Seasonal Variation of the Mesospheric Inversion Layer, Thunderstorms and Mesospheric Ozone Over India

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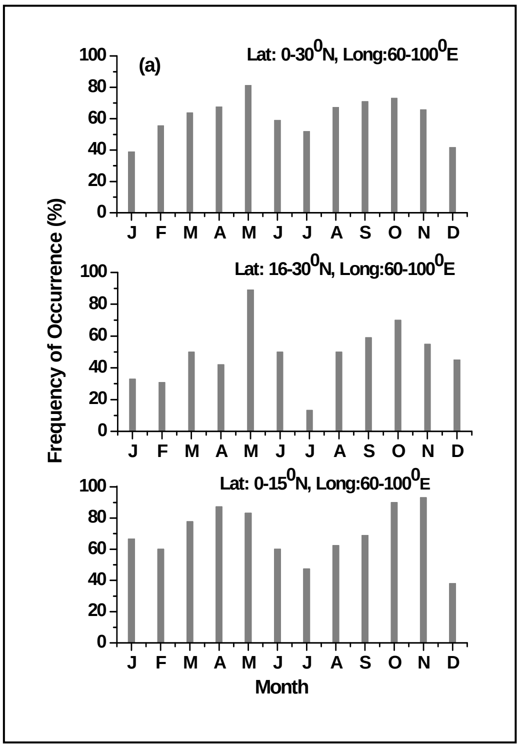
Temperature and ozone volume mixing ratio profiles obtained from the Halogen Occultation Experiment (HALOE) aboard the Upper Atmospheric Research Satellite (UARS) over India and over the open ocean to the south of equator during the period 1991-2001 are analyzed to study the characteristic features of the Mesospheric Inversion Layer (MIL) at 70 to 85 km altitude and its relation with the ozone mixing ratio at this altitude. We have also analyzed both the number of lightning flashes measured by the Optical Transient Detector (OTD) onboard the MicroLab-1 satellite for the period April 1995 - March 2000 and ground-based thunderstorm data collected from 200 widespread Indian observatories for the same period to show that the MIL amplitude and thunderstorm activity are correlated. All the data sets examined exhibit a semiannual variation. Figure 1 exhibit seasonal variations of frequency of occurrence of MIL. It shows semiannual variation over different belts over the Indian region. On the inversion days thunderstorm activity is reported at a nearby station and lightning flashes were recorded by the OTD on the same day as indicated in table 1. On the non inversion days no thunderstorm activity is reported at a nearby station and no lightning flashes recorded by the OTD in this vicinity on the same day. The seasonal variation of MIL amplitude and the frequency of occurrence of the temperature inversion indicate a fairly good correlation with the seasonal variation of thunderstorms (as shown in figure 2) and the average ozone volume mixing ratio across the inversion layer. The observed correlation between local thunderstorm activity, MIL amplitude and mesospheric ozone volume mixing ratio are explained by the generation, upward propagation and mesospheric absorption of gravity waves produced by thunderstorms.

Key words: Mesospheric Inversion layer, mesospheric ozone, Thunderstorms and Gravity waves.

Temperature inversion observed in HALOE temperature profile on (Day /Month/Year)	HALOE Position	Thunderstorm activity reported at ground station	Number of lighting flashes recorded by OTD within 3^0 x 3^0 grid centered at
29/5/95	10.16^0 N, 88.64^0 E	Cuddalore- 11.46^0 N, 79.45^0 E Nagapattinam-10.46^0 N, 79.5^0 E	30 (10^0 N , 86^0 E)
27/7/97	22.66^0 N, 71.05^0 E	Ahemedabad- 23.04^0 N, 72.38^0 E Ambikapur- 23.15^0 N, 83.15^0 E	41 (22^0 N, 72^0 E)
15/9/99	26.92^0 N, 76.26^0 E	Dubrugarh–27.29^0 N, 94.5^0 E	7 (26^0 N 76^0 E)
5/2/2000	29.04^0 N, 76.21^0 E	New Delhi- 28.35^0 N,77.12^0 E Dubrugarh– 27.29^0 N, 94.5^0 E	16 (27^0 N, 77^0 E)

Table 1: Inversion days observed in the HALOE temperature profile and thunderstorm activity reported at a nearby station and the number of lightning flashes recorded by the OTD on the same day.


(a)
Lat: 0-30⁰N, Long:60-100⁰E
Lat: 16-30⁰N, Long:60-100⁰E
Lat: 0-15⁰N, Long:60-100⁰E
Frequency of Occurrence (%)
J F M A M J J A S O N D
Month

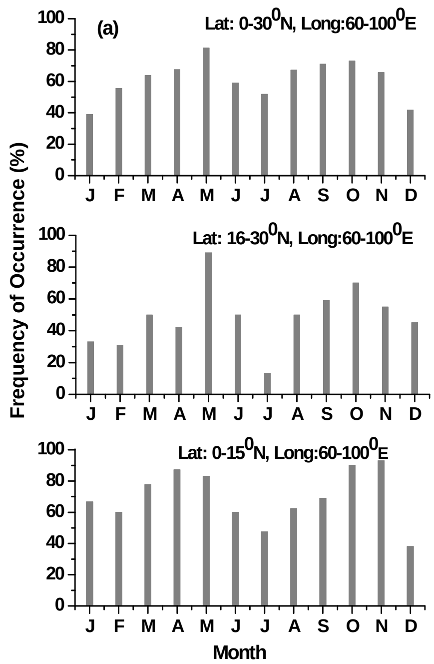
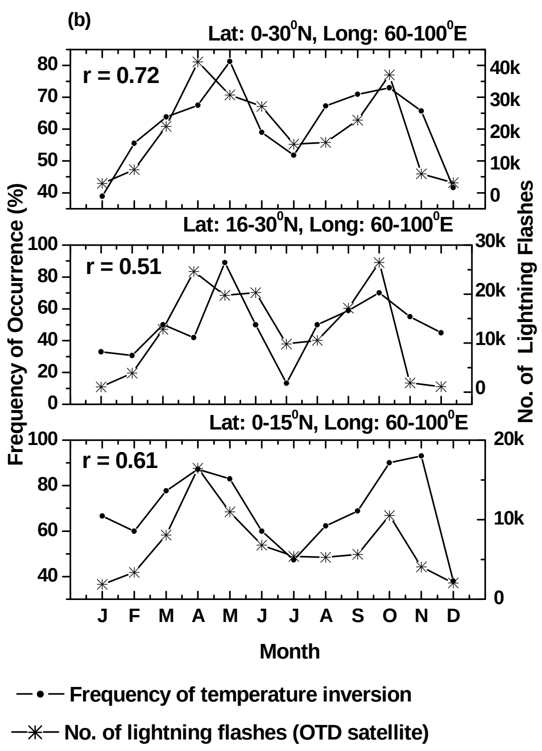


Figure 1 Monthly variation of the frequency of the temperature inversion over the Indian region (0 -30^0 N, 60 -100^0 E), the band-1(0 - 15^{0}N, 60 - 100^{0}E) and the band-2 (16-30^0 N, 60-100^0 E) for the period 1991- 2001.

Figure 2



Seasonal variation of the (a) Fre