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Assessment of Temporal and Spatial Variation of Pan Evaporation with Related Climatological Factors in Bangladesh

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Abstract

Pan evaporation is an effective way to analyze the multidimensional impact of climate change on irrigation water requirement since pan evaporation measures the integrated effect of radiation, wind, temperature and humidity on the evaporation from an open-water surface. The characteristic trends of pan evaporation and related climatological factors, as developed in this paper, indicate that most of the regions of Bangladesh have undergone a significant amount of decrease in evaporation through the years. The reduction in sunshine duration as a consequent of climate change can be attributed to be the principal reason for the decrease in evaporation. The spatial distribution of seasonal variation of pan evaporation along with solar radiation and humidity was analyzed, and solar radiation seemed to have the major influence on evaporation. The study also reveals that summer and spring are the seasons of highest evaporation in most of the regions. The characteristic trend and spatial distribution of seasonal pan evaporation correlated with related climatological factors developed in this study could aid in water resources development and planning for irrigation purposes.

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Keywords: Climate Change, Humidity, Irrigation, Pan Evaporation, Radiation, Trend Analysis.

1. Introduction

Bangladesh is recognized as one of the countries potentially vulnerable to the impacts of global warming

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and climate change [1]-[5]. Rising temperatures and changes in rainfall patterns have direct effects on crop yields, as well as indirect effects through changes in irrigation water availability [6]. The agriculture is the major sector for consumption of water in Bangladesh, a country with population of about 162 million in 2009 and is projected to be about 215 million in 2040 [7]. Demand for water will increase with the rising population for increased agricultural productivity particularly for growing demand of rice which consumes a lot of water. Therefore, it is essential to estimate the agricultural water demand in the changing environment for long term water resources development and planning. This paper reports studies on characterization and trend analysis of pan evaporation with related climatological factors in various regions of Bangladesh.

2. Scope

The overall objective of this study is to characterize the pan evaporation under changing climate and analyze its future trend. This would allow the development of agricultural water demand planning, and appropriate adaptation and climate risk management strategies. The specific objectives of the study are:

- Analyze the seasonal changes in pan evaporation, solar radiation and humidity at different regions of Bangladesh and identify the controlling parameter affecting pan evaporation by a comparative study.
- Evaluation of long-term changes in pan evaporation in different regions of Bangladesh.
- Analysis of spatial distribution of mean seasonal pan evaporation in different regions of Bangladesh

It must be mentioned that the study is limited to the period from 1988-2010; the result, thereby, exhibit the very recent trends and not long term trends.

3. Methodology

3.1. Data and selection of study area

The data were collected from different hydro-meteorological stations of Bangladesh Meteorological Department (BMD). Class A evaporation pan was used to measure the pan evaporation. The data were initially available for a period of 23 years ranging from 1988 to 2010. To reduce the analysis volume, only some selected locations spread over the Bangladesh have been considered for trend analysis. In this study, Bangladesh is divided into eight regions for analysis purpose. One climatic station was selected for analysis from each of the eight regions. The stations are Dinajpur (North West), Joydebpur (North Central), Sylhet (North East) Faridpur (Central), Khulna (South West), Barisal (South Central), Comilla (south East) and Rangamati (Eastern Hill).

3.2. Assessment of seasonal variation

To analyze the seasonal variation, data of the parameters (pan evaporation, radiation and humidity) for all of the study stations were collected for the year 2010. The whole year was divided into four seasons: spring (February to April), summer (May to July for), autumn (August to October) and winter (November to January). The seasonal variations of the variables were spatially distributed in different regions by using ArcGIS 9.2 map to evaluate the relationship between the pan evaporation and related climatological factors.

3.3. Trend analysis of daily pan evaporation and humidity

To analyze the changing pattern of pan evaporation as an effect of climate change, spatial distribution of normalized value of average daily pan evaporation in January for recent two span years (2006-2010 and 2001