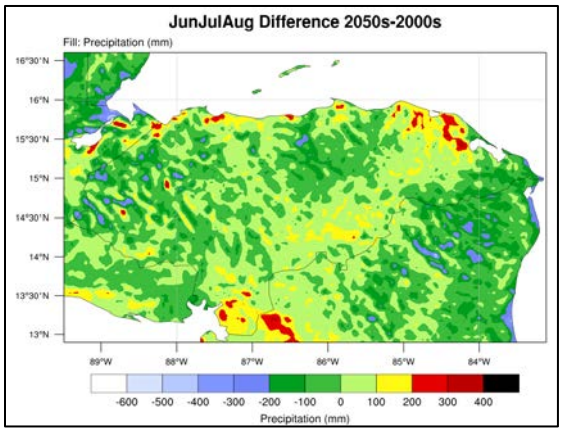
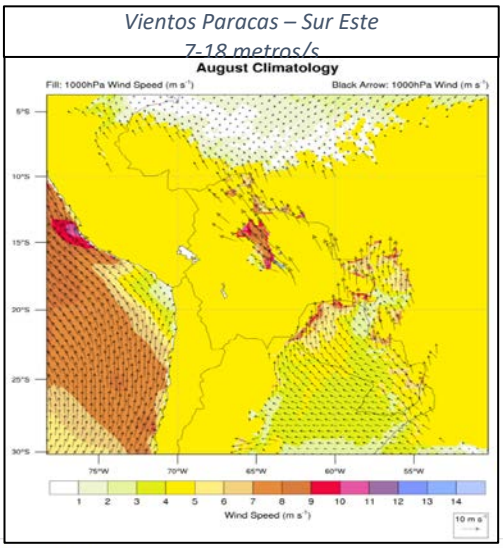
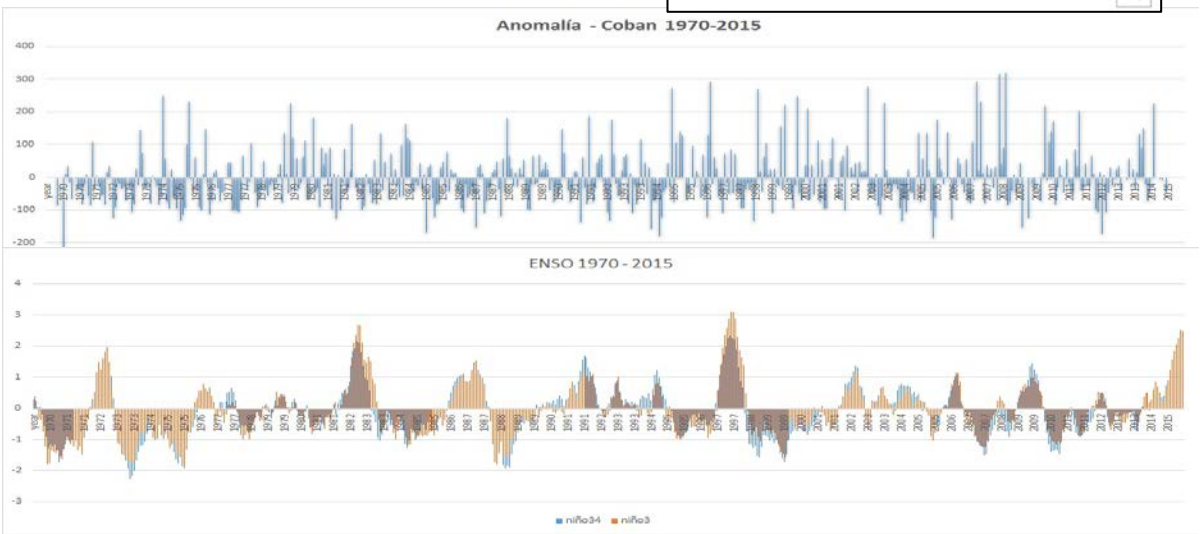
Strengthening Institutional Capacity to Improve the Assessment of Impacts of Climate Change in Latin America and the Caribbean

Contract # INE/CCS-RG-T2612-SN1







Technical Report #2

Proceedings of the Second Workshop

Strengthening Institutional Capacity to Improve the Assessment of Impacts of Climate Change in Latin America and the Caribbean

Contract # INE/CCS-RG-T2612-SN1

Technical Report #2

Proceedings of the Second Workshop

prepared by

Robert J. Oglesby and Clinton M. Rowe
Department of Earth & Atmospheric Sciences
University of Nebraska-Lincoln
Lincoln, Nebraska, USA
November 2016

Contents

Appendices

Workshop 2: Continuing Regional Climate Change Activities

Step 2 (15-18 November 2016)

Overview

The second Consortium workshop was held at the facilities of CATHALAC on the campus of the City of Knowledge in Panama City, Panama from 15-18 November 2016 (see Appendix A for agenda). Nine representatives from 7 countries were in attendance, and the Workshop was directed by two scientists from the University of Nebraska-Lincoln (see Appendix B for list of participants).

The Workshop was four days in length, and focused primarily on the Working Groups each meeting and discussing and analyzing key topics and items under our guidance. Specifically, each Working Group met to discuss progress and update regional and topical needs, and then on the last day presented these results to the entire group. Initial *MapMaker* updates were demonstrated and discussed, and the participants were able to try them out under our guidance, and suggest still further enhancements. New collaborative possibilities with the US National Center for Atmospheric Research (NCAR) were discussed. Finally, there was a group assessment and lengthy discussion of project progress to date, and the next steps to take.

Workshop Objectives

The objectives for this second Workshop were straightforward, and emphasized putting the 'work' into 'workshop'. That is, the activities focused around the Participants working together, exchanging ideas, learning new methods from us and from each other, and so forth. The updated Working Group membership is given in Appendix C.

1) Meetings of each Working Group to discuss progress and update regional needs. This was a key focus of the Second Workshop.

2) Individual participant discussion of specific country progress and continued needs. This was a key outcome of the Workshop, as they were not shy!

3) Regular reports of each Working Group to all participants (see Appendix D).

4) Update on, demonstration, and discussion of new MapMaker improvements and enhancements

5) Group assessment of progress, and the next steps to take.

A real strength of this second Workshop was the frank and open group discussions we had about the scope of the project, what the expectations were, and how best to proceed, both with the workshops and, importantly, between them.

Working Groups

A brief description is provided below of each Working Group and the charge they have taken upon themselves. The updated membership of each Working Group is given in Appendix C.

Working Group 1: Tropical Systems

This Working Group focuses on weather systems that start as tropical waves and subsequently may develop into tropical storms and possibly then into a hurricane. Both the Atlantic and eastern Pacific basins are considered, as either can affect the LAC, especially Central America, Mexico, and the Caribbean. Because of the large geographic area involved, this group is focused on the region-wide simulations for Mesoamerica and the Caribbean.

Working Group 2: ENSO

This Working Group focuses on El Nino and La Nina events, which can have major impacts on Central America and the Pacific coast of northern South America (Peru, Ecuador, and Colombia. Because of the availability of WRF simulations of sufficient length, at least initially the group is concentrating on Guatemala and surrounding regions.

Working Group 3: Mountain Precipitation and Glaciers

This Working Group focuses on precipitation in the very mountainous terrain that comprises much of the region. In Central America this is primarily rainfall, but in the northern Andes of Bolivia, Peru, and Ecuador snowfall and the resultant impacts on mountain glaciers is also extremely important. At least initially the group is concentrating on Bolivia (and surrounding regions) because of the availability of a catalog of long and relevant simulations with WRF.

Deliberations by each Group continued much of the day Tuesday, Wednesday and Thursday, as well as Friday morning. This was the focus of the Workshop. As always, the staff from the University of Nebraska circulated among the Groups, answering questions and providing advice and guidance.

On Friday afternoon, before the close of the Workshop, each Working Group presented a report that described progress made during the workshop. In addition, each Group discussed their plans until the next (second) workshop schedule for March or April of next year. These plans included activities, a time line by which they would occur, and an outline of the scientific papers and reports they expect to produce. The presentation slides and other material presented are collected in Appendix D.

We continue to be extremely pleased with the continuing progress each Working Group was able to make during this second Workshop. Each Group has a coherent plan for moving forwarded and, especially once relevant *MapMaker* enhancements are implemented, appear to have the knowledge, capabilities, and resources necessary to carry out their plans.

Planned MapMaker Development

Participants were again asked to identify and propose any additional capabilities they would like to see added to *MapMaker*. Existing capabilities and proposed additional functionality are summarized in the table below. *MapMaker* development will be on-going during the contract period.

Group Assessment of Progress, and the Next Steps to Take

A real strength of this second Workshop was the frank and open group discussions we had about the scope of the project, what the expectations were, and how best to proceed, both with the workshops and importantly in-between them.

The conflicting needs of the Participants was discussed, that is, the requirements of the BID contract funding the project, versus the individual country needs of the participants, which had wide variation and was not always compatible with Working Group objectives.

The need to stay in better contact was also discussed at length. The individual Working Group Skype sessions between the first and second workshops were not well organized (the UNL staff takes full responsibility for this). This meant participation was spotty. Scheduling these Skype sessions at least a month in advance, followed by timely reminders, is therefore a priority.

Activities Between Workshops

A key facet is that project activities are not restricted to just the workshops, and preparations for them. In the time between workshops we will maintain steady contact via monthly Skype sessions with the participants, especially via the Working Groups but also individually as needed.

We recognize there were some issues following the first Workshop in coordinating these regular Skype sessions. This was a topic of discussion during the Workshop and we mutually agreed that we all need to be more proactive in scheduling these as far in advance as possible and block the time off in our schedules. This contact will be done via video conferencing, email, and other methods as appropriate. Also, based on Participant suggestions, all Working Group Skypes will be open to all Participants. This is both to ensure continuity and compatibility

between the Working Groups, and because the interests of many of the Participants intersect the specific Working Group themes.

Summary of current *MapMaker* suite capabilities and proposed additional functions. Updates from Workshop 2 highlighted in red.

***MapMaker* Capabilities – Present & Proposed**				
	Overall	***MapMaker***	**Data Download**	**Verification**
Present capabilities		monthly maps	full files only (1 year of monthly data/domain)	GSOD "only" – just WMO stations
		basic variables	netCDF only	pre-processed
		averaging months (2-12)		5 variables
		Zoom		basic statistics table
		change plot parameters		basic plot types
		change color tables		
		several graphic formats		
Proposed additions	utilize daily data	"get map data" button	sub-setting by time, latitude-longitude box, point, etc.	"country" data & metadata (units, QC, etc.)
	add more data (GSOD, "country", other model) for additional time periods	% change for precip	Averaging	ability to select begin/end times for verification (within available data/model times)
	statistics (distributions, percentiles, etc.)	cross-model averaging	additional data formats (e.g., CSV)	"get data" button
	pre-compute standard climate extreme indices	storage (temporary) of data from other sources for comparison		
		custom plot titles		
		better overlay capability		

Assumptions going forward:

- capacity to store all UNL WRF daily data (in place November 2016) and use these to compute requested parameters (e.g., averages, threshold exceedances, dry/wet runs)
    - might be desirable to pre-process and store some standard monthly and climatological parameters (speed vs. storage)
- sufficient processing power to perform some computations "on the fly" (in place November 2016)
- countries will need to provide their data in some simple, standardized format with standardized naming convention
    - metadata (units, QC, etc.) must be provided, as well
- rename "years" for GCM-driven simulations from nominal years to "model years" to avoid a common source of confusion (e.g., nominal 2006 becomes MY01, nominal 2056 becomes MY51), based on discussion at the Workshop (implemented July 2016)

Workshop Summary

In summary, the Workshop was a successful continuation to the Regional Consortium.

The next steps include:
Next workshop would in March or April 2017.

New features of MapMaker decided upon will be available in the coming months

MapMaker is now on **http://rccdp.unl.edu** and this will continue to be developed and enhanced.

Working Groups are requested to be in touch, with better collaboration between the groups.

DATA

- To include more station data in Mapmaker, as provided by the Participants.
- To include more stations from national meteorology and hydrology services in the region (INSIVUMEH, INETER, as examples).
- To perform quality control and homogenization process to stations data. This is crucial, but may require a technical person devoted to the effort.

COORDINATION

- Include all groups into one discussion list to enhance different skills or expertise
- Define short term goals based on country needs or interests
- Skype meetings with all groups
- Discuss a preliminary agenda with the Group prior to the next Workshop.

Appendix A: Workshop Agenda

- AGENDA –

Workshop 2

Continuing Regional Climate Change Consortium Activities: Step 2
(15-18 November 2016)

Day 1:		
Morning		
8:30 am	Registration	
9:00 am	Introduction and Scope of Workshop	(plenary)
9:30 am	Status reports from each Working Group	(plenary)
10:30 am	***Break***	
10:45 am	*MapMaker* update	(plenary)
11:15 am	Group discussion: *MapMaker* needs	(plenary)
12:30 pm	***Lunch***	
Afternoon		
2:00 pm	Working Groups meet	(breakout)
3:30 pm	***Break***	
3:45 pm	Working Groups meet	(breakout)
4:30 pm	Group discussion: key themes, ideas, and needs identified so far	(plenary)
5:00 pm	***Adjourn for the day***	

Day 2: ***Working Group Meetings***		
Morning		
8:30 am	Status reports from each Working Group	(plenary)
9:15 am	Working Groups meet	(breakout)
10:30 am	***Break***	
11:00 am	Collateral Activities at NCAR	(plenary)
12:30 pm	***Lunch***	
Afternoon		
2:00 pm	Working Groups meet	(breakout)
3:30 pm	***Break***	
4:00 pm	Group discussion: key themes, ideas, and needs identified so far	(plenary)
5:00 pm	***Adjourn for the day***	

Day 3: *Working Group Meetings*		
Morning		
8:30 am	Status reports from each Working Group	(plenary)
9:15 am	Working Groups meet	(breakout)
10:30 am	***Break***	
11:00 am	Group discussion: *MapMaker* update prioritization	(plenary)
12:30 pm	***Lunch***	
Afternoon		
2:00 pm	Working Groups meet	(breakout)
3:30 pm	***Break***	
4:00 pm	Group discussion: key themes, ideas, and needs identified so far	(plenary)
5:00 pm	***Adjourn for the day***	

Day 4: *Workshop Conclusions and Next Steps*		
Morning		
8:30 am	Working Groups finalize plans	(breakout)
10:30 am	***Break***	
11:00 am	Working Groups report	(plenary)
12:30 pm	***Lunch***	
Afternoon		
2:00 pm	What we have accomplished during this workshop	(plenary)
2:30 pm	Key needs moving forward	(plenary)
3:30 pm	***Break***	
4:00 pm	Next steps	(plenary)
4:30 pm	Workshop conclusions: Future objectives, tasks, and goals	(plenary)
5:00 pm	***Adjourn the workshop***	

Appendix B: List of Participants

	Nombre del Evento:	Segundo Taller Regional del Programa "Fortalecimiento de capacidades institucionales para mejorar la evaluación de los impactos del cambio climático en América Latina y el Caribe"
	Fechas:	15 al 18 noviembre 2016
	Lugar:	Ciudad de Panamá, Panamá

	Nombre	Cargo	Organización	email
1	**Edita Caceli Talledo Flores**	**Dirección de Meteorología Aplicada**	**Servicio Nacional de Meteorología e Hidrología (SENAMHI), Perú**	etalledo@senamhi.gob.pe
2	**Marcos Andrade Flores**	**Laboratorio de Física de la Atmósfera**	**Universidad Mayor de San Andrés, Bolivia**	mandrade@atmos.umd.edu mandrade@fiumsa.edu.bo
3	**Gabriela Alfaro Marroquín**	**Directora Interina**	**Centro de Estudios Ambientales y Biodiversidad, Universidad del Valle de Guatemala**	gabyalfaro@yahoo.com
4	**Francisco Javier Argeñal Pinto**	**Sub Jefe del Centro Nacional de Estudios Atmosféricos, Oceanográficos y Sísmicos**	**Comisión Permanente de Contingencias (COPECO), Honduras**	fjargenal@gmail.com
5	**Juan José Nieto**	**Jefe de Servicios Climáticos**	**Centro Internacional para la Investigación del Fenómeno de El Niño (CIIFEN), Ecuador**	j.nieto@ciifen.org
6	**Josué Iván Batista Lao**	**Dirección de Hidrometeorología**	**ETESA**	jbatista@ETESA.com.pa
7	**Marcelo Oyuela**	**GIS Specialist**	**CATHALAC**	Marcelo.Oyuela@cathalac.int
8	**Robert Oglesby**	**Professor**	**University of Nebraska-Lincoln**	roglesby2@unl.edu
9	**Clint Rowe**	**Professor**	**University of Nebraska-Lincoln**	crowe1@unl.edu

Appendix C: Working Group Memberships at Workshop 2

Working Group 1: Tropical Systems

Francisco Argeñal, Josué Batista

Working Group 2: ENSO

Juan José Nieto, Gabriela Alfaro, Dusstin Barrera

Working Group 3: Mountain Precipitation and Glaciers

Marcos Andrade, Edita Talledo Flores, Marcelo Oyuela

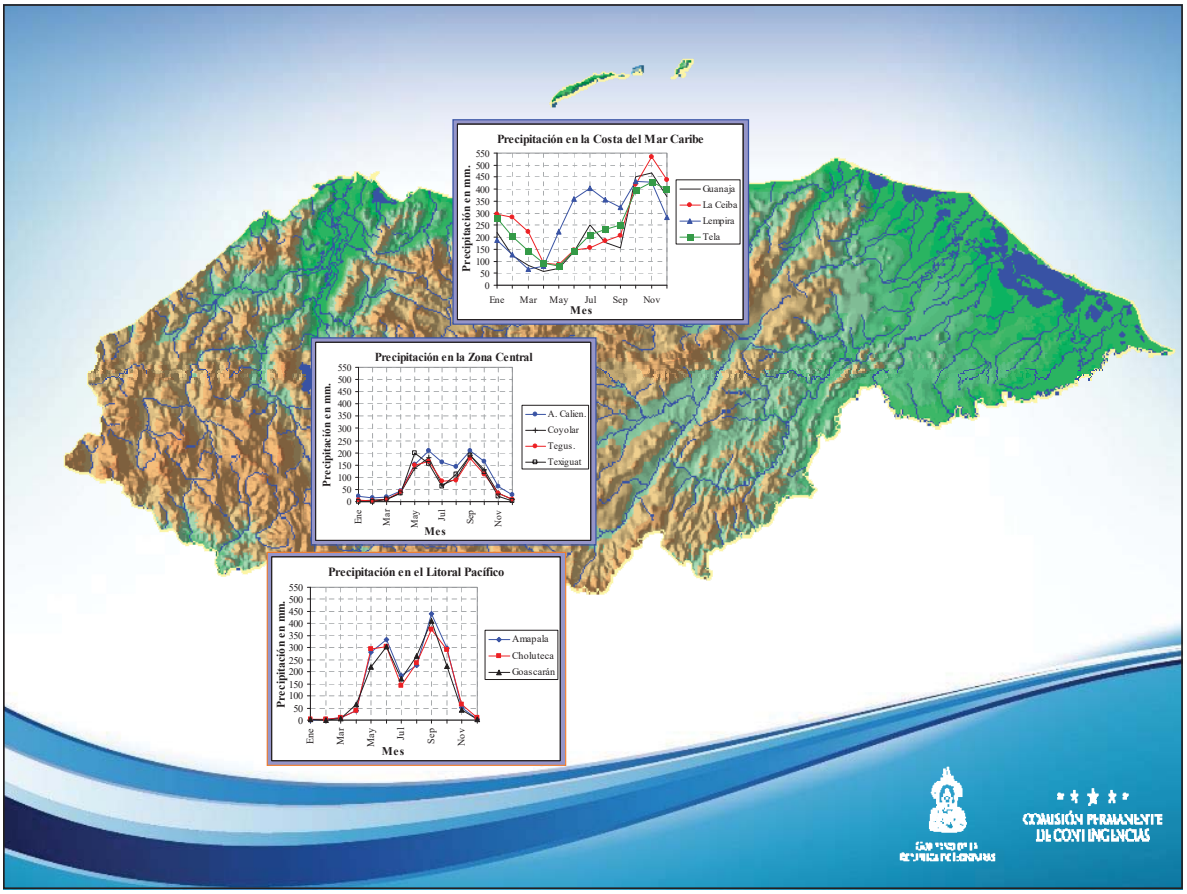
Appendix D: Working Group Reports

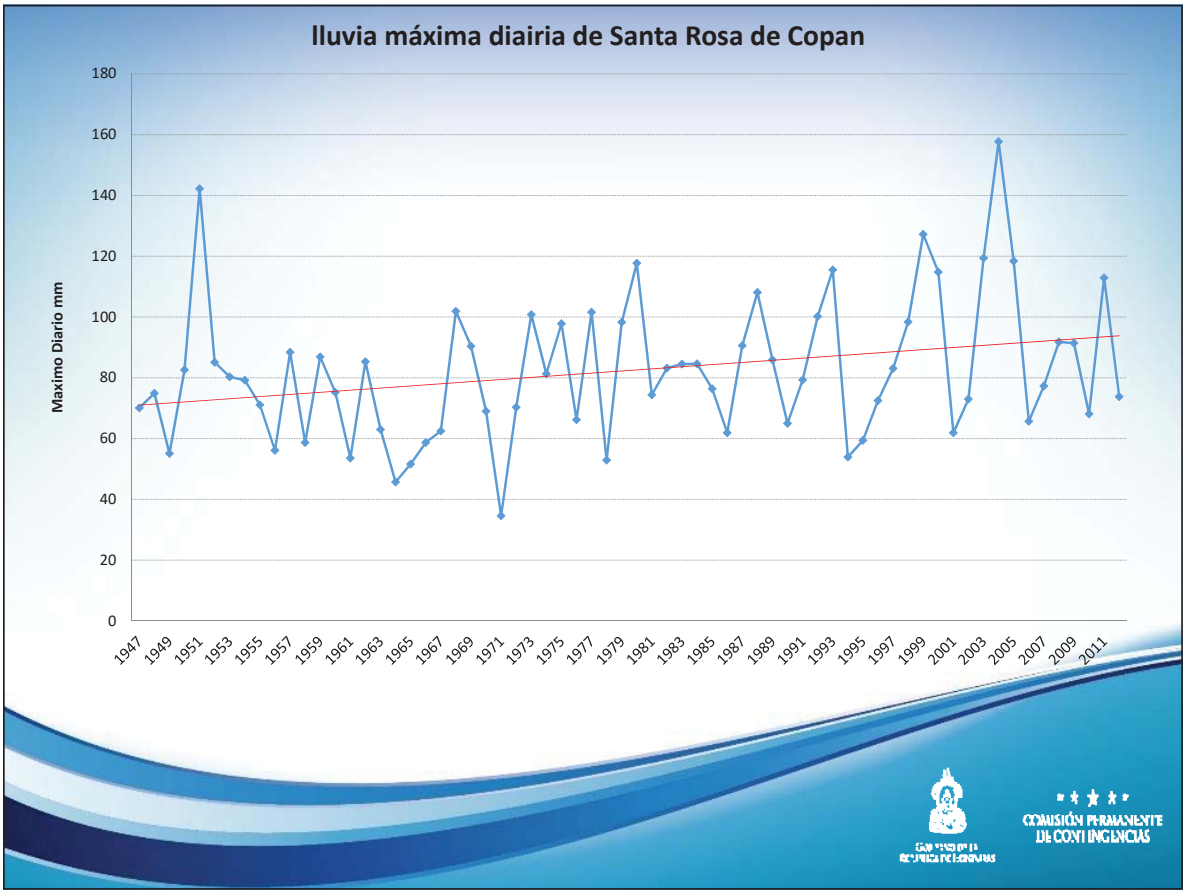
Working Group 1: Tropical Systems

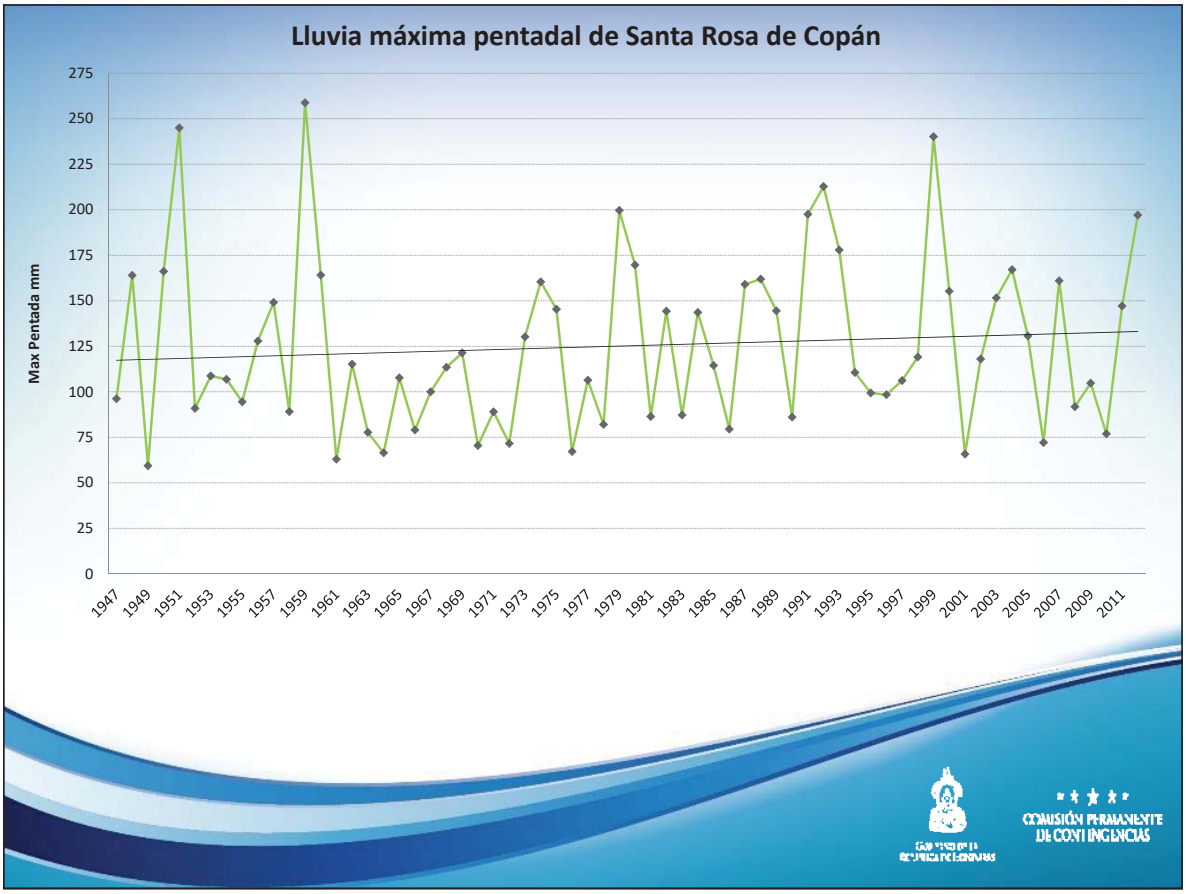
Francisco Argeñal, Josué Batista

CAMBIO CLIMATICO EN HONDURAS

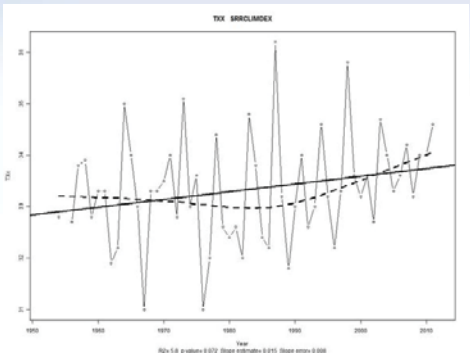
ESCANARIOS WRF




lluvia máxima diairia de Santa Rosa de Copan
Maximo Diario mm
180
160
140
120
100
80
60
40
20
0
1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011
COMISIÓN PERMANENTE DE CONTINGENCIAS

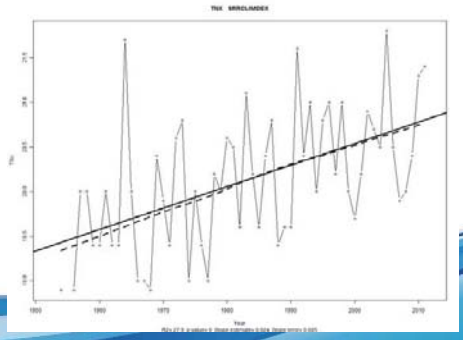

Lluvia máxima pentadal de Santa Rosa de Copán
Max Pentada mm
275
250
225
200
175
150
125
100
75
50
25
0
1947 1949 1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011
COMISIÓN PERMANENTE DE CONTINGENCIAS

Tendencias Climáticas de Santa Rosa de Copan



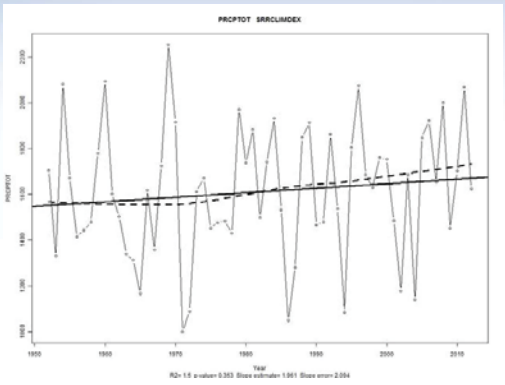
Tendencia de la Temperatura de las tardes

Tendencia de temperaturas matutinas

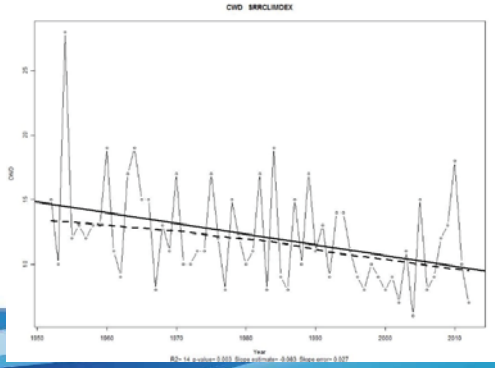


COMISIÓN PERMANENTE DE CONTINGENCIAS

Tendencias Climáticas de Santa Rosa de Copan

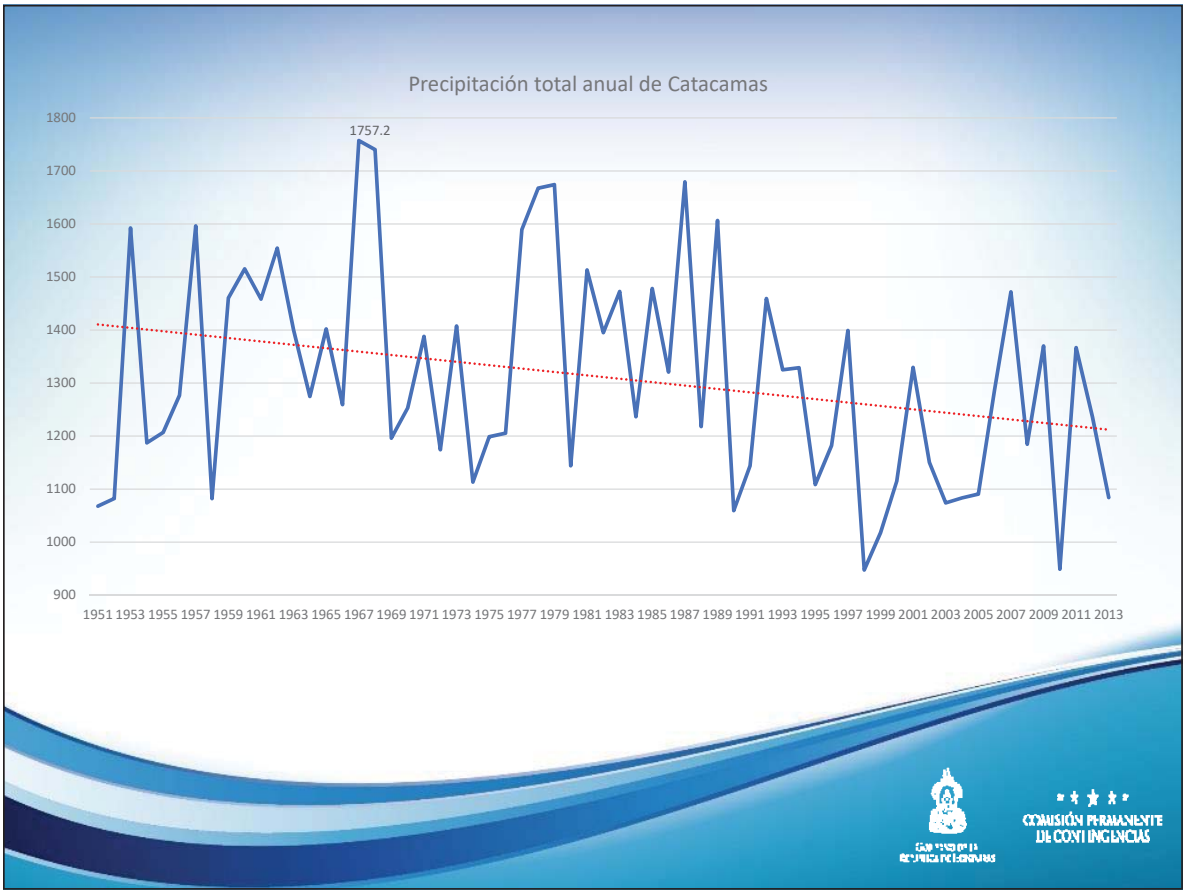


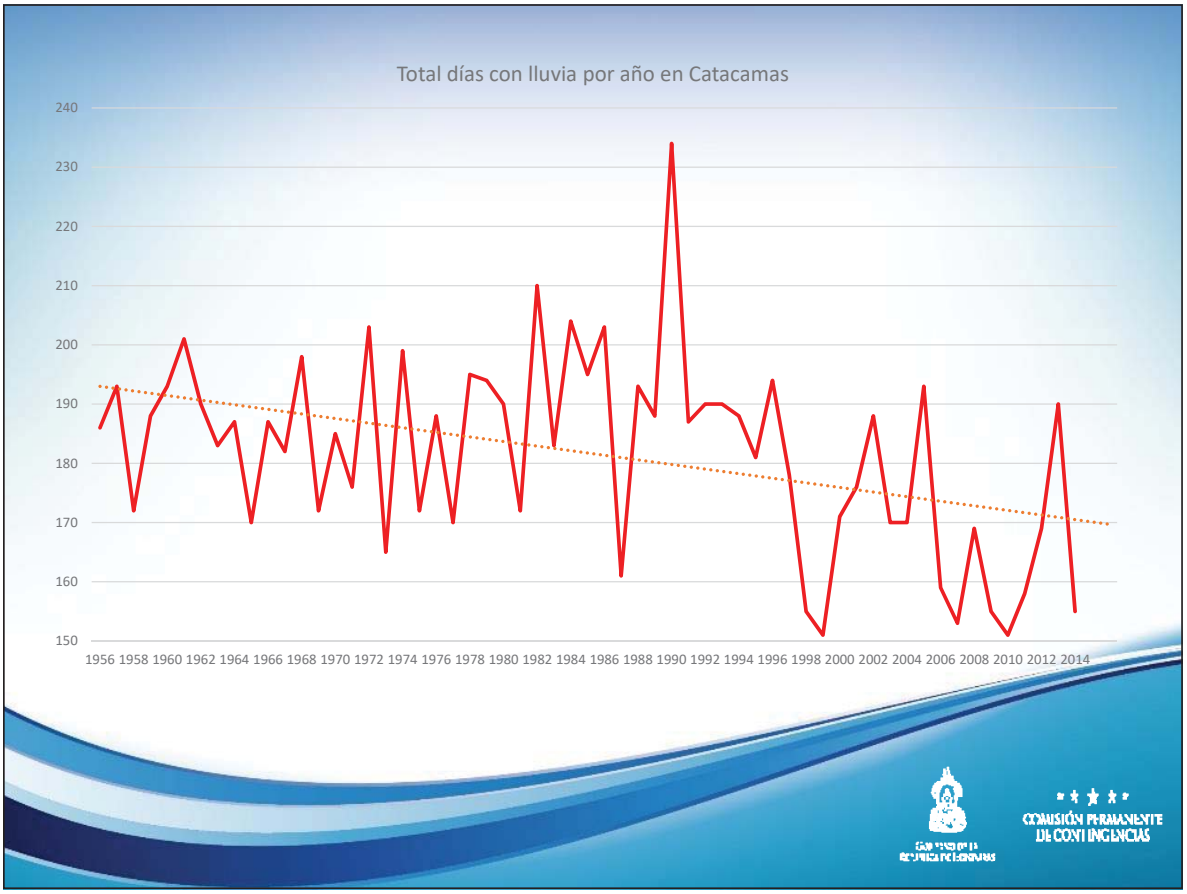
Tendencia de la Precipitación anual

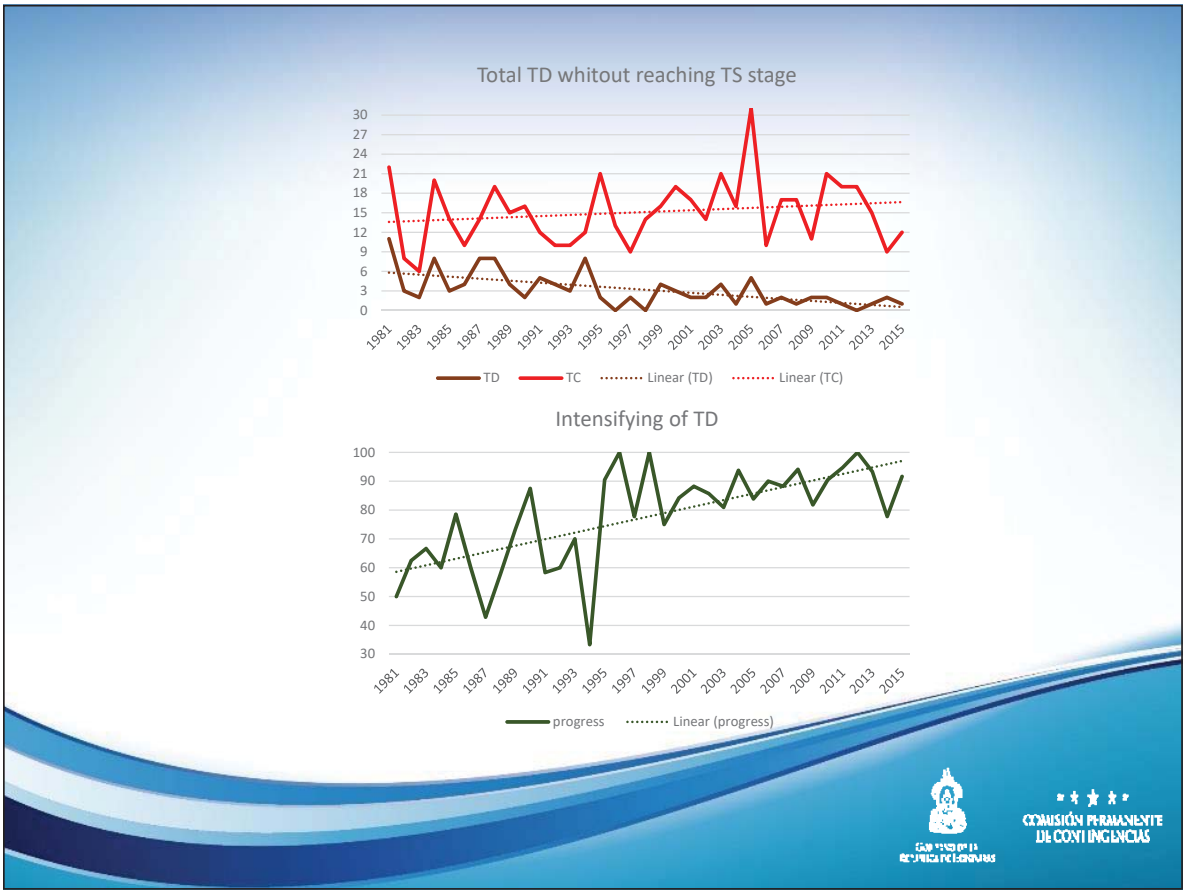


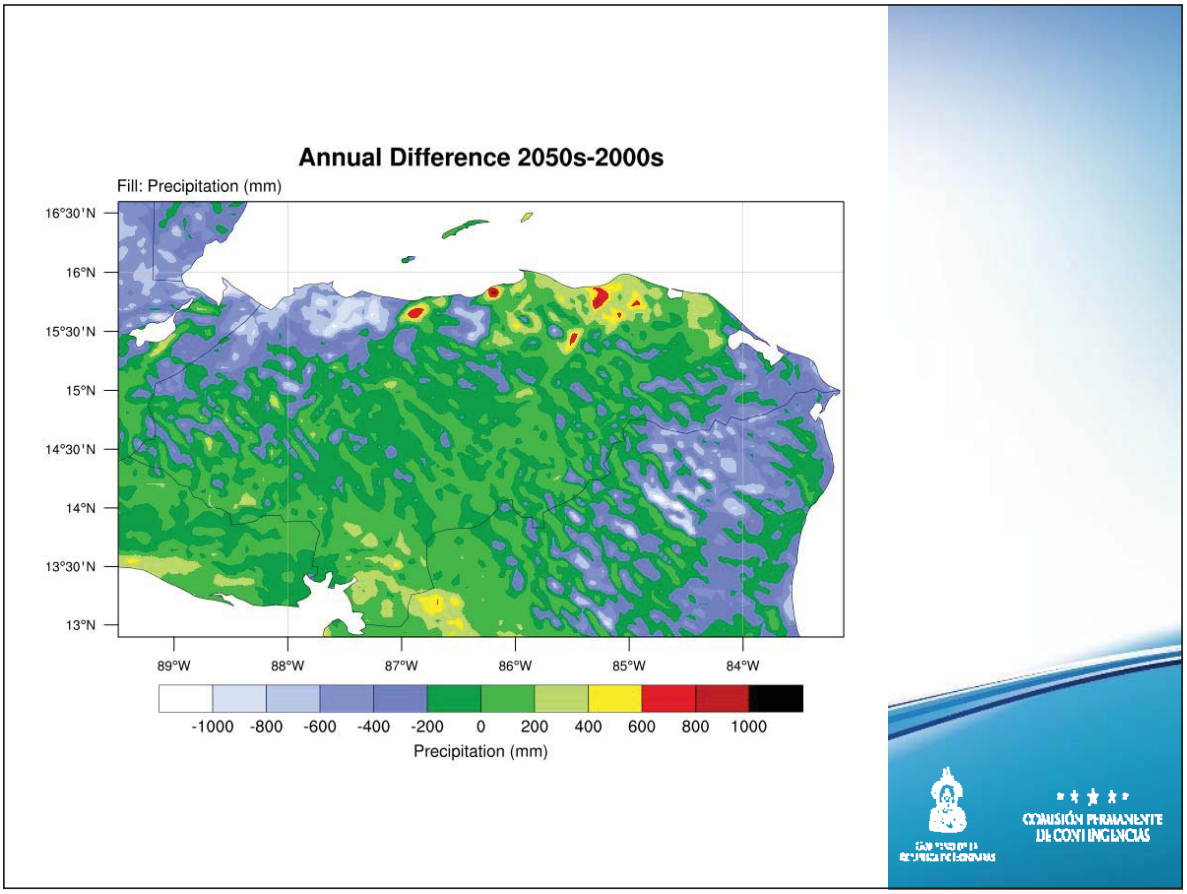
Tendencia de número de días con lluvia

COMISIÓN PERMANENTE DE CONTINGENCIAS

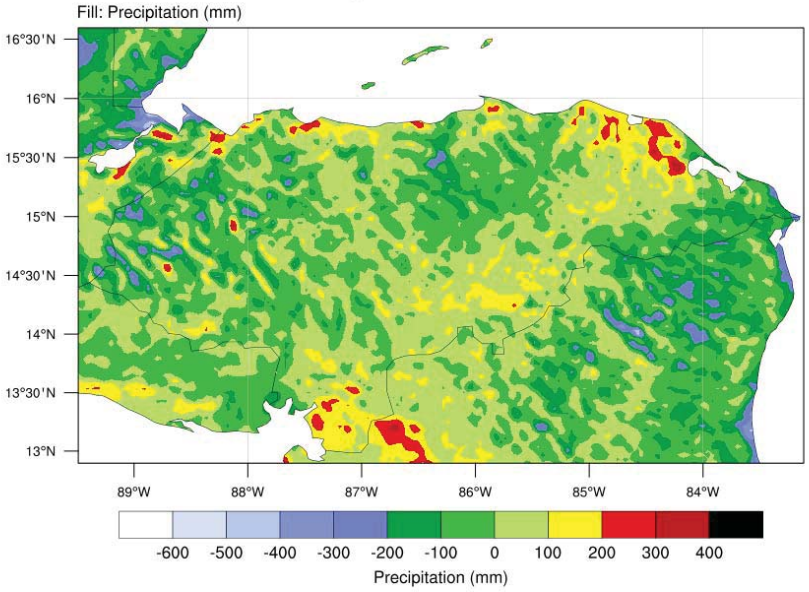

Precipitación total anual de Catacamas
1757.2
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
1951 1953 1955 1957 1959 1961 1963 1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
COMISIÓN PERMANENTE DE CONTINGENCIAS


Total días con lluvia por año en Catacamas
240
230
220
210
200
190
180
170
160
150
1956 1958 1960 1962 1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014
COMISIÓN PERMANENTE DE CONTINGENCIAS


Total TD whitout reaching TS stage
30
27
24
21
18
15
12
9
6
3
0
1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
TD
TC
Linear (TD)
Linear (TC)
Intensifying of TD
100
90
80
70
60
50
40
30
1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
progress
Linear (progress)
COMISIÓN PERMANENTE DE CONTINGENCIAS

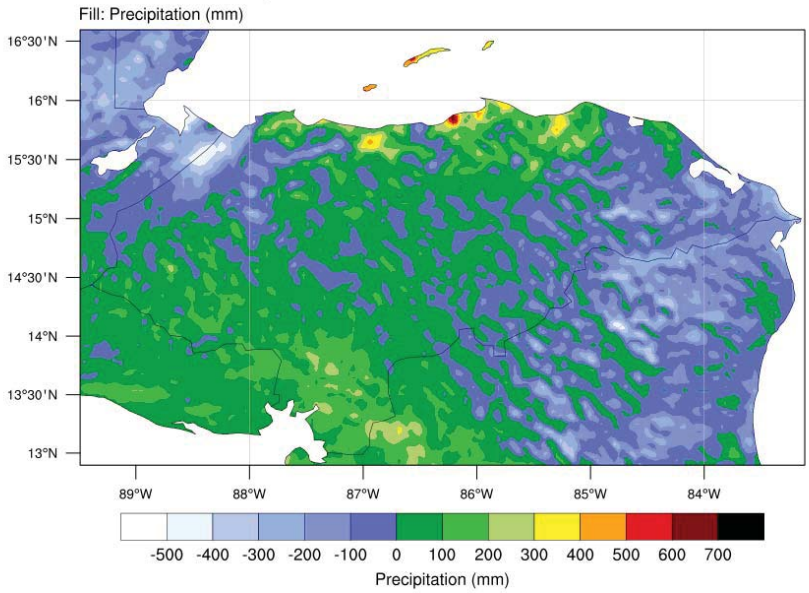

Annual Difference 2050s-2000s
Fill: Precipitation (mm)
16°30'N
16°N
15°30'N
15°N
14°30'N
14°N
13°30'N
13°N
89°W
88°W
87°W
86°W
85°W
84°W
-1000 -800 -600 -400 -200 0 200 400 600 800 1000
Precipitation (mm)
COMISIÓN PERMANENTE DE CONTINGENCIAS

JunJulAug Difference 2050s-2000s



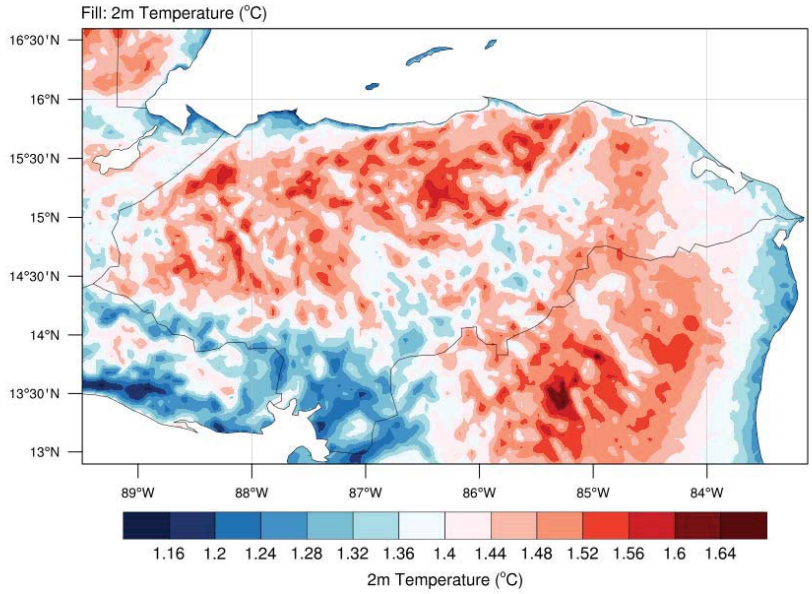
COMISIÓN PERMANENTE DE CONTINGENCIAS

SepOctNov Difference 2050s-2000s



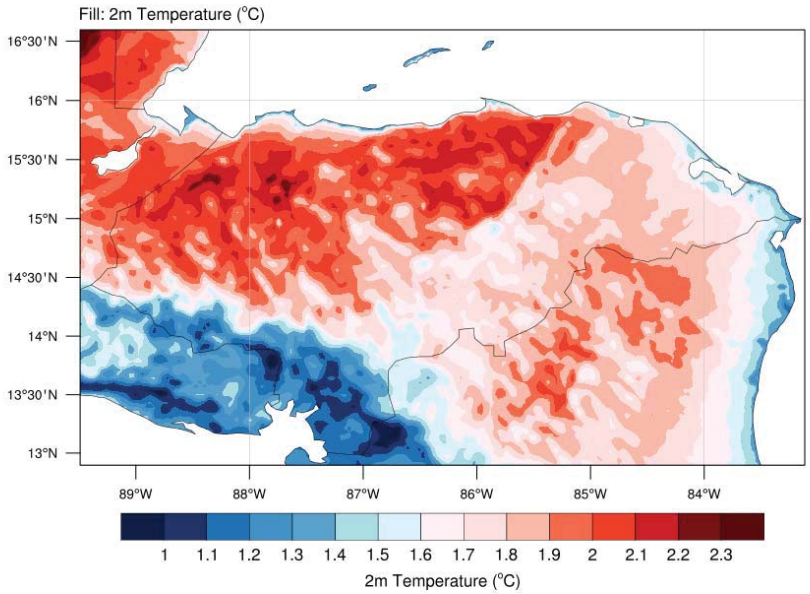
COMISIÓN PERMANENTE DE CONTINGENCIAS

Annual Difference 2050s-2000s

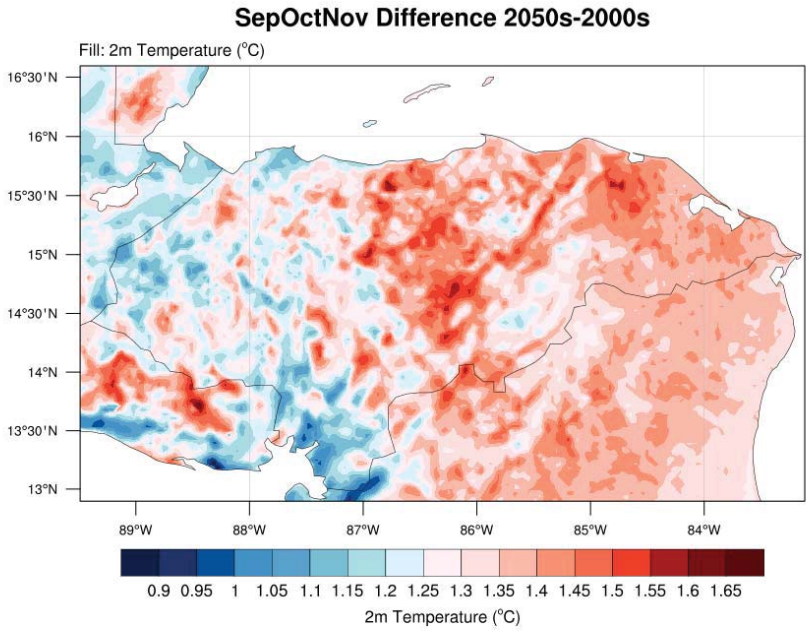


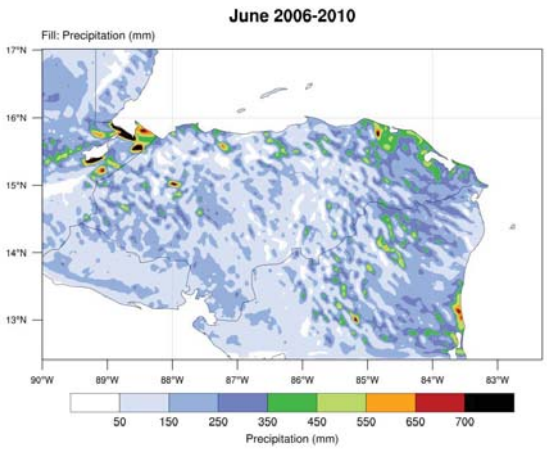
COMISIÓN PERMANENTE DE CONTINGENCIAS

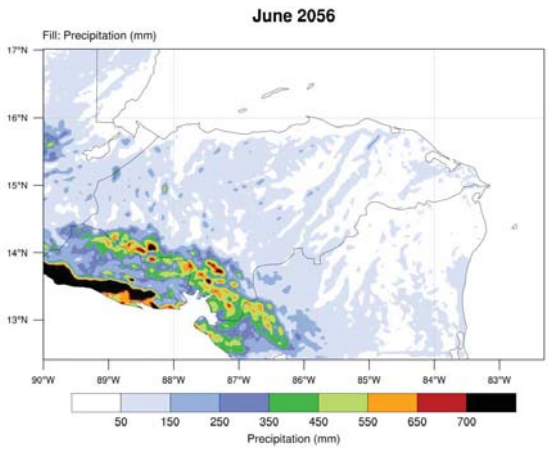
JunJulAug Difference 2050s-2000s

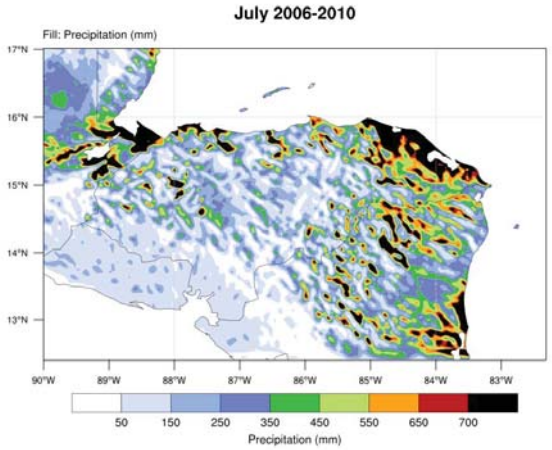


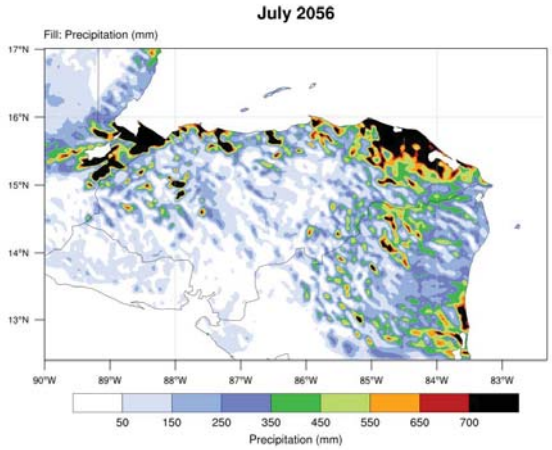
COMISIÓN PERMANENTE DE CONTINGENCIAS


SepOctNov Difference 2050s-2000s
Fill: 2m Temperature (°C)
16°30'N
16°N
15°30'N
15°N
14°30'N
14°N
13°30'N
13°N
89°W
88°W
87°W
86°W
85°W
84°W
0.9 0.95 1 1.05 1.1 1.15 1.2 1.25 1.3 1.35 1.4 1.45 1.5 1.55 1.6 1.65
2m Temperature (°C)

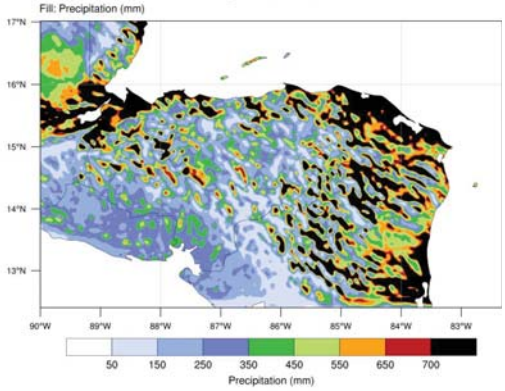

June 2006-2010
Fill: Precipitation (mm)
17°N
16°N
15°N
14°N
13°N
90°W
89°W
88°W
87°W
86°W
85°W
84°W
83°W
50 150 250 350 450 550 650 700
Precipitation (mm)

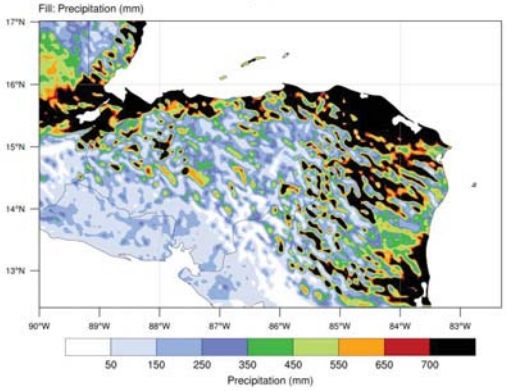

June 2056
Fill: Precipitation (mm)
17°N
16°N
15°N
14°N
13°N
90°W
89°W
88°W
87°W
86°W
85°W
84°W
83°W
50 150 250 350 450 550 650 700
Precipitation (mm)





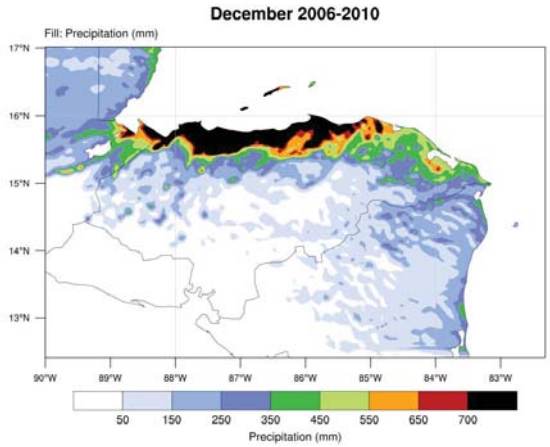
COMISIÓN PERMANENTE DE CONTINGENCIAS

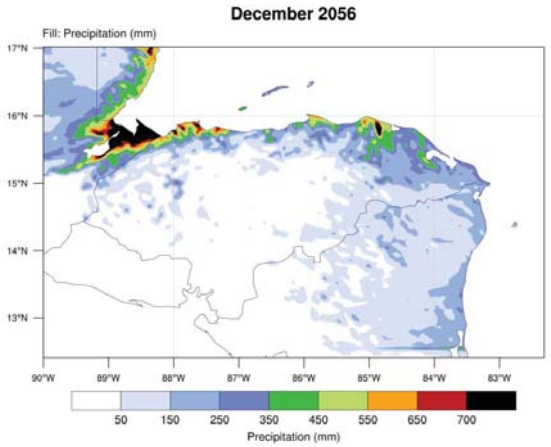




COPECO HONDURAS

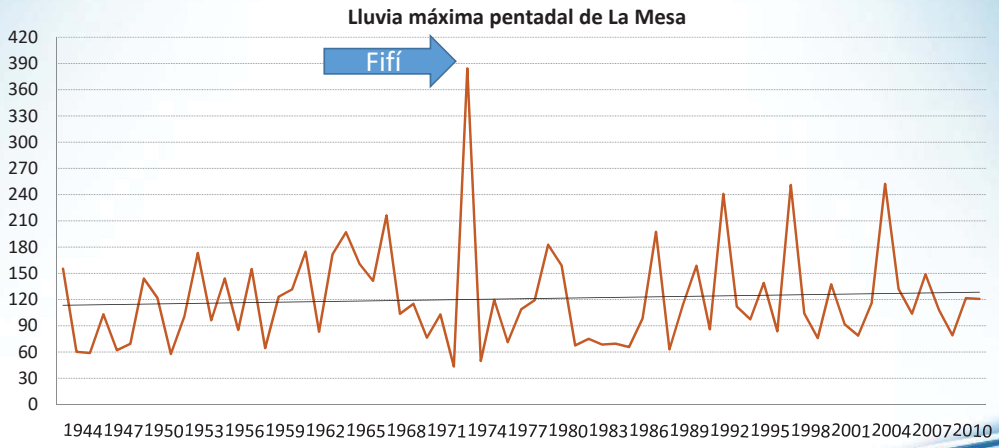
COMISIÓN PERMANENTE DE CONTINGENCIAS





COMISIÓN PERMANENTE DE CONTINGENCIAS

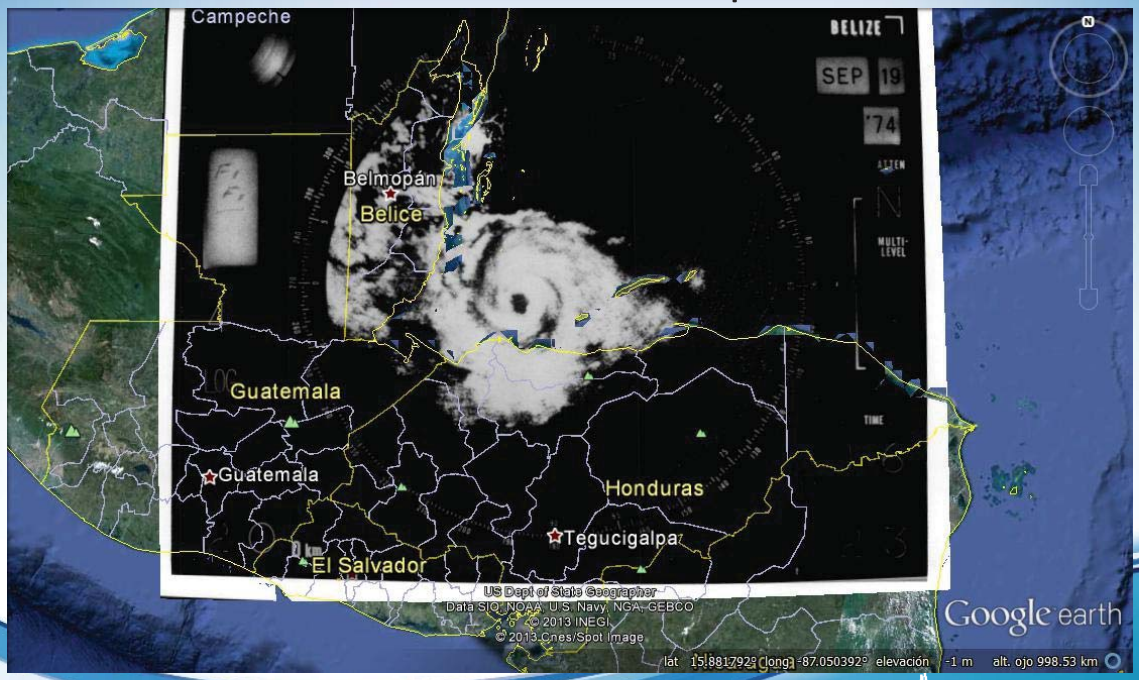
Tendencias Climáticas del Valle de Sula



COPECO HONDURAS

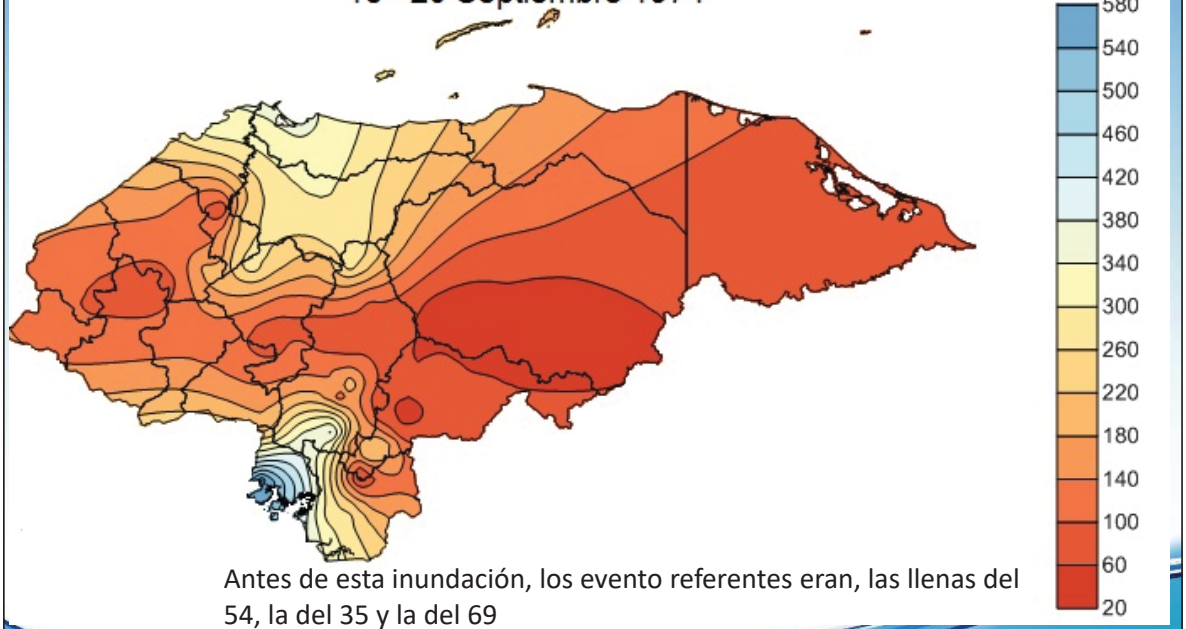
COMISIÓN PERMANENTE DE CONTINGENCIAS

Huracán Fifí, 19 Sept 1974



COMISIÓN PERMANENTE DE CONTINGENCIAS

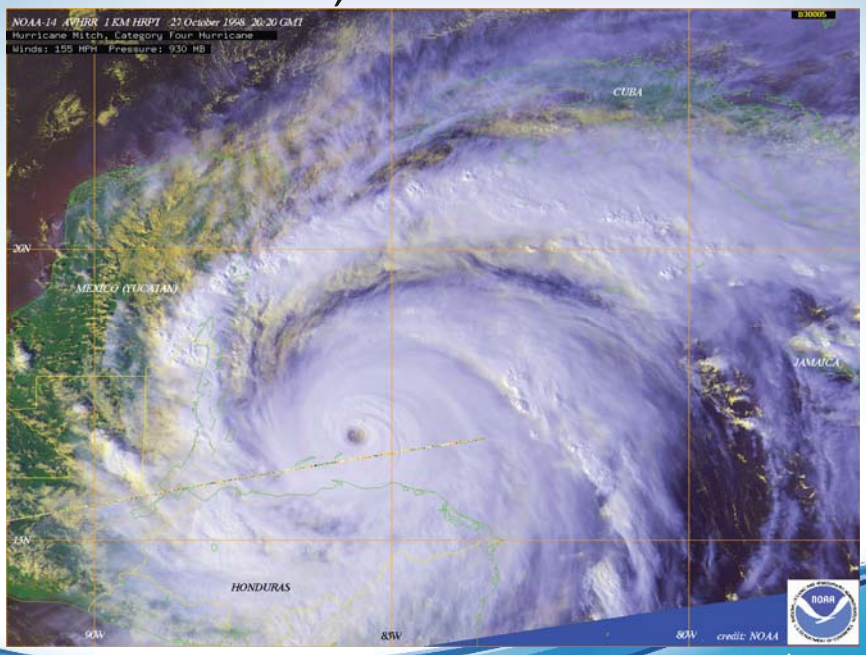
Lluvias generadas por el huracán Fifí
15 - 20 Septiembre 1974



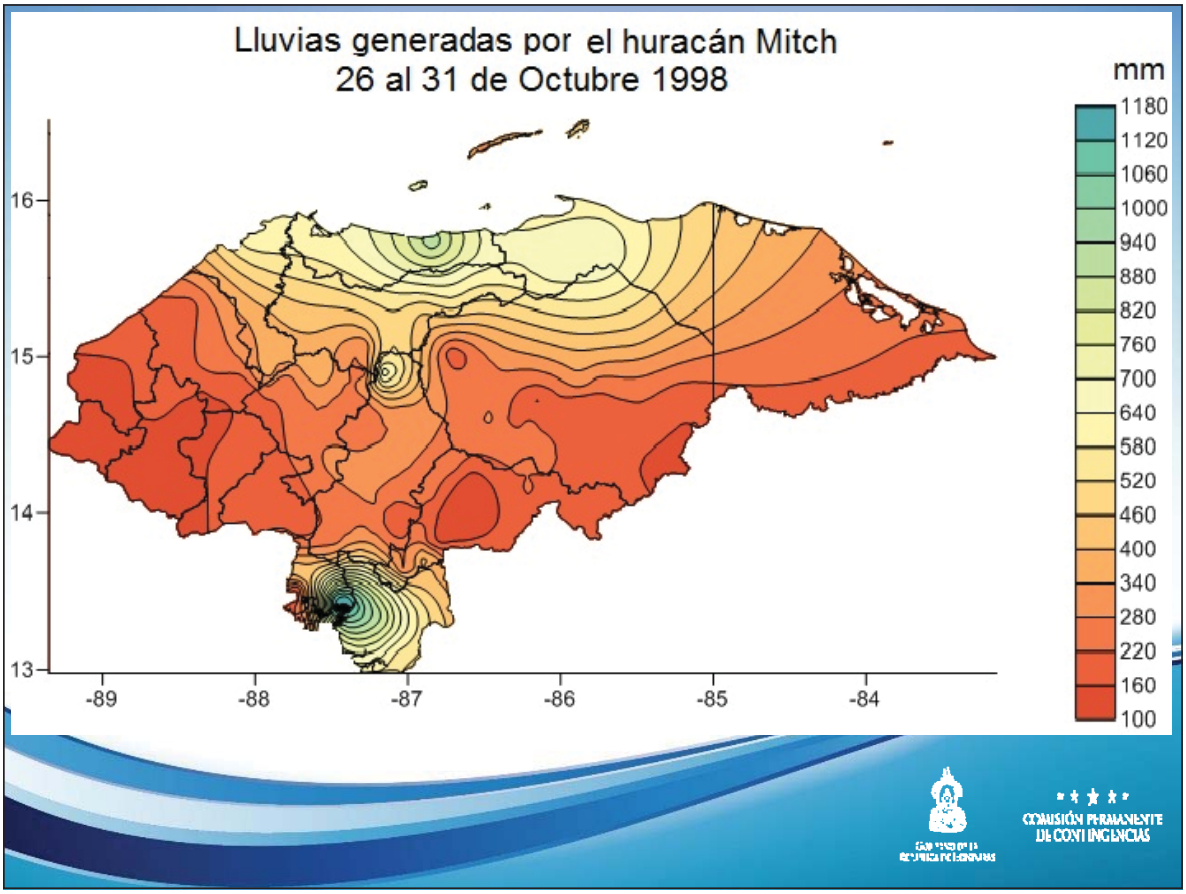
Antes de esta inundación, los evento referentes eran, las llenas del 54, la del 35 y la del 69

COMISIÓN PERMANENTE DE CONTINGENCIAS

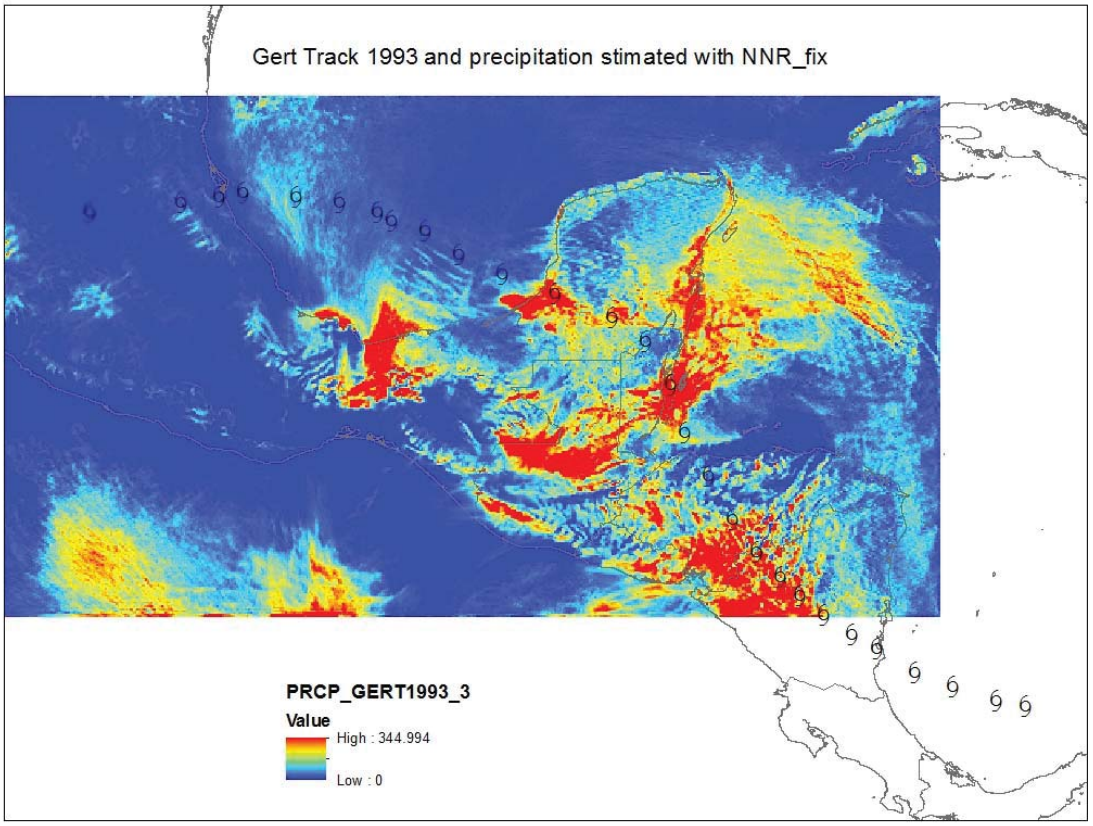
Huracan Mitch, 27 de octubre 1998



COMISIÓN PERMANENTE DE CONTINGENCIAS



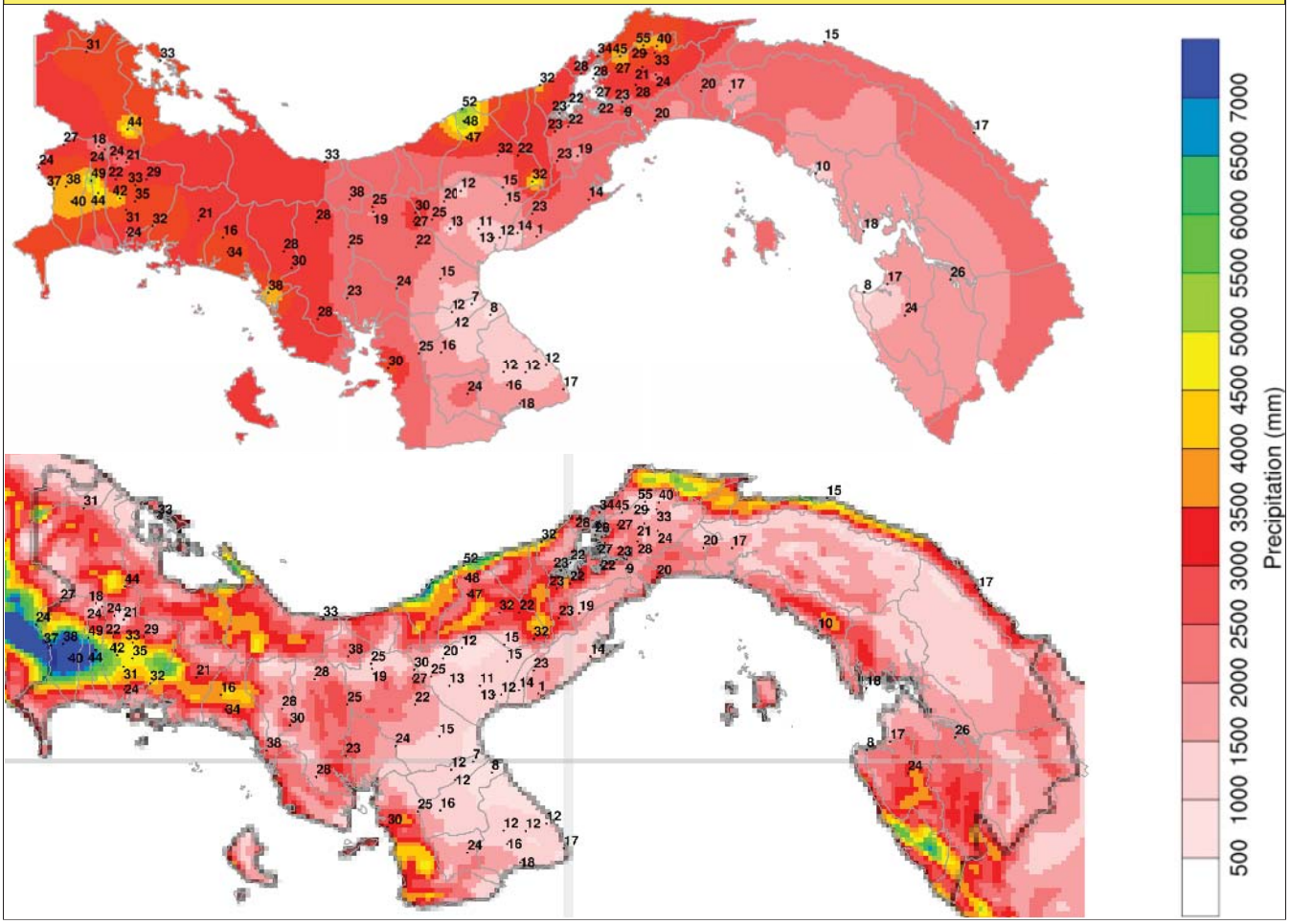
COMISIÓN PERMANENTE DE CONTINGENCIAS



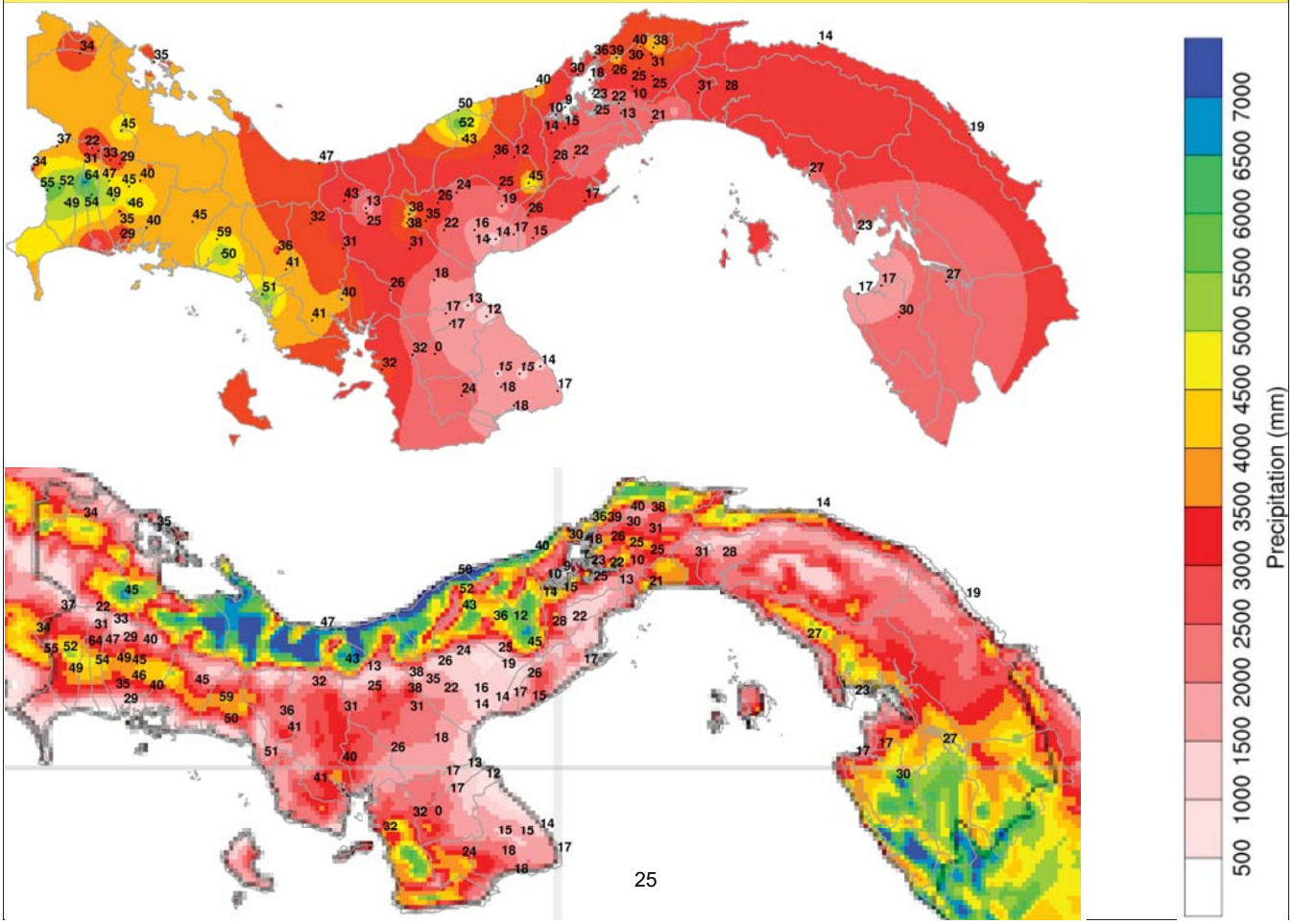
Recomendations

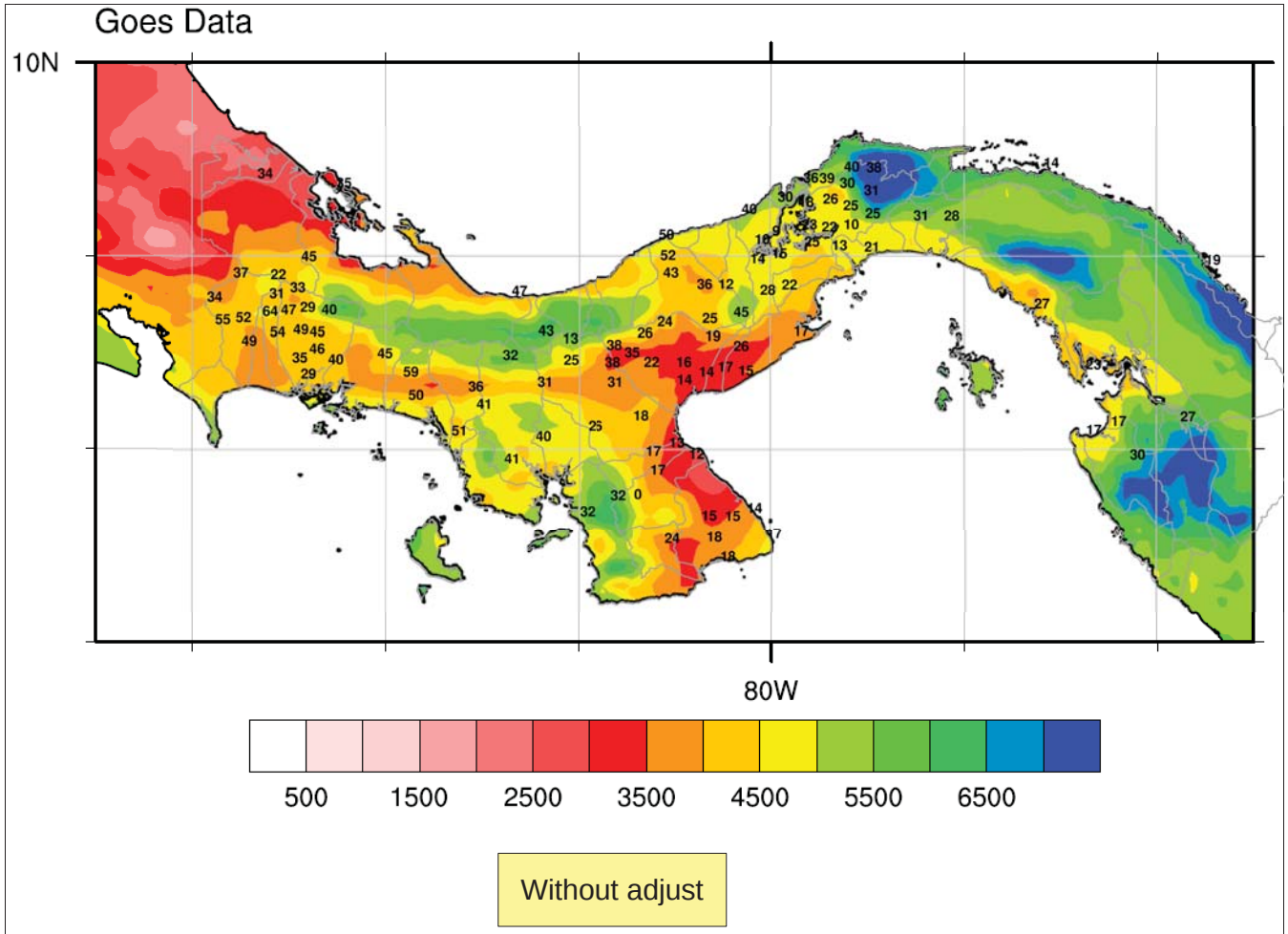
- Help to develop more programation and GIS skills
- To stablish schedule to achieve goal in short term by groups.
- UNL should make available runs for RCP2.6 scenarios

Datos de las estaciones (puntos) vs Datos del NCAR (raster) 1991-1993

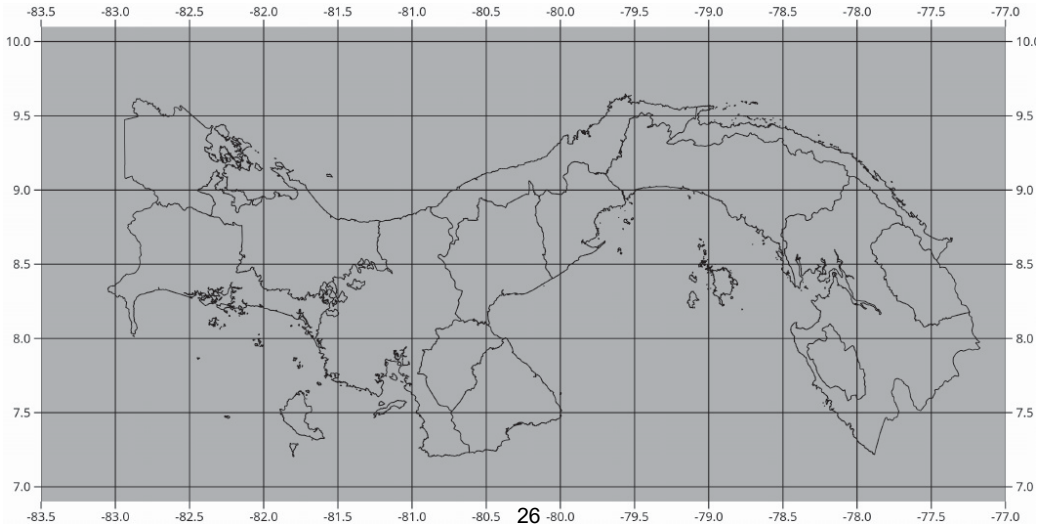


Datos de las estaciones (puntos) vs Datos del modelo (raster) 2006-2010

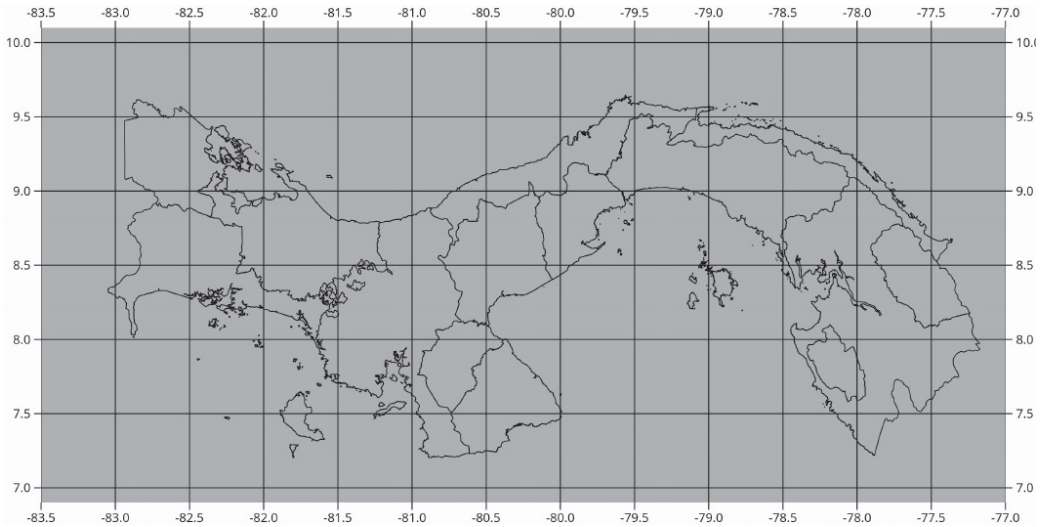


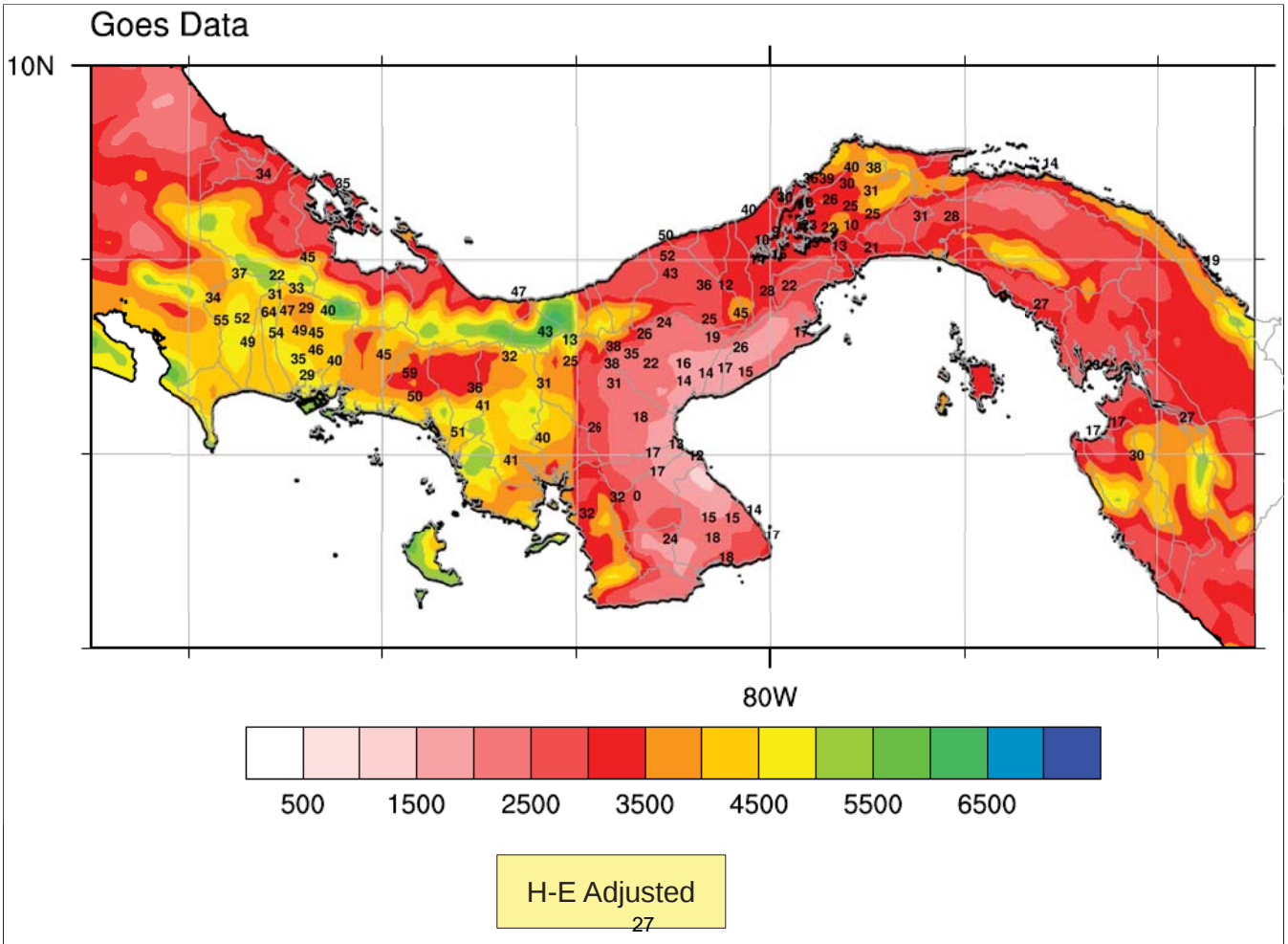


Name	cpt:X	cpt:Y	2006-01	2006-02	2006-03	2006-04	2006-05	2006-06	2006-07	2006-08	2006-09	2006-10	2006-11	2006-12
Estaciones														
1-cap-Boc			587	172	334	165	166	325	366	357	237	278	195	332
2-cap-Coc			37	11	25	66	154	249	305	354	265	258	376	65
3-cap-Col			146	73	151	234	396	219	446	368	256	290	619	145
4-cap-Chi			137	27	43	163	416	440	426	308	358	601	394	167
5-cap-Dar			33	4	26	31	172	137	216	165	82	120	303	113
6-cap-Her			14	1	1	40	127	154	228	182	144	184	187	29
7-cap-Los			20	10	0	20	156	199	222	197	159	212	198	45
8-cap-Pan			42	32	91	151	263	307	386	328	242	386	501	63
9-cap-Ver			50	14	11	131	269	339	329	359	331	414	431	32
Modelo H-E			06-01mea	06-02mea	06-03mea	06-04mea	06-05stde	06-06stde	06-07stde	06-08stde	06-09stde	06-10stde	06-11stde	06-12stdev
Bocas del Toro			107	31	52	250	51	60	56	102	56	42	61	17
Coclé			9	43	36	136	72	104	74	82	73	99	83	31
Colón			15	10	3	124	66	39	13	75	60	43	143	51
Chiriquí			199	12	37	217	126	80	16	127	105	124	176	105
Darién			190	86	95	296	99	68	157	113	89	68	109	224
Herrera			102	47	13	257	108	107	105	49	80	81	74	160
Los Santos			19	75	2	103	47	66	25	62	45	39	58	76
Panamá			41	16	53	151	119	79	49	144	66	117	200	110
Veraguas			161	74	25	269	78	92	121	93	115	69	96	100



0	84.0	83.5	83.0	82.5	82.0	81.5	81.0	80.5	80.0	79.5	79.0	78.5	78.0	77.5	77.0
10.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9.5	1	1	1	1	1	1	1	1	0.10	0.55	1	1	1	1	1
9.0	1	1	0.18	0.18	1	1	1	0.10	0.55	0.99	0.99	0.99	1	1	1
8.5	1	1	1.46	0.82	1	3.24	1.19	0.61	0.99	1	0.99	3.41	5.83	1	1
8.0	1	1	1.46	1.46	1.46	3.24	3.55	0.23	1	1	1	5.83	5.83	5.83	1
7.5	1	1	1	1	3.24	3.24	3.79	0.96	1	1	1	5.83	5.83	5.83	1
7.0	1	1	1	1	1	1	2.10	0.96	1	1	1	1	5.83	1	1



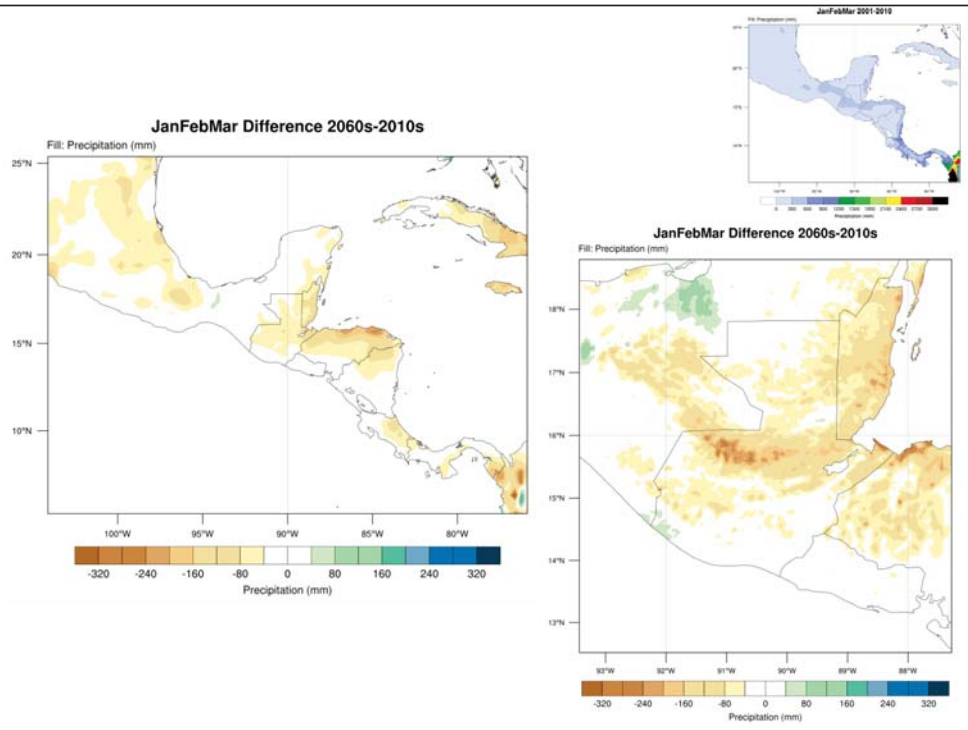


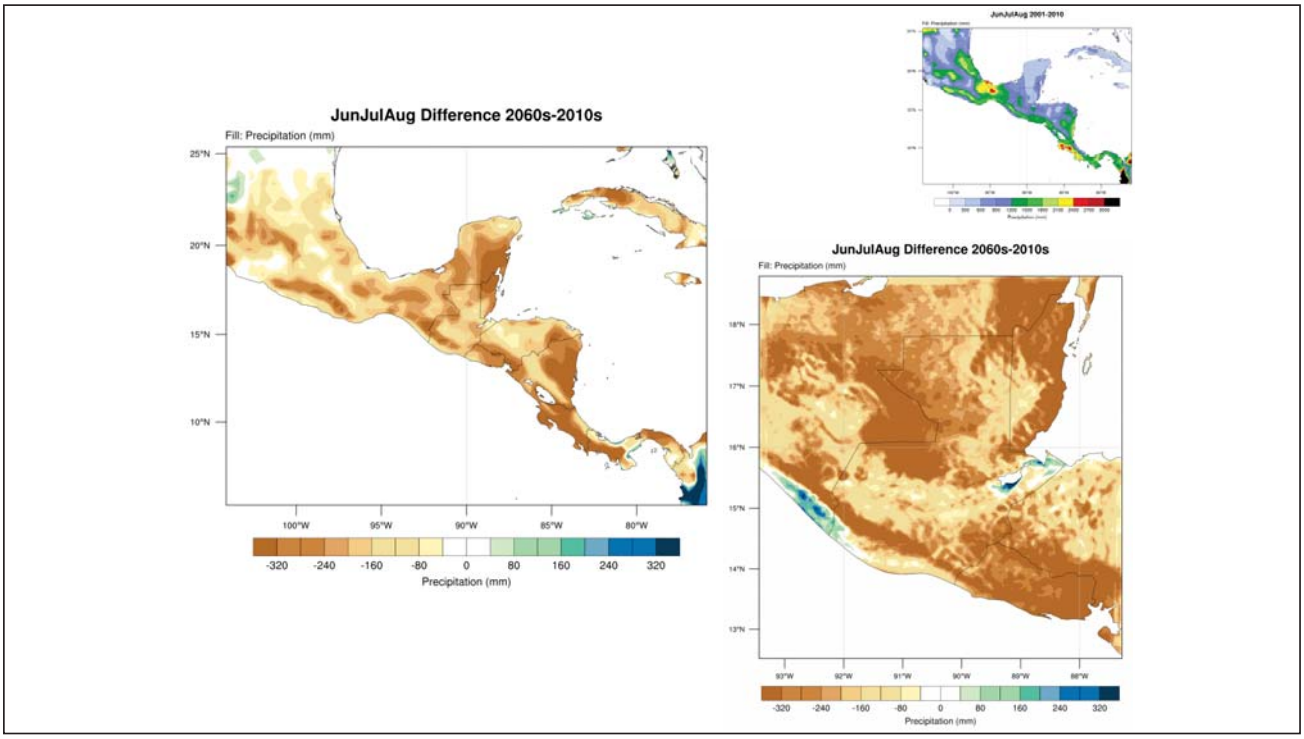
Working Group 2: ENSO

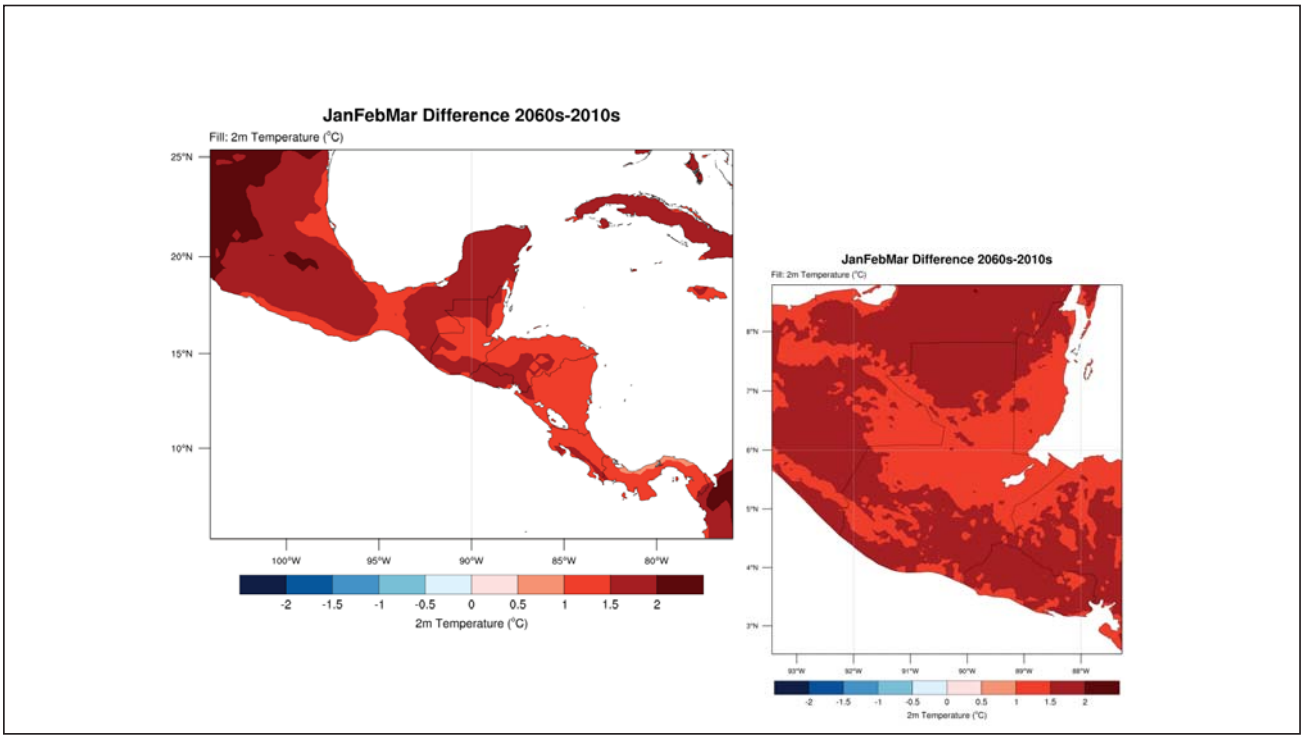
Juan José Nieto, Gabriela Alfaro, Dusstin Barrera

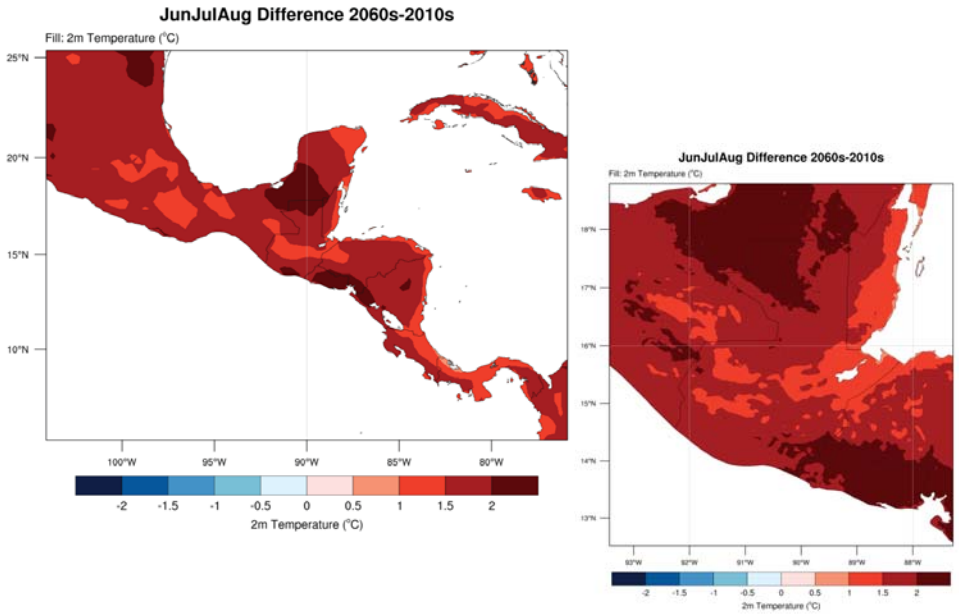
ENSO group

Gabriela Alfaro
Dusstin Barrera
Juan José Nieto



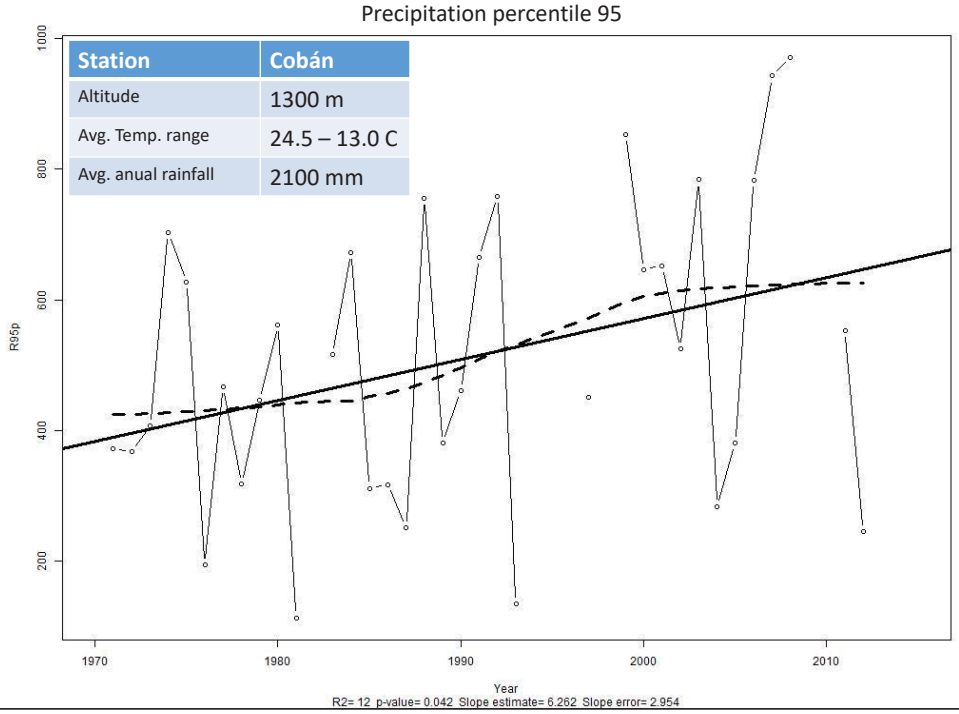

JunJulAug Difference 2060s-2010s
Fill: Precipitation (mm)
25°N
20°N
15°N
10°N
100°W
95°W
90°W
85°W
80°W
-320
-240
-160
-80
0
80
160
240
320
Precipitation (mm)
JunJulAug 2001-2010
JunJulAug Difference 2060s-2010s
Fill: Precipitation (mm)
18°N
17°N
16°N
15°N
14°N
13°N
93°W
92°W
91°W
90°W
89°W
88°W
-320
-240
-160
-80
0
80
160
240
320
Precipitation (mm)


JanFebMar Difference 2060s-2010s
Fill: 2m Temperature (°C)
25°N
20°N
15°N
10°N
100°W
95°W
90°W
85°W
80°W
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2m Temperature (°C)
JanFebMar Difference 2060s-2010s
Fill: 2m Temperature (°C)
8°N
7°N
6°N
5°N
4°N
3°N
93°W
92°W
91°W
90°W
89°W
88°W
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2m Temperature (°C)

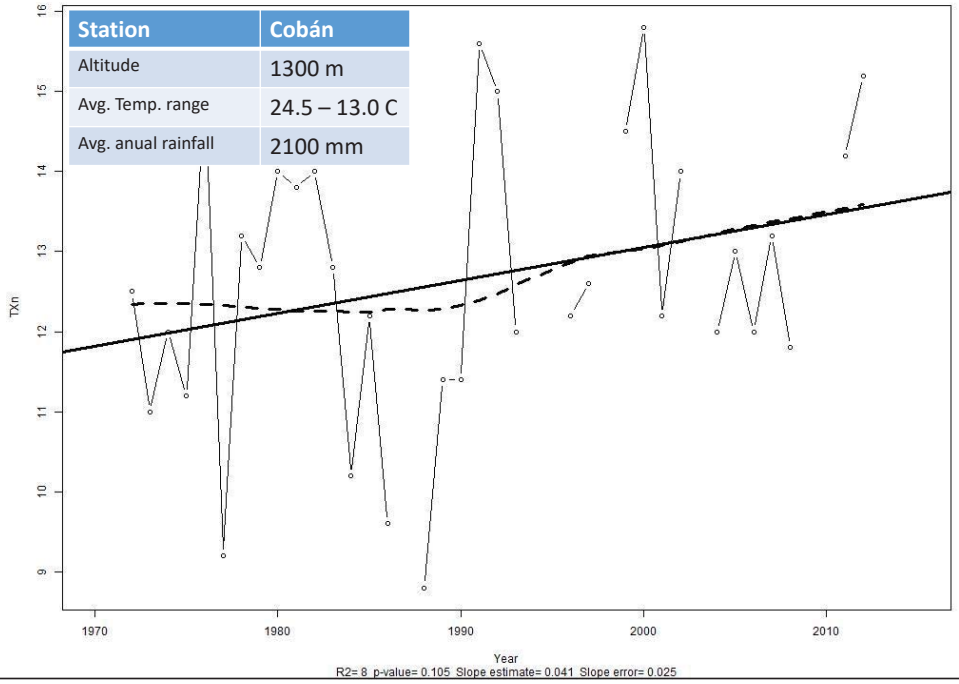


Precipitation percentile 95

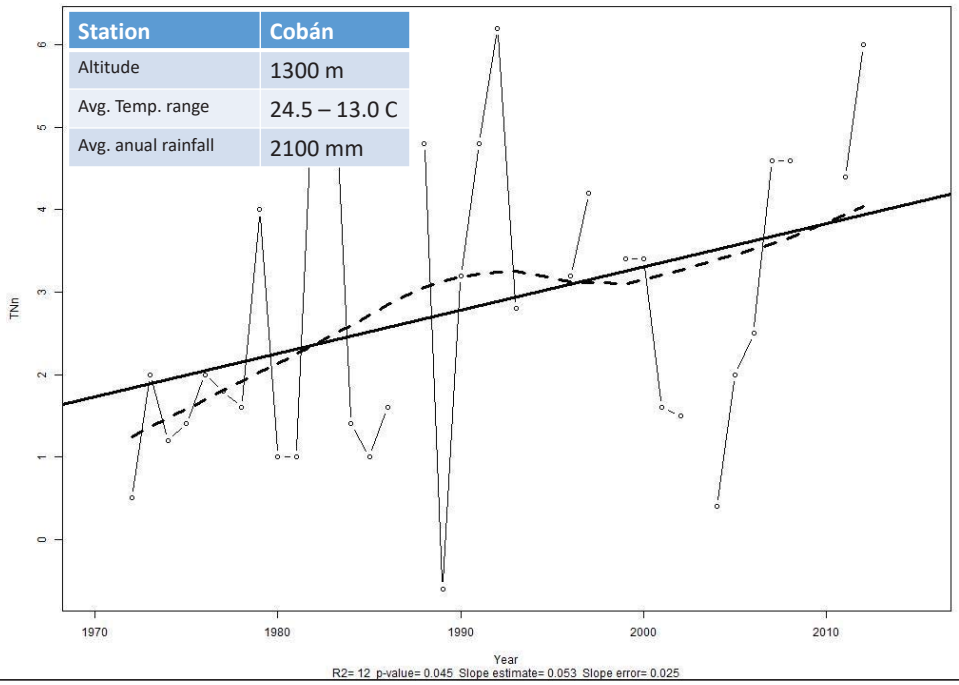
Station	Cobán
Altitude	1300 m
Avg. Temp. range	24.5 – 13.0 C
Avg. anual rainfall	2100 mm

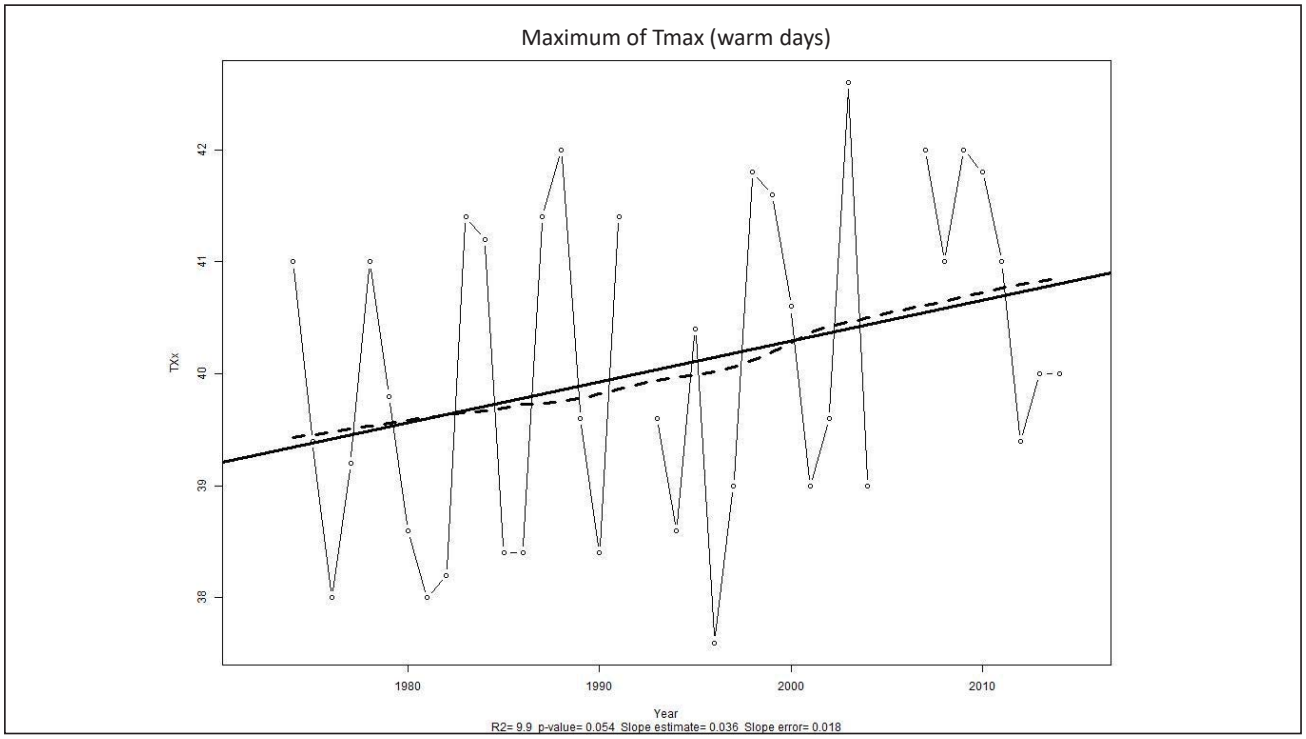


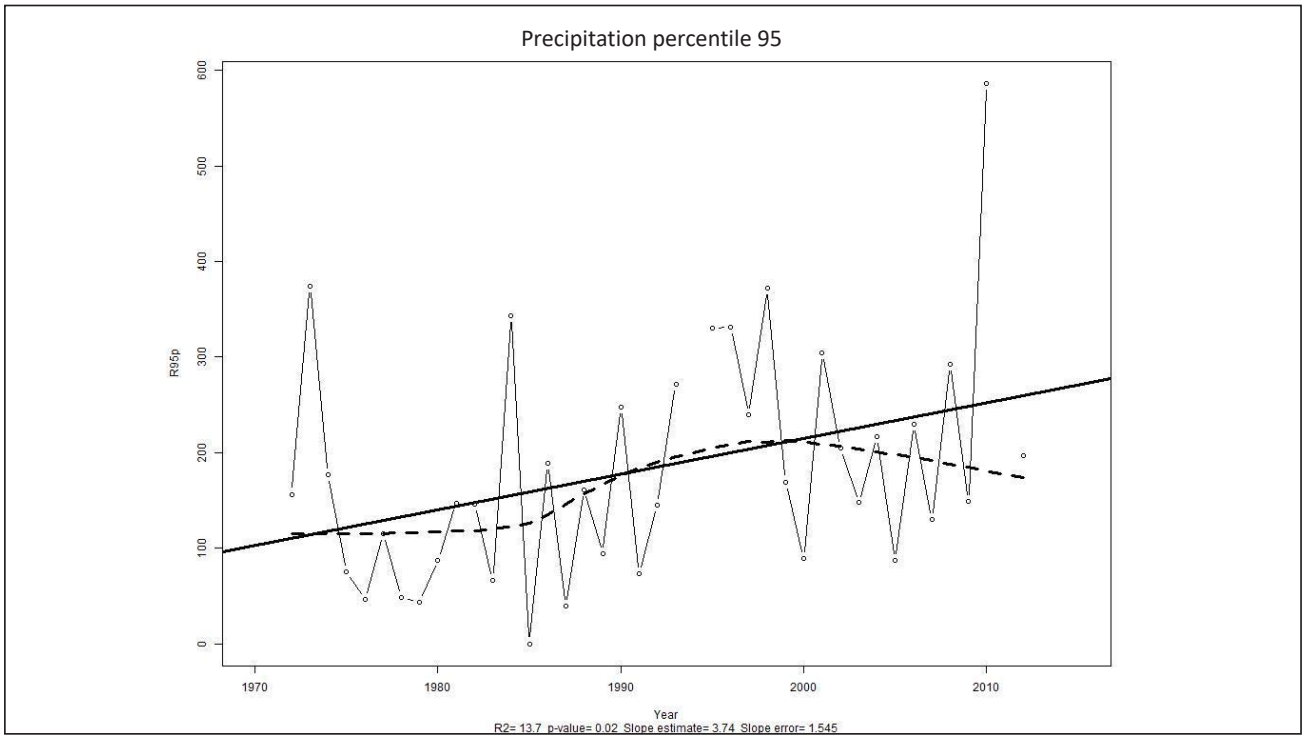
Maximum of Tmax (warm days)

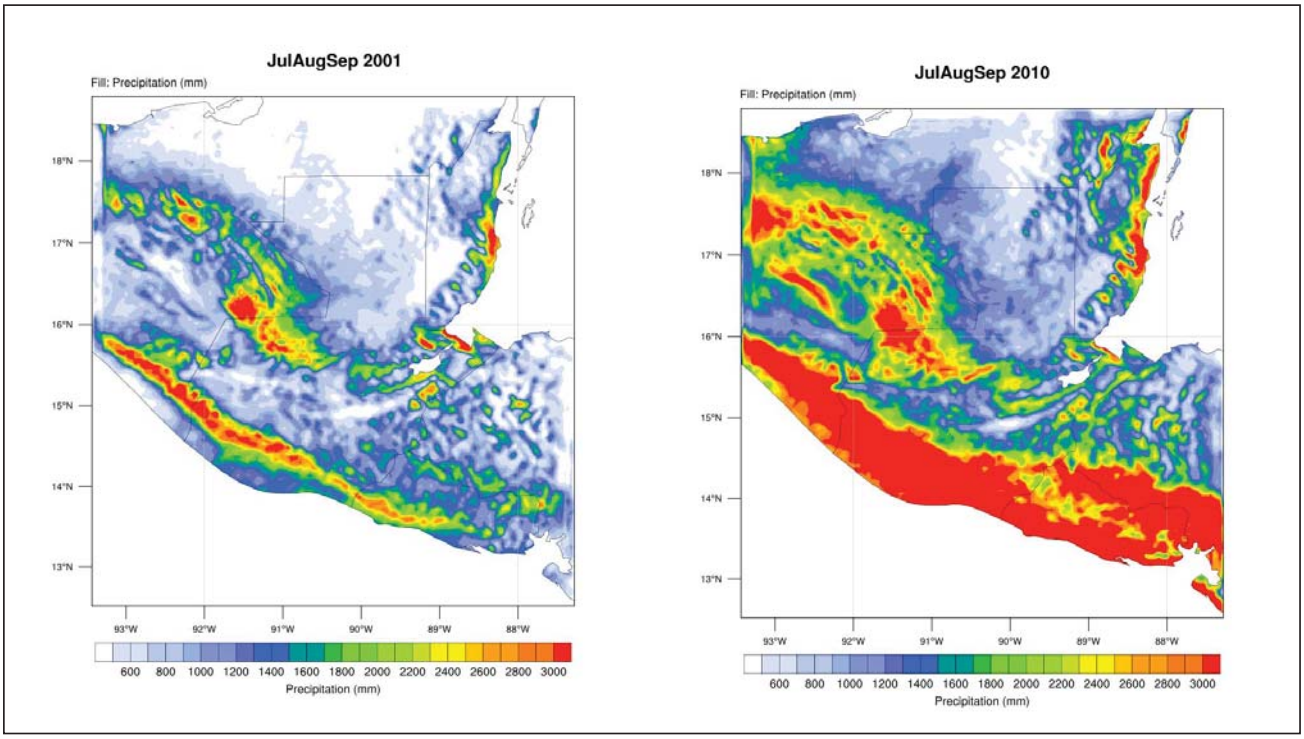


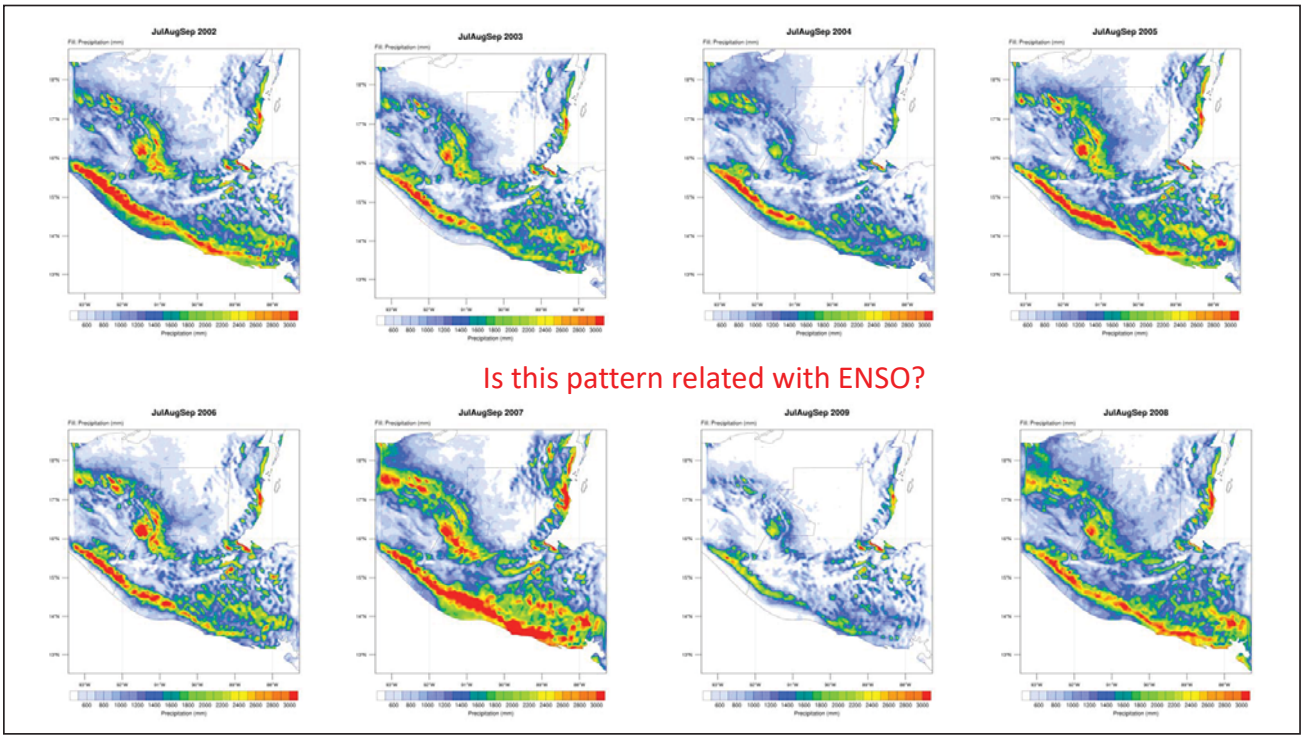
Minimum of Tmin

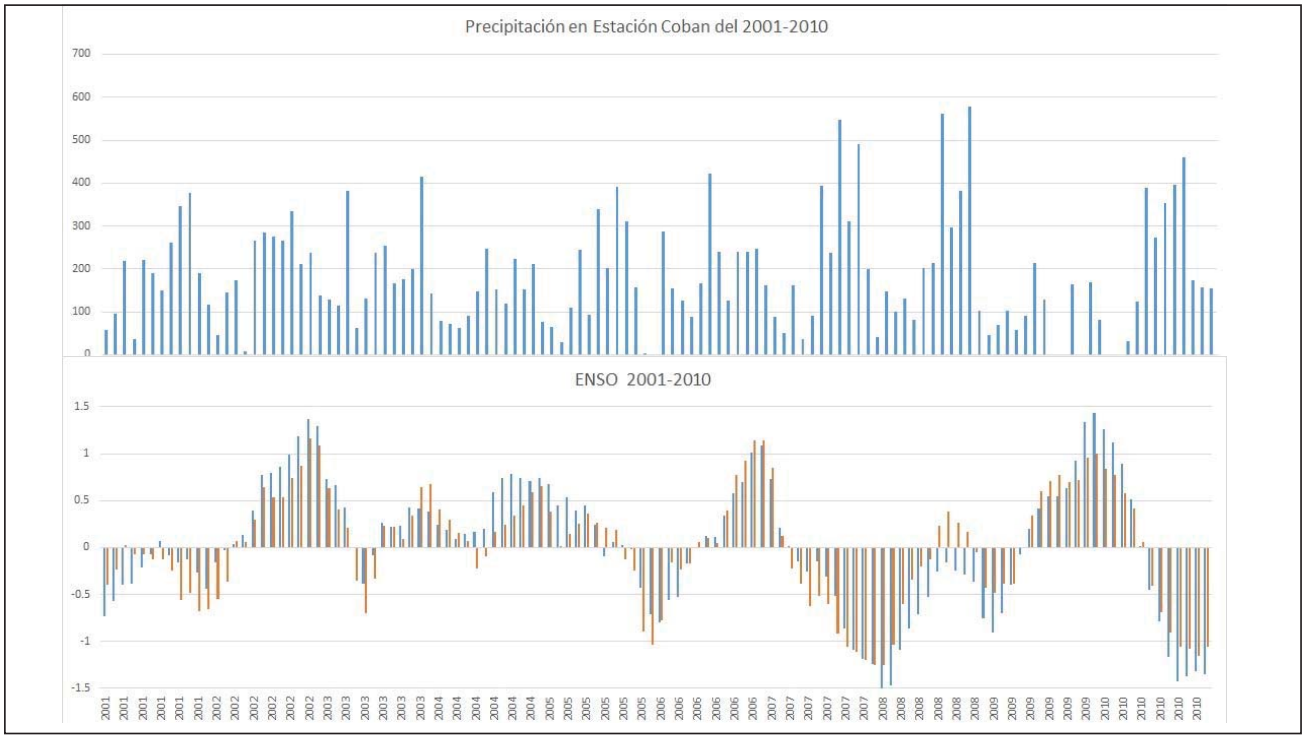


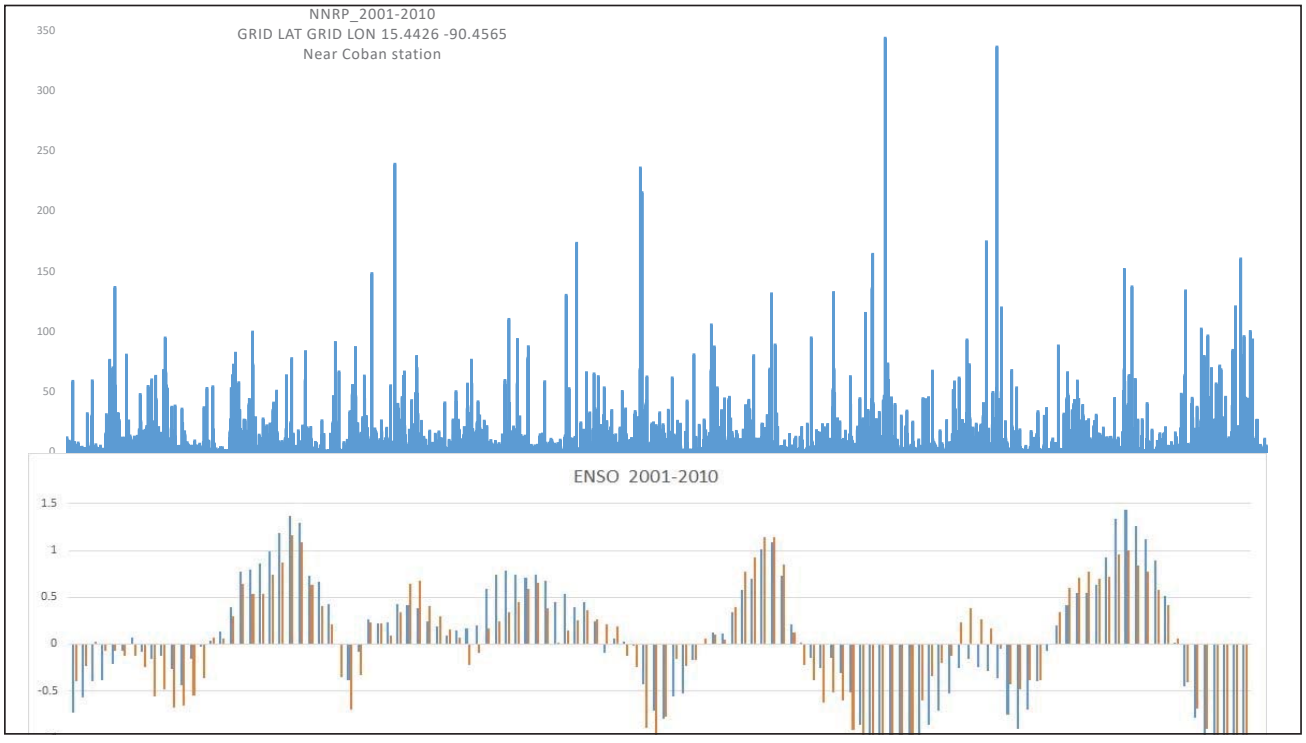

Maximum of Tmax (warm days)
TXx
38
39
40
41
42
1980
1990
2000
2010
Year
R2= 9.9 p-value= 0.054 Slope estimate= 0.036 Slope error= 0.018

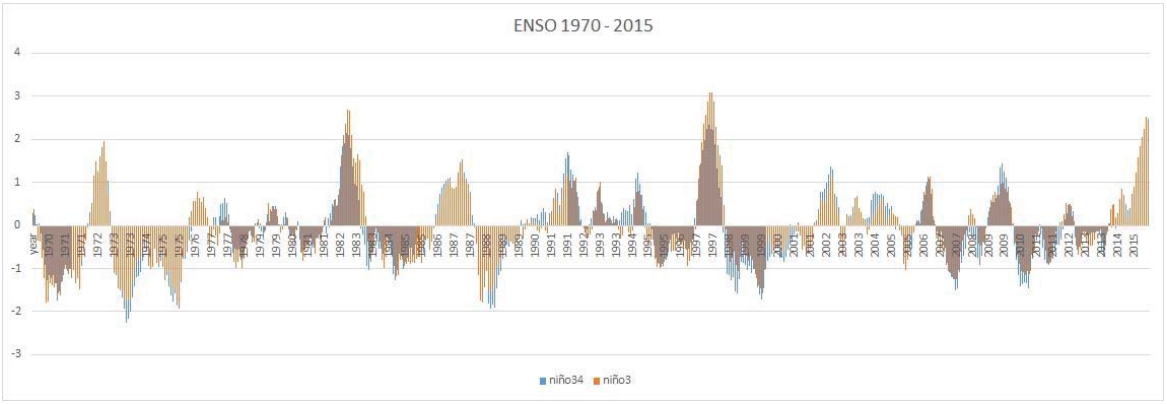

Precipitation percentile 95
R95p
0
100
200
300
400
500
600
1970
1980
1990
2000
2010
Year
R2= 13.7 p-value= 0.02 Slope estimate= 3.74 Slope error= 1.545

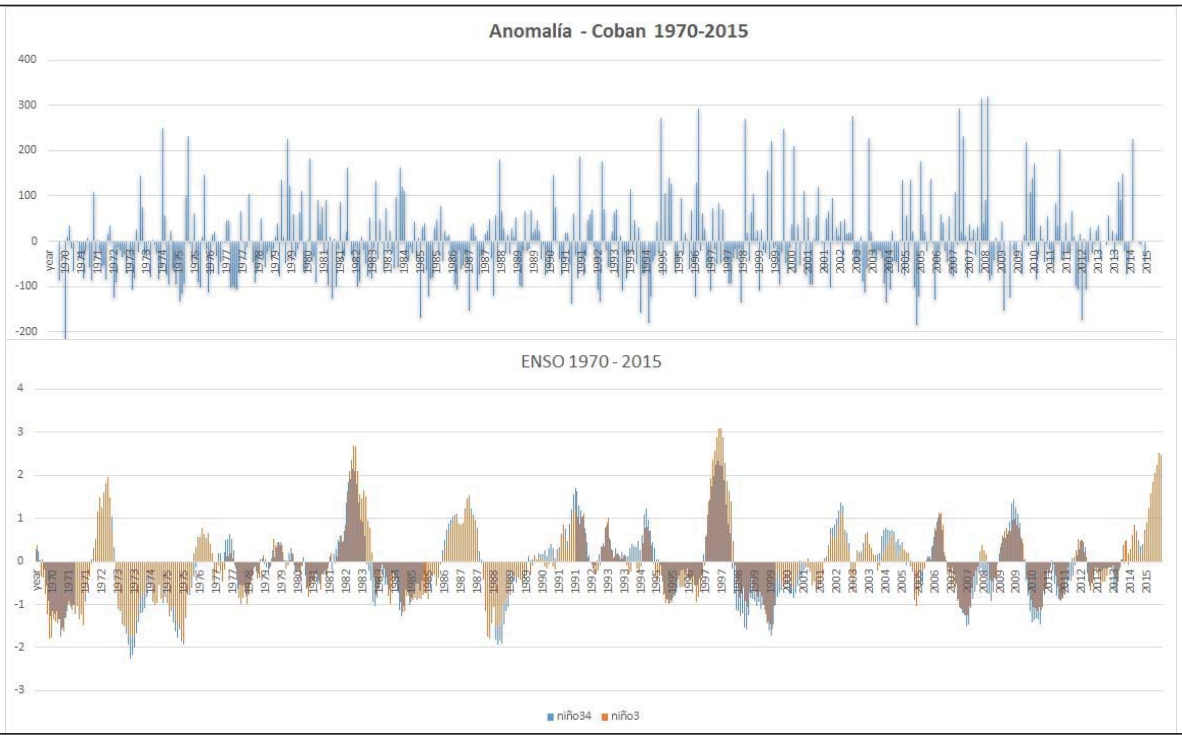

JulAugSep 2001
Fill: Precipitation (mm)
18°N
17°N
16°N
15°N
14°N
13°N
93°W
92°W
91°W
90°W
89°W
88°W
600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000
Precipitation (mm)
JulAugSep 2010
Fill: Precipitation (mm)
18°N
17°N
16°N
15°N
14°N
13°N
93°W
92°W
91°W
90°W
89°W
88°W
600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000
Precipitation (mm)

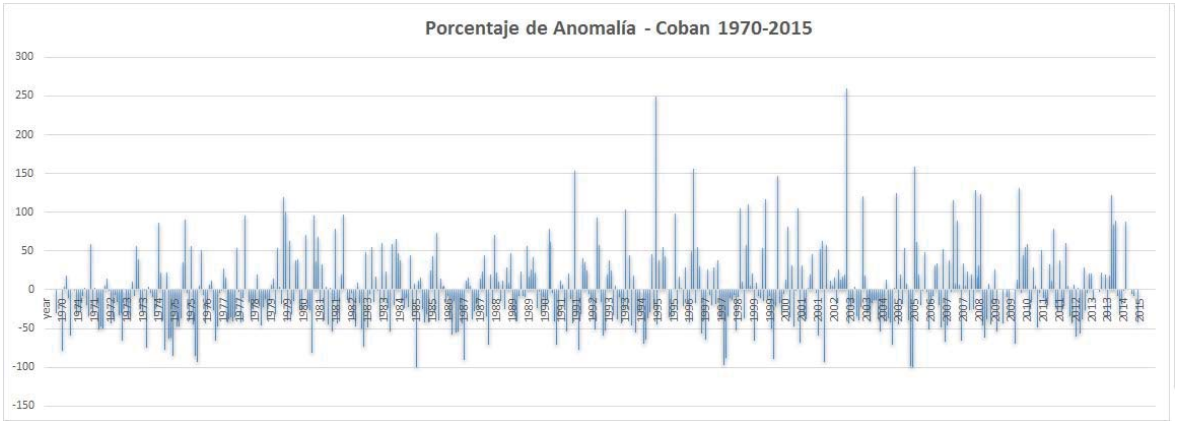

JulAugSep 2002
JulAugSep 2003
JulAugSep 2004
JulAugSep 2005
Is this pattern related with ENSO?
JulAugSep 2006
JulAugSep 2007
JulAugSep 2009
JulAugSep 2008

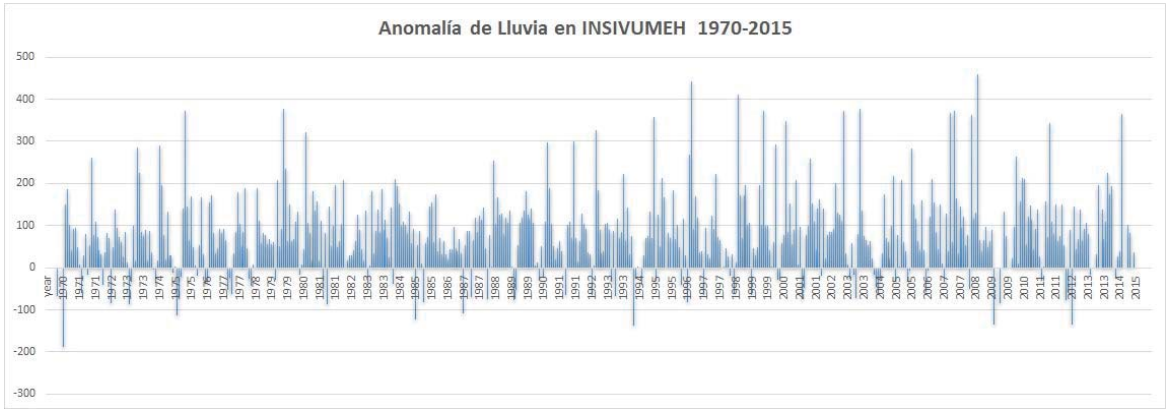

Precipitación en Estación Coban del 2001-2010
700
600
500
400
300
200
100
0
ENSO 2001-2010
1.5
1
0.5
0
-0.5
-1
-1.5


NNRP_2001-2010
GRID LAT GRID LON 15.4426 -90.4565
Near Coban station
350
300
250
200
150
100
50
0
ENSO 2001-2010
1.5
1
0.5
0
-0.5


ENSO 1970 - 2015
niño34
niño3


Anomalía - Coban 1970-2015
ENSO 1970 - 2015
niño34
niño3


Porcentaje de Anomalía - Coban 1970-2015
300
250
200
150
100
50
0
-50
-100
-150
year


Anomalía de Lluvia en INSIVUMEH 1970-2015
500
400
300
200
100
0
-100
-200
-300
year

Next steps / recommendations

DATA

To include stations data in map maker
To include more stations from INSIVUMEH
To perform quality control and homogenization process to stations data

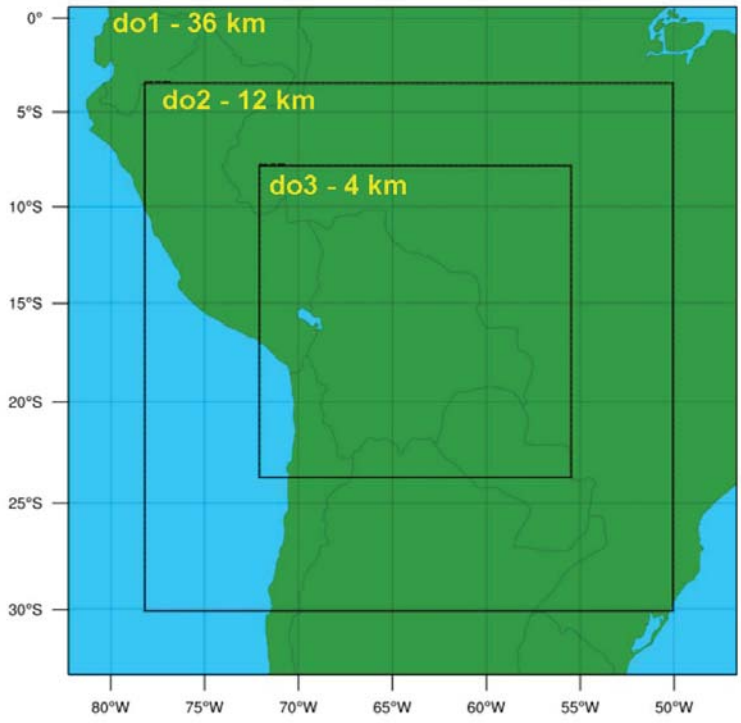
COORDINATION

Prepare a brief for the participants that couldn't attend this workshop
Include all groups into one discussion list to enhance different skills or expertise
Define short term goals based on country needs or interests
Skype meetings with all groups
Previous to the next workshop to discuss a preliminary agenda

Working Group 3: Mountain Precipitation and Glaciers

Marcos Andrade, Edita Talledo Flores, Marcelo Oyuela

Validation of the WRF-UNL outputs for Bolivia: focus on precipitation



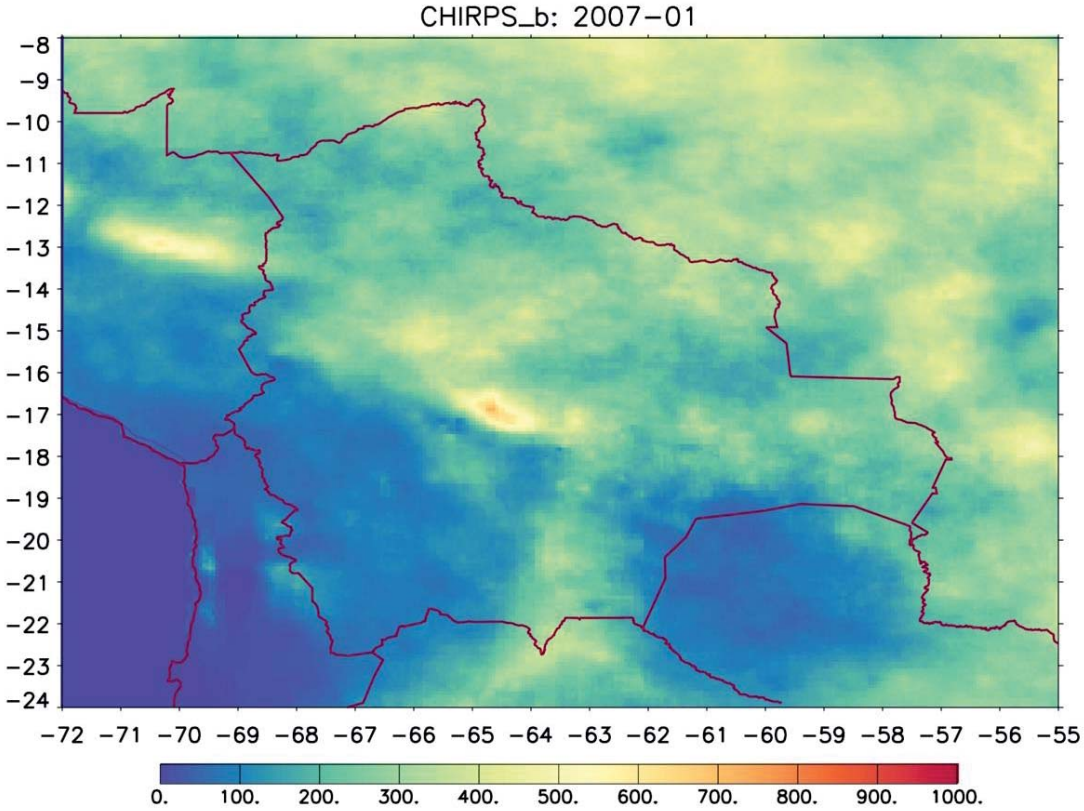
Observations

- Surface observations
- CHIRPS: Climate Hazards Group InfraRed Precipitation with Station data*
- CFIN: Combination of surface observations, re-analysis CFSR and TRMM

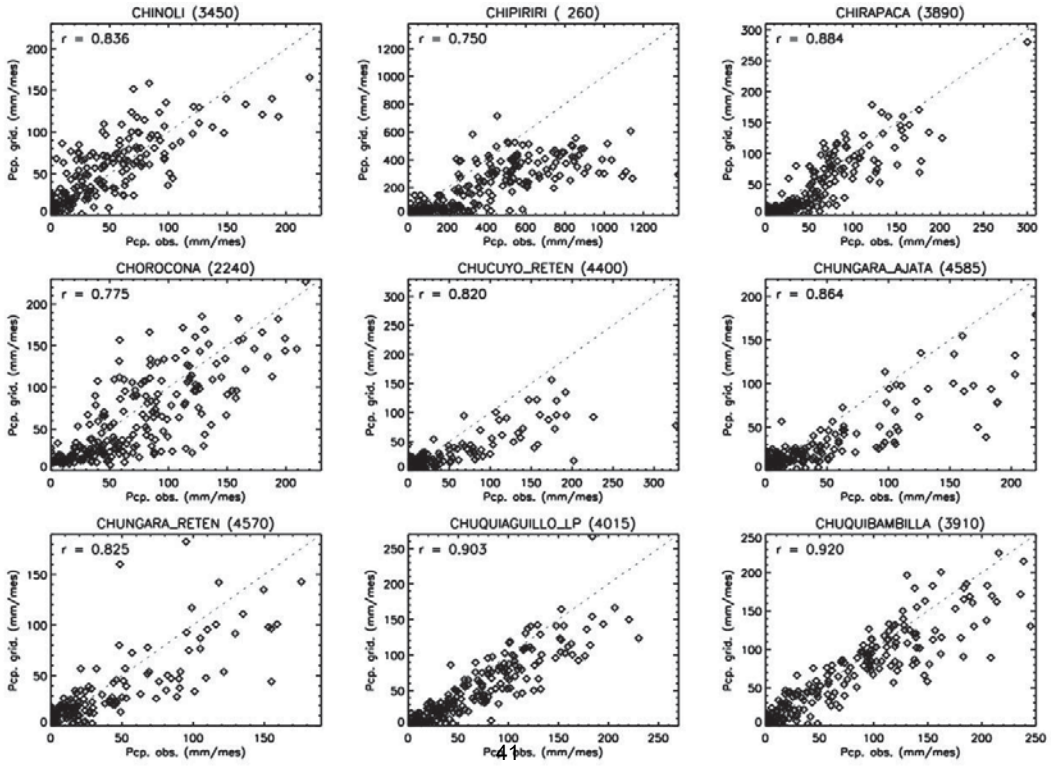
* Funk et al., *The climate hazards infrared precipitation with stations—a new environmental record for monitoring extremes*, Scientific Data, 2015

CHIRPS (Obs)

Jan 2007

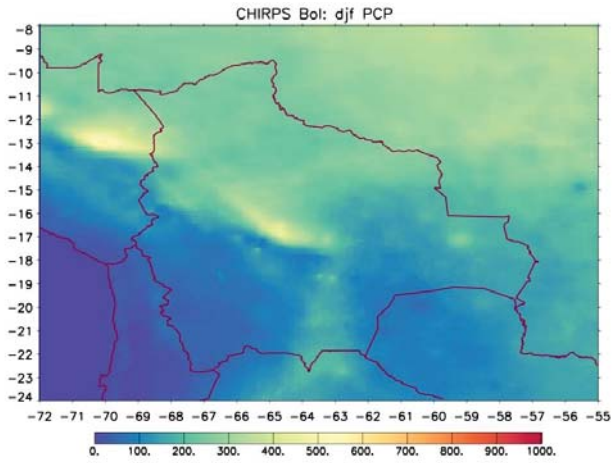


Comparison of CHIRPS data with observations

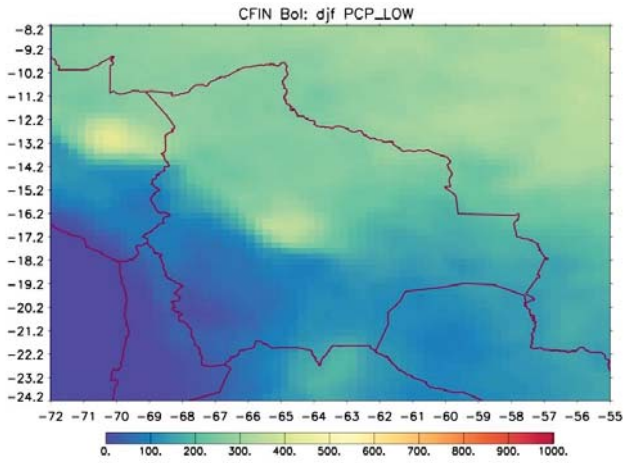


Climatology DJF

("Observations")



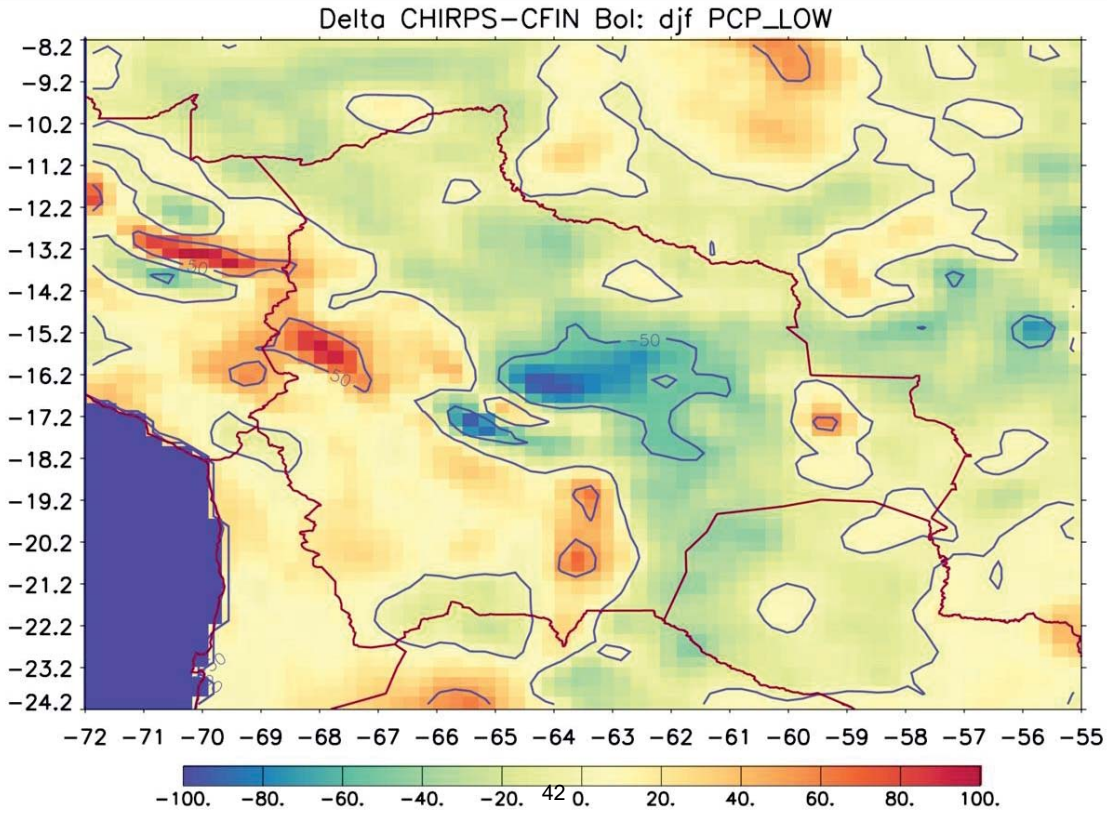
CHIRPS



CFIN

CHIRPS – CFIN difference

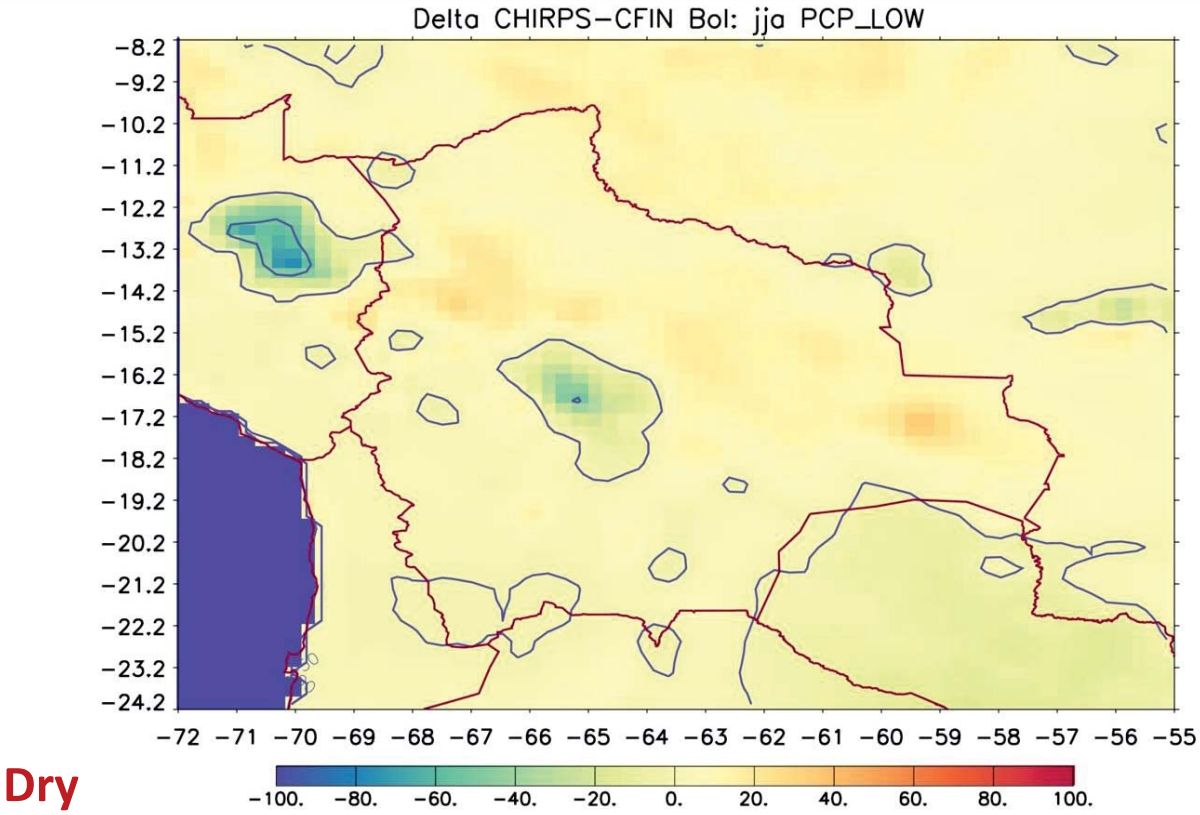
DJF



Wet

CHIRPS – CFIN difference

JJA

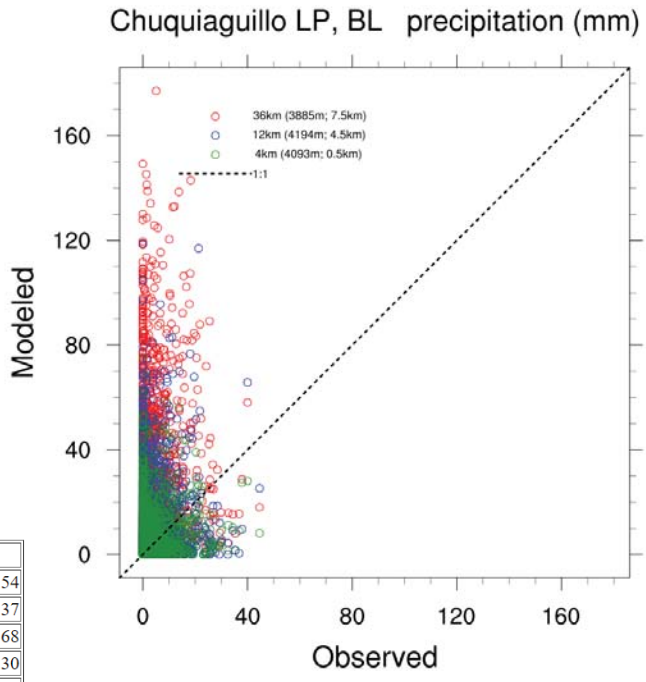


Dry

Model Outputs: Validation

- For domain d03 (~4 km)
- Interpolated to CHIRPS' grid
- Climatological differences

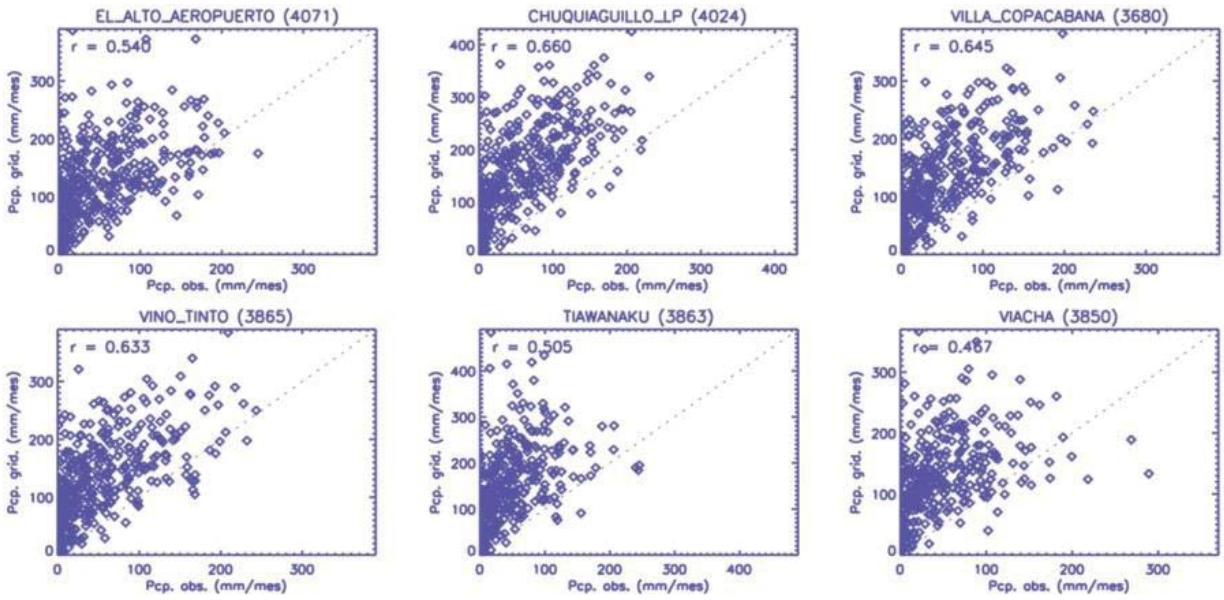
Comparison for daily data



Chuquiaguillo LP, BL precipitation (mm)

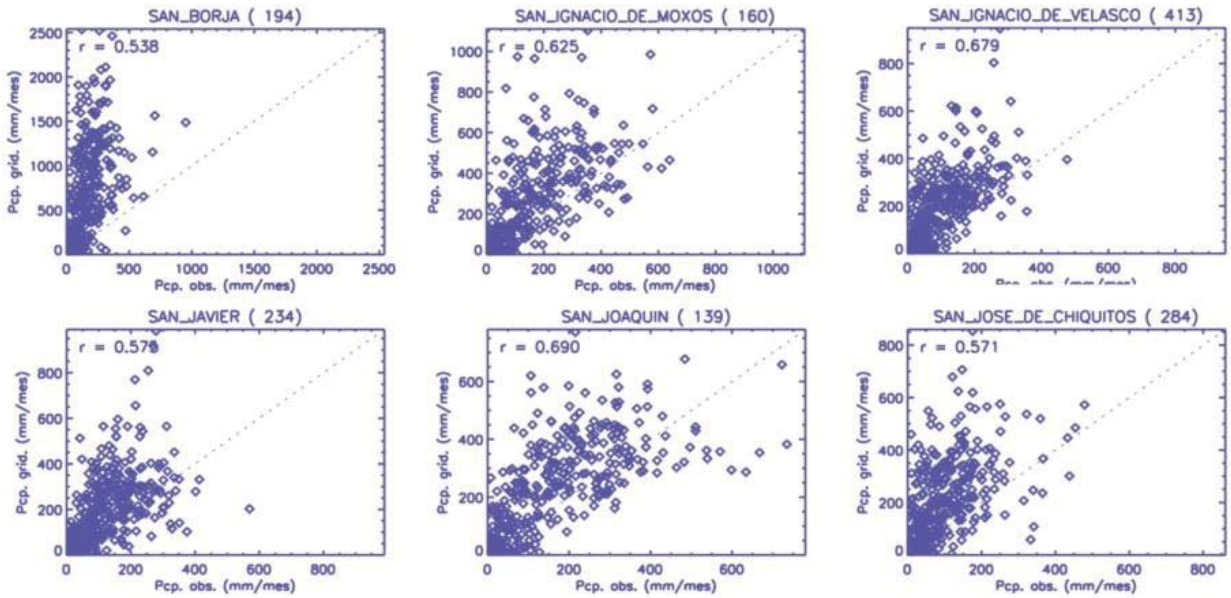
N = 3583	obs	36km	12km	4km
Mean	1.86	17.55	7.24	5.54
Std Dev	4.46	22.89	12.24	8.37
Bias		15.69	5.38	3.68
MAE		16.30	6.90	5.30
RMSE		27.36	13.25	9.46
Corr		0.225	0.200	0.182
Elev (m)	4024	3885	4194	4093
Dist (km)		7.5	4.5	0.5

Monthly comparison by stations



(Altiplano)

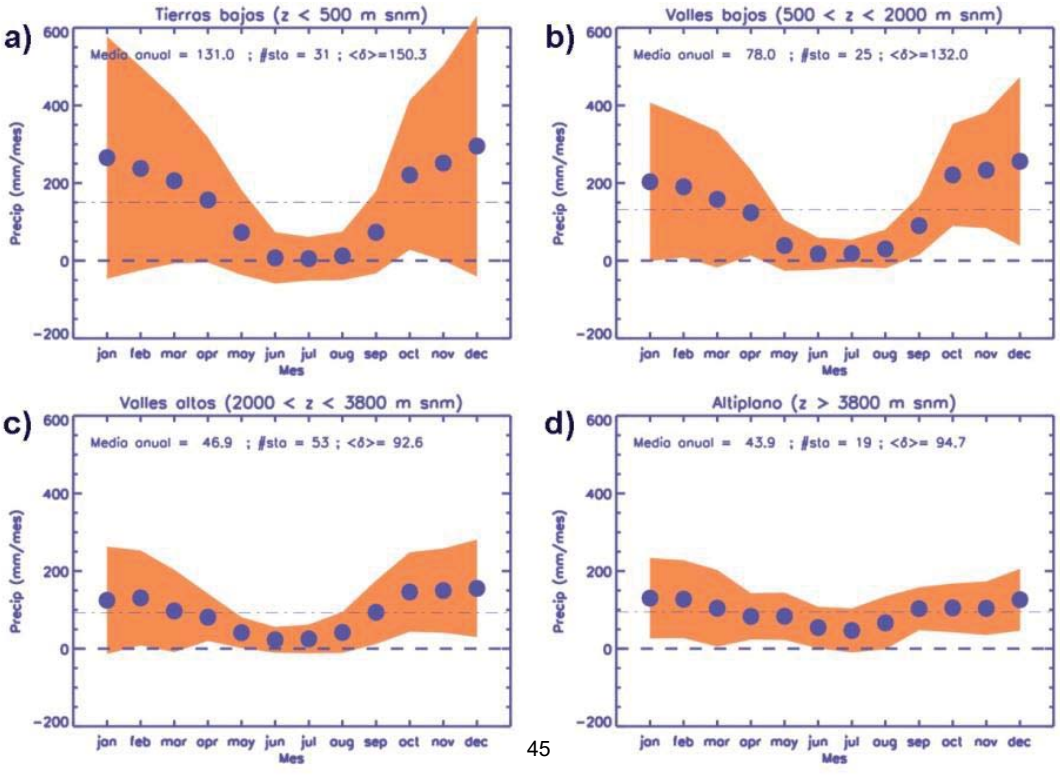
Comparison by stations



(Lowlands)

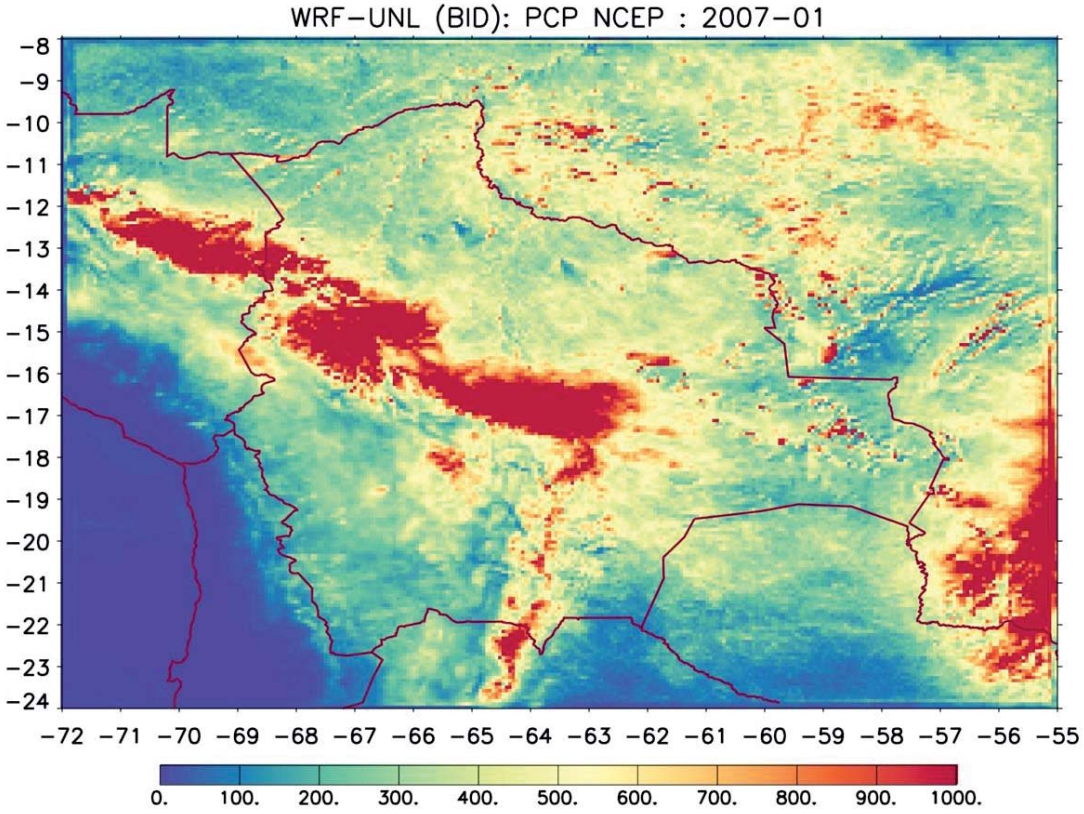
Model – Observations

(by altitude)



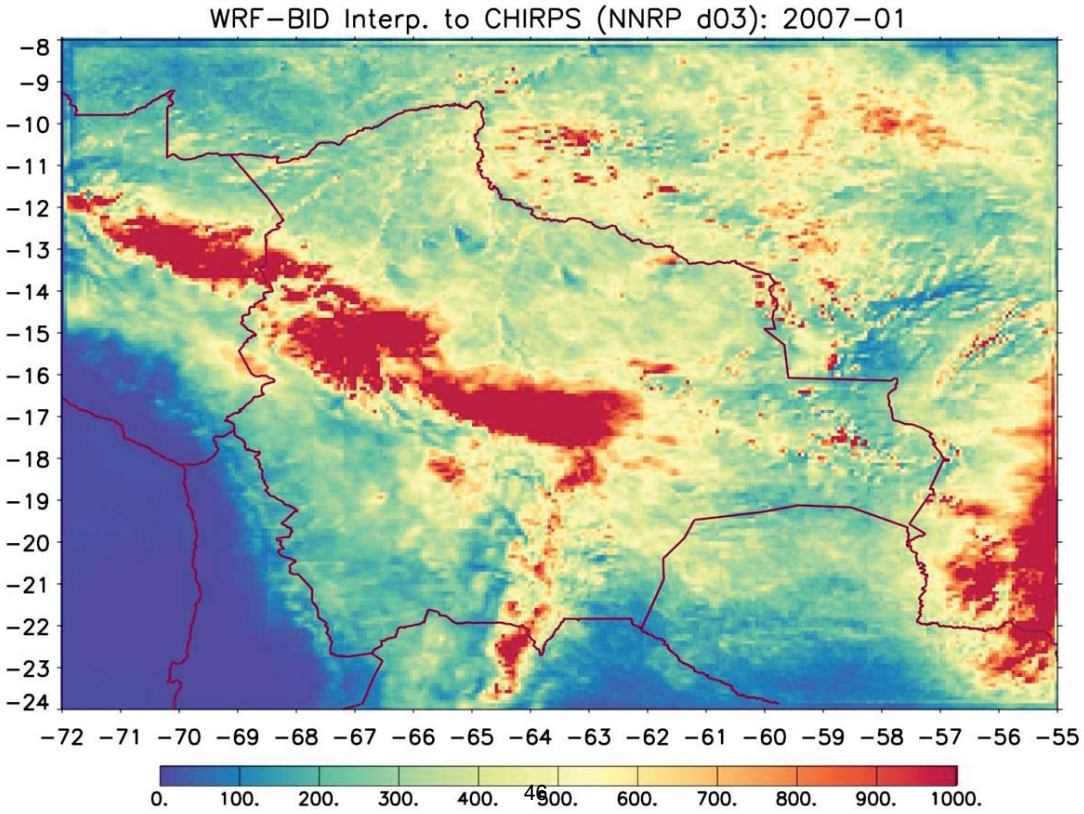
WRF-UNL (Historical)

Jan 2007



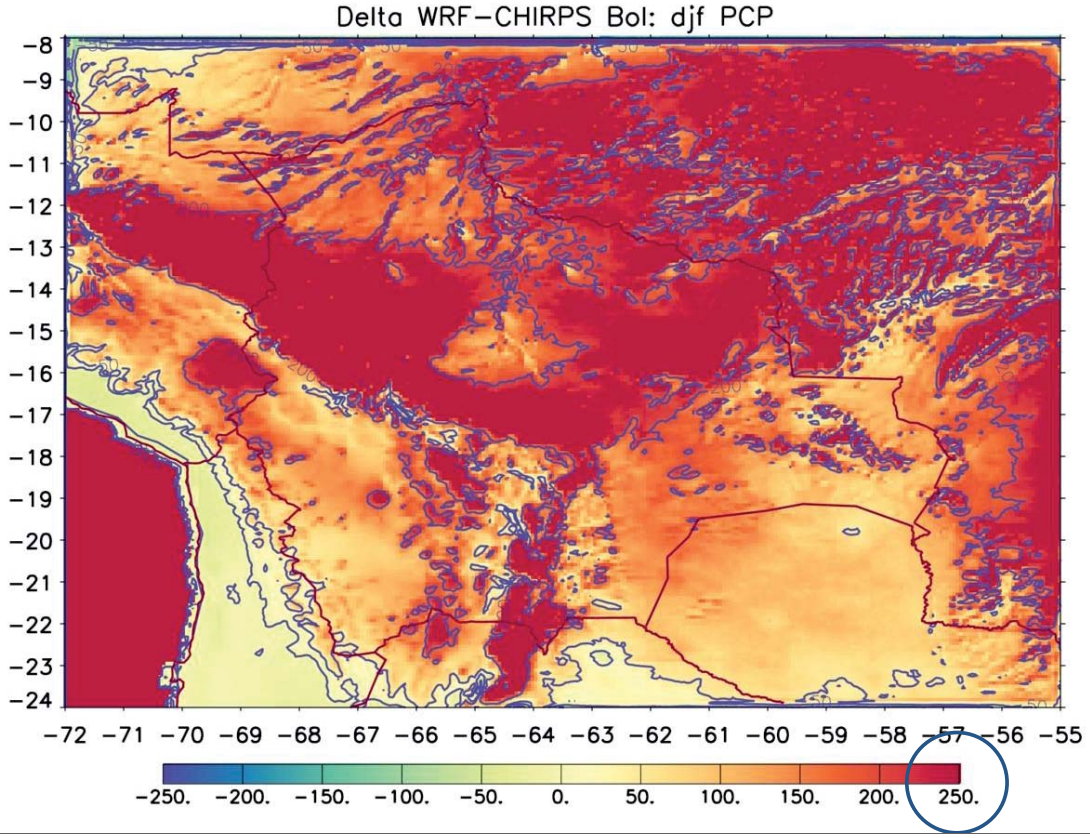
WRF-UNL interpolated to CHIRPS grid

Jan 2007



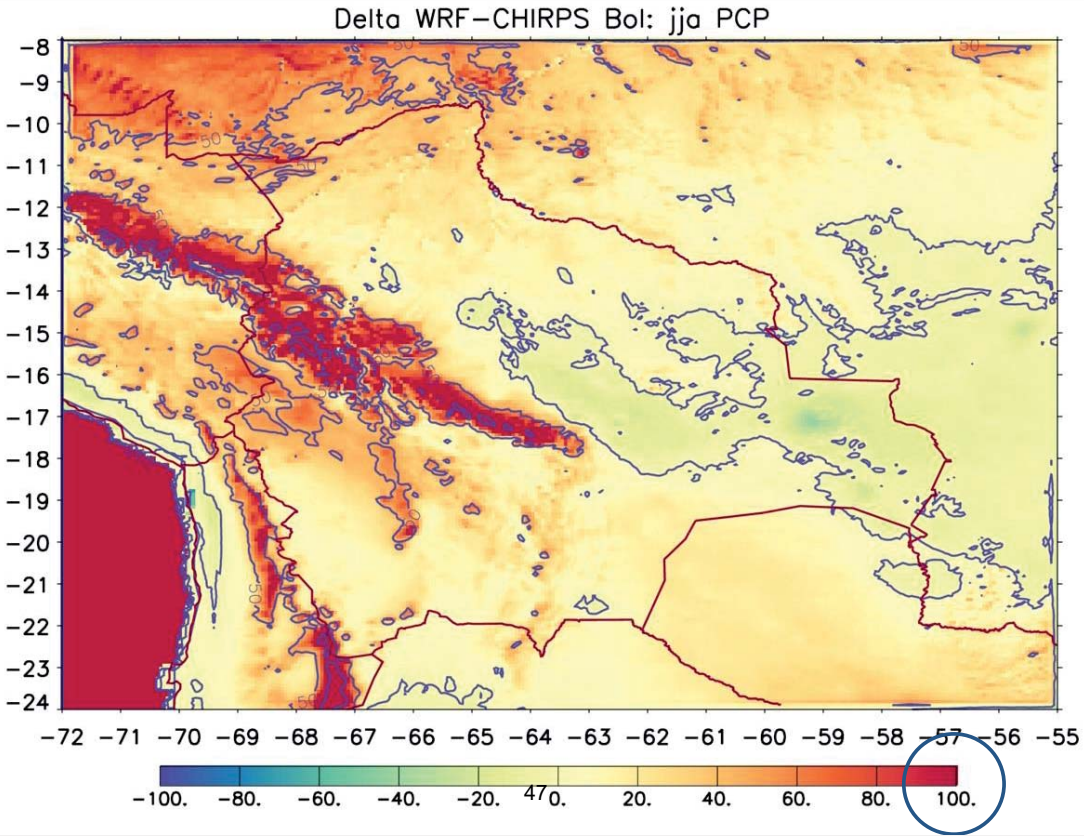
WRFint – CHIRPS difference

DJF



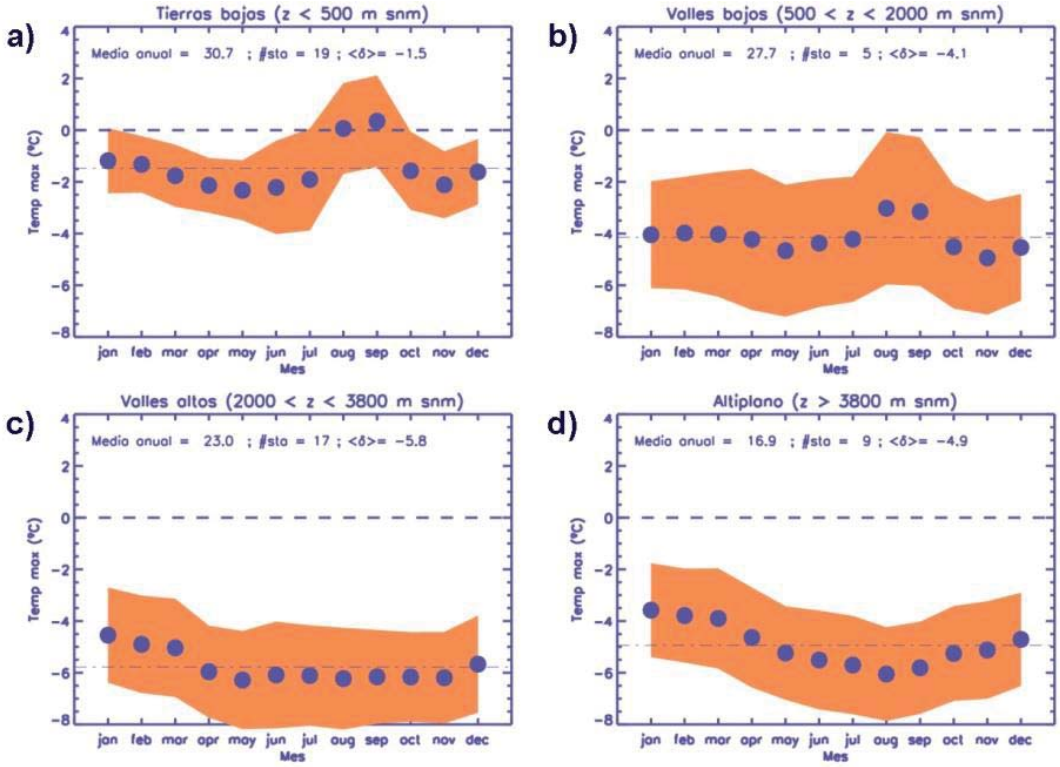
WRFint – CHIRPS difference

JJA

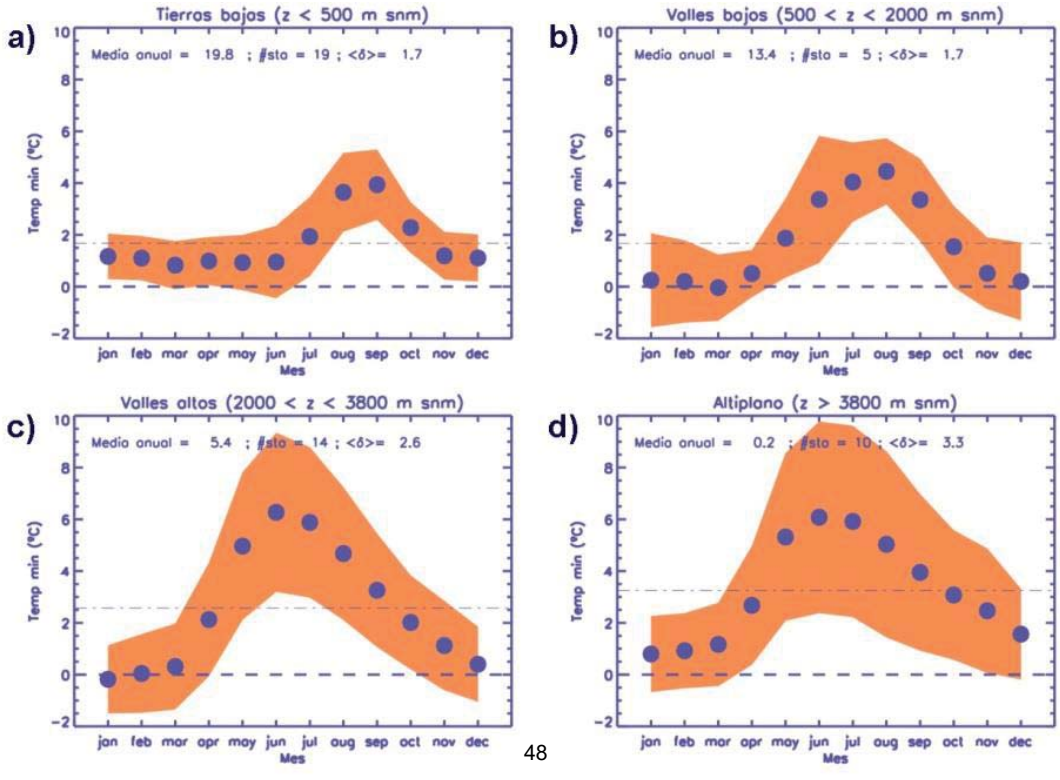


Dry

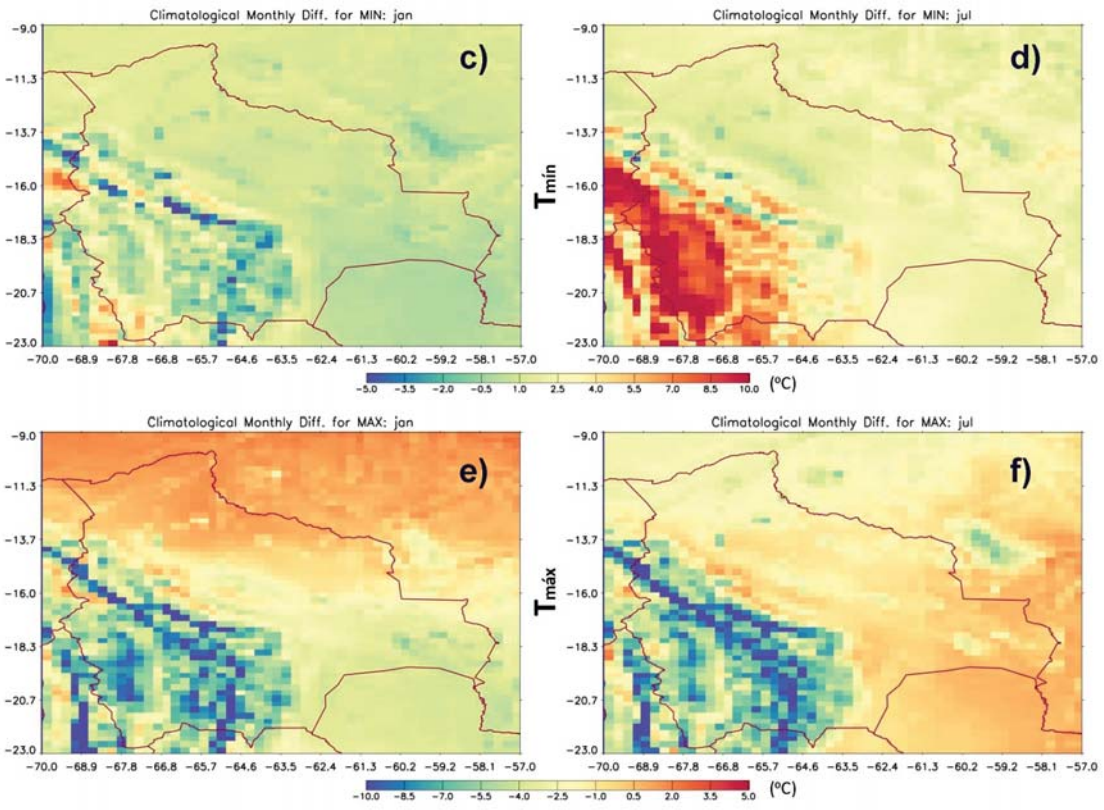
Difference in maximum temperature



Difference in minimum temperature



Difference in temperature



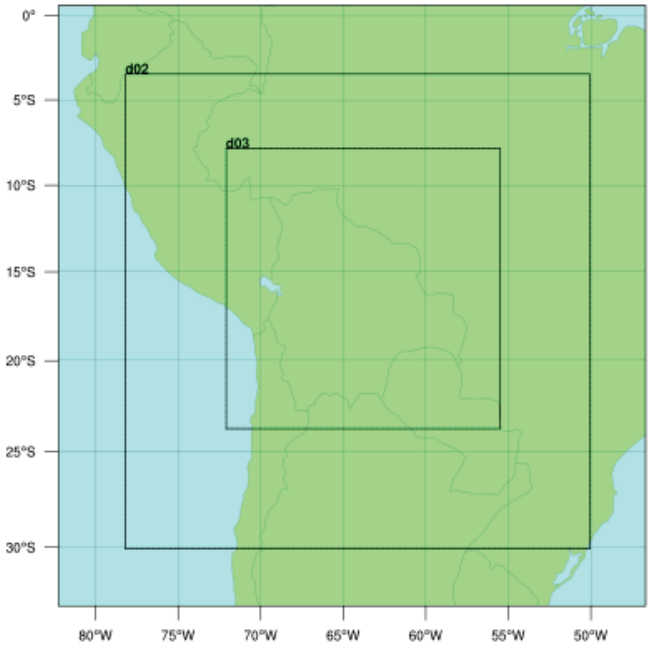
Summer

Winter

ANALISIS DEL PRODUCTO MAPMAKER

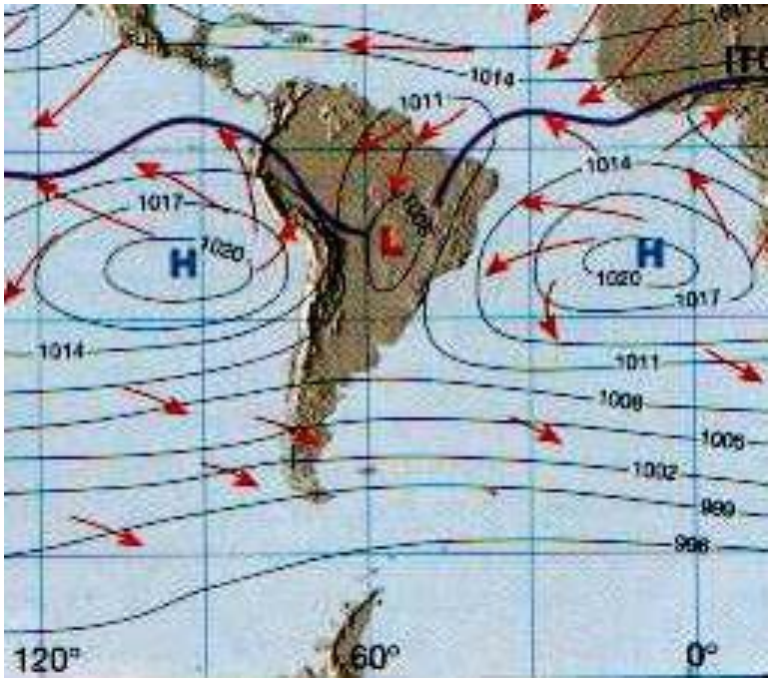
PERU

Producto Bolivia
tres dominios (36km, 12km y 4km)

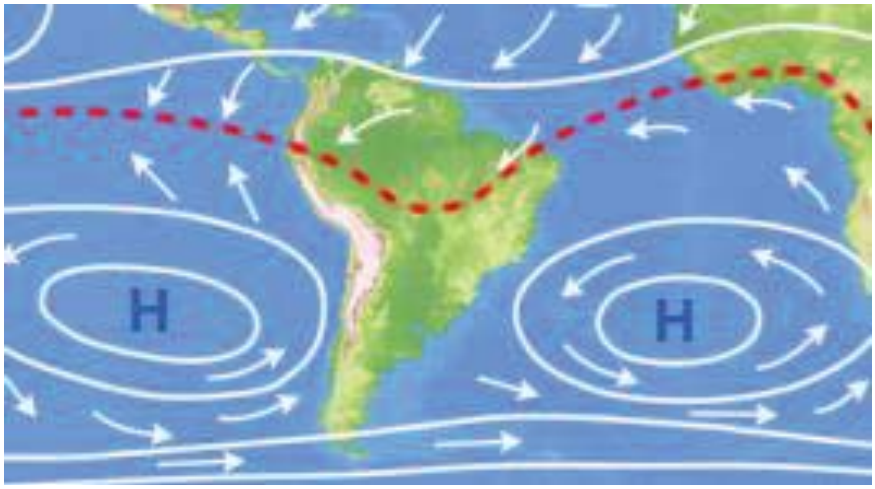


REPRESENTACION DE SISTEMAS SEMIPERMANENTES EN SUDAMERICA a través del histórico NNRP (1979-2012)

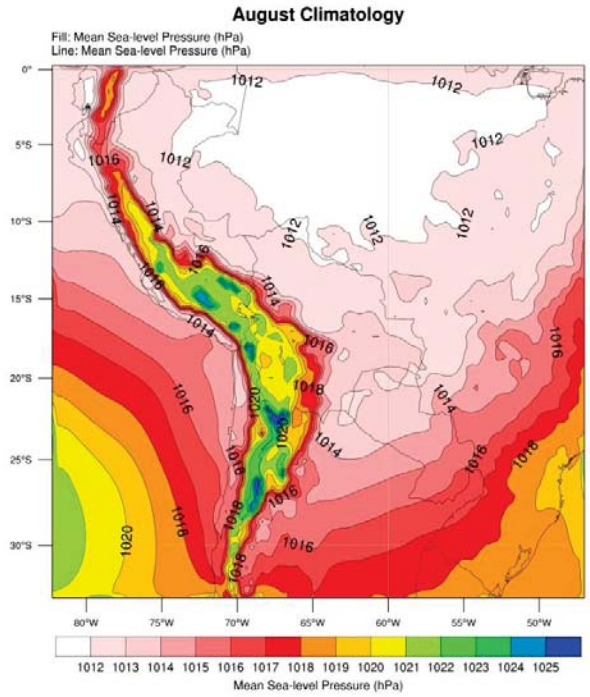
PRESION A NIVEL DEL MAR



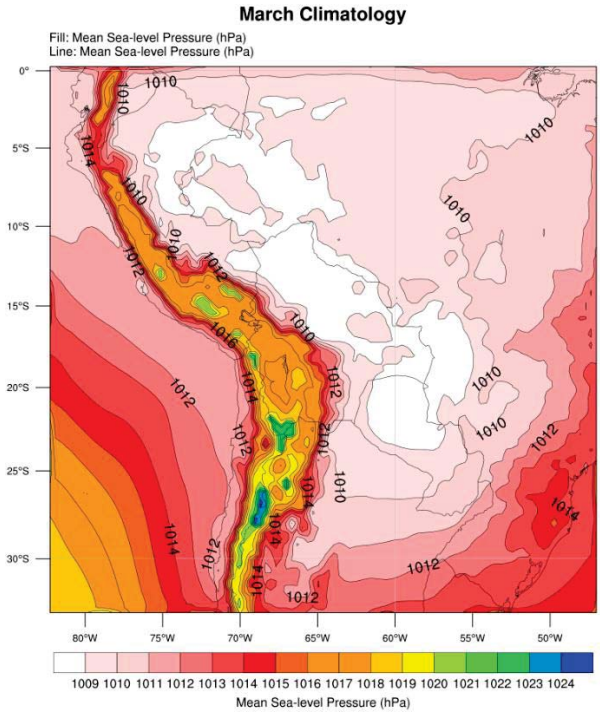
PRESION A NIVEL DEL MAR
PATRON DEL FLUJOS DE VIENTO



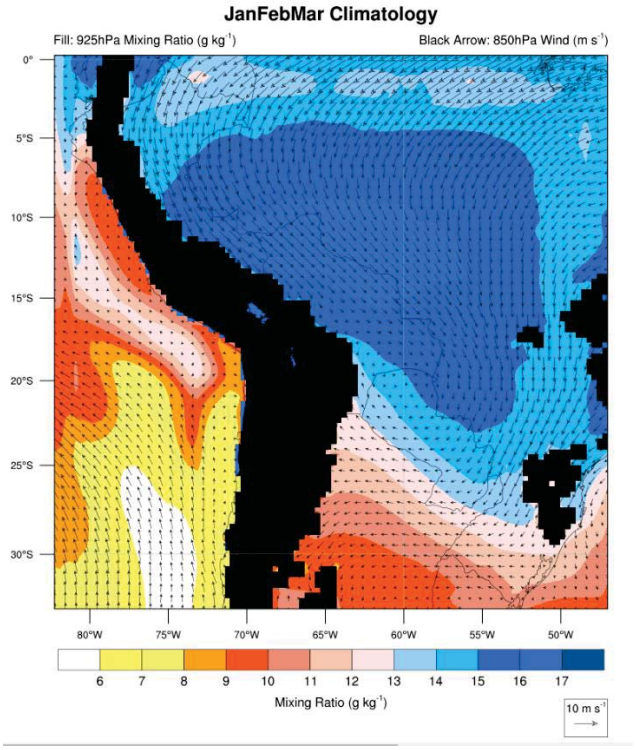
Nivel del mar
El anticiclón del pacifico sur - agosto(1021hp)
28-30°s y 90-95°w



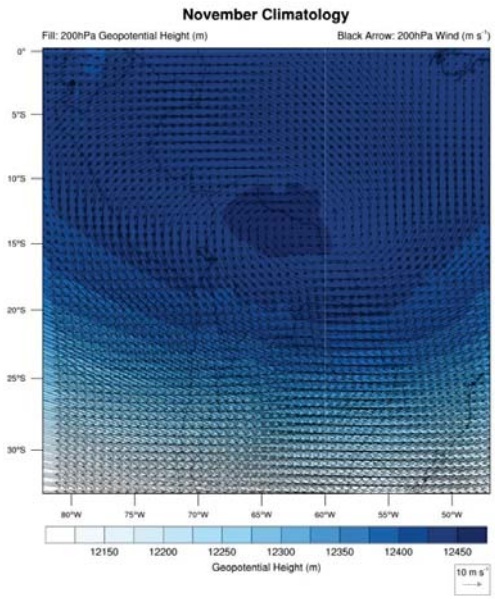
Nivel del mar
El anticiclón del pacifico sur - MArzo(1019hp)
32-35°s y 95°w



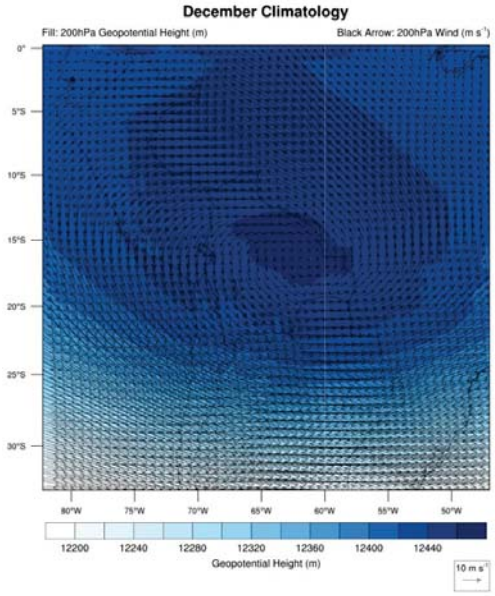
Niveles bajos
Vientos y Humedad - EFM(1019hp)
32-35°S y 95°W



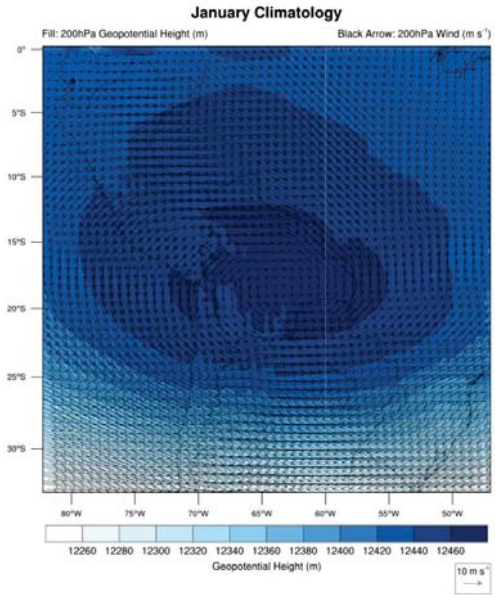
Niveles Altos
alta de Bolivia- nov
12°S - 62°W



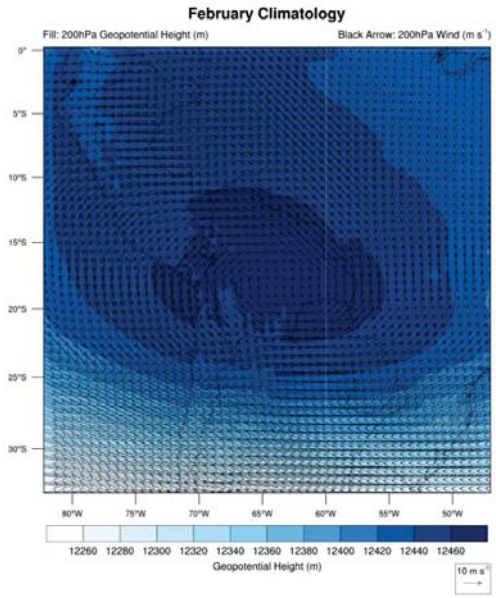
Niveles Altos
Alta de Bolivia- Dic (Sur)
15°S - 62°W



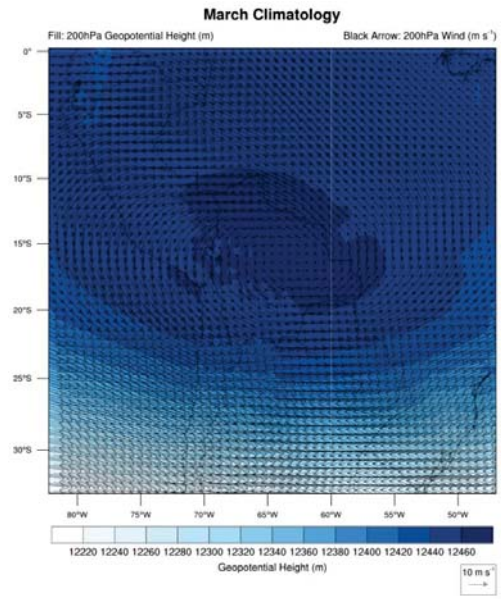
Niveles Altos
Alta de Bolivia- Ene (SurOeste)
18°S - 65°W



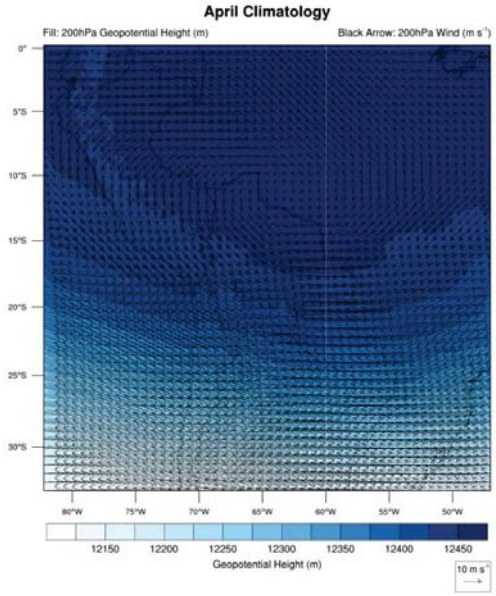
Niveles Altos
Alta de Bolivia- Feb (Se mantiene)
18°S - 65°W



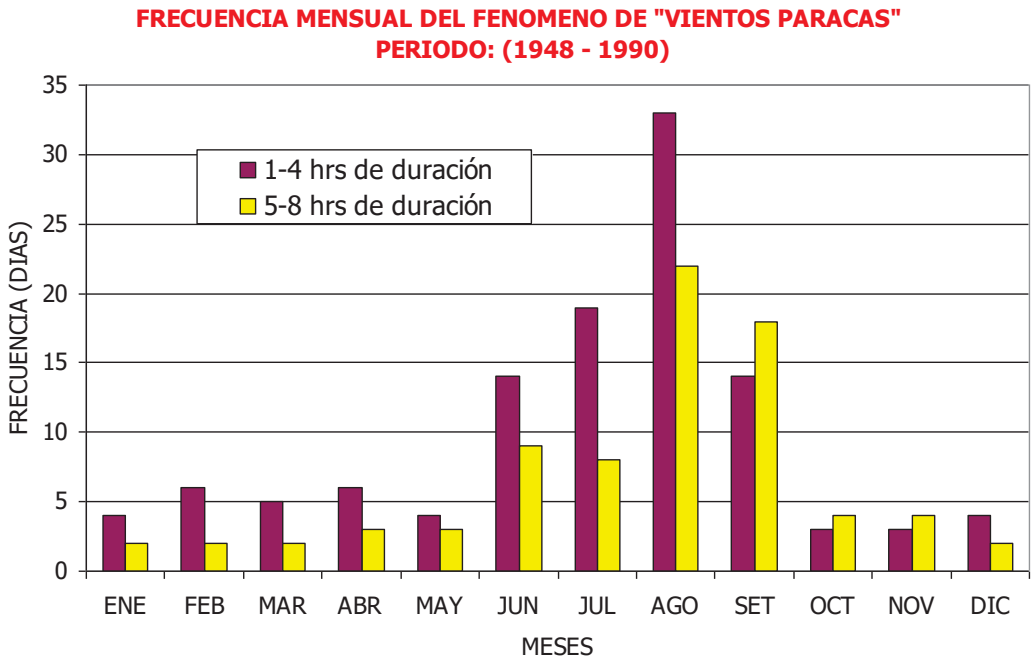
Niveles Altos
Alta de Bolivia- Mar (Norte-est)
15°S - 64°W



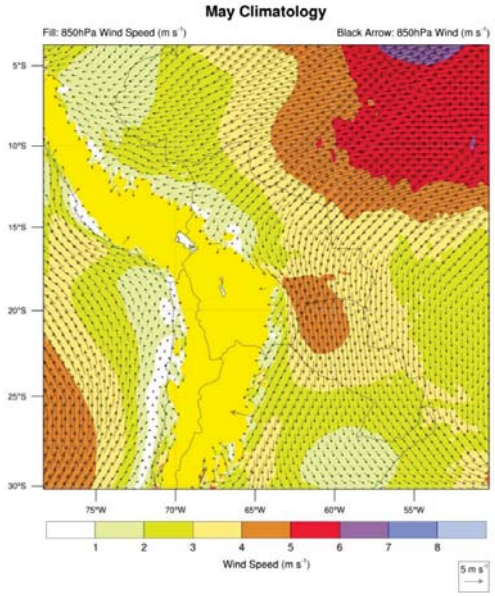
NIVELES ALTOS
ALTA DE BOLIVIA- ABRIL (NORESTE)
10°S - 62°W



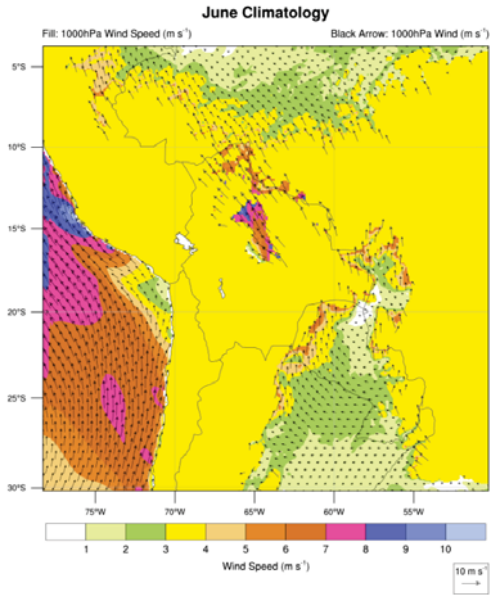
VIENTOS PARACAS – SUR ESTE
10-21 METROS/S



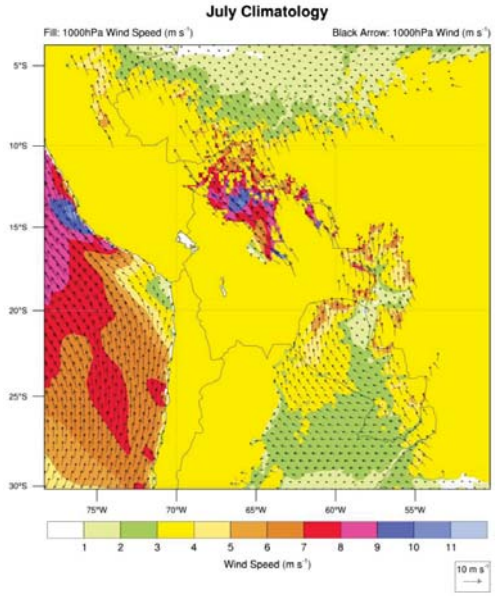
VIENTOS PARACAS – SUR ESTE
7-18 METROS/S
MAYO



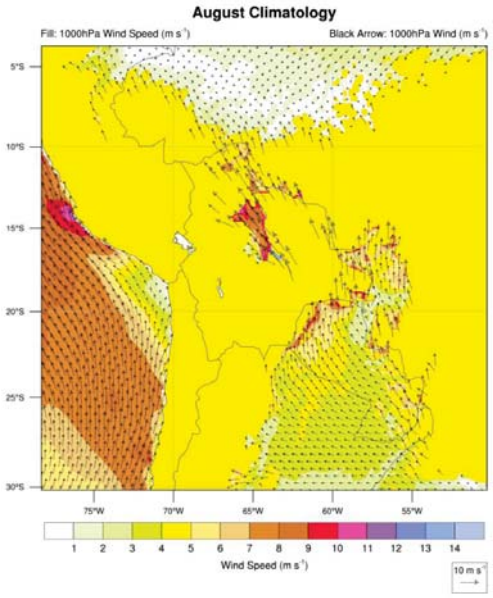
VIENTOS PARACAS – SUR ESTE
7-18 METROS/S
JUNIO



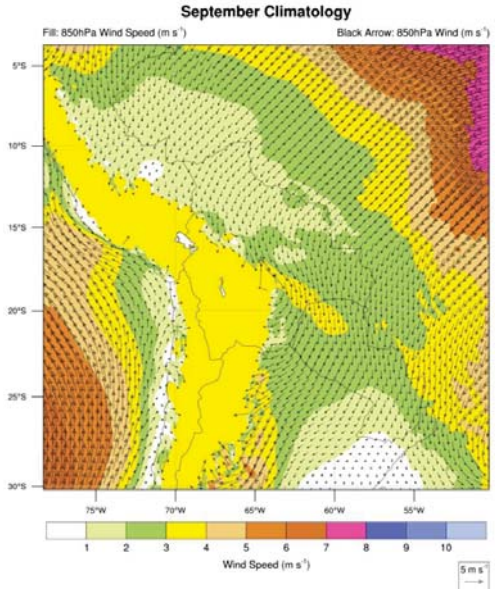
VIENTOS PARACAS – SUR ESTE
7-18 METROS/S
JULIO



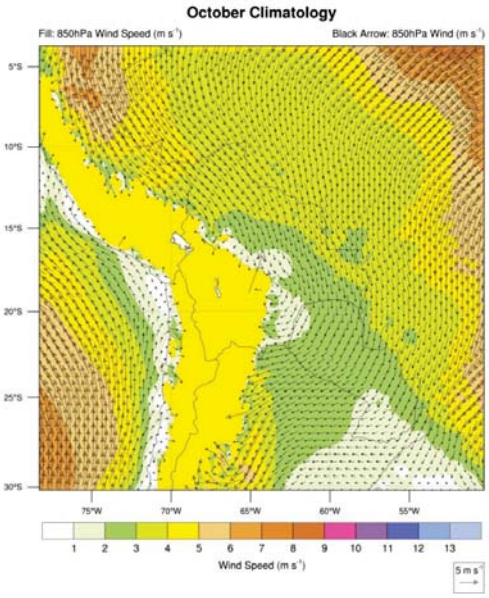
VIENTOS PARACAS – SUR ESTE
7-18 METROS/S
AGOSTO



VIENTOS PARACAS – SUR ESTE
7-18 METROS/S
SETIEMBRE

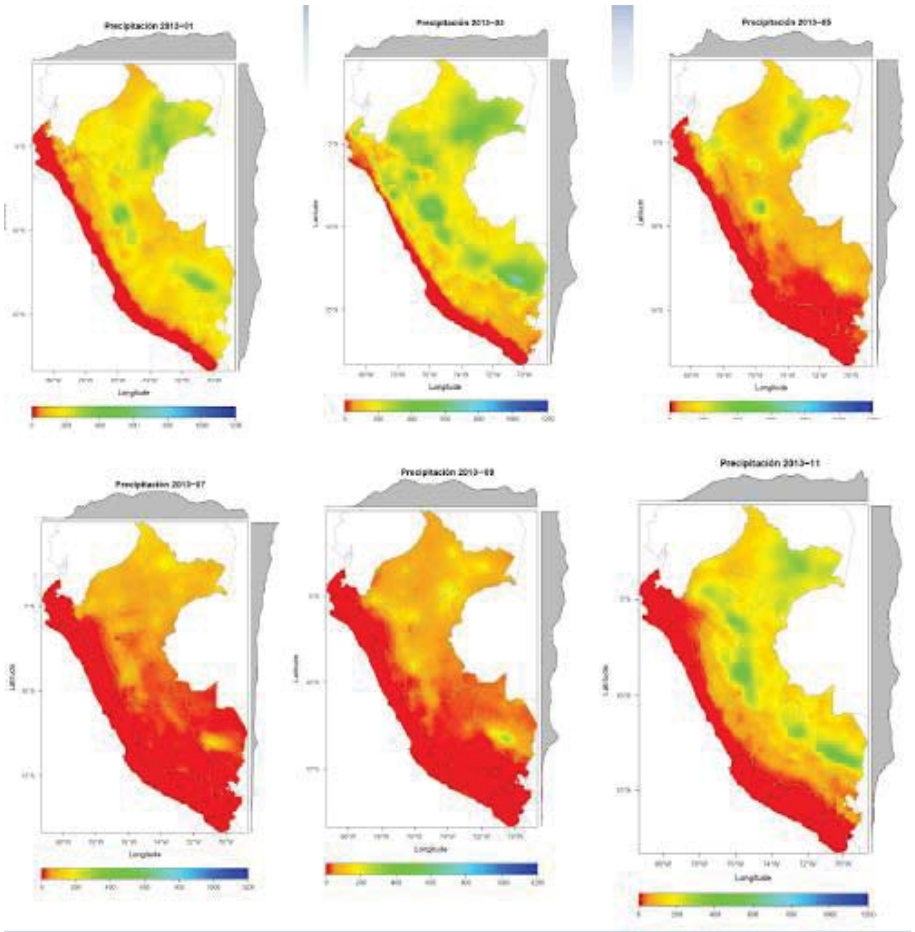


VIENTOS PARACAS – SUR ESTE
7-18 METROS/S
OCTUBRE

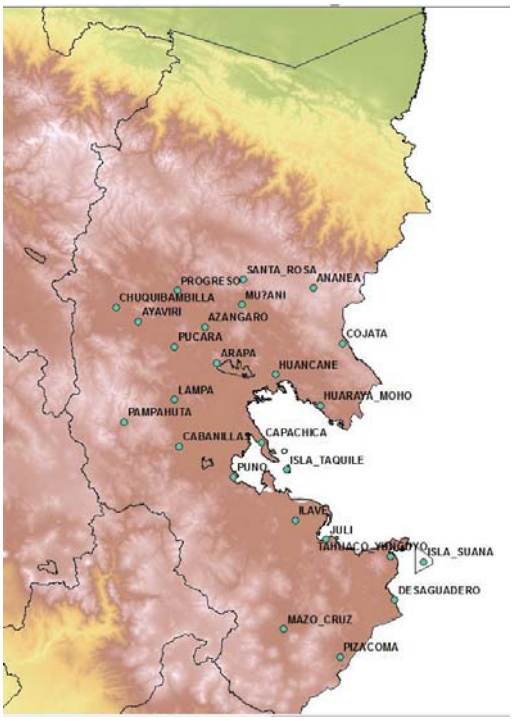


EVALUACIÓN DEL REANÁLISIS NNRP (2001-2010) FRENTE A DATOS OBSERVADOS GRILLADOS Y EN PUNTO DE ESTACIÓN

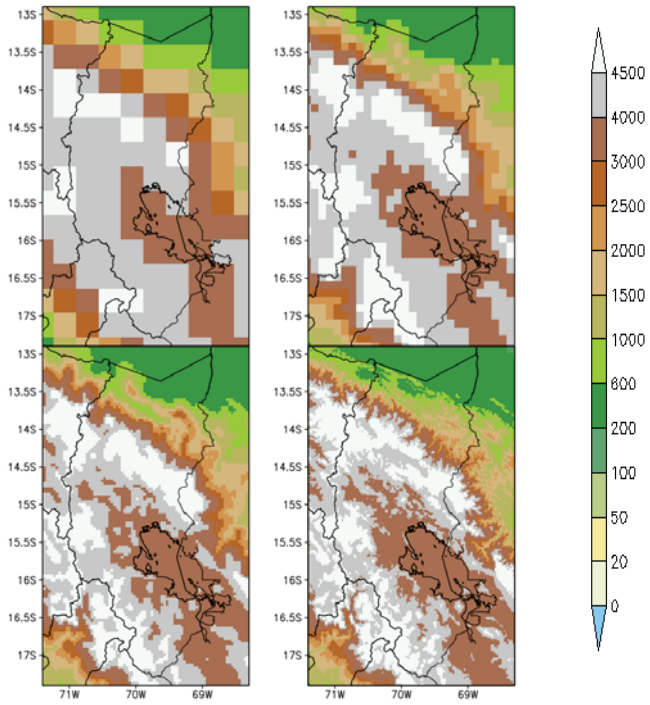
DATA OBSERVADA GRILLADA DATOS PISCO (5KM) 1981-2013



ESTACIONES EN EL DEPARTAMENTO DE PUNO

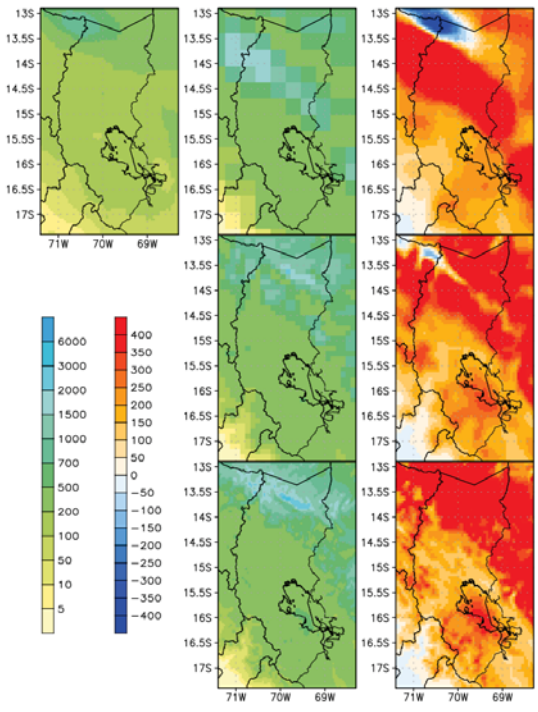


EVALUACION DE LA TOPOGRAFIA



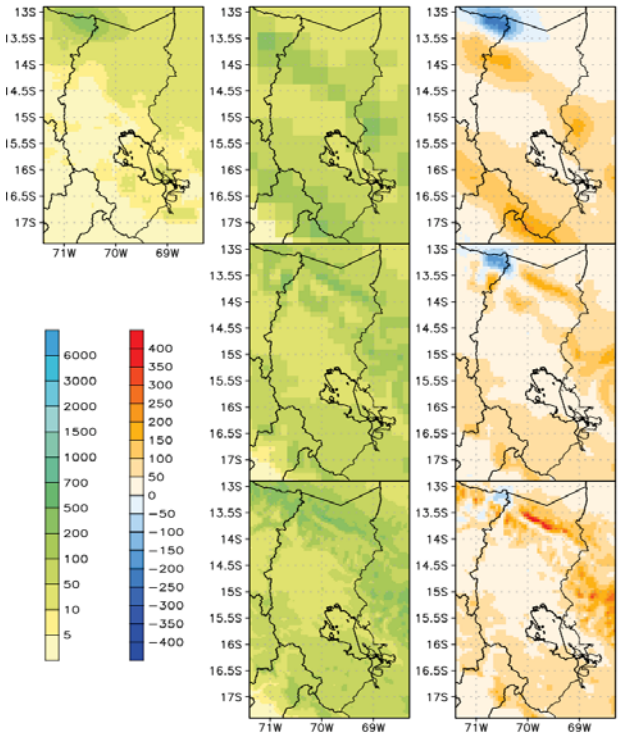
EVALUACIÓN DEL CICLO ESTACIONAL DE LA PRECIPITACIÓN
TRIMESTRE DEF

DATA OBSERVADA GRILLADA (SUPERIOR DERECHA) Y RESULTADOS DEL MODELO (CENTRO) PARA CADA UNO DE LOS TRES DOMINIOS (DE ARRIBA A ABAJO). DIFERENCIA ENTRE EL MODELO Y LA DATA OBSERVADA (IZQUIERDA).

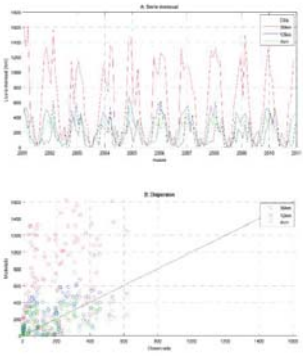


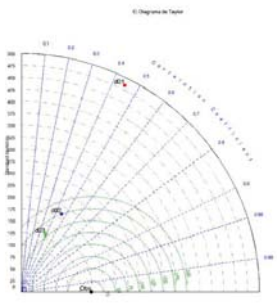
EVALUACIÓN DEL CICLO ESTACIONAL DE LA PRECIPITACIÓN-DEF

DATA OBSERVADA GRILLADA (SUPERIOR DERECHA) Y RESULTADOS DEL MODELO (CENTRO) PARA CADA UNO DE LOS TRES DOMINIOS (DE ARRIBA A ABAJO). DIFERENCIA ENTRE EL MODELO Y LA DATA OBSERVADA (IZQUIERDA).



EVALUACIÓN EN PUNTO DE ESTACIÓN DE LA PRECIPITACIÓN PARA PUNO





ESTACION: AZANGARO

COD: 114041

LAT: -14.91472

LON: -70.19111

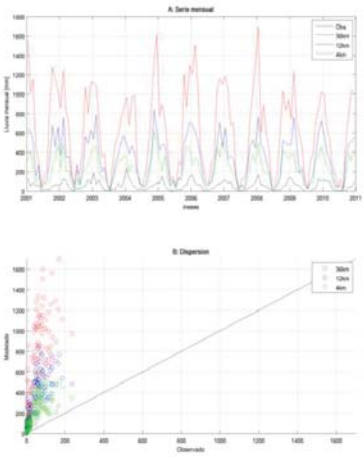
ALTITUD D1:

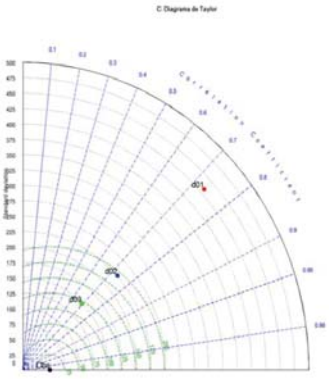
Altitud D2:

Mejora notable de la exactitud y fiabilidad del modelo para los dominios de mayor resolución.

En la correlación se redujo ligeramente.

EVALUACIÓN EN PUNTO DE ESTACIÓN DE LA PRECIPITACIÓN PARA PUNO





ESTACION: HUARAYA_MOHO

COD: 115038

LAT: -15.38972

LON: -69.49139

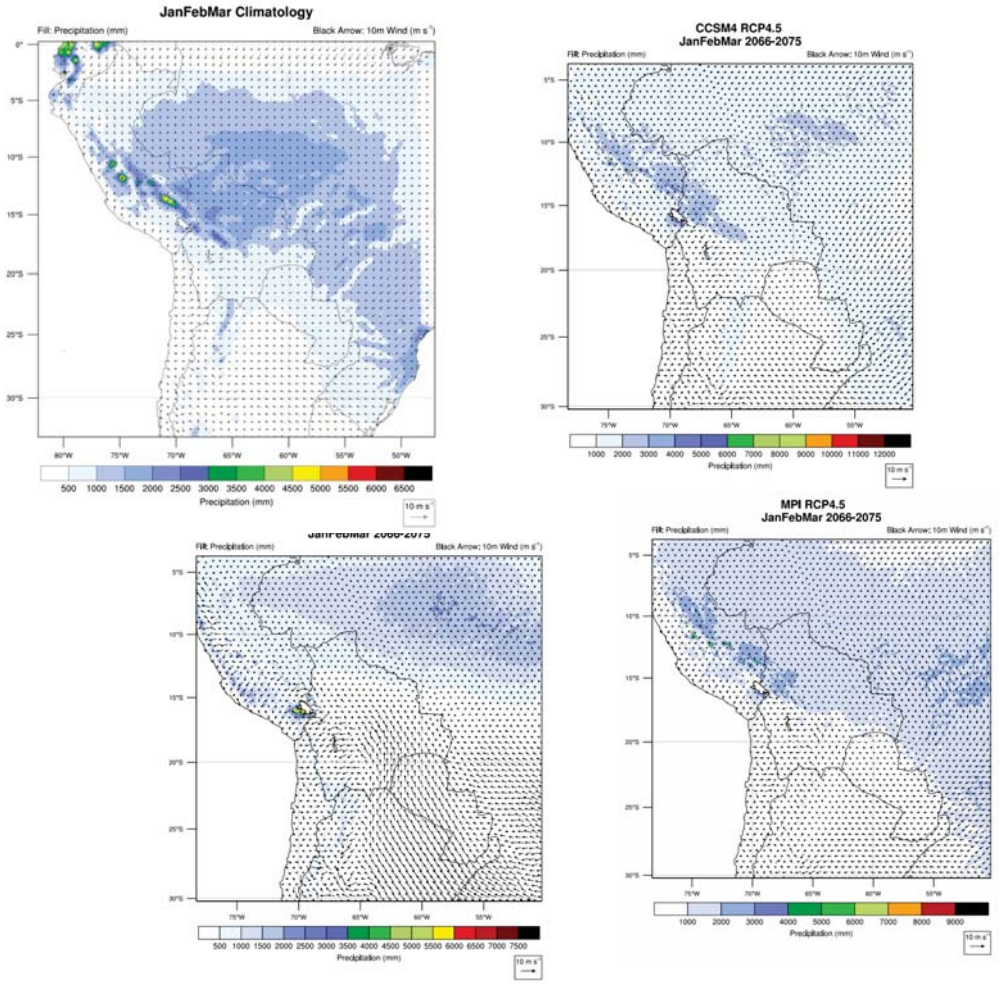
Altitud D1:

Altitud D2:

Altitud D3:

El dominio D2 Y D3 presenta buena fiabilidad y exactitud y mientras que la correlación se mantuvo igual respecto del dominio D1.

EVALUACIONES PARA ALGUNOS ESCENARIOS RCP 4.5 PARA LA PRECIPITACION



CONCLUCIONES Y RECOMENDACIONES

- Del análisis del ciclo estacional de Puno, se observo sobreestimacion del modelo en mayor intensidad en la época lluviosa (Setiembre -Marzo) que la época seca.
- De la evauacion con estaciones observadas en el caso de Puno resalta la sobre estimación en todos los dominios, mejorando en algunos casos la exactitud y/o la fiabilidad del modelo en los dominios de mayor resolución. En el caso de la correlación, esta tuvo valores aceptables en su mayoría incluso para el dominio de grilla más gruesa no mejorando necesariamente al aumentar la resolución.

- Evaluar las tendencias.