WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

REGIONAL SUBPROJECT IMPLEMENTATION PLAN FOR THE FULL DEMONSTRATION PHASE OF THE SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT (SWFDP) FOR EASTERN AFRICA

ARUSHA, REPUBLIC OF TANZANIA, 31 MAY 2013

IMPLEMENTATION PLAN

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Regional Subproject Implementation Plan (RSIP)
Version 31 May 2013

1. Introduction

1.1 Principles of the SWFDP

Numerical Weather Prediction (NWP) systems have become increasingly relevant and indeed essential to the severe weather forecasting process, with a growing number and variety of sophisticated outputs, currently available from NWP producing centres, which could be beneficial to severe weather forecasting to many National Meteorological and Hydrological Services (NMHS). The Severe Weather Forecasting Demonstration Project (SWFDP) was being organized as potentially a series of regional subprojects whose scope is to (1) further explore and enhance the use and application of the products currently available from NWP centres, or products which could be readily made available from current NWP systems, available through WMO's Global Data-Processing and Forecasting System (GDPFS) network of meteorological centres, with the goal to improving severe weather forecasting in countries where sophisticated model outputs are not currently used; and (2) deliver warning services through the Public Weather Services Programme (PWSP). The original focus of the project was on the phenomena of heavy precipitation that could cause serious flooding, and strong destructive winds. Such a demonstration project would use a cascading (forecasting) approach to provide greater lead-time for severe weather and would at the same time contribute to capacity building and improving links with Disaster Management and Civil Protection Authorities (DMCPA).

According to the recommendations of the CBS-XIII (2005), the goals of the SWFDP are the following:

- to improve the ability of NMHSs to forecast severe weather events;
- to improve the lead time of alerting these events;
- to improve the interaction of NMHSs with DMCPA before and during events;
- to identify gaps and areas for improvements;
- to improve the skill of products from GDPFS centres through feedback from NMHSs.

The CBS-Ext.(06) stressed the need to work with civil protection authorities and media organizations to improve delivery of severe weather warning services to end users. Subsequently, the Public Weather Services (PWS) and disaster risk reduction aspects have been integrated into the SWFDP.

1.2 The cascading forecasting process

In the framework of the general organization of the Global Data-Processing and Forecasting System (GDPFS), the SWFDP implies a coordinated functioning among three types of GDPFS centres. Conceptually, it should involve one (or more) global centre(s), one (or more) regional centre(s) and a small number of NMHSs located within the area of responsibility of the regional centre.

According to the conclusions of CBS-XIII, the proposed SWFDP is an excellent way to apply the cascading approach for forecasting severe weather in three levels, as follows:

- global NWP centres to provide available NWP products, including in the form of probabilities;

- regional centres to interpret information received from global NWP centres, run limited-area models to refine products, liaise with the participating NMHSs;
- NMHSs to issue alerts, advisories, severe weather warnings; to liaise with DMCPAs and the media, and to contribute to the evaluation of the project.

The SWFDP will implement a cascading forecasting process implying the participation of selected centres chosen within a geographical area affected by an agreed type of severe weather event. The cascading process aims to ensure the real-time distribution of the relevant available information produced by both a Global Centre(s) and a Regional Centre(s) to selected NMHSs. Moreover it is necessary to continue the cascade by making the final authoritative products of hazardous conditions (advisories or warnings) produced by the NMHSs available to the final users such as local Services in charge of hydrology (flash flooding) and/or DMCPAs, agriculture, fisheries, etc.

The cascading process concerns both short-range and medium-range products. In the framework of the Regional Subproject described hereafter, short-range is defined as up and including day-2 while medium-range is defined as day-3 up to and including day-5. An outlook from day-6 up to including day-10 could be available for agricultural purposes.

A near real-time evaluation will be conducted, based on observations of the meteorological variables from regional observing systems/networks as well as information gathered on the impacts of the severe weather phenomena as reported by DMCPA Services. This evaluation of the performance of the cascading process will then be provided as feedback to the participating centres to further fine tune the process itself.

1.3 Expected benefits

- SWFDP activities in RA I will raise the operational capacity of NHMSs in the region to produce effective severe weather alerts and warnings for the people in their countries and also to strengthen the role of RSMC Nairobi as the lead regional centre for the project by 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.
- The NMHSs in turn will be responsible for providing the forecast and warning services to the key target users defined as the general public, disaster management and civil protection agencies, media, agriculture, and fisheries In addition, this project will also strengthen the role of other centres in the production of specialized products for agriculture and fisheries, and the delivery of warning and forecast services over the Lake Victoria region and the coastal areas of the western Indian Ocean.
- A positive impact of daily use of SWFDP products (RSMC Daily Severe Weather Forecasting Guidance, NWP/EPS outputs and satellite-based products) which will allow forecasters to improve their understanding of the prevailing meteorological situation and evolution. The availability of the new products and the RSMC Daily Severe Weather Forecasting Guidance will help forecasters to boost their confidence and reinforce their credibility in the eyes of the various user communities.
- Implementation of the SWFDP Regional Subproject (Eastern Africa) will lead to an increase in the lead-time for alerting customers of impending severe weather events.
- Difficulties that may be encountered by NMHSs, in particular those relating to predictions (e.g. obtaining reliable heavy rainfall predictions (occurrence and amounts) and forecasting destructive winds associated with convective events, etc.) will all be consolidated in order to assist in devising strategies for improvements.
- The daily use of the NWP/EPS products coming from the Global Centres will allow identification of any weaknesses of the model outputs. Feedback, which would be

provided by the NMHSs, will help Global Centres to better take into account the problems linked to the rapid development of mesoscale destructive convective events. In addition, the regional centres in the region will verify high-resolution NWP over the overall project footprint (RSMC, Nairobi) and the Lake Victoria (TMA) for improving model's performance.

- Improved NWP guidance from the SWFDP project would be used to improve agricultural weather forecasts and advisories.
- Availability of early warning information on severe weather events will enhance preparedness and minimize associated impacts of the events.

1.4 The four phases of the SWFDP

The SWFDP can be divided into four phases as follows:

- Phase I: Overall Project Planning. This phase includes the preparatory work necessary to prepare the project specifications, the list of types of products to be exchanged and the work of the Project Steering Group (PSG) to identify the possible participating centres and to select suitable regional subprojects according to the geographical area, the type of severe weather and the chosen period for the experimentation.
- Phase II: Regional Subproject Implementation Planning and Execution. This phase begins with the preparation of the detailed specifications (data and products to be exchanged, performance measurements, reviewing and reporting) allowing the participants (representatives of the participating GDPFS and national centres) to develop the specific subproject implementation plan, including a training programme, and to manage its implementation and then to carry out the experimentation itself which is likely to last about one year.
- Phase III: Regional Subproject Evaluation. This phase includes the analysis and the evaluation of the entire subproject as well as contributing to the evaluation of the overall SWFDP with respect to the goals proposed initially. This phase gives the opportunity to identify gaps and deficiencies, and areas for improvement in order to ensure a sustainability of the organization tested during the regional subproject and to provide improved specifications for other similar regional subprojects.
- Phase IV: Regional Subproject Long-term Sustainability and Future Developments. This phase includes long-term sustainability of the benefits gained and a process of continual improvement. This phase gives the opportunity to continuously take advantage of future capability and technology developments, and to foster broadening of activities in synergy with other WMO programmes. In this phase, the responsibility for management, including seeking funding, lies with the Regional Association, while the PSG continues to be informed of developments and to provide advice as appropriate.

It has to be noted that the Phase II, III and IV are specific to each regional subproject and will be repeated for each of the selected subproject. From the point of view of the project management, it is clear that the overall SWFDP project begins with the first step of the Phase I and after completion of the Phase III of the selected regional subprojects, the responsibility becomes that of the Regional Associations. It is clear also that each selected regional subproject of the SWFDP will have its own date of beginning and date of completion of Phase III and transitioning to Phase IV.

1.5 Foundation laid for formulation of the Regional Subproject for Eastern Africa

1.5.1 Regional situation

Major natural hazards that affect Kenya are: (a) droughts; (b) floods; (c) landslides; (d) hail storms. Other hazards include: strong wind storms, lightening, ocean/lake large waves, 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 meteorological and hydrological disasters, advocacy and outreach programmes to reach the users in communities. These include school visits to KMD, interviews on TV and public call-in live, using local languages. All forecasts are communicated to the users through the Regional Directors of Meteorology (RDMs), RANET, Line ministries, FM Radio Station; including Electronic and Print Media.

Primary severe weather phenomena that affect Tanzania are:

(a) Hailstorms in north-west part of the country near Lake Victoria basin (Northern Kigoma and Kagera regions);
(b) Strong gusty winds during the hot season;
(c) Floods over some parts of the country (Kilosa part of Morogoro region);
(d) Drought particularly over the North-eastern part of the country (Kilimanjaro, Arusha and Mara regions); and,
(e) Landslides over some parts of the country (Kilimanjaro regions).

Floods and droughts are the major hazards affecting Ethiopia. The National Meteorology Agency of Ethiopia (NMAE) issues warnings of heavy rain when rainfall amount may exceed 30mm and 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.

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

The severe weather phenomena that affect Rwanda are: drought, floods, landslides, strong wind, frost, hail storm and lightening.

Burundi is impacted by a number of severe weather and extreme events, some of them are as follows:

- Rainstorms;
- 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;
- Strong and devastating winds;
- Floods (flash foods and river bank flooding);
- Drought, particularly over the Northeastern part of the country (Bugesera ecological region);

- Landslides over mountainous parts of the country.

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).

1.5.2 Subproject development and approval

The fifteenth session of the World Meteorological Congress (2007), the sixty-first and sixty-second sessions of the WMO Executive Council (2009; 2010), recognized the important successes of the SWFDP in Southern Africa, and more recently in the South Pacific Islands, and decided that the SWFDP should be expanded and implemented throughout Regional Association I (RA I) and to other WMO Regions, to benefit other developing countries and LDCs. The Steering Group for the SWFDP, at its third session (February 2010), therefore proposed to initiate an SWFDP in RA I – Eastern Africa, focused on severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture and fisheries.

A Technical-Planning Workshop on Severe Weather Forecasting Demonstration Project Development for Eastern Africa (SWFDP-EA) was held in Nairobi, Kenya, from 4 to 8 October 2010. The workshop concluded that the implementation of an SWFDP in Eastern Africa would be technically feasible and would bring benefits to the participating countries, namely Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda, in terms of enhancement of technical capacity in operational forecasting and advancement in the delivery of weather servicesto the general public and key socio-economic application areas such as agriculture and fisheries.

From 21 to 24 June 2011, the Regional Subproject Management Team (RSMT) for the Severe Weather Forecasting Demonstration Project (SWFDP) for Eastern Africa was held in Nairobi, Kenya. 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 in accordance with *SWFDP Guidebook for Planning Regional Subprojects* (Rev.2010). The full report is available on the WMO Web site at: http://www.wmo.int/pages/prog/www/CBSReports/documents/Final_report_SWFDPEastern_AfricaNairobi_workshop.pdf.

2 The framework of the Regional Subproject in Eastern Africa (RA I)

2.1 Key objectives

Primary objectives of the first field phase are:

(1) To establish the technical operating infrastructure of the demonstration project incorporating the cascading forecasting process, in order to improve the lead time and accuracy of forecasts for extreme weather phenomena;

(2) To develop/enhance dissemination systems to improve delivery of products and services to the general public, disaster management and media as the main users with a particular focus on i) agricultural activities, food security and food aid; and ii) safety of fishing and transport vessels on the Lake Victoria and over the coastal areas of western Indian Ocean;

(3) To improve communication of warnings and forecasts with users at all levels but with

a particular focus on the community level with a view to measuring progress in the uptake and use of the information provided through the project, at the community level.

2.2 Participating countries / organizations

The participating countries and organizations in three levels of GDPFS centres are listed as follows:

- NMCs
  - Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania and Uganda.
- Regional Centres
  - RSMC Nairobi (Kenya) to take up the lead role as Regional Centre for the project, covering the entire Eastern Africa region,
  - TMA to provide training and technical support for the Lake Victoria region (e.g. high resolution nested WRF/HRM and wave models, etc.), where appropriate;
- Global Centres
  - Met Office UK;
  - DWD (providing GME data needed for nesting COSMO);
  - NCEP GFS/GEFS (including GFS data for nesting WRF);
  - ECMWF.

2.3 Targeting severe weather events

The SWFDP in Eastern Africa has two major components; the first component is aimed at improving the severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture; and the second component focuses on improving severe weather forecasting and warning services over the Lake Victoria and the coastal areas of the western Indian Ocean for the safety and protection of fishers.

The regional subproject focuses on the following severe weather events for the entire project footprint in order of decreasing priority (and associated hazards such as flooding, droughts, etc):

- 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, fog.

2.4 Target domain

The domain to be covered for monitoring, analyzing and predicting the various severe weather events was agreed to be bounded by (see Figure):

- 5E – 55E; 30N – 25S (for products to be provided by the global centres. If possible, global centres will be asked to provide products for the whole of Africa domain);
- 23E – 53E; 16N – 15S (for LAMs);
- 31E – 36E; 2N – 4S (for the Lake Victoria region).

2.5 Field phase period

Given that the rainfall seasons when severe events are likely to occur in this part of Eastern Africa are from March to May and October to December, the field phase of the project starts in September 2013.

2.6 Projects in synergy with SWFDP-Eastern Africa

There are two projects in the region which have synergy with the development and delivery of the SWFDP.

World Bank Lake Victoria project

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

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

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

Mobile Weather Alert in Uganda and Tanzania

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.

An important component of the Uganda pilot is a full evaluation of the benefits of the warning and forecast service and, if appropriate, the development of a "blue print", or business case, for the wider rollout of the initiative. This project is now being initiated in Tanzania.

The pilot would also include a trial of the quality of data from Automatic Weather stations installed at mobile phone mast sites and address issues of data integration that have been identified by NMHSs participating in the initial project.

Early Warning System in Rwanda

The Rwanda Meteorological Service (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.

3. The Regional Subproject Management Team (RSMT)

The Regional Subproject Management Team (RSMT) is set up with the aim of preparing the implementation of the project and managing its execution. The management of the Regional Subproject is the responsibility of the Management Team and within the activities of CBS.

The RSMT will consult with regional groups and bodies, primary and foremost the East African Community (EAC), and the IGAD Climate Prediction and Applications Centre (ICPAC) during the planning and implementation of the SWFDP in Eastern Africa for a seamless early warning system. National representatives will also consult with national groups, such as the Western Kenya Community driven flood mitigation project (WKCDFMP), etc.

3.1 Roles and responsibilities of the RSMT

The main responsibilities of the RSMT are defined as follows:

- to prepare the Regional Subproject Implementation Plan;
- to manage the implementation of the regional subproject;
- to manage the execution during the field phase;
- to report on the status of the implementation on a quarterly basis;
- to evaluate the system.

3.2 Members of the RSMT

The Regional Subproject Management Team is chaired by Mr. James Kongoti and the vice chair is Dr. Hamza Kabelwa. The representative of EAC will be invited to participate in the activities of the RSMT.

The members of the RSMT are appointed by the Permanent Representative (PR) or Director of each participating NMHS or Centre and generally consist of the senior forecaster in charge of the forecasting team in the NMHS (able to direct and guide other forecasters). Each member is accountable to his/her respective PRs. The list of the members of the RSMT is as follows:

- NMHSs:
  - Mr Ruben BARAKIZA (Burundi);
  - Mr Tesfaye GISSILA (Ethiopia);
  - Mr Vincent Newton SAKWA (Kenya; RSMC Nairobi);
  - Mr Anthony TWAHIRWA (Rwanda);
  - Dr Hamza A. KABELWA (Tanzania);
  - Mr Paulino OMAY (South Sudan);
  - Mr John EZA (Uganda).
- Regional Centres:
  - Mr Vincent Newton SAKWA (Kenya; RSMC Nairobi);
  - Dr Hamza A. KABELWA (Tanzania).
- Global Centres:
  - Mr David RICHARDSON (ECMWF);
  - Dr Ulrich BLAHAK (DWD);
  - Mr Steve PALMER (Met Office UK);
  - Dr Wassila THIAW (US African Desk).
- Regional PWS representative:
  - Ms Helen Msemo (Tanzania)
- Regional AgM representative:
  - Mr Isack YONAH (Tanzania).

Mr James Kongoti (Kenya Meteorological Department) is the RA I representative to the CBS Project Steering Group (PSG) for the SWFDP.

3.3 Responsibilities of the Members of the RSMT

The RSMT is responsible for the elaboration of an implementation plan for the regional subproject. The Regional Subproject Implementation Plan (RSIP) must include the following actions with milestones:

- to gather the participants to develop the RSIP;
- to submit the RSIP to the PSG;
- to conduct preparatory training for the participants;
- to start the field phase;
- to conduct mid-term project review;
- to submit the final report to PSG.

The tasks of the members of the management team, during the preparation phase of the SWFDP are as follows:

3.3.1 The RSMT Chairperson, with the assistance of the vice-Chairperson, will be responsible for:

- drafting a detailed regional subproject implementation plan;
- developing preparatory training requirements specifically for participating operational forecasters who will be involved in the demonstration project and to provide information to WMO Secretariat;
- reporting on the Project.

3.3.2 The lead person for each participating NMC will be responsible for:

- coordinating all aspects of project implementation and execution at their respective centres;
- evaluating possible data-processing and forecasting developments (e.g. work required to adjust or tailor NWP products), as well as observational and telecommunications aspects;
- arranging for forecasters in the centres to receive or have access to the agreed products;
- defining the information to be exchanged with their DMCPA and other users;
- defining the information to be transmitted to the media;
- identifying preparatory training requirements;
- preparing regular evaluation of the forecasts and warnings during the field phase;
- coordinate with the national PWS and AgM Focal Points in the preparation of the quarterly reports;
- reporting on a quarterly basis on the status of the activities in the respective centre;
- arranging for verification of products from his/her national centre.

3.3.3 The lead person for each participating Regional Centres will be responsible for:

- coordinating all aspects of project implementation and execution at their respective centres, especially the cascading structure;
- evaluating and implementing possible data-processing and forecasting developments (e.g. work required to adjust or tailor NWP products), as well as observational and telecommunications aspects;
- Coordinate with the AgM and PWS representatives, as appropriate;
- identifying preparatory training requirements;
- preparing regular evaluation of the Regional Severe Weather Forecasting Guidance during the field phase;
- reporting on a quarterly basis on the status of the activities in the respective centre;
- arranging for verification of products from his/her regional centre.

3.3.4 The lead person for each participating Global Centres will be responsible for:

- coordinating all aspects of project implementation and execution at their respective centres, especially the cascading structure;
- evaluating and implementing possible data-processing and forecasting developments (e.g. work required to adjust or tailor NWP/EPS products);
- evaluating possible satellite-based developments (e.g. work required to adjust or tailor satellite-based products), where appropriate;
- arranging for verification of products from his/her global centre.

3.3.5 The regional AgM representative will be responsible for:

- Liaising and keeping regular contact with the lead person in each participating NMS to ensure the implementation of the AgM component of SWFDP
- reviewing required forecast products relevant for agrometeorology;
- coordinate the agromet working group on relevant issues, including service delivery to the agriculture community;
- advising NMHSs on using products from the SWFDP project to improve agricultural weather forecasts and advisories, and in determining potential crop production impacts, especially due to extreme events.

3.3.6 The regional PWS representative will be responsible for:

- Liaising and keeping regular contact with the lead person in each participating NMS to ensure the implementation of the PWS component of SWFDP
- Providing advice and guidance to the lead person in each participating NMS on strengthening dialogue with the media organizations,
- Providing advice and guidance to the lead person in each participating NMS on strengthening collaboration with the disaster management and civil protection agencies,
- Advising and reminding national PWS Focal Points to work with the lead person in each participating NMS in the preparation of feedback reports,
- Consulting with the lead person in each participating NMS and assisting them to clearly identify their users' specific requirements for services
- Keeping regular contact with the WMO PWS Programme to inform of activities in the region and to inform lead persons in the participating NMSs of latest developments in PWS which can be applied in the region.

Each participating country to nominate a PWS focal point (where not existing) for liaison with the region PWSrepresentative.

3.3.7 The contact person of the CBS SWFDP Project Steering Group (PSG) will be responsible for:

- liaising with the PSG on aspects of the regional subproject;
- providing regular updates on the implementation of the RSIP.

4. Responsibilities of Participating Centres in Subproject Implementation

The full demonstration phase of the SWFDP in Eastern Africa is focused on severe weather forecasting and warning services for the benefit of the general public and socio-economic sectors, in particular agriculture and fisheries. It includes forecasting, agrometeorological, and service delivery aspects over the entire project footprint. This phase also includes a specific component addressing severe weather forecasting and warning services over the Lake Victoria, including marine aspects for the safety and protection of fishers. A forecast and warning verification module is also part of the full demonstration phase of the project.

4.1 Implementation at Global Centres

Responsibilities of NOAA/NCEP Africa Desk:

- Ensemble Prediction Systems (EPS) adapted specifically for assessing the risk of severe weather and associated hazards;

- To tailor products to the requirements of the Regional Centres including the provision of sub-domains and probabilistic products according to the lists given in Annexes A and B; (All NMHSs to review available sounding forecast points on the NCEP website and send additional or new locations to include in the product suite)

- To provide access to the satellite rainfall estimates for Africa (RFE) to help assess the quality of global NWP/EPS products (where appropriate); This task is already ongoing as the RFE data and products are available on the NCEP ftp and website, respectively.

- To provide access to operational verifications of NCEP forecasts.

- To enhance the NCEP professional development residency training program and align it better with the WMO SWFDP objectives and the needs of the countries.

- To establish a process to evaluate the efficiency of tailored products incorporating feedback from other Centres.

Responsibilities of the Met Office UK:

- to provide medium-range products from deterministic global models and Ensemble Prediction Systems (EPS) adapted specifically for assessing the risk of severe weather and associated hazards;
- to tailor products to the requirements of the Regional Centres including the provision of sub-domains and probabilistic products according to the lists given in Annexes A and B;
- to suggest suitable existing satellite imagery and satellite-based products that are helpful in assessing the current meteorological situation, and therefore also assess the quality of global NWP/EPS products (where appropriate);
- to estimate the time necessary to be able to complete this work;
- assisting in verification of products of participating global centres;
- to indicate the level of participation in preparatory training (essentially for medium range products, including EPS);
- to establish a process to evaluate the efficiency of tailored products incorporating feedback from other Centres;
- to provide Global Guidance Support;
- to provide lightning observations.

Responsibilities of the ECMWF:

- to provide medium-range products from deterministic global models and Ensemble Prediction Systems (EPS) adapted specifically for assessing the risk of severe weather and associated hazards;
- to tailor products to the requirements of the Regional Centres including the provision of sub-domains and probabilistic products according to the lists given in Annexes A and B;
- to suggest suitable existing satellite imagery and satellite-based products that are helpful in assessing the current meteorological situation, and therefore also assess the quality of global NWP/EPS products (where appropriate);
- to estimate the time necessary to be able to complete this work;
- assisting in verification of products of participating global centres;
- to indicate the level of participation in preparatory training (essentially for medium range products, including EPS);
- to establish a process to evaluate the efficiency of tailored products incorporating

feedback from other Centres.

Responsibilities of the DWD:

- Provide the necessary GME data for running the COSMO-model to KMD and TMA.
- DWD provides a ~1 year old version of the COSMO-model for free to developing countries.
- Support for installing, upgrading and running the models. Two Romanian experts (Mr. Cosmin Barbu, Ms. Rodica Dumitrache) from the COSMO-consortium are available for free support of COSMO users during model installation and system upgrades (via email or remote ssh login to the local computing facility). Also possible: on-site support by two scientists from Romania and one scientist from IBL or MFI. Here, NMS has to pay all expenses related to the training.
- Assisting in verification of DWD products (models and GME data).

4.2 Implementation at Regional Centres

Regional centres participating in the SWFDP for Eastern Africa will contribute according to their area of specialisation and/or geographic region.

4.2.1 The Lead Regional Forecasting Support Centre for Eastern Africa (RSMC Nairobi)

The responsibilities of the Lead Regional Forecasting Support Centre are:

- to be the lead regional centre for this project, including the responsibility for the development and management of a dedicated project Web Portal;
- to redirect toward the NMHSs relevant products issued from the global centre (if necessary);
- to develop daily guidance products for NHMSs containing an interpretation of medium-range deterministic and EPS products and an assessment of alternative scenarios;
- to make available all relevant guidance products via a password-protected Web Portal and develop product archival procedures;
- to provide regional guidance support (liaise with Global and National Centres by videoconference)
- to participate in the provision of training, including training of national forecasters through attachments to the regional centre;
- to train regional guidance forecasters though attachments to global guidance centres
- to implement an archival process for relevant products and data;
- to implement an evaluation and feedback process on the effectiveness of guidance and improved warnings from NMHSs;
- to list duties and procedures for operational forecasters and systems staff;
- to estimate the time and resources necessary to complete this work.

4.2.2 The Regional Forecasting Support Centre for the Lake Victoria region and verification activities (TMA)

The responsibilities of the Regional Forecasting Support Centre for the Lake Victoria region and verification activities are:

- assist RSMC Nairobi for this project, where appropriate;

- develop daily severe weather guidance products for NMHSs containing interpretation of short range forecasting Lake Victoria region;
- to provide regional guidance support (liaise with Global and National Centres by videoconference)
- regional observing system information sharing over Lake Victoria region;
- severe weather events verification;
- warnings verification coordination over Lake Victoria region;
- assist RSMC Nairobi in the verification of products for the western Indian Ocean
- to participate in the provision of training, including training of national forecasters through attachments to the regional centre;
- to train regional guidance forecasters though attachments to global guidance centres.

4.3 Implementation at National Meteorological Centres (NMC) of NMHSs

The responsibilities of national meteorological centres are:

4.3.1 Forecasting:

- to develop products and services and training tools to meet the requirements of users involved in emergency management and response;
- to develop the capacity to interpret NWP/EPS and satellite-based guidance products provided by Global and Regional Centres;
- to issue forecasts, alerts and warnings for users (DMCPAs, media, the public and specialized service users);
- to use available nowcasting tools (satellite imagery or satellite based products, radar products) to update warnings;
- to implement 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;
- to implement an evaluation and feedback process on the effectiveness of guidance provided by Regional and Global Centres;
- to list duties and procedures for operational forecaster (e.g. evaluation, acknowledgement of receipt of guidance from Regional Centre);

4.3.2 Service delivery:

- to identify major stakeholders, map emergency preparedness and response decision processes and actions, and identify requirements for meteorological products and services at national and international levels;
- to develop a communication strategy with DMCPAs and the media to ensure effective response to alerts and warnings;
- to develop 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 exchange information on warnings between participating NMHS, and between NMHS and Regional 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;

4.3.3 Agromet

- to integrate the forecasting guidance into the various agromet products.

4.3.4 Infrastructure:

- to ensure necessary telecommunication is in place (e.g. Internet access, operational e-mail) and alternative means for timely access to data;

5. Data and Products to be provided by the participating Centres

5.1 Products which will be provided by the Global Centres

Global NWP Products which can be made available by the four global centres ECMWF, NCEP, Met Office UK, should be cut and formatted to fit the project area (see item 2.4). The table in Annex A gives the comprehensive list of the products and indicates which centre(s) will provide them; the list comprises mainly:

- deterministic Forecasts:6-hourly up to 48 hours, then 12-hourly up to 120 hours;
- ensemble forecasts:12-hourly up to 120 hours, wave height, direction and period maps;
- meteograms at selected locations whose list is given in Annex B.
- lightning observations.

Products which are not routinely transmitted through the WIS/GTS should be provided in graphical form (Web pages) via Internet for rapid display and dissemination, and may also be made available by other methods (FTP). Provision of data in digital format may assist regional centres in producing charts of derived parameter.

5.1.1 Current Deterministic NWP fields

Up to 2 days at 6h Intervals (12h intervals after 2 days up to 10 days). The domain of the area of coverage is defined in item 2.4. NWP forecasts should be updated every 12 hours. In addition to the daily production all the forecasts should be archived for a minimum of 10 days.

The recommended products include:

- charts to depict the large-scale flow (MSLP, 950/850/700/300/200 hPa wind, geopotential height, temperature and humidity);
- charts of vorticity at 500/300 hPa, vertical velocity at 700/300 hPa, 850 hPa wet bulb temperature, 100-500 hPa thickness;
- surface weather elements: 6-hour accumulated precipitation, 24 hour accumulated precipitation; 10-day accumulated precipitation,10m wind-speed, 2m minimum and maximum temperatures, relative humidity;
- atmospheric column characteristics: precipitable water, CAPE, theta-e, Lifted Index, K index, total totals, CIN;
- thermodynamic diagrams e.g. tephigrams, skewT/logP issued from the model at several locations.
- wave products for the western Indian Ocean.

5.1.2 Probabilistic Forecast Products based on EPS

- probability of severe weather events such as precipitation and wind higher/lower than the given thresholds;
- “spaghetti” plots (e.g. 500hPa geopotential height in extra-tropics, precipitation and wind higher than given thresholds);

- stamp maps (e.g. streamlines in the tropics, wind speed, accumulated precipitation);
- dispersion diagrams (plumes and EPSgrams) for weather elements at specific locations;
- representative members of a classification of weather pattern such as clustering or tubing (optional product depending on possibilities of Global Centre);
- severe weather risk index such as Extreme Forecast Index (where available).

5.1.3 Data and products to be provided by DWD

- GME data necessary to run the nested COSMO at KMD and TMA;
- COSMO-model (~1 year old version).

5.2 Data and Products which will be provided by the Regional Centres

The requested fields are the same as those proposed for the outputs from global models, where available. In addition, wave forecast products for Lake Victoria.

Products which are not routinely transmitted through the WIS/GTS should be provided in graphical form (Web page) via Internet for rapid display and dissemination, and may also be made available by other methods (e.g. FTP).

Interpretation of fields available from global and regional centres synthesized in the form of three daily severe weather forecasting guidance bulletins:

- a short range (48 h) guidance mainly based on the interpretation of NWP models, issued during the morning;
- a medium range (up to 5 days) guidance mainly based on the interpretation of EPS products, issued during the afternoon;
- an outlook (6-10 days) guidance mainly based on the interpretation of EPS products, issued during the afternoon;
- satellite imagery and satellite based products (e.g. cloud imagery, NDVI, RFE, RFE anomalies).

5.2.1 RSMC Nairobi:

- fields given by the Limited Area Model (LAM) running at RSMC Nairobi. This model (COSMO) will take its lateral boundary conditions from the DWD/GME;
- guidance for short range and medium range as requested by the NMHSs (An example of the content of the guidance bulletins is given in the Annex C). This daily guidance has to be archived.
- archives of all products relevant to the project on case-to case basis (when severe weather event is either observed or forecast).
- satellite imagery and satellite based products.
- 5-day accumulated precipitation map, number of dry days map (1-5 day period)

Additional products

- ‘poor-man’s ensemble’ rainfall predictions;
- archive of all products relevant to the project on case-by-case basis (when severe weather event is either observed or forecast).

5.2.2 RSFC Dar:

- NWP products given by LAM running at TMA covering the Lake Victoria region;

- an interpretation of NWP products in form of graphical severe weather guidance for short range over Lake Victoria region;
- regional observing system information sharing over Lake Victoria region;
- severe weather events verification;
- warnings verification coordination over Lake Victoria region.

5.3 Data and Products which will be provided by the National Meteorological Centres are as follows

Complying with the obligation for sharing data under WMO resolutions 40 (Cg-XII) and 25 (Cg-XIII).

6. Verification aspects by NMHSs/NMCs

The purpose of the evaluation is:

- to verify the efficiency of the forecast issued from the NMHS (comparison between the forecast and the reality each time a severe weather event occurs (occurrence and intensity, lead-time, false alarm ratio, probability of detection);
- to assess the guidance issued by the Regional Centres;
- to provide feedback from DMCPA services, media, general public, sector specific users (farmers and fishers), e.g. impacts of the severe event, usefulness of warnings/ bulletins.

To achieve this evaluation, a bulletin will be filled in by the NMHS and transmitted to Regional Centres. A template of such an evaluation bulletin is given in the Annex E (final form will be produced by RSMC Nairobi as soon as possible). The evaluation bulletin will need to be formatted in a convenient form (Excel file) in order to simplify the processing and archiving of the data. The products which have been used in the production of severe weather forecasts must also be archived for use in future case studies.

7. Specific aspects

7.1 Forecasting aspects

1. Capacity development on Forecasting through attachments of regional forecasters to global centres, national forecasters to regional centres for hands-on practical training on the use and interpretation of NWP/EPS products, and on verification (global and regional training desks)
2. Daily Videoconference (09 UTC / 12:00 local time) – next rainy season – participants: national forecasters, led by regional centres, with the support of global centres (UKMO)
3. Visits of forecasters from regional centres to NMCs for hands-on practical training on the use and interpretation of NWP/EPS products
4. make available through the website additional NWP/EPS products including in support for AgM (see updated list of products from global and regional centres).
5. Promote and provide access (web Link) to RCOF regional statement (outlook)for seamless EWS 6. Upgrade WRF and COSMO and Wavewatch III Lake Victoria models at regional centres to allow nesting and data assimilation in the future (oning process)
7. Preparation of case studies with the involvement of global, regional and national centres.
8. Establish skype account in all national forecasting offices for real-time communication with regional centres in case of severe event
9. Secretariat to coordinate all training opportunities to ensure participation of forecasters from SWFDP-EA.

7.2 PWS aspects

1. Capacity development on Service Delivery (SD) through attachment of the PWS focal points to NMSs with proven SD capabilities for hands-on practical training on service delivery to different user groups and the required accompanying coordination activities.
2. Awareness raising among policy-makers of the value and worth of warning services through national or regional seminars preferably through political regional bodies meetings on issues related to climate and severe weather -related disasters.
3. Initiation or strenghtning of a process to establish meteorological legislation or law in support of the single official voice role and responsibility of NMSs.
4. Capacity development in media-related issues including provision of training for TV presenters, refurbishment of the studio and equipment and transmission to the TV station, and provision of some training to media representatives and journalists.
5. Development of user friendly and high quality web sites for the NMSs.
6. Training and awareness raising on the socio-economic benefits of services through seminars for heads and senior managers of NMSs and key government officials in finance and development ministries.
7. Introducing and developing capacity in impact-based forecasting. This will imply providing advice on impact of a severe weather event in addition to issuing warning of severe weather. Coordination with other government agencies involved in preparedness and response is crucial for this purpose.

7.3 AgM aspects

1. Capacity development, including Roving seminars
2. NWP Products (list) – to integrate the forecasting guidance into the various agromet products, and make available on the SWFDP-EA website
3. More integrated face-to-face meetings on how to communicate uncertainty to farmers and fishers (also for other user sectors)

7.4 Verification aspects

1. Request new dataset from 3 global centers – 1 year (2012), locations specified by NMSs (start with epsgram locations)
2. Global centres add in obs they have from GTS; NMS add their own data
3. Start training on eps verification – especially epsgrams
4. Redo the quarterly report template to reinclude verification.
5. Further encourage verification in NMSs

7.5 WIGOS aspects

1. All participating countries will review their current observing networks to ensure that all stations in the RBSN and RBCN are reported internationally on the GTS, and that their records in Volume A and lists of stations in the RBSN and RBCN are correct. In addition, where additional stations meet the quality requirements of the RBSN or RBCN (even if they do not produce observations at the frequency required by the RBSN), participating countries should publish those observations on the GTS. All countries will start documenting their existing observing procedures to support implementation of WIGOS and modify them as necessary to make them compliant with WMO Technical Regulations and recommendations. WMO Secretariat will provide appropriate support.
2. All participating countries will contribute to the Region I WIGOS Implementation Plan, ensuring that the Plan will deliver the observations and supporting metadata needed to support delivery of Severe Weather Warnings, and negotiate appropriate funding and resources to implement the plan in their own country, and contribute as necessary to

regional funding activities. WMO Secretariat will provide appropriate support.
3. All participating countries will review the requirements for observations within their own country, and review all the observing systems operating in their country (whether operated by the NMHS or other organization) and identify the extent to which the observing networks currently meet the requirements for observations and the supporting observation metadata and meet quality requirements. The national plan must address all aspects of designing, implementing, operating and maintaining observations networks, including funding, management and quality management as well as technologies and capacity development. All participating countries will prepare a national WIGOS Implementation Plan, and ensure that it addresses the needs of SWFDP and that it is compatible with the Region I WIGOS Implementation Plan. WMO Secretariat will provide appropriate support.

7.6 WIS aspects

1. RTH Nairobi will coordinate work by each participating country that is experiencing difficulties in using the GTS to implement ways of exchanging information on the GTS using technologies available to those countries, supported as appropriate by WMO Secretariat.
2. A regional workshop will be used to train participating countries in what is expected of them to participate in WIS, and each country will update its WIS metadata records, and a WIS implementation plan will be prepared and implemented for participating countries (consistent with Region I planning), supported as appropriate by WMO Secretariat.
3. Each participating country will plan and implement a national programme of work to upgrade its national telecommunications, supported by a workshop to develop a methodology for creating and managing these plans in a consistent way, supported as appropriate by WMO Secretariat.

8. Training

8.1 Overview

Training is necessary to ensure that forecasters from Regional Centres and NMHSs are able to correctly interpret the various NWP/EPS, satellite-based and guidance products made available for the SWFDP regional subproject and to prepare user-focused information. Also, the training will inform forecasters of all responsibilities as outlined in the RSIP.

The NMHSs are requested to assess the current capacity in the use of NWP/EPS and satellite-based products and provide information to the RSMT to assist in the development of the training.

8.2 Training topics for the workshop

Training will be delivered in the use of NWP/EPS, satellite-based and guidance products during the full demonstration phase of the project. The aim of the training is, ‘To position operational forecasters in the participating NMHSs to take optimum advantage of the state of the art NWP model output’. Global and regional centres will be contributing to the training course.

Possible contents of this workshop are listed as follows:

- interpretation and best practice use of deterministic and probabilistic NWP products for the forecasting of severe weather;
- general characteristics, strengths and weaknesses and biases of the different atmospheric models e.g. ECMWF, UKMO, GFS, etc.;
- how to use probabilities in the preparation of weather forecasts;

- understanding and interpretation of specialized NWP products for forecasting severe weather events, including post-processing and diagnostic tools for severe weather forecasting;
- deep/severe convection (instability indices, etc.);
- model verification as part of the forecast process;
- interpretation of regional guidance products;
- interpretation of radar- and satellite-based products;
- guidance on the completion of the SWFDP evaluation form;
- use and applications of the project WebPortal;
- feedback mechanisms, contingency plans, and standard operating procedures (SOPs);
- coordination with user communities, including agriculture and fisheries;
- coordination with DMCPAs for delivery of warnings services;
- coordination with the media;
- user satisfaction and perception evaluation including use of surveys;
- public outreach and awareness raising;
- verification of warnings;
- how to prepare case-studies;
- using NWP products to improve agromet services;
- ocean and lake wave forecasting.

8.3 Other training opportunities

- ECMWF Training Course on the Use and Interpretation of ECMWF Products for WMO Members, Reading, United Kingdom, October 2013;
- Capacity Building in Regional Numerical Weather Prediction Based on HRM and COSMO Models Training Workshop, Langen, Germany, July 2013;
- US African Training Desk;
- Met Office UK training events;
- SAWS Virtual Lab (satellite);
- Attachments to global and regional centres (global and regional Training Desks) on forecasting and verification
- Attachments to other NMHSs on service delivery

9. Monitoring and Evaluation

A continuous evaluation procedure must be implemented to check that the cascading forecasting process works efficiently, to assess the usefulness of guidance products in improving severe weather forecasts and the effectiveness of NHMSs in fulfilling the requirements of DMCPAs and other users. A final evaluation of the regional subproject will be carried out by the RSMT to identify gaps and areas for improvement to ensure future sustainability of the demonstrated procedures and for other similar subprojects.

To achieve the ongoing evaluation, a form will be filled in by the NMHS and transmitted to the RSMC. A template of such an evaluation bulletin is given in the Annex E. The evaluation bulletin is formatted in a convenient form (Excel file) in order to simplify the processing and archiving of the data. The products which have been used in the production of severe weather forecasts must also be archived for use in future case studies.

In the final evaluation of the regional subproject, a qualitative assessment will be made of the success of the SWFDP related to the specific benefits of the Project and in particular the measurable improvements that have been noted in the warning services that are provided to the national DMCPAs.

10. Timetable of implementation and execution of the field phase of the Regional Subproject

When	What Task	Who RSMT Member
May 2013	Meeting of the Regional Subproject Management Team of the SWFDP – Eastern Africa (Arusha, 27-31 May 2013) to finalize and approve the Regional Subproject Implementation Plan (RSIP)	All
June 2013 – Aug 2013	Preparatory work (while continues the previous phase)	All
Nov 2013	Training Workshop (Burundi)	Regional centres and WMO Secretariat (DPFS, PWS and AgM)
January 2014	First progress report (September 2013 – December 2013)	Participating regional and national centres
May 2014	Second progress report (January 2014-April 2014)	Participating regional and national centres
September 2014	Third progress report (May 2014-August 2014)	Participating regional and national centres
January 2015	Fourth progress report (September 2014 – December 2014)	Participating regional and national centres
April-May 2015	Comprehensive report – 1.5 year after the start of the field phase of the project	RA I representative in the Project Steering Group
April-May 2015	Meeting of the RSMT	All

11. Costs

For the purpose of evaluating the total cost of the regional subproject, participating centres are required to estimate all additional costs associated with the SWFDP. This should include human costs (equivalent person-months) as well as expenditures of funds if any directly related to the project.

In the final evaluation of the regional subproject, a qualitative assessment will be made of the success of the SWFDP related to the specific benefits of the Project and in particular the measurable improvements that have been noted in the warning services that are provided to end users.

12. Communication and publicity of the project (Stakeholder engagement)

Informing stakeholders about the Project is an important ongoing task. There should be publicity about the initiation of the Project as well regular progress reports.

Stakeholders include:

- NMHSs in the region;
- NDMOs and disaster related NGOs;
- Agricultural and fishing communities in each country.
- Media;
- RA I Management Group;
- Relevant RA I Working Groups and Rapporteurs;
- WMO Executive Council;
- WMO Congress;

- CBS and other relevant WMO technical commissions (e.g. CAgM, JCOMM);
- Relevant regional organizations (e.g. EAC, IGAD);
- Aid agencies and development partners;
- World Bank;
- WMO Regional Office for Africa;
- Relevant departments within the WMO Secretariat.

Communication could be through newsletters, information pamphlets, presentations (e.g. at regional meetings), documents for sessions of WMO constituents bodies.

The Implementation Plan should be passed to stakeholders for information and feedback.

Responsibility for communicating the Project and publicity is a task for all participants, but with overall coordination by the Chairperson and vice-Chairperson.

13. List of the Annexes

- Annex A: Availability of Minimum Required NWP Products from Global Centres.

- Annex B: List of the stations where EPSgrams are required by the participating NMHSs.

- Annex C and Annex D: Example of the guidance on short-range and medium-range forecasts to be provided by RSMC Nairobi in the framework of the SWFDP (to be finalized).

- Annex E: Example of the evaluation form (in form of an Excel file).

Annex A

Availability of Minimum Required NWP Products from Global Centers

For the SWDFP – Eastern Africa

Note that tbd means: to be determined

Deterministic Forecasts: 6-hourly out to 72 hours, then 12-hourly up to 144 hours	Availability		
	ECMWF	UK Met	NCEP
Levels: sfc, 925mb, 850mb, 700mb, 500mb, 300mb, 200mb Parameters: wind (streamlines and speed/direction), temperature, geopotential height, humidity Purpose: General forecasting parameters to gain a perspective on the overall atmosphere. For determination of frontal system and pressure maxima locations.			
Level: 500mb, 300mb Parameter: vorticity Purpose: Determination of frontal and low pressure system locations. Crucial in locating potential severe weather outbreak locations. Can be used in determination of severe weather type.			
Level: 850mb, 700mb, 300mb Parameter: vertical velocity Purpose: Determination of mesoscale patterns of rising and sinking air masses (convective updrafts)			
Level: 850mb Parameter: 850mb wet bulb potential temperature Purpose: Frontal position diagnosis and change in airmass			
Level: sfc Parameters: instantaneous and accumulated precipitation, minimum temperature, maximum temperature, sea level pressure, relative humidity Purpose: General forecasting parameters.			
Level: partial atmospheric column			

Parameter: 1000-500mb thickness Purpose: Freezing level determination and air mass distinguishing			
Level: atmospheric column Parameter: precipitable water Purpose: Determination of total liquid water in the atmosphere and thus potential rainfall			
Level: atmospheric column Parameter: convective available potential energy (CAPE), Theta-E Purpose: Amount of energy available in the atmosphere for storm production			
Level: stability index Parameter: lifted index, K index, total index Purpose: Pre-calculated indices to generalize severe weather potential			
Level: stability index Parameter: convective inhibition (CIN) Purpose: Strength of force preventing convective initiation. The amount of energy (frontal forcing or daytime heating) that is needed to begin convection.			

Ensemble Forecasts:	**Availability**		
12-hourly out to 144 hours	**ECMWF**	**UK Met**	**NCEP**
Probability of 6-hour accumulated precipitation exceeding 20, 30, 50mm and 100mm threshold value			
Probability of 24-hour accumulated precipitation exceeding 20, 30, 50mm and 100mm threshold value			
Probability of 20 mm or more in next 5- day and 25 mm or more in 10-day accumulated precipitation			
Probability of less than 5 mm/day precipitation in the next 10-day or more			
Probability of Temperatures > 35 C, Temp < 10 C, < 5 C, and < 0 C during 5 day period,			
Probability of hailstorm			
Forecast 5- and 10-day soil moisture maps			

Probability of having less than 3 hours sunlight in 5 consecutive days			
Probability of 10-meter wind speed exceeding 20kts and 30kts threshold value			
Ensemble Prediction System meteograms for specified locations (ECMWF-10 per country; UK MOGREPS-2 per country; NCEP)			
Spaghetti diagrams for 500mb geopotential height			
Spaguetti diagrams for isolines corresponding to accumulated precipitation greater than 20, 30, 50mm/6h at 6 hours intervals			
Spaguetti diagrams for winds greater than 20 knots and 30 knots at 6 hours intervals			
Thumbnails of probability of precipitation in excess of threshold of 20, 30, 50mm/6h at 6 hours intervals			
ECMWF Extreme Forecast Index for precipitation, wind and other parameters			
Chances of dry and wet spell during rainy season (1 or 3 month ensembles) - Dry spell of 10 consecutive days or more - Wet spell of 5 consecutive days or more (>20 mm per day)			

Other Forecasts / Analyses:	**Availability**		
	ECMWF	**UK Met**	**NCEP**
5- and 10-Day running daily accumulated precipitation (total, anomaly, percent normal, mean) from the CPC Africa Rainfall Climatology (ARC)			
Previous 5- and 10- day soil (total, anomaly, percent normal, mean)			
10-day forecast with two maps: 1-10 day and 6-10 day			
Number of rainy days in 10-day period (>3mm)			

Extreme temperature Forecasts for 10 day period (4 maps or if possible on one map) - Chance of having Maximum Temp > 35 C during 5 day period - Chance of having Minimum Temp < 10 C during 5 day period - Chance of having Minimum Temp < 5 C during 5 day period - Chance of having Minimum Temp < 0 C during 5 day period			
Evapotranspiration ETo maps (cound be based on Penman-Montieth method based on FAO Publication) - Previous 5 and 10 day period - Forecast (10-day) - Anomalies (10 day)			
Moisture index (10 day forecast) - rainfall / ETo			
Previous 10-day soil moisture ((EUMETSAT?)			
Forecast Soil moisture maps (10 day)			

Other REQUESTED Products:	**Availability**		
	ECMWF	**UK Met**	**NCEP**
SKEW-T logarithmic forecast plots for selected grid points based on NWP output (out to 144 hours, 12-hourly)			
Ocean waves exceeding given thresholds (2m; 4m; 6m; and 8m) for the western Indian Ocean			
Wave EPSgrams for coastal areas of Kenya and Tanzania			
Significant wave height in Lake Victoria			

Products and Services to be provided by the Met Office, UK

The Met Office uses the Unified Model (UM). This is a collaborative partnership with Australia BoM, MetNo (Norway), KMA (Korea), SAWS, NIWA (New Zealand), NCMWRF (India).

Deterministic NWP:

Three operational models support the SWFDP-EA:

- Global UM - currently 25 Km resolution to T+144 hours, 4 runs per day. This is likely to change to 16 – 20 Km resolution in 2014.

- North Africa LAM 12 Km to T+48 hours, four runs per day. This is obsolescent and will cease in October 2013. Products currently derived from this model will be replaced with equivalent Global UM products.

- Lake Victoria 4 Km, two runs per day. The area will be expanded from October 2013, though dissemination of the expanded area will be delayed while initial verification is undertaken.

Distribution of the following products is done through EuMetCast to the PUMA2010 workstations in NMHSs in Africa:
Global UM fields at a resolution of 0.36 degrees over an Africa cutout. Confusingly, this is labelled as UKMO-3.0 on the PUMA2010 workstations, and internally the GRIB is labelled as Africa LAM
Hemispheric Global UM fields at 1.25 degrees resolution

Products from the North Africa LAM and Lake Victoria 4Km are distributed as web graphics, using the full model resolution.
Current Website: http://www.metoffice.gov.uk/weather/africa/lam/
Future website: http://africalam.metoffice.gov.uk/ (May 2013 - not yet finished). Note that when the former is withdrawn, the address will divert to the replacement site. When the North Africa 12Km is withdrawn, the products will be generated from the Global UM at full resolution.

Ensemble NWP Products:

MOGREPS Medium-Range Ensemble at 60Km resolution to 15 days, run twice daily

The following products are sent by ftp to RSMC Nairobi and put on the Regional Guidance website at http://www.meteo.go.ke/rsmc/ukeps/

EPSGrams for 64 sites currently (others may be added if required).
Probability Maps at 6-hourly intervals to T+84 then 12-hourly to T+144 of:

6-hour Precipitation >100mm
6-hour precipitation > 50mm
6-Hour precipitation > 25mm
12-hour Precipitation >100mm
12-hour precipitation > 50mm
12-Hour precipitation > 25mm
24-hour precipitation >100mm
24-hour precipitation > 50mm
10m Windspeed > 20 kts
10m windspeed > 30 kts

Spaghetti plots for 500HPa Geopotential Height at 6-hourly intervals to T+84 then 12-hourly to T+144

Lightning Observations:

The Met Office ATDNet lightning detection system uses long range VLF detection, with a detection preference for cloud-to-ground strokes. In the East Africa area, location accuracy is currently about 17Km. Strike locations are collected every minute. Currently a plot of 6 hours worth of lightning data superimposed on a satellite IR image over Africa (updated hourly) is put on the website http://www.metoffice.gov.uk/weather/africa/lam/ . A similar plot with 60 minutes of lightning data updated every 15 minutes is now under test on the website http://africalam.metoffice.gov.uk/. BUFR bulletins are sent every 15 minutes to EuMetSat for EumetCast (though the PUMA2010 display systems cannot show these at present).

Global Guidance Unit:

The aim of the GGU is to extend current UK and global severe weather impacts best practice to provide guidance to SWFDP participants, through the cascading structure of the SWFDP.

The Met Office Global Guidance Unit is a forecasting section in the Met Office Hazard Centre, Exeter. The GGU is staffed by experienced forecasters with access to the full suite of model products available on the Met Office systems, including UM, ECMWF, NCEP, (and could potentially use the relocatable 1.5Km model too).

There is a daily video conference with the Regional Guidance Centres in Nairobi and Dar. During this, all participants can share graphics. In addition, a Huddle site has been set up to share further information. The Huddle site also collects case studies, and evaluation studies are carried out, with feedback both for use and improvement of the models and products.

The GGU is set up to host visiting forecasters, to give them experience in the products and tools available, to build relationships for effective

co-operative working in the guidance conferences with the Regional Centres, and includes a training component in hazard forecasting.

Annex B

List of the stations where Global Centres will provide EPSgrams in the framework of SWFDP

I – Kenya

I.1 – List of stations for EPSgrams from ECMWF

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	63686	Eldoret	0°31'N	35°17'	646
2	63710	Kericho	0°22'	35°16'	1976
3	63708	Kisumu	0°06'N	34°35'	1149
4	63695	Meru	0°05'N	37°39'	1524
5	63820	Monbasa	4°02'	39°37'	6
6	63619	Moyale	3°32'N	39°03'	113
7	63741	Nairobi	1°18'	36°45'	1798
8	63714	Nakuru	0°16'	36°04'	1901
9	63793	Voi	3°24'	38°34'	1560
10	63671	Wajir	1°45'N	40°04'	244

I.2 – List of stations for EPSgrams from Met-Office UK

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	63741	Nairobi	1°18'	36°45'	1798
2	63708	Kisumu	0°06'N	34°35'	1149

II – Ethiopia

II.1 – List of stations for EPSgrams from ECMWF

N°	WMO id.	Station Name	Latitude (North)	Longitude (East)	Altitude (Metres)
1	63330	Mekele	13.50°	39.48°	2500
2	63332	Bahir Dar	11.60°	37.40°	1770
3	63333	Combolcha	11.07°	39.44°	1804
4	63402	Jimma	7.67°	36.83°	1725
5	63450	Addis Ababa	9.03°	38.75°	2354
6	63453	Methehara	8.52°	39.54°	930
7	63500	Arba Minch	6.08°	37.63°	630
8	63533	Negelle	5.33°	39.57°	1544
9	63478	Gode	5.90°	43.58°	295
10	63471	Dire Dawa	9.60°	41.85°	1260

II.2 – List of stations for EPSgrams from Met-Office UK

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	63332	Bahir Dar	11.60°	37.40°	1770
2	63450	Addis Ababa	9.03°	38.75°	2354

III – Burundi

III.1 – List of stations for EPSgrams from ECMWF

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	64390	Bjumbura	3,23°	29,25°	781
2	X	Gisozi	3,34°	29,41°	2097
3	X	Gitega	3,51°	29,91°	1645
4	X	Kirundo	2,67°	30,09°	1449
5	X	Mparambo	2,95°	28,97°	887
6	X	Musasa	4,07°	30,09°	1260
7	64397	Muyinga	2,95°	30,38°	1755
8	X	Ngozi	2,95°	29,81°	1860
9	X	Nyanza-Lac	4,36°	29,60°	792
10	X	Bururi	4,07°	29,53°	1886

III.2 – List of stations for EPSgrams from Met-Office UK

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	64390	Bjumbura	3,23°	29,25°	781
2	64397	Muyinga	2,95°	30,38°	1755

IV – Tanzania

IV.1 – List of stations for EPSgrams from ECMWF

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	63756	Mwanza	2°67’	32°91’	1180
2	63789	Arusha	3°23’	36°56’	1657
3	63801	Kigoma	4°53’	29°40’	1005
4	63894	Dar es Salaam	6°89’	39°09’	117
5	63862	Dodoma	6°10’	35°46’	1120
6	63832	Tabora	5°05’	32°50’	1182
7	63870	Zanzibar	6°13’	39°13’	18
8	63932	Mbeya	8°56’	33°28’	1758
9	63962	Mahenge	8°85’	36°84’	1200
10	63971	Mtwara	10°21’	40°11’	113

IV.2 – List of stations for EPSgrams from Met-Office UK

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	63894	Dar es Salaam	6°89’	39°09’	117
2	63756	Mwanza	2°67’	32°91’	1180

V – Rwanda

V.1 – List of stations for EPSgrams from ECMWF

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	64387	Kagali	1°58’	30°08’	1490
2	X	Kawangire	1°49’	30°27’	1473
3	X	Kibungo-Kazo	2°10’	30°30’	1604
4	X	Nyagatare	1°18’	30°20’	1377
5	X	Byumba	1°36’	30°03’	2235
6	64383	Ruhengeri Airport	1°30’	29°38’	1878
7	64380	Kamembe Airport	2°28’	28°55’	1591
8	64381	Gisenyi Airport	1°40’	29°15’	1554
9	X	Gikongoro	2°29’	29°34’	1910
10	64384	Butare Airport	2°36’	29°44’	1760

V.2 – List of stations for EPSgrams from Met-Office UK

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
11	64387	Kagali	1°58’	30°08’	1490
2	64384	Butare Airport	2°36’	29°44’	1760

VI – Uganda

VI.1 – List of stations for EPSgrams from ECMWF

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	63702	Mbarara	0°36’	30°41’	4734
2	63658	Soroti	1°43’N	33°37’	3697
3	63684	Toroto	0°41’N	34°10’	3840
4	63602	Arua	3°03’N	30°55’	3951
5	63705	Entebbe Airport	2°43’N	32°27’	3761
6	63630	Gulu	2°47’N	32°17’	3624
7	63726	Kabale	1°15’	29°59’	6138
8	63680	Kampala (Makerere)	0°19’N	32°34’	4000
9	63674	Kasese	0°10’N	30°06’	3146
10	63654	Masindi	1°41’N	31°43’	3760

VI.2 – List of stations for EPSgrams from Met-Office UK

N°	WMO id.	Station Name	Latitude (South)	Longitude (East)	Altitude (Metres)
1	63702	Mbarara	0°36’	30°41’	4734
2	63658	Soroti	1°43’N	33°37’	3697

VII – South Sudan

VII.1 – List of stations for EPSgrams from ECMWF

NO:	Stations	lat	long	codes
1	Juba	31.60	04.87	HSSJ
2	Malakal	31.65	09.55	HSSM
3	Wau	28.02	07.70	HSWW
4	Raja	25.68	8.47	HSRJ
5	Renk	32.78	11.75	HSRN
6	Rumbek	29.68	06.8	HSMK
7	Yambio	28.42	04.57	HSYA
8	Bor	31.57	6.23	HSBR
9	Aweil	27.4	8.76	HSAW
10	Bentiu	29.47	9.11	HSTH

VII.2 – List of stations for EPSgrams from Met-Office UK

Annex C

GUIDANCE TO BE ISSUED BY THE RSMC NAIROBI TOWARD THE NMHSs FOR SHORT RANGE SEVERE WEATHER FORECASTING UP TO 48 H

The SW Short guidance comprises three parts:

- Part A: Text; depiction of the expected evolution of the weather up to 48 h and comments about the more representative short range products that are used with reference to figures included in the part B or to charts clearly identified (model, parameter, level, forecast range).

- Part B: Figures; charts or graphics coming essentially from deterministic models (global or LAM).

- Part C: The assessment of the degree of confidence of the forecast by the forecaster.

- Part D: Two tables (for 24 h and 48 h, respectively), summarizing the risk of severe weather as assessed by the RSMC Nairobi as proposed below. In order to provide more information about the geographical location of the severe event the following convention is adopted when filling in the cells : X for the whole country, N for the northern part, S for the southern part, W for the western part and E for the eastern part.

Country	No risk	Low risk	Medium risk	High risk
Kenya	Heavy precip.			
	Strong Winds		N	
Ethiopia	Heavy precip.			
	Strong Winds	X		
Etc…				

This table is only an example and has to be definitively defined by the RSMC Nairobi. The separation of the evaluation of the risk into four categories (no risk, low risk, medium risk and high risk) is only given as an example.

- Part E: Two geographical maps (for 24 h and 48 h, respectively) including the boundaries of the countries with contours identifying the areas which are likely to be hit by the severe weather event.

Annex D

GUIDANCE TO BE ISSUED BY THE RSMC NAIROBI TOWARD THE NMHSs FOR MEDIUM RANGE SEVERE WEATHER OUTLOOK FOR DAYS D+3, D+4 and D+5

- Part A :Text; depiction of the expected evolution of the weather for days 3, day 4 and day 5 and comments about the more representative medium range products that are used with reference to figures included in the part B or to graphics clearly identified (EPS charts or meteograms).
-
- Part B: Figures; charts or graphics coming essentially Ensemble Prediction Systems (EPS).

- Part C: The assessment of the degree of confidence of the forecast by the forecaster.

- Part D: Three tables (for day 3, day 4 and day 5, respectively), summarizing the probabilities of precipitation and wind higher than a given threshold as proposed below. In order to provide more detailed information about the geographical location of probabilities the following convention is adopted when filling in the cells : X for the whole country, N for the northern part, S for the southern part, W for the western part and E for the eastern part.

Country	Probability	< XX%	> XX% and < YY%	> YY80%
Kenya	Prec.> 50mm/6h	N		
	Winds > 30 kt		N	
Ethiopia	Prec.> 50mm/6h	X		
	Winds > 30 kt			X
Etc…				

This table is only an example and has to be definitively defined by the RSMC Nairobi (number of columns, lower and upper limits).

- Part E: Three geographical maps (for day 3, day 4 and day 5, respectively) including the boundaries of the countries with contours identifying the probabilities areas for the occurrence of the weather event.

Annex E

Evaluation Form

	A	B	C	D	E	F	G	H	I	J	K	L	M
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													
3	Please fill out this table for each event, either forecast or observed or both, for each region of the country where an event occurred and/or an event was forecast. For "false alarms" only columns F to J and M need to be filled. For missed events, only columns A to H and L need to be filled in; but please also evaluate the guidance in those cases.						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)		
4								Severe weather chart: Prob Table		ECMWF: NCEP: UKMO global: UKMO regional:			
5	1	rain> 50 mm	NW	01/11/10 12 UTC	01/11/10 17UTC		1	1	01/11/10 11UTC	01/11/10 24 UTC	1 h		
6	Example (This large box can be used for any comments on the event, explanations of problems etc.)					(all observations whether extreme or not, 24h totals)	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)	minor flooding	Warning received just in time for start of flooding
7								Severe weather chart: ✔ Prob Table ✔	4 (comment) 3 (comment)	ECMWF: ✔ NCEP: UKMO global: UKMO regional: ✔	ECMWF: 3 NCEP: UKMO global: UKMO regional: 2		
8													
9							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)		
10								Severe weather chart: Prob Table		ECMWF: NCEP: UKMO global: UKMO regional:	ECMWF: NCEP: UKMO global: UKMO regional:		
11													
12							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)		
13								Severe weather chart: Prob Table		ECMWF: NCEP: UKMO global: UKMO regional:	ECMWF: NCEP: UKMO global: UKMO regional:		