

Increased temperature and risk of pandemics

Ideas from GAM based analyses

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Github repo: https://github.com/arinbasu/pandemic_2021

Pandemics by death toll (Source: Wikipedia)

Epidemics and pandemics with at least 1 million deaths

| Rank ↕ | Epidemics/pandemics ↕ | Disease ↕ | Death toll ↕ | Global population lost ↕ | Regional population lost ↕ | Date ↕ | Location |
|--------|--|-------------------------------------|---|--|--|---|--|
| 1 | Black Death | Bubonic plague | 75–200 million | 17–54% ^[Note 1] | 30–60% of European population ^[4] | 1346–1353 | Europe, Asia, and Africa |
| 2 | Spanish flu | Influenza A/H1N1 | 17–100 million | 1–5.4% ^{[5][6]} | – | 1918–1920 | Worldwide |
| 3 | Plague of Justinian | Bubonic plague | 15–100 million | 7–56% ^[Note 1] | 25–60% of European population ^[7] | 541–549 | Europe and West A |
| 4 | HIV/AIDS global epidemic | HIV/AIDS | 36.3 million (as of 2020) | ^[Note 2] | – | 1981–present | Worldwide |
| 5 | Third plague pandemic | Bubonic plague | 12–15 million | ^[Note 2] | – | 1855–1960 | Worldwide |
| 6 | COVID-19 pandemic | COVID-19 | 5.2–20.5 million (as of 5 December 2021) ^[Note 3] | 0.07–0.25% ^[2] | – | 2019 ^[Note 4] –present | Worldwide |
| 7 | Cocoliztli epidemic of 1545–1548 | Cocoliztli | 5–15 million | 1–3% ^[Note 1] | 27–80% of Mexican population ^[13] | 1545–1548 | Mexico |
| 8 | Antonine Plague | Smallpox or measles | 5–10 million | 3–6% ^[3] | 25–33% of Roman population ^[14] | 165–180 (possibly up to 190) | Roman Empire |

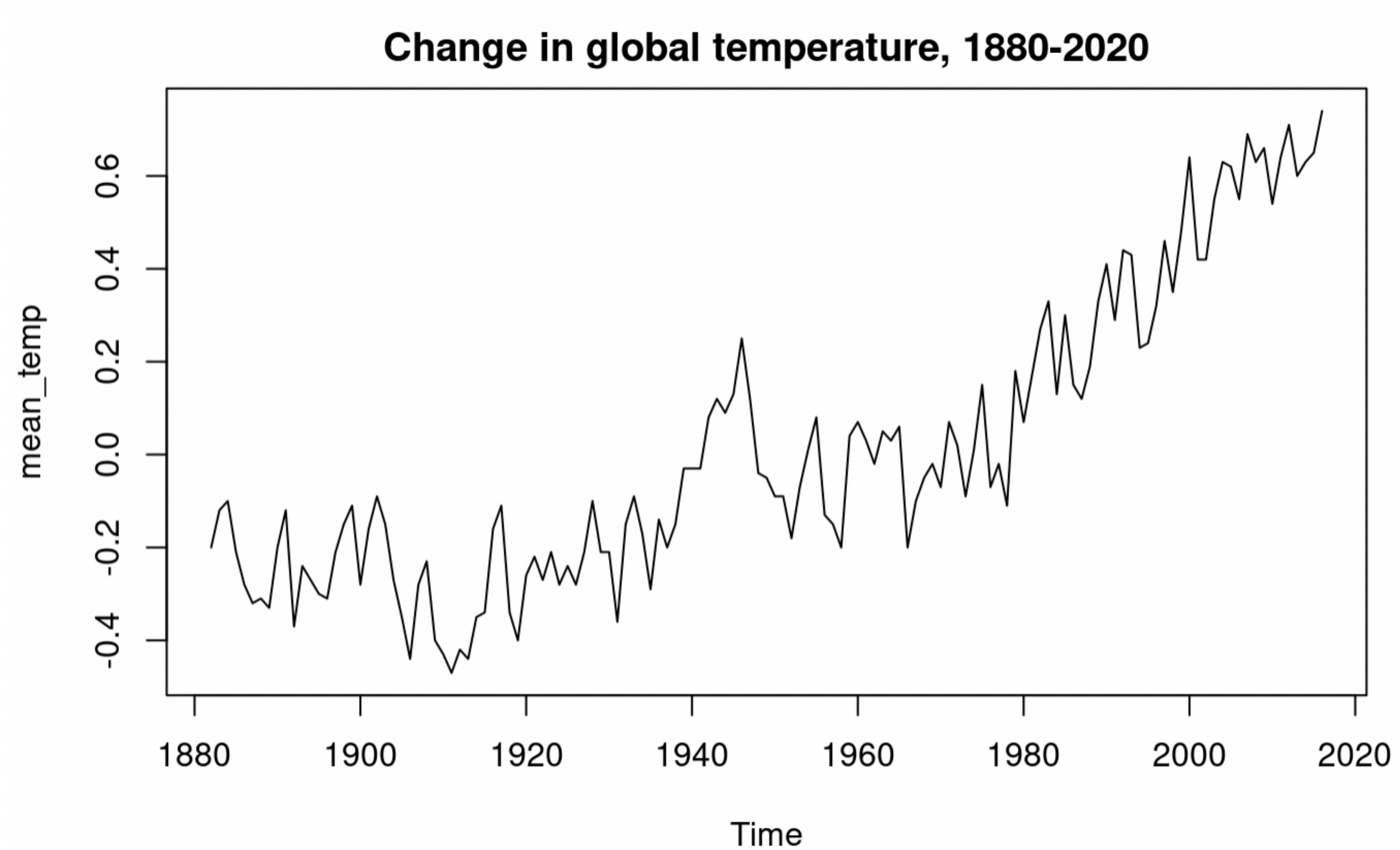
Pandemics and Epidemics since antiquity

248 pandemics and epidemics of various sizes ...

| Event | Date | Location | Disease |
|--|---------------------------------|--|---|
| 1350 BC plague of Megiddo | 1350 BC | Megiddo, land of Canaan | Amarna letters EA 244, Biridiya, mayor of Megiddo complains to Amenhotep III of his area being "consumed by death, plague and dust" |
| Plague of Athens | 429–426 BC | Greece, Libya, Egypt, Ethiopia | Unknown, possibly typhus, typhoid fever or viral hemorrhagic fever |
| 412 BC epidemic | 412 BC | Greece (Northern Greece, Roman Republic) | Unknown, possibly influenza |
| Antonine Plague | 165–180 (possibly up to 190) | Roman Empire | Unknown, possibly smallpox |
| Jian'an Plague | 217 | Han Dynasty | Unknown, possibly typhoid fever or viral hemorrhagic fever |
| Plague of Cyprian | 250–266 | Europe | Unknown, possibly smallpox |
| Plague of Justinian (beginning of first plague pandemic) | 541–549 | Europe and West Asia | Bubonic plague |
| Roman Plague of 590 (part of first plague pandemic) | 590 | Rome, Byzantine Empire | Bubonic plague |

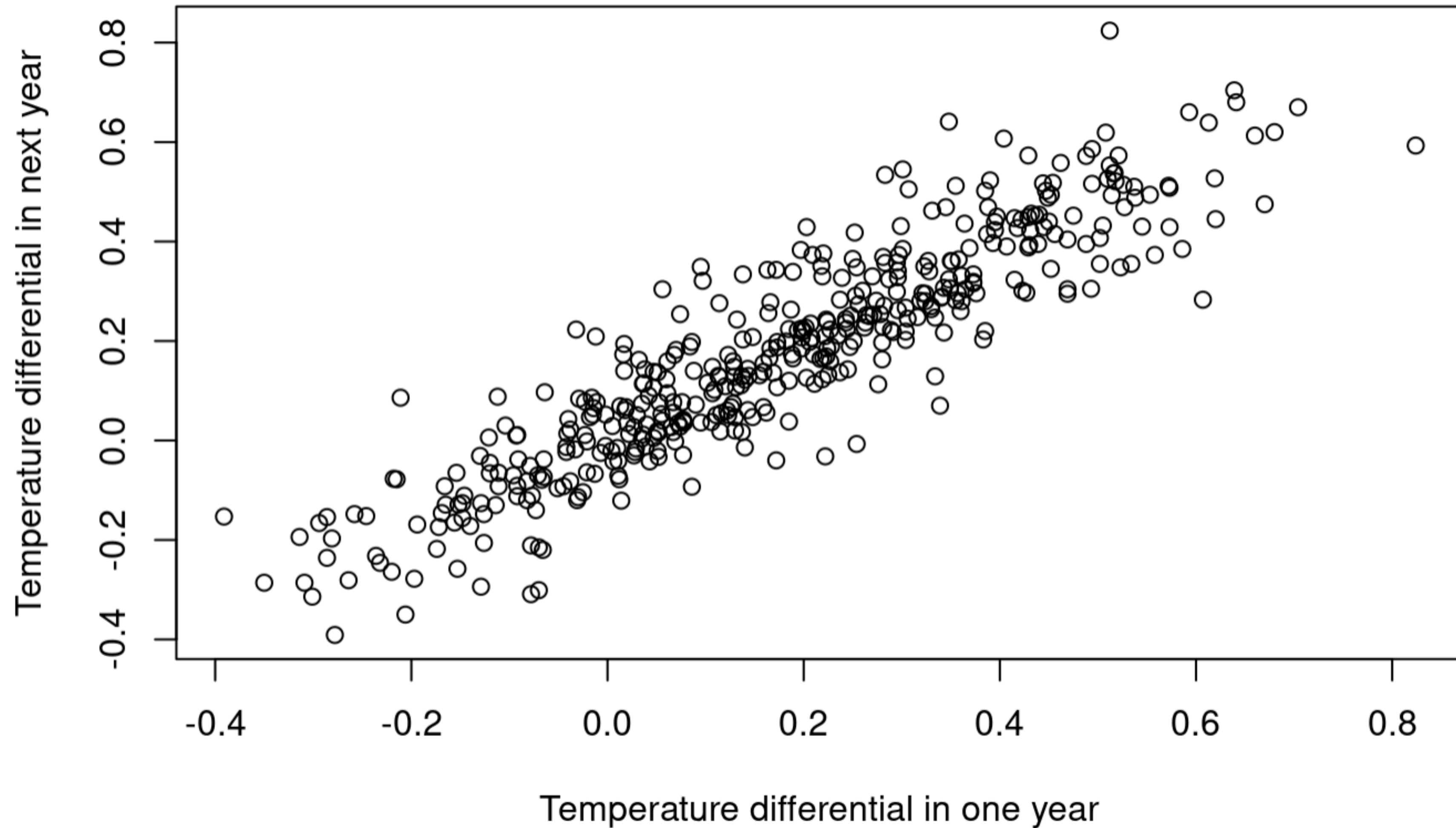
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|--|--------------|----------------------------------|---|--|
| 2019–2020 dengue fever epidemic | 2019–2020 | Asia-Pacific, Latin America | Dengue fever | 3,930 |
| 2019 Nigeria Lassa fever epidemic | 2019–present | Nigeria | Lassa fever | 247 (as of May 2021) |
| COVID-19 pandemic | 2019–present | Worldwide | Coronavirus disease 2019 / COVID-19  SARS-CoV-2 virus | 5.2–20 million+ (as of 25 November 2021) |
| 2020 Democratic Republic of the Congo Ebola outbreak | 2020 | Democratic Republic of the Congo | Ebola | 55 |
| 2020 Nigeria yellow fever epidemic | 2020–present | Nigeria | Yellow Fever | 296 (as of 31 December 2020) |
| 2021 India black fungus epidemic | 2021–present | India | Black fungus / COVID-19 associated mucormycosis | 4,332 |

Change in global temperature relative to average of 1961-1990

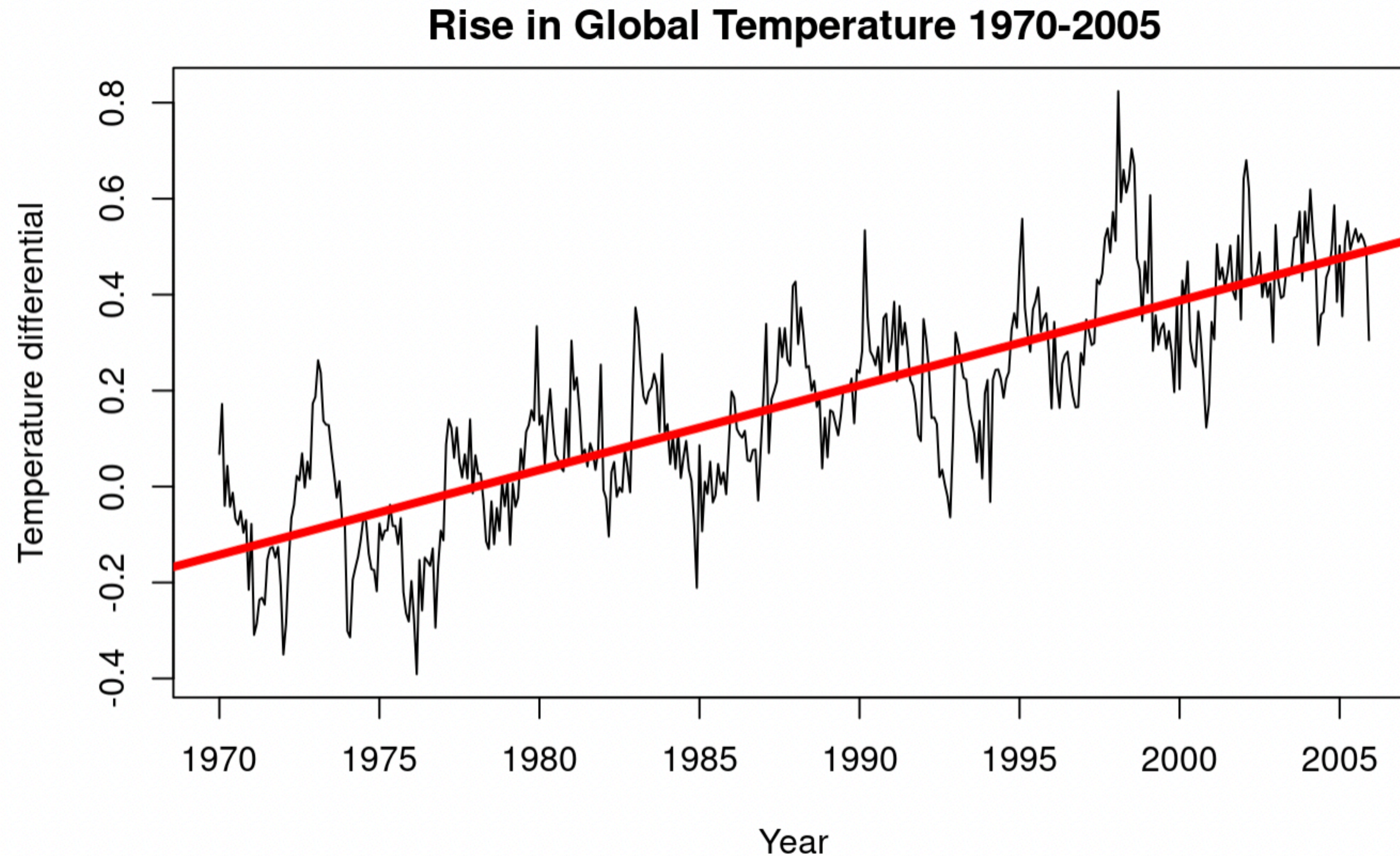


Pattern of temperature change over time

Variation in temperature differential (baseline 1961-1990), since 1885

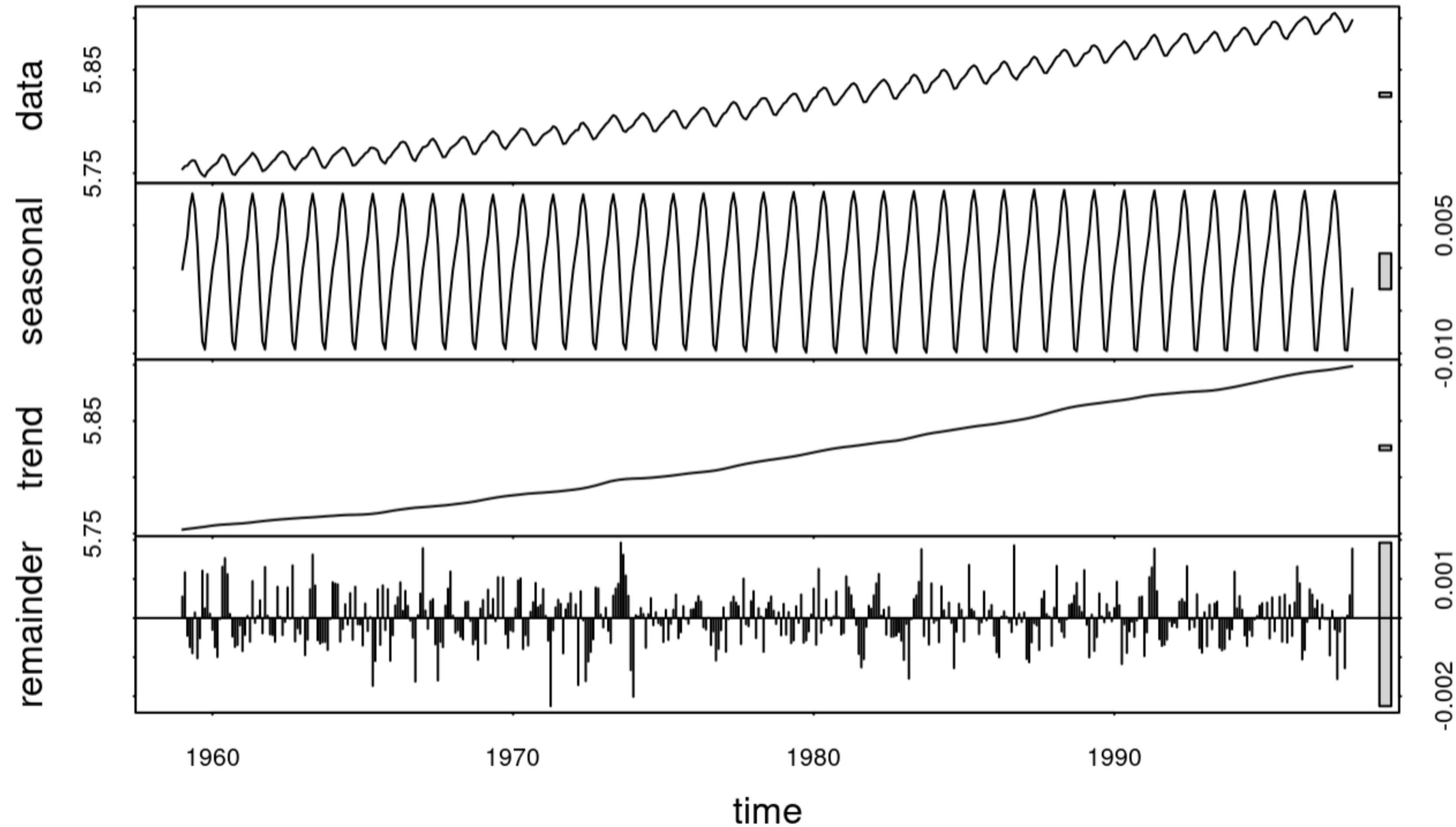


Since 1970, there is a persistent and linear pattern of rising temperature

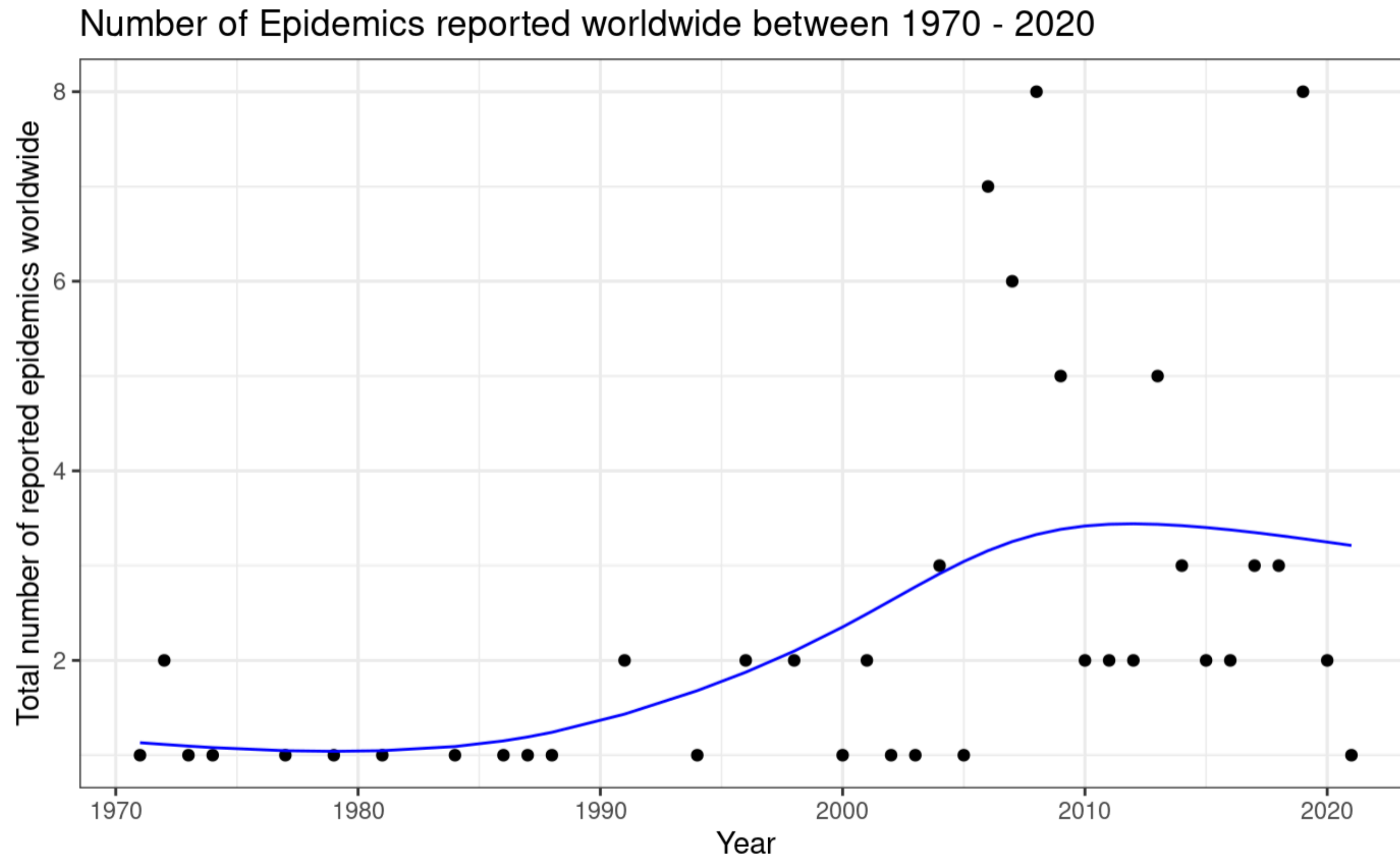


Worldwide carbon emission over time

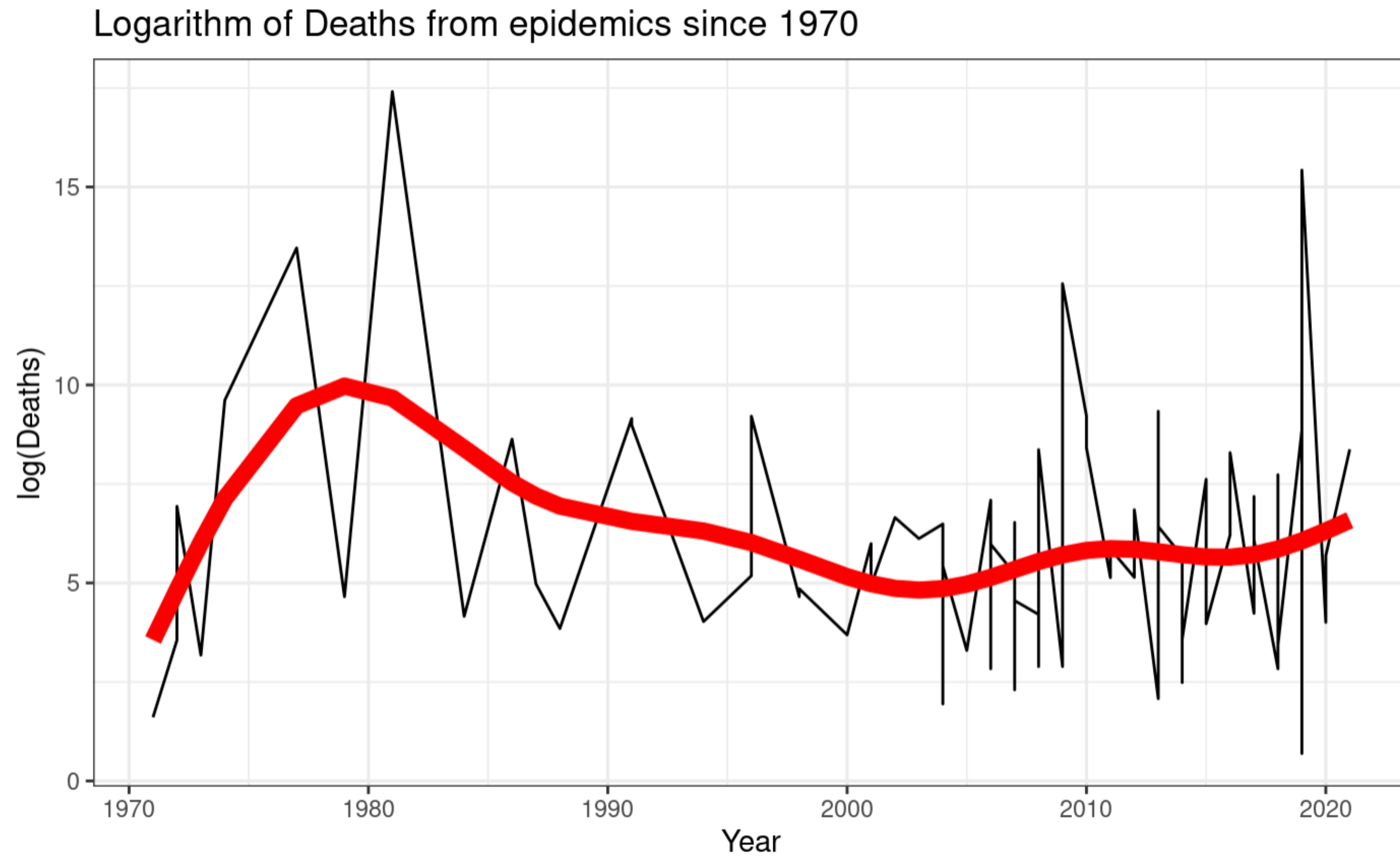
Pattern of CO2 emission since 1960



Number of epidemics reported worldwide



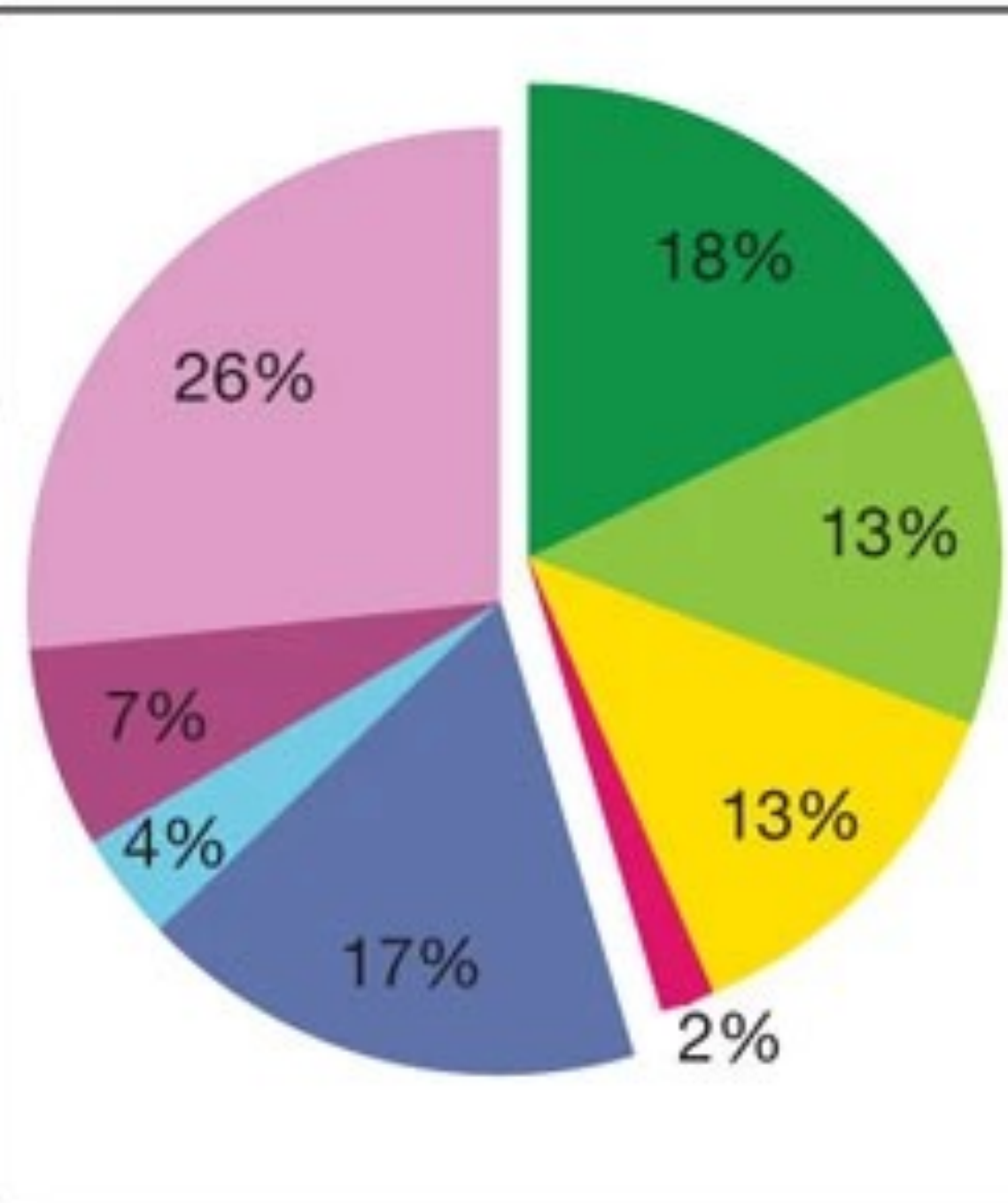
Deaths from epidemics since 1970 (the red line is the GAM prediction line)



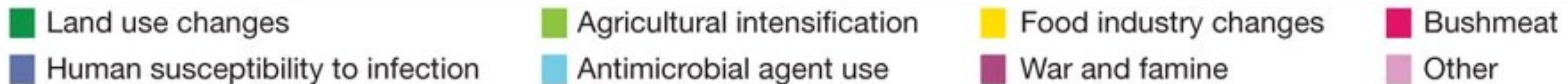
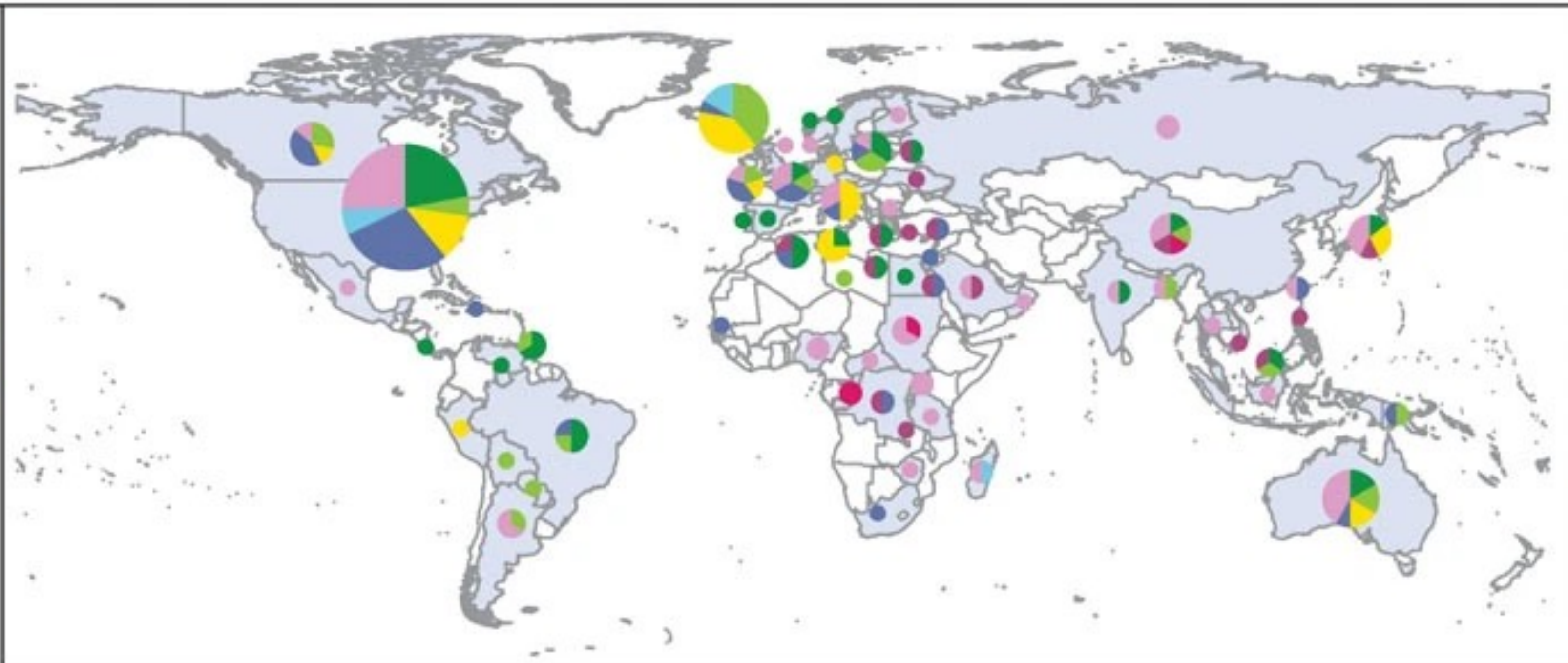
Linkage between human activities and zoonotic diseases

(From: <https://www.nature.com/articles/nature09575>)

a



b



Putting the context to Onehealth

- A rapid increase in temperature and warming has occurred between 1970
- Starting in about late 1990s, the number of infectious disease epidemics and pandemics have sharply increased
- At the same time, death rates from pandemics and epidemics have increased and continue to increase
- Human activities impacting animal habitats, animal trafficking, deforestation, fossil fuel consumption continue unabated
- Need to characterise and quantify the extent to which temperature change may impact emerging pandemics and epidemics