

Variability of atmospheric electric parameters during pre-lockdown and lockdown periods of 2020 – 2021 at Tirunelveli (Tamilnadu, India)

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ABSTRACT

We got unique opportunity to carry out the globally improved air pollution-based atmospheric electricity experiments from 2020 to 2021. This period composes of lockdown phases of the Covid-19 pandemic. Tirunelveli (8.7°N, 77.8°E) in Tamil Nadu, is one of the southern Indian peninsular stations for the observations of atmospheric electric parameters (AEP). A comparative study of AEP has been made during the pre-pandemic period and the lockdown period imposed to control the spread of Novel Corona virus infection with the help of ground-based indigenously developed atmospheric electric instruments. The analysis of both 2020 and 2021 data showed a marked difference in electric field and air-Earth (AE) current density. The difference in the AEP pattern is attributed to some extent to the decrease in aerosol loading caused by minimum human activities, drastically reduced emissions from industry, building construction, quarrying and mining, cement plants, vehicular emission, and stoppage of particulate matters, etc, which seem to have reduced the resistivity load in a global electric circuit (GEC).

Keywords: Global electric circuit, Meteorology, Atmospheric electric parameters (DC), Statistic analysis, Pollution, Resistivity load, Covid-19 pandemic, Tirunelveli

INTRODUCTION

Particulate matters are a complex mixture of organic and inorganic substances that are found in the ambient air and play a vital role in the radiation budget of the atmosphere via the scattering and absorption processes (Qu et al., 2017). Other main sources are vehicular emissions, industry, building construction, quarrying and mining, cement plants, and the burning of fossil fuels from power plants. All these constituents are the cause of air pollution and a major environmental concern, which affects the atmospheric electric measurements. During the period 2020-2021, the Government of India and the State Government of Tamil Nadu, imposed a lockdown from April 2020 to June 2020 and again during the second wave from April 2021 to May 2021 to stop the spreading of the Novel Coronavirus (Covid-19) infection. During the lockdown period, these emissions were cut-off due to severely restricted human, industrial, and transportation activity. As such, a change in air pollution levels was expected. Numerous studies were performed globally to evaluate air pollution during Covid lockdown phases (Resmi et al., 2020; Gautam, 2020; Sharma et al., 2020; Kannaiah et al., 2020; Bao and Zhang, 2020; Shi and Brasser, 2020; Kinoshita et al., 2020; Tobias et al., 2020; Nakada and Urban, 2020; Asir, 2021). Few studied the role of atmospheric variation in surface NO, NO₂, CO, SO₂, NH₃, volatile organic compounds (VOCs), and particulate matter (PM) variations (Qu et al., 2017).

Globally too, several investigations have been made on the pollution rate/air quality index during lockdown phases (Bao and Zhang, 2020; Shi and Brasser, 2020; Kanniah et al., 2020; Tobioas et al., 2020; Nakada and Urban, 2020).

Bao and Zhang (2020) reported a significant decrease in SO₂, NO₂, CO, and particulate matter (PM_{2.5} and PM₁₀) in China. Kannaiah et al. (2020) revealed that the restricted industrial activity imposed during the lockdown period resulted in a reduced concentration of aerosol optical depth and tropospheric NO₂ over the East Asian region. Shi and Brasser (2020), Tobias et al., (2020) and Nakada and Urban (2020) studied such changes in air quality in China, Barcelona (Spain), and São Paulo in Brazil, respectively. A similar type of observation in air quality index and pollution levels has been reported in India (Resmi et al., 2020, Gautam, 2020, Sharma et al., 2020). Resmi et al. (2020) and Asir (2021) carried out similar investigations at the regional level in India. During the pre-lockdown period and different stages of lockdown, Resmi et al. (2020) reported the diurnal variability of pollutants in Kerala; while, Asir (2021) studied the pollution levels during the lockdown period in the southern region of Tamil Nadu. Both these studies indicate that the concentration of pollutants declined by 50% or above from pre-lockdown days to lockdown days. Regional air-quality reports from Tirunelveli Pollution Control Board also suggested that during lockdown days, vehicular emissions, NO₂, CO, etc. are considerably reduced by more than 55% per day. Overall, these studies indicate that the air pollution levels decreased by about 40-55 % or even more during the lockdown period.

These lockdown days provided an excellent opportunity for atmospheric scientists to study the changes in atmospheric electric parameters and happenings in the tropospheric boundary layer when the air pollution was considerably reduced. As such, this dramatic decline in air pollution during the lockdown period is expected to have significant