Impact of El Nino Southern Oscillation (ENSO) on Rainfall in Mauritius

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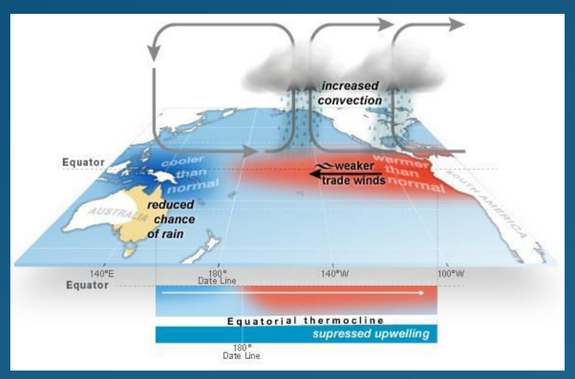
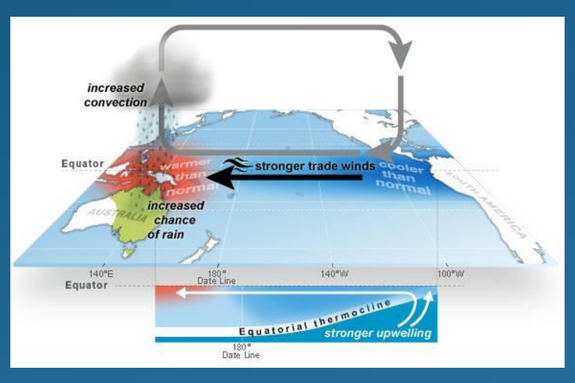
Introduction

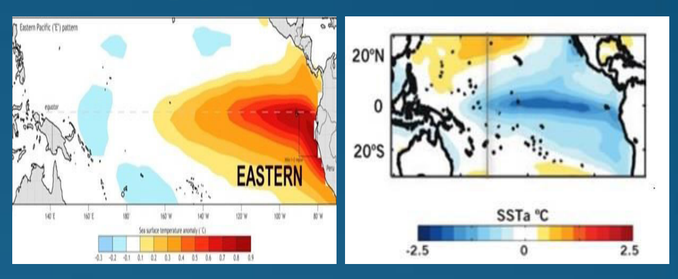




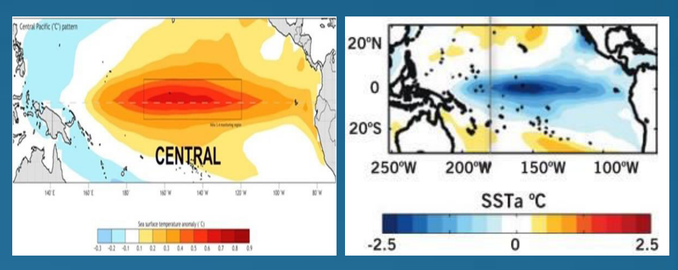
El Nino Conditions and La Nina Conditions
(Source: Bureau of Meteorology, Australia)

El Nino is the warm phase of a phenomenon known as the El Nino Southern Oscillation (ENSO), a periodical change in atmospheric conditions caused by variations in sea surface temperatures over the central and eastern equatorial Pacific Ocean. The cold phase is known as La Nina, while the absence of El Nino and La Nina conditions is called the Neutral phase. During an El Nino/La Nina event, the ocean surface in the equatorial Pacific Ocean typically warms/cools by a few degrees Celsius above the long term normal. This occurs because of a change in the winds over the equatorial Pacific. Changes occur on the time frame of several months to a year. While there are many oscillations that naturally occur around the globe that can have both direct and indirect effects on the weather patterns on regional and local scales, the most predictable one out in the seasonal time range is the ENSO.

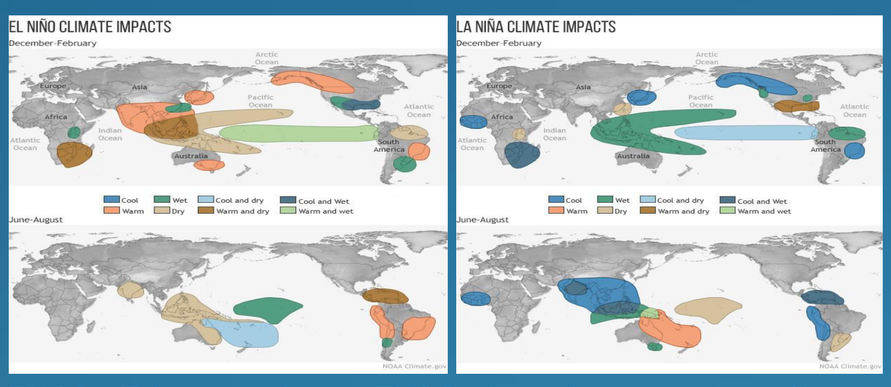
Types of ENSO



The Eastern Pacific (EP) type of ENSO has its SST anomaly maximum in the eastern equatorial Pacific. The EP El Nino is characterized by relatively large SST anomalies in the Nino-3 region(5^0 S - 5^0 N, 150^0 – 90^0 W).

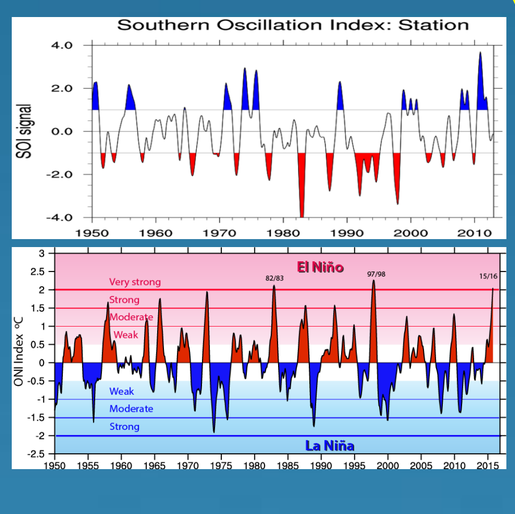


The Central Pacific (CP) type of ENSO has its SST anomaly maximum in the central Pacific. The CP type of El Nino is associated with SST anomalies mostly confined to the Nino-4 region (5^0 S - 5^0 N, 160^0 – 150^0 W)

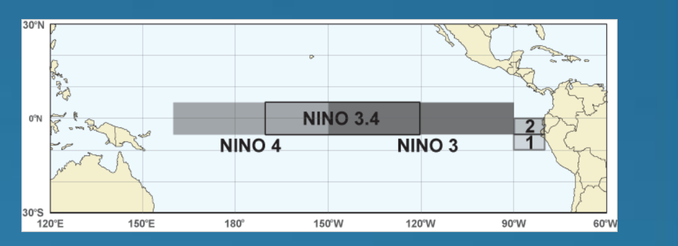


ENSO Teleconnections. ENSO is unique among climate phenomena in its strength, predictability, and global influence, projecting beyond the tropical Pacific through atmospheric teleconnections that affect patterns of weather variability worldwide.

ENSO Indices (SOI & Nino)



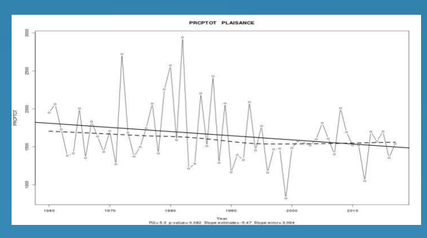
Southern **O**scillation **I**ndex (SOI) is the difference between standardized Darwin and Tahiti surface pressure values. It represents the atmospheric component of the ENSO whereas Nino indices are the sea surface temperature anomalies in the equatorial Pacific Ocean. The sign of SOI is opposite that of the Nino indices.



Graphical depiction of the four Nino Regions

Aim of the study

The aim of this research is to investigate the extent to which annual and seasonal rainfall variability in Mauritius and the SWIO is associated with El-Nino or La Nina events and to comprehensively study the impact of different types of ENSO (EP and CP) on the rainfall patterns over Mauritius and the South West Indian Ocean.



The rainfall distribution over Mauritius shows a lot of inter-annual and intra-seasonal variability

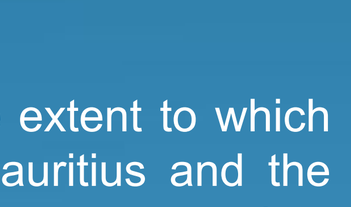
Motivation

At present, the exact relationship between ENSO and the rainfall patterns over the South West Indian Ocean is still not well understood and needs further investigations.
Studying the intra-seasonal and inter-annual spatial and temporal variability of rainfall is vital for long range forecast and understanding climate change impacts in the SWIO.

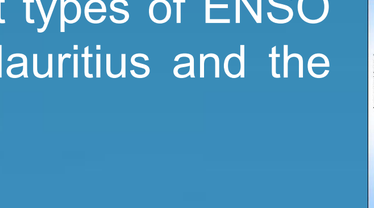
Methods

➢For the study, two types of ENSO indices will be used:

1. The Nino3 index, for the representation of the canonical El Niño, calculated by averaging the SST anomalies in the central tropical Pacific, in the region 150°–90°W, 5°S–5°N.
2. El Nino Modoki Index (EMI), following the methodology proposed by Ashok et al. (2007) defined as:
   $EMI = [SSTA]_C – 0.5[SSTA]_E – 0.5[SSTA]_W$



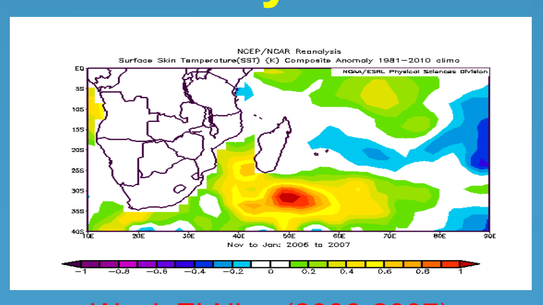
Region for calculating Nino3



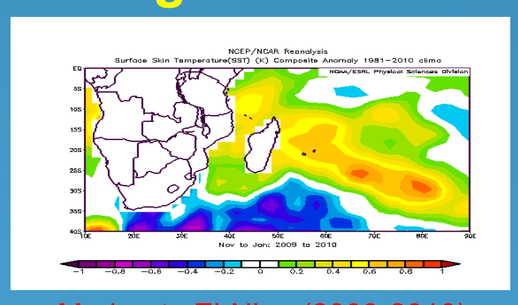
Regions for calculating EMI

➢The study will focus on seasonal rainfall of summer (Nov-Apr) and winter (Jun-Sep).
➢Correlation and regression analysis will be used to establish the relationship of ENSO on the rainfall patterns.
➢The relationships between ENSO and rainfall will be tested at 95% confidence level.

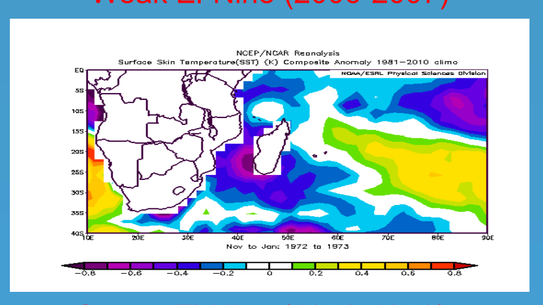
Re-Analysis of SST during El-Nino



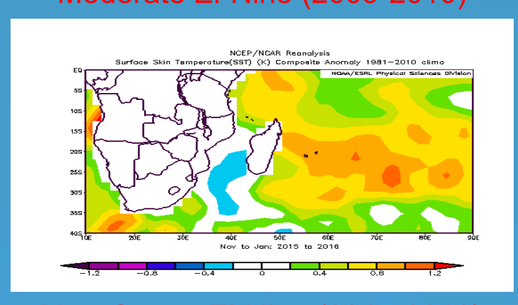
Weak El-Nino (2006-2007)



Moderate El-Nino (2009-2010)



Strong El-Nino (1972-1973)



Very Strong El-Nino (2015-2016)

SST in SWIO shows different responses to varying intensity of the El-Nino phases. This in turn has typical influences on the atmospheric processes in the region and consequently distinct impacts on the rainfall patterns.

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Acknowledgements:
1. SPSAS Organisers
2. Mauritius Meteorological Services
3. São Paulo University
4. Oceanographic Institute São Paulo

References:
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