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The Observed Climate, Climate Variability and Change of Majuro Atoll, Republic of the Marshall Islands

Introduction

Located between 4° and 19° North latitude and 160° and 175° East longitude, the Republic of Marshall Islands (RMI) is a nation of 29 atolls and 5 islands, which form two vast parallel chains scattered over 2.1 million km^2 of the western Pacific. They make up a total of 181 km^2 of land. Twenty-two of the atolls and four of the islands are inhabited. Majuro and Kwajalein are the two most populated atolls, accounting for 70% of the total national population of 50,000 (*1999 census*).

Data availability and homogeneity

There are 9 rainfall and 9 temperature stations with records that can be used to some extent for climate change and trend monitoring in the RMI. Although not all of these sites have been tested for in-homogeneities and some lack very good exposure, most of these stations have undergone stringent quality control, and corrections have been made where they are needed.

A long time series of temperature is available from Majuro Weather Service Office. This station is used for the analysis presented in this poster.

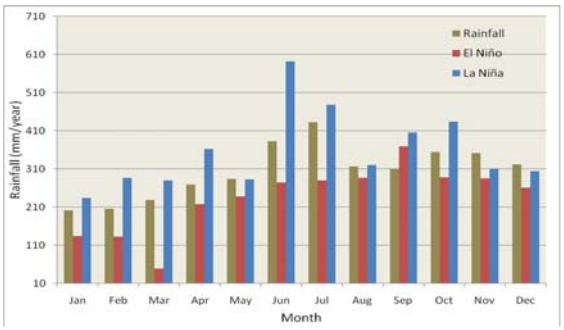

Figure 1. Average rainfall for each month of the year at Majuro. Shown are averages for all years (brown bars), El Niño years (red bars) and La Niña years (blue bars).

Seasonal Cycles

The climate of the RMI varies enormously from north to south. The atolls at 10ºN latitude and above receive less than 50 inches (1250 mm) of rain annually and are very dry in the dry season. Atolls 7º North latitude and equatorward receive more than 100 inches (2500 mm) of rain annually.

At Majuro (see Fig. 1) the influence of ENSO can be clearly seen with La Niña events significantly wetter than El Niño years.

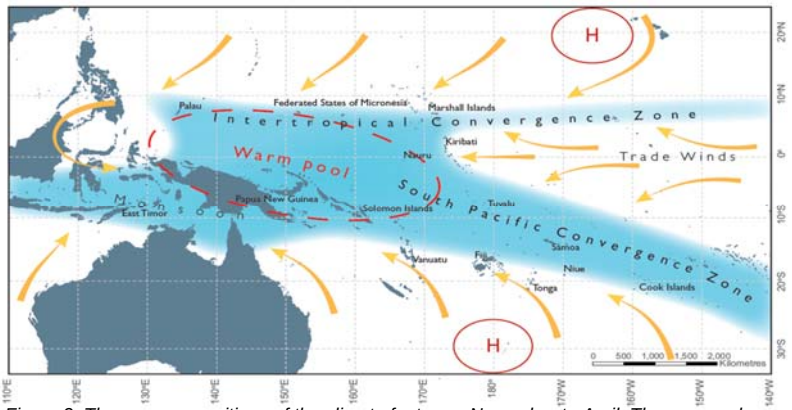

Figure 2. The average positions of the climate features--November to April. The arrows show near surface wind, the blue shading denotes the bands of rainfall (convergence zones), the dashed oval shows the West Pacific Warm Pool, and H's represent the mean positions of the subtropical highs.

Climate Drivers

The main climate drivers affecting the Republic of Marshall Islands are the El Niño-Southern Oscillation (ENSO), the Intertropical Convergence Zone (ITCZ), trade wind trough, Madden-Julian Oscillation (MJO), the Tropical Upper Tropospheric Trough, and the North Pacific Subtropical High. Some of these features are shown in Figure 2. These features influence the RMI's rainfall, winds, tropical cyclone (TC) activity, temperature ranges, ocean currents, and other aspects of the climate.

Observed inter-annual variability and trends

A long time series of temperature is available from Majuro Weather Service Office. Inter-annual variability of temperature is quite small in the RMI. Over the entire time series both have increasing trends. Maximum temperatures have shown an accelerated pace of warming since 1973, and the linear trend since 1973 shows a warming of around 1ºC in the 30-year period. The trend in minimum temperature, by contrast, has been increasing more slowly over the same period. Rainfall (not shown), has been decreasing over the last several decades.

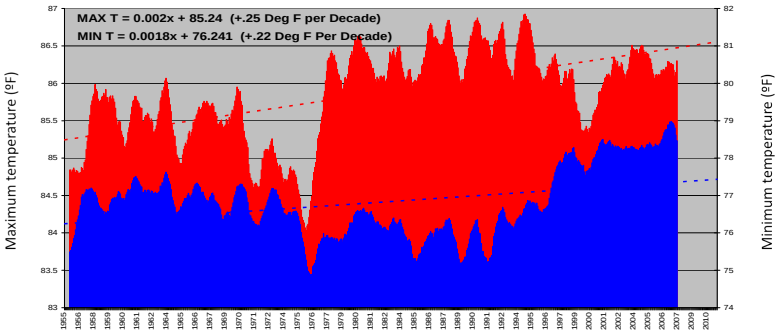

Figure 3. Maximum (red) and minimum temperature (blue) time series at Majuro station. Linear trends of +0.25ºF (+0.14ºC) (maximum) and +0.22ºF (+0.12ºC) (minimum) are shown.

Impacts and Extremes

TCs and droughts are the main extreme events that impact the RMI. TCs can form in the RMI from September-November, but they are normally weak. But during an El Niño year the Pacific Warm Pool migrates over or east of the RMI area and strong TCs form in or east of the RMI. Thus, TCs are more frequent and destructive in years when an El Niño is occurring and are rare in La Niña years.

Droughts can occur in the first 4-6 months of the year following an El Niño. In a severe El Niño event, rainfall can be less than 20% of normal. Also, the dry season can begin much earlier and end much later than normal. The ENSO also modulates sea level, and this modulation can significantly affect the ability to pump fresh water from the aquifers.

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