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GAS-CHROMATOGRAPHIC MEASUREMENTS OF ATMOSPHERIC METHANE AT SYOWA STATION BETWEEN FEBRUARY 1986 AND JANUARY 1987

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Abstract: Atmospheric methane (CH_4) was measured by a gas-chromatographic method. Air samples were collected at Syowa Station between February 1986 and January 1987. The mean volume mixing ratio in this period was 1.613 ppm.

An increasing trend for mixing ratios of CH_4 including those in 1983 was 1.1%/year as of January 1987.

1. Introduction

Methane (CH_4) is an important trace gas in the atmosphere, because it contributes significantly to the atmospheric greenhouse effect and to the chemistry of both the troposphere and the stratosphere. Since the end of the 1970's, atmospheric CH_4 has been increasing by 1–2%/year (KHALIL and RASMUSSEN, 1983; BLAKE and ROWLAND, 1986; FRASER *et al.*, 1986). Such increase may significantly affect the earth's climate (WANG *et al.*, 1986) and the depletion of the stratospheric ozone (WMO, 1985; UNEP, 1987).

In order to obtain the global distributions of minor constituents such as CF_2Cl_2, $CFCl_3$, N_2O, and CH_4, air samples have been collected at Syowa Station and on board between Tokyo and Syowa Station since the 23rd Japanese Antarctic Research Expedition (JARE-23) (HIROTA *et al.*, 1984).

Preliminary results for CH_4 measurement were reported in the previous paper (HIROTA *et al.*, 1987), and subsequent results for samples collected at Syowa Station between February 1986 and January 1987 (JARE-27) will be reported here.

2. Experimental

Details of our air sampling and gas-chromatographic measurement are described in the previous papers (HIROTA *et al.*, 1984, 1987). Only modifications are thus given below.

Air samplings were performed once a month in 1986 and five times in January 1987, when the wind directions were between NNE and E.

The reference gas was changed to a new one (Takachiho). The volume mixing ratio of CH_4 in the new reference gas was 1.774 ppm, which was ascertained in comparison with the previous one (1.790 ppm).

Stability of CH_4 in the sampling cylinder was checked by measuring the reference gas which was kept in a same sampling cylinder. For seven measurements in two years and a half, the mean mixing ratio showed 99.7% for that of the reference gas and the variation coefficient was 0.4%.

3. Results and Discussion

Volume mixing ratios of CH_4 observed at Syowa Station (69.0°S, 39.6°E) between February 1986 and January 1987 are shown in Fig. 1 together with those reported in the previous paper (HIROTA *et al.*, 1987). Two samples in December 1984 (solid circles) were collected on the icebreaker "SHIRASE" at 55° and 66°S.

A mean value between February 1986 and January 1987 was 1.613 ppm, where the value in January was a mean value for five air samples. Using values in the same months (April–November) in 1983 and 1986, atmospheric CH_4 was found to be increasing by 53 ppb in 3 years (1.1%/year at January 1987). This linear trend is shown by a solid line in Fig. 1.

Dotted lines from April 1983 to December 1985 are monthly mean values at Cape Grim (41°S, 145°E) (FRASER *et al.*, 1987). Open triangles are the values of January at the South Pole (RASMUSSEN and KHALIL, 1986). These values are in good agreement with the values at Syowa Station in 1983 and 1984. This indicates that the atmospheric CH_4 was rather uniform in the mid-to-high latitudes of the Southern Hemisphere. At Cape Grim, the increasing trend from 1984 to 1985 became smaller than the one from 1981 to 1983.

Values of CH_4 in 1986 show some seasonal variation. This seasonal variation is also shown in Fig. 2, where the residuals of each value from the linear trend are

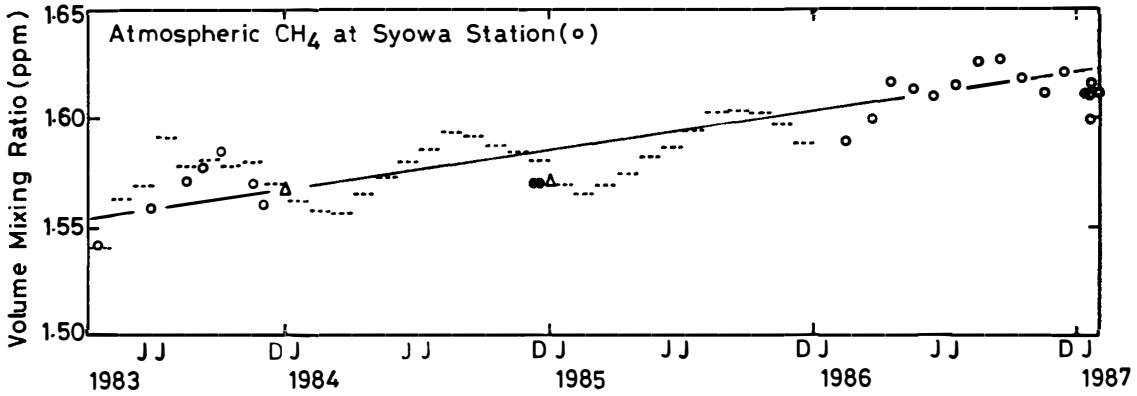

Fig. 1. Time variation of atmospheric CH_4 at Syowa Station.
○: at Syowa Station.
——: linear trend at Syowa Station.
●: at 55° and 66°N. (Samples were collected on the icebreaker "SHIRASE.")
. . . . : monthly mean value at Cape Grim (FRASER et al., 1987).
△: at the South Pole (RASMUSSEN and KHALIL, 1986).

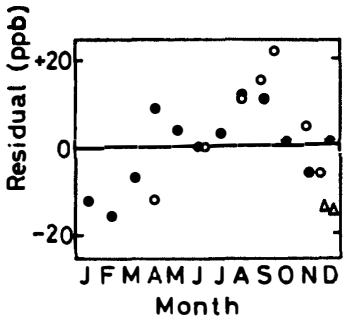

Fig. 2. Seasonal variation of atmospheric CH_4 at Syowa Station.
○: at Syowa Station in 1983.
●: at Syowa Station between February 1986 and January 1987.
△: at 55° and 66°N. (Samples were collected on the icebreaker "SHIRASE.")

plotted. Open circles indicate the value in 1983. Solid circles indicate those between February 1986 and January 1987, and open triangles in 1984. The value in January 1987 was a mean value.

FRASER *et al.* (1986) have reported some seasonal variations of CH_4 at Cape Grim and at Mawson Station (68°S, 63°E) with a maximum in austral late winter-spring and a minimum in late summer-autumn since 1980. Though our observations were few, values at Syowa and Mawson Stations in 1983 showed good agreement with each other (HIROTA *et al.*, 1987). This suggested, therefore, that the usual seasonal variation in the Southern Hemisphere (STEELE *et al.*, 1987) was also observed at Syowa Station. In 1986, however, observations at Syowa Station showed two maximums in April and August–September. Two maximums were also observed at Cape Grim in 1981 and at Mawson in 1982 (FRASER *et al.*, 1986). These observations suggest that the seasonal variation of CH_4 could be locally modulated.

The trend and seasonal variation of atmospheric CH_4 at Syowa Station will be discussed in more detail after continuous measurement is started in 1988.

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