International CLIMATE CHANGE ADAPTATION Initiative

Pacific Climate Change Science 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

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).

Honiara has a very marked wet season when on average almost 70% of the yearly total rain falls. In the dry season (May to October) 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.

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.

extreme weather events

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.

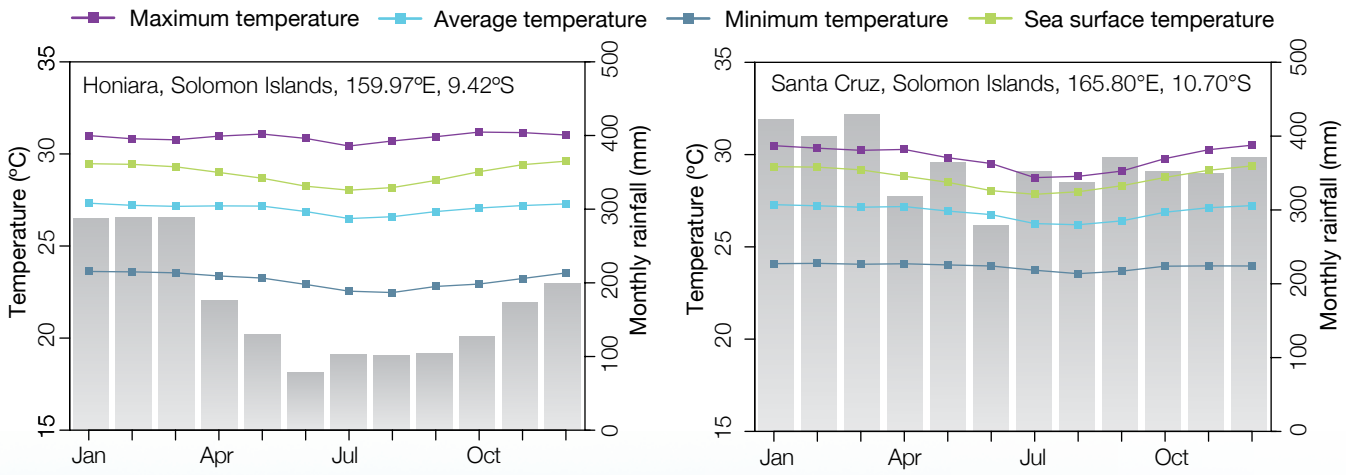

Figure 1: Seasonal rainfall and temperature at Honiara and Santa Cruz.

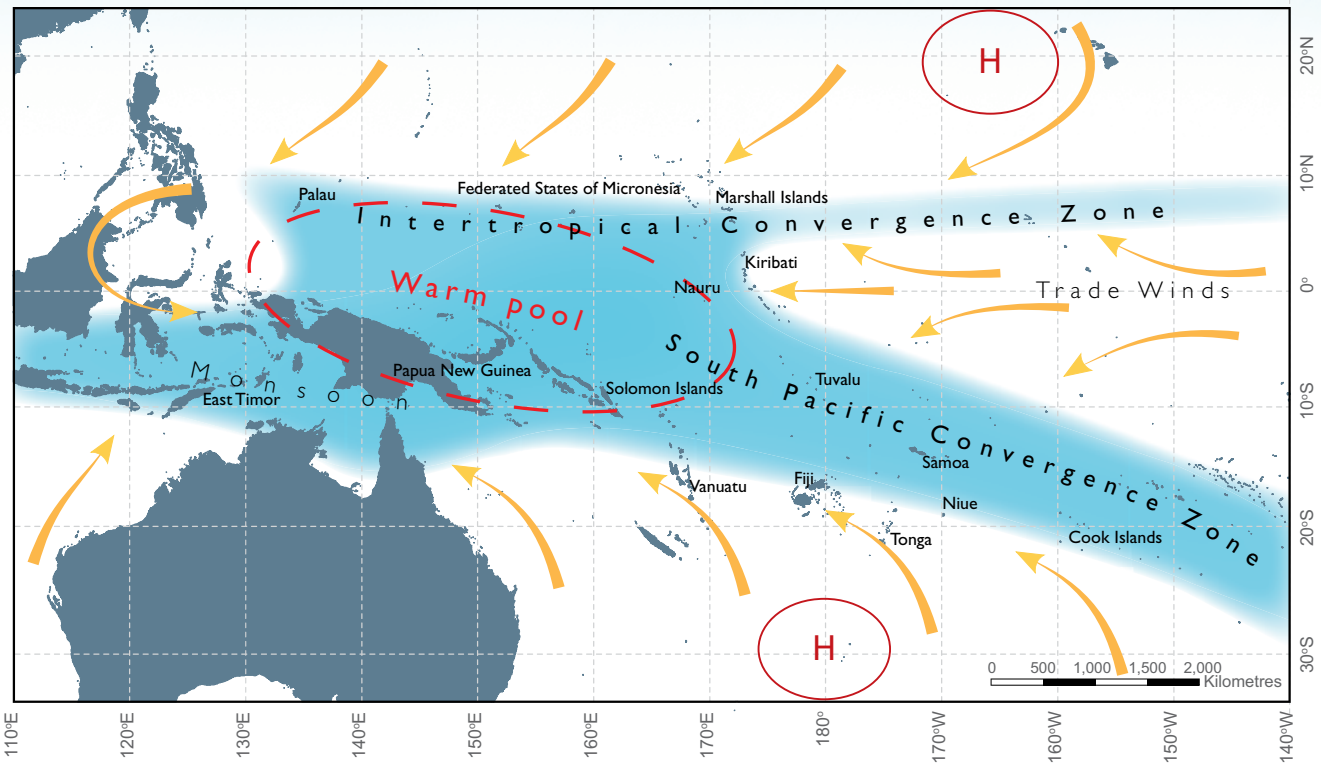

Figure 2: The average positions of the major climate features in November to April. The arrows show near surface winds, the blue shading represents the bands of rainfall convergence zones, the dashed oval shows the West Pacific Warm Pool and H represents typical positions of moving high pressure systems.

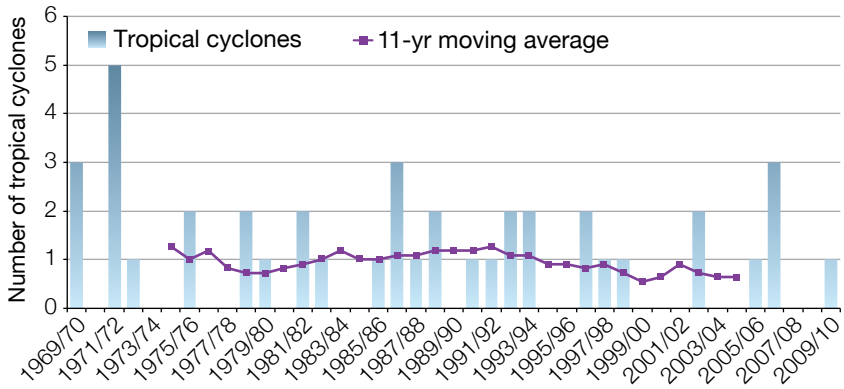

Figure 3: Number of tropical cyclones passing within 400 km of Honiara. Eleven-year moving average in purple.

Tropical cyclones

Tropical cyclones affect the Solomon Islands between November and April. In the 41-year period between 1969 and 2010, 41 tropical cyclones passed within 400 km of Honiara, an average of one cyclone per season (Figure 3). The number of cyclones varies widely from year to year, with none in some seasons but up to five in others. Over the period 1969–2010, cyclones occured more frequently in El Niño years.

Changing climate
of the Solomon Islands

Temperatures have increased

Annual maximum and minimum temperatures have increased in Honiara since 1951 (Figure 4). Maximum temperatures have increased at a rate of 0.15°C per decade since 1951. These temperature increases are consistent with the global pattern of warming.

No rainfall change

Data for Honiara since 1950 show no clear trends in annual or seasonal rainfall. Over this period, there has been substantial variation in rainfall from year to year.

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.

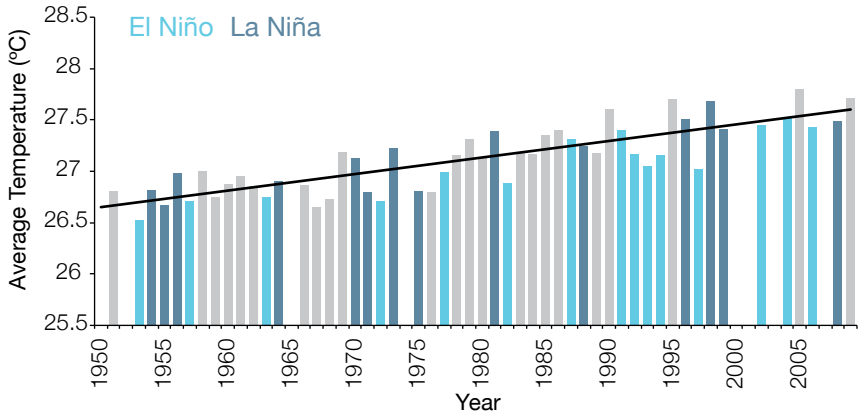

Figure 4: Annual average temperature for Honiara. Light blue bars indicate El Niño years, dark blue bars indicate La Niña years and the grey bars indicate neutral years.

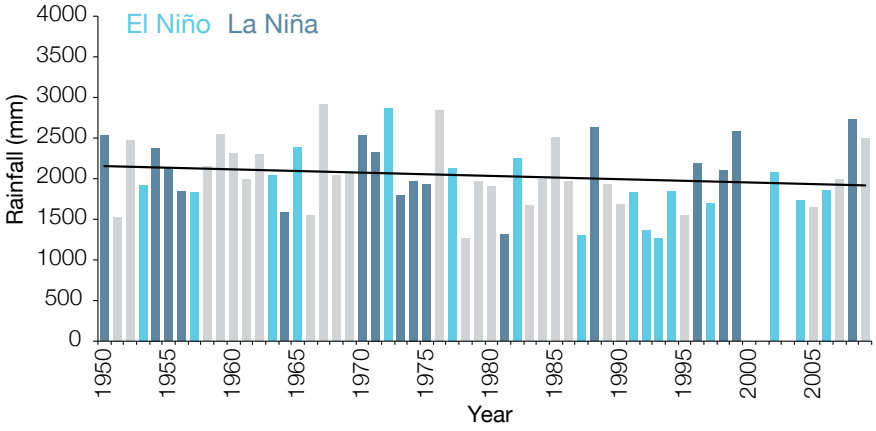

Figure 5: Annual rainfall for Honiara. Light blue bars indicate El Niño years, dark blue bars indicate La Niña years and the grey bars indicate neutral years.

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.

Coastal village of Lilisiana, Malaita Province.

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.

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 Program (PCCSP) have evaluated 24 models from around the world and found that 18 best represent the climate of the western tropical Pacific region. These 18 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. The Intergovernmental Panel on Climate Change (IPCC) developed a series of plausible scenarios based on a set of assumptions about future population changes, economic development and technological advances. For example, the A1B (or medium) emissions scenario envisages global population peaking mid-century and declining thereafter, very rapid economic growth, and rapid introduction of new and more efficient technologies. Greenhouse gas and aerosol emissions scenarios are used in climate modelling to provide projections that represent a range of possible futures.

The climate projections for the Solomon Islands are based on three IPCC emissions scenarios: low (B1), medium (A1B) and high (A2), for time periods around 2030, 2055 and 2090 (Figure 6). Since individual models give different results, the projections are presented as a range of values.

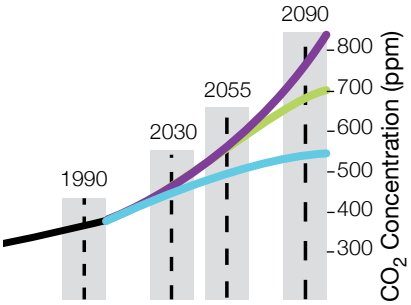

Figure 6: Carbon dioxide (CO_2) concentrations (parts per million, ppm) associated with three IPCC emissions scenarios: low emissions (B1 – blue), medium emissions (A1B – green) and high emissions (A2 – purple). The PCCSP has analysed climate model results for periods centred on 1990, 2030, 2055 and 2090 (shaded).

Aerial view of Western Province.

Flooding, Sikaiana Atoll, Malaita Province 2006.

Ministry of Environment, Climate Change, Disaster Management and Meteorology

Future climate of the Solomon Islands

This is a summary of climate projections for the Solomon Islands. For further information refer to Volume 2 of *Climate Change in the Pacific: Scientific Assessment and New Research*, and the web-based climate projections tool – *Pacific Climate Futures* (available at www.pacificclimatefutures.net).

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 high emissions scenario, this increase in temperature is projected to be in the range of 0.4–1.0°C.

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.

Table 1: Projected annual average air temperature changes for the Solomon Islands for three emissions scenarios and three time periods. Values represent 90% of the range of the models and changes are relative to the average of the period 1980-1999.

	2030 (°C)	2055 (°C)	2090 (°C)
Low emissions scenario	0.2–1.0	0.7–1.5	0.9–2.1
Medium emissions scenario	0.4–1.2	0.9–1.9	1.5–3.1
High emissions scenario	0.4–1.0	1.0–1.8	2.1–3.3

Above: king tide, Ta'arutona, West Are'Are, Malaita Province, 2008.

Right: damage from Tropical Cyclone Zoe in Tikopia, Temotu Province, 2002.

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

Changing rainfall patterns

Average annual and season rainfall is projected to increase over the course of the 21st century. Wet season increases are likely due to the expected intensification of the South Pacific Convergence Zone and the Western Pacific Monsoon. However, there is some uncertainty in the rainfall projections and not all models show consistent results. Drought projections are inconsistent across the Solomon Islands.

More extreme rainfall days

Model projections show extreme rainfall days are likely to occur more often.

Less frequent but more intense 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 and an increase in the proportion of the more intense storms.

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 high emissions scenario, this rise in sea level is projected to be in the range of 4-15 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.

Table 2: Sea-level rise projections for the Solomon Islands for three emissions scenarios and three time periods. Values represent 90% of the range of the models and changes are relative to the average of the period 1980-1999.

	2030 (cm)	2055 (cm)	2090 (cm)
Low emissions scenario	4–14	10–26	17–45
Medium emissions scenario	5–14	8–30	19–58
High emissions scenario	4–15	8–30	20–60

Ocean acidification will continue

Under all three emissions scenarios (low, medium and high) 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 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.

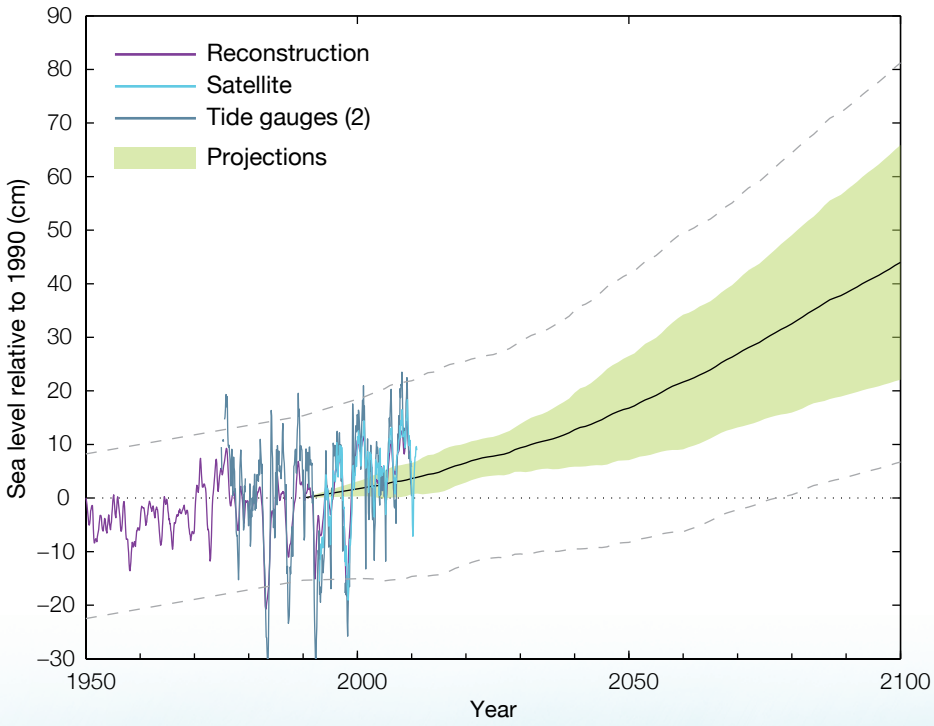

Figure 7: Observed and projected relative sea-level change in Solomon Islands. The observed sea-level records are indicated in dark blue (relative tide-gauge observations) and light blue (the satellite record since 1993). Reconstructed estimates of sea level near the Solomon Islands (since 1950) are shown in purple. The projections for the A1B (medium) emissions scenario (representing 90% of the range of models) are shown by the shaded green region from 1990 to 2100. The dashed lines are an estimate of 90% of the range of natural year-to-year variability in sea level.

Changes in the **Solomon Islands' climate**

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

> Rainfall at Honiara shows no clear trend since 1950. Rainfall is generally projected to increase over this century with more extreme rainfall days expected.

> By the end of this century projections suggest decreasing numbers of tropical cyclones but a possible shift towards more intense categories.

> 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.

The content of this brochure is the result of a collaborative effort between the Solomon Islands Meteorological Service and the Pacific Climate Change Science Program – a component of the Australian Government's International Climate Change Adaptation Initiative. This information and research conducted by the Pacific Climate Change Science Program builds on the findings of the 2007 IPCC Fourth Assessment Report. For more detailed information on the climate of the Solomon Islands and the Pacific see: *Climate Change in the Pacific: Scientific Assessment and New Research. Volume 1: Regional Overview. Volume 2: Country Reports.* Available from November 2011.

www.pacificclimatechangescience.org

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