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ABSTRACT

Conventional data and ATOVS retrievals, in the form of geopotential heights, were assimilated by RPSAS (Regional Physical-Space Statistical Analyses System) at CPTEC (Center of Weather Prediction and Climate Studies – Centro de Previsão de Tempo e Estudos Climáticos) and verifications were done with outputs to quantify the impact of the assimilated data on RPSAS analyses. Also a case study was carried out about a frontal system that appeared in Brazil in 09 of July of 2007. Comparisons to a control experiment without ATOVS profiles, as Mean Absolute Error, were made to observe the impact of these retrievals on the analyses generated by RPSAS. Furthermore, an Analysis Impact Index (AI) was calculated by taking the NCEP analyses as a "perfect" representation of the atmosphere state at some synoptic times during the period of 01st to 31 of July of 2007. The results show that the profiles assimilation of the profiles provided improvements in analysis quality, although these improvements were not observed over the entire RPSAS domain.

INTRODUCTION

In a operational data assimilation system, satellite data are combined with conventional data (e. g. surface data, TEMP) and short range forecasts (background field) to yield a best estimate of the atmospheric state. This representation is the "analysis" and will be used as an initial condition to a new run of the atmospheric model.

Objective: The main purpose of this study is to evaluate the impact of the assimilation of geopotential ATOVS (Advanced TIROS N Operational Vertical Sounder) retrievals on the analyses generated by RPSAS, and on the precipitation forecasts generated by a frontal system that took place in the South region of Brazil in July of 2007.

DATA AND METHODOLOGY

Two experiments were conducted with RPSAS, coupled with Eta model, using a horizontal resolution of 20km. In the first, hereafter called ATOVS, conventional and geopotential ATOVS profiles were assimilated, from the 01st through the 31st of July of 2007. In the second experiment, hereafter called CONTROL, only conventional data were assimilated over the same period.

It was calculated the Mean Absolute Error (MAE) between the ATOVS and CONTROL for the synoptic times of 00, 06, 12 and 18Z on the pressure surface layers of 850, 500 and 300hPa, for the temperature, specific humidity, geopotential height and zonal wind fields.

The Analysis Impact Index (IP) was calculated for the ATOVS and CONTROL experiment analyses, taking NCEP analysis as the standard. IP was calculated using the formulation proposed by Zapotocny (2005) for forecasts and by Andreoli et al (2007) for analyses.

$$IP = 100 \cdot \sqrt{\frac{\sum (CONTROL - NCEP)^2}{N} + \frac{\sum (ATOVS - NCEP)^2}{N} + \frac{\sum (ATOVS - CONTROL)^2}{N}}$$

Finally, Analyses of precipitation forecast for 1 to 3 days, and subjective compares between ATOVS and CONTROL experiments data with observed data obtained from the INMET (National Meteorological Institute - Instituto Nacional de Meteorologia) observation net, for the period of 09 to 11 of July.

The assimilated ATOVS profiles have a irregular distribution in time, due to NOAA satellites orbits. The impact on analyses were more intense on ones for 06 and 18Z. Figure 1 shows examples of spatial profiles distribution.

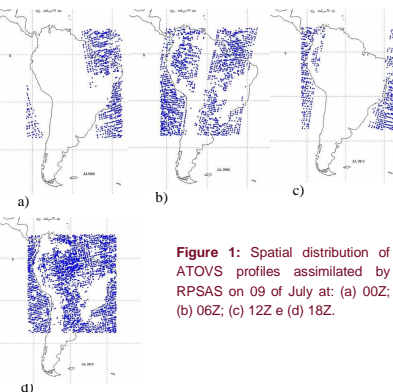


Figure 1: Spatial distribution of ATOVS profiles assimilated by RPSAS on 09 of July at: (a) 00Z; (b) 06Z; (c) 12Z e (d) 18Z.

RESULTS

The calculated MAE is showed in the Figure 2, for the synoptic time of 06Z (others are not shown). It is possible to identify the areas with greater departures from the CONTROL fields.

The calculated IP are showed in the Figure 3, for fields of temperature, zonal wind, geopotential and specific Humidity. The IP shows that the assimilation of ATOVS geopotential retrievals generates analyses with outputs closer to analyses from NCEP in some regions, but not for all domain of RPSAS.

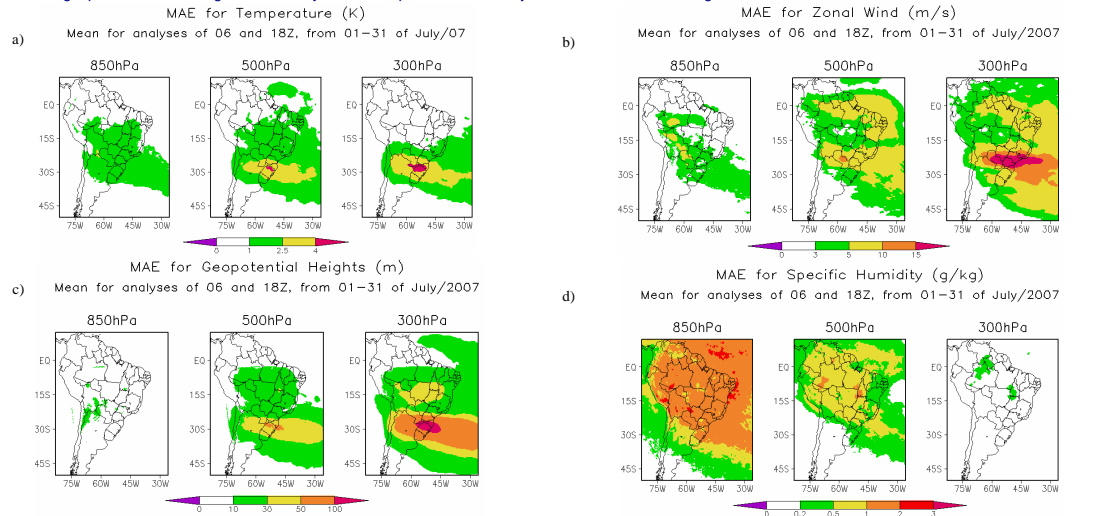


Figure 2: (Top) Mean Absolute Error for (a) temperature, (b) zonal wind, (c) geopotential height and (d) specific humidity fields for the synoptic time of 06Z (monthly mean for RPSAS analyses for the period of the 01 through 31 of July of 2007).

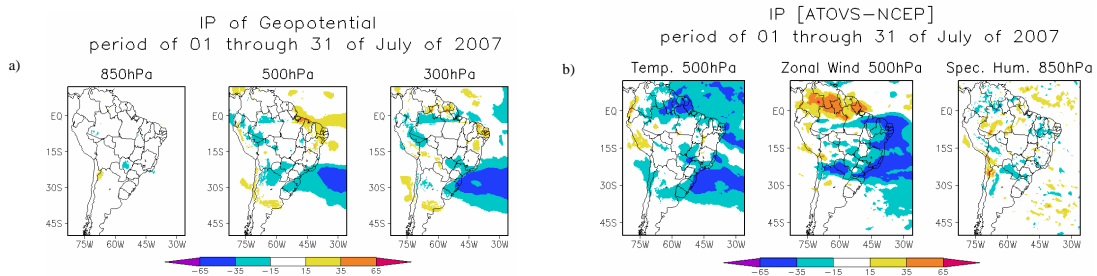


Figure 3: (Top) Analyses Impact Index for (a) geopotential at levels of 850, 500 and 300 hPa; and (b) Temperature at 500hPa, Zonal wind at 500hPa, and Specific Humidity at 850 hPa level. "Improvements" to analyses are showed in yellow, orange and red. Aqua and dark blue shows the opposite.

Figure 4 shows the precipitation forecasts for 24, 48 and 72h for the ATOVS and CONTROL experiments and the observed precipitation data for 10th of July for the South region of Brazil.

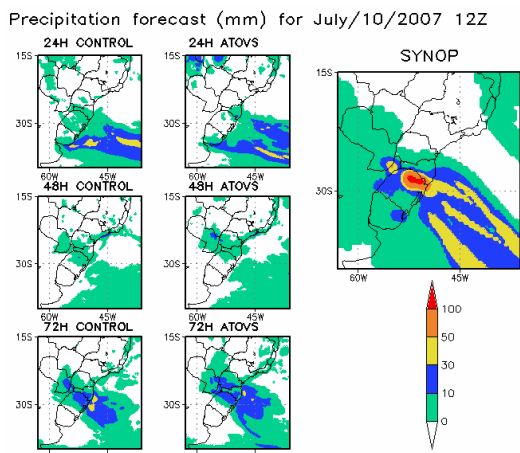


Figure 4: Precipitation Forecasts for 1-3 days generated by CONTROL and ATOVS experiments, and the observed precipitation field for 10th of July of 2007 (data from INMET).

CONCLUSIONS

This preliminary study suggests that, for the period of July 1st to 31st, 2007, the ATOVS data assimilation yields a significant improvement in a quality of analysis fields over much, but not all, of the domain of RPSAS. More diagnostic studies are needed to determine, with more confidence and accuracy, the impacts of ATOVS geopotential height data assimilated by RPSAS over South America.

Further studies made by the Data Assimilation Group of CPTEC, in a form of Operational Research, suggested that the newer parameterizations of surface changes implemented to RPSAS implied a "spin-up" (time demanded for the system to be stabilized) of about two and a half months, because the boundaries conditions have been taken from Eta model instead of from global model CPTEC/COLA T213L42. This work was carried out using data processed within this spin-up period, and some care must be taken with analyses considered specially with humidity near the surface and other surface changes.

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