

DIAGNOSING CPTEC/AGCM ATMOSPHERIC CONDITION PREDICTIONS FOR THE NORTHEAST BRAZIL MAM 2013 DROUGHT EPISODE

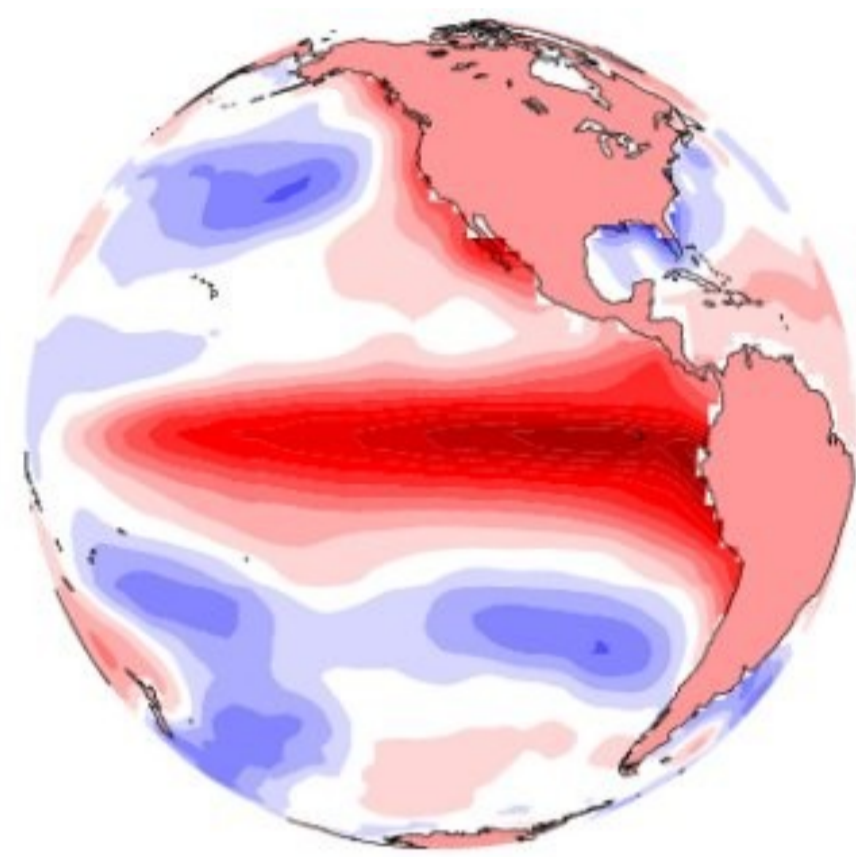
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ABSTRACT: The AGCM/CPTEC forecasts have indicated rainfall deficit for Northeast Brazil, and such forecasts are consistent with observed patterns since 2012 and mid-2013. This study aims to evaluate the AGCM/CPTEC seasonal climate forecasts in reproducing the large-scale atmospheric features associated with drought conditions occurred in Northeastern Brazil during March, April and May 2013 (MAM/2013). The mentioned period is one of the most important in terms of rainfall distribution, being observed high volumes of rainfall over Northeast, mainly in the east and north portions. In this study, we analyzed wind fields at low and upper-levels, specific humidity, vertical velocity and precipitation ensemble forecasts. Both the boundary condition of persisted as well as forecasted SST anomalies indicated warmer than normal conditions over tropical North Atlantic Ocean, as well as conditions ranging from normal to slightly below normal in tropical South Atlantic Ocean. The upper-level anomaly circulation forecasted by the model indicated a trough over Northeast Brazil. At low-levels, a prevailing anomalous anticyclonic circulation centered over South Atlantic Ocean, near the coast of Southeast Brazil, generated an anticyclonic circulation perpendicular to the coast of the Northeast Brazil. This pattern could favor the humidity increase in the coastal area, however, according to the field of vertical motion at 500 hPa, the prevailing downward movement over the region contributed to suppression of convection and negative precipitation anomaly forecasts. This anomalous pattern was identified in all versions of the AGCM/CPTEC, but more intense in the model versions with forecasted SST anomaly. This mechanism has been associated with the response to the warmer than normal oceanic conditions over tropical North Atlantic, generating a local Hadley Cell over Northeast Brazil. Also, the model forecast indicated negative anomaly of specific humidity, also more intense in the forecasted SST anomaly versions. This pattern may be a compensatory response to the subsidence of the Hadley Cell, which favors the subsidence of dry air over the Northeast from the upper-levels of the atmosphere.

INTRODUCTION

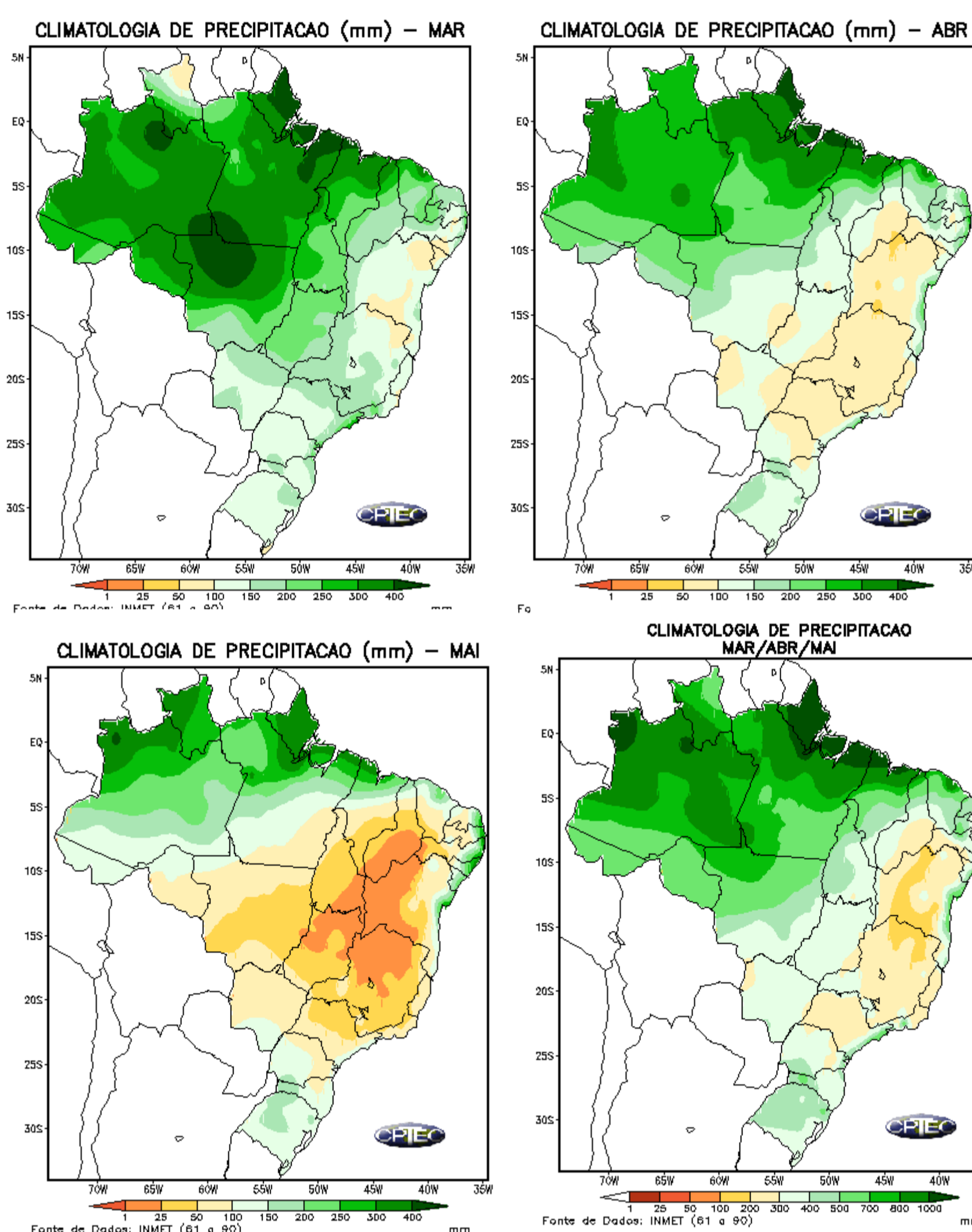
Seasonal forecasts

Tools used in the planning of various socioeconomic activities



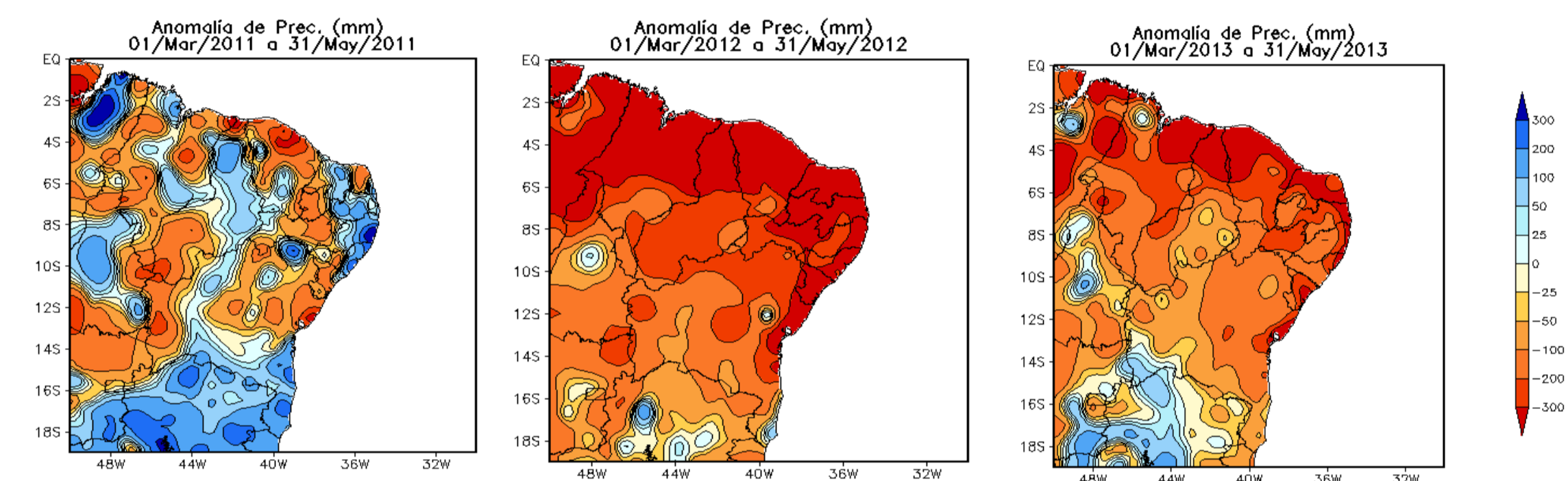
Knowing weather patterns on seasonal time scale contributes to:

Minimize losses in the agricultural and energy Offers to the people and government tool for planning its future activities



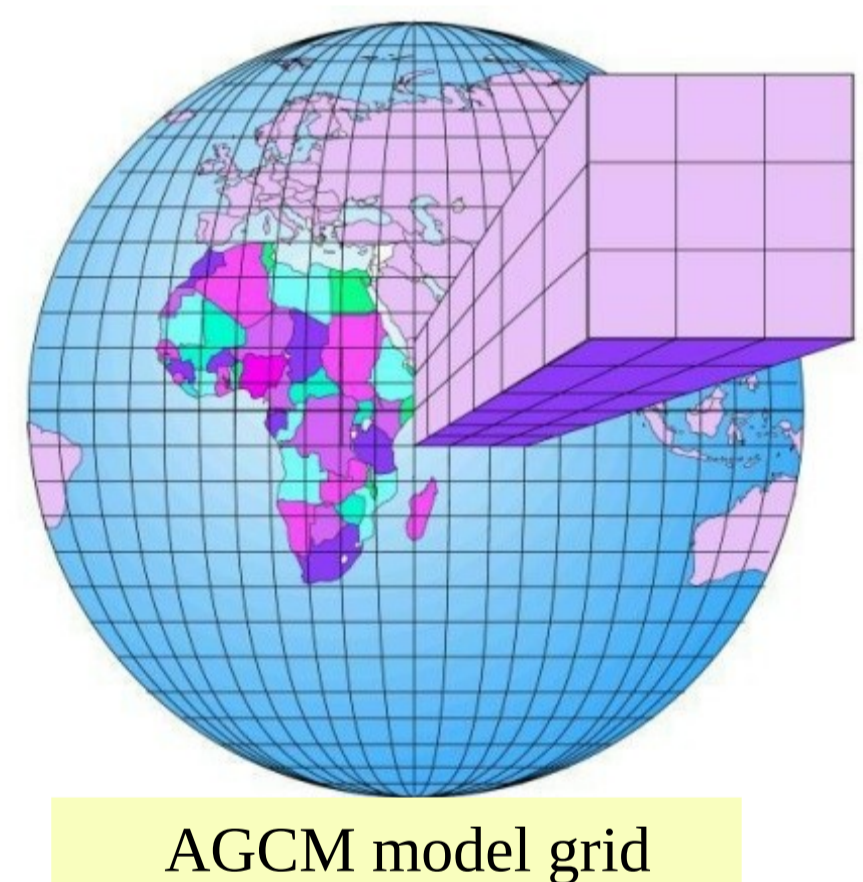
The Northeast of Brazil is typically affected by the occurrence of drought events, mainly due to the climatological unequal distribution of rainfall regimes. Changes in the atmospheric patterns can affect the quality of the different regimes in the rainy season in Northeast Brazil, producing long periods of drought. Since mid-2012 a persistent drought condition has been observed in Northeastern Brazil. This characteristic also has persisted throughout 2013. The Center for Weather Forecasting and Climate Studies (CPTEC) of the National Institute for Space Research (INPE) routinely performs seasonal climate forecasts with the Atmospheric General Circulation Model (AGCM/CPTEC)

This study aims to evaluate the AGCM/CPTEC seasonal climate forecasts in reproducing the large-scale atmospheric features associated with drought conditions occurred in Northeastern Brazil during March, April and May 2013 (MAM/2013). The mentioned period is one of the most important in terms of rainfall distribution, being observed high volumes of rainfall over Northeast, mainly in the east and north portions.



DATA AND METHODOLOGY

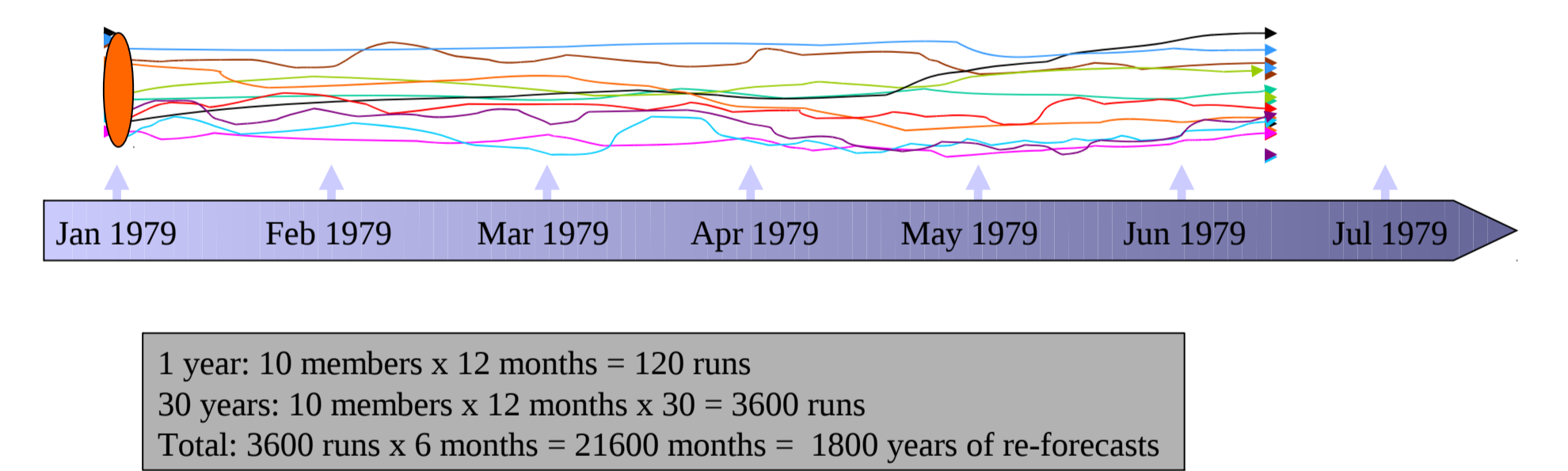
The AGCM/CPTEC is integrated with fifteen different initial conditions, three different convective parameterization schemes and two boundary conditions, as follow: persisted sea surface temperature (SST) anomaly and coupled ocean-atmosphere model of the National Centers for Environmental Prediction, National Center for Atmospheric Research (NCEP/NCAR) forecasted SST anomaly, generating an ensemble of 90 members.



AGCM model grid

Two-tier forecasting system
 CPTEC AGCM: T062L28 (Cavalcanti et al., 2002; Marengo et al., 2003)
 Cumulus parameterization: Grell (1993), Kuo (1974), RAS
 Boundary conditions: Persisted SST anomaly
 Atmospheric initial conditions: NCEP/NCAR Reanalysis (Kalnay et al., 1996) (lagged approach using 10 analysis)
 Hindcast period: 1979 to 2008 (30 years)

6 months of hindcasts, 10 ensemble members

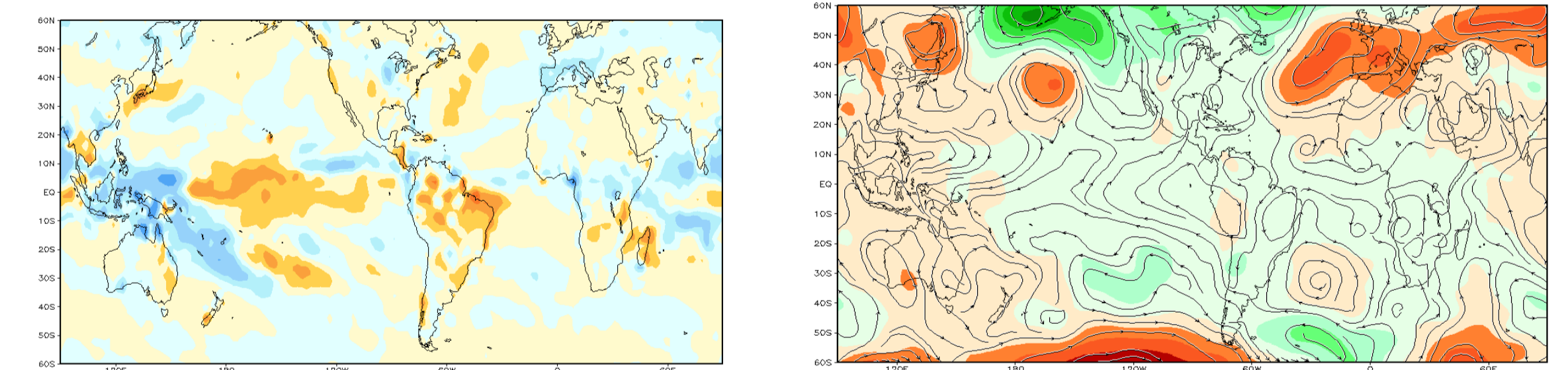
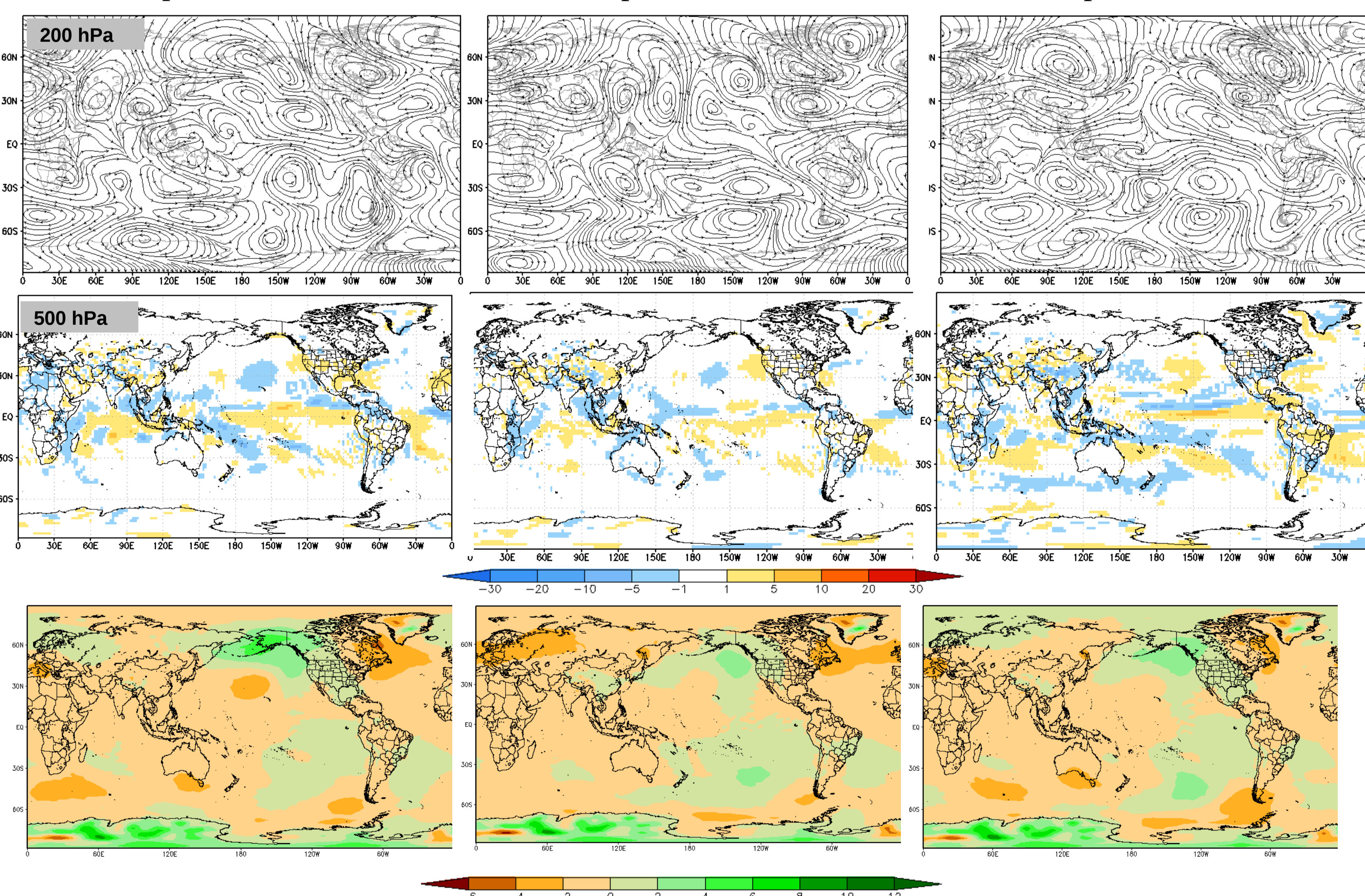


RESULTS and CONCLUSIONS

Grell persisted SST

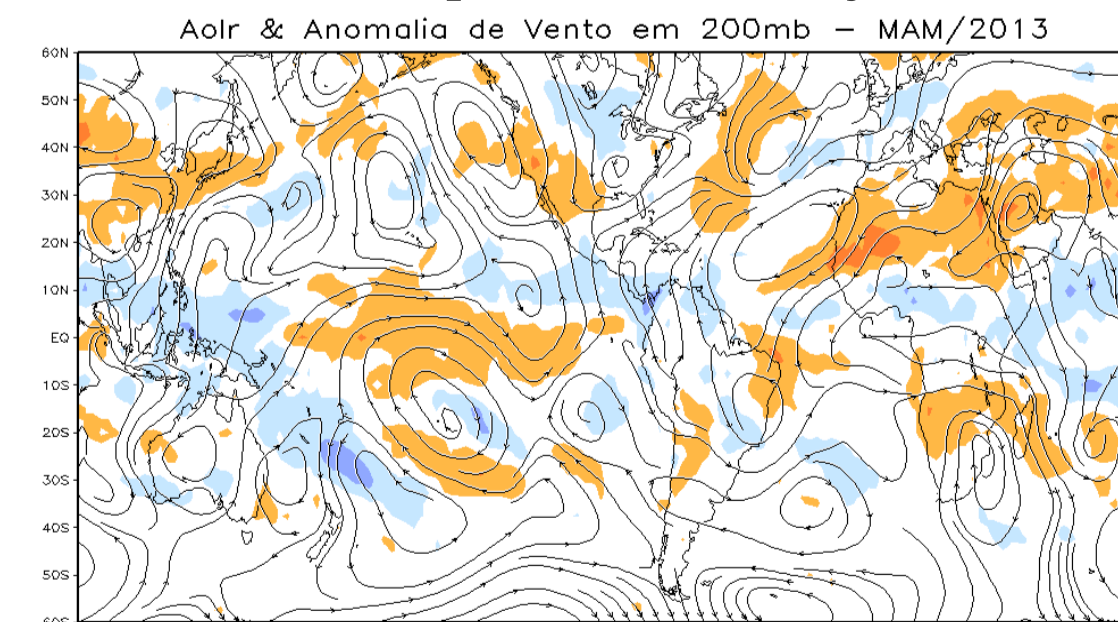
Kuo persisted SST

RAS persisted SST

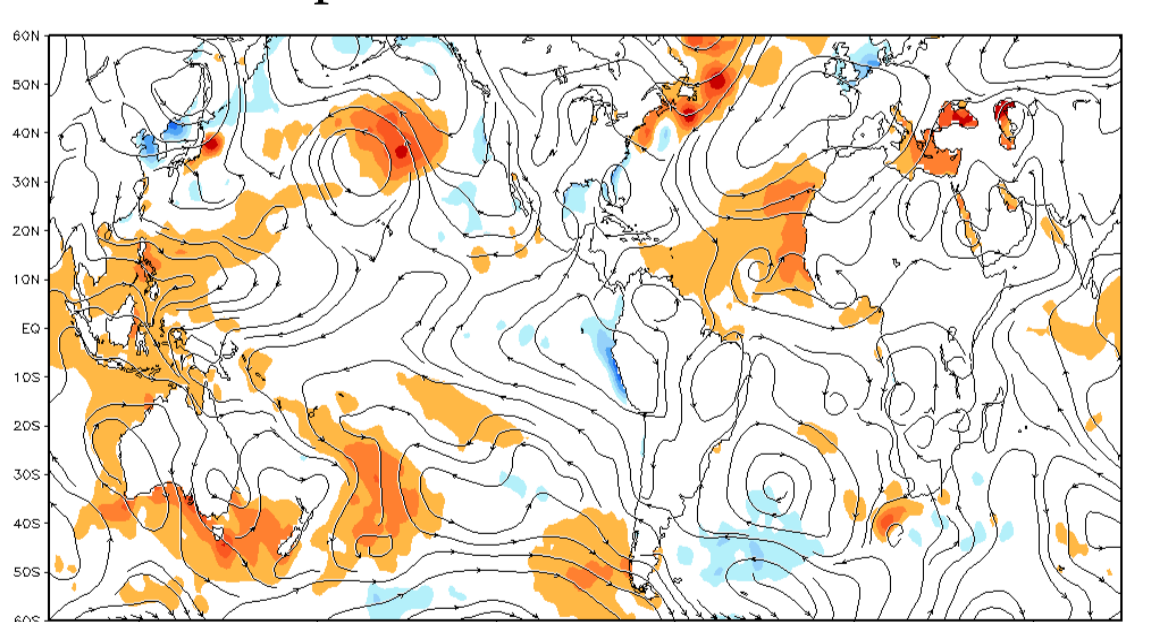


Precipitation anomaly

Sea level pressure and 850 hPa wind anomalies



Sea surface temperature and 850 hPa wind anomalies



Sea surface temperature and 850 hPa wind anomalies

Both the boundary condition of persisted as well as forecasted (not showed) SST anomalies indicated warmer than normal conditions over tropical North Atlantic Ocean, as well as conditions ranging from normal to slightly below normal in tropical South Atlantic Ocean

The upper-level anomaly circulation forecasted by the model indicated a trough over Northeast Brazil prevailing downward movement over the region contributed to suppression of convection and negative precipitation anomaly forecasts

References:
 CAVALCANTI, I. F. A. et al., Global climatological features in a simulation using the CPTECCOLA AGCM. *J. Climate*, 15, 2965–2988, 2002.
 KALNAY, et al., The NMC/NCAR 40Year Reanalysis Project". *Bull. Amer. Meteor. Soc.*, 77, 437471, 1996