The Relationship Between Atmospheric Circulation Patterns and Total Ozone Variations in Isfahan

Dr. Abbasali Arvin (Spanani)
Assistant Professor of Climatology
University of Payame Noor

Introduction
The ozone layer as a protective shield life on biosphere has very oscillations from view point of quantity and volume. The ozone gases in both troposphere and stratosphere layers have been affecting on human life by two ways. The ozone in stratospheric that its name is surface ozone is an extremely poisonous gases and has destructive affect on lung and plant tissue. The surface ozone has been measured in measurement pollutant stations as one of seven pollutant gases. The ozone gas in stratospheric layer unlike the surface ozone is very necessary for human and other organism lives. The stratospheric ozone is measured in meteorological stations by name of total ozone (TO). Studies show that amount of ozone in stratospheric layer has been reduced. Variations in ozone layer were effected of changing in solar radiation, volcanic eruption cosmic dust, meteoric stones and etc. that those get name as natural parameter of ozone changes. Effect of natural parameter concentration on stratospheric ozone lead to fix ozone content in long term (spanani 2004). The amount of ozone in stratospheric layer particularly in the lower stratospheric has considerable oscillations (increase/decrease) under the affection of atmospheric activities. For example V. C. Roldugin (2000) showed that passing the wave crest in the pressure field ceases the convergence of ozone poor air under the tropopause and divergence of ozone rich air above the tropopause and decreases the ozone content. The passing of a wave through simulate the opposite process and increase the ozone content T. Narayana Rao at all (2003) opining that the climatology of ozone clearly shows a significant seasonal cycle with the ozone maxima changing with height. The monthly variability of ozone as well as its seasonal maximum is found near the tropopause. Variation in tropopause height is due mainly to the passage of tropospheric weather systems and is responsible for the large monthly variability of ozone near the tropopause. In the lower stratosphere, inter annual variations are at a maximum in winter and spring, and are the result of variations in wave driven stratospheric circulation, which peaks in winter. Regarding this matter that total ozone have been affected from atmospheric parameter in lower stratosphere or upper troposphere, we decide to study the role of pattern circulation on ozone variations in Isfahan.
Research Methodology

In this research the environmental to circulation method has been used for synoptic patterns analysis. The mean daily of total ozone (TO) data related to Isfahan ozone survey center in the time period of 2005-2009 were used. From the total 1975 days, 174 days was missing value therefore the daily data of 1801 days (TO) have been used in analysis. The days that (TO) were under 250/above 310Du considered as min/max amount of ozone. The days that (TO) also was around the mean (284 Du) and had highest frequency (274 Du) had been used.

Then mean daily of geo-potential height for 100, 300 and 500mb levels for distance of 0 to 80° east and 10° to 70° North was taken from the NCEP/NCAR climatic data center. The 100 and 300mb levels were selected for finding the trough or ridge affect and the 500mb to find the low height (low pressure) or high height (high pressure) have been selected to find atmospheric stability or instability affecting on ozone variation. Correlation methods and multiple liner regression have been used for relation analysis between TO maps and synoptic pattern maps. For this aim, mean daily data of total ozone for distance of geographical 10°-10° degree had been got from the total ozone spectrometer mapping center (NASSA/GSFC). Then the total ozone isolate maps were drawn for days that the total ozone is max, min or high frequency. Then by the use of correlation relation, the total daily amount of ozone and geo potential were analyzed.

Discussion and Results

The ozone variability depends on the atmospheric activity. Thus it is so variable in winter due to atmospheric instability, high contents in spring due to universal increasing, low variability caused by atmospheric stability in summer and low content cased by the global decrease of ozone in autumn. We review two periods (one of them related to minimum and another to maximum of total ozone (TO) content) of circulation patterns from the 21 periods. The maps of 8 to 10 December 2005 were analyzed as the minimum ozone indicates a stable and calm atmosphere on Iran. On December eighth, a ridge is entering in to Iran at elevation 100 & 300 mb, and includes the negative vortices and anticyclone. In this day the amount of ozone is 236 Du. At December ninth, the ridge pattern is at 100 and 300mb elevation and anticyclone condition, at 500mb elevation is placed on Iran completely and the content of total ozone has decreased to 222Du. Thus in time that ridge axes is at 100 and 300mb elevation and dynamic anticyclone at elevation 500mb is placed on Isfahan completely, the ozone poor air is transferred to Isfahan and the total ozone is decreased to the lowest amount. The maps of 30 March to 1 April 2009 are analyzed as the maximum pattern of TO. An instability atmospheric has overcome on Isfahan in this period. The trough pattern in 100mb and a completely cyclone typical in 500mb that deepens to 300mb level was on Iran that has caused the increase of TO to 349Du. The trough axes in 100mb level and very deep cyclone in 500mb to 300mb level has been set in center of Iran that the TO has increased to 371Du in day 31 March. Amount of 7.4 millimeter rainfall has been recorded in Isfahan meteorological station on 31March. Thus the relation between the daily maps of TO with the pattern of synoptic maps were analyzed through correlation relations.
The analyses show that at the three levels of 100,300 and 500 mb, there are a significant inverse relation between TO and geo-potential height in 0.01 sig level. The most important effective variable in maximum occurrence time is the changes of 100mb level height and in mode occurrence and minimum amount of ozone is the changes of 300 mb level height. Relationship between geo-potential variation and TO content in upper level of troposphere (100 and 300mb) is stronger because density of ozone is higher under the tropopause. Thus with increase/decrease of geo-potential height (high/low pressure conditions), the TO increase/decrease simultaneously. Mass effect of three level balance on TO variability is surveyed by linear multiple regression method and show that geo-potential height affect on TO by correlation coefficient of R=0.994, R=0.885 and R=0.897 in order to mod, maximum and minimum of TO occurrences. Thus 89.1%, 80.5% and 78.4% of TO variations is explained by variability of geo-potential height in order mod, maximum and minimum of TO occurrences. Density of ozone iso-path in around of low pressure center in 500mb level show that the TO have been increased with the decrease of atmospheric pressure.

Conclusion

Our research showed that a part of TO variation in Isfahan correlated with geo-potential height variations in troposphere layer. The occurrence of content min/max of TO has been adapted with ridge/trough pattern in 100 and 300mb levels and dynamic anticyclone/dynamic cyclone in 500mb level. The lowest/highest TO content occurred in time that ridge/trough axes taken place on Iran and Isfahan. TO oscillation is low in warm season and synoptic parameter affect on its variation is very low. Thus atmospheric instability ceased variety and oscillation of TO in cold season but atmospheric stability ceased to fix content of TO in warm season. There is a significant reverse correlation between geo-potential height and content of TO that this relation is stronger in upper level of troposphere.

Keywords: Isfahan, Total ozone (TO), Circulation patterns, Stratosphere, Multi variable linear regression.

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