7.4 How will climate change affect us?

This section introduces the impacts of climate change on the natural environment and human society, and discusses the impacts on biodiversity, public health and the economy

1 Impacts on the natural environment

2 Impacts on human society

3 Impacts on Hong Kong

1 Impacts on the natural environment

Climate change disrupts the delicate balance of ecosystems. In response to the changing climate, some terrestrial, freshwater and marine species change their geographical distributions, seasonal behaviours, migration patterns, population sizes, and interactions with other species. Species that cannot adapt quickly enough to the changing climate may decline in number or even face extinction.

1.1 Geographical distribution of species

For those species unable to adapt to warmer environments, they must migrate to cooler areas. While terrestrial species migrate to higher latitudes or elevations, marine species migrate to higher latitudes or deeper oceans. Examples:

a. American lobsters migrating to the higher–latitude Gulf of Maine

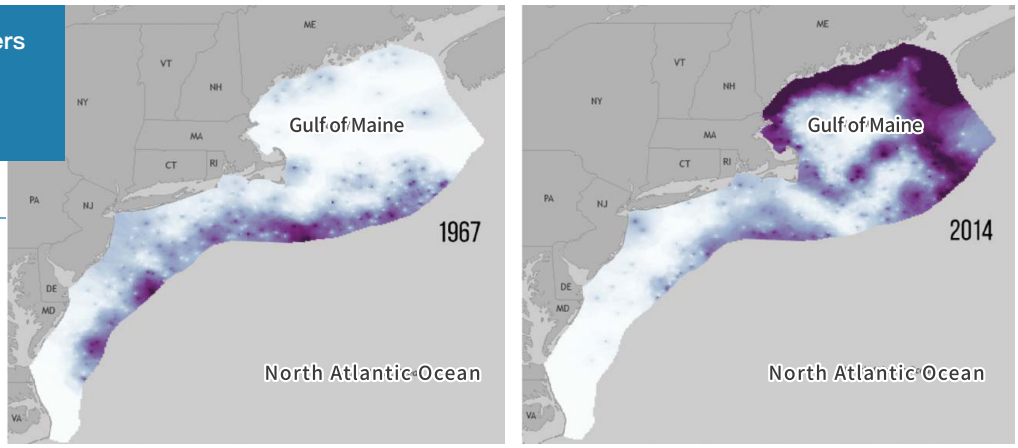


Fig 1 Change in American lobster distribution

Amounts of lobster caught

low mid high

Source: NOAA

b.The prairie climate of the Midwest in North America shifting northward into boreal forest zone

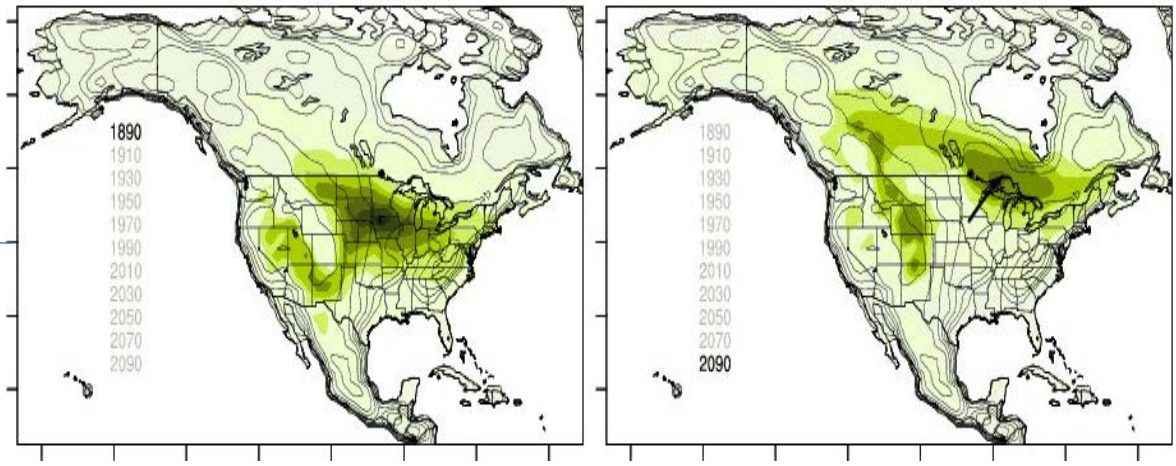


Fig 2 Climate model projection on shifting of prairie climate in North America

Source: Charles Koven, Lawrence Berkeley National Lab

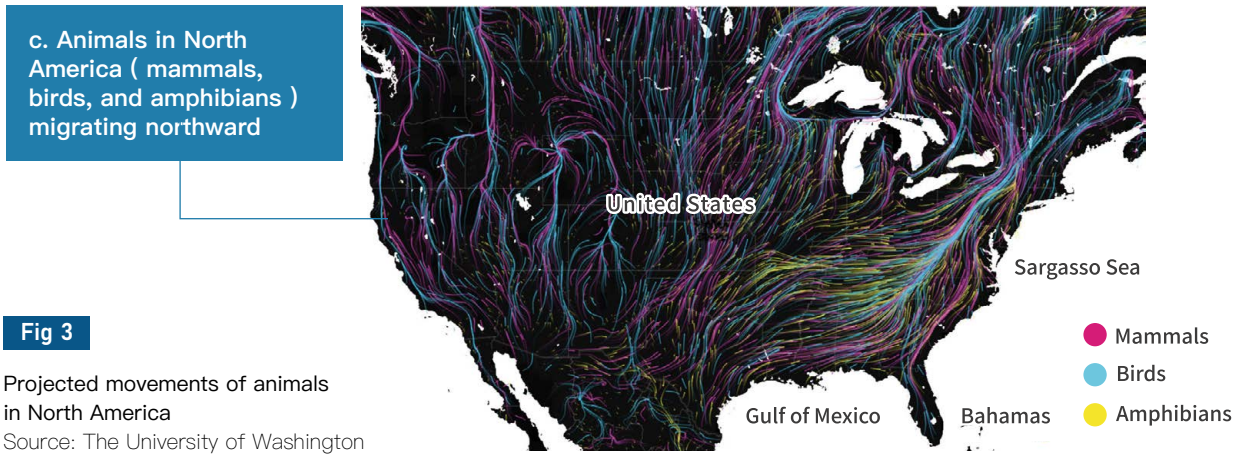


Fig 3
Projected movements of animals in North America
Source: The University of Washington

Migration may not be a feasible option for species restricted by specific habitats. For example, the Giant Spiny Frog (Quasipaa spinosa) in Hong Kong inhabits high-altitude streams on Tai Mo Shan and may have nowhere to go as the climate warms.

Fig 4 Hong Kong Giant Spiny Frog
Source: Gary Chan

1.2 Phenology

Phenology refers to the behaviors and phenomena of organisms that occur in response to seasonal or climatic changes. Climate warming, along with increased precipitation, may extend the growing season for plants in some areas. Changes in seasonal timing can disrupt the migration routes and cycles of migratory birds. An early arrival of spring may cause trees and flowers to bloom earlier and shorten the hibernation periods of animals. A mismatch between bloom time and pollinator arrival can affect plant reproduction and food availability for the pollinators, leading to profound consequences. A mismatch between the timing of migration and breeding of migratory birds and the emergence of their prey significantly reduces the reproduction rate of migratory birds, resulting in long-term impacts on the population size and structure of the species. Phenology refers to the cyclical patterns that emerge from the interactions between plants, animals, and natural seasonal changes. Over time and with the progression of seasons, biological activities correspond with climatic and environmental shifts, forming a regular cycle of adaptation.

Fig 5 Insect pollination
Source: Dickson Wong

However, warming of climate extends the plant growing season and may lead to earlier flowering times. If the emergence of plant pollinators does not adjust accordingly, it can impact plant reproduction and the food sources of pollinators. Similarly, if hibernating animals wake up earlier but face a mismatch in food supply, they may suffer from energy depletion and starvation, increasing the risks of death and lowering their chances of successful reproduction and survival through the winter, ultimately leading to population decline. Seasonal disruptions break the synchrony between plants and animals, potentially upsetting the balance of the ecosystem.

In addition, earlier springs caused by warming of climate may disrupt the migratory routes and schedules of birds, while the growing frequency of extreme weather events poses further threats. Records from the Hong Kong Bird Watching Society indicate that from March 31 to April 1, 2025, the peak migration period of barn swallows coincided with an unseasonably cold spell that lasted for two days. Additionally, Hong Kong's unusually dry and warm weather in March had already hindered insect growth and reproduction. The compound effects resulted in a significantly higher mortality rate compared to previous records. Migratory birds expend substantial energy during each long-distance flight, and as the likelihood of encountering extreme weather and insufficient food resources during their journeys increases, so does their mortality rate.

Fig 6 Barn swallows that pass through Hong Kong in spring for breeding
Source: Gary Chan

1.3 Habitat

Habitat refers to the environment in which a species lives and reproduces. Whether on land or in the ocean, climate change can cause direct or indirect damage to the habitats of species. Examples:

a

A study shows that with high greenhouse gas emissions, by 2100, the persistence of nearly all polar bear populations will be threatened due to a sharp decline in reproduction and survival rates, with the exception of a few high-latitude Arctic subpopulations.

Fig 7 Polar bear and cubs
Source: Pixabay

b

The rising sea surface temperatures in Antarctic coastal regions may negatively affect the rearing of Adélie penguins. Their population in Antarctica is projected to decline by about 60% by the end of this century.

Fig 8 Antarctica Adélie penguin
Source: Jerzy Strzelecki

c

Rising sea levels submerged the habitat of the Bramble Cay melomys, making it the first mammal in the Great Barrier Reef to go extinct as a result of climate change.

Fig 9 Great Barrier Reef Bramble Cay
Source: Ian Bell©Queensland Government

More Information

Effects of extreme weather events on barn swallow in Hong Kong in Spring 2025 (Chinese Only)

Impact on polar bear survival conditions

d

As seawater warms, corals tend to expel the symbiotic algae living in their tissues and turn white. Bleached corals become fragile and weak, and may even die. About one-fourth of the carbon dioxide emitted by human activities is absorbed by the ocean, leading to ocean acidification and affecting coral growth. The death of coral reefs will lead to the loss of habitat or food for many marine species, disrupting the food chain and threatening the ecosystem.

Between 2016 and 2024, five mass coral bleaching events occurred in Australia's Great Barrier Reef. According to the IPCC Sixth Assessment Report, if global warming exceeds 1.5° C, many coral reefs will undergo irreversible changes. Even under a low greenhouse gas emissions scenario, coral reefs still face the risk of widespread decline by the middle of this century.

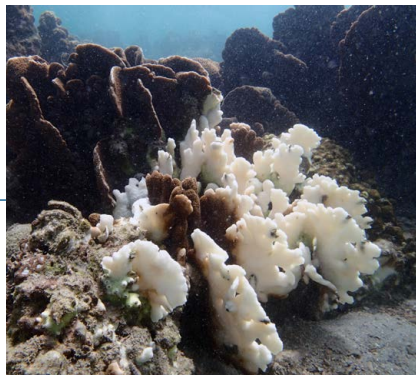


Fig 10
Coral bleaching
Source: Dickson Wong

e

Wetlands, which are home to a wide variety of species, may be inundated by rising sea levels, leading to habitat loss.

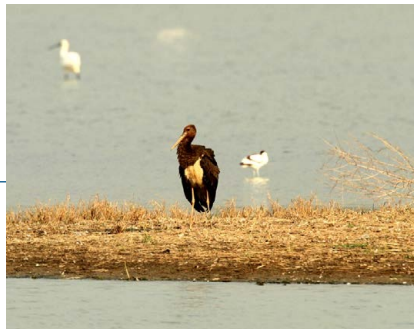


Fig 11
A Wetland habitat
Source: Kwok Chi Tai

f

High temperatures and drought increase the risk of wildfires. Research shows that fire seasons are lengthening across the globe. Habitats for many species will be lost when forests are burned down. Besides, forests face a greater risk of pests and diseases.

Fig 12
NOAA satellites monitored southern California wildfires on 9 January, 2025
Source: NOAA

More Information

Ocean acidification and deoxygenation

Coral bleaching

AR6 Chapter 3: Oceans and Coastal Ecosystems and their Services

2 Impacts on human society

2.1 Health

High temperatures are becoming more frequent due to global warming, with heat waves (anomalous high temperatures sustained for an extended period of time) occurring more often, more intense, and lasting longer. Extreme heat can lead to health problems such as heatstroke and heat exhaustion, and increase the morbidity rates of respiratory and cardiovascular diseases.

	Event	Description	More Information
a	2003 Heat wave in Europe	• In 2003, the summer temperatures in Europe were much higher than the long-term mean. Research reveals that human influence has more than doubled the chance of the heat wave. • The heat wave led to drought and wildfires. Water levels in major rivers (such as Rhine, Danube) dropped to record lows. This heat wave led to over 70,000 deaths.	
b	2010 Heat wave in Russia	• In July 2010, Russia recorded its hottest July since 1880. Research shows that human influence has increased the chance of the heat wave by three times. • This heat wave led to a severe drought with around 9 million hectares of crop perished. Also, widespread wildfires caused severe air pollution. • This heatwave led to an estimated 55,000 deaths.	
c	2021 Heat wave In the United States and Canada	• Between 26 and 29 June, 2021, under the influence of a nearly stationary high-pressure system, record-breaking temperatures were observed in the Pacific Northwest region of the United States and western Canada. • On 28 June, temperatures reached 46.7° C in Portland and 42.2° C in Seattle. On 29 June, Lytton in Canada recorded a shocking 49.6° C. • Nearly 700 people died due to the heat wave in British Columbia and Alberta, Canada, while almost 200 deaths were reported in Washington and Oregon in the United States.	
d	2022 Heat wave in China	• From 13 June to 30 August, 2022, large areas of central and eastern China experienced a prolonged heat wave, lasting for 79 days. In Chongqing, the daily maximum temperature reached 45° C for two consecutive days. The persistent heat caused negative impacts on agriculture, electricity supply, and human health. During this period, electricity consumption reached record highs in southern regions such as Zhejiang and Shanghai. • A model-based study estimated that the number of deaths related to the 2022 heatwave in China could be up to 50,900.	

Climate warming creates favourable environment for some disease vectors (e.g. mosquitoes) to expand their geographical distribution. Some studies point out that the distribution of mosquitoes will spread to higher latitudes (e.g. the United States, Europe) and higher altitudes, increasing the risk of spreading tropical disease. In 2024, there was a significant increase in dengue cases, with human–induced climate change being one of the contributing factors. In addition, bacteria have become more active, threatening human health.

Global warming may have some positive impacts in certain cold regions as there would be fewer cold related illnesses with generally warmer winters. However, research shows that under a business–as–usual scenario of carbon emissions, the negative health impacts of climate change will disproportionately affect warmer and poorer regions.

2.2 Fishery and agricultural production

According to the IPCC Sixth Assessment Report, human–induced warming has slowed the growth of agricultural productivity in low to mid latitude regions over the past 50 years. Ocean warming and acidification have had adverse effects on some wild fish populations and aquaculture. Climate–related extreme events have led to reduced food supply and rising food prices. In the future, the impacts of climate change on terrestrial and aquatic food production are expected to become increasingly negative, although certain regions may benefit in the short term. In addition, climate change will have negative impacts on food safety.

More Information

Medical alert! Climate change is harming our health

Climate change already damaging health of millions globally

Deadly heatwaves could affect 74% of the world's population

Dengue: the threat to health now and in the future

AR6 Chapter 5: Food, fibre and other ecosystem products

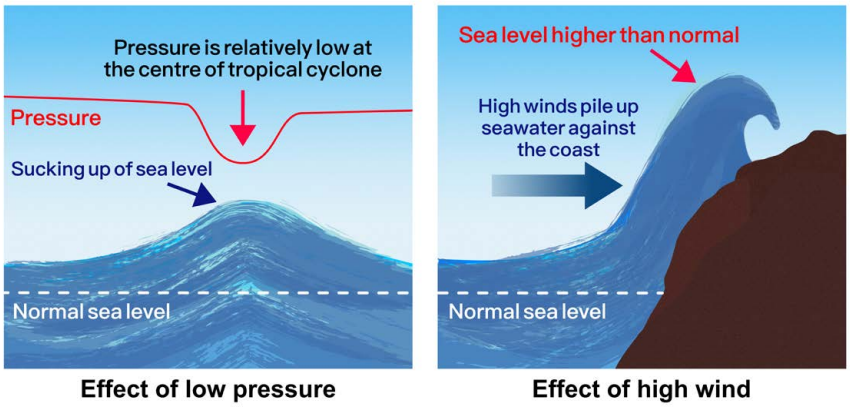
2.2 Risk of coastal inundation by seawater

Many densely populated cities around the world are situated in coastal areas. Rising sea level not only increases the risk of inundation by seawater, but also heightens the threat of storm surges. In addition, some island nations such as the Maldives in the Indian Ocean, Tuvalu and Kiribati in the Pacific Ocean are facing the threat of being submerged. Hurricane Ian struck the United States in late September 2022, causing severe destruction, particularly in Florida. It brought a catastrophic storm surge to the southwestern coast of Florida, with peak levels reaching 10 to 15 feet above ground level. The hurricane caused 66 direct deaths and 90 indirect deaths, with estimated damages totaling $112.9 billion in the United States. Tens of thousands of structures were affected, many of which were destroyed. More than 9 million people in the United States lost power due to Ian.

More Information

National Hurricane Center Tropical Cyclone Report: Hurricane Ian

Fig 13 Aerial assessment imagery collected in the aftermath of Hurricane Ian on 29 September, 2022
Source: NOAA



Effect of low pressure | Effect of high wind

Fig 14 Formation of storm surge

More Information

Typhoon Hazards: Strong Winds, Heavy Rain, High Seas

What is storm surge?

Storm surge is a rise of sea level due to the combined effects of low air pressure and high winds associated with tropical cyclones.

2.4 Water resources

In some areas, decrease of precipitation and increase of evaporation may cause lake shrinkage and reduced river discharge, leading to decrease in fresh water resources. The warming climate accelerates melting of glaciers and ice caps, which may increase freshwater supplies in short term. However, the problem of water shortage will emerge immediately if the glaciers and ice caps melt away completely without replenishment.

As sea level rises, seawater intrusion into rivers and groundwater will increase the salinity of fresh water, making the water not suitable for drinking and irrigation.

相關資料

Water scarcity

Fig 15a Arapaho Glacier in 1904
Source: NSIDC

Fig 15b Arapaho Glacier in 2021
Source: NSIDC

2.5 Infrastructure and transport

Extreme weather may damage urban infrastructure such as buildings, transport networks, power supply and communication facilities, disrupting normal functions of cities and even causing economic losses. Buildings and infrastructure built on permafrost may be damaged due to the thawing of permafrost.

The loss of Arctic Sea ice may open up more convenient shipping routes. However, it could also lead to increased human activities and resource extraction, in particular fossil fuels, resulting in more pollution and greenhouse gas emissions.

2.6 Energy supply

Both hydroelectric and thermoelectric power generation (e.g. fossil–fueled, nuclear) rely on adequate water resources (e.g. rivers). In other words, energy production can be affected by climate change. In addition, thermoelectric power generation facilities need water for cooling. Therefore, the temperature of water will also affect energy production.

The IPCC Sixth Assessment Report indicates that climate change has already had negative impacts on hydropower and thermoelectric power generation due to droughts, changes in river flow, and rising water temperatures.

In the future, thermoelectric power capacity is projected to decline. Although the global hydropower capacity is expected to increase, there will be significant regional differences. For example, in the Mediterranean parts of Europe, if warming reaches 3°C, hydropower potential is projected to decrease by as much as 40%.

2.7 Tourism

A number of tourist attractions are being damaged as a result of climate change, for example, coral bleaching and death in Australia's Great Barrier Reef. Sea level rise would also damage tourist facilities in some island countries.

More Information

AR6 Chapter 4: Water

Global coral reefs impacted by largest bleaching event on record

2.8 National security

Climate change is related to national security.

According to the "National Security Law of the People's Republic of China", national security encompasses major fields including food security, ecological security and polar security. Food security is an important cornerstone for national security and the most important issue that concerns people's livelihood. Climate change intensifies extreme weather events, such as heatwaves and heavy rain, threatening the stability and quality of food production. Ecological security covers the security of water, land, atmosphere and biological species. Climate change disrupts supply and demand of water resources, alters phenology and habitats, and undermines ecosystem stability. It also threatens biodiversity and heightens ecological risks. Additionally, polar regions, at the forefront of scientific research on global environmental and biological changes, are significantly affected by global warming. The polar environments and ecosystems are threatened by the rising temperatures and accelerated melting of snow and ice.

More Information

Twenty major fields of national security

Fig 16 A holistic approach to national security
Source: National Security Education Day, GovHK

Climate migration

Many studies have found a significant connection between extreme weather events and both domestic and international migration.

According to a World Bank report, by 2050, climate impacts may force 1.9 million Moroccans to migrate from rural areas to urban centers. Climate-driven migration has also reduced the labor force in Caribbean countries, where migration rates are already high.

More Information

Key risks across sectors and regions

Work Bank Report

3 Impacts on Hong Kong

The climatic trends observed in Hong Kong are generally consistent with the global trends. As for the future climate in Hong Kong, the Hong Kong Observatory utilized climate model data from the IPCC Sixth Assessment Report to make projections under various greenhouse gas emissions scenarios, including very low, low, intermediate, high, and very high emissions scenarios.

Under the intermediate greenhouse gas emissions scenario, the annual number of hot nights and very hot days in Hong Kong will increase significantly each year. Under the very high greenhouse gas emissions scenario, by the end of this century, the annual number of hot nights and very hot days is projected to reach 167 and 152 days respectively. For the rest of this century, the average rainfall intensity, the amount and frequency of extreme rainfall events are expected to increase. Regardless of the greenhouse gas emissions scenario, sea level in Hong Kong will continue to rise. (Fig. 17)

	Temperature		Precipitation				Sea level
	Annual number of hot nights (Day)	Annual number of very hot days (Day)	Annual maximum daily rainfall+	Annual maximum 5-day rainfall+	Annual number of extreme rainfall days* (Day)	Average rainfall intensity # # (mm/day)	Annual mean sea level+
Actual observations (1995-2014)	21	14	203mm	382mm	4.3	23.8	1.45m
Projection scenario	Projected mean						Projected median
Projection for very high greenhouse gas emissions scenario (2081–2100)	167	152	Increase 28.1%	Increase 27.3%	6.0	28.3	Increase 0.78m #
Projection for intermediate greenhouse gas emissions scenario (2081–2100)	117	95	Increase 16%	Increase 14.2%	5.3	26.4	Increase 0.56m #

Fig 17 Future climate of Hong Kong
Source: HKO

\+ Projected change relative to 1995–2014 average
\# Projection for 2100
* Daily rainfall ≥ 100mm
annual rainfall divided by the number of rain days

As the climate warms, the average intensity of tropical cyclones and their associated rainfall is expected to increase. According to the Hong Kong Observatory, since records began in 1884, the highest one-hour, two-hour, and twelve-hour rainfall records were measured on September 7—8, 2023. Extreme rainfall was triggered by the remnant circulation of Severe Typhoon Haikui, which brought an active southwest monsoon and an extensive trough of low pressure to Hong Kong and the Pearl River Delta region. The event led to widespread severe flooding, landslides, transport disruption etc., causing significant damage to society.

Against the backdrop of global warming, extreme weather events are becoming more frequent, and Hong Kong is not exempt. More intense tropical cyclones will bring greater destructive power, and combined with rising sea levels, the threat of storm surges will also increase.

Fig 18 Condition in Wong Tai Sin District on 8 September, 2023
Source : Commercial Radio Hong Kong

More Information

Super Typhoon Mangkhut

Super Typhoon Hato

Super Typhoon Doksuri

Super Typhoon Saola

Climate change also affects biodiversity, public health, energy supply, economy and infrastructure in Hong Kong.

Impacts on the natural environment

Biodiversity

More pressure on montane and freshwater ecosystems due to increasing temperature and more frequent extreme weather events; loss of inter–tidal habitats such as coral reefs and mangroves because of sea level rise; change in species distribution and migration patterns as a result of climate change.

Fig 19 Increase in temperature affects the breeding of Paramesotriton hongkongensis
Source: Ho Koon Nature Education cum Astronomical Centre

Impacts on the public

Human health

Chronic illness issues aggravated; risk of heat exhaustion, heat stroke and asthma exacerbated; more accidents and emergency situations; changes in transmission patterns of infectious diseases.

Food and water resources

Reduction in local food production due to more frequent extreme weather events; higher water demand because of rising temperature. If food production elsewhere in the world is affected by extreme weather or drought, there will be less food supply and price hikes may be triggered.

Energy supply

Climate warming increases the energy demand for cooling and the pressure on the power supply system, resulting in overloads and power outages. More frequent extreme weather will increase damage risk of power lines and other power supply facilities.

Economy

Higher maintenance and insurance costs will be induced by damages caused by extreme weather. The insurance sector will bear higher risks associated with extreme weather.

Infrastructure

More frequent extreme rainfall will increase the risks of floods and landslides which can damage building foundations, utility cables and roads, etc. Rising sea level accentuates the risk of storm surge inundation to coastal facilities, especially underground facilities.

7.4 Chapter Summary

How will climate change affect us?

1 Impacts on the natural environment

- **Ecosystem changes and habitat destruction**
  Climate change causes direct or indirect damage to habitats, threatening the survival of species such as polar bears and Adélie penguins. In addition, sea level rise and extreme weather events also affect wetlands and coral reefs.
- **Species migration**
  Species are forced to migrate to cooler areas, but for those with limited habitats, such as the Hong Kong Giant Spiny Frog, migration may not be feasible.
- **Greenhouse gases**
  The timing of plant and animal behaviors no longer aligns with seasonal changes, affecting reproduction and food chains.

2 Impacts on human society

- **Health**
  An increase in hot weather hightens the risks of health issues such as heatstroke, heat exhaustion, respiratory and cardiovascular diseases, as well as certain infectious diseases.
- **Agriculture**
  Human–induced warming has slowed the growth of agricultural productivity in low to mid latitude regions. Climate–related extreme events have led to reduced food supply.
- **Coastal risks**
  Sea level rise increases the risk of flooding in coastal cities, affecting the economy and infrastructure.
- **Water resources**
  In certain regions, the decrease of precipitation, increase of evaporation, melting of glaciers and ice caps, and seawater intrusion may affect fresh water resources.
- **Infrastructure and transport**
  Extreme weather may damage urban infrastructure and transport system.
- **Energy supply**
  Energy production and demand can be affected by climate change.
- **Tourism**
  A number of tourist attractions are damaged as a result of climate change.
- **National security**
  Climate change is also a matter of national security, including food security and ecological security.

3 Impacts on Hong Kong

- The climatic trends observed in Hong Kong are generally consistent with the global trends. It is projected that there will be a significant increase in the annual numbers of hot nights and very hot days, more frequent extreme rainfall events and continued rise in sea level.
- Stronger tropical cyclones, along with their associated rainfall and storm surges, will pose greater threats to Hong Kong.