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Investigating for influence of Cosmic Rays on Ozone Layer Depletion at Beijing China

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ABSTRACT

In the present study monthly and annually data of ozone depth and cosmic rays intensity at China Beijing during the period of 1984-2010 have been analyzed to investigate the effects of cosmic rays intensity on ozone depletion. This communication implements statistical analysis on the data sets for the specified period mentioned above. The analyses exhibit that mean monthly variation of cosmic rays intensity increases. Our further investigation claim that in the month of May (1984-2010) changes occurred in the decrease the ozone depth due to the increase in cosmic rays intensity. This sort of study confirms cosmic rays influence on the ozone layer depletion.

INSPEC Classification : A9385, A9410D

Keywords : Cosmic ray, ozone layer, ozone depth, ozone depletion.

1. INTRODUCTION

Cosmic rays have strong biological and Climatic effects.CR is the main source of ionization on atmosphere and increase low latitude cloud, increase planetary albedo[6].Cosmic rays also increase production of oxides of nitrogen (NO, NO2) and oxides of hydrogen (OH) on earth biosphere thus enhance destruction of OLD, reducing sunlight, reducing potential global cooling. The effects on global climate change and increase UV radiation flux at surface of earth due to OLD (L.V.Egorova, V.Ya.Vovk, O.A. Troshichev, 2000), (Marco Padovani, Daniele Galli, 2009), (Mikhail V. Medvedev and Adiran L. Melott, 2006), (Rolf Muller, 2003), (Q. B. Lu, 2009). In 200,Lu and Sunche indicate that the action of cosmic rays on polar stratospheric clouds (PSC) effects rapidly destruction of Chlorofluorocarbons (CFC) and HCL .This show a new path to enhance " Ozone Hole". They further suggested that Ozone loss strongly correlated with cosmic rays ionization-rate variation with altitude and solar cycle (Q. B. Lu, 2009), (Q.-B. Lu and L. Sanche, 2001). Since Ozone, depletion

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causes an increase in the solar UV-flux because of the reduced absorption, where as the radiation flux in the range decreases due to larger absorption by NO2, thus the opacity of the atmosphere changes, which leads to green house effect and alterations in the temperature and geo potential heights. There is causing a disturbance in the atmospheric circulation. In general, a cosmic ray certainly plays a significant role in the atmospheric ion chemistry, leading to ozone depletion and to the green house effect. Cosmic rays affect the increase of atmospheric pressure. (L.V.Egorova, V.Ya.Vovk, O.A. Troshichev, 2000) Cosmic rays also effect on the global electric circuit (G.A. Bazlevskaya ,M.B. Krainev, V.S. Makhmutov, 2000).

It is also known that cosmic rays create devastation in computers because they affect persistent performance of electronic logic memories and affect memory failure or error in computers (Reserva,R.L,De Asis, 2002). Since Cosmic rays are relatively high-energy particles that influence highly on earth atmosphere and induced diverse effect. The study of cosmic rays originated approximately in 1900 because of observation of balloon experiment. Cosmic Rays investigated first time by V. Hess in 1912 and discovered that high penetrating radiations are coming from outer space. Later they are termed as cosmic rays Mikhail V. Medvedev and Adiran L. Melott, 2006). After 1937 Street and Stevenson discover the neon particle in cosmic rays. In 1982 Stekido and Elliot give correct explanation of cosmic rays that how ionized atom i.e. cosmic rays from outer space hitting the atmosphere. That is why cosmic rays become one of the most important problems in experimental as well as theoretical astrophysics. Observations of Henrik Svensmark and Eiglil Friis-Christensen reported a (3-4) % variation of global cloud cover during the recent solar cycle is effectively correlated with cosmic ray flux and inversely correlated with solar activity (Henrik Svensmark and Eigil Friis-Christensen, 1997).

In 2009, the highest flux of galactic cosmic rays during the whole history of the regular monitoring of cosmic rays in the atmosphere measured. The flux of CR with $E > .2$ GeV was about 20% higher than maximum flux observed in 1995 (Y. I. Stozhkov, N.S. Sivrzhkevsky, G.A.Bazilevskaya, 2011). A new research of 2009 by Q. B. Lu, clearly showing a strong correlation between Cosmic rays and Ozone Depletion, especially ozone content over Antarctica and consequences point out strong evidence of physical mechanism that CR-driven electron reaction of halogenated molecule leads significant role to effect the ozone hole. Further, this mechanism indicates extreme ozone content in 2008-2009 and probably another maximum in 2019-2020.

Data and Method of Analysis

Monthly ozone depth data (1984-2010) taken from the Chinese Academy of sciences Institute of Atmospheric Physics at Beijing China ,where Dobson Spectrophotometers have been installed under supervision of World Meteorological Organization (WMO) . Cosmic rays data recorded at Beijing super neutron monitor (18-MN-64) situated in the Suburbs of Beijing (40.08N, 116.260E) with altitude 47m, Center for Space Science and Applied Research, Chinese academy of science and taken from World Neutron Monitor Network (WDC).

In atmospheric science, especially in the field of meteorology and astrophysics, various techniques of statistical analysis are used. Current studies express Data analysis and exploratory analysis (EDA). Data analysis and EDA are widely used in statistical analysis to explored Time series analysis, regression analysis etc. It expose in regression or correlation to establish a cause and effect relationship between two variables. For computational technique, we have used the statistical tool Minitab.

Figure 1
Monthly mean variation of CR of China with all data set of China O3 for Period 1984-2010

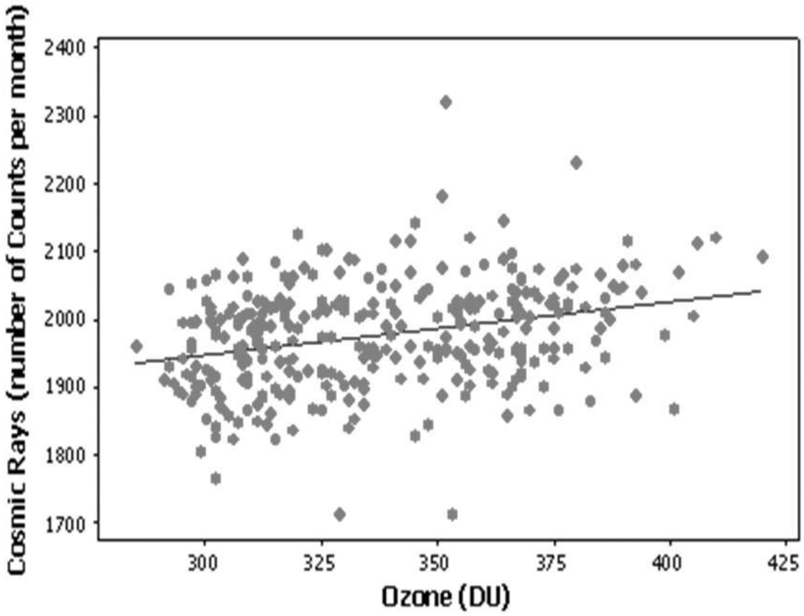


Figure 2
Scatter Plot of monthly mean of China Ozone vs China Cosmic Rays for period 1984-2010

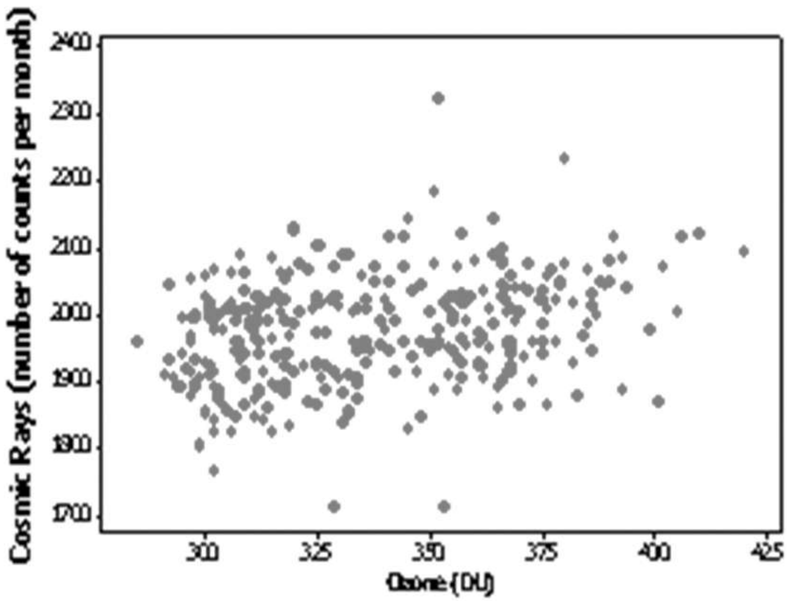


Figure 3
Comparison of annual mean of China Cosmic rays and Ozone for month of May from 1984-2010

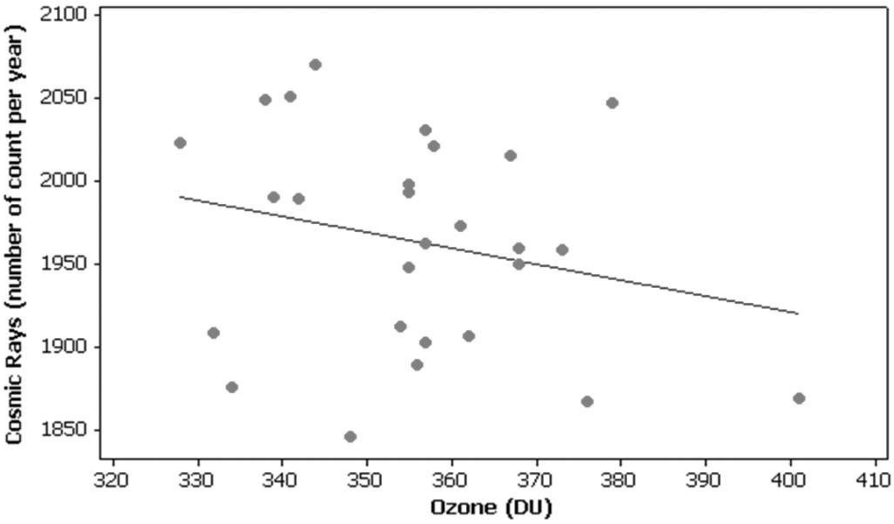


Figure 4
Comparison of mean percent variation of CR intensity and annual mean Ozone depth of China during the period 1984-2010.The CR data were taken from World Neutron Monitor Network (WDCCR) while ozone data were obtained from World Meteorological Organization (WMO).

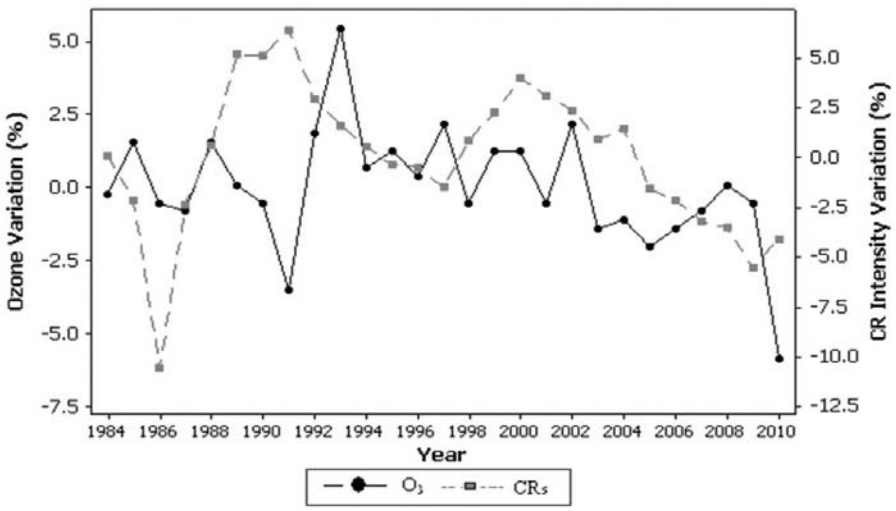


Figure 5

Comparison of monthly mean variation of CR intensity and monthly mean Ozone depth of China during the period 1984-2010.The CR data were taken from World Neutron Monitor Network (WDCCR) while ozone data were obtained from World Meteorological Organization (WMO).

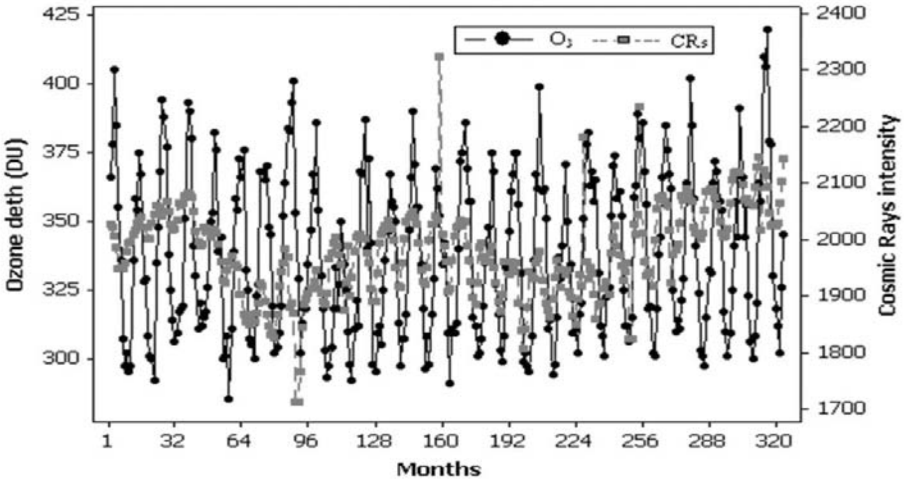
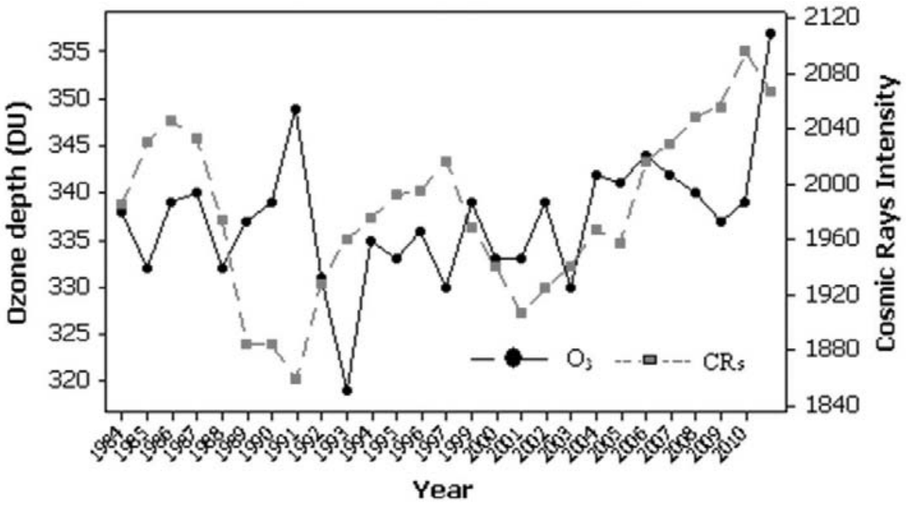


Figure:6

Comparison of mean variation of CR intensity and annual mean Ozone depth of China during the period 1984-2010.The CR data were taken from World Neutron Monitor Network (WDCCR) while ozone data were obtained from World Meteorological Organization (WMO).



Results and Discussion

The monthly averages of Cosmic Rays intensity plotted against the stratosphere Ozone to verify their independence or interaction over each other. This is because cosmic rays play a key role in annual and monthly variation of ozone. When the cosmic rays inter in the atmospheric region, they ionize the nitrogen and oxygen and produce nitrogen oxides compounds, which are responsible for Ozone destruction. The model equation of given observations (for n=324) taken as

$$CR_{(China)} = 1715 + 0.780\, O_{3\,(China)} \quad \dots \qquad (1)$$

Where, $b_\circ$ = 1715, (parameter value of intercept), b_1 = 0.780, (parameter value of slop), this indicates that the parametric value of slope is positive so Cosmic rays are increase with slope 0.78 when ozone thickness increases. Where R^2 is 8.5% and R^2 (adj) = 8.3%. This indicates only 8.5% of variation is explained by regression model.

The regression coefficient b_1 = 0.780 is well considerable because the P-value < 0.05 at 95% level of significance for confidence interval. For F-Test, observed F-value is 30.07 and P-value is 0.00 so it is highly significant. Hence, the model may be successful linear model. This relationship illustrated in Figure: 1.

In view of long time duration data of cosmic rays and ozone are compared. The correlation of cosmic rays with ozone depth from 1984-2010 is shown in Figure: 2. the significance level of correlation which shown in figure 2 are estimated as r = 0.291. Where, ozone depth positively correlated with cosmic rays intensity (95% significance level).it shows that no meaningful relationship is exhibited between cosmic rays intensity and ozone depth.

Current discussion discuss whether there exists a time correlation between CR intensity and O_3 depth of China .The data shows a time correlation between the annual mean O_3 and CR intensity. Figure: 4 shows clearly establish the correlation of O_3 depletion with CR intensity. Percentage variation of Ozone depletion shows inversely with the CR intensity. This Observation provides evidence of the time correlation between CR intensity and O_3

depletion. Figure: 3 shows negative correlation in month of May from 1984-2010. Model equation for the month of may shown as

$$CR_{(c)} = 2077 - 0.394\, O_{3(C)} \quad \dots\dots\dots\dots\dots \quad (2)$$

Where, value of slop is negative (b_1 = -0.394) which describes in the month of May at China region the Ozone thickness is decreased when cosmic rays are increased.

In this study we have compared ozone depth and Cosmic rays intensity of China with time. Figure: 5 compared monthly mean variation of ozone depth and cosmic rays intensity with time and Figure: 6 shows comparison of annual mean variation of CR intensity and annual mean Ozone depth of China during the period 1984-2010 which shows that cosmic rays are increase at Beijing China due to increase of Ozone depth.

Conclusion

From the above discussions, our judgment has find that the model equation (1) shows linearity between cosmic rays and ozone depth in China region. We have find a coefficient of determination R^2 = 8.4% between monthly mean cosmic rays intensity and ozone depth of China Beijing. It indicates that only 8.4% explained by regression model. We have also able to find a negative correlation in the month of May as in equation (2). Clearly shows negative relationship of cosmic rays intensity against ozone depth of China. Therefore during month of May from 1984-2010 the ozone deplete with increase of cosmic rays intensity. At last, evidence of our quantitative treatment shown increasing trend of monthly mean variation and only mean month of May shown decreasing trend at Beijing China.

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