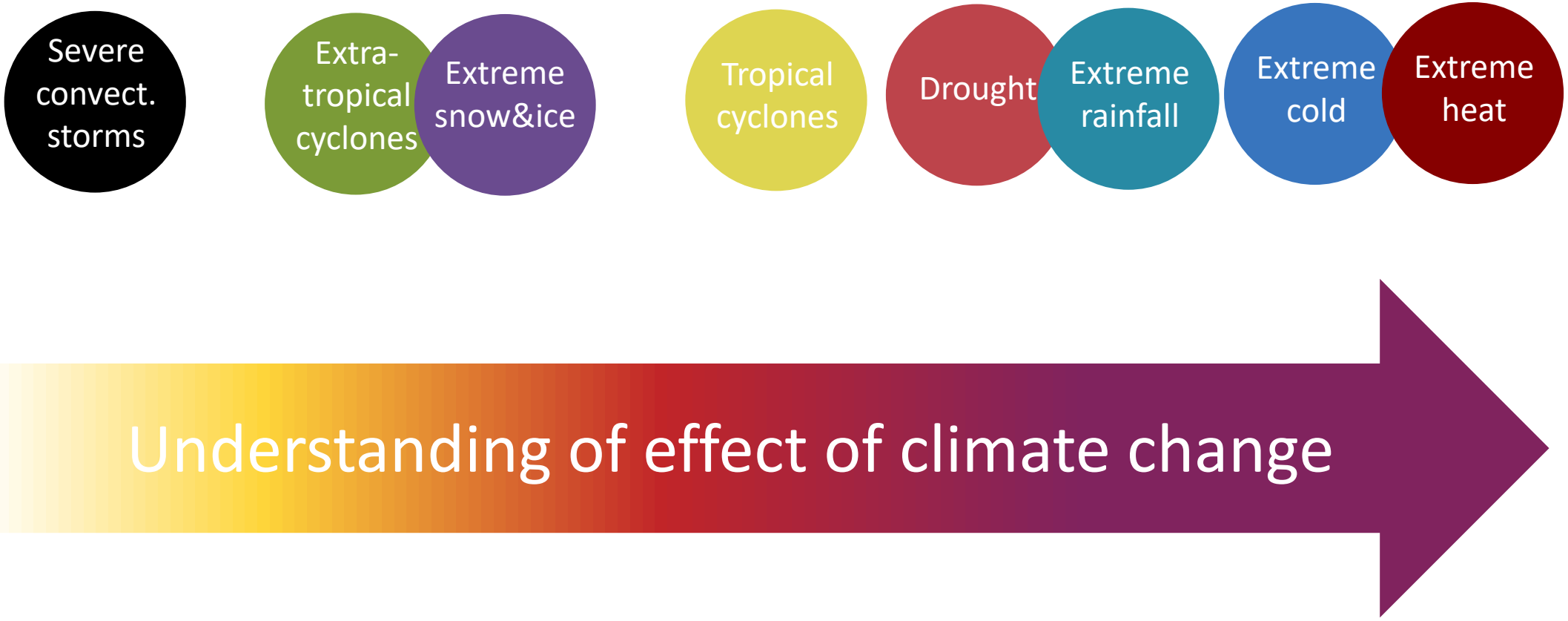
[Credit: Yoda Adaman | Unsplash]

"It is indisputable that human activities are causing climate change, making extreme climate events, including heat waves, heavy rainfall, and droughts, more frequent and severe.

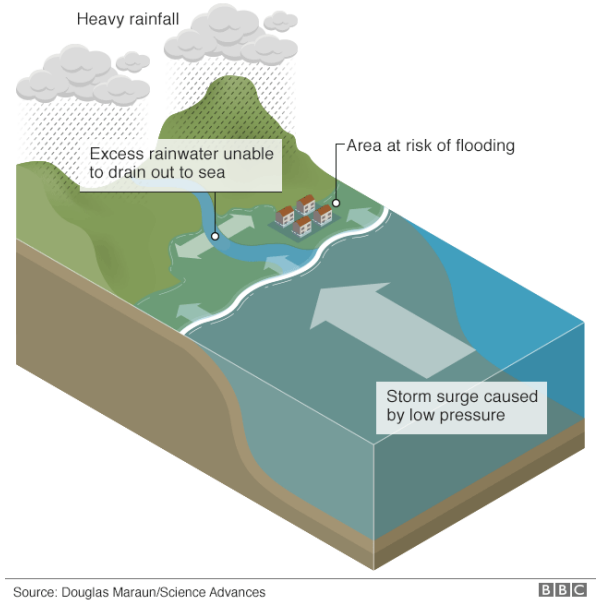


“The proportion of intense tropical cyclones (Category 4–5) and peak wind speeds of the most intense tropical cyclones are projected to increase at the global scale

Level of confidence



Storm surge (compound event)

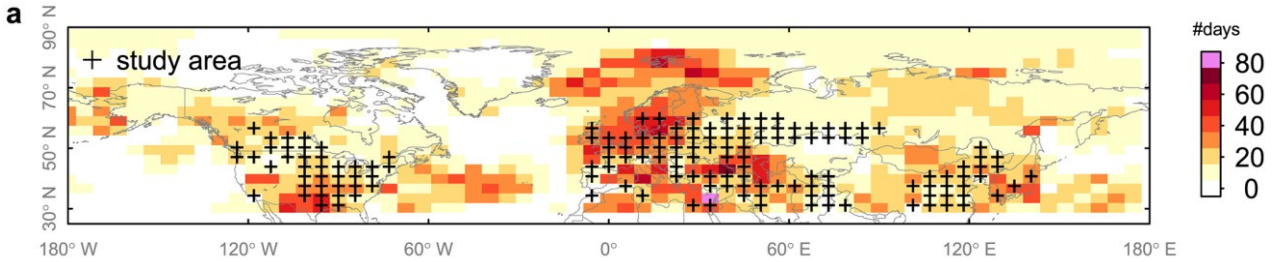


Bevacqua et al. (2017)

Compound events

«Misfortunes never come singly»

Co-occurring heatwaves 2018



Vogel et al. (2019)

Conclusions

- **Heatwaves, droughts, extreme rainfall** events and the fraction of intense **tropical cyclones** are changing in a warming climate
- We need to prepare for events of **unprecedented** intensity
- Probability of record-shattering heat extremes depends on **warming rate**

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