

Climate Change Causes and Hydrologic Predictive Capabilities

V. V. Srinivas

Department of Civil Engineering, Indian Institute of Science, Bangalore 560 012, India; PH +91-80-2293-2641; email: vvs@civil.iisc.ernet.in

Abstract

In the past few decades there is growth in evidence that the climate of Earth is changing at both global and regional scales, and over various temporal scales. Investigations of climatologists suggest that Earth's past climate has been dynamic and both natural and anthropogenic factors are responsible for the past episodes of climate change. Ever since industrial revolution, anthropogenic factors are primarily believed to be responsible for increase in concentrations of atmospheric greenhouse gases such as carbon dioxide, methane and nitrous oxide. These gases together with atmospheric aerosols are believed to alter the radiation balance of the Earth's atmospheric system by absorbing solar radiation reflected by the earth's surface back into the atmosphere. This has triggered substantial rise in the global temperature in the recent decades, and the consequences are evident in various forms. For example, the melting of the Greenland and west Antarctic ice sheet, sea level rise and ocean acidification that has implications on marine life and coastal regions, changes in the thermohaline circulation in the north Atlantic that affects global ocean heat transport, dieback of the Amazon rainforest leading to changes in circulation patterns and carbon cycle feedbacks, intensification of desertification, crop failures, displacement of major vegetation regimes, changes to duration of seasons, amount and pattern of precipitation, and frequency and severity of hydrologic extremes such as floods and droughts. The current major global concern is to assess implications of climate change on water as well as other vulnerable resources of Earth. Numerical models referred to as General Circulation Models (GCMs) are regarded as a reliable tool available to simulate future climatic conditions on earth corresponding to various emission scenarios identified by Intergovernmental Panel on Climate Change (IPCC). The GCMs simulate general circulation variables that can form the basis to arrive at projections of water resources. But GCMs operate at spatial scales that are much coarser when compared to watershed scale at which hydrological processes are modeled to assess water resources. Therefore, the output of a GCM is downscaled to obtain the information relevant to hydrologic studies.

The talk would provide a brief overview of various factors responsible for climate change and state-of-the-art downscaling methodologies available to predict climate change impacts on hydro-meteorological variables (e.g., rainfall, temperature, humidity, wind speed, solar radiation), evapotranspiration, river flows and groundwater. Strengths and weaknesses of the downscaling methodologies, and various forms of uncertainty which needs to be addressed in the task of arriving at reliable predictions of climate change impacts on water resources and the associated challenges would be discussed. Typical results obtained from application of some of

the methodologies to regions within India and elsewhere would be presented. Further, gaps where more research needs to be focused would be highlighted.