

Sea-level rise in the western tropical Pacific

Sea level is affected by tides, weather and natural climate variability as well as climate change. A small amount of overall, long-term sea-level rise due to climate change will compound the effects of natural variability and cause extreme sea levels to happen more often.

What factors affect sea level?

Sea levels change daily, monthly and annually due to a combination of tides, weather and climate variability.

Perhaps the most familiar change in sea level is from daily tidal fluctuation caused by the gravitational pull of the Sun and

the Moon on the Earth. Over the course of any year, unusually large ("king") tides can occur, but all tides are natural and generally periodic and predictable events.

Weather and climate variability also affect sea level, particularly under extreme conditions. For example, storm surge caused by tropical cyclones

can cause a change in local sea level that may be up to several metres at a particular time and place.

Climate variability due to seasonal changes and large-scale climate features such as the El Niño Southern Oscillation (ENSO) can lead to overall changes in trade wind patterns and temperature, which in turn may affect sea level at timescales of months to years. For instance, ENSO can cause sea-level changes up to 30 cm in the western tropical Pacific, depending on time of year and location.

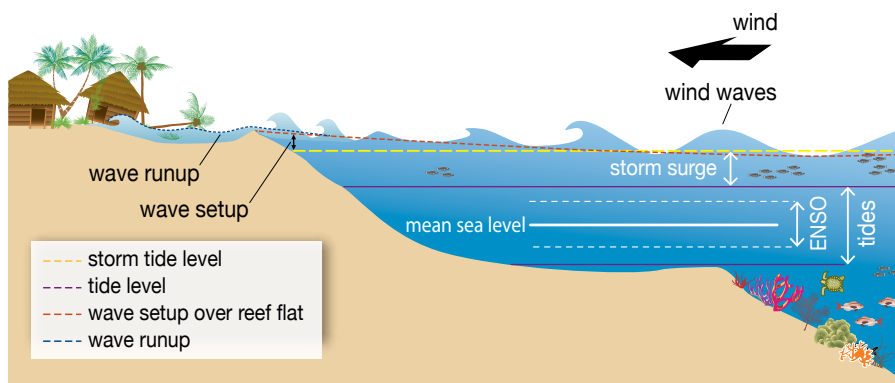
Occasionally, tides, weather and climate variability combine to cause sea-level extremes, resulting in flooding, erosion and other serious impacts to coastal resources and infrastructure.

Climate change and sea-level rise

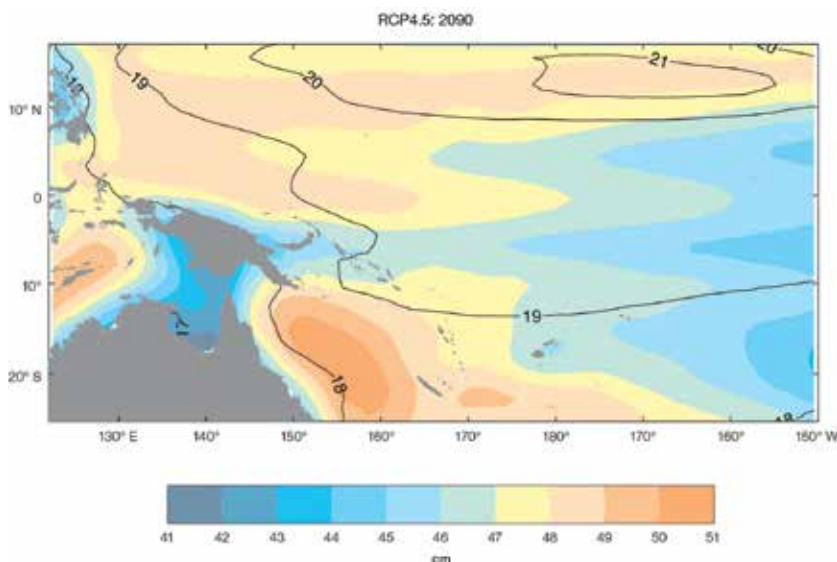
Climate change causes changes in sea level at a global scale, primarily due to thermal expansion and melting polar ice:

- (1) As oceans warm, the water expands causing an increase in sea levels. This thermal expansion is very small but the average depth of most oceans is 3500 m, meaning that even a little expansion has an important influence on sea-level rise.
- (2) Over the past century, warmer atmospheric temperatures have caused most glaciers, ice caps and ice sheets on land to melt at an accelerating rate. This increased run-off of melt-water to the sea has contributed to sea-level rise (note that melting of floating sea-ice does not cause sea-level rise).

In many locations, including the Pacific, natural sea-level changes due to tides, weather and climate variability can be quite large at any one time compared to sea-level rise through climate change alone. A small amount of overall,



Sea levels can change due to tides, winds, storms and climate features such as the El Niño Southern Oscillation (ENSO).



The regional distribution of projected sea-level rise for the period 2081–2100 relative to 1986–2005 from emissions scenario RCP4.5. The uncertainty is indicated by the contours (in centimetres).

long-term sea-level rise due to climate change will compound the effects of natural variability and cause an increase in extreme sea levels to happen more often.

How much has the sea level risen in the Pacific?

Tide gauges and satellites show that the average sea level in the Pacific has increased by about 15 cm in the last 100 years, and most estimates show that the rate of change has accelerated over the last few decades. This increase is due to global climate change but has not been the same everywhere in the Pacific.

How much will sea level rise in the future?

Future sea-level rise for Pacific island countries is likely to be similar to the global average. Projecting the amount of sea-level rise in the Pacific over the next 100 years is challenging because we do not know how much greenhouse gas human activities will

continue to emit. The amount of emissions determines the extent of global warming and therefore how fast ice sheets and glaciers will melt. Current estimates range between 20–60 cm by 2100, although scientists warn that larger rises could be possible.

What are the impacts of sea-level rise in the Pacific?

The impacts of sea-level rise in the Pacific are expected to include:

- more frequent and severe coastal flooding due to the combined effects of storm surge, high tides and higher sea levels
- increased erosion and shoreline changes
- saltwater contamination of freshwater aquifers, surface water storages and agricultural soils
- damage to inshore reef structures and ecosystems, including biodiversity and biological productivity.

Low-lying Pacific islands are particularly exposed to the physical impacts of sea-level rise. Local communities on these islands, with a high dependency on coastal resources and infrastructure for supporting sustainable livelihoods (such as housing, water and food security and health services) and for generating income (from fisheries, agriculture and tourism), are especially vulnerable to these impacts.

Building resilience for a more sustainable future

Sea-level rise is only one of many challenges that climate variability and change present to local communities in the western tropical Pacific. Adaptation is essential to enhance the resilience of the most vulnerable communities in the face of potential climate impacts.

The timely provision of reliable scientific understanding and evidence to inform decision-making will enable more effective and efficient adaptation planning; an essential requirement for securing sustainable development in the region.

CASE STUDY

Sea-level rise in Kiribati

Kiribati is a small island nation consisting of a series of low-lying atolls less than three metres above sea level. For this reason, rising sea levels pose very serious threats to Kiribati, including:

- Saltwater contamination of drinking water in wells, which could cause major health risks for communities.
- Saltwater contamination of soil, which limits agricultural production.
- Exacerbation of the impact of storm surges, which cause erosion and/or inundation of coastal infrastructure such as roads, ports and public and private buildings, including community places such as ‘maneaba’ meeting huts.



Aerial view of South Tarawa, Kiribati (above), showing concentration of communities, infrastructure and natural resources in low-lying coastal areas immediately adjacent to the Pacific and (left) sea wall under construction in Kiribati to combat rising sea level.

Other fact sheets in the series include: • Climate extremes in the western tropical Pacific • Climate variability and climate change in the western tropical Pacific • Large-scale climate features in the western tropical Pacific • Ocean acidification in the western tropical Pacific



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