# Supplementary Information for "Spatiotemporal Assessment of $PM_{2.5}$ in Senior High Schools in Kumasi, Ghana Using Low-Cost Sensors"

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# 1 Introduction

Supplementary information (SI) provides additional details on the analysis that was performed and their results.

# 2 Seasonal variations in $PM_{2.5}$ concentrations

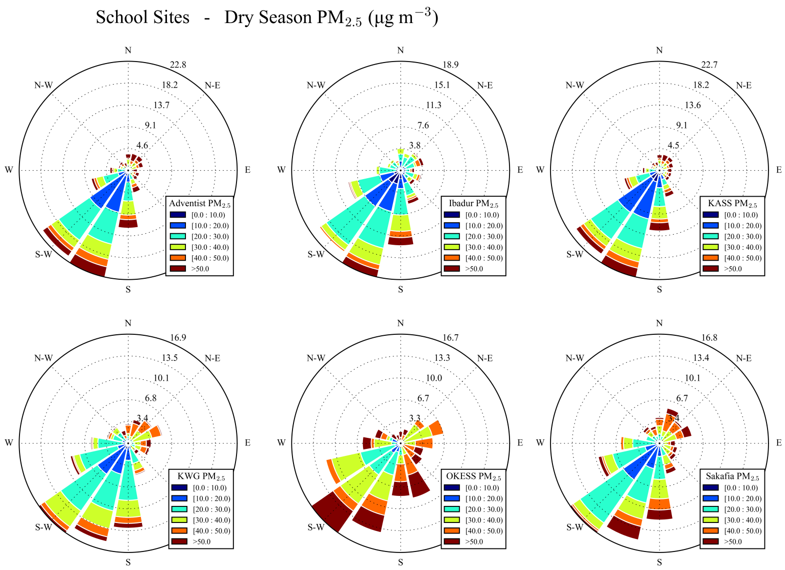


**Fig. SM1** Pollution rose plots showing hourly $PM_{2.5}$ concentrations over the six study locations during the dry season

Real-time monitoring of $PM_{2.5}$concentrations in the six high schools in Kumasi, Ghana, revealed distinct seasonal patterns strongly influenced by meteorological conditions. Fig SM1 is a pollution rose plot displaying hourly $PM_{2.5}$ concentrations over the six schools during the dry season. Elevated $PM_{2.5}$ concentrations were observed at all sites during the dry season, characterized by Harmattan and driven by a combination of long-range dust transport from the Sahara and local emissions. Adventist and OKESS recorded the highest concentrations, frequently exceeding 50 $\mu g/m^3$, with major contributions from dust resuspension, traffic activities, and emissions from nearby trading centers. In contrast, KASS and Sakafia exhibited moderate $PM_{2.5}$ levels, while KWG and Ibadur generally experienced lower concentrations with occasional pollution spikes.

During the wet season (as shown in Figure SM2), $PM_{2.5}$ concentrations decreased markedly at all sites. This improvement is primarily attributed to the scavenging effect of rain and suppression of dust suspension due to higher humidity. Despite the overall reduction, long-range transport from the southwest continued to influence background pollution levels, albeit with a lower intensity compared to the dry season. Localized emissions were still evident but appeared less dominant, likely reflecting reduced open burning activities and altered atmospheric dispersion conditions. These

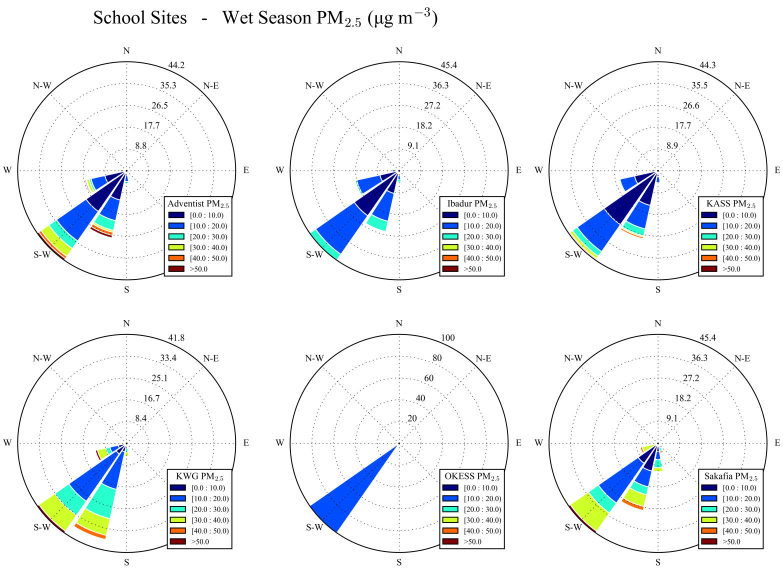


**Fig. SM2** Pollution rose plots showing hourly $PM_{2.5}$ concentrations over the six study locations during the wet season

results highlight the critical role of meteorological drivers, particularly precipitation and Harmattan winds, in shaping seasonal air quality patterns in Kumasi.

# 3 Source attribution based on wind sector analysis

## 3.1 Pre-monsoon

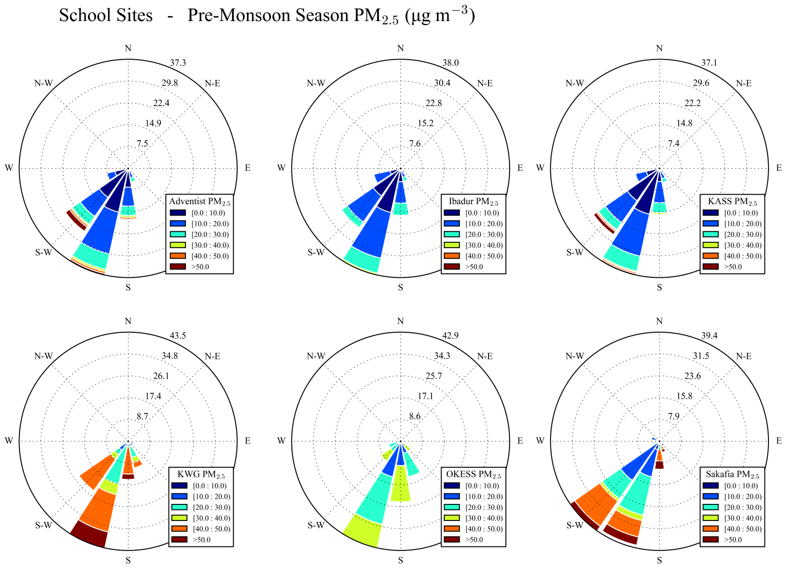


**Fig. SM3** Pollution rose plots showing hourly $PM_{2.5}$ concentrations over the six study locations during Spring

## 3.2 Post Monsoon

# 4 Air Quality Index (AQI) from uncorrected $PM_{2.5}$

## 4.1 Variation in AQI over the entire study period

Fig SM5 and SM6 illustrate the temporal variations in AQI across six Senior High Schools in Kumasi using uncorrected $PM_{2.5}$ concentrations, observed over different timeframes and at varying temporal resolutions. In Fig SM5, daily AQI values are presented from mid-2022 to mid-2023, showing variability in air quality levels among the schools. The data points are color-coded according to the AQI categories ranging from “Good” to “Hazardous.” Among the schools, Adventist SHS and KASS recorded

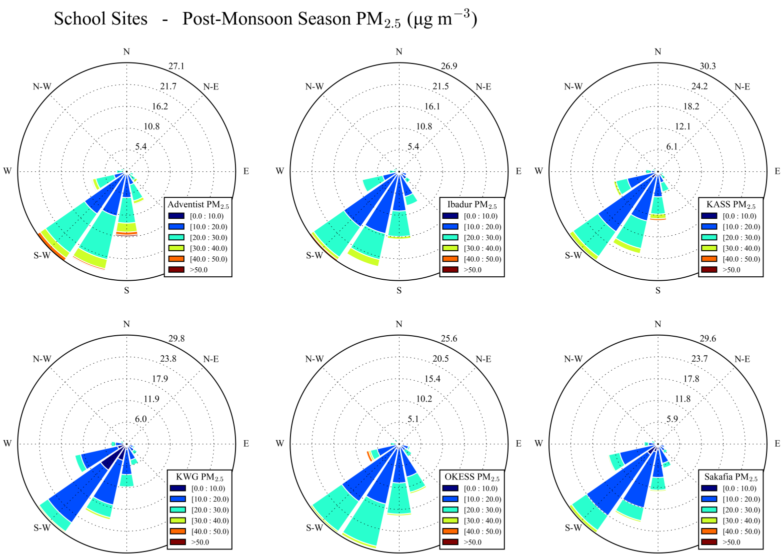


**Fig. SM4** Pollution rose plots showing hourly $PM_{2.5}$ concentrations over the six study locations during the Fall season

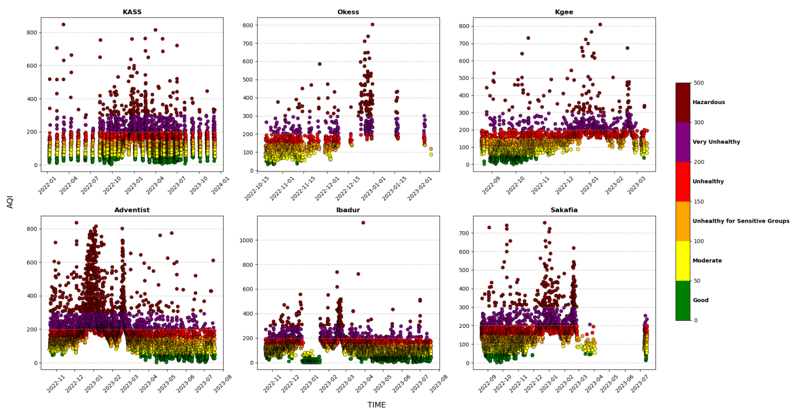


**Fig. SM5** Variation in AQI from uncorrected $PM_{2.5}$ over the entire study period for the six locations.

a wider range and higher frequency of elevated AQI levels, with several instances exceeding 500. Okess and Sakafia also experienced notable AQI spikes, particularly between December 2022 and March 2023. Kgee, Ibadur, and Sakafia generally maintained AQI levels within the moderate to unhealthy range, with seasonal fluctuations evident in all schools.

## 4.2 Diurnal variation in AQI from uncorrected $PM_{2.5}$ on a monthly time scale

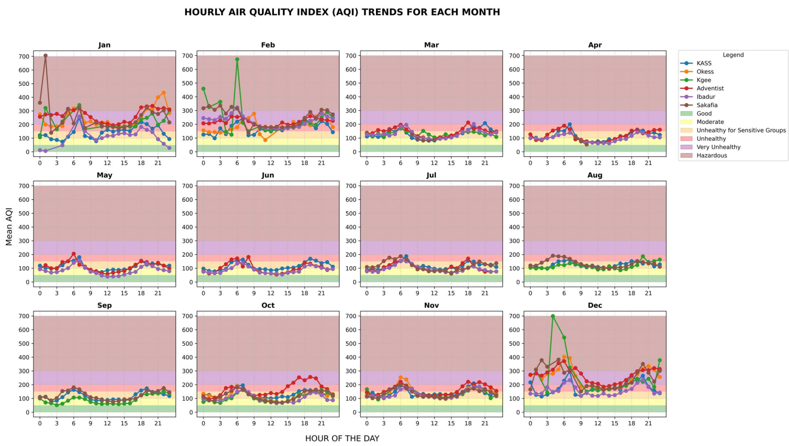


**Fig. SM6** Diurnal variation of AQI from uncorrected $PM_{2.5}$ across the six schools.

Fig SM6 presents hourly mean AQI trends for each month, disaggregated by school. Diurnal patterns were consistent across months, with most schools exhibiting elevated AQI levels during early morning hours (04:00–08:00) and late evening hours (18:00–22:00). These peaks were more pronounced during the harmattan and dry months (e.g., January and February), especially at Adventist SHS, Sakafia, and OKESS, where hourly mean AQI values often surpassed 300. During the mid-year months (May to August), overall AQI values remained lower, with smoother curves and reduced variability across hours. The background shading highlights AQI categories, with many months showing extended durations in the “Unhealthy” to “Very Unhealthy” ranges. Distinct weekday-weekend differences were also observable, with some months (e.g., December and March) showing weekend peaks in schools such as Ibadur and KASS.