Letters to the Editor

A CLIMATOLOGICAL STUDY OF THE HEIGHTS OF RADAR CLOUD TOPS

Several studies have been made on the heights of radar cloud tops over different parts of our country. Kulshreshtha (1962) studied the heights of Cb cloud tops over north India. Seshadri (1963) reported a study on the heights of tops of Cb clouds around New Delhi. Bhattacharya and Dc (1966) studied the radar cloud tops in the Gangetic valley of West Bengal. A similar study for Madras and neighbourhood has been attempted and the results are presented in the paper. Earlier Lakshmanaswamy and Rao (1974) had reported a climatological study of the radar echoes over Madras and neighbourhood. There, only the areal distribution of the radar echoes around Madras Airport has been studied in great detail and the present paper attempts to study the climatological aspects of the height distribution of the radar echoes. The authors have also attempted to find out the possible relationship between radar echo heights and the corresponding rainfall over Madras and neighbourhood. The object of this study is to see whether the clouds, when they grow vertically higher, will systematically give rise to larger amounts of precipitation. The results of this study will be presented in a future communication.

2. The present study is based on observations taken with a 3 cm Decca radar installed at Madras Airport (Meenambakkam). The maximum range of the radar is 250 km. The available radar data during the period 1965-69 have been analysed and presented.

3. The heights of the radar echoes were subdivided into six height intervals (as shown in Table 1 a).

In order to study the diurnal variation of the heights of cloud tops the data are again subdivided into five broad periods as shown in Table 1(b).

The echo heights distribution is also studied during the four different seasons shown in Table 2 (a).

Table 1 gives the percentage mean frequency distribution of the echoes (a) for different height ranges, and (b) for different periods of the day. Tables 2 (a) & (b) give the mean seasonal distribution of radar echoes for different height ranges and during different periods of the day.

4. It is seen from the frequency distribution for different heights that during the month of October the maximum number of radar echoes are observed, the least being in the month of February. Also most of the echo tops are below 5 km heights. Only during April and May the echo tops reach beyond 13 km. During monsoon season and especially during July and August the tops do not reach beyond 12 km and during winter season the echoes are less in number and do not go beyond 10 km. From the frequency distribution of the echoes during different parts of the day it is seen that most of the echoes occur only during the afternoon, i.e., between 1230 & 1730 IST, which is the period of maximum convective activity. It is further noticed that the maximum number of occurrence of radar echoes (the percentage being 44 per cent) is seen during the monsoon season and during the winter season it is the least being only 4 per cent. During the post monsoon season during which period Madras gets the major amount of rainfall, the percentage of occurrence is 41 per cent.

Thus it is seen that though the post monsoon season gives the major amount of rainfall over Madras city, the number of echoes are more during the monsoon season and the echo tops are higher during the pre-monsoon season.

5. From the frequency distribution it is seen that 40 per cent of the rainfall is due to the echoes which fall in the height range of 15,000 to 20,000 feet. 30 per cent is between 25,000 & 30,000 feet. Incidentally it may be mentioned that the maximum number of occasions of rainfall occurs when the echo heights are just above the freezing level (viz., 16,000 feet over Madras).
LETTERS TO THE EDITOR

TABLE 1 (a)
Monthly mean frequency distribution of radar echoes for different height (km) ranges

<table>
<thead>
<tr>
<th></th>
<th>&lt;5 km</th>
<th>5.1 to 7 km</th>
<th>7.1 to 9 km</th>
<th>9.1 to 11 km</th>
<th>11.1 to 13 km</th>
<th>&gt;13 km</th>
<th>Total (echoes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>49</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>51</td>
</tr>
<tr>
<td>February</td>
<td>10</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>March</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>51</td>
</tr>
<tr>
<td>April</td>
<td>39</td>
<td>30</td>
<td>24</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>105</td>
</tr>
<tr>
<td>May</td>
<td>39</td>
<td>53</td>
<td>40</td>
<td>16</td>
<td>5</td>
<td>1</td>
<td>154</td>
</tr>
<tr>
<td>June</td>
<td>105</td>
<td>94</td>
<td>33</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>239</td>
</tr>
<tr>
<td>July</td>
<td>132</td>
<td>69</td>
<td>13</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>215</td>
</tr>
<tr>
<td>August</td>
<td>218</td>
<td>104</td>
<td>25</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>349</td>
</tr>
<tr>
<td>September</td>
<td>161</td>
<td>77</td>
<td>13</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>254</td>
</tr>
<tr>
<td>October</td>
<td>297</td>
<td>130</td>
<td>14</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>443</td>
</tr>
<tr>
<td>November</td>
<td>219</td>
<td>42</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>265</td>
</tr>
<tr>
<td>December</td>
<td>192</td>
<td>43</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>239</td>
</tr>
<tr>
<td>Whole year</td>
<td>1,481</td>
<td>662</td>
<td>179</td>
<td>44</td>
<td>12</td>
<td>2</td>
<td>2,380</td>
</tr>
</tbody>
</table>

TABLE 1 (b)
Monthly mean frequency distribution of echoes for different periods of the day (Time IST)

<table>
<thead>
<tr>
<th></th>
<th>0530-0830</th>
<th>0830-1230</th>
<th>1230-1730</th>
<th>1730-2030</th>
<th>2030-0530</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>8</td>
<td>11</td>
<td>15</td>
<td>7</td>
<td>10</td>
<td>51</td>
</tr>
<tr>
<td>February</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>March</td>
<td>3</td>
<td>6</td>
<td>20</td>
<td>9</td>
<td>13</td>
<td>51</td>
</tr>
<tr>
<td>April</td>
<td>12</td>
<td>16</td>
<td>47</td>
<td>14</td>
<td>16</td>
<td>105</td>
</tr>
<tr>
<td>May</td>
<td>10</td>
<td>13</td>
<td>61</td>
<td>35</td>
<td>35</td>
<td>154</td>
</tr>
<tr>
<td>June</td>
<td>5</td>
<td>4</td>
<td>98</td>
<td>69</td>
<td>63</td>
<td>239</td>
</tr>
<tr>
<td>July</td>
<td>6</td>
<td>3</td>
<td>83</td>
<td>59</td>
<td>64</td>
<td>215</td>
</tr>
<tr>
<td>August</td>
<td>11</td>
<td>16</td>
<td>113</td>
<td>82</td>
<td>127</td>
<td>349</td>
</tr>
<tr>
<td>September</td>
<td>16</td>
<td>16</td>
<td>75</td>
<td>56</td>
<td>91</td>
<td>254</td>
</tr>
<tr>
<td>October</td>
<td>51</td>
<td>75</td>
<td>129</td>
<td>64</td>
<td>124</td>
<td>443</td>
</tr>
<tr>
<td>November</td>
<td>35</td>
<td>41</td>
<td>69</td>
<td>38</td>
<td>82</td>
<td>265</td>
</tr>
<tr>
<td>December</td>
<td>25</td>
<td>41</td>
<td>58</td>
<td>32</td>
<td>83</td>
<td>239</td>
</tr>
<tr>
<td>Total</td>
<td>186</td>
<td>245</td>
<td>773</td>
<td>466</td>
<td>710</td>
<td>2,380</td>
</tr>
</tbody>
</table>

TABLE 2 (a)
Mean seasonal distribution of radar echoes for different height ranges

<table>
<thead>
<tr>
<th>Season</th>
<th>&lt;5 km</th>
<th>5.1-7 km</th>
<th>7.1-9 km</th>
<th>9.1-11 km</th>
<th>11.1-13 km</th>
<th>&gt;13 km</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter (Jan-Feb)</td>
<td>59</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>66</td>
</tr>
<tr>
<td>Hot Weather (Pre-monsoon) (March, April, May)</td>
<td>98</td>
<td>98</td>
<td>74</td>
<td>30</td>
<td>8</td>
<td>2</td>
<td>310</td>
</tr>
<tr>
<td>Monsoon (June-Sept)</td>
<td>616</td>
<td>344</td>
<td>84</td>
<td>11</td>
<td>2</td>
<td>0</td>
<td>1,057</td>
</tr>
<tr>
<td>Post monsoon (Oct-Dec)</td>
<td>708</td>
<td>215</td>
<td>19</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>947</td>
</tr>
<tr>
<td>Total</td>
<td>1,481</td>
<td>662</td>
<td>179</td>
<td>44</td>
<td>12</td>
<td>2</td>
<td>2,380</td>
</tr>
</tbody>
</table>
TABLE 2 (b)

Mean seasonal distribution of radar echoes for different periods of the day

<table>
<thead>
<tr>
<th>Season</th>
<th>0530-0830 IST</th>
<th>0830-1230 IST</th>
<th>1230-1730 IST</th>
<th>1730-2030 IST</th>
<th>2030-0530 IST</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>12</td>
<td>14</td>
<td>20</td>
<td>8</td>
<td>12</td>
<td>66</td>
</tr>
<tr>
<td>Pre-monsoon</td>
<td>25</td>
<td>35</td>
<td>128</td>
<td>58</td>
<td>64</td>
<td>310</td>
</tr>
<tr>
<td>Monsoon</td>
<td>38</td>
<td>39</td>
<td>369</td>
<td>266</td>
<td>345</td>
<td>1,057</td>
</tr>
<tr>
<td>Post monsoon</td>
<td>111</td>
<td>157</td>
<td>256</td>
<td>134</td>
<td>289</td>
<td>947</td>
</tr>
<tr>
<td>Total</td>
<td>186</td>
<td>245</td>
<td>773</td>
<td>466</td>
<td>710</td>
<td>2,380</td>
</tr>
</tbody>
</table>

TABLE 3

Percentage frequency distribution of number of occasions of rainfall

<table>
<thead>
<tr>
<th>Radar echo ht range in 1000 ft</th>
<th>Pre-monsoon Apr-May (a)</th>
<th>Monsoon Jun-Sep (b)</th>
<th>Post monsoon Oct-Dec (c)</th>
<th>a+b+c (Apr-Dec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>10-15</td>
<td>20</td>
<td>18</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>15-20</td>
<td>32</td>
<td>36</td>
<td>47</td>
<td>40</td>
</tr>
<tr>
<td>20-25</td>
<td>20</td>
<td>35</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>25-30</td>
<td>11</td>
<td>8</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>&gt;30</td>
<td>17</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Also from the same table it is seen that only 20 per cent of the occasions of rainfall is due to clouds below 15,000 feet (i.e., below freezing level) and the rest 80 per cent is due to clouds reaching above freezing level. So we can say that over Madras the rain due to warm clouds is only 20 per cent.

6. The authors are thankful to Dr. A. A. Rama Sastry for his encouragement. The assistance rendered by S/Shri A. K. Balakrishnan, V. Ramaswamy and K. Subramaniam in collecting data and preparation of the diagrams is gratefully acknowledged. We also thank Shri B. Sundararajan for typing the manuscript.

Regional Meteorological Centre, Madras
24 February 1979

References


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523.78

OBSERVATION OF 10.4 CM RADIO NOISE FROM THE SUN DURING THE SOLAR ECLIPSE OF 16 FEBRUARY 1980

The “radio sun” is taken to be much larger than the optically observed sun’s disc, as the low frequency radio waves emanate mostly from the corona. However, at centimetre wavelengths most of the radiation appears to originate from within the chromosphere (Kundu 1965). In a total or near total solar eclipse the radio wave flux at these wavelengths should, therefore, decrease sharply (Hagen 1957).