ENVIRONMENTAL REPORT

LAGOS 2025: DYNAMIC MONITORING

WORLD ATHLETICS™

INTRODUCTION

This report summarizes data from dynamic monitoring during the **Access Bank Lagos Marathon 2025**.

The dynamic monitoring was part of a six-month long project called Running for Clean Air. Running for Clean Air is a World Athletics initiative funded by the Clean Air Fund. By integrating air quality monitoring and public awareness campaigns into road running events, the initiative seeks to make clean air a priority for city governments, event organisers, and the public, ultimately contributing to healthier urban environments and better conditions for physical activity.

World Athletics has been monitoring air quality at a fixed location in Lagos, Nigeria, for 6 months prior to the city marathon. Findings from this static monitoring can be found on the project's website. Thanks to these long-term and solid datasets, the local community is equipped with strong arguments when communicating the health benefits of clean air.

This report focuses solely on the results of the dynamic monitoring.

DYNAMIC REPORTING

Dynamic monitoring was conducted in Nigeria's largest city during its major running event. The Access Bank Lagos City Marathon took place on February 15th, 2025. The same air quality sensor, which was used for the static monitoring during the preceding six months, was mounted on a bike and took around the race course.

The starting point was the National stadium Surulere and the finishing point Eko Atlantic City on Victoria Island. Thanks to a high sampling frequency, the data was collected every ten seconds and allowed for a continuous route mapping.

DISCLAIMER

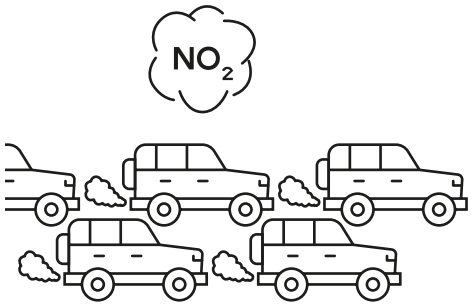
The data presented in this report is collected with sensor technologies which are not regulatory-grade instrumentation following Directive 2008/50/EC. Therefore, the results presented should be considered as informative and not be used for regulatory compliance checking purposes. Any communication of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

CONTENTS

MAIN POLLUTANTS MEASURED

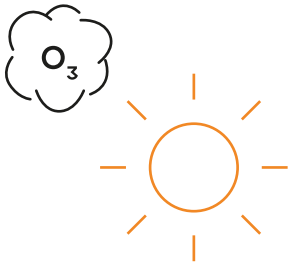
The sensor used in Lagos was Kunak Air Pro. Besides the described pollutants, it also measures climate-related data, such as humidity, temperature, dew point, wind direction, and wet globe bulb temperature.

The sensor-systems details and specifications can be downloaded from the manufacturer's website. More methodological details are published by Ribalta et al., 2024.



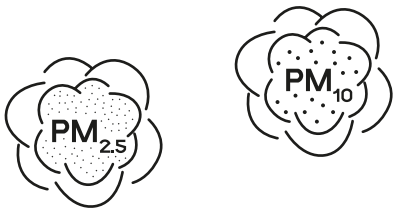
Nitrogen Dioxide

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



Ozone

Ground-level ozone is created by chemical reactions between NO_x gases (oxides of nitrogen produced by combustion) and volatile organic compounds in the presence of sunlight



Particulate matter

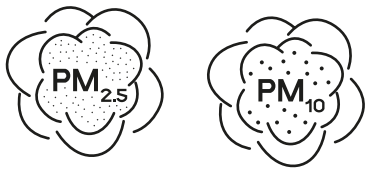
Mixture of solid particles and liquid droplets found in the air. Some are emitted directly from a source, such as heating in residential, construction sites, unpaved roads, fields, smokestacks, fires or transported by the wind

EUROPEAN AIR QUALITY INDEX

The European Air Quality Index (AQI) was used to aggregate the individual measured values of O_3, NO_2, NO, PM_{10} and $PM_{2.5}$.

Gaseous pollutants

Particulate Matter



EUROPEAN AIR QUALITY INDEX

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 exporsures.

POOR
76-100

Effects can be immediatlely 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 AIR QUALITY INDEX

AQI varies from “good” to “extremely poor”, based on the poorest level of any of the five pollutants.

A simplified AQI supplied with the Kunak device is based on this table, including 4 pollutants without sulphur dioxide (SO_2).

Level index

(based on pollutant concentrations in µg/m^3)

	GOOD 0-25	FAIR 26-50	MODERATE 51-75	POOR 76-100	VERY POOR 101-125	EXTREMELY POOR 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

DYNAMIC MONITORING METHODOLOGY

MEASUREMENT PERFORMED

Temperature and Humidity

Gas sensors (ug/m^3): NO, NO_2, O_3

Particulate Matter sensor (ug/m^3): $PM_{2.5}$, PM_{10}

GPS Positioning

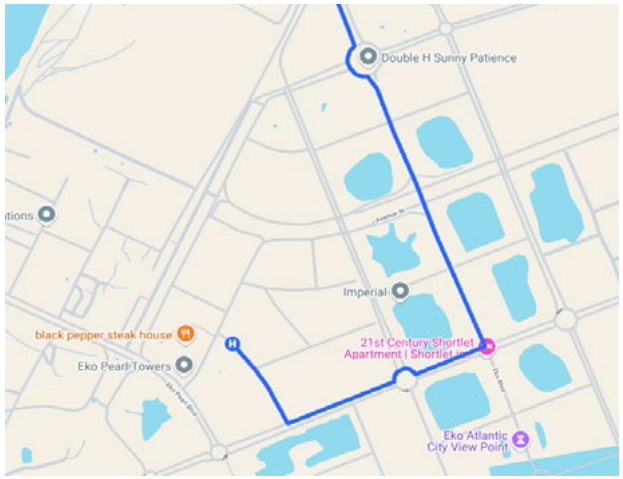
RACEDAY 15/02/2025
Start time: 06:30 - Cut off: 12:30

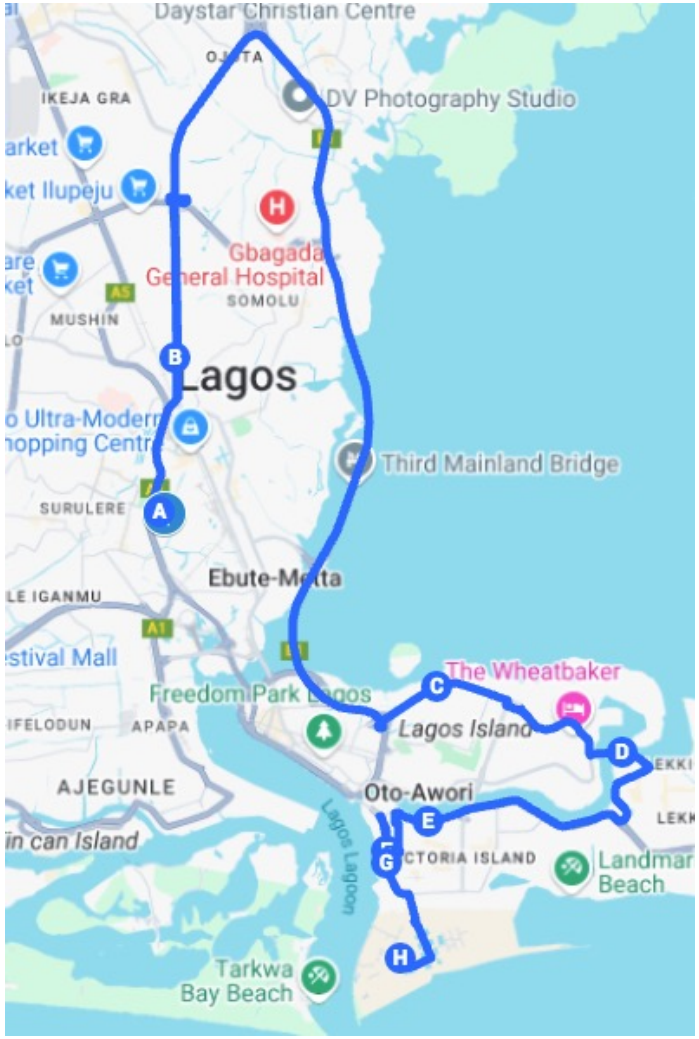
The device is installed on a bike, following the female elite runners and the itinerary of the racecourse at a constant speed.

RACECOURSE

START

FINISH



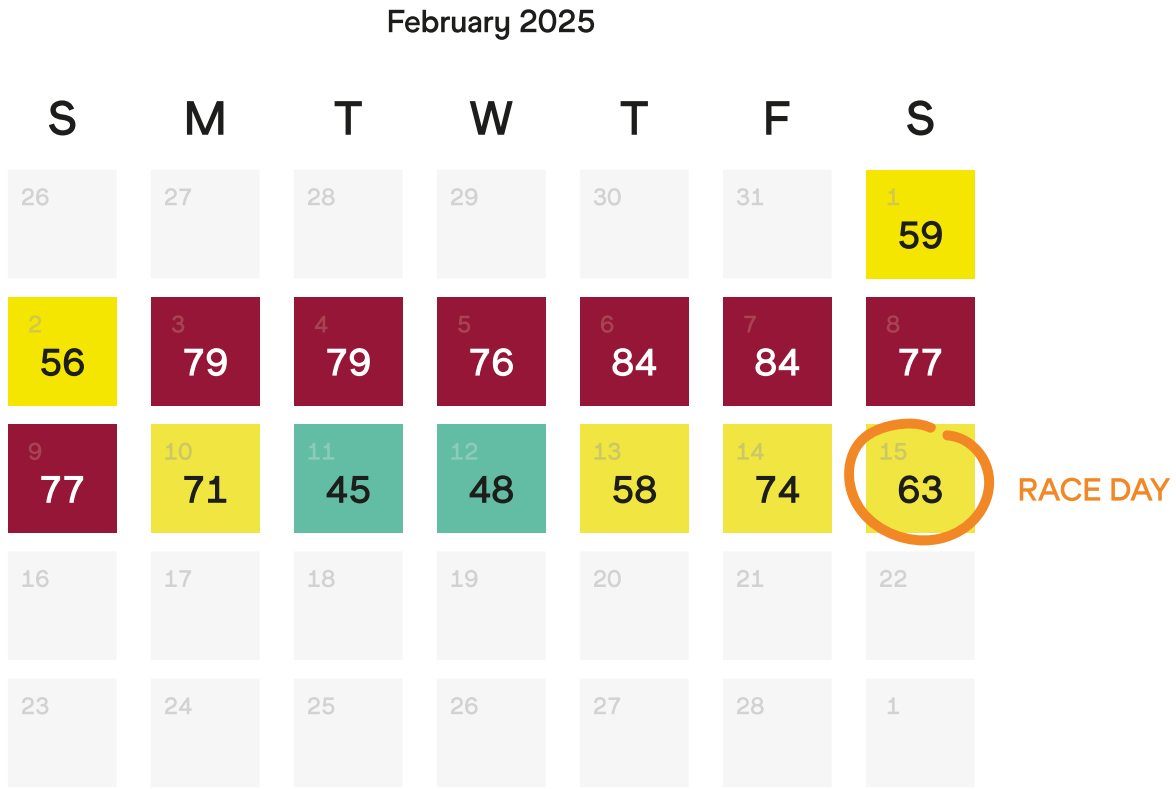


RACE DAY DYNAMIC MONITORING 15/02/2025

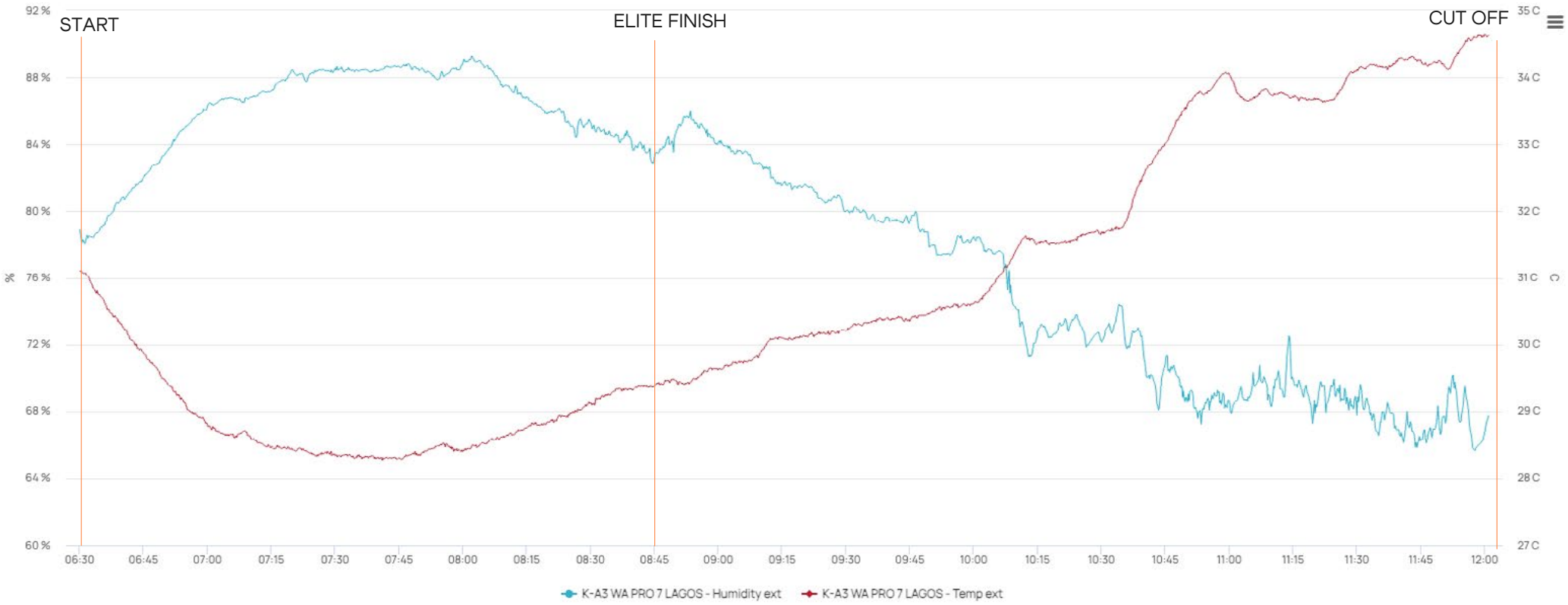
EUROPEAN AIR QUALITY INDEX IN LAGOS FEBRUARY

The calendar plot indicates the AQI for each monitoring day in February 2025, helping us to have a first glimpse of the conditions for each day. The AQI measured in February shows a moderate to poor air quality. The AQI measured on the race day was 63 and was mostly influenced by particulates matters PM_{10}.

EXTREMELY POOR 126-200
VERY POOR 101-125
POOR 76-100
MODERATE 51-75
FAIR 26-50
GOOD 0-25



TEMPERATURE & HUMIDITY



The temperature during the event was very high and represented a significant level of heat stress for athletes.

Temperature at start: 31.1°C

Temperature at cut off: 34.6°C

HEATMAPS

The data collected during the dynamic monitoring enabled effective visual analysis of the marathon course. Heatmaps were plotted to identify pollution hotspots linked to the design of the racecourse (e.g., street canyons, vicinity of major roads, etc.).

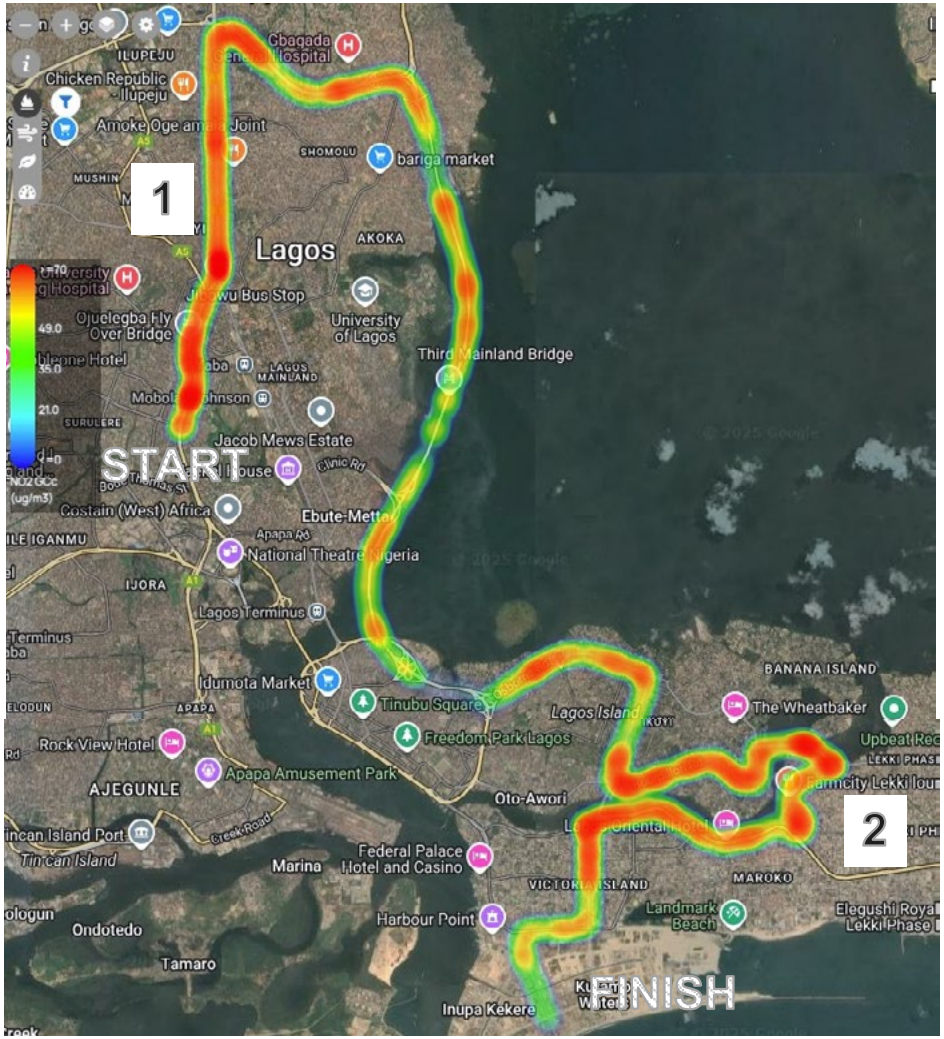
Our heatmaps show the intensity of values of PM_{10} and NO_2. The reason to create heatmaps with these two pollutants is because they are typical of situations we may encounter in urban environments. Particulate matter is primarily emitted by combustion sources, such as vehicles, diesel engines, and industrial facilities. It can also be generated from construction sites, unpaved roads, fires, smokestacks, and wood stoves, or agricultural operations. Short-term exposures to PM_{10} have been associated primarily with worsening of respiratory diseases, including asthma and chronic obstructive pulmonary diseases. NO_2 is a traffic-related air pollutant and its association with cardiovascular and respiratory mortality following short-term exposure.

HEATMAP NO_2

The levels observed for NO_2 follow the pattern of traffic emissions. The data shows moderate level of concentration. The highest NO_2 concentration was observed at the beginning of the recording and at the western part of the route (Area 1 & 2) probably caused by main roads intersection, greater presence of traffic and an urban canyon effect with much narrower streets.

The area between these two more polluted section is a 11.8km long bridge where the traffic was closed completely. Along the rest of the racecourse, the traffic always remained opened in the runners' opposite direction.

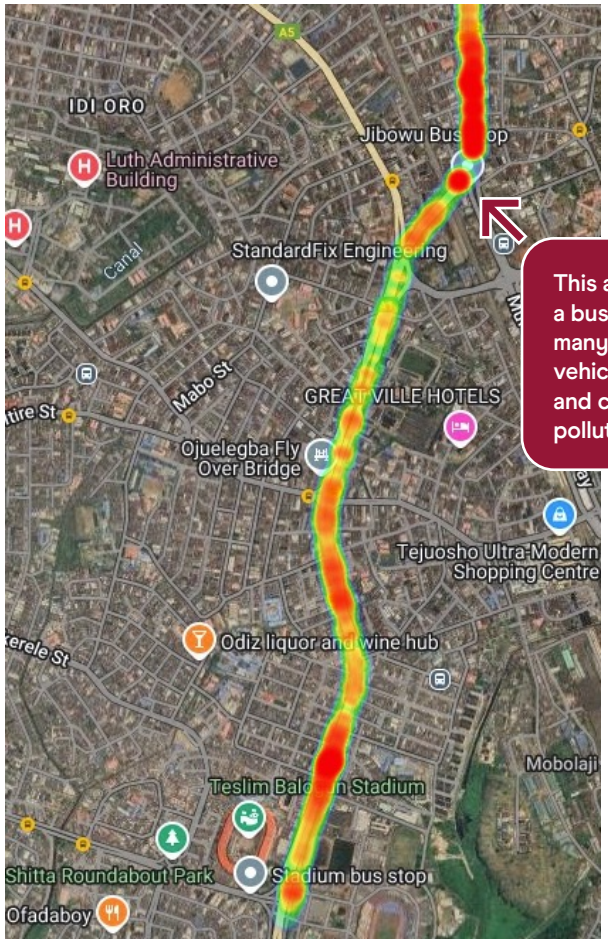
Similarly, the area around the finish line appears in greener tones because it has less or zero cars (it is a restricted residential area).



Guideline values NO_2
25 µg/m³ (24h)
200 µg/m³ 1-hour mean

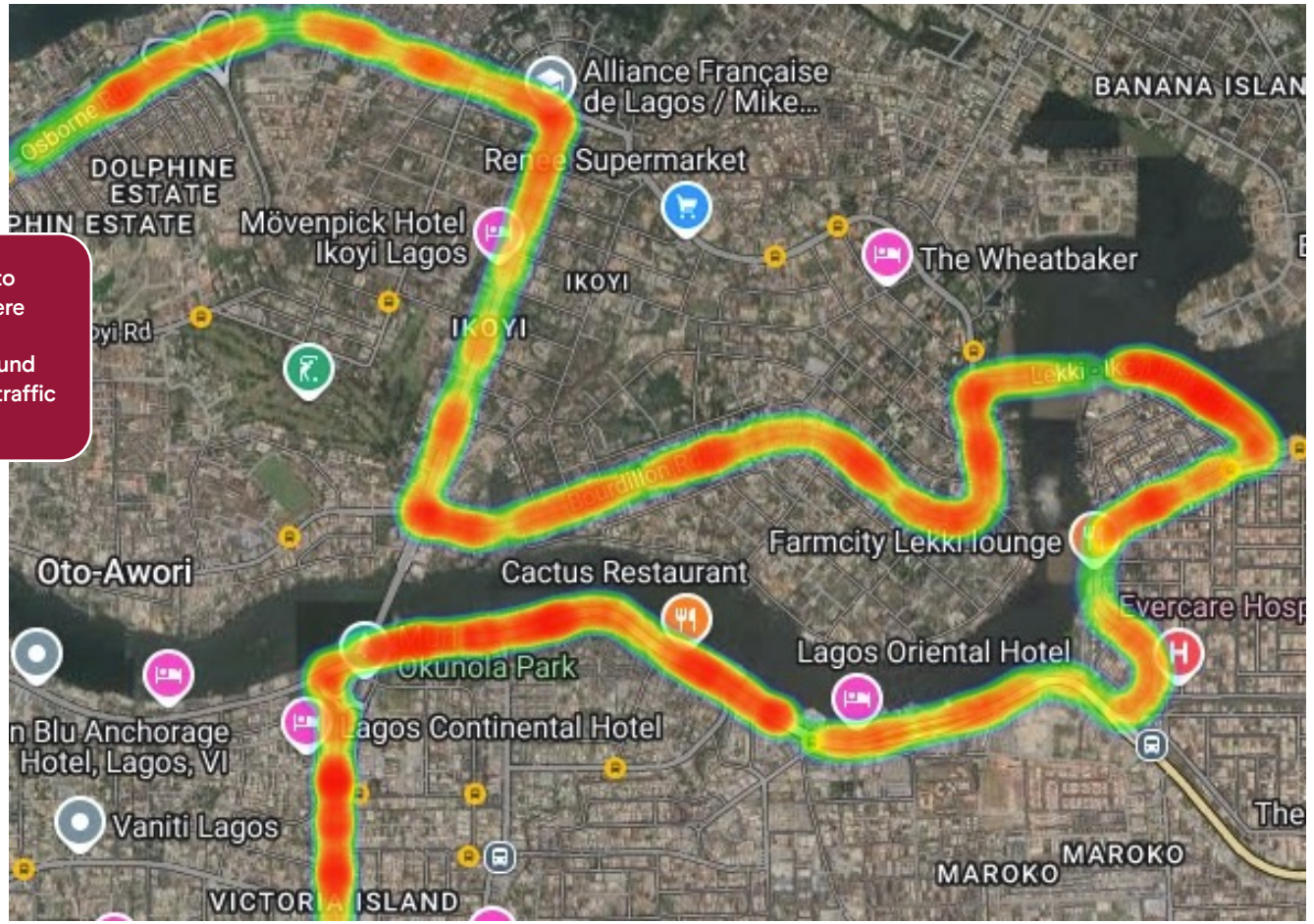
AREAS MOST AFFECTED BY NO_2

AREA 1



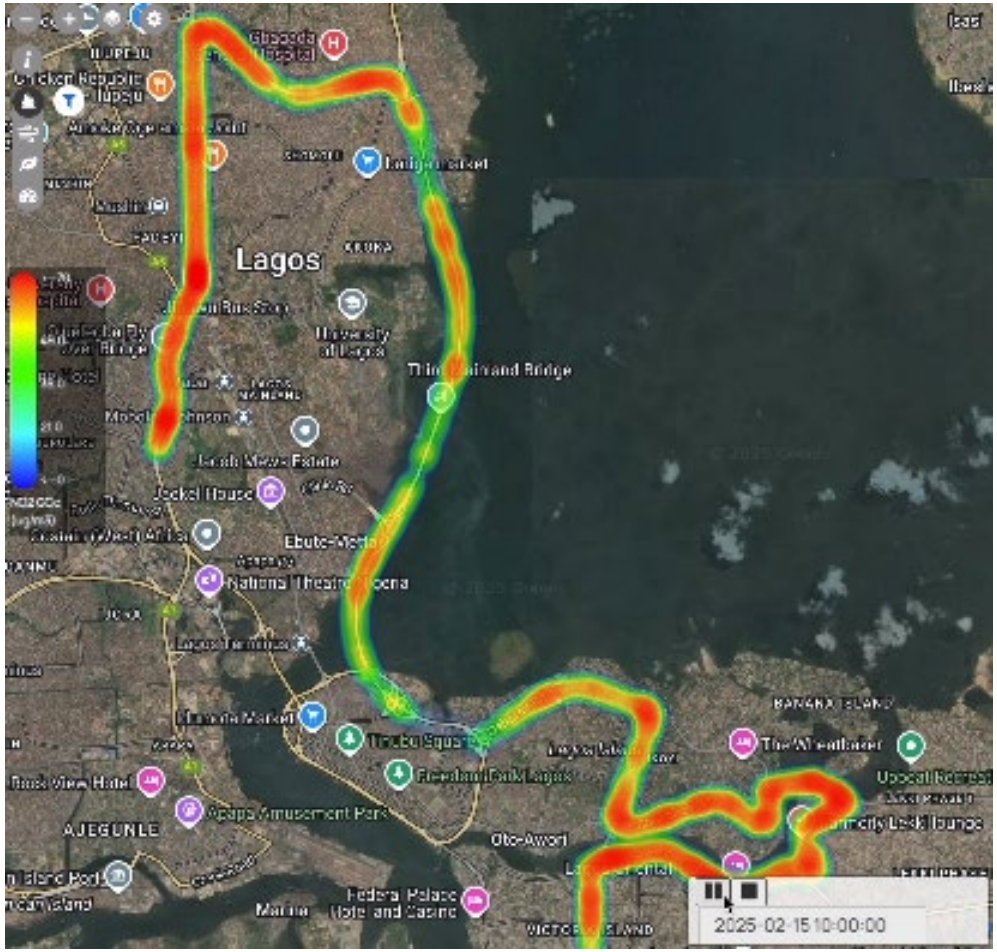
This area is close to a bus terminal where many commercial vehicles move around and cause higher traffic pollution.

AREA 2



HEATMAP VIDEO BY NO_2

Click on the image below to play the video.



HEATMAP PARTICULATE MATTER (PM_{10})

The levels of PM_{10} measured show important concentration. The highest concentration of PM_{10} were observed at the beginning of the monitoring (Area 1) and in Areas 2 & 3.

This could be explained by dust from construction sites, landfills and agriculture, pollen, industrial sources and cooking over an open fire. PM_{10} exposures in many fast-developing cities are often far higher than in developed cities of comparable size.

Area 2 is where runners noticed a lot of smoke, most likely caused by a local fish-smoking community.

Area 3 has a lot of ongoing construction and it is also known for a bad waste-management with a lot of rubbish lying around.

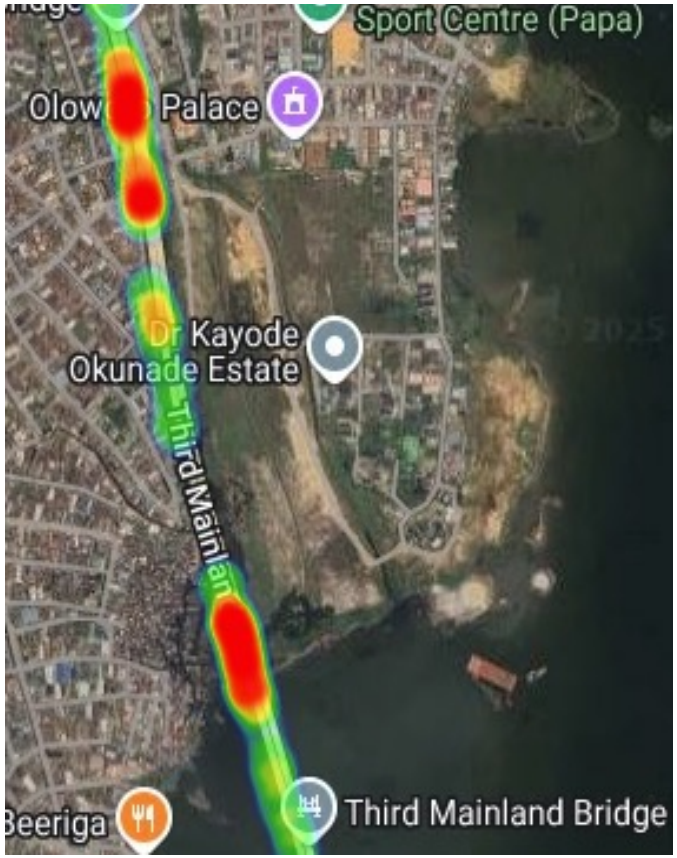
The final section shows a more positive situation. This area is empty of industrial buildings, consists mainly of skyscrapers and office buildings, houses are more spread out, and there are more trees.

Guideline values PM_{10}
Coarse particulate matter
(PM10): 45 µg/ m^3 24-hour mean

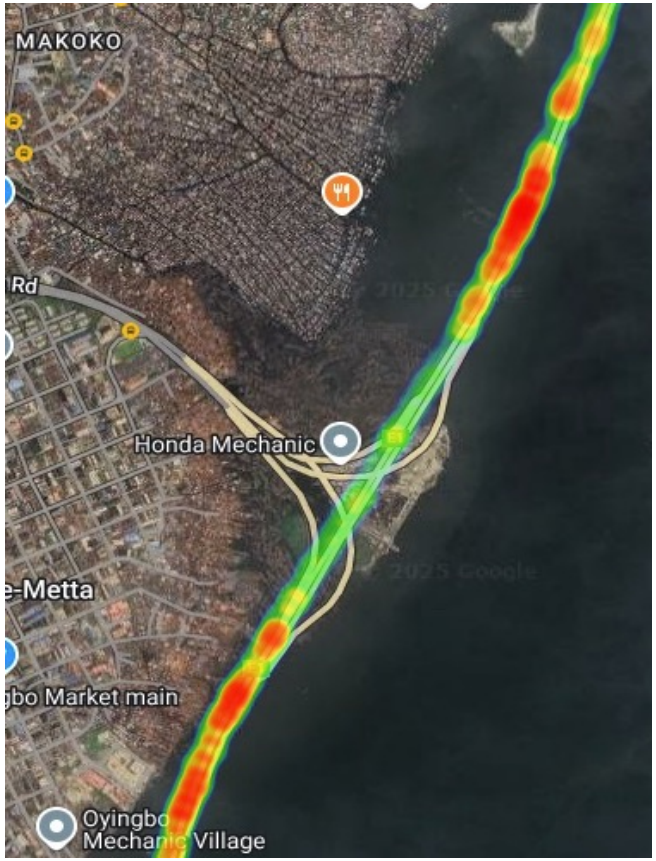
AREAS MOST AFFECTED BY PM_{10}

AREA 1

AREA 2



AREA 3



HEATMAP VIDEO BY PM_{10}

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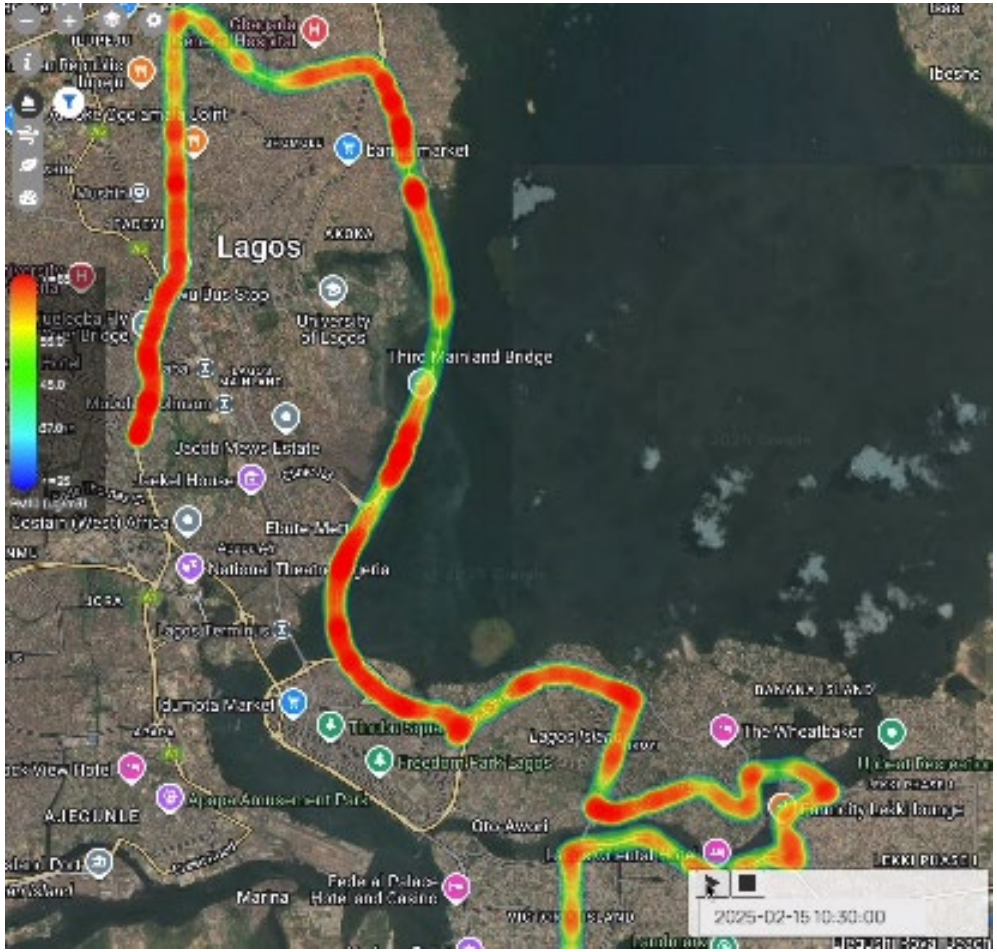

OZONE

Guideline values for O_3
100 µg/ m^3 8-hour mean

An increase of the concentration with the advance of the day was observed. The maximum values near 80 µg/ m^3 are lower than the limit values from WHO.

Ground-level ozone is one of the main components of photochemical smog. It is formed by the reaction with sunlight (photochemical reaction) of pollutants such as nitrogen oxides (NO_x) from vehicle and industrial emissions and volatile organic compounds (VOCs) emitted by vehicles, solvents and industry. As a result, the highest levels of ozone pollution occur during periods of sunny weather. Excess ozone in the air can have a marked effect on human health. It can cause respiratory problems, trigger asthma, reduce lung function and lead to lung disease.

CONCLUSION

Findings from this report can be used by:

- runners to understand the conditions of the race they participated in
- race organizers to include them into decision-making of the future race routes
- city government to have insights into the most polluted areas of their city and take action there

1. The AQI measured on the race day was moderate and was mostly influenced by particulates matters PM_{10}.
2. The temperature during the event was very high and represented a significant level of heat stress for athletes.
3. The levels observed for NO_2 are influenced by traffic emissions. The data shows a moderate level of concentration. The highest NO_2 concentration was observed at the beginning of the recording and at the western part of the route probably caused by main roads intersection, greater presence of traffic and an urban canyon. Thanks to effective traffic restrictions the finish line area is less impacted.
4. The levels of PM_{10} measured show a significant concentration. The highest peaks were observed at the beginning of the monitoring. The nature of the soil (dusty or sandy near parks); human activity (smoke, most likely caused by a local fish-smoking community; ongoing construction; bad waste-management) or factories close to the marathon route may cause an increased levels of exposure to air pollution.
5. The ozone levels recorded in the morning did not really affect the athletes because of the early start to the race.

healthandscience@worldathletics.org
www.worldathletics.org
@WorldAthletics

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6-8, Quai Antoine 1er, BP 359
MC 98007
Monaco Cedex