

Study of a dumpyard fire in Perungudi and its effect on tropospheric ozone in an urban region of Chennai, India

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ABSTRACT

The rise of ozone in the atmosphere and its effects on human health and the environment are one of the main concerns in urban areas. This paper examines the environmental threats with focus on concentration of ozone in association with the burning of household waste in open piles in Perungudi. The effects of ozone were investigated from daily values of Perungudi and nearby residential area of Velachery during and after the dumpyard fire for the period April 27, 2022 to July 27, 2022. This study is an effective step toward a better understanding of ozone changes in Perungudi under the changing influence of smoke during the dumpyard fire. Box plot analysis is used to find the nature of the ozone data by identifying mean and median in both the places. Histogram is used to explore the nature of the frequency distribution. Autocorrelation is employed to check the presence of trend or randomness. Results indicate presence of trend, which are not random. The Pearson correlation coefficient was applied to correlate the ozone (O₃) concentration in Velachery. The results show that the ozone concentration in Perungudi is higher when compared with the nearby residential area of Velachery.

Keywords: Dumpyard fire, Box-plot, histogram, Autocorrelation, Pearson correlation coefficient, Perungudi (Chennai, Tamil Nadu)

INTRODUCTION

The quality of air is adversely hit by the aerosol released due to garbage burning, which can be assessed by measuring the concentration of atmospheric pollutants like ozone (O₃). Atmosphere constitutes of various components such as PM₁₀, PM_{2.5}, NO₂, SO₄ ground ozone and lead, not to forget to mention the water vapour which plays a key role in the climate of a region. There are other dynamical factors which is more significant in affecting climate (Tamil Selvi et al., 2022). After carbon dioxide and methane, tropospheric ozone is the third leading cause of global warming (Stevenson et al., 2006; Fowler et al., 2008). Tropospheric ozone plays an important role in atmospheric chemistry, air quality, and climate change and is harmful to human health and agricultural production (WHO, 2003; Zeng et al., 2008; Monks et al., 2015; Agathokleous et al., 2020). In recent years, high levels of ozone (O₃) and its effect on air quality have become a global challenge (Paoletti et al., 2014; Li et al., 2019). It has been suggested that for every 10 µg/m³ increase in ozone concentration, the daily human death rate increases by about 0.3% and the death rate of heart patients by about 0.4% (Colls and Tiwary, 2009).

Tropospheric ozone (O₃) is a very strong oxidant that is an indicator of photochemical oxidants. Ozone is a summer pollutant and an important short-lived climate pollutant (Faridi et al., 2018). Ozone has an associated radiative forcing of 0.35 W/m², but its maximum concentrations on the ground rarely last more than two to three hours (Cross and Pierson, 2013). The half-life of tropospheric ozone at 20

degrees Celsius is about three days (Shindell et al., 2012). Tropospheric ozone is produced by chemical reactions between Volatile Organic Compounds (VOCs) and carbon monoxide (CO) and hydroxyl radicals (OH) in the presence of nitrogen oxides in the atmosphere. Therefore, nitrogen oxides and VOCs (as well as CO) are precursors of tropospheric ozone (Crutzen, 1974; Retama et al., 2015). In other words, ozone is formed when pollutants react chemically in the presence of sunlight (Sudo and Akimoto, 2007; Cao et al., 2019). They are typically enhanced by increased atmospheric temperatures. (Zhang et al., 2019).

Garbage burning in the residential areas emits substantial amount of pollutants and toxins, and this is a source with the most uncertainty in the inventories (Sarath, et al., 2015). The massive landfill in Perungudi, a locality in South Chennai, caught fire on April 27, 2022 and continued for three days. With Perungudi as the centre, solid waste is dumped within Chennai city's limits. Around 4,500 tonnes of solid waste is dumped every day by the city Corporation. Concentrated toxic fumes spread over a radius of 6 km above the burning debris. The Velachery neighbourhood near Perungudi and the Pallikaranai marshland were the most affected. The smoke has the potential to affect the native flora and fauna and the health of the urban residents. Children below the age of five, persons with cardio-respiratory conditions, asthmatic patients, people with weak immunity, etc., are affected by the smoke. The smoke enveloped the residential area. The air was thick with ash and smoke. Burnt particulate matter from the dumpyard was suspended in the air around most of the residential neighborhoods in the area (www.the hindu.com).