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# A PILOT STUDY OF TROPOSPHERIC OZONE CONCENTRATION OVER PUNE BY USING EVA SPECTROMETER

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**Abstract**

Tropospheric ozone is also commonly known as ground-level air pollutants which are produced due to the fast development of the economy and society around the world. In our modern society ozone is considered a substance that touches on our society in many ways. [1] This work aims to use the EVA spectrometer for estimation of the ozone concentration and ozone column density over Pune. It consists of input variables such as relative humidity, temperature, the concentration of ozone, the concentration of nitrogen dioxide, column density of nitrogen dioxide, column density of ozone, air mass factor obtained from routine monitoring, and the data recorded. The preliminary findings show that the meteorology conditions and emission patterns play an important part in influencing the ozone concentration. However, a particular system is appropriate sufficient to evaluation the concentration in spite of any situations. Thus, it can be concluded that the EVA spectrometer is able to give reliable and satisfactory estimations of ozone concentration. [3]



***Keywords:***

Ozone;
concentration;
pollutant;
temperature;
Humidity.

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## 1. INTRODUCTION

Study of atmospheric chemistry and minor constituents is linked with the problem of changing environments. Some of the constituents (major as well as minor) affect incoming solar radiation and outgoing re-radiation from the earth. Constituents like carbon dioxides water vapors, ozone's

methane and several other gases and aerosols control the radiations budget, influencing possible global and regional climate changes. We know that the troposphere and the middle atmosphere are linked dynamically, radiatively and chemically and that these three areas are interred linked also. The most obvious link is the direct exchange of radiation between the Stratosphere and the troposphere by emission and absorption of radiation by various trace gases. The radiative linkage is in turn influenced by photochemical processes of some active trace gases (such as NOx and CFC's) that control the atmospheric ozone budget. Thus major, minor and trace constituents of the atmosphere modify the climate through different processes such as greenhouse effect ,ozone depletion, chemical interaction and large scale motions in the stratosphere. Hence it is of great importance to understand these physical and chemical processes. For understanding these processes and their effect on climate variability, it is necessary to monitor the maximum number of constituents involved in this processes.Basically, ozone is created by oxygen molecules. Oxygen molecules (O2) have two oxygen atoms. Ozone molecules (O3) have three oxygen atoms. In the near-earth atmosphere, ozone is found in two different layers. In the troposphere, bad ozone is found in the layer nearest the ground. Tropospheric ozone is an adverse pollutant that is formed when reacting with sunlight.[4]

While in the stratosphere, “Good” ozone is formed. Stratospheric ozone is created naturally and it helps to protect us from ultraviolet (UV) radiation in sunlight that can produce sunburn and skin cancer. In the stratosphere, ozone formation takes place when a photon of ultraviolet “light” from the Sun strikes a normal oxygen molecule and breaking it apart. One of the atoms of oxygen is freed by this photo-dissociation method and attaches itself to another oxygen molecule, converting it into ozone.[6]

In the troposphere, a series of substance responses can generate ozone. Tropospheric ozone is made when daylight attacks many human-generated contaminants, containing nitrogen oxides, carbon monoxide and hydrocarbons. Ozone can cause irritation in the throat and lungs and may also cause a burning sensation in the eyes. Ozone also harms plants and damages some types of materials, especially objects made-up of rubber. [12]

Ozone in the stratosphere protects us from ultraviolet radiation present in sunlight. The ozone layer is a sort of sunscreen for planet Earth & the various creatures living on it. It absorbs most of the incoming UV “light” before it reaches the ground.[13]

The ozone fragments which captivate UV radiation advanced re-radiate the energy as hotness, warming the stratosphere. Several substances that humans discharge into the air can finish ozone in the stratosphere. This has resulted in the thinning of the ozone layer in recent years and even holes in the ozone layer over Earth’s poles. [7]

Ozone stages are naturally maximum throughout the afternoon periods of the summer months when the impact of through sunlight is the extreme. Parameters like temperature, relative humidity, and wind speed can affect ozone concentration. Wind can move together the position and

attentiveness of ozone contamination. NOx and VOC emissions can travel hundreds of miles on air currents, forming ozone far from the original emissions sources. [14]

Surface ozone is also of immense significant concern due to its harmful impact on humans, plants and buildings as one of the important atmospheric pollutants and also due to its involvement in global warming and climate change as one of the greenhouse gases. It comes into direct contact with different life-forms on the earth and displays its adverse side mainly due to its toxicity. Most of the studies have documented the adverse effects of surface ozone on crop production, forest growth, and human health. [15]

This study & observation shall be carried out using EVA spectrometer. Ethylene-vinyl acetate (EVA) is the most commonly used photovoltaic (PV) encapsulated material. As such, it is exposed to UV, thermal cycles, temperature gradients between the glass side and the silicon wafer side, and moisture ingress.[16]

Ozone molecules are much fewer steady than ordered ($O_2$) oxygen molecules. They are very disposed to respond chemically with additional substances. Ozone is likewise a kind of greenhouse gas. Ozone is moreover demolished by sunlight and responses concerning natural mixtures that comprise chlorine, nitrogen, and hydrogen. It is also considered as one of the greenhouse gas, trapping heat and thereby responsible for climate change. [8]. A small amount of ozone is also found at ground level on the earth. Some amount of ozone is released from plants and soils and some is emigrated down from the stratosphere. The maximum amount of ozone found near ground actually comes from, power plants, vehicle emission and emissions from factories, and refineries. From 1900, Due to vehicle and industrial emission, the level of ozone has become double.[9] The formation of tropospheric ozone takes place due to the interaction of sunlight, particularly ultraviolet light, with hydrocarbons and nitrogen oxides, which are produced by automobiles and industrial emission. During summer ozone level is found to be maximum in the urban areas.

Basically, ozone levels reach to their maximum value in the middle of noon, after emission of smoke from morning rush hour has had time to react in sunlight. The perfect environment for the production of ozone pollution is the hot and sunny day.[10]

For the production of ozone, sunlight is the best fuel. A peak level of ozone pollution causes adverse effects on human respiratory problems to take more precautions or to remaining doors. If it is inhaled, ozone can inflict lung tissues. Ozone also produces a bad effect on all types of cells. The tropospheric ozone is also responsible for chest pain asthma, coughing, cause eye irritation, chest congestion, nausea, and headaches. It also creates bronchitis, heart disease, and emphysema.[11]

## 2. RESEARCH METHOD

### Site Description

This study shall be carried out in a designated engineering & research organization located in Pune city. Pune city is located in the state of Maharashtra known for its richhistory and cultural heritage (18°32'N, 73°5' E) part of India. It lies on the foothills of the Sahyadri Mountains. The background of Pune district is dispersed triangularly inWestern Maharashtra at the foothills of the Sahyadri Mountains and is divided into parts:"Ghatmatha", "Maval" and "Desh". Pune district has formed a part of the tropical Monsoon land and therefore shows a significant seasonal variation in temperature as well as rainfall conditions.[4]

Climatically, In Pune, the summer can get a little severe with the daytime temperatures rising up to 38 ° C at times with evenings bringing in the much-needed relief. The rainy season starts from July till August-September. Pune experiences monsoons, which can result in high humidity and the winter months of late October. Generally, November, December and February are very pleasant with average temperatures ranging between 12-36° C. Maximum and minimum temperatures in summer are normally 38°C and 20°C, respectively, while in the winter ranges between 36°C to 12°C. August is the month with the highest relative humidity which is 82%. Months with the lowest relative humidity are March and April (36%). [5]

The drizzliest month with the uppermost rain reduction is July (187.2mm). The dried out month with the lowermost rainwater is January (0mm). The month with maximum sunlight is May (Average sunshine: 10.2h). The month with the minimum sunshine is August (Average sunshine: 3.6h). It is the ninth extreme populated city in the country with an assessed population of 3.13 million. Beside with its prolonged city bounds Pimpri Chinchwad and the three cantonment settlements of Pune, Khadki and Dehu Road, Pune methods the city core of the eponymous Pune Metropolitan Region.

The ultraviolet/visible absorption spectrometry does not measure as wide range of species as IR spectrometer because many of the molecules do not possess the fine structure in the UV / visible region which is needed for specificity. However molecular absorption bands in the UV and visible region tend to be rather broader because of the simultaneous involvement of electronic, vibrational and rotational transitions and certain species which play key role in the chemistry of atmosphere do have sufficiently structured electronic absorption spectra so that UV / visible spectrometry can be used for their detection and measurements.[6]

The absorption coefficient in the ultraviolet/visible region is generally much greater than those in the infrared, leading to higher sensitivity for those species which can be measured by this technique. Thus the use of UV / visible absorption spectrometry is now increasing.[7]

**3. WORK PLAN**

Preliminary observations and procedure for calculating the total column density of N02and 03 observations of zenith sky spectra with a visible spectrometer shall be considered in this study. The optical paths traversed by solar radiations at different solar zenith angles would be considered for calculating slant column densities. The process of molecular (Rayleigh) scattering and absorption by NO2 and O3 shall also be considered for calculating the amount of scattered intensity reaching ground. For obtaining the total column density, the ratio of zenith sky intensity measured during twilight hours to that during noon hours in 4368-4485 A° spectral regions will be taken. Matrix inversion technique will be used for deriving the contribution made by the absorption due to NO2and O3 in the same spectral region which will give the total columnar density of NO2 andO3.[6]

The infrared absorption spectrometry has proven highly useful in atmospheric studies but it is not possible to measure all constituents with the desired specificity and sensitivity with this technique. The ground-based stratospheric technique are more economical compared to satellite measurements and monitoring of different atmospheric species with ground-based stereoscopic technique absorbed to provide an additional asset to satellite observations. The data shall be collected from both the primary and the secondary sources and subsequently would be processed though to do analyses and drawconclusions using the suitable formulae. [18]The primary data shall be collected designated regions using the said spectrometer. While the secondary data would be taken from the past and ongoing published research works .In a typical configuration, NO2 will be measured in the 430-450nm range ( we will call it “NO2” range in the successive) and O3 in the 470-490 nm range ( the ozone range ).

The instrument is capable of taking 200 samples (one every 0. 1 nm) per spectral / range, each sample being an average of 128 individual readings. The total time required for a single scanning is approximately one second. The instrument is programmed for a sequence that takes an alternate measurement. The instrument is composed of five separate parts, the optical unit,the acquisition unit theancillary material,personal computer and the control unit.[20]

1.**OPTICAL UNIT**:-The optical unit is composed of the following parts. a)Light Input Device b) Light Guide (LG) c) Spectrometer d) PhotoMultiplier (PMT)

2.**ACQUISITION UNITS: -** A number of electronic cards which command the spectrometer and interfaces the computer. It has the following parts: a) Process Unit b) Input/ Output Units. C)Digital Output Units

3.**ANCILLARY MATERIAL:-**a)Housing, aluminum Zareges container b) Pipe for LG c) Humidity and temperature probe d) Power supply

4. **PERSONAL COMPUTER (PC)**

5.**SOFTWARE: -** a)Instrument control b) Analysis

## 4. CONCLUSION

The study concludes that, by choosing inputs to represent seasonal, monthly, diurnal and annual emission patterns and its relationship to temperature, relative humidity, rainfall, cloud condition the EVA spectrometer model can give an ozone concentration pattern as we
ll as ozone colum density. The above predictor model uses the variable that is obtainable from routine monitoring and data recorded. By using above instrument can be used for multiple pollutants based on the common influencing parameters. Ozone concentrations are mostly affected by meteorology conditions and emission patterns.

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