

Dário *et al.* 2024. Long-term trends and probability distribution functions of air pollutant concentrations in the megacity of São Paulo. *Derbyana*, 45: e816 (Supplementary Material).

SUPPLEMENTARY MATERIAL: STATISTICS FOR EACH AIR QUALITY STATION

In this section, some statistics for each air quality monitoring station are presented separately. Concerning the long-term trends, table S1 shows that all stations showed a significant decreasing trend between 2000 and 2023, although with different intensities, ranging from -0.58 to $-1.45 \mu\text{g}\cdot\text{m}^{-3}\cdot\text{yr}^{-1}$. On the other hand, for O_3 , a significant trend was observed only at Pq. D. Pedro II station, increasing $0.94 \mu\text{g}\cdot\text{m}^{-3}\cdot\text{yr}^{-1}$. The reasons behind this increase are beyond the scope of this study but may be associated with changes in the emission patterns of NO_x and VOCs near this station. Figure S1 shows the variability of PM_{10} and O_3 concentrations in each monitoring station between 2021 and 2023. In the case of O_3 , concentrations were rather homogeneous across the stations, while PM_{10} showed a greater spatial variability. The average time series considering these ten selected stations was used to represent the average air quality conditions in the MASP. Finally, tables S2 and S3 show the expected values and probability of exceedance of PM_{10} and O_3 considering different periods for selected stations.

TABLE S1 – Trends in PM_{10} (DMMA24) and O_3 (DMMA8) annual mean concentrations between 2000 and 2023, separately at each monitoring station and considering the mean time series. Uncertainties are represented in parenthesis. Statistically significant trends ($p < 0.05$) are highlighted in italic.

	PM_{10}		O_3	
	<i>Slope</i> ($\mu\text{g}\cdot\text{m}^{-3}\cdot\text{yr}^{-1}$)	<i>p-value</i>	<i>Slope</i> ($\mu\text{g}\cdot\text{m}^{-3}\cdot\text{yr}^{-1}$)	<i>p-value</i>
<i>Capuava</i>	<i>-0.58(13)</i>	1E-03	0.12(16)	2E-01
<i>Diadema</i>	<i>-1.21(21)</i>	4E-06	-0.03(18)	9E-01
<i>Ibirapuera</i>	---	---	0.43(22)	1E-01
<i>Mauá</i>	<i>-0.74(15)</i>	2E-04	---	---
<i>Mooca</i>	---	---	0.33(23)	2E-01
<i>Pq. D. Pedro II</i>	<i>-1.45(23)</i>	2E-04	<i>0.94(12)</i>	1E-05
<i>Santana</i>	---	---	-0.16(23)	6E-01
<i>Santo Amaro</i>	<i>-1.34(11)</i>	4E-08	---	---
<i>Paulicéia</i>	<i>-1.25(16)</i>	9E-06	---	---
<i>São Caetano</i>	<i>-0.78(13)</i>	3E-05	0.19(24)	4E-01
<i>Mean</i>	<i>-1.04(9)</i>	9E-07	<i>0.30(13)</i>	0.018

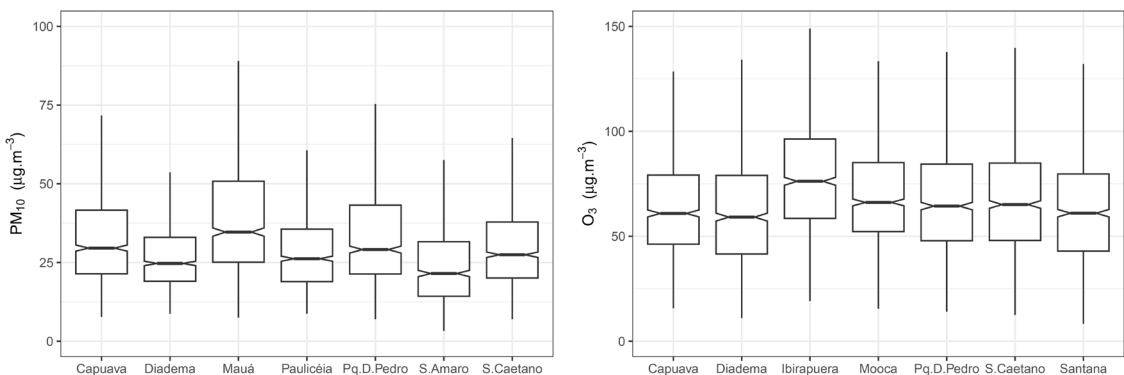


FIGURE S1 – Boxplots for PM_{10} (left) and O_3 (right) concentrations in each air quality monitoring station, considering data between 2021 and 2023. Daily maximum of moving average concentrations were considered, respectively DMMA24 and DMMA8.

TABLE S2 – PM₁₀ expected values (E), standard deviation (σ) and probability (P) of exceeding the WHO standard (45 $\mu\text{g.m}^{-3}$), the state standard (100 $\mu\text{g.m}^{-3}$) and the Brazilian standard (120 $\mu\text{g.m}^{-3}$), considering five monitoring stations in three different periods: 2000-2023, 2021-2023 and 2020. E[x] and $\sigma[x]$ were calculated based on fitted parameters of lognormal distributions. Probabilities of exceedance were calculated from empirical CCDFs.

		Diadema	Mauá	Pedro II	Capuava	Caetano
2000-2023	E[x] $\pm\sigma[x]$ ($\mu\text{g.m}^{-3}$)	38 \pm 18	42 \pm 23	43 \pm 25	37 \pm 17	41 \pm 21
	P>45 $\mu\text{g.m}^{-3}$ (%)	28.1	36.9	36.4	26.9	34.2
	P>100 $\mu\text{g.m}^{-3}$ (%)	1.0	1.6	3.4	0.3	1.7
	P>120 $\mu\text{g.m}^{-3}$ (%)	<0.1	0.4	1.5	<0.1	0.5
2021-2023	E[x] $\pm\sigma[x]$ ($\mu\text{g.m}^{-3}$)	28 \pm 11	40 \pm 21	35 \pm 19	33 \pm 16	31 \pm 15
	P>45 $\mu\text{g.m}^{-3}$ (%)	19.3	33.0	22.5	20.2	16.3
	P>100 $\mu\text{g.m}^{-3}$ (%)	<0.1	0.4	0.8	<0.1	<0.1
	P>120 $\mu\text{g.m}^{-3}$ (%)	<0.1	0.1	0.2	<0.1	<0.1
2020	E[x] $\pm\sigma[x]$ ($\mu\text{g.m}^{-3}$)	27 \pm 12	28 \pm 16	32 \pm 18	24 \pm 10	31 \pm 16
	P>45 $\mu\text{g.m}^{-3}$ (%)	8.5	14.0	22.5	2.9	16.9
	P>100 $\mu\text{g.m}^{-3}$ (%)	<0.1	0.4	0.3	<0.1	0.6
	P>120 $\mu\text{g.m}^{-3}$ (%)	<0.1	<0.1	<0.1	<0.1	0.3

TABLE S3 – O₃ expected values (E), standard deviation (σ), and probability (P) of exceeding the WHO standard (100 $\mu\text{g.m}^{-3}$), the state standard (130 $\mu\text{g.m}^{-3}$) and the Brazilian standard (140 $\mu\text{g.m}^{-3}$), considering five monitoring stations in three different periods: 2000-2023, 2021-2023, and 2020. E[x] and $\sigma[x]$ were calculated based on fitted parameters of gamma distributions. Probabilities of exceedance were calculated from empirical CCDFs.

		Diadema	Ibirapuera	Pedro II	Capuava	Caetano
2000-2023	E[x] $\pm\sigma[x]$ ($\mu\text{g.m}^{-3}$)	62 \pm 30	74 \pm 35	59 \pm 31	64 \pm 29	67 \pm 31
	P>100 $\mu\text{g.m}^{-3}$ (%)	11.1	20.8	9.6	12.1	14.7
	P>130 $\mu\text{g.m}^{-3}$ (%)	2.4	6.2	1.9	2.8	3.5
	P>140 $\mu\text{g.m}^{-3}$ (%)	1.5	4.0	1.0	1.7	2.1
2021-2023	E[x] $\pm\sigma[x]$ ($\mu\text{g.m}^{-3}$)	62 \pm 26	80 \pm 28	68 \pm 27	65 \pm 25	69 \pm 27
	P>100 $\mu\text{g.m}^{-3}$ (%)	9.2	21.5	12.3	10.0	12.6
	P>130 $\mu\text{g.m}^{-3}$ (%)	1.0	5.0	2.1	2.2	2.7
	P>140 $\mu\text{g.m}^{-3}$ (%)	0.9	2.9	0.9	1.1	1.3
2020	E[x] $\pm\sigma[x]$ ($\mu\text{g.m}^{-3}$)	65 \pm 26	88 \pm 32	69 \pm 27	67 \pm 24	67 \pm 24
	P>100 $\mu\text{g.m}^{-3}$ (%)	11.1	30.8	14.1	10.9	11.8
	P>130 $\mu\text{g.m}^{-3}$ (%)	1.9	10.8	3.3	1.9	1.9
	P>140 $\mu\text{g.m}^{-3}$ (%)	0.8	9.0	1.4	1.2	<0.1

