Assessment of RegCM4.3 over the CORDEX South America Domain

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Objective

To find the better configuration of the

RegCM4.3 to represent the

South America climate

Simulation Design

Domain: Cordex

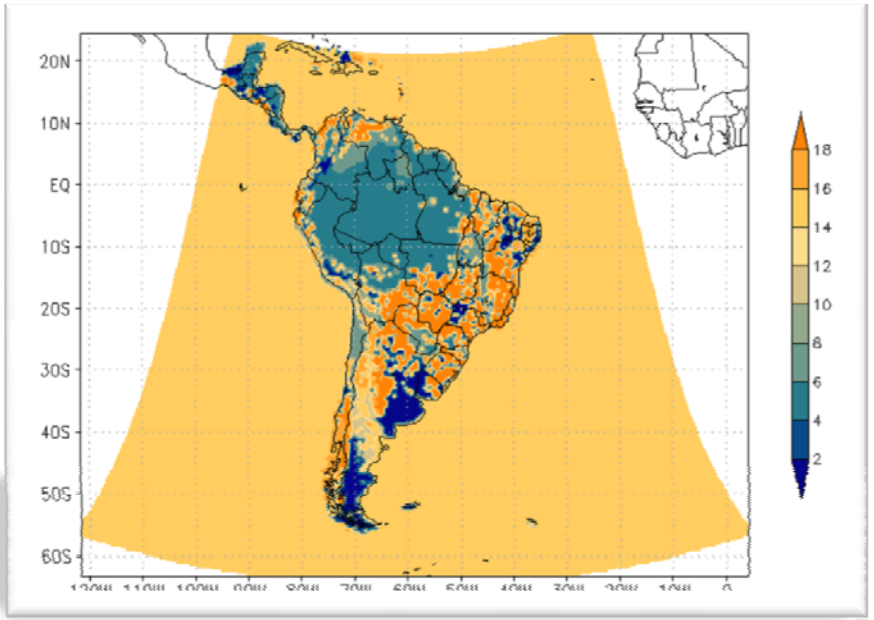
Grid Points: 202 latitudes x 192 longitudes

Projection: Rotated Mercator

Horizontal Resolution: 50 km

Vertical Levels: 18

Land Use



Boundary Conditions: ERA-Interim and OI Weekly

Period: 01/01/1990 – 01/01/1994 (4 yrs)

Ocean Fluxes: Zeng et al. (1998)

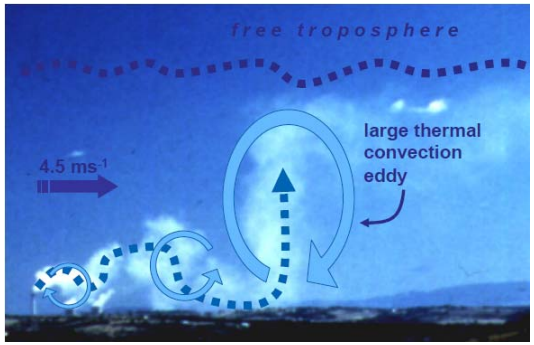
Model Version: RegCM4.3_rc4 with corrected bugs in Tiedkte and CLM

Time Parameters

dtrad	**=**	**30**
dtabem	**=**	**18**
dtsrf	**=**	**900**
dt	**=**	**100**

Experiments	Physics Schemes		
	Surface Scheme	Boundary Layer	Cumulus Convection
exp_CTRL 	BATS	Holtslag (1990) Ibltyp=1	Grell over land and Emanuel over ocean icup=99
exp_Tiedtke 	BATS	Holtslag (1990) Ibltyp=1	Tiedkte (1986) icup=5 Modifications: entrpen = 1.0D-4 to 0.5D-4 cmtcape = 40.0D0 to 20.0D0 ctrigger = -1.1D01
exp_BM was not successful			
exp_MIT* 	BATS	Holtslag (1990) Ibltyp=1	Emanuel (1991) icup=4 Modification elcrit = 0.011D0 to 0.00011D0, coeffr = 1.0D0 to 2.0D0
exp_PBL 	BATS	UW PBL (Bretherton and McCaa, 2004): Ibltyp=2 Modification atwo=15.0D0 to atwo=10.0D0	Grell over land and Emanuel over ocean icup=99
exp_PBL_MIT 	BATS	UW PBL (Bretherton and McCaa, 2004): Ibltyp=2 Modification atwo=15.0D0 to atwo=10.0D0	Emanuel (1991) icup=4
exp_CLM 	CLM	Holtslag (1990) Ibltyp=1	Grell over land and Emanuel over ocean icup=99
exp_CLM_MIT 	CLM	Holtslag (1990) Ibltyp=1	Emanuel (1991) icup=4 Without modifications

Experiments Comparisons



Convection

- Exp_CTRL
- Exp_Tiedtke
- Exp_MIT*

Land Surface

- Exp_CTRL
- Exp_CLM
- Exp_CLM_MIT

PBL

- Exp_CTRL
- Exp_PBL
- Exp_PBL_MIT

Preliminary Design of Analysis

Variables to be analyzed

air temperature

precipitation

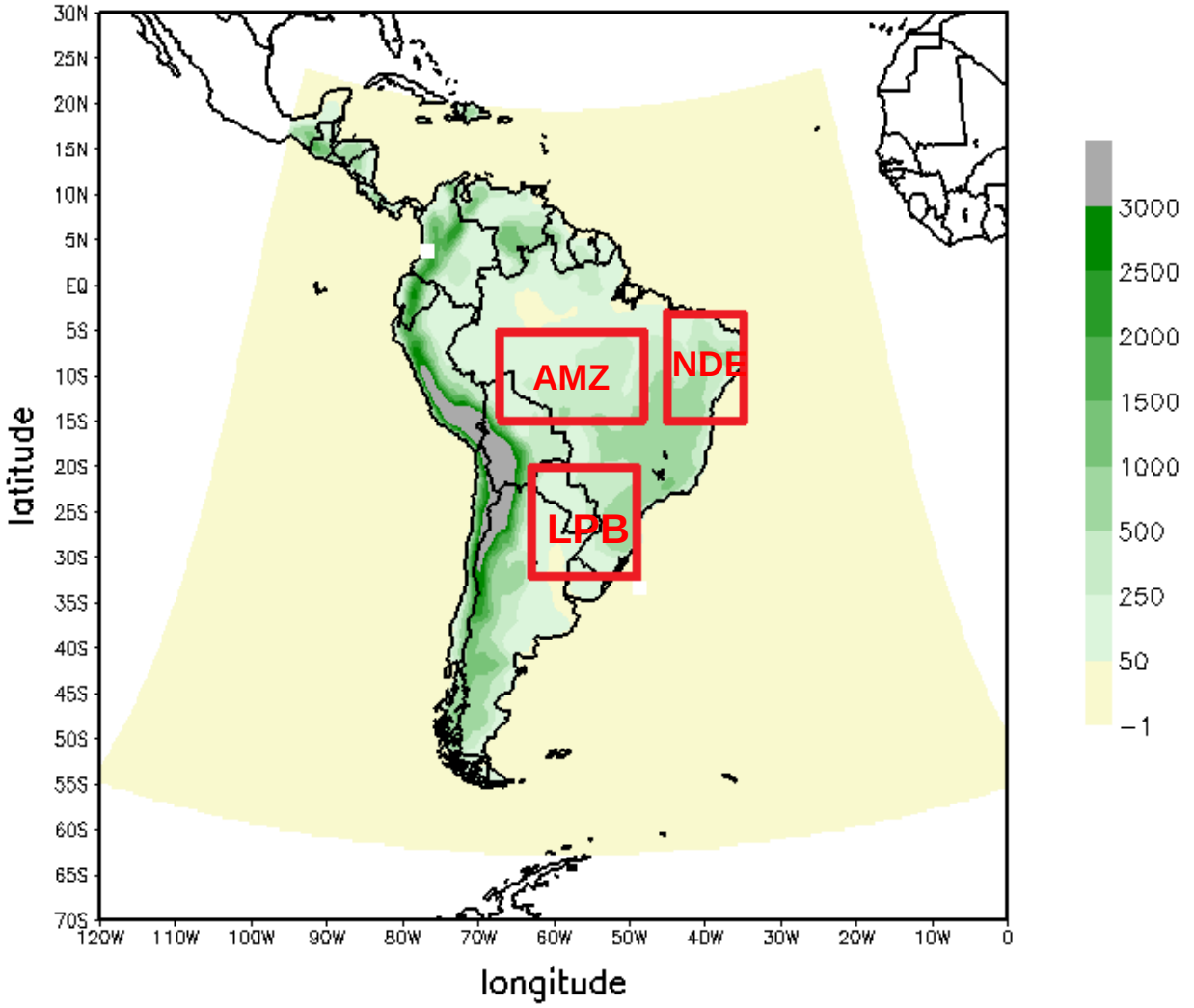
Spatial patterns

DJF and JJA maps

Box Averages

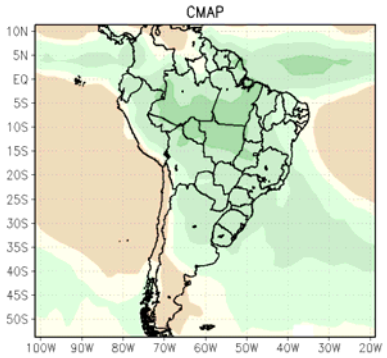
Annual Cycle

Time Series

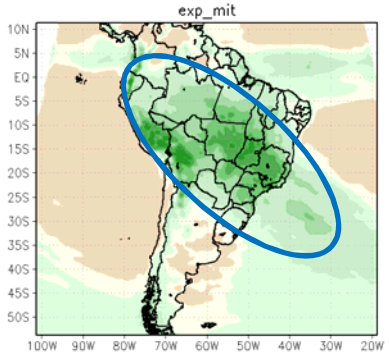


Precipitation (DJF)

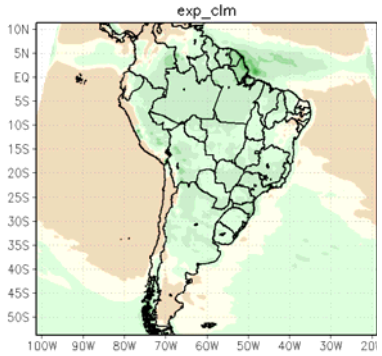
CMAP



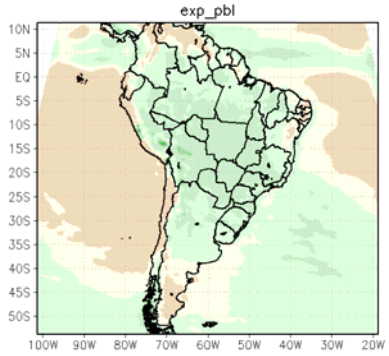
Exp_MIT*



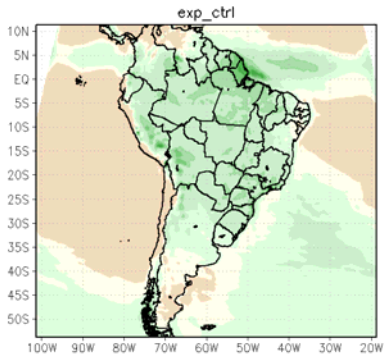
Exp_CLM



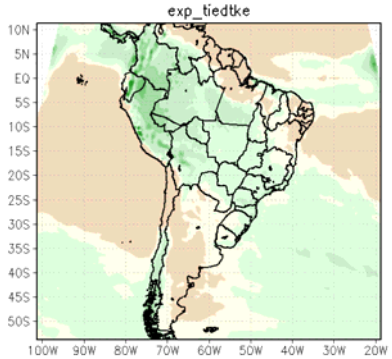
Exp_PBL



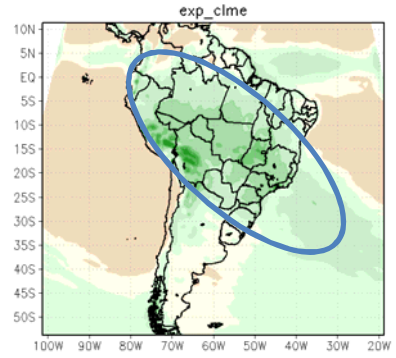
Exp_CTRL



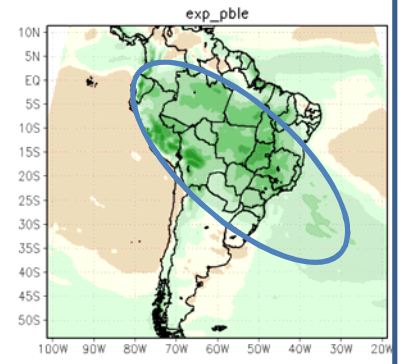
Exp_Tiedtke

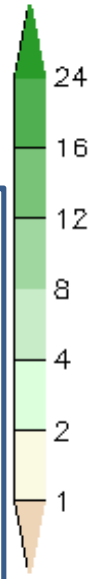


Exp_CLM_MIT



Exp_PBL_MIT

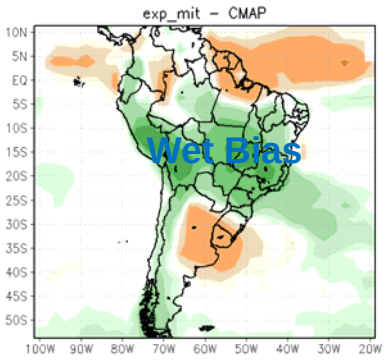




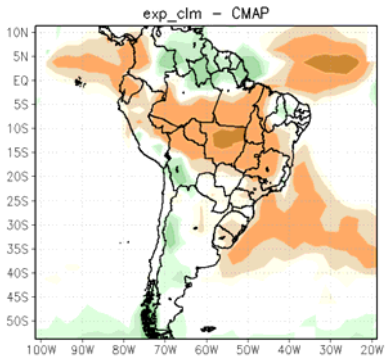
- Experiments with MIT are wetter than other convection schemes
- CLM and UW PBL experiments with MIT are wetter than with Mixed scheme

Precipitation Anomalies (Experiment-CMAP) (DJF)

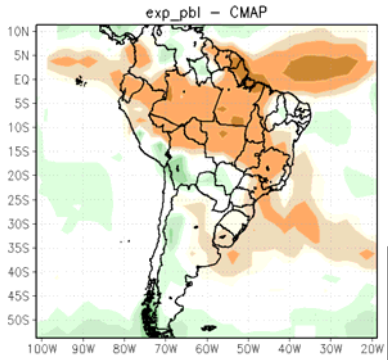
Exp_MIT*



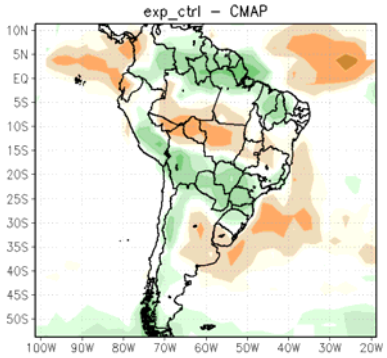
Exp_CLM



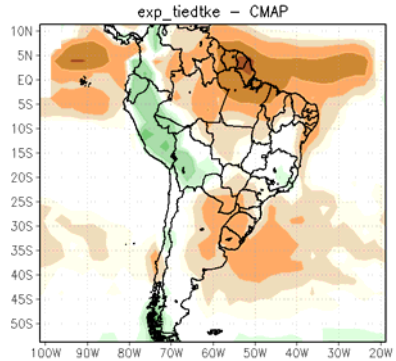
Exp_PBL



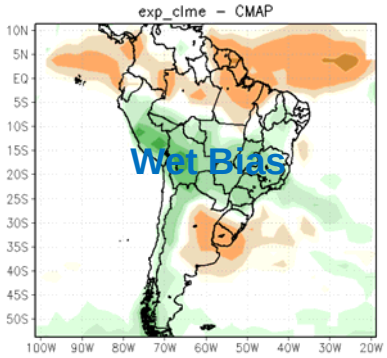
Exp_CTRL



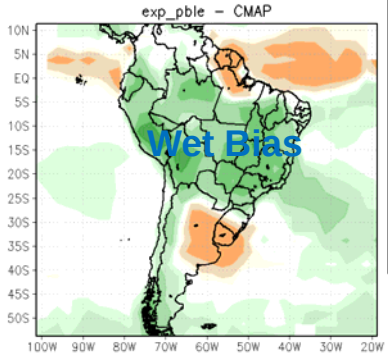
Exp_Tiedtke

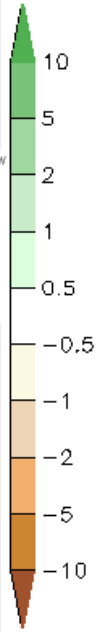


Exp_CLM_MIT



Exp_PBL_MIT



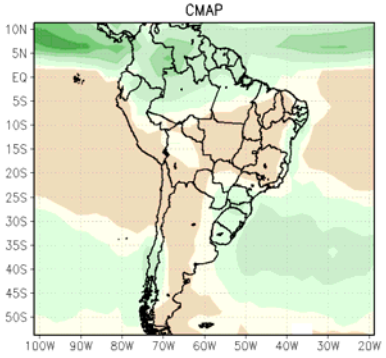


- Wet bias (MIT) and dry bias (Mixed) over central South America
- Dry bias in the north and southeast of South America (Tiedtke)

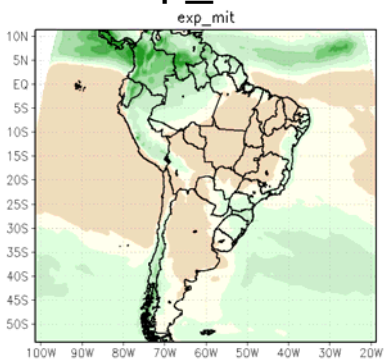
- Lowest bias in Exp_CTRL

Precipitation (JJA)

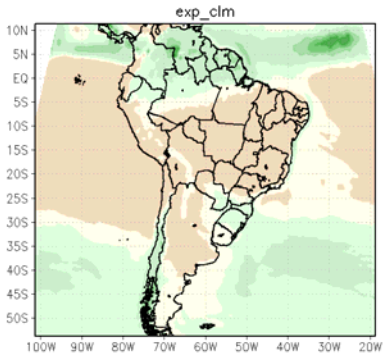
CMAP



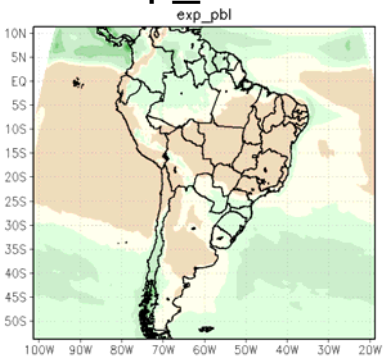
Exp_MIT*



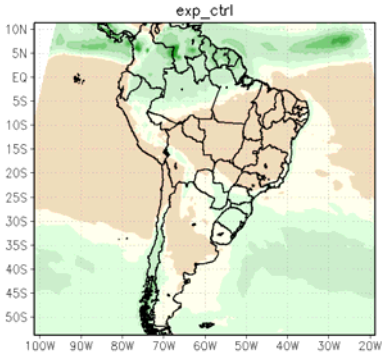
Exp_CLM



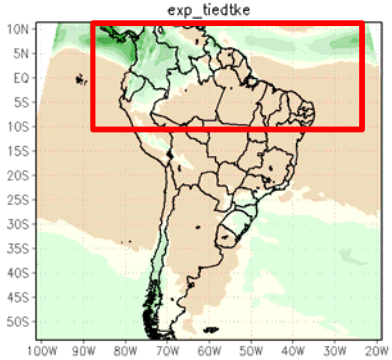
Exp_PBL



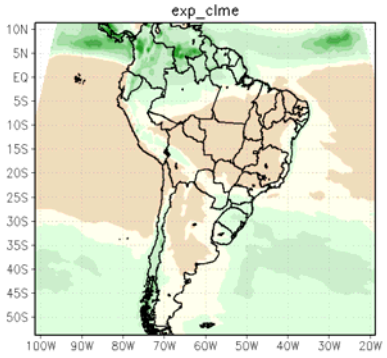
Exp_CTRL



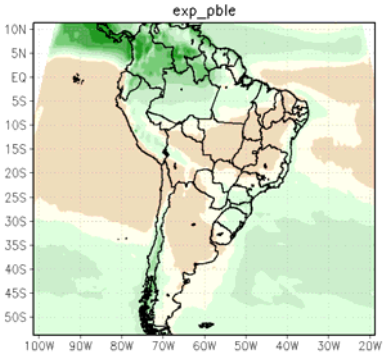
Exp_Tiedtke

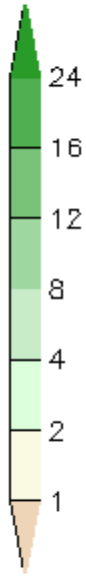


Exp_CLM_MIT



Exp_PBL_MIT



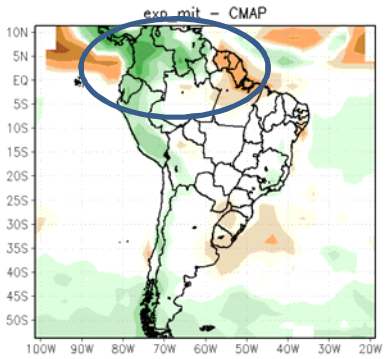


In general, all runs were able to capture the wet tropics (including ITCZ) and the dry conditions in central part of Brazil.

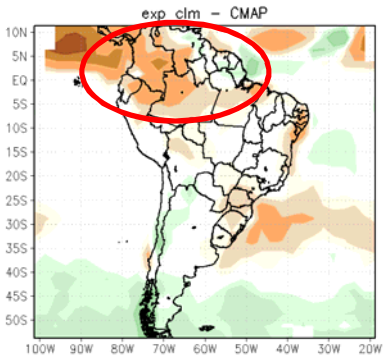
Except Tiedtke that is drier in the north of Brazil

Precipitation Anomalies (Experiment-CMAP) (JJA)

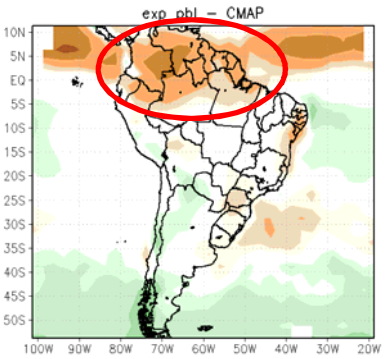
Exp_MIT*



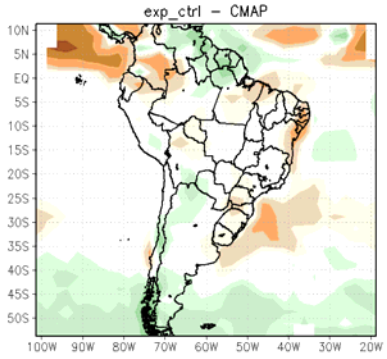
Exp_CLM



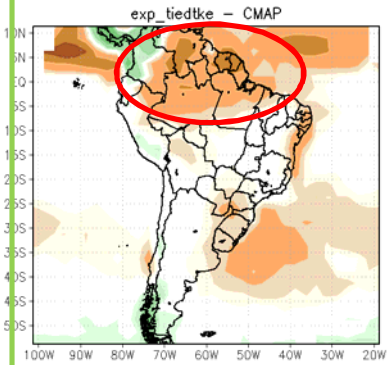
Exp_PBL



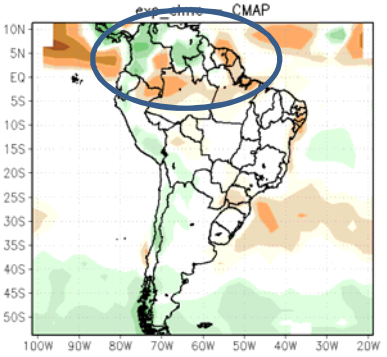
Exp_CTRL



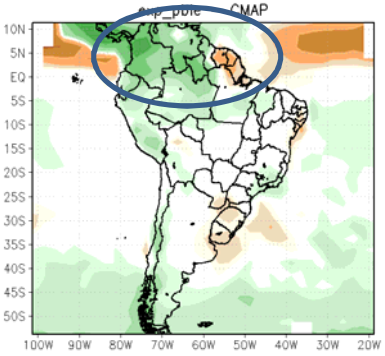
Exp_Tiedtke

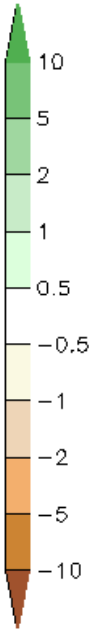


Exp_CLM_MIT



Exp_PBL_MIT



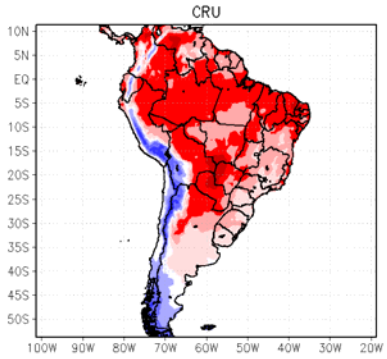


- Wet bias (MIT) and dry bias (Mixed, Tiedtke) over northern South America
- In CLM and UW PBL runs, dry bias is reduced with MIT

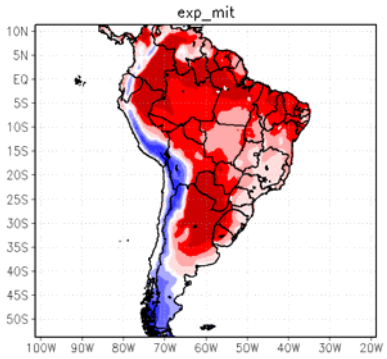
- Lowest bias in Exp_CTRL, Exp_CLM_MIT

Air Temperature (DJF)

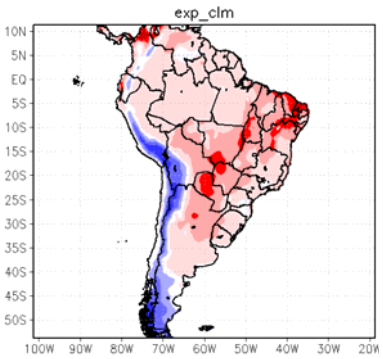
CRU



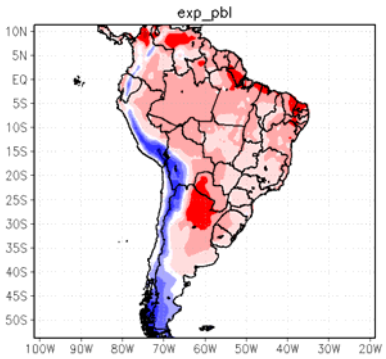
Exp_MIT*



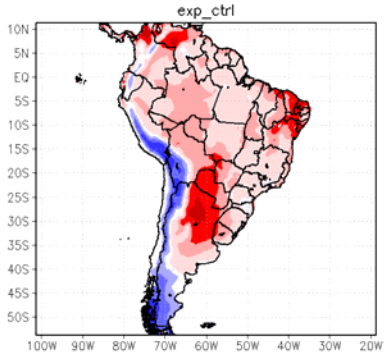
Exp_CLM



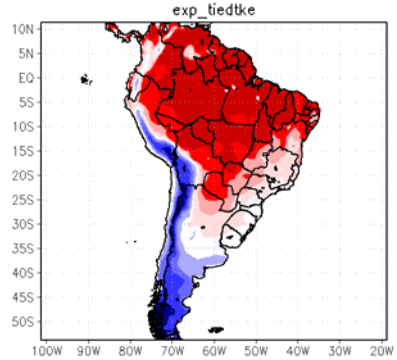
Exp_PBL



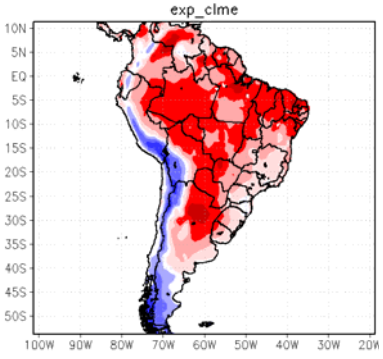
Exp_CTRL



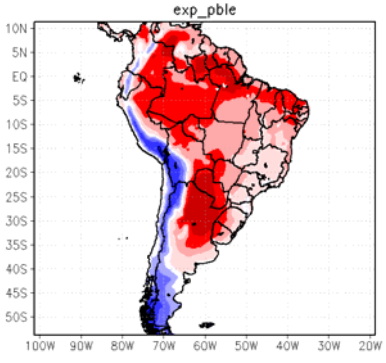
Exp_Tiedtke

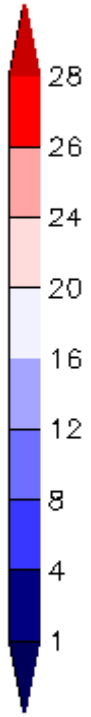


Exp_CLM_MIT



Exp_PBL_MIT

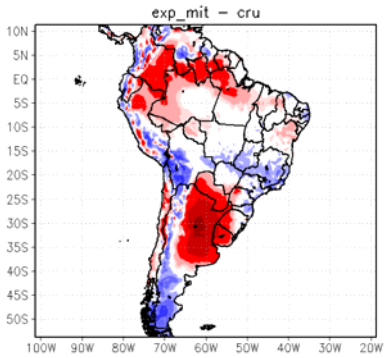




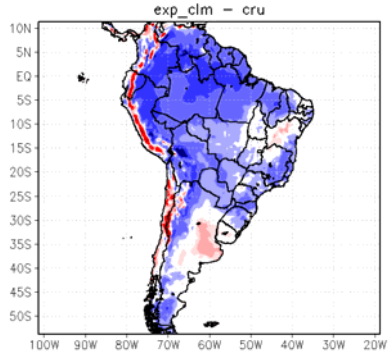
Compared with CRU, Exp_CTRL is colder and Exp_Tiedtke is warmer

Air Temperature Anomalies (Experiment-CRU) (DJF)

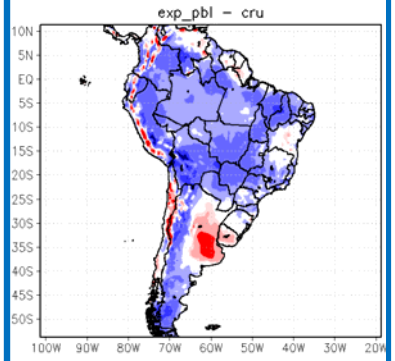
Exp_MIT*



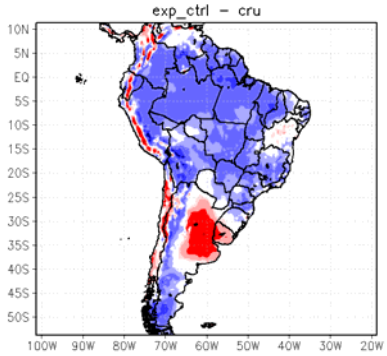
Exp_CLM



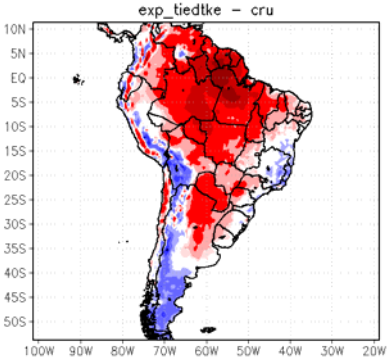
Exp_PBL



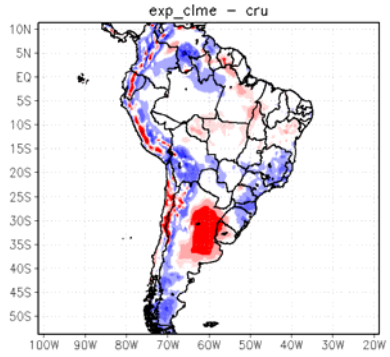
Exp_CTRL



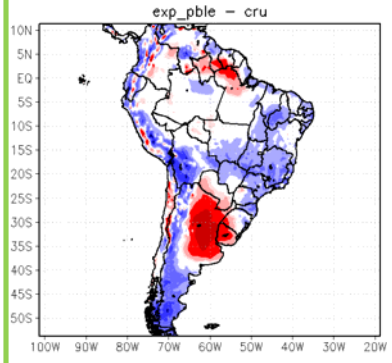
Exp_Tiedtke

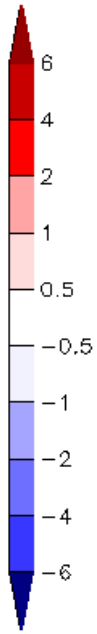


Exp_CLM_MIT



Exp_PBL_MIT

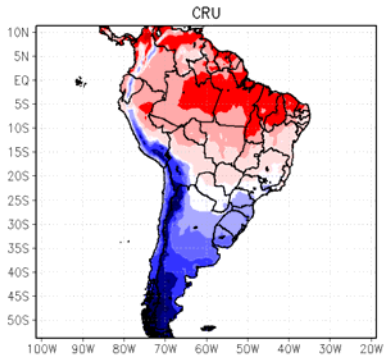




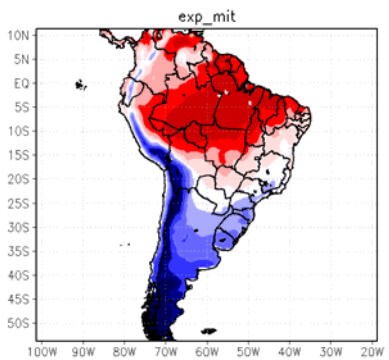
- Over north and central South America, cold bias (Mixed), strong warm bias (Tiedtke)
- CLM, UW PBL tend to reduce the cold bias with MIT scheme
- Lowest bias for Exp_CLM_MIT (except over southeast South America)

Air Temperature (JJA)

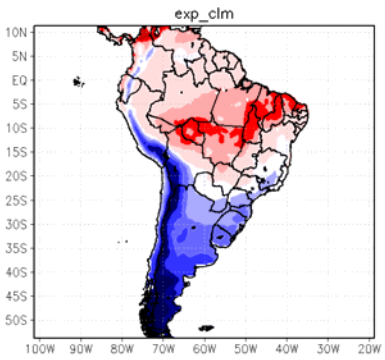
CRU



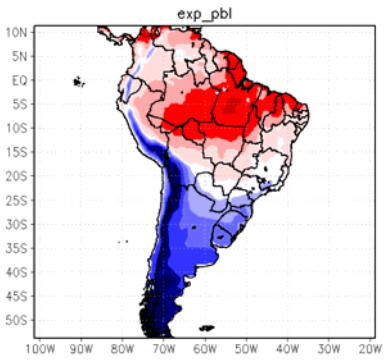
Exp_MIT*



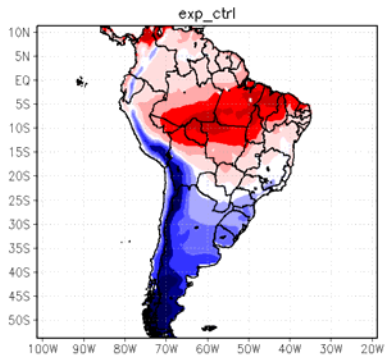
Exp_CLM



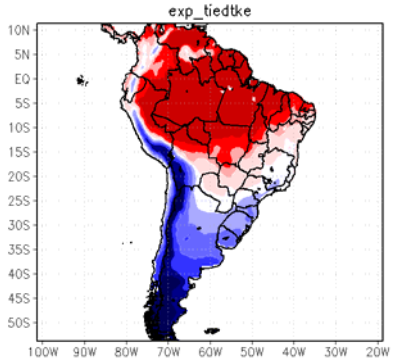
Exp_PBL



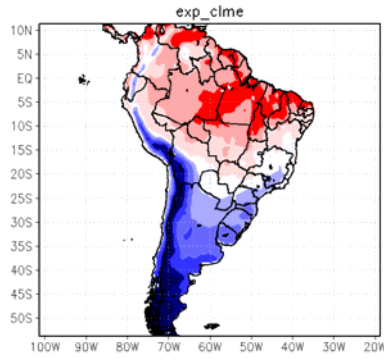
Exp_CTRL



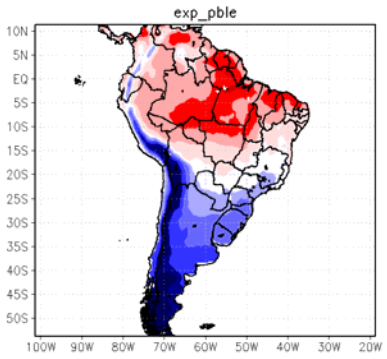
Exp_Tiedtke

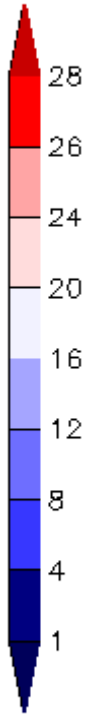


Exp_CLM_MIT



Exp_PBL_MIT

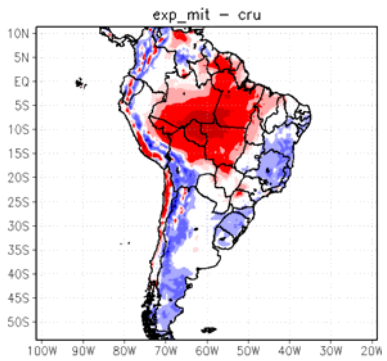




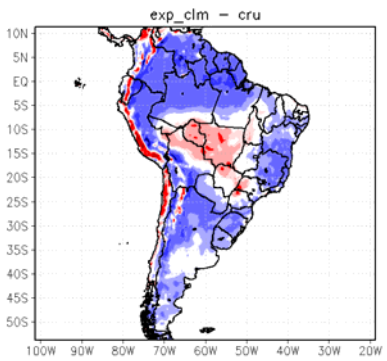
Exp_MIT* and Exp_Tiedtke warmer than CRU over northern and central South America

Air Temperature Anomalies (Experiment-CRU) (JJA)

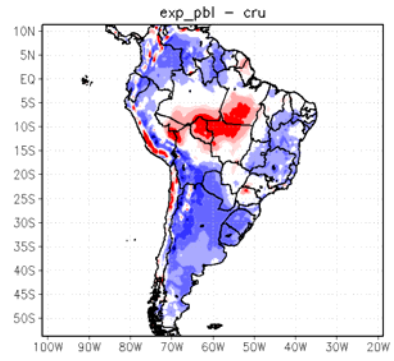
Exp_MIT*



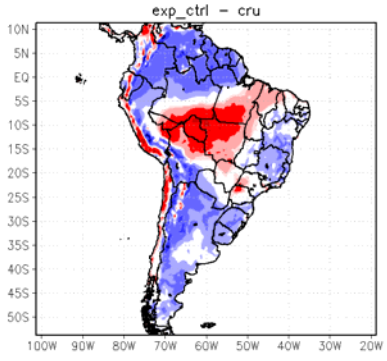
Exp_CLM



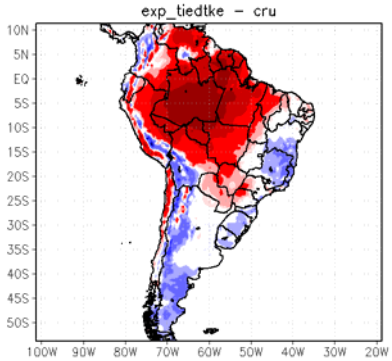
Exp PBL



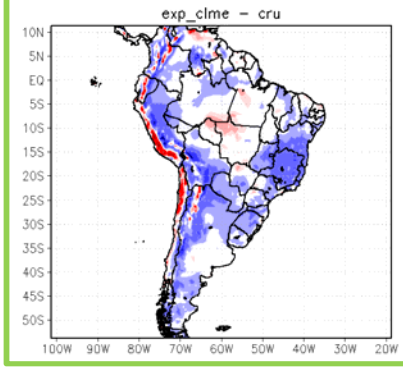
Exp_CTRL



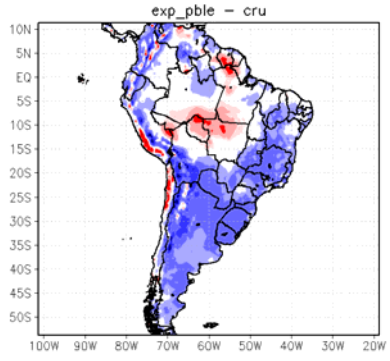
Exp_Tiedtke

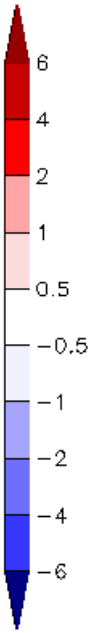


Exp_CLM_MIT



Exp_PBL_MIT

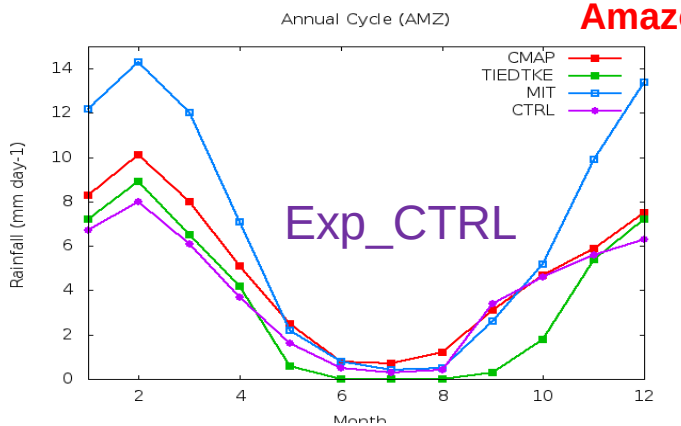


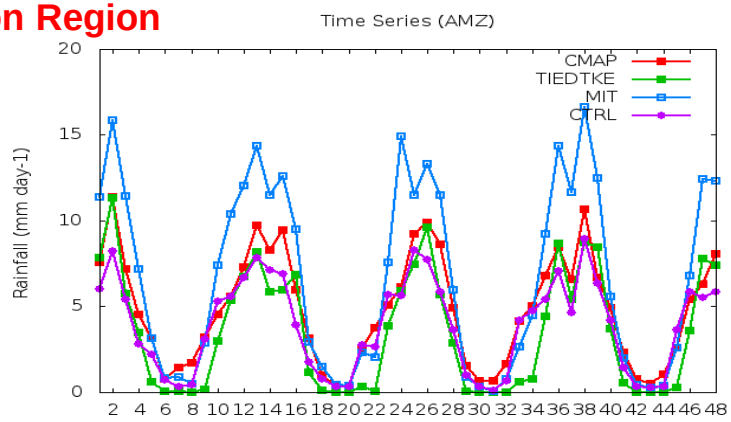


- Strong warm bias in MIT* and Tiedtke
- Similar temperature anomaly pattern with Exp_CTRL when UW PBL is used
- Warm bias over central South America in Exp_CTRL is reduced with CLM
- Lowest bias for Exp_CLM_MIT

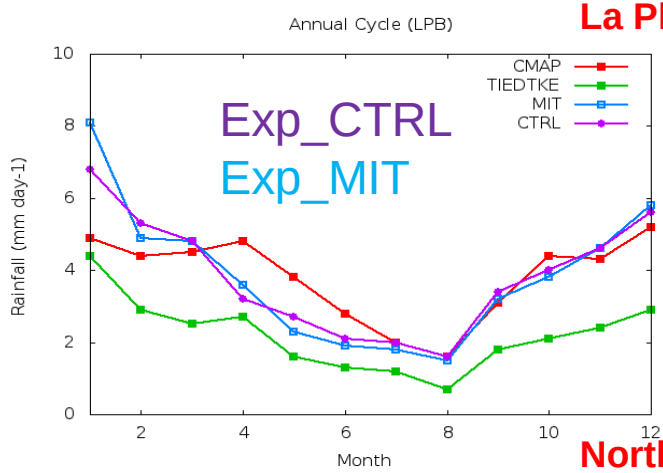
Convection experiments: Precipitation

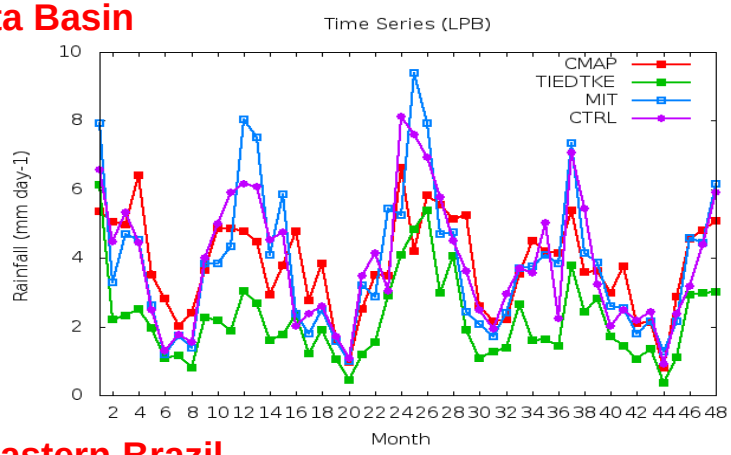
Amazon Region



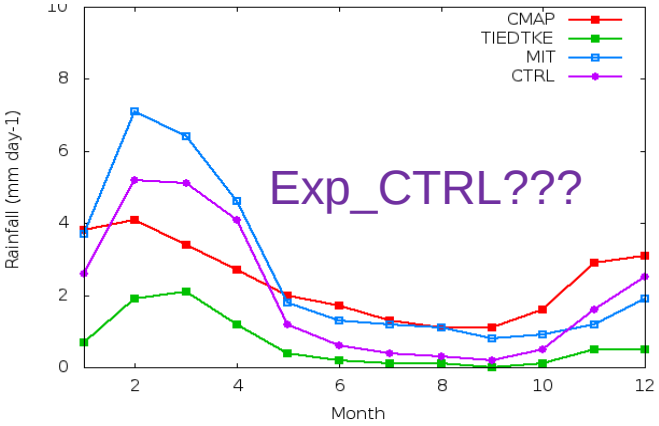


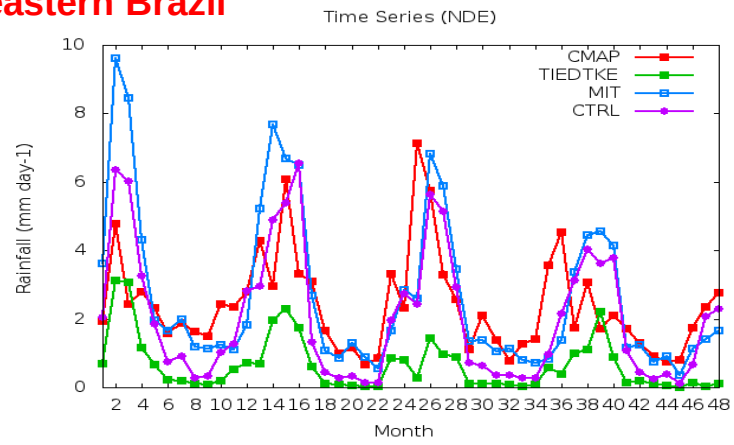
La Plata Basin

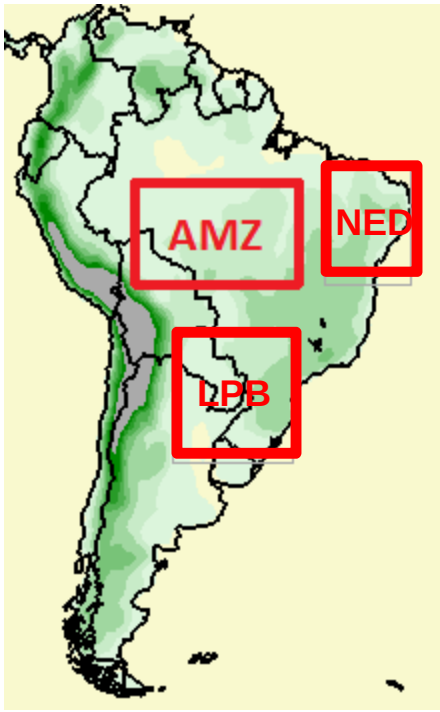




Northeastern Brazil







CMAP

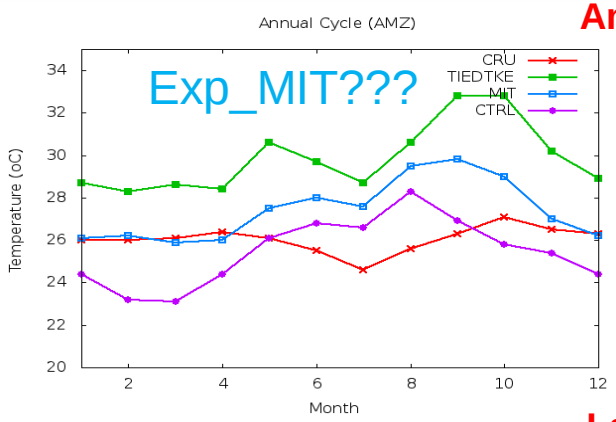
Tiedtke

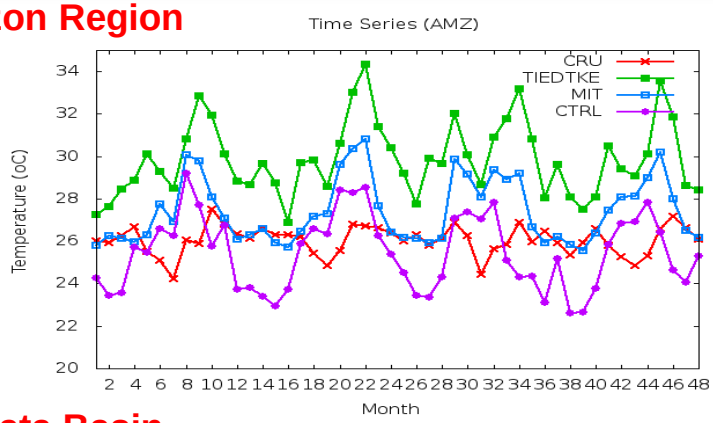
MIT

CTRL

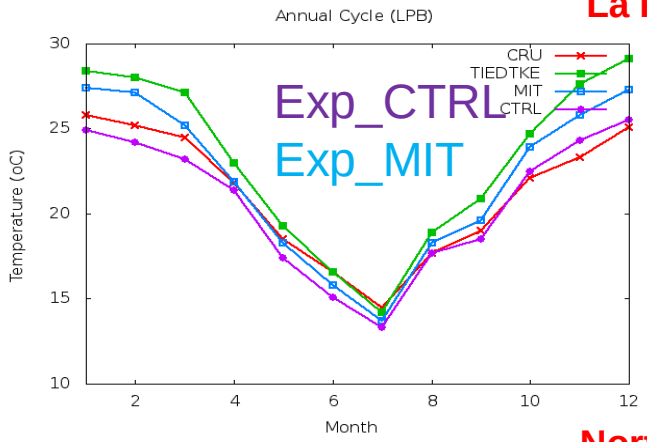
Convection experiments: Air Temperature

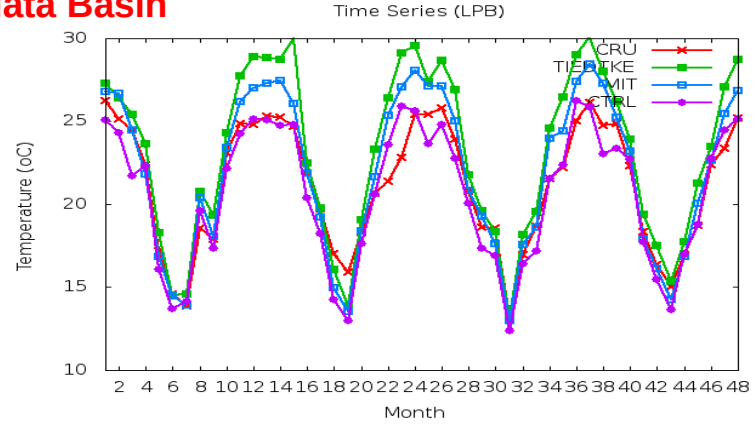
Amazon Region



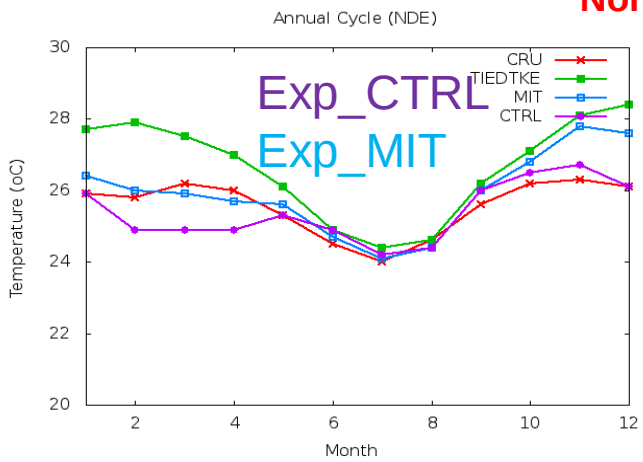


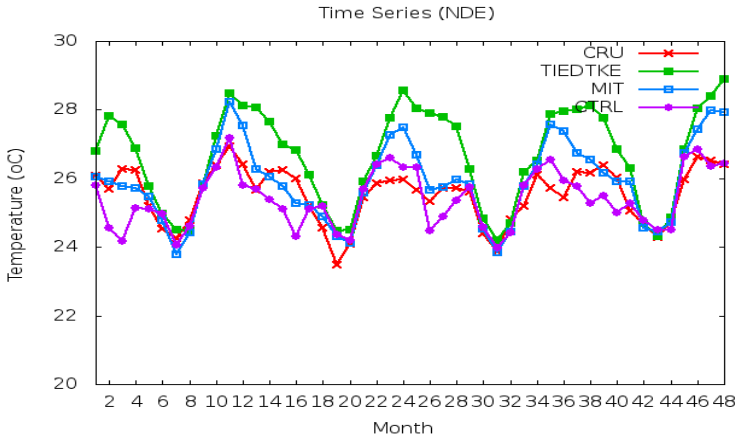
La Plata Basin

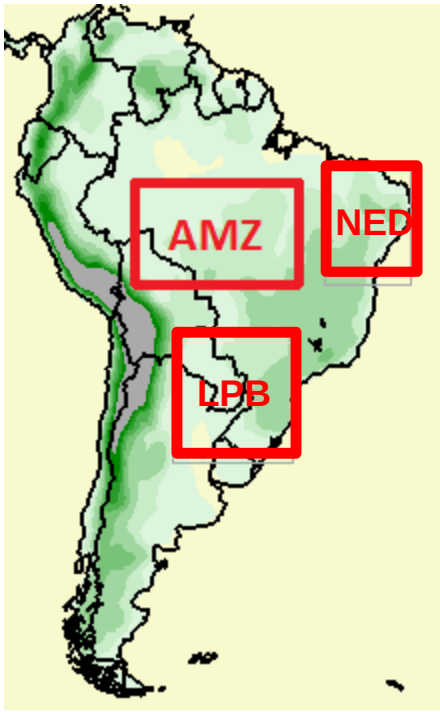




Northeastern Brazil







CRU

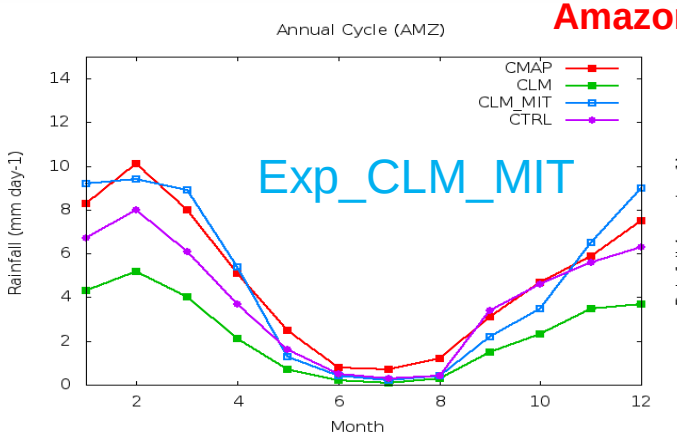
Tiedtke

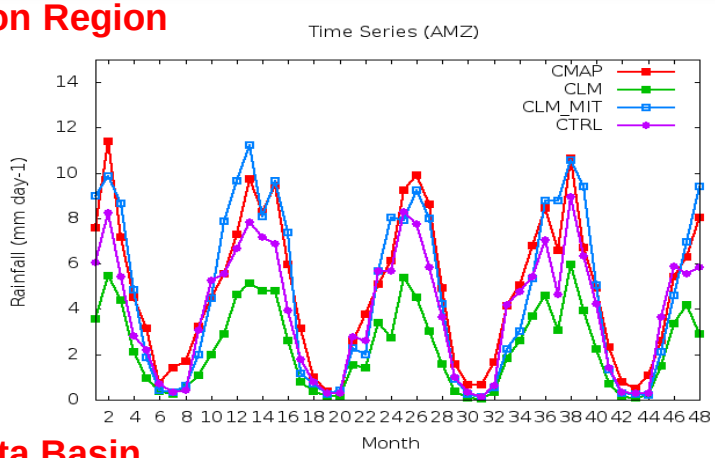
MIT

CTRL

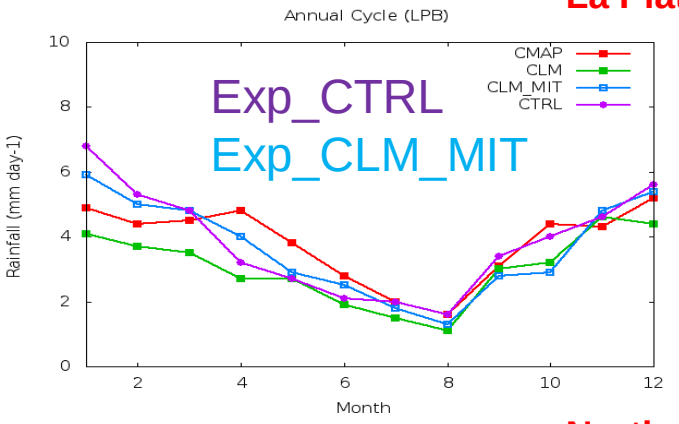
Land surface experiments: Precipitation

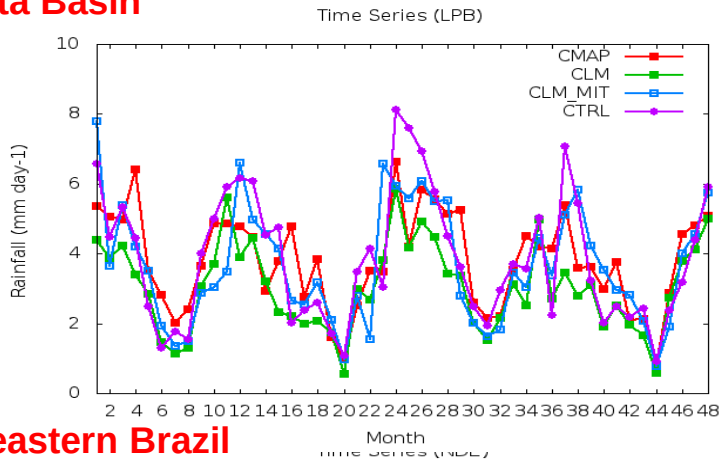
Amazon Region



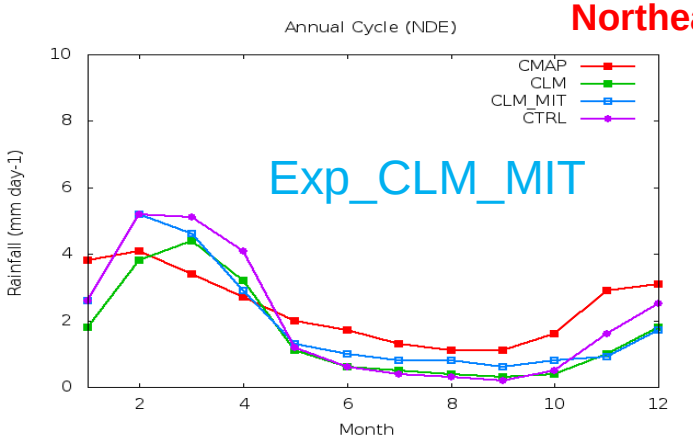


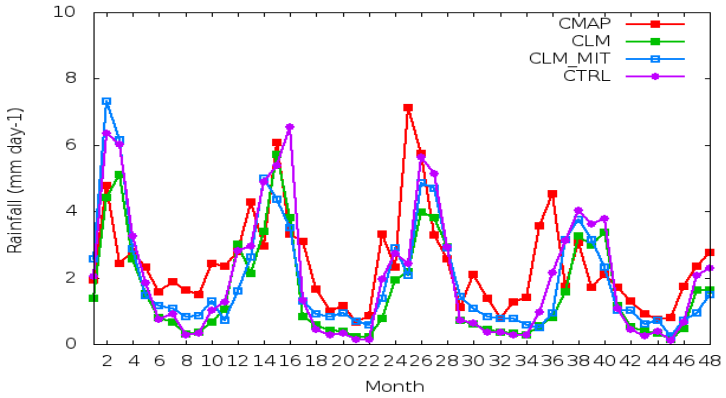
La Plata Basin

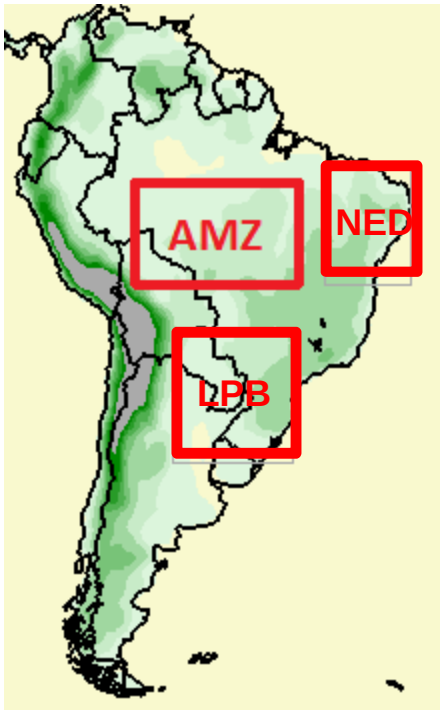




Northeastern Brazil







CMAP

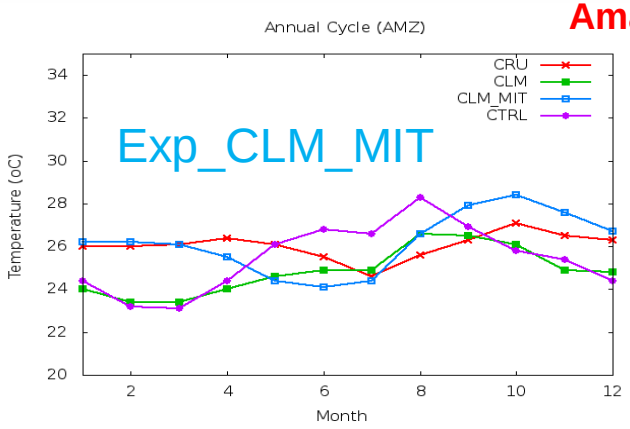
CLM

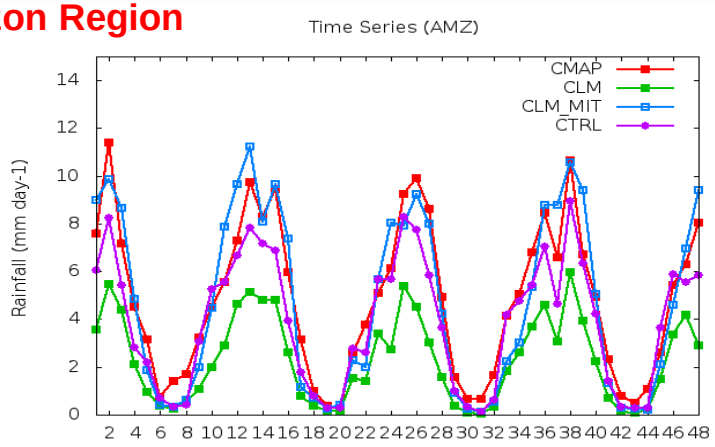
CLM_MIT

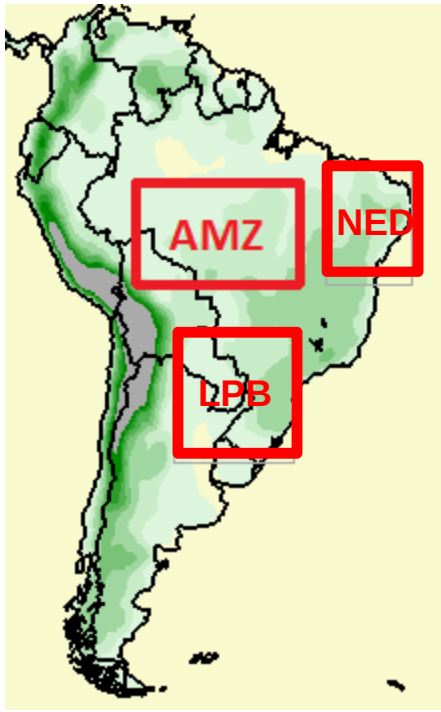
CTRL

Land surface experiments: Air Temperature

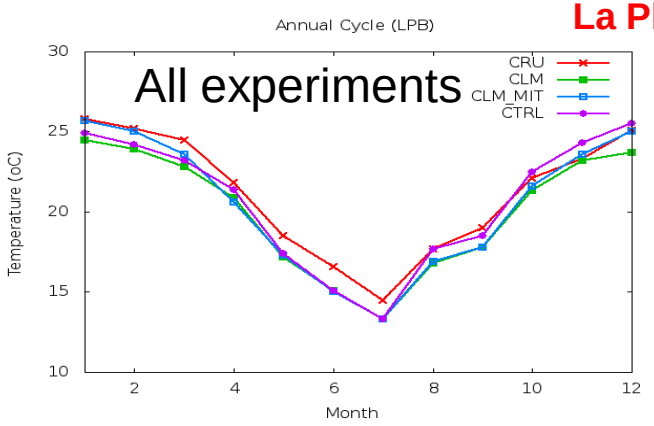
Amazon Region

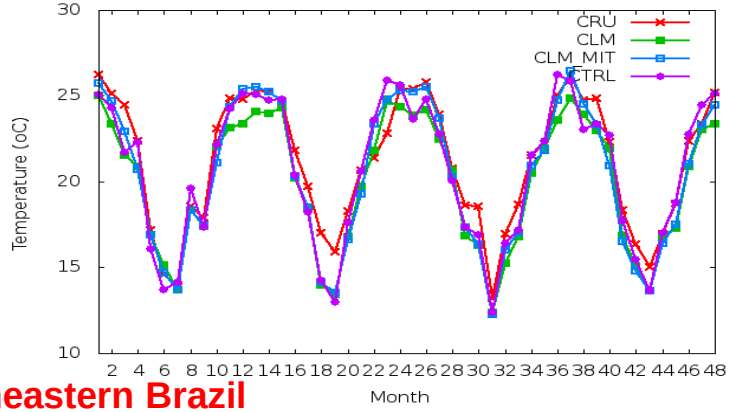




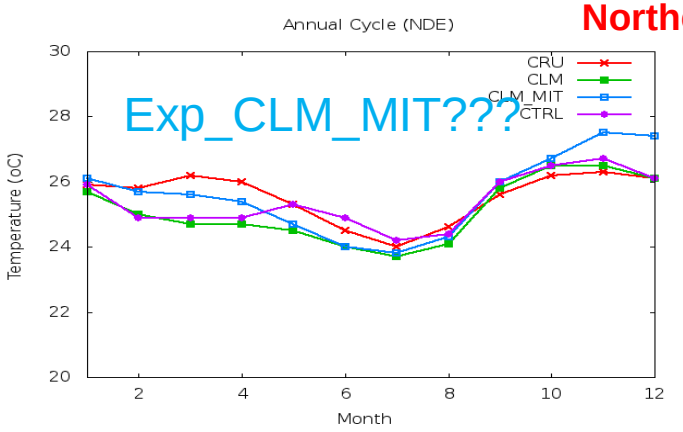


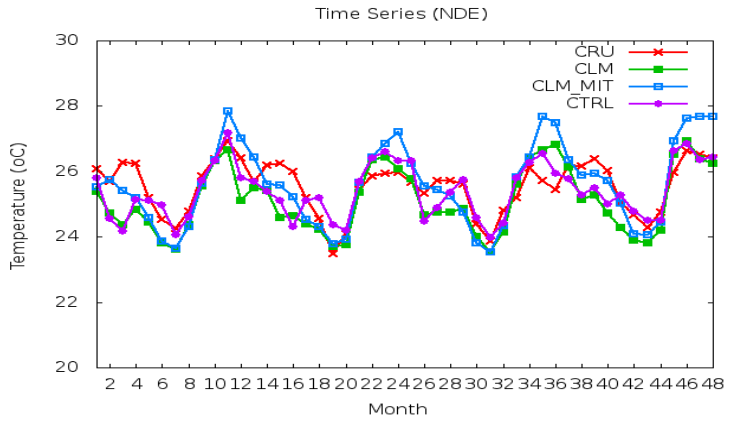
La Plata Basin





Northeastern Brazil





CRU

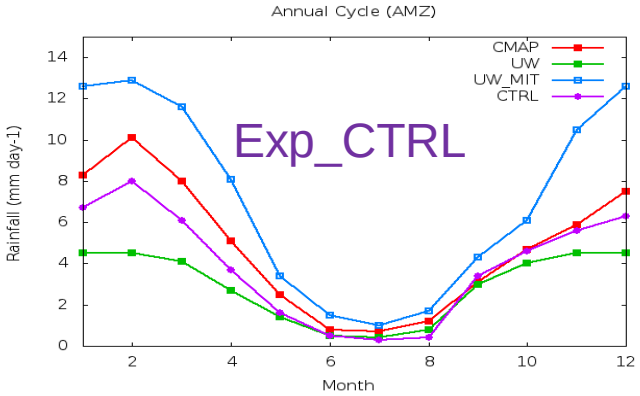
CLM

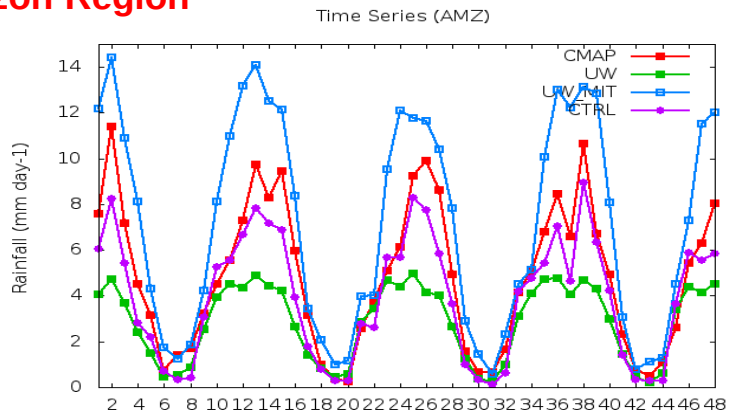
CLM_MIT

CTRL

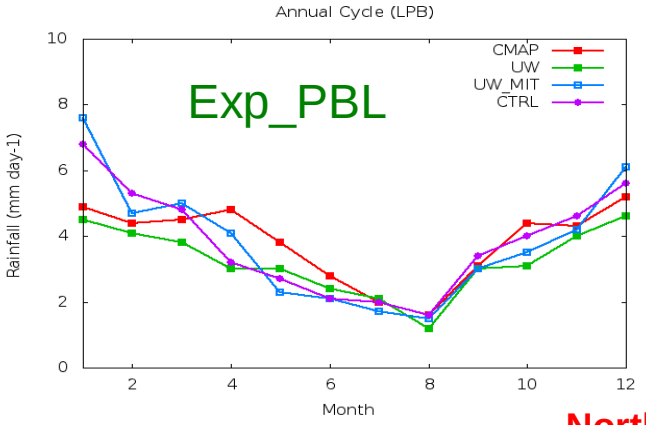
PBL experiments: Precipitation

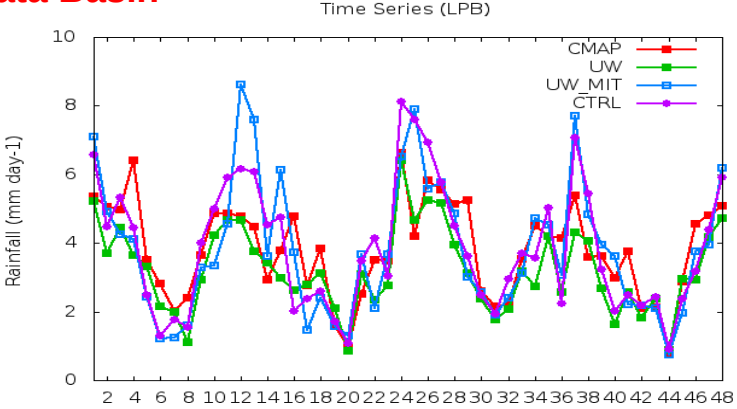
Amazon Region



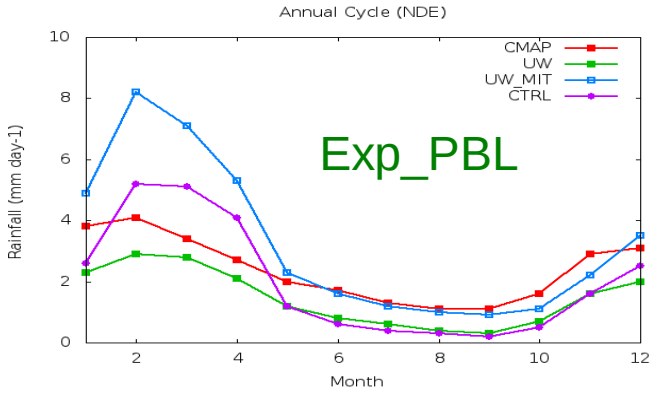


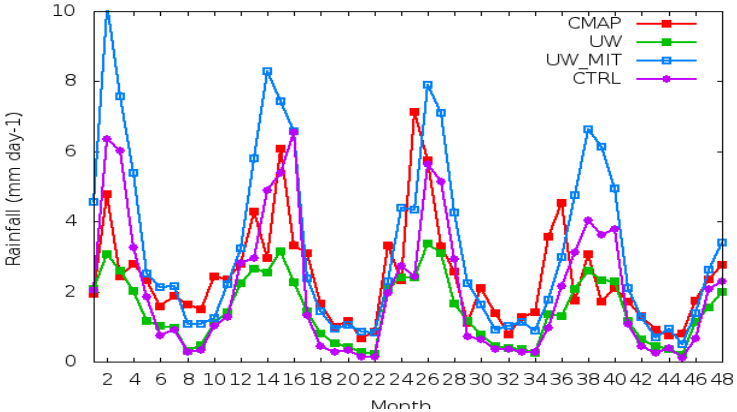
La Plata Basin

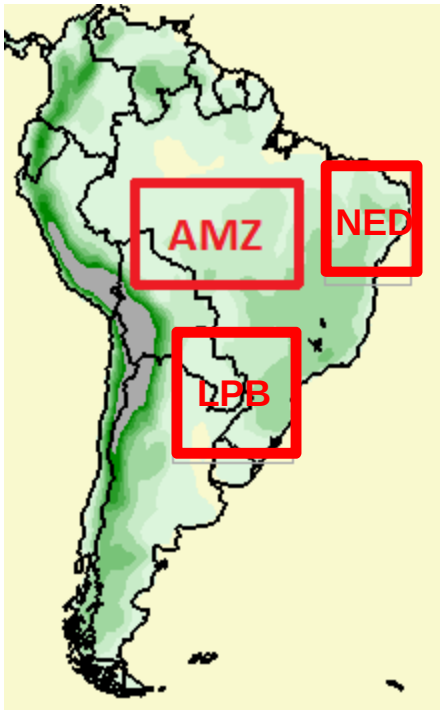




Northeastern Brazil







CMAP

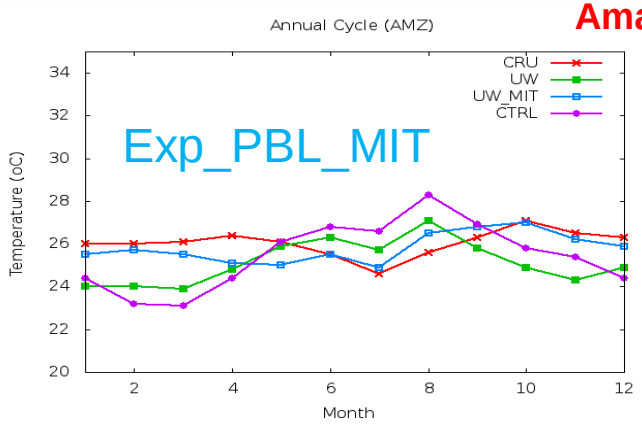
PBL

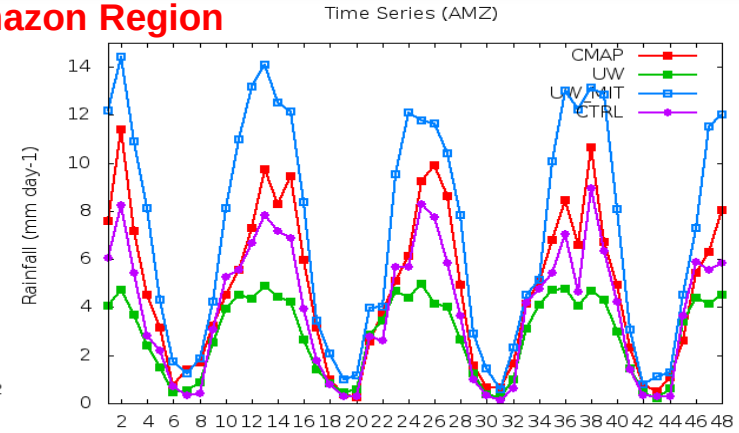
PBL_MIT

CTRL

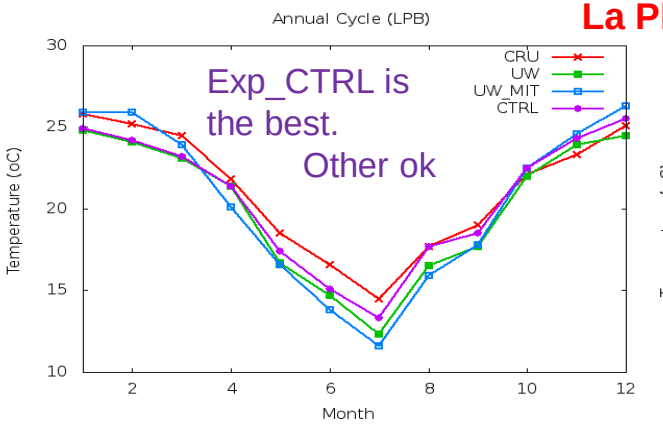
PBL experiments: Air Temperature

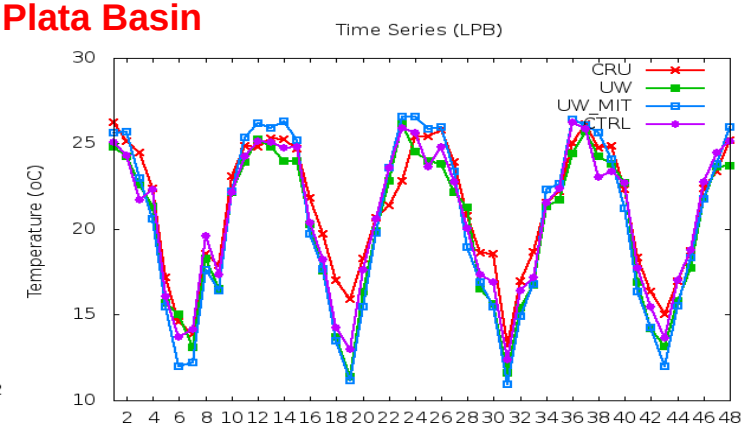
Amazon Region



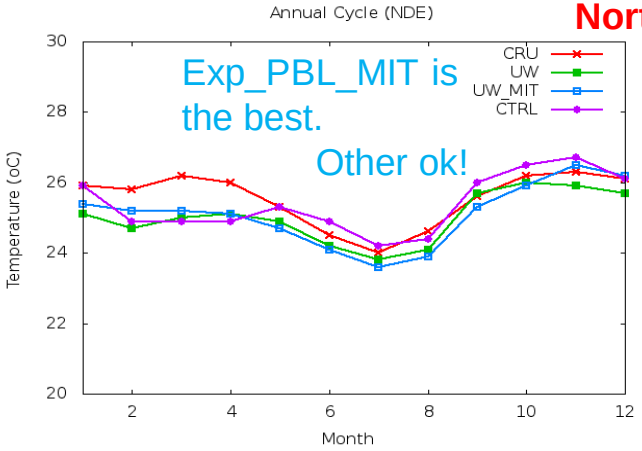


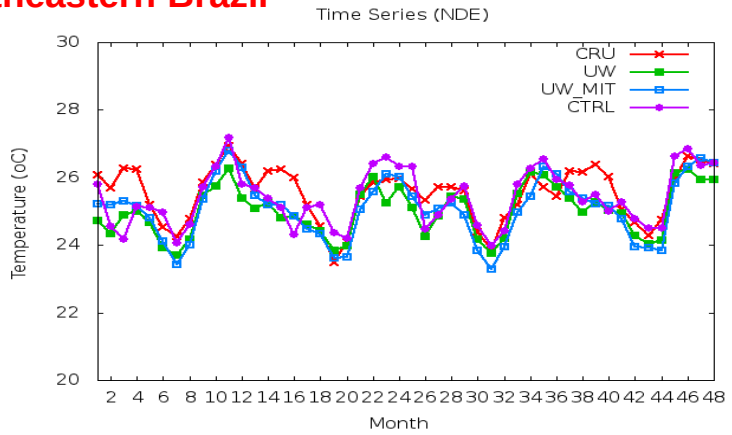
La Plata Basin

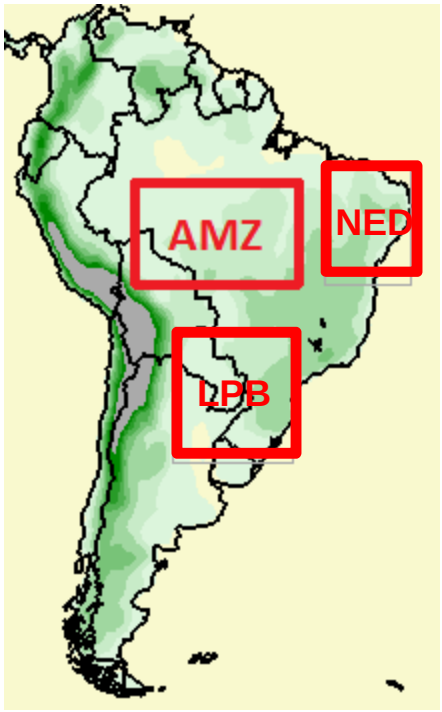




Northeastern Brazil







CRU

PBL

PBL_MIT

CTRL

Summary over South America

South America

Precipitation	Experiment
DJF	Exp_CTRL
JJA	Exp_CLM_MIT

Temperature	Experiment
DJF	Exp_CLM_MIT
JJA	Exp_CLM_MIT

Convection experiments

Region	Precipitation	Temperature
Amazon	Exp_CTRL	Exp_MIT
La Plata Basin	Exp_CTRL / Exp_MIT	Exp_CTRL / Exp_MIT
Northeastern Brazil	Exp_CTRL????	Exp_CTRL / Exp_MIT

Land surface experiments

Region	Precipitation	Temperature
Amazon	Exp_CLM_MIT	Exp_CLM_MIT
La Plata Basin	Exp_CTRL / Exp_CLM_MIT	All Experiments
Northeastern Brazil	Exp_CLM_MIT	Exp_CLM_MIT

PBL experiments

Region	Precipitation	Temperature
Amazon	Exp_CTRL	Exp_PBL_MIT
La Plata Basin	Exp_PBL	Exp_CTRL (all experim.)
Northeastern Brazil	Exp_PBL	Exp_PBL_MIT (all experim.)

Ideas for future studies

Additional testing in the RegCM4.3 is needed, for example, adjusting / tuning some parameters in the schemes in the following experiments:

1. CLM with MIT
2. PBL with MIT
3. PBL, CLM and MIT


Rio2016
Brasil 2014
FIFA WORLD CUP
Thank you very much!!!