A Project Proposal for 2020 HPS Summer School at University of Reading

Much of Africa has limited advanced experimental research facilities in many areas of fundamental and applied sciences. Scientific understanding of the East African climate and the level of technical expertise needed to support climate modeling, for instance, remains generally low. The Greater horn of Africa climate is characterized by high seasonal and interannual variability. This is mainly explained by the complex interaction between the local factors, regional circulation patterns and remote forcings/teleconnections. Climate models are a crucial tool for weather forecasting and climate prediction. Global Circulation Models (GCMs) have the potential to give physically reliable estimates of climate change at global, continental or regional scales, but their simulations are currently of too coarse horizontal resolution to capture the smaller scale features of climate and climate change, especially in East Africa. Dynamic regional climate models (RCMs) applied at high resolution (at convective permitting scales) have become promising tools to project regional climate change. To realistically simulate cumulus convection at different spatial scales over regions with varied topography, resolutions of the model should be high enough to capture and simulate the key synoptic-scale features.

A tentative summer school academic group project which proposes two research activities based on model limitations over East Africa can be explored. First, identify a convective-scale Numerical Weather Prediction (NWP) model or an RCM, to be run at high resolution, say 1.5km over Eastern African region. The second activity addresses the opportunity of using the simulations for extreme event attribution. Event attribution involves the understanding of the role and contribution of anthropogenic climate change in extreme weather/climate events. To achieve this, large ensemble runs specifically designed to inform assessments of variability, long-term trends, and the anthropogenic role in extreme weather over terrestrial areas are considered. In most cases, atmosphere-only models run at relatively high resolution with prescribed Sea Surface Temperatures (SSTs) and Sea-Ice extent are used. A case in point is the large ensemble of simulations (thousands) generated by ClimatePrection.net distributed computing platform and the Climate of 20th Century Plus Detection and attribution (C20C+ D&A) project for attribution studies. Due to big (volume and variety) data and computationally-intensive techniques involved, HPC provides an excellent environment to achieve this through provision of parallel processing, memory and storage.

Kenya Meteorological Department (KMD), like most weather agencies, is faced with the challenging task of providing accurate and timely forecasts, and seasonal climate predictions. For operational purposes, KMD runs the Weather Research and Forecasting (WRF) Model, the Consortium for Small-scale Modeling (COSMO) and Providing Regional Climates for Impacts Studies (PRECIS) models. The capability of these models to simulate cumulus convection can be tested by running them at different spatial scales over East African regions with steep topography and around large inland water bodies e.g. Lake Victoria. Knowledge and insights gained from this project will create a multiplier effect through my work as a Meteorologist/Climate scientist at KMD, my research of the East African Climate, collaboration with other researchers and in mentoring of young scientists.

Key words: High resolution climate modeling, convective permitting, cloud resolving, extreme scale computation, Extreme event Attribution.