



Tonga

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# Climate, climate variability and change of Tonga

## Introduction

The island of Tongatapu is the main island of the Tongan Archipelago. It lies at the southern end of the Tonga Group which extends from 15° to 23.5°S and 173° to 177°W. Tongatapu covers a land area of 260km<sup>2</sup> and is very flat with an elevation of 2m over the northern periphery of the island and gently slopes to about 10m towards the southern part of the island. The highest point in Tongatapu is Fua'amotu (38m).



Figure 1: Map showing the location of Tonga in the Pacific region (above) and observing sites in Tonga (right).



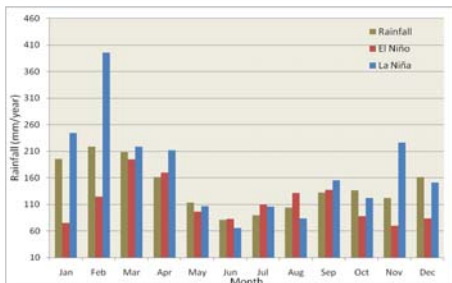
## Data availability and homogeneity

The Tonga Meteorological Service (TMS) is a Division of the Ministry of Transport. TMS has 30 staff spread over 6 meteorological stations.

TMS operates 24 hours a day and has a Forecasting Section, Climate Section, Observations and Monitoring, Coast Radio Service and a Technical Support Section.

The Climate Section issues monthly climate summaries, 3 month rainfall and temperature predictions (SCOPIC), drought advisories and ENSO updates.

Climate data dates back to as far as 1945 in Nuku'alofa. There is one rainfall and temperature station, Nuku'alofa (91789) with high quality, long-term records (1947-2009). This data were tested for in-homogeneities and none were found.



Damage to Ha'apai Meteorological Station by Tropical Cyclone Wilma Jan 2011



Weather observation training at the Tonga Met Service Feb 2010



Meteorology enclosure at Fua'amotu Airport, Tonga

## Climate Drivers

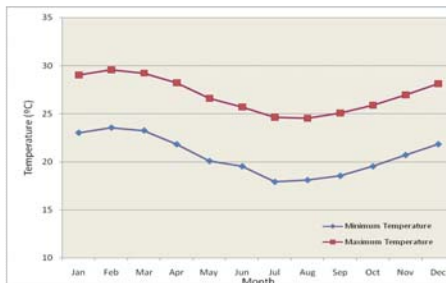
Several climate drivers and features have important impacts on Tonga's climate:

- ◆ El Niño – Southern Oscillation:
  - ◆ El Niño brings drought and more tropical cyclone activity in the wet season, and a slight increase in rainfall and cooler minimum temperatures in the dry season.
  - ◆ La Niña brings significantly higher rainfall (up to 3 times that in El Niño years) and less than average tropical cyclone activity.
- ◆ South Pacific Convergence Zone (SPCZ) affects the climate year round, but mainly in the wet season. When it moves away to the northeast in El Niño years rainfall decreases.
- ◆ Southern Annular Mode impacts via the movement of high pressure systems. In the dry season, when they move south trade winds weaken and maximum and minimum temperatures increase.

## Seasonal Cycles

Tongatapu has a marked seasonal cycle in rainfall due to the strong influence of the South Pacific Convergence Zone (SPCZ) and sub-tropical highs. Most of the yearly rainfall (61%) falls in the wet season (November through April) and the dry season is from May to October. The northward and southward shift of the SPCZ during winter and summer drives the annual cycle of rainfall in Tongatapu.

Figure 2: Annual cycles of average rainfall for all years, El Niño and La Niña years (left) and of maximum and minimum temperatures (right) at Nuku'alofa.



## Observed inter-annual variability and trends

With the strong influence of ENSO, interannual variability in rainfall in Tonga is high (see Figure 3). From 1947-2009 the linear trend in rainfall is downward at a rate of -43.6 mm/decade.

Over the entire time series temperatures have been warming with linear trends in maximum temperatures of 0.22°C/decade and in minimum temperatures of 0.19°C/decade (see Figure 3).

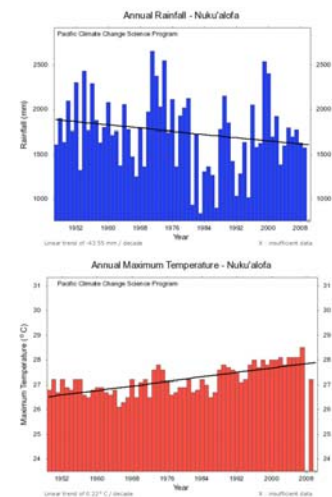


Figure 3: Time series of annual total rainfall (top) and of maximum temperatures (bottom) at Nuku'alofa. Linear trend lines are also shown.

## Impacts and extremes

Tropical cyclones are the main extreme weather events to affect Tonga.

They are more frequent in seasons when El Niño is occurring (an average of 1.9 per season) and less frequent in La Niña years (1.6 per season).

