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VARIABILITY OF SOME METEOROLOGICAL ELEMENTS DURING THE SOUTHWEST MONSOON SEASON IN BANGLADESH

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ABSTRACT

Statistical computation and analysis of the co-efficient of variation of different meteorological parameter such as mean sea level pressure, rainfall, dew-point depression, minimum temperature and maximum temperature over Bangladesh during the onset, on-going and withdrawal phases of southwest monsoon, season of 1981- 2010 was dealt with. The study reveals that the coefficient of variation of the mean sea level (msl) pressure is practically small over Bangladesh during the onset and ongoing phases of southwest monsoon. During the onset phase, the CV of msl pressure is relatively higher and decreases during the on-going phase. The variation of msl pressure increases slightly in the withdrawal phase of monsoon. The ranges of CV of msl pressure are 0.064 - 0.197%, 0.079 - 0.809%, 0.091 - 0.793%, 0.069 - 0.272%, 0.0695 - 0.229% and 0.127 - 0.32% in May, June, July, August, September and October, respectively. The variation of dew-point depression decreases in the eastern part during the onset phase of southwest monsoon and becomes lower all over Bangladesh during the on-going phase of monsoon. It again increases during the withdrawal phase. The maximum co-efficient of variation of rainfall exists over the southeastern part of Bangladesh during the on-going phase of southwest monsoon and decreases in June and July over Bangladesh i.e. during the early on-going phase of monsoon. The co-efficient of variation of minimum and maximum temperatures is found to decrease during the onset and on-going phases of southwest monsoon and increases during the withdrawal of monsoon from Bangladesh.

Key words: Variability, Metrological elements, Southwest monsoon, Mean sea level pressure, Dew-point depression

INTRODUCTION

Bangladesh is a southeast Asian country extending from 20º30′ to 26º40′N and from 88º03′ to 92º40′E. Most part of this country is a plain low land, with the hills in the south-eastern, eastern and north-eastern parts. It is surrounded by the Assam Hills to the east, by the Himalayan to the north. The Bay of Bengal lies to the south of the country; in the west lies the contiguous plain of West Bengal and the Gangetic plain of India (Razzaque 2006).

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Meteorologically, there are four seasons in Bangladesh such as: pre-monsoon (March-May), southwest monsoon (June-September), post-monsoon (October-November) and northeast monsoon (December-February). Monsoon contributes about 75% rainfall to the total annual rainfall in Bangladesh. It is agreed that monsoon results from the differential heating of the land and ocean. During this season, the weather pattern involves winds blowing from the south-west direction (known as the south-west monsoon) from the Indian Ocean onto the sub-continental land mass. These winds are generally laden with much moisture and bring rains to most parts of the subcontinent (Wiki: access on 5 September 2015).

Pant *et al*. (1988) studied the long-term variability of the Indian summer monsoon and related parameters. The parameters studied within the monsoon systems are: (a) monsoon rainfall of the country as a whole, (b) number of break monsoon days during July and August, (c) number of storms/depressions in the bay of Bengal and Arabian Sea during the monsoon season and (d) the dates of onset of summer monsoon over south Kerala coast. It is observed that the smoothed time series of the parameters within the monsoon system comprise a common slowly varying component in an episodic manner distinctly showing the excess and deficit of rainfall epochs.

The study made by Sivakumar *et al*. (2011) reveals that the past and present climate trends and variability in south Asia can be characterized by increasing air temperatures and there is an increasing trend in the intensity and frequency of extreme events in South Asia over the last century. Based on observational analysis and model experiments, Charney and Shukla (1981) hypothesized that the interannual variability of the seasonal mean monsoon is determined mainly by the slowly varying boundary conditions such as the sea surface temperature (SST), soil moisture and snow cover. The role of the intraseasonal variability of the monsoon in determining the seasonal mean has been a matter of debate. Palmer (1994) suggested that the role of the boundary condition (such as SST) is to merely alter the probability distribution function of the rainfall to be biased toward either active or break phase. The frequency and length of the active and break phases within each season then determine the seasonal mean rainfall. However, Krishnamurthy and Shukla (2000) showed that there was no bimodality in the probability distribution function by analyzing 70-year long daily rainfall data over India. They suggested that the interannual variability of the seasonal mean monsoon is a linear combination of seasonally persistent large-scale component and a statistical average of the intraseasonal variations, as an extension of Charney-Shukla hypothesis.

Karmakar and Khatun (1995) studied the variability and probabilistic estimates of rainfall in Bangladesh during the southwest monsoon season and found that the variability of rainfall decreases from June to July and then starts increasing from August to September. The study also revealed that the mean rainfall and the probabilistic rainfall extremes were maximum over the southeastern and northeastern parts of the country where the variability of rainfall was low and reliable.

Dhar and Nandagiri (1999) made a study to find out the contribution of low pressure areas (or lows) towards the rainfall of northern and central India during the monsoon months of June to September in the absence of more intense cyclonic disturbances such as depressions, deep depressions and cyclonic storms. This study has shown that the occurrence of moderate to heavy rainfall mainly depends upon their frequency, life span, track followed and origin of these disturbances provided there are not inhibiting meteorological factors like 'break' monsoon situations.

The present study has been undertaken to study the variability of different meteorological parameters during the onset, on-going and withdrawal phases of southwest monsoon over Bangladesh. The significance of the study is that the variability of one climatic parameter over an area is linked with the variability of other parameters and as such the variability of different climatic parameters over Bangladesh is expected to be used in different sectors such as agriculture, monsoon forecasting and development planning. In South Asia as well as in Bangladesh, southwest monsoon plays a very important role in the socio-economic conditions of the people of Bangladesh; this study will help understanding how the climatic elements vary with the onset, progress and withdrawal of southwest monsoon.

MATERIALS AND METHODS

Daily mean sea level pressure, rainfall data, dew point temperature, maximum and minimum temperature for the period May-October of 1981 to 2010 at 34 stations (shown in Fig. 1) of Bangladesh Meteorological Department (BMD) are collected and utilized in the present study. From the daily temperature and dew-point temperature, daily dew-point depression ($TT - T_dT_d$) is computed at each station and the monthly average of dew-point depression are determined for study period. Monthly total rainfall, monthly mean maximum temperature, mean minimum temperature, mean dew-point depression and mean sea level pressure are also computed.

The co-efficient of variation of all the above parameters for the onset, on-going and withdrawal phases of southwest monsoon season is computed with the following formula:

$$CV = \frac{\pm \times 100}{\bar{x}} \% \quad (1)$$

where $\bar{x}$ is the long-term mean of a parameter x and σ is the standard deviation of the parameter. The co-efficient of variation is generally expressed as percentage.

Winsurfer software has been used for the spatial distribution of the above parameters in Bangladesh.

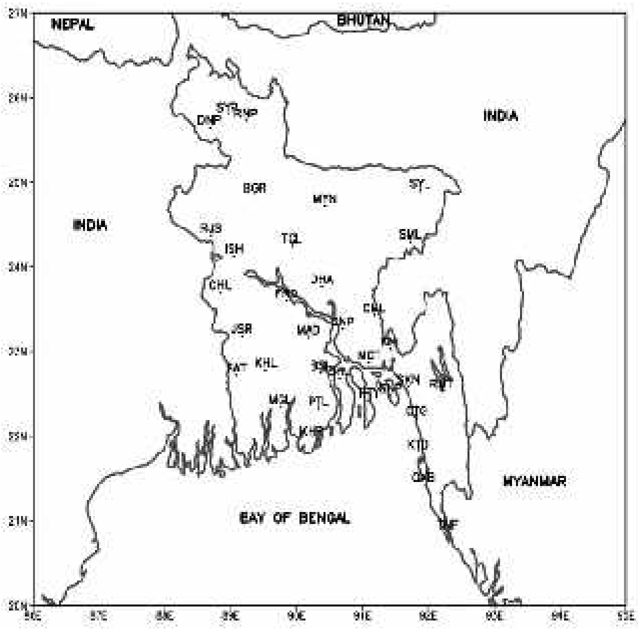

Fig. 1. Location of meteorological stations of BMD.

RESULTS AND DISCUSSION

The mean and standard deviation of different parameters such as monthly rainfall total, monthly mean maximum temperature, mean minimum temperature, mean dew-point depression and mean sea level pressure are computed and these values are used to determine the co-efficient of variation (CV) of each parameter for the months May to October.

Co-efficient of variation of mean sea level (msl) pressure over Bangladesh : The distributions of the co-efficient of variation of msl pressure over Bangladesh for May-October in 2011 are shown in Fig. 2(a-f). The coefficient of variation of mean sea level pressure is, in general, very small during May-October ranging from 0.064 to 0.809%. The small CV is mainly due to the fact that the value of pressure is high (>999 hPa) and the standard deviation is small (<8.5 hPa). The ranges of CV of msl pressure are 0.064 - 0.197%, 0.079 - 0.809%, 0.091 - 0.793%, 0.069 - 0.272%, 0.0695 - 0.229% and 0.127 - 0.32% in May, June, July, August, September and October, respectively. The spatial distribution of CV of msl pressure over Bangladesh in May shows that the CV is relatively small over western Bangladesh and higher 0.197% over Khulna region (Fig. 2a). In June, CV is relatively higher than in May. The higher CV of msl pressure exists over Chuadanga region, which is 0.809% as can be seen in (Fig. 2b) and the minimum coefficient of variation of pressure seen over the middle part of Bangladesh. The higher variability of pressure in June may be due to the variability in setting the monsoon of the country. In July, the coefficient of variation of pressure is maximum over Chuadanga region, which is about 0.793% and the CV is less all over the country with uniform distribution. This less CV and its uniform distribution is due to the setting of southwest monsoon over the country (Fig. 2c). In August, CV is relatively lower than in July. The higher CV of msl pressure exists over Bogra and Madaripur regions, which is 0.27% as shown in Fig. 2(d).

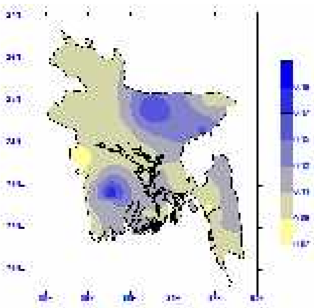

Fig. 2(a): Coefficient of variation of mean sea level pressure in May over Bangladesh during 1981-2010.

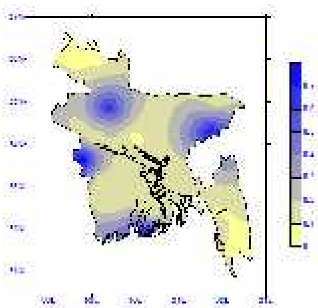

Fig. 2(b): Coefficient of variation of mean sea level pressure in June over Bangladesh during 1981-2010.

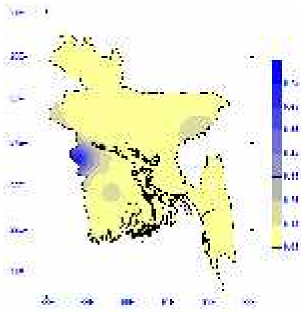

Fig. 2(c): Coefficient of variation of mean sea level pressure in July over Bangladesh during 1981-2010.

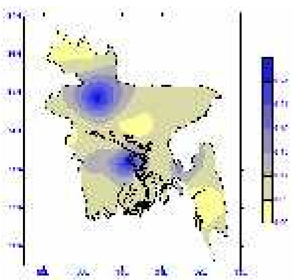

Fig. 2(d): Coefficient of variation of mean sea level pressure in August over Bangladesh during 1981-2010.

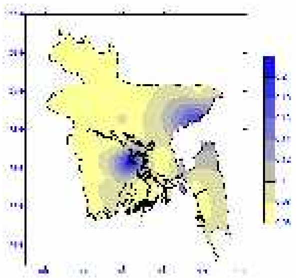

Fig. 2(e): Coefficient of variation of mean sea level pressure in September over Bangladesh during 1981-2010.

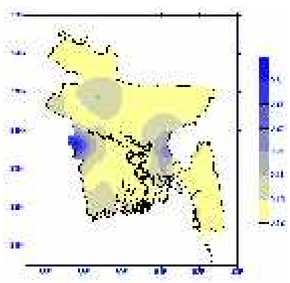

Fig. 2(f): Coefficient of variation of mean sea level pressure in October over Bangladesh during 1981-2010.

The msl pressure of CV in September has decreased ranging from 0.0695 - 0.229%. In this month, high CV of msl pressure exists over Madaripur region and the CV is less all over the country with uniform distribution (Fig. 2e). In October, the (Fig. 2f) shows that the highest CV of msl pressure exists over Chuadanga region, which is 0.32%. The secondary maximum exists over Comilla regions. The CV of msl pressure is minimum over the northern part of the country. The high coefficient of variation of surface pressure over central west has become more prominent. In this month, the CV of msl pressure has increased considerably over the country ranging from 0.127 - 0.32% in the northern and western parts of the country.

From the above discussion it appears that the coefficient of variation of the mean sea level pressure is practically small over Bangladesh during the onset and ongoing phases of southwest monsoon. During the onset phase, the CV of msl pressure is relatively higher and decreases during the on-going phase. The variability of msl pressure increases slightly in the withdrawal phase of monsoon.

Co-efficient of variation of monthly dew-point depression over Bangladesh : Fig. 3(a-f)) shows the co-efficient of variation of monthly dew-point depression over Bangladesh during May-October of 1981 - 2010. During the onset phase of monsoon in May, the co-efficient of variation of dew-point depression ranges from about 8.9% in the southeastern part to about 22.67% in the western part of Bangladesh (Fig. 3a). The maximum CV is found in the western and middle part of Bangladesh. A region of relatively lower CV exists over the Chittagong region. In June, the CV of dew-point ranges from 9.12 to about 26.41% (Fig. 3b), having relatively lower variability eastern half and higher variability in the western half of the country. This is because of the onset of southwest monsoon over the eastern part earlier than the western part.

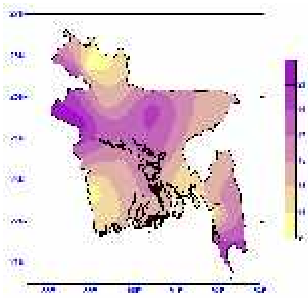

Fig. 3(a). Coefficient of variation of dew point depression in May over Bangladesh during 1981-2010.

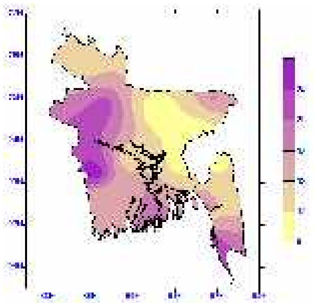

Fig. 3(b). Coefficient of variation of dew point depression in June over Bangladesh during 1981-2010.

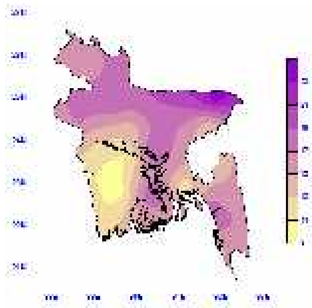

Fig. 3(c). Coefficient of variation of dew point depression in July over Bangladesh during 1981-2010.

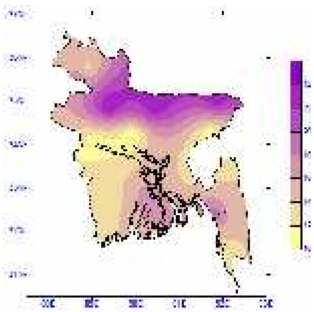

Fig. 3(d). Coefficient of variation of dew point depression in

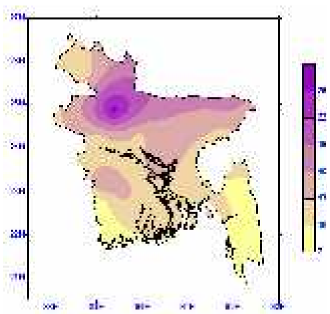

Fig. 3(e). Coefficient of variation of dew point depression in September

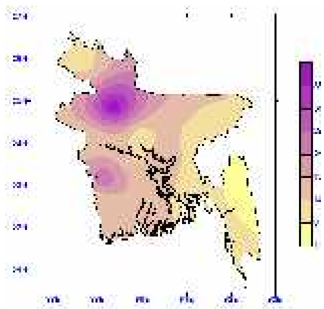

Fig. 3(f). Coefficient of variation of dew point depression in October

August over Bangladesh during 1981-2010.

over Bangladesh during 1981-2010.

over Bangladesh during 1981-2010.

In July, the range of CV of dew-point depression is from 9.18% in the southwest part to about 23.99% in the northeast of the country (Fig. 3c), the dry zone over the north-northeastern part of Bangladesh is found to extend towards south as a narrow zone through the central part. The variability is relatively lower in July than that of June. In August, the coefficient is lower over the country in general ranging from 9.88% in the middle to extreme west and 24.46% in the northwest of Bangladesh (Fig. 3d).

In September, the CV of dew-point depression is found to range from 8.14% in the extreme southern part to 26.39% in Bogra region (Fig. 3e). Practically the variability of dew-point depression is higher over north-northwestern part of the country and minimum elsewhere. In October, the withdrawal phase of south west monsoon, the coefficient of variation of dew-point depression ranges from 5.8% in the south eastern part of the country to about 44.93% in the Bogra region (Fig. 3f). The distribution pattern of CV of dew-point depression is almost similar to that in September but the variability has increased in the northern and southwestern parts of Bangladesh. This higher variability of the dew-point depression is mainly due to the withdrawal of southwest monsoon from Bangladesh.

It is apparent that the CV of dew-point depression decreases in the eastern part during the onset phase of southwest monsoon and becomes lower all over Bangladesh during the on-going phase of monsoon. It again increases during the withdrawal phase.

Co-efficient of variation of monthly rainfall over Bangladesh : Fig. 4(a-f)) show the co-efficient of variation (CV) of monthly total rainfall over Bangladesh from May through October during 1981 - 2010. During the onset phase of monsoon in May, the CV of rainfall ranges from about 33% at Rangpur in the north-west to about 65% at Patuakhali in the southwest as shown in (Fig. 4a). It indicates that that the rainfall is maximum variable in the central south region, which may be less thunderstorm activities in the south. In June, the coefficient of variation of rainfall ranges from 33% at Sylhet in the northeast to about 64.5% at Chandpur extending to southwestern part of the country (Fig. 4b). But the variability is maximum at Sandwip where it is 71.95%. It has been seen that the co-efficient of variation is less at 25 stations out of 34 stations i.e. 73.5% cases in June as compared to May.

The variability of rainfall is higher in the southwestern part and Tangail-Bogra-Mymensingh region. The CV of rainfall is relatively less in the eastern part of the country, which may be due to the onset of monsoon in Bangladesh. It is, therefore, clear that the rainfall is less variable in June as compared to May. In July, the coefficient of variation of rainfall ranges from 28.8% at Cox's Bazar in the southeast to about 53% at Rangpur in the extreme northwest (Fig. 4c). The figure shows that the co-efficient of variation of rainfall is maximum in the northwestern part of Bangladesh, having the CV of 53% at Rangpur and 50.67% at Syedpur. The CV of rainfall is minimum over Cox's Bazar, southwestern and northeastern parts of the country with the minimum value of 28.8% at Cox's Bazar and 29.67% at Patuakhali. It has been seen from the analysis of data that the CV of rainfall is less at 23 stations out of 34 stations (68% cases) in July as compared to that in June. In August, the pattern of CV is maximum over Syedpur with CV of 69.72% (Fig. 4d).

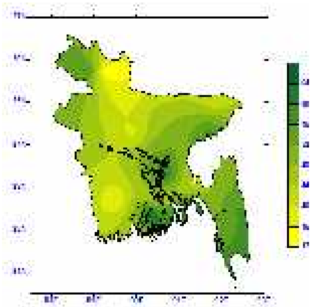

Fig. 4(a). Coefficient of variation of rainfall in May over Bangladesh during 1981-2010

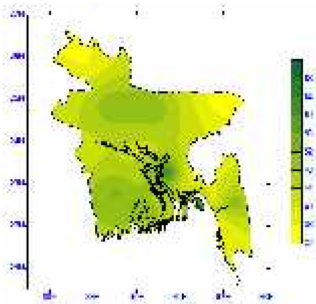

Fig. 4(b). Coefficient of variation of rainfall in June over Bangladesh during 1981-2010

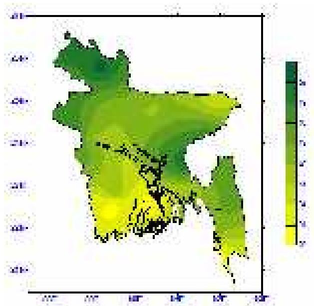

Fig. 4(c). Coefficient of variation of rainfall in July in Bangladesh during 1981-2010.

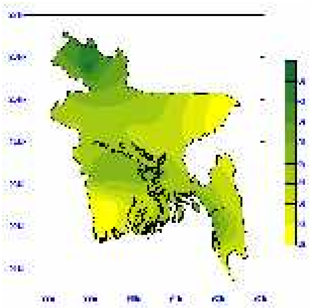

Fig. 4(d). Coefficient of variation of rainfall in August in Bangladesh during 1981-2010.

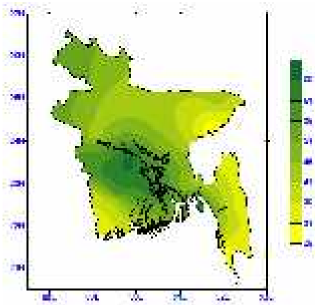

Fig. 4(e). Coefficient of variation of rainfall in September over Bangladesh during 1981-2010.

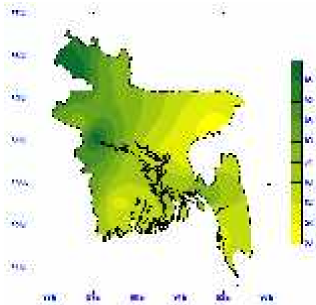

Fig. 4(f). Coefficient of variation of rainfall in October over Bangladesh during 1981-2010.

The secondary maximum CV of 58.7% exists over Chittagong. In this month, the lowest coefficient of variation of rainfall is 28.44% in the southeastern region of the country i.e. at Teknaf. The CV of rainfall is less at 12 stations out of 34 stations (35% cases) in August as compared to that in July. It indicates that the CV of rainfall increases in most places in August as compared to July. In September, the CV of rainfall is maximum over Faridpur-Madaripur-Barisal-Dhaka region having isolated maximum of 69.29% at Sandwip. Secondary maximum CV exists over extreme northwest. It is minimum at Srimangal (26.59%), Cox's Bazar (27.56%) and Rangamati (35.9%) as well as extreme southwestern part of the country (Fig. 4e). The CV of rainfall is higher at 23 places out of 34 stations (i.e. 67.65% cases), indicating that the CV of rainfall increases in most places in September. In October, the withdrawal phase of southwest monsoon, there is lower CV of rainfall in the northeastern part of Bangladesh. The CV of rainfall is higher in the northwestern Bangladesh and extreme northwest. It ranges from 52.3% in the Srimangal and about 104.9% in the northwestern part of the country i.e. in Dinajpur (Fig. 4f). The CV of rainfall is higher at 34 places out of 34 stations (100% cases), indicating that the CV of rainfall increases in Bangladesh in October.

From the above discussion it is apparent that the maximum CV of rainfall exists over the southeastern part of Bangladesh during the on-going phase of southwest monsoon and decreases in June and July over Bangladesh i.e. during the early on-going phase of monsoon. It starts increases again from August and become higher in the withdrawal phase as compared to the on-going monsoon phase. The decrease in the variability of rainfall during June-September is comparable with the study of Karmakar and Khatun (1995).

Co-efficient of variation of monthly mean minimum temperature over Bangladesh: The spatial distributions of the co-efficient of variation of mean minimum temperature over Bangladesh from May through October during 1981-2010 are shown in Fig. 5(a-f). During the onset phase of monsoon in May, the CV of minimum temperature ranges from about 2.2% at Mongla in the southwest to about 7.1% in the Dinajpur in the northwest of Bangladesh as shown in (Fig. 5a). In June, the coefficient of variation of minimum temperature is relatively lower over Bangladesh with minimum CV of 1.57% in Rangpur and 7.23% in the northwest region i.e. in Dinajpur (Fig. 5b). In this month, the CV of minimum temperature is less at 33 stations out of 34 stations (97% cases) except Dinajpur as compared to May. The relatively lower coefficient of variation in June all over the country is mainly due to the onset of southwest monsoon. In July, the CV of minimum temperature ranges from 1.11% in the Kutubdia to about 5.79% in the northwestern region i.e. in Dinajpur (Fig. 5c). It is found that the CV of minimum temperature is less at 32 stations out of 34 stations (94% cases) as compared to June except Sandwip and Sylhet where the CV is higher in July. In August, range of the coefficient of variation of minimum temperature is from 0.95% over Sitakunda to 2.56% in the Sandwip region (Fig. 5d). The CV of minimum temperature is relatively higher over the eastern part of Bangladesh and lower in the western part of the country. It is found that the CV of minimum temperature is less at 31 stations out of 34 stations (88% cases) as compared to July except Teknaf, Rangamati, Chittagong and Madaripur where the CV is higher in August. In September, the CV of minimum temperature is lower in the southern and western parts of the country and higher in the northern and eastern parts. The lowest CV of minimum temperature is about 0.69% at Ambagan (Chittagong region) and highest CV is 3.75% at Sandwip. It is found that the CV of minimum temperature has increased at 24 stations out of 34 stations (71% cases) as compared to August. This is because of the fact that September is the end month of southwest monsoon (Fig. 5e) when the variability of minimum temperature increases. October is the withdrawal phase of southwest monsoon and the CV of the minimum temperature has increased considerably. The CV of minimum temperature ranges from 2.2% Ambagan in Chittagong to 4.3% at Rangamati (Fig. 5f). The distribution pattern has changed with higher CV in the east and lower CV of minimum temperature to the south.

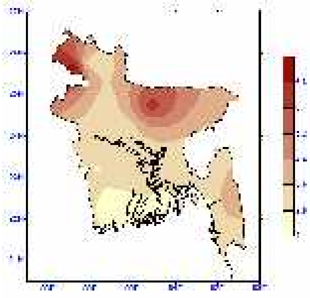

Fig. 5(a). Coefficient of variation of minimum temperature in May over Bangladesh during 1981-2010.

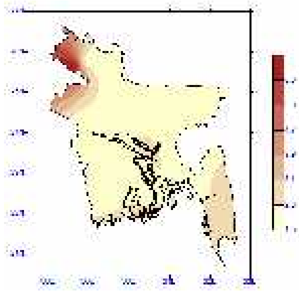

Fig. 5(b). Coefficient of variation of minimum temperature in June over Bangladesh during 1981-2010.

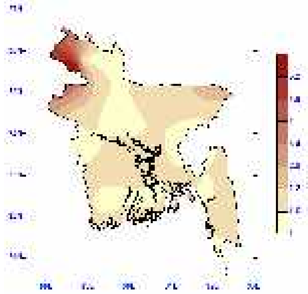

Fig. 5(c). Coefficient of variation of minimum temperature in July over Bangladesh during 1981-2010.

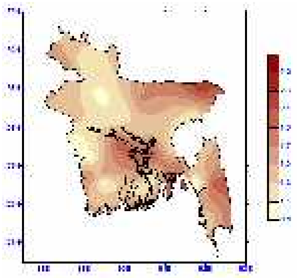

Fig. 5(d). Coefficient of variation of minimum temperature in August over Bangladesh during 1981-2010.

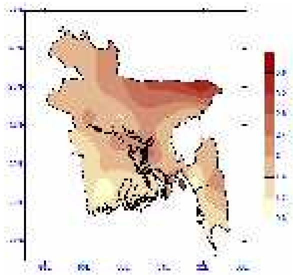

Fig. 5(e). Coefficient of variation of minimum temperature in September over Bangladesh during 1981-2010.

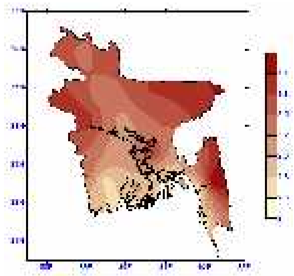

Fig. 5(f). Coefficient of variation of minimum temperature in October over Bangladesh during 1981-2010.

It is apparent from the above discussion that from onset to withdrawal phases of the southwest monsoon the lower value of the coefficient of variation of minimum temperature is shifting from middle to southern part of the country and higher value of CV from northwestern part to the eastern part. The co-efficient of variation of minimum temperature decreases during the onset and on-going phases of southwest monsoon and increases as the monsoon withdraws from Bangladesh.

Co-efficient of variation of monthly mean maximum temperature over Bangladesh: The Co-efficient of variations of mean maximum temperature over Bangladesh from May through October during 1981 - 2010 are shown in Fig. 6(a-f). In May, the CV of maximum temperature ranges from about 1.58% at Teknaf to 4.8% at Dinajpur as can be seen in (Fig. 6a). The coefficient of variation of maximum temperature is relatively lower in the south. The highest CV of maximum temperature is found in the northwestern and northeastern parts of Bangladesh. In June, the CV of maximum temperature ranges from 1.8% at Rangpur in the northwest to about 3.53% in the west i.e. Rajshahi (Fig. 6b). It is found that the CV of maximum temperature has decreased in 19 stations out of 34 stations i.e. in 56% cases as compared to that in May; the decrease is found in the areas through which the monsoon advances and this is mainly due to the onset of southwest monsoon over Bangladesh when rainfall occurs more over the country. In July, the CV of maximum temperature ranges from 1.08% at Hatiya to 3.03% at Sandwip (Fig. 6c). In this month, the CV of maximum temperature has decreased at 29 stations out of 34 stations i.e. in about 85% cases as compared to that in June. This decrease is mainly rainfall throughout the month due to active monsoon in Bangladesh.

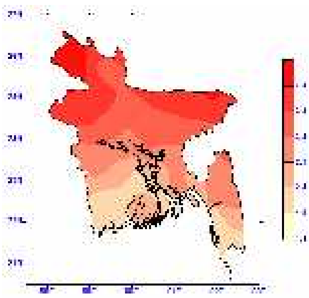

Fig. 6(a). Coefficient of variation of maximum temperature in May over Bangladesh during 1981-2010.

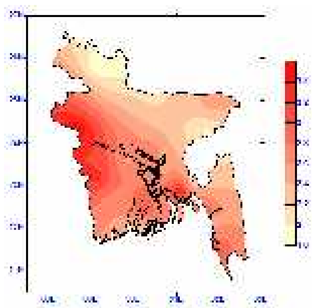

Fig. 6(b). Coefficient of variation of maximum temperature in June over Bangladesh during 1981-2010.

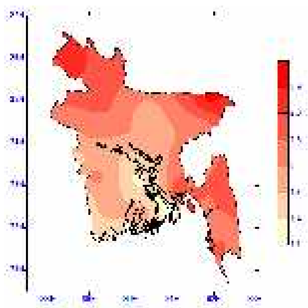

Fig. 6(c). Coefficient of variation of maximum temperature in July over Bangladesh during 1981-2010.

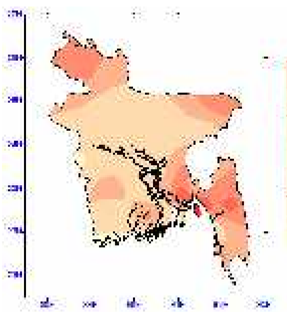

Fig. 6(d). Coefficient of variation of maximum temperature in August over Bangladesh during 1981-2010.

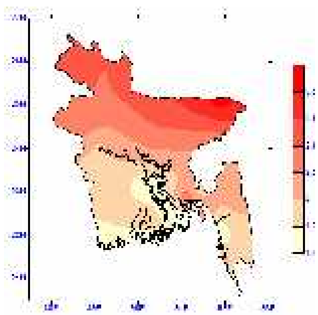

Fig. 6(e). Coefficient of variation of maximum temperature in September over Bangladesh during 1981-2010.

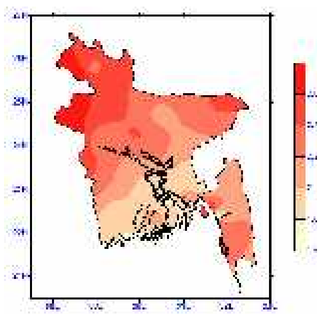

Fig. 6(f). Coefficient of variation of maximum temperature in October over Bangladesh during 1981-2010.

In August, the CV of maximum temperature range is 1.48% in Teknaf to 3.53% in Sandwip (Fig. 6d). In this month, the CV is relatively lower at 17 stations i.e. in 50% cases as compared to that in July. The CV of maximum temperature in September has the range from 1.3% at Madaripur to 3.2% at Sylhet (Fig. 6e). In this month CV of maximum temperature is less in 21 stations out of 34 stations i.e. about 62% cases as compared to that in August. The distribution patterns of the CV of maximum temperature in this month reveals that the higher values are in the northern part of the country and lower values are in the southern part of the country, indicating that the maximum temperature is more variable in the north. In October, the CV of maximum temperature ranges from 1.43% in the southeastern part of the country i.e. is at Ambagan in Chittagong to about 2.74% in the northwestern part of the country i.e. in Dinajpur (Fig. 6f). It can be seen that the distribution patterns are similar to that in the month of May. This is because of the fact that October is the month for withdrawal of southwest monsoon. The CV increased at 23 stations i.e. about 68% cases as compared to that in September.

The above discussion substantiates that the CV of maximum temperature is higher in the northwestern and northern parts of Bangladesh during the onset and withdrawal phases of southwest monsoon. Lower coefficient of variation of maximum temperature exists in the southern part of the country during the onset and withdrawal phases of the monsoon. The CV of maximum temperature was found to decrease during the onset and on-going phases of monsoon and increase during the withdrawal phase, indicating that the maximum temperature is less variable during the onset and on-going phases of the southwest monsoon.

CONCLUSIONS

The coefficient of variation of the mean sea level pressure is practically small over Bangladesh during the onset and ongoing phases of southwest monsoon. During the onset phase, the CV of msl pressure is relatively higher and decreases during the on-going phase. The variability of msl pressure increases slightly in the withdrawal phase of southwest monsoon. The co-efficient of variation of dew-point depression decreases in the eastern part during the onset phase of southwest monsoon and becomes lower all over Bangladesh during the on-going phase of monsoon. The variability of dew-point depression increases again during the withdrawal phase of monsoon.

The maximum co-efficient of variation of rainfall exists over the southeastern part of Bangladesh during the on-going phase of southwest monsoon and decreases in June and July over Bangladesh i.e. during the early on-going phase of monsoon. It starts increasing again from August and becomes higher in the withdrawal phase as compared to the on-going phase of monsoon. The co-efficient of variation of minimum and maximum temperatures decreases during the onset and on-going phases of southwest monsoon and increases as the monsoon withdraws from Bangladesh. The findings would be useful in forecasting the variation of monsoon, in agricultural purposes and in any development plan of Bangladesh.

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