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COMPARISON OF SEASONAL FORECAST PRODUCED BY NESTING REGIONAL ETA MODEL IN CGCM AND IN AGCM

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INTRODUCTION

• The seasonal forecasts are important in several economic sectors such as agriculture, energy. These sectors have used seasonal forecasts for planning their activities.

• The regional climate models can represent the climate with more detail than the global models, due to higher resolution.

OBJECTIVE

• This work aims to verify the advantage of nesting regional model in CPTEC coupled-ocean atmospheric model (CGCM) for seasonal forecast over Tropical Atlantic and South America regions.

METHODOLOGY

• Four runs were setup: two nested runs and two global runs (Table 1).

Table 1: Description of the four runs.

runs	Models	BCs*	lower BC of SST
1	AGCM	-	OI/NOAA* persisted anomalies of Nov.
2	CGCM	-	CGCM
3	Eta	AGCM	OI/NOAA persisted anomalies of Nov.
4	Eta	CGCM	CGCM

*BCs :Boundary conditions
* OI/NOAA: Optimal Interpolation from NOAA (Reynolds et al., 2002)

• The global models was set to T062L28, and the limited area model was set to 40-km horizontal resolution and 38 vertical levels.

• Approximately 15 days of atmospheric component spin-up time was included in the runs, whereas the ocean component spin-up time was 30 years.

• The atmospheric initial conditions were taken from NCEP reanalyses (Kalnay et al., 1996), whereas the oceanic initial conditions were SST and salinity from Levitus climatology (1 º x1 º). The ocean model (MOM3) was forced by NCEP reanalysis winds, shortwave radiation climatological from Oberhuber (1988) and surface heat fluxs (Rosati e Miyakoda,1988)

• One-way nesting was applied to downscale the global global model conditions. For consistency, the limited area model used the same sea surface temperature and initial atmospheric conditions as the GCMs.

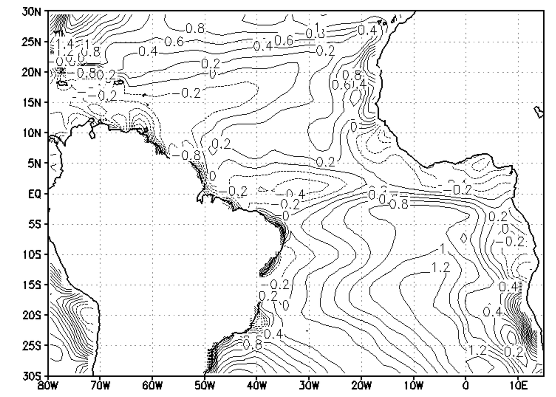
• Ensemble of three members were constructed, therefore the integrations started at 1200 UTC, on the 16, 17 and 18 of November of each year and ended on 28 or 29 February.

• Ten austral summers were considered in the period of 1997 until 2006. Therefore, each global model carried out 30 integrations, and the Eta Model carried out a total of 60 integrations.

• The domain spans from 80º W and 15º E, and 30º S and 30º N, which includes the tropical South America, western Africa and the tropical Atlantic Ocean (see Fig. 1).

RESULTS

• SST bias

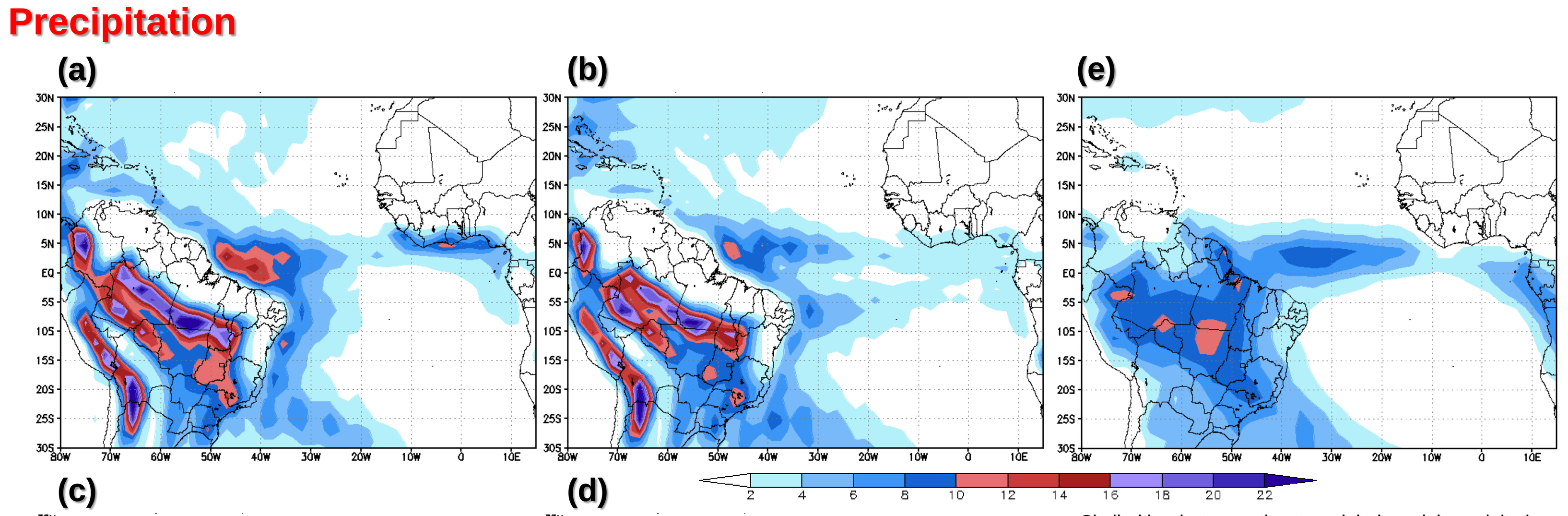


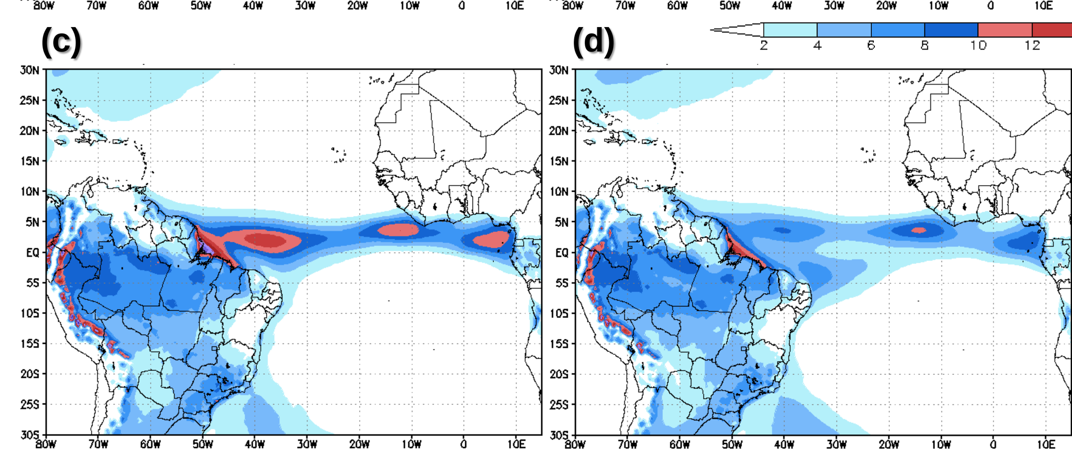
- In most of the tropical Atlantic Ocean the mean SST errors are positive.

- Some smaller areas along the equatorial Atlantic, in eastern South Atlantic and western North Atlantic negative errors were found.

Figure 1 – SST bias (ºC) from the CGCM, DJF means from 1997-2006.

• Precipitation





- Similarities between the two global model precipitation patterns, as the two nested runs of the regional model.

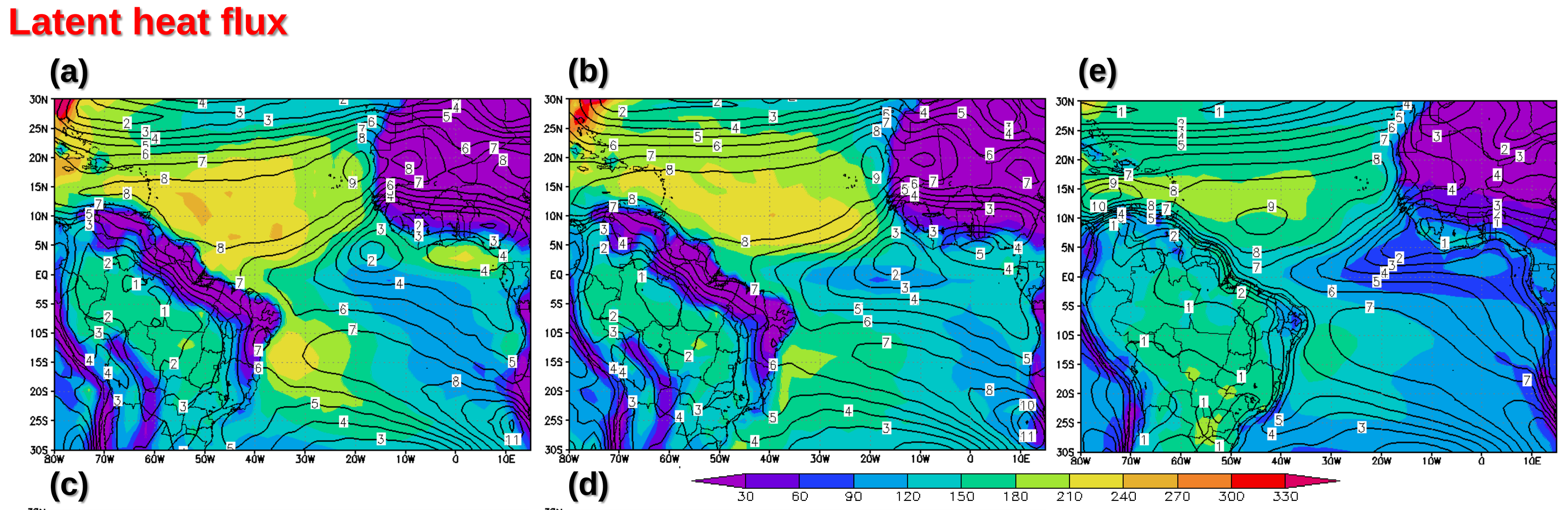
- The precipitation pattern from the regional model improved considerably the precipitation forecasts over the two global models, in comparison with CMAP observations.

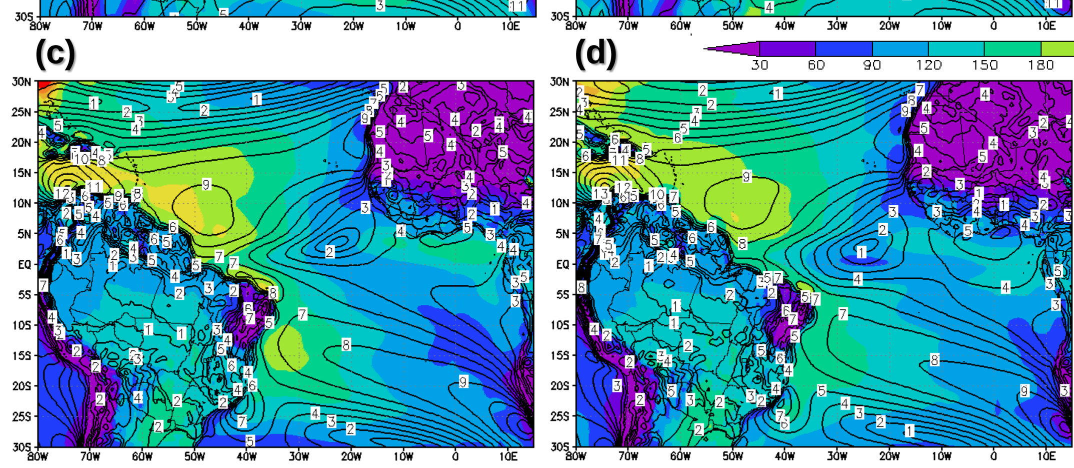
- In the western equatorial Atlantic, in the region of ITCZ activity, and the central part of continent, the AGCM and the Eta nested in the AGCM produced more precipitation than the observations.

- The CGCM and the Eta nested in the CGCM produced a split in the ITCZ precipitation band, the split is not observed in the CMAP data.

Figure 2 – Precipitation (mm.day^{-1}) from (a) the AGCM, (b) the CGCM, (c) the Eta Model nested in the AGCM, (d) the Eta Model nested in the CGCM and (e) the CMAP observations, DJF means from 1997-2006.

• Latent heat flux





- Similarities between the two global model latent heat flux patterns, as the two nested runs of the regional model.

-In general, the AGCM produced more flux than the CGCM, which influenced the flux patterns of the two nested runs of Eta Model.

- The Eta model reduced the excessive latent heat flux generated by global models.

- In north of South America, The two global models produced insufficient latent heat flux, which is not observed. The two nested runs of Eta Model improved the latent heat flux forecasts in this area.

Figura 3 – Latent heat flux (W.m^{-2},shaded) and wind speed in 1000 hPa (m.s^{-1},contours) from (a) the AGCM, (b) the CGCM, (c) the Eta Model nested in the AGCM, (d) the Eta Model nested in the CGCM and (e) the Era Interim reanalysis, DJF means from 1997-2006.

• Comparison against PIRATA buoys

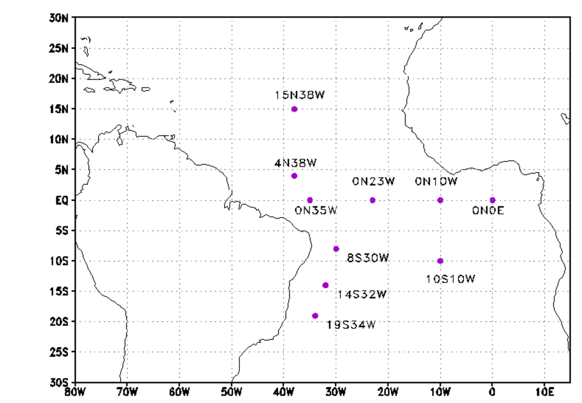


Figure 4 – PIRATA buoys over Tropical Atlantic used in this work.

Table 2 : Precipitation mean error (ME) and root mean square error (RMSE) (mm.day^{-1}) from four runs.

Precipitation (mm.day^{-1})		AGCM	CGCM	Eta+AGCM	Eta+ CGCM
Mean in PIRATA buoys	ME (bias)	1,72	0,77	1,03	0,14
	RMSE	5,12	4,42	4,09	3,77

• In mean of all PIRATA buoys, the precipitation EM and RMSE (Table 2) of the Eta Model nested in the CGCM were the smallest.

CONCLUSIONS

• The average patterns of the global models did not exhibit significant differences between them, which also occurred in the patterns of Eta model nested in these two global models. Therefore, it is suggested that the lateral boundary conditions have more effect than lower boundary conditions of sea surface temperature (SST).

•The CGCM had produced a cold SST bias between the two bands of precipitation generated by the CGCM and Eta model nested in the CGCM. This bias may have contributed to the formation of the double like ITCZ.

• The Eta model reduced the excessive latent heat flux bias generated by global models.

• In general, the patterns of the Eta model had agreed more with the observations than the patterns of the global models, except for the incoming surface shortwave radiation. For this variable, the Eta Model had negative bias, partly caused by errors in the forecast of the low/warm clouds.

• Comparison against PIRATA buoys showed that the Eta model nested in the CGCM resulted in smaller precipitation forecast error.

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