

AIR QUALITY COMPARISON: HONG KONG VS. MEXICO CITY (2012–2024)

Week 2 – Seasonal and Spatial Analysis

Comparative analysis of key air pollutants across two major cities, focusing on trends, spatial patterns, and seasonality.

OVERVIEW OF MONITORING STATIONS AND POLLUTANTS (1/3)

Table A. Data Coverage

City	Overall Data Available Period	Data Selection Period (Daily Avg)	Pollutants Available	Pollutants Selected
HK	1990-01-01 to 2025-04-30	2012-01-01 to 2024-12-31	CO, PM10, NO ₂ , NOx, O ₃ , PM _{2.5} , SO ₂	PM10, PM _{2.5} , O ₃ , NO ₂ , SO ₂
MC	2012-01-01 to 2024-12-31	2012-01-01 to 2024-12-31	O ₃ , NO ₂ , NO, NOx, CO, SO ₂ , PM10, PM _{2.5}	PM10, PM _{2.5} , O ₃ , NO ₂ , SO ₂

Table B. Monitoring Stations (Hong Kong)

Station	Selected	Latitude	Longitude	Altitude	Type
Causeway Bay		22.28	114.18	77	Urban
Central		22.28	114.15	204	Urban
Central / Western	*	22.28	114.14	195	Urban
Eastern	*	22.28	114.22	123	Urban
Kwai Chung		22.36	114.13	29	Urban
Kwun Tong	*	22.31	114.23	15	Urban
Mong Kok		22.32	114.16	8	Urban
North		22.49	114.13	22	New Town
Sham Shui Po	*	22.33	114.16	14	Urban
Shatin	*	22.38	114.18	54	New Town
Southern		22.25	114.16	59	Urban
Tai Po	*	22.45	114.16	14	New Town
Tap Mun	*	22.47	114.36	32	Rural
Tseung Kwan O		22.32	114.26	12	Urban
Tsuen Wan	*	22.37	114.11	35	Urban
Tuen Mun		22.39	113.98	9	New Town
Tung Chung	*	22.29	113.94	14	New Town
Yuen Long	*	22.45	114.16	14	New Town

OVERVIEW OF MONITORING STATIONS AND POLLUTANTS (2/3)

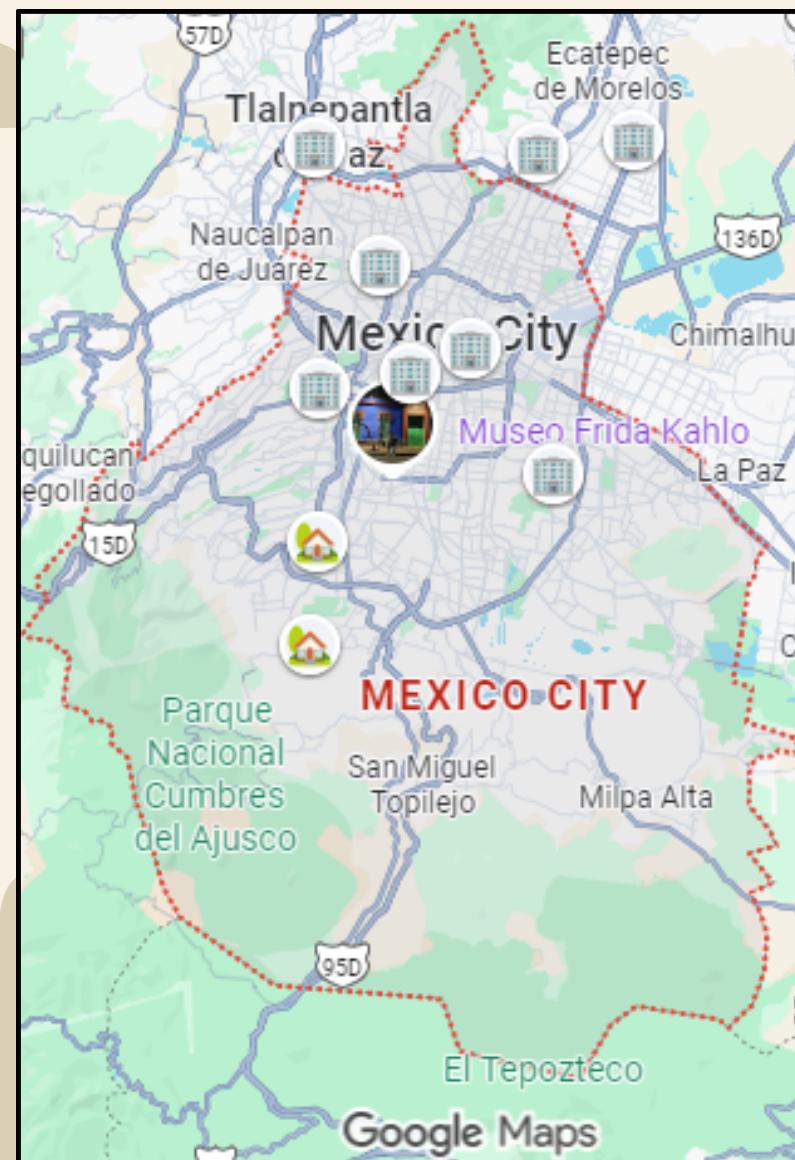
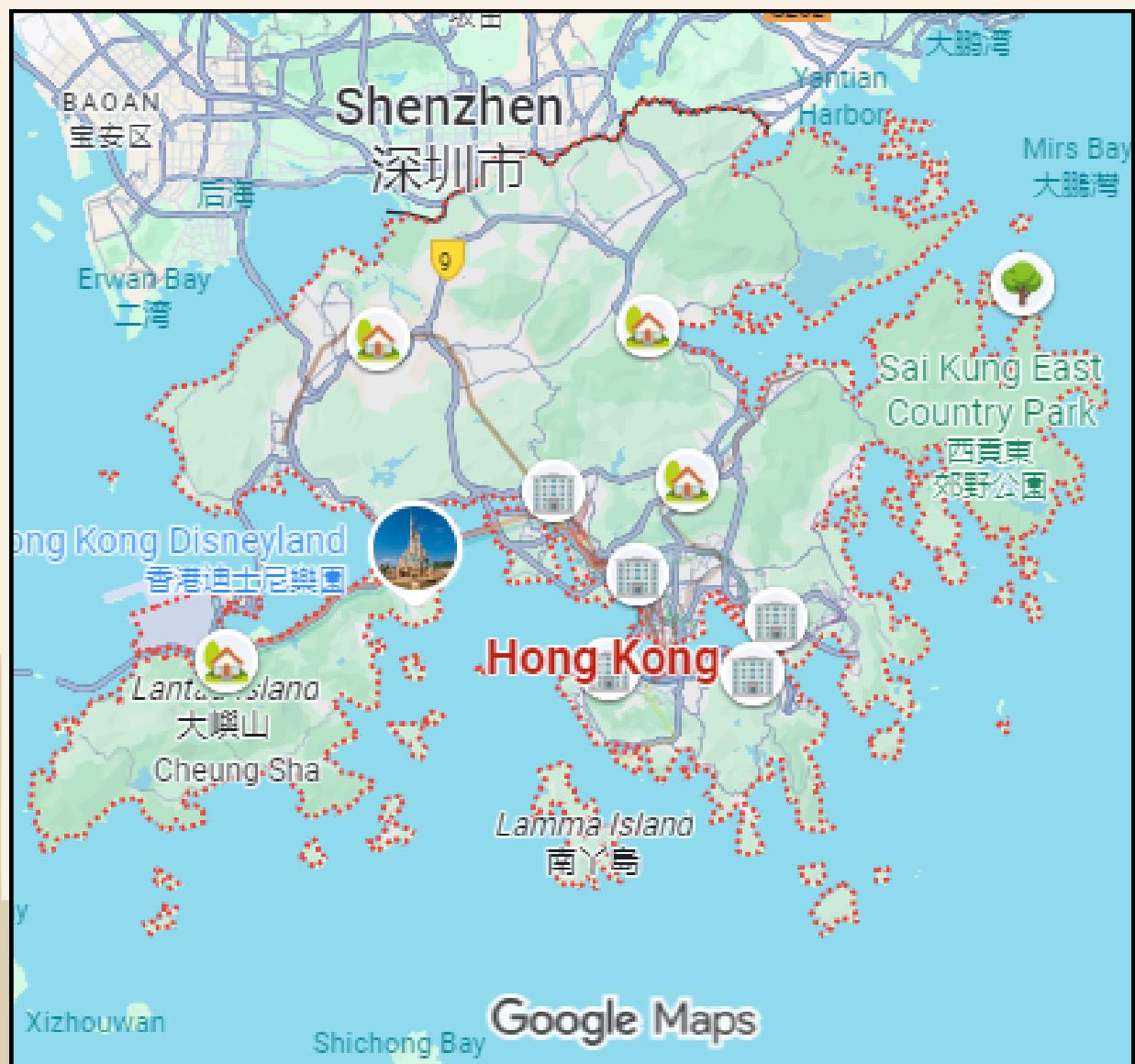
Table C. Monitoring Stations (Mexico City)						Table C. Monitoring Stations (Mexico City) (cont.)					
Station	Selected	Latitude (°N)	Longitude	Altitude	Type	Station	Selected	Latitude	Longitude	Altitude	Type
Acolman		19.63	-98.91	2198	Peripheral	Merced	*	19.42	-99.12	2245	Urban
Ajusco Medio	*	19.15	-99.16	2548	Peripheral	Miguel Hidalgo	*	19.4	-99.2	2327	Urban
Atizapán		19.57	-99.25	2341	Peripheral	Milpa Alta		19.18	-98.99	2594	Peripheral
Benito Juárez		19.37	-99.15	2249	Urban	Montecillo		19.46	-98.9	2252	Peripheral
Camarones	*	19.37	-99.16	2233	Urban	Nezahualcóyotl		19.39	-99.03	2235	Urban
CCA		19.32	-99.17	2294	Peripheral	Pedregal	*	19.33	-99.2	2326	Peripheral
Chalco		19.26	-98.88	2253	Peripheral	San Agustín	*	19.53	-99.03	2241	Urban
Coyoacán		19.35	-99.15	2260	Urban	San Juan de A.		19.45	-99.09	2258	Urban
Cuajimalpa		19.36	-99.29	2704	Peripheral	Santa Fe		19.36	-99.26	2599	Peripheral
Cuautitlán		19.72	-99.19	2263	Peripheral	Santa Úrsula		19.31	-99.15	2279	Urban
FES Acatlán		19.48	-99.24	2230	Peripheral	Santiago		19.35	-99.01	2293	Peripheral
FES Aragón		19.47	-99.05	2299	Urban	Tláhuac		19.25	-99.01	2297	Peripheral
Gustavo A. M.		19.48	-99.09	2227	Urban	Tlalnepantla	*	19.53	-99.2	2311	Urban
Hospital GM	*	19.41	-99.15	2234	Urban	Tlalpan		19.34	-99.12	2242	Urban
IIN		19.29	-99.38	3082	Peripheral	Tultitlán		19.6	-99.18	2313	Urban
Iztacalco		19.38	-99.12	2238	Urban	UAM Iztapalapa	*	19.36	-99.07	2221	Urban
La Presa		19.53	-99.12	2302	Urban	UAM		19.3	-99.1	2246	Peripheral
LAA		19.48	-99.15	2255	Urban	Villa de las F.		19.66	-99.1	2242	Peripheral
Los Laureles		19.58	-99.04	2230	Peripheral	Xalostoc	*	19.53	-99.08	2160	Urban

OVERVIEW OF MONITORING STATIONS AND POLLUTANTS (3/3)

Table D. Sources

Aspect	Hong Kong	Mexico City
Data: stations/periods/pollutants	https://cd.epic.epd.gov.hk/EPICDI/air/parameter/	https://www.aire.cdmx.gob.mx/default.php?opc=%27aqBhnMQ=%27
Altitude	https://www.advancedconverter.com/es/herramientas-de-mapa/encontrar-altitud-desde-coordenadas	https://repositorio-salud.conacyt.mx/jspui/handle/1000/235
Coordinates / location	https://www.aqhi.gov.hk/en/monitoring-network/air-quality-monitoring-stations.html	https://repositorio-salud.conacyt.mx/jspui/handle/1000/235
Type	https://www.aqhi.gov.hk/en/monitoring-network/air-quality-monitoring-stations.html	own classification based on experience

GEOGRAPHIC DISTRIBUTION OF SELECTED STATIONS

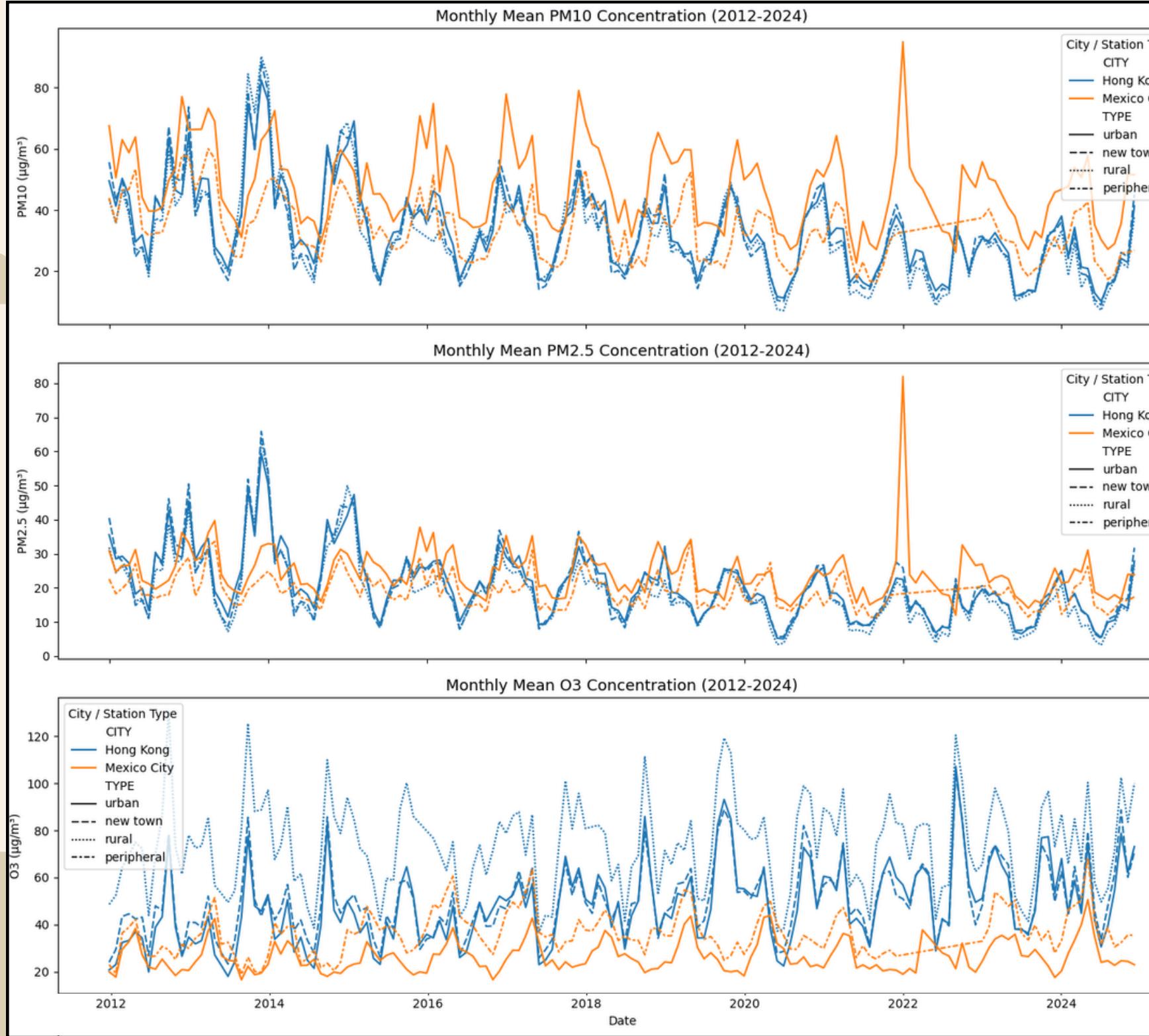


LEGEND

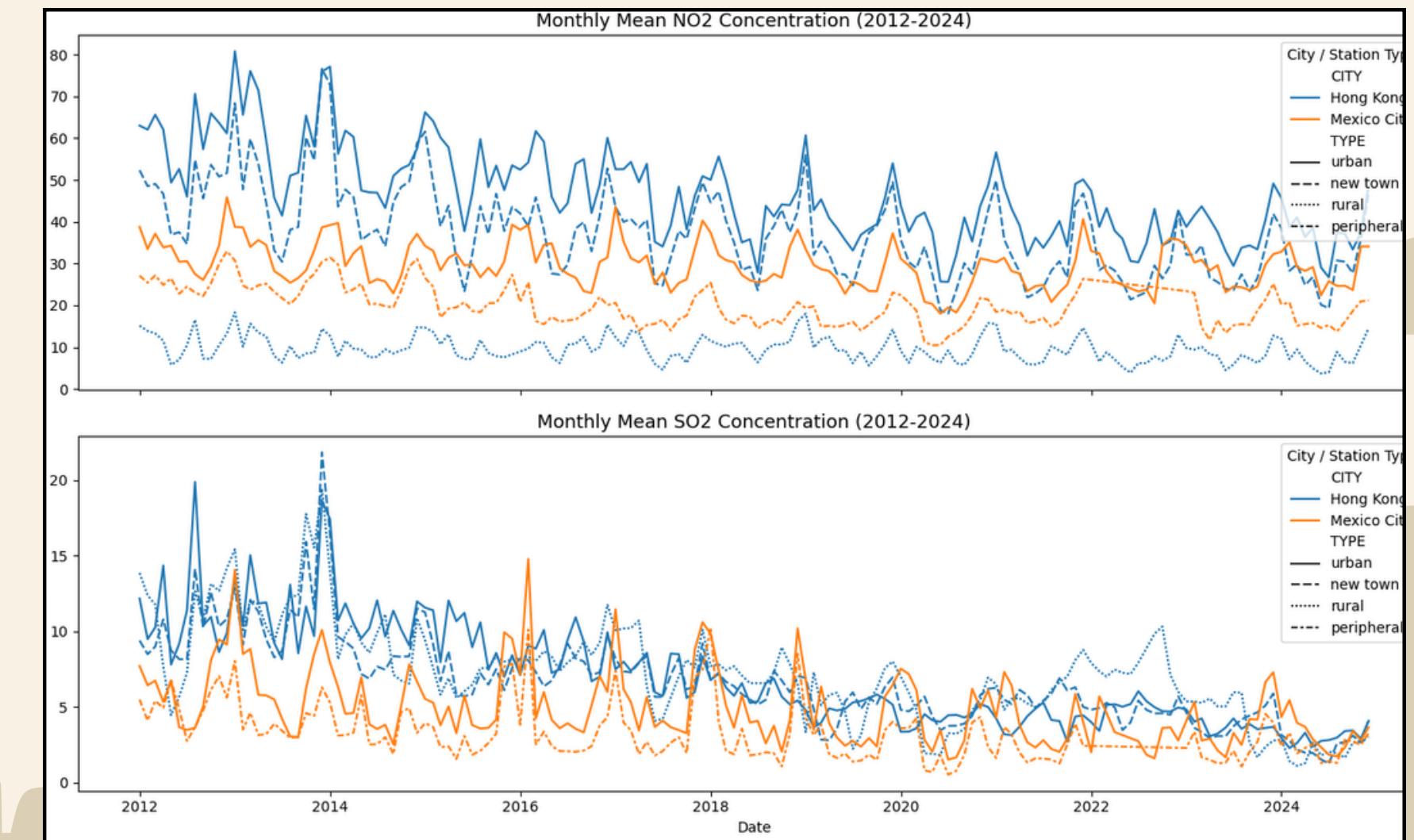
- - Urban
- - New Town / Peripheral
- - Rural

- HK: roadside stations excluded; selected stations based on lower proportion of missing values (NaNs) and more spatial coverage across the territory.
- MC: stations selected because they contained all 5 pollutants at some point within the available period (2012–2024).

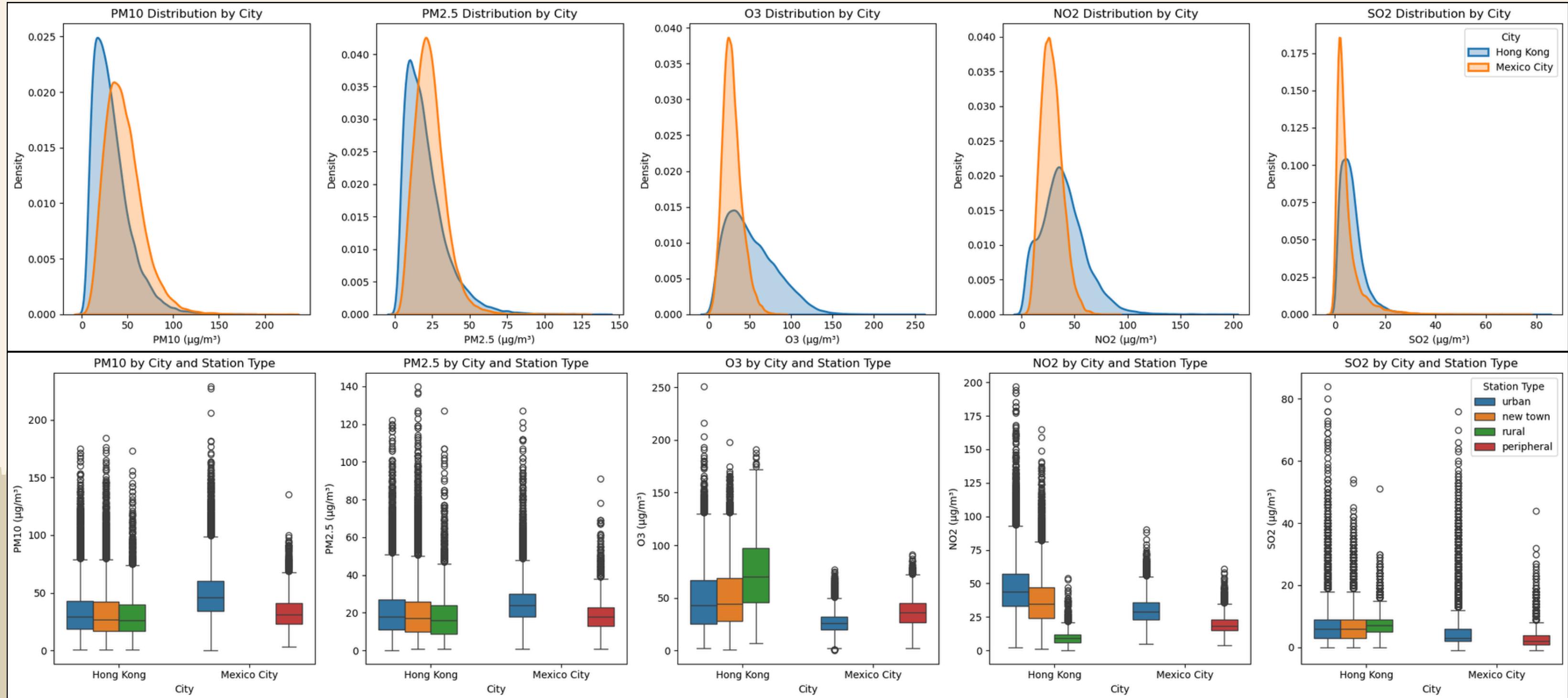
TEMPORAL TRENDS IN AIR POLLUTANTS



- Mexico City shows higher PM10 and PM2.5, especially in urban areas.
- Hong Kong has higher O₃ and NO₂, with clear seasonal and regulatory trends.



DISTRIBUTION AND OUTLIERS OF POLLUTANTS



- Mexico City: broader, higher PM distributions; Hong Kong: higher O3 and NO2.
- Outliers indicate episodic pollution events.

MAXIMUM OBSERVED VALUES BY STATION

Table E. Maximum values by city and season (2012–2024)

City	Station	PM10	PM2.5	O ₃	NO ₂	SO ₂
Hong Kong	Central/Western	164	120	251	162	54
Hong Kong	Eastern	160	91	203	162	46
Hong Kong	Kwun Tong	175	122	166	197	65
Hong Kong	Sham Shui Po	152	116	177	185	84
Hong Kong	Shatin	146	118	165	149	45
Hong Kong	Tai Po	151	112	165	125	36
Hong Kong	Tap Mun	173	127	191	54	51
Hong Kong	Tsuen Wan	171	111	180	192	66
Hong Kong	Tung Chung	162	126	175	165	54
Hong Kong	Yuen Long	184	140	198	159	53
Mexico City	Ajusco Medio	95	68	91	58	27
Mexico City	Camarones	141	102	65	83	56
Mexico City	Hospital General de México	124	94	75	79	54
Mexico City	Merced	161	96	69	72	57
Mexico City	Miguel Hidalgo	140	127	64	90	36
Mexico City	Pedregal	135	91	90	61	44
Mexico City	San Agustín	206	106	69	58	48
Mexico City	Tlalnepantla	154	111	73	88	70
Mexico City	UAM Iztapalapa	140	107	77	62	49
Mexico City	Xalostoc	229	121	64	71	76

- Highest PM10 in Mexico City (XALOSTOC, 229 µg/m³); highest O₃ in Hong Kong (CENTRAL/WESTERN, 251 µg/m³).
- Extreme values highlight need for targeted interventions.

SPATIAL PATTERNS: URBAN VS. RURAL

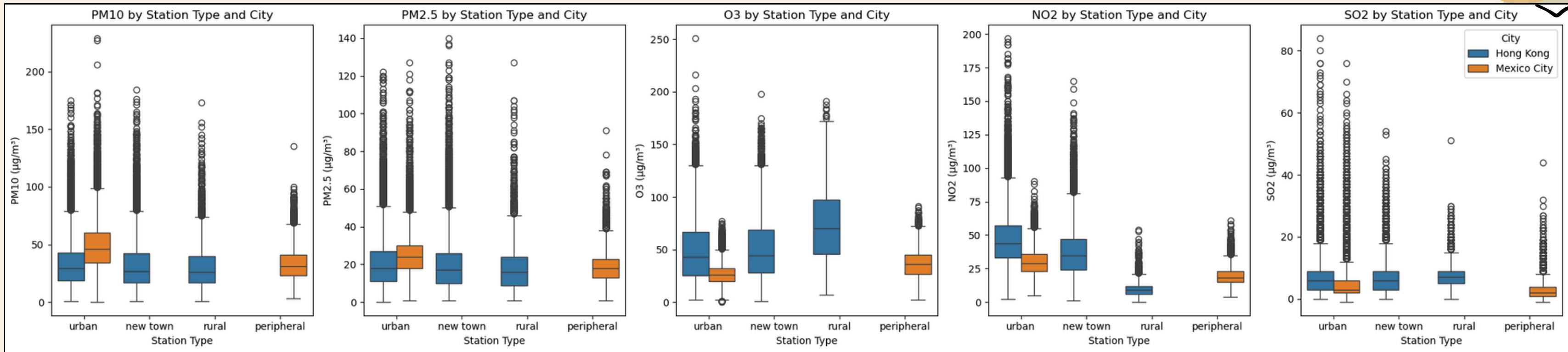


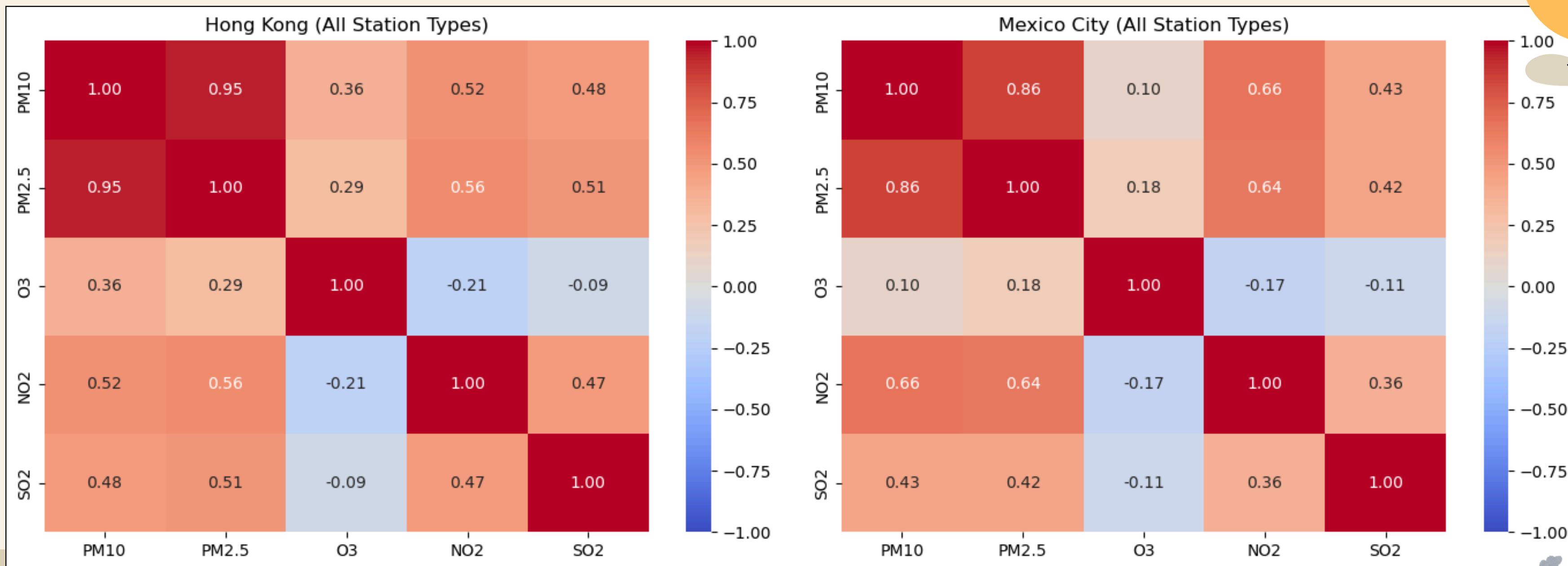
Table F. Mean pollutant concentrations by city and station type (2012–2024)

City	Station Type	PM10	PM2.5	O ₃	NO ₂	SO ₂
Hong Kong	New Town	32.38	20.44	50.33	37.18	6.63
	Rural	31.1	18.52	73.93	9.62	7.22
	Urban	33.14	20.68	48.07	46.62	6.98
Mexico City	Peripheral	33.13	18.86	36.7	19.55	3.13
	Urban	48.97	24.69	26.62	30.24	5.22

- Urban Mexico City: highest PM; rural Hong Kong: highest O₃.
- Spatial differences reflect local sources and atmospheric processes.

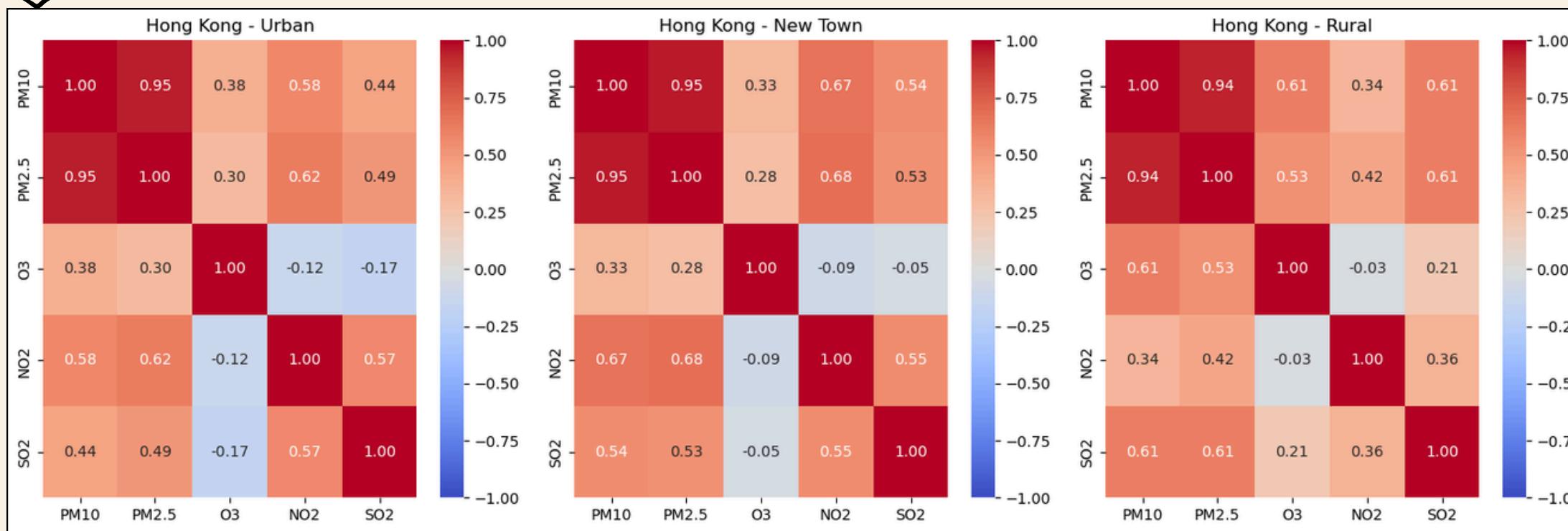


CORRELATIONS BETWEEN POLLUTANTS (1/2)

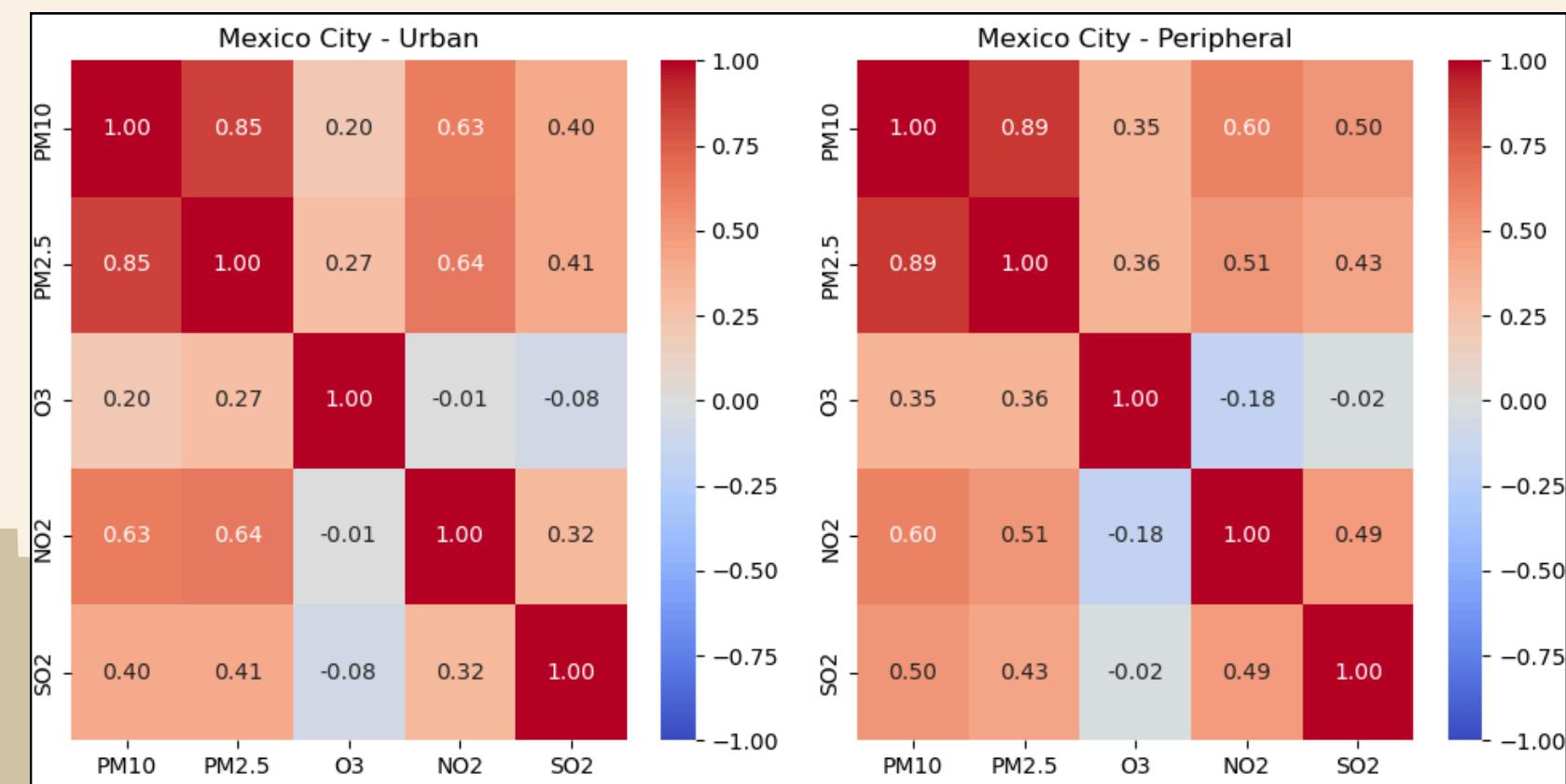


- Strongest correlations between PM10 and PM2.5.
- O3 negatively correlated with NO2, especially in Hong Kong.

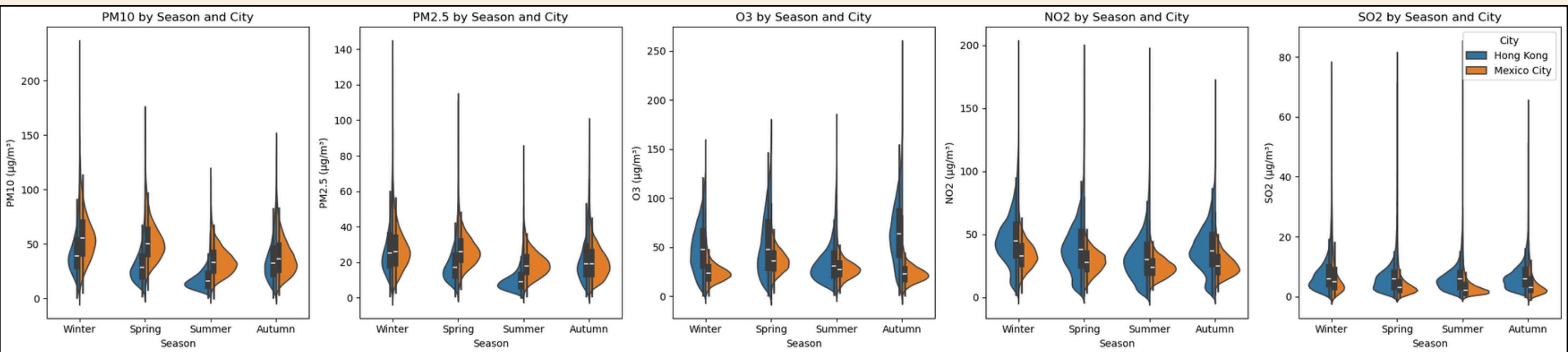
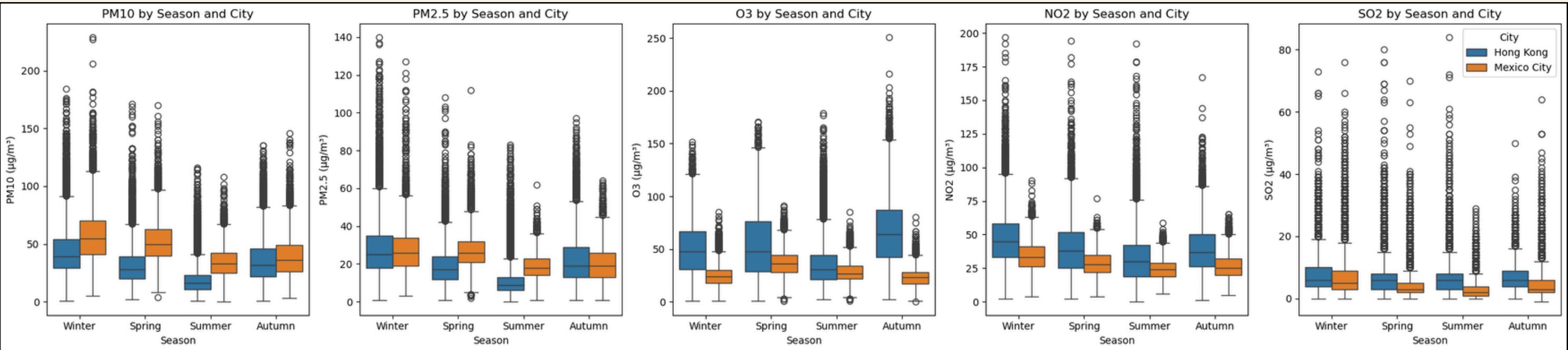
CORRELATIONS BETWEEN POLLUTANTS (2/2)



- The strongest relationships are always between PMs, regardless of city or station type.
- NO₂ and PMs are also closely linked, especially in urban environments, highlighting the role of combustion sources.
- O₃ behaves differently: it is generally not correlated or is negatively correlated with primary pollutants, reflecting its secondary formation and the titration effect with NO₂.
- SO₂ shows moderate positive correlations with particulates and NO₂, but these are weaker than the PM–PM or PM–NO₂ links.

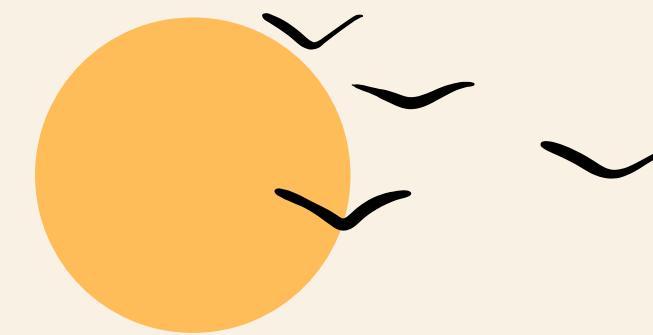


SEASONAL TRENDS AND VARIABILITY



- Winter and spring: highest PM and NO₂ in both cities.
- Ozone peaks in autumn (HK) and spring/summer (MX).
- Seasonality driven by meteorology and photochemistry.





INSIGHTS & NEXT STEPS

- Mexico City experiences higher and more variable PM10 and PM2.5, especially in winter and spring.
- Hong Kong shows higher O₃ and NO₂, with strong seasonal and spatial patterns.
- Urban areas in Mexico City are most affected by particulates; rural Hong Kong sees the highest ozone.
- Strongest correlations are between PM10 and PM2.5; O₃ is negatively correlated with NO₂.
- Seasonality is key: winter/spring for PM and NO₂, autumn/spring for O₃.
- Further analysis planned:
 - Explore the influence of meteorological conditions (e.g., temperature, wind, humidity) on pollution episodes.
 - Compare air quality indices (AQHI) between Hong Kong and Mexico City.
 - Focus on specific stations and periods for a deeper event-based analysis.



EXTRA: MEXICO CITY AIR QUALITY INDEX (IAS) STRUCTURE

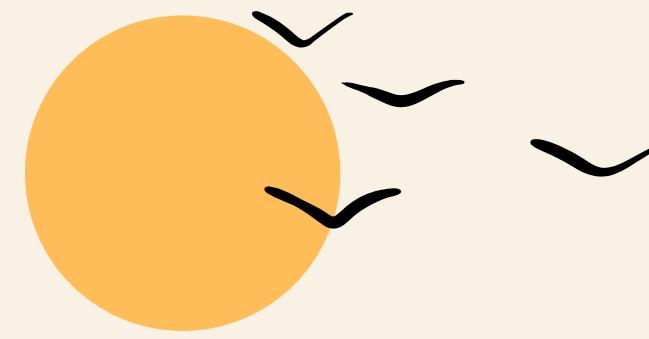


Table G. Mexico City Air Quality and Health Index (IAS)

Air Quality & Health Index	Associated Risk Level	Recommendations		
		Cardiovascular/Respiratory Patients & >60 years	Children <12 & Pregnant Women	General Population
Good	Low – minimal or no health risk	Enjoy outdoor activities.		
Acceptable	Moderate – Sensitive groups to O ₃) or particulate matter (PM ₁₀ , PM _{2.5}) may experience eye irritation and respiratory symptoms.	Light outdoor physical activity such as walking, cycling, skateboarding, etc. is possible. Reduce vigorous outdoor physical activity. If you experience symptoms, consult a doctor. Monitor air quality.	You can do outdoor activities. Check the air quality.	
Poor	High – In sensitive population, there is an increased risk of respiratory symptoms and/or decreased lung function. The likelihood of involvement in the general population is low.	Reduce all outdoor physical activity. If you experience symptoms, consult a doctor. Check the air quality.	You can engage in light outdoor physical activity such as walking, cycling, skateboarding, etc., with rest periods. Reduce vigorous outdoor activities. If respiratory or cardiac symptoms occur, discontinue the activity and seek medical advice. Check the air quality.	You can engage in outdoor activities. If you experience symptoms such as coughing or shortness of breath, take breaks and reduce the intensity of your activity. Check the air quality.
Very Poor	Very High – General population may experience health problems. In vulnerable populations, the risk of worsening asthma, COPD, or cardiovascular events increases.	You can engage in indoor physical activity, as long as it's tobacco-free. Avoid physical activity and going outdoors. If you experience symptoms, consult a doctor. Check the air quality.	Reduce outdoor physical activity; indoor activities are fine, as long as they are tobacco-free. Avoid vigorous or prolonged outdoor physical activity. Check the air quality.	
Extremely Poor	Extremely High – Entire population is at greater risk of experiencing serious health effects.	Stay indoors where you can engage in physical activity, reschedule your outdoor activities, and if you experience respiratory and/or cardiac symptoms, seek medical advice. Check the air quality.		



THANK YOU!



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18/09/2025



SOURCES / USEFUL LINS

Table H. Sources / Useful Links

Hong Kong	Mexico City
<u>Data (pollutants):</u> https://cd.epic.epd.gov.hk/EPICDI/air/parameter/	<u>Data (pollutants):</u> https://www.aire.cdmx.gob.mx/default.php?opc=%27aqBhnMQ=%27
<u>AQ objectives:</u> https://www.epd.gov.hk/epd/english/environmentinhk/air/air_quality_objectives/air_quality_objectives.html	<u>IAS index info:</u> https://www.aire.cdmx.gob.mx/default.php?opc=%27ZaBhnMl=&dc=%27Zw==
<u>AQHI info:</u> https://www.aqli.gov.hk/en/what-is-aqli/about-aqli.html	<u>IAS data (historical):</u> https://www.aire.cdmx.gob.mx/default.php?opc=%27aKBhnMl=%27&opcion=ZmU=
<u>AQHI past data:</u> https://www.aqli.gov.hk/en/past-data/past-aqli.html	<u>Monitoring stations list:</u> https://www.aire.cdmx.gob.mx/default.php?opc=%27ZaBhnMl=&dc=%27ZA==
<u>Station network (types/locations):</u> https://www.aqli.gov.hk/en/monitoring-network/air-quality-monitoring-stations.html	<u>Station map (official):</u> https://www.aire.cdmx.gob.mx/default.php?opc=%27ZaBhnMl=%27
<u>Altitude (tool):</u> https://www.advancedconverter.com/es/herramientas-de-mapa/encontrar-altitud-desde-coordenadas	<u>Repositorio CONACYT (stations, coords, altitudes):</u> https://repositorio-salud.conacyt.mx/jspui/handle/1000/235