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MLR Based Statistical Downscaling of Temperature and Precipitation in Lidder Basin Region of India

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Abstract

In the present study, the multiple linear regression technique was employed to relate the monthly predictors obtained from the Global Climate Model namely CGCM3 (Canadian Centre for Climate Modelling and Analysis) with the monthly Predictands such as the locally observed precipitation and temperature at Pahalgam meteorological station which is located in the Lidder River Basin. Appropriate predictand-predictor relationships were found out for the region by carrying out sensitivity analysis .Regression equations were developed and subsequently future monthly and annual projections for precipitation, maximum temperature and minimum temperature for the entire 21st century were made. It was observed that at the end of the 21st century the CGCM3 model predicted an increase of 18.07% annual precipitation, whereas the average maximum and minimum annual temperatures were predicted to increase by 0.62°C and 0.76°C, respectively.

Keywords: General circulation models; Downscaling; Multiple linear regression; Predictors

Introduction

Climate change has been defined as a "Change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" [1]. Downscaling techniques are used to bridge the spatial and temporal resolution gaps between what climate modellers are currently able to provide and what impact assessors require. GCM outputs are converted into local meteorological variables by different downscaling methods. Two fundamental approaches exist for downscaling of GCM outputs:

1. Dynamical downscales: the use of regional climate models (RCM) or limited-area models which use the lateral boundary conditions from a GCM to produce high resolution outputs [2].
2. Statistical downscaling: a range of methods which rely on the fundamental concept that regional climate is related to the large-scale atmospheric state, expressed as a deterministic and/or stochastic function between the large-scale atmospheric variables (predictors) and local or regional climate variables [3,4].

tributary of River Jhelum. It has a catchment area of 1159.38 km² which constitutes about 10 per cent of the total catchment area of River Jhelum [5]. The steep slopes in the Lidder valley along with depleted forest cover have been major factors of and sedimentation. These factors have also affected the drainage pattern of Lidder stream significantly and made the system extremely fragile as it has started showing signs of degeneration. The catchment area of Lidder stream occupies the south eastern part of the Kashmir valley and is situated between 33° 45′ 01″ N-34° 15′ 35″ N and 74° 06′ 00″ E–75° 32′ 29″ E (Figure 1).The lidder basin has an elevation range from 1440 m-5385 m above sea level .It consists of some of the major tourists attractions in the form of Pahalgam (world famous resort), Lidder river, Aru, Sheeshnag lake and Marsar lake. The land use characteristics of the lidder basin are given in Table 1. The Lidder valley forms part of the western Himalaya and lies between the Pir Panjal range in the south, south-east, and southwest Zanskar range. The valley begins from the base of the two snow fields, the Kolahoi and Sheshnag where from its two main upper streams; the West and the East Lidder originate and join each other near the famous tourist spot Pahalgam town and finally joins the Jhelum at Gur village (Anantnag District).

Multiple linear regressions

The association of three or more variables can be investigated by the multiple regression and correlation analysis [6]. The multiple-regression relation may be expressed in the form of Eq.