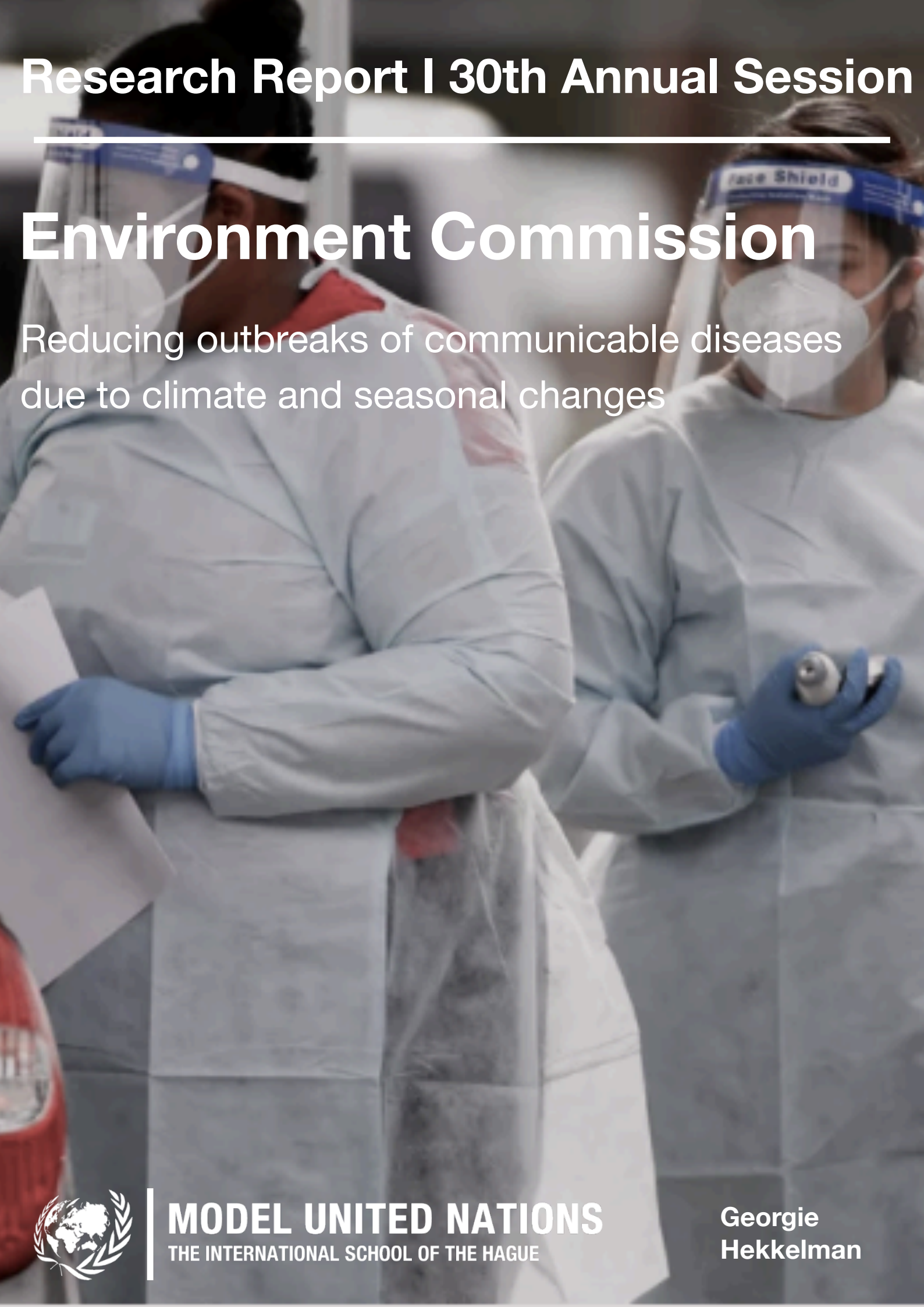
Environment Commission

Reducing outbreaks of communicable diseases due to climate and seasonal changes



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Introduction

Even before we understood the notion of infectious agents, humans understood that climatic conditions had a huge effect on epidemic infections. The Roman aristocrats would retreat to their resorts in the hills to avoid malaria each summer. South Asians learnt early if they curried their foods in the summer they had less chance of diarrhoeal diseases. And in more recent times it is well known that in the winter we have recurring influenza epidemics.

Often it is extremely helpful when looking at infectious diseases to look at it within an ecological framework. This is important because infectious agents obtain their necessary energy and nutrients, this often happens because they become parasites attaching themselves to other larger organisms. Often infections are harmless and some are actually beneficial to the host and the microbe. Only a minority of the infectious agents are damaging to the host of the infectious agent.

Both the infectious agents (viruses, bacteria, protozoa, etc.) and their associated vector organism or physical vehicle (water droplets, mosquitoes, ticks, etc.) are extremely small and therefore devoid of thermostatic mechanisms. This is why there is often a limited range of weather and climate conditions in which the infective agent or the associated vector organism can reproduce and survive. This is because the temperature and fluid levels are directly determined by their environment. It is also extremely important to realise that the incubation period of the infectious agents within the vector organism is typically extremely sensitive to changes in temperature, which can usually be displayed in an exponential relationship when drawn in a graph. The infectious agent, vector and host may also be sensitive to other climatic and weather conditions, such as duration of sunlight, level of precipitation and sea-level elevation.

Definition of Key Terms

Communicable disease

Communicable diseases are diseases that are spread from one person to another, which can happen through a variety of ways. Such as contact with an infected person or contact with their blood or bodily fluids, an example of this is influenza which is spread through droplets. By coming in contact with infected surfaces or objects, such as salmonella is caused by coming in contact with contaminated food. Or through a vector, for example mosquitoes are often a vector for the transmission of the deadly disease malaria.

Directly transmitted anthroponoses

Directly transmitted Anthroponoses are diseases which are usually transmitted from one human to another through human contact or droplet exposure. The transmission cycle of these anthroponoses usually comprises two factors: the pathogen and the human. Therefore they are less likely to be impacted by climatic factors as the pathogen spends little time outside the host. Examples of anthroponoses are TB, measles and sexually transmitted diseases.

Indirectly transmitted anthroponoses

Indirectly transmitted anthroponoses are diseases which have three components to their transmission cycle: the pathogen, a vector or vehicle and the human. Examples of indirectly transmitted anthroponoses are malaria which is transmitted using a mosquito as a vector and for example water is a vehicle for cholera.

Directly transmitted zoonoses

Directly transmitted Zoonoses are similar to the directly transmitted anthroponoses because they are passed on through physical contact or exposure to droplets. However, these pathogens are naturally passed on among animals and the infection of a human is seen as an accidental encounter. An example of directly transmitted zoonoses is rabies. Many of today's anthropogenic diseases (such as TB and HIV) originally emerged from animals.

General Overview

When looking at communicable diseases and their infectious agents and vector organisms it is often already known how sensitive they are to seasonal patterns and changes in climatic and weather conditions. For example we know there is often an epidemic of influenza during the mid-winter season in more developed countries. And the number of cases of malaria often go up as the temperature and humidity goes up, as these are the preferred climatic condition for their vector (the mosquito) to survive and reproduce in. However, a concern is that we do not know to what extent the changes in disease patterns will occur under the changing climatic conditions because of climate change.

However, we do have to realise that climatic conditions are only one out of several important factors which influence the incidences of infectious diseases. Other important factors to consider are for example socio-demographic influences such as human transportation and migration. But also environmental factors such as deforestation and urbanization. This is why the changes in the climate are unlikely to be the only reason the communicable disease changes. Rather the effect is likely to be dependent on the ways humans learn to cope with the trends. Nonetheless, the topic we are trying to find a solution to is Reducing outbreaks of communicable disease due to climate and seasonal changes, therefore we should be focussing on the way climatic and seasonal changes affect the outbreaks of communicable diseases.

The sensitivity of infectious agents to seasonal changes

Many communicable diseases exhibit cycle seasonal patterns. This means that they are more broadly affected by the changes in the weather because of the seasons. In diverse areas around the world examples of these infectious agents show significant seasonal fluctuations. An example of this is in North America when often there are influenza outbreaks during the mid-winter. But also in Bangladesh cholera outbreaks occur more frequently during the monsoon season. In Scotland, campylobacter infections are characterized by short peaks during the spring. Furthermore, when looking at vector-borne diseases (such as malaria and dengue fever) they often show significant seasonal patterns where transmission from vector to host is often highest during the months where there is high humidity and heavy rainfall. This is because these conditions are necessary for the vector to survive and

reproduce. The seasonal fluctuations of infectious diseases mean that the infectious agent, the vector or host are influenced by climatic changes.

The sensitivity of vector-borne diseases to climatic conditions

When looking at the transmission rate of a certain vector-borne disease it is important that you consider the following factors. The vectors survival and reproduction rate, the time of year and the level of activity of the vector and the rate of reproduction of the infectious agent within the vector. This means for the transmission rate of the vector to be high there would need to be certain optimal climatic conditions, and even a minor change in these conditions could greatly affect the transmission rate of the pathogen. There are many different climatic conditions which greatly affect the transmission rate of the infectious agent, examples of these are, temperature, precipitation level, sea-level elevation, the duration of daylight and the amount of wind.

The sensitivity of water-borne infections to climatic conditions

Another type of communicable disease that is highly impacted by climatic conditions are water-borne infections. They occur as a result of contact with contaminated drinking water, coastal water, recreational water or even food. Even though water-borne infections may be a result of improper sewage waste or other consequences of human processes, but often may also be a result of weather events. For example, rainfall affects the transportation of infectious agents. Temperature is also an important climatic factor as temperature of for example the water affects the growth and survival rate of the infectious agents. For example, warmer temperatures create more favourable conditions for blooms of toxic red algae which then may result in more shellfish poisonings.

Effects of climate change on outbreaks of communicable diseases

As outlined above the transmission rate of infectious agents to hosts or via vectors and then to hosts are extremely dependent on seasons and the climate. But because of climate change, these factors that affect the outbreak of communicable disease are changing. Winters are becoming shorter and summers are becoming longer. The sea levels are rising and the general temperature of the oceans are going up. These changes are affecting the transmission rate of infectious agents, mostly in a negative way which is causing more major outbreaks of communicable diseases.

Major Parties Involved

World Health Organisation (WHO)

The WHO is a specialised United Nations organisation which is responsible for international public health and has the goal to reach the highest possible level of health for all people. The WHO is involved in the topic of reducing outbreaks of communicable disease due to climate and seasonal changes as it has been doing research into what the effect of climate change has been on the transmission of both directly and indirectly transmitted anthroponoses and zoonoses.

India

India is one of the many nations which is highly impacted by outbreaks of communicable disease. An example of a vector-borne infection which affects India is for example malaria. However, malaria does not only just affect India as it also affects many other South-Asian nations such as Bangladesh and Sri Lanka, but also many other nations around the world.

Bangladesh

Bangladesh is also highly impacted by outbreaks of communicable diseases. As stated above it is affected by malaria but is also for example highly impacted by cholera outbreaks during their monsoon season.

Sub-Saharan Africa

Sub-Saharan Africa is often affected by many outbreaks of communicable disease (such as meningococcal meningitis) during their hot and dry season, however, they often subside once the rainy season starts.

Timeline of Key Events

The timeline outlines the major outbreaks of communicable diseases. It is important to note that there are many outbreaks of different communicable diseases each year and in the following timeline only the most significant are noted. To see a list of all communicable disease outbreaks please visit the WHO website (for source see appendix I).

February 1996 - January 1997	An outbreak of the Ebola virus in Western Africa, Gabon is especially hit hard.
January - March 1998	An outbreak of Influenza A(H5N1) in Hong Kong
October - November 2001	There is an outbreak of zoonotic disease anthrax in the United States of America.
2004 - 11	An outbreak of Avian influenza A(H5N1), especially in Vietnam in 2004 and later in 2005 spreads to other South Asian nations. Later it spreads to other nations around the world such as Egypt, after 2008 the number of cases became less.
2009 - August 2010	An outbreak of Influenza A(H1N1), later declared a pandemic
2014	A major outbreak of the Ebola virus in Western Africa.
2014 - 2017	The circulation of Middle East respiratory syndrome coronavirus (MERS-CoV) mostly in the Middle East but also reported cases in other nations.
May 2018 - June 2020	An outbreak of the Ebola virus in the Democratic Republic of Congo, number of cases go down after the mid-2019 but the virus does keep circulating.
January 2020 - present	A major pandemic of the Novel Coronavirus

UN involvement, Relevant Resolutions, Treaties and Events

There are currently barely any resolutions relating to the issue of reducing outbreaks of communicable diseases due to climate and seasonal changes. There are resolutions relating to the prevention and control of non-communicable diseases, these are:

- Prevention and control of non-communicable diseases, 10 July 2014 (A/RES/68/300)
- Prevention and control of non-communicable diseases, 12 April 2018 (A/RES/72/274)

The World Health Organisation (WHO) has also done research into the transmission of communicable diseases and how that may be affected by climate change. The outcomes of the research is published in the book "Climate change and human health - risks and responses" published by WHO in collaboration with UNEP and WMO. The summary of the relevant chapters can be found on the following sources and the pdf for the full booklet and relevant chapters can be found in appendix II.

- “Climate Change and Human Health - Risks and Responses. Summary chapter 6.” *World Health Organization*, World Health Organization, 25 Oct. 2012, www.who.int/globalchange/summary/en/index5.html.
- “Climate Change and Human Health - Risks and Responses. Summary chapter 7.” *World Health Organization*, World Health Organization, 25 Oct. 2012, www.who.int/globalchange/summary/en/index6.html.

Previous Attempts to solve the Issue

There haven’t been very many attempts to solve the issue of reducing outbreaks of communicable diseases due to climate and seasonal changes. The United Nations have got resolutions which are helping to control and prevent non-communicable diseases however they haven’t written any resolutions regarding the communicable diseases. However, the World Health Organisation (WHO) together with the United Nations Environmental Programme (UNEP) and the World Meteorological Organisation (WMO) have done research into what effect climate change may have on human health. This research can create a

baseline for future resolutions as it shows us the potential effect climate change may have on not only communicable diseases but also on other threats to human health.

Possible Solutions

When trying to reduce the number of outbreaks of communicable disease due to climatic and seasonal changes there are many different angles you can come from. It is important to consider that there are many different factors that affect the transmission rate of the diseases and that they are not all depending on the seasonal and climatic changes. Another thing to consider is that this is an extremely large problem and will need many long term solutions to solve it, however, there are also short term solutions necessary to help the people who are directly affected by current outbreaks of communicable diseases. The following solutions should be a start to solving the issue but there is also a lot more action needed to fully solve it.

The first thing which is necessary to start reducing the cases of communicable diseases is the increase in global disease surveillance. There is often a lack of precise knowledge of the communicable disease incidence rates and therefore it is hard to determine if this is affected by changing climatic conditions. The data is needed to determine a baseline for many different studies and it is needed to validate current predictive models. But the data is often extremely difficult to gather especially in more rural areas. Therefore it would be helpful to create a centralized computer database which can be accessed by all researchers so that they can share their data.

It is also an extremely important potential solution to this problem is the continuation and extension of current research into the subject of how climate change is affecting the transmission rate of communicable diseases. This research is crucial so that we can get the full picture of what is going on and it will provide us with more answers of how to combat this issue. A way this solution can be reached is potentially creating a new UN board which should act together with the World Health Organisation (WHO). This board could be in charge of both the collecting of the necessary data, providing it to the suitable researchers and overseeing their research. The models the researchers come up will be extremely crucial in the future to predict transmission rates of new unknown communicable diseases.

Both of the possible solutions above are long term and more theoretical and are important to predict trends of communicable diseases. However, it is also extremely important that we have short term solutions which help the people who are directly affected by outbreaks of communicable diseases. That is why it is necessary to improve the public health infrastructure in many nations. This includes emergency response, quarantining new outbreaks of communicable diseases and reaching communities in more rural areas. By improving the public health infrastructure it will most likely reduce how big the outbreaks are of a disease but also help with how lethal a communicable disease may be as people can get the correct care to have the highest survival rate.

The final major long term solution to reduce the number of communicable disease outbreaks is by reducing and minimizing the impact of climate change as much as possible. How much climate change may impact the amount of outbreaks of communicable is fairly unknown. However, we do know that different infectious agents are impacted by seasonal and climatic changes. For example, we know that there are more cases of malaria when it is more humid and there is more precipitation. As the global temperatures rise there the monsoon seasons will most likely become longer and so the period where there are most malaria cases will also increase and the outbreaks will become longer. Therefore to solve the issue of reducing outbreaks of communicable diseases we need to do something about the long term issue of global warming.

These are just a few of the ways we can potentially solve the issue of Reducing outbreaks of communicable disease due to climate and seasonal changes. However, there are many other possible solutions as this is an extremely important issue to solve or else it may have severe consequences for the future of human health.

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Appendix I

“Disease Outbreaks by Year.” *World Health Organization*, World Health Organization, 2 July 2020, www.who.int/csr/don/archive/year/en/.

Appendix II

PDFs for the booklet on "Climate change and human health - risks and responses" published by WHO in collaboration with UNEP and WMO. Chapter 6 and 7 are the most relevant to the issue at hand, however other chapters also hold valuable information.

Full booklet - https://www.who.int/globalchange/environment/en/ccSCREEN.pdf?ua=1

Chapter 6 - https://www.who.int/globalchange/climate/en/chapter6.pdf

Chapter 7 - https://www.who.int/globalchange/environment/en/chapter7.pdf