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LIDAR OBSERVATION OF THE MESOSPHERIC SODIUM LAYER IN ANTARCTICA

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The mesospheric sodium layer has been observed at Syowa Station in Antarctica (geographic longitude 39.6°E, geographic latitude 69.0°S, geomagnetic longitude 79.4°E, geomagnetic latitude 70.0°S) during the wintering period (January 1985 to January 1986) of the 26th Japanese Antarctic Research Expedition (JARE-26). A lidar observation of the polar middle atmosphere at the station has been performed as a part of the Middle Atmosphere Program (MAP) since 1983. At first stratospheric aerosols have been observed by the system based on a ruby laser (694.3 nm and 347.2 nm). In 1985 a new transmitting system consisting of a tunable dye laser (589.0 nm) was added to that system to observe the sodium layer, too. The characteristics of the lidar system are given in table 1.

In this paper we report the results of the mesospheric sodium layer observed on 42 nights during the period from March to October in 1985.

There appears to be no significant winter maximum in variation of nightly average abundance for that period. This result is different from those obtained at mid-latitude in the northern hemisphere. Moreover the results of the nightly average height distribution showed that the sodium layer was stable for that period, that is, the height of the maximum density was 90±3 km and the width of the layer was 13±3 km. These results are similar to those obtained in the southern

hemisphere by Simonich et al. (1979). But it may be found to oscillate with a period of several hours in the nocturnal variation of abundance. The variation of amplitude (maximum to minimum of abundance) is large compared with those obtained at mid- or low- latitude, which is similar to that at high latitude in the northern hemisphere by Juramy et al. (1981). This oscillation has been frequently observed, expecially in winter. We may consider that the oscillatory variation has been caused by dynamic processes rather than by photochemical ones because the solar activity has been very weak in winter in the polar region.

Fortunately we had a chance to study a rare occurrence with the appearance of an aurora that largely influenced the profile and abundance of the sodium layer. These variations are compared with those of the geomagnetic field and of the cosmic noise absorption (CNA) observed by a Riometer. It is found that the abundance suddenly decreases when associated with a geomagnetic field and the CNA decreases when the breakup of the aurora occurs. Moreover the topside of the layer appears to be modified by that breakup. From a sequence of observations under the existing aurora it has been observed that the modification of the layer by the appearance of this aurora is related to the decrease of CNA rather than the geomagnetic variation.

References

(1) D. M. Simonich, B. R. Clemesha and V. W. J. H. Kirchhoff; J. Geophys. Res. 84, 1543 (1979)

(2) P. Juramy, M. L. Chanin, C. Megie, G. F. Toulinov and Y. P. Doudoladov; J. Atmos. Phys. 43, 209 (1981)

Table 1 Characteristics of lidar system

Transmitter		
	Ruby	YAG
wavelength	694 nm 347 nm	589 nm
Energy	0.8J/pulse o.3J/pulse	0.2J/pulse
Linewidth		0.003nm
Pulse width	38ns	500ns
Repetition rate	0.5 Hz	0.5Hz
Receiver		
Telescope Dia.	0.5 m	
Height resolution	0.1 - 10 km (Photon counting mode)	
	7.5 - 750 m (Analog mode)	