

Análisis de los posibles efectos del Cambio Climático sobre la Precipitación y la Temperatura en Guatemala, utilizando el modelo CCSM4-WRF

Objetivo General

Analizar el comportamiento de la precipitación y temperatura en clima presente y en el futuro bajo el escenario de cambio climático RCP8.5 de junio a agosto (verano en el Hemisferio Norte).

Objetivos Específicos

- Describir el clima de la región de estudio.
- Verificar los datos modelados contra observados de clima presente (2001- 2010).
- Evaluar la variabilidad climática estacional.
- Analizar las evidencias de Cambio Climático utilizando R-Climdex.
- Cuantificar los cambios futuros (2060) de Precipitación y Temperatura bajo el escenario RCP8.5.

Plan de Trabajo

Actividades:

- Descripción climática de la región de estudio.
 - ✓ Revisar.
- Verificación 2001-2010 (Clima presente)
 - ✓ Ciclo estacional (Faltan trimestrales).
 - ✓ Series de tiempo (Faltan trimestrales).
 - ✓ Histogramas de frecuencia GRS-WRF.
 - ✓ Diagramas de Taylor (Falta trimestral).
 - ✓ Análisis espacial (Map maker) (Faltan trimestrales).
- Variabilidad Climática estacional
 - ✓ Anomalías de temperatura y precipitación.
 - ✓ Correlación con el índice ATSM (El Niño 3.4).
 - ✓ Análisis espacial ENSO.
- ~~Analizar las evidencias de Cambio Climático utilizando R-Climdex.~~
 - ✓ ~~R-climdex P10, P90 (extremos).~~
 - ✓ ~~Tendencia P/t T/t (Observados).~~
- Cuantificar los cambios futuros (2060) de de Precipitación y Temperatura bajo el escenario RCP8.5.
 - ✓ Estaciones
 - ✓ Análisis espacial (Map Maker).
 - ✓ Distribución estadística.

Preguntas:

1. La variabilidad del futuro se puede asociar con el ENSO?
2. En la corrida del presente, el modelo ve fluctuaciones muy similares a lo observado. Podemos decir si el modelo asocia la señal del ENSO.

Sugerencias para el MAPMAKER:

1. Poder elegir sets estacionales. Por ejemplo: Nov 200 Dic 2000 enero 2001.

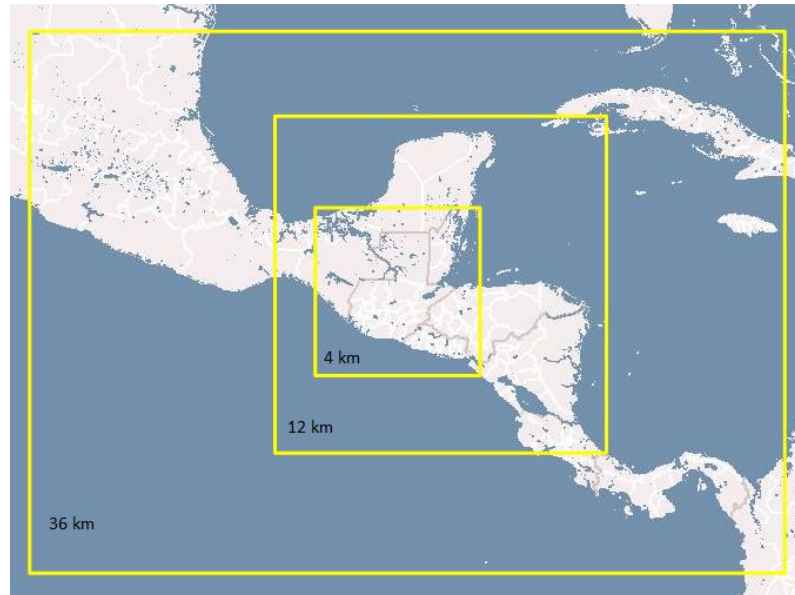
2. Además de las descargas CSV y netCDF, descargar gráficas para las coordenadas seleccionadas.
3. Que calcule índices de Cambio Climático.
4. Que genere curvas de distribución entre lo observado, simulado y futuro y su correlación.
5. Incluir “hints” con instrucciones de a qué se refiere cada opción.
6. Hacer el taller en Nebraska o Utila.
7. Que grafique ciclos anuales y series de tiempo específicos.
8. Para corridas largas que pueda calcular tendencias de índices climáticos .

Compromisos Adicionales:

Entregar en formato MapMaker datos de estaciones de Guatemala (Gaby).

Análisis de los posibles efectos del Cambio Climático sobre la Precipitación y la Temperatura en Guatemala, utilizando el modelo CCSM4-WRF.

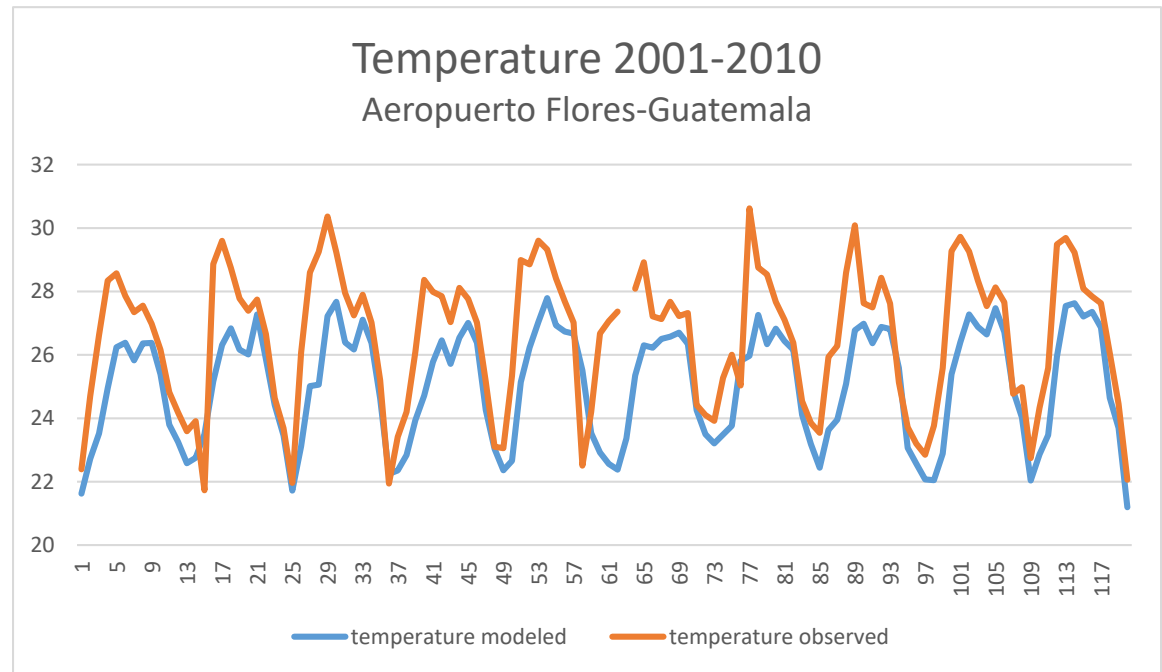
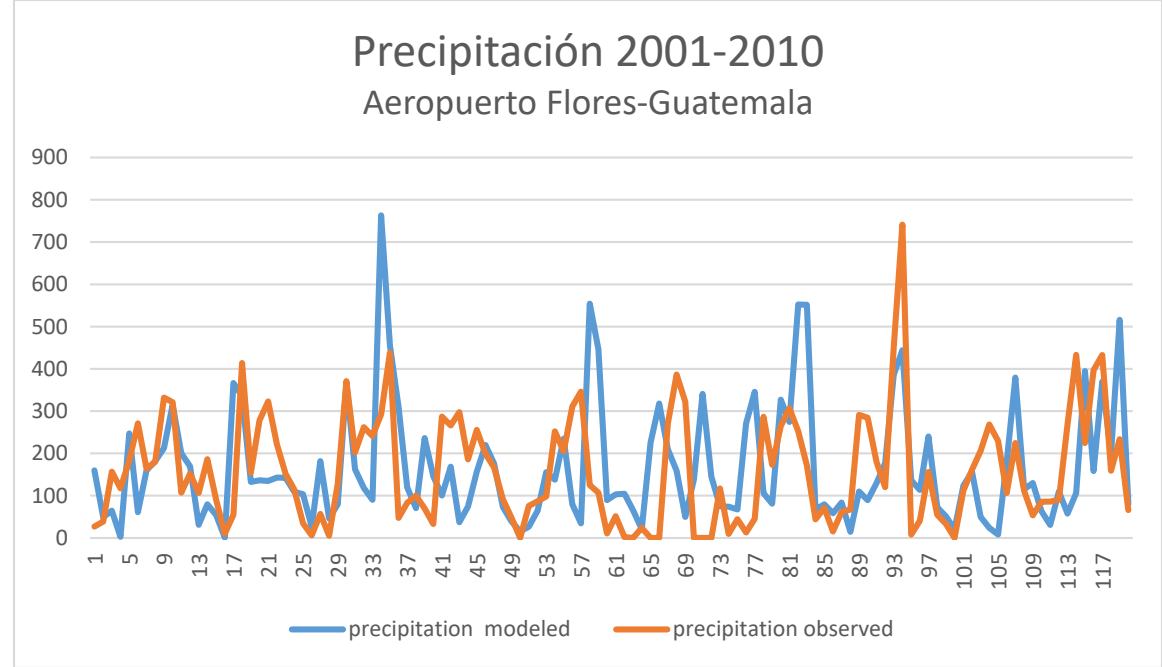
Alfaro G., Alvarado L., Barrera D., Nieto JJ. y Ruiz, F. 2018.



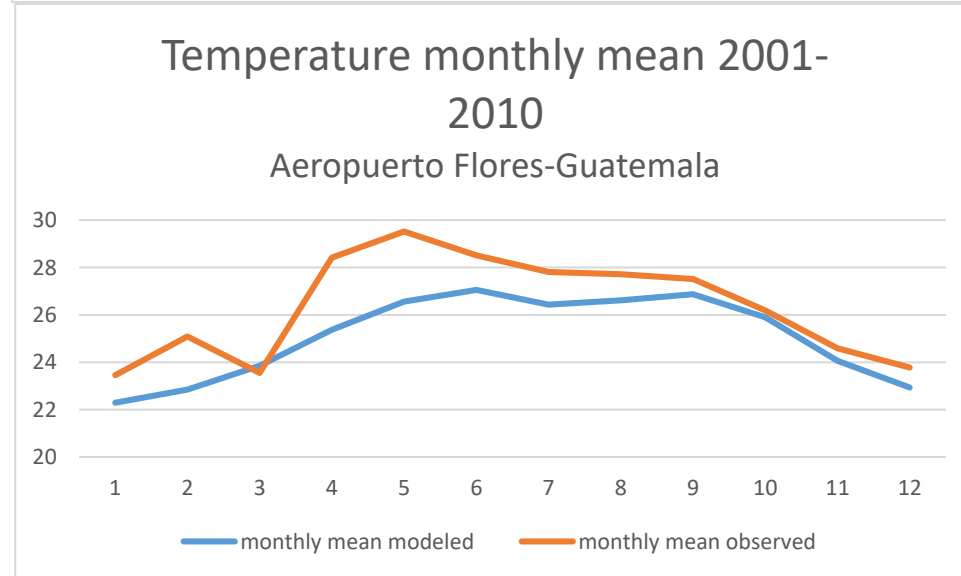
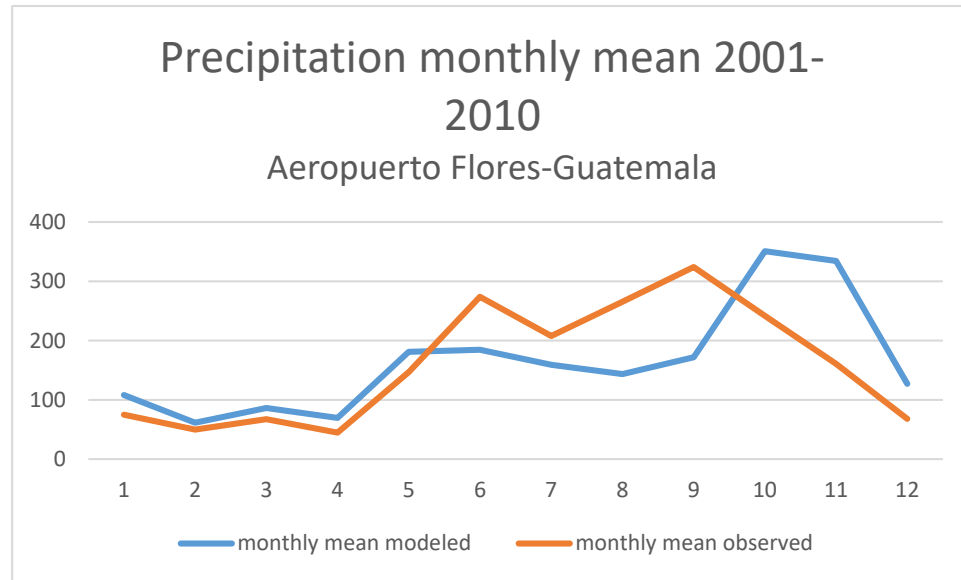
Ubicación de Estaciones Guatemala



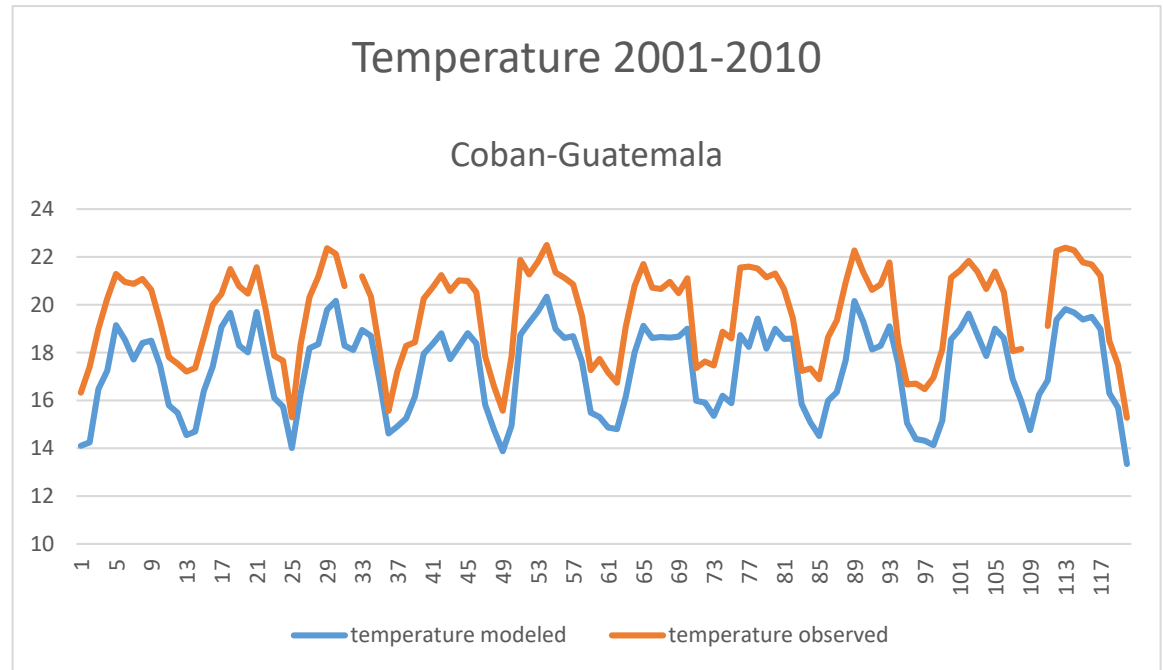
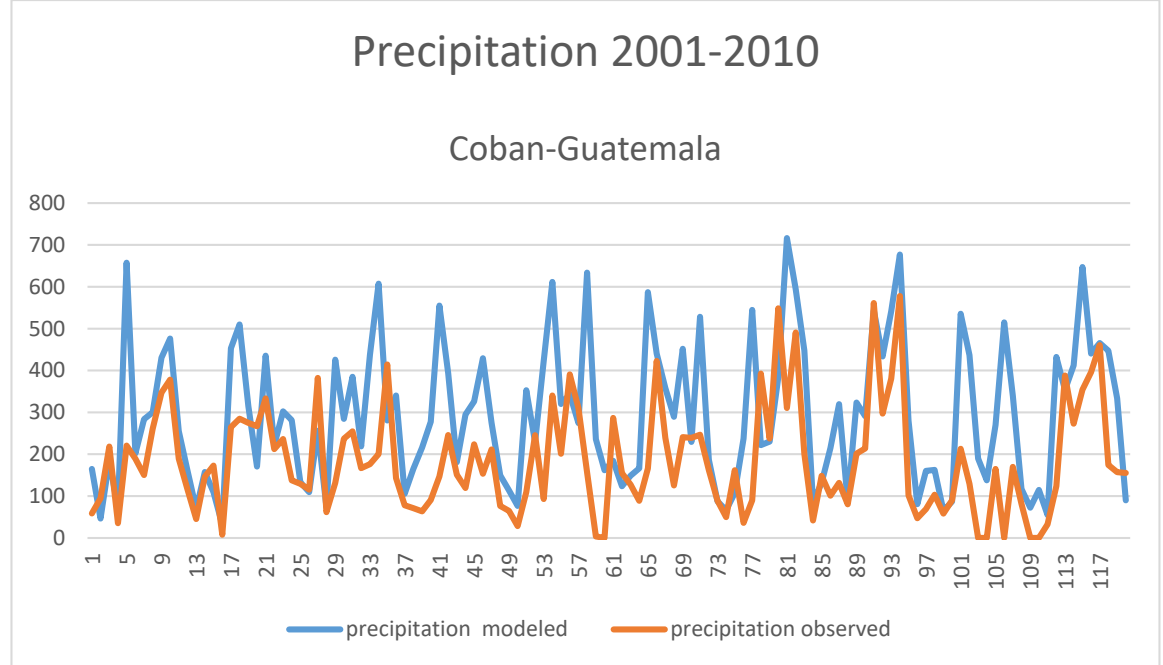
**Series de tiempo
Modelo
vs
Observado
Aeropuerto
Flores**



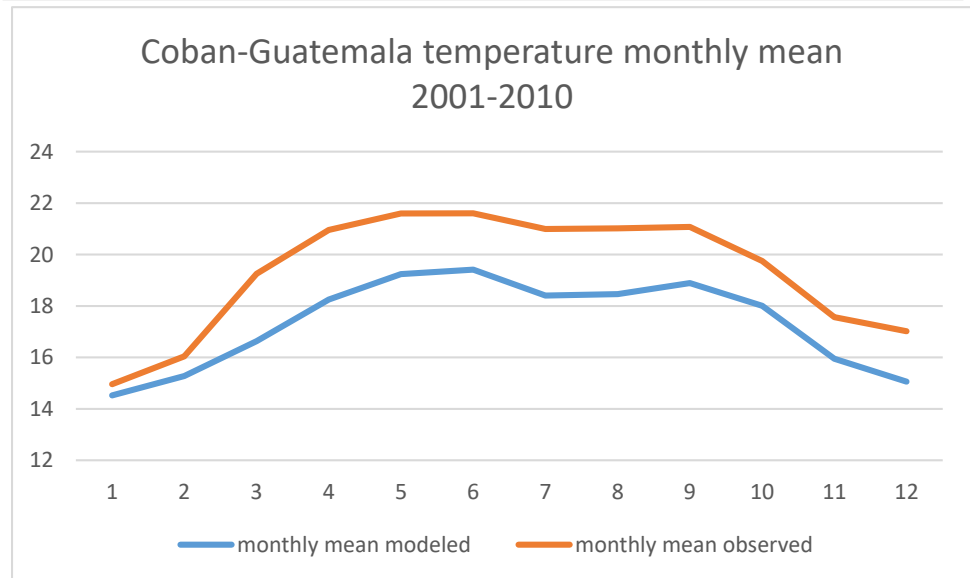
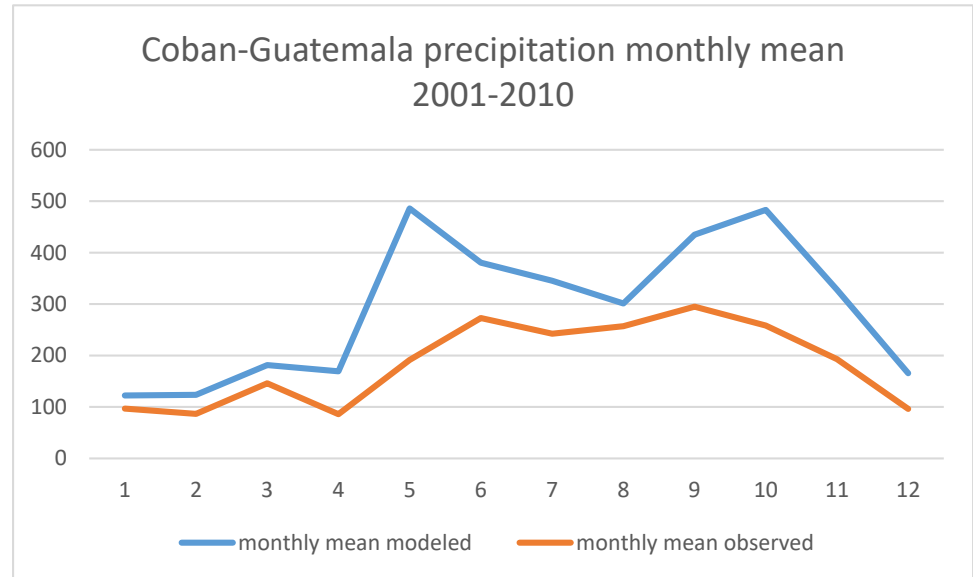
**Series de tiempo
Modelo
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Observado
Aereopuerto
Flores**



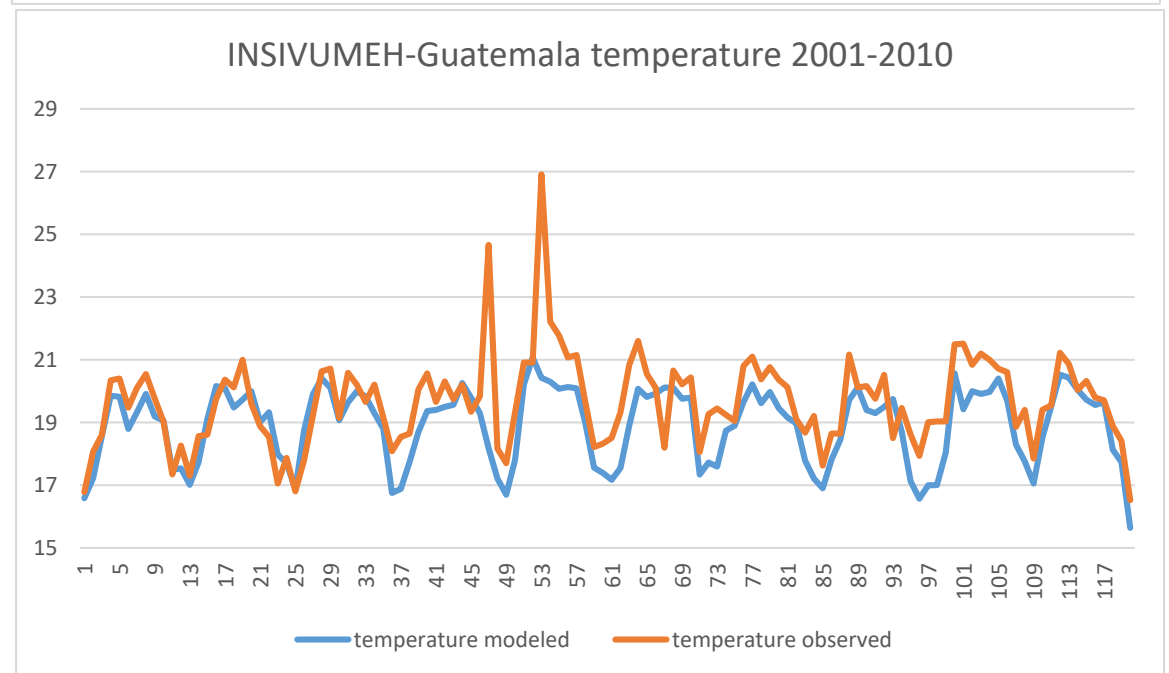
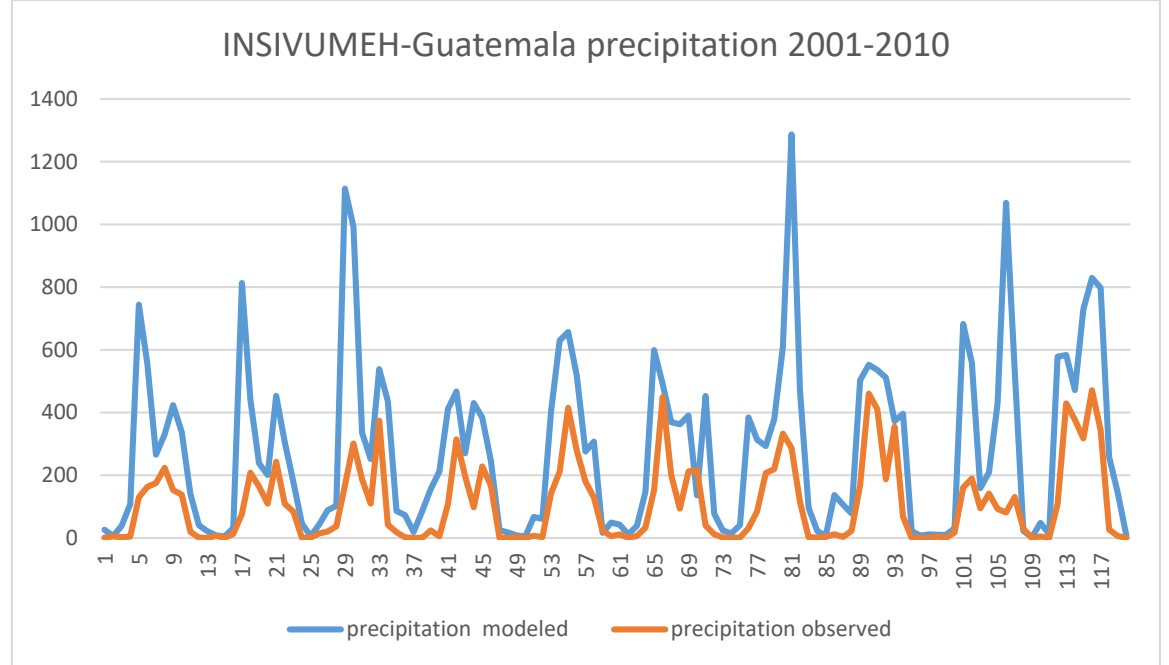
**Series de tiempo
Modelo
vs
Observado
Cobán**



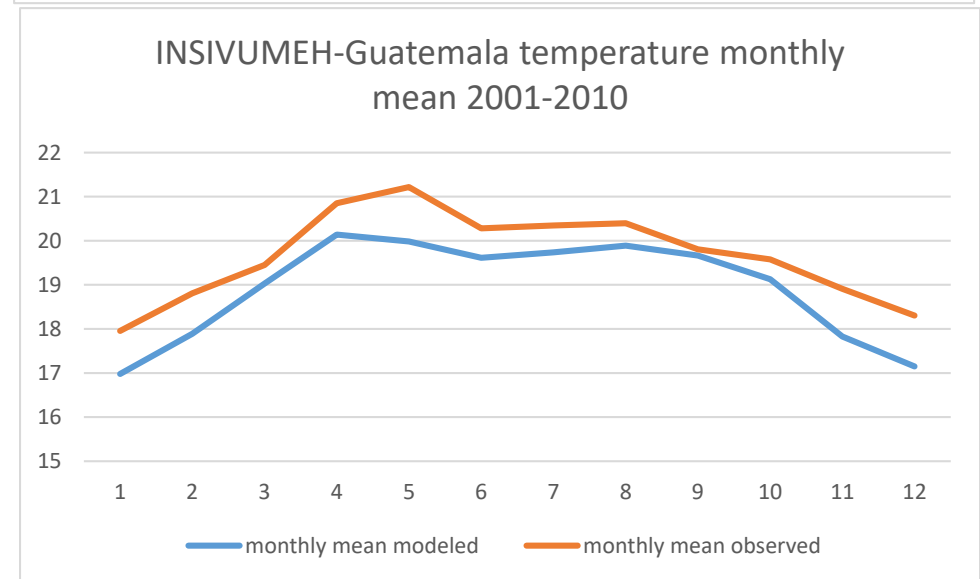
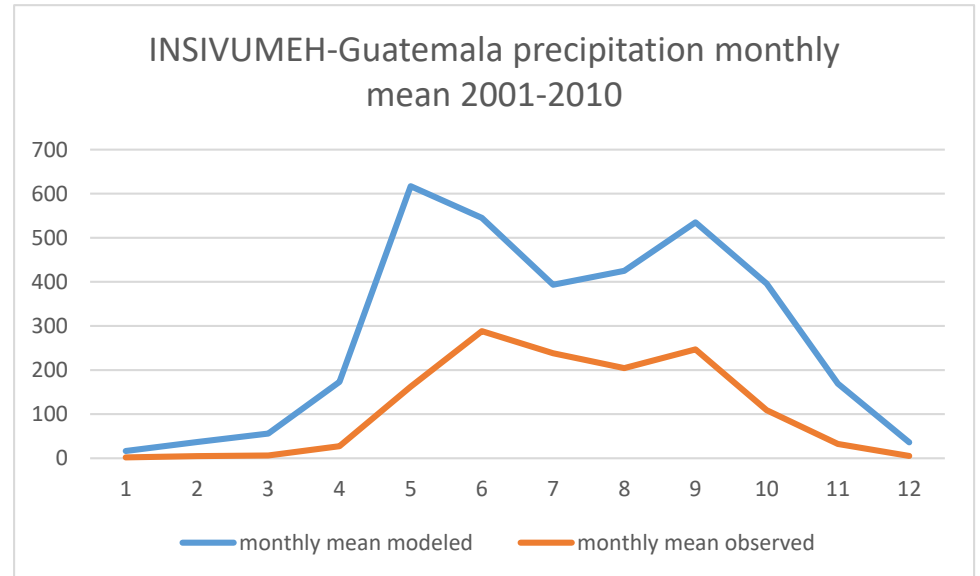
**Series de tiempo
Modelo
vs
Observado
Cobán**



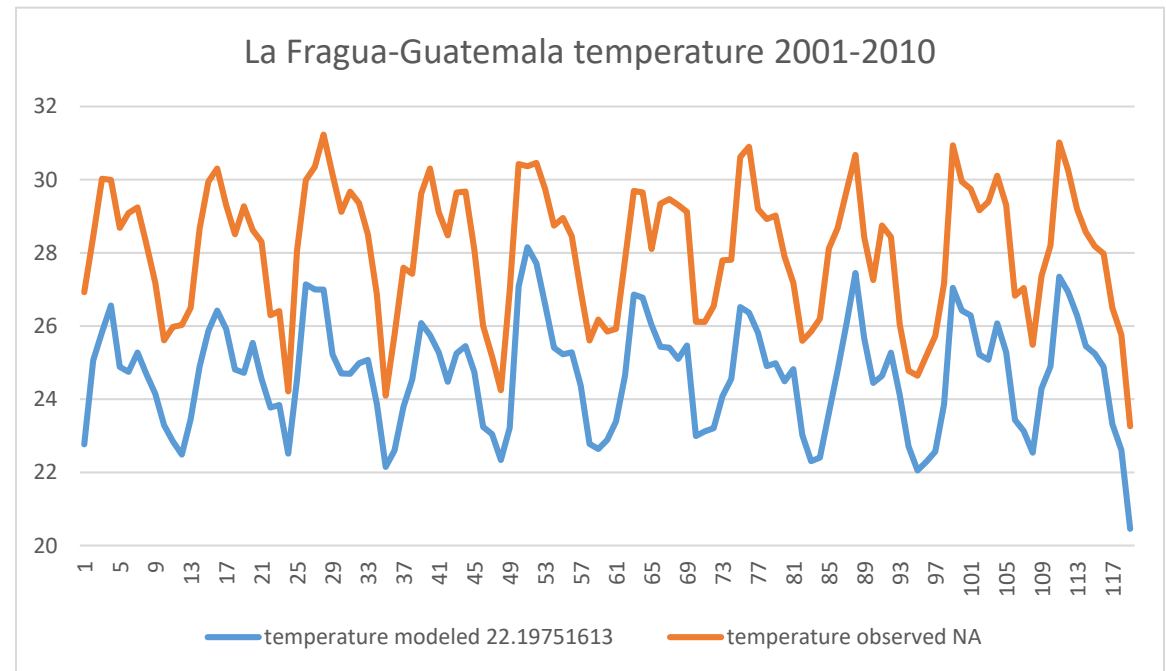
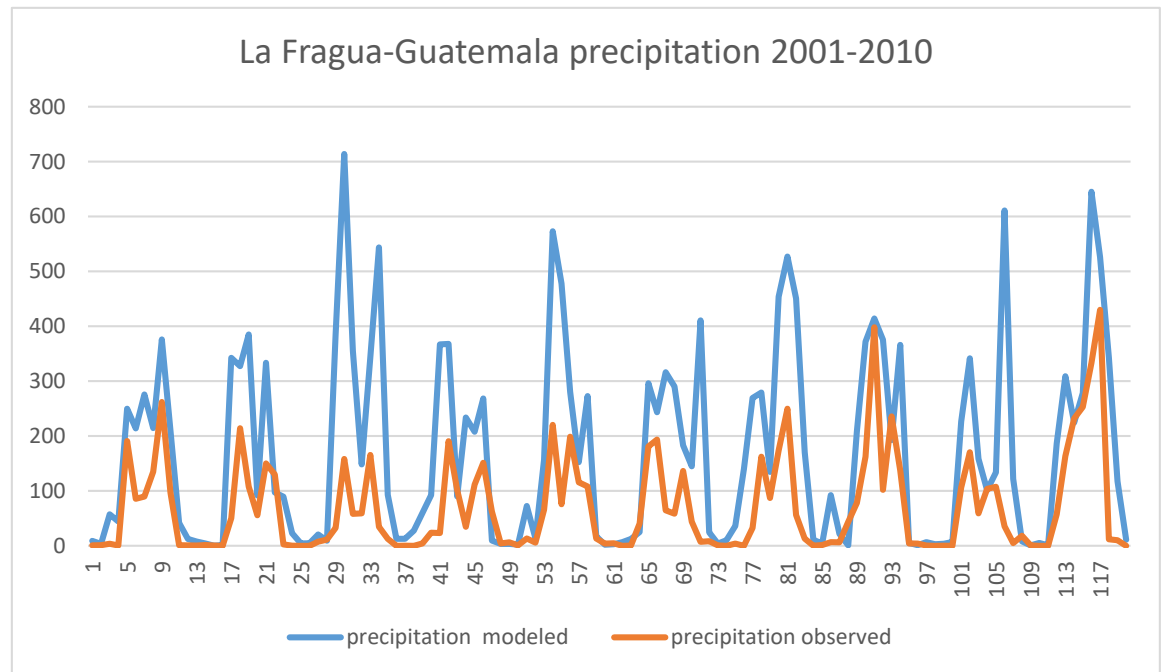
**Series de tiempo
Modelo
vs
Observado
INSIVUMEH**



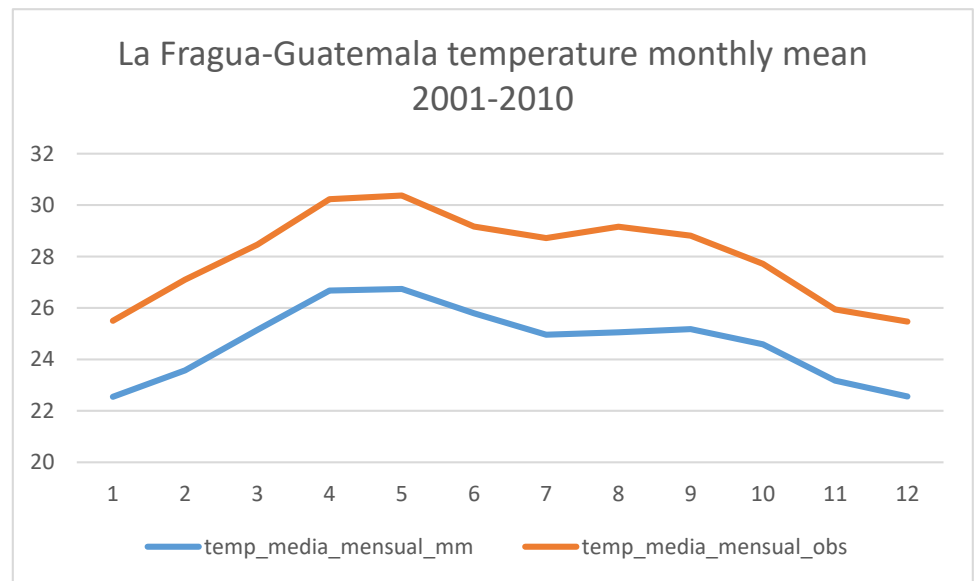
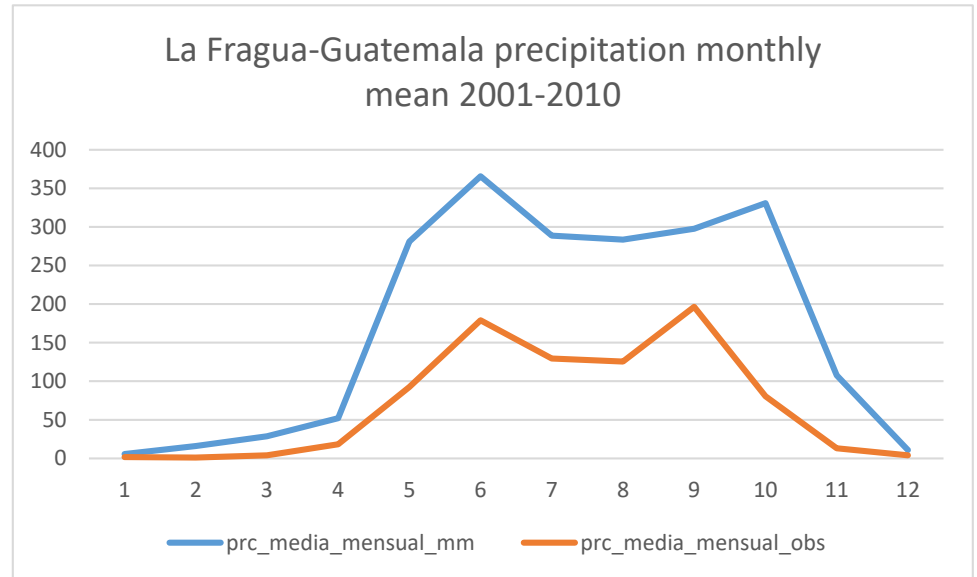
**Series de tiempo
Modelo
vs
Observado
INSIVUMEH**



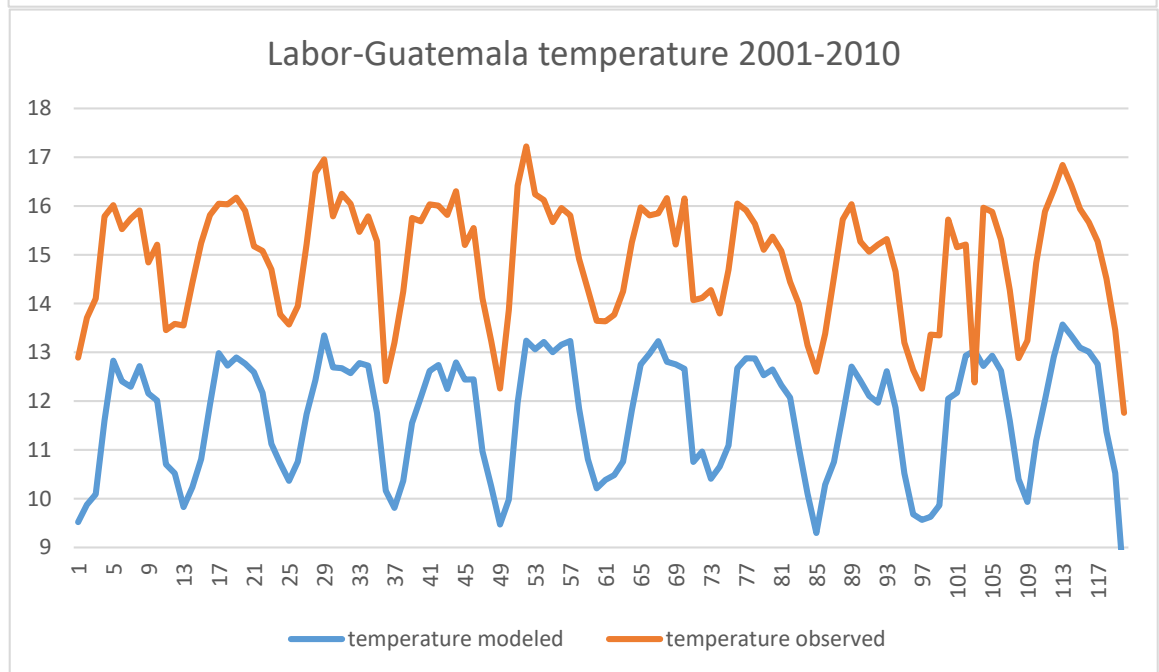
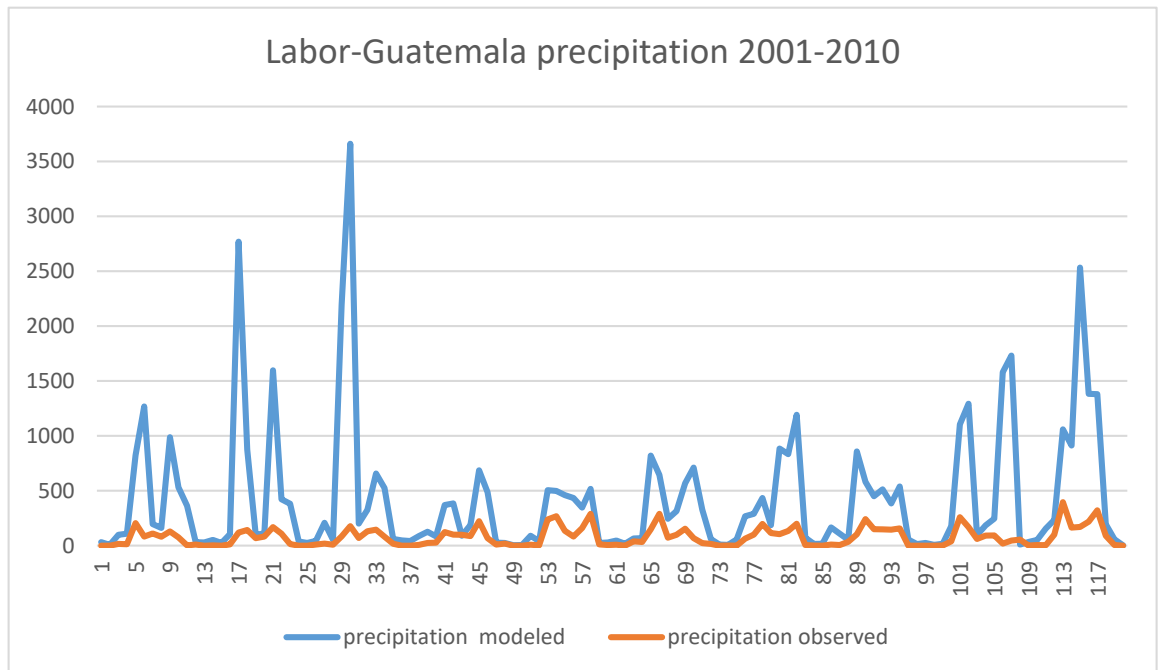
**Series de tiempo
Modelo
vs
Observado
La Fragua**



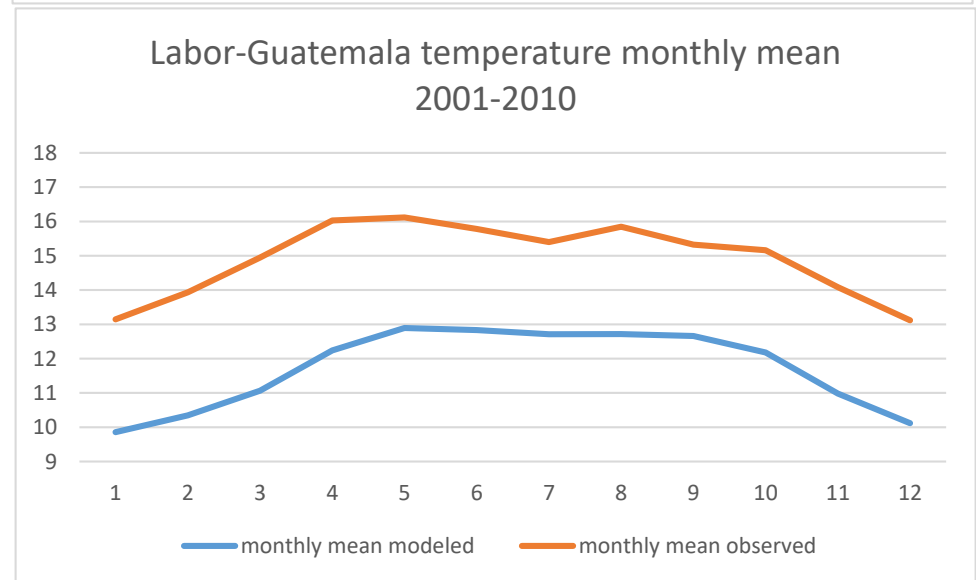
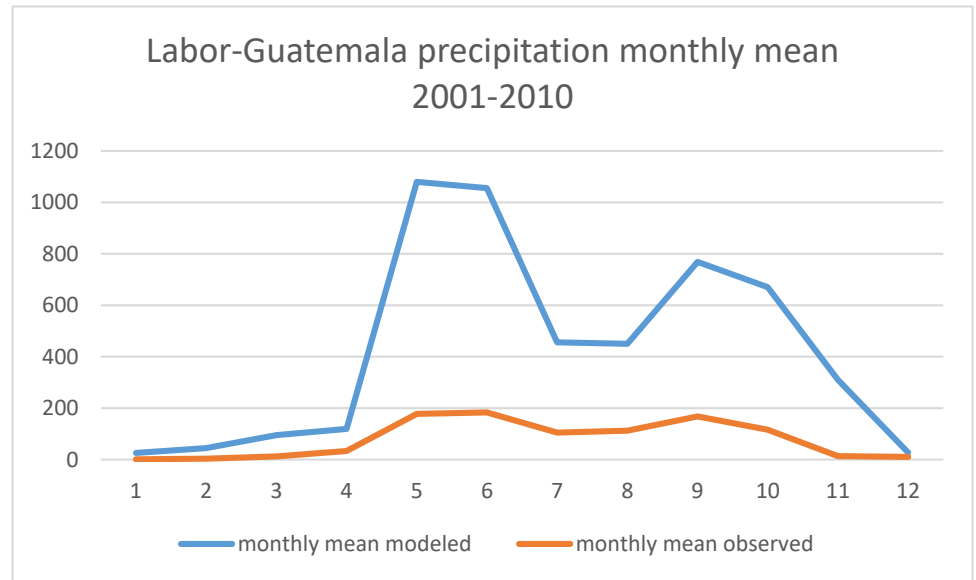
**Series de tiempo
Modelo
vs
Observado
La Fragua**



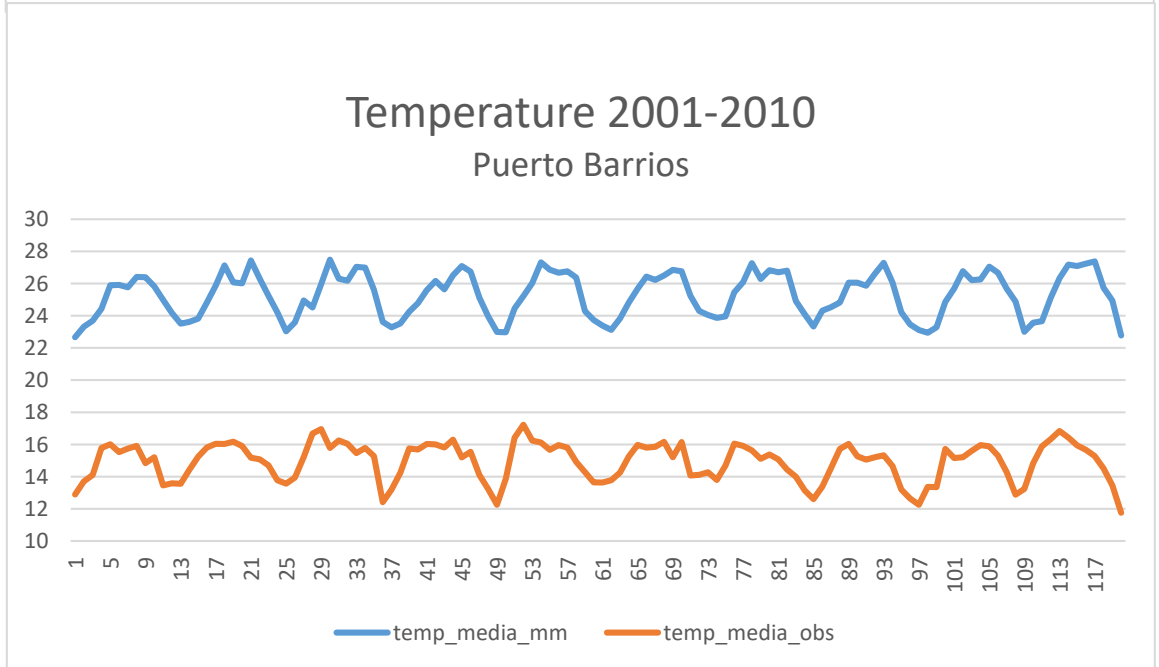
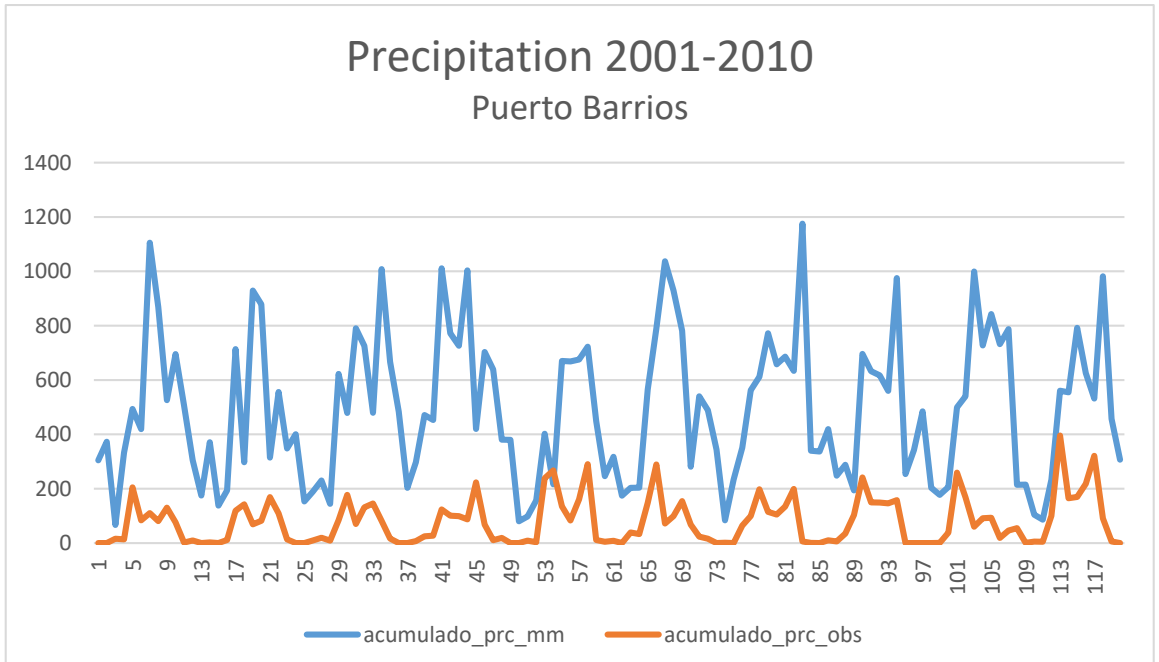
**Series de tiempo
Modelo
vs
Observado
Labor**



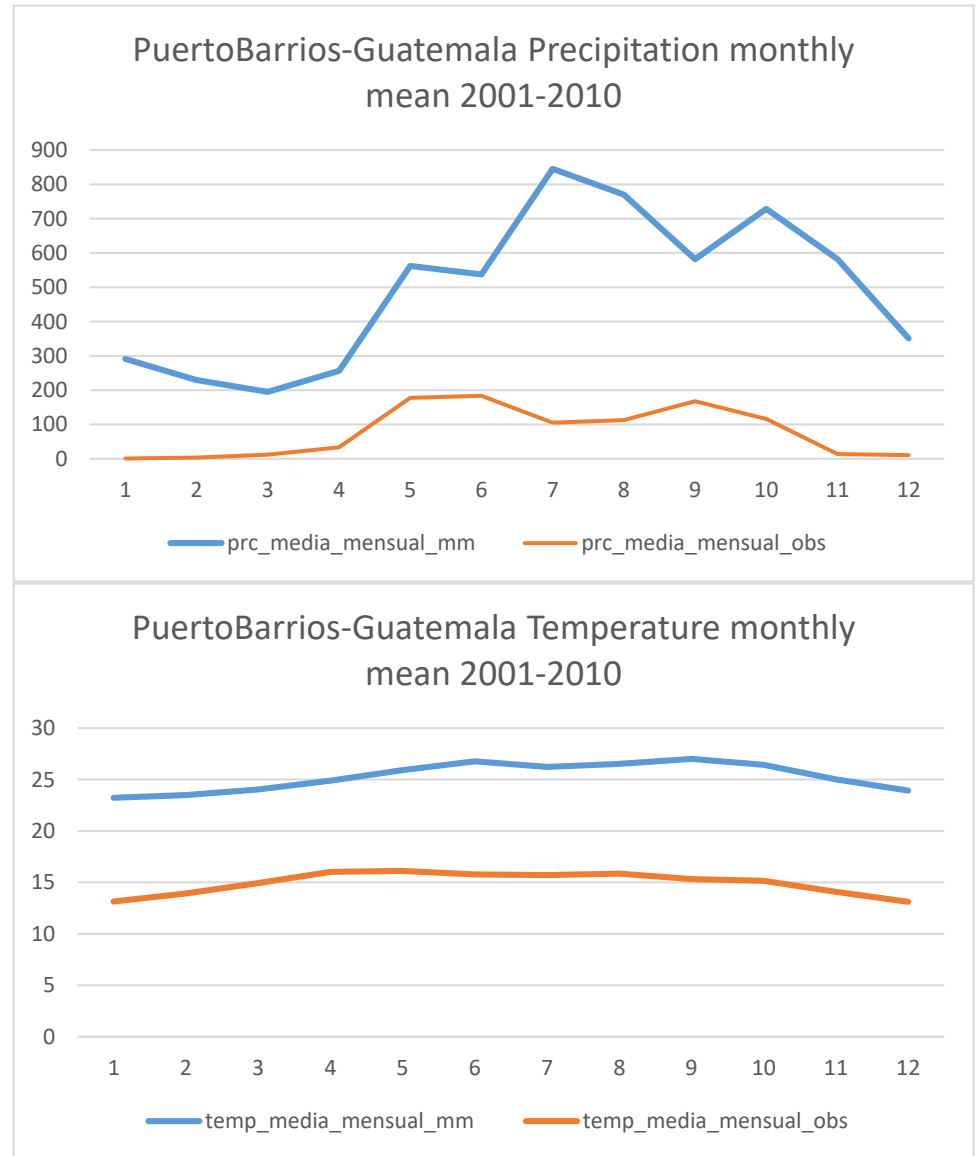
**Series de tiempo
Modelo
vs
Observado
Labor**



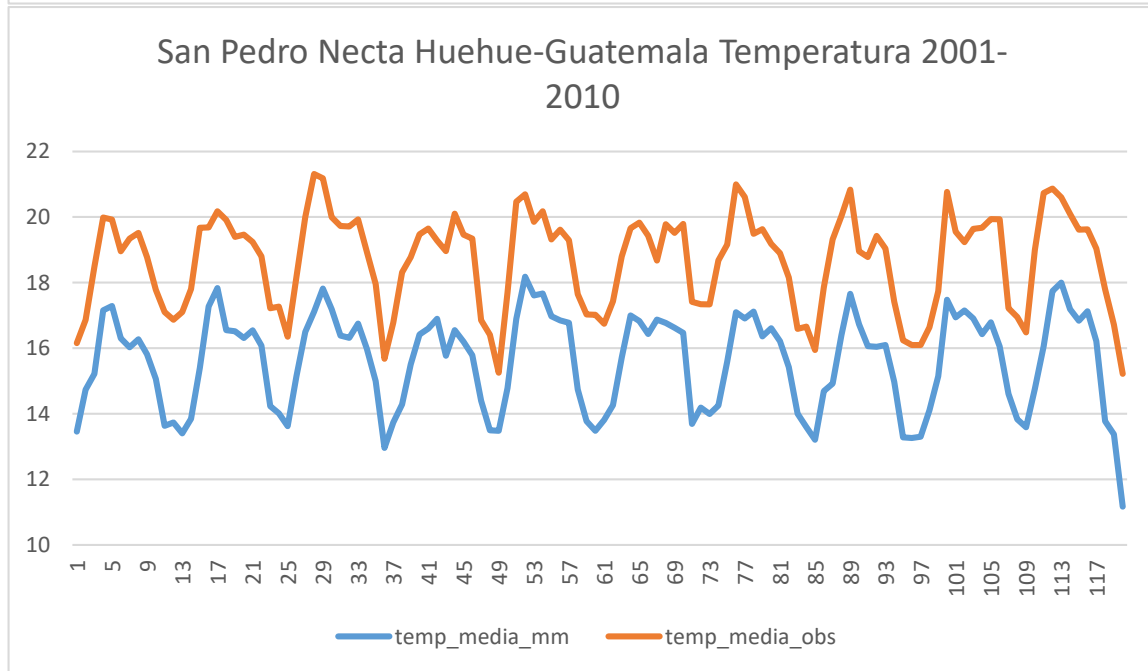
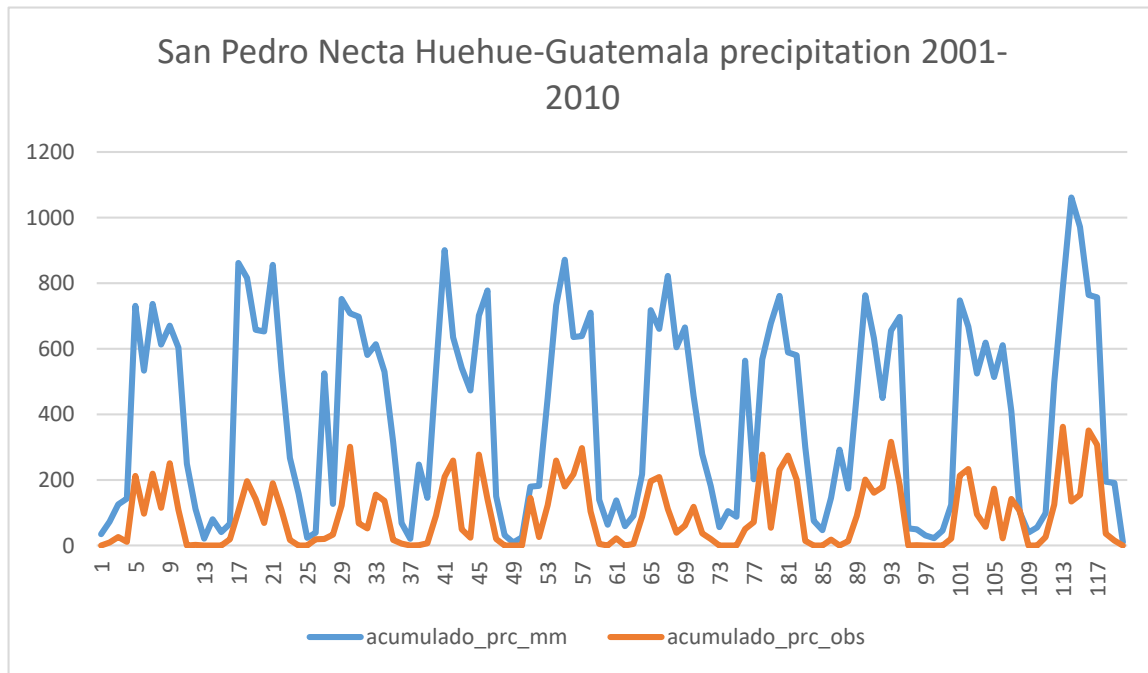
**Series de tiempo
Modelo
vs
Observado
Puerto Barrios**



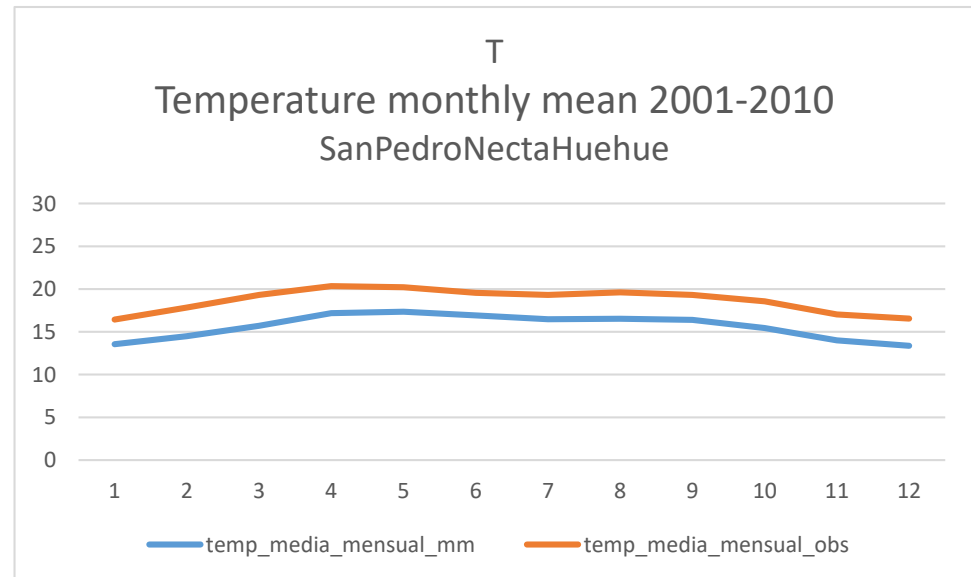
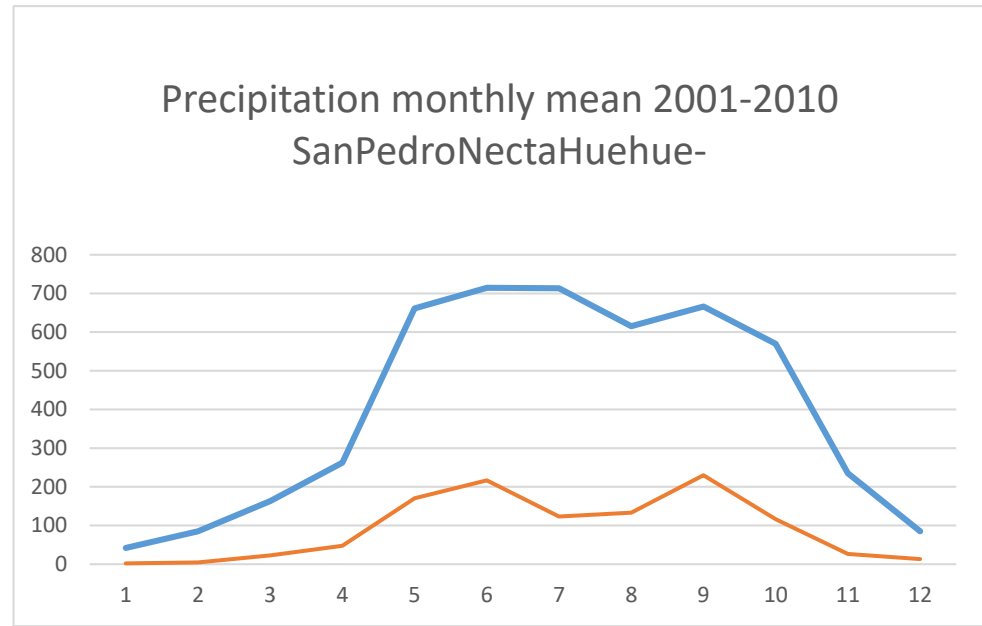
Series de tiempo Modelo VS Observado Puerto Barrios



**Series de tiempo
Modelo
vs
Observado
Huehuetenango**



**Series de tiempo
Modelo
vs
Observado
Huehuetenango**

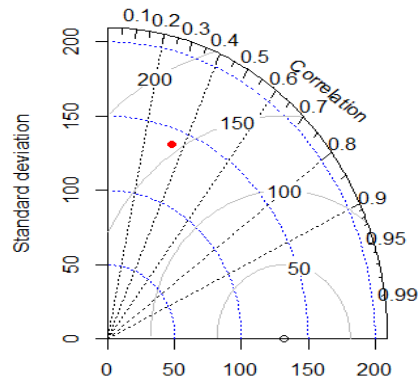


Diagramas de Taylor

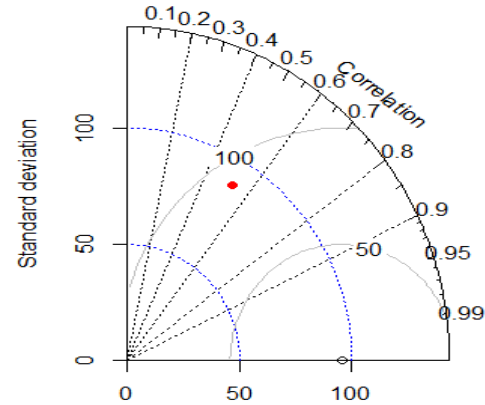
Datos observados vs Datos modelados

Estación: Aeropuerto Flores

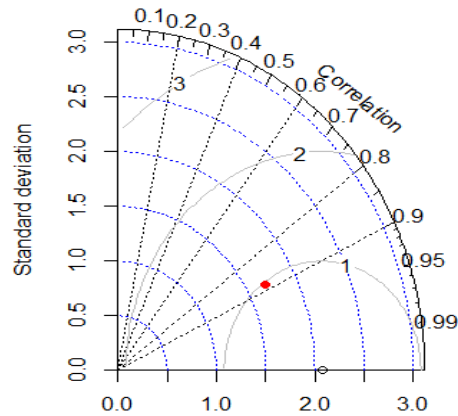
Aeropuerto Flores - Precipitación



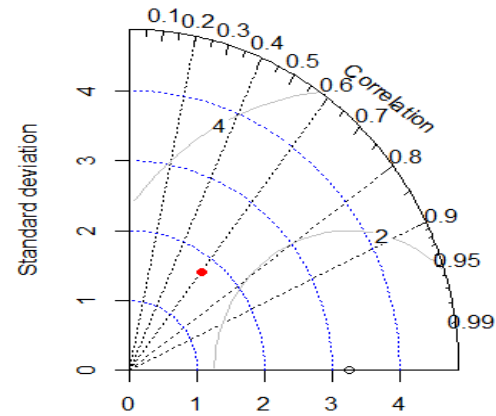
Aeropuerto Flores - NH. Precipitación



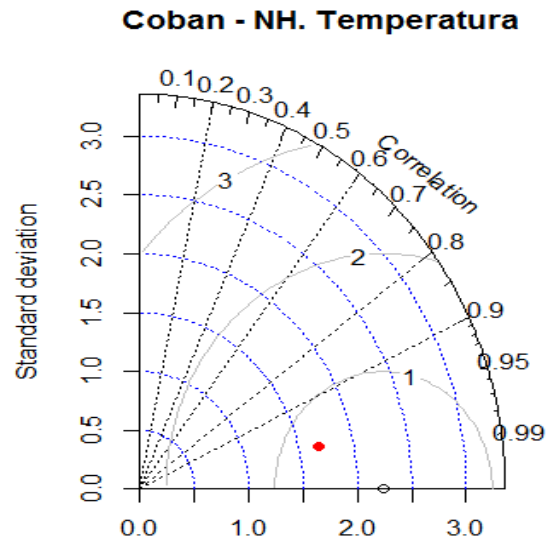
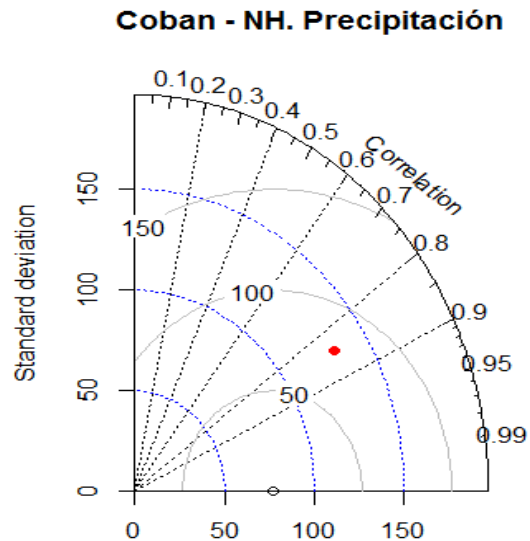
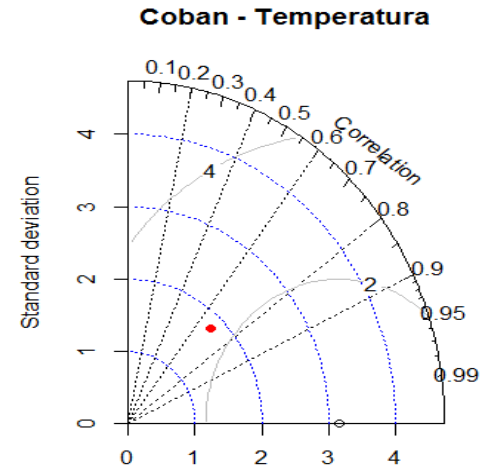
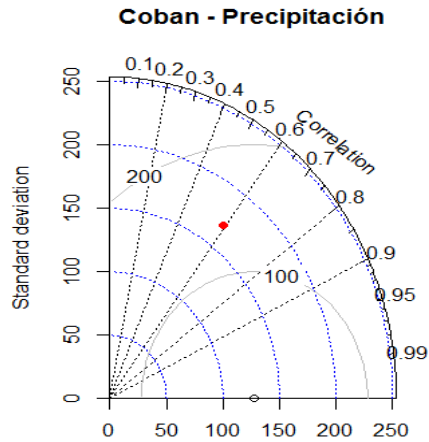
Aeropuerto Flores - NH. Temperatura



Aeropuerto Flores - Temperatura

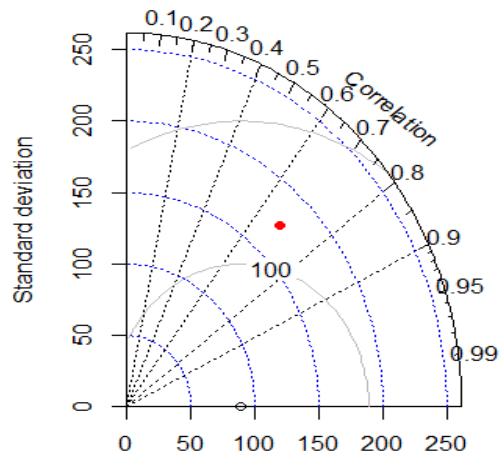


Estación: Cobán

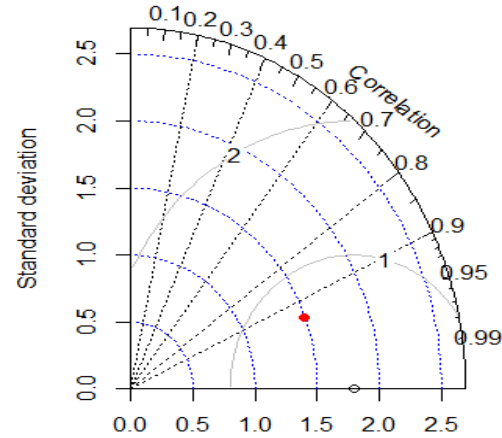


Estación: La Fragua

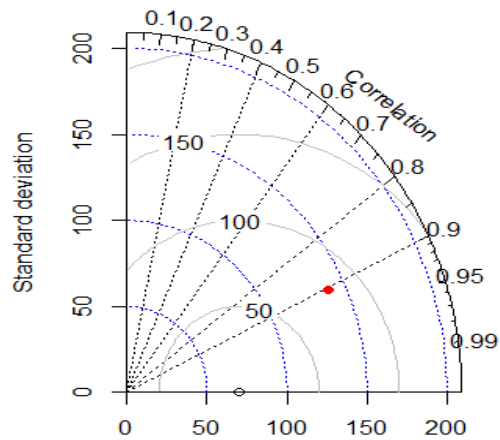
La Fragua - Precipitación



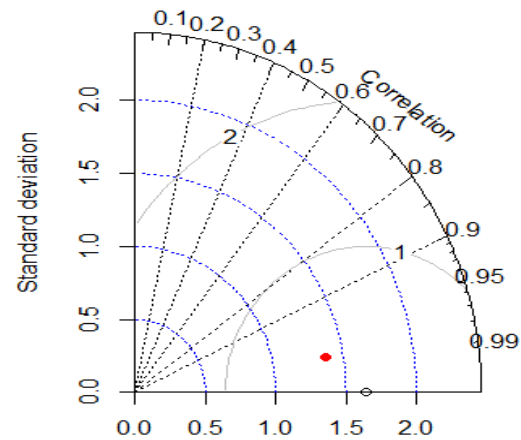
La Fragua - Temperatura



La Fragua - NH. Precipitación

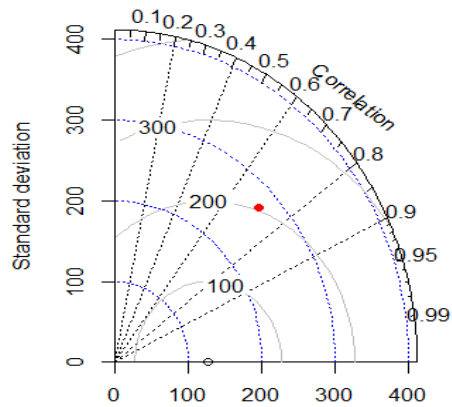


La Fragua - NH. Temperatura

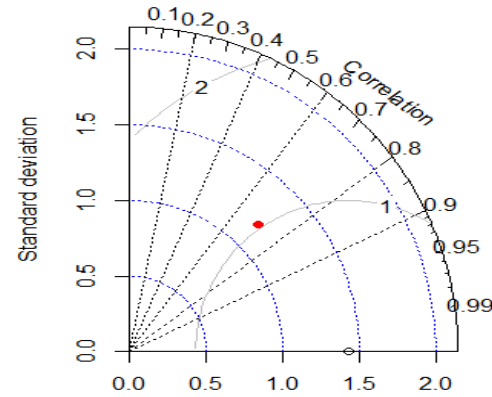


Estación: INSIVUMEH

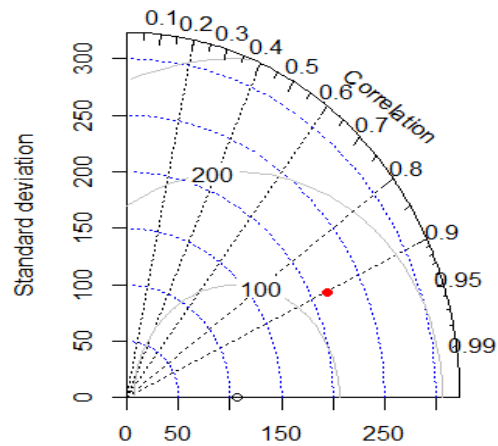
INSIVUMEH - Precipitación



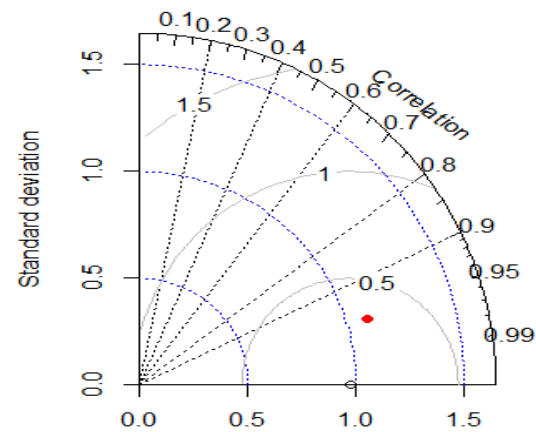
INSIVUMEH - Temperatura



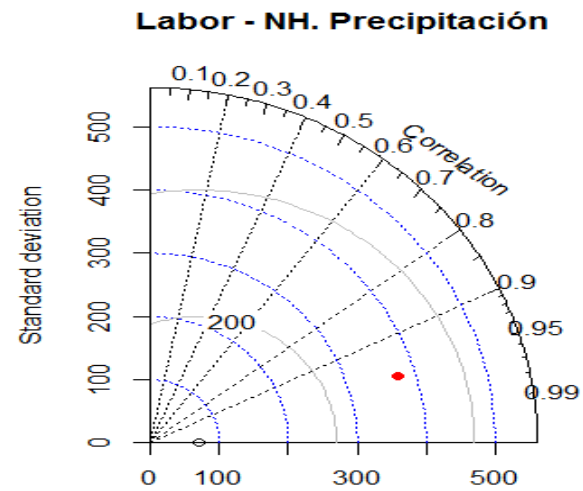
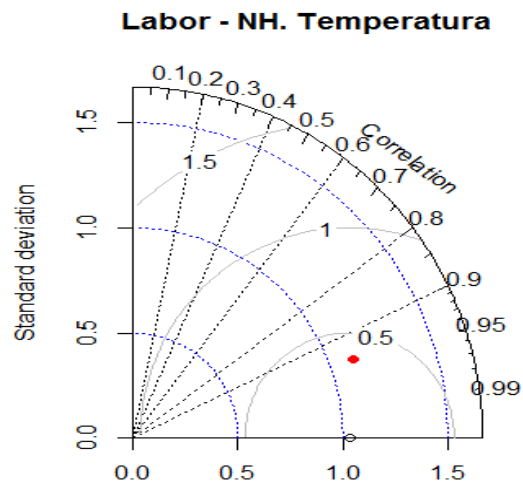
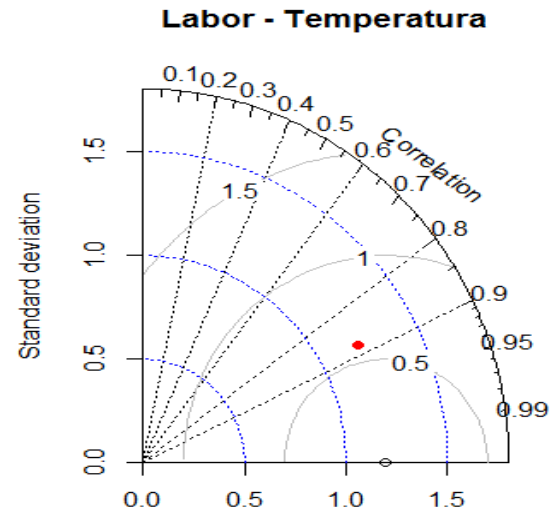
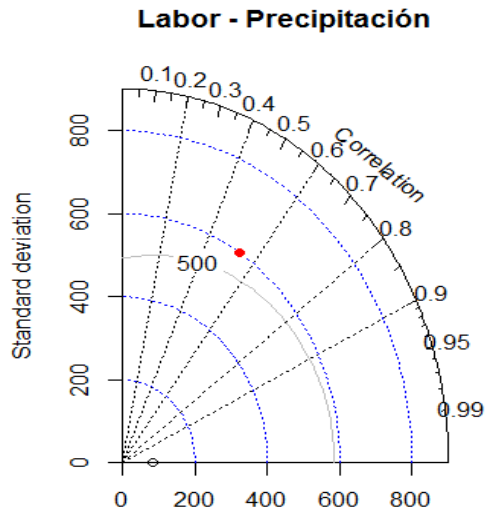
INSIVUMEH - NH. Precipitación



INSIVUMEH - NH. Temperatura

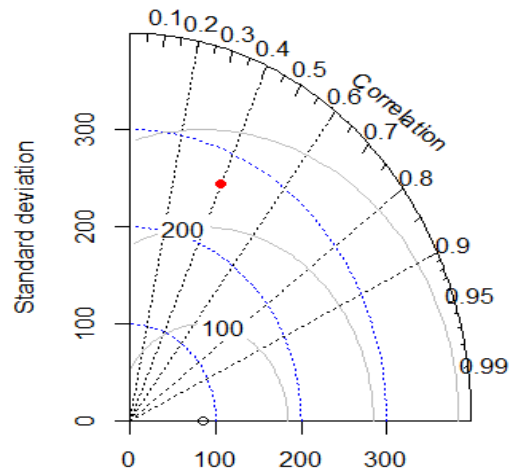


Estación: Labor

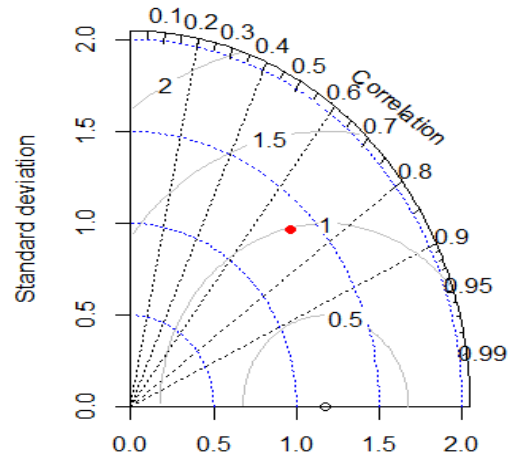


Estación: Puerto Barrios

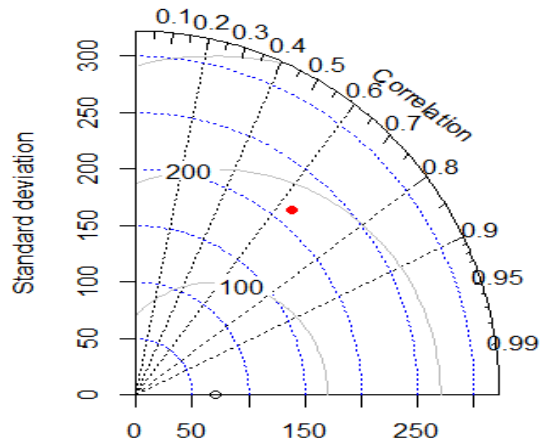
Puerto Barrios - Precipitación



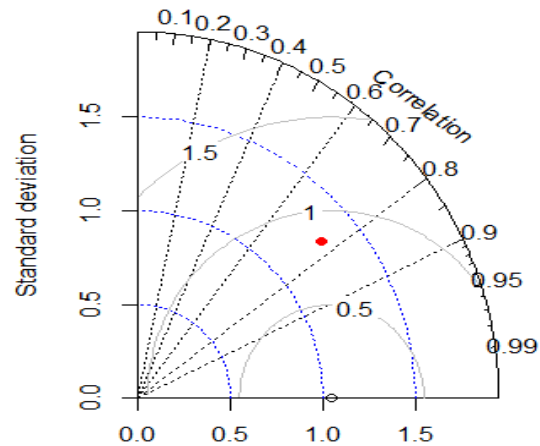
Puerto Barrios - Temperatura



Puerto Barrios - NH. Precipitación

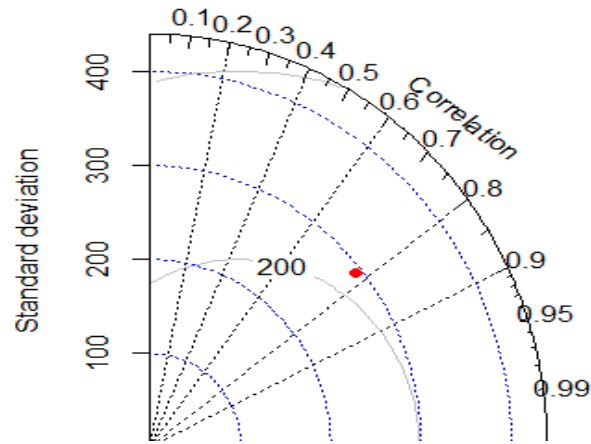


Puerto Barrios - NH. Temperatura

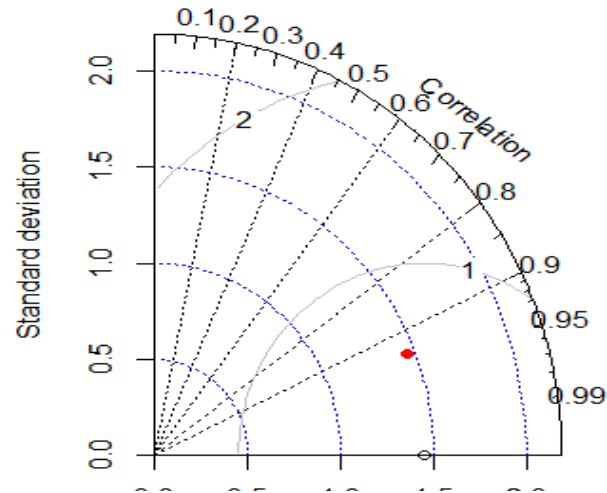


Estación: San Pe

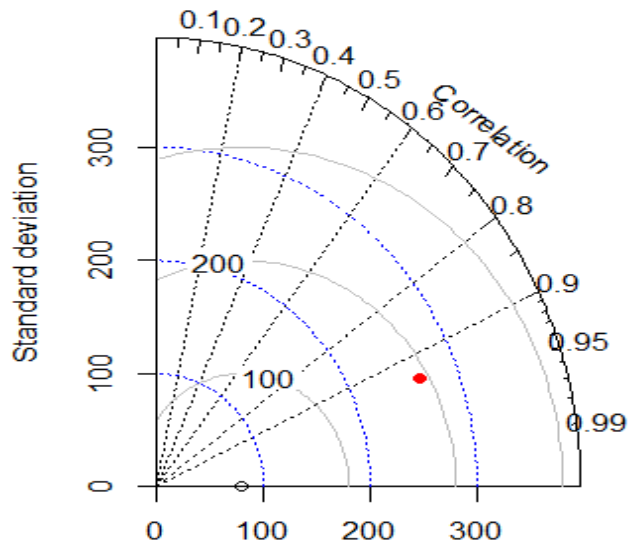
San Pedro - Precipitación



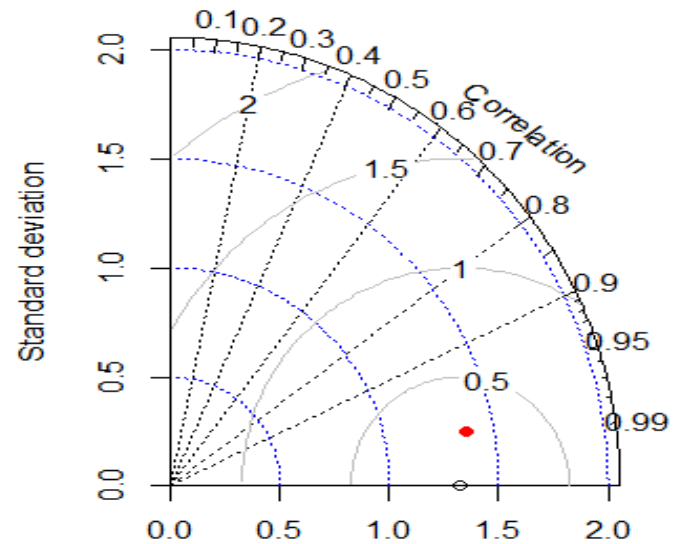
San Pedro - Temperatura



San Pedro - NH. Precipitación



San Pedro - NH. Temperatura



EVENTOS NIÑO y NIÑA

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

Nota:

Jul= Jun-Jul-Ago
 I= inicio
 F= final
 HS1 = 1971-1980
 HS2 = 2001-2010

HS1 (1971 - 1980)							
	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 (2011-2016)							
	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				

Proyecto: Guatemala

Escenario: Histórico

Dominio: D03 Guatemala (4 km)

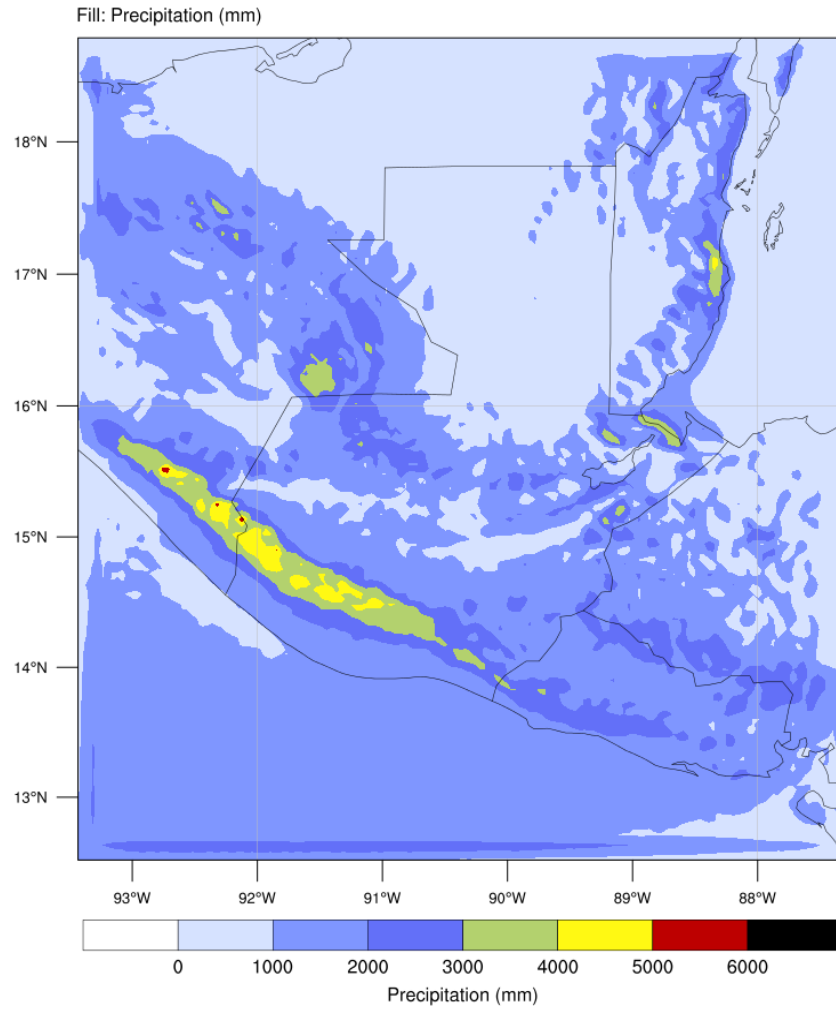
Corrida: NNRP: **1971-1980**

Temporada : verano (junio-agosto)

Variable: lluvia (mm)

CLIMATOLOGIA (1971-1980)

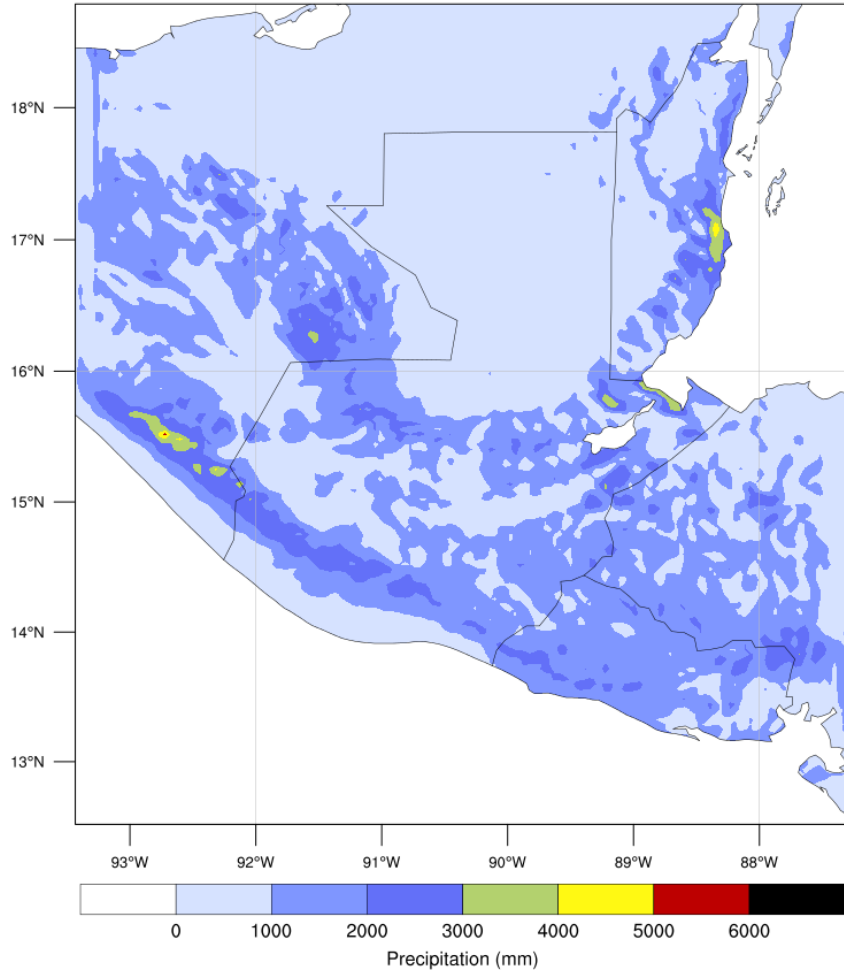
JunJulAug Climatology



EVENTO: LA NIÑA 1971

JunJulAug 1971

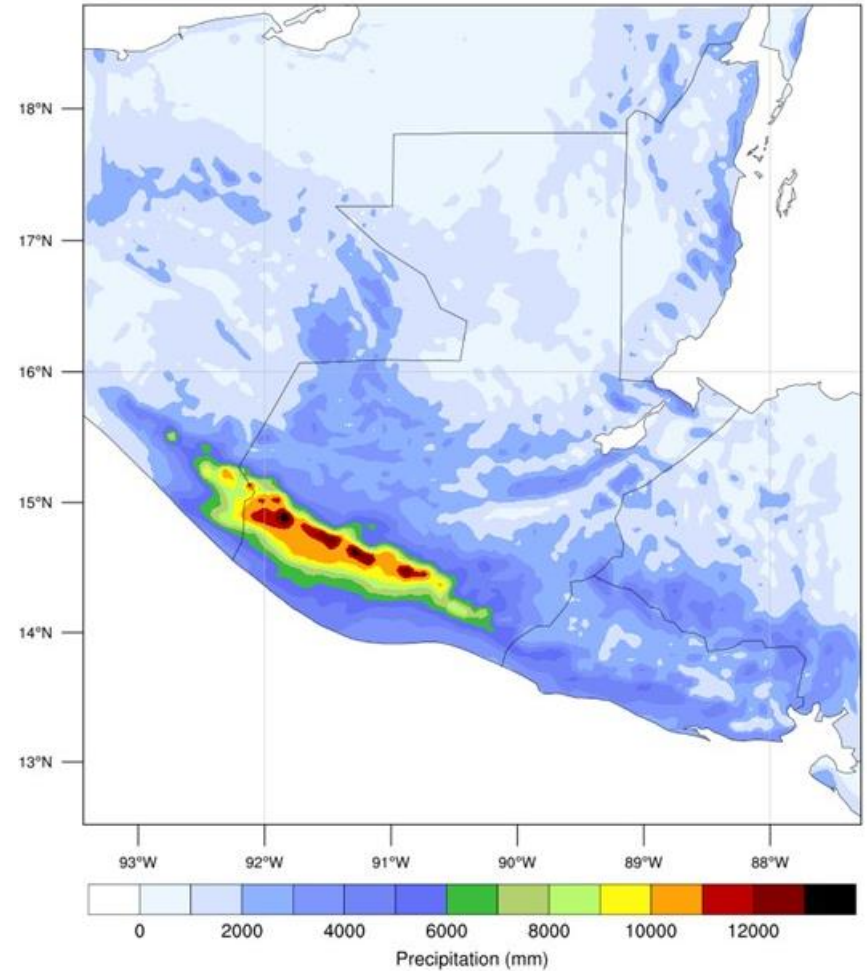
Fill: Precipitation (mm)



EVENTO: EL NIÑO 1972

JunJulAug 1972

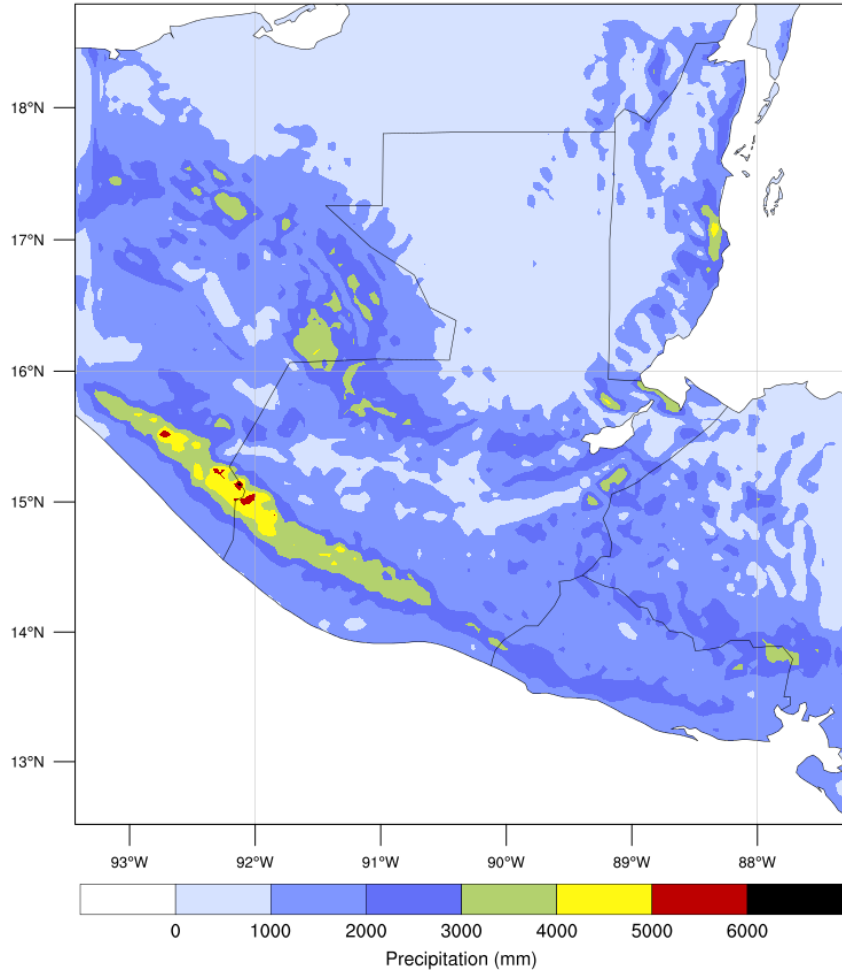
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EVENTO: LA NIÑA 1973

JunJulAug 1973

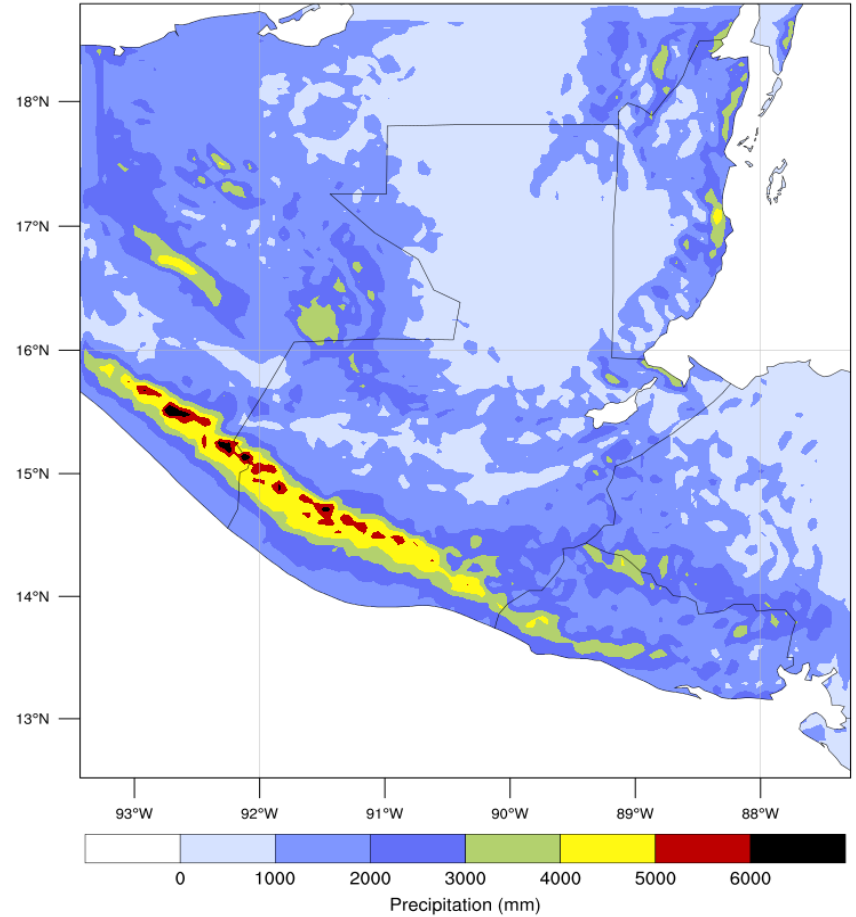
Fill: Precipitation (mm)



EVENTO: LA NIÑA 1974

JunJulAug 1974

Fill: Precipitation (mm)



Proyecto: Guatemala

Escenario: Histórico

Dominio: D03 Guatemala (4 km)

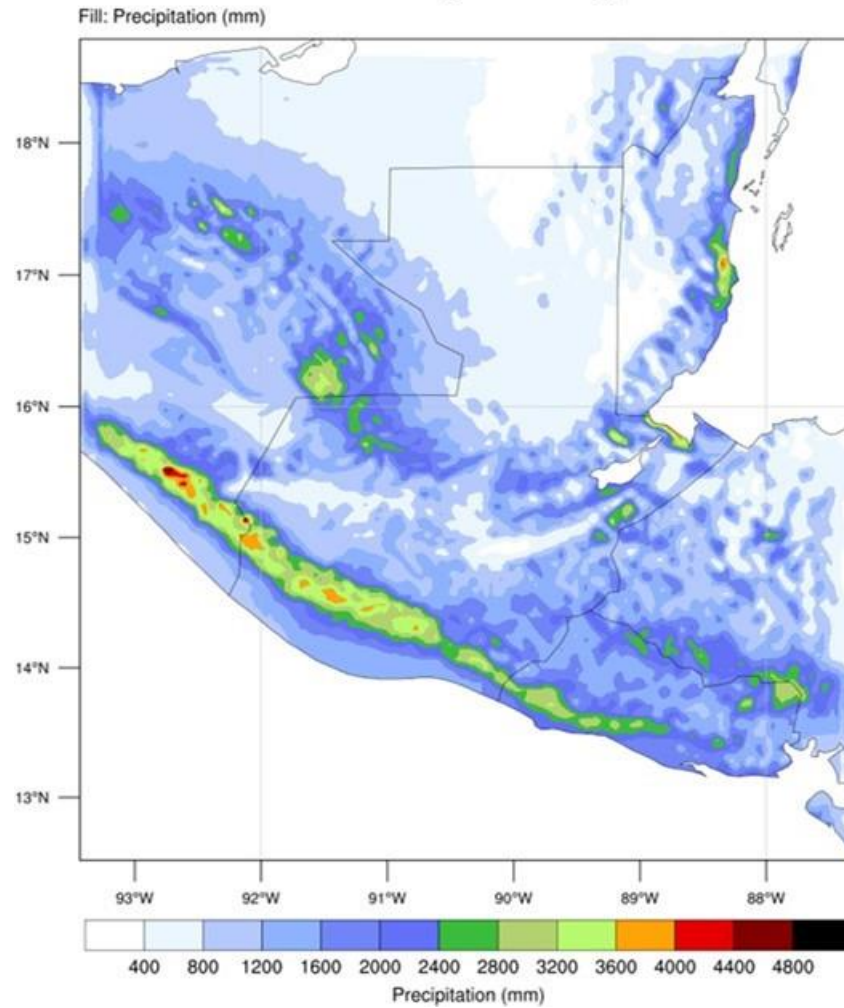
Corrida: NNRP: **2001-2010**

Temporada : verano (junio-agosto)

Variable: lluvia (mm)

CLIMATOLOGIA (2001-2010)

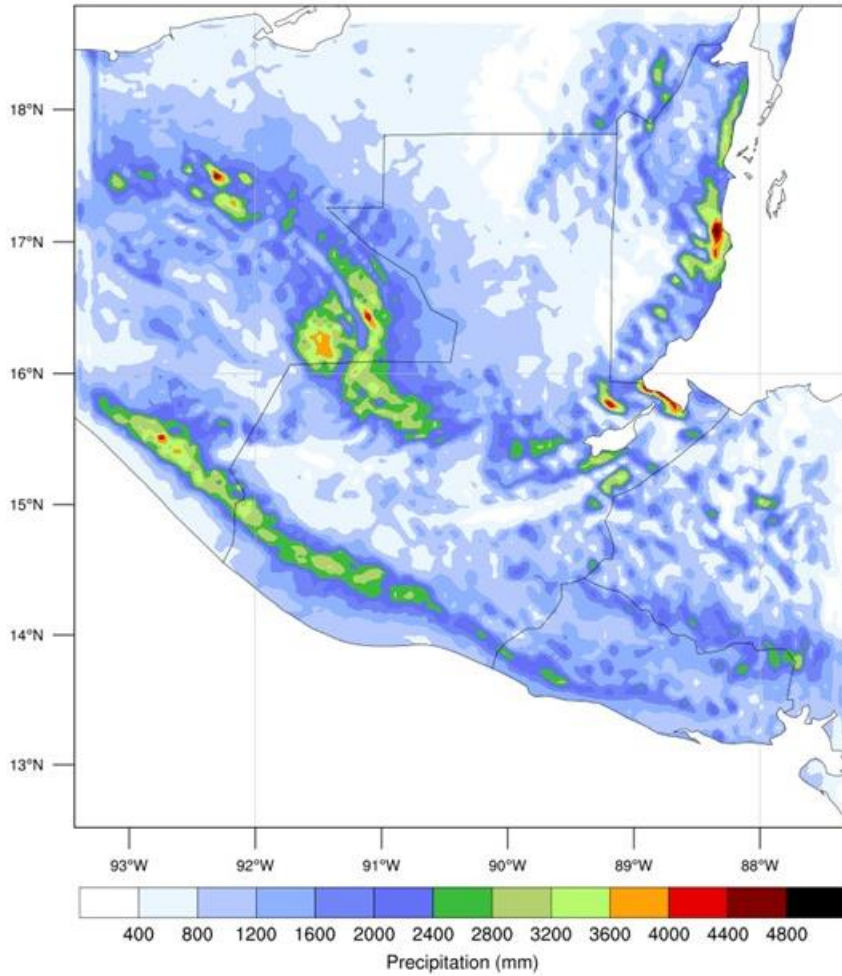
JunJulAug Climatology



EVENTO: EL NIÑO 2002

JunJulAug 2002

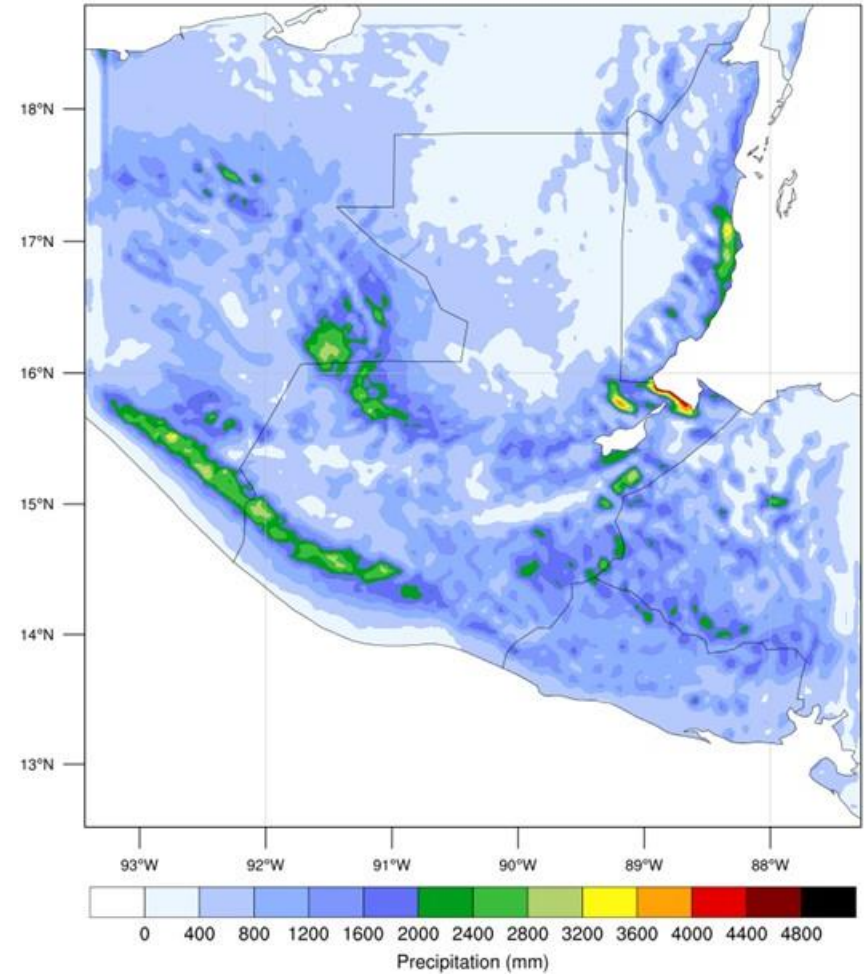
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EVENTO: EL NIÑO 2004

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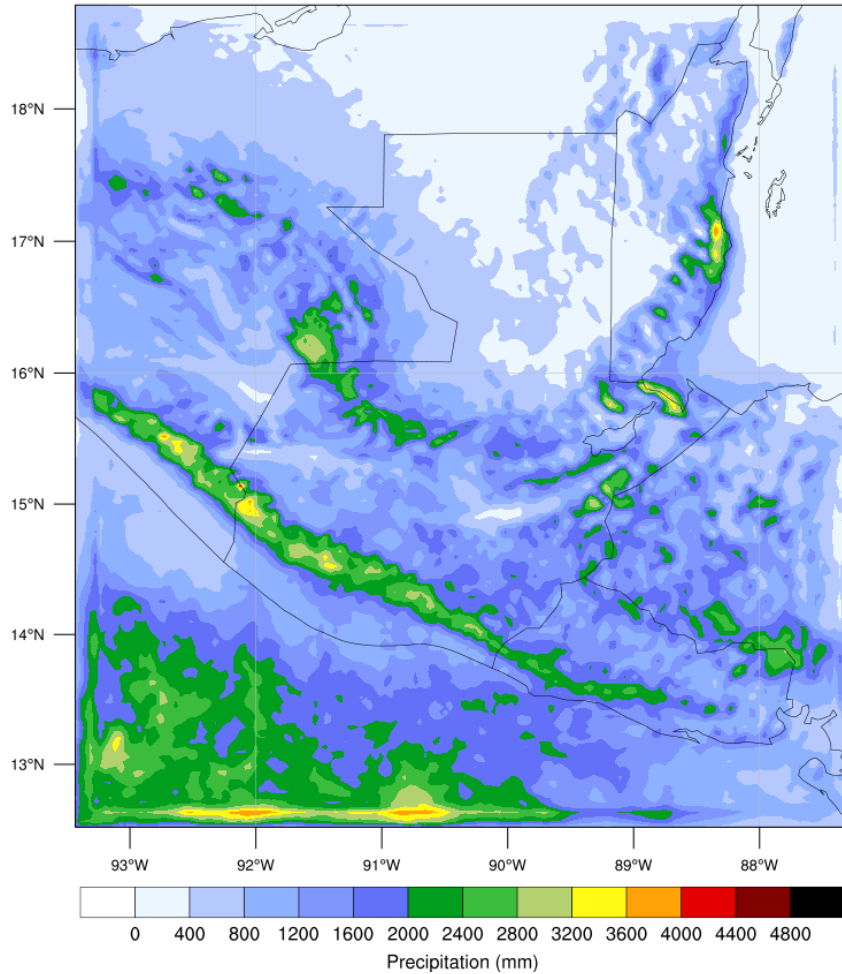
Fill: Precipitation (mm)



EVENTO: LA NIÑA 2008

JunJulAug 2008

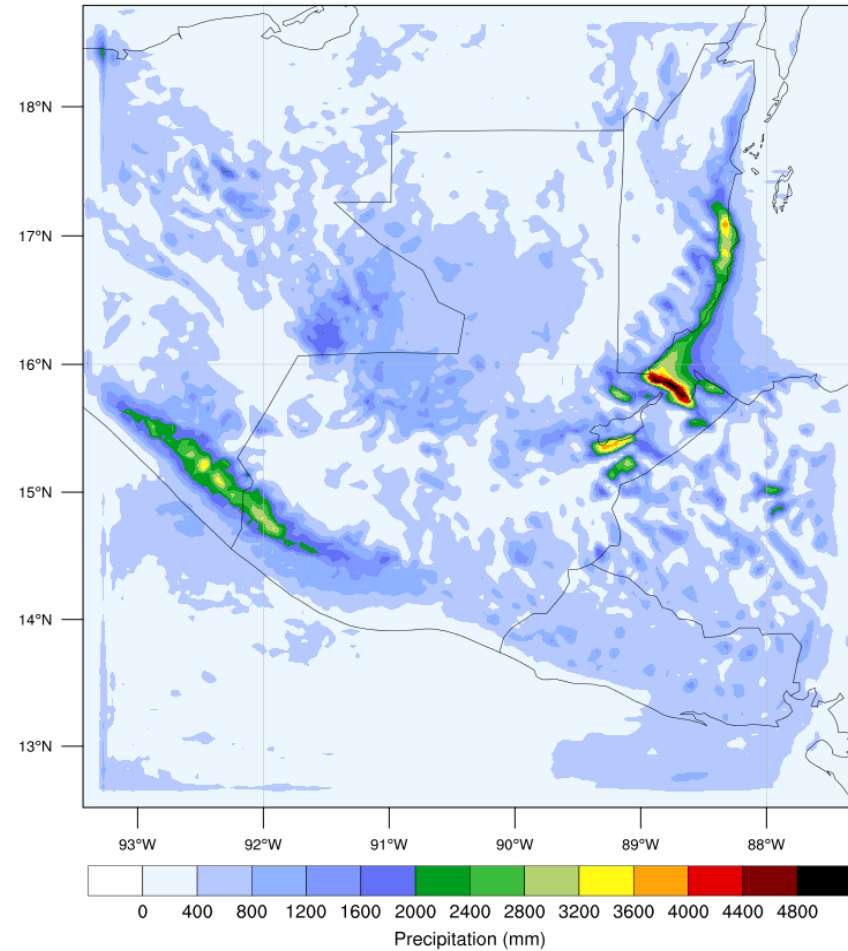
Fill: Precipitation (mm)



EVENTO: EL NIÑO 2015

CCSM4 RCP8.5
JunJulAug 2015

Fill: Precipitation (mm)



Proyecto: Guatemala

Escenario: Histórico

Dominio: D01 Guatemala (36 km)

Corrida: NNRP: **1971-1980**

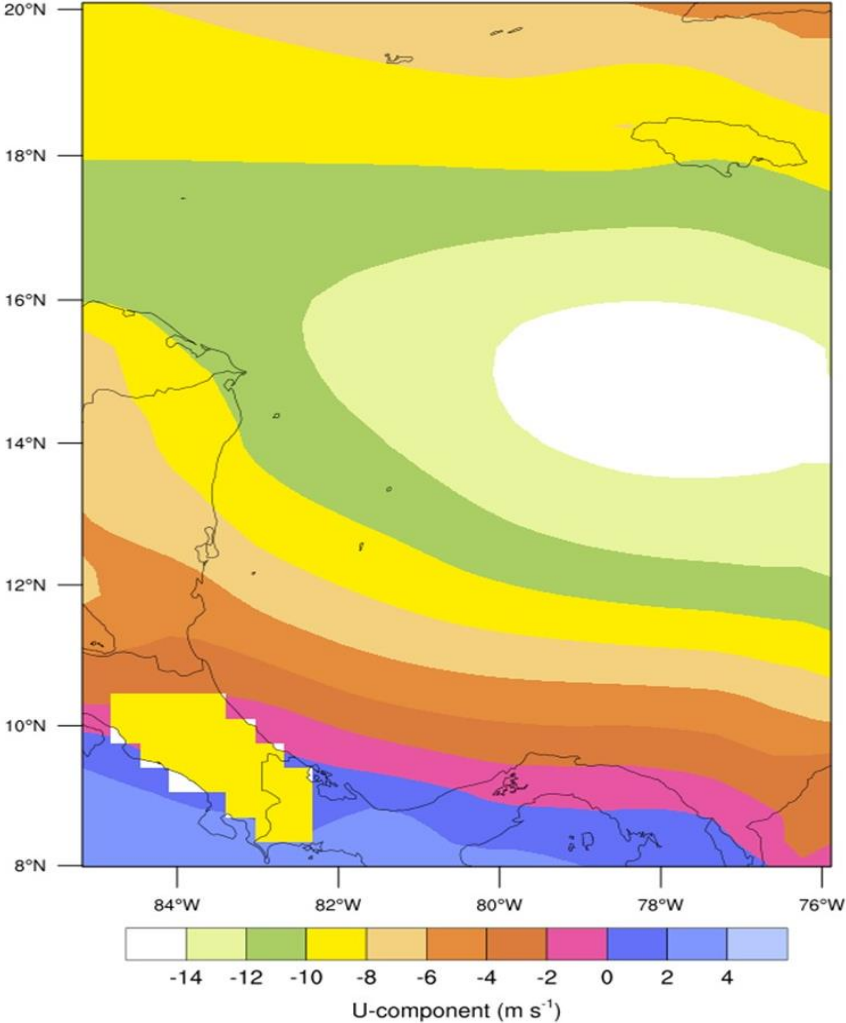
Temporada : verano (junio-agosto)

Variable: U-925 (m/s)

“Corriente en chorro del Caribe”

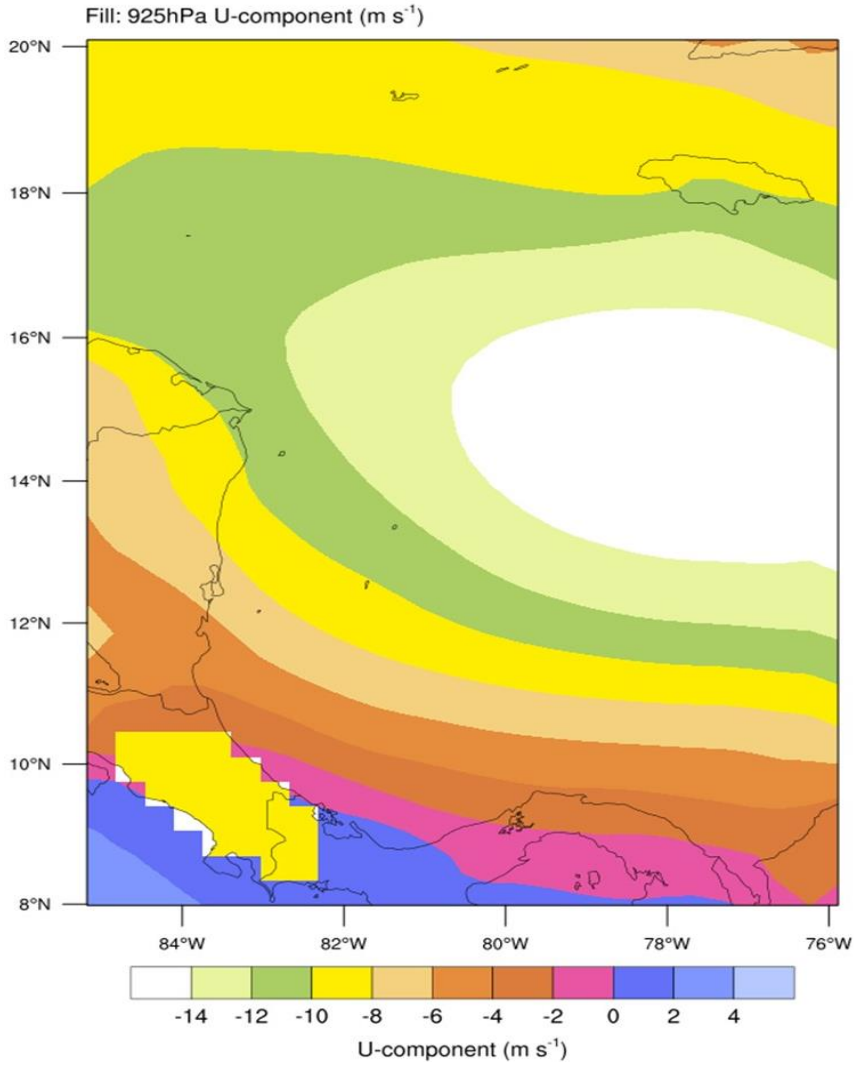
JunJulAug Climatology

Fill: 925hPa U-component (m s^{-1})



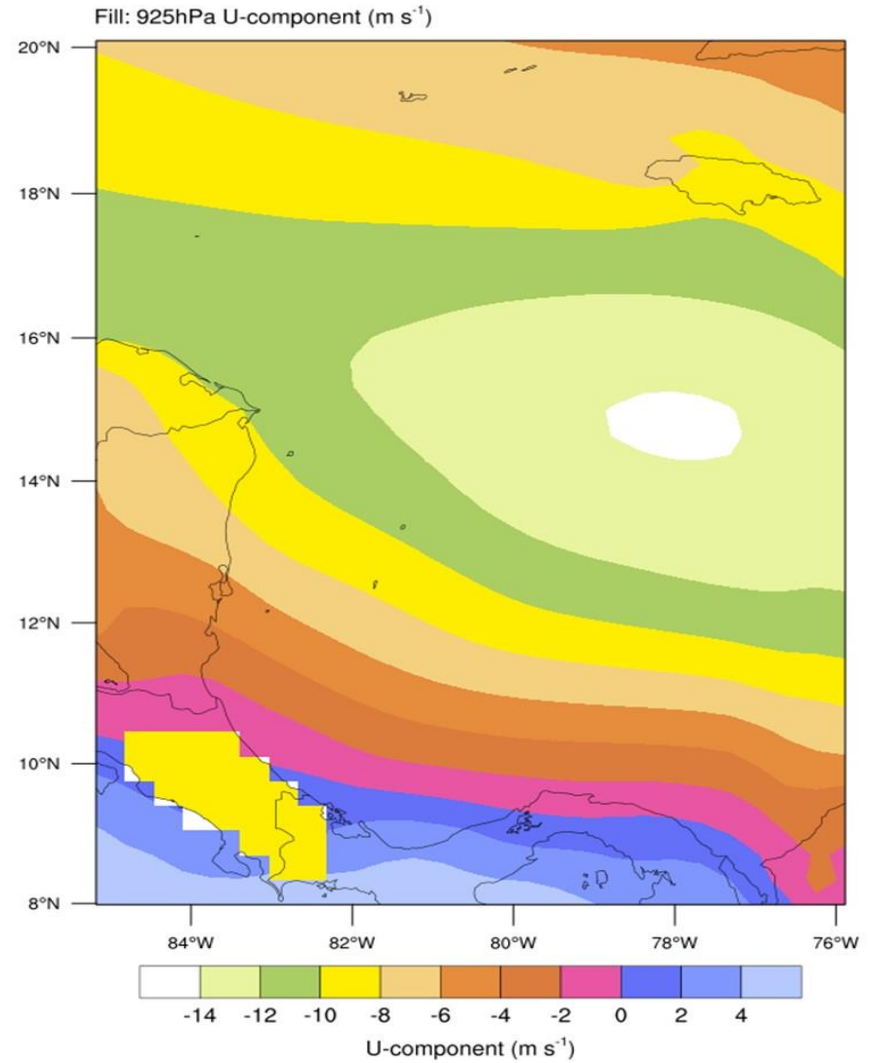
EVENTO: EL NIÑO 1972

JunJulAug 1972



EVENTO: LA NIÑA 1973

JunJulAug 1973



Proyecto: Guatemala

Escenario: Histórico

Dominio: D03 Guatemala (4 km)

Corrida: NNRP: **1971-1980**

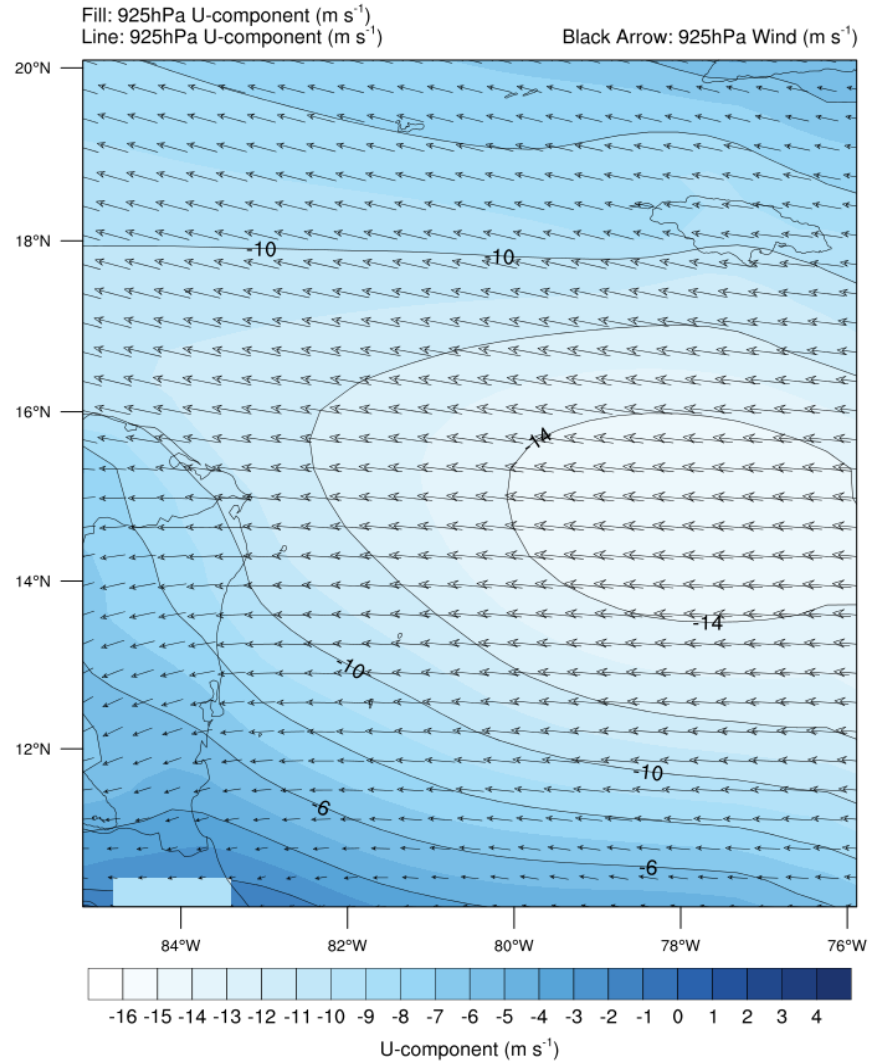
Temporada : verano (junio-agosto)

Variable: U-925 (m/s)

“Corriente en chorro del Caribe”

CLIMATOLOGIA (1971-1980)

JunJulAug Climatology

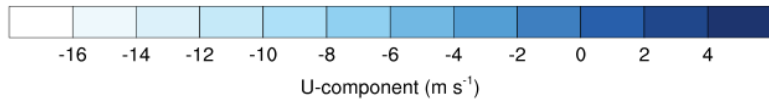
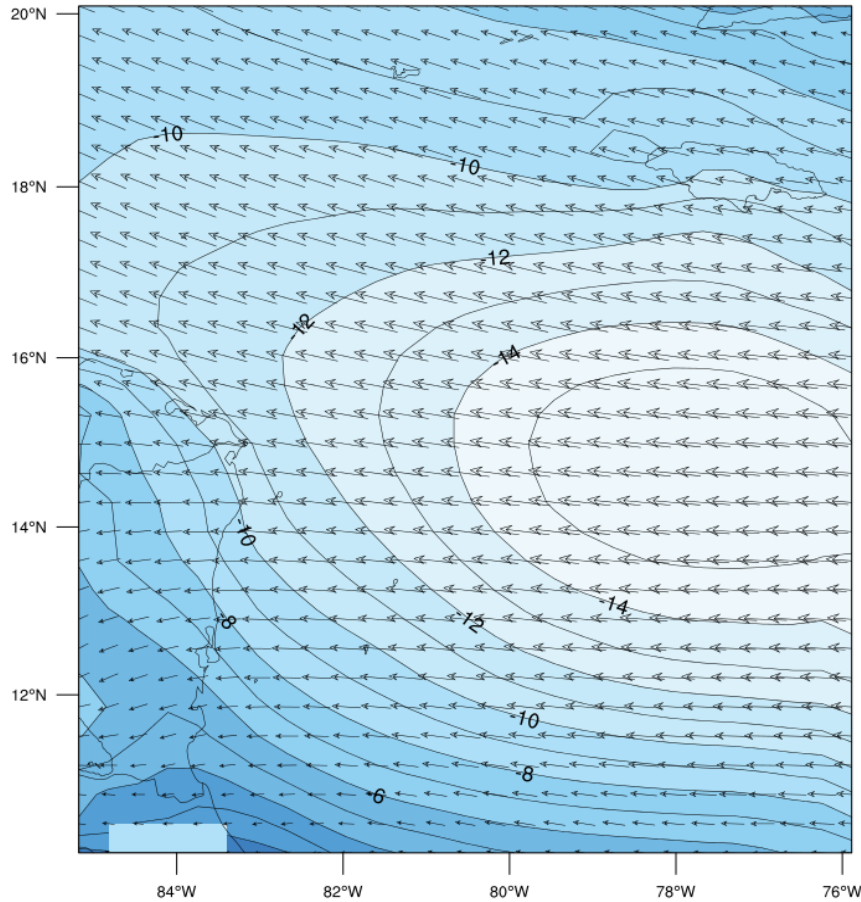


EVENTO: EL NIÑO 1972

JunJulAug 1972

Fill: 925hPa U-component ($m s^{-1}$)
Line: 925hPa U-component ($m s^{-1}$)

Black Arrow: 925hPa Wind ($m s^{-1}$)

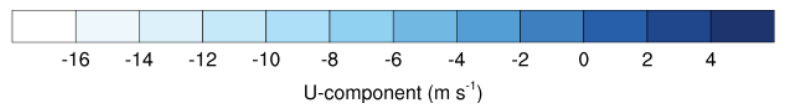
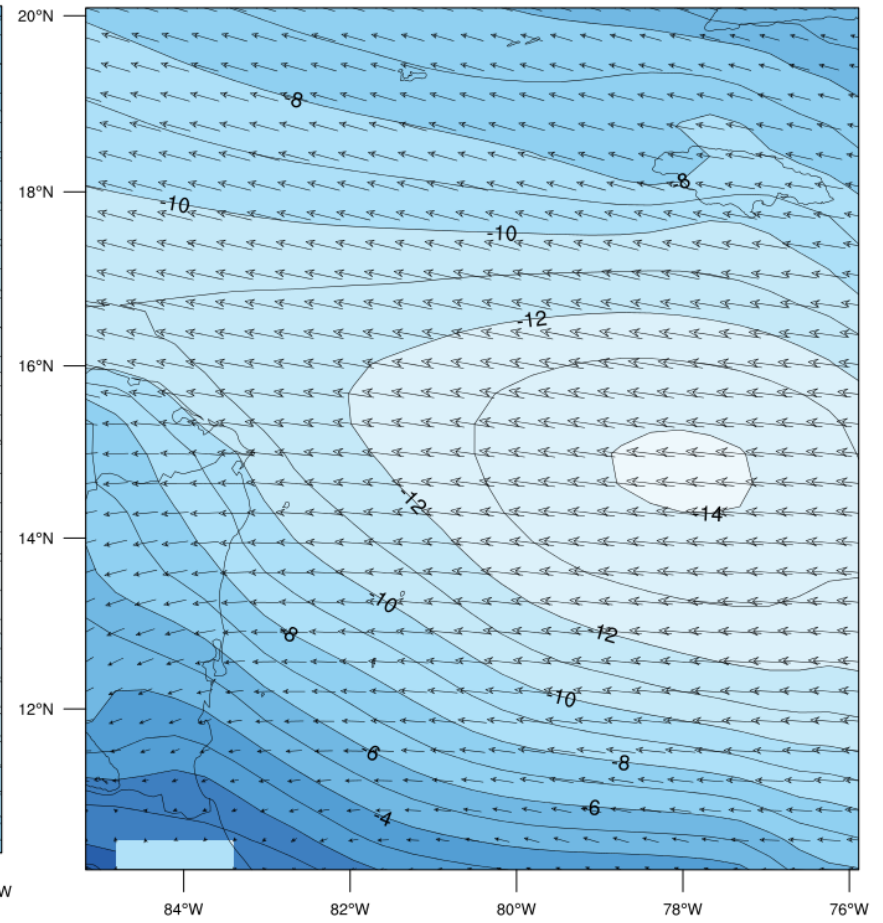


EVENTO: LA NIÑA 1973

JunJulAug 1973

Fill: 925hPa U-component ($m s^{-1}$)
Line: 925hPa U-component ($m s^{-1}$)

Black Arrow: 925hPa Wind ($m s^{-1}$)



Proyecto: Guatemala

Escenario: Histórico

Dominio: D03 Guatemala (4 km)

Corrida: NNRP: **2001-2010**

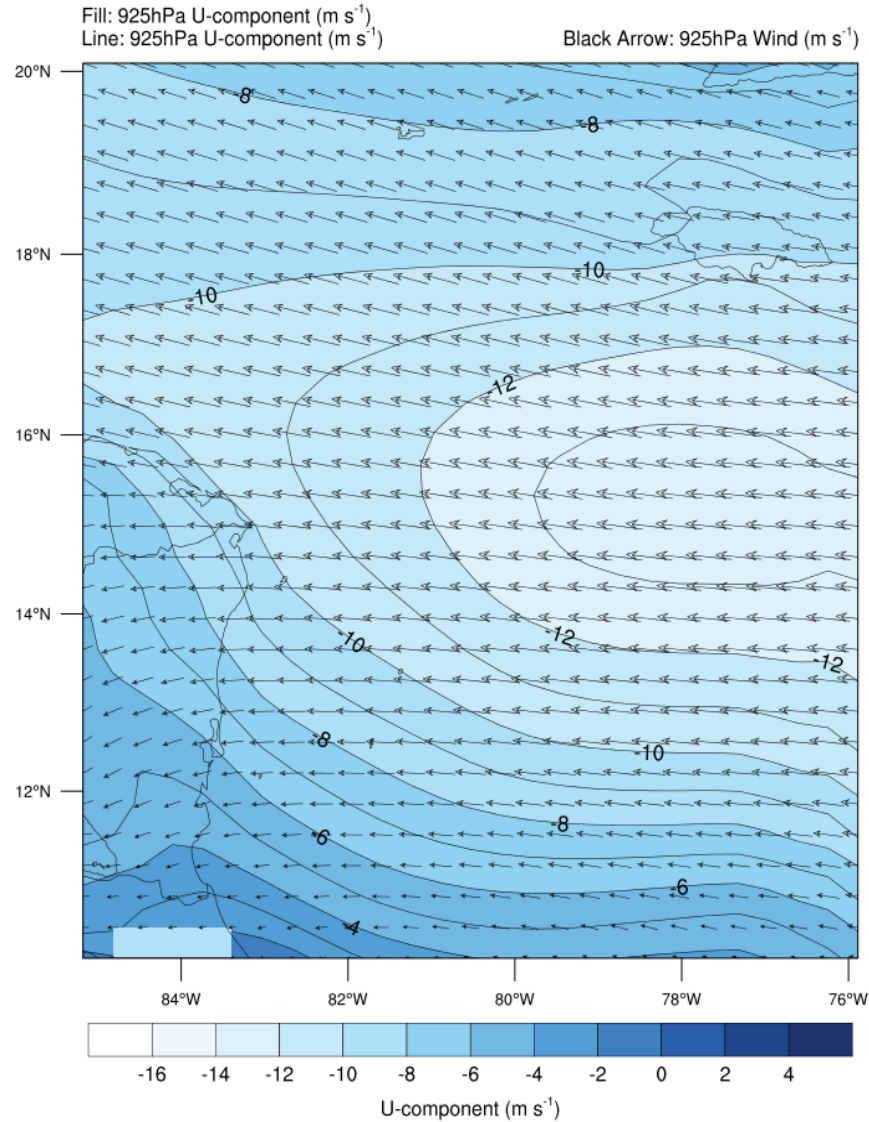
Temporada : verano (junio-agosto)

Variable: U-925 (m/s)

“Corriente en chorro del Caribe”

CLIMATOLOGIA (2001-2010)

JunJulAug Climatology

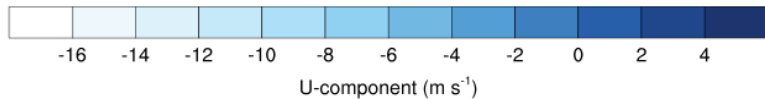
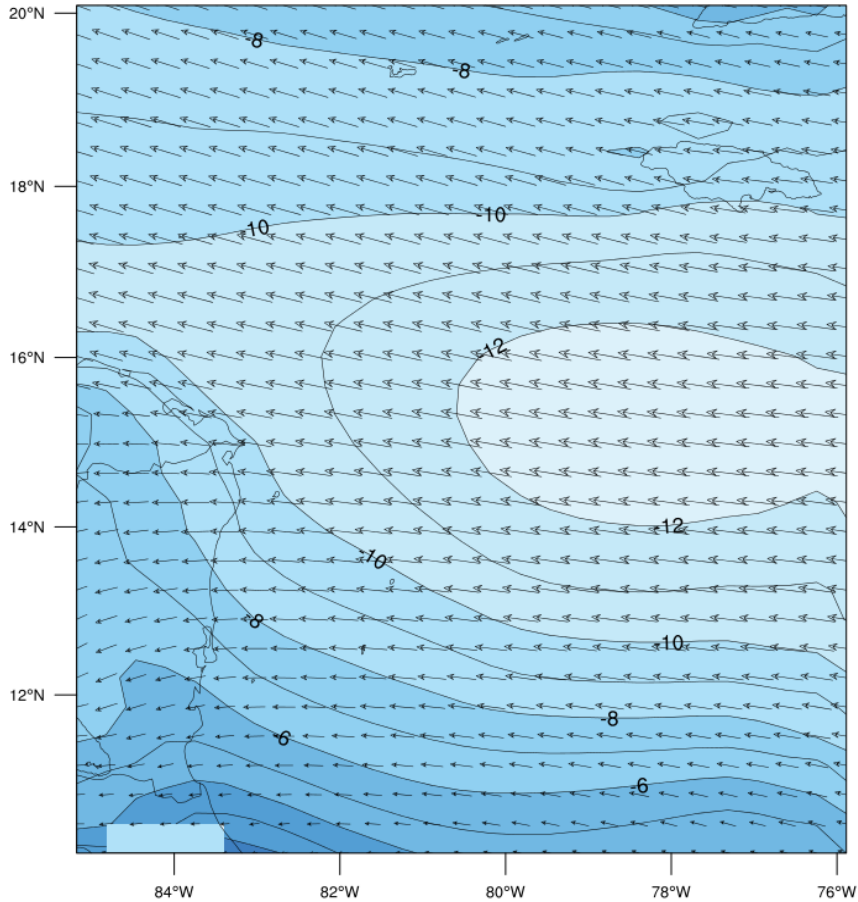


EVENTO: LA NIÑA 2008

JunJulAug 2008

Fill: 925hPa U-component (m s^{-1})
Line: 925hPa U-component (m s^{-1})

Black Arrow: 925hPa Wind (m s^{-1})

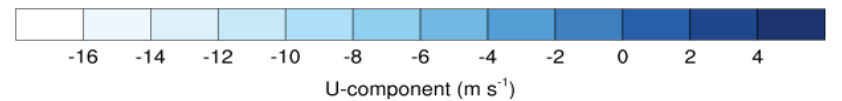
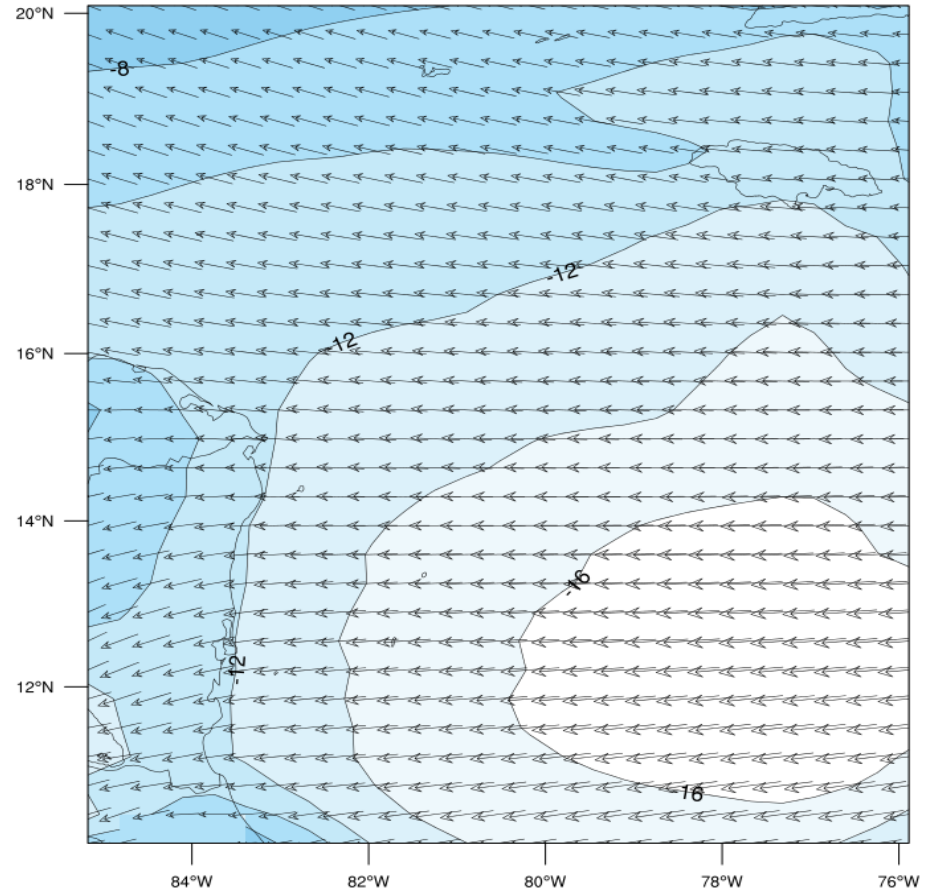


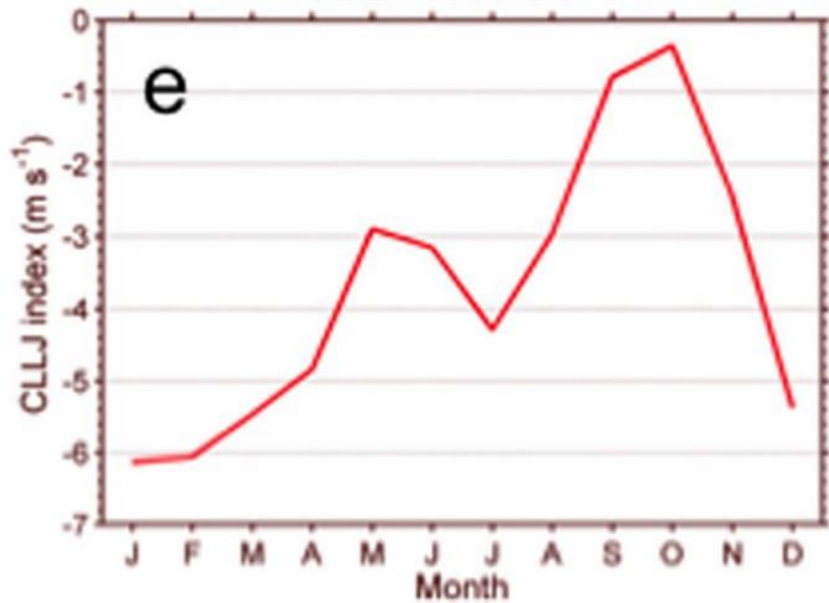
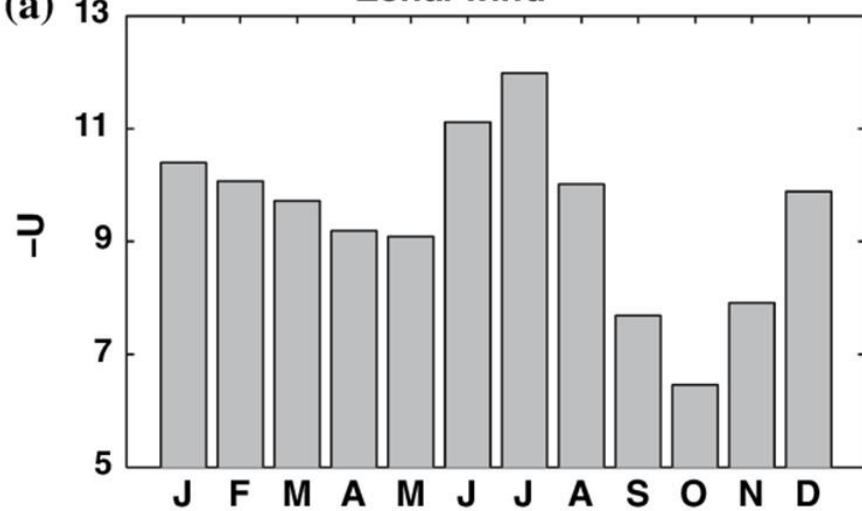
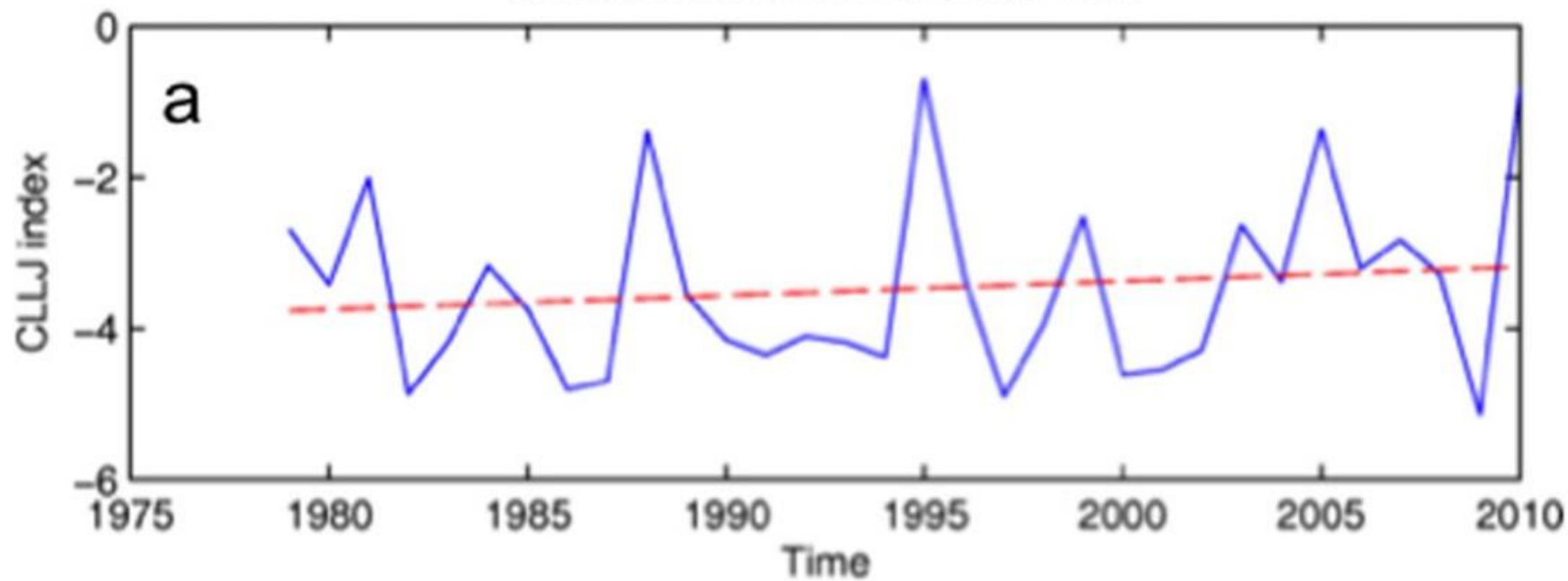
EVENTO: EL NIÑO 2015 (BL, rcp8.5, D01)

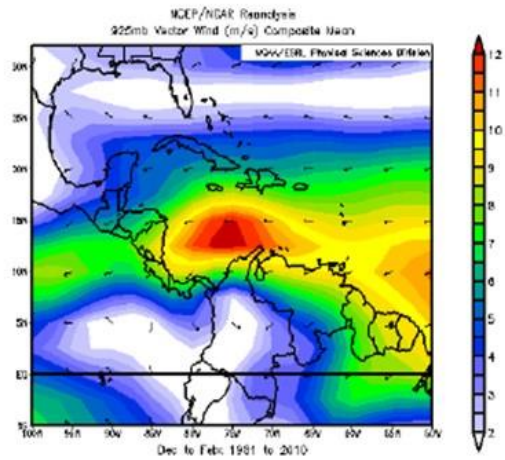
CCSM4 RCP8.5
JunJulAug 2015

Fill: 925hPa U-component (m s^{-1})
Line: 925hPa U-component (m s^{-1})

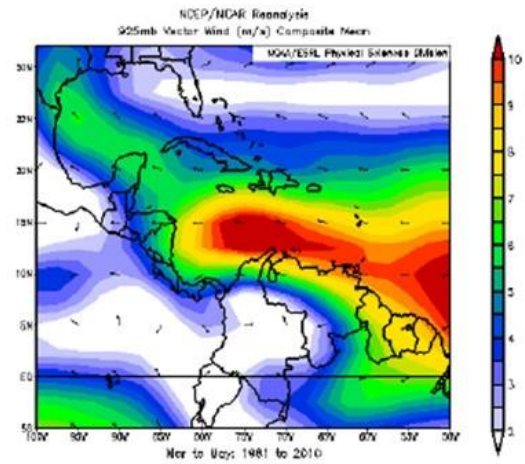
Black Arrow: 925hPa Wind (m s^{-1})



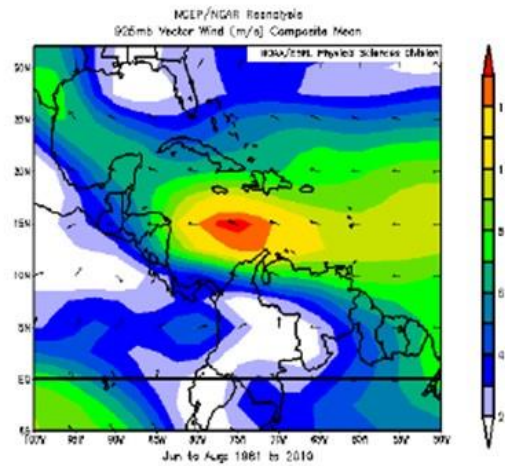
CLLJ 1979-2010**(a) Zonal wind****JJA Caribbean Low Level Jet Index**



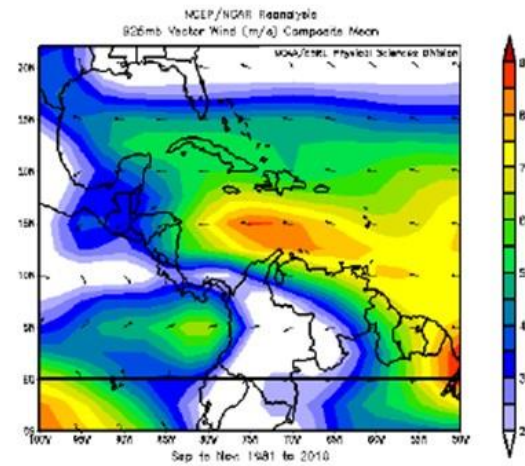
Dec-Jan-Feb



Mar-Apr-May



Jun-Jul-Aug



Sep-Oct-Nov

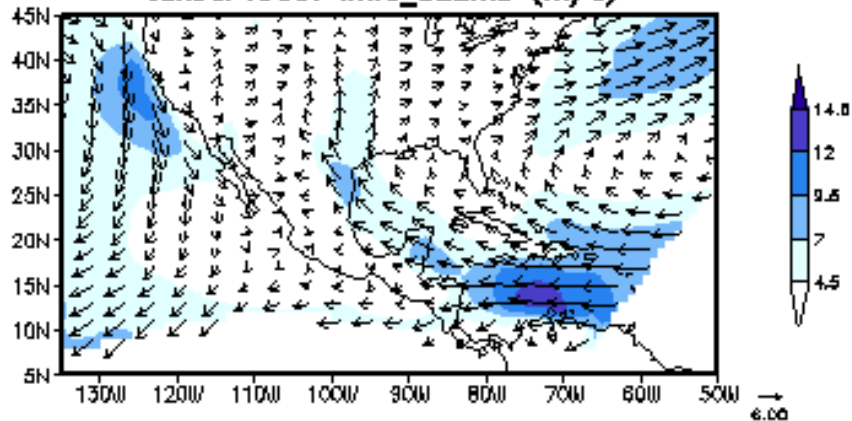
Vectors winds to 925 hPa.

JunJul & AugSep averages of 925 mb wind

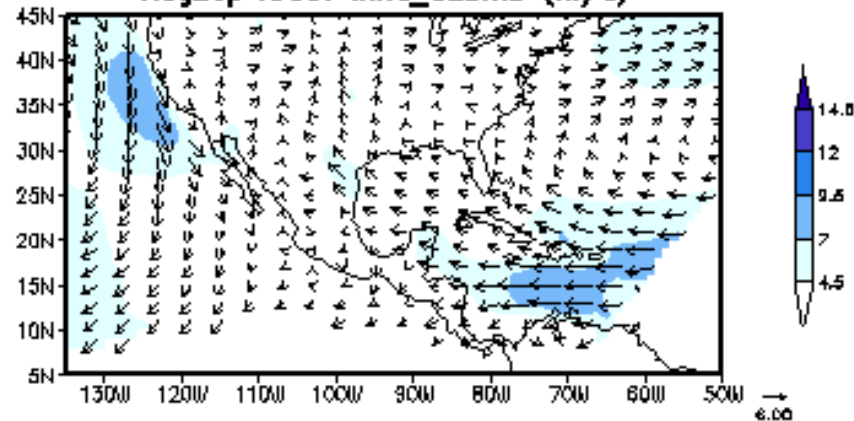
JunJul

AugSep

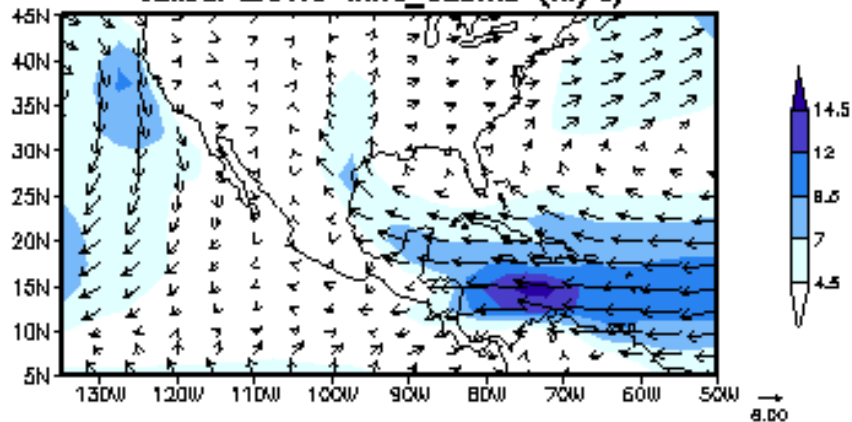
JunJul NARR Wind_925mb (m/s)



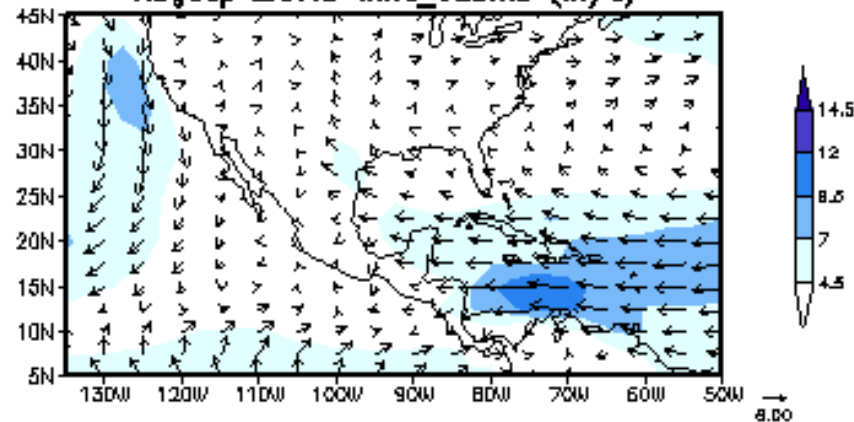
AugSep NARR Wind_925mb (m/s)



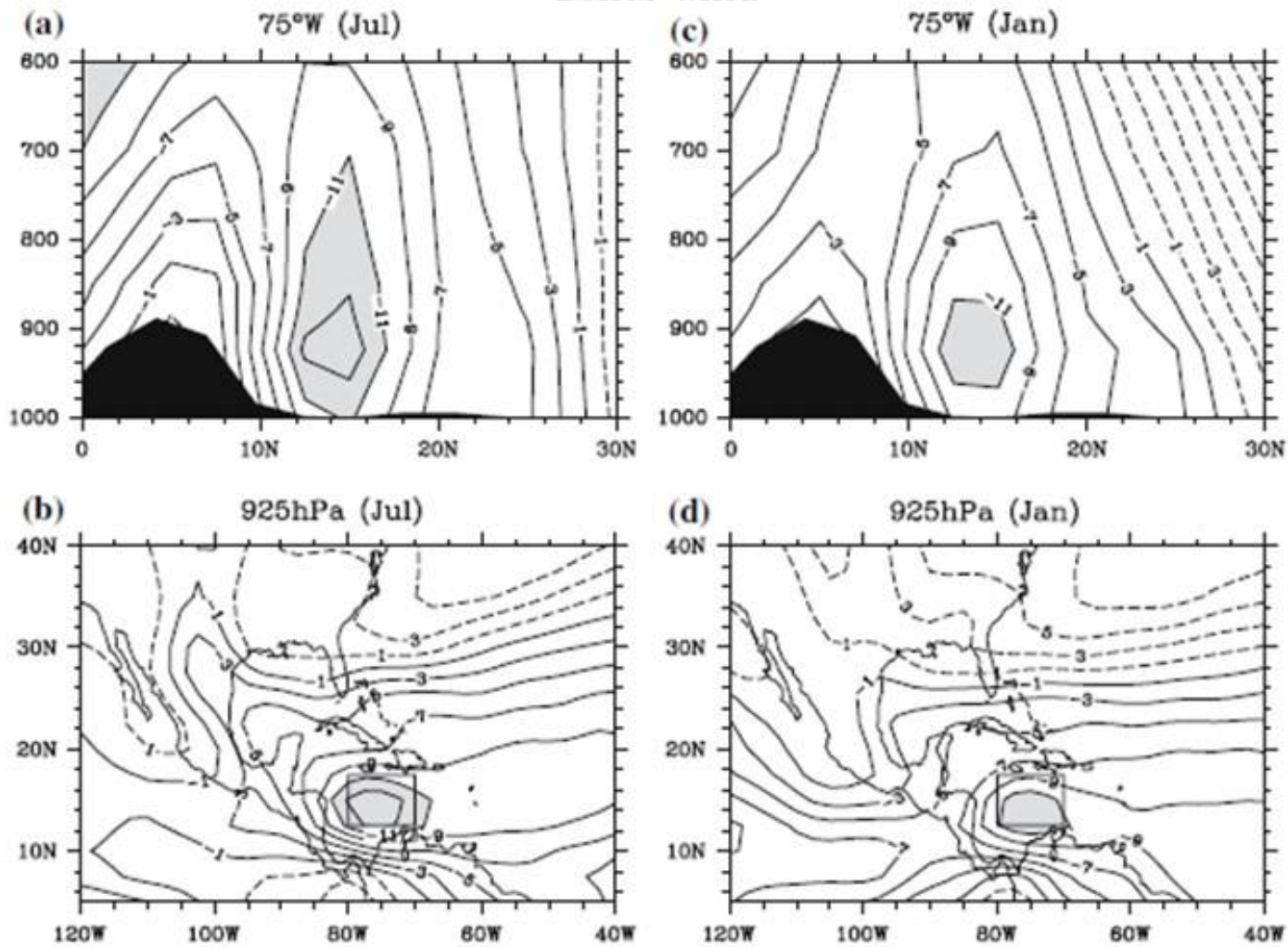
JunJul ERA40 Wind_925mb (m/s)



AugSep ERA40 Wind_925mb (m/s)



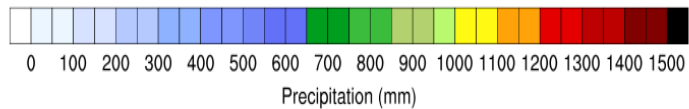
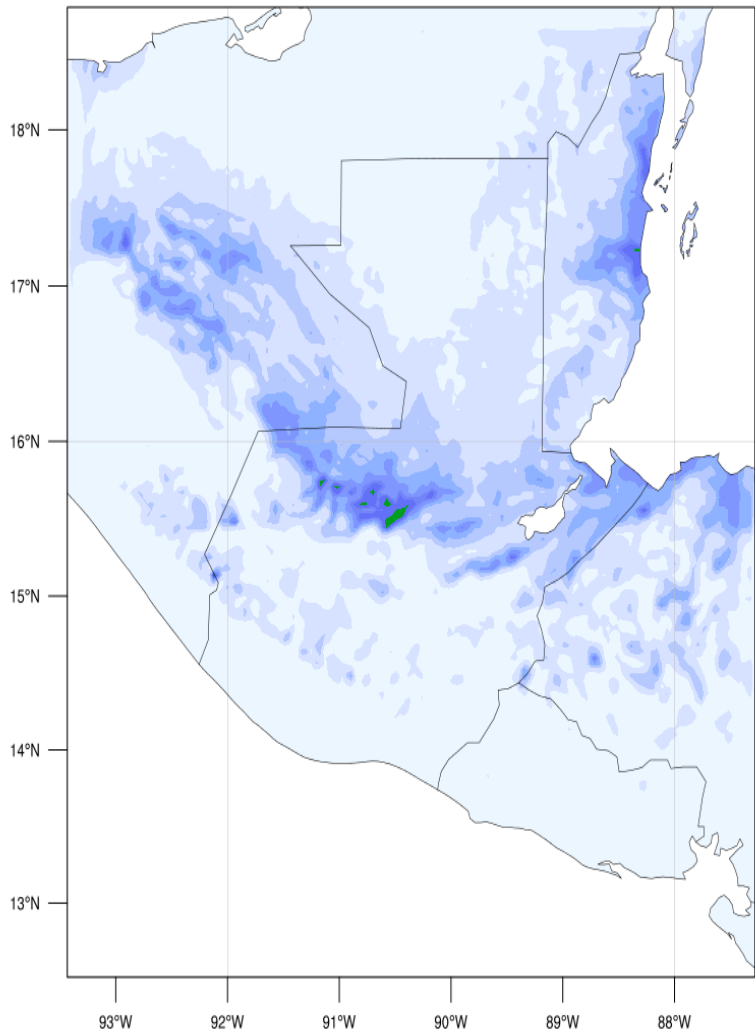
Zonal Wind



Eventos La Niña

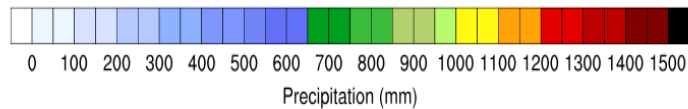
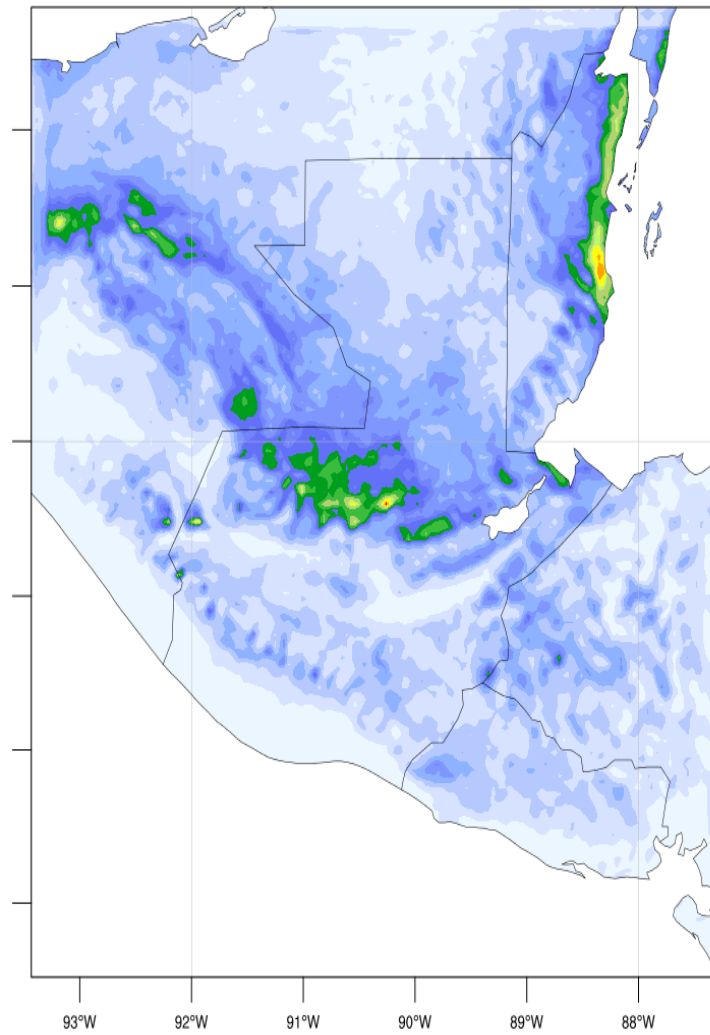
JanFeb 1971

Fill: Precipitation (mm)



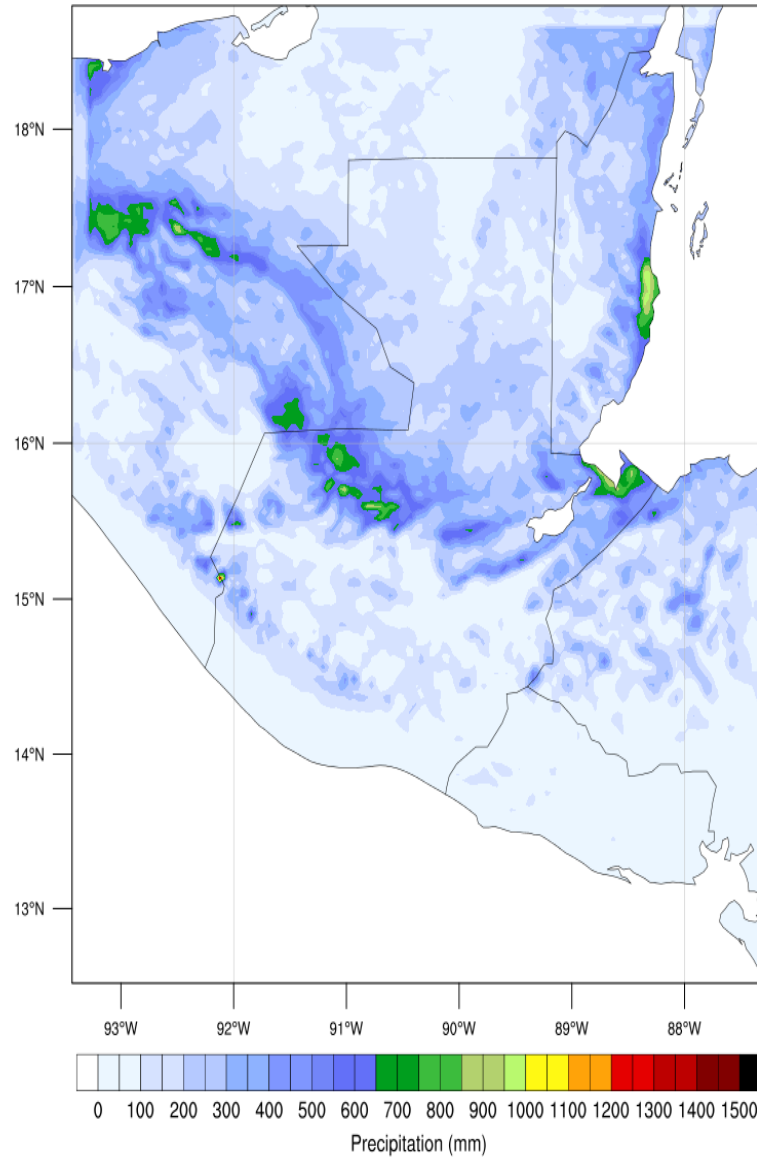
JanFeb 1972

Fill: Precipitation (mm)



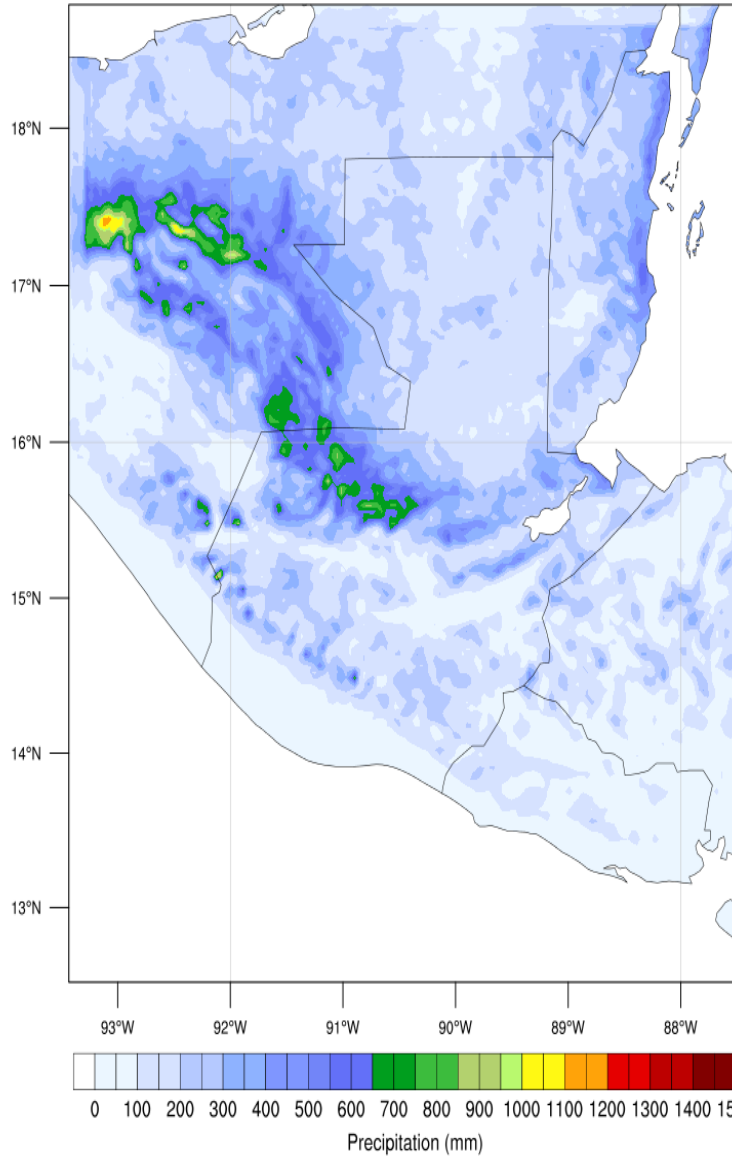
JanFeb 1974

Fill: Precipitation (mm)



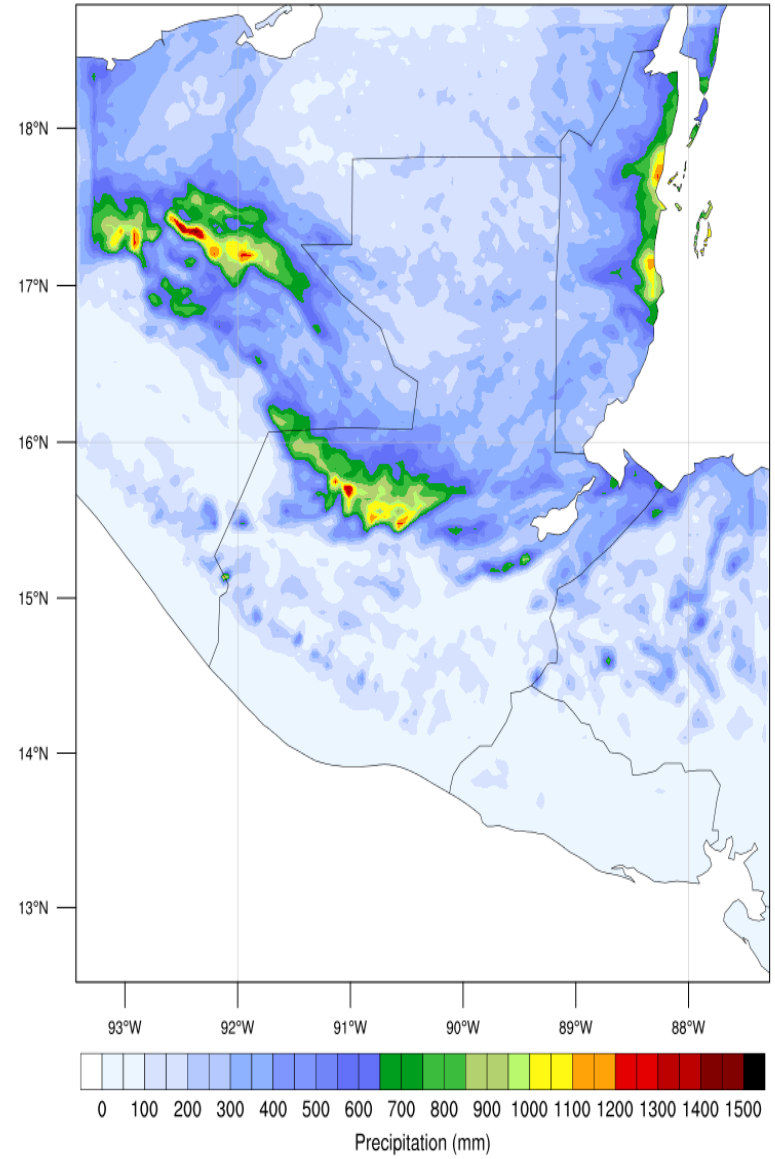
JanFeb 1975

Fill: Precipitation (mm)



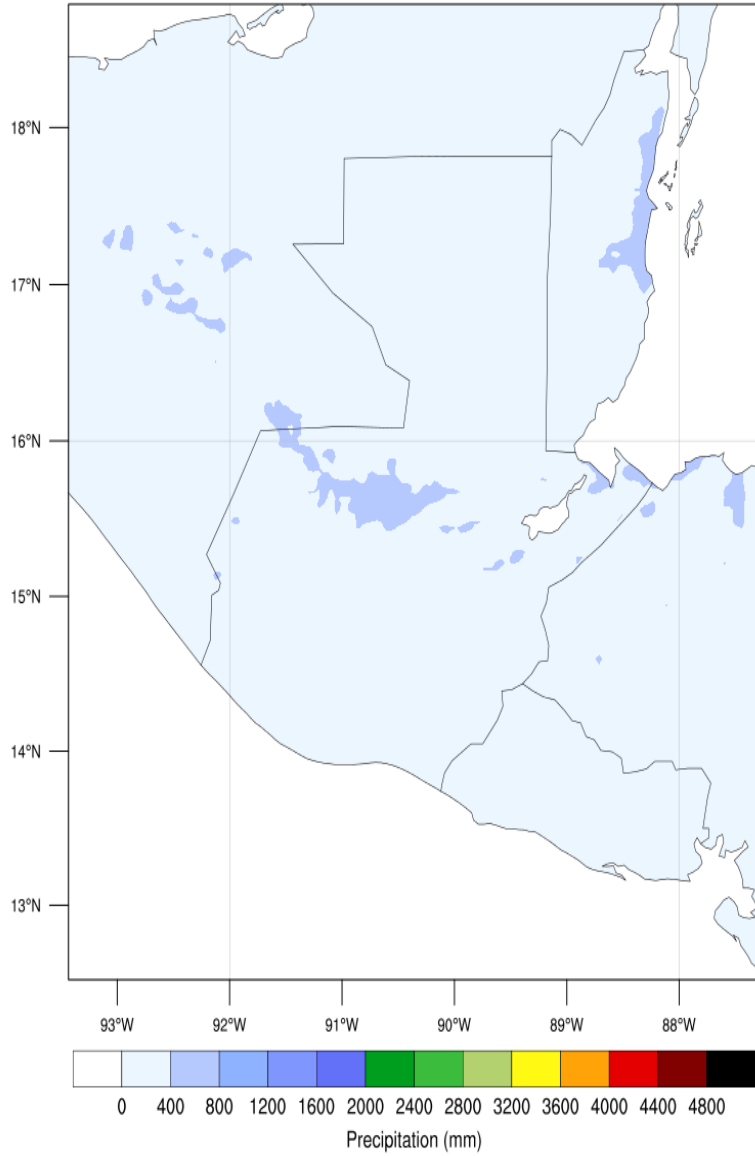
JanFeb 1976

Fill: Precipitation (mm)



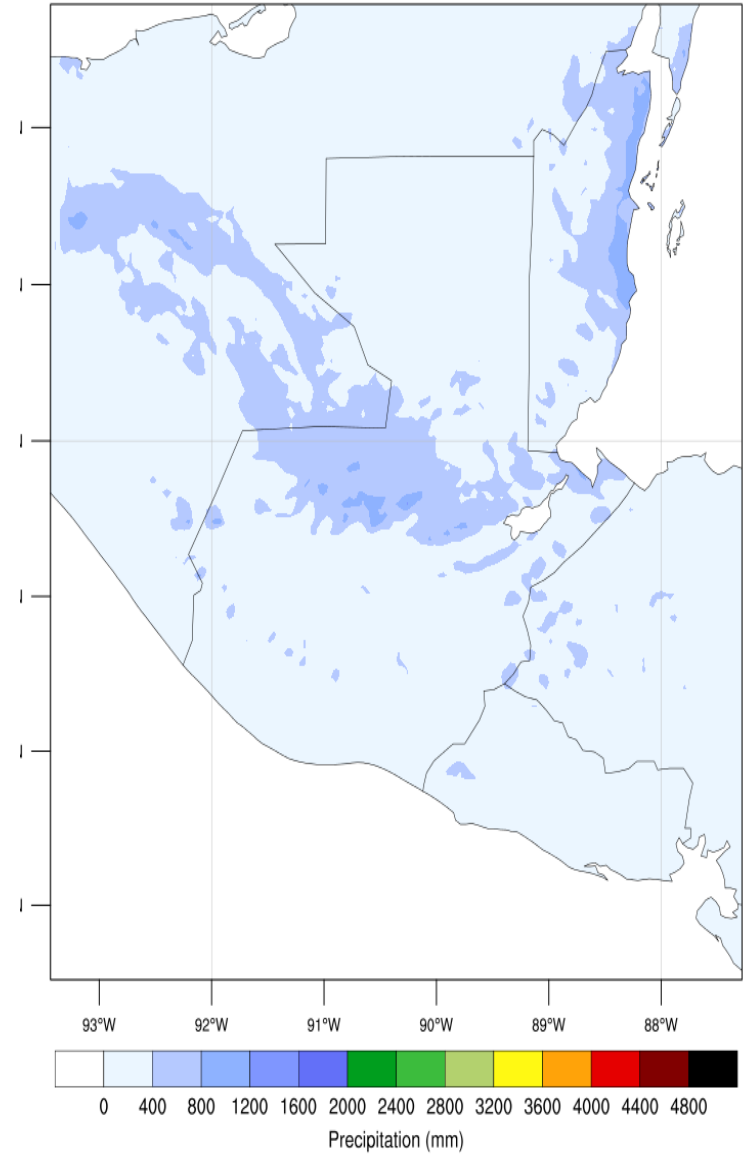
JanFeb 1971

Fill: Precipitation (mm)



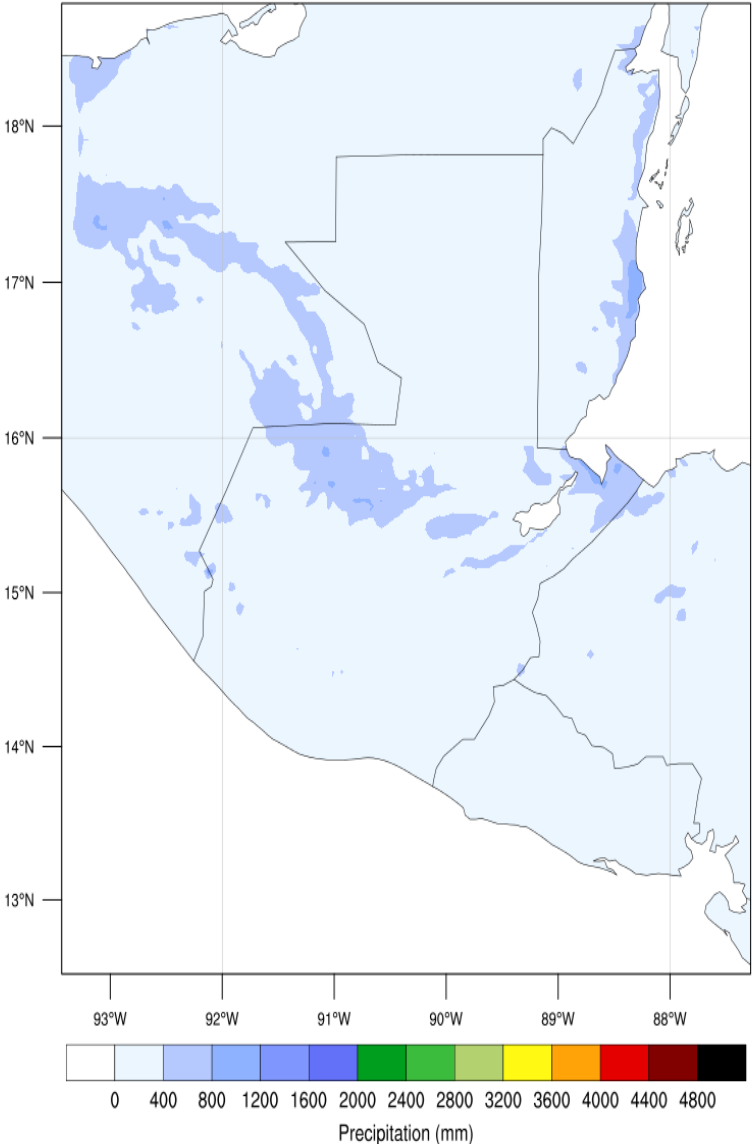
JanFeb 1972

Fill: Precipitation (mm)



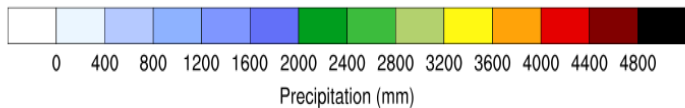
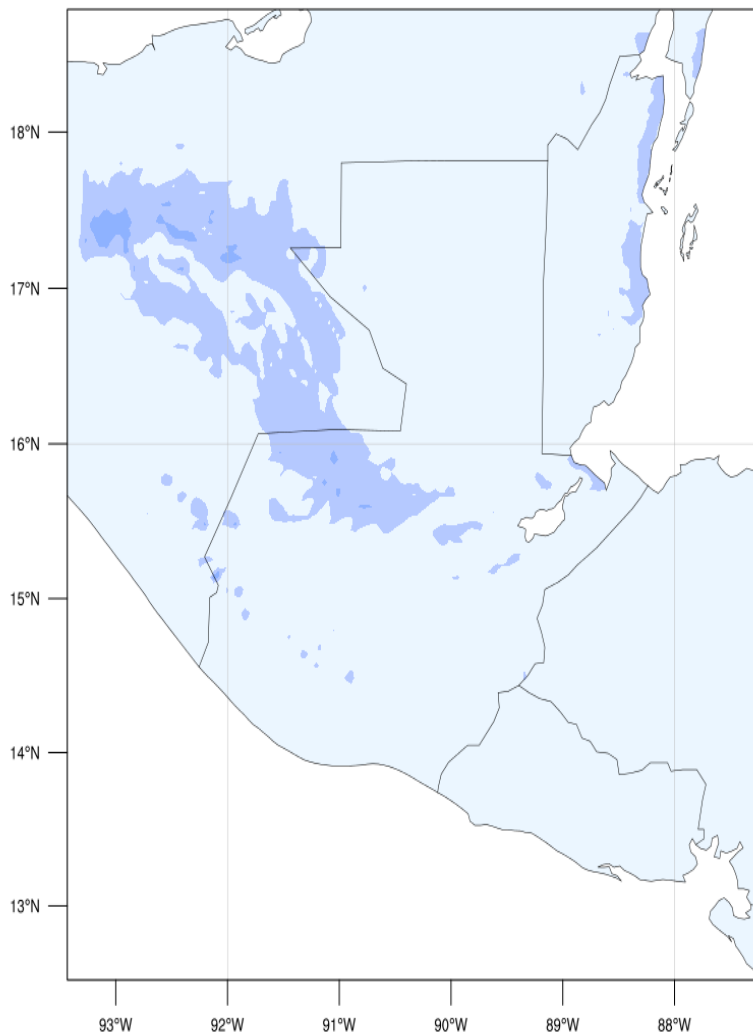
JanFeb 1974

Fill: Precipitation (mm)



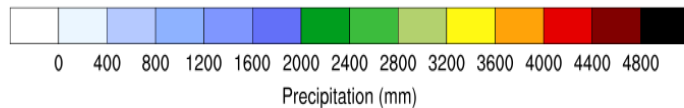
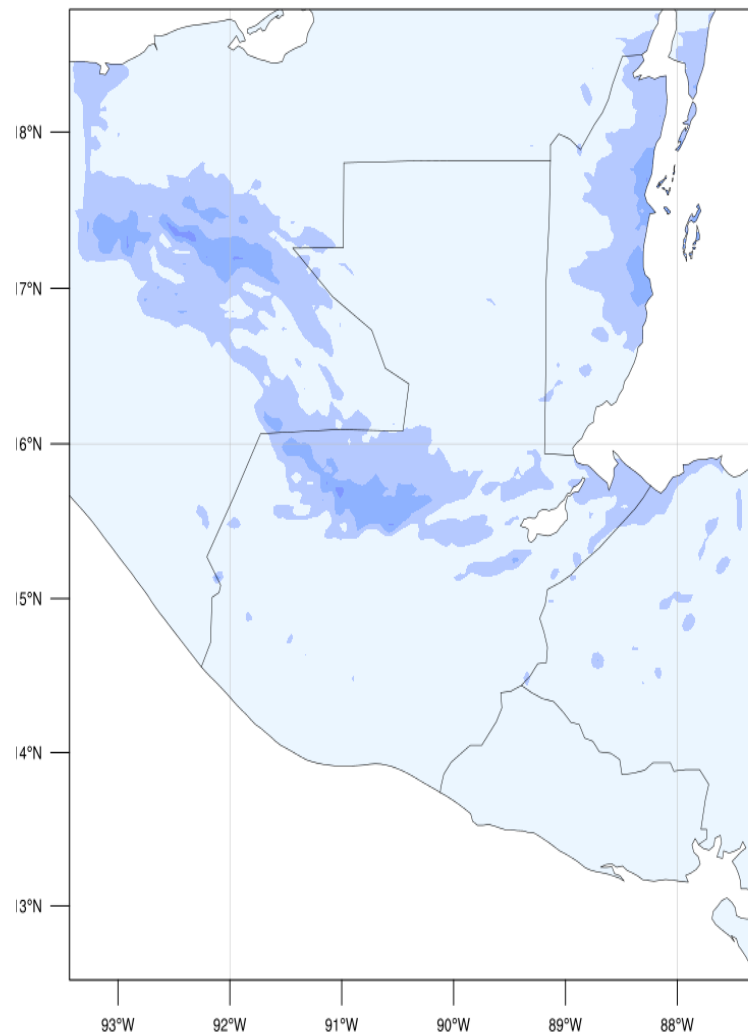
JanFeb 1975

Fill: Precipitation (mm)



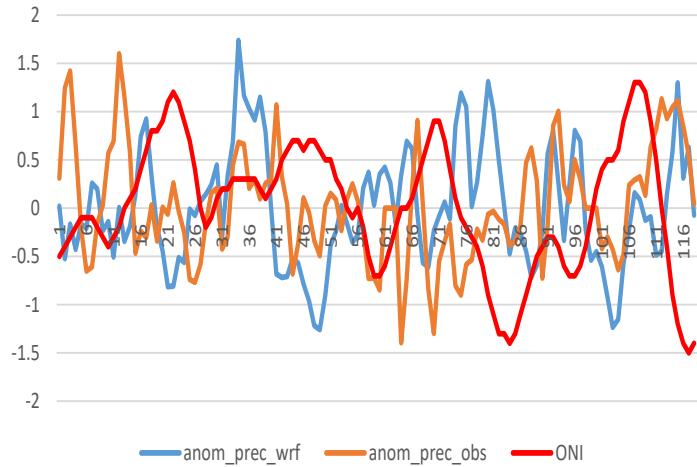
JanFeb 1976

Fill: Precipitation (mm)

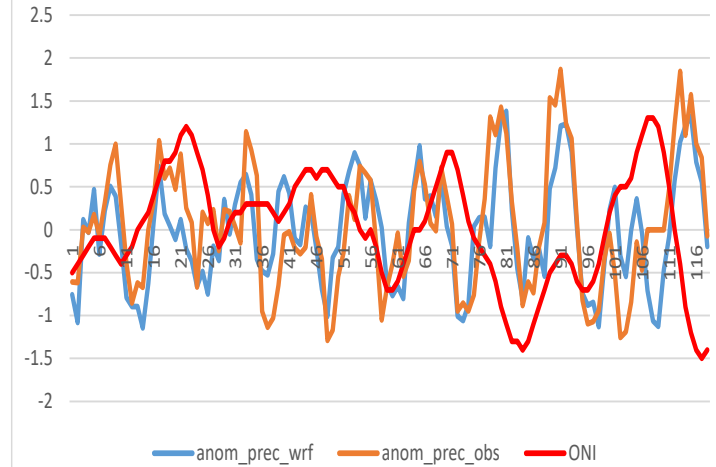


Variabilidad Climática (Presente 2001-2010)

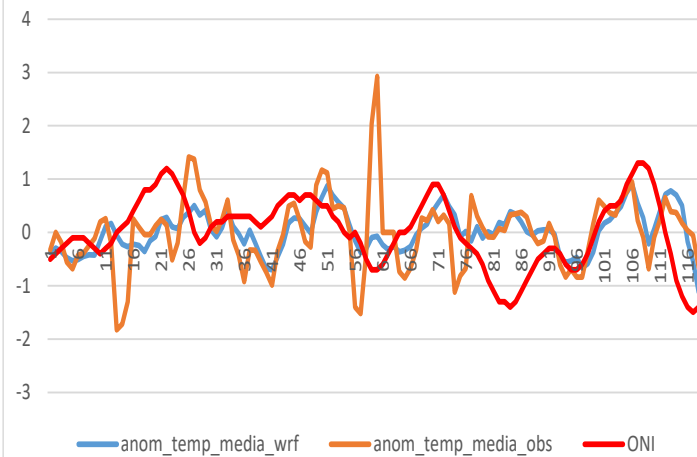
Aeropuerto Florez



Coban



Aeropuerto Florez



Coban

