# MODEL OUTPUT STATISTICS TO IMPROVE SEVERE STORMS PREDICTION OVER WESTERN SAHEL

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(Dated: July 11, 2007)

## I. INTRODUCTION

Several studies (for example Glahn, 1985; Stanski *et. al.,* 1989; Wilks, 1995; Kalnay, 2003) have shown that Numerical Weather Prediction (NWP) models and their forecasts are subject to errors and biases due to complex atmospheric uncertainties and our incomplete knowledge of the mathematical formulations of the atmospheric physics. The atmosphere is known as a non-linear dynamic system which is not perfectly predictable in a deterministic sense; statistical methods are therefore useful and have indeed become a necessary part of weather forecasting. Model Output Statistics (MOS) is a statistical method that relates weather elements (predictands) to the appropriate variables (predictors). MOS method uses large multiple regression equations (Wilks, 1995) which have the advantage of recognising model predictability, removing systematic model biases and providing reliable probabilities and specific element forecasts. The MOS method and the corresponding MOS equations generated by this study will help to correct NWP model biases and errors in predicting severe storms over the western Sahel. This is expected to assist weather forecasters issue improved, reliable and more accurate quantitative severe storm forecasts.

## II. PRESENTATION OF RESEARCH

The MOS equations required to correct forecast systematic biases and errors from the 20 km resolution Limited Area Model over Africa (Africa LAM) developed by the United Kingdom Meteorological Office (Met Office) is suggested in this study. Daily observations for 2005 to 2006 for rainfall for 36 stations distributed across the western Sahel (WS) were obtained and T+24h model forecast from Africa LAM over the same period were retrieved. The MOS analysis was principally done and adapted using the Climate Predictability Tool (CPT) developed at the International Research Institute (IRI), USA. The MOS equations provided in this study were formulated as follows;

$$Ot = OGI + f\text{MOS}\ (Xt)$$

where,
Ot = expected observation for time t (or MOS forecast),
OGI = Optimal Goodness Index
Xt = Africa LAM Forecast pertaining to the future time t, and
*f*MOS = MOS regression coefficient.

| | North | South |
|---|---|---|
| JFM | $O_t = 0.09 + 0.81X_t$ | $O_t = 0.03 + 0.52X_t$ |
| AMJ | $O_t = 0.08 + 0.52X_t$ | $O_t = 0.07 + 0.74X_t$ |
| JAS | $O_t = -0.01 + 0.48X_t$ | $O_t = 0.04 + 0.62X_t$ |
| OND | $O_t = 0.12 + 0.81X_t$ | $O_t = -0.03 + 0.64X_t$ |

TABLE I: The MOS equations required to correct Africa LAM T+24h rainfall forecasts

FIG. 1: Africa LAM T+24h Rainfall forecasts compared with observed.

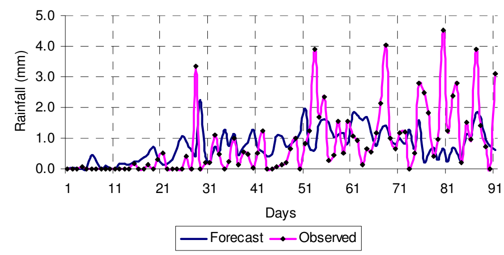
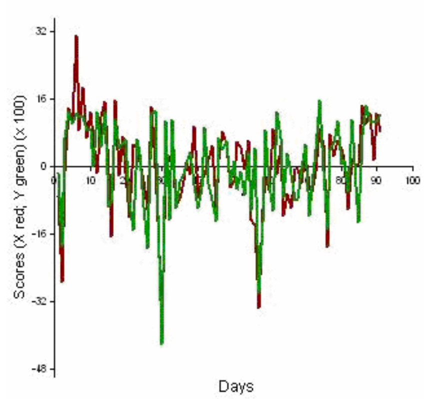



FIG. 2: Temporal Canonical Correlation Analysis (CCA) scores of Africa LAM T+24h rainfall forecasts (X red) vs. Observation (Y green) after cross–validated MOS regression analysis.




## III. RESULTS AND CONCLUSIONS

Comparing Figures 1 and 2, the marked differences between model rainfall forecasts and corresponding station observations identified in Figure 1 have been closed-up or effectively reduced after the MOS cross-validated analysis as shown by Figure 2. This shows that the MOS method could effectively correct (as suggested by Wilks, 1995; Kalnay, 2003) the model rainfall forecast systematic errors and biases. The MOS equations required to correctly forecast rainfall (severe storms) during the JFM, AMJ, JAS and OND seasons and for the north and southern regions of WS are presented in Table 1.

The set of MOS equations provided in this study if applied, will assist weather forecasters to issue more accurate and timely severe storm forecasts, and especially by reducing NWP model systematic forecast errors and biases.

## IV. AKNOWLEDGMENTS

The authors would like to thank the Met Office and WMO who provided funding for this work.

## V. REFERENCES


Glahn H.R., 1985: Statistical Weather Forecasting. In Probability, Statistics, and Decision Making in the Atmospheric Sciences. *A.H. Murphy and R.W. Katz Edition, Westview, Boulder CO.* 289-335.

Jolliffe I.T., Stephenson D.B., 2003: Forecast Verification. A Practitioner's Guide in Atmospheric Science. *Wiley and Sons Ltd.,* 30-220

Kalnay E., 2003: Atmospheric modeling, data assimilation and predictability. *Cambridge University Press, Cambridge.* 1-281

Stanski H.R., Wilson L.J., Burrows W.R., 1989: Survey of common verification methods in meteorology. *WMO Research Report, 89-5, 1-81*

Wilks D., 1995: Statistical Methods in the Atmospheric Sciences, *Academic Press.* 159-255