AN EMPIRICAL MODEL OF SAHEL CLIMATE

by

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy at the University of East Anglia

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September 2005

Abstract

Since 1968, the semi-arid region of sub-Saharan Africa, known as the Sahel, has seen a series of devastating droughts, which have been the subject of many studies. The majority of these have approached the problem by investigating the interannual variability of rainfall. Few have attempted to study the variability at shorter time scales. In this thesis, an empirical model is developed to study the daily variability of Sahel rainfall.

The model is developed in three parts. Initially, a 1° gridded daily data set of Sahel rainfall is formed for 1958 – 1997 from station data, using smoothing thin plate splines. A suite of atmospheric predictors is created by extracting the main modes of atmospheric variability in the NCEP reanalysis using a three-dimensional Principal Component Analysis. The domain of the PCA covers four atmospheric levels over sub-Saharan North Africa.

The atmospheric predictors are linked to daily rainfall in six regions of the Sahel, via a series of gamma-distributed Generalised Linear Models, with separate models developed for the two halves of the wet season. The predictors used in the model are picked with a forward stepwise selection procedure. Of the fields examined, specific humidity and zonal and meridional wind speed are seen to have the largest influence on rainfall.

June and July rainfall is most associated with the presence of easterly waves, and with the monsoon, providing southerly flow transports it over the Guinea Coast region. August and September are dominated by the strength of the monsoon flow in the Gulf of Guinea, but are also influenced by several factors describing variability in East Africa, which require further study.

Acknowledgements

I wish to express my thanks to all those who have aided me during the writing of this thesis. Firstly, many thanks to my supervisory team: Jean Palutikof, Tom Holt, Phil Jones and Declan Conway, for all their support, advice and encouragement. Secondly, thanks to the Climatic Research Unit and the School of Environmental Sciences at UEA for the friendly environment and technical support. In particular, thanks to Effie, Amanda, Kate, and all others I have shared an office with, for your assistance and understanding, and for making CRU an enjoyable place to work.

I am grateful to those who have generously provided data for use in this project. In particular, thanks to Daouda Diarra of the Mali Meteorological Service; to Peter Lamb and Issa Lele Mouhamadou of the University of Oklahoma; and to David Lister and CRU, for providing station rainfall data. The NCAR / NCEP reanalysis was provided by the NOAA-CIRES Climate Diagnostics Center, Boulder, Colorado, and is accessible via their Web site at http://www.cdc.noaa.gov. The thin plate splines were fitted using MATLAB routines obtained from Stephen Billings at the University of British Colombia.

Finally, a big thanks to Liz, and rest of my friends and family, for all the support and encouragement you've provided me over the past few years. Without you, this thesis would have remained unwritten.

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