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PRELIMINARY STUDY IN THE USE OF PSEUDO-TEMPS FOR A SACZ PREDICTION DURING 13-19 JANUARY 2003 USING AGCM/CPTEC/COLA

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1. INTRODUCTION

For several decades, it has been known that numerical weather forecasts are sensitive to small changes in initial conditions. This means that even if the atmosphere could be modeled perfectly, errors in the initial conditions would grow, leading to forecast errors and failures (Morss et al., 2001). Since we will never know the true state of the atmosphere due to inaccurate observations, the errors in the initial conditions always exist. Because the observation network is heterogeneous, in any forecast situation there are likely to be regions where information about the initial conditions is particularly important, but with are insufficient observations (Morss et al., 2001). In these data sparse regions a forecast model and a Data Assimilation System (DAS) could be used to simulate observations, an analysis and forecast cycle. These simulated observations could be useful for a more realistic weather situations representation.

The objective of the present study is performed to assess the impact of pseudo-temps (extracted vertical profiles from simulated observations) on forecast over a usually data sparse region, as over the oceans, and at east of the Andes Mountain in a case study of South Atlantic Convergence Zone (SACZ) during 13-19 January 2003.

2. METHODS

The additional observations are included in the data assimilation system of CPTEC to prepare the initial conditions used to integrate the Atmosphere Global Circulation Model (MCGA/CPTEC/COLA). In this study, we used the Pseudo-Temps from analyses of the European Centre for Medium-Range Weather Forecasting (ECMWF). This data are specified in a regular grid pattern with a spacing of 10°lat x 10°lon from 180°W at 40°W longitude to 60°S at 10°N and from 30°W at 0°W longitude to 20°S at 10°N. The geographical distribution of Pseudo-Temps is shown in Fig. 1. This distribution shows a broad view the mean atmospheric circulation pattern in this region. It was used 216 atmospheric profiles from zonal (u) and meridional (v) wind components, as well as specific humidity.

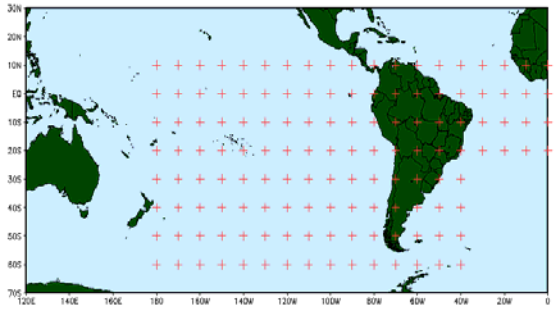

Fig.1: Geographical distribution of Pseudo-temps (red cross). The area is 10°lat x 10°lon from 180°W at 40°W longitude to 60°S at 10°N and from 30°W at 0°W longitude to 20°S at 10°N.

3. THE DATA ASSIMILATION SCHEME

The data assimilation scheme blends observations with a short term (6-hour) forecast, which is a first guess of the state of the atmosphere. The scheme implemented is the Physical-space Statistical Analysis System

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(PSAS), developed at the Global Model Assimilation Office (GMAO/NASA) (Da Silva et al. 1996; Cohn at al. 1998). PSAS is a global analysis system with characteristics of 3D-Var and Optimal Interpolation, in which the minimization is performed in physical space of the observations, rather than in model space. PSAS solves the analysis equation globally rather than locally, similar to the global spectral variational analysis system (3D-Var) and it is fundamentally independent of the forecast model formulation.

The scheme runs with the spectral AGCM/CPTEC/COLA, with T126L28 resolution, with approached horizontal resolution of 1°x1° and 28 levels in the vertical sigma coordinate. More details of this model can be found in Cavalcanti et al., 2002.

4. PRELININARY RESULTS

During the analyzed period, it was observed a wide and long zone of moisture convergence oriented northwest to southeast, near the coast of Southeast Brazil, known as the SACZ (Kodama, 1992). This SACZ episode can be seen in the GOES-8 satellite imagery for January 15, representing the third day of this event (Fig.2).

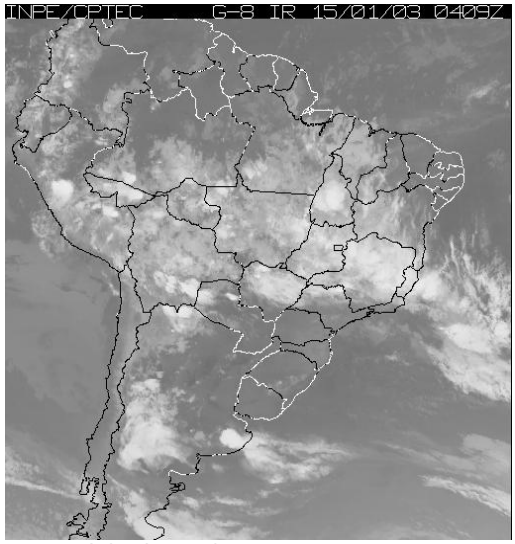

Fig.2: GOES-8 infrared imagery on January 15, 2003, 04:09 UTC.

The associated cloudiness band shows a displacement towards oceanic areas near Sao Paulo and Rio de Janeiro States. This cloudiness band was kept by the incursions of cold fronts and the formation of cyclonic vortices at high levels on the Northeast Brazil. The accumulated precipitation for the analyzed period exceeded 150 mm in isolated areas of the Southeast Region, beyond north of the Mato Grosso and south of the Para (Fig.3). In Barão dos Cocais e Santa Barbara, in Minas Gerais State, 100 mm of rain amounts on day 16 had been registered, and, in Franca, Sao Paulo State, the values of precipitation reached 94 mm (day 18).

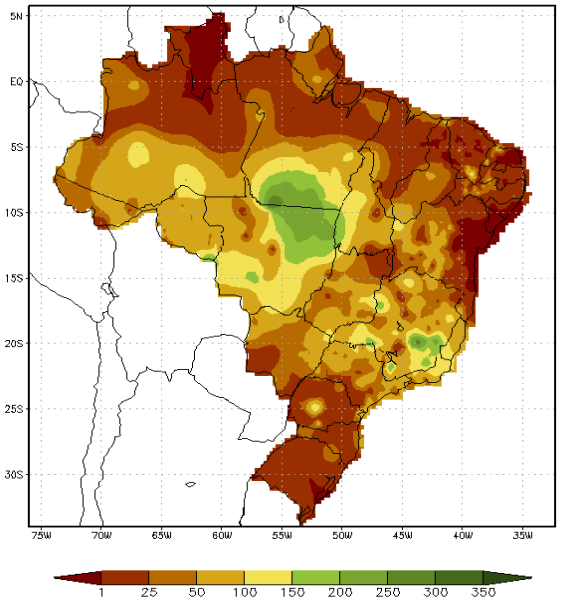

Fig3: Accumulated Precipitation (mm), illustrating a SACZ episode during the 13-19 January 2003 period by the GOES-8 Satellite.

Two experiments were performed, one without Pseudo-Temps data (Control), and another one including the additional Pseudo-Temps data (Experiment). The objective of this method was to verify the impact of assimilating the additional data in the analysis and model forecast.

It is observed in Figure 4 that for both cases, Control and Experiment, there is a humid layer in the low troposphere, between about 1000-800hPa. Theses results agrees with the analyzed period, when it could be seen the frontal system intensification, in regions favorable for moisture increase. In Figure 4C, it can be seen that the inclusion of pseudo-temps favored the intensification of the amount of humidity in the days that the frontal system intensification occurred on the region. Also it is possible to observe that the lesser values of humidity well had been represented, in schedules where it had weakness of the cloudiness band.

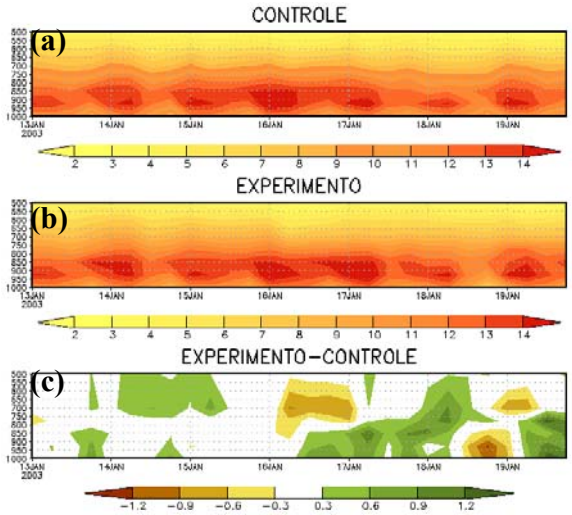

Fig.4: Time serie (13-19 January 2003) of specific humidity at 19.94S, 43.76W for (a) control, (b) experiment, (c) difference between (a) and (b).

In Figure 5 it can be seen that the simulation depicted larger values of OLR along the NW-SE band in Southeastern regions and Center-West of Brazil, beyond the north of Paraguay. In Pacific Ocean center-north area and in the Intertropical Convergence Zone (ITCZ), it is noted that both simulations had presented lesser values of OLR. In all NW-SE OLR band over central Brazil, the experimental run presented values closed to the observed. In the ITCZ region, the Control run reveled better estimative near the coast, already the experimental run revealed better in the oceanic region.

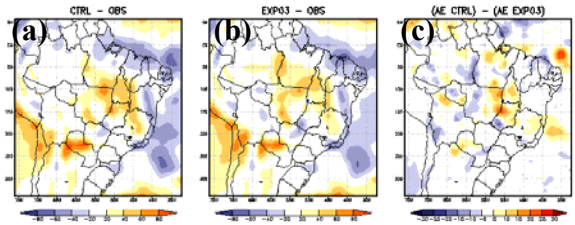

Fig.5: Comparations of control and experiment OLR with NOAA OLR. The (c) panel is a difference of the absolute value of the fields in the (a) and (b) panels.

Figure 6 shows that the precipitation fields are not consistent with the precipitation maximum values occurred during SACZ episode SACZ. In the regions of maximum precipitation, both simulations had presented a reduction with relation to the observed values, however it should be standed out that in the experimental run it had a subtle improvement in the representation of these values near to the Southeastern Region coast, central area and extreme north of Brazil.

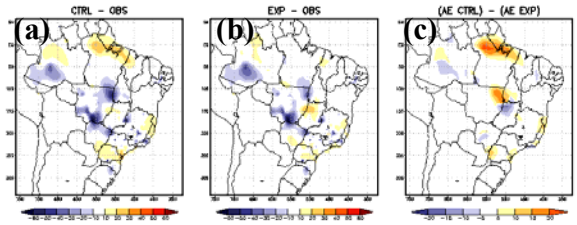

Fig.6: Comparations of control and experiment 24 forecast precipitations with GOES-8 data. The (c) panel is a difference of the absolute value of the fields in the (a) and (b) panels.

5.CONCLUSIONS

Two experiments were performed to assess the impact of extra data inclusion in the CPTEC/INPE data assimilation system. The obtained results indicate that both experiments reveled similar features, but the atmospheric circulation characteristic was better simulated in the experiment with the addition of pseudo-temps. In general it was observed an increase in the moisture amount represented by model, revealing more coherence with the synoptic situation of the period.

6. ACKNOWLEDGMENTS

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