PRE-GHACOF 35 CAPACITY BUILDING TRAINING WORKSHOP AND REGIONAL CLIMATE MODELING TOWARDS SEPTEMBER-DECEMBER 2013 FORECAST

IGAD Climate Prediction and Applications Centre
Nairobi, Kenya

12th – 20th August 2013

Report

August, 2013

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ACRONYMS

AfDB	Africa Development Bank
CBTW	Capacity Building Training Workshop
CCA	Canonical correlation analysis
COF	Climate Outlook Forum
DRR	Disaster Risk Reduction
ENSO	El Niño/Southern Oscillation
GHA	Greater Horn of Africa
GHACOF35	Thirty Fifth Greater Horn of Africa Climate Outlook Forum
GPCs	Global Producing Centres for Long Range Forecasts
ICPAC	IGAD Climate Prediction and Application Centre
IGAD	Inter-Governmental Authority on Development
IOD	Indian Ocean Dipole
KMA	Korea Meteorological Administration
LRF	Long Range Forecasts
MMEs	Multi-model ensembles
NMSs	National Meteorological Services
NWP	Numerical Weather Prediction Model
SOND2013	September - December 2013 rainfall season in the GHA
SOI	Southern Oscillation Index
SST	Sea surface temperature
SVD	Singular Value Decomposition
WMO	World Meteorological Organization

PREFACE

The IGAD Regional Climate Centre, ICPAC continues provide climate services in support of regional efforts towards resilience building against societal impacts of climate extremes such as drought and floods which severely impact on the socio-economic welfare GHA region. In striving to provide climate information products to guide contingence planning in critical sectors like food security, water resources and disaster risk reduction, the climate service providers must be continuously trained and their skills updated to ensure that they can perform climate process diagnosis, predictive analysis and dynamical modeling with application of the most recent operational concepts, skills and tools. To address this capacity need for National Meteorological Services of GHA countries and process the regional climate scenario for September to December 2013, ICPAC hosted the pre-COF 35 capacity building training workshop alongside regional climate modeling from 12th to 20th August 2013. The training workshop as well as the hands-on regional modeling was held within the auspices of African Development Bank (AfDB) regional support to ICPAC.

The core participants were climate scientists drawn from all the National Meteorological Services of GHA countries. I thank AfDB for the intuitional support, the permanent representatives of GHA member countries with WMO, the participants and facilitators for tireless training, thoughtful climate analysis and modeling work which was the most important input into the Thirty Fifth Greater Horn of Africa Climate Outlook Forum.

Prof Laban A Ogallo,
Director, ICPAC

1.0 **Introduction**

The IGAD Climate Applications Centre continues to provide climate information for the Greater Horn of Africa (GHA) region in order to inform planning and implementation of socio-economic activities which are most sensitive to persistent climate extremes and changes. Over the GHA region, climate extremes impact negatively on societies and sectors of economic and general welfare. For example failure of seasonal rainfall impacts very adversely on individuals and communities with disasters like famine and water shortages, often leading to conflicts over diminishing resources. Proper planning to avert and cushion communities against these kind of climate driven disasters can only be supported by climate information well in advance if availed to all sectors well in advance. Thus climate stress and associated disasters is a major concern influencing socio-economic welfare of the GHA and ICPAC continues provide the regional climate information needs by carrying out and issuing real time climate monitoring, diagnosis and forecasts for socio-economic sectors, particularly agriculture/food security and water resources as critical sectors whose productivity is sensitive climatic conditions.

The Intergovernmental Authority on Development (IGAD) recognizes that consolidation of climate information has direct implications on regional socio-economic welfare and has a significant role in the realization of sustainable development in the region. Adverse climatic extremes and conditions stress communities and governments across all the member states. More often than not, the impacts are negative to regional common good. It is these negative impacts which have motivated the new IGAD strategy on climate extremes and change impacts, namely to build regional resilience against adverse impacts.

It is for this purpose that IGAD Climate Prediction and Applications Centre (ICPAC) organized a 9 days capacity building training workshop (CBWT) and regional climate modeling workshop towards regional climate forecast for the period September – December 2013. The hands-on workshop and regional climate modeling addressed processes and mechanisms which would be the most dominant drivers of regional climate evolution during September to October 2013. Outputs of the workshop were the main

inputs into GHACOF35 that was held in Boma Inn, Eldoret, Kenya from 21 - 23 August 2013.

1.2 Objectives

The objective of this capacity building training and regional climate modeling workshop (CBTW) was to carry out diagnosis and prognosis of the drivers of global, regional climate and local scale climate evolution, all with implications on the most plausible scenario during September – December 2013 season and to avail this information for use in resilience building against adverse impacts of climate extremes as support to climate smart development efforts, disaster risk reduction, Climate change adaptation and sustainable development.

Specific Objectives included:

i) To enhance the expertise of climate service providers of the national meteorological services (NMSs) of the ICPAC member states.

ii) To undertake diagnosis and modeling the global, regional and local scale processes and mechanisms with predictive linkage to the regional climate scenario during the season September – December 2013 over the whole of GHA.

iii) To provide the GHACOF35 consensus regional climate outlook for September – December 2013 to be used by applications sectors agriculture like food security, water resources, and disaster risk contingency planners inform their strategic activities during September to December 2013 season over the region.

1.3. Methodology

The training part of the pre-COF35 regional climate modeling and capacity building workshop involved each country participant preparing his country rainfall data templates for each climatological zone in their own countries for the September – December season during the 52 years analysis period 1961 to 2012. The participants were guided through data consistency checking, quality control and diagnosis analysis

involving construction of anomalies and identification of major modes of interannual rainfall variability during September to December for each year over each zone.

The diagnosis analysis was followed by process based predictive modeling using linear and non-linear techniques as well as deterministic dynamical model and ensembles. Some of the predictors which were used in the statistical-probabilistic modeling included sea surface temperatures over Indian, Atlantic and Pacific Oceans and their evolving influence on regional rainfall temporal evolution patterns nearly average Indian Ocean dipole mode index (IOD), generally warmer equatorial Atlantic, and ENSO neutral with a weak Southern Oscillation Index (SOI).

All participants used these predictors to fit predictions models, test performance and use most skillful models to forecast the September to December 2013 rainfall over homogeneous climatological zones in each country. In cases where models were linear regression type, predictors were screened to eliminate redundancy and use only those predictors with physical association with rainfall in the homogeneous climatological zones. Co-variability between regional rainfall and predictors was also done using canonical correlation analysis (CCA) performed under the module of singular value decomposition (SVD). Care was taken to ensure that models used captured most of the extremes in observed rainfall during September – December season and that the predictors were consistent and persistent enough to force the regional climate up to the end of December 2013.

The prediction results for each country were supplemented by dynamical model ensembles using the set of 12 dynamical models from global producing centres (GPCs) outputs for September-December 2013 provided by the World Meteorological Organization (WMO) through the lead centre for standardization and multimodel ensemble post-processing hosted by the Korea Meteorological administration (KMA) through an on-line processing at the link. http://www.wmolc.org/. All participants were trained on how to select the dynamical model domain relevant to the country on interest as well as the whole region and post process the dynamical multimodel ensemble forecasts for September – December 2013 season.

Output of these methodologies provided the regional GHA consensus climate forecast for September-December 2013. This consensus climate forecast was the main information product used to drive activities during the Thirty Fifth Greater Horn of Africa Climate outlook Forum (GHACOF35) held at Boma Inn hotel, Eldoret, Kenya from 21st to 23rd August 2013.

2. Workshop presentations

In giving his training presentation, Dr J N Mutemi highlighted the basis of both statistical and deterministic modeling for climate prediction. He noted that interannual climate variability is strongly correlated to variability of ocean characteristics which impacts on the nature of atmospheric circulation, and thus rainfall distribution. Best example is the existence of sea surface temperature (SST) differences which directly derives atmospheric circulation cell with moist influence in land areas within the vicinity of warmer ocean and consequent drier conditions in the neighborhood of colder ocean areas. Thus SST influence is the basis of seasonal climate predictability and this is why SSTs are the main boundary forcing mechanism in dynamical models. The strongest manifestation of this signal is in the form of El Niño/ Southern Oscillation Index (ENSO) in the tropical Pacific. SST differences in equatorial Indian Ocean with warmer than average conditions over the western sector and colder than average conditions over the eastern sector in form of Indian Ocean Dipole (IOD) is well correlated with atmospheric circulation which has positive impacts on rainfall in the equatorial sector of the GHA. Dr Mutemi concluded his presentation with demonstration of evolving patterns of tropical ocean SST anomalies and atmospheric circulation patterns at various levels of the atmosphere all with predictive implications on September – December 2013 rainfall the GHA region. Process evolutions up to July/early August 2013 were dominated by neutral conditions in all tropical oceans and this calls for careful modeling to determine the likely scenario of regional climate during the next 4 fourths up to the end of December 2013.

In his presentation, Dr C Oludhe illustrated to the participants step by step basics of statistical model fitting, verification and running of forecasts. Dr Oludhe informed the participants to ensure that predictors used have strong and explainable linkage with

rainfall over each zone to ensure that models are physically consistent with major processes of rainfall during the target September – December 2013 season.

In his presentation, Dr W Gitau illustrated how to process baseline climatology and anomaly maps for each country and how to merge these country maps into regional patterns. Regional patterns with processes similar to those prevailing during July/August 2013 were of special interest as analogues of the forecast being made.

In his presentation, Dr F Opijah took the participants through the process of post processing dynamical model and ensemble combinations using the dynamical model runs available through the WMO GPC lead centre.

In his presentation, Dr A Colman of the UK Met Office took the participants through the forecast calibration and verification for September to December 2013 season by use of the Climate prediction tool.

In his presentation, Prof R Anyah of the University of Connecticut illustrated the dynamical regional modeling and downscaling schematic being configured to run at ICPAC. The system consist of global model providing low frequency boundary inputs into the regional model and also a numerical weather prediction (NWP) model with capability for daily to decadal forecasts.

The country participants used the skills demonstrated and guided by the resource persons to make country forecasts and eventually the consensus September – December 2013 forecast that was used in GHACOF35. **Annex 1** is a sample of participant presentations.

3. Conclusion, Recommendation and Way Forward

All the participants learned how perform verification of seasonal climate forecasts as well as perform diagnosis of the major extremes which characterize the September to December rainfall in the countries as well as the whole GHA region.

The forecast output produced by the pre-COF 35 capacity building and regional modeling indicated likelihood of near normal rainfall during September – December 2013 over most of equatorial sector, with likelihood of slightly above average rainfall over the western sector of the equatorial sector covering mainly Western Kenya, Uganda, South Sudan, Rwanda and Burundi.

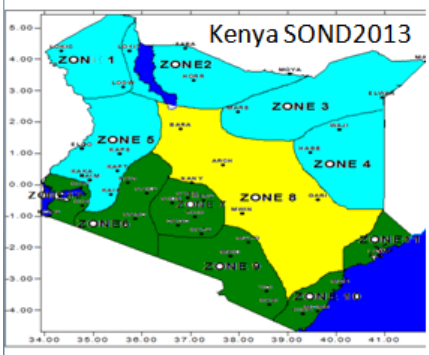
The participants recommended that intraseasonal variability should be addressed in future capacity building and regional modeling in order to provide important climate attributes like most probable dates of onset, and succession of wet and dry events.

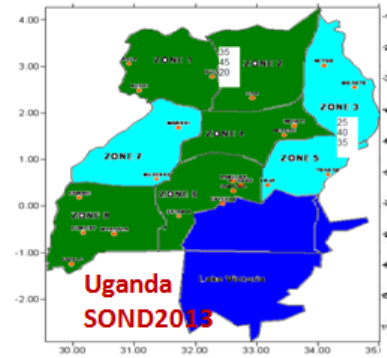
ICPAC member countries should avail daily station data, especially rainfall and temperature (minimum and maximum) so that regional user guides such as onset climatology maps can be generated.

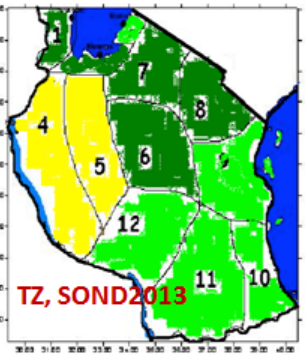
Acknowledgements

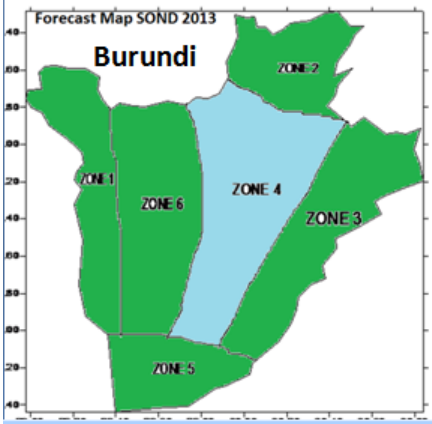
The national focal point participants and resource experts expressed gratitude to the development partners of ICPAC, in particular African Development Bank (AdDB) for continued support to ICPAC, the PRs of the ICPAC member countries and to ICPAC director Prof L. A Ogallo for effective regional leadership in climate services. Participants thanked renowned organizations and institutions supporting operational climate science services in the region, in particular the World Meteorological Organization (WMO), UK Met Office, the National Oceanic and Atmospheric Administration (NOAA) and Korea Meteorological Agency (KMA).

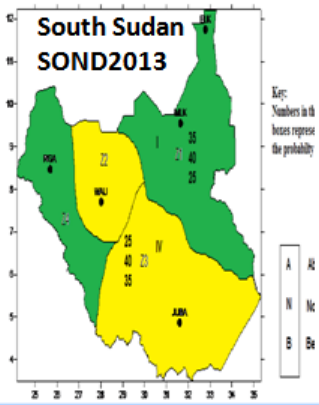
ANNEX 1: SAMPLE PARTICIPANT CBWT PRESENATIONS, REGIONAL CONSENSUS OUTLOOK SOND2013



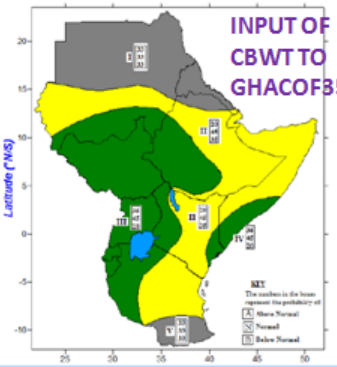








CONSENSUS SOND2013 OUTLOOK



ANNEX 2: PROGRAM: **REGIONAL CLIMATE MODELING AND CAPACITY BUILDING TRAINING WORKSHOP (CBTW) FOR CLIMATE SCIENTISTS AND FORECASTING OF THE GHA CLIMATE DURING SEPTEMBER-DECEMBER 2013. HOSTED BY ICPAC: 12th – 19th AUGUST 2013**

WEEK 1

TIME	SUNDAY 11th AUG. 2013	MONDAY 12th AUG. 2013	TUESDAY 13st AUG. 2013	WEDNESDAY 14nd AUG. 2013	THURSDAY 15rd AUG. 2013	FRIDAY 16th AUG. 2013	SATURDAY 17th AUG. 2013
8.30 - 10.30	Arrival of participants	-Introductions and workshop perspectives by the director of ICPAC: **Prof Ogallo** -Recent processes and evolutions with implications on GHA SOND2013 climate scenario: **J Mutemi.** **Practical 1:** Generation and saving of country data templates by homogeneous zones - SOND rainfall series 1961 – 2012 **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed**	**Practical 3**: Statistical-predictive modeling of SOND 2013 rainfall scenario over homogeneous zones in all countries -Model Fitting with identified predictors -Model Testing and verification **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed, G Ouma**	**SEMINAR 1:** Presentation and discussion of modelling results for SOND2013 in countries -Burundi **-Djibouti** **-Ethiopia** **-Eritrea** **-Kenya** **-Rwanda** **-Somalia** **-South Sudan** **-Sudan** **-Tanzania** **-Uganda** **All Resource Persons**	**Practical 6:** Dynamical Forecast **With GPCs and Regional Model** Overview of ICAP dynamical modelling scheme: Global→ Regional Model: Example of System under configuration (e.g. Sep & Oct 2013 GSM downscaled with RSM) -WMO GPC forecasts for GHA SON 2013 (rainfall & temperatures) -Skill of Individual GPCs (SON2013 Rainfall) **J Mutemi, F Opijah, B Mohamed**	**Practical 7:** Statistical and dynamical consensus Regional and country SOND2013 forecasts -Determination of areas common skill by all methods -Determination of areas of lowest skill by all methods -Attribution of major causes of skill towards consensus SOND2013 regional outlook -Additional methods (Analogue, pattern matching, etc). **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed, A Colman (Uk Met).**	**SEMINAR 2:** Presentation and discussion of Consensus SOND2013 -Burundi **-Djibouti** **-Ethiopia** **-Eritrea** **-Kenya** **-Rwanda** **-Somalia** **-South Sudan** **-Sudan** **-Tanzania** **-Uganda** **All Resource Persons**
10.30-11.00		COFFEE	BREAK	COFFEE	BREAK	COFFEE	BREAK
11.00-13.00	Arrival of participants	**Practical 1**: Continued ..1 **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed, G Ouma**	**Practical 3**: Continued…1… -Model Fitting with identified predictors -Model Testing and verification **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed, G Ouma**	**SEMINAR 1:** **…Continued…** **-Identification of common problems and discussion on how to implement corrective modelling for SOND20132013** **All Resource Person**	**Practical 6:** …Continued 1…. The Regional Model **J Mutemi, F Opijah, B Mohamed**	**UK MET OFFICE OND2013 GHA FORECAST** **A Colman (Uk Met)**	**Seminar 2** **Continued…1** **Drafting of Regional Consensus outlook Following** **-Statistical** **-GPCS** **-Regional Model** **-Expert interpretation** **-Analogues, etc**
13.00-14.00		LUNCH	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
14.00-15.30	Arrival of participants	**Practical 2**: Generation of SOND 2013 Indicators and Predictors -Recapping the statistical models used during pre-COF32 (OND2012) and subsequent update of predictors -ENSO Indices focusing on likely La Nina being a significant factor during Aug-October 2013 (NINO3, SOI, Oceanic heat-index, etc) -SSTs and SST modes (IOD, ATL Meridional gradient) -Other indices: NAO, QBO. -Global scale circulation process indicators -Regional circulation processes and Indices (including monsoons precursors of OND2013 rainfall in the GHA)	Overview and Basic principles of Screening Model performance -J Mutemi **Parctical 4:** Screening Models and tune-up for first results of GHA SOND2013 rainfall for all zones in the countries - Predictor filtering, removal of overlaps, multicollinearity, and optimization of useable skill and model signals **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed, G Ouma**	**Practical 5:** **Corrective modelling following Seminar 1** -Draft 1 country outlook for all zones -Draft 1 regional consensus SOND 2013 outlook from statistical modelling **J Mutemi, C Oludhe, W Gitau, P Omondi, F Opijah, G Ouma**	**Practical 6:** …Continued 2…. **The Regional Model Experimental set up and preliminary run for dynamical forecast over the Region** **J Mutemi, F Opijah**	**Practical 7:** …Continued 2…. **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed,** **A Colman (Uk Met)**	**Seminar 2** **Continued…2** Smoothing and writing GHACOF35 outlook details with highlight implications for critical application sectors (Agriculture & water resources) **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed, G Ouma** **A Colman (Uk Met**
15.30-18.00		COFFEE	BREAK	COFFEE	BREAK	COFFEE	BREAK
18.00-19.30	Arrival of participants	**Practical 2**: …Continued 1….. **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed, G Ouma**	Practical 4….. …Continued…. (Preparation for Seminar 1)	**Practical 5:** Continued….. **J Mutemi, W. Gitau, C Oludhe, F Opijah, P. Omondi, B Mohamed , G Ouma**	**Dynamical consensus SON2013** -GPCs (Rainfall & temperature) -RSM (if done: Rainfall & temperature) **J Mutemi, F Opijah, B Mohamed**	Preparation for Seminar 2	**Retire/Free**
20.00-23.00	**Arrival of participants**	**Documentation**	**Documentation**	**Documentation**	**Documentation**	**Documentation**	

⇨ **Week 1 Resource Persons: Prof L A. Ogallo, Dr J N Mutemi, Dr W Gitau, Dr C Oludhe, Dr F. Opijah, Dr A Colman (Uk Met), Mr B Mohamed, Dr G Ouma, Prof R. Anyah (Univ. of Connecticut, USA).**

ANNEX 2: CONTINUED: WEEK 2 PROGRAM (1 day):

TIME	MONDAY 19th AUG. 2013	TUESDAY 20th AUG. 2013	WEDNESDAY 21st AUG. 2013	THURSDAY 22nd AUG. 2013	FRIDAY 23st AUG. 2013	SATURDAY 24th AUG.2013
08.30-10.30	**Finalization of Country Reports and Documentation of consensus SOND2013 Regional outlook finalization**	Move to Eldoret for GHACOF35 activities	**GHACOF35 SEPARATE PROGRAM IN ELDORET, KENYA.**			**Departure from GHACOF35**
10.30-11.00	**Coffee Break**					
11.00-13.00	**Finalization of Country Reports and Documentation of consensus SOND2013 Regional outlook finalization**					
13.00-14.00	**Lunch**					
14.00-15.30	**Finalization of Country Reports and Documentation of consensus SOND2013 Regional outlook finalization**					
15.30-18.00						
18.00-19.30						
20.00-23.00	**-Close of pre-COF35 CBTW**					

⇨ **Week 2: Resource Persons: Prof L A. Ogallo, Dr J N Mutemi, Dr W Gitau, Dr C Oludhe, Dr F. Opijah, Dr A Colman (Uk Met), Mr B Mohamed, Dr G Ouma.**

ANNEX 3: LIST OF FOCAL POINT PARTICIPANT FOR EACH COUNTRY

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11						

ANNEX 4: LIST OF RESOURCE PERSONS

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6	Dr G Ouma	Kenya	University of Nairobi	gouma@uonbi.ac.ke
7	Dr W Gitau	Kenya	University of Nairobi	wi.gitau@uonbi.ac.ke
8	Dr F Opijah	Kenya	University of Nairobi	fopijah@uonbi.ac.ke
9	Mr B Mohamed	Sudan	ICPAC	bmohamed@icpac.net