SURFACE OZONE OBSERVATION AT SYOWA STATION, ANTARCTICA FROM FEBRUARY 1982 TO JANUARY 1983

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Abstract: This paper presents the result of surface ozone measurement at Syowa Station from February 1982 to January 1983 with a Dasibi ozone meter. In order to improve the reliability, the instrument was calibrated in Japan before and after the observation. The surface ozone mixing ratio at Syowa Station shows the annual change with a winter maximum and a summer minimum, being quite similar to that at Amundsen-Scott (South Pole) Station.

1. Introduction

OLTMANS and KOMHYR (1976) and OLTMANS (1985) reported that there were a winter maximum and a summer minimum in the surface ozone concentration in Antarctica and that there was little diurnal variation.

At Syowa Station (69°00'S, 39°35'E) surface ozone observations were carried out only for two years of 1961 (SEINO *et al.*, 1963) and 1978 (ITO, 1983). ITO (1983) pointed out that the winter maximum and the summer minimum were observed at Syowa Station as well. This paper describes the result of surface ozone observations at Syowa Station from February 1982 to January 1983. A Dasibi ozone meter was used for this particular observation, and its calibration was made in Japan before and after the observation. The comparison with the results of ozonesonde soundings is also discussed.

2. Instrumentation and Observation

The surface ozone mixing ratio was measured with the same Dasibi ozone meter (model 1003-AH) as that ITO (1983) used in 1978. The observation was carried out in the Upper Atmosphere Observation Building of Syowa Station. The sampling air was taken through a Teflon tube on the roof of the building. There is a chimney of an oil heater 9 m southwestward away from it. The observation was carried out from February 16, 1982 to January 10, 1983. Before and after this observation, the ozone meter was compared with an ozone meter of the same type calibrated with chemical method at the National Institute for Environmental Studies (NIES). The result of these comparisons is shown in Fig. 1. As the observation at Syowa Station was carried out between these calibrations, the error due to drift of offset at Syowa Station may have not exceeded the range from +2 to −5 ppbv. However, these zero-offset drifts are not corrected in Fig. 1. It is difficult to define the time of occur-

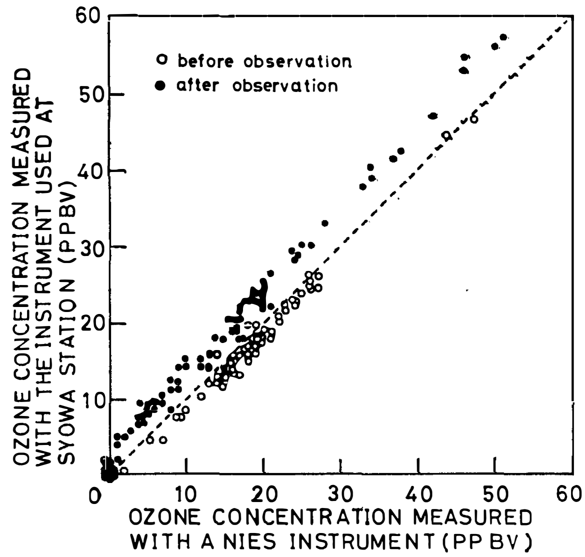

Fig. 1. Calibration of the Dasibi ozone meter used at Syowa Station with the one at the National Institute for Environmental Studies.

rence and the amount of these zero offset drifts, because the Dasibi ozone meter was transported by ship from Japan to Syowa Station before observation and from Syowa Station to Japan after observation.

The instrument sensitivity depends on the pressure and temperature. The errors due to pressure change were already corrected. The room temperature was controlled at 20±5°C. The temperature of the sample air became almost the same as the room temperature while the air was passing through the Teflon tube of 4 m long. The error due to temperature change is at most ±2%. So the total error (zero offset drift and temperature change) is between +4 to −6 ppbv.

The output signal sometimes became noisy when the exhaust smoke from an oil heater was taken in. This trouble was removed by cleaning the absorption cell of the instrument. There was another trouble due to the blizzard on September 8, when the instrument took in snow. In that case we had to dry the instrument, so as to change the instrument condition. After this trouble, the output signal sometimes became noisy but gradually recovered. However, this is not a cause of the large scatter after September because these noisy data are excluded as mentioned before.

3. Results

3.1. Annual change of surface ozone mixing ratio

The daily mean values of the surface ozone mixing ratio are shown in Fig. 2. The noisy data were excluded. However, this did not affect the daily mean, because there was little diurnal variation as shown in Fig. 3. The mean value for all the data in the observed period is 28 ppbv, which agrees with the value at 70°S obtained by GALBALLY and ROY (1981). As the observation was not available between January 11 and February 15, the true annual mean may be a little lower than 28 ppbv. Figure 2 shows an annual cycle with a maximum (monthly mean of 37 ppbv) in July and a

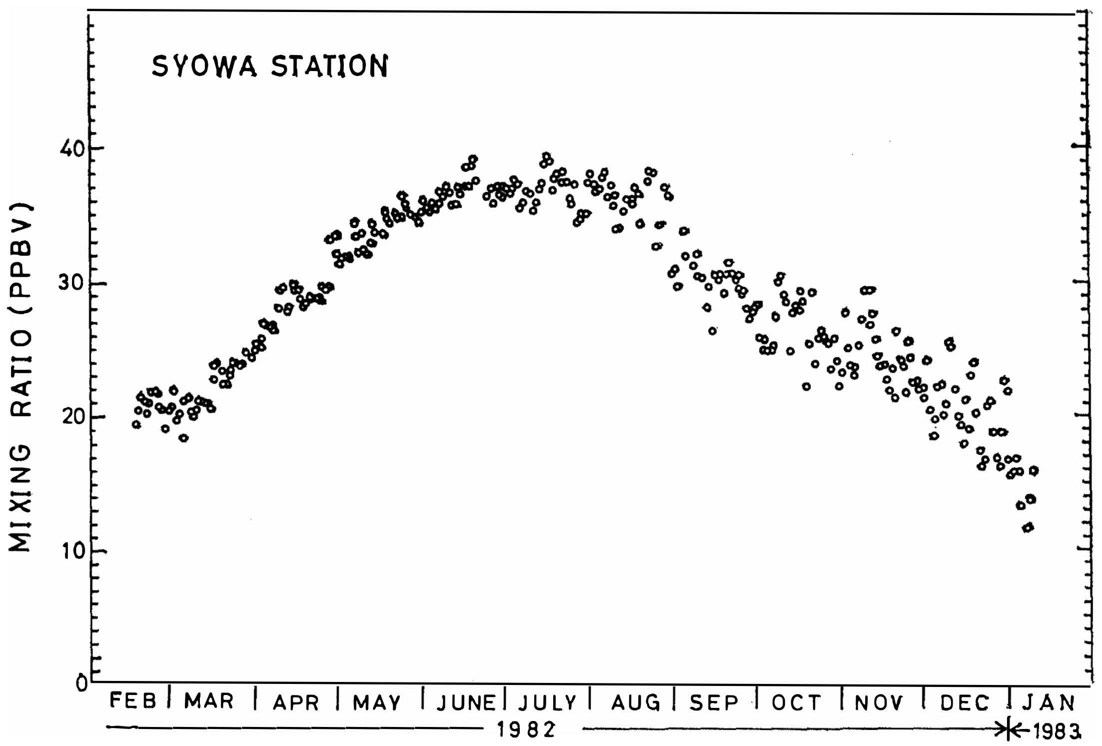

Fig. 2. The annual change of the surface ozone mixing ratio at Syowa Station from February 1982 to January 1983.

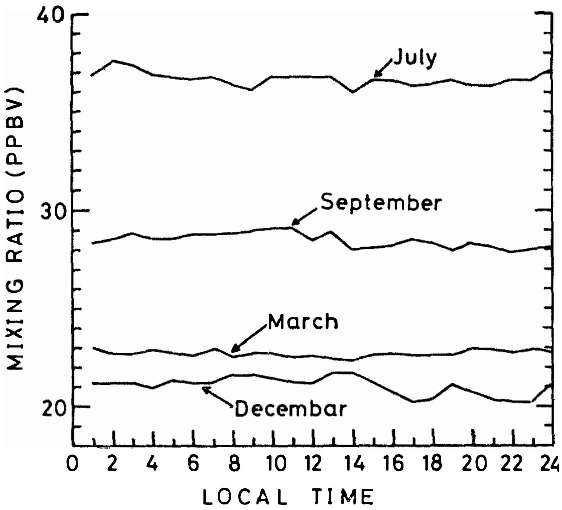

Fig. 3. The diurnal variation of the surface ozone mixing ratio for full day observations of March (7 days), July (4 days), September (4 days), and December (2 days).

minimum (monthly mean of 15 ppbv) in January. These characteristics were also seen in the surface ozone observed in 1978 by Ito (1983). A winter maximum of total ozone amount was observed at Syowa Station in 1982 (Chubachi, 1985). These winter maxima in surface ozone mixing ratio and total ozone amount agreed well with each other in their time of peak.

3.2. Tropospheric ozone mixing ratio observed by ozonesonde soundings

Figure 4 shows the annual variation of ozone mixing ratio in the troposphere and on the ground surface measured with ozonesondes and the Dasibi ozone meter. This figure shows that the ozone mixing ratio is nearly uniform up to 400 mb in winter (from June to October) and that the vertical variation of mixing ratio is large from November to April. This fact shows that the air in the troposphere is mixed well

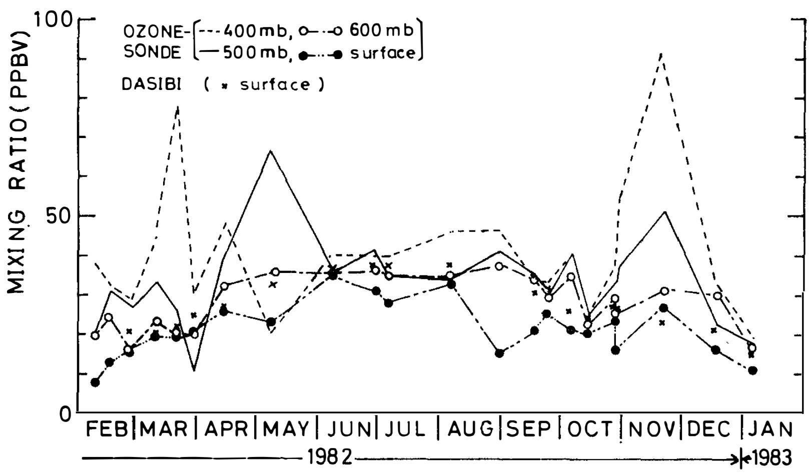

Fig. 4. Ozone mixing ratios in the troposphere measured with ozonesondes and with the Dasibi ozone meter.

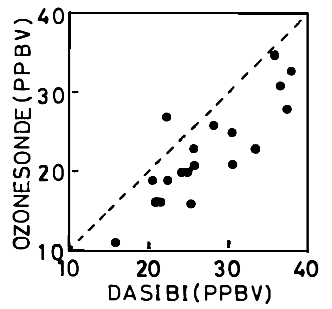

Fig. 5. Intercomparison of the surface ozone mixing ratios between those measured with ozonesondes and with the Dasibi ozone meter.

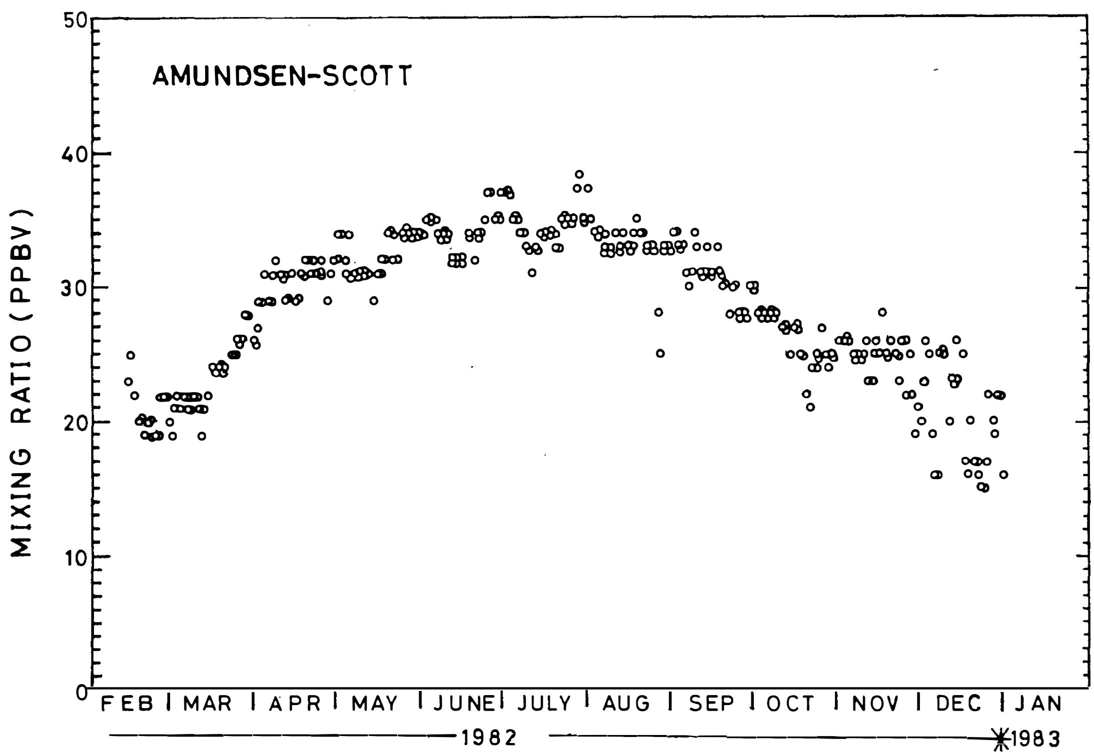

Fig. 6. The surface ozone mixing ratio observed at Amundsen-Scott in the same period as in Fig. 2.

vertically in winter over Antarctica. In Fig. 5 the comparison is made between the surface ozone mixing ratios measured with the Dasibi ozone meter and with ozonesondes. We can see the ozonesonde gives smaller values (about 5 ppbv) than the Dasibi ozone meter.

3.3. *Comparison between Syowa Station and Amundsen-Scott*

The surface ozone data at Amundsen-Scott (South Pole) Station measured with a Dasibi ozone meter are available for the same period as ours. The data are given in partial pressure (ATMOSPHERIC ENVIRONMENTAL SERVICE OF CANADA, 1983), so they were converted to mixing ratios by the use of normal monthly means of surface pressure (KOKURITSU KYOKUCHI KENKYÛJO, 1985), and are shown in Fig. 6. The mixing ratios of the surface ozone at Syowa Station and Amundsen-Scott agree well with each other.

4. Conclusion

The surface ozone observation was carried out at Syowa Station from February 16, 1982 to January 10, 1983. The characteristics of the surface ozone revealed by this observation are as follows.

1) The mixing ratio shows a winter maximum and a summer minimum.

2) The mean value for all observation period is 28 ppbv.

3) The vertical variation of ozone mixing ratio in the troposphere is smaller in winter than in summer.

4) The diurnal variation of ozone mixing ratio is very small.

5) The characteristics of annual variation of surface ozone mixing ratio are similar to those at Amundsen-Scott (South Pole).

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