

Characterisation of historical and projected climate of rice prone areas in South-Kivu province, DRC

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Abstract

The nature of climate variability in South-Kivu is not yet well understood and how the impacts of climate variability affect agriculture, especially rice production has not been well documented. This study aimed therefore at characterizing historical and project future climate of two selected rice prone areas of South-Kivu namely Kavumu and Luberizi. Rainfall and maximum and minimum temperatures were considered in the study. Twenty General Circulation Models (GCMs) were used to project climate for two Representative Concentration Pathways (RCP=4.5 and 8.5) and for two periods namely mid and end centuries. Result shows that annual rainfall amount did not significantly vary over the last thirty years ($P<0.05$), but the coefficient of variation (CV) has been gradually declining with years ($P<0.05$) for both sites. The mean annual temperatures had a gradually increasing trend for the last thirty years in both sites. However, projected rainfall and temperature are likely to increase for RCP and periods. The mean increment in minimum temperature (Tmin) is likely to be relatively higher than maximum temperature (Tmax) in both sites.

Key words: Climate change and variability, D.R. Congo, rice

Résumé

La nature de la variabilité du climat au Sud-Kivu n'est pas encore bien appréhendée. Les études de l'impact de cette variabilité climatique sur l'agriculture et de manière spécifique sur la production du riz demeurent insuffisantes. Ainsi, cette étude s'est fixé comme objectif de caractériser les variabilités historiques et futures du climat de deux sites propices à la production du riz dans le Sud-Kivu à savoir Kavumu et Luberizi. La pluviométrie ainsi que les températures maximum et minimum sont les paramètres climatiques qui ont été considérées dans cette étude. Vingt GCMs ont été utilisés pour projeter le climat sous deux RCP (4.5 et 8.5) et en considérant deux périodes notamment le milieu et la fin du siècle. Les résultats ont montré pour les 30 années passées que les quantités de pluies annuelles était constantes ($P<0.05$) mais le CV diminuaient graduellement au fil des années dans les deux sites. Les températures moyennes annuelles ont par contre montré une tendance plus ou moins ascendante aussi bien à Kavumu qu'à Luberizi. Les projections montrent que la pluviométrie et la température vont probablement augmenter sous les deux RCP, aussi bien

au milieu qu'à la fin du siècle. L'accroissement moyen des températures minimales sera supérieur à celui des températures maximales dans les deux sites.

Mots clés: Changement et variabilité climatique, D.R. Congo, riz

Background

Climate variability has been identified as a major challenge hindering most developing countries from attaining Millennium Development Goals (UNDP, 2007). Climate variability manifests as floods, droughts erratic and unreliable rainfall and other extreme weather events, and has not only negative impact on natural and human systems but also creates serious developmental challenges in developing countries (AIACC, 2007). Nsombo et al, (2012) using CSIRO model predicted rainfall reduction of up to 150 mm annually and temperature increase averaging 1.4°C in D.R. Congo over the next 40 years. South-Kivu has been experiencing during the two last decades variability in monthly rainfall (Karume et al, 2008). There is limited information on the projection of the other GCMs both at national and village level in D.R. Congo. This study aimed therefore at characterizing the nature of historical and future climate in Kavumu and Luberizi.

Methodology

The study was conducted in two selected territories of South-Kivu namely Luberizi and Kavumu. Both sites are part of the Tanganyika basin. Climate data for both sites were obtained from the NASA's Modern Era-Retrospective Analysis for Research and Applications (MERRA). Data used in this study included daily rainfall, maximum and minimum temperatures covering the period of 1980-2010 as reference period. Average annual and seasonal values were computed. A temporal trend was determined using regression techniques. In addition standard deviations and coefficient of variation were computed.

The reference data was then used to project rainfall and temperature values in 2040-2069 (Mid-century) and 2070-2099 (End century) for two RCP (4.5 and 8.5) using delta method for twenty GCMs. This was done using R software version 3.1 following the AgMIP protocol.

Results

Results show for historical climate that annual rainfall amount did not significantly change over the years and for the last thirty years ($P < 0.05$), but the coefficient of variation (CV) has been gradually declining with years ($P < 0.05$) for both sites (Figs. 1 and 2). Mean annual temperatures showed a gradually trend for the last thirty years in both sites (Figs. 3 and 4).

Projected rainfall and temperature for mid and end centuries are likely to increase for the different RCPs and periods. Increment in rainfall amount is likely to be relatively higher for Kavumu compared to Luberizi; while ΔT_{max} is likely to be relatively higher in Luberizi than in Kavumu. For both sites $\Delta T_{min} > \Delta T_{max}$ (Table 1 and 2). Increments are relatively higher for End century and higher value of RCP.

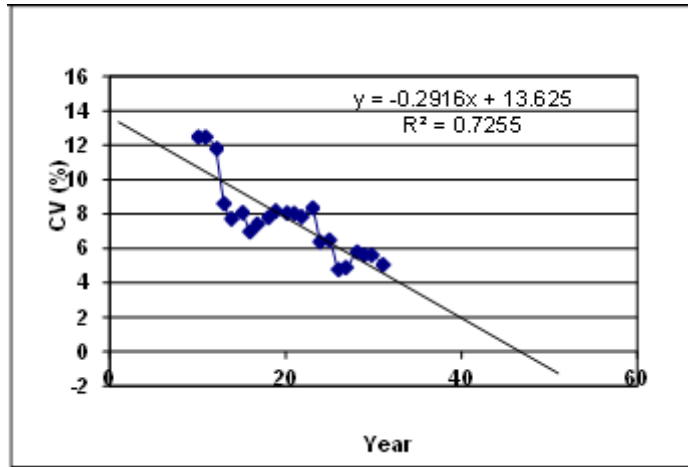


Figure 1. Annual rainfall CV trend in Kavumu.

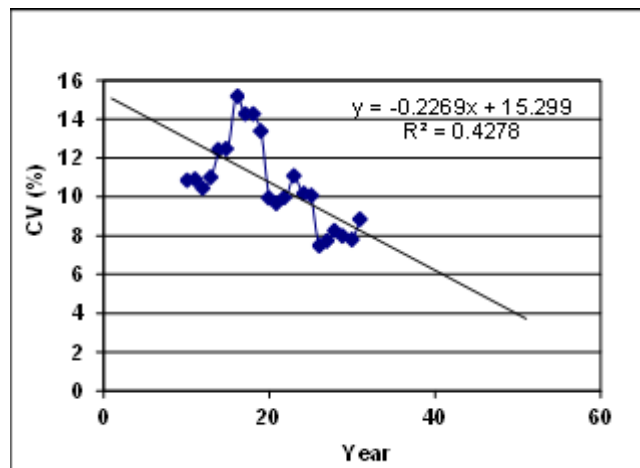


Figure 2. Annual rainfall CV trend in Luberizi.

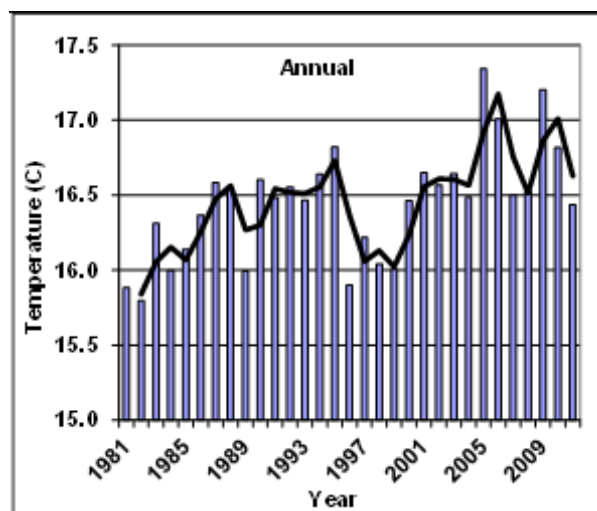


Figure 3. Annual temperature trend in Kavumu.

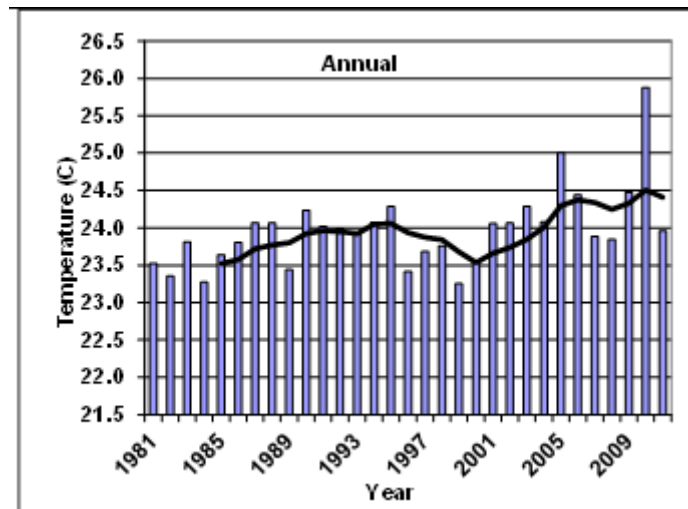


Figure 4. Annual temperature trend in Luberizi.

Table 1. Projected change in Temperature and rainfall (RCP4.5) in Luberizi and Kavumu.

Sites	Mid-Century			End-Century		
	ΔT_{max}	ΔT_{min}	Rainfall	ΔT_{max}	ΔT_{min}	Rainfall (%)
	°C		%	°C		%
Luberizi	1.64	1.75	3.66	2.38	2.41	4.63
Kavumu	1.48	1.74	4.86	2.34	2.42	6.06

Table 2. Projected change in Temperature and rainfall (RCP8.5) in Luberizi and Kavumu.

Sites	Mid-Century			End-Century		
	ΔT_{max}	ΔT_{min}	Rainfall	ΔT_{max}	ΔT_{min}	Rainfall (%)
	°C		%	°C		%
Luberizi	2.02	2.21	5.31	4.11	4.20	11.29
Kavumu	1.90	2.21	6.28	4.04	4.18	14.06

Conclusion and recommendations

Based on the above results, it was concluded that rainfall has remained quasi-uniform across the years and mean annual temperature has been gradually increasing over the year. Rainfall and temperature are projected to increase for mid and end centuries for all RCPs. It is recommended that adaptation measures are planned for rice production in particular and for the all agricultural sector in general to fit the coming changes in climate considering that both precipitation and temperature are likely to increase.

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