Glossary

Commonly used acronyms and abbreviations:

air	Air temperature
AEJ	African Easterly Jet
AEW	African Easterly Wave
CGS	Continuous Global Surface
CRU	Climatic Research Unit
ECMWF	European Centre for Medium-Range Weather Forecasts
ENSO	El-Niño Southern Oscillation
EEOF	Extended Emiprical Orthogonal Functions
EOF	Empirical Orthogonal Functions
GCM	General Circulation Model
GLM	Generalised Linear Model
gph	Geopotential Height
ITCZ	Intertropical Convergence Zone
MJO	Madden-Julian Oscillation
MLR	Multiple Linear Regression
NCAR	National Center for Atmospheric Research
NCEP	National Centers for Environmental Prediction
omega	Vertical Velocity
PCA	Principal Component Analysis

RCM	Regional Climate Model
RMSE	Root Mean Square Error
SST	Sea Surface Temperature
shum	Specific Humidity
TEJ	Tropical Easterly Jet
UEA	University of East Anglia
uwind	Zonal Wind
vwind	Meridional Wind

Commonly Used Mathematical Symbols:

Chapter 3: Construction of a Rainfall Dataset

λ_k	Interpolation weights for a fitted surface
v	Trade-off parameter in a smoothing thin plate spline
$f\ (\mathbf{x}_n)$	Function describing observed rainfall at $\mathbf{x}_n$
$J\ (\ s\ )$	Penalty function for a spline s
N	Number of stations available for gridding
$s\ (\mathbf{x}_n)$	Fitted value of a spline at $\mathbf{x}_n$
$\mathbf{x}_n$	Location of station n

Chapter 4: Formulating the Predictor Variables

λ_k	kth eigenvalue of $\mathbf{\Sigma}$
$\mathbf{\Sigma}$	Covariance matrix of $\mathbf{X}$
$\mathbf{A}$	Matrix of PC coefficients
n	Number of observations
p	Number of input variables in a PCA
$\mathbf{S}$	Sample covariance matrix of $\mathbf{X}$
$\mathbf{T}$	Transform matrix for a rotated PCA
$\mathbf{X}$	Data matrix
$\mathbf{Z}$	Matrix of PC scores

Chapter 5: Creating the Empirical Model

β_k	Regression coefficient in a MLR or GLM
η_i	Linear predictor
μ_i	Expected value of $\mathbf{Y}_i$
φ	Dispersion parameter
D	Deviance of a GLM
$g(\cdot)$	Link function
x_{ij}	Value of jth predictor variable at the ith observation
$\mathbf{X}_k$	Predictor variable
y_i	ith observation of the response variable
$\mathbf{Y}_i$	Random variable representing the response at ith observation

References

Abuarrea, J. and Asín, J., 2005, Forecasting local daily precipitation patterns in a climate change scenario: *Climate Research*, **28,** 183-197.

Aspliden, C. I., Tourre, Y., and Sabine, J. B., 1976, Some climatological aspects of West-African disturbance lines during GATE: *Monthly Weather Review*, **104,** 1029-1035.

Atkinson, A. C., 1981, Likelihood Ratios, Posterior Odds and Information Criteria: *Journal of Econometrics*, **16,** 15-20.

Behera, S. K., Rao, S. A., Saji, H. N., and Yamagata, T., 2003, Comments on "A cautionary note on the interpretation of EOFs": *Journal of Climate*, **16,** 1087-1093.

Billings, S. D., Beatson, R. K., and Newsam, G. N., 2002a, Interpolation of geophysical data using continuous global surfaces: *Geophysics*, **67,** 1810-1822.

Billings, S. D., Newsam, G. N., and Beatson, R. K., 2002b, Smooth fitting of geophysical data using continuous global surfaces: *Geophysics*, **67,** 1823-1834.

Bolton, D., 1984, Generation and propagation of African squall lines: *Quarterly Journal of the Royal Meteorological Society*, **110,** 695-721.

Buell, C. E.. The topography of the empirical orthogonal functions. Fourth Conference on Probability and Statistics in Atmospheric Sciences, 188-193. 1975. Tallahassee, FL., American Meteorology Society.

Buell, C. E.. On the physical interpretation of empirical orthogonal functions. Sixth Conference on Probability and Statistics in Atmospheric Sciences, 112-117. 1979. Banff, Alta., American Meteorology Society.

Buishand, T. A., Shabalova, M. V., and Brandsma, T., 2004, On the choice of the temporal aggregation level for statistical downscaling of precipitation: *Journal of Climate*, **17,** 1816-1827.

Burpee, R. W., 1972, The origin and structure of easterly waves in the lower troposphere: *Journal of the Atmospheric Sciences*, **29,** 77-90.

Camberlin, P. and Diop, M., 2003, Application of daily rainfall principal component analysis to the assessment of the rainy season characteristics in Senegal: *Climate Research*, **23,** 159-169.

Camberlin, P., Janicot, S., and Poccard, I., 2001, Seasonality and atmospheric dynamics of the teleconnection between African rainfall and tropical sea-surface temperature: Atlantic vs. ENSO: *International Journal of Climatology*, **21,** 973-1005.

Carlson, T. N., 1969, Some remarks on African disturbances and their progress over the Tropical Atlantic: *Monthly Weather Review*, **97,** 716-&.

Cattell, R. B., 1952, Factor Analysis: Harper and Row, New York.

Cattell, R. B., 1966, Scree test for number of factors: *Multivariate Behavioral Research*, **1,** 245-276.

Chandler, R. E. and Wheater, H.. Climate change detection using generalized linear models for rainfall - A case study from the west of Ireland, II, Modelling of rainfall amounts on wet days. Tech. Report 195. 1998. Dep. of Stat.Sci., Univ. Coll. London, London.

Chandler, R. E. and Wheater, H. S., 2002, Analysis of rainfall variability using generalized linear models: A case study from the west of Ireland: *Water Resources Research*, **38,** art-1192.

Chappell, A. and Agnew, C. T., 2004, Modelling climate change in West African Sahel rainfall (1931- 90) as an artifact of changing station locations: *International Journal of Climatology*, **24,** 547-554.

Charney, J. G., 1975, Dynamics of desert and drought in the Sahel: *Quarterly Journal of the Royal Meteorological Society*, **101,** 193-202.

Charney, J. G., Quirk, W. J., Chow, S. H., and Kornfield, J., 1977, A comparative study of the effects of albedo change on drought in semi-arid regions: *Journal of the Atmospheric Sciences*, **34,** 1366-1385.

Charney, J. G., Stone, P. H., and Quirk, W. J., 1975, Drought in the Sahara: a biogeophysical feedback mechanism: *Science*, **187,** 434-435.

Chong, M., Amanyenc, P., Scialom, G., and Testud, J., 1987, A tropical squall line observed during the COPT-81 experiment in West-Africa. Part 1: Kinematic structure inferred from dual-Doppler radar data: *Monthly Weather Review*, **115,** 670-694.

Claussen, M., 1997, Modeling bio-geophysical feedback in the African and Indian monsoon region: *Climate Dynamics*, **13,** 247-257.

Coe, R. and Stern, R. D., 1982, Fitting models to daily rainfall data: *Journal of Applied Meteorology*, **21,** 1024-1031.

Cook, K. H., 1999, Generation of the African easterly jet and its role in determining West African precipitation: *Journal of Climate*, **12,** 1165-1184.

Courel, M. F., Kandel, R. S., and Rasool, S. I., 1984, Surface albedo and the Sahel drought: *Nature*, **307,** 528-531.

Dai, A., Lamb, P. J., Trenberth, K. E., Hulme, M., Jones, P. D., and Xie, P., 2004, The Recent Sahel Drought is Real: *International Journal of Climatology*, **24,** 1323-1331.

Davison, A. C. and Hinkley, D. V., 1997, Bootstrap Methods and their Applications: Cambridge University Press, Cambridge.

Diedhiou, A., Janicot, S., Viltard, A., de Felice, P., and Laurent, H., 1999, Easterly wave regimes and associated convection over West Africa and tropical Atlantic: results from the NCEP/NCAR and ECMWF reanalyses: *Climate Dynamics*, **15,** 795-822.

Dobson, A. J., 2002, An Introduction to Generalized Linear Models: Chapman & Hall/CRC, Boca Raton.

Dommenget, D. and Latif, M., 2002, A cautionary note on the interpretation of EOFs: *Journal of Climate*, **15,** 216-225.

Dommenget, D. and Latif, M., 2003, Comments on "A cautionary note on the interpretation of EOFs" - Reply: *Journal of Climate*, **16,** 1094-1097.

Druyan, L. M., 1989, Advances in the study of sub-Saharan drought: *International Journal of Climatology*, **9,** 77-90.

Druyan, L. M., Lonergan, P., and Saloum, M., 1996, African wave disturbances and precipitation at Niamey during July August 1987 and 1988: *Climate Research*, **7,** 71-83.

Duchon, J., 1976, Interpolation des fonctions de deux variables suivant le principe de la flexion des plaques minces: *RAIRO Analyse Numérique*, **10,** 5-12.

Eltahir, E. A. B. and Gong, C. L., 1996, Dynamics of wet and dry years in West Africa: *Journal of Climate*, **9,** 1030-1042.

Fahrmeir, L. and Tutz, G., 2001, Multivariate Statistical Modelling Based on Generalized Linear Models: Springer-Verlag, New York.

Farmer, G. and Wigley, T. M. L.. Climatic trends for tropical Africa. Research report for the Overseas Development Administration. 136pp. 1985. Climatic Research Unit, University of East Anglia.

Faure, H. and Gac, J. Y., 1981, Will the Sahelian drought end in 1985: *Nature*, **291,** 475-478.

Fink, A. H. and Reiner, A., 2003, Spatiotemporal variability of the relation between African Easterly Waves and West African Squall Lines in 1998 and 1999: *Journal of Geophysical Research-Atmospheres*, **108,** art-4332.

Folland, C. K., Owen, J. A., and Ward, M. N., 1991, Prediction of season rainfall in the Sahel region of Africa using empirical and dynamical methods.: *Journal of Forecasting*, **10,** 21-56.

Folland, C. K., Palmer, T. N., and Parker, D. E., 1986, Sahel rainfall and worldwide sea temperatures, 1901-85: *Nature*, **320,** 602-607.

Fontaine, B. and Janicot, S., 1992, Wind-field coherence and its variations over West Africa: *Journal of Climate*, **5,** 512-524.

Fontaine, B., Janicot, S., and Moron, V., 1995, Rainfall anomaly patterns and wind field signals over West Africa in August (1958-89): *Journal of Climate*, **8,** 1503-1510.

Fontaine, B., Roucou, P., and Trzaska, S., 2003, Atmospheric water cycle and moisture fluxes in the West African monsoon: mean annual cycles and relationship using NCEP/NCAR reanalysis: *Geophysical Research Letters*, **30,** art-1117.

Fontaine, B., Trzaska, S., and Janicot, S., 1998, Evolution of the relationship between near global and Atlantic SST modes and the rainy season in west Africa: statistical analyses and sensitivity experiments: *Climate Dynamics*, **14,** 353-368.

Giannini, A., Saravanan, R., and Chang, P., 2003, Oceanic forcing of Sahel rainfall on interannual to interdecadal time scales: *Science*, **302,** 1027-1030.

Goddard, L., Mason, S. J., Zebiak, S. E., Ropelewski, C. F., Basher, R., and Cane, M. A., 2001, Current approaches to seasonal-to-interannual climate predictions: *International Journal of Climatology*, **21,** 1111-1152.

Gong, C. L. and Eltahir, E., 1996, Sources of moisture for rainfall in West Africa: *Water Resources Research*, **32,** 3115-3121.

Grist, J. P., 2002, Easterly waves over Africa. Part I: The seasonal cycle and contrasts between wet and dry years: *Monthly Weather Review*, **130,** 197-211.

Grist, J. P. and Nicholson, S. E., 2001, A study of the dynamic factors influencing the rainfall variability in the West African Sahel: *Journal of Climate*, **14,** 1337-1359.

Grist, J. P., Nicholson, S. E., and Barcilon, A. I., 2002, Easterly waves over Africa. Part II: Observed and modeled contrasts between wet and dry years: *Monthly Weather Review*, **130,** 212-225.

Hastenrath, S., 1984, Interannual variability and annual cycle - mechanisms of circulation and climate in the Tropical Atlantic sector: *Monthly Weather Review*, **112,** 1097-1107.

Hastenrath, S., 1991, Climate Dynamics of the Tropics: Kluwer Academic, Dordrecht.

Hastenrath, S. and Wolter, K., 1992, Large-scale patterns and long-term trends of circulation variability associated with Sahel rainfall anomalies: *Journal of the Meteorological Society of Japan*, **70,** 1045-1055.

Hulme, M., 2001, Climatic perspectives on Sahelian desiccation: 1973-1998: *Global Environmental Change-Human and Policy Dimensions*, **11,** 19-29.

Hutchinson, M. F., 1998a, Interpolation of Rainfall Data with Thin Plate Smoothing Splines - Part I: Two Dimensional Smoothing of Data with Short Range Correlation: *Journal of Geographic Information and Decision Analysis*, **2,** 139-151.

Hutchinson, M. F., 1998b, Interpolation of Rainfall Data with Thin Plate Smoothing Splines - Part II: Analysis of Topographic Dependence: *Journal of Geographic Information and Decision Analysis*, **2,** 152-167.

Hutchinson, M. F. and Gessler, P. E., 1994, Splines - more than just a smooth interpolator: *Geoderma*, **62,** 45-67.

Janicot, A., 1992a, Spatiotemporal variability of West Africa rainfall. Part I: Regionalizations and typings: *Journal of Climate*, **5,** 489-497.

Janicot, A., 1992b, Spatiotemporal variability of West Africa rainfall. Part II: Associated surface and airmass characteristics: *Journal of Climate*, **5,** 499-511.

Janicot, S., Moron, V., and Fontaine, B., 1996, Sahel droughts and ENSO dynamics: *Geophysical Research Letters*, **23,** 515-518.

Janicot, S. and Sultan, B., 2001, Intra-seasonal modulation of convection in the West African monsoon: *Geophysical Research Letters*, **28,** 523-526.

Janicot, S., Trzaska, S., and Poccard, I., 2001, Summer Sahel-ENSO teleconnection and decadal time scale SST variations: *Climate Dynamics*, **18,** 303-320.

Jeffrey, S. J., Carter, J. O., Moodie, K. B., and Beswick, A. R., 2001, Using spatial interpolation to construct a comprehensive archive of Australian climate data: *Environmental Modelling & Software*, **16,** 309-330.

Jolliffe, I. T., 1987, Rotation of principal components - some comments: *Journal of Climatology*, **7,** 507-510.

Jolliffe, I. T., 1990, Principal Component Analysis: A Beginner's Guide - I. Introduction and application: *Weather*, **45,** 375-383.

Jolliffe, I. T., 1993, Principal Component Analysis: A Beginner's Guide - II. Pitfalls, myths and extensions: *Weather*, **48,** 246-253.

Jolliffe, I. T., 2002, Principal Component Analysis: Springer-Verlag, New York.

Jolliffe, I. T., 2003, A cautionary note on artificial examples of EOFs: *Journal of Climate*, **16,** 1084-1086.

Jolliffe, I. T., Uddin, M., and Vines, S. K., 2002, Simplified EOFs - three alternatives to rotation: *Climate Research*, **20,** 271-279.

Kalnay, E., Kanamitsu, M., Kistler, R., Collins, W., Deaven, D., Gandin, L., Iredell, M., Saha, S., White, G., Woollen, J., Zhu, Y., Chelliah, M., Ebisuzaki, W., Higgins, W., Janowiak, J., Mo, K. C., Ropelewski, C., Wang, J., Leetmaa, A., Reynolds, R., Jenne, R., and Joseph, D., 1996, The NCEP/NCAR 40-year reanalysis project: *Bulletin of the American Meteorological Society*, **77,** 437-471.

Kane, R. P. and Trivedi, N. B., 1986, Are droughts predictable: *Climatic Change*, **8,** 209-223.

Karayampudi, V. M. and Carlson, T. N., 1988, Analysis and numerical simulations of the Saharan air layer and its effects on easterly wave disturbances: *Journal of the Atmospheric Sciences*, **45,** 3102-3136.

Kidson, J. W., 1977, African rainfall and its relation to the upper air circulation: *Quarterly Journal of the Royal Meteorological Society*, **103,** 441-456.

Klink, K. and Willmott, C. J., 1989, Principal components of the surface wind-field in the United States - a comparison of analyses based upon wind velocity, direction, and speed: *International Journal of Climatology*, **9,** 293-308.

Koteswaram, P., 1958, The easterly jet stream in the tropics: *Tellus*, **10,** 43-57.

Kraus, E. B., 1977a, Subtropical drought and cross equatorial energy transports. The seasonal excursion of the ITCZ.: *Monthly Weather Review*, **105,** 1009-1018.

Kraus, E. B., 1977b, The seasonal excursion of the Intertropical Convergence Zone: *Monthly Weather Review*, **105,** 1052-1055.

Lamb, P. J., 1978a, Case studies of tropical Atlantic surface circulation patterns during recent sub-Saharan weather anomalies: 1967 and 1968: *Monthly Weather Review*, **106,** 482-491.

Lamb, P. J., 1978b, Large-scale tropical Atlantic surface circulations patterns associated with sub-Saharan weather anomalies: *Tellus*, **30,** 240-251.

Lamb, P. J., 1983, West-African water-vapor variations between recent contrasting sub-Saharan rainy seasons: *Tellus Series A-Dynamic Meteorology and Oceanography*, **35,** 198-212.

Lamb, P. J. and Peppler, R., 1992, Further case studies of tropical Atlantic surface atmospheric and oceanic patterns associated with sub-Saharan drought: *Journal of Climate*, **5,** 476-488.

Landsea, C. W. and Gray, W. M., 1992, The strong association between western Sahelian monsoon rainfall and intense Atlantic hurricanes: *Journal of Climate*, **5,** 435-453.

Le Barbe, L. and Lebel, T., 1997, Rainfall climatology of the HAPEX-Sahel region during the years 1950-1990: *Journal of Hydrology*, **189,** 43-73.

Le Barbe, L., Lebel, T., and Tapsoba, D., 2002, Rainfall variability in West Africa during the years 1950-90: *Journal of Climate*, **15,** 187-202.

Lebel, T., Diedhiou, A., and Laurent, H., 2003, Seasonal cycle and interannual variability of the Sahelian rainfall at hydrological scales: *Journal of Geophysical Research-Atmospheres*, **108,** art-8389.

Legates, D. R., 1991, The effect of domain shape on principal components analyses: *International Journal of Climatology*, **11,** 135-146.

Legates, D. R., 1993, The effect of domain shape on principal components analyses - a reply: *International Journal of Climatology*, **13,** 219-228.

Lézine, A. M., 1989, Late quaternary vegetation and climate of the Sahel: *Quaternary Research*, **32,** 317-334.

Long, M. D., Entekhabi, D., and Nicholson, S. E., 2000, Interannual variability in rainfall, water vapor flux and vertical motion over Africa: *Journal of Climate*, **13,** 3827-3841.

Lough, J. M., 1986, Tropical Atlantic sea-surface temperatures and rainfall variations in sub-Saharan Africa: *Monthly Weather Review*, **114,** 561-570.

Madden, R. A. and Julian, P. R., 1994, Observations of the 40-50-day tropical oscillation - a review: *Monthly Weather Review* , **122,** 814-837.

Matthews, A. J., 2004, Intraseasonal variability over tropical Africa during northern summer: *Journal of Climate*, **17,** 2427-2440.

McCullagh, P. and Nelder, J. A., 1989, Generalized Linear Models: Chapman & Hall, London.

Mestas-Nunez, A. M., 2000, Orthogonality properties of rotated empirical modes: *International Journal of Climatology*, **20,** 1509-1516.

Moron, V., 1994, Guinean and Sahelian rainfall anomaly indices at annual and monthy time scales (1933-1990): *International Journal of Climatology*, **14,** 325-341.

Moron, V., Philippon, N., and Fontaine, B., 2003, Skill of Sahel rainfall variability in four atmospheric GCMs forced by prescribed SST: *Geophysical Research Letters*, **30,** art-2221.

Mounier, F. and Janicot, S., 2004, Evidence of two independent modes of convection at intraseasonal timescale in the West African summer monsoon: *Geophysical Research Letters*, **31,** art-L16116.

New, M., Hulme, M., and Jones, P., 1999, Representing twentieth-century space-time climate variability. Part I: Development of a 1961-90 mean monthly terrestrial climatology: *Journal of Climate*, **12,** 829-856.

Newell, R. E. and Kidson, J. W., 1984, African mean wind changes between Sahelian wet and dry periods: *Journal of Climatology*, **4,** 27-33.

Nicholson, S. E., 1980, The nature of rainfall fluctuations in subtropical West Africa: *Monthly Weather Review*, **108,** 473-487.

Nicholson, S. E., 1981, Rainfall and atmospheric circulation during drought periods and wetter years in West Africa: *Monthly Weather Review*, **109,** 2191-2208.

Nicholson, S. E., 1986, The spatial coherence of African rainfall anomalies: Interhemispheric teleconnections: *Journal of Climate and Applied Meteorology*, **25,** 1365-1381.

Nicholson, S. E., 1988, Land surface atmosphere interaction - physical processes and surface changes and their impact: *Progress in Physical Geography*, **12,** 36-65.

Nicholson, S. E., 1994, Recent rainfall fluctuations in Africa and their relationship to past conditions over the continent: *Holocene*, **4,** 121-131.

Nicholson, S. E., 1995, Variability of African rainfall on interannual and decadal time scales *in* Natural Climate Variability on Decade-to-Century Time Scales: Climate Research Committee SE, Ed., National Academy Press, Washington, DC.

Nicholson, S. E., 2001, Climatic and environmental change in Africa during the last two centuries: *Climate Research*, **17,** 123-144.

Nicholson, S. E. and Grist, J. P., 2001, A conceptual model for understanding rainfall variability in the West African Sahel on interannual and interdecadal timescales: *International Journal of Climatology*, **21,** 1733-1757.

Nicholson, S. E. and Palao, I. M., 1993, A re-evaluation of rainfall variability in the Sahel. Part I. Characteristics of rainfall fluctuations: *International Journal of Climatology*, **13,** 371-389.

Nicholson, S. E., Some, B., and Kone, B., 2000, An analysis of recent rainfall conditions in West Africa, including the rainy seasons of the 1997 El Nino and the 1998 La Nina years: *Journal of Climate*, **13,** 2628-2640.

Nicholson, S. E., Tucker, C. J., and Ba, M. B., 1998, Desertification, drought, and surface vegetation: An example from the West African Sahel: *Bulletin of the American Meteorological Society*, **79,** 815-829.

North, G. R., Bell, T. L., Cahalan, R. F., and Moeng, F. J., 1982, Sampling errors in the estimation of empirical orthogonal functions: *Monthly Weather Review*, **110,** 699-706.

Norton, C. C., Mosher, F. R., and Hinton, B., 1979, Investigation of surface albedo variations during the recent Sahel drought: *Journal of Applied Meteorology*, **18,** 1252-1262.

Oort, A. H.. Global atmospheric circulation statistics, 1958-73. 1-180. 1983. Geophysical Fluid Dynamics Laboratory. NOAA Professional Paper 14.

Palmer, T. N., 1986, The influence of the Atlantic, Pacific and Indian Oceans on Sahel rainfall: *Nature*, **322,** 251-253.

Palmer, T. N., Brankovic, C., Viterbo, P., and Miller, M. J., 1992, Modeling interannual variations of summer monsoons: *Journal of Climate*, **5,** 399-417.

Payne, S. W. and McGarry, M. M., 1977, The relationship of satellite inferred convective activity to easterly waves over west Africa and the adjacent ocean during phase III of GATE: *Monthly Weather Review*, **105,** 413-420.

Peterson, T. C., Easterling, D. R., Karl, T. R., Groisman, P., Nicholls, N., Plummer, N., Torok, S., Auer, I., Boehm, R., Gullett, D., Vincent, L., Heino, R., Tuomenvirta, H., Mestre, O., Szentimrey, T., Salinger, J., Forland, E. J., Hanssen-Bauer, I., Alexandersson, H., Jones, P., and Parker, D., 1998, Homogeneity adjustments of in situ atmospheric climate data: A review: *International Journal of Climatology*, **18,** 1493-1517.

Poccard, I., Janicot, S., and Camberlin, P., 2000, Comparison of rainfall structures between NCEP/NCAR reanalyses and observed data over tropical Africa: *Climate Dynamics*, **16,** 897-915.

Pravdova, V., Boucon, C., de Jong, S., Walczak, B., and Massart, D. L., 2002, Three-way principal component analysis applied to food analysis: an example: *Analytica Chimica Acta*, **462,** 133-148.

Pravdova, V., Walczak, B., Massart, D. L., Robberecht, H., Van Cauwenbergh, R., Hendrix, P., and Deelstra, H., 2001, Three-way principal component analysis for the visualization of trace elemental patterns in vegetables after different cooking procedures: *Journal of Food Composition and Analysis*, **14,** 207-225.

Preisendorfer, R. W., 1988, Principal Component Analysis in Meteorology and Oceanography: Elsevier, Amsterdam.

Pytharoulis, I. and Thorncroft, C., 1999, The low-level structure of African easterly waves in 1995: *Monthly Weather Review*, **127,** 2266-2280.

Raicich, F., Pinardi, N., and Navarra, A., 2003, Teleconnections between Indian monsoon and Sahel rainfall and the Mediterranean: *International Journal of Climatology*, **23,** 173-186.

Reed, R. J., Hollingsworth, A., Heckley, W. A., and Delsol, F., 1988a, An evaluation of the performance of the ECMWF operational system in analyzing and forecasting easterly wave disturbances over Africa and the Tropical Atlantic: *Monthly Weather Review*, **116,** 824-865.

Reed, R. J., Klinker, E., and Hollingsworth, A., 1988b, The structure and characteristics of African easterly wave disturbances as determined from the ECMWF operational analysis forecast system: *Meteorology and Atmospheric Physics*, **38,** 22-33.

Reed, R. J., Nordquist, D. C., and Recker, E. E., 1977, The structure and properties of African wave disturbances as observed during phase III of GATE: *Monthly Weather Review*, **105,** 317-333.

Richman, M. B., 1986, Rotation of principal components: *Journal of Climatology*, **6,** 293-335.

Richman, M. B., 1987, Rotation of principal components - a reply: *Journal of Climatology*, **7,** 511-520.

Richman, M. B., 1993, Comments on - the effect of domain shape on principal components analyses: *International Journal of Climatology*, **13,** 203-218.

Ropelewski, C. F. and Halpert, M. S., 1987, Global and regional scale precipitation patterns associated with the El-Nino southern oscillation: *Monthly Weather Review*, **115,** 1606-1626.

Roux, F., 1988, The West-African squall line observed on 23 June 1981 during COPT-81 - Kinematics and thermodynamics of the convective region: *Journal of the Atmospheric Sciences*, **45,** 406-426.

Rowell, D. P., 2001, Teleconnections between the tropical Pacific and the Sahel: *Quarterly Journal of the Royal Meteorological Society*, **127,** 1683-1706.

Rowell, D. P., 2003, The impact of Mediterranean SSTs on the Sahelian rainfall season: *Journal of Climate*, **16,** 849-862.

Rowell, D. P., Folland, C. K., Maskell, K., and Ward, N., 1995, Variability of summer rainfall over tropical North Africa (1906-92): Observations and modelling: *Quarterly Journal of the Royal Meteorological Society*, **121,** 669-704.

Rowell, D. P. and Milford, J. R., 1993, On the generation of African squall lines: *Journal of Climate*, **6,** 1181-1193.

Semazzi, F. H. M., Burns, B., Lin, N., and Schemm, J., 1996, A GCM study of the teleconnections between the continental climate of Africa and global sea surface temperature anomalies: *Journal of Climate*, **9,** 2480-2497.

Semazzi, F. H. M., Mehta, V., and Sud, Y. C., 1988, An investigation of the relationship between sub-Saharan rainfall and global sea surface temperatures: *Atmosphere-Ocean*, **26,** 118-138.

Semazzi, F. H. M. and Sun, L. Q., 1997, The role of orography in determining the Sahelian climate: *International Journal of Climatology*, **17,** 581-596.

Servain, J., 1991, Simple climatic indexes for the Tropical Atlantic Ocean and some applications: *Journal of Geophysical Research-Oceans*, **96,** 15137-15146.

Shukla, J., 1995, On the Initiation and Persistence of the Sahel Drought *in* Natural Climate Variability on Decade-to-Century Time Scales: Climate Research Committee SE, Ed., National Academy Press, Washington, DC.

Smith, G. L., Rutan, D., Charlock, T. P., and Bess, T. D., 1990, annual and interannual variations of absorbed solar-radiation based on a 10-year data set: *Journal of Geophysical Research-Atmospheres*, **95,** 16639-16652.

Stern, R. D. and Coe, R., 1984, A model-fitting analysis of daily rainfall data: *Journal of the Royal Statistical Society Series A-Statistics in Society*, **147,** 1-34.

Sultan, B. and Janicot, S., 2000, Abrupt shift of the ITCZ over West Africa and intra-seasonal variability: *Geophysical Research Letters*, **27,** 3353-3356.

Sultan, B. and Janicot, S., 2003, The West African monsoon dynamics. Part II: The "preonset" and "onset" of the summer monsoon: *Journal of Climate*, **16,** 3407-3427.

Sultan, B., Janicot, S., and Diedhiou, A., 2003, The West African monsoon dynamics. Part I: Documentation of intraseasonal variability: *Journal of Climate*, **16,** 3389-3406.

Tabachnick, B. G. and Fidell, L. S., 2001, Using Multivariate Statistics: Allyn & Bacon, Needham Heights, MA, USA.

Taleb, E. H. and Druyan, L. M., 2003, Relationships between rainfall and West African wave disturbances in station observations: *International Journal of Climatology*, **23,** 305-313.

Tarhule, A. and Lamb, P. J., 2003, Climate research and seasonal forecasting for West Africans - Perceptions, dissemination, and use?: *Bulletin of the American Meteorological Society*, **84,** 1741-+.

Tarhule, A. and Tarhule-Lips, R. F. A., 2001, Discontinuities in precipitation series in the West African Sahel: *Physical Geography*, **22,** 430-448.

Taylor, C. M., Lambin, E. F., Stephenne, N., Harding, R. J., and Essery, R. L. H., 2002, The influence of land use change on climate in the Sahel: *Journal of Climate*, **15,** 3615-3629.

Tegen, I. and Fung, I., 1994, Modeling of mineral dust in the atmosphere - sources, transport, and optical-thickness: *Journal of Geophysical Research-Atmospheres*, **99,** 22897-22914.

Tegen, I. and Fung, I., 1995, Contribution to the atmospheric mineral aerosol load from land- surface modification: *Journal of Geophysical Research-Atmospheres*, **100,** 18707-18726.

Tegen, I., Lacis, A. A., and Fung, I., 1996, The influence on climate forcing of mineral aerosols from disturbed soils: *Nature*, **380,** 419-422.

Thorncroft, C. and Hodges, K., 2001, African easterly wave variability and its relationship to Atlantic tropical cyclone activity: *Journal of Climate*, **14,** 1166-1179.

UNCOD, 1977, Desertification: Its causes and consequences. United Nations Conference on Desertification, Pergamon Press, Oxford, United Kingdom.

UNCTAD, 2004, The Least Developed Countries Report, 2004: Linking International Trade with Poverty Reduction, United Nations Publications.

USAID, 2000, FEWS Sahel 1999/2000 Current Vulnerability Assessment. U.S.Agency for International Development, Washington, DC, USA.

von Storch, H. and Zwiers, F. W., 1999, Statistical Analysis in Climate Research: Cambridge University Press, Cambridge, United Kingdom.

Wang, G. L., Eltahir, E. A. B., Foley, J. A., Pollard, D., and Levis, S., 2004, Decadal variability of rainfall in the Sahel: results from the coupled GENESIS-IBIS atmosphere-biosphere model: *Climate Dynamics*, **22,** 625-637.

Ward, M. N., 1998, Diagnosis and short-lead time prediction of summer rainfall in tropical North Africa at interannual and multidecadal timescales: *Journal of Climate*, **11,** 3167-3191.

Wickens, G. E., 1997, Has the Sahel a future? *Journal of Arid Environments*, **37**, 649-663.

Winstanley, D., 1973, Rainfall patterns and the general atmospheric circulation: *Nature*, **245,** 190-194.

Xue, Y. K. and Shukla, J., 1993, The influence of land-surface properties on Sahel climate: 1. Desertification: *Journal of Climate*, **6,** 2232-2245.

Yan, Z. W., Bate, S., Chandler, R. E., Isham, V., and Wheater, H., 2002, An analysis of daily maximum wind speed in northwestern Europe using generalized linear models: *Journal of Climate*, **15,** 2073-2088.

Zeng, N., 2003, Drought in the Sahel: *Science*, **302,** 999-1000.

Zheng, X. Y. and Eltahir, E. A. B., 1998, The role of vegetation in the dynamics of West African monsoons: *Journal of Climate*, **11,** 2078-2096.

Zheng, X. Y., Eltahir, E. A. B., and Emanuel, K. A., 1999, A mechanism relating tropical Atlantic spring sea surface temperature and west African rainfall: *Quarterly Journal of the Royal Meteorological Society*, **125,** 1129-1163.