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Air Quality Improvement during COVID-19 Lockdown in Colombo, Sri Lanka

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Abstract

This study presents a time series analysis of concentrations of particulate matter less than 2.5 micrometers (PM_{2.5}) measured in a Colombo coastline site to determine whether air quality improves in 2020 and 2021 due to COVID-19 related travel restrictions. A package of data analysis tools that includes dedicated functions for air quality data analysis called “*openair*” developed on R statistical software is used in this study. When time-series data from 2017 to 2021 are analyzed, a clear reduction in PM_{2.5} concentration is observed. When the trend of PM_{2.5} concentration from late 2017 to 2021 is calculated using the Theil-Sen method, it suggests a decrease of PM_{2.5} concentration at a rate of 10.92 mg/m³ per year (CI 8.91-13.18). Colombo is a coastal city that is greatly affected by the southwest monsoon. When monthly pollution rose diagrams were analyzed, a diurnal variation of wind pattern is observed with increasing stormy weather during the southwest monsoon season from May to September, from 2017 to 2021. To exclude the fact that the reduction in pollutant concentration is due to the increase in wind speed during the monsoon season, a cluster analysis technique has been used to separate the effect of dilution of pollutants due to the gusty winds during the monsoon season from non-monsoon seasons. The cluster analysis was performed on the concentration polar plot drawn for late 2017 to 2021, and two clear clusters were identified. Cluster-1 represented data during the monsoon season from May to September, and cluster-2 represented the data during the non-monsoon season. Cluster-1 clearly showed an inverse relationship between wind speed and PM_{2.5} concentration suggesting the dilution effect of concentration with the increasing wind speed. Cluster-2 clearly showed a directly proportional relationship, implying that pollutants from the city are transported to the site with increasing wind speeds. When trend analysis was performed, both clusters showed a decreasing trend. Results of the study suggest that the increasingly stormy weather during monsoons over the years has reduced the PM_{2.5} concentration in the study site at a rate of 11.57 mg/m³ per year (CI 9.08-14.55). The reduction in human travel that caused a decrease in traffic-related air pollution over the years has reduced the PM_{2.5} concentration in the study site at a rate of 7.91mg/m³ per year (CI 4.68-11.92).

Keywords: COVID-19, Lockdown, Colombo, PM_{2.5} concentrations, Polar plot