

# Sea-breeze at Ahmedabad

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**ABSTRACT.** It is found that summer months at Ahmedabad are marked by the arrival of sea-breeze from the Gulf of Cambay (about 50 miles to the south) during the evening hours. The occurrence of sea-breeze is more frequent and its effect more pronounced in the months of May and June. A few statistical data relating to this sea-breeze are given in this paper.

## 1. Introduction

A preliminary study of the lower atmospheric wind structure over Ahmedabad has already been made (Venkateswaran 1953). The author, during the course of his day-to-day forecasting work at Ahmedabad, had also noticed the arrival of a cool, humid and gusty breeze during the evening hours of summer months, having all the characteristics of sea-breeze. With a view to study further the nature of this sea-breeze, a detailed analysis of autographic records of Ahmedabad, for a period of two years (October 1952 to September 1954) was carried out. The results of this study are given in this paper.

It may be mentioned here that small changes in surface wind and decrease of temperature may not always necessarily indicate the replacement of land air by fresh sea-breeze. Such changes are sometimes caused by disturbed weather at or near the station. Care has been taken to exclude all such instances, while selecting data for the purpose of this study. The statistics given in Tables 1 to 4 are all in terms of *averages*, obtained by dividing the total number of occasions by the number of years, for which the records were examined (in this case by two).

## 2 Physical features of Ahmedabad

The city of Ahmedabad is situated on the banks of river Sabarmati, which flows through the whole district. There are no mountains or hills; the entire place is a vast flat land sloping towards southwest.

About 50 miles to the south is the Gulf of Cambay, where the rivers Sabarmati and Mahi pour their waters.

## 3. General characteristics of sea-breeze at Ahmedabad

Sea-breeze arrives at Ahmedabad from Gulf of Cambay generally after 1600 IST and is marked by the following characteristics—

- (i) Drop in temperature
- (ii) Rise in relative humidity
- (iii) Strengthening and backing of surface wind from northwest or west to southwest or south.

## 4. Frequency of occurrence of sea-breeze during different months

Records of self-recording instruments at Ahmedabad, for a period of two years (October 1952 to September 1954) were examined to find out the average number of days of occurrence of sea-breeze, marked by the above characteristics. Table 1 gives the average number of days in each month, when sea-breeze set in during the evening hours. From Table 1, it will be seen that sea-breeze occurs more frequently in the hot months of May and June, when there is a sharp contrast of temperatures between land and sea.

## 5. Sea-breeze during monsoon

During the monsoon months, July to September, the prevailing winds being from the southwest, and the humidity content of the air being fairly high, there is more or

TABLE 1  
Average number of days of occurrence of sea-breeze during different months (October 1952 to September 1954)

Jan	1.0	May	20.5	Sep	4.0
Feb	Nil	Jun	13.5	Oct	1.0
Mar	Nil	Jul	6.5	Nov	Nil
Apr	5.5	Aug	4.0	Dec	Nil

less a constant sea-breeze blowing during this season. However, on a few days of weak monsoon it was noticed that the wind which was westerly throughout the day, suddenly backed to southwest or south, the change being accompanied by increase in wind speed. There was also a simultaneous fall in dry bulb temperature and rise in relative humidity. And although the changes in temperature and humidity were not so marked as in summer months, it was quite clear that these were due to the arrival of a cooler and more moist air from the south, presumably caused by temperature gradient between land and sea in other words sea-breeze. While preparing statistics of sea-breeze for monsoon months, the author has picked up such instances only. This point is to be clearly borne in mind; or otherwise the reader may get the impression that there are very few days of sea-breeze occurrence during the monsoon season, when in fact the monsoon air itself is a large-scale sea-breeze.

#### 6. Sea-breeze during winter

During the period of two years, for which records were examined, it was found that the winter months, November to March, are generally marked by absence of sea-breeze. However, there were two days in January 1954 (*viz.*, 18th and 19th) when this phenomenon was observed. On 18th sea-breeze set in shortly before 1900 IST with a sudden shift in wind direction from WNW to SW and an increase in wind speed from 8 mph to 15 mph. This was accompanied by a fall of  $3.5^{\circ}$  in dry bulb temperature and a rise of 22 per cent in relative humidity. On 19th, sea-breeze set in at about 1945 IST, causing surface wind to change from NW/2 mph to SW/8 mph.

Dry bulb temperature fell by  $2.0^{\circ}$  and relative humidity rose by 38 per cent. It will be worthwhile to know what was the special feature responsible for the occurrence of sea-breeze on these days. The special feature of synoptic situation on these two days was that a low pressure area had formed over Lower Sind, Rajasthan and the adjoining Punjabs. Now during the winter season, the prevailing direction of winds being from northeast to east, the penetration of sea-breeze from the south, is naturally suppressed. But under the influence of the above low pressure area, the normal easterly circulation had been replaced by winds from a westerly direction; and this seems to have helped bring about the incursion of sea-breeze.

#### 7. Frequency of setting-in of sea-breeze at different hours of day

Table 2 gives the average number of days in each month, when sea-breeze set in at different hours.

It will be noticed that the most frequent period of occurrence of sea-breeze is between 1600 to 2200 IST.

#### 8. Temperature changes associated with sea-breeze

As has been mentioned above, the arrival of sea-breeze is marked by a sudden fall of temperature, the fall being more marked if the time of onset is nearer the time, when maximum temperature is attained. An analysis of temperature fall of different order associated with advent of sea-breeze is given in Table 3.

It may be noted that the number of occasions of a large fall of temperature, is maximum in the month of May and then gradually decreases, being lowest in October.

#### 9. Relative humidity changes

The arrival of sea-breeze is also accompanied by increase in relative humidity, the magnitude of increase being chiefly dependent on the temperature and moisture content of the previous land air and the fresh sea-breeze. The average number of occasions of humidity rise of different order associated with the arrival of sea-breeze are given in Table 4.

TABLE 2

Average number of days in each month when sea-breeze set in at different hours  
(October 1952—September 1954)

Month	1500- 1559	1600- 1659	1700- 1759	1800- 1859	1900- 1959	2000- 2059	2100- 2159	2200- 2259	2300- 2359	Total
Jan				0.5	0.5					1.0
Apr				0.5		2.5	0.5	1.0	1.0	5.5
May		1.0	4.5	5.0	5.5	3.0	0.5	1.0		20.5
Jun		0.5	5.0	5.5	1.0	0.5	0.5	0.5		13.5
Jul	0.5	1.0	1.0	3.0	1.0					6.5
Aug		0.5	1.0	1.0	1.0		0.5			4.0
Sep			0.5	1.0	0.5	1.5	0.5			4.0
Oct						1.0				1.0

TABLE 3

Average number of days of temperature fall (°F) of different order  
(October 1952—September 1954)

Month	<1.0	1.0- 1.9	2.0- 2.9	3.0- 3.9	4.0- 4.9	5.0- 5.9	6.0- 6.9	7.0- 7.9	8.0 or more	Total
Jan			0.5	0.5						1.0
Apr	1.0	2.0	1.5			0.5	0.5			5.5
May	0.5	3.5	9.5	4.0	0.5	1.0	1.0			20.0
Jun	2.5	4.5	2.5	2.5	0.5			1.0		13.5
Jul	0.5	1.0	2.5	2.5						6.5
Aug	1.5	2.0	0.5							4.0
Sep	1.5	2.5								4.0
Oct	0.5	0.5								1.0

TABLE 4

Average number of occasions of rise of relative humidity (%) of different order  
(October 1952—September 1954)

Month	< 5	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40 and above
Jan					0.5			0.5	
Apr		0.5		1.0	3.0	1.0			
May		1.0	5.0	4.0	5.5	3.0		1.0	1.0
Jun	0.5	3.0	4.0	2.0	1.5	1.0	0.5	0.5	0.5
Jul		0.5	0.5	2.0	3.0	0.5			
Aug	1.0	1.5	0.5	1.0					
Sep		1.0	2.0	0.5	0.5				
Oct					0.5	0.5			

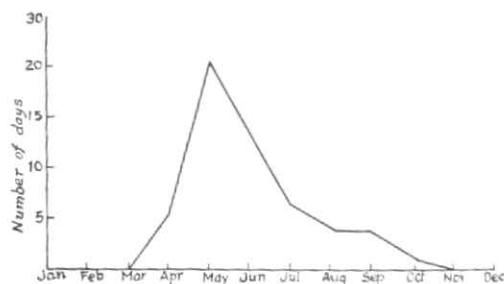


Fig. 1. Number of days of sea-breeze (Table 1)

Here also as in the case of temperature fall, the number of occasions of a large increase in relative humidity, is highest in the months of May and June and then gradually decreases becoming lowest in October. Graphical representation of Tables 1 to 4 is given in Figs. 1 and 2.

#### 10. Typical instances of sea-breeze

In Fig. 3 are shown the anemograph, thermograph and hygrograph records of

Ahmedabad for two days, viz., 18 April 1953 and 19 May 1954 to illustrate the effects of sea-breeze. On 18 April 1953, sea-breeze set in at about 1845 IST with a sudden shift in wind direction from west to southsouthwest and an increase in wind speed from 8 to 26 mph. It caused dry bulb temperature to fall by approximately 6°F and relative humidity to rise by 26 per cent on 19 May 1954, sea-breeze set in at about 1940 IST with a shift in wind direction from northwest to southwest and an increase in speed from 6 to 14 mph. The dry bulb temperature registered a drop of nearly 7°F and relative humidity shot up from 5 to 50 per cent.

#### 11. Acknowledgement

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#### REFERENCE

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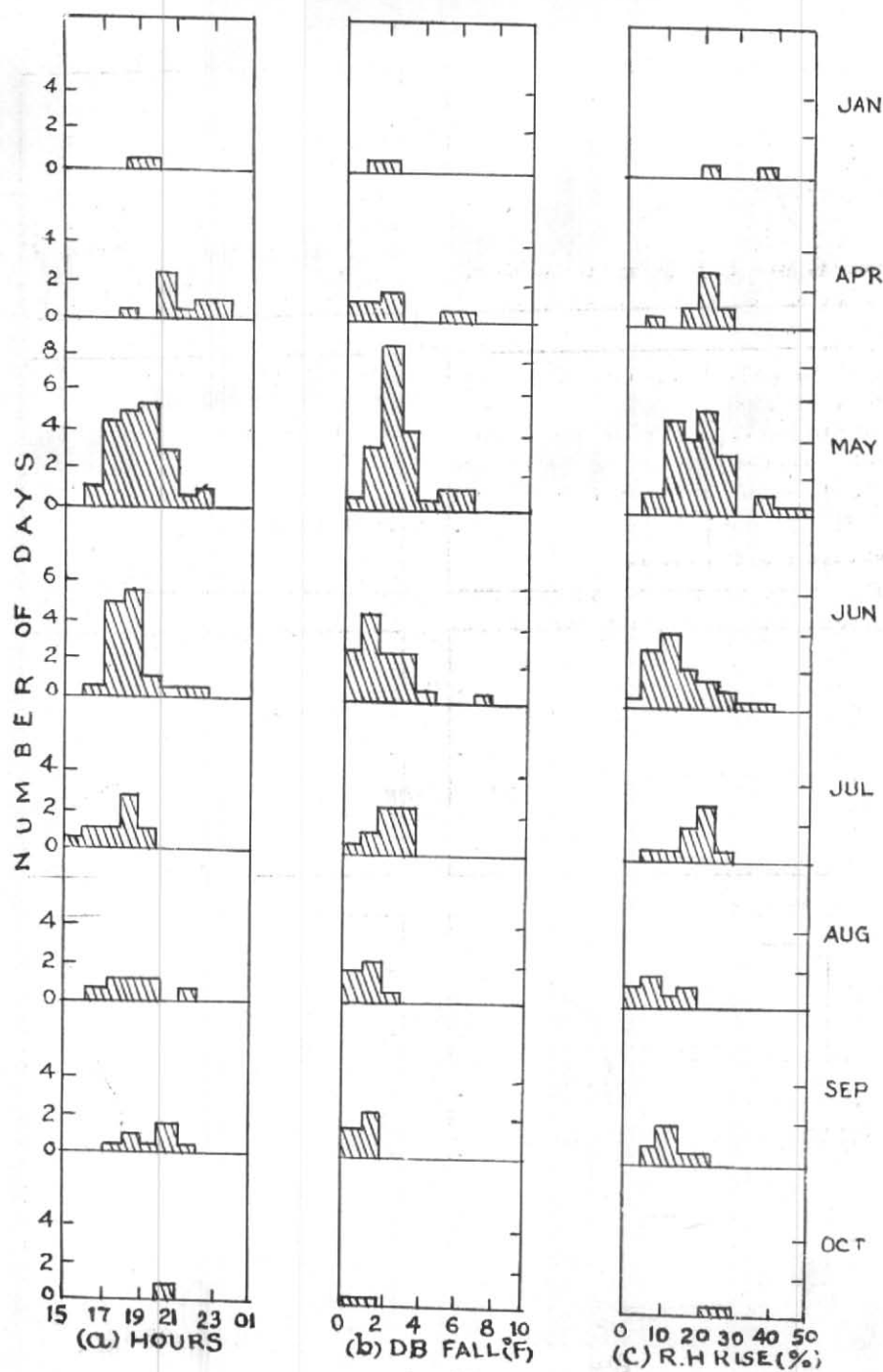


Fig. 2. Frequency distribution of (a) times of onset of sea-breeze (Table 2);  
 (b) dry bulb fall of different orders (Table 3);  
 (c) relative humidity rise of different orders (Table 4)

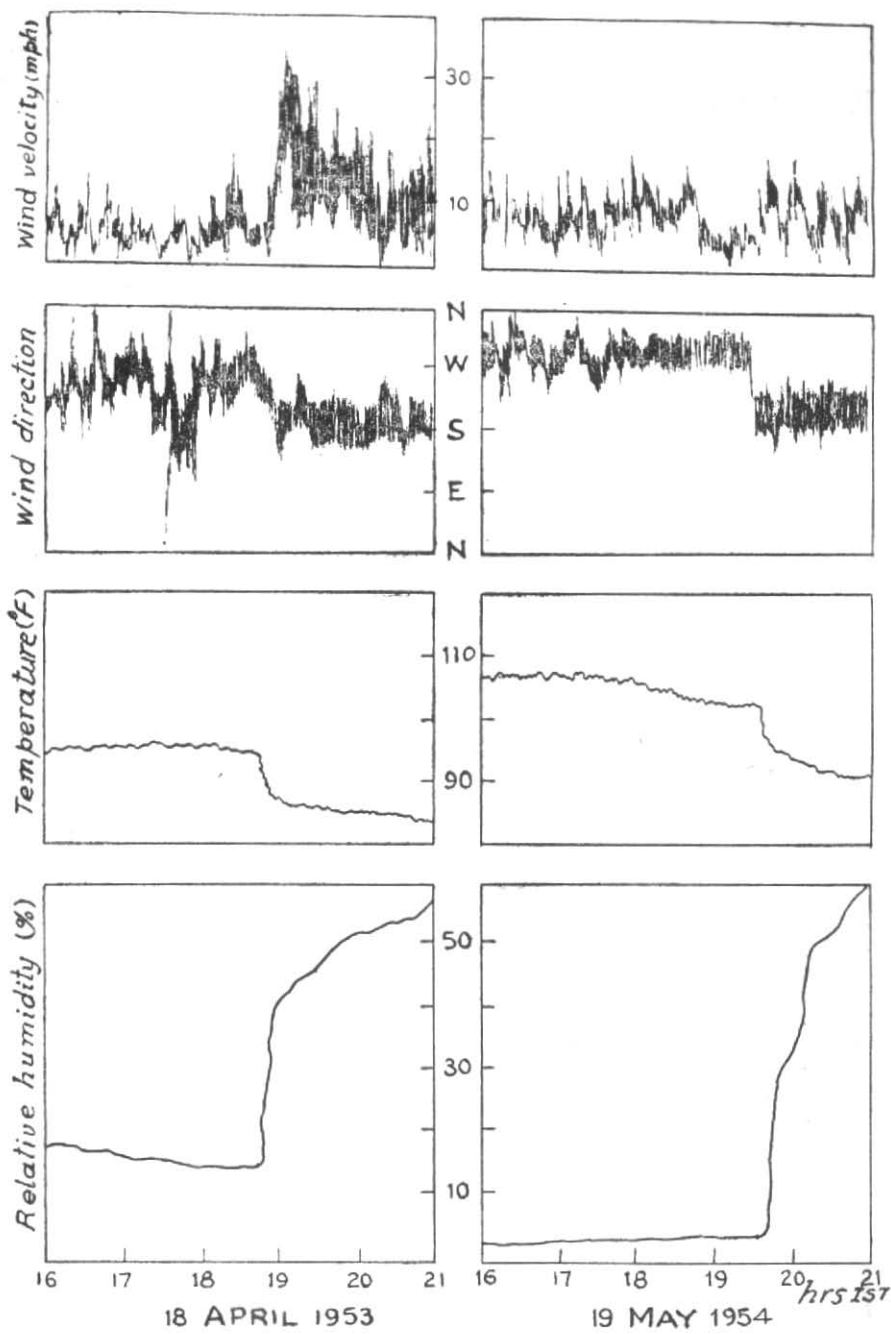


Fig. 3