

# Study of air quality and aerosol over Indian region: A case study from COVID-19 period

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## ABSTRACT

Pandemic from CoronaVirus Disease 2019 (COVID-19, caused by SARS-CoV-19), remains a serious hazard to human health and life, which also led to significant economic losses across the world. In some cases, it resulted in loss of a large number of human life. The associated ambient air pollutants: ( $O_3$ ), nitrogen dioxide ( $NO_2$ ), sulphur dioxide ( $SO_2$ ), and carbon monoxide (CO), black carbon (BC) and particulate matter (PM), are directly linked to the enhanced risk of stroke, heart disease, asthma, and lung cancer. In order to have quantitative estimate, a comparative study of these pollutants, aerosol optical depth (AOD), surface temperature, ozone, carbon monoxide (CO) and  $NO_2$ , aerosol size distribution over India, have been analysed for the months March- June during the lockdown period of 2020 which are compared with the averages during 2015-2019. The aerosol optical depth (AOD) from MODIS satellite, show a decrease in AOD during the lockdown period by 40% over the Indian region, compared to 5-year mean level (2015-2019), whereas the ground based AOD from AERONET (Aerosol Robotic Network), was reduced to 75 % at Kanpur, and 74 % at Gandhi College (Ballia) in India. The drop in AOD observed in lockdown, is a clear-cut indication of reduced level of air pollution. Peak of aerosol size distribution over Kanpur and Gandhi College, has also been analysed which show a reduction by 33% to 50 % from the average level. Enhancement in total ozone column of ~8% from the average level, is noticed during the lockdown period, which is attributed to the suppression in  $NO_2$  and CO concentration that are supposed to destroy the formation of ozone through chemical reactions. The black carbon (BC) concentration during the lockdown period, also got reduced and found maximum at New Delhi (80%). The comparative analysis of other pollutants between all the three cities of India is also made. The decrease in temperature during the lockdown over New Delhi, was found to be greater than that observed over Kanpur and the Gandhi College in Ballia.

**Keywords:** Covid-19, Surface temperature, Air pollutants, Satellite and ground based measurements, Aerosol optical depth (AOD), Black carbon

## INTRODUCTION

The coronavirus disease 2019, commonly known as COVID-19, was a global pandemic that emerged as a major health concern across the globe. It was first identified in Wuhan, China, in December 2019 (Bukhari and Jameel, 2020; Kanniah et al., 2020; Şahin, 2020). On January 30, 2020, the World Health Organization (WHO) declared the outbreak as a public health emergency of international concern. The virus rapidly spread across numerous countries, and on March 11, 2020, it was officially classified as a "pandemic." (Kumar, 2020; Ranjan et al., 2020; Usman et al., 2020). Due to very fast spread of COVID-19, it became a very serious matter for world, with around 17.77 million cases and a total death of 6,83389 people worldwide by the end of July 2020.

Recently, the World Health Organization (WHO) said that Covid-19, spread through aerosols in closed areas (Kumar, 2020; Ranjan et al., 2020). Air pollutants mainly include ozone ( $O_3$ ), nitrogen dioxide ( $NO_2$ ), sulphur dioxide ( $SO_2$ ) and particulate matter (aerosol), which are directly associated with the risk of stroke, heart disease, asthma and lung cancer. The air pollution itself caused 3.7 million

premature deaths worldwide in 2012. When these pollutants are inhaled, they first come into contact with the respiratory tract lining (RTL). RTL antioxidant levels have been shown to decrease with the presence of  $NO_2$  and  $O_3$ , thereby weakening the body's defences against environmental oxidants. These also help fight tissues. Surprisingly, the presence of  $NO_2$  and  $O_3$  caused more damage than the combined effect of each pollutant alone. The solar EUV radiations, meteorological parameters and aerosol significantly affect the coronal transmission and its survival time in the air is around few hours (Gabbrielli et al., 2021; Wei et al., 2022). To date, understanding of the mechanisms by which this damage occurs is limited and quite complex. The government announced transportation closures, people's movement, and business restrictions in the country to prevent the spread of COVID-19. These activities were expected to reduce air pollution. Table 1 shows the duration of lockdown in India ([https://en.wikipedia.org/wiki/COVID-19\\_pandemic\\_lockdown\\_in\\_India](https://en.wikipedia.org/wiki/COVID-19_pandemic_lockdown_in_India)).

The response of 2019-nCoV to air pollutants and aerosols, is currently a matter of investigation and the subject of international challenges (Dhaka et al., 2020; Bukhari and