Following the rains: Perceptions of climate change around Kibale National Park, Uganda.

Elvira Breytenbach, M.S., Jeremy E. Diem, Ph.D.
GSU, Department of Geosciences

Joel N. Hartter, Ph.D., Michael W. Palace, Ph.D.
UNH, Department of Geography

Sadie J. Ryan, Ph.D. SUNY, Department of Environmental and Forest Biology

Colin A. Chapman, Ph.D., McGill, Department of Anthropology & School of Environment

Funded by:

Abstract: Rainfall in Uganda has been particularly variable since the 1990's, with the occurrence, duration, and amount of rainfall varying from long-term means. About 80% of Uganda's rapidly growing population is rural and depends on rain-fed agriculture for sustenance, pointing to the necessity to better understand the relationship between changing rainfall and agriculture. This project uses mixed methods to gain an understanding of the changes in rainfall that are occurring in the vicinity of Kibale National Park, Uganda.
Social data was collected through surveys on the perceptions of farmers regarding changes in rainfall and possible agricultural adaptations. Monthly climatological rainfall data derived from the African Rainfall Climatology version 2 (ARC2) satellite was analyzed. A rainfall regionalization and trend analysis was performed, indicating two homogenous rainfall regions and negative trends in rainfall for certain months. Results from satellite analyses were validated by local perceptions of change, with the vast majority of respondents indicating that rainfall has changed. Farmers have adapted to changes by making changes in planting schedules of certain crops.

Research Problem

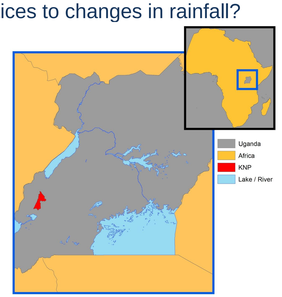
Changes in rainfall have been observed for the African continent by the scientific community, as well as by communities whose livelihoods depend on the seasonal distribution of rains. Much of the research in climate change is focused on continental or regional changes and impacts. More information is needed on how climate change has manifested on the local level and how people are affected by changes. This project aims to take a closer look at localized changes in rainfall around Kibale National Park (KNP), Uganda.

Questions

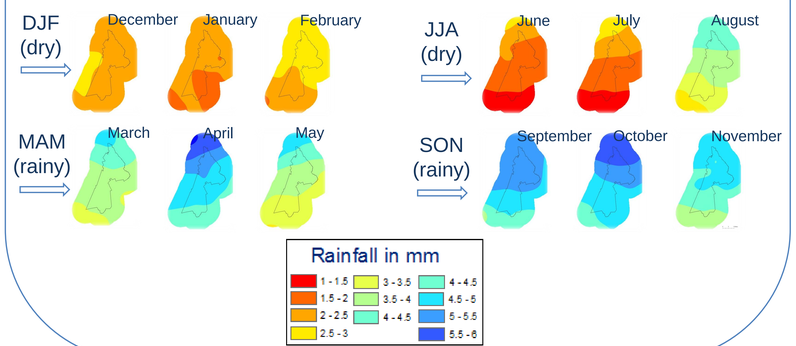
(1) How has rainfall around KNP varied from 1983 to 2012?
(2) How have people adapted their agricultural practices to changes in rainfall?

Study Area

KNP is a protected forest park located within the Albertine Rift Valley, a densely populated biodiversity hotspot with a largely rural population that is dependent on rain fed, smallholder agriculture and ecosystem services for sustenance. KNP lies between the wet equatorial and moist subtropical precipitation zones, and the Inter-Tropical Convergence Zone (ITCZ) is the primary driver of seasonal rainfall in the region. Elevation in the study area ranges from 900 m in the east to over 5000 m along the western border of Uganda. Rainfall in the region is bimodal, and four distinct seasons have been classified (Basalirwa, 1995; Ogallo, 1989; Stampone et al 2011).



Average Monthly Rainfall

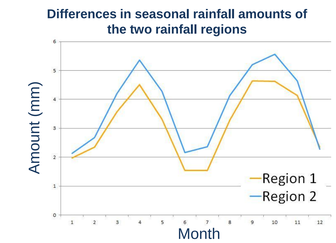


Social Data

1. Permission to conduct this work was obtained from Georgia State University's Institutional Review Board, Uganda National Council for Science and Technology, Uganda Wildlife Authority, local council leaders, and village elders.
2. The "Superpixel" sampling strategy was used for this project. The sampling strategy has been successfully used in interdisciplinary research around parks in Africa since 2004 (Goldman et al. 2008).
   Nine ranger stations exist in KNP. 7 of these ranger stations were in proximity of villages. 5km radii were drawn around these ranger stations and 10 sampling locations were randomly determined within these 5 km radii. Each of these sampling locations were 9 ha circles, and households that fell within these 9 ha circles were surveyed.
3. Households were surveyed by trained local enumerators. Questions dealt with people's perceptions of changes in rainfall, and possible agricultural adaptations.
4. 180 survey were entered into SPSS, and frequencies of responses are given below.

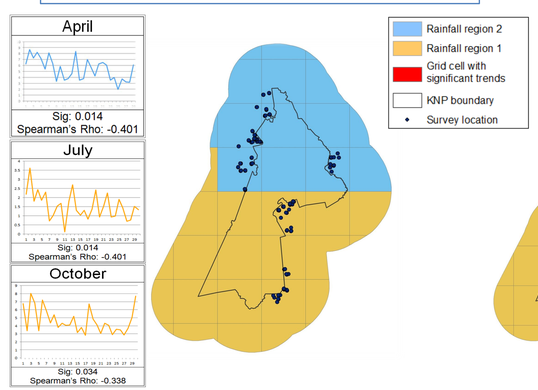
Climatological Data

1. Daily Rainfall estimates from the African Rainfall Climatology version 2 (ARC2) satellite of the Famine Early Warning System were obtained. Grid cells corresponding to KNP along with a 10 km buffer around the park for the period of 1983 to 2012 were included in this analysis. Each grid cell has a 0.1 degree resolution.
2. A Principal Component Analysis was used to find homogenous rainfall regions that may exist in the area. The square-root of 22-day rainfall totals were used for 37 Grid cells. Rotated PCA modes were used to determine the spatial characteristics of the zones. Two rainfall regions emerged, which explain 90.34% of the variance.
3. A Spearman's rank order correlation test was used to check for significant trends with regard to changes in monthly rainfall for the period of 1983 – 2012 for each rainfall region.
4. Grid cells that corresponded to survey sites were checked for significant trends in monthly rainfall for the period 1983 - 2012.

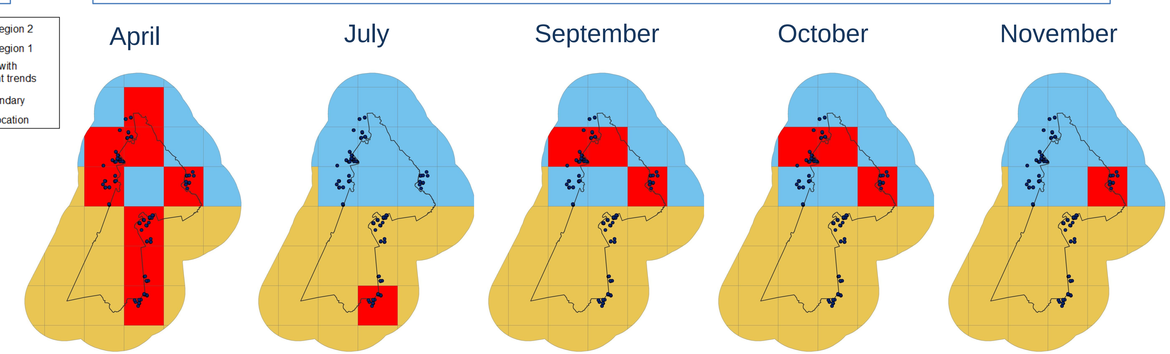


Results

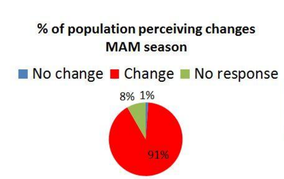
Significant trends by rainfall region

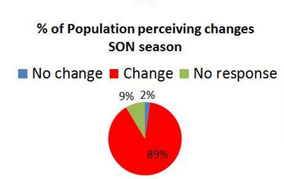


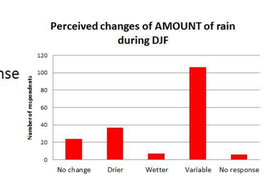
Significant trends by grid cell

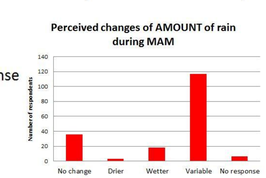


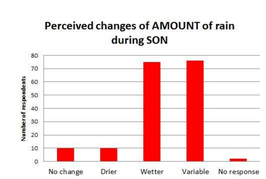
Perceptions of change and agricultural adaptations

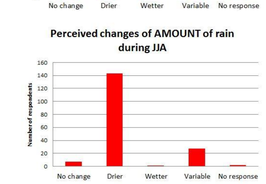


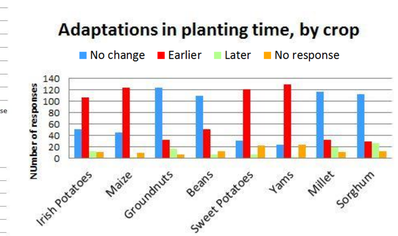












- Two homogenous rainfall regions exist around KNP; a wetter region to the north and a drier region to the south.
- Significant negative trends in rainfall were found for the northern region during April, and for the southern region during July and October.
- Analyses of populated grid cells indicate that all cells experienced decreases for April, and several cells experienced decreases for September and October.
- Changes in April, September, and October are cause for concern since these months fall within critical growing periods
- Results from satellite analyses are validated by local perceptions of change, with the vast majority of respondents perceiving changes in rainfall.
- Farmers have adapted to changes by planting certain crops earlier than normal.

References
Basalirwa, C. P. K. 1995. "Delineation of Uganda into climatological rainfall zones using the method of principal component analysis." *International Journal of Climatology*. 15: 1161-1177.
Ogallo, L.J. 1989. The spatial and temporal patterns of the East African seasonal rainfall derived from principal component analysis. *International Journal of Climatology*. 9 (2): 145-167.
Stampone, M. D., J. Hartter, and S. J. Ryan. 2011. "Trends and Variability in Localized Precipitation Around Kibale National Park, Uganda, Africa." *Research Journal of Environmental and Earth Sciences* 3 (1): 14 - 23.
Goldman, A., Hartter, J., Southworth, J., Binford, M. *2008*. Studying the Human Landscape around Kibale National Park. The human landscape around the island park: impacts and responses to Kibale National Park. In: Wrangham, R. and E. Ross (Eds.). *Science and Conservation in African Forests: The Benefits of Longterm Research*. pp. 129-144. Cambridge University Press, Cambridge.