

2.084 Assessment of Photo-stationary state of ozone over Delhi .

Early Career Scientist

Presenting Author:

Renu Masiwal, Environmental Sciences & Biomedical Metrology Division, CSIR - National Physical Laboratory, Dr. K. S. Krishnan Road, New Delhi -110012, India, tuliprenu@gmail.com

Co-Authors:

C. Sharma, Environmental Sciences & Biomedical Metrology Division, CSIR - National Physical Laboratory, Dr. K. S. Krishnan Road, New Delhi -110012, India

D.K. Shukla, Environmental Sciences & Biomedical Metrology Division, CSIR - National Physical Laboratory, Dr. K. S. Krishnan Road, New Delhi -110012, India

B.C. Arya, Environmental Sciences & Biomedical Metrology Division, CSIR - National Physical Laboratory, Dr. K. S. Krishnan Road, New Delhi -110012, India

Abstract:

The ozone (O_3) production in troposphere takes place via photo-oxidation of nitrogen dioxide (NO_2) and destruction via titration with nitrogen oxide (NO). When these two processes achieve equilibrium photo-stationary state (i.e. $\phi = 1$), it indicates that no additional processes are involved in ozone production. In moderately polluted or in the clean environment, the per-oxy (PO_2) radical can influence the photo-stationary state (PSS). Limited efforts have been made so far to assess the PSS over Delhi which is facing serious air quality issues.

This study presents the assessment of the photo-stationary state of ozone in Delhi's atmosphere based on the in-situ measurements of the surface ozone, oxides of nitrogen (NO_x) and non-methane hydrocarbons (NMHCs) carried out at Delhi. The highest values of ozone concentrations were observed during the period from 11:00 to 14:00 hours while the lowest O_3 concentrations were observed during night-time and early morning periods. The hourly averaged ozone values were found to vary from 4 to 170 ppb during the daytime. Whereas, the highest values of NO_x concentrations were observed during the morning and evening periods coinciding with the heavy traffic hours.

The ϕ values, calculated using the measured values of O_3 , NO, NO_2 and calculated values of NO_2 photolysis rate (JNO_2), were found to vary from 0.05-5.9 with the predominance of values ranging between 0.5 to 2.5. The PO_2 values, found to vary from 0.001 to 2.5ppb, were used to calculate the extended- ϕ (i.e. ϕ_1). The values of ϕ_1 have been found to vary from 0.02 to 0.9 with an average value of 0.3 ± 0.1 . The ozone production rate ($ppb \text{ min}^{-1}$) was calculated using the classical equations. The steady state time constant was also calculated for the ozone photo-stationary state which showed that the steady state was established over the study site for the duration of ~ 10 -50 seconds.