Rainfall variability in the southern region of Guatemala influenced by the Madden-Julian Oscillation

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Introduction

This study try to determine the influence of the MJO on precipitation in the southern region of Guatemala. The MJO is an equatorial wave that have intra-seasonal variation and is generated in the high atmosphere, and generated effects on surface levels, mainly in precipitation. Daily precipitation data from local stations will be used in addition to MJO amplitude data. The years to be analyzed are 35 from 1980 to 2015.
Propagation, detail

Madden-Julian Oscillation

eastward movement

200 mb

upward motion

850 mb

stormy and wet

equator

sunny and dry

longitude

30° E 60° E 90° E 120° E 150° E 180° 150° W
Monitoring
Monitoring

MATTHEW C. WHEELER AND HARRY H. HENDON, 2004
Data

- Database of 8 stations in the southern region of Guatemala 1980 to 2015 - INSIVUMEH, Camantulul, San José, Champerico, Montufar, the slaves, Mazatenango, Retalhuleu, and big savanna.
- Simple speedy circulation model, ICTP. https://www.ictp.it/research/esp/models/sppeedy.aspx
South Region, local stations

- Montufar
- Pto. S. J
- Catarina S.
- Sabana Grande
- Camaná
- Tecun Uman
- Retalhuleu
- Pto. S. J
- Montufar
Target 1

- Detect and describe the patterns of climate variability of the pp related to the Madden Julian Oscillation.
- Methodology and data:
  - MJO detection whit Low pass filter
  - Weeler and kiladis Zonal wave number-frequency spectrum, using speedy.
  - Wavelet Transform of precipitation.
  - Accumulation of pp in each phase of the MJO.
Spectrograms, Amplitude of MJO and pp
South Region of Guatemala

Amplitud MJO

PP south region

Seasonal

Intra-seasonal

Low pass Filter
OMJ wavenumber frequency spectrum

MJO_Parsys_u_200 LOG[Power: 15S-15N]

MJO_Parsys_prec LOG[Power: 15S-15N]

U_200

Precipitation
Wavelet power spectrum of the stations average

- a) Precipitation (days) (1980-2015)
- b) Precipitation Wavelet Power Spectrum (in base 2 logarithm)
- c) Global Wavelet Spectrum
- d) 20-60 days Scale-average Time Series
Accumulated precipitation during each phase of MJO. Local stations
Target 2

- Quantify the influence of the activity of the WMO in the rainy season of the southern region of Guatemala.
- Methodology
  - Basic statistics of the Amplitude Frequency Distribution
  - Relationship with the accumulated rainfall detected in the pattern
OMJ Amplitude Histogram

Low amplitude of MJO Yellow _ < 0.8

High amplitude of MJO Red > 1.5

Frecuencia

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y may or...
Box plot precipitation when the Amplitude of MJO is low and high

Fase_1 mm/dia vrs Amplitud

Fase_4 mm/dia vrs Amplitud

Amplitud (Baja y Alta)

Amplitud (Baja y Alta)
PP asociado con A alto y Bajo en la fase 1.

PP asociado con A alto y Bajo en la fase 4.
• The precipitation in each phase was quantified in mm/day and percentage, compared to the total precipitation (historical average).

• The difference between precipitation was found when the amplitude is high and low.
Rates of mm/day for months associated with the phases of the MJO, based on the differences of the pp with high amplitude and low

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In the region, 1,266 mm are precipitated annually.

The standard deviation is 14 mm / year.

1.12% of the annual rainfall.
Target 3

- Establish criteria for predicting the precipitation contribution of the Madden Julián Oscillation (OMJ) in the Southern Region of Guatemala.
- Methodology
  - NOAA Forecast
  - Amounts of rainfall with the pattern by month and by phase detected.
Forecast of the month

Accumulator de lluvia Abril, Boca Costa

Días

mm

0,0 5 10 15 20 25 30

0,0 20,0 40,0 60,0 80,0 100,0 120,0 140,0 160,0 180,0

Acumulado Boca_Costa
1.) Verify magnitude of the amplitude of the MJO
2.) Verify number of forecast days and faces.
3.) Verify accumulated rainfall so far and compare with seasonal forecast in that month.
4.) Multiply the number of days by the value of pp. of the pattern of pp. of that month
5.) Subtract or add from the monthly accumulated.

Procedure to validate
• The contribution influence of the OMJ is mainly in phase 1. and inhibition occurs in phase 4.
• The first part of the rainy season is where the influence of the OMJ is most evident, with phase 1.
• The percentage of contribution and inhibition of precipitation associated with the OMJ annual is 1.2% but by mouth can be more than 10%.
• The amplitude of the MJO hay a seasonal variations.
• Relation with the stream events
• Relation between the ENOS and Amplitude of MJO.
• Relations with other climatic forces, like NASH, Monsoons and meteorology phenomena like east waves.
Thanks for your attention!

Climate Change and Sustainability USAC

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