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ASSESSING THE DATA ASSIMILATION SYSTEM 4D-LETKF/AGCM-CPTEC USING DATA FROM THE BARCA/LBA FIELD EXPERIMENT

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1 - INTRODUCTION

The Local Ensemble Transform Kalman Filter (LETKF, Hunt et al. 2007; Ott et al., 2002) is an efficient data assimilation scheme of the square root ensemble Kalman filter family. It was developed by Weather and Chaos Group at the University of Maryland (UMD) - EUA. Unlike other square-root schemes that solve the Kalman filter equations in observation space (Anderson 2001, Bishop et al. 2001), LETKF solves the equations locally in model space. In this way, LETKF can utilize parallel computation and is more efficient when assimilating satellite observations.

This study evaluates the performance of a new data assimilation system using the LETKF with the Atmospheric General Circulation Model (AGCM) of the Center for Weather Forecast and Climate Studies (CPTEC). Additionally, the results LETKF/AGCM were compared with the operational data assimilation system from CPTEC: the Global Physical-space Statistical Analysis System (GPSAS).

Radiosondes collected during the Balance Regional Atmospheric Carbon in the Amazon/Large Scale Biosphere-Atmosphere Experiment in Amazonia (BARCA/LBA) field experiment were used to validate the analysis and forecasts generated by the LETKF/AGCM and GPSAS assimilation systems. The BARCA/LBA field experiment was aimed to understand the Amazon region as a regional entity. During 9 to 30th June 2008, around four atmospheric radiosondes were launched around daily at 00, 06, 12 e 18 UTC in five sites: Manaus-AM, Tabatinga-AM, Rio Branco-AC, Belém-PA and Carolina-MA. In this work, we used the radiosondes of the site Carolina-MA (7.34°S x 47.60°W) only in the 850hPa level.

2 – METHODOLOGY

In this study we used the LETKF system with AGCM model of the CPTEC, in the resolution T126L28. The system were used with an ensemble of 20 members. The study area includes South America, for the period from 1-30 June 2008, being considered the first 5 days as a period of spin up of the assimilation system. The assimilation was performed each 6 hours, so that were generated daily analysis at synoptic times (00, 06, 12, 18 UTC). Non satellite data from surface and upper air have been assimilated by LETKF/AGCM.

The results LETKF/AGCM system, in the resolution T126L28, were compared with the analysis and forecasts from the GPSAS system of the CPTEC, in the T213L42 resolution.

The Root Mean Square Error (RMSE) was done over South American area using NCEP high resolution analysis as true. The RMSE errors of the LETKF and of the GPSAS were calculated to 00 and 12UTC for the analysis. The same computation was used for the weather forecasts of 48 hours.

Validation of the analysis and forecasts have been shown by plotting time evolution, at 850hPa level: i) LETKF ii) GPSAS, iii) BARCA.

3 - RESULTS

Time evolution of the BARCA/LBA Radiossonds x LETKF x GPSAS

Analysis

48 h Forecast

RMSE - Time mean in the South America

Analysis   **48h Forecast**

4 - SUMMARY

On average, the vertical profiles showed more significant impacts in analysis than in the forecasts.

During the study period, there is an agreement between the assimilation systems and the data observed in the BARCA/LBA experiment (850mb), for the analysis and for the forecasts.

Results LETKF/AGCM verified from observational data of the BARCA/LBA field experiment at 850hPa were very satisfactory.

We observed the occurrence of squall lines and cold fronts during the period studied, so the GPSAS data assimilation system that has higher spatial resolution has more advantage to simulate the observations than LETKF. Beside of that LETKF still giving reasonable results .

The next stage of this work is the direct assimilation of radiances by 4D-LETKF, which should help to reduce the analysis error and reproduce results closer to observations.
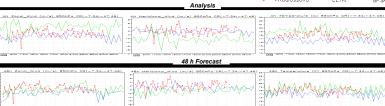
BARCA/LBA x LETKF x GPSAS (850hPa)

The zonal and meridional wind obtained by LETKF are closer to the radiosonde BARCA/LBA than the analysis of the GPSAS.

The forecasts of the meridional wind obtained by LETKF are closer to the radiossonagens than forecast of the GPSAS. The forecasts of zonal wind are satisfactory for both systems.

Analysis and forecasts of temperature for LETKF and GPSAS are satisfactory.

RMSE

On average, the vertical profiles showed more significant impacts in analysis than in the forecasts.

The analysis LETKF/AGCM shows better results than GPSAS for the zonal and meridional wind field in all levels.

The temperature analysis obtained by LETKF/MCGA showed better results only at low levels. The greatest differences were observed in 700hPa and 100hPa levels.
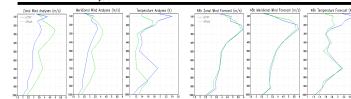
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