Pacific-Australia Climate Change Science and Adaptation Planning Program (PACCSAP)

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Climate variability and climate change in the western tropical Pacific

Each region of the world has its own unique climate, which is the typical weather the region experiences. Natural cycles cause variations in the climate on timescales of months, seasons and years. Climate change occurs over much longer timescales as a result of natural processes and human activities.

What is the difference between weather and climate?

Weather refers to atmospheric conditions such as temperature and rainfall over a short period of time (a few hours or a few days).

Climate is the average pattern of weather for a particular place over a long period of time, usually at least 30 years. The natural variation in climate that typically occurs from month to month, season to season, year to year and decade to decade is referred to as **climate variability**.

Climate change refers to the long-term changes in the climate that occur over decades, centuries or longer. Climate change is both a natural and a man-made phenomenon. This can mean a long-term change in average climate conditions (such as rainfall and temperature) and/or a change in extreme weather events (such as tropical cyclones and droughts). On a global scale, temperatures are increasing and long-term weather patterns are changing. Anthropogenic (man-made) climate change is caused by rapidly increasing greenhouse gas levels in the Earth's atmosphere due mostly to burning fossil fuels (such as coal, oil and natural gas). Natural climate change is usually much slower and driven by changes in sunspot activity, the Earth's orbit around the Sun or volcanic eruptions.

How do climate variability and climate change relate?

The annual cycle of wet and dry seasons is one example of natural climate variability experienced by every island in the western tropical Pacific. This cycle varies in timing and intensity between years. Much of year-to-year climate variability is caused by natural variations in the conditions of the atmosphere and ocean.

The most dramatic cause of climate variability in the western tropical Pacific is the El Niño Southern Oscillation (ENSO). The two extremes of ENSO are El Niño and La Niña. El Niño tends to bring weaker trade winds and warmer ocean conditions near the equator across much of the Pacific, whereas La Niña tends to bring stronger trade winds and cooler ocean conditions. Pacific island countries can experience very wet or very dry conditions (depending on their location) in years when El Niño or La Niña occur, as well as cooler or warmer than normal temperatures. ENSO also affects climate variability in the Pacific through its influence on other large-scale climate processes, including the South Pacific Convergence Zone, the Intertropical Convergence Zone and the Western Pacific Monsoon.

Over a long period of time (decades or even centuries) the climate changes, however human activities are causing much faster climate change than the slower natural causes. Temperatures are increasing in the Pacific, resulting in more hot temperature extremes and fewer cold extremes, and there is some evidence that extreme rainfall is also occurring more frequently.

Natural climate variability such as ENSO continues to occur as climate change slowly increases. This means that droughts and floods due to El Niño and La Niña still occur due to natural climate variability, but some of the impacts may intensify due to climate change.

Building resilience for a more sustainable future

Managing climate variability and climate change is a significant challenge for 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.

Extreme La Niña rainfall and associated flooding events in Vanuatu in May, 2008 (top; source Vanuatu Meteorological Geo-Hazard Dept.) **and in Nadi, Fiji, in January, 2012** (bottom; source www.fijivillage.com)

CLIMATE CASE STUDY > **Suva, Fiji**

In Fiji there is a clear wet and warm season from November to April, and a dry and cool season from May to November each year. Figure 1 shows the annual cycle for mean monthly temperature (T, air temperature; min, minimum; max, maximum; SST, sea-surface temperature) and rainfall at Suva, Fiji, for the baseline averaging period 1961–1990. The wettest month at Suva is normally April, when more than twice as much rain on average falls than in the driest month of July. The coolest month of the year on average is also July, while February is the warmest. These are the natural seasonal variations in the climate, however some years are naturally hotter or colder than average. An El Niño or La Niña will also affect temperatures in years when they occur, as well as how strong and from which direction the trade winds blow, the amount of rainfall and also the location of tropical cyclones.

In addition to these natural variations, anthropogenic climate change is having a noticeable effect on temperatures in Fiji. The mean annual minimum air temperature at Suva, which has year-to-year ups and downs due to natural variability, is also steadily warming over the longer term (Fig. 2). This warming in the average temperatures due to climate change has also resulted in changes in the occurrence of extreme temperatures. In Suva, a strong decrease in extreme cool temperature events, including frequency of 'cool nights' (Fig. 3), and an increase in extreme hot temperature events, such as frequency of 'warm nights' (Fig. 4), are apparent. Research on the period 1940–2010 shows the cool nights that used to occur about 80 times a year in Suva are now infrequent. Likewise warm nights, which used to occur only a few times each year, now occur about 75 times per year and in some years even more often.

These long-term changes in the frequency of extreme temperatures have the potential to significantly impact on infrastructure, natural resources and the wellbeing of people and communities in climate vulnerable Pacific island countries like Fiji.

Figure 1 Mean annual cycle of air temperature and rainfall

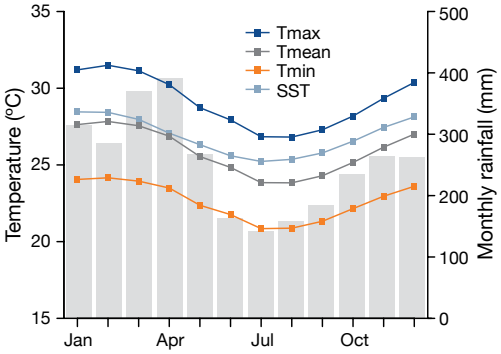


Figure 2 Steady warming over the longer term: mean annual cycle of air temperature

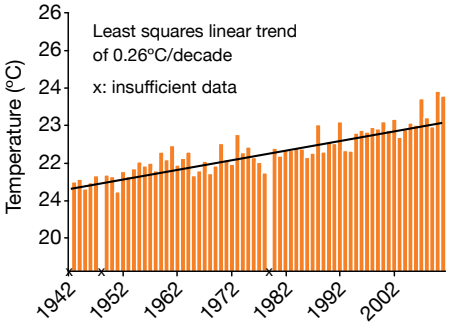


Figure 3 Fewer cool temperature extremes: annual number of cool nights

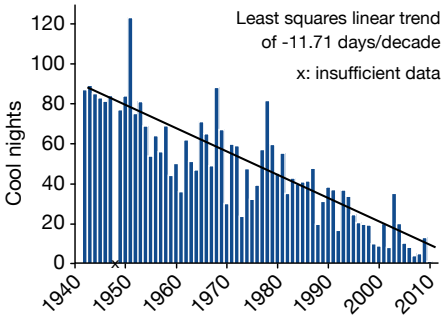
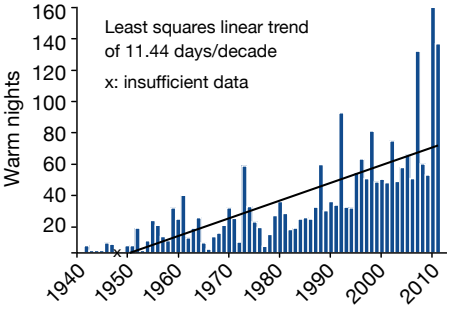


Figure 4 More hot temperature extremes: annual number of warm nights



Other fact sheets in the series include:

- Climate extremes in the western tropical Pacific
- Large-scale climate features in the western tropical Pacific
- Ocean acidification in the western tropical Pacific
- Sea-level rise in the western tropical Pacific

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