WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

TECHNICAL-PLANNING WORKSHOP ON SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP) DEVELOPMENT FOR EASTERN AFRICA

NAIROBI, KENYA, 4-8 OCTOBER 2010

FINAL REPORT

EXECUTIVE SUMMARY

The Technical-Planning Workshop on Severe Weather Forecasting Demonstration Project (SWFDP) for Eastern Africa was held in Nairobi, Kenya, from 4 to 8 October 2010. Participants included representatives (forecasters and Agmet) of Burunbi, Ethiopia, Kenya, Rwanda, Uganda and Tanzania, and the WMO Secretariat.

The meeting unanimously agreed in principle that the implementation of an SWFDP in Eastern Africa would be technically feasible and would bring benefits in terms of enhancement of technical capacity in operational weather forecasting and advancement in service delivery to general public and key application areas such as agriculture and fisheries, in countries of the region, including Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. Specifically, the proposed regional subproject should focus on the following severe weather events in order of decreasing priority (and associated hazards such as flooding, droughts, etc): (a) heavy rain/flooding and deficit of precipitation/dry spells; (b) strong winds in relation to thunderstorms and any other phenomena over the Indian Ocean and major lakes; and (c) hazardous Indian Ocean and major lake waves.

Following the *SWFDP Guidebook for Planning Regional Subprojects* the following conclusions were reached:

(a) the domain to be covered for monitoring, analyzing and predicting the various severe weather events was proposed to be bounded by 5E – 55E; 30N -25S; a specific domain for the Lake Victoria should be considered;
(b) Met Office UK, DWD (GME data needed for nesting HRM), NCEP GFS/GEFS (including GFS data for nesting WRF) and ECMWF to provide NWP guidance material as Global Centres;
(c) RSMC Nairobi (Kenya) to take up the role as regional centre for the project, with TMA to provide training and technical support (e.g. high resolution nested WRF/HRM and wave models, etc.) where appropriate;
(d) Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda to participate as National Meteorological Centres (NMCs);
(e) the project should focus on severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture and fisheries (safety and protection of fishers); and
(f) further planning to be pursued following a timeline that would launch a one-year field phase in May 2011.

In addition, based on the above conclusions, the following recommendations were made:

(a) The RA I representative at the Steering Group for the SWFDP to coordinate the setting up of a small project development team to undertake the drafting of an implementation plan, and team members to include Kenya and Tanzania, plus one or two others to provide input from the perspectives of Global Centres and RA I;
(b) WMO Secretariat to follow up on developing a provisional programme for the Preparatory Training activities;
(c) NWP Centres to have model outputs adapted to SWFDP – Eastern Africa domain window;
(d) NMCs to provide operational information regarding forecasting programme;
(e) NMCs to develop plans for: warning service delivery, communication/contact channels and outreach programmes; and the review processes of validation, feedback, analysis and reporting;
(f) To encourage the forecasting and agrometeorological NMHS staff to work together to develop forecasting products with regards to the SWDFP;
(g) Secretariat to support NMCs efforts by providing training on design of products and services, and in the development of cross-border exchanges of alerts and warnings.

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING

1.1 The Technical/Planning Workshop on Severe Weather Forecasting Demonstration Project (SWFDP) Development for Eastern Africa was opened by Mr Ben Mugambi, Senior Deputy Secretary, on behalf of Hon. John N. Michuki, EGH, MP, the Minister for Environment and Mineral Resources, at 09.50 hours on Monday, 4 October 2010, at the Institute for Meteorological Training and Research of Kenya Meteorological Department (KMD), in Nairobi, Kenya. At the opening ceremony presided by Mr Kongoti, he first welcomed the participants to KMD and to Nairobi, and invited them to introduce themselves to facilitate interactions throughout the workshop. Welcoming remarks were given by:

(a) Mr Peter Chen, Chief of the Data-Processing and Forecasting System Division, on behalf of Mr Michel Jarraud, the Secretary-General of WMO.

(b) Col Vincent Lee Anami, Director General of the National Disaster Operation Centre (NDOC).

(c) Mr Philip Omondi, on behalf of Prof Laban Ogallo, Director IGAD Climate Prediction and Application Centre (ICPAC).

(d) Dr Joseph Romanus Mukabana, Director of Meteorological Services and Permanent Representative of Kenya with WMO.

(d) Mr Ben Mugambi, Senior Deputy Secretary, on behalf of Hon. John N. Michuki, EGH, MP, the Minister for Environment and Mineral Resources.

1.2 Mr Peter Chen welcomed participants to the meeting and expressed the gratitude and appreciation of WMO to the Government of Kenya, the Kenya Meteorological Department (KMD), and Dr Joseph Romanus MUKABANA, Permanent Representative of Kenya with WMO, for hosting this meeting in Nairobi. Mr Chen also thanked Mr Kongoti, Mrs Stella Aura and Mr Nicholas Maingi of the Kenya Meteorological Department (KMD) for their work in organizing the local arrangements.

1.3 Mr Chen explained that the Severe Weather Forecasting Demonstration Project (SWFDP) initiative is intended, to (1) further explore and enhance the application of outputs of existing NWP systems, available through WMO's Global Data-Processing and Forecasting System (GDPFS), in the improvement of severe weather forecasting in countries where sophisticated NWP outputs are not currently used, or poorly used, and (2) delivery of warning services through the Public Weather Services Programme (PWSP). He noted that the SWFDP had been implemented successfully in southern Africa and a second project is in progress for the South Pacific Islands. Following the request by the WMO Executive Council to further expand the SWFDP to other WMO Regions, plans had initiated to consider SWFDP regional subprojects for Southeast Asia and hopefully this workshop would consider an SWFDP regional project for Eastern Africa as an excellent opportunity to improve both the application of science and technology that supports forecasting and severe weather warning services, and to enhance the capabilities of NMHSs in more effectively supporting the disaster management and civil protection organizations, as well as socio-economic sectors, in particular agriculture and fisheries, within their countries, and coordinated effectively within a geographical region. He added a personal note, to recognize the role that Mr William Nyakwada had played, at that time senior staff at KMD, in the early development of concepts for the SWFDP.

1.4 Col Vincent Lee Anami pointed out that disaster management authorities are one of the beneficiaries of projects such as the SWFDP that are designed to improve severe weather forecasting and warning services. He recalled that weather forecasting is important for both planning and emergency activities, and therefore was pleased to note that plans are initiating to

develop an SWFDP in Eastern Africa in order to assist countries in the region in improving severe weather forecasting and warning services, thereby contributing to disaster risk reduction.

1.5 Mr Philip Omondi noted that severe weather events are a result of climate change and therefore any results from the SWFDP would contribute to the work of IGAD Climate Prediction and Application Centre (ICPAC), which would become a WMO Regional Climate Centre (RCC) in a near future. He pointed out that human resources and computing facilities are required to improve services provided by centres in the region, and therefore thanked WMO and the Met Office UK for its initiatives that help ICPAC and NMHSs in building capacity for weather and climate prediction and services.

1.6 Dr Joseph Romanus Mukabana recalled that agriculture drives the economy of Kenya, as well as in the neighbour countries. He therefore noted with appreciation the plans for developing an SWFDP for Eastern Africa focusing on severe weather forecasting and warning services, which would enhance the capabilities of NMHSs to more effectively supporting the disaster management and civil protection organizations, as well as socio-economic sectors, in particular agriculture and fisheries, within their countries, and coordinated effectively within the Eastern Africa region. Dr Mukabana noted that Kenya is affected by a significant number of hazards such floods, droughts, hailstorms, heat waves, tornados, rough sea state, etc. Understanding the atmospheric phenomena that generate hazardous impacts is crucial for better providing forecasts and warnings which would help the disaster management authorities in saving lives and properties. He concluded by thanking WMO for assisting its Members in better fulfilling their mandates.

1.7 Mr Ben Mugambi noted with appreciation that this technical-planning workshop would prepare a roadmap for the development and implementation of an SWFDP for Eastern Africa. He acknowledged the consistent efforts of WMO and other collaborating partners in designing, conducting and expanding SWFDP regional subprojects to many parts of the world. Mr Mugambi was pleased to note that Kenya had offered to take the role as lead regional centre and host it at the Regional Specialized Meteorological Centre (RSMC) Nairobi. He also noted that the goals of the SWFDP would contribute to climate change adaptation through skilful and useful weather and climate prediction services.

1.8 Mr Mugambi noted that Africa is known to suffer from severe weather events, which makes this workshop important for the people in the eastern part of the continent. He further noted that SWFDP offers an important opportunity to demonstrate, learn and refine the cascading forecasting process for the Eastern Africa and improve links with disaster management and civil protection authorities, and agriculture and fishery organizations in this region. He thanked WMO, the Met Office UK, other collaborating partners and participants for their contributions to this important workshop, whose deliberations would be fruitful and help to enhance disaster reduction strategies in all countries in Eastern Africa. Mr Mugambi concluded by declaring the Technical-Planning Workshop on SWFDP Development for Eastern Africa officially open.

1.9 Finally, Ms Stella Aura, Deputy Director/Principal of the Institute of Meteorological Training and Research, thanked the distinguished panel for their presence, and concluded by welcoming and all participants in the workshop to KMD and to the WMO Regional Training Centre.

2. ORGANIZATION OF THE WORKSHOP

2.0 The meeting was invited to nominate from among the participants a chairperson to conduct the business of the workshop. Mr James G. Kongoti and Mr Peter G. Ambenje (Kenya Meteorological Department) were unanimously elected to act as Co-Chairpersons.

2.1 Adoption of the agenda

2.1.1 The meeting adopted the provisional agenda without change, as provided in Annex I.

2.2 Working arrangements

2.2.1 All documents submitted for the meeting are referenced and hyperlinked in the Documentation Plan (INF. 1), which had been posted on the WMO web site at:

http://www.wmo.int/pages/prog/www/DPFS/Meetings/RAI-EA-TPW-SWFDP_Nairobi2010/DocPlan.html

2.2.2 The participants agreed its hours of work and other practical arrangements for the meeting, including the tentative work programme. The list of participants in the meeting is provided in Annex II.

3. INTRODUCTION TO SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP)

3.1 Overall Framework

3.1.1 The Secretariat informed the meeting of the WMO SWFDP framework, including guidance from the Commission for Basic Systems (CBS), and introduced the basic documents: "SWFDP Overall Project Plan (2010)", and "SWFDP Guidebook for Planning Regional Subprojects (2010)" that have been developed by the CBS Steering Group on the SWFDP.

3.1.2 The meeting noted that SWFDP aims to contribute to capacity-building and to help developing countries in particular to have available and implement the best possible use of existing NWP products for improving warnings of hazardous weather conditions and weather-related hazards. Global-scale products, as well as data and information provided by other regional centres, are integrated and synthesized by a designated Regional Specialized Meteorological Centre (RSMC), which, in turn, provides daily guidance for short-range (days 1 and 2) and medium-range (out to day-5) on specified hazardous meteorological phenomena (e.g. heavy rain, strong winds, etc) to participating National Meteorological Centres (NMCs) of the region. This is a "Cascading" concept of the forecasting process, which is further discussed under item 6.

3.1.3 The meeting recalled that the SWFDP had been implemented successfully in southern Africa and a second project is in progress for the South Pacific Islands. Plans had initiated to consider SWFDP regional subprojects for Southeast Asia. The meeting reviewed progress and benefits of the SWFDP – Southern Africa under agenda item 3.2, and discussed lessons learnt from this project and the potential replication in Eastern Africa.

3.1.4 The meeting noted that the "SWFDP Overall Project Plan (2010)" is a high-level document targeting senior managers, which describes the SWFDP technical aspects related to weather forecasting (GDPFS) and public weather services (PWS) programmes; and general principles and conceptual framework for guiding project planning; while the "SWFDP Guidebook for Planning Regional Subprojects (2010)" provides a "template" and procedures for developing a Regional Subproject Implementation Plan (RSIP). The meeting noted that the development of an Implementation Plan for an SWFDP for Eastern Africa should follow the procedures as described in the Guidebook, with the required adjustments to address particular aspects of the region. The meeting further noted that the Implementation Plan would be reviewed by the Steering Group for the SWFDP prior to its implementation to ensure that the required procedures had been properly addressed. Both the "SWFDP Overall Project Plan (2010)" and the "SWFDP Guidebook for Planning Regional Subprojects (2010)" are available at:
http://www.wmo.int/pages/prog/www/DPFS/Meetings/RAI-EA-TPW-SWFDP_Nairobi2010/DocPlan.html

3.2 Summary of experience and progress of and synergy with the SWFDP in Southern Africa

3.2.1 The Secretariat briefed the workshop on the development and progress of the SWFDP in the southern African region. The meeting noted that the SWFDP is an innovative approach to take

what NWP products that already exist and making them accessible and better used by forecasters in developing countries. Forecasters of developing countries who have received training could return to their home offices and put into use their newly acquired knowledge and skill through the SWFDP. The meeting noted positively that through the SWFDP, forecasters and representatives of disaster management organizations participated together in workshops to discuss forecasting and warning services. The meeting further noted that similar training, conducted for countries of Eastern Africa, would be held in Dar-Es-Salaam, Tanzania, from 18 to 29 October 2010.

3.2.2 The meeting reviewed the mid-term report of the SWFDP – Southern Africa, covering the period from November 2008 to September 2009, which spanned the region's rainy season. The meeting noted that this mid-term report is a comprehensive evaluation of the organization and procedures carried out under the framework of the SWFDP and attempts to describe the shortcomings as described by the participants and proposes improvements in order to ensure the sustainability of the Cascading Forecasting Process and the organization among the participating centres of the GDPFS, as well as to further enhance public weather services and other meteorological services.

3.2.3 The meeting noted that by using the information provided through the quarterly reports submitted by the participating NMHSs in the SWFDP – Southern Africa, Quarterly Progress Reports were prepared to summarize the occurrence of severe weather events throughout the quarter, to assess the utility and quality of the RSMC Daily Guidance provided by RSMC Pretoria, the relevance and the skill of the various NWP products relative to severe weather, the pertinence of the severe weather warnings issued by the NMHSs, and the improvement of the services they delivered to Disaster Management and Civil Protection Authorities (DMCPA). The meeting noted that a similar level of commitment (e.g. reporting and verification of the occurrence of severe weather events: preparation of quarterly reports, etc.) would be required to the participating NMHSs in a potential SWFDP regional subproject for Eastern Africa.

3.2.4 Mr Vincent Sakwa (KMD) presented the SWFDP – Southern Africa Web site to illustrate how the SWFDP functioned, and in particular the importance of the RSMC Daily Guidance Products in both providing an early alert of possible hazardous weather as well as in increasing the confidence in the forecasters to predict severe weather with longer lead-times. The meeting noted that identified thresholds for heavy rain and strong winds for the Southern Africa region may not be the appropriate for the Eastern Africa region and that the definition of the thresholds would require an evaluation of the impacts such as flooding. The meeting agreed that this issue should be carefully addressed when developing the Implementation Plan for the SWFDP – Eastern Africa.

3.2.5 The meeting agreed that the SWFDP had brought capacity building of forecasters and improved cooperation and integration of activities among NMHSs that contribute to disaster risk reduction and support socio-economic sectors, including agriculture and fisheries. The meeting also agreed that the SWFDP could serve as a vehicle to facilitate the development of a business case for improving observational networks by identifying gaps and demonstrating improved forecasting through making effective use of observations e.g. in post-processing, assimilation and verification.

3.2.6 The meeting discussed lessons learnt from the SWFDP – Southern Africa and potential benefits in replicating it in Eastern Africa. The meeting recognized that there is an added-value in building regional partnerships, as those established within the SWFDP framework, for improving severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture and fisheries.

3.3 Synergy with Other Projects

3.3.1 The meeting was informed about two projects in the region which have synergy with the development and delivery of the SWFDP.

3.3.2 A World Bank funded project has been established with the aim of enhancing the security of the livelihoods of farmers and fishermen in and around Lake Victoria. This project has two components:

(a) Improving agricultural productivity through increased access to weather information for agricultural decision making; and

(b) Reducing loss of life due to severe weather and climate by improving the reach of tailored forecast products from NMHSs to fishing communities and farmers in case of severe weather and climate-related events (drought, etc.).

3.3.3 The meeting noted that through the World Bank Lake Victoria project, funds would be available to support certain components of the proposed SWFDP for Eastern Africa. Some funds have already been provided to support this technical-planning workshop and its outcomes would also be used to propose an outline for use of these funds in 2011.

3.3.4 The meeting was informed about the continued collaborative pilot project between Uganda Department of Meteorology and Ericsson. This builds upon the work started through the WIFA initiative and is mainly focussed on piloting the use of mobile phone technologies to communicate forecasts and warnings to farmers and fishermen in the Lake Victoria region. The meeting realized that completion of the SWFDP is essential to help develop the capacity within NMHSs to deliver reliable and accurate forecasts and warnings to be disseminated in this manner.

3.3.5 The meeting agreed that an important component of the Uganda pilot will be a full evaluation of the benefits of the warning and forecast service and, if appropriate, the development of a "blue print", or business case, for the wider rollout of the initiative. To this end, the meeting recommended the engagement of the stakeholders and an end-user feedback mechanism. The pilot would also include a trial of the quality of data from Automatic Weather stations installed at mobile phone mast sites and address issues of data integration that have been identified by NMHSs participating in the initial project. The meeting discussed issues of formats and availability of the data by the NMHSs, and recommended that these aspects be carefully addressed in the pilot.

3.3.6 The meeting recognized that the synergy between SWFDP and other initiatives in the region would optimize the benefit to NMHSs, disaster management, the agricultural and fishery sectors and ultimately the end users.

3.4 Status of the Global Data-processing and Forecast System (GDPFS) in RA I – Eastern Africa

3.4.1 The Secretariat briefed the participants on the status of the GDPFS in RA I, largely based on the information provided by Members to the Secretariat in the annual report of the status of the Global Data-Processing and Forecasting System (GDPFS), which is available on the WMO Web site at http://www.wmo.int/pages/prog/www/DPFS/ProgressReports/2010/2009_GDPFS-NWP.html. A summary table was prepared by the Secretariat, which is available at http://www.wmo.int/pages/prog/www/DPS/documents/STATUSTA2009.doc.

3.4.2 The meeting noted that there was a significant number of Members in RA I that had not submitted a recent annual report or had not implemented a NWP system. In this context, participants were encouraged to access and use the information, as well as provide updates on their respective NMC's NWP activities where appropriate. The meeting requested the Secretariat to guide them in the preparation of their respective annual reports.

3.5 Status of the Public Weather Services activities in RA I – Eastern Africa

3.5.1 The meeting was informed of the projects that WMO, through the Public Weather Services Programme (PWSP), is implementing in Africa, which include: (1) SWFDP – Southern Africa; (2)

Learning Through Doing Project – Madagascar; (3) Weather and Climate impacts on Community Health and Public Health Services – Ethiopia; (4) Weather and Climate and Health projects - Burkina Faso, Mali, Mauritania, Niger and Nigeria; (5) Radio Internet (RANET) Projects; and (6) SWFDP for Eastern Africa (to be initiated by early 2011). Detailed information about these projects can be found at http://www.wmo.int/pages/prog/www/DPFS/Meetings/RAI-EA-TPW-SWFDP_Nairobi2010/DocPlan.html.

3.5.2 The meeting also considered the results of PWS survey in RA I, and focused on the achievements and the needs that were revealed by the survey, as well as the capacity-building priorities as viewed by Members that participated in the survey. The results of the questionnaire revealed that most of the RA I Members ranked heavy rain as the high-impact weather that caused them the highest concern, followed by hot dry weather (drought). The survey detected that there was still a need for building capabilities as regards to: improving interaction with users, developing cross-border exchange of alerts and warnings, public education and awareness, nowcasting techniques, media skills, and training on the design of products and services. These recommendations had been addressed through the SWFDP in Southern Africa and will also form the thrust of PWS component of the SWFDP in Eastern Africa.

3.5.3 PWSP has also been implementing the Severe Weather Information Centre (SWIC, http://severe.worldweather.wmo.int) Website, which displays warnings and alerts on Tropical cyclones and storms; and official observations of heavy rain and snow; and thunderstorms; and the World Weather Information Service (WWIS, http://worldweather.wmo.int) Website that offers easy access to official forecasts and climatological information issued by NMHSs for the media and the public in eight (8) languages (Arabic, Chinese, English, French, German, Italian, Portuguese and Spanish). The meeting noted that out of 55 RA I Members, 37 were currently participating in WWIS, and therefore encouraged the Members participating in the workshop to initiate and/or increase their contributions to the WWIS.

3.6 Status of the Agricultural Meteorology activities, including for fisheries, in RA I – Eastern Africa

3.6.1 The meeting was informed of the activities of WMO Agricultural Meteorology programme in RA I which included: (1) a background of agrometeorological advice provided by the National Meteorological Service of Mali; (2) the METAGRI project of Roving Seminars on Weather, Climate, and Farmers in West Africa; (3) the Rockefeller Foundation Grant for the Training of Trainers on Weather and Climate Information and Products for the Agricultural Extension Services in Ethiopia; (4) the World AgroMeteorological Information Service (WAMIS); and (5) WMO drought activities around the world and in Africa. Detailed information about these projects can be found at http://www.wmo.int/pages/prog/www/DPFS/Meetings/RAI-EA-TPW-SWFDP_Nairobi2010/DocPlan.html

3.6.2 The meeting considered the various agrometeorological activities that increased the interaction of NMHS and farmers and how this could lead to better products and services. One significant example presented was the work of the Mali Meteorological Service to organize Roving Seminars in which weather and climate information and simple planting advice is provided to rural farmers in their local language. These Seminars also provide an opportunity for farmers to ask questions and provide feedback to the Meteorological Service which is important for obtaining feedback on weather forecasts and products. The meeting was particularly interested in the study which indicated that crop yield and incomes increased for farmers which attended the Seminar versus those farmers how did not attend the seminar. The meeting discussed that more studies like this needed to be done to show the usefulness of weather information to the agricultural sector. Based on this successful experience in Mali, the METAGRI project was been funded by the State Agency for Meteorology in Spain (AEMET) and the Rockefeller Foundation Grant in Ethiopia.

3.6.3 The meeting then considered the development and current status of the World AgroMeteorological Information Service (WAMIS). As of March 2010, products from 50 countries or institutions were available on the WAMIS Website (http://www.wamis.org/). Currently, the website

averages about 15,000 visits per month. Most of the products hosted on WAMIS are agrometeorological bulletins and three countries in Eastern Africa already provide bulletins on WAMIS. It was pointed out there is a potential for NWP derived products for agricultural applications could added to the bulletins in the future. However, the meeting stressed that in the near-term, improved NWP guidance from the SWFDP project should used to improve agricultural weather forecasts and advisories. There was a suggestion that a Regional workshop be considered by WMO on the standards or guidelines for agrometeorological bulletins and advisories.

3.6.4 The meeting also considered an overview of WMO drought activities along with the importance of drought early warning systems and the potential role of NWP products in assisting with drought monitoring and prediction.

4. SEVERE WEATHER FORECASTING IN EASTERN AFRICA (Kenya, Tanzania, Uganda, Rwanda, Burundi, Ethiopia)

4.1 Severe weather forecasting and warning services, including delivery and communication to the users

4.1.1 The representatives of Kenya, Tanzania, Ethiopia, Uganda, Burundi and Rwanda presented the status of weather forecasting especially for severe weather, and the means of disseminating and communicating such information for the benefit of the general public and socio-economic sectors, in particular agriculture and fisheries. The relationship with disaster management and civil protection authorities and the media, as well as with agricultural and fishery agencies, was also addressed.

Kenya

4.1.2 Mr Vincent Sakwa informed the meeting that KMD uses the High Resolution Regional Model (HRM) and the Weather Research and Forecasting (WRF) model for severe weather forecasting. Operational HRM-Kenya is based on GME data at 30 km horizontal resolution and 60 vertical levels. HRF-Kenya Model domain (Mesh size: 0.125° ~ 14 km) extends from latitudes (12^0 S, 12^0N) and longitudes (26^0E, 51^0E). WRF Environmental Modeling System (EMS) is a complete, full-physics NWP package that incorporates dynamical cores from both NCAR/ARW and NCEP Non-hydrostatic Mesoscale Model (NMM-WRF) releases into a single end-to-end forecasting system. WRF has a similar domain as HRF-Kenya and 15.5km horizontal resolution. Global climate models e.g. ECMWF, UK, etc and statistical models are used for forecasting the climate in Kenya. The meeting noted that KMD provides different types of forecasts, including: nowcasts (0-6h); short- range forecasts (24h-5days); medium-range forecasts (7-14 days); and extended-range forecasts (30-90 days).

4.1.3 Mr Julius Kabubi recalled that Kenya is located between latitudes 5.5°N and 5°S, and longitudes 34°E and 42°E. It covers a surface area of 582646sq. Km. The meeting noted that the major natural hazards that affect Kenya are: (a) droughts; (b) floods; (c) landslides; (d) hail storms; and (e) more recently snowfall. Other hazards include: strong wind storms, lightening, water sprouts, dust devils and high temperature.

4.1.4 The meeting noted that KMD has initiated measures to communicate and educate the communities on the impacts and mitigation required to avoid socio-economic losses emanating from weather-related disasters. In this context, KMD has been liaising with many stakeholders in disaster risk management, training and awareness programmes on hydro-climatic disasters, advocacy and outreach programmes to reach the communities and other users. These include school visits to KMD, interviews on TV and public phone-in live, using local languages. The meeting noted that all forecasts are communicated to the users through the Provincial Directors of Meteorology (PDMs), RANET FM, Radio Station; including Electronic and Print Media.

Tanzania

4.1.5 Dr Hamza Athumani Kabelwa recalled that the Tanzania Meteorological Agency (TMA) has been benefiting from participating in the SWFDP – Southern Africa and would be able to share its experience with participating countries in the proposed SWFDP – Eastern Africa. The meeting noted that TMA is putting more efforts in enhancing severe weather forecasting and warnings for disaster risk reduction in Tanzania by improving the observing system and modernization of computing system, from lower-speed category to a higher one computer system in order to improve the assimilation of synoptic data and remote-sensing. TMA uses global and regional NWP, and EPS products from ECMWF, RSMC UM-SA12, NCEP and its own NWP products for severe weather forecasting, in particular the Extreme Forecast Index (EFI), EPSgrams, and other products from MOGREPS and the Global Ensemble Forecast System. The meeting noted that TMA also uses the SAWS-EPS products that have been available as of January 2010, and products from the ALADIN model for Tropical Cyclone (TC) forecasting over south-western Indian Ocean. In addition, TMA runs the following limited-area models (LAM): the Weather Research and Forecasting (WRF; horizontal resolution 5-15km; forecasting length: 48-54h); the WRF-BOGUS for TC track during the TC season (horizontal resolution 10km; forecasting length: 48-72h) for experimental purposes; and the High Resolution Regional Model (HRM; horizontal resolution 14km; forecasting length: 78h), which are also used for severe weather forecasting.

4.1.6 The meeting noted that the primary severe weather phenomena that affects Tanzania are: (a) thunderstorms over the southern part Lake Victoria basin (Kagera, Mwanza and Mara regions); (b) hailstorms in north-west part of country part nearby Lake Victoria basin (Norther Kigoma nd Kagera regions); (c) strong gusty winds during the hot season; (d) floods over some parts of the country (Kilosa part of Morogoro region); (e) drought particularly over the North-eastern part of the country (Kilimanjaro, Arusha and Mara regions); and (f) landslide over some few parts of the country (Kilimanjaro regions).

4.1.7 The meeting noted that there is sufficient appreciation of services (advisory and warning) issued by TMA to public, however it is quite difficult to get a broad picture. Noting with concern that the survey made on the use of weather and climate information from TMA showed that less than 1% of TMA's information is used by the media, TMA has been mobilizing the role of media in dissemination of weather information through conducting press conferences from time to time, and through its participation in various exhibitions events and public lectures through media such as TV and Radio.

4.1.8 The meeting noted that TMA regularly exchanges views with Disaster Management and Civil Protection Agency (DMCPA) regarding areas for required improvement, and regular meetings are conducted with participation of TMA, Prime Minister's Office, Disaster Management Department (PMO-DMD) and other Stakeholders for improved understanding of terminology used in forecasts and warning issued by TMA. In addition, TMA invites DMCPA and other stakeholders (Food security, Water resources, Health, Media, energy sector, etc) for one day discussion before issuing the press release for the seasonal outlooks (two times a year). Dr Kabelwa pointed out to the fact that an effective interface between TMA and Disaster Management Agencies, media and user communities is highly needed in the Early Warning System (EWS) in the country. The meeting supported TMA's plans to integrate the available Standard Operating Procedures (SOPs) in TMA with Disaster Management and Media including the community at risk. It noted that this would pilot similar type activities in other countries and therefore recommended the Secretariat to closely follow these developments in order to incorporate relevant guidance on such aspects in the "SWFDP Guidebook for Planning Regional Subprojects".

Ethiopia

4.1.9 Mr Lemessa Dufera Debela informed the meeting of the severe weather forecasting and warning services in Ethiopia. The meeting noted that the National Meteorology Agency of Ethiopia (NMAE) uses NWP products from different Global Centres, including the ECMWF (public domain) and the Met Office UK. For seasonal forecasting, the NMAE uses products from RSMC Nairobi. The NMAE was encouraged to use the ECMWF products available to all WMO Members

(password protected). The NMAE also runs two models: WRF and MM5 experimentally and has good Internet facilities.

4.1.10 The meeting noted that floods and droughts are the major hazards affecting Ethiopia. The National Meteorology Agency of Ethiopia issues warnings of heavy rain when rainfall amount may exceed 30mm and of droughts if the amount of rainfall expected to occur is below normal. Forecasts and warnings are disseminated to Prime Minister; D/Prime Minister; Ministry of Rural Development; Ministry of Agriculture; Ministry of Water Resources; DPPC and EPPC; Regional States; Dam Administrators; Mass Media; Universities, colleges; Research Centres; etc. The NMAE has a TV broadcasting system, by which it disseminates the forecasts in four languages: 1 international language, 1 national language, and 2 local languages.

Uganda

4.1.11 Ms Mary Vincent Nambalirwa informed the meeting of the severe weather forecasting and warning services in Uganda. The meeting noted that Uganda is a landlocked country located between latitudes 4°N and 2° S and longitudes 28°E and 35°E. It covers a surface area of 241139sq. Km with altitude from 620m to2400m. It is boarded by Tanzania in the south, Kenya in the east, Sudan in the north and DR Congo in the west. The meeting also noted that water bodies (e.g. Lake Victoria, Lake Albert and Lake Kioga), rivers (especially River Nile), and highland areas (e.g. Mt Elgon and Mt Ruwenzori) and Muhavura ranges and Western Rift Valley, all influence the weather and climate in Uganda.

4.1.12 The meeting noted that the following synoptic features affect the weather in Uganda: (a) location and movements of the 4 semi-permanent high pressure systems (St Hellena, Mascarene, Azores, Arabian ridge and the East African ridge); (b) movement of the cold fronts and warm fronts both over the Northern and the Southern Hemispheres; (c) location and oscillation of the ITCZ; and (d) oscillation of the Inter-Tropical Depression (ITD, Congo air mass). Forecasts are prepared based on: (a) synoptic surface charts (06 and12 UTC); (b) 300hpa upper air chart; (c) satellite imagery (received every 15 min); and (d) other products downloaded from the Internet, primary from NOAA, NCMRWF (India), ECMWF (public domain), Norway (4-day city forecast) and South Africa (synoptic weather chart). The meeting noted that Uganda Meteorological Service uses satellite imagery not only for very short-range forecasting, including nowcasting, but also for tracking the movement of important features for forecasting the developments in the following days 1 and 2. The Uganda Meteorological Service was encouraged to use the ECMWF products available to all WMO Members (password protected).

4.1.13 The meeting noted that the primary severe weather phenomena that affects Uganda are: floods, droughts, heavy thunderstorms, embedded CBs and squall lines, heavy dust storms (Karamoja and some parts of northern districts), severe haze (during June-July for southern part and December- January for northern), thick fog (south-western, and Entebbe airport), and mist (during rainy season in south-western).

4.1.14 The meeting noted that Uganda Meteorological Service issues daily, city, 3-day, 10-day, 3-months and 6-months forecasts. Daily forecasts are disseminated through e-mail and mobile telephones to identified users; and 10-day forecasts are provided to agricultural officers on districts (to help them in giving good advice and advisory to farmers on the onset and cessation of the wet season). Communications through the media is still a challenge. Regular workshops with stakeholders, including disaster managers, are held to address seasonal forecasting (e.g. droughts and floods). Major users are: office of the President; office of the Prime Minister; Ministry of Defense; Ministry of Agriculture; National Environment Management Authority (NEMA); media; civil aviation authority; and construction, research centres, universities, etc.

Burundi

4.1.15 Mr Balthazar Ntibasharira informed the meeting of the severe weather forecasting and warning services in Burundi. Burundi Meteorological Service (BMS) issues forecasts up to day-3,

based on NWP products from Global Centres such as DWD, NCEP, and ECMWF (public access), and MSG products (EUMETSAT), available on the Internet. The BMS has recently acquired a high speed Internet system, which allows downloading of products. The meeting encouraged BMS to make use of the ECMWF products that are available to all WMO Members (password protected).

4.1.16 The meeting noted that BMS uses 850hPa charts to detect areas of wind convergence and advection of low level humidity either from Lake Victoria or from the Congo Air Mass. It also uses satellite imagery (from EUMETSAT) to follow diurnal convection and advection affecting the country, for nowcasting and very short-range forecasting, and to verify the models.

4.1.17 The meeting noted that forecasts and warnings are disseminated mainly through a mobile network and radio broadcasting. Noting the recent acquisition of a high speed internet system, the meeting strongly recommended using the Web site as a way to communicate the weather information (point-to-multipoint system). The meeting noted that a TV broadcasting system is not set up as yet, and strongly recommended that the BMS initiate first steps by sending forecasts by e-mail to media points that could be read during the TV news, while at the same time building a TV broadcasting system. Other countries in the region could share their experiences and the Met Office UK could eventually assist with training on media broadcasting. While noting that workshops are being held to facilitate interactions between BMS and national disaster management and civil protection authorities, the meeting recommended the development of a well-established relationship among stakeholders.

Rwanda

4.1.18 Mr Athanase Ngabonziza informed the meeting of the severe weather forecasting and warning services in Rwanda. The meeting noted that Rwanda Meteorological Service (RMS) prepares forecasts based on observations and products from global centres, including ECMWF (password protected), SADIS (for access to aviation products of the World Area Forecast System), GFS (NOAA), South Africa Synoptic Weather, etc. The meeting noted that the following synoptic features affect the weather in Uganda: (a) location and movements of the 4 semi-permanent high pressure systems (St Hellena, Mascarene, Azores, Arabian ridge and the East African ridge); (b) location and oscillation of the ITCZ; and (d) oscillation of the Inter-Tropical Depression (ITD, Congo air mass). The meeting noted that the severe weather phenomena affecting Rwanda area: thunderstorms; heavy rainfall (> 50mm); embedded CB; and fog.

4.1.19 The meeting noted that forecasts are disseminated through the Rwanda Television, radio, newspapers and Web site. Rwanda Meteorological Service issues 24-hours, 7-days, monthly (30-days) and Seasonal (90-days) forecasts through media (i.e. radio, newspapers and TV). The RMS also provides specialized services to other sectors of the economy including: aviation, health, infrastructures, agricultures, water resources, energy, tourism, etc.

4.2 Current severe weather related initiatives

4.2.1 The representatives of Kenya, Tanzania, Ethiopia, Uganda, Burundi and Rwanda informed the meeting of current severe weather-related initiatives in their countries.

Kenya

4.2.2 KMD has been involved in the following projects at national and/or regional levels:

1. Western Kenya Community driven flood mitigation project (WKCDFMP)
   Aims:
   (a) Real time observations of rainfall amounts and water levels in Nzoia river;
   (b) Fitting of observations to a rainfall-runoff model;
   (c) Release of warnings to the communities in the lower reaches of the catchment, using RANET;
   (d) Lead-time (3 days).

2. Weather modification flagship project
   Aims:
   (a) Hail suppression over Kericho/Nandi hills tea growing areas;
   (b) Improve rainfall amounts over the arid and semi-arid zones of Kenya.

3. Implementation of the Integrated Meteorological Information System (IMIS)
   Aims:
   (a) Improving skills in forecasting and improving lead-time in the provision of weather forecasts

Tanzania

4.2.3 In addition to those projects described in items 4.1 and 6.2, the Government of Tanzania has been supporting the improvement of the observational network, including the installation of weather radars, and capacity building (training). In particular, there is a project to facilitate data collection. TMA is working with stakeholders, farmers and universities to generate integrated forecasts.

Ethiopia

4.2.4 Two National Task Force teams were established in Ethiopia: Task Force for Floods and Task Force Team for Agriculture, which brings together the different stakeholders. The National Meteorology Agency of Ethiopia (NMAE) is represented in these Task Force Teams to address severe weather-related issues. These Teams prepare national contingency plans and standard operating procedures. Internally at the NMAE, there are plans to further upgrading the forecasting system.

Uganda

4.2.5 A cooperative pilot project between Uganda Department of Meteorology and Ericsson has been implemented in Uganda, as described in item 3.3.

All six countries

4.2.6 The meeting was informed that satellite receiving stations and processing software (PUMA/Synergy) are being renewed for a large majority of countries of Africa, including the six countries represented at the meeting, through the “AMESD” project. These stations are ready and would be deployed at the NMHSs by early 2011. ICPAC has been coordinating these activities and would provide training as appropriate. The meeting agreed that the SWFDP will benefit from these developments.

4.2.7 The meeting was informed by several countries that Normalized Difference Vegetation Index (NDVI) products were no longer available from the Famine Early Warning System Network (FEWSNET). In addition, Cold Cloud-top Duration products have been available for several years from SADC.

5. REQUIREMENTS FOR FORECASTING AND WARNING SERVICES, INCLUDING DELIVERY AND COMMUNICATION TO AGRICULTURE AND FISHERY COMMUNITIES

5.1.1 The meeting was informed of the various aspects of using weather forecasts for agricultural decision-making. It was stressed that under the mandate of the WMO Commission for Agricultural Meteorology, the definition of agriculture includes row crops, tree crops, forests, livestock (animals and rangeland), and food aspects of fisheries. Agricultural users included international agencies, government officials, agricultural extension agents, farmers, ranchers, foresters, and fishers. Agricultural weather forecasts or advisories are based on the standard weather elements such as

temperature, precipitation, relative humidity, and wind speed. Fundamental questions that needs to asked are: What weather events impact agricultural decision-making? How to relate weather / climate information to meaningful agricultural actions / practices? For the weather time scale (1-10 days), this involves tactical agricultural applications which are decisions based on crop state and current or forecast weather and include cultivating, irrigating, spraying, and harvesting. Direct agricultural losses can occur from the following weather hazards: frost; heavy rain / floods; strong winds; hail; sand and dust storm; forest and bush fires; and drought.

5.1.2 The meeting then discussed the potential of using NWP products for agricultural applications. Some advantages of using NWP products are that they provide worldwide weather data with temporal and spatial resolution that could be sufficient for many applications in agricultural meteorology and there are no missing data with NWP output, therefore, no need of filling data gaps from ground stations. However, some drawbacks include the need for significant technical resources (computers, programmers) and that NWP outputs at the surface are modelled estimates not observed data and therefore must be used with caution especially if NWP outputs are provided directly to users. The meeting highlighted the following NWP applications that have been used for agriculture: statistical downscaling of NWP; forest fire danger rating and fire behaviour; crop and animal pest and disease forecasting; irrigation scheduling; drought prediction; and crop production forecasting. There was some discussion on obtaining high quality topographical, soil, and land use data to improve the NWP models and the importance of vegetation cover in modelling soil moisture.

5.1.3 The meeting summarized that NWP can benefit agrometeorological applications in the near-term by improving guidance to NMHS agrometeorologist through internal NMHS procedures; developing wave, wind, and severe weather forecasts over Lake Victoria; and improving forecasting and advice to farming community through Agromet bulletins. The direct use of NWP output for agrometeorological products has future potential and needs to be explored carefully.

6. CASCADING FORECASTING PROCESS: ROLES OF PARTICIPATING CENTRES

6.1 Global: DWD (Germany), Met Office (UK), ECMWF, African Desk (USA)

6.1.1 Representatives of possible Global Products Centres for an SWFDP for Eastern Africa informed the meeting of the general features of its global and regional NWP production systems, including the kinds of NWP/EPS products that could be provided to the project, with focus on severe weather monitoring and forecasting.

DWD (Germany)

6.1.2 Dr Ulrich Blahak informed the meeting the DWD has a longstanding tradition in providing its regional model HRM to developing countries to enable them to run their own numerical weather prediction system. He noted that DWD provides the model, support, the external data (i.e., orography, soil and vegetation data), and the necessary initial and boundary data from the global model GME in a custom tailored and efficient way, i.e., the countries get the necessary fields in the original GME resolution (approximately 30 km grid spacing, 60 vertical model levels from 10 m to 36 km above the ground), cut to exactly the required HRM domains to reduce the amount of GME data transferred via the Internet, and with a very short cut-off time of 2:50 h based on 00, 06, 12 and 18 UTC. GME-data are provided up to a forecast lead time of +5 days at 3-hourly intervals. The HRM users already form a quite active community around the world, and there are regular HRM training courses once a year in Germany. For example, Kenya is one of the countries which already benefits from this. In doing so, DWD tries to pursue realistic goals and concepts, to enable the respective countries to build up capabilities and expertise on their own.

6.1.3 Dr Blahak informed the meeting that DWD would support an SWFDP for Eastern Africa by providing and extending the necessary models, data and training to enable the regional centre to continuously run the HRM (nested into GME) as the LAM component of the SWFDP, to provide short term numerical weather predictions up to a lead time of +5 days. Targeted severe weather

elements would be e.g. strong precipitation events, wind storms, and extreme temperatures. Detail information, including a list of products, would be included in the Regional Subproject Implementation Plan for the SWFDP – Eastern Africa, which would be developed in due course, prior to the demonstration phase of the project (see item 7.5 for timelines). Regarding training, priority would be given to participating countries in SWFDPs to attend the annual HRM training course in Germany. Noting the worldwide availability of software for post-processing, the meeting recommended that such developments (verification, products/graphics generation, running e.g. MOS, wave model, etc.) be undertaken at the regional centre.

6.1.4 The meeting noted that HRM, which may be run at a horizontal resolution of 6km to 20km, with 40-60 vertical levels, contains the same physics as GME; including two alternative convective schemes (Tiedke, Bechthold). Noting that the geographical footprint for the SWFDP – Eastern Africa would cover mostly the Tropics, the meeting requested the global products centres to give special attention to validation studies for deep convection.

6.1.5 The meeting was also informed that the COSMO consortium recently decided to provide (in the near future) an "older" version of its non-hydrostatic high resolution limited area model (COSMO-model) to developing countries that plan to run regional NWP models at grid spacing of 7 km or less. The COSMO consortium is also planning to provide a similar support, initial and boundary data, and training as it has been already providing for the HRM, however, its implementation would require additional work to be initiated by 2011. DWD could also consider on-site training (1 or 2 weeks) at the regional centre, depending on funds available to the project to DWD.

Met Office (UK)

6.1.6 Mr Tom Butcher informed the meeting that the Met Office UK would be able to offer a range of products and training in support of the SWFDP for Eastern Africa. This includes the Met Office Global and Regional Ensemble Prediction System (MOGREPS), the Limited Area Model for Africa (Africa-LAM), and the ATD Lightning detection.

6.1.7 The Met Office Global and Regional Ensemble Prediction System (MOGREPS) is a short-range ensemble prediction system for forecasts up to 2-days ahead. The ensemble has 24 members which are run at a horizontal resolution of 60km. Model outputs that will be provided include: site specific EPS meteograms, known as EPSgrams; tailored regional precipitation threshold probability charts; wind speed threshold probability charts; spaghetti diagrams; and tropical cyclone track forecasts. Participating countries in an SWFDP for Eastern Africa are encouraged to identify two different locations (preferably synoptic stations to allow for verification) for which the Met Office UK will provide EPSgrams.

6.1.8 The Met Office UK is currently running a Limited Area Model for Africa (Africa-LAM) at a horizontal resolution of 20km with 38 vertical levels. The model has daily outputs of a variety of parameters out to T+54. The model data are disseminated via EUMETCast and images are made accessible via a password protected website (http://www.metoffice.gov.uk/weather/africa/lam/; Username: afr_nms, Password: uk_alam). It is planned that the resolution of the model will be increased to 12km and 70 vertical levels in February 2011. The domain of the model would also be adjusted so that it covers Northern, Central, West and East Africa to 8^0 South. This would complement South African Weather Service who is running the UK model at 12km to cover Southern Africa to the equator.

6.1.9 The meeting noted that the Met Office UK would also be able to make available ATDNet (Arrival Time Difference Network) Lightning data over Africa for this project. Initially this would be made available through a website: http://www.met-elearning.org/atd_demo/. It is hoped that this would also be provided through EUMETCast in coming months. The lightning detection system could be a useful tool for forecasters to use to complement satellite systems and other observational data for nowcasting during severe rainfall events.

6.1.10 The meeting was informed that the Met Office UK would be able to provide two trainers to support the training component of this SWFDP. The first trainer is an expert in the interpretation of NWP products, and in particular ensemble products, for severe weather forecasting. Recognizing the lessons learned through the SWFDP – Southern Africa, the Met Office UK would also supply a Public Weather Service Advisor, who is expert in interpreting forecast outputs for specific stakeholder groups and communicating forecast messages in a format that can be easily interpreted and acted upon.

6.1.11 Based upon experience from the SWFDP – Southern Africa, the importance of feedback on the products was emphasised. The meeting was pleased to note that the Met Office UK is proud to continue to support the SWFDP initiative and see it as an effective means of working together to improve severe weather forecasting around the world.

ECMWF

6.1.12 Dr David Richardson informed the meeting that ECMWF has a cooperation agreement with WMO and actively supports its work. The meeting was pleased to note that ECMWF has indicated its support to the SWFDP. For the SWFDP – Southern Africa and SWFDDP – South Pacific Islands, ECMWF has been providing a range of products from both the deterministic forecasts and the Ensemble Prediction System (EPS), focusing on early warning for severe weather. These are provided as graphical products, mainly as charts focused on the region of interest for the SWFDP. The products are accessible via the ECMWF web site (see http://www.ecmwf.int/about/wmo_nmhs_access/index.html), on a password-protected page. For the proposed SWFDP – Eastern Africa, ECMWF would also be able to provide a range of products from its high-resolution deterministic forecast and its ensemble prediction system (EPS). These products would be aimed at providing indication about the risk of severe weather. Initially these would be based on the existing product range, plotted on the geographical area of interest for the SWFDP, and would include:

- probabilities of precipitation and winds exceeding given thresholds;
- extreme forecast index (EFI); identifies locations where the ensemble is substantially far from the model climate, indicating potential severe event;
- tropical cyclone tracks and strike probability maps;
- site-specific forecasts for surface weather parameters (EPSgrams) for specified locations (up to 10 stations for each participating country). Participating countries in an SWFDP for Eastern Africa were encouraged to identify ten different locations (preferably synoptic stations to allow for verification) for which the ECMWF would provide EPSgrams. The list of locations is given in Annex III.

6.1.13 The meeting noted that all products would be updated twice a day with forecasts from 00 and 12 UTC; and an archive of the previous 7 days would also be provided to assist in evaluation. All products will be provided in graphical format on the ECMWF web site (password-protected). The ECMWF contact person for the SWFDP is David Richardson (david.richardson@ecmwf.int). ECMWF would consider requests for additional products to support the SWFDP, but the resources required to undertake the work would need to be taken into account.

6.1.14 The meeting noted that ECMWF encouraged and supported evaluation of the SWFDP, and requested participants to provide feedback on the application and usefulness of ECMWF products during the project. The meeting noted that participants have been experiencing some difficulties in the interpretation of EPSgrams, in particular the cloud coverage, and recommended training on these aspects. ECMWF would explore the possibility of providing the EPSgrams row data of the locations identified for the SWFDP – Eastern Africa. Participants provided some initial feedback regarding ECMWF products.

6.1.15 The meeting noted that ECMWF had prepared a guide to the use of its EPS products for WMO Members. The guide also includes the additional products that are available to the participants in SWFDPs. In addition, ECMWF runs an annual training course on the Use and

Interpretation of ECMWF Forecast Products for forecasters from WMO Members. The purpose of the course is to train forecasters in the use and understanding of ECMWF products, especially those that may not be familiar, such as the probabilities from the Ensemble Prediction System (EPS), the EPSgrams, Extreme Forecast Index, and tropical cyclone strike probabilities. In recent years a number of participants from the SWFDP – Southern Africa and SWFDDP - South Pacific Islands had benefited from participating in this course. The next course would be held at ECMWF in October 2011 (see http://www.ecmwf.int/newsevents/training/). Priority would be given to participating countries in SWFDPs to attend this course.

US African Training Desk, National Centres for Environmental Prediction (NCEP)

6.1.16 Mr Vadlamani Balakrishna Kumar explained that the concept of the NOAS/NCEP/CPC African Training Desk is to provide a special opportunity for training of African meteorologists at NCEP on operational weather and climate forecasting to strengthen the capacity of African focusing on the operational use and application of numerical model products, and climate forecasting and modelling tools.

6.1.17 The meeting noted that the African Training Desk was established in 1994 through the WMO/VCP and has three staff members. Six visiting meteorologists from African NMHSs train at the NCEP African Training Desk each year, each spend 4-months at NCEP, arriving at staggered intervals. The training curriculum includes: NAWIPS (US forecaster workstation); use and interpretation of NWP; ensembles; writing forecast bulletins; GIS applications; week 1 forecasts; access and processing of large data sets; model verification; and WRF modelling.

6.1.18 The meeting noted that through the SWFDP, a wide range of forecast products, including bulletins and advisories, would become available from NCEP via the African Desk website (http://www.cpc.ncep.noaa.gov/products/africa_desk). While noting that daily forecast guidance would also be issued by visiting meteorologists at the African Desk as part of their training, the meeting acknowledged that this product is not an official NCEP prediction. In addition, the African Desk would be able to facilitate access to: (a) GFS forecast Charts; and (b) Global Ensemble forecast Charts. It was explained that verification of the NCEP Ensemble predictions runs on an IBM supercomputer using available observation data from the GTS. However, if individuals wanted to conduct additional verification trials, NCEP African Desk may be able to provide some guidance and scripts.

6.1.19 The meeting noted that a new website is currently being developed, partly in support of the proposed SWFDP – Eastern Africa (http://www.cpc.ncep.noaa.gov/products/africa_desk/cpc_intl). This web site would have regional and sub-regional charts, and a wide range of products and information relevant to the SWFDP – Eastern Africa. In particular, the portal would provide access to:

(a) Forecast soundings – using weather model data to create a forecast sonde output. Two locations per country participating in SWFDP will be set up.
(b) Satellite rainfall estimates;
(c) Real time monitoring of Monsoons rainfall maps: 7-days, 30-days, 90-days and 180 days;
(d) Global Tropical Cyclone Alert System – these alerts can also be emailed.

6.1.20 The meeting recognized that close cooperation with the NCEP African Desk is essential to the success of the SWFDPs in Africa. It was suggested that the Africa Desk accesses the SWFDP RSMC Daily Guidance Products (presently from RSMC Pretoria in the SWFDP – Southern Africa project), and when appropriate interacts with the SWFDP. Further ways of increasing this synergy should be investigated, in particular to strengthen forecasting processes at smaller African Met Services.

6.1.21 The meeting noted that as part of the support provided by NCEP African Desk, Tanzania Meteorological Agency (Mr P. Mlonganile) is currently running nested WRF for Lake Victoria at 5km horizontal resolution. This issue was further discussed under agenda item 6.2.

6.2 Regional: RSMC Nairobi (Kenya), TMA (Tanzania)

6.2.1 Representatives of RSMC Nairobi (Kenya) and TMA (Tanzania) informed the meeting of the general features of their (regional or limited-area) NWP production system(s), relevant observational datasets, including satellite-based, that could be provided to the SWFDP, relevant to severe weather monitoring and forecasting.

RSMC Nairobi (Kenya)

6.2.1 Mr Vincent Sakwa recalled that KMD uses the High Resolution Regional Model (HRM) and the Weather Research and Forecasting (WRF) models for nowcasting and short-range forecasting severe weather (see agenda item 4.1 for details). He informed the meeting that products from these models could be made available through the project. These include: precipitation probability forecasts, real time access to charts for a number of surface and column parameters from the above-mentioned models and products from global centres.

6.2.2 The meeting noted that KMD could make available through the SWFDP the observational datasets from 36 synoptic stations and 3 upper level stations (Dagoretti, Lodwar and Garisa met stations) in Kenya. It further noted that data from 16 out of the 36 synoptic stations are available on the GTS and stressed that any additional data would be extremely useful to global centres, in particular for model verification. Regarding upper level data, the meeting recommended the NMHSs represented at the meeting to initiate a dialogue with their national airlines in order to install weather sensors in their planes, which would improve the AMDAR network, thereby contributing to improve the weather forecasting. In addition, the meeting noted that satellite-based data could also be accessed through the remote sensing station in Kenya.

6.2.3 The meeting noted that through the SWFDP, KMD would also be able to share products from both global climate models (e.g. ECMWF, UK, etc.) and Empirical Statistical models, which can be used for preparing seasonal climate outlooks.

TMA (Tanzania)

6.2.4 Dr Kabelwa Hamza Athumani recalled that TMA uses the Weather Research and Forecasting (WRF) and High Resolution Regional Model (HRM) models for issuing weather forecasts over Tanzania (see agenda item 4.1 for details). He noted that currently the computing facility at TMA is not sufficient enough to provide NWP products over the Eastern Africa region at high resolution. However, the meeting noted that TMA has already started to upgrade its forecasting system, and in the future would be able to provide products at high resolution about 5km over the region including nesting over Lake Victoria Basin and evolution of tropical cyclone over Southwest Indian Ocean using Data Assimilation (DA). TMA is currently running nested WRF for Lake Victoria at 5km horizontal resolution at an experimental basis when there is a potential for a severe event. Whilst this high resolution model output requires further validation, it was suggested that this could be a useful tool for further investigation during the SWFDP in particular for severe weather forecasting for safety of fishermen on Lake Victoria. In addition, the meeting noted the interest of TMA in installing a wave model for the Lake Victoria, which would contribute to the safety of fishermen on Lake Victoria; and therefore recommended the support of NCEP and any other global centre to assist TMA in this regard.

6.2.5 The meeting noted that TMA has installed one high resolution radar with a range of 480km in the coastal zone of Tanzania (Dar-es-Salaam), which would operate towards the end of October 2010. According to the range, coverage areas include the coast of East Africa. Second weather radar is already in the procurement procedure of which installation would be made in the Lake Victoria Basin (Mwanza) with coverage of the entire Lake and countries within the its basin. This would be very useful to act as intervention of a predicted weather condition over Lake Victoria nested by NWP and improve when necessary, would be done through assimilation process. While noting that the radar network system would contribute significantly to early warning systems of

countries in the Eastern Africa region, the meeting stressed that there are data policy issues that need to be addressed at the regional level if the weather radar data are to be available through the project. However, the meeting was informed that countries participating in the proposed SWFDP – Eastern Africa would be indirectly benefiting from this weather radar network through the improved NWP products.

6.3 National Meteorological Centres

6.3.1 Representatives of Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda considered the information provided by the global products centres and regional centres, and agreed that a large number of real-time products, in particular probabilistic forecasts, would be useful for enhancing the weather monitoring and forecasting processes, and to improve the provision of weather and warning services for the benefit of the general public and key application areas, including agriculture and fisheries, in their respective countries. The meeting encouraged its participants to make maximum use of these products and provide feedback of their usefulness and performance to the global products centres and regional centres. The meeting noted that some practical measures to facilitate ease of access to, and efficient use of these products would be appreciated, such as cutting global products to a prescribed regional geographic window, and organizing the products on Web sites in such a way as to permit rapid access to specific products.

6.3.2 The meeting discussed other products and developments that could be relevant for the region and that global products centres and regional centres could consider providing or developing for the project. These include:

(a) Making available wave products along the Indian Ocean coasts of Kenya and Tanzania (e.g. wave EPSgrams from the ECMWF and/or NCEP).

(b) Implementing a shallow water wave model for the Lake Victoria for the safety of fisheries (e.g. WaveWatch-III from NCEP). The meeting noted that a number of countries run HRM post-processing applications and models, including wave models, that could eventually be implemented at the regional centre. Further investigation is required regarding this issue.

(c) Implementing a high resolution atmospheric model over the Lake Victoria for the safety of fisheries. The meeting recalled that TMA is currently running nested WRF for Lake Victoria at 5km horizontal resolution on an experimental basis when there is a potential for a severe event, and as well noted that the Met Office UK is considering running its limited area model at 1.5km horizontal resolution. The meeting strongly supported these activities and recommended that case studies be prepared using these two models in order to evaluate their performance, in particular regarding deep convection events. The meeting also recommended that these models be implemented operationally and their outputs be shared among the participating countries in the proposed SWFDP – Eastern Africa.

(d) Assisting Rwanda Meteorological Service in getting access to products from VAAC Toulouse in case of volcanic ash events. The meeting recalled that a number of countries run HRM post-processing applications and models, including dispersion models, that could eventually be implemented at the regional centre. Further investigation is required regarding this issue.

6.3.3 The meeting noted that forecasting convection would require a good knowledge of the surface temperature of the Lake Victoria, and therefore discussed a potential implementation of an observational network over the Lake Victoria. This could include deployment of buoys, the installation of Automatic Weather Stations in ferries, and availability of remote-sensed imagery. In order to explore the feasibility of these possibilities, the meeting recommended that the Secretariat liaise with the Lake Victoria Community regarding the surface observational network aspects and the WMO Space Programme to assist the participating countries in the proposed SWFDP – Eastern Africa in getting access to the relevant remote-sensed imagery. The meeting noted that KMD is planning to deploy a buoy in the Lake Victoria in a near future.

6.3.4 The meeting noted that for agricultural applications, it would be important to have access to monthly and seasonal forecasts. It further noted that there are forecasting aspects that could complement the RCOFs (consensus forecasts). The meeting agreed that it is premature to consider these issues in an initial phase of the SWFDP – Eastern Africa, however it suggested that extended-range forecasting be considered in a later phase of the project.

7. PLANNING A REGIONAL SUBPROJECT FOR EASTERN AFRICA

7.1 Specific goals and objectives to improve forecasting and delivering of weather services for general public, media, and disaster management and civil protection authorities

Guidelines on preparing a country implementation plan: the PWS component of SWFDP

7.1.1 The meeting supported the focus of the PWS component, which is equipping the participants with information to enable them prepare a country plan for implementing the PWS component of the SWFDP. The meeting recognized that just as in forecasting, core competencies are required to deliver PWS and that these competencies are essential in ensuring that SWFDP achieves its objectives. A very important first step in the delivery of PWS is user focus and in particular:

- Identification of the users to be served or engaged in the project and determination of their requirements through applying different methods;
- Understanding the user community;
- Understanding how the information is used in decision making;
- Ensuring that NMHS staff are aware of the user needs;
- Ensuring that users are aware of potential NMHS services, as well as the limitations of those services.

7.1.2 The meeting fully supported that communication is one of the most necessary skills for the forecaster who is charged with service delivery tasks, but it is a skill rarely taught during academic training in Meteorology. Effective two-way communication implies listening skills as well as speaking skills. Confidence is an important element in communication, and this cannot be taught directly, but must be developed within each person. Formal communication training courses for forecasters (in whatever media they are required to operate – telephone, radio, television, etc.) are crucial in developing communication skills. Furthermore, the meeting agreed that in general NMHSs seem to have difficulties in dealing with media organizations. Some of these difficulties stem from the culture differences of Meteorological Services and Media organizations. The meeting agreed that NMHSs need to develop close working relationships with the media and that it could take time to build two way trust between them and the media. NMHSs need to keep in mind that's the media functions both as a "user" and a conduit to "users". However, there is usually a substantial common interest between NMHSs and public service broadcasters in providing a quality weather service to the public and good communication skills will be recognized and valued by media organizations. It would also be useful if NMHSs acquired some technical knowledge of broadcast technologies, so that they could recognize the appropriate formats in which information should be supplied – the easier it is for a media organization to assimilate and broadcast (or print) this information, the more likely it is to be used. Therefore, a dialogue, or two-way communication, needs to be established with media. This is best achieved by a combination of formal (seminars, training courses) and informal (social events, familiarization visits, etc.) contacts.

7.1.3 The meeting agreed that the goal of a warning issued through the PWS channels is to maximize actions taken by the responsible authorities, communities and individuals. The components of a warning system include detection of hazards and issuing warnings which are the basic functions of a forecasting service; communication of the warnings and response to the warnings. The latter depends on the content and clarity of the message, credibility of the issuing organization and state of preparedness of receiving authorities.

7.1.4 The meeting carefully considered the elements of a severe weather warning programme and agreed that to be successful, such a programme should ensure that everyone at risk must receive the warning; understand the information presented; believe the information; personalize the information; make correct decisions; and, respond in a timely manner. In addition, the meeting agreed that NMHS staff should be equipped with the necessary knowledge to craft effective warning messages. When composing a warning, it is important that the heading stand alone and stand out; the components of the message are clearly defined; the message is simple; it personalizes the event, the consequences and the actions required; the most important message be placed first; allowance be made for shortening of the message by broadcasters; and, location be made relative to well-known places, etc.

7.1.5 The importance of the outreach to the public and other users was emphasized and the meeting agreed that it was essential to seize every opportunity to work with users and their communities to introduce them to the activities of the NMHS. This strategy would help create weather-aware communities who would respond better to the information and services provided by the NMHS. It would also help users to better understand the limitations and potential of weather forecasts and warnings and to better appreciate the reasons for why the forecasts may not always be accurate.

7.1.6 The meeting endorsed the concept of monitoring, evaluation and continuous improvement of delivering the warning and forecast services. Formal verification involves ensuring that the warnings and forecasts are accurate and skilful from a technical point of view. In addition and just as important, the assessment of the utility or value of the services to users must be built within the warning system. Service evaluation determines whether services are meeting user requirements and ascertains whether users understand the products and services provided and are making optimum use of them. To be effective the service has to contribute significant social or economic benefits to its clients. Consequently, evaluation must include an assessment of the value added to clients by the programme. The evaluation process should be kept simple with the aim of having some results available when talking to decision-makers and in response to media enquiries.

7.1.7 The meeting agreed that a good plan is specific not just on the actions to be taken but also on the persons to take the action. The implementation of the PWS component requires identifying the responsible persons who will take part in all the aspects of the project and lead it through training and implementing the recommendations contained within the project.

Response to questions on how does each country disseminate and communicate its forecasting products

Kenya

7.1.8 Mr Ayub Shaka informed the meeting that at the Kenyan Meteorological Department (KMD), once a forecast is given, the Public Weather Service section of KMD sends the forecast to newspapers, FM radio, TV stations, releases it on the its internet site and RANET, and sends it various users via email. KMD ranks the important weather hazards as drought, landslides, and floods. The meeting noted that KMD have established a response desk to specifically answer questions from the public. They also produce a flood watch and agrometeorological bulletin. Kenya provides a lot of attention to the release of the seasonal forecast. For example, Radio and TV have invited experts on their programs and media houses come to KMD for interviews. KMD also provides public forums and once a year participates in the Kenyan Government public service week where all government agencies are present. During significant severe weather and ENSO events, they establish a small committee that handles the public communication of these events.

Tanzania

7.1.9 Mr Isack Yonah informed the meeting that the Tanzania Meteorological Agency (TMA) provides agrometeorological and regular daily weather forecasts. On the release of seasonal

weather forecasts, the media are invited. The agrometeorological service provides information via emails to disaster management agencies, Ministry of Agriculture, WAMIS, the Famine Early Warning System Network (FEWSNET) offices in Tanzania. Decadal and monthly weather forecasts are also produced and TMA participates in agricultural shows and fairs to create awareness.

Ethiopia

7.1.10 Mr Dadimos Wondifraw (agromet) and Mr Lemessa Dufera Debela (PWS) informed the meeting that the National Meteorological Agency of Ethiopia (NMA) provide daily forecasts in the national language, English, and in several local languages. NMA provides hydrological and agrometeorological information via radio, and through their 10-day and monthly agrometeorological bulletins. Daily forecasts are proved to newspapers. The participants from Ethiopia commented that they were having problems with TV presentation software called Weather Eye from the UK Met Office. A participant from Kenya commented that they also were having problems with this software but have contacted the UK Met Office about the problem.

Uganda

7.1.11 Mr Samuel Edward Senkunda informed the meeting that the PWS section was within the forecasting division and that 24 hour forecasts on TV are provided. The PWS section is located in Entebbe where the forecasters are also located. The Agmet section is located in Kampala at the headquarters of the Department of Meteorology. This needs stronger coordination between the forecasting desk and the agrometeorology desk. Seminars with media are organized for the seasonal forecasts with information disseminated via radio and TV and there is a 30 minute weather program on national radio.

Burundi

7.1.12 Mr Balthazar Ntibasharira informed the meeting that they have five forecasters in their service and that PWS are not very well developed in Burundi. The Met Service provides a seasonal climate forecast, 10-day forecast from the climate section and it interacts with users from water resources, agriculture, and civil protection sectors. The service also interacts with UN agencies such as FAO and provides information to users on-demand. The meeting noted that one problem in Burundi is that the public is not aware that the weather information provided by the Met Service is useful to them.

Rwanda

7.1.13 Mr Jean-Baptiste Uwizeyimana informed the meeting that there are 10 forecasters in the Met Service and that the service provides forecasts on TV. The Met service provides weather and seasonal climate information to users in the Ministry of Agriculture and to the water resources sector.

All six countries

7.1.15 The meeting noted that in order for Met Services to be effective in disseminating weather and climate information, PWS and agrometeorological staff of the NMHS needs to get out of the office and interact directly with users. It was also noted that the media misinterpret weather forecast and in some case are negligent in accurately portraying the weather information. It was suggested that more media training was needed. The meeting noted the experience of KMD in which the PWS staff actively interact with media. The NMHSs can lead by example by using demonstration projects such as improve the productively of garden plots located on KDM land. It was stressed that NMHS must build credibility with users but this is slow process which can take years of efforts before yielding results.

PWS aspects for the development of a SWFDP for Eastern Africa

7.1.16 The meeting discussed the delivery of warning services, in conjunction with the improved production of forecasts and warnings through the SWFDP, and concluded with the following:

(a) Participating NMHSs should develop a national plan for delivering services based on the SWFDP products and the guidance provided by the Secretariat (see annex IV) on preparing such a plan;

(b) Based on the plan, the participating NMHSs should work on: User identification and user requirements (through the development of an assessment table similar to the one provided by the Secretariat and attached as annex V); Dialogue and communication with the primary users and partners, namely the media, disaster management authorities and the public as well as the specific user communities of farming and fishing; and mechanisms for such communications;

(c) Using the guidance materials available through the PWS Programme (all PWS guidelines are available on the PWS webpage in pdf format) the participating NMHSs should establish Public Education and Outreach activities as part of the public awareness raising campaign and should carry out these activities periodically, particularly prior to the important weather seasons;

(d) NMHSs should develop plans for obtaining user feedback and user satisfaction assessment, through surveying and interviewing the users. These plans should be implemented using guidance materials and sample surveys provided by the Secretariat and reported regularly as part of the implementation of SWFDP.

7.2 Specific goals and objectives to improve forecasting and delivering of weather services for agriculture and fishery communities

7.2.1 The following questions were given to the agrometeorologists as initial discussions to the project development.

1) List / rank three of the most significant/important weather hazard that impacts agriculture in your country?

2) Do you make specialized agrometeorological advisories/ forecasts? If so, how many days (1-5 days)? Which weather forecast products?

3) What kind of weather forecast products / guidance do you need to make better advisories?

4) How do you disseminate / communicate this information to users?

7.2.2 Mr Peter Njuguna informed the meeting that the main agricultural crops in Kenya are maize and beans. It was also noted that Kenya ranked the significant weather hazards impacting agriculture are rainfall (drought / flooding), severe thunderstorms including hailstorms and wind gusts, and frost. For question 2, Kenya produces a decadal bulletin and utilizes a 4 to 7 day forecast from KMD for the bulletin. The agrometeorological staff of KMD work together to undertake crop assessments and utilizes NDVI in the bulletin. For question 3, Kenya would like to have information on a clear onset and end of the rainy season, the temporal distribution of rain during the season, knowledge of dry spells during the season, frost occurrence, areas of wind gusts, information on relative humidity, Cold Cloud-Top Duration (CCD) and radiation. For question 4, Kenya disseminates agrometeorological information by the internet, sometimes by email, village meetings with chief (barrazas), via officers in charge throught 36 county offices, media, farmer field days, through Kenyan Agricultural Society shows and trade fairs, public service weeks, and focal point farmers.

7.2.3 The meeting also discussed the issues of how to disseminate agrometeorological bulletins by email and/or distributing paper copies. KMD informed the meeting that there are 60 to 80 subscribers to the bulletin via email. The meeting noted that there are 13 agrometeorological stations in the country with 11 located Kenyan Agriculture Research Instituite (KARI) lands.

7.2.4 The meeting noted that NMHS should not rely on only one dissemination method of information. There are traditional (paper, fax) and modern (email, internet) methods. Also, standard operating procedures (SOP) need to be developed for specialized bulletins.

Tanzania

7.2.5 Mr Isack Yonah informed the meeting that Tanzania ranked the significant weather hazards impacting agriculture are drought, floods, thunderstorms, hailstorms, and cold / chilly temperatures. For question 2, it was noted that no weather forecasts were provided. For question 3, Tanzania indicated that a rainfall outlook is needed. For question 4, Tanzania disseminated agrometeorological information by email, the TMA and WAMIS websites, TV, radio, print papers, public servants week and agriculture shows. Information has been provided via RANET but it is no longer working. It was noted that TMA contributes to the Food Security and Nutrition Report and issue agromet advisories to the Same District Agriculture Community through TMA/SUA joint project.

Ethiopia

7.2.6 Mr Dadimos Wondifraw (agromet) informed the meeting of complex growing and rainy seasons that occur for rainfed agriculture in Ethiopia. It was noted that Ethiopia ranked the significant weather hazards impacting agriculture as floods, drought (dry spells and forest fires) and hailstorm. The outbreak of crop pests and diseases also had a significant impact on agriculture. For question 2, precipitation, temperature, humidity and wind forecasts are provided. The meeting was informed that soil water balance information and flood guidance based on soil moisture was calculated. Crop planting advice was produced once per season from the World Food Programme (WFP) LEAP model which calculates the Water Requirement Satisfaction Index (WSRI). A 10-day and monthly agrometeorological forecast is also provided. For question 3, Ethiopia is experimenting with a NWP model for the country which provides a 24 hour forecast. Question 4 was answered in section 7.1.

Uganda

7.2.7 Mr Samuel Senkunda informed the meeting that Uganda ranked the significant weather hazards impacting agriculture as drought, floods, strong winds, dry spells which occur on average 10 to 20 days. It was noted that precipitation was the most limiting factor for agriculture. For question 2, the meeting was informed that the Met Service provides a 10-day and monthly advisory and that 10 day outlook utilizes text forecasts from the forecasting division. For question 3, remote sensing (satellite) products rainfall estimates are needed. It was noted that there is a MOU between the Met Service and WFP to purchase AWS 13 stations. Also, there is a need to build capacity to interpret and use products remote sensinfg products such as NDVI. For question 4, agrometeorological information is disseminated to users via media seminars, emails, and radio programs. Also, it was noted that there are some problems with RANET.

Burundi

7.2.8 Mr Didace Rwabitega (agromet) informed the meeting that Burundi ranked the significant weather hazards impacting agriculture as drought, floods, strong winds and hailstorms. For question 2, agrometeorological advisories / forecasts are not very developed. There is some interaction between the Met Service and the Ministry of Agriculture on how the upcoming rainy season is going to develop. The meeting was informed that soil moisture information is needed along with short-term weather forecasts. Both participants from Burundi indicated that the duration of the rainy season is becoming shorter and therefore it would be helpful for better prediction of the rainy season. For question 4, weather information is disseminated by radio and the internet and to various government agencies. There are 3 agrometeorologists in the Met service.

Rwanda

7.2.9 Mr Jean-Baptiste Uwizeyimana informed the meeting that Rwanda ranked the significant weather hazards impacting agriculture as floods, landslides, and hailstorms. It was noted that there are two main rainfall zones in Rwanda. For question 2, it was noted that are agrometeorological advisories are prepared every 15 days for the next two weeks. Every season crop assessments are prepared. Due to the previous 1994 genocide, all stations were destroyed. Currently, there are 30 stations in Rwanda with a mix of automatic and manual raingauges. There are about 90 rainguages in 13 districts. No agrometeorological bulletins are produced. It was noted that seasonal climate forecasts are sent ot the Ministry of Agriculture and farmer associations. For question 3, all kind sof weather data is needed (temperature, humidity, solar radiation, rainfall, wind) to calculate evapotranspiration and soil water balance based on FAO guidelines. It was noted that weather data is provided to the agriculture weather insurance industry, and the World Bank and the Popular Bank intervene in helping the farmers. For question 4, agrometeorological information is disseminated every 15 days based on information from NCEP. Information is also disseminated via TV, radio, national newspaper, local language and by local meetings with farmers.

Conclusions:

- Provide advisories to livestock farmers;
- More capacity building activities are needed especially with specialized software packages and remote sensing applications;
- More staff agrometeorological staff and infrastructure is needed;
- Provision of NWP products from Global and regional weather centres readily available will enable NMHSs to make more accurate, timely, and reliable weather forecasts for many applications;
- It is important that the cascading information process continues throughout the NMHS (forecasting, public weather services, and agricultural meteorology) to the local communities and target groups;
- The Agromet advisories from the NMHS should be disseminated in a timely manner;
- Users should be made more aware of the agromet advisories;
- At the country level, a successfully implemented SWFDP can contribute to reduced costs to agriculture and fishery and reduced crop and livestock losses due to the protection and avoidance from severe weather events.

7.3 Organizational framework (the Regional Subproject Management Team)

7.3.1 The Secretariat briefed the meeting on the basic constructs for an implementation plan, and the process for developing and establishing such a plan for a specific regional subproject, as described in the “SWFDP Guidebook for Planning Regional Subprojects (2010)”. The meeting discussed the roles, responsibilities and functions of the participating centres in the Cascading Forecasting Process, and developed recommendations for a proposed project in Eastern Africa, and their conclusions and recommendations are included in the section below entitled: “Conclusions and recommendations”.

7.4 Technical components (roles, guidance, products, routines, etc.)

7.4.1 The meeting developed recommendations on the essential technical components for a proposed project, based on the guidelines from the Guidebook, and their conclusions and recommendations are included in the section below entitled: “Conclusions and recommendations”.

7.5 Timetable for planning and development of an Implementation Plan

7.5.1 In consideration of important deadlines, the meeting developed recommendations on a timetable for planning and development of a proposed project in relation to key milestones noted in the Guidebook, and their conclusions and recommendations are included in the section below entitled: “Conclusions and recommendations”.

7.6 Conclusions and recommendations

7.6.1 The meeting unanimously agreed in principle that the implementation of an SWFDP in Eastern Africa would be technically feasible and would bring benefits in terms of enhancement of technical capacity in operational weather forecasting and advancement in service delivery to general public and key application areas such as agriculture and fisheries, in countries of the region, including Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. Specifically, the proposed regional subproject should focus on the following severe weather events in order of decreasing priority (and associated hazards such as flooding, droughts, etc):

(a) Heavy rain/flooding and deficit of precipitation/dry spells;
(b) Strong winds in relation to thunderstorms and any other phenomena over the Indian Ocean and major lakes;
(c) Hazardous Indian Ocean and major lake waves.

7.6.2 After an in-depth discussion on the various aspects in the planning of an SWFDP in Eastern Africa, following guidelines as laid out in the "SWFDP Guidebook for Planning Regional Subprojects (2010)" (hereafter referred to as the Guidebook), the following conclusions were reached:

(a) the domain to be covered for monitoring, analyzing and predicting the various severe weather events was proposed to be bounded by 5E – 55E; 30N -25S; a specific domain for the Lake Victoria should be considered;
(b) Met Office UK, DWD (GME data needed for nesting HRM), NCEP GFS/GEFS (including GFS data for nesting WRF) and ECMWF to provide NWP guidance material as Global Centres (ref. Guidebook Section 2.4.1);
(c) RSMC Nairobi (Kenya) to take up the role as regional centre for the project (ref. Guidebook Section 2.4.2), with TMA to provide training and technical support (e.g. high resolution nested WRF/HRM and wave models, etc.) where appropriate;
(d) Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda to participate as National Meteorological Centres (NMCs) (ref. Guidebook Section 2.4.3);
(e) the project should focus on severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture and fisheries (safety and protection of fishers); and
(f) further planning to be pursued in accordance with the following timeline:
    (i) SWFDP – Eastern Africa key players, in particular Kenya, to attend Technical Conference in conjunction with CBS Extraordinary Session, which will be held in Windhoek, Namibia (Nov 2010);
    (ii) WMO Secretariat to send official letters to PRs, including reference to establishment of project management team (Dec 2010);
    (iii) SWFDP – Eastern Africa management team meeting be held when a draft implementation plan for the project be ready for discussion (Mar/April 2011);
    (iv) Implementation plan revised and finalized before start of field phase (May 2011);
    (v) Preparatory training workshop (Oct/Nov 2011);
    (vi) End of field phase (May 2012 or later).

7.6.3 Based on the above conclusions, the following recommendations were made:

(a) The RA I representative at the Steering Group for the SWFDP to coordinate the setting up of a small project development team to undertake the drafting of an implementation plan, and team members to include Kenya and Tanzania, plus one or two others to provide input from the perspectives of Global Centres and RA I;
(b) WMO Secretariat to follow up on developing a provisional programme for the Preparatory Training activities;
(c) Prior to field phase implementation: (i) Met Office UK, NCEP African Desk and ECMWF to adapt model output products to the SWFDP – Eastern Africa domain window, and possibly RSMC Nairobi to run the LAM covering the same region; and (ii)

TMA to post-process for display at the SWFDP – Eastern Africa Web site, the high resolution nested WRF/HRM model using the Lake Victoria domain window;

(d) NMCs to prepare a list of forecasting and warning products required;

(e) NMCs to provide all warning criteria currently used;

(f) NMCs to provide information on Internet access capability;

(g) To encourage the forecasting and agrometeorological NMHS staff to work together to develop forecasting products with regards to the SWDFP;

(h) NMCs to develop plans for service delivery based on guidance/templates provided by WMO Secretariat (e.g. users identification, users' requirements, delivery mechanisms);

(i) NMCs to develop plans for communication/contact channels and outreach programmes;

(j) NMCs to develop plans for the processes of user feedback, analysis and reporting;

(k) Secretariat to support NMCs efforts by providing training on design of products and services, and in the development of cross-border exchanges of alerts and warnings;

(l) Secretariat to prepare a questionnaire table for gather information under (d) - (f)

8. ANY OTHER BUSINESS

8.1 There were no other issues raised during the meeting.

9. CLOSING

9.1 The Technical/Planning Workshop on Severe Weather Forecasting Demonstration Project (SWFDP) Development for Eastern Africa closed at 15:30 on Friday, 8 October 2010.

Annex I

Agenda

1. OPENING

2. ORGANIZATION OF THE WORKSHOP

2.1 Adoption of the agenda
2.2 Working arrangements

3. INTRODUCTION TO SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP)

3.1 Overall Framework
3.2 Summary of experience and progress of and synergy with the SWFDP in Southern Africa
3.3 Synergy with World Bank Development Grant Facility (DGF) Project: "Support for the Weather and Climate Service delivery in the Lake Victoria Region"
3.4 Status of the Global Data-processing and Forecast System (GDPFS) in RA I – Eastern Africa
3.5 Status of the Public Weather Services activities in RA I – Eastern Africa
3.6 Status of the Agricultural Meteorology activities, including for fisheries, in RA I – Eastern Africa

4. SEVERE WEATHER FORECASTING IN EASTERN AFRICA (Kenya, Tanzania, Uganda, Rwanda, Burundi, Ethiopia)

4.1 Severe weather forecasting and warning services, including delivery and communication to the users
4.2 Current severe weather related initiatives

5. REQUIREMENTS FOR FORECASTING AND WARNING SERVICES, INCLUDING DELIVERY AND COMMUNICATION TO AGRICULTURE AND FISHERY COMMUNITIES

6. CASCADING FORECASTING PROCESS: ROLES OF PARTICIPATING CENTRES

6.1 Global: DWD (Germany), Met Office (UK), African Desk (USA), ECMWF
6.2 Regional: RSMC Nairobi (Kenya), TMA (Tanzania)
6.3 National Meteorological Centres

7. PLANNING A REGIONAL SUBPROJECT FOR EASTERN AFRICA

7.1 Specific goals and objectives to improve forecasting and delivering of weather services for general public, media, and disaster management and civil protection authorities
7.2 Specific goals and objectives to improve forecasting and delivering of weather services for agriculture and fishery communities
7.3 Organizational framework (the Regional Subproject Management Team)
7.4 Technical components (roles, guidance, products, routines, etc.)
7.5 Timetable for planning and development of an Implementation Plan
7.6 Conclusions and recommendations

8. ANY OTHER BUSINESS

9. CLOSING

Annex II

List of participants (including David Richardson (ECMWF) by video-conference)

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Annex III

List of locations (synoptic stations) for each country for which the ECMWF and Met Office UK would provide EPSgrams

Burundi

	Station name / ID	ECMWF	Met Office UK
1	Bjumbwa / 64 390	already up	add
2	Muyinga / 64 397	add	add

Ethiopia

	Station name / ID	ECMWF	Met Office UK
1	Mekele / 330	add	-
2	Bahrdar / 332	add	add
3	Combolcha / 333	add	-
4	Jimma / 402	add	-
5	Addis Ababa / 450	already up	add
6	Methehara / 453	add	-
7	Arbaminch / 500	add	-
8	Negelle / 533	add	-
9	Gode / 478	add	no
10	Diredawa / 471	add	no

Kenya

	Station name / ID	ECMWF	Met Office UK
1	Eldoret	already up	-
2	Kericho	already up	-
3	Kisumu	already up	-
4	Meru	already up	-
5	Monbasa	already up	-
6	Moyale	already up	-
7	Nairobi	already up	-
8	Nakuru	already up	-
9	Voi	already up	-
10	Wajir	already up	-

Rwanda

	Station name / ID	ECMWF	Met Office UK
1	Kagali	already up	add
2	Butare Airport	add	add
3	Byumba	add	-
4	Gikongoro	add	-
5	Gisenyi Airport	add	-
6	Kamembe Airport	add	-
7	Kawangire	add	-
8	Kibungo-Kazo	add	-
9	Nyagatare	add	-
10	Ruhengeri Airport	add	-

Tanzania

	Station name / ID	ECMWF	Met Office UK
1	Dar Es Salaam	already up	already up
2	Arusha	already up	-
3	Dodoma	already up	-
4	Kigoma	already up	-

5	Mahenge	already up	-
6	Mbeya	already up	-
7	Mtwara	already up	-
8	Mwanza	already up	-
9	Tabora	already up	-
10	Zanzibar	already up	-

Uganda

	Station name / ID	ECMWF	Met Office UK
1	Mbarara	already up	add
2	Soroti	already up	add
3	Toroto	already up	-
4	Arua	already up	-
5	Entebbe Airport	already up	-
6	Gulu	already up	-
7	Kabale	already up	-
8	Kampala	already up	-
9	Kasese	already up	-
10	Masindi	already up	-

Annex IV

Guidance on Developing Service Delivery Mechanisms in NMHSs

1. Introduction

Effective service delivery is a fundamental requirement for NMHSs if they are to meet national needs. There are many different interpretations of the concept of service delivery as it relates to the provision of weather-, climate- and water-related services. To this end, WMO has developed a "Strategy for Service Delivery" to guide NMHSs in the provision of weather, climate and water-related services that take into account user needs. This "Guidance on Developing Service Delivery Mechanisms in NMHSs" incorporates many of the elements of the "WMO Strategy for Service Delivery".

2. Purpose of this Guide

While there is no prescriptive way to provide services, this "Guidance on Developing Service Delivery Mechanisms in NMHSs" is a step-by-step guide on how an NMHS may develop and implement a mechanism that would enable it to better deliver services to users. Effective services, however have the certain attributes in common as outlined below.

3. Attributes of effective services

Effective services should be:

- Available: at time and space scales that the user needs;
- Dependable: delivered regularly and on time;
- Usable: presented in user specific formats so that the client can fully understand;
- Useful: to respond appropriately to user needs;
- Credible: for the user to confidently apply to decision-making;
- Authentic: entitled to be accepted by stakeholders in the given decision contexts;
- Responsive and flexible: to the evolving user needs,
- Sustainable: affordable and consistent over time, and,
- Expandable: to be applicable to different kinds of services.

4. Step 1: Focus on the user

(a) Identify the users

The purpose of preparing and delivering services to users is to enable them to make better decisions by using weather and climate information. User engagement and feedback is essential in designing and delivering effective services. For the implementation of a successful service delivery mechanism, it is very important to identify specific users that your Service will be serving, and to engage with them appropriately. Generally, users may be divided into five main groups as follows:

- The hazards community - The mission (shared with the NMHS) of these organisations is to ensure safety of life, livelihood and protection of property.

The NMHS should consult and coordinate closely with them, know their specific requirements and give them high priority. The public safety, emergency and civil defence agencies constitute this important group. Their mandate and responsibilities make them major players in planning for and responding to most emergency situations. It is clearly in the interest of NMHSs to ensure that coordination with these important organizations be given a high priority.

- Government authorities – Governments are the most important users of the services and information provided by NMHSs. The most important users are usually the host ministry where the NMHS is situated. It is important to ascertain the requirements of this group and to maintain formal communication with them.

- Weather-sensitive economic sectors – Public Weather Services can be of significant value to weather-sensitive sectors of the economy such as agriculture, forestry, fishing, marine, air and land transport, energy production, construction, sport, tourism and outdoor entertainment. Many NMHSs also provide specialized meteorological, climatological and hydrological services The needs of this user group can be very specific, ranging from long-range forecasts and climate information for planning purposes to short range forecasts and warnings for daily operations.

- Media (print, radio, TV and others) - The media is the most important user and partner of NMHSs products and services. Different media types and outlets have well defined expectations in regards to the final product they require from NMHSs. The final forecast product would need to be tailored to suit the media delivering the product.

- The public – The general public is the largest user group of NMHSs. The most important need of the public concerns warnings of severe weather so as to take prompt action to preserve life and secure property. Their routine needs relate to travel, leisure and general convenience. The requirements of general public are not as precise and well-defined as those for other user sectors and have to be better ascertained through establishing feedback mechanisms including comprehensive, fact-finding surveys.

(b) Determine user needs

Different users have different needs and the only way to determine their exact requirement is through consultation and gathering information. The starting point should be to ask very clearly how the currently available weather information is used in daily decision making by users, how they apply it and what would be the negative impact of lack of such information. The following lists a number of techniques that can be applied to gather such information:

- Surveys, questionnaires, interviews and in-depth case studies to identify a broad overview of the users' needs and expectations. Expertise outside of NMHSs, such as professional survey designers may be required for this type of information gathering;
- Fora and workshops with users' participation in order to learn their requirements and to explain to them of the capabilities of the NMHS;
- Pilot projects in collaboration with users to develop products and services on a longer term to meet the stated requirements;
- Monitoring feedback of user response through press clippings, letters, phone-calls, fax, suggestion boxes or the Internet;
- Interaction with users during Open Days, World Meteorological Day and activities of the NMHS outreach programme;
- Regular meetings with government agencies and emergency managers to ascertain their information needs.

(c) Ensure that users are aware of NMHS services

It is important that users be made aware of the services that an NMHS can deliver as well as understand the limitations of forecast and warning products. Hosting discussion and short training events by NMHSs for different user groups helps to make them aware of how weather and climate products are prepared. Operational forecasters should be involved in such training for fruitful dialogue with users. **Table 1** below shows user groups and suggested approaches to educate or reach out to them.

User Groups	***Training Courses***	***Seminars***	***Informal***	***Leaflets / Pamphlets***	***Media***	***One-to-One***
Politicians / Senior Public Servants			x		x	x
Emergency Managers		x	x			x
Water Managers		x				x
Transport Authorities		x				x
Power Supply Engineers		x				x
Media	x		x			x
Farmers		x		x	x	
Fishermen		x		x	x	
Schools	x			x	x	
General Public				x	x	

Table 1*: User groups and suggested approaches to educate or reach out to them*

Step 2: Focus on internal organization of your NMHS

(a) Get the NMHS ready to deliver service

Delivery of effective public weather services needs an organisation-wide commitment involving the NMHS leadership, technical systems and those directly involved in service delivery. An enthusiastic and motivated focal point or team of officers trained in different aspects of service delivery such as consultation and communication with user groups and with skills in dissemination and presentation of NMHSs products would be a necessity for effective service delivery. Where possible, a Public Weather Services (PWS) office or unit should be established for this purpose.

(b) Ensure that NMHS staff are aware of the user needs

This step requires that members of staff in charge of service delivery are informed in detail of the requirements of different users and the NMHS processes for preparing and delivering the required services. This may require training, to be conducted within the NMHS so that all staff would follow the same rules and regulations and ‘read from the same page’ as they serve users.

(c) Develop an effective warning programme

Since preparing and issuing warnings of hazardous weather is one of the most essential activities of NMHSs, it is crucial to develop an effective warning programme. The NMHS staff in charge of forecasting and public weather service provision should be involved in the development of the programme as they are aware of the realities on the ground in terms of strengths and limitations of the NMHS. To be successful, a warning programme strives to ensure that everyone at risk must:

- Receive the warning;
- Understand the information presented;

- Believe the information;
- Personalize the information;
- Make correct decisions; and,
- Respond in a timely manner.

The ideal warning process has to take into account each of the above components to be successful. It takes training and planning as well as strong collaboration with other partner agencies such as the disaster management and media, to implement a warning programme.

Step 3: Improve communication skills of NMHS Staff

Communication is one of the most necessary skills for a forecaster, but it is a skill rarely taught during academic training in Meteorology. Communication, at its most fundamental, involves the transmission of thoughts, emotions and meaning from one person to another. While words (written or spoken) are usually thought of as the primary medium of communication, studies have shown that many other factors (tone of voice, inflection and body language) play a significant role in aiding (or impeding) communication. Effective two-way communication implies listening skills as well as speaking skills. Confidence is an important element in communication, and this cannot be taught directly, but must be developed within each person. Formal communication training courses for forecasters (in whatever medium they are required to operate – telephone, radio, television, etc.) are crucial in developing communication skills, but they should be augmented with mentoring and feedback schemes and with regular refresher training.

Step 4: Engage users

(a) Formalize NMHS working relationship

Formalize the working relationship with the user and agree on the following:

- Detailed description of products and services needed by the users;
- Detailed description of products and services provided by the NMHS;
- Service delivery procedures including product formats and delivery times;
- Responsibilities of the NMHS – ensuring high quality products and timely delivery;
- Responsibilities of the user – providing regular feedback on the quality of the services. (This is important to the NMHSs for use in service improvement);
- Training that may be required for users, including schedules;
- Assigning NMHS and user focal points who would: be easily accessible; capable of responding to concerns that may arise and; oversee the success of the mutual engagement.

(b) Engage and educate the media

Many NMHSs have difficulties in working successfully with media organizations. However, there is a substantial common interest between NMHSs and the media in providing a quality weather service to the public. Therefore, a dialogue needs to be established with media representatives through which NMHS personnel can gain a full understanding of the media concerns while the media representatives can gain an appreciation of the services that the NMHS can deliver. This is best achieved by a combination of formal (seminars, training courses) and informal contacts such as social events, familiarisation visits, etc. In order to kick off media engagement where it has not existed before, training by internationally-respected experts, organised through WMO is recommended. The NMHS may learn the following from the media:

- How to write appropriate press releases for use by the media;
- How to organize proper press conferences, press briefs etc;
- How to perform effectively during radio, television or newspaper interviews etc.

The media may learn the following from the NMHS:

- Understanding and interpreting basic weather terminologies;
- Understanding and interpreting forecasts, advisories and warnings correctly;
- The limitations associated with the accuracy of weather forecasts;
- Communicating forecast uncertainty and confidence etc.

Step 5: Conduct Service Evaluation for Improvement

(a) Verification

This involves assessing the accuracy of forecasts and warnings from a technical point of view. It serves to inform the NMHS about the skills of its forecast procedures and the aspects of forecasting that need improvement. If no verification procedure exists in the NMHS, start with very simple steps to verify one or two elements (e.g., rainfall, temperature) in a few key locations, and use many available WMO resources to have staff trained on more advanced verification methodologies.

(b) Assessing user satisfaction and perception

Service evaluation determines whether services are meeting user requirements and ascertains whether users understand the products and services provided and are making optimum use of them. Some of items to consider include the language used in communicating forecasts (non-technical and simple for non-meteorologists), the timeliness of forecasts, presentation formats, and communication and dissemination methods. Evaluation must include an assessment of what value the users gained from the NMHS products and services and how such services helped them with making informed decisions. The evaluation process should be kept simple with the aim of having some results available when talking to decision-makers and in response to media enquiries. Annexes to this document provide examples of service delivery evaluation surveys.

Step 6: Make a PWS implementation / Improvement Plan

(a) Timelines

A Service Delivery Plan for the NMHS, should include an implementation programme in the form of a table of activities to be carried such as meetings with respective users or user groups, training seminars or workshops, the agreements to be entered into etc. The plan should take into account the realities of the situation on the ground, including budgetary and personnel matters. These considerations are essential in helping to fix realistic timelines for achievement of milestones of the implementation of the plan.

(b) Action persons

A good plan is specific, not just on the actions to be taken, but also on the person to take the action. Contact details of the action persons should be included as appropriate. The action people should include focal points from the user organization(s) engaged in the project.

Annex V

Assessment table

NMHS ------- (Country)

Q1. From where do you obtain weather information of your country?

1. Radio
2. Television
3. Newspaper
4. Directly from the Meteorological Service
5. Meteorological service Website
6. Other Websites
7. Mobile phones
8. Other sources (please specify)

Q2. Do you consider the warnings of severe weather of your country over the past several months accurate or inaccurate?

1. Very accurate
2. Somewhat accurate
3. Average
4. Somewhat inaccurate
5. Very inaccurate
6. Don't know / no comment(s)

Q3. How easy is it for you to understand the format and the language used in the severe weather warnings?

1. Very easy
2. Easy
3. Neutral
4. Difficult
5. Very difficult
6. Don't know / no comment(s)

Q4. How do compare the current severe weather warnings with those from the first two (2) years?

1. More accurate
2. About the same
3. Less accurate
4. Don't know / no comment(s)

Q5. Are the severe weather warnings useful in helping you decide on appropriate response action (e.g., stay at home, do not take the car out of the house, keep children indoors, etc.)?

1. yes
2. No

Q6. On the whole, how satisfied are you with the severe weather warnings provided by your country?

1. Very satisfied
2. Satisfied
3. Neutral
4. Dissatisfied
5. Very dissatisfied
6. Don't know / no comment(s)