

PROF. TIMOTHY DUBE

tackles SA's climate crisis with innovative AI solutions for water security

In sub-Saharan Africa, two-thirds of rivers are non-perennial, meaning they do not flow all year round. These intermittent waterways have been historically neglected in research – a problem in an era where Climate Change threatens local and global water security. Prof. Timothy Dube, Director of the Institute for Water Studies at the University of the Western Cape (UWC) and winner of the 2024 NSTF-Water Research Commission (WRC) Award at the NSTF-South32 Awards, is tackling the climate crisis with innovative AI solutions to better utilise often-overlooked non perennial rivers in the country's semi-arid regions.

Climate Change has become a global talking point, widely discussed and impossible to ignore. According to the Climate Change Knowledge Portal (CCKP) website, Climate Change is defined as: "The significant variation of average weather conditions becoming, for example, warmer, wetter, or drier – over several decades or longer". Undoubtedly, its impact is devastating for all of us. In South Africa, Climate Change is already altering our ecosystems, economies and livelihoods. As mentioned on the United States Agency for International Development (USAID) website, since 1990, the national average temperature has increased twice as fast as global temperatures. According to South Africa's National Adaptation Plan, there is evidence that extreme weather events are increasing, with heat waves more likely, dry spell durations lengthening slightly, and rainfall intensity increasing.

Climate impacts on water security are particularly severe, with more frequent drought and water shortages resulting in water scarcity in parts of the country. The projected changes in temperature extremes put additional strain on the health system, including the increasing disease burden, and also affect infrastructure, services, the availability of medicines, medical supplies and emergency services.

South Africa is experiencing an increasing water problem affecting many provinces across the country, exacerbated by Climate Change. The latest example is Durban, where eThekweni residents must prepare for water shedding as the city urgently works to increase its water capacity before supplies run out.



Prof. Timothy Dube utilises AI and satellite technology to address South Africa's water security challenges.

Prof. Timothy Dube is committed to addressing water security challenges by leveraging artificial intelligence (AI), machine learning and remote sensing technologies: "Technological advancements enable us to respond to environmental changes in real-time, optimise water usage and develop predictive models for better resource planning".

Witnessing the struggles people face due to limited access to clean water has profoundly impacted him.

"It highlighted the critical importance of water in every aspect of life and would define my career going forward," Dube explained.

The model developed by Dube and his team estimates water availability within non-perennial rivers (N-PRs) with approximately 85% accuracy – a significant development in regions where traditional monitoring methods fall short.

"Our goal is to provide decision makers with the most accurate and up-to-date information possible," he says. "By harnessing new-generation Sentinel satellite data, we're able to detect and monitor water resources in ways that were previously impossible, addressing pressing environmental challenges and promoting better water resource management."

"The integration of AI and machine learning into hydrological modelling presents exciting opportunities to improve predictive capabilities and optimise water management strategies," he says. "It's crucial to equip

young scientists with the tools they need to tackle future challenges."

Dube stands as a pioneering force in the realm of GIScience and Earth Observation applications within Environmental and Water Sciences. Renowned for his innovative research, he wields expertise in leveraging state-of-the-art satellite and in-situ Earth Observation technologies to meticulously track Climate Change impacts and monitor the dynamic pulse of global water resources. As the Director for Water Studies, his leadership steers groundbreaking initiatives funded by esteemed entities.

Dube's research and teaching interests also include spatial modelling of water resources and their interactions with the environment, as well as ecosystem responses to changes in the climate and water cycle. He received the prestigious 2024 NSTF-South32 Award for his pioneering and innovative methods using satellite technology merged with machine learning (AI) to monitor water resources in semi-arid regions, enhancing ecological sustainability and community resilience.

For more information on STEM careers, refer to the National Science and Technology Forum (NSTF) STEMulator Career Booklet: Climate scientist (p 14); Computer scientist (p 15); and Environmental Engineer/Chemist/Scientist (pp 20-21).

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