Ocean and Coasts

A Summary of key findings from the United Nations **Intergovernmental Panel on Climate Change's** (IPCC) Sixth Assessment Report (AR6) on the Physical Science Basis

Once in 100 year

extreme sea level events will occur

annually or more frequently

at up to a quarter of the Pacific region by 2050

Marine heatwaves

will continue to increase in

- **frequency**
- **duration**
- **intensity**

By 2050, Pacific island shorelines may retreat **40m**

Abrupt climate change events could contribute an additional **1 metre** of sea level rise

sea level rise

extreme coastal events

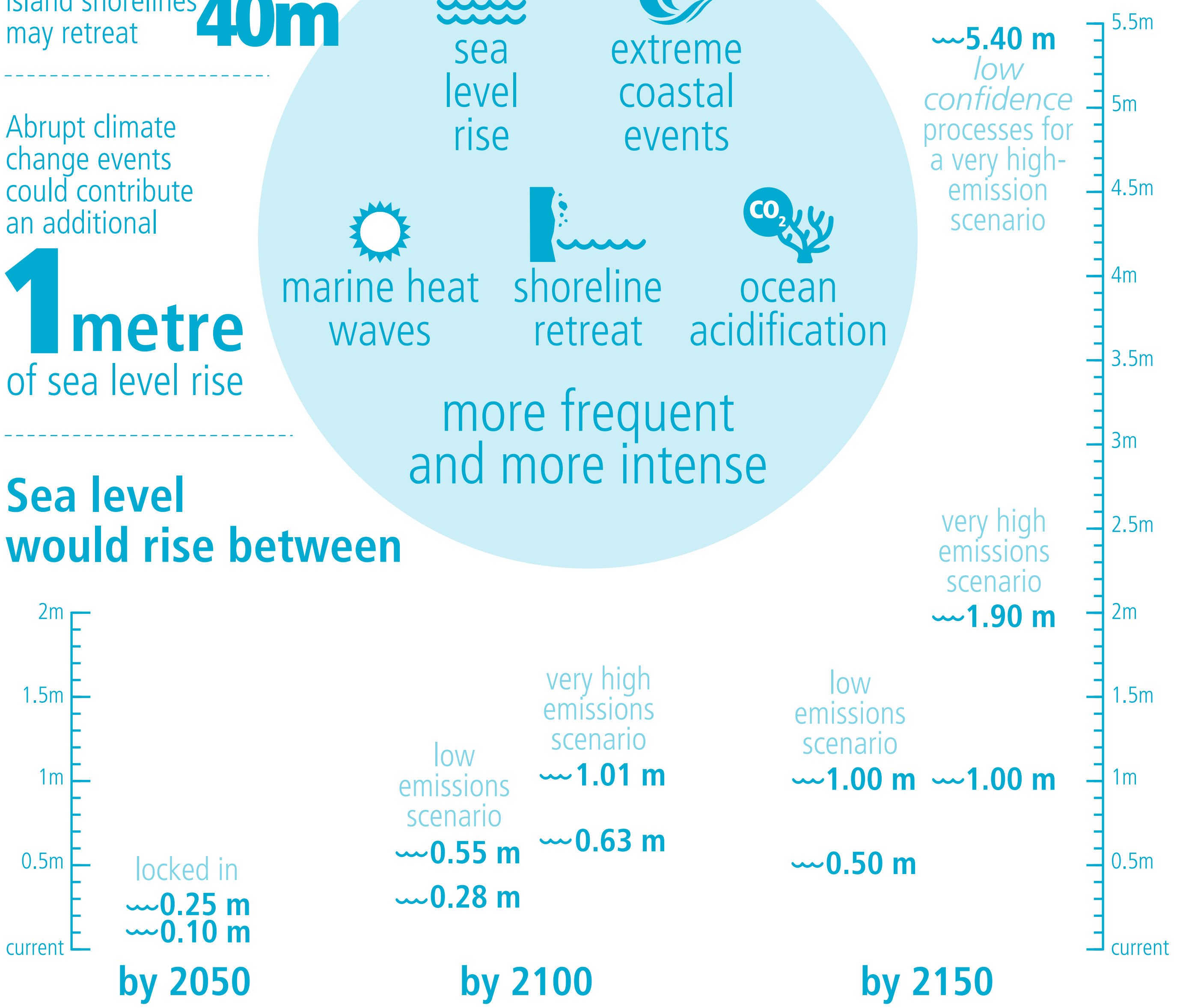
marine heat waves

shoreline retreat

ocean acidification

more frequent and more intense

Sea level would rise between



Ocean and Coasts

A Summary of key findings from the United Nations **Intergovernmental Panel on Climate Change's** (IPCC) Sixth Assessment Report (AR6) on the Physical Science Basis

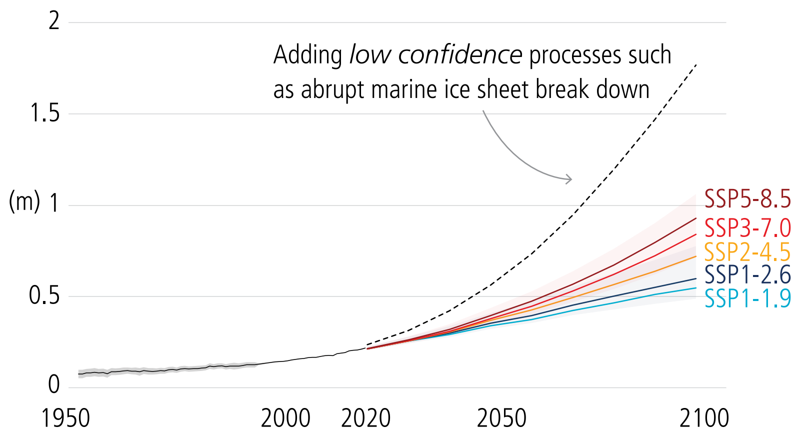
Sea level rise, extreme coastal events, marine heatwaves, shoreline retreat and ocean acidification are expected to become more frequent and intense than previously anticipated by IPCC estimates throughout the Pacific.

CHANGES SO FAR

In the Western Pacific, sea levels rose faster than anywhere else in the world between 1993 and 2015.[1] The global average sea level was 0.15–0.25 m higher in 2018 than in pre-industrial times and it is *very likely* that human activity has been the main driver of sea level rise since 1970.[2] Sea level rise to date has resulted from the thermal expansion of water.

Between 1984-2016, the Central Pacific experienced coastal erosion at a rate of 1-2 m per year based on satellite observations. This occurred at a slower rate in the South Pacific, which experienced 0.5 m of coastal erosion per year.[3] Analysis of aerial and satellite imagery shows severe shoreline retreat in six islands in Solomon Islands and the disappearance of five vegetated reef islands between 1947 to 2014, which may be due to the interaction between sea level rise and waves. In some cases, there is shoreline growth on other parts of the islands.[4]

Global mean sea level change relative to 1900



Global mean sea level rise relative to 1900. Excerpt from Figure SPM.8 from the IPCC's *AR6 Physical Science Basis* report.

Humans are changing the chemistry of the world's oceans:

- **Acidification:** Acidification at the ocean surface is strengthening as a result of the ocean's continuing uptake of CO_2 from human emissions. This is causing changes in seawater chemistry that result in the decrease of pH. This inhibits the construction of shells and skeletons of many marine creatures.[6]
- **Deoxygenation:** There is *high confidence* that oxygen levels have dropped in many ocean regions since the mid-20th century. This can form "dead-zones", where marine life cannot be sustained. Changes in the oxygen content of the Pacific Ocean will persist at depth for thousands of years.[7]
- **Changes in salinity:** It is *very likely* that the Pacific Ocean has freshened, though this trend is subject to decadal variability. Freshening of ocean waters can cause major changes in ocean circulation, with impacts ranging from large-scale climate processes to changes in marine species range.[8]

Sea levels will rise by 0.10–0.25 m by 2050 irrespective of a reduction in greenhouse gas emissions

Content sourced from the IPCC's AR6 Physical Science Basis report:

1 9.2.4, 9.6.1 2 A.1.7 3 12.4.7.4 4 12.4.7.4 5 FAQ.9.2 6 5.3 7 B.5.1 8 9.2.2.2

FUTURE PROJECTIONS

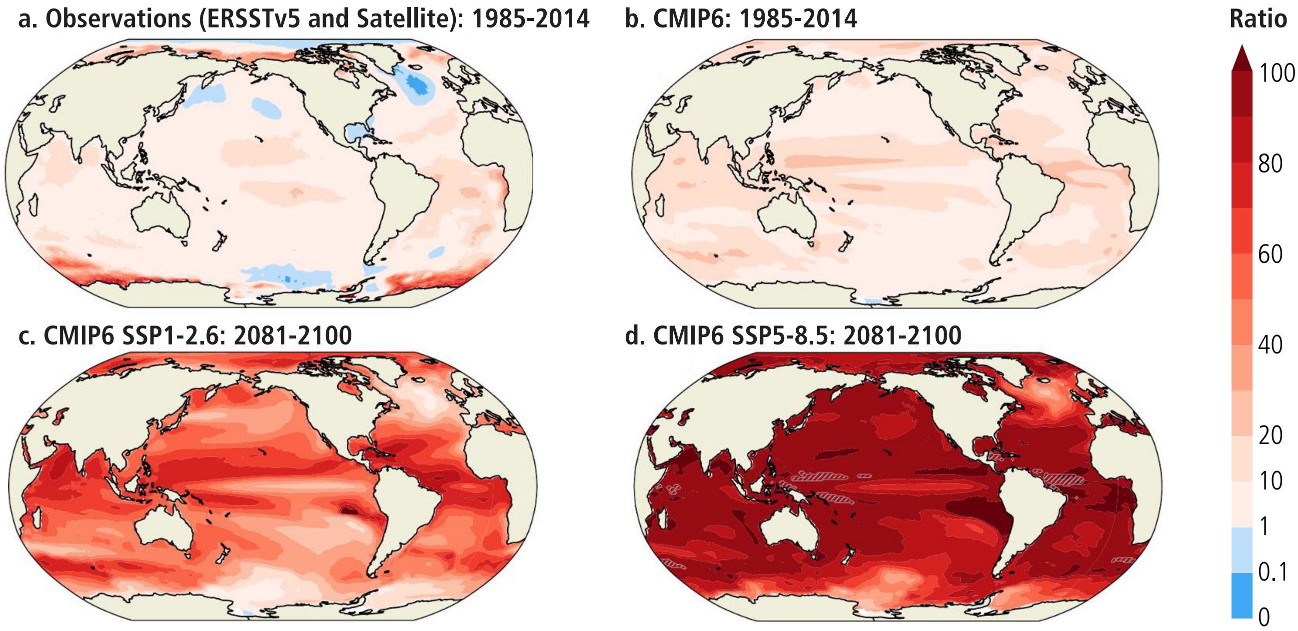
Sea levels will rise by 0.10–0.25 m by 2050 irrespective of a reduction in greenhouse gas emissions.[9] By 2100, it is *likely* there would be a rise of 0.28-0.55 m under a very low-emission and 0.63-1.01 m under a very high-emission scenario relative to 1995-2014 levels.[10] By 2150, there is a 1 in 2 chance of mean sea level rise of 0.5-1.0 m under a low-emission scenario. This will nearly double under a very high-emission scenario to 1.0-1.9 m, assuming no acceleration in ice-sheet mass breakdown after 2100.[11] Processes such as ice-sheet breakdown which are not yet fully understood could drive mean sea level rise under a very high-emission scenario by as much as 5.4 m by 2150.[12] Beyond 2150, sea levels will continue to rise for centuries to millennia due to continuing deep ocean heat uptake and mass loss from ice sheets, and will remain elevated for thousands of years.

Abrupt climate change events could trigger additional higher sea level rise before 2100. Examples include the earlier than projected disintegration of marine ice shelves, the abrupt, widespread onset of marine ice sheet and ice cliff instability around Antarctica, and faster than projected discharge from Greenland. In combination, such processes could contribute more than one additional metre of sea level rise by 2100 noting that this is a low likelihood scenario.[15] These processes are characterised by deep uncertainty arising from limited process understanding and limited data availability but nevertheless are starting to be observed.[16]

Sea level rise will increase the frequency and severity of extreme coastal events such as storm surges, wave inundation and tidal floods. Extreme sea level events that were recently expected once in 100 years will occur annually or more frequently for up to a quarter of the Pacific region by 2050 regardless of emissions trajectory.[13] Island shorelines in the equatorial and south Pacific may retreat by a median of 40 m by mid-century relative to 2010 as a result of persistent sea level rise and extreme coastal events.[14]

Marine heatwaves will continue to increase in frequency, duration and intensity irrespective of future warming. Over the rest of the 21st century, the projected rate of ocean warming could double in a very low-emission scenario and be up to eight times higher in a very high-emission scenario relative to the current rate of warming.[17] Marine heatwaves are projected to be more intense and prolonged, with the equatorial Pacific seeing an increase in annual mean marine heatwave duration from around 30 days today to 100 days at 1.5°C of warming. This would double at 2.0°C of warming, reaching 200 days in average duration.[18] Marine heatwaves contribute to coral bleaching events in the Pacific and changes in marine productivity and the location of fish populations that are essential to food security and local economies.

Observed and simulated regional probability ratio of marine heatwaves (MHWs) - MHWs will last much longer under a very-high emission scenario than a low-emission scenario



Observed (from the Extended Reconstructed Sea Surface Temperature version 5 [ERSSTv5] and Satellite) and simulated using the sixth phase of the Coupled Model Intercomparison Project's (CMIP6) projections regional probability ratio of marine heatwaves (MHWs) for the 1985-2014 period and for the end of the 21st century. This figure shows two different greenhouse gas emissions scenarios, where Shared Socio-economic Pathway (SSP) 2.6 is a low-emission scenario and SSP 8.5 is a very high-emission scenario. The probability ratio is the proportion by which the number of MHW days per year has increased relative to preindustrial times. Excerpt from Chapter 9 Box 9.2, Figure 1 from the IPCC's *AR6 Physical Science Basis* report.

9 FAQ.9.2
10 B.5.3
11 9.6.3.3
12 9.6.3.3
13 FAQ.9.2
14 12.4.7.4
15 Box TS.4
16 9.6.3, Cross-Chapter Box 9.4
17 B.5.1
18 12.4.7.4