Research Application Summary

Assessment of climate change scenarios and variability in Uganda

Nandozi, C. [1], Komutunga, E.[2], Majaliwa, J.G.M.[1], Aribo, L.[3] & Omondi, P.[4]
[1]Institute of Environment and Natural Resources, Makerere University, P.O. Box 7062, Kampala, Uganda
[2]Mbarara Zonal Agricultural Research and Development Institute (MBAZARDI), P.O. Box 389, Mbarara, Uganda
[3]Meteorology Department, P.O. Box 3, Entebbe, Uganda
[4]ICPAC, Nairobi, Kenya
Corresponding author: cnandozi@cit.mak.ac.ug, lynsharoti@yahoo.com

Abstract

Understanding how climate will change over time provides a valuable insight into how the challenges as result of climate change (CC) and variability can be responded to. The general objective of the study was to generate information to guide activities geared towards building resilience of agro-based communities in adapting to and mitigating present and future climate change and variability impacts. Specifically, it assessed the performance of different global climate models (GCMs) in the MAGICC/Scengen tool with the view to obtain the best combination to be used for downscaling for projecting climate change and variability in Uganda. The preliminary results show ECHO-G and UKHADCM3 as the best projectors of climate change and variability in Uganda.

Key words: Climate impacts, climate parameters, projections, Regional models

Résumé

Comprendre comment le climat va changer au fil du temps fournit des indications précieuses sur la façon dont les défis résultant du changement climatique (CC) et la variabilité peuvent être résolus. L'objectif général de cette étude était de produire des informations pour orienter les activités visant à renforcer la résilience des communautés à base agricole de s'adapter et à atténuer les impactes actuels et futurs du changement climatique et de la variabilité. Plus précisément, il a évalué les performances de différents modèles climatiques globaux (MCG) dans l'outil MAGICC / SCENGEN en vue d'obtenir la meilleure combinaison à utiliser pour la réduction d'échelle pour projeter les changements climatiques et la variabilité en Ouganda. Les résultats préliminaires montrent que ECHO-G et UKHADCM3 sont les meilleurs des

projecteurs du changement climatique et de la variabilité en Ouganda.

Mots clés: les effets du climat, les paramètres climatiques, les projections, les modèles régionaux

Background

Climate change is one of the current and future major challenges to world human development and ecological well being (UNCTAD/WTO, 2007). Uganda is one of the developing countries most vulnerable to the adverse climate change impacts (Lukwiya, 2009). However global climate model (GCM) predictions only provide global overview are coarse and do not represent the fine-scale detail that characterizes the climate of a country for the benefit of the local community users who require detailed projections of climate for their day to day farming activities (Met office, 2007). The spatial-temporal pattern of climate change and variability in Uganda, as in several other places, will depend on topography, land-use cover change, and distribution of water bodies which can affect the global circulation (Lukwiya, 2009). Therefore, developing countries such as Uganda needs to generate their own detailed national scenarios of climate change and variability to inform decision makers for appropriate adaptation and mitigation strategies (ICPAC, 2009; Met office, 2007).

Study Description

This study was conducted in Uganda. Uganda is a landlocked country located in East Africa astride the Equator between 4° North and 1° South and stretching from 29.5° to 35.5° East. It has a total area of 241 040 km^2, a north-south extent of about 650 km and a maximum east-west extent of about 500 km. The country borders Sudan to the north, Kenya to the east, the United Republic of Tanzania and Rwanda to the south, and the Democratic Republic of the Congo to the west. Much of the country lies at an altitude of 900 to 1,500 m, with an average altitude of 1,200 m.

Selection of best GCMs projectors for Uganda. Thirty-six weather observing stations located in different parts of Uganda that provide available data matching with the satellite data were used. Twenty global climate models (GCMs) within the MAGICC/Scengen software were evaluated based on the precipitation parameter and greenhouse gases as a factor affecting climate change. Outputs of individual and combinations of models were spatially and statistically analysed. Statistical

analysis was based on the ensembled mean output contribution, root mean square and biasness.

Research Application

Preliminary analysis indicate that the best GCMs projectors are CCMA-31, MRI-232A, ECHO-G and UKHACM3 (Table 1). However ECHO-G and UKHADCM3 are the most relevant to the East African region and Uganda in particular. GCMs are projecting the same general increasing precipitation towards the west by 2050.

Table 1. Statistical analysis of GCMs.

Area specified by MASK. MASKFILE = MASK.N : MASKNAME = AFRICA

Cosine weighted statistics

MODEL	CORREL	RMSE degC	BIAS degC	CORR-RMSE degC	RK INDEX	NUM PTS
BCCRBCM2	0.97	3.291	-2.922	1.514	5.455	416
CCCMA-31	0.949	3.187	-2.488	1.992	4.699	416
CCSM—30	0.908	2.725	-0.243	2.714	3.398	416
CNRM-CM3	0.953	3.967	-3.339	2.142	5.97	416
CSIR0-30	0.954	2.567	-1.768	1.862	3.428	416
ECHO—G	0.936	2.338	0.403	2.303	2.715	416
FGOALS1G	0.952	2.105	-0.833	1.933	2.195	416
GFDLCM20	0.939	3.574	-2.792	2.231	5.125	416
GFDLCM21	0.946	2.965	-2.155	2.037	4.42	416
GISS—EH	0.944	2.497	1.453	2.031	2.97	416
GISS—ER	0.95	2.054	0.711	1.927	2.557	416
INMCM-30	0.904	4.255	-3.199	2.805	5.732	416
IPSL_CM4	0.923	2.419	-0.321	2.397	2.622	416
MIROC-HI	0.976	1.648	-0.624	1.525	2.587	416
MIROCMED	0.961	2.088	-0.857	1.904	2.506	416
MPIECH-5	0.969	1.547	0.284	1.52	2.401	416
MRI-232A	0.965	1.717	0.245	1.699	2.126	416
NCARPCM1	0.911	4.834	-4.058	2.626	7.293	416
UKHADCM3	0.962	1.742	-0.408	1.693	2.006	416
UKHADGEM	0.923	3.116	-2.01	2.381	3.92	416
MODBAR	0.976	1.863	-1.246	1.385	3.706	416

This study will guide future vulnerability assessment and impact studies. The results will also be used to inform decision makers on options, adaptation and mitigation strategies.

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References

Awais Piracha and Zahid Majeed.2009.Water use in Pakistan's agricultural sector: Water conservation under the changed climatic conditions. University of Western Sydney, Sydney, Australia,Water and Power Development Authority, Lahore,

Pakistan http://www.idosi.org/ijwrae/evaluated-articles &reprots/148-IJWRAE-2010-2029/148-IJWRAE.pdf

Holger Meinke, Rohan, N., Phil Kolkic, Stone, R., Ramasamy Selvaraju and Baethgen, W. 2006. Actionable climate knowledge: From analysis to synthesis. *Climate Research* 33:101-110.

International Trade Centre UNCTAD/WTO, 2007. Research Institute of Organic Agriculture (FiBL) Organic Farming and Climate Change, ID=39115.

Ludwig, F. and Asseng, S. 2005. Impacts and adaptation to climate change in Western Australian wheat cropping systems http://www.mssanz.org.au/modsim05/papers/ludwigf.pdf

Met Office, 2007. An introduction to PRECIS PRECIS. Validating and Evaluating a Regional Climate Model PRECIS Workshops, Nairobi, Kenya.