

Onset and Demise of the South American Monsoon in Two Simulations of RegCM3

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Introduction and Objective

Many studies have been done to estimate the onset and demise of the South America Monsoon (SAM) using reanalyses dataset.

However, it is also important to verify if the climate models can simulate the SAM lifecycle.

Therefore, the purpose of this study is to identify the onset, demise and length of the SAM in two simulations of Regional Climate Model – version 3 (RegCM3) from 1960 to 1990.

Simulations

Two simulations were carried out with RegCM3:

- one simulation was driven by output of the **Hadley Centre Coupled Model (HadCM3)** and
- other by global model from the **Max Planck Institute for Meteorology (ECHAM5)**.

The simulations will be called by **RegHad** and **RegECHAM**, respectively.

Simulation Design

Domain: Cordex

Grid Points: 202 latitudes x 192 longitudes

Projection: Rotated Mercator

Horizontal Resolution: 50 km

Vertical Levels: 18

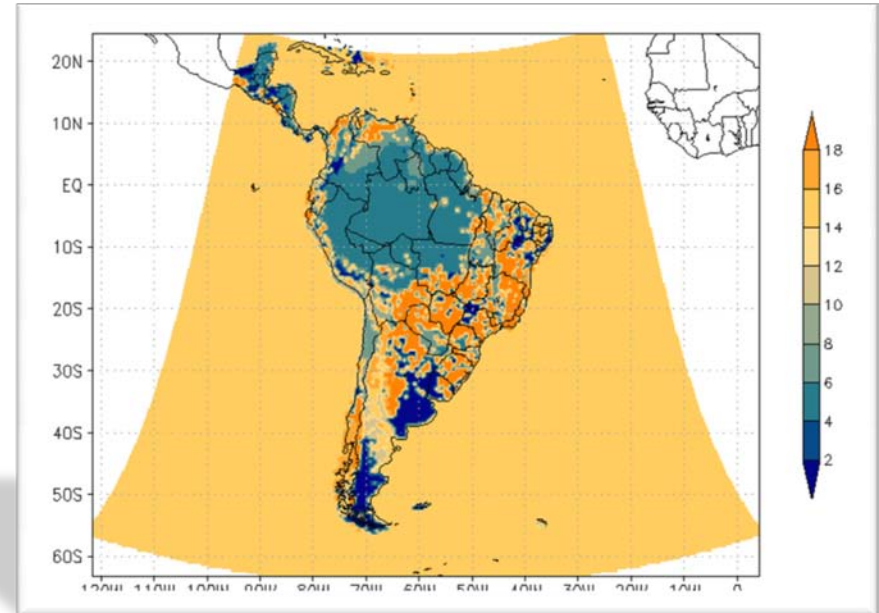
Period: 01/1959 – 01/1991

First year was considered as spin-up period.

Ocean Fluxes: Zeng et al. (1998)

Convection Scheme: Grell

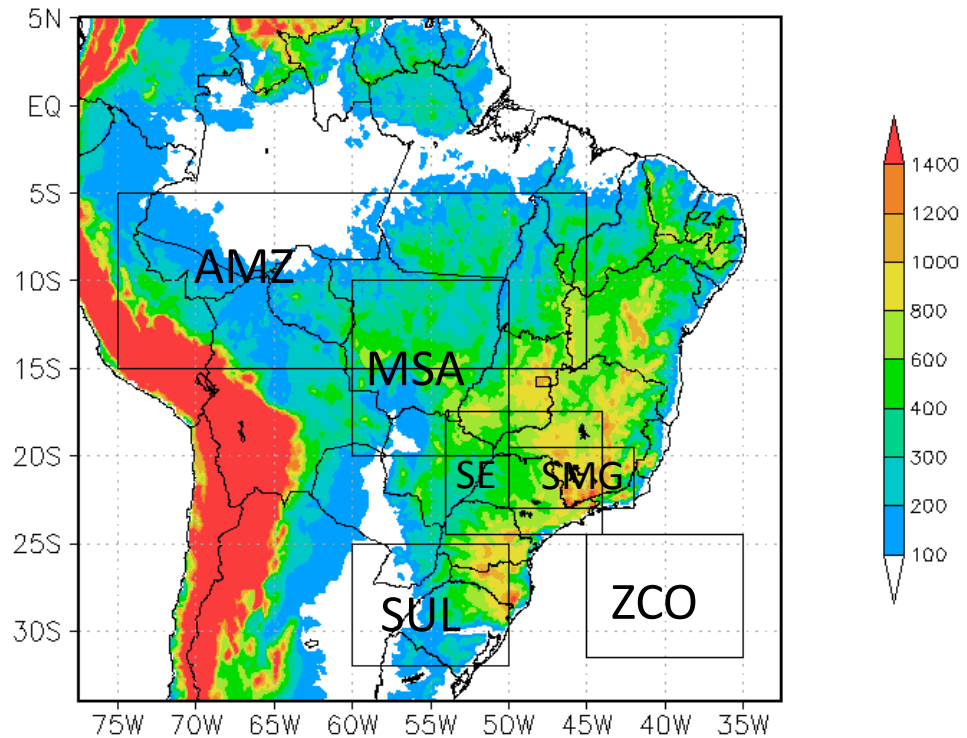
Land Use



Precipitation Validation

Spatial patterns
DJF and JJA maps

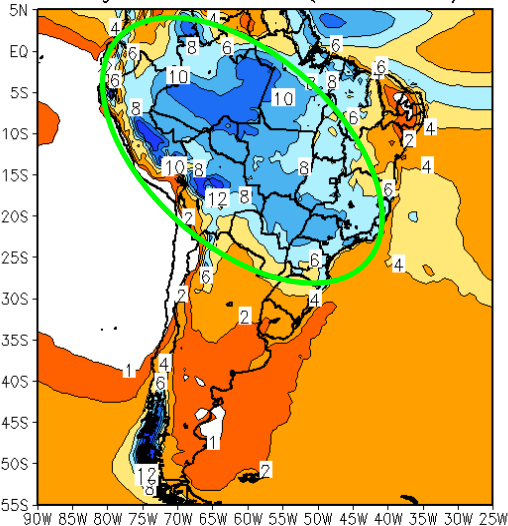
Box Averages
Annual Cycle



Results: Precipitation in the Summer

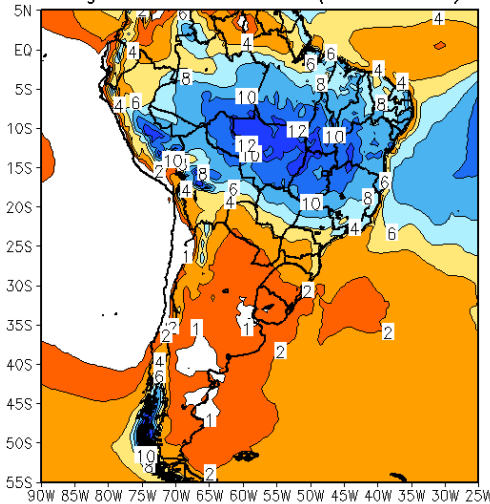
RegHad

RegHad - Summer (1960-1990)



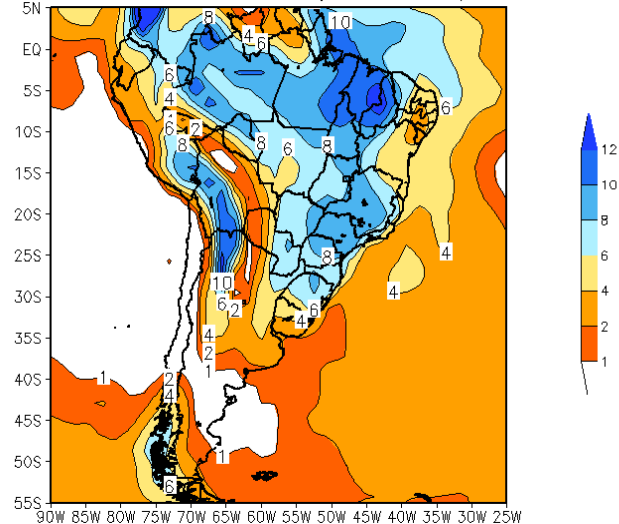
RegECHAM

RegEcham - Summer (1960-1990)



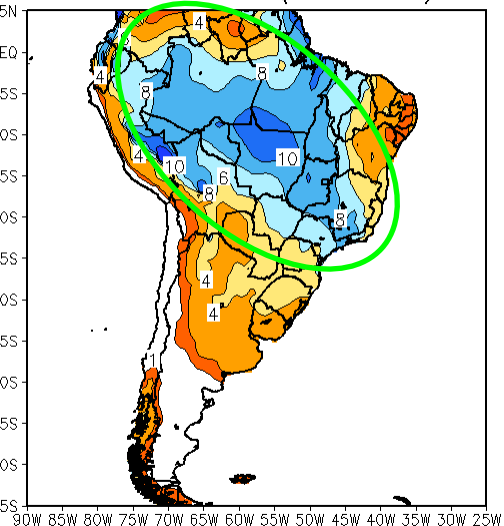
NCEP1

NCEP1 - Summer (1960-1990)



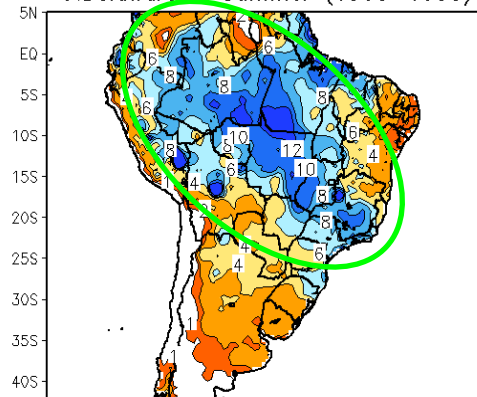
CRU

CRU - Summer (1960-1990)



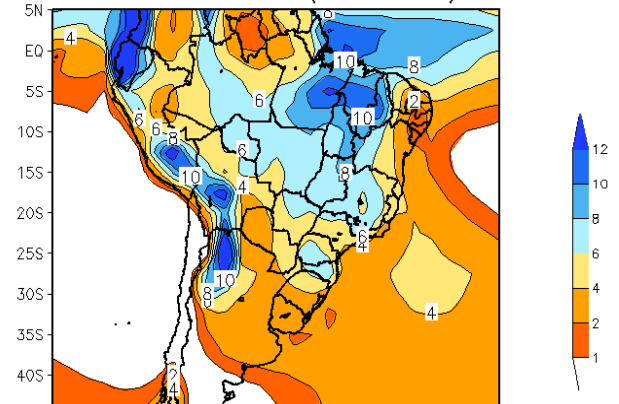
U. Delaware

U.Delaware - Summer (1960-1990)



ERA-40

Era40 - Summer (1960-1990)

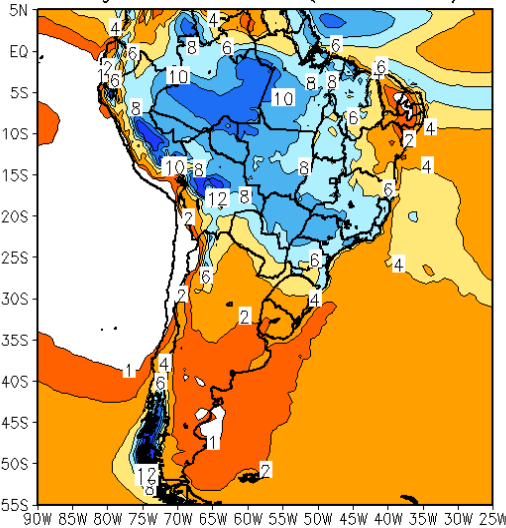


RegHad simulates the South Atlantic Convergence Zone, but it displaces this zone to southward compared to the observations.

Results: Precipitation in the Summer

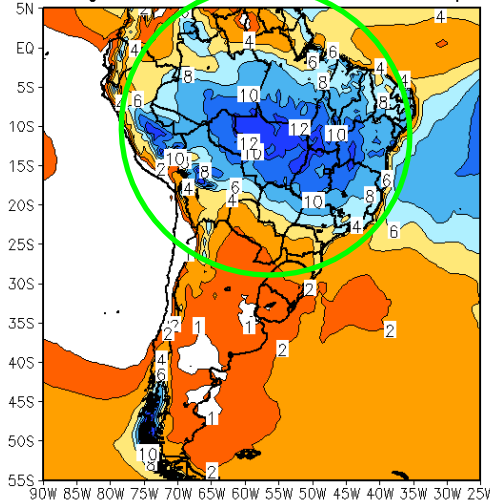
RegHad

RegHad - Summer (1960-1990)



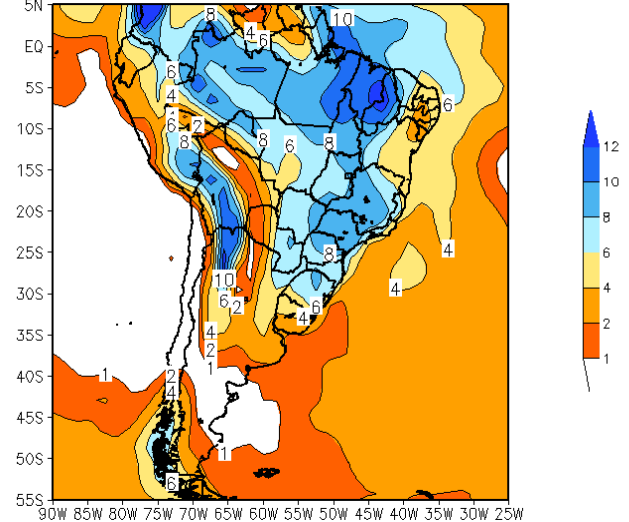
RegECHAM

RegEcham - Summer (1960-1990)



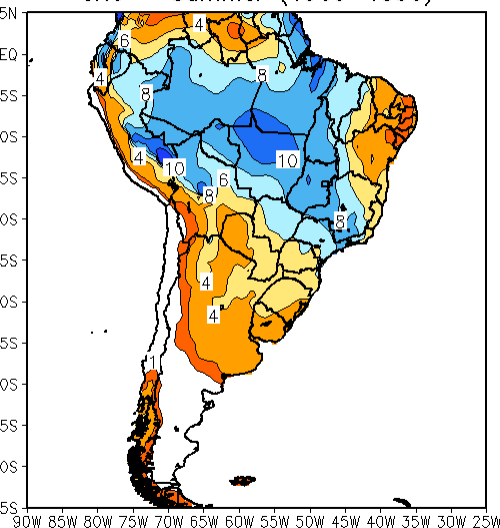
NCEP1

NCEP1 - Summer (1960-1990)



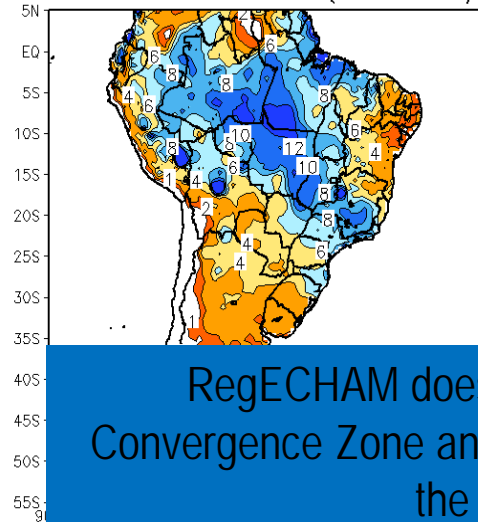
CRU

CRU - Summer (1960-1990)



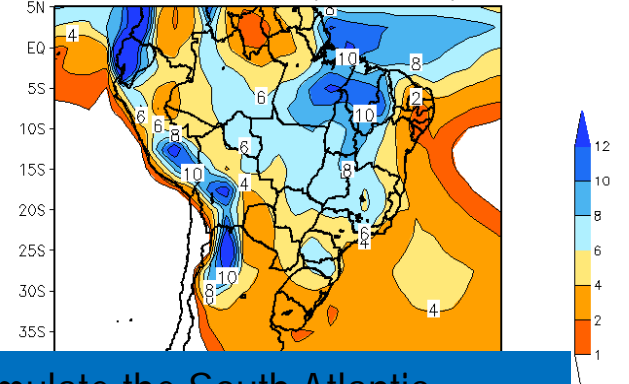
U. Delaware

U.Delaware - Summer (1960-1990)



ERA-40

Era40 - Summer (1960-1990)

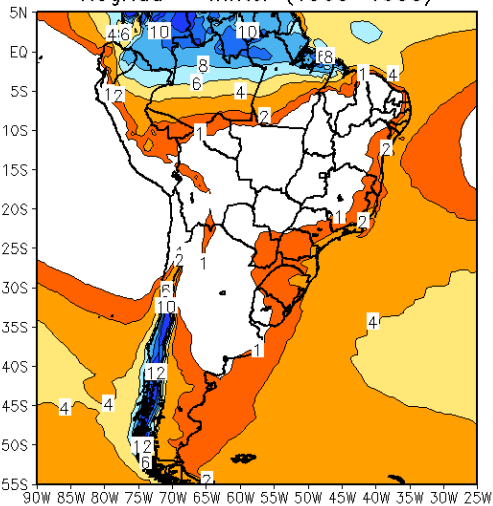


RegECHAM does not simulate the South Atlantic Convergence Zone and overestimates the precipitation over the northeast of Brazil.

Results: Precipitation in the Winter

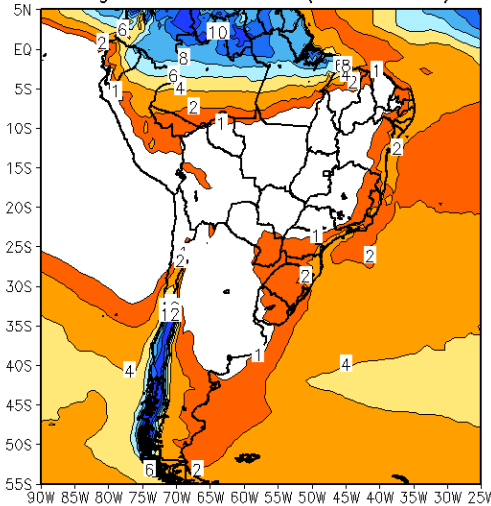
RegHad

RegHad - Winter (1960-1990)



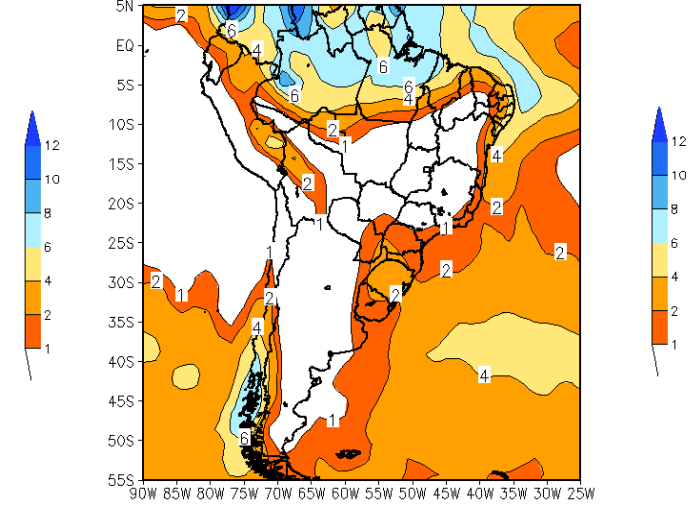
RegECHAM

RegEcham - Winter (1960-1990)



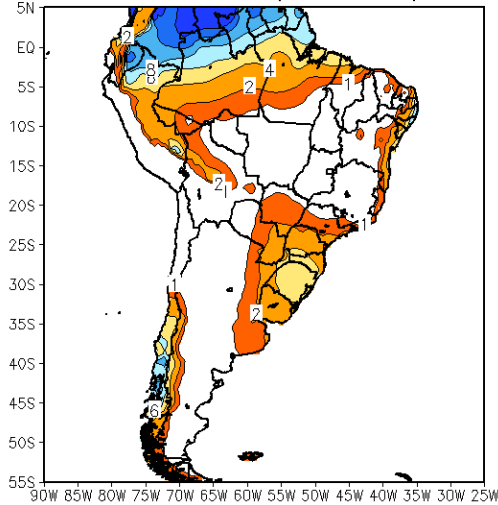
NCEP1

NCEP1 - Winter (1960-1990)



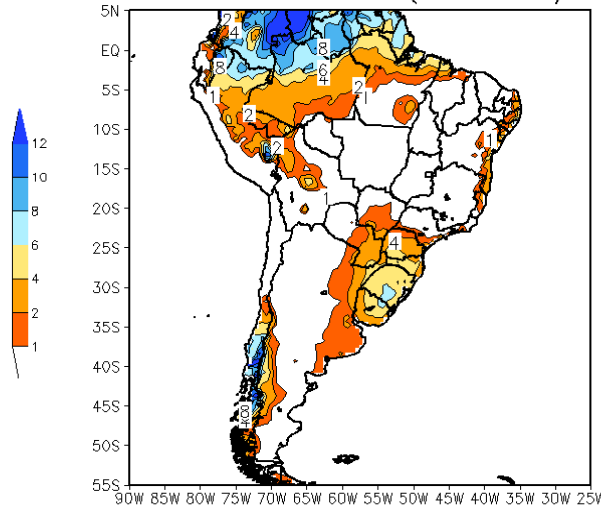
CRU

CRU - Winter (1960-1990)



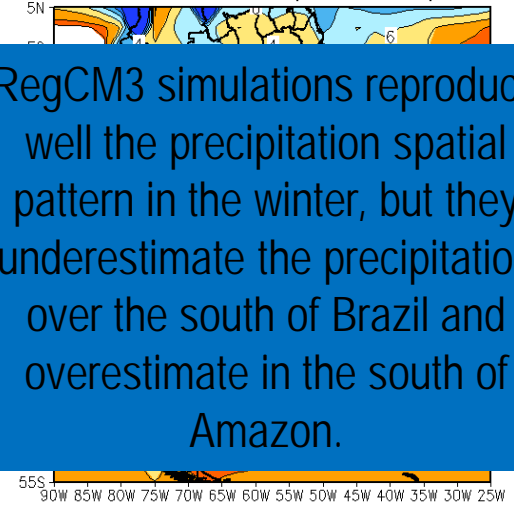
U. Delaware

U.Delaware - Winter (1960-1990)



ERA-40

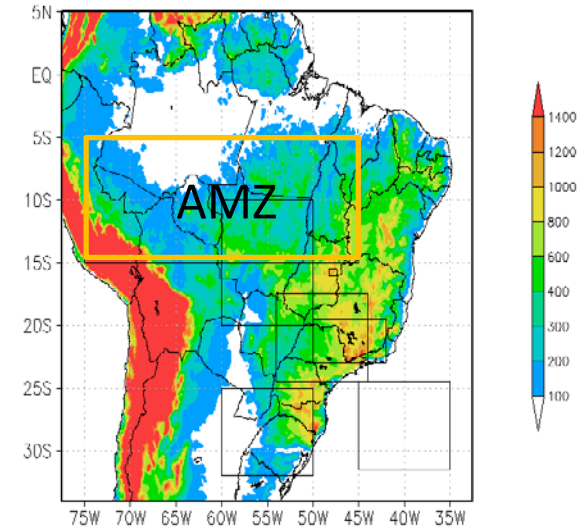
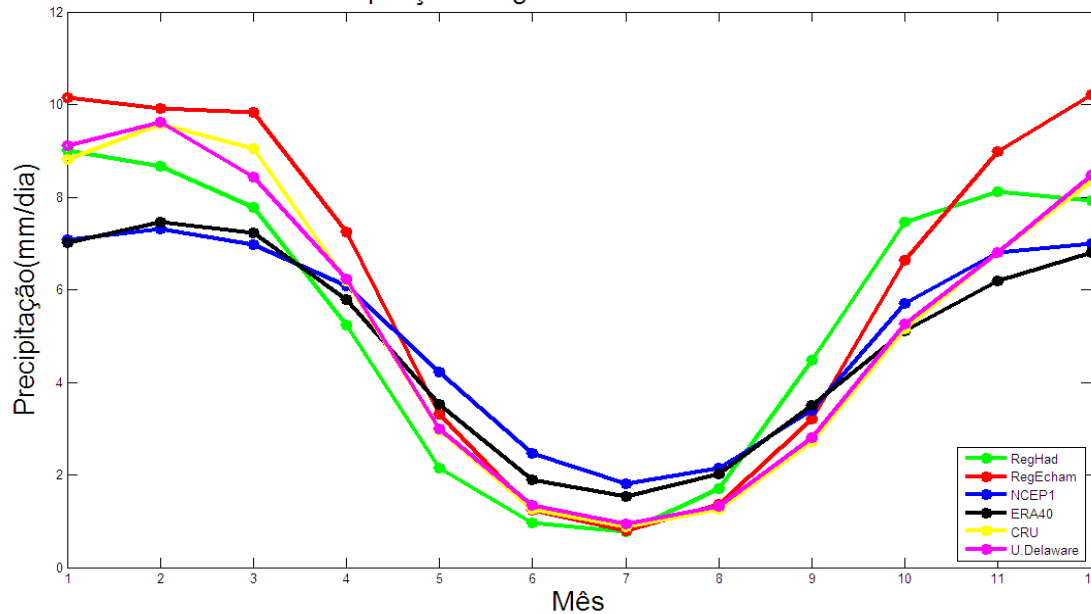
Era40 - Winter (1960-1990)



RegCM3 simulations reproduce well the precipitation spatial pattern in the winter, but they underestimate the precipitation over the south of Brazil and overestimate in the south of Amazon.

Results: Annual Cycle

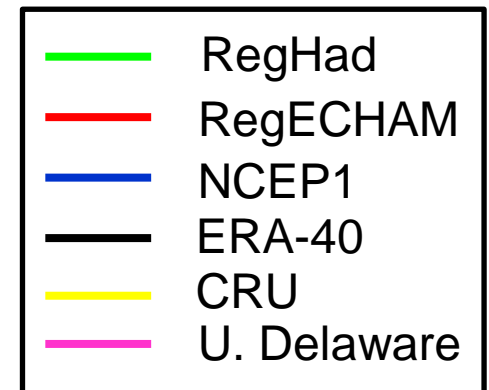
Precipitação- Região Amazônica 1960-1990



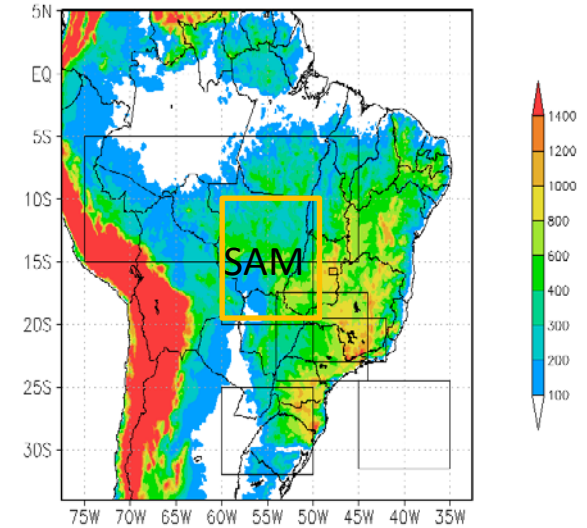
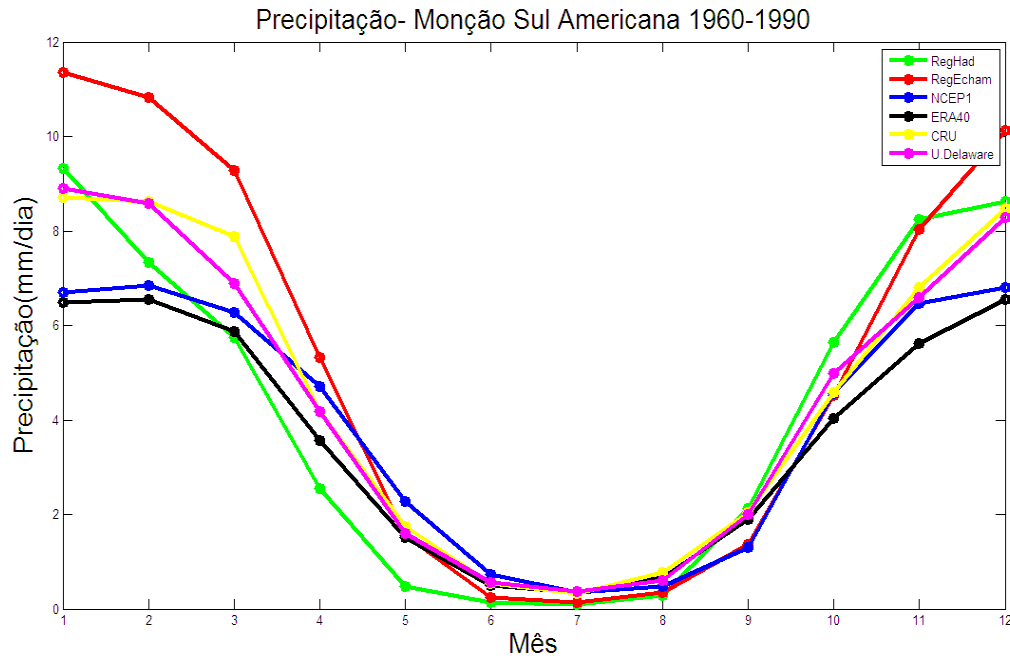
RegHad → underestimates the prec from Feb to June
overestimates from Aug to Nov

RegECHAM → overestimates from Oct to Apr
similar to the observations from May to Sep

There is no a better simulation.



Results: Annual Cycle

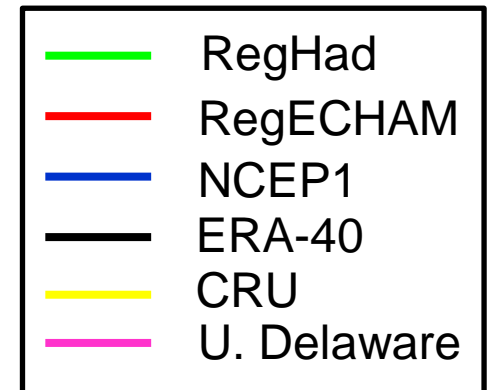


RegHad → underestimates the prec from Feb to June
 similar from Jul to Sep
 overestimates from Oct to Nov

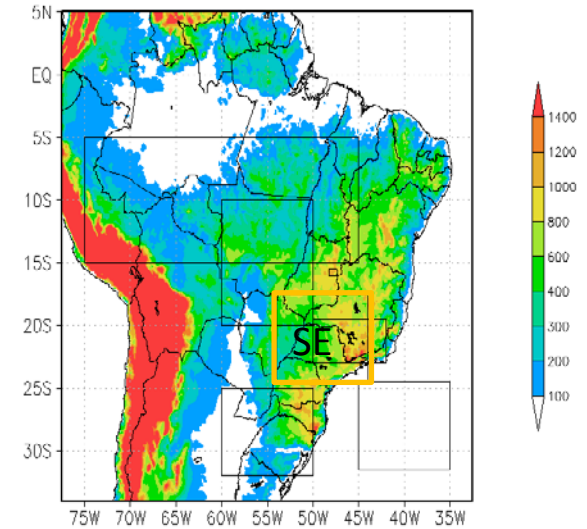
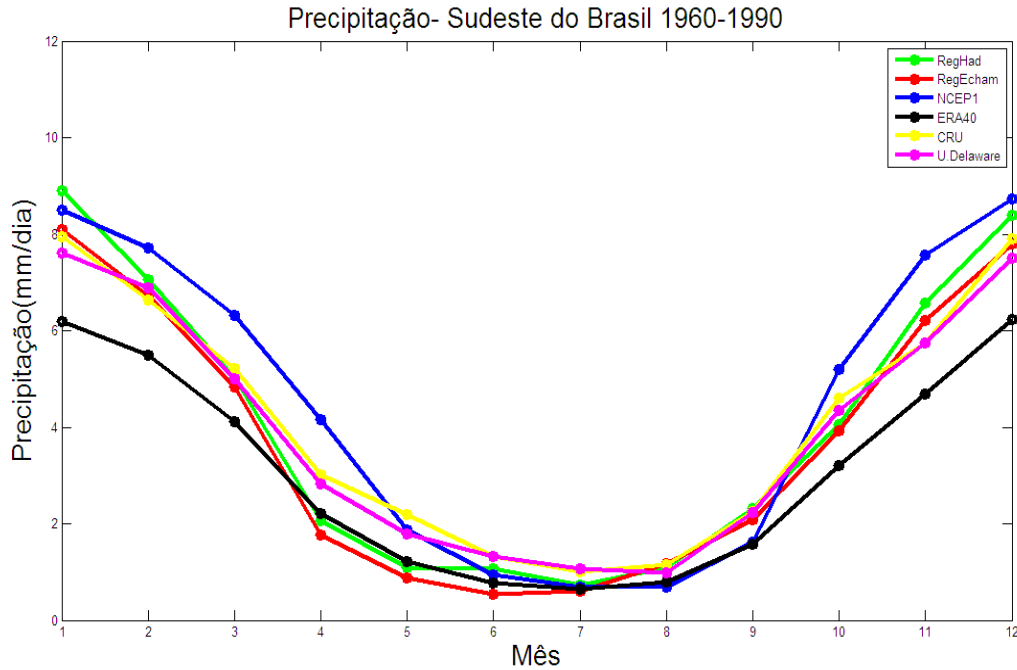
RegECHAM → overestimates from Dec to Apr
 similar to the observations from May to Sep

There is no a better simulation.

NCEP1 reproduces the annual cycle, but it underestimates the prec from Dec to May.



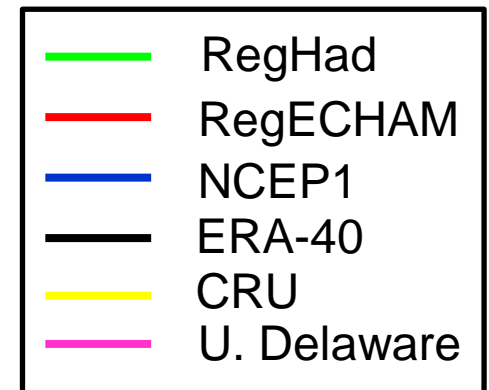
Results: Annual Cycle



Both simulations have a good performance over the southeast of Brazil.

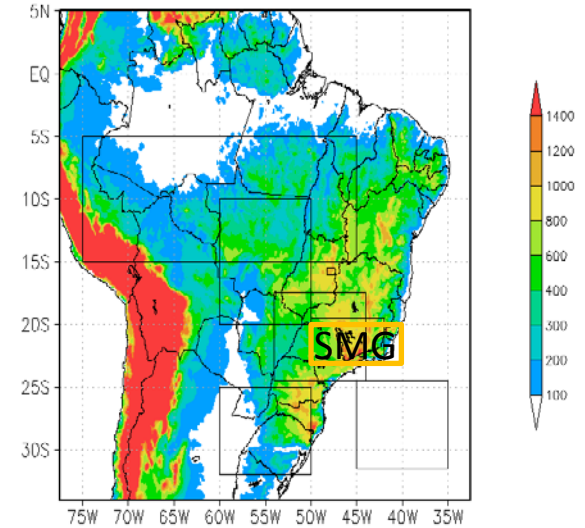
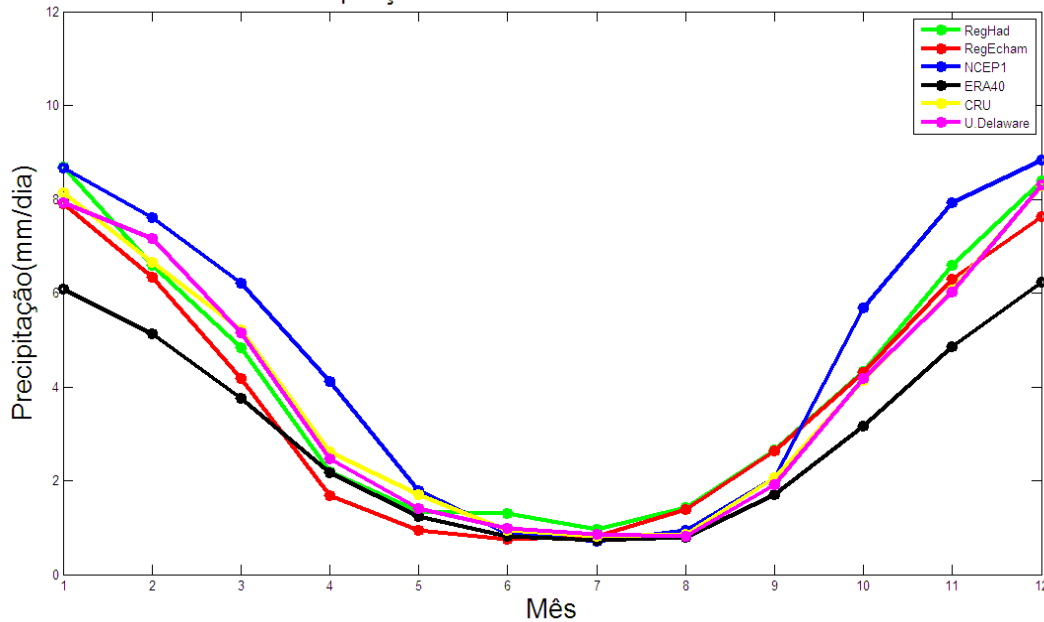
But,

they have a small underestimation from Apr to Jun.



Results: Annual Cycle

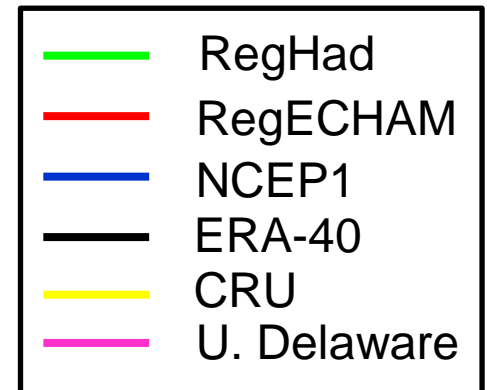
Precipitação- Sul de Minas Gerais 1960-1990



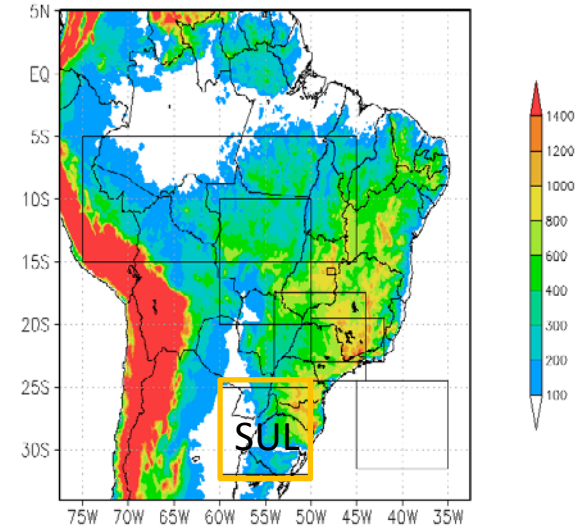
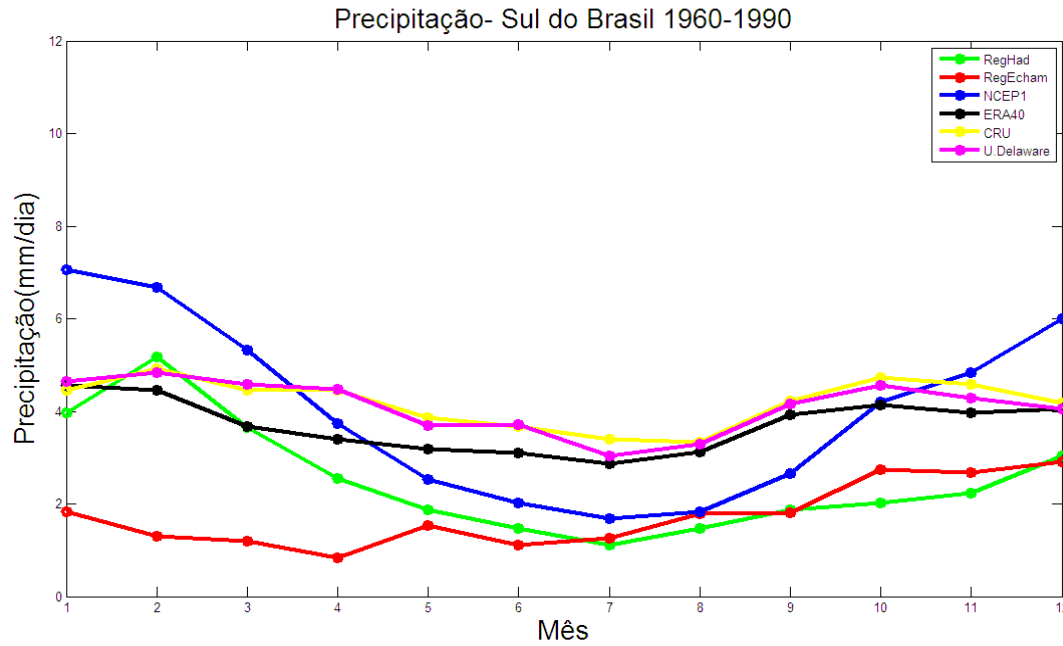
RegHad → similar to observations

RegECHAM → underestimates slightly the prec from Mar to Jun

In this region, RegHad has a better performance.

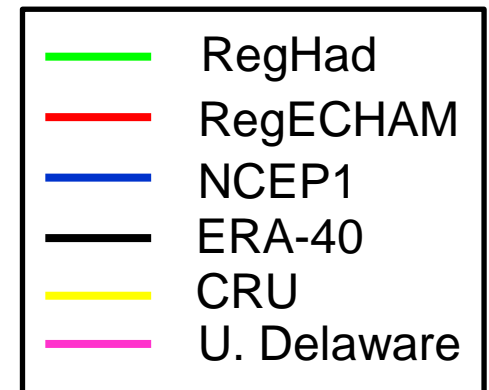


Results: Annual Cycle



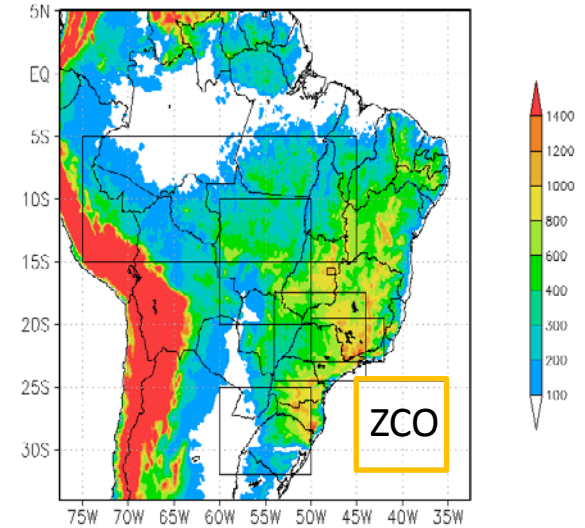
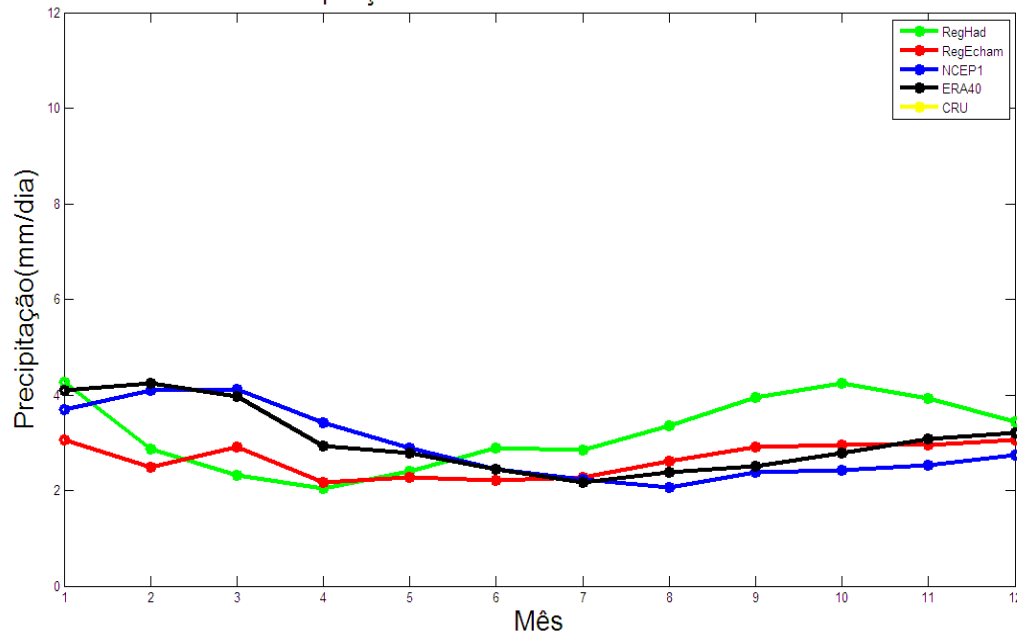
Both simulations do not reproduce the annual cycle and underestimate the precipitation values.

Underestimation is higher in **RegECHAM** from Jan to Jun.



Results: Annual Cycle

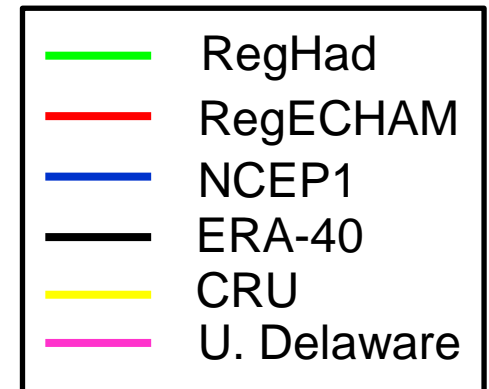
Precipitação- Oeste do Atlântico Sul 1960-1990



RegHad → underestimates the prec from Feb to May
overestimates from Jun to Nov

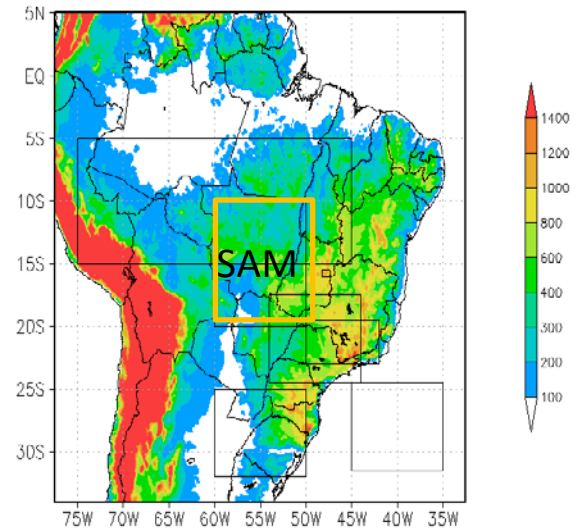
RegECHAM → underestimates the prec from Jan to May
similar to Jun to Dec

RegECHAM has a better performance.



SAM Features

We investigated the SAM onset, demise and length in the **NCEP1** and in **two simulations** of RegCM3. CRU and U. Delaware analysis were not included because they do not have daily data.



The SAM onset and demise were determined using a precipitation index that is defined considering the pentad mean precipitation over West-Central Brazil region (60°W - 50°W and 10°S - 20°S), **Figure above**.

The SAM onset (demise) occur when a pentad shows precipitation higher (lower) than 4 mm/day, and this value persists during at least 6 out of 8 subsequent pentads (Gan et al., 2006).

SAM Features: Onset

Table 1 Mean and standard deviation of the pentad of onset and demise and length of the SAM as identified by Gan et al. (2006) and in the and RegCM3 simulations.

	GAN et al. (2006)	NCEP1	RegECHAM	RegHad
Onset	58 (± 3)	58 (± 4)	58 (± 2)	56 (± 2)
Demise	22 (± 2)	24 (± 4)	24 (± 2)	19 (± 4)
Length	38	40	40	37

The SAM onset in the literature begins in the pentad number 58 that is the same of the NCEP1 and RegECHAM. In RegHad, the SAM onset occurs two pentads earlier (56).

SAM Features: Demise

Table 1 Mean and standard deviation of the pentad of onset and demise and length of the SAM as identified by Gan et al. (2006) and in the and RegCM3 simulations.

	GAN et al. (2006)	NCEP1	RegECHAM	RegHad
Onset	58 (± 3)	58 (± 4)	58 (± 2)	56 (± 2)
Demise	22 (± 2)	24 (± 4)	24 (± 2)	19 (± 4)
Length	38	40	40	37

In **RegHad**, the SAM demise occurs four pentads earlier (19), which is reported in **Gan et al. (2006)** to occur in the pentad 22. Comparing with this value, both **NCEP1** and **RegECHAM** present a delay in the SAM demise (pentad 24).

SAM Features: Length

Table 1 Mean and standard deviation of the pentad of onset and demise and length of the SAM as identified by Gan et al. (2006) and in the and RegCM3 simulations.

	GAN et al. (2006)	NCEP1	RegECHAM	RegHad
Onset	58 (± 3)	58 (± 4)	58 (± 2)	56 (± 2)
Demise	22 (± 2)	24 (± 4)	24 (± 2)	19 (± 4)
Length	38	40	40	37

Although in **RegHad** the SAM onset and demise is different from Gan et al. (2006) the SAM length of 37 pentads is similar (38 pentads). **NCEP1** and **RegECHAM** present 40 pentads for SAM length.

Conclusions

The SAM study indicates that in RegECHAM, SAM features are more similar to the Gan et al. (2006) than in RegHad.

However, the analysis of the precipitation spatial pattern showed that RegHad simulates this better than RegECHAM. For example: South Atlantic Convergence Zone is not well defined in the RegECHAM that displaces the maximum precipitation to the northeast of Brazil.

Therefore, this study highlight that there is no a better simulation. According to the application and region of study one simulation can be more appropriated than the other.

RegCM3 reproduces the SAM features!

Thank you very much!!!