A BACKGROUND ERROR COVARIANCE MATRIX FOR THE CPTEC DATA ASSIMILATION SYSTEM

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1. Introduction

The background error covariance matrix is one of the main components of a data assimilation system. At CPTEC, the past operational data assimilation system ran using available background error covariance matrices that used background information from other models/systems. CPTEC started to use the GSI as its operational data assimilation system, a GFS based background error covariance matrix was used as a starting point. Currently, CPTEC is preparing a new version of its global data assimilation system and a new background error covariance matrix was constructed using the NMC method and the pairs of forecasts of its global circulation model, the Brazilian Atmospheric Model (BAM, Figueroa et al., 2016). In this present work, we show the results of its application in a 3DVar data assimilation system by means of single observation assimilation experiment.

2. CPTEC New Background Error Covariance Matrix

The application of a new background error covariance matrix for a 3DVar global data assimilation system is shown here at a low resolution (TQ0062L028, roughly 200 km near the Equator with 28 sigma levels). This version was also applied to test a hybrid 3DVar system (CPTEC has plans to make it a future update to its global data assimilation). This matrix was calculated using the NMC method from a database of 1,460 pairs of 48 and 24 hours forecasts.

3. Single Observation Test Application within GSI and Future Plans

In order to test the new background error covariance matrix, we made a series of single observation tests. The single observation test is run under the GSI framework using a pure 3DVar system and makes use of a synthetic observation. With this type of tests, it is possible to control the magnitude of the observation error and innovation. Figure 1 shows the result of a single observation assimilation of zonal wind component placed at 250hPa, and centered at the point with coordinates 45°N, 180°W (lat x lon, respectively). Both the observation error and innovation magnitude were adjusted to 1 ms^{-1}. As the GSI allows for the application of the error covariances using an anisotropic filter, we also tested the application of the new background error covariance matrix using the anisotropic filter and compared its result against the GSI default matrix (using the same configuration) in order to see how the covariances accommodate the analysis increment. As can be seen, with the BAM/CPTEC background error covariance matrix, the resulting zonal wind analysis increment is broader than its GFS/ NCEP counterpart. This may be due to a more detailed covariance structures (not shown) due to the use of a high number of forecast pairs. On the other hand, the application of the new BAM-based background error matrix should be properly tuned within GSI.

A complete version of this development was recently published in the Brazilian Journal of Meteorology, in which a more complete characterization of the new background error covariance matrix is made, accounting for its spatial features and quantitative characteristics.

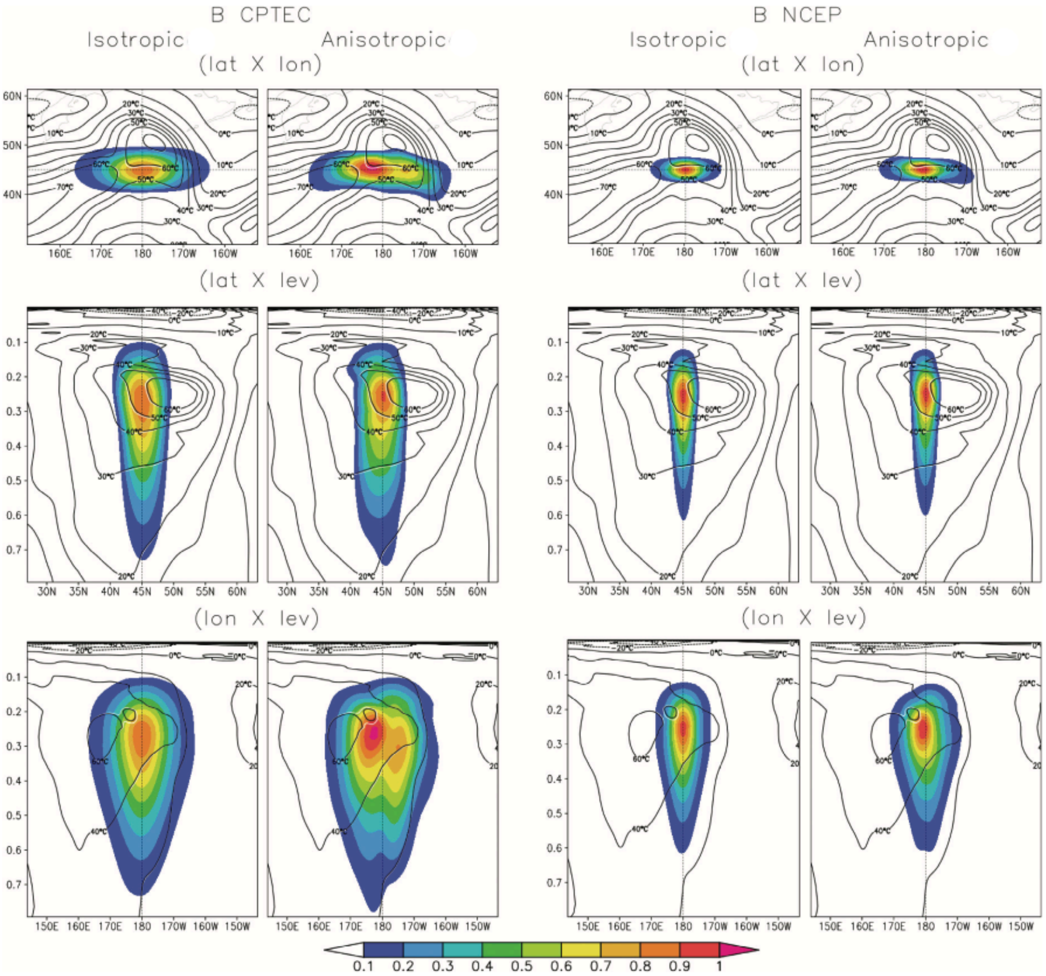

Figure 1. Horizontal wind (isolines) analysis increments (shaded) at 250 hPa, using the background error covariances matrices from CPTEC and NCEP, respectively. In the first row are shown the latitudinal sections, in the second rows, the longitudinal sections and in the third row, the vertical sections. At left, the analysis increment in isotropic and at right, the analysis increment is anisotropic.

References

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