

Ozone Studies in Antarctica during 7th and 13th Indian Antarctic Expeditions

G.SUDHAKAR RAO, S.B.GAONKAR and S.K. PESHIN

India Meteorological Department, New Delhi

Abstract

Ozone programme of IMD, ozone observations and results at Dakshin Gangotri during 7th and at Maitri during 13th Indian Scientific Expeditions to Antarctica are discussed. Comparison with available data of Syowa and George Foster shows that Indian results are in agreement with those obtained by other workers. Ozone depletion phenomena at Maitri during 1994 is quite similar to that observed at Dakshin Gangotri during 1988.

Introduction

India Meteorological Dept is showing keen interest on the recent developments like ozone depletion over Antarctica and India is one of the few countries in ozone monitoring and ozone depletion studies over Antarctica.

There was an international collaboration for comparative observations of ozonesondes during 1993(1st to 9th Sep '93) between Neumayer, Sanae, Maitri, Novolazaravskaya and Syowa called ROSA(Regional Ozone Soundings in Antarctica). The typical profiles of Neumayer, Maitri and Syowa on 3.9.93 are shown in Fig. 1. All the the three profiles show a peak around 60 mb and there is a sharp fall on either side. Temperature profiles also showing similar trends at all levels except near lower troposphere.

Ozone Programme

IMD programme for XIII Expedition consists of continuous recording of surface ozone and measuring of vertical profiles of ozone by ozonesonde ascents at Maitri for the study of seasonal variation of ozone over Antarctica. During VII Expedition, IMD also recorded total ozone observations using Dobson ozone spectrophotometer in addition to ozonesondes at Dakshin Gangotri. For implementation of these programmes observations were undertaken as follows:

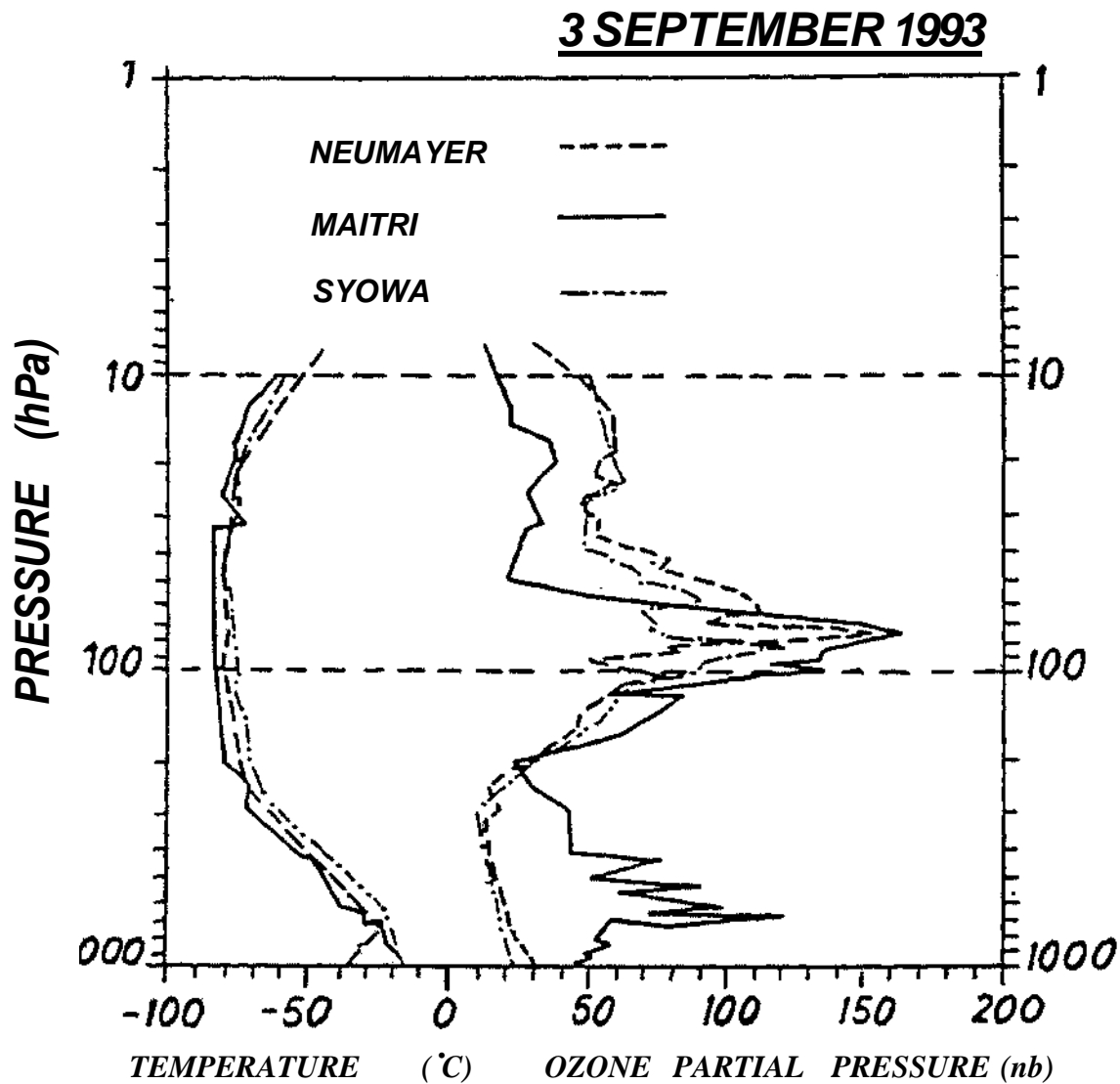


Fig. 1: The Ozonesonde profiles of Neumayer, Maitri and Syowa on 3.9.93

At Maitri, during XIII IAE, surface ozone was recorded continuously throughout the year during 1994 and ozonesonde ascents were taken at the rate of about once in a week. At Dakshin Gangotri, during VII IAE, in addition to the ozonesondes at the rate of about once in a week; total ozone was recorded continuously throughout the year 1988 on all clear-sunny days using the Dobson Spectrophotometer.

Results and Discussion

(a) Total ozone

Fig. 2 shows the variation of daily mean values of total ozone in Dobson Units (DU) at Dakshin Gangotri, George Foster (Lat 70 Deg 46 Min S, Long

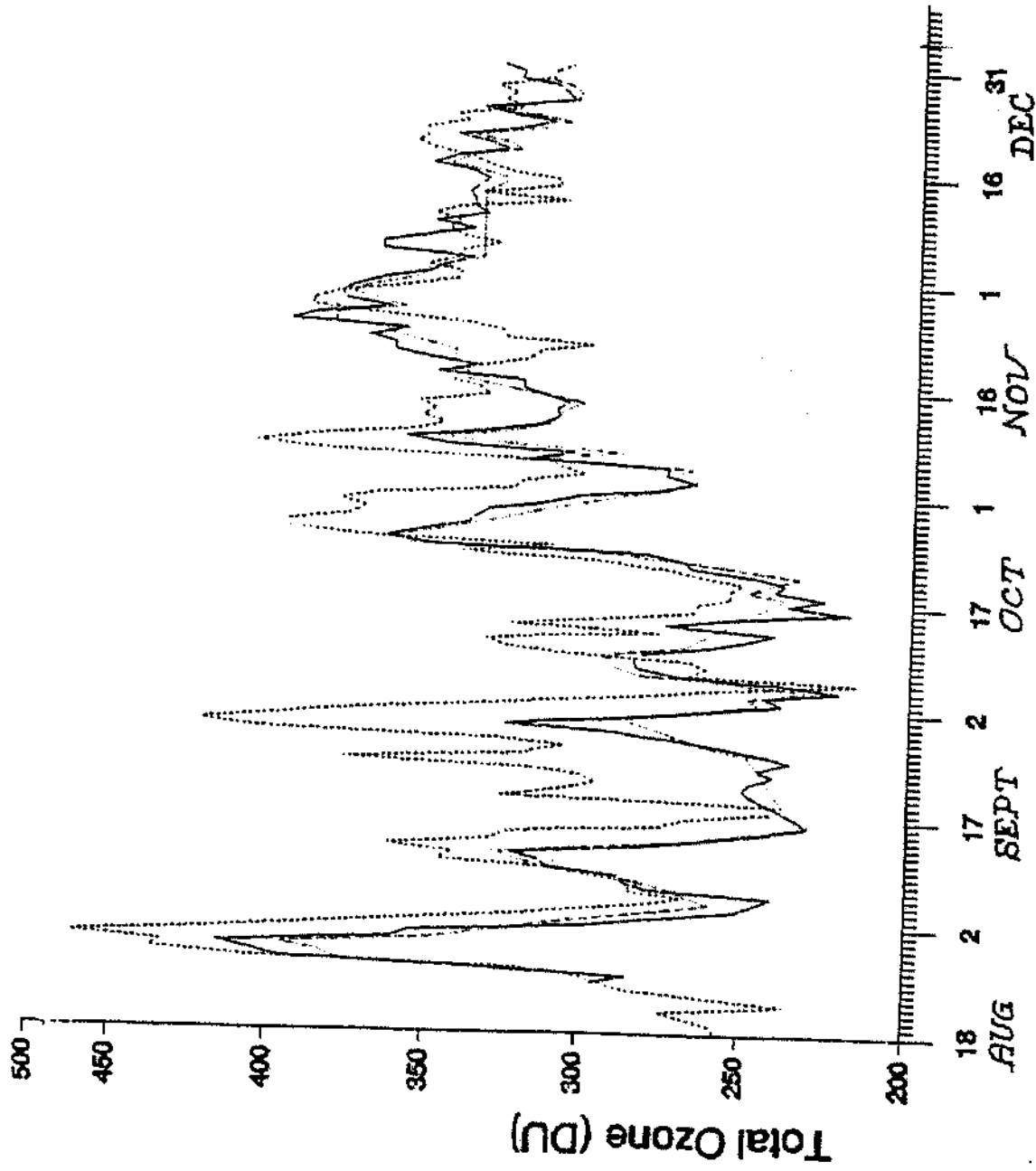


Fig: The variation of daily mean 5otal ozon at Dakshin Gangotri, George Forster and Syowa during the year 1988

11 Deg 50 Min E) and Syowa (69 Deg 00 Min S/ 39 Deg 35 Min E) for the period August to December 1988. Day to day amounts of total ozone are variable throughout the year. The tendency of variations is increasing and then decreasing and it is of repetitive though the periodicity and magnitude of variations in ozone amounts is not constant. This may be due to the north and south movement of sub-polar trough around the periphery of Antarctica. At Dakshin Gangotri daily mean amounts of total ozone are always more than 300 DU in August and from second week of November. The main depletion is seen from second week of September to third week of October. Lowest daily amounts of total ozone recorded at Dakshin Gangotri during 1988 are 230 DU on 16th September and the same value on 5th October. Similar variations in day to day total ozone amounts can be seen at George Foster and Syowa stations. George Foster recorded lowest value during September 230 DU on 16th (same as Dakshin Gangotri) and during October 219 DU on 16th. The lowest values recorded at Syowa station were 240 DU on 19th September and 216 DU on 6th October. Fig. 3 gives the variation of total ozone amounts at Syowa during

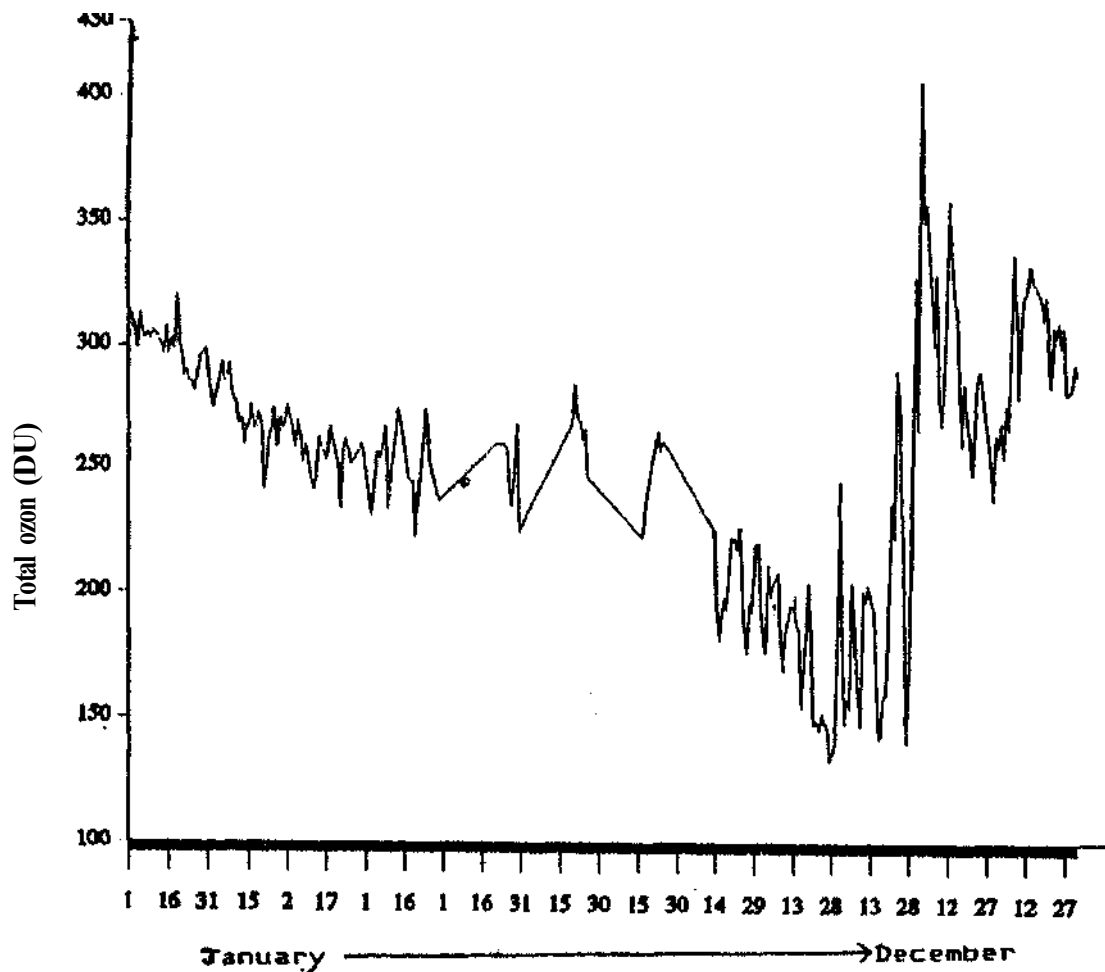


Fig. 3: The variation of daily mean total ozone at Syowa during 1994

1994. It is seen that, though magnitudes vary, the trends during both 1988 and 1994 are similar.

(b) Vertical profiles of ozone

Fig. 4 shows selected ozone soundings during pre-depletion, depletion and post-depletion periods taken at Dakshin Gangotri during 1988. The soundings show the decrease of ozone partial pressure values mainly in Stratosphere during Ozone-hole (Sep- Oct) period and their revival during post-depletion period(Oct-Nov).

At Dakshin Gangotri tropopause is noticed around 300 hPa. level at a height of about 8 to 9 km above mean sea level. The soundings indicate that partial pressures of ozone in the troposphere and in lower stratosphere upto about 100 hPa (about 16 km height) are not affected much. Remarkable reduction in partial pressures are seen at the levels of maximum ozone and mainly during September and October. During May-June period when there was no depletion at all, generally we see single peak value in partial pressure profile of ozone around 60-70 mb. During September and first half of October the partial pressures around the level of maximum are reduced drastically resulting in zigzag variations of values and multiple maxima and lesser integrated amounts. By the end of October and during November-December the depletion fills up reviving partial pressures of ozone in stratosphere. During this period generally we observe double peaks in the partial pressure profiles.

Fig. 5 to Fig. 7 show the profiles during 1994 at Maitri on 12th May-25th Sep(Winter & Spring), 20th Oct-17th Nov(Spring & Summer) & 14th Oct-6th Dec(Spring & Summer) respectively. The occurrence of depletion and its sequence is similar at Maitri during 1994 to that noticed at Dakshin Gangotri during 1988.

Fig. 8 shows the variation of monthly mean surface ozone amounts in nanobars and standard deviation of daily mean surface ozone values recorded at Maitri during 1994. Mean monthly surface ozone value increased continuously from January reaching peak in April and then decreased till July and with interesting rise again in August and then decreasing trend. Extreme maximum and minimum values of the month also showed almost similar trend as monthly mean values.

Conclusion

During 1988, ozone-hole at Dakshin Gangotri was recorded during second week of September to third week of October. Lowest daily mean total ozone at the station was 230 Dobson Units recorded on 16th September and 5th October.

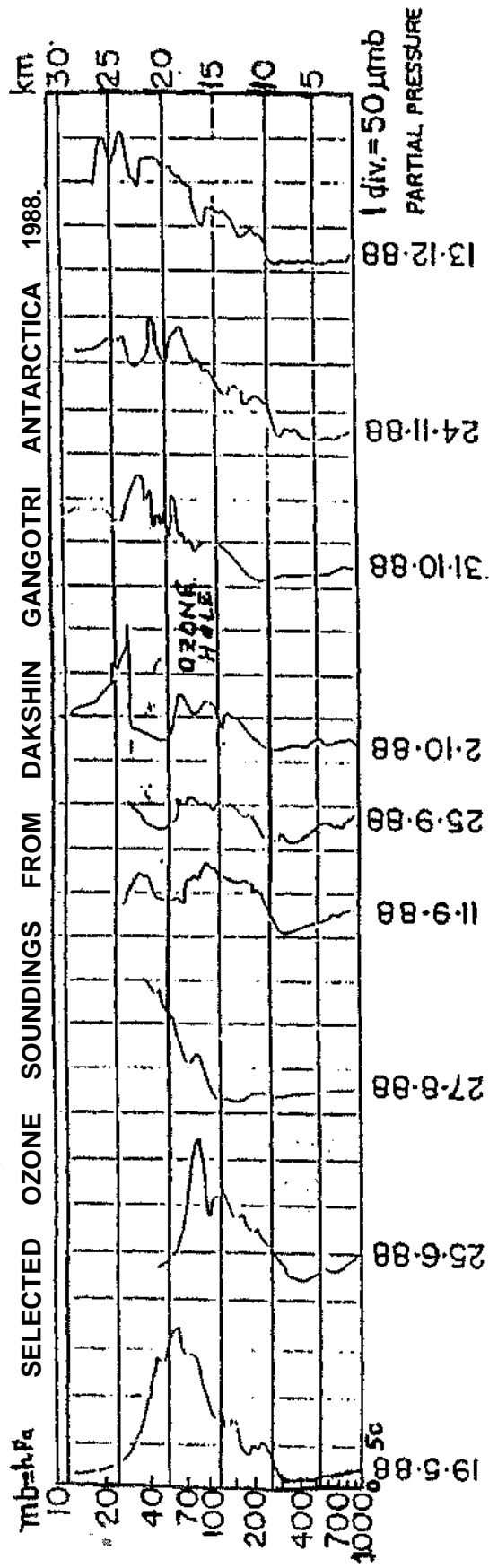


Fig. 4: Profiles of the selected ozone soundings taken at Dakshin Gangotri during 1988

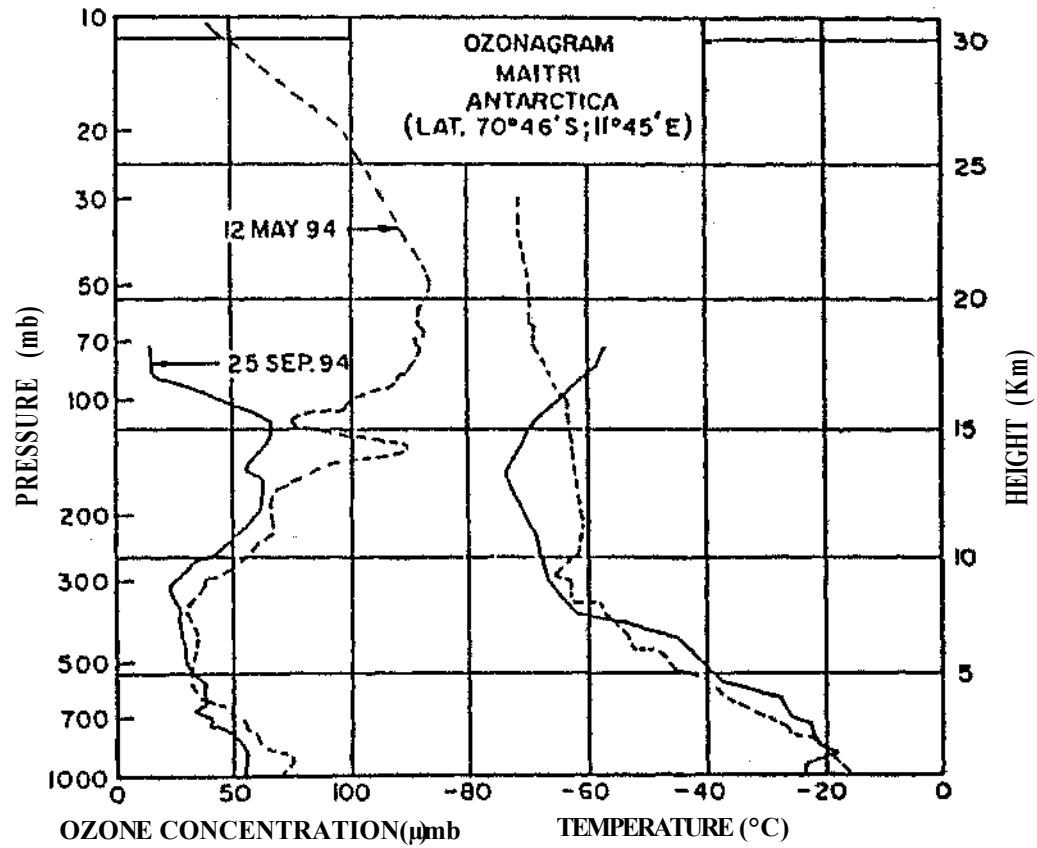


Fig. 5: The ozone profiles during 1994 at Maitri on 12th May-25th Sep (Winter & Spring)

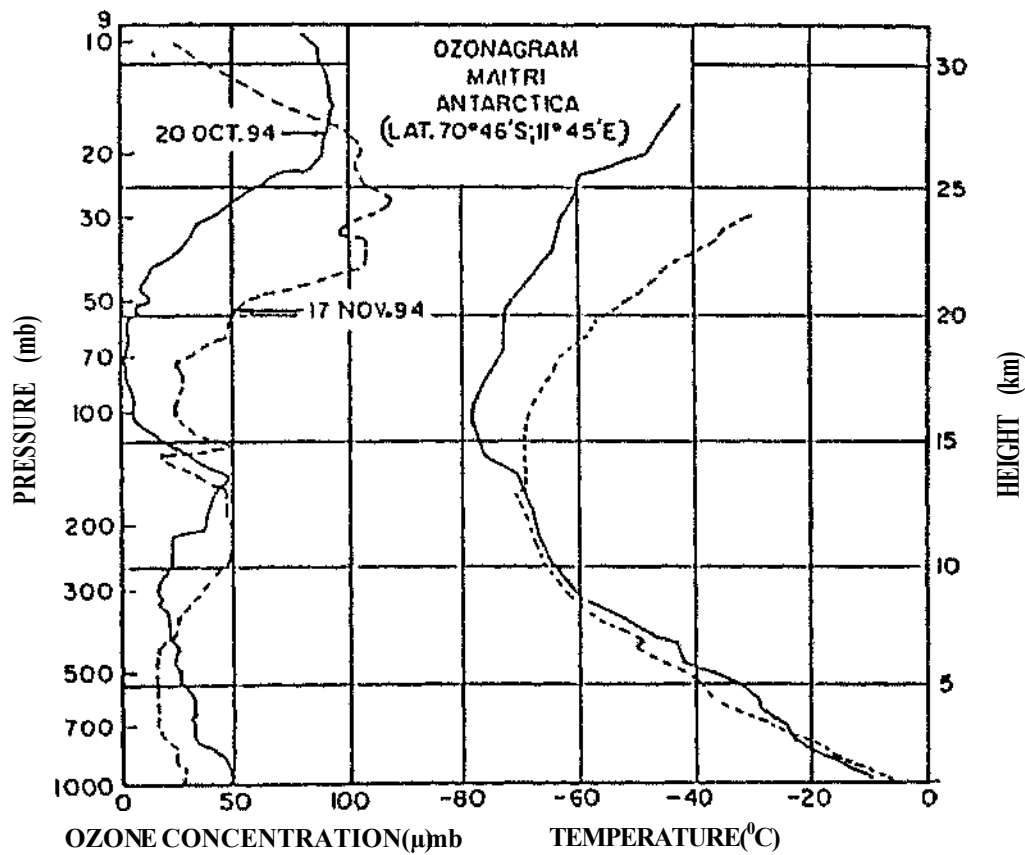


Fig. 6: The ozone profiles during 1994 at Maitri on 20th Oct-17th Nov (Spring & Summer)

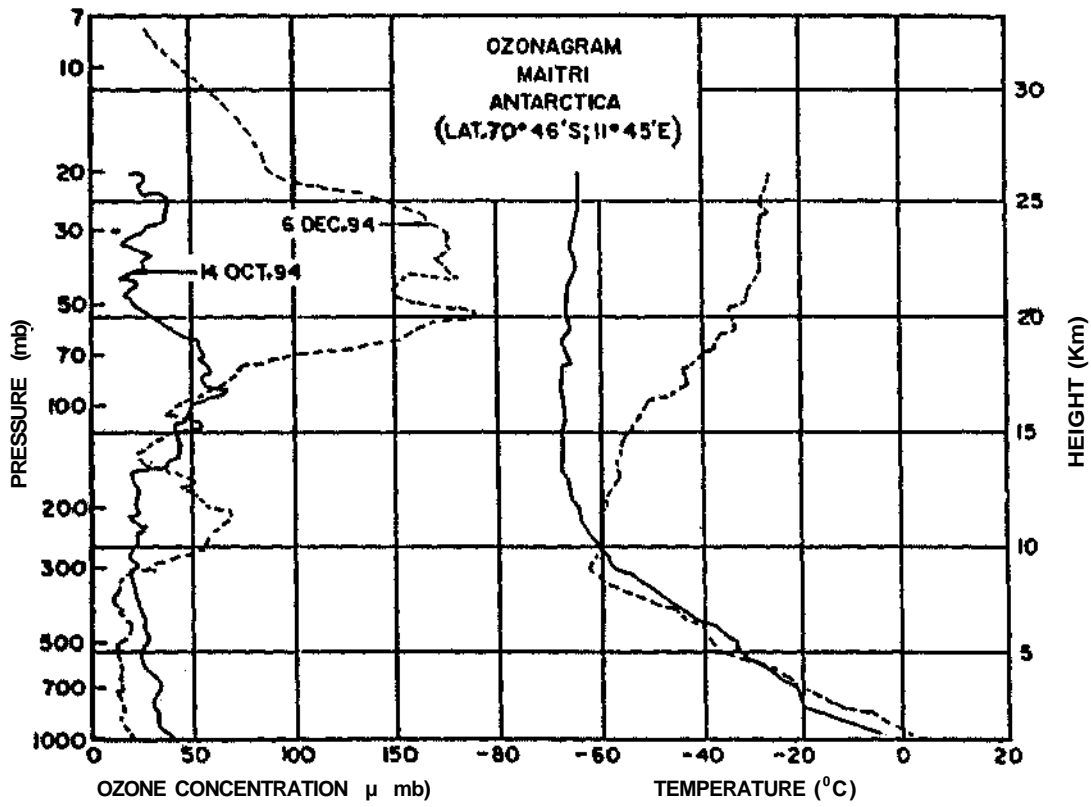


Fig. 7: The ozone profiles during 1994 at Maitri on 14th Oct-6th Dec(Spring & Summer)

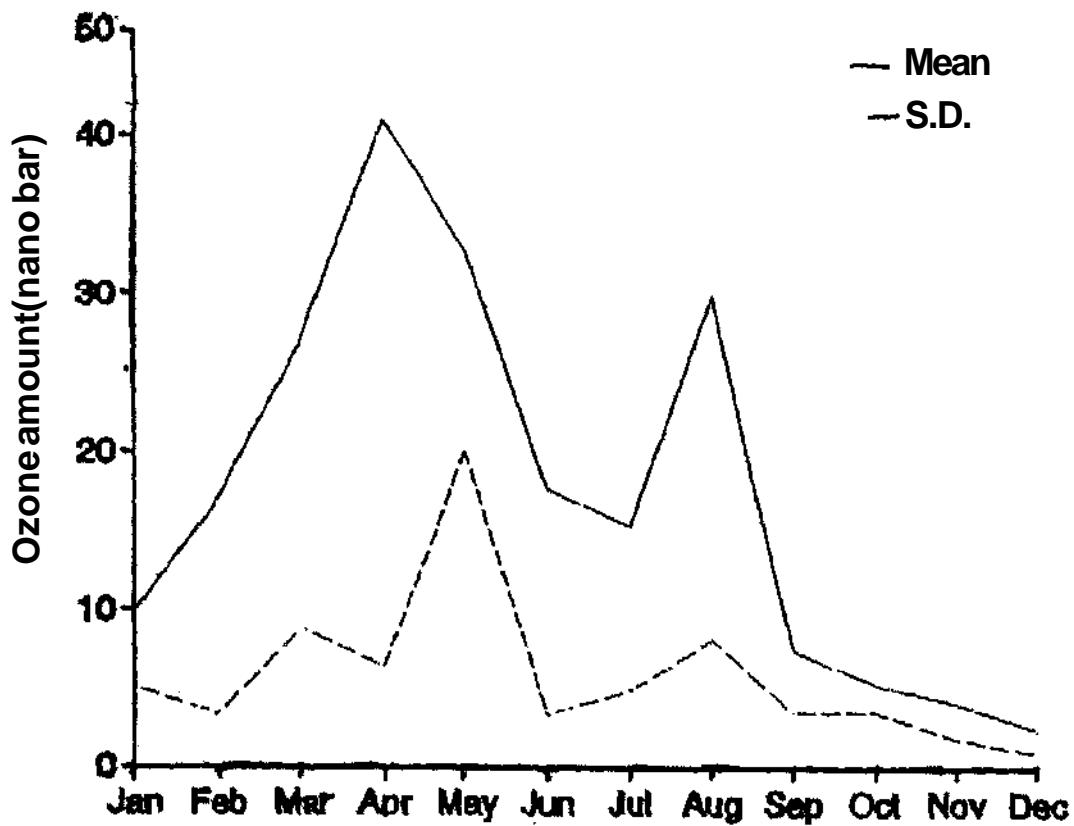


Fig. 8: Mean surface ozone amount and standard deviation of surface ozone values recorded at Maitri during 1994

The remarkable depletion in the partial pressure of ozone was around the level of maxima in stratosphere. During 1994, the ozonesondes data recorded at Maitri indicates that the sequence of occurrence of ozone depletion both in time and space is same as at DG during 1988 and at Syowa in 1994. Monthly mean values of surface ozone values at Maitri during 1994 show almost continuous rise from January reaching peak in April and then decreased with significant secondary rise in August.

Acknowledgements

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