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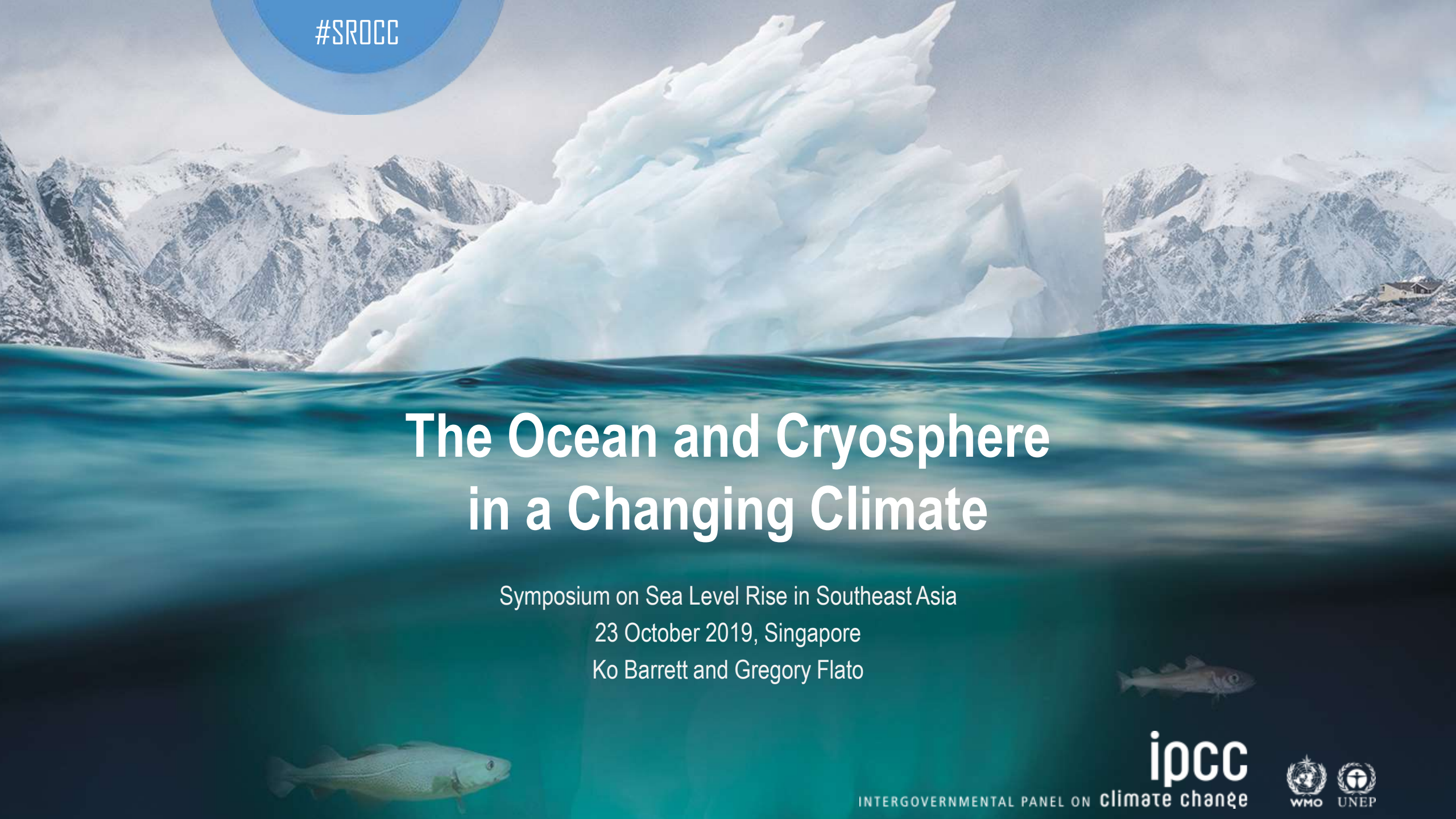

The Ocean and Cryosphere in a Changing Climate

Symposium on Sea Level Rise in Southeast Asia

23 October 2019, Singapore

Ko Barrett and Gregory Flato

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The world's ocean and cryosphere have been 'taking the heat' from climate change for decades.

Consequences for nature and humanity are sweeping and severe.

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High
Mountains


Polar
Regions


Ocean &
Marine Life
Photo: Mr. JK


Sea
Level Rise

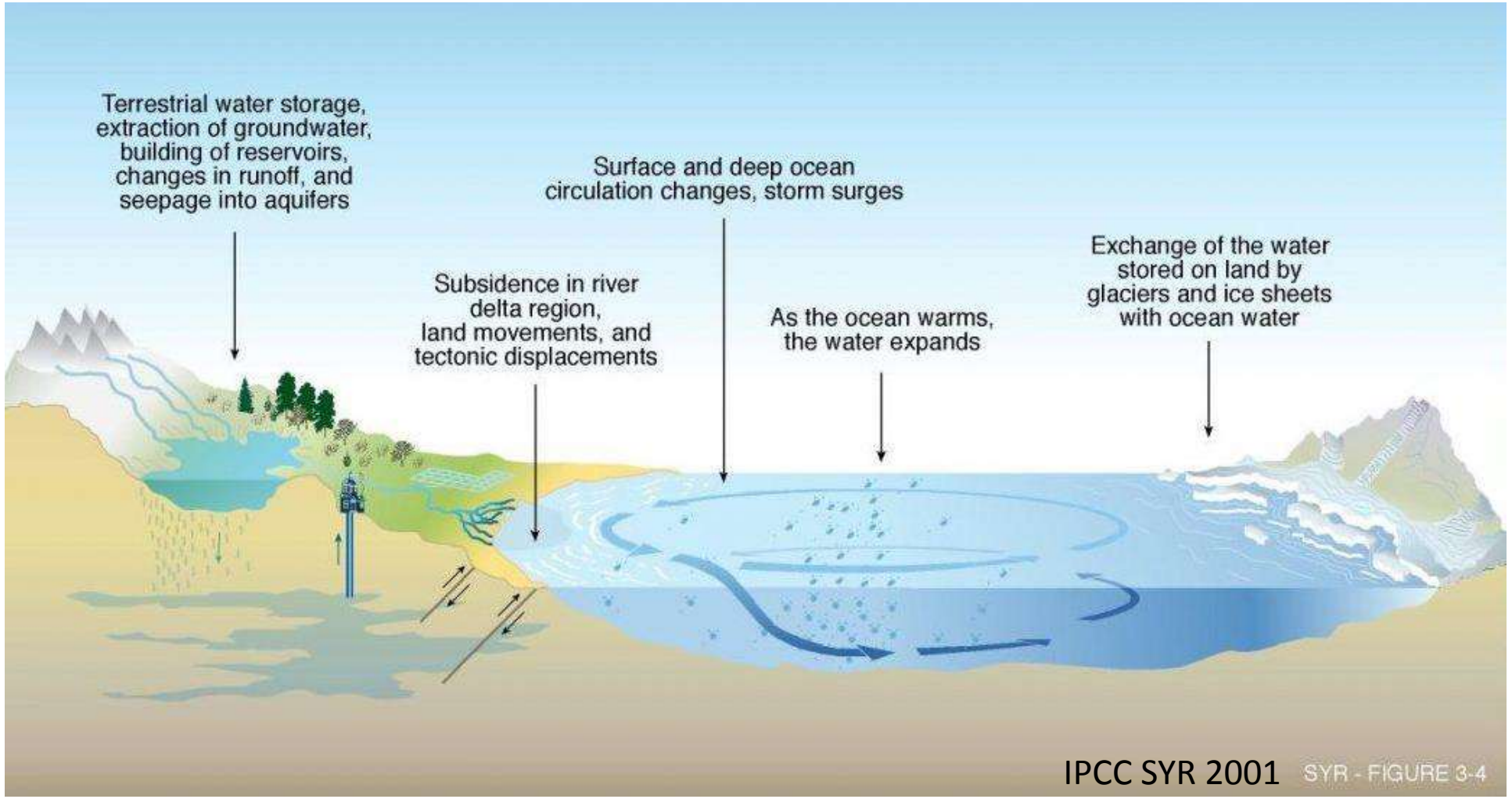
Sea Level Rise

Photo: Glenn R. Specht

Key findings relevant to Sea Level Rise

- **Greenland and Antarctic ice sheets are melting**, and are now the major cause of accelerating global sea level rise, outpacing sea level rise caused by ocean thermal expansion.
- During the 20th century, the **global mean sea level** rose by about 15cm. Sea level is currently rising more than twice as fast and continuing to accelerate.
- **Marine heatwaves** have doubled in frequency since the 1980s and have become longer-lasting, more intense and more extensive, especially harming warm-water corals, kelp forests and the distribution of marine life.

Sea level changes for several reasons



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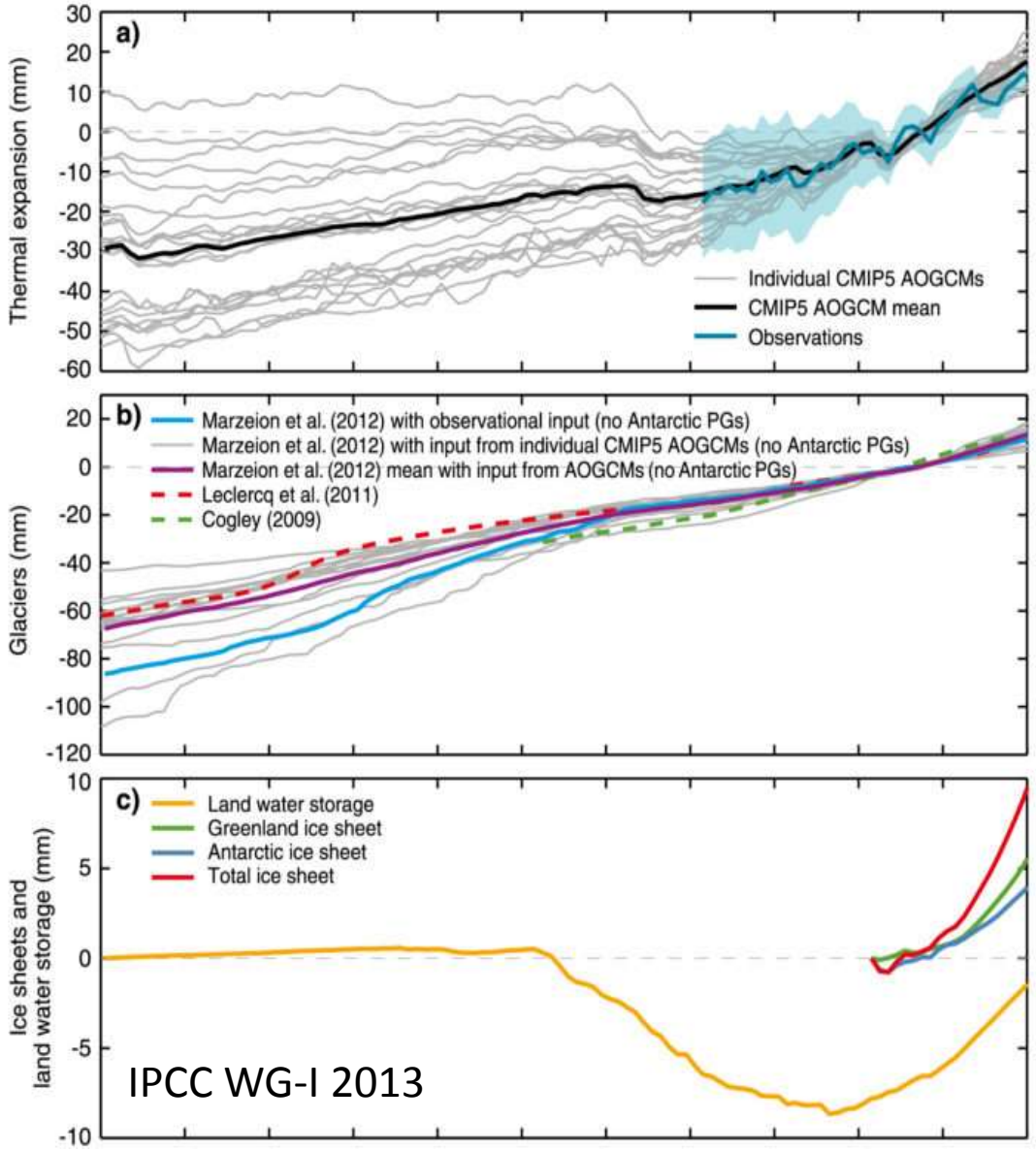
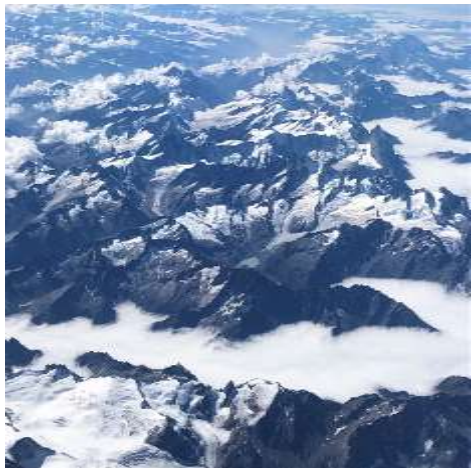
We can observe and model these changes

Ocean warming

Greenland/Antarctica ice sheet loss



Melting mountain glaciers



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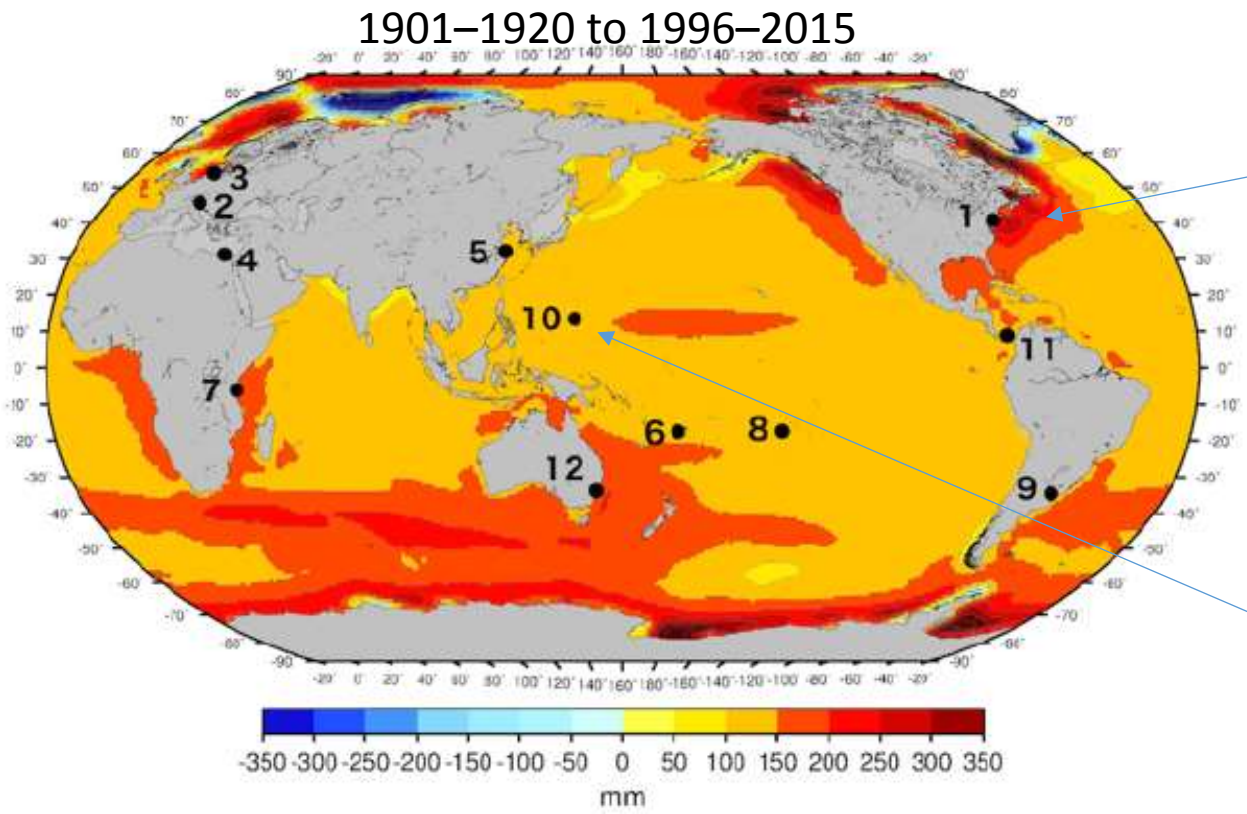
Historical values

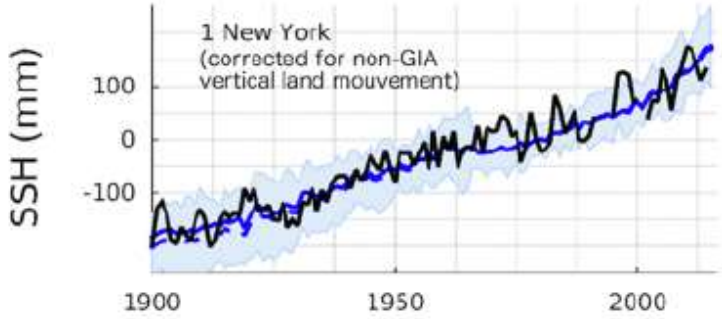
- Global mean sea-level rise, over the period 1902–2015, is 0.16 m (*likely* range 0.12–0.21 m). The rate of rise is unprecedented over the last century (*high confidence*).
- The sum of ice sheet and glacier contributions over the period 2006–2015 is the dominant source of sea-level rise, exceeding the thermal effect.
- The dominant cause of global mean sea level rise since 1970 is anthropogenic (human) forcing (*high confidence*).

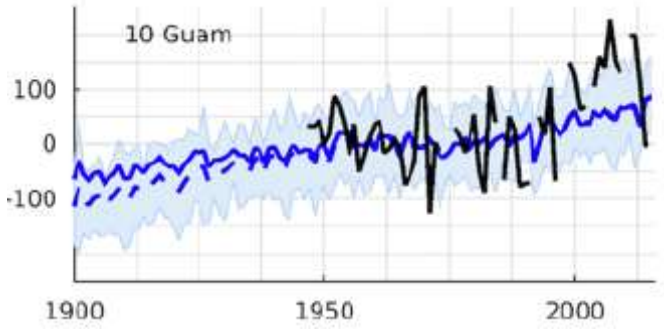
Current Status

- Sea-level rise has accelerated (*extremely likely*) due to increased ice loss from the Greenland and Antarctic ice sheets (*very high confidence*).
- Mass loss from the Antarctic ice sheet over the period 2007– 2016 tripled relative to 1997–2006. For Greenland, mass loss doubled over the same period (*likely, medium confidence*).
- Acceleration of ice flow and retreat in Antarctica, which has the potential to lead to sea-level rise of several metres within a few centuries, is observed in some locations of Antarctica (*very high confidence*).

- Sea-level rise is not globally uniform and varies regionally. Regional differences, within ±30% of the global mean sea-level rise, result from land ice loss and variations in ocean warming and circulation.

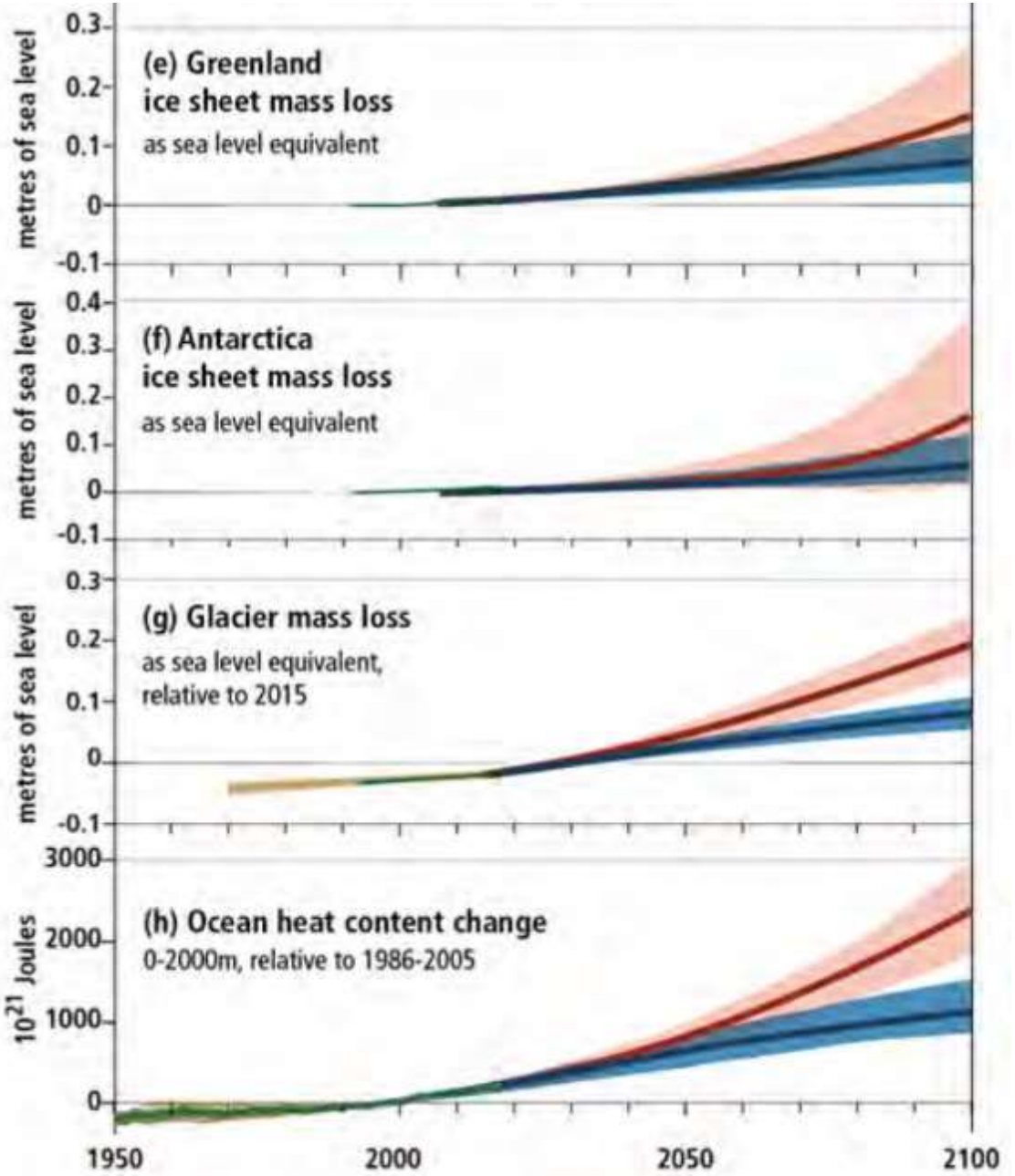


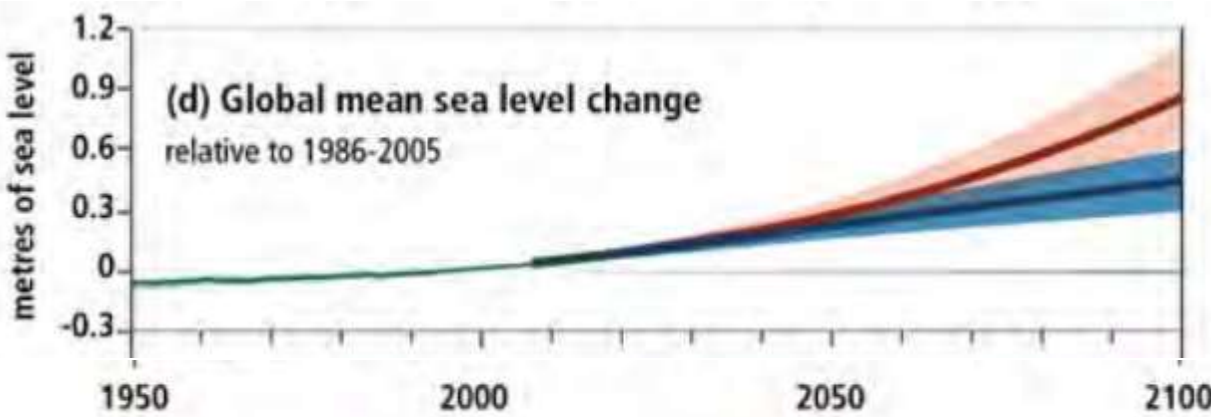




(Based on climate model simulations)

Future Projections
(based on *high* and *low* emission scenarios)





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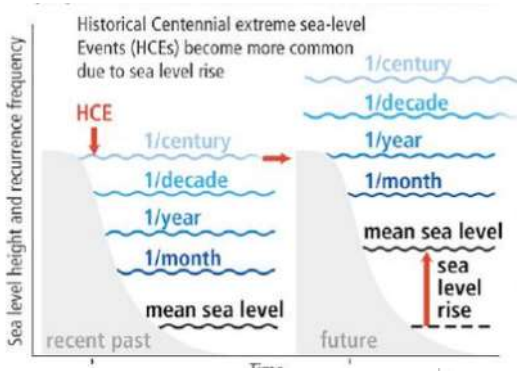
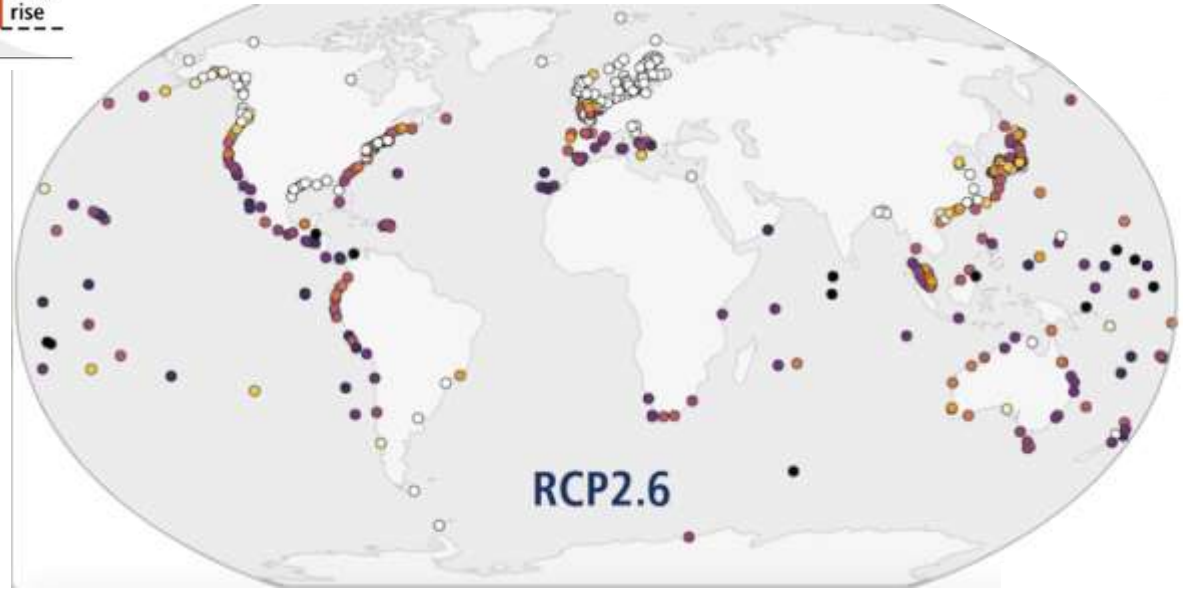
Sea level extremes

Due to projected global mean sea-level rise, local sea-levels that historically occured once per century are projected to become at least annual events at most locations during the 21st century





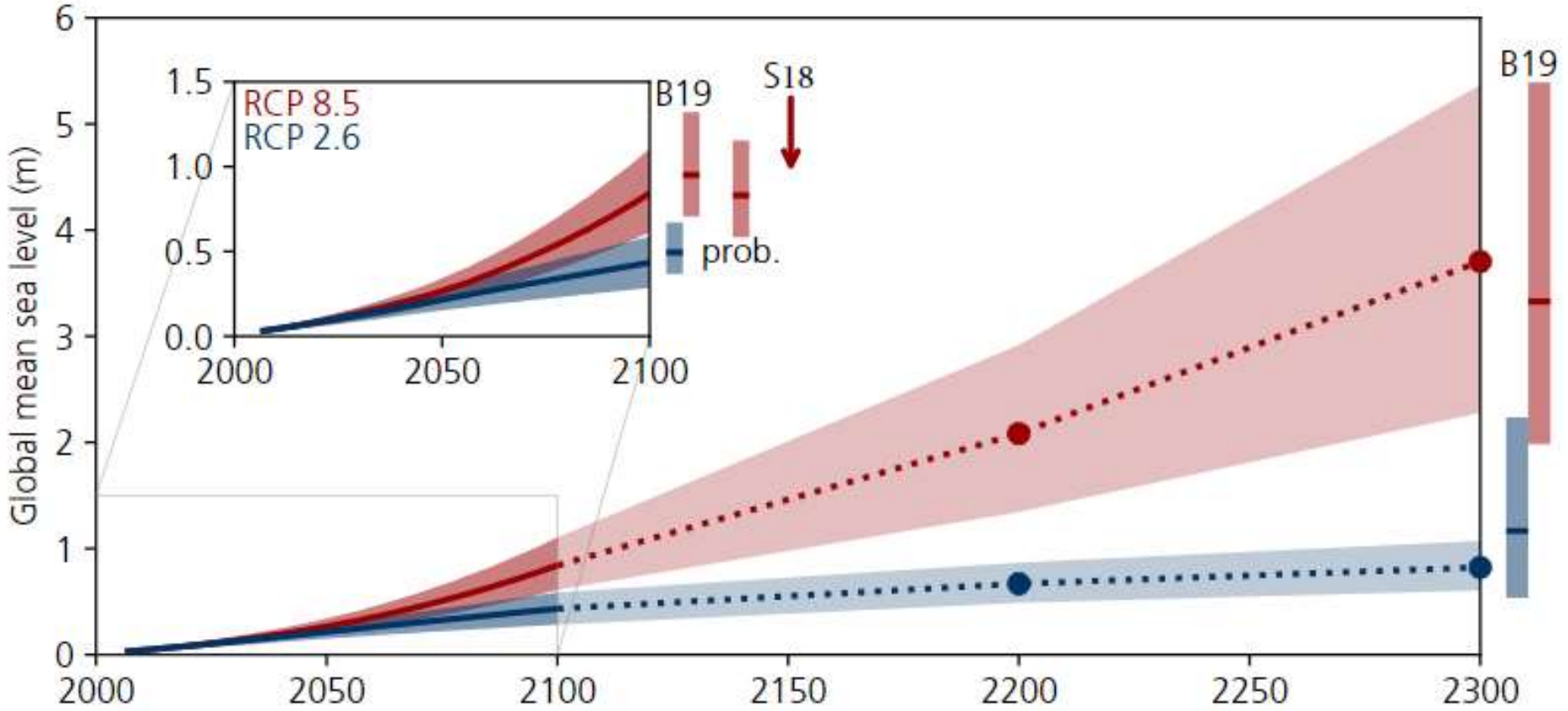
Year at which event becomes annual

Response options

- Various adaptation approaches are already being implemented, including:
  - protection
  - accommodation
  - ecosystem-based adaptation
  - coastal advance
  - managed relocation
- People with the highest exposure and vulnerability are often those with the lowest capacity to respond.

In the longer term, choices matter

Although ongoing sea-level rise is inevitable, ambitious mitigation will have a profound effect on the rate and ultimate magnitude of sea-level rise.



Knowledge for action

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

- highlights **the urgency** of prioritizing **timely, ambitious and coordinated action** to address **widespread and enduring changes** in the ocean and cryosphere;
- empowers people, communities and governments to tackle the unprecedented transitions in all aspects of society;
- provides evidence of the benefits of combining scientific with local and indigenous knowledge.

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 for ecosystems and people around the world – today and in the future.

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Our ocean and cryosphere –

They sustain us.
They are under pressure.
Their changes affect all our lives.

The time for action is now.

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