551.524.4 : 551.501.724 : 551.510.52(547.1)

HEIGHT OF MIXING LAYER AND ITS RELATION WITH HEIGHT OF TEMPERATURE INVERSIONS OVER BOMBAY

1. The method of base of first elevated inversion FEI has been used in this study for the estimation of maximum height of mixing layer for Bombay for 1970 and the results have been compared with the mixing layer ZH using Holzworth method (1962). The values of base of FEI and ZH were estimated using the original T-ϕ grams of Santacruz (Bombay). The depth and the lapse rate of FEI were also estimated from these T-ϕ grams. Unlike ground based inversion which forms during nocturnal hours and dissipates during daytime, FEI is found to occur both at 00 and 12 GMT.

2. *FEI at 1730 IST* — The monthly frequency (per cent) of FEI of various depths at 1730 IST is given in Table 1. The monthly frequency of FEI is comparatively smaller during rainy season and nearly 100 per cent during winter months. Table 2 gives the monthly frequency of FEI of various lapse rates which shows that FEIs during April and May have stronger temperature gradients than in other months. The strongest lapse rate of greater than 0·05°C/m for FEI occurred during April month. The monthly average height of bases of FEI varies from 868 m to 3358 m with the minimum occurring in March and maximum in August (Fig. 1). The monthly average depth of FEI varies from 220 m in November to 363 m in February (Table 3).

3. *FEI at 0530 IST* — A study of FEI at 0530 IST was also made to find its behaviour in comparison to the one at 1730 IST. Values of monthly average height of FEI and average depth of FEI are given in Table 3. Monthly frequency variation of FEI for few depths for 0530 and 1730 IST are given in Fig. 2 which shows nearly similar monthly variation.

4. *Comparison of ZH and FEI* — As mentioned earlier, the height of the base of FEI at 1730 IST gives the height of mixing layer at that hour. Since the time of this flight is about 2-3 hours later than the time of surface maximum temperature, the base of FEI at this hour would be fairly close to the maximum height of mixing layer (Fig. 1). During rainy season, the values of ZH are comparatively

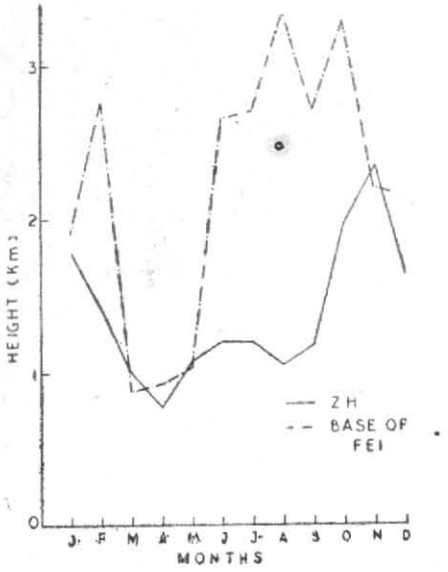

Fig. 1. Comparison of monthly average height of base of FEI at 12 GMT and ZH at Bombay for 1970

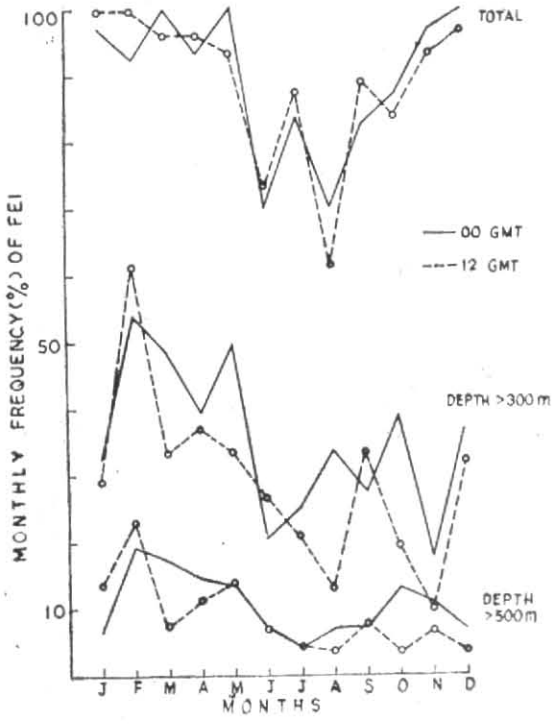

Fig. 2. Monthly frequency (%) variation of FEI for few values of depths

TABLE 1

Monthly frequency (%) of FEI of various depths

Month	Total (%) of FEI	Frequency (%) of FEI of depth (m)				
		>100	>300	>500	>700	>1000
Jan	100·0	96·8	29·1	12·9		
Feb	100·0	100·0	61·5	23·0	11·5	
Mar	96·2	92·5	33·3	7·3	3·7	
Apr	96·2	85·1	37·0	11·1	3·7	
May	93·4	86·7	33·4	13·3		
Jun	73·3	63·3	26·6	6·6	2·3	
Jul	87·4	83·3	20·8	4·1		
Aug	61·3	61·3	12·9	3·2	3·2	
Sep	89·0	89·0	33·4	7·4		
Oct	83·8	77·3	19·3	3·2	3·2	3·2
Nov	93·2	86·5	9·9	6·6	3·3	
Dec	96·8	90·3	32·3	3·2		

TABLE 2

Monthly frequency (%) FEI of various lapse rates

Month	Frequency of FEI of lapse rate (10^{-2} °C/m)						
	>0·1	>0·5	>1	>2	>3	>4	>5
Jan	51·6	32·3	6·5				
Feb	57·6	11·5					
Mar	80·6	57·6	23·0	3·8			
Apr	84·3	84·3	61·3	30·6	15·3	7·6	3·8
May	86·6	59·9	53·2	19·9	6·7		
Jun	13·3	3·3					
Jul	41·7	33·3	20·8	8·3	4·1		
Aug	38·7	16·1	12·9				
Sep	29·6	14·8	3·7				
Oct	45·2	35·5	19·4	9·7	3·2		
Nov	70·0	56·7	40·0	3·3	3·3	3·3	
Dec	67·3	44·7	18·9	6·5			

smaller than FEI. It should be noted here that the value of ZH does not give the correct measure of maximum height of mixing layer during wet months because the assumption of existence of dry adiabatic layer near the surface, involved in determining ZH is not valid on the rainy days. The ratios of monthly average heights of base of FEI at 1730 IST and ZH (Table 3) are mostly higher than one and the standard deviation of ZH is nearly 1/3 rd than that of the base of FEI indicating a comparatively large amount of day to day variation of base of FEI. A possible explanation for this large variation of FEI than that of ZH is that the procedure for determination of ZH ignores the details of thermal structure of the

TABLE 3

Comparison of monthly average of base of FEI at 12 GMT and ZH and FEI at 00 GMT

Month	FEI at 1730 IST			ZH		Ratio (Ht. of base of FEI and ZH)	FEI at 0530 IST	
	Ht. of base (m)	Depth (m)	Std. dev. (m)	Ht. (m)	Std. dev. (m)		Ht. of base (m)	Depth (m)
Jan	1902	279	1527	1777	527	1·07	2183	273
Feb	2773	363	2354	1420	484	1·95	1755	376
Mar	868	287	1317*	1004	383	0·86	1648	331
Apr	922	272	1676*	769	279	1·20	1768	320
May	1031	305	1275*	1072	354	0·96	958	335
Jun	2776	275	1926	1195	565	2·24	2366	276
Jul	2626	248	1326	1191	502	2·29	2309	273
Aug	3358	258	1655	1041	342	3·31	2688	307
Sep	2703	285	1491	1179	324	2·29	2140	281
Oct	3269	245	1917	1954	929	1·67	2825	296
Nov	2209	220	892	2345	509	0·94	2451	256
Dec	2148	242	1480	1620	552	1·33	1809	245

*Std. dev. is more than mean because of skewness of the distribution.

mixing layer whereas, the FEI is measured from the point of the lowest temperature discontinuity of the elevated inversion which is found to exhibit a larger variation. This may also be the reason why a study of correlation coefficient between ZH and base of FEI did not show any significant correlation between them. But when individual values of FEI and ZH were compared, it was noted that whereas, the ratio of FEI to ZH varied from 0·09 to 11·62, a good number of values were close to 1. This closeness of FEI to ZH was studied by examining the frequency distribution of the ratio FEI/ZH which was found to fit a log-normal distribution. The geometric mean and the geometric standard deviation of the ratio were estimated for each month from their plot on log probability paper and the values are given in Table 4. It may be noted from this table that the geometric mean of FEI/ZH is nearly 1 or slightly more than 1 for winter months, less than 1 for summer months, and significantly higher than 1 for rainy season. This comparison indicates that FEI and ZH are most close to each other in November and farthest apart in August. The geometric standard deviation of the ratio FEI/ZH varies from 1·05 to 4·53 with minimum in November and maximum in June.

TABLE 4

Geometric mean and geometric standard deviation of FEI (1730 IST)/ZH

	Geometric			Geometric	
	Mean	Std. dev.		Mean	Std. dev.
Jan	0·98	2·72	Jul	2·37	1·87
Feb	1·20	3·00	Aug	5·20	2·89
Mar	0·52	1·73	Sep	2·35	2·61
Apr	0·59	1·79	Oct	1·85	2·40
May	0·74	2·11	Nov	1·02	1·05
Jun	3·35	4·53	Dec	1·09	1·51
			Annual	1·47	2·63

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