

# Severe Situation of Human Impact on Climate Change, Impact on Infectious Diseases and Solutions

Ying Yang<sup>1</sup> and Zhi Chen<sup>1\*</sup>

<sup>1</sup> State Key Laboratory for Diagnosis and Treatment of Infectious Diseases, National Clinical Research Center for Infectious Diseases, National Medical Center for Infectious Diseases, Collaborative Innovation Center for Diagnosis and Treatment of Infectious Diseases, The First Affiliated Hospital, Zhejiang University School of Medicine, Hangzhou 310003;

**Abstract.** The activities of the human activities, especially since the industrial revolution caused the greenhouse effect and the severe climate change situation, leading to a variety of suffering such as natural disasters, the collapse of the food system and extinction, also infectious diseases and mental diseases and so on. These grim situation makes most countries reach a consensus of net zero discharge and limiting the temperature rise to 1.5 °C. To cope with and adapt to climate change threat in the future, we should carry out cross-regional and multidisciplinary cooperation as much as possible, develop high-tech products for early warning of climate health risks, carry out a number of climate health monitoring projects, strengthen the monitoring and early warning capacity of climate change risks, and work together to maintain and promote a good climate for the earth and human health.

## 1 Introduction

The global human disaster caused by COVID-19 is not over yet, and climate change is increasingly becoming a global focus. Climate change not only exacerbates COVID-19, but also causes or aggravates other diseases or discomfort. Climate change and general health are issues that need to be addressed together with the strength of all mankind. After decades of discussion, climate change has become an urgent issue. Most countries in the world jointly participated in the Kyoto Protocol and the Paris Agreement, aiming at the core targets of carbon peak and carbon emission. This article also gives some examples of measures to solve the climate problem. We must respect nature, and the climate issue should be an issue that requires a high degree of solidarity among mankind. We should take this as an opportunity to build a cultural environment of solving problems through negotiation and mutual trust among countries on a global scale. Although it is difficult to unite and cooperate in this era of individualism, nationalism and the supremacy of interests, I believe that mankind can unite and find a solution after experiencing the pain of climate

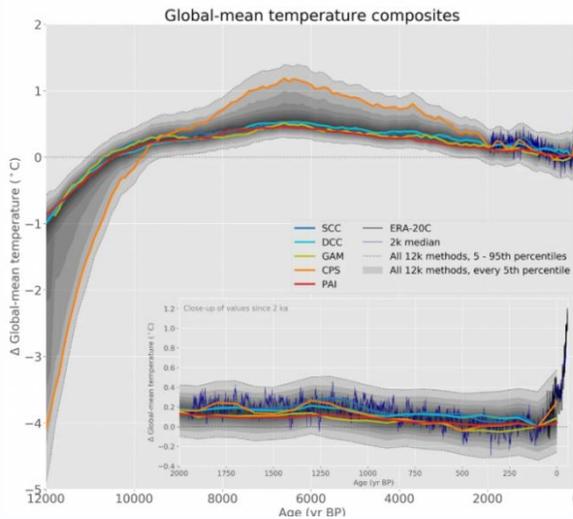
---

\* Correspondence: [zjuchenzhi@zju.edu.cn](mailto:zjuchenzhi@zju.edu.cn)

change and holding the clear understanding that if it is not solved, it will probably lead to the extinction of mankind.

## 2 Grim situation and consensus on human activities changing climate

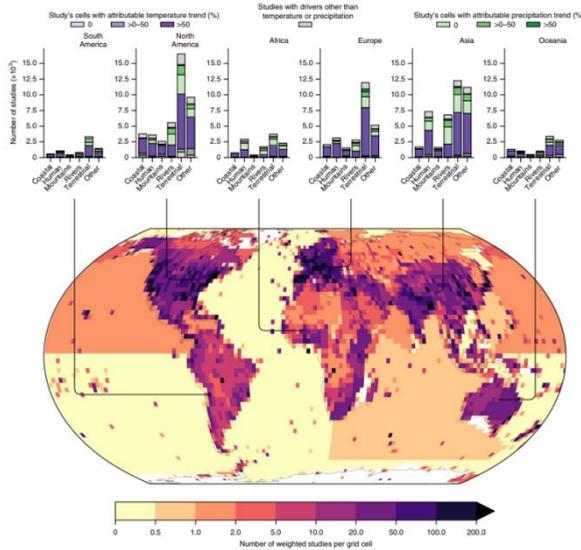
A team consist of 93 scientists has published a exceptionally comprehensive record of paleoclimatic data across the past 12,000 years. It contains 1,319 data records collected from 679 sites around the world and from samples such as marine sediments, lake sediments, peat, coral, cave sediments and glacial ice cores. From this data, the researchers mapped changes in surface air temperatures over the 12,000 years since the last iceage. The figure is compared to the century average temperature between 1800 and 1900 to track changes likely to be brought about by the Industrial Revolution. As expected, temperatures at the start of the period were much cooler than the 19th century baseline. But over the next few thousand years, temperatures rose steadily, eventually surpassing the baseline. Temperatures peaked 6,500 years ago, and since then, the planet has been slowly but surely cooling, seemingly driven by slow cycles in Earth's orbit, which reduced the amount of sunlight in the northern hemisphere's summer and ultimately led to the 'Little Ice Age' of recent centuries. In a relatively short period since the middle of the 19th century, human activity has increased the average temperature by as much as 1°C, a huge peak that is higher than the peak of 6500 years ago (Fig.1) [1].



**Fig. 1.** Global mean surface temperature from the Temperature 12k database using different reconstruction methods [1].

A recent report by Xu Chi, a professor at the School of Life Sciences at Nanjing University, showed that, on a global scale, humans have been distributed in more stable climate conditions for the past 6,000 years. The research was conducted using interdisciplinary studies such as ecology, archaeology and climatology. If the global population is to remain in this climatic niche, according to the current trends in climate change, by 2070, some 3 billion people would be living in extreme temperatures similar to those currently found in the heart of the Sahara.

Max Callaghan and other researchers used Bert model machine learning to identify and classify 100,000 climate impact research papers, in an attempt to determine how many people in the world are already experiencing the effects of the climate crisis. They drew important conclusions: For climate change research, it is more focused on richer countries in Europe and North America, with about twice as many studies as low-income countries such as Africa and the Pacific Islands. The combined results show that the vast majority of the world, with more than 80% of the land area and 85% of the population, is currently experiencing the impacts of the climate crisis (Fig.2) [2].



**Fig. 2.** A global density map of climate impact evidence

The people of the Republic of Kiribati, an island nation in the central Pacific Ocean, have been forced to move their homes due to rising sea levels. They are at constant risk of flooding and waves. The rich and the rich countries emit more carbon, while the poor don't even own a house or a car. The poor who are most dependent on nature and want to live in harmony bear more of the impacts of climate change. The modern mode of development and industrialization were brought by the people of rich countries. Their technological strength, sustainable development concept, capital and management strength can also bring about visible results in a short period of time. There is no doubt that developed countries need to take the lead in solving the climate problem.

### 3 IPCC report

The effects of human activities on the climate system has been the core content of every assessment report by the United Nations' Intergovernmental Panel on Climate Change (IPCC).The latest sixth IPCC assessment report adopted climate models participating in the Coupled Model Intercomparison Project Phase 6 (CMIP6), so that the impacts of different anthropogenic forcing factors on the climate system can be further recognized and quantified, and the understanding of the effects of human activities on climate change can be deepened. The indicators in different layers of the climate system, including the atmosphere, oceans, cryosphere and the surface of the change of the climate change , can

detect the influence of human activity. The sixth time evaluation report suggests extreme cold and extreme warm events change in global and most of the mainland are likely to be the main reason of the greenhouse gases caused by human activities. The intensification of global heavy rainfall in recent decades may also be due to the influence of human activities. The decline in spring snow cover in the Northern Hemisphere since 1950 has also been linked to human activity, which is also likely to be a major driver of the recent universal glacier retreat that has occurred nearly worldwide. Human activity is most likely the main driver of global sea-level rise and ocean heat content increase since the 1970s. On 28 February 2022, the IPCC released its report "Climate Change 2022: Impacts, Adaptation and Vulnerability". The report argues that warming has pushed the majority of the planet's ecosystems to "hard limits of human adaptation" -- the point at which human societies will be unable to adapt to any more change. Antonio Guterres, Secretary-General of the United Nations, said: Today's IPCC report is an 'atlas of human suffering' ", and the climate problem is worse than ever [3]. The latest IPCC report, which is more than 2,000 pages and was compiled by 270 scientists after reviewing numerous independent studies, provides a comprehensive overview of the entire body of scientific research on climate change, with a focus on its effects on ecosystems, wildlife and human societies. According to the IPCC report, some of the consequences we are already seeing at current levels of warming include:

- 1) The disease is spreading to more areas
- 2) Species are dying out everywhere
- 3) Local animal and plant populations die or migrate, irreversibly changing local ecosystems
- 4) Plants and mammals died in large numbers due to droughts and heat waves
- 5) Major food systems begin to collapse
- 6) Past carbon sinks, such as the Amazon rainforest and Arctic permafrost, turn into sources of greenhouse gas emissions
- 7) As a result of climate change, half of the world's living things are at present moving habitats, destroying ecosystems everywhere. Half the world's population faces water shortages for at least part of the year. The risks to the food system are high: about 8 percent of the world's farmland could become unusable if warming reaches 1.5 degrees.

## **4 The serious impact of climate change on infectious diseases, etc**

### **4.1 Increase the spread of infectious diseases**

The Lancet Countdown on Health and Climate Change released its 2020 report, along with the first regional report for the Asian region. An accompanying editorial in The Lancet noted that both the climate crisis and the zoonotic disease COVID-19 are caused by human activities that trigger environmental degradation, and that the impacts of these two crises are also intersecting and superimposed [4]. When these two crisis responses are developed in collaboration, they offer an opportunity of population health improvement, shaping a sustainable future, and better conservation of the earth's remaining natural resources and biodiversity. After the COVID-19 pandemic, governments will begin implementing economic recovery plans, with special attention to climate change and a green recovery.

In the latest study, published in the August issue of Nature Climate Change, Camilo Mora et al. systematically screened the literature to link 286 unique human pathogen diseases to 10 climate hazards, such as warming, flooding or drought. Of these, 277 were exacerbated by at least one climate hazard and only nine were weakened by it. Overall, 58%

of the reliably documented list of infectious diseases affecting humans have been shown to be exacerbated by climate change [5].

The five-year study of 3,139 mammal species simulated how their movement trajectories would change under a range of global warming scenarios and then analyzed how virus transmission would be affected, according to a study published April 28 in *Nature*. By 2070, as global warming causes thousands of mammal species to migrate, this will drive thousands of viruses to spread between different mammals. Even at relatively low levels of global warming, projections suggest that at least 15,000 events of cross-species transmission of one or more viruses will occur within the next 50 years. These viruses pose a huge threat, since humans lack immunity to them due to never being exposed to these viruses [6].

The risk of dengue fever spreading in China has increased over the past three or four decades. Dengue fever is a mosquito-borne disease. Climate change has changed the humidity and temperature of the environment, and improved the transmission environment and survival of mosquitoes. As a result, the risk of transmission of this infectious disease has increased worldwide, and its epidemic range is also spreading to the northern regions, which used to be colder. Climate change increases the risk of foodborne, waterborne and vector-borne diseases. Climate change and its drivers are creating conditions for the spread of infectious diseases as warming expands the distribution of pathogens and their hosts, as precipitation changes accelerate pathogen maturation and vector reproduction. Dengue fever, chikungunya, Zika, malaria and cholera threaten unravel decades of progress that countries have made in controlling diseases like dengue fever, Chikungunya, Zika, malaria and cholera.

## 4.2 Effects on other aspects of health

Renee Salas, a climate and health expert at Harvard University's Institute for Global Health, told the media that the health problems caused by heat waves in warmer cities are often less obvious than those caused by other weather disasters. Its impact on the human body is a process of accumulation, especially for patients with chronic diseases such as hypertension and heart disease; there is a delay effect of 3-5 days or even longer.

High temperature will overburden the body temperature control system, leading to increase fatality rate significantly. Heat stroke, Cardiovascular and respiratory diseases and other heat-related diseases are common causes of death. The number of hospitalizations has increased significantly due to high temperatures for conditions such as kidney failure, water and electrolyte disturbances, sepsis and urinary tract infections. In addition, the *Lancet* reported that high temperature would also affect people's mental health and work ability [7]. The number of deaths and injuries caused by heat waves is now rising much faster than all other extreme weather events.

Climate change will make heat waves more frequent, longer and more intense, and it will further lead to more frequent wildfires. In addition to the direct human deaths, wildfires also produce large amounts of soot containing hazardous particulate matter, which can pose a health risk to people. For example, symptoms of mild impact include transient cough, mild throat pain, serious effects include worsening of lung disease, increased risk of preterm birth and increased risk of death.

Most research of the climate change effects on human life has aimed at how extreme weather affects economic and social health on a large scale. However, climate change is also likely to have a strong impact on a range of basic everyday human activities, including behaviour, mental states and physical signs, which are crucial to happiness. According to a study published in *One Earth* on May 20, 2022, rising global ambient temperatures are negatively affecting human sleep, and the lead author of the paper is Kelton Minor from

University of Copenhagen, Denmark [8]. By 2099, inappropriate temperatures could result in 50 to 58 hours of lost sleep per person per year. In addition, the effect of temperature on sleep loss was much greater for residents from low-income countries, as well as for older people and women. Researchers anonymously collected worldwide sleep data using sleep tracking wristbands with accelerometers. The data include 7 million nighttime sleep records from more than 47,000 people in 68 countries, covering every continent except Antarctica. "In this research, we provide the first global-scale evidence that above average temperatures erode sleep in humans. "This erosion is mainly reflected in the delayed time to sleep and earlier time to wake up." Studies show that on hot nights (over 86 degrees Fahrenheit or 30 degrees Celsius), sleep duration decreases by an average of 14 minutes. The odds of sleeping less than seven hours a night also rose with temperature. The researchers have compelling evidence that the effects of climate warming on sleep loss are unequal across the globe, and subsequent studies should consider more vulnerable populations, especially those living in the hottest and poorest parts of the world.

## 5 The solutions

We must achieve net zero emissions by 2050 to meet the global net zero emissions goal of limiting warming to 1.5 °C by 2100. This requires aggressive climate action to limit global warming. China and India have both announced plans to achieve net zero emissions by 2060. Infrastructure needs to be built, the economy needs to be reformed, and supply chains and industries that have not changed for decades must be optimized.

In his book *Wizard and The Prophet*, Charles C.Mann, an American science writer, summed up two ideas to solve the environmental problems caused by the population boom and industrialization. One is a wizard, and the other is a prophet. Both have a clear vision of the common environmental challenges for humanity, but their proposed solutions are very different. Wizards emphasize faith in science, and believe that scientific methods can constantly solve new problems. Wevin emphasizes that there is no essential difference between human beings and other successful plants and animals, rapid reproduction will breed the seed of genocide, what should be done is to respect the law of nature, understand the overall strength of nature, that is, environmental carrying capacity, from changing their own habits to solve environmental problems. What we need now are practical, cost-effective, fast-acting solutions to reduce emissions of greenhouse gas and adapt to the impacts of the climate crisis. We should not only make use of the power of science and technology, but also respect the laws of nature to develop science and technology and products to deal with climate change.

### 5.1 Consensus and institutions

In addressing the threat of climate change in the future, we should implement the concept of whole-health, carry out cross-sectoral, multi-disciplinary and multi-faceted cooperation, strengthen the monitoring and early warning capacity of climate change risks, and work together to safeguard and promote human health.

As the author Halford J. Mackinder points out, "No matter how great the individual achievement, the forces of geography tend to work on human culture and ultimately win out." Climate has changed the human society, economy, and the influence of the level of industry and national status. The analysis and study on the trend, not only will form a combination of climate change with the new version of history, and it also is of great significance for the development and utilization of climatic resources and the value of the human spirit, which will cause a revolution of the humanities in the field of climatology. Human should establish "human climate destiny community" concept. In terms of

connotation, it is a kind of global governance order based on the international climate mechanism that can be widely accepted in the world, reflecting distinct dependence, fairness and sustainability. As many countries and people as possible in the world, especially students, have started thinking and discussing about global warming, a worldwide environmental problem. According to the regional differences in climate environment, it should strengthen the health risks of climate change science popularization, in rural cities and communities. It is important to carry out health adaptation action on climate change, and write health risks guidelines to cope with the extreme weather events, further enhancing the scientific health risk awareness on climate change, and building the belief of the inevitable harmonious coexistence between human and nature.

## **5.2 Health monitoring and product development**

For public health in China, a number of climate health programs has been carried out by the Chinese Center for Disease Control and Prevention, such as monitoring the effect of air pollution on population health, heat stroke, and national vectors. From the perspective of climate and climate change, the National Climate Center has also carried out sub-seasonal early warning of health risks of extreme climate events such as high temperature, and health risk regionalization and prediction under the background of future climate change.

It is necessary to develop health risk warning products to increase public awareness. Pregnant women, outdoor workers, the elderly and newborns are among the most vulnerable to climate change-related health hazards. How to protect the health of these populations from the effects of climate change is the focus of research. How to strengthen the research to deal with the population health threat under the risk of climate change has not attracted the full attention of the domestic academic circle. It is imperative to strengthen inter-departmental cooperation and accelerate the research and development of monitoring and early warning products for climate-sensitive diseases. Lu Bo suggested that cooperation between departments should be further strengthened to give full play to the professional characteristics of each department on the basis of the preliminary work, strengthening the research and development of multi-time scale early warning products of climate change health risks, and improving the protection capacity and emergency response of climate-sensitive diseases.

The meat industry's contribution to the climate crisis is huge. According to the United Nations, livestock accounts for 14 percent of all greenhouse gas emissions worldwide. The beef industry alone is responsible for 65 percent of the industry's emissions. Using vegan protein formulations such as plant protein derived mainly from non-genetically modified soybeans, peas and rice, researchers will develop products such as plant milk, seafood food and 3D printed bionic animal meat. Israel stands out as an important country for climate innovation, with various companies and start-ups in the field, as well as significant investments in areas such as research and development. Together, these elements create a remarkable climate innovation ecosystem that includes more than 1,200 companies and start-ups and is still growing, according to Israel's first State of Climate Technology Report 2021. The fact that around 10 per cent of all new high-tech companies founded in Israel last year were in the area of climate innovation, which is just one example of the vibrancy of Israeli start-ups. Israel offers a wide range of solutions. In agriculture, Israel provides drip irrigation and precision agriculture. In the area of water management and water loss prevention and control in urban systems, Israel holds a world record of 3% water loss rate and 90% waste water recycling rate. Israel also provide solutions in seawater desalination, the energy stored in compressed air or ice, energy efficiency, reforestation and sustainable traffic and transportation, the development of new materials, animal protein substitutes (this is in the field of the world's leading Israel, such as 3 d printing steak), the grain loss

prevention, and many other exciting fields. Israel hopes that by sharing its knowledge and collaborating to implement these solutions. More countries will partner with Israel or follow the example of setting up high-tech businesses in the field of climate innovation.

### 5.3 Green energy measures

Throughout the history of human development, every major leap is closely related to energy transition. To achieve carbon neutrality means to replace fossil energy with renewable energy, which is a systematic change of economic and social development and a green revolution of mankind. Tackling global warming is bound to be a difficult road and requires strong measures to push forward the energy transition at an extraordinary speed. Holger Thorsten Schubart, CEO of Neutrino Energy Group, said that not only scarce fossil fuel resources could be replaced by infinitely accessible particle energy from space in the future, but environmental disasters such as climate change could also be prevented. However, Bill Gates also gave us a less optimistic analysis in *Climate Economy and the Future of Humanity* [9]. With fossil fuels accounting for two-thirds of global electricity generation by 2020, there is still a long way to go to achieve clean electricity. Different from solar and wind energy, nuclear energy is the only carbon-free energy source that can provide reliable electricity continuously, but its disadvantages such as the risk of nuclear leakage are also obvious.

### 5.4 Building measures

In addition to cement and concrete, the common manufacturing materials are steel, plastic and glass. As skyscrapers continue to rise, tons of steel, cement, glass and plastic continue to pump huge amounts of greenhouse gases into the air, accounting for 31 percent of all global greenhouse gas emissions (Table 1). Adopt a variety of innovative ways to achieve net zero emission balance in buildings. These buildings operate efficiently in a variety of ways -- from generating their own energy through solar or wind power to having less energy-intensive cooling systems and more efficient insulation. With the help of changes in planning codes and standards, these changes have created sustainable new developments. Net zero buildings can seamlessly replace the current architectural status quo. In addition, energy efficiency in large enterprises can lead to greater savings and lower administrative costs, which is good for the global economy.

**Table 1.** The percentage of greenhouse gas emissions attributable to human activity

Field	Percentage
Production and manufacturing (cement, steel, plastics)	31%
Electricity production and storage (electricity)	27%
Grow and breed (plants, animals)	19%
Transportation (aircraft, trucks, cargo ships)	16%
Heating and cooling (heating system, cooling system, cooling system)	7%

In accordance with the local climate and the main building materials, these buildings such as the establishment of tiled houses, yurts, stilted buildings, bamboo buildings, cave

dwellings and family boats, not a uniform cement house in modern times, have good permeability, and reduce the dependence on air conditioning and heating. In addition, the characteristic architectural styles inherited long time ago are incorporated into modern buildings to create a harmonious and energy-saving building between human and nature.

## **5.5 Transportation**

Transport is responsible for 16% of global greenhouse gas emissions (Table 1). Among all types of transportation, passenger cars (cars, motorcycles, etc.) account for 50 percent of emissions. Fortunately, we already have effective solutions in this area, namely new energy vehicles such as hybrid electric vehicles, pure electric vehicles and fuel cell electric vehicles. At the same time, to reach the zero-carbon target, electricity needs to come from "zero-carbon" sources. Another option is to use "alternative fuels", such as biofuels and hydrocarbon fuels.

## **5.6 Multidisciplinary joint research measures**

In 2020, Climate change attribution, a technique associated with climate analysis, was included in the MIT Technology Review's list of the World's Top 10 Breakthrough Technologies. The technology will lead to a clearer understanding of how climate change is worsening weather and what we need to prepare for it. The increased computing power allows scientists to run more accurate simulations and conduct more virtual experiments. This, together with a series of other multidisciplinary technological advances, has led to more results in climate change research. Goncalves Gresse of the University of Hamburg, who works at the Elite Cluster on Climate in Climate Change and Society (CLICCS), takes part in a research project that focuses on how climate and society are changing and how that in turn affects climate. Exploring interactions between humans and the environment from the perspectives of sociology, economics, physics, meteorology, and oceanography, researchers want to collectively infer which climates are likely in the future and which seem plausible. Some of the work done by the elite cluster, such as analysing social and physical dynamics and their impact on climate change, is presented in the annual Hamburg Climate Vision for the Future report. Goncalves Gresse believes the report has a wide audience and hopes to reach beyond science to influence politics and society. The real impetus for his research is to identify the connections between science and politics, theory and practice, natural and social sciences, or to identify the connections between Europe, Latin America and other continents.

## **6 Conclusions**

The field of climatology is not only a humanistic revolution in social science, but also a humanistic medicine revolution. Human beings re-examine nature, society, modern science and modern medicine. Human beings follow the concept of harmonious coexistence of nature from birth to death, making the sustainable progress and development of modern science and modern medicine, and achieving the harmonious coexistence of nature, society and man. Our several thousand years of Chinese traditional humanistic philosophy always pay attention to the laws of nature and protect the natural environment, not draining the pond to get all the fish. In the traditional Chinese cultural background, we combine the Chinese traditional culture, traditional Chinese medicine, science, and psychology, the relationship between natural science and social science, we conduct a variety of practical activities beneficial to health of body and mind, we broadcast globally the concept of nature

- society - human harmonious, building human climate destiny community. We humans will achieve net zero emissions by 2050 and the global net zero emissions goal of limiting warming to 1.5 °C by 2100, so as to curb the momentum of warming and build a better planet for all.

## Authors' contributions

Ying Yang and Zhi Chen conceive and write this paper.

## Acknowledgments

Tanks to the professor of Zhejiang University.

## References

1. Darrell Kaufman, Nicholas McKay, Cody Routson, et al. Holocene global mean surface temperature, a multi-method reconstruction approach. *Sci Data*. 2020 Jun 30;7(1):201. DOI: <https://doi.org/10.1038/s41597-020-0530-7>.
2. Max Callaghan, Carl-Friedrich Schleussner, Shruti Nath, et al. machine-learning-based evidence and attribution mapping of 100000 climate impact studies. *Nature Climate Change*, 2021, 11:966-972. [www.nature.com/articles/s41558-021-01168-6](http://www.nature.com/articles/s41558-021-01168-6).
3. 2022. Atlas of Human Suffering: New UN Climate Report Is Shockingly Grim.
4. Nick Watts, Markus Amann, Nigel Arnell, et al. The 2020 report of the Lancet Countdown on health and climate change: responding to converging crises. *Lancet*. 2021 Jan 9; 397(10269):129-170. DOI: [https://doi.org/10.1016/S0140-6736\(20\)32290-X](https://doi.org/10.1016/S0140-6736(20)32290-X).
5. Camilo Mora, Tristan McKenzie, Isabella M Gaw , et al. Over half of known human pathogenic diseases can be aggravated by climate change. *Nat Clim Chang*. 2022; 12(9):869-875. DOI: <https://doi.org/10.1038/s41558-022-01426-1>.
6. Colin J Carlson, Gregory F Albery, Cory Merow, et al. Climate change increases cross-species viral transmission risk. *Nature*. 2022 Jul; 607(7919):555-562. DOI: <https://doi.org/10.1038/s41586-022-04788-w>.
7. Kristie L Ebi, Anthony Capon, Peter Berry, et al. Hot weather and heat extremes: health risks *Lancet*. 2021 Aug 21; 398(10301):698-708. DOI: [https://doi.org/10.1016/S0140-6736\(21\)01208-3](https://doi.org/10.1016/S0140-6736(21)01208-3).
8. Kelton Minor, Andreas Bjerre-Nielsen, Sigga Svala Jonasdottir, et al. rising temperatures erodes human sleep globally. *One Earth*, 2022,. [https://www.cell.com/one-earth/fulltext/S2590-3322\(22\)00209-3#%20](https://www.cell.com/one-earth/fulltext/S2590-3322(22)00209-3#%20).
9. Bill Gates, *The Climate economy and the future of Humanity*. Zhaoqiang Chen, translation, Version 1. Beijing: Citic Publishing Group, 2021, April.