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Effects on tropospheric NOx level due to lightning

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Today, major cities are identified as having problems on air pollution due to the rapid urbanization and industrialization. Therefore, it is a must to pay attention to the sources that influence air pollution. Sources can be natural or manmade. This study was carried out to understand the effect of natural source "lightning" on air pollution with special attention to the variation of tropospheric nitrogen dioxide concentration so that the manmade contribution to tropospheric nitrogen dioxide can be better estimated.

The tropospheric nitrogen dioxide concentration, rainfall, wind speed and lightning flash densities related to the time period 2003-2008 were used for the analysis. The weekly average concentrations of nitrogen dioxide at Colombo Fort monitoring site (automated system) were obtained from the Central Environmental Authority, Battaramulla. The corresponding rainfall and wind speed data were obtained from the Department of Meteorology, Colombo and the daily lightning flashes available in the NASA database were used as lightning data for the analysis.

Analysis was made using the MATLAB software tool. The wind speed and rainfall were found to be inversely related to tropospheric nitrogen dioxide concentration with correlation coefficients (r) -0.76 and -0.64 respectively. In contrast, lightning flash densities were found to be positively correlated (r=0.59) with tropospheric nitrogen dioxide concentration. The multiple linear regression analysis technique was used and a mathematical model for the system was developed. The model provides a basic idea about how tropospheric nitrogen dioxide level in Colombo varies with meteorological parameters and lightning flash densities. This model also provides the contribution from the man made sources to the tropospheric nitrogen dioxide level in Colombo. The model predicts that with one unit increase in wind speed and rainfall, tropospheric nitrogen dioxide concentration decrease by 3.1194×10^{-4} ppm and 1.5780×10^{-4} ppm respectively. It is also found that with one unit increase in lightning flash density, tropospheric nitrogen dioxide concentration would increase by 1.17×10^{-6} ppm. Therefore this model will be useful in urban planning which makes Colombo a better place to live without compromising the present economic status.

Keywords: Air pollution, lightning, nitrogen dioxide, rain fall, tropospheric NO_x

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