VERTICAL AND HORIZONTAL RESOLUTION COMPARISONS OF CPTEC/COLA GCM

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1-Introduction

The choice of horizontal and vertical resolution for climate studies at Centro de Previsão de Tempo e Estudos Climáticos (CPTEC) has originated this study. Climate prediction has been made in CPTEC since January 1995, using a version of Center for Ocean-Land and Atmosphere (COLA) model, with horizontal truncation of T62 and vertical resolution of 28 levels, until March 1995. T62 L18 was used from April to October.

In order to investigate the performance of the model with different horizontal and vertical resolutions, results using T62 L28, T62 L18, T42 L28 and T42 L18 were analysed and compared to observations. The experiment is made using 4 initial conditions of 14, 15, 16, 17 February 1995 (National Center for Environmental Prediction (NCEP) analyses), observed SST fields and persistent April SST anomalies for the following 6 months. Climatological SST values are used to get the model climatology. Average of May, June and July is used to analyse the results. Observed precipitation data are obtained from Instituto Nacional de Meteorologia (INMET) and global observed OLR and wind fields from NCEP analyses.

2-Results

Precipitation anomalies obtained from different model resolutions are shown in Fig. 1. Observed anomalies can be seen in Fig. 2. T62 L28 shows the main features found in the observed values. Positive anomalies occur at north of Northeast and at South Brazil and close to normal in other regions. Strong negative anomalies are seen at Northeast Brazil in T62 L18 results. The area with positive values is displaced northward and near normal anomalies are seen in other regions. Compared to the other resolutions, this shows the worst result. When the resolution is T42 L28, near normal values are observed at the Northeast and South. T42 L18 shows also negative anomalies at Northeast, but smaller than those showed with T62 L18. Using this resolution, the model tries to represent positive anomaly at the south, but displaced to the east.

The smallest differences between observed and predicted rainfall anomalies occur in T62L28 and the largest in T62 L18.(Figures not shown). The errors at the Northeast are larger using T42L18 than using T42 L28. Although the anomaly precipitation at Northeast and at South Brazil is predicted by T62L28, the anomaly precipitation observed at the east of Northeast is not well predicted by the model. At this time of the year the precipitation there is caused by low level clouds associated with low level easterly flow. Even though the wind field anomaly at 850 mb shows the flow entering perperdicular to the east coast of Northeast (Fig.3), the model does not form the expected clouds.

Differences between observed and predicted OLR anomalies(Figures not shown) exist for all resolutions, but T62 L28 presents the smallest differences mainly over South America and South Atlantic Ocean. The largest errors are found at the Indonesian region for all resolutions. The wind field at 200 hPa is well predicted by T62L28, which presents the main configuration over South America and also the position of the Australian jet. The other resolutions also reproduce the position of this jet, but the configuration over north of South America is displaced to the east. At 850 hPa the global characteristics of the flow are reproduced by all resolutions. The differences between the resolutions are greater at 200 hPa than at 850 hPa. This seems to be related to the number of levels in the stratosphere. L28 has 18 levels in the troposphere and 10 levels in the stratosphere. L18 has 14 levels in the troposphere and 4 levels in the stratosphere.

The model results compared to observed values show that T62 L28 gives the best prediction. When the vertical resolution is reduced (L28 to L18), keeping the horizontal resolution (T62), there is a remarkable change on the results. The increase of horizontal resolution improves the result. Table I shows the rms of rainfall for the area of Brazil, calculated to all resolutions, for the average of May, June and July. Two areas were analysed, the Northeast (50W-30W, 10S-3S) and a large area of Brazil (55W- 35W, 33S-0^{o}) . The largest error is found in T62L18 and the smallest error in T62L28, for both areas.

3-Conclusion

Changing the vertical resolution implies greater changes on the results than changing the horizontal resolution. The worst combination is found when the highest horizontal resolution and the lowest vertical resolution are used. If the number of levels is reduced, it is necessary to use a compatible horizontal resolution. The increase of horizontal resolution implies in an increase of high frequency waves, which are not well resolved when the vertical resolution is low. The result is improved at some areas if high resolution is used in the vertical, keeping the lowest horizontal resolution. Although T62 L28 showed the best results, the changes reducing the horizontal resolution were not too large. More experiments, including the S.H. summer time, will be performed to decide which resolution should be used in climate experiments to obtain closer realistic simulations/predictions, adequate to our computacional resource.

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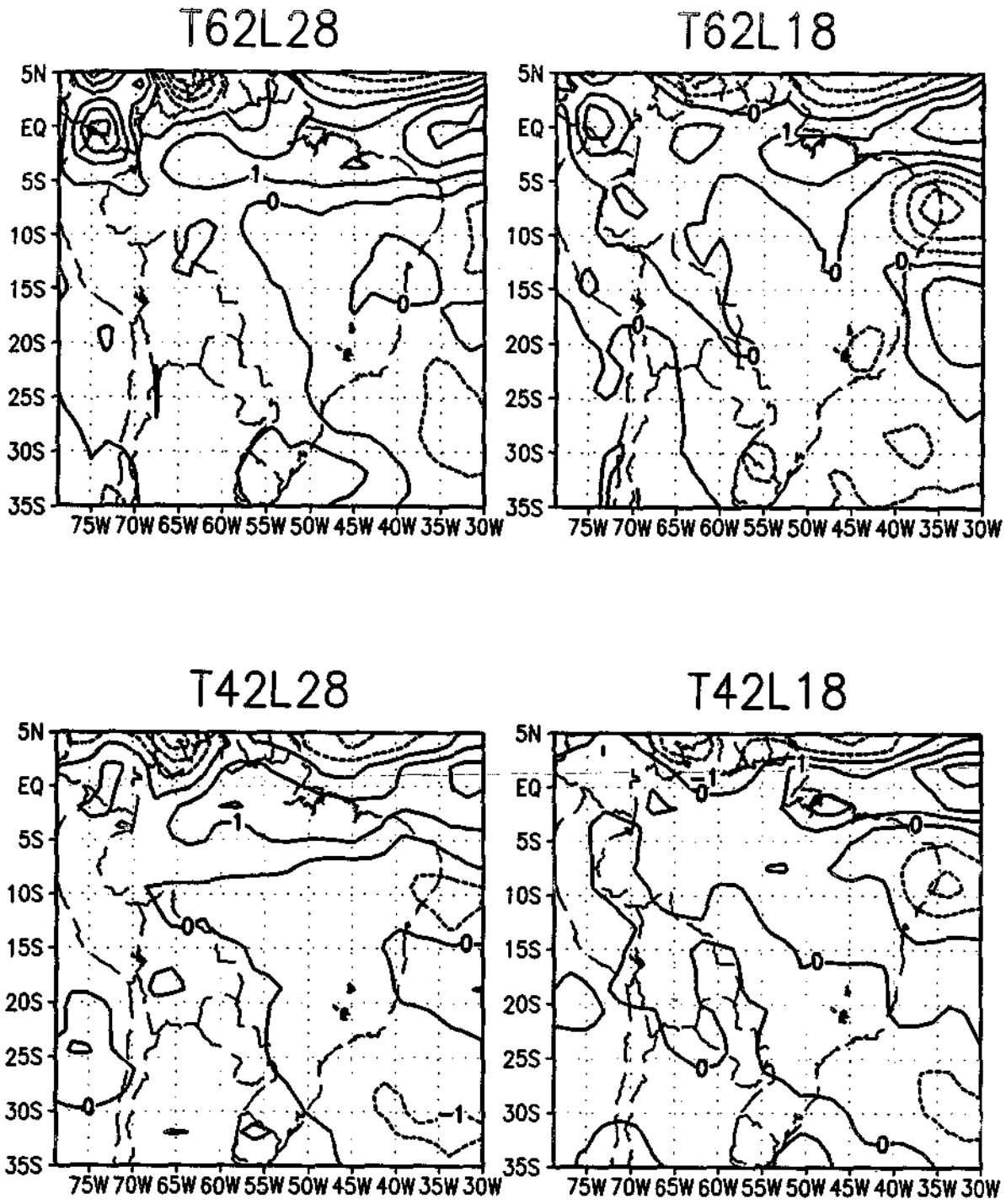

Fig.1— Precipitation anomaly (mm/day) of MJJ(1995)

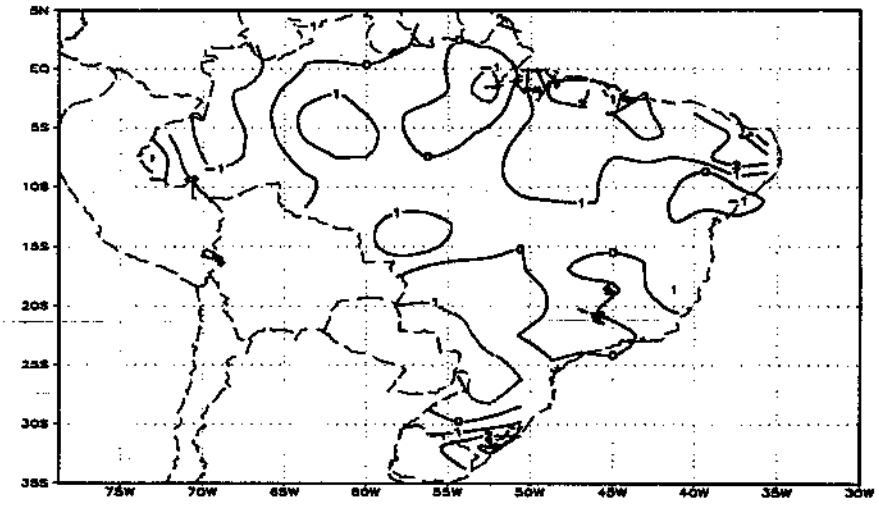

Fig.2—Observed precipitation anomaly(mm/day) (mm/day) for May,June and July 1995.

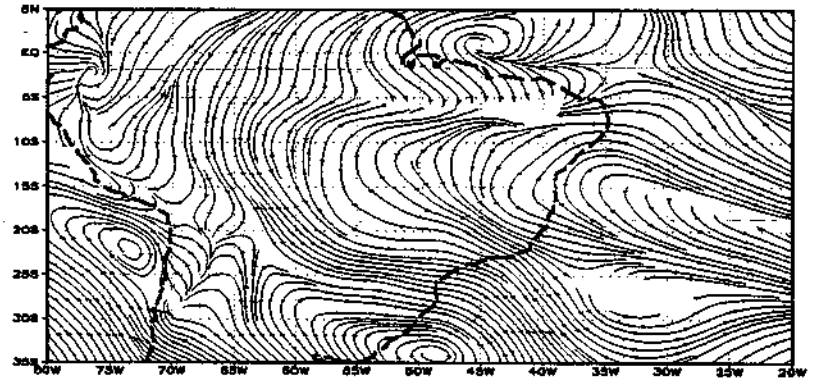

Fig.3—Wind field anomaly at 850 hPa for May, June and July 1995, using T62L28.

	50W-30W, 10S-3S	55W-35W, 33S-0
T62 L28	1.67	1.08
T42 L28	2.12	1.29
T42 L18	2.45	1.24
T62 L18	2.94	1.55

Table I- Rms(mm/day) calculated from the results with different resolutions .