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# Life Conference 2022

23-25 November, ACC Liverpool

**#LifeConf**





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# Climate Change, Health and Longevity Risk

Nick Spencer  
Nicola Oliver

**#LifeConf**



# Agenda

Physical and economic impacts of climate change  
**Nick Spencer (Gordian Advice)**

Health impacts arising from climate change, air pollution  
and lack of biodiversity including zoonotic diseases,  
mortality trends and reasons for hope  
**Nicola Oliver (Medical Intelligence)**



# Climate Change Health & Longevity

How does Climate impact health and longevity risks?

- 1 Physical Impacts
- 2 Transition Impacts
- 3 Interaction impacts e.g. inequalities, biodiversity, food systems and one-health





# Climate risks are coming

## Two choices: change or catastrophe

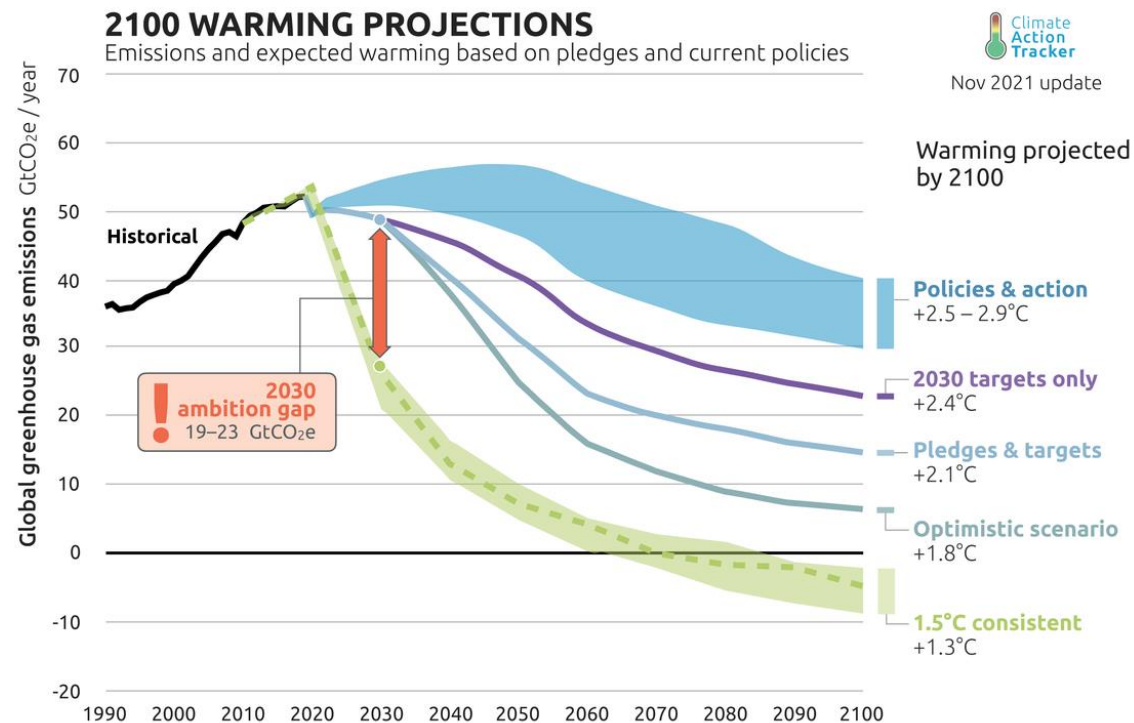


Chart Source: Climate Action Tracker, <https://climateactiontracker.org/global/temperatures/>

1. Throughout this presentation use of "Carbon" or "CO<sub>2</sub>" are used as a proxy for greenhouse gas emissions and their CO<sub>2</sub> equivalent impact on climate warming.

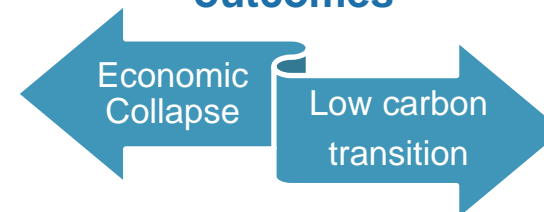
2. Eg Schroder Climate Progress dashboard, 3.3°C of warming (August 2022)  
<https://www.schroders.com/en/uk/pensions/insights/climate-progress-dashboard/>

- CO<sub>2</sub> concentrations<sup>1</sup> are at record levels and still rising
- Different estimators offer a range of temperature projections but 3 – 4°C by 2100 and rising often quoted based on current efforts<sup>2</sup>
- A 4°C rise is almost certainly inconsistent with our modern global economy

*"In any case, we have no choice: a 2°C world might be insurable, a 4°C world certainly would not be."*

**Henri de Castries, CEO AXA 2015**

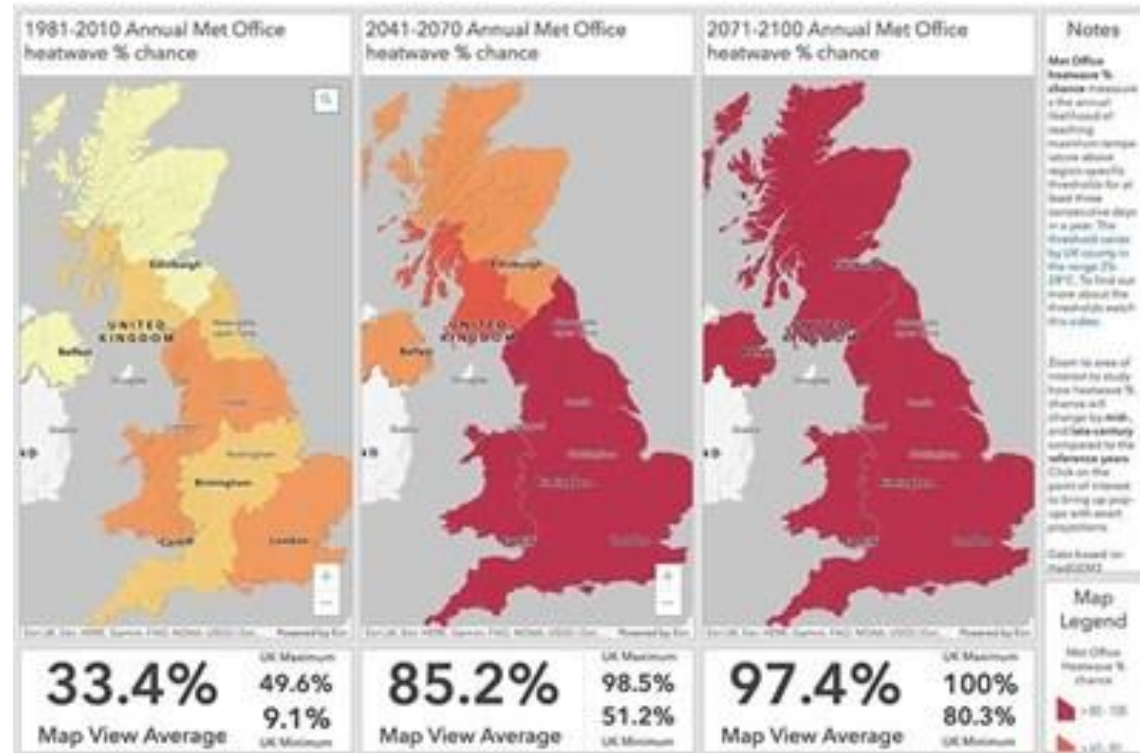
**The Paris Agreement exists as there are only two outcomes**



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# Physical Impacts: the heat is on

- Land temperature rising faster.
- Health impacts from prolonged and extreme exposures.
- Dramatic impacts expected on heatwaves (graphs show UK probability of heatwave (25°-28°, 3+ days))
- Climate models not yet at local scale and current impacts are significantly ahead of predictions



Source: <https://www.sec-ed.co.uk/resources-products/cop26-climate-change-resources-met-office-esri-uk-geography-1/>

*Very significant impacts on mis-aligned housing and infrastructure – adaptation required with spending likely to fall short for the more vulnerable.*



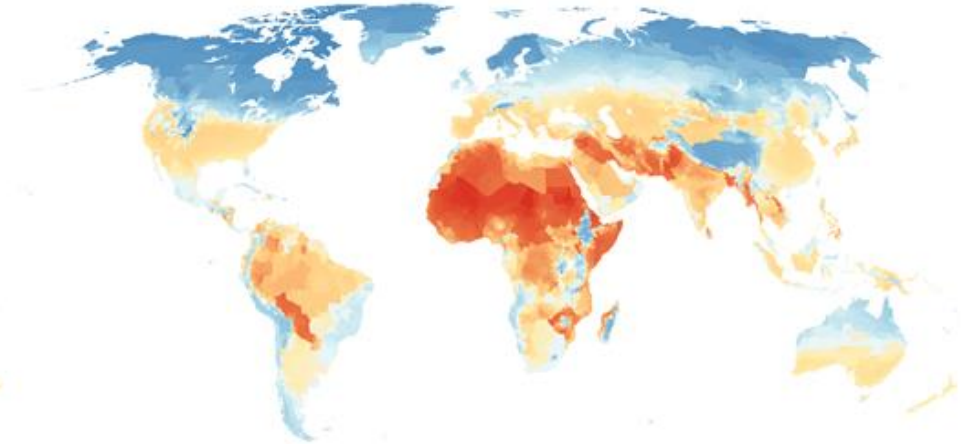
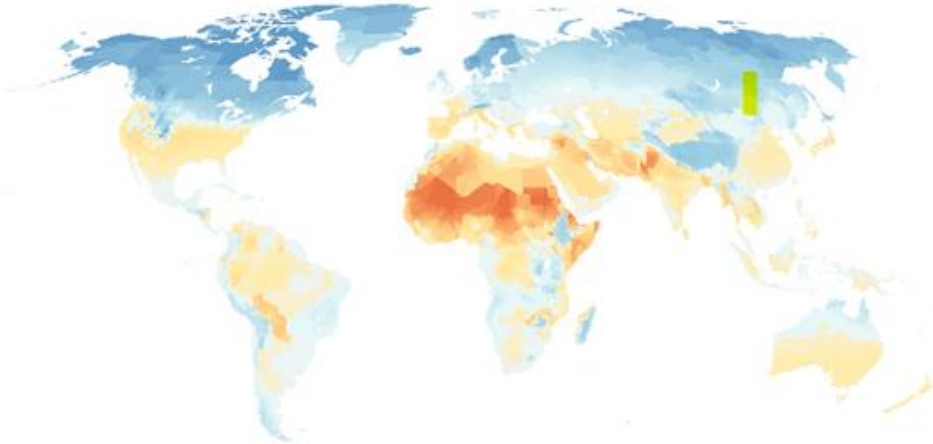
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# Mortality risk changes from temperature shifts

## Moderate and higher climate forcing scenarios

SSP3-RCP4.5 (2100)

SSP3-RCP8.5 (2100)

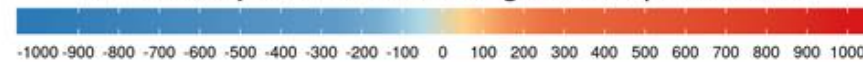


Full mortality risk of climate change (deaths per 100,000)



Min: -264.8773 Max: 242.8699

Full mortality risk of climate change (deaths per 100,000)



Min: -624.4095 Max: 887.1235

Source: <https://impactlab.org/research/valuing-the-global-mortality-consequences-of-climate-change-accounting-for-adaptation-costs-and-benefits/>

***Under high emissions, temperature impacts on projected global death rates increase by 73 per 100,000 on par with today's leading causes of death...before other impacts***



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# Physical Impacts: not just hotter

## Coastal zones and regional seas

- Sea level rise
- Increase in sea surface temperatures
- Increase in ocean acidity
- Northward migration of marine species
- Risks and some opportunities for fisheries
- Changes in phytoplankton communities
- Increasing number of marine dead zones
- Increasing risk of water-borne disease

## Mediterranean Region

- Large increase in heat extremes
- Decrease in precipitation and river flow
- Increasing risk of forest fires
- Increased competition between different water users
- Increase in mortality from heatwaves
- High vulnerability to spillover effects of climate change from outside Europe

## Atlantic Region

- Increase in heavy precipitation events
- Increase in river flow
- Increasing risk of river and coastal flooding
- Increasing damage risk from winter storms
- Decrease in energy demand for heating
- Increase in multiple climatic hazards



## Continental region

- Increase in heat extremes
- Decrease in summer precipitation
- Increasing risk of river floods
- Increasing risk of forest fires
- Decrease in economic value of forests
- Increase in energy demand for cooling

## Boreal Region

- Increase in heavy precipitation events
- Decrease in snow, lake, and river ice cover
- Increase in precipitation and river flows
- Increasing potential for forest growth and increasing risk of forest pests
- Increasing damage risk from winter storms
- Increase in crop yields
- Decrease in energy demand for heating
- Increase in hydropower potential
- Increase in summer tourism

## Mountain region

- Temperature rise larger than European average
- Decrease in glacier extent and volume
- Upward shift of plant and animal species
- High risk of species extinctions
- Increasing risk of forest pests
- Increasing risk from rock falls and landslides
- Changes in hydropower potential
- Decrease in ski tourism

Not just hotter – but more floods, wildfires, hurricanes, cold/freezing weather and sea level rises/storm surges.



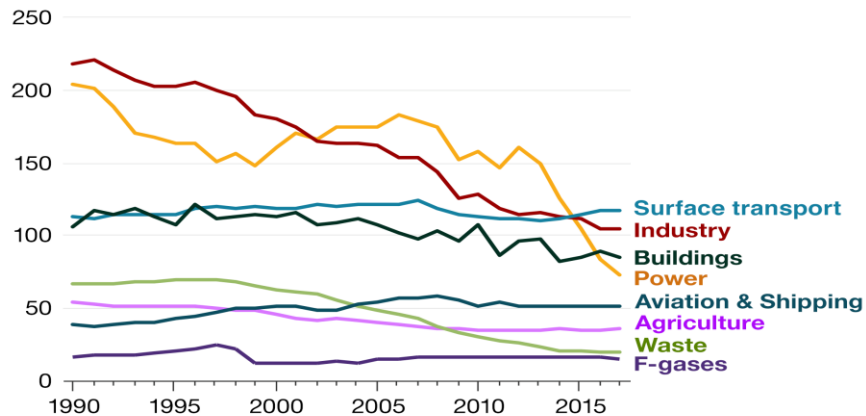


# Transition Risks: climate changes everything

## What needs to happen: 2021 UK Climate Change Committee report

### Progress reducing emissions in the UK has been imbalanced

Annual emissions, million tonnes of CO2 equivalent

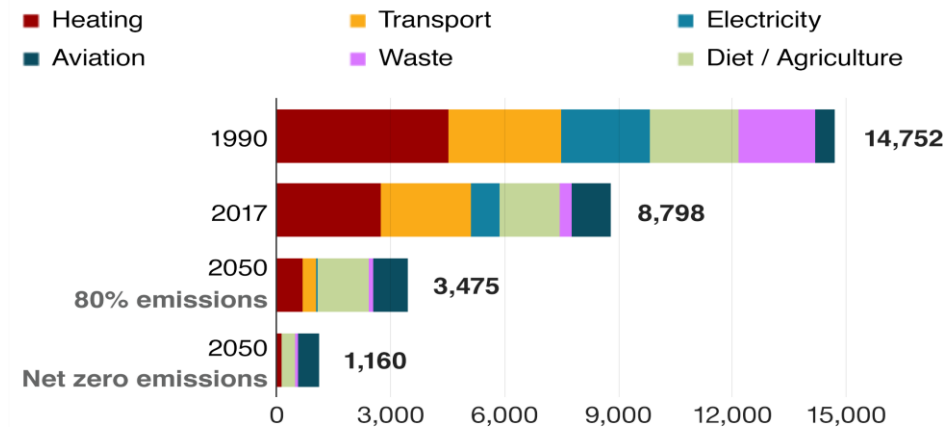


Source: Climate Change Committee/BEIS (2019)



### Household emissions in 1990, 2017 and 2050

Annual emissions, kilogrammes of CO2



Source: Climate Change Committee/BEIS (2019)



### Existing changes focused in “easier” sectors

#### Next phases harder:

- Housing (10 million homes < Eff. Band C)
- Low carbon heating (c 30% but little progress)
- Farming (c 15% and future path unclear)
- Industry (harder conversions remain)
- Aviation & shipping (hard)

### Transformational changes in just 30 years...

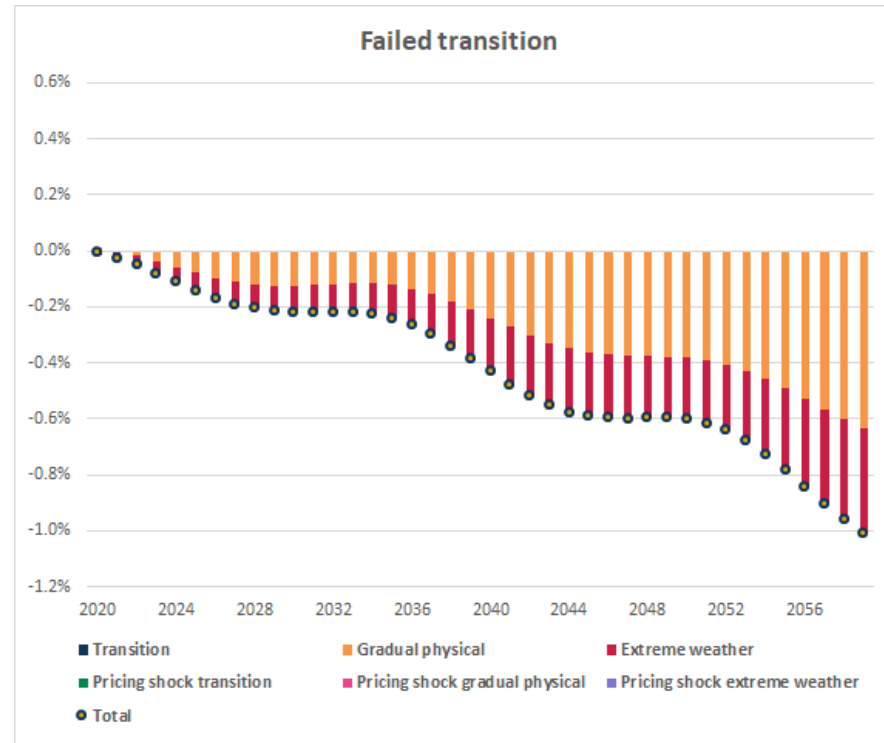
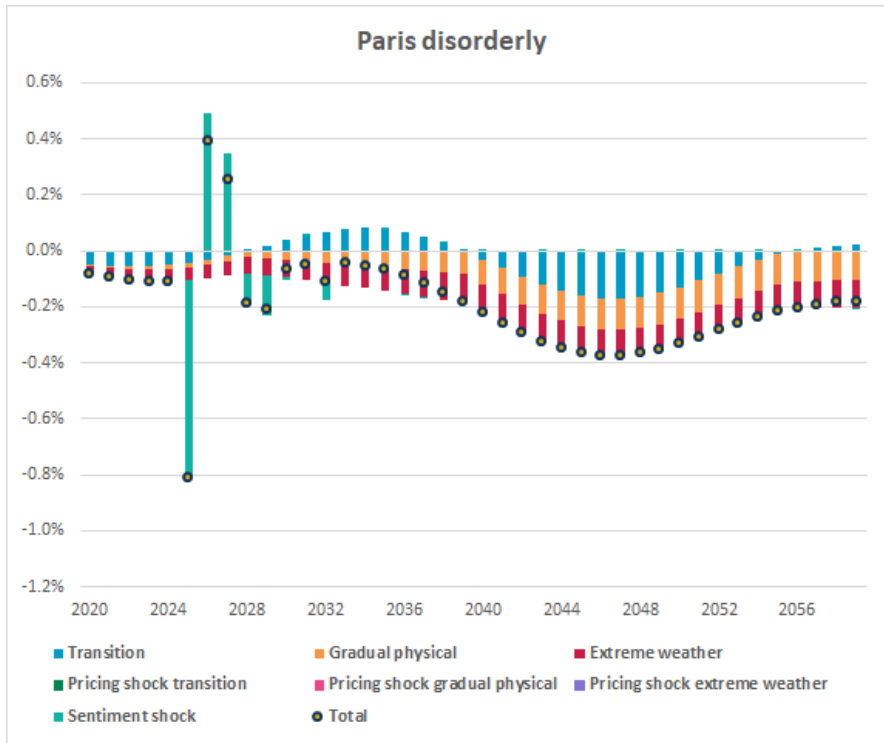
- 4x amount of electricity
- Significant retro-fitting to buildings
- Gas networks to hydrogen
- Limiting aviation; electric cars from 2030s
- Less meat consumption
- Less waste, more recycling



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# Climate GDP impacts are material

Material for “Paris Aligned”, starts overwhelming productivity in failed transition



Percentage difference in the level of annual UK GDP explained by the various climate risk drivers (difference to climate-uninformed baseline pathway)



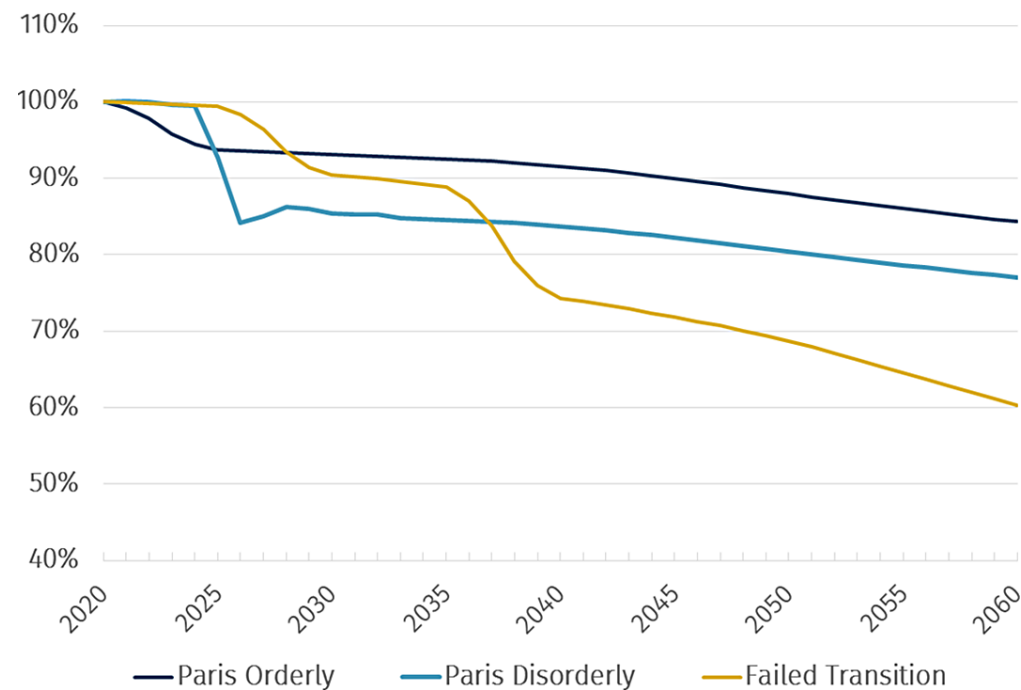
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# Intersectionalities: Markets and Wealth

Reflects on broader healthcare and adaption challenges

- Underperformance by 60% or more for some asset classes by 2060 (Global Equities over 70%)
- Market impact a reflection of GDP and wealth impacts
- GDP & wealth will impact healthcare spending as well as healthcare R&D and financing physical adaptations

**Figure 17.** Climate-adjusted UK equity returns (ratio of cumulative medians to the cumulative median of climate-uninformed baseline pathway).



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# Intersectionalities: air pollution

Increased Ozone and PM 2.5 Concentrations could create similar annual excess deaths to those of COVID19 (3-4 million pa)

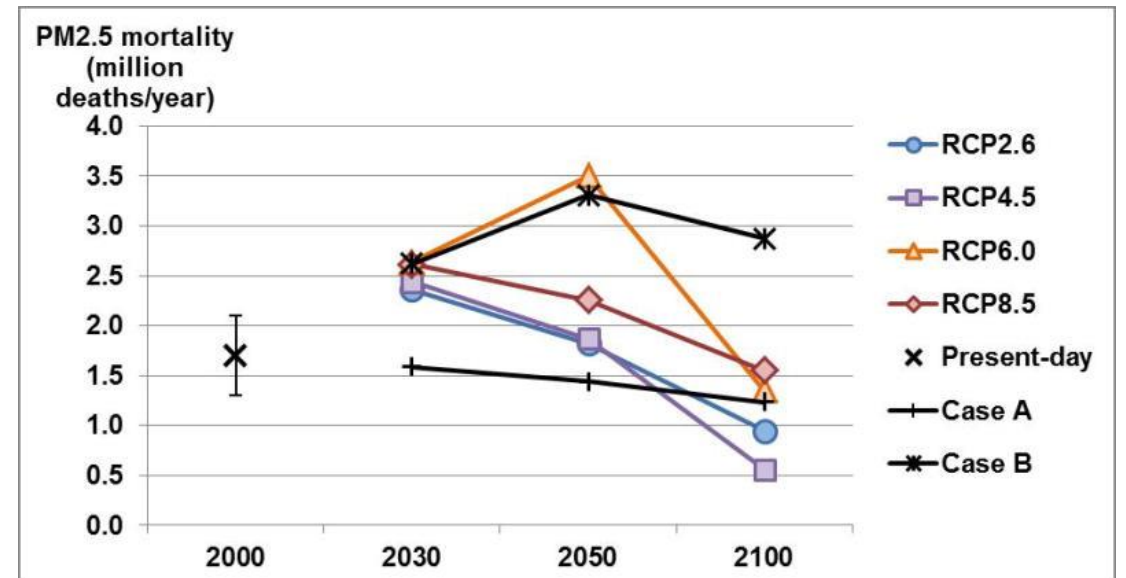
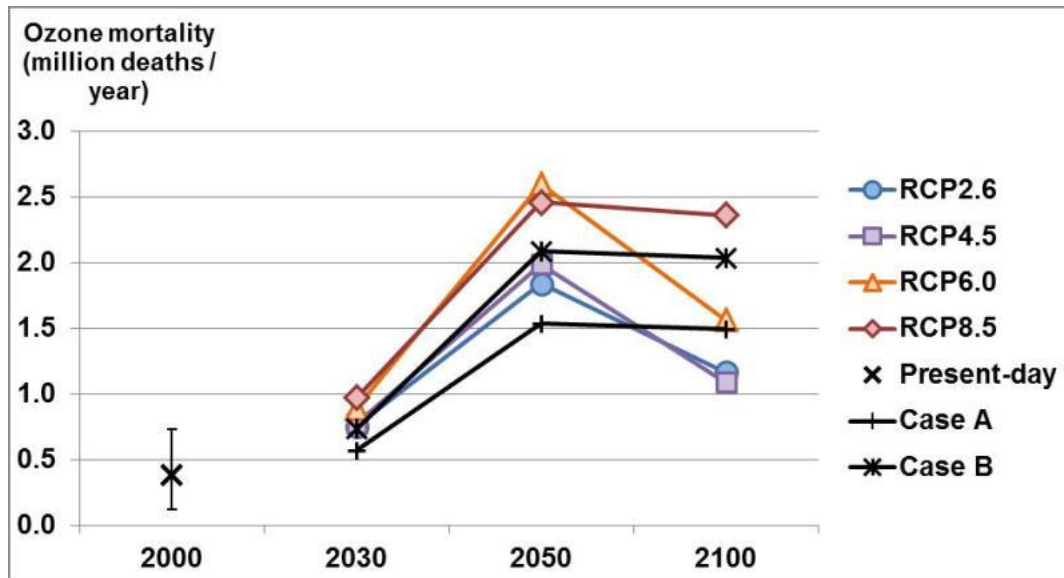


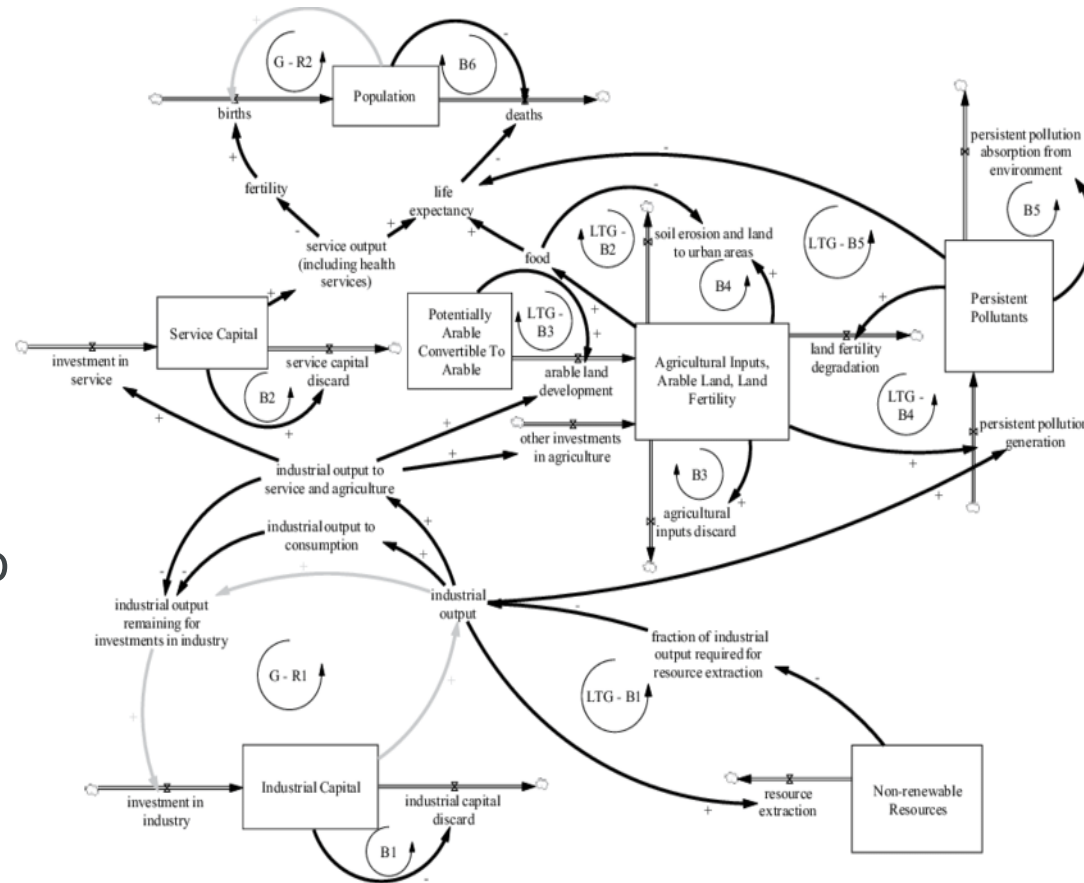
Image Source: [The effect of future ambient air pollution on human premature mortality to 2100 using output from the ACCMIP model ensemble - PubMed \(nih.gov\), 2016](#)



# Intersectionalities: Food system

## Access to, and equality of, nutrition

- Food systems... it's complicated
- Shift in climate likely to have significant impact especially on price and the variability of supply
- Supply insecurity and price volatility quite likely to lead to food nationalism and thus a significant geopolitical issue
- Access to, and equality of, nutrition will be reduced

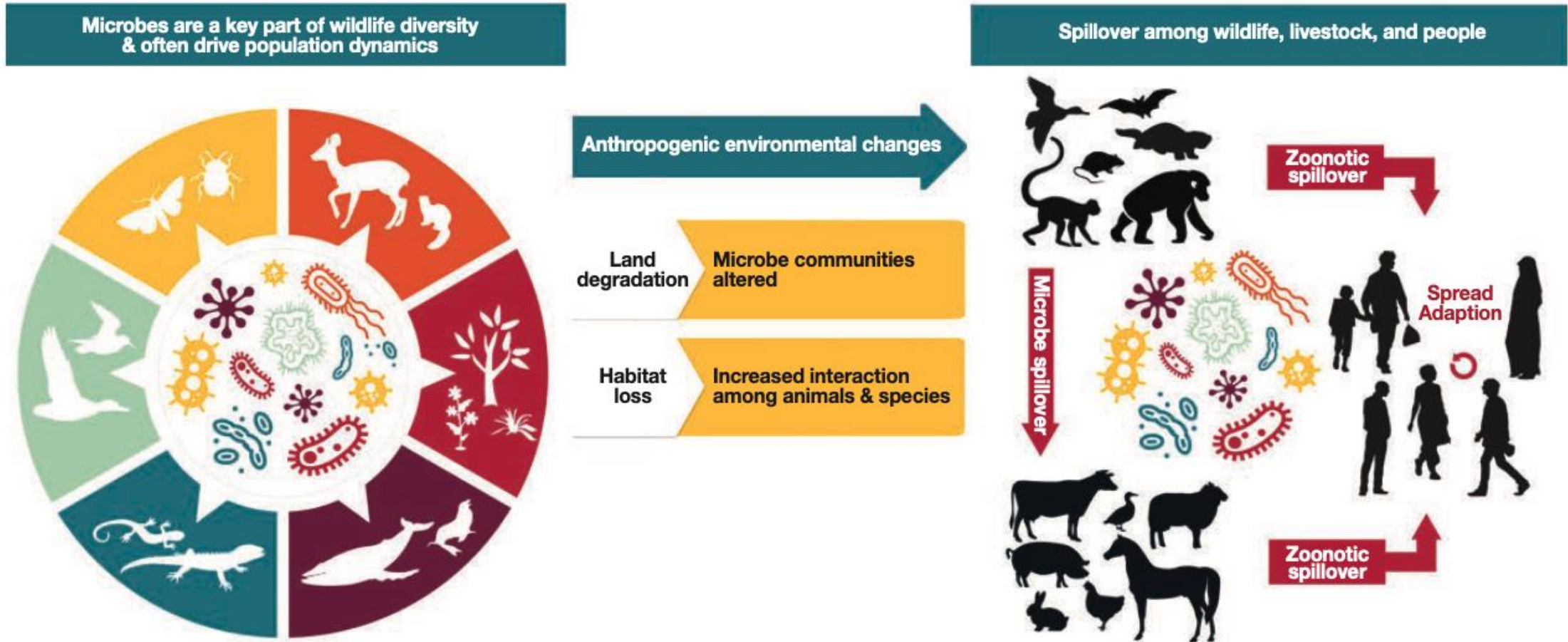


Major feedback loops and accumulation processes in the World3-03

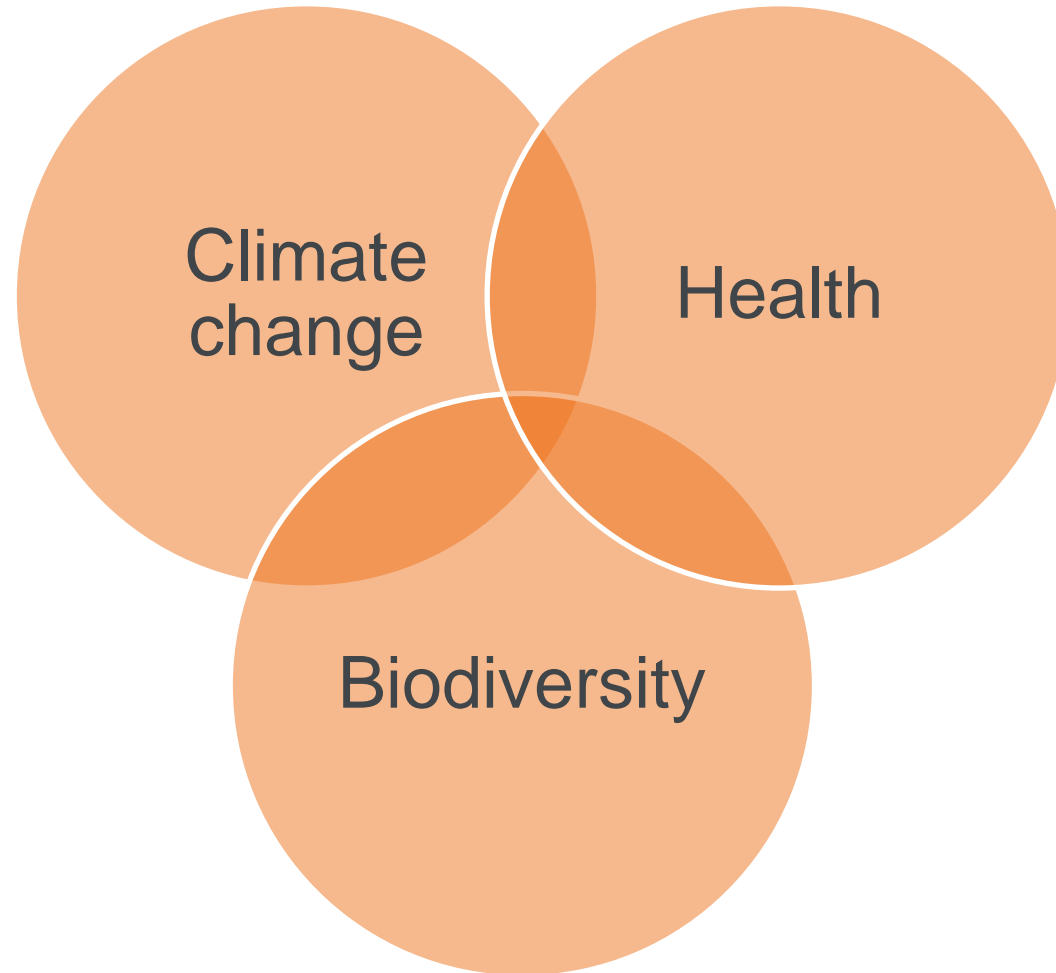


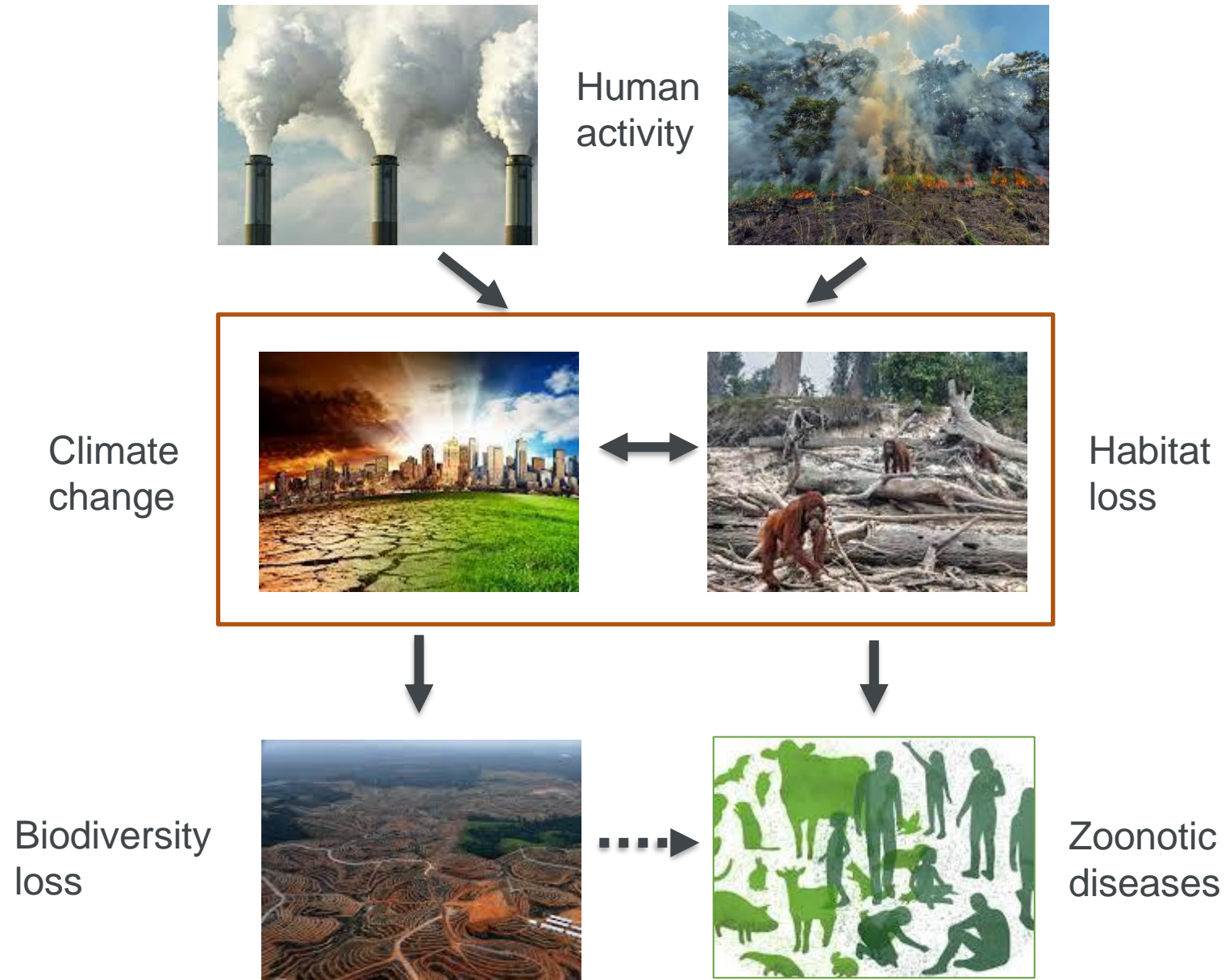
# Intersectionalities: biodiversity and “One health”

## Origins and drivers of emerging zoonotic diseases and pandemics



# Health implications







# Air Pollution



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# Air

## What is Particulate Matter?

Extremely small particles that enter via the lungs, absorbed by blood, and spread within the body

< 1/5 of width of a hair: PM10

< 1/20 of width of a hair: PM2.5

Released by:

- Burning fossil fuels
- Climate-related wildfires

PM2.5  
PM10

Hair

# Air Pollution

## Why does air quality matter?

**7m** premature deaths p.a. due to air pollution vs +- 60m total

**99%** of the global population breathes air below WHO recommended limits

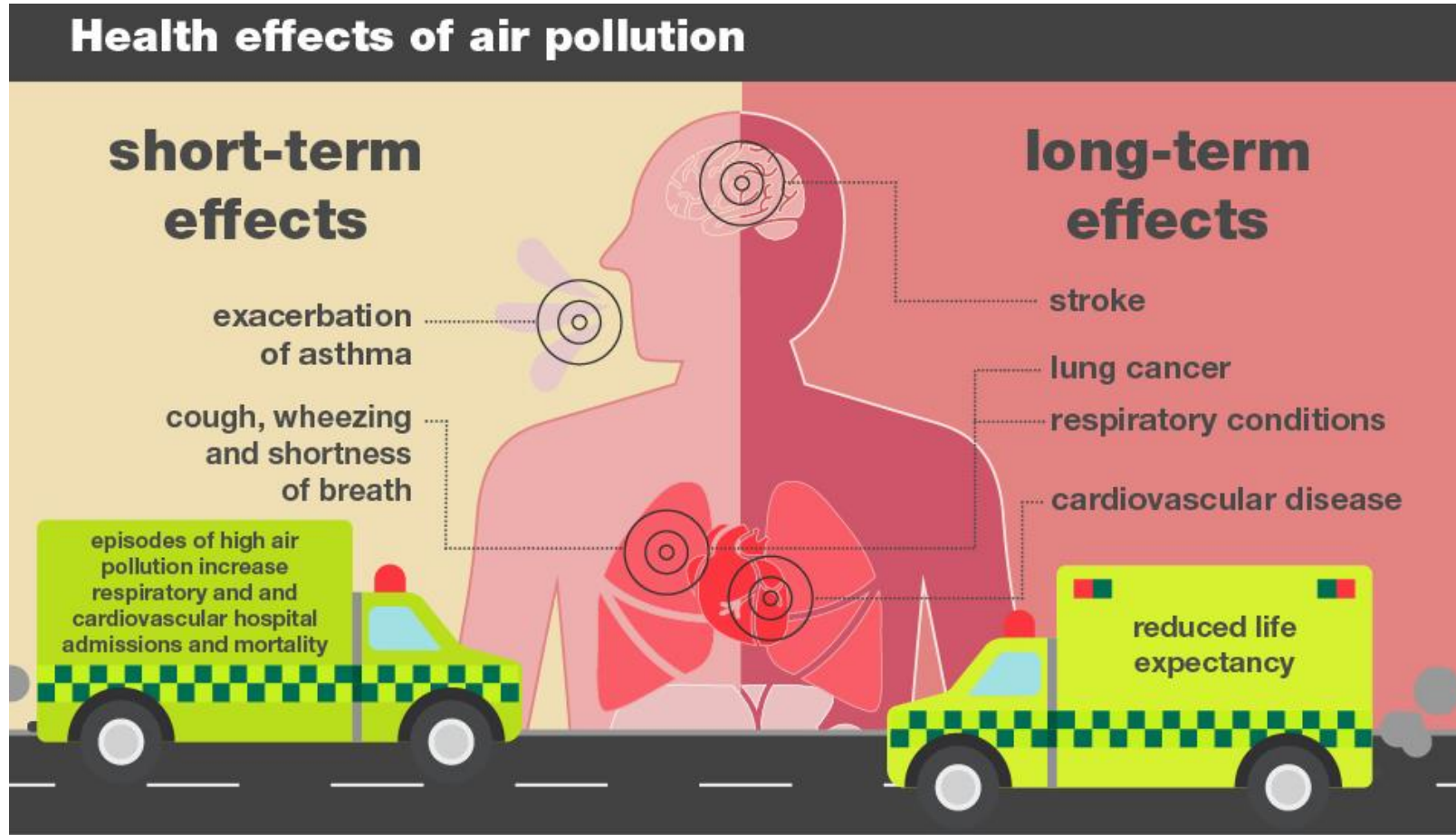
[The Lancet Planetary Health](#)

[World Economic Forum](#)



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# Air Pollution



# Air Pollution

## Scale of the problem

It is estimated that **long-term exposure to man-made air pollution in the UK** has an annual effect equivalent to:



**28,000 to 36,000 deaths**

Over the following 18 years a **1  $\mu\text{g}/\text{m}^3$  reduction in fine particulate air pollution in England** could prevent around:



**50,900** cases of coronary heart disease

**16,500** strokes



**9,300** cases of asthma

**4,200** lung cancers





# Air Pollution

Climate > News

## Ella Kissi-Debrah inquest: Coroner says air pollution contributed to death of nine-year-old in landmark ruling

Case is first time exposure to air pollution has been recorded as medical cause of death

Harry Cockburn | Wednesday 16 December 2020 18:01 | comments



Ella Kissi-Debrah died after being exposed to 'excessive air pollution' (PA)

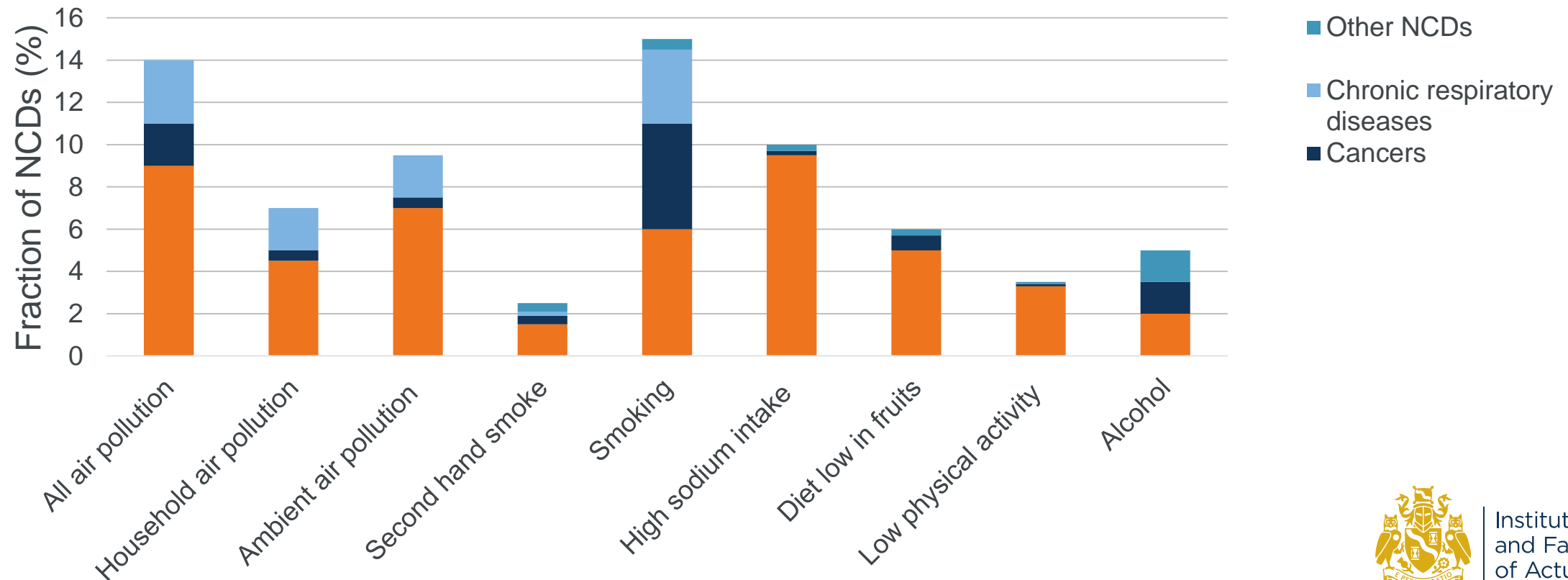


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# The effect of air pollution to NCDs is equivalent in scale to the effect of smoking

2016 global study

[Environmental risks and non-communicable diseases | The BMJ](#)



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# How much does mortality risk increase when air pollution increases?

- Numerous epidemiological studies
- Study of 29 European countries: respiratory mortality increased by **0.58%** for every 10  $\mu\text{g}/\text{m}^3$  increase in PM10
- US Medicare study: Respiratory diseases increased by **2.07%**, hospitalisation rate increased by **8%** for 10  $\mu\text{g}/\text{m}^3$  increase in PM2.5
- US cohort study over 7 years: lifespan **0.35 years** shorter for every 10  $\mu\text{g}/\text{m}^3$  increase in PM2.5
- American Cancer Society study: increase in mortality **4%**, cardiopulmonary disease mortality **6%** and lung cancer mortality **8%** for every 10  $\mu\text{g}/\text{m}^3$  increase in PM2.5
- American Cancer Society cohort study over 26 years: lung cancer mortality increased **15-27%** for 10  $\mu\text{g}/\text{m}^3$  increase in PM2.5
- 11 European cohort studies: after balancing smoking and other interfering factors, hazard ratio of lung adenocarcinoma was **2.4** for every 10  $\mu\text{g}/\text{m}^3$  increase in PM2.5
- US cohort study over 28 years, National Health Interview Surveys: hazard ratios for all-cause mortality **1.12**, cardiopulmonary mortality **1.23**, lung cancer mortality **1.12** for 10  $\mu\text{g}/\text{m}^3$  increase in PM2.5 long-term exposure

[The impact of PM2.5 on the human respiratory system - PMC \(nih.gov\)](#)

[Mortality Risk and Fine Particulate Air Pollution in a Large, Representative Cohort of U.S. Adults | Environmental Health Perspectives | Vol. 127, No. 7 \(nih.gov\)](#)



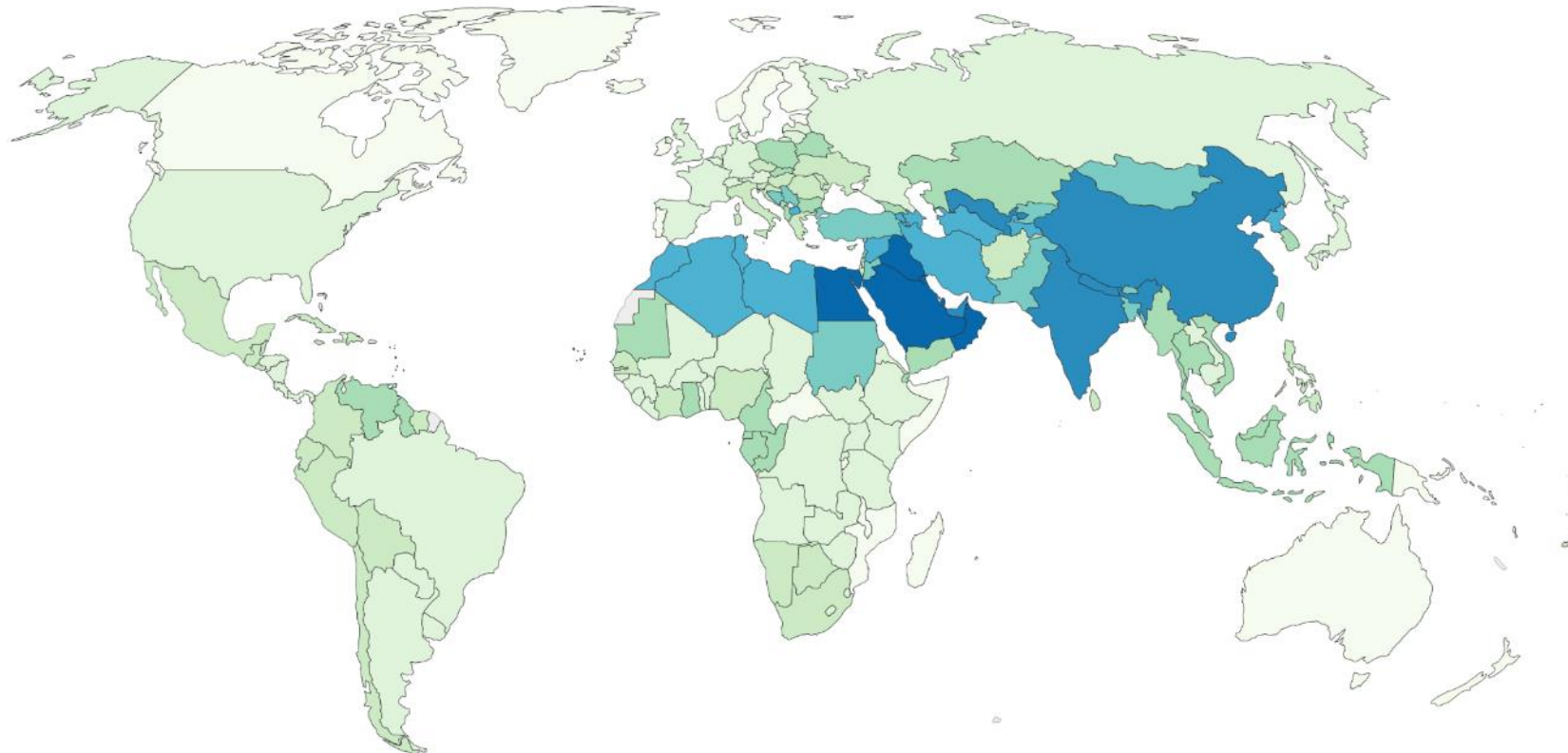
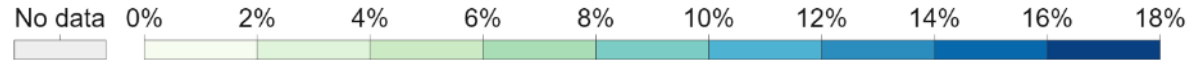
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# Distribution of % deaths due to outdoor air pollution across the globe

## Share of deaths attributed to outdoor air pollution, 2019

Share of deaths, from any cause, which are attributed to outdoor air pollution – from ambient particulate matter and ozone – as a risk factor.

Our World  
in Data



# Extreme Temperatures



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## How is the body affected?



**Heart** – blood pressure falls when blood moves from central organs to periphery for cooling, heart beats faster, can cause fainting, even heart failure



**Brain** – hypothalamus is thermostat, nerve cell malfunction, personality changes, clumsiness, may never fully recover in up to 20% of heatstroke cases



**Kidneys** – control water and salt, lost through sweat, recurrent heat stress and dehydration causes chronic kidney disease



**Gut** – blood moves to periphery, lack of oxygen causes inflammation, nausea, vomiting, flare-ups of inflammatory bowel disease

### Who is most vulnerable?

Elderly, less abled and already infirm

Infants, children and pregnant women

Outdoor and manual workers

Athletes

Poor, displaced and homeless

[Heat and Health \(who.int\)](http://who.int)

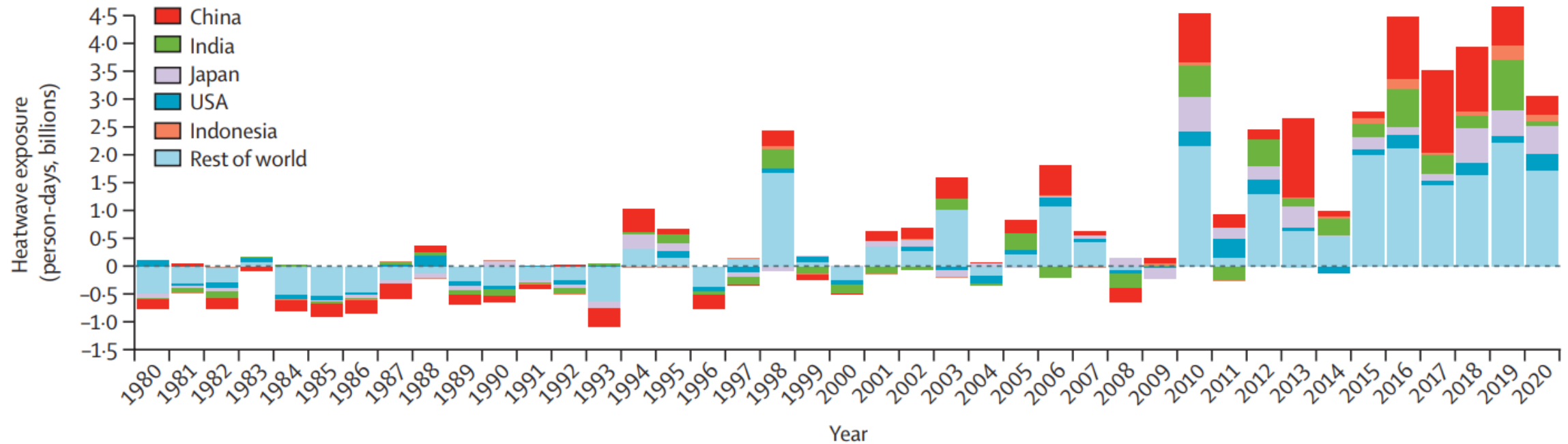


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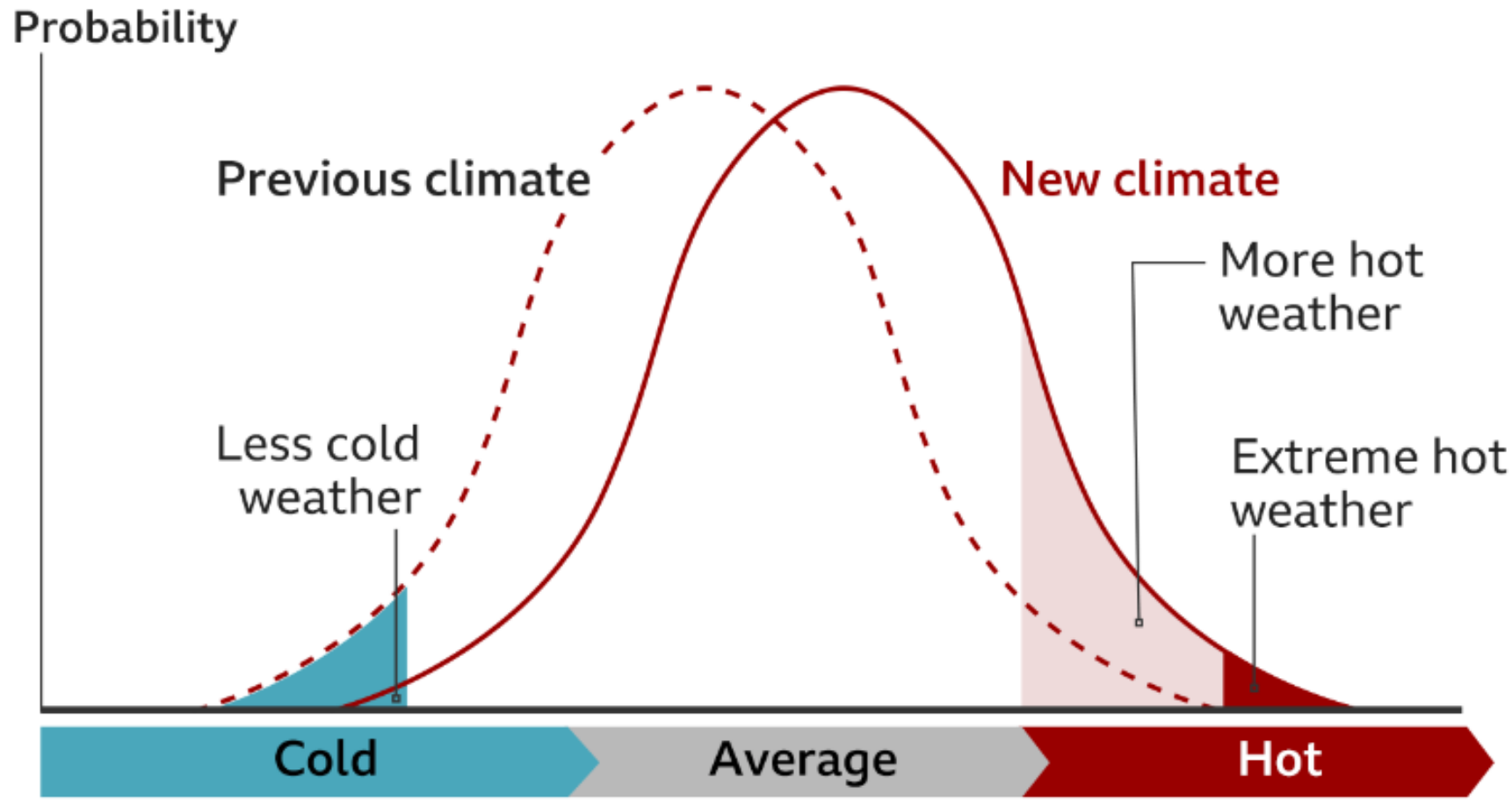
# People are exposed to increasingly more hot days

Change in person-days of heatwave exposure relative to the 1986-2005 baseline:  
People older than 65 years

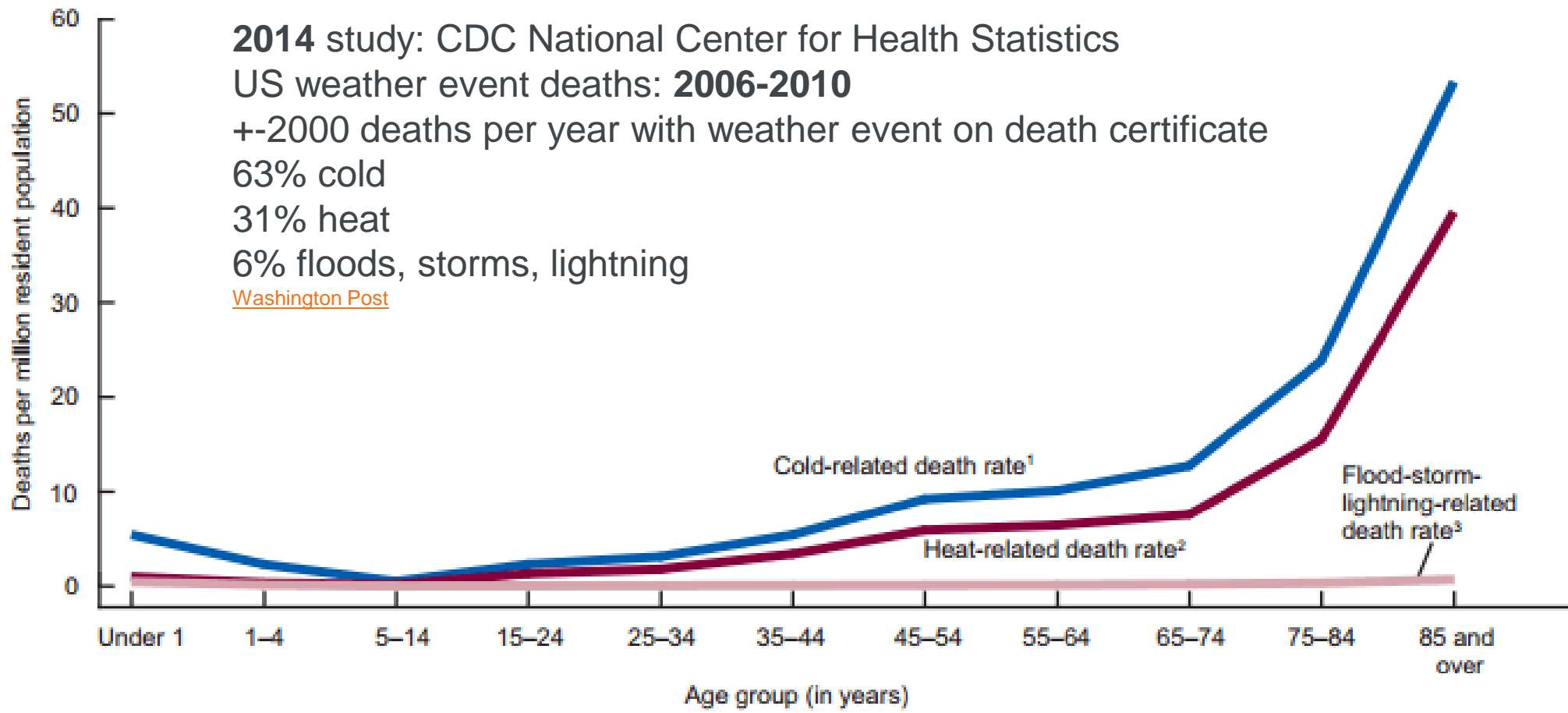
[The 2021 report of the Lancet Countdown on health and climate change: code red for a healthy future - The Lancet](#)



# Hot days are increasing in both frequency and intensity



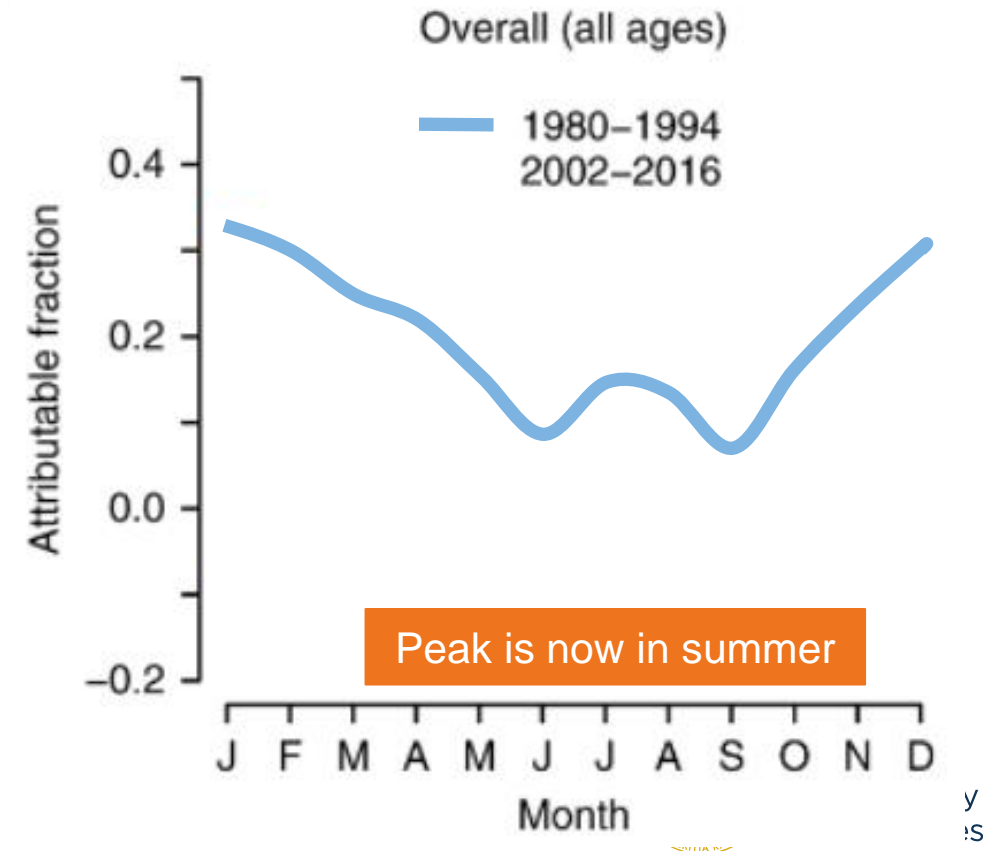
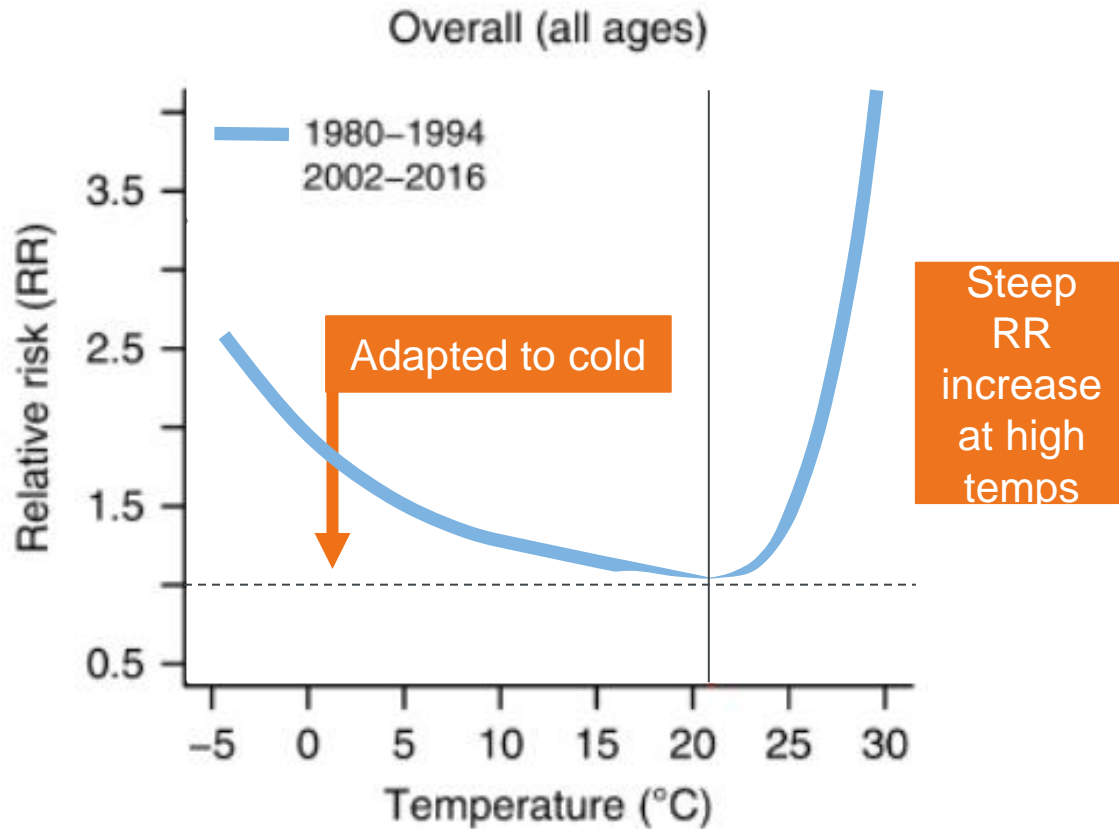
# We can expect a shift in deaths from extreme cold to extreme heat



# We have learnt to adapt to cold, and now deaths are reversing in seasonality

Respiratory disease deaths in Spain: 1980 - 2016

[Reversal of the seasonality of temperature-attributable mortality from respiratory diseases in Spain | Nature Communications](#)





# Uncertainty



## Uncertainty between scenarios

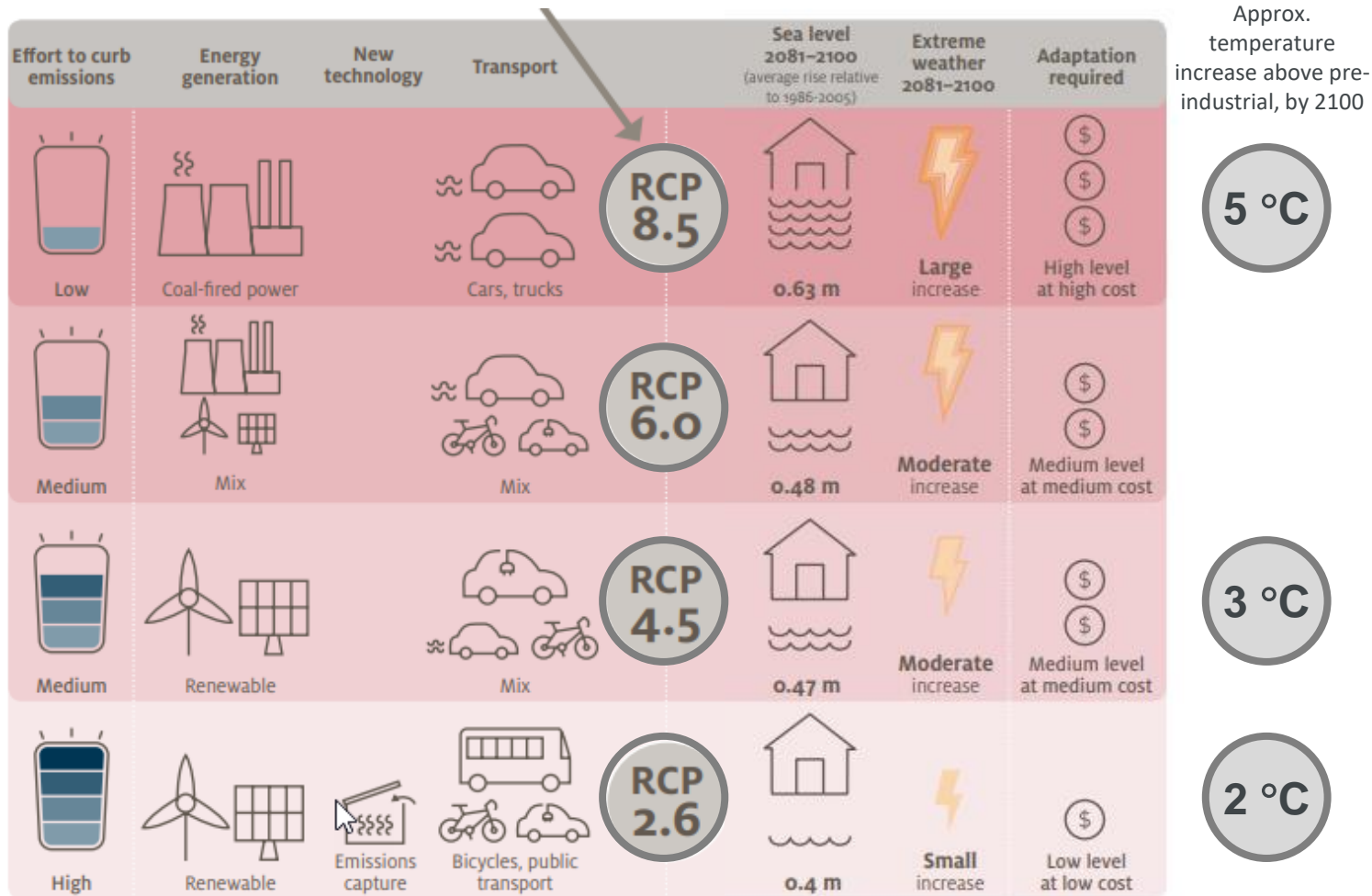
Which transition pathway will we follow?

## Uncertainty within scenarios

Within whichever pathway we follow, how will systems and people adapt?



# The Representative Concentration Pathways (RCPs) illustrate the tradeoff decision between mitigation efforts, adaptation costs and impact.

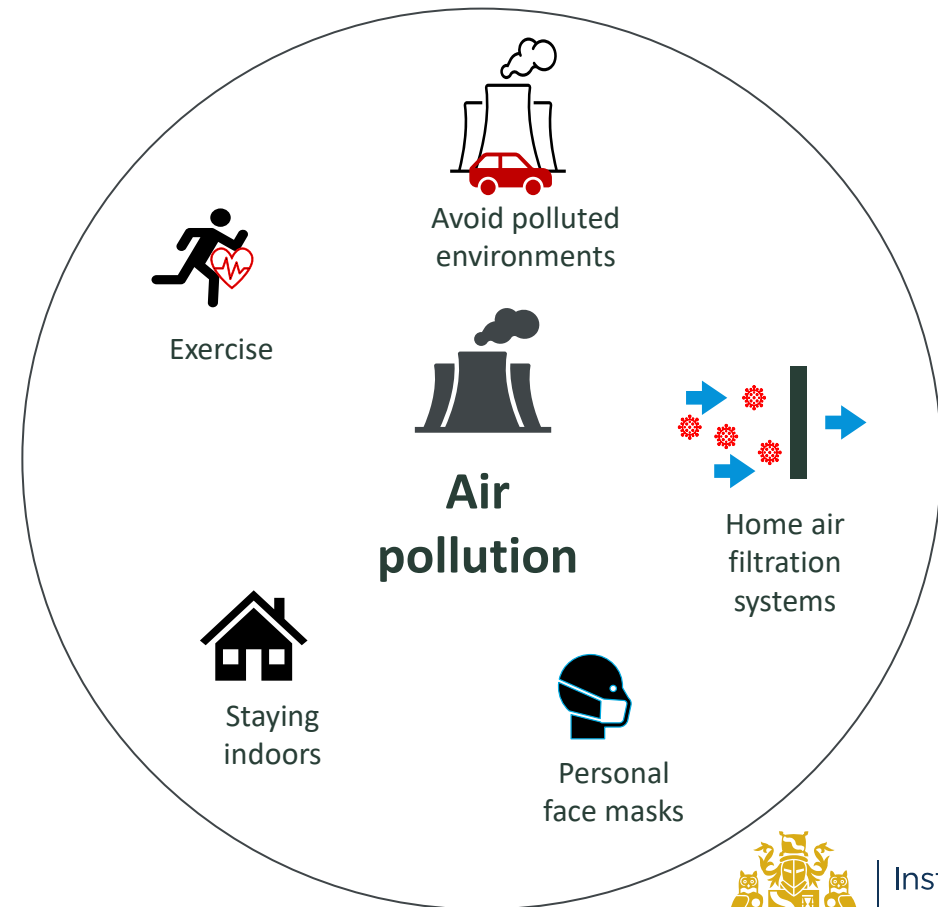
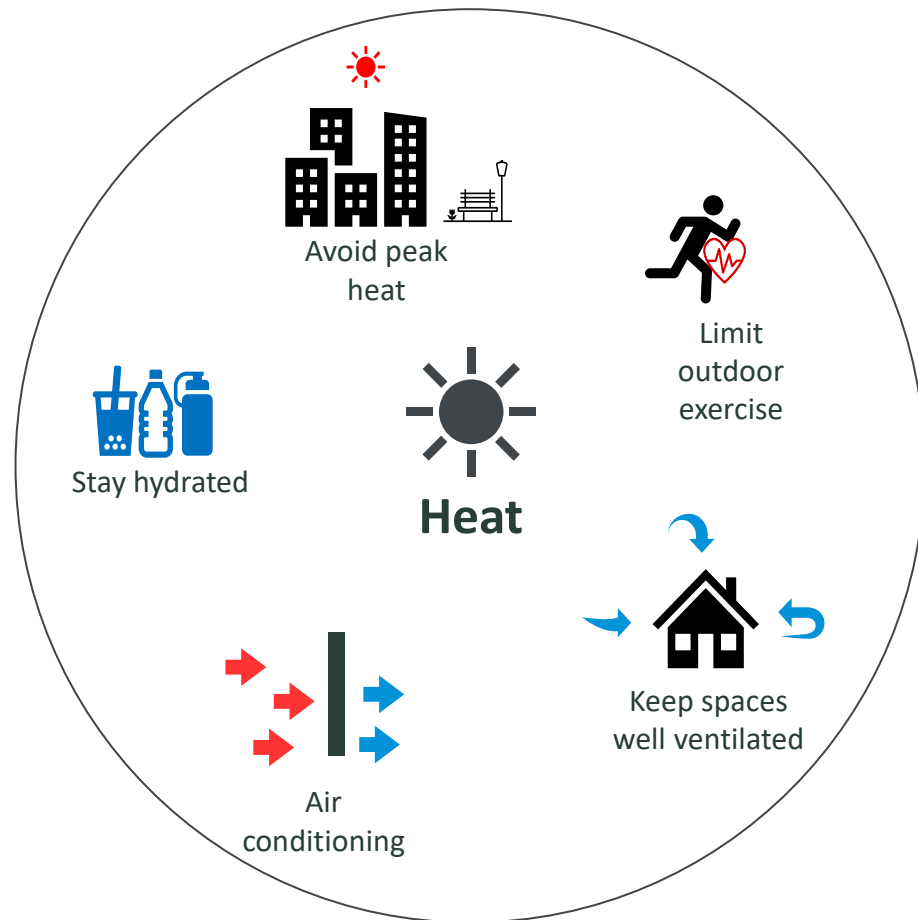


We are currently tracking close to RCP8.5, which would require **significant health system adaptation.**

Achieving RCP4.5 would limit the worst effects of heat and unlock the health benefits of cleaner air.



# Personal strategies may help to reduce heat and air pollution exposure, but will the resources to do so be widely available?







# Habitat destruction, loss of biodiversity and the emergence of zoonotic diseases



# How do pathogens spread between animals and people?



“An infectious disease which can be transmitted from an animal to a human.”



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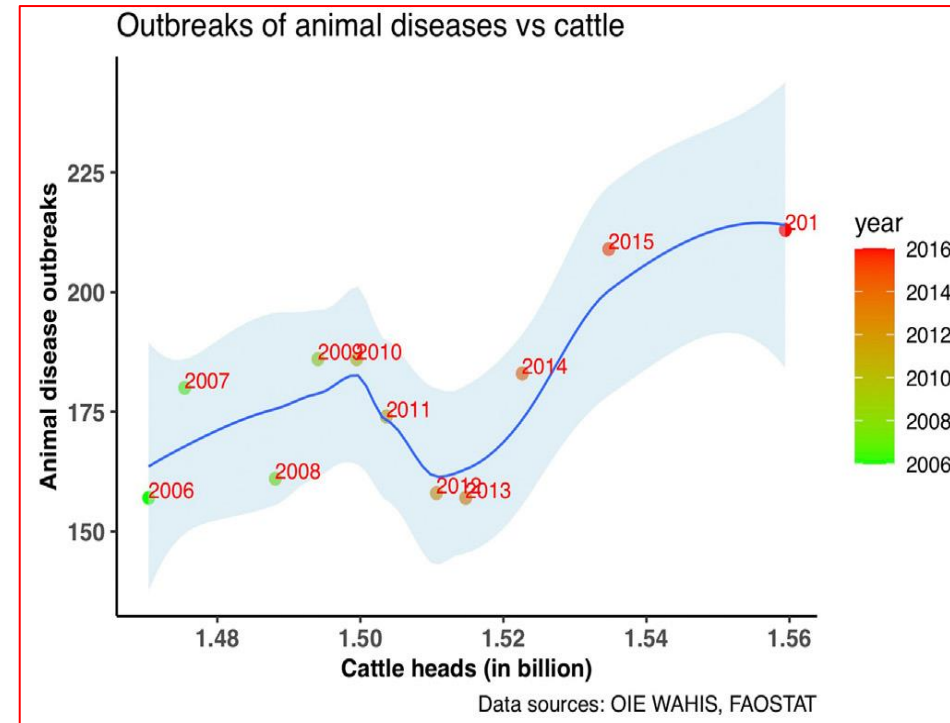
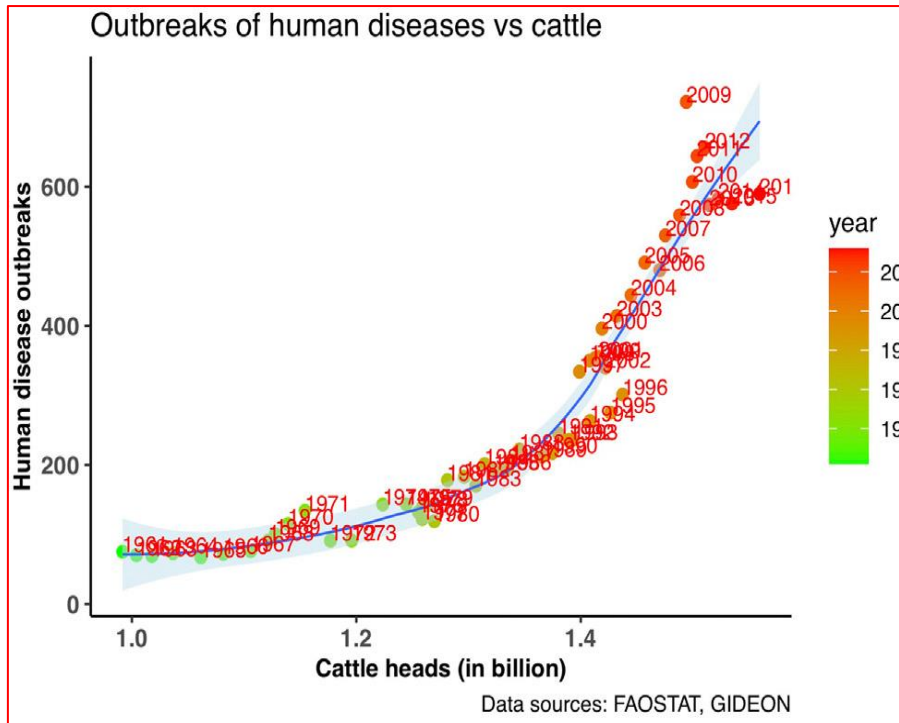
Virus	Deaths	Deaths per million
'Spanish' influenza (1918)	50,000,000	27,322
H2N2 Influenza (1957)	1,100,000	383
Hantaan virus (1951)	46,430	18
H3N2 influenza (1968)	1,000,000	282
Lassa fever (1969)	250,000	69
Ebola (1976)	12,930	3.11
HIV (1980)	10,700,000	2400
COVID-19 (2020)	4,000,000	496

**It is estimated that zoonoses are responsible for 2.5 billion cases of human illness and 2.7 million human deaths worldwide **each year****

**Mortality from zoonotic viral emergence since 1918**



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**Emerging diseases, livestock expansion and biodiversity loss are positively related at global scale (2020) Biological Conservation**



**Favours  
reservoir and  
vector  
populations**

**Affects disease  
transmission**

**Increasing  
human contact**



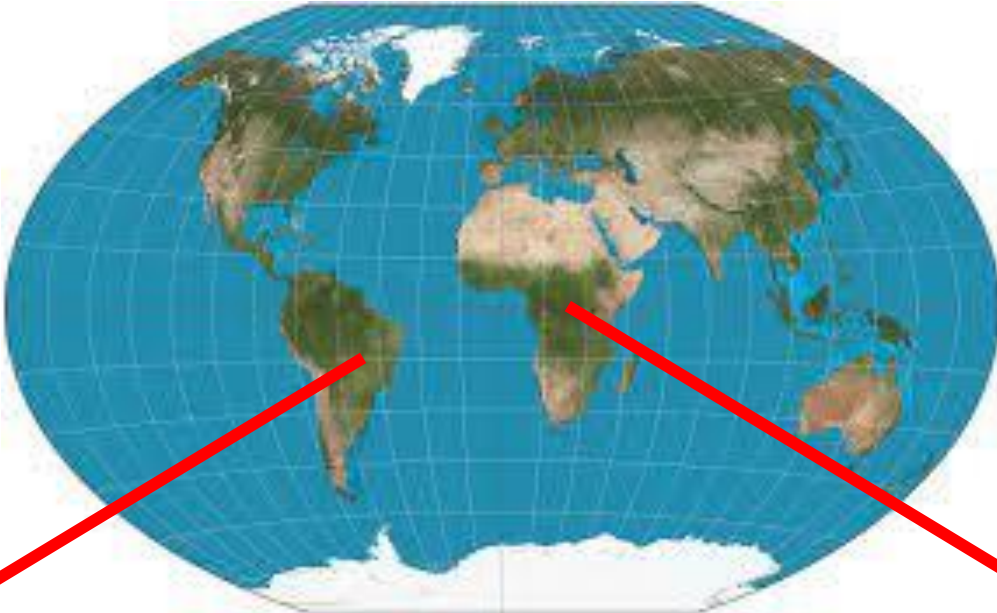
*Outbreaks of Vector-Borne and Zoonotic Diseases Are Associated With Changes in Forest Cover and Oil Palm Expansion at Global Scale (2021) Frontiers in veterinary science*

## **Deforestation and zoonotic diseases**

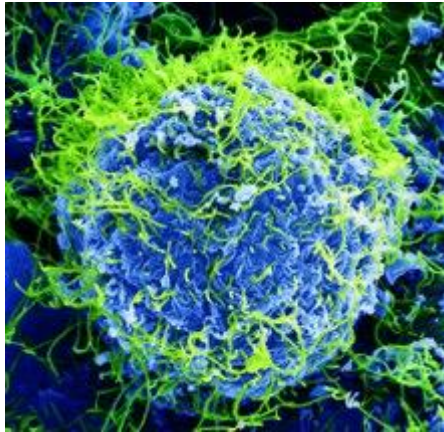


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# Deforestation and zoonotic diseases



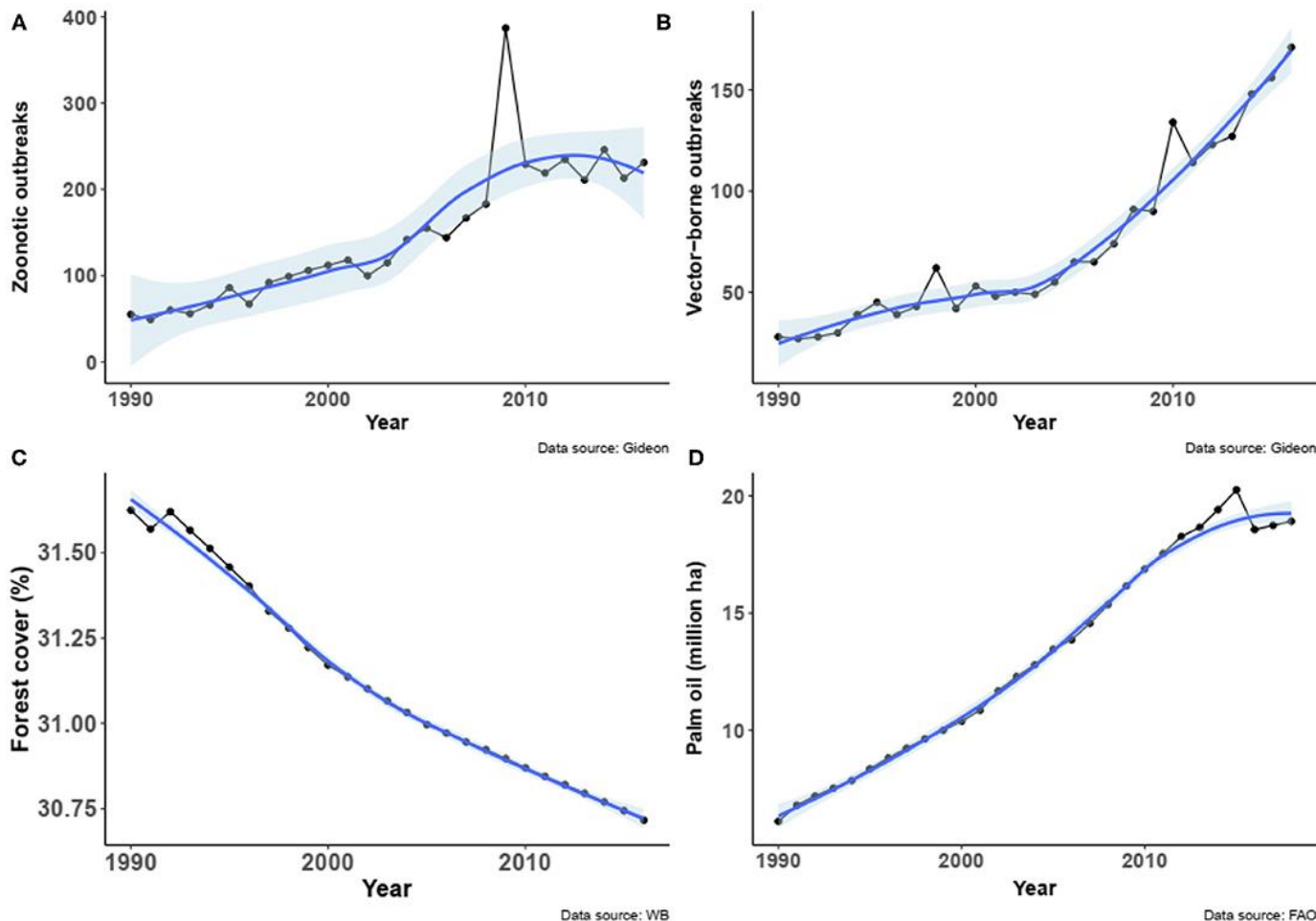
Dengue  
Zika Chikungunya  
Malaria  
Yellow fever



**Ebola**



# Lack of Biodiversity



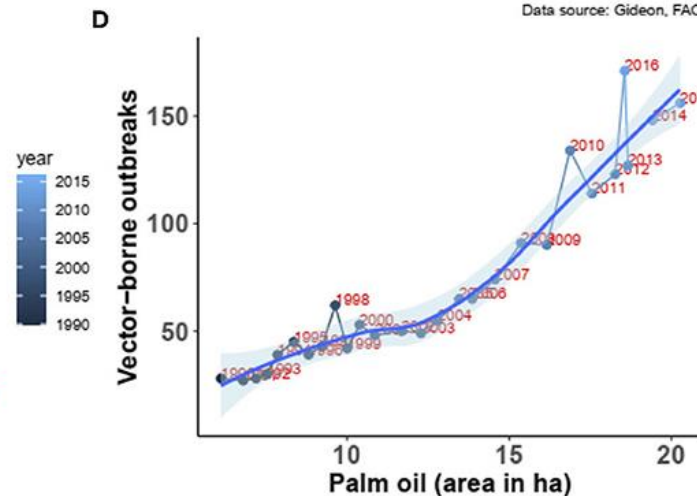
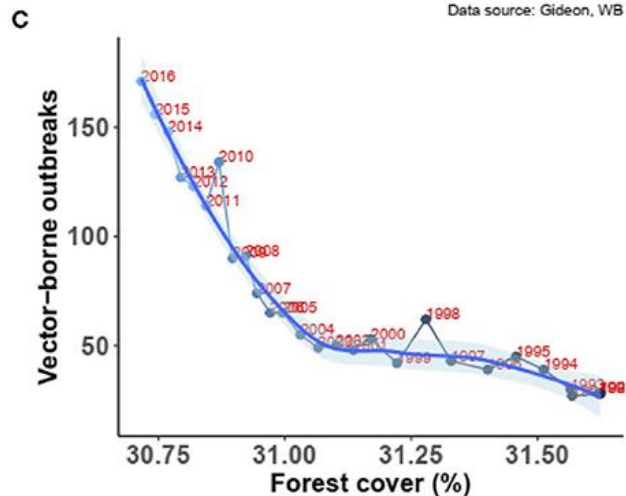
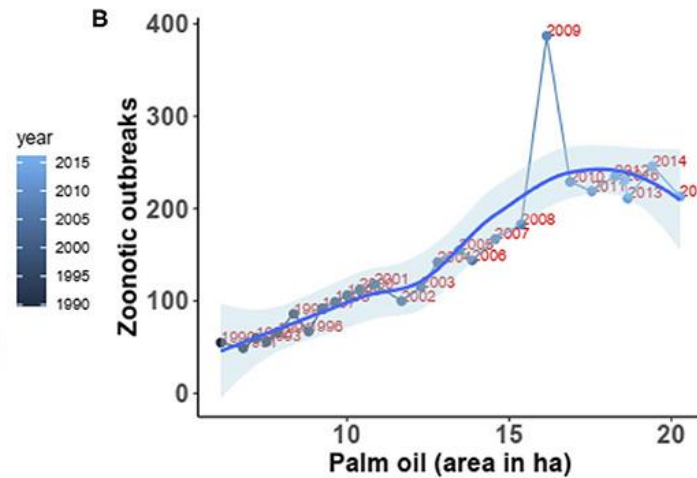
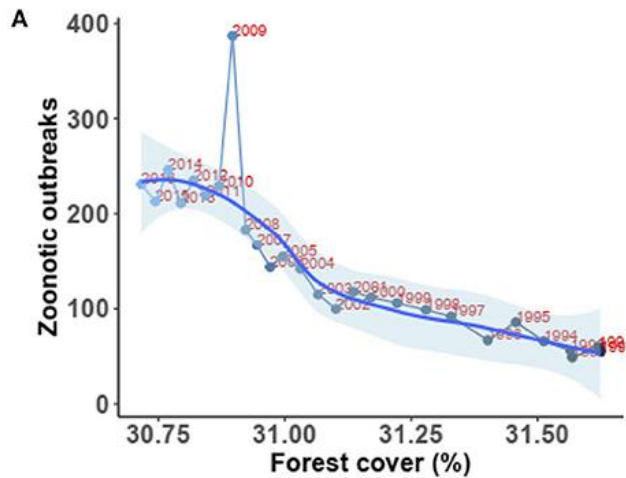
(A) Number of outbreaks of zoonotic diseases worldwide from 1990 to 2016  
(B) Number of outbreaks of vector-borne diseases worldwide from 1990 to 2016  
(C) Global change in forest cover (in share of global land) from 1990 to 2016  
(D) Relationship between the number of outbreaks of zoonotic diseases worldwide and the change in forest cover from 1990 to 2016.

Fitted smooth regressions (in blue) with confidence intervals (in light blue) are shown.





# Lack of Biodiversity



(A) Association between the change in forest cover and the number of outbreaks of zoonotic diseases from 1990 to 2016.

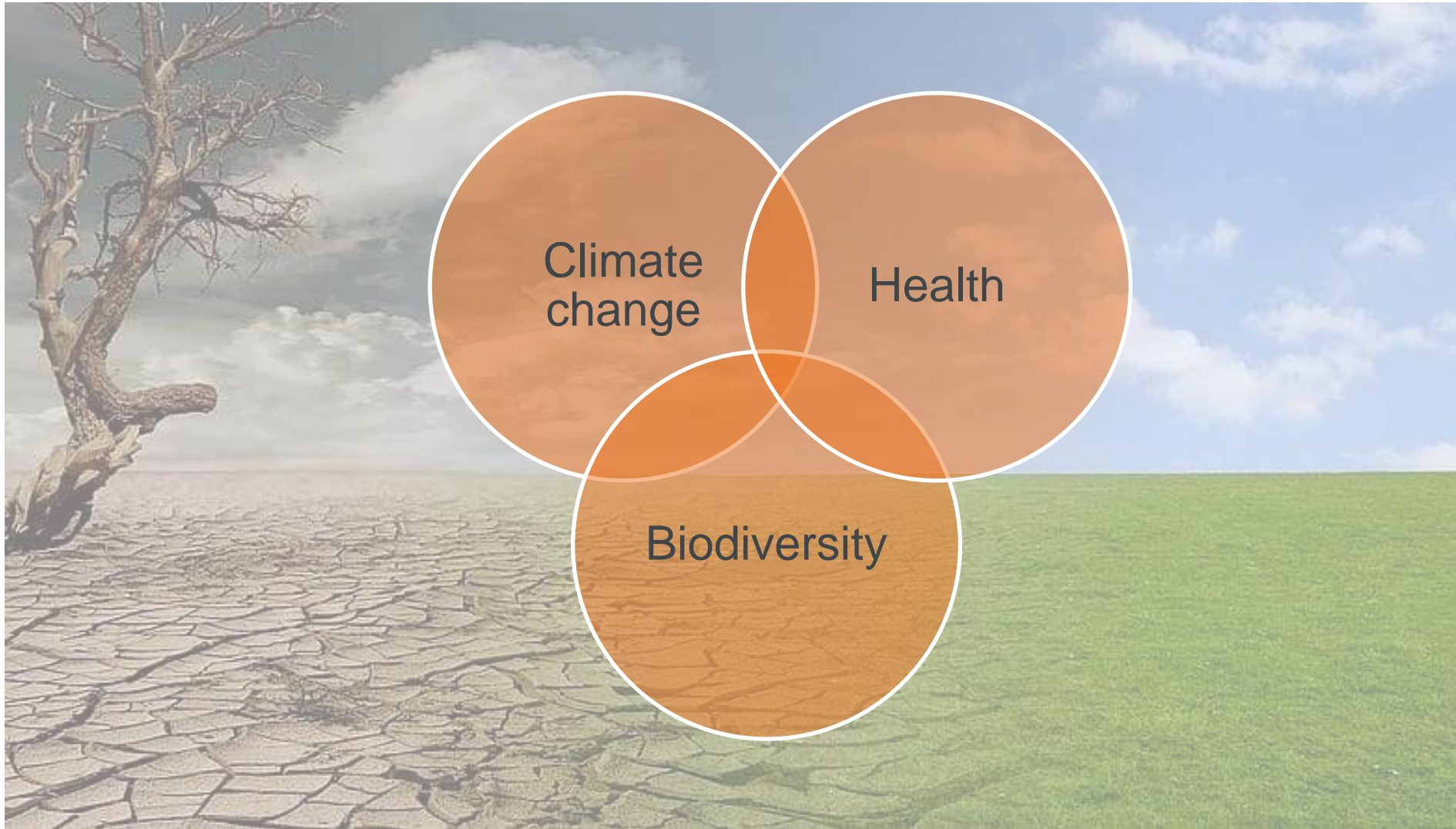
(B) Association between the change in forest cover and the number of outbreaks of vector-borne diseases from 1990 to 2016.

(C) Association between the change in palm oil areas and the number of outbreaks of zoonotic diseases from 1990 to 2016.

(D) Association between the change in palm oil areas and the number of outbreaks of vector-borne diseases from 1990 to 2016.

Fitted smooth regressions (in blue) with confidence intervals (in light blue) are shown







# A new era of adaptation, but how will human behaviour and choices change?

10-16 July 2022:  
510 people in Spain died from heat-related causes

Late July 2022 in Seville, Spain:  
The world's first named heatwave

## Zoe

An experiment in behavioural science?

It's going to be hot tomorrow...

Here comes Heatwave Zoe!

[World's First Named Heat Wave, Zoe, Arrives in Seville | Time](#)





# Climate hope: Biomimicry offers repair at scale

Work by CCCR and others are finding ways to repair the climate at a sufficient scale

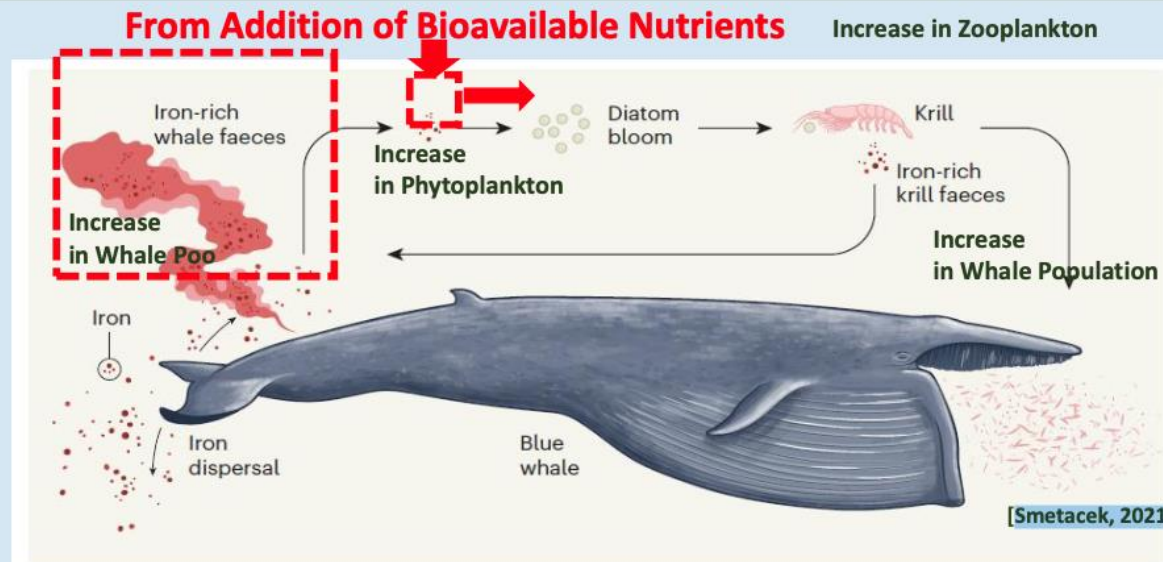
Cambridge Centre for Climate Repair (CCCR) researching solutions for 1 GTCO<sub>2</sub>e+ removal

## Aim of MBR: Mimicking the Distribution of Whale Faeces



[1 GTCO<sub>2</sub>e > 2% of current emissions which is meaningful to get to net negative, beyond net zero]

**“By spreading limited nutrients from the research vessel!”  
→ Regenerating Marine Biomass & Carbon Sequestration**



**Strengthening Positive Feedback Cycle of Whale Faeces Pump**



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# Want to know more?

The 2022 report of the *Lancet* Countdown on health and climate change: health at the mercy of fossil fuels



[https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(22\)01540-9/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)01540-9/fulltext)

*Because of the rapidly increasing temperatures, vulnerable populations (adults older than 65 years, and children younger than one year of age) were exposed to **3.7 billion more heatwave days in 2021 than annually in 1986–2005** (indicator 1.1.2), and **heat-related deaths increased by 68% between 2000–04 and 2017–21** (indicator 1.1.5), a death toll that was significantly exacerbated by the confluence of the COVID-19 pandemic*



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# Questions

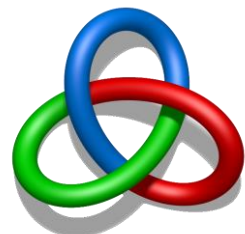
# Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenters.



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## Gordian Advice

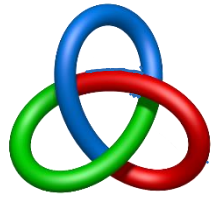
*Cutting to sustainable solutions*

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# Gordian Advice

Gordian Advice has advised UK Pension Funds, mastertrusts & insurers with over £00 bn in assets, to integrate sustainable investment into their investment portfolios and investment strategy. It does so by helping them:

- Understand the Sustainability and Climate Change risks that are embedded in their investment portfolios and unlock potential opportunities
- **Develop beliefs, policies and practices** to manage and monitor these risks
- **Understand the potential impact of sustainability and climate change risks on their investment strategy and seek rewarding opportunities**
- **Understand the impact of their investment portfolios on climate change and broader sustainability goals**
- **Improve the Stewardship** of their assets and **consider their purpose, their agency and their impact**

## Why Gordian Advice?

Gordian Advice currently works with a number of clients across insurers and pension funds who are responsible for over £100 bn in assets. Gordian Advice offers differentiated support:

- ✓ **Partner-level engagement:** cost effective due to low overheads
- ✓ **Action-oriented advice not a just consultation:** specific advice & recommendations based on applying experience & insights to your needs and not a consultation of your preference between pre-packaged options
- ✓ **Seek market savvy strategies:** focused on integrating current investment outlook & opportunities with long-term strategic objectives
- ✓ **Sustainability thought-leadership:** at the forefront of the UK actuarial profession's thinking, a co-authoring a prize-winning paper: [Climate change considerations for actuarial financial assumptions & the role of scenario analysis](#)
- ✓ **Bespoke engagements:** targeted to your needs & to maximise the benefit from the available budget



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# Thank you

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