Future Sea Level Rise

Impact of Coastal Inundation and erosion

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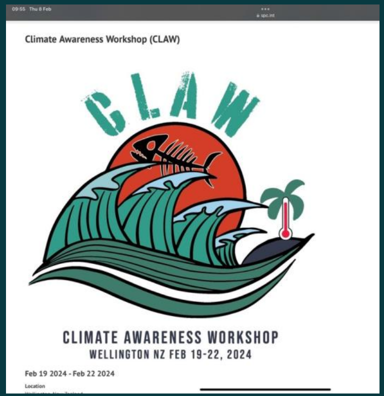

Sea Level Rise and Coastal Impacts

Outline

- Historical Sea Level Rise
- Future Projections of Sea Level Rise
- Long-term Response of Sea Level Rise
- Ice-sheets
- Extreme Water Levels - Coastal Inundation and erosion
- Dynamic Adaptation Policy Pathways

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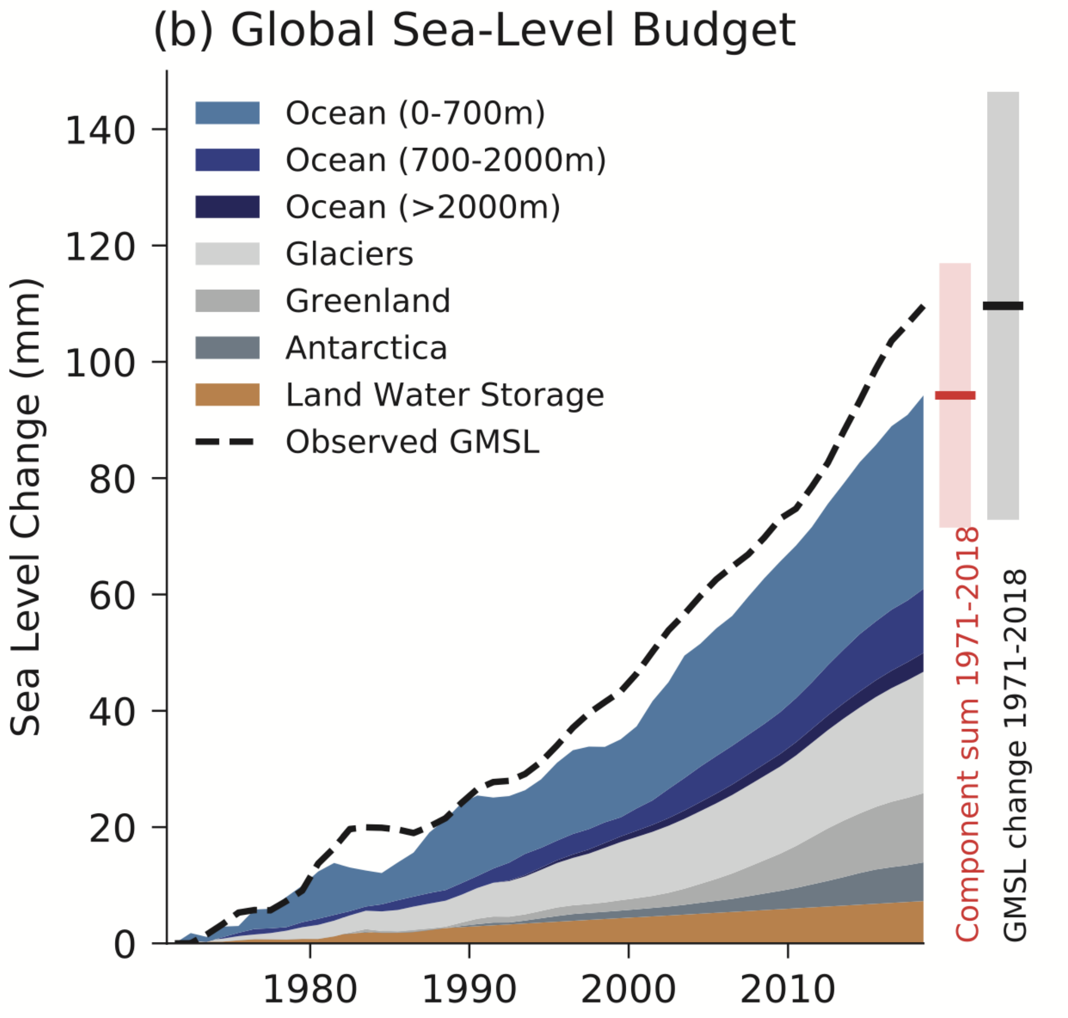
Key Messages


Figure 3.5: UAV aerial view of beach erosion at Narrabeen-Collaroy in June 2016 (Source: UNSW Water Research Laboratory, 2016).

- Global Sea Level has risen by about 12 cm since 1971
- Future Projections of Sea Level Rise is about 1m by 2100
- However, Sea Level Rise will continue beyond 2100 even if we stabilise global temperatures
- Ice-sheets response to global warming is uncertain and can dramatical alter future sea level – meters of additional sea level rise
- Coastal Inundation and erosion combines tides, waves, surge and sea level rise
- Given the long-time response of sea level rise a Dynamic Adaptation Policy is needed (e.g. short and long-term adaptation decisions)

Global Sea Level Budget: 1971-2017



Observed Sea Level Rise comes from tide gauges (1971-1993) and satellites (altimeter for 1993-2018)

Ocean warming (50%)
Glacier and Ice Sheets (42%)

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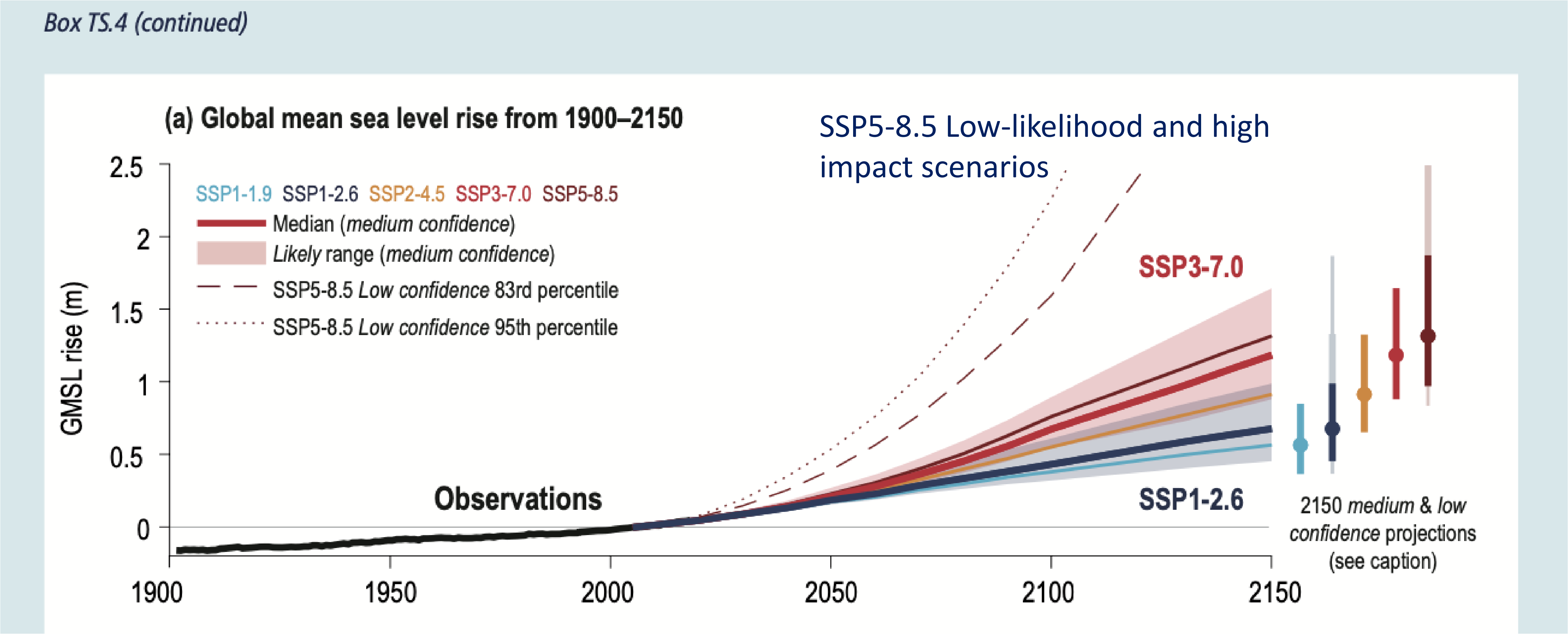
Future Global Sea Level



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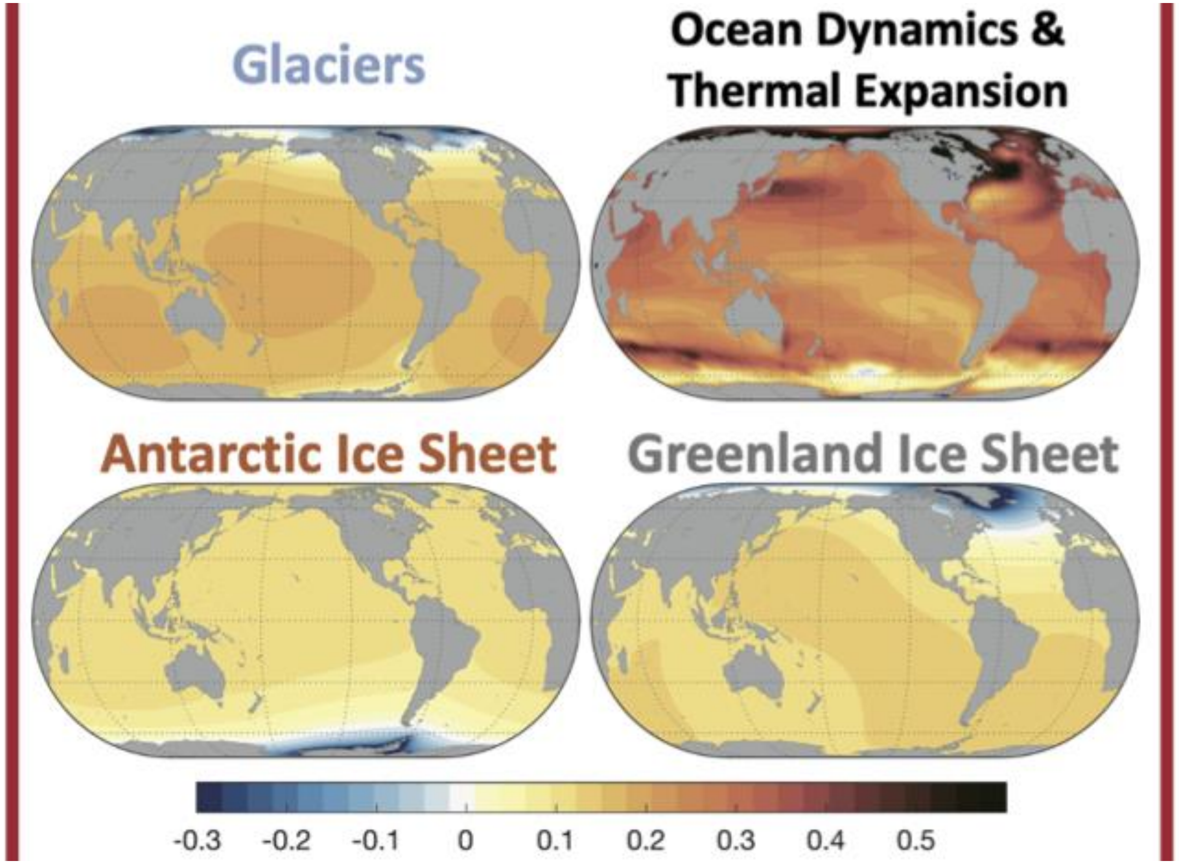
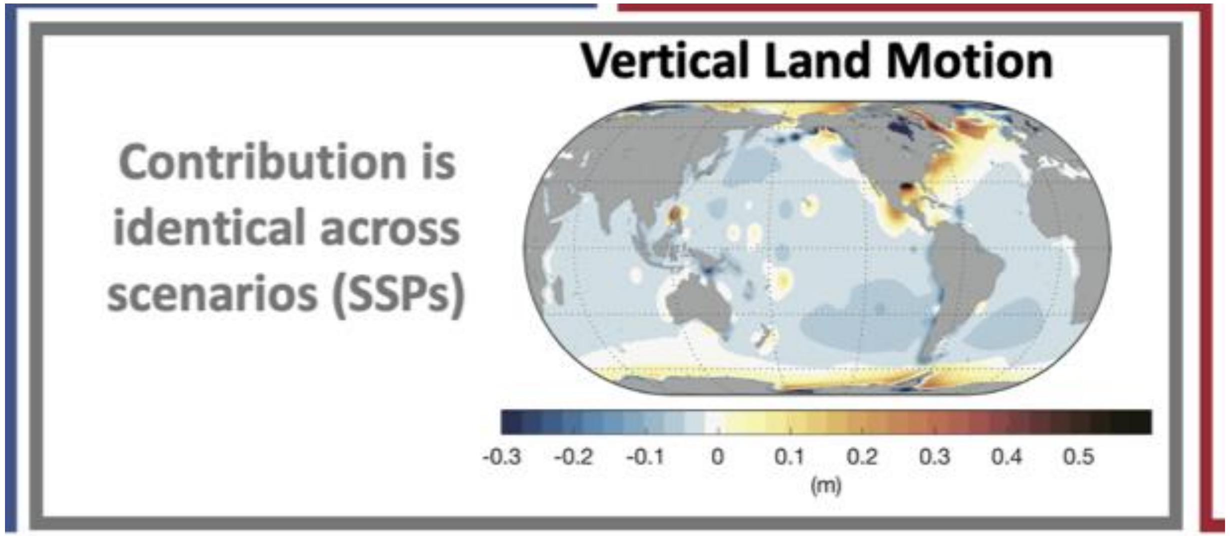
Future Regional Sea Level: SSP5-8.5



Regional expression of global sea level rise

Vertical Motion



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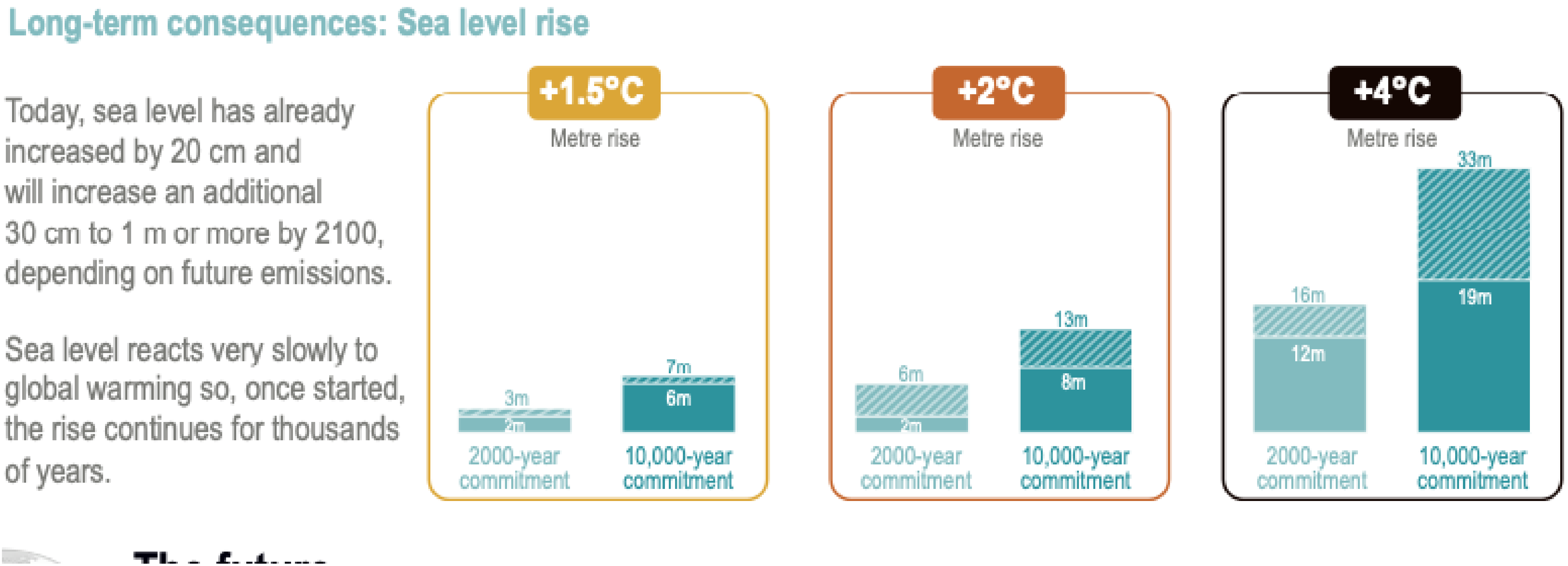
Role Ice Sheets on Global Sea Level



Long-term sea level rise due to long-term ice sheet melt

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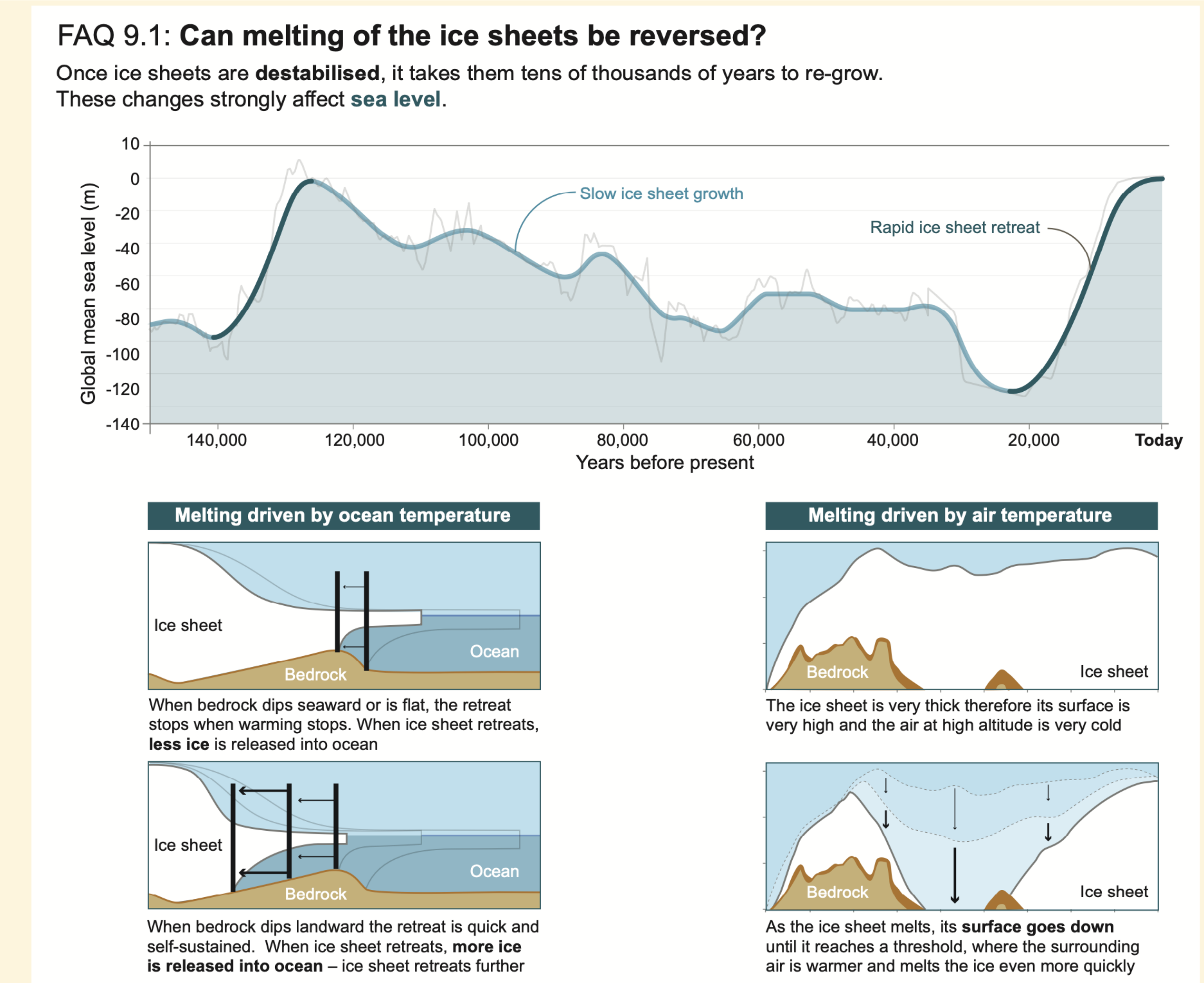
Ice Sheets

Destabilising ice sheet and Reversing their melting

Ice Sheet melt rate much greater than its growth rate



Antarctic Ice Sheets

Greenland Ice Sheet

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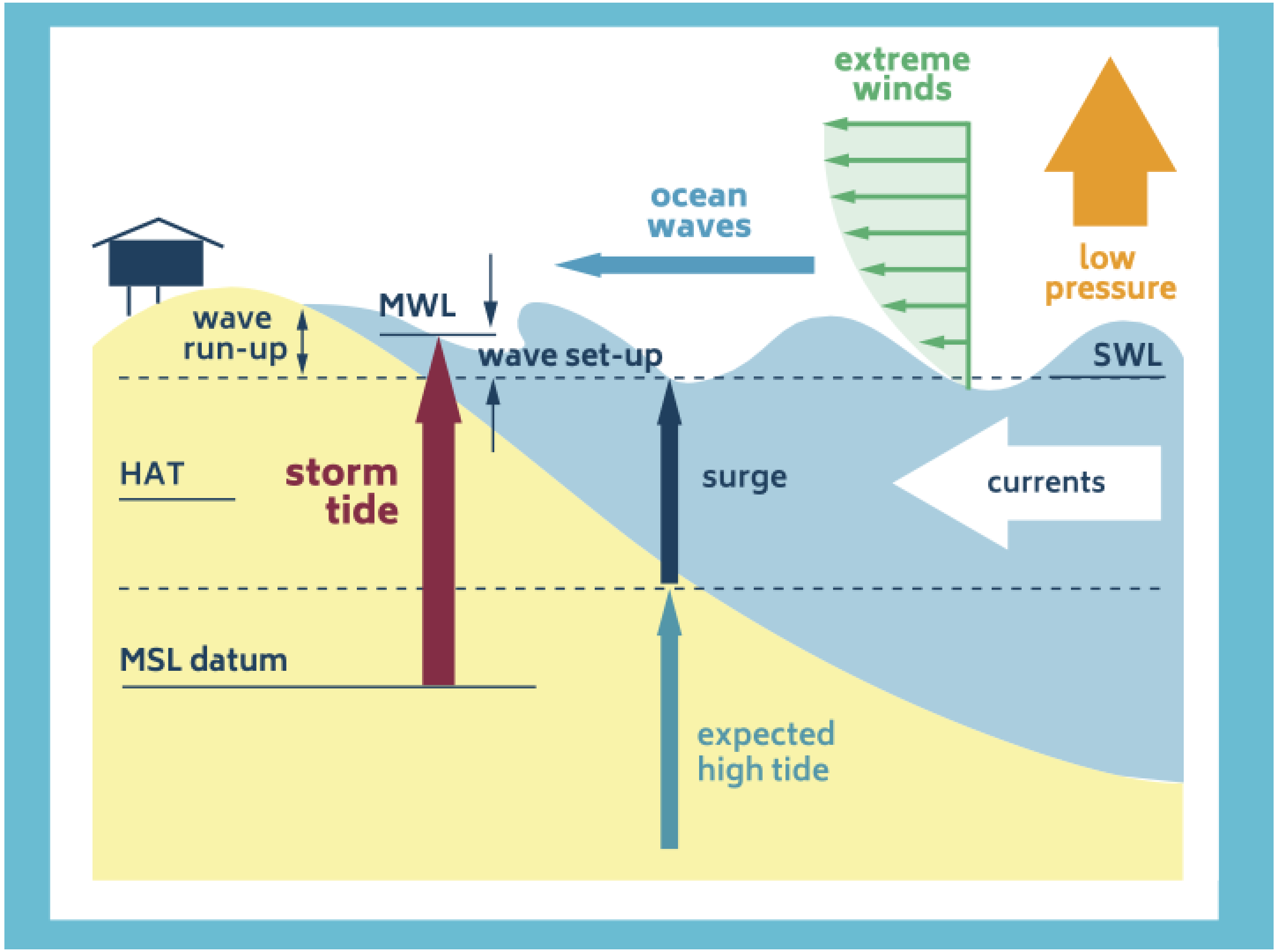
Coastal Inundation: tides, wind, waves, and Sea level rise

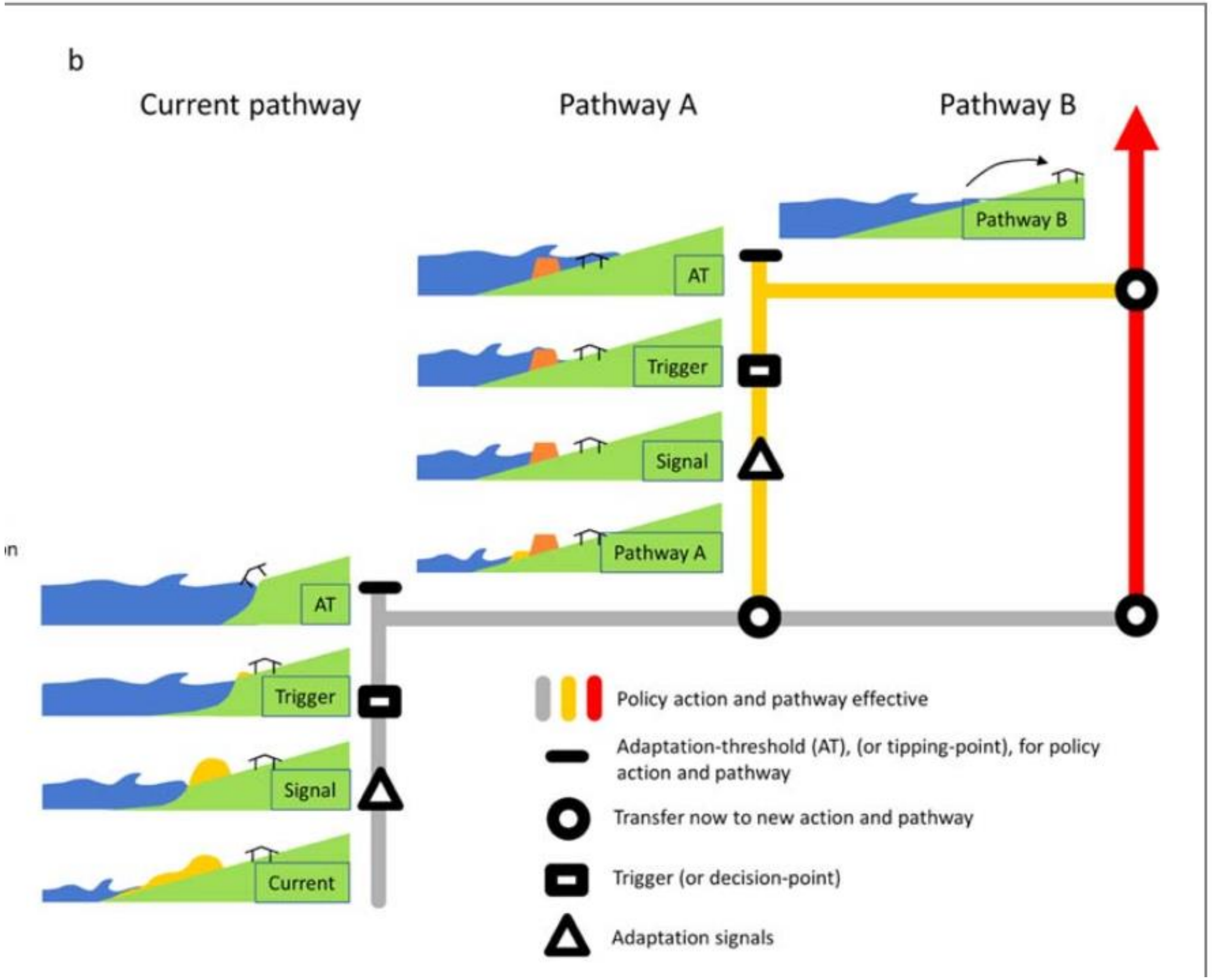


- Tides,
- wind waves and wave set-up,
- surge,
- sea level rise

- ocean currents

Harper 2001

Dynamic Adaptation Policy Pathways



Adaption Decisions

- Build Coastal structures
- Retreat

Stephens et al 2018 Environ. Res. Lett

Key Messages

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Contact us

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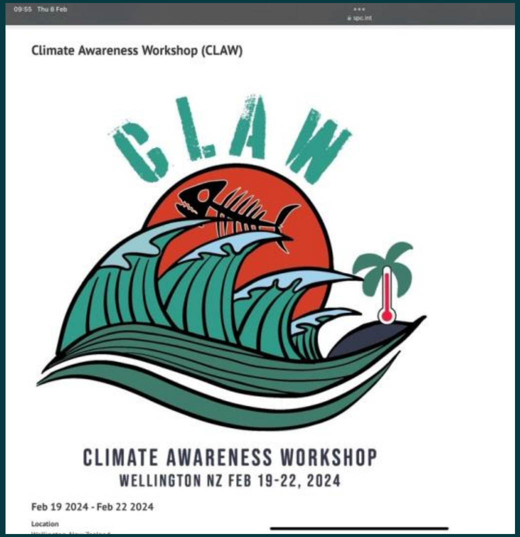
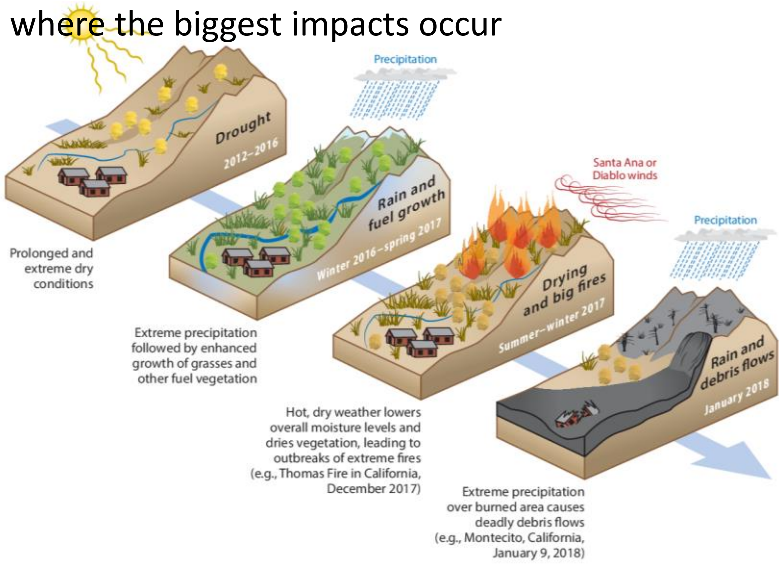
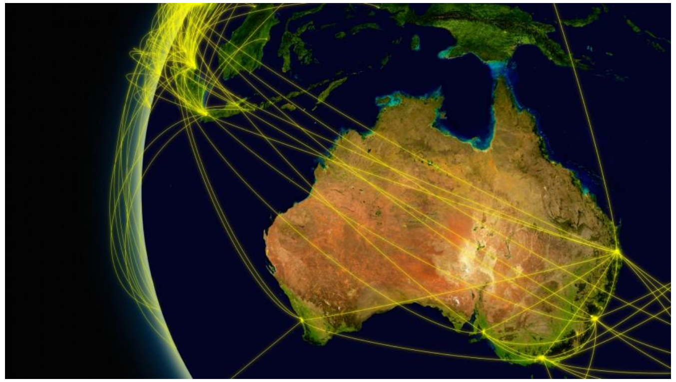


Some additional points : complex risk, global impacts and tipping points

Increased Variability: Compound and consecutive extremes, cascading impacts can be where the biggest impacts occur

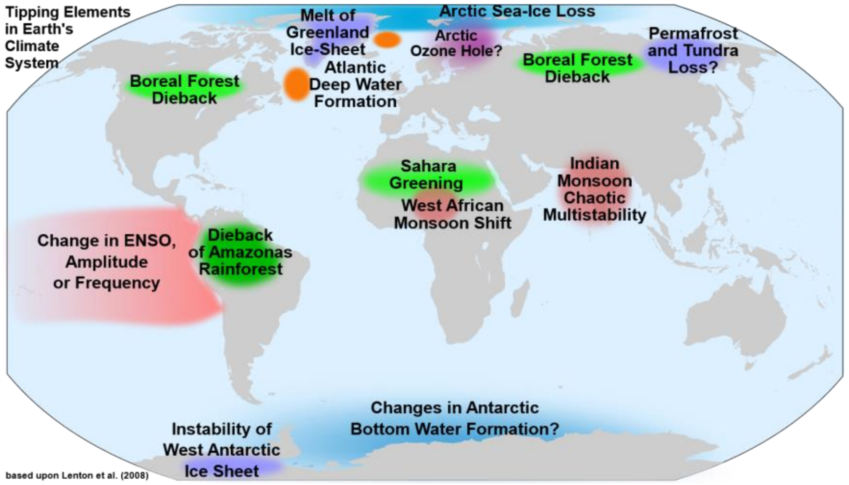


Sequence of extremes California 2018 (AghaKouchak et al. 2020 Climate Extremes and Compound Hazards in a Warming World. *Annual Review of Earth and Planetary Sciences*)



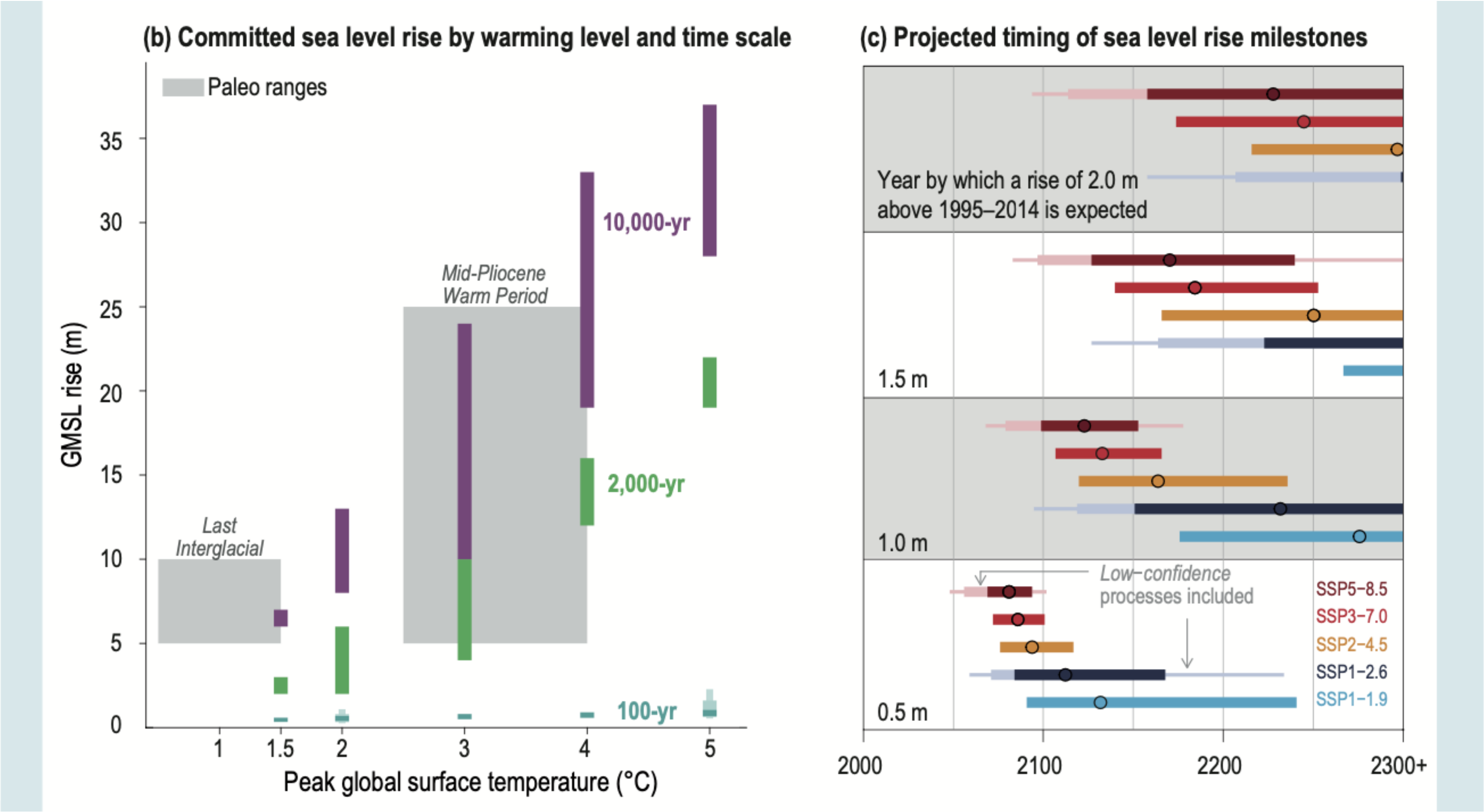
Connected: climate change cross borders and impacts Trade, Migration, Food Security, Conflict, …

Known Unknowns: Reaching global climate ‘Tipping Points’ may mean abrupt change, effects on Australia beyond projections shown here



Also consider regional ‘regime shifts’ with local abrupt change ‘tipping points’ within systems

Role Ice Sheets on Global Sea Level



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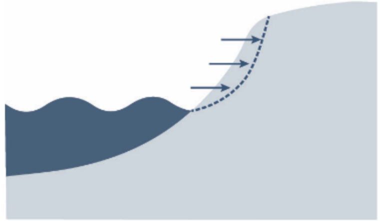
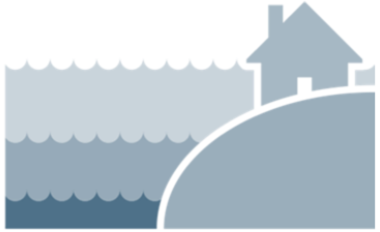
Coastal Response

The CMIP6 historical simulations still show a cold tongue bias in SST, which also causes a bias in

Table E.1: Summary of key Actions of the Sea processes.

Action of the Sea		Description of Process
Tidal Inundation		Inundation of normally dry land caused by elevated coastal water levels which are above Highest Astronomical Tide (HAT) levels due to variations in coastal water levels that occur outside a severe weather event. Tidal inundation excludes other flooding that is associated with severe weather including rainfall run-off or riverine flooding or ocean storms. Tidal inundation of land that is not currently impacted by seawater, except in severe weather events, will be an increasing risk with future sea level rise.
Coastal and Estuarine Inundation		Inundation of normally dry land caused by elevated coastal water levels which are above Highest Astronomical Tide (HAT) levels due to severe weather event processes. Inundation of this type can be a result of any single (one) or combination of the following processes: elevated coastal water levels including storm surge, wave action, rainfall run-off and/or riverine flooding.

Action of the Sea		Description of Process
Coastal Erosion		Scour of material (such as sand) primarily due to wave action resulting from a severe weather event. Erosion can cause damage to structures, including buildings, landscaping and supporting structures. Erosion during severe storms can result in movement of the beach and shoreline, landslide and subsidence.
Shoreline Recession		The erosion of shorelines from ongoing coastal processes and sea level rise. Shoreline recession can lead to damage to structures, including buildings, landscaping and supporting structures. Recession is inter-related with beach and shoreline erosion, landslide and subsidence.
Sea level rise		Sea level rise is not a distinct process causing impact on its own, but rather increases properties' exposure and impacts from other coastal processes (including tidal inundation, coastal inundation, coastal erosion and shoreline recession).
Tsunami		A tsunami event that impacts on the Australian coastline, typically from distant sub-sea earthquakes, that may cause inundation, coastal erosion or structural damage.

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