Trying to understand the type of air quality in Greater Cairo in Egypt using the observed data

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Cairo Suffocates .. Let it breathe !

73 years ago, in 1948, an Egyptian magazine called “El Mosawer” warned that Cairo will go to the following:

A farmer burns rice straw at his field in Qalyubia in 2016, causing a "black cloud" of smoke that spreads across the Nile valley, near the agricultural road that leads to Cairo

The face wiper after a day walk around Cairo

Sources of pollutants data

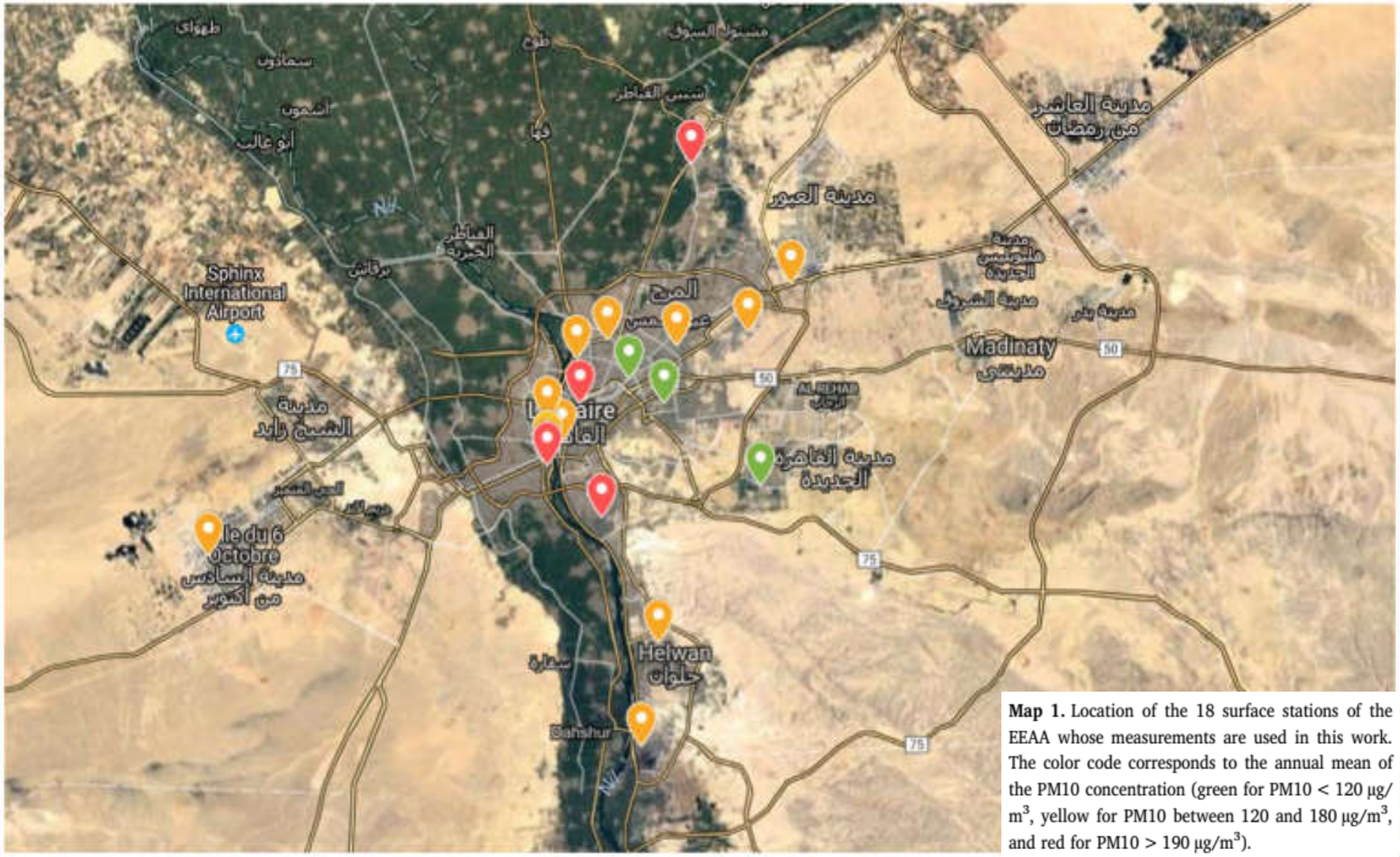
A. <u>The Egyptian Environmental Affairs Agency</u>

(EEAA) data from 2010 to 2015.

B. <u>The Egyptian Meteorological Authority</u> (EMA)

data from 2000 to 2004

18 monitoring stations distributed over GC



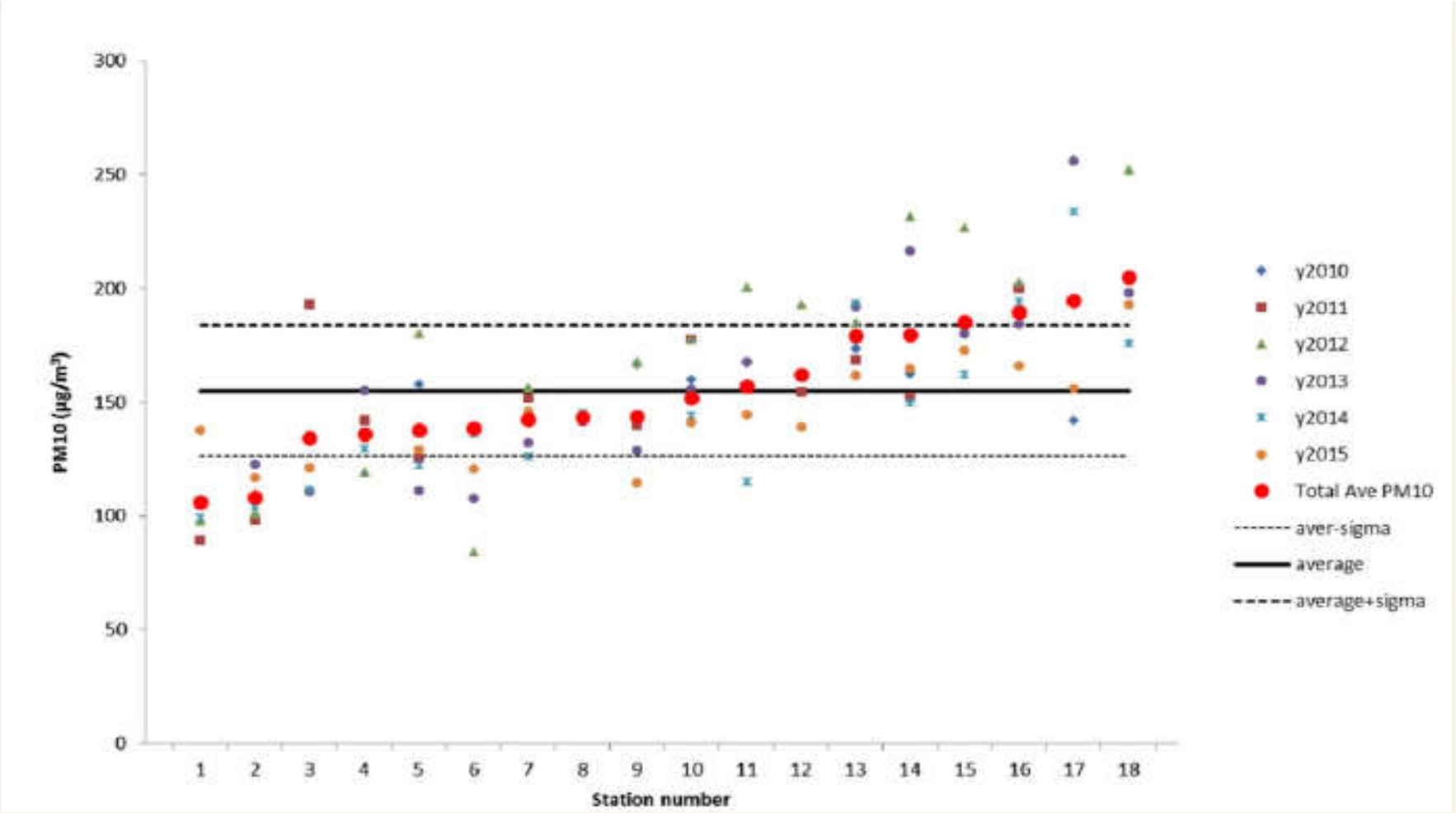
Map 1. Location of the 18 surface stations of the EEAA whose measurements are used in this work. The color code corresponds to the annual mean of the PM10 concentration (green for PM10 < 120 μg/m^3, yellow for PM10 between 120 and 180 μg/m^3, and red for PM10 > 190 μg/m^3).

Information of the 18 monitoring stations

Name, classification, location (latitude, longitude.) and type of measurements performed at the 18 monitoring stations of Greater Cairo whose data are used in this study.

#	Name	Classif.	Lat	Long	PM10	PM2.5	NO2	O3
1	Abbasseya	Urb /Res	30 ° 04` 39. 75	31° 17 ` 18. 63	X		X	X
2	Nasr City	Residential	30 ° 03` 17. 96	31° 19 ` 34. 28	X		X	
3	New Cairo	Residential	30° 2'34.01	31°20'21.88	X		X	
4	Salam	Road side/Urb	31°26'51.99"	30° 9'22.71"	X			
5	Cairo Airport TB4	Road side/Urb.	30° 7'5.45	31°24'22.15	X			X
6	Giza Square	Traffic	30° 1'8.90"	31°12'43.71"	X	X	X	
7	Nasr Institute	Road side/Urb	30° 5'40.71	31°14'21.74	X		X	
8	Helwan	Road side/Urb	29°50'57.01	31°20'2.58	X		X	
9	06-oct	Road side/Urb	29°56'9.32"	30°52'59.37"	X	X	X	
10	Kasr Aini	Road side/Urb	30° 1'43.17"	31°13'32.30"	X		X	
11	Shobra El Khima	Industrial	30° 6'40.80"	31°16'13.56"	X	X	X	
12	Masr Gadida	Road side/Urb	30° 5'30.00	31°20'37.75	X	X	X	
13	Tabbin	Industrial	29°46'21.72	31°19'33.60	X	X	X	
14	Mohandseen	Residential	30° 2'47.70"	31°12'43.39"	X			
15	Masara	Residential	29°54'22.86	31°17'58.43	X	X	X	
16	Maadi	Residential	29°58'2.71"	31°15'51.80"	X	X	X	
17	Qulaly	Road side/Urb	30° 38.3` 13``	31° 37.14` 23``	X	X	X	
18	Abou Zabaal	Road side/Urb	30°14'29.40	31°24'39.60	X	X	X	

Particulate matter concentrations



Annual means of the PM_{10} concentrations measured from 2010 to 2015 at the 18 surface stations of Greater Cairo.

The average PM_{10} concentration

The average PM_{10} concentration for the whole Greater Cairo area is 155 ($\pm$ 35, standard deviation) $\mu g/m^3$.

The average PM_{10} concentration

The multi-year average concentration doubles from Abbasseya to Abou Zabaal and the inter-site variability is large.

The average PM_{10} concentration

The range of concentrations measured at all stations is well above the 20 $\mu g/m^3$ AQG of the WHO, the 40 $\mu g/m^3$ legal yearly limit of the European Union, and the 75 $\mu g/m^3$ Egyptian one.

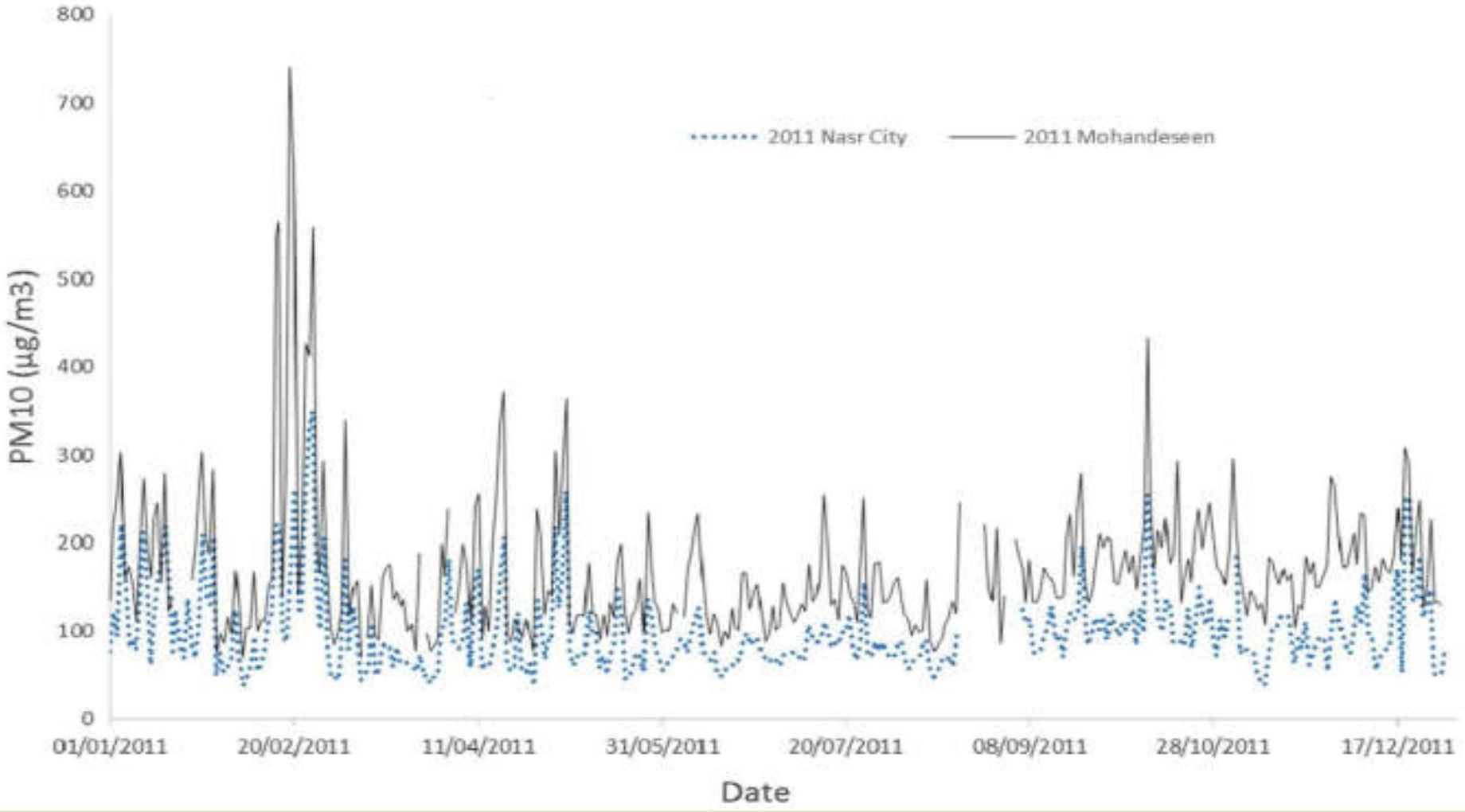
Variability of the PM concentration

Table 4

Results of five consecutive years of PM10 concentration (in $\mu g/m^3$) measurements performed at one of the less polluted (Nasr City) and one strongly polluted (Mohandseen) sites of Greater Cairo. Valid days are days with measurements.

	Nasr City					Mohandseen				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Min	43	38	35	32	31	54	13	52	60	78
Percentile 25	71	69	67	82	64	114	119	128	118	136
Median	88	86	82	99	88	157	154	166	177	172
Percentile 75	124	116	114	145	124	205	193	207	238	229
Max	356	350	463	698	664	646	741	876	847	866
Percentile 90.4	182	156	177	207	167	289	249	288	300	293
Valid days	323	346	269	272	318	290	348	353	277	272
%days > 50	97	94	96	99	92	100	100	100	100	100

The comparison of the temporal variations of the PM at Nasr City and Mohandeseen



Derivation Of The PM2.5 From The PM10 Concentrations

- Using the monthly concentrations measured for 3 years (2013–2015) at the stations of the EEAA
- The annual averages of the PM2.5 concentrations were calculated from the PM10. ones using the PM2.5/PM10 ratio and were found to increase from about 50 µg/m3 in Abasseya to 110 µg/m3 in Abou Zabaal.
- One obtains an average of 0.47 ± 0.19 (standard deviation).
- This ratio tends to be smaller in spring (0.45 ± 0.18), which is the peak of the dust season, than in summer (0.52 ± 0.15).

Gases

O3 analysis and results:

The hourly O3 concentrations measured on the top of the EMA building in Abbasseya have been used to calculate the daily maximum of the 8 h-sliding averages

O3 analysis and results

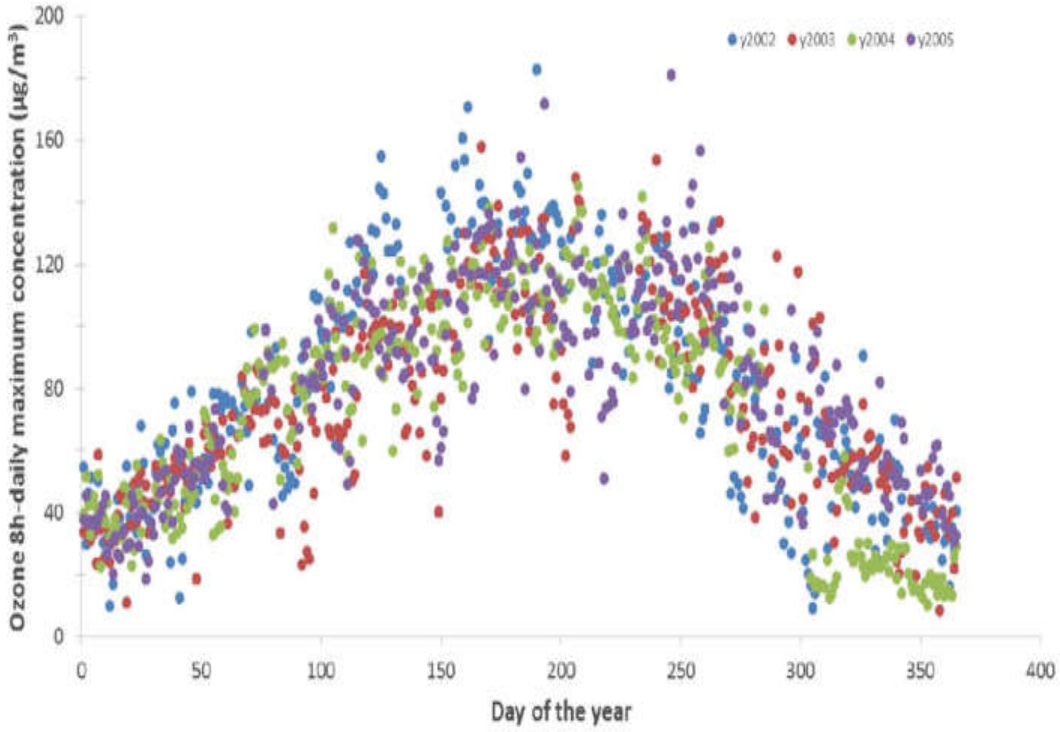


Fig. 3. Four years of surface 8 h-max ozone concentrations measured at the urban residential station of Abbasseya.

Discussion and concluding remarks

- In Greater Cairo, the sharpest peaks of PM concentration are mostly due to the massive transport of mineral dust from the desert towards the city.
- With an annual mean of PM2.5 concentrations differing by at least a factor two from one sector of the city to the other.
- The same problem occurs with NO2 whose concentration exceeds the WHO air quality guidelines in some particular sectors of the city strongly affected by traffic or industrial activities but not in the others.
- The data available do not allow the assessment of the spatial variability of O3 because the measurements performed at the Abbasseya station only

Thank You for your Attention