

The Best Way to Predict the Future is to Create It

Climate change, climate action, and health in the 21st century

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Faculty Disclosure Information

I have had no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider(s) of commercial service(s) discussed in this lecture.

I do not intend to discuss an unapproved/investigative use of a commercial product/device in my presentation

Learning Objectives

At the conclusion of the session, participants should be able to:

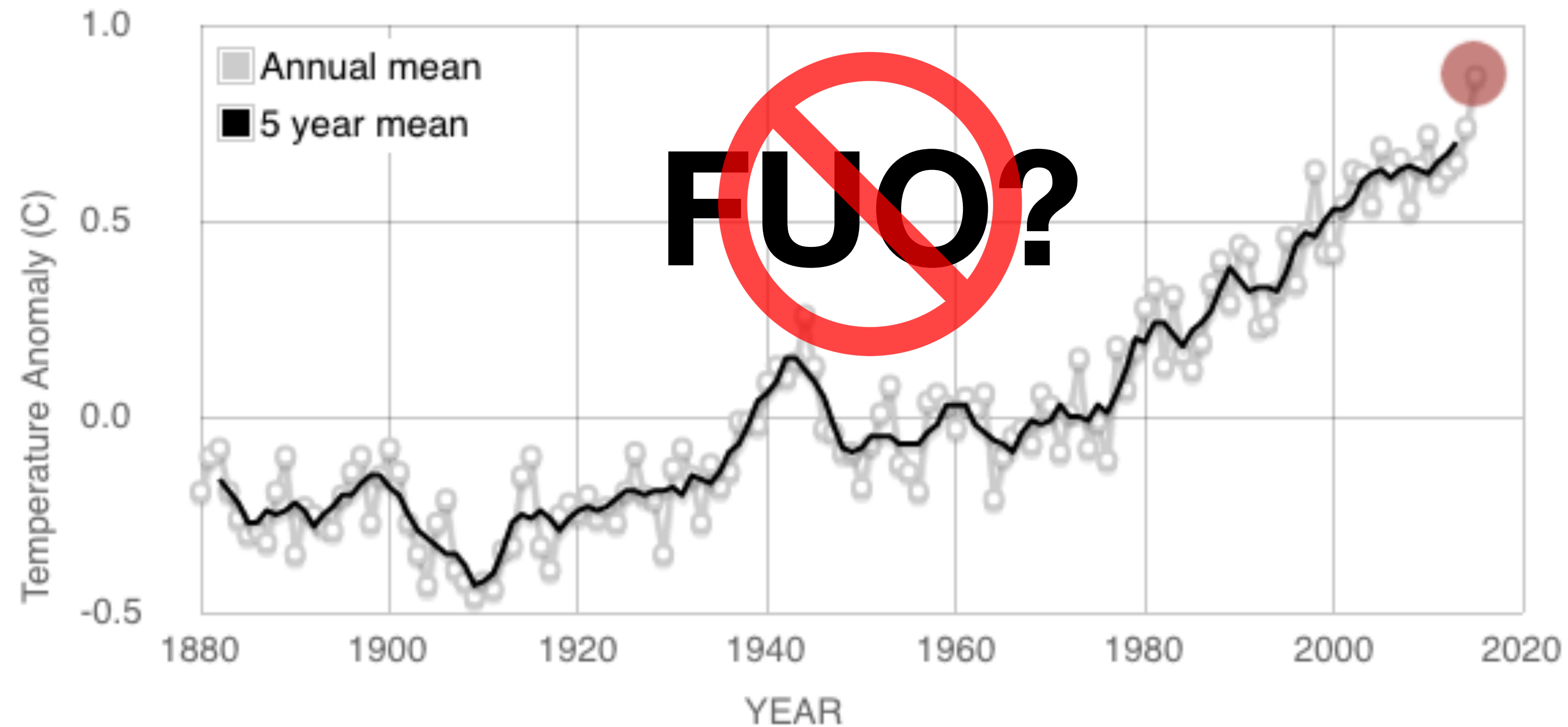
- 1) trace pathways from greenhouse gas emissions to health outcomes.
- 2) analyze the multiple benefits that can come from climate action.
- 3) recognize the equity implications of decarbonization, especially as relates to air quality.

Temperatures are rising

GLOBAL LAND-OCEAN TEMPERATURE INDEX

Data source: NASA's Goddard Institute for Space Studies (GISS).

Credit: NASA/GISS



You are seeing a 16yo F who presents with nightmares that wake her from sleep. She is having difficulty going to school because going there tends to provoke flashbacks to the nightmares. Her nightmares involve her house getting burned down.

What is your differential diagnosis?



The Camp Fire

November 8 - 25, 2018

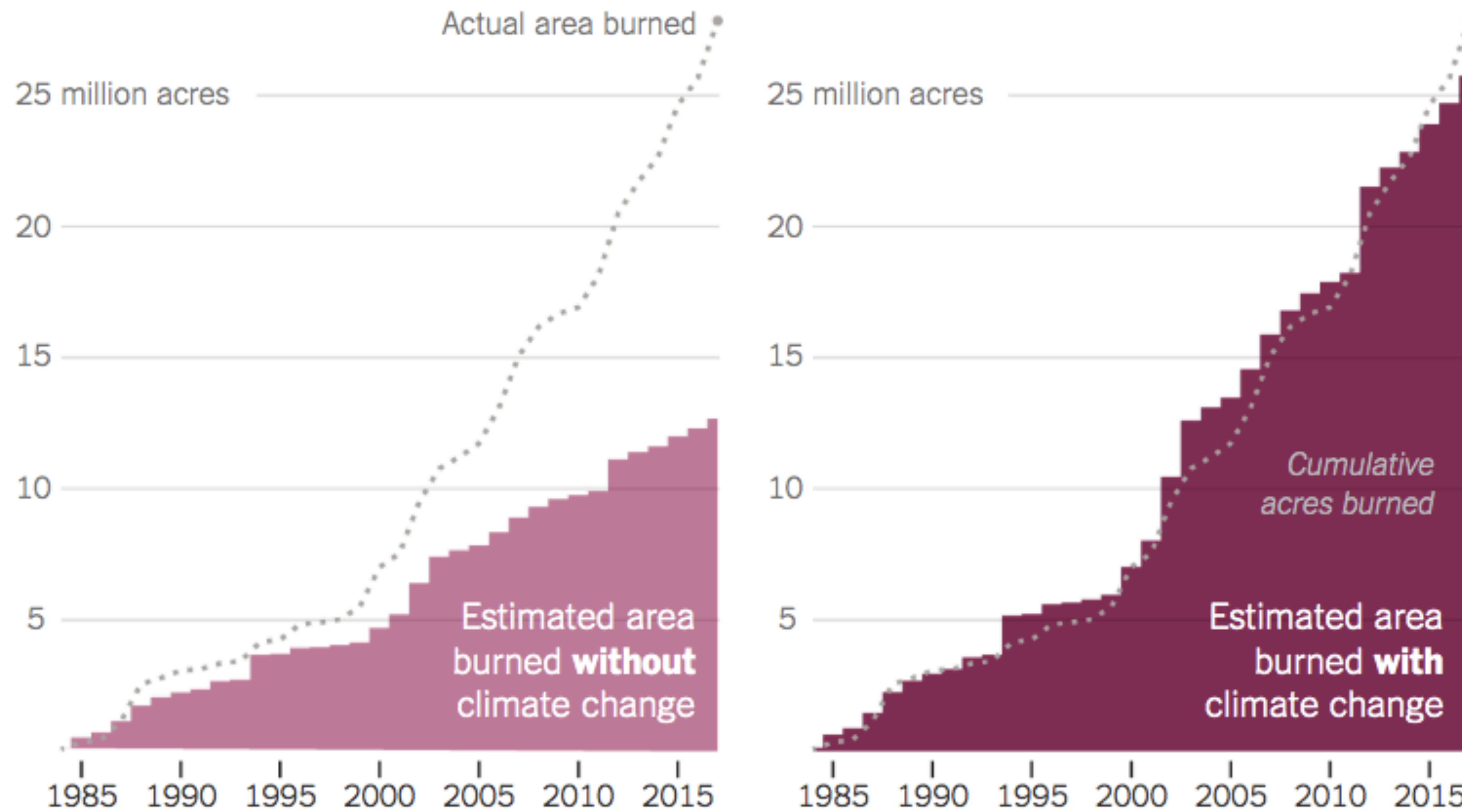
~14,000 homes destroyed

86 deaths

Credit: California National Guard/Creative Commons License

Homes leveled by the Camp Fire line a development Paradise, Calif., Nov. 17, 2018.

In the West, forest fires burn more acres in a world warmed by climate change



Source: Proceedings of the National Academy of Sciences; data updated through 2017 by A. Park Williams



November 9, 2018



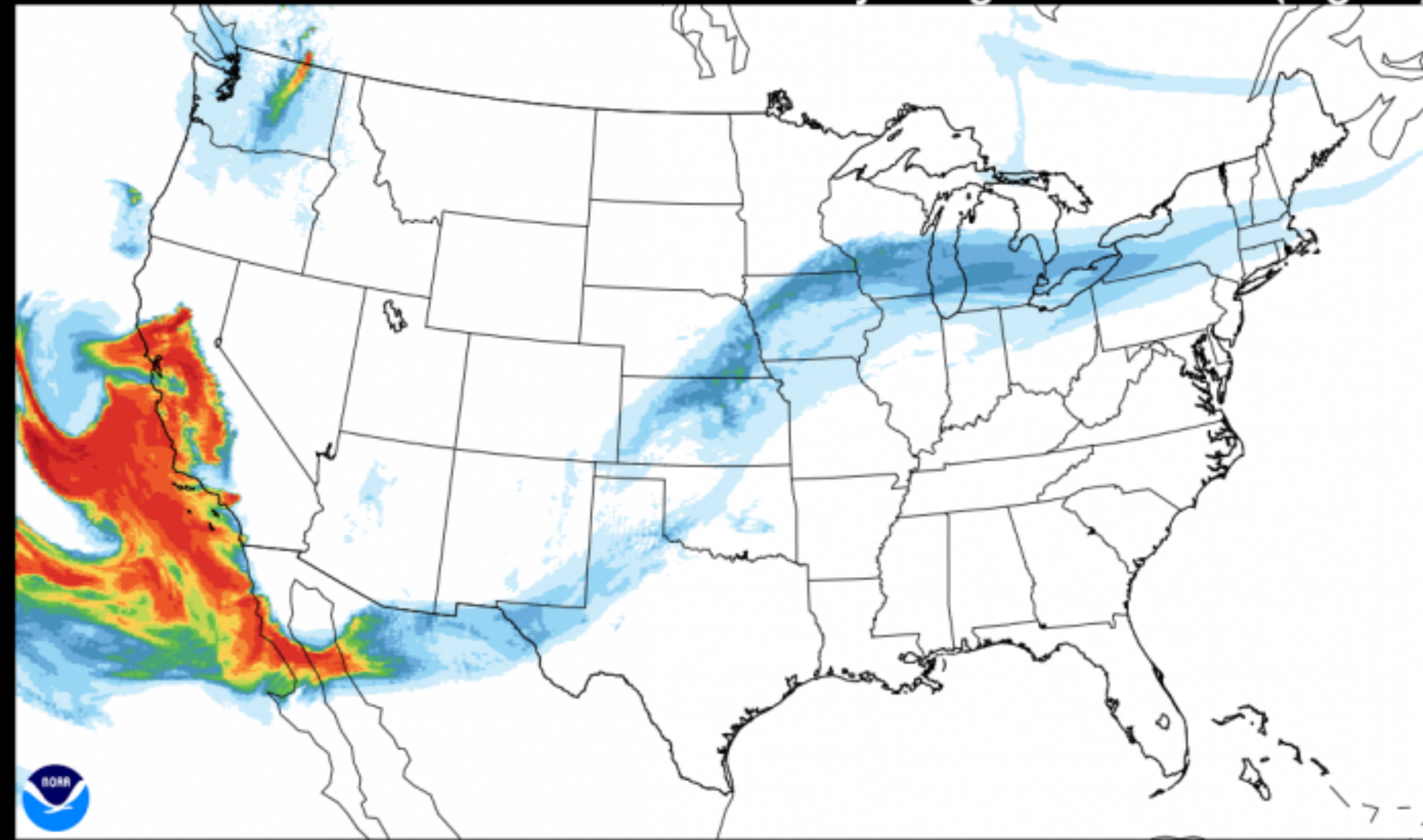
Smoke exposure equivalent to 15-20 cigarettes a day

Credit: USGS/NASA MODIS

CAN WILDFIRE SMOKE MAKE YOU SICK? PLUMES FROM WORST WILDFIRE IN CALIFORNIA HISTORY REACH MASSA

BY [ARISTOS GEORGIU](#) ON 11/12/18 AT 12:49 PM

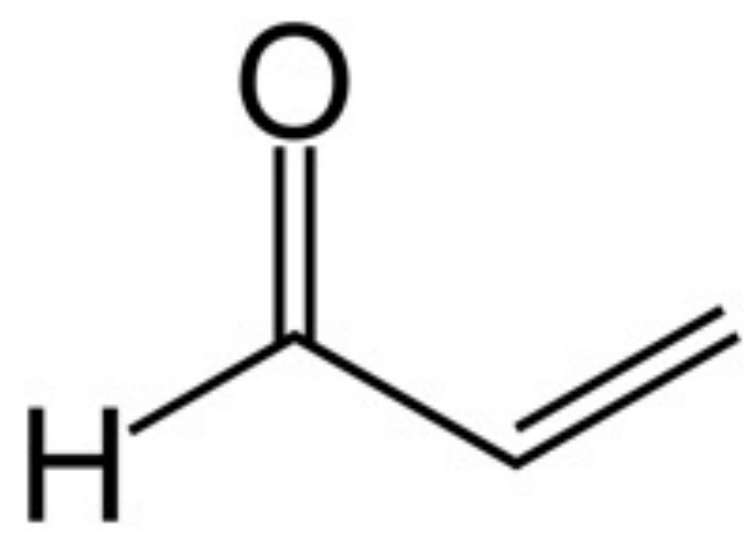
HRRR-SMOKE 2018-11-12 00 UTC 7h fcst - EXPERIMENTAL Valid 11/12/2018 07:00 UTC
Vertically Integrated Smoke (mg/m²)



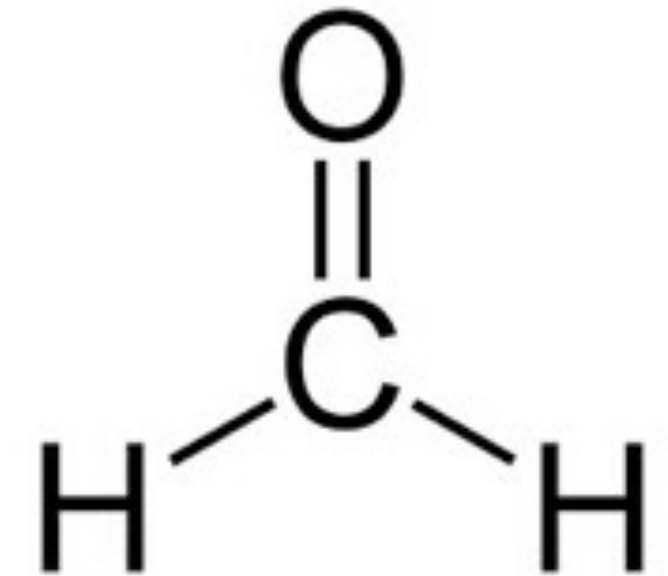
2 5 8 11 15 20 25 30 40 50 75 150 250 500



Smoke is bad for your health



acrolein



formaldehyde



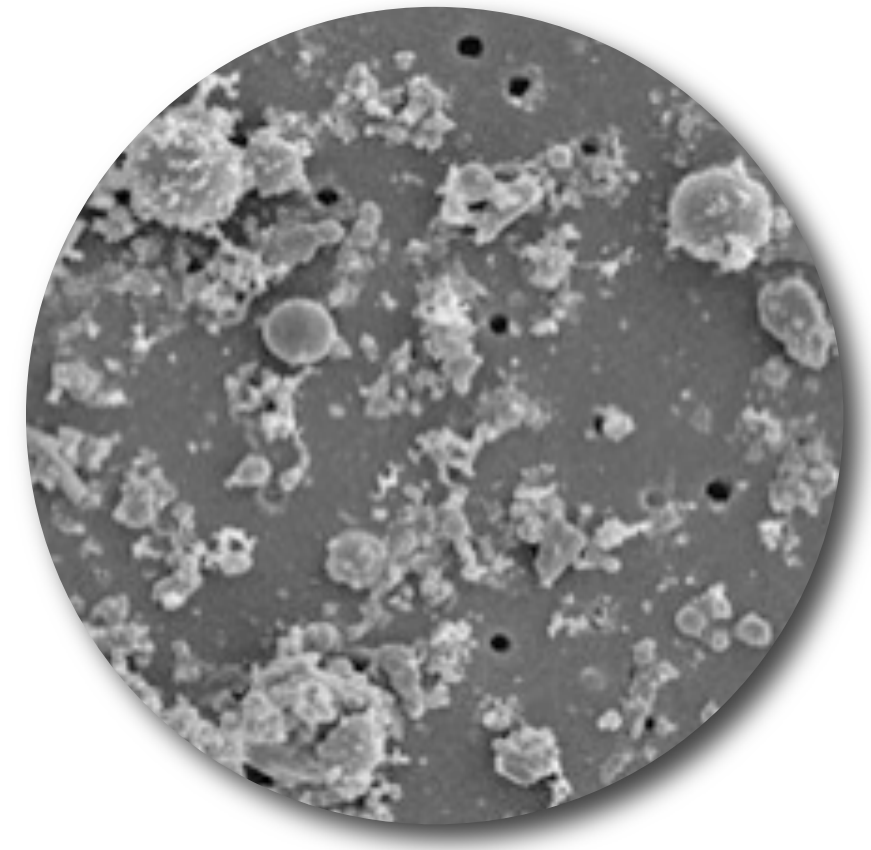
benzene/PAHs

Leukemia/lymphoma
Anxiety/depression
ADHD

NOx

oxides of nitrogen

Asthma (causal)
Respiratory infections



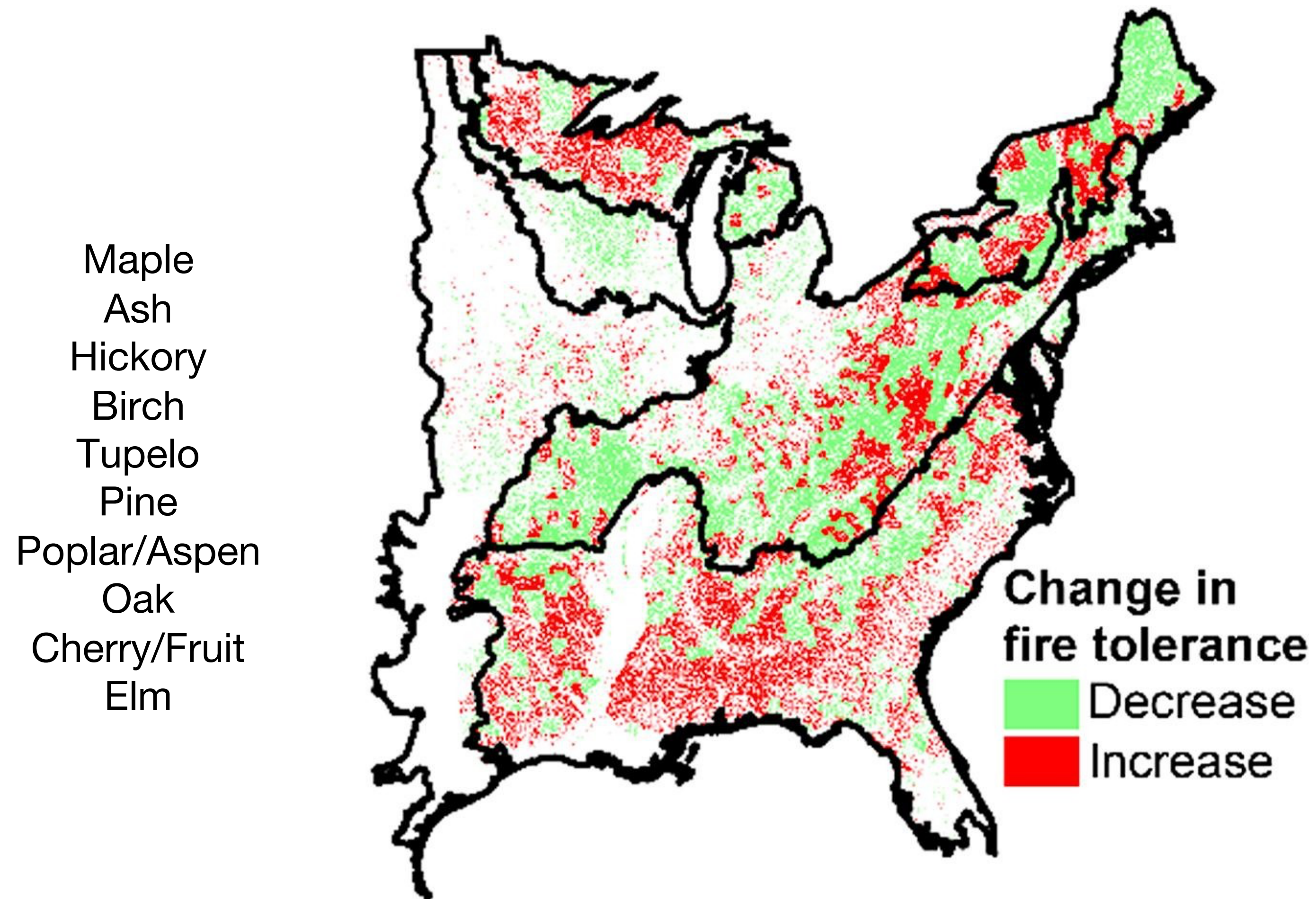
PM_{2.5}

Wildfire source PM may be more toxic than PM in general

Nature Communications 12.1 (2021): 1-8.

Change in county-level fire tolerances from the early 1980s to 2015

10 most prevalent tree genera



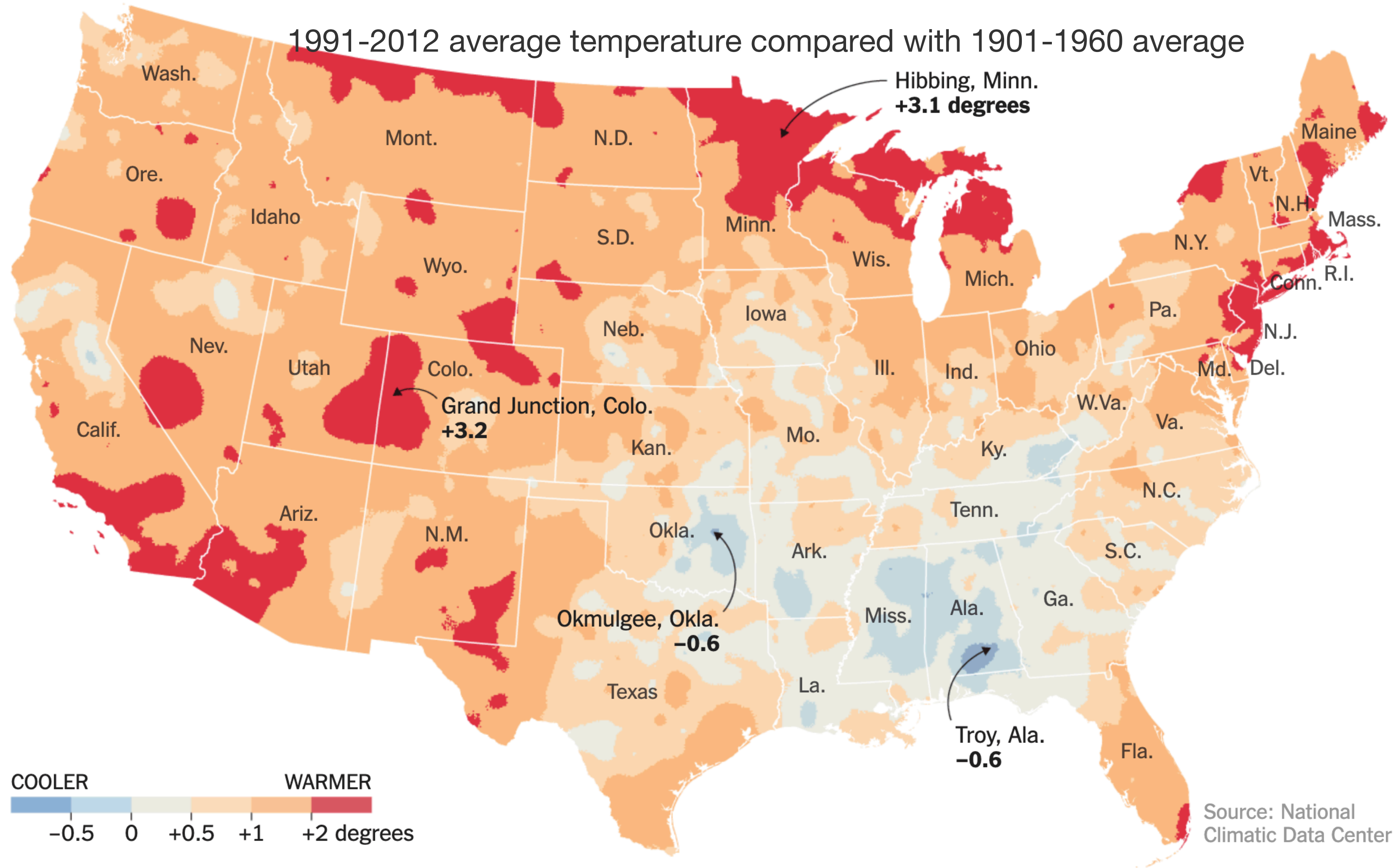
You are seeing an 8 year old boy with autism and longstanding history of aggression for which he takes several medications including quetiapine and cogentin. Last week, his psychiatrist increased his quetiapine dose as his behaviors escalated.

His mother has brought him to see you for an urgent care visit because he's been acting confused after he came home from playing outside for a few hours. He has complained of headache and nausea.

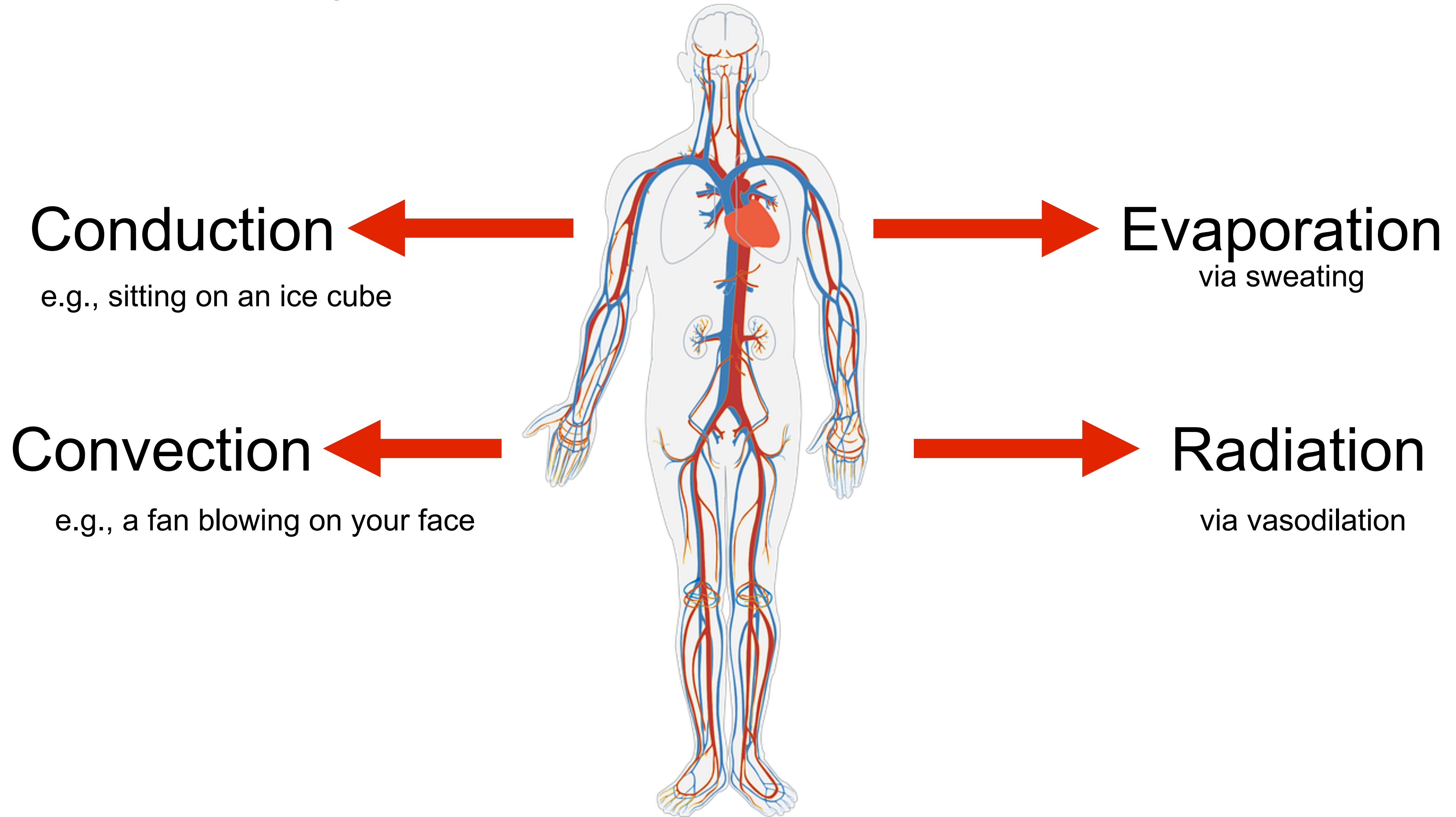
T 40.1 HR 130 BP 102/60 RR 22. He appears flush. His skin is diffusely red and dry. When asked what he was doing outside he said he had a great time dancing with wildcats.

What is your diagnosis?

Warming is already happening

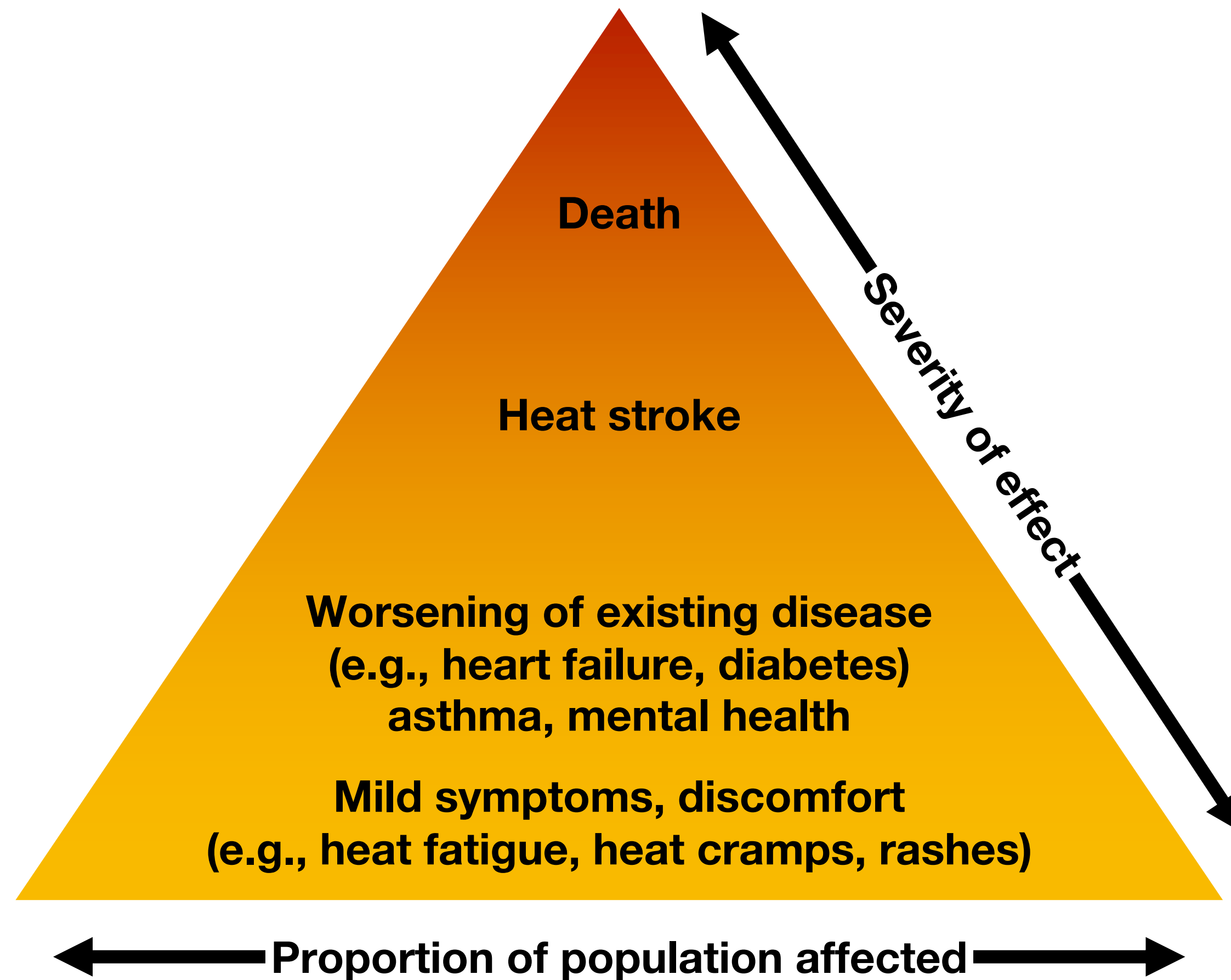


Ways to dissipate heat



**When ambient temperature exceeds body temperature,
sweating works best**

Health effects associated with extreme heat



Health effects associated with extreme heat

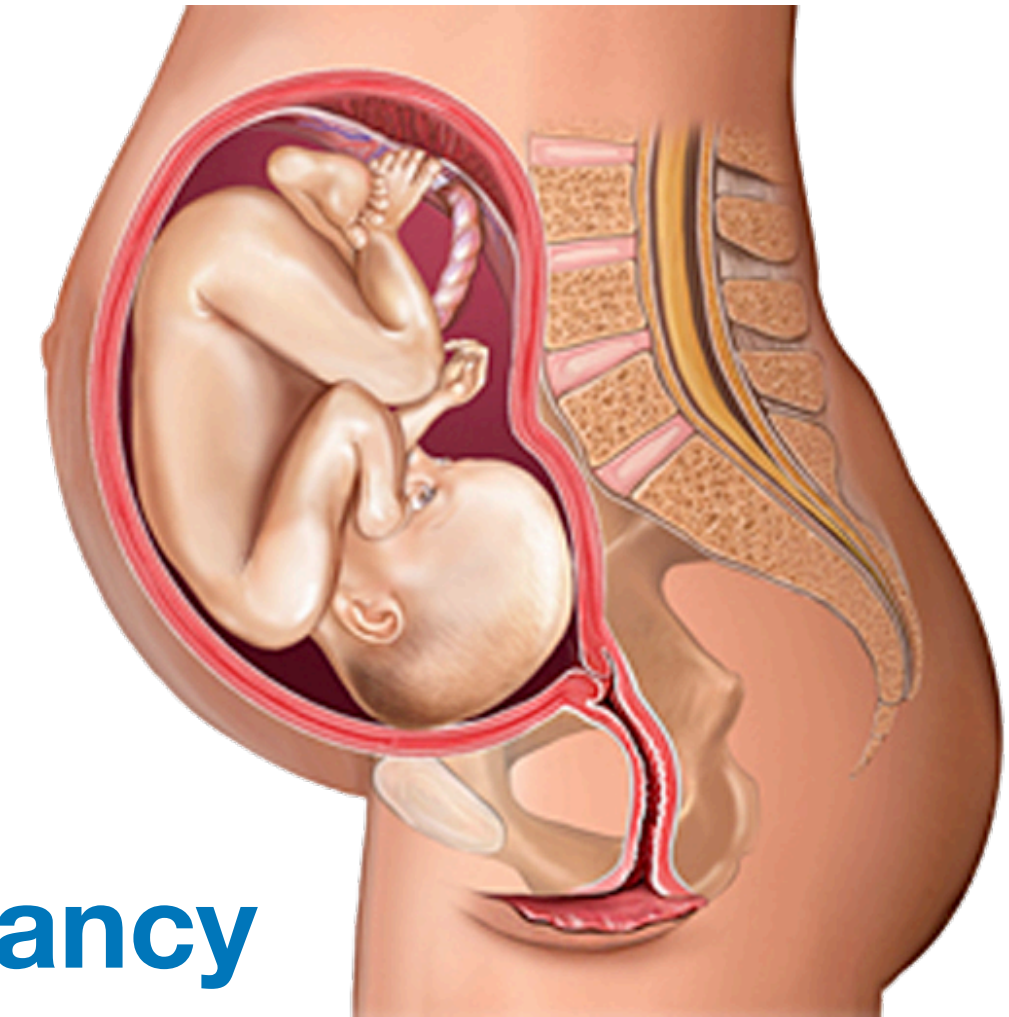
Mental health



Suicide rate 1 to 37% times higher per 1°C warming

Public Health. DOI: 10.1016/j.puhe.2018.06.008

Pregnancy



Preterm birth odds ~1.2x higher during heat waves

BMJ 2020;371:m3811 | doi: 10.1136/bmj.m3811

Medications



15% decreased dose

60°C (car trunk) vs 4°C

Am J Health-Syst Pharm—Vol 62 Nov 1, 2005 2

Workplace injuries



6-9%↑ injury claims, including indoors

50°F vs 90°F

Working while hot may be more risky than we realize

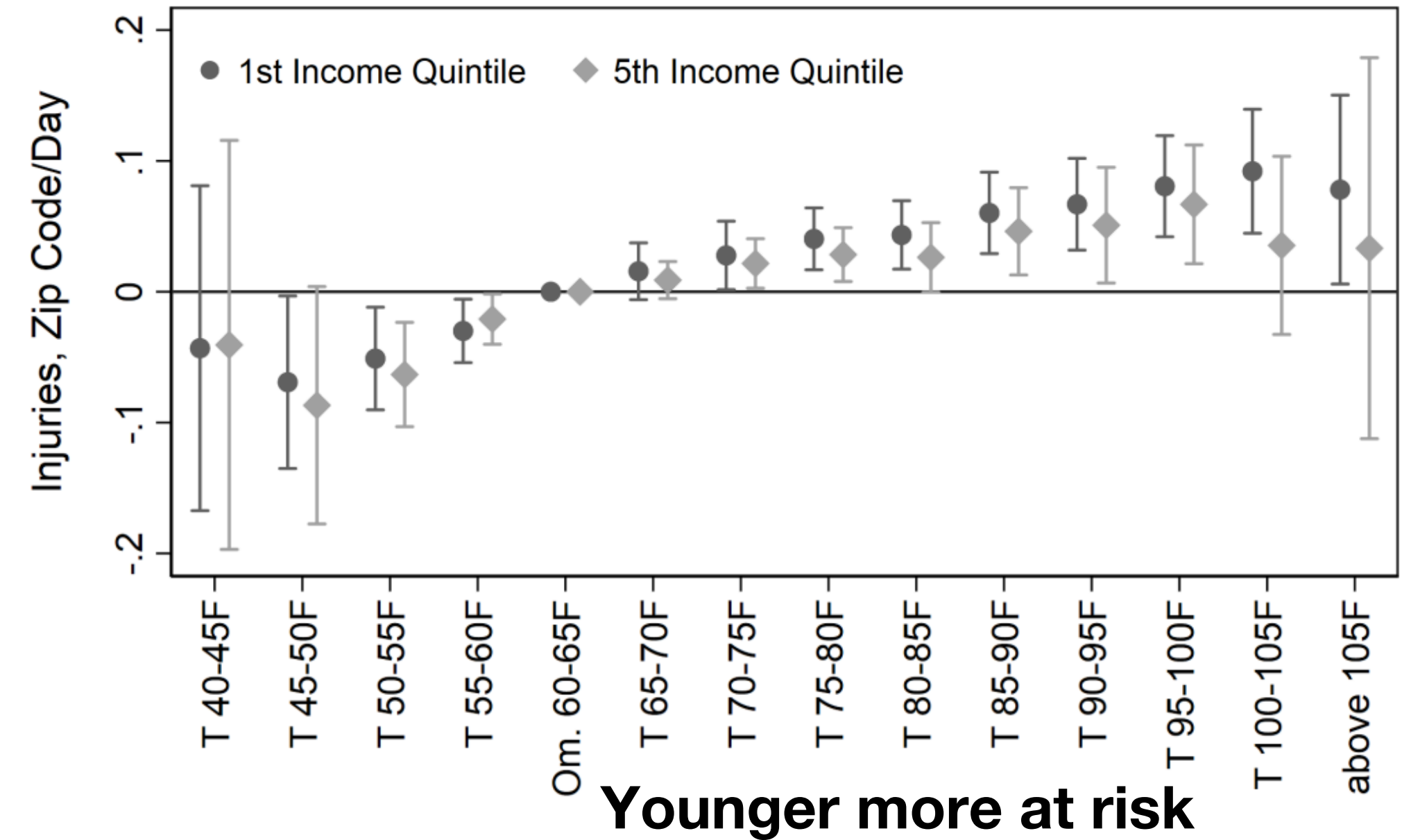
Park et al. IZA DP No. 14560: Temperature, Workplace Safety, and Labor Market Inequality
 Data from California Department of Workers' Compensation, 2001 to 2018

An additional day in temperatures >90°F increases injuries ~5%

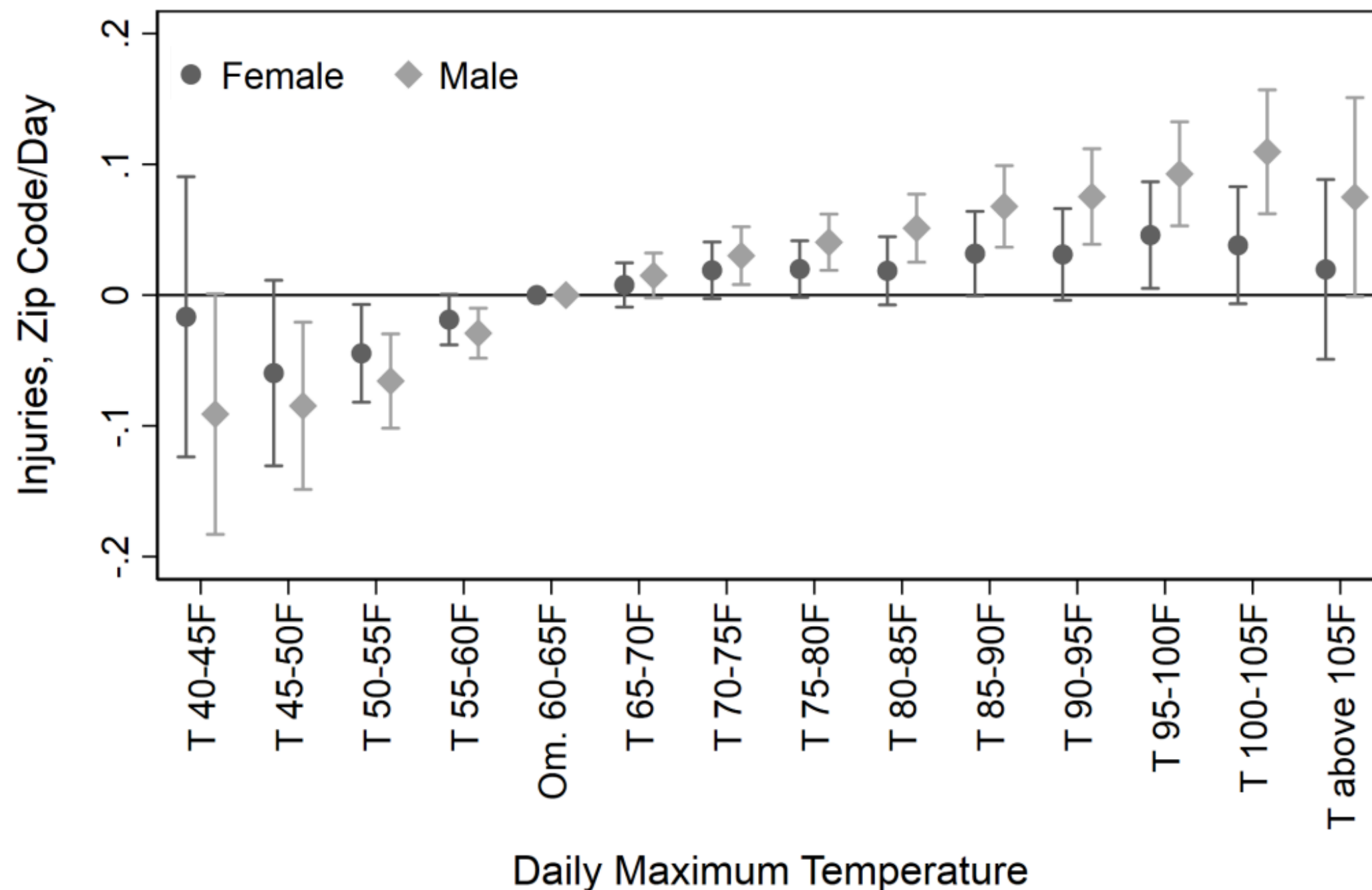
20,000 injuries per year due to temps >70°F
 (~19x injuries attributed to heat in workers compensation records)

Injuries often not obviously heat related
 e.g., falling from heights, struck by vehicle, mishandling dangerous machinery

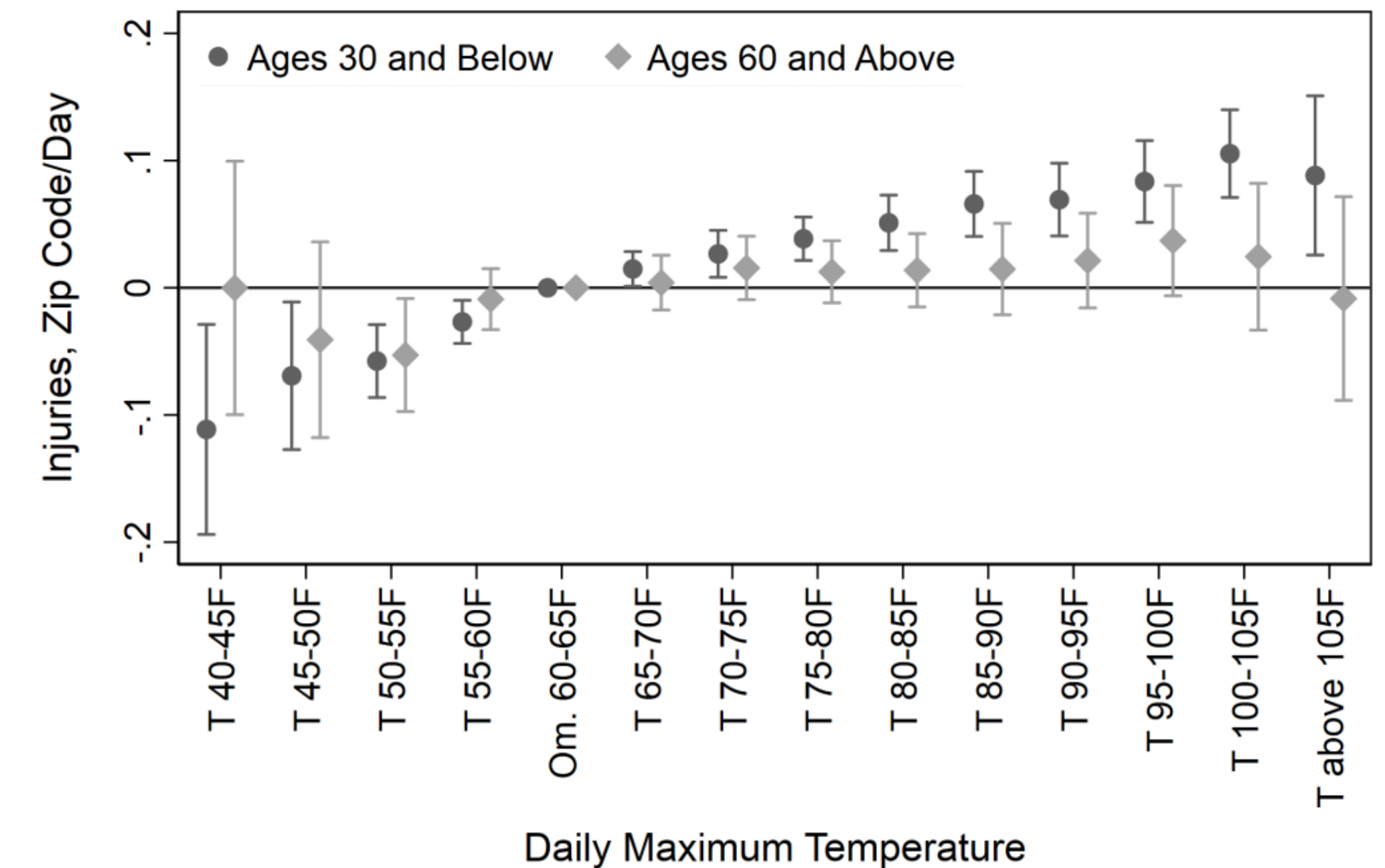
Poor at greater risk



Men at greater risk

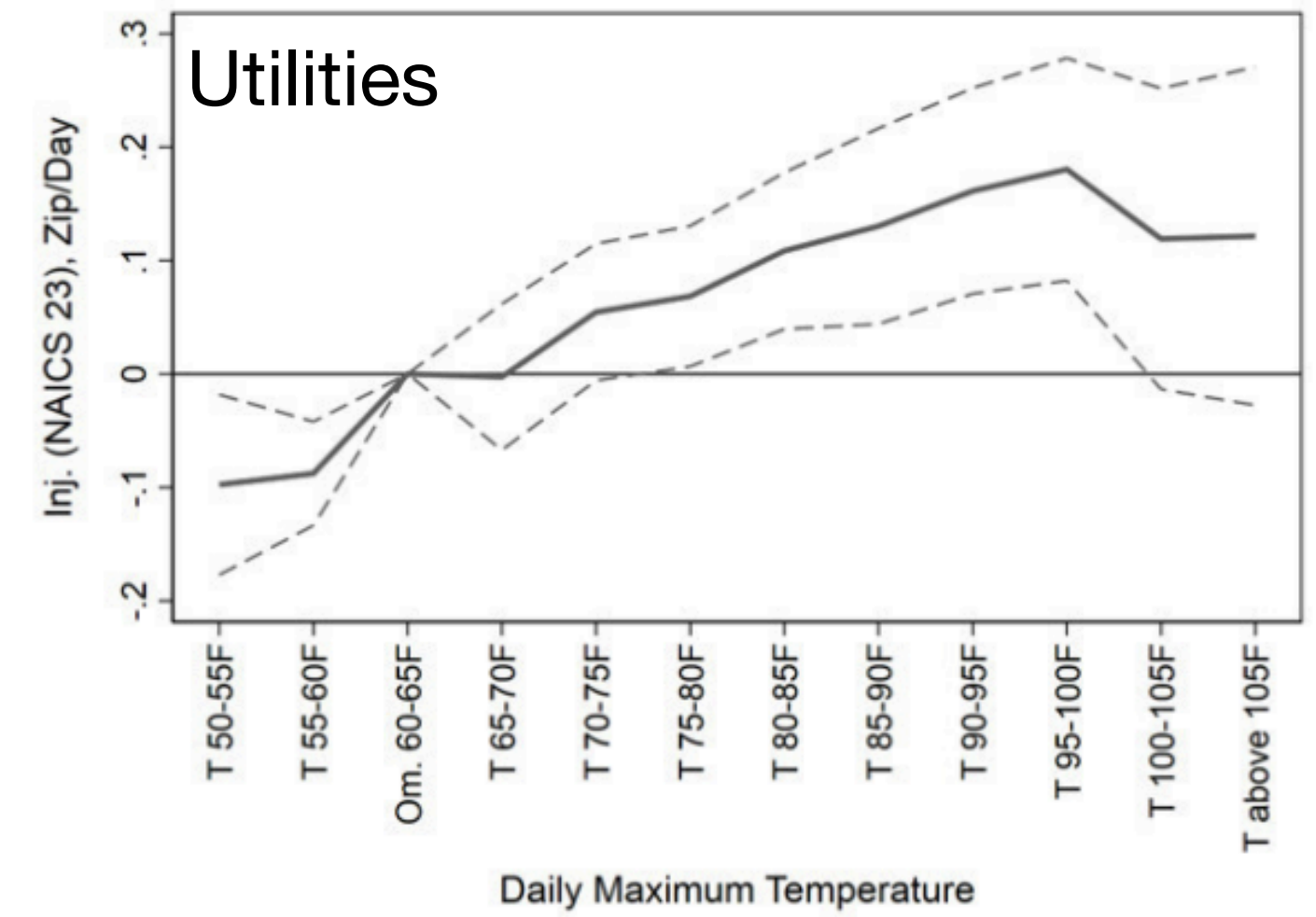
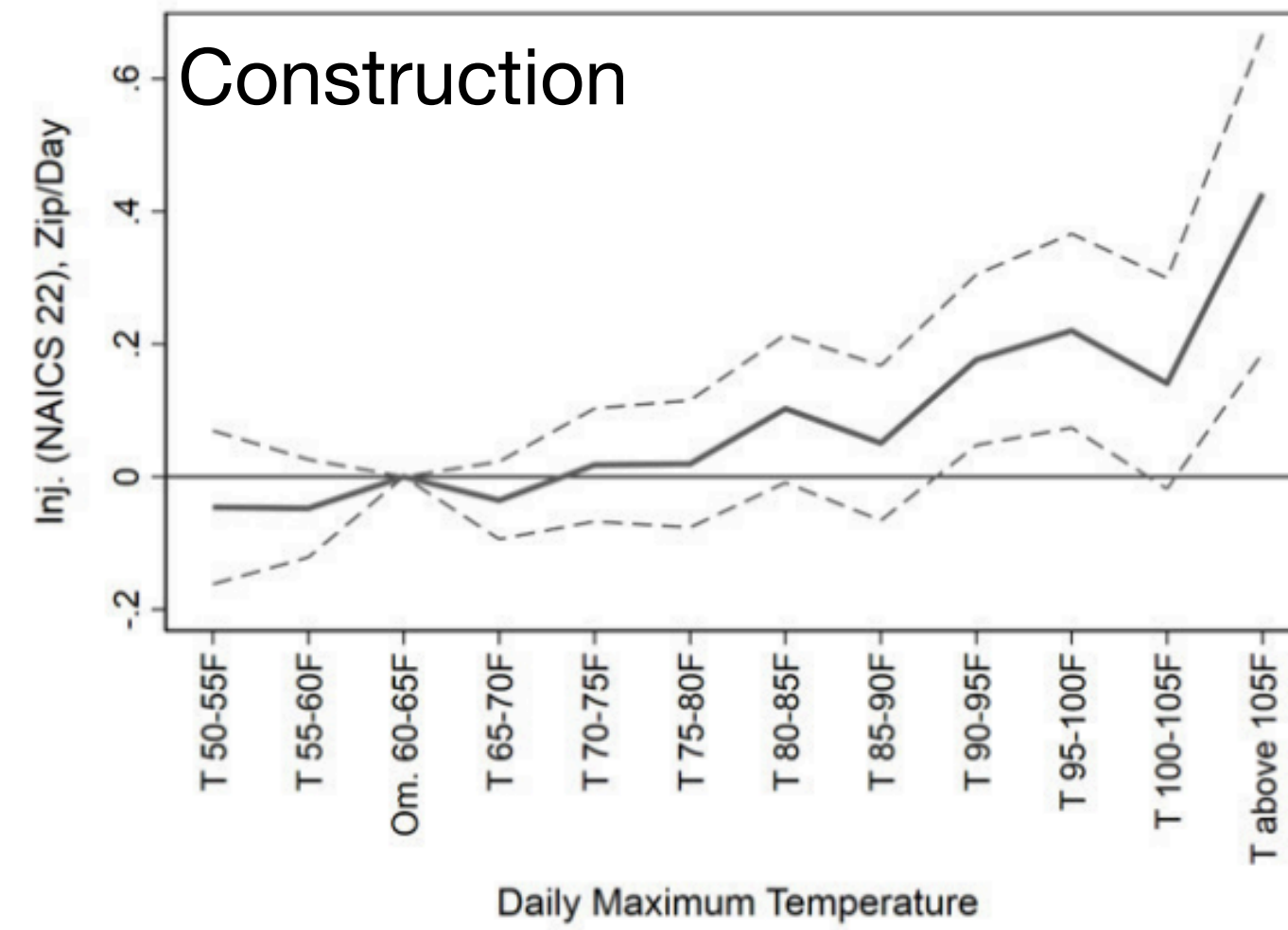
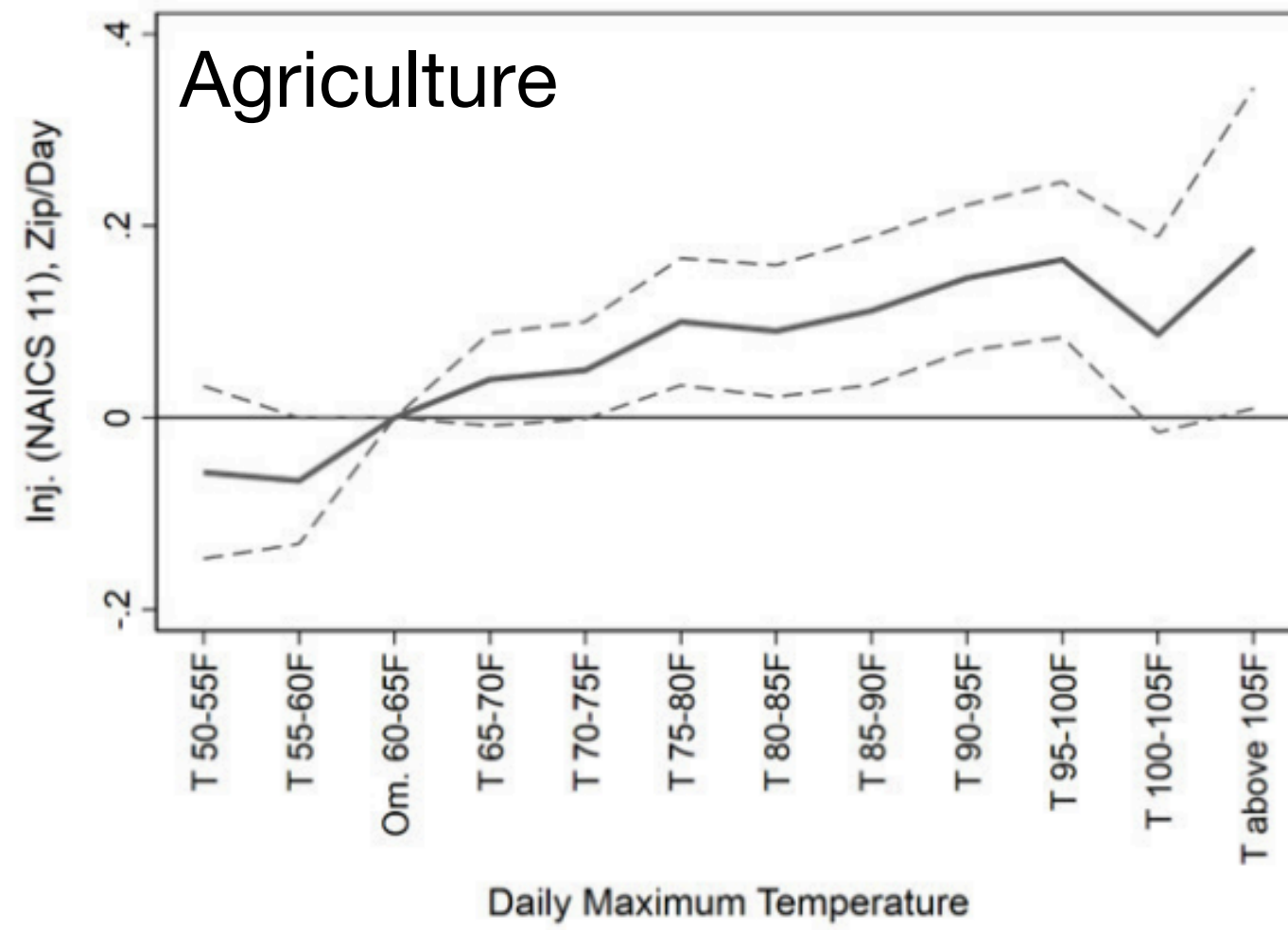


Younger more at risk

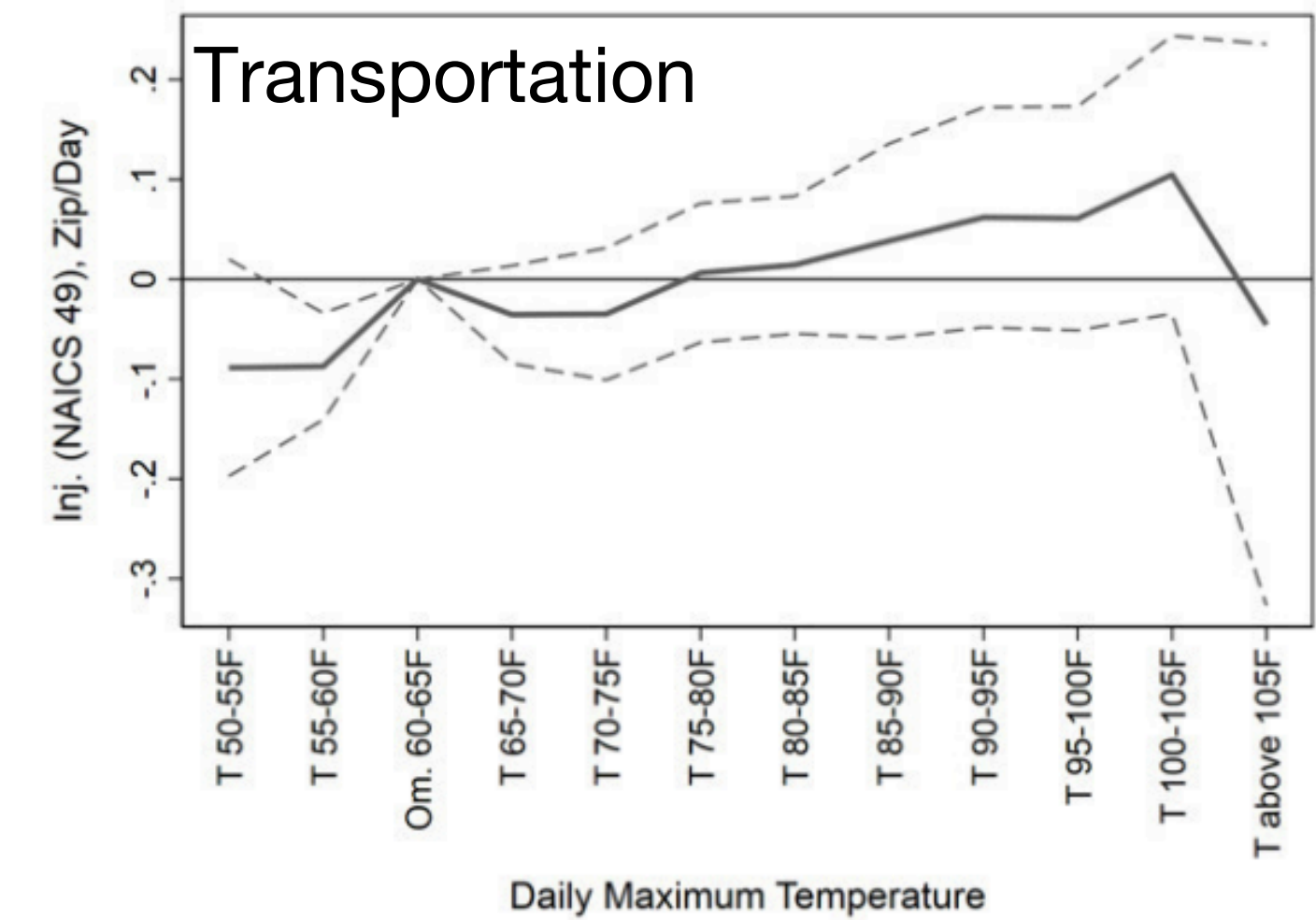
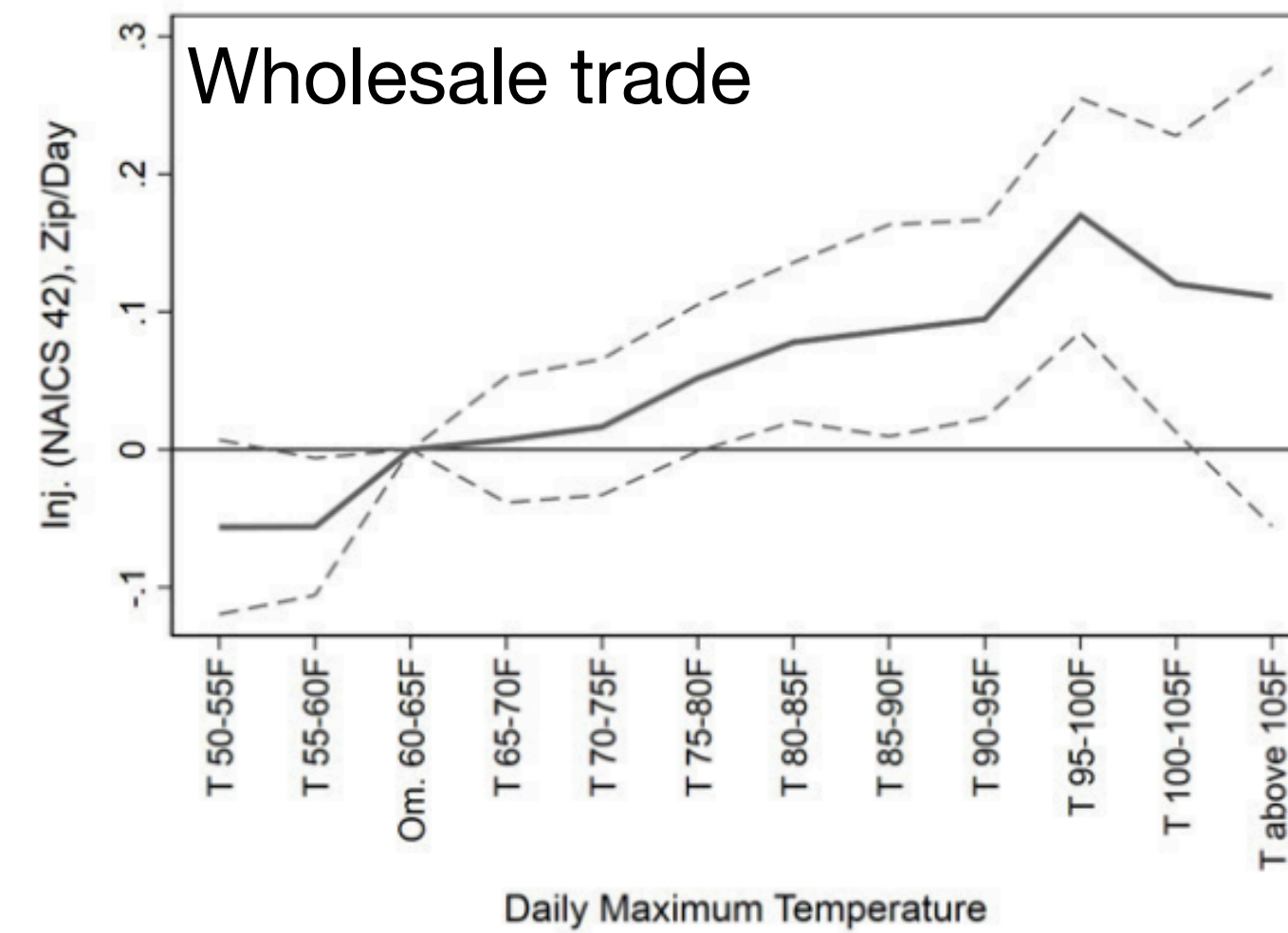
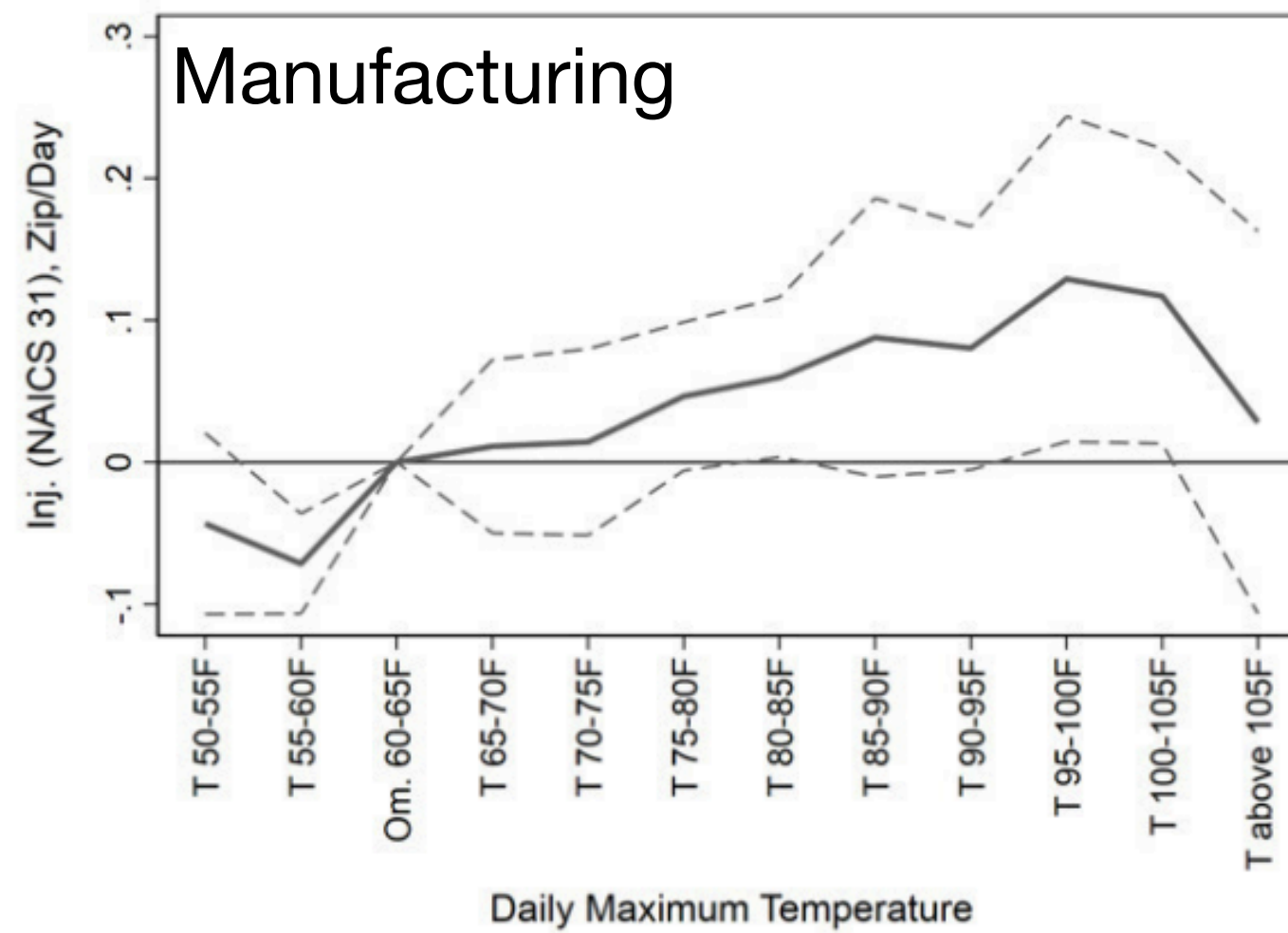


Outdoor *and* indoor workers are at risk

Outdoor Industries



Indoor Industries



How safe are the medications you prescribe?

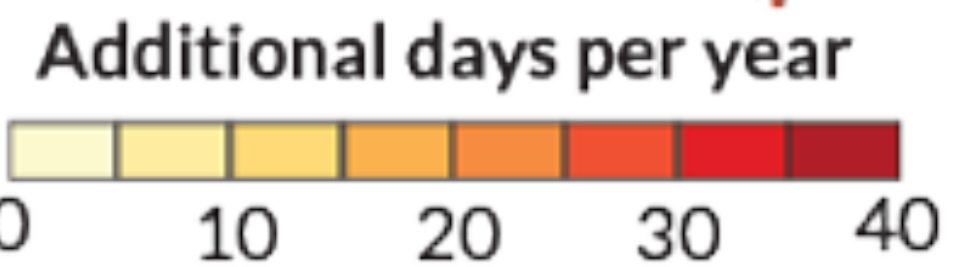
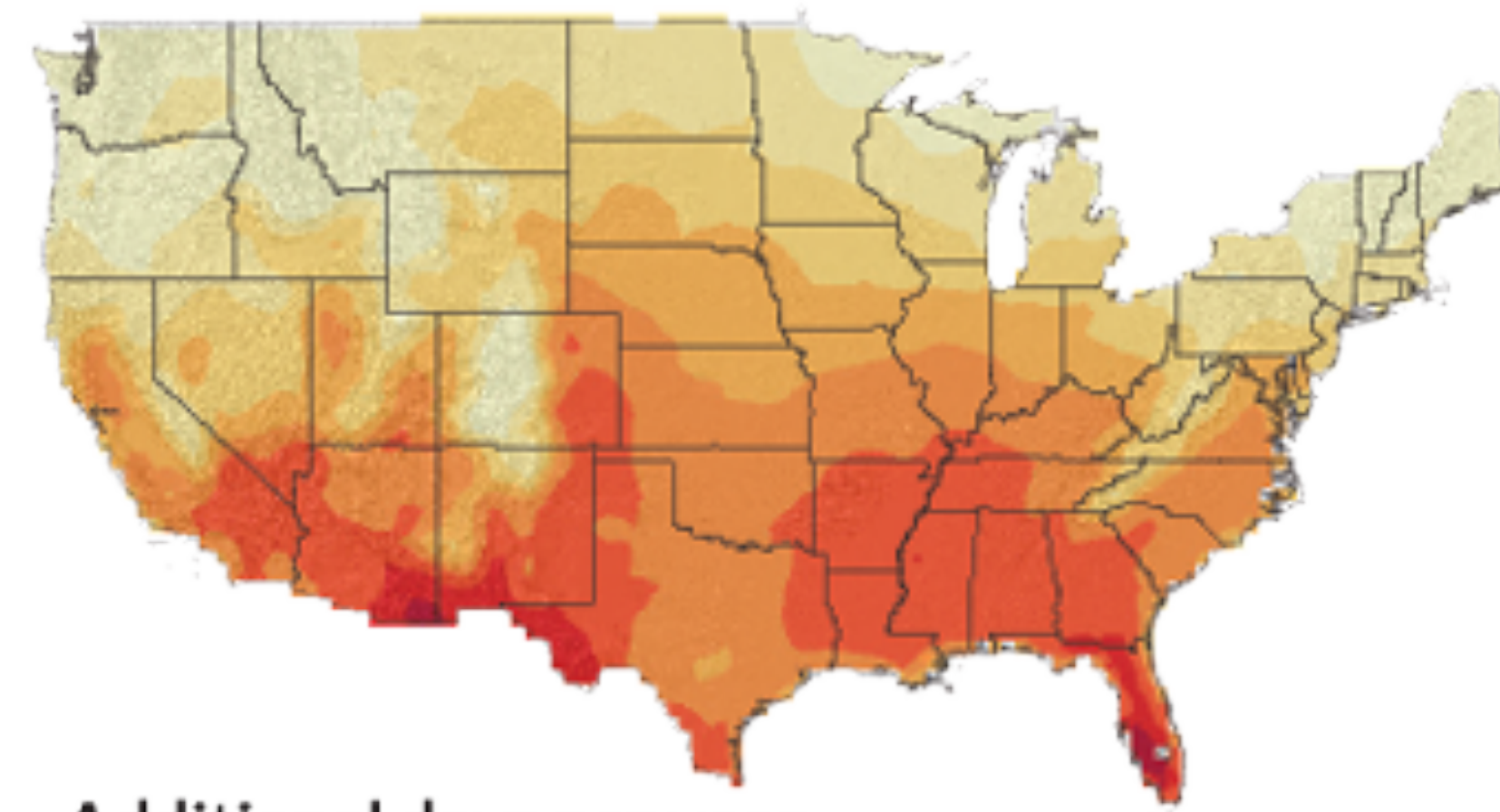
During summer months, relative risks of hospitalization with heat exposure & drug



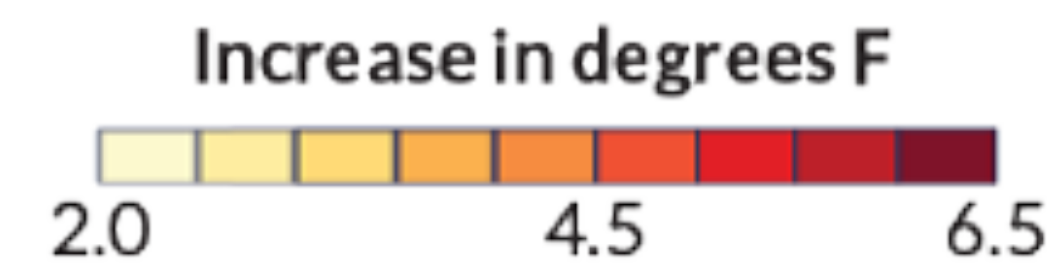
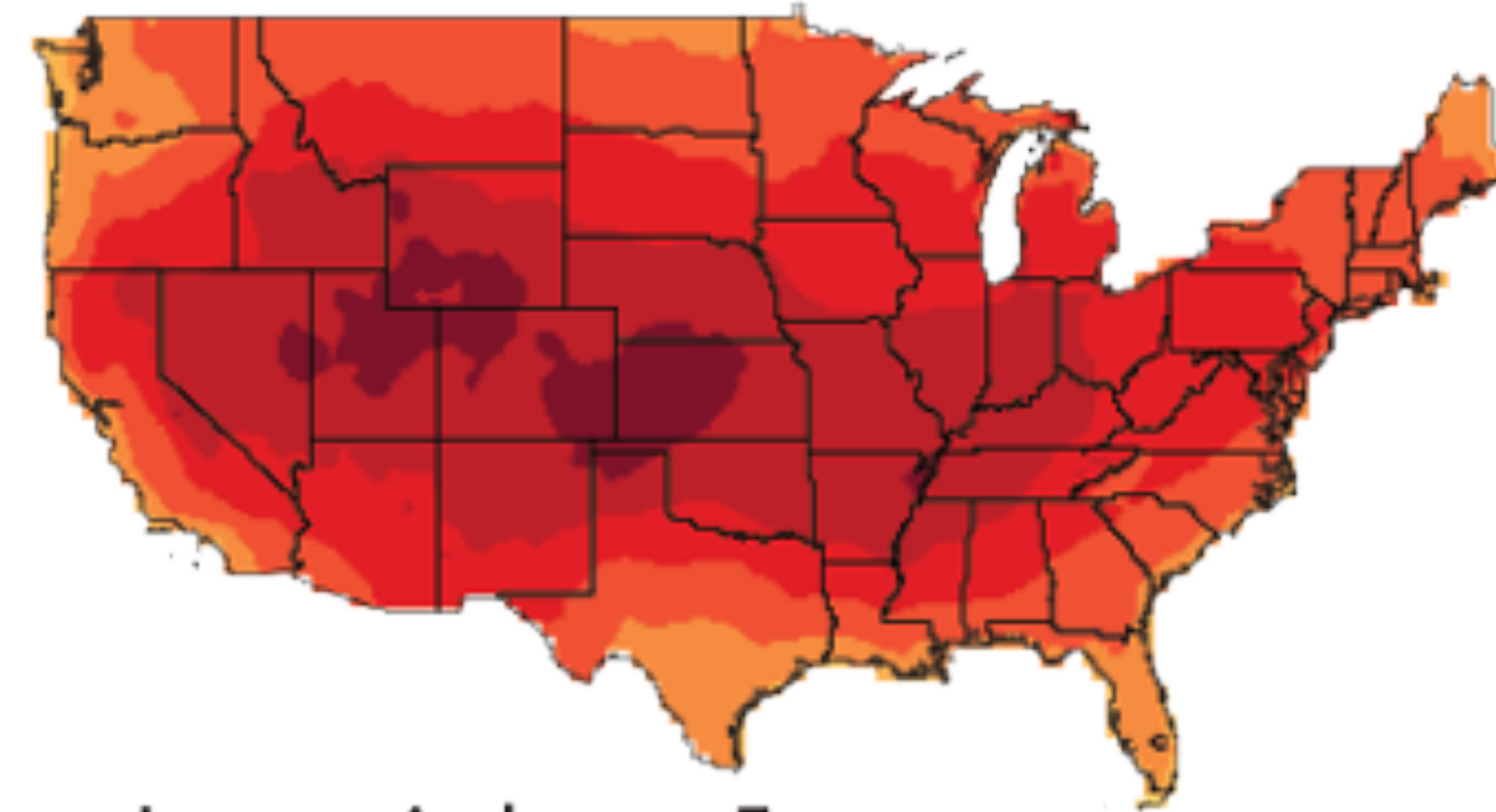
Heatwave defined as ≥ 2 days $> 95^{\text{th}}$ max temperature percentile

Changes in extreme and average heat by *mid century* with business as usual greenhouse gas emissions

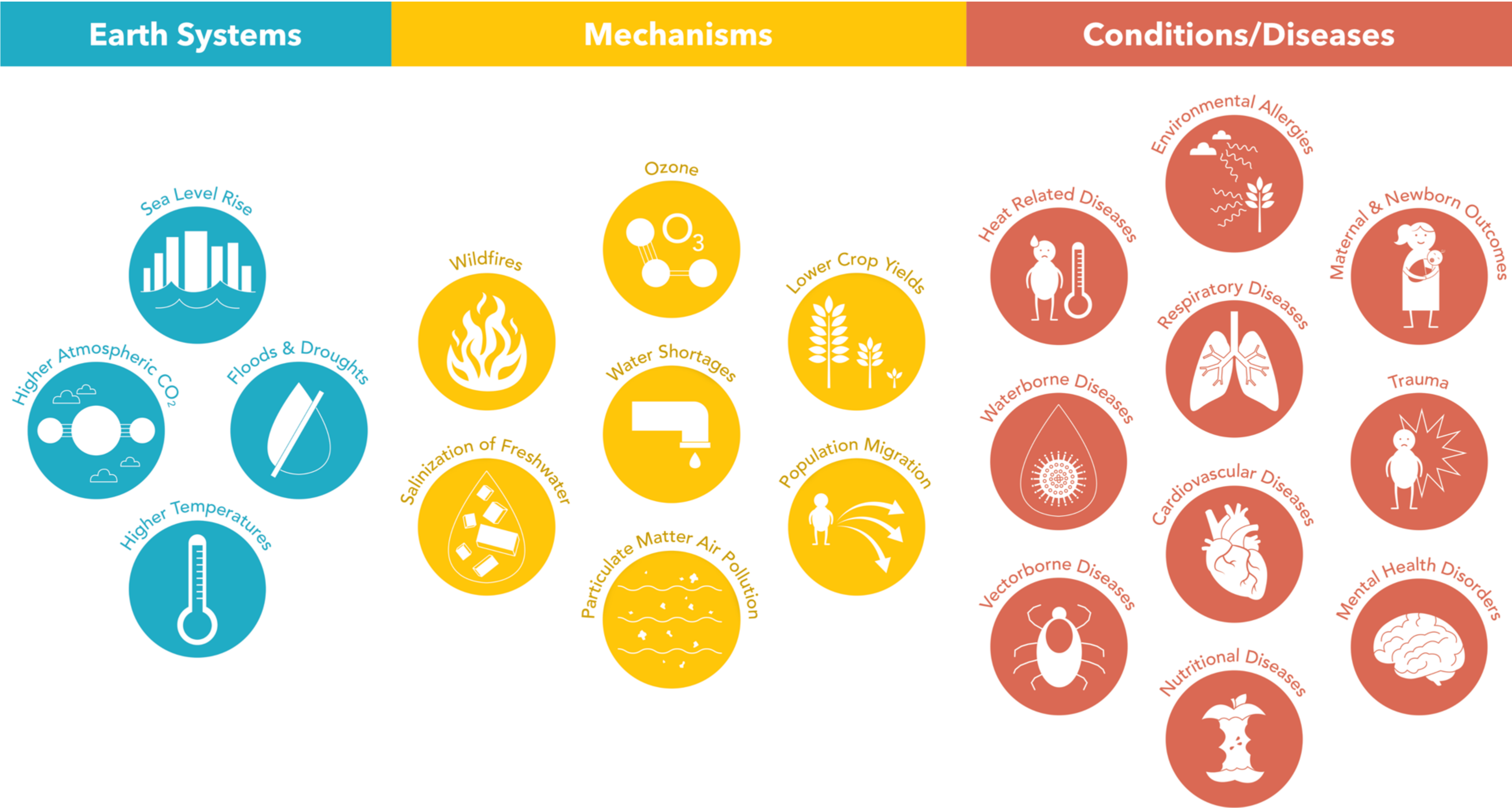
Change in number of days above 95° F



Change in average summer temperatures



Pathways from greenhouse gas emissions to health outcomes



You are seeing a 12 year old M with a history of ADHD and depression, BMI of 32 with insulin resistance, and moderate persistent asthma. He presents for a well-child check-up. He takes methylphenidate, sertraline, montelukast, and fulticasone/salmeterol.

He reports that he has been short of breath several times a week and has been having difficulty walking more than a flight of stairs. He also says he avoids going outside.

He reports getting teased at school because of his weight and he is feeling increasingly down and has had passive suicidal thoughts.

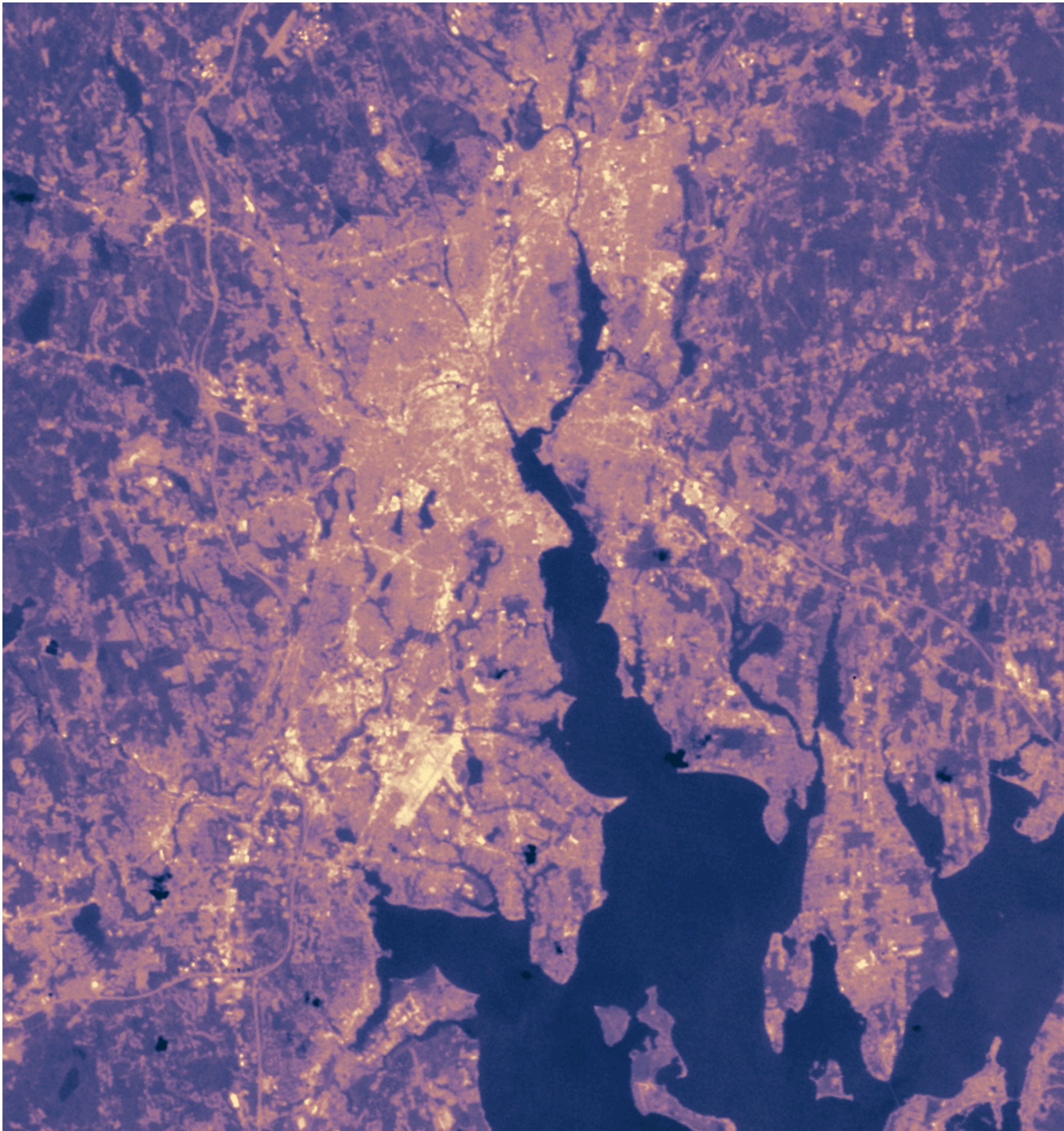
What can we do to improve the health of this child?

Make his neighborhood cool (or green)

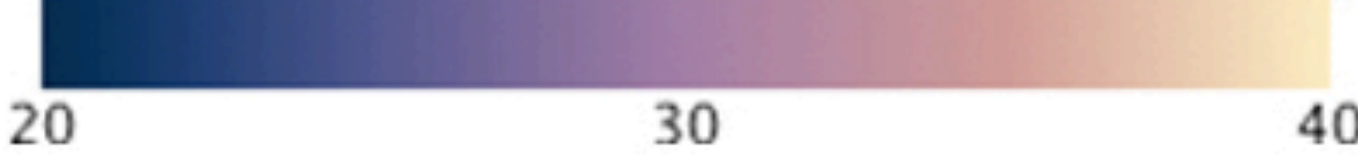
Providence, RI



Vegetation



Brightness Temperature (°C)



Greenspace
Reduces heat (utility bills)
Improves air quality
Reduces runoff, waterborne disease/HABs

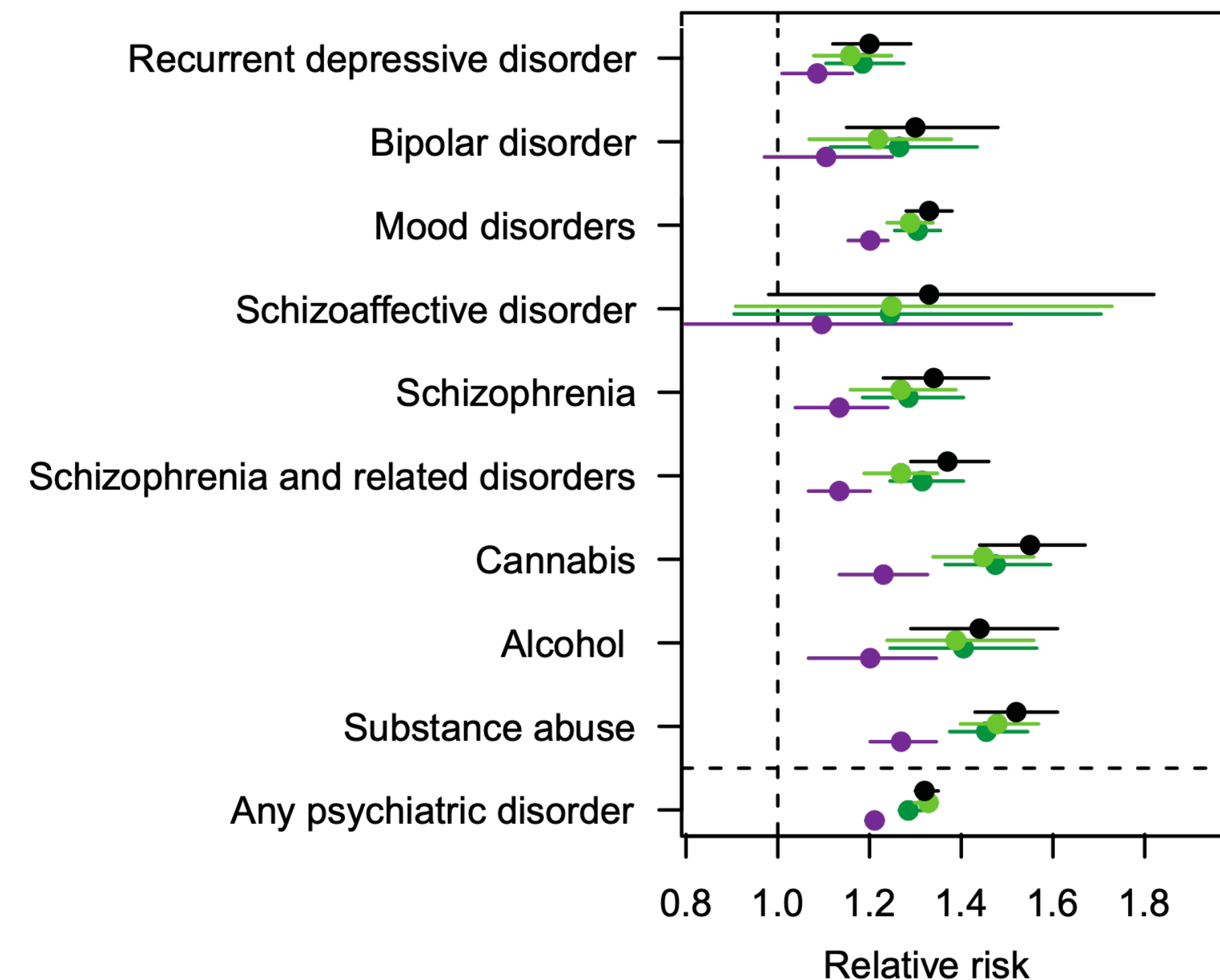
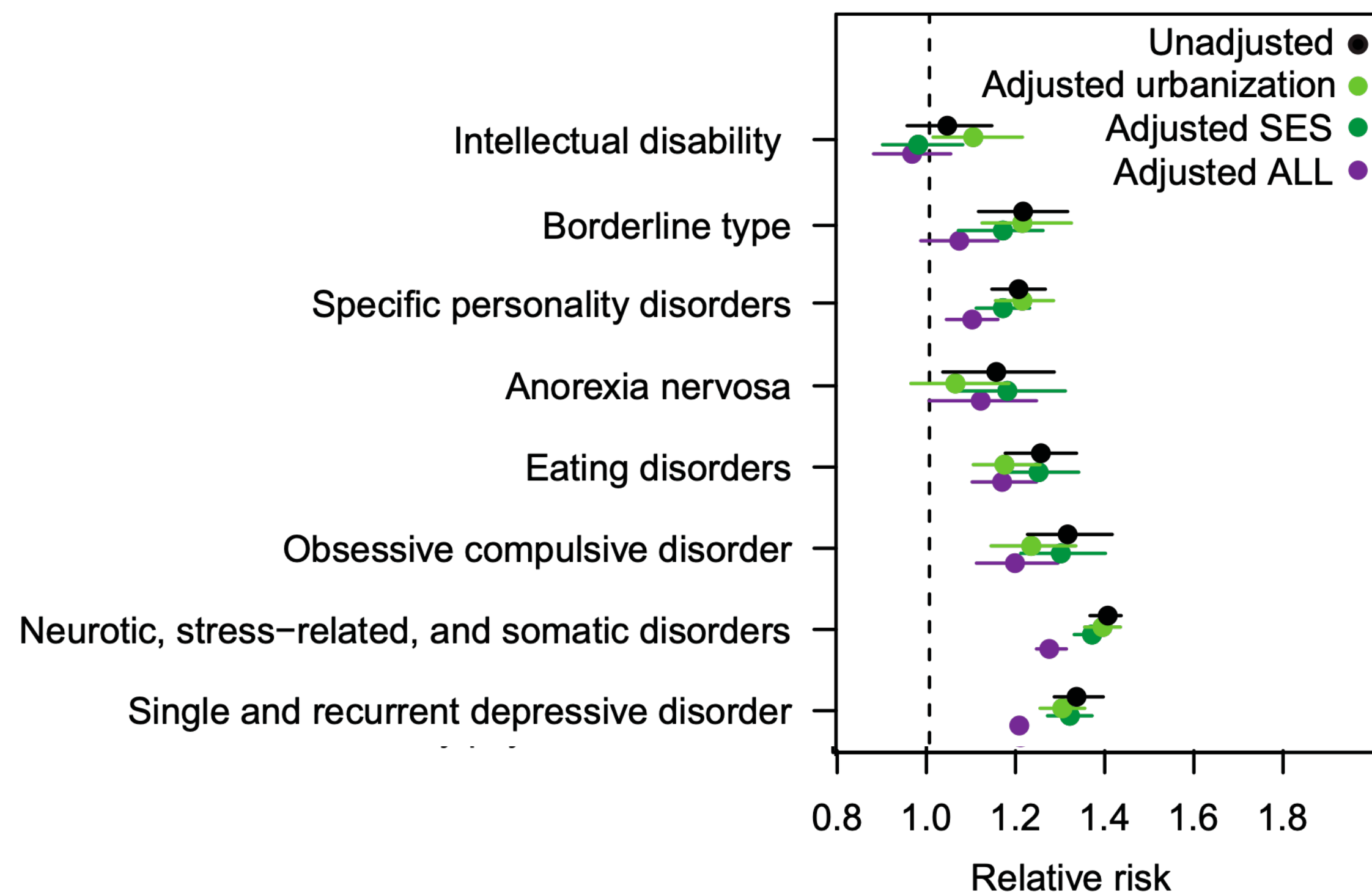
It's easier being (around) green

Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood

Kristine Engemann^{a,b,c,1}, Carsten Bøcker Pedersen^{c,d,e}, Lars Arge^f, Constantinos Tsirogiannis^f, Preben Bo Mortensen^{c,d,e}, and Jens-Christian Svenning^{a,b}

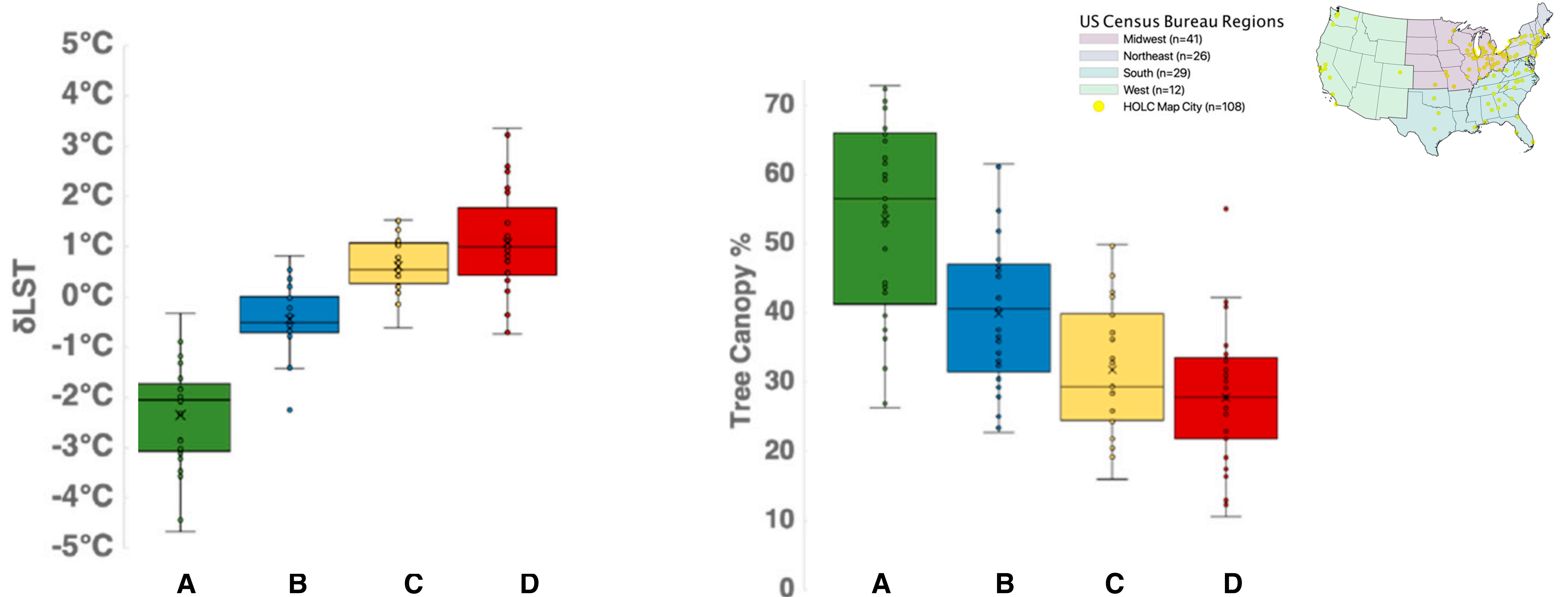
55% fewer mental health problems

Greenspace assessed birth to 10yo via normalized difference vegetation index @ 30m, 943,000+ 10 year olds



RR compared to highest decile of green space, adjustment for urbanization, socioeconomic factors, parental history of mental illness, and parental age

Difference in land surface temperature and tree canopy coverage by Home Owners' Loan Corporation Security Rating, Southern cities



We can build green



Between 2000-2016 green certified buildings:

saved \$6.7 billion in energy costs

30MT CO₂

and prevented

hundreds of deaths

~11,000 asthma attacks

~16,000 lost days of school

Give him access to affordable & reliable public transportation, increase safety and convenience of active transportation and electrify motor vehicles





Increase his consumption of affordable fruits & vegetables and decrease consumption of processed foods



IF FOOD WASTE WERE A COUNTRY



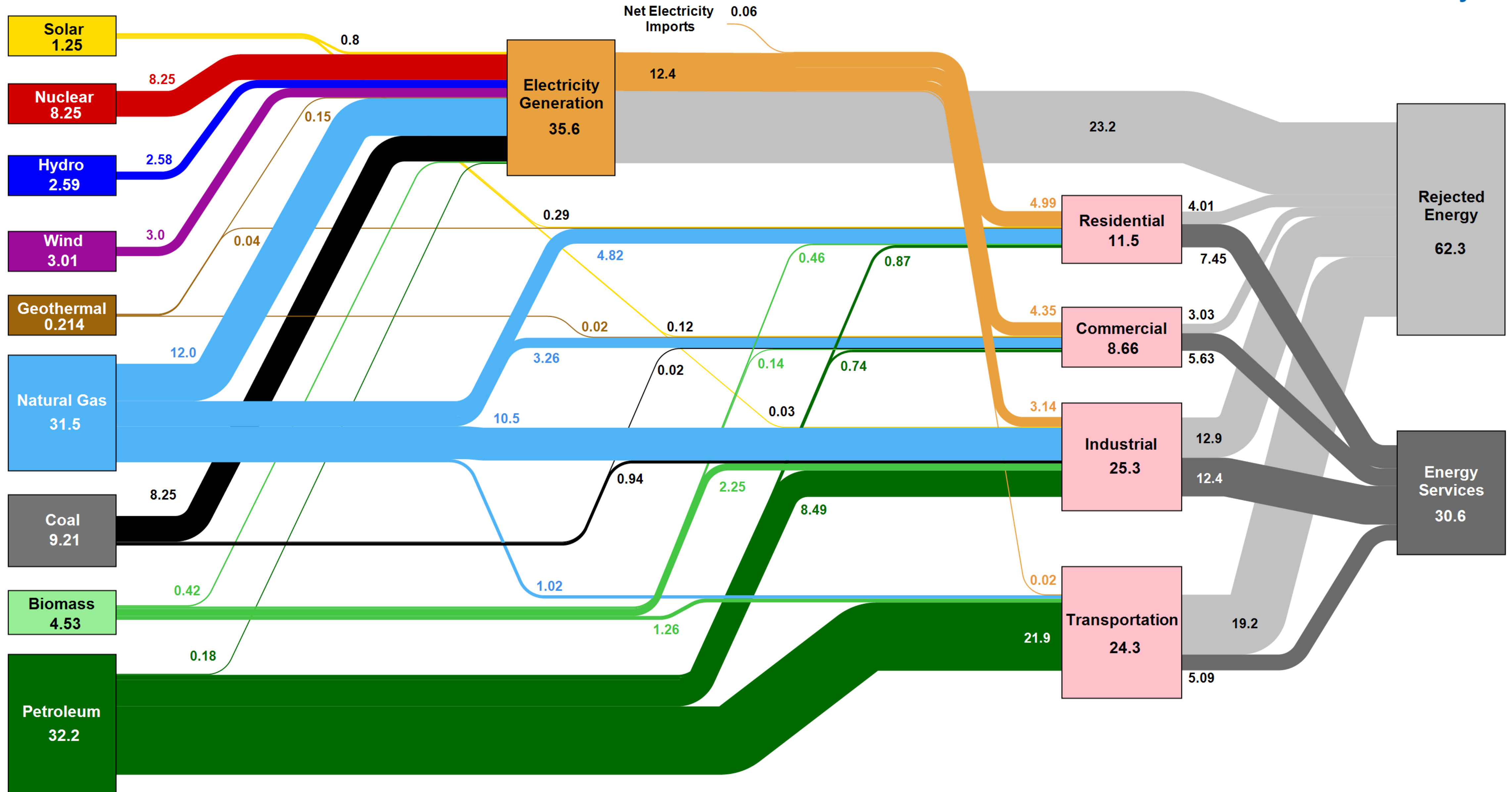
Greenhouse Gas Emissions

© Carrier Corporation 2015

Source: Food and Agriculture Organization of the United Nations, Food Waste Footprint Impacts on Natural Resources, 2013

Accelerate adoption of clean, renewable energy

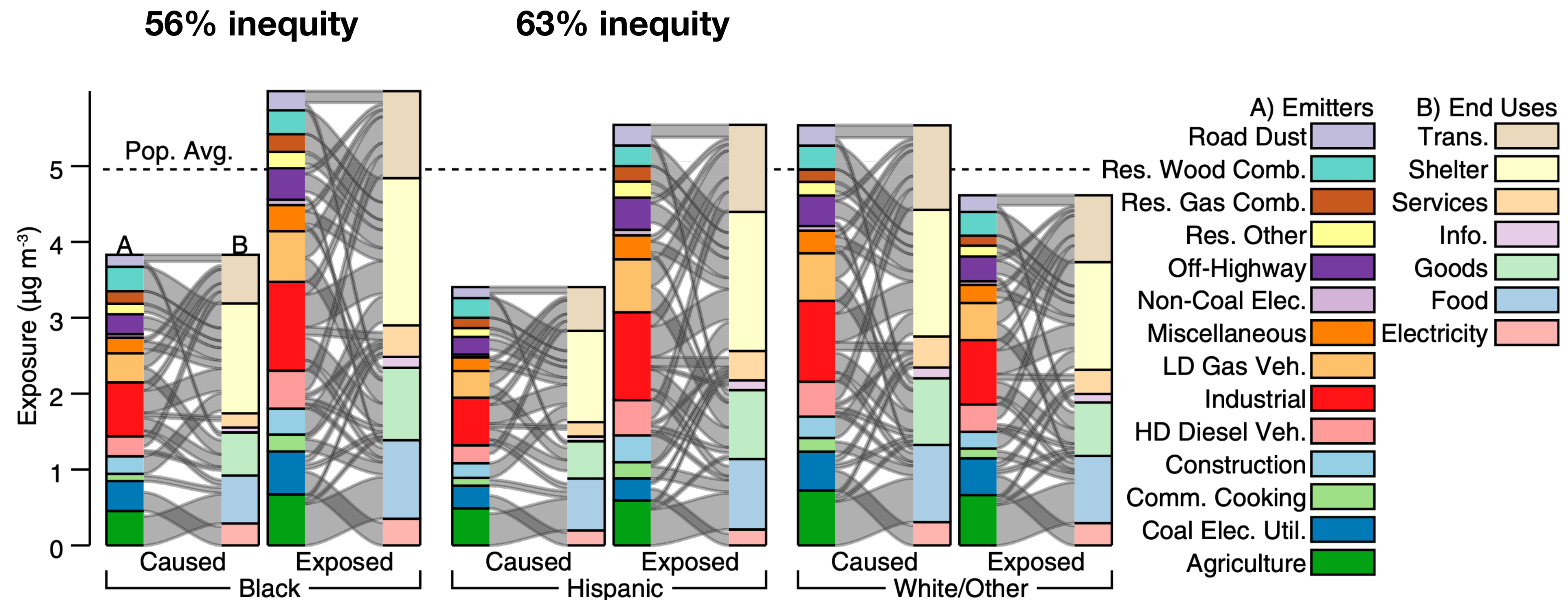
Estimated U.S. Energy Consumption in 2020: 92.9 Quads



Climate actions promote health equity

~300k Americans die each year from fossil fuel sourced air pollution

Air pollution is not an equal opportunity killer



We cannot leave anyone behind

The Washington Post

**In small towns across the nation, the death of a coal plant leaves an
unmistakable void**

By [Brady Dennis](#) and [Steven Mufson](#)

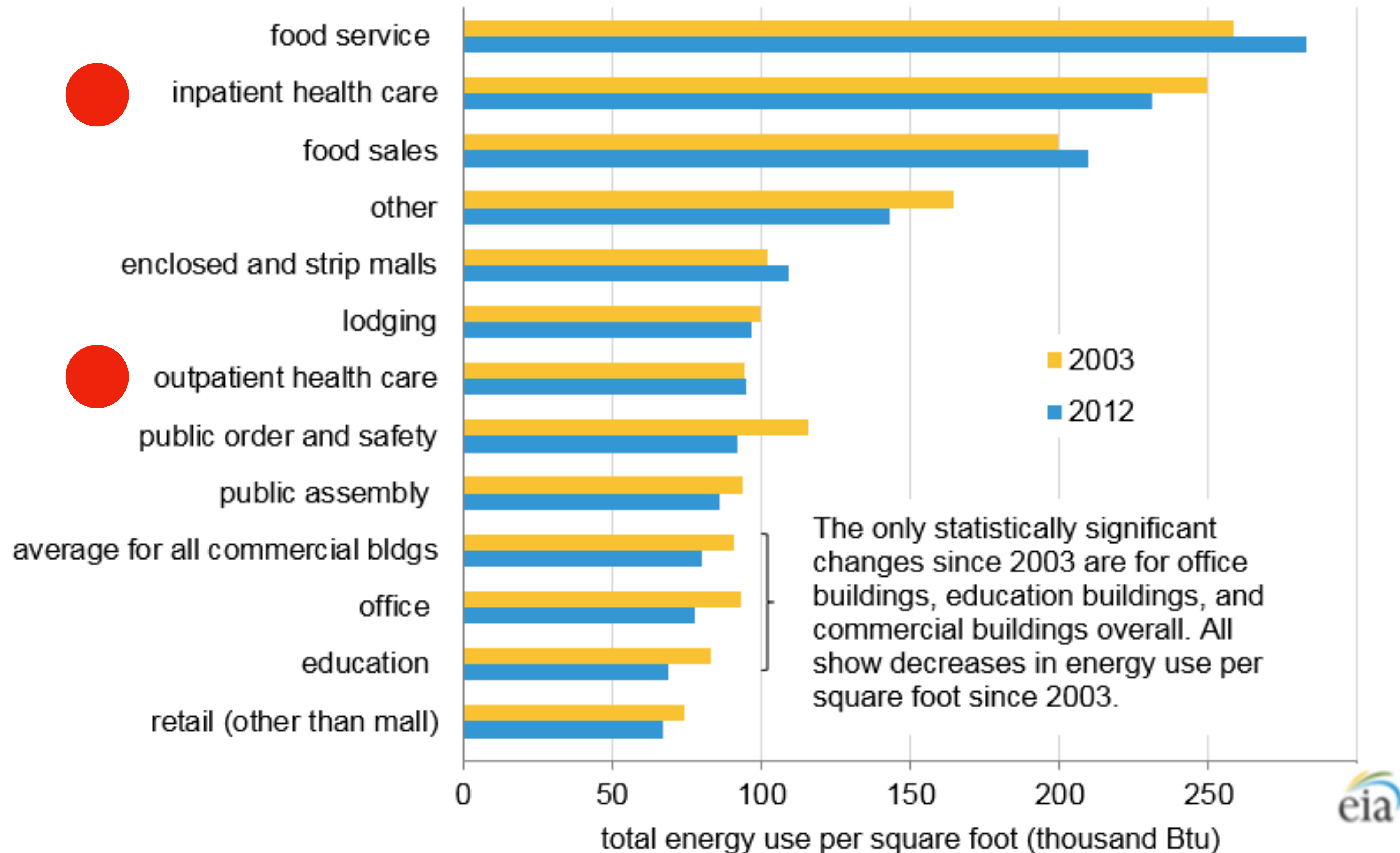
March 28,



The shuttered Killen Station and J.M. Stuart Station power plants in Manchester, Ohio (Luke Sharrett/For The Washington Post).

Get our own house in order

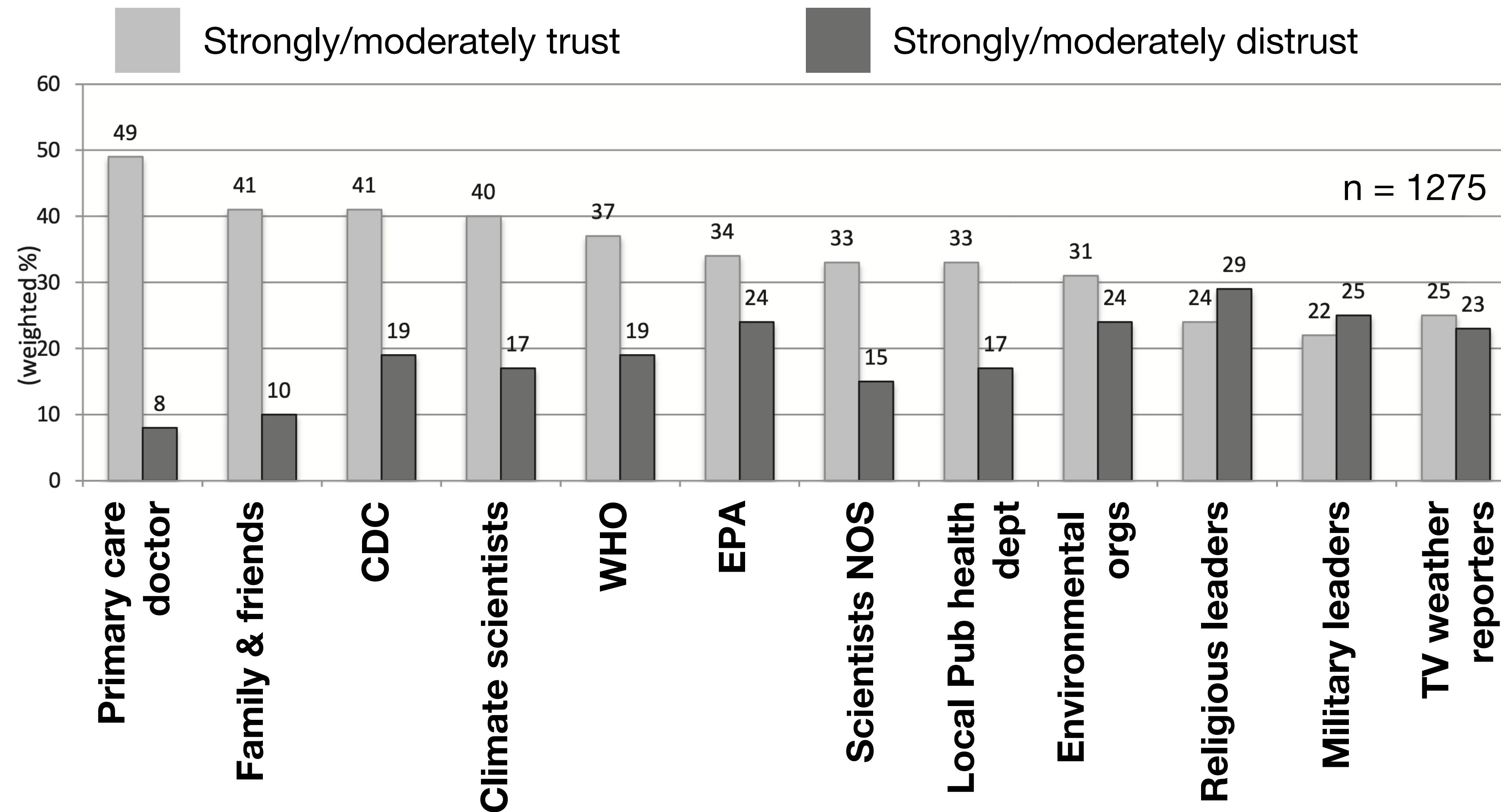
Healthcare accounts for ~10% of all greenhouse gas emissions in the U.S.



American's trust to communicate information on climate and



American's trust to communicate information on climate and



Messaging on climate and health



SIMPLE, CLEAR MESSAGES.

REPEATED OFTEN.

BY A VARIETY OF TRUSTED VOICES.

1. There is a consensus among scientists that climate change is happening and that humans are causing it.
2. It's bad *for people*.
3. It's solvable.

Health messages have the greatest force in making Americans see climate as an issue worth taking on.



HARVARD T.H. CHAN
SCHOOL OF PUBLIC HEALTH

C-CHANGE

CENTER FOR CLIMATE, HEALTH,
AND THE GLOBAL ENVIRONMENT

The
**Climate
Optimist**

It's real. It's now. We have solutions.



**Your monthly dose of *good news*
about climate change.**

Climate heroes are not only designing and building the healthier future we need; they are also defending against actions that threaten science and our health. This issue highlights key stories from this month.