Climate service for air pollution (PM2.5)

Abidjan, Côte d'Ivoire

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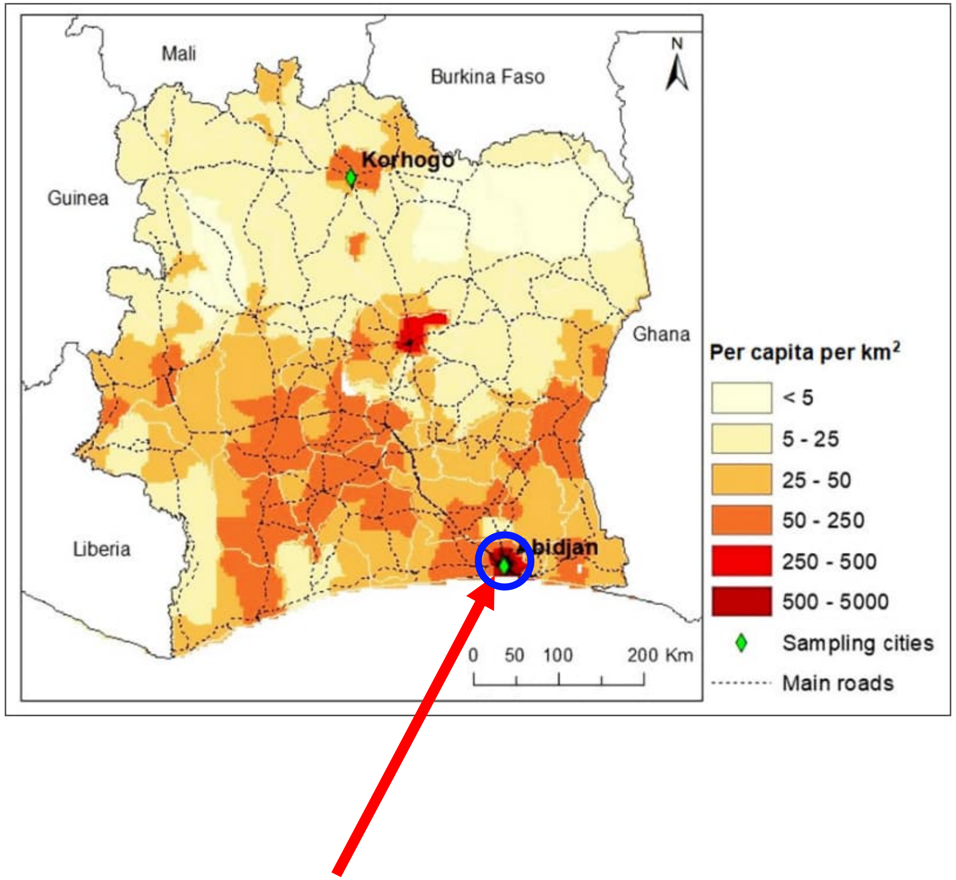
kadi-project.eu

Introduction

- Abidjan : Economic capital of C.I.
- Demographic surge : 6.5M residents (2.43% annual growth)
- Economic dominance : 60% of national GDP concentrated in 0.7% of land (2,119/322,462 sq km)



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Introduction

Abidjan faces several interconnected climate stressors and associated risks that threaten its environmental, economic, and public health stability.

Key climate stressors in Abidjan (1/2) :

- **Temperature rise and extreme heat** of 0.5°C - 0.8°C, between 1970 and 2000 (*World Bank. 2021*)

- **Rainfall variability and flooding**. As example, in June 2022, torrential rains displaced 2,418 people and affected 11,478 in Abidjan, damaging homes and infrastructure.

- **Sea-level rise and coastal erosion.** 30 cm sea-level rise by 2050 (*World Bank. 2021*)

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Introduction

- Key climate stressors in Abidjan (2/2) :

  - **Water scarcity and quality degradation**. 47% of urban residents rely on informal sources, with women in areas like Abobo spending hours fetching water.

  - **Air pollution (PM2.5) and health risks** (*Djossou et al., 2018*)

In Abidjan, the economic capital of Côte d'Ivoire, in September 2016. ISSOUF SANOGO / AFP

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Introduction : Hazards and occourence

Hazard	Timing	High-risk locations	Key drivers
Flooding	Apr–Oct (rainy season)	Abobo, Cocody, coastal slums	Poor drainage, waste dumping, storms
Coastal erosion	Chronic, accelerating	Port areas, Greater Bassam	Sea-level rise, storm surges
Water scarcity	Year-round (dry season peaks)	Informal settlements, coastal aquifers	Rainfall decline, urbanization, salt intrusion
PM2.5 pollution	Dec–Feb (dry season); daily cooking	Traffic zones, waste sites, homes	Traffic, biomass burning, waste incineration

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Introduction : Vulnerable groups and risk drivers

Group	Key risk drivers	Health outcomes	Source location
Children <5	Biomass cooking, waste burning proximity	Pneumonia, stunted lung development	Yopougon Andokoi
Women fish smokers	Firewood combustion, confined workspaces	Respiratory infections	Lubafrique market
Taxi drivers	Traffic emissions, long working hours	Cardiovascular disease, lung cancer	Abidjan transit corridor
Waste pickers	Open burning, heavy metal inhalation	Toxicity, infections	Akouédo dump
Elder urban poor	Cumulative exposure, limited healthcare access	Desease exacerbation, premature mortality	Informal settlements

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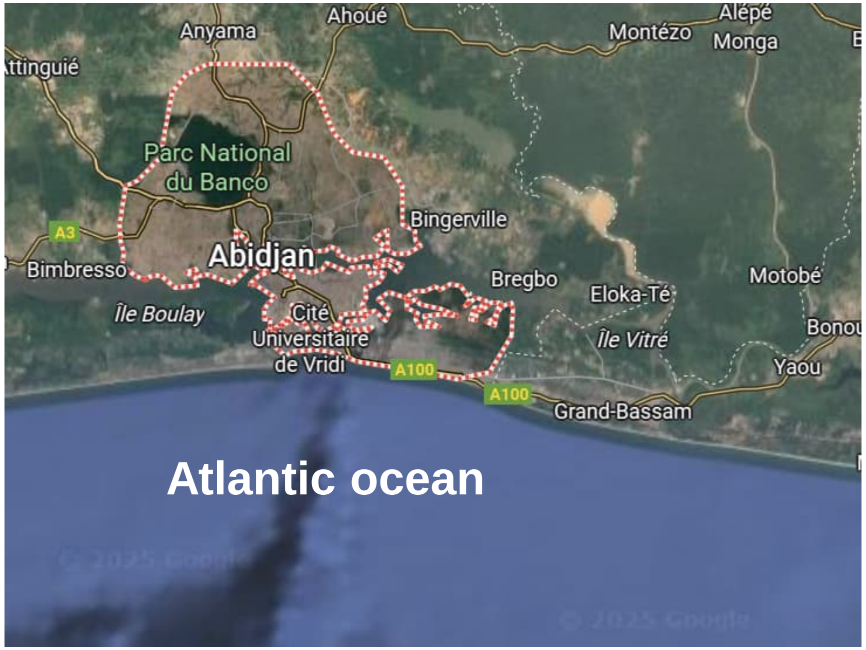
Introduction : Geographical context

1. Geographic and climatic setting

- Coastal location and topography : Along the Gulf of Guinea characterized by coastal lagoons and a humid equatorial climate, proximity to the Atlantic ocean influences aerosols dispersion and trap pollutants due to high RH and temp. inversion.

- Urban morphology: Rapid urbanization has expanded informal settlements (Yopougon, Abobo) into industrial zones and near waste sites, creating localized hotspots. Traffic and landfills exacerbate exposure disparities *(Gnamien at al., 2021).*



Google map, access &a&²on 08/08/2025

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Introduction : Geographical context

2. Seasonal air pollution dynamics

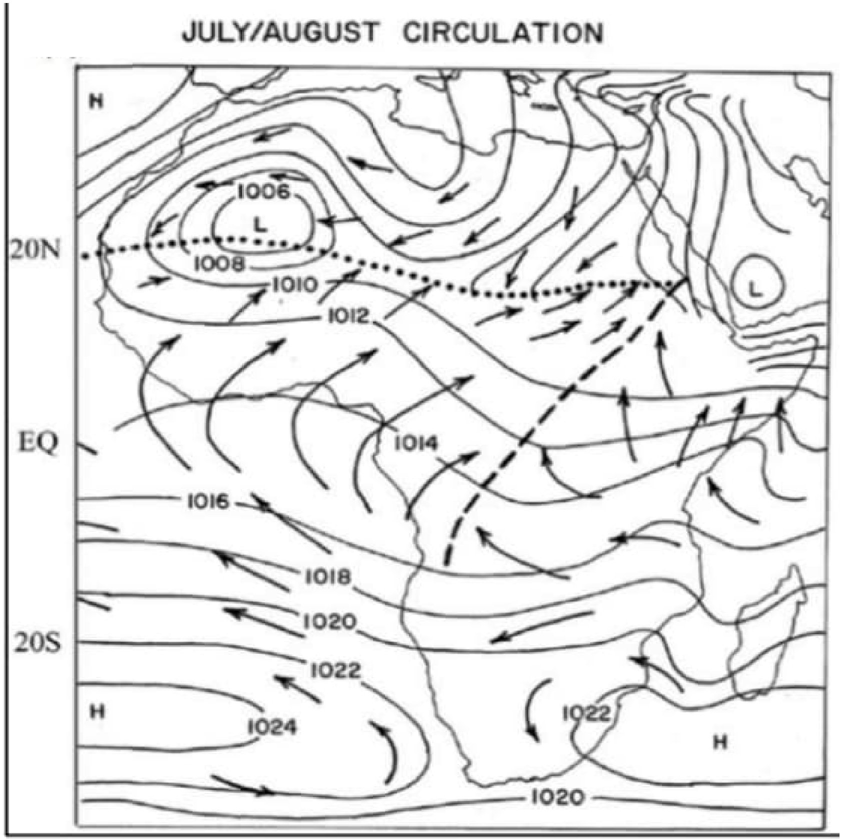
- Harmattan influence (Dec-Feb) :

Northeasterly winds transport Saharan dust, increasing PM2.5 by 40–60%. Annual averages (26 µg/m³) peak at 50 µg/m³ during this period, exceeding WHO guidelines by 5–8x (*Gnamien et al., 2021*).

- Rainy season (Apr-Jul, Oct-Nov) :

Reduced PM2.5 due to wet deposition, but stagnant air in October traps local emissions (traffic, waste burning), causing short-term spikes (*Bahino et al., 2024*)

- Diurnal variability : Morning traffic emissions (e.g., two-wheel vehicles) peak at 50 µg/m³; evening residential burning (biomass cooking) sustains elevated levels overnight (*Bahino et al., 2024*)



Nicholson, 2011

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Introduction : Socio-economic, environmental, and cultural characteritics

1. Social & health vulnerabilities

- High-risk groups : Children in informal settlements (e.g., Yopougon) exhibit 72.4% lung impairment due to PM2.5 exposure near waste-burning sites. Women in informal sectors (e.g., fish smokers) face high levels of PM2.5 during cooking.

- Awarness gaps : Only 27% of residents link pollution to health risks, necessitating community-led awareness programs *(Gnamien at al., 2021).*

(GET *website, 2020*)

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Introduction : Socio-economic, environmental, and cultural characteritics

2. Economic & infrastructure barriers

- Informal economy dominance: Traffic emissions stem from aged vehicle fleets (avg. 20 years) and adulterated fuels. Waste burning is prevalent due to inadequate municipal collection.
- Energy poverty: >80% of low-income households use biomass fuels, contributing to 30% of PM2.5 emissions.
- Funding gaps: Limited maintenance budgets hinder sensor network sustainability despite low-cost options (e.g., RAMP monitors).

Abidjan.net website

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Introduction : Socio-economic, environmental, and cultural characteritics

3. Environmental & cultural drivers

- Emission sources :Traffic, domestic Fires, waste burning (near dumps).
- Cultural practices: Open waste burning and biomass cooking are entrenched due to tradition and lack of alternatives. Gender roles increase women's exposure during cooking

Bahino et al., 2018

Introduction : Socio-economic, environmental, and cultural characteritics

4. Governance & equity challenges

- Policy fragmentation: Air quality management is split across ministries (Environment, Transport, Health), weakening enforcement.
- Spatial inequality: Low-income areas endure PM2.5 levels 4–8× higher than affluent neighborhoods.
- Gender & youth exclusion: Women/youth are underrepresented in decision-making despite high exposure risks.

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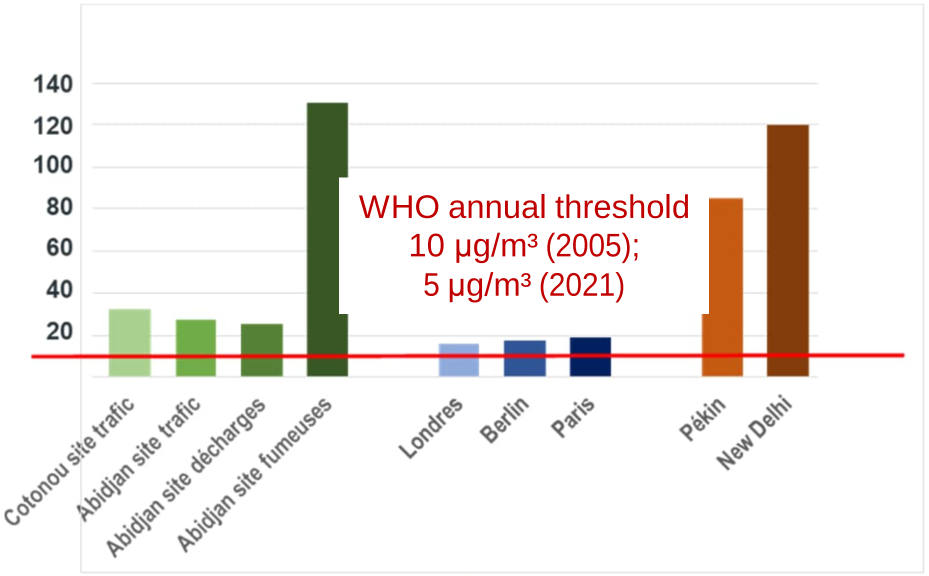
Climate Service in Abidjan : Objectives

Main objective of the Abidjan pilot project : Design a warning system for fine PM2.5 pollution.

This system will be implemented through :

- a PM2.5 measurement network and
- an effective communication network to inform users when the thresholds prescribed by the WHO are exceeded.



Julien Djossou| LPR UAC 2018

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Climate Service in Abidjan : Data

The project implements a *participatory approach*, involving various stakeholders and the local community:

- Deployment of four low-cost sensors (Félix Houphouët-Boigny University - UFHB, Port-Bouët Airport, Treichville University Hospital, National Institute of Youth and Sports in Marcory).
- Installation of twenty additional low-cost sensors in the Cocody district and the municipality of Bingerville, chosen to represent various standards of living and sources of pollution.
- Use of nearly ten years of historical pollution and meteorological data.
- Measurement of other pollutants for scientific reasons (black carbon, organic carbon, NO_2, SO_2, NH_3, nitrates, nitric acid, ozone)

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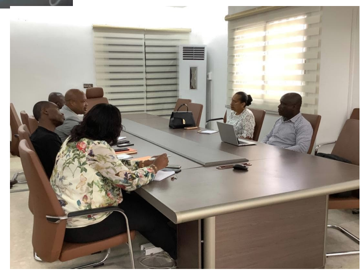
Climate Service in Abidjan : Collaborations

Close collaboration with :

- Population
- Key institutions such as the National Institute of Public Health (INHP) for socio-demographic and health data, the Ivorian Anti-Pollution Center (CIAPOL) for industrial pollution data and communication, and the District of Abidjan for support in extending the project citywide, ...

- Organization of 2 workshops and participatory meetings to discuss needs and gaps (2024 and 2025).
- Participation in multidisciplinary conferences.



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Climate Service in Abidjan : Capacity building

- Organizing events such as the GEIA (Global Emissions Initiative) conference in Abidjan in July 2025, including a training and research school for African researchers and decision-makers.
- Training stakeholders on the use of equipment and data analysis.

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Climate Service in Abidjan : Theory of change

Short term impacts

• Improved quality and coverage of climate and environmental data.

• Better understanding of pollution sources and their dispersion.

• Increased public awareness of pollution risks and reduction measures.

• More informed decision-making by authorities and political leaders.

• Strengthened collaboration and networks between stakeholders, researchers, and decision-makers at the local, national, and international levels.

• Increased local scientific and technical expertise in air quality monitoring and emissions inventories.

• Development of a robust database and data infrastructure related to air quality.

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Climate Service in Abidjan : Theory of change

Long-term impacts

Ultimately, these intermediate results should lead to the following impacts:

- Improved air quality in Abidjan, contributing to the protection of public health.
- Strengthened resilience of urban systems to climate and environmental shocks.
- Behavioral change among the population to adapt to and reduce pollution.
- More effective evaluation of pollutant emission reduction policies and adaptation of strategies based on trends.
- Contribution to the design and implementation of a sustainable pan-African research infrastructure for climate services.
- Support for sustainable energy policies and evidence-based strategies.
- Strengthening Africa's voice in international climate negotiations through locally produced scientific evidence.

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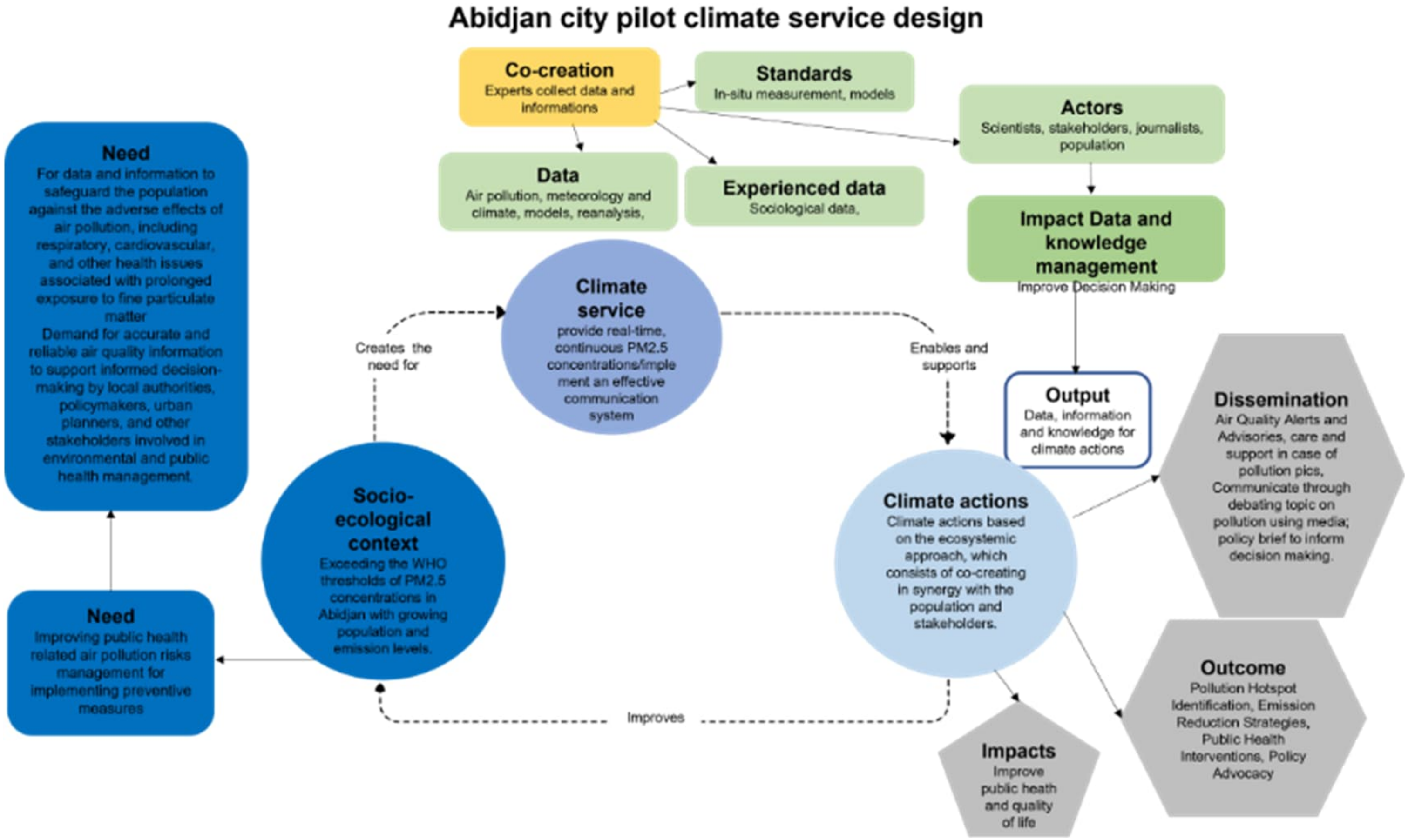
Highlights of the results : Abidjan system map



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Highlights of the results : Some measurement instruments

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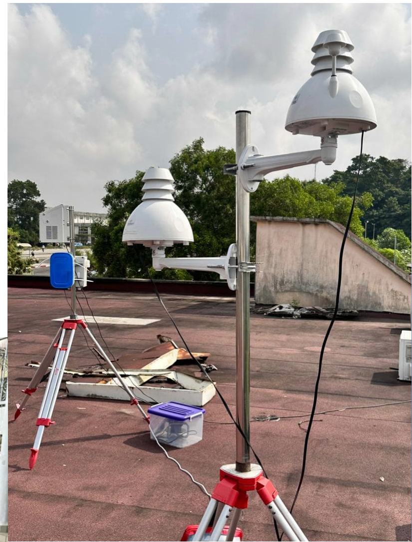
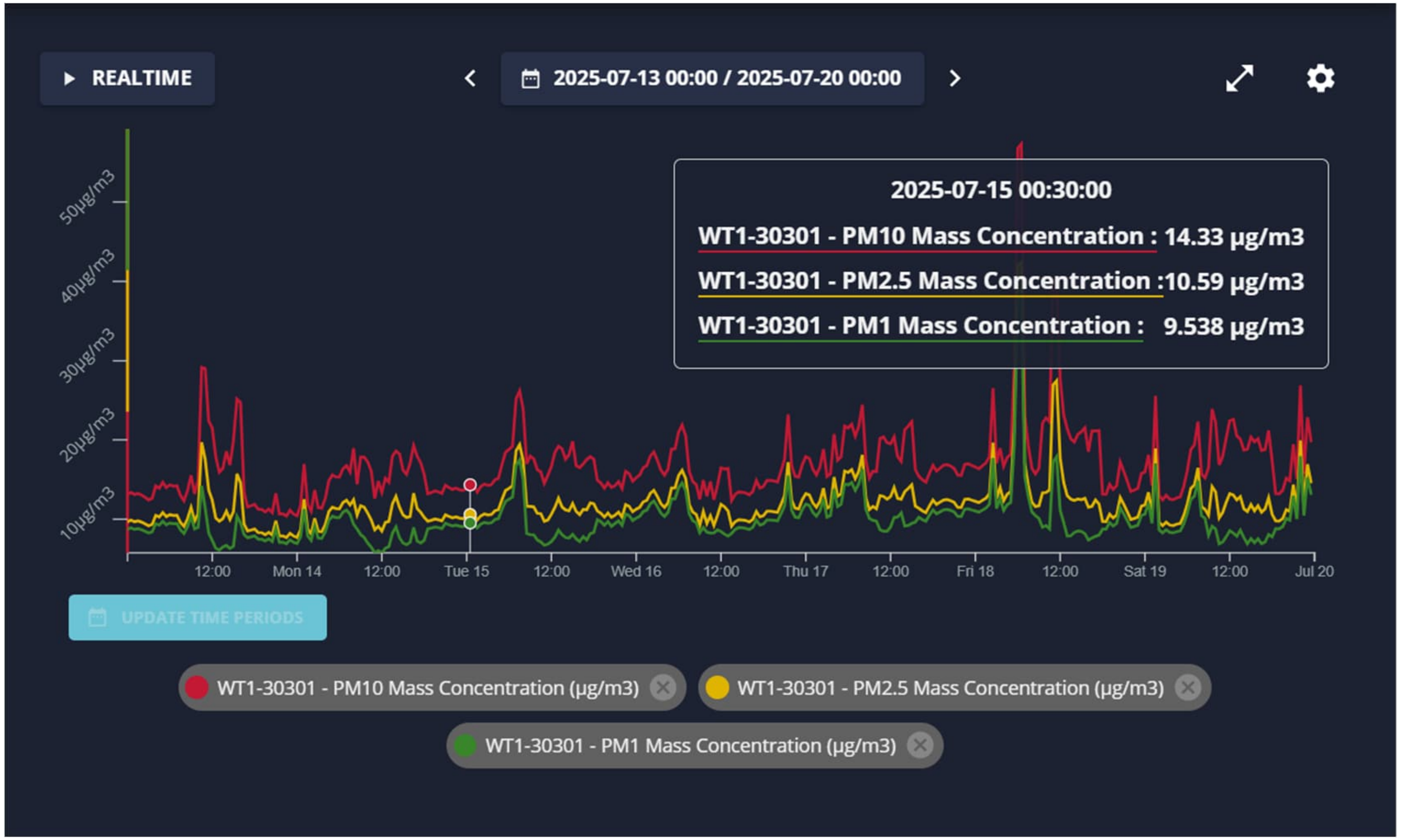


Highlights of the results : Permanent data acquisition site



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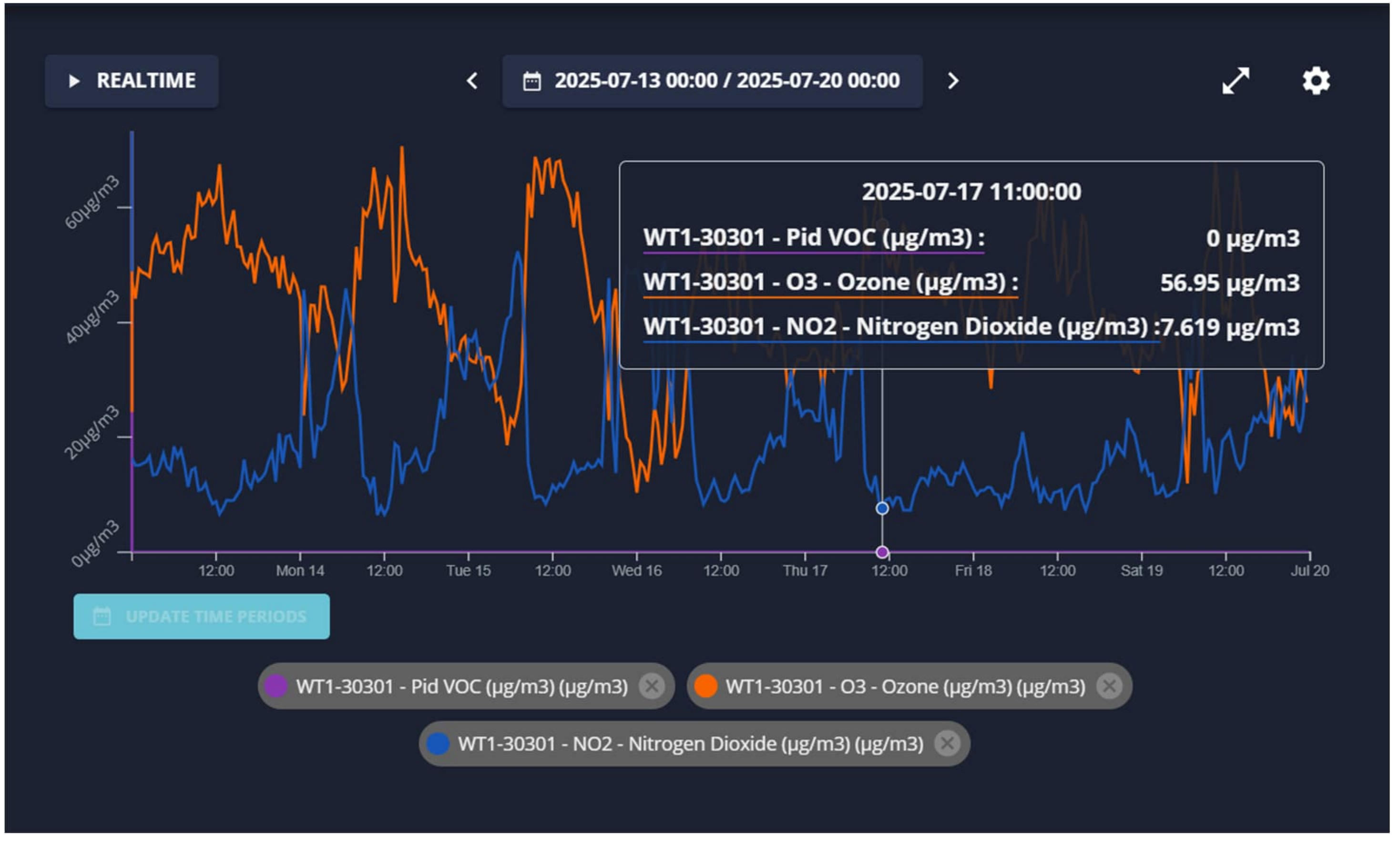

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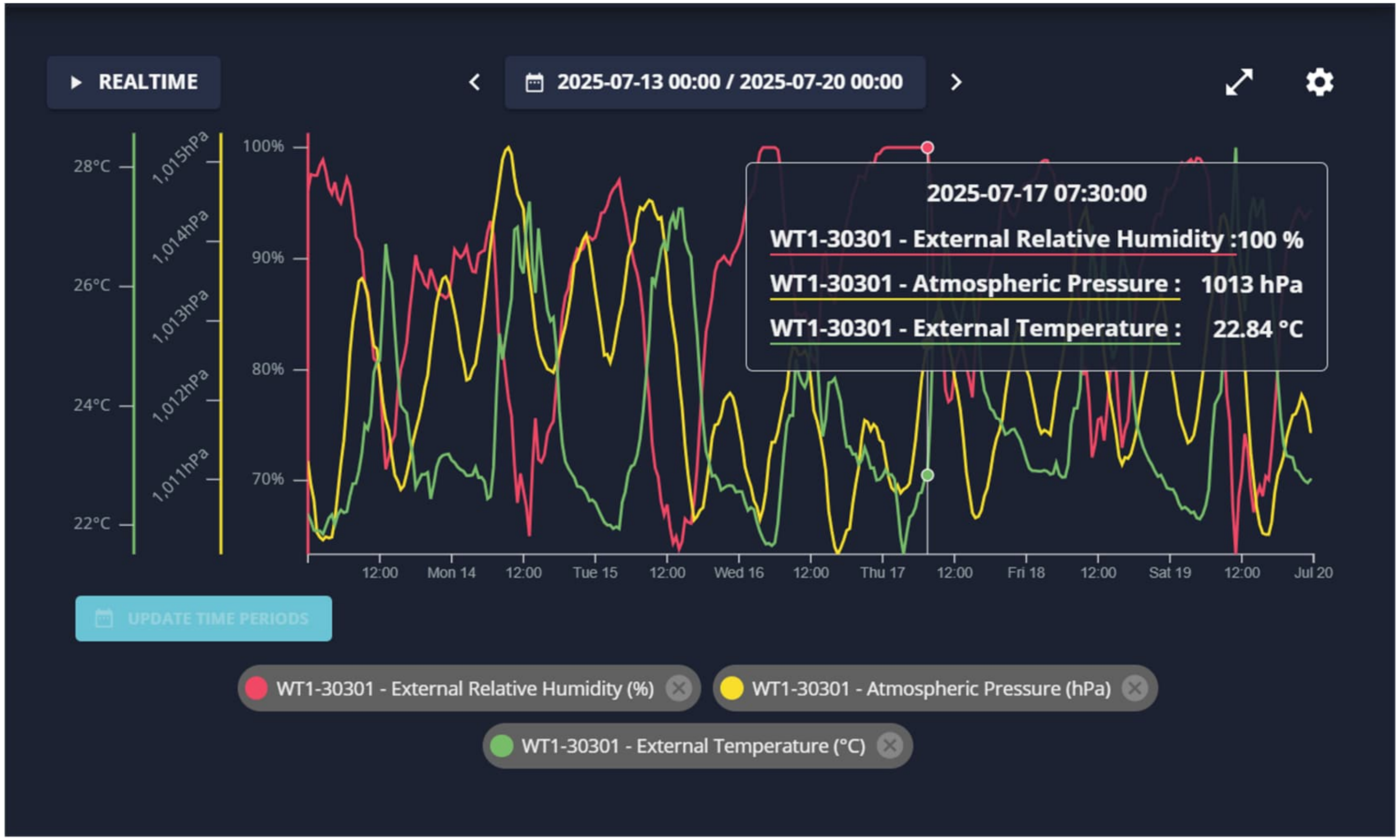

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Lessons learned : Stakeholders and communities

- Active inclusion: Involve local communities, public authorities, NGOs, and the private sector from the outset to ensure ownership of the service.
- Ongoing dialogue: Maintain constant communication between stakeholders to adjust the service's objectives and methods according to actual needs.
- Training and awareness: Train local actors on the use of data and the impact of pollution to promote informed participation.
- Local accountability: Encourage communities to contribute to data collection and validation to ensure reliability and relevance.
- Sustainable partnerships: Build strong collaborations between scientific institutions, governments, and civil society to ensure the sustainability of the service.

Lessons learned : Role of data tools

- Data quality: Ensure the collection of accurate, reliable, and representative data using instruments adapted to the local context.
- Accessibility: Set up open and understandable platforms so that data is accessible to everyone, including non-specialists.
- Multi-source integration: Combine data from fixed and mobile sensors, satellites, and modeling for a comprehensive and detailed view.
- Real-time analysis: Use digital tools capable of processing data quickly for responsive decision-making.
- Feedback: Develop mechanisms that allow users to comment on and continuously improve the quality and usefulness of data.

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Lessons learned : Actions to take

- Promote the adaptation of technologies to local conditions (climate, resources, infrastructure).
- Integrate a social and cultural dimension into service design.
- Establish clear and measurable performance indicators.
- Encourage transparency in the sharing of data and results.
- Promote communication campaigns to raise awareness among the public and decision-makers.

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Lessons learned : Actions to avoid

- Impose a service without first consulting the beneficiaries.
- Exclusive use of complex technologies that are not mastered locally.
- Neglect the maintenance and regular monitoring of equipment.
- Alienate key stakeholders through a lack of coordination.
- Underestimate language and cultural barriers in the dissemination of information.

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Lessons learned : Expanded to African cities

- Common problem : PM2.5 pollution affects many African cities, which often face similar sources (traffic, biomass, waste, industry).
- Adaptable methodology: PM2.5 measurement and analysis methods are standardized and can be adapted to different urban contexts.
- Modular technology: The sensors and tools used can be deployed with a flexible configuration depending on the size and resources of the cities.
- Accumulated experience: The know-how and best practices developed can serve as a model and guide for other cities.
- Growing need: The demand for reliable air quality data is increasing to support public health and urban planning.

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Lessons learned : Requirements for expansion or transfer

- Strong local commitment: Support from municipal authorities and involvement of local stakeholders to ensure ownership.
- Technical capabilities: Training of local teams in installation, equipment maintenance, and data analysis.
- Financial resources: Sufficient budget for the acquisition, installation, monitoring, and maintenance of sensors.
- Contextual adaptation: Adjustment of tools and protocols according to the climatic, geographical, and socioeconomic specificities of the new city.
- Strong partnerships: Collaboration with scientific institutions, NGOs, and local stakeholders to ensure sustainability.

Lessons learned : Obstacles or shortcomings

- Limited funding: Difficulty securing a stable budget for equipment and maintenance.
- Lack of technical skills: Insufficient trained staff to manage technical and analytical aspects.
- Poor infrastructure: Problems related to electricity, internet, or transportation that can hinder proper functioning.
- Weak institutional coordination: Lack of clear collaboration between different stakeholders.
- Insufficient awareness: Difficulty in mobilizing the population and decision-makers around air pollution issues.

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Lessons learned : Next steps

- Providing real-time information (app, sms, …) to populations and partners
- Support for victims through policy

Take-away messages

- Improved air quality: This service will enable better monitoring of PM2.5 levels and reduce the population's exposure to pollution.
- Increased awareness: Through clear and regular communication, the population will be better informed about the risks and actions to be taken.
- Informed decision-making: Reliable data will enable decision-makers to implement more effective environmental policies.
- Community involvement: The project includes local stakeholders, ensuring greater ownership and sustainability.
- Replicable model: This pilot will serve as a reference for other African cities facing the same pollution challenges.

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References and further reading

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Stakeholders meeting June 28, 2024

Thanks a lot !
Asante sana !
Merci beaucoup !

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Stakeholders meeting July 22, 2025

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