Rollout Event of the IPCC Special Report on
The Ocean and Cryosphere in a Changing Climate

INTERGOVERNMENTAL PANEL ON climate change

The Sea Level Rise and Implications for Low Lying Islands, Coasts and Communities

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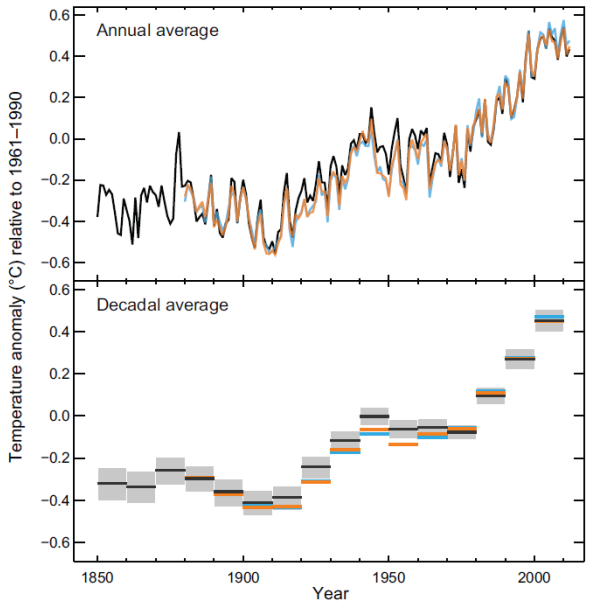
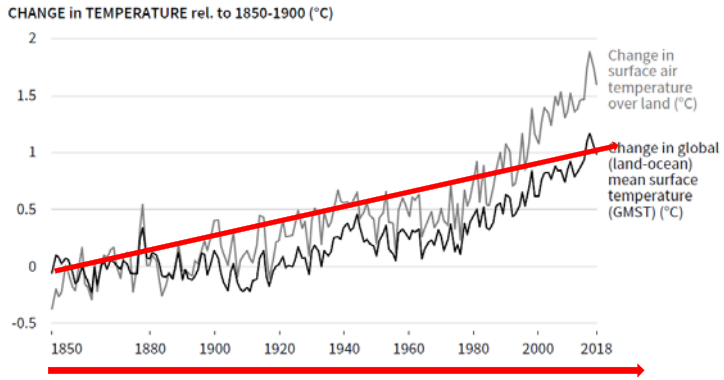
Outline

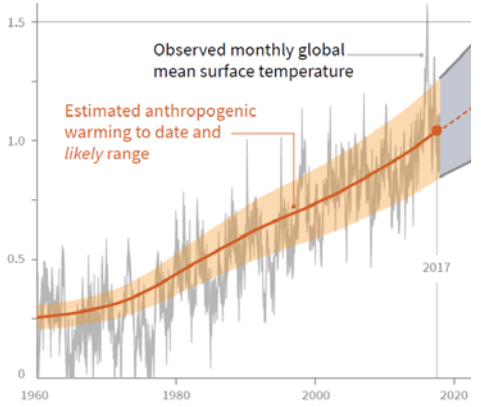
1. Sea level changes
2. Impacts and risks
3. Adaptation
4. Concluding remarks

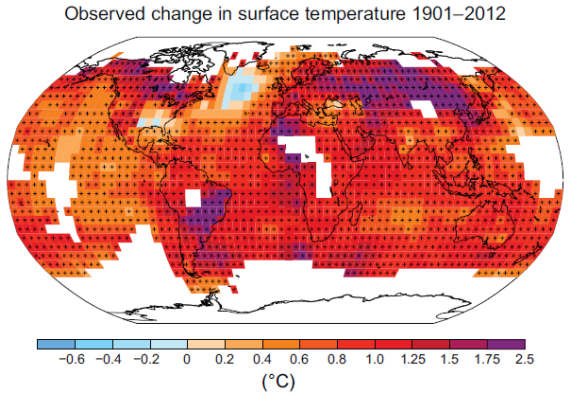
1. Sea level Changes —Warming

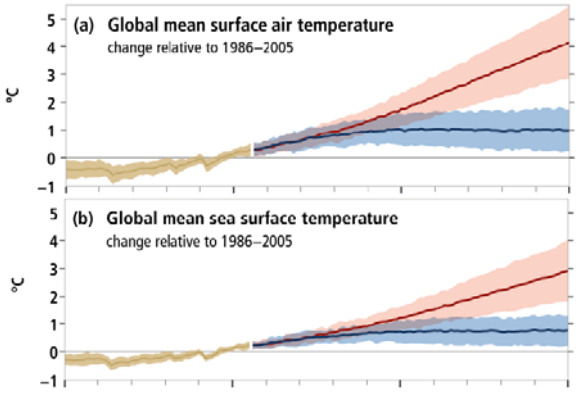
Observed globally averaged combined land and ocean surface temperature anomaly 1850–2017











(IPCC AR5, 2013; IPCC SR1.5°C 2019; IPCC SRCCL, 2019; IPCC SROCC, 2019)

The global nature systems have encountered substantial warming over the past century, especially the recent decades.

1. Sea level Changes —GMSL

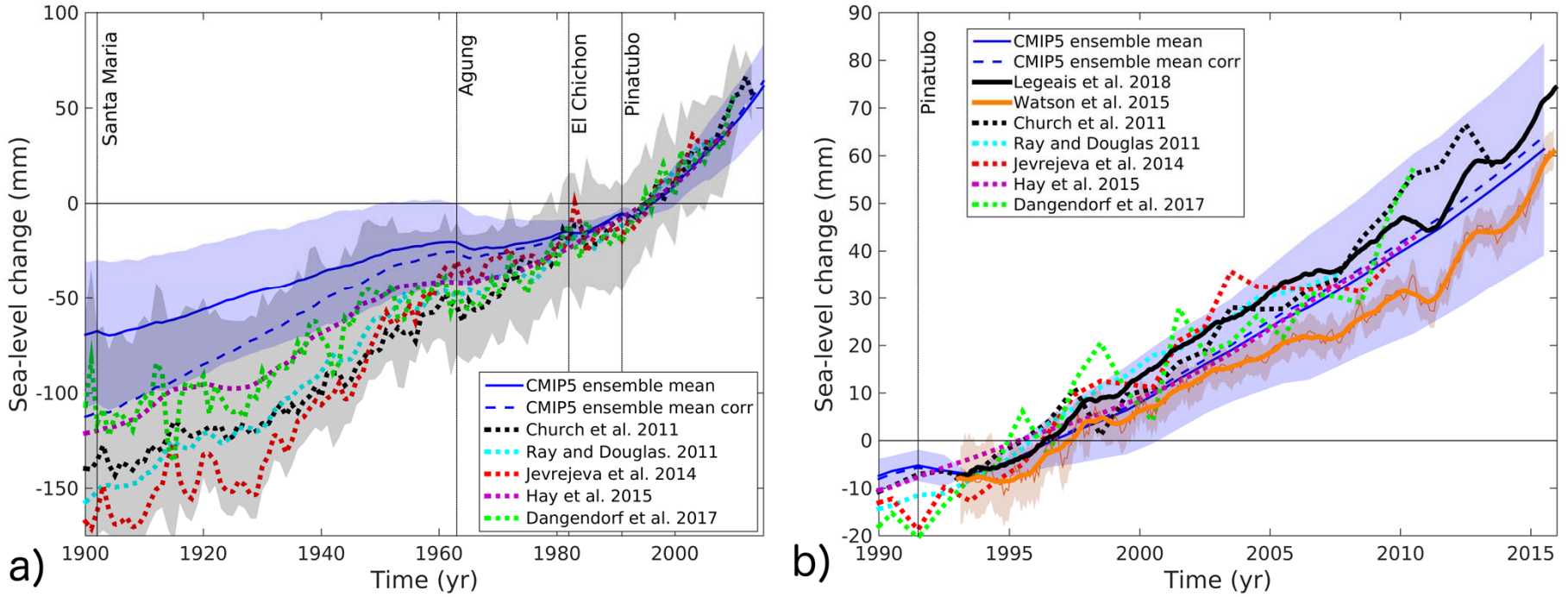
Under the global warming, the more and more water from mountain areas and polar regions flows to the oceans due to rapidly melting ice.

(IPCC SROCC, 2019)

Global mean sea level (GMSL) is rising and accelerating.
GMSL rise can be mainly attributed to the continued ice loss from glacier and ice sheet and ocean thermal expansion.

1. Sea level Changes —GMSL

The global mean sea level change since 1901 (a) and since 1993 (b).



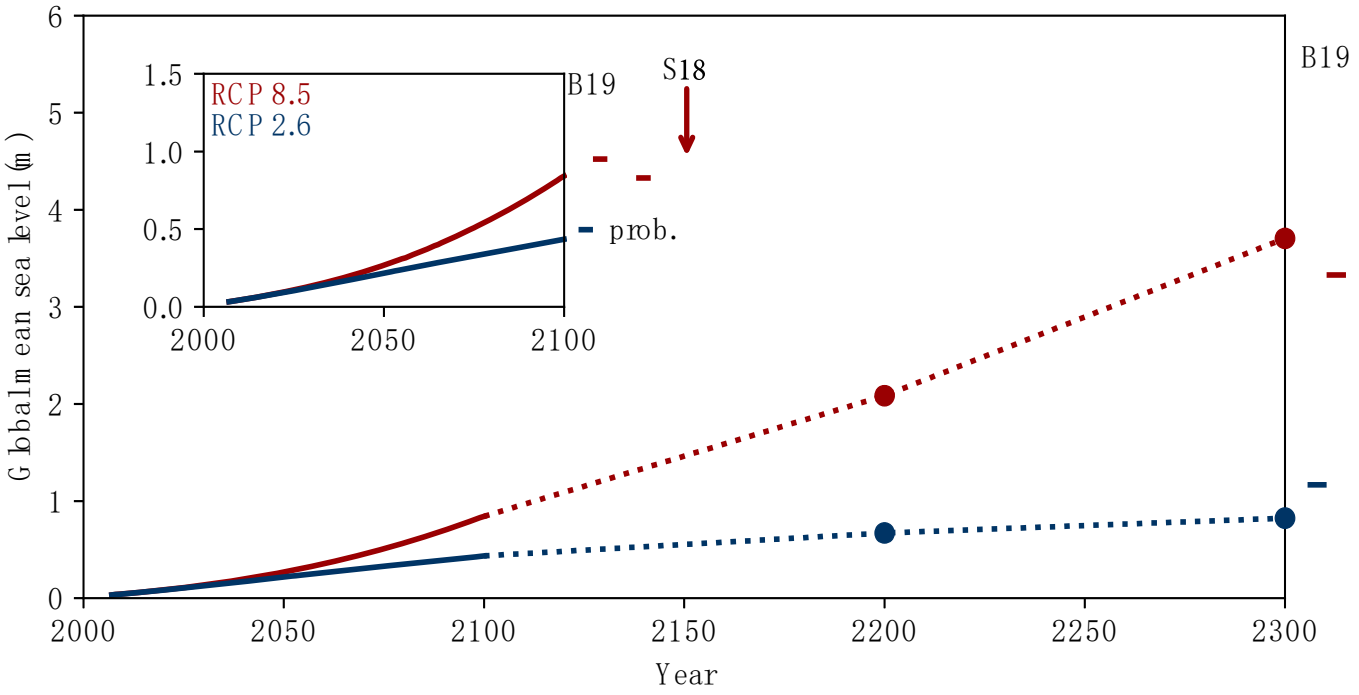
(IPCC SROCC, 2019)

The Total GMSL rise for 1902–2015 is 0.16 m.

The rate of GMSL rise for 2006–2015 is 3.6 mm yr^{-1}, which is unprecedented over the last century, and about 2.5 times the rate for 1901–1990 of 1.4 mm yr^{-1}. The sum of glacier and ice contributions to SLR is greater than the effect of ocean thermal expansion since 2006.

1. Sea level Changes —GMSL

By 2050, GMSL will rise between 0.24 (0.17–0.32) m under RCP2.6 and 0.32 (0.23–0.40) m under RCP8.5.



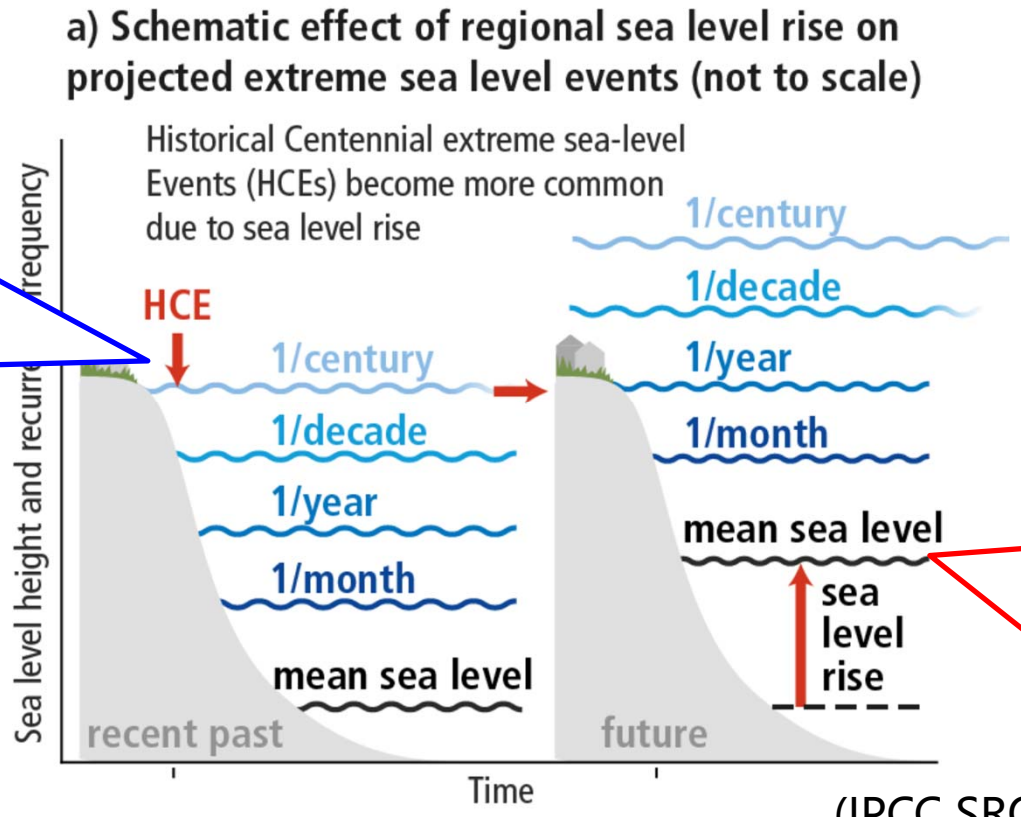
(IPCC SROCC, 2019)

By 2100, GMSL is projected to rise between 0.43 (0.29–0.59) m under RCP 2.6 and 0.84 (0.61–**1.10**) m under RCP 8.5.

1. Sea level changes —Extreme sea level

Extreme sea level events are typically expressed in terms of their average recurrence Time.

The coastal water level which, during recent past, is exceeded once every 100 years (Historically Centennial Event).



Mean sea level rise can transform HCEs into annually recurring events.

(IPCC SROCC, 2019)

It is noted that, for regions with larger tides and storm surges, the timing is strongly dependent on RCP scenario.

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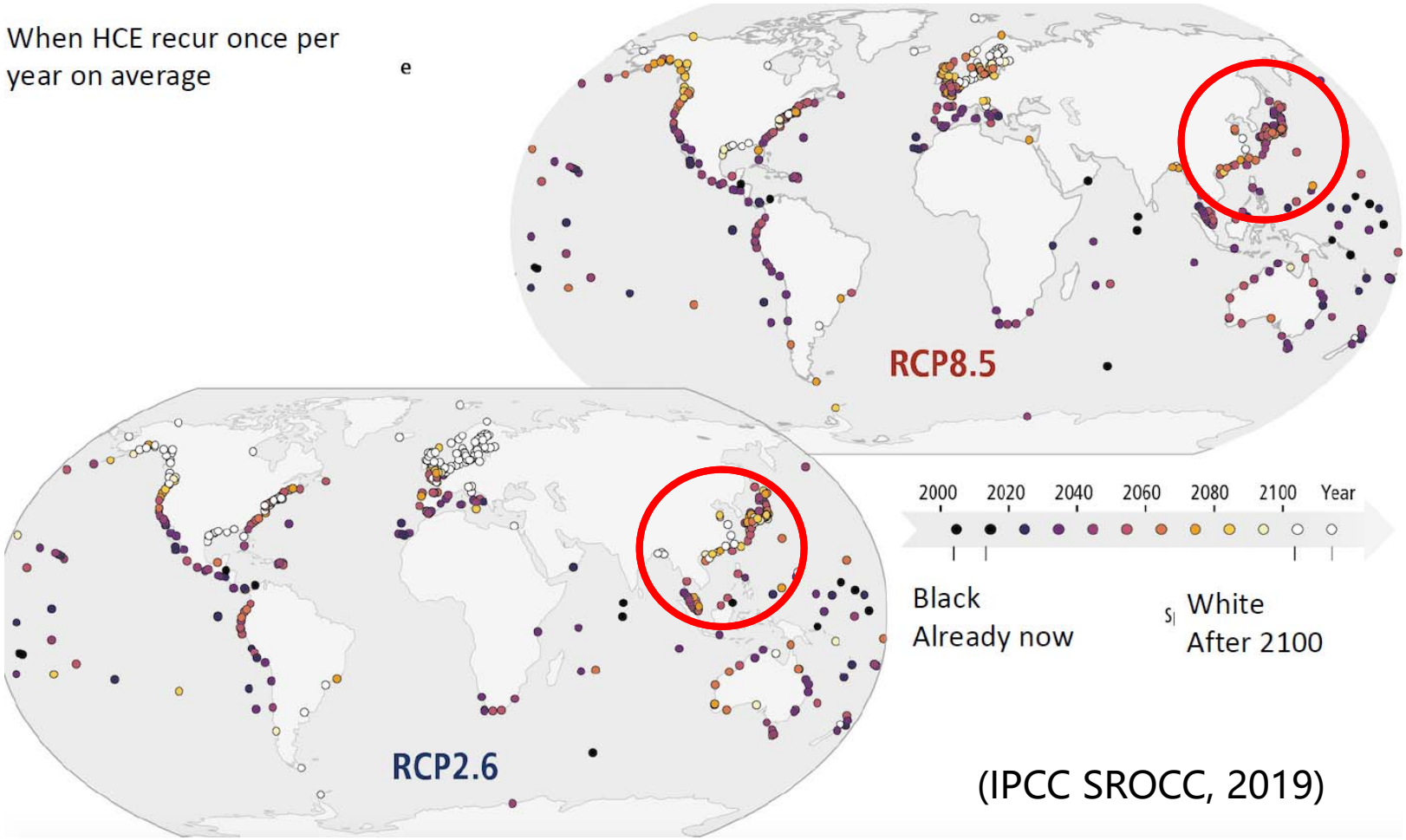
1. Sea level changes —Extreme sea level



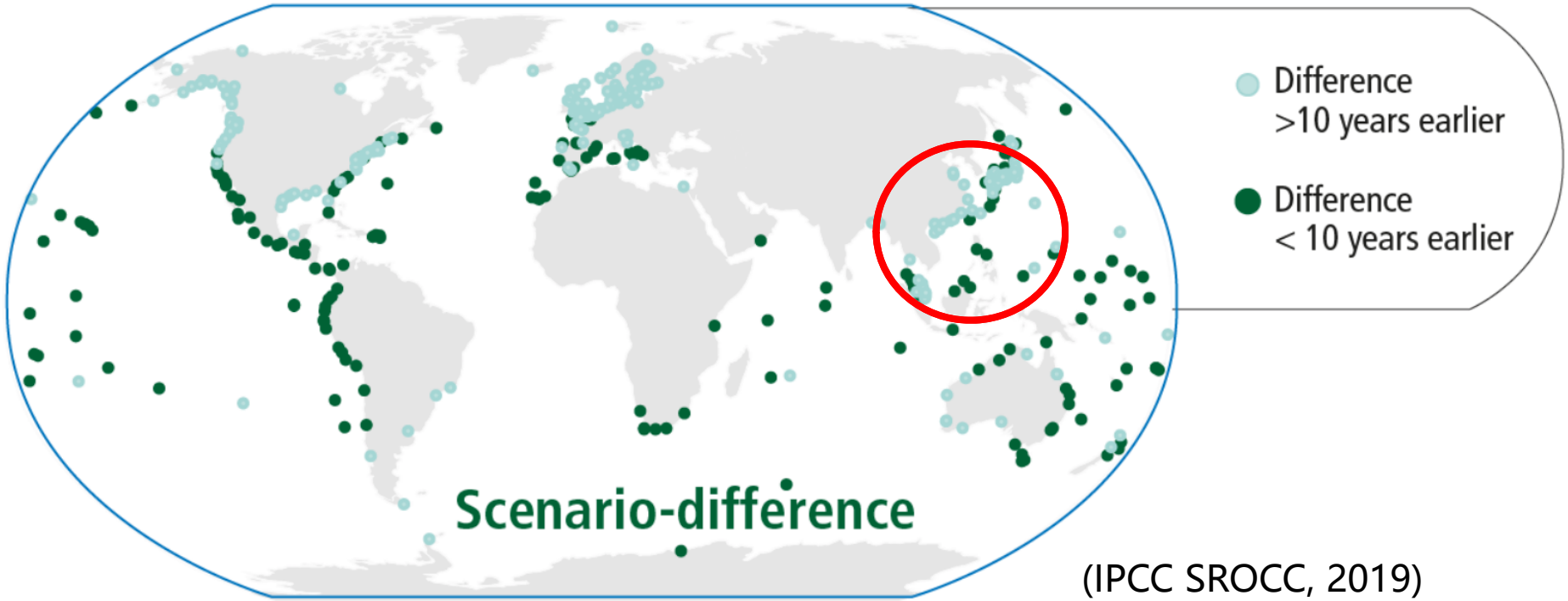
(IPCC SROCC, 2019)

Due to projected GMSL rise, local sea levels that historical rarely occurred once per century are expected to become annually at many locations during 21st century.

1. Sea level changes —Extreme sea level

c) Scenario-difference

The difference map shows locations where the HCE becomes annual at least 10 years earlier under RCP8.5 than under RCP2.6.

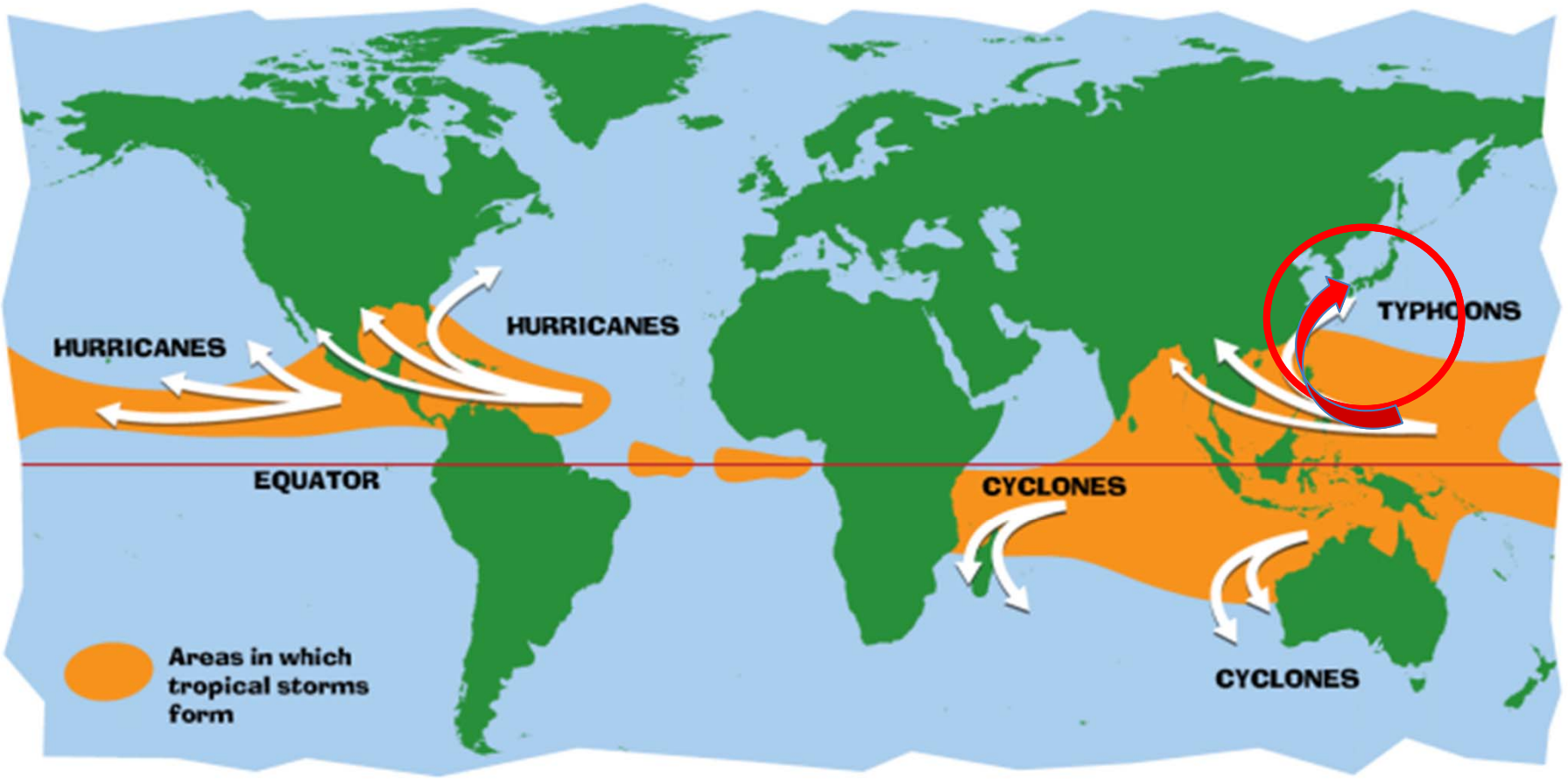


(IPCC SROCC, 2019)

Under RCP8.5, the HCE becomes annual at least 10 years earlier than that under RCP2.6.

Why will the coastal areas of East Asia suffer much more ESL events in the future?

1. Sea level changes —Extreme sea level

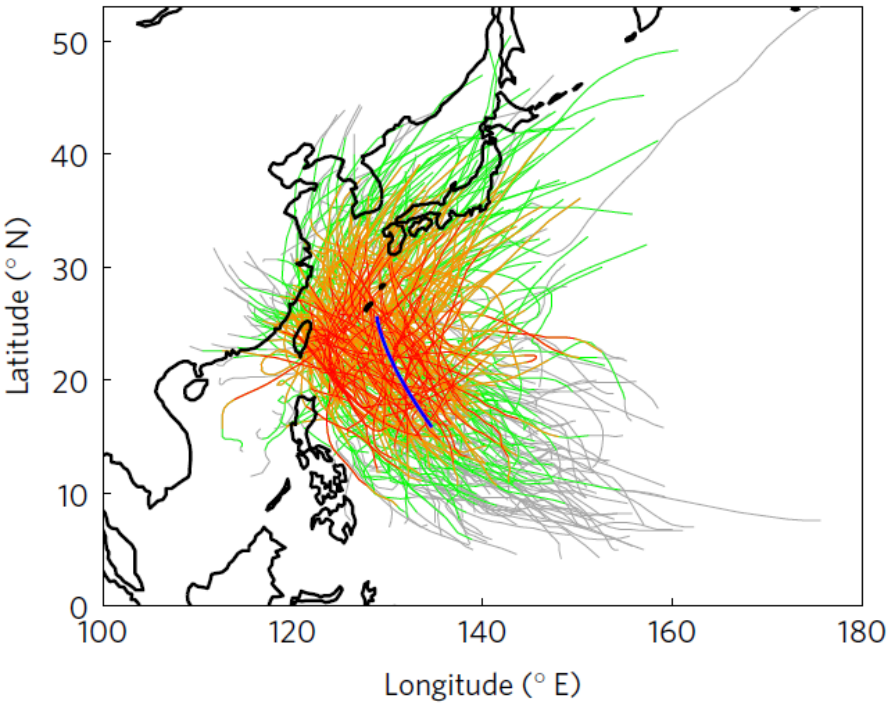


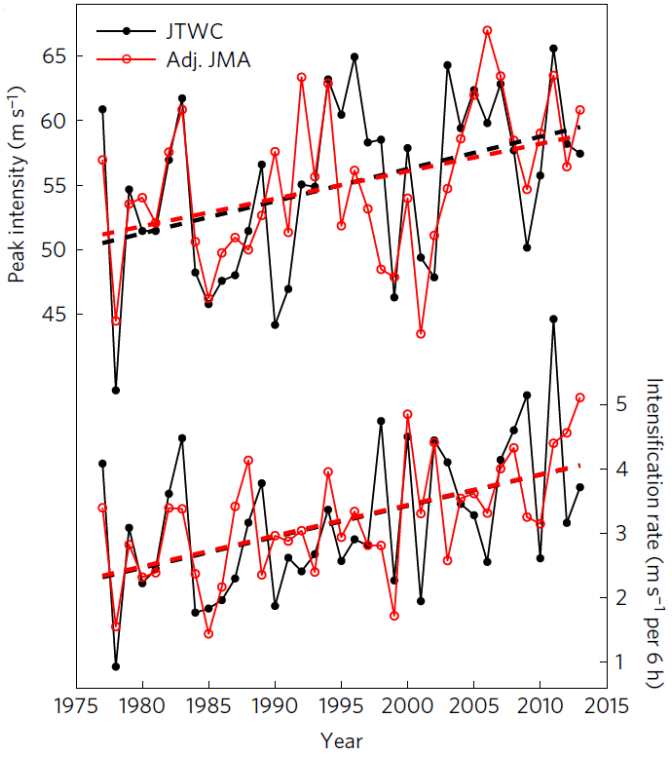
(Wang, 2019)

Some studies indicate that the effect of ocean warming is to weaken the subtropical high, which is favorable for typhoon to move towards the north or towards the northeast.

2. Impacts and risks —Intensified cyclones

Tropical cyclones tend to determine ESL events, such as coastal storm surges, high water events, coastal floods, and their associated impacts on coastal communities around the world.



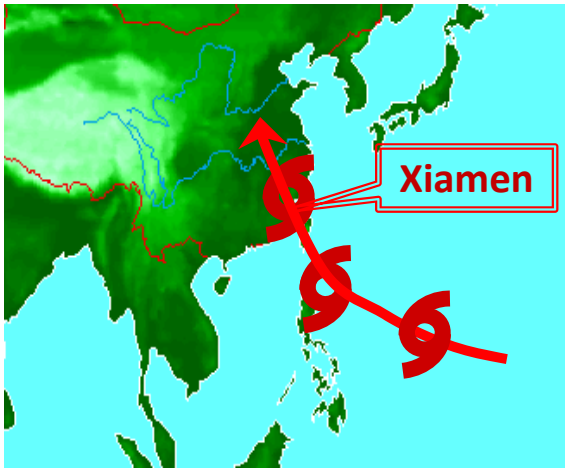


(Mei and Xie, 2016)

The intensification of landfalling typhoons over the northwest Pacific since the late 1970s due to the enhanced ocean surface warming.

2. Impacts and risks— Coastal flooding

The disasters caused by the combined effects of SLR & climate extremes on coastal cities and low-lying areas became very severe.



Flooding in Xiamen University

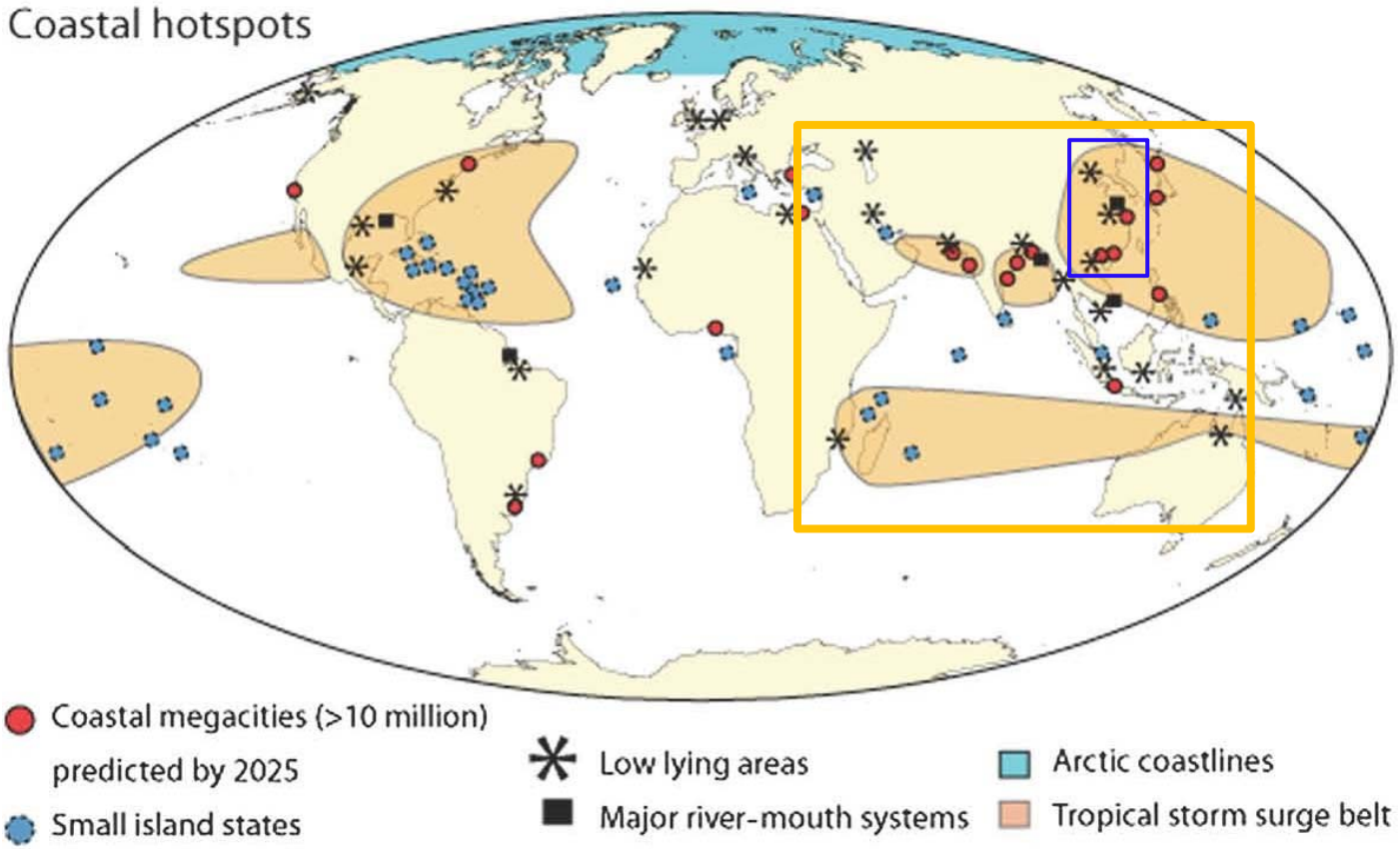
Sea level rise and climate extremes pose major threats to coastal low-lying area and communities.

Typhoon Saomai in 2006, Fishing port in Fujian

Typhoon Meranti in 2016, Xiamen

2. Impacts and risks— Coastal erosion

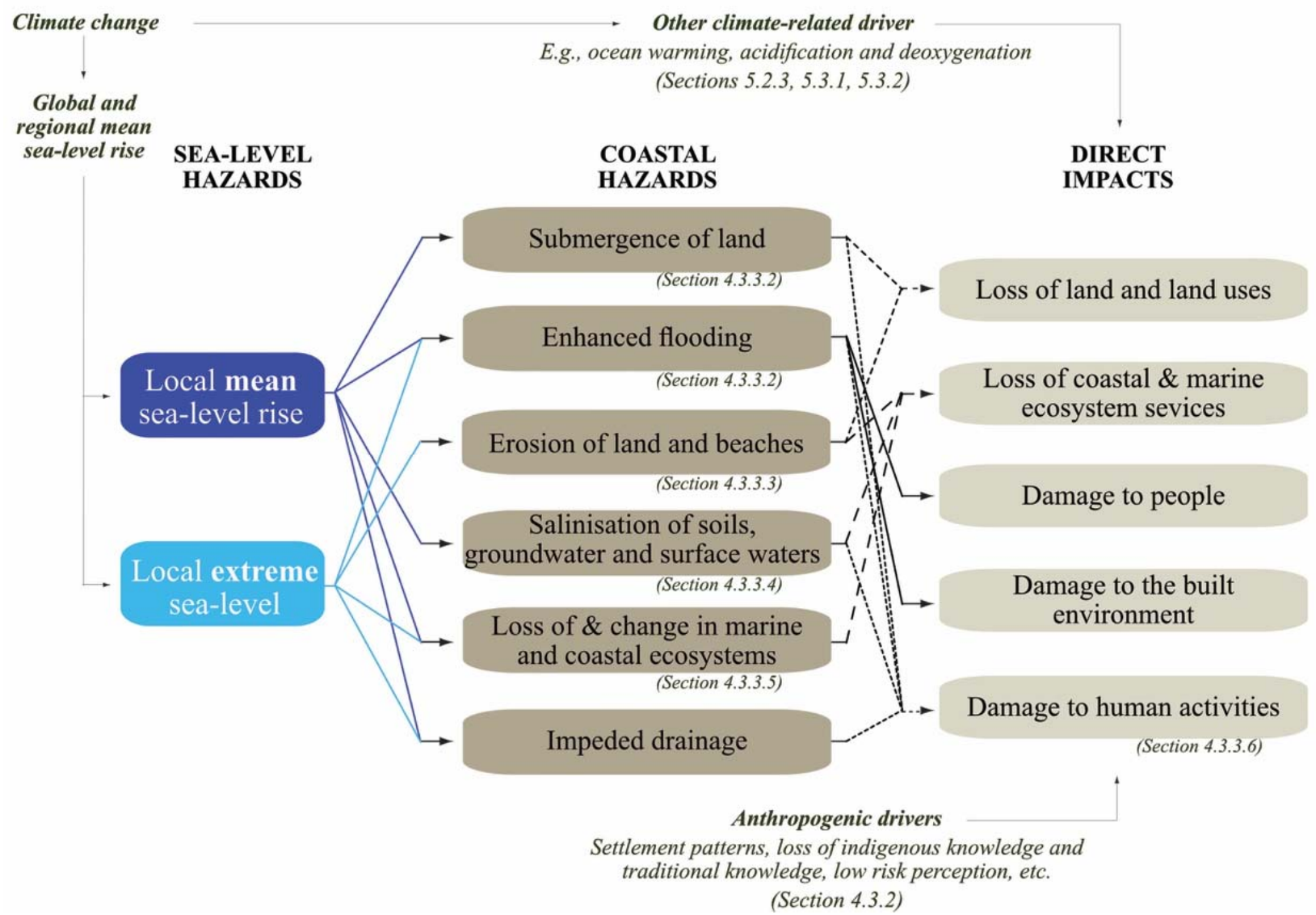
- Under the background of sea level rise, coastal systems & low-lying areas will be increasingly subject to submergence, coastal flooding & erosion.



(Newton et al 2011)

SLR & Climate extremes pose major threats to the Indian-Asian coasts, e.g., severe erosion prevails on 1/4 to 1/3 of coastlines in the southeast Asia.

2. Impacts and risks— Hazard & impacts

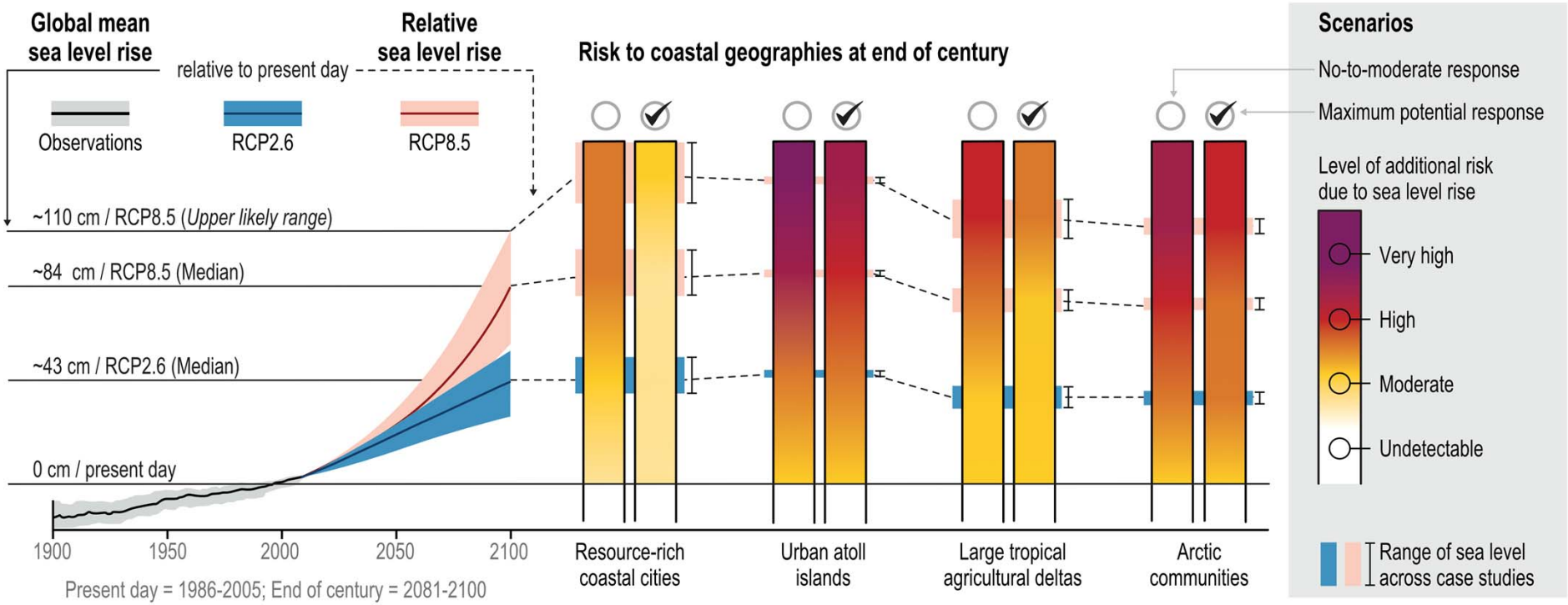


(IPCC SROCC, 2019)

Overview of the main cascading effects of sea-level rise.

2. Impacts and risks — Risks

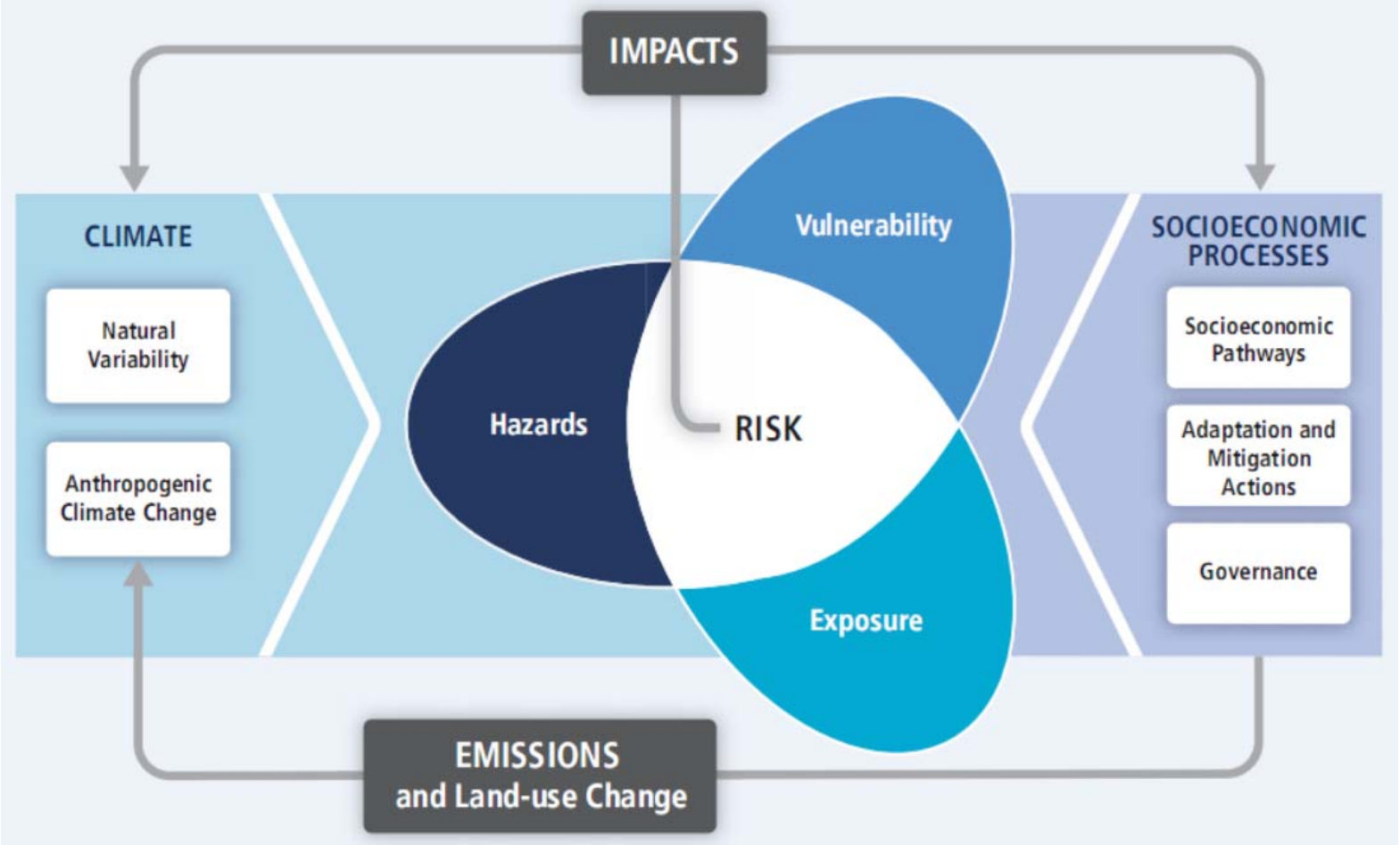
Rising mean and extreme sea level threaten coastal zones through a range of coastal hazards, e.g., submergence, flooding, erosion etc.



(IPCC SROCC, 2019)

Without strong adaptation, the vast majority of low-lying islands, coasts and communities such as coastal megacities, urban atoll islands, densely populated deltas, and Arctic communities face substantial risk from the coastal hazards, and high to very high risks are expected at the upper end of the RCP8.5 likely range.

3. Adaptation — Risks



(IPCC AR5, 2014)

The risk framework of IPCC WGII AR5:

Risks of SLR-related impacts result from the interaction of SLR-related hazards with the vulnerability and exposure of coastal social-ecological systems.

3. Adaptation — How to effectively manage risks?

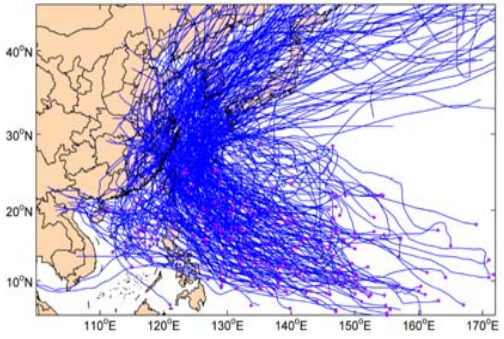
How to adapt to and effectively manage the SLR-related impacts and compound risks?

—How to reduce the exposure & vulnerability of coastal social-ecological systems?

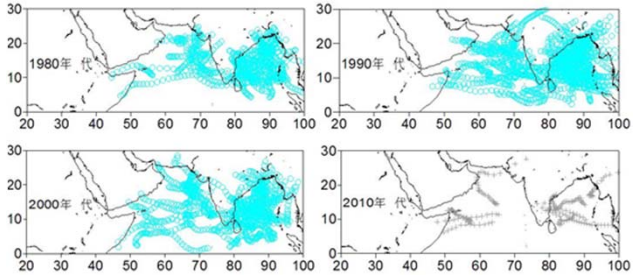
—How to enhance the resilience of coastal social-ecological systems?

—How to effectively manage the climate-related impacts and compound risks?

Challenges: deep uncertainties in the cascading effects of SLR and climate extremes, dynamic exposure and vulnerability in a changing climate.



Typhoon pathway in the northwest Pacific Ocean



Tropical storm pathway (1980-2010) in the Indian Ocean (Qi and Cai, 2017)

3. Adaptation — How to effectively manage risks?

Despite the large challenges, adaptation over decades to a century still can be made now.

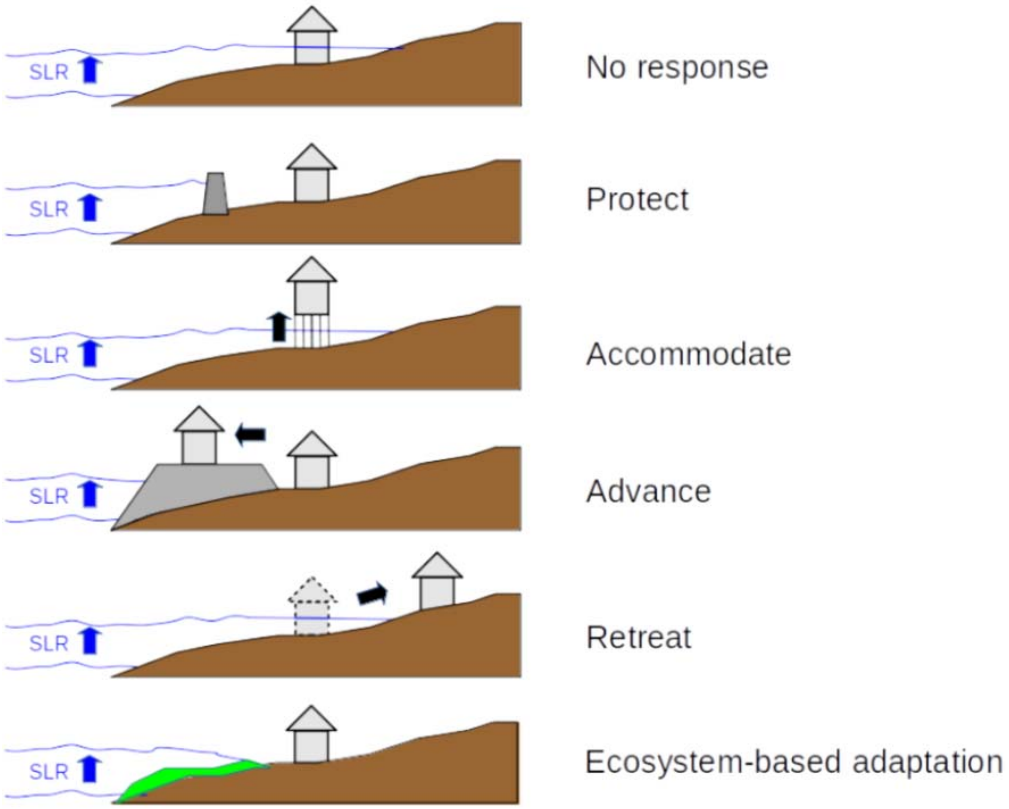
Hard protection and advance (building into the sea) is economically efficient in most urban contexts facing land scarcity

Accommodation measures such as early warning systems and flood-proofing of buildings, are often both low cost and highly cost-efficient in all context.

"hard" protection
(Photo from Hay, 2018)

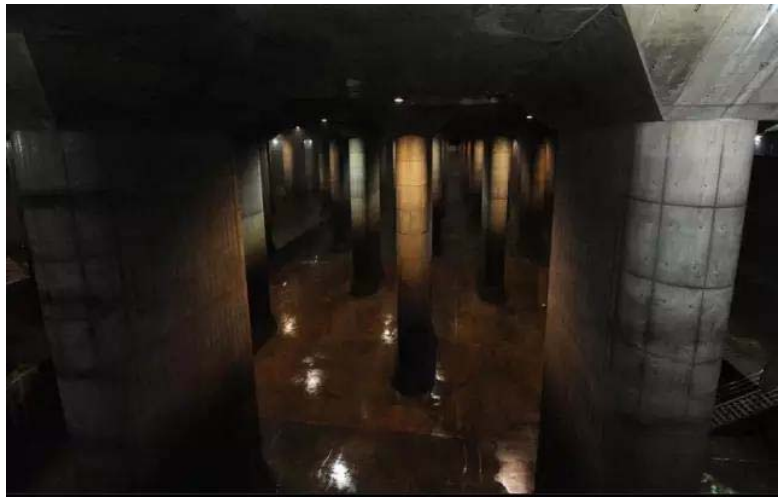
(Pictures from Internet, 2019)

3. Adaptation — how to effectively manage risks?



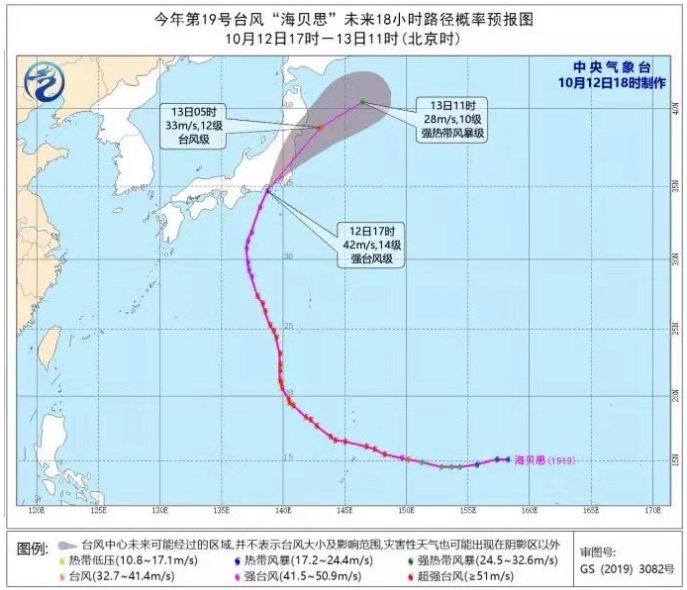
Different types of responses to coastal risk and SLR

(IPCC SROCC, 2019)



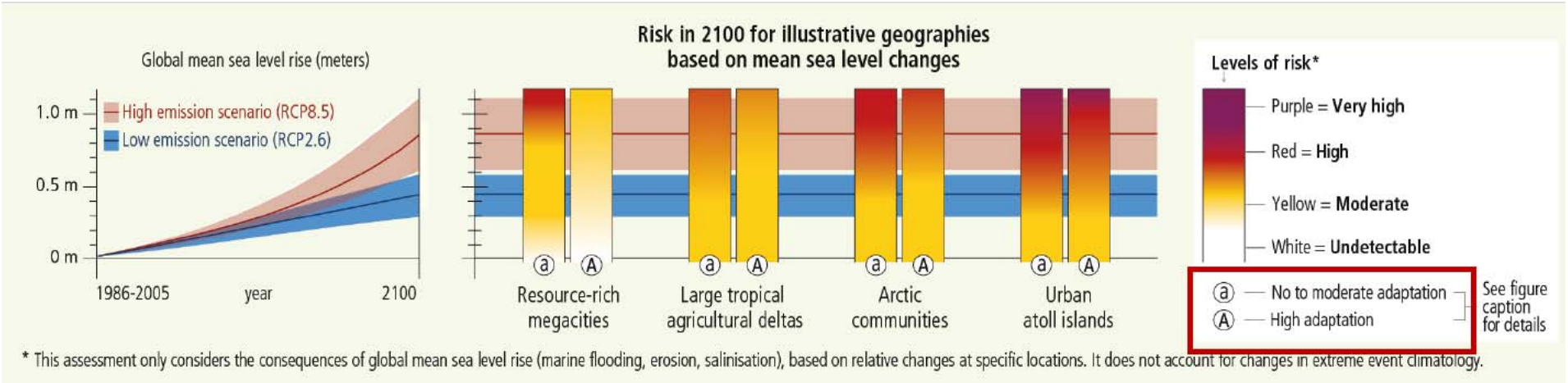
Excellent drainage system in Jasper county, Japan (日本琦玉县)
(Photos from Internet, 2019)

3. Adaptation — How to effectively manage risks?



(Pictures from Internet, 2019)

Super typhoon Hagibis landed in Japan on Oct. 12



(IPCC SROCC, 2019)

4. Concluding remarks

*In a warmer world, increased mean and extreme sea level are expected to exacerbate risks for human communities in low-lying small islands and coasts.

*Strong adaptation is expected to reduce risk, but with context-specific benefits.

*The more decisively and earlier we act, the more able we will be to address unavoidable changes, manage risks, improve our lives and achieve sustainability.

Thanks for your attention !

Acknowledgements: I deeply thank the Ocean Policy Research Institute of the Sasakawa Peace Foundation for offering this IPCC SROCC outreach opportunity.