DIURNAL AND SEASONAL VARIATION OF SURFACE OZONE AT SHEVGAON

A.D.Kakade[1], C.N.Potangale[2] and N.S.Suruse[3]

[1,3] *Department of Physics New Arts, Commerce and Science College, Shevgaon.*

[2]*Department of Chemistry New Arts, Commerce and Science College, Shevgaon.*

Corresponding author:-adk.kakade@rediffmail.com

Abstract-**The continuous measurement of surface ozone(O_3), made at rural site Shevgaon (19.35^{0}N, 75.22^{0}E, 1669 feet above sea level), India from January 2016 to December 2016. The maximum and minimum average O_3 mixing ratios were observed in winter and monsoon seasons 23.5ppbv (parts per billion by volume) and 11.8 ppbv respectively. The annual average O_3 mixing ratio is 20.8 ppbv. The 38% of data points lie in the range 10.0 ppbv to 20.0 ppbv. The hourly averaged O_3 mixing ratio exceeds 70 to 80 ppbv in premonsoon and winter.**

Keywords- Surface ozone, seasonal variations, rural, frequency distribution.

I. INTRODUCTION

z

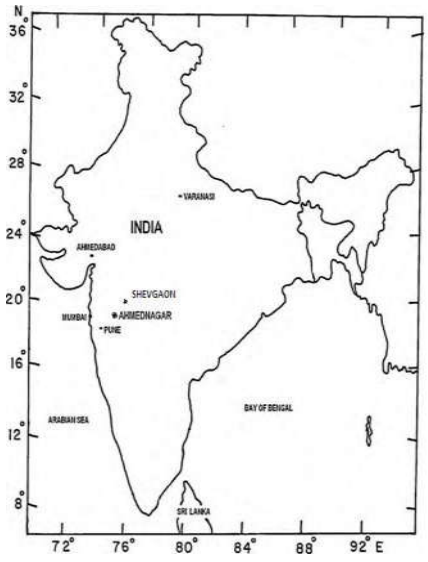

Fig. 1 Location map of the observation site at Shevgaon.

80% of the annual rainfall (62cm).The weather during post monsoon season (October-November) is calm. Fair weather conditions prevail during winter season (December-February). The hot weather is observed in premonsoon season (March-May).

III. MEASUREMENT TECHNIQUES:

The Aeroqual Series 500 monitor has been built up to accurate and precise measurement of ambient gas. There are different sensor heads for particular gases and interchangeable on the same unit. The monitors are modular in design and composed of two main components, a series 500 monitor and a sensor head. The sensor head is calibrated and does not normally need to calibrated. The concentration can be displayed either in ppm or mg/m^3. The monitor is able to log upto 8000 data prints. The data logging interval can be set in one minute increments. In this study, all O_3 analysis are based upon the hourly average data.

IV. RESULT AND DISCUSSION:

Frequency Distribution of O_3 mixing ratio

Frequency distribution of O_3 mixing ratio (ppbv) in different ranges during January 2016 to December 2016 at observation site Shevgaon is presented (bar diagram) in (Fig 2). It shows that 38% of all data points of O_3 mixing ratio measurement lie in the range of 10-20 ppbv, followed by 24% of data points lie

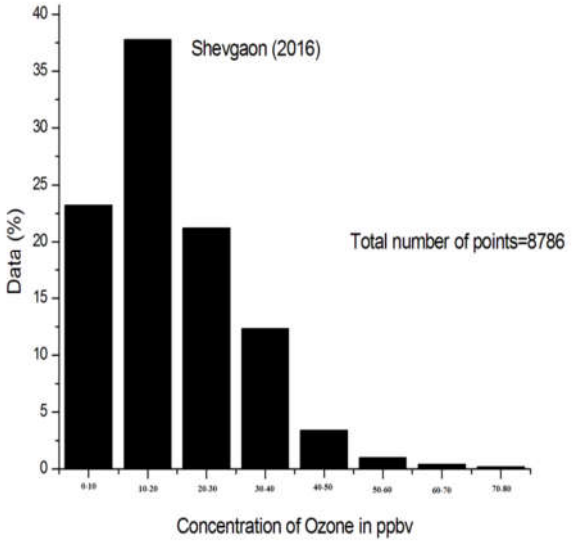

Fig.2 Frequency distribution of O_3 concentration at Shevgaon.

in the 0-10 ppbv.It is also noted that lowest 1.2% of total datapoints lie in the range of 50-80 ppbv. The very few 1 hourly average O_3 data points exceeds air quality standards (80 ppbv) at noon in the premonsoon season.

Table1. Seasonal O_3mixing ratio (ppbv) during night and daytime at Shevgaon.

Season	Average O_3 mixing ratio (ppbv)	
	Nighttime (0000h-0200h)	Daytime (1200h-1400h)
Premonsoon	18.4	37.2
Monsoon	8.5	13.4
Postmonsoon	13.7	31.8
Winter	15.6	38.3
Average	14.1	30.2

The table1 show that comparison of average seasonal variation of O_3maxing ratio during nighttime and daytime. The daytime O_3mixing ratio is found to be highest in premonsoon and winter season attributed to intencesolar radiation. Also, low nighttime O_3mixing ratio indicates loss of $O_3$and no production of O_3. During nighttime, production of O3 ceases and hence due to lack of sunlight, O_3 decreases throughout nighttime by chemical loss of O3, to a lesser extent with nitrate radical (NO_3). The rains washout the O_3precurs or gases in monsoon season reflecting the less photochemical activity of O_3 production. The average O_3mixing ratio is 30.2 ppbv during daytime and 14.1 ppbv during nighttime.

Diurnal variation

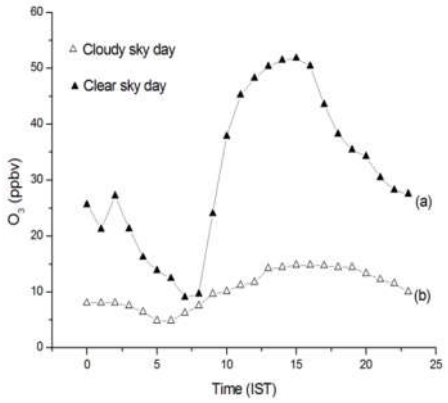

Fig. 3 Average diurnal variation of O_3 mixing ratio (ppbv) during clear sky day(30/04/2016) and cloudy day (11/07/2016) at Shevgaon.

Day to day variations in$O_3$are very important because the photochemical production of $O_3$is mostly affected by metrological parameters. Fig.3(a and b) shows average diurnal variation of O_3on clear sky day (30th April 2016) and cloudy day (11th July 2016). The highest O_3mixing ratio 51.8 ppbv is observed on 30th April 2016 at 1500h. The meteorological parameters such as maximum air temperature (40.6^0 C), low relative humidity (about 10%)and low cloud cover (8-10%) are favorable for highest O_3 mixing ratio during clear sky day Fig.3 (a). Fig. 3 (b) show that highest O_3mixing ratio 14.8 ppbv is observed on cloudy day. Overall, itshows almost constant O_3mixing ratio throughout the cloudyday. The corresponding meteorological parameters during cloudy day are low air temperature (~30^0 C), high relative humidity (60-70%) and high cloud cover (75-85%). These are all unfavorable condition for O_3production. The diurnal pattern of O_3shows large amplitude on clear sky day as compared to low amplitude on cloud day.

Seasonal diurnalO_3 variation

Fig. 4 shows the average duration variation of O_3 mixing ratio in different seasons observed at Shevgaon. The highest maximum O_3 about 41.5 ppbv at 1600h lowest 18.0 ppbv at 1700h Winter and monsoon respectively. Corresponding lowest minimum are 5.2 ppbv and 4.0 ppbv at 0700h. The high O_3 in winter is attributed to low boundary layer height which traps the precursor gases (NO_x, CO) near to ground level. The premonsoon season shows the highest maximum O_3 mixing ratio 39.2 ppbv at around 1500h and the lowest minimum O_3 about 9.9 ppbv at 0700h; because of high air temperature, low cloud cover, low relative humidity and no rainfall activity. It indicates sufficient NO_x load present due to increasing human activity in rural environment. In rural India, the burning of biofuels, such as wood, dung, biomass burning and agricultural waste.

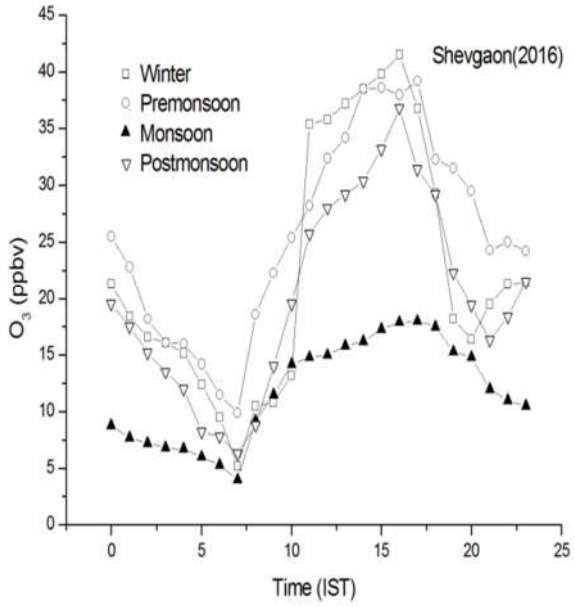

Fig. 4 Seasonal diurnal O_3 variation of O_3 mixing ratio at Shevgaon.

In the monsoon season diurnalamplitude of $O_3$was low due to near absence of incoming solar radiations. Hence, the diurnal amplitude of$O_3$was observed to the flat in the monsoon as compare to the winter and pre monsoon season.

V. CONCLUSIONS

The results of this study shows that the mixing ratio of surface $O_3$are higher in winter than monsoon season. The diurnal variation of O_3shows a broad daytimepeak extending from 1200h to late in the afternoon. The amplitude of O_3vary with season. The average nighttime O_3mixing ratio is nearly half of the that of daytime**.**

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the University Grant Commission, Western Regional office, Pune-7, for providing financial assistance for this research work.

REFERENCES

[1] WHO, *Guidelines for air quality*, world health organization, Geneva, pp 190, 2000.

[2] P. Sicard, P. Coddeville and J. C.Galloo, Near-surface ozone levels and trends at rural stations in France over the 1995-2003 period. Environ. Monit. Assess. 156, 141-157, 2009.

[3] S.Sillman, The use of NOy, H_2O_2, and HNO_3 as indicator for ozone-NOx-hydrocarbon sensitivity in urban locations. J., Geophys. Res. 100, 14175-14188, 1995.

[4] P. Crutzen, Discussion of chemistry of some of the minor constituents in stratosphere and troposphere. Pure Appl. Geophys. 106,1385-1399, 1973.

[5] J.H.Seinfeld andS.N.Pandis, Atmospheric Chemistry and Physics from Air Pollution to Climate Change, John Wiley and Sons, Inc.,New York, 1998, pp 2006.

[6] J.Pandey, M. Agrawal, N. Khanam, D. Narayan and D.N.Rao, Air pollutant concentrations in Varanasi, Atmos. Environ. 26b, 91-98, 1992.

[7] S.L. Jain, B.C. Arya, A. Kumar, S.D. Ghuge and P.S. Kulkarni, Observational study of surface ozone at New Delhi, India, Int. J. Remote Sens. 21 (16),3515-3526, 2005.

[8] S.B.Debaje andA.D,Kakade, Surface ozone variability over western Maharashtra, India, J. Hazard. Mater.161, 686-700, 2009.

[9] M. Najaand S. Lal, Surface ozone and precursor gases at Gadanki (13.50N, 79.20E), a tropical rural site in India, Geophys. Res. 107, D14, doi:10.1029/2001JD000357, 2002.

[10] A. D. Kakade, Impacts of meteorology on surface Ozone Variability at Shevgaon, Int.Res.J. of Sc. &Engg, 2018;Special Issue A2:94-97, 2018.