Summary: Climate Change in the Cook Islands

Historical and Recent Variability, Extremes and Change

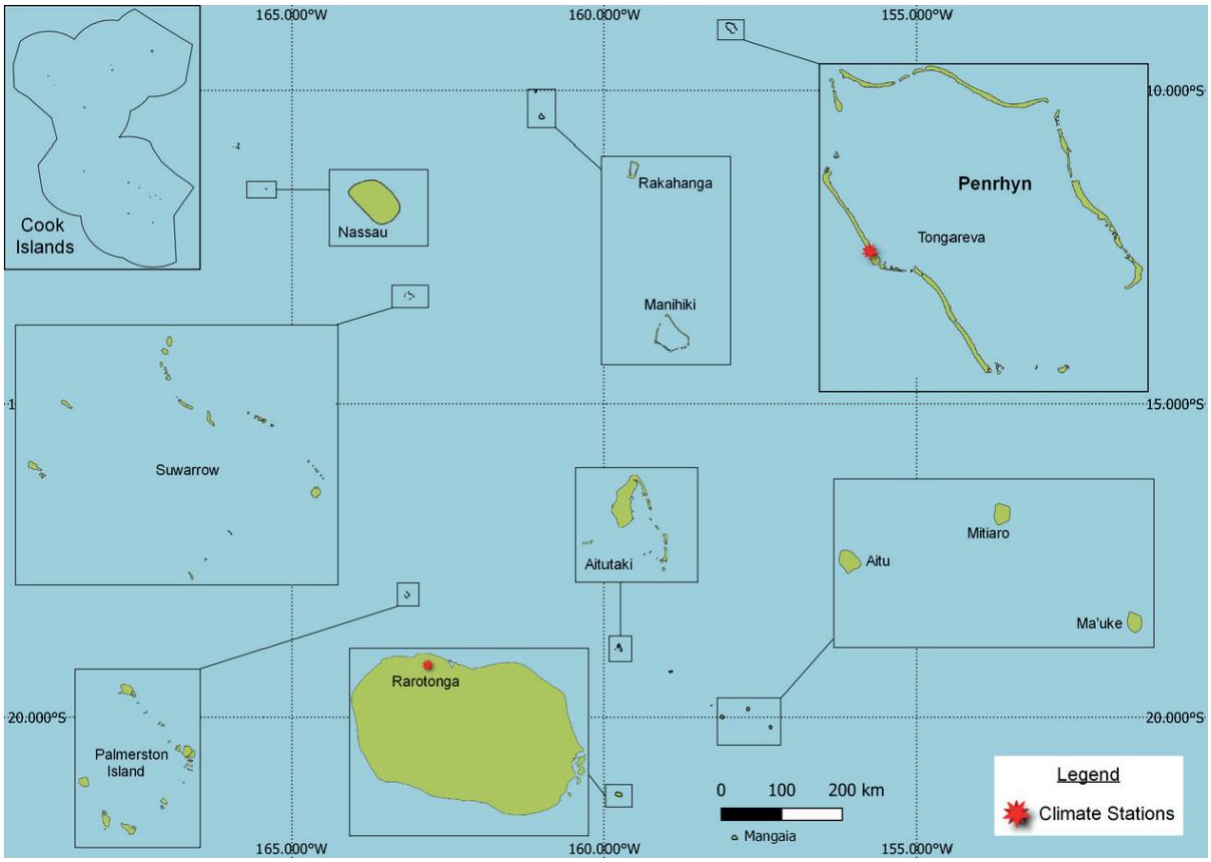
COSPPac
Climate and Oceans Support Program in the Pacific

This brochure provides a snapshot of key long-term changes in climate and ocean variables in the Cook Islands. Long-term changes were determined by analysing trends in historical climate and ocean data. Trends provide information about climate change in the Cook Islands 'to date'.

Climate variability strongly influences extreme events in the Cook Islands. The brochure also provides up-to-date scientific information on climate variability and its influence on extreme events.

Figure 1:

The Cook Islands and locations of the climate stations used in Climate Change in the Pacific 2022 report.

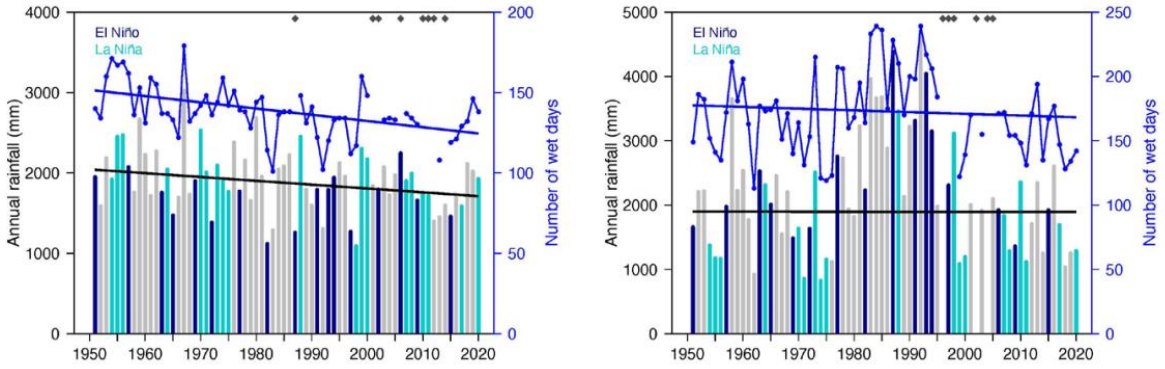


Annual and dry season rainfall has decreased at Rarotonga

Annual and dry season (May–October) rainfall has decreased since 1951 at Rarotonga (Figure 2) by 48 mm/decade and 22 mm/decade respectively. Further, the annual number of wet days has decreased by around 4 days/decade. There has been no significant change in annual and seasonal rainfall at Penrhyn.

Figure 2:

Annual rainfall (bar graph) and number of wet days (where rainfall is at least 1 mm; line graph) at Rarotonga (left) and Penrhyn (right). Straight lines indicate linear trends for annual rainfall (in black) and number of wet days (in blue). Diamonds indicate years with insufficient data for one or both variables.



El Niño–Southern Oscillation (ENSO) – a natural mode of climate variability – influences rainfall variability from year to year at both Rarotonga and Penrhyn. At Rarotonga, La Niña years typically experience higher rainfall than El Niño years. The reverse applies at Penrhyn. Other than the number of wet days at Rarotonga, there have been no significant long-term changes in extreme rainfall at Rarotonga and Penrhyn. There has also been little long-term change in meteorological drought at Rarotonga.

Air Temperature has increased

Average annual temperatures at Rarotonga have increased by 0.16 °C per decade since 1951. Average wet season (November–April) and dry season (May–October) temperatures also warmed at approximately the same rate. Daily minimum temperatures warmed faster than daily maximum temperatures.

The number of hot days and warm nights has increased, and the number of cool days and cold nights has decreased at Rarotonga. Since 1951, the number of hot days has increased by about 7 days per decade. Hot days have a maximum temperature above 26.4–31.1 °C at Rarotonga, depending on the time of year.

The number of days where air conditioning is required to cool a building down to 25 °C has increased by 22 days per decade, indicating that energy demand for cooling has increased significantly since 1951.

Long-term increases in both average temperature and temperature extremes in the Pacific are likely driven by human-associated climate change, due to the rate of the observed changes and consistency with global trends that have been attributed to climate change (PCCM, 2021).

Tropical cyclone severity has decreased

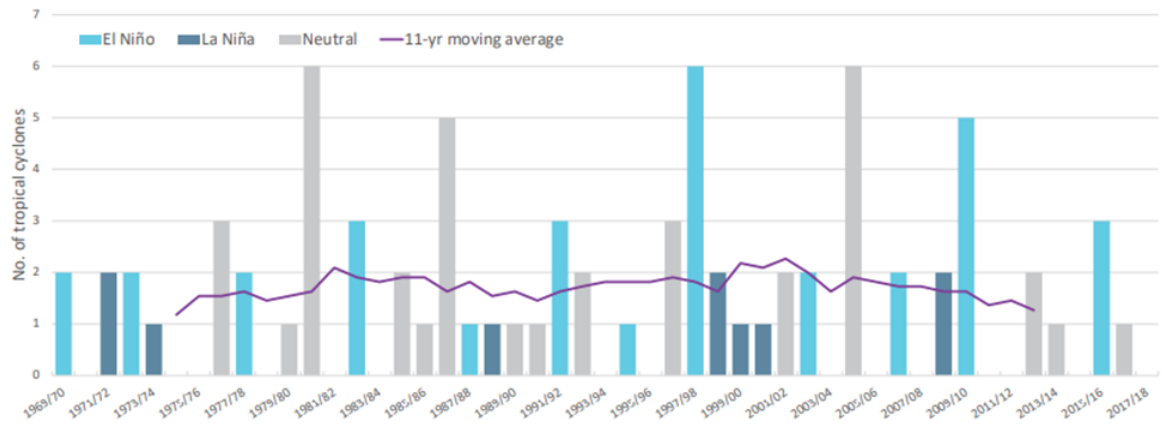
In the greater Southwest Pacific, the total number of **severe** tropical cyclones[1] has decreased over the last 40 seasons. There has been little change in the total number of tropical cyclones of any category in the southwest Pacific. The number of tropical cyclones that became severe events has marginally declined.

Tropical cyclones usually affect the Cook Islands during the southern hemisphere tropical cyclone season, which is from November to April, but also occasionally occur outside the tropical cyclone season.

The number of tropical cyclones occurring in the Cook Island's EEZ varies considerably from one year to the next and this variability is influenced by ENSO (Figure 3). Tropical cyclones were most frequent in El Niño years (25 cyclones per decade), followed by neutral years (17 cyclones per decade) and least frequent in La Niña years (7 cyclones per decade).

Figure 3:

Number of tropical cyclones passing within the Cook Islands EEZ per season. Each season is defined by the ENSO status, with light blue being an El Niño year, dark blue a La Niña year and grey showing a neutral ENSO year. The 11-year moving average is presented as a purple line and considers all years.



Due to this high interannual variability and the relatively small number of tropical cyclones passing through any country's EEZ since reliable records began, individual country analysis of long-term trends in frequency and intensity is not possible.

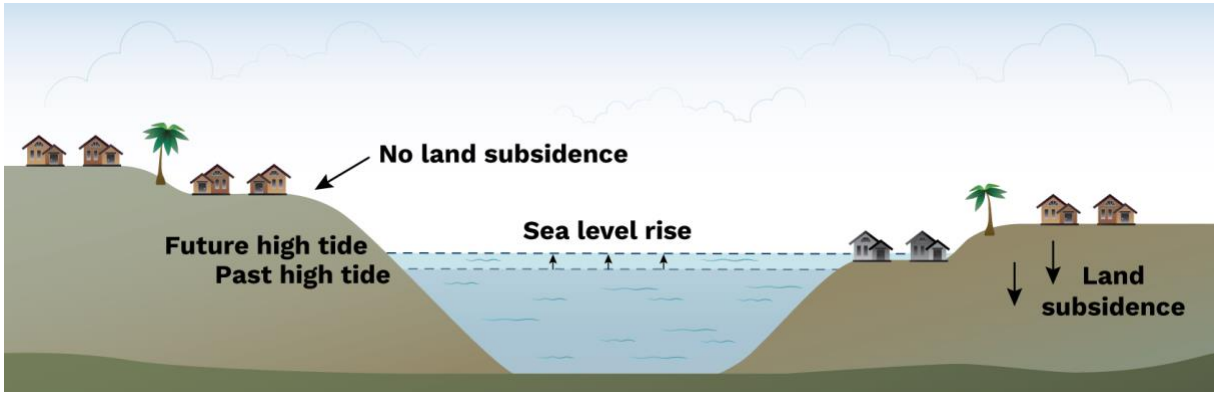
[1] A 'severe' tropical cyclone is defined as having a minimal central pressure of <970 hectopascals (hPa). Pressure is often used when comparing intensity of tropical cyclones.

Sea level has increased

A combination of sea level rise and land subsidence has increased relative sea level by 3.9 mm per year at Rarotonga since 1993 (Figure 5). The number of hours per month that sea level has exceeded the 99th percentile of historical maximum sea level has increased since 2006. Peak sea levels typically occur between October and May.

Figure 5:

The effect of sea level rise and land subsidence on local sea level.



The long-term trend in sea level across the Cook Islands EEZ is 2.5–5.5 mm per year since 1993. For some regions, this trend is higher than the global average trend (3.1 ±0.4 mm per year).

The rise in Pacific mean sea level since 1993 is primarily attributable to global warming. Naturally-occurring modes of climate variability in the Pacific region - for example, the El Niño–Southern Oscillation (ENSO) on interannual time scales, and the IPO (Interdecadal Pacific Oscillation)/PDO (Pacific Decadal Oscillation) on decadal to multi-decadal time scales - influence sea level and can amplify or dampen the underlying trends arising from global warming (PCCM, 2021).

Muri Lagoon

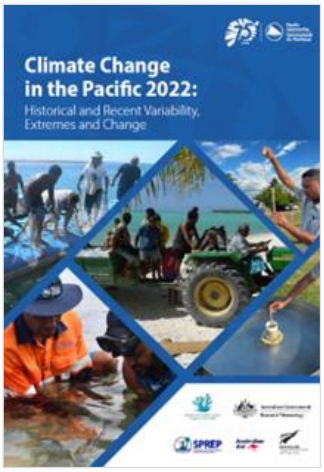
Waves

Waves at Rarotonga come from the southeast to the southwest. On average, Rarotonga experiences 3 extreme wave events per year - defined as reaching or exceeding a wave height of 4.01 m.

There has been no long-term change in average annual wave height since 1979. Wave height, wave period (the time interval between two waves) and wave direction changes from month to month with the seasons and, to a lesser degree, year to year with climate variability modes. The highest waves usually occur between April and September and the longest wave periods occur in March to July.

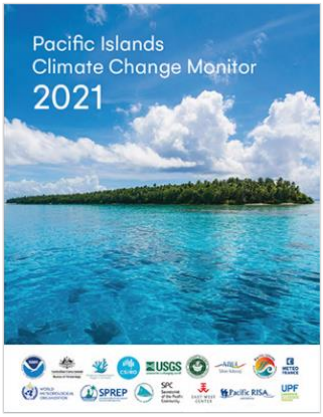
Further reading

For more information, refer to Climate Change in the Pacific 2022: Historical and Recent Variability, Extremes and Change. Climate and Oceans Support Program in the Pacific. Fifteen country chapters are available at https://purl.org/spc/digilib/doc/kskiv



For more information on Pacific-wide observed and future trends in climate indicators, see the Pacific Islands Climate Change Monitor 2021, available at https://www.pacificmet.net/sites/default/files/inline-files/documents/PICC%20Monitor_2021_FINALpp_0.pdf

Historical climate trends and basic climate information from observation sites across the Pacific Islands are available through the web-based Pacific Climate Change Data Portal at www.bom.gov.au/climate/pccsp



Information about future climate change can be found in the 'NextGen' Projections for the Western Tropical Pacific country reports https://www.csiro.au/en/research/environmental-impacts/climate-change/pacific-climate-change-info

Moturakau, Aitutaki atoll

The content of this brochure is an outcome of the high degree of cooperation and collaboration that exists between the implementing partners of the Australian Aid funded Climate and Oceans Support Program in the Pacific (COSPPac), specifically the Bureau of Meteorology (the Bureau), the Pacific Community (SPC) and Pacific Regional Environmental Programme (SPREP), together with the valuable ongoing support from the national meteorological services in the 15 partner countries and territories. Publication support has been provided through New Zealand Aid Programme.

For more detailed information on the climate of the Cook Islands and the Pacific, see:
McGree, S., G. Smith, E. Chandler, N. Herold, Z. Begg, Y. Kuleshov, P. Malsale and M. Ritman. 2022. Climate Change in the Pacific 2022: Historical and Recent Variability, Extremes and Change. Climate and Oceans Support Program in the Pacific. Pacific Community, Suva, Fiji.

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