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

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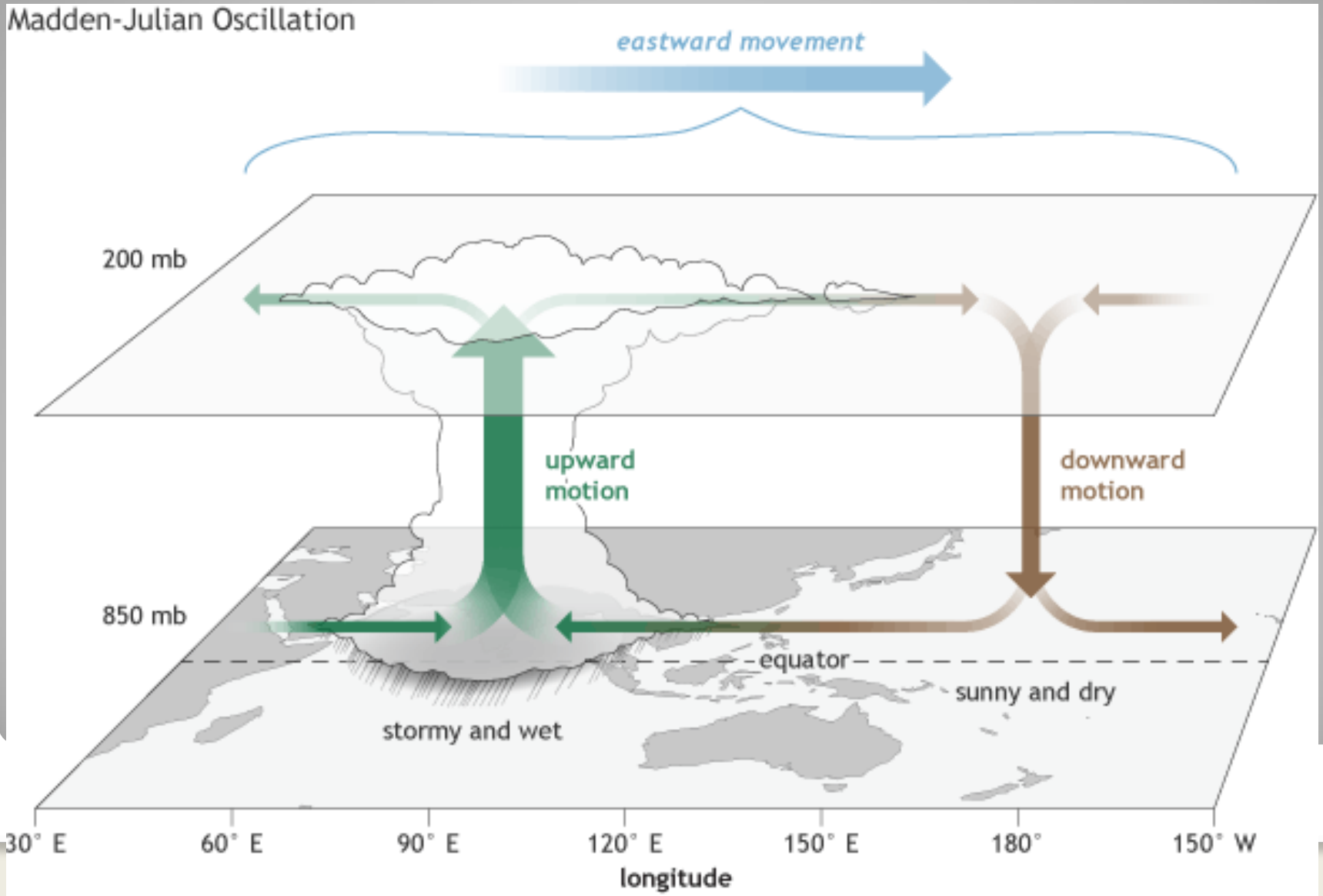
Content

- Introduction
- Targets and Results
- Preliminary conclusions

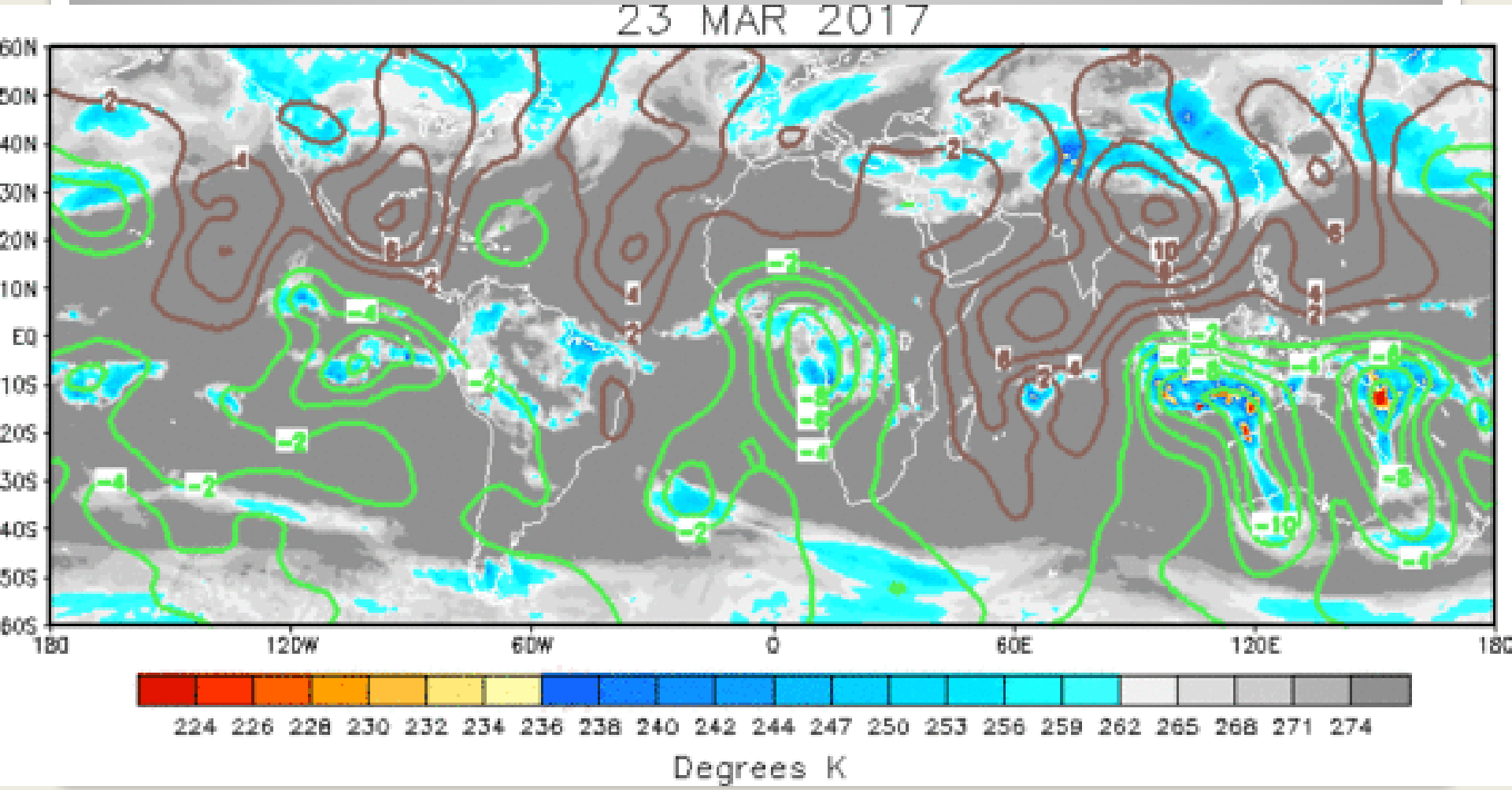
Introduction

- 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

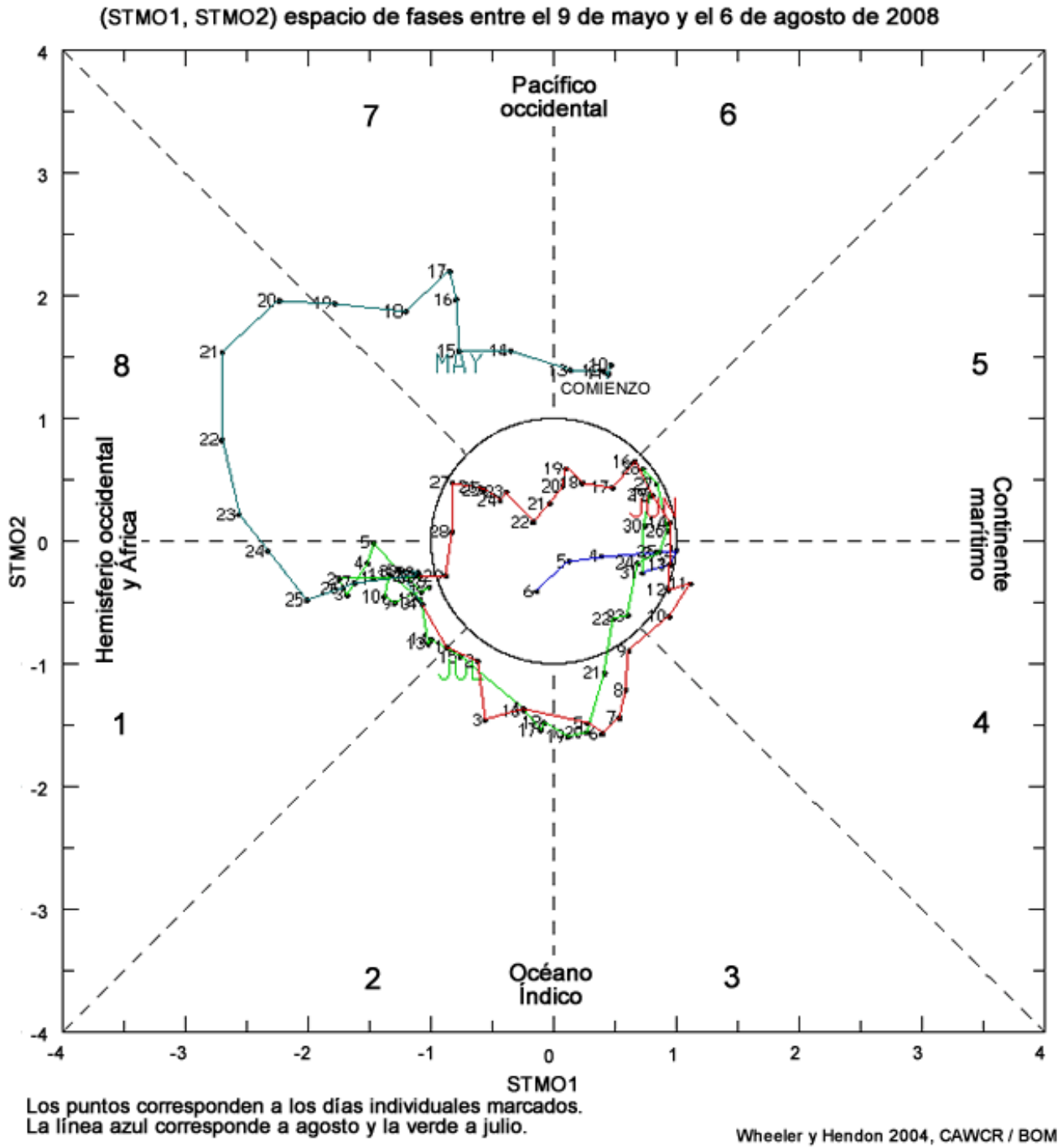


Monitoring


23 MAR 2017
60N
50N
40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
60S
180
120W
60W
0
60E
120E
180
224 226 228 230 232 234 236 238 240 242 244 247 250 253 256 259 262 265 268 271 274
Degrees K

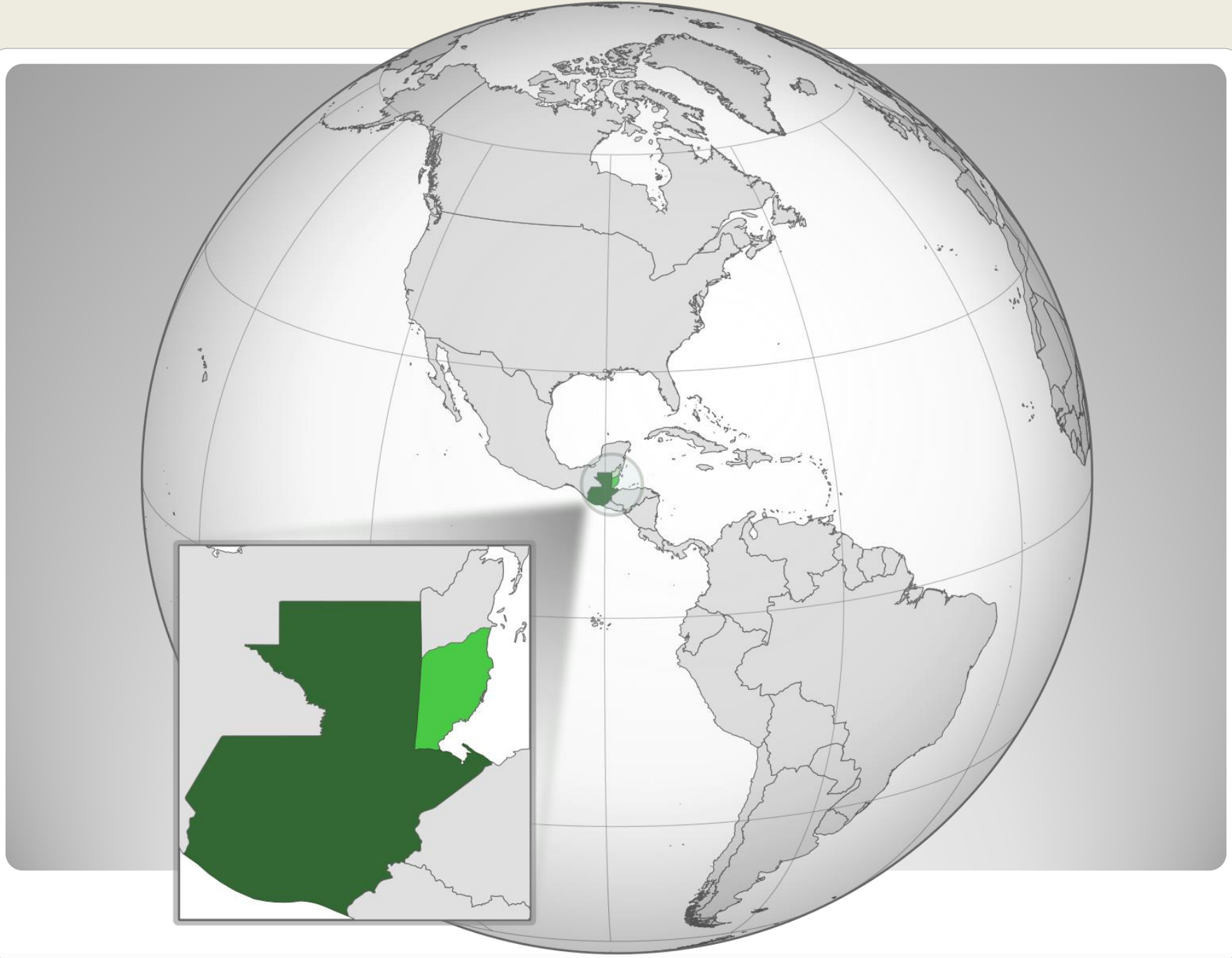
Monitoring

MATTHEW C. WHEELER AND HARRY H. HENDON, 2004

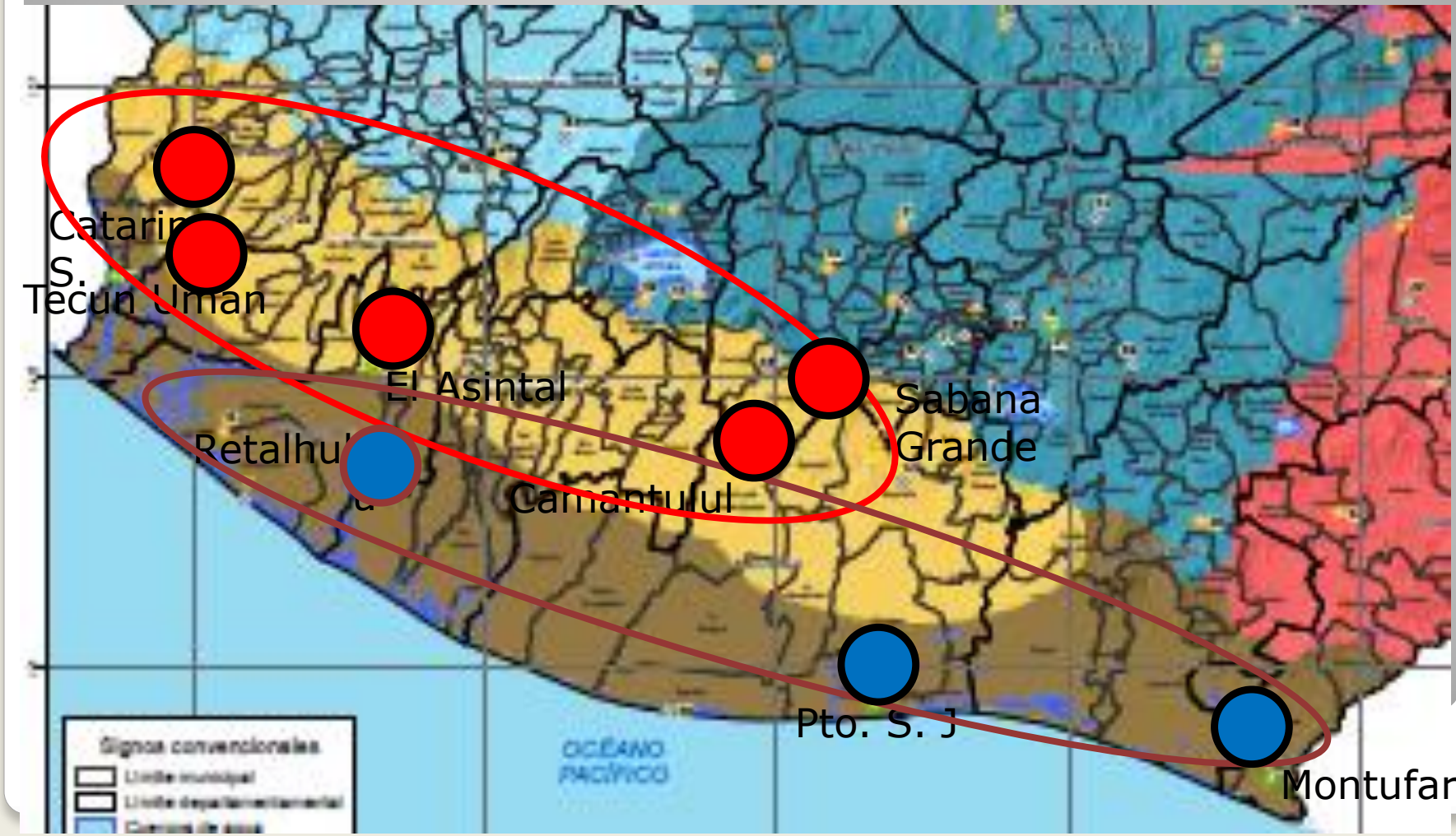


Data

- 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.
- MJO amplitude data from 1980 to 2015 - Australian Bureau of Meteorology. http://www.bom.gov.au/climate/mjo/graphics/rmm.74toRealtime.txt
- Simple speedy circulation model, ICTP. https://www.ictp.it/research/esp/models/speedy.aspx



South Region, local stations



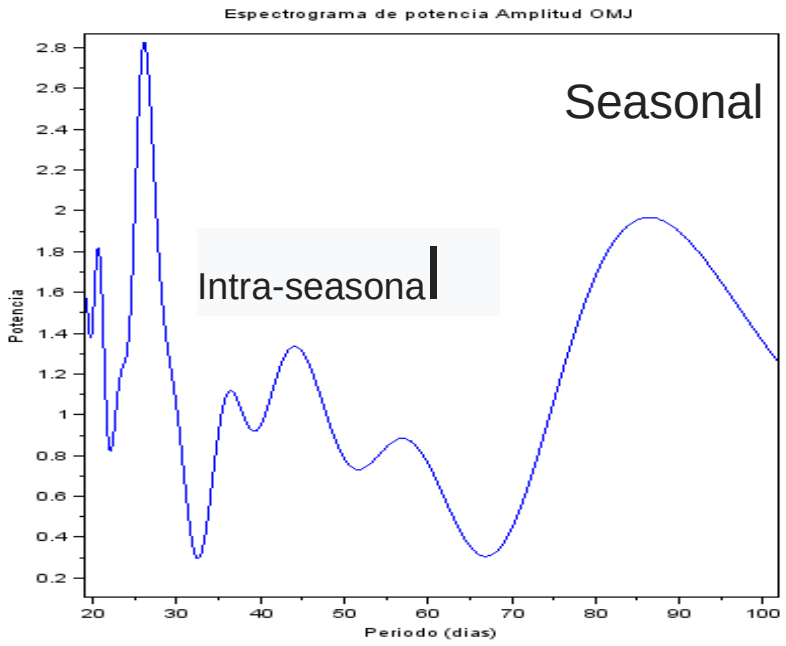
Target 1

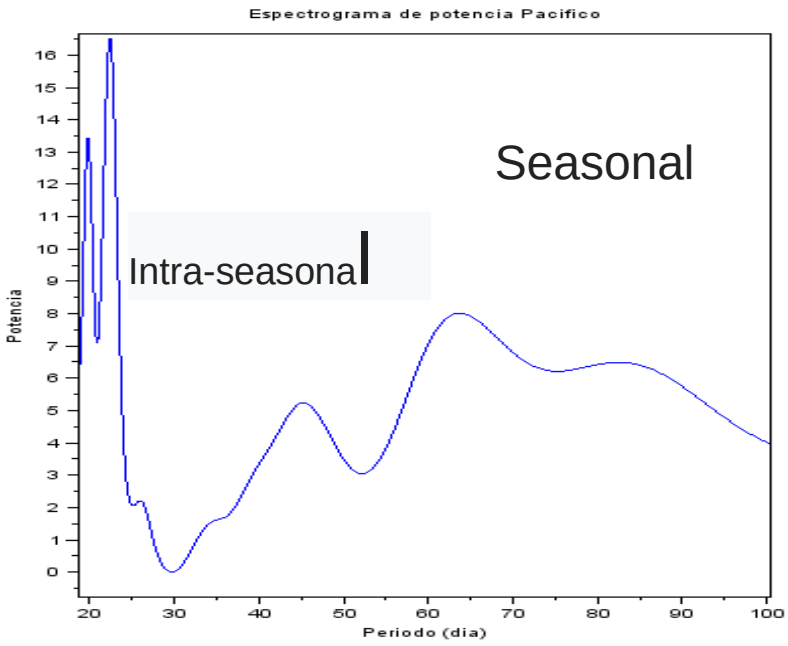
- Detect and describe the patterns of climate variability of the pp related to the Madden Julian Oscillation.
- Methodology and data:
  - MJO detection whit Low pass filter
  - Weeler and kiladis Zonal wave number-frequency spectrum, using speedy.
  - Wavelet Transform of precipitation.
  - Accumulation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

Spectrograms, Amplitude of MJO and pp South Region of Guatemala

Amplitud MJO

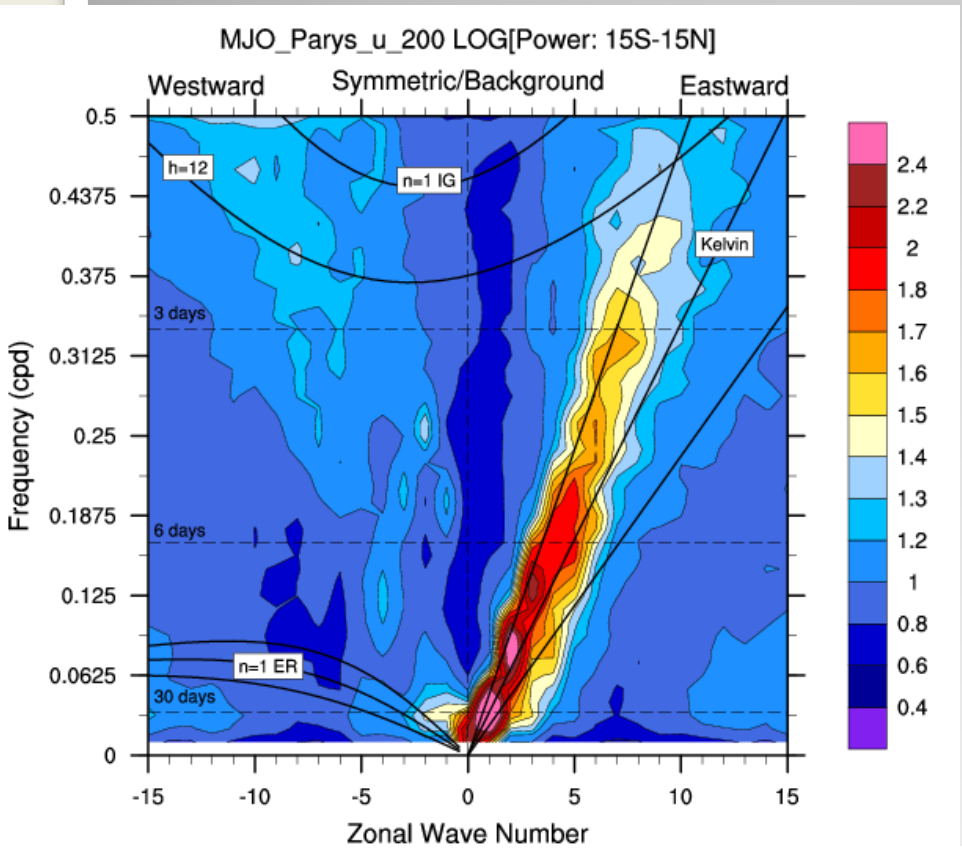
PP south region



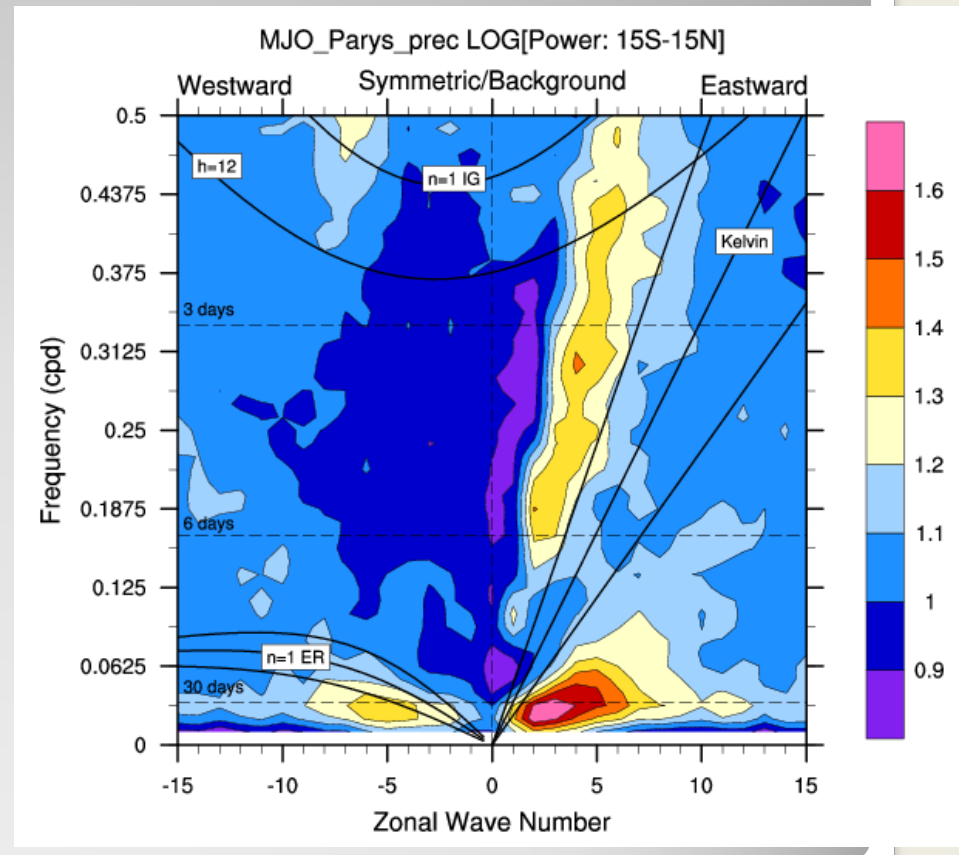


Low pass Filter

OMJ wavenumber frequency spectrum

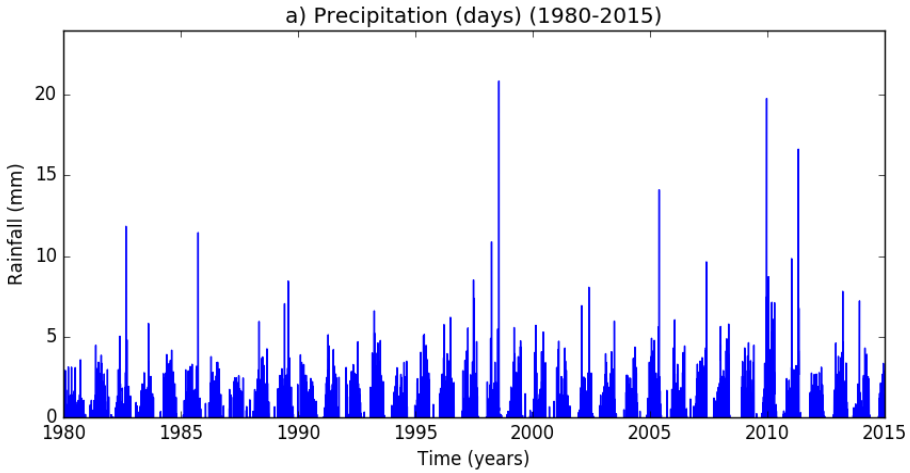


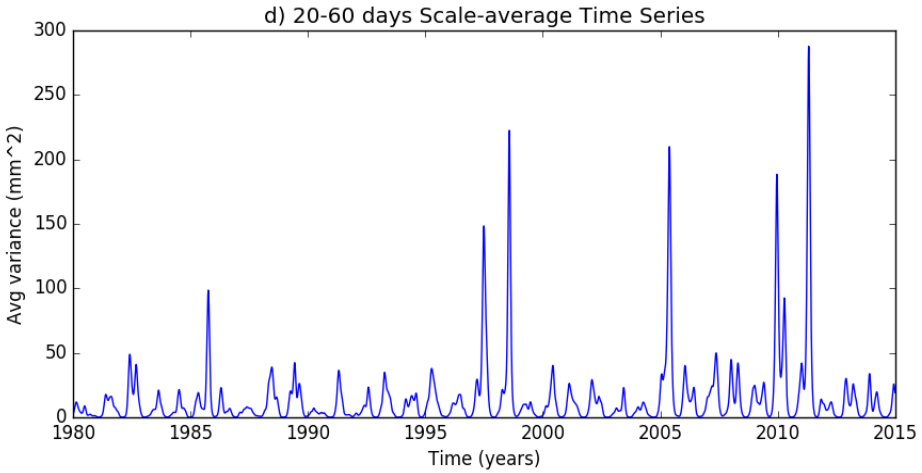
U_200

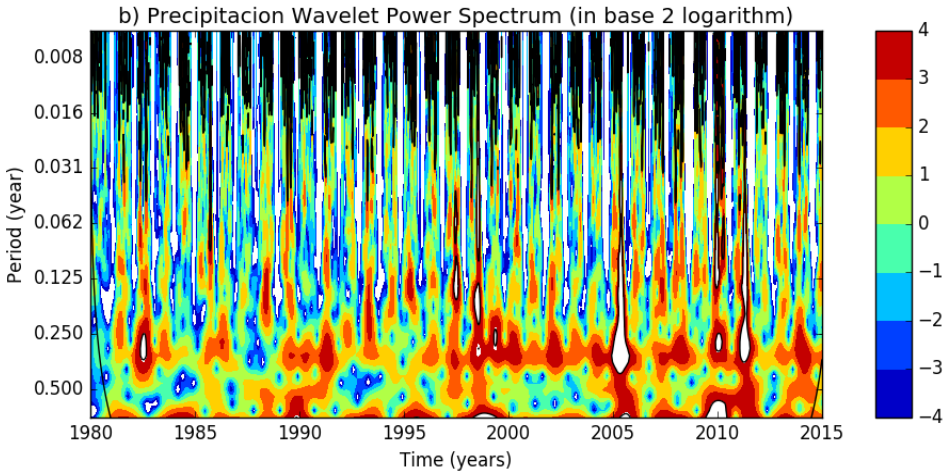


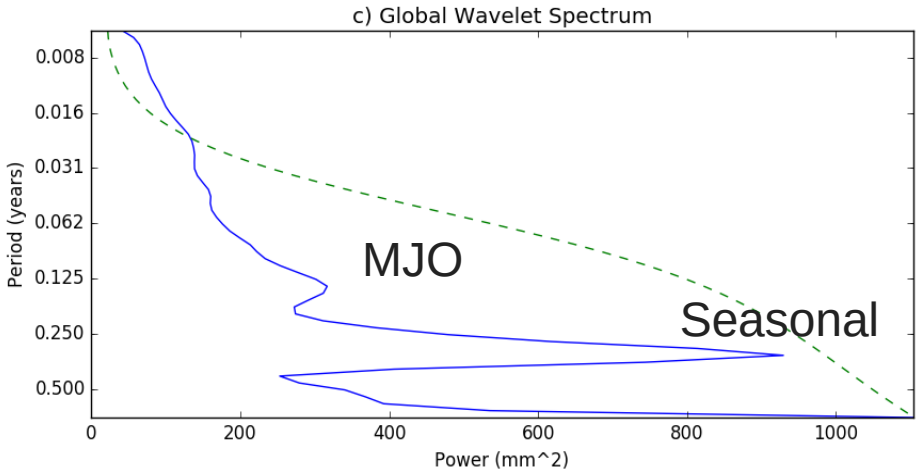
Precipitation

Wavelet power spectrum of the stations average

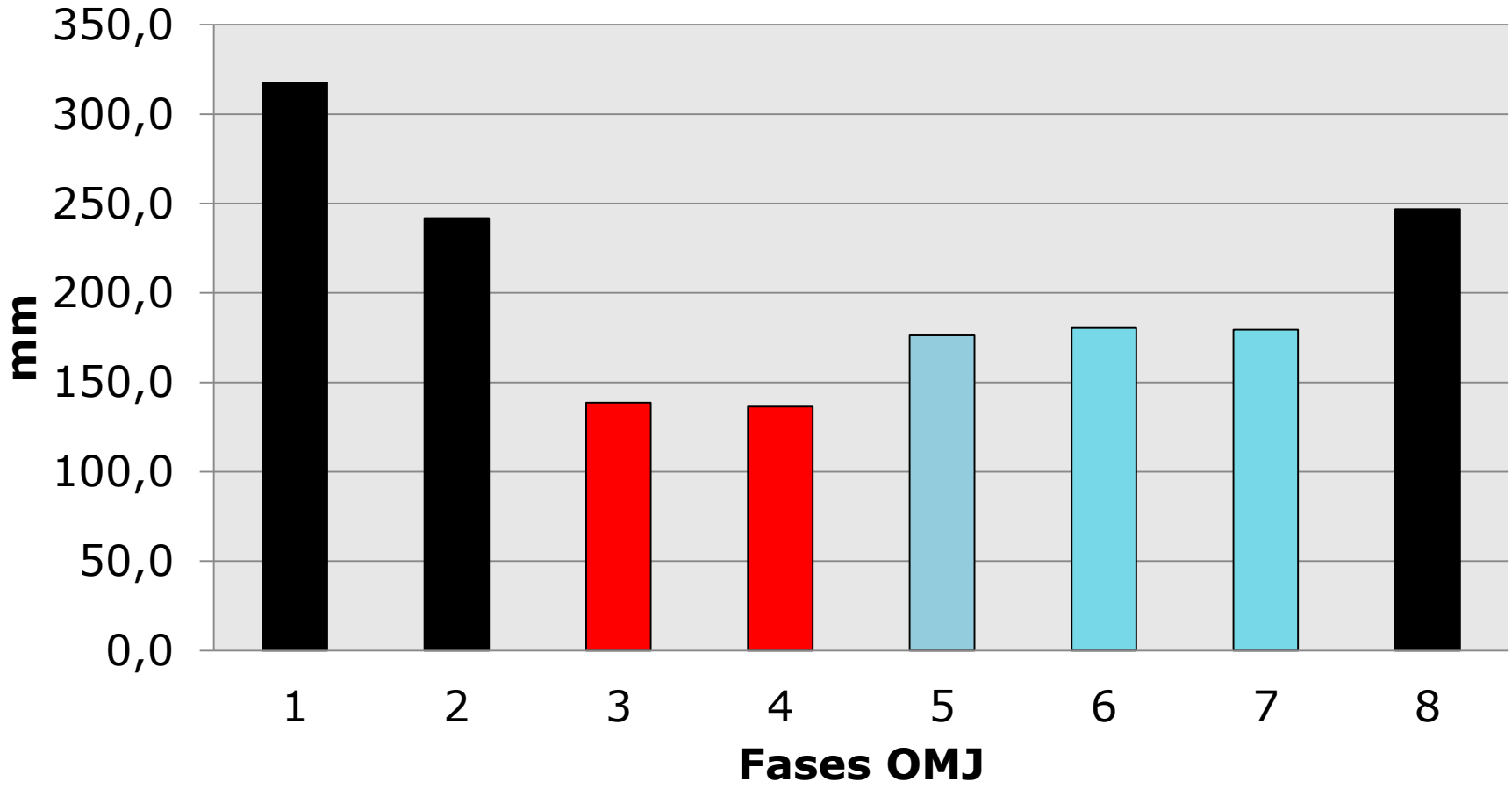








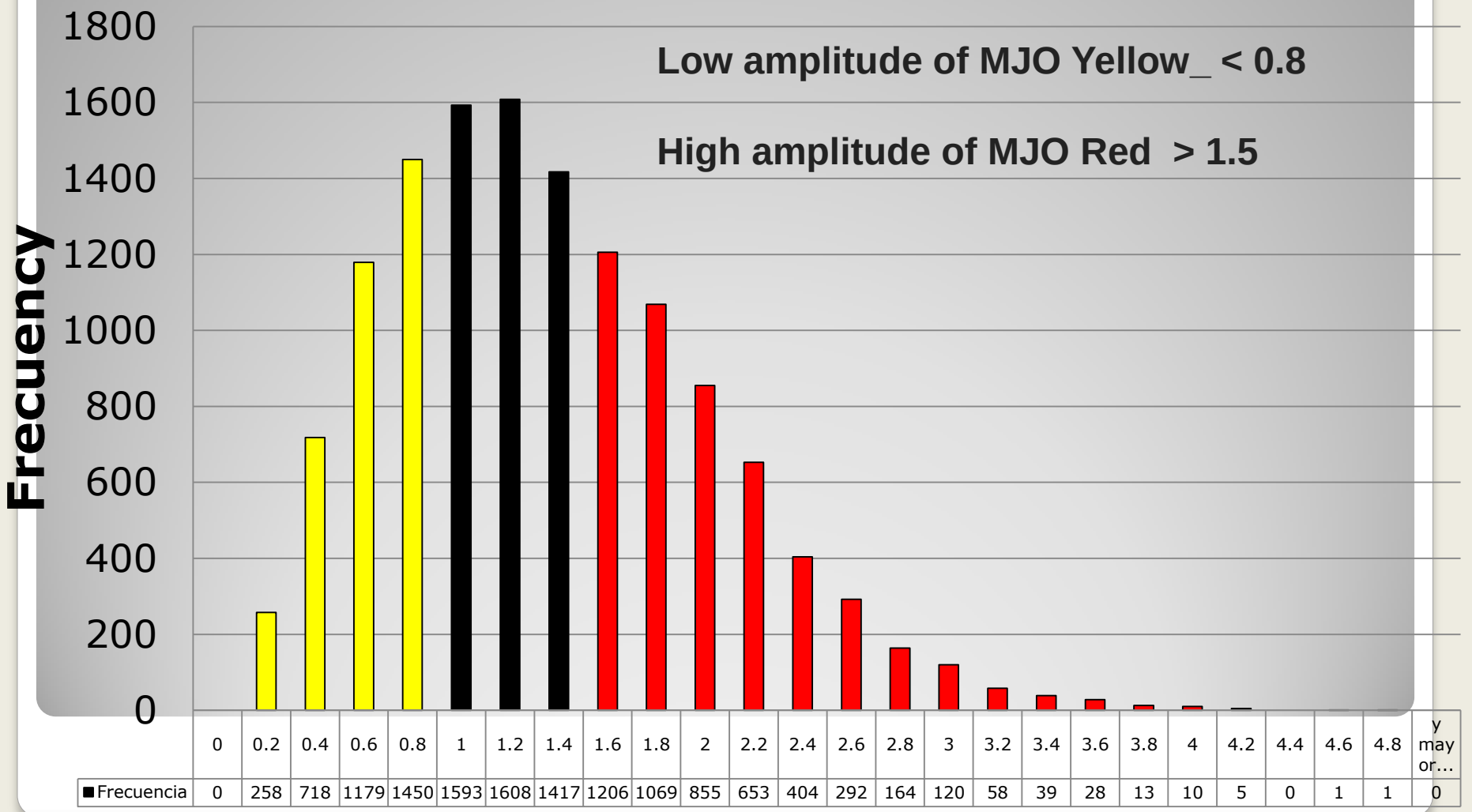
Accumulated precipitation during each phase of MJO. Local stations



Target 2

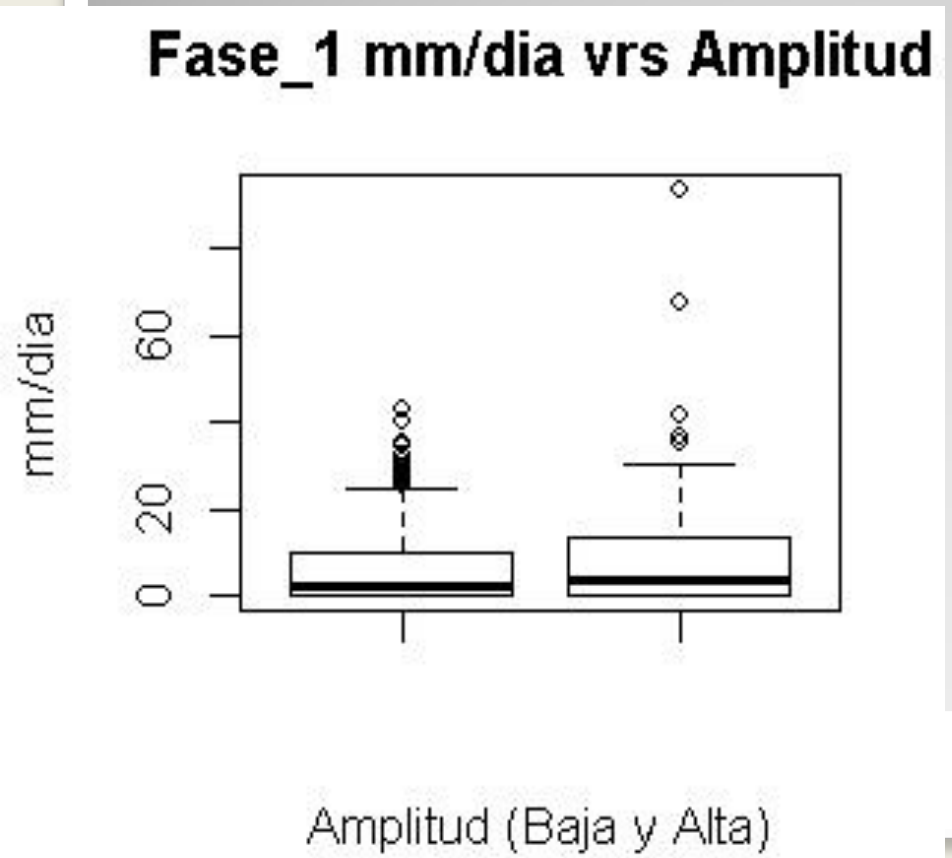
- Quantify the influence of the activity of the WMO in the rainy season of the southern region of Guatemala.
- Methodology
  - Basic statistics of the Amplitude Frequency Distribution
  - Relationship with the accumulated rainfall detected in the pattern

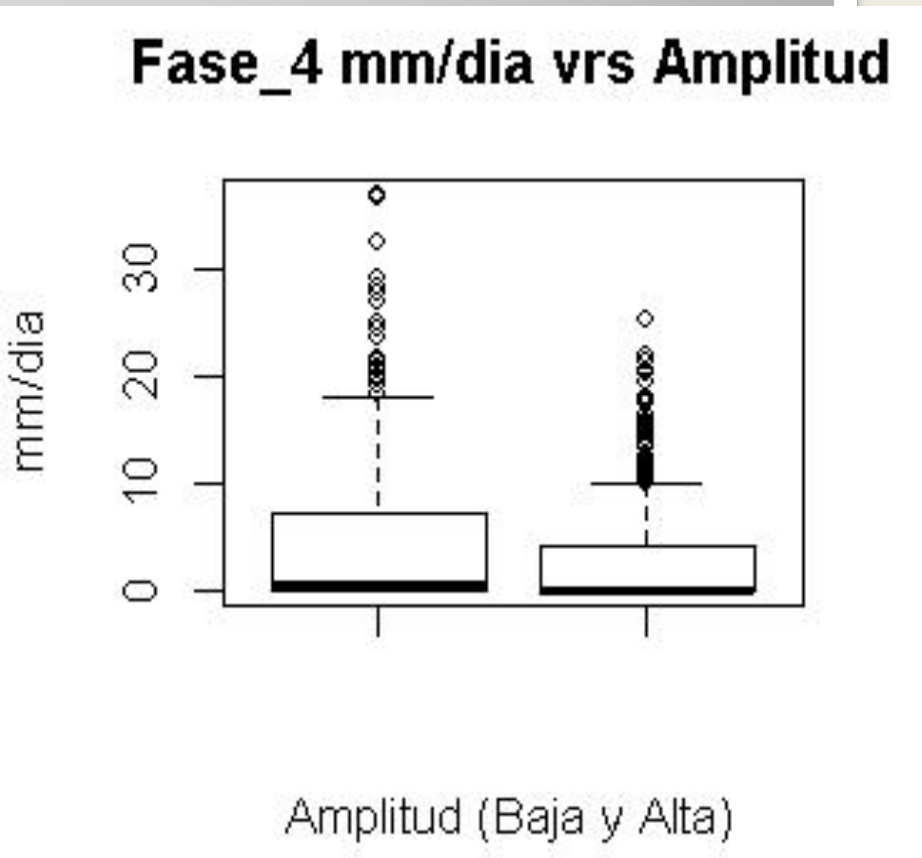
OMJ Amplitude Histogram

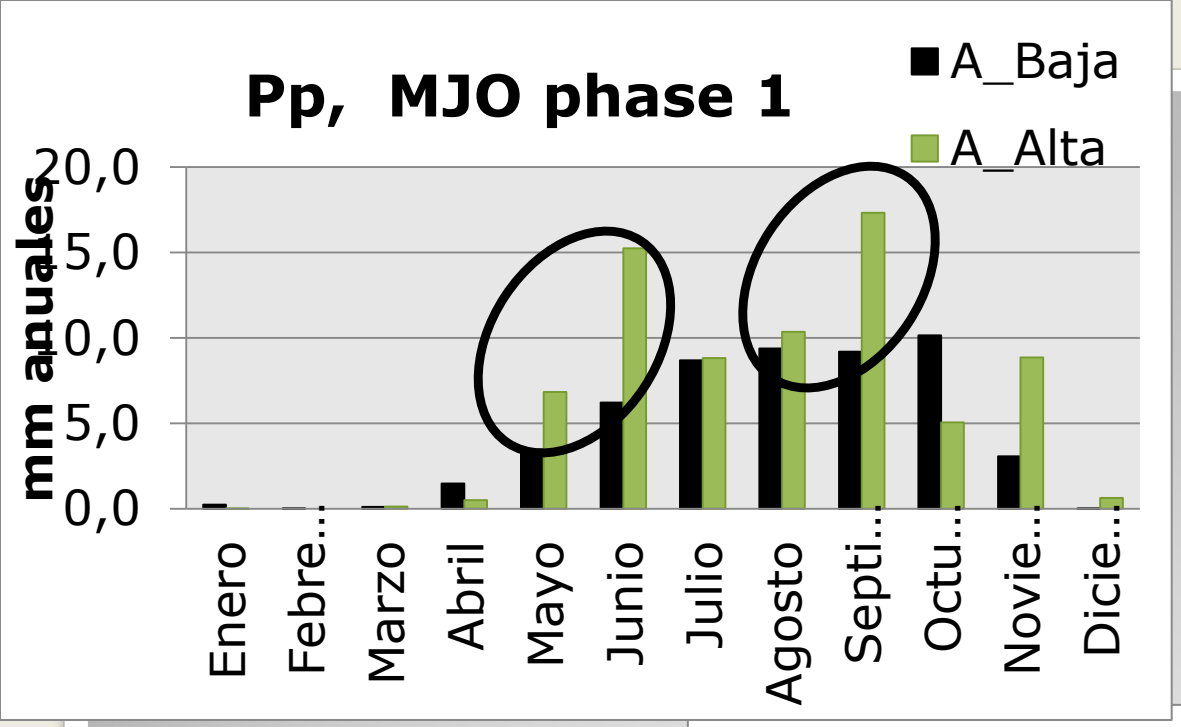


	0	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	3.2	3.4	3.6	3.8	4	4.2	4.4	4.6	4.8	y may or...
Frecuencia	0	258	718	1179	1450	1593	1608	1417	1206	1069	855	653	404	292	164	120	58	39	28	13	10	5	0	1	1	0

Box plot precipitation when the Amplitude of MJO is low and high

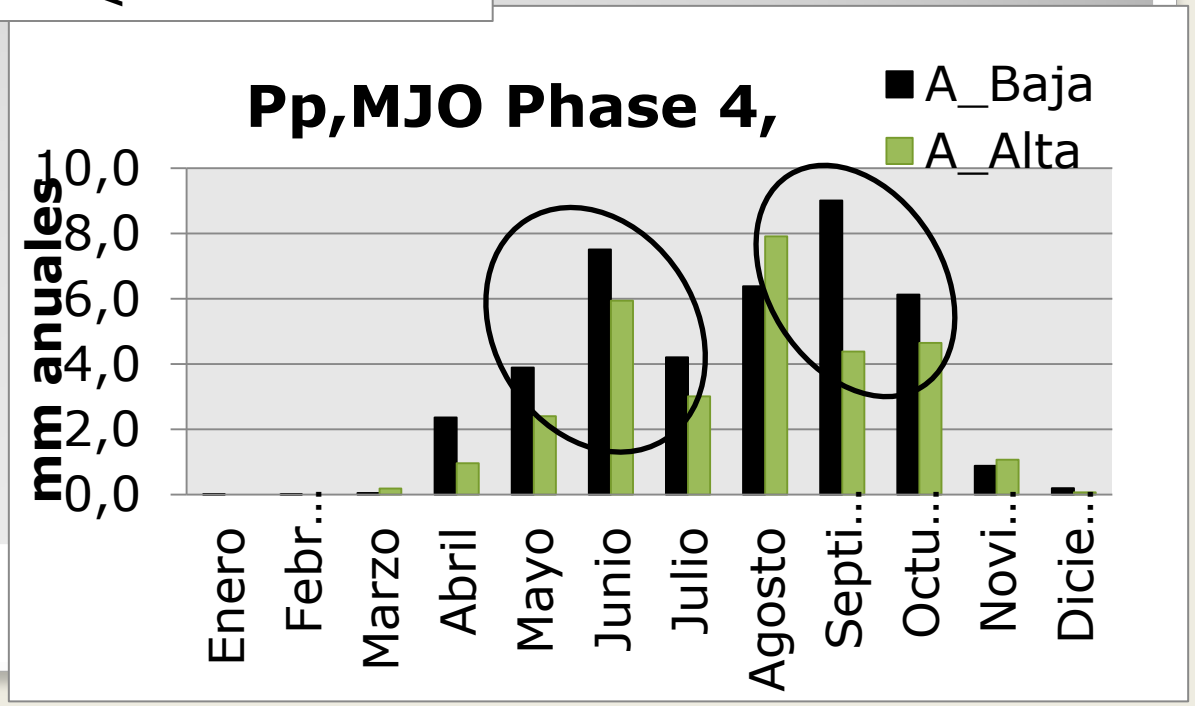






PP associated with A high and Low Phase **1**.

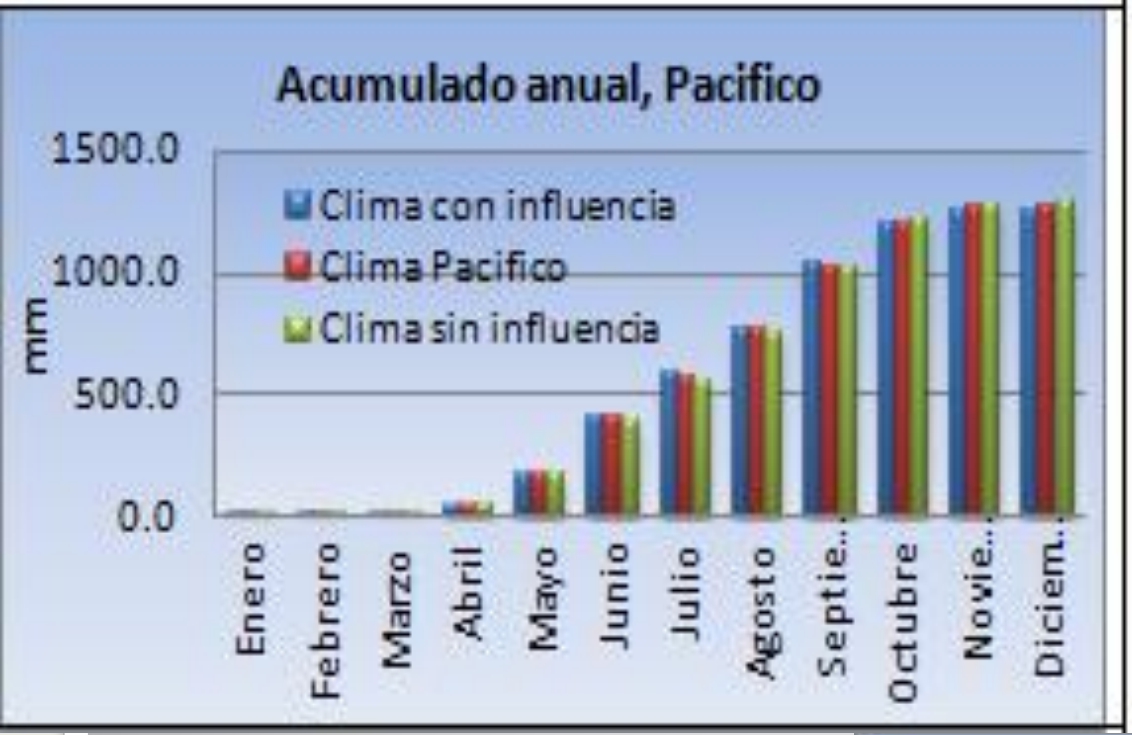
PP associated with A high and Low Phase **4**



- 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.

	FASE 1	FASE 2	FASE 3	FASE 4	FASE 5	FASE 6	FASE 7	FASE 8
ENERO	-0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.1
FEBRERO	0.0	0.0	0.0	0.0	0.5	-0.4	0.0	0.0
MARZO	0.0	0.5	0.2	0.1	0.0	0.0	0.0	0.0
ABRIL	-1.0	-0.4	-1.6	-1.4	-0.1	-0.5	0.0	-0.4
MAYO	3.4	1.5	0.2	-1.5	-2.8	-1.0	1.0	3.6
JUNIO	9.0	4.1	-5.2	-1.6	-4.4	4.1	2.5	4.0
JULIO	0.1	2.0	-0.6	-1.2	-1.4	0.4	0.5	7.5
AGOSTO	1.0	-0.8	-2.7	1.5	-3.6	-3.4	0.5	0.0
SEPTIEMBRE	8.1	4.6	-3.6	-4.6	-3.6	-9.3	-1.1	6.2
OCTUBRE	-5.1	-2.8	-5.6	-1.5	-0.7	-1.2	4.6	-7.2
NOVIEMBRE	5.8	0.5	0.2	0.2	-11.0	-2.1	0.0	2.1
DCIEMBRE	0.6	-0.1	0.0	-0.1	-0.2	0.0	0.2	0.3

Rates of mm/day for months associated with the phases of the MJO, based on the differences of the pp whit high amplitude and low



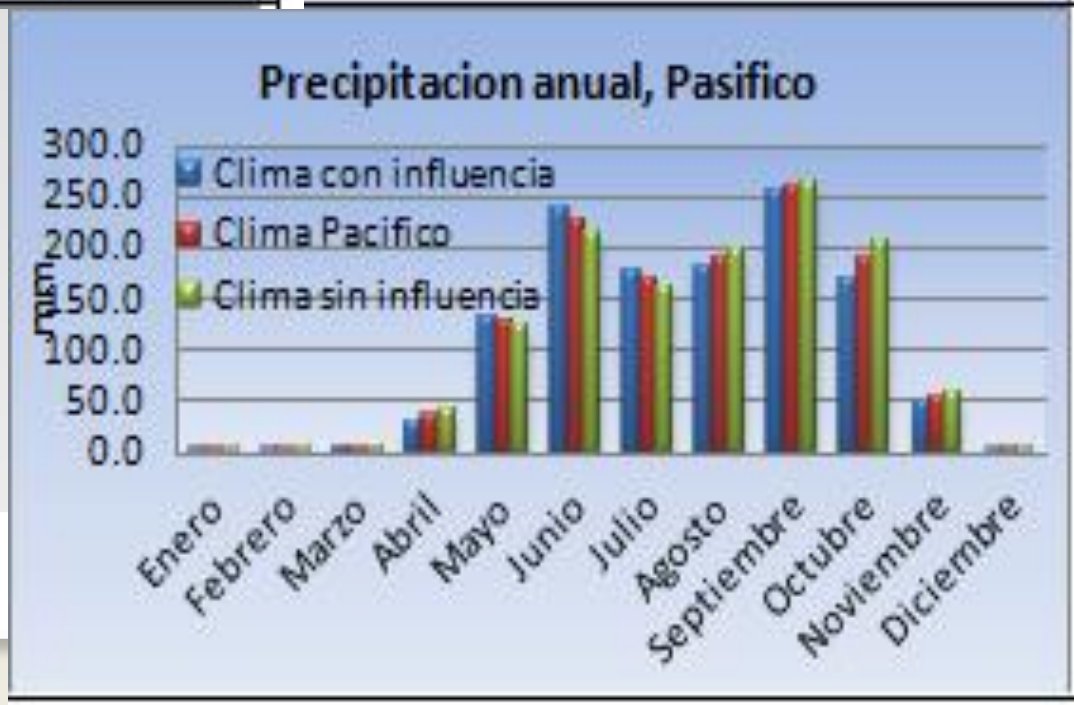
In the region, 1,266 mm are precipitated annually.

The standard deviation is 14 mm / year.

1.12% of the annual rainfall.

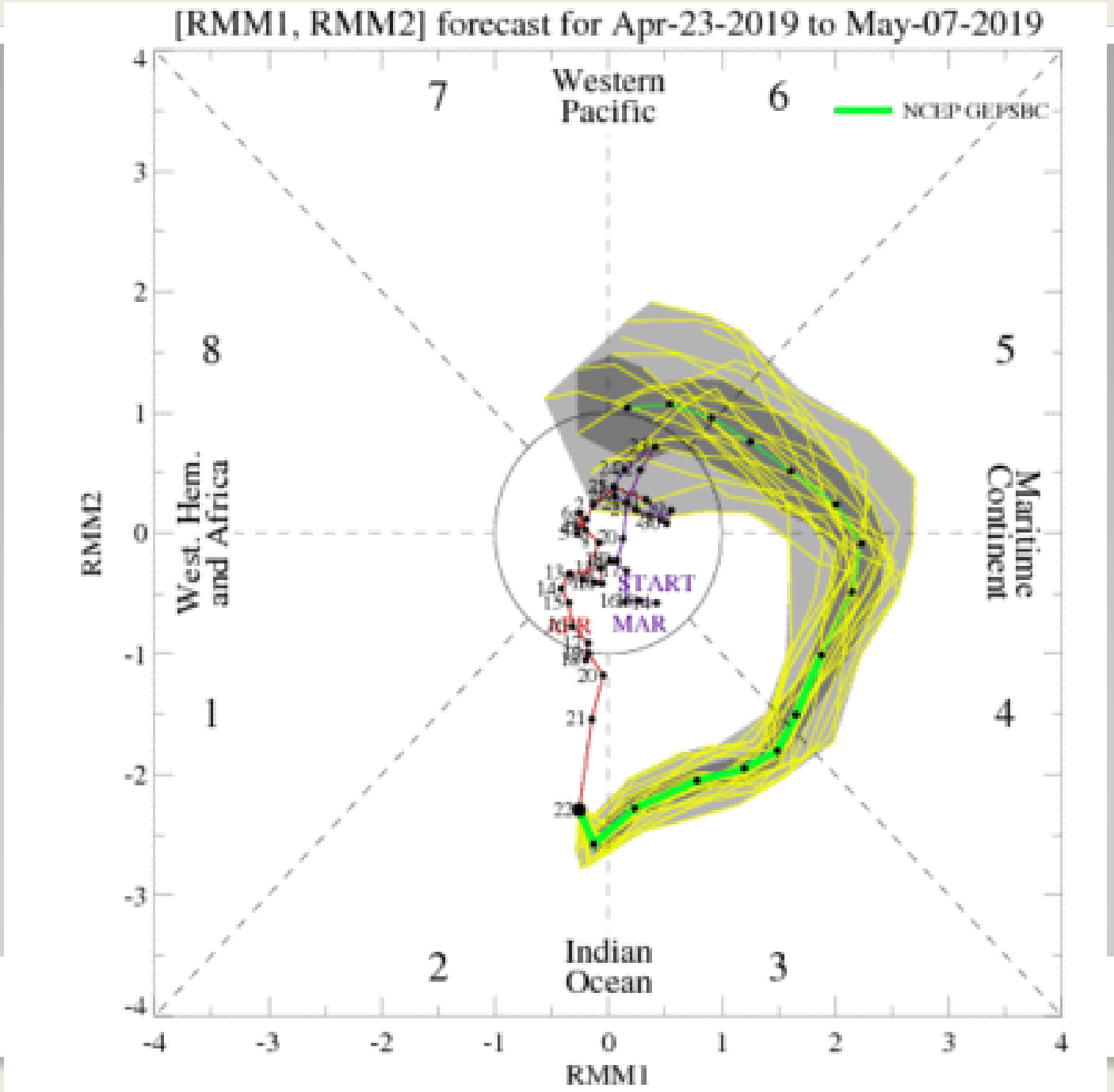
Meses	% mensual
Enero	+ - 0%
Febrero	+ - 7%
Marzo	+ - 26%
Abril	+ - 21%
Mayo	+ - 5%
Junio	+ - 9%

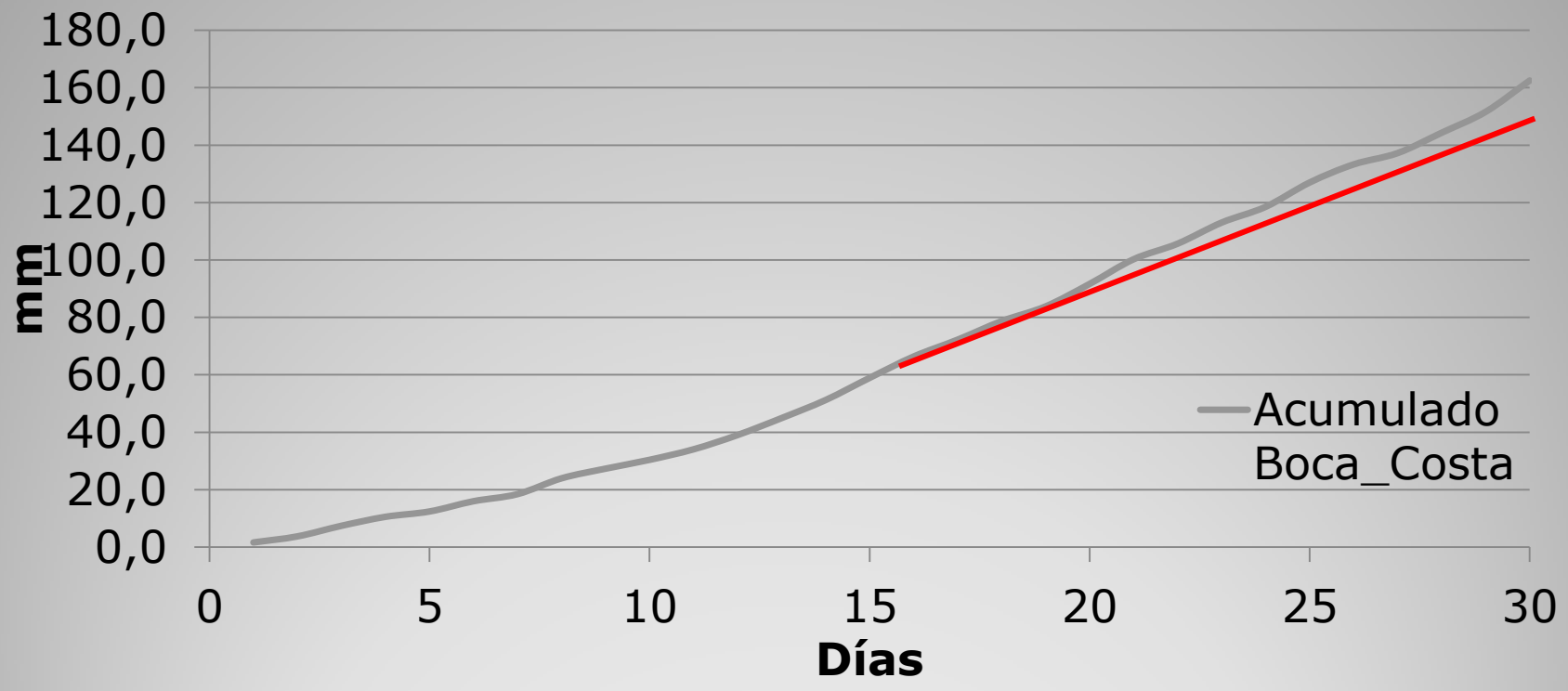
Meses	% mensual
Junio	+ - 9%
Julio	+ - 7%
Agosto	+ - 6%
Septiembre	+ - 2%
Octubre	+ - 15%
Noviembre	+ - 11%
Diciembre	+ - 29%



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.


[RMM1, RMM2] forecast for Apr-23-2019 to May-07-2019
Western Pacific
7
6
5
8
1
4
2
3
Indian Ocean
West. Hem. and Africa
Maritime Continent
NCEP GEPSBC
START
MAR
APR
RMM1
RMM2



Forecast of the month

Procedure to validate

- 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.

- 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.

Preliminary conclusions

- 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.

Futures targets

Thanks for your attention!

Climate Change and Sustainability USAC

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