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5-YEAR ETA MODEL SEASONAL FORECAST CLIMATOLOGY OVER SOUTH AMERICA

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1. Introduction

Seasonal forecasts for South America using the Eta Model has been run monthly since 2002 at CPTEC. At longer integration model tend to show some drift and systematic errors. To identify these errors and evaluate model ability to capture inter-annual variability, model climatology was built based on 5-year seasonal runs. This climatology can be later used to extract the anomaly from the seasonal forecasts. Some users of these climate products tend to use the signal of the predicted anomaly.

An evaluation of seasonal precipitation forecasts of the year 2002 was carried out by Chou et al. (2005). The evaluation showed that the regional model improved the forecasts over the Global driver model. The equitable threat score showed lower skill in Northeast Brazil compared to the Amazon and Center-South regions. Larger systematic errors in precipitation were found along some coastal areas. The construct of the model climatology can help to identify and remove these systematic errors.

The objective of this work is to evaluate the Eta model 5-year climatology of December-January-February (DJF) and June-July-August (JJA) seasons over South America. Seasonal climatology were produced on a monthly basis, however, only the results of DJF season (a rainy season) and JJA season (a dry season) are shown here.

2. Methodology

2.1 The Eta Model

The Eta Model (Mesinger et. al, 1988) was configured, with 40-km horizontal resolution and 38 layers, to cover a domain which includes most of South America. The convection precipitation is generated by the Betts-Miller-Janjic scheme (Betts and Miller, 1986) and the large-scale precipitation is produced by the Zhao scheme (Zhao and Carr, 1997). The land-surface processes are solved by the OSU scheme (Chen et al, 1997). The radiation package was developed by GFDL.

The model was run for the years: 1997, 1998, 1999, 2000 and 2001. The forecast length was 4.5 months. The forecasts of the 3 last months of the integration are evaluated. Monthly mean observed sea surface temperature was daily updated during the integration. Soil moisture was initialized from a monthly mean data. The initial conditions were taken from NCEP analyses at T62L28. The lateral boundary conditions were taken from CPTEC T62L28 GCM simulations and were updated every 6 hours. The Eta Model used the seasonal climatology of albedo.

Results were shown for two seasons: December-January-February (DJF) and June-July-August (JJA), which are the rainy and dry seasons, respectively, over most of South America.

The systematic errors of the regional Eta model were identified. The interannual variability was verified in 4 regions: whole domain (SA), Center-South (CS), North (N) and Northeast Brazil (NE).

3. **Results**

The pattern of the 5-year model climatology of precipitation compared reasonably well with surface observations. The rainy season precipitation is shown in Figure 1. The observations indicated a daily mean precipitation between 10-15 mm/day over the central part of Brazil (Fig. 1a). This region is the climatological position of the South Atlantic Convergence Zone (SACZ), a summer feature of the continent. The daily mean precipitation predicted by the model showed the same pattern (Fig.1b). The observed precipitation over the Northeast Brazil is about 5 mm/day. The predicted precipitation indicated higher values than the observed precipitation at some coastal areas. The precipitation forecast bias (Fig. 1c) indicated, in general,

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overestimate at coastal areas, at eastern part of Center-south region and over Colombia; and underestimate over Guyanas region.

In dry season, there are two regions with significant observed precipitation: Southern Brazil and north part of South America (Fig. 2a). The model showed a similar pattern (Fig. 2b). The precipitation forecast bias indicated the same pattern of the rainy season (Fig. 2c) along the eastern coastal areas. The positive precipitation bias in southern Chile occur in both seasons.

Upper, medium and lower level fields were compared with NCEP analysis data. Mean sea level pressure, specific humidity at 850 hPa, geopotential high at 500 hPa and the zonal and meridional wind components at 200-hPa were compared. In general the model forecasts showed a good agreement with the analysis for both seasons. The main differences were noted in the mean sea level pressure, specific humidity and meridional wind. Mean sea level pressure showed some overestimate of the high pressure system over the South Atlantic Ocean in both seasons (Fig. 3). In the rainy season, the specific humidity was underestimated over the central region of the domain (Fig. 4), whereas in the dry season, the errors were small. 200-hPa meridional wind component showed underestimate values in the model result (Fig. 5). Most of model errors showed similarity to the global driver model errors.

Inter-annual variability of the seasonal precipitation was well predicted for the whole continent, although the values were underestimated (Fig. 6). This underestimate is due to the North region. The model captured well the interannual variability in the North and Center-South regions, however, in Northeast Brazil where predictability is often considered higher, the variability was not well captured.

Conclusions:

5-year model climatology of seasonal Eta Model forecasts over South America was produced and evaluated against surface observations and NCEP analyses. The model, in general captured the precipitation patterns of the rainy and dry seasons. Some overestimate occurred along three coastal areas: south Chile, equatorial Atlantic and eastern Northeast Brazil. The interannual variability of the continental rains are well predicted by the model in both seasons.
Further investigation is necessary to identify the source of the model errors.

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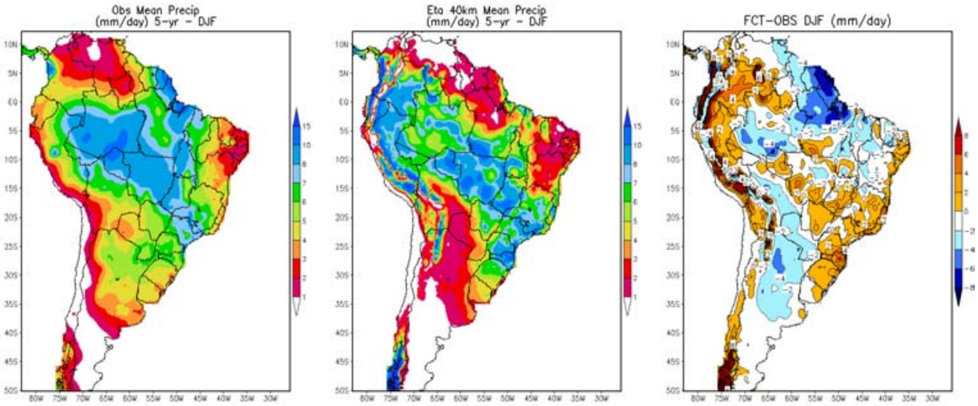

Figure 1 - DJF precipitation: (a) observed, (b) predicted and (c) model bias (mm/day).

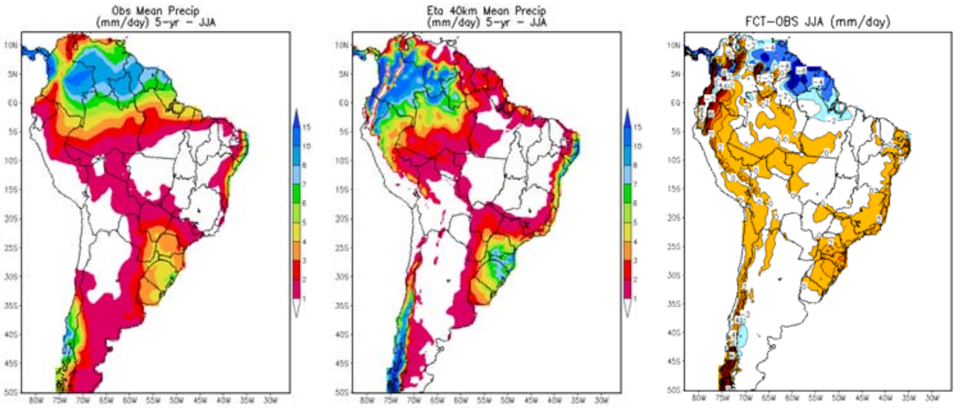

Figure 2 -- JJA precipitation: (a) observed, (b) predicted and (c) model bias (mm/day).

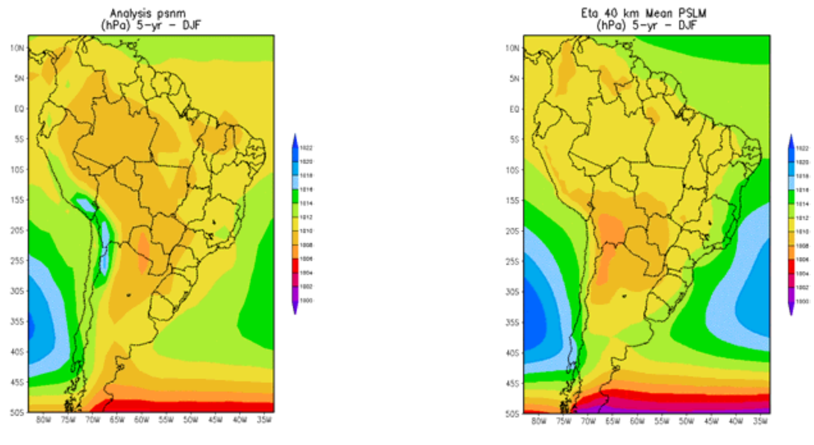

Figure 3 – Mean sea level pressure (hPa): (a) NCEP analysis and (b) Eta forecast.

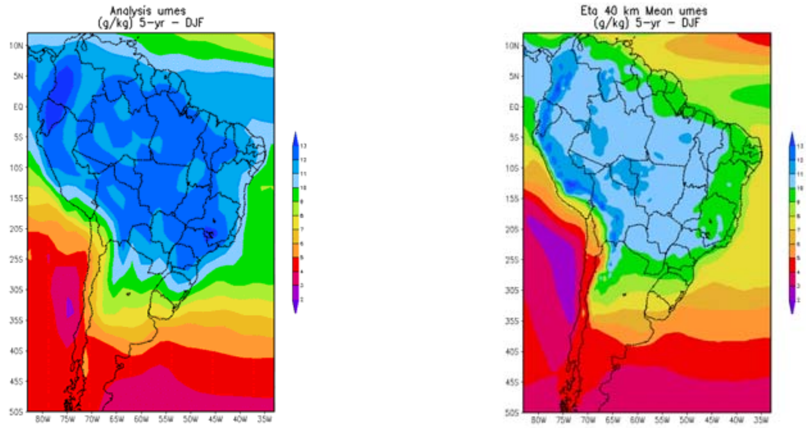

Figure 4 – 850 hPa specific humidity: (a) NCEP analysis and (b) Eta forecast.

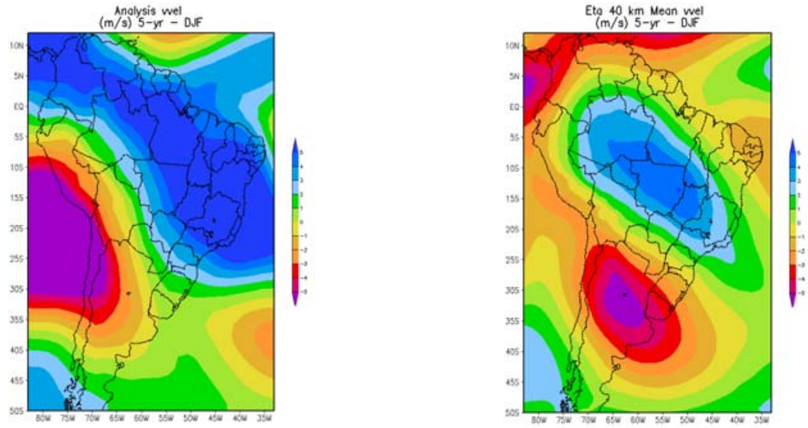

Figure 5 – 200-hPa Meridional wind component (m/s): (a) NCEP analysis and (b) Eta forecast.

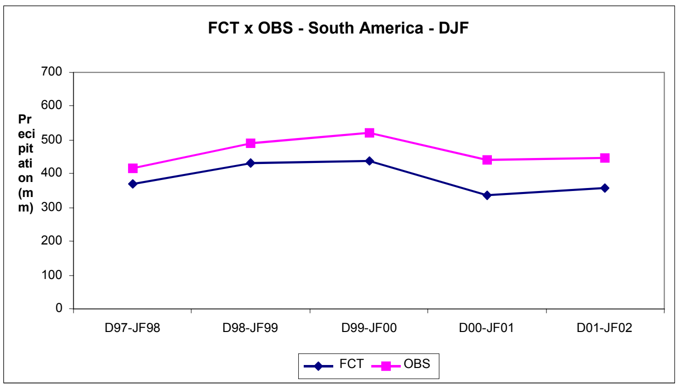

Figure 6 – Seasonal total precipitation over South America (mm). Observation versus Forecast.