WORLD ATHLETICS

CLEAN AIR FUND

nationale nederlanden

45th NATIONALE-NEDERLANDEN WARSAW MARATHON

Environmental Report

WARSAW AUGUST 2024

RUNNING FOR CLEAN AIR

DISCLAIMER

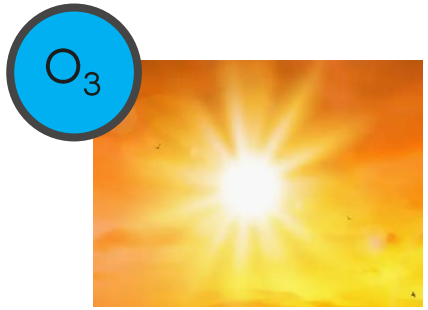
This report contains data from the Air Quality monitoring station installed at Park Pole Mokotowskie, Warsaw, POLAND, operating since May 7th, 2024.

The data presented in this report is collected with sensor technologies which are not regulatory-grade instrumentation following Directive 2008/50/EC. Therefore, the results presented should be considered as informative and not be used for regulatory compliance checking purposes. Any communication of the data should include this statement. After deployment, the monitors are not routinely inter-compared with reference instruments at each destination.

MAIN POLLUTANTS MEASURED

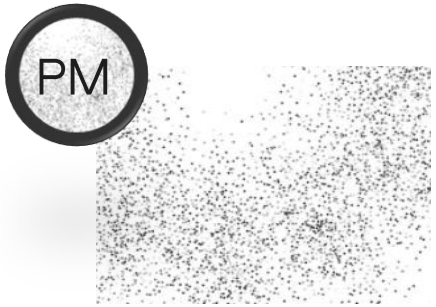
Nitrogen Dioxide

Primarily gets in the air from the burning of fuel by cars, trucks and buses, power plants



Ozone

Created by chemical reactions between (NOx) and (VOC) in the presence of sunlight



Particulate matter

Mixture of solid particles and liquid droplets found in the air. Some are emitted directly from a source, such as heating in residential, construction sites, unpaved roads, fields, smokestacks, fires or transported by the wind

TO BUILD A SIMPLIFIED AIR QUALITY INDEX (AQI)

Gaseous pollutants

NO NO_2 O_3

Particulate Matter

PM 1 PM 2.5 PM 10

EUROPEAN AQI INDEX

Help us understand data measured by the stations

EXTREMELY POOR	126-200	May cause respiratory issues in healthy people, and serious health issues in people with lung/heart disease.
VERY POOR	101-125	The pollution level has reached a critical level. Even healthy people may show symptoms for short exposures.
POOR	75-100	Effects can be immediately felt by individuals at risk. Everybody feels the effects of prolonged exposure.
MODERATE	51-75	The air has reached a high level of pollution. Higher than the maximum limit for 24 hours established by WHO.
FAIR	26-50	The air is moderately polluted. A long-term exposure constitutes a health risk.
GOOD	0-25	The air is pure, ideal for outdoor activities.

EUROPEAN AQI LEVELS

European Environment Agency

Measurements of up to five key pollutants (O3, NO2, SO2, PM10, PM2.5) determine the index level that describes the current air quality situation at the location of each Kunak device. The index corresponds to the poorest level for any of the five pollutants based on the following scheme:

Pollutant	Level index (based on pollutant concentrations in µg/m^3)					
	Good	Fair	Moderate	Poor	Very poor	Extremely poor
	(0-25)	(26-50)	(51-75)	(76-100)	(101-125)	(126-200)
$PM_{2.5}$ (24h)	0-10	10-20	20-25	25-50	50-75	75-800
PM_{10} (24h)	0-20	20-35	35-50	50-100	100-150	150-1200
NO_2	0-40	40-90	90-120	120-230	230-340	340-1000
O_3	0-50	50-100	100-130	130-240	240-380	380-800
SO_2	0-100	100-200	200-350	350-500	500-750	750-1250

https://www.kunak.es/doc/08.Manuals/html/Kunak_Cloud_UserManual_EN.html#_Toc102586013

World Health Organization

RECOMMENDED AIR QUALITY GUIDELINES LEVELS & INTERIM TARGETS

Pollutant	Averaging time	Interim target				AQG level
		1	2	3	4	
$PM_{2.5}$, µg/m³	Annual	35	25	15	10	5
	24-hour[a]	75	~~50~~	~~37.5~~	~~25~~	15
PM_{10}, µg/m³	Annual	70	50	30	20	15
	24-hour[a]	150	~~100~~	~~75~~	~~50~~	45
O_3, µg/m³	Peak season[b]	100	70	–	–	60
	8-hour[a]	160	~~120~~	–	–	100
NO_2, µg/m³	Annual	40	30	20	–	10
	24-hour[a]	120	~~50~~	–	–	25

AIR QUALITY GUIDELINES FOR NITROGEN DIOXIDE (SHORT AVERAGE TIME) REMAIN VALID

Pollutant	Averaging time	Air quality guidelines that remain valid
NO_2, µg/m³	1-hour	200

Recommended 2021 AQG levels compared to 2005 air quality guidelines

Pollutant	Averaging Time	2005 AQGs	2021 AQGs
$PM_{2.5}$, µg/m³	Annual	10	5
	24-hour[a]	25	15
PM_{10}, µg/m³	Annual	20	15
	24-hour[a]	50	45
O_3, µg/m³	Peak season[b]	-	60
	8-hour[a]	100	100
NO_2, µg/m³	Annual	40	10
	24-hour[a]	-	25
SO_2, µg/m³	24-hour[a]	20	40
CO, mg/m³	24-hour[a]	-	4

https://apps.who.int/iris/bitstream/handle/10665/345329/9789240034228-eng.pdf?sequence=1&isAllowed=y

WORLD ATHLETICS

METHODOLOGY

Meteo sensors

Temperature
(WBGT) Wet bulb globe temperature
Relative Humidity

Gas sensors (ug/m3)

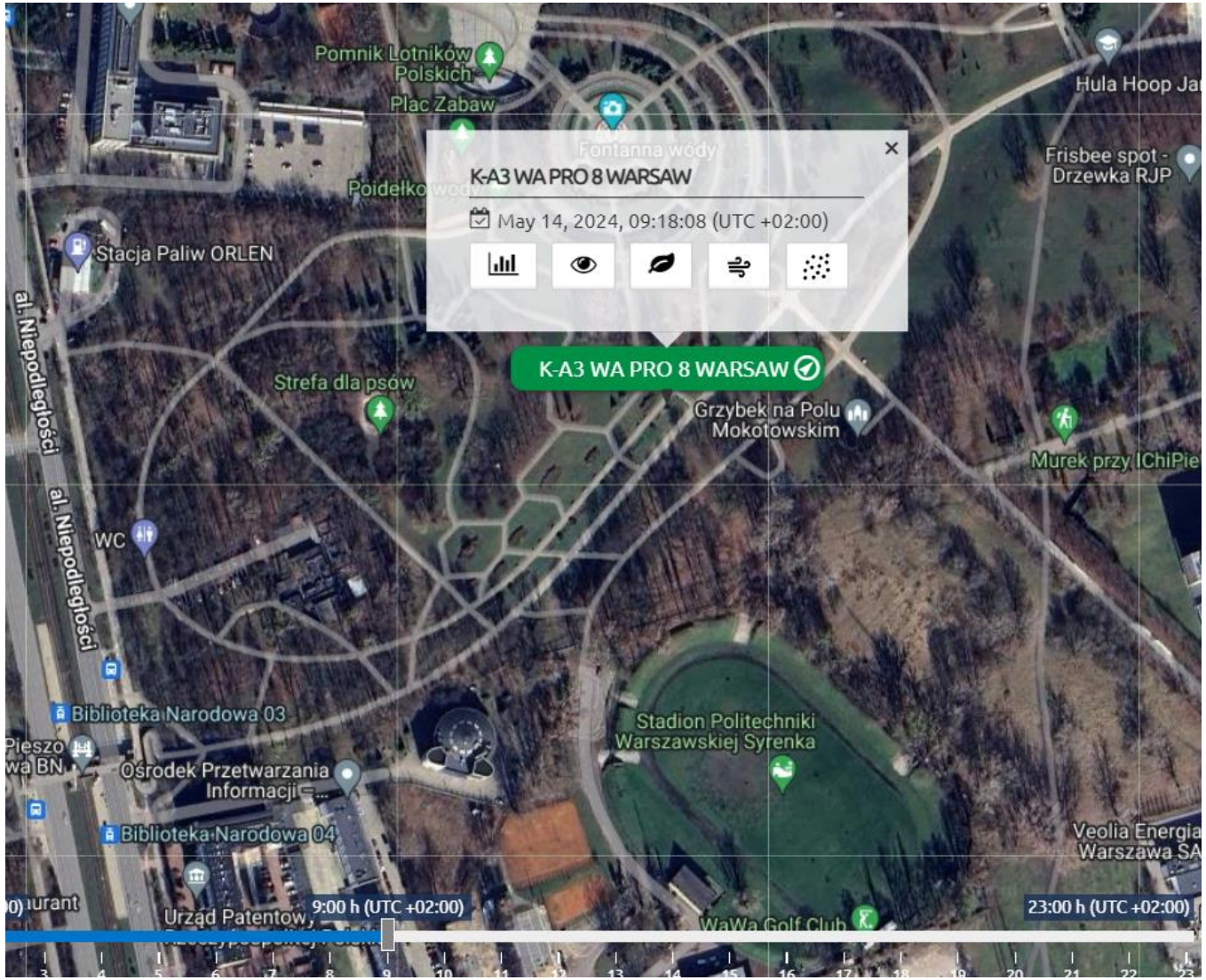
NO, NO2, O3

Particulate Matter sensor (ug/m3)

PM2.5, PM10

Positioning

GPS



WORLD ATHLETICS

AGGREGATED DATA August 1st to August 31st

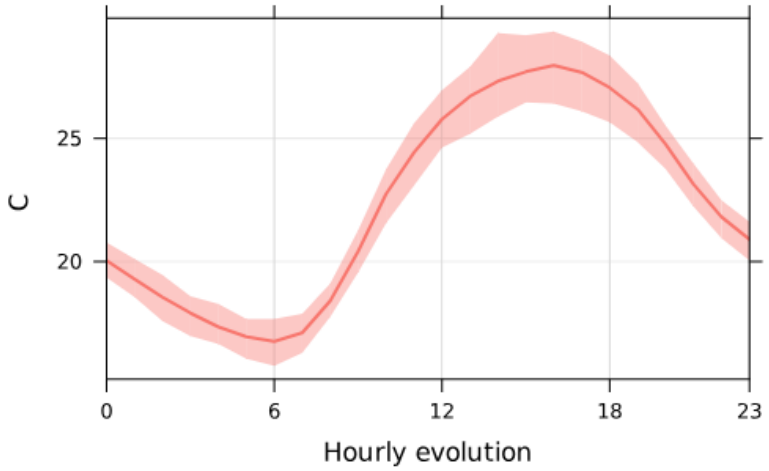
ENVIRONMENTAL DATA & AIR QUALITY INDEX

DEVICE LOCATED AT

Park Pole Mokotowskie

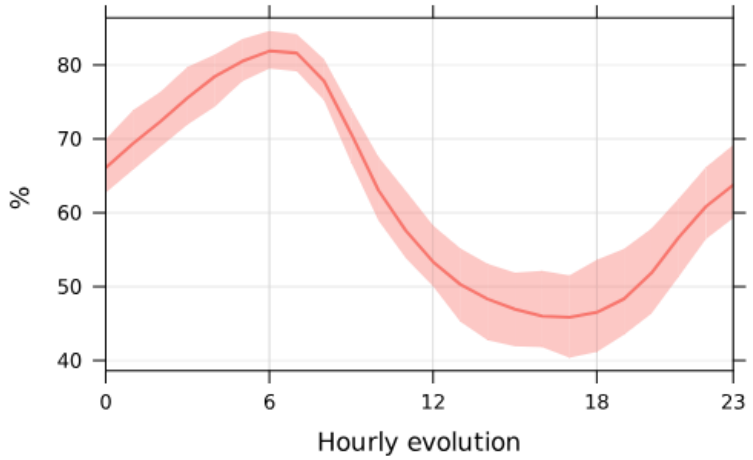
TEMPERATURE & HUMIDITY – Time variation - August 1st to August 31st

Air Temperature



Aggregated data of the temperature hourly evolution indicate that the lowest temperature is measured at 06:00 and the highest between 15:00 and 17:00

Relative Humidity



Aggregated data of the humidity hourly evolution indicate that the lowest humidity is measured at 17:00 and the highest at 06:00

WET BULB GLOBE TEMPERATURE - Time variation - August 1st to August 31st

WBGT is a measure of heat stress in direct sunlight.

It is a comprehensive measure of all the weather-related factors

(i) air temperature;

(ii) humidity;

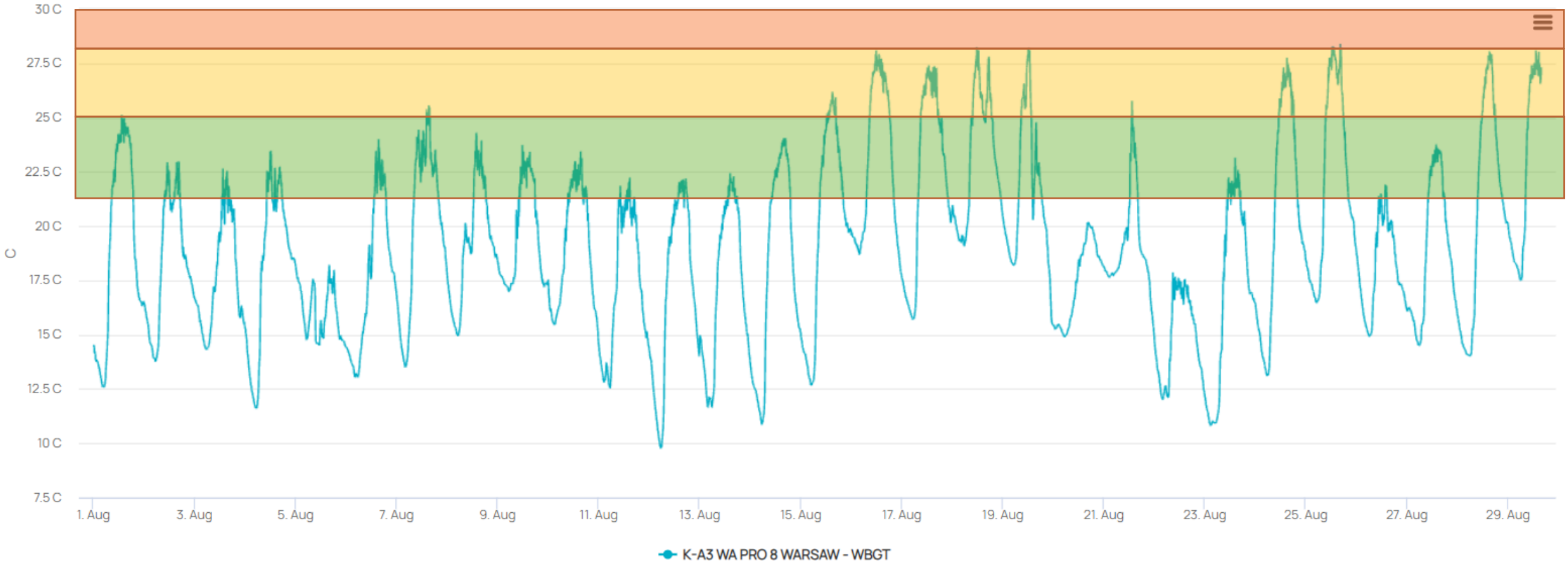
(iii) wind speed;

(iv) solar radiation

that impact the health and performance of athletes.

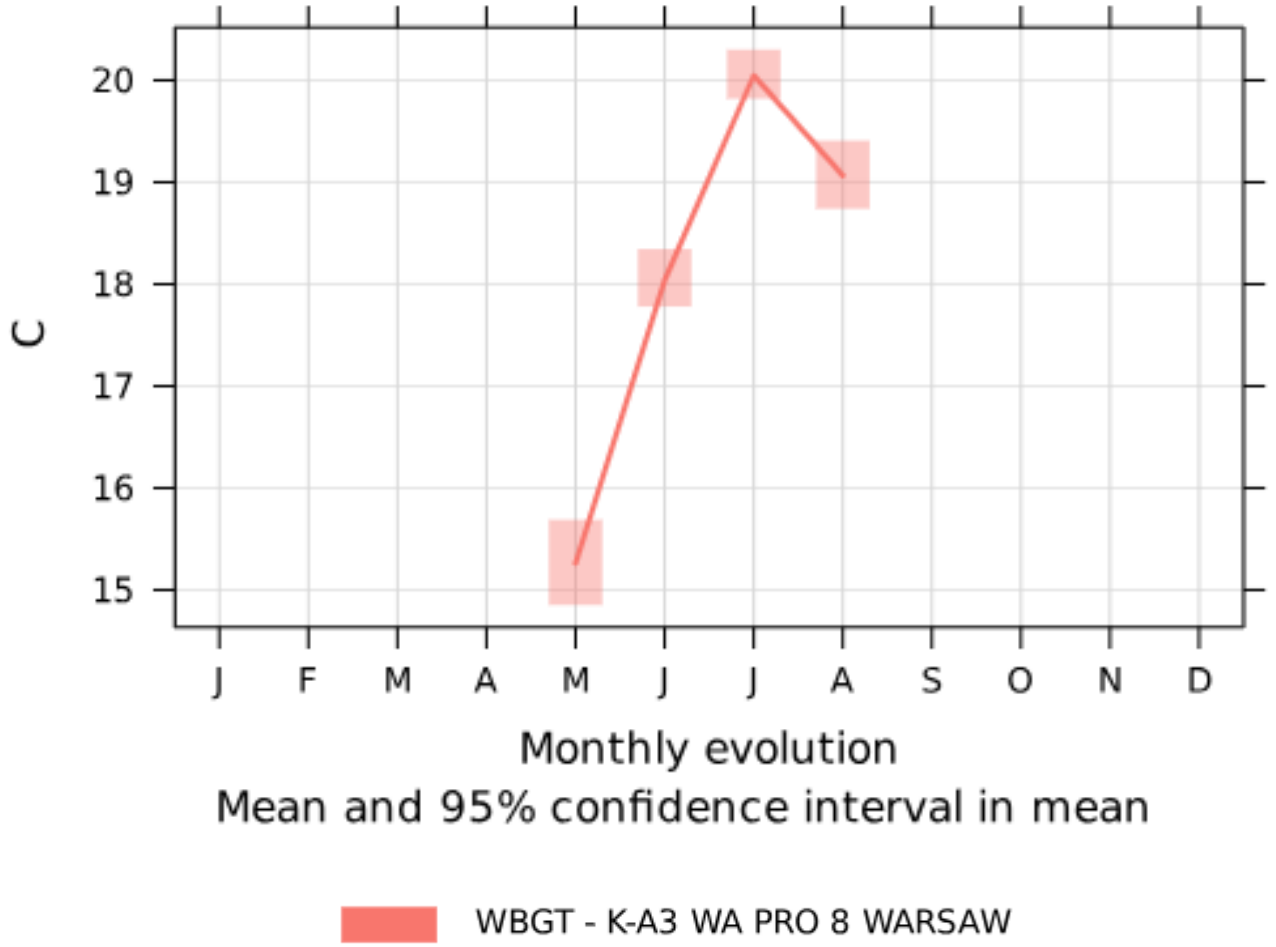
WBGT - Time variation August 1st to August 31st

WBGT index during this period was important for 8 days and acceptable the rest of the month and did not represent a significant level of heat stress for training athletes.

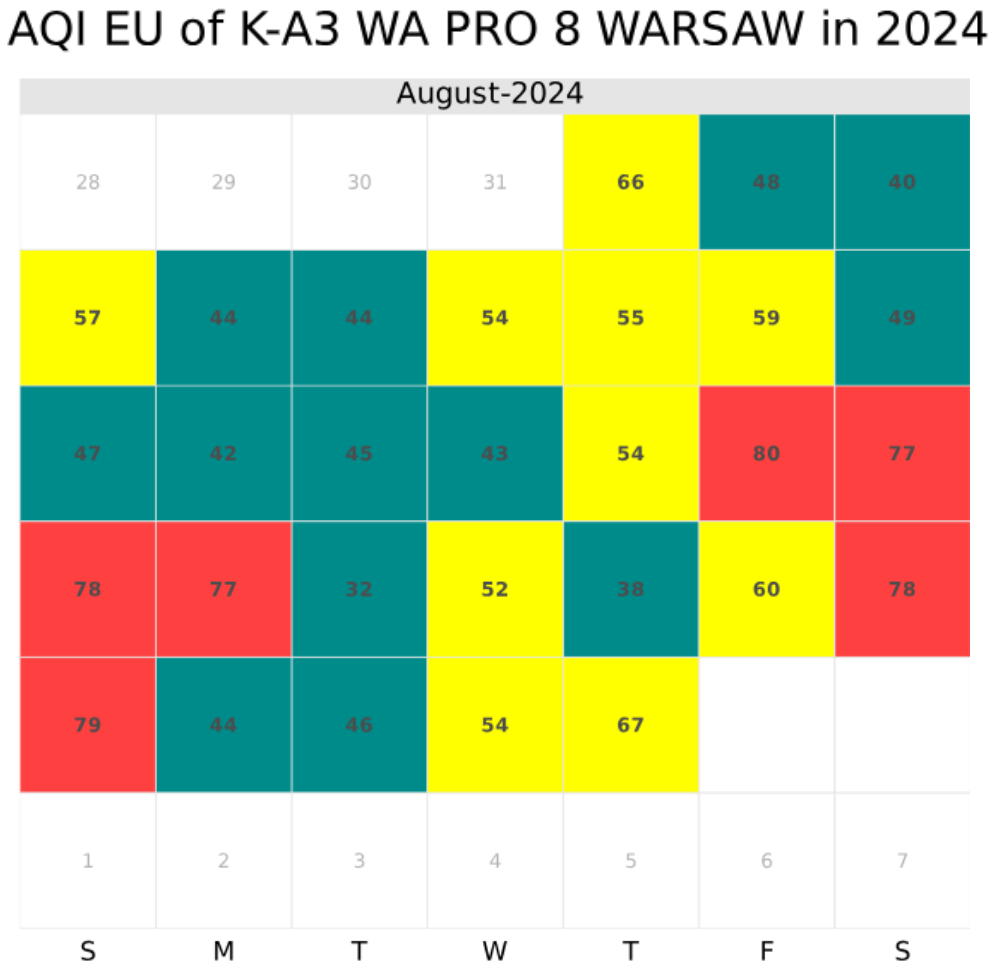


WBGT	Almost safe <21°C	Caution 21-25°C	Warning 25-28°C	Severe warning 28-30°C	Danger > 30°C

WBGT evolution from May to August



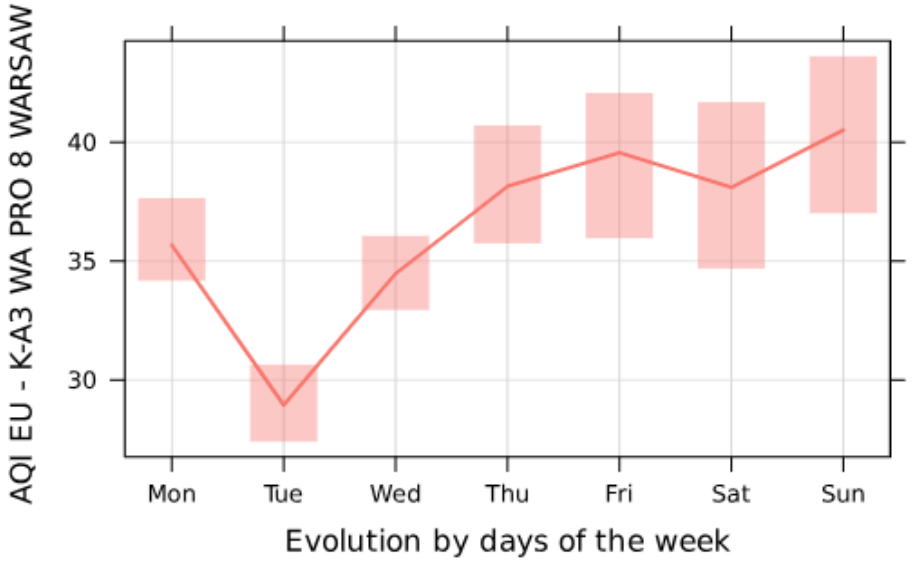
AQI EU - August 1st to August 31st



EXTREMELY POOR
126-200
VERY POOR
101-125
POOR
75-100
MODERATE
51-75
FAIR
26-50
GOOD
0-25

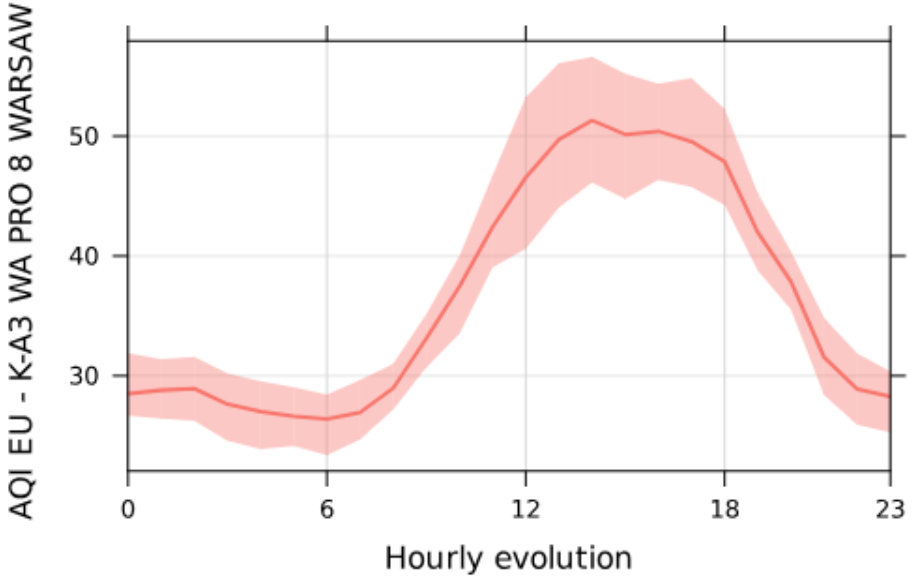
The AQI calendar plot indicates the AQI for each day during the monitoring period. Helping us to have a first glimpse of the conditions for each day. The AQI measured in August shows a moderate to poor air quality. The worst and best AQI values reported over the period are (80) and (32) respectively.

AQI - Time variation - August 1st to August 31st



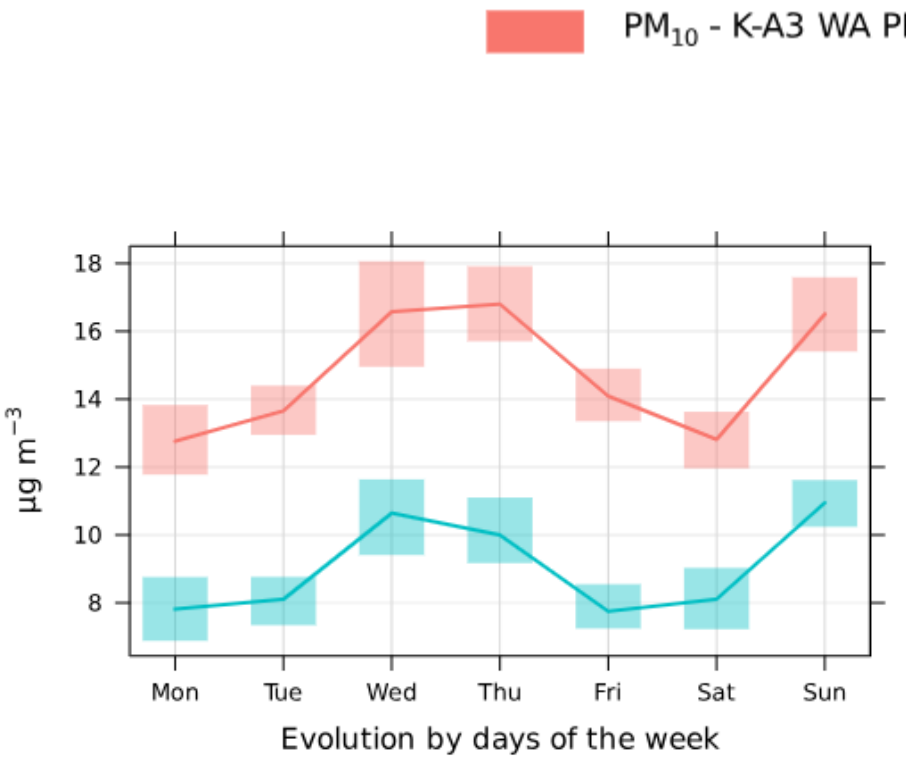
Aggregated data of the AQI evolution throughout the monitoring period helps us understand how the AQI changed based on day of the week and time of the day.

Aggregated data of the evolution by days of the week indicates the lowest AQI values were recorded on Tuesday this month.



Aggregated data of the AQI hourly evolution indicates the lowest AQI values during nights and mornings, and highest AQI values during early afternoon between 13:00 and 16:00

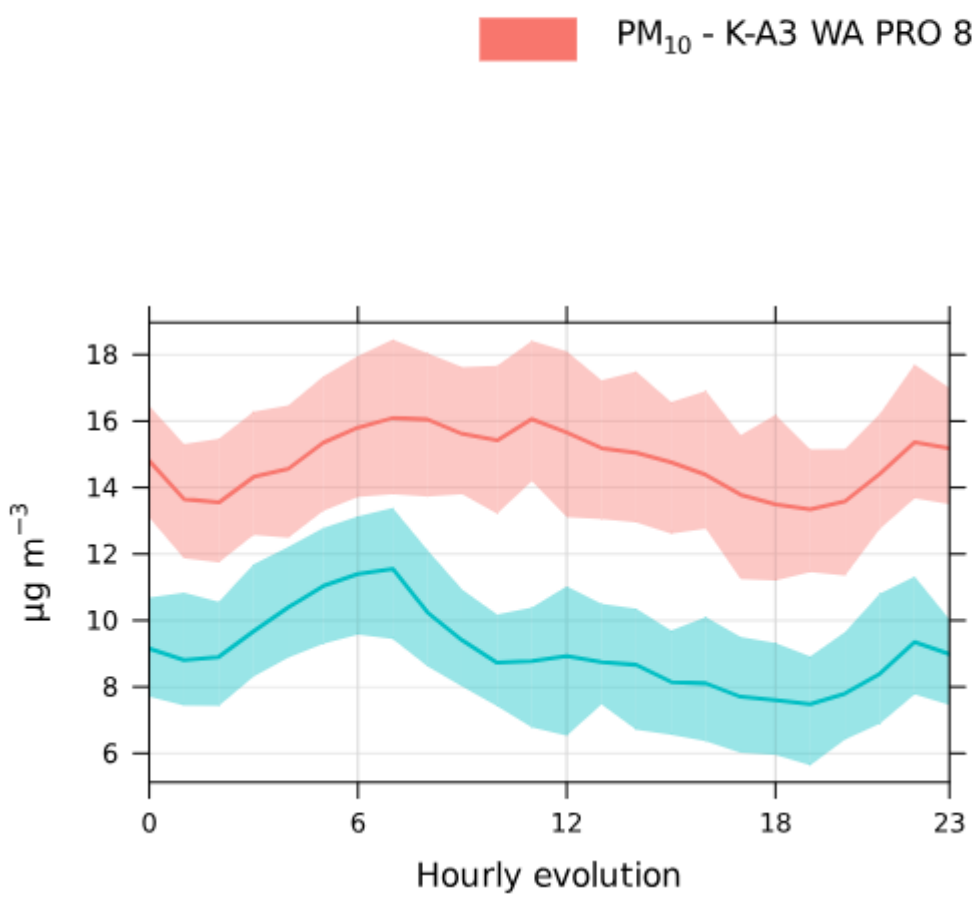
PARTICULATE MATTERS - Time variation - August 1st to August 31st



Aggregated data of the particulates pollutants evolution by days of the week indicates that absolute concentrations were higher on Thursday.

Guideline values
Coarse particulate matter (PM10): 45 µg/ m^3 24-hour mean
Fine particulate matter (PM2.5): 15 µg/ m^3 24-hour mean

PARTICULATE MATTERS - Time variation - August 1st to August 31st



Aggregated data of the particulates pollutants hourly evolution show a moderate levels. PM2.5 and PM10 showed higher concentrations at early morning from 05:00 to 7:00 follow by a second increase from 19:00 to 22:00 These organic compounds can be emitted by both natural sources, such as trees and vegetation, as well as from man-made (anthropogenic) sources, such as industrial processes and motor vehicle exhaust. In this situation, both hypotheses are likely.

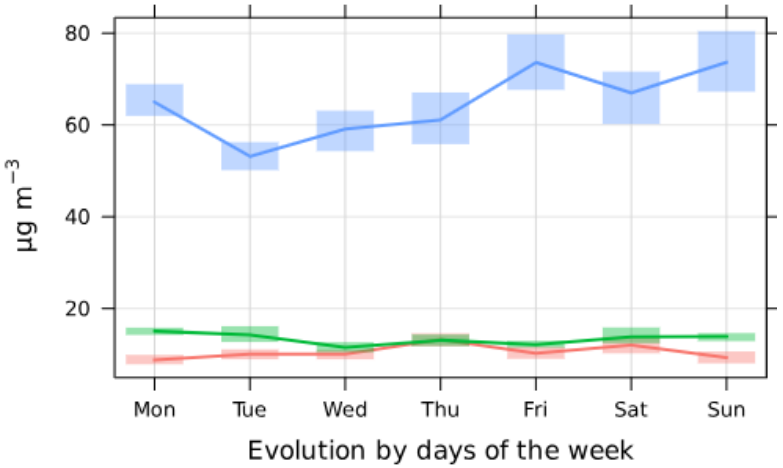
Guideline values
Coarse particulate matter (PM10): 45 µg/ m^3 24-hour mean
Fine particulate matter (PM2.5): 15 µg/ m^3 24-hour mean

GASEOUS POLLUTANTS - Time variation - August 1st to August 31st

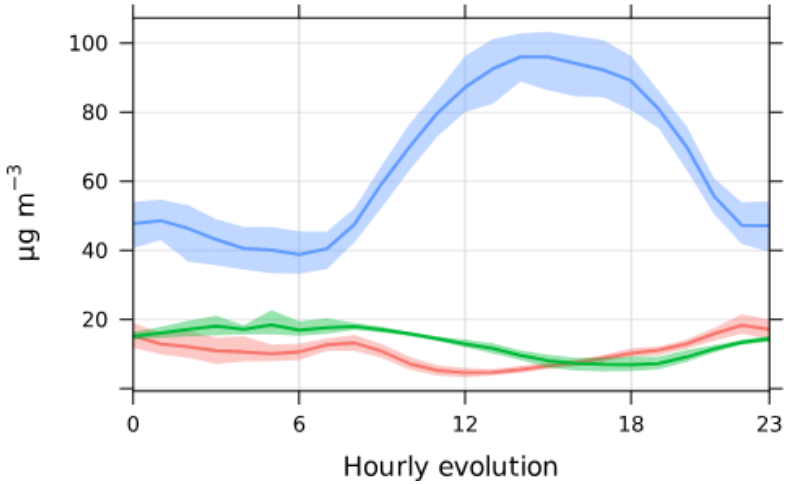
NO_2 GCc - K-A3 WA PRO 8 WARSAW

NO GCc - K-A3 WA PRO 8 WARSAW

O_3 GCc - K-A3 WA PRO 8 WARSAW



Aggregated data of the gaseous pollutants evolution by days of the week indicates that absolute concentrations were relatively low for NO2, NO. 03 shows constant values at a relatively higher levels.

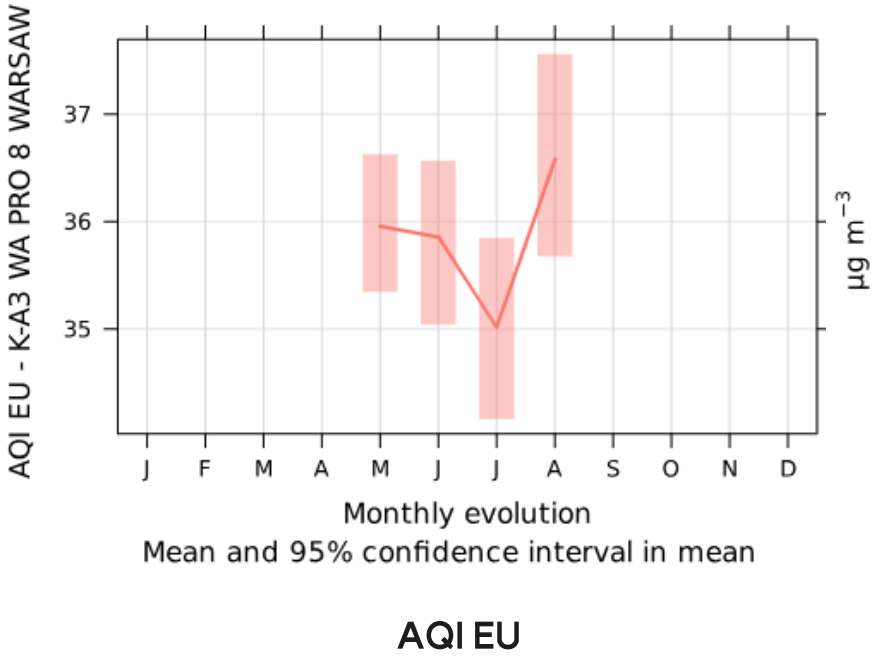


Aggregated data of the gaseous pollutants hourly evolution do not show any typical trends for NO2 and NO suggesting a very low influence of vehicle traffic emissions (morning and evening rush hours) in this location. O3 peaked in the early afternoon between 14:00 and 16:00. Typically, ozone levels reach their peak in mid-afternoon, after exhaust fumes from morning rush hour have had time to react in sunlight.

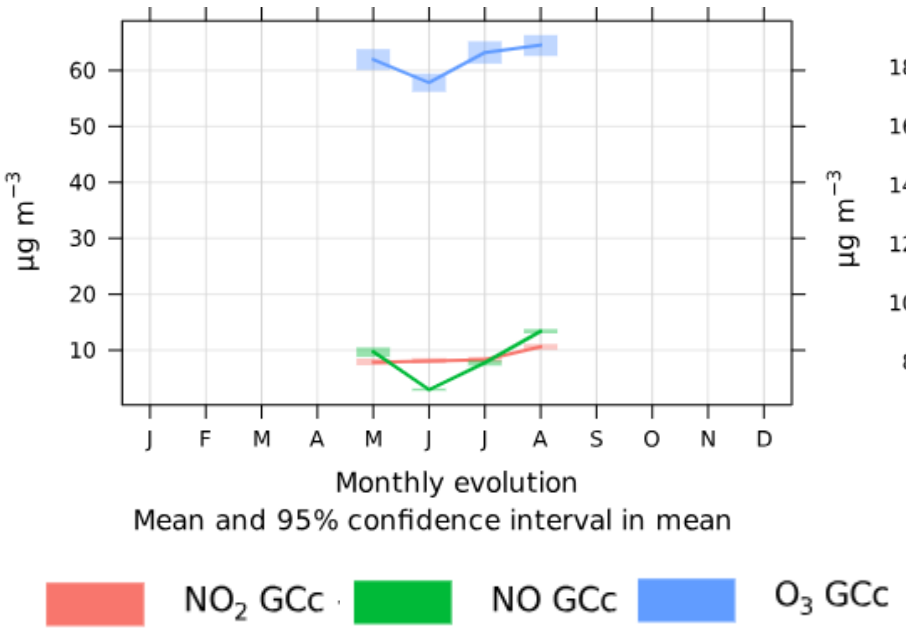
Guideline values NO2
25 µg/m³ (24h)
200 µg/m³ 1-hour mean

Guideline values O_3
100 µg/m³ 8-hour mean

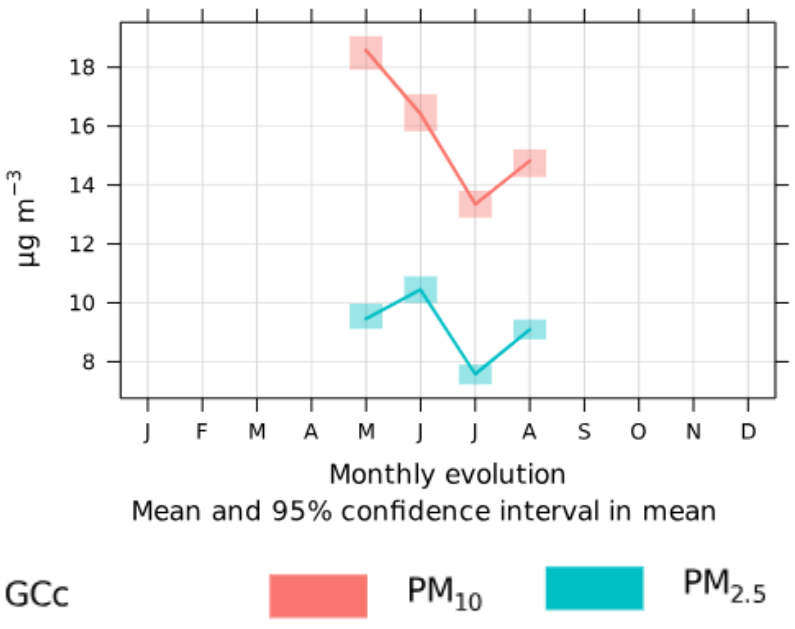
Comparison from May to August



AQI EU



NO_2 GCc NO GCc O_3 GCc



PM_{10} $PM_{2.5}$

CONCLUSIONS

Air Quality Index values recorded during the month of August shows a moderate to poor levels of air pollution. AQI index was largely influenced by Ozone levels.

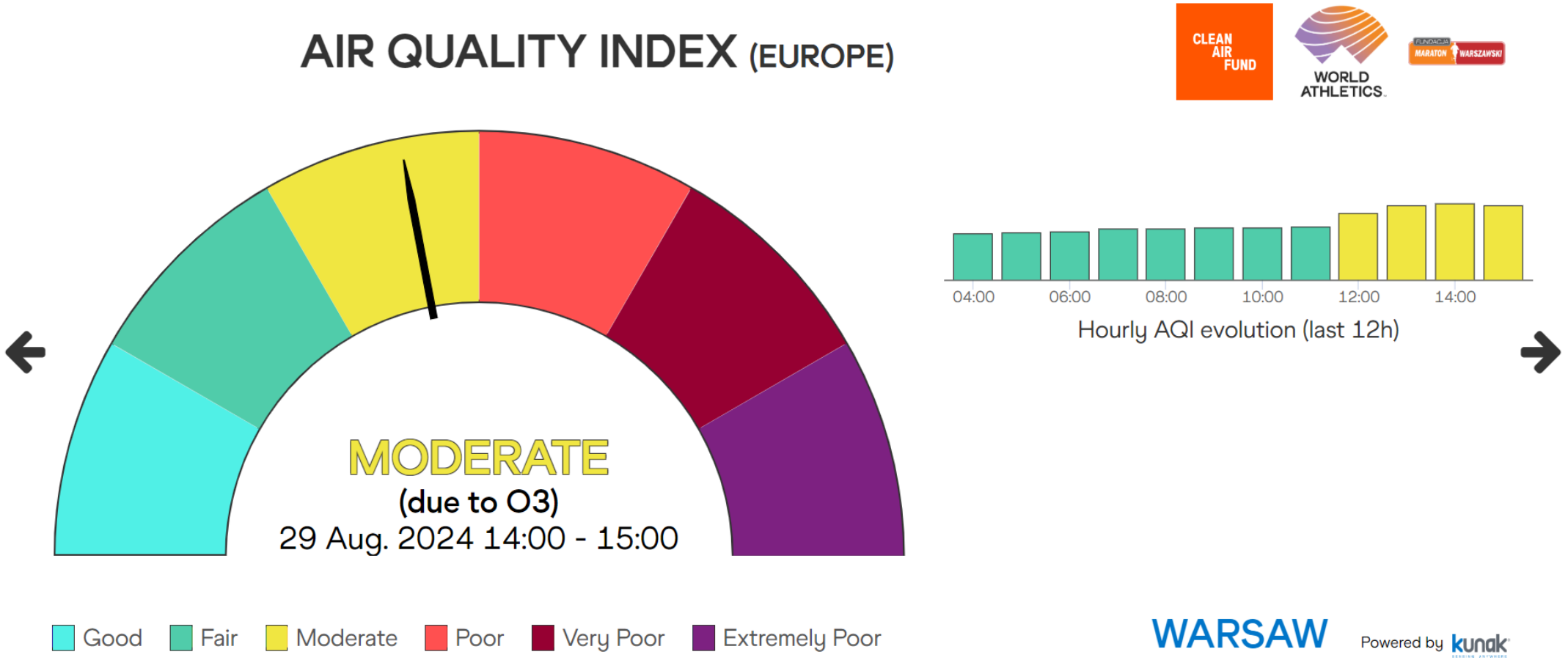
WBGT index during this period was important for 8 days and acceptable the rest of the month and did not represent a significant level of heat stress for training athletes.

Aggregated data of the gaseous pollutants hourly evolution for NO2 and NO do not show any typical trends suggesting a very low influence of vehicle traffic emissions (morning and evening rush hours) in this location. **Ozone** levels reached their peak in the early/mid-afternoon, after exhaust fumes from morning rush hours have had time to react to the sunlight. Ozone levels continue to rise this month compared with previous months.

Aggregated data of the particulates pollutants hourly evolution show a moderate to poor levels. PM2.5 and PM10 showed higher concentrations at early morning, These organic compounds can be emitted by both natural sources, such as trees and vegetation, as well as from man-made (anthropogenic) sources, such as industrial processes and motor vehicle exhaust. In this situation, both hypotheses are likely.

AQI level is worsened compared with previous months.

Appendix


AIR QUALITY INDEX (EUROPE)
MODERATE
(due to O3)
29 Aug. 2024 14:00 - 15:00
Good
Fair
Moderate
Poor
Very Poor
Extremely Poor
04:00
06:00
08:00
10:00
12:00
14:00
Hourly AQI evolution (last 12h)
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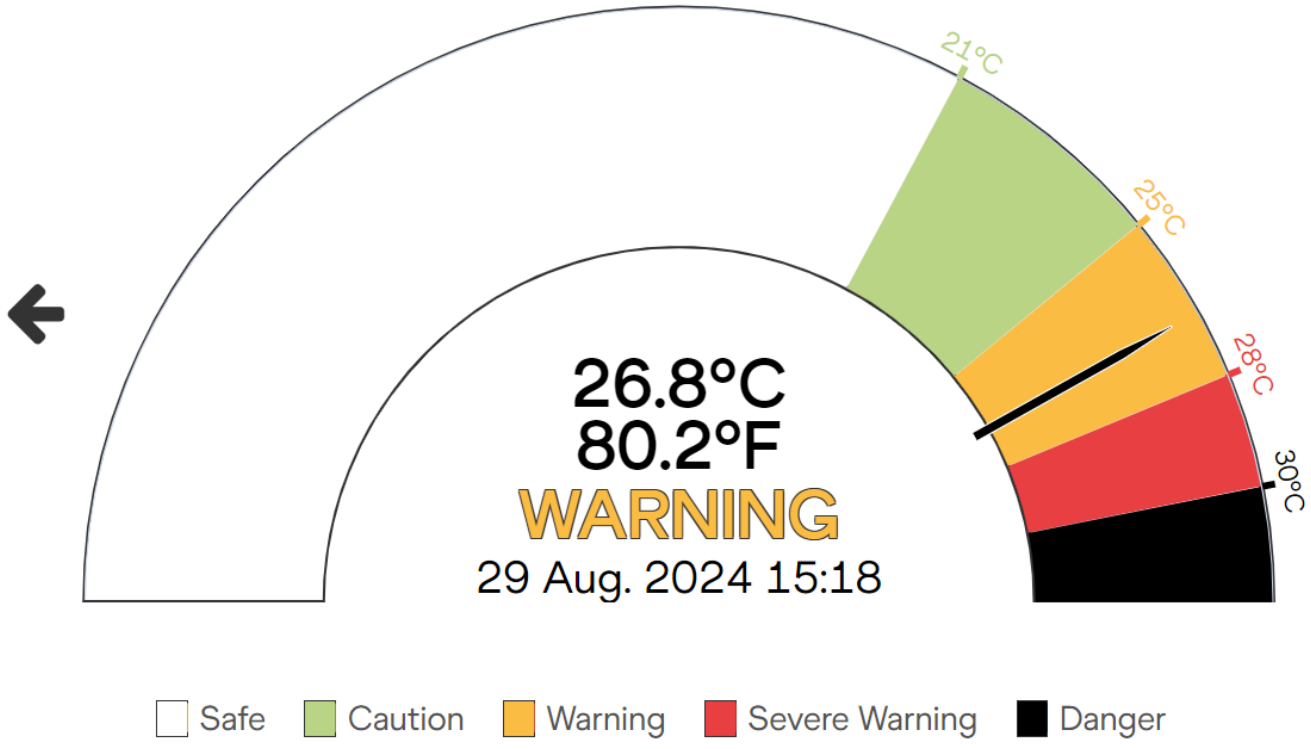
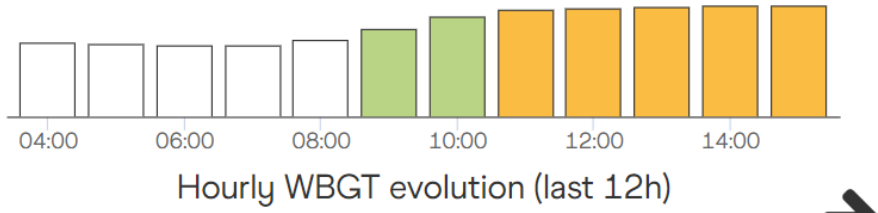
Appendix

HEAT STRESS INDEX
WET BULB GLOBE TEMPERATURE





Air Temperature 33.7 °C / 92.7 °F

Relative Humidity 36.1 %

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Contact: healthandscience@worldathletics.org