Proceedings of 8 ICSHMO, Foz do Iguaçu, Brazil, April 24-28, 2006, INPE, p. 1897-1899.

EVALUATION OS WEATHER FORECASTS MADE FOR RIO DE JANEIRO CITY

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1. INTRODUCTION

Most of the operational centers in meteorology don't bother to verify and to validate its forecasts, mainly those that are done through numeric models.

For Rio de Janeiro city there are several sources that release daily its public forecasts. Besides the Instituto Nacional de Meteorologia (INMET) and the Centro de Previsão do Tempo e Estudos Climáticos (CPTEC/INPE), there are in the Internet, forecasts done by the Laboratório de Prognósticos em Mesoescala (LPM/UFRJ), Fundação GeoRio - Sistema Alerta-Rio and companies like Somar and Climatempo.

In this study are showed the results of verification of the forecasts for the horizons of 24, 48, 72 and 96 hours of rainfall occurrence, values of maximum and minimum temperatures and cloudiness done by the centers and companies aforementioned in the periods from May to September 2004 and July to September of 2005. These variables are generally of greater interest for the public in general.

This study has as objective to show to the user, layman or not, which of the forecasts supplied by the several centers and existent companies is more reliable or has larger probability of happening.

2. METODOLOGY

The methodology used to verify the rate of successes in the rainfall forecasts, consists of the categorical comparison (hit or miss) between forecast and rain occurrence.

For such comparison, it was used data of rainfall of FUNDAÇÃO GEORIO stations (http://www.rio.rj.gov.br/georio/alerta), which measures it every 15 minutes. It was considered as the minimum for rainfall occurrence the value of 0.2 mm.

With the comparison done every month, the indexes of precision, tendency and skill were calculated.

As measure of precision has:

Hit Rate (H) - Proportion of correct forecasts independently that is occurrence or not of the event.

Probability of Detection (POD) - Probability of occurrence of the event supposedly foreseen.

Critical Success Index (CSI) - it is adapted for the evaluation of the forecast quality in situations where the event of larger importance is of low occurrence probability (for example, rainfall occurrence) as in the cases in that the event is trivial.

False Alarm Rate (FAR) - it is the proportion of the foreseen events that didn't happen.

For perfect observations the indexes H, POD and CSI assume the value of 1. Already FAR in a system of forecasts assumes a value the same to zero.

BIAS - it represents the reason between the total of forecasts of the event and the total number of occurrences of the same. We considered that the system is overestimating the forecast of occurrence of the event when its value is> 1 and underestimating when its value is <1.

As measure of Ability:

Heidke Skill Score (HSS) - it is projected to evaluate the relative precision of the forecast accomplished in comparison to an index or system of reference forecast. HSS uses as reference the chance or randomness and in this study as measure of precision the proportion of successes (H). Forecast systems with HSS equal for 1 are said perfect while outlines with HSS equal for 0 present the same ability of a random outline. Forecast outlines with HSS negative show worse acting than a random outline in which to decide the forecast based on the throw of a coin would be more appropriate or he/she would have a larger precision.

In relation to verification of the temperature forecasts, it was made the comparison among the observed data removed of the newspaper O Globo and of the INMET website (www.inmet.gov.br) foreseen data, in the case of Climatempo the forecasts disclosed in the same newspaper and for the other companies and or analyzed institutions, the data were retired of its respective sites. For temperature it was used as measure of precision the Root Mean Square Error (RMSE) and the Bias. The bias show us if the

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forecast system is overestimating or underestimating the values of the temperature. Positive bias indicates overestimate and negative bias indicates underestimate. RMSE already gives us the measure of the error that is being made.

For the verification of cloudiness forecasts disclosed by the companies and/or institutions, the categories "Sunshine", "Partially Cloudy" or "Cloudy ", they were compared with the daily observations of the cloudiness in Santos Dumont's stations and Galeão, disclosed through METAR messages obtained thru Brazilian Air Force website (http://www-redemet.aer.mil.br) and the calculated indexes in a similar way to the rainfall.

3. RESULTS

To simplify data visualization, was used an verification method based on the forecast system characteristics called Relative Operating Characteristics (ROC), that allows evaluate both the hits and the false alarms. The closest the scatter dots are from the upper left corner of the graphs, greater is the skill of the forecast system. The line that divides diagonally the graph is called null performance line.

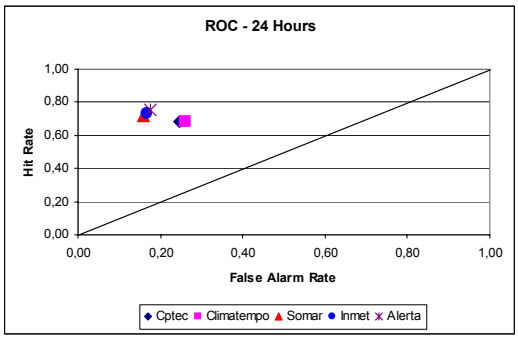

Figure 1: ROC for 24 hours

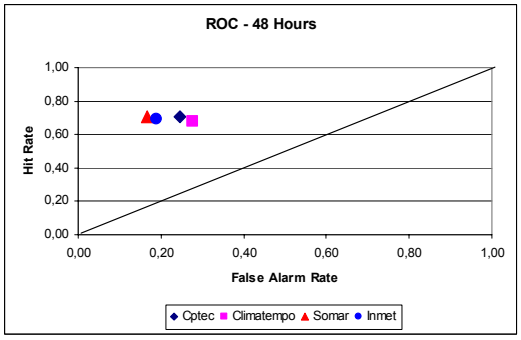

Figure 2: ROC for 48 hours

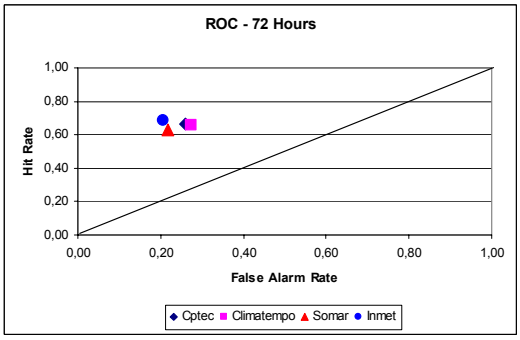

Figure 3: ROC for 72 hours

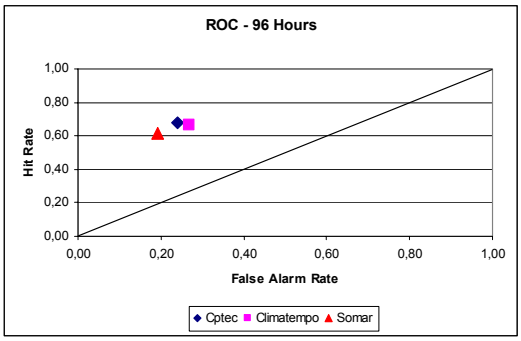

Figure 4: ROC for 96 hours

For rainfall forecasts for the 24 hours horizon (Figure 1), Sistema Alerta-Rio, Somar and INMET show the best scores for Rio de Janeiro City. On the 48 hours horizon (figure 2), Somar and INMET still show the best scores in rainfall forecasts. On the 72 hours horizon (figure 3), INMET excels having the greatest H and the lowest FAR. However, on the 96 hours horizon (figure 4), besides CPTEC and Climatempo show a higher H than Somar, the FAR also follows the same trend.

4. Conclusion

This study showed the results of verifications done on forecasts made by companies Climatempo and Somar, operational centers CPTEC, INMET and Alerta-Rio for Rio de Janeiro City during May to September of year 2004 and July to September of the year 2005.

It shows that a perfect forecast system is not possible, and that each forecast source excel in the forecast of a given variable.

On temperature forecasts, both maximum and minimum, all sources overestimate the values on all forecast horizons.

The Laboratório de Prognósticos em Mesoescala excel on sunshine forecasts, showing the lowest FAR. For partially clouded forecasts, all sources show a high FAR. For Cloudy forecasts,

all sources show low FAR, specially Climatempo, with the lowest FAR.

5. REFERENCES

Wilks, 1995
Mason e Graham, 1999