

LIDAR OBSERVATIONS OF MESOSPHERIC SODIUM LAYERS IN MID-LATITUDE

Chikao Nagasawa and Makoto Abo

Department of Electronics and Information Engineering, Tokyo Metropolitan University

Minami-Osawa, Hachioji, Tokyo 192-03, JAPAN

Phone: 81-426-77-2766 Facsimile:81-426-77-2756

Observations of mesospheric sodium layers were preliminarily performed on June 1991 and have been routinely produced since November 1991 with a Na ground-based lidar above Tokyo Metropolitan University (TMU) at Hachioji, Tokyo (35.6°N, 139.4°E) in mid-latitude.

The TMU lidar system consists of a tunable dye laser pumped by a frequency doubled Nd:YAG laser, receiving telescope, a photomultiplier tube detector, a computer-controlled monitoring system of the transmitted laser wavelength and a data acquisition system. The TMU lidar system in the early stage and a few results obtained preliminarily were already reported on the 16th ILRC, and the improved lidar system and several results of the sodium layers observed routinely are presented in this paper.

The receiving telescope was mainly improved. Before October 1992, a Schmidt-Cassegrain telescope with a 28cm diameter primary mirror was used and after November 1992, a Schmidt-Cassegrain telescope with a 35cm diameter primary mirror was used for the receiving telescope. Moreover, since December 1993, a Hextek Cassegrain telescope with a 60cm diameter primary mirror has been used. Therefore, the S/N ratio was improved about 4 times better than the first stage system. The signal from 2000 laser shots are accumulated for each profile. Consequently, one profile is observed once every 4 minutes. The laser shot number is selected to assure an acceptable signal-to-noise for each profile. The TMU Na lidar system parameters are summarized in Table 1.

We could observe more than 100 events of the sporadic Na layers for two years from November 1991 until October 1993 in this mid-latitude lidar site, and the large sporadic Na layers had been observed especially during spring and summer. However, these events were rarely observed at the other mid-latitude lidar sites. Two examples of the enhanced Na layers observed at the TMU lidar site are shown in Figure 1. The data are smoothed by forming a sliding average over 900m for heights. Though we could see frequently two different forming of the sporadic Na layer as

Figure 1(a) and (b), it is not clear whether those observations have recorded in situ formation of sporadic Na layer above the lidar, or advection of an already-formed sporadic Na layers across the fixed field-of-view of the TMU lidar.

Figure 2 shows time lag histogram of occurrence of the large sporadic Na layers after those of the large sporadic *E* layers which were observed by the ionosonde of Communications Research Laboratory where is 12km nearly north-east of the TMU lidar site. Most of these events were accompanied by sporadic *E* layers and the most enhancement of the sporadic *E* layers preceded mostly that of the sporadic Na layers by 0 to 30 minutes.

It is very interesting to measure the mesospheric temperature with the Na concentration. We prepare to measure them simultaneously.

Acknowledgement

We thank Dr. K. Igarashi and Dr. T. Tanaka of Communications Research Laboratory in Japan presenting us ionosonde data.

Table 1 system parameters of the TMU Na lidar system.

Transmitter	
Laser	Nd:YAG SHG pumped Dye
Wavelength	589 nm
Pulse energy	100 mJ
Linewidth	2 pm (FWHM)
Repetition rate	10 Hz
Pulse length	6 ns
Beam divergence	0.2 mrad
Receiver	
Telescope aperture	280mm(before Oct. 1992) 350mm(after Nov. 1992) 600mm(after Dec. 1993)
Field of view	0.7 mrad
Optical bandwidth	3.5 nm (FWHM)
Data acquisition	
Method	Photon counting
Range resolution	100m

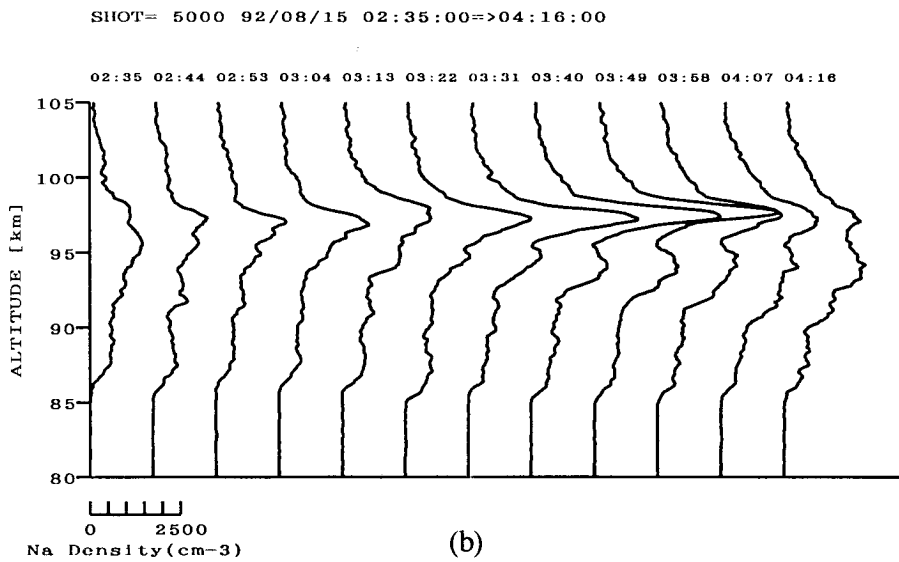
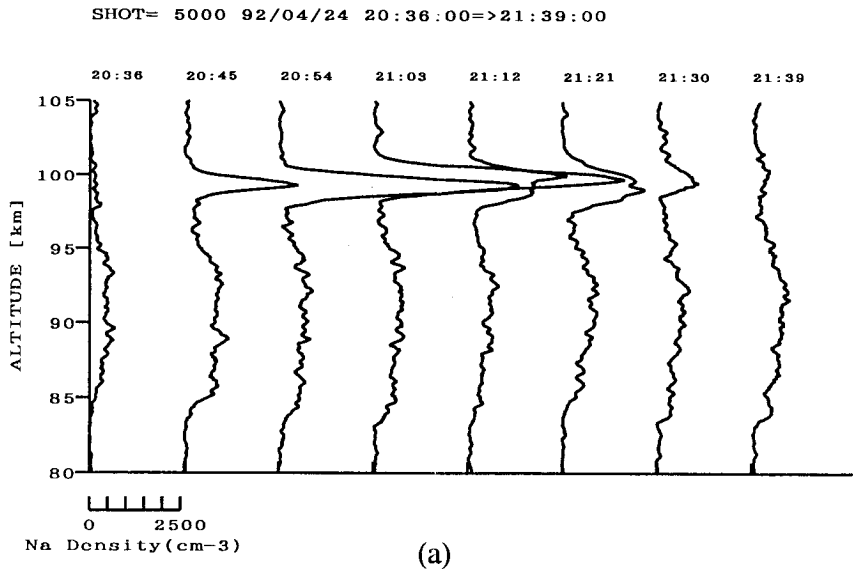


Fig. 1 Sequence of Na density profiles observed on (a) 24 April 1992, (b) 15 August 1992, at Hachioji Tokyo. The profiles are spaced at 9 minute intervals and plotted on a linear scale.

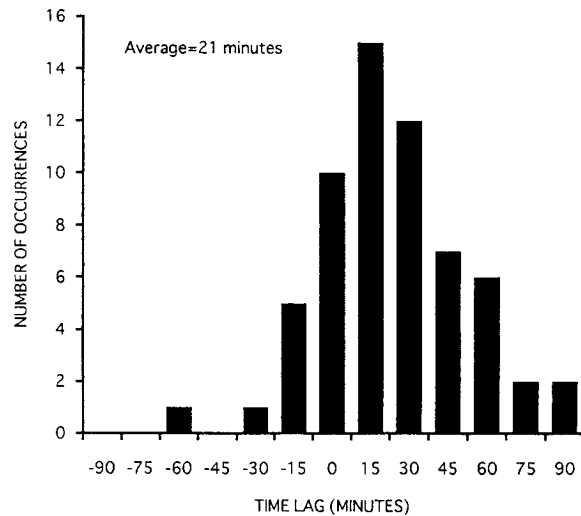


Fig. 2 Time lag histogram of the enhancement of sporadic Na after the enhancement of sporadic *E*.