EXTREME PRECIPITATION OVER LA PLATA BASIN AND SOUTHEAST BRAZIL, IN SOUTH AMERICA, AND INFLUENCES OF TELECONNECTIONS SIMULATED BY THE CPTEC AGCM AND CMIP3 CGCMS.

Iracema F.A. Cavalcanti *
Fernanda C. Vasconcellos

Center for Weather Forecasting and Climate Studies/ National Institute for Space Research (CPTEC/INPE) Rod. Presidente Dutra, Km 40, Cachoeira Paulista, S.P. , Brazil

1.INTRODUCTION

The La Plata Basin and Southeastern Brazil regions are affected by extreme precipitation that are responsible for floods or droughts which have a large impact in sectors as agriculture and hydrological resources besides the damages in roads and towns. Cases of landslides in mountain areas also happen associated with the extremes. These two regions have opposite behavior already seen in several observational studies (Nogues-Paegle and Mo, 1997, Cunningham and Cavalcanti, 2006). The atmospheric features associated with convection in these regions are associated with the Pacific South America (PSA) pattern, which is the main tropical –extratropical teleconnection in the Southern Hemisphere. In the summer, this pattern has influence on South Atlantic Convergence Zone (SACZ), as discussed in Cunningham and Cavalcanti (2006), Carvalho et al (2004). The objective of this study is to analyze the Southern Hemisphere features associated with extreme precipitation over La Plata Basin and southeastern Brazil in a long-range simulation with an AGCM and CGCMs to verify the ability of the models in representing the associated teleconnections identified in observations, in a seasonal variability scale.

2.MODEL RESULTS AND METHODS

Model results from a long term simulation with the CPTEC/COLA AGCM are analyzed for DJF in the period of 1951 to 2001. The atmospheric model is spectral with resolution of T62L28, and the simulations were performed using, as boundary conditions, monthly observed SST. HADCM3 and GFDL CGCM from CMIP3 simulations are also analyzed for the twenty century and future climate (SRES A2 scenario) considering the last 51 years of each simulation.

* *Corresponding author address:* Iracema F.A. Cavalcanti, CPTEC/INPE, Rod. Presidente Dutra, Km 40, Cachoeira Paulista, São Paulo, Brazil e-mail:iracema@cptec.inpe.br

Composites of the 5 extreme precipitation years (wet and dry) during austral summer (DJF), over Southeastern Brazil and La Plata Basin, are analyzed.

3.PRECIPITATION ANOMALIES AND ASSOCIATED TELECONNECTIONS

EOF analyses of precipitation and 200 hPa geopotential austral summer anomalies reveal that the CPTEC/COLA AGCM model simulates the main modes of observed variability. The north-south precipitation anomaly dipole (La Plata and Southeastern Brazil) associated with the SACZ, and the PSA pattern affecting the SACZ region are shown in Fig.1. Composites of extreme positive and negative precipitation anomalies over southeastern Brazil display these main modes of variability, indicating that these cases are associated with the SACZ occurrences (wet in southeastern Brazil and dry in La Plata Basin) or with lack of those occurrences (dry in southeastern Brazil and wet in La Plata Basin), (Fig.2a,b). These configurations are similar to those obtained in an intraseasonal variability scale with observed data (Cunningham and Cavalcanti, 2006; Carvalho et al. 2004) and model simulation (Cavalcanti and Cunningham, 2006). In the seasonal scale the observations display also similar results (Vasconcellos, 2008).

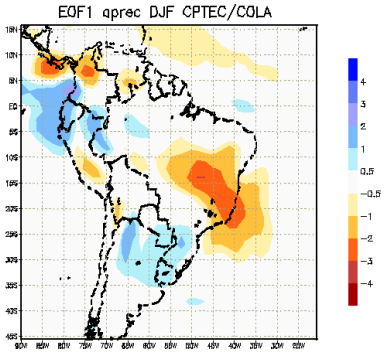
The model simulates the SH atmospheric configurations associated with the two opposite extremes in the two regions, which are related to teleconnections: the PSA pattern in opposite phases and the annular mode (Antarctica Oscillation-AAO) in opposite phases. Extreme wet (dry) summers over Southeastern Brazil (La Plata Basin) occur in a positive AAO phase and the opposite occurs in the negative AAO phase. Silvestri and Vera (2003) showed negative correlations of AAO phase with precipitation over Paraguay and adjacent regions in ND, but they mention that no significant correlation was found in the summer. The model results in this study compare well with the patterns obtained in an observational study of Vasconcellos (2008).

Composites of the 5 extreme precipitation anomalous years from GFDL and HADCM3 also

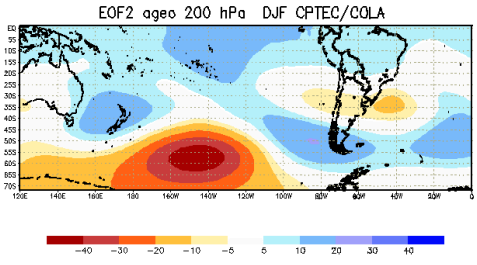
show the dipole pattern (opposite phases between Southeastern Brazil and La Plata Basin) in the 20th century and also in the future climate A2 SRES scenario. Correlations between precipitation anomaly over Southeastern Brazil and other regions show the same dipole patterns in both periods in both GFDL and HADCM3 models, with intensification of correlations in the future scenario (Fig. 3). The models simulate the atmospheric conditions, associated with the extreme precipitation anomalies, and the opposite phases of the annular mode related to the wet and dry cases are also reproduced.

4.CONCLUSION

The atmospheric model (CPTEC/COLA) and the coupled models (HADCM3 and GFDL) represent the main mode of precipitation variability which is seen in observations, with opposite behavior between Southeastern Brazil and La Plata Basin. The models also simulate the main atmospheric configurations of teleconnections, as the PSA and the Antarctica Oscillation associated with extreme precipitation anomalies in these regions.



(a)



(b)

Fig.1. (a) First EOF of DJF precipitation anomalies; (b) Second EOF of DJF 200 hPa geopotential anomalies.

5.References

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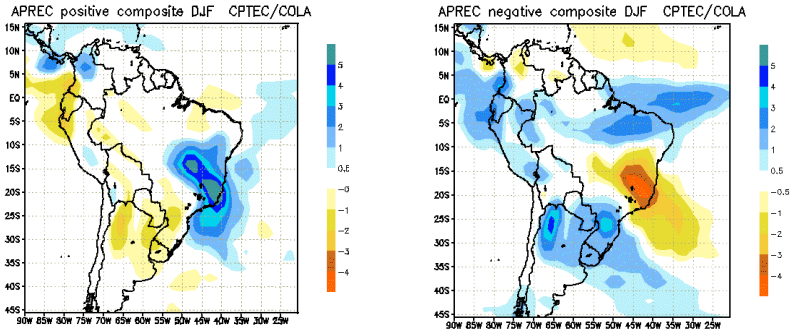
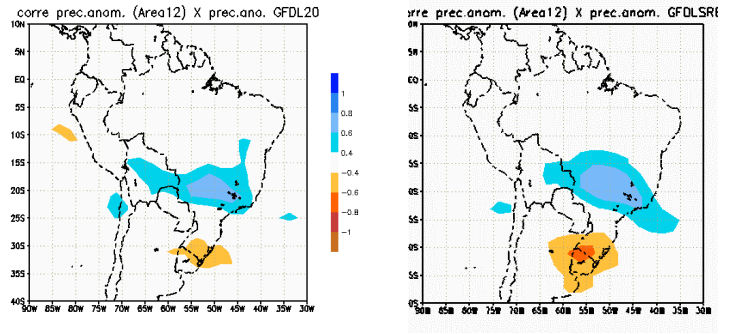
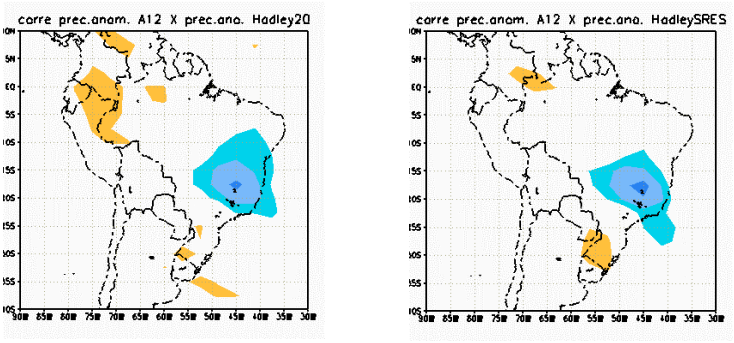


(a) (b)

Fig.2. Composites of 5 extreme precipitation anomalies over Southeastern Brazil (a) wet cases, (b) dry cases.



(a) (b)



(c) (d)

Fig.3. Precipitation anomaly correlation between area (15^0S-20^0S; 40^0 W-50^0 W) and other grid points. (a) GFDL 20th century, (b) GFDL SRES A2 scenario, (c) HADCM3 20th century, (d) HADCM3 SRES A2 scenario.