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Squalls at Begumpet

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1. Introduction

Begumpet (Lat. 17°27′ N, Long. 78°28′E) is an important aerodrome in the aviation map of India. Main aviation hazards here during the pre-monsoon and monsoon periods include thunderstorm activity with associated surface squalls. A study of the features of the surface squalls during the year is made in this paper, with the aid of the anemograms and barograms of Begumpet. This study is made more or less on the lines of Ramakrishnan(1957).

2. Data

A Dines Pressure Tube Anemograph was functioning till 1952 at the Nizamiah Observatory which is situated just about 1½ miles south of the Begumpet aerodrome. Later, the anemograph was shifted to the present site (Begumpet aerodrome). The records as a whole for the years 1935 to 1957 (23 years) form part of the study of this paper. Records of the barograph for the whole period were also available and hence the changes in barometric pressure in association with the surface squalls have also been worked out.

The height of the Dines Anemograph at the Nizamiah Observatory was about 52 ft above ground and the height of the Dines at the Begumpet airport is 61 feet above ground.

3. Frequency of occurrence of squalls

The number of days on which at least one squall occurred in each month, in each of the 23 years, and the means per month, are shown in Table 1. On the average, there are 14·3 squally days in the year and this number varies from 3 in 1948 to 25 in 1937. Out of this, the largest number of squally days (3·5) occur during the month of May with April closely following with 2·7 days and June with 2·5 days. The maximum number of squalls on a single day was 3 on 15 May 1936.

The number of actual squalls occurring in each month, in each of the 23 years and the mean per year are given in Table 2. For analysis purposes, the year has been divided into four seasons, the cold weather period (January and February), the pre-monsoon period (March to May), the monsoon period (June to September) and the post-monsoon period (October to December). It is interesting to note that Begumpet is almost free from squalls during the cold weather period (the total number of squalls for 23 years for this season was only 7) and also during the post-monsoon period (the total was 6 for this season for 23 years) although there is a good amount of thundery activity over Hyderabad during the post-monsoon period. The maximum number of squalls have occurred during the month of May (4 squalls on the average). The total number of squalls for May was 92 out of the 356 squalls studied for the entire period of 23 years (*i.e.* about 26 per cent). On a comparison of Tables 1 and 2, it is seen that they are more or less identical,

and it can be assumed that once a squall has occurred on any day, the chances of another squall on the same day, are very little.

A study of the distribution of squally days (week by week) during May (which has the maximum number of squalls) revealed that they are practically evenly distributed throughout the month. Details of the same are given in Table 3.

4. Times of commencement

The distribution of squalls according to their times of occurrence, month by month, for the whole year is shown in Table 4. Only 4 of the 356 squalls, occurred between the hours 0600 and 1300 IST. Such squalls as occur between midnight and 0600 IST are mostly in the months of March to June.

5. Duration of squalls

The distribution of squalls according to their duration in steps of quarter hour upto two hours, and half hour steps from two to four hours is shown in Table 5. It is seen that 72 per cent of the squalls during the cold weather period die off within 30 minutes of their commencement. During the premonsoon period, 82 per cent of the squalls exhaust themselves within one hour of their commencement. 16 per cent of the squalls in this season have exceeded one hour duration but have died off before 2 hours. During the monsoon months, 93 per cent of the squalls exhaust themselves, before one hour. Only 3 squalls (2 per cent) have reached 3 hours duration. In the matter of duration, there is not much striking difference between the pre-monsoon and monsoon squalls.

6. Maximum velocity

The distribution of squalls according to the maximum gust speed is shown in Table 6. It is seen that 65 per cent of the squalls attain the maximum gust speed of less than 39 mph. 24 per cent of the squalls reach a speed 40-49 mph and 8 per cent reach a speed of 50-59 mph and the number falls off steeply for the speed intervals of 60-69 mph and more than 70 mph. In the matter of speed, the squalls of pre-monsoon and monsoon seasons are absolutely identical, excepting for the fact that the more violent ones (more than 70 mph) occur during the pre-monsoon season. The highest gust speed in squall during the 23 years studied, was recorded at 1338 IST on 11 March 1957, the speed being 89 mph.

7. Direction of squalls

The number of squalls which occurred from different directions and wind direction before the onset of the squalls during the pre-monsoon and monsoon seasons have been shown in Table 7. During the cold weather period, all the squalls have occurred from the sector SW to NNW (clock-wise). There were only 7 squalls during this period —2 each from SW, (SE) and W(NE, ENE) and 1 each from WNW(S), NW(SE) and NNW(NNE), the directions within bracket being of wind before the squalls. During the pre-monsoon season, the squalls have a wide scatter and a major portion (75 per cent) of these have occurred from the sector SW to NE (clock-wise). During the monsoon period, out of the total of 153 squalls, 146 squalls (95 per cent) have occurred from the semi-circle south to north (clock-wise). Out of the 146 squalls in this semi-circle, as many as 129 squalls have occurred from SW to NW.

During the post-monsoon season, there were 6 squalls—2 from ENE (ENE, SE), and 1 each from NE(NE), SSW(NE), SW (SW) and NNW(WNW), the directions within bracket being of wind before the squalls.

8. Changes in barometric pressure

The changes in barometric pressure attendant upon the squalls are given in Table 8. It is seen that while the pressures have normally risen with surface squalls, there have been some cases where pressures have also fallen. The rise in pressure has generally been of the order of 0·1 to 2·0 mb in

a major portion of the cases.

9. Duration of squalls with reference to their times of occurrence

The duration of squalls with reference to their times of occurrence is given in Table 9. It is found that squalls occurring during the period 1400 and 1800 IST last on an average even upto $1\frac{1}{2}$ hours.

10. Distribution of squalls according to maximum gust speed (with reference to directions)

Wind-roses representing the distribution of squalls according to their maximum speed (direction-wise) in the pre-monsoon and monsoon seasons and whole year are shown in Figs. 1, 2 and 3.

It is seen from these figures that the squalls of speed less than 49 mph have occurred from all directions during the pre-monsoon season. During the monsoon period, the major portion of squalls upto 49 mph have confined themselves to the directions south to north through west.

During the cold weather period, there were 4 squalls with maximum speed upto 39 mph (2 from SW and 1 each from W and WNW), 2 squalls with speed limit 40-49 mph (1 each from W and NNW) and 1 squall from NW with maximum speed 50 to 59 mph.

In the post-monsoon period, there were 6 squalls with maximum wind speed upto 39 mph (2 from ENE and 1 each from NE, SSW, SW and WNW).

11. Acknowledgement

I am grateful to Shri Y.P. Rao, Director, Regional Meteorological Centre, Madras who was kind enough to go through the paper, and to Shri V. Balasubramaniam, Meteorological Officer, Begumpet Airport, for his useful suggestions.

REFERENCE

Ramakrishnan, K. P. 1957 *Indian J. Met. Geophys.*, **8**, 3, p. 289.

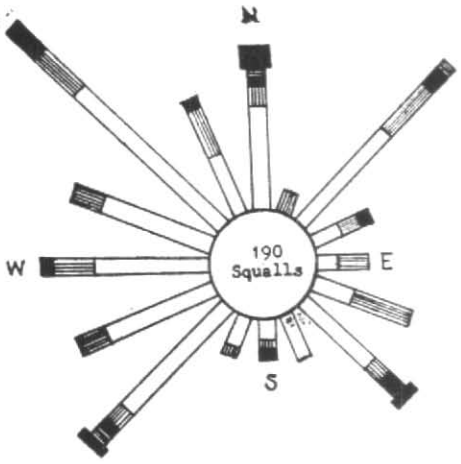


Fig. 1. Pre-monsoon period

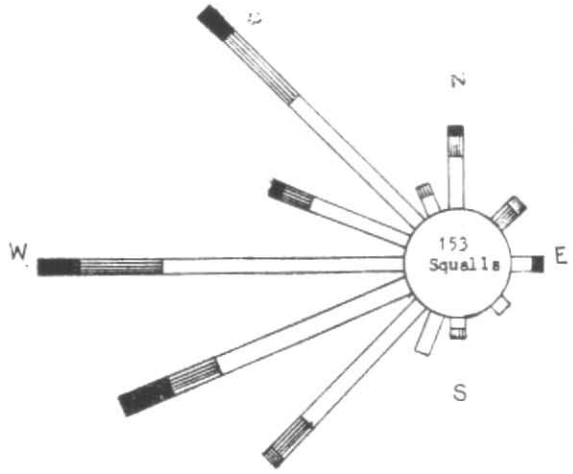
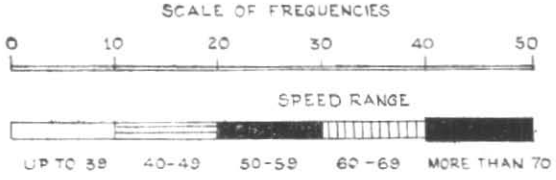


Fig. 2. Monsoon period



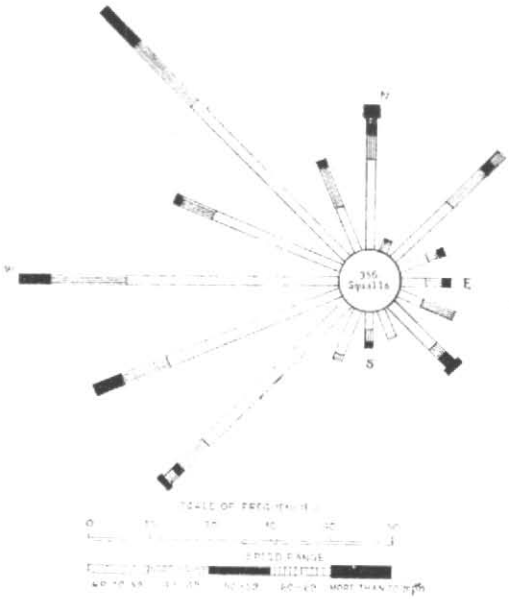


Fig. 3. Whole year

TABLE 1

Number of days with squalls at Begumpet (1935-1957)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1935			1	2	3	3	2	1	1	1			14
1936		2	1		9	5	2	1	1				21
1937		1	8	5	1	3	5	1	1				25
1938		1		4	5	2	1	2	2	2			19
1939			2	2	3				2	2			11
1940				4	2	3		2	1				12
1941	1			3	4	3	2	1					14
1942				4	3	2	1			1			11
1943			2	3	1	1	2	1	1				11
1944			4	2	6	6		1	2				21
1945				3	2	1	7	4					17
1946		1	2	6	3	1		2	1				16
1947	1				3	1	2	1					8
1948			1	1				1					3
1949				1	2	4	1						8
1950					6	3	1						10
1951			2	1	5	2		1	2				13
1952				3	4	4		1					12
1953				4		1							5
1954			2	1	3	3	3	1	2				15
1955			1	3	3	2	5	3					17
1956				6	8	2	4	3					23
1957			2	3	5	6	2	2	2				22
Total	2	5	28	61	81	58	40	29	18	6			328
Mean per year	0·1	0·2	1·2	2·7	3·5	2·5	1·7	1·3	0·8	0·3			14·3

TABLE 2

Number of squalls at Begumpet (1935-1957)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1935			1	3	4	3	2	1	1	1			16
1936		2	1		12	5	2	1	1				24
1937		1	9	5	1	3	5	1	1				26
1938		1		5	5	2	2	2	2	2			21
1939			4	2	3				2	2			13
1940				4	2	3		2	2				13
1941	1			4	4	3	2	1					15
1942				4	4	2	1			1			12
1943			2	4	1	1	2	1	1				12
1944			4	2	7	6		1	2				22
1945				3	2	1	8	4					18
1946		1	2	7	3	1		2	1				17
1947	1				3	1	2	1					8
1948			1	1				1					3
1949				1	2	4	1						8
1950					6	3	1						10
1951			2	1	7	2		1	2				15
1952				3	5	4		1					13
1953				4		1							5
1954			2	1	3	3	3	1	2				15
1955			1	4	4	2	6	3					20
1956				6	9	2	4	4					25
1957			2	3	5	9	2	2	2				25
Total	2	5	31	67	92	61	43	30	19	6			356
Mean per year	0·1	0·2	1·3	2·9	4·0	2·7	1·9	1·3	0·8	0·3			15·5

TABLE 3

Distribution of squally days during May at Begumpet week by week (1935-1957)

I week (1st—7th)	II week (8th—14th)	III week (15th—21st)	IV week (22nd—28th)	Rest of the month (29th—31st)
17	18	17	21	8

TABLE 4

Distribution of squalls at Begumpet according to time of commencement, hour by hour (1935-1957)

Hour (IST)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
0001—0100			2	3	4	2		1					12
0101—0200			1		1	1							3
0201—0300				1		1							2
0301—0400				3	2								5
0401—0500			1	1	5		1						8
0501—0600		1	1	1			1						4
0601—0700				1									1
0701—0800					2								2
0801—0900													
0901—1000													
1001—1100													
1101—1200				1									1
1201—1300													
1301—1400			1	3	1			1	2				8
1401—1500		1	2	3	11	1	2		2	1			23
1501—1600	1	1	7	12	9	4	4	5	4				47
1601—1700			1	9	19	13	3	3	2	1			51
1701—1800			2	9	15	7	10	7	2	1			53
1801—1900				6	6	6	9	3	2	2			34
1901—2000	1		4	3	3	12	6	4	2				35
2001—2100		1	3	4	6	6	3	3	2				28
2101—2200			1	2	2	3	1		1	1			11
2201—2300		1	4	2	2	4	2	3					18
2301—2400			1	3	4	1	1						10

TABLE 5

Distribution of squalls at Begumpet according to duration (1935-1957)

Hour	Cold weather period (Jan and Feb)	Pre-monsoon period (Mar to May)	Monsoon period (Jun to Sep)	Post-monsoon period (Oct to Dec)	Year
$\frac{1}{4}$	2	45	60	3	110
	(29)	(24)	(39)	(50)	(31)
$\frac{1}{4}$—$\frac{1}{2}$	3	51	51	1	106
	(43)	(27)	(33)	(17)	(30)
$\frac{1}{2}$—$\frac{3}{4}$	1	38	20	2	61
	(14)	(20)	(13)	(33)	(17)
$\frac{3}{4}$—1	—	22	13	—	35
		(11)	(8)		(10)
1—1$\frac{1}{4}$	—	9	2	—	11
		(5)	(1)		(3)
1$\frac{1}{4}$—1$\frac{1}{2}$	1	9	1	—	11
	(14)	(5)	(1)		(3)
1$\frac{1}{2}$—1$\frac{3}{4}$	—	6	1	—	7
		(3)	(1)		(2)
1$\frac{3}{4}$—2	—	5	2	—	7
		(3)	(1)		(2)
2—2$\frac{1}{2}$	—	1	—	—	1
		—			—
2$\frac{1}{2}$—3	—	1	3	—	4
		—	(2)		(1)
3—3$\frac{1}{2}$	—	2		—	2
		(1)			(1)
3$\frac{1}{2}$—4	—	1	—	—	1
		—			—
Total	7	190	153	6	356

The figures in brackets are percentages of totals of season or year

TABLE 6

Distribution of squalls at Begumpet according to maximum gust speed (1935-1957)

	Upto 39 mph	40—49 mph	50—59 mph	60—69 mph	More than 70 mph	Total
January and February (Cold weather period)	4 (57)	2 (29)	1 (14)	—	—	7
March to May (Pre-monsoon period)	122 (64)	47 (25)	14 (7)	3 (2)	4 (2)	190
June to September (Monsoon period)	101 (66)	35 (23)	15 (10)	2 (1)	—	153
October to December (Post-monsoon period)	6 (100)	—	—	—	—	6
Year	233 (65)	84 (24)	30 (8)	5 (1)	4 (1)	356

The figures in brackets are percentages of totals of season or year. The highest gust speed of 89 mph in a squall (during the period 1935-1957) was recorded at 1338 IST on 11 March 1957

TABLE 7

Direction of squalls at Begumpet (1935-1957)

Direction before squall	Direction of squall															
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
(a) Pre-monsoon period (March to May)																
N			1	1		2								2	2	
NNE	1									1		1	1		1	2
NE	2	1	1	1	1	1	1	1	1		1	1	2		8	2
ENE	2		1	1			1			1	1					1
E	3		1		2	1	2				4		2	2	5	2
ESE			3	1		2	1						1	2	1	
SE	2					1	3			1	1	1	1		1	2
SSE			1	1			3	1			1		1	1	1	
S			3		1	1	1	1			2				1	
SSW											1			1	1	
SW	2		3	1		1		2	1			1	2			2
WSW			1				1				3	2	3	1	2	1
W	1					1			1		2	4	2	1	2	
WNW			1											1		
NW	2		1				1		1	1	3	3	1		1	
NNW		1	2											2		
Var.			1													
Calm	1		1		1							1		1	2	
Total	16	2	21	6	5	10	14	5	4	4	19	14	16	14	28	12
(b) Monsoon period (June to September)																
N			2		1						1		1	1	2	
NNE																
NE															1	
ENE																
E																
ESE																
SE															1	
SSE									1	1						
S											1					
SSW									1		2	4			1	
SW	1		1				1			1	6	3	5		3	
WSW	1										2	10	5	4	6	
W	2									1	5	5	18	2	5	
WNW	1				1					1	1	5	4	5	5	1
NW	3				1						2	3	1	2	4	1
NNW																1
Var.																
Calm											1		1		1	
Total	8		3		3		1		2	4	21	30	35	14	29	3

TABLE 8

Changes in pressure attendant upon squalls at Begumpet (1935-1957)

Direction	Rise in pressure (mb)									
	0·1 to 0·5	0·6 to 1·0	1·1 to 1·5	1·6 to 2·0	2·1 to 2·5	2·6 to 3·0	3·1 to 3·5	3·6 to 4·0	4·1 to 4·5	4·6 to 5·0
N	8	5			1	1	2			
NNE	1	1								
NE	5	5	4	2	1	3	1			
ENE	1	3		2		1				
E	1	4				1				
ESE	2	2	1	3						
SE	3	3		2	1			1		
SSE	2	1	1							
S	1	2	1	1						
SSW	4	1	1							
SW	16	8	10				1			
WSW	12	14	7	2	2					
W	18	12	7	6	1	1	1			
WNW	7	10	6	2	2	1				
NW	11	16	12	4	4					
NNW	5	4	4	1		1				1

Direction	Rise in pressure (mb)				Fall (mb)			No change	No record	Total
	5·1 to 5·5	5·6 to 6·0	6·1 to 6·5	6·6 to 7·0	0·1 to 0·5	0·6 to 1·0	1·1 to 1·5			
N					1			4	1	23
NNE										2
NE					1			2	1	25
ENE								1		8
E								2		8
ESE								2		10
SE	1				1			3		15
SSE								1		5
S								1		6
SSW					1			2		9
SW								8		43
WSW								6	1	44
W			1					6		53
WNW								2		30
NW				1	2		1	6	1	58
NNW								1		17

TABLE 9

Duration of squalls at Begumpet with reference to their times of occurrence (1935—1957)

Times of occurrence (IST)	Duration (hrs)												Total
	Upto $\frac{1}{4}$	$\frac{1}{4}$-$\frac{1}{2}$	$\frac{1}{2}$-$\frac{3}{4}$	$\frac{3}{4}$-1	1-1$\frac{1}{4}$	1$\frac{1}{4}$-1$\frac{1}{2}$	1$\frac{1}{2}$-1$\frac{3}{4}$	1$\frac{3}{4}$-2	2-2$\frac{1}{2}$	2$\frac{1}{2}$-3	3-3$\frac{1}{2}$	3$\frac{1}{2}$-4	
0001—0100	3	5	2	1			1						12
0101—0200				1		1		1					3
0201—0300	1	1											2
0301—0400	2	1	1	1									5
0401—0500	2	1	2	2			1						8
0501—0600		1	1	2									4
0601—0700		1											1
0701—0800		2											2
0801—0900													
0901—1000													
1001—1100													
1101—1200		1											1
1201—1300													
1301—1400	2	3	2			1							8
1401—1500	8	5	3	4	1	1					1		23
1501—1600	16	13	8	3	2	1	1	1		1	1		47
1601—1700	22	10	11	5	2					1			51
1701—1800	22	12	9	2	2	3		2				1	53
1801—1900	10	13	4	4		1		1	1				34
1901—2000	6	15	5	5	2		1			1			35
2001—2100	8	10	4	2	1		3						28
2101—2200	1	5	3	2									11
2201—2300	4	4	5	1		2		2					18
2301—2400	3	3	1		1	1					1		10