E M I B A M A

YEETHIOPIA YEMETEOROLOGY BALEMUYAWOCH MAHIBER
***(ETHIOPIAN* METEOROLOGICAL SOCIETY)**

Proceedings
of

EMIBAMA First Scientific Conference

on

"Climate Change and Variability and its Impact on Ethiopia and Eastern Africa"

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Edited by: Endalkachew Bekele
Workneh Degefu
Tesfaye Haile

Conference Rapporteur: Tesfaye Gissila

President of FDRE Ato Girma Woldegeorges opening the Second Assembly and the First Scientific Conference of EMIBAMA

1. OPENING SPEECH
BY
HIS EXCELLENCY GIRMA WOLDEGIORGIS
PRESIDENT OF THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

Dear Representatives of the World Meteorological Organization

Dear Representatives of Meteorological Societies of Eastern Africa countries,

President and Board Chairman of Yeethiopia Yemeterology Balemoyawech Mahiber (Ethiopian Meteorological Society), EMIBAMA,

Dear members of the Ethiopian Meteorological Society,
Invited guests,
Ladies and Gentlemen,
It is an honour and a privilege for me to address the opening of the Second General Assembly and the First Scientific Conference of EMIBMA. On behalf of the government of the Federal Democratic Republic of Ethiopia and my own, I would like to express my appreciation to you for hosting this important conference. I wish also to thank the organizing board and committee members of EMBMA for their contribution in the organization of this event, and the National Meteorological Agency for the facilities provided to host the conference.
I am pleased to commend EMIBMA for the achievements made in a very short span of time since its inception two years ago. The EMBMA has undertaken numerous tasks related to the establishment of the meteorological society. In its first General Assembly, concerned members and board members with the cooperation of the National Meteorological Agency established the office of the society. A number of committees were created and officers were appointed for undertaking the organizational and the society activities. To this end the contributions of each member of the society and the support provided by the National Meteorological Agency in strengthening the operational capability of the society is commendable.

As you all know, the science of meteorology has made significant provision for the improvement of the well-being and life condition of mankind. In 50 years lifespan the National Meteorology Agency has played a crucial role in the development of the socio-economic sectors by providing timely weather and climate information to the public community. The horizon of meteorology in Ethiopia is continually expanding and it has covered a broad range of activities for improving the economic and social conditions in which people live and work. In this connection, the EMIBMA is expected to undertake a major role in assisting the economic development of the country.

The ultimate goal of EMIBMA being to promote research and studies in meteorology, hydrology and environmental sciences, the society should help the training of young professionals for the effective use of weather and climate information in our country. Our capability to cope with extreme weather and climate situations such as droughts, floods and the water supply for towns and industry, rural areas and energy production. Especially, the strengthening of emergency Early Warning Services for the agricultural sector as well as hydrological information for irrigation would be possible if EMIBMA creates an

enabling environment to satisfy the need for the availability of trained specialists and professionals in weather and climate predictions.

The hazard posed by global warming on our Planet is the focus of attention in our country. The government of Ethiopia is taking various actions and regulatory measures as well as steps to minimize the impact of global warming and the adverse effects of climate change and variability. While there have been major advances in our national capacity for addressing the impacts of climate change and climate variability, there remain deficiencies in capacities at national and regional levels. To this end, a much greater effort in combating weather and climate impacts will be essential to translate new scientific and technological capabilities into effective climate service for local communities, especially the farming community.

The development of effective response measures to tackle climate change and variability will also require enhanced cooperation with various stakeholders and international organizations for the exchange, monitoring, and analysis of climate information.

In this regard, at national level, mitigating strategies has been undertaken in association with the celebration of Ethiopian Millennium. Thus, the general public have participated in planting trees for environmental protection. However, this limited action alone could not solve the complex threat of global warming. Therefore, it is essential to introduce appropriate decisions and policies aimed at ensuring the participation of the general public and the community at large.

In Ethiopia, awareness creation in public education, public information and transparency form the basis of policies that will make the population less vulnerable to the ever increasing impacts of weather and climate. In addition for sound scientific knowledge and modern technical facilities for observing, researching and exchanging information about the global climate system will ensure to mitigate the impacts of the vagaries of weather and climate change, I believe, therefore, that it is essential that the conference makes a strong call for enhanced climate monitoring and research.

I would also like to note that the National Meteorological Agency needs to enhance the development of applications and delivery of its services, and the provision of timely warnings and forecasts to support the sustainable economic growth that the country achieved in the last five years and to assist in ensuring sustainable economic growth and in fulfilling the poverty reduction strategy.
In conclusion, I wish this Assembly every success and I believe that the scientific session of the Conference will debate on issues and challenges posed by climate change and variability and global warming. In realizing your objectives the government of Ethiopia will help you in your endeavors to attain your objectives.

Thank you and God bless you.

2. INTRODUCTORY REMARKS
BY
WORKNEH DEGEFU
PRESIDENT AND BOARD CHAIRMAN
EMIBAMA

H. E . Ato Girma Woldegiorgis , President of the Federal Democratic Republic of Ethiopia (FDRE)
Representative of the World Meteorological Organization
Representatives of sister Meteorological Societies from Eastern African countries

Representatives of sister Professional Societies from Ethiopia

Members of EMIBAMA

Invited Guests

Ladies and Gentlemen

On behalf of EMIBAMA I would like to express my heart felt thanks to H. E. the President of FDRE for gracing us with his presence today to officially open the General Assembly and the Scientific Conference of our Society.

I would also like to thank the World Meteorological Organization, national and regional sister Societies and other institutions for accepting our invitation to participate in these important events.

Your Excellency
Dear Members and Participants

It gives me great satisfaction to report to you that EMIBAMA has made significant progress since its First General Assembly a year ago. These include the establishment of EMIBAMA's office and making it operational, the establishment of four standing committees; the recruitment of 49 additional members; the initiative taken to establish branches of EMIBAMA at Arba Minch University and Adama; and the steep taken to establish a Chapter of EMIBAMA in North America. In addition a periodic Newsletter is being published and distributed to members. Important and useful discussion were held with relevant national and international institutions notably with the officials of the World Meteorological Organization, on possible cooperation and on ways and means of strengthening the activities of the Society..

In the coming years EMIBAMA has plans to accomplish several important tasks. These include strengthening of the work of the standing committees; developing and implementing research projects; publishing periodic scientific journals; establishing and implementing fellowships and scholarship programmes; recruiting additional members and enhance the financial recourses of the Society.

Finally I would like to take this opportunity to thank all those in one way or another contributed and supported the activities of EMIBAMA. In particular, the National Meteorological Agency. the Science and Technology Agency and the World Meteorological Organization deserve to be mentioned in this regard.
I thank you for your attention..

3. STATEMENT
BY
STEPHEN NJOROGE
Regional Representative
WORLD METEOROLOGICAL ORGANIZATION

H.E Ato Girma Woldegioriges President of the Federal Democratic Republic of Ethiopia

Ato Kidane Asefa, Permanent Representative of Ethiopia with WMO and Director General of Ethiopia Meteorological Agency,

Ato Workneh Degefu, President of Ethiopia Meteorological Society,

Representatives of Meteorological Societies in Eastern Africa

Members of the Ethiopia Meteorological Society,
Invited Guests,
Ladies and Gentlemen,

It is with great pleasure that I visit Ethiopia for the Second Ethiopian Meteorological Society on Climate Change and variability and Its Impact on Ethiopia and Eastern Africa. On behalf of the World Meteorological Organization, and on my own, I wish to thank Mr. Kidane for his kind invitation of behalf of the Society and to congratulate Mr. Degefu, President of the Ethiopian Meteorological Society and the sponsors for organizing this important event, I bring you the well wishes of the WMO Secretary General, Mr. Michel Jarraud who would have liked to be here in person, but because of prior commitments he could not. He is looking forward to the outcomes of this conference.

May I express to H.E. and through him to the people of Ethiopia for the very warm hospitality we have received since our arrival in this beautiful and historical city of Addis Ababa.

Your Excellncy,
Meteorological societies have been established in many countries through the years, essentially to promote research, the development and dissemination o knowledge o the atmospheric and related oceanic and hydrologic sciences. Such societies have helped foster the link between research workers and operational meteorologists and others who have general interest in the weather, climate and in the environment as a whole. They have also aimed to further the application of meteorology to socio-economic activities and promote education on all aspects of meteorology and related sciences among schools, teachers and the public-at-large.

With some exceptions, not many Metrological services in Africa are doing research work. By their nature, the NMSs have been almost completely absorbed in day-to-day operational activities, providing crucial weather information and services to an ever-growing circle of users. WMO has focused primarily on assisting the development of the National Meteorological and Hydrological Services to enable them to meet their national development needs. In the past, research has been a secondary activity, but the situation is now changing in many countries. With the continued training of research personnel, a core of highly qualified and talented young scientists has emerged.

Climate variability and change influence the well-being of society through interactions with life-supporting systems. Humankind has always observed nature to monitor and predict climate conditions, thereby taking advantage of favorable conditions and managing

associated risks. WMO's scientific and research programmes are very relevant to fostering research in climate and related aspects. For the application of the research outcome, some of you may recall that WMO was instrumental in the establishment of the IGAD Climate Prediction and Application Center (ICPAC) in Nairobi, and the African Center of Meteorological Applications for Development (ACMAD) in Niamey. At the start of every season, ICPAC organizes Climate Outlook Forum, with experts from Ethiopia and Greater Horn of Countries and issue a seasonal forecast which is circulated to all sectors of development. I thank the Director of ICPAC prof. Laban Ogallo for the excellent services and leadership.

Your Excellency.

The emergence of meteorological societies in several African countries is making a significant contribution to bringing research and its applications to the forefront, by bridging the gap between the theory and operations, and between national Meteorological and Hydrological Services (NMHs) and research institutes such as Universities. Within short time since its establishment, the Ethiopia Meteorological Society (EMIBAMA) has gone a long way in meeting its objective in the advancement of meteorology in Ethiopia and beyond. The present workshop is the second to be organized by the Society. Its theme, "Climate Change and Variability and Its Impact on Ethiopia and Eastern Africa", is appropriate and timely against the background of growing world interest in climate variability and climate change and associated impacts on societies and national economies. EMIBAMA is fortunate to be founded and supported by a strong Meteorological Agency. EMA is known to have a good compliment of qualified staff. The Early Warning System in EMA is a model copied by many Meteorological Services in the region. WMO has been involved in the further development of EMA through project formulations and implementation and through training.

To assist the Ethiopian Meteorological Society in furthering its goals, in light of the growing requirements for meteorological products and services in support of the socio-economic development, I would like to make few proposals that the Society could address:

(i) Constantly review all its activities, in light of the multidisciplinary nature of meteorology and the numerous allied sciences.

(ii) Place greater emphasis upon reaching out to the broad spectrum of the public. This implies more activities and outreach directed to decision-makers as well as generating grass-root support through education of the public.

In addition, the Ethiopian Meteorological Society could further promote meteorology in Ethiopia and the Greater Horn of Africa as a whole by:

- Inviting other societies to participate in its activities, such as workshops;
- Encouraging joint research between its members and those from other disciplines and societies;
- Considering the establishment of research groups or commissions from among its members to examine specific areas of interest;
- Publishing a bulletin to facilitate dissemination of research results by scientists within Ethiopia and beyond;
- Encouraging young scientists through offering awards and pries to young scientists and meteorologists, and for the best dissertation in meteorology and related fields in Ethiopian universities and institutions;

- Paying special attention to schools and teachers and influencing the inclusion or improvement of meteorology in school curricula; and,

- Organizing exhibition on the occasions of the World Meteorological Day.

Your Excellency,

WMO has a long tradition of fruitful collaboration with several national meteorological societies and encourages the efforts of meteorologists to work together for the advancement of atmospheric science, its applications and related services. Through its various scientific and research programmes, WMO offers a unique opportunity to the scientific community in its member countries to participate in various regional and global research activities. Several areas of possible collaboration between WMO and EMIBAMA exist. The Society should therefore encourage its research members to participate actively in the work of the WMO scientific and technical commissions. They should also be encouraged to have their work considered for the various WMO awards, such as the WMO *Research Award for Young Scientists*, and the *Vaisala Award*.

Let me conclude by reassuring you H.E. that WMO will continue to support the National Meteorological and Hydrological Services, as well as the meteorological societies worldwide, including the Ethiopian Meteorological Society, in its efforts to promote human resources development, research and applications of meteorology.

Your presence today, Your Excellecncy, is an inspiration to the meteorological community in Ethiopia and the region for the importance your Government attaches to this profession.

I wish you all a successful conference.
Thank you

4. summary of the Conference proceedings

The Second General Assembly and the First Scientific Conference of the Ethiopian Meteorological Society (EMIBAMA) was held on the 15th and 16th of October 2008 at the headquarters of the National Meteorological Agency in Addis Ababa, Ethiopia. The events were officially opened by His Excellency Ato Girma Woldegiorgis, President of the Federal Democratic Republic of Ethiopia. Papers at the Scientific Conference were presented under the theme ‘’Climate Change and variability and its Impact on Ethiopia and Eastern Africa”.

The events were attended by members of the Society, representatives of the sister societies from Ethiopia and Eastern African Countries, the World Meteorological Organization, Professionals from different universities and research institutions as well as governmental and non-governmental organizations.

Due to the financial support of the Ministry of science and Technology and the World Meteorological Organization as well as the full cooperation of the National Meteorological Agency, the two meetings were successfully held. The Scientific Conference was the first undertaking since the founding of EMIBAMA in 2007.

The scientific conference started with a welcoming address by Mr Workneh Degefu, President and Board Chairman of EMABAMA. At the Scientific Conference10 research papers were presented and fruitful discussions were held on the theme of the Conference.

The first session was chaired by the President of the Society, Mr Workneh Degefu, and the key note presentation was delivered by Professor Laban Ogallo under the title “Climate change challenges and consequences for Eastern Africa.”

In this presentation, the importance of climate as a renewable resource was identified as the most important issue, to understand the consequences and challenges of Climate change for Eastern Africa. Thus it was stressed that climate change issues are greatly intertwined with addressing the critical question of socio-economic resources of human society.

The major outcomes of the first Scientific Conference (FSC) include:

- The presentation of good research papers, the follow-up discussions and the useful conclusions recommendations presented;
- The interaction and the sharing of experiences of the national meteorological societies of the Eastern African countries.; and
- The signing of a Memorandum of understanding (MOU) which laid the foundation for future cooperation and collaboration among the Eastern African meteorological societies as well as a step towards the strengthening of the African Meteorological Society.

Session I – OVERVIEW

CLIMATE VARIABILITY AND CHANGE: THE IMPACTS IN EASTERN AFRICA SUBREGION

Prof. Laban Ogallo

IGAD Climate and Applications Centre (ICPAC), Nairobi, Kenya
logallo@icpac.net

ABSTRACT

The close linkages of climate, sustainability of most environment resources, and human kind livelihoods are well demonstrated by the devastating socio-economic impacts of extreme climatic variability such as floods and droughts. A single drought or flood can draw back for many years the national socio-economic development in many developing countries including eastern Africa. Permanent changes in the traditional patterns of climate are known to have wiped out some of the past powerful civilizations world wide. The recent IPCC fourth assessment report, indicate that the least developing countries, especially Africa, and the low lying coastal areas / islands nations are most vulnerable. Sustainable development including achievement of the Millennium Development Goals will remain a dream without effectively addressing the climate risk challenges of the region, including issues related to reducing climate variability risks and adaptation to climate change.

The climates of eastern Africa are complex and highly variable. These have significant implications on both climate variability and change. Providing realistic climate risk management strategies for reducing climate variability risks as well as adapting to climate change will require good knowledge of the past and present climates, and accurate projections of local and regional climate expectations which are some of the key mandates on the National Meteorological and Hydrological services (NMHSs), World Meteorological Organization (WMO), the rest of the meteorological community, together with the other related fields.

This paper highlights some of the key challenges, experiences and lessons regarding regional climate risks proofing; with special references to the NMHSs; WMO; the regional climate centers such as the IGAD Climate Prediction and Application Centre (ICPAC), among others. These issues addressed include adequacy of the national/ regional climate observation systems; data archiving and data management; hazard mapping; prediction and early warning; national/ regional climate change detection and attribution; mitigation; regional climate change scenarios for impacts, vulnerability and adaptation assessments; capacity building; policy issues; education and awareness; sector specific applications of climate information and products; inter disciplinary/ regional/ international collaborations; outreach, communication and network systems; research; among many others.

Discussions on Session I

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Q.1. The three most important components of the Kyoto Protocol, where developing countries can benefit are the Joint Development Mechanism, the CDM and the Carbon trading. Do you have any information on any country benefiting from these three components?

A1. Both negotiations for Carbon trading CDM application are underway to be implemented in South Africa. Regarding the CDM project in Kenya, ICPAC has been asked for advice, and there have been negotiations to pave the way for implementation. The Professor further noted that, negotiations involving multi-disciplinary professionals and Government decision makers are the surest method of achieving success in this field.

Q.2. Can you elaborate Kenyan experiences in the coordination of climate change activities?

A.2. There is a wide spectrum of participation from the Government and non-Governmental organization which includes lawyers, environmentalists, NGOs, Different Governmental departments, professional societies the foremost of which is the Kenyan Meteorological Society and the ICPAC , which work closely with the Kenyan Government on Climate change issue. Governing systems are different in different countries. What we need is that we have to use the best part of the Government side to advance the address of the issues of Climate Change. It would be very much advisable to sit down and discuss and negotiate with the stake-holders so as to bring meaningful results. When we go to negotiations, we have to consult with the different professional people such as lawyers and other professionals with the expertise needed to strengthen our negotiation capacity

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Session II - CLIMATE SCIENCE AND MODELING

1.CLIMATE CHANGE SCENARIOS FOR ETHIOPIA

Abebe Tadege

ABSTRACT

Information about possible changes to the climate of Ethiopia in the short-term and long-term future is the basis for a number of purposes including land use planning and assessing climate change impact on various economic sectors. The future climate depend on many factors such as solar radiation, volcanic eruption and greenhouse gas emissions, Current approach to predicting the future climate is by using Global Climate Models (GCMs). Climate models use quantitative methods to simulate the interactions of the atmosphere, Ocean land surface, and ice.

In this paper climate projections for Ethiopia generated using the software MAGICC/SCENGEN (Model for the Assessment of Greenhouse-gas Induced Climate Change)/ (Regional and global Climate SCENario GENerator) coupled model (Version 4.1) for three periods centered around the years 2030, 2050 and 2080 based on IPCC (2001) SRES emission scenarios are presented. Recommendations to improve information on climate change scenarios are also made.

2.CLIMATE CHANGE IMPRINTS IN ETHIOPIA

Abebe Yeshanew

ABSTRACT

Based on long-term historical time-series climate data, climate change fingerprints are detected over Ethiopia and its proximity using robust and modern techniques. The analyses are done based on different epochs through removing the anthropogenic components and maintaining the natural signals. Hence, space-time imprints of climate change are found long-term historical climate data. The research contributes in detecting anthropogenic part of climate using new and vigorous techniques.

3. USE OF THE ICTP'S REGCM3 IN SIMULATING THE RECENT PAST AND THE FUTURE CLIMATE OF ETHIOPIA

Endalkachew Bekele

ABSTRACT

Regional Climate Models have become useful tools for downscaling seasonal predictions and climate change projections dynamically. In this work, the ICTPs Regional Climate Model version 3 (RegCM3) is Customized in a way that it simulates well the climatology and rainfall variability of the Spring rainfall (small rainy season) of Ethiopia.
The simulation experiment indicated that the Grell convection scheme with Fritsch-Chapel closure assumption simulates the Spring rainfall of Ethiopia better than the other convection schemes of the RegCM3.

Further simulation experiment was performed using the Grell convection scheme and we have found that precipitation efficiency, maximum depth of stable layer between LCL & LFC and the Fritsch & Chappell ABE removal timescale are the most important parameters of the Grell convection scheme in customizing RegCM3 for simulating the Spring rainfall of Ethiopia. This customized model can be used for dynamically downscaling seasonal predictions and climate change projections.

4. CHANGES IN THE FREQUENCY AND INTENSITY OF EXTREMES OVER NORTHEAST AFRICA

Gebru Jember

ABSTRACT

Climate of Northeastern Africa varies from humid to semi-arid with both abundant and scarce moisture. Hence, flooding and drought are frequent phenomena which have a direct impact on the agriculture, health, water and other socio-economic sectors of the region. Analysis for the expected changes in the frequency and intensity of extreme rainfall induced by climate change in Ethiopia is the aim of this study.

The Ethiopian area has been divided into three homogeneous rainfall regimes (Zone A-C).The seasonal classification of the region,

especially over Ethiopia, is from February to May, June to September and October to January, called Belg, Kiremt and Bega, respectively. Here, more emphasis is given to the Kiremt and Belg seasons.

Anomalous wet and dry decades were identified using ERA-40 data. The condition of the main rain bearing systems during these decades has been assessed and from this result systems which favor more for the extremes have been detected. Among the systems that control the weather activity in the region are: Inter-tropical Convergence Zone (ITCZ), Tropical Easterly Jet (TEJ), East African Low Level Jet (EALLJ), El Niño-Southern Oscillation (ENSO) as well as Mascarena, St. Helena, Azores and Arabian High pressure systems. Then simulations from GFDL and CCCma were analyzed.

There is large decadal variability in the occurrence of extreme rainfall events. During the Kiremt season, 90-96% wet anomalies were mostly occurring in the 1958-1979 time range. The dry anomalous decades were mostly found in 1980-2001 for both zone-A and -B. During Belg, all the dry anomalies are in the third decade of March for zone-B. During April and May, most of the dry anomalies are in the first decade. For zone-C, most of the dry anomalies are in the third decade of March.

The sources of moisture, the means of transport and the dynamic conditions should be satisfied to have a wet anomaly. During the driest decades these conditions are not fulfilled. The future scenario runs from GFDL and CCCma indicate that both models have a consistent trend. However, as most models have limitations, even the seasonality is not well represented in both models.

5. CLIMATE CHANGE AND VARIABILITY DETECTION FROM HARMONIC ANALYSIS OF METEOROLOGICAL VARIABLES IN ETHIOPIA

Eyale Bayable

ABSTRACT:

Climate change is the serious challenge which is believed to be caused by the accumulation of anthropogenically emitted green house gases after industrial revolution. It has immense negative cosequences on developing nations as these countries have economic activities based on natural resources such as biodiversity and water resources which are the part and parcel of the climate system. Moreover, they lack economic development and institutional capacity to take proactive as well as reactive measures against the change.

The Subsaharan Africa countries are likely among the most vulnerable to the impacts of climate change. Situated in the Horn of Africa, Ethiopia is one of the least developed countries in the subsaharan region which is more vulnerable to climate variability and chgange. Since climate has the potential to exert a significant impact on agricultural activity, the agriculture-Development Lead Industralisation(ADI) Strategy of the Ethiopian government will be paradoxically challenged by climate change impacts .This paradox is self explanatory for how much climate change studies have significant importance for Ethiopia .However, climate change studies made so far are limited and they are mostly based on the regional projections of the different years of the IPCC reports for national

communications. Therefore, studies at a national level from in-situ measurements are needed to provide fine-scale climate information for impact assessment and adaptation options to cope with the challenge. Because the country is characterized by a diverse biota, climate and heterogeneous land surfaces which will be affected by climate change differently. In this study, climate change and variability of Ethiopia is investigated using multi-scale harmonic analysis of the two most important meteorological variables(temperature and precipitation). The results revealed some details of the change and variability at various spatial and temporal scales.

Keywords: Harmonic analysis, temperature, precipitation, multi-scale harmonics, anthropogenic green house gases.

6. A SIMPLE MODEL FOR SCENARIO STUDIES OF CHANGES IN GLOBALCLIMATE

Tadesse Terefe

ABSTRACT

This paper gives a documentation of a simple climate model for studying the effects of future climate gas emissions on global mean temperature and sea level. Input to the model is global emissions of 29 gases. Atmospheric concentration of carbon dioxide (CO2) is calculated on the basis of work published by Joos et al. (1996). The parameterization is founded on complex models for the carbon cycle where the exchange of carbon between the atmosphere, the biosphere and the oceans
is considered. Future concentrations of other gases are calculated by standard equations based on emissions and chemical decay of the different gases in the atmosphere. Radioactive forcing from the modeled concentrations in source gases is calculated by applying standard parameterizations published in the literature. In addition, radioactive forcing is calculated for soot and sulphate aerosols (direct and indirect effects) as well as the secondary components tropospheric and stratospheric
ozone and stratospheric water vapor. The estimated Radioactive forcing serves as input to an energy balance climate/upwelling-diffusion ocean model developed by Professor Michael E. Schlesinger (Schlesinger et al., 1992). The global and hemispherical change in annual mean temperature is calculated based on the exchange of energy between the atmosphere and the oceans, and the transport of energy in the ocean. The model uses prescribed values for

climate sensitivity based on GCM results. The change in sea level rise is both determined by the melting of glaciers and the thermal expansion of the ocean. The model serves as a useful tool in the analysis of possible global
climatic changes caused by present and future greenhouse gas emissions. However, the intention
is to extend the model so that regional predictions of
temperature and other climate variables can be carried out.

Discussions on Session II

Q. 1. How can we assess the increase in rainfall and the hazard thereof, with a corresponding increase in temperature due to Global warming, and how consistent can this relation be?

A.1. More temperature means more water vapor in the Atmosphere and if there is a cooling system then precipitation is supposed to increase, but that depends on the cooling system, which depends on the area. Thus impacts will not be the same for all areas.

Q.2. The years selected were 1984 and 1996, is that based only on the rainfall?, I was expecting El Nino and La Nina episodic years, and what was the criteria for selecting the two years?

A2. The years were selected based on rainfall not based on episodic events.

Q.3. How can we say that the developing countries are more vulnerable to Climate Change as compared with the developed countries, because in contrast we are witnessing the increasing frequencies and intensities of hurricanes and also their impact for example on the USA? Like the Katrina, are these not the results of climate change, with damages in loss of billion of dollars?

A.3. Professor Laban Ogallo indicated that vulnerability depends on Policy, Institutions adaptive capacity and others. Dr Abebe Yeshanew further added that for the last five years, western USA was affected by drought and the impact did not produce any disastrous humanitarian consequence, the reason was that the adaptive capacity of the USA was very high. If there had been drought for five years in another developing country, think of the humanitarian disaster that would have occurred and since we do not have the adaptive capacity we are more vulnerable to climate change. Adaptive capacity is the potential to respond to the disaster etc, thus we can say that developed countries are less vulnerable and developing countries are more vulnerable to Climate Change. Mr Abebe Tadege further explained that we have to understand what vulnerability means. It is a function of sensitivity and adaptive capacity. For example, Agriculture is more sensitive to climate variability. Adaptive capacity includes how much capacity you have in the form of institutions, wealth, infrastructure, etc. Thus depending on these factors, there is variability in vulnerability all over the world. Even there is a variability of vulnerability in a single country. Though the cause for GHG emissions, the sources are the developed countries, the impact is greatest over developing countries.

Session III - IMPACTS, IMPLICATIONS AND ADAPTATION

1. CLIMATE IMPACT ASSESSMENT AND RESPONSE STRATEGY FOR ETHIOPIA

Tesfaye Haile

ABSTRACT

Since Ethiopia has been frequently affected by extreme climate events, such as drought and flood, it is found necessary to introduce brief climate profile of the country.

Different studies have shown that due to the influence of climate change /climate variability /, at global and regional levels, temperature rises and rainfall regimes shift leading to enhanced drought and flood, which are expected to occur in the tropics, including Ethiopia.

In this connection, therefore, it is anticipated that the country's environment would be degraded. Also pest and diseases together with desert locusts are anticipated to frequently generate. Such negative impacts would lead to significant decline of the socio –economic development of the country. In view of such unfavorable situation, the majority of the people are expected to be vulnerable to the occurrences of extreme weather events.

With a view to coping up with such impacts of climate extremes, it is of paramount importance that appropriate measures must be undertaken at global and national levels as well as at local levels by the rural population.

In order to withstand the effects of climate variability and possibly climate change, it is imperative to seriously consider for undertaking relevant mitigating measures, in different socio –economic sectors, which include agriculture and food security, forest and bio-diversity, water resources, energy, transport and industry, human settlement and health together with atmospheric protection.

2. EFFECTS of Climate Change on Agriculture particularly in Semi-Arid Tropics of the world with some Examples of selected areas of Ethiopian conditions"

Almaz Demessie

ABSTRACT

Today climate change is a burning issue all over the world because of its global nature. Fears have arisen that; climate may be changing for the worse and its impact on agricultural production, which will reduce the supply of food to growing population, especially in developing countries. Climate change would affect various human activities. Agriculture is one of the activities, which can e seriously affected by climate change. Due to high inter-annual variability and uneven distribution of rainfall during the rainy season, recurrent droughts have observed in semi-arid tropics of the world over the last three decades. As White, (cited in Climate Variability and Agriculture by Y.P Abrol, S. Gadgil and

G. B.Pant 1996) pointed out rain fed agriculture in the semi-arid tropics is limited mostly by high climatic variability with principal limiting factor being rainfall. The main crops of traditional rain fed agriculture are sorghum, millet, maize, cowpea, pulses, and sesame. Adverse climatic conditions are the bottleneck of Ethiopia's rain fed agriculture development. Besides, agricultural production suffers from periodic outbreak of pests and diseases, both pre- and post harvests, in most parts of Ethiopia. Some pests are becoming a serious problem in some areas where the rainfall condition is erratic. For instance, *Sorghum Chafer* becomes a chronic problem since 1993 over northeastern highlands of Ethiopia including Afar regions.

The objective of the research study is to identify and characterize the effect of climate change on agriculture by assessing the climatic condition of the selected areas and its effect on agriculture.

3. CHEMICAL COMPOSITION AND AIR TRAJECTORY ANALYSES OF ATMOSPHERIC POLLUTION FROM PRECIPITATION SAMPLES IN ADDIS ABABA.

Haileselase Gebremariam

ABSTRACT

Atmospheric deposition has been recognized as a serious environmental problem in many parts of the world. Countries are striving for corrective measures based on research outputs to minimize human health and ecological problems related to atmospheric deposition. This study tries to present the chemical composition of 22 precipitation samples collected between March and June 2007 at AAU Science campus.

The major cautions and anions of the rainwater samples were analyzed using DX-600 Ion Chromatography and Buck scientific 210 VGP Flame Atomic Absorption Spectrophotometer. Conductivity and pH measurements carried out immediately after sample collection have showed ranges of variation between 14.00 μScm^{-1} and 58.43μScm^{-1}, and 6.28 and 7.44 with mean values of 27.36μScm^{-1} and 6.99 for the respective parameters. Volume weighted mean concentrations of 65.55,57.04,54.58,50.50,29.16,11.66,9.94,5.53,1.41, and 0.15 μeqL^{-1} have been detected for the ionic species of $N\text{-}NH_4^+$, HCO_3^-, $S\text{-}SO_4^{2-}$, Ca^2, $N\text{-}NO_3^-$, Na^+, Cl^-, Mg^{2+}, and K^+ respectively. Analytical results of the flame atomic absorption spectrophotometer for lead concentrations have also revealed the presence of lead in 5 samples above the detection limit of the instrument (>0.1 mg/L).

The dominant abundance of NH_4^+, and Ca^{2+} from agricultural activities including livestock breeding and soil dust dictate the neutral to alkaline character of the rain water samples. Hence, the majority of the hydrogen ions (acids) generated in the atmosphere from the oxidation of SO_2 and nitrogen oxides (NO_x) are primarily neutralized by ammonia (NF_{NH4+}=0.78) followed by calcium (NF_{Ca2+}=0.60). Forty eight hours back trajectory analysis performed for the rain events corresponding to peak sulphate and ammonium concentrations have revealed the advection of SO_2 from the active volcanic center at Erta' Ale (13.60^{o}N, 40.67^{o}E; summit elev. 613m)) in the rift valley of northern Ethiopia. Form the trajectory analysis, calm weather conditions over the city are also observed to stagnate and favour the accumulation of SO_2 which in turn proves the presence of significant SO_2 emissions from vehicles and industries in the city. Finally, the need for ecological impact assessment regarding the excessive ammonium and calcium deposition has become evident from the analytical results.

Key words:

Wet deposition, ionic species, precipitation, Trajectory, Addis Ababa.

4. USES OF NDVI FOR DROUGHT MONITORING OVE ETHIOPIA

Yitaktu Tesfatsion

ABSTRACT

In Ethiopia the surface based meteorological observation net work is sparse. Only few of the stations report on regular basis. It could take months to collect climatologically data from the meteorological stations network. As a result of their utility for operational purposes, drought monitoring, pest control, flood forecasting, food security purposes and fire control, and so on limited. Hence, the use of remote sensing techniques for rainfall estimation and vegetation monitoring is vital in a country like Ethiopia, where the meteorological stations are in adequate and not evenly distributed.
The National Meteorological Services Agency (NMSA) had been receiving and processing digital Satellite data from METEOSAT and NOAA 1991. The NOAA data is used among other things for vegetation and fire monitoring while the METEOSAT data is used for rainfall estimation. In this study the data set used are monthly GAC NDVI for the period 1984 to 1995 and mean monthly rainfall over Ethiopia. An attempt is made through statistical analysis to investigate the importance of NDVI in drought monitoring.

The analysis indicate that in the short rainy season (Belg) the vegetation

shows a significant increases over south-western part in the month of May, for the long rainy season (Kiremt) the maximum vegetation is over western parts in the month of September, while October is the peak for the southern parts in the dry season (Bega). Time series analysis was done for some selected areas to see the relationship between NDVI values and rainfall **g**enerally, which shows a one moth lagged response of vegetation to rainfall.

The seasonal variability and correlation coefficient has been done for the two seasons namely MAM the months are March, April and May and JJASO the months are June, July, August, September and October. Most of the areas are affected by drought in the years 84,91,90,92 and 94 respectively. Vegetation depends on several factors, however rainfall is one of the most important factor for vegetation activity. In general results of the analysis agree with other studies, which had been done earlier.

DISCUSSIONS ON SESSION III

Professeur Ogall'o Comment,

- The role of Indigenous knowledge is very powerful tool and we must understand how to use indigenous knowledge. There have been a lot of projects on indigenous prediction methods in Kenya.
- The relation between the occurrences of droughts and Floods with climate change can best be understood in terms of the frequency of their occurrences. For-example, frequency of episodic La Nina and El Nino events have increased recently and if this is as has been indicated by different researchers to be associated with climate change, then extreme weather events associated with these episodic events would increase in frequency, and for example increased frequency of La Nina/El Nino events can have the impact of more flooding events/drought events over Ethiopia as La Nina/ElNino events are usually associated with above normal rainfall/below normal rainfall over Ethiopia.
- The relation between the rainfall and crop yield depends on the area and also the rainfall time scale. Decadal (ten-daily rainfall) distribution can have greater relation with the crop yield, where as total seasonal rainfall may not have a good relation with the crop yield, as characteristics of the

temporal distribution of the rainfall may have important impact on the performance of crops.

- Meteorological societies in their own respective countries can become more effective in persuading Stake holders, to mainstream climate change knowledge in the short and long term planning and vision of Governmental and Non-Governmental Organizations. It should be possible for everyone to understand what is at stake, and this can best be approached through Cost benefit analysis on the use of climate information for both operational and planning activities.

Ato Workneh Degefu's Comment,

- The relation between El-Nino/La Nina events and the rainfall performance over Ethiopia is more the function of the season. As has been shown by different researchers, La Nina events have the tendency of being associated with above normal rainfall (flooding events in the extreme case), during the rainfall season of June-September(which is considered as the main rainy season of most parts of the country, where as they have the tendency of being associated with below normal rainfall during the rainfall season of Feb/March –May (which is considered as a short rainy season for the crop growing areas of the country and the main rainy season for the southern and the southeaster agro-pastoral areas of the country.

- By contrast, El Nino years are usually associated with below normal rainfall during the rainfall season of June to September (Where most of the notable drought years have occurred) and with above normal rainfall during the rainfall season of February to May and also the same association has also been observed during El Nino events in the rainfall season of September-October for the southern and the southeaster agro-pastoral areas of the country.

Mr. S. Njoroge's Comment,

- The research papers presented were of a very high quality, with good scientific content and analysis of the situation, and also being the cause for a much lively of scientific discussion regarding the Climate change issue over our region. He further commented that we have to concentrate more on the applications side of the research activities. This includes the development of adaptation techniques and mitigation options, in agriculture, the water sector, the health sector, and other economic sectors and this needs working together with the other major stake-holders.

Session IV

EXPERIENCES OF NATIONAL METEOROLOGICAL SOCIETIES

1. Tanzanian Meteorological Society (Dr. M. Mhita)

Members are about 100 and the society has representatives from the 8 zones in the country. Corporate members include Air lines, Governmental Departments in the Water Sector, Civil Aviation and Army aviation and others. Moreover honorary members of the society include the former president of Tanzania.

2. Kenyan Meteorological Society (Mr. F. Nguatah)

Kenyan Meteorological Society was registered in 1987 as a non profit institution. Kenyan Meteorological Department is a very good partner with the Kenyan Meteorological Society. The Kenyan Meteorological society has been actively involved in the reduction of the impacts of Climate change and Climate Variability. The society undertakes bi-annual meetings in the form of scientific conferences. The society has been instrumental in the popularization of weather clubs in schools in the country, which has greatly helped in the dissemination of information on weather and Climate. Kenya Meteorological Department, which is a life member of the society, is very helpful in the matter of funding of the society.

3. Sudan Meteorological Society(Mr. F.E.El Sayem)

Sudan Meteorological Society has been founded in 2003, registered as an NGO. The major objective of the formation of the Sudan Meteorological Society has been the enhancement of the understanding of citizens on climate issues, and to promote scientific researches. There were four occasions where the society has been instrumental in the celebration of the WMO day through the Mass Media in Radio and TV by discussions on Climate, weather and hydrology.

4. From Ugandan Meteorological Society (Mr. J. Magazi)

It is founded in 1997, as a non-profit mass organization has a membership of 21 and is headed by an executive committee. The major objective of the society has been to promote applied research. The society is also moreover involved in consultative works on Climate change. The major constraints on the society have been the problem of funding.

.5. African Meteorological Society (Mr. S. Njoroge)

The society was founded in Bujumbura in 1987. There were two scientific conferences in 1993 and in 1996 in Bujumbura. The challenges facing the society are that of the legal aspect of the society, i.e., though it is a continental society, some of the activities are constrained, when they encompass across countries activities.

6. Ethiopian Meteorological Society, EMIBAMA (Mr. W. Degefu)

The Society was founded in 2007 and membership is about 200. Mr Workineh Degefu, the President of the society presented the future plans of the society. The President of the Federal Republic Of Ethiopia has become the honorary member of the society and greater effort would be undertaken so that distinguished personalities in the country would become honorary members of the society as the Climate Agenda is becoming a serious problem to be tackled.

The society has also plans to open its branch offices in the regions as there have been various requests from the members working in the Meteorological Branch Offices.

The achievements so far have become possible with in a short time first due to the support given by the Ethiopian National Meteorological Agency.

SIGNING OF MOU

The major theme of the discussion on Meteorological Societies of East Africa was how to learn from each other's experience. Thus the need to develop partnership has been stressed. Mr Workineh Degefu informed the participants that already there is this tendency also in strengthening the close cooperation of Meteorological Societies internationally. In the near future there would be an international Conference of Meteorological Societies. Thus finally a memorandum of understanding between the Meteorological societies of Ethiopia, Kenya, Uganda, Sudan and Tanzania was prepared, read before the audiences and was signed by the representatives of the societies.

CLOSING REMARKS

By

Ato Kidane Assefa

Director General

National Meterological Agency

Hounerable members of Yeethiopia Yemeteorology Balemuyawoch Mahiber, EMIBAMA

Hounerable Representative of the WMO

Hounerable invited Guests from sister Meteorological Societies in Eastern African Countries,

Invited Guests.

It is my great pleasured to make the closing remark of the First Scientific Conference, Which have been successfully concluded.

As you are well a ware, Ethiopia has been frequently affected by drought and occasionally by flood. Nevertheless, recently such effects have been enhanced and widely spread not only in Ethiopia but also in the neighboring countries and beyond. The timely excellent presentations at this conference have clearly demonstrated that climate change and its subsequent adverse impacts seems to hover over the earth, particularly in our sub- region.

In view of such unprecedented circumstances, it is the right time to take collective and appropriate actions at both national and Sub-regional levels. In this regard I recommend that cooperation mechanisms among societies in Eastern Africa be established to exchange experiences and research results.

- Distinguished invited guests,
- Ladies and gentlemen

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Since the impacts of climate extremes that include drought and flood are anticipated to adversely affect all sectors of the economy that include agriculture, water, food security, energy, transport, industry, etc., it is recommended that potential users must make the best use of weather / climate information, predictions, advisories and warnings in their short, medium and long term planning and routine activities. Such practical steps are envisaged to ameliorate the adverse effects of climate/weather variability and changes.

In view of this, I urge potential users to regularly make the best use of metrological information as effectively as possible.

- Dear participants
- Ladies and gentlemen.

I would like to convey my sincere gratitude to the world Meteorological Organization (WMO), the Intergovernmental Panel on Climate Change (IPCC) and the Ethiopian Science and Technology Agency for their generous financial contribution for making possible in holding this timely scientific conference.

I also would like to extend my sincere appreciation to all members of the EMIBAMA and participants from Meteorological societies in Eastern Africa as well as to invited guests, who actively participated and contributed

towards the successful completion of the Second General Assembly and the timely Scientific Conference.

In addition, I would like to extend my appreciation for the board of the EMIBAMA and its office as well as to the different committee members for organizing such valuable Scientific Conference.

I would like also to thank those who directly or indirectly involve in holding the second general assembly and the first scientific conference.

At last but not the least, I wish invited gusts from neighboring sister countries, to return safe and sound to their respective countries.

I now declare the second General Assembly and the First Scientific Conference is officially closed.

Appendix 1 – Conference Time Table

EMIBAMA First Scientific Conference on Climate Change and Variability and its Impact on Ethiopia and Eastern Africa

16 October 2008
PROGRAMM

TIME	ACTIVITY	PRESENTERS	MODERATOR
8:30 – 9:00	**Registration**		
9:00 – 9:10	Introduction	Chairman	Mr. Workneh Degefu (Ethiopia)
Session I – Over view			
9:35 – 10:00	limate Variability and Change: he impacts in Eastern Africa Subrigion	Prof. l. Ogallo	
10:00 – 10:20	**Coffee Break**		
Session II - Climate Science and Modeling			Mr. J.B. Magezi-Akiiki (Uganda)
10:20 – 10:40	Climate Scenarios for Ethiopia	Mr. Abebe Tadege	
10:40 – 11:00	Climate change imprints in Ethiopia	Dr Abebe Yeshanew	
11:00 – 11:20	Use of the ICTP's RegCM3 in simulating the recent past and the future climate of Ethiopia	Mr. Endalkachew Bekele	
11:20 – 11:40	CHANGES IN THE FREQUENCY AND INTENSITY OF EXTREMES OVER NORTHEAST AFRICA	Mr. Gebru Jember	
11:40 – 12:00	Climate Change and Variability Detection from Harmonic Analysis of Meteorological Variables in Ethiopia	Mr. Eyale Bayable	
12:00 – 12:20	A simple model scenario studies of changes in global climate	Mr .Tadesse Terefe	
12:20 – 13:00	Discussion		

13:00 – 14:30	**Lunch Break**		
Session III - Impacts, Implications and Adaptation			Prof. H.S. Adam (Sudan)
14:30 – 14:50	Climate Impact Assessment and Response Strategy for Ethiopia	Mr .Tesfaye Haile	
14:50 – 15:10	Effects of Climate Change on Agriculture Particularly in Semi-Arid Tropics of the World with Some Representative Examples of Ethiopian Conditions	Mrs. Almaz Demisse	
15:10 – 15:30	Chemical Composition and Air Trajectory Analyses of Atmospheric Pollution from precipitation samples in Addis Ababa	Mr. Haileselasse Gebremariam	
15:30 – 15:50	Climate variability and change and its impact on food production of Tigray Regional State, Ethiopia	Mr. Michael Gebrekiros	

15:50 – 16:10	Use of NDVI for Drought Monitoring over Ethiopia	Ms.Yitaktu Tesfatsion	
16:10 – 16:40	Discussion		
16:40 – 17:00	**Tea Break**		
	Session IV - Experiences of National Meteorological Societies		Mr. Abebe Tadege (Ethiopia)
17:00 – 17:10	Kenya Meteorological Society	Representative	
17:10 – 17:20	Tanzania Meteorological Society	Representative	
17:20 – 17:30	Sudan Meteorological Society	Representative	
17:30 – 17:40	Uganda Meteorological Society	Representative	
17:40 – 17:50	Ethiopia Meteorological Society	Representative	
17:50 – 18:00	African Meteorological Society	Representative	
18:00 – 18:10	Closing remark	Mr. Kidane Asefa	

Appendix 2: List of participantS

1. Members of EMIBAMA				
No	**Name**	**Address**		
		Postal	**Telephone**	**Email**
1.1	Abrham W/Yohannes	NMA Box-1090 Addis Ababa	0913 19-33-04	ravo-102@yahoo.com
1.2	Abebe Tadege	NMA Box-1090 Addis Ababa	0911 03-41-05	a_tadege@yahoo.com
1.3	Abeb Yeshanew(Dr)	NMA Box-1090 Addis Ababa	0911 03-98-18	ayesha@ethionet.et
1.4	Abera Anger	Adama - MBO Box-1182 Adama	0912 19-62-83	abe angere@yahoo.com
1.5	Addisu Kebede	Kombolcha Sub-MBO	0911 77-66-32	
1.6	Adugna Zemenu	NMA Box-1090 Addis Ababa	0911 47-41-07	
1.7	Amare Babu	NMA Box-1090 Addis Ababa	0116 61-57-90	Amareb2002@yahoo.com
1.8	Almaz Demissie	NMA Box-1090 Addis Ababa	0911 19-71-20	almzds@yahoo.com
1.9	Ayano Zewde	NMA Box-1090 Addis Ababa	0913 94-44-43	ayuz-2006@yahoo.com

1.10	Belachew Kebede	NMA Box-1090 Addis Ababa	0116 61-57-79	
1.11	Bekuretsion Kassahun	P.O.Box 70986 Addis Ababa	0911 64-16-46	Bekuretsion@yahoo.com
1.12	Bekure Ketema	FEACC Box-3479819 Addis Ababa	0911 88-32-51	bekure_k@yahoo.com
1.13	Betelhem Abi	NMA Box-1090 Addis Ababa	0911 77-00-25	beti_abi2007@yahoo.com
1.14	Birhanu G/Hana	Box-1090 Addis Ababa	0116 63-96-98	b_gebrehana2000@yahoo.com
1.15	Birhanu G/Hana Serda	NMA Box-1090	0116 61-57-79	
1.16	Defaru Ashenafi	NMA Box-1090	0115 52-37-54	
1.17	Dadimos Wondifraw	NMA Box-1090 Addis Ababa	0911 36-96-65	daddimoswon@yahoo.com
1.18	Diriba Korcha	NMA Box-1090	0116 61-57-79	dkorecha@yahoo.com
1.19	Estifanos Fikadu	NMA Box-1090 Addis Ababa	0116 61-57-79	estefanosf@yahoo.com
1.20	Geremew Aragaw	NMA Box-1090 Addis Ababa	0116 61-57-79	geremewaragaw@yahoo.com
1.21	Girmaw Gezahegn	NMA Box-1090 Addis Ababa	0116 66-50-62	Girmaw.Gezagne@yahoo.com
1.22	Habtamu Tadegegn	NMA Box-1090 Addis Ababa	0115 51-22-99	
1.23	Hadush Kidane	A.M.University Box-21 Arbamench	0913 33-28-20	Kidanehadush@yahoo.com
1.24	Henok Hailu	NMA Box-1090 Addis Ababa	0911 77-10-78	henmsg@yahoo.com
1.25	Kassa Fekadu	NMA Box-1090 Addis Ababa	0911 15-35-63	Kassa_fekadu@yahoo.com
1.26	Kidane Assefa	NMA Box-1090 Addis Ababa	0911 20-80-25	Kidaneasefa@yahoo.com

1.27	Kinfe H/Mariam	NMA Box-1090 Addis Ababa	0911 61-41-11	Kinfe_hm@yahoo.com
1.28	Kidanu Mehiretu	NMA Box-1090 Addis Ababa	0911 42-79-90	Kidanu10@yahoo.com
1.29	Kidus Belay	NMA Box-1090,Addis Ababa	0911 01-68-30	Kibe_30201@yahoo.com
1.30	Lemessa Dufera	NMA Box-1090 Addis Ababa	0913 11-58-70	Leme_duf2006@yahoo.com
1.31	Melaku Geta	NMA ASSOSA-MBO Box-143 Assosa	0911 96-40-48	yeredaw2006@yahoo.com
1.32	Mersha Sahilu	Box-17135 Addis Ababa	0912 18-65-05	
1.33	Mohamed Kedir	NMA Gambella-MBO Box-282 Gambella	0911 73-87-35	MKedir20@yahoo.com
1.34	Nebiyat Yilma	A.M.University Box-21 Arbaminch	0912 03-20-06	yilmanebiat@yahoo.com
1.35	Negede Mengistu	NMA Box-1090 Addis Ababa	0116 61-57-79	Negede-mengistu@yahoo.com
1.36	Robel Takele	NMA Box-1982 Adama	0913 62-30-66	Robel.takele@yahoo.com
1.37	Sisay Desta	NMA Box-1090 Addis Ababa	0911 35-46-73	ssydesta@yahoo.com
1.38	Sisay Shewa	NMA Box-1090	0115 51-22-99	Sisay32a@yahoo.com
1.39	Sisay Siamreghe	NMA Hawassa-MBO Box-161 Hawassa	0911 06-67-19	Sis@yahoo.com
1.40	Solomon Yohanes	NMA Box-1090 Addis Ababa	0911 82-81-89	solomonmart@yahoo.com

1.41	Sufyan Seifu	NMA-Jimma MBO Box-28 Jimma	0911 77-31-26	Sufisef@yahoo.com
1.42	Tadele Badebo	NMA-Semera MBO Box-40 Semera	0913 35-24-73	
1.43	Tadesse Mekonen	NMA-Jigiga-MBO Box-2790	0912 21-86-69	
1.44	Tafesse Regass	NMA Box-1090 Addis Ababa	0116 62-52-92	retassa.gurmu@gmail.com
1.45	Tafesse OlKeba	Box-170197 Addis Ababa	0116 63-52-20	
1.46	Tesfaye Gissila	NMA Box-1090	0911 07-19-86	tesfayegissila@yahoo.com
1.47	Tesfaye Haile	EMIBAMA Box-24137/1000 Addis Ababa	0911 97-54-21	tesfayehg@yahoo.com
1.48	Tigist Misganaw	NMA Box-1090 Addis Ababa	0911 88-44-72	tigista2002@yahoo.com
1.49	Tsegaye Ketema	NMA Box-1090 Addis Ababa	0913 06-05-20	tsegaye2020@yahoo.com
1.50	Tuemay Hayelom	NMA Box-1090 Addis Ababa	0911 54-82-41	Tuemayhayelom@yahoo.com
1.51	Wogayehu Legesse	NMA Robe sub-MBO Box-129 Robe	0913 12-19-59	dnwog2000@yahoo.com
1.52	Workinen Degefu	EMIBAMA Box-24137/1000 Addis Ababa	0911 79-03-07	etmetsoc@ethionet.et
1.53	Yaregal Chemet	NMA A.M.University Box-21 Arbaminch	0918 70-66-68	yaregal.g@yahoo.com
1.54	Yenenesh W/Gebreiel	NMA Box-1090 Addis Ababa	0116 61-57-79	yenenesh--w@yahoo.com

1.55	Yosef Tesfaye	NMA Box-1090 Addis Ababa	0116 61-57-79	maty-yas@yahoo.com
1.56	Zerihun Bikila	NMA Box-1090 Addis Ababa	0116 61-57-79	Zereb2007@yahoo.com
1.57	Zerihun Walelgne	NMA Box-1090 Addis Ababa	0912 02-38-44	Zerihunw@yahoo.com
1.58	Zewde Teshome	EMIBAMA Box-24137/1000 Addis Ababa	0911 37-54-31	etmetsoc@ethionet.et
2. Local Guest participants				
2.1	Dr.Alan Nicol	111 west Minster Bridge Rd.London Se1750	0911 19-66-86	a.nicol@odi.org.uk
2.2	Ali Mohammed	MOWR Addis Ababa	0911 82-24-69	mas651511@yahoo.com
2.3	Eyale Beyable	AAU Box-1175	0911 07-53-40	eyaleb@yahoo.com
2.4	Getachew Abebe	Jimma University Box---- Jimma	0911 82-12-06	Getachewab-2008@yahoo.com
2.5	Kassahun Awoke	AAU Box-1176 Addis Ababa	0911 95-35-38	Kassahuntire@yahoo.com
2.6	Mesiker Tesfaye	EPA-APC Box-12760 Addis Ababa	0911 75-18-34	meskirt@yahoo.com
2.7	Nigatu Zemede	Hawassa ARC Box-06 Hawassa	0912 14-34-83	Zemedamu@yahoo.com
2.8	Senait Regassa	Oxfam-USA DHGeda tower Addis Ababa	0911 71-96-00	Sregassa@Oxfamamerica.com
2.9	Seifu Tigist	NMA Box-1090 Addis Ababa	0116 61-57-79	

2.10	Tadesse Terete	AAU Box-10/1048	0911 98-88-45	tadessekid@yahoo.com
2.11	Tesfazghi	AAU – A.A Box-56761	0911 46-46-50	Tesfazghi2000@yahoo.com
2.12	Wondifraw Getenet	A.M.University Box-21 Arbaminch	0913 61-00-91	w.getinet@gmail.com
3. Foreign Participants				
3.1	Prof.H.Adam	Box 719 Khartoum,Sudan	00249 912699326	nsadam2002@yahoo.com
3.2	Prof.F.E.Elsayem	SMS Box-719 Khartoum, Sudan		
3.3	Mr. James Magezi.A	Dept.of Met. Box-7025 Kampala, Uganda	25677 2413311	mageziakiibj@yahoo.com
3.4	Dr. M.Mhita	TMS Box-3056 Daresalam, Tanzania	25522 2460706	mmhita2002@yahoo.co.uk
3.5	Prof.L. Ogallo	IGASS-ICPAC Box-10304 Nairobi, Kenya		logallo@icpac.net
3.6	MR.S.Nioroge	Sub-Regional Wigo Office Box-76523 Nairobi, Kenya	254203877372	snjoroge@wmo.int
3.7	Mr. F. Nguatah	Kenya Met. Society Nairobi, Kenya		nguatah@meteo.go.ke nguatah@yahoo.com