AMMA Conference

28 November-2 December, 2005
Dakar, Senegal

Multiyear Streamflow and Rainfall In the Ankobra River, Ghana 1961-2003

Michael M. Tanu, Karen I. Mohr, and Anantha R. Aiyyer
Department of Earth and Atmospheric Sciences
University at Albany, SUNY
Albany, NY

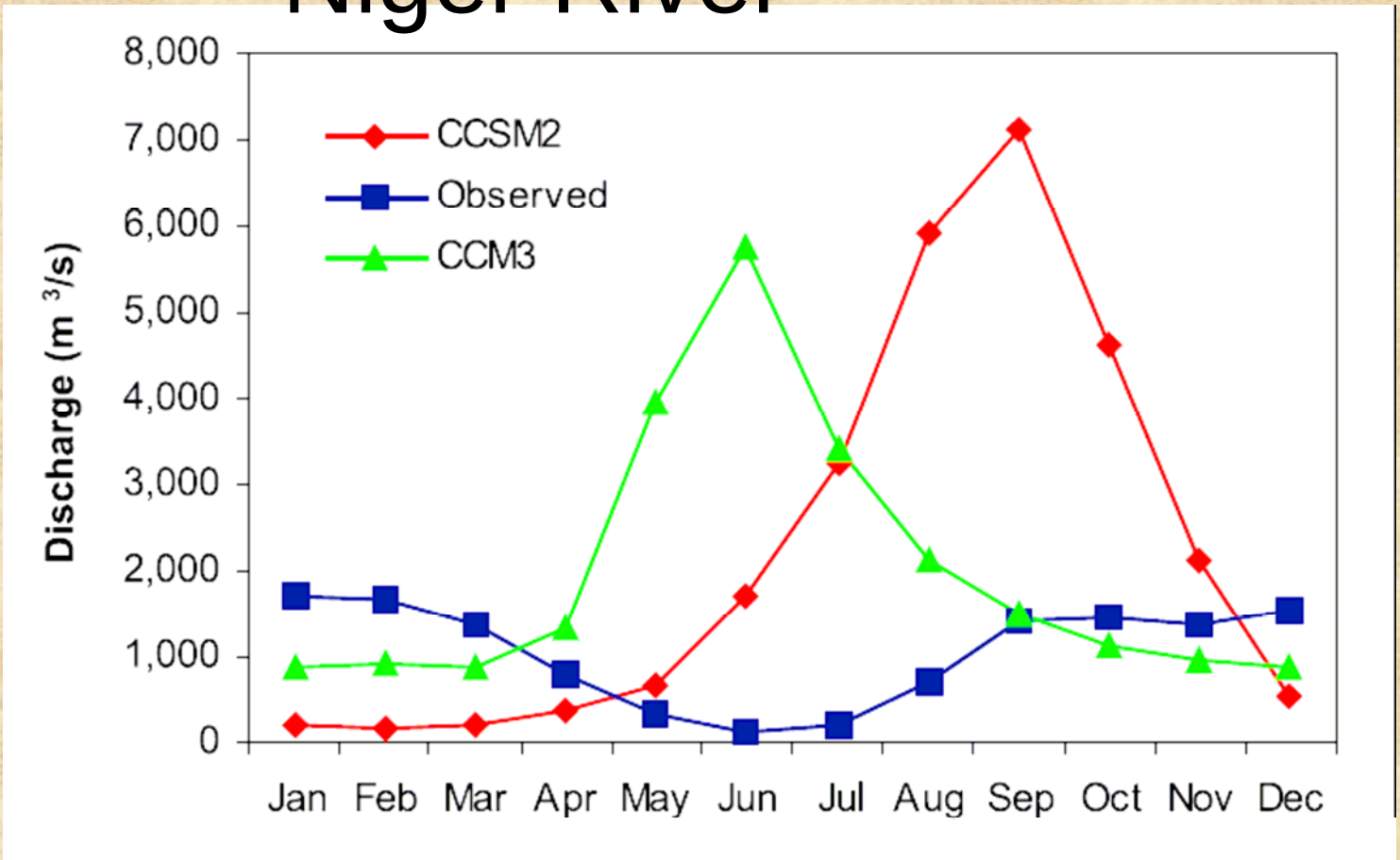
Support for Study: National Science Foundation
Acknowledgement: Thanks to Ademe Mekonnen for helping in discussion

Study Motivation

- Continental runoff to the oceans is a critical component of the global climate system. (e.g., Webster 1994; Branstetter and Erickson 2003).
- Branstetter and Erickson (2003) evaluated the model-simulated freshwater discharge from 19 large rivers.
  - Model performance for African rivers, both timing and magnitude, was particularly poor.
- Analysis of trends in hydroclimatological variables such as streamflow and precipitation have been found to be an effective way to investigate regional climate variability.
  - Improving prediction of regional climate requires a better understanding of the rainfall-runoff relationship.

Monthly mean discharge from the Niger River

Graph from Branstetter and Erickson (2003)

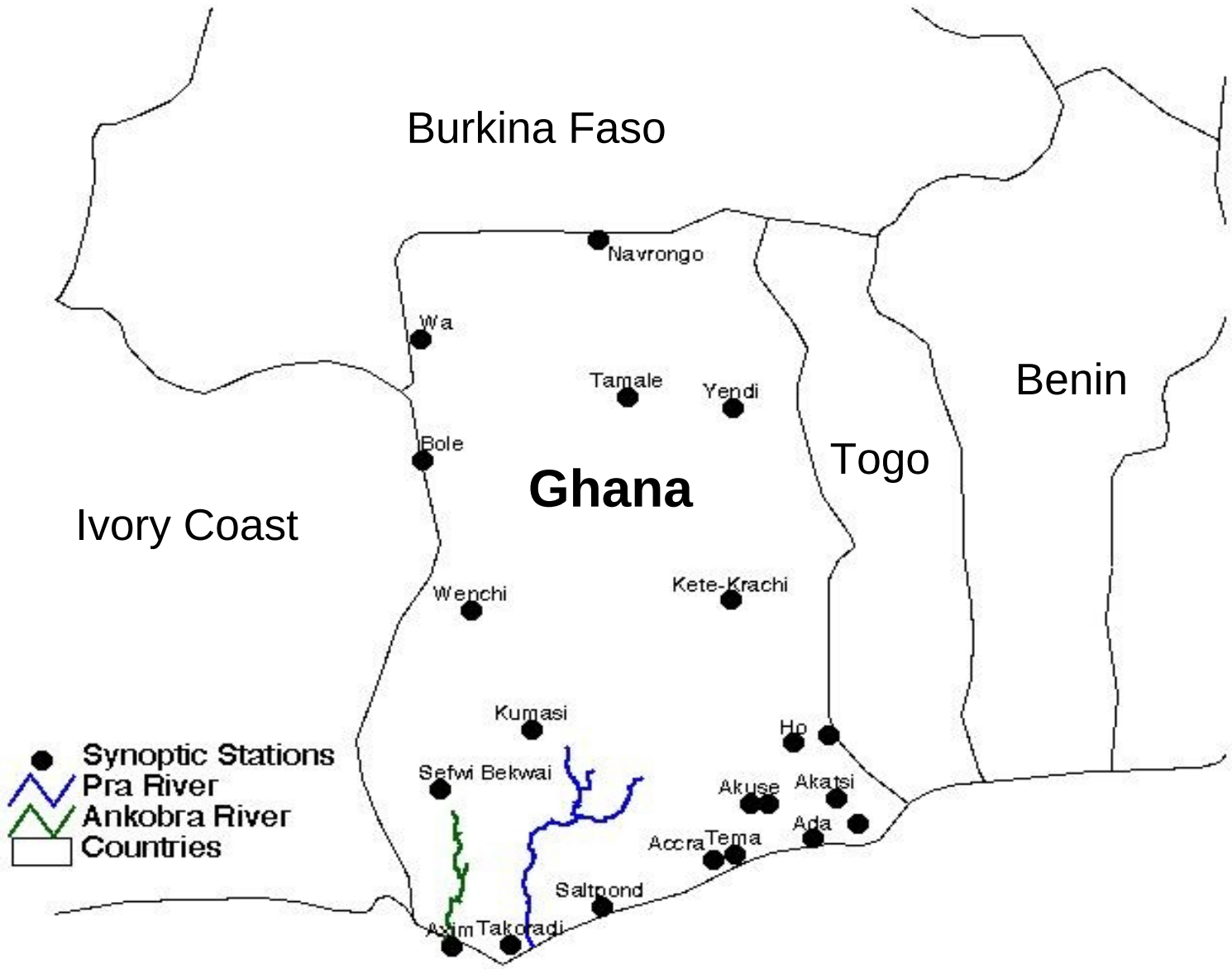


CCSM2 – Community Climate System Model, version 2 (newer)
CCSM3 – Community Climate System Model, version 3 (older)
Observations from Vörösmarty et al. (1998)

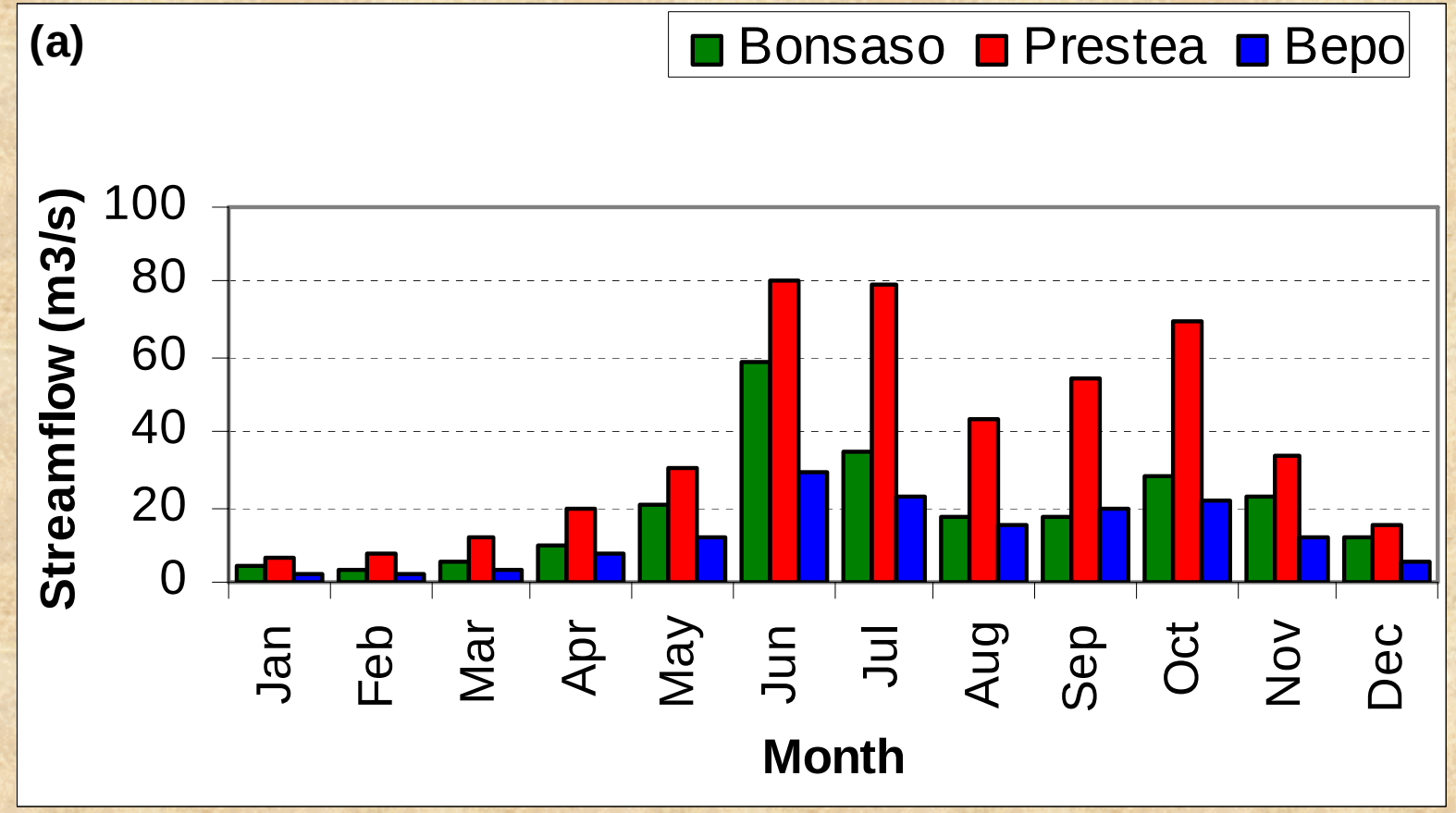
Data and Analysis

- Daily streamflow values for the Ankobra River, Ghana and rainfall for synoptic stations in Ghana were converted to monthly values.
- The Mann-Kendall trend test (e.g., Molnar and Ramirez 2000) was used to evaluate monthly and yearly trends.
- The Kendall-Thiel Robust Line was computed for areas showing a decreasing trend in rainfall.

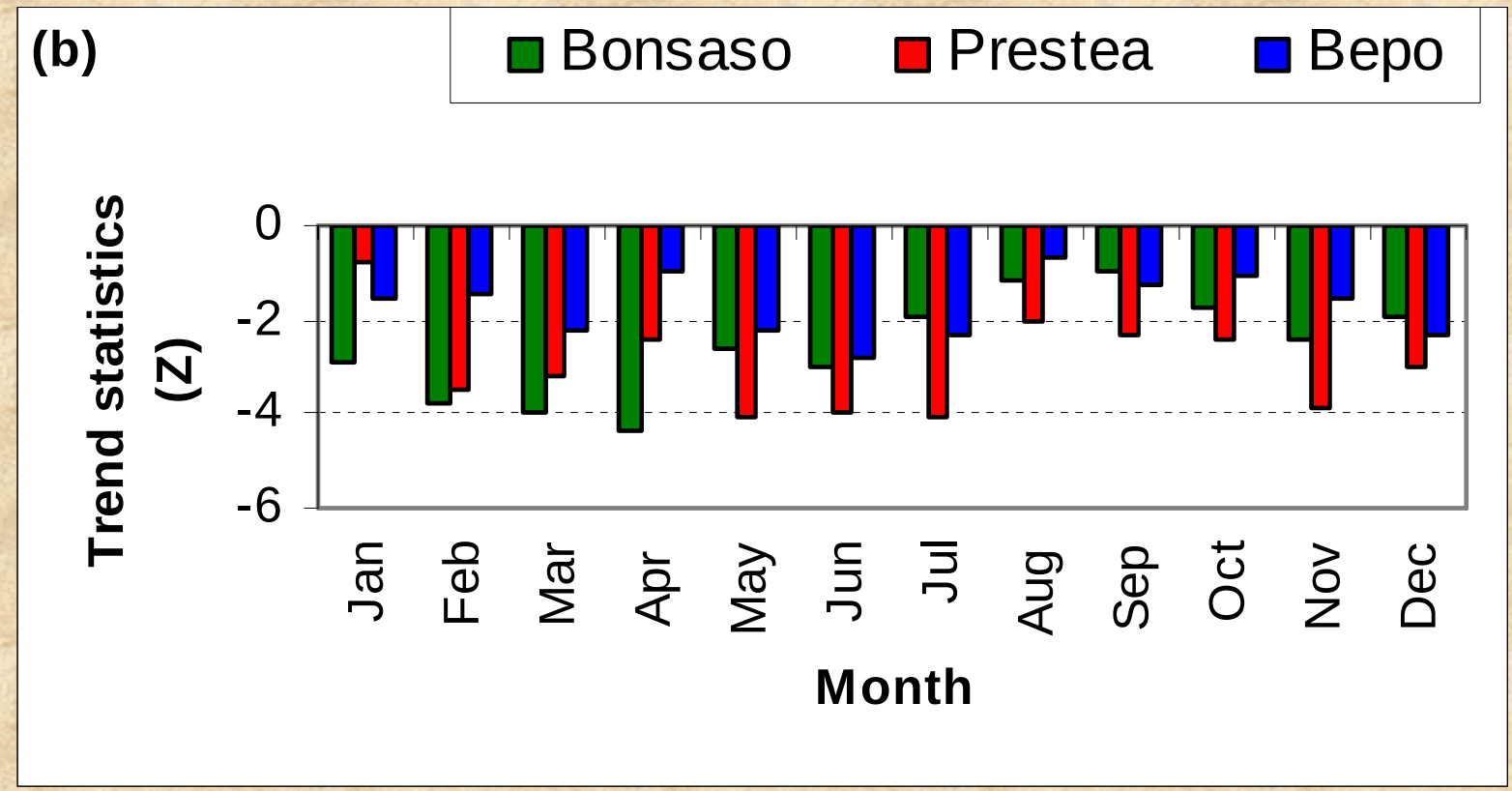
Map of Study Area



Streamflow for three Ankobra sites (1961-2003)



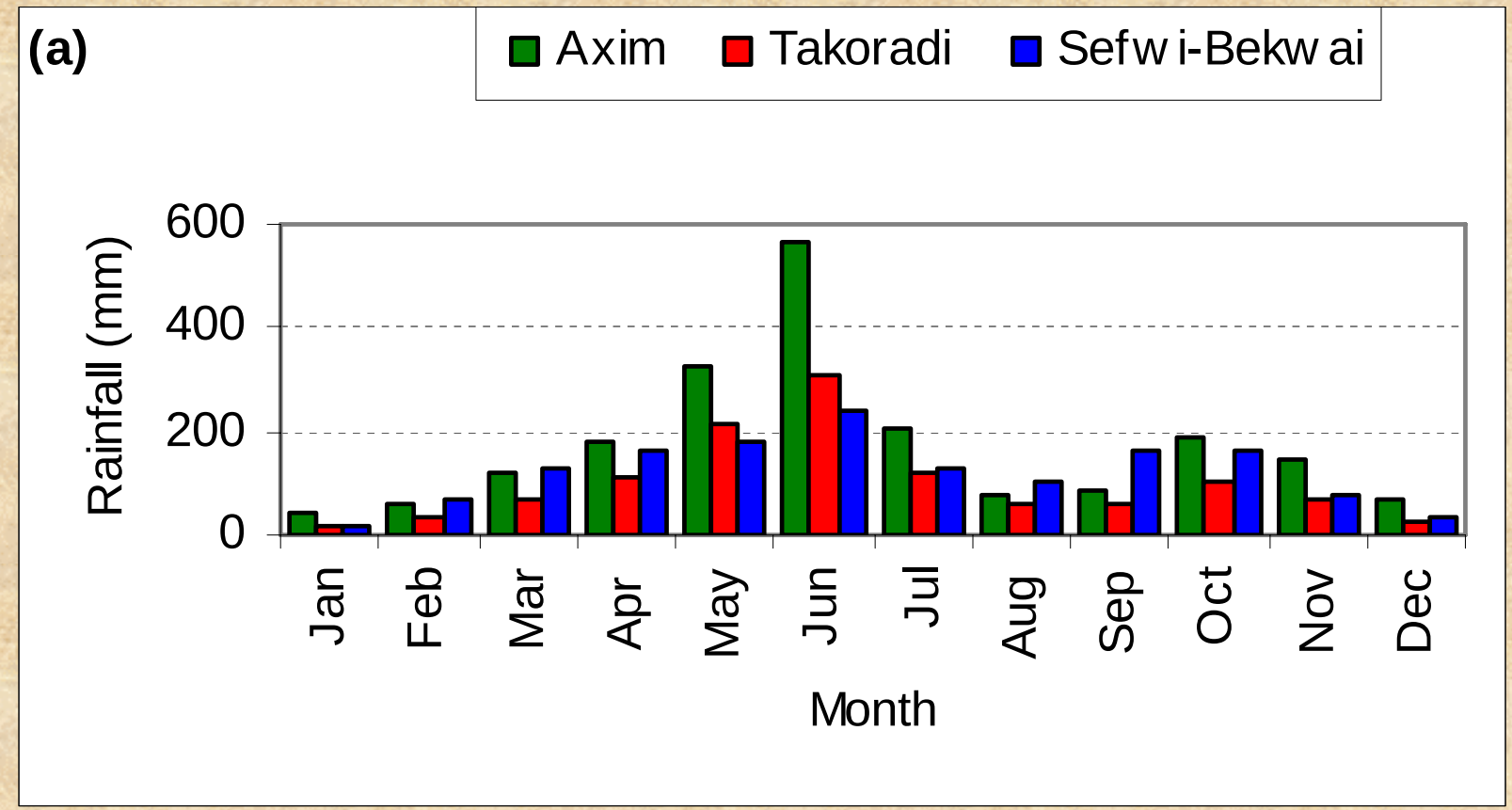
Trend statistics (Z) for streamflow for the three Ankobra sites



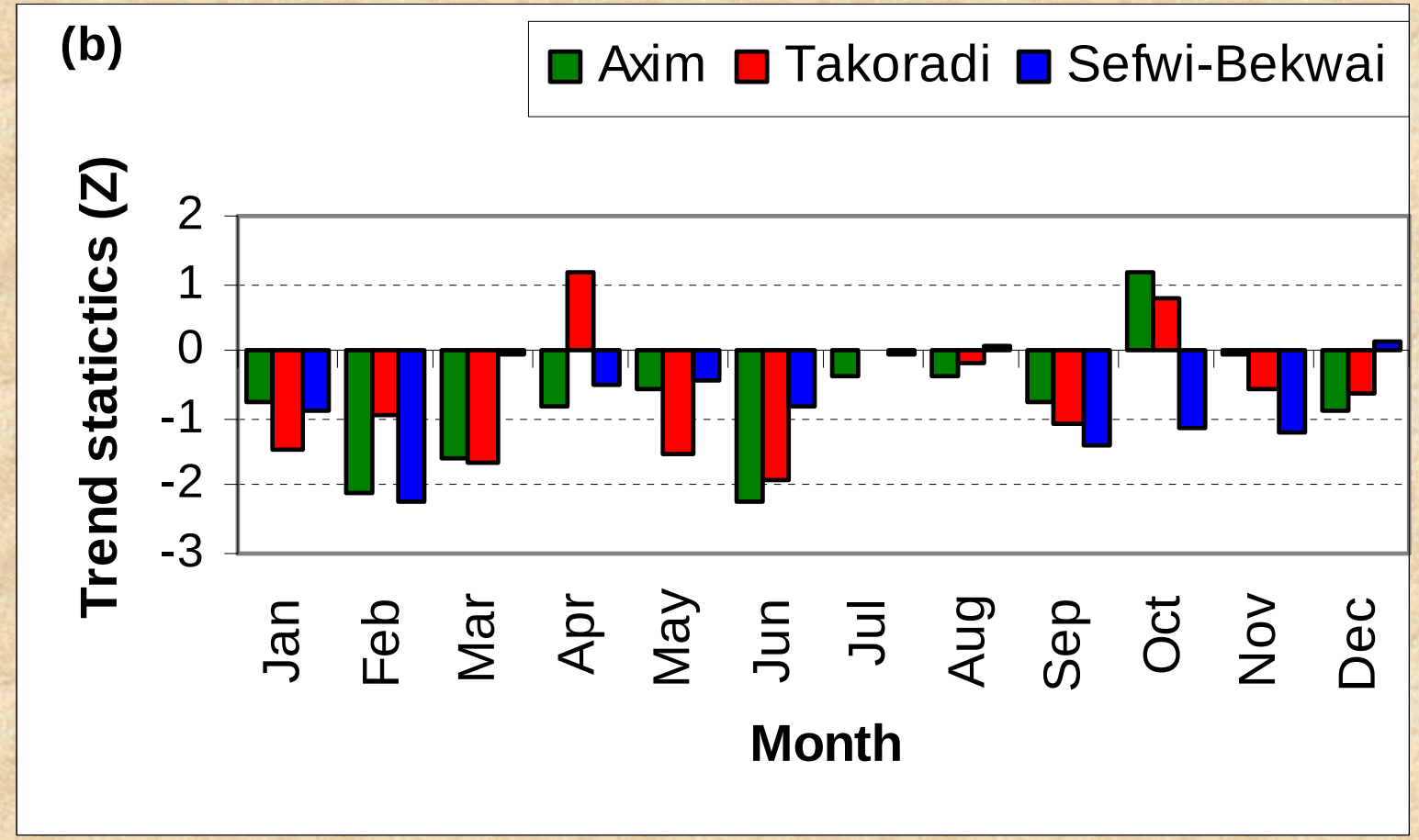
Significant at 95% confidence level, $|Z| > 1.96$

RAINFALL ANALYSIS
1961-2003

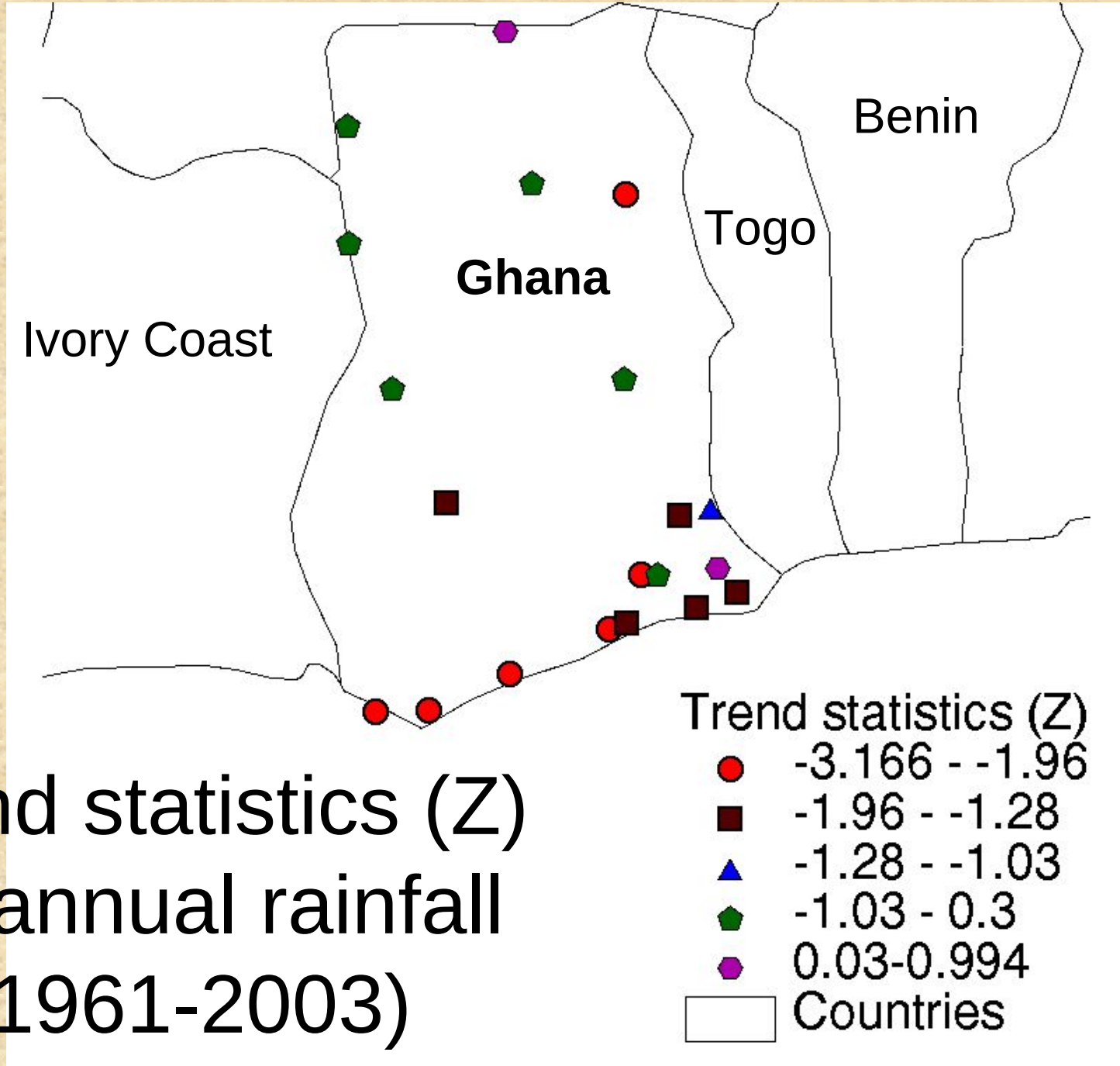
Rainfall closest to the Ankobra streamflow sites (1961-2003)



Trend statistics (Z) for the rainfall sites

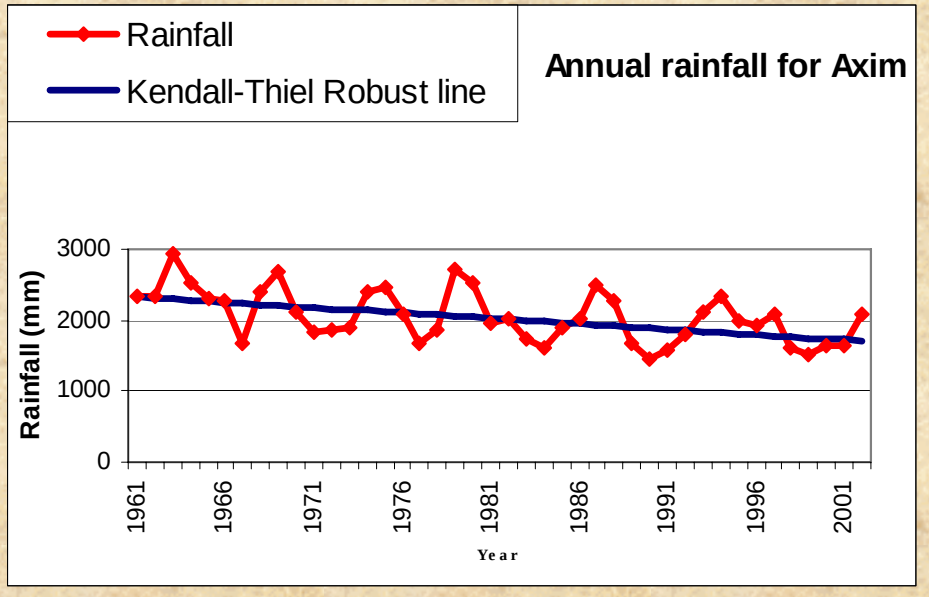


Significant at 95% confidence level, $|Z| > 1.96$

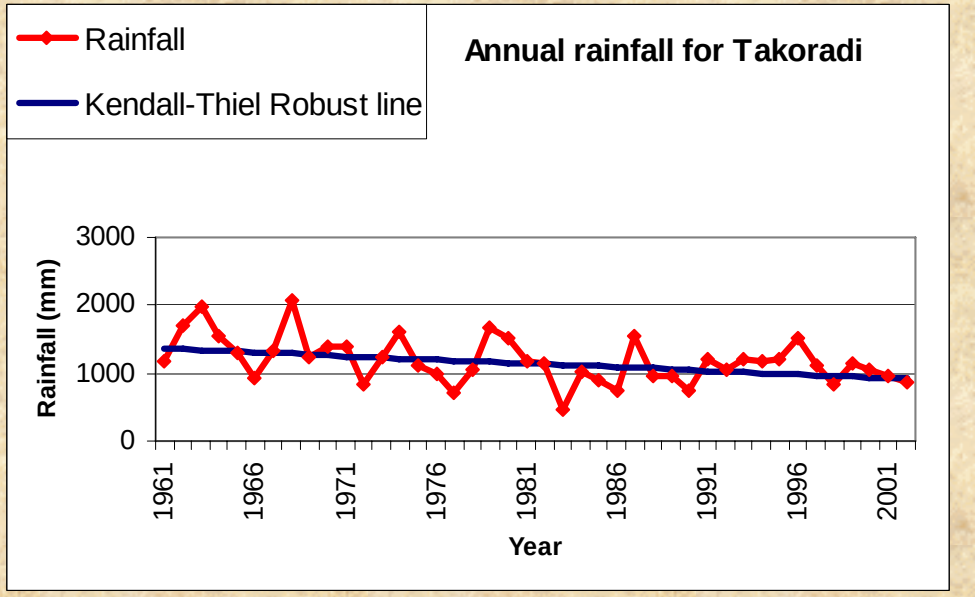


Trend statistics (Z) for annual rainfall (1961-2003)

Trends for Takoradi and Axim rainfall

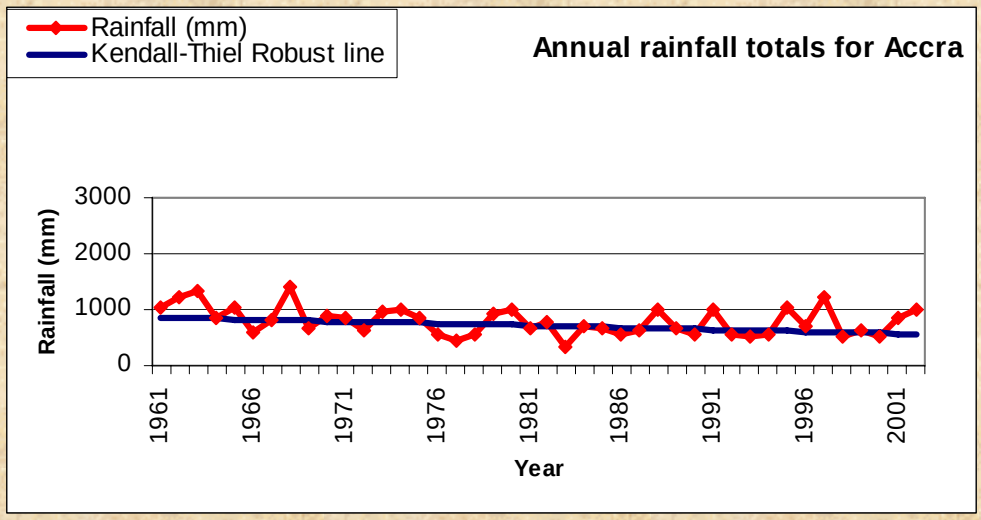


T= -15.2 mm/yr

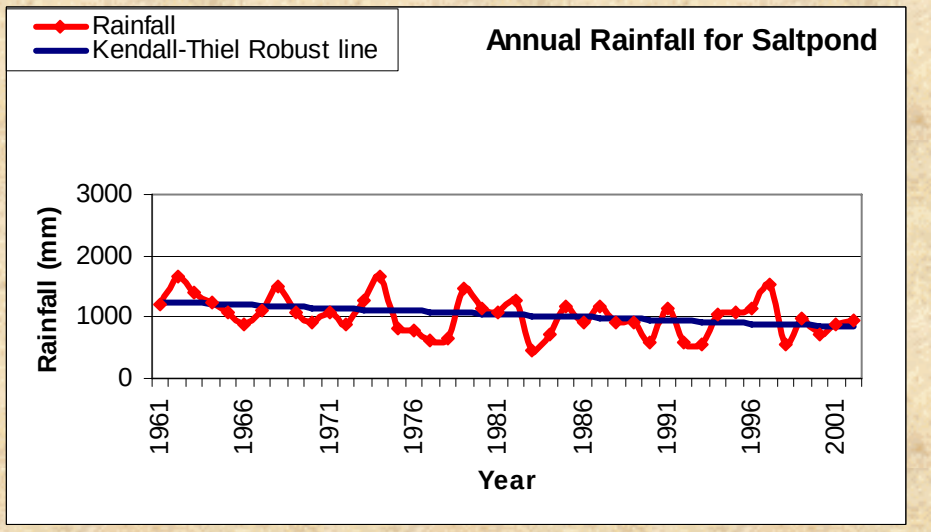


T= -10.8 mm/yr

Trends for Accra and Saltpond rainfall

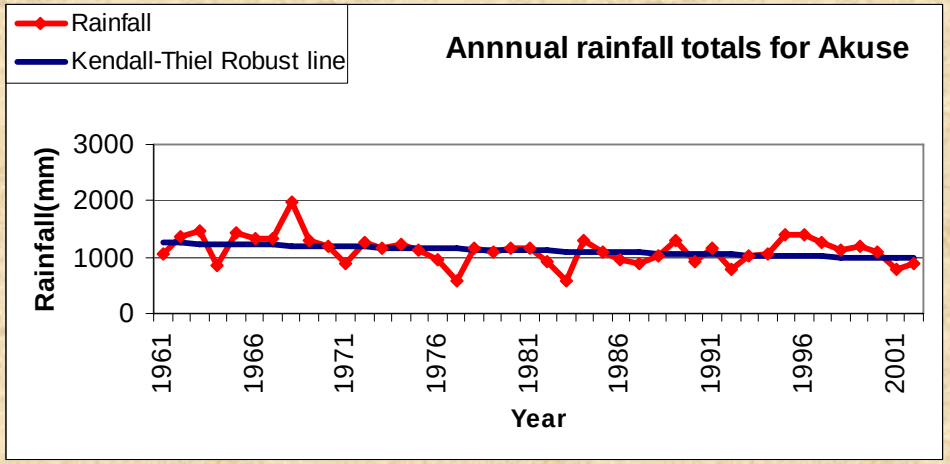


T = - 7.2 mm/yr

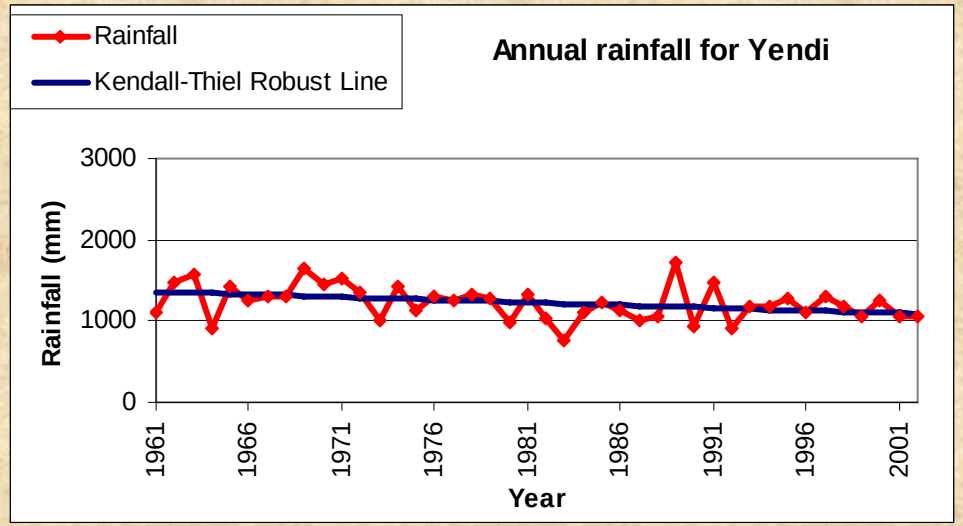


T = - 9.9 mm/yr

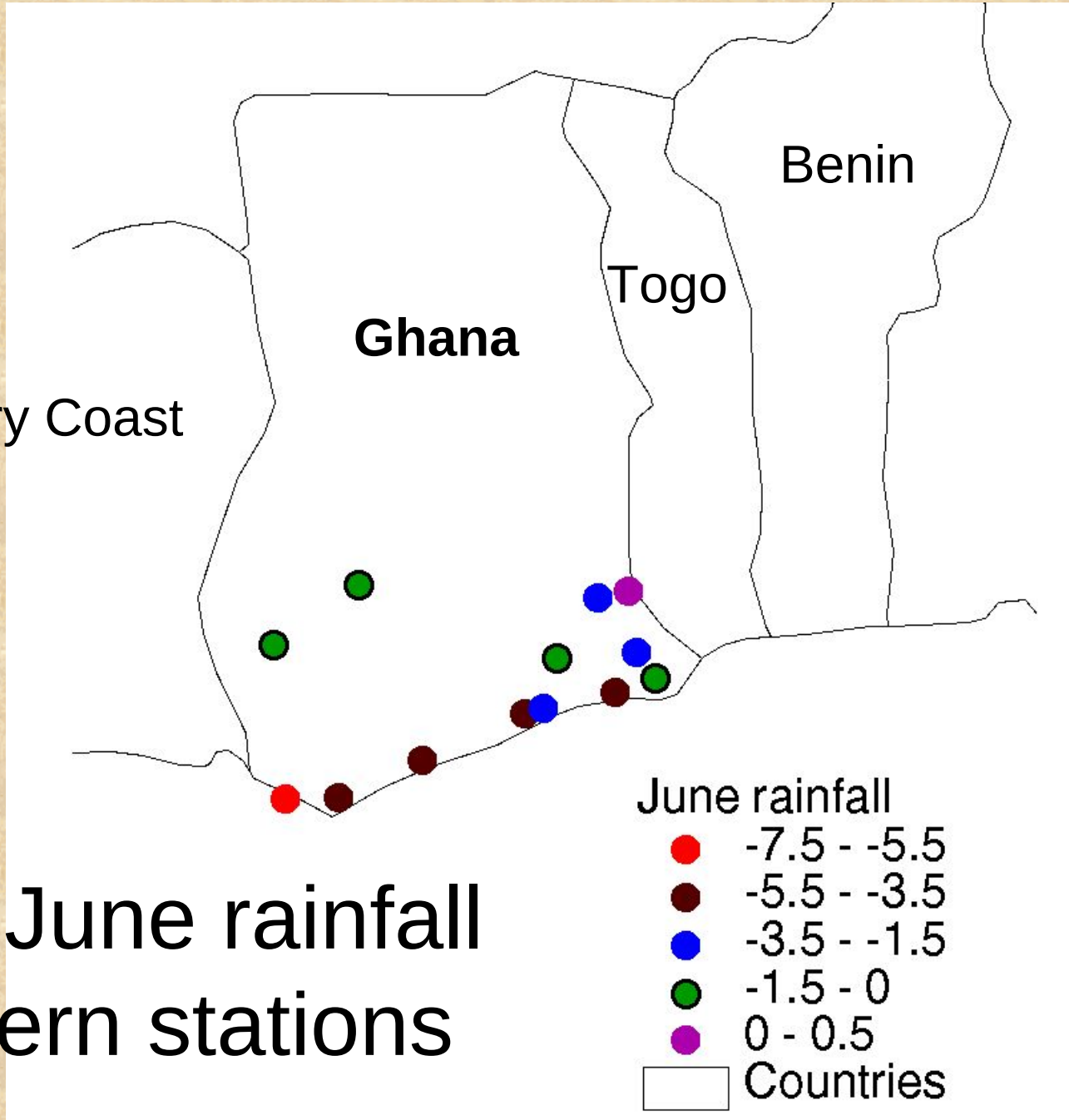
Trends for Akuse and Yendi rainfall



T = -6.8mm/yr



T = -6.7mm/yr

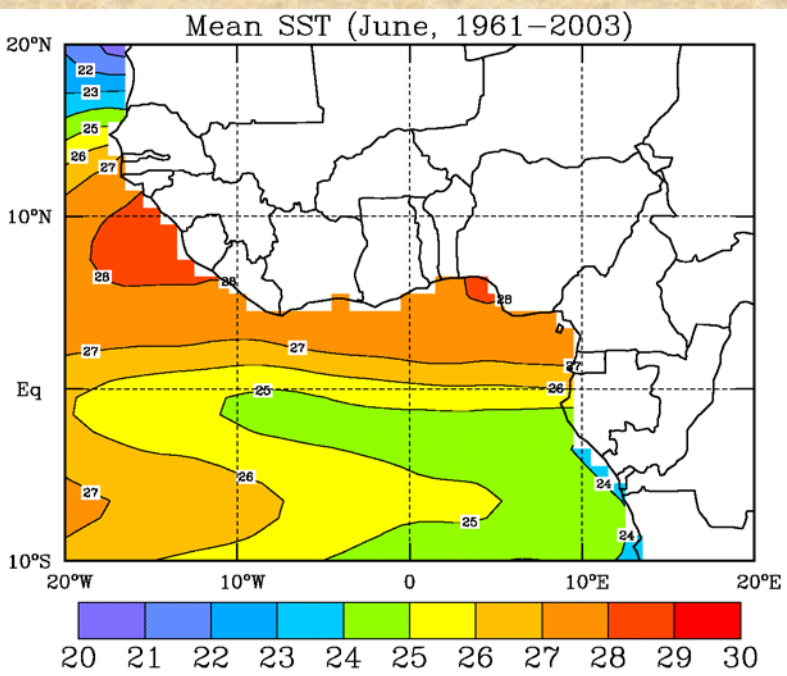


Trend for June rainfall for southern stations

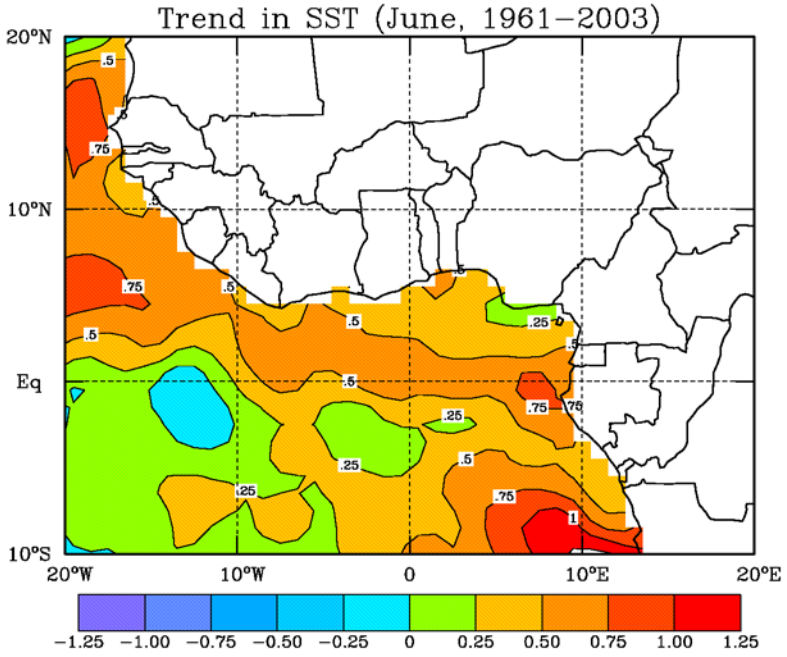
LARGE SCALE SYSTEMS

SST and Meridional winds

(1961-2003)

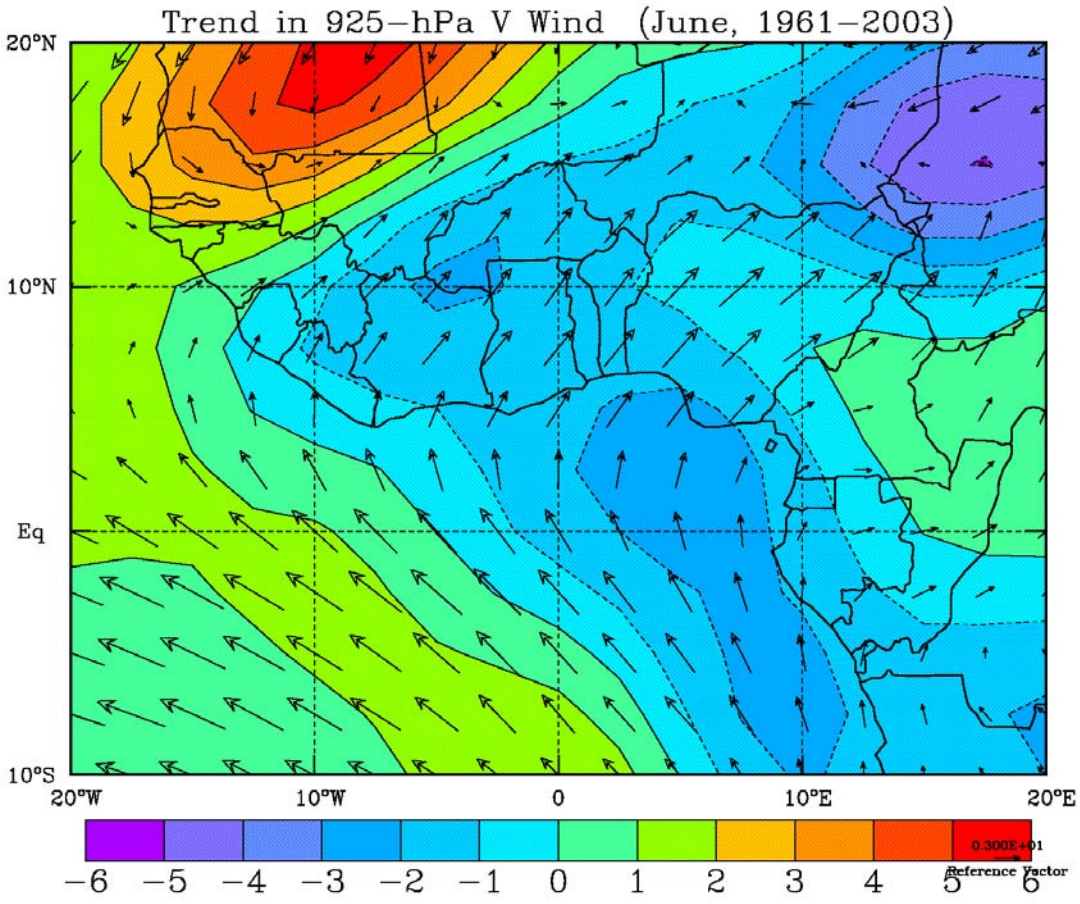


Mean SST



Trend

Mean Vector wind and trend in the Meridional wind

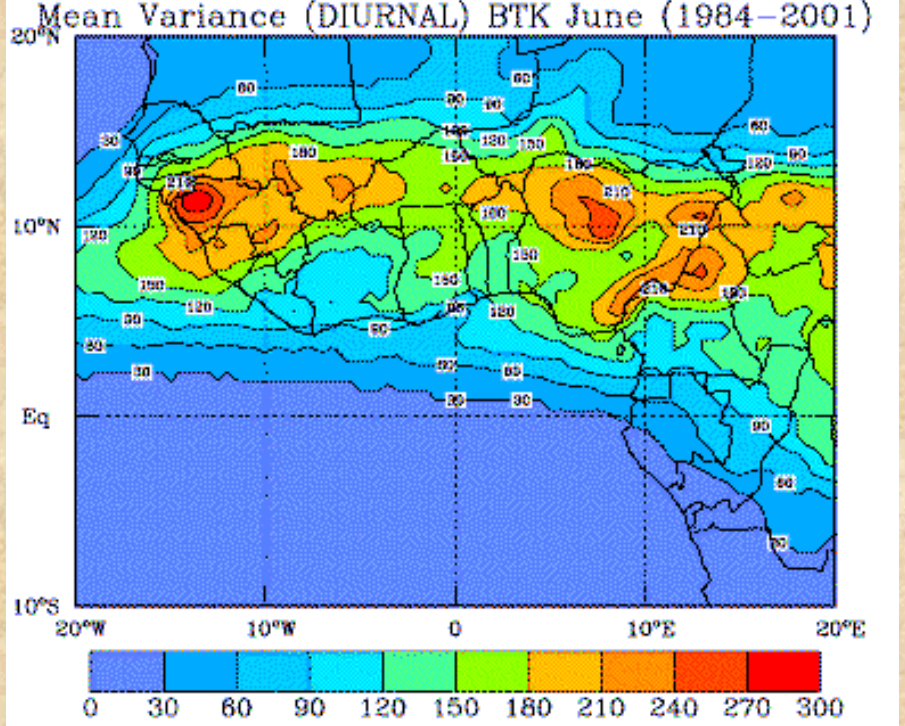


CONVECTION

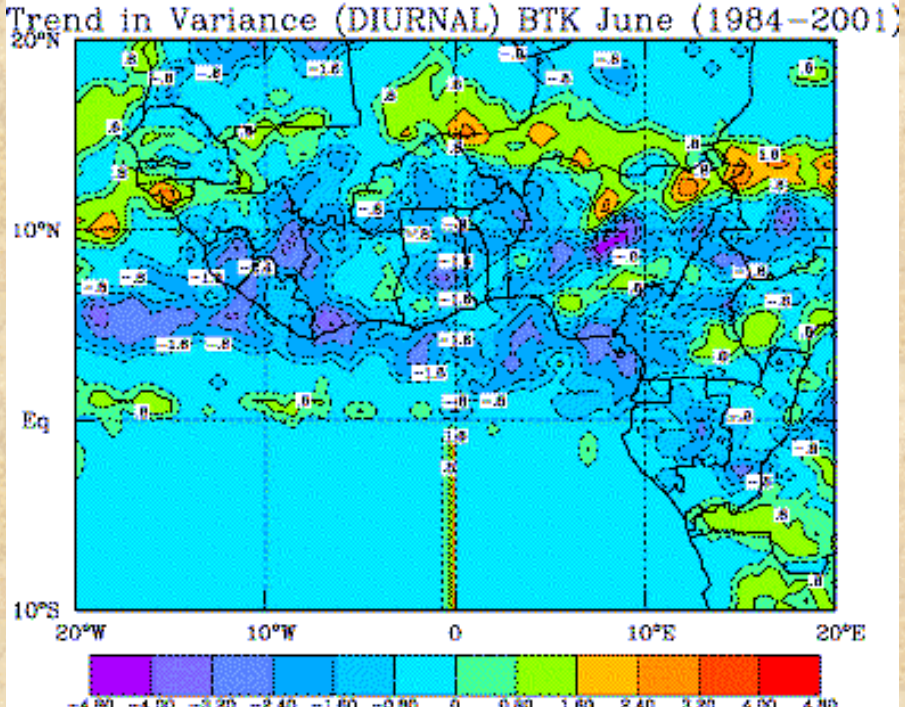
CLOUD TOP BRIGHTNESS TEMPERATURE

Diurnal and synoptic scale

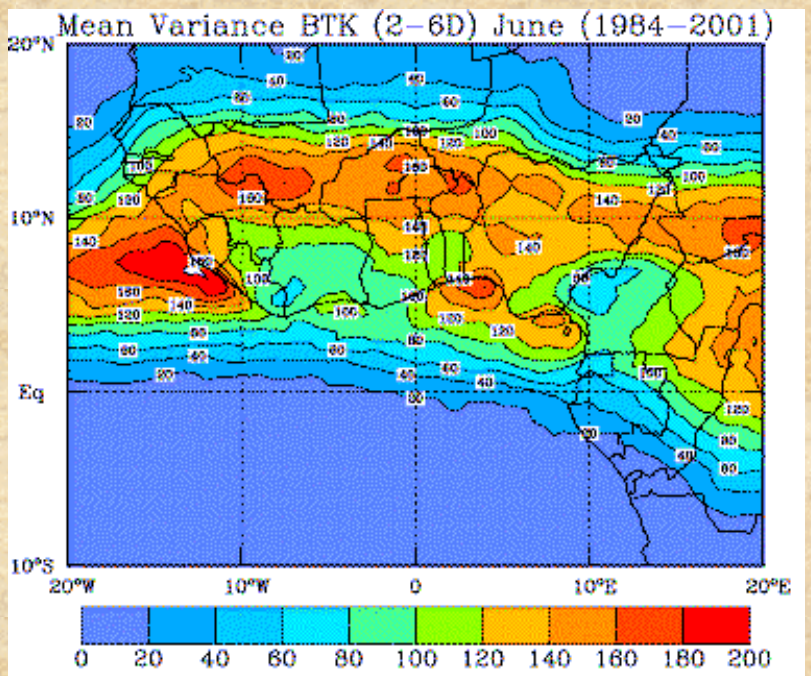
(1984-2001)



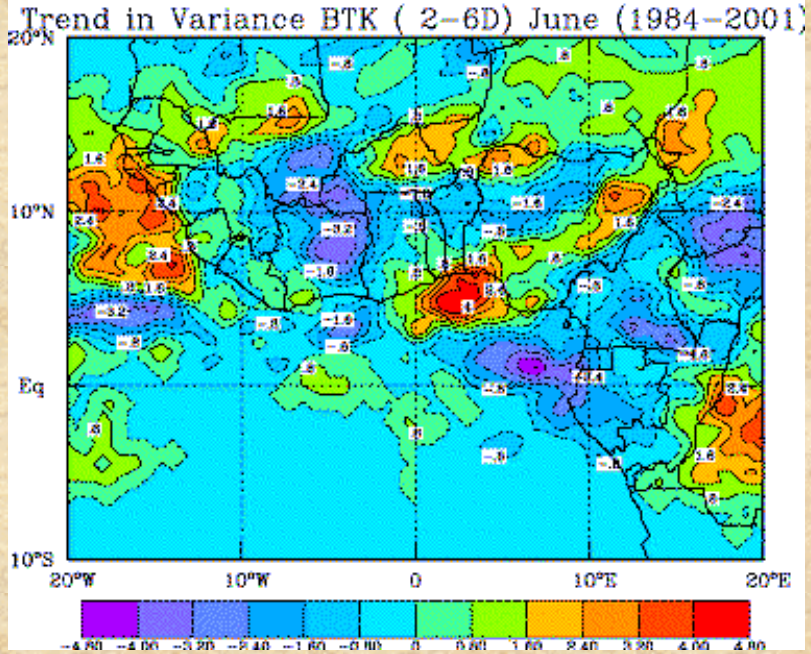
Mean Variance (Diurnal) BTK June (1984-2001



Trend



Mean variance BTK
2-6D June(1984-2001



Trend

Summary

- Streamflow from March to July has a significant decreasing trend.
- A significant decreasing trend in rainfall occurs in areas closest to the Gulf of Guinea.
- The month of June has the largest decreasing trend.
- SST show an increase trend over the Gulf coast closer to Ghana.
- Meridional wind, diurnal, and synoptic scale activities for June indicate decrease trend over Ghana.

Future work

Investigate trend analysis in more detail and extend to other major rivers in the region.

Investigate variability of various scales (SST, atmospheric circulation, convection, land surface condition)