

15TH SESSION OF THE PACIFIC ISLANDS CLIMATE OUTLOOK & STAKEHOLDER FORUM

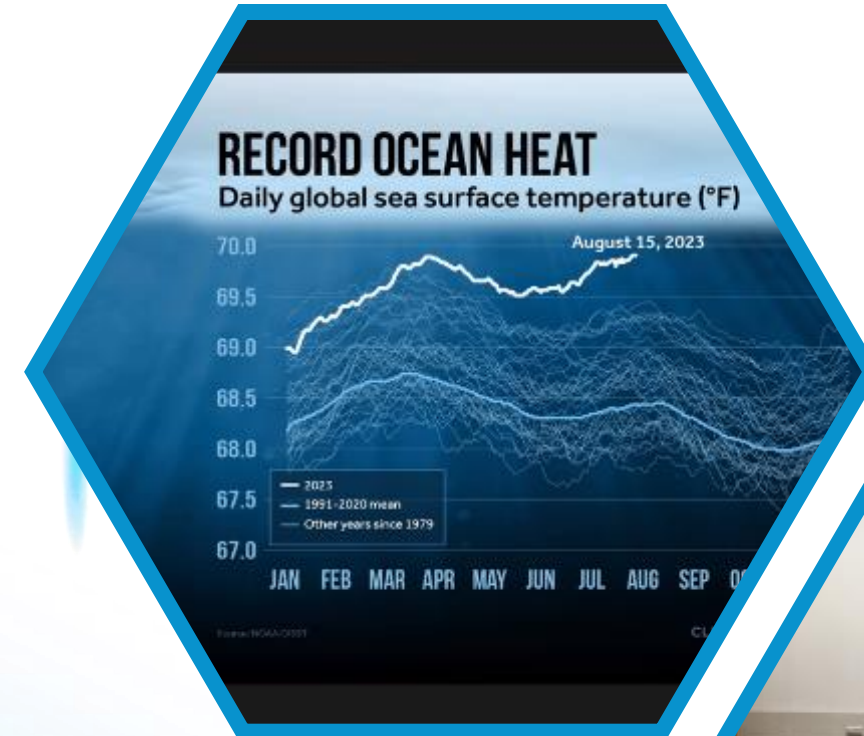
PICOF-15

14 - 15 OCTOBER, 2024

HYBRID

IN-PERSON: NUKU'ALOFA, TONGA

ONLINE: ZOOM



CLIMATE AND CLIMATE PROJECTIONS FOR THE WESTERN TROPICAL PACIFIC

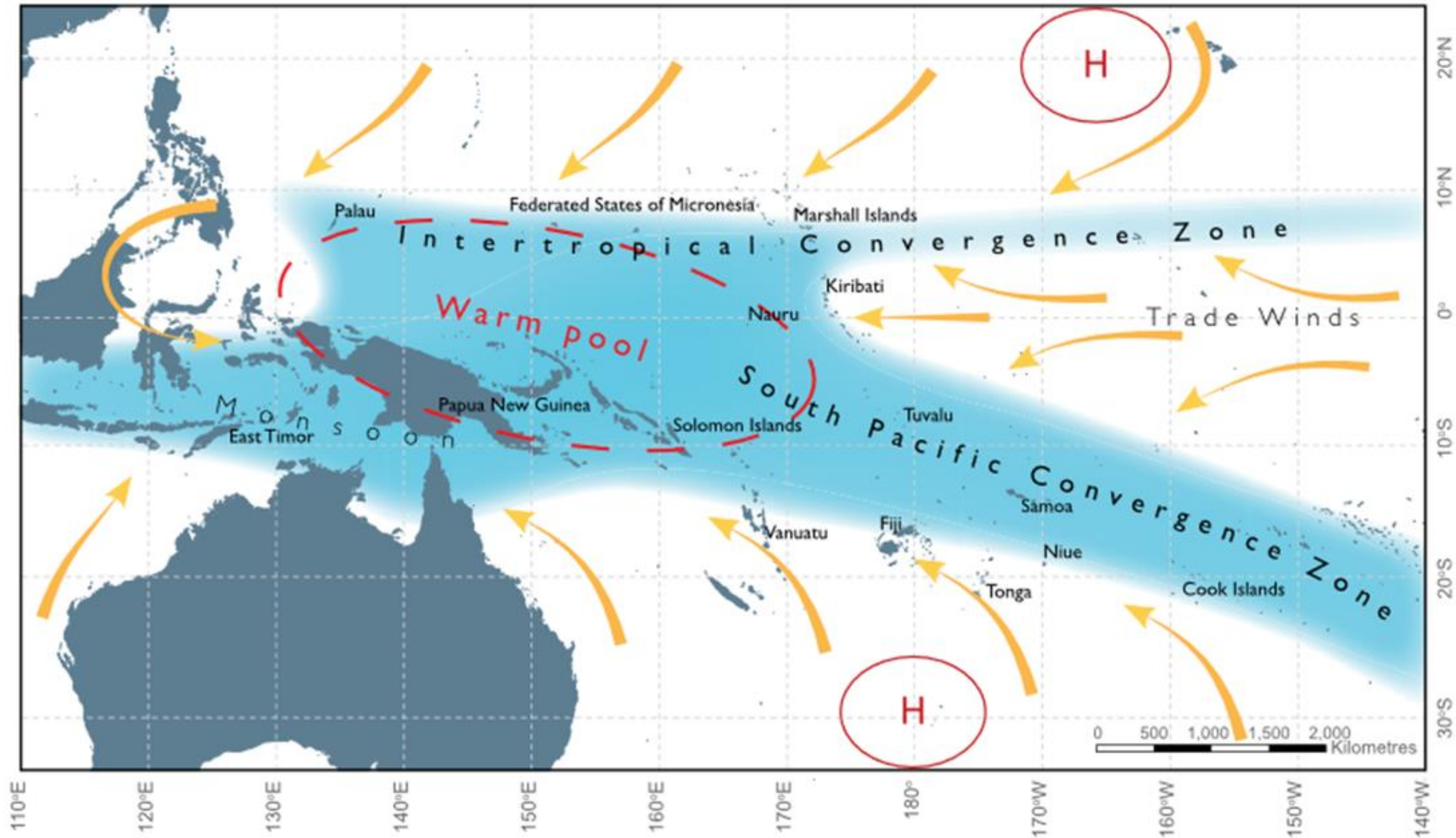
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Science Lead, Asia Pacific Climate Intelligence
CSIRO



NIWA
Taihoro Nukurangi





Major climatic features and drivers

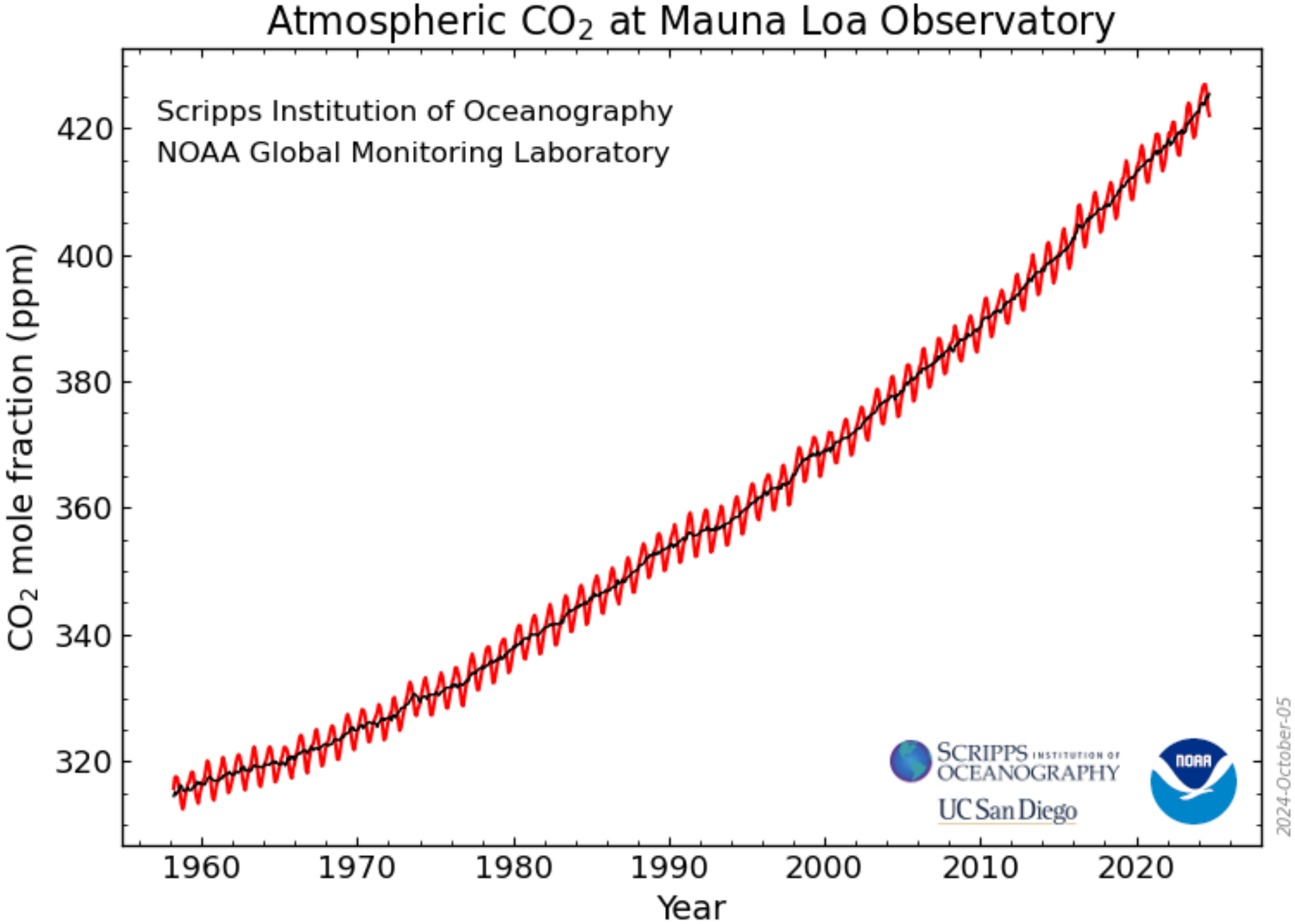
Source: Chand et al. 2023

The climate is already changing

- Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850–1900 in 2011–2020.
- Widespread and rapid changes in the atmosphere, ocean, cryosphere, and biosphere have occurred. Human-caused climate change is already affecting many weather and climate extremes in every region across the globe.
- This has led to widespread adverse impacts and related losses and damages to nature and people. Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected.

Source: IPCC 2023

The climate is already changing

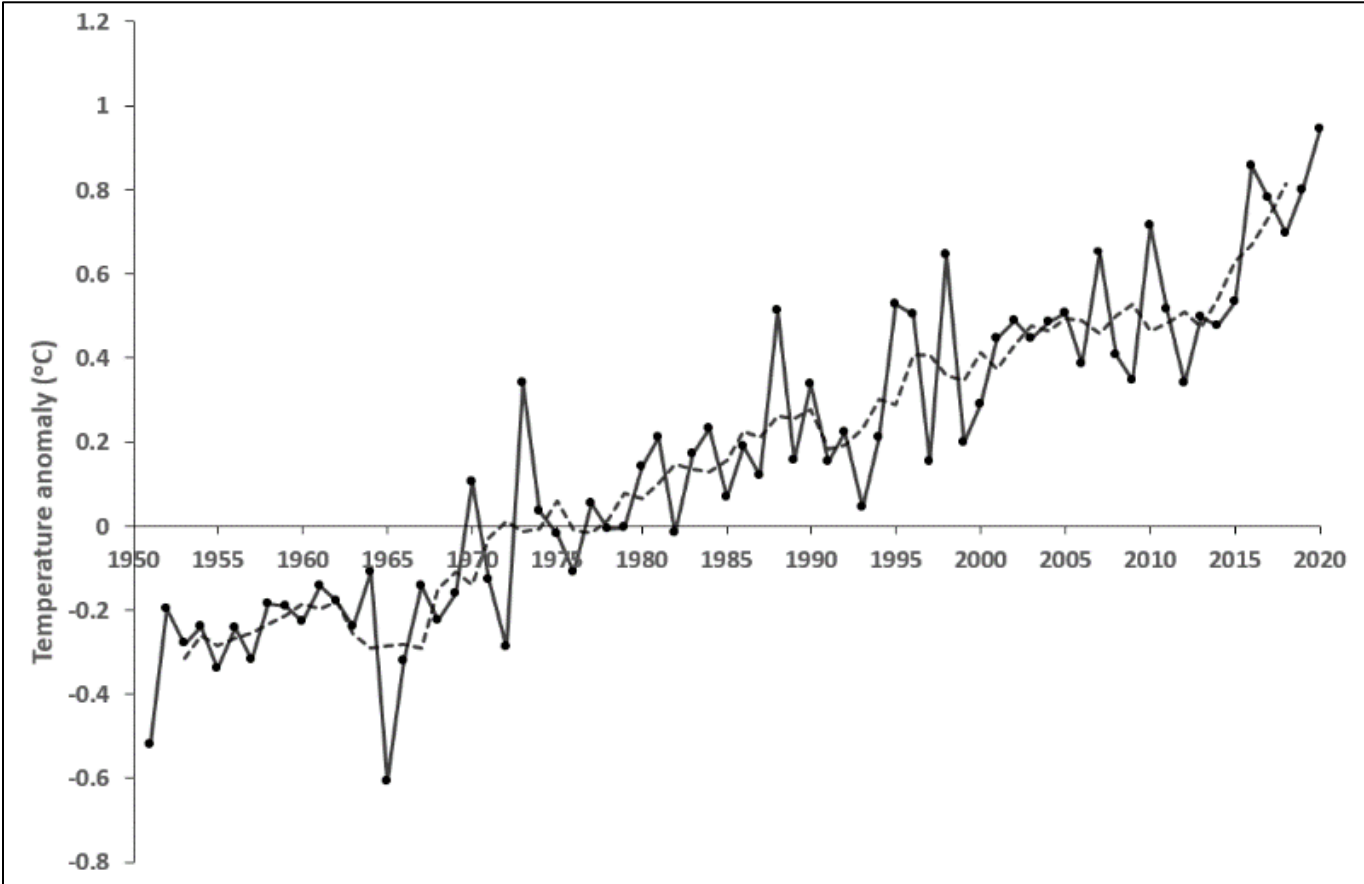


Source: <https://gml.noaa.gov/ccgg/trends/>

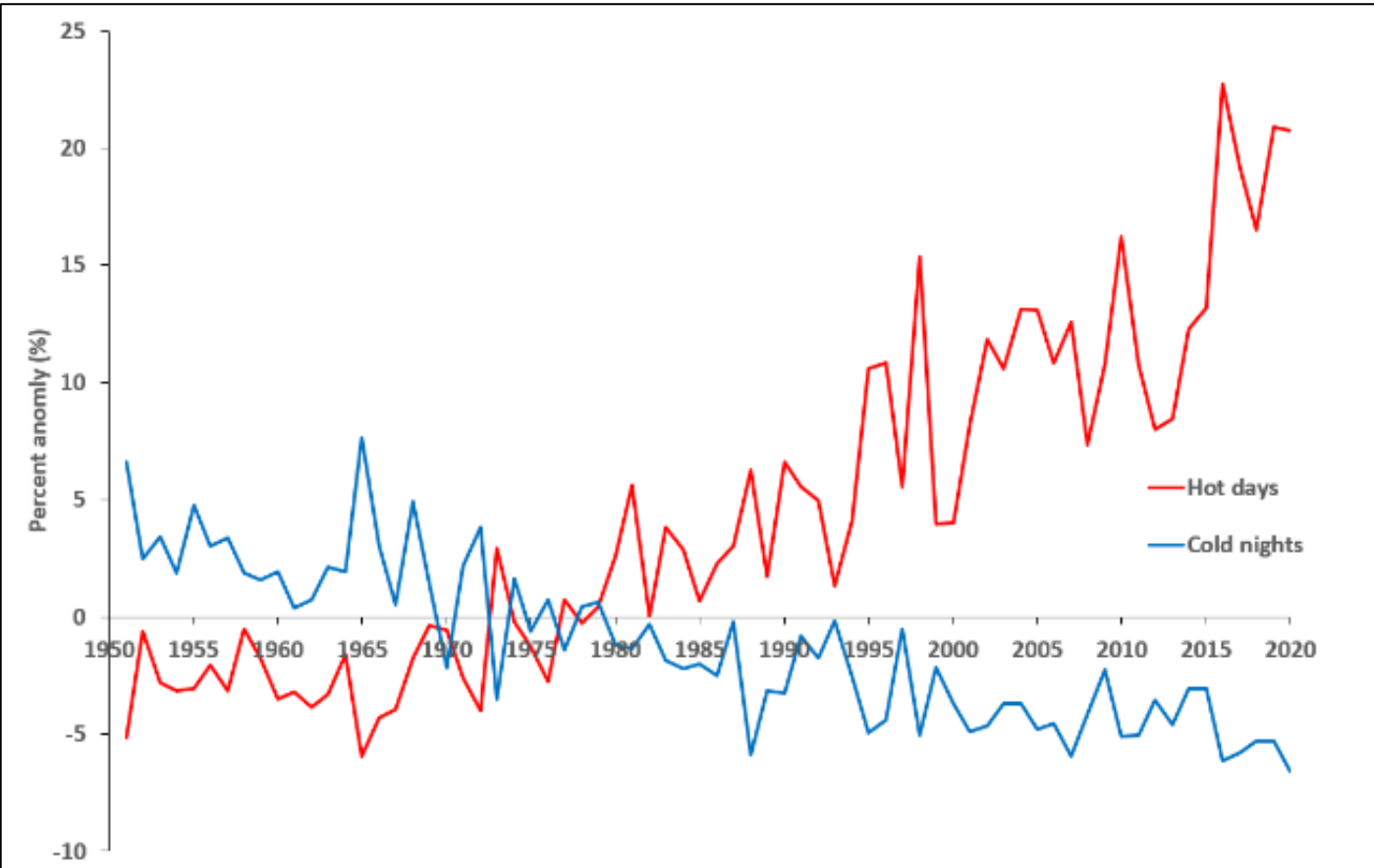


The climate is already changing

The Pacific Island climate has warmed.

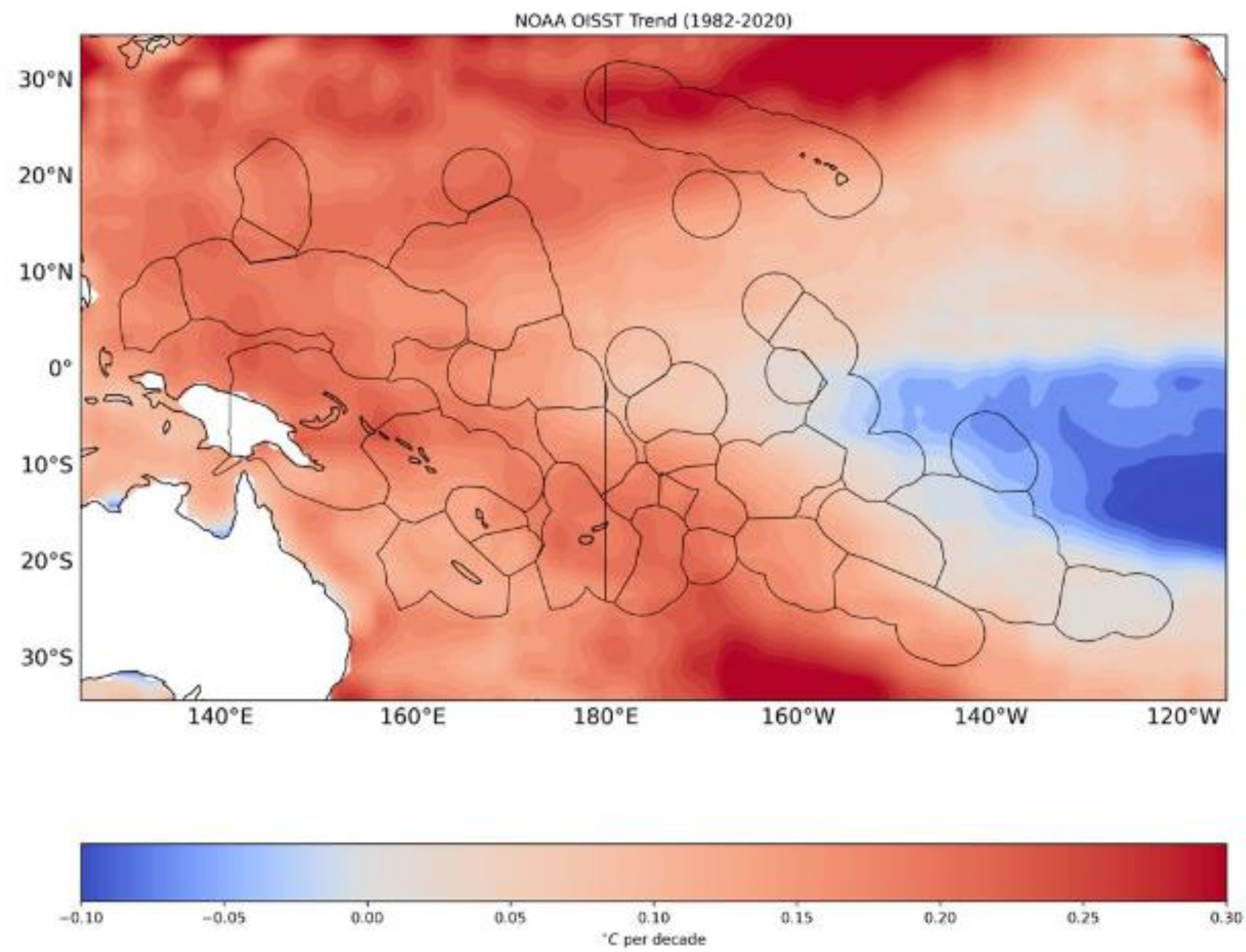


Mean temperature over land increased by 1.1°C since 1951



The percentage of hot days has increased
The percentage of cold days has decreased.

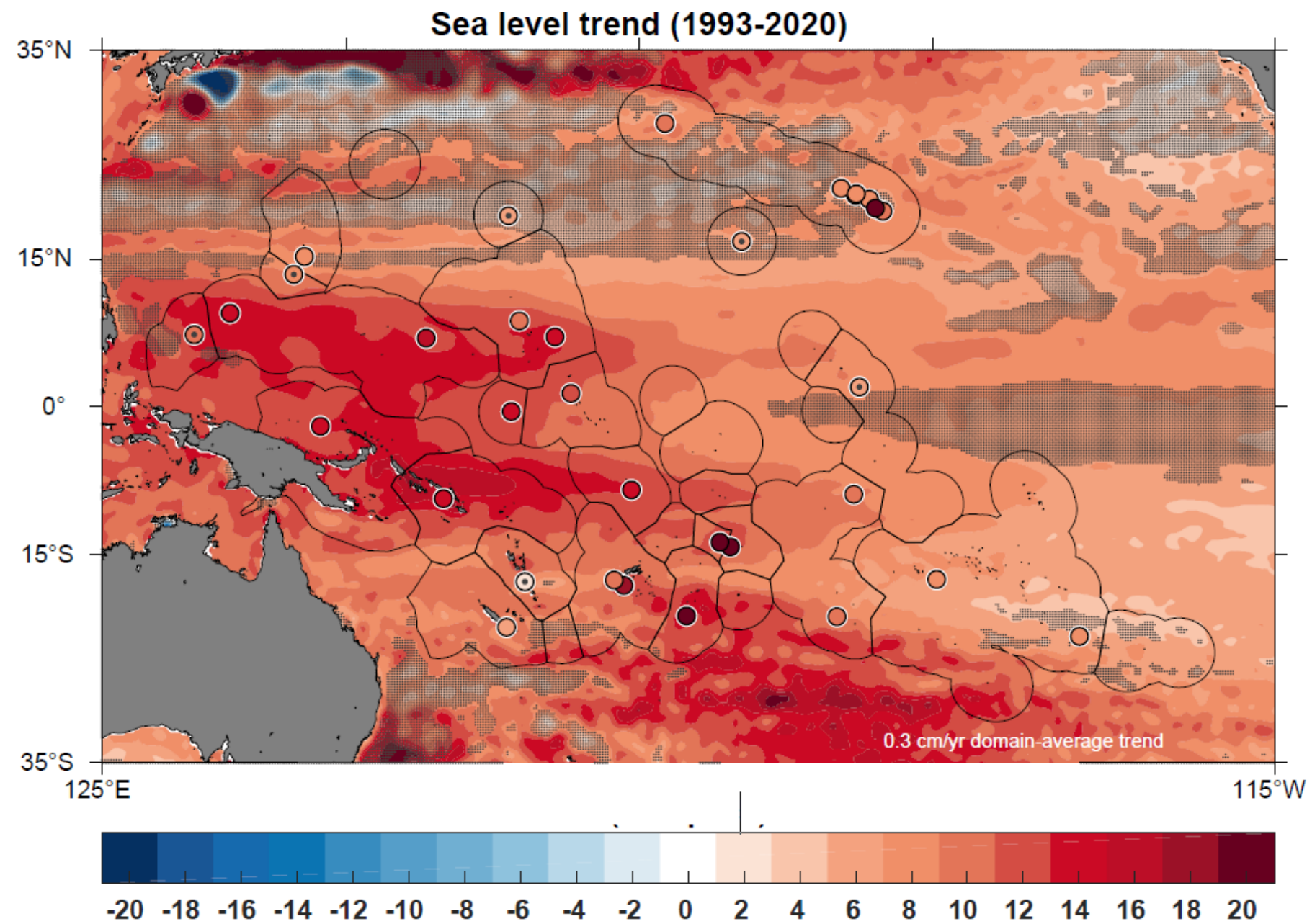
Source: Marra et al. 2021



Across the 1982-2020 period, most countries have experienced sea surface temperature warming between 0.1 and 0.2 deg C per decade.

Sea Surface Temperature Trends

Source: Marra et al, 2021

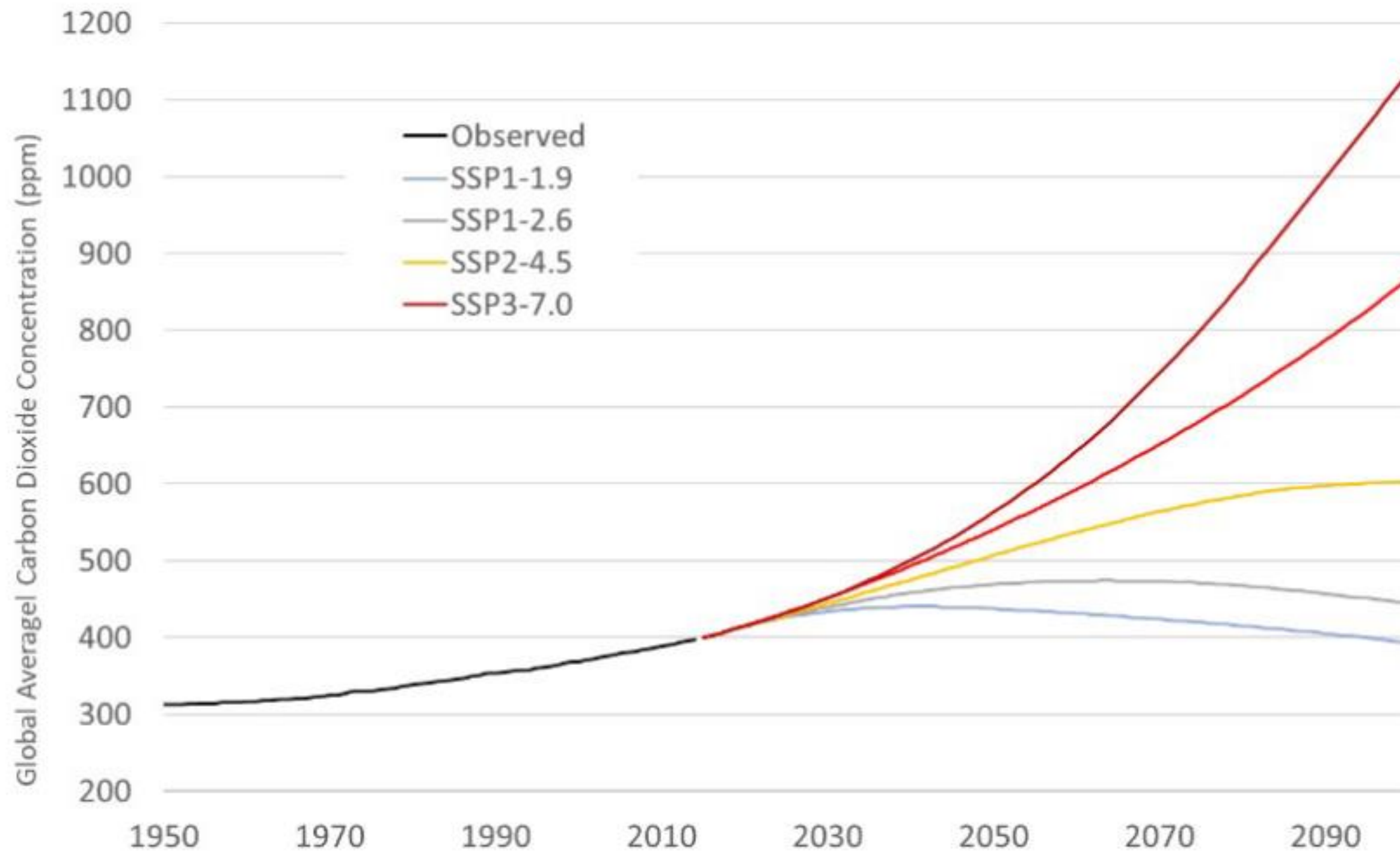


Trends from satellite altimetry (coloured contours) and from tide gauges (circles) since the beginning of the satellite record (1993).

- Sea level rise observations vary regionally.
- Generally, it is largest in the tropical western Pacific.

Sea Level Trends

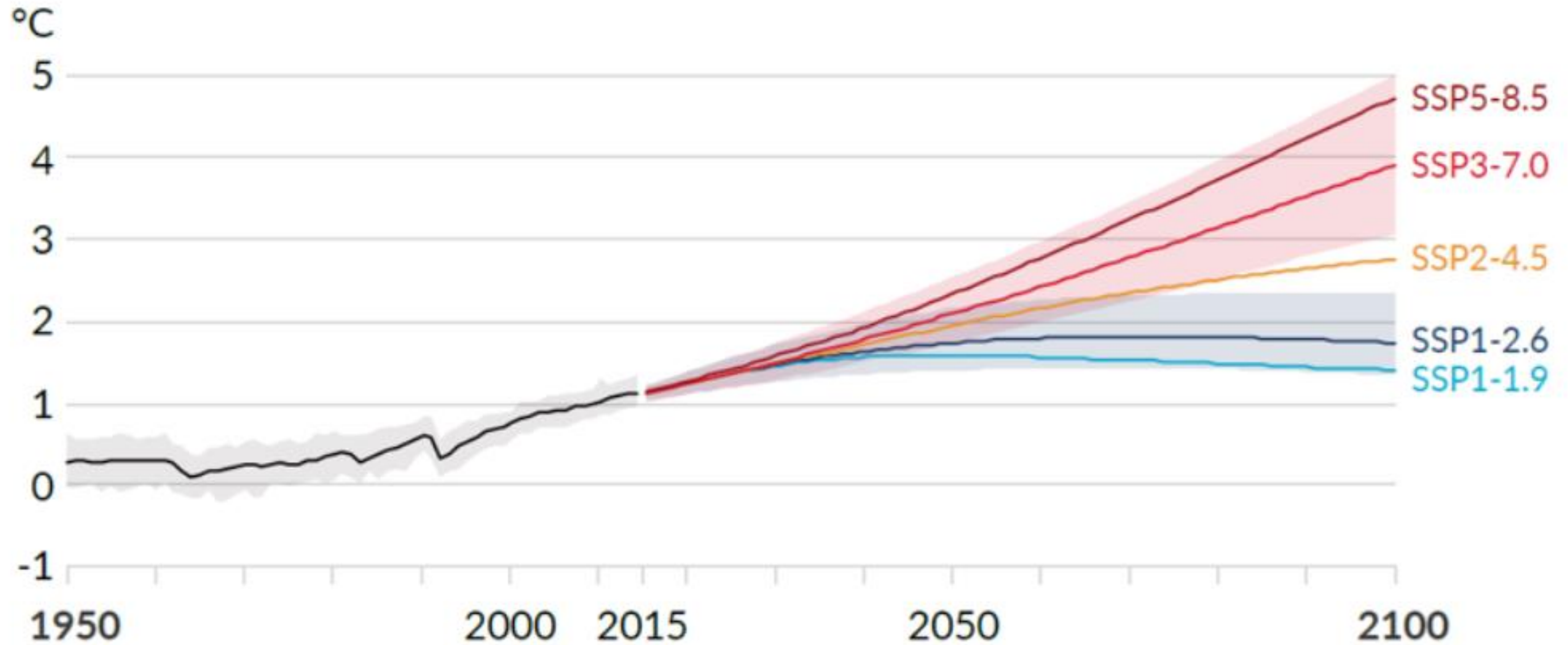
Source: Marra et al, 2021



Future greenhouse gas pathways

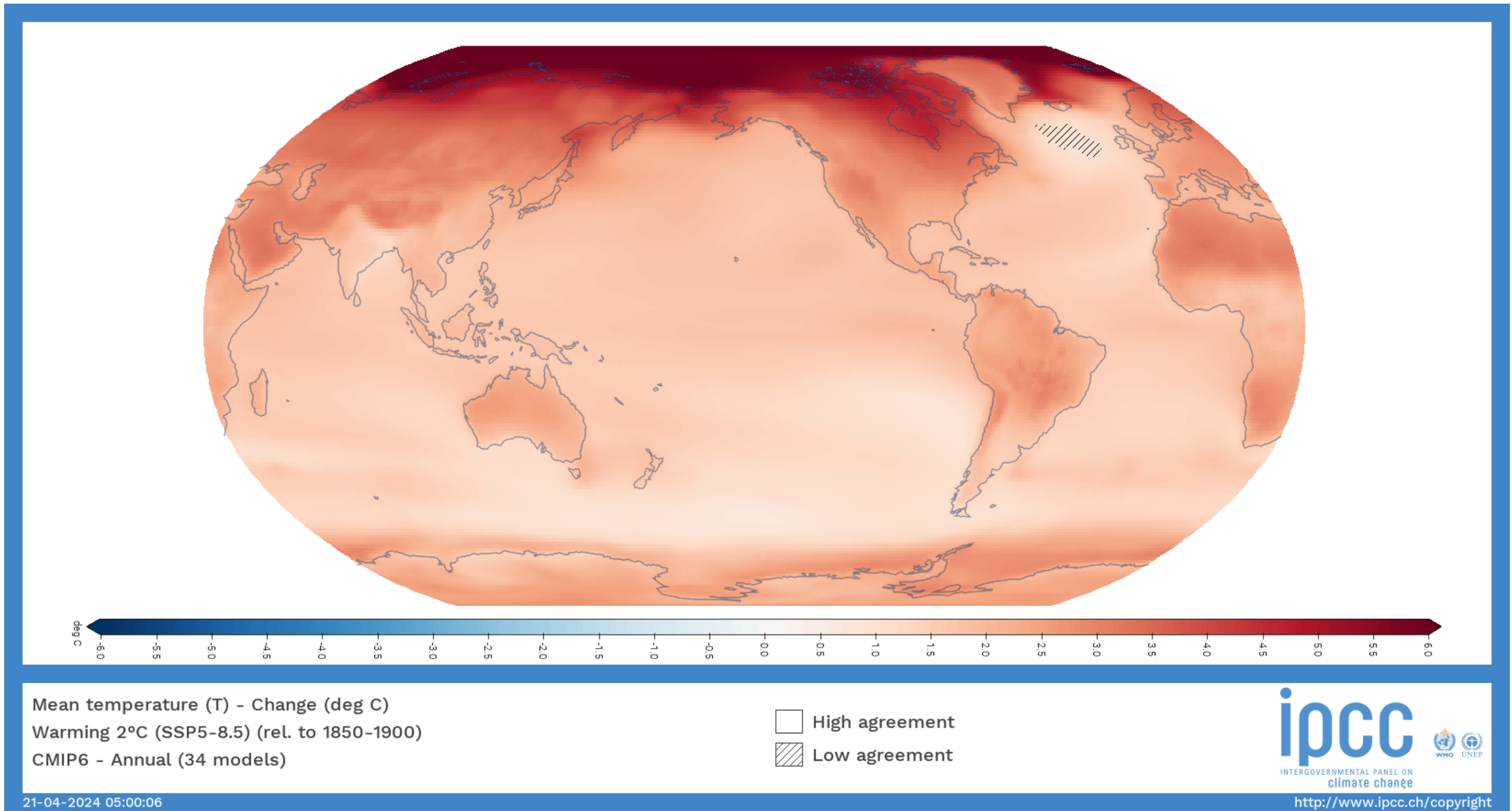
Source: O'Neill et al. 2016

- Global surface temperature change relative to 1850-1900



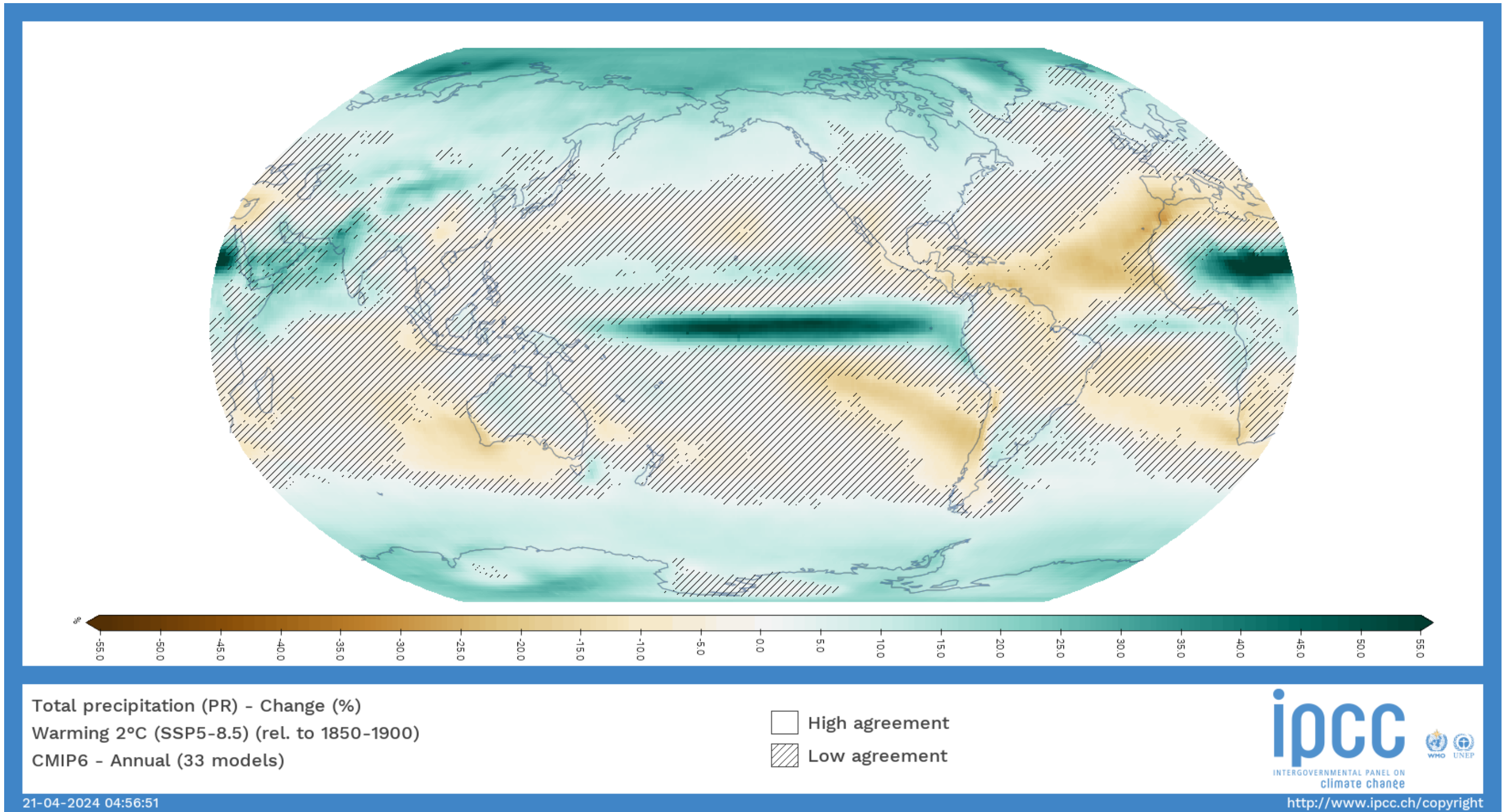
Projected temperature change

Source: IPCC, 2023



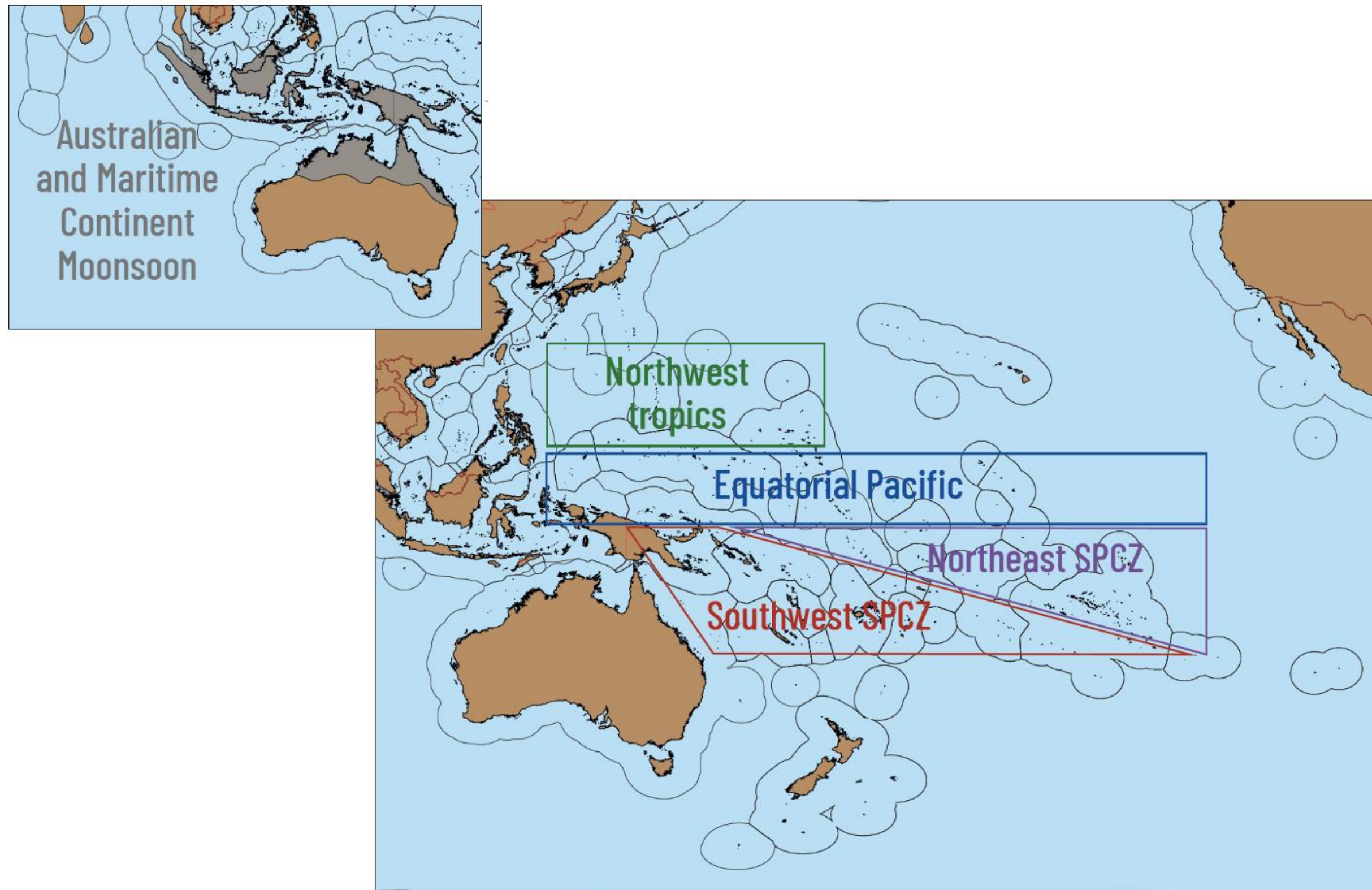
Projected temperature change ~ 2 deg C warming

Source: IPCC Interactive Atlas, 2024



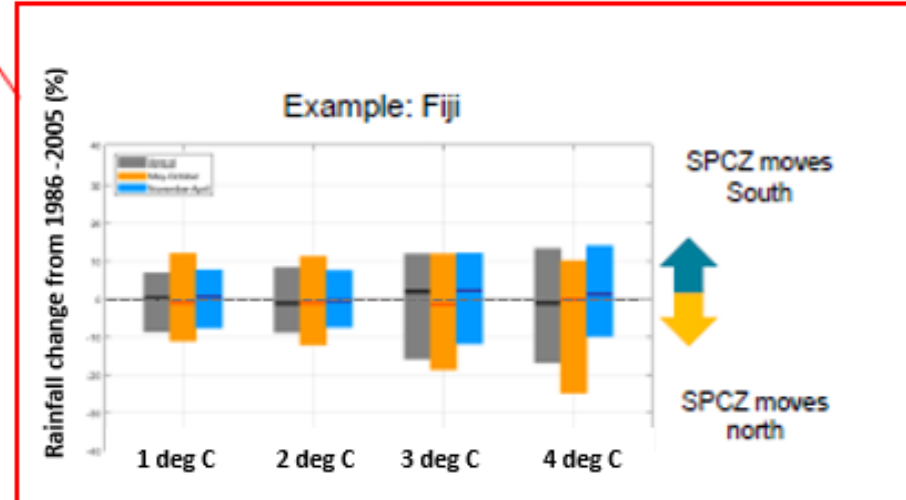
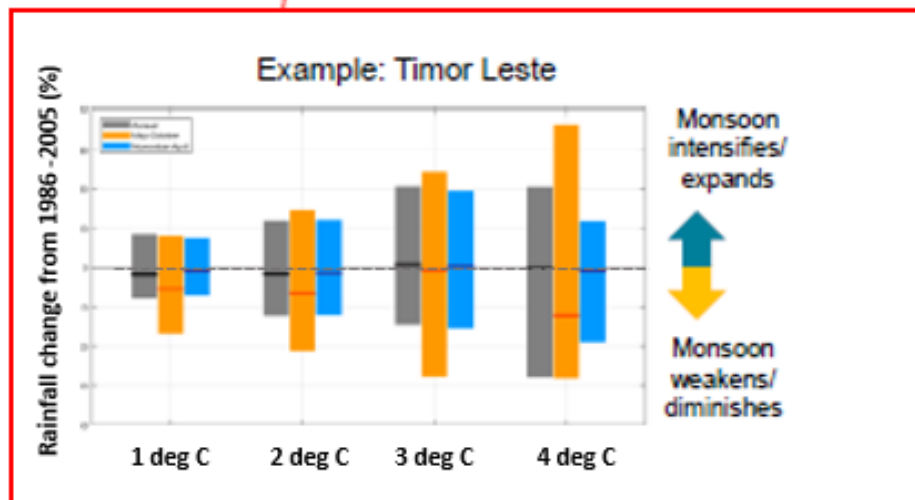
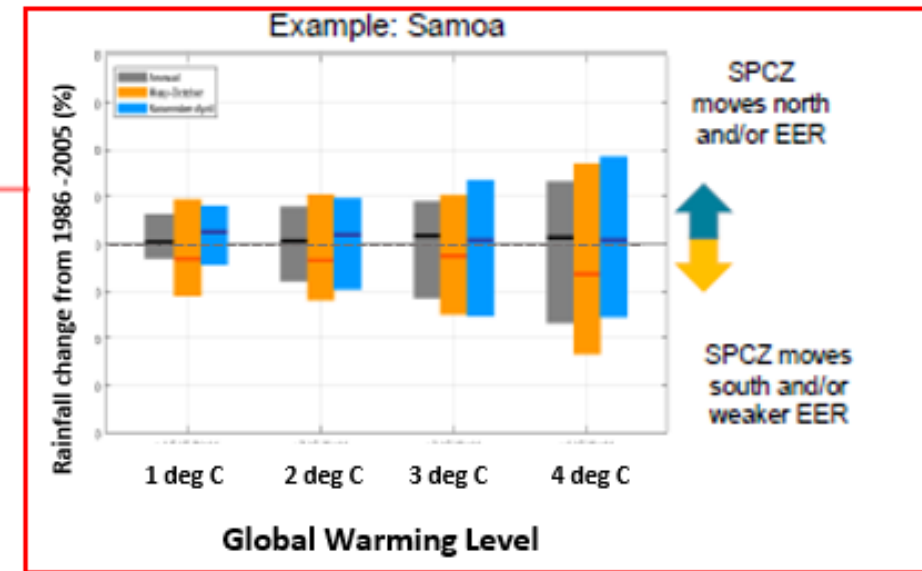
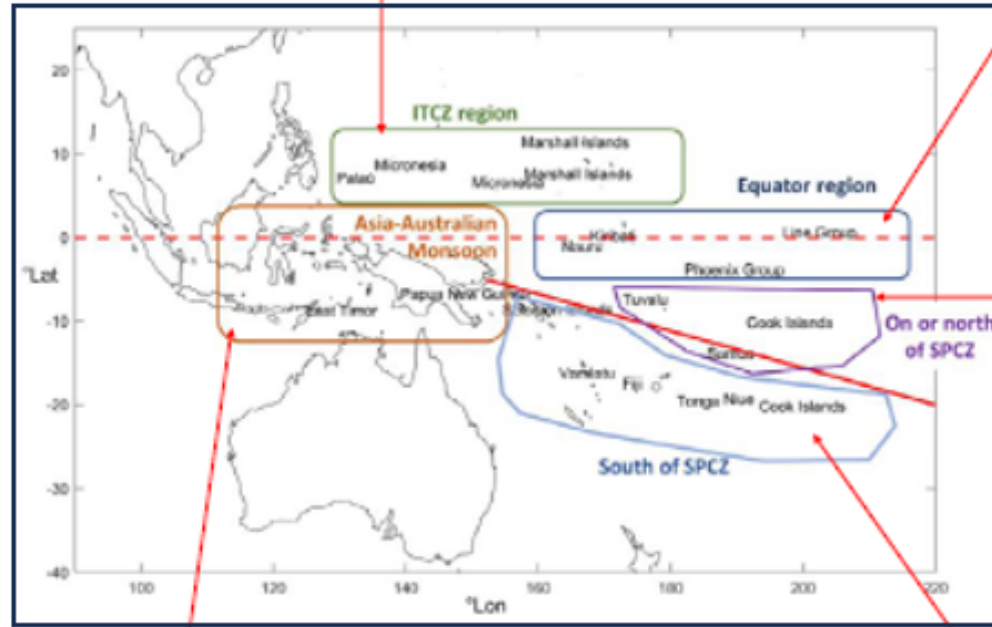
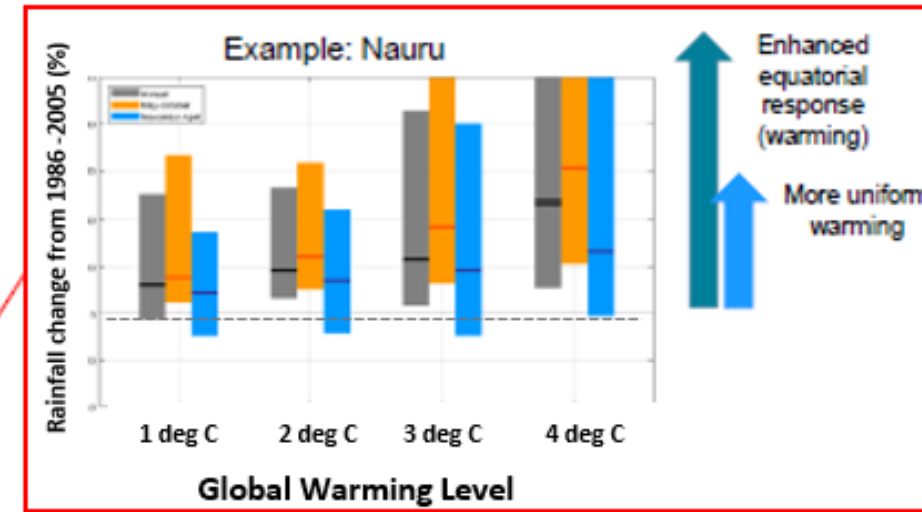
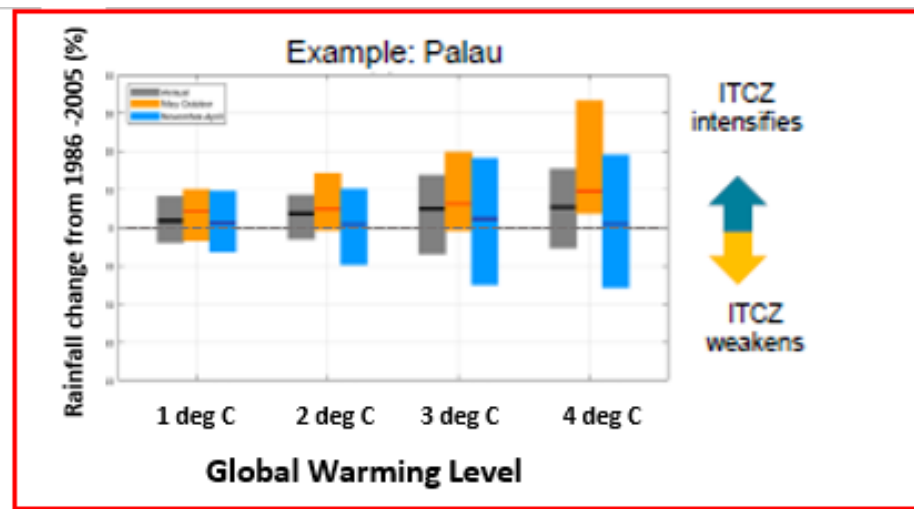
Projected precipitation change ~ 2 deg C warming

Source: IPCC Interactive Atlas, 2024



IPCC Atlas small island regions for Pacific

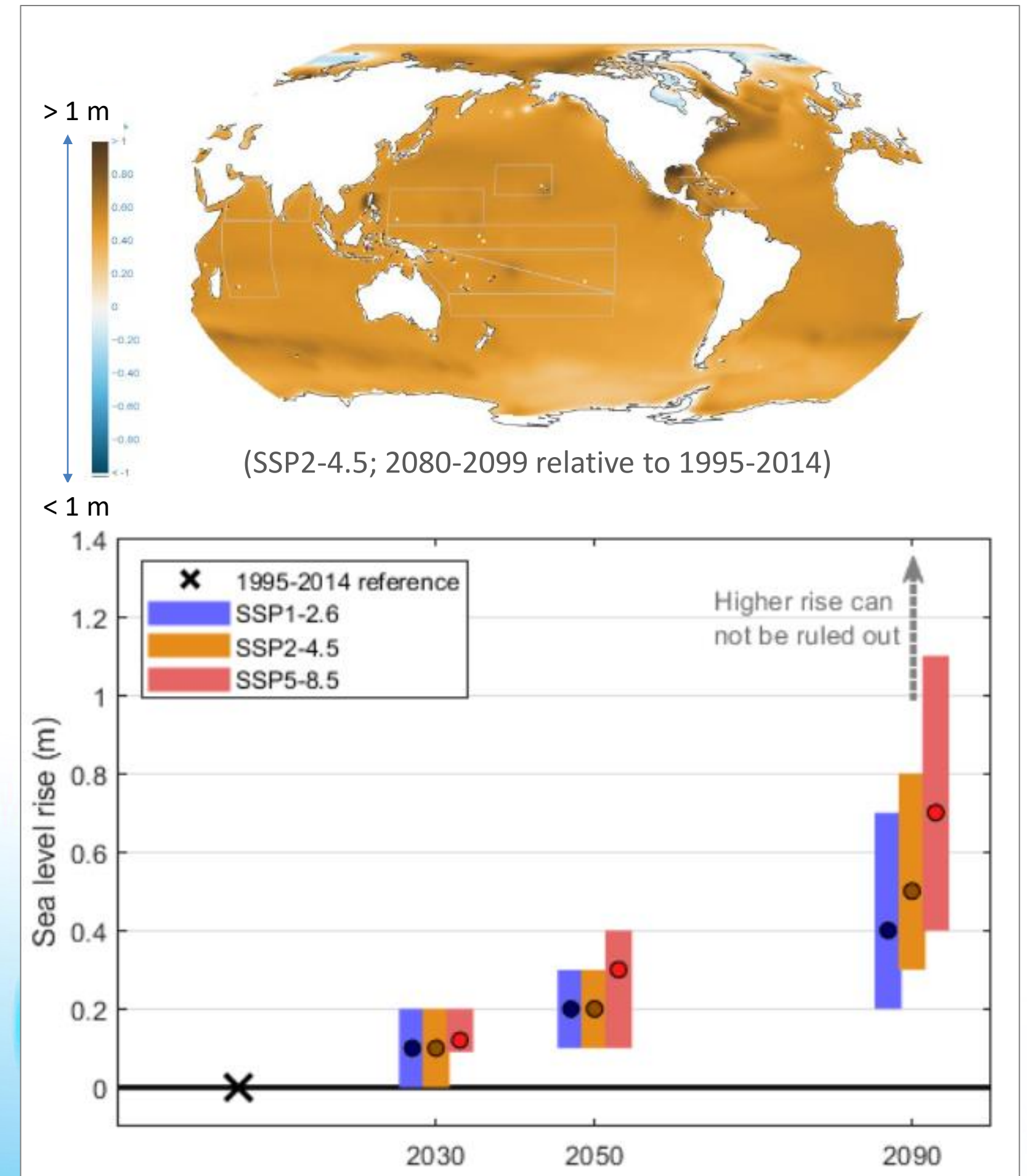
Source: Webb et al, in prep



Projected annual and seasonal rainfall change under different GWL's

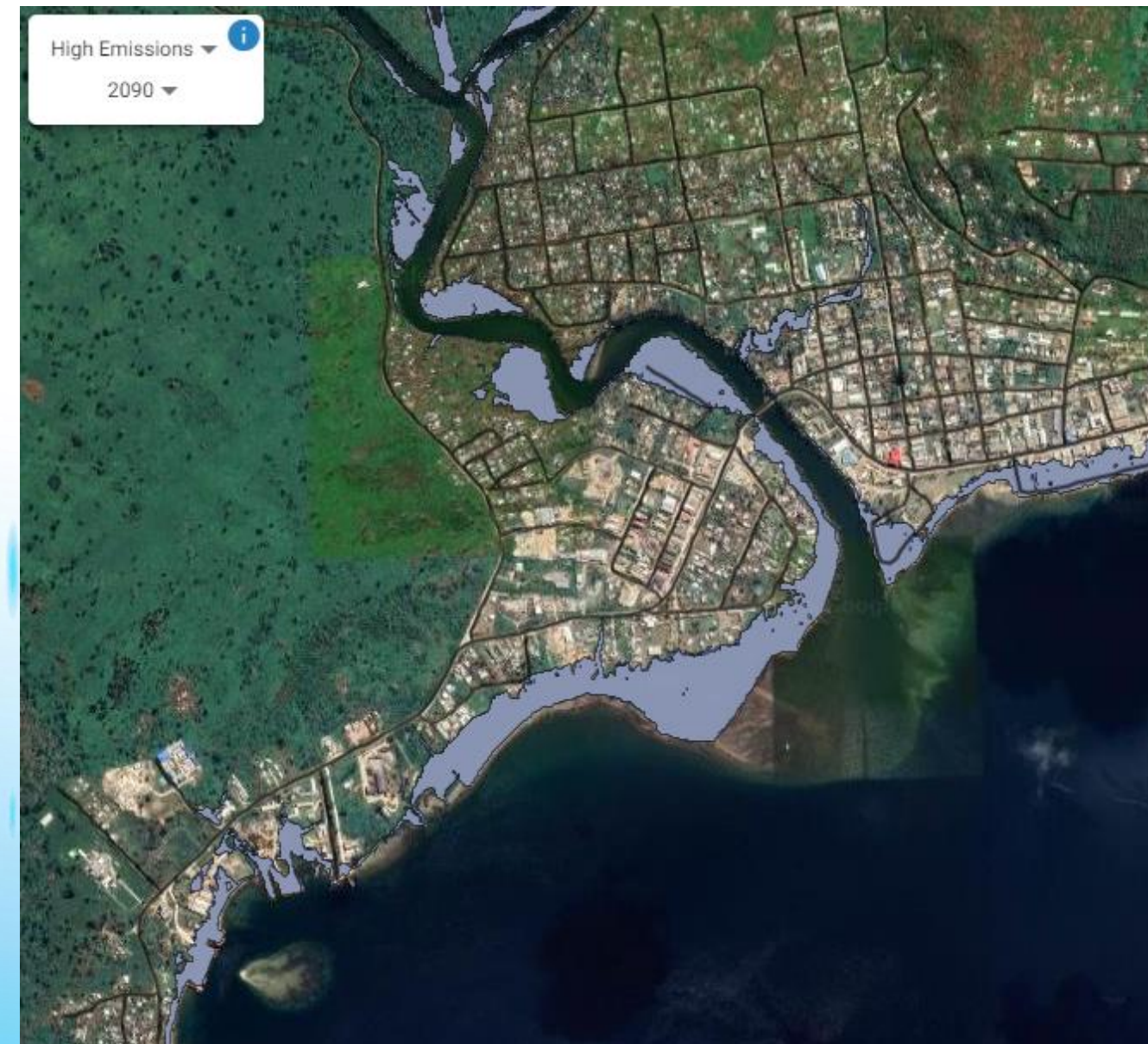
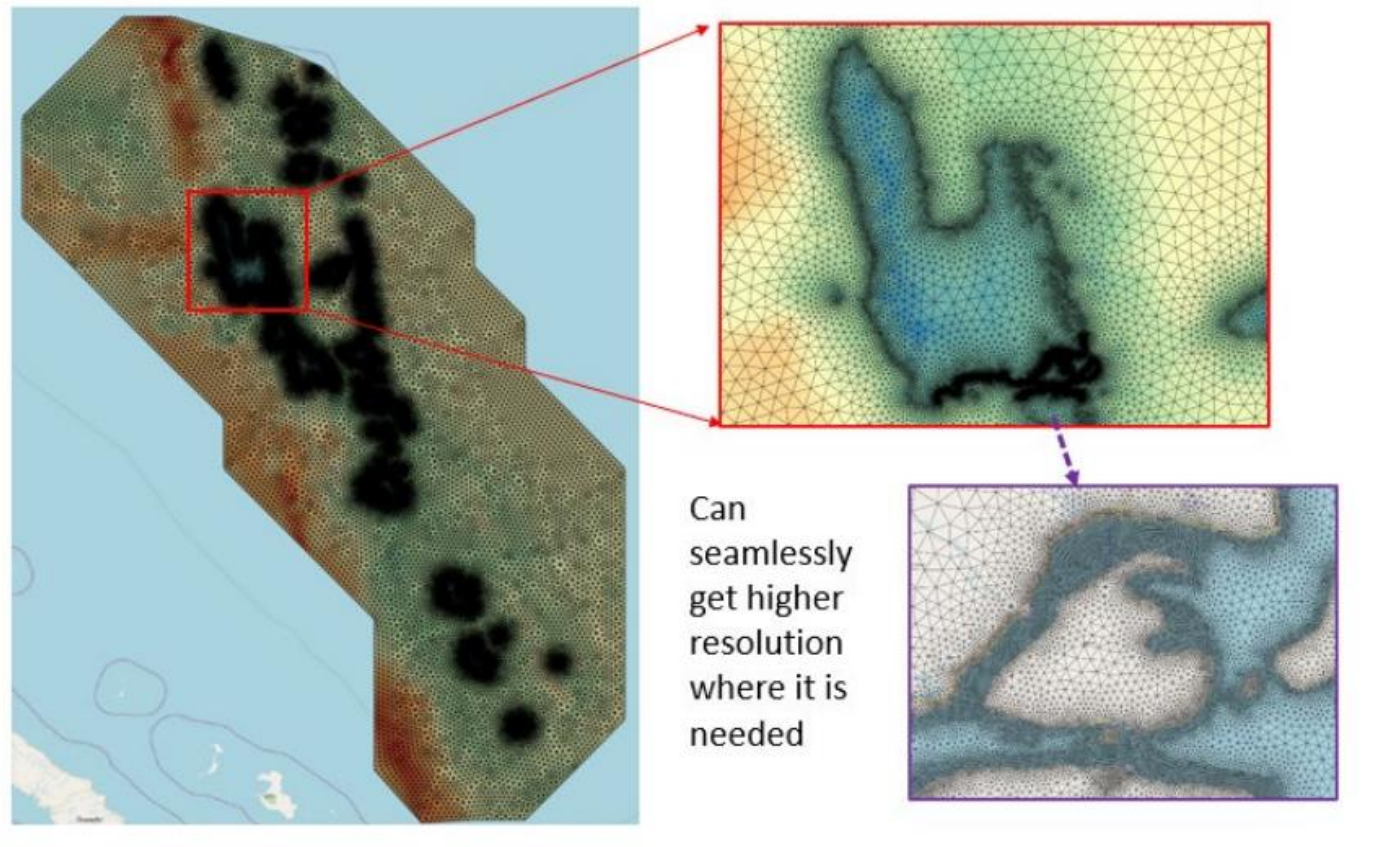
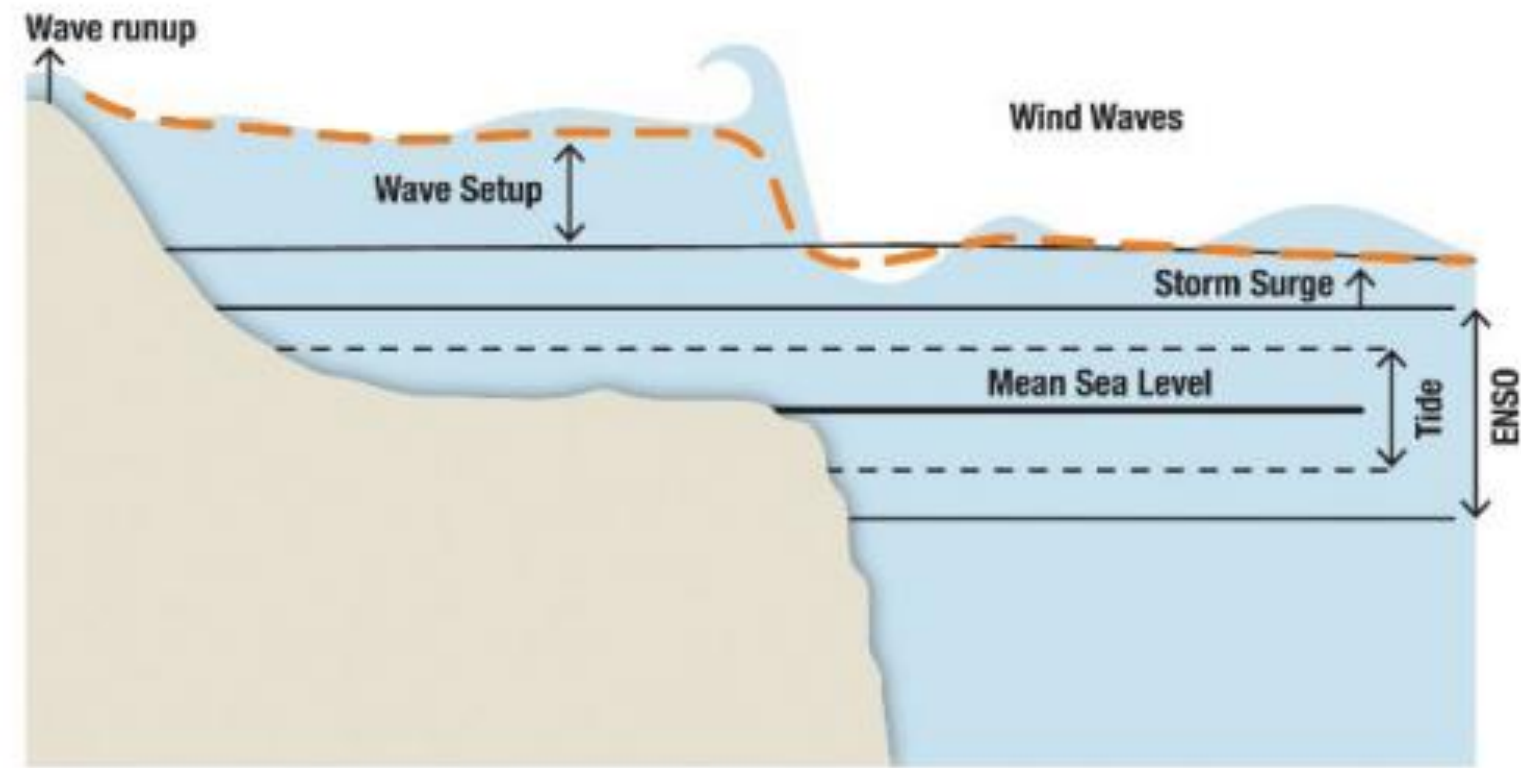
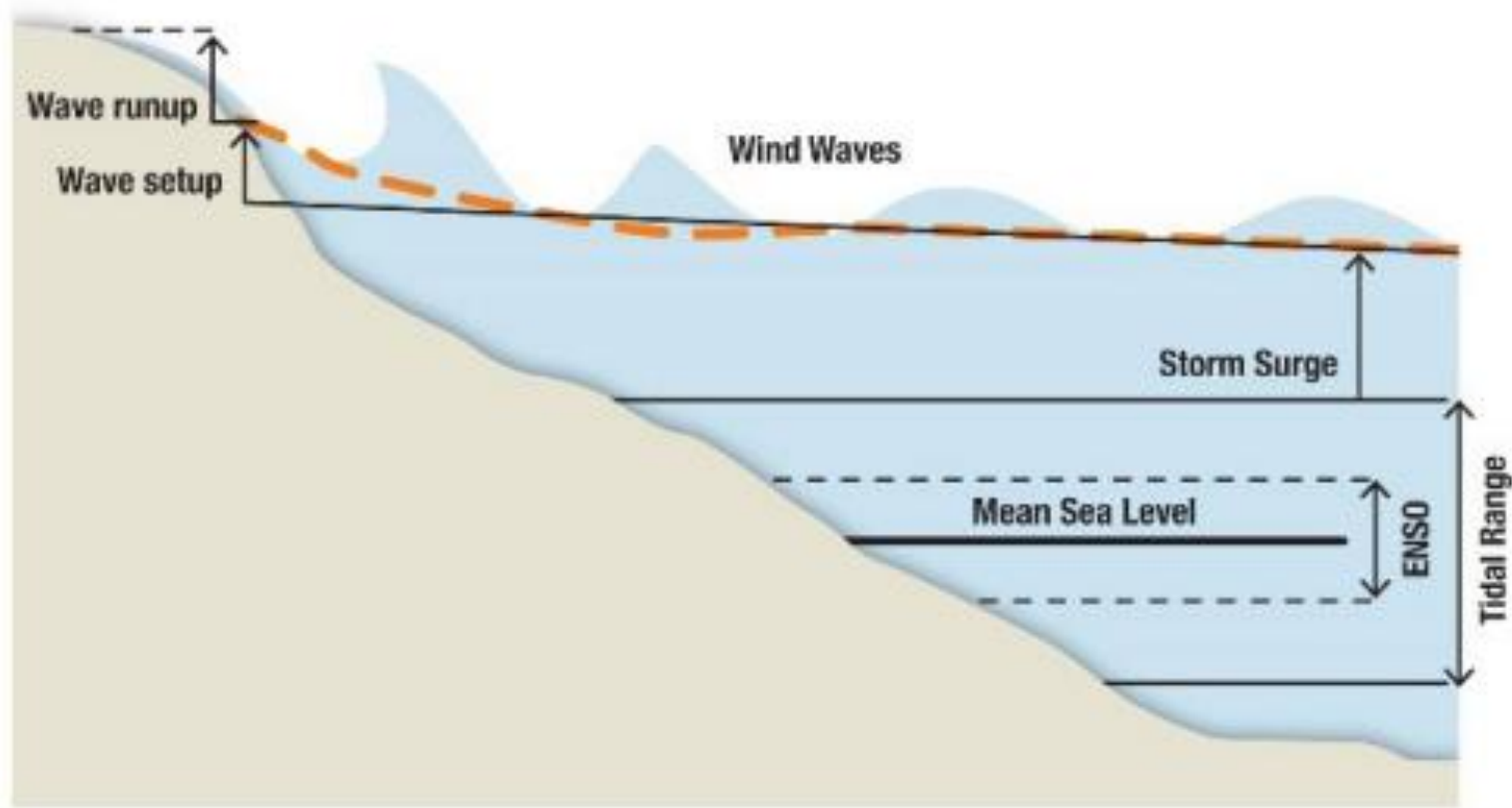
Source: Grose et al, 2022

- The map shows the global spatial pattern of projected sea level rise
- Due to regional influences, sea level is projected to rise slightly faster in the Pacific than the global average, but lower than some areas of the world.
- Locally, vertical land subsidence (or uplift) could also lead to higher (or lower) observed sea level rise.



Projected sea level rise

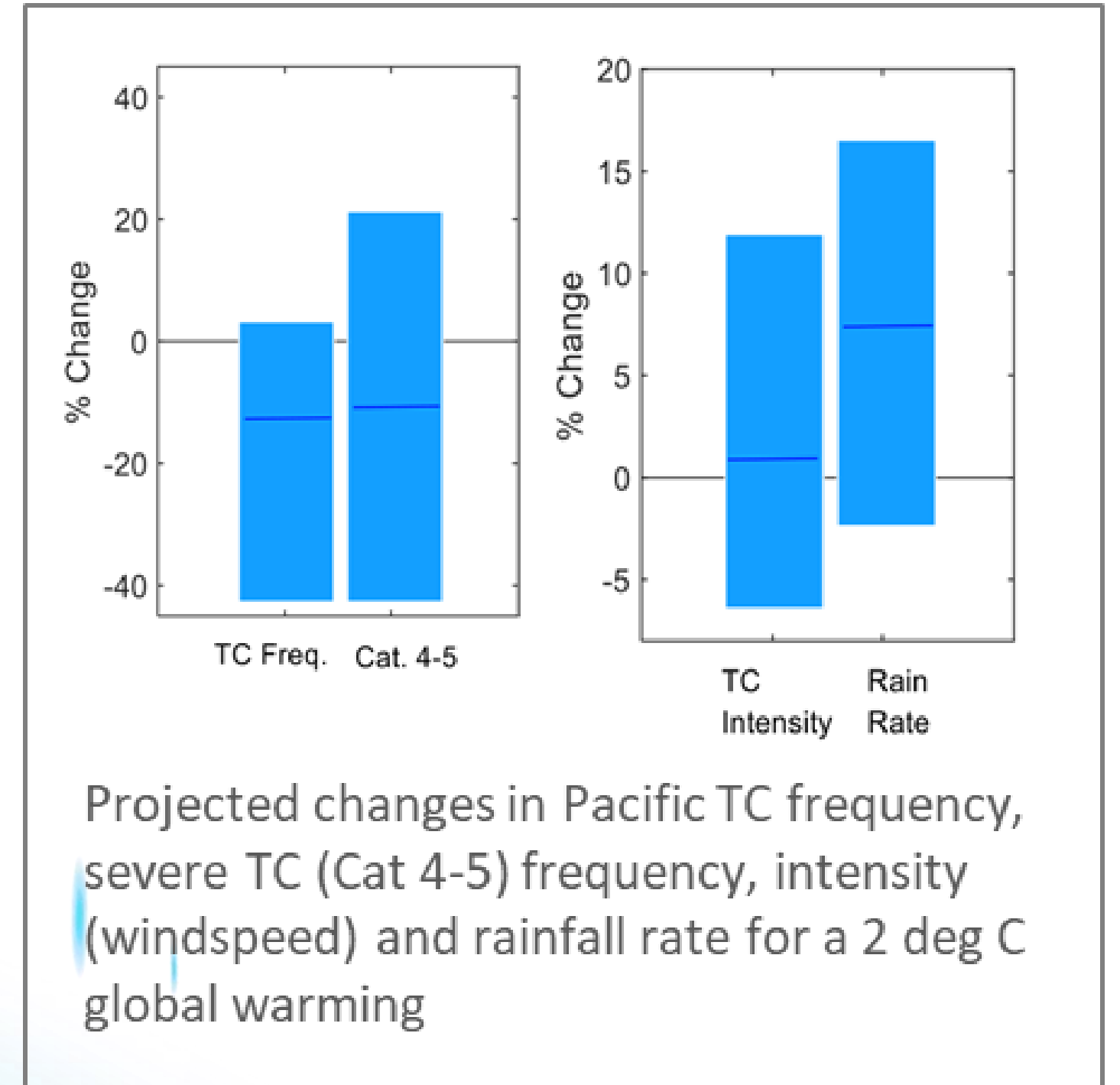
Source: Marra et al. 2021, IPCC Interactive Atlas 2024



Extreme sea level and coastal inundation

Source: Vanuatu Climate Futures Portal

- Decreased frequency (High confidence)
- Frequency of severe TCs will decrease (Low confidence)
- Increase in average cyclone intensity (windspeed) (Medium to high confidence)
- Increase in TC rainfall rates (Medium to high confidence)
- Sea level rise will increase cyclone-related storm surge events (High confidence)
- Therefore, projected increase in average TC intensity, combined with sea level rise and increased rainfall rates, would increase cyclone impacts



Tropical Cyclone Projections

Source: CSIRO and SPREP, 2021

- Extreme temperature: increase
- Extreme rainfall events: increase
- Drought: varies depending on region
- Tropical Cyclone: increase intensity and rain rate, decrease frequency, increase impacts
- Extreme sea level: increase
- Marine heatwaves: increase
- Coral bleaching: increase
- Ocean acidification: increase

Projected climate extremes

Source: Marra et al. 2021, IPCC, 2022



Confidence ratings based on:

- 1: Amount of evidence
- 2: Degree of agreement between lines of evidence

Uncertainty ranges based on:

- 1: Different emissions pathways
- 2: Different climate model responses to each pathway
- 3: Natural climate variability. Strongly influences near-term outlooks

Limitations:

- 1: Global climate models (GCMs) have coarse resolution (100-200 km) providing useful climate projections at large scales.
- 2: GCMs cannot adequately represent weather-scale (1–10 km) phenomena
- 3: Downscaling can add value, downscaled projections are plausible, rather than precise.

Confidence, uncertainties and limitations

Source: IPCC, 2022



Summary

- The climate of the western tropical Pacific is influenced by many different climate drivers
- The climate is changing due to increases in atmospheric greenhouse gas concentrations
- For example, temperatures have increased on land and in the oceans, and sea levels have risen
- With further increases in greenhouse gas emissions:
 - Temperatures will continue to increase
 - Precipitation patterns may change in different ways in different regions: increase, decrease or stay the same
 - Sea level will continue to rise, with greater chance of coastal inundation
 - Tropical cyclones are projected to reduce in frequency, with the proportion of severe TCs increasing, and an increase in TC rain rates.
 - Impacts from TCs may increase with corresponding sea level rises and increased TC rain rate
 - Many of the more extreme climate events are projected to increase in frequency and magnitude



THANK YOU!

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