Summary: Climate Change in Tokelau 2022

Historical and Recent Variability, Extremes and Change

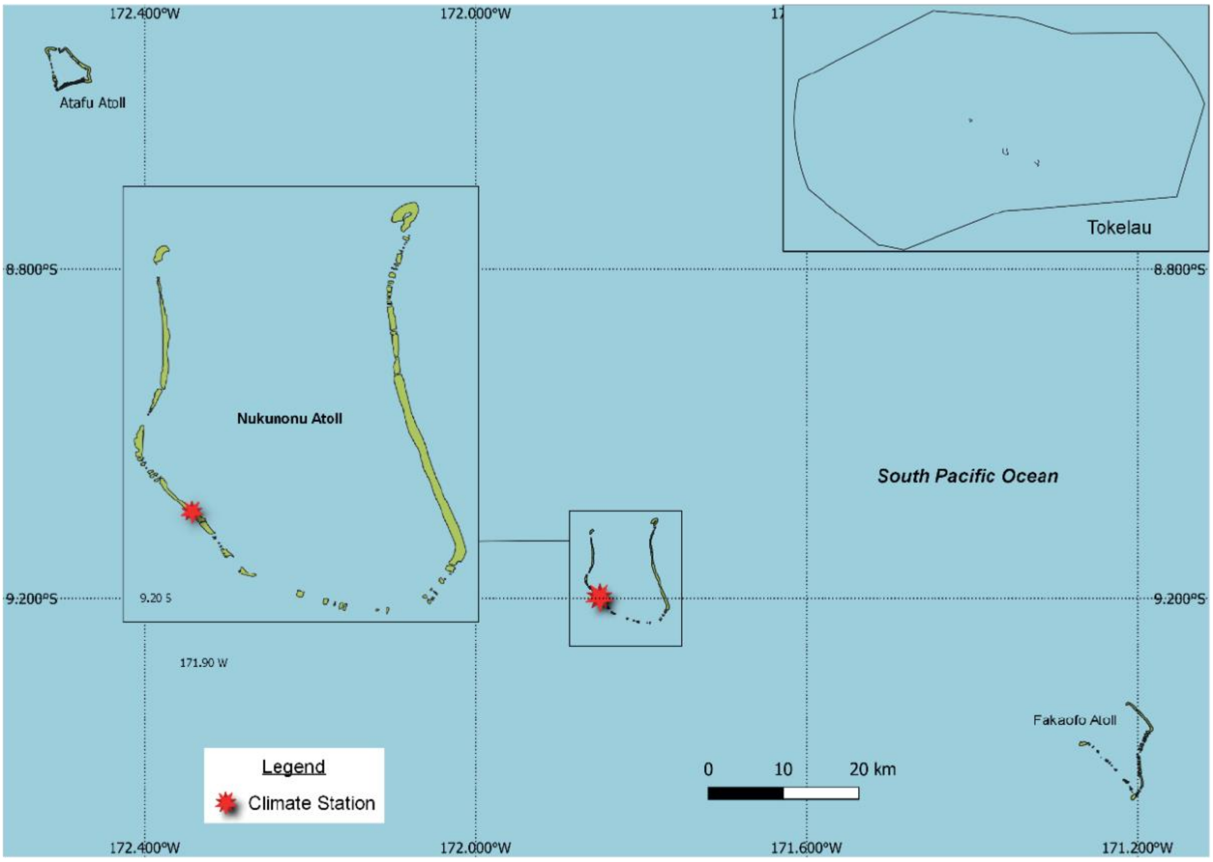
COSPPac
Climate and Oceans Support Program in the Pacific

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

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

Figure 1:

Tokelau and the location of the climate station used in Climate Change in the Pacific 2022 report.



Cover image: An aerial view of Atafu Atoll in Tokelau. It is the smallest of Tokelau's three atolls with a land area of only 2.5 square kilometres. Photo: NASA

Most of Tokelau's rainfall received between October and March

At Nukunonu, annual rainfall varied between 1400 and 3800 mm between 1946 and 1993. Further, the maximum amount of rainfall that fell on one-day varied between 50 and 250 mm. Rainfall records for Nukunonu (as well as Atafu and Fakaofo) are too short for robust calculation of long-term trends in total and extreme rainfall.

Rainfall is dominated by the South Pacific Convergence Zone (SPCZ), which is a band of persistent rainfall and cloudiness that is typically located to the southwest of Tokelau during the wet season when the SPCZ is most active. The wettest months at Nukunonu fall between October and March, with 60% of the rainfall during these months. At Nukunonu, approximately half of all days each year experience some rainfall.

Air Temperature has increased

Average annual temperatures at Nukunonu increased by 0.12 °C per decade since 1979. Average November–April temperatures warmed faster than May–October temperatures.

The number of hot days and warm nights has increased, and the number of cool days has decreased at Nukunonu since 1979. Hot days increased by about 23 days per decade. Hot days have a maximum temperature above 28.1–29 °C, depending on the time of year.

The number of days where air conditioning is required to cool a building down to 25 °C increased by 44 days per decade, indicating that energy demand for cooling has increased significantly since 1979.

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

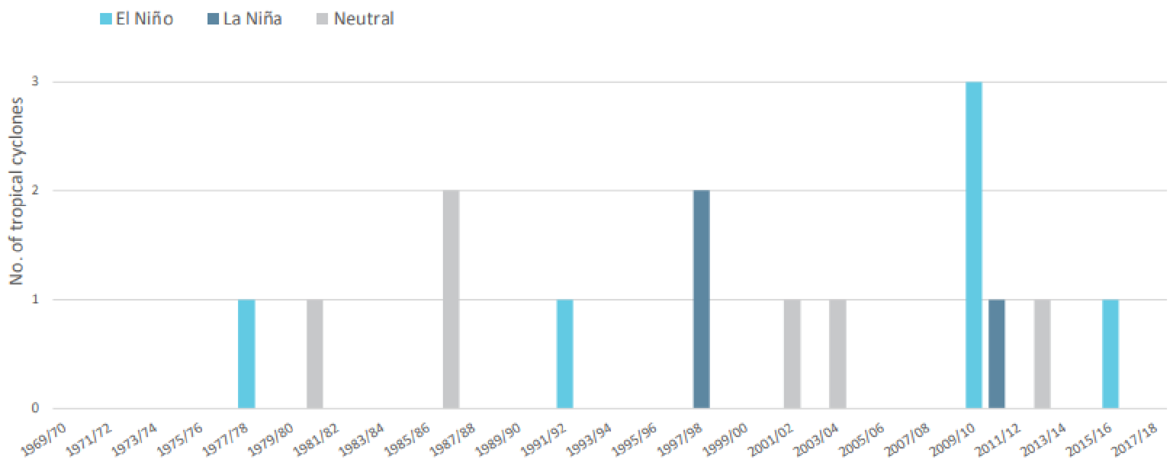
In the greater Southwest Pacific, the total number of **severe** tropical cyclones[1] has decreased over the last 40 seasons. There has been little change in the total number of tropical cyclones of any category in the southwest Pacific. The number of tropical cyclones that became severe events has marginally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

Tropical cyclones usually affect Tokelau 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 Tokelau's Exclusive Economic Zone (EEZ) varies considerably from one year to the next (Figure 2). Tropical cyclones were equally likely in El Niño and neutral years (3 cyclones per decade), and less frequent in La Niña years (2 cyclones per decade).

Figure 2:

Number of tropical cyclones passing within Tokelau's 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.

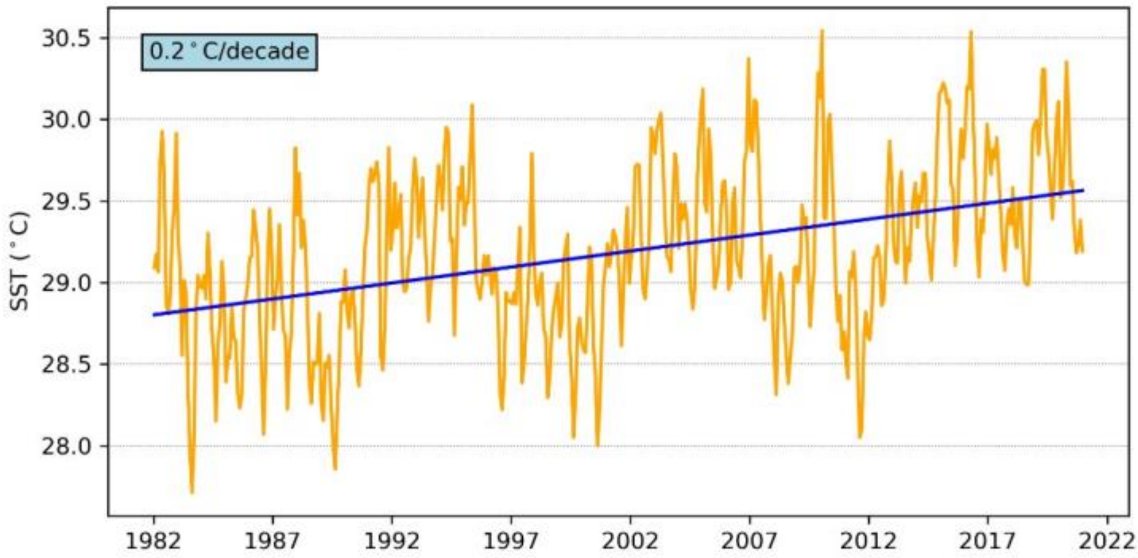
[1] A ‘severe’ tropical cyclone is defined as having a minimal central pressure of <970 hectopascals (hPa). Pressure is often used when comparing intensity of tropical cyclones.

Sea surface temperature has increased

Sea surface temperatures averaged across Tokelau's EEZ increased by 0.20 °C per decade since 1982 (Figure 3).

Figure 3:

Sea surface temperature from satellite observations averaged across Tokelau EEZ, shown as the orange line. The blue line shows the linear regression trend.



Globally, sea surface temperature is one of the most widely used indicators used to monitor human-associated climate change. Modes of climate variability influence sea surface temperatures on an interannual and decadal/multi-decadal basis; however, climate change is a driver of the long-term positive trend (PCCM, 2021).

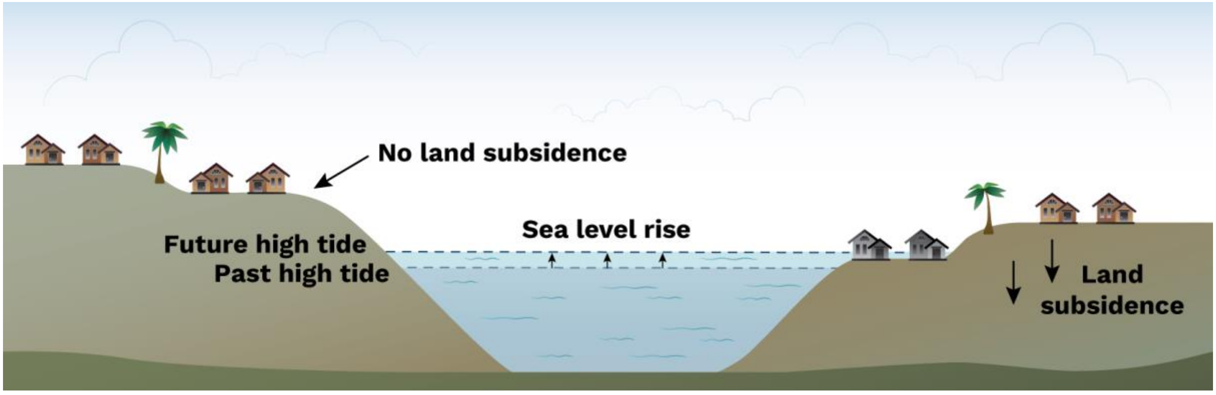
Sea surface temperatures at satellite observations near Nukunonu tend to be warmest in April, reaching, on average, a maximum of 39.5 °C. Sea surface temperatures are coolest in August, reaching, on average, a minimum of 28.6 °C. Daily temperatures can be up to 1 °C higher or lower than these monthly averages at Nukunonu and may differ at other locations in Tokelau.

Sea level has increased

Sea level has increased across Tokelau's EEZ at a rate of 3.5–4.5 mm per year since 1993 (Figure 4). This long-term trend in sea level (estimated from satellite altimetry) is higher than the global average trend. Peak sea levels near Nukunonu typically occur between January and May.

Figure 4:

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



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).

© Landscape, Tokelau, 2011. Photo: New Zealand Ministry of Foreign Affairs and Trade

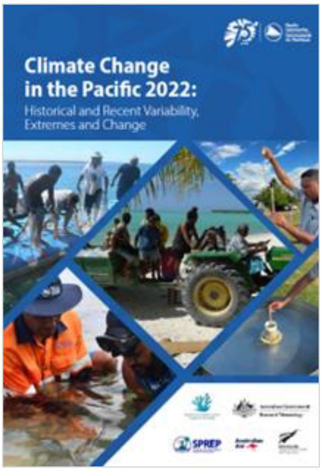
Waves

Waves at Nukunonu come from the southeast. On average, Nukunonu experiences approximately three extreme wave events – defined as reaching or exceeding a wave height of 2.78 m per year.

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 June to September and the longest wave periods also occur from January to March.

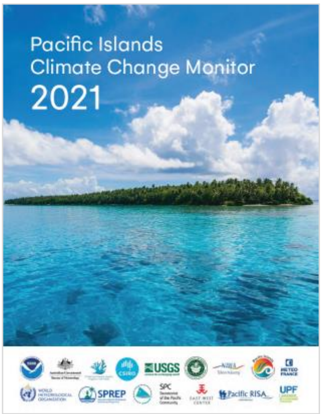
Further reading

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

© Damaging winds from Cyclone Percy, Tokelau 2005. Photo: AusAID

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For more detailed information on the climate of Tokelau 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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