EFFECT OF GLOBAL WARMING ON THE STREAMFLOW OF A HIGH ALTITUDE SPITI RIVER

PRATAP SINGH
National Institute of Hydrology, Roorkee (U.P.) 247 667, India

Global warming is likely to change temperature and precipitation, which may affect the quantity and quality of freshwater resources. One of the most important impacts of future climatic changes is expected to be on the regional water availability, particularly the timing of magnitude and surface runoff and soil moisture fluctuations. Existing global models suggest that climatic changes will have dramatic impacts on water resources, leading to major alterations in regional water systems. The vulnerability of the Indian subcontinent to the impact of changing climate is vital because the major impact of climate change in this continent would be on the hydrology, water resources, and agricultural economy. The main river systems of the Indian subcontinent, namely the Brahamaputra, Ganges, and Indus, which originate in the Himalayas, are expected to be more vulnerable to climate change because of the substantial contribution of snow and glacier melt runoff to these river systems.

In the present study, the possible changes in snowmelt runoff, glaciermelt runoff, and annual streamflow due to expected changes in temperature and precipitation have been studied for the Spiti River. It is a high altitude Himalayan river located in the western Himalayan region. The Spiti basin covers an elevation range from about 2,900 to 7,000m and its area is about 10,000km^2. This basin experiences very heavy snowfall during winter. Hypothetical scenarios of temperature and precipitation, based on the simulation of climate change over the Indian subcontinent by Hamburg, coupled with the Atmosphere-ocean Climate Model were adopted and used in the present study. The Hamburg Climate Model has demonstrated a good simulation for both climatology and hydrology over the Indian subcontinent. The UBC Watershed Model is used to simulate the hydrological response of the basin to changed climatic scenarios.

The study reveals that snowmelt runoff, glaciermelt runoff, and total streamflow vary linearly with increase in temperature. The most prominent effect of increase in temperature has been noticed on glaciermelt runoff. Results related to the influence of precipitation show that snowmelt runoff and total streamflow vary linearly with changes in precipitation, while glaciermelt runoff is inversely related to changes in precipitation. It was also found that snowmelt runoff is more sensitive than glaciermelt runoff to changes in precipitation. In general, the period of snow accumulation, snowmelt, and glaciermelt runoff, and timings of peak runoff are not influenced by changes either in temperature or precipitation for the scenario studied. The effect of various temperature and precipitation scenarios on total streamflow for a period of three years (1987/88, 1988/89 and 1989/90) is given in Fig. 1.

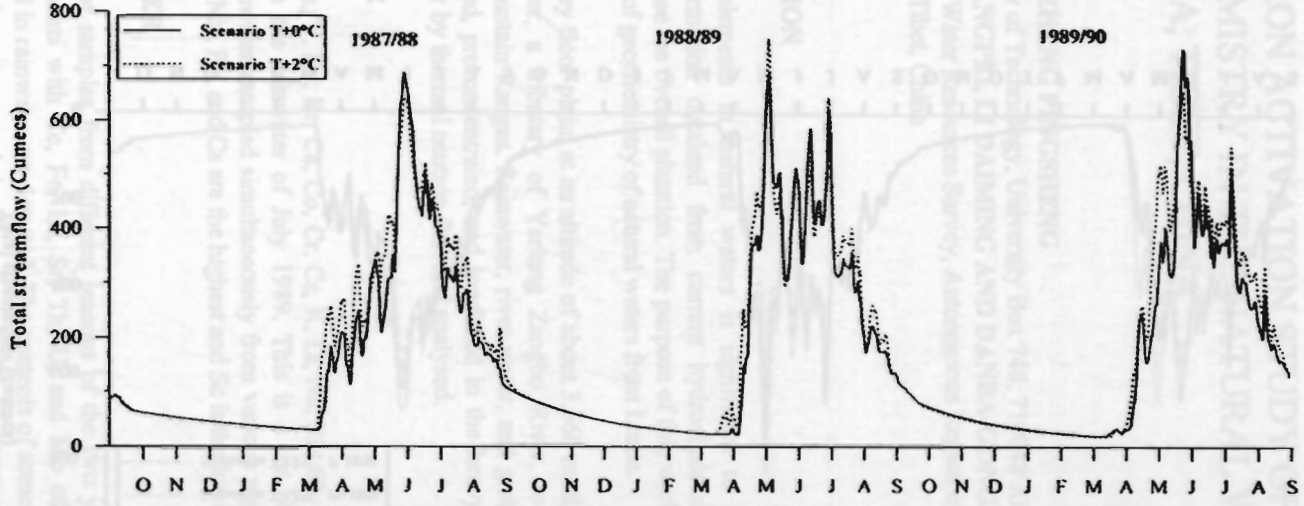

Fig. 1(a) : Effect of increase in temperature on daily total streamflow

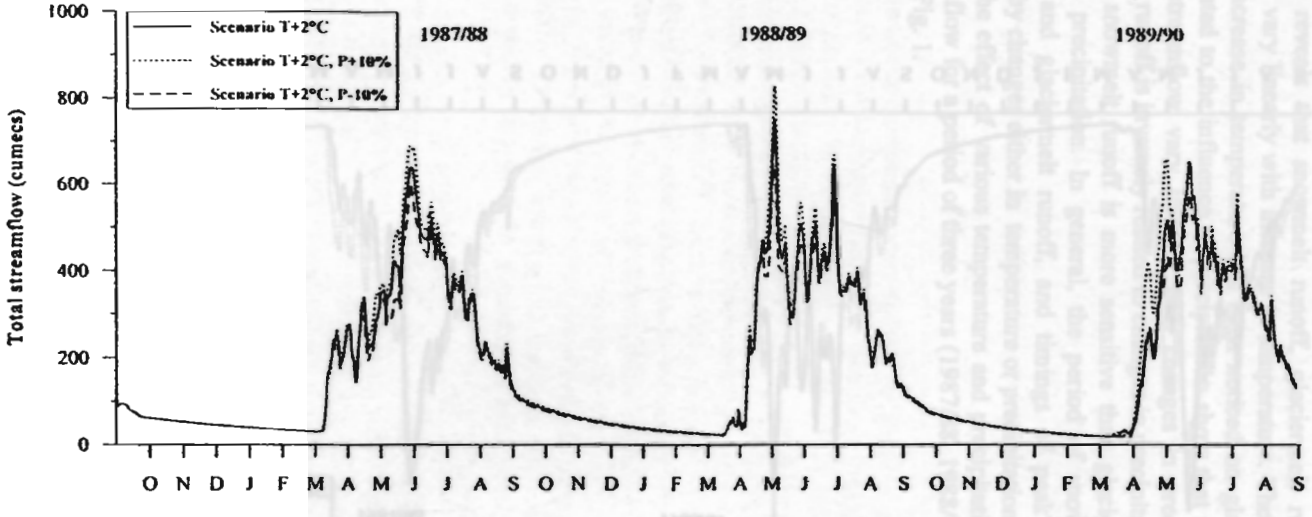

Fig. 1(b) : Effect of changes in precipitation on daily total streamflow over a T+2°C scenario