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Climate, climate variability and change in Samoa

Introduction

Samoa is a small island country in the south-west Pacific (Fig. 1) with a population of around 181,000 and an economy based on agriculture, fisheries and tourism. Samoa's climate is typically tropical and marked by distinct "wet and warm" (November-April) and "dry and cool" (May-October) seasons.

Climate change is one of the largest challenges Samoa faces, affecting all aspects of life on the island.

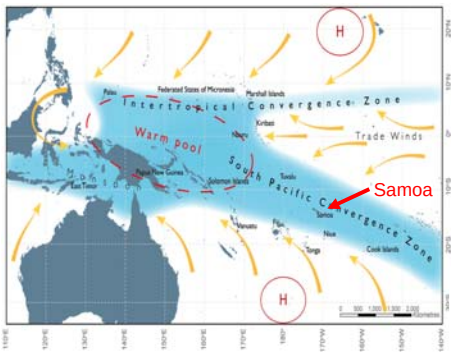

Figure 1. Climate drivers and features of the Pacific region with Samoa location shown.

Data availability and homogeneity

Monthly rainfall data for Apia station is considered the best of all rainfall sites as it has the longest record (from 1890) and no missing observations. Homogeneity testing of this record revealed several change points that were verified with metadata. The most significant was the 2008 change point when a new office building was constructed near the observation site.

Data from Apia (1930-2009) was used for the temperature analysis. The monthly maximum and minimum temperature records for Apia station were also tested and adjusted for homogeneity.

Climate Drivers

Samoa's climate is greatly influenced by the El Niño-Southern Oscillation (ENSO). The El Niño phase of ENSO generally brings dry conditions over the island group. This can result in drought across all regions, the most severe in the north-west of the main islands. In contrast, La Niña tends to bring wetter conditions and is associated with flooding in downtown Apia.

The other main driver of Samoa's climate is the South Pacific Convergence Zone (SPCZ). When positioned over Samoa, the SPCZ brings unsettled weather conditions.

The dominant south-east trade winds bring moisture and rain to the windward side of the mountainous islands.

Coastal erosion

Climate observations are key to understanding climate change

Flooding in Apia affecting businesses

Seasonal Cycles

Samoa's seasonal temperature cycle is relatively uniform throughout the year (Fig. 2). During the dry months from May to October, temperatures are up to a degree cooler than other months due to the strengthening of the south-east trade winds.

Samoa has a distinct seasonal rainfall cycle influenced by the position of the SPCZ and trade wind strength. The mean monthly rainfall peaks in January, and is lowest during June to September (Fig. 2).

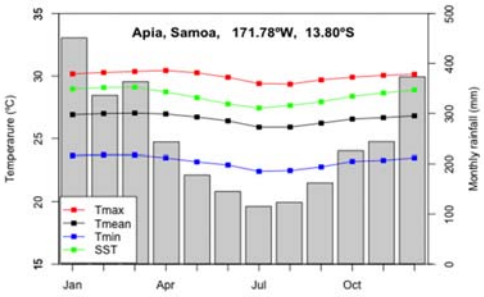

Figure 2. Mean seasonal cycles in temperature and rainfall at Apia.

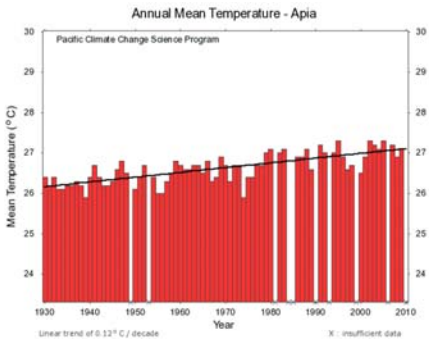

Figure 3. Homogeneous annual mean temperature at Apia.

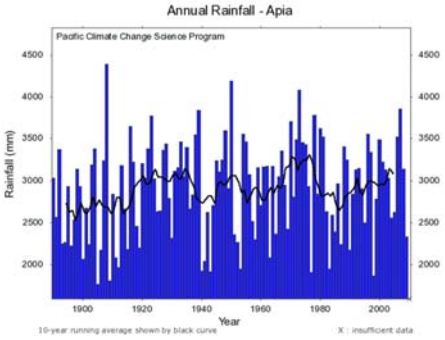

Figure 4. Homogeneous annual total rainfall at Apia.

Observed inter-annual variability and trends

Inter-annual variability of temperature is small at Apia. Consequently, the annual mean temperature series shows a clear warming trend of 0.12°C/decade since 1930 (Fig. 3). Stronger warming is evident in maximum temperatures (0.19°C/decade), than minimum temperatures (0.04°C/decade). The background warming trends at Apia are consistent with global warming.

Inter-annual variability in total annual rainfall at Apia is large (Fig. 4), due to the influence of ENSO and tropical cyclones (TCs). Apia rainfall also shows inter-decadal variability associated with movement of the SPCZ. Overall, there is a weak positive trend of 23.3mm/decade in annual rainfall since 1890. An increase in rainfall since 1980 is associated with a northward shift of the SPCZ over this time.

Impacts and extremes

The most profound climate extremes that affect Samoa are TCs, floods and droughts.

The average number of TCs per season passing within 400km of Apia is 1.29, with more during El Niño seasons (1.56) and less during La Niña seasons (0.88). Storm surges, heavy rains and high winds associated with TCs damage agricultural plantations, infrastructure, industries and human settlements. Coastal communities are the most affected. In 1990 and 1991, TCs Ofa and Val caused significant damage, with cost estimates of approximately four times the gross domestic product of Samoa.

The dry areas along the north-west coasts are the most vulnerable to droughts and forest fires. Important sources of income and food are severely disrupted during these extremes, resulting in significant social and economic costs. Samoa experienced four major forest fires from dry periods during 1982/83, 1997/98, 2001/02 and 2002/03. The 2002/03 drought led to rationing of electricity.

Flooding in low-lying areas of Apia and nearby areas normally occur during La Niña seasons. Flooding during El Niño and ENSO neutral phases is usually associated with abnormal displacement of the SPCZ or enhanced TC activity.

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