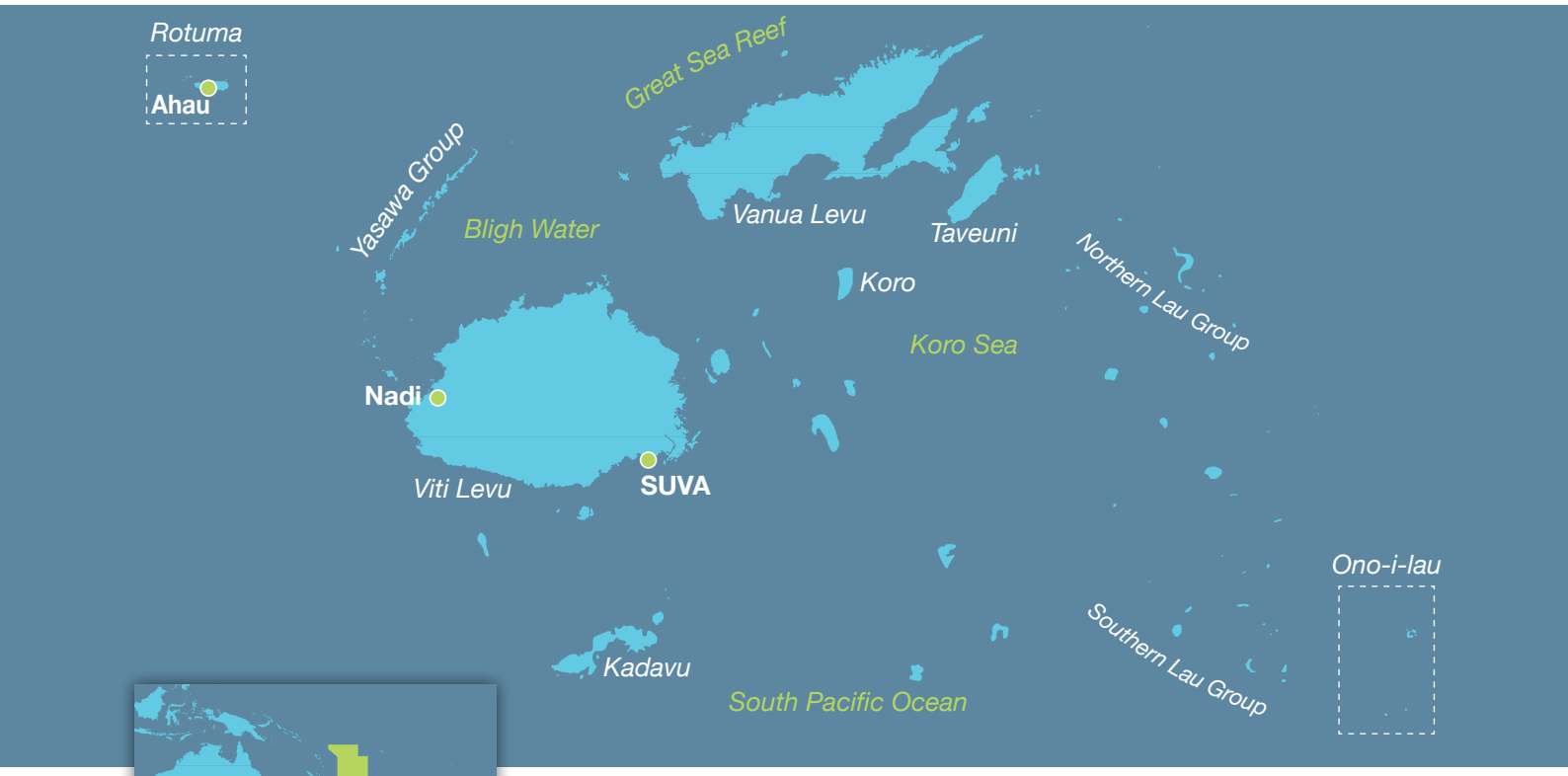
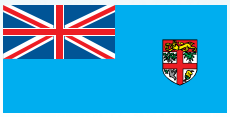
International CLIMATE CHANGE ADAPTATION Initiative

Pacific Climate Change Science Program



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



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

Australian Government

Fiji's **current climate**

Across Fiji the annual average temperature is between 20-27°C. Changes in the temperature from season to season are relatively small and strongly tied to changes in the surrounding ocean temperature.

Around the coast, the average night-time temperatures can be as low as 18°C and the average maximum day-time temperatures can be as high as 32°C. In the central parts of the main islands, average night-time temperatures can be as low as 15ºC. The country has two distinct seasons – a warm wet season from November to April and a cooler dry season from May to October (Figure 1).

Much of Fiji's rainfall is associated with the movement of the South Pacific Convergence Zone which is closest to Fiji in the wet season. This band of heavy rainfall is caused by air rising over warm water where winds converge, resulting in thunderstorm activity. It extends across the South Pacific Ocean from the Solomon Islands to east of the Cook Islands with its southern edge usually lying near Fiji (Figure 2).

Rainfall across Fiji can be highly variable. On Fiji's two main islands, Viti Levu and Vanua Levu, rainfall is strongly influenced by high mountain peaks up to 1300 m. On the south-eastern slopes of Viti Levu, near Suva, the average annual rainfall is about 3000 mm. In contrast, the lowlands on the western side of Viti Levu, near Nadi, are sheltered by the mountains and have an annual average rainfall of 1800 mm with a well-defined dry season favourable to crops such as sugar cane.

Fiji's climate is also influenced by the trade winds, which blow from the east or south-east. The trade winds bring moisture onshore causing heavy showers in the mountain regions.

Fiji's climate 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. In Suva, El Niño events tend to bring dry seasons that are drier and cooler than normal, while La Niña events usually bring wetter than normal conditions.

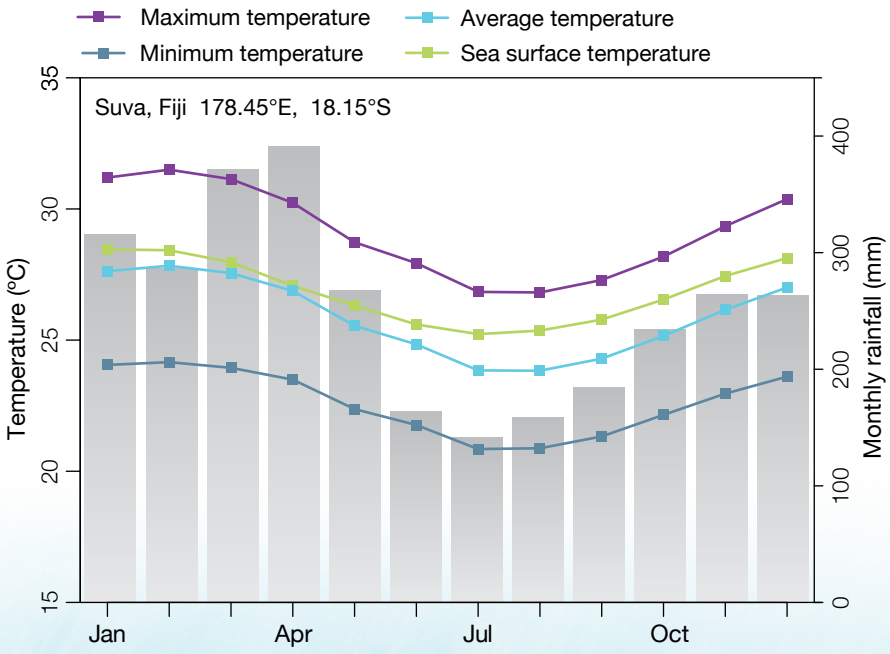


Figure 1: Seasonal rainfall and temperature at Suva.

Floods and **droughts**

River flooding occurs almost every wet season and occasionally in the dry season during La Niña events. Major floods tend to be associated with severe weather events, such as tropical depressions and cyclones that bring high intensity rainfall.

Most meteorological droughts since 1920 are associated with El Niño events. Recent severe droughts occurred in 1987, 1992, 1997-98, 2003 and 2010 (Figure 5).

Fiji Meteorological Service

2003 drought, Yaqara, northern Viti Levu.

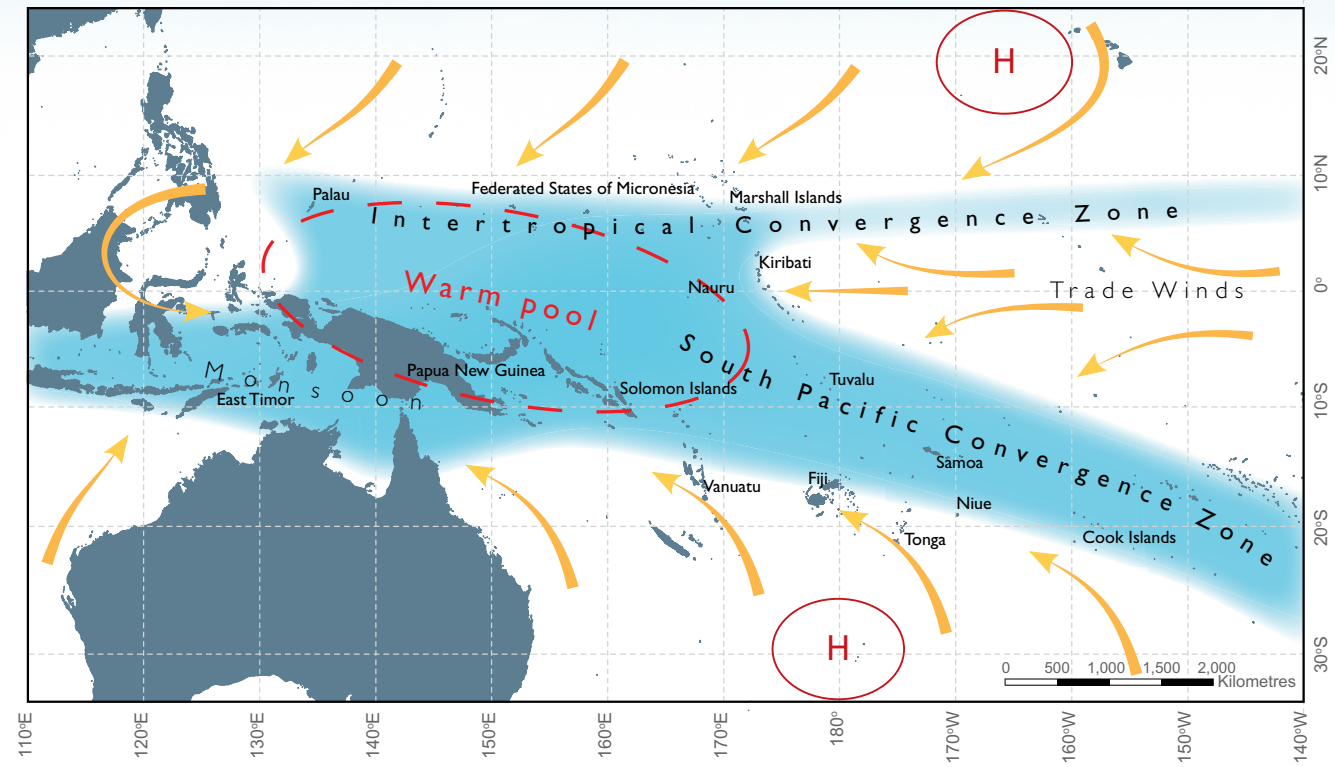


Figure 2: The average positions of the major climate features in November to April. The arrows show near surface winds, the blue shading represents the bands of rainfall convergence zones, the dashed oval shows the West Pacific Warm Pool and H represents typical positions of moving high pressure systems.

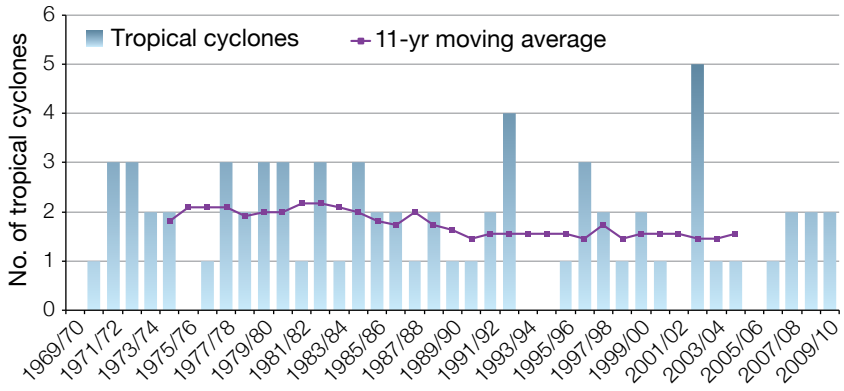


Figure 3: Number of tropical cyclones passing within 400 km of Suva. Eleven-year moving average in purple.

Tropical cyclones

Tropical cyclones usually affect Fiji between November and April, and occasionally in October and May in El Niño years. In the 41-year period between 1969 and 2010, 70 tropical cyclones passed within 400 km of Suva, an average of one to two cyclones per season. Over this period, cyclones occurred more frequently in El Niño years.

Fiji's **changing climate**

Temperatures have increased

Annual maximum and minimum temperatures have increased in both Suva (Figure 4) and Nadi since 1950. In Suva, maximum temperatures have increased at a rate of 0.15°C per decade and at Nadi Airport the rate of increase has been 0.18°C per decade. These temperature increases are consistent with the global pattern of warming.

No rainfall change

Data for Suva and Nadi Airport (Figure 5) 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. Instruments mounted on satellites and tide gauges are used to measure sea level. Satellite data indicate sea level has risen in Fiji by about 6 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. The natural variation in sea level can be seen in Figure 7 which includes the tide gauge record since 1972 and the 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 Fiji's waters.

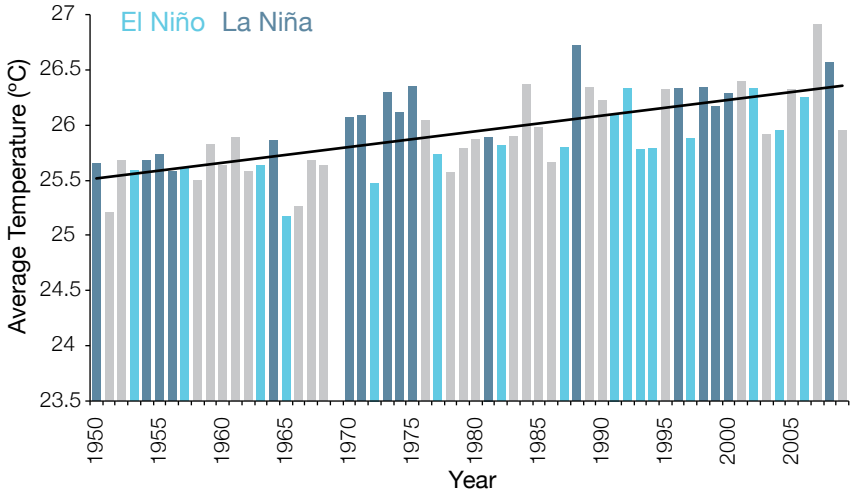


Figure 4: Annual average temperature for Suva. Light blue bars indicate El Niño years, dark blue bars indicate La Niña years and the grey bars indicate neutral years.

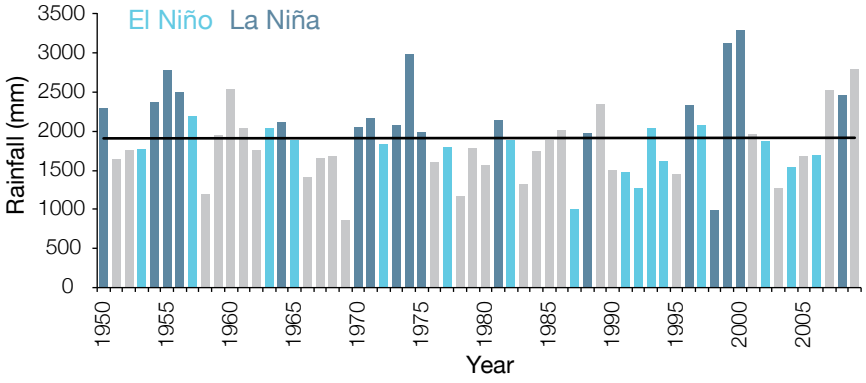


Figure 5: Annual rainfall for Nadi Airport. Light blue bars indicate El Niño years, dark blue bars indicate La Niña years and the grey bars indicate neutral years.

Taking rainfall observations, Laucala Bay Meteorology Office.

Fiji's **future climate**

Climate impacts almost all aspects of life in Fiji. Understanding the possible future climate of Fiji 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 Fiji.

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 Fiji 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.

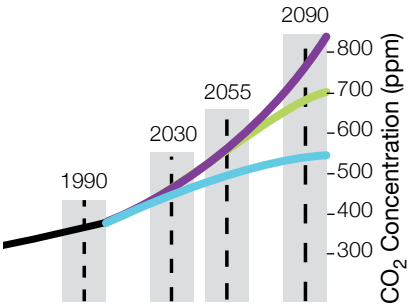


Figure 6: Carbon dioxide (CO_2) concentrations (parts per million, ppm) associated with three IPCC emissions scenarios: low emissions (B1 – blue), medium emissions (A1B – green) and high emissions (A2 – purple). The PCCSP has analysed climate model results for periods centred on 1990, 2030, 2055 and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

Rain clouds, Coral Coast, Viti Levu.

Coral Coast, Viti Levu.

Fiji's **future climate**

This is a summary of climate projections for Fiji. 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).

Temperature 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 Fiji (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 the average temperature 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 Fiji 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	0.5–1.5	0.7–2.1
Medium emissions scenario	0.2–1.2	0.9–1.9	1.3–2.9
High emissions scenario	0.4–1.0	1.1–1.7	2.0–3.2

Changing rainfall patterns

There is uncertainty around rainfall projections as model results are not consistent. However, projections generally suggest a decrease in dry season rainfall and an increase in wet season rainfall over the course of the 21st century. Increased wet season rainfall is expected due to the projected intensification of the South Pacific Convergence Zone. Drought projections are inconsistent for Fiji.

More extreme rainfall days

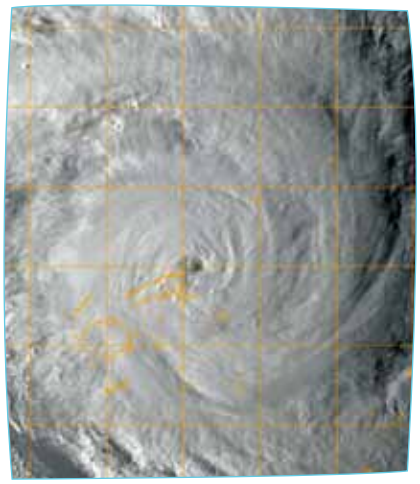
Model projections show extreme rainfall days are likely to occur more often.

Bridge across the Sigatoka River partially destroyed by severe flooding in January 2009.

Less frequent but more intense tropical cyclones

On a global scale, 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 Fiji 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.



National Oceanic and Atmospheric Administration

Tropical Cyclone Tomas (Category 4) struck Fiji in March 2010 causing significant damage.

Sea level will continue to rise

Sea level is expected to continue to rise in Fiji (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 3-16 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 Fiji 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	5–16	10–27	16–47
Medium emissions scenario	5–15	9–31	20–59
High emissions scenario	3–16	8–31	21–62

Ocean acidification will continue

Under all three emissions scenarios (low, medium and high) the acidity level of sea waters in the Fiji 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.

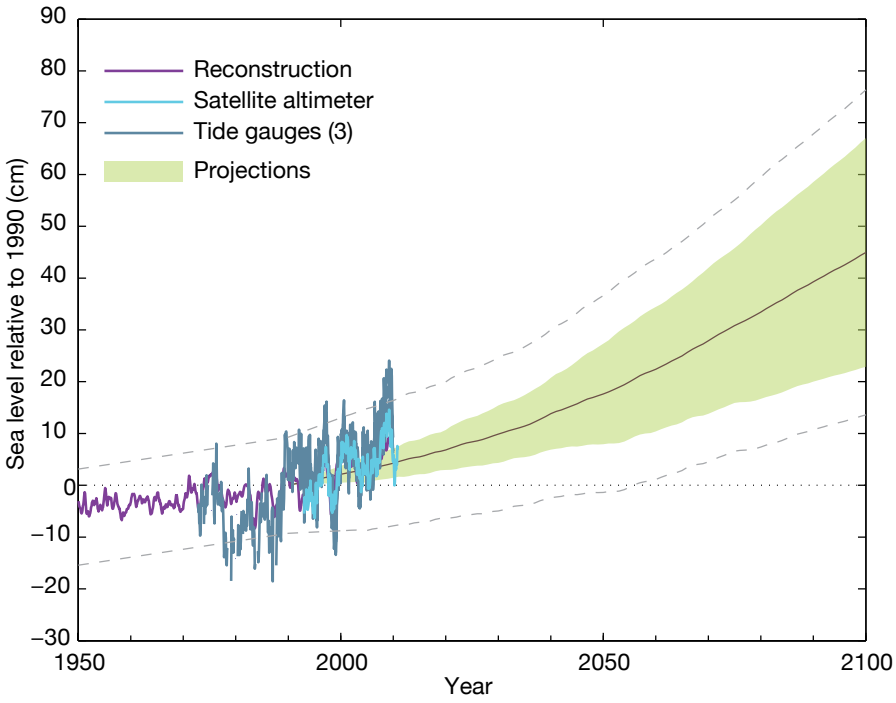


Figure 7: Observed and projected relative sea-level change near Fiji. The observed sea-level records are indicated in dark blue (relative tide-gauge observations) and light blue (the satellite record since 1993). Reconstructed estimates of sea level near Fiji (since 1950) are shown in purple. The projections 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 Fiji's climate

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

> Rainfall at Suva and Nadi Airport shows no clear trend since 1950. Rainfall patterns are projected to change 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 Fiji has risen and will continue to rise throughout this century.

> Ocean acidification has been increasing in Fiji's 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 Fiji 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 Fiji 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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