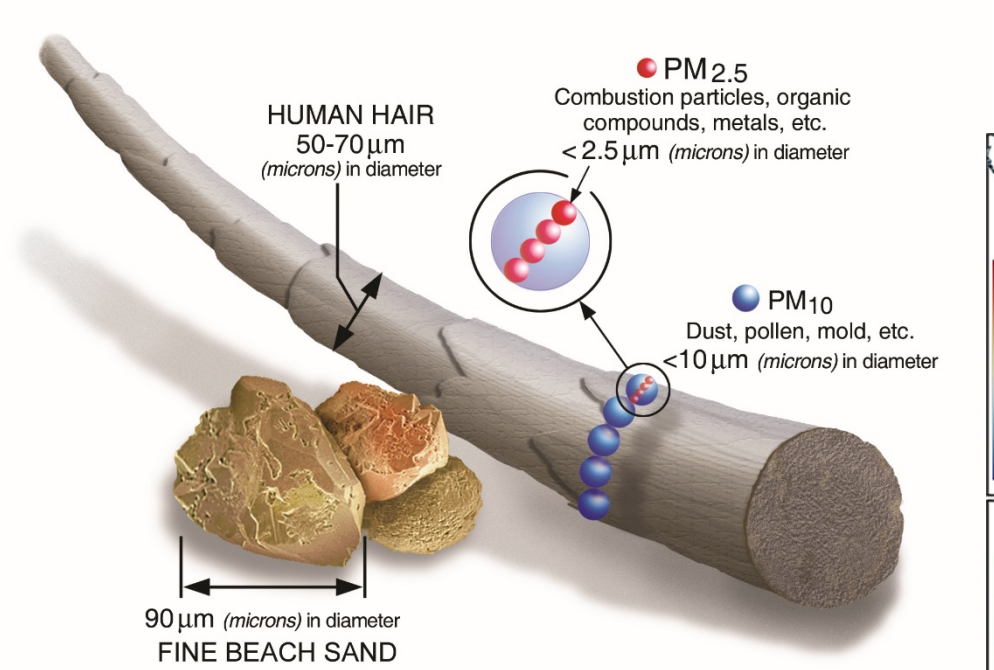
Climate change and air quality

Sebastian Eastham
MIT Global Change Forum XLV

http://globalchange.mit.edu/

Air quality today

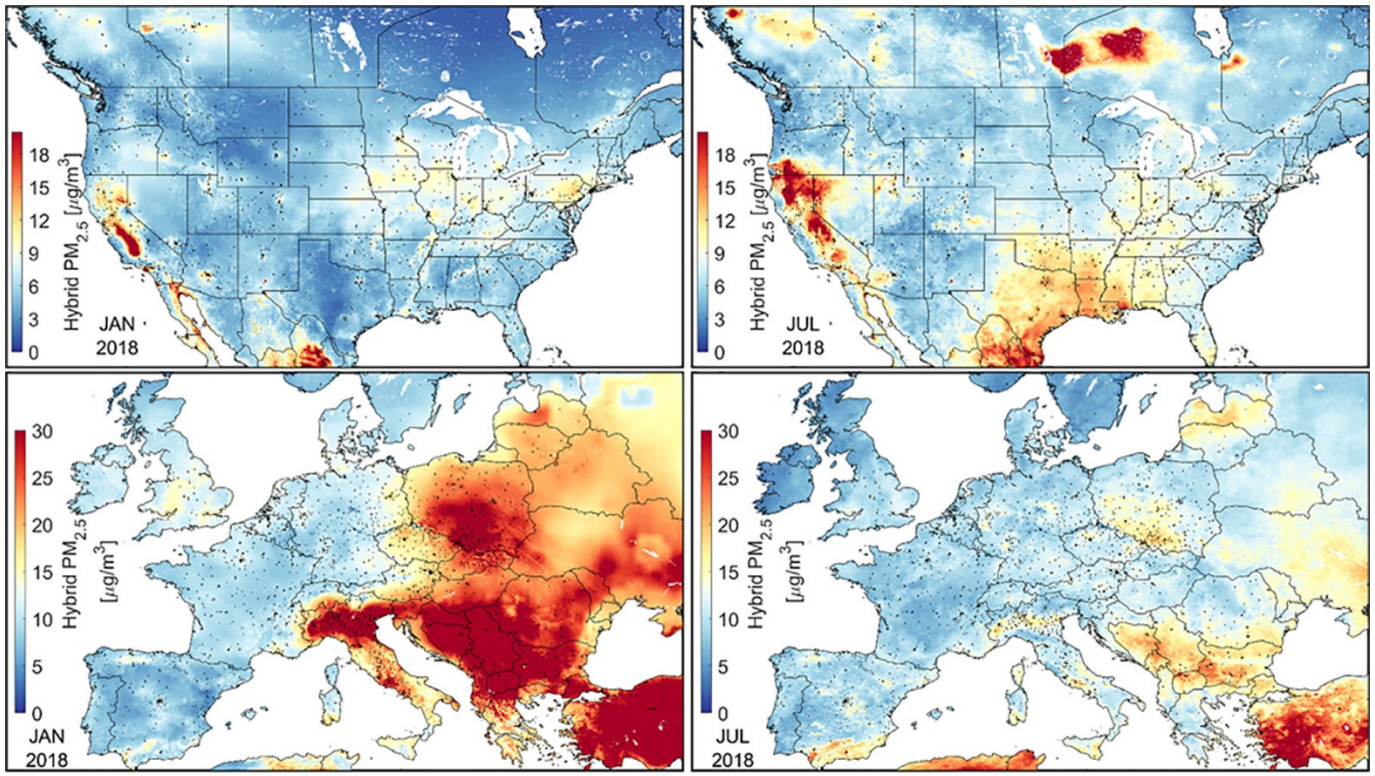
The fundamentals



Air pollution dominated by **ozone** and **fine particulate matter** ($PM_{2.5}$)

Results from **industrial activity** interacting with the **natural atmosphere –** highly **seasonal**

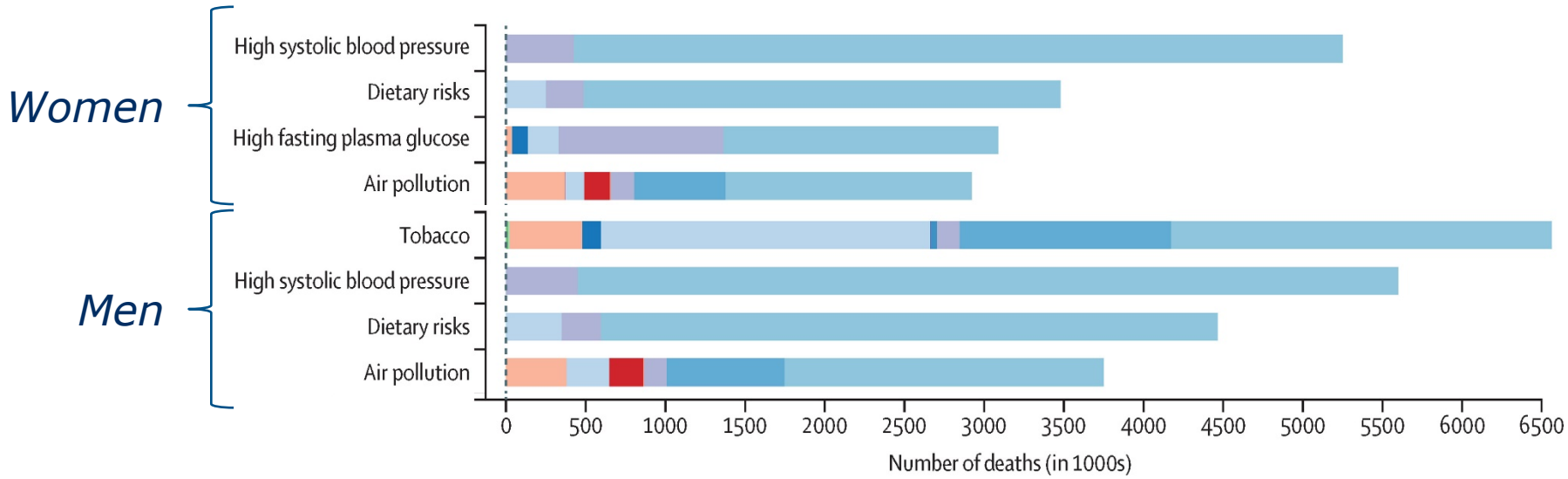
January 2018 *July 2018*



Source: US EPA, van Donkelaar et al. 2021

Air quality today

The fourth leading risk factor for early death



6.7 million early deaths per year
due to exposure to air pollution

Situation improving – but
slowly and **unevenly**

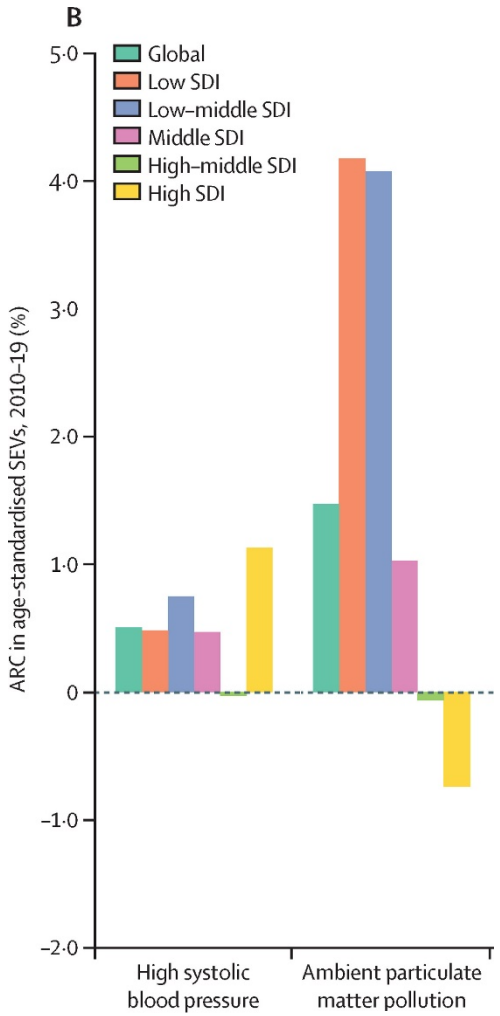
Source: Global burden of disease study 2019

Air quality today

International disparities in exposure

- Regions with lower socio-demographic indices (SDIs) are hit harder by air pollution:
  - Fewer resources to **mitigate or adapt**
  - Weaker **regulation**
  - **Compounding** stressors

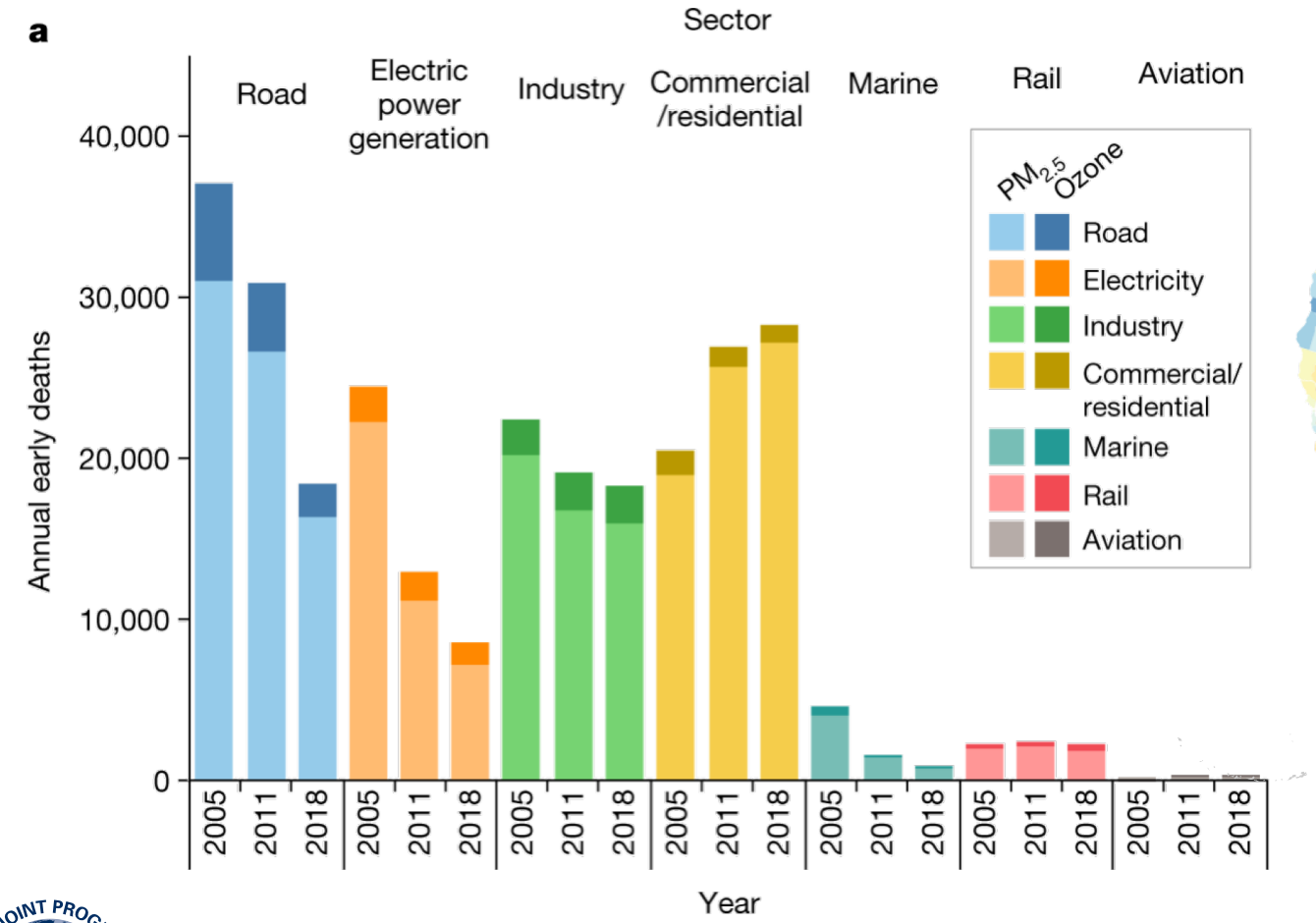
- Despite gradual global improvement, current trends are towards **larger disparities**

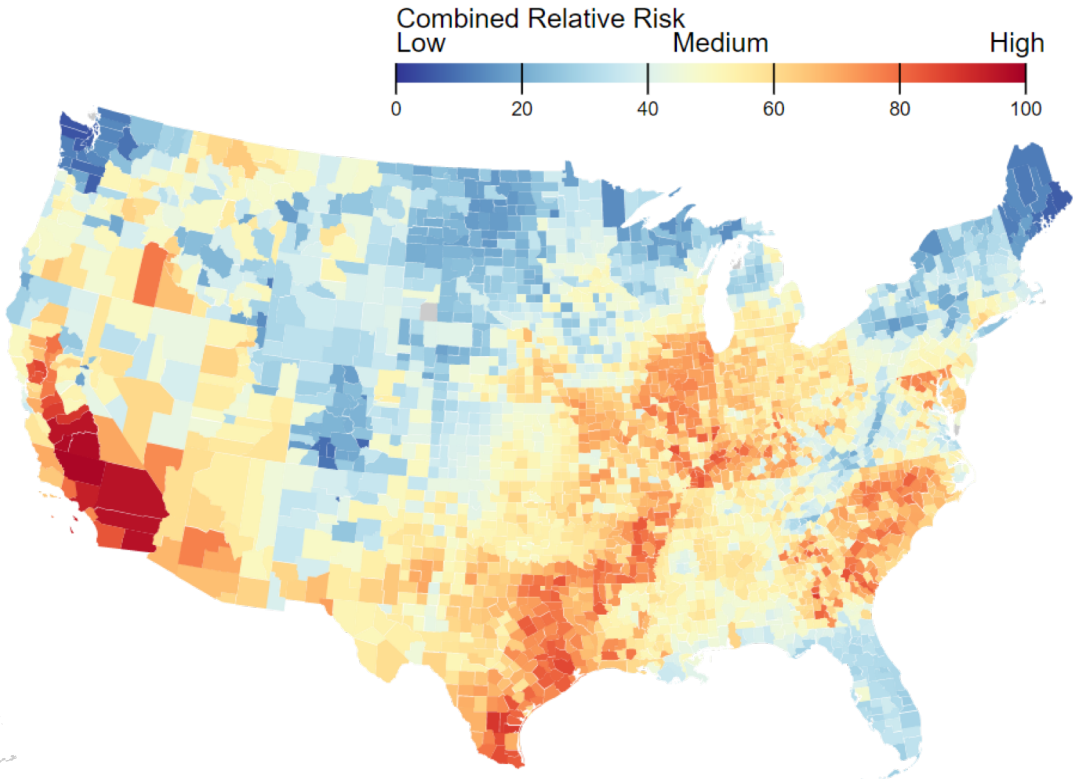


Source: Global burden of disease study 2019

Air quality today

A complex story even within the US



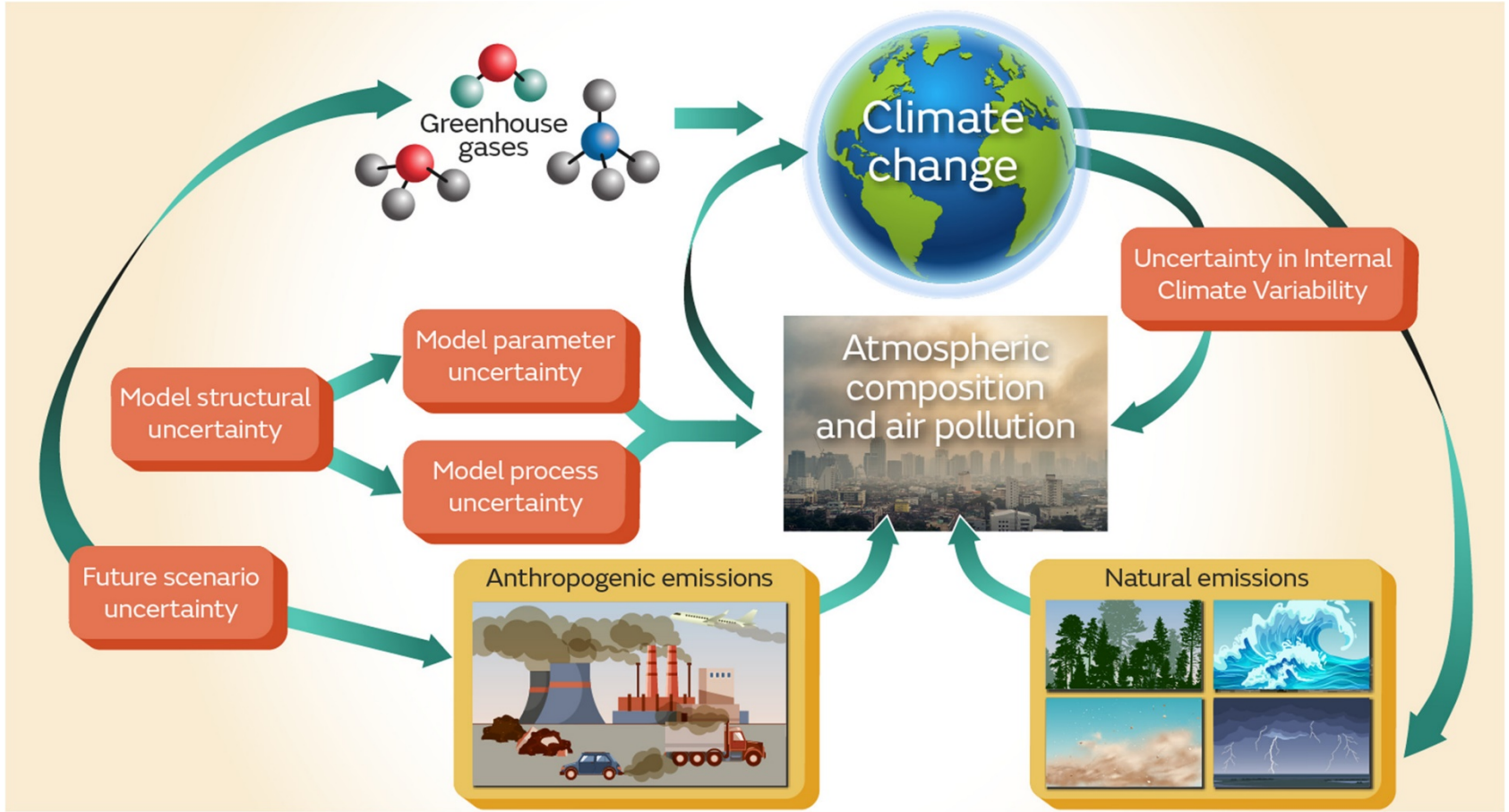


Compounding risk due to heat, water quality, and airborne pollution

Sources: Dedoussi et al. 2020, Schlosser et al. (in press)

Future air quality

Uncertain impacts – but accumulating

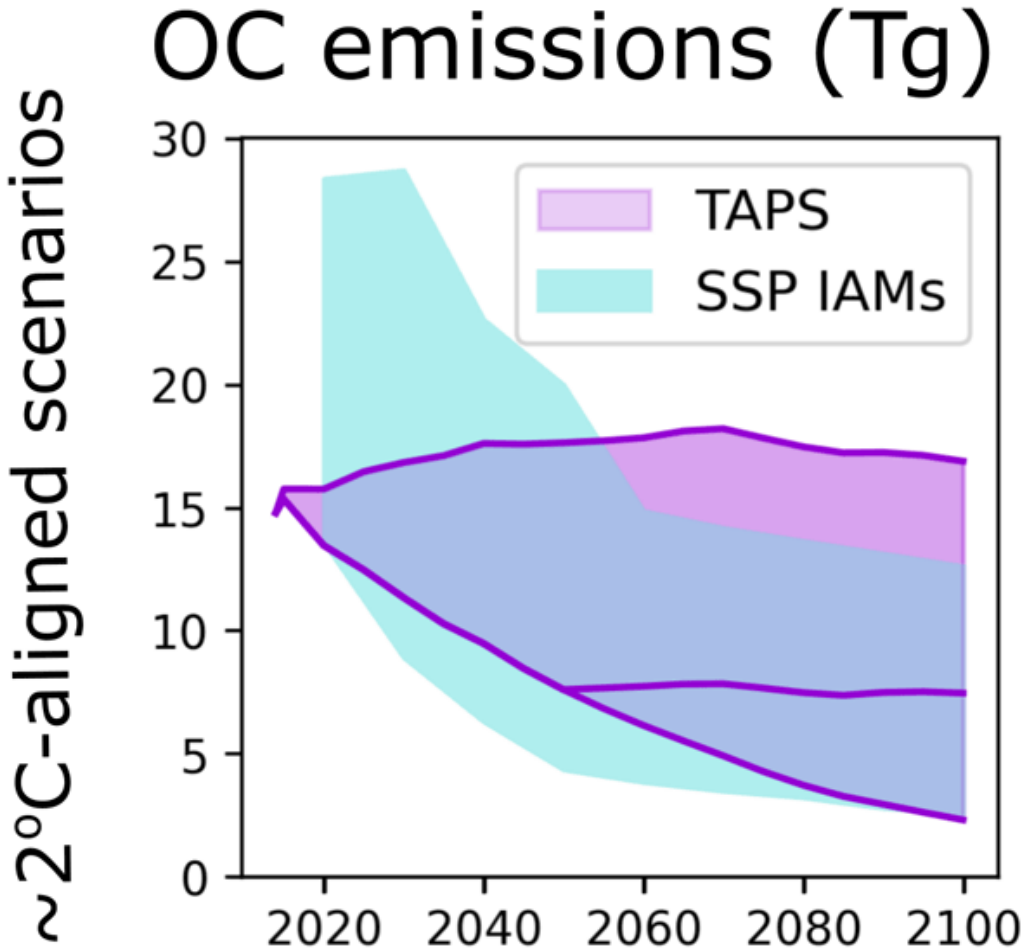


Source: Doherty et al. 2022

Future air quality

No free lunch: controlling emissions

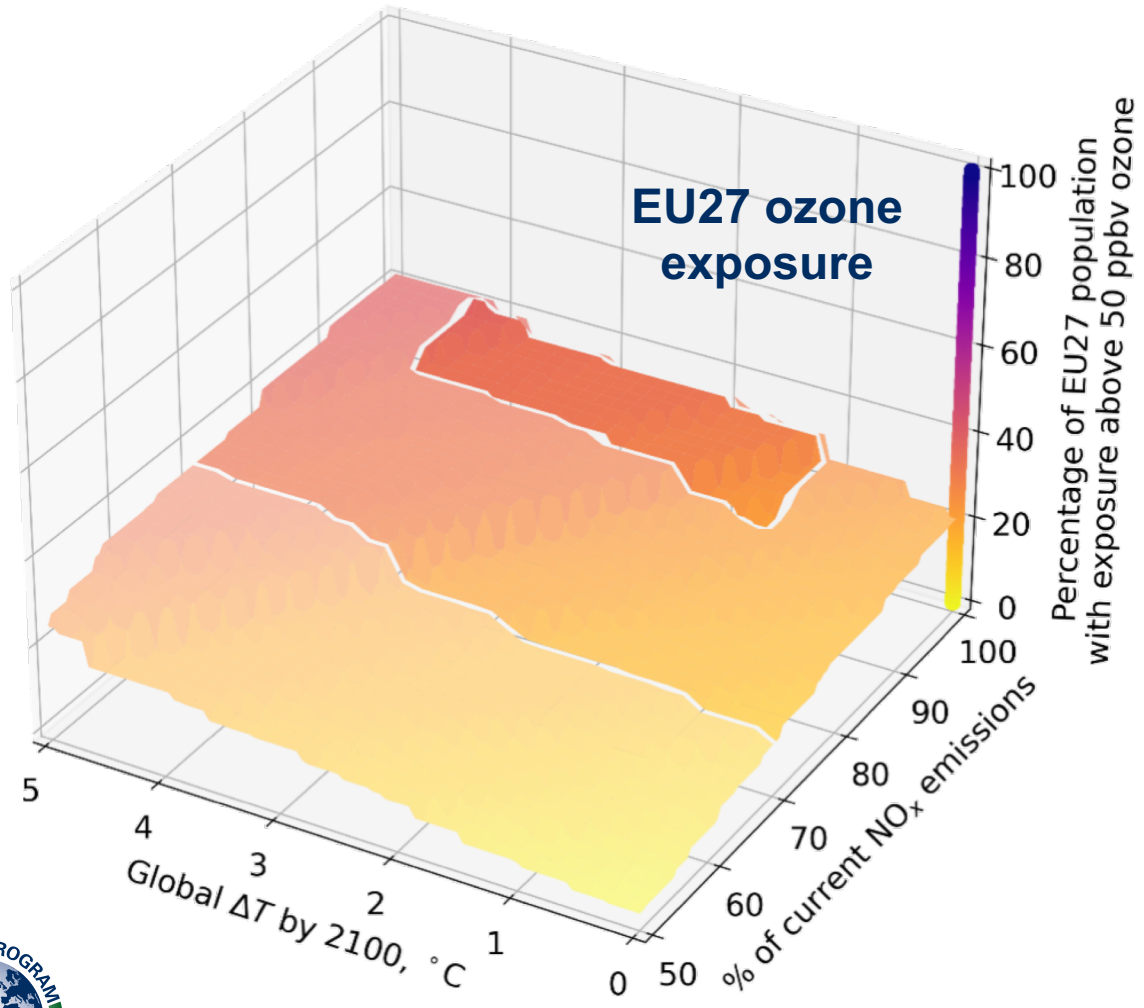
- Specifying climate policy is **not enough** to specify air quality
- Example: emissions of **organic carbonaceous aerosol** (OC)
- The Tool for Air Pollution Scenarios (TAPS) allows us to explore the (in)effectiveness of climate policy in reducing air pollutant **emissions**



Source: Atkinson et al. 2022

Future air quality

No free lunch: controlling impacts

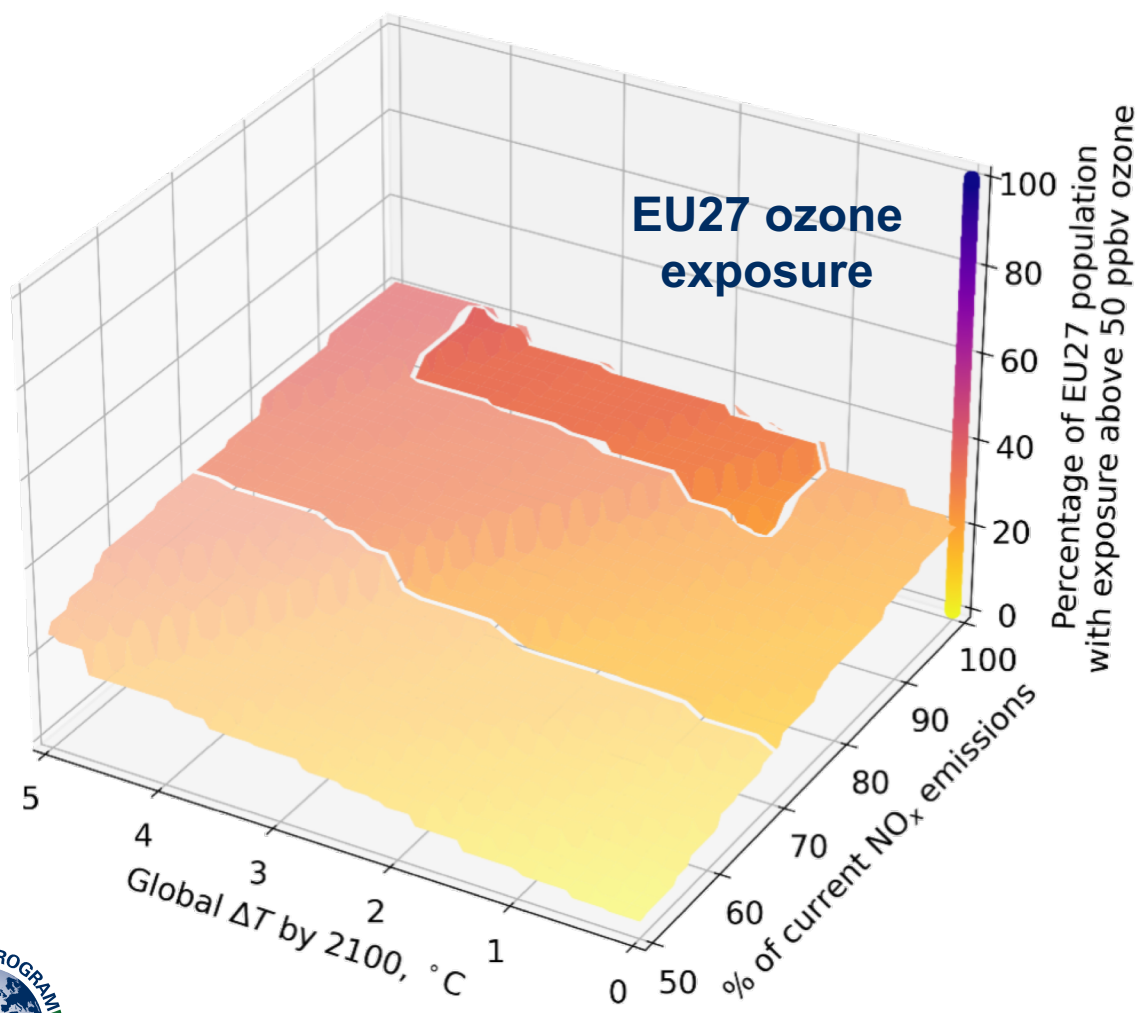


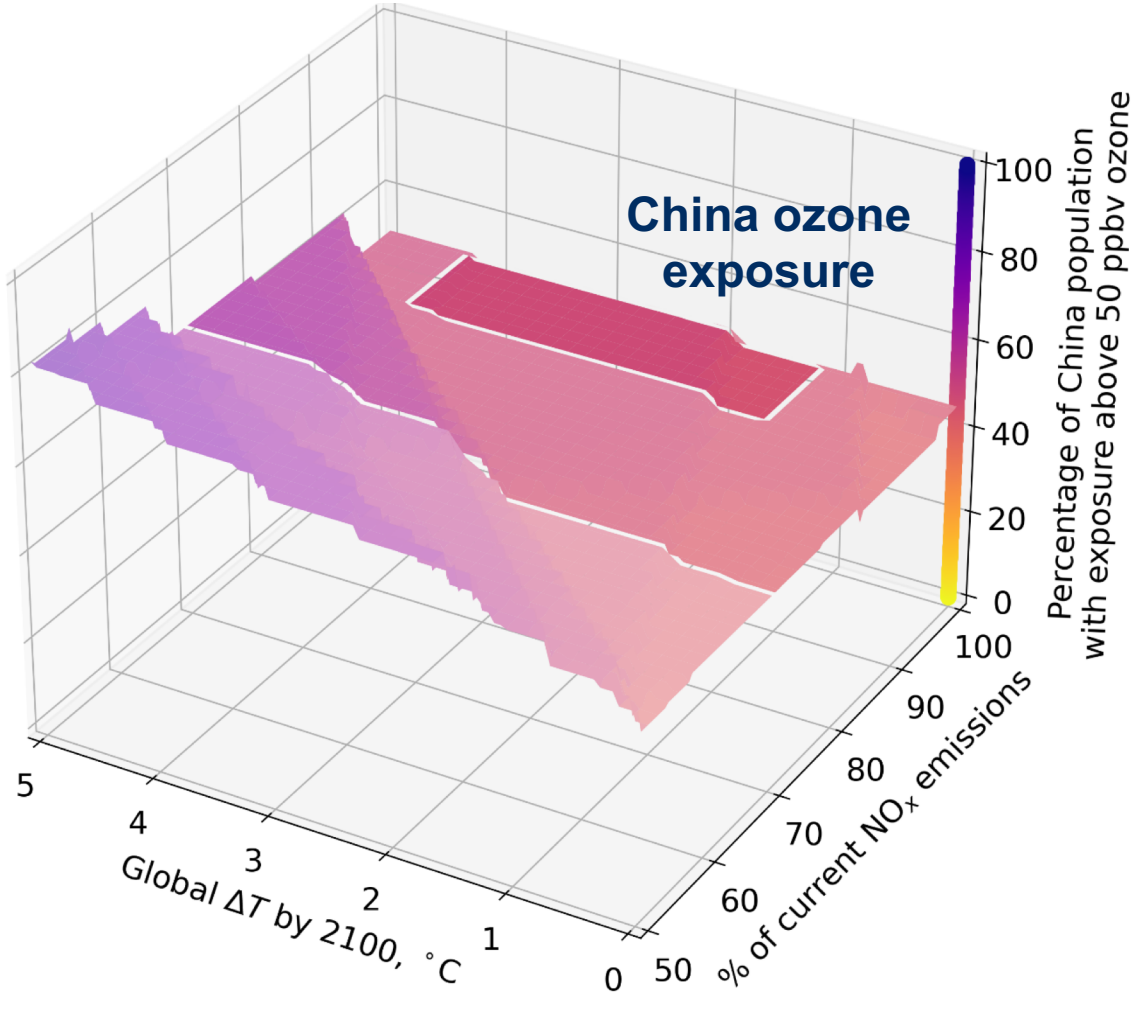
- Mitigating climate change is expected to yield some direct benefits
- Combining climate change mitigation with air pollutant emissions reductions may yield **compounding benefits**
- However, these benefits are **region specific** and **not guaranteed**

Source: Eastham et al. 2023

Future air quality

No free lunch: controlling impacts





Source: Eastham et al. 2023

Where do we go next?

Action in the face of uncertainty