



Seeing Gauteng in a new light

By Tiana Cline

We may look to the night sky for answers, but sometimes, what matters most is what we can see looking down. For Yashena Naidoo, a spatial data scientist and researcher at the Gauteng City-Region Observatory (GCRO), the glowing lights of Johannesburg led to economic insight. Her work turns satellite-based night-time imagery into a proxy for understanding where economic activity thrives and declines across Johannesburg.

Naidoo's research began as an experiment for GCRO's "Map of the Month" series, when she came across freely available satellite data to visualise light intensity across Gauteng. "The lights are all artificial, and they represent where we are," she says, or, put another way, the lights are a proxy for human and economic activity.

Access to fine-grained, high-resolution economic data in South Africa is scarce. Official data sources like GDP are often locked at municipal or provincial levels, with little granularity for planners trying to understand what is actually happening on the ground. Naidoo, whose background is in geoinformatics, wanted to change that. Her work models Gross Value Added


(GVA) – a component of GDP that captures the value of goods and services produced – down to a 1km² grid across Johannesburg, using open datasets and machine learning (ML). She trained a Random Forest model (a common ML algorithm that combines the output of decision trees to reach a result) with satellite night-light data, population estimates and existing economic figures from the CSIR to build a time-series model of economic activity from 2011 to 2021.

One of Naidoo's main goals was to make the method replicable. "I really want this to work because if I can get it right using open data, someone else can take it in their context and replicate it," she says. Naidoo's commitment to open access means she deliberately avoids proprietary tools, favouring transparency and

reproducibility. That ethos aligns with the GCRO's broader mandate: producing research that is not only academically rigorous, but usable by policymakers, civil society and planners. The model builds on earlier work done with the City of Johannesburg and extends GVA projections beyond 2016 using publicly available night-light data from visible infrared imaging radiometer suite (VIIRS) sensors and LandScan population database estimates. While GVA is traditionally mapped only to the CSIR's mesozone layer – demarcated zones in which socioeconomic data can be analysed – Naidoo's model breaks that down to ward level and year-on-year resolution. This enables trend analysis at a much finer scale than standard national statistics allow.

Yashena Naidoo,
Gauteng City-Region Observatory

Photograph: Karolina Komendera



Once the model was trained, and the data could be compared from before, during and just after the pandemic, there were unexpected patterns. Commercial centres, particularly those in traditional economic hubs, didn't recover the way many had hoped. "You'd expect some commercial areas to bounce back after Covid, but they didn't. Others we assumed were stable actually declined, that surprised me," she says. Meanwhile, economic activity showed up in unexpected places: small nodes on the outskirts of the city, in townships and in places previously overlooked in macroeconomic models.

These insights are supported by modelled compound annual growth rates between 2012 and 2021. Gauteng's average rate was 1.47%, with wide variation across municipalities. Lesedi, in southern Gauteng, for instance, recorded the highest growth rate, while the City of Johannesburg underperformed the provincial average. Declines were particularly stark in places like Emfuleni in Vanderbijlpark and Rand West City. While the GVA values are modelled approximations, the spatial patterns they reveal are consistent with urban and economic shifts that have been observed over the past decade. Naidoo hopes future iterations of the model will help identify and quantify informal economic contributions that are often invisible in traditional datasets. She says the model also has the potential to highlight areas in need of infrastructure support or economic intervention. As a change-detection tool, it can help track spatial economic shifts over time and flag where something may need deeper investigation.

Despite strong interest from agencies like the Gauteng Department of Economic Development and the City of Johannesburg, getting models like this into formal planning frameworks is a slow process. "Unfortunately, with the architecture of government, it's very difficult to get it into

the system," says Naidoo. That's why she's also working on publishing an academic paper to strengthen the model's credibility and open up opportunities for peer replication. Her PhD, jointly supervised by Wits and the University of Edinburgh through the Wits-Edinburgh Sustainable African Futures doctoral programme, is helping shape the next phase of her work. It will test how far this method can stretch: to other metros, into sectoral analysis, or even toward mapping informal economic clusters with greater clarity.

At its core, her research remains grounded in a spatial ethos: economic data shouldn't just exist, but be visible and useful. But as much as the maps reveal, Naidoo is careful not to overstate their implications. Loadshedding, for example,

complicates the accuracy of night-light readings. And satellite imagery can't replace traditional economic measurement, but it can supplement it, highlight gaps and, hopefully, trigger conversations. "I remember when we presented the first maps to people in Johannesburg," she says. "They would immediately point to an area and say, 'Oh, that used to be where I worked. It's all brown now.'" This is the colour she chose to represent declining economic activity. "It was interesting to see how the maps validated what people had seen and felt." Naidoo's maps may use the light captured by satellites, but they tell grounded stories of place, presence and economic possibility. Gauteng, as it turns out, looks different when you see it in the dark. ■

Compound Average Change per Municipality (%)

	-3%	-2%	-1%	0%	1%	2%
Lesedi						2.67%
Mogale City						2.56%
City of Tshwane						2.42%
Midvaal						2.13%
Ekurhuleni						1.78%
Gauteng					1.47%	
Johannesburg					0.92%	
Merafong City					0.88%	
Rand West City				-0.09%		
Emfuleni			-1.6%			

Chart: Yashena Naidoo and Gillian Maree. Created with Datawrapper