International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 5, Issue 2 (February 2016), PP.53-55

Changes in Atmospheric Ozone Concentration Following Moderate Earthquake at Indian Capital New Delhi (28.6°N, 77.4°E)

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Abstract:- Impact of earthquake on atmospheric ozone concentration if any and its change when earthquake with magnitude 5.2 on the Richter scale occurred in New Delhi on March 5, 2012 has been studied with the help of satellite data obtained from Total Ozone Mapping Spectrometer (TOMS), and Ozone Monitoring Instrument. Delhi being the capital territory of India with humid subtropical climate and a region belonging to Northern India where frequent earthquakes are observed the affect of earthquake on March 5, 2012 and its affect on atmospheric ozone concentration is reported. The ozone concentration was found to be 272 Dobson Units(DU) on the day of the earthquake, and reached a maximum value of 313 Dobson Units within 20 days after the day of earthquake. The increase in ozone concentration was found to be dependent on the magnitude of the earth quake, depth of focus, wind direction and geographical location of the epicenter.

Keywords:- Atmospheric ozone, earthquake, magnitude, epicenter

I. INTRODUCTION

Regular monitoring and analyzation of the profiles of atmospheric trace gases was very significant for weather forecasting, climate modeling and monitoring of environmental conditions in day to day life. In this context, it is a known fact that ozone concentration plays a significant role in the chemistry of the earth's atmosphere. Stratospheric ozone is naturally formed by chemical reactions involving ultraviolet sunlight and oxygen molecules. These reactions occur continually wherever ultraviolet sunlight is present. The earth's stratospheric ozone layer plays a critical role in absorbing ultraviolet radiation emitted by the sun. In the last thirty years, it has been discovered that stratospheric ozone is depleting as a result of anthropogenic pollutants. There are a number of chemical reactions that can deplete stratospheric ozone; however, some of the most significant of these involves the catalytic destruction of ozone by halogen radicals such as chlorine and bromine. In addition to these reactions natural disasters like earth quakes also have impact of variability in ozone concentration. Hence it is very important to study the variability of ozone concentration if any due to earth quake which may alter the incoming UV radiation and also changes in the dynamics of the climate. It is a known fact that earth's crust is made up of several pieces called tectonic plates, which fit together to form the outer shell of the earth. An earthquake occurs due to release of stress caused by the movement of tectonic plates. In this process heat is produced due to friction between plates to vent to the surface, which in turn heats the atmosphere in contact with it. Gravity waves caused by temperature change on the earth's surface during earthquakes may be considered as a source which transmits this heat energy from the surface to upper layers, thus creating a low atmospheric pressure region at the earthquake site. Pal (2002) has observed an intense low atmospheric pressure area during earthquakes in North India[1]. High electric fields have been found over seismically active regions a few days prior to a strong earthquake, which is believed to penetrate into the ionosphere and create specific irregularities of electron concentrations over the active regions [2], and also leads to a large amount of particle precipitation at stratospheric altitudes [3]. This may lead to some changes in the ozone concentration.

II. DATA

Total ozone data has been obtained from the website http://www.esrl.noaa.gov/gmd/grad/neubrew/SatO3DataTimeSeries.jsp . The data was collected by Ozone Monitoring Instrument (OMI) which provide high resolution daily global information about the total ozone content of the atmosphere by measuring ultraviolet sunlight backscattered from the ground. Data for 60 days 30 before the day of earthquake and 30 days after the day of earth quake was collected.

III. RESULTS AND DISCUSSION

Changes in atmospheric ozone concentration for North Indian station Delhi where earthquake with a magnitude 5.2 on the Richter scale that occurred during 5th March 2016 has been studied. The figure below shows the variation of ozone concentration after and before the day of occurrence of earthquake.

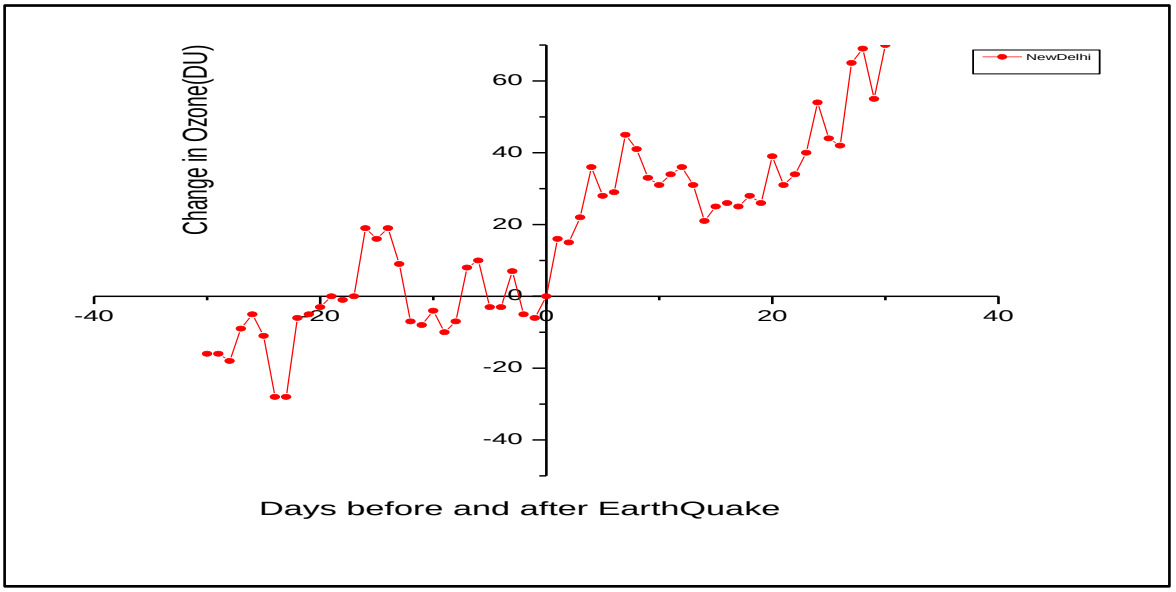

Figure 1. Comparison of change in total ozone (Dobson Units) with respect to The ozone concentration on the earthquake day for Delhi

The trend of variation in total ozone concentration after earth quake for Delhi was shown in Figure 1. Here it is observed that mean ozone concentration was almost 262 Dobson Units for the days before earthquake and it reached 272 Dobson Units on the day of earth quake. After the earthquake the mean ozone concentration increased gradually to 313 Dobson Units in the next 15 to 20 days.

As shown above ozone concentration initially decreased and then increased after earth quake and this change may be due to change in the dynamics of the upper troposphere. However anthropogenic modifications that lead to change trace gases like NO_x that affect upper ozone concentration cannot be measured during earthquakes. This may lead to incomplete analysis of the change in ozone concentration during earthquakes. Moreover, the contribution of these gases may not be large enough to produce such a significant increase in total ozone in such a short time.[4]

IV. CONCLUSIONS

Ozone data obtained from satellite instruments have been used to investigate the variations in atmospheric ozone concentration at Delhi which encountered moderate earthquake. The ozone concentration was found to be low on the day of the earthquake and increased thereafter. Dynamical disturbances, wind direction and transport processes may have a greater influence on the observed increase in ozone concentration compared to photochemical production of tropospheric ozone from some of the gases emitted from the earth's interior during earthquakes. However, since ground based trace gas monitoring measurements are not available at the time and place of occurrence of the earthquakes, it is difficult to conclude strongly on the mechanism leading to the observed increase in ozone concentration.

V. ACKNOWLEDGMENT

The author wishes to sincerely acknowledge his gratitude to N.D.Ganguly, St.Xaviers College , Gujrat whose paper entitled "Variation in atmospheric ozone concentration following strong earthquakes" has been very helpful to analyze the above results for Indian station.

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