WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

MEETING OF THE REGIONAL SUBPROJECT MANAGEMENT TEAM (RSMT) OF THE SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP) FOR EASTERN AFRICA

ARUSHA, REPUBLIC OF TANZANIA, 27 – 31 MAY 2013

FINAL REPORT


Meeting of the Regional Subproject Management Team of the SWFDP - Eastern Africa
At Kibo Palace Hotel, 27th - 31st May 2013
Arusha - Tanzania
WMO

EXECUTIVE SUMMARY

The meeting of the Regional Subproject Management Team (RSMT) of the Severe Weather Forecasting and Demonstration Project (SWFDP) for Eastern Africa was held in Arusha, Republic of Tanzania, from 27 to 31 May 2013. Participants included representatives of:

- Global products centres: Met Office UK, NOAA/NCEP (US), DWD (Germany), and ECMWF (represented by a WMO Consultant);
- Regional centres: RSMC Nairobi (Kenya) and RFSC Dar (Tanzania);
- National Meteorological Centres of Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania, and Uganda; and,

the WMO Secretariat (DPFS, PWS, AgM, WIGOS, WIS, DRA and CPA).

The meeting discussed the respective roles and capacities in the cascading forecasting process involving participating centres, with respect to severe weather forecasting, production and dissemination of warnings; public weather services and agrometeorological applications, observations and telecommunication aspects, and verification activities.

The meeting reviewed the draft Regional Subproject Implementation Plan, taking into consideration the *SWFDP Guidebook for Planning Regional Subprojects*, and discussed all components of the Implementation Plan, including the following aspects:

- Membership, chairperson of the RSMT, and the members' responsibilities;
- Responsibilities and products provided by global, regional and national centres, including those for agricultural applications;
- Liaison with media and disaster management and civil protection at national level;
- Liaison with agriculture and fishery communities;
- WIGOS and WIS aspects;
- Verification aspects, monitoring and evaluation, and reporting (severe weather events, and progress reporting of the project);
- Training aspects and plans;
- Timetable of implementation (milestones and responsible member).

The Regional Subproject Implementation Plan for the full demonstration of the SWFDP is available at: http://www.wmo.int/pages/prog/www/CBS-Reports/documents/RSIP_SWFDP-EA_May2013.pdf

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING

1.1 The Meeting of the Regional Subproject Management Team (RSMT) of the Severe Weather Forecasting Demonstration Project (SWFDP) for Eastern Africa was opened by its chairperson, Mr James Kongoti (Kenya), at 09.30 hours on Monday, 27 May 2013, at the Arusha Palace Hotel, in Arusha, Republic of Tanzania. Dr Hamza Kabelwa (Head of the Forecasting Department of the Tanzania Meteorological Agency, TMA) welcomed participants to the meeting on behalf of Dr Agnes L. Kijazi (Ms), Permanent Representative of Tanzania with WMO. Official opening remarks by the host, the WMO and the East African Community (EAC) were delivered at the joint session with the EAC meeting of the Heads of Meteorological Services (held on Wednesday, 29 May 2013), which directed the implementation of the next phase of the SWFDP (i.e. next 18 months), as a contributing mechanism for the implementation of the EAC five-years Meteorological Development Plan and Investment Strategy (see item 3.3).

2. ORGANIZATION OF THE MEETING

2.1 Adoption of the agenda

2.1.1 The meeting adopted the provisional agenda, 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-SWFDP-EA-RSMT_Arusha2013/docplan.html

2.2.3 The participants agreed its hours of work and other practical arrangements for the meeting, including the tentative work programme. Participants briefly introduced themselves, to facilitate interactions throughout the meeting. 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 Ms Alice Soares, Scientific Officer, Global Data-processing and Forecasting System (GDPFS) Programme of WMO, 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, including EPS, 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 and Hydrological Services (NMHSs) of the region. This is a "Cascading" concept of the forecasting process, which is further discussed under item 7.

3.1.3 Ms Soares recalled that in addition to this regional project, the SWFDP has been in implemented successfully in Southern Africa and in the South Pacific Islands. Preparations have been initiated to implement SWFDP regional projects in Southeast Asia and in the Bay of Bengal region (South Asia). The meeting reviewed the progress and benefits of the SWFDP for Eastern Africa under agenda item 3.2, and discussed experiences and lessons learnt from the pilot phase of the project.

3.2 Summary of experience and progress of the Severe Weather Forecasting Demonstration Project (SWFDP) for Eastern Africa (RA I)

3.2.1 The meeting was informed of the experiences and progress of the SWFDP in Eastern Africa, which in its pilot phase involved the national meteorological services of Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda, and RSMC Nairobi (Kenya), and RSFC Dar (Tanzania), as well as the global products centres of DWD (Germany), ECMWF, Met Office (UK) and NOAA/NCEP (US).

3.2.2 The meeting noted that the pilot phase of the SWFDP in Eastern Africa had provided an opportunity to trial everything associated with the project from the exchange of data on the project website (http://www.meteo.go.ke/rsmc/login.php) – to the roles played out by the various centres, the evaluation and reporting carried out by RSMCs and NMHSs every three months, which are available at: ftp://ftp.wmo.int/Documents/PublicWeb/www/swfdp/RAI/Quarterly%20reports/. The meeting was pleased to note that the SWFDP in Eastern Africa had got off to a very good start and all participating countries seemed to be making use of the various Numerical Weather Prediction (NWP)/Ensemble Prediction System (EPS) products and the processed information available on the Regional Daily Guidance charts produced by RSMC Nairobi for the project footprint and RSFC Dar for the Lake Victoria Basin.

3.2.3 The meeting recalled that the first RSMT meeting (Nairobi, June 2011) finalized the Implementation Plan for the pilot phase of the SWFDP in Eastern Africa, which outlined the roles and responsibilities of participants and how the various components of the Plan would fit together. The meeting noted that during the pre-pilot phase (from October 2010 to August 2011), the project website was built from scratch, with a layout similar to the one of the SWFDP in Southern Africa. During this period, global products centres provided NWP/EPS products in a form that was readily useable and displayable on the project website. The meeting also noted that annual training workshops were carried out for the NMHSs of participating countries, to enable them to utilize the products on project website for generating their own forecasts and warnings. These workshops included one week training on forecasting and other week on public weather services and agricultural meteorology.

3.2.4 The meeting noted that the pilot phase of the project was carried out from 1 September 2011 to 31 May 2013. During this period, RSMC Nairobi and RSFC Dar prepared regional daily guidance containing an interpretation of the global and regional guidance out to 5 days. Information on *Heavy Rain (> 50mm in 24 hours), Strong Winds (≥25knots; 20knots over the Lake Victoria), Hazardous Waves – Indian Ocean and Lake Victoria (≥ 2m)* was included whenever the criteria (in brackets) were expected to be met. The meeting noted that while the project was also focusing on dry spells, limited guidance has been provided. Users include general public, disaster management, media, agriculture and fisheries. Verification has also been a major component of the project. Daily videoconferences, which entail real-time interpretation of the model outputs and verification by RSMC Nairobi and RFSC Dar, with the support by Met Office UK, is ongoing and it is expected to be expanded to include all SWFDP – Eastern Africa participants in the full demonstration phase. The meeting agreed to further review the outcomes of and evaluate the pilot phase of the SWFDP in Eastern Africa under agenda item 4.

3.2.5 The meeting noted that WMO procured a Linux based Server and supported the migration process of the RSMC Nairobi Website for the project, which was currently in progress.

3.3 Synergy with and contributions to the EAC's five years meteorological development plan and investment strategy (2013-2018) – joint session with the EAC meeting of the Heads of Meteorological Service

3.3.1 A joint session with the EAC meeting of the Heads of Meteorological Services was held on Wednesday, 29 May 2013. The programme is provided in Annex III. This session provided a direction to the implementation of the next phase of the SWFDP (i.e. next 18 months), as a contributing mechanism for the implementation of the EAC five-years Meteorological Development Plan and Investment Strategy. The following paragraphs summarized the outcomes of this session.

> *The EAC Heads of National Meteorological Services participated in the second meeting of the Regional Subproject Management Team (RSMT) for the Severe Weather Forecasting Demonstration Project (SWFDP) in Eastern Africa to be informed of achievements and challenges, and provide direction on its future implementation and possible expansion. The outcome of the meeting will inform the EAC five-year Meteorological Development Plan and Investment Strategy.*
>
> *The Heads welcomed the significant contributions of the SWFDP to disaster risk reduction, sustainable development and climate change resilience, as well as to vital socio-economic sectors as agriculture and fisheries. They agreed that the Project has enhanced the authority and visibility of National Meteorological Services (NMSs), and built public and government confidence in the accuracy and reliability of forecasts and warnings of severe weather events.*
>
> *The Heads acknowledged that the SWFDP represents a systematic and practical approach for strengthening capacity in and for transferring new knowledge and skills to NMSs in developing and least developed countries, to deliver improved forecasts and warnings of severe weather to save lives, livelihoods and property.*
>
> *The Heads therefore recommended that the Project should be sustained and strengthened as it moves from demonstration to operational stage. This will necessitate additional resources and commitment at regional and national levels to ensure EAC leadership in transforming the Project into an integral part of the forecasting and warning services of NMSs in the region.*

3.4 Synergy with the Mobile Weather Alert (MWA) Project

3.4.1 The meeting noted that several studies in East Africa have shown that weather and climate information is generally seen as essential information for decision making for livelihood management by small holder farmers and fishers and that their preferred ways to access weather and climate information are through mobile phones as well as radios and intermediaries including traditional government extension services and NGOs. In fact, the number of mobile subscribers has been increasing exponentially in the past decade in Eastern Africa despite of some intra-regional variability, making mobile phone an increasingly important channel to reach last mile end users in the region. Taking advantage of this technology advancement, Mobile Weather Alert (MWA) Uganda piloted the use of mobile phone to communicate weather and climate information to end users at community level in Uganda in 2011-2013. The final survey of the MWA Uganda Pilot Project has shown that mobile telephony is an effectiveness communication channel, but as a way forward, it was pointed out that more strategic approach taking into account the following points would be necessary:

- Heterogeneity of mobile ownership according to socio-economic status, education, gender and other socio-economic factors;
- Better understanding of information sharing patterns in rural communities;
- Translation of weather/climate information into local languages;
- Better packaging of information;
- Limitation of SMS in terms of the amount of information it can carry at a time;

- Complementarities of other communication channels, especially community radios;
- High demand for more location specific weather and climate information;
- Capacity of community level end users to fully utilize weather and climate information for decision making and taking appropriate actions;
- Sustainable business model to reach end users at scale; and,
- Better integration with the SWFDP in Eastern Africa.

3.4.2 This project is now being considered in Tanzania.

4. EVALUATION OF THE PILOT PHASE OF THE SWFDP FOR EASTERN AFRICA (RA I)

4.1 The meeting reviewed the outcome of the pilot phase of the SWFDP in Eastern Africa with a view to provide input to the development of the Implementation Plan for the full demonstration of the SWFDP – Eastern Africa, to be discussed under agenda item 11.

4.2 The meeting noted that during the pilot phase of the project, feedback from the participating NMHSs was generally very positive about the guidance and model products. Mr James Kongoti (chairperson of the SWFDP – Eastern Africa RSMT) presented the results of the regional project evaluation. The achievements relative to the project's goals were summarized:

- Improved accuracy and lead-time in the weather forecasts, alerts and advisories;
- Enhanced capacity development;
- Created a "critical-mass" of champions at all levels (Sectors);
- Created a platform for data/product/information sharing;
- Created confidence among the weather/climate producers and users;
- Forecasters appreciated the usefulness of the NWP products;
- Improved service delivery.

4.4 Emerging issues, future plans and challenges identified from the SWFDP – Eastern Africa include:

- Build strong feedback mechanisms;
- Prepare simple and clear forecast information and warning/advisory messages, giving clear statements on what is happening, forecasts of what may happen and expected impact including what action should be taken;
- Implement an open discussions or fora of the "Expert Group" or focal points among the participating NMCs;
- Require more data fro verification purposes e.g. Radar, AWS, among others;
- Use of appropriate communication channels;
- Community-driven weather/climate products;
- Possibility of expanding to other countries and address more hazards.

4.5 Mr Antonio Garcia-Mendez presented a summary of the case studies and a review of the national quarterly reports 2011-2013 on the forecasting aspects. The meeting noted that the reports received from the countries and supporting Centres show a general agreement regarding the usefulness of the products both deterministic and probabilistic received from ECMWF, UKMO and NCEP. It is clear that they have moved from a subjective evaluation of different models in a poor man's ensemble mode to a more objective discrimination in terms of probabilities regarding the occurrence of severe events in their areas of surveillance. The case studies provided through the last year are particularly important to give feedback to the forecasters and Centres running NWP models. An example was shown related with the lack of details of ECMWF EPS probabilities around Lake Victoria. This feedback has triggered an investigation at ECMWF, which is still ongoing. Some results were shown regarding a striking difference in the ECMWF precipitation model climate between D+1 and longer term forecasts on that area. Recommendations about how to build case studies were shown and guidance on how to prepare a case study is provided in Annex IV.

4.6 The meeting stressed that although the models tend to underestimate the precipitations or strong winds, the thresholds used in the products as guidance to issuing warnings look low on occasions. It therefore agreed to review the thresholds under agenda item 11.

4.7 The meeting suggested also that there's a need to receive Grib data in addition to the graphic charts. In this context, the meeting was informed that there is a basic reception of data from ECMWF in Grib2 format for all WMO countries.

4.8 A review of the national quarterly reports 2011-2013 on service delivery and verification aspects are reported under agenda items 9 and 10, respectively.

5. IN SITU OBSERVATIONS AND REMOTE-SENSED DATA-PROCESSING SYSTEMS AND PRODUCTS FOR VERY SHORT-RANGE FORECASTING, INCLUDING NOWCASTING, AND ASSOCIATE TELECOMMUNICATION ASPECTS – LINKAGE TO WIGOS AND WIS SUB-REGIONAL IMPLEMENTATION PLANS FOR EASTERN AFRICA

5.1 WMO Integrated Global Observing System (WIGOS)

5.1.1 The presentation on the WIGOS concept and its implementation was provided by the Secretariat, Mr Igor Zahumensky. Background information on WIGIS is provided in Annex V. The meeting noted that there was the WIGOS framework Implementation Plan (WIP) endorsed by the Council that addresses the necessary activities to establish an operational WIGOS by the end of the period 2012-2015.

5.1.2 A special focus was given to the observing and quality management practices and procedures to be used for timely delivered, quality assured, quality controlled, well documented, and compatible observations not only for the purposes of the SWFDP, including verification purposes but for any applications; the need for documenting of known data quality was underlined specifically.

5.1.3 The sustainability and shortcomings of the national observing networks in this region, and the reduced availability of data from those networks, is an issue of concern. WIGOS has the potential to strengthen these networks through an optimized design and evolution of the current observing systems, improved operation and maintenance. Implementing QMS practices and procedures, including regular maintenance and inspection, is another issue that should be addressed urgently.

5.1.4 The meeting noted the development of the RA I WIGOS Implementation Plan (R-WIP-I) by the Task Team on WMO Integrated Global Observing System (WIGOS) (RAI/TT-WIGOS) and the plans for organizing subregional workshops in RA I aimed at senior management of the NMHSs responsible for observing networks and their operation.

5.1.5 The RA I Sub-Regional WIGOS Workshop for the East Africa (Burundi, Comoros, Djibouti, Ethiopia, Eritrea, Kenya, Rwanda, Tanzania, Uganda, Somalia, Sudan, South Sudan) is tentatively planned to be held in Tanzania, III.Q. 2013 depending the availability of funds.

5.1.6 EAC inputs for the RAI WIGOS Implementation Plan (R-WIP-I) taking into account the requirements of SWFDP in a synergy with "EAC-5" (Alignment of R-WIP-I with EAC priorities, needs, requirements) should be drafted in due course. The meeting recommended that at least Chair of the Regional Subproject Management Team (RSMT) should participate at the workshop for EAC.

5.2 WMO Information System (WIS)

5.2.1 Mr Steve Foreman (WMO Secretariat) presented the WMO Information System (WIS). WIS, the WMO Information System became operational in January 2012. The aims of WIS are to:

increase data visibility, broaden data access, and simplify data use. WIS provides an authoritative source of weather, climate and water information.

5.2.2 National Centres gather national information and make it available for international exchange, and make information they receive through the WIS available to users in their country. Data Collection or Production Centres have an international role associated with a WMO Programme; this role can be collating information (for example, a Regional Telecommunications Hub, RTH), creating information (for example ECMWF), or archiving information (for example a World Meteorological Centre). Global Information System Centres have two main tasks: publishing the WIS Metadata Catalogue, that allows users to find information, and to make sure that information is transferred globally between the GISCs so that it is available in all regions. There are seven operational GISCS, with three more about to start operation.

5.2.3 WIS enhances the Global Telecommunications System by introducing Discovery, Access and Retrieval service through the GISCs. This relies on accurate and complete descriptions of all information that is available through the WIS. These descriptions, known as WIS Discovery Metadata records, are published by the GISCs in the WIS Metadata Catalogue, but each country is responsible for creating and maintaining the WIS Discovery Metadata records for the information that it shares through the WIS. After finding information by searching the catalogue, users can use the information in the metadata record to request the information – if the information is intended for routine global exchange, users can download the information directly from a GISC, or they would be referred to the data owner. In addition to making it easier to find information, the WIS makes it simpler to provide information to others and to receive information; centres do not need a GTS connection to participate in the WIS.

5.2.4 Plans by SWFDP-EA to improve telecommunications to support production of forecasts should be consistent with WIS and form part of the regional WIS implementation plan. The plans need to include quality management through a “plan, do, check, act” cycle, both during the enhancement activities and in managing operations. The telecommunications plan needs to deliver early improvements; these are most likely to come from correcting problems with the current arrangements for using the GTS. It also needs to structure activities so that there is a constant stream of improvements being made. In addition to the regional plan, each country needs its own plan to ensure it has the national infrastructure to support SWFDP-EA activities. Although there will be many differences between the needs of countries, there will also be issues that are common to many, such as the approach to identifying needs, solutions and the project plan, or exploration of the potential technologies to address specific issues. So, even though the details of each plan will differ, there would be benefit in using a common methodology and using regional cooperation to reduce duplication of technical activities.

6. LINKAGE AND FUTURE TRIALING OF PRODUCTS FROM THE WWRP PROJECT FOR LAKE VICTORIA

6.1 Mr Paul Joe and Ms Estella deConing, representing the WWRP, presented (by videoconference) a research project that would develop a nowcasting system for the East African region in collaboration with the SWFDP – Eastern Africa. The meeting noted that an understanding project is necessary to provide a scientific basis for and to verify and validate the nowcasting system. In order to optimize the implementation and to leave a solid legacy, a complementary capacity building component is necessity.

6.2 The meeting noted that there are four major components envisioned in this research project:

(a) Field project to understand the phenomena and to validation/verification the nowcast system outputs;
(b) Development of a nowcasting system that primarily uses global observation and predictions systems;
(c) Integrate the nowcast systems outputs with SWFDP;
(d) Capacity Building for establishing the project legacy.

6.3 The meeting supported this research project and requested the chairperson and the vice-chairperson the RSMT to follow up this issue with the WWRP experts

7. CASCADING FORECASTING PROCESS: ROLES OF PARTICIPATING COUNTRIES

7.1 Global Products Centres

7.1.1 Representatives of Global Products Centres (Mr Wassila Thiaw (NOAA/NCEP, US), Mr Steve Palmer (Met Office, UK), Mr Antonio Garcia-Mendez on behalf of Mr David Richardson (ECMWF), and Ulrich Blahak (DWD, Germany)) informed the meeting of the general features of their global and regional NWP production systems, including the kinds of NWP/EPS products that were and/or could be provided to the SWFDP in Eastern Africa, with focus on severe weather monitoring and forecasting.

NOAA/NCEP African Desk (USA)

7.1.2 The meeting noted that the National Centres for Environmental Prediction (NCEP) has been acting as a global products centre in support of the WMO SWFDP since the beginning of the project in 2006. As part of the Department of State outreach to the international community through the WMO Voluntary cooperation Program (VCP), the National Weather Service (NWS) authorized NCEP to expand the African Desk activities to include short and medium range weather forecasting for Africa in support of the SWFDP.

7.1.3 Through the African Desk, NCEP continues to deliver routine NWP products (global forecast system (GFS) and global ensemble forecast system (GEFS)) to NMHSs via the Internet. A web site has been implemented to provide access to the NCEP model suite. NCEP model guidance is packaged for the globe as well as continental and regional domains, including East Africa, Northern Africa, Southern Africa, and West Africa. Both deterministic and ensemble guidance products are displayed. The ensemble page features products critical to forecasting severe weather events. Graphical displays include: (1) probability of exceedance of parameters such as precipitation and winds for various threshold values. For precipitation, the range is from 1 mm to more than 100 mm. For winds the range is from 10kt to 100kts. The forecasts lead time for daily parameters are 24 hours to 14 days. Week-1 and Week-2 outlooks as well as seasonal rainfall guidance are also available. The page also features a wide range of current analyses including outputs from the Global Data Assimilation System (GDAS) and satellite rainfall estimates. For Eastern Africa, products are available at http://www.cpc.ncep.noaa.gov/products/african_desk/cpc_intl/eafrica/eafrica.shtml. The meeting requested NCEP to provide forecasting soundings for additional locations in order to improve forecasting convective thunderstorms in Eastern Africa, especially over Lake Victoria,

7.1.4 The meeting noted that the African Desk training curriculum has been developed to accommodate the needs for training from NMHSs in Africa, especially on the use and interpretation of NWP/EPS products. Model guidance from other global centres (such as the Met Office UK and ECMWF) are included in the daily forecast discussions. Under the supervision of the weather instructor, the trainees write daily forecast bulletins for lead time up to 3-5 days. The bulletins are posted on the African Desk web site and shared with forecasters in Africa. In addition, the students receive training on how to access and download NCEP GFS, GEFS and TIGGE data; Write Unix scripts to process the data sets, evaluate the performance of the NCEP model, and perform diagnostic studies for selected cases. Training on WRF modelling is provided to the trainees who are interested in developing proficiency on WRF. Opportunities to include Wave Watch III modelling and wave forecasting in the African Desk training curriculum are being explored in collaboration with WMO.

ECMWF

7.1.5 The meeting noted that the ECMWF has a cooperation agreement with WMO and actively supports its work. For the SWFDP in Eastern Africa, the ECMWF had 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 were provided as graphical products, mainly as charts focused on the region of interest for the SWFDP in Eastern Africa. The products are accessible via the ECMWF website (http://www.ecmwf.int/about/wmo_nmhs_access/index.html), on a password-protected page. For the full demonstration phase of the SWFDP in Eastern Africa, the ECMWF would also be able to continue providing a range of products from its high-resolution deterministic forecast and its EPS. 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. ECMWF would consider requests for additional products to support the SWFDP. If required, digital data may be provided on a case-by-case basis.

7.1.6 The meeting noted that a combination of EFI, model climate and EPSgrams could help in assessing forecast consistency and reliability. An introduction to the clickable EFI and the concept "your room" was also presented. The meeting expressed interest in the products derived from the clickable EFI charts in particular the 15 days EPSgrams; and pointed out the usefulness of the monthly forecast as a prospect for the future. It requested the WMO Secretariat to explore the possibility with the ECMWF to provide additional products for the SWFDP in Eastern Africa. The meeting also expressed interest in the concept of "your room" to organize easily the work of the forecasters in an operational environment (i.e. description of the forecasting process).

7.1.7 The meeting was informed that the 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 EPS, the EPSgrams, and Extreme Forecast Index. In recent years a number of participants from the SWFDP – Eastern Africa had benefited from participating in this course. The next course would be held at ECMWF in October 2013 (http://www.ecmwf.int/newsevents/training/2013/wmo_training_course/index.html). Priority would be given to participating countries in SWFDP regional projects to attend this course.

7.1.8 The meeting noted that the ECMWF encouraged and supported evaluation of the SWFDP, and requested participants to provide feedback, including in the form of case studies, on the application and usefulness of ECMWF products in Eastern Africa. Participants were encouraged to collaborate with ECMWF in verifying forecast products, such as QPF.

Met Office (UK)

7.1.9 The meeting noted with appreciation that the Met Office UK has been an enthusiastic supporter of the SWFDP from its inception, because it is an effective way of strengthening the essential Public Weather Service role of promoting safety of life and property of citizens and enhancing sustainable socio-economic development. The information cascade central to the SWFDP emphasizes the primary responsibility of the National Meteorological and Hydrological Services as information providers to their Governments for early warning services.

a) **Global Guidance Unit** within the Met Office Hazard Centre. The GGU provides guidance support to the forecasters in the SWFDP-Eastern Africa Regional Guidance units in Nairobi and Dar. There is a daily video-conference, during which analysis, forecasts and impacts are discussed, including 3-way sharing of relevant charts and other information. Presentations, charts and written discussion are carried by a Huddle group site, and reference material is being collected. Support will be provided to extend conferencing between Regional and National Centres.

b) **NWP Model** output from the Unified Model (UM). The Global UM runs at 25Km resolution four times per day. Through EuMetCast to the PUMA2010 workstations, the Met Office provides Global UM fields at a resolution of 0.36 degrees over an Africa cutout, and further hemispheric areas at 1.5 degrees resolution. The North Africa UM is run at 12Km – this model will cease in October 2013. The Lake Victoria UM is run at a resolution of 4Km to T+54 twice a day. It is expected that the area of this model will increase in October 2013.

Outputs from the North Africa LAM and Lake Victoria models are available through a website, currently http://www.metoffice.gov.uk/weather/africa/lam/ - this will be replaced soon.

c) **MOGREPS** products are from a Global UM ensemble. A set is provided through ftp to KMD Nairobi for inclusion in the Regional Guidance website.

d) **ATDNet Lightning** observations in real time. This is made available to NMHSs through http://www.metoffice.gov.uk/weather/africa/lam/ which is updated hourly, the replacement will be updated every 15 minutes. ATDNet Lightning data are being provided to Eumetsat.

e) Improvements in **surface observation processing**, working closely with Kenya Met Dept and ACMAD for real-time ingestion of both manual and AWS observations into a Climate Data Management System and transmission as TDCF into WIS.

f) **Climate Science Research Programme** - support for Seasonal Forecasting with support to RCOFS and National COFs and a TWIKI for in-season updates.

g) Met Office VCP projects include support for TV Weather Presentation, recording audio for radio stations, and e-learning courses including “Management Essentials” and “Introduction to QMS” (with WMO).

DWD (Germany)

7.1.10 The meeting noted that currently, more than 25 countries are operational users of the COSMO model, including a number of African countries. It also noted that, since the last meeting of the RSMT (Nairobi, Kenya, July 2011), operational LAM forecasting with the COSMO-model and WRF has been established at KMD on a new HPC Linux cluster with several hundred processors delivered by Météo-France International (MFI). As part of a cooperation of DWD and MFI, the COSMO-model, pre-processor and operational scheduler have been installed on the system. Since then, KMD runs the COSMO-model with a resolution of 7 km and parameterized convection over a large East African domain twice daily. Some graphics from this are available at the SWFDP webpage. DWD provides the necessary external data to run the model (i.e., orography, soil and vegetation data), and also the necessary initial and boundary data from the global model GME twice daily for 0 and 12 UTC (06 and 18 UTC would be possible as well). GME-data are provided up to a forecast lead time of +3 days (up to +5 days are possible) at 3-hourly intervals.

7.1.11 The meeting was informed that there are also modelling activities with the COSMO-model coming up at TMA. Recently, TMA was able to acquire a new HPC Linux cluster, which is currently in its installation phase (to be completed in July 2013). The COSMO-model and WRF will be installed on that system. The meeting considered the synergetic integration of these activates into the SWFDP framework.

7.1.12 After having established LAM routine forecasts, useful next steps would be:

- Assessment of the forecaster’s perception of the LAM products; needs for additional products?
- Quality assessment, verification of the LAM forecasts.
- Proper initialization of the water temperatures of the East African lakes.
- To resolve orographic effects and daily cycle of the tropical convection better, more detailed simulations using grid spacing < 3 km and switching off the convection parameteriztion, out to a lead time of +1-2 days or so, depending on available computing resources.
- Hail forecasting based on model output: perhaps combination of precursors (e.g., CAPE maps) with the occurrence of convective cells in the above high resolution model.

7.1.13 The meeting was presented with a case study of a period of tropical convection in Eastern Africa starting from March 18, 2013, 0 UTC. The COSMO-model was run with a 7 km resolution and parameterized convection, driven by GME-data, in a similar way as it is currently the case at KMD. Nested herein was a model run on a smaller domain around Lake Victoria and Lake Tanganjika with a resolution of 2.8 km and no convection parameterziation, to investigate the possible benefits of having such a configuration in the SWFDP. In this case study, higher resolution without convection parameterization lead to:

- Differences in daily cycle of tropical convection;
- Higher peak precipitation values, more isolated convections;
- Better forecast of orographically induced convection and Lake Victoria convection, but some problems over the Tanzanian central highlands;
- More fine-structure in temperature and winds;
- But: Model verification necessary to show potentails / benefits / problems of higher resolution on a more systematic basis.

7.1.14 The models start from interpolated global analyses (20 km resolution). Therefore, in the longer run one should think about data assimilation based on locally available data. The COSMO-model offers the simple but effective „nudging“ technique (also for radar-derived precipitation by the „latent heat nudging“). However, this needs adequate and quality controlled data in the first place (at least 3-hourly SYNOP from a „dense“ network; radiosondes; aircraft data; radar derived precipitation, etc.) Further, the setup of such a system needs training and further support from DWD. There will be a special training course this year in August (see below). The possibility for further support for setup of data assimilation by DWD or COSMO-consortium has to be discussed with the respective responsible persons.

7.1.15 The meeting noted that DWD and the COSMO-consortium will continue their support for the LAM activities of the SWFDP as before. Additionally:

- This year additional 2-weeks course in Langen for data assimilation with the COSMO-model, right after the annual "Capacity building" training course.
- Possible on-site training and support for model installation and setup by one or two Romanian experts from the COSMO-consortium (need and availability to be determined).

7.1.16 Based on the discussions, the meeting concluded that::

- Model verification should be first priority. Need strategy for that. Has to be done at the center where the model is run because of model data issues. Proposition: start with looking at case studies, later more routinely procedure based on station output / meteogram output of the model. Another issue is data quality assurance! Also problem: technical setup and maintenance of a routine verification system.
- Verify the external parameters by local people, who know the country, the vegetation, the soils etc.
- NCEP satellite precipitation product for EA over the African Desk in near real time. DWD gridded station product, available approx. 1 month behind, 0.25 deg resolution. Invaluable for model verification.
- Model tuning and data assimilation depend on model verification.
- Getting local obs data onto GTS and Eumetcast, so that also global DA profits.
- Nudging data assimilation with the COSMO-model is highly awaited.
- There are very good projects of UKMO to aquire data of the surface temperatures of the African great lakes: Ship AWS, measuring platforms, Satellite. KMD already has two floating stations measuring surface temperature.

7.2 Regional: RSMC Nairobi (Kenya), RFSC Dar (Tanzania)

7.2.1 Representatives of Regional Centres (Mr Vincent Sakwa (RSMC Nairobi), and Mr Hamza Kabelwa (RSFC Dar)) informed the meeting of their roles and contributions to the project.

RSMC Nairobi (Kenya)

7.2.2 The meeting noted that the RSMC Nairobi (Kenya) will act as the lead regional centre for the SWFDP – Eastern Africa, including (among other activities) the responsibility for the development and management of a dedicated project Web Portal. KMD makes available outputs from the COSMO Model and the Weather Research and Forecasting (WRF) model, and is responsible for synthesizing all available and relevant products and information, and making the best use of all these products for diagnosing the convective systems, in order to provide daily severe weather forecasting guidance for the entire project footprint to NMHSs in Eastern Africa region (day-1to day-5, and an outlook for days-6 to 10).

7.3.2 The verification of the performance of the RSMC is done every day through teleconference (Met Office UK, Kenya and Tanzania), and otherwise. The RSMC Nairobi team has designed a template that scores the forecast guidance statement against the observation. For the observation, the following are used:

- Satellite images (MSG2 IR108) which are relied on for convective and thunderstorm activities ;
- Meteograms - depiction of spatial and temporal distribution of synoptic features for the member countries (Kenya, Uganda and Tanzania) and spatial rainfall maps (Kenya);
- Actual Observations from the stations as recorded at 0600z every day.

7.3.3 Verification of the COSMO and WRF models is ongoing. The model output products being considered in the verification exercise are the temperature, wind fields and moisture. So far the two models are doing quite well over this region. Verification exercise will contribute positively to the success of SWFDP program.

RFSC Dar (Tanzania)

7.3.4 The meeting noted that RFSC - Dar es Salaam continued to assist RSMC – Nairobi in issuing severe weather forecasting guidance for the Lake Victoria basin and verification of the forecasts. The guidance forecasts issued by the center are based on available NWP products provided by global centres, 4km ALAM and 5km resolution WRF (Dar es salaam). To support the centre; in October 2011, TMA has established Severe and Medium Range Weather Forecasting (SEMERAWF) desk in order to perform its function. The guidance products are available in the password protected webportal http://www.meteo.go.tz/severe.

7.3.5 The meeting was informed that from late September 2012 towards February, 2013 (Phase I of the Global Guidance services) the RFSC – Dar es salaam and RSMC – Nairobi were receiving guidance forecasts and additional model fields from the Met Office UK. These guidance forecasts were very useful in the RFSC's activities and improved the skills of the forecasts issued. From March 2013 to present, the project has moved to a phase II of the Global Guidance service where the audio-visual conference is held daily between the experts at the RFSC – Dar es salaam, RSMC – Nairobi and the Global Guidance Unit (GGU) of the Met Office UK of which the model forecasts are discussed and the consensus forecast for the region is reached. This process is very useful as it involves experts from region.

7.3.6 The meeting was informed that TMA is planning to increase the surface observation network by installing new automatic weather stations for the entire country including the lake Victoria basin. In addition, TMA is in the process of installation of a Meteorological S-band Doppler Radar at Mwanza, South of the Lake Victoria and expected to be operational towards the end of the year 2013. On its operational stage the Mwanza Radar will be expected to play a significant role in raising skills of the forecast in the Lake Victoria basin especially in now casting of the severe weather by expanding observational capability and resolution.

7.3.7 The meeting was informed that the RFSC – Dar es Salaam faces a number of challenges in its daily activities. These include:

(a) The Internet connection is not always stable. It varies in connection speed in day to day thereby sometimes reduction of the quality of audio-visual conference and other operational activities. The Tanzania Meteorological Agency has taken this challenge and it is in the plan of upgrading its Internet services by joining the national optical fibber network direct from its offices.

(b) Unavailability of observational meteorological data from the NMHSs of the member states for verification of forecasts. The observational meteorological data are not readily available for verification of our forecasts from the member states within the Lake Victoria basin. The only data available are those from the synoptic stations that are in the GTS network. These stations are very few for example RFSC- Dar es salaam can access not more than five stations from Uganda and only four stations from Rwanda.

7.3 National Meteorological Centres

7.3.1 The representatives of Burundi (Mr Rubem Barakiza), Ethiopia (Mr Tesfaye Gissila), Kenya (Mr Vincent Sakwa), Rwanda (Mr Anthony Twahirwa), Tanzania (Ms Helen Msemo) and Uganda (Mr John Eza) 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. Observational and telecommunications aspects were also assessed, in support of effective severe weather forecasting and warning services.

Burundi

7.3.2 The meeting noted that Burundi NMHS has plans to run a numerical model. The Burundi NMHS has established a high speed internet connectivity, which enables the access to NWP products from global centres, including NOAA/NCEP, ECMWF, etc. though the SWFDP – Eastern Africa website and Portal that are used for improving forecasts and warnings of severe weather warning in the country. Burundi NMHS also has access to satellite-based products.

7.3.3 The meeting noted that Burundi is impacted by a number of severe weather and extreme events, including: (i) rainstorms; (ii) hailstorms, particularly over the high ground region called Nile/Congo Crest region, which is a high ground crest dividing the two river basins in the country; (iii) strong and devastating winds; (iv) floods (flash foods and river bank flooding); (v) drought, particularly over the Northeastern part of the country (Bugesera ecological region); and (vi) landslides over mountainous parts of the country.

7.3.4 The meeting noted that Burundi NMHS is issuing (on a daily basis) weather forecast bulletins to the general public and other socio-economic sectors through various media (i.e. national broadcasting radio, telephone, emails and newspapers). It also noted that Burundi NMHS does not have yet a studio for Television presentation, which would enhance weather information dissemination to users. The users are, among others, the general public, farmers, various governmental institutions. Challenges include: (a) most extreme weather events such as hail, strong winds, etc. are associated with small scale thunderstorms, sometimes not materialized by global models; (b) inadequate feedback from user community; and (c) low level of awareness and disaster preparedness in the general public leading to low coping capacity.

Ethiopia

7.3.5 The meeting noted that the National Meteorology Agency of Ethiopia (NMAE) uses NWP products from different Global Centres, including the ECMWF and the Met Office UK. For seasonal forecasting, the NMAE uses products from NOAA CPC and IRI. The NMAE also runs two models: WRF and MM5 experimentally and has good Internet facilities. RSMC Nairobi Guidance Forecast is used to get more lead time, for the early warning of extreme weather events, however some events are missed.

7.3.6 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 much below normal for an extended period. Forecasts and warnings are disseminated to Prime Minister; D/Prime Minister; Ministry of Rural Development; Ministry of Agriculture; Ministry of Water Resources; Disaster Risk Management and Food security Sector (DRMFSS) and EPPC; Regional States; Dam Administrators; Mass Media; Universities, colleges; Research Centres; etc. The National Meteorological Agency of Ethiopia (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.

7.3.7 NMAE has been performing verification activities to undertake calibration of NWP model products to the local condition, including verification work for the numerical forecasting products from the Global centers; and to assess the skill of the Agency's forecast, since customers usually enquire about the skill of our forecast products.

7.3.8 NMAE is on the process of the procurement of a computing facility through the World Bank supported Flood early warning project of the Tana Beles Project. This computing facility is expected to improve the capacity of the Agency in NWP. Short-term training on the COSMOS model has also been undertaken for two meteorologists in Germany. NMAE has also started procurement process for an upper air observation station, automatic weather station telemetry systems and a meteorological radar through different capacity building projects. In addition, there has been a marked increase of projects dealing with community targeted agro-meteorological service in Ethiopia. These include the Rockfeller agro-meteorology project supported by the WMO, Climate change adaptation pilot project over seven locations supported by the UNDP, and recently over the northern parts of the country in Tigray, with the support of Ireland and the WMO.

Kenya

7.3.9 The meeting noted that 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 spouts, dust devils and high temperature. 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. All forecasts are communicated to the users through the Provincial Directors of Meteorology (PDMs), RANET FM, Radio Station; including Electronic and Print Media.

7.3.10 The meeting noted that KMD is increasing its observational network, including 37 synoptic and agrometeorological stations, 3 upper air observing stations (radiosondes), 17 hydrometeorological AWSs, and 3 tide gauges along the Kenyan coast. Procurement process for the acquisition of three radar systems has started. Plans have been initiated to acquire and deploy Acoustic Doppler Current Profilers (ADCPs) in the Kenyan coastal areas of the western Indian Ocean, and 2 fixed buoys (with water and atmospheric sensors) have been deployed in the Lake Victoria. The meeting encouraged KMD to share its observational data within the framework of the SWFDP, in particular considering its role as the lead regional centre for the project.

7.3.11 Responsibilities of national meteorological centre Nairobi are:

- Identifies major stakeholders, map emergency preparedness and response decision processes and actions, and identifies requirements for meteorological products and services at national and international levels;
- Develops products and services and training tools to meet the requirements of users involved in emergency management and response;

- Ensures necessary telecommunication is in place (e.g. Internet access, operational e-mail) and alternative means for timely access to data (Teleconference, Skype);
- Develops the capacity to interpret NWP/EPS and satellite-based guidance products provided by Global and Regional Centres;
- Issues forecasts, alerts and warnings for users (DMCPAs, media, the public and specialized service users);
- Uses available nowcasting tools (satellite imagery or satellite based products) to update warnings;
- Exchanges information on warnings between participating NMHS, and between NMHS and Regional Centres through the web portal;
- Develops a communication strategy with DMCPAs and the media to ensure effective response to alerts and warnings (Internet, email, Ranet, etc);
- Implemented a practical verification system for forecasts and warnings and an archival system to store relevant products and data when severe weather is either forecast or observed;
- Developed a generic set of standard operational procedures (SOPs) between NMHS and disaster risk management agencies, between NMHS and media and assist and guide in preparing a set of SOPs between DRM and media to ensure effective use of the SWFDP products.
- To implement an evaluation and feedback process on the effectiveness of guidance provided by Regional and Global Centres,
- To implement an evaluation and feedback process on the effectiveness of improved warnings and alerts for DMCPAs, general public and media.
- To design and implement an evaluation and feedback process to work with the farmers and fishers at the community level to assess and measure the effectiveness of the improved warnings and forecasts;
- To list duties and procedures for operational forecaster (e.g. evaluation, acknowledgement of receipt of guidance from Regional Centre);

Rwanda

7.3.12 The meeting noted that Rwanda Meteorological Service (RMS) prepares forecasts based on observations and products from global centres, including met Office UK, ECMWF (password protected), GFS (NOAA), etc. The meeting noted that the following severe weather events affect Rwanda: droughts, floods, landslides, strong winds, frost, hail storm and lightening.

7.3.13 The meeting noted that forecasts are disseminated through the Rwanda Television, radios, newspapers and Web site. Rwanda Meteorological Service issues 24hours, 3days, 10days, monthly (30days) and Seasonal (90days) 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.

7.3.14 The meeting noted that RMS is carrying out a early warning system pilot project in four districts, involving the following key partners: Ministry of Disaster Management and Refugees, Red Cross, Rwanda Environment Authority, Police, Army, Rwanda Natural Resources Authority and Ministry of Agriculture.

South Sudan

7.3.15 The meeting noted that the South Sudan Meteorological Service (SSMS) was formed under the Ministry of Transport in July 2011 as a result of the independence, and become member in WMO in December 2012. At present there are only five Synoptic stations are working i.e. Juba, Malakal, Wau, Raja and Renk. SSMS does not run any numerical model. Forecasters prepare daily weather forecast based on surface observations, surface charts, and numerical and satellite products from global and regional centres. Weather forecasting section has a good internet connectivity which makes it possible to access weather forecast websites.

7.3.15 The meeting noted that South Sudan is impacted by a number of severe weather and extreme events, some of them are as follows: rainstorms, heavy thunderstorms accompanied by strong wind and lightening in most parts of country; heavy dust storms in northern parts of country (EL Renk , Aweil , Raja); floods; drought or dry spells south eastern parts(kapoeta).

7.3.16 SSMS issues warnings of heavy rain when rainfall amount>30mm and of drought if the amount of rainfall expected to occur is much below normal for an extended period 15 days, strong wind >25kts. Delivery of weather forecasts to the public and other stockholders in South Sudan is limited and not sufficient. Currently, SSMS issues on daily weather forecasting and delivers to the public and other socio-economic sectors via, and emails. SSMS does not have yet a studio for TV presentation and national TV does not disseminate severe weather and warnings.

7.3.17 Challenges include:

- Lack of essential meteorological communication networks to the regional distribution and international centers i.e. AFTN , GIT.
- Lack of Telecommunication link between weather forecast section in Juba and MET.offices in the states.
- Difficulty in delivery of early warnings information for disaster Risk Management needed by users due to lack of official Websites and poor coordination with media Houses i.e. companies. Radio , TV, newspaper , mobile phone .
- Very few meteorological instruments in use.
- Lack of surface observation station in most cities .and no upper air observation station across the country

Tanzania

7.3.18 The meeting noted that Tanzania through TMA has been able to effective apply Global products such as Deterministic, probabilistic and EPS from MOGREPS, ECMWF, RSMC-Nairobi COSMO, RFSC-Dar Es Salaam WRF at 5km and COSMO, UK-MET Global Model, Africa LAM at 4km Lake Victoria Model and NCEP that have improved forecasting of severe weather events at better skills and reasonable lead-time. TMA also issues probabilistic forecast through mobile phone operator TiGO Tanzania.

7.3.19 The meeting also noted that through SWFDP, TMA has conducted training workshops, which have enhanced interactions, awareness and feedback between Tanzania Meteorological Agency and Prime Minister's Office Department of Disaster Management (PMO-DMD). Further more, coordination has been well improved with the media and other user sectors.

7.3.20 The meeting was informed of the effort of Tanzania in widening the service delivery to the public through the use of social media such as facebook (www.facebook.com/tmaservices), Twitter (www.twitter.com/tma_services) and YouTube (www.youtube.com/TanzaniaMetAgency); and local social forums i.e. www.jamiiforum.com, where the general public are privileged to comment their feedbacks about the forecasts. TMA continues to gets feedback through live talk shows on Television and radio stations. The socio media are update everyday.

7.3.21 TMA has also continued its participation in WMO Day and the domestic exhibitions such as farmers' week (popular as NaneNane) and the week for civil servants, these are used by TMA as platforms to highlight ,interact and answer public queries regarding weather and related hazards.

7.3.22 TMA evaluates it warnings, alerts and advisories forecasted and issued through feedback gathered from the general public, media and disaster management and civil protection authorities and socio media interaction section. These feedbacks have been gathered through media reports, direct oral conversations and the social media.

7.3.23 In the need to reach large community at risk, it was also highlighted that TMA is conducting a Mobile Weather Alert program in Sengerema district over Mwanza region (Southern part of LVB)

7.3.24 The meeting was also informed that Tanzania is determined to support the objectives WMO program, WIS .TMA has already formed a team for the implementation process in the country, some initiatives are already in place such as establishment of the communications with GISC Exeter in UK, Tanzania has been given guidelines on the way forward to make metadata catalogues as required by the GISC Exeter and access to the OpenWIS solution of GISC Exeter.

7.3.25 The meeting also noted that, despite the initiatives and ongoing activities, TMA is facing some challenges in human resource, thus there is a need for long and short term training programs in the fields of Meteorology and applied meteorology (ie. Marine, Agromet, etc),Public Weather Services and Numerical Weather prediction, capacity building in floods and droughts, weather verification and tools.

Uganda

7.3.26 The meeting noted that the Uganda Department of Meteorology has been implementing the pilot project "Mobile Weather Alert", with the partnership of WMO, Ericsson, MTN and the National Lake Rescue Institute.

7.3.27 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 (southwestern, and Entebbe airport), and mist (during rainy season in southwestern). Forecasts are prepared based on observations (in situ and satellite-based) and on NWP products available from global centres.

7.3.28 The meeting noted that Uganda Meteorological Service issues daily, city, 3day, 10day, 3months and 6months forecasts. Daily forecasts are disseminated through email and mobile telephones to identified users; and 10day 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).

7.3.29 The Ugandan society and the government have never comprehended the vital linkage between weather, climate and socio-economic development. This has resulted into the relegation of the weather and climate sector to the bottom of the budget priorities of the government. Other challenges include;

- Lack of equipment and tools such as weather radar for tracking storms.
- Inadequate data (very narrow data collection base).
- NWP models shortcomings such as underestimation of precipitation, showing no precipitation signals, early prediction and switching off of convective processes, model simulations and
- Insufficient or no feedback from users of weather data information.

A major setback is in the area of weather information dissemination due to non-vailability of an operational weather studio which would enable accessibility of weather information by a large proportion of the population.

7.3.30 The Uganda Department of Meteorology (UDoM) is currently transforming into a semi-autonomous body, the Uganda National Meteorological Authority (UNMA). The current budget constraints that have drastically affected all facets of weather service delivery in the country are expected to be addressed by the new entity. This is expected to lead to improvement in severe weather forecasting capabilities (quality and timeliness of forecasts) and dissemination of forecasts and early warning systems and hence improvement of disaster prevention and mitigation in the country.

7.4 Roles of and contributions by Centres for Limited Area Modelling over the Lake Victoria Region

7.4.1 The meeting noted that in addition to severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture, for the entire project footprint, the SWFDP – Eastern Africa includes a specific component addressing severe weather forecasting and warning services over the Lake Victoria, addressing marine meteorological aspects for the safety and protection of fishers. This would contribute to the search and rescue (SAR) community to ensure improved warning services for safe operations over the lake(s) of the region.

7.4.2 The meeting noted that both the Met Office UK and TMA run high-resolution LAM over the Lake Victoria (4km and 5km, respectively), and TMA is responsible for synthesizing all available information and produce a daily severe weather guidance map for the Lake Victoria domain (day-1 and day-2).

7.4.3 The meeting noted that Kenya, Tanzania, Uganda and Rwanda have initiated the process for acquiring and installing radars covering entirely or partially the Lake Victoria region. Noting the importance of the radar data for severe weather forecasting and warning services for this region, the meeting encouraged that these data be shared among the participating countries in the project and a composite/mosaic be produced. Noting that there are data policy issues associated with such proposal, the meeting requested that this proposal be pursued with the Directors of the NMHSs in the region, within the EAC framework.

8. AGRICULTURAL APPLICATIONS

8.1 Review of the requirements and use of NWP and satellite-based products for preparing agrometeorological forecasts

8.1.1 The WMO Secretariat (C/AGM, Mr Bob Stefanski) presented a review of agrometerological activities related with the SWFDP. A review was made of impact of agrometeorological services and the value of climate data and analysis to provide better services to the agricultural community. It was pointed out that there are many difference users of agrometeorological users including international officials (i.e. Red Cross, WFP), Government officials (Ministries of Agriculture, Water Resources), extension agents, producers (farmers, ranchers, foresters, fishers), the media and general public. A key question in agrometeorology is: what are the weather / climate events that impact agricultural decision-making?

8.1.2 The meeting noted that there was a SWDFP related training event on “Operational Agrometeorology for serving end-user’s requirement” held in Pune, India from 28 January to 9 February 2013. The training was hosted by the Meteorological Training Institute of the India Meteorological Department, The funding for the participants travel was provided by WMO and the housing and a portion of the per diem was provided by IMD. There were sixteen participants in total with 2 each from Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda and one from Bangladesh, Sri Lanka, Thailand and Myanmar. This training incorporated countries involved in the SWFDP-EA and SWFDP-Bay of Bengal. The main objectives of the training was to train participants o develop understanding of intricacies of location specific weather forecasting to prepare agro advisories for the farming community and to utilize agromet products/data in a better way while preparing advisories.

8.1.3 In February 2012, a SWFDP Agromet Working Group (AgWG) meeting in Entebbe, Uganda, which developed a list of requirements and use of NWP and satellite-based products for preparing agrometeorological forecasts. The requirements and recommendations from this meeting are provided in Annex VI. The global and regional were asked if they could provide some of these products.

8.1.4 Mr Isack Yonah, the Agromet representative of the SWFDP-EA, noted that the SWFDP provided enhanced information sharing through regional collaboration among Agro-meteorologists/ forecasters. The project also increased access to weather forecast products for improved agromet products. He pointed out recent agrometeorological activities of the Tanzania Meteorological Agency (TMA) including the GeoWRSI Training workshop at MAFC which was conducted a GeoWRSI expert from FEWSNet (SADC). Another application used in TMA was the Climate Monitoring Tool that facilities the quantification of rainfall performance for impact assessment (temporal and spatial analysis). Communicating agromet forecasts and advisories and developing crop calendars were also presented. In conclusion, weather forecast products for Agromet application need to be reliable and specific. However, there is a lack of well established communication pathways and insufficient knowledge to information user groups.

8.2 Forecast products for fisheries

8.2.1 The Agromet representative of the SWFDP-EA, Mr Isack Yonah, presented potential requirements of NWP forecast products for fisheries. He highlighted the following parameters: wind direction and speed; wave heights; rainfall; sunshine duration; tsunami warnings. During the discussion of this presentation, other participants pointed out other oceanic parameters such as sea-surface temperatures and upwelling information.

9. MAINTARGET USER GROUPS: WORKING WITH AND PROVIDING SERVICES TO THE GENERAL PUBLIC; MEDIA; DISASTER MANAGEMENT; FARMERS; AND FISHERS

9.1 Review of the national quarterly reports on PWS

9.1.1 Ms Haleh Kootval, Chief, Public Weather Services Programme of WMO, presented a report on the national quarterly feedback of the participating countries on the PWS component of the SWFDP-Eastern Africa. The feedback contained the results of interaction of NMSs with the main target user groups defined by the Project as: the general public; disaster management authorities; media; farmers and fishers, with particular attention paid to the general public; disaster management authorities and the media. The report gave a background perspective of these user groups, their expectations from their respective NMS and the methods and means of collaborating with them in providing them with fit for purpose services.

9.1.2 The review of the national quarterly reports 2011-2013 has provided valuable information about the progress of the Project in the participating Members. Ms Kootval noted that very few countries had included any PWS-related challenges as part of the overall valuation against the SWFDP goals and noted the desirability to add specific challenges that do not fit under any other sections in the reporting form. The major findings common to most participating NMSs are summarized below.

(1) It was strongly recommended that the reports should cover the period under review and give the details of target groups' feedback or actions taken to obtain such a feedback during that period only.
(2) Lack of a Memorandum of Understanding (MOU) or SOP between the NMS and media or DMA has been repeatedly cited as a problem, but it has not been indicated if any action has been taken to remedy the situation.
(3) Lack of a television (TV) broadcast studio for dissemination of forecasts/warnings is cited as a problem.
(4) Lack of a Website for the NMS is a problem for some.
(5) Slow Internet speed to allow access to information and timely dissemination of forecasts seems to be a problem.
(6) In several reports, mention is made of questionnaires being sent out to users, but no mention is made of the outcome of the exercise.
(7) Misinterpretation of forecasts and warnings by media is a common complaint.

(8) Media's lack of consideration of forecasts/severe weather warnings as priority is a problem.
(9) Demand by Media for payment for airing forecasts is another problem.
(10) Media and other stakeholders' demand for payment to attend meetings with the NMS is a problem.
(11) A common complaint is that media sensationalize forecasts.
(12) The need for an outreach programme with journalists has been indicated.
(13) While some reports repeat the same problems there is no mention of any actions taken to address them.
(14) Use of social media by some NMSs, has also helped to get feedback. The sharing of experiences and results in the use of social media with others is highly recommended.
(15) More location-specific forecasts are requested.
(16) Timeliness of warnings is an issue for users.
(17) There is a need to improve forecast dissemination.
(18) Improved forecasts have resulted in increased confidence in dealing with media.

9.1.3 Ms Kootval pointed out that many of these issues had been addressed at the PWS/SWFDP workshops, and guidance, advice, and guidelines had also been provided to the participating NMSs. She advised the participating NMSs to make use of the training and tools provided for addressing these problems at a national level.

9.2 Discussion of challenges in delivery of services to the main target user groups

9.2.1 The points emerging from the quarterly reports clearly identified some of the challenges in the delivery of public weather forecasts and warnings services to the user groups. These are summarized below:

(i) **Institutional challenges**; deal with the position of the NMS in the government, the commitment of the government authorities to the role and responsibility of the NMS in the protection of life and property and ultimately the existence of legislature or a law governing this issue, to help limit unauthorized warnings in support of the "single official source" for warnings principle.
(ii) **Technical challenges**; concern lack of access to tools and facilities such as adequate observations, models, remote-sensing products and knowledge of interpreting those products to produce as accurate forecasts as possible essential for the delivery of fit for purpose services to users.
(iii) **Human challenges**; relate to the set of skills that are required for the effective delivery of services and includes such skills as engagement with users, written and oral communication, public presentation and speaking, building relationships and partnerships, team work and flexibility.
(iv) **Financial challenges**: can lead to inadequate staffing or lack of sufficient training for the staff in service delivery, as well as lack of adequate dissemination capacities.

9.3 Presentation of the plans to improve PWS and delivery of services to user groups based on country visits

9.3.1 Ms Kootval informed the meeting of the PWS missions to Burundi, Rwanda and Uganda to address some of the challenges facing those NMSs. Based on the missions plans were developed to help them with their dissemination and presentation requirements, the implementation of which is underway.

9.4 Discussion of further requirements by individual countries

9.4 In looking towards future, Ms Kootval informed the meeting that depending on the availability of funds, further requests from the participating countries for strengthening their service delivery capability would be considered for action. These are discussed under agenda item 11.

10. VERIFICATION OF FORECASTS AND WARNINGS; AND THEIR EVALUATION, INCLUDING USEFULNESS AND USER RESPONSE

10.1 Mr Laurence Wilson (WMO Consultant) informed the meeting about forecast verification activities that had been carried out as part of the SWFDP. The contingency table methods were outlined, with emphasis on the data processing activities required to prepare the tables, and examples were shown of verification results prepared by NMSs in the Eastern Africa SWFDP. A summary of the verification activity for the SWFDP – Eastern Africa, as contained in the Quarterly reports from September 2011 to March 2013, is provided in Annex VII.

10.2 The verification method for the RSMC Pretoria severe weather risk guidance chart (SWFDP – Southern Africa) was also shown. It was noted that the comparison of this chart with the hydroestimator product provides valuable information on both the quality of the RSMC product and also the quality of the hydroestimator product. Since the hydroestimator product will be available also in the Eastern Africa SWFDP, the meeting recommended that this verification be carried out as soon as possible.

10.3 With respect to the verification of global model products, it was noted that ECMWF, M et Office UK, and NOAA/NCEP have kindly provided timeseries of their models and ensemble forecasts for all the Eastern Africa stations for which GTS data was received, for the 2010-2011 wet season. This data was used to set up verification exercises for the Training Workshop in the fall 2011. The meeting recommended that global centres continue to provide timeseries of their model outputs for the rainy seasons, and requested the Secretariat to pursue this approach.

10.4 The meeting noted that effective verification depends on the availability and free exchange of station data among the participating countries. It was further noted that relatively little data from African stations makes it onto the GTS in real time, and that much more data is routinely collected. The meeting strongly recommended that:

a) Attention be given to increasing the amount of data that is submitted to the GTS in real time, and to their respective metadata;
b) Explore more data which are not available on the GTS;
c) Participating countries make available historical time series of observations to the regional centres for use in verification (regionalized activity), including at the Regional training desks where national forecasters will be able to participate.

10.5 A verification study was presented by TMA.

11. DEMONSTRATION FRAMEWORK, FEEDBACK AND REPORTING

11.1 The meeting reviewed the template for a quarterly report, including the progress evaluation table to report on severe weather events (observed and forecast), which is provided in Annex VIII. The meeting recalled of the national warning criteria (in country thresholds for creating warnings), and reviewed and agreed the criteria for alerting severe weather in the RSMC Daily Guidance charts, which would be:

- Heavy rain: ≥ 50 mm/24hr, (also ≥30mm/h criterion in text guidance only);
- Strong winds: ≥ 25 Kts;
- Ocean/lake large waves: ≥ 2m;
- Dry spells during the rainy season: dry spell of one to 5 days (from LAMs); dry spell of 5 to 10 days (from global models); (a dry day has rainfall less than 3mm a day, warnings needed during the rainy season only);
- Lightning : lightning risk of 4 or 5 (on 1-5 scale);
- Hailstorms: hailstorm risk of 4 or 5 (on 1-5 scale);

- Extreme temperatures: maximum ≥ 35 C; maximum ≥ 40 C sustained for more than the period specified in WHO guidance; minimum < 10 C, < 5 C, < 0 C plus additional warning if these criteria are sustained.

Potential parameters for future consideration: dust storms, frosts, separate criterion for waves over lakes, storm surges, and fog.

11.2 The meeting reviewed the progress in developing the project website/portal and agreed on further developments as follows:

- A specific section for the Lake Victoria region (NWP and guidance products, including marine products) – done;
- A specific section for verification products – to be further developed;
- A specific section to share observations (starting by those available on the GTS) – to be further developed;
- A link to marine products for the coastal areas of the western Indian Ocean – done;
- An outlook for 6-10 days (guidance product for the project footprint) – to be developed;
- A link to the WMO project website (http://www.wmo.int/swfdp), which includes background and training materials– to be developed;
- A link to relevant documentation about the LAMs used in the region– to be developed;
- Specific section on PWS aspects (e.g. education materials, etc) – documentation plus regular updates – to be developed;
- Case studies (example) and Quarterly Reports – to be developed;
- Test area (area for developments) – e.g. include dust maps, start the development for the meteoalarm (start sharing warnings) – to be developed.

12. IMPLEMENTATION OF THE FULL DEMONSTRATION OF THE SWFDP IN EASTERN AFRICA

12.1 Regional Subproject Management Team

12.1.1 The meeting decided on its regional subproject management system and in particular the responsibilities of the members who were appointed to the Regional Subproject Management Team (RSMT). Membership was confirmed (list available in the Regional Subproject Implementation Plan), and Mr James Kongoti and Dr Hamza Kabelwa were unanimously reelected chairperson and vice-chairperson, respectively.

12.1.2 The meeting nominated Ms Helen Msemo (Tanzania) as the regional PWS representative and re-nominated Mr Isack Yonah (Tanzania) as the regional AgM representative. The meeting agreed that each country will nominate national PWS and AgM focal points.

12.2 Regional Subproject Implementation Plan

12.2.1 The meeting reviewed the draft Regional Subproject Implementation Plan, taking into consideration the *SWFDP Guidebook for Planning Regional Subprojects*, and discussed all components of the Implementation Plan, including the following aspects:

- Membership, chairperson of the RSMT, and the members' responsibilities*;*
- Responsibilities and products provided by global, regional and national centres, including those for agricultural applications;
- Liaison with media and disaster management and civil protection at national level;
- Liaison with agriculture and fishery communities;
- WIGOS and WIS aspects;
- Verification aspects, monitoring and evaluation, and reporting (severe weather events, and progress reporting of the project);
- Training aspects and plans;

- Timetable of implementation (milestones and responsible member).

12.2.2 The Regional Subproject Implementation Plan for the full demonstration of the SWFDP is available at: http://www.wmo.int/pages/prog/www/CBS-Reports/documents/RSIP_SWFDP-EA_May2013.pdf

13. ANY OTHER BUSINESS (AOB)

13.1 There were no other issues raised during the workshop.

14. CLOSING

14.1 The Meeting of the Regional Subproject Management Team (RSMT) of the Severe Weather Forecasting Demonstration Project (SWFDP) for Eastern Africa closed at 14:20 on Friday, 31 May 2013.

Annex I

AGENDA

1. OPENING

2. ORGANIZATION OF THE MEETING

2.1 Adoption of the agenda
2.2 Working arrangements

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

3.1 Overall framework
3.2 Summary of experience and progress of the Severe Weather Forecasting Demonstration Project (SWFDP) for Eastern Africa (RA I)
3.3 Synergy with and contributions to the EAC's five years meteorological development plan and investment strategy (2013-2018) – joint session with the EAC meeting of the Heads of Meteorological Service
3.4 Synergy with the Mobile Weather Alert (MWA) Project

4. EVALUATION OF THE PILOT PHASE OF THE SWFDP FOR EASTERN AFRICA (RA I)

5. IN SITU OBSERVATIONS AND REMOTE-SENSED DATA-PROCESSING SYSTEMS AND PRODUCTS FOR VERY SHORT-RANGE FORECASTING, INCLUDING NOWCASTING, AND ASSOCIATE TELECOMMUNICATION ASPECTS – LINKAGE TO WIGOS AND WIS SUB-REGIONAL IMPLEMENTATION PLANS FOR EASTERN AFRICA

5.1 WIGOS
5.2 WIS

6. LINKAGE AND FUTURE TRIALING OF PRODUCTS FROM THE WWRP PROJECT FOR LAKE VICTORIA

7. CASCADING FORECASTING PROCESS: ROLES OF PARTICIPATING COUNTRIES

7.1 Global: DWD (Germany), Met Office (UK), NOAA/NCEP African Desk (USA), ECMWF
7.2 Regional: RSMC Nairobi (Kenya), RFSC Dar (Tanzania)
7.3 National Meteorological Centres
7.4 Roles of and contributions by Centres for Limited Area Modelling over the Lake Victoria Region

8. AGRICULTURAL APPLICATIONS

8.1 Review of the requirements and use of NWP and satellite-based products for preparing agrometeorological forecasts
8.2 Forecast products for fisheries

9. MAINTARGET USER GROUPS: WORKING WITH AND PROVIDING SERVICES TO THE GENERAL PUBLIC; MEDIA; DISASTER MANAGEMENT; FARMERS; AND FISHERS

9.1 Review of the national quarterly reports on PWS
9.2 Discussion of challenges in delivery of services to the main target user groups
9.3 Presentation of the plans to improve PWS and delivery of services to user groups based on country visits
9.4 Discussion of further requirements by individual countries

10. VERIFICATION OF FORECASTS AND WARNINGS; AND THEIR EVALUATION, INCLUDING USEFULNESS AND USER RESPONSE

11. DEMONSTRATION FRAMEWORK, FEEDBACK AND REPORTING

12. IMPLEMENTATION OF THE FULL DEMONSTRATION OF THE SWFDP IN EASTERN AFRICA

12.1 Regional Subproject Management Team
12.2 Regional Subproject Implementation Plan

13. ANY OTHER BUSINESS (AOB)

14. CLOSING

Annex II

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Joint Session with EAC Heads Of Meteorological Services

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Annex III

PROGRAMME OF THE JOINT SESSION WITH THE EAC MEETING OF THE HEADS OF METEOROLOGICAL SERVICE

Wednesday, 29 May 2013

Time	**INTRODUCTION AND SETTING THE SCENE**		**Duration**
1400-1500	Opening • SWFDP-EA Chairperson • WMO secretariat • Remarks by Heads - NMCs • Guest of Honor	• J. Kongoti • A. Soares • PRs of UG, RW, KE, BU • A. L. KIjazi	60 minutes
1500-130	Overview framework of the SWFDP-EA	• RSMT-SWFDP-EA Chairperson J Kongoti	30 minutes
1530-1600	**GROUP PHOTO; COFFEE / TEA BREAK**		**30 minutes**
1600-1630	**Video - Conference**	**UKMO/RSMC/RFSC**	**30 minutes**
1630-1750	Global Centres • UK-Met Office • NOAA-NCEP • ECMWF • DWD	• S. Palmer • W. Thiaw • A. Garcia • U. Blahak	20 minutes each
1750-1830	Discussion and closing	All	

Annex IV

GUIDANCE FOR DEVELOPING A SIGNIFICANT EVENT CASE STUDY FOR THE SWFDP

The following is a template for a significant event case study with suggested sections. Such a case study is one of the requirements of the regular project reports to be provided by participating countries in the SWFDP. Based on a suggested template for RA V[1]

Abstract:

You should summarize the main facts of the case and your main conclusions. The reader should be drawn to read further.

Introduction

Why are you considering this case study? What leads up to this? What is the importance of this study? Have there been any others like this one? Is there a scientific body of knowledge that supports this type of case - this type of phenomenon?

As in any good narrative tell your readers why they should be reading your report. You should also give them an indication of what they are about to read- the “story” line.

You should repeat that story in the conclusion.

Links should be referenced as: (example)

World Data Center for Meteorology (Beijing, China[2]; Russian Federation[3]; Ashville, USA[4]) provides access to weather observations.

Overview of the weather situation

Draw on facts and images that describe the overall weather situation. In many cases this would be a surface map with important features outlined. What was the upper flow like? What were the forcing features, the precursors to the phenomena that you will describe? E.g. Tropical cyclones start from tropical depressions – what was the track? ; large extra-tropical lows start from rapidly developing lows.

For Meso-scale phenomena: for large convective storms describe: the weather situation; atmospheric stability; vertical profiles; low level humidity; shear; triggers;

Local effects – the weather situation in the local area should be described as well as the forcing involved e.g. Sea breeze (water and land temperatures, predominant winds; stability); valley or gap winds (topographic features, predominant winds, pressure gradient, stability).

Coastal flooding: High tide and storm surge – consider moon and sun tides; wind induced storm surge; wind waves and swell;

River flooding: describe precondition of the river, lake; catchment basin, weather description and precipitation amounts;

Atmospheric phenomena: eg. Rainbows; parhelic circles; condensation trails; describe weather situations and atmospheric conditions that are precursors for the phenomena

[1] http://www.wmo.int/pages/prog/www/CBS-Reports/documents/CASESTUDY_template_v12May2011.doc
[2] http://cdc.cma.gov.cn/
[3] http://meteo.ru/english/
[4] http://www.ncdc.noaa.gov/oa/wdc/index.php

Figures should be labelled (indicate the product, source and time and the features that should be noted by the reader) e.g. see **Fig. 1** (example) below:

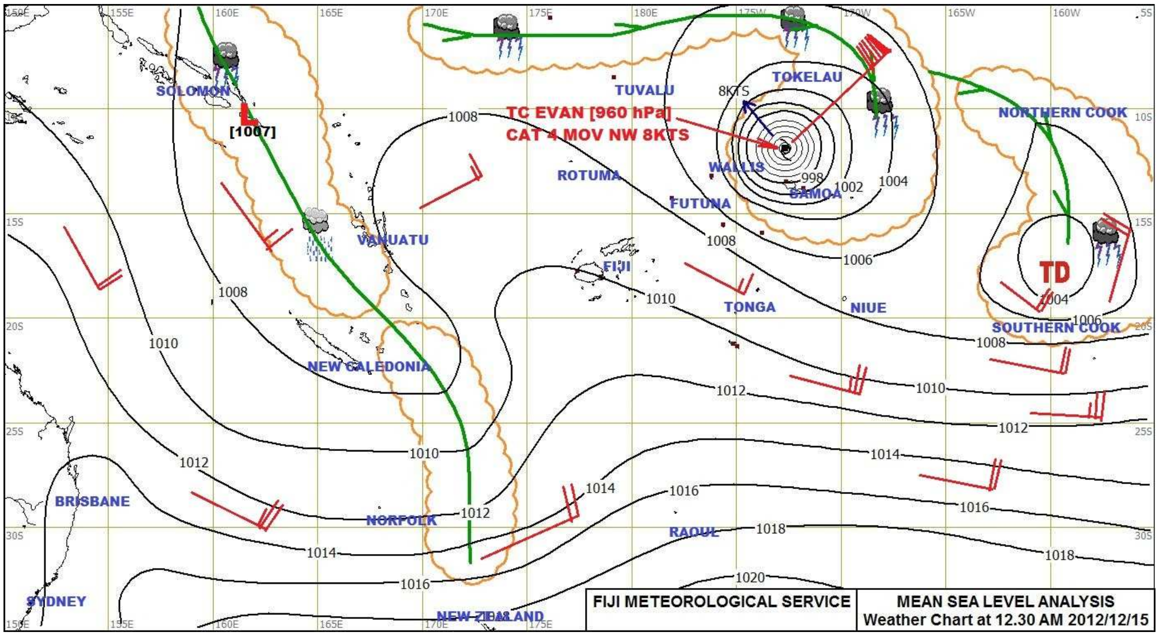

Figure 1: Fiji Meterological Service Mean sea level pressure analysis as at 12:30 am (Fiji local time) 12 Dec 2012. Note the position of TC Evan to the NW of Samoa and moving NWward. TC Evan subsequently turned toward the southwest. Note also the tropical depression in the Cook Islands.

Forecasts and warnings issued

In a case study of a significant event; provide a list of the forecasts and warnings issued; the more detailed ones should be annexed. Carefully differentiate the issue time, validity time, the area affected and the intensity of the phenomena being forecast against the observations to arrive at your conclusion. When was the warning issued to the DMCPA? Where there any interactions with the DMCPA?

Weather products used

Products from supporting RSMC's including graphical and worded advisories could be included. Details should be annexed but referred to in the body of the text. Consider products from global centres. Each product and service type should be described with details about the product content, technical foundation (i.e. what kind of model?, spatial and temporal scales (if necessary e.g. 4km WRF model), availability (e.g. from ECMWF 12UTC run). Each should be labelled as a Figure in the text with the appropriate legend. . More specific technical details should be annexed. Local models could also be included however the details should be annexed.

Observations and impacts

Present observations that support the severity of the phenomenon being considered e.g. max sustained wind and gusts for how long; precipitation how much and over what period – how widespread was this phenomenon; satellite imagery and radar could be used for the observations;

Impacts

Present facts about the extent and severity of the flooding; wind damage e.g. trees blown down houses destroyed; injuries and deaths; gathered from news reports, or better still, authoritative information obtained from national disaster management or civil protection authorities . If the reports are long they could be summarized, quoted, or annexed.

Evaluation of the forecasts

How good were the local forecasts? Make sure to respect the valid times of the forecasts. Evaluate the quality of the forecast with respect to the intensity of the phenomenon being forecast, the affected area with the supporting observations.

How good were the RSMC advisories and supporting forecasts?

How good was the numerical model support? Consider both global and local models.

Conclusion, recommendations

What are the main conclusions to be drawn for the evidence provided**?** For the evaluation of an event how well was it forecast? Could something have been done better? Should this procedure be followed in the future? Why? How could this case study be of help in a future event?

If the case is reporting on an event that is **not** well handled or well forecast – what could or should be done to make it better in the future? What could have been done differently?

Scientific article should be referenced using standard reference notation: e.g:

References

Carr, L.E., III, and R.L. Elsberry, 1997: Models of tropical cyclone wind distribution and beta-effect propagation for application to tropical cyclone track forecasting. *Mon.Wea. Rev.*, **125**, 3190-3209

QUATERLY REPORT OF THE SEVERE WEATHER REGIONAL SUBPROJECT (Template)

NMC : - - - - - - - -
PERIOD: (Start date to end date)

1. HIGHLIGHTS OVER THE PERIOD

2. OVERVIEW OF PRODUCTS

a. Usefulness of RSMC-Severe Weather Daily Guidance
b. Usefulness of SWFDP NWP/EPS Products received from each global centre and RSMC Limited Area Model (if available)

3. PROJECT EVALUATION AGAINST SWFDP GOALS

SWFDP GOAL	COMMENTS ON PROGRESS TOWARDS EACH GOAL	Questions to help you with an answer for each box
To improve the ability of NMHSs to forecast severe weather events		How did the products on the RSMC…….help you make better severe weather forecasts and warnings?
To improve the lead time of alerting these events		How much earlier do you issue severe weather forecasts & warnings now compared to before?
To improve the interaction of NMHSs with Disaster Management and Civil Protection authorities (DMCPAs), the media, each identified user sector, before, during and after severe weather events		Comment on any interactions with your disaster agency, media agencies and identified user sectors. If there hasn't been any since the last report, just say so.
To identify gaps and areas for improvements		What are the weaknesses in your forecast and dissemination systems?
To improve the skill of products from Global Centres through feedback from NMHSs		What weaknesses have you found in the products from RSMC …, UKMO, ECMWF, etc?

4. EVALUATION OF SEVERE WEATHER FORECASTS AND WARNINGS

A) Have you received any feedback from the general public?
B) Have you taken any actions to obtain feedback from the general public? Please elaborate on these actions.

Have you received any comments from the public on how they reacted when they heard or received the warnings?

C) Have you received any feedback from the particular user sectors identified in this project, in particular farmers and fishers?
D) Have you taken any actions to obtain feedback from these user sectors? Please elaborate on these actions.

What have been specific difficulties in getting these feedbacks? Please elaborate on these.
How have improved forecasts and warnings impacted the areas of activities of these sectors?

E) Have you had any feedback from the disaster management authorities about the timeliness and usefulness of the warnings?
F) Have you taken any actions to obtain such feedback? Please elaborate on these actions.

Have you had any comments from your emergency management organisations on how they worked with other organisations?

Did messages issued from your emergency management organisation were in agreement with the forecasts/warnings?

G) Have you received any feedback from the media?
H) Have you taken any actions to obtain feedback from the media?

How did the relationship with the media work in getting forecasts/warnings out as quickly as possible?

What particular issues or difficulties emerged in working with media during the period under consideration?

I) Complete the Progress Evaluation Table if you experienced a severe weather event

5. SUMMARY (general comments, challenges, etc)

6. CASE STUDY (PowerPoint presentation to include guidance products (RSMC and NWP), satellite imagery, warnings issued, impact evidence etc)

Case studies for each severe weather event ***DON'T*** need to be completed at the same time as the rest of this report.

Comment: Case studies don't need to be long. What's important is the learning experience that you gain from actually doing the case study.

Progress Evaluation Table (Use the information from the Severe Weather Event Evaluation Form)

Annex V

WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

BACKGROUND INFORMATION

Purpose of WIGOS

1. The WMO Integrated Global Observing System (WIGOS) provides a new framework for WMO observing systems, including the contributions of WMO to co-sponsored observing systems. It is important to recognize that WIGOS is not replacing the existing observing systems, but is rather an over-arching framework for the evolution of these systems that will continue to be owned and operated by a diverse array of organizations and programmes. WIGOS will focus on the integration of governance and management functions, mechanisms and activities to be accomplished by contributing observing systems, according to the resources allocated on a global, regional and national level.

2. WIGOS will enable all Members and the WMO Programmes to provide timely, quality-assured, quality-controlled, and well-documented compatible long-term observations for enhanced and extended services.

Collaboration with the WMO co-sponsored observing systems and international partner organizations and programmes

3. WIGOS will be an integrated, comprehensive, and coordinated system primarily comprising the surface-based and space-based observing components of the GOS, GAW, GCW, and WMO Hydrological Observing System (incl. World Hydrological Cycle Observation System, WHYCOS), including all WMO contributions to the GCOS, GOOS and GTOS. It should be noted that in contrast to the primarily NMHS owned observing systems upon which the World Weather Watch (WWW) was built, the proposed WIGOS component observing systems are owned and operated by a diverse array of organizations and programmes, both research and operational.

4. Strengthening the interaction between research and operational observing communities is therefore important for sustaining and evolving observing systems and practices, in line with new science and technology outcomes, and for operational availability and migration to operations, where appropriate, of some research-based observing systems.

Design, Planning and Optimized Evolution of WIGOS component observing systems

5. WIGOS provides a mechanism to meet the evolving observing requirements of WMO Members and partner organizations. Coordinated planning based on gap analysis and the Rolling Review of Requirements (RRR) process with new application areas important from the climate, cryosphere and other perspectives have great potential to enhance observing system capabilities and to increase cost-effectiveness of observing efforts and investments.

6. An observing network design will be addressed through a coordinated effort of NMHSs and other data providers by minimizing duplication and optimizing the observing network design and its flexibility to incorporate new observing systems/networks after their successful testing and evaluation. It can be a mix of systems with the optimized geospatial/temporal distribution of observing points and data to meet global/regional/subregional/national needs in accordance with requirements of significant users and application areas. Where there are a large number of smaller countries and/or large areas of ocean, this may be a practical move forward.

Observing System Operation and Maintenance

7. WIGOS involves, between observing systems, a process for sharing of operational experiences, of ideas and best practices, of expertise and for pooling resources for joint activities. The benefit is to realize synergies and greater efficiencies. These interactions may be between different teams within a single organization (such as an NMHS) or between organizations. These may benefit from technical guidance from relevant technical commissions and, while occurring primarily at a national level, may also occur at a regional or global level. For example:

(a) Maintenance visits: meteorological, hydrological and other networks often require their technicians to visit similar geographical areas to maintain observing equipment. It may be possible, where appropriate, to manage maintenance visits as a joint activity thereby realizing efficiencies;

(b) Calibration and Traceability: Potential for efficiencies and improvements to observational data quality through combining efforts at a national, regional and global level;

(c) Spectrum management: greater influence nationally which feeds into the International Telecommunication Union (ITU).

Quality Management

8. The WIGOS Quality Management approach is to apply the WMO Quality Management Framework (QMF) to the WIGOS component observing systems (see WMO Technical Regulations (WMO-No. 49), Vol. IV). WIGOS Quality Management will strive for compliance of all components of WIGOS with international standards, such as the ISO 17025 standard (i.e. with respect to instrument calibration and traceability of data) and others where appropriate.

9. In addition to the WMO QMF document, further guidance to Members on WIGOS Quality Management will be provided via the standard and recommended practices and procedures specified in the WMO Technical Regulations (WMO-No. 49), Vol. I) and further described in the WIGOS related Regulatory Materials, such as the WIGOS Manual and Guide. Such guidance, for both mandatory and desirable practices, can be referenced for the application and implementation of quality management in national observing systems. In this context, WIGOS will give attention to:

(a) The examination of current quality management practices being used by WMO observing programmes;

(b) The documentation of the quality of observation at all stages of data processing; and

(c) Ensuring, where possible, traceability to the International System of Units (SI).

10. A key aspect of WIGOS Quality Management that requires particular attention under WIGOS is the systematic and rigorous performance monitoring and evaluation (PM&E) of WIGOS capabilities, in terms of both: (a) the flow of observational data/products to models; and (b) provision of products/ information for decision-support tools and services in accordance with requirements specified by end users. Effective PM&E can improve the overall performance of WIGOS and its ability to effectively interact with its user community and to meet community needs and requirements.

11. Responsibility for the development of WIGOS Quality Management, and for the provision of guidance to Members on how to achieve compliance with the relevant technical standards, lies with the WMO Technical Commissions and with CGMS, while the responsibility for ensuring compliance with the WIGOS quality principles (such as ISO 9001, 9004, 17025) will fall primarily to the WMO Members themselves.

Standardization, System Interoperability[5] and Data Compatibility

12. Taking into account the ongoing rapid progress in technology that will continue to provide a basis for further improvements in the capability, reliability, quality and cost-effectiveness of observations, WIGOS must utilize international standards and best practices set by WMO and partner organizations.

13. The required key areas of standardization are:

(a) Instruments and methods of observation across all components including surface-based and space-based elements (observations and their metadata);

(b) WIS information exchange, as well as Discovery, Access and Retrieval (DAR) services; and

(c) Data Management (Data Processing, Quality Control, Monitoring and Archival).

14. The interoperability (including data compatibility) of WIGOS component observing systems is achieved through utilization and application of the same, internationally accepted standards and

[5] Interoperability is a property referring to the ability of diverse systems to work together (inter-operate)

best practices (that is, standardization). Data compatibility is also supported through the use of standardized data representation and formats. In this regard, observing system interoperability and data compatibility are key to turning observations into effective data/products that meet real needs of various users.

15. All standard and recommended practices and procedures will be documented in the WMO Technical Regulations (WMO-No. 49). Technical guidelines will be documented in the Guides and other technical documentation under the responsibility of the respective technical commissions.

The WIGOS Operational Information Resource (WIR)

16. The WIGOS Operational Information Resource (WIR), accessible via a centralized point (web portal), will provide access to all WIGOS related operational information, including observational user requirements, a description of the contributing observing networks (instrument/site/platform metadata), and their capabilities, list of standard and recommended practices and procedures used in the WIGOS framework, data policies applicable, and information on how to access data. It will also provide general information on WIGOS benefits, and impacts to Members. It will be a tool for conducting critical reviews as part of the Rolling Review of Requirements process, and assist Members and regional associations for conducting observing network design studies as appropriate.

17. It will be providing guidance on how to develop capacities in developing countries according to WIGOS requirements, and will be providing them with a toolbox to be used nationally if and when required. The information collected is intended in particular to identify the gaps in the observing networks, identify areas where existing observing systems could be used, or their scope expanded at limited cost to address the requirements of more application areas. The information provided on standard and recommended practices and procedures will support the production of more homogeneous data-sets and make the observations traceable and of known quality.

18. The WIR will also include information on planned observing networks, and the planned evolution of existing observing systems, allowing having a vision of the future global, regional, and national contributions to WMO networks, and how they will address user requirements. It will rely on and give access to key WIGOS support tools as shown schematically in Figure 1. Based on feedback from Members and users of the information resource, the need for additional functionality and/or information sources to be accessible from within the resource will be considered by ICG-WIGOS once it has been implemented.

Data Discovery, Delivery and Archival

19. Within the WIGOS framework, the WMO Information System (WIS) provides exchange of data and interpretation metadata[6], and management of related discovery metadata[7]. These discovery metadata play an important role in the discovery, access and retrieval of WIGOS observations and products.

20. Submission, management and archival of the data themselves is generally the responsibility of observing system owners/data custodians. However, several World Data Centres and a number of regional or specialized data centres exist that collect, manage and archive basic observational data that are relevant to WMO Applications.

21. An important aspect of WIGOS implementation is to ensure all participants adopt WIGOS and WIS standards and make their data and metadata available through WIS for delivery or for discovery, access and retrieval services. In this regard, promotion and implementation of DCPCs (Data Collection and Production Centres) as well as National Centres will be supported and encouraged. Guidance will be developed and provided through the appropriate WIGOS regulatory and technical documents.

[6] Interpretation metadata is the information required to interpret the data

[7] Discovery metadata is the information describing the data-sets, generally using ISO-19115 standard, and WMO core profile in case of WIS

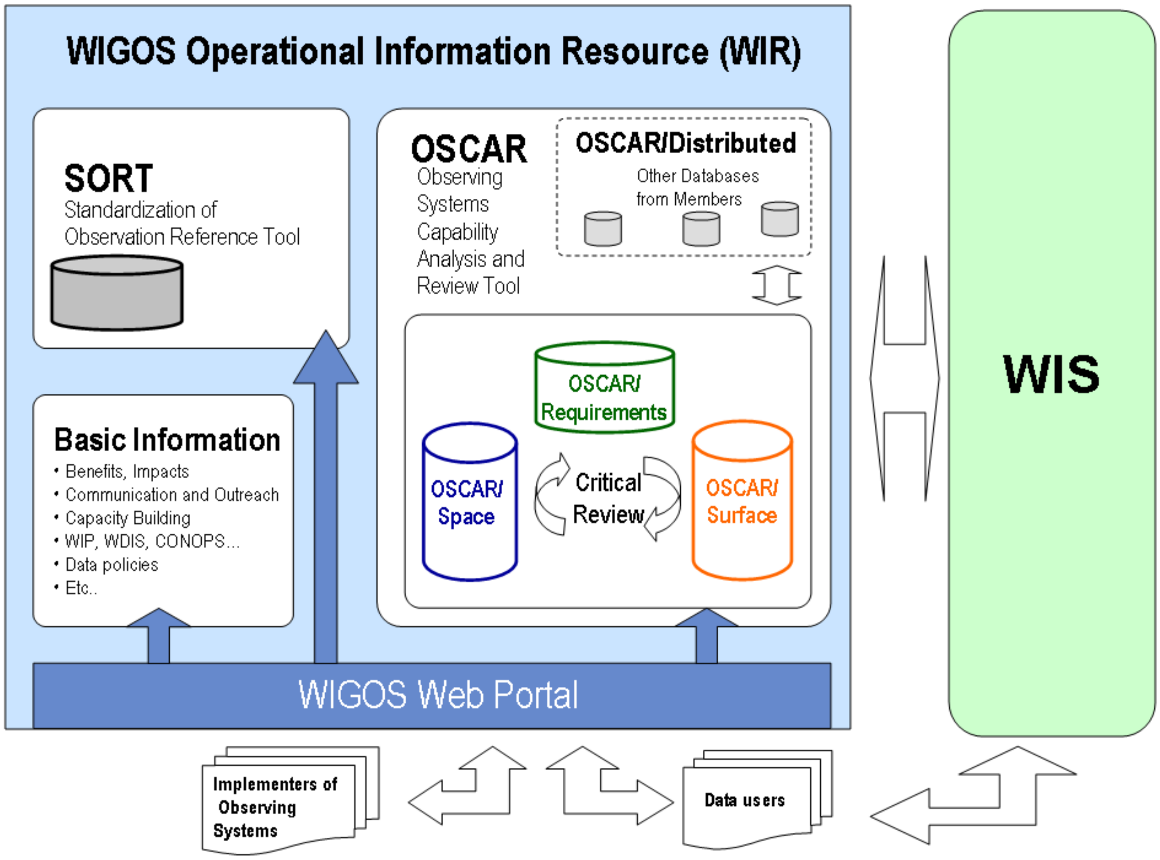

Figure 1: WIGOS Operational Information Resource (WIR) and its Key Support Tools

The key support tools of WIR are:

1. **The Portal**: A portal with access to general information and to the other components;
2. **The "Standardization of Observations" Reference Tool (SORT)**: A tool linking to information on WIGOS standards and recommended practices and procedures;
3. **The Observing Systems Capabilities Analysis and Review tool (OSCAR)**: A tool for Rolling Review of Requirements (RRR) process, network design and planning, providing information on observational user requirements and observing systems capabilities, including description of WIGOS component observing systems (i.e. observational metadata), and linkages to existing databases (e.g. WMO Country Profile database, when applicable).

Annex VI

REQUIREMENTS AND RECOMMENDATIONS FROM THIS MEETING

Proposed Agromet Products developed from AgWG Meeting

The following products were identified by the regional Agro-meteorological working group as important information to be provided in the regional portal for agro-meteorological guidance;

1. Previous 10-day rainfall anomaly maps
    a. previous past 10 days (ICPAC & NOAA)
    b. LTM

2. Cumulative forecast rainfall
    a. 1-5 day forecast from RSMC-LAM
    b. 10-day forecast from global centers
        i. 1-10 day
        ii. 6-10 day
    c. Number of rainy days in forecast period (>3mm)
    d. Rainfall Intensity (>20 mm per hour)
    e. Chances of dry and wet spell during rainy season (global centers) Ensembles
        i. 1 and 3 month
        ii. Dry spell of 10 consecutive days or more
        iii. Wet spell of 5 consecutive days or more (>20 mm per day)

3. NDVI (SPOT or NOAA)
    a. Difference from Last dekad (current product)
    b. Actual for current dekad
    c. NDVI Anomalies (actual & LTM) (SPOT or NOAA)

4. Extreme temperature Forecasts (same map)
    a. Chance of having Maximum Temp > 35 C during 5 day period
    b. Chance of having Minimum Temp < 10 C during 5 day period
    c. Chance of having Minimum Temp < 5 C during 5 day period
    d. Chance of having Minimum Temp < 0 C during 5 day period

5. Evapotranspiration ETo maps
    Penman-Montieth method based on FAO Publication
    a. Current
    b. Forecast (5 day LAM / 10-day global centers)
    c. Anomalies

6. Moisture index
    a. rainfall / ETo

7. Soil moisture maps
    a. Forecast soil moisture
    b. previous 10 day from Global center (EUMETSAT)

8. EUMETSAT / GEONETCAST products

9. Rangeland condition index forecast

10. Crop water requirement satisfaction index (WRSI)
    a. Need a developer
    b. Planting dates
    c. Degree-days - LAM

d. GEO Spatial WRSI

Recommendations from AgWG Meeting

(a) All WG members will research and develop a list of all existing agromet products that are of use to the region. Members are also requested to identify products that they would like to see on the portal.
   a. WG Members to review FEWSNET site and products

(b) Revise the SWDFP portals (Nairobi / Das Es Saalam)
   a. Add a Agromet Links section to lower right portion of portal
   b. Add links to AGRHYMET and FEWSNET
   c. RFSC site: add Day 1 Rainfall total and Day 2 Rainfall total
   d. RFSC: TMA WRF Forecast products, add maximum temperature

(c) Develop a regional Agromet Guidance Product
   a. Initial users are NMHS agromets, users could be expanded
   b. Goal is to improve outlook information to users and for bulletins
      i. Provide regional expert advice
   c. Produced every 10 days as graphical Map product
      i. previous 10 day information as input
      ii. SWFDP regional and global centre products
   d. Need to identify resource persons
   e. Could be used for early warning (disasters: drought/floods)
   f. Potential linkages with existing products (NOAA Africa Desk , FEWSNET)

(d) Liaise with fisheries community to determine possible products for the RFSC- Dar Es Saalam

Training Recommendations

(a) Group agreed to the proposal on having a training event focused on developing agrometeorological advisories based on weather forecasts
(b) WG members to notify WMO on 2 participants per country for the training event
(c) Group agreed to promote the use of the following applications: Crop modeling (DSSAT, APSIM), Yield forecasting, WRSI, Remote sensing (NDVI, RFE) and Analysis tools (GIS, SURFER, ARCVIEW).

Annex VII

SUMMARY OF VERIFICATION ACTIVITY FOR THE EASTERN AFRICA SWFDP AS CONTAINED IN THE QUARTERLY REPORTS, SEPTEMBER 2011 TO MARCH 2013

1. Tools for the verification

During the first phase of the Eastern Africa SWFDP, there were two tools available to assist participants in the preparation of data for verification. The main tool is the “Events Table”, an example of which is illustrated in Figure 1. This table was designed so that severe weather events and forecasts could be documented in near-real time, while the information on the event is still fresh. For each event, whether observed or forecast or both, one large row of the table is to be filled out, as soon as possible after the event occurs. The single thin row at the top of each block gives the description of the event, observations on the left and forecasts on the right, with impacts identified in the last two columns. Aside from the single line of information on the beginning and end of the event, and the forecast valid time, larger blocks are provided for the forecasters to fill out information on the usefulness of the forecast products that were available to them. This information is important as feedback to the global and regional centers which generate the forecast guidance.

1	Event No.	Event type	Region	OBS start time (to nearest h in UTC)	OBS end time (to nearest h)	observations (list all reports in region)	Severe weather observed? (Yes=1, No=0)	Warning Issued? (Yes=1, No=0)	FCST start time (to nearest h)	FCST end time (to nearest h)	Lead time of warning (0=time of observed start)	Impact of event	Impact of the warning
2		strong wind >20KT	ENTIRE COAST	06UTC	13UTC		1	1	18/07/12 06UTC	18/07/12 18UTC	1		
3	EVENT DATE 18/07/2012						Guidance:	RSMC: (check each one used)	Evaluation: 1 to 4 (1=useless, 4=best) 4	Other Products (check each one used)	Evaluation: 1 to 4 (1=useless; 4=best)		
4						Pemba 20KT Zanzibar 25KT D'salaam 20KT Mtwara 20KT		Severe weather chart: ✓ Prob Table ✓	4 4	ECMWF: ✓ NCEP: UKMO global: UKMO regional:	4	A BOAT SANK IN OCEAN	WARNING DELIVERED
5	1	strong wind >20KT	ENTIRE COAST				0	1	18/07/12 18UTC	19/07/12 18UTC			
6	EVENT DATE 19/07/2012						Guidance:	RSMC: (check each one used)	Evaluation: 1 to 4 (1=useless, 4=best)	Other Products (check each one used)	Evaluation: 1 to 4 (1=useless; 4=best)		WARNING DELIVERED
7								Severe weather chart: ✓ Prob Table ✓	3 3	ECMWF: ✓ NCEP: UKMO global: UKMO regional: ✓	ECMWF: 3 NCEP: UKMO global: UKMO regional: 3		
8	2	strong wind >20KT	ENTIRE COAST	10 UTC	17 UTC		1	1	25/07/12 18UTC	26/07/12 18UTC	4		
9	EVENT DATE 26/07/2012					Zanzibar 20-25KT Pemba 20KT D'salaam 20KT Mtwara 20KT	Guidance:	RSMC: (check each one used)	Evaluation: 1 to 4 (1=useless, 4=best)	Other Products (check each one used)	Evaluation: 1 to 4 (1=useless; 4=best)	NO IMPACT REPORTED	WARNING DELIVERED
10								Severe weather chart: Prob Table		ECMWF: ✓ NCEP: UKMO global: UKMO regional: ✓	ECMWF: 4 NCEP: UKMO global: UKMO regional: 4		
11	3	strong wind >20KT	ENTIRE COAST	09 UTC	13 UTC		1	1	26/07/12 18UTC	27/07/12 18UTC	4		
12	EVENT DATE 27/07/2012					Zanzibar 20KT Tanga 20KT	Guidance:	RSMC: (check each one used)	Evaluation: 1 to 4 (1=useless, 4=best)	Other Products (check each one used)	Evaluation: 1 to 4 (1=useless; 4=best)	NO IMPACT REPORTED	WARNING DELIVERED
13								Severe weather chart: Prob Table		ECMWF: ✓ NCEP: UKMO global: ✓ UKMO regional: ✓	ECMWF: 4 NCEP: UKMO global: 3 UKMO regional: 4		
14	4	strong wind >20KT	ENTIRE COAST	08 UTC	13 UTC		1	1	28/07/12 18UTC	29/07/12 18UTC	4		
15	EVENT DATE 29/07/2012					Mtwara 20KT D'salaam 20KT Zanzibar 20KT	Guidance:	RSMC: (check each one used)	Evaluation: 1 to 4 (1=useless, 4=best)	Other Products (check each one used)	Evaluation: 1 to 4 (1=useless; 4=best)	NO IMPACT REPORTED	WARNING DELIVERED
16								Severe weather chart: ✓ Prob Table ✓	4 4	ECMWF: ✓ NCEP: UKMO global: UKMO regional: ✓	ECMWF: 4 NCEP: UKMO global: UKMO regional: 3		
17	5	strong wind >20KT	ENTIRE COAST				0	1	29/07/12 18UTC	30/07/12 13UTC			
18	EVENT DATE 30/07/2012						Guidance:	RSMC: (check each one used)	Evaluation: 1 to 4 (1=useless, 4=best)	Other Products (check each one used)	Evaluation: 1 to 4 (1=useless; 4=best)		WARNING DELIVERED
19								Severe weather chart: ✓ Prob Table ✓	3 2	ECMWF: ✓ NCEP: UKMO global: UKMO regional:	ECMWF: 3 NCEP: UKMO global: UKMO regional:		

Figure 1. An example of an Event Table, as filled out by the Tanzanian Meteorological Agency.

A second tool is the “Evaluation form”. This two-page form was originally intended to be filled out for every severe event which occurred, and asks for more detailed information than the events table. However, it was recognized that this might be an onerous burden if there would be too many events in a specific period. Therefore, it makes most sense to fill out this form only for events which are the subject of investigation in the form of a case study or for storms of significant impact. It is the other form, the events table that should be filled out for all events, so that the data can be used in verification activities.

In addition to these two tools for data collection, an excel spreadsheet is also available for the computation of contingency tables and their scores using the data from the events table, which has to be transcribed into the spreadsheet. This approach was demonstrated and used in exercises at training workshops in November 2011 and November 2012.

2. Verification activity

Table 1 shows the frequency of reporting via the events table and in terms of contingency table verification, in terms of the six quarters from September 2011 to March 2013, numbered 1 through 6 on the table. A "0" indicates no events table was submitted for any quarter. Note, however, that the smaller countries Burundi and Rwanda, might not have recorded any severe events in some quarters, in which case submitting the events table would be unnecessary. When it is true that no severe weather was forecast or occurred during a quarter, then it is recommended to submit a blank events table to indicate that fact, or to state clearly in the quarterly report that there were no events observed or forecast. This is so that the verification can distinguish between 0 events and missing reports.

	Events Table	Verification in Q Report?
Tanzania	1,2,4,5	1,2,3
Kenya	3,4	1,5
Uganda	1,2,3,4,5	0
Rwanda	0	0
Burundi	0	0
Ethiopia	6	0

Table 1. Use of the events table and verification activity as indicated in the quarterly reports for the 6 quarters in the period September 2011 to March 2013. (As of May 31 2013)

Overall, the results were a little disappointing. The events table was compiled only in the three largest countries, and also not all the time. Ethiopia, which just started sending quarterly reports in the 6th quarter, has started using the events table, which is good. Again, in some cases perhaps there is no table because of no events, but it wasn't always clear from the report that this is the case.

Verification activity based on the data collected was carried out only in Tanzania and Kenya, at least partly in connection with the RSMC activities. In TMA, during the first three quarters, a comparative study was done to evaluate the TMA forecasts against the RSFC forecasts from Dar Es Salaam, based on contingency table scores. An example of this study is shown in Figure 2.

Contingency Table - RFSC-DAR ES SALAAM			
	OBS YES	OBS NO	
FCST YES	0	1	1
FCST NO	2	88	90
	2	89	91

Contingency Table - Tanzania Met Agency			
	OBS YES	OBS NO	
FCST YES	6	10	16
FCST NO	7	68	75
	13	78	91

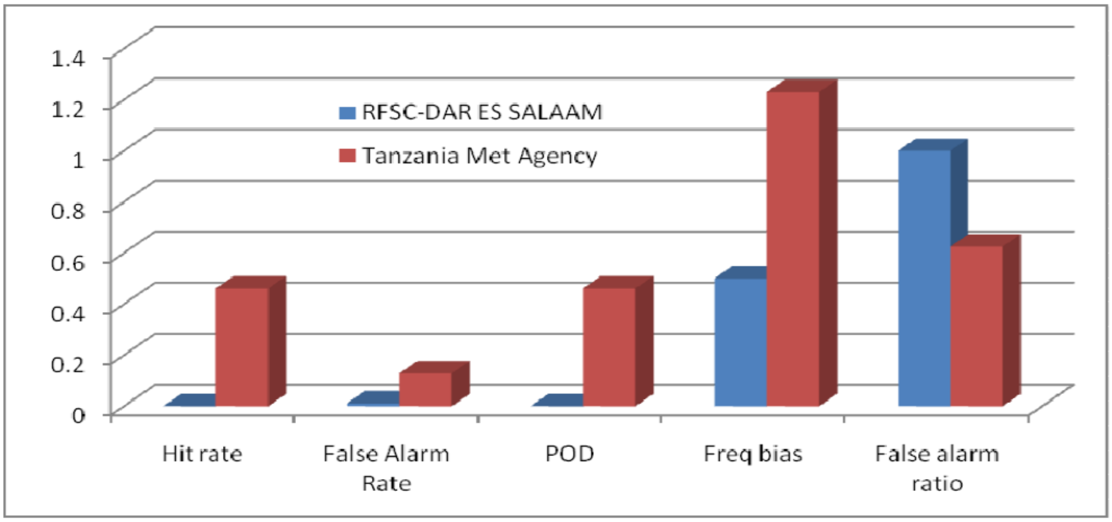

Fig2 Contingency table parameters for RFSC Dar es Salaam and Tanzania Meteorological Agency.

In each case, the TMA forecasts were shown to improve on the RFSC Dar forecasts. These interesting studies were stopped after the third quarter because of data problems.

RSMC Nairobi also prepared some contingency table verification results, an example of which is shown as Figure 3. Here, two tables are presented, one for severe weather events > 50 mm precipitation in 24h and the other for cases where 24h precipitation was greater than 100 mm. Three of the contingency table scores, probability of detection (POD or hit rate), the false alarm ratio (FAR), and the Threat score (CSI – critical success index), were computed. These tables illustrate the difficulty of small sample sizes of event occurrence: In the lower table, there were only 3 events, and all 3 were misses. Because it is difficult to get meaningful scores from contingency tables where there were few events represented, it is recommended that the tables be computed only if there are 10 events or more, and that the tables be accumulated over multiple quarters until there is are enough cases for meaningful verification. Where there are fewer than 10 events, the verification results should still be discussed in the quarterly report, following the template, but the computation of the table and scores isn't necessary for small samples.

For the two tables in Figure 3, the number of correct negatives was not estimated. While this is acceptable for small numbers of events as in this case, it limits the scores which can be used to those which involve only the numbers of hits, misses and false alarms. Estimating the correct negatives is important, and allows the use of many more meaningful scores such as the Pierce skill score (Hanssen-Kuipers) and the new Extremal dependency index (EDI), which was designed specifically for low frequency, extreme event verification. Estimating the number of correct negatives is not difficult: Simply count one non-event for each day when no severe weather was forecast or observed, through the full verification period.

		Observed		
		Yes	No	
Forecast	Yes	5	1	6
	No	3	0	3
		8	1	9

Probability of detection = 5/6 = 83 %

False Alarm ratio = 1/6 = 17 %

Critical success index or threat score = 55 %

ii.) Number of day with rainfall >100 mm over 24 hours period: 3
Number of bulletin/warnings giving an indication of rainfall >100 mm: 0

		Observed		
		Yes	No	
Forecast	Yes	0	0	0
	No	3	0	3
		3	0	3

Probability of detection = 0/0 = 0%

False Alarm Ratio = 0/0 = 0%

Figure 3. An example of contingency table verification results prepared by RSMC Nairobi. Upper table is for a threshold of 50 mm/24 h and the lower table for 100 mm per 24 h.

3. Recommendations

The following suggestions arise from the previous analysis of the quarterly reports received so far.

a) All NMHSs should fill out the Events Table. It is recommended to accumulate the information over one year, rather than starting a new table each quarter. Separate tables should be kept for different types of severe weather, e.g. rainfall > 50 mm, Wind speed > 25 kt., according to the thresholds which have been established for each country.

   Filling out the events table is important because this forms the basic dataset for verification. The verification itself can always be done later when sufficient data has been accumulated, but if the table is not filled out, the severe weather information is lost forever. Events (forecasts of severe weather, or observations, or both) should be added to the table as soon as observations are obtained for the valid time of the forecast. The latest version of the table can be submitted with each quarterly report.

b) The contingency table verification should be done when the number of events in the events table reaches 10. It is recommended to transfer the occurrence/non-occurrence of forecast and observation (the columns with only 1s and 0s in it) to the spreadsheet which was used in the lab exercise, and which will shortly be available as part of the SWFDP verification document. This spreadsheet computes the table for up to 200 events and the associated scores automatically.

c) It must be made clear in the quarterly reports that there were no severe events of a particular type forecast or observed, if that is the case. We can't assume that no report means no events.

d) The amount of attention to verification in NMHSs is somewhat disappointing. To help encourage verification activity, the quarterly report template should be revised to include questions on verification.
This was done at the RSMT meeting, and the new version of the template should be used from now on.

Annex VIII

REGIONAL SUBPROJECT (Template)

NMC : - - - - - - - -
PERIOD: (Start date to end date)

6. HIGHLIGHTS OVER THE PERIOD

7. OVERVIEW OF PRODUCTS FOR SHORT RANGE FORECASTS

a. Usefulness of RSMC-Severe Weather Daily Guidance:
These products are used: daily___ sometimes___rarely_ not at all___
Which products are most often used? For products which are less often used, why are they less often used (e.g. not often available in time, difficult format, not considered accurate enough, not needed other reason?)
b. Usefulness of SWFDP NWP/EPS Products received from ECMWF:
These products are used: daily___ sometimes___rarely_ not at all___
Which products are most often used? For products which are less often used, why are they less often used (e.g. not often available in time, difficult format, not considered accurate enough, not needed, other reason?)
c. Usefulness of SWFDP NWP/EPS Products from UK Met Office:
These products are used: daily___ sometimes___rarely_ not at all___
Which products are most often used? For products which are less often used, why are they less often used (e.g. not often available in time, difficult format, not considered accurate enough, not needed, other reason?)
d. Usefulness of SWFDP/EPS Products from NCEP:
These products are used: daily___ sometimes___rarely_ not at all___
Which products are most often used? For products which are less often used, why are they less often used (e.g. not often available in time, difficult format, not considered accurate enough, not needed, other reason?)
e. Usefulness of SWFDP/EPS Products from RSMC-Nairobi:
These products are used: daily___ sometimes___rarely_ not at all___
Which products are most often used? For products which are less often used, why are they less often used (e.g. not often available in time, difficult format, not considered accurate enough, not needed, other reason?)
f. Usefulness of SWFDP NWP/EPS Products from RSMC-Dar es Salaam Limited Area Model
These products are used: daily___ sometimes___rarely_ not at all___
Which products are most often used? For products which are less often used, why are they less often used (e.g. not often available in time, difficult format, not considered accurate enough, not needed, other reason?)
g. Usefulness of SWDFP NWP derived agromet products from global and RSMCs:
These products are used: daily___ sometimes___rarely_ not at all___
Which products are most often used? For products which are less often used, why are they less often used (e.g. not often available in time, difficult format, not considered accurate enough, not needed, other reason?)

8. OVERVIEW OF PRODUCTS FOR MEDIUM RANGE FORECASTS

a) What products do you use for forecasts beyond 2 days?
b) Do you use the EFI? If so, do you use it in combination with other products? Which ones? .
c) Have you issued any warnings for ranges beyond two days? If so based on which products?

9. PROJECT EVALUATION AGAINST SWFDP GOALS

SWFDP GOAL	COMMENTS ON PROGRESS TOWARDS EACH GOAL	Questions to help you with an answer for each box
To improve the ability of NMHSs to forecast severe weather events		How did the products (name them) help you make better severe weather forecasts and warnings?
To improve the lead time of alerting these events		How much earlier do you issue severe weather forecasts & warnings now compared to before?
To improve the interaction of NMHSs with Disaster Management and Civil Protection authorities (DMCPAs), the media, each identified user sector (i.e. agriculture, fisheries, etc), before, during and after severe weather events		Comment on any interactions with your disaster agency, media agencies and identified user sectors (i.e. agriculture, fisheries, etc). If there hasn't been any since the last report, just say so.
To identify gaps and areas for improvements		What are the weaknesses in your forecast and dissemination systems?
To improve the skill of products from Global Centres through feedback from NMHSs		What weaknesses have you found in the products from RSMC …, UKMO, ECMWF, etc?

10. VERIFICATION/EVALUATION OF SEVERE WEATHER EVENTS AND WARNINGS

a. Fill out the Events table for all warnings and observed events during the quarter.
   1. How many hits occurred during the period? (A “hit” is recorded when a warning was issued before the occurrence of the severe weather event, and severe weather conditions were observed in the area for which the warning is valid)
   2. How many false alarms occurred during the period? (A “false alarm” is recorded when a warning is issued, but there is no evidence that any severe event occurred in the warning area)
   3. How many missed events occurred during the period? (A “missed event” is recorded when severe weather conditions occur when no warning has been issued before the start of the event.)

b. If the total of 1, 2, and 3 is more than 10, compute the contingency table and scores for the period. Use the "CT calculator" template replacing the data with your own data from the events table. Add the appropriate number of correct negatives, one for each day during the period where there was no warning issued and no severe weather occurred OR Prepare your own contingency table and compute hit rate, false alarm ratio and threat score, and others if interested.

c. Based on the verification results, what improvements would you like to make to the forecast service?.

11. EVALUATION OF SEVERE WEATHER FORECASTS AND WARNINGS

J) Have you received any feedback from the general public?

K) Have you taken any actions to obtain feedback from the general public? Please elaborate on these actions.

Have you received any comments from the public on how they reacted when they heard or received the warnings?

L) Have you received any feedback from the particular user sectors identified in this project, in particular farmers and fishers?

Were any SWFDP agromet forecast and/or analysis products used in any dissemination product (bulletin, website, newspapers)?

M) Have you taken any actions to obtain feedback from these user sectors? Please elaborate on these actions.

What have been specific difficulties in getting these feedbacks? Please elaborate on these.
How have improved forecasts and warnings impacted the areas of activities of these sectors?

N) Have you had any feedback from the disaster management authorities about the timeliness and usefulness of the warnings?

O) Have you taken any actions to obtain such feedback? Please elaborate on these actions.

Have you had any comments from your emergency management organisations on how they worked with other organisations?

Did messages issued from your emergency management organisation were in agreement with the forecasts/warnings?

P) Have you received any feedback from the media?

Q) Have you taken any actions to obtain feedback from the media?

How did the relationship with the media work in getting forecasts/warnings out as quickly as possible?

What particular issues or difficulties emerged in working with media during the period under consideration?

12. SUMMARY (general comments, challenges, etc)

13. CASE STUDY (PowerPoint presentation to include guidance products (RSMC and NWP), satellite imagery, warnings issued, impact evidence etc)

Case studies should include the Severe Weather Event Evaluation Form for the case which has been studied.

Case studies for each severe weather event ***DON'T*** need to be completed at the same time as the rest of this report.

Comment: Case studies don't need to be long. What's important is the learning experience that you gain from actually doing the case study.