Concept Paper: Enhancing Weather and Climate Prediction Project

1. Title: Enhancing Weather and Climate Prediction of Ethiopia Using Numerical Weather Prediction Technique.

2. Introduction

Eradication of poverty and the achievement of sustainable socio-economic development are the major challenges facing Ethiopia today. The nation's economy is based on weather-sensitive sectors such as agriculture, energy, water resources, health, construction, tourism etc. Approximately 80% of the population is working in agriculture, and almost 90% of the electricity is produced by hydro-power. The country is also adversely affected by climate related natural disasters such as drought and flood. Weather and climate information is, therefore, critical for achieving national goals for achieving the Millennium Development Goals (MDGs). However, the National Meteorological Agency (NMA) is not in the position to meet the ever increasing demands from various stakeholders and other end users in the country (including local communities, public institutions, policy and decision makers) for accurate and timely seasonal and short-term weather forecasts, and other early warning advisories on the occurrence of extreme weather and climate events.

The outputs of large-scale NWP models are utilized in operational weather services. The spatial resolution of these products is, however, not adequate for accurate local and regional weather and climate services in Ethiopia, where the complex topography spawns large small scale variations in temperature, wind and precipitation. The gap can be filled by mesoscale models. Operational mesoscale model forecasts can be used in weather forecasts for the public and aviation as well as in early warning services such as flash flood. In research experiments applying a mesoscale model, also observations from the climate data base can be utilized for initial conditions and validation, and the results can be applied in research related to climate, agrometeorology, and air quality, as well as for further improvement of operational services.

3. Background

National Meteorological Agency of Ethiopia has 2 upper air and more than 1000 ground observation stations that spans from synoptic to only rainfall measuring stations. Among these 17 stations are synoptic and reporting every 3 hours to the central system. About 100 stations are first class and reporting to the central station every day. The system of communication via Single Side Band (SSB) from station to 9 branch offices which are using DRS radio communication system. This enables us to get real time data for data analysis and forecasting. The remaining stations are third and fourth class stations that mainly measure minimum and maximum temperature, and precipitation as well. The means of communication for data exchange is postal mail.

The real time data obtained from 120 stations are used for analysis. The summery of this analysis together with the forecast distributed to different governmental and non-governmental organizations in agriculture, water sector and health as well as to the decision maker every 10 days, month and season. Moreover, the Agency disseminates 24-72 hours short range weather forecast through mass media such as radio, television and so on.

Since the major source of electricity in the country is hydro-electric power. This is also affected by high climate variability of the country, hence, the Agency is a member of inter-institutional committee to manage hydro-electric power generating dams. In addition, parts of Ethiopia is vulnerable to drought occurrence. Thus, the Agency is also a member of national disaster and early warning group, which is responsible for preparing timely information to the government on disaster associated with extreme weather events. Recently, the Agency is involved in crop yield forecast project funded by European Commission through FAO where the major participants are Ministry of Agriculture, Central Statistics Authority and NMA.

The Agency is using clidata software as its data base system to manage the digitized data (computerized data) of maximum and minimum temperature and rainfall. However, other meteorological parameters such as sunshine, radiation, wind speed and direction, etc are expected to be digitized in 2009 through FAO project.

The data base system of 11 branch offices has been simple excel worksheet format up to now. Progress is underway to have an improved data base system so that the collected data can be available at the center.

The Agency communication system is based on GTS (Global Telecommunication System) to obtain and disseminate data regionally and globally. Besides, the Agency has two MSGs (Meteosat Second Generation) satellite data receiving stations, one is mainly dedicated for operational, the other one is for research. It sounds a good potential for data assimilation of the model especially for model verification and to prepare initial and boundary conditions for the model using the observed data. The broadband internet connection with speed of 128Kb/s is available at the head quarter for various purpose. However, the speed of the internet connection is not enough to download the inputs (the initial and boundary conditions) for mesoscale and regional climate models from global models.

Currently, National Meteorological Agency is running mesoscale models (MM5, Eta and WRF) at national level with limited resource. We found that the products of these models are very useful for operational forecasting and also the models can further help to study the local weather phenomena by going down to the regional level. In order to improve our services down to the grass root level, we have a plan to establish numerical weather prediction center at each regional office. However, establishing numerical weather prediction center is resource demanding especially in capacity building. Due to the budget constraint, the government is unable to fulfill the above requirements. To achieve our goal, we are seeking fund to alleviate the problem that we faced.

Moreover, the Agency has also got modest material supply and training from NBI (Nile Basin Initiative) so as to start running of NWP. The objective of the support is to predict heavy rainfall amount which causes flood in the eastern Nile Basin member countries. However, it is not operational due to the limited computing capacity and slow internet connection.

4. Objectives

4.1 To forecast weather and climate parameters quantitatively and at specific location and time
4.2 To study the local weather and climate using numerical weather prediction
4.3 To have high resolution of wind mapping so that it can be studied the wind

potential for wind energy

4.4 To prepare initial and boundary conditions by using data assimilation

5. Output:- The major output of the project include numerical weather prediction output, which would be disseminated to the agricultural, water, health and transport sectors in the country.

6. Budget:- The expense needed for the project will be mainly for the procurement of 11 super mini-supercomputer, software and on job training.

7. Work plan:-

   first quarter:- purchase and procurement of equipments

   second quarter:- installation the hardware and software, mesoscale models, etc.

   Third quarter:- Training of how to use super computing facilities, training in mesoscale modeling and Linux operating system.

8. Duration of the project:- If the necessary resources such as financial, human and others have been made available, the project is going to be completed from 3-5 years.