

Research in Africa to tackle the climate crisis

How biometeorology is interdisciplinary and requires connections and communication between different fields of science

Biometeorology is the study of the impacts of climate change on plants, animals, and people. Africa is an exciting location for biometeorological research. Many countries across the continent rely economically on agriculture and tourism – sectors which are heavily reliant on favourable and predictable climate, and which have been the focus of biometeorological research for many decades.

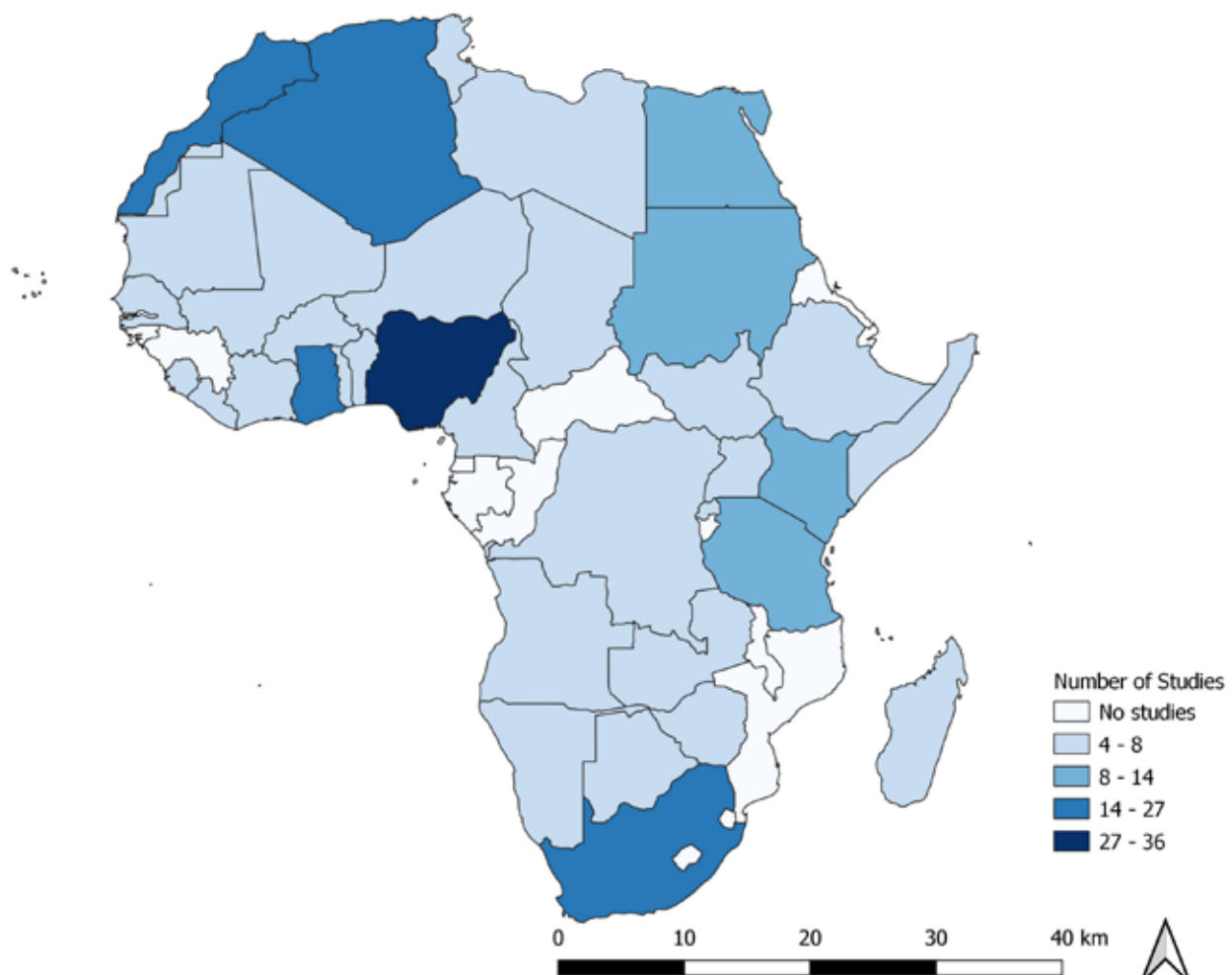
Many climate-sensitive diseases, such as malaria, cholera and Ebola, occur in Africa. Africa is highly vulnerable to climate change. Projections of temperature in Africa suggest that the places on the continent will experience temperature increases as much as 1.5 times higher than that of the global mean temperature by 2100.

Africa is also vulnerable to climate change because of its relatively low adaptive capacity, for example, not having infrastructure to adapt to climate change, such as

building retaining walls to prevent flooding and installing desalination plants for fresh water during droughts. These steps often have large costs, which are difficult to fund while countries strive to meet more immediate human rights-related needs like food and shelter.

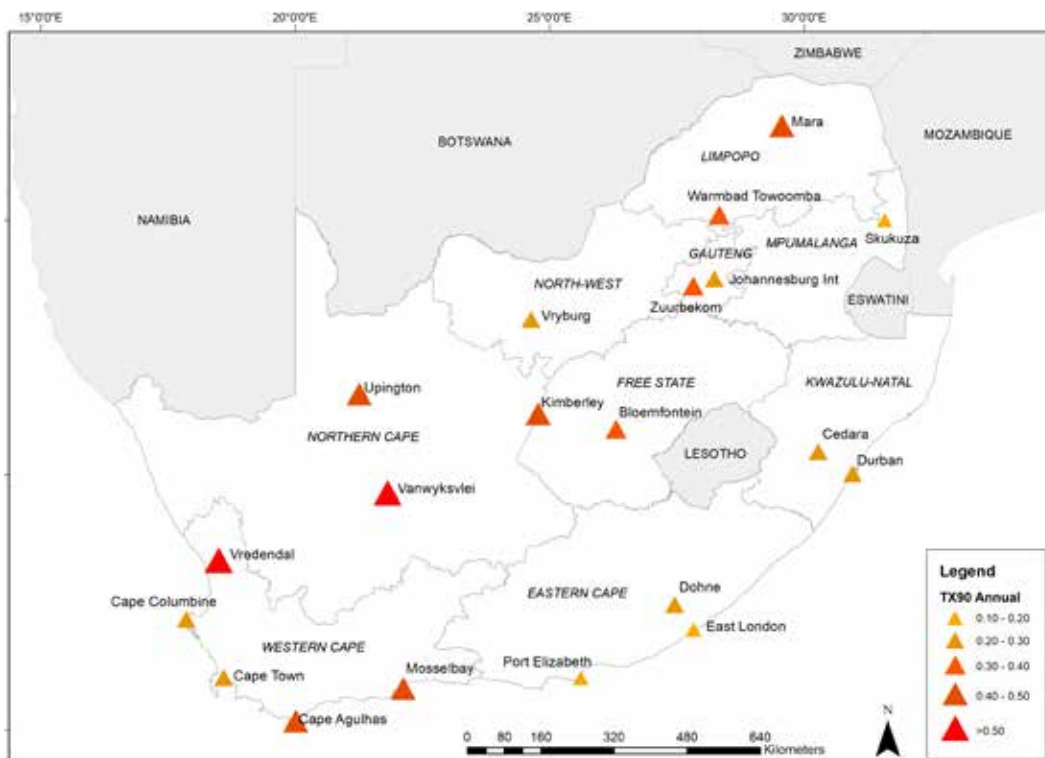
Until now, Africa has not featured much biometeorological research. Of the 4,014 research papers that had been published in the *International Journal of Biometeorology* by the end of June 2020, only 135 were on biometeorology of or in an African country. The majority of this research was done in Nigeria on animal biometeorology, and in South Africa on climate and building design, tourism and climate change, thermal comfort and stress, and health biometeorology.

The reason why so little biometeorological research has been done in Africa is probably because many African



Number of studies on biometeorology per African country (adapted from Fitchett, 2021).

researchers have not yet heard about biometeorology. They could be doing work on the intersection between climate and health, climate and ecology, or climate and tourism, and submitting their research to journals that focus on health, ecology or tourism, respectively, or to climate or climate change journals. This will change as we leverage existing African networks, and communicate among researchers, students and practitioners across the continent to increase the African biometeorology footprint.



Map showing increases in the incidence of temperatures in the 90th percentile over the period 1960-2016 (Adapted from van der Walt and Fitchett, 2021).

What kind of research is being conducted in biometeorology in Africa?

Phenology

Phenology refers to the timing of annually recurrent biological events like the flowering of plants each spring,

and leaves turning orange in autumn. Phenology also includes migration of birds each winter to warmer climates, and the timing of hibernation of many mammals. Phenology is one of the most sensitive bioindicators of climate change. When temperatures increase, the triggers that tell a plant or animal that springtime has started will occur earlier in the year. Such triggers might be temperatures above a certain level, or a couple of warmer than usual days. It might even be the early onset of rainfall.

In South Africa, this has recently been documented for the Jacarandas in Gauteng and for the Namaqualand Daisies. Both are flowering about a month earlier than they used to, most likely as a result of global warming over the past century.

Biometeorology, climate and human health

The climate has an impact on what diseases we are exposed to, and when and where we are at risk. A common example is that we know when we travel to malaria-endemic regions in summertime, the risk of being bitten by a mosquito can be high and getting malaria is a possibility. We try to prevent this by wearing long-sleeved shirts, long pants and taking medicine called prophylaxis.

Biometeorological research on malaria and mosquitoes has shown that in a changing climate, the malaria risk area of South Africa is increasing in size, expanding further west and south.

Other biometeorological research on health includes studying the impact that climate has on COVID-19 transmission, and understanding the role of the seasons in when colds and flu occur.



Jacaranda tree in bloom in Johannesburg in October 2021.

Caradee Wright

Caradee Wright



An ostrich on an ostrich farm in Schoemanskloof, South Africa.

Thermal comfort and extreme climate events

Plants, animals and people are all adapted to specific climates. When experiencing climatic conditions within the usual range of temperature and humidity, human energy use, comfort and productivity will be maximised. As the boundaries of those conditions are reached, or exceeded, thermal (or temperature) stress is likely to occur.

In humans, the temperature levels we can cope with have increased with adaptations like wearing cooler or less clothing, and using air conditioning and mechanical fans. However, we do still experience heat and cold stress when conditions have been exceeded by too large a margin, or when temperatures change very rapidly.

In South Africa, extreme temperature events are sometimes called heatwaves and cold snaps. In biometeorology, thermal comfort indices (which are mathematical equations that use weather data to calculate the chance of heat comfort or stress) are used to identify these events. Recently, increases in the frequency of heatwaves are being recorded across the country.

Climate change and tourism

South Africa is marketed as ‘sunny South Africa’, particularly to international tourists who escape to our warm summers during their cold, dark and rainy winters across Europe and parts of the United States of America.

Our climate is well-suited for tourism, as calculated through tourism climate indices. This is fortunate because a lot of our tourism is outdoors, such as beach tourism, nature-based tourism and adventure tourism. But while this is an important drawcard for South Africa now, it also makes South Africa vulnerable to future climate change. If the

weather is less favourable, tourists may choose other sunny destinations. Biometeorological research explores the climatic preference of tourists, the weather experienced at a range of destinations, and makes projections about how this weather and climate will change in future.

Animal biometeorology

Animal biometeorology explores the impact of weather and climate on a range of physiological experiences of animals. This includes things like their thermal comfort, thermal stress, metabolic conditions, and fertility (ability to reproduce).

Some animal biometeorology focuses on livestock, such as cattle and sheep, and other studies look at hamsters, toads, dogs, lizards and prawns, to name just a few. While some of these studies are conducted in the field observing animals in their living environment, some are conducted in laboratories under experimental conditions.

Biometeorological research that brings together researchers from different fields is crucial for Africa. This includes fields of geography, biology, history, engineering, ecology, botany, zoology, demography, psychology and others. When these researchers work together, they will be able to better address climate change and other environmental challenges and their impacts on Earth. Climate change is not a threat of something that might happen in the future – it is happening now and we are already seeing the impacts of it.

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CURRICULUM CORNER

NATURAL SCIENCES: GRADE 7-9

Life and living

- Interactions and interdependence within the environment
- Conservation of the ecosystem

LIFE SCIENCES: GRADE 10-12

Environmental studies

GEOGRAPHY: GRADE 8 and 12

Climate regions (focus: South Africa and world)
Climate and weather: cyclones, local climate.

Afrika I ndhawu yo tsakisa hi thlelo ra vulavisisi bya Biometereorological. Biometeorological I dyondzo ya swa ku cinca ka ntshamelo-maxelo eka swimilana, swiharhi na vanhu. Vanhu vo tala vale Afrika lava va endlaka vulavisisi va sungula ku tirhisana eka swilo swo fana na maxelo na rihanyo, maxelo na dyondzo ya ntumbuluko, kumbe maxelo na swa vupfumba.

Translated by Millicent Masina, South African Agency for Science and Technology Advancement