IMPACT ASSESSMENT OF GLOBAL CLIMATE CHANGE ON SOME COMPONENTS OF HYDROMETEOROLOGY IN ETHIOPIA: APPLYING ATMOSPHERIC GENERAL CIRCULATION MODEL (MRI-AGCM)

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Abstract

The effects of climate change such as rising temperature and changes in precipitation are undeniably clear with impacts already affecting environment, water resources, ecosystem, biodiversity and people and related others. Unless mitigated, climate change in future inevitably will have wide-ranging of effects on the environment, including water resources, agriculture, terrestrial ecosystems, and others. As a result of global warming, the type, frequency and intensity of extreme events, such as floods, droughts and heavy precipitation events, are expected to rise even with relatively small average temperature increases (IPCC, (2007). Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding.

Vulnerability to the global climate changes varies from region to region. Africa is considered as one on the most vulnerable continent to the climate changes. As apart of Africa Ethiopia is one of the most vulnerable countries with clear indications of intensified recurrent droughts since recent years affecting lives of millions of people. As Ethiopia is almost entirely dependent on rain fed agriculture, the future climate change with increasing droughts and desertification makes the country more vulnerable.

Studies of historical climate change are limited not only over Ethiopia but for continental scale Africa. Only a few comprehensive assessments of broad continental-scale change have been published. Coupled with a paucity of long period recorded data over many parts of the country, the view of historical change in Ethiopia has many gaps remaining. Most of future climate change prediction models and publications are also in continental-scale, which could obscure local climate changes and may not be viable for country scale studies.

This study investigates the past and future climate change impact in Ethiopia employing observed meteorological station data, and result of Atmospheric General Circulation Model (MRI-AGCM). The MRI-AGCM is one of the highest resolution (60km x 60km) models in the world, developed on the bases of A1B emission scenario at Japan Meteorology Agency. The observed climate change analysis is carried out for the past half century (1955-2004), while future prediction by MRI-AGCM is for

middle 21st century.

As climate change is any long-term significant change in the "average weather" that a given region experiences, it can be expressed in terms of changes to average temperature, precipitations, wind patterns and others. Even though there are limited long period observed data in Ethiopia the trend of mean of temperatures in Ethiopia has been analyzed and compared with global trend. Different period's mean temperatures were compared to observe quantitative changes. Incase of rainfall observed data from different climatic regions has been analyzed. Annual, seasonal and monthly changes during different period have been compared. Significant change of rainfall has been observed for the time series considered. The stations observed indicates considerable changes to rainfall which could represent most part of the country.

Since knowledge of future climate change and processes controlling rainfall is essential to development, Atmospheric General Circulation Models (AGCMs) provide tremendous valuable information. The projections of precipitation and river runoff associated with climate change are important sources of information for utilization of water resources and prevention of floods and drought (Seckler et al. 1999; Vörösmarty et al. 2000; Milly et al. 2002; Oki et al. 2003). Future climate change predictions will have substantial importance to be considered in development plans in water resources, agriculture and similar other sector in Ethiopia to overcome the impacts of intensifying recurrent droughts.

The future climate change impact in Ethiopia has been analyzed applying the result of projection of MRI-AGCM. The model target periods are present end of 20th century and future middle of 21st century. Future change relative to the present has been examined for components of hydrometeorology (temperature, rainfall, evaporation, transpiration, intercept, soil moisture, and river discharge). To verify model uncertainty observed meteorological station data has been compare with simulated data and the bias has been examined. The result of MRI-AGCM projection revealed that there will be significant future climate change impact in the middle of 21st century; particularly the changes to rainfall in the main rainy seasons (June, July and August (JJA) and March, April, May (MAM)) will have a considerable effect on rain fed agriculture in future in Ethiopia.