551.510.534 : 523.982

ANTARCTIC O_3 DEPLETION AND ITS CORRELATION WITH RELATIVE SUN-SPOT NUMBER

1. A critical study have been performed to study the correlation between Antarctic O_3 concentration and relative sun-spot number. From correlation coefficient between monthly mean value of O_3 concentration of Antarctic Survey station and that of relative sun-spot number, it is inferred that chemical processes in association with special atmospheric conditions prevailing over Antarctica are responsible for dramatic decrease of O_3 concentration at Antarctica during spring time.

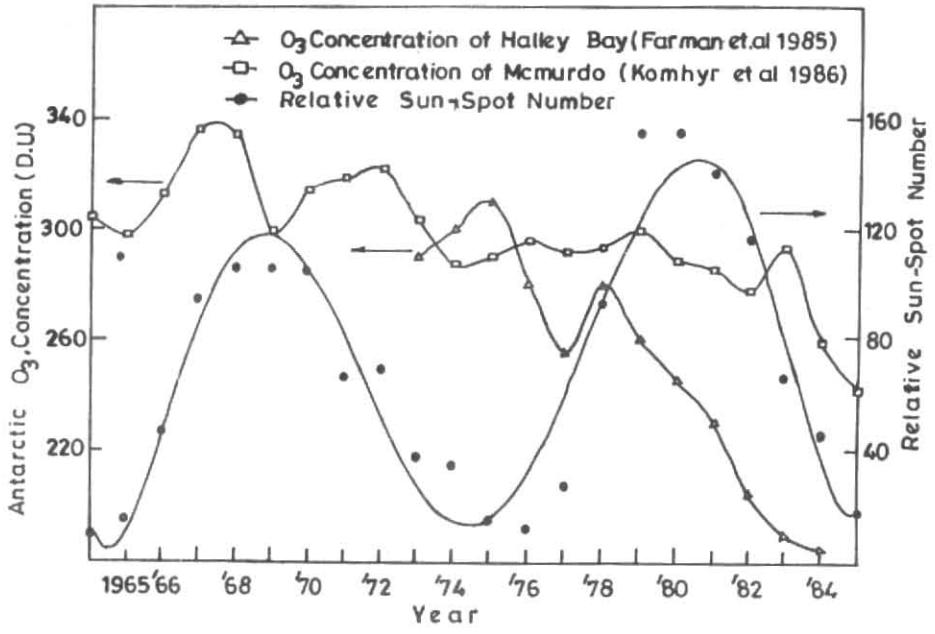

Fig. 1. Variation of Antarctic O_3 concentration and relative sun-spot number during the period 1964-85

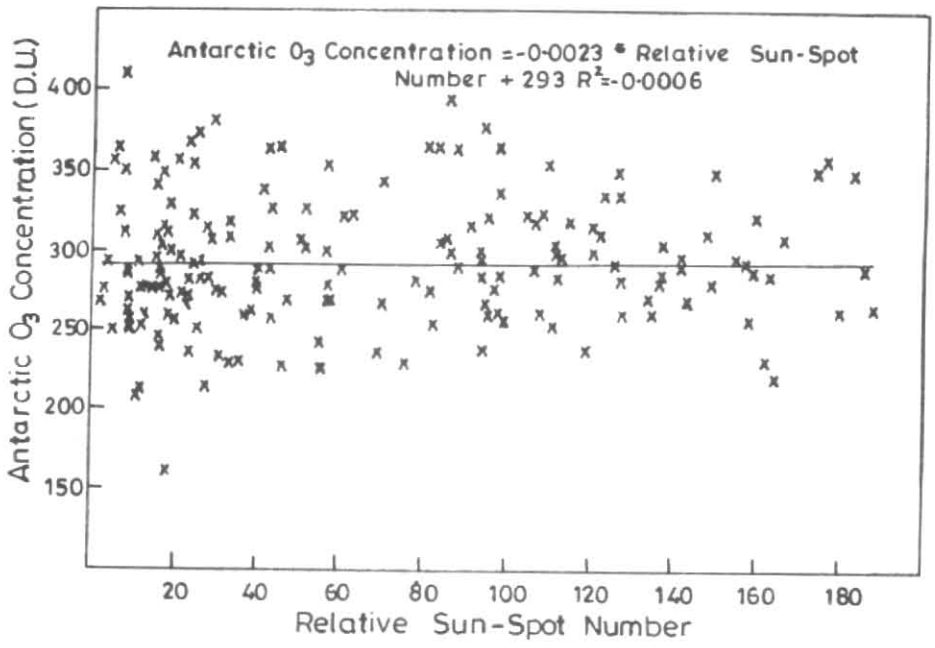

Fig. 2. Variation of Antarctic O_3 concentration with relative sun-spot number

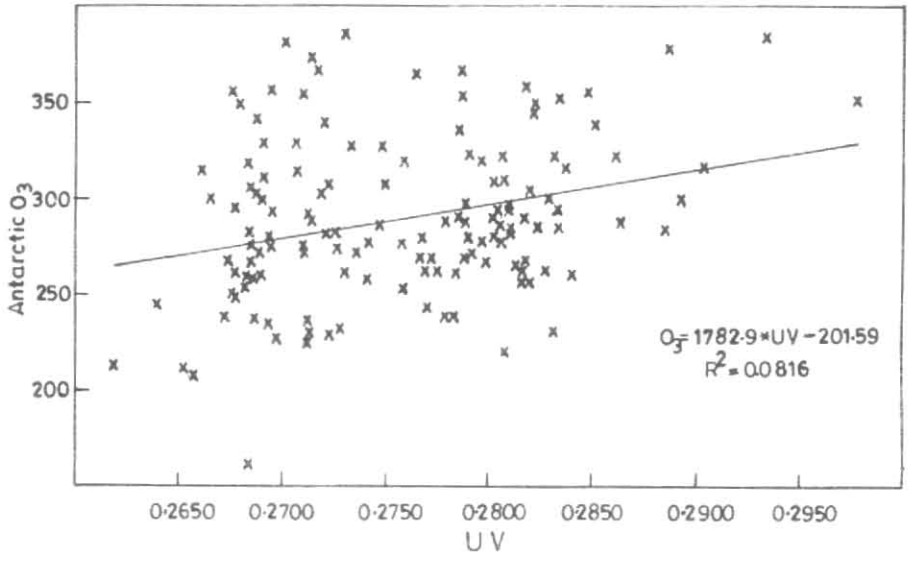

Fig. 3. Variation of Antarctic O_3 concentration with solar UV radiation

2. O_3 is a minor constituent of the atmosphere. It plays important role to control the chemical kinetics of the atmosphere. Dramatic decrease of Antarctic O_3 concentration during spring time is presented in our previous paper (Ghosh and Midya, 1994) and is now well established phenomenon. The paper presents the correlation between Antarctic O_3 concentration and relative sun-spot number. It is concluded that correlation coefficient between Antarctic O_3 concentration and relative sun- spot number is insignificant during spring time and chemical processes are responsible for dramatic decrease of O_3 concentration over Antarctica.

Monthly mean relative sun-spot number for the period 1964-85 and Solar UV for the period 1966-85 are taken from Solar Geophysical Data Book, NOAA, published by De-

TABLE 1
Correlation coefficient between different parameters for different months

Correlation coefficient between	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly mean [O_3]and monthly mean relative sun-spot number	0.06	0.13	*	*	0.10	0. 26	0.31	0.20	*	0.04	-0.04	0.19
Monthly mean [O_3] and yearly mean [O_3] during 1964-85	0.26	-0.05	*	*	0.77	0.38	0.43	0.82	*	0.90	0.47	0.69
Monthly mean and yearly mean relative sun-spot number during 1964-85	0.95	0.93	0.92	0.93	0.93	0.96	0.97	0.96	0.95	0.94	0.96	0.95
Monthly mean relative sun-spot number and monthly mean UV	0.75	0.80	0.90	0.77	0.79	0.81	0.76	0.84	0.89	0.67	0.80	0.79

"*" signifies that correlation coefficients are not calculated due to insufficient data.

partment of Commerce, U.S.A. Monthly mean O_3 concentration for Antarctic Survey stations are taken from Komhyr *et al.* (1986) and Farman *et al.* (1985).

The nature of variation of O_3 concentration of two Antarctic Survey Stations with relative sun-spot number is shown in Fig. 1. Relative sun-spot number clearly follows the 11 years solar cycle. O_3 concentration follows decreasing trend with relative sun-spot number upto the year 1974-75. Afterwards relative sun- spot number begins to increase but we see that O_3 concentration continues its decreasing trend.

3. For analysis of data, O_3 concentration of McMurdo is used (Komhyr *et al.* 1986). In case of relative sun-spot number we see that correlation coefficient between monthly mean and yearly mean of relative sun-spot number is nearly same for all the months and it is very high Table 1. In case of correlation coefficient between monthly mean values of relative sun-spot number and that of UV radiation we have also obtained very high correlation coefficient for each month (Table 1). The correlation coefficient between monthly mean values of Antarctic O_3 concentration and that of relative sun-spot number is calculated for different months Table 1. It is observed that the correlation coefficient between two parameters during Antarctic spring is not significant. It implies that relative sun-spot number does not play any important role to control the O_3 concentration during Antarctic Spring. It is also clear from the scatter diagram (Fig. 2) that variation of Antarctic O_3 concentration with relative sun-spot number is almost a straight line which is parallel to relative sun-spot number axis. This implies that O_3 concentration is independent of relative sun-spot number.

A scattered diagram between solar UV radiation and O_3 concentration of Antarctic Survey Station is drawn (Fig.3). A straight line is obtained with positive slope. From regression analysis we obtained an empirical equation as given in Fig. 3. From positive slope, it is clear that O_3 concentration increases with increase of solar UV radiation. It confirms that solar UV is not responsible for O_3 hole at Antarctica.

In another communication (Midya *et al.* 1998) we have shown that correlation coefficient between Antarctic O_3 concentration and solar flare index is not significant. Solar flare index is the actual energy output of any flare event. In this connection it may be mentioned that we have obtained satisfactory result in finding the effect of solar flare index on different airglow emission lines (Midya *et al.* 1993a, Midya *et al.*, 1993b). Here we also see that relative sun-spot number has not any significant role in the special depletion of O_3 at Antarctica during spring time. Different processes such as active chlorine formation from chlorofluorocarbons, chlorine-bromine reactions, PSC cloud formation at temperature lower than -80°C during Antarctic spring (Ghosh and Midya, 1994) are responsible for depletion of ozone at Antarctica during spring time.

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References

Farman, J.C., Gardiner, B.G., and Shanklin, J.D., 1985, "Large losses of total ozone in Antarctica reveal seasonal CLOx / NOx interaction", *Nature*, **315**, 207-210.

Ghose, S.N. and Midya, S.K., 1994, "Atmospheric Ozone, its depletion and Antarctic Ozone Hole", *Ind. J. Phys.*, **68 B** (6), 473-493.

Komhyr, W.D., Grass, R.D. and Leonard, R.K., 1986, "Total Ozone decrease at South Pole, Antarctica, 1964-85", *Geo.Res. lett.*, **13**, 1248-1251.

Midya, S.K., Tarafdar, G. and Das, T.K., 1993a, ""Evening and morning twilight airglow emission of 5577° A and 5893 ° A line at Calcutta and Allahabad and their correlation with flare index", *Earth, Moon and Planets (Netherlands)*, **63**, 199-207.

Midya, S.K., Tarafdar, G. and Das, T.K., 1993b, "The effect of solar flare index on the seasonal variation of 5893°A line intensity in Calcutta", *J. Pure and Appl. Phys.*, **5**, 181-189.

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