temperatures in spring. Specially, in summer, sometimes dry climate is exacerbated by Ghibly, a hot arid wind that blows from the south. The wind carries large quantities of sand dust which turns the sky into red and reduces visibility to less than even 20 yards. The heat of wind is increased by rapid drop of relative humidity.

3. Rainfall — Plantation of many crops, vegetables and plants are closely related with first rainfall. In Benghazi, first rainfall generally occurs in the month of October and the last rainfall in April with monthly average 7.5 mm. Heavy rainfall with strong winds generally occurs in winter. The standard deviation and coefficient of variation of rainfall is less in winter as compared to other seasons.

The distribution of rainfall has direct impact on agriculture as the plantation and growth of crops, vegetables and plants depend on amount of water in different stages of their growth. Rainfall is the main sources of water for Benghazi area, specially for the winter crops. Table 1 gives the annual, monthly rainfall totals with their means, standard deviations in millimetre and coefficient of variations for the period 1980-1989.

4. Relative humidity — Benghazi experiences high relative humidity in winter which varies on an average from 62% to 65% (Table 2). Relative humidity is more or less stable in summer.

5. Conclusions — The following conclusions can be made from the available data for Benghazi: (i) The warmest months are July and August when Benghazi experiences mean monthly temperatures of 18°C to 30°C, whereas the coolest months are January and February with mean monthly temperatures of 8°C to 17°C. (ii) First rainfall generally occurs in October and last occurs in April. Heavy rainfall normally occurs in the months of December and January with average amount of 50.6 mm and 44.0 mm respectively.

MANINDRA KUMAR ROY
University of Chittagong,
Bangladesh
3 May 1991

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TROUGH IN LOW LEVEL MONSNOON W ESTERLIES AND ASSOCIATED RA INFALL OVER TEESTA CATCHMENT

1. The river Teesta is one of the major rivers of North Bengal which is always susceptible to the flash floods endangering Jalpauguri city. As the size of concentration for the rivers of hilly region is less, forecaster has to appraise the synoptic situation and issue heavy rainfall warnings at the shortest possible time. The river Teesta originates in the glaciers of north Sikkim at an altitude of 6400 m. The catchment area of Teesta river up to Indo-Bangladesh border is about 12650 sq km, 75% of which lies in hilly region. The Teesta basin gets about 217.0 cm of rains during monsoon months. The main synoptic situations responsible for heavy rainfall over the basin are identified as: (i) break monsoon condition, (ii) the low pressure area/cyclonic circulations in the neighbourhood of west of the catchment, and (iii) the passage of low level trough in monsoon westerlies between east Nepal hills to Assam & Meghalaya (Biswa et al. 1984). The high influence of the low level trough in monsoon westerlies can be appreciated by the fact that during period 1980-90, 39% occasions of heavy rainfall (areal rainfall of more than 25.0 mm) over Teesta basin are associated with this system. The importance of this system was recognised by earlier workers (Srinivasan et al. 1972).

2. The trough in the low level monsoon westerlies are mainly associated with break monsoon situation. They may form and travel as far as west Madhya Pradesh to Assam & Meghalaya. However, in the majority of the cases the system appears between east Nepal hills to Assam & Meghalaya and travels eastwards. However, the movement is not regular. The position of the trough at 00 UTC over 25°N is determined at 900 m, 850 hPa, 2100 m and 700 hPa level by analysing available upper air data during period 1980-90. The characteristics of the rainfall recorded at 03 UTC next day over Teesta basin are studied and tabulated. As an illustration, the trough positions in low level monsoon westerlies during 4 to 9 July’88 at 900 m, 850 hPa, 2100 m and 700 hPa with streamline analysis of 7 July’88 is shown in Fig. 1. The highest rainfall caused by this system was recorded on 8 July’88. The isohyetal pattern of this rainstorm is shown in Fig.2.

3. During the period 1980-90, there were 35 occasions when the low level trough in monsoon westerlies was identified with available data. The average characteristics of rainfall over Teesta basin associated with this system (Table 1) indicates that the system has a strong potential of producing heavy rainfall over Teesta basin during the months July and August. The influence of the system lasts generally for the duration of 3 to 4 days. The average highest one day rainfall over Teesta basin is of the order of 34.0 mm. The heaviest rainfall will occur on any of the first two days after the appearance of the system (Table 2). From
Fig. 1. Streamline analysis on July 1988 (00 UTC) and position of trough during 4-9 July 1988.

**TABLE 1**
Main features of rainfall and associated trough in monsoon westerlies (Period: 1989-90)

<table>
<thead>
<tr>
<th>No. of occasions of trough in low level monsoons westerlies</th>
<th>Average rainfall duration (mm) over Teesta catchment (days)</th>
<th>Average 1-day highest rainfall (mm)</th>
<th>Absolute rainfall (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun</td>
<td>4</td>
<td>3.0</td>
<td>47.5</td>
</tr>
<tr>
<td>Jul</td>
<td>14</td>
<td>3</td>
<td>93.0</td>
</tr>
<tr>
<td>Aug</td>
<td>6</td>
<td>3</td>
<td>89.3</td>
</tr>
<tr>
<td>Sep</td>
<td>11</td>
<td>4</td>
<td>56.2</td>
</tr>
</tbody>
</table>

**TABLE 2**
Average rainfall for each day under the influence of the trough in low level monsoons westerlies (rainfall in terms of percentage of total rain during the passage of the system)

<table>
<thead>
<tr>
<th>Day</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
<th>7th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun</td>
<td>32</td>
<td>51</td>
<td>15</td>
<td>2</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Jul</td>
<td>39</td>
<td>31</td>
<td>13</td>
<td>10</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Aug</td>
<td>37</td>
<td>33</td>
<td>23</td>
<td>5</td>
<td>2</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Sep</td>
<td>31</td>
<td>45</td>
<td>15</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>---</td>
</tr>
</tbody>
</table>
Table 3 it may be seen that possibility of heavy rain-storm (one day average areal rainfall more than 25.0 mm), which has high potential of causing severe floods over Teesta basin, is maximum when the location of the system is west of 89°E at 25°N and the least when it is east of 89°E. From the illustrations depicted in Fig. 1 and Fig. 2 also it may be observed that heaviest rainfall was recorded on 8 July ’88 when the trough position was between 88°E and 89°E at 25°N on preceding day 7 July ’88. Also out of 124 occasions of the presence of this system, the system lingers west of 89°E on 106 occasions. It moves faster eastwards after crossing 89°E and becomes unimportant as far as the rainfall of the Teesta basin is concerned.

4. Conclusions

(i) The low level trough in monsoon westerlies is one of the important synoptic situations responsible for heavy rainstorms over Teesta basin.

(ii) The heaviest rainfall associated with this system can be expected on any of the first two days after the appearance of the system.

(iii) The system is more effective in producing heavy rainfall over Teesta basin during the months July and August particularly when it is west of 89°E.

(iv) The system may cause rainfall of the order of 70.0 mm during its passage over and in neighbourhood of Teesta catchment.

References


N. Y. APTE

A. K. DAS

L. C. RAM

Flood Meteorological Office, Jalpaiguri

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