Impact of Earthquake on Ozone Concentration at Manipur (24.8^0 N, 93.6^0E)

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Abstract: Atmospheric ozone concentration and its change when earthquake with magnitude 6.7 on the Richter scale that occurred in Manipur (North East India) on January 4, 2016 has been studied with the help of satellite data obtained from Total Ozone Mapping Spectrometer (TOMS), and Ozone Monitoring Instrument. Manipur being a hill station the affect of earthquake on one of the atmospheric parameter ozone concentration is studied. The ozone concentration was found to be high 271 Dobson Units(DU) on the day of the earthquake, decreased gradually after the earthquake and reached a maximum value and thereafter decreased to its normal value. 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.

1. 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 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. 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 (Singh et al. 2007), and also leads to a large amount of particle precipitation at stratospheric altitudes (Tertyshinikov 1996). This may lead to some changes in the ozone concentration.

2.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.

3. Results and discussion

Changes in atmospheric ozone concentration for North East Indian station Manipur where earthquake with a magnitude 6.7 on the Richter scale that occurred during 4th January 2016 has been studied. The figure below shows the variation of ozone concentration after and before the day of occurrence of earthquake

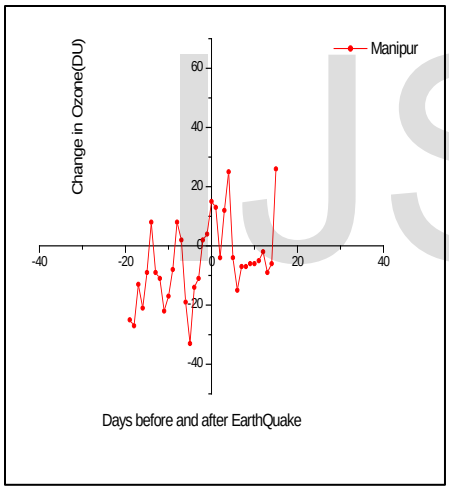

Figure 1. Comparison of change in total ozone (Dobson Units) with respect to the ozone concentration on the earthquake day for Manipur

The trend of variation in total ozone concentration after earth quake for Manipur was shown in Figure 1. Here it is observed that ozone concentration was high on the day of the earthquake. After the earthquake ozone concentration decreased and increased gradually. The ozone concentration reached a maximum value within 5 days and further decreased to its normal value. The ozone concentration on the day of earthquake which is 271 DU and prior to earth quake day before 5 days it is 252 DU and after 5 days it is 252 DU. This indicate a change of 20 DU before and earth quake in this hill station.

As shown in Figure 1. 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. Conclusions

Ozone data obtained from satellite instruments have been used to investigate the variations in atmospheric ozone concentration at Manipur which encountered strong 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

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