# SATELLITE REMOTE SENSING BASED ASSESSMENT OF TOTAL AND TROPOSPHERIC OZONE AND **ANALYSIS OF FACTORS INFLUENCING THEM**

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#### **RESEARCH PROBLEM**

#### THE HINDU \* WEDNESDAY, JUNE 11, 2014 Delhi reels under the wave

#### of deadly ozone pollution



With the heat wave raging, ozone the CSE has warned that fast track action needs peaks to dangerous levels in the city. to be taken to ensure that pollution alert systems PHOTO: MEETA AHLAWAT and next generation air pollution control mea-

sures are brought in with stringent controls on nitrogen oxide an This summer, a study of the real-time air qual- toxic and volatile gases." ity data available from the key monitoring loca- "This exposes worrying trends in the city. ions of the Delhi Pollution Control Committee Though there is a variation in trends across y to early June 2014, shows rapid months, there is a clear trend towards newer



#### ngton, DC, EPA/600/R-10/076F, 2013

munol. 2009; 103:474-9. Villeneuve PJ, Chen L, Rowe BH, Coates F. Outdoor air pollution and ccess Sci Source, 2007; 6:40.

### WAYS TO MEASURE OZONE

- **Ground based measurement**: It is more than a century that ground stations are being used for measurement of ozone
- > **Dobson Spectrometer**: It is developed in 1924 and is the earliest instrument to measure ozone
- Air borne measurement: It is a direct method for determining atmospheric ozone concentration
- > Balloons: They are used for measuring ozone concentration up to a height of 40 km from the surface of the Earth and can provide data on a daily basis
- > Aircrafts: They are used to measure ozone concentration in both the stratosphere and the troposphere
- Satellites: They measure the concentration of ozone over the entire globe and have a fixed temporal resolution

SL. NO.	SATELLITE OR SENSOR	LAUNCH DATE	END OF OPERATION



lickly as soon as the heat wave hit Delhi in th first week of June. The average temperature ha June 1 to more than 44 degrees Celsius on Jun 6. As a result, the ozone level shot up by 87 pe owdhury said: "Ozone is the new cent in Civil Lines, 171 per cent in Punjabi Bag health threat and a difficult 315 per cent at Mandir Marg and 82 per cent a

- Ozone is a layer in the stratosphere part of the atmosphere that protects the Earth from the harmful ultraviolet rays of the Sun
- But when this ozone is found near the surface of the Earth and it reacts with the nitrogen oxides and the sulphur oxides present in our atmosphere, then it can cause adverse effects on the inhabitants of this planet and to the environment
- In this study focus has been given on tropospheric ozone concentration and the amount of tropospheric ozone concentration over the state of Jharkhand has been assessed

# INTRODUCTION

- The chemical composition, air quality, and climatic evolution of the troposphere are being greatly controlled by the layer of ozone in our atmosphere and hence it is of great interest to atmospheric scientists
- The major portion of the ozone in the atmosphere is present in the stratosphere layer which ranges in height from 10 km to 50 km from the surface of the Earth
- Ozone is also found in the tropospheric layer of our atmosphere which ranges in height from the ground level up to 15 km from the surface of the Earth and this ozone is known as the surface ozone
- Photolysis is the major mechanism for the production of ozone in the stratosphere
- The process of photolysis is defined as the breaking up of oxygen molecules into oxygen atoms in the presence of the ultraviolet rays of the Sun and is the followed by the reaction of oxygen atom with oxygen molecules to finally form ozone

 $O_2 + UV \longrightarrow [O] + [O]$  $[O] + O_2 \longrightarrow O_3$ 

1.	NIMBUS 7	24 <sup>™</sup> OCTOBER 1978	1995
2.	SAGE II	24 <sup>™</sup> OCTOBER 1984	31 <sup>st</sup> AUGUST 2005
3.	METEOR 3 – 5	15 <sup>™</sup> AUGUST 1991	13 <sup>TH</sup> FEBRUARY 2013
4.	HALOE	12 <sup>TH</sup> SEPTEMBER 1991	21 <sup>ST</sup> NOVEMBER 2005
5.	AURA	15 <sup>™</sup> JULY 2004	OPERATIONAL TILL DATE

- Aura Satellite: Aura is the Latin word for breeze.
- $\succ$  It is used to measure ozone and other important gases throughout the atmosphere. It was launched on 15th July 2004 from Vandenberg Western Test Range.
- ▶ It monitors the Earth from an elevation of 705 km. It crosses the equator at around 1:45 PM.
- $\succ$  It measure trace gases in the atmosphere by detecting their unique spectral signature.
- $\succ$  A short description of four payloads on board the satellite is as follows:
- 1. MLS: observe faint microwave emissions from ozone, chlorine and other trace gases.
- HIRDLS: measures infrared radiation from ozone, water vapour, CFCs, methane and nitrogen compounds.
- TES: measures tropospheric ozone in infrared wavelength, also carbon monoxide, methane and nitrogen oxides.
- OMI: molecular absorption of backscattered sunlight in visible and ultraviolet wavelength.

# **OBJECTIVES**

- Determination and assessment of Total Ozone Column over the state of Jharkhand from 2005 to 2018
- Determination and assessment of Stratospheric Ozone Column over the state of Jharkhand from 2005 to 2018
- Determination and assessment of Tropospheric Ozone Column over the state of Jharkhand from 2005 to 2018
- Assessment of variation of ozone on latitudinal and altitudinal factors
- Assessment of contribution of fire episodes in increase of tropospheric ozone
- The life on the surface of the Earth is protected from the harmful UV rays of the Sun by the layer of ozone in the stratosphere and hence the Stratospheric Columnar Ozone (SCO) is referred to as good ozone
- The cooling of the stratospheric temperature is cited as the main cause for the depletion of the stratospheric ozone. The photochemical reactions between the oxides of nitrogen (NO<sub>x</sub>) and Volatile Organic Compounds (VOCs) is considered to be the main reason for the generation of Tropospheric Columnar Ozone (TO) which is also known as the ground level ozone and is considered to be bad ozone
- If there is an increase in the amount of surface ozone, then it will also cause serious negative effects such as persistent decrease in lung function, influenza, pneumonia, asthma etc. and decrease the crop yield and will contribute to the global warming as it is a greenhouse gas
- Satellite observations help us in determining and detecting the spatial and temporal changes of our ozone layer
- It is believed that increase in temperature will accelerate the rate of reaction for the formation of surface ozone and it has been proved by the scientists that a high positive correlation exists between warmer days with high temperatures and higher ozone levels

 $RO_2 + NO \longrightarrow RO + NO_2$  $NO_2 + UV \longrightarrow NO + [O]$  $O + O_2 + M \longrightarrow O_3 + M$ 

The Dobson Unit (DU) is the most common unit of measurement for stratospheric ozone

#### **STUDY AREA**

- The study is done in the eastern Indian state of Jharkhand
- The state is situated in the northern hemisphere having a latitudinal extension from 21<sup>0</sup>N to 26<sup>0</sup>N and extends longitudinally from 82<sup>0</sup>E to 89°E.
- The state shares its border with the state of Bihar to its north, Uttar Pradesh to the North-West, Chattisgarh to the West, Odisha to the South

### ESRI & OTHER TECH USED

- ArcGIS 10.3.1
- Spatial Analyst Extension
- Raster to Point Tool
- Clip Tool
- Data Management Toolbox
- ➢ Raster Calculator
- HDF Viewer
- Microsoft Excel

#### DATA USED

- Total Ozone Concentration data obtained from OMI
- Stratospheric Ozone data obtained from MLS
- Jharkhand Boundary Map obtained from Survey of India toposheet
- Fire Incident data obtained from Aqua and Terra sensors on-board **MODIS** satellite

# METHODOLOGY



# CONCLUSION

- The Total Ozone Concentration increases during the spring and summer months and decreases during the winter months
- The average value of Total Ozone Concentration is highest in the month of May and lowest in the month of December
- Tropospheric Ozone Concentration has increased by 15 DU from 2005 to 2018
- Total Ozone Concentration increases in the pre-monsoon and monsoon period and decreases thereon
- Total Ozone Concentration shows high positive correlation with latitude and low negative correlation with altitude
- Forest fires contribute to the increase in the value of tropospheric ozone

# **FUTURE SCOPE OF STUDY**

- Ozone pollution from industrial areas needs to be analysed
- Variation of tropospheric ozone concentration over various land use and land cover classes needs to be done
- Variation in tropospheric ozone concentration over urban and rural areas needs to analysed Correlation of tropospheric ozone concentration with climatic parameters such as rainfall, relative humidity, temperature, lighting etc. and pollutants such as NO<sub>x</sub>, SO<sub>x</sub>, PM2.5 and PM10 needs to be found out and analyzed Ground sensors should be developed to verify results from satellite measurements and further identify hotspots of ozone concentration so that the Government can take stringent steps in curbing ozone pollution



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