Research Horizons Day
April 7, 2015

COLLEGE OF SCIENCE
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

River Discharge as Affected by Precipitation, Temperature and Soil Characteristics.

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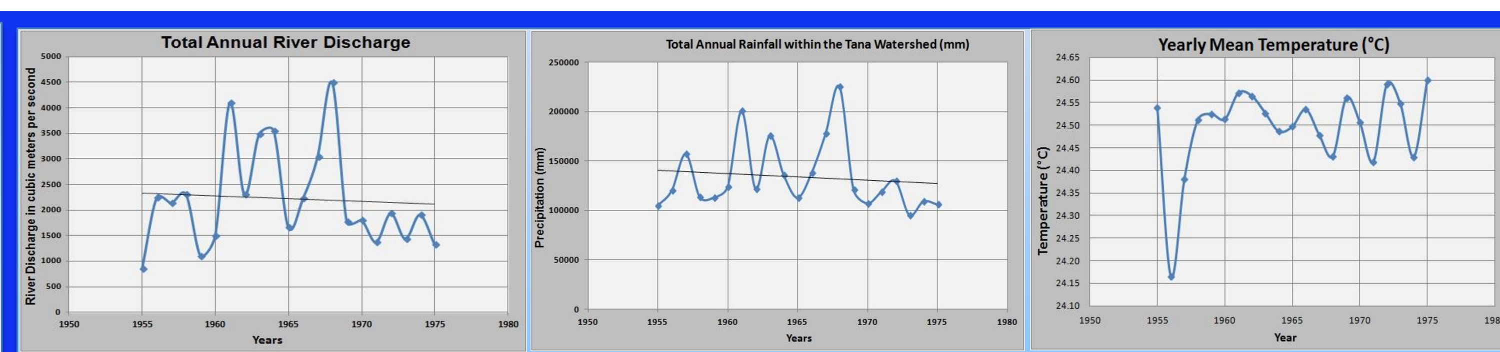
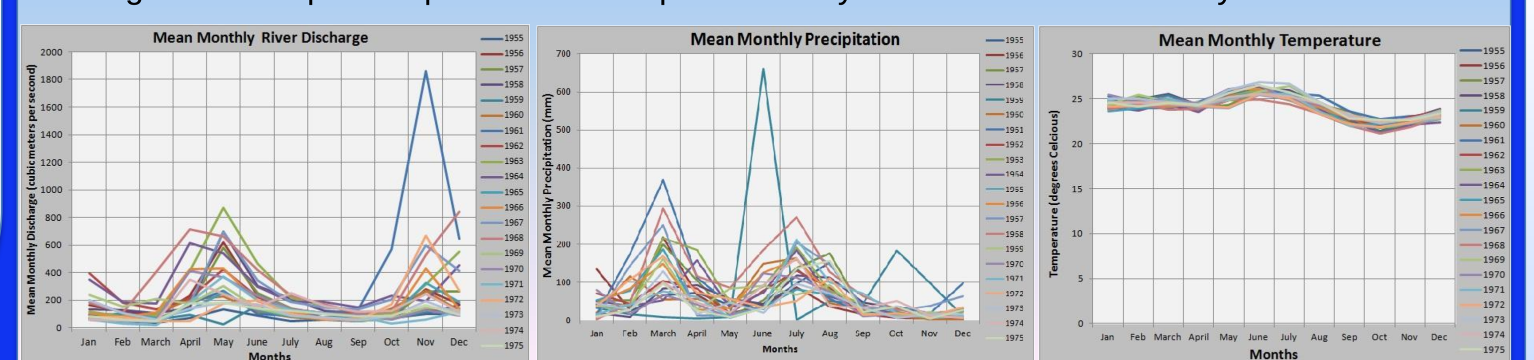
Introduction

Maintaining the hydrological balance to ensure supply of normal water flows in rivers requires optimal care with regards to the activities that disrupt a balanced cycle. Increasing populations and consequent rise in demand for natural resources such as water has led to overexploitation, thus affecting the ecological balance of hydrological cycles around the world. Changes in precipitation patterns and temperature can be used to measure how the ecological activity of a region is changing. This research examined the extent to which change in river discharge over time for the Tana River is influenced by changes in precipitation and temperature dynamics as they relate to soil water retention characteristics within the watershed. With the climate of the watershed varying from arid to highly humid mountain tops, spatial analysis was also done.



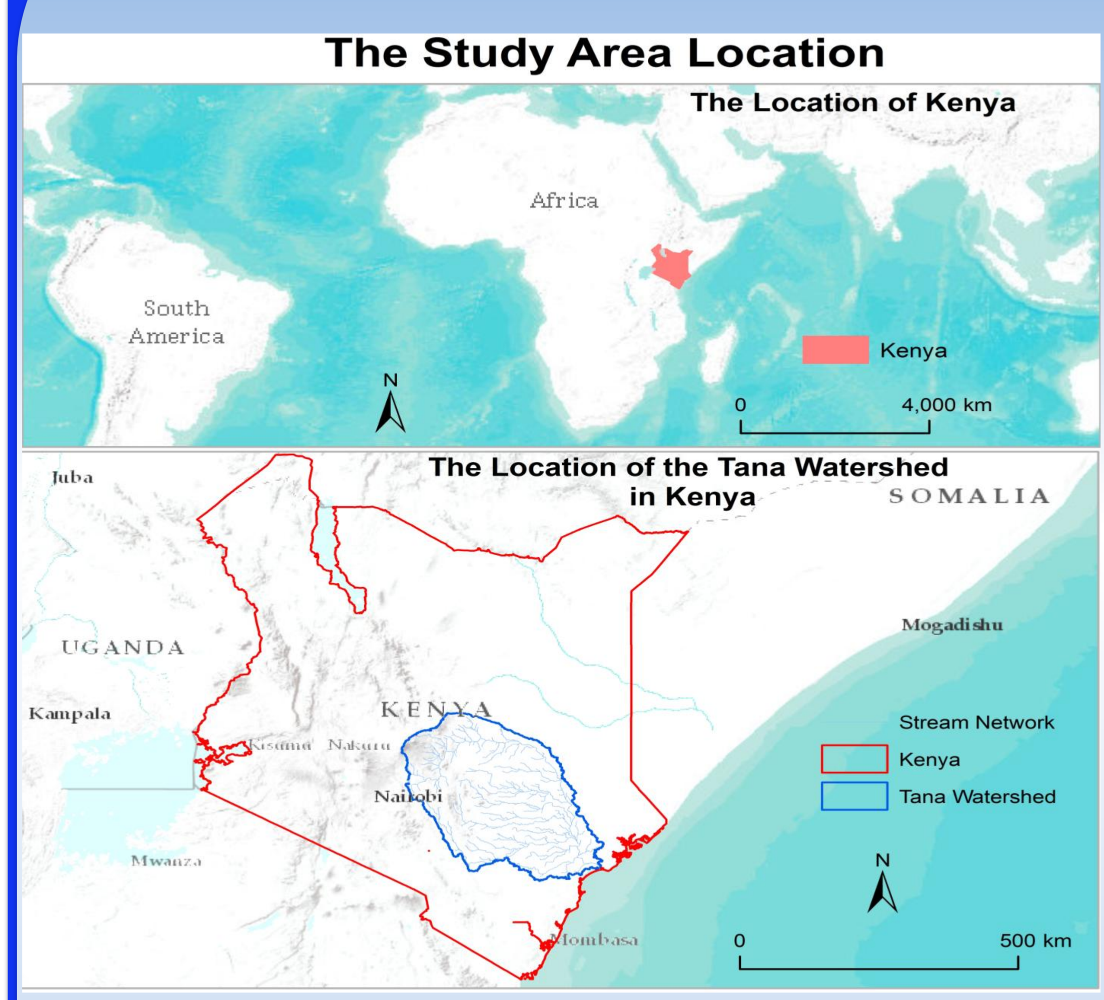
The lines graphs represent time series analysis of river discharge for the Tana River as recorded from a point station along the main course of the Tana in Garisa. The values are assumed to represent surface flow from the Tana watershed and should therefore be representative of a certain proportion of the total precipitation within the watershed. The goal was to determine the extent to which precipitation and temperature influence discharge for the Tana River and the nature of the existing relationships. Temperature was represented by both annual and monthly means



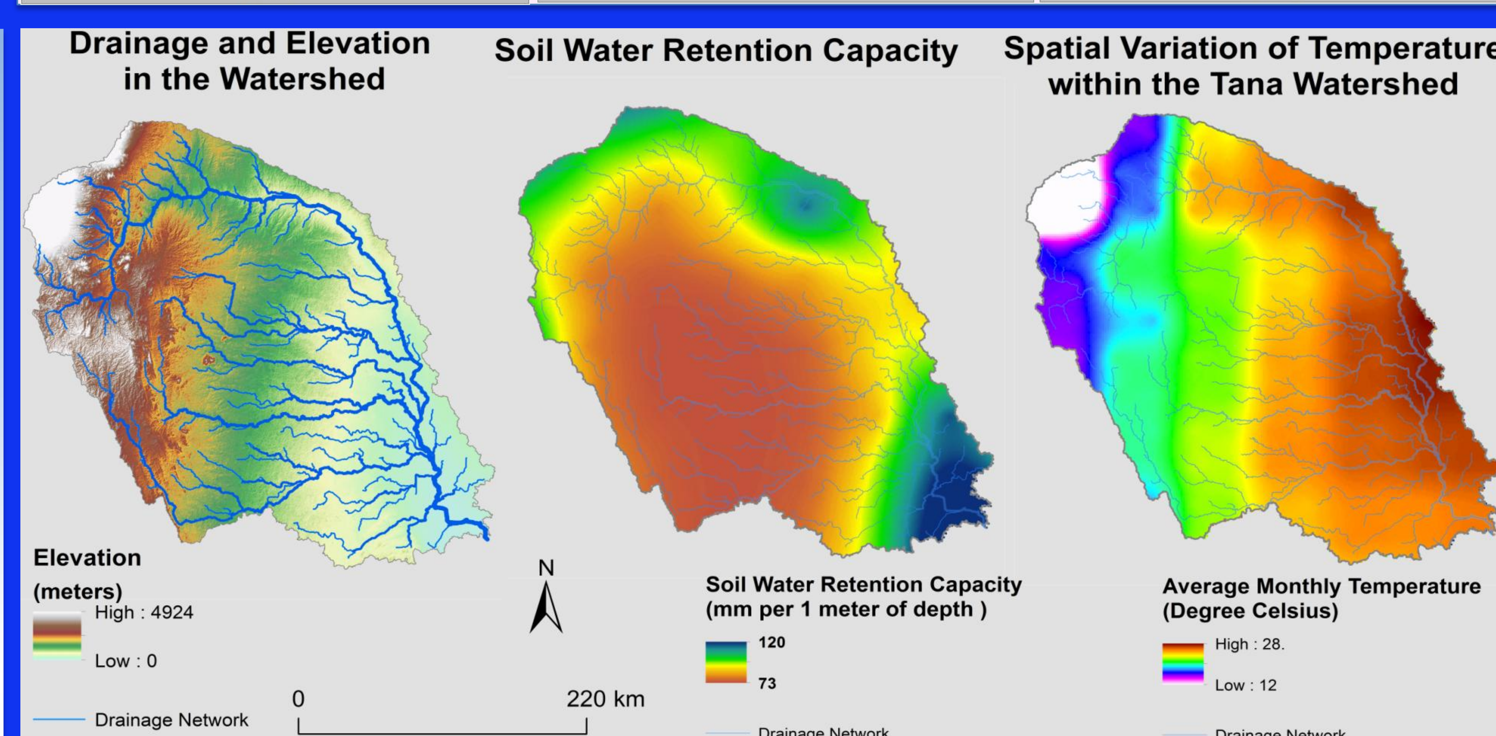
Results

A positive relationship exists between river discharge and precipitation. Looking at the graphs representing total annual river discharge and the graph representing total annual precipitation, river discharge volumes seems to increase with precipitation. High rates of river discharge tend to follow high volumes of precipitation. The peak rainfall events between the months of February and April are followed by high flow rates in the months between April and July. The same is observed between May and September, and between October and December for precipitation and river discharge. No consistent pattern relating the rate of river discharge and mean temperature was observed.

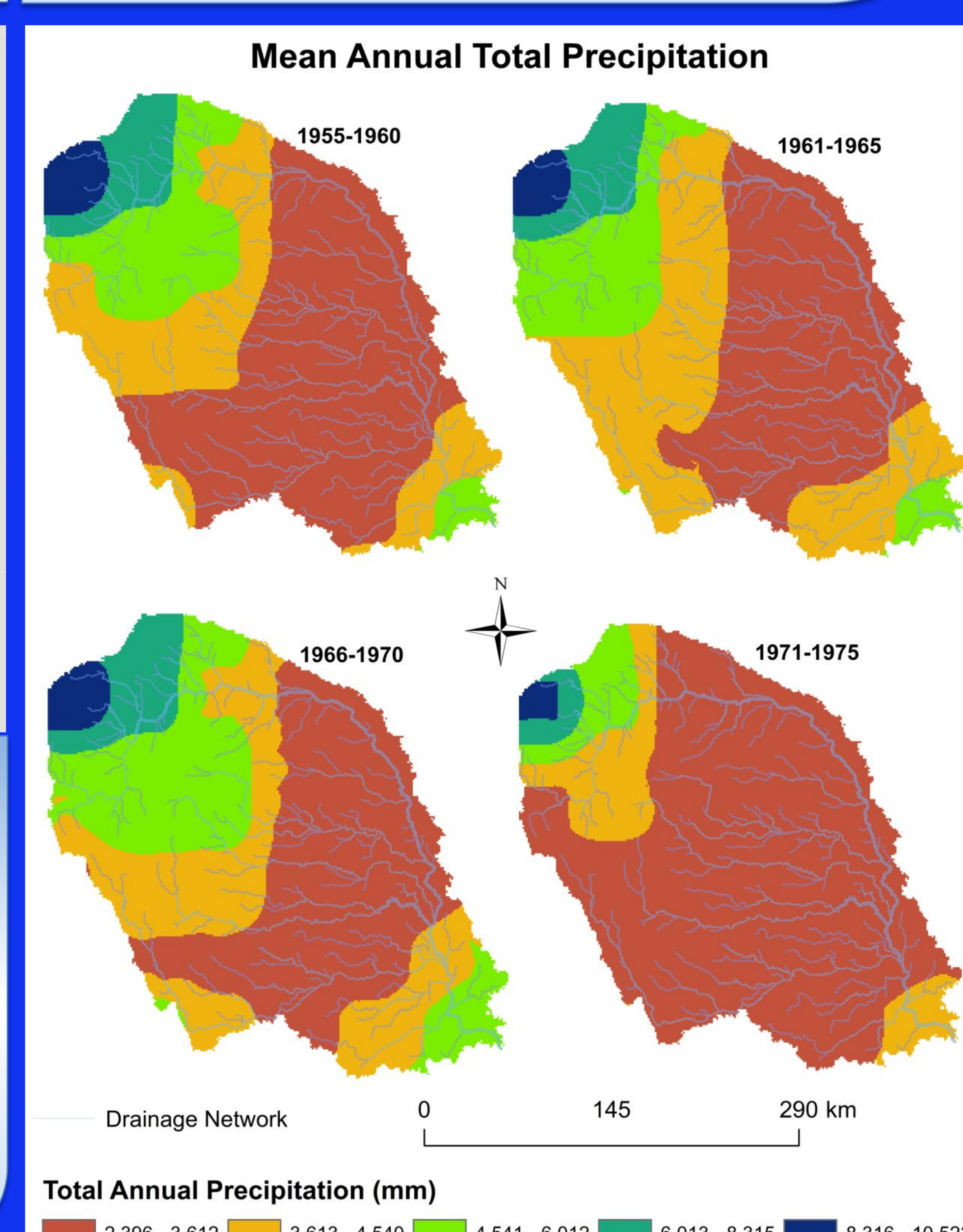
Study Area



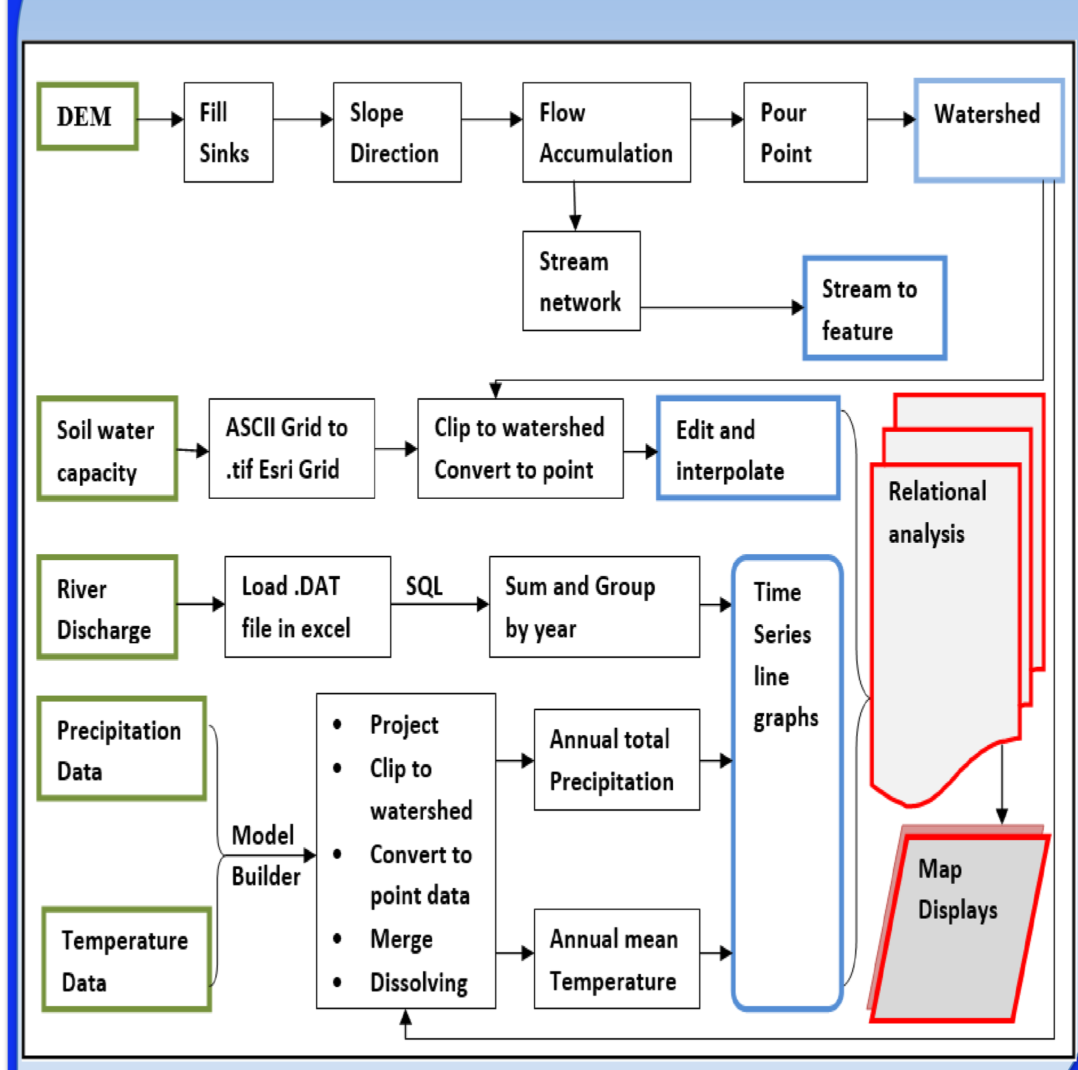
The Tana watershed extends from the Indian Ocean to the highland of Kenya.



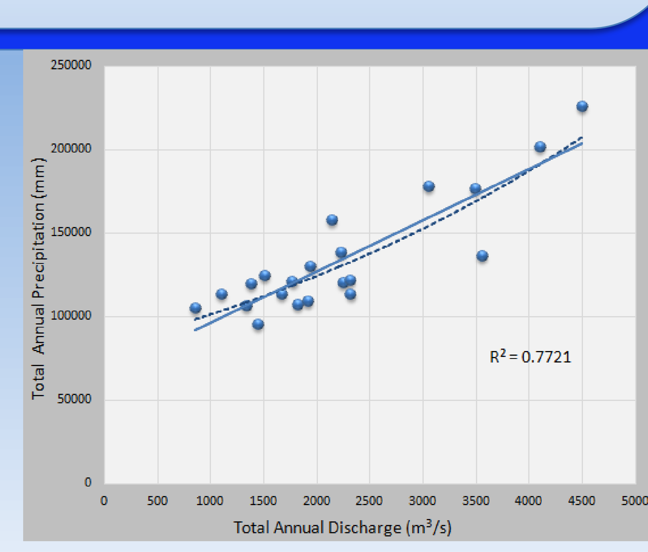
The maps above compares elevation, soil water holding capacity, and mean temperature within the watershed. The water holding capacity of the soils is higher along the main course of the river. Also, mean temperatures are higher along these areas as well, with the exception of areas of highest elevation which are forested. Low soil water holding capacities may be attributed to the fact that the areas are highly elevated and therefore water drains off by gravity, soil and bed rock types, impermeable surfaces or deforestation.



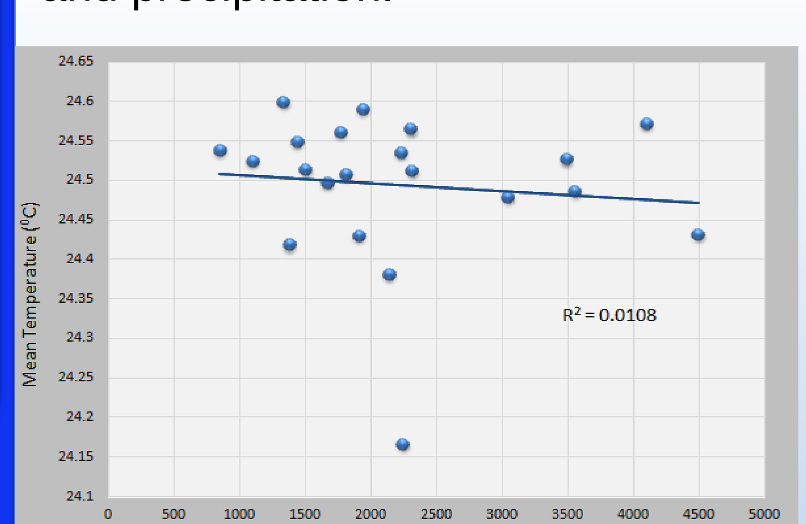
Work Flow



Precipitation variations are both temporal and spatial. Looking at the four mean annual total precipitation maps above, the period between the years 1971-1975 is the driest, while 960 to 1970 is the wettest. This trend is seen from the precipitation and river discharge line graphs. Total annual precipitation was found to account for approximately 77% of the total annual river discharge. A positive correlation exists between river discharge rates and precipitation.



The effect of temperature on river discharge is significantly low. Variations in temperature within the watershed can explain up to only about 1% of the river discharge rates. This could mean low evapotranspiration rates. Further research is necessary to examine the effects of humidity on discharge as well.



Conclusions

The research provided insights into the dynamics of a watershed environment in regards to temperature and precipitation as they affect river flow. Precipitation and temperature were evaluated and compared to local soil characteristics (water holding capacity). The analysis helped to explain the extent to which river discharge is influenced by precipitation and temperature and therefore the proportion of river discharge that is a result of surface runoff. This research provides a simplified methodology for assessing water resource use within the Tana watershed. It also provides a historical perspective, a benchmark on which similar and more current research can be compared.

Acknowledgements

The research was completed by use of data from the Oakridge National Laboratory Distributed Active Archive Center (ORNL) for biogeochemical dynamics with the support and assistance from Dr. Robert Griffin (UAH) and Dan Irwin (NASA/SERVIR).

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