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Climate, climate variability and change of Vanuatu

Introduction

Vanuatu is located in the Southwest Pacific and stretches over some 1,300 km between 13°-21°S and 165°-170°E. The 83 islands (65 are inhabited) have a total land area of 12,190 km^2 ranging from atolls to mountainous and volcanic islands with the highest peak about 1800 meters located on the largest island, Santo Island.

Data availability and homogeneity

Vanuatu's longest data record is from Analguahat station (Aneityum Island), stretching from 1952 for rainfall and 1948 for temperature. Other stations have different starting dates. Monthly data were tested for spurious inhomogeneities: some were found so corrections to some time series were necessary. The map to the right shows the position of the stations used in this poster.

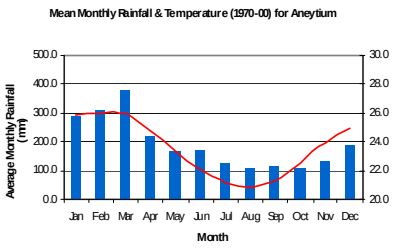


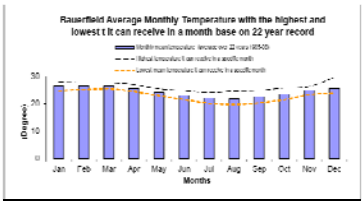
Figure 1. Mean monthly rainfall (blue bars) and mean temperature (red line) at Analguahat.

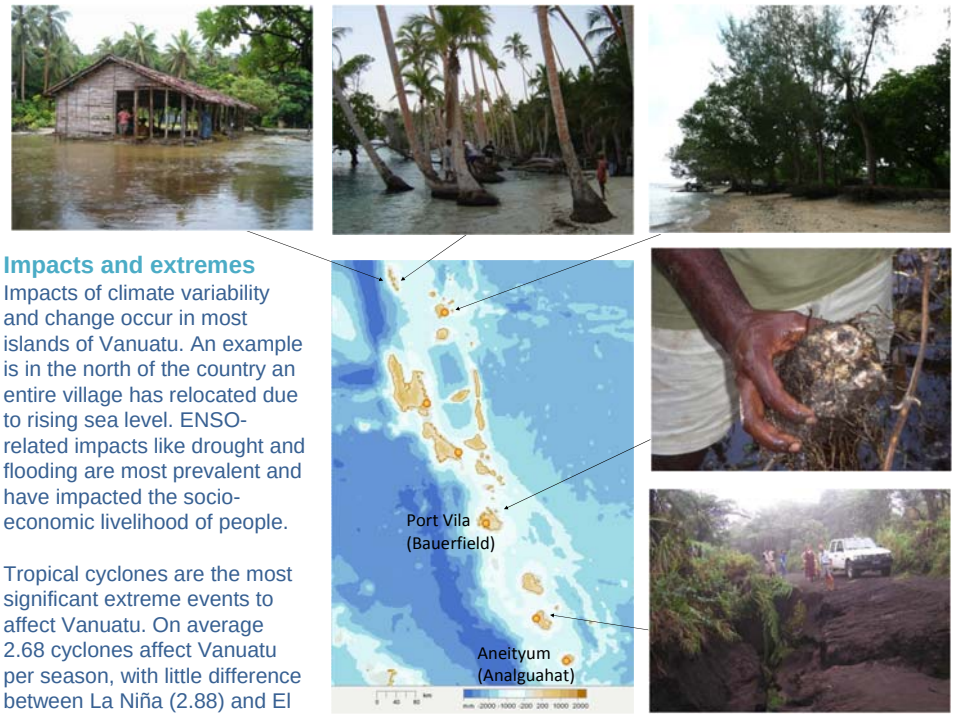
Seasonal Cycles

Vanuatu has two distinct seasons, a wet season from November to April and a dry season from May to October (see Figure 1). On average more than 65% of the total annual rain falls during the wet season, most coming from the SPCZ, ITCZ, MJO and subtropical frontal systems which are main climate drivers in Vanuatu. Historically the rainfall pattern depicts a higher rainfall in the northern part of the country, lower in the central islands and higher further south.

Differences between maximum and minimum temperatures in the northern region are small compared to those that exist further south. The southern region has average temperatures between 19°C and 27°C while the northern region recorded between 23°C and 26°C.

Figure 2. Average monthly temperatures (blue bars) with highest and lowest temperature (blue and red dotted lines) at Bauerfield station.





Impacts and extremes

Impacts of climate variability and change occur in most islands of Vanuatu. An example is in the north of the country an entire village has relocated due to rising sea level. ENSO-related impacts like drought and flooding are most prevalent and have impacted the socio-economic livelihood of people.

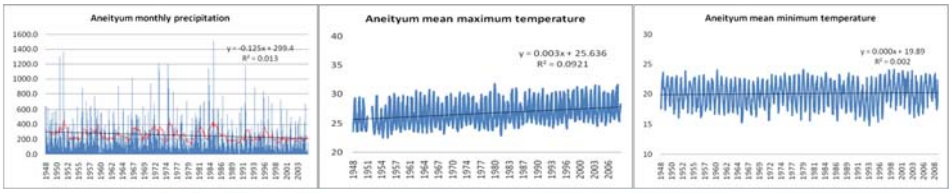
Tropical cyclones are the most significant extreme events to affect Vanuatu. On average 2.68 cyclones affect Vanuatu per season, with little difference between La Niña (2.88) and El Niño years (2.75 per season).

Climate Drivers

Vanuatu's climate is closely linked to a number of climate drivers and features:

- El Niño Southern Oscillation (ENSO) – affects Vanuatu every three to seven years and past El Niño and La Niña events caused tremendous hardship on the country's economy and the livelihood of the people.
- South Pacific Convergence Zone (SPCZ) – brings more rainfall to the country as its position changes seasonally. It lies north of the country during the winter and further south during summer. Embedded low systems associated with it often trigger tropical cyclones during the cyclone season.
- Madden Julian Oscillation (MJO) – originates from the Indian ocean and has a 30-60 day cycle. During strong events it passes over Vanuatu bringing rainfall over country.
- Subtropical weather systems – frontal systems from higher latitudes - bring rainfall, often short lived, to the southern and central parts of the country, while high pressure cells bring cold winds from south of the country, lowering temperatures.

Figure 3. Long-term time series of monthly rainfall, maximum and minimum temperature since 1948 at Analguahat station.



Observed inter-annual variability and trends

Vanuatu's climate records were correlated with indices of regional climate features to identify the important drivers in climate variability. Most year-to-year variability is related to ENSO. The NINO3.4 index correlation with total wet season rainfall is -0.5 and with mean wet season maximum temperature is -0.25. El Niño events tend to bring a late start to the wet season and lower annual rainfall, and the associated reduced cloud cover brings warmer temperatures. Opposite anomalies are usually observed during La Niña events.

Annual time series were analyzed for trends. There is no clear trend of rainfall – some stations have increasing trends and others have declining trends.

In stations where rainfall is increasing, there is strong inter-decadal variability. There is a clear indication from Analguahat station (Fig. 3) that the extreme daily rainfall events are becoming more frequent. Daytime temperatures have increased by around 0.018ºC/decade since 1950 and the rate of warming is increasing, while a night-time temperature trend is unclear in recent decades.

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