

Some characteristics of fog over Guwahati airport

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सार — इस शोध पत्र में गुवाहाटी हवाई अड्डे पर कोहरा बनने की आवृत्तियों, इसके प्रारम्भ होने का समय, इसकी अवधि, इसके फैलाव का समय और इसकी सघनता जैसे सांख्यिकीय अभिलक्षणों का पता लगाया गया है और नवम्बर से फरवरी तक के माहों में वर्ष 1994–95 से 2003–04 के दौरान 10 वर्षों के आंकड़ों का उपयोग करते हुए इसका विश्लेषण किया गया है। इसमें क्रमशः कोहरे की मासिक आवृत्ति की भिन्नता के गुणांक का आकलन करते हुए और कोहरा बनने की दैनिक संभाव्यता में महत्वपूर्ण आवृत्तियों का आकलन करते हुए कोहरा बनने की अंतः वार्षिक और अंतः मौसमी भिन्नताओं का भी विश्लेषण किया गया है। कोहरा बनने के पूर्वगामी संकेतों का पता लगाने के लिए गुवाहाटी हवाई अड्डे पर आगामी रात अथवा सुबह 1200 यू. टी. सी. पर मौसम विज्ञानी प्राचलों से बनने वाले कोहरे का भी विश्लेषण किया गया है। तालिकाओं में सांख्यिकीय अभिलक्षण दिए गए हैं और उनके महत्त्व पर विचार विमर्श किया गया है। यह देखा गया है कि ओसांक अवदाब (डी. पी. डी.) और सतह पवन का मानीटरन करने से गुवाहाटी हवाई अड्डे पर कोहरा बनने और इसकी सघनता का पूर्वानुमान लगाने में सहायता मिल सकती है।

ABSTRACT. The statistical characteristics like frequencies of occurrence, time of onset, duration, time of dispersal and intensity of fog over Guwahati airport are found out and analysed using 10 years data during 1994-95 to 2003-04 for the months of November to February. Also the interannual and intraseasonal variations of occurrence of fog are analysed by calculating the coefficient of variation of monthly frequency of fog and by calculating the significant periodicities in the daily probability of occurrence of fog respectively. The meteorological parameters at 1200 UTC leading to fog in the following night or morning over Guwahati airport are analysed to find out the precursors for occurrence of fog. Statistical characteristics are given in tables and their significance discussed. It is observed that monitoring of Dew Point Depression (DPD) and surface wind can help prediction of occurrence of fog and its intensity over Guwahati airport.

Key words – Fog, Visibility, Frequency, Intensity, Onset, Duration, Dispersal.

1. Introduction

As fog occurrence is mainly dependent on local factors apart from synoptic features, attempts have been made by many to study the characteristics and predict the occurrence and intensity of fog over different airports. Some of such studies in recent years include those of Mohapatra and Thulsidas (1998) for Bangalore airport, Madan *et al.* (2000) for Hindon airport near New Delhi, Bhushan *et al.* (2003) for north India, Roy Bhowmik, *et al.* (2004) for Safdarjung airport, New Delhi and Singh and Kant (2006) for north India. However, a few studies have been made on fog over Guwahati airport and its neighborhood. Fog is most common phenomenon during winter in northeast India and it is one of the major hazards to aviation activities. It affects the aircraft landing and taking off. Guwahati is gateway of northeast region of

India and the only international airport of the region. Hence, the fog over Guwahati airport has high impact on economy as well as the life of people in the region.

Basu (1957) has analysed the statistical characteristics of fog over Guwahati airport, Mohanbari airport and Tezpur, all in Assam based on data of 1950-52 for the months of November, December, January and February. The above study has limitation as it is based on small data sample. According to climatology (India Meteorological Department, 1999) based on the data of 1951-80, about 91 % of total fog in a year occur over Guwahati airport during the period of November to February.

The height of Guwahati airport is 54 meter above mean sea level. It is situated in the Brahmaputra valley

and at the northern foothills of Garo-Khasi-Jayantya hills and on the southern bank of Brahmaputra river. The great Himalayas (eastern) lies to the north with many snow covered peaks. The valley has gentle slope from east to west. The fog over Guwahati airport is generally associated with western disturbance and other topographical features. The synoptic situation associated with formation of fog has been discussed by Basu (1957). Baghare (1972) has analysed the fog over Guwahati airport based on data of 1967-68 to 1970-71 for the period of 15 November to 31 January and found out the favourable conditions in terms of dry bulb temperature, wet bulb depression at 1500 UTC for occurrence of fog to the next morning. However, the above study is based on data over short period.

Considering all the above it is felt essential to study the characteristic of occurrence, onset, duration, dispersal and intensity of fog over Guwahati airport. The meteorological parameters at 1200 UTC, which are favourable for formation of fog in the following night/morning have been analysed. This study may help in monitoring and prediction of fog over Guwahati. It may be helpful in flight planning and other aviation and non-aviation related activities.

2. Data and methodology

The study has been carried out based on data of four months from November to February over a period of ten years from 1994-95 to 2003-04. The data on day of occurrence of fog, time of onset, time of dispersal, associated visibility and lowest visibility etc are collected from the current weather Register of Meteorological Office, India Meteorological Department, Guwahati airport. The data are quality checked. The monthly and total frequencies during November to February are calculated for occurrence of fog to find out the monthly variation. Also the standard deviation and coefficient of variation (CV) of the monthly frequencies and total frequencies are calculated and analysed to find out interannual variation. The mean frequencies are compared with that during 1951-1980 (India Meteorological Department, 1999) to find out the significant differences, if any. The frequency of years recording fog on each day during 1 November to 28 February over the period of 1994-95 to 2003-04 are calculated. From these data, the daily probability of occurrence of fog during 1 November to 28 February are calculated and analysed to find out the intraseasonal variation in the occurrence of fog. The power spectrum analysis (Blackman & Tukey, 1958) is applied to this daily probability of 120 days (1 Nov-28 Feb) with a maximum lag of 60 days to find out the significant periodicities if any in the occurrence of fog.

TABLE 1

Mean, standard deviation (SD) and coefficient of variation (CV) of frequency of fog over Guwahati airport

Parameter	Period				Total
	Nov	Dec	Jan	Feb	
Mean	8.5	17	15.4	3.9	44.8
SD	3.7	4.2	5.8	3.4	13.9
CV (%)	43	24	38	97	31

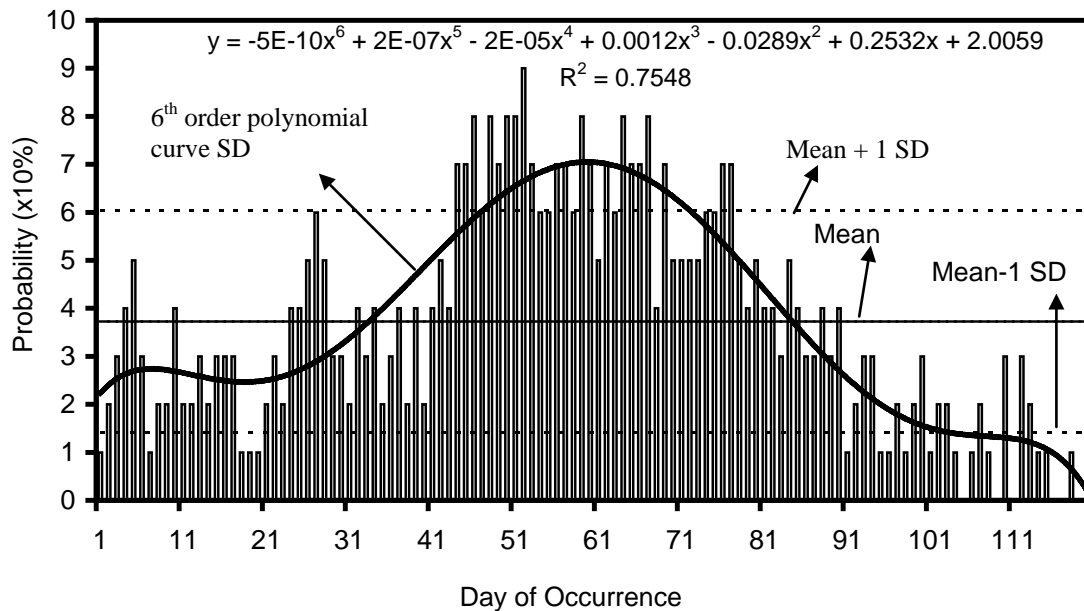
The frequencies of fog with different onset times are calculated and analysed. For this purpose, the frequencies are calculated for every half an hour interval of time of onset. Similarly, the frequencies of fog with different time range of dispersal of fog are calculated and analysed. From the time of onset and dispersal, the duration of fog is calculated for all the occasions. The frequency of fog with different durations are calculated and analysed. The intensity of fog is analysed by finding out the lowest visibility recorded during fog. The frequencies of fog with different lowest visibility ranges are calculated and analysed. Also, the time of occurrence of lowest visibility are found out and analysed.

To find out the favourable meteorological parameters leading to fog, the weather parameters at 1200 UTC over Guwahati airport leading to occurrence of fog at Guwahati airport in the following night/morning are collected from the India Daily Weather Report (IDWR) published by India Meteorological Department. The weather parameters considered in the study include surface wind, Dry bulb temperature (T), Dew Point (DP) and Dew Point Depression (DPD), Mean Sea Level Pressure (MSLP). The zonal wind (U) and meridional wind (V) are calculated from the wind data. The zonal westerly and meridional southerly winds are taken as positive. The zonal easterly and meridional northerly winds are taken as negative. The mean vector wind and the mean values of all the other parameters as mentioned above are calculated and analysed. The CV, maximum values and minimum values of all these parameters are also calculated and analysed to find out the variation in the favourable parameters leading to fog over Guwahati airport.

3. Results and discussion

3.1. Frequency of occurrence of fog

The fog has occurred on 448 occasions over a 10 years period with an average of 44.8 events per year over Guwahati airport (Table 1). The frequency of fog is maximum during month of December followed by



1 corresponds to 1 November, 2 corresponds to 2 November, ...
 120 corresponds to 28 February

The equation for the 6th order polynomial curve fitted to probability distribution and the squared correlation coefficient (R^2) are shown at the top of the figure.

Fig. 1. Day-wise probability ($\times 10\%$) of occurrence of fog over Guwahati airport

January, November and February, same as the climatological pattern. As per climatology of Guwahati (India Meteorological Department, 1999), 16.5 days of fog has occurred in the month of December followed by 11.1 days in January, 9.4 days in November and 1.4 days in February during 1951-80. Comparing with climatology during 1951-80, we find that frequency of fog has significantly increased at 97.5% level of confidence according to Student's "t" test, in January and February and there is no significant change in the frequency during November and December over the years. The occurrence frequency is 38% in December, 34% in January, 19% in November and only 9% in February. This shows that 72% fog occurs during months of December and January and rest in November and February. There has been two such years during the period under study when there has been no fog in whole month of February. Considering CV, the month with higher frequency of occurrence shows less interannual variation and *vice versa* (Table 1).

According to Basu (1957), When the area is affected by western disturbance, Guwahati experiences fog following the western disturbance. According to him, fog develops on about 70% occasion over Guwahati during November to January when the area is not affected by the western disturbance. Following the passage of western

disturbance anticyclonic circulation sets in over north India and dry cold air associated with this anticyclonic circulation, sets in over the area and produces clear skies, although occasionally high clouds and scattered cumulus clouds in the afternoon are not unusual. After 1200 UTC, these clouds begin to dissipate and by early part of night, the sky clears and remains so until 0400 or 0500 UTC on the following morning. Such a clearing together with light surface wind inevitably produces favourable conditions for fog formation in the early morning hours. On the other days of the winter months (November to January), when light northerly/northeasterly winds at lower levels with clear skies prevail over the region during the night hours, advection of moisture from Brahmaputra river allows the surface layers of air to form aerial lakes which under the influence of radiative cooling produces favourable conditions necessary for fog formation.

3.2. Day of occurrence of fog

It is observed that occurrence of fog in November is more probable (probability $> 50\%$) during first and last weeks (Fig. 1). The occurrence of fog is also more probable during the second half of December and first half of January with probability being more than 50% on most days. The occurrence of fog in February is less with

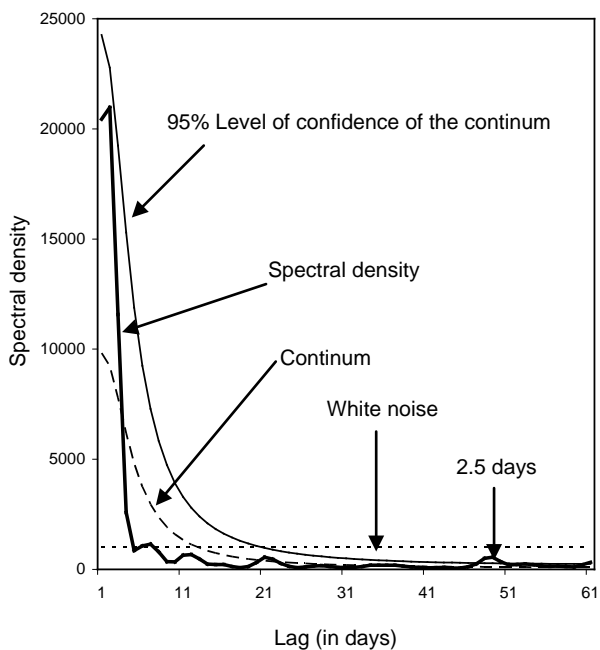


Fig. 2. Spectral density of probability of occurrence of fog during November-February over Guwahati airport

maximum probability of 30% during a few days. In other words, the occurrence of fog is random in nature during February. An attempt has been made to fit the polynomial to the daily probability of occurrence of fog. It is found that the 6th order polynomial can be well fitted (Fig. 1), as it explains more than 75% of total variance (R^2).

The power spectrum analysis of the daily probability of occurrence of fog over Guwahati airport during the period of 1 November to 28 February indicates that there is a significant periodicity of 2.5 days (Fig. 2). The 2.5 days periodicity may be associated with the prevalence of western disturbances or their remnants over the region almost with the same periodicity during December and January.

3.3. Onset of fog

The annual frequency of onset of fog is maximum between 0001 to 0030 UTC followed by 0031 to 0100 UTC and 2331 to 2400 UTC (Table 2). About 35% of total fogs occur during 0001 to 0030 UTC, 12% in 0031 to 0100 UTC, and 11% in 2331 to 2400 UTC. About 48% of total fogs occur in 0001 to 0100 UTC and 59 % between 2331 to 0100 UTC. The monthly distribution of frequency of onset of fog shows that maximum onset takes place between 0001 to 0030 UTC for all the months (Table 2).

TABLE 2

Time of onset of fog over Guwahati airport during November to February over the period of 10 years (1994-95 to 2003-04)

Time of onset (UTC)	Number of days				Total
	Nov	Dec	Jan	Feb	
0001-0030	24	56	59	19	158
0031-0100	3	23	26	3	55
0101-0130	7	11	12	4	34
0131-0200	3	0	2	0	5
0201-0230	1	3	0	0	4
0231-0300	1	0	1	1	3
0301-0330	0	1	0	0	1
0331-0400	0	0	0	0	0
0401-0430*	0	0	1	0	1
1331-1400	0	0	1	0	1
1401-1430	0	0	1	0	1
1431-1500	0	0	1	0	1
1501-1530	0	1	0	0	1
1531-1600	0	0	3	0	3
1601-1630	0	1	0	0	1
1631-1700	0	1	2	0	3
1701-1730	0	0	0	0	0
1731-1800	0	1	1	0	2
1801-1830	0	0	1	0	1
1831-1900	1	4	7	1	13
1901-1930	0	0	0	0	0
1931-2000	1	4	5	0	10
2001-2030	0	2	1	0	3
2031-2100	1	9	0	1	11
2101-2130	1	4	1	0	6
2131-2200	5	11	3	3	22
2201-2230	3	5	3	2	13
2231-2300	5	10	7	1	23
2301-2330	12	6	2	2	22
2331-2400	17	17	14	2	50

* There was no onset of fog during 0431-1330 UTC

There has been no onset of fog after 0430 and before 1331 UTC in all the months. It shows that maximum Number of fog occurs around or just after sunrise, which is in well agreement with physical principle. Just after sunrise, the turbulence mixing of air in shattered layer slightly increases helping in the formation of fog.

3.4. Duration of fog

The longest duration of fog was 36 hours 40 minutes from 1430 UTC of 03 January 2004 to 0310 UTC of 05

TABLE 3

The frequency distribution of duration (in hours and minutes) of fog over Guwahati airport during November to February over the period of 10 years (1994-95 to 2003-04)

Duration		Number of days				Total
H	M	Nov	Dec	Jan	Feb	
00	01 – 00	8	4	1	1	14
00	31 – 01	7	26	21	10	64
01	01 – 01	14	25	19	5	63
01	31 – 02	15	29	26	5	75
02	01 – 02	12	15	20	5	52
02	31 – 03	4	14	15	3	36
03	01 – 03	9	6	6	2	23
03	31 – 04	5	6	6	1	18
04	01 – 04	2	8	4	2	16
04	31 – 05	1	5	3	1	10
05	01 – 05	1	5	3	1	10
05	31 – 06	6	6	3	0	15
06	01 – 06	0	3	2	1	6
06	31 – 07	0	4	2	1	7
07	01 – 07	0	2	0	0	2
07	31 – 08	0	3	2	0	5
08	01 – 08	1	2	5	0	8
08	31 – 09	0	1	3	0	4
09	01 – 09	0	2	3	0	5
09	31 – 10	0	1	1	0	2
10	01 – 10	0	1	2	1	4
10	31 – 11	0	0	1	0	1
11	01 – 11	0	1	0	0	1
11	31 – 12	0	0	0	0	0
12	01 – 12	0	1	1	0	2
12	31 – 13	0	0	0	0	0
13	01 – 13	0	0	0	0	0
13	31 – 14	0	0	1	0	1
14	01 – 14	0	0	2	0	2
14	31 – 15	0	0	0	0	0
15	01 – 15	0	0	0	0	0
15	31 – 16	0	0	0	0	0
16	01 – 16	0	0	1	0	1

H : Hours, M : Minutes

January 2004. The shortest duration was of 17 minutes on 23 November 1999. The monthly distribution of fog duration (Table 3) shows that maximum number of fogs has the duration of one and half-hour to two hours for all the months except February. The maximum number of fog in February has the duration of half an hour to one hour. About 50% of total fog have the duration of two hours or less. Comparing individual months, the fog is generally more durable in January followed by December.

TABLE 4

Frequency distribution of dispersal of fog over Guwahati airport during November to February, over the period of 10 years (1994-95 to 2003-04)

Time of dispersal (UTC)	Number of days				Total
	Nov	Dec	Jan	Feb	
0001 - 0030	6	0	1	1	8
0031 - 0100	8	6	3	5	22
0101 - 0130	13	39	15	8	75
0131 - 0200	12	36	30	5	83
0201 - 0230	15	22	24	6	67
0231 - 0300	15	34	25	4	78
0301 - 0330	11	5	14	4	34
0331 - 0400	3	13	15	3	34
0401 - 0430	1	6	4	1	12
0431 - 0500	0	2	8	0	10
0501 - 0530	1	3	4	2	10
0531 - 0600	0	2	6	0	8
0601 - 0630	0	1	4	0	5
0631 - 0700	0	1	1	0	2

TABLE 5

The percentage of total fogs dispersed by 0300 UTC and 0400 UTC

Months	By 0300 UTC	By 0400 UTC
November	75%	98%
December	81%	91%
January	64%	82%
February	74%	92%
Total	74%	90%

3.5. Dispersal of fog

The times of dispersal of fog during different month are shown in Table 4. This shows that maximum number of fog (83 out of 448) has dispersed between 0131 & 0200 UTC followed by 0231 to 0300 UTC and 0101 to 0130 UTC. During the period of 0101 to 0300 UTC, about 65% of total fogs have dispersed in November, 77% in December, 61% in January, 59% in February and on average 68% of total fogs have dispersed during 0101 to 0300 UTC. The percentages of dispersal of fog during different months by 0300 UTC and by 0400 UTC are given in Table 5. It shows that there has been late dispersal of fog during month of January as compared to other months. This table also shows that on an average, 90% of total fogs have dispersed by 0400 UTC. The earliest dispersal has been observed at 0010 UTC for two occasions on 05 November 1998 & 24 November 1999 and latest dispersal has been observed at 0715 UTC on 28 December 2003.

TABLE 6

Frequency distribution of different ranges of visibility due to fog over Guwahati airport during November to February over the period of 10 years (1994-95 to 2003-04)

Visibility range (Meters)	Number of days				Total
	Nov	Dec	Jan	Feb	
0	0	2	1	0	3
1-50	9	34	28	4	75
51-100	17	23	14	2	56
101-150	0	4	3	0	7
151-200	10	8	7	3	28
201-250	0	0	1	0	1
251-300	3	5	4	2	14
301-350	0	1	4	0	5
351-400	2	5	6	3	16
401-450	1	0	0	0	1
451-500	11	27	18	5	61
501-550	0	0	0	0	0
551-600	3	8	10	2	23
601-650	0	0	0	0	0
651-700	2	1	3	1	7
701-750	0	0	0	0	0
751-800	24	46	46	11	127
801-850	0	0	0	0	0
851-900	3	6	9	6	24

3.6. Intensity of fog

The intensity of fog can be measured in terms of minimum visibility associated with it. The frequency distributions of lowest visibility during fog are shown in Table 6. The time of occurrence of lowest visibility is given in Table 7. The visibility has been zero on three occasions including two in December and one in January. From Table 6, it can be inferred that the more intense fogs occur over Guwahati airport during December and January. The lowest visibility due to fog occurs usually between 2300 UTC and 0200 UTC and frequency of lowest visibility is maximum during 0001 and 0100 UTC. More than 90% of fogs have caused lowest visibility between 2300 and 0200 UTC. Considering visibility in the intervals of 100 meters, the predominant lowest visibility over Guwahati airport has been less than 100 meters (134 cases out of 448).

3.7. Favourable meteorological parameters leading to fog

The mean values of meteorological parameters and their CV at 1200 UTC leading to fog during following night/morning over Guwahati airport are shown in Tables 8(a) & 8(b) respectively. From Table 8(a) the fog occurs with relatively lower T at 1200 UTC in January

followed by December compared to other months under consideration. According to Baghare (1972), if in previous day at 1500 UTC, T is in range of 15° to 18° C and wet bulb depression falls below 0.6° C, poor visibility of around one km can be forecast for next morning with probability of prediction being successful at 75% of cases. When T ranges 14° to 15° C and wet bulb depression falls upto 1° C, then one is likely to be successful in 70% of cases in predicting occurrence of fog in next morning.

The DP is also less in January than in other months at 1200 UTC leading to fog. While on the average, DPD of about 5° C favours formation of fog in the following night/morning during January & December, DPD of about 4° C & 6° C at 1200 UTC are associated with fog during November and February respectively. The wind speed is light at 1200 UTC with speed of less than one knot from northeasterly direction. According to Climatology, (India Meteorological Department, 1999), in about 80% of the days surface wind remains calm at 1200 UTC during months of November and December. In about 50 to 70 % of days, wind remains calm during months of January and February over Guwahati. Next to calm wind, the northeasterly winds with average speed of 10 knots predominates over Guwahati airport at 1200 UTC during all these month.

While the T, DP and MSLP have been highly stable at 1200 UTC for all the fog days, there is significant variation of wind and DPD associated with fog over Guwahati airport. The CV of DPD varies from 30% to 40% during different months at 1200 UTC leading to fog in the next morning. The higher DPD leads to less intense fog, lower DPD may lead to more intense fog. Similarly, while the relatively stronger wind may lead to shallow fog, weak wind leads to more intense fog. It suggests that the variation in intensity of fog may be attributed largely to the variation in DPD and wind at 1200 UTC.

The maximum and minimum values of meteorological parameters at 1200 UTC leading to fog during following night/morning are shown in Tables 9(a) & 9(b) respectively. The T, favouring occurrence of fog, ranges from 19° to 27° C, 15° to 23° C, 14° to 22° C and 16° to 25° C during November, December, January and February respectively. Similarly DP ranges from 16° to 23° C, 9° to 20° C, 8° to 18° C & 11° to 19° C during November, December, January and February respectively. The DPD ranges from 1° to 8° C, 1° to 9° C, 1° to 10° C & 2° to 10° C during November, December, January and February respectively. The wind speed ranges from calm to 10 knots in November, calm to 6 knots in December & February and calm to 8 knots in January. The MSLP ranges from 1005 to 1015 hPa, 1010 to 1021 hPa, 1008 to 1018 hPa and 1006 to 1019 hPa respectively during November, December, January and

TABLE 7
Time of occurrence of lowest visibility due to fog over Guwahati airport

Visibility (meters)	Onset time (UTC) of lowest visibility													
	0001-0100	0101-0200	0201-0300	0301-0400	0401-0500	0501-0600	1601-1700	1701-1800	1801-1900	1901-2000	2001-2100	2101-2200	2201-2300	2301-2400
0	1	1	0	0	0	0	0	0	0	0	0	0	0	1
1-50	26	19	3	0	0	0	0	0	0	1	0	0	6	20
51-100	23	12	3	0	0	0	0	0	0	0	0	1	3	15
101-150	4	2	0	0	0	0	0	0	0	0	0	0	1	0
151-200	15	9	0	0	0	0	0	0	0	0	1	0	0	3
201-250	0	1	0	0	0	0	0	0	0	0	0	0	0	0
251-300	8	5	0	0	0	0	0	0	0	0	0	0	0	1
301-350	3	1	0	0	0	0	0	0	0	0	0	0	0	1
351-400	8	4	1	0	0	0	0	0	0	0	0	0	0	3
401-450	0	0	0	0	0	0	0	0	0	0	0	0	0	1
451-500	35	15	2	0	0	0	0	0	0	0	1	0	1	7
501-550	0	0	0	0	0	0	0	0	0	0	0	0	0	0
551-600	17	2	0	0	1	0	0	0	0	0	0	0	1	1
601-650	0	0	0	0	0	0	0	0	0	0	0	0	0	0
651-700	6	0	0	0	0	0	0	0	0	0	0	0	0	1
701-750	0	0	0	0	0	0	0	0	0	0	0	0	0	0
751-800	83	14	2	1	1	0	1	0	0	0	0	1	4	17
801-850	0	0	0	0	0	0	0	0	0	0	0	0	0	0
851-900	16	4	0	0	0	1	0	0	0	0	0	0	1	2

TABLE 8 (a)

Mean Values of meteorological Parameters at 1200 UTC leading to fog during following night/ morning over Guwahati airport

Period	Meteorological Parameters							
	<i>T</i> (°C)	DP (°C)	DPD (°C)	WS (kt)	<i>U</i> (kt)	<i>V</i> (kt)	Vector wind (ddd/ff)	MSLP (hPa)
Nov	23.8	19.9	3.9	0.6	-0.23	-0.45	063/0.46	1011.9
Dec	20.1	15.6	4.6	0.3	-0.23	-0.12	028/0.26	1014.4
Jan	18.7	13.5	5.3	0.3	-0.14	-0.11	038/0.18	1014.2
Feb	21.1	14.9	6.3	0.9	-0.51	-0.59	049/0.78	1011.4
Total	20.4	15.6	4.8	0.4	-0.23	-0.23	045/0.33	1013.6

T : Temperature, DP: Dew Point, DPD: Dew Point Depression, WS : Wind Speed, *U* : Zonal Wind, *V*: Meridional wind, MSLP: Mean Sea Level Pressure, ddd/ff : Direction (in degree) / wind speed (in knots)

TABLE 8 (b)

The CV (%) of meteorological Parameters at 1200 UTC leading to fog during following night/ morning over Guwahati airport

Period	Meteorological Parameters						
	<i>T</i> (°C)	DP (°C)	DPD (°C)	WS (kt)	<i>U</i> (kt)	<i>V</i> (kt)	MSLP (hPa)
Nov	7.4	9.1	35.5	282	293	322	0.2
Dec	7.3	10.2	39.4	363	361	451	0.2
Jan	8.5	12.8	39.9	352	709	590	0.2
Feb	9.3	12.1	30.6	192	239	204	0.3
Total	12	18	41	313	408	401	0.3

T: Temperature, DP: Dew Point, DPD: Dew Point Depression, WS: Wind Speed, *U*: Zonal wind, *V*: Meridional wind, MSLP: Mean Sea Level Pressure

TABLE 9 (a)

Maximum values of meteorological Parameters at 1200 UTC leading to fog during following night/ morning over Guwahati airport

Period	Meteorological Parameters				
	T (°C)	DP (°C)	DPD (°C)	WS (kt)	MSLP (hPa)
Nov	27.4	23.5	7.9	10	1015.5
Dec	23.4	19.9	9.5	6	1020.5
Jan	22	18.1	10.2	8	1018.8
Feb	25.2	18.6	10.3	6	1019
Total	27.4	23.5	10.3	10	1020.5

T-Temperature, DP-Dew Point, DPD-Dew Point Depression, WS- Wind Speed, MSLP- Mean Sea Level Pressure.

TABLE 9 (b)

Minimum values of meteorological parameters at 1200 UTC leading to fog during following night/ morning over Guwahati airport

Period	Meteorological Parameters				
	T (°C)	DP (°C)	DPD (°C)	WS (kt)	MSLP (hPa)
Nov	19.4	16	0.9	0	1004.8
Dec	15.4	8.9	1.3	0	1009.6
Jan	13.6	8.3	0.7	0	1008
Feb	16.4	10.8	2.1	0	1005.7
Total	13.6	8.3	0.7	0	1004.8

T-Temperature, DP-Dew Point, DPD-Dew Point Depression, WS- Wind Speed, MSLP- Mean Sea Level Pressure.

February. All the above information at 1200 UTC on meteorological parameters may help the forecaster in monitoring and forecasting of fog over Guwahati airport.

4. Conclusions

The following broad conclusions are drawn from the above results and discussion.

The frequency of fog is maximum in December followed by January. The months of December and January together account for about 72% of total fog during the period. The fog is more probable during second half of December and first half of January. There is a significant periodicity of 2.5 days in the probability of occurrence of fog over Guwahati airport.

Comparing with climatology based on data of 1951-80, the frequency of fog has significantly increased in January and February and there is no significant change in November and December over the years.

The onset of fog mostly takes place between 2331 to 0100 UTC. About 60% of total onset take place during

this period. About 50% of total fogs have the duration of two hours or less. Comparing individual months, the fog is generally more durable in January followed by December. About 90% of total fogs disperse by 0400 UTC. The late dispersal of fog takes place more frequently during January.

More than 90% of total fogs have caused lowest visibility between 2300 and 0200 UTC with frequency of lowest visibility being maximum during 0001 and 0100 UTC. About 30% of total cases of fog lead to lowest visibility of less than 100 meters over Guwahati airport. Considering days with visibility < 100 meters, The fog is more intense in December followed by January.

The occurrence of fog and its variation of intensity mainly depend on the dew point depression and the surface wind over Guwahati airport. The monitoring of these parameters can help in prediction of occurrence and intensity of fog.

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