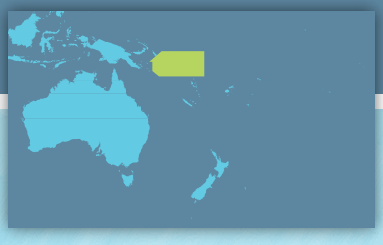
Pacific-Australia Climate Change Science and Adaptation Planning Program



Current and future climate of the **Solomon Islands**

> Solomon Islands Meteorological Service
> Australian Bureau of Meteorology
> Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Australian Government

Current climate of the **Solomon Islands**

Temperature

Temperatures in the Solomon Islands are relatively constant throughout the year with only very small changes from season to season. Across the Solomon Islands temperatures are strongly tied to changes in the surrounding ocean temperature. The country has two distinct seasons – a wet season from November to April and a dry season from May to October (Figure 1).

Rainfall

Honiara has a very marked wet season when on average almost 70% of the yearly total rain falls. In the dry season on average about 100 mm falls per month compared to upwards of 300 mm in wet season months. Further to the east, Santa Cruz receives more constant rainfall during the year, averaging between 280 mm and 420 mm per month.

Rainfall in the Solomon Islands is affected by the movement of the South Pacific Convergence Zone and the Intertropical Convergence Zone. These bands of heavy rainfall are caused by air rising over warm water where winds converge, resulting in thunderstorm activity. The South Pacific Convergence Zone extends across the Pacific Ocean from the Solomon Islands to the Cook Islands. The Intertropical Convergence Zone extends across the Pacific just north of the equator (Figure 2). The West Pacific Monsoon also influences rainfall in the Solomon Islands. The monsoon is driven by large differences in temperature between the land and the ocean, and its arrival usually brings a switch from very dry to very wet conditions.

Year-to-year variability

The climate of the Solomon Islands varies considerably from year to year due to the El Niño-Southern Oscillation. This is a natural climate pattern that occurs across the tropical Pacific Ocean and affects weather around the world. There are two extreme phases of the El Niño-Southern Oscillation: El Niño and La Niña. There is also a neutral phase. El Niño events bring warmer, drier wet season conditions, while La Niña events usually bring cooler, wetter wet seasons. The impact is stronger in Santa Cruz than in Honiara.

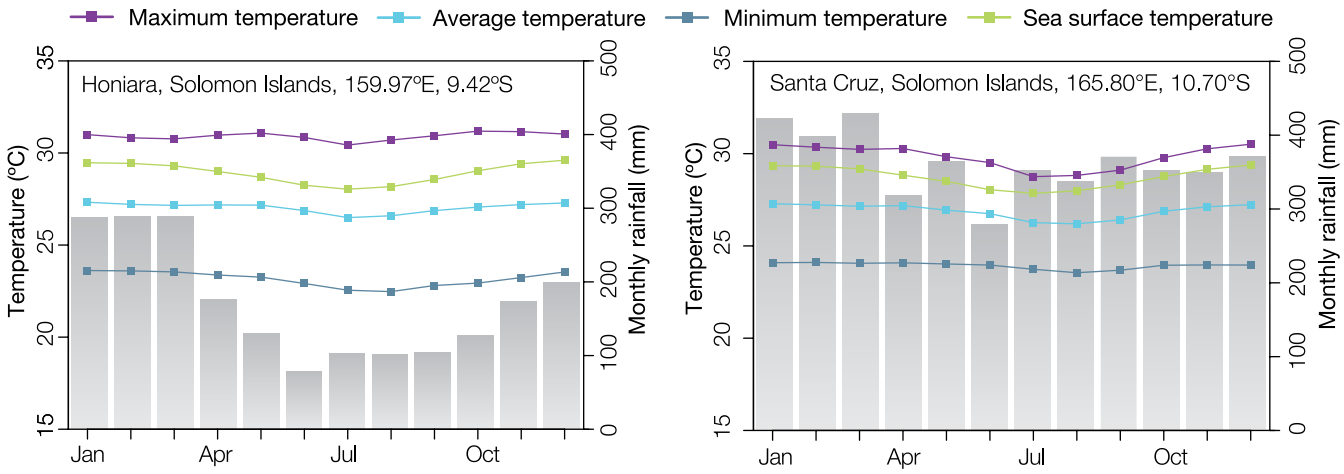


Figure 1: Seasonal rainfall and temperature at Honiara and Santa Cruz.

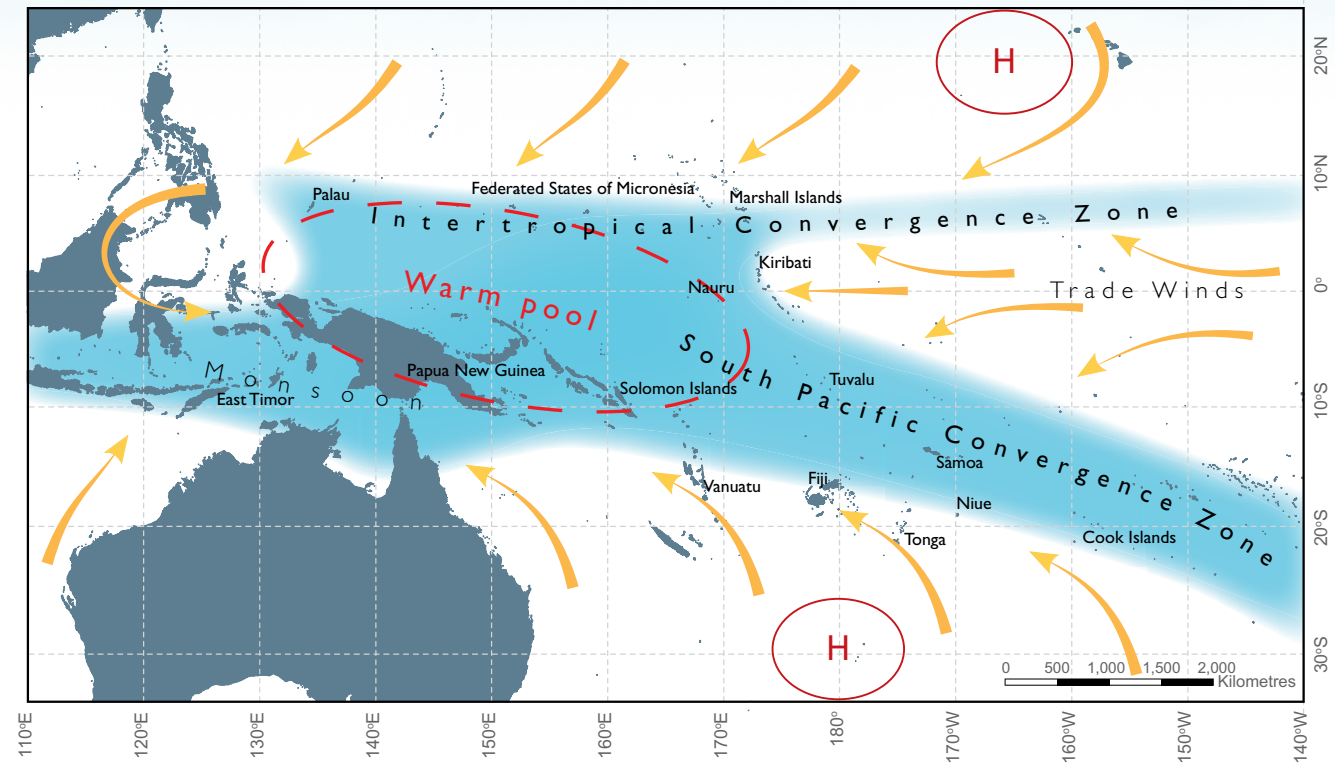


Figure 2: Average positions of the major climate features in November to April. The arrows show near surface winds, the blue shading represents the bands of rainfall convergence zones, the dashed oval shows the West Pacific Warm Pool and H represents typical positions of moving high pressure systems.

Tropical cyclones

Tropical cyclones result in flooding and wind damage in the Solomon Islands. There have been severe floods on Guadalcanal, Malaita, Makira and Santa Isabel in recent years with a number of lives lost, and severe damage to agriculture and infrastructure.

Tropical cyclones tend to affect the Solomon Islands between November and April. In the 42-year period between the 1969 and 2010 seasons, 120 tropical cyclones developed in or crossed into the Solomon Islands Exclusive Economic Zone, an average of 29 cyclones per decade (Figure 3). The number of cyclones varies widely from year to year, with none in some seasons but up to eight in others. Over this period cyclones occurred most frequently during El Niño years.

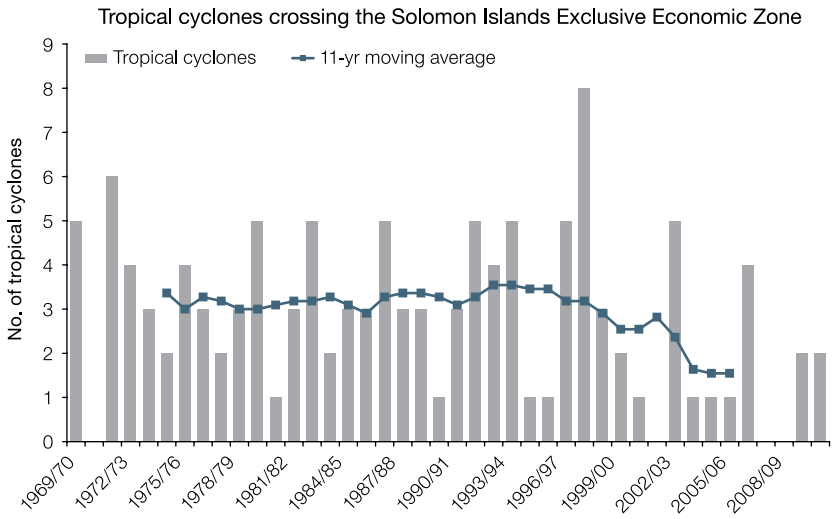


Figure 3: Number of tropical cyclones developing within and crossing the Solomon Islands Exclusive Economic Zone per season. The 11-year moving average is in blue.

Wind-driven waves

Wind-waves around the Solomon Islands vary across the country. They are relatively small at Honiara (Figure 4, top), while at the outlying islands such as Santa Cruz the waves are much larger (Figure 4, bottom). Seasonally, waves are influenced by the trade winds and the West Pacific Monsoon. Waves are from the east and north-east from April to November, and from the north from December to March. From year to year they vary with the El Niño–Southern Oscillation.

Coastal village of Lilisiana, Malaita Province.

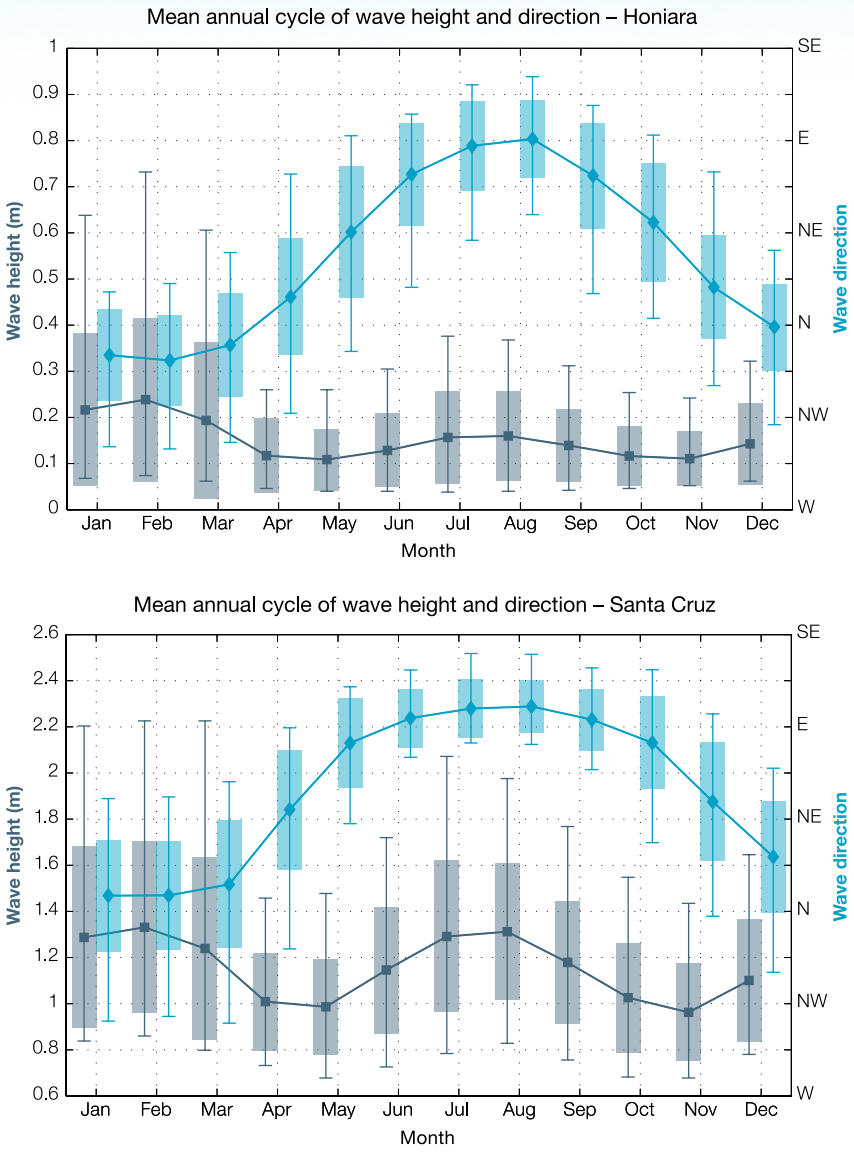


Figure 4: Annual cycle of wave height (grey) and wave direction (blue) at Honiara (top) and Santa Cruz (bottom) based on data from 1979–2009. The shaded boxes represent one standard deviation around the monthly means, and the error bars indicate the 5–95% range, showing the year-to-year variability in wave climate. The direction from which the waves are travelling is shown (not the direction towards which they are travelling).

Changing climate of the **Solomon Islands**

Temperatures have increased

Annual and seasonal mean temperatures at Honiara and Munda have increased since 1953 and 1962 respectively (Figure 5). Annual temperatures have increased at a rate of 0.12°C per decade at Honiara and 0.14°C per decade at Munda. Annual minimum temperatures have increased by 0.17°C per decade at Honiara and 0.18°C per decade at Munda over the same period. There have also been increases in the number of warm nights and decreases in the number of cool nights at both sites. These temperature increases are consistent with the global pattern of warming.

Rainfall varies from year to year

There are no clear trends in rainfall over the Solomon Islands since the mid-1950s (Figure 5). Over this period there has been substantial variation in rainfall from year to year. There has also been little change in extreme daily rainfall over the same period.

Sea level has risen

As ocean water warms it expands causing the sea level to rise. The melting of glaciers and ice sheets also contributes to sea-level rise.

Instruments mounted on satellites and tide gauges are used to measure sea level. Satellite data indicate the sea level has risen near the Solomon Islands by about 8 mm per year since 1993. This is larger than the global average of 2.8–3.6 mm per year. This higher rate of rise may be partly related to natural fluctuations that take place year to year or decade to decade caused by phenomena such as the El Niño-Southern Oscillation. This variation in sea level can be seen in Figure 7 which includes the tide gauge record since 1974 and satellite data since 1993.

Ocean acidification has been increasing

About one quarter of the carbon dioxide emitted from human activities each year is absorbed by the oceans. As the extra carbon dioxide reacts with sea water it causes the ocean to become slightly more acidic. This impacts the growth of corals and organisms that construct their skeletons from carbonate minerals. These species are critical to the balance of tropical reef ecosystems. Data show that since the 18th century the level of ocean acidification has been slowly increasing in the Solomon Islands' waters.

Aerial view of Western Province.

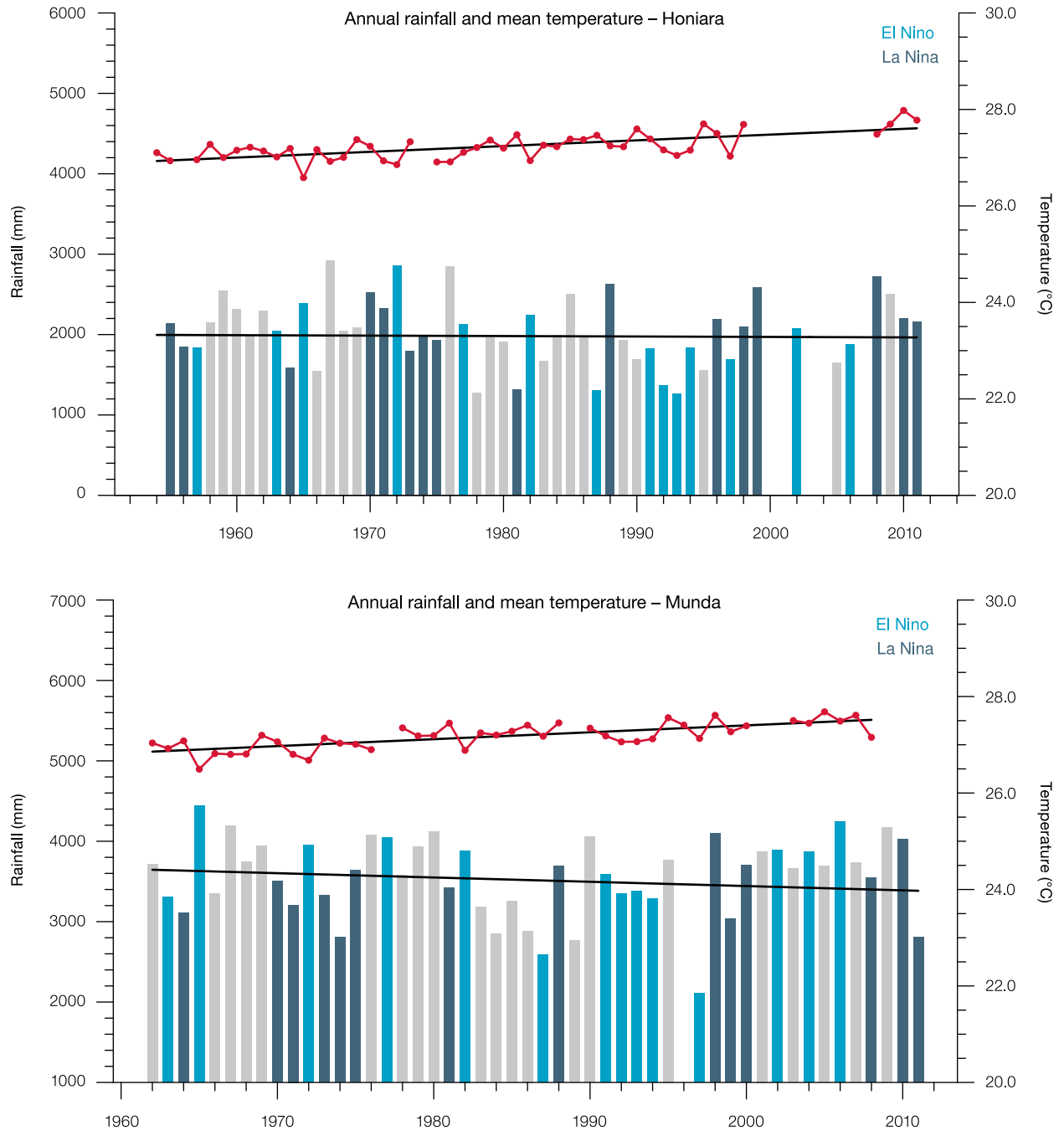


Figure 5: Annual average air temperature (red dots and line) and total rainfall (bars) at Honiara (top) and Munda (bottom). Light blue, dark blue and grey bars indicate El Niño, La Niña and neutral years respectively. No bars indicate that data is not available. The solid black lines show the trends.

Future climate of the **Solomon Islands**

Climate impacts almost all aspects of life in the Solomon Islands. Understanding the possible future climate of the Solomon Islands is important so people and the government can plan for changes.

At a glance

- El Niño and La Niña events will continue to occur in the future, but there is little consensus on whether these events will change in intensity or frequency.

- Annual mean temperatures and extremely high daily temperatures will continue to rise.

- Annual rainfall is projected to increase slightly, with more extreme rain events.
- Incidence of drought is projected to decrease slightly.

- Sea level will continue to rise.
- Ocean acidification is expected to continue.
- The risk of coral bleaching is expected to increase.
- December-March wave heights are projected to decrease, while there are no significant changes projected in June–September waves.

- Tropical cyclones are projected to be less frequent but more intense.

Temperatures will continue to increase

Projections for all emissions scenarios indicate that the annual average air temperature and sea-surface temperature will increase in the future in the Solomon Islands (Table 1). By 2030, under a very high emissions scenario, this increase in temperature is projected to be in the range of 0.5–1.0°C. Later in the century the range of the projected temperature increase under the different scenarios broadens.

Table 1: Projected changes in the annual average surface air temperature for the Solomon Islands. Values represent 90% of the range of the models and are relative to the period 1986–2005.

	2030 (°C)	2050 (°C)	2070 (°C)	2090 (°C)
Very low emissions scenario	0.4–0.9	0.6–1.2	0.4–1.2	0.4–1.2
Low emissions scenario	0.4–1.0	0.7–1.4	0.9–1.8	1.0–2.1
Medium emissions scenario	0.5–0.9	0.7–1.4	1.0–2.0	1.3–2.6
Very high emissions scenario	0.5–1.0	1.0–1.9	1.5–3.0	2.0–4.0

More very hot days

Increases in average temperatures will also result in a rise in the number of hot days and warm nights and a decline in cooler weather.

Changing rainfall patterns

Average annual and season rainfall is projected to increase over the course of the 21st century. However, there is some uncertainty in the rainfall projections and not all models show consistent results. Wet and dry years will still occur in response to natural variability. Drought frequency is expected to decrease slightly by the end of the century.

More extreme rainfall days

Projections show extreme rainfall days are likely to occur more often and be more intense.

Less frequent tropical cyclones

On a global scale, the projections indicate there is likely to be a decrease in the number of tropical cyclones by the end of the 21st century. But there is likely to be an increase in the average maximum wind speed of cyclones by between 2% and 11% and an increase in rainfall intensity of about 20% within 100 km of the cyclone centre.

In the Solomon Islands' region, projections tend to show a decrease in the frequency of tropical cyclones by the late 21st century.

Damage from Tropical Cyclone Zoe in Tikopia, Temotu Province, 2002.

King tide, Ta'arutona, West Are'Are, Malaita Province, 2008.

Photos courtesy of the Ministry of Environment, Climate Change, Disaster Management and Meteorology

Sea level will continue to rise

Sea level is expected to continue to rise in the Solomon Islands (Table 2 and Figure 7). By 2030, under a very high emissions scenario, this rise in sea level is projected to be in the range of 8–18 cm. The sea-level rise combined with natural year-to-year changes will increase the impact of storm surges and coastal flooding. As there is still much to learn, particularly how large ice sheets such as Antarctica and Greenland contribute to sea-level rise, scientists warn larger rises than currently predicted could be possible.

Ocean acidification will continue

Under all four emissions scenarios the acidity level of sea waters in the Solomon Islands region will continue to increase over the 21st century, with the greatest change under the very high emissions scenario. The impact of increased acidification on the health of reef ecosystems is likely to be compounded by other stressors including coral bleaching, storm damage and fishing pressure.

Wave climate will change

December to March wave heights are projected to decrease, while there are no significant changes projected in June to September waves. Wave period is also projected to decrease during December to March.

Table 2: Sea-level rise projections for the Solomon Islands. Values represent 90% of the range of the model results and are relative to the period 1986–2005.

	2030 (cm)	2050 (cm)	2070 (cm)	2090 (cm)
Very low emissions scenario	8–18	14–31	19–45	24–60
Low emissions scenario	7–17	14–31	21–48	29–67
Medium emissions scenario	7–17	14–30	21–47	30–69
Very high emissions scenario	8–18	16–35	28–58	40–89

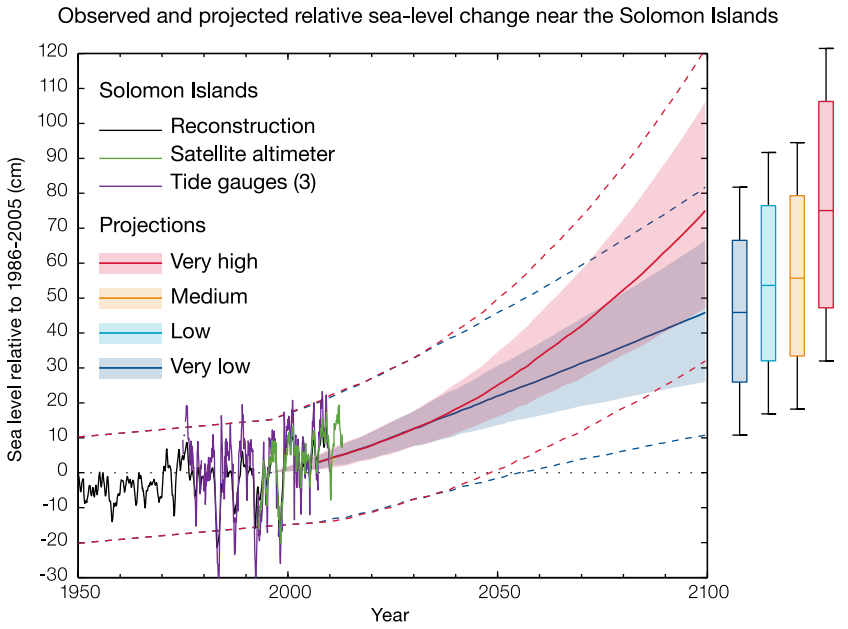


Figure 7: Tide-gauge records of relative sea level (since 1974) are indicated in purple, and the satellite record (since 1993) in green. The reconstructed sea level data at the Solomon Islands (since 1950) is shown in black. Multi-model mean projections from 1995–2100 are given for the very high (red solid line) and very low emissions scenarios (blue solid line), with the 5–95% uncertainty range shown by the red and blue shaded regions. The ranges of projections for the four emissions scenarios by 2100 are also shown by the bars on the right. The dashed lines are an estimate of year-to-year variability in sea level (5–95% uncertainty range about the projections) and indicate that individual monthly averages of sea level can be above or below longer-term averages.

How do scientists develop climate projections?

Global climate models are the best tools for understanding future climate change. Climate models are mathematical representations of the climate system that require very powerful computers. They are based on the laws of physics and include information about the atmosphere, ocean, land and ice.

There are many different global climate models and they all represent the climate slightly differently. Scientists from the Pacific Climate Change Science and Adaptation Planning Program have evaluated 26 models from around the world and found that 24 best represent the climate of the Solomon Islands region of the western tropical Pacific. These 24 models have been used to develop climate projections for the Solomon Islands.

The future climate will be determined by a combination of natural and human factors. As we do not know what the future holds, we need to consider a range of possible future conditions, or scenarios, in climate models. Greenhouse gas and aerosol emissions scenarios are used in climate modelling to provide projections that represent a range of possible futures. The Intergovernmental Panel on Climate Change (IPCC) has developed four greenhouse gas and emissions scenarios, called Representative Concentration Pathways (RCPs). These scenarios cover a broad range of possibilities. For example, the lowest scenario shows the likely outcome if global emissions are significantly reduced, while the highest scenario shows the impact of a pathway with no policy of reducing emissions.

The climate projections for the Solomon Islands are based on the four IPCC RCPs: very low emissions (RCP2.6), low emissions (RCP4.5), medium emissions (RCP6.0) and very high emissions (RCP8.5), for four 20-year time periods centred on 2030, 2050, 2070 and 2090, relative to a 20-year period centred on 1995 (Figure 8). Since individual models give different results, the projections are presented as a range of values. When interpreting projected changes in the mean climate in the Pacific, it is important to keep in mind that natural climate variability, such as the state of the El Niño-Southern Oscillation, strongly affects the climate from one year to the next.

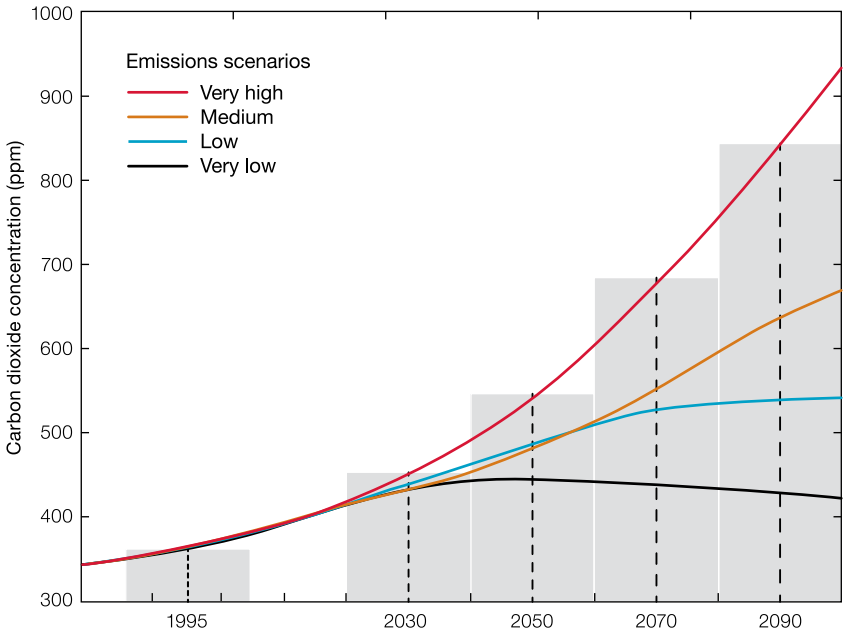


Figure 8: Carbon dioxide concentrations (parts per million, ppm) associated with the very low (RCP2.6), low (RCP4.5), medium (RCP6.0) and very high (RCP8.5) emissions scenarios for 20-year time periods (shaded) centred on 1995 (the reference period), 2030, 2050, 2070 and 2090.

This brochure contains a summary of climate projections for the Solomon Islands. For more information refer to the technical reports *Climate Change in the Pacific: Scientific Assessment and New Research (Volume 2)* and *Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports.*

These reports are available at **www.pacificclimatechangescience.org**.

Climate projections are also available through the web-based Pacific Climate Futures tool at **www.pacificclimatefutures.net**.

Changes in the **Solomon Islands' climate**

> Temperatures have warmed and will continue to warm with more very hot days in the future.

> Rainfall shows no clear trend since the mid-1950s. Projections of annual rainfall are unclear with some models suggesting a slight increase by the end of the century. Extreme rainfall events are projected to become more frequent and more intense. Drought frequency is projected to decrease slightly by the end of the century.

> By the end of this century projections suggest the frequency of tropical cyclones will decrease.

> Sea level near the Solomon Islands has risen and will continue to rise throughout this century.

> Ocean acidification has been increasing in the Solomon Islands' waters. It will continue to increase and threaten coral reef ecosystems.

> December to March wave heights and period are projected to decrease.

This publication updates the original *Current and future climate of the Solomon Islands* brochure published in 2011.

The content of this brochure is the result of a collaborative effort between the Solomon Islands Meteorological Service and the Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) Program – a component of the Australian Government's International Climate Change Adaptation Initiative. The information in this publication, and research conducted by PACCSAP, builds on the findings of the 2013 IPCC Fifth Assessment Report, and uses new emissions scenarios and climate models.

For more detailed information on the climate of the Solomon Islands and the Pacific see *Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports* (2014) and *Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports* (2011).

www.pacificclimatechangescience.org

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