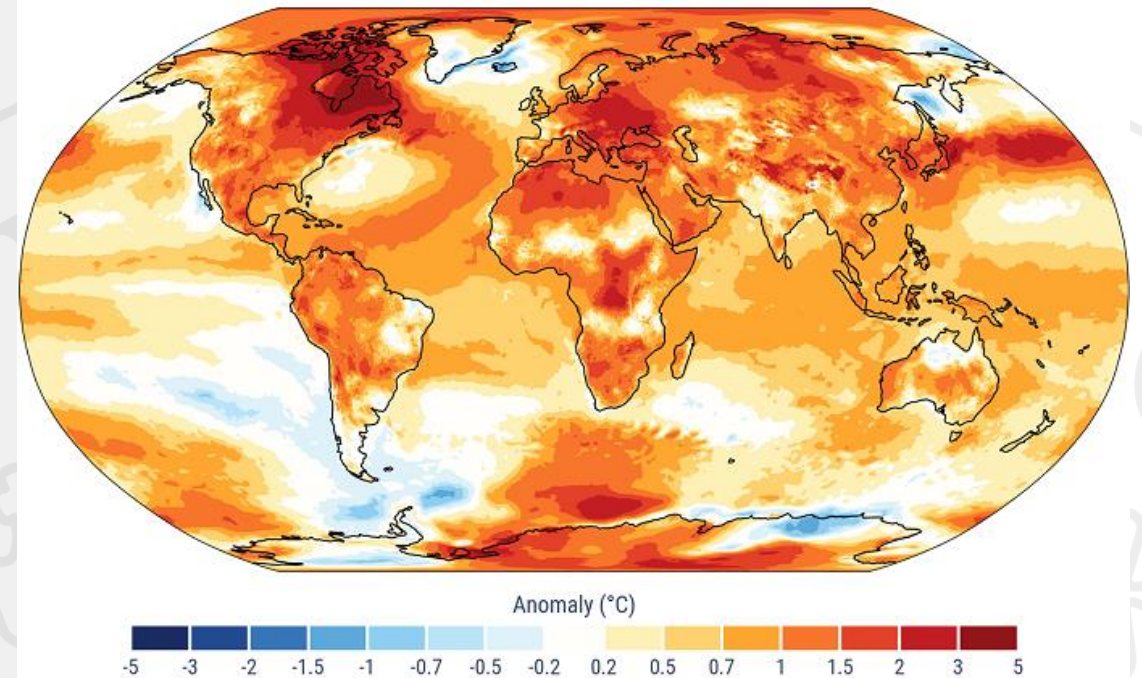


Heatwaves: a public health emergency for respiratory systems

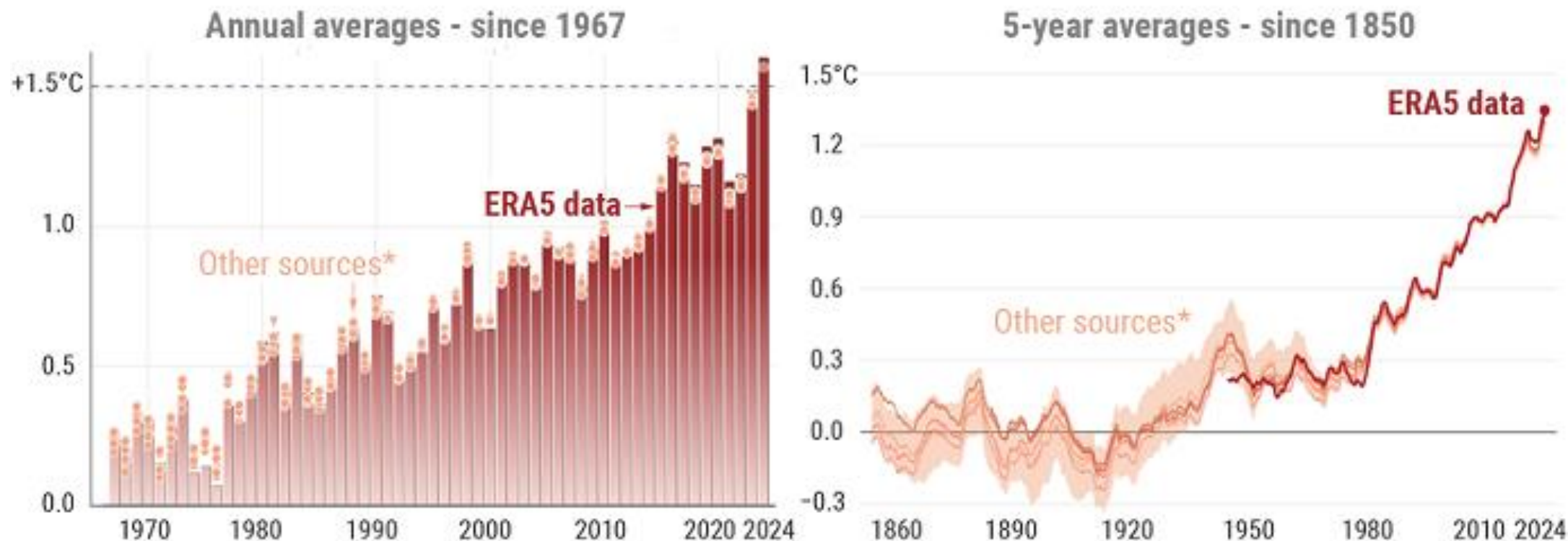
March 17th, 2025

Zorana Jovanovic Andersen, Professor in Environmental Epidemiology, Department of Public Health, University of Copenhagen, Denmark; Former Chair of the European Respiratory Society (ERS) Environment and Health Committee;



Global surface temperature increase above pre-industrial

Reference period: pre-industrial (1850–1900) • Credit: C3S/ECMWF



*Other sources include JRA-3Q, GISTEMPv4, NOAA GlobalTempv6, Berkeley Earth and the HadCRUT5 ensemble mean. Shading shows the range of the HadCRUT5 ensemble.

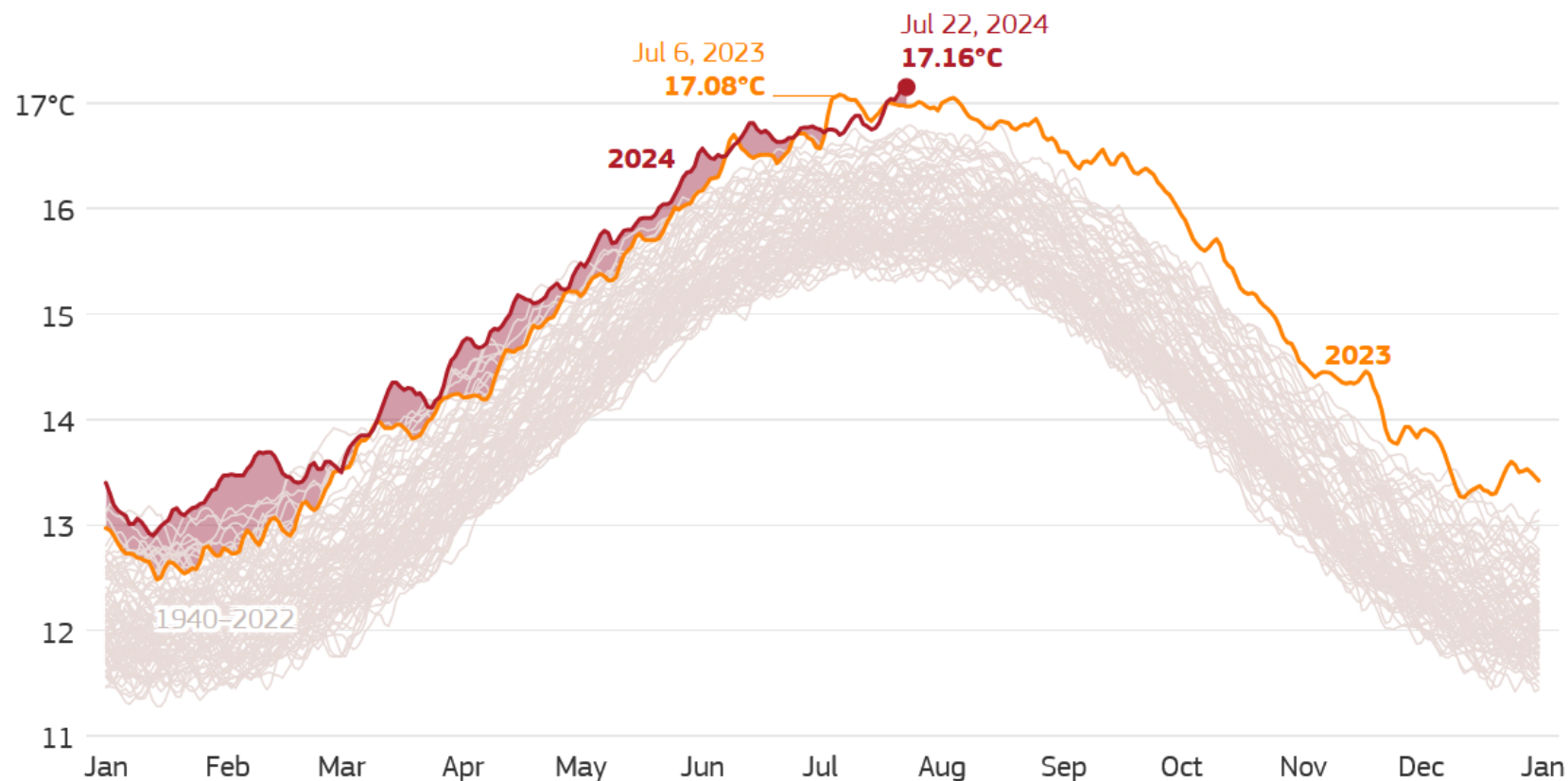


PROGRAMME OF
THE EUROPEAN UNION



New record daily global average temperature reached in July 2024

Daily global surface air temperature



The Earth has just experienced its warmest day in recent history: on 22 July 2024, the daily global average temperature reached a new record high at 17.16°C. This exceeds the previous records of 17.09°C, set just one day before on 21 July 2024, and 17.08°C, set a year earlier on 6 July 2023.

Daily global average surface air temperature for 2024 (red), 2023 (orange), and all years between 1940 and 2022 (grey). Red shading indicates the difference between the daily global average temperatures from 2023 to 2024, for days where 2024 has been warmer than 2023.

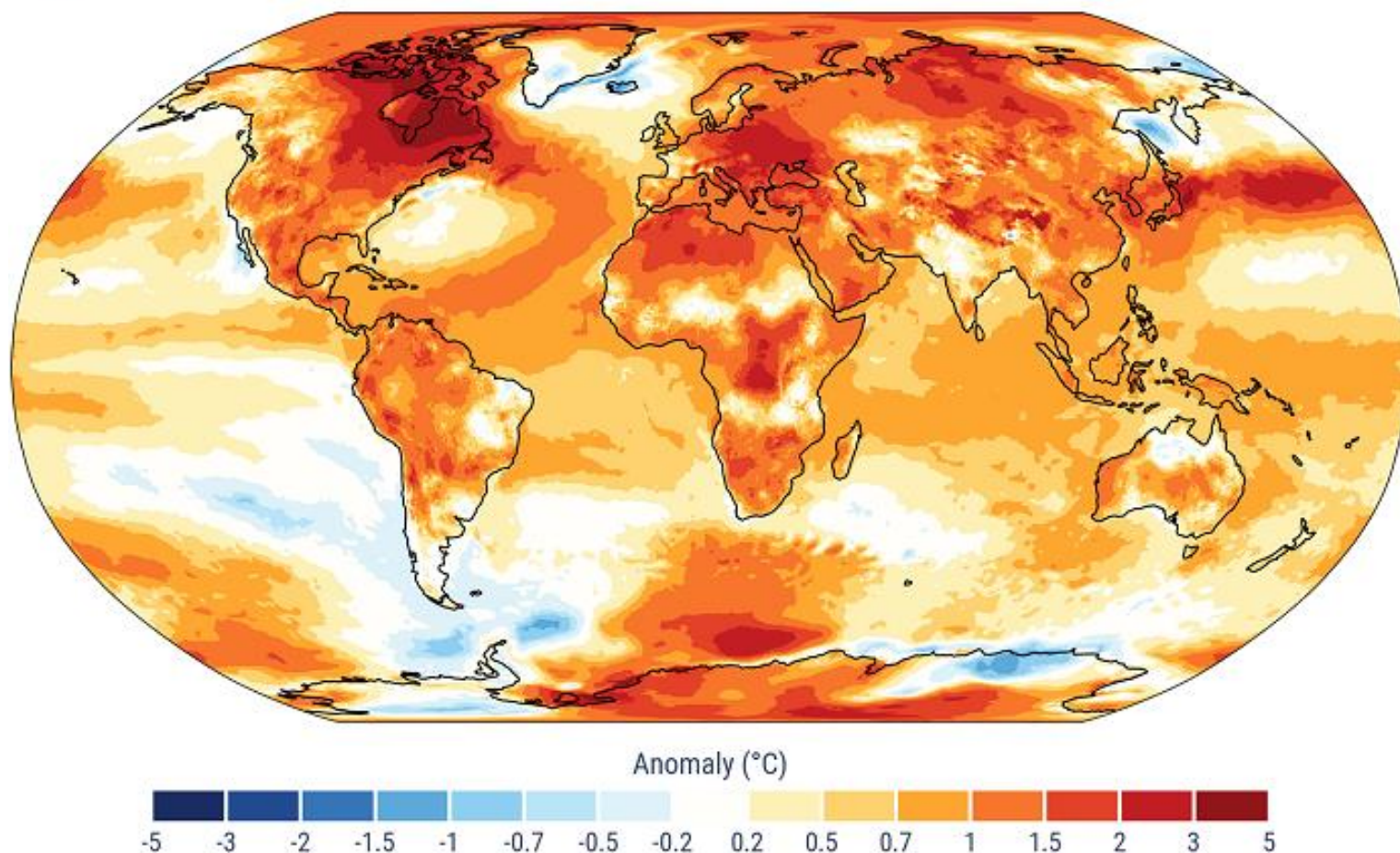
Data for 2024 shown up to 23 July. Data for 23 July 2024 is preliminary

Data source: ERA5 • Credit: C3S/ECMWF

<https://climate.copernicus.eu/new-record-daily-global-average-temperature-reached-july-2024>

Surface air temperature anomalies in 2024

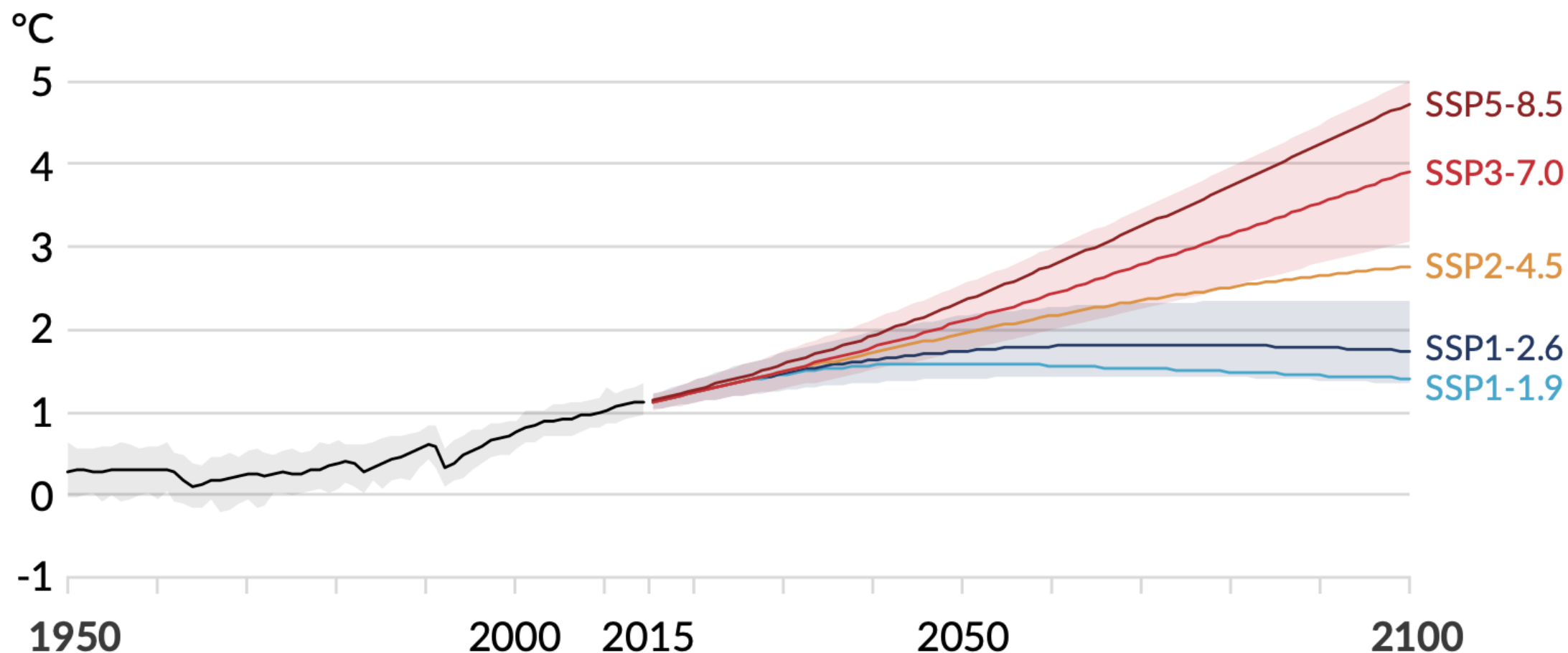
Data: ERA5 • Reference period: 1991–2020 • Credit: C3S/ECMWF



April 22nd, 2024

Climate Change Projections

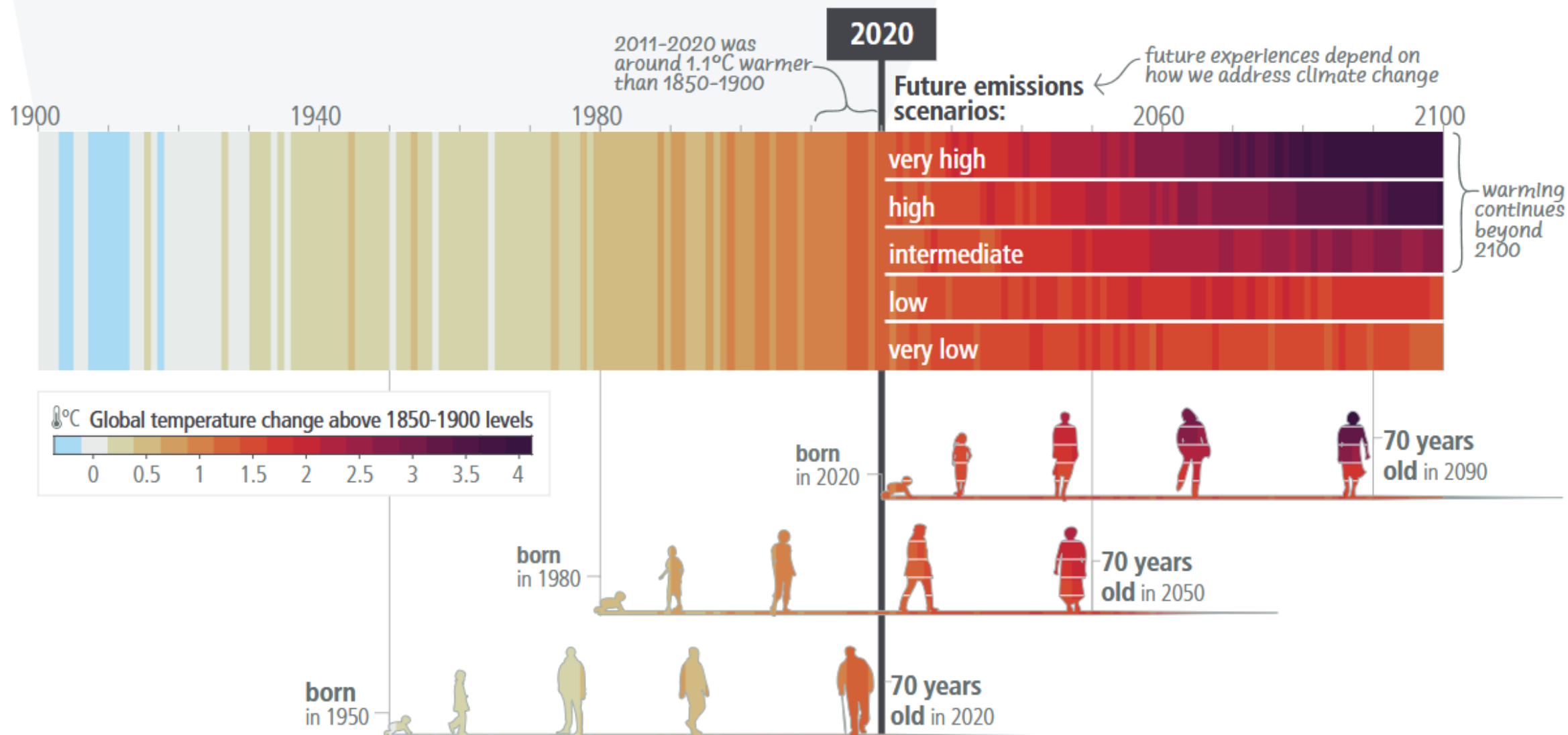
a) Global surface temperature change relative to 1850-1900



The most important **environmental threat** of our era



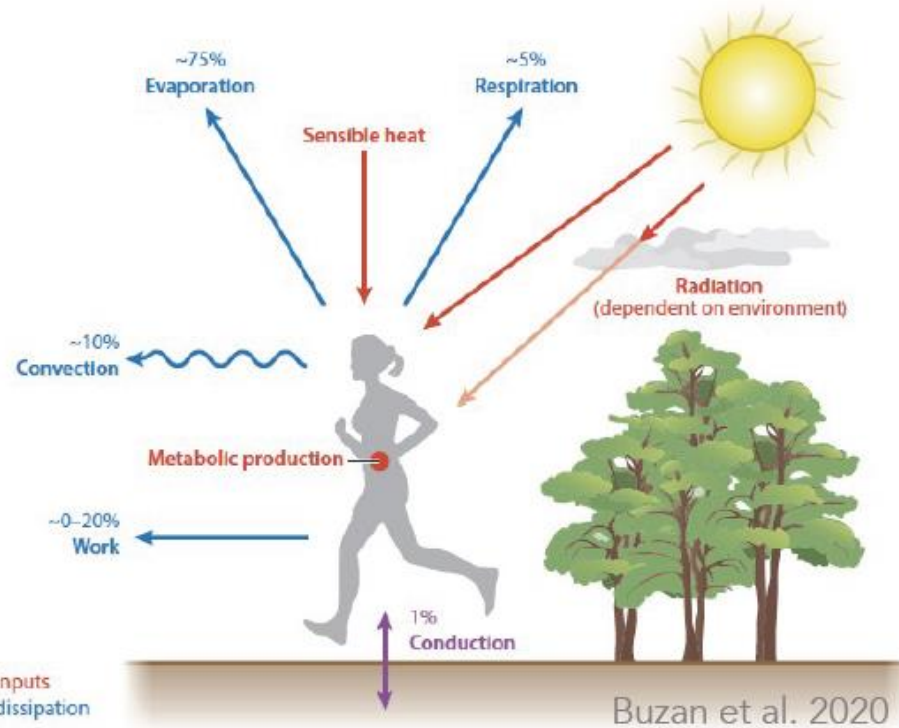
c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near term



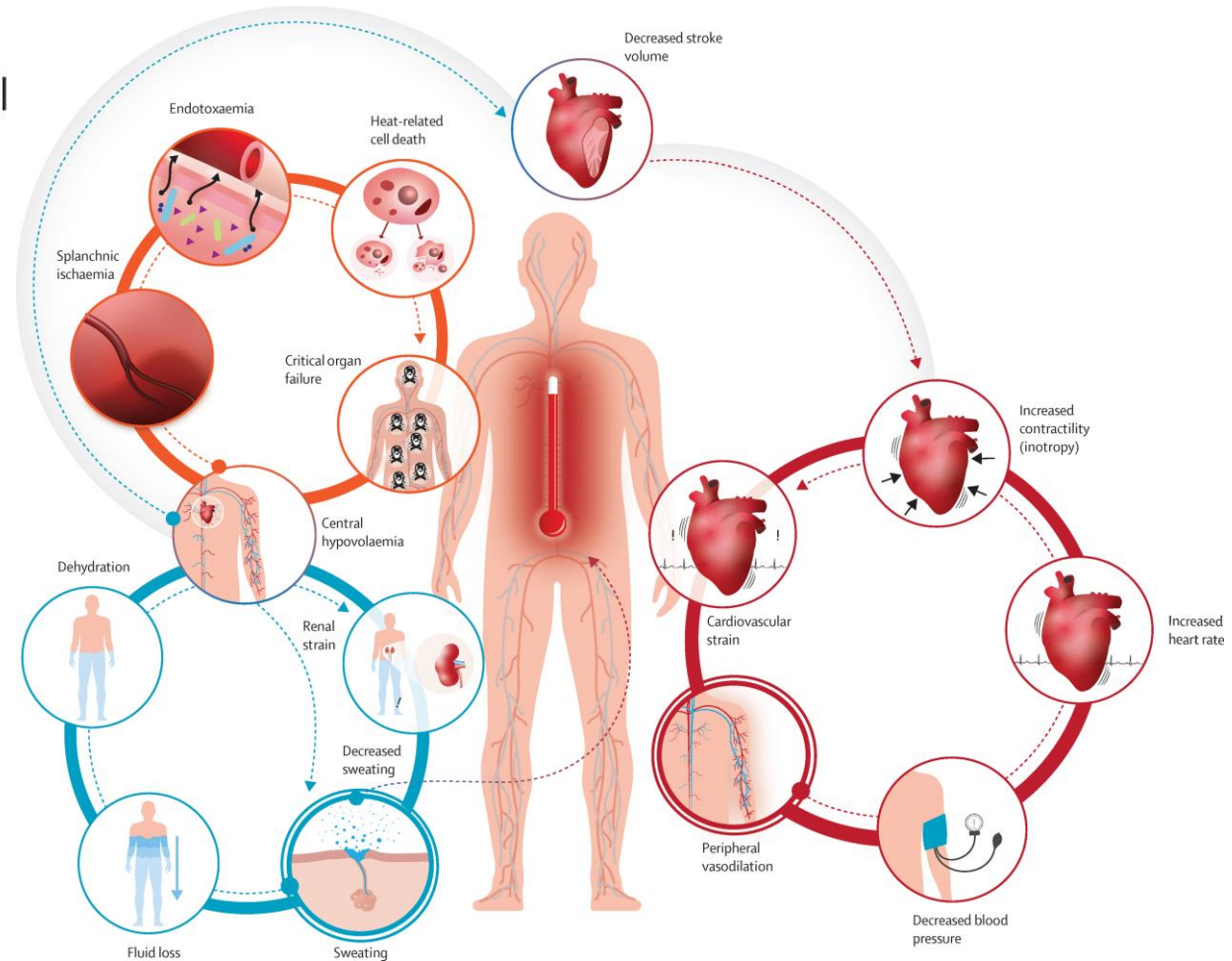
Direct impacts

HEAT

One of the most important environmental hazards for human health

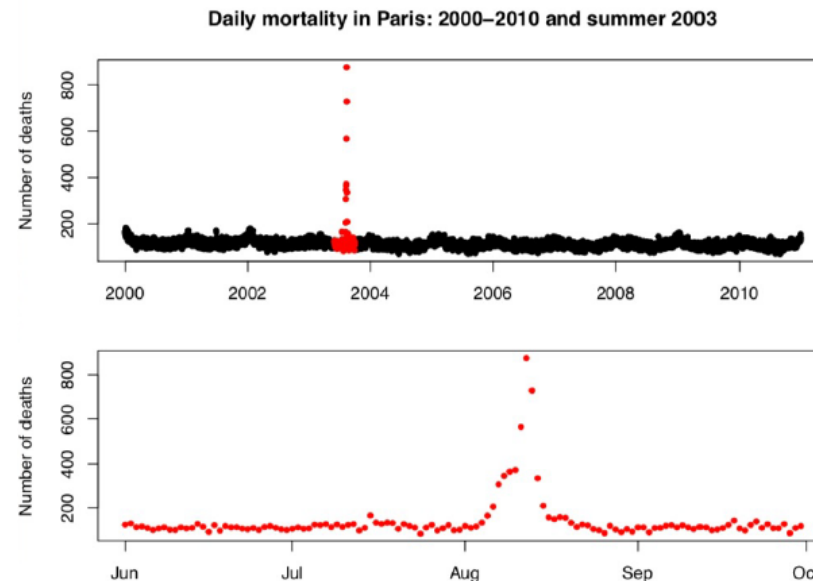
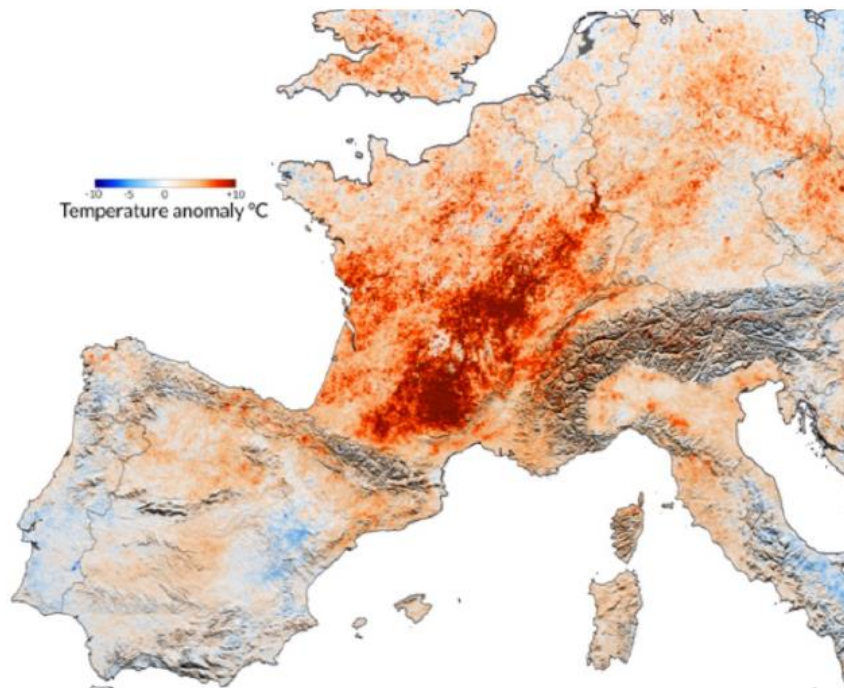


- Two main mechanisms to cope with heat:
- Redistribution of blood flow towards the skin
 - Sweating



During prolonged exposures or extreme heat, or if preexisting health conditions – ➡ Heat strain mechanisms may fail

Heat impact on health: heatwave of 2003



A turning point in the development of public health policies against climate change

From August 1st to 5th, 2003, the average maximum temperatures recorded in France increased from a value close to the normal value (25°C) to 37°C, then remained between 36 and 37°C until August 13th, before beginning to fall (28°C on August 16th). Almost all of the population of France, i.e. approximately 60 million people, was exposed to the heat wave: the temperature exceeded 35°C for at least 9 days in 61 of the 96 French *departements*.

Temperature-related mortality in Europe

- 70,000 heat-related deaths in 2003^a
- 61,672 heat-related deaths in 2022^b
- 47,690 heat-related deaths in 2023 in 35 countries^c

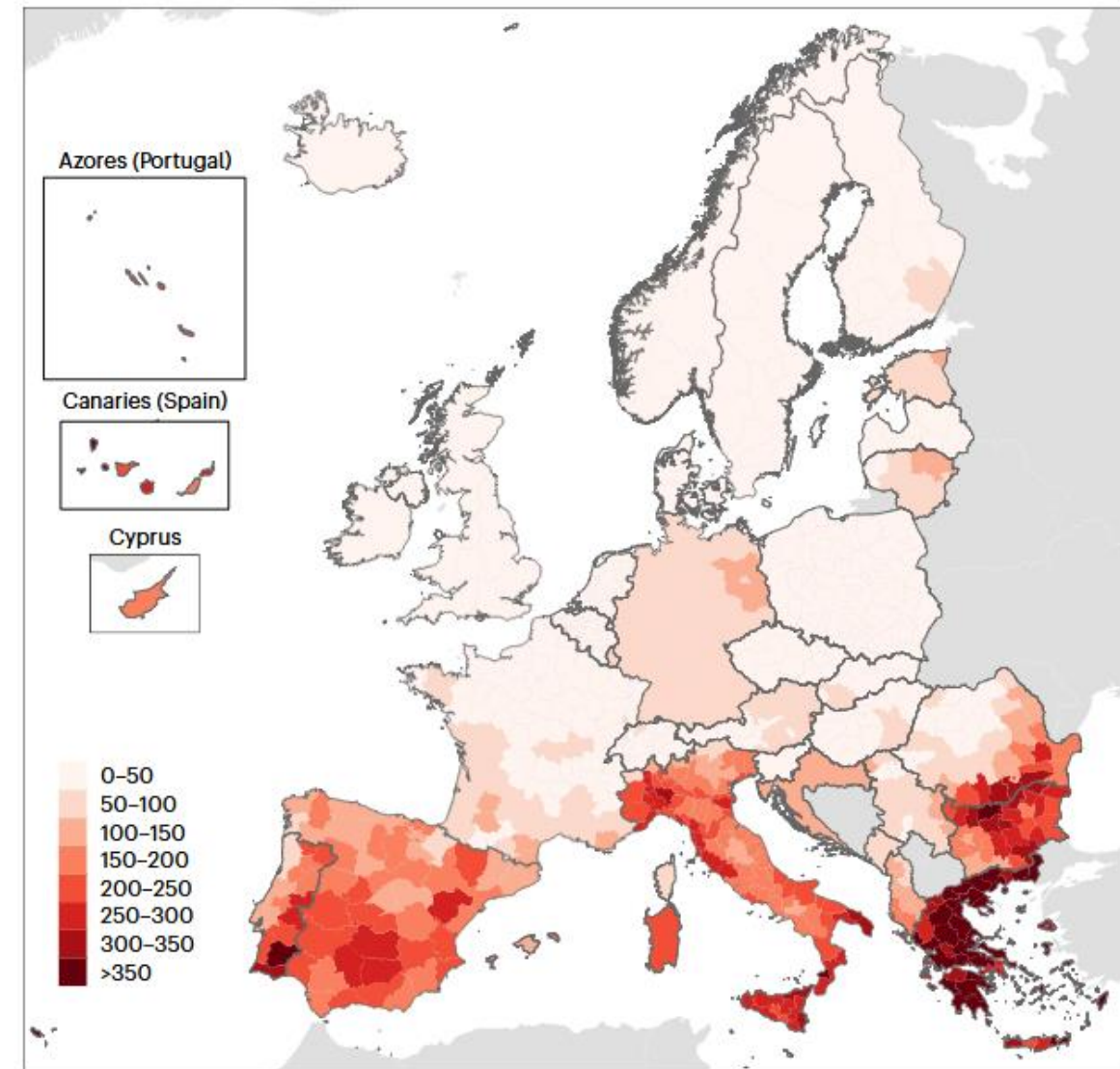


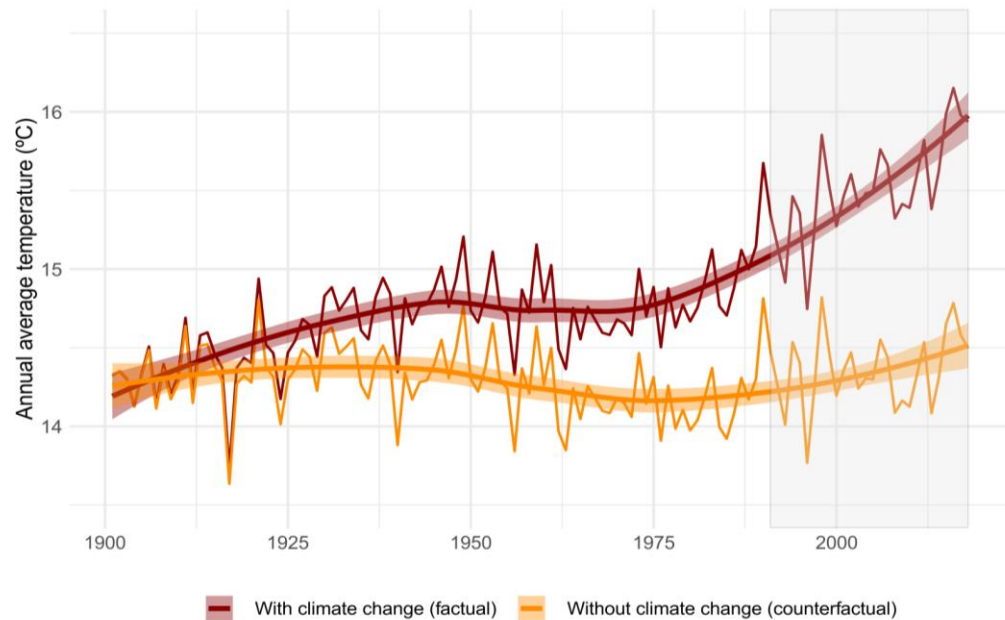
Fig. 1 Temperature-related mortality risk and incidence. The regional heat-related mortality rate (deaths per million) aggregated over the year of 2023.

^aRobine JM, Cheung SL, Le Roy S, Van Oyen H, Griffiths C, Michel JP, Herrmann FR. Death toll exceeded 70,000 in Europe during the summer of 2003. C R Biol. 2008 Feb;331(2):171-8.

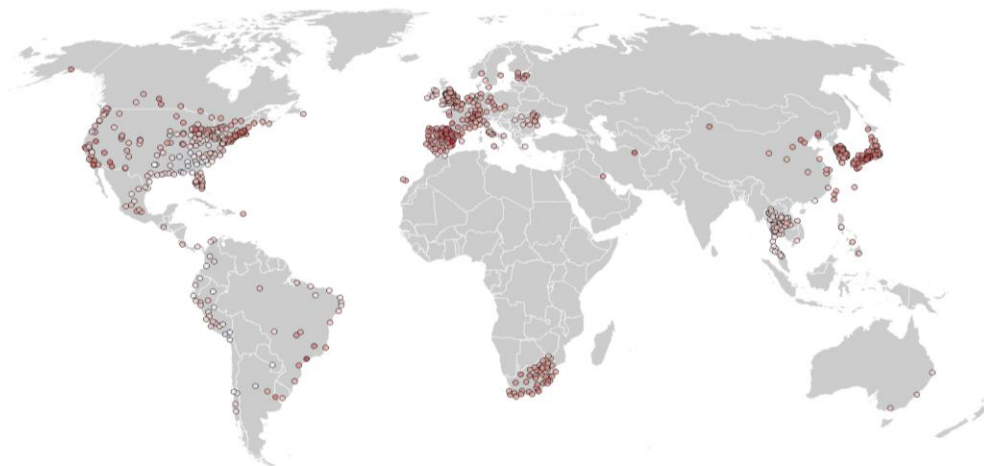
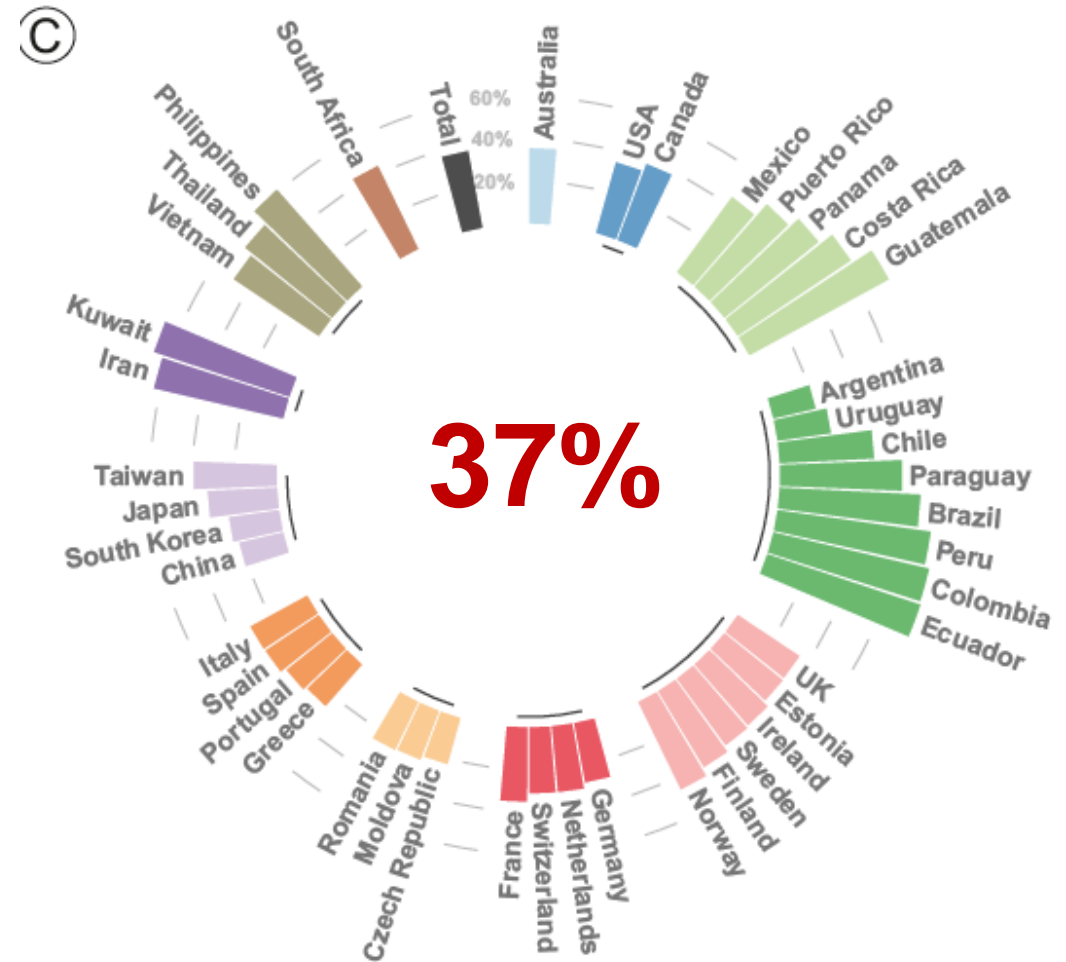
^bBallester, J. et al. Heat-related mortality in Europe during the summer of 2022. Nat. Med. 29, 1857–1866 (2023).

^cGallo E, Quijal-Zamorano M, Méndez Turrubiates RF, Tonne C, Basagaña X, Achebak H, Ballester J. Heat-related mortality in Europe during 2023 and the role of adaptation in protecting health. Nat Med. 2024 Nov;30(11):3101-3105.

Climate Change & health: HEAT

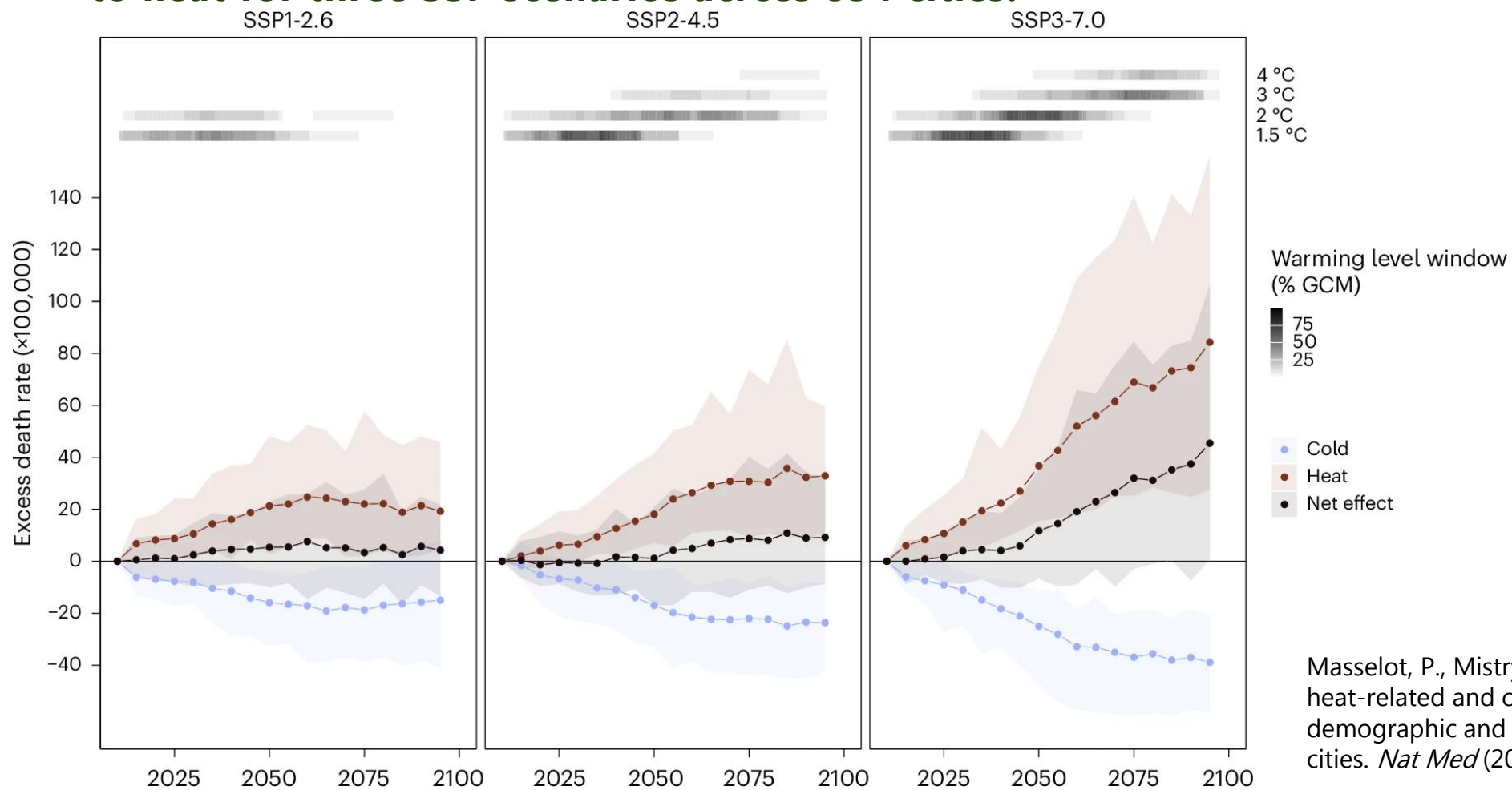


The burden of heat-related mortality attributable to recent human-induced climate change



The increasing burden of heat-related mortality

Fig. 1: Projection of net changes in temperature-related excess death rates from 2015 to 2099 under no adaptation to heat for three SSP scenarios across 854 cities.



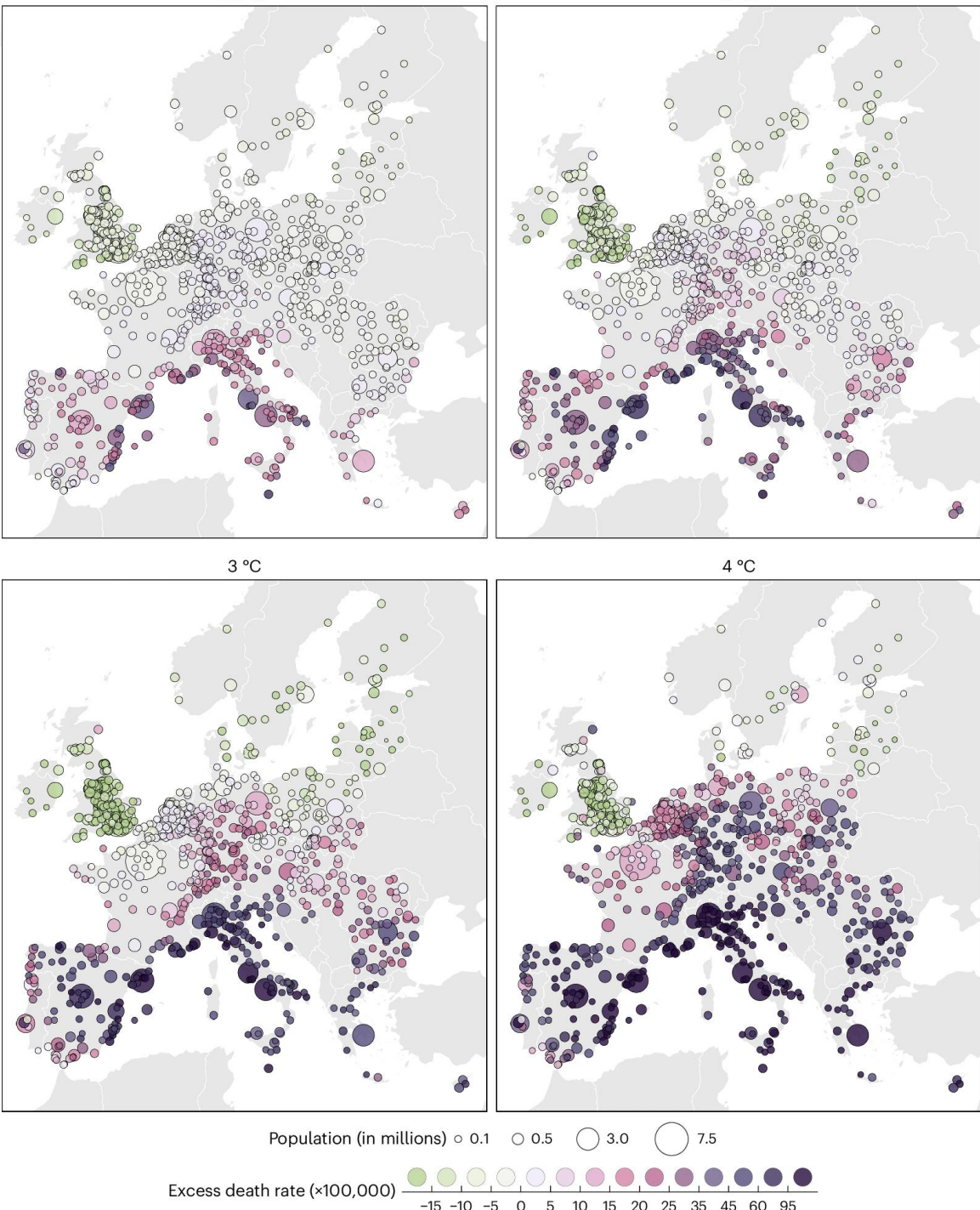
Masselot, P., Mistry, M.N., Rao, S. *et al.* Estimating future heat-related and cold-related mortality under climate change, demographic and adaptation scenarios in 854 European cities. *Nat Med* (2025).

Fig. 3: City-level net changes in temperature-related excess death rates for each warming level under scenario SSP3-7.0 and no adaption to heat.

Under the lowest mitigation and adaptation scenario (SSP3-7.0), a net death burden due to climate change increasing by 49.9% and cumulating 2,345,410 climate change-related deaths between 2015 and 2099.

Regional differences suggest a slight net decrease of death rates in Northern European countries but high vulnerability of the Mediterranean region and Eastern Europe areas.

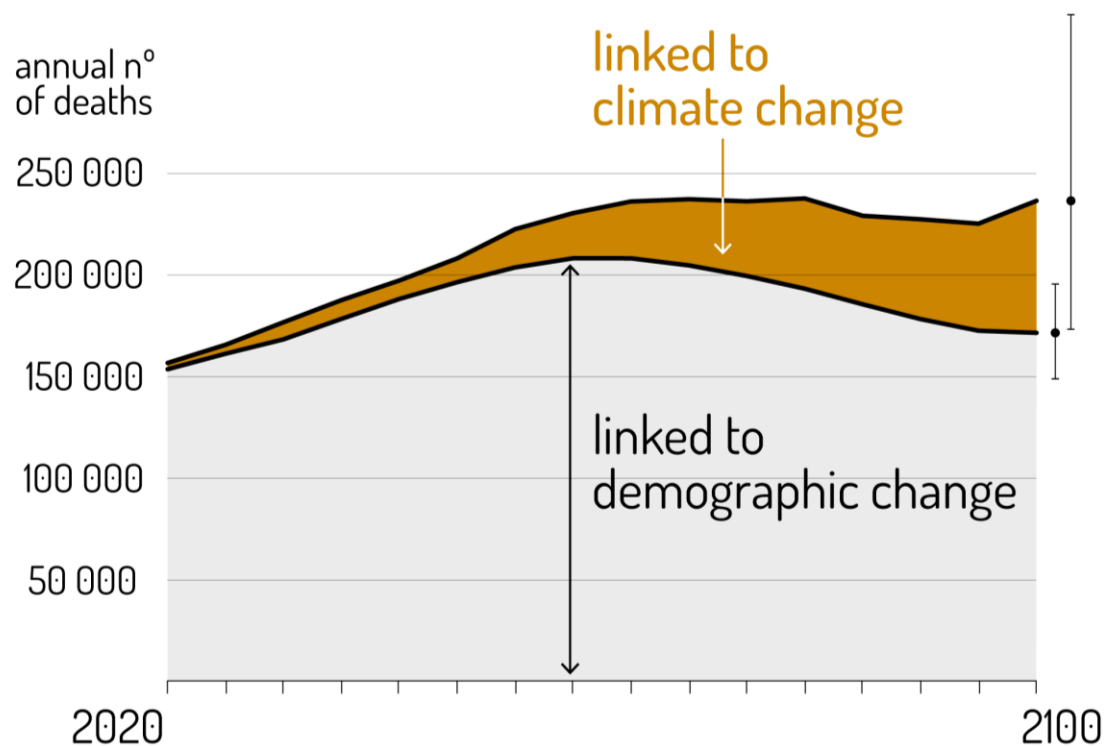
Unless strong mitigation and adaptation measures are implemented, most European cities should experience an increase of their temperature-related mortality burden.



EXHAUSTION Project: By the end of the century climate change may have claimed over 2,2 million lives in European cities

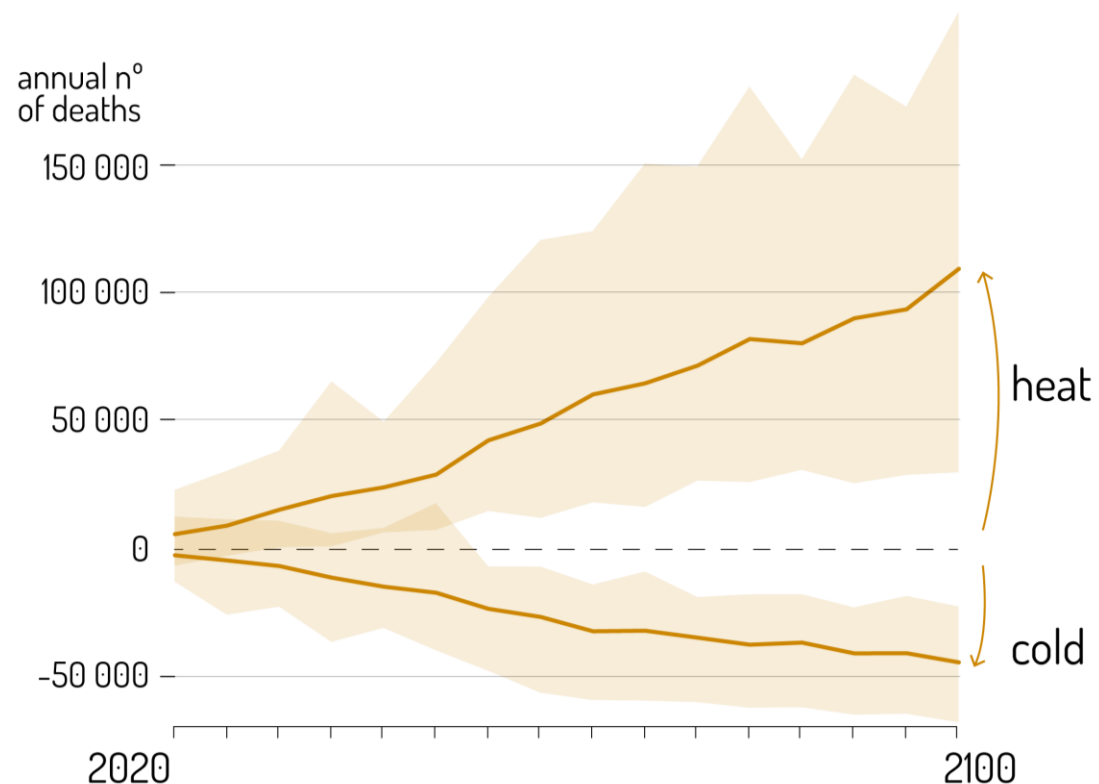
ESTIMATED ANNUAL DEATHS IN EUROPE DUE TO TEMPERATURE

Climate change will be responsible for an **increase** in temperature-related deaths per year, from **3 100** in 2020 to **64 900** in 2100.



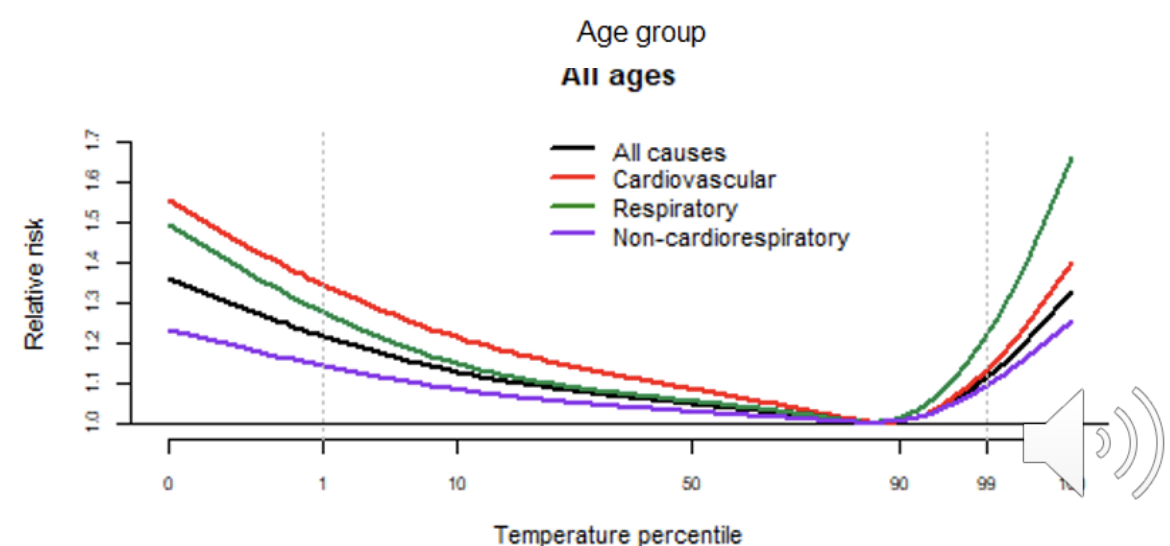
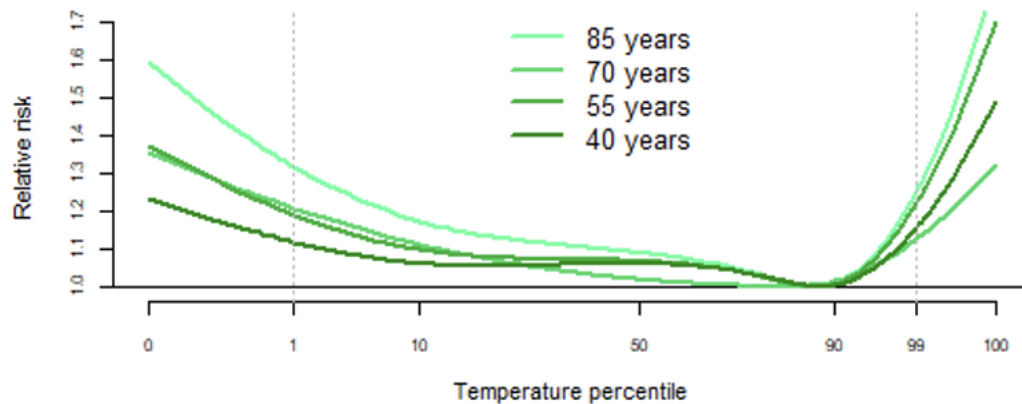
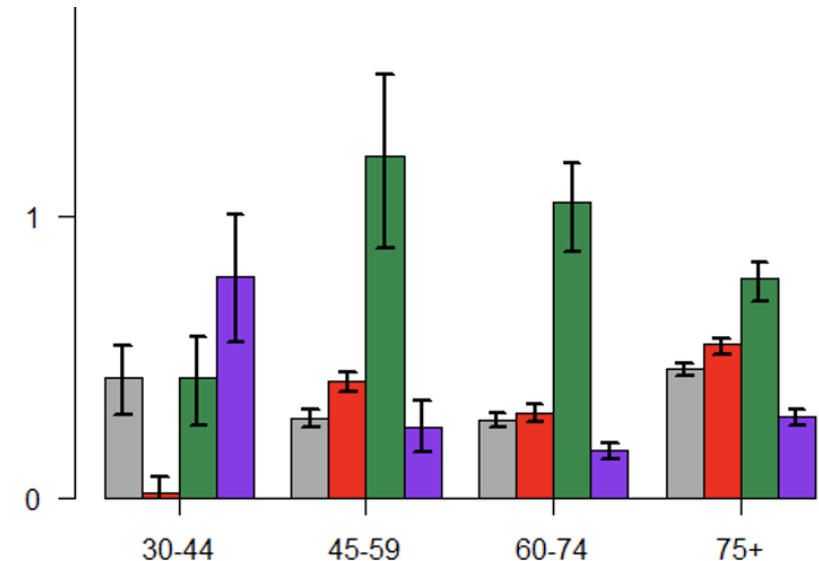
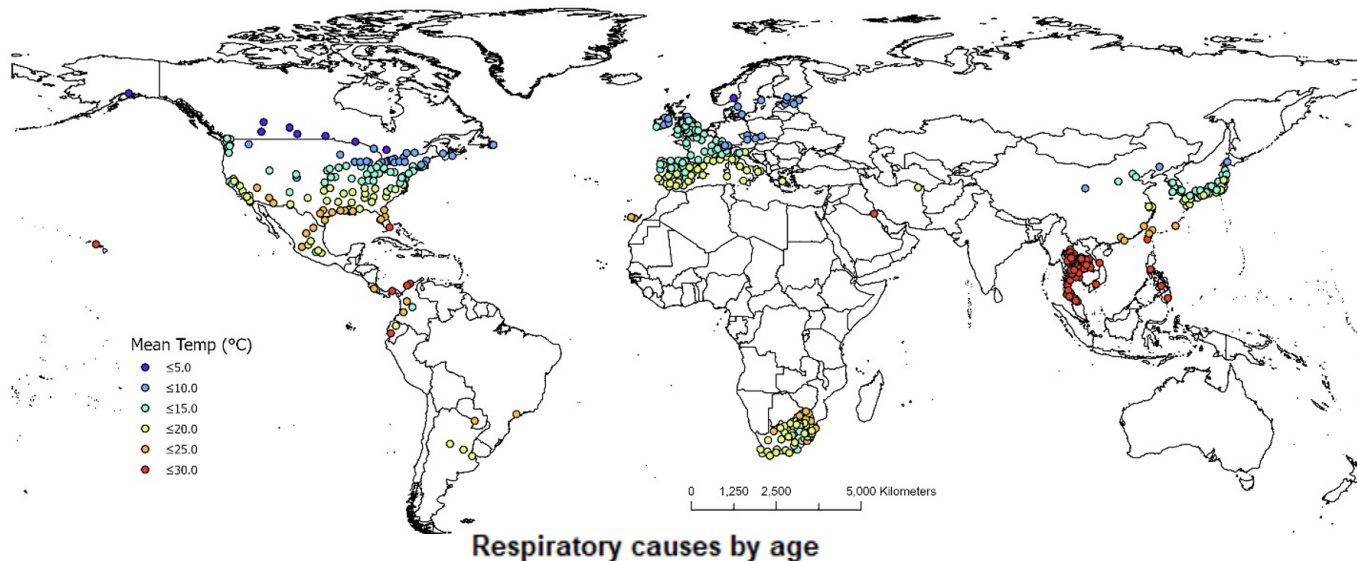
DEATHS IN EUROPE DUE TO CLIMATE CHANGE, BY HEAT AND COLD

Climate change will cause a significant increase in heat deaths and a decrease in cold deaths, resulting in **more deaths overall**.



Heat & Respiratory Health: mortality

Comparison between cardiovascular/respiratory mortality - worldwide

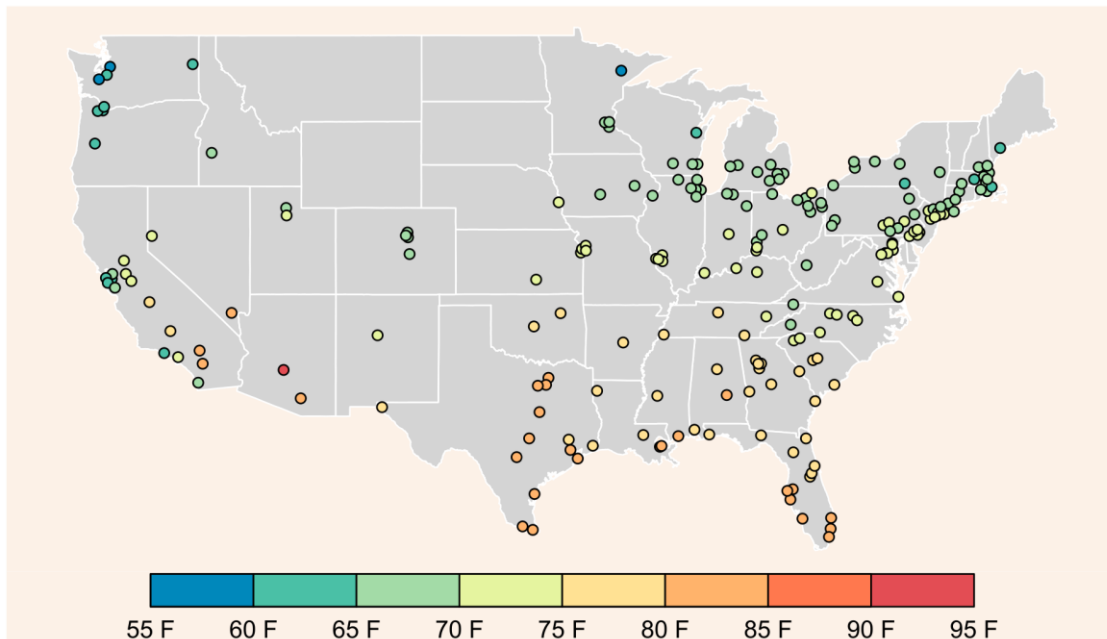


Scovronick N, et al. Temperature-mortality associations by age and cause: a r country multi-city study. Environ Epidemiol. 2024 Sep 24;8(5):e336.

Heat & Respiratory Health: morbidity

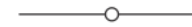
US Medicare population – emergency hospitalizations

Each 10 F increase in daily temperature, translated to approximately 30 excess respiratory Medicare hospitalizations per day across these 213 study counties



Anderson et al. 2013

National



Specific cause

COPD



RTI

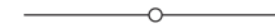


Gender

Female



Male



Age

65 to 74



75 to 84



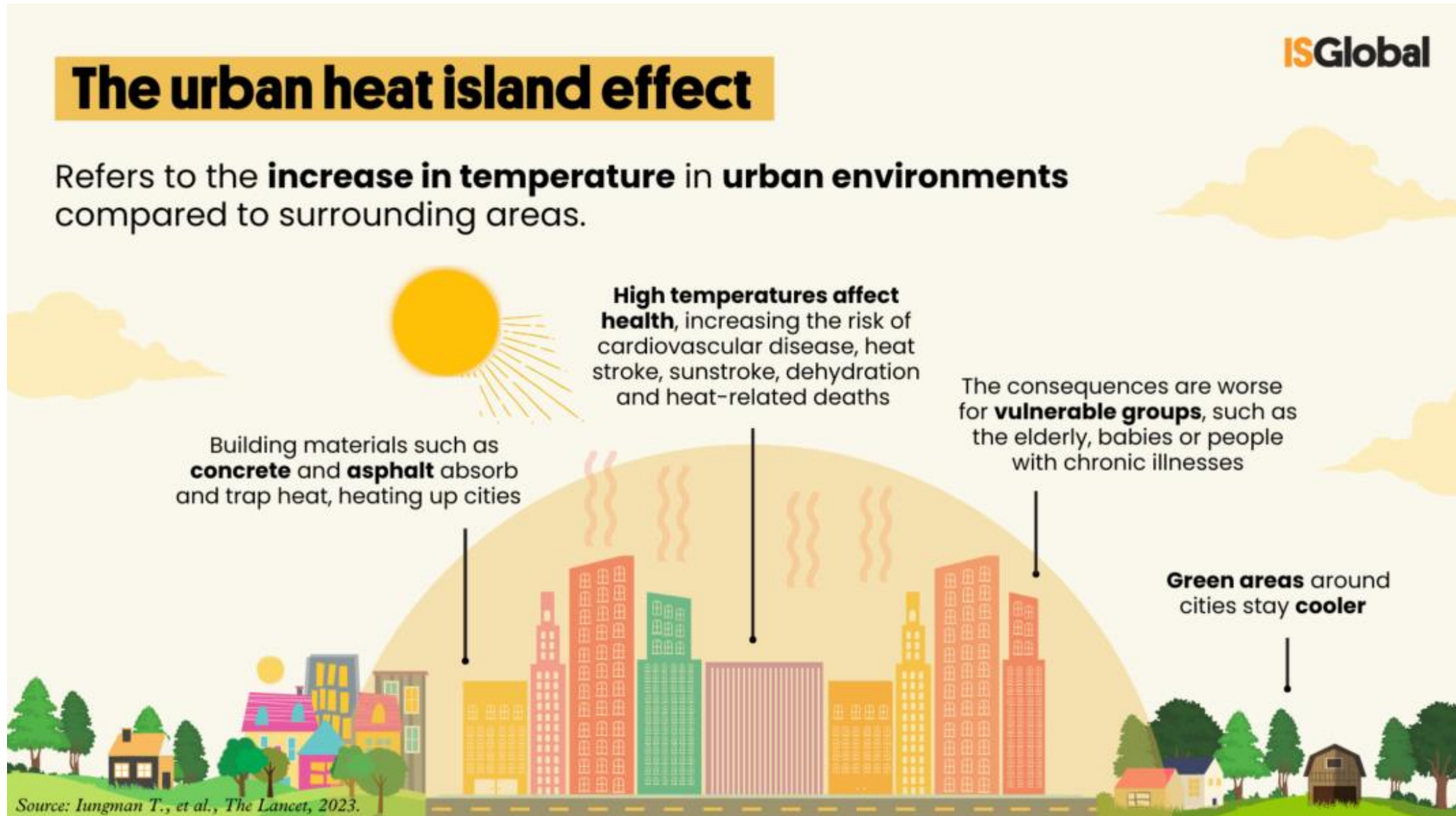
85 and older



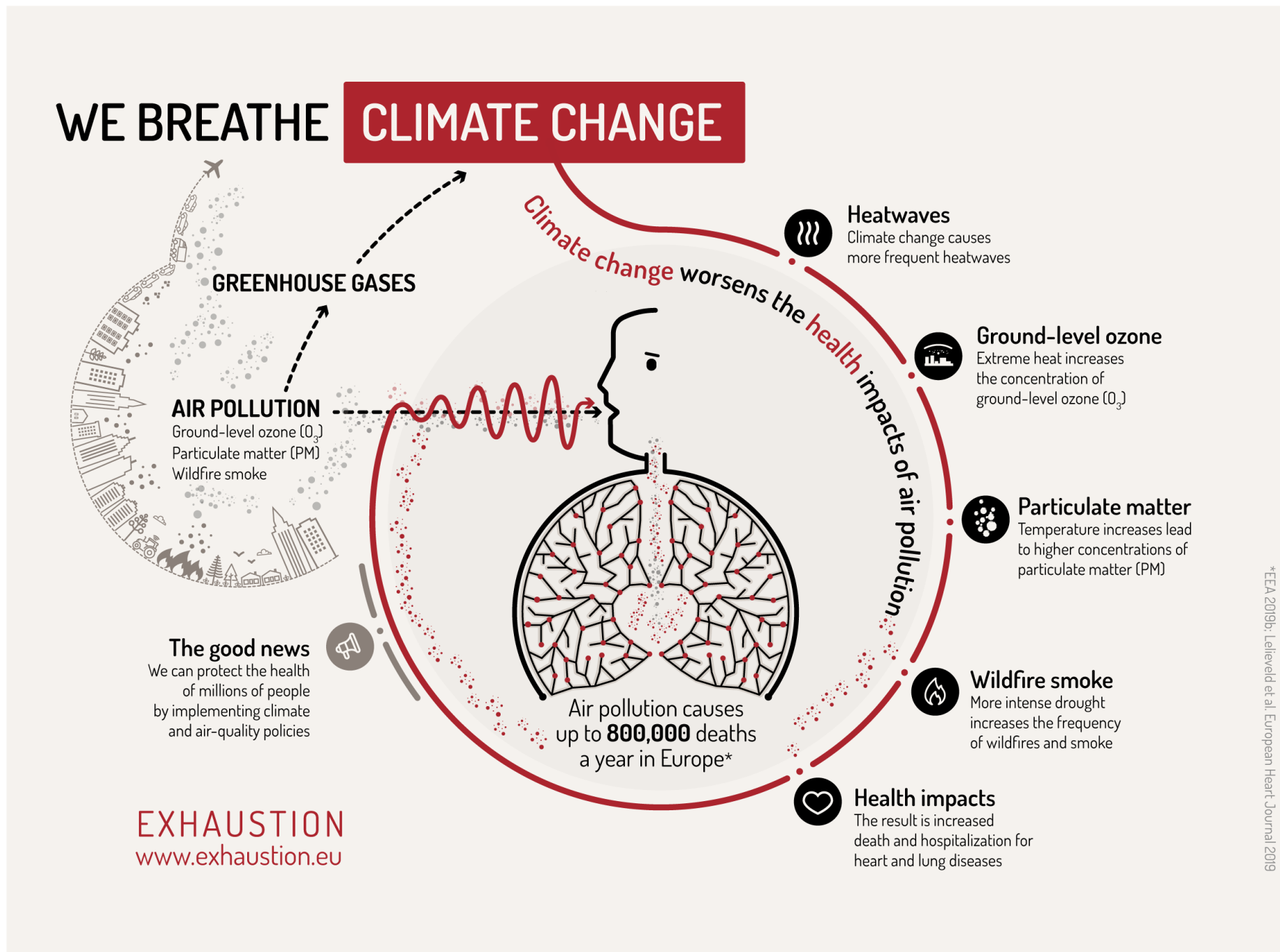
% increase in hospitalizations
per 10 °F increase in temperature



Cities- 'hot spots' of heat and air pollution



Climate change worsens the health impacts of air pollution

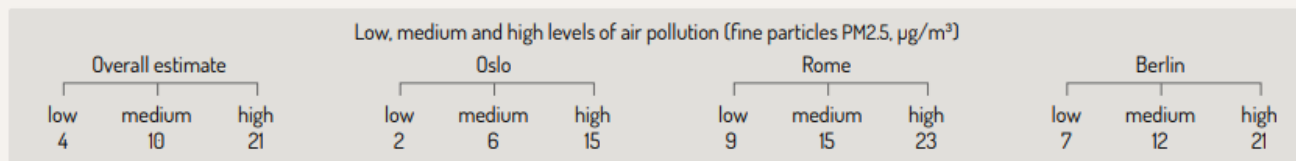
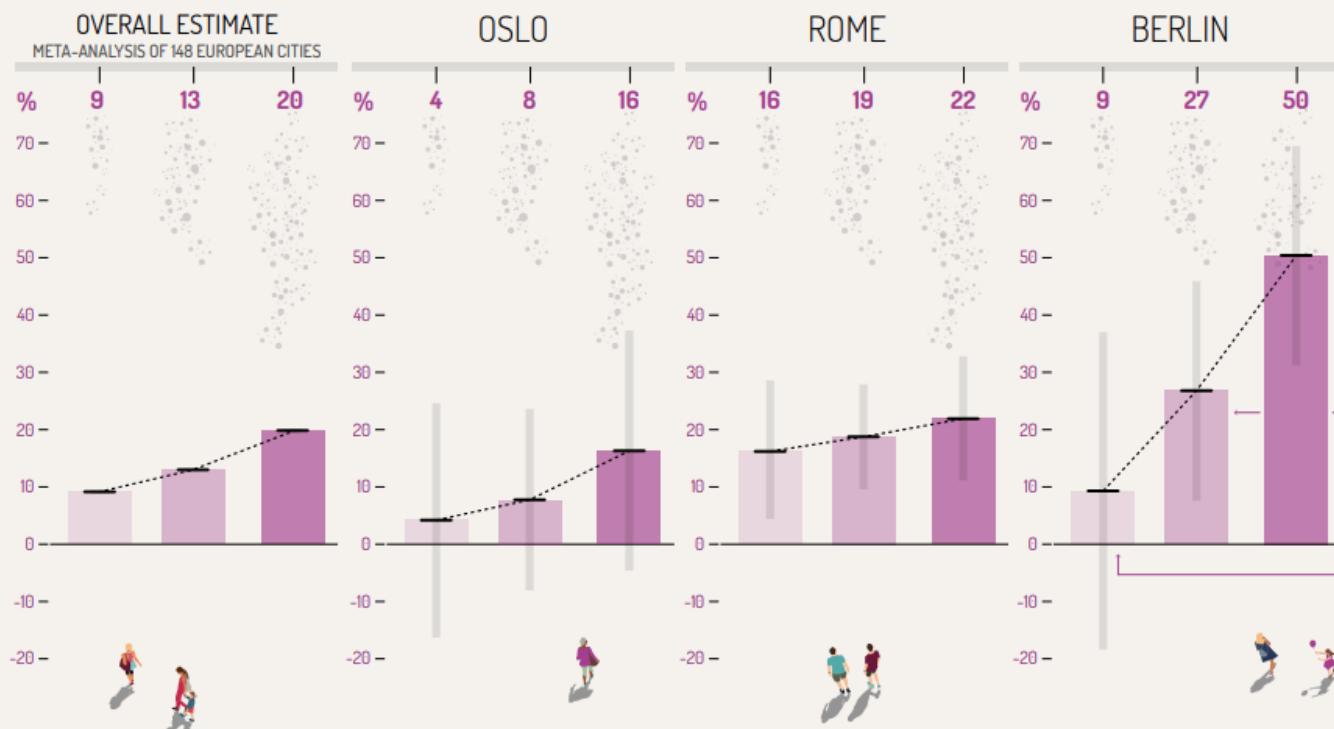


WE BREATHE CLIMATE CHANGE

More people will die of **lung** diseases in our cities when high temperatures are combined with high levels of air pollution. This is especially true for those of us who are 65 and older.



Change in number of deaths from lung diseases in European cities (%) in association with high temperatures, by different levels of air pollution (PM2.5)



EXHAUSTION
www.exhaustion.eu



The good news

Policies that make us less exposed to heat and air pollution will be beneficial for our health and wellbeing.



LEGEND

Change in n° of deaths from lung diseases when we are exposed to moderate temperatures compared to:

High temperatures and high air pollution

High temperatures and medium air pollution

High temperatures and low air pollution

Confidence interval: the estimate lies in this interval, with very high probability

Moderate temperature level: in the study period, 75% of the days in the city have a temperature below this level (°C)

	Oslo	Rome	Berlin
Overall estimate	20.2	15.3	25.7

High temperature level: in the study period, 1% of the days in the city have a temperature above this level (°C)

	Oslo	Rome	Berlin
Overall estimate	26.4	21.7	29.6



INDEPENDENT

Europe is the fastest-warming continent, at nearly twice the average global rate

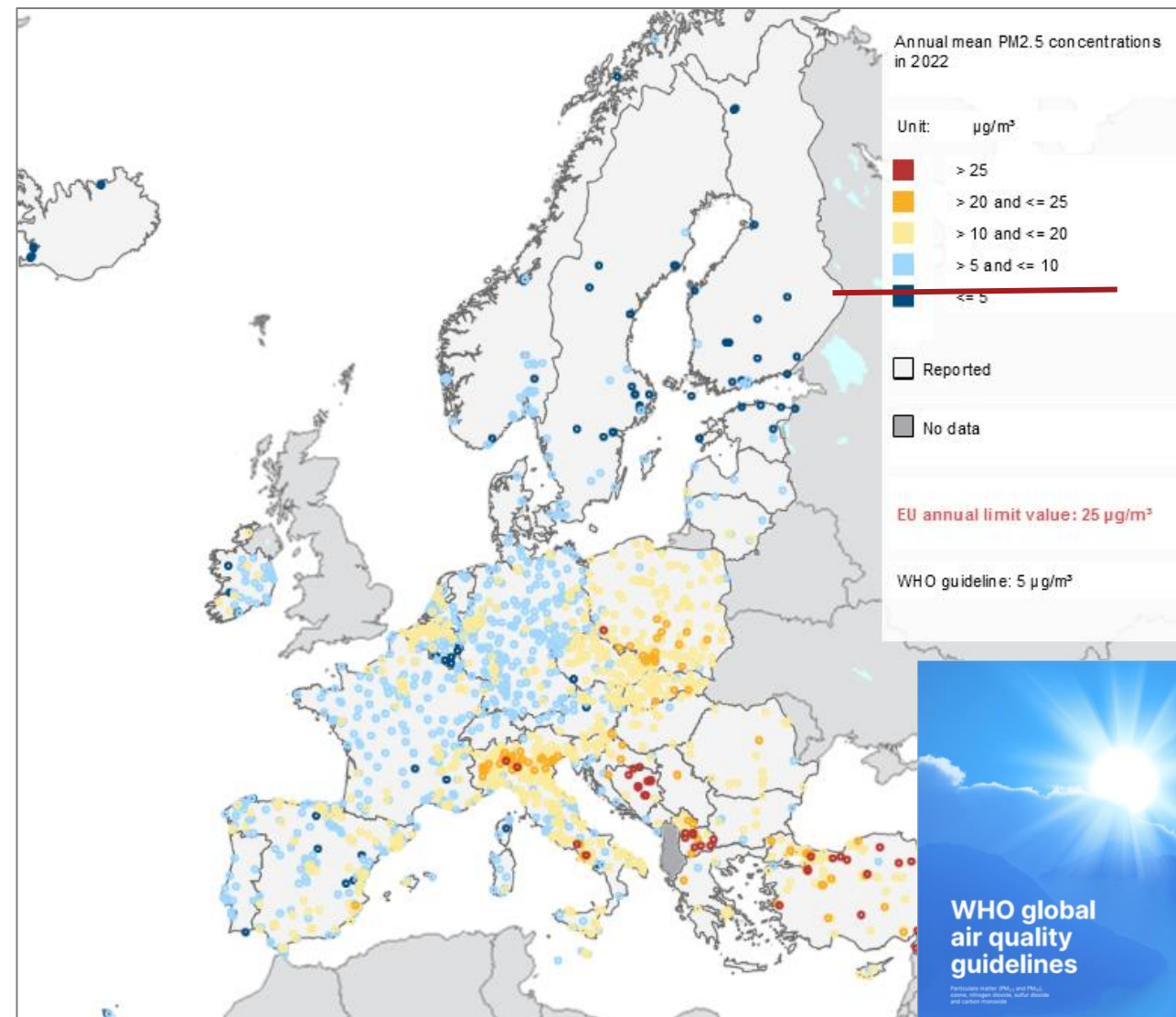


HEAT ISLANDS
Temperature varies with land use



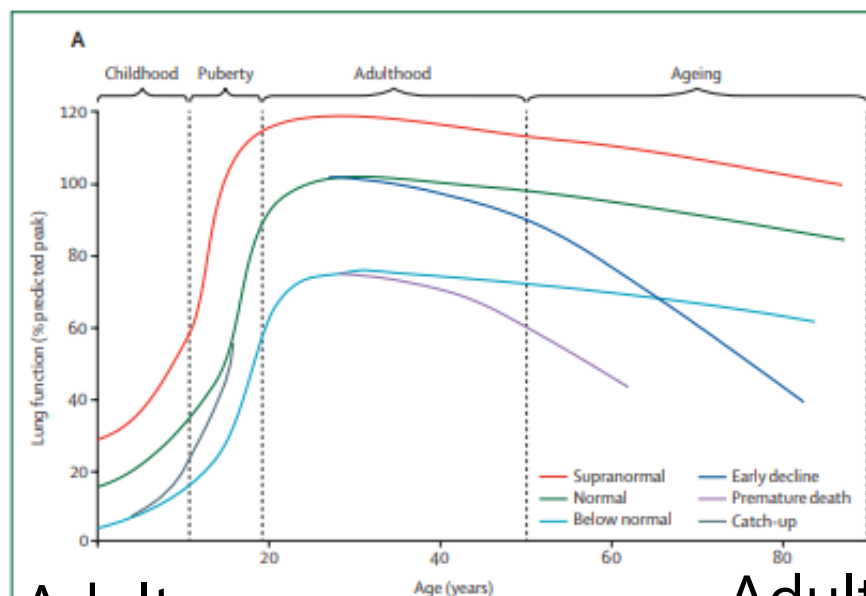
Everyone is exposed & health burden is huge

1. Everyone is exposed to harmful levels of air pollution (96% population)
2. Health burden is huge (2022):
 - Mortality: 239,000 premature deaths $\text{PM}_{2.5} > 5 \mu\text{g}/\text{m}^3$, 413,000 in total due to $\text{PM}_{2.5} > 0 \mu\text{g}/\text{m}^3$
 - Morbidity: Millions of cases of symptoms, lost quality of life, doctor visits, ER visits, hospital admissions, sick days (school & work), medication prescriptions



Air Pollution and Lung

Long-term (years, lifetime)
and short-term (hours,
days) exposure to air
pollution



Childhood
asthma



**16% asthma cases
in children due to
air pollution***

Childhood
ALRI



**ALRI – acute lower respiratory
infections**

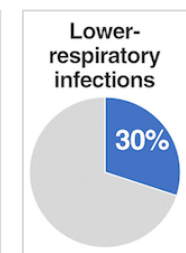
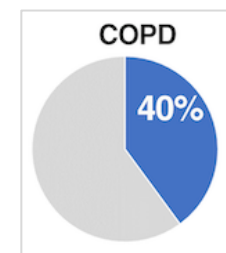
Adult
asthma



COPD



Adult ALRI
Pneumonia/COVID-19



Ella Adoo-Kissi-Debrah: Air
pollution a factor in girl's death,
inquest finds

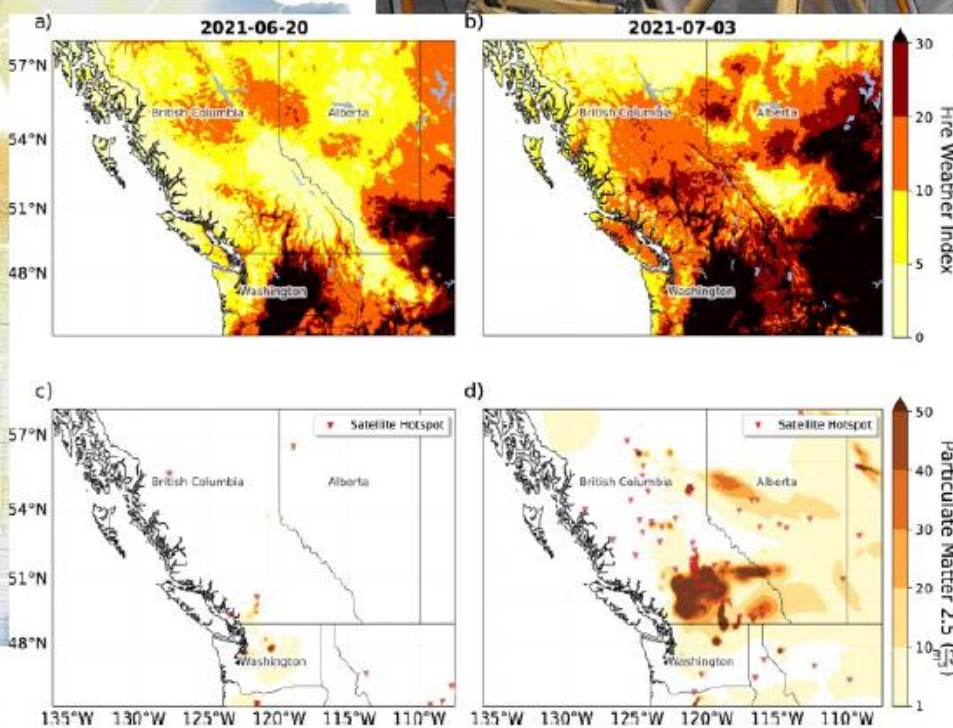
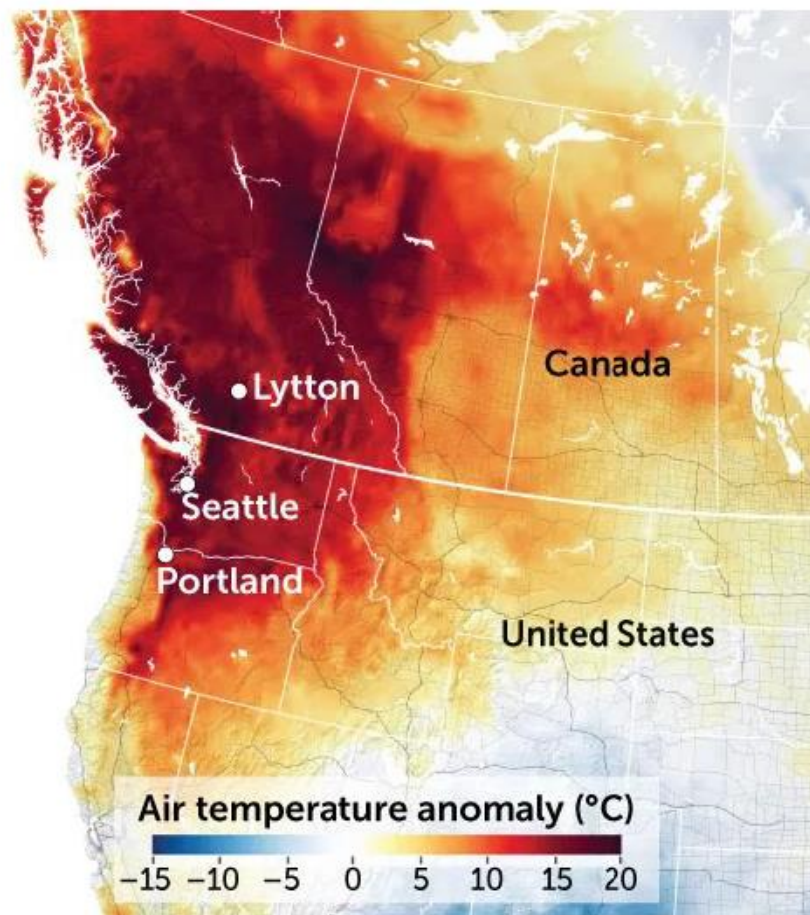
© 16 December 2020



**Ella Kissi-Debrah - 9 year old
girl suffered fatal asthma
attack triggered by air
pollution, London, February
2013**

Climate change & health

2021 Pacific Northwest Heatdome



Cascading events –
Heat (heat dome) +
severe existing
drought → wildfires

Wildfires following the heat dome

White et al. Nature Comms 2023

u^b

UNIVERSITÄT
BERN

Conclusions - Heat and lung health

- Global warming and heatwaves present major and increasing challenge for respiratory patients
- Interaction with air pollution and other climate change-related hazards (pollen, drought, humidity, wildfires, dust storms) pose additional concerns and demand more research
- Research also needed to clarify mechanisms how heat affects respiratory health, and identify those who are most vulnerable

Urgent need for climate mitigation and adaption actions to protect lung health

Urgent clean air action would also mitigate adverse effects of heat on lung health

Information and education of respiratory clinicians and patients important

- Understand impacts & vulnerabilities and address them in clinic → to prevent health burden due to climate change
- Climate advocates → source of information/recommendations to health care professionals, patients and general public to protect environment



Climate change and respiratory health: a European Respiratory Society position statement

Ana Maria Vicedo-Cabrera^{1,2}, Erik Melén³, Francesco Forastiere^{4,5}, Ulrike Gehring⁶, Klea Katsouyanni^{7,8}, Arzu Yorgancioglu⁹, Charlotte Suppli Ulrik^{10,11}, Kjeld Hansen^{12,13}, Pippa Powell¹², Brian Ward¹⁴, Barbara Hoffmann¹⁵ and Zorana Jovanovic Andersen¹⁶



ERS statement: climate change and respiratory health

Highlighting the threats posed by climate change to respiratory health

Calling for health to be central to the development of climate change mitigation strategies and air pollution reduction policies

Urging support from the professional respiratory community to advocate for the protection of our planet and for the health of people that live and depend on it

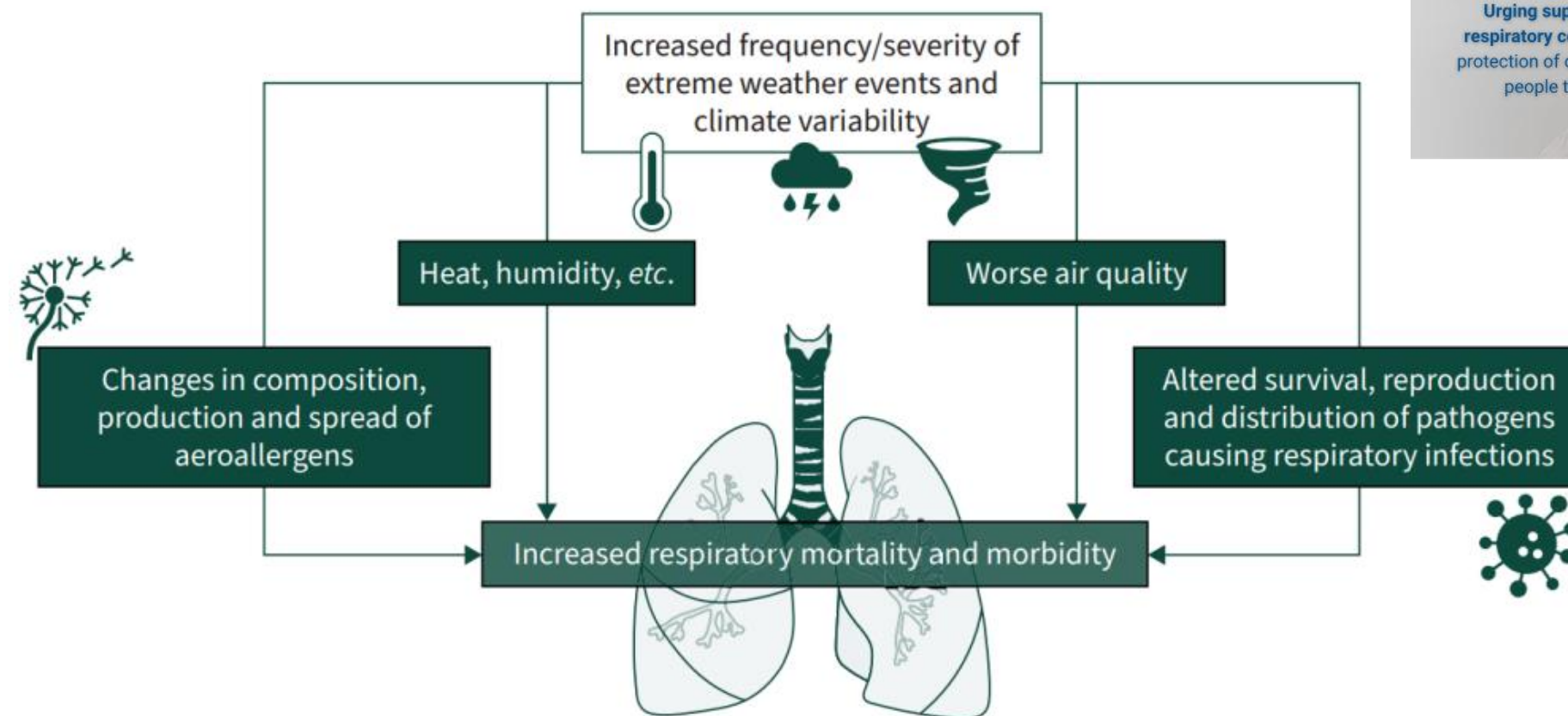


FIGURE 1 Summary scheme of the pathways linking climate change and impacts of respiratory health.



Thank You

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@zoranaajova



ERS

