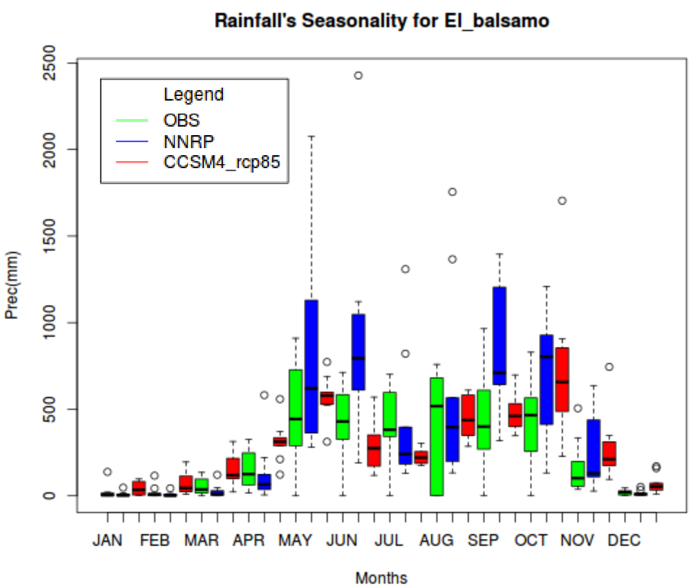
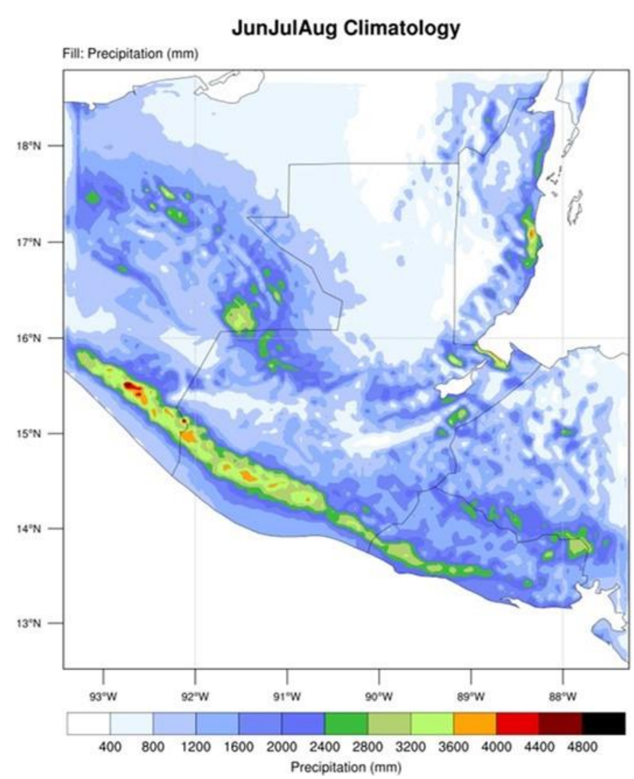
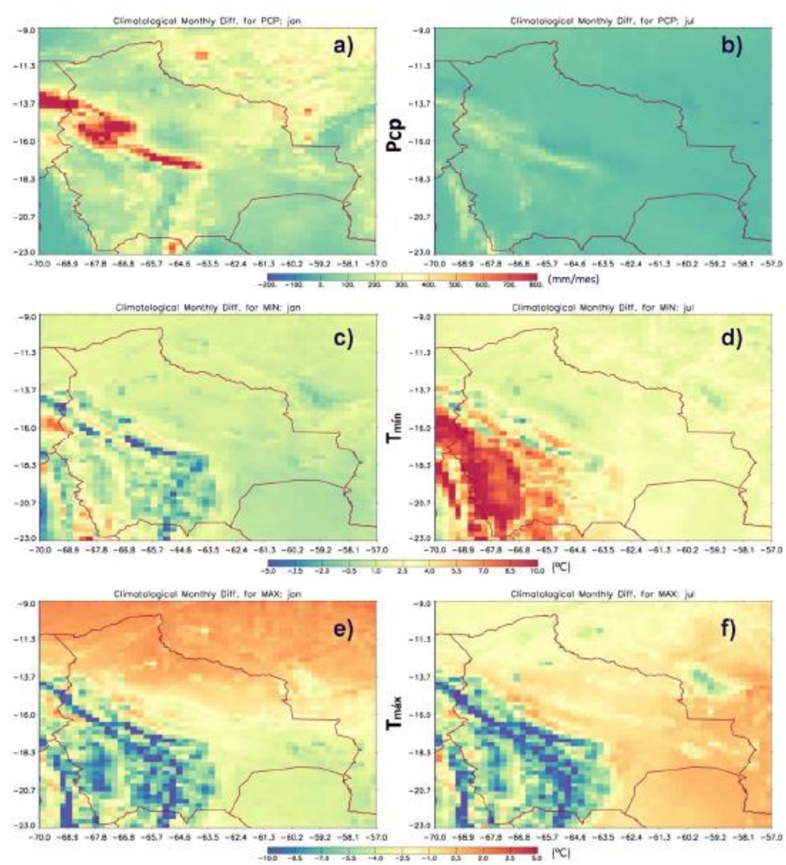
Strengthening Institutional Capacity to Improve the Assessment of Impacts of Climate Change in Latin America and the Caribbean

Contract # INE/CCS-RG-T2612-SN1







Technical Report #4

Proceedings of the Fourth Workshop

prepared by

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University of Nebraska-Lincoln
Lincoln, Nebraska, USA
July 2017

Contents

Appendices

Workshop 4: Continuing Regional Climate Change Activities Step 4 (10-13 July 2017)

Overview

The fourth Consortium workshop was held at the facilities of CATHALAC on the campus of the City of Knowledge in Panama City, Panama from 10-13 July 2017 (see Appendix A for agenda). Representatives from 9 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).

As with the previous Workshops, this fourth one was also four days in length, and focused primarily on the Working Groups. Each group met to discuss progress and update regional and topical needs, and presented these results regularly through the week to the entire group. Continuing *Climate Portal* updates and enhancements were demonstrated and discussed, and the participants were able to try them out under our guidance, and suggest still further improvements. 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 Fourth Workshop continued to emphasize 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.

1) Meetings of each Working Group to discuss progress and update regional needs. This has been a key focus of each Workshop, including this fourth one.

2) Individual participant discussion of specific country progress and continued needs. This was a key outcome of the Workshop, as always 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 *Climate Portal* improvements and enhancements

5) Group assessment of progress, and the next steps to take (including scheduling the fifth Workshop).

A continuing strength of this fourth 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

Deliberations by each Group continued much of the day Monday, Tuesday, and Wednesday as well as Thursday morning. As for previous workshops, 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 Tuesday and Wednesday, Jayaka Campbell and Marcos Andrade gave presentations summarizing other programs with which they are involved that parallel some aspects of the Consortium.

On Wednesday afternoon and Thursday morning, each Working Group presented a report that described progress made during the workshop. In addition, each Group discussed their plans until the final workshop, scheduled for this coming November. The presentation slides and other material presented are collected in Appendix C.

We continue to be extremely pleased with the continuing progress each Working Group was able to make both before and during this fourth Workshop. Each Group has a coherent plan for moving forwarded and appear to have the knowledge, capabilities, and resources necessary to carry out their plans.

Climate Portal Developments

On the first day of the Workshop, Clint gave an update on progress implementing a more comprehensive suite of climate downscaling tools we are now calling the "*Climate Portal*", as it represents the doorway for analysis and visualization of dynamically downscaled climate simulation results. Currently, it consists of four separate and distinct components:

1. *MapMaker*: the original application created for this project, with enhanced functionality, additional parameters, and increased user options;
2. *Verification*: an improved interface to compare historical, dynamical downscaling results with observations of daily weather across the various project domains;
3. *Time Series*: a new application to compute and visualize daily climatologies from station observations, historical downscaling results, as well as present-day and mid-century climate change downscaling results; and
4. *Data Download*: an improved interface to select, subset (temporally, geographically, and by climate parameter) and download data from any of the project downscaling simulations for use in external applications.

Details on each of these applications and the *Climate Portal*, in general, are included in Appendix D.

A fifth application is under development and will be made available before the next Workshop. This application will provide for the computation and display of various standard climate indices that can be used to evaluate and interpret the results of our dynamically downscaled simulations, both historical and climate change runs. These indices will include (using "month" as the reporting interval; seasonal, half-year and annual indices will also be available):

- **To be implemented forthwith**:
    - TXx = monthly maximum of daily maximum temperature
    - TNx = monthly maximum of daily minimum temperature
    - TXn = monthly minimum of daily maximum temperature
    - TNn = monthly minimum of daily minimum temperature
    - DTR = monthly average diurnal temperature range
    - SU = summer days (number of days in month w/ maximum temperature > 25C)
    - TR = tropical nights (number of days in month w/ minimum temperature > 20C)
    - FD = frost days (number of days in month w/ minimum temperature < 0C)
    - ID = icing days (number of days in month w/ maximum temperature < 0C)
    - Rx1day = (maximum 1-day precipitation in month)
    - PRCTOT = (total precipitation in month)
    - R10mm = (number of days in month w/ precipitation >= 10mm)
    - R20mm = (number of days in month w/ precipitation >= 20mm)

    - R*NN*mm = (number of days in month w/ precipitation >= *NN*mm, with *NN* selected by user, 1 <= *NN* <= 99))
- **To be implemented as soon as possible**:
    - GSL = growing season length (days; annual index only)
    - Rx5day = (maximum 5-day precipitation in month)
    - SDII = simple daily intensity index (average precipitation on wet days [precipitation >= 1mm])
    - CDD = maximum number of consecutive dry days in month (precipitation < 1mm)
    - CWD = maximum number of consecutive wet days in month (precipitation >= 1mm)
- **Planned to be implemented at a later date** (requires developing robust measures of percentiles from limited data):
    - percentile-based indices (e.g., TX90p, TN90p, R95p – daily maximum and minimum temperature exceeding 90th percentile and daily precipitation exceeding 95th percentile, respectively; and many others)

Group Assessment of Progress

A continuing strength of this fourth Workshop, as with all previous ones, 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 during the time in-between them.

The conflicting needs of the Participants were 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.

Workshop Summary

In summary, the Workshop was a successful continuation to the Regional Consortium. The Participants continued to make considerable progress in the three Working Groups. Each group spent considerable time meeting separately, with the discussions in each case focused on understanding the model downscaled results. The focus was further organized into two themes: 1) The likely impacts for the people and infrastructure involved; and 2) Preparation of a paper reporting on these findings to be submitted to an appropriate scientific journal.

In addition to these separate Working Group meetings, there were also numerous ‘plenary’ sessions were held with all three groups (i.e., all Participants) meeting together. This led to considerable cross-communication between Working Groups, the need for which had been stressed during our monthly Skype sessions. It is anticipated that at least one joint scientific paper, as well as several crosscutting reports will be a key result.

The Next Steps

The monthly Skype sessions will resume on the first Wednesday of each month. These will continue to be joint, so as to help ensure communication within and between Working Groups, and among individual participants.

The next workshop is scheduled for November 2017.

Climate Portal is now on **http://rccdp.unl.edu/portal** and this will continue to be developed and enhanced. It is expected that, before the next workshop, the *Time Series* and *Climate Indices* applications will be more complete and usable by the participants.

DATA

- To include more station data in *Climate Portal*, as provided by the Participants.
- To include more stations from INSIVUMEH (INETER and other NMHSs), as an example.
- To perform quality control and homogenization process to stations data. This is crucial, but may require a technical person devoted to the effort.

COORDINATION

- Skype meetings with all groups
- Discuss a preliminary agenda with the Group prior to the next Workshop.

Appendix A: Workshop Agenda

- AGENDA –

Workshop 4

Continuing Regional Climate Change Consortium Activities: Step 4

(10-13 July 2017)

Day 1:		
Morning		
9:00 am	Registration Introduction and Scope of Workshop	
9:30 am	Status reports from each Working Group	(plenary)
10:30 am	***Break***	
10:45 am	Climate Portal introduction and update	(plenary)
11:15 am	Group discussion: Climate Portal 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	Summary of progress to date	(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	Working Groups meet	(breakout)
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:	Cuarto 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:	10 al 13 julio 2017		
	Lugar:	Ciudad de Panamá, Panamá		
	Nombre	**Cargo**	**Organización**	**email**
1	**Alberto López López**	**Investigador**	**Instituto de Investigaciones Eléctricas, México**	**alopezl@ineel.mx**
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	**Jose Franklyn Ruiz Murcia**	**Subdirección de Meteorología**	**Instituto de Hidrología, Meteorología y Estudios Ambientales (IDEAM), Colombia**	**jruiz@ideam.gov.co**
7	**Alan Gerardo LLacza Rodríguez**	**Dirección de Meteorología Aplicada**	**Servicio Nacional de Meteorología e Hidrología (SENAMHI), Perú**	**allacza@senamhi.gob.pe**

	Nombre	Cargo	Organización	email
8	Jayaka Campbell	Research Fellow, Climate Studies Group	University of the West Indies, Jamaica	jayaka.campbell02@uwimona.edu.jm
9	Luis Fernando Alvarado Gamboa	Climatología	Instituto Meteorológico Nacional, Costa Rica	luis@imn.ac.cr
10	Robert Oglesby	Professor	University of Nebraska-Lincoln	roglesby2@unl.edu
11	Clinton Rowe	Professor	University of Nebraska-Lincoln	crowe1@unl.edu

Appendix C: Working Group Reports

Working Group 1: Tropical Systems

Jayaka Campbell, Alberto López, Francisco Argeñal

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.

In addition to the presentation included here, Working Group 1 gave am extensive update on their progress in writing the first manuscript on their results and plans for one or two additional manuscripts.

Climate Modelling Data Availability

THE CARIBBEAN REGIONAL TRACK OF THE PILOT PROGRAMME FOR CLIMATE RESILIENCE (PPCR)

JD Campbell

July 12, 2017

Objectives of the PPCR Regional Track

1. To improve regional processes to acquire, store, analyse, access and disseminate climate relevant information

2. To pilot and scale up innovative climate resilient initiatives in the region

Objective 1

Objective: To improve availability of downscaled future climate projections to support adaptation planning, decision making, sectoral modelling & projections.

- **Improve technological capacity to analyse existing regional climate modelling outputs & generate & assess new outputs**
- **Establish framework linking regional & sectoral climate models for adaptation planning in 4 sectors**
- **Develop a Regional Coastal Zone Integrated Info. Management System**

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MONA CAMPUS

IDB
Inter-American Development Bank

Regional Climate Models

RegCM4.6 and RegCM4.3

- Hydrostatic and Non-Hydrostatic Core
- Convective Schemes
  - Using Emmanuel Convective Schemes
  - Using Mixed Convective Schemes
- Fully Compliant LAC Cordex Domain
- Output
  - 3 hour intervals
  - Daily Statistics
  - RCPS

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IDB
Inter-American Development Bank

Regional Climate Models

PRECIS 2.0 , 1.8 and 1.5

- Blackbox model
- Smaller LAC Domain

- Output
  - Daily, monthly, yearly time step
  - Over 360 ATM and Surface Variables
  - SRES and RCP

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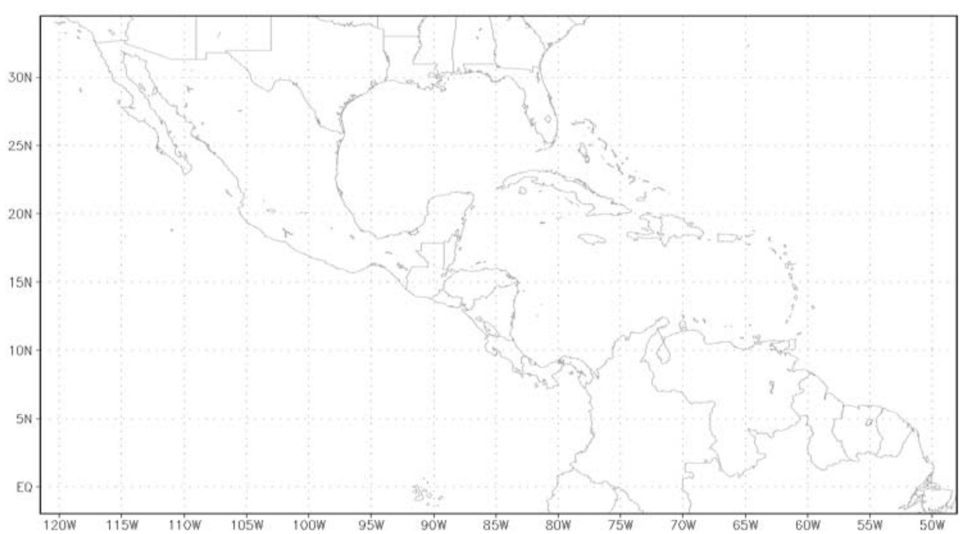
Inter-American Development Bank

Data Availability

PRECIS 1.8 and 1.5

- SRES A2, B2 and A1B



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Data Availability

PRECIS 1.5 and 1.8

- SRES A2, B2 and A1B

PRECIS-1.5	ECHAM4 SRES A2	1960-2100	50km
PRECIS-1.5	ECHAM4 SRES B2	1960-2100	50km
PRECIS-1.5	HadAM3P SRES A2	1960-1990	50km
PRECIS-1.5	HadAM3P SRES B2	1960-1990	50km
PRECIS-1.5	HadAM3P SRES A2	2070-2100	50km
PRECIS-1.5	HadAM3P SRES B2	2070-2100	50km
PRECIS-1.8	HadCM3 Q0 SRES A1B	1960-2100	25km
PRECIS-1.8	HadCM3 Q3 SRES A1B	1960-2100	25km
PRECIS-1.8	HadCM3 Q4 SRES A1B	1960-2100	25km
PRECIS-1.8	HadCM3 Q10 SRES A1B	1960-2100	25km
PRECIS-1.8	HadCM3 Q11 SRES A1B	1960-2100	25km
PRECIS-1.8	HadCM3 Q14 SRES A1B	1960-2100	25km
PRECIS-1.8	ECHAM5 Q14 SRES A1B	1960-2100	25km

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Data Availability

PRECIS 2.0

- RCP 2.6, 4.5 and 8.5
  - Some experiments completed
  - Analysis and experiments ongoing
  - Will be available for sharing soon

PRECIS-2.0	HADGEM-ES RCP2.6	1960-2100	25km
PRECIS-2.0	HADGEM-ES RCP4.5	1960-2100	25km
PRECIS-2.0	HADGEM-ES RCP8.5	1960-1990	25km

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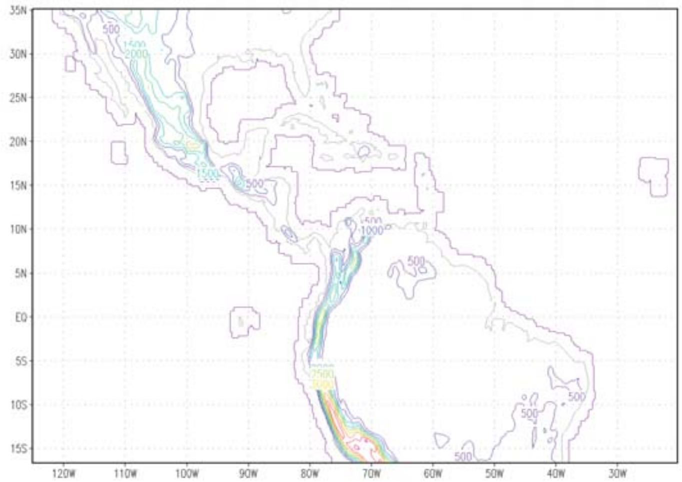
Data Availability

RegCM 4.3 and 4.6

- RCP 2.6, 4.5 and 8.5,



Data Availability

RegCM 4.3 and 4.6

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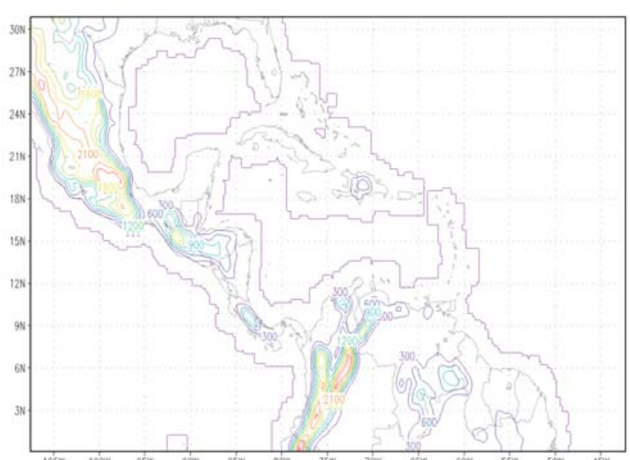


Data Availability

RegCM 4.3 and 4.6

- RCP 2.6, 4.5 and 8.5,

RegCM4	Had-GEM2-ES-Historical	1960-2005	50 km, 20 km
RegCM4	Had-GEM2-ES-RCP4.5	2020-2100	50 km, 20 km
RegCM4	CNRM-CM5-Historical	1960-2005	50 km, 20 km
RegCM4	CNRM-CM5-RCP4.5	2020-2100	50 km, 20 km
RegCM4	CNRM-CM5-Historical	1960-2005	50 km
RegCM4	CNRM-CM5-RCP8.5	2020-2100	50 km
RegCM4	MPI-ESM-MR-Historical	1960-2005	50 km

Ongoing and Upcoming Experiments

RegCM 4.6

GCM	RCP2.6	RCP4.5	RCP8.5	Historical	Reanalysis
EC-EARTH		X	X	X	
CNRM-CM5		X	X	X	
HADGEM2	X	X	X	X	
MPI-ESM-MR	X	X	X	X	
GFDL-ESM2M	X	X	X	X	
IPSL-CM5A-LR		X	X	X	
CanESM2		X	X	X	
CSIRO-MK36		X	X	X	
EIN75					X
EIN15					X
NNRP1					X
NNRP2					X
ERA40					X

Data Requests

jayaka.campbell02-at-uwimona.edu.jm

https://www.planwallpaper.com/static/images/thankyou3.png

Working Group 2: ENSO

Juan José Nieto, Gabriela Alfaro, Franklyn Ruiz, Luis Fernando Alvarado

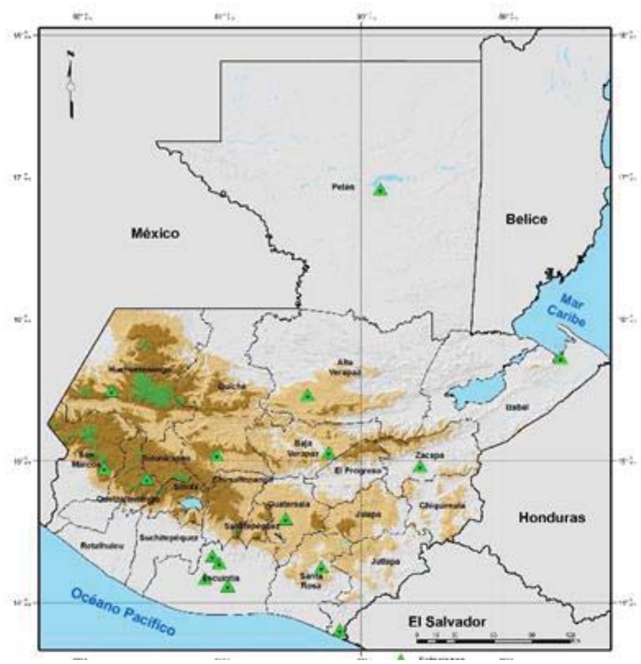
This Working Group focuses on El Nino and La Nina events, which can have major impacts on Central America and the Pacific coast of northern South America (Peru, Ecuador, and Colombia. Because of the availability of WRF simulations of sufficient length, at least initially the group is concentrating on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

Análisis de los posibles efectos del Cambio Climático en Guatemala, utilizando el modelo CCSM4-WRF.

Alfaro G., Alvarado L., Barrera D., Nieto JJ. y Ruiz, F. 2017.

13 de julio 2017

Ubicación de Estaciones Analizadas



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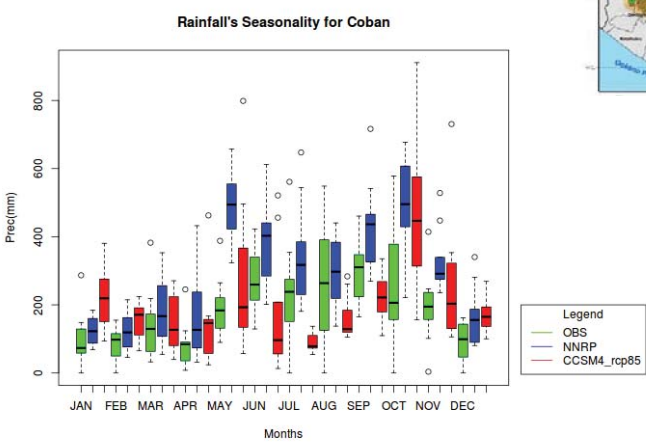

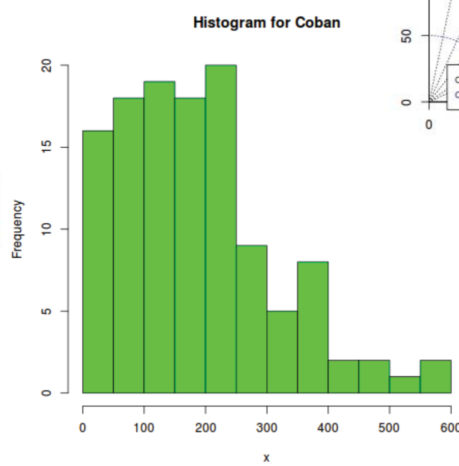

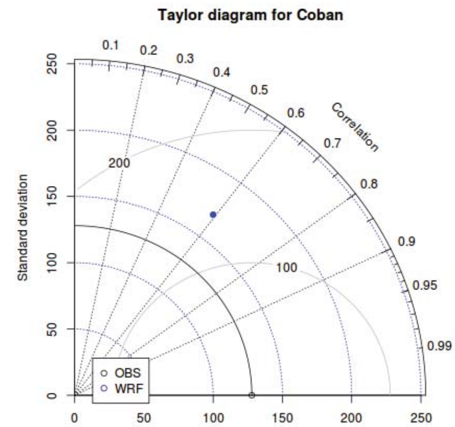

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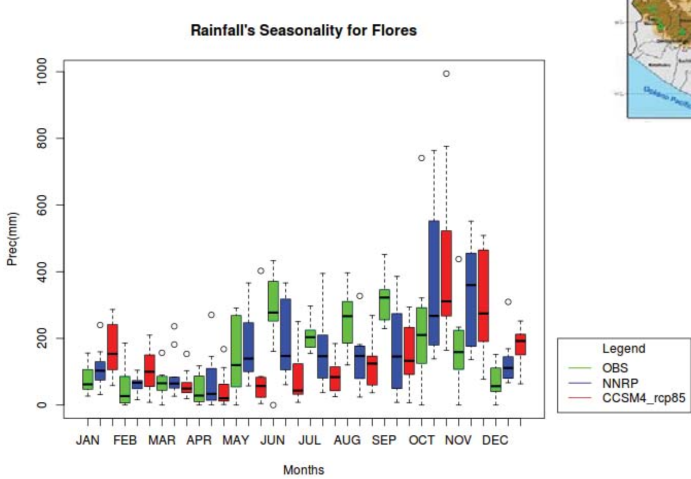
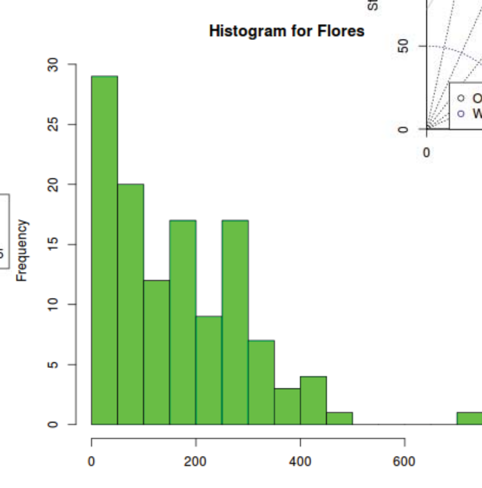
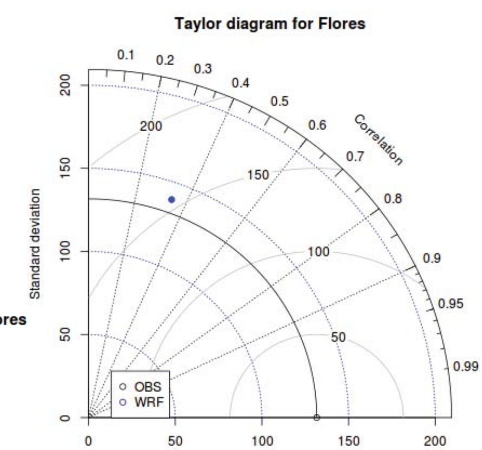
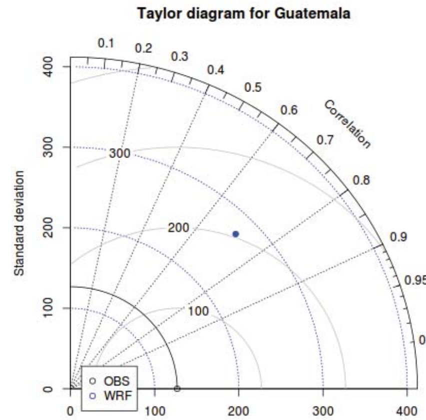
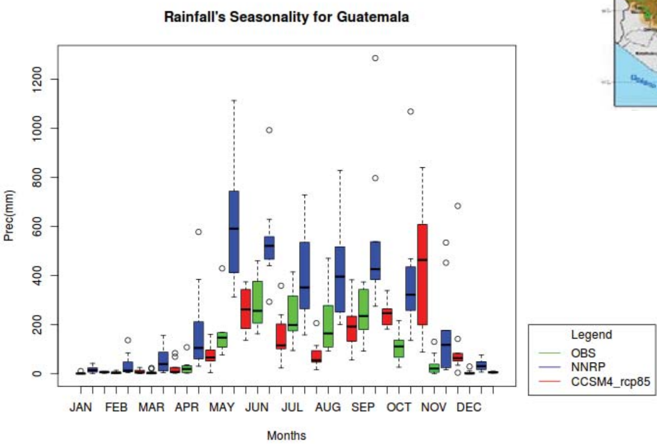


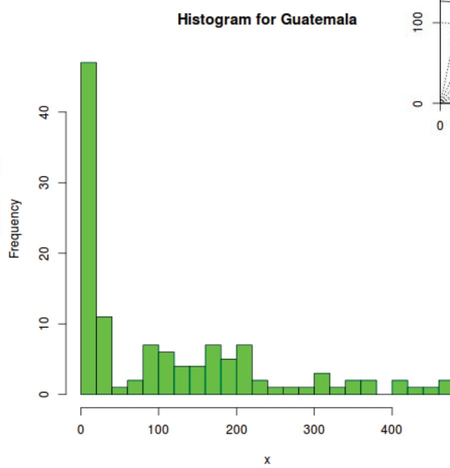




Guatemala Are







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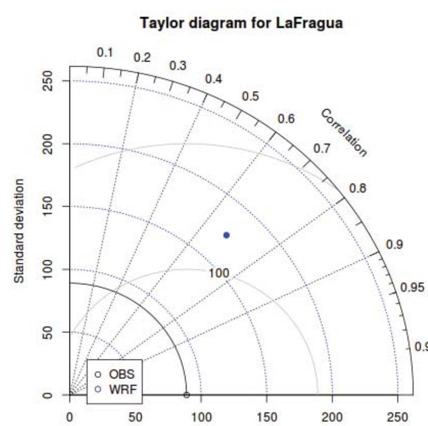

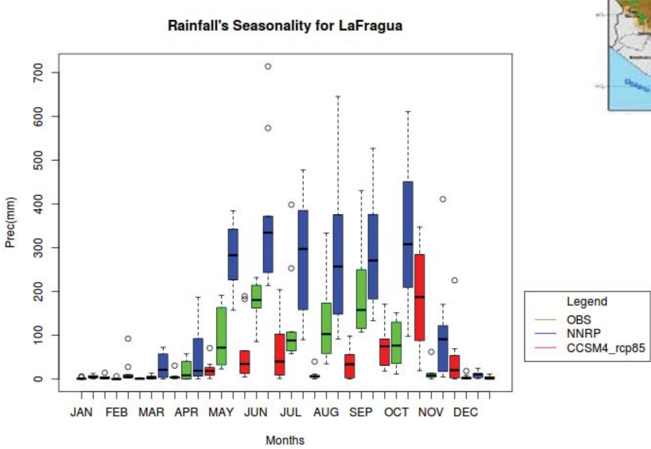

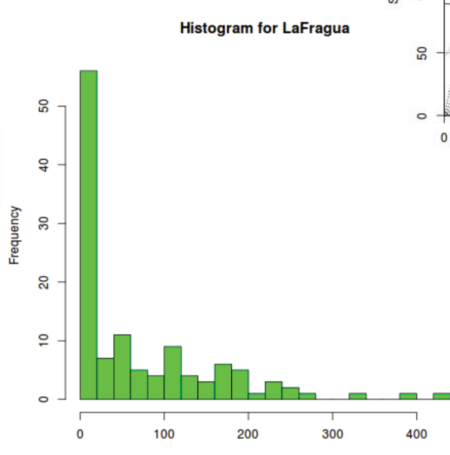

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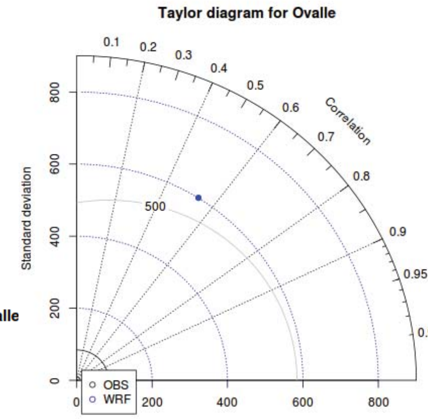

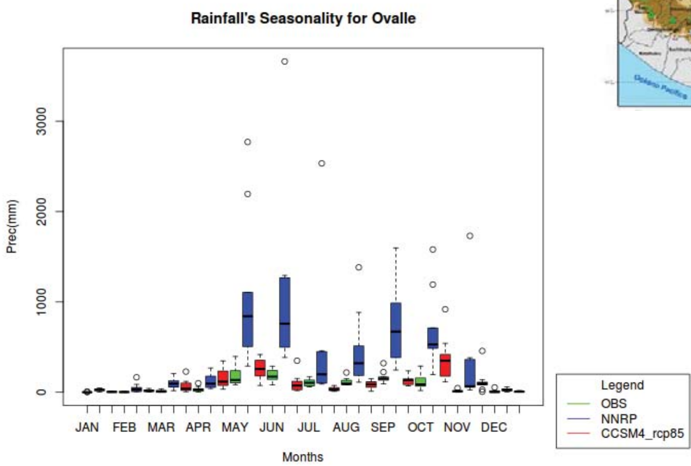

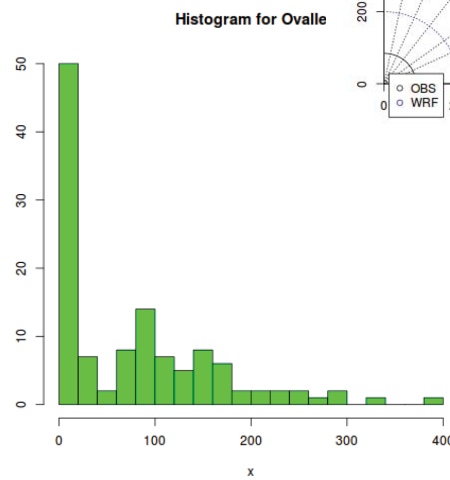

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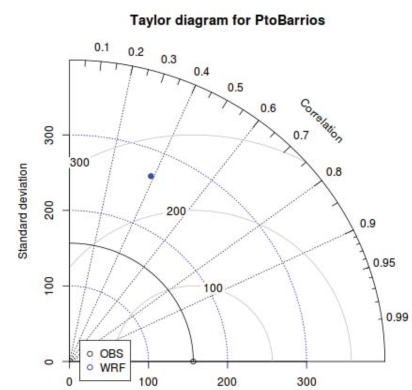

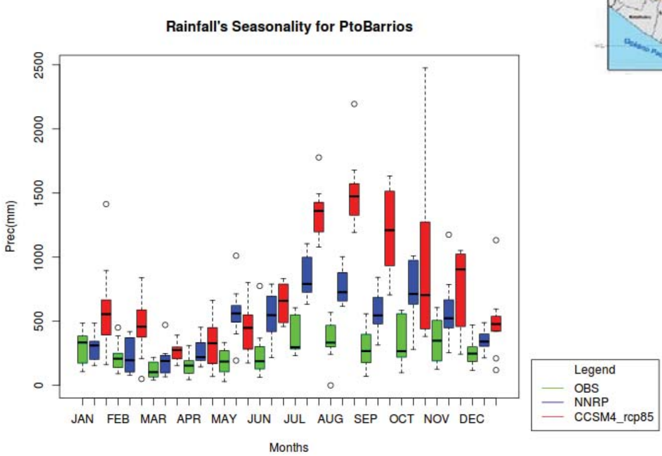

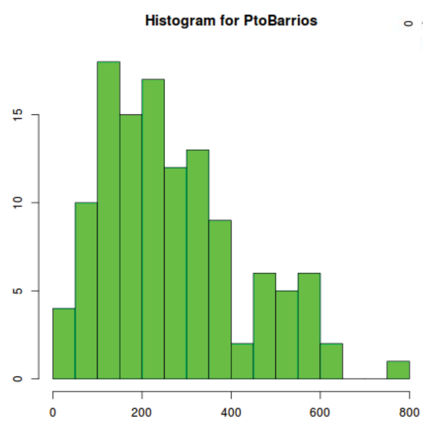

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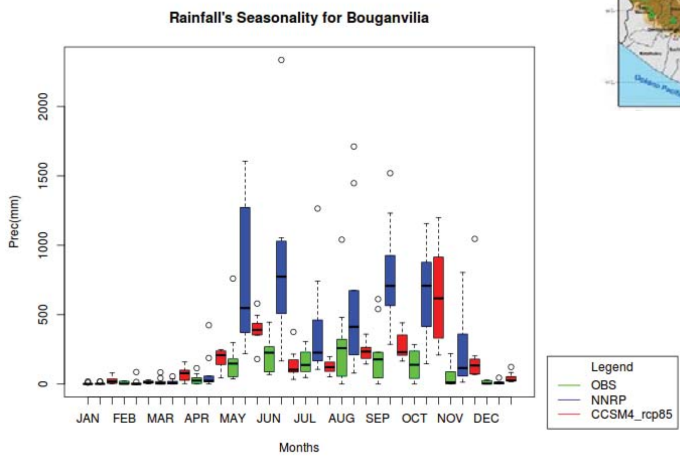

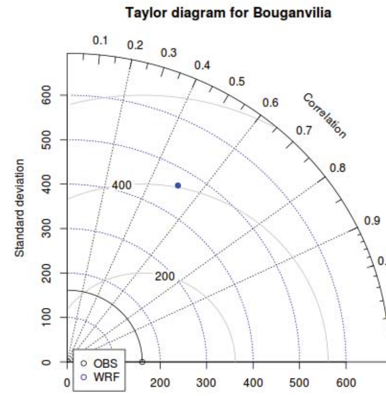

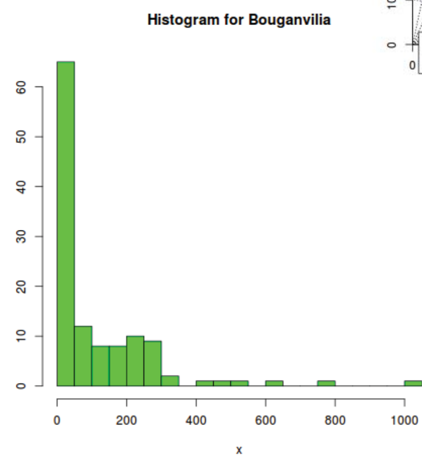

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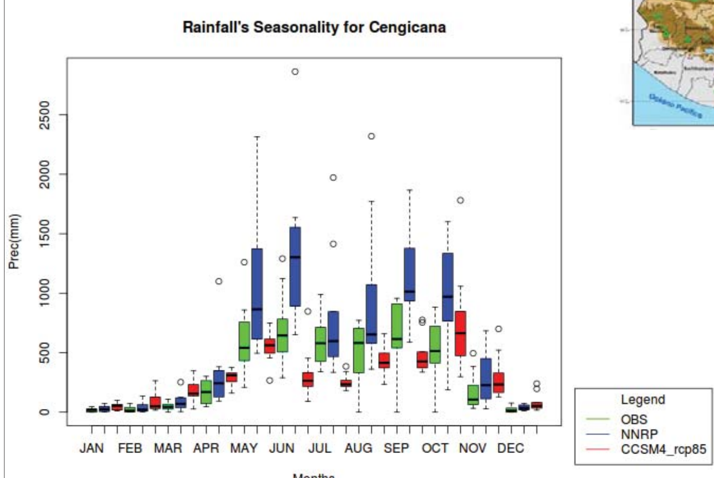

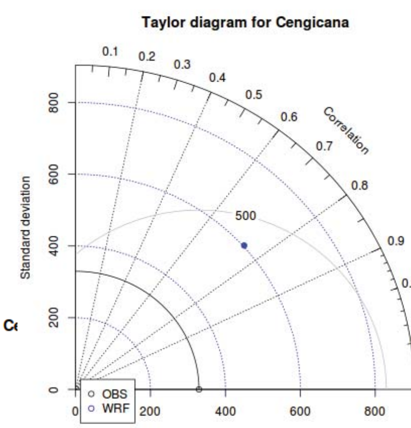

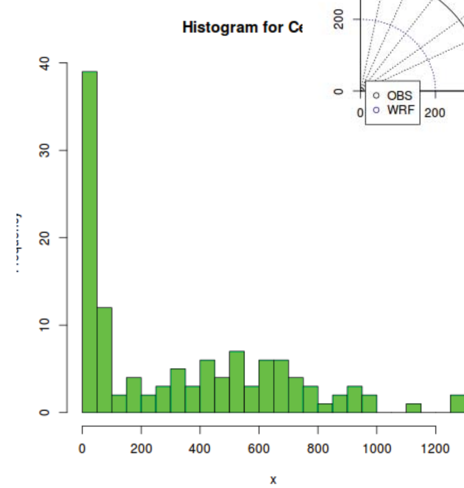

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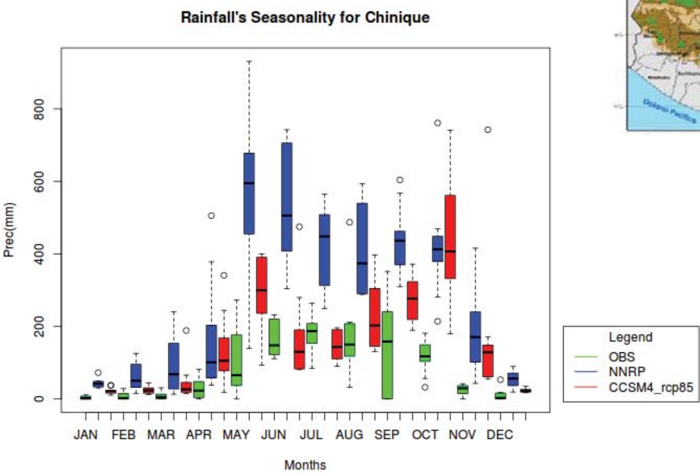

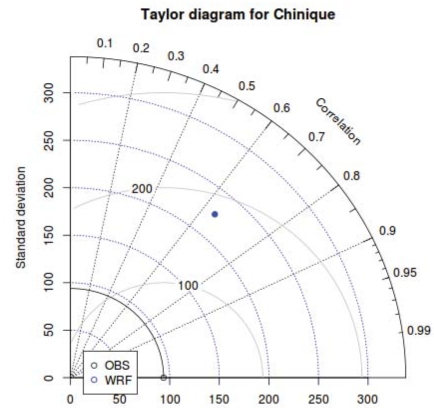

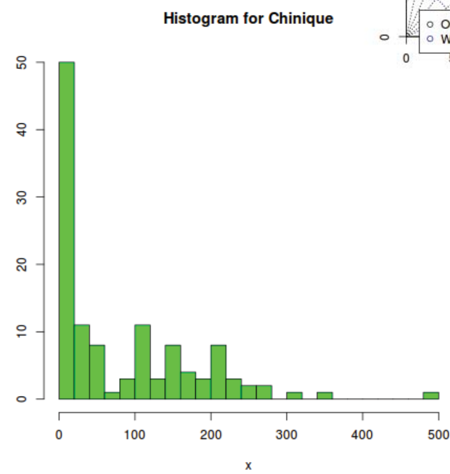

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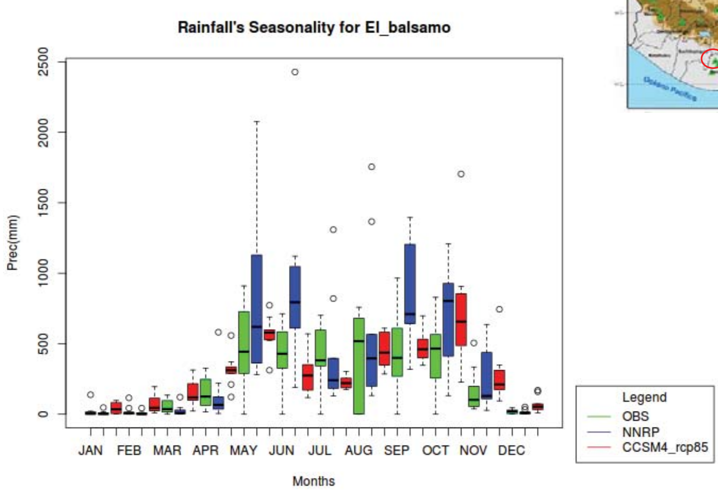

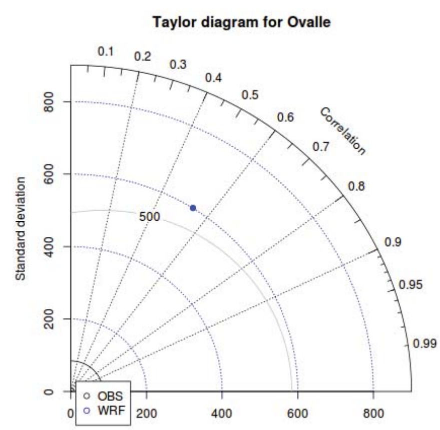

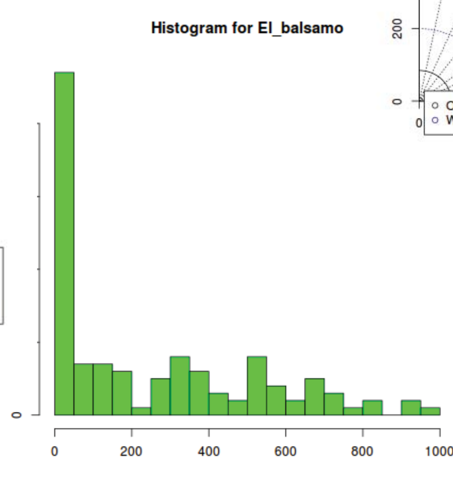

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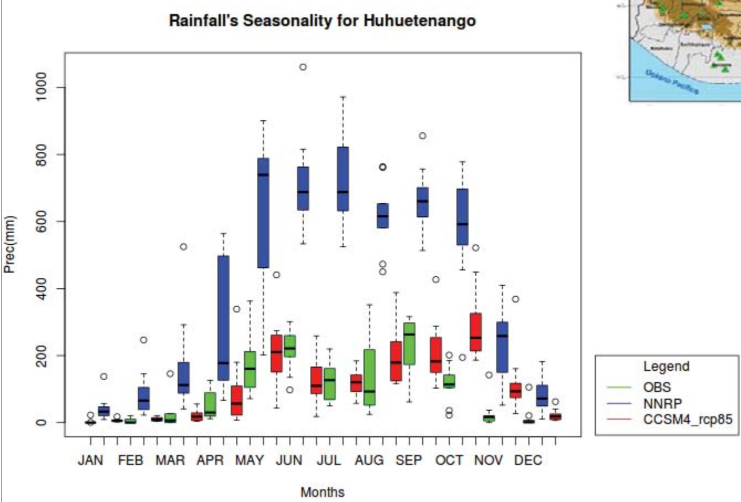

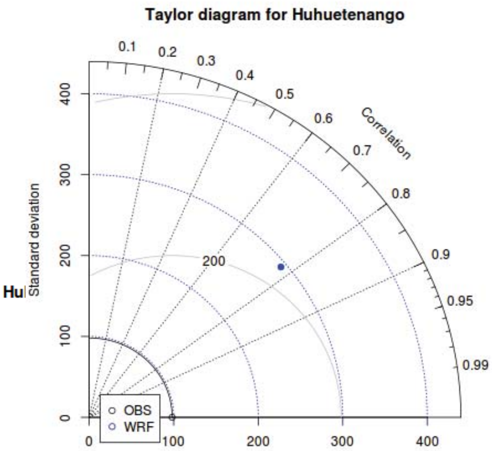

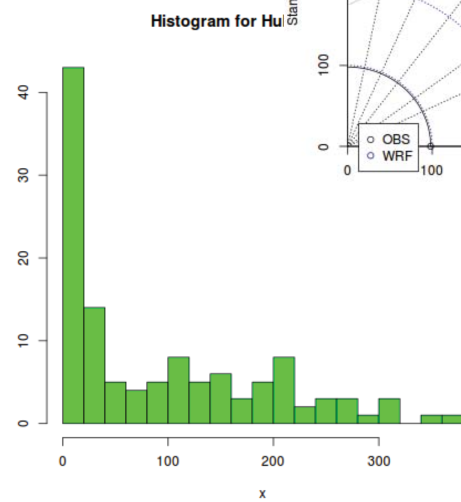

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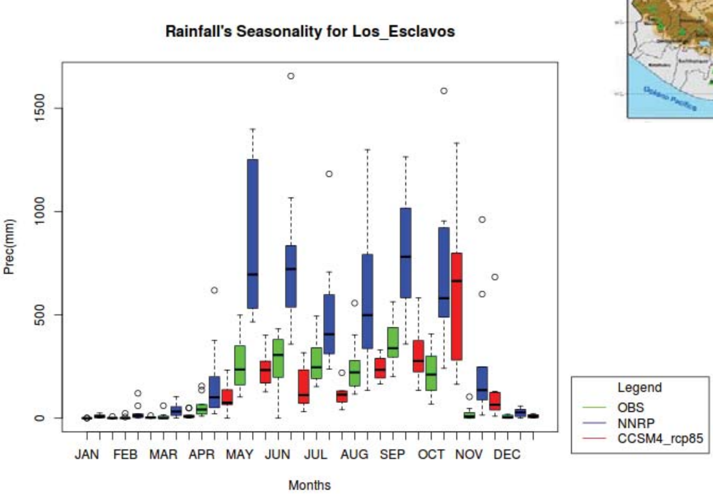

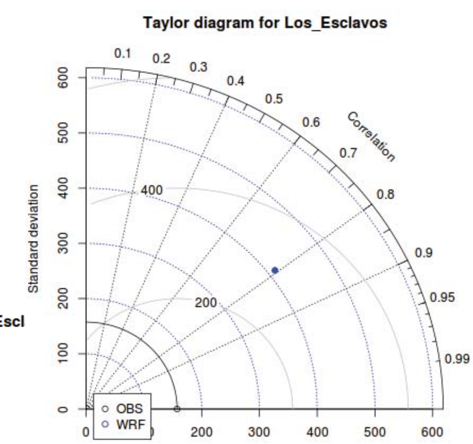

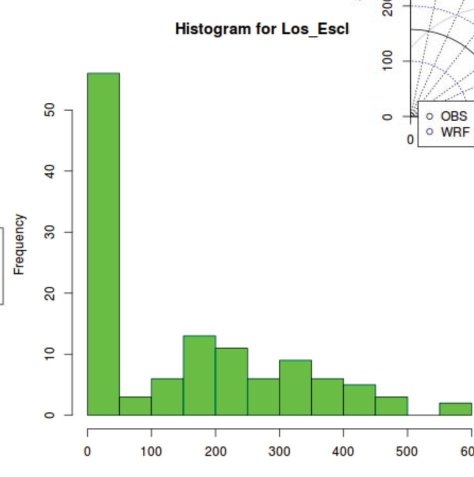

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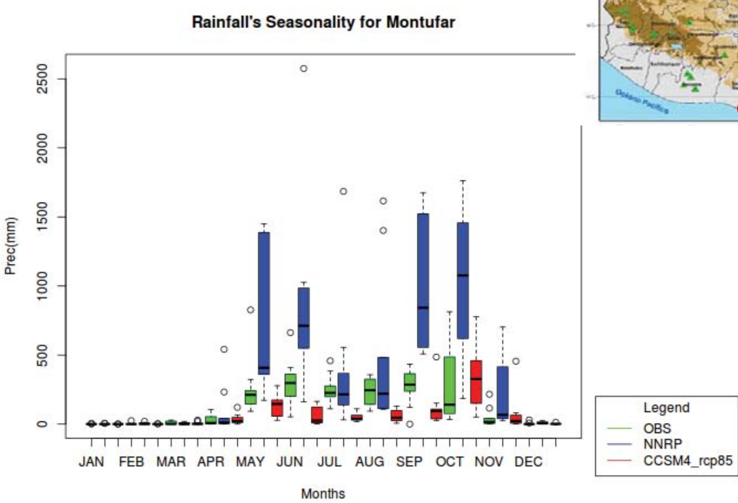

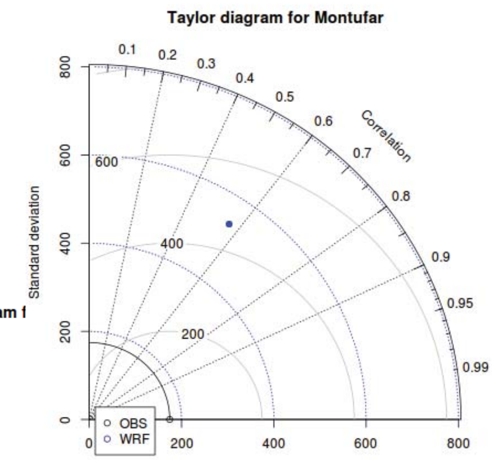

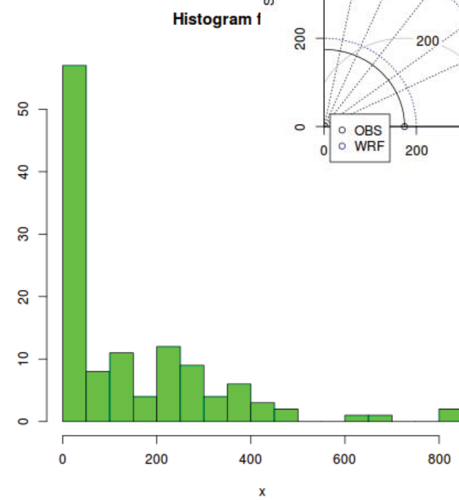

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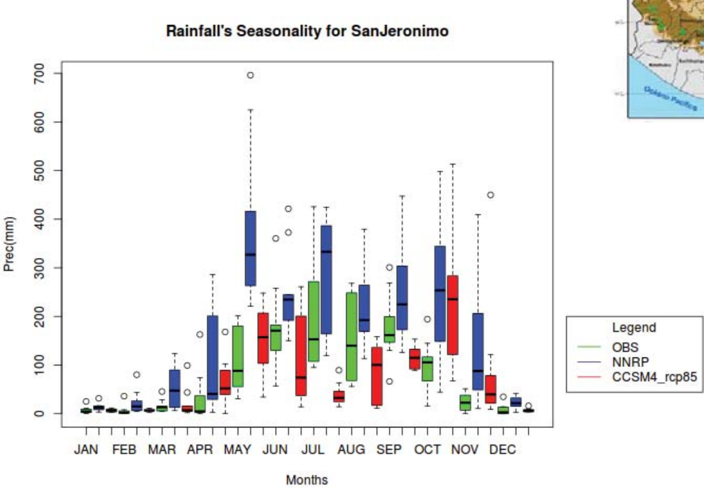

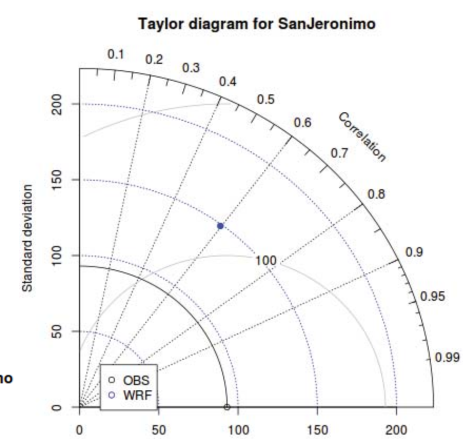

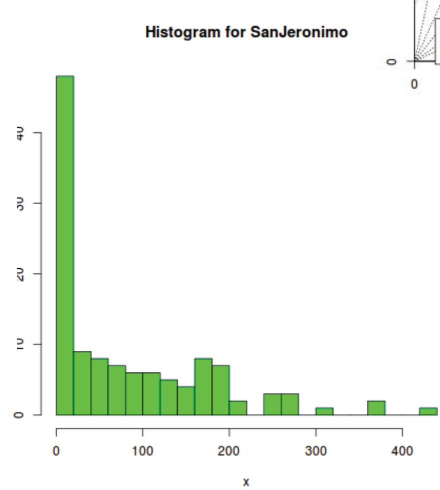

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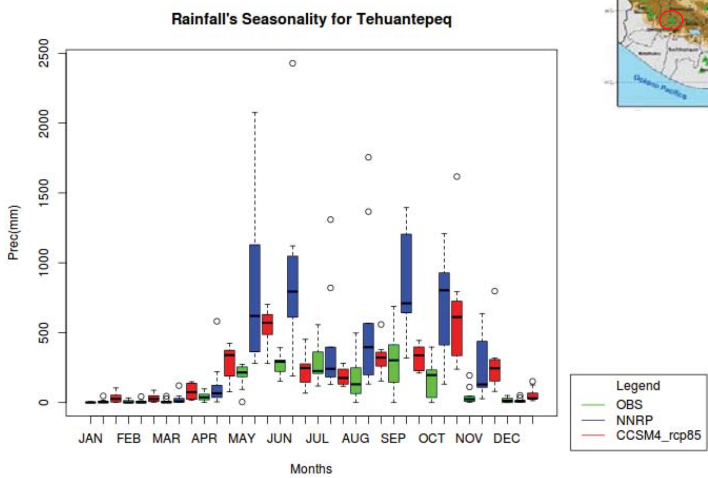
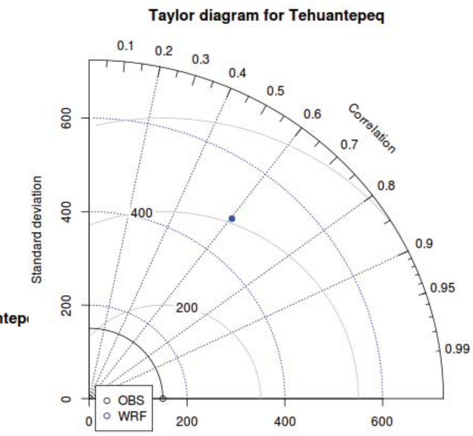
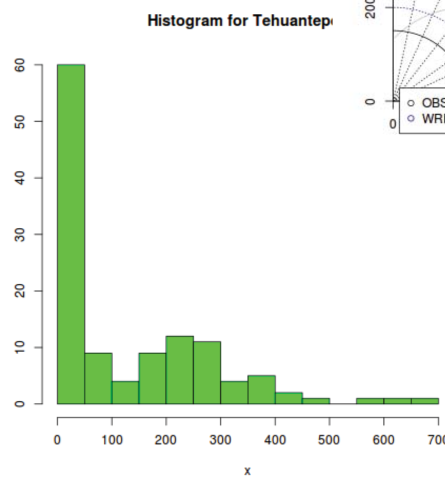
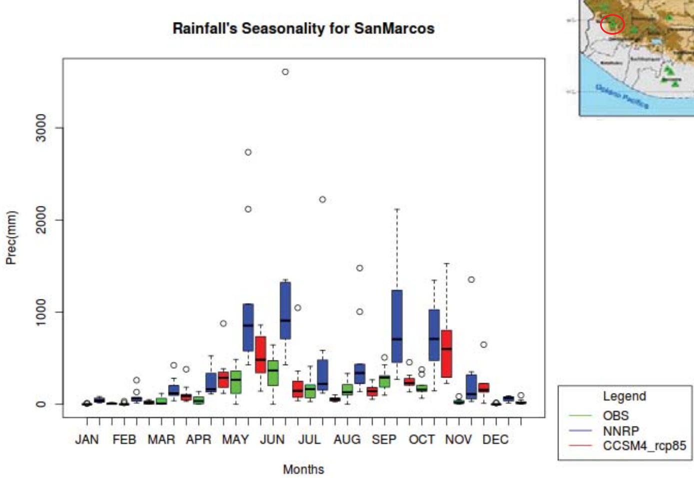
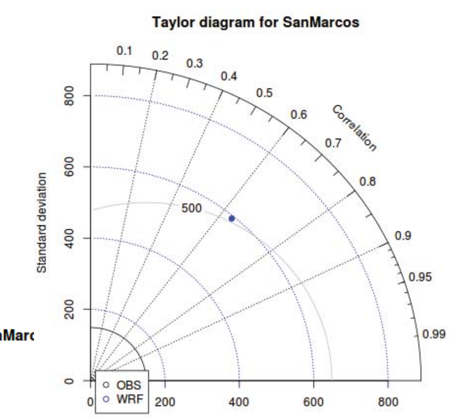


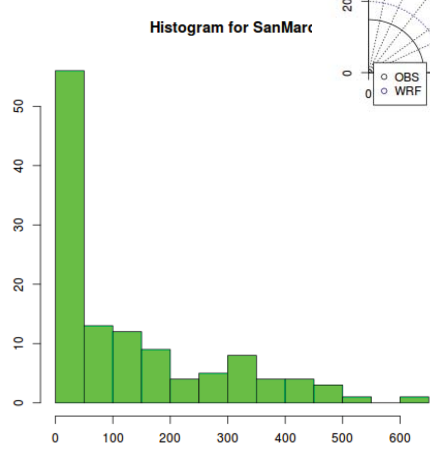




San Marcos







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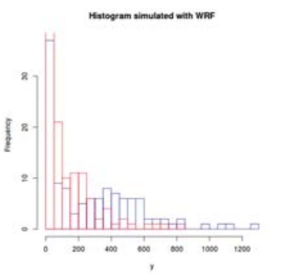
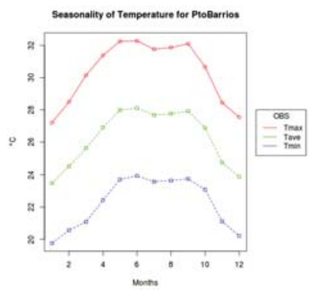




3.2.1. The Delta change method

By assuming that the relative changes obtained from the GCMs are more representative than the absolute ones, the simple Delta method maintains the temporal structure of the projected series, hence does not consider changes in variability. The future daily rainfall ($P_{Fut,d}$) is obtained by multiplying the observed daily series ($P_{Obs,d}$) by the ratio of the mean monthly rainfall value for the GCM scenario series ($P_{Sce,m}$) to the control series ($P_{Con,m}$).

$$P_{Fut,d}[mm/day] = P_{Obs,d} \times \frac{P_{Sce,m}}{P_{Con,m}} \quad (3)$$

The advantages of the Delta method are:

- it is simple to apply
- it preserves the observed pattern of temporal and spatial variability

The disadvantages of the Delta method include the following:

- it only accounts for the changes in mean; this is done while ignoring other possible changes in the distribution of the variables
- changes in the length of dry or wet spells are not taken into consideration
- it is not suitable for extreme events
- it requires data to be normally distributed

EVENTOS NIÑO y NIÑA

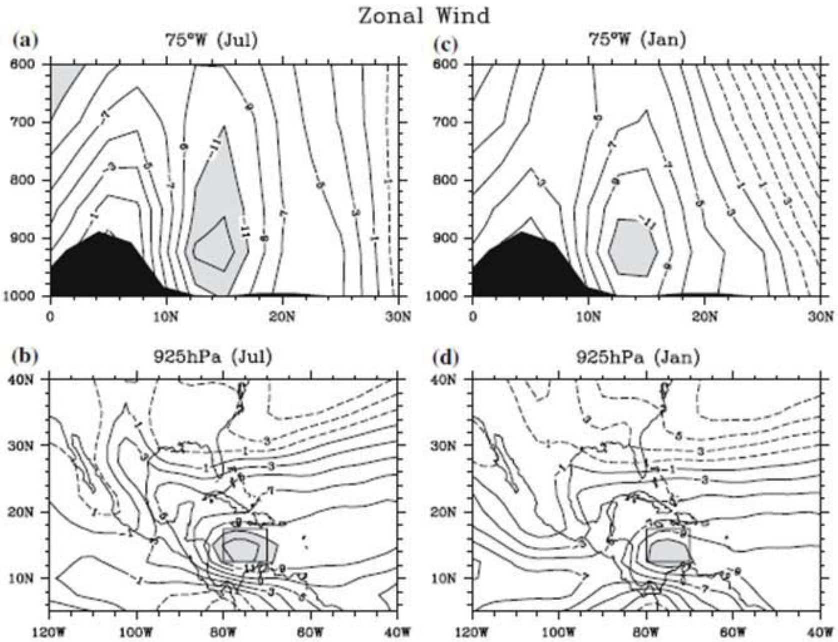
Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.6	-1.4	-1.1	-0.9	-0.7	-0.7	-0.6	-0.5	-0.6	-0.7	-0.8	-0.8
2001	-0.7	-0.5	-0.4	-0.3	-0.2	-0.1	-0.1	-0.1	-0.2	-0.3	-0.4	-0.3
2002	-0.2	0.0	0.1	0.2	0.4	0.6	0.8	0.8	0.9	1.1	1.2	1.1
2003	0.9	0.7	0.4	0	-0.2	-0.1	0.1	0.2	0.2	0.3	0.3	0.3
2004	0.3	0.3	0.2	0.1	0.2	0.3	0.5	0.6	0.7	0.7	0.6	0.7
2005	0.7	0.6	0.5	0.5	0.3	0.2	0	-0.1	0	-0.2	-0.5	-0.7
2006	-0.7	-0.6	-0.4	-0.2	0.0	0.0	0.1	0.3	0.5	0.7	0.9	0.9
2007	0.7	0.4	0.1	-0.1	-0.2	-0.3	-0.4	-0.6	-0.9	-1.1	-1.3	-1.3
2008	-1.4	-1.3	-1.1	-0.9	-0.7	-0.5	-0.4	-0.3	-0.3	-0.4	-0.6	-0.7
2009	-0.7	-0.6	-0.4	-0.1	0.2	0.4	0.5	0.5	0.6	0.9	1.1	1.3
Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2010	1.3	1.2	0.9	0.5	0.0	-0.4	-0.9	-1.2	-1.4	-1.5	-1.4	-1.4
2011	-1.3	-1.0	-0.7	-0.5	-0.4	-0.3	-0.3	-0.6	-0.8	-0.9	-1.0	-0.9
2012	-0.7	-0.5	-0.4	-0.4	-0.3	-0.1	0.1	0.3	0.3	0.3	0.1	-0.2
2013	-0.4	-0.4	-0.3	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.3	-0.3	-0.3
2014	-0.5	-0.5	-0.4	-0.2	-0.1	0.0	-0.1	0.0	0.1	0.4	0.5	0.6
2015	0.6	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.7	2.0	2.2	2.3
2016	2.2	2.0	1.6	1.1	0.6	0.1	-0.3	-0.6	-0.8	-0.8	-0.8	-0.7
2017	-0.4	-0.1	0.2	0.4	0.5							

HS1 (1971 - 1980)						
	Niña			Niño		
	I	F	M.I.	I	F	M.I.
1	Jul(1970)	Feb(1972)	-1.3			
2				May(1972)	Mar(1973)	2
3	Jun(1973)	Mar(1976)	-1.9			
4				Set(1976)	Feb(1977)	0.8
5				Set(1977)	Ene(1978)	0.8
6				Oct(1979)	Feb(1980)	0.6

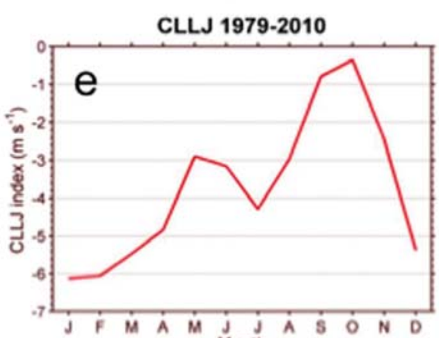
HS2 (2001 - 2010)						
	Niña			Niño		
	I	F	M.I.	I	F	M.I.
1	Ene(2000)	Feb(2001)	-1.6			
2				Jun(2002)	Feb(2003)	1.2
3				Jul(2004)	Abr(2005)	0.7
4				Set(2006)	Ene(2007)	0.9
5	Ago(2007)	Jun(2008)	-1.4			
6				Jul(2009)	Abr(2010)	1.3

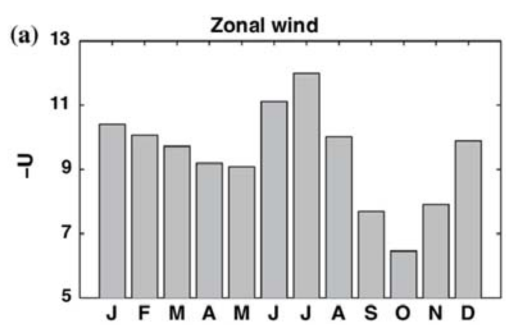
BL (2011-2020)						
	Niña			Niño		
	I	F	M.I.	I	F	M.I.
1	Jul(2010)	Abr(2011)	-1.5			
2	Ago(2011)	Feb(2012)	-1			
3				Nov(2014)	May(2016)	2.3
4	Ago(2016)	Nov(2016)	-0.8			

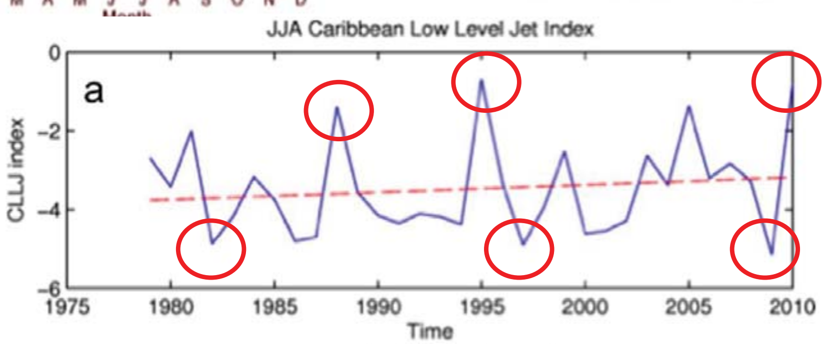
Climatología del Chorro de bajo nivel del Caribe (CLLJ)



Climatología del Chorro de bajo nivel del Caribe (CLLJ)







Climatología del CLLJ e importancia para Guatemala

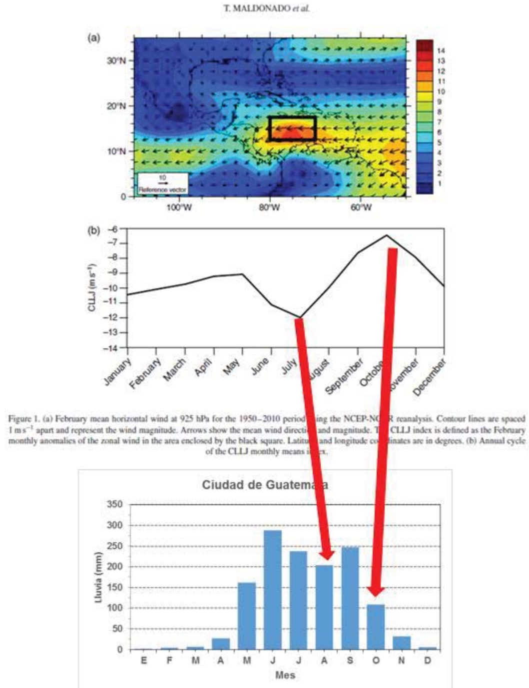
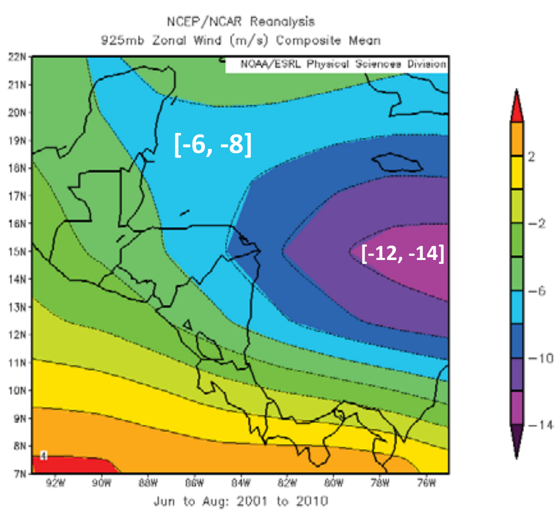


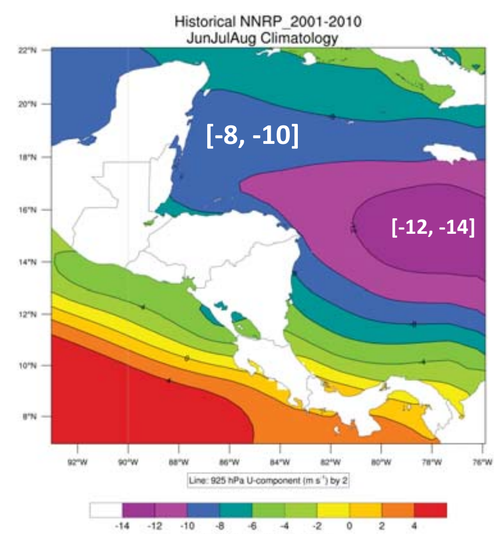
Figura 1. Ciclo anual de la lluvia en Ciudad de Guatemala para el periodo de línea base (2001-2010). Datos del downscaling del modelo WRF con el forzamiento del reanálisis NCEP/NCAR (NNRP)

Resultados WRF: chorro de bajo nivel del Caribe (CLLJ)

Reanálisis NNRP (BL)



WRF-NNRP (BL)



El modelo WRF presenta un sesgo (bias) negativo respecto a u-925 hpa: el viento del este es más alto en el WRF.

Resultados WRF:
chorro de bajo nivel del Caribe
(CLLJ)

Figura 2. Ciclo anual medio del periodo 2001-2010 de la componente zonal (u, m/s) del viento para el nivel de 925 hPa en las coordenadas 15°N, 78°O.

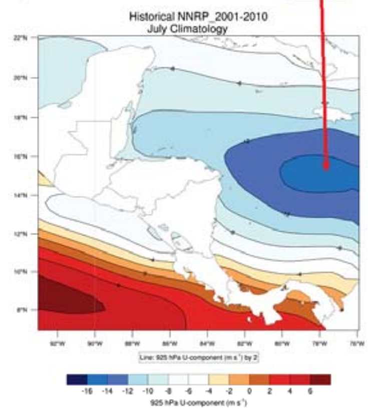


Figura 3. Variación horizontal de la componente zonal media del viento en 925 en julio en el periodo histórico (HS).

Resultados WRF:
chorro de bajo nivel del Caribe
(CLLJ)

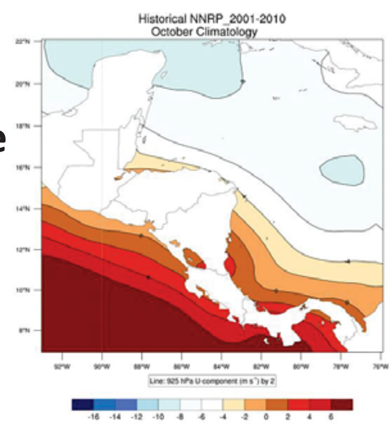


Figura 4. Lo mismo anterior pero para octubre.

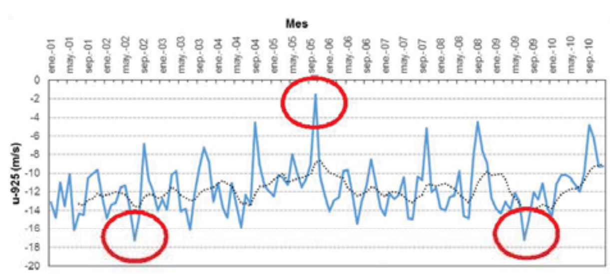


Figura 5. Variación mensual del viento zonal en 925 hPa en el periodo histórico (HS).

Resultados WRF: chorro de bajo nivel del Caribe (CLLJ)

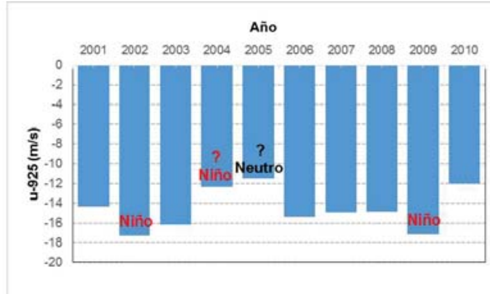


Figura 6. Variación interanual de la componente zonal del viento en julio y en 925 hPa.

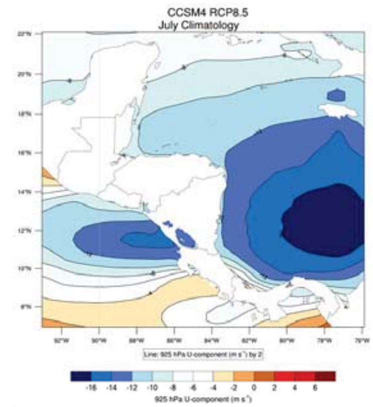


Figura 7. Variación horizontal de la componente zonal media del viento en 925 hPa en el mes de julio del periodo de línea base (BL, 2011-2020).

Resultados WRF: chorro de bajo nivel del Caribe (CLLJ)

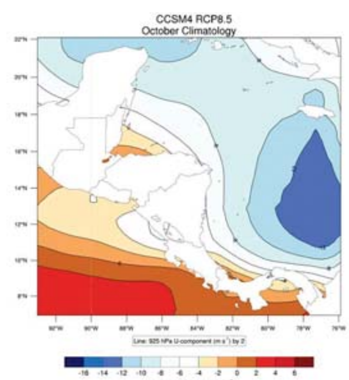


Figura 8. Lo mismo anterior pero para el mes de octubre (BL).

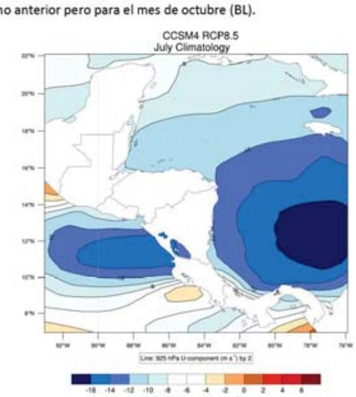


Figura 9. Lo mismo que la figura 6 pero para el periodo de futuro (FT, 2061-2070) según el escenario de emisiones RCP8.5

Resultados WRF: chorro de bajo nivel del Caribe (CLLJ)

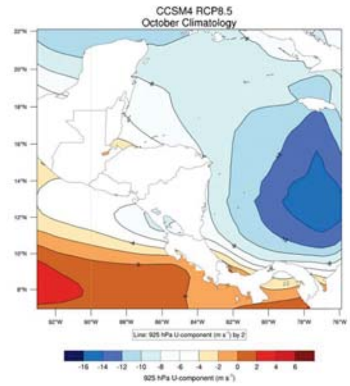
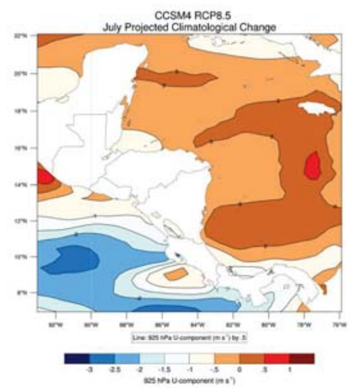


Figura 10. Lo mismo que la figura 8 pero para el periodo de futuro (FT, 2061-2070) con el forzamiento del modelo global NCAR_CCSM4 y el escenario de emisiones RCP8.5



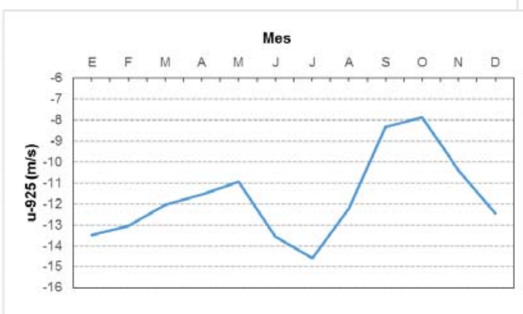
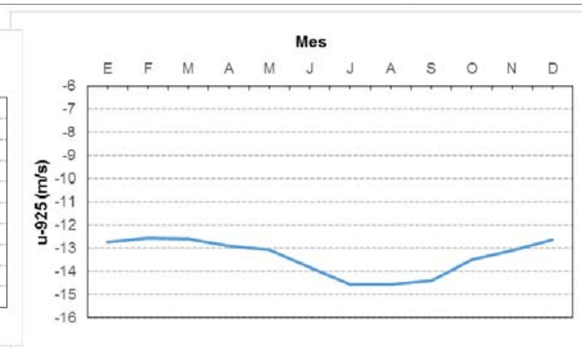
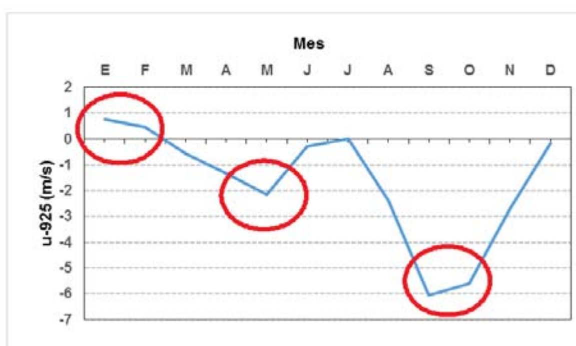


Figura 2. Ciclo anual medio del periodo 2001-2010 de la componente zonal (u, m/s) del viento para el nivel de 925 hPa en las coordenadas 15°N, 78°O.



u-925 (FT, 2061-2070), 15°N, 78°O.



Cambio u-952 (FT-BL), 15°N, 78°O.

Proyecto: Guatemala

Escenario: Histórico

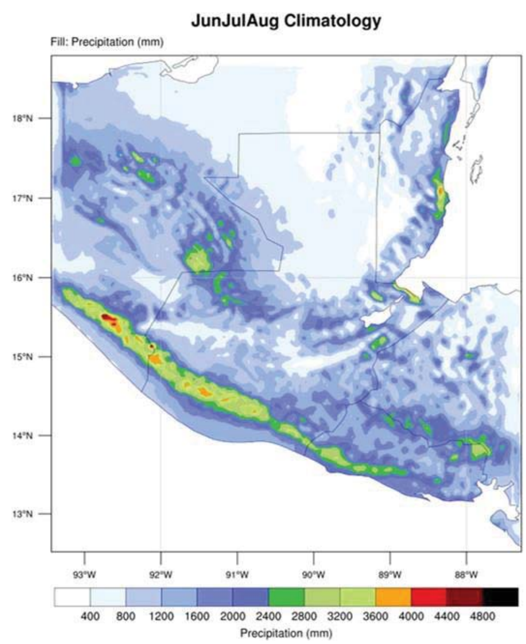
Dominio: D03 Guatemala (4 km)

Corrida: NNRP: 2001-2010

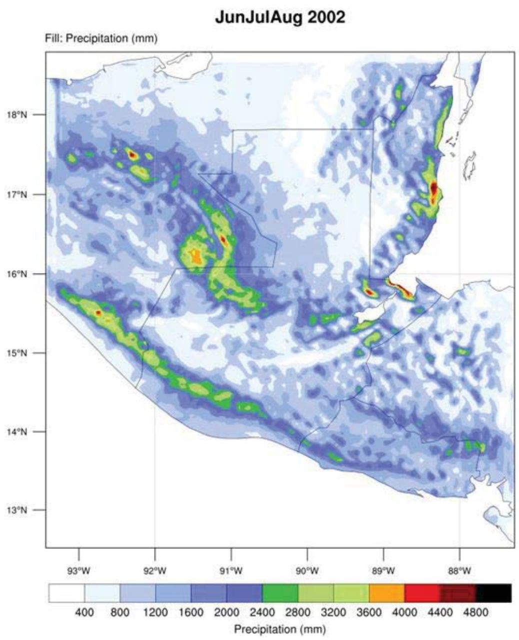
Temporada : verano (junio-agosto)

Variable: lluvia (mm)

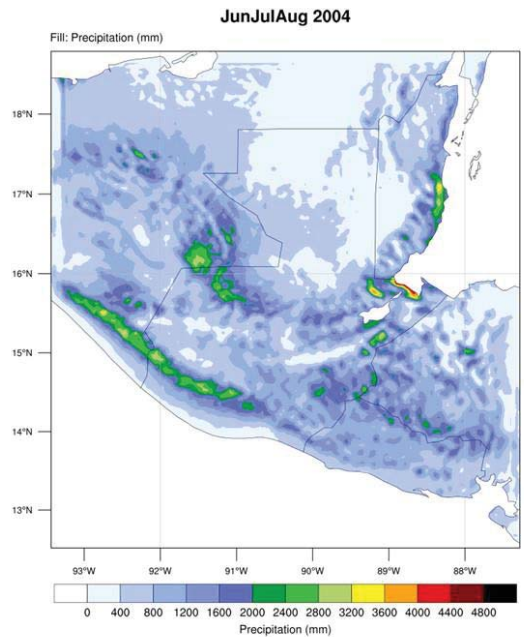
CLIMATOLOGIA (2001-2010)



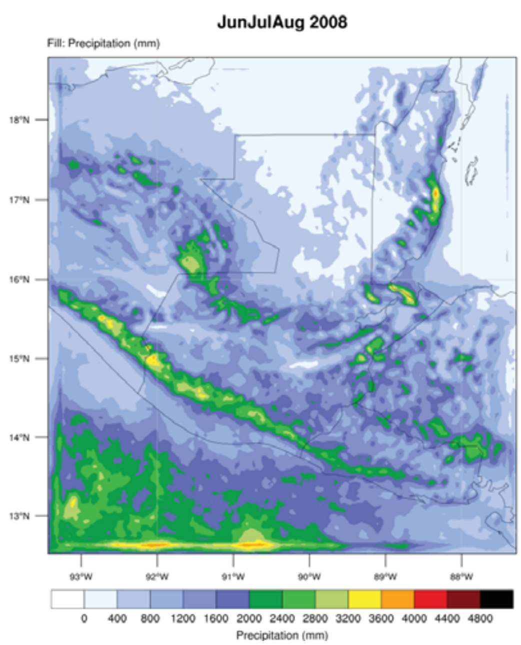
EVENTO: EL NIÑO 2002



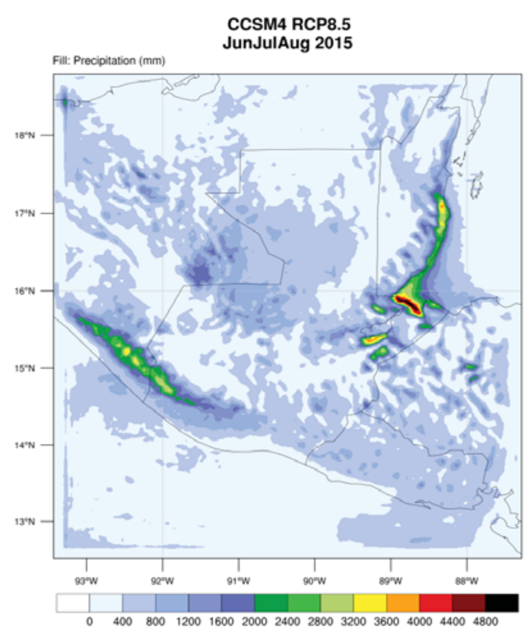
EVENTO: EL NIÑO 2004



EVENTO: LA NIÑA 2008



EVENTO: EL NIÑO 2015



Working Group 3: Mountain Precipitation and Glaciers

Marcos Andrade, Alan LLacza

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.

Working Group 3:
Precipitation at the Altiplano in the Central Andes

Marcos Andrade: Universidad Mayor de San Andrés, Bolivia
Alan Llacza: Servicio Nacional de Meteorología e Hidrología del Perú

Tentative title: **Results from a regional high-resolution model for evaluating possible climate changes at the Central Andean region**

Resultados de un modelo regional de alta resolución espacial para la evaluación de posibles cambios del clima en los Andes centrales

Outline

1. Introduction
2. Data
3. Methodology
4. Results and discussion
5. Conclusions
6. References
7. Acknowledments
8. Annex

The regions with glaciers (above 4500 masl) have not been considered in this study. Solid precipitation has some problems and time series for those stations have not been QA/QC checked. In addition not too many stations are available for a long period

2. Description of the data

2.1. Regional model WRF

2.2. Surface data: QA/QC ok from a DECADE project (Univ. Of Bern MetoSwiss, SENAMHI's Peru and Bolivia, and UMSA)

2.3. Gridded data for precipitation (PISCO v11) and maximum and minimum temperature (Serrano et al 2017)

2.4. Winds at regional level for 200 and 850 mb from the ERA-Interim reanalysis: Aim -> moisture transport (converge and divergence)

3. Methodology

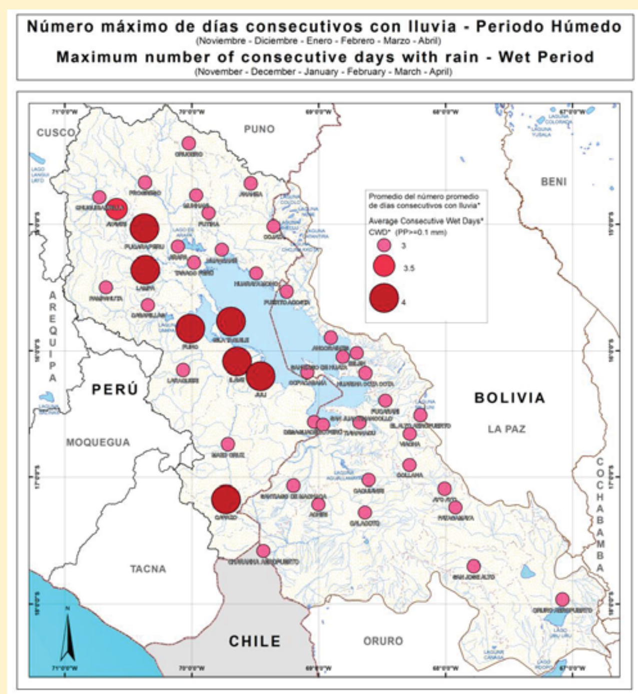
3.1. Evaluation of the model

3.1.1. Selection of the region of interest:

- Central Andes, the South American Altiplano
- There are previous works for the region,
- Other projects interested in the region
- Bi-national interest
- Observations of good quality available for the region

3.1.2 Selected period: 1981-2010

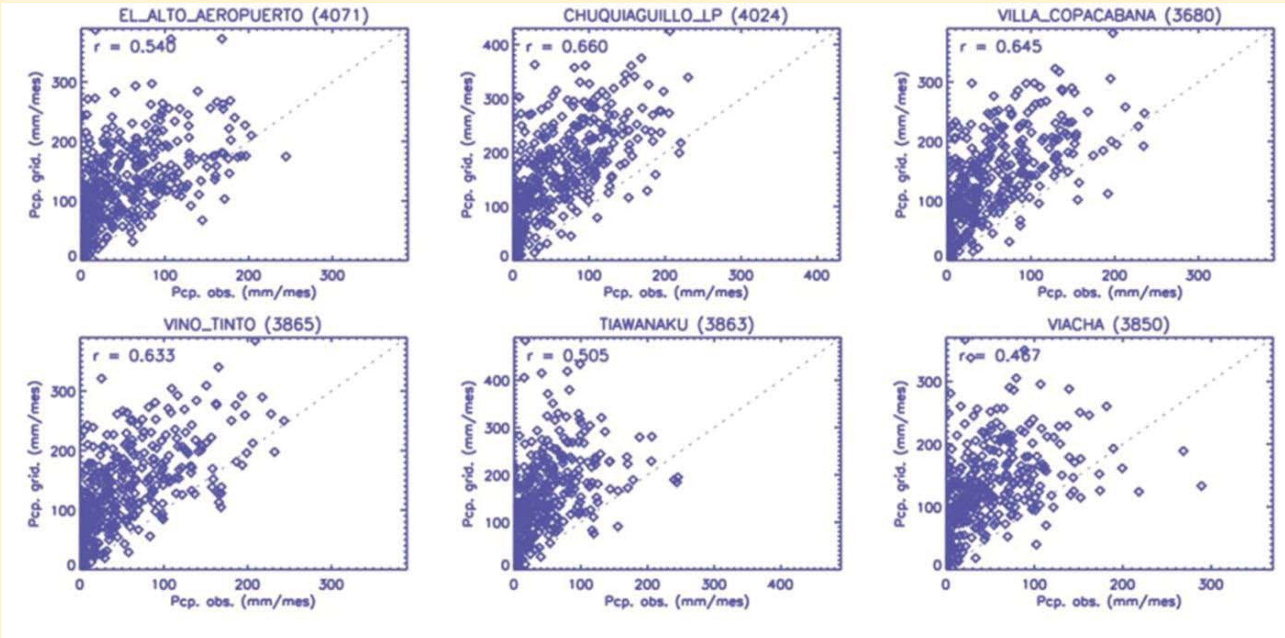
- Observational and model data available for this period



3. Methodology (cont)

3.1.3 Comparison observations vs model outputs

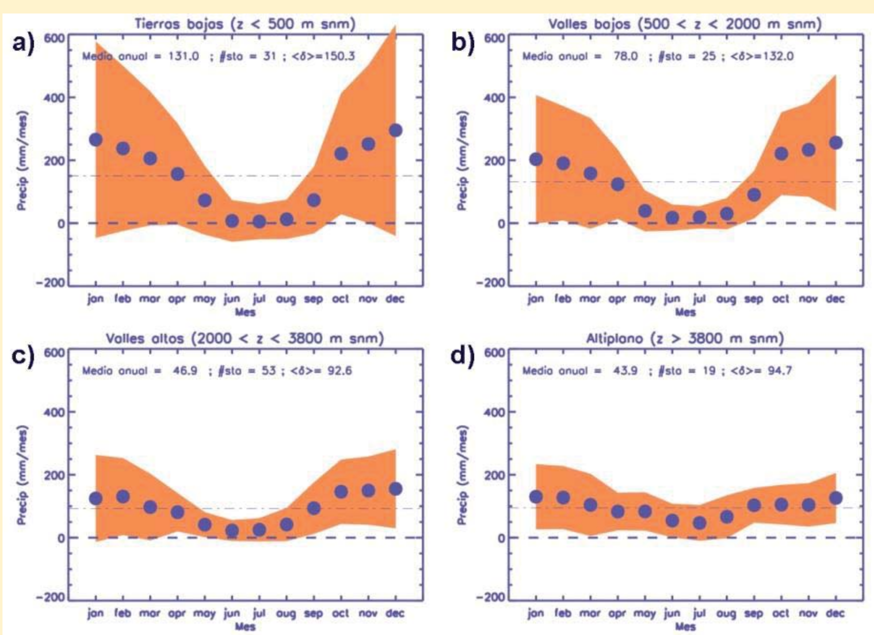
3.1.3.1 Dispersion plots for temperature and precipitation (to be updated)



3. Methodology (cont)

3.1.3 Comparison observations vs model outputs

3.1.3.2 Monthly mean differences model-observations (to be updated)



PCP

3. Methodology (cont)

3.1.3 Comparison observations vs. model outputs (Precipitation)

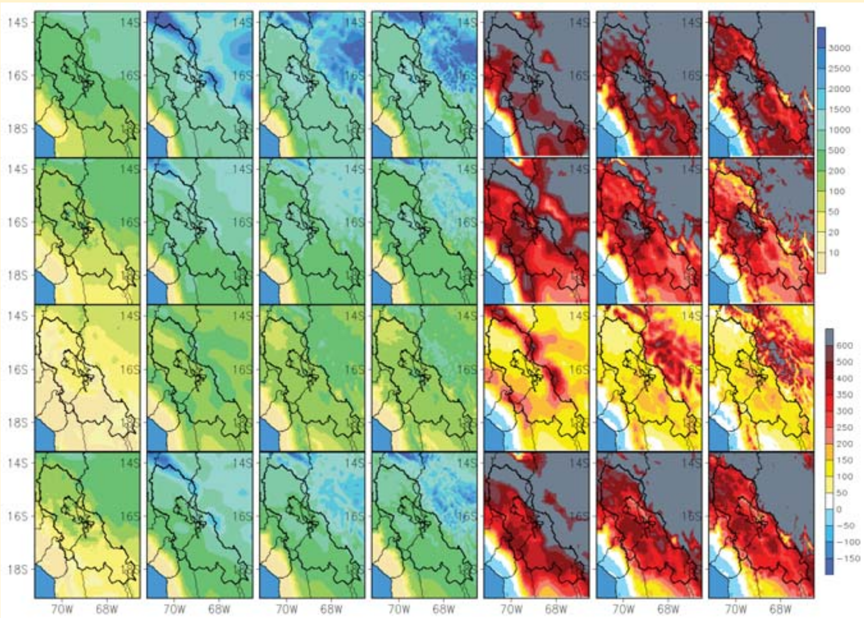
OBS UNL 36 UNL 12 UNL 4

DJF

MAM

JJA

SON



3.1.3.3 Maps of differences model-observations: monthly and by season (wet and dry)

Conclusions:

1) Hay estacionalidad
2) La mejora de la resolucion especial mejora la distribucion especial de precipitacion.
3) Hay una sobrestimacion en todos los trimestres.

3.1.3 Comparison observations vs. model outputs (Maximum Temperature)

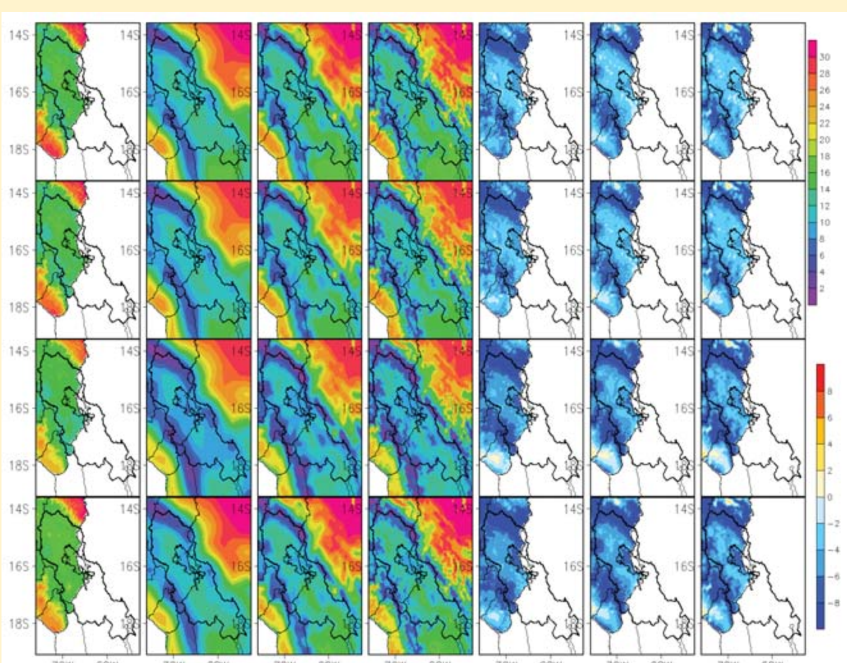
OBS UNL 36 UNL 12 UNL 4

DJF

MAM

JJA

SON



3.1.3.3 Maps of differences model-observations: monthly and by season (wet and dry)

Conclusions:

1) Hay estacionalidad.
2) Hay una subestimacion en toda el area de estudio.

3.1.3 Comparison observations vs. model outputs (Minimum Temperature)

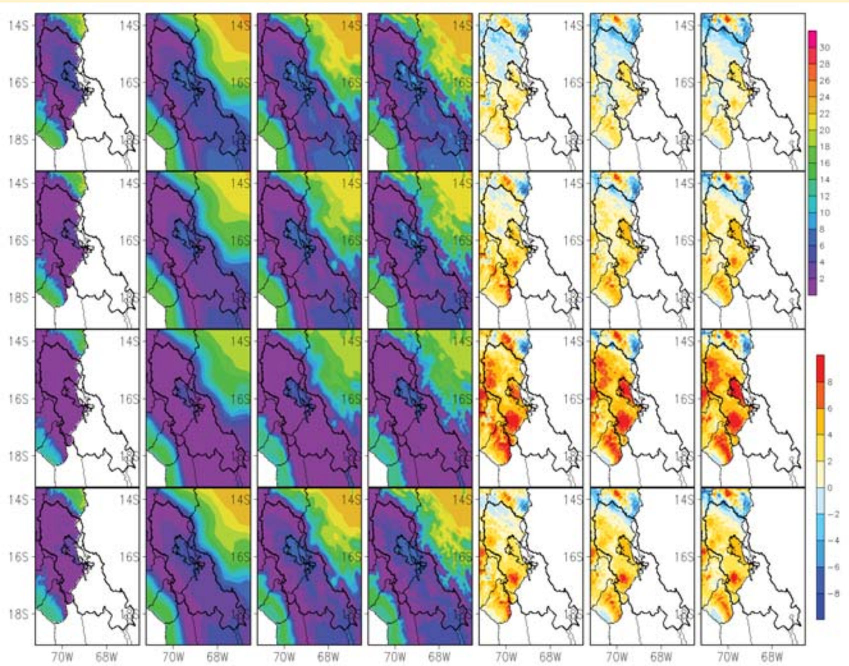
OBS UNL 36 UNL 12 UNL 4

DJF

MAM

JJA

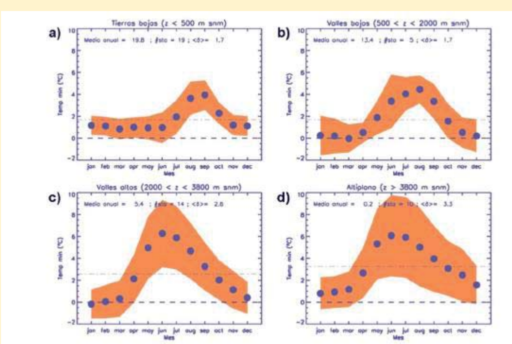
SON

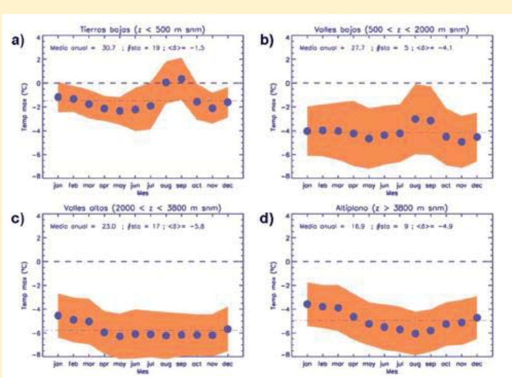


3.1.3.3 Maps of differences model-observations: monthly and by season (wet and dry)

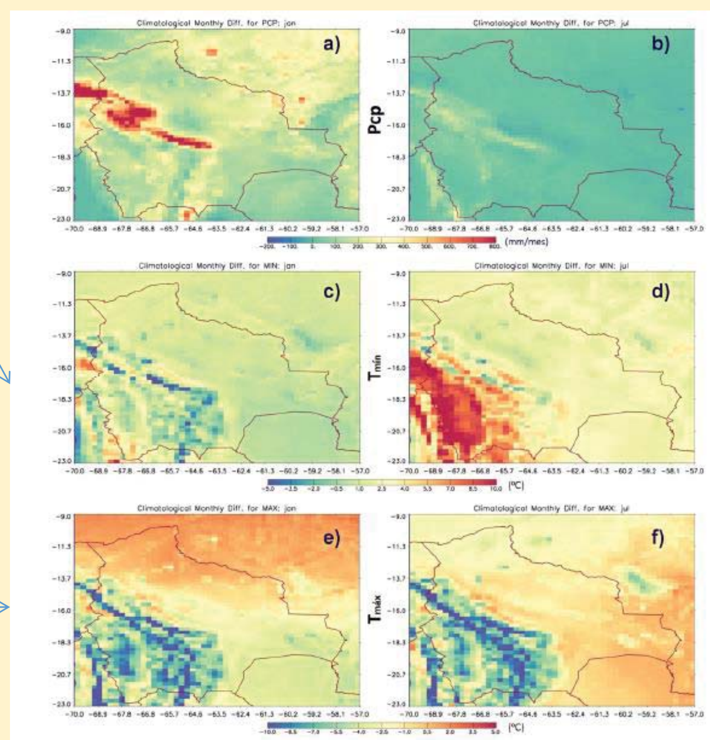
Conclusions:

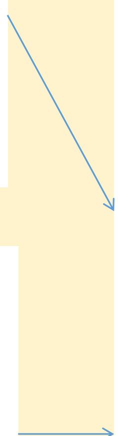
1) Hay estacionalidad.
2) Hay una sobrestimacion que depende del lugar principalmente en JJA, except en la region norte del area de studio en DJF.





Summer Winter





3. Methodology (cont)

3.1.3 Comparison observations vs model outputs

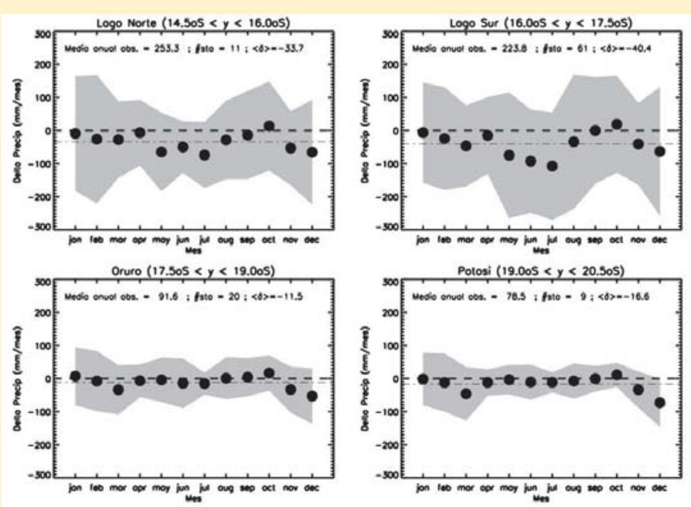
3.1.3.4. Maps of differences for winds at 200 mb

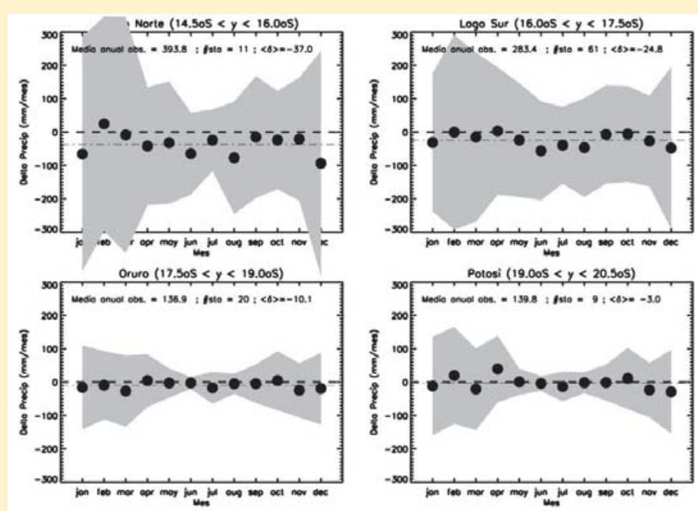
3.1.3.5. Moisture either integrated or at different levels (?)

3. Metodology (cont)

3.2 Projected changes: RCP8.5 on main text (but RCP4.5 & RCP2.6 in annex)

3.2.1. Annual evolution of monthly changes FUTURE-PRESENT (both absolute and relative for TMP and PCP respectively)



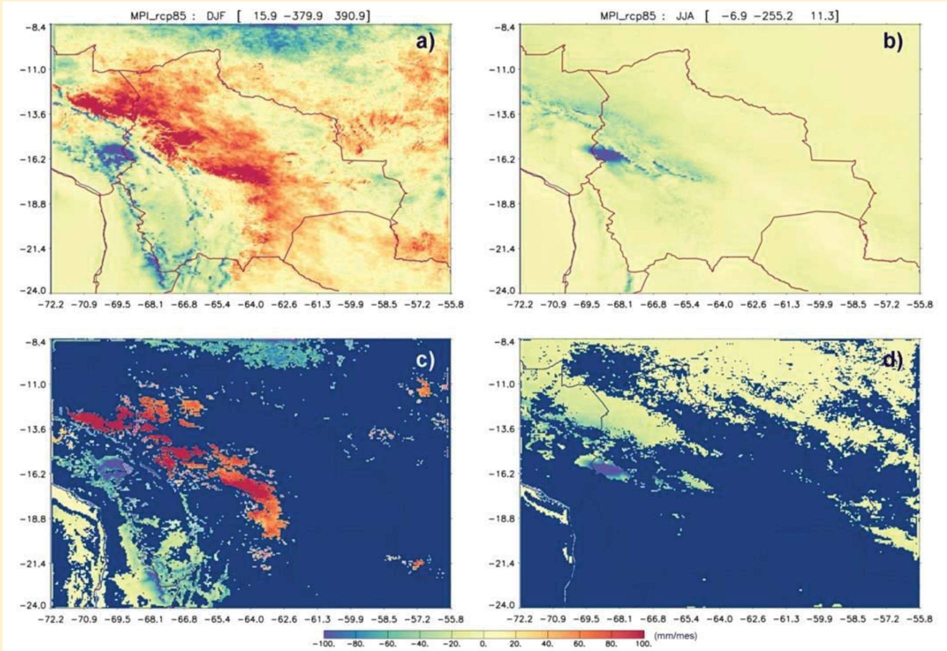


MPI **CCSM4**

3. Methodology (cont)

3.2 Projected changes: RCP8.5 on main text (but RCP4.5 & RCP2.6 in annex)

3.2.2 Maps of change both in PCP and TMP with statistical significance



4. Results and discussion

4.1. Evaluation

4.2. Differences future-present: implications

4.3. Uncertainties

Tabla 3. Valores de cambio entre futuro y presente (en mm) y en porcentaje por franja latitudinal para cada GCM forzante de WRF. Se colocan los valores promedio 9en %) por modelo o por franja.

MODELO	Lago Norte			Lago Sur			Oruro			Potosí			
	δ	Media Pres	Cambio %	δ	Media Pres	Cambio %	δ	Media Pres	Cambio %	δ	Media Pres	Cambio %	
MPI	-33.7	253.3	**-13.3**	-40.4	223.8	**-18.1**	-11.5	91.6	**-12.6**	-16.6	78.5	**-21.1**	**-16.3**
MIROC	-46.9	187	**-25.1**	-19.6	120	**-16.3**	-12.9	56	**-23.0**	-20.5	80.2	**-25.6**	**-22.5**
CCSM4	-37	393.8	**-9.4**	-24.8	283.4	**-8.8**	-10.1	136.9	**-7.4**	-3	139.8	**-2.1**	**-6.9**
			-15.9			**-14.4**			**-14.3**			**-16.3**	

	RCP2.6	RCP4.5	RCP8.5
MPI			
CCSM4			
MIROC			

5. Conclusions

6. References

7. Annex

Results for RCP2.6 and RCP4.5

About how well the models perform

IN BOX
INSIGHTS and INNOVATIONS

How Well Do Coupled Models Simulate Today's Climate?

BY THOMAS REICHLER AND JUNSU KIM

BAMS 2009

TABLE 1. Climate variables and corresponding validation data. Variables listed as "zonal mean" are latitude–height distributions of zonal averages on twelve atmospheric pressure levels between 1000 and 100 hPa. Those listed as "ocean," "land," or "global" are single-level fields over the respective regions. The variable "net surface heat flux" represents the sum of six quantities: incoming and outgoing shortwave radiation, incoming and outgoing longwave radiation, and latent and sensible heat fluxes. Period indicates years used to calculate observational climatologies.

Variable	Domain	Validation data	Period
Sea level pressure	ocean	ICOADS (Woodruff et al. 1987)	1979–99
Air temperature	zonal mean	ERA-40 (Simmons and Gibson 2000)	1979–99
Zonal wind stress	ocean	ICOADS (Woodruff et al. 1987)	1979–99
Meridional wind stress	ocean	ICOADS (Woodruff et al. 1987)	1979–99
2-m air temperature	global	CRU (Jones et al. 1999)	1979–99
Zonal wind	zonal mean	ERA-40 (Simmons and Gibson 2000)	1979–99
Meridional wind	zonal mean	ERA-40 (Simmons and Gibson 2000)	1979–99
Net surface heat flux	ocean	ISCCP (Zhang et al. 2004), OAFLUX (Yu et al. 2004)	1984 (1981) –99
Precipitation	global	CMAP (Xie and Arkin 1998)	1979–99
Specific humidity	zonal mean	ERA-40 (Simmons and Gibson 2000)	1979–99
Snow fraction	land	NSIDC (Armstrong et al. 2005)	1979–99
Sea surface temperature	ocean	GISST (Parker et al. 1995)	1979–99
Sea ice fraction	ocean	GISST (Parker et al. 1995)	1979–99
Sea surface salinity	ocean	NODC (Levitus et al. 1998)	variable

Reichler and Kim (2008)

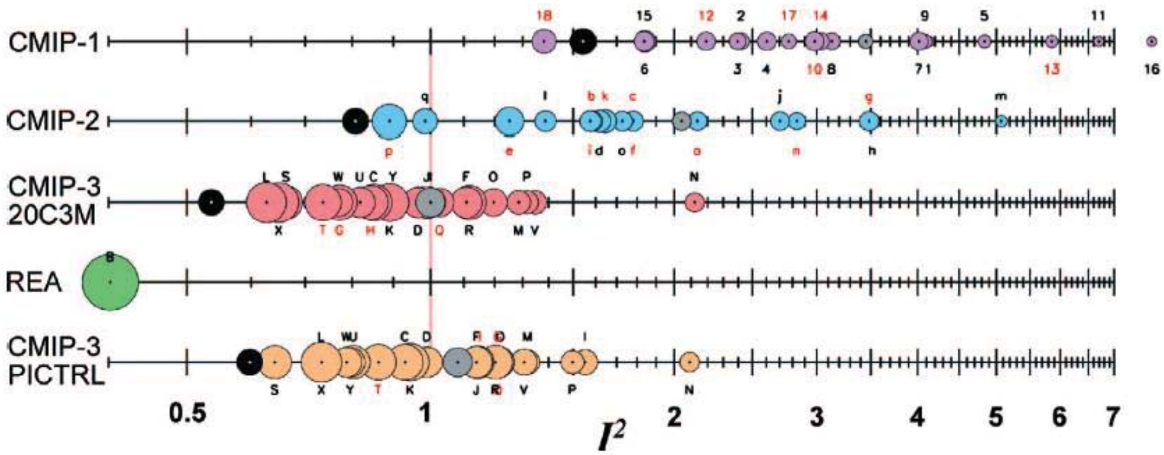
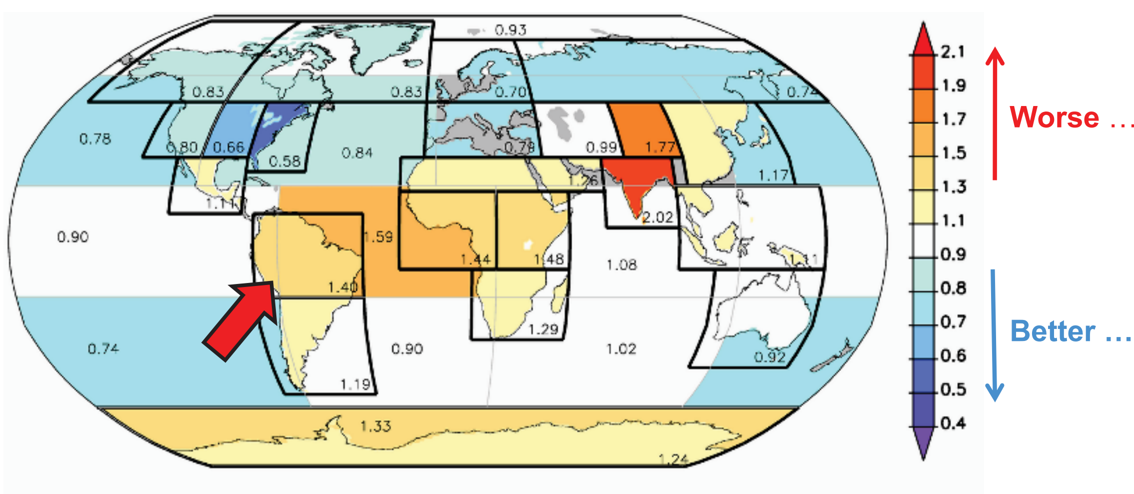


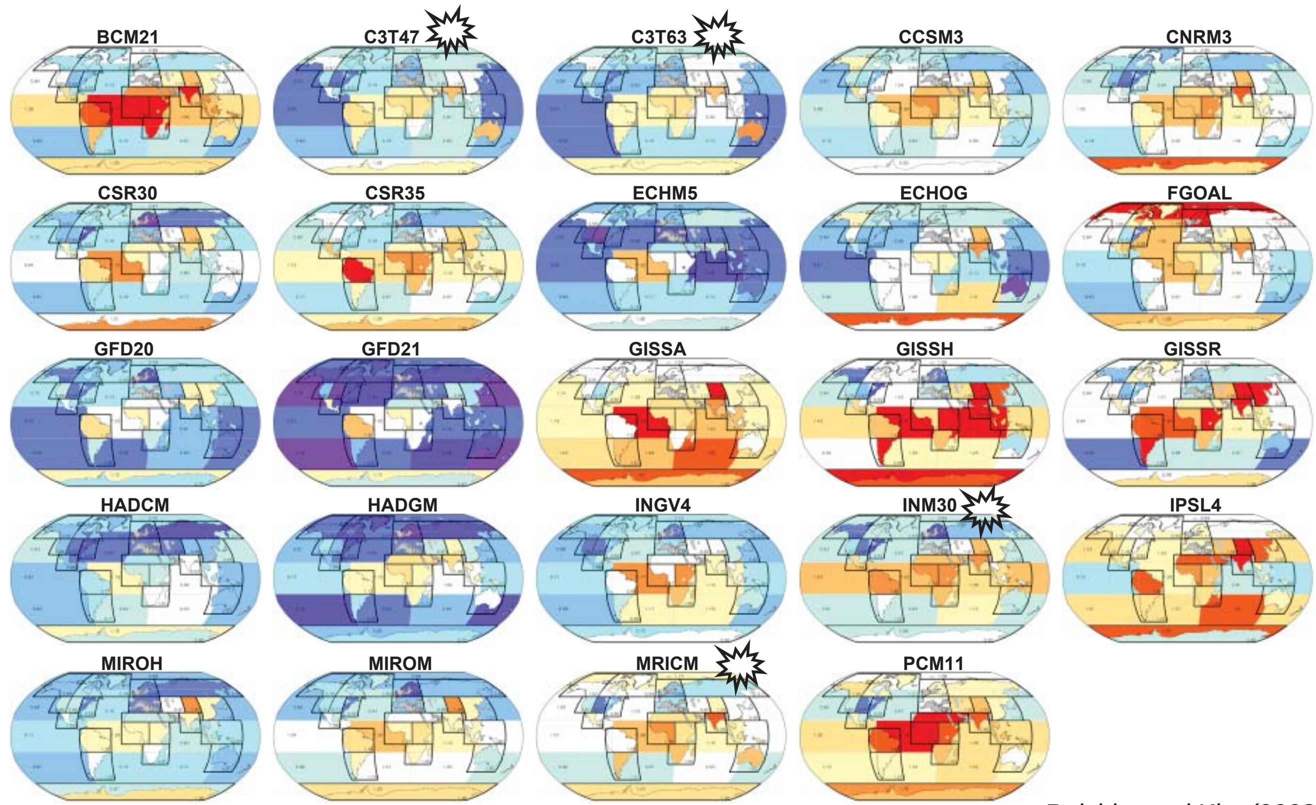
FIG. 1. Performance index I^2 for individual models (circles) and model generations (rows). Best performing models have low I^2 values and are located toward the left. Circle sizes indicate the length of the 95% confidence intervals. Letters and numbers identify individual models (see supplemental online material at doi:10.1175/BAMS-89-3-Reichler); flux-corrected models are labeled in red. Grey circles show the average I^2 of all models within one model group. Black circles indicate the I^2 of the multimodel mean taken over one model group. The green circle (REA) corresponds to the I^2 of the NCEP/NCAR reanalyses. Last row (PICTRL) shows I^2 for the preindustrial control experiment of the CMIP-3 project.

Average Model Performance



Reichler and Kim (2008)

Individual models(IPCC 2007)



Reichler and Kim (2008)

About observations used for validating model performance

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Int. J. Climatol. (2017)
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/joc.5037

RMetS
Royal Meteorological Society

Identifying, attributing, and overcoming common data quality issues of manned station observations

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[e] *Servicio Nacional de Meteorología e Hidrología de Bolivia (SENAMHI), La Paz, Bolivia*
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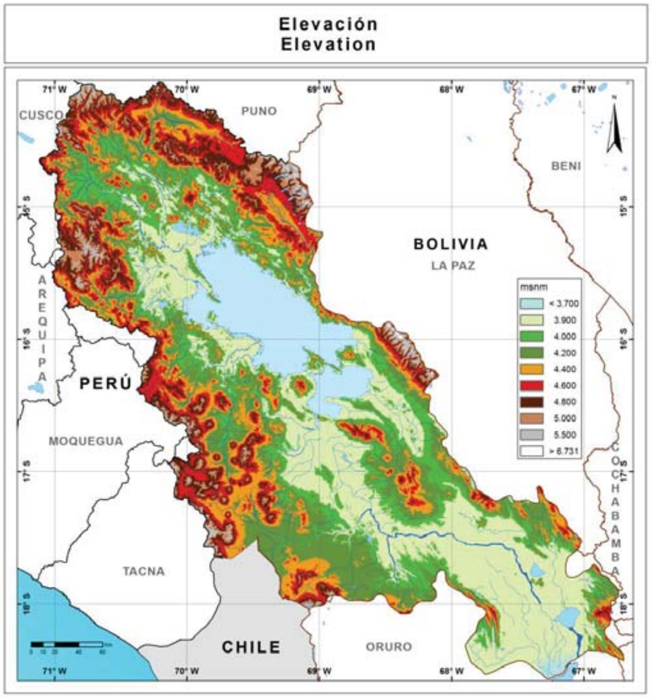

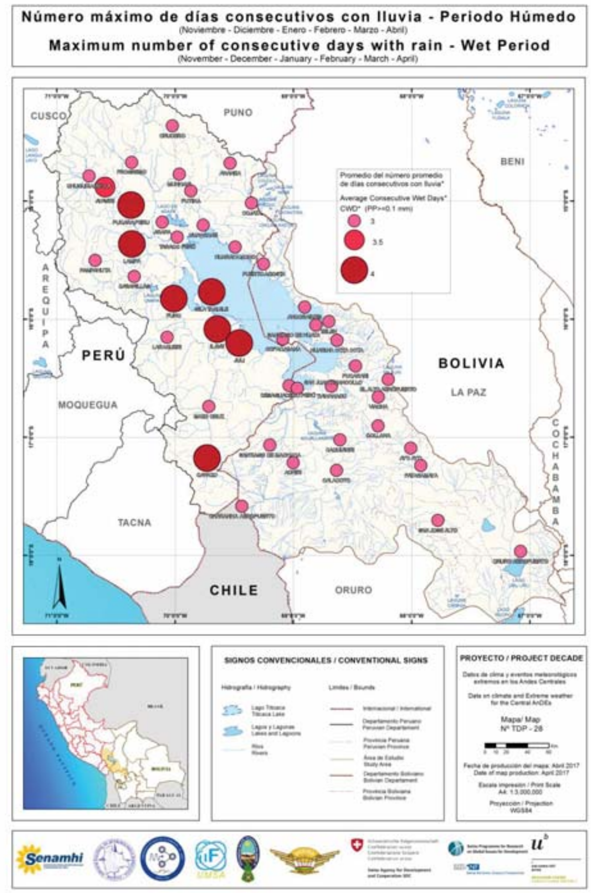

Borrador
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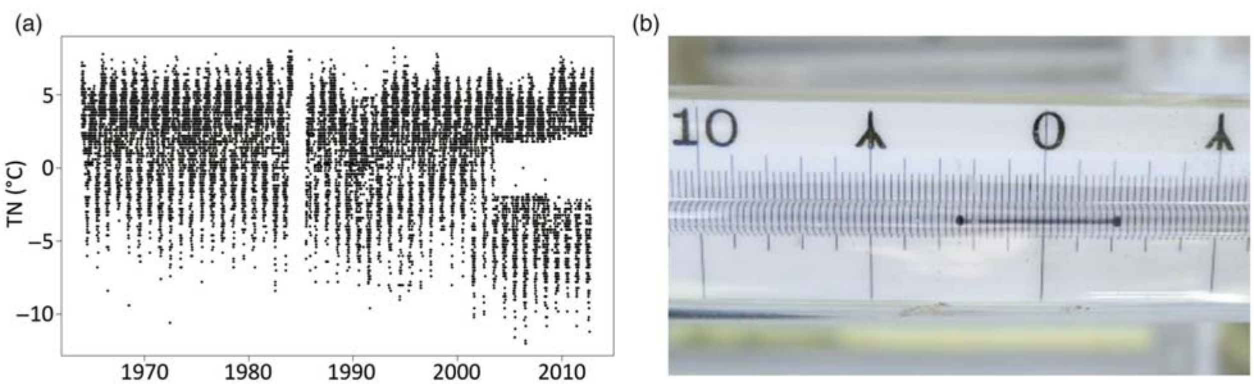


Figure 2. (a) Minimum temperature (TN) time series of Progreso (Peru). Since 2003, a missing temperature interval between approximately −2 and +2 °C is observed. (b) Liquid-in-glass minimum thermometer at the station Progreso. Values to the right of the zero point are positive, to the left negative. The temperature must be read on the right side of the rod (slightly above +2 °C for the case shown). However, if the centre of the rod was below 0 °C, the observer erroneously read the temperature on the rod's left side. Hence, the length of the rod (corresponding to about 4.2 °C) determines the missing temperature range. [Colour figure can be viewed at wileyonlinelibrary.com].

(Hunziker et al., 2017a)

IDENTIFYING, ATTRIBUTING, AND OVERCOMING COMMON DATA QUALITY ISSUES

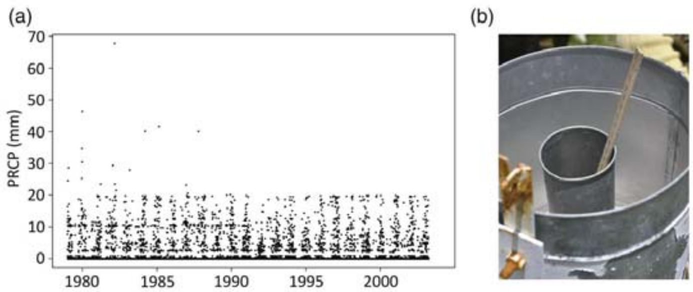


Figure 3. (a) Precipitation (PRCP) observations of the station in Aguirre (Bolivia). Only a few PRCP values above 20 mm are reported until 1988, followed by a complete truncation. The time series is temporarily affected by further errors, namely an excess of values around 10 mm and a missing interval of values between 1 and 2 mm. (b) Hellmann rain gauge as usually used by SENAMHI Bolivia. It is topped by a cone that directs the precipitation into the inner container of the instrument. Overflowing rainwater of the inner container is collected by the outer container. The observer measures precipitation by sticking a scale into the inner container and reading the water mark on the scale. The volume of the 20 cm high inner container corresponds to 20 mm of precipitation. [Colour figure can be viewed at wileyonlinelibrary.com].

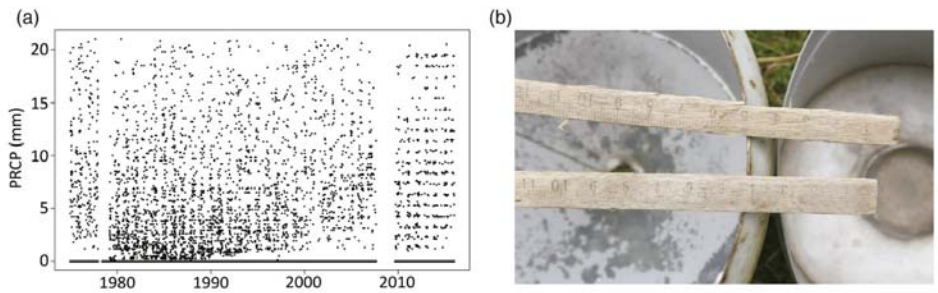


Figure 4. (a) In the data of the Bolivian station Chorocona, precipitation (PRCP) values between 0 and up to about 3 mm are largely missing until the early 1980s and from the 1990s onward. Values >21 mm are not shown in the plot. (b) Precipitation in Bolivia is measured by sticking a scale in the inner container of the Hellmann rain gauge and reading the water mark on the scale (1 cm on the scale corresponds to 1 mm of PRCP). Some scales are aged and have faded scale marks, especially towards the ends. [Colour figure can be viewed at wileyonlinelibrary.com].

(Hunziker et al., 2017a)

S. HUNZIKER *et al.*

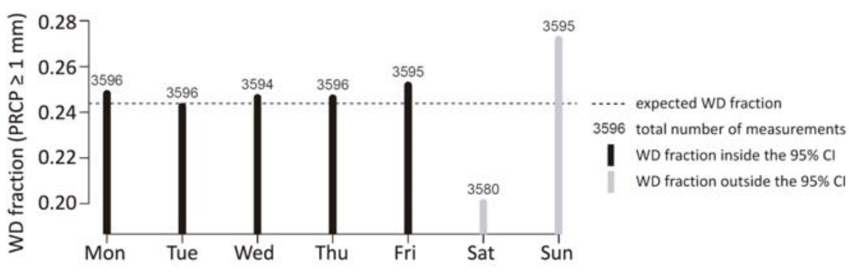


Figure 5. Fraction of wet days (WD) in San Calixto (Bolivia). WD fractions outside the 95% confidence interval (CI) are marked in grey. The fraction of WDs on Saturdays (Sundays) is significantly lower (higher) than the expectation. The number of reported measurements on Saturdays (3580) is only negligibly lower (0.4%) than on the other days of the week.

(Hunziker et al., 2017a)

Appendix D: *Climate Portal* Update

Website & Portal Updates

Workshop 4

10-13 July 2017

March 2017

- 24 March 2017
  - *Upload:* [not yet operational] password-protected page for upload of country data and metadata
- 30 March 2017
  - *MapMaker:* added "Change" and "Offset" datasets for Bolivia
  - *MapMaker:* added "True winter" option (i.e., DJF, instead of JFD) for seasonal averaging
- 31 March 2017
  - *Download:* return domain limits if user selects out-of-domain point(s) for data selection
  - *Download:* daily/monthly dataset selection

April 2017

- 7 April 2017
  - *MapMaker:* error message for relative humidity on "Change" and "Offset" runs – no map produced
  - *MapMaker:* allows for user selection of any NCL color table
    - dropdown includes MeteoSwiss colortables plus "default"
    - user can enter text name of any available NCL colormap

May 2017

- 3 May 2017
  - *MapMaker:* added TSK (skin temperature), for SST
  - *MapMaker:* added ability to mask water, land, or neither
- 10 May 2017
  - *Verify:* new unified verification application activated
    - downscaled Historical runs for all projects
    - observational data from 2 international databases (GSOD and GHCN-D)
- 16 May 2017
  - *Verify:* fixed timeout problem so large datasets can be used (*e.g.*, Bolivia)

May 2017 (cont'd)

- 26 May 2017
  - *MapMaker:* new version installed
    - completely re-written in Python
    - will allow additional variables to be computed, as needed
    - previous version remains available for use
- 30 May 2017
  - *Verify:* added country-contributed data for Bolivia; tools in place to add data from other countries as they are made available

June 2017

- 13 June 2017
  - *Download:* new version installed
    - region or location selectable on accompanying map
      - click on the small black square (■) on the map controls to select a region using a rubberband rectangle
      - click on the marker icon ( ) on the map controls to select a single point
      - the selected latitude(s) and longitude(s) will be displayed in the appropriate text boxes
    - additional parameters added, including relative humidity, SST, and upper-air and soil data
    - if upper-air parameters or soil parameters selected, data levels may be selected; if data levels are not selected, all data levels are included
    - if a single point is selected, both netCDF and CSV files will be created; for areas, only a netCDF file is created at this time
    - in CSV files:
      - missing data are indicated by "M". This should only occur for upper-level data on pressure levels below ground (*e.g.*, at Mexico City, data on the 1000 hPa, 925 hPa and 850 hPa levels would be missing, as the surface pressure at that location is generally near 750 hPa)
      - for upper-air and soil parameters, the level is appended to the parameter name (*e.g.*, geopotential height at 925 hPa is labeled "Z@925" in the CSV file)
    - previous version remains available for use

June 2017 (cont'd)

- 14 June 2017
  - *Download:* added flux parameters
  - *MapMaker:* added flux parameters
  - *portal:* posted table of WRF variables with descriptions
- 19 June 2017
  - *MapMaker:* dropdown menu for selecting color map now has images of each color map. These represent a selected subset (i.e., "MeteoSwiss") of all NCL color maps; alternatively, you may enter the name of any valid NCL color map in the text box.
  - *portal:* all portal pages now have a blue background and a modern, sans-serif font, because Clint got tired of looking at Time New Roman on a plain, white background (he's still working on some other styling issues)

June 2017 (cont'd)

- 21 June 2017
  - *TimeSeries:* plot climatological time series of selected parameters from observations, historical model runs, and climate change scenario projections. Observing station, geographic point or region can be selected for averaging.
- 28 June 2017
  - *MapMaker:* added "Get Data" button to map page
    - downloads netCDF file with data used to make plot
    - if domain was subset, downloaded data are subset
  - *Verify:* added "Get Data" button to plot page
    - downloads CSV file with data used to make plot
  - *TimeSeries:* added "Get Data" button to plot page
    - downloads CSV file with data used to make plot
    - if data were smoothed, downloaded data are smoothed

July 2017

- 3 July 2017
  - *MapMaker:* added "Map" button in "Plot Modifications" to allow graphical selection of a subregion from the desired domain. Clicking this button will pop up a map window with project domains drawn. Click on the small black square (■) on the map controls to select a region using a rubberband rectangle.
    Important: the "project" and "domain" must be selected in the top drop-down menus before using this option and the region selected **must** be entirely within the chosen domain.

July 2017 (cont'd)

- 6 July 2017
  - *Verify, TimeSeries, Download:* added "background job" button (near "Output" options). For large data requests that time out, choose this option to have job run in the background and email notification when completed.
    Important: some preliminary testing has determined that background jobs are processed correctly in all major modern browsers except Safari and Internet Explorer. Chrome, Firefox, Edge, and Opera correctly put the job in the background, although Firefox never "finishes" loading the notice page, even though it has completed.

To-do list

- Add climate indices
- Add GCM forcing datasets

- Country data!
  - Upload site prototype in place
  - Need data contributions from participant countries

Website design

- New design for consortium and portal webpages

- Need input on content and links

- Let’s take a tour!

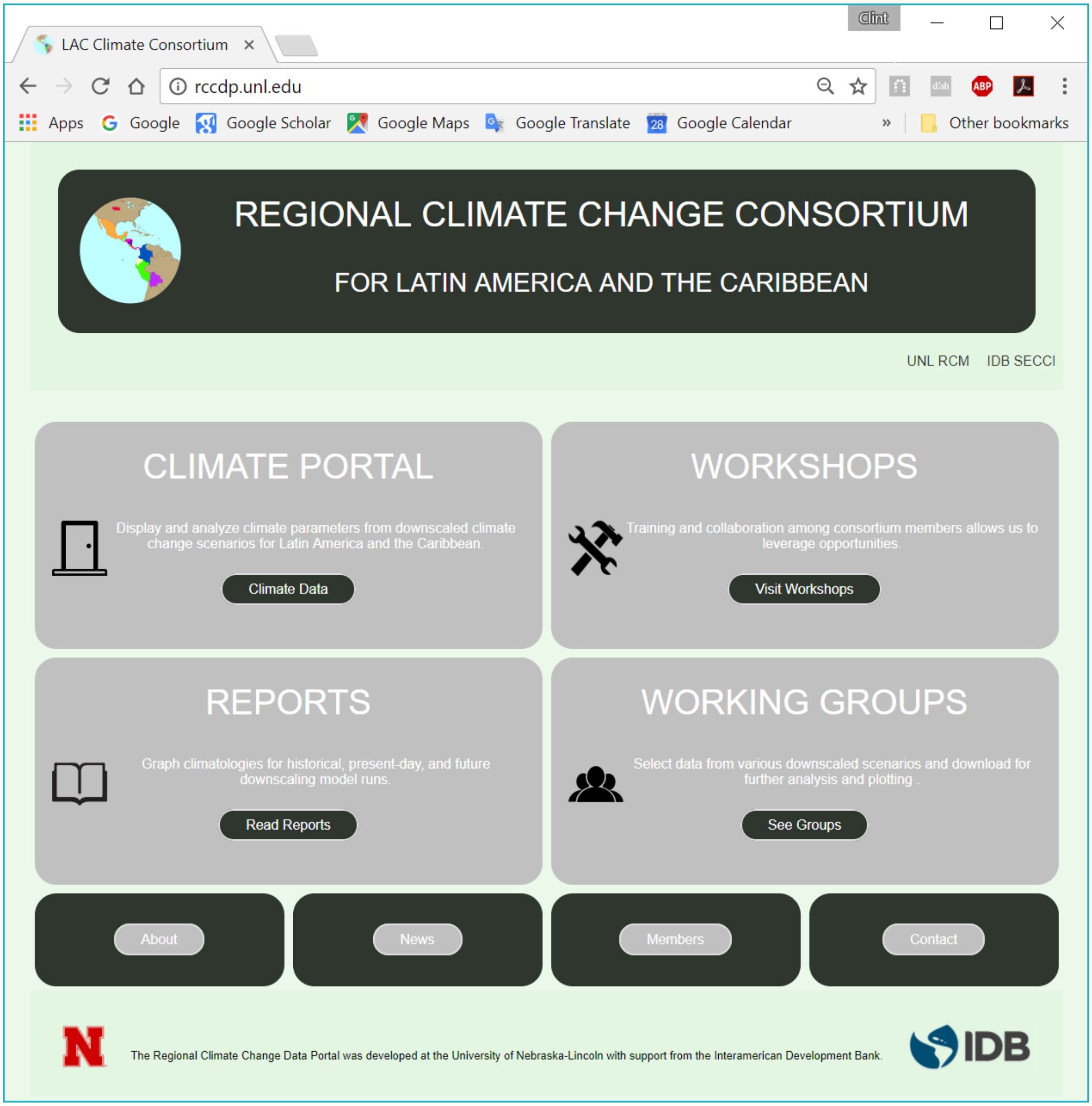


Figure D1: New, main Consortium web page (http://rccdp.unl.edu), which provides links to the Climate Portal, workshops, reports, and working groups, along with basic information about the Consortium and its members.

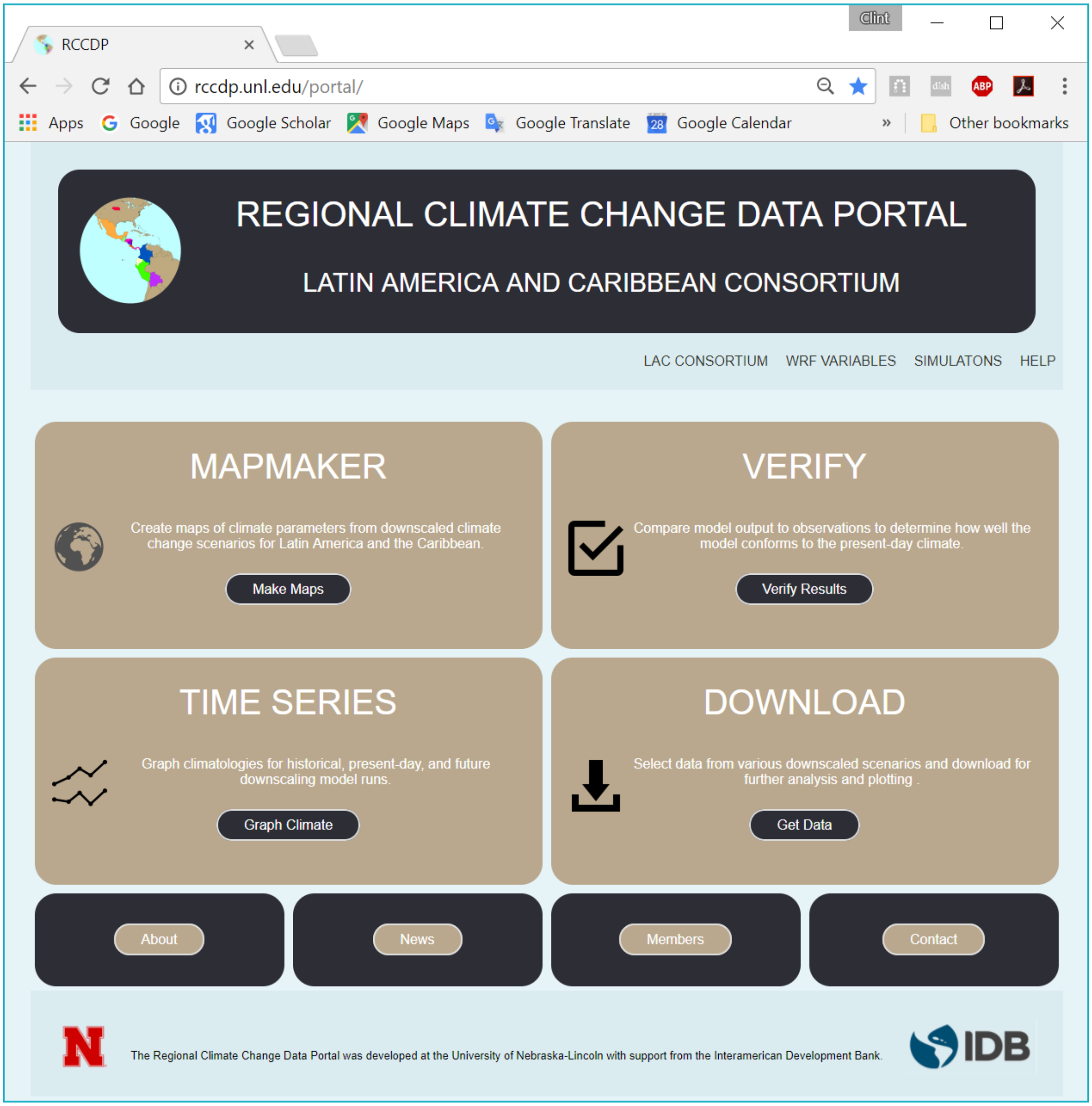


Figure D2: New, main Climate Portal web page (http://rccdp.unl.edu/portal), which provides links to the application web pages that allow users to access, analyze, and visualize the results of our dynamical downscaling for Latin America and the Caribbean.

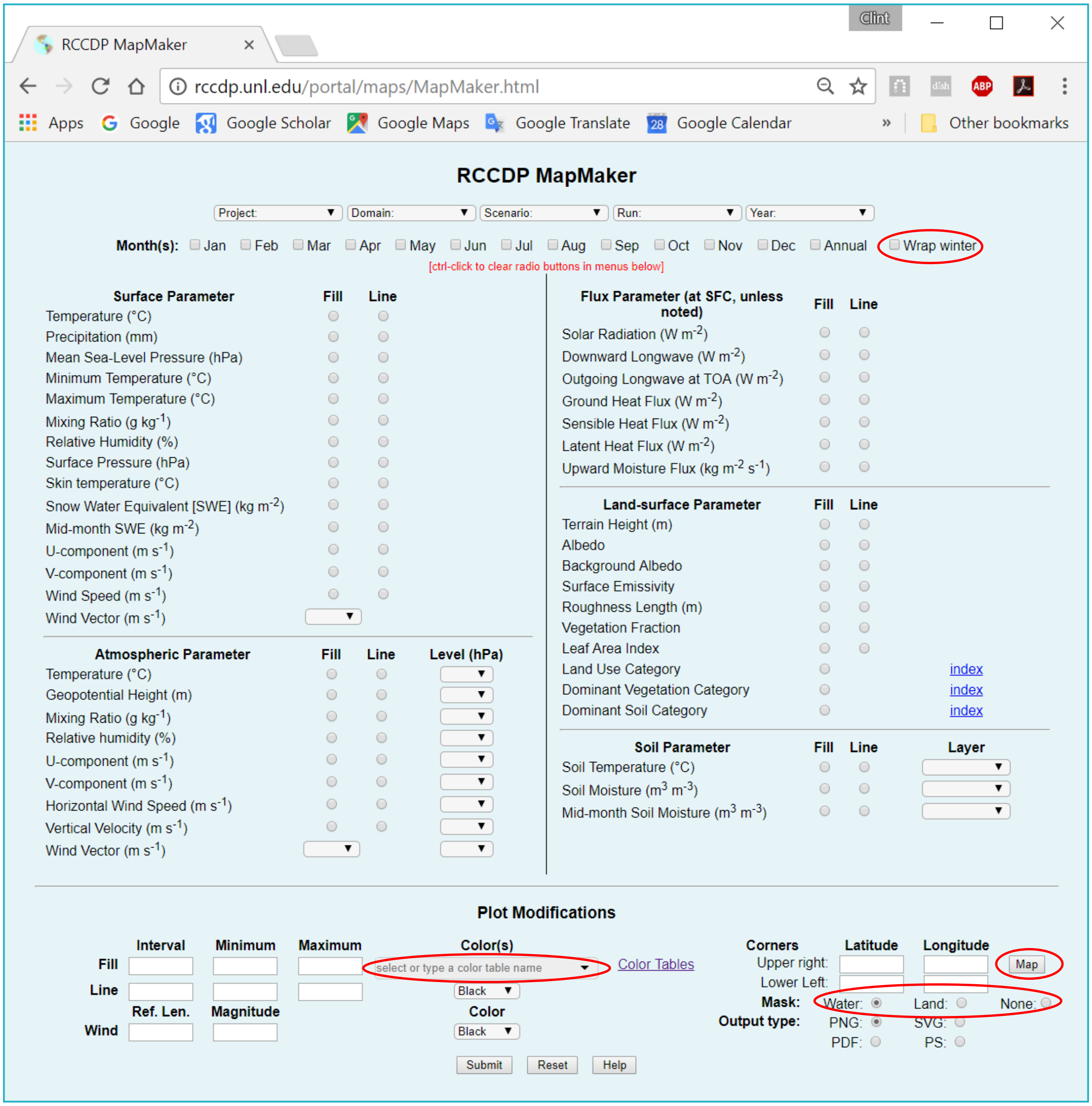


Figure D3: New MapMaker page (http://rccdp.unl.edu/portal/maps/MapMaker.html). Updates include the addition of flux parameters (upper-right section of menu). New features (circled in red, above) include the ability to 1) "wrap" months across the end of a calendar year to get true seasonal averages (e.g., Dec 1991, Jan 1992, Feb 1993 for a winter); 2) choose a pre-selected color table (dropdown menu with sample color swatches) or enter a color table name; 3) mask land, water, or neither; and 4) graphically select a portion of the desired domain from a pop-up map (Figure D4).

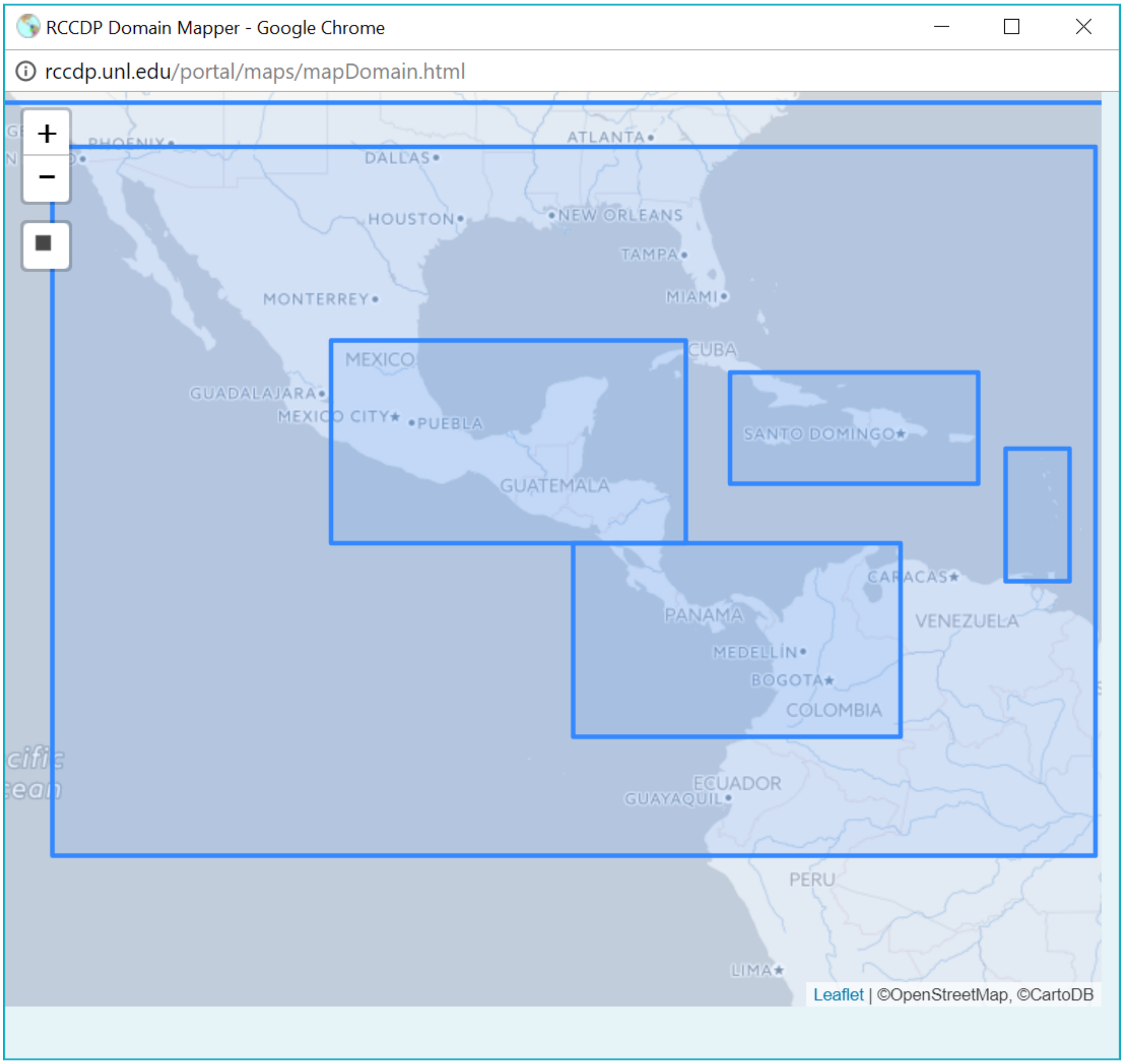


Figure D4: Pop-up map used to select a subset of a domain for use by MapMaker. Clicking on the black rectangle widget allow the user to "rubber band" an area on the map. The latitude/longitude coordinates of the rubber band are used by MapMaker to zoom in on the selected region.

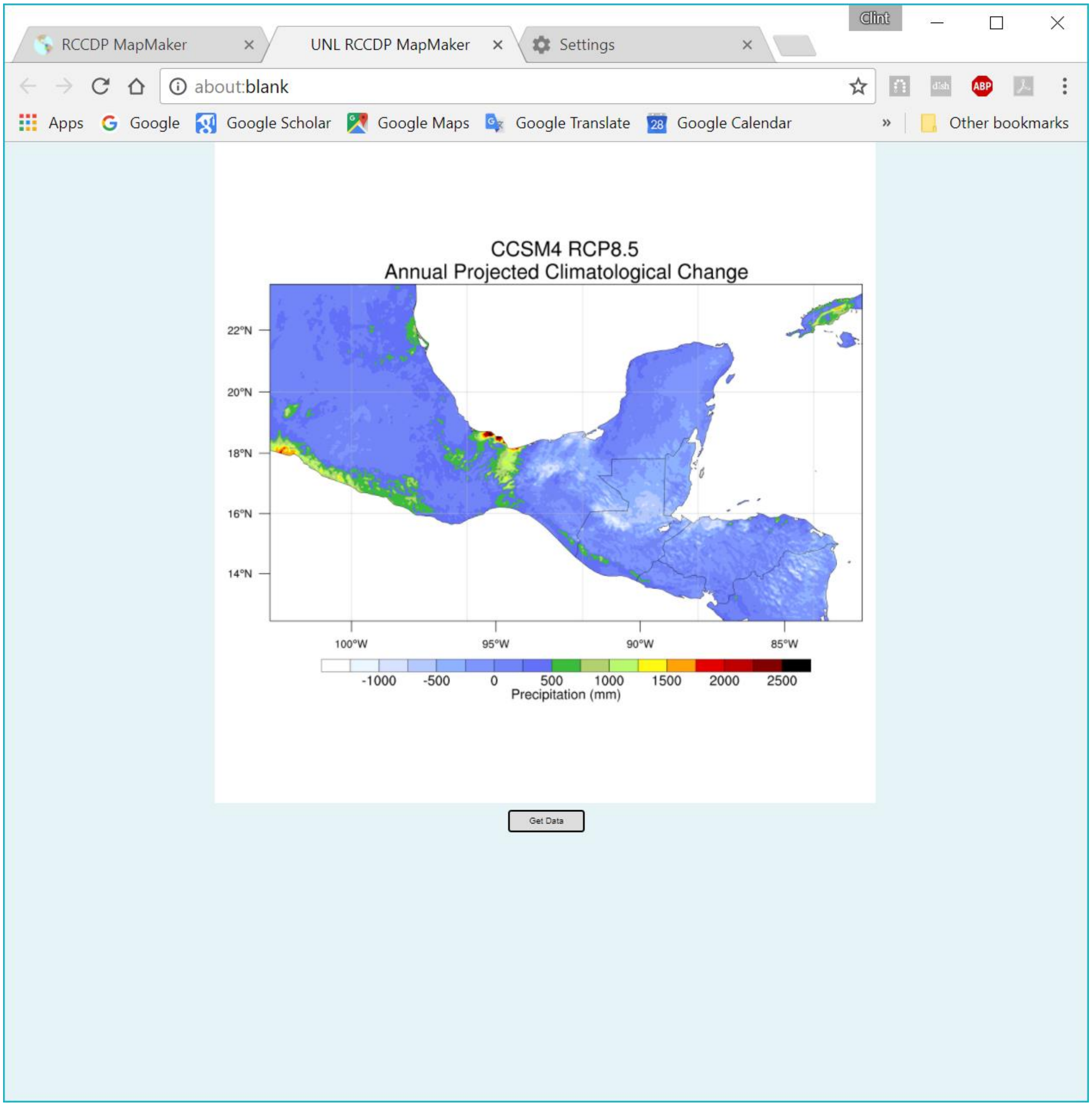


Figure D5: Example MapMaker output. This map shows projected annual precipitation change from the early 21st century to mid-century for the Northern Mesoamerica subdomain of the Mesoamerica and Caribbean Project. Note the "Get Data" button that allows the used to quickly download the data (in netCDF format) used to draw the map.

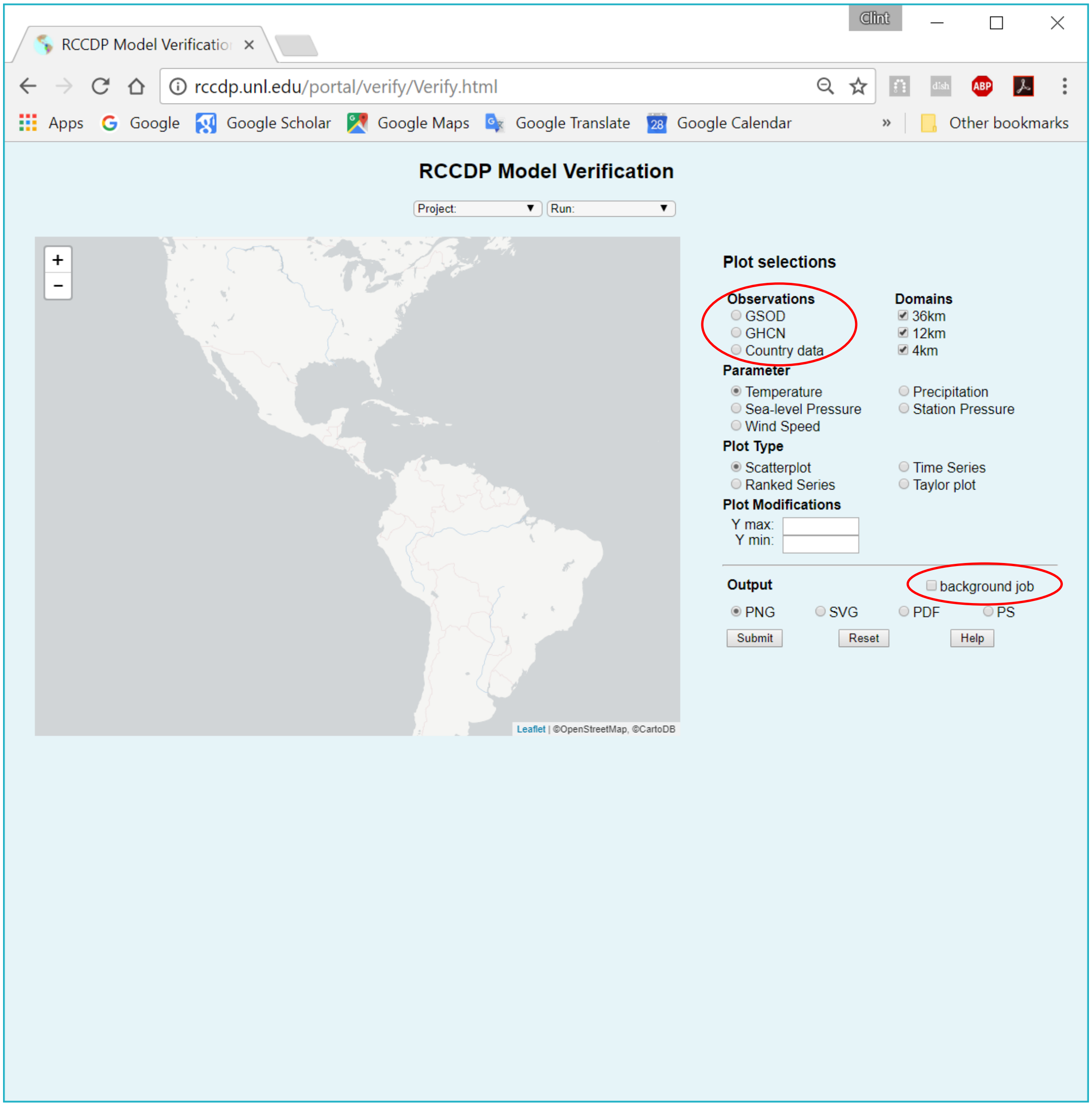


Figure D6: New Model Verification page (http://rccdp.unl.edu/portal/verify/Verify.html). New features (circled in red, above) include: 1) the ability to use either of two international datasets or contributed country data (if available) for verification; and 2) the ability to submit the job for processing offline and email results to the user.

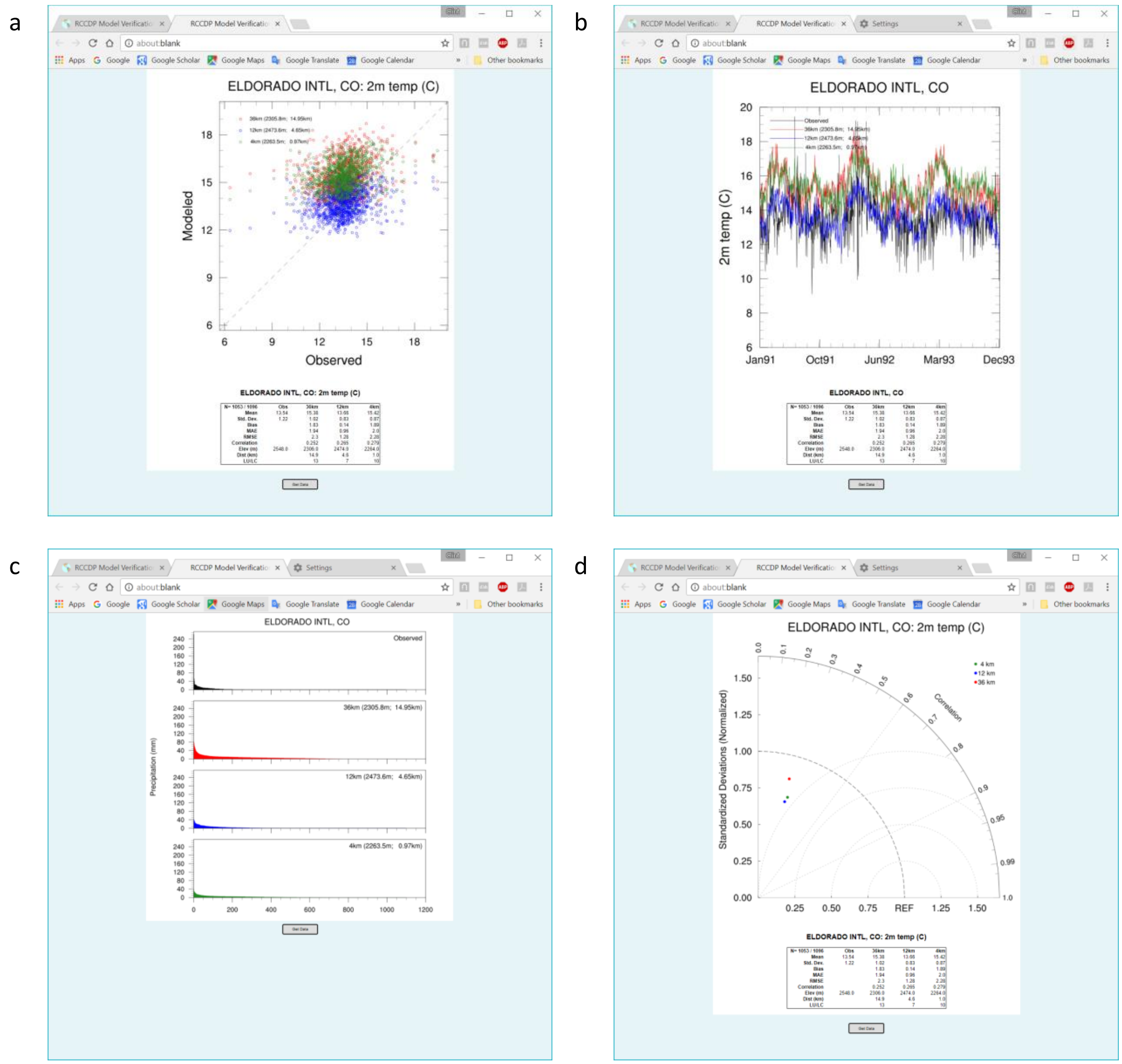


Figure D7: Example Model Verification output. a) scatterplot of model temperature vs observed temperature at El Dorado International Airport, Bogata, CO; b) time series of same data; ranked time series of precipitation at El Dorado; and d) Taylor diagram for temperature. Again, note "Get Data" button at bottom of each page to download the data (in CSV format) used for this plot.

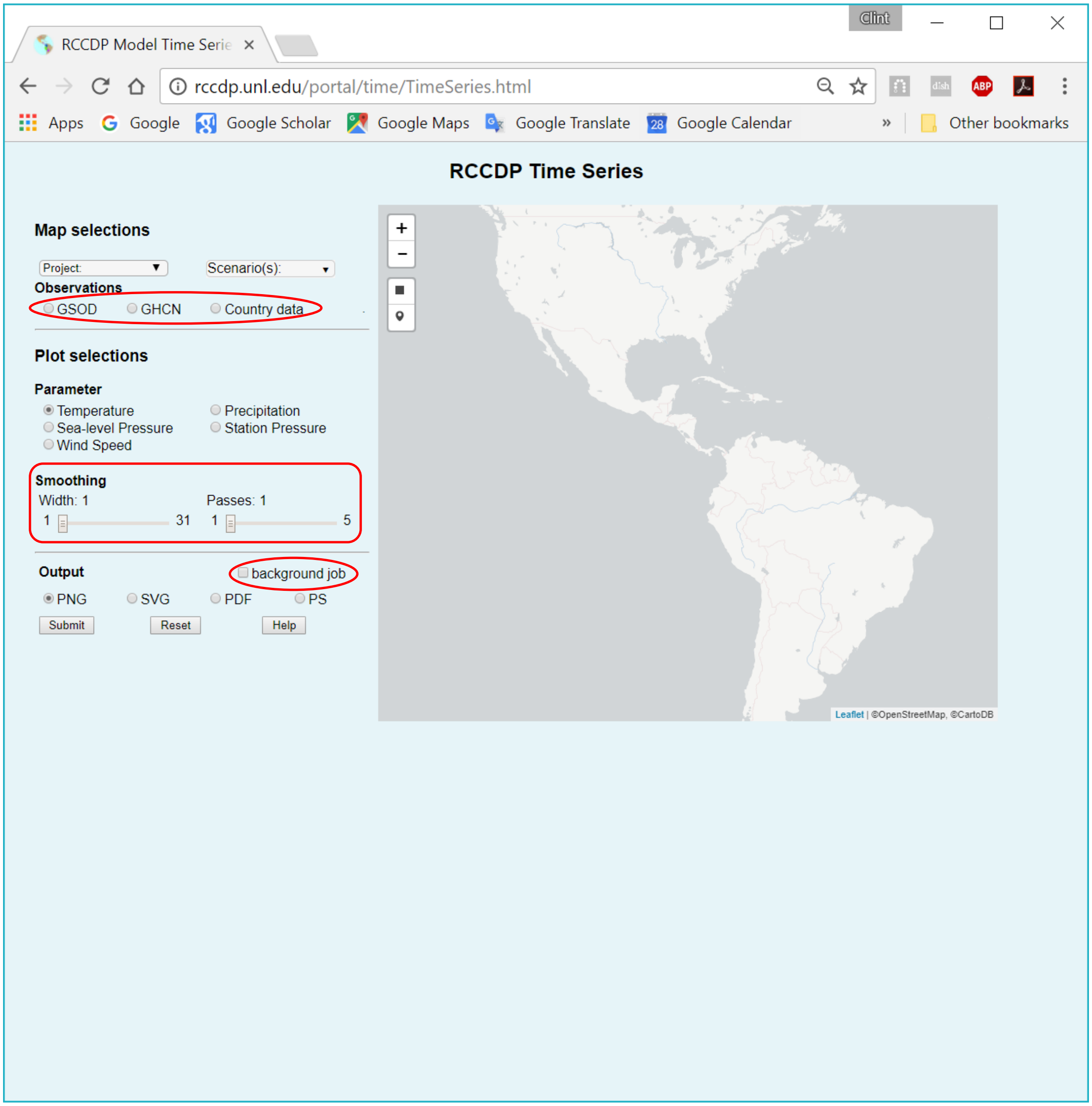


Figure D8: New Model Time Series page (http://rccdp.unl.edu/portal/time/TimeSeries.html). Features (circled in red, above) include: 1) the ability to use either of two international datasets or contributed country data (if available) for verification; 2) data smoothing; and 3) the ability to submit the job for processing offline and email results to the user.

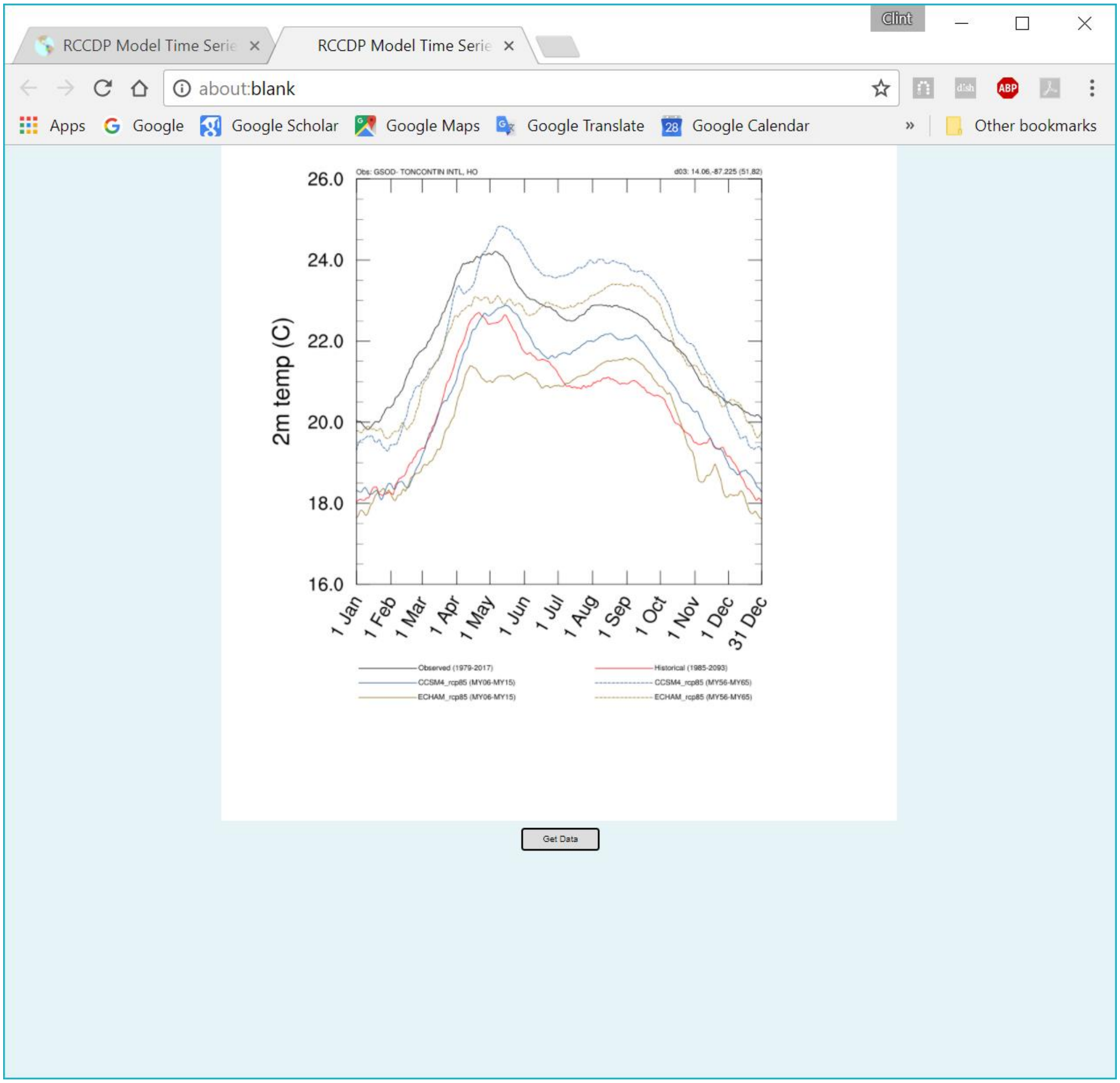


Figure D9: Example Model Time Series output. Plot includes climatological daily temperature data for Toncontín International Airport, Tegucigalpa, HO from observations, a historical downscaling run, and two GCM downscaling runs for both present-day and mid-century periods. Again, note "Get Data" button at bottom of each page to download the data (in CSV format) used for this plot.

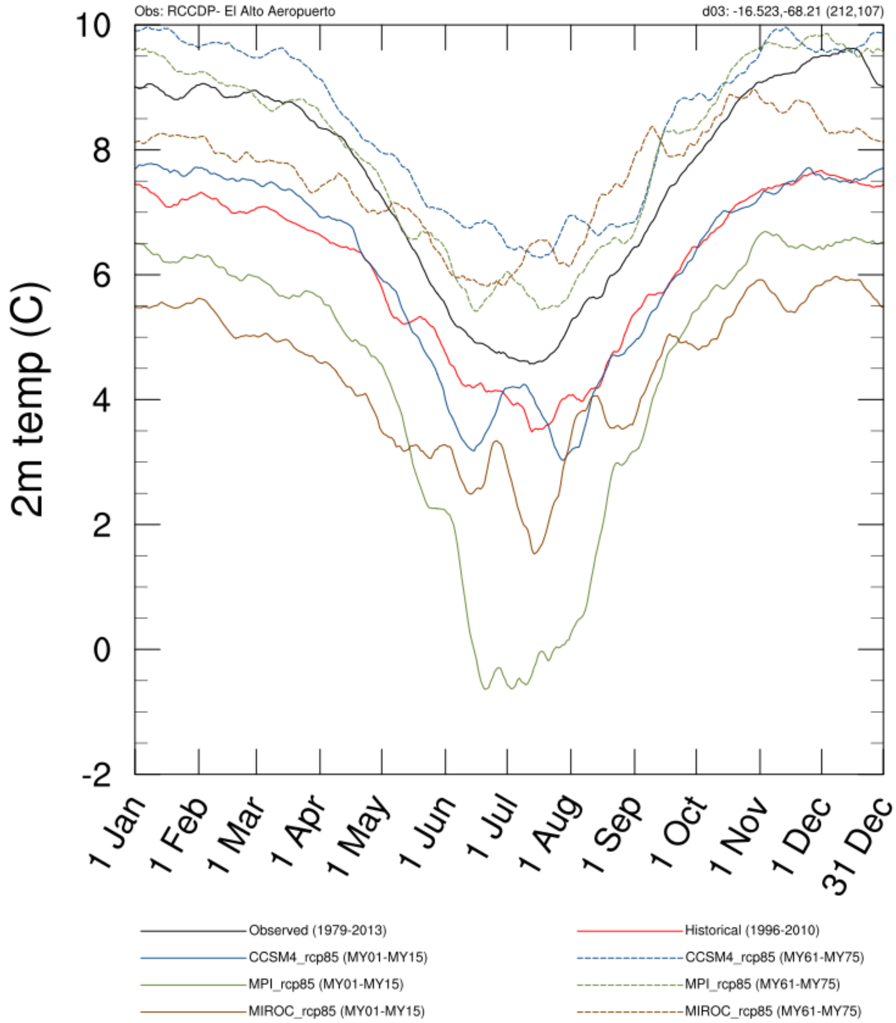


Figure D10: Example Model Time Series output. Plot includes climatological daily temperature data for El Alto Airport, La Paz, BL from country-supplied observations, a historical downscaling run, and three GCM downscaling runs for both present-day and mid-century periods. This plot was generated using the "background job" option; a link to the data used is included in the email sent upon job completion.

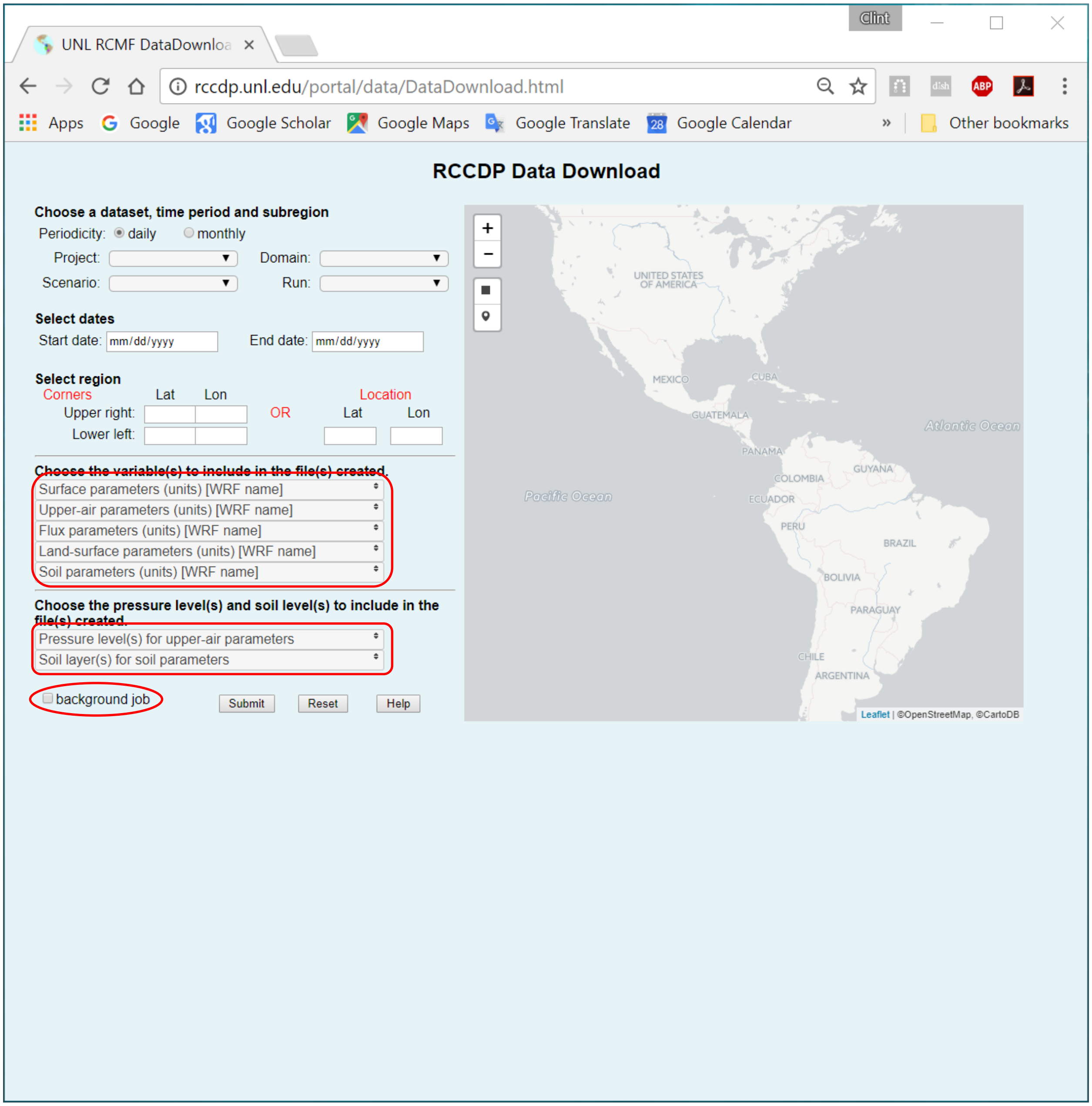


Figure 11: New Data Download page (http://rccdp.unl.edu/portal/data/DataDownload.html). Geographic regions or specific points can be selected from the map using either a rubber band (to select a region) or marker (to select a point). New features (circled in red, above) include: 1) dropdown menus for all parameters; 2) dropdown menus for pressure levels and soil layers; and 3) the ability to submit the job for processing offline and email results to the user.

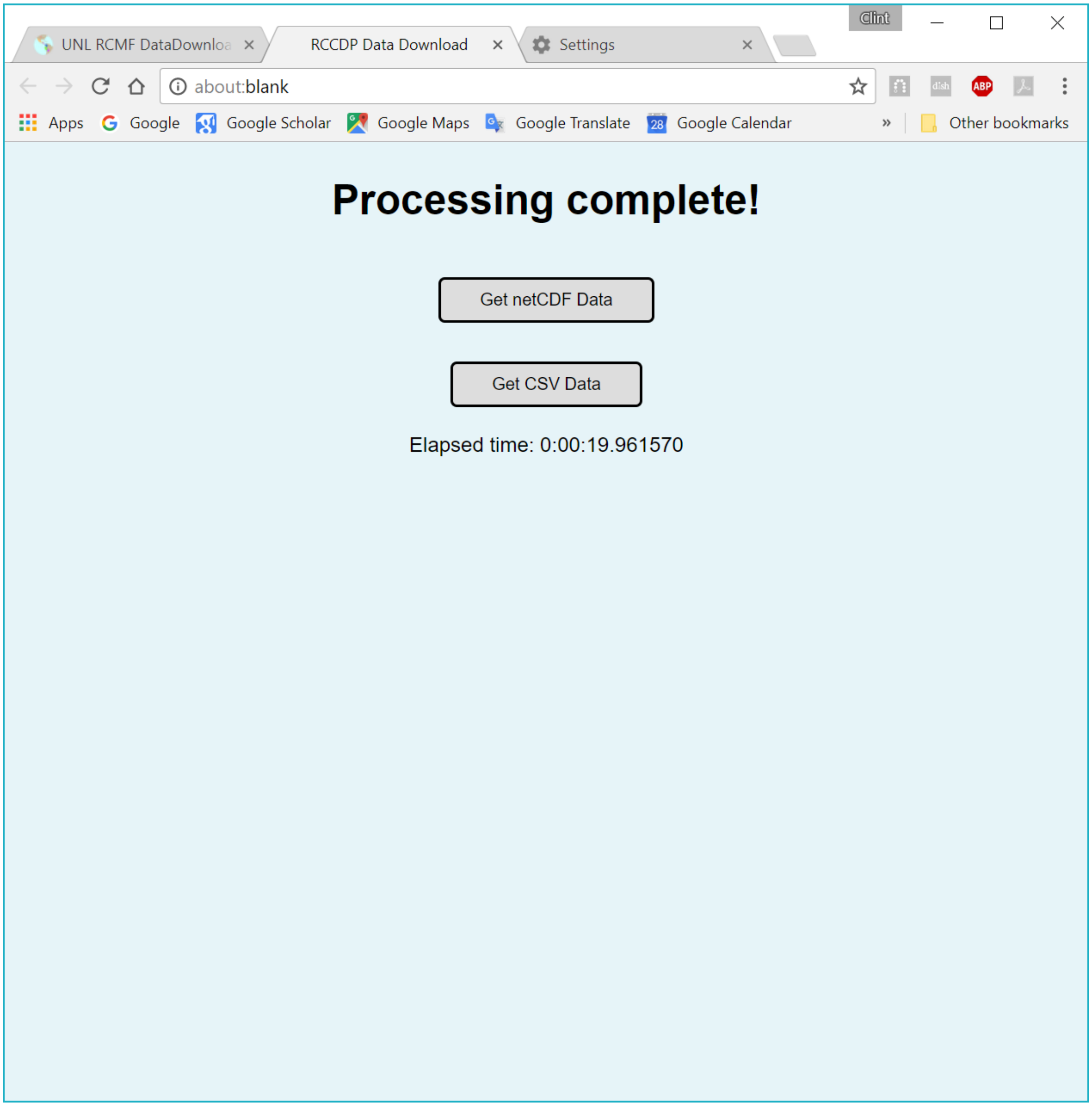
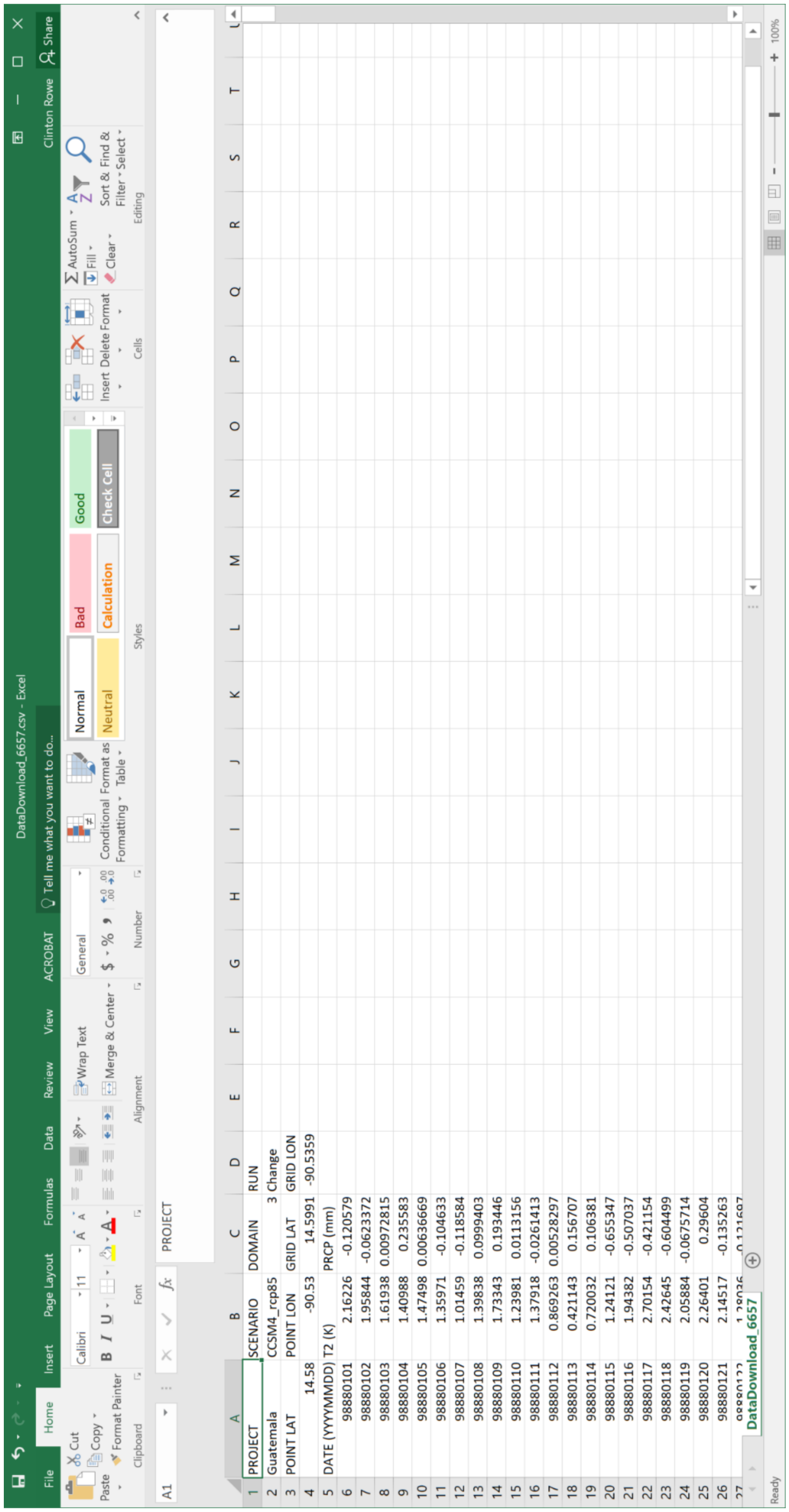


Figure D12: Sample output from Data Download. Links are provided to both netCDF and, for point data, CSV formats.



	A	B	C	D
1	PROJECT	SCENARIO	DOMAIN	RUN
2	Guatemala	CCSM4_rcp85		3 Change
3	POINT LAT	POINT LON	GRID LAT	GRID LON
4	14.58	-90.53	14.5991	-90.5359
5	DATE (YYYYMMDD)	T2 (K)	PRCP (mm)	
6	98880101	2.16226	-0.120579	
7	98880102	1.95844	-0.0623372	
8	98880103	1.61938	0.00972815	
9	98880104	1.40988	0.235583	
10	98880105	1.47498	0.00636669	
11	98880106	1.35971	-0.104633	
12	98880107	1.01459	-0.118584	
13	98880108	1.39838	0.0999403	
14	98880109	1.73343	0.193446	
15	98880110	1.23981	0.0113156	
16	98880111	1.37918	-0.0261413	
17	98880112	0.869263	0.00528297	
18	98880113	0.421143	0.156707	
19	98880114	0.720032	0.106381	
20	98880115	1.24121	-0.655347	
21	98880116	1.94382	-0.507037	
22	98880117	2.70154	-0.421154	
23	98880118	2.42645	-0.604499	
24	98880119	2.05884	-0.0675714	
25	98880120	2.26401	0.29604	
26	98880121	2.14517	-0.135263	

Figure D13: Sample output for Data Download. Temperature and precipitation changes from present-day to mid-century for Guatemala City, GT, based on the Guatemala project downscaling runs.