

# Climate change exacerbates almost two-thirds of pathogenic diseases affecting humans

A comprehensive and systematic literature review reveals that over 58% of human pathogenic diseases are aggravated by climatic hazards that are sensitive to greenhouse gas emissions.

## This is a summary of:

Mora, C. et al. Over half of known human pathogenic diseases can be aggravated by climate change. *Nat. Clim. Change* <https://doi.org/10.1038/s41558-022-01426-1> (2022).

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## The mission

The links between greenhouse gas emissions, worsening climatic hazards (such as warming, flooding, heatwaves and sea-level rise, among others) and the associated aggravation of certain pathogenic diseases (caused by pathogenic microorganisms) in humans are well documented in the scientific literature<sup>1–3</sup>. However, past studies have largely focused on specific pathogens, transmission types and/or climatic hazards. No study to date has attempted to comprehensively quantify the magnitude of human exposure to pathogenic diseases that can be influenced by climate change. We attempted to fill this gap by performing a comprehensive literature review of diseases with a documented link to climate change. Understanding the magnitude of the threat posed by the increased incidence of pathogenic diseases induced by climate change is an important piece in comprehending human vulnerability to climate change. Increased awareness of the threat to human health posed by climate change will ideally motivate more aggressive plans to reduce greenhouse gas emissions.

## The observation

To address this knowledge gap, we conducted a systematic literature review of empirical observations of pathogenic human diseases linked to ten climatic hazards<sup>4</sup>. We obtained the list of diseases from the Global Infectious Diseases and Epidemiology Network (GIDEON) and the United States Centers for Disease Control and Prevention (CDC) databases. Conditions for paper inclusion were limited to reports of a climatic hazard affecting a specific disease, in a defined place and/or time. We examined over 77,000 scientific papers, of which 830 met our search criteria. Case examples were methodically documented in a database for climatic hazard, transmission type (for example, vector-borne, water-borne or food-borne), disease and pathogen. We also opted to include diseases that are not transmitted via microbes (for example, diseases associated with plant or fungal allergens) and communicable diseases (with human-to-human transmission), owing to their links with climatic hazards and the increased prominence of associated respiratory and skin illnesses.

Overall, we observed 1,006 transmission pathways for climatic hazards that, through varying transmission types, resulted in increased incidence and prevalence of pathogenic diseases (Fig. 1). We found that over 58% of pathogenic diseases affecting humans can be exacerbated by

climate change. Atmospheric warming, heavy precipitation and flooding were all associated with increased incidence of 160, 122 and 121 diseases, respectively. Climatic hazards that facilitated vector-borne transmission (the most common transmission pathway) led to increases in incidence and prevalence of over 100 vector-borne diseases. An interactive visual database of our findings is publicly available<sup>5</sup>, where users can view an interactive display of the climatic hazards, transmission types and diseases, as well as the associated case examples and citations.

## The implications

Climate change is an unprecedented threat to human civilization as we know it. The large number of diseases that are sensitive to climate change and their numerous transmission pathways represent an insurmountable task for disease control in the absence of aggressive mitigation of greenhouse gas emissions. Arguably, the COVID-19 pandemic has revealed substantial disparities in disease outbreak preparedness globally, and further emphasizes that humanity is currently unable to prepare for the onslaught of multiple coinciding disease outbreaks that are worsened by climatic hazards. Thus, urgent action as a global community to reduce greenhouse gas emissions is necessary to diminish the effects of increased incidence, transmission, and geographical distribution of rarer and more serious diseases.

We present a conservative estimate for diseases aggravated by climatic hazards, as our findings are limited to what has been previously documented. For instance, rare diseases and outbreaks in rural or impoverished areas are historically not well documented. Furthermore, disease outbreaks among Indigenous populations are often undocumented, whereas these groups disproportionately face some of the strongest effects of climate change<sup>3</sup>. Yet, even with conservative estimates, the message is clear – greenhouse gas emissions must be reduced. The large body of evidence for numerous climate-change-aggravated diseases, case examples and transmission pathways demonstrates that the consequences of continuing under the 'business as usual' scenario will result in grave outcomes for human health.

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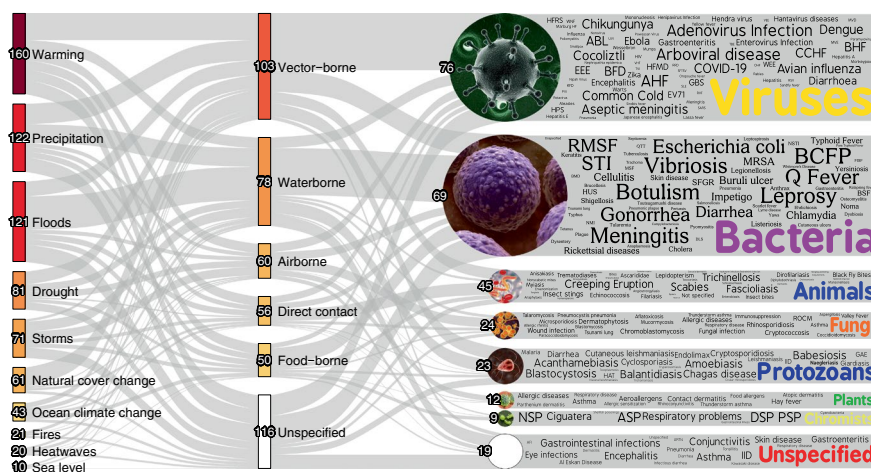
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## EXPERT OPINION

The outstanding feature of this work is the identification and illustration of the unique pathways in which climatic hazards lead to cases of pathogenic diseases. This study, along with its interactive webtool, would prove incredibly useful

for researchers working in environmental health, as well as anyone working in the wider medical or environmental communities and trying to better understand each of these elements in isolation and in combination.”  
**An anonymous reviewer.**

## FIGURE



**Fig. 1 | Climatic hazards and transmission pathways for diseases that are aggravated by climate change.** Line thickness and colour gradient are proportional to the number of unique pathogenic diseases and the proportional quantity of diseases, respectively. Darker colours indicate larger quantities and vice versa. An interactive version is also available<sup>5</sup>. Credit: word clouds, WordArt.com; bacteria, Wikimedia Commons ([www.scientificanimations.com](http://www.scientificanimations.com)); other images, istockphoto. © 2022, Mora, C. et al.

## BEHIND THE PAPER

This work was conceived as part of a graduate-level course at the University of Hawai‘i at Mānoa. As it was a collective effort, all members of the class are co-authors on the resulting research article. We chose the topic for this research in January 2020, after recognizing the absence of a comprehensive review of the effects of climate change on diseases. The most challenging aspect was carefully searching and reading such a large volume of scientific papers,

particularly because the bulk of the literature review took place from March through May 2020 (arguably one of the most unsettling periods during the COVID-19 pandemic). As the database grew, we became both fascinated and distressed by the number of available case studies and the extensive impact that climate-change-aggravated diseases had already had on a substantial number of people globally.  
**T.M. and I.M.G.**

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**An interactive visual database documenting our findings from the literature review.**

## FROM THE EDITOR

Understandably, the topics of human disease — as well as how human activities are increasing disease risks — have received a lot of attention in the past years. This work stands out for its scope — covering an impressive range of human diseases and maladies, and investigating how they will be affected by the various effects of anthropogenic climate change.” **Editorial Team, Nature Climate Change.**