



## **Sandfield Primary School – Brief Air Quality Report**

**(late December to August 2021)**

The schools resumed their normal operation after 08 March 2021. Since then, the UK government roadmap for ending all restrictions has elapsed multiple stages (e.g. 12 April, 17 May, and 19 July 2021), which led to observing variations in the number of on-road vehicles (see Figure 1) and expected pollution concentrations. The released report by the UK Department for Transport shows that domestic car usage is started to increase when lockdown measures eased. For example, from the week commencing mid-May (17 May 2021) onwards, the number of domestic transports reached a relatively maximum level and remained constant onwards. Since the major source of air pollutants are from vehicular emissions, we simplified these stages into five phases (Table 1) and explored their impacts during each phase considering meteorological factors as shown in Figure 2.

- A summary of statistics and the time-series plot covering the entire domain (late in December 2020 to early August 2021) and the accomplished roadmap in five phases, which are defined as late December to 08 March, 08 March to 12 April, 12 April to 17 May, 17 May to 19 July, and 19 July until 01 August 2021, are shown in Table 1 and Figure 3, respectively. Apart from Ozone (O<sub>3</sub>) and noise levels, which follow increasing trends, the concentration of other pollutants did not show appreciable increase.
- Although easing restrictions has led to more on-road vehicles (Figure 1), analysis of measured hourly averaged pollutant concentrations showed that concentrations of the most pollutants (CO, NO<sub>2</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub>) did not show appreciable increase from Phase I to Phase IV. For example, the averaged PM<sub>2.5</sub> concentration (in  $\mu\text{g m}^{-3}$ ) reduced in the order of  $9.0 \pm 9.0$  (Phase I) >  $8.4 \pm 5.9$  (Phase II) >  $6.0 \pm 2.9$  (Phase III) >  $5.5 \pm 3.9$  (Phase IV). Conversely, an increase in O<sub>3</sub> formation was observed due to an increase in the consumption rate of NO<sub>2</sub> in the presence of spring/summer sunlight. A clear increase in pollutant concentrations, when the number of on-road cars increased during Phase V (e.g. PM<sub>2.5</sub> level increased slightly to  $9.1 \pm 7.8 \mu\text{g m}^{-3}$ ) intensifies the importance of meteorological variations on measured concentrations.
- The wind direction (see wind rose diagrams in Figure 2) shows that the frequency of predominant wind directions (%) during the phases (simplified by red arrows) are from the school (from Southwest) and/or parallel to the Stoke Road (from South) with notable strength (wind speed), which result in dilution and slightly decreasing trend in detecting ambient air pollutants by domestic transport use via the monitoring station. The wind direction pattern may change seasonally, which could slightly empower wind speed from other directions in future. This may lead to detecting slightly higher concentrations as we keep our eyes on it to monitor changes.
- The noise level has also slightly increased and remained constant as the use of domestic transport reached a steady level over the phases (see Figure 2), whereas the average Noise levels during these phases increased and remained constant. The noise level during the phases was  $57.5 \pm 5.8$  (Phase I) <  $59.6 \pm 6.4$  (Phase II) <  $60.2 \pm 7.2$  (Phase III) =  $60.2 \pm 6.8$  (Phase IV) =  $60.2 \pm 6.7$  (Phase V). The sound levels showed the importance of noise pollution in the school, which is usually underestimated.

Table 1. The impact of the UK government roadmap as defined in five phases for ending all restrictions on pollutant concentrations and noise pollution around Sandfield school, Guildford.

<b>Period</b>	<b>Statics</b>	<b>CO [<math>\mu\text{g m}^{-3}</math>]</b>	<b>NO<sub>2</sub> [<math>\mu\text{g m}^{-3}</math>]</b>	<b>Noise Lev. [dB]</b>	<b>O<sub>3</sub> [<math>\mu\text{g m}^{-3}</math>]</b>	<b>PM<sub>2.5</sub> [<math>\mu\text{g m}^{-3}</math>]</b>	<b>PM<sub>10</sub> [<math>\mu\text{g m}^{-3}</math>]</b>
30 Dec to 08 March	Average	427.2	22.2	57.5	24.1	9.0	15.8
	Median	404.6	21.1	59.1	23.2	6.7	11.4
	Min	253.8	10.8	45.3	0.5	0.4	0.6
	Max	1593.7	47.0	71.2	70.6	88.2	105.3
	STD	131.1	4.9	5.8	13.9	9.0	14.6
08 March to 12 April	Average	353.9	17.8	59.6	39.2	8.4	13.5
	Median	339.6	17.2	62.0	41.2	7.2	12.1
	Min	239.6	7.4	45.1	2.9	1.3	2.4
	Max	899.1	40.1	70.4	90.0	43.7	52.2
	STD	67.9	4.2	6.4	16.9	5.9	8.2
12 April to 17 May	Average	330.1	16.4	60.2	42.7	6.0	8.8
	Median	315.5	15.2	63.1	42.7	5.5	7.4
	Min	203.9	6.4	45.8	2.2	1.2	1.2
	Max	651.4	41.3	72.5	99.6	23.8	78.3
	STD	74.2	5.5	7.2	19.5	2.9	5.6
17 May to 19 July	Average	288.5	16.8	60.2	46.1	5.5	7.6
	Median	284.1	16.0	62.7	41.5	4.7	6.2
	Min	137.4	1.4	45.2	0.0	0.4	0.6
	Max	476.6	63.3	75.2	148.2	28.4	41.6
	STD	45.1	5.5	6.8	27.1	3.9	5.3
19 July to 01 August	Average	280.4	21.8	60.2	60.0	9.1	10.9
	Median	276.3	18.7	62.0	47.4	7.1	9.5
	Min	201.3	9.0	45.3	10.4	2.3	2.0
	Max	592.4	84.5	70.2	174.0	60.3	69.0
	STD	45.6	10.9	6.7	39.2	7.8	7.9

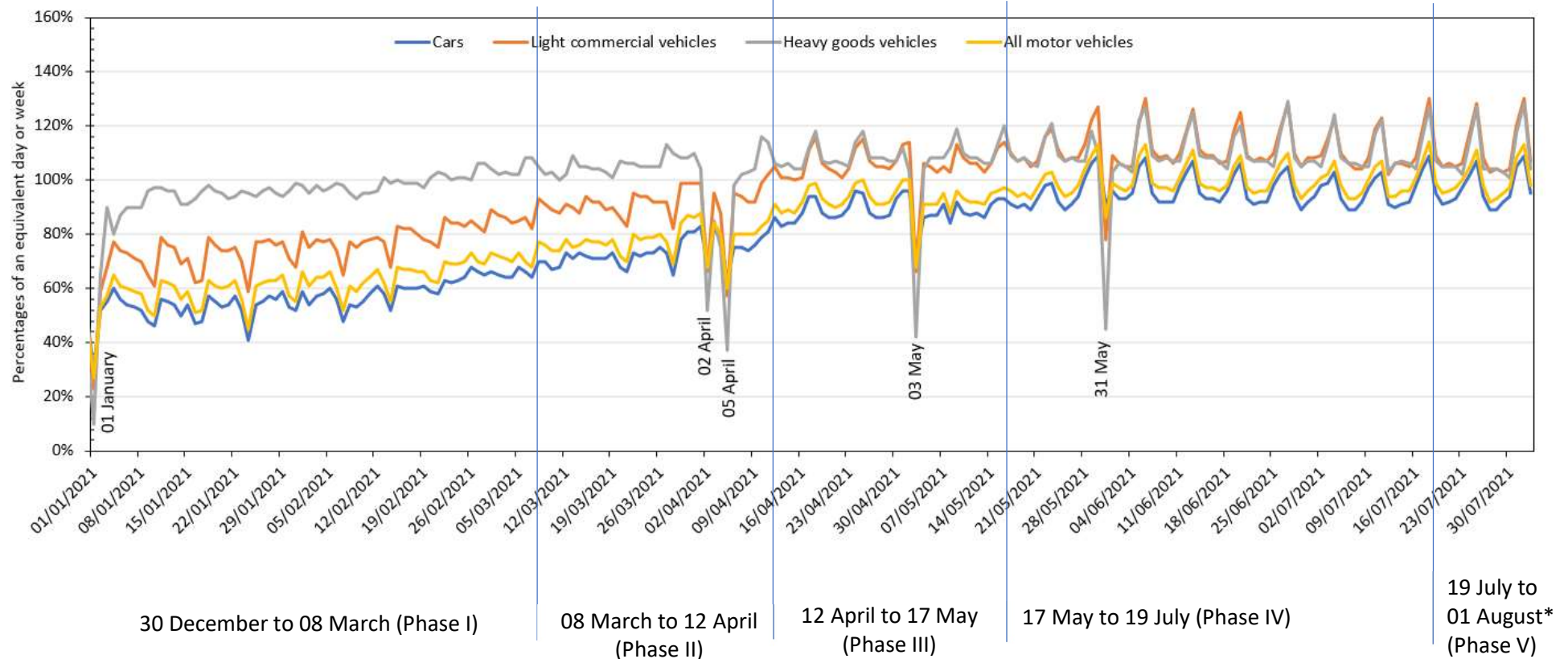
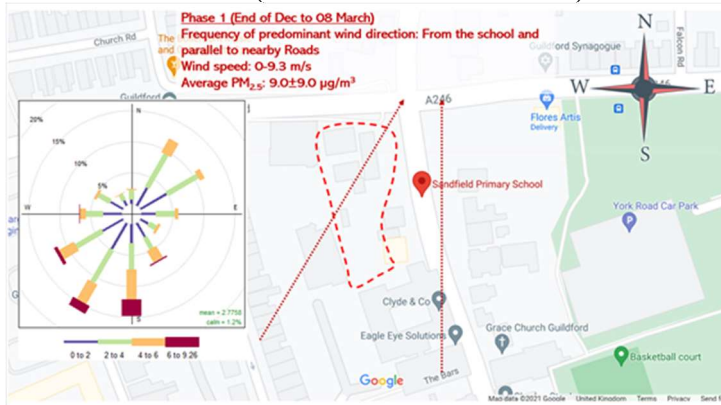


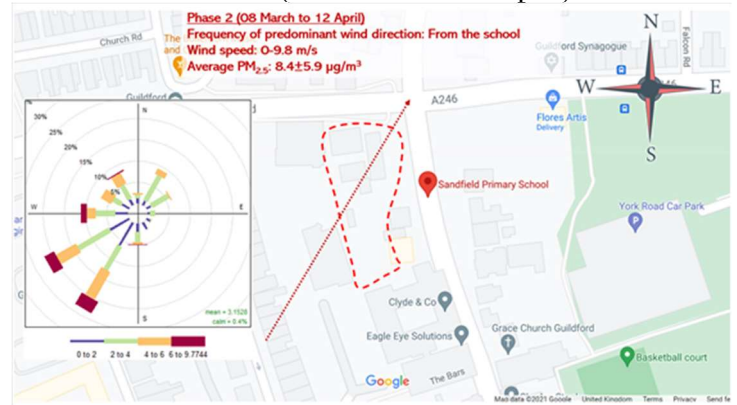
Figure 1. DfT statistics on domestic transport use during COVID-19 pandemic (see <https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic>). The statistics data shows about 11 days of data for transport use during Phase V at the time we prepared this report. The sudden reductions in domestic transport use are linked to holidays.



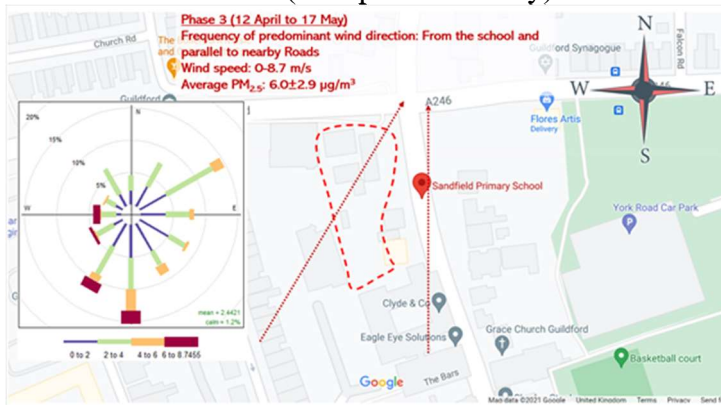
### Phase 1 (End of Dec to 08 March)



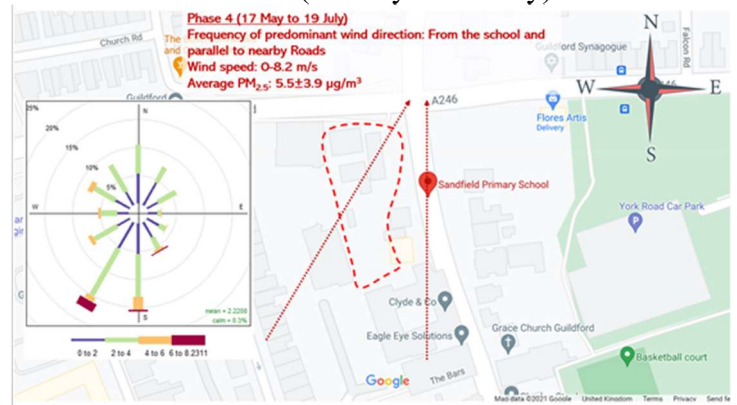
### Phase 2 (08 March to 12 April)



### Phase 3 (12 April to 17 May)



### Phase 4 (17 May to 19 July)



### Phase 5 (19 July to 01 August)

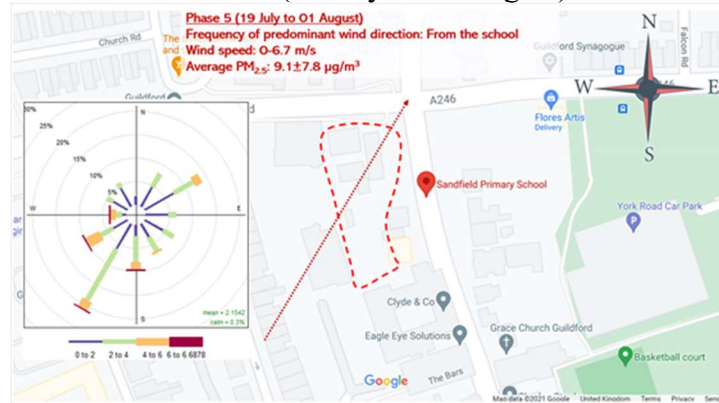
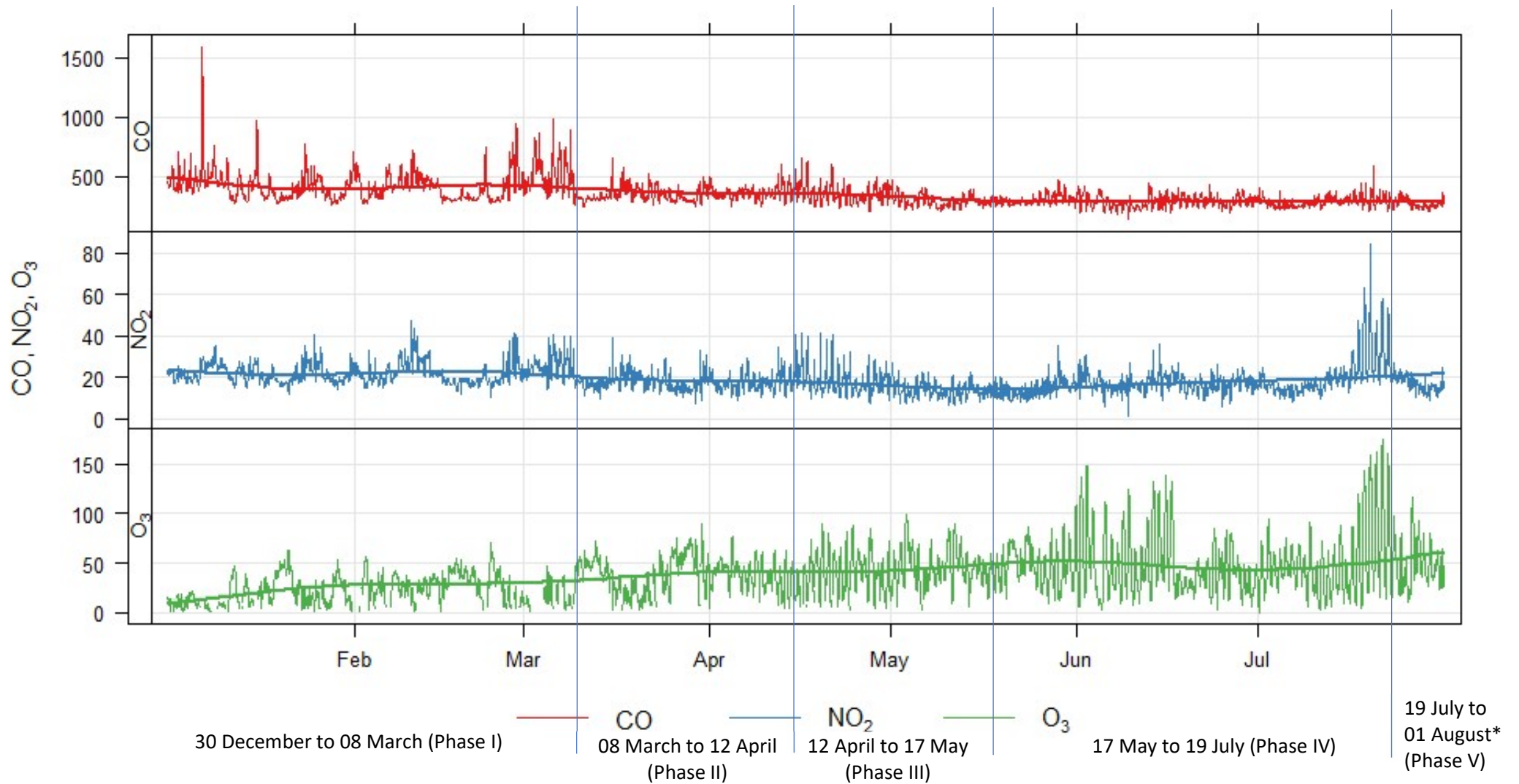


Figure 2. Windrose diagram on a map of the school for each phase. The predominant wind directions are simplified by red arrows, which show the frequency of wind direction from and/or to the school. The colour bars represent the magnitude of the wind speed (in  $\text{m s}^{-1}$ ) in each specific direction. The location of the school is specified by a red-dotted enclosure.



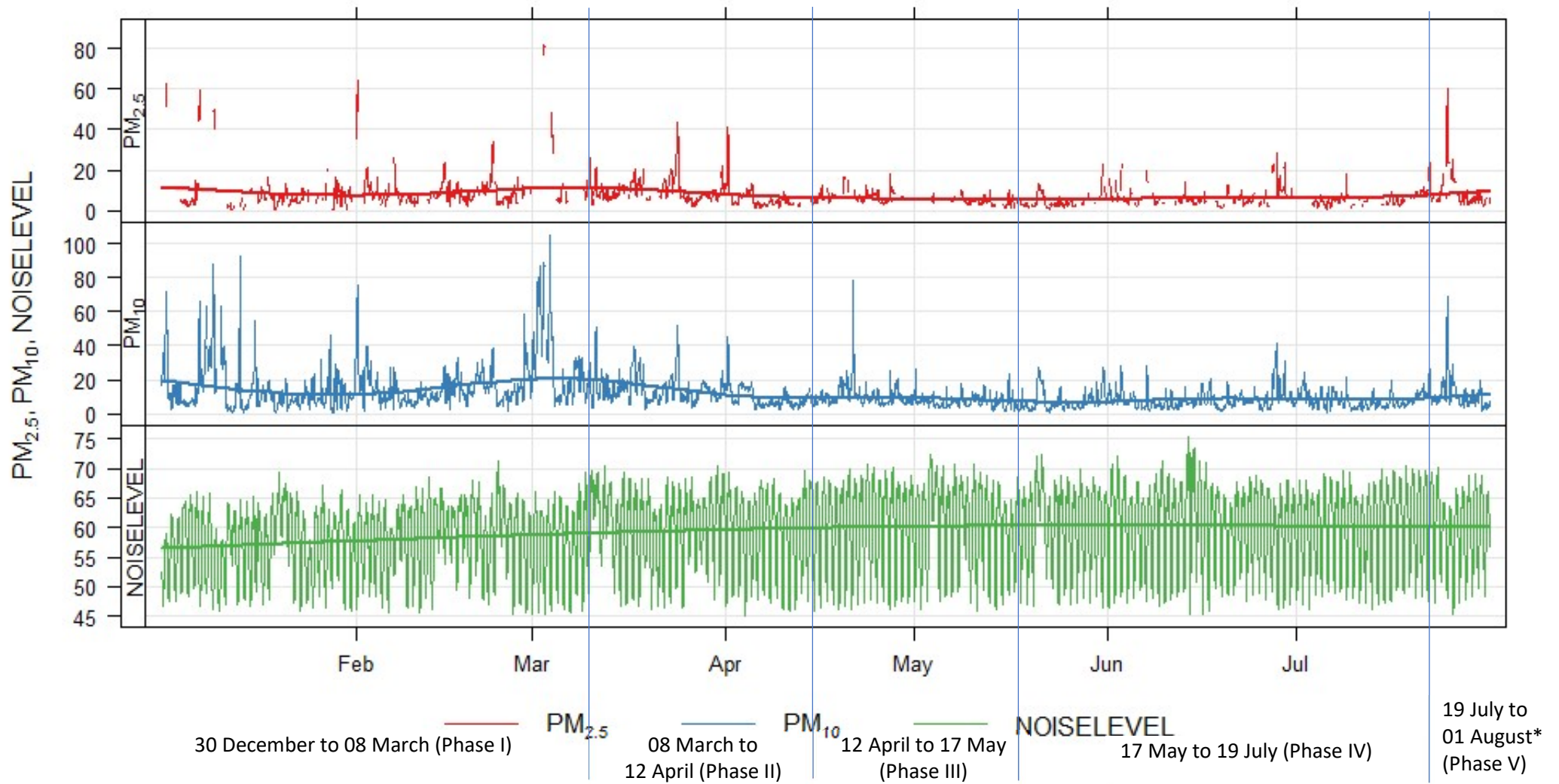


Figure 3. Time-series showing variations in gaseous and particle pollutants ( $CO$ ,  $NO_2$ ,  $O_3$ ,  $PM_{2.5}$  and  $PM_{10}$  in  $\mu g\ m^{-3}$ ) and noise level (in dB) during five phases of this study at Sandfield School. Except for  $O_3$  and noise level, a decreasing trend for the rest of the pollutants is observed in the first four phases.