

USAf IMPACT CASE STUDY SUBMISSION

Title of the Impact Case Study:

AI_r: Artificial intelligence for affordable air-quality monitoring, early warning and environmental health

Submitting University:

University of the Witwatersrand, Johannesburg

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Summary of the impact:

AI_r is a South African-designed and assembled environmental-intelligence system developed at the University of the Witwatersrand through the South African Consortium of Air Quality Monitoring (SACAQM). It combines affordable sensors, Internet of Things communications and artificial intelligence to provide continuous, localised air-quality information in places that conventional monitoring networks do not adequately cover.

The work has already produced substantial societal impact. Project records indicate that approximately 100 sensors form one of the largest known dense, low-cost air-quality networks in Africa. Funding is currently available to scale to 500 sensors. Through a partnership with the South African Local Government Association (SALGA), systems have been installed in Merafong City, Mogale City, Sedibeng District, Rand West City, the City of Johannesburg and the City of Tshwane. Systems also operate in Limpopo, Mpumalanga, the Western Cape and the Eastern Cape. In the United Kingdom, 90 systems are being deployed around Leeds with the University of Leeds and its Horizons Institute, creating a substantial university-led network.

The platform has moved beyond passive measurement. It detects sudden pollution spikes and moving pollution clouds, geolocates affected areas and uses agentic AI to interpret events. Live event detection is operational; formal public-warning, acknowledgement and stakeholder-response procedures are still being tested. Residents, schools, municipalities, health partners and researchers can access localised information through digital platforms. Individual user numbers are not yet reliably quantified because public access does not require registration. Local assembly and rapid deployment provide a practical route to closing monitoring gaps without costly reference stations.

Underpinning academic work:

AI_r arose from research and technology-transfer work led by Wits scientists with experience in particle physics, sensor systems, large-scale data acquisition,

communications and artificial intelligence. These capabilities were adapted from the demanding environment of collider experiments, where thousands of sensors must operate reliably and large data streams must be analysed rapidly.

The academic work is led through the Institute for Collider Particle Physics and SACAQM, a multidisciplinary collaboration involving physics, electrical and information engineering, data science, public health, chemistry and environmental science. The work falls principally within Natural Sciences and Engineering and Technology, with strong Medical and Health Sciences applications.

The research addressed three connected barriers to effective air-quality management in South Africa: the high cost of conventional stations, the limited spatial coverage of existing networks, and the difficulty of turning large volumes of environmental data into timely, actionable information. The team developed compact sensor nodes, low-power communications, cloud-based data pipelines, calibration and quality-control procedures, spatio-temporal analytics, public dashboards and AI-supported interpretation. Publications can be downloaded from [SACAQM Publications](#).

The resulting platform measures particulate matter and other environmental parameters and transmits data continuously. Machine-learning methods identify abnormal changes across multiple sensors, distinguish local spikes from broader moving pollution events, and map their development. An agentic-AI layer brings together measurements, location, timing and contextual information to generate interpretable assessments. The programme's distinctive contribution is the operational integration of dense low-cost sensing, real-time event detection, geolocation and agentic-AI-supported interpretation, rather than an absolute claim that it is the first system of its kind. The programme also provides interdisciplinary training across hardware, communications, calibration, cloud computing and AI, converting advanced research capacity into locally retained skills.

Narrative description of the impact:

Air pollution is a major environmental-health risk, but many South African communities have little or no access to local, real-time information. Conventional monitoring stations are costly and sparsely distributed. As a result, short-lived pollution events and neighbourhood-level differences may not be visible to residents or decision-makers.

AI_r changed this situation by making dense monitoring technically and financially feasible. In Gauteng, project records indicate that approximately 100 operational sensors provide continuous measurements across communities and institutional sites, making this one of the largest known dense low-cost networks of its kind in the province. Through SALGA, systems have been installed in Merafong City, Mogale City, Sedibeng District, Rand West City, the City of Johannesburg and the City of Tshwane. These municipalities include areas affected by traffic, industry, mining and waste burning, where neighbourhood-level evidence has historically been limited.

The impact is not simply the installation of sensors. The platform functions as a lightweight environmental monitoring dashboard, displaying sensor status, measurements, trends and detected events centrally. Continuous analysis identifies sharp pollution spikes and moving clouds. Geolocation indicates where an event is developing and which areas may be affected, while agentic AI supports interpretation. Live event detection is operational; formal public-warning and user-acknowledgement workflows are being tested with partners before public-alert impact is claimed.

In the six SALGA-partnered municipalities, the network gives environmental-health teams, schools, communities and researchers a shared evidence base. Data can identify recurring hotspots, compare neighbourhoods, guide follow-up inspections and support public communication. It can support investigation of illegal burning or unusual industrial emissions, although no faster response or enforcement outcome is claimed without a documented case. The network also shows whether an event is local, affects neighbouring areas or travels further. Specific municipal and community uses are being documented through project records and supporting letters.

The reach has expanded beyond Gauteng. Deployments in Limpopo, Mpumalanga, the Western Cape and the Eastern Cape demonstrate operation across different climates, settlement patterns and pollution environments. Together with the SALGA-partnered Gauteng installations, this five-province footprint is establishing a nationally relevant capability rather than a single-city pilot.

The international deployment demonstrates transferability and wider societal relevance. With the University of Leeds and the Horizons Institute, 90 AI_r systems are being deployed in underserved communities in and around Leeds. This is a substantial university-led air-quality network; any comparative claim about its United Kingdom ranking will depend on independent confirmation from Leeds. The collaboration connects environmental measurements with community experience and public-health research, demonstrates the international relevance of African-developed technology, and creates two-way knowledge exchange between South Africa and the United Kingdom.

The significance of the impact lies in the transition from sparse retrospective monitoring to continuous, local and increasingly proactive environmental intelligence. Beneficiaries can access local conditions and use evidence for protective action, communication, research and policy engagement. As alerting and acknowledgement procedures are tested and adopted, the infrastructure can support earlier notification of hazardous events. The system also trains young African scientists and engineers in socially responsible AI, sensor technology and public-interest innovation.

Public visibility has extended the impact by increasing awareness of air pollution and of practical African-led solutions. International television coverage has included TV5MONDE, CGTN Africa, CGTN Français, CCTV, WION and others. The work has also been covered by Reuters and international radio services including RFI and BBC Radio, alongside extensive South African television, radio, newspaper and digital reporting. This coverage

has taken the project from a national science story to an internationally recognised example of responsible AI for environmental health.

Evidence and sources to corroborate the impact:

1. Independent recognition includes the [ODESS 2025 Prize](#) from the Pierre Fabre Foundation in France and the [2025 Presidential Award in Artificial Intelligence and Robotics received by Dr Edward Nkadameng](#), a key member of the team
2. Prof. Mellado was awarded the VC award [for Innovation and Social impact](#) in 2025.
3. Reuters reported on 20 April 2026 that the SACAQM system detects a growing frequency of pollution spikes and is being used to develop public warnings for Johannesburg residents. [Reuters report](#)
4. The International Development Research Centre documented the South African development, affordability and scaling of the technology, including its use of low-cost sensors and AI. [IDRC evidence](#) and [IDRC sponsored video](#)
5. The University of Leeds Horizons Institute documents the SYNERGIA collaboration linking communities, environmental monitoring, health research and data justice in South Africa and the UK. [Horizons Institute evidence](#)
6. SACAQM's public media archive documents coverage by CGTN Africa, CGTN Français, WION, Reuters, RFI and other international outlets. Project records additionally document television coverage by TV5MONDE and CCTV, radio coverage by BBC Radio and many others. [International media archive](#)

Any other information considered relevant:

AI_r contributes directly to SDG 3 (Good Health and Well-Being), SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action). Its distinguishing contribution is the integration of affordable sensing, communications, a live monitoring dashboard, real-time analytics, geolocation and agentic AI into an operational system designed for public benefit. Current evidence-building priorities are documented municipal actions, community use and tested alert-response workflows.

Signed off on behalf of the University by (Name, position and email address):

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Date:

15 June 2026

