



Tonga

Moleni Tu'uholoaki and Uinita Vea, Tonga Meteorological Service.

Pacific-Australia Climate Change Science and Adaptation Planning program

International
**CLIMATE
CHANGE
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Initiative

Observed Climate and Future Climate Change in Tonga

Introduction

The climate of Tonga is changing and adverse effects of climate change on the environment are being felt. The Tongan Government understands these impacts and has considered them as high priorities in its National Strategic Planning Framework, 2009-2014. The present study indicates that the detrimental effects observed now will be exacerbated by future climate change.

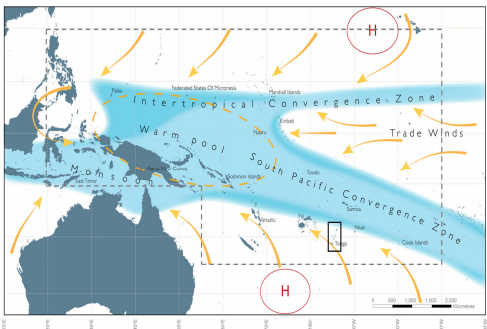


Figure 1: Location of Tonga (rectangular box to the east of Fiji). Light blue shaded area indicates the average position of the South Pacific Convergence Zone (SPCZ) and the Inter-tropical Convergence Zone (ITCZ).

Observed climate

Tonga has two distinct seasons

- a warm wet season (Nov- April)- when the South Pacific Convergence Zone (SPCZ) (Figure 1) is most intense.
- a cooler dry season (May-Oct).

Tonga's air temperatures are strongly dependent upon the

- surrounding ocean temperature (Figure 2), and
- eastward movement of sub-tropical highs to the south (Figure 1).

Tonga's climate is affected by the El Niño- Southern Oscillation:

- El Niño events bring cooler dry seasons and drier wet seasons than normal and,
- La Niña events bring wetter than normal.

Tropical Cyclones affect Tonga between November and April with the centres of 17 cyclones (on average) per decade passing within 400km of Nukualofa between the 1969/70 and 2009/10 seasons. Cyclones were most frequent during El Niño years. A limited historical record and large variability makes identifying long terms trends difficult.

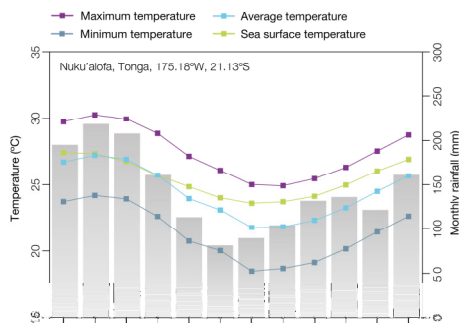


Figure 2: Seasonal rainfall and temperature at Nukualofa, Tonga.

Observed climate change

Recent implications of climate change that are already observed in Tonga and are consistent with the global pattern are:

- the annual average temperatures have increased (Figure 3),
- that the aragonite saturation state has declined (~3.9-4.1 by 2000)

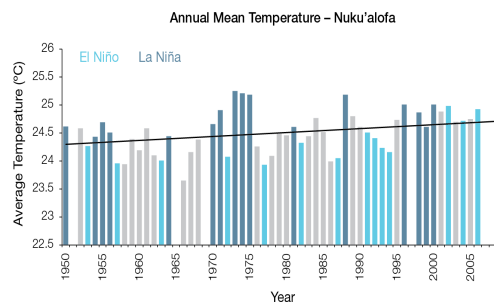


Figure 3: Annual average temperature for Nuku'alofa. Light blue bars indicate El Niño years, dark blue bars indicate La Niña and the grey bars indicate neutral years.

Climate projections

Analysis of projections for air and sea temperatures, rainfall, extreme events, ocean acidification, mean sea level and tropical cyclones.

Methods

The results shown here are based on simulations of 18 global models known as CMIP3. The 18 were chosen out of 24 models in which six were discarded after failing to simulate the observed climate.

The projections are provided for scenarios B1, A1B and A2 of the Intergovernmental Panel on Climate Change (IPCC) and projected for three 20-year time periods centered on 2030, 2055 and 2090 (Figure 4).

Results are an average over a broad geographic region and surrounding ocean but not on a specific point.

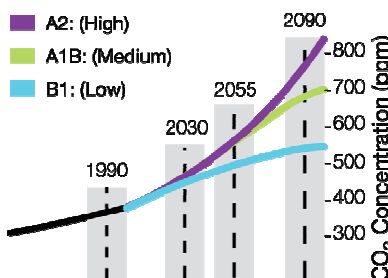


Figure 4: CO2 concentrations (ppm) associated with 3 IPCC emissions scenarios: low emissions (B1-blue), medium emissions (A1B-green) and high emissions (A2- purple).

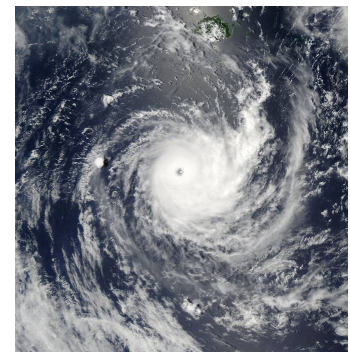


Inundation event in Tonga

Summary of Projections

Projections for all the scenarios indicate that the:

- annual average air temperatures and sea surface temperatures will continue to rise (Figure 5),
- generally rainfall decreases in the dry season and increases in the wet season,
- extreme rainfall days are projected to occur more often,
- Tropical cyclones frequency are projected to decrease,
- Tropical cyclones intensity are projected to increase,
- sea levels are projected to continue to rise in Tonga,
- aragonite saturation levels in the ocean will reach 3.5 by 2035 and continue to decline after.



Cyclone Wilma caused substantial damage to Tonga in January 2011. Picture is courtesy of NASA.

In summary this study shows that the adverse impacts that are observed now will be exacerbated by future climate change in Tonga in particular and the world in general unless CO2 concentrations in the atmosphere are stabilised at non- dangerous level. Much of the material in this poster was obtained from BoM and CSIRO (2011) *Climate Change in the Pacific: Scientific Assessment and New Research (Vol. 2: Country Reports)* produced by the Pacific Climate Change Science Program.

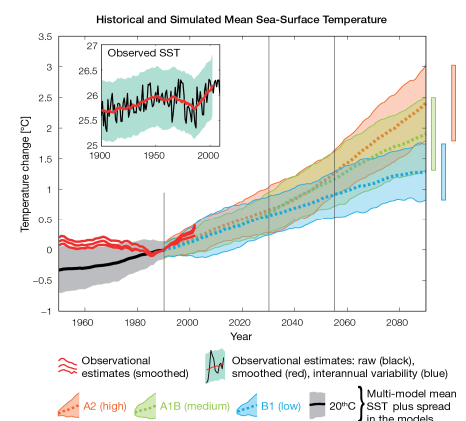


Figure 5: Observed and projected sea surface temperature near Tonga