KENYA

1.0 Summary of highlights

One of the main activities undertaken at the Kenya Meteorological Department (KMD), Nairobi, is the enhancement of the forecasting capability through capacity building and infrastructural development. The forecasting division is therefore charged with the responsibility of improving the skill of the short and medium range weather forecasts as well as the long-range forecasts. For the short – medium range forecasts, the HRM model is now installed and running quasi-operationally using the appropriate FORTRAN90/95 compilers. The model is optimized to run on Multiple-Processor shared-memory platforms.

2.0 Equipment in use at the centre

At the Kenya Meteorological Department, there are a number of PCs that are networked for purposes of Data Processing

3.0 Data and Products from GTS in use

The data and products from the GTS that are in use at the KMD include SYNOP, TEMP. METARS, Fascimile charts, Forecast products from other centers, Global input data for input into a limited NWP High Resolution model, SATEM, SIGMET, AIREP, CLIMAT TEMP, PILOT, and AMDAR

4.0 Data Input System

The Data input system is semi-automated

5.0 Quality Control System

There is an in-built Quality Control System within the Data Processing System. The centre disseminates controlled information to the GTS. The observations are subjected the observatories (observers) before suspect values are accepted or altered.

6.0 Monitoring of the observing system

Surface observations are monitored on both the national and regional levels.

7.0 Forecasting System

7.1 System run schedule

The prognosis for the short range forecast model at KMD uses the 300-hPa chart to develop the surface systems twice in a day (0600 & 1200 GMT) to provide the 24-hr forecast. This is supplemented by outputs from the NWP HR model being run at the centre.

7.2. Medium range forecasting system (4-10days) – Semi-operational

Maximum lead-time is three days for the following parameters:

- Rainfall
- Temperature
- Winds
- Relative humidity
- Cloud cover
- Radiation

7.2.1: Data assimilation, objective analysis and initialization

The data assimilation is carried out at the DWD, which sends the 3-hour Initial and Lateral Boundary data sets from the German Global Modell (GME) to KMD, Nairobi, via the GTS link. This is done twice daily for the corresponding data of 00UTC and 12UTC. The areal coverage is the whole of East Africa and the resolution of the model is 40Km horizontally with 40 vertical layers.

7.2.2. The Model

Description of the model is given in the various sections outlined below

7.2.2.1 Numerical Techniques

The model has been implemented on a 2 processor PC under Redhat Linux version 7.3 operating system. The visualization software used to display the model output includes Grid Analysis and Display System (GraDS and Vis5D). The analyzed variables include Surface pressure (Ps) ; Temperature (T0); Water vapour (qv0) ; Cloud water(qc) .;Cloud ice (qi) -optional ; Horizontal wind (u, v); Several surface/soil parameters; Vertical velocity (□□Geopotential height (□□Cloud cover (clc) ; Diffusion coefficients(tkvm/h)

7.2.2.2 Model Numerics

□Regular or rotated latitude/longitude grid;
□Mesh sizes between 0.25° and 0.05° (~ 28 to 6 km);
□Arakawa C –grid stagger, second order centered differencing;
□Hybrid vertical coordinate, 20 to 40 layers ;
□Split semi-implicit time stepping; □t = 150s at □= 0.25°;
□Helmholtz equation solved by direct method Fast Fourier Transformation (FFT) and Gauss solver;
□Lateral boundary formulation ;
□Radiative upper boundary condition as an option ;
□Linear fourth-order horizontal diffusion, slope correction for temperature;
□Adiabatic implicit nonlinear normal mode initialization.

7.2.2.3 Model Physical Parameterizations

□□-two stream *radiation* scheme including long- and shortwave fluxes in the atmosphere and at the surface; full cloud - radiation feedback; diagnostic derivation of partial cloud cover (relative humidity and convection);
□Grid-scale *precipitation* scheme including parameterized cloud microphysics;
□Mass flux *convection* scheme differentiating between deep, shallow and mid -level convection;
□Level-2 scheme of *vertical diffusion* in the atmosphere, similarity theory at the surface.
□Two-layer *soil model* including snow and interception storage; three-layer version for soil moisture as an option

to their consistency in time, space and internally. In some cases clarification is sort from the observatories (observers) before suspect values are accepted or altered.

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7.2.3: Numerical Weather Prediction Products

Variables that outputs from the model integration include:

Rainfall, Temperature, Winds, Relative humidity, Cloud cover and Radiation. These have a lead time of three (3) days

7.2.4: Operational technical for application NWP Products

There none in place currently but ongoing research involves the development of a Model Output Statistics (MOS) by use of the conventional Multiple Linear Regression method as an initial step towards an operational forecasting system.

8.0: Verification of products

Verification of the model products against the actual observations is ongoing and model performance is being examined by the use of correlation analysis. As the model started running recently, sufficient data to train the MOS has not yet been produced. However, preliminary model outputs have already demonstrated good prediction potential on specific point-to- point (location) basis. The verification of the model outputs has been initiated on a location-to-location basis to determine how well the model simulates the station observations before the model is adopted for operational purposes.

9.0: Plans for the future

Following are the envisaged plans the coming year if financial and computing activities will be available:

- acquition an eight node Linux Cluster and two IBM RISC System 6000, in order to meet the NWP needs for Kenya
- Data assimilation of Nairobi and Dar-es-Salaam station Radio-Sonde atmospheric sounding data;
- The establishment of a comprehensive verification system, consisting of calculations of forecasted Root Mean Square Errors (RMSE) and bias between the forecasts and analyzed fields for the standard pressure levels;
- Integration of remotely sensed data from weather radar and Meteosat Second Generation (MSG) satellites;

Assessment of the potential offered by Ensemble Prediction Systems (EPSs) in medium-range and seasonal weather forecasting;

Continuously evaluate the performance of the regional model by validating the outputs against observed data.