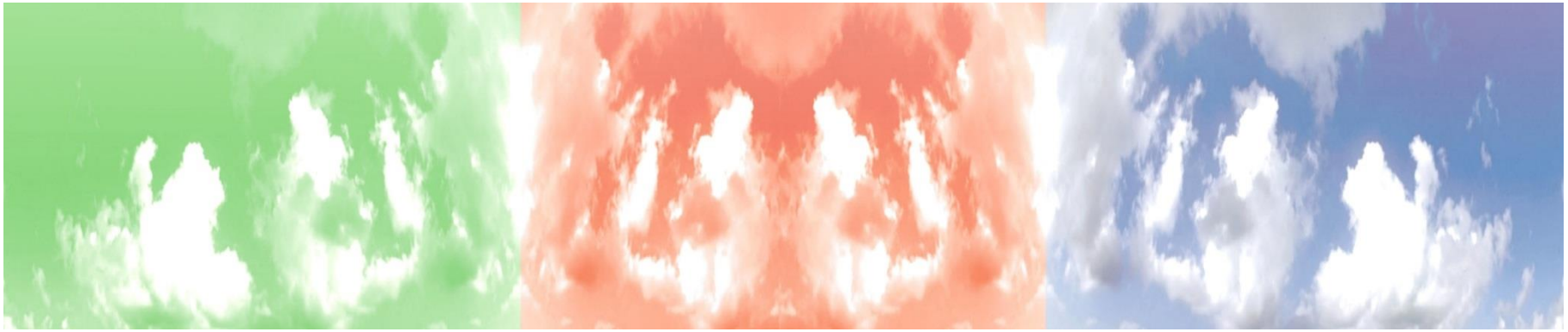


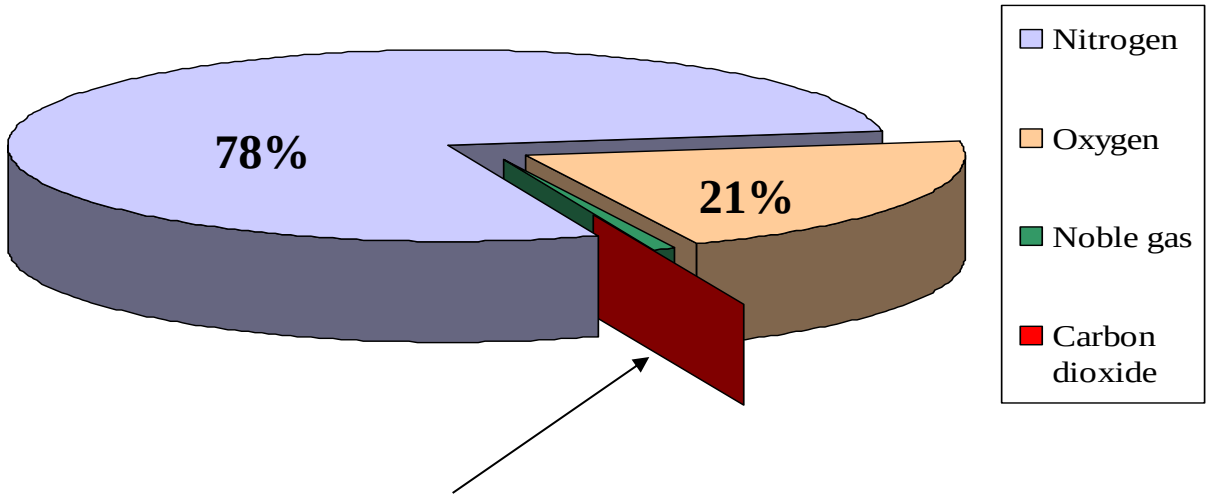
Climate Change

香港天文台
HONG KONG OBSERVATORY

(Suitable for secondary school)

(Updated in March 2018)

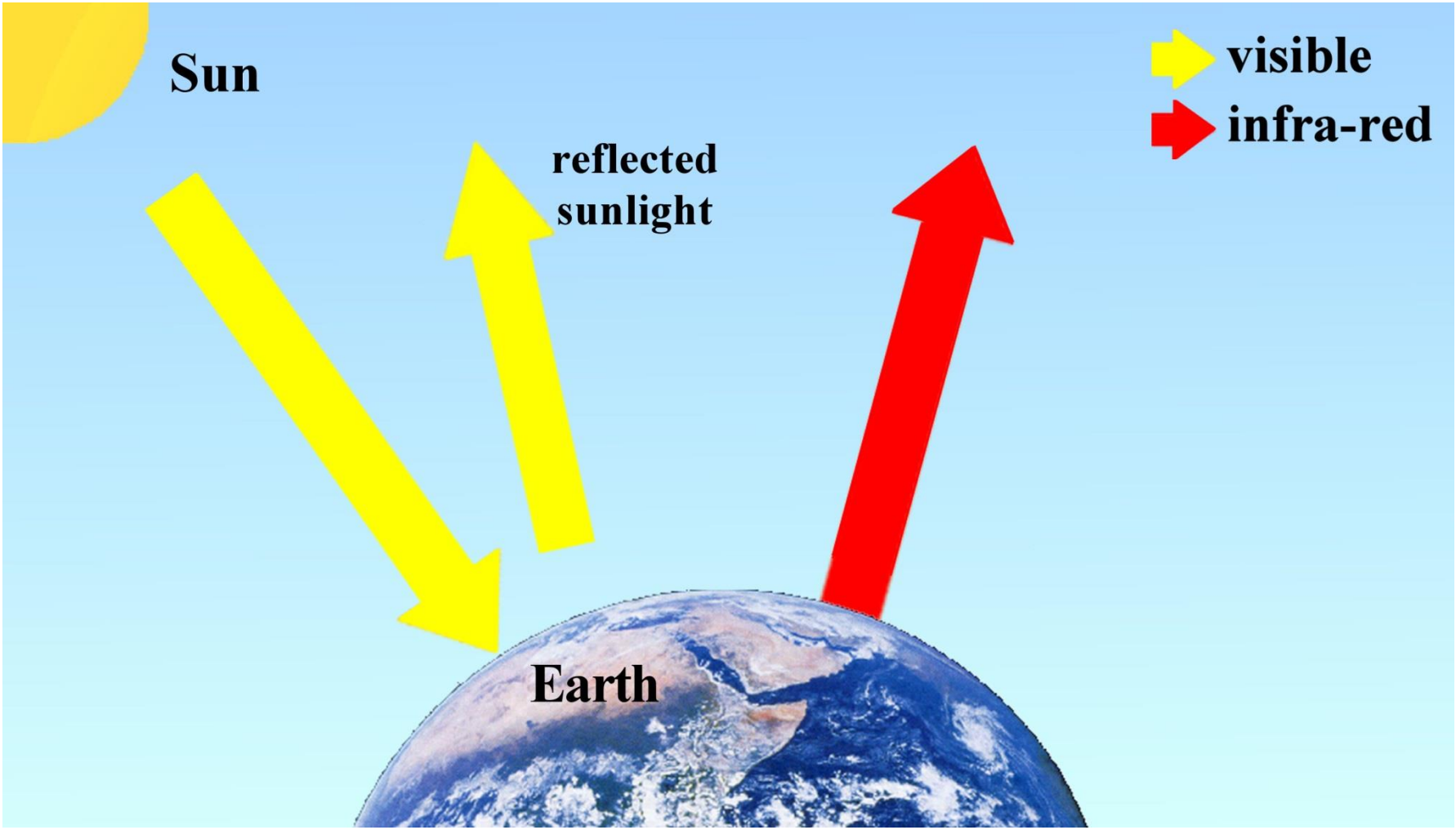
Air composition



carbon dioxide 0.04%

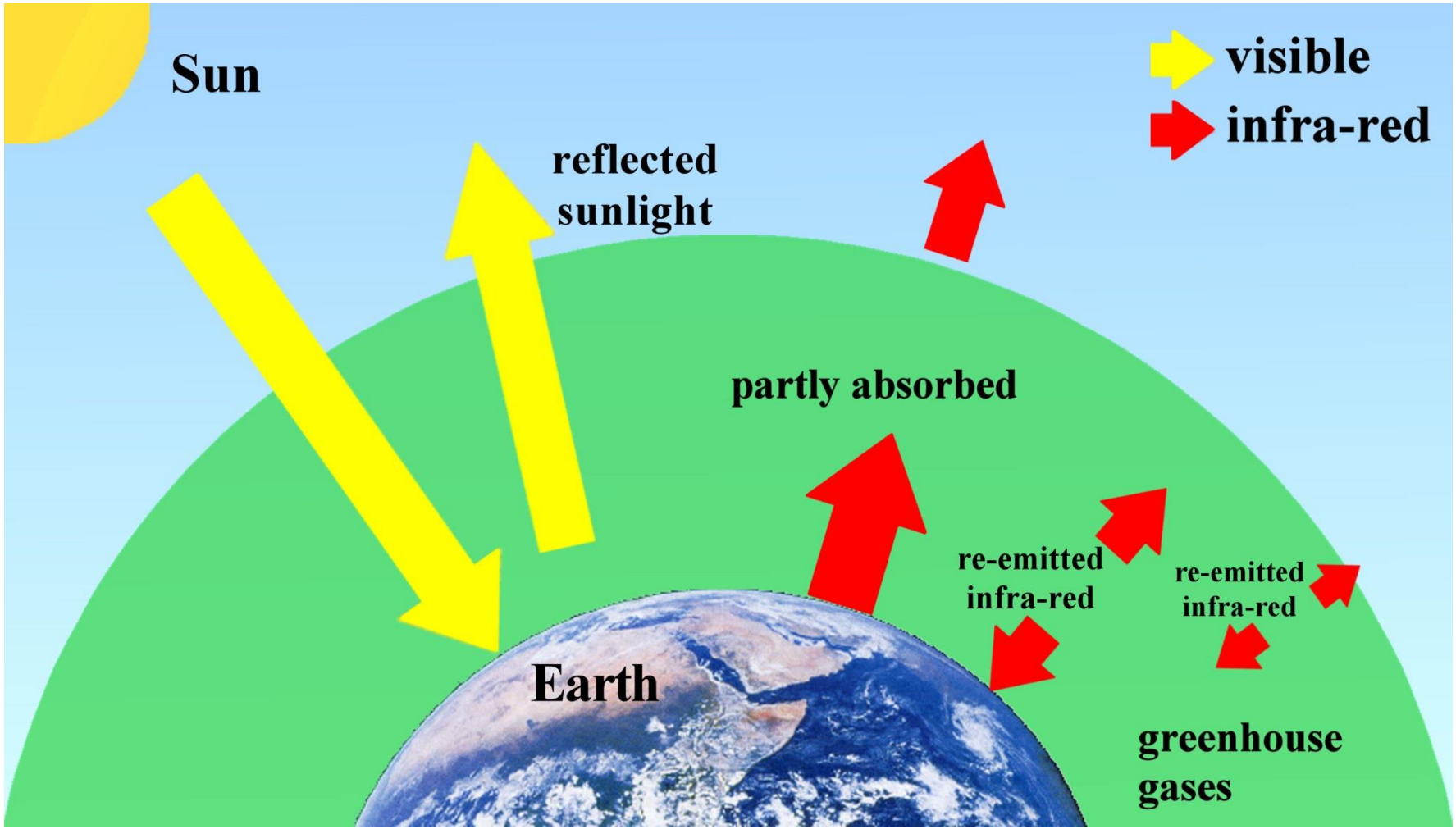
Air consists of nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), noble gases (argon (Ar), helium (He) etc) and variable amount of water vapour (H_2O)

Heating and heat dissipation of the earth are in equilibrium



Condition for no greenhouse gas in the atmosphere

Greenhouse effect



Condition for greenhouse gases in the atmosphere; greenhouse gases include carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), chlorofluorcarbons (CFCs) , ozone (O_3) and water vapour (H_2O)

Human activities produce greenhouse gases

energy production, industry: carbon dioxide(CO_2)

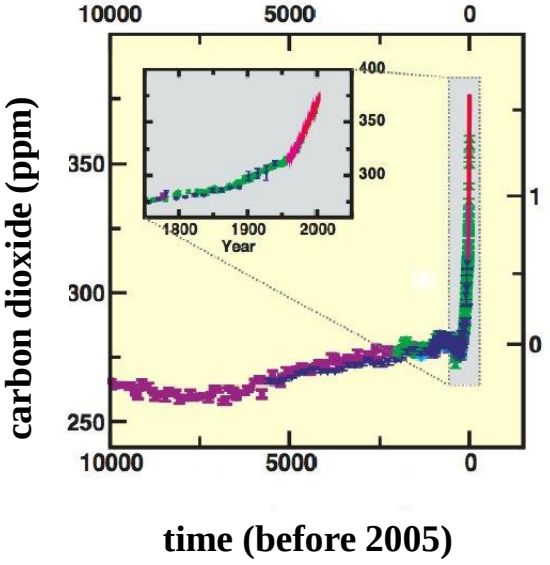
waste landfill: nitrous oxide(N_2O)

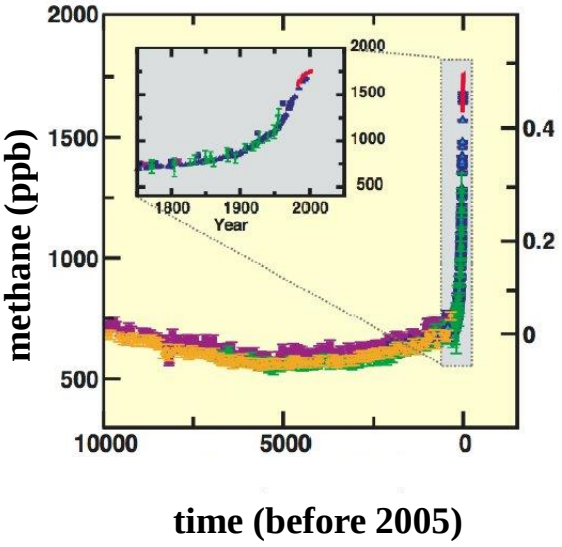
husbandry: methane(CH_4)

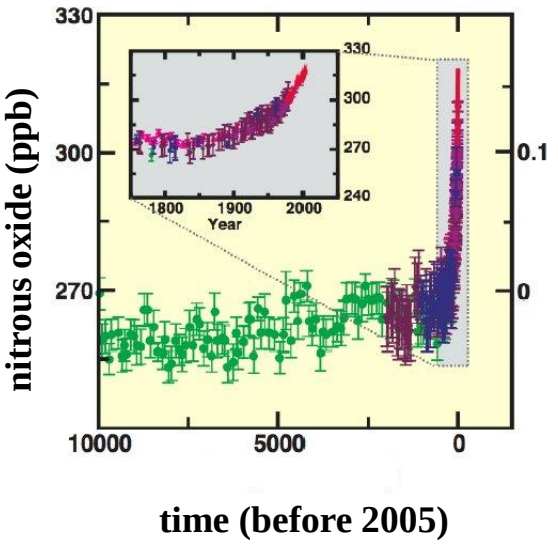
freezer, aerosol spray: chlorofluorcarbons(CFCs)

vehicle exhaust : ozone(O_3)

Rising trends of greenhouse gases



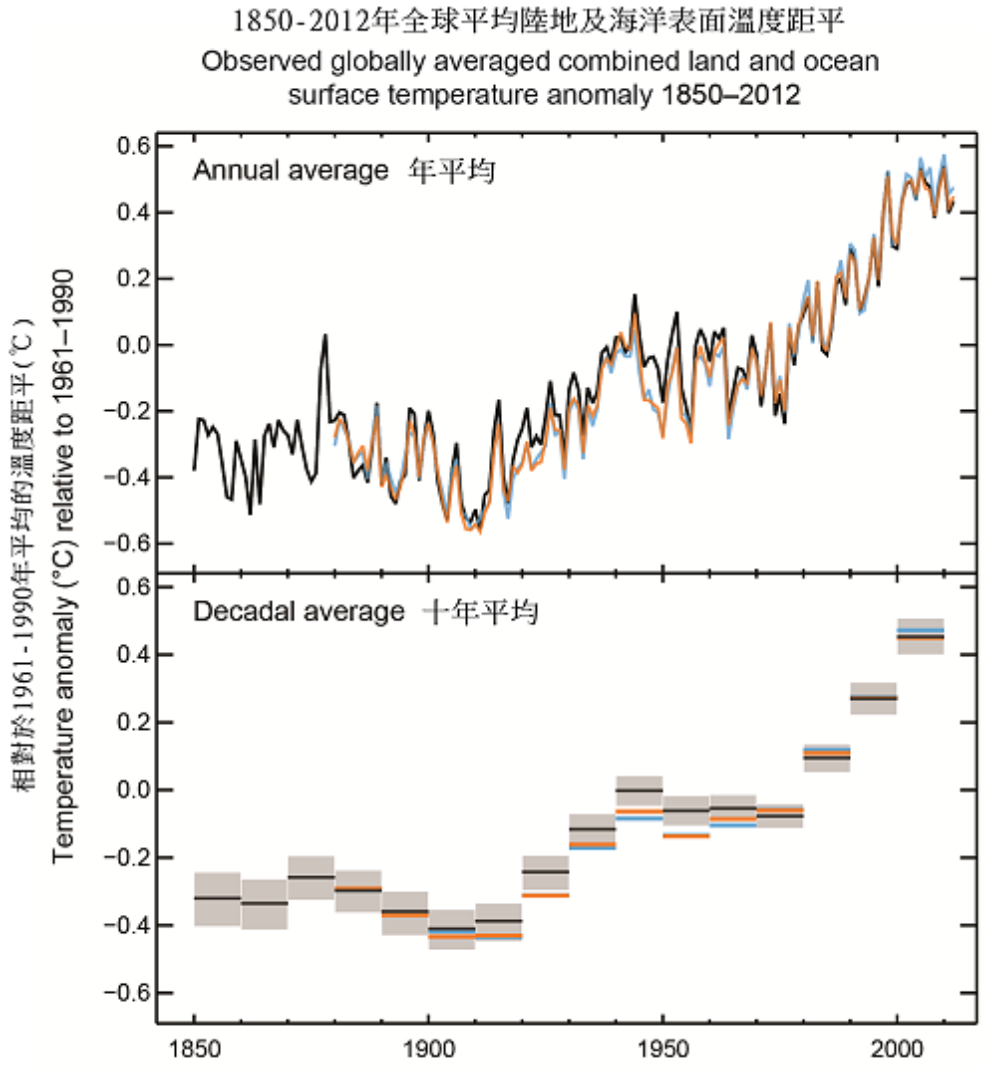




(Source: Intergovernmental Panel on Climate Change)

Since 1750, the concentrations of global atmospheric carbon dioxide, methane and nitrous oxide have risen sharply due to human activities

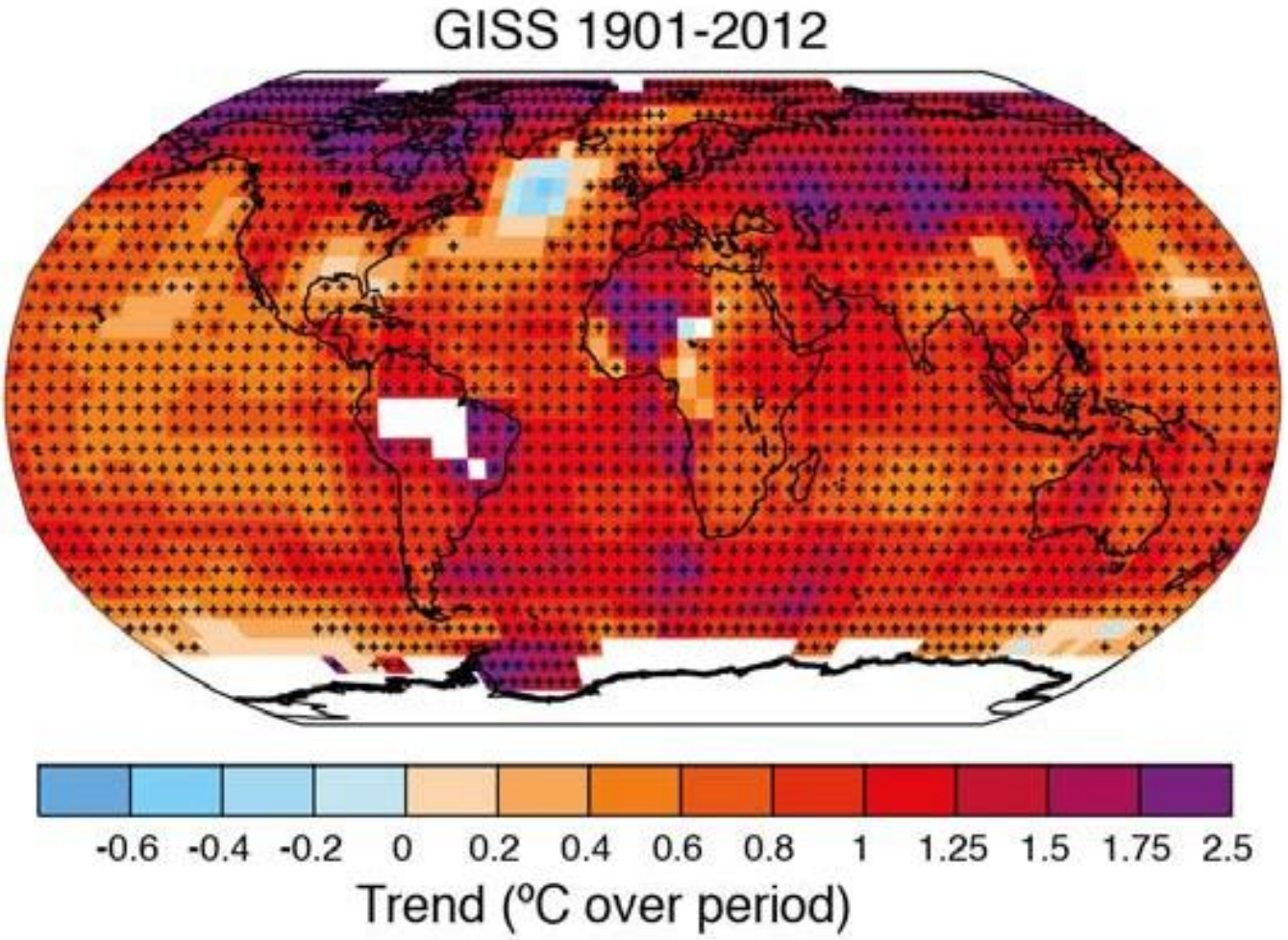
Mean temperature of the earth's surface



(Source: Intergovernmental Panel on Climate Change)

The first decade of the 21st century has been the warmest since instrumental record began

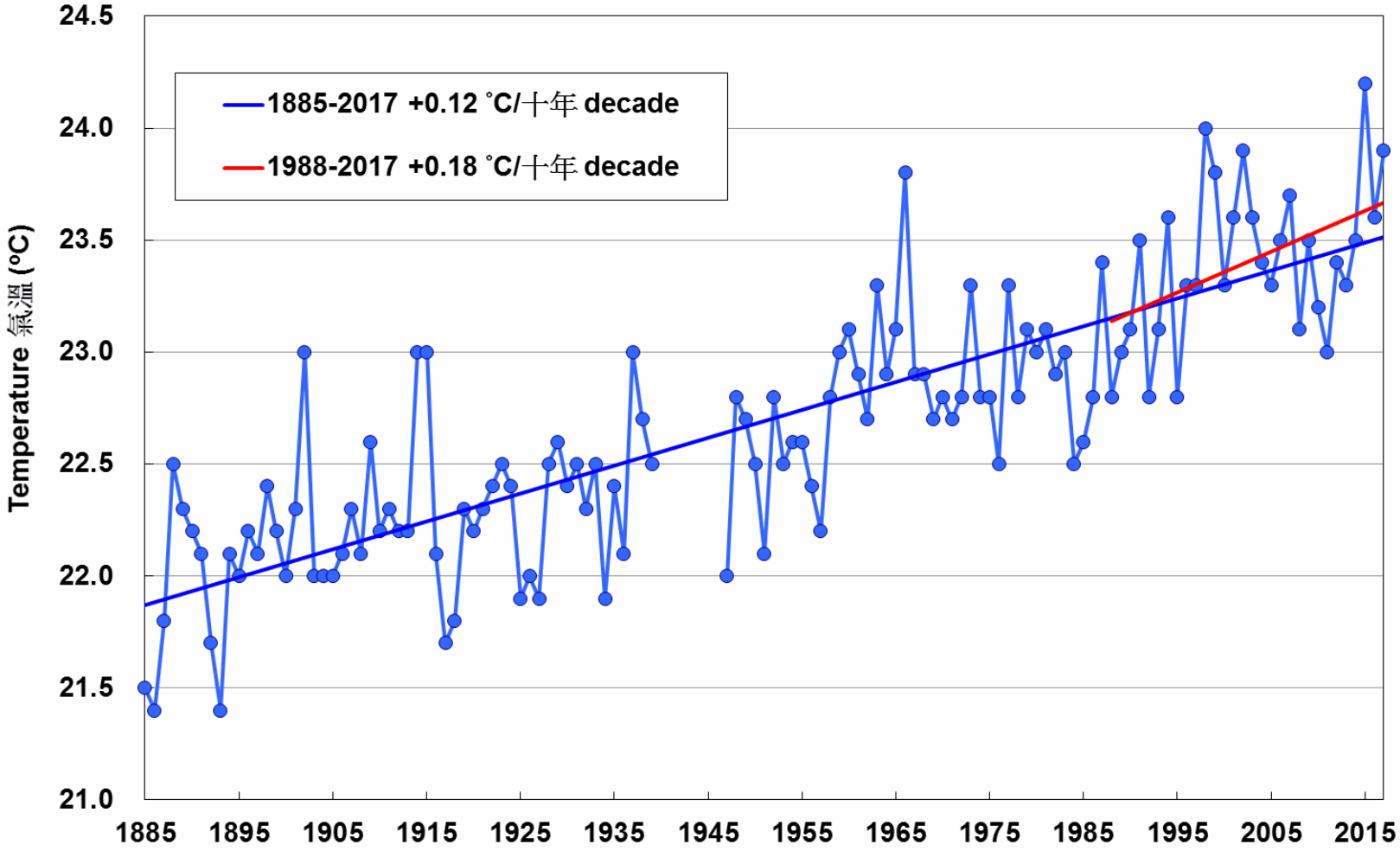
Annual mean temperature trend in 1901-2012



(Source: Intergovernmental Panel on Climate Change)

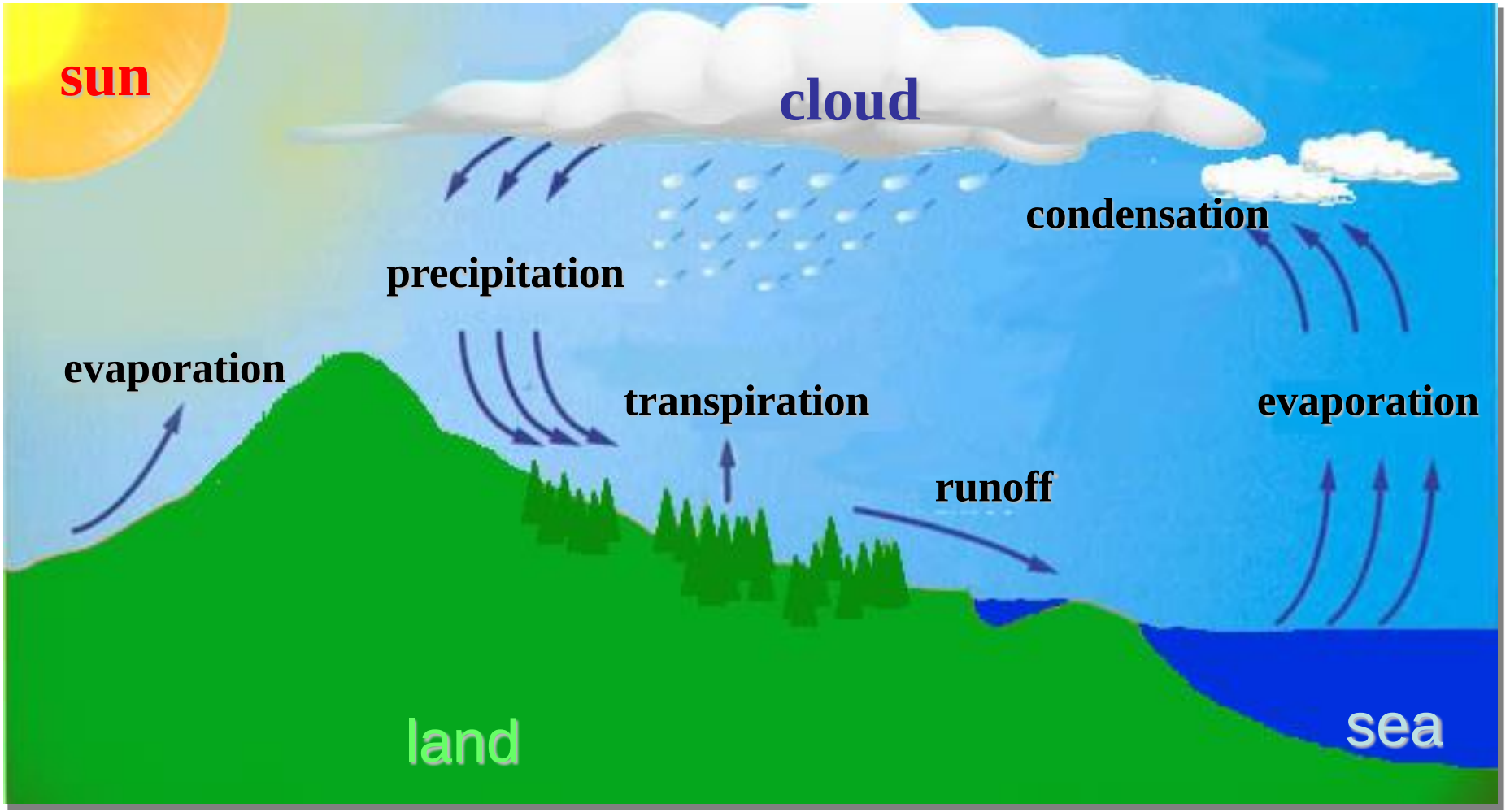
Temperature has been rising in almost all regions, larger rises are observed in high-latitude than low-latitude areas, and in land areas than oceans

Annual mean temperatures of Hong Kong Observatory Headquarter at Tsim Sha Tsui (1885-2017)

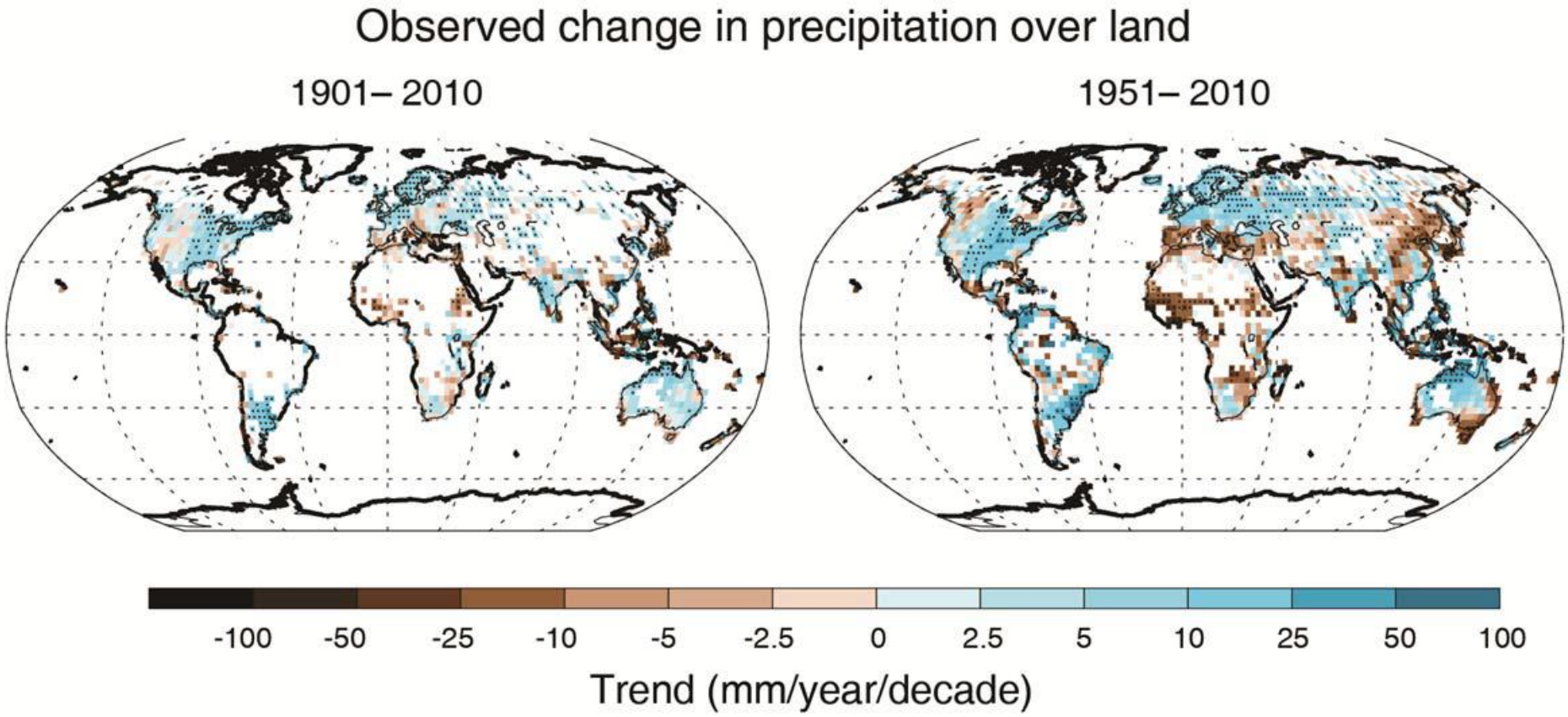


Trend of temperature rise was 0.18 degree per decade in recent 30 years.

Water cycle


sun
cloud
condensation
precipitation
evaporation
transpiration
evaporation
runoff
land
sea

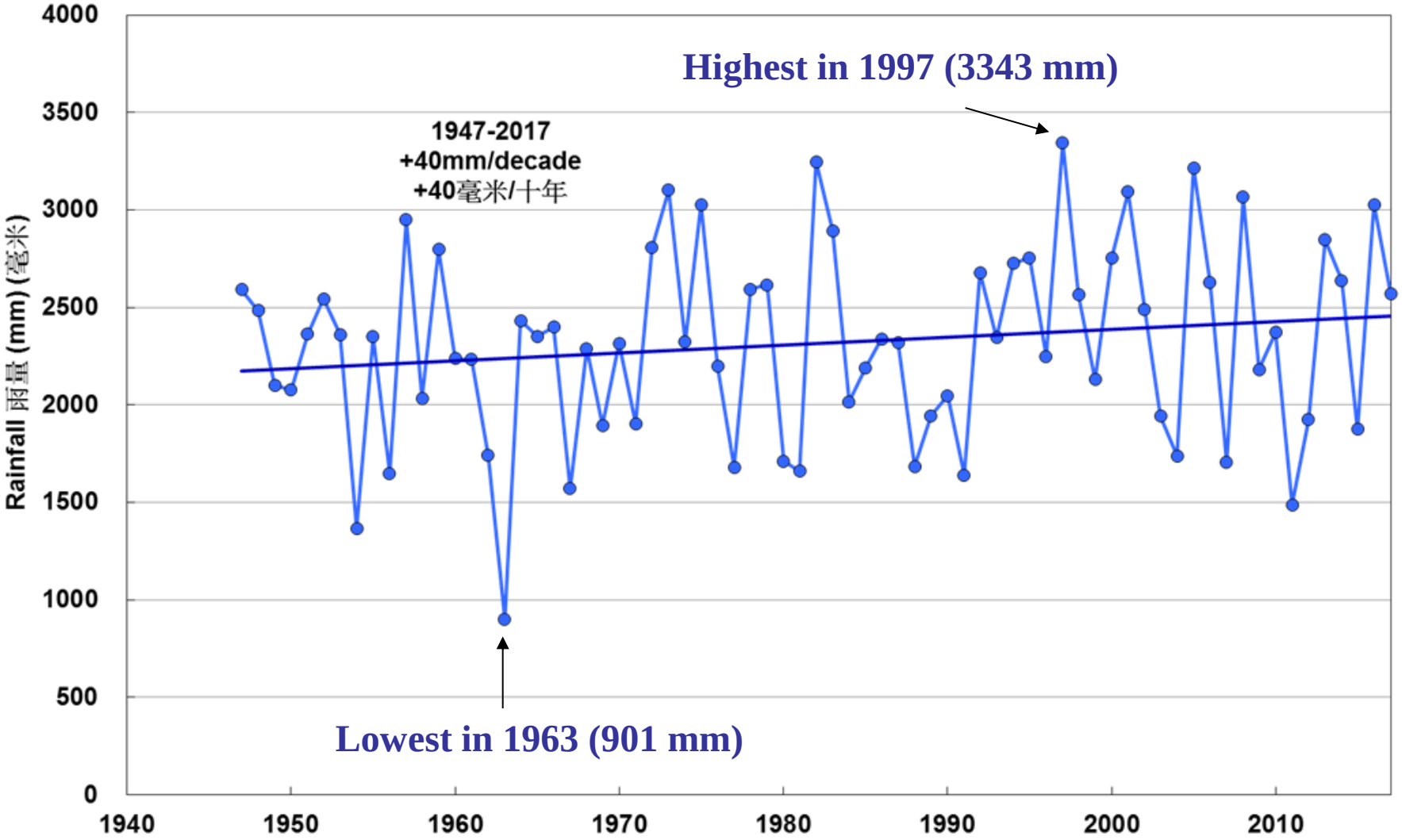
Regional differences in land precipitation



(Source: Intergovernmental Panel on Climate Change)

The diagram shows the precipitation trends at various regions. Blue colours indicate an increase in precipitation, brown colours indicate an decrease in precipitation.

Annual rainfall at Hong Kong Observatory Headquarters (1947 – 2017)

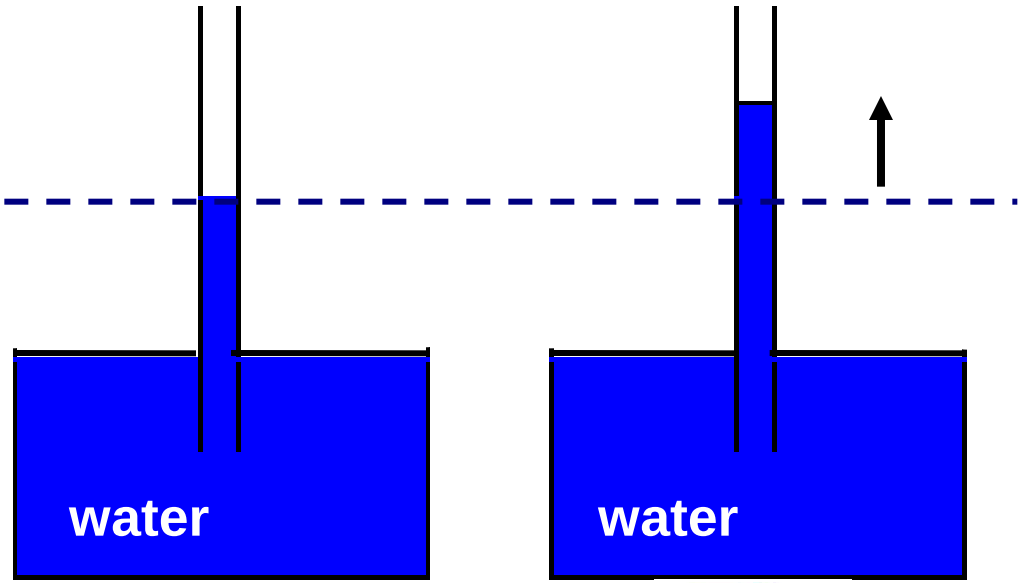


Rise in sea level

- thermal expansion of sea water

- melting of ice on land

Expansion of water by heating

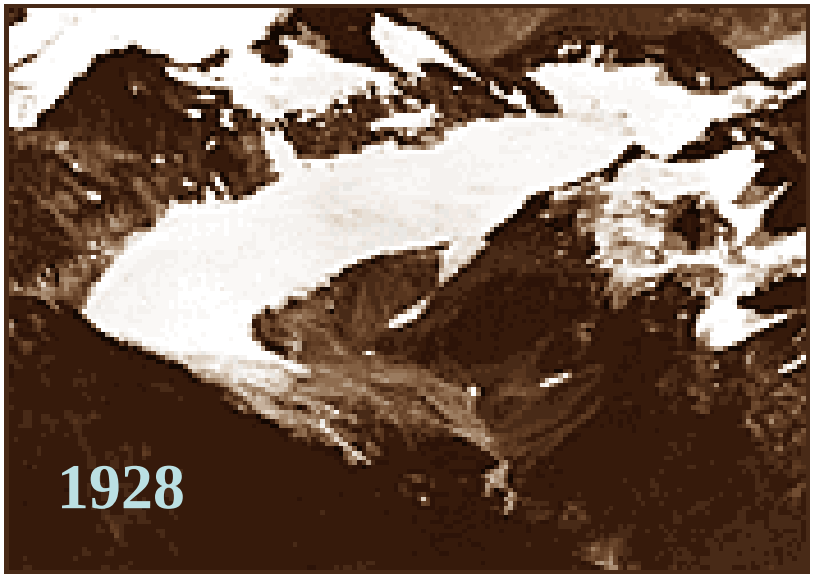


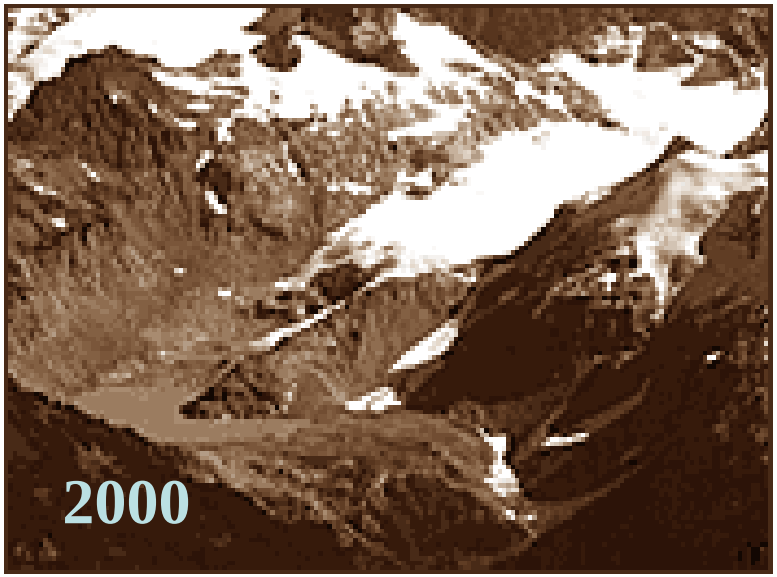
water expands when heated, water level rises as a result

heating

Rise in global sea temperature leads to expansion of sea water and a rise in sea level

Melting of ice caps and glaciers

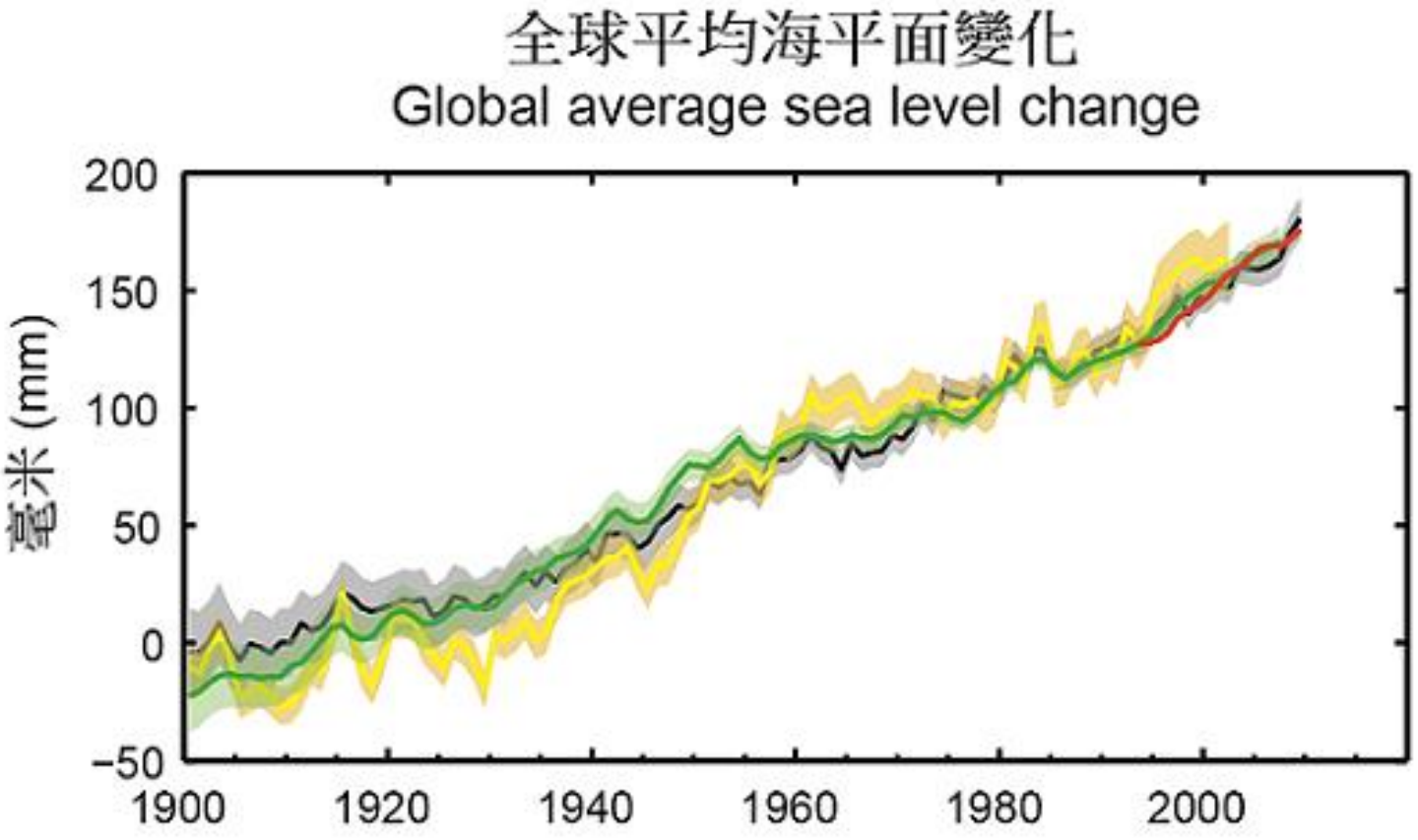




(Source : US Geological Survey)

Global warming leads to the melting of ice caps over polar land areas and the glaciers on high mountains. The melted ice-water flows into the sea and contributes to the sea level rise.

Sea level rise



(Source: IPCC)

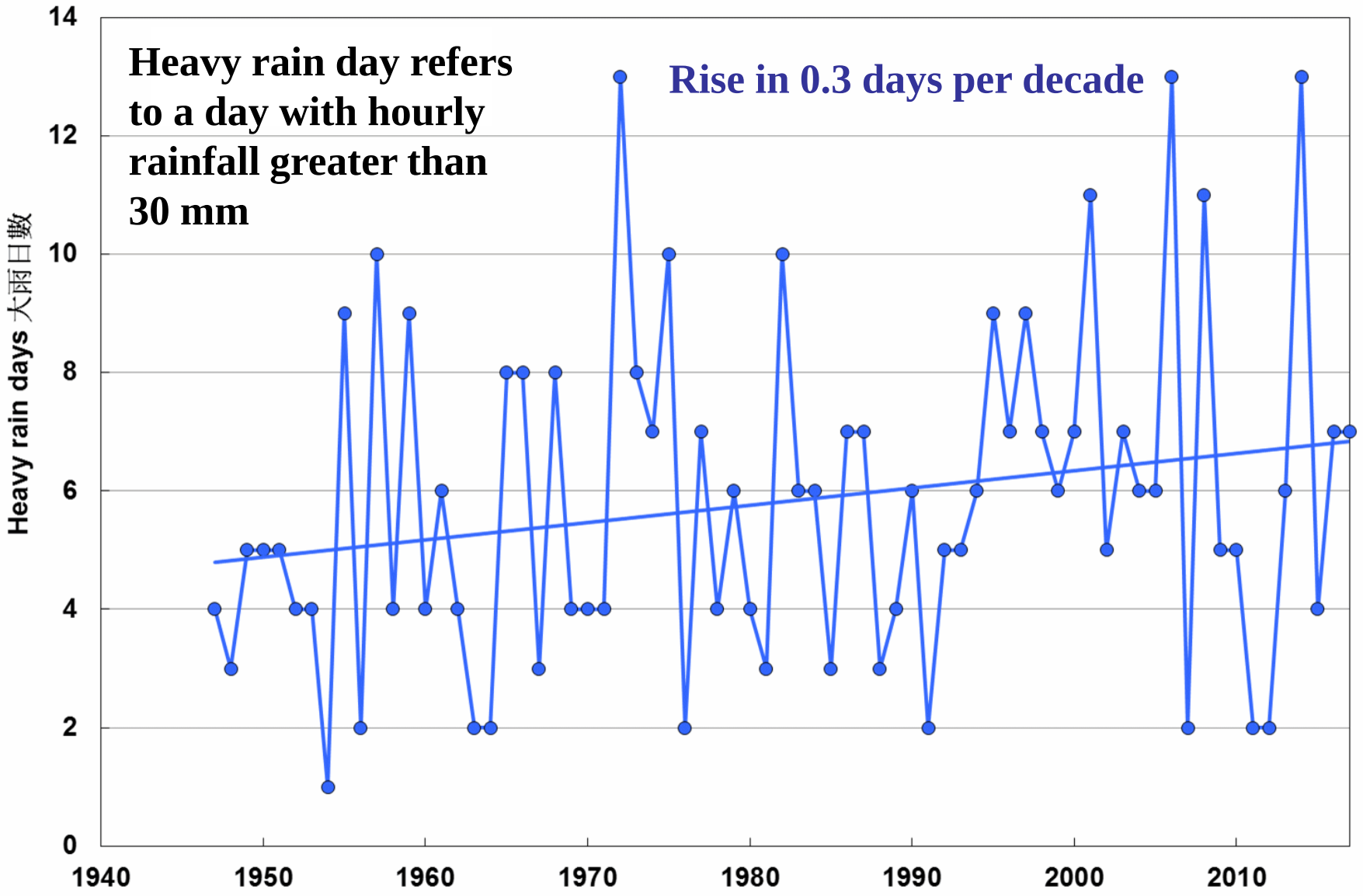
Global mean sea level has been rising at 1.7 mm per year in 1901-2010. The rate of sea level rise is higher at 3.2 mm per year in 1993-2010.

Weather and climate extremes

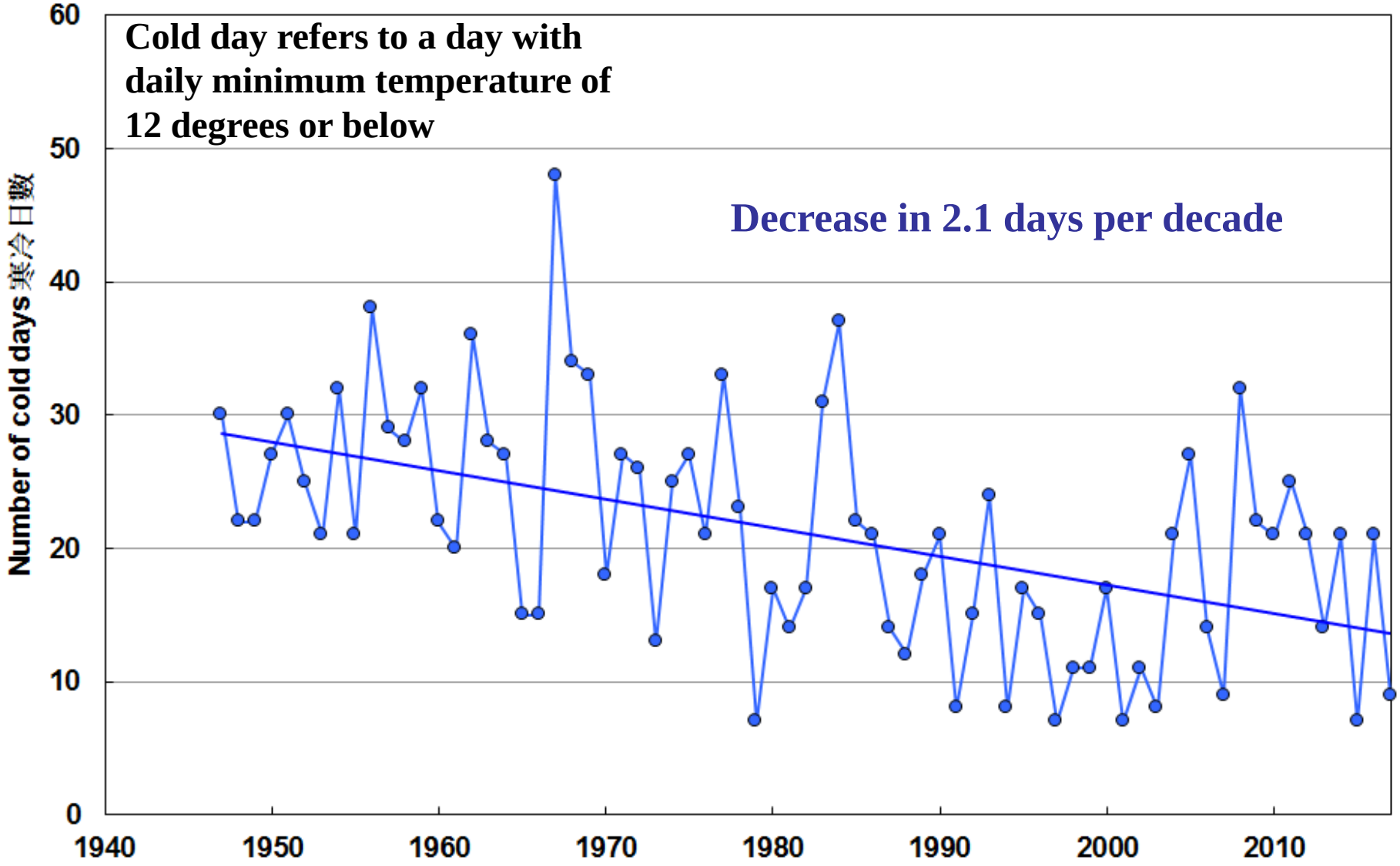
(Source: US National Oceanic Atmospheric Administration)

Global warming leads to increase in occurrence of heat wave, drought and flooding events, and the increase in tropical cyclone intensity of the Atlantic.

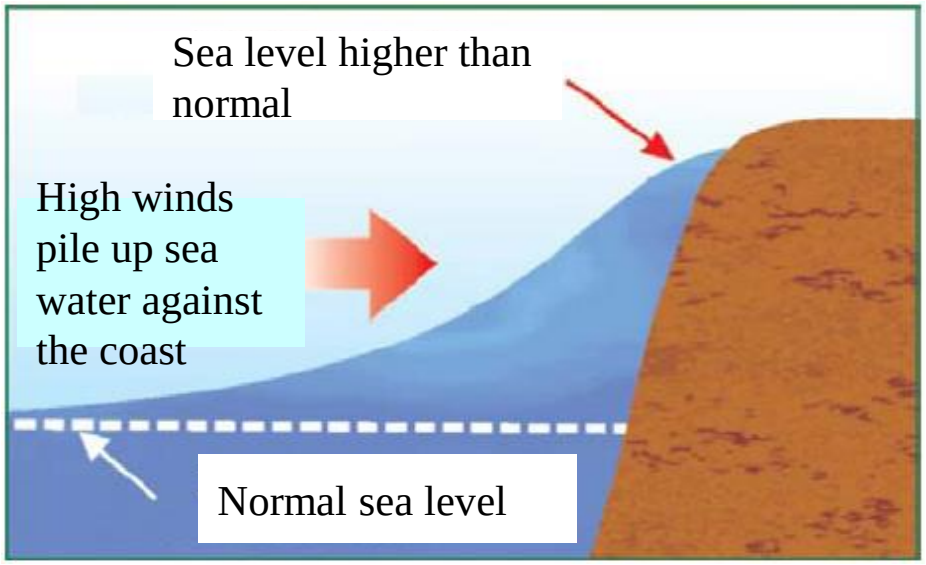
Number of heavy rain days recorded at Hong Kong Observatory Headquarters (1947-2017)



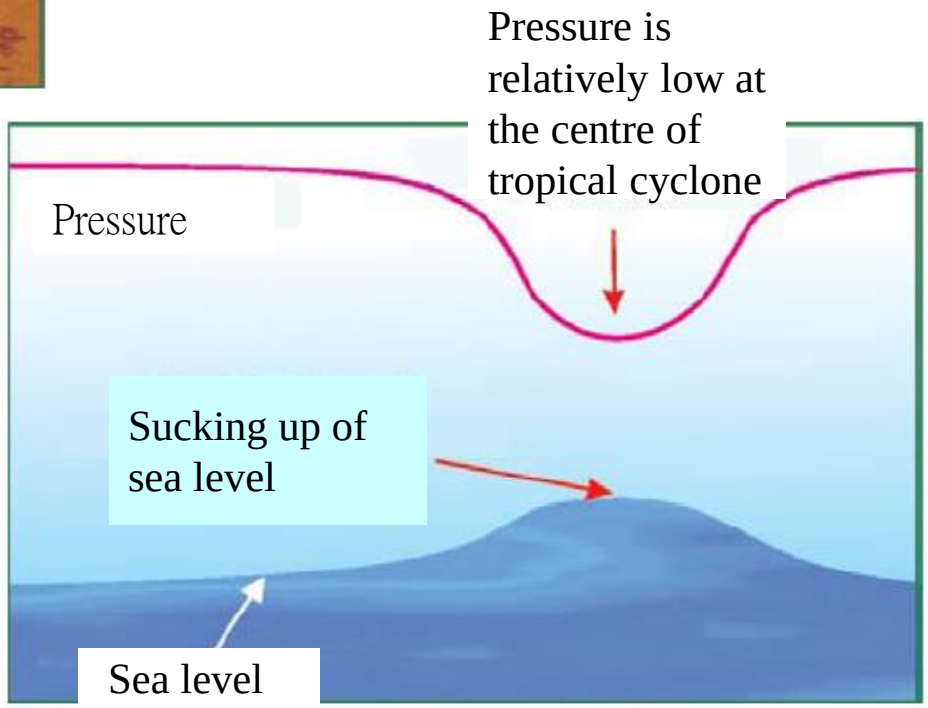
Number of cold days recorded at Hong Kong Observatory Headquarters (1947-2017)



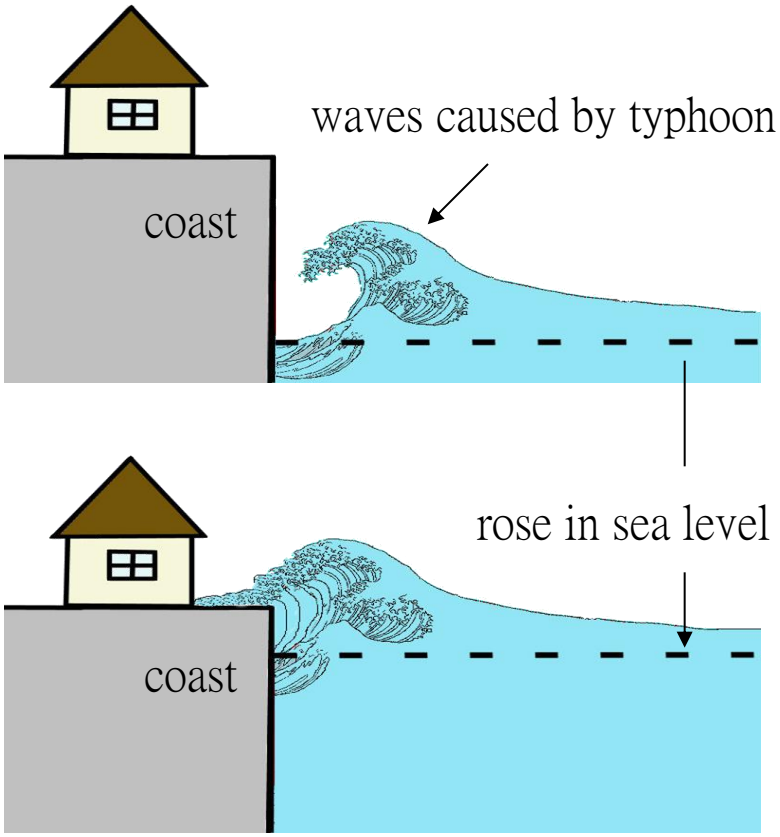
Storm surge



High winds and low pressure near the centre of a tropical cyclone lead to the rise in sea level



Sea level rise causes flooding of coastal areas easier



(Source: US National Oceanic Atmospheric Administration)

Flooding of the coastal areas becomes easier during typhoon approaches or heavy rain

Extreme weather threatens life and property

(Source: Geotechnical Engineering Office)

(Source: Apple Daily)

Sea level rise leads to the increase in flooding risk in coastal areas

(Source : US Geological Survey)

Change in temperature and rainfall affect the growth of plants

Less food production in certain places

Affect human health

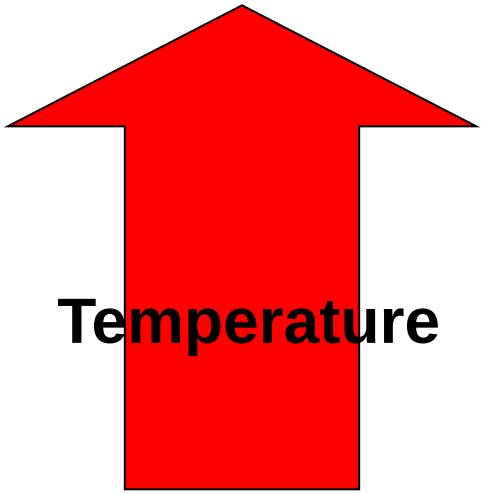
More mosquitoes, easier to transmit dengue fever and malaria

More ticks, easier to transmit some infectious diseases

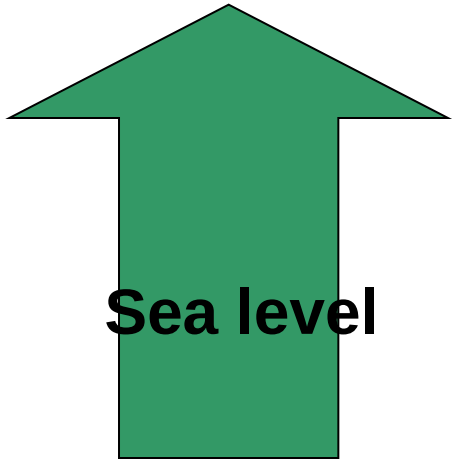
Global temperature and sea level at the end of the 21st century

Under high emission scenario

2.6 to 4.8 degree

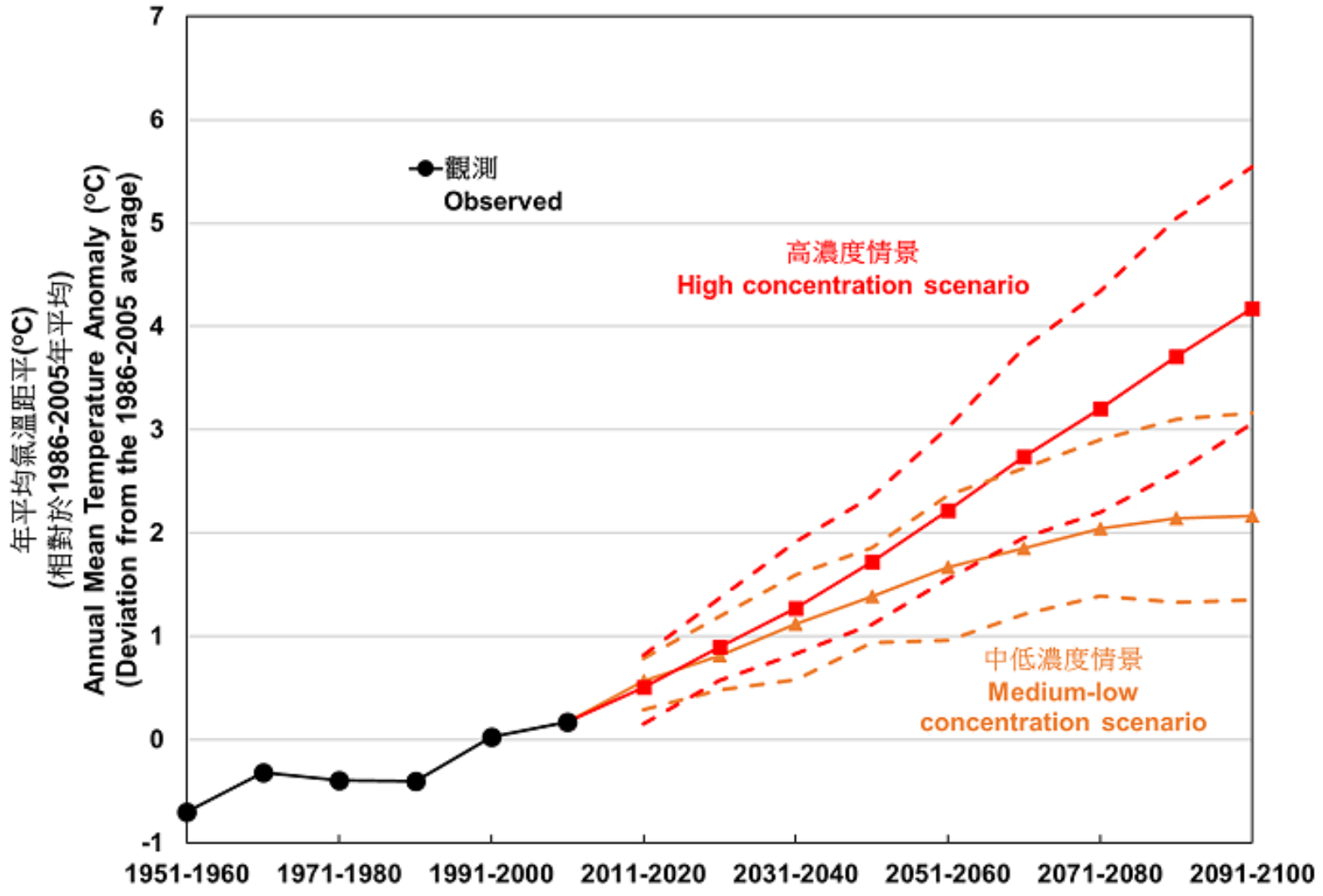


0.45 to 0.82 m

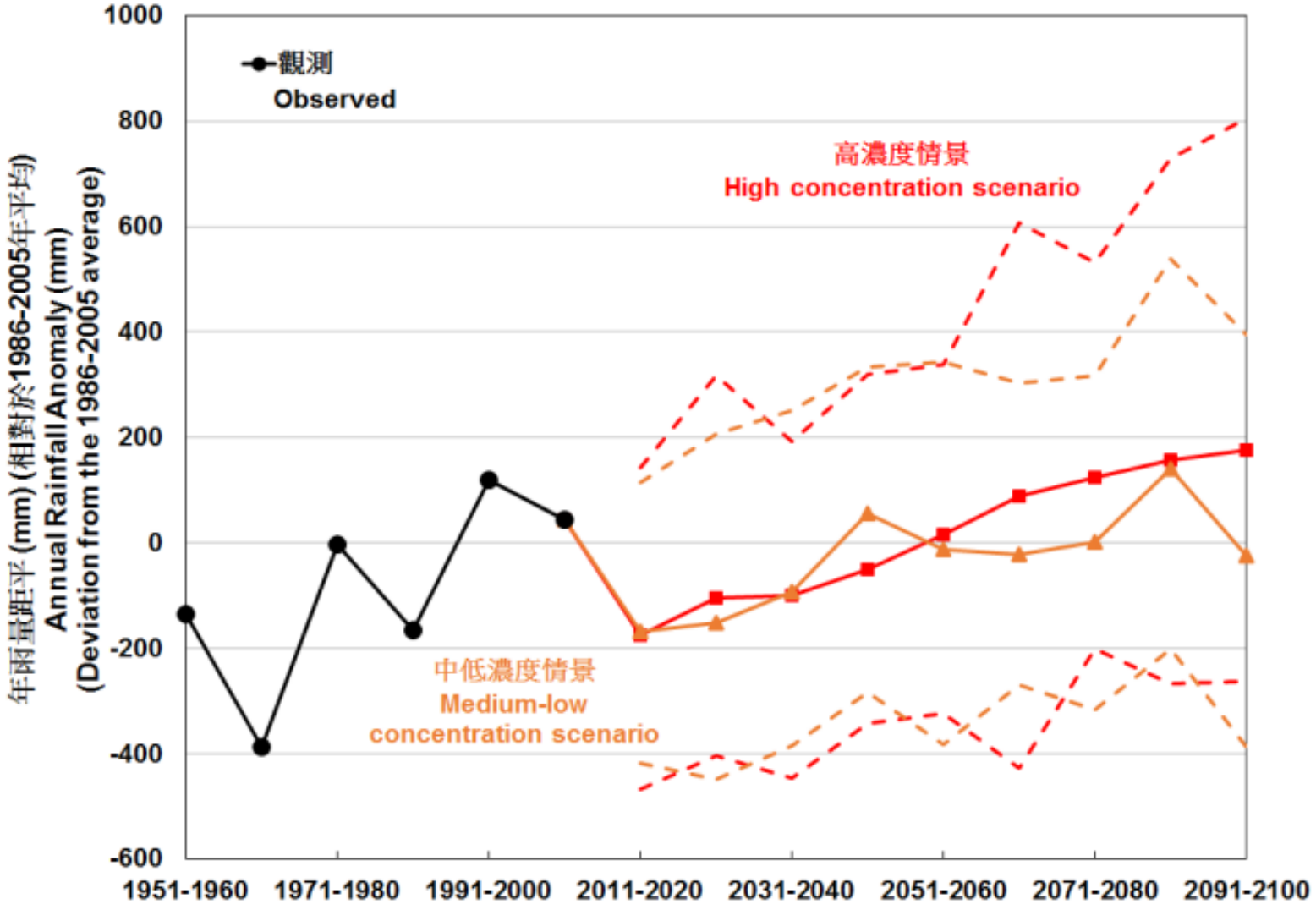


In the high greenhouse gas concentration scenario, temperature will most likely increase by 2.6 to 4.8 degrees and sea level rise by 0.45 to 0.82 metres.

Past and projected change in annual mean temperature for Hong Kong



Past and projected change in annual rainfall for Hong Kong



Under the high greenhouse gas emission scenario …

Period	Extremely dry years	Extremely wet years
	 (Photo from Water Supplies Department)	 (Photo from Drainage Services Department)
1885 - 2005	2	3
2006 - 2100	2	12

Notes : Extremely dry years - annual rainfall less than 1289 mm; extremely wet years - annual rainfall more than 3168 mm

Ways to reduce atmospheric greenhouse effect (1)

- **Reduce the burning of fossil fuels**

Save energy

More use of renewable energy

(Source : Electrical and Mechanical Services Department)

- **Use mass transport system whenever possible**

Ways to reduce atmospheric greenhouse effect (2)

- **Reduce waste**
- **Save paper**
- **Plant trees**
- **Prevent hill fires**

(Source: Agriculture, Fisheries and Conservation Department)

Ways to reduce atmospheric greenhouse effect (3)

- **Reduce expenditure**

Large amount of energy is used in producing commercial products and releasing carbon dioxide

Reduce global warming

with a simple life style !