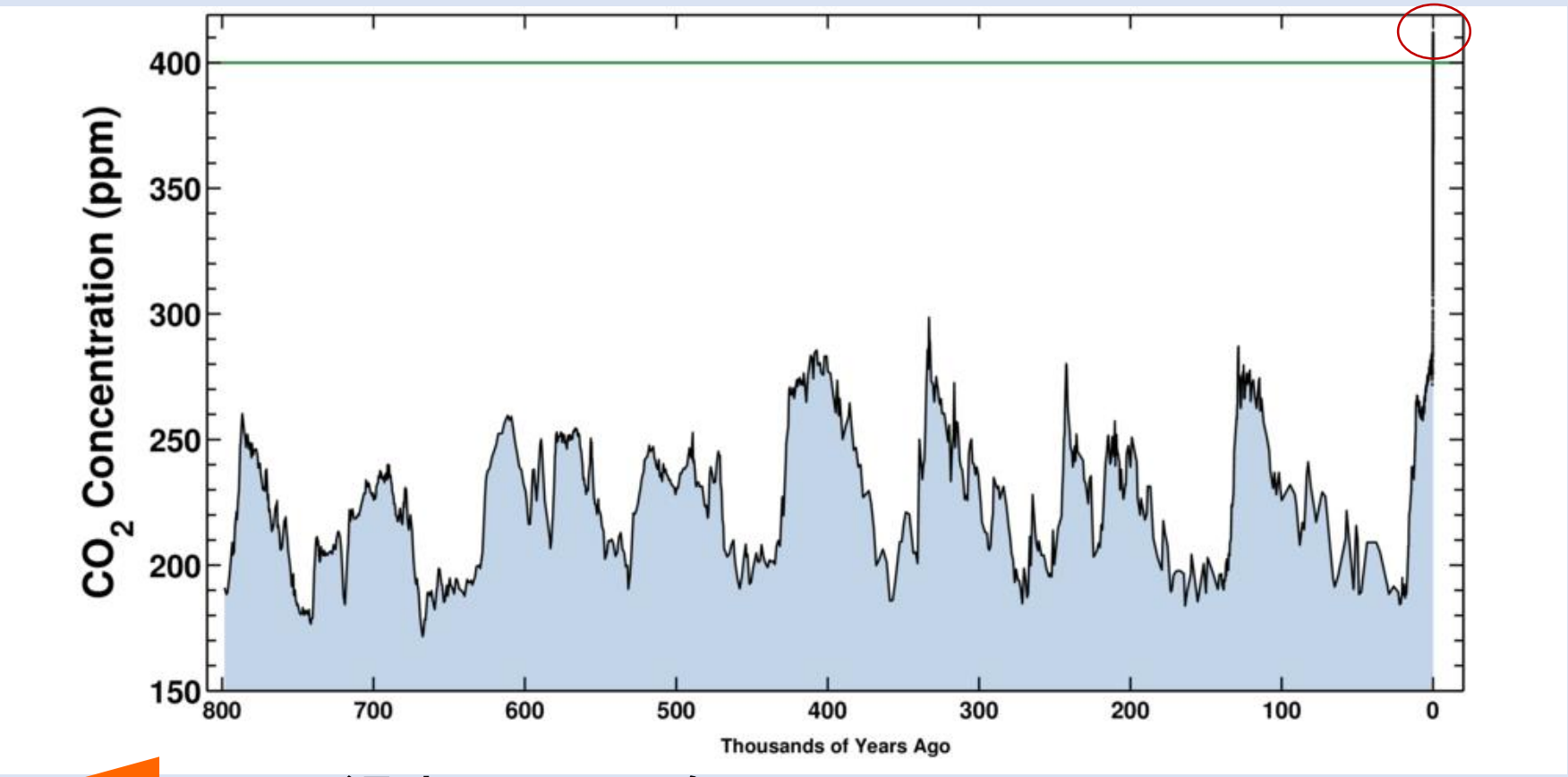
氣候變化 – 何去何從

唐恒偉

香港天文台

現今的CO2濃度為過去80萬年以來最高

Aug 2020: 412.55 ppm



過去800,000年 The last 800,000 years

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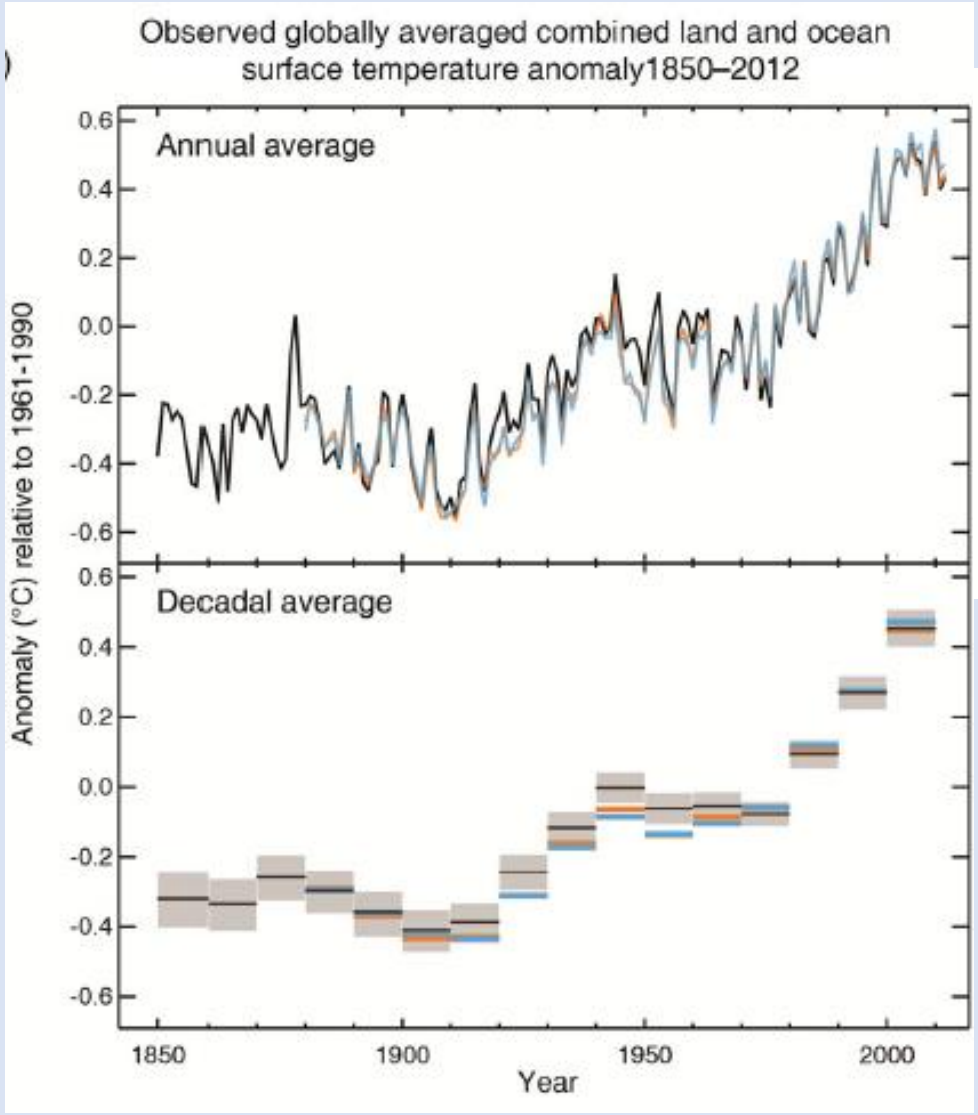
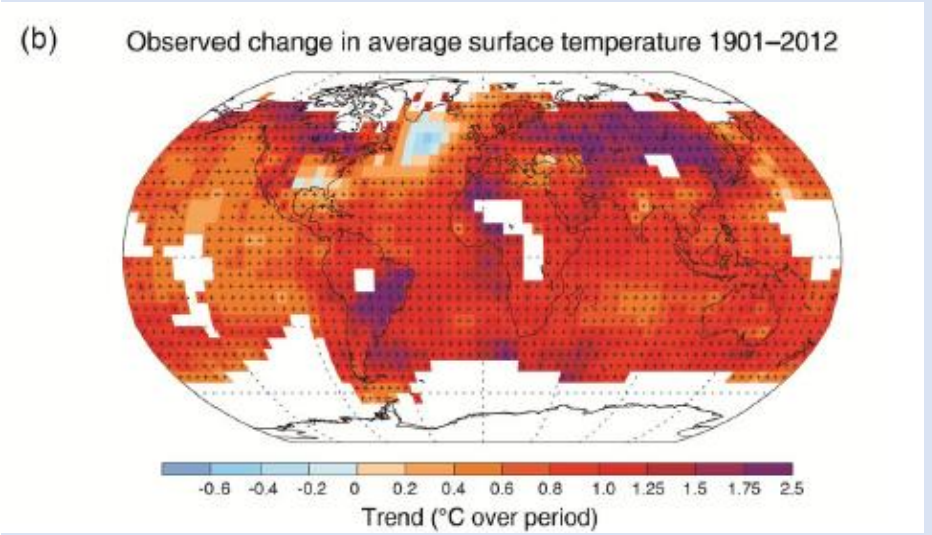
全球表面平均溫度在1880至2012年期間上升了0.85°C





廿一世紀第一個年代是自**1850**年以來最暖的年代

全球幾乎每個角落都變暖了

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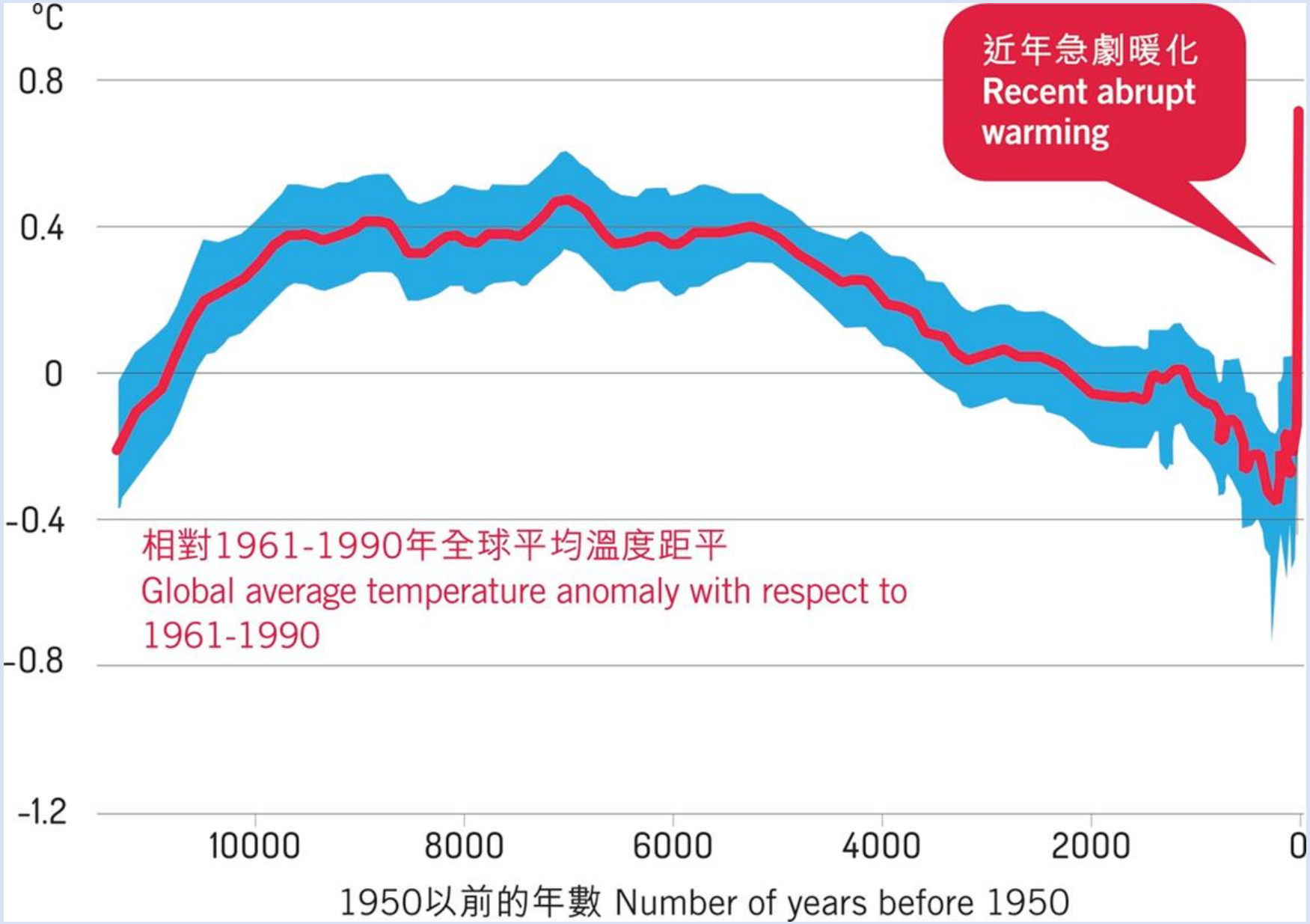
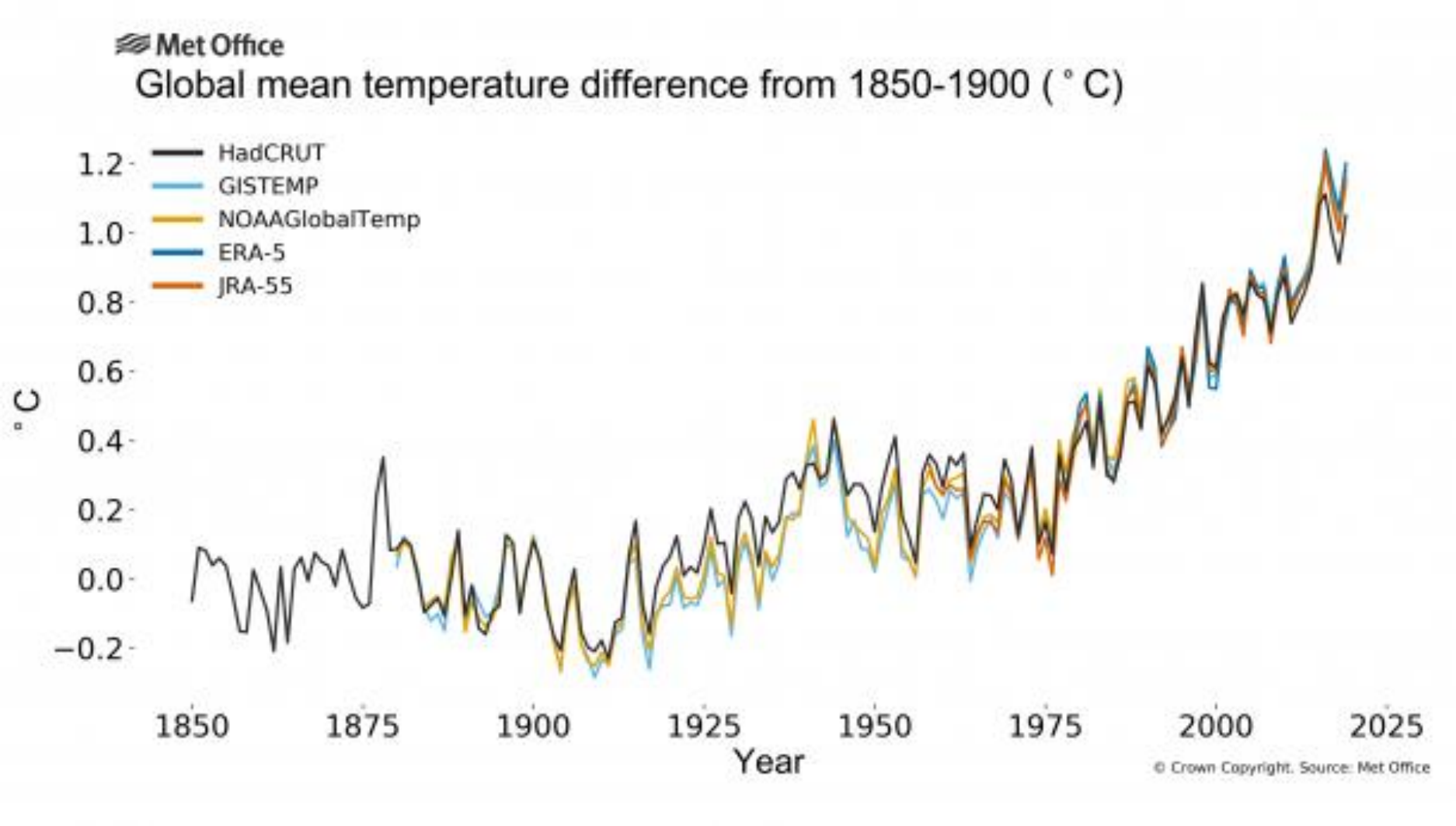


- 約5000年前地球溫度下降
- 但全球暖化扭轉了這趨勢

2015-2019 是有記錄以來最暖的5年



Global mean temperature anomalies with respect to the 1850-1900 baseline, for the five global datasets

(Source : WMO Statement on the state of the global climate in 2018)

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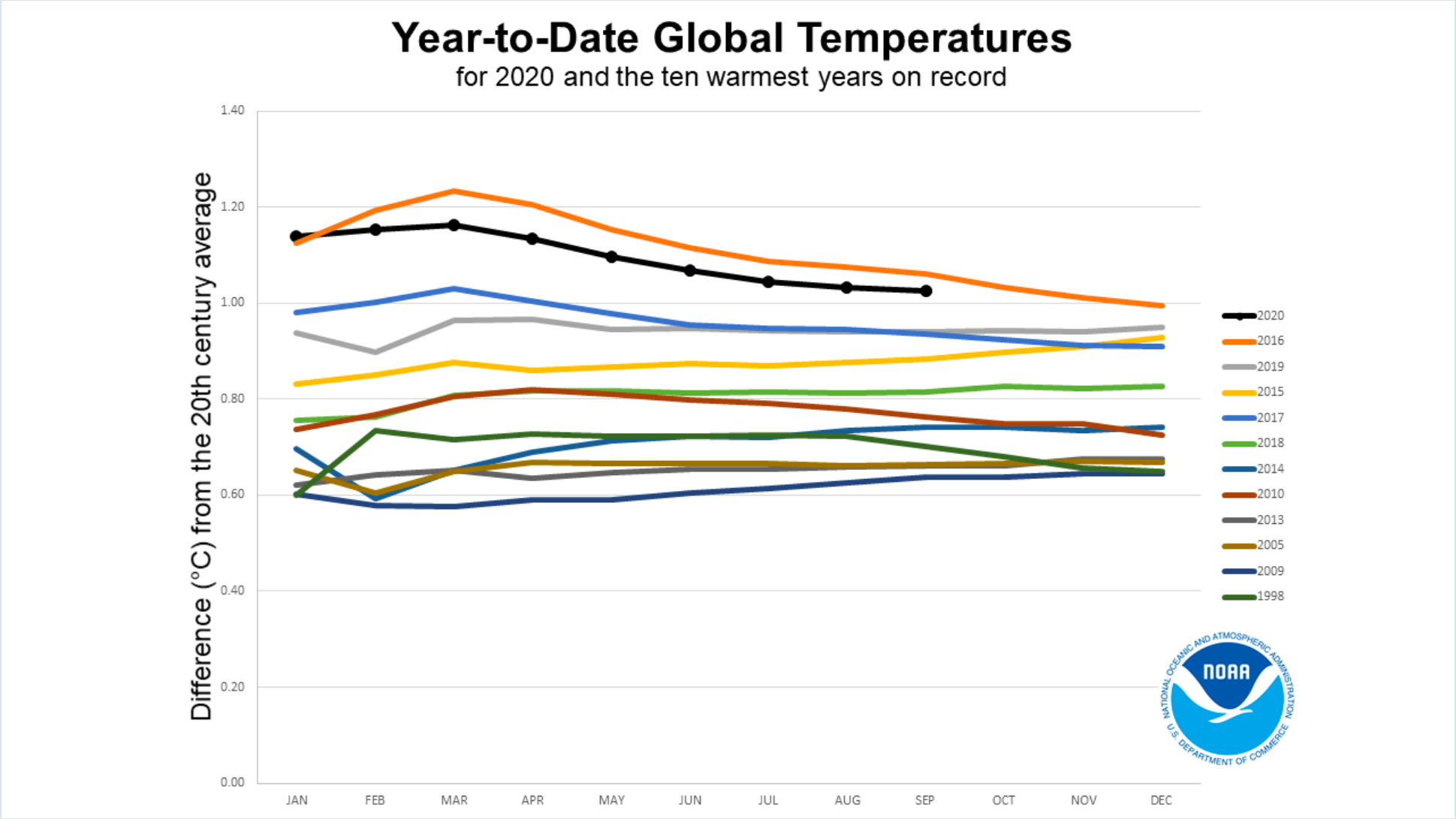
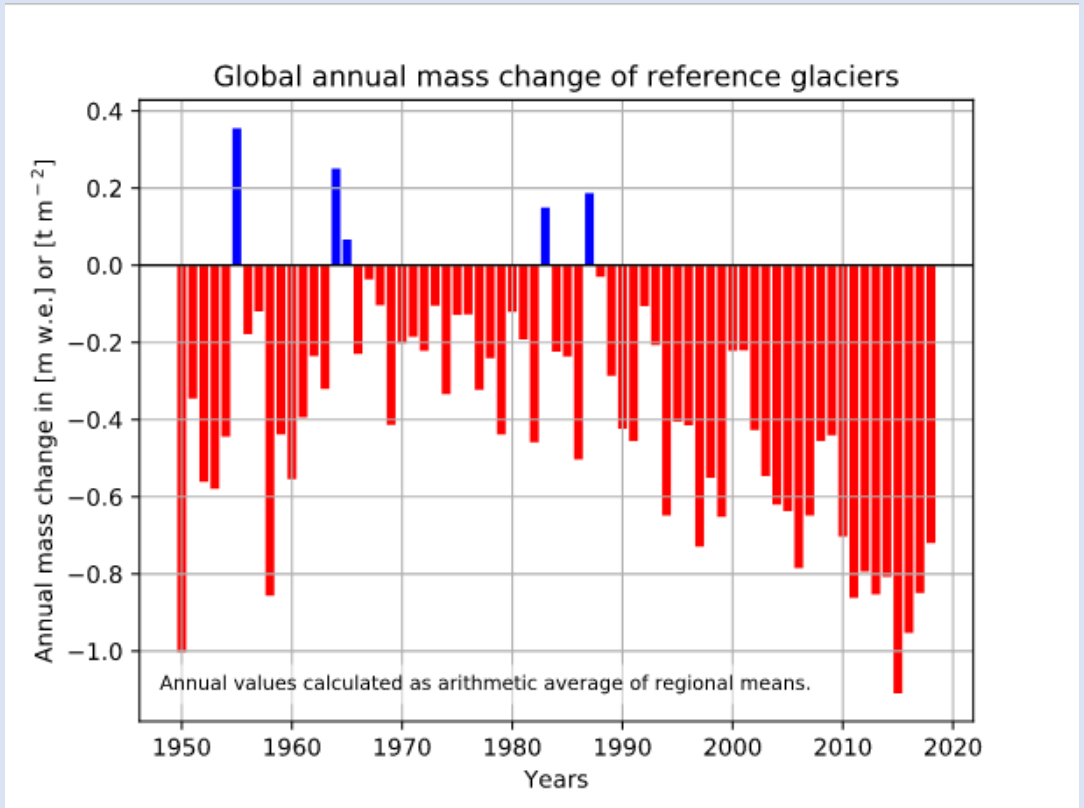
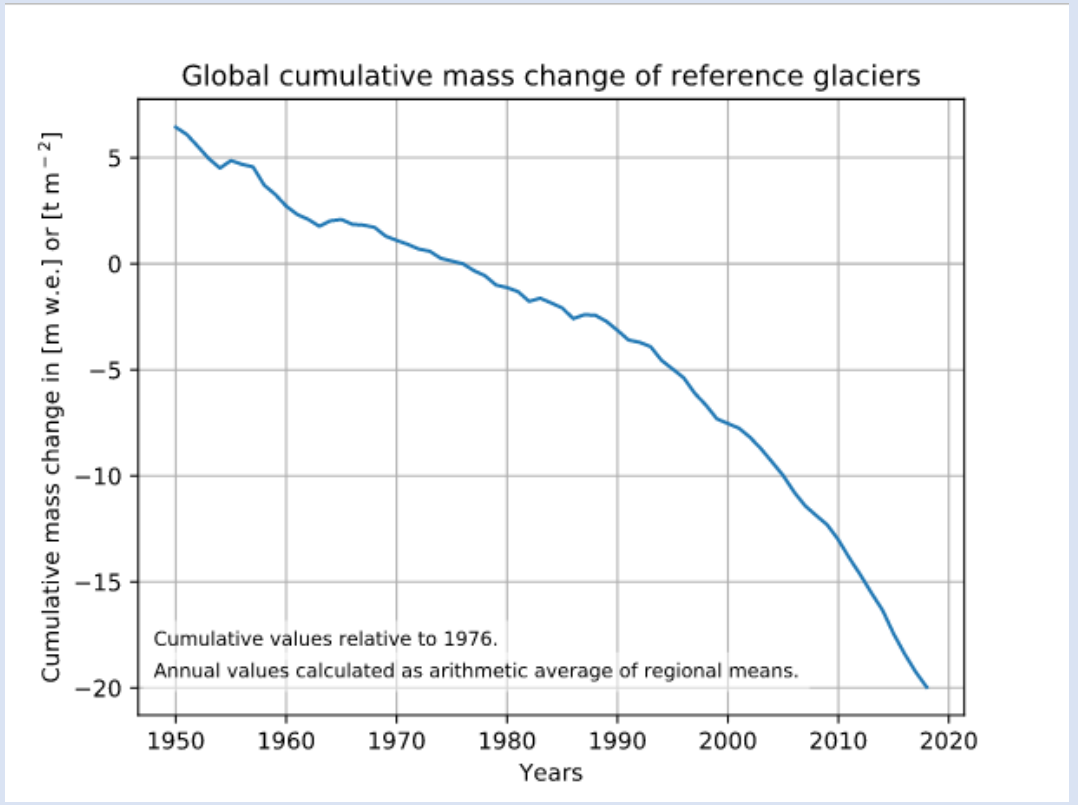
2020年有可能是有記錄以來第二最暖



不斷融化的冰川



Annual mass balance of reference glaciers with more than 30 years of ongoing glaciological measurements. Annual mass change values are given on the y-axis in the unit meter water equivalent (m w.e.) which corresponds to tonnes per square meter (t m-2).



Cumulative mass change of reference glaciers. Cumulative values relative to 1976 are given on the y-axis in the unit meter water equivalent (m w.e.). Since the mid-1970s, the cumulative glacier mass change of global reference glaciers as displayed in the graph above is estimated to about 20 m w.e.

(Ref : World Glacier Monitoring Service, https://wgms.ch/global-glacier-state/
IPCC, Special Report on the Ocean and Cryosphere in a Changing Climate, https://www.ipcc.ch/srocc/home/)

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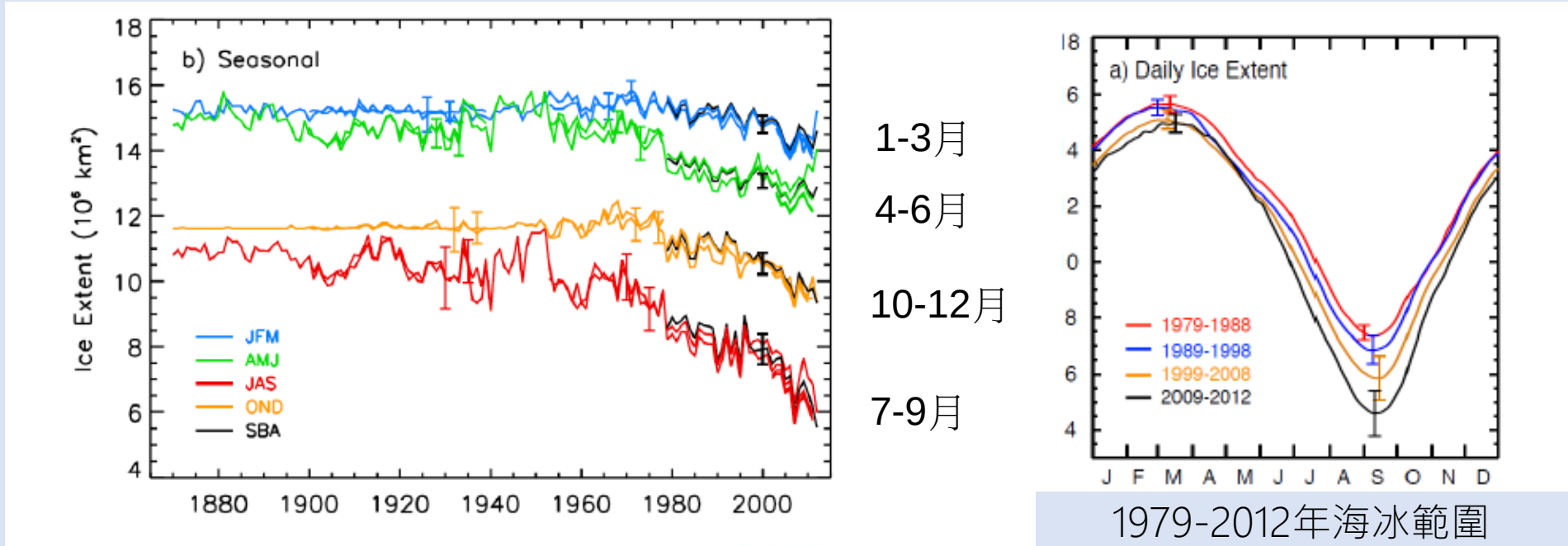
最近30年夏季海冰減少的情況
最少在過去1450年來屬於異常



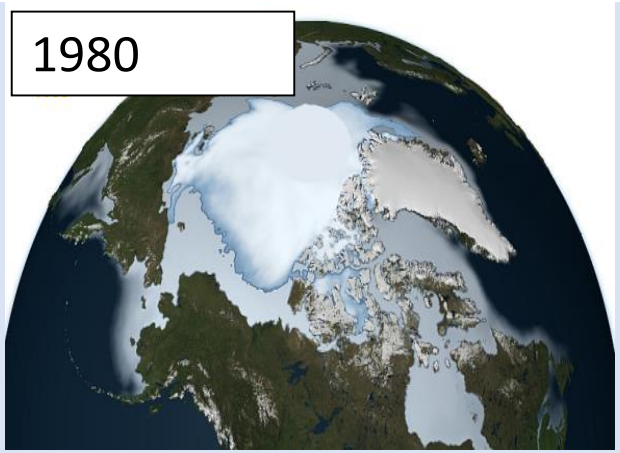
1-3月

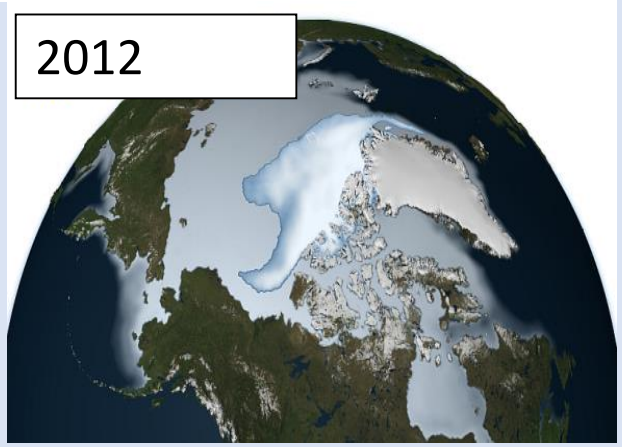
4-6月

10-12月

7-9月

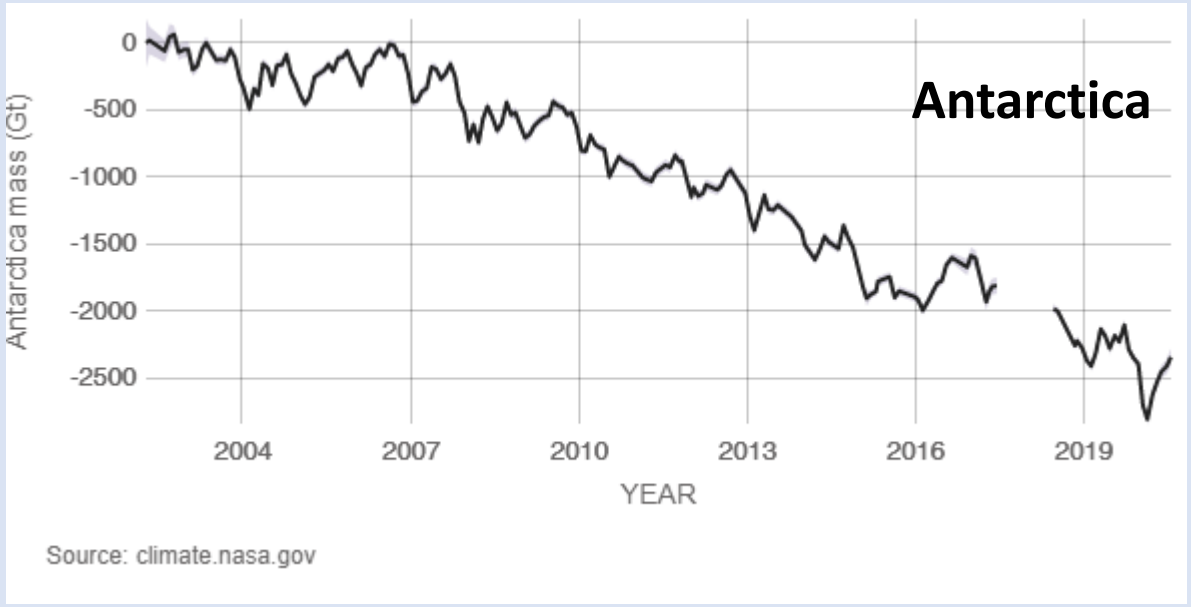
1979-2012年海冰範圍

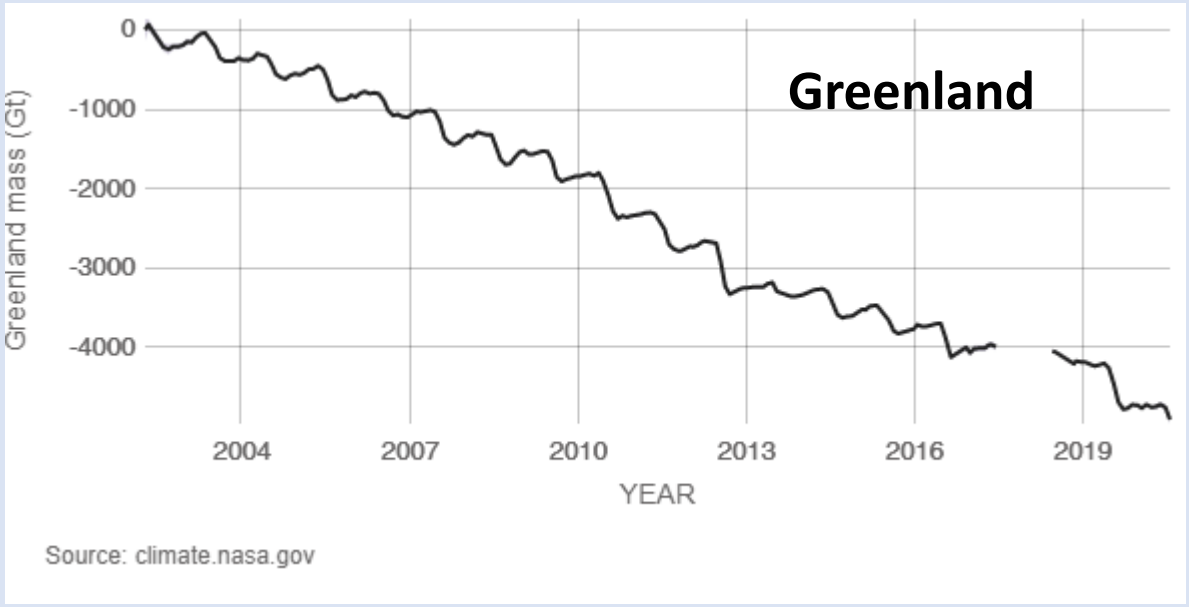




南極洲及格陵蘭冰蓋持續融化

Data from NASA's GRACE satellites show that the land ice sheets in both Antarctica (left chart) and Greenland (right) have been losing mass since 2002. Both ice sheets have seen an acceleration of ice mass loss since 2009.





About -155 billion tonnes/year in 2006-2015

About -278 billion tonnes/year in 2006-2015

(Ref : GRACE satellite data, https://climate.nasa.gov/
IPCC, Special Report on the Ocean and Cryosphere in a Changing Climate, https://www.ipcc.ch/srocc/home/)

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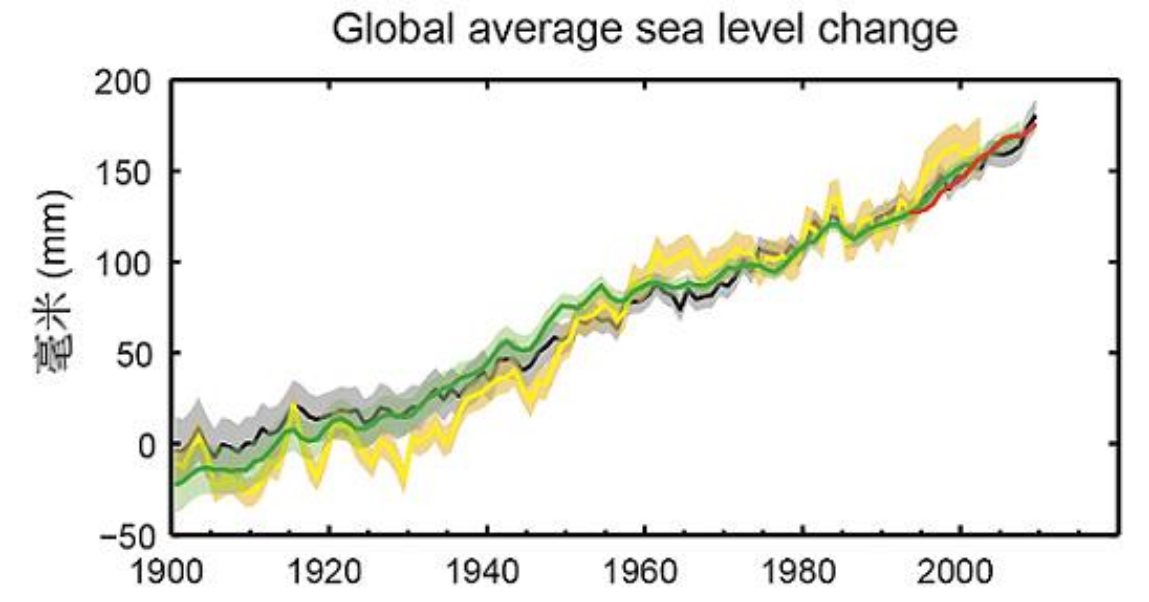
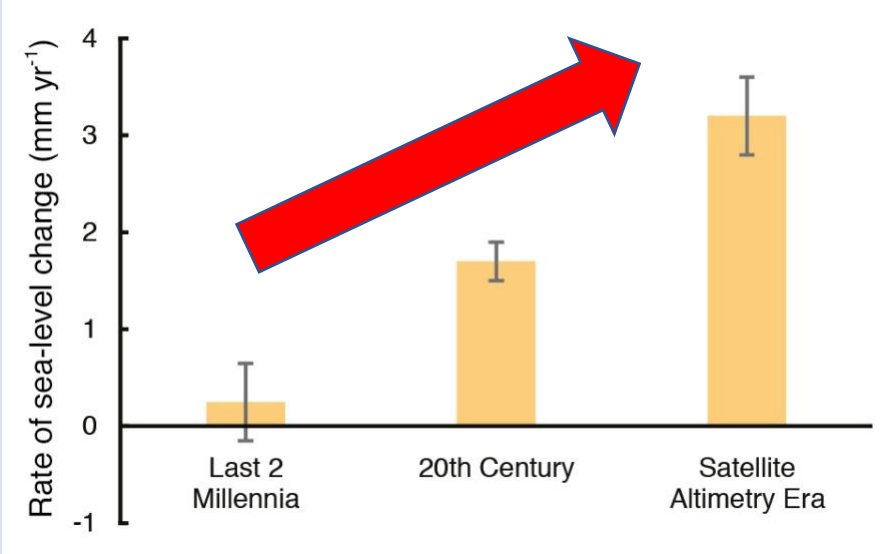
海水受熱膨脹 + 陸地冰雪融化 → 海平面上升



海平面上升正在加速!
1.7毫米/年(1901 – 2010)
3.2毫米/年(1993 – 2010)



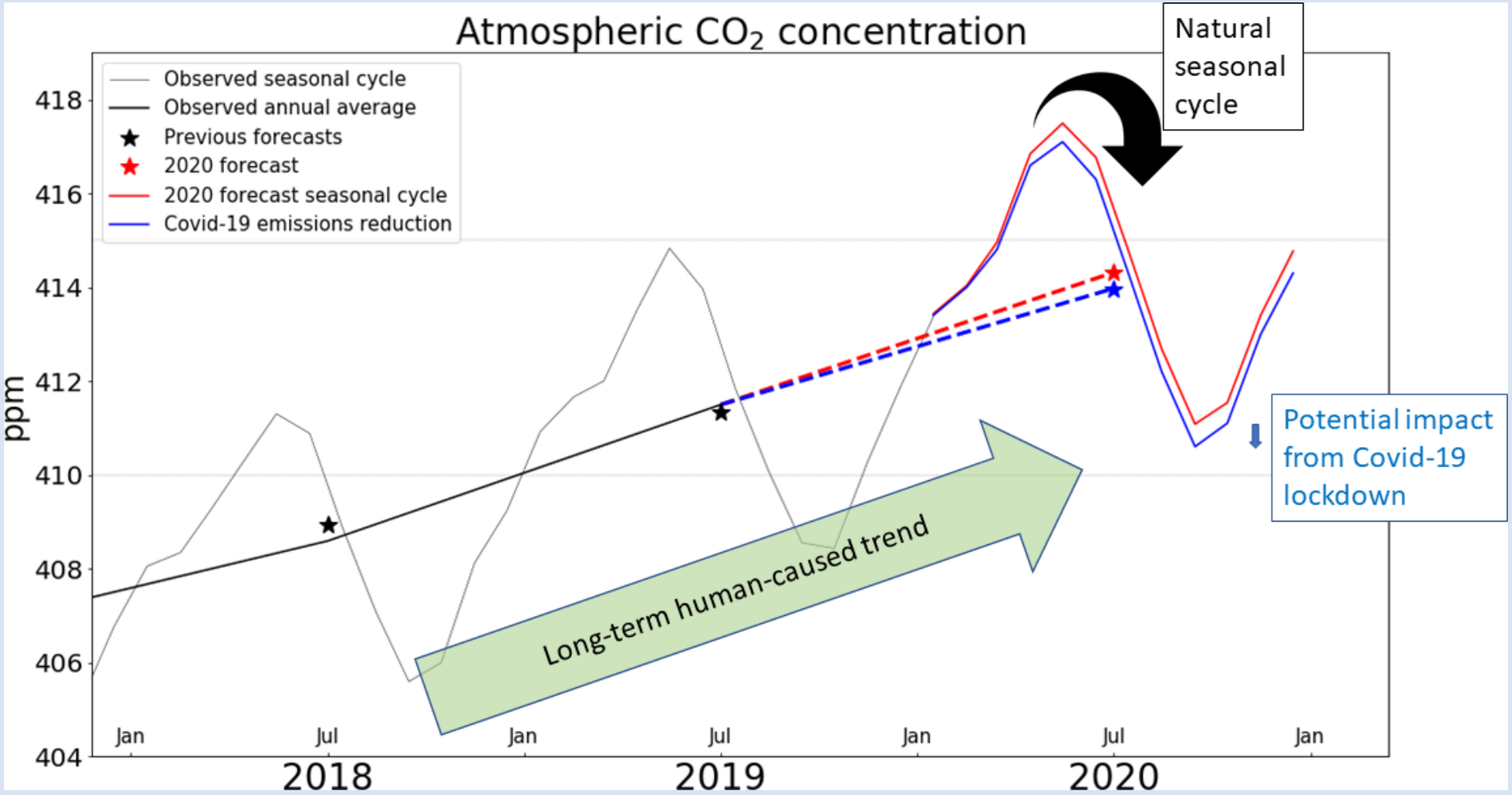
COVID-19 對CO2排放有什麼影響?

- WMO press release (Apr 2020) –

  - Past experience suggests that emissions declines during economic crises are followed by a rapid upsurge. We need to change that trajectory.

  - It is too early to assess the implications of the slacking-off in economic activity for concentrations of greenhouse gases that are responsible for long-term climate change.

COVID-19 對CO2排放影響輕微



Source: UK Met Office

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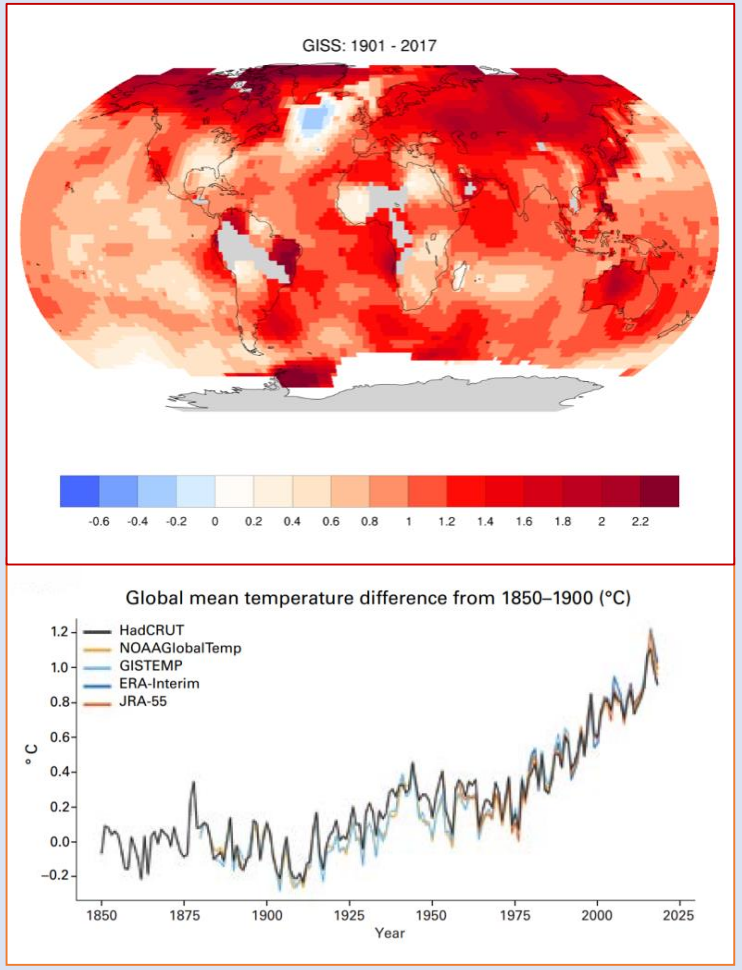
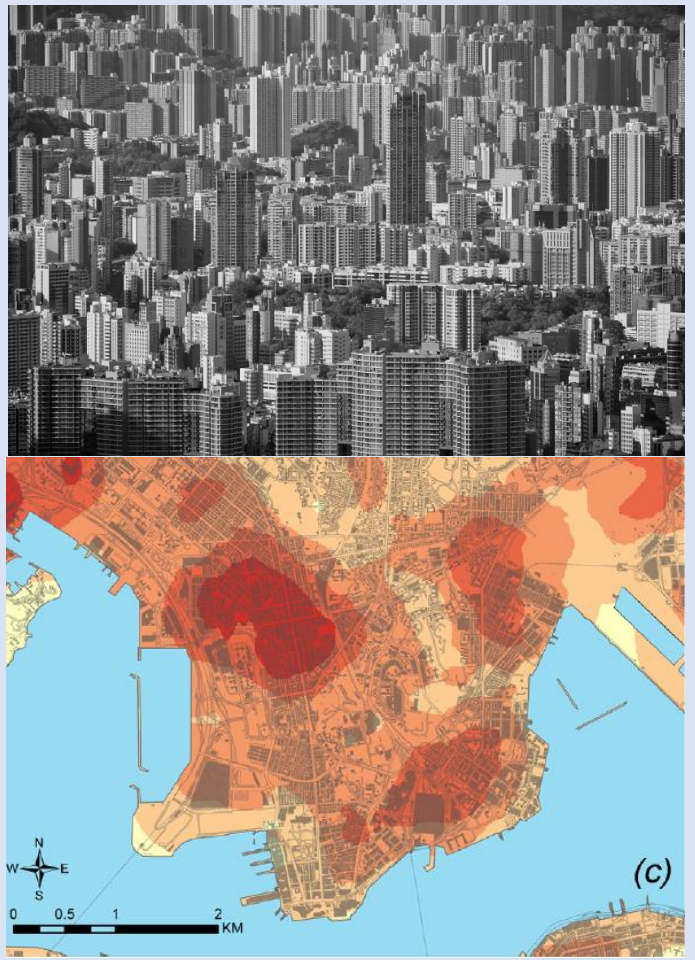
氣候變化@香港

全球暖化



+

本地城市化



(Photos : Yuan et al., 2019 : Assessing spatial variability of extreme hot weather conditions in Hong Kong: A land use regression approach, Environmental Research, Volume 171, Pages 403-415 and WMO Statement on the state of the global climate in 2018)

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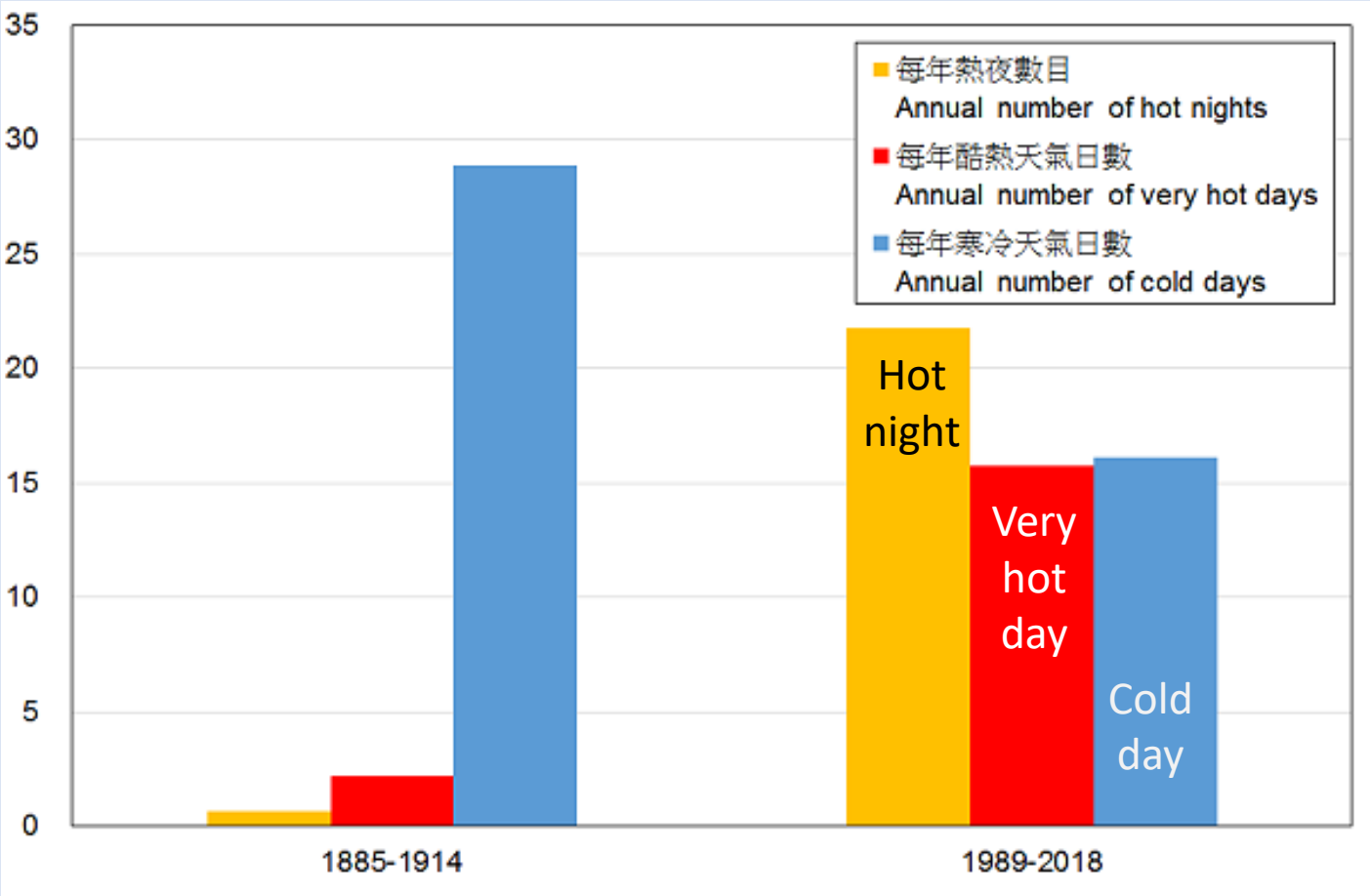
氣候變化@香港


更多極端降雨
+1.2℃
/世紀
century
更多酷熱天氣日數
熱
HOT
冷
COLD
更少寒冷天氣日數
海平面
Sea Level
+3mm / 年 year

香港熱夜、酷熱天氣日數增加；寒冷天氣日數減少



Hot night: daily minimum temp. >= 28°C
Very hot day: daily maximum temp. >= 33°C
Cold day: daily minimum temp. <= 12°C

最初30年　　最近 30年

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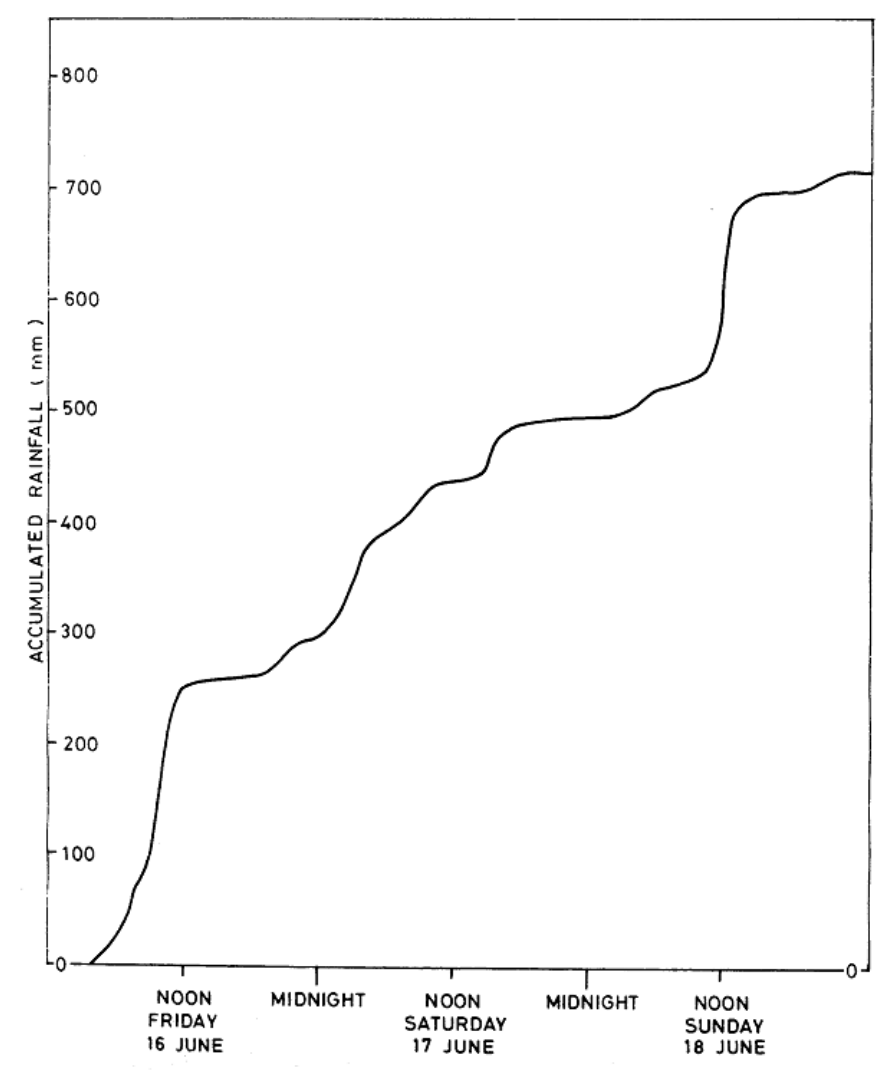
2020年香港破紀錄高溫事件 (up to 29 Sep 2020)

Record-breaking events (since records began in 1884)	Date/Period	New record
Highest Mean Max Temperature for winter	December 2019 to February 2020	21.5℃
Highest Number of Hot Nights for June	June 2020	18 Days
Highest Number of Consecutive Hot Nights for June	June 2020	12 Days
Highest Number of Consecutive Hot Nights	19 June to 1 July 2020	13 Days
Highest Mean Temperature for the first half of year (on par with 2019)	January to June 2020	23.0℃
Highest Mean Max Temperature for All Months	July 2020	33.3℃
Highest Mean Temperature for All Months	July 2020	30.2℃
Highest Mean Min Temperature for All Months	July 2020	28.3℃
Highest Number of Very Hot Days for All Months	July 2020	20 Days
Highest Mean Maximum Temperature for summer	1 June 2020 to 31 August 2020	32.6℃
Highest Mean Temperature for summer	1 June 2020 to 31 August 2020	29.6℃
Highest Mean Minimum Temperature for summer	1 June 2020 to 31 August 2020	27.7℃
Highest Annual Number of Very Hot Days (up to 29 Sep 2020)	2020	47 Days
Highest Annual Number of Hot Nights (up to 29 Sep 2020)	2020	50 Days

The 16-18 June 1972 Rainstorm



Estimated accumulated rainfall at
Po Shan Road from 16-18 June 1972

(Ref : HKO Technical Note No. 51, The Severe Rainfall Occasion, 16-18 June 1972)

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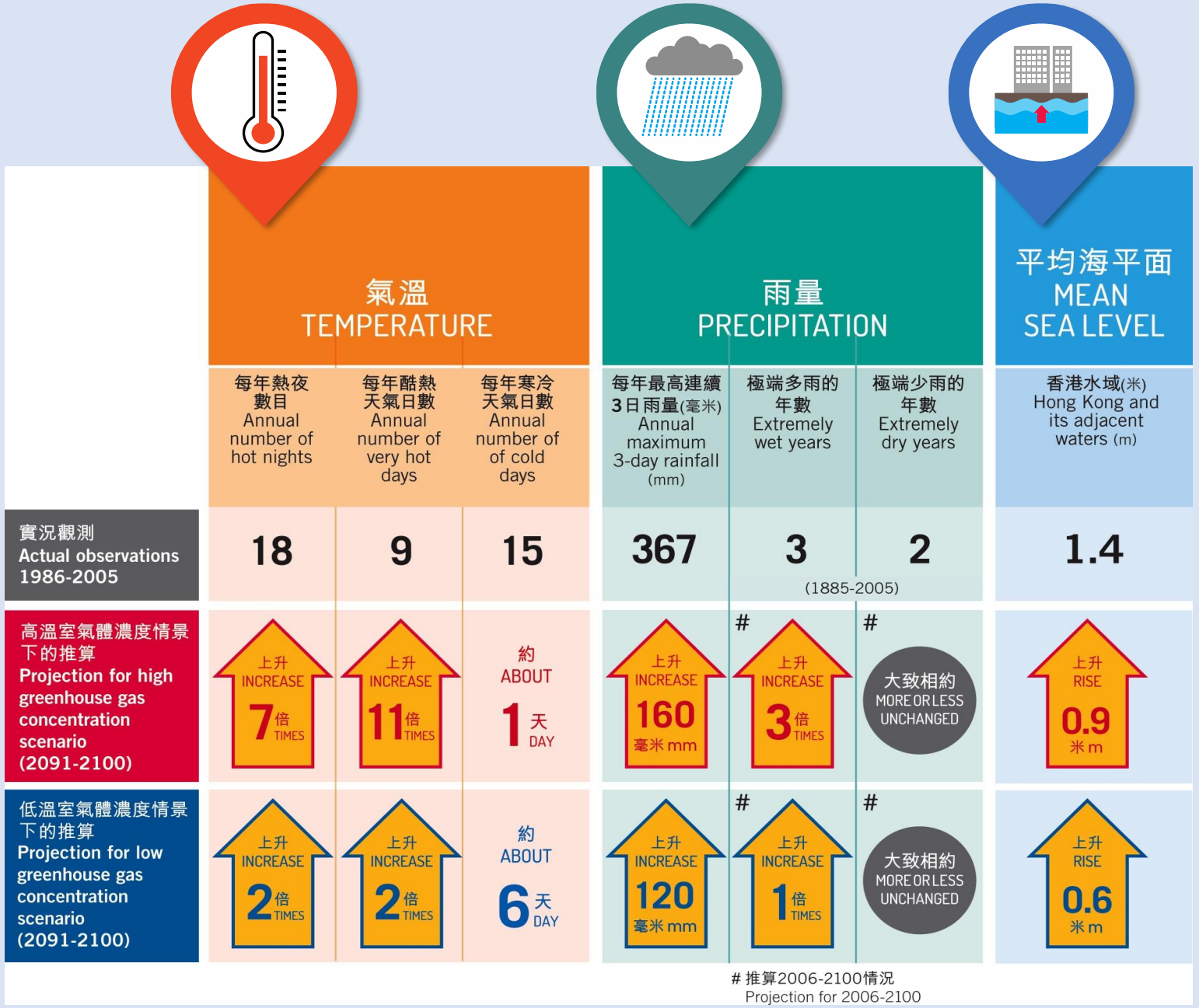
Rainstorm of 7 June 2008

Landslides in Tai O, Lantau Island

(Source : Rising to the Challenges of Natural Terrain Landslides, H N Wong, GEO 2009)

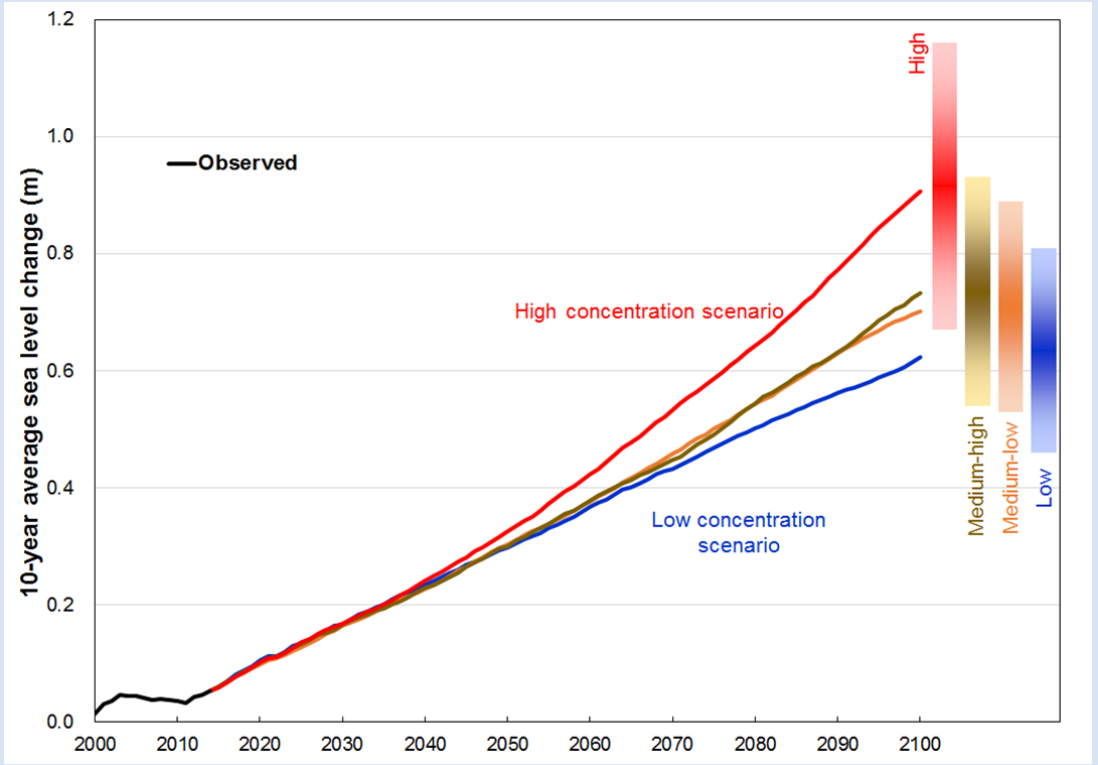
香港的氣候推算



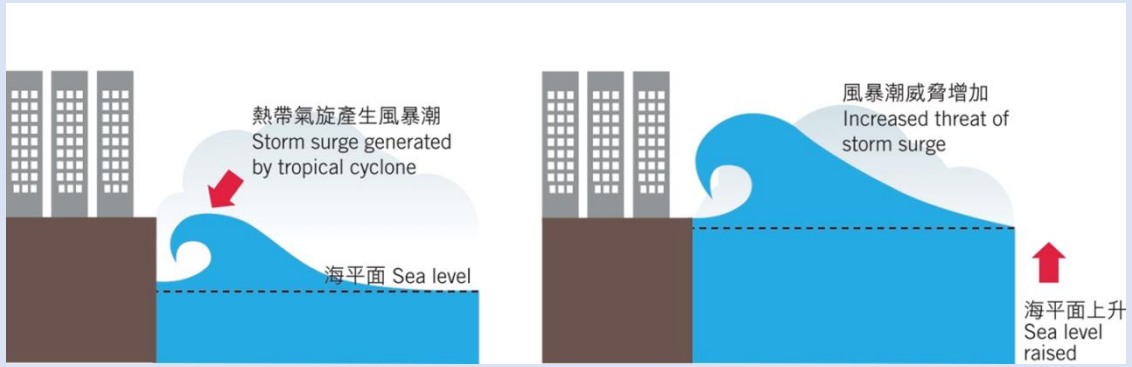
RCP 8.5

RCP 2.6

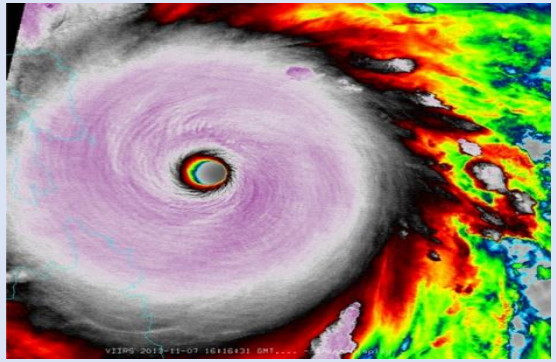
平均海平面在所有濃度情景都會繼續上升



海平面上升增加風暴潮的威脅

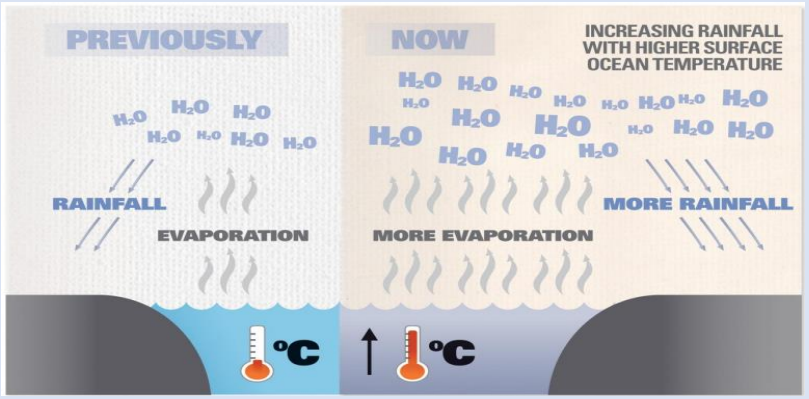


氣候變化導致更強的熱帶氣旋



(Photo source: Dan Lindsey, NOAA)

Increase in TC intensity and proportion of very intense TCs



(Photo Source: Climate Commission)

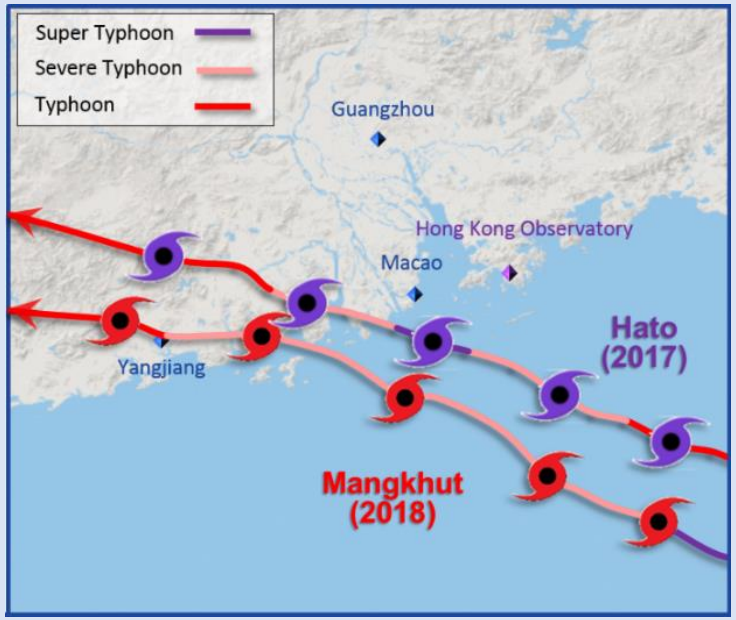
Increase in TC rainfall rates due to a warmer atmosphere holding more water vapor

(Photos by Christina and H C Chan)

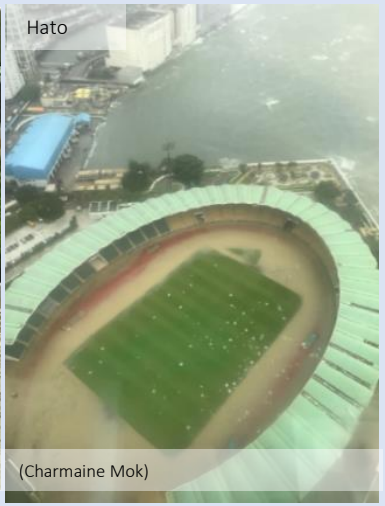
Storm surge will be exacerbated by future sea level rise. Plausible increase in TC induced extreme wind waves due to the projected increase in TC intensity may further aggravate the impacts of storm surge and sea level rise on coastal structures

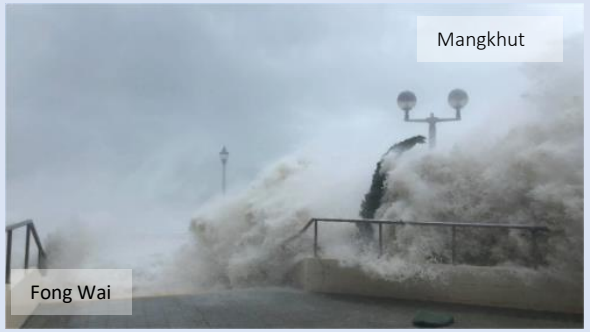
(Ref : IWTC-9, Topic 7.1 https://www.wmo.int/pages/prog/arep/wwrp/tmr/documents/IWTC-9_Subtopic_7-1.pdf)

天兔(2017) 和 山竹 (2018)



Widespread damage by destructive winds and severe storm surge





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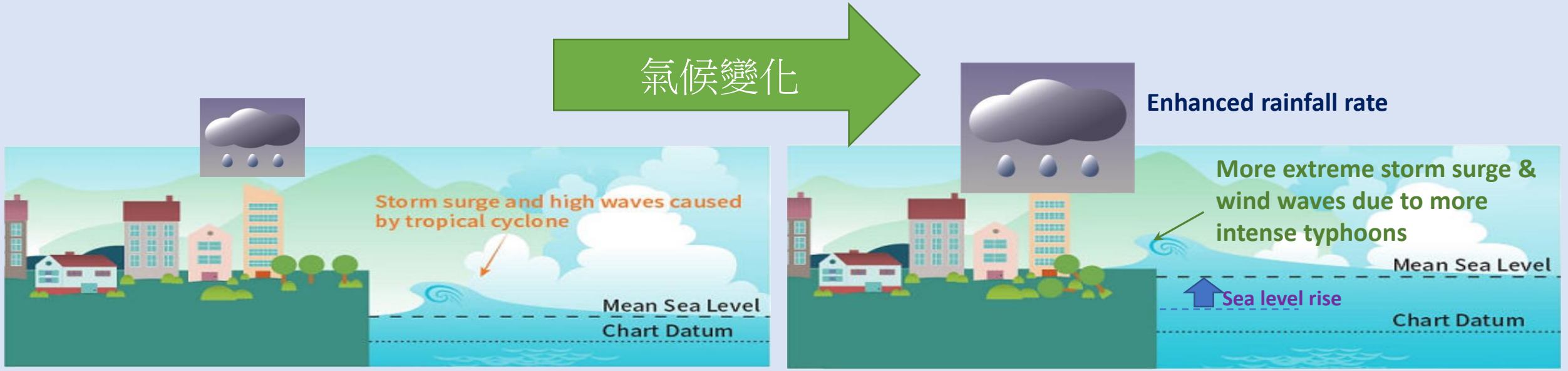
沿岸地區可能會因為更極端的降雨和更強的熱帶氣旋而引發多重災害

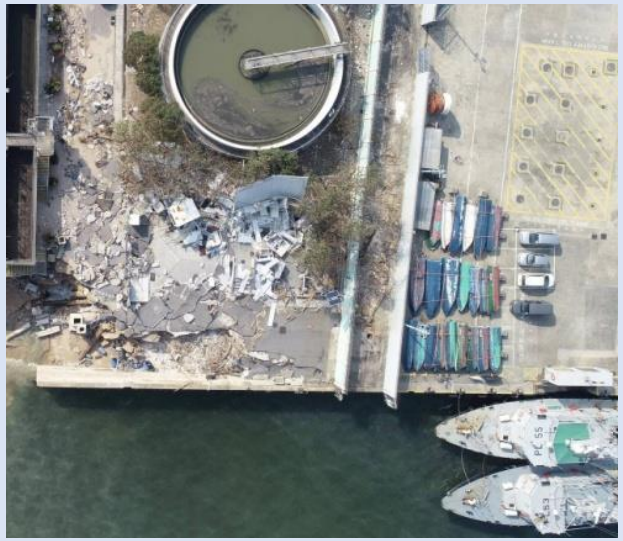
極端降雨 + 海平面上升+ 風暴潮 + 大浪



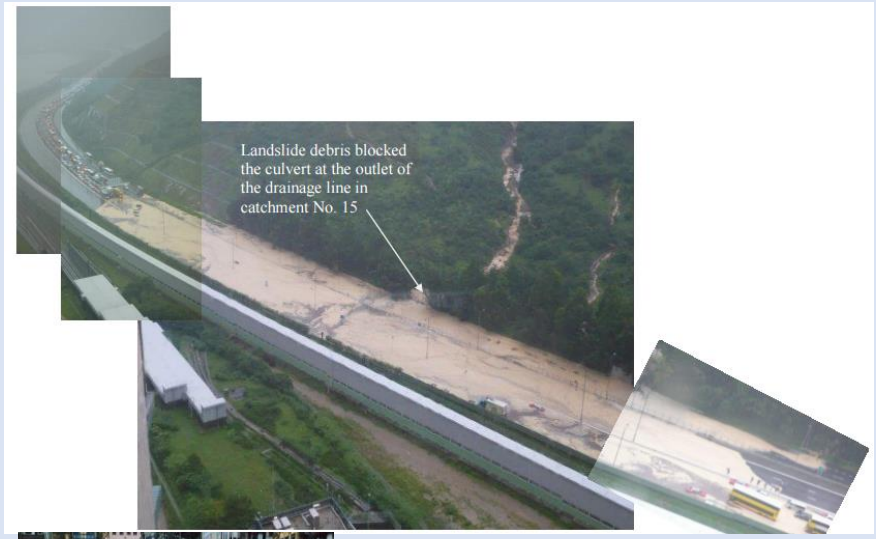
(For illustration purpose only, not to scale)

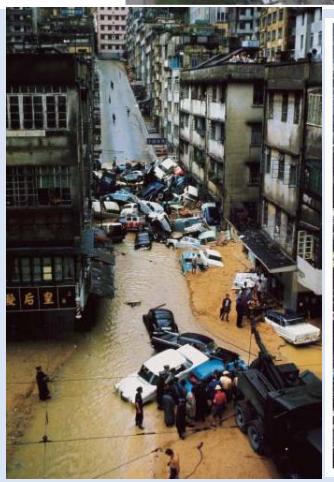
氣候變化和極端天氣導致多重災害

Storm surge and overtopping waves
- Coastal damages and inundation



Rainstorms
- Floodings and landslides





High winds
- Tree failure, building damages, interruptions of transportation and power supply

(Photo sources : CLP, CWOS, SCMP, GEO, CEDD)

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HONG KONG OBSERVATORY

PARIS AGREEMENT

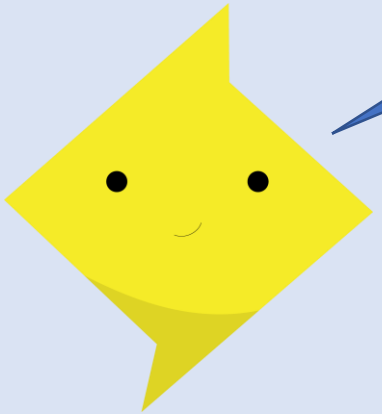
UNEP

WWF

巴黎協定

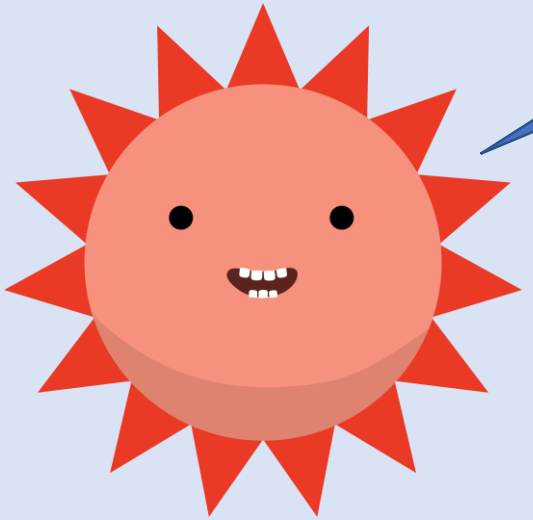
- 把全球平均溫度升幅控制在2℃之內(較工業革命前水平)，並努力將氣溫升幅限制在1.5℃之內
- 全球溫室氣體排放應儘快達到峯值，然後迅速減少
- 締約方應採取國內減緩措施，以實現**國家自主貢獻(INDC)的目標**

今餐總共食左$1000，
你地每人願意出幾多?



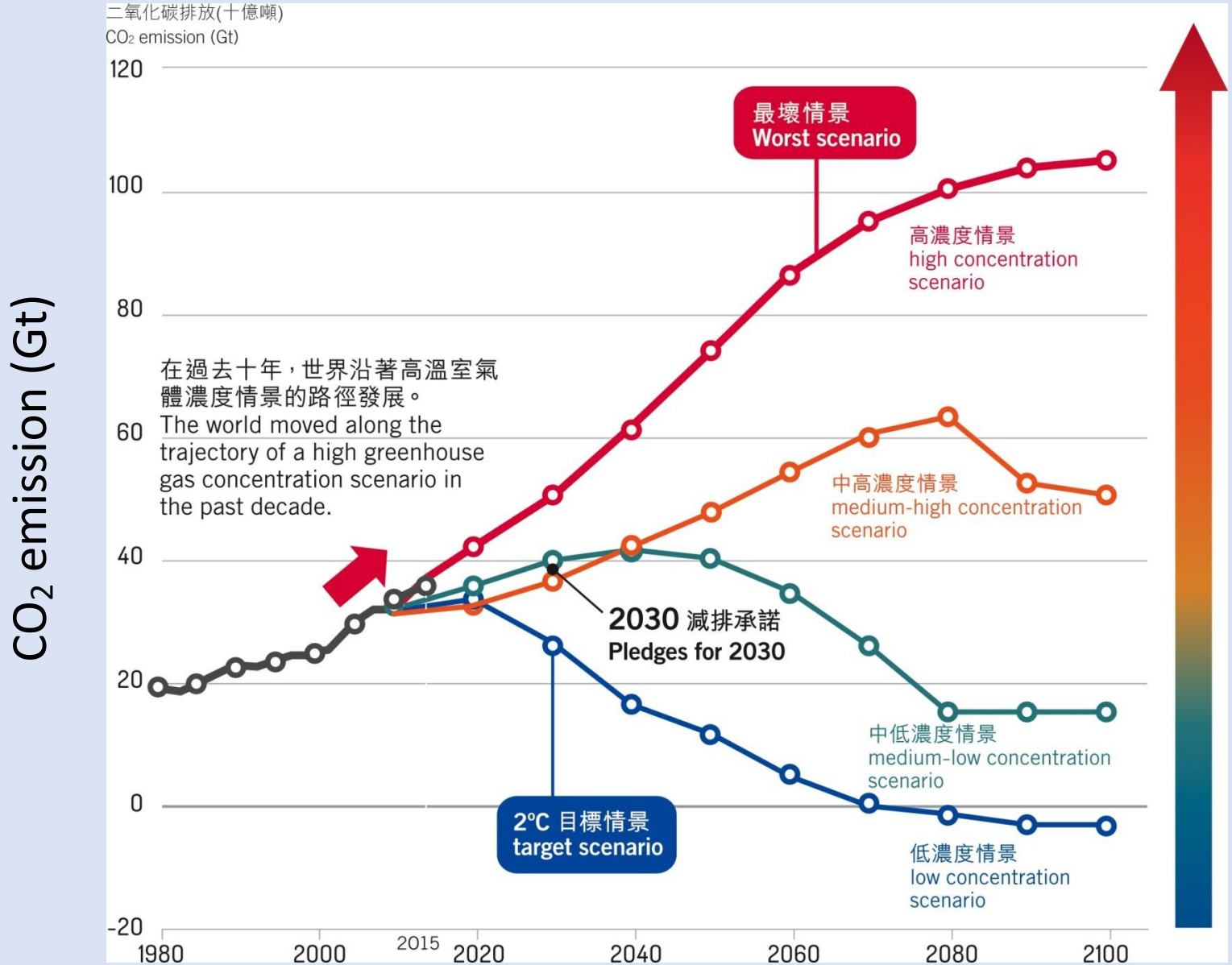
$100

$200



$100

唔夠喎，點算?



CO_2 emission (Gt)

(Source : https://www.globalcarbonproject.org/carbonbudget/archive.htm)

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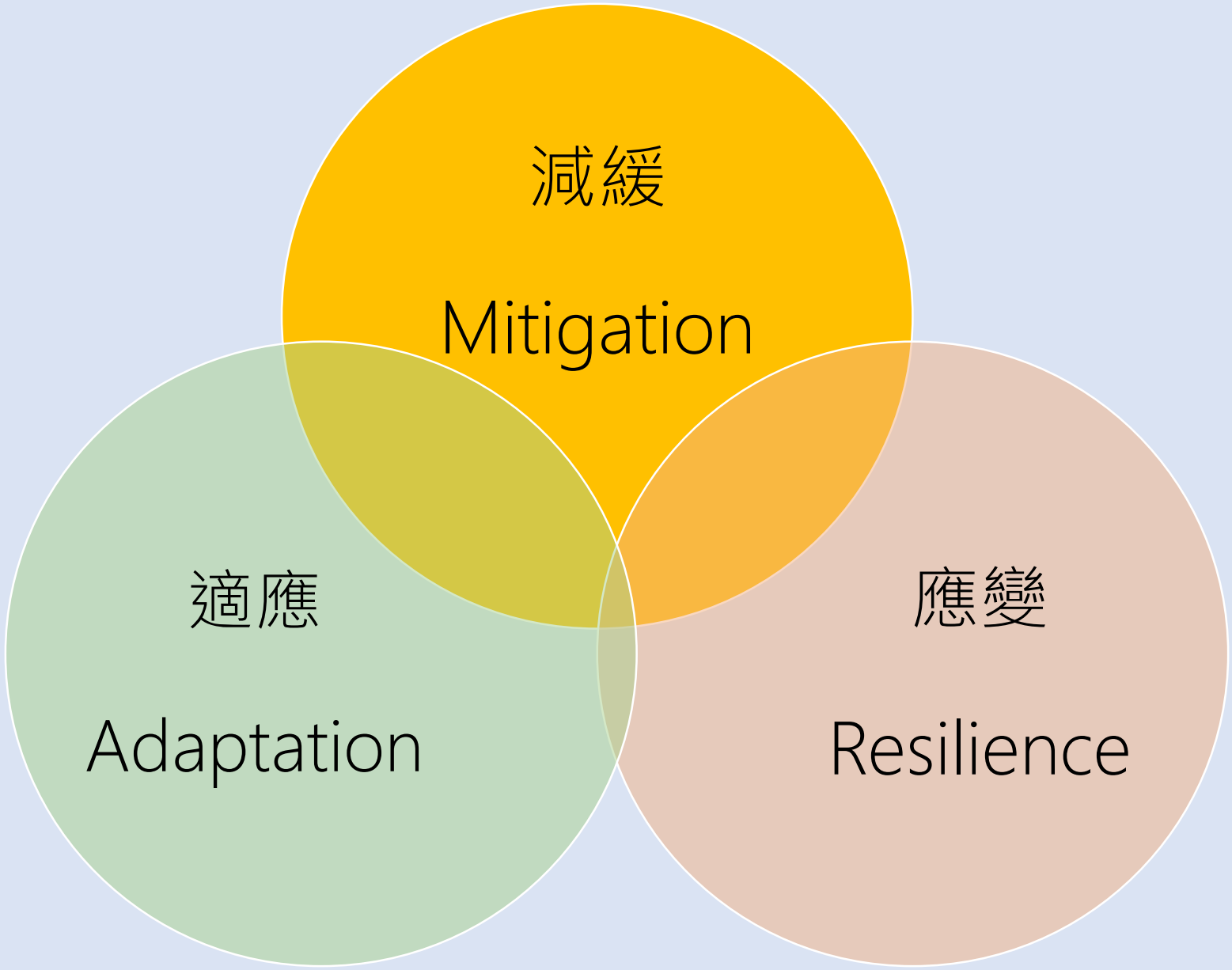
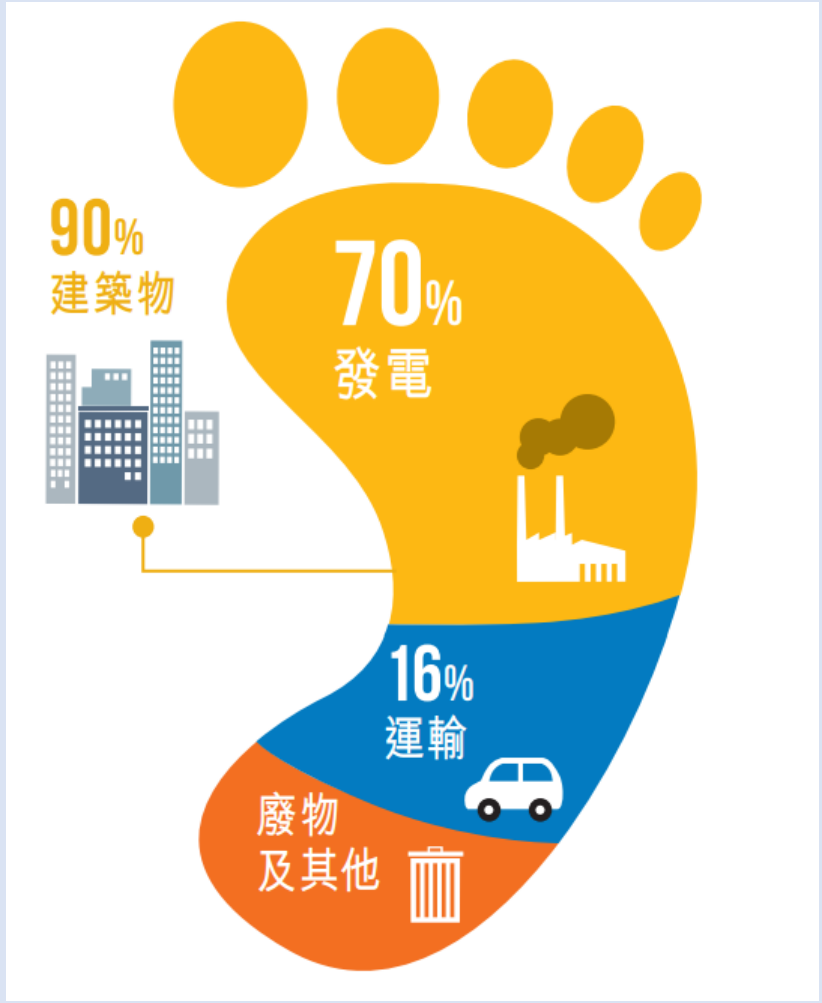
HONG KONG OBSERVATORY

全球暖化下的災害應對

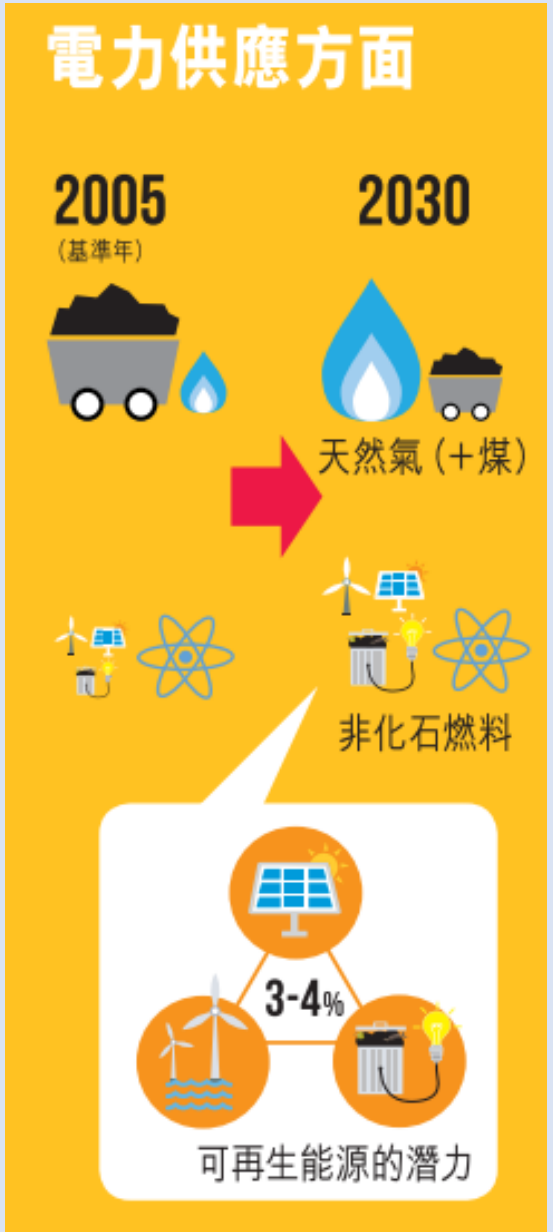


減緩

本地碳排放源



電力供應方面



低碳消費

低碳運輸

適應

位於跑馬地遊樂場的雨水集蓄作灌溉運動球場用途

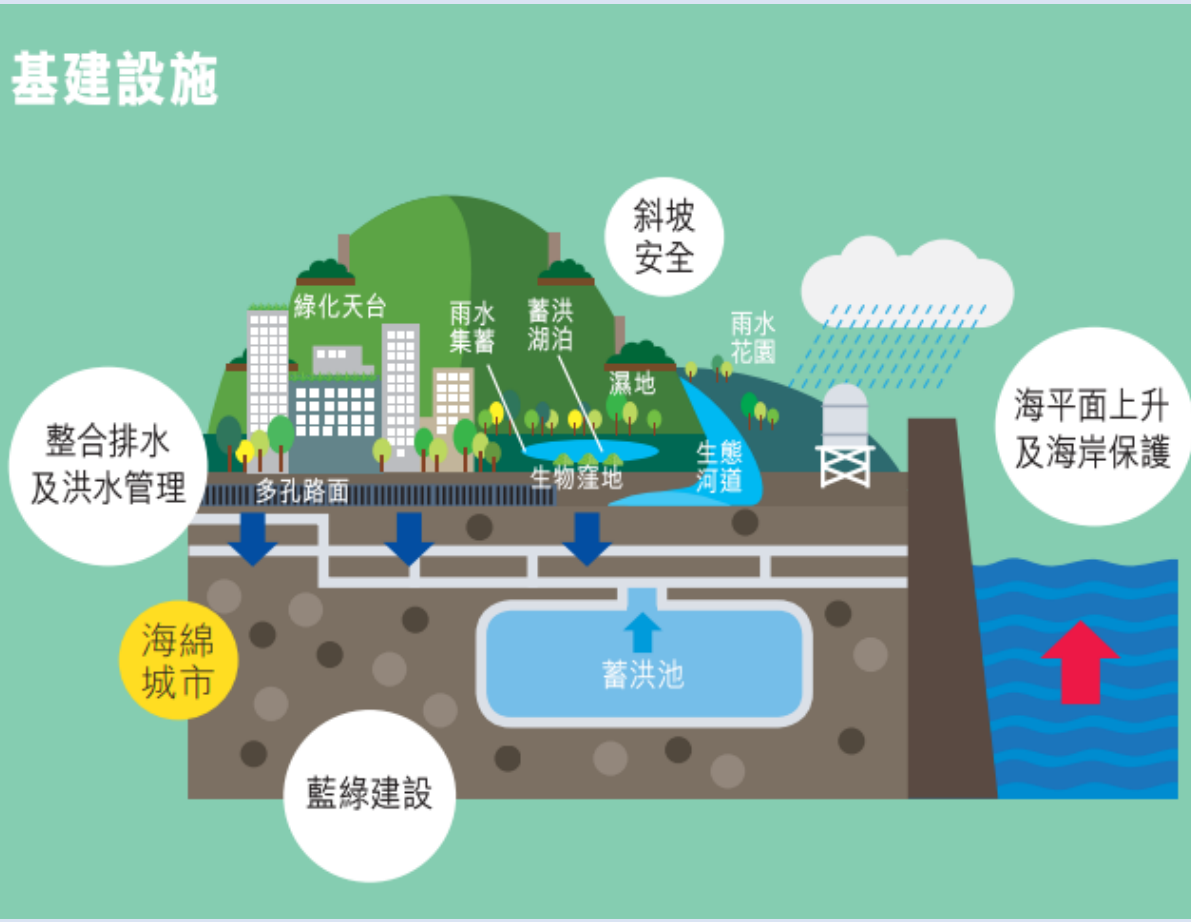
城市規劃

強化城市結構

- 更新香港風力效應作業守則
- 都市氣候規劃
- 市區再生

發展智慧城市

基建設施



氣候應變能力 (resilience)

加強應變能力的途徑

1. 就資訊差距和監控變化進行研究
2. 加強機構能力和政策重點
3. 進行演習
4. 適時更新災難和緊急應變計劃
5. 改善與私營機構的對話和協調
6. 提高社區意識

減緩氣候變化，我們可以做些什麼?

Thank You !

香港天文台
HONG KONG OBSERVATORY