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# UMLINDI
## The Watchman

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NATURAL RESOURCES AND ENGINEERING
Soil, Climate and Water

CONTENTS:



agriculture, land reform & rural development
Department: Agriculture, Land Reform and Rural Development
REPUBLIC OF SOUTH AFRICA

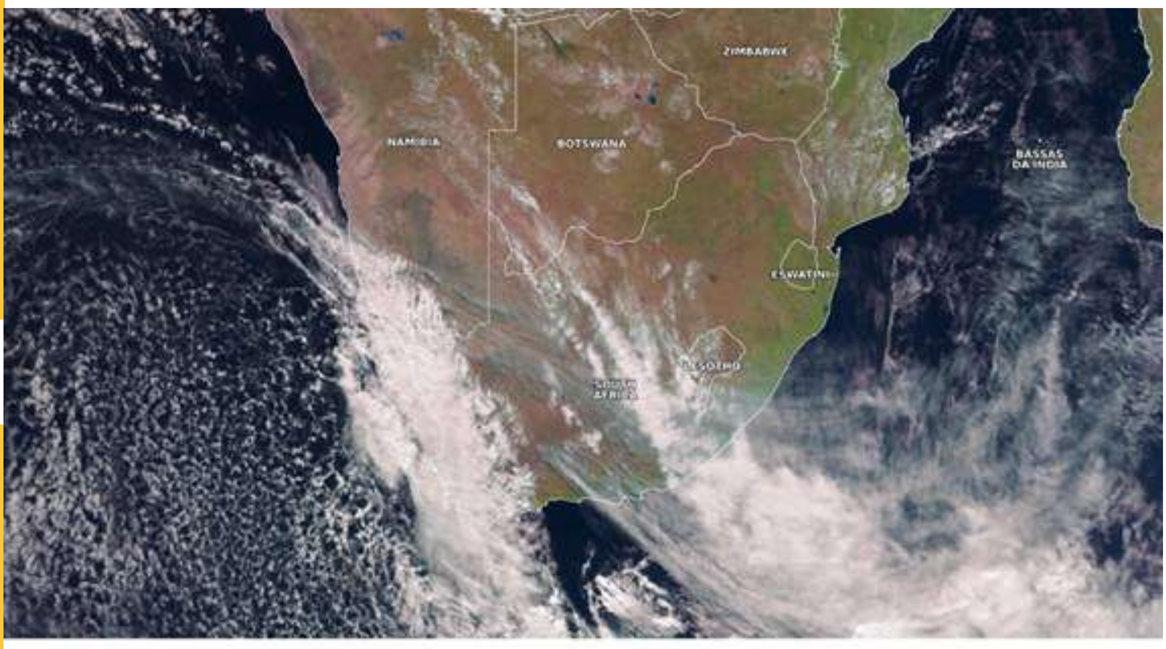
South African Weather Service

251st Edition

# Image of the Month

## Late-autumn cooling ahead of winter transition

A notable cold spell signalled the arrival of typical late-autumn conditions in South Africa following the passage of a well-defined cold front on 20 May 2025 (see satellite image below). This system ushered in a marked temperature drop, particularly across the Western Cape where it made landfall with rain and strong winds. As the front moved inland, it brought colder air to the central and southern interior, leading to sharp overnight temperature declines across many areas. Clearer conditions were observed over parts of the country on 21 May with the interior remaining cooler, while light snowfall occurred in some high-lying areas. This event signalled the transition into winter, with more cold fronts expected to bring similar conditions in the weeks ahead. However, these conditions also present increased risks for agriculture such as frost damage to crops and potential hypothermia or weight loss in livestock. As colder conditions become more frequent, farmers and other agricultural stakeholders should begin planning protective measures such as frost covers, livestock shelters and adjusted irrigation schedules in order to minimize risk and support crop and animal health through the winter season.




The Agricultural Research Council - Natural Resources and Engineering (ARC-NRE) Soil, Climate and Water campus collected the data, generated the products and compiled the information contained in this newsletter, as part of the Coarse Resolution Imagery Database (CRID) project that was funded by the Department of Agriculture and Department of Science and Technology at its inception and is currently funded by the Department of Agriculture, Land Reform and Rural Development (DALRRD).

# 1. Rainfall

***Overview:***

Rainfall persisted across much of the country in April 2025, maintaining a pattern of widespread wet conditions that has characterized recent months. Much of the rainfall was confined to the summer rainfall region, including the central and eastern interior, where monthly totals often exceeded 150 mm and reached over 300 mm in certain areas. Large parts of the Free State, North West, Mpumalanga Highveld, KwaZulu-Natal and the eastern Northern Cape recorded rainfall far above the long-term mean, with some places exceeding 300% of the April average. Compared to April 2024, most of the interior received over 200 mm more rain, highlighting a strong recovery from the short-term drought scare earlier in the season. These conditions were consistent with historically wetter April months. However, not all areas benefited equally. The northeastern Lowveld, particularly in Limpopo and northeastern Mpumalanga, recorded below-normal rainfall, with some locations receiving less than 25% of their long-term average. Similarly, the winter rainfall region, including Cape Town and parts of the West Coast, remained drier than normal for April, with totals often below 25 mm. However, as the seasons transition towards winter, rainfall across this region is expected to gradually increase in the coming months.

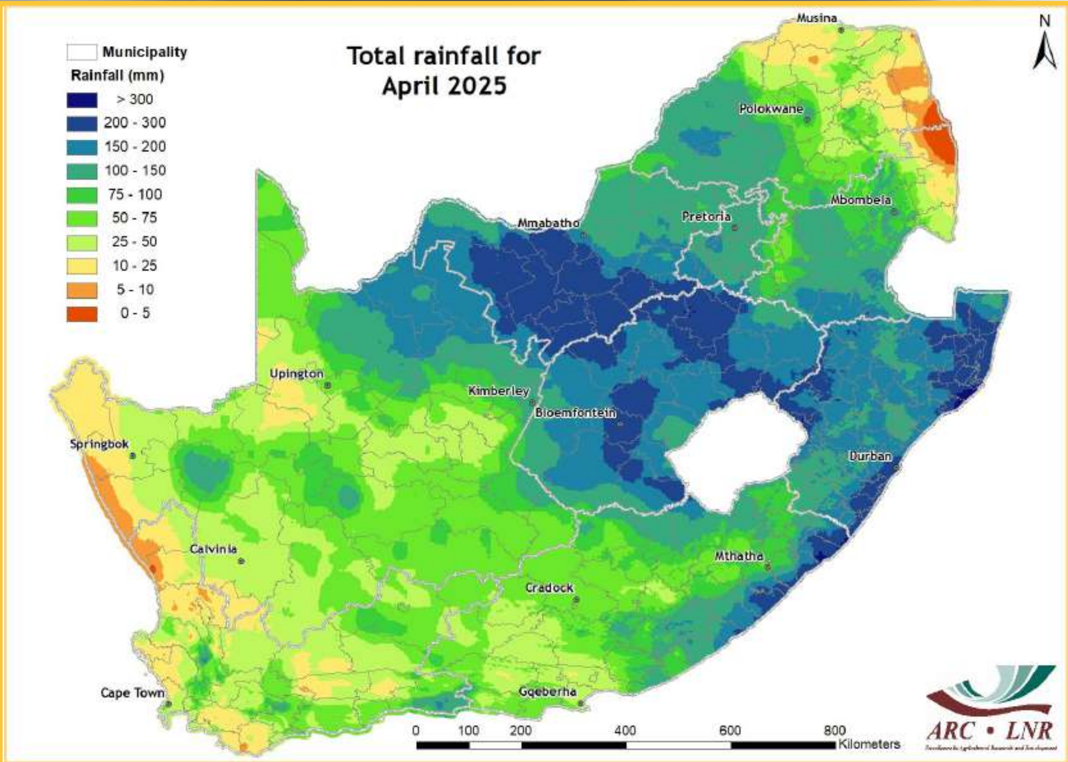



Figure 1

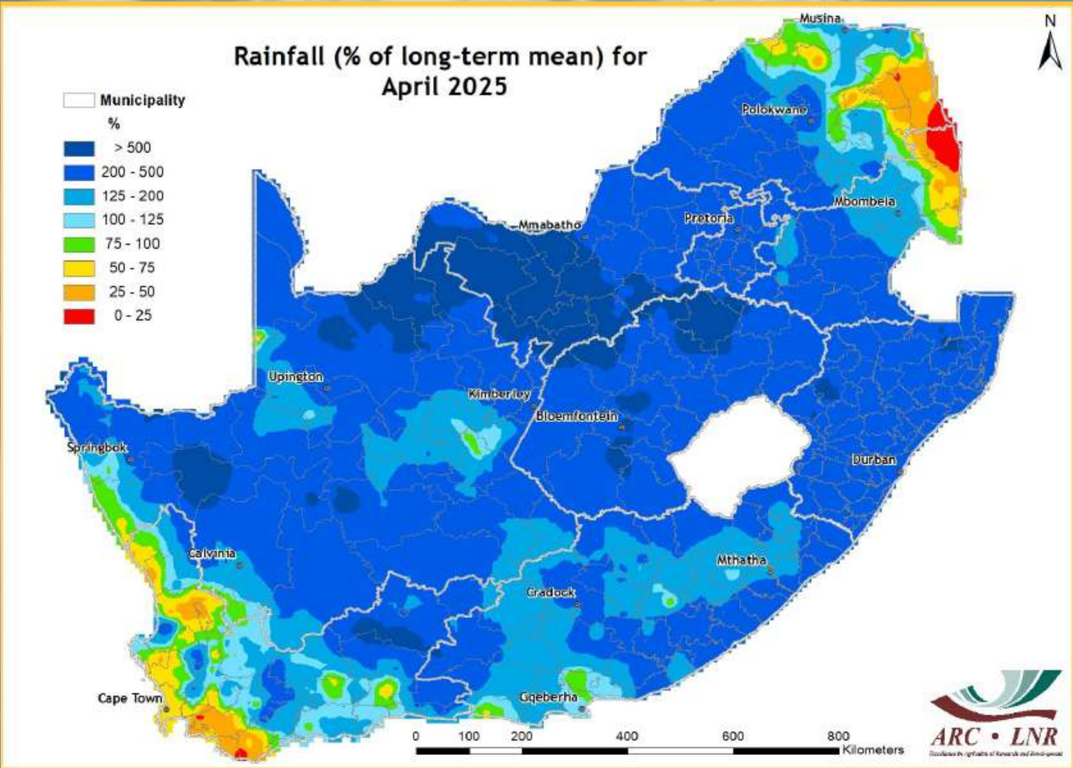



Figure 2

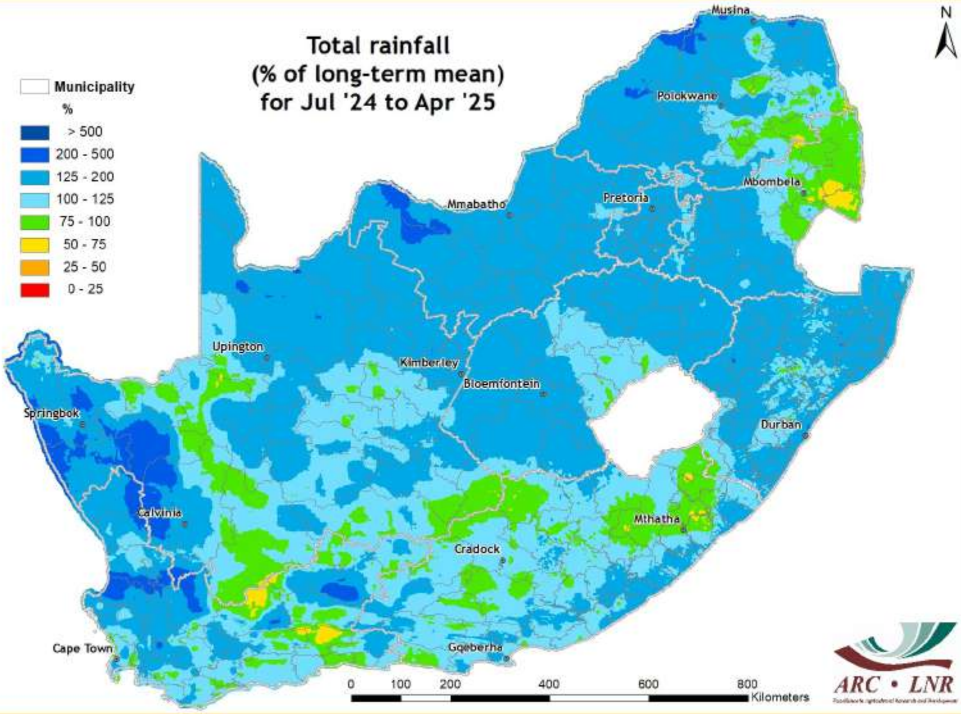



Figure 3

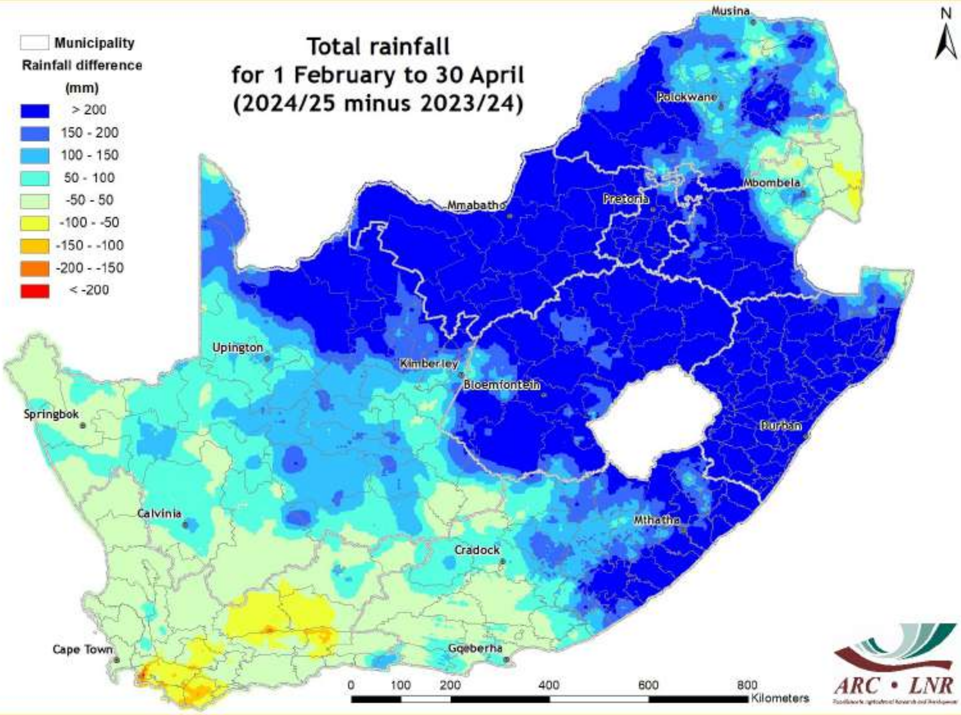



Figure 4

**Figure 1:**
Total rainfall for April 2025 ranged from less than 5 mm in parts of the northeastern Lowveld and the north-western coastal areas near Spring-bok to over 300 mm in parts of the central interior and along the eastern escarpment.

**Figure 2:**
Widespread rainfall resulted in above-normal conditions across most of the country in April. The only areas that recorded below-normal rainfall were the Limpopo and Mpumalanga Lowveld, as well as parts of the City of Cape Town extending north to-wards the West Coast.

**Figure 3:**
Since July 2024, most parts of the country have generally experienced above-normal rainfall, except for some areas in the western and southern interior, as well as parts of Mpumalanga, which recorded near-normal conditions.

**Figure 4:**
When comparing rainfall accumula-tion from February to April 2025 with the same 3-month period last year, most parts of the interior received over 200 mm more rain. The rest of the country recorded similar totals, while parts of the Western Cape ex-perienced lower rainfall.

**Questions/Comments:**
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# 2. Standardized Precipitation Index

## Standardized Precipitation Index

The Standardized Precipitation Index (SPI - McKee *et al.*, 1993) was developed to monitor the occurrence of droughts from rainfall data. The index quantifies precipitation deficits on different time scales and therefore also drought severity. It provides an indication of rainfall conditions per quaternary catchment (in this case) based on the historical distribution of rainfall.

REFERENCE:
McKee TB, Doesken NJ and Kliest J (1993) The relationship of drought frequency and duration to time scales. In: Proceedings of the 8th Conference on Applied Climatology, 17-22 January, Anaheim, CA. American Meteorological Society: Boston, MA; 179-184.

The SPI maps revealing short-term (6-month), medium-term (12-month) and long-term (24- and 36-month) drought conditions ending in April 2025 are shown in Figures 5-8. The short-term SPI map indicates widespread wet conditions across most of the country, with extremely wet conditions dominating the northern parts, including the North West and Limpopo provinces, extending eastward through Gauteng, Mpumalanga, the eastern Free State and KwaZulu-Natal. In contrast, moderate drought persists in the southwestern parts, particularly in the winter rainfall region. These dry conditions are not visible on the medium-term SPI map but the wet conditions remain evident. The long-term maps reveal widespread near-normal to wet conditions, with moderate drought confined to isolated areas of the Northern Cape, Free State, Limpopo and Mpumalanga.

**Questions/Comments:**
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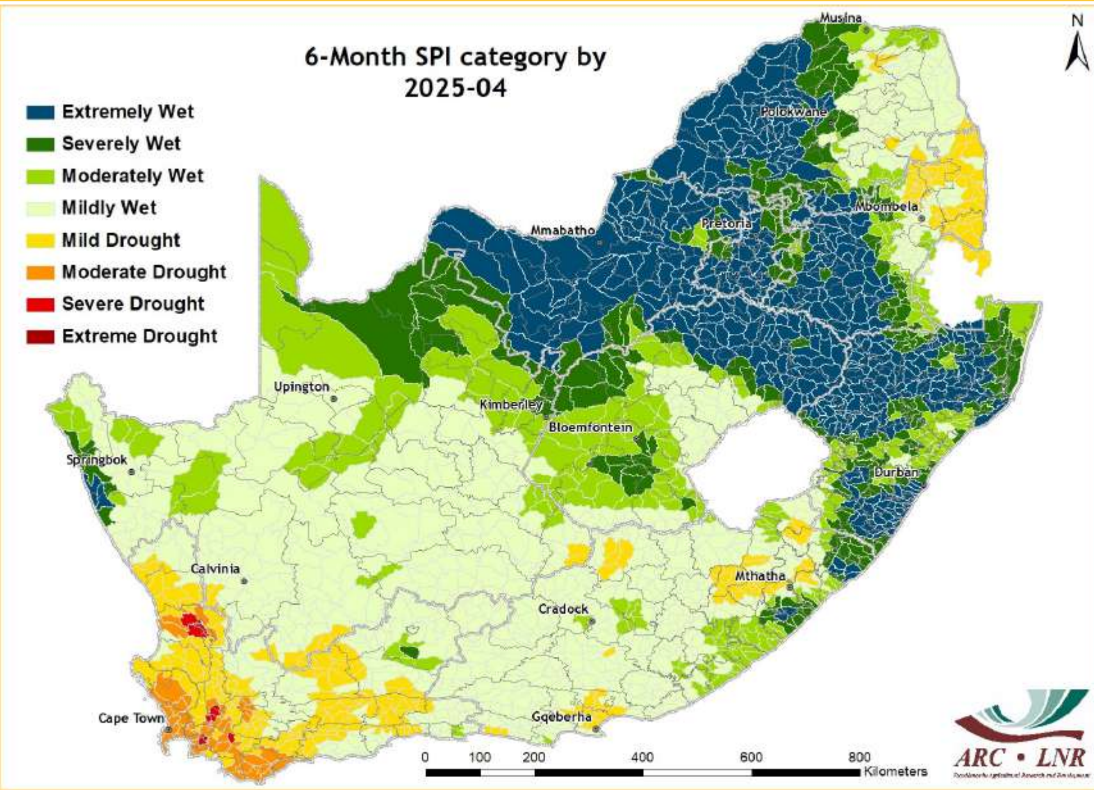


Figure 5

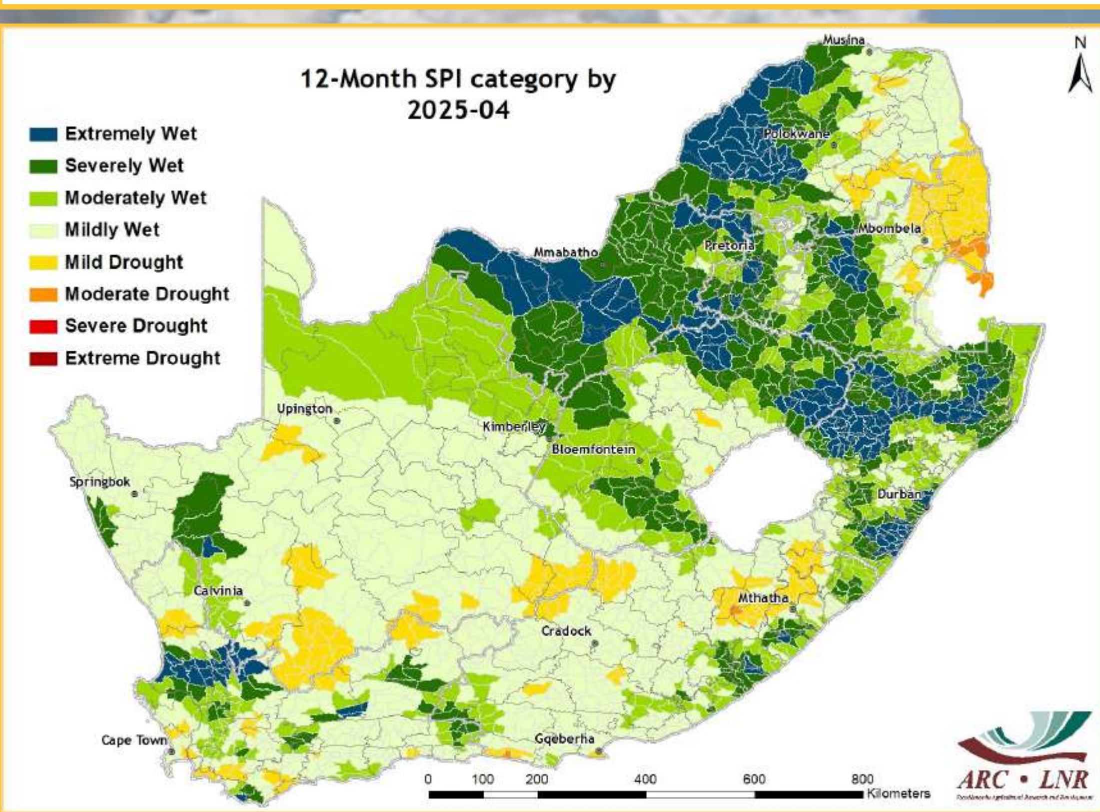


Figure 6

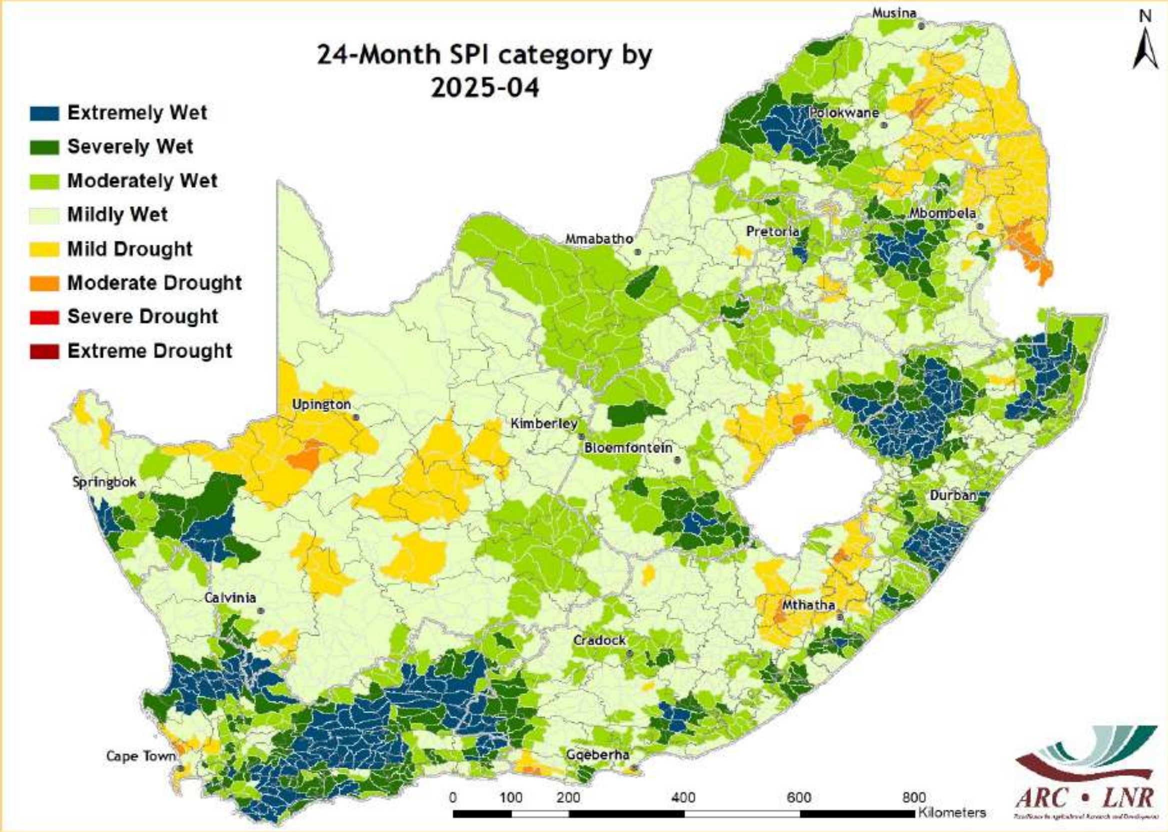


Figure 7

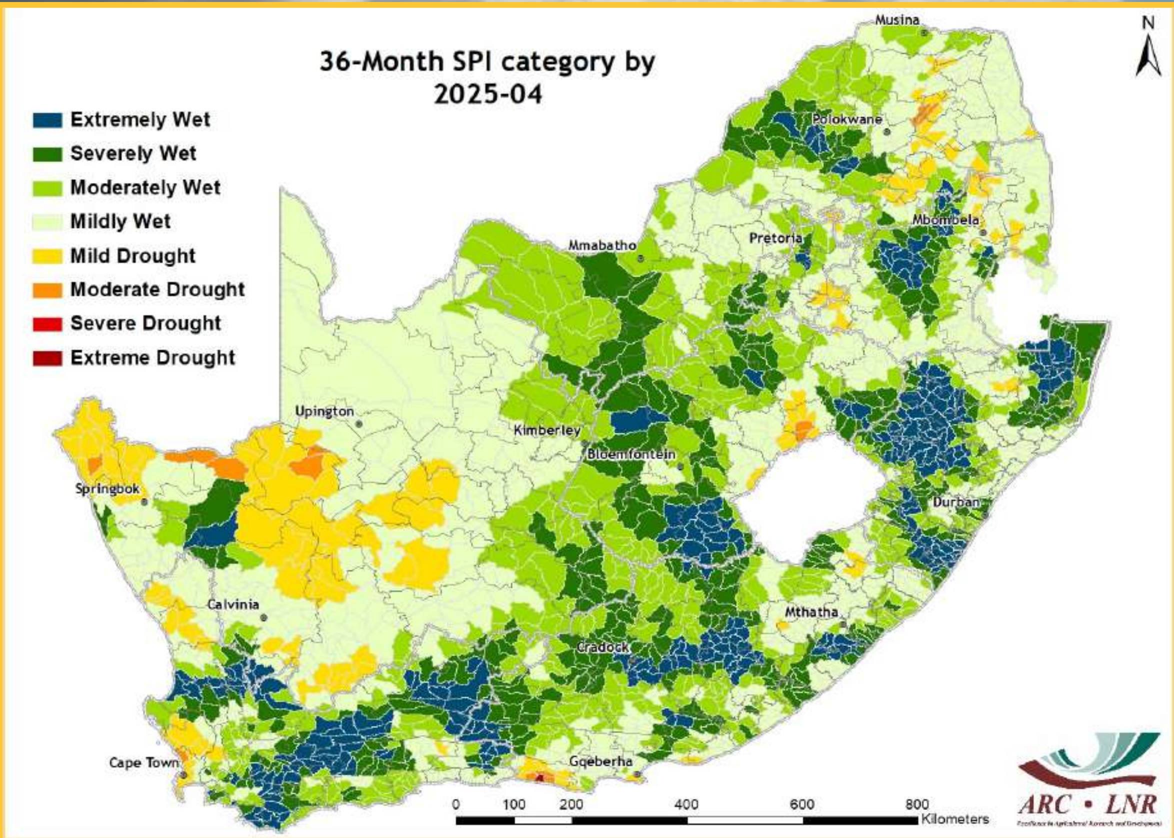


Figure 8

# 3. Rainfall Deciles



Deciles are used to express the ranking of rainfall for a specific period in terms of the historical time series. In the map, a value of 5 represents the median value for the time series. A value of 1 refers to the rainfall being as low or lower than experienced in the driest 10% of a particular month historically (even possibly the lowest on record for some areas), while a value of 10 represents rainfall as high as the value recorded only in the wettest 10% of the same period in the past (or even the highest on record). It therefore adds a measure of significance to the rainfall deviation.

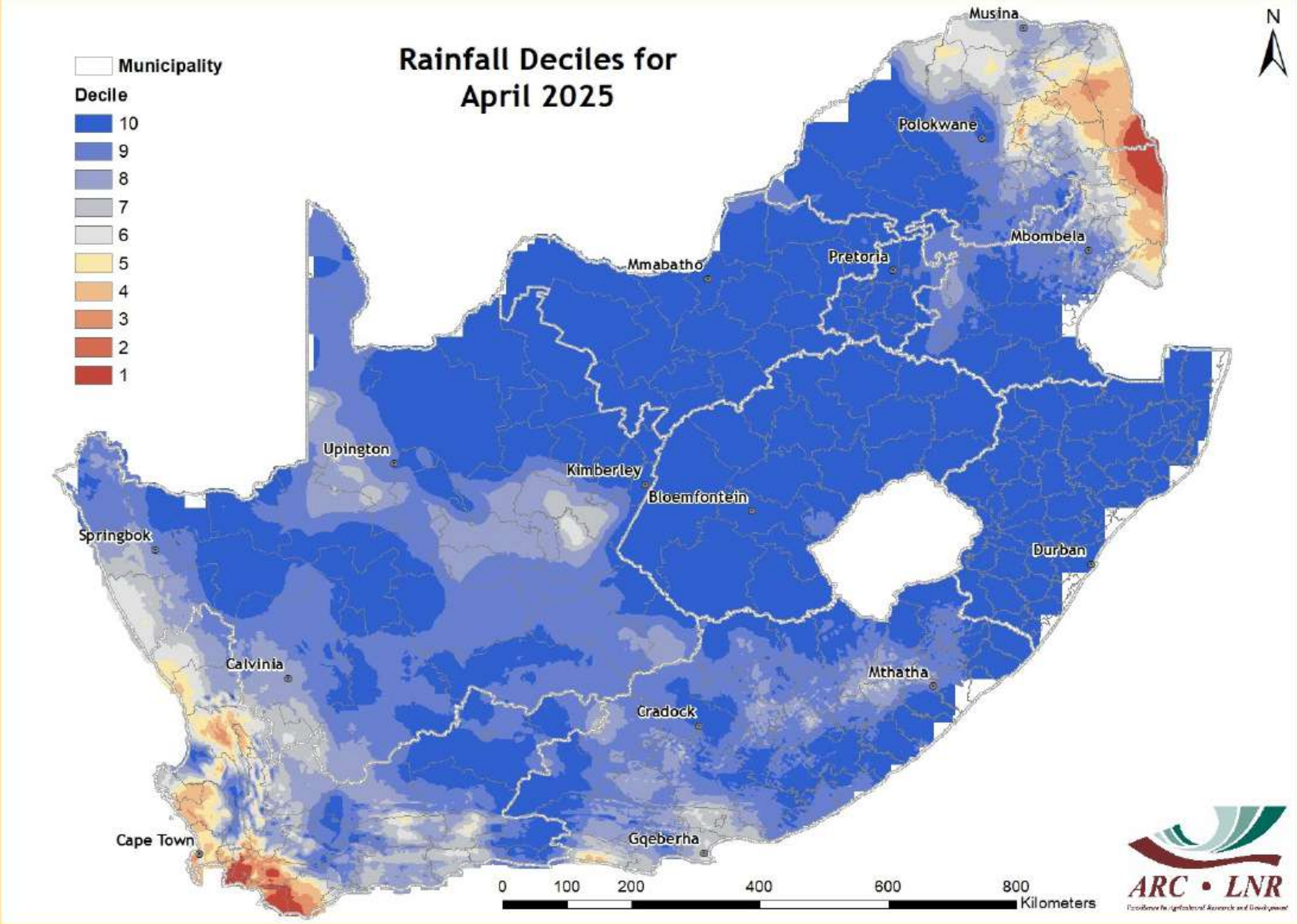


Figure 9

**Figure 9:**
The above-normal rainfall experienced over greater parts of the country during April 2025 was comparable to historically wetter April months. The only areas with rainfall totals similar to those of historically drier April months were the far southwestern and northeastern corners of the country.

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# 4. Vegetation Conditions

## Vegetation Mapping

The Normalized Difference Vegetation Index (NDVI) is computed from the equation:

NDVI=(IR-R)/(IR+R)

where:
IR = Infrared reflectance &
R = Red band

NDVI images describe the vegetation activity. A decadal NDVI image shows the highest possible "greenness" values that have been measured during a 10-day period.

Vegetated areas will generally yield high values because of their relatively high near infrared reflectance and low visible reflectance. For better interpretation and understanding of the NDVI images, a temporal image difference approach for change detection is used.

The Standardized Difference Vegetation Index (SDVI) is the standardized anomaly (according to the specific time of the year) of the NDVI.

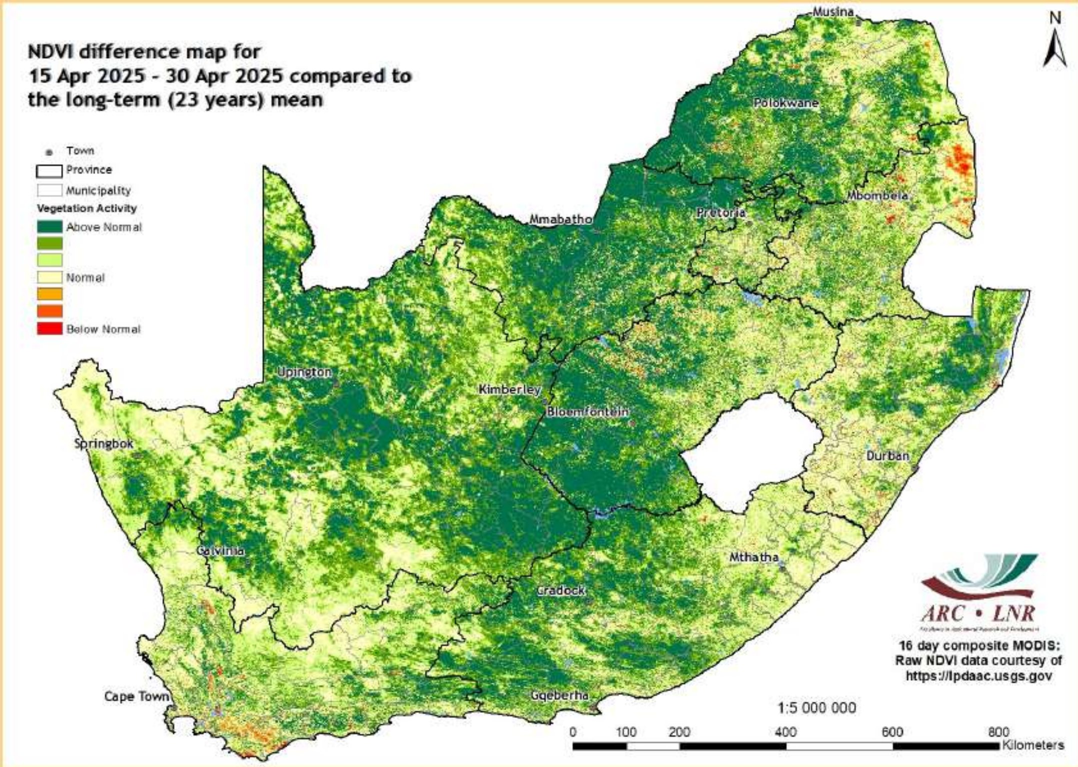


Figure 10

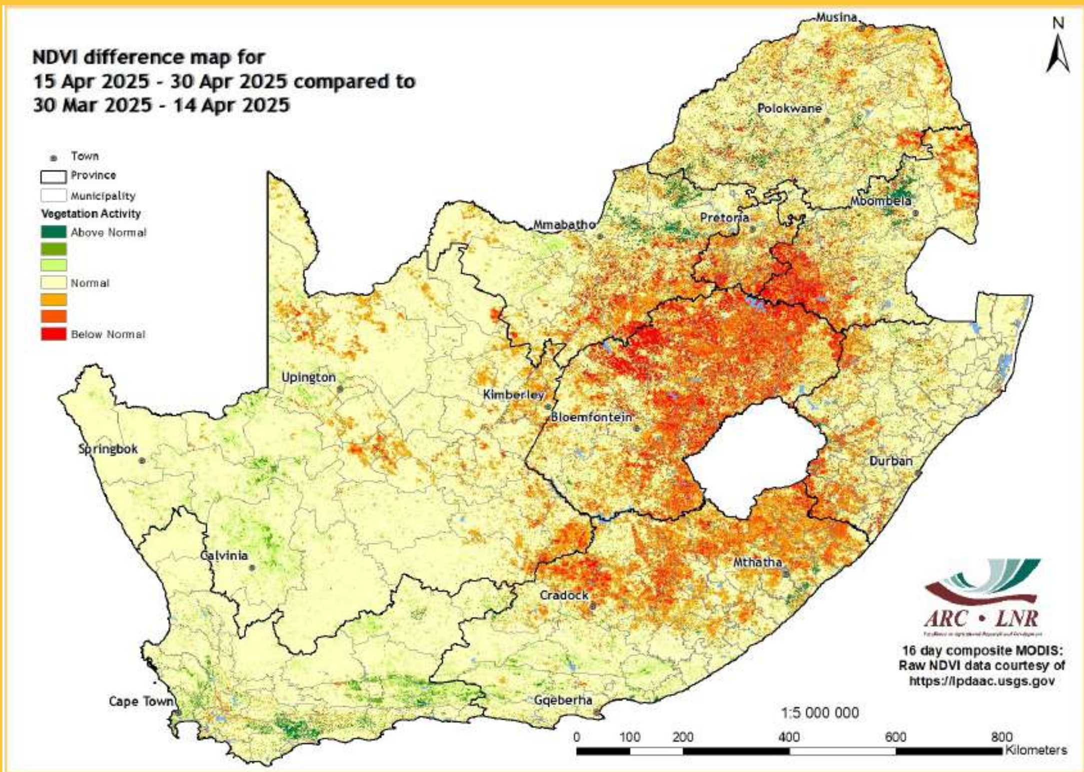


Figure 11

**Figure 10:**
Compared to the historical averaged vegetation conditions, the 16-day NDVI map for April 2025 shows that above-normal conditions persist in many parts of the country with patches of below-normal vegetation activity in isolated areas.

**Figure 11:**
The 16-day NDVI difference map for April 2025 compared to the preceding 16-day period shows that many parts of the country experienced normal to above-normal vegetation conditions, with the exception of the central interior which experienced below-normal activity.

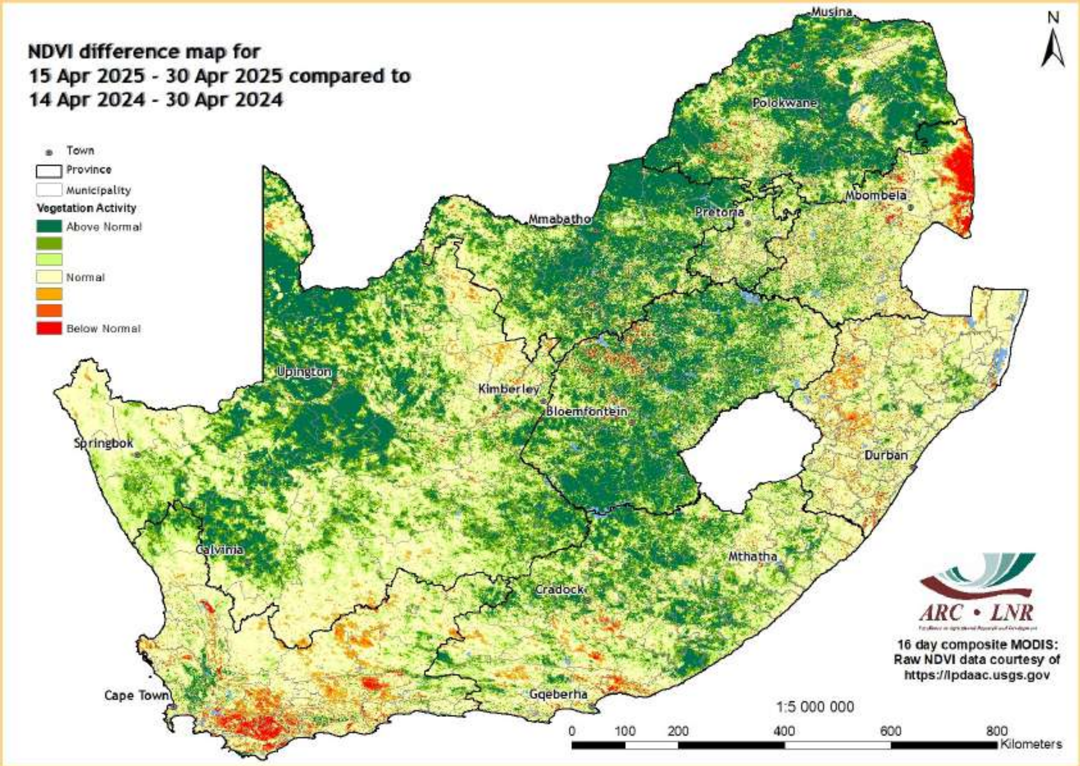


Figure 12

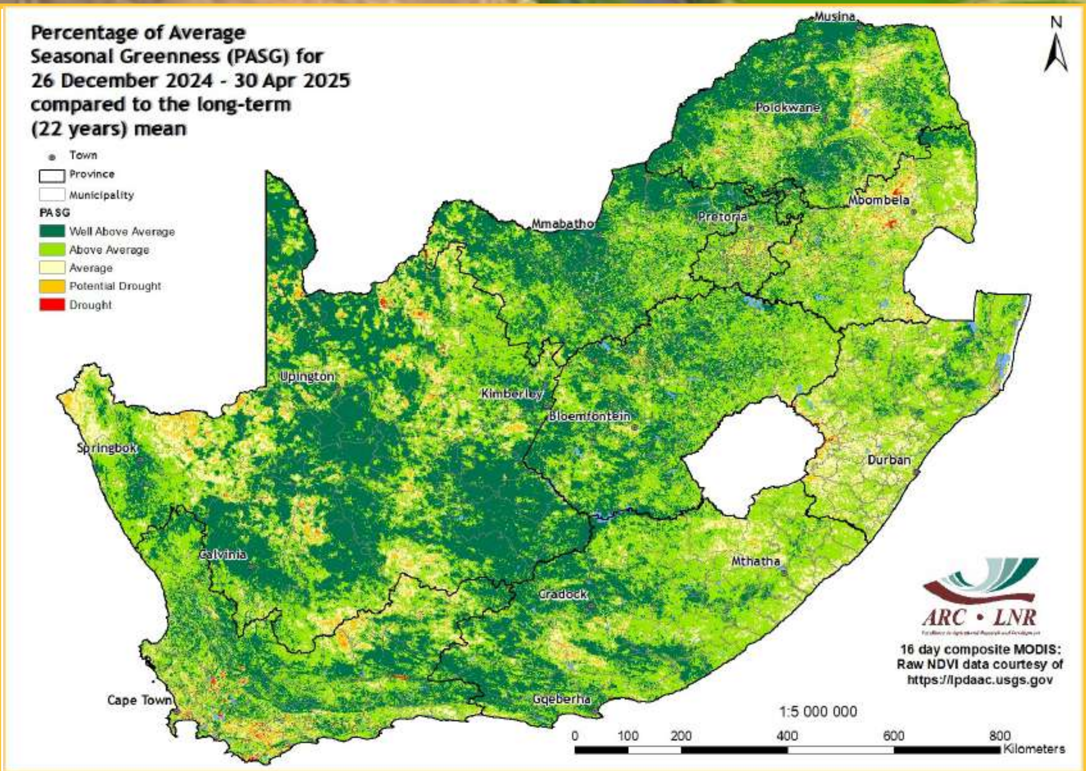


Figure 13

## Vegetation Mapping
***(continued from p. 7)***

### Interpretation of map legend

NDVI-based values range between 0 and 1. These values are incorporated in the legend of the difference maps, ranging from -1 (lower vegetation activity) to 1 (higher vegetation activity) with 0 indicating normal/the same vegetation activity or no significant difference between the images.

### Cumulative NDVI maps:

Two cumulative NDVI datasets have been created for drought monitoring purposes:

**Winter:** January to December
**Summer:** July to June

**Figure 12:**
The 16-day NDVI difference map for April 2025 compared to the same period last year shows that many parts of the country experienced above-normal vegetation conditions, with patches of below-normal activity in isolated areas.

**Figure 13:**
The Percentage of Average Seasonal Greenness (PASG) map for the past 4 months shows that many parts of the country are experiencing above-average vegetation conditions in the current season, with the exception of a few isolated areas that are experiencing potential drought.

**Questions/Comments:**
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# 5. Vegetation Condition Index



## Vegetation Condition Index (VCI)

The VCI is an indicator of the vigour of the vegetation cover as a function of the NDVI minimum and maximum encountered for a specific pixel and for a specific period, calculated over many years.

The VCI normalizes the NDVI according to its changeability over many years and results in a consistent index for various land cover types. It is an effort to split the short-term weather-related signal from the long-term climatological signal as reflected by the vegetation. The VCI is a better indicator of water stress than the NDVI.

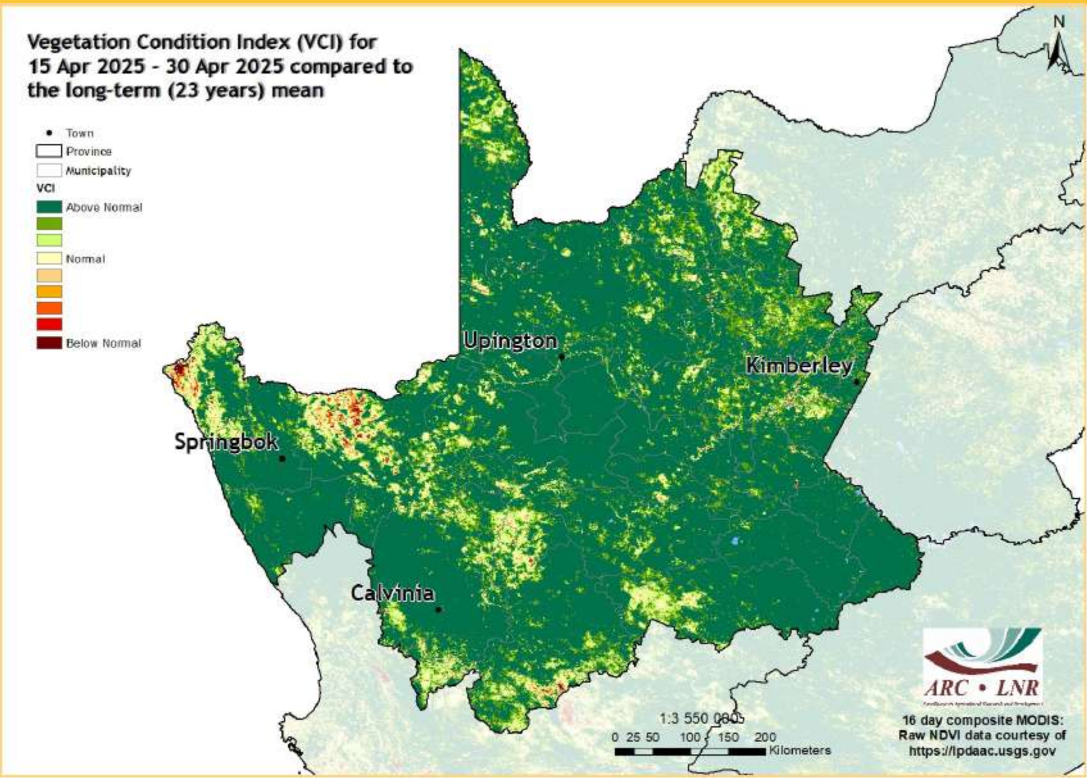



Figure 14

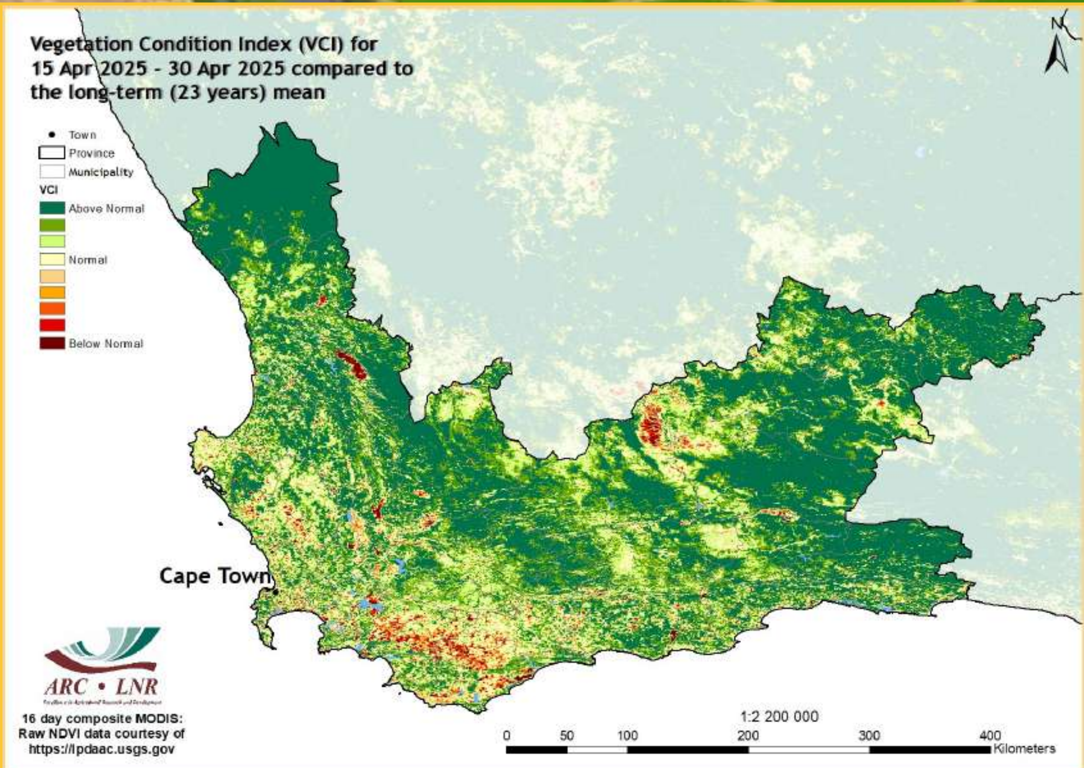
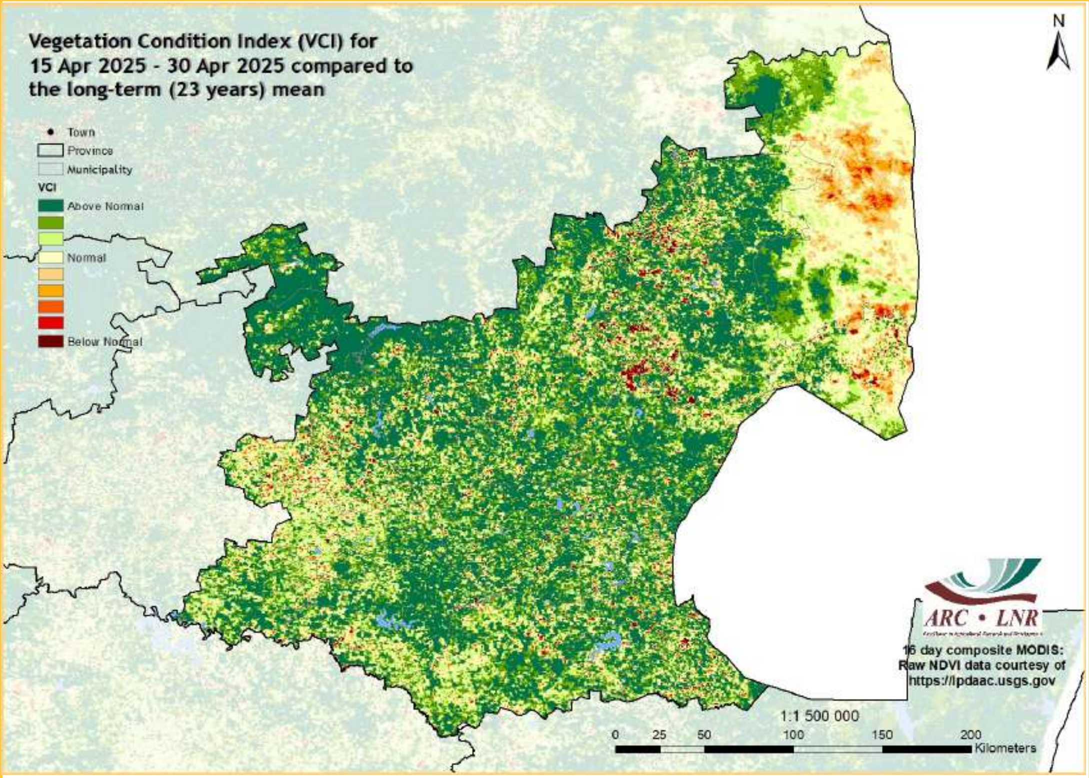



Figure 15

**Figure 14:**
The 16-day VCI map for April 2025 shows that improved vegetation conditions persist across most of the Northern Cape, with the exception of the northwestern parts as well as a few other isolated areas across the province.

**Figure 15:**
The 16-day VCI map for April 2025 shows improved vegetation activity in many parts of the Western Cape, with some patches of below-normal activity in isolated areas.

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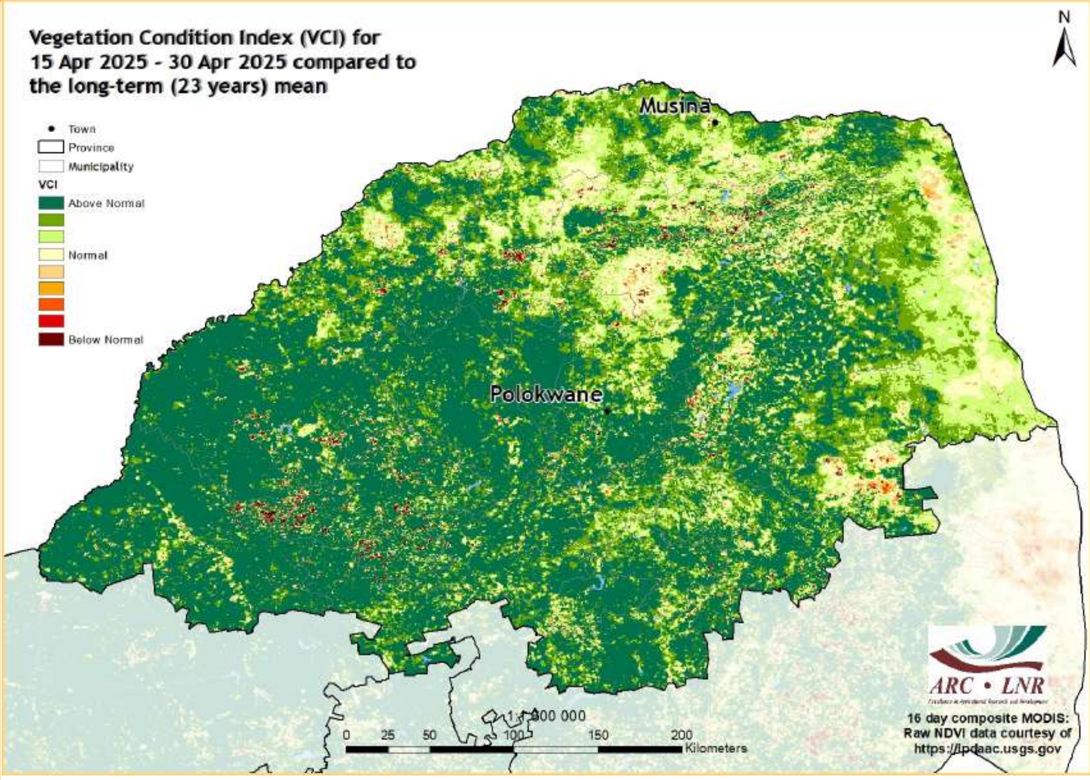


Figure 17

**Figure 16:**
The 16-day VCI map for April 2025 indicates that most parts of Mpumalanga continue to experience above-normal vegetation conditions, except for the far eastern area which experienced below-normal activity.

**Figure 17:**
The 16-day VCI map for April 2025 shows that many parts of Limpopo are experiencing favourable vegetation conditions with patches of below-normal activity in isolated areas.

**Questions/Comments:**
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# 6. Vegetation Conditions & Rainfall

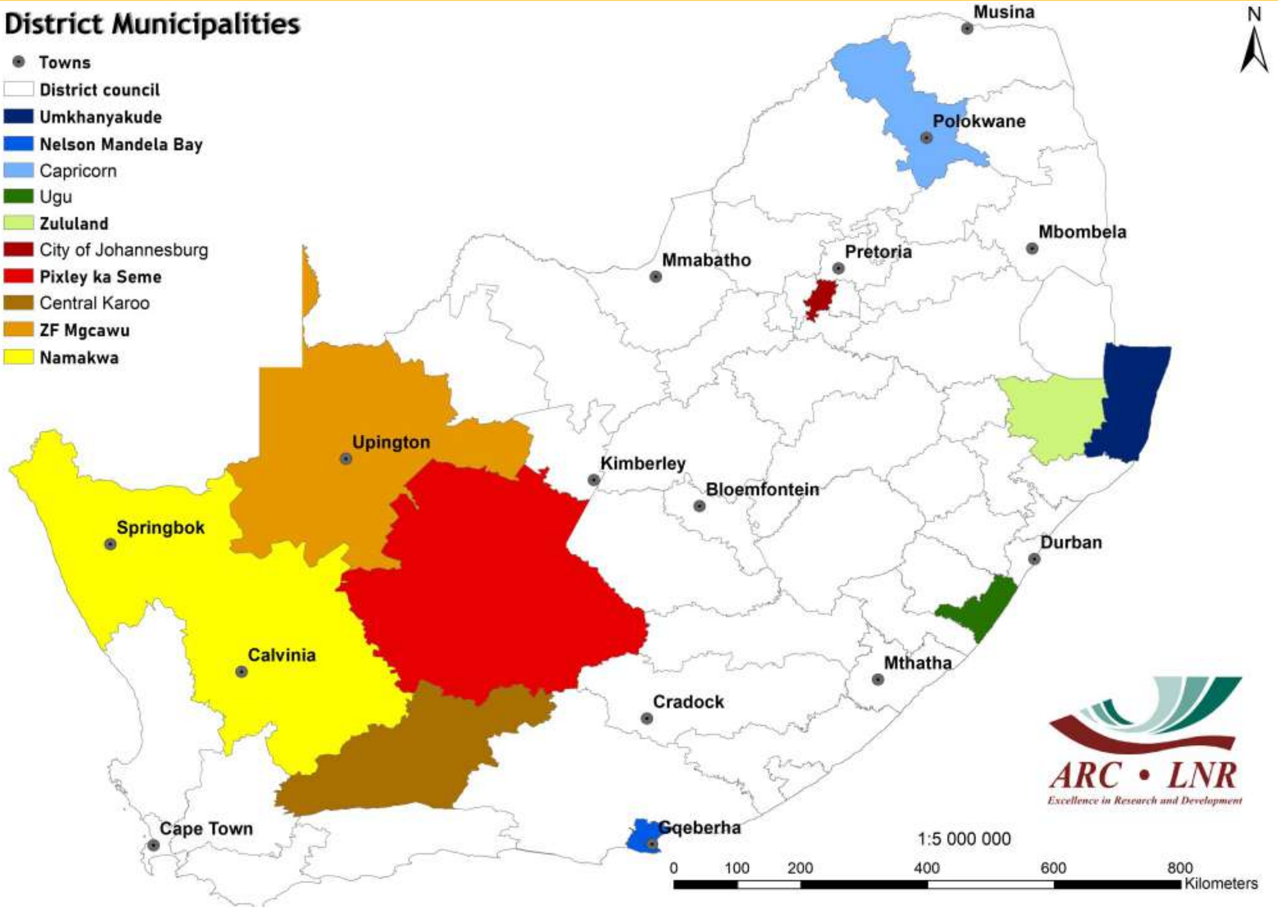


Figure 18

## Rainfall and NDVI Graphs

**Figure 18:**
Orientation map showing the areas of interest for April 2025. The district colour matches the border of the corresponding graph.

**Questions/Comments:**
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**Figures 19-23:**
Indicate areas with higher cumulative vegetation activity for the last year.

**Figures 24-28:**
Indicate areas with lower cumulative vegetation activity for the last year.

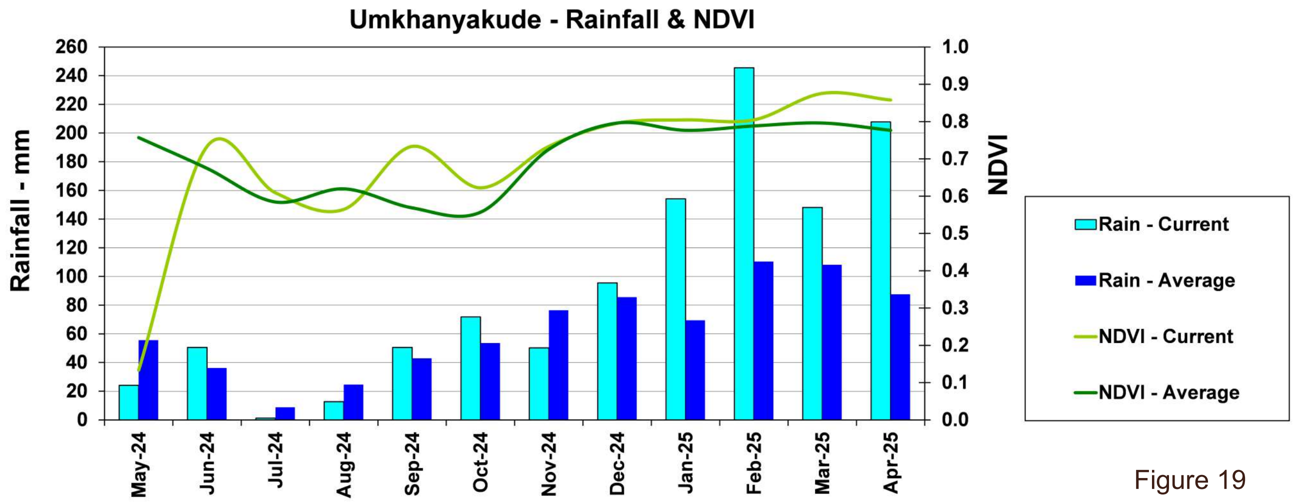
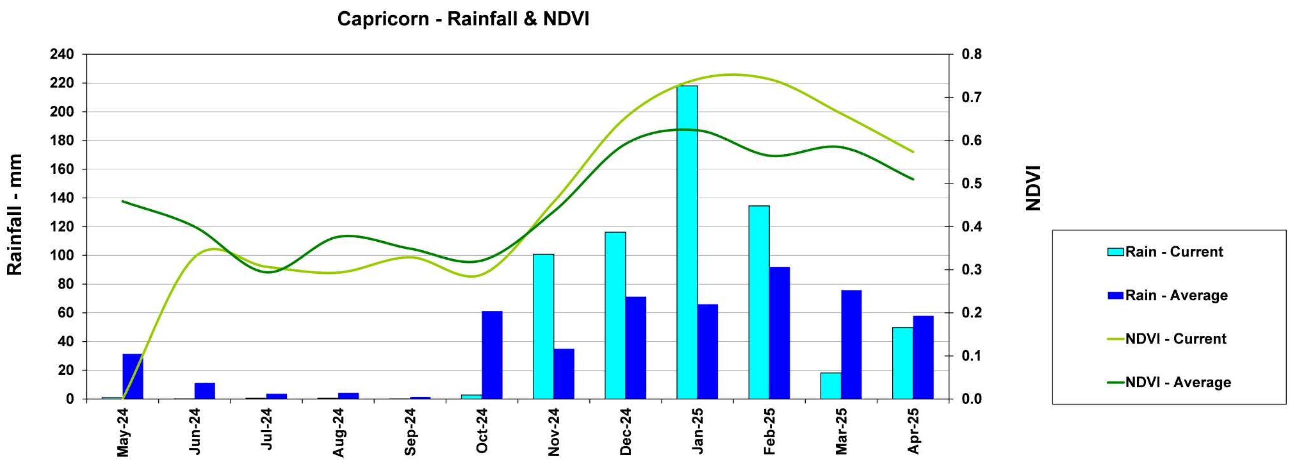



Figure 19

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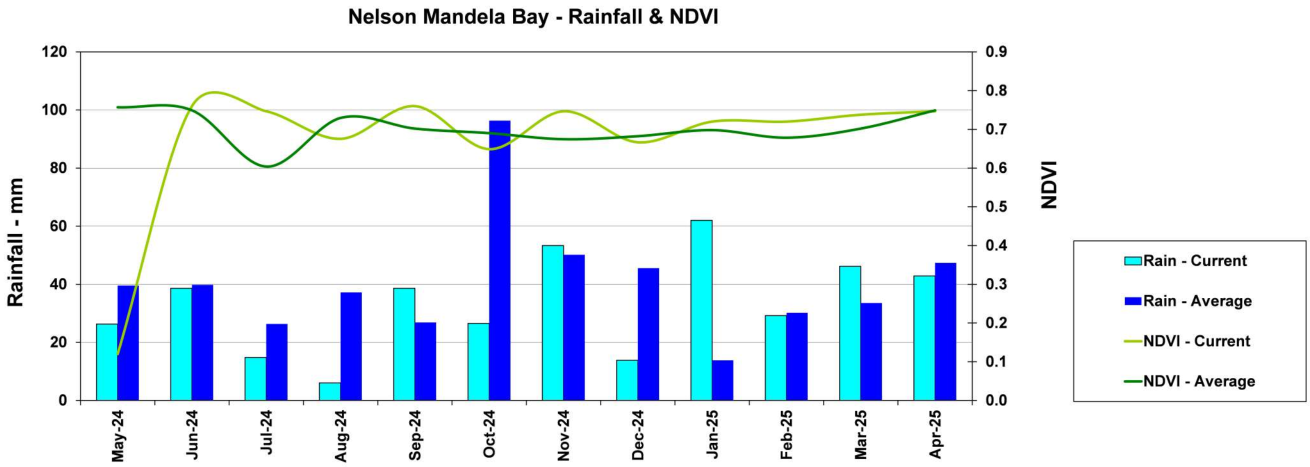


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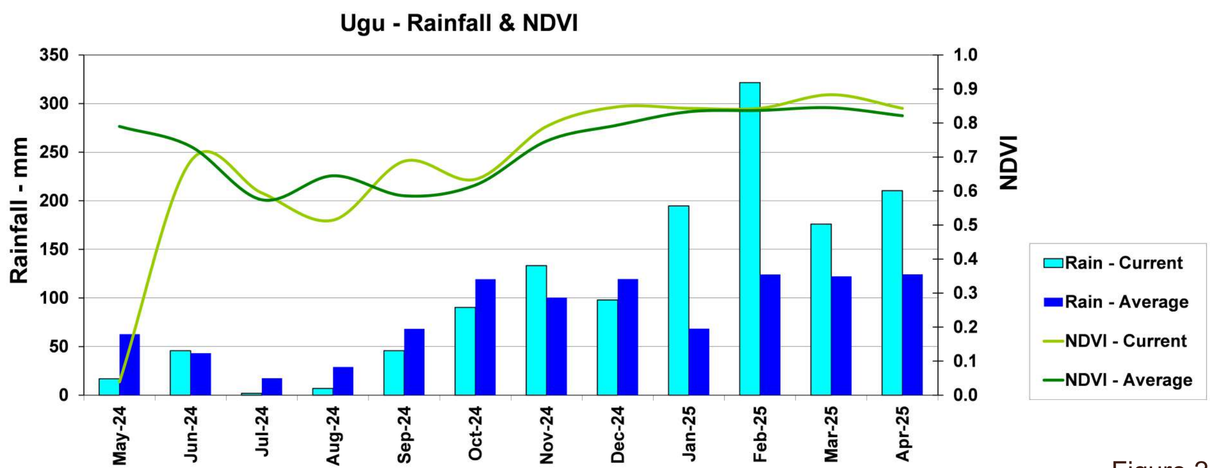


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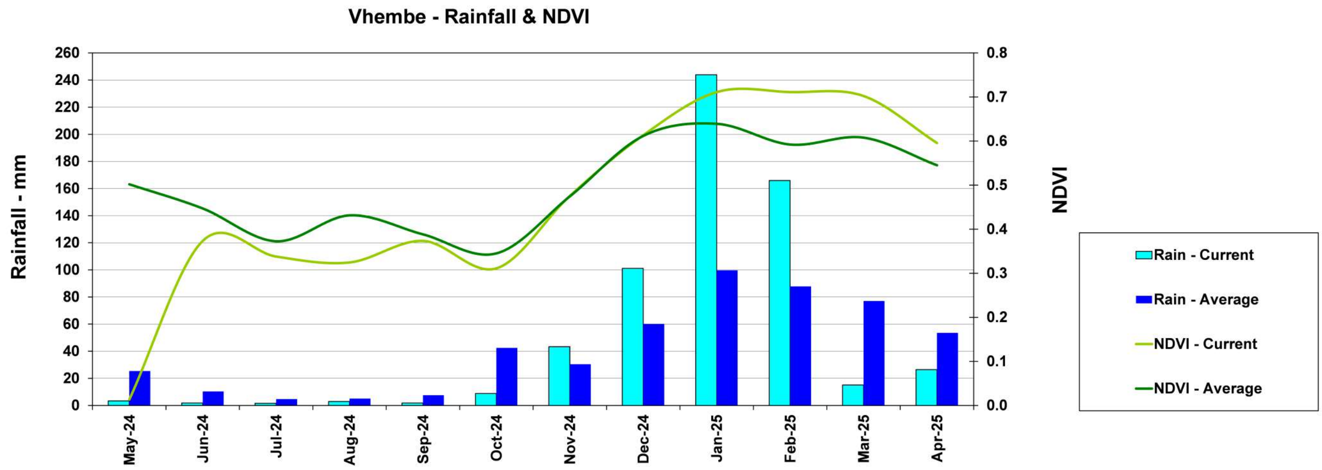


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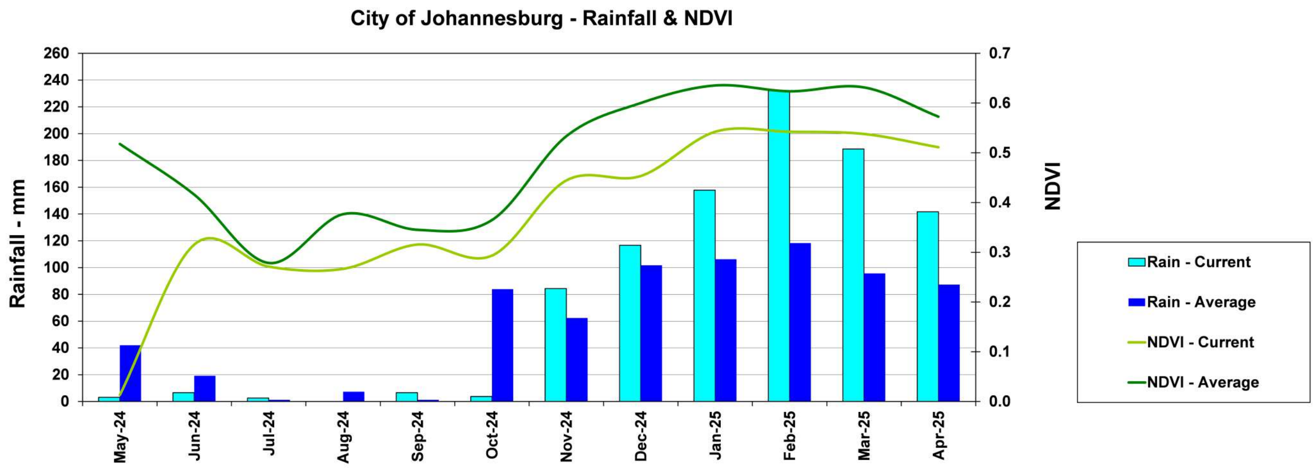
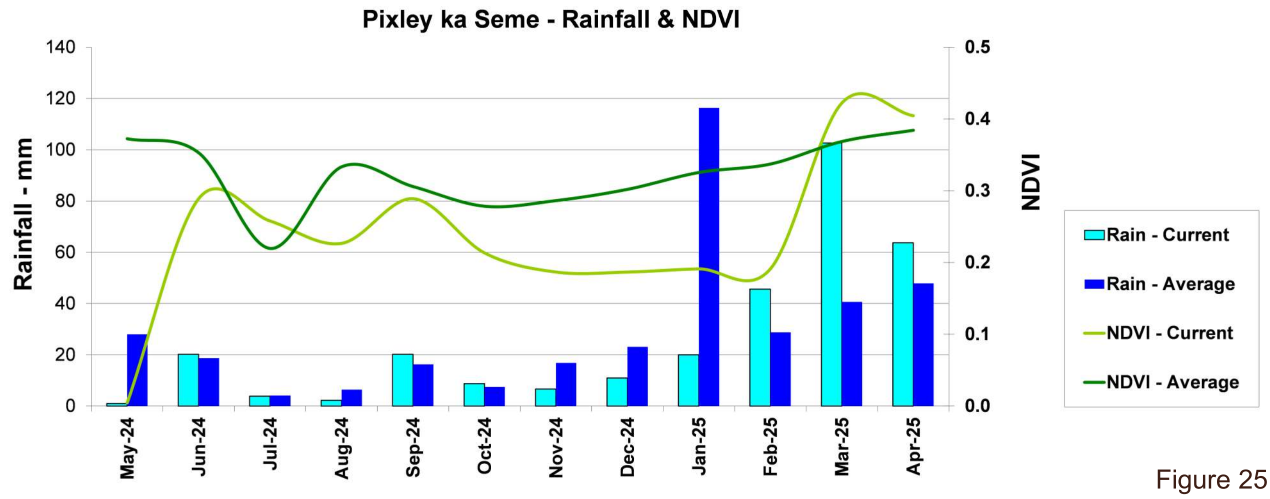



Figure 24

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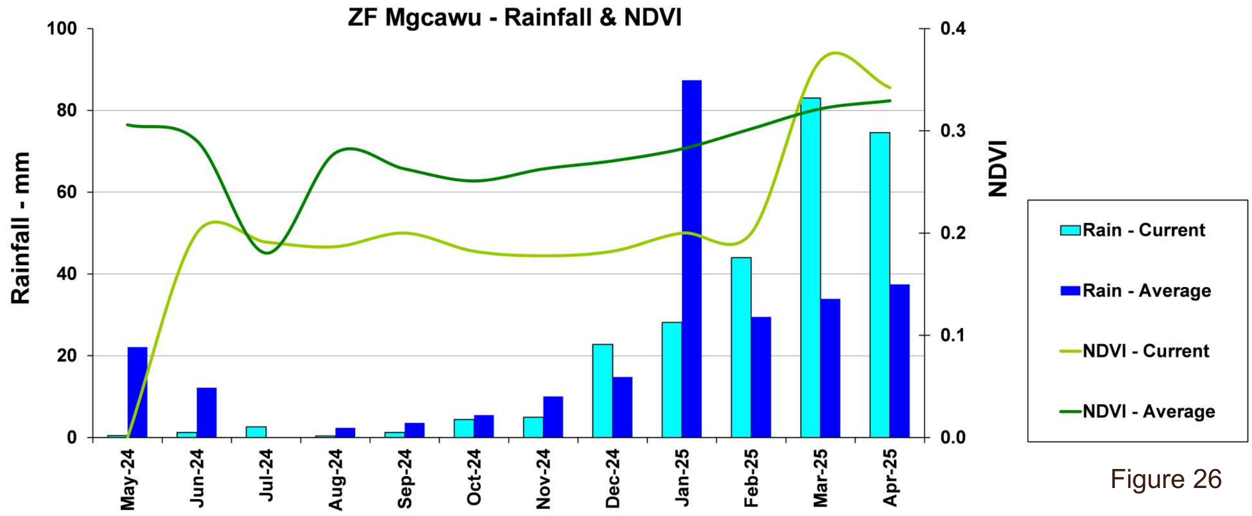


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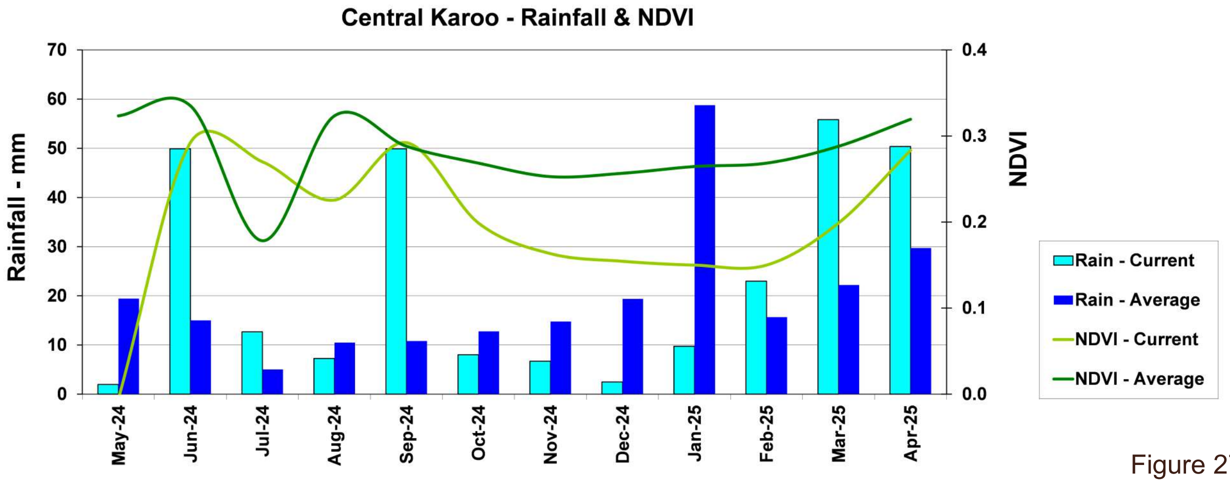


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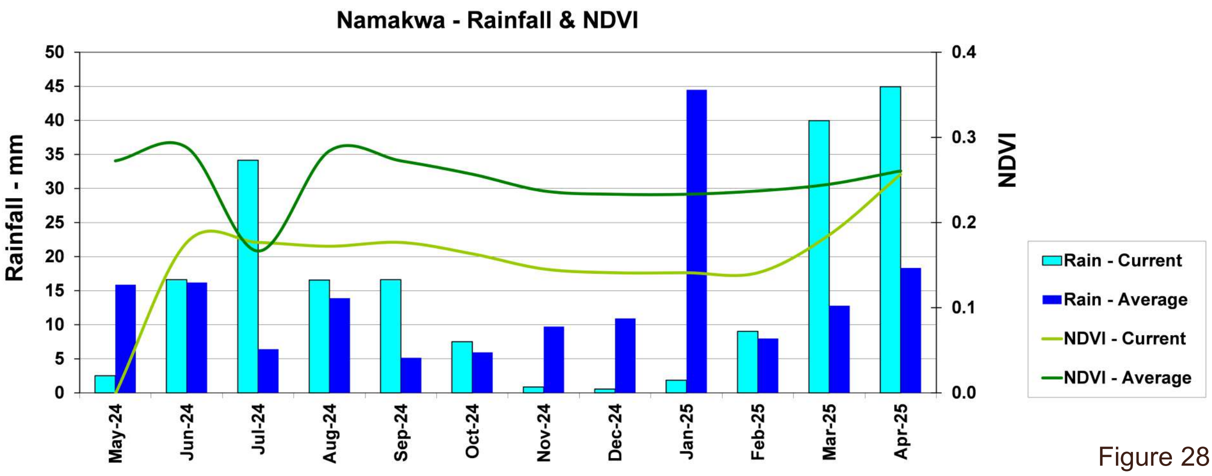


Figure 28

# 7. Fire Watch

**Active Fires** *(Provided when data is available)*

Forest and vegetation fires have temperatures in the range of 500 K (Kelvin) to 1000 K. According to Wien's Displacement Law, the peak emission of radiance for blackbody surfaces of such temperatures is at around 4 μm. For an ambient temperature of 290 K, the peak of radiance emission is located at approximately 11 μm. Active fire detection algorithms from remote sensing use this behaviour to detect "hot spot" fires.

**Figure 29:**
The graph shows the total number of active fires detected from 30 March to 30 April 2025 per province. Fire activity was lower in all provinces compared to the long-term average.

**Figure 30:**
The map shows the location of active fires detected between 30 March and 30 April 2025.

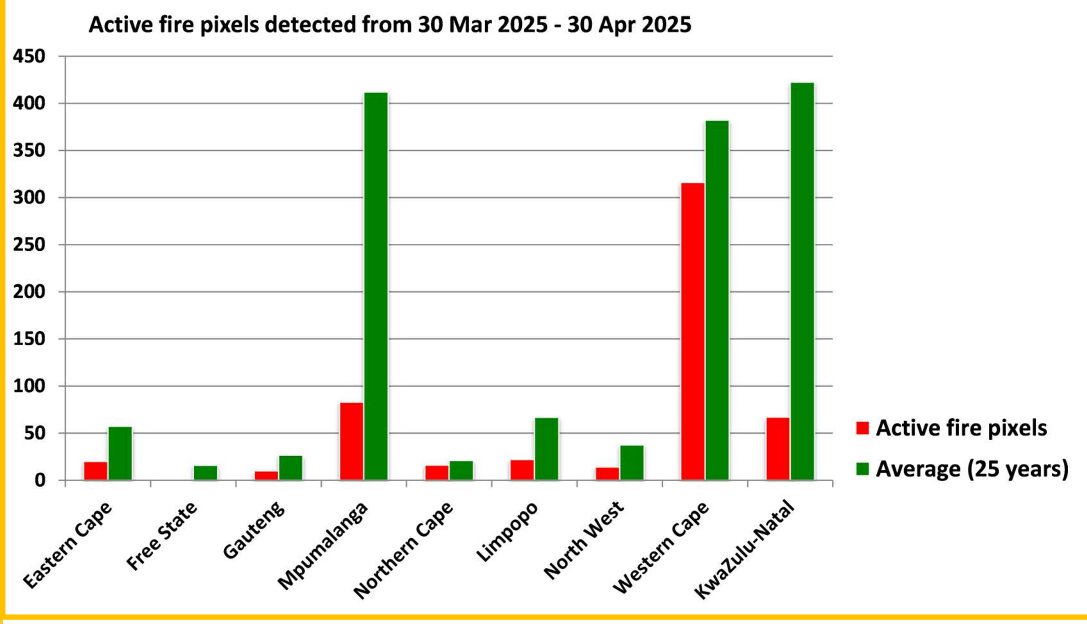


Figure 29

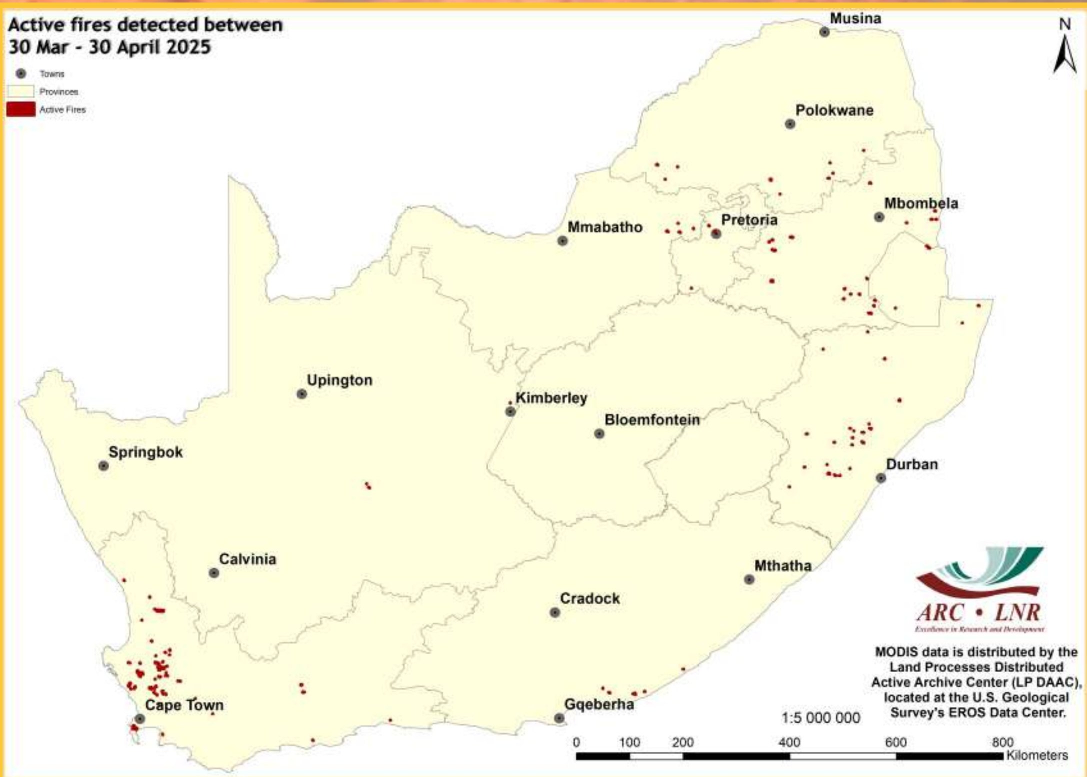


Figure 30

**Active Fires** *(Provided when data is available)*

Forest and vegetation fires have temperatures in the range of 500 K (Kelvin) to 1000 K. According to Wien's Displacement Law, the peak emission of radiance for blackbody surfaces of such temperatures is at around 4 µm. For an ambient temperature of 290 K, the peak of radiance emission is located at approximately 11 µm. Active fire detection algorithms from remote sensing use this behaviour to detect "hot spot" fires.

**Figure 31:**
The graph shows the total number of active fires detected from 1 January to 30 April 2025 per province. Fire activity was lower in all provinces compared to the long-term average.

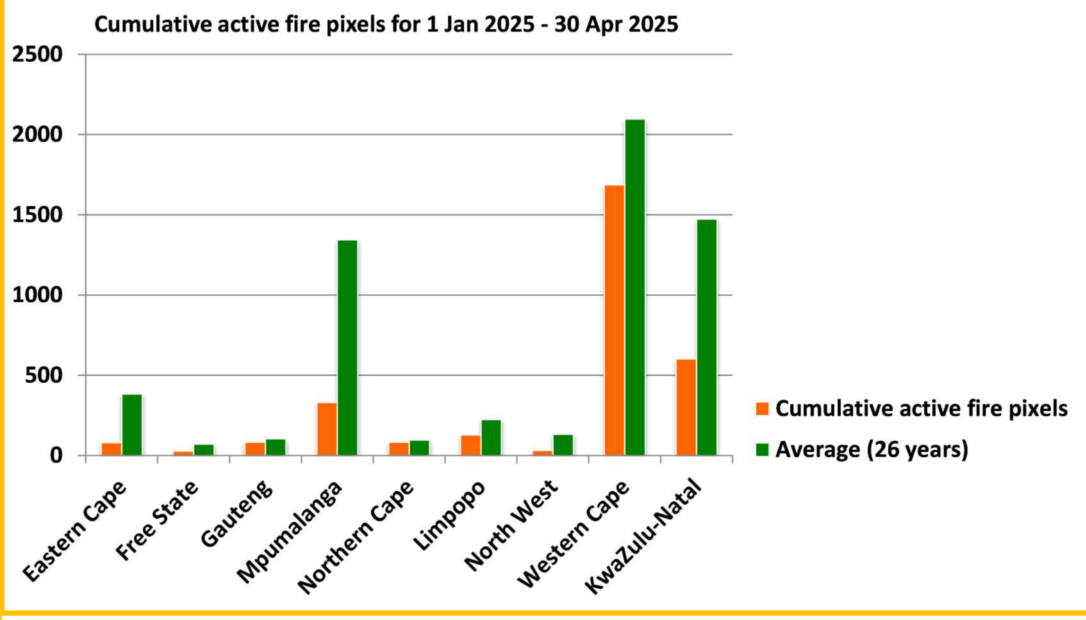


Figure 31

**Figure 32:**
The map shows the location of active fires detected between 1 January and 30 April 2025.

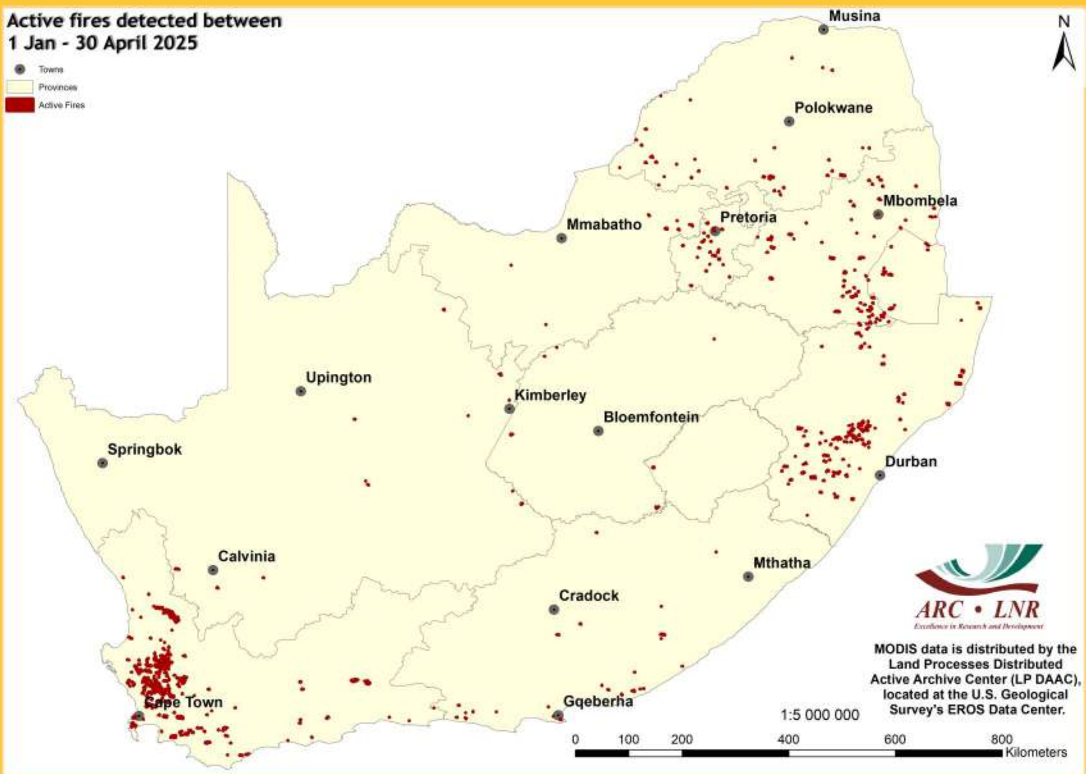


Figure 32

**Questions/Comments:**
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# 8. Surface Water Resources

**Countrywide surface water areas (SWAs) are mapped on a monthly basis by GeoTerraImage using Sentinel-2 satellite imagery from the start of its availability at the end of 2015.**

Figure 33 represents a comparison between the area of water available now and the maximum area of surface water recorded in the last 9 years. This 9-year historical window represents the operational period of the satellite from which the water information has been generated. In this map, any value less than 100 represents water catchments within which the current month's total surface water is less than the maximum extent recorded for the same area since the end of 2015.

Figure 34 represents a comparison between the area of surface water now and for the same month last year. In this map, any value less than 100 represents water catchments within which the current month's total surface water is less than that recorded in the same water catchment, in the same month, last year.

The long-term map for April 2025 continues to show significant increases in water levels across the summer rainfall region, with just about the entire country being at levels of 80-100%. This increase can again be attributed to the impact of the significant persistent rainfall received in this region from January through to April. Only some small areas in the Western Cape and along the Eastern Cape coast are showing lower water levels.

The comparison between April 2025 and Aprl 2024 shows a similar pattern to that observed in the previous month, again representing the significant improvement in water levels across the country. Catchment areas across the northern parts of the Northern Cape, North West and Limpopo provinces show increasing water levels compared to the March comparison, but the Karoo region is starting to show reduced water levels.

*The SWA maps are derived from the monthly data generated and available through GeoTerraImage's 'Msanzi Amanzi' web information service: https://www.water-southafrica.co.za*

**Questions/Comments:**
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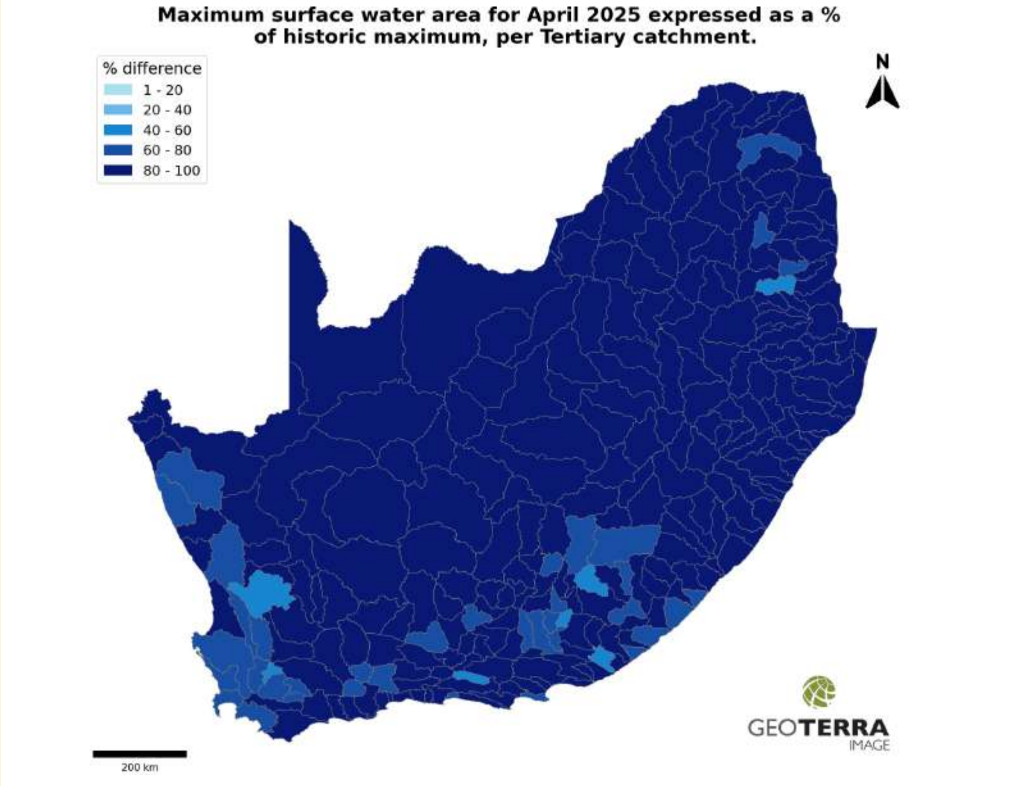


Figure 33

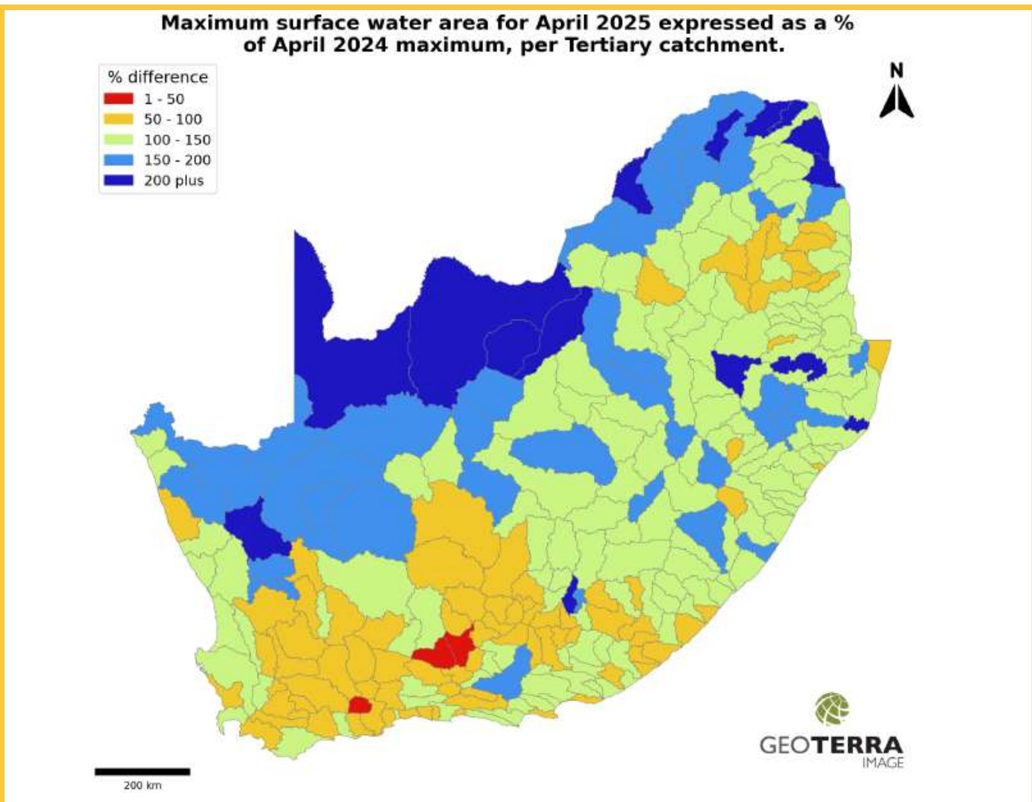


Figure 34

GEOTERRA IMAGE

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ARC - NATURAL RESOURCES AND ENGINEERING

SOIL, CLIMATE AND WATER

# Agrometeorology

***The programme uses weather and climate information for agricultural planning and the enhancement of crop and livestock production systems. The impact of climate variability and change in the agricultural sector is investigated. Due to the increasing pressure to reduce greenhouse gas emissions globally, climate change mitigation is also an important facet of our activities. The Weather Station Network and Climate Database are maintained as a national asset for the benefit of the agriculture sector.***

## Activities

### Agrometeorology and Crop Modelling

- Assessing climate risk for an area in relation to a particular crop
- Agroclimatological analysis of the suitability for crop production at a particular location
- Development of early warning systems for climate hazards (e.g. drought, floods)
- Agrometeorological forecasting and advisory services
- Crop modelling to assess the impact of weather conditions and climate on agriculture
- Conducting crop yield forecasting exercises, hydrological modelling, hydrometeorology and biometereology studies

### Climate Change Adaptation and Mitigation

- Conducting research on possible impact of projected climate change on agricultural activities, potential, greenhouse gas emissions from various land use, climate change, mitigation and adaptation strategies for agriculture
- Developing greenhouse gas inventories at farm and national levels
- Conducting research on climate change mitigation and adaptation strategies for agriculture
- Promoting low-carbon technologies

### Climate Monitoring, Products and Services

- Developing and maintaining a network of over 500 weather stations distributed all over the country
- Archiving historical and current weather data of good quality with some datasets dating back to 1900
- Developing weather/climate products and services together with stakeholders and clients to meet their specific requirements
- Disseminating weather/climate data, products and services via multiple platforms

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## ARC - NATURAL RESOURCES AND ENGINEERING

## SOIL, CLIMATE AND WATER

# GeoInformatics

***The programme focuses on applied Geographical Information Systems (GIS) and provides leadership in GIS products, solutions and decision support systems for agriculture and natural resources management. The Coarse Resolution Satellite Image Archive and Information Database is maintained as a national asset.***

## Activities

### Digital/Smart Agriculture/Drone Platform - Applications

- Yield & production estimation
- Insurance index
- Mapping crop types
- Monitoring growth stages
- Weed/invasive sp. mapping
- Water requirement
- Smart & digital agriculture
- Disease/pests

### Applications in Natural Resources/National Assets

- Early warnings
- National & Provincial advisories
- Crop suitability changes
- Crop statistics
- Crop stress
- Spatially explicit information dissemination systems, e.g. Umlindi newsletter

### Applications in Rangelands, Livestock and Wildlife

- Early warnings
- National & Provincial advisories
- Rangeland suitability
- Rangeland dynamics
- Rangeland stresses
- Spatially explicit information dissemination systems, e.g. Umlindi newsletter

***Contact Person:*** *Dr George Chirima*
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**ARC-Natural Resources and Engineering**
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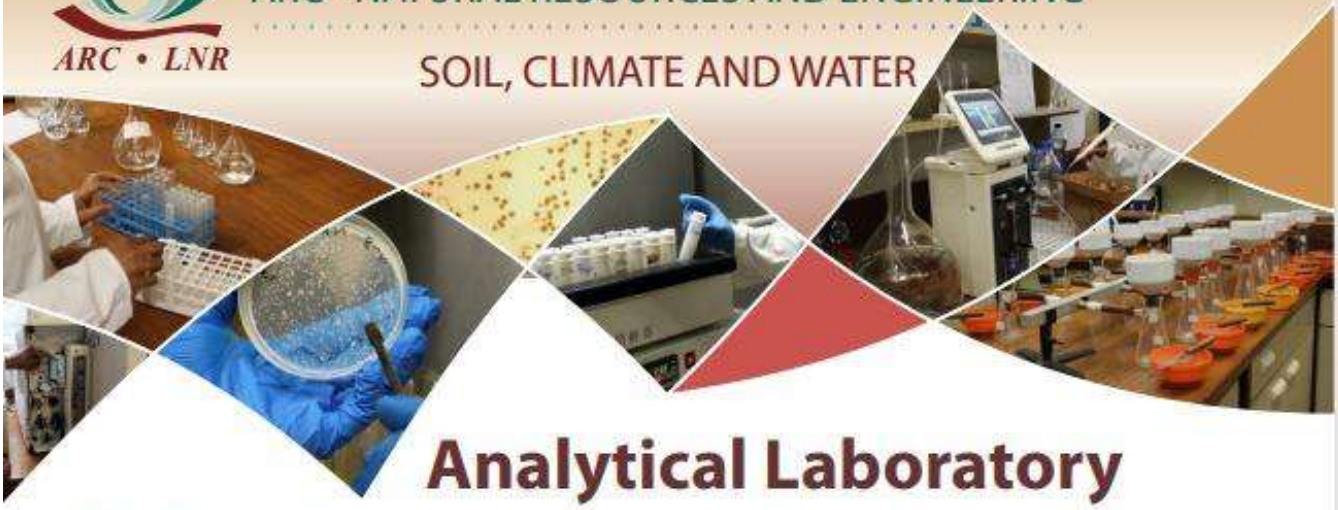

# Analytical Laboratory

***The unit focuses on the various procedures to analyze and determine the properties of soil, water and associated materials, mainly for agricultural purposes. The laboratory operates a range of equipment and participates in various quality control schemes, both local and international. The water analysis for anions is SANAS-accredited and other accreditations are underway.***

## Analyses and Services

### Soil Physical Analysis

- Texture (sand, silt and clay content)
- Water-holding capacity
- Soil moisture content
- Bulk density
- Shrink-swell capacity

### Soil Chemical Analysis

- pH
- Exchangeable and extractable cations
- Acidity
- Soil Organic Carbon
- Nitrogen content and C/N ratio
- Phosphorus
- Micronutrients

### Soil Fertility

- Analysis package for farmers & gardeners
- Fertilizer recommendations for specific crops

### Water Analysis

- pH, EC, anions, cations
- Water quality

### ICP Scan

- Semi-quantitative scan for a range of elements (Li, Be, Ti, V, Cr, Mn, Co, Ni, Cu, Zn, As, Se, Rb, Sr, Mo, Cd, Sn, Sb, Te, Cs, Ba, La, W, Pt, Hg, Tl, Pb, Bi, U), can be done on soil, water and plant

### Plant Material Analysis

For example: leaves, roots, growth media, etc. – drying, milling, pH, EC, C, N, nutrients and toxic elements

### Special Sample Analysis

- For example: sludges, compost, fertilizers – composition and other properties
- Elemental analysis of animal tissue (e.g. hair, bones, liver, muscle, milk)

***For more information or to obtain prices or quotation, contact the Laboratory Manager:*** *Ms. Zanele Hlam*
*Tel: 012 310 2531 • E-mail: HlamZ@arc.agric.za*

***In order to assist clients who wish to send samples to ARC, the courier costs can be borne by ARC for analysis packages of R10 000 or more.***

***Contact the Laboratory Manager for details.***

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# Microbiology and Environmental Biotechnology Laboratory

***The Microbiology and Environmental Biotechnology Research Group forms part of the Soil Science Programme at ARC-SCW. The research group utilizes both fundamental as well as applied microbiology and biotechnology approaches to address soil, climate and water related problems in a sustainable and eco-friendly manner.***

## Analyses and Services

**Renewable energy generation**

- Gas Chromatography analysis of biogas - methane and carbon dioxide content measurements

**Nanotechnology**

- UV-Visible spectrophotometer analysis for colloidal nanoparticle synthesis

**Phytochemical extraction**

- Hotplate extraction of phytochemicals
- Soxhlet extraction of phytochemicals
- Microwave-assisted extraction of phytochemicals

**Community-Level Physiological Profiling (CLPP)**

- Microbial functional analysis using Biolog 31C plates

***For information on microbiological analyses contact***
*Dr Ashira Roopnarain*
*Tel: 012 310 2650 • E-mail: RoopnarainA@arc.agric.za*

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# The Coarse Resolution Imagery Database (CRID)

**NOAA AVHRR**

ARC-NRE has an archive of daily NOAA AVHRR data dating from 1985 to 2004. This database includes all 5 bands as well as the Normalized Difference Vegetation Index (NDVI), Active Fire and Land Surface Temperature (LST) images. The NOAA data are used, for example, for crop production and grazing capacity estimation.

**MODIS**

MODIS data is distributed by the Land Processes Distributed Active Archive Center (LP DAAC), located at the U.S. Geological Survey's EROS Data Center. The MODIS sensor is more advanced than NOAA with regard to its high spatial (250 $m^2$ to 1 $km^2$) and spectral resolution. ARC-NRE has an archive of MODIS (version 4 and 5) data.

- MODIS v4 from 2000 to 2006
- MODIS v5 from 2000 to present

Datasets include:

- MOD09 (Surface Reflectance)
- MOD11 (Land Surface Temperature)
- MOD13 (Vegetation Products)
- MOD14 (Active Fire)
- MOD15 (Leaf Area Index & Fraction of Photosynthetically Active Radiation
- MOD17 (Gross Primary Productivity)
- MCD43 (Albedo & Nadir Reflectance)
- MCD45 (Burn Scar)

Coverage for version 5 includes South Africa, Namibia, Botswana, Zimbabwe and Mozambique.
More information:
**http://modis.gsfc.nasa.gov**

**VGT4AFRICA and GEOSUCCESS**

SPOT NDVI data is provided courtesy of the VEGETATION Programme and the VGT4AFRICA project. The European Commission jointly developed the VEGETATION Programme. The VGT4AFRICA project disseminates VEGETATION products in Africa through GEONETCast.

ARC-NRE has an archive of VEGETATION data dating from 1998 to the present. Other products distributed through VGT4AFRICA and GEOSUCCESS include Net Primary Productivity, Normalized Difference Wetness Index and Dry Matter Productivity data.

**Meteosat Second Generation (MSG)**

ARC-NRE has an operational MSG receiving station. Data from April 2005 to the present have been archived. MSG produces data with a 15-minute temporal resolution for the entire African continent. Over South Africa the spatial resolution of the data is in the order of 3 km. ARC-NRE investigated the potential for the development of products for application in agriculture. NDVI, LST and cloud cover products were some of the initial products derived from the MSG SEVIRI data. Other products derived from MSG used weather station data, including air temperature, humidity and solar radiation.

**Rainfall maps**

- Combined inputs from 450 automatic weather stations from the ARC-NRE Soil, Climate and Water weather station network, 270 automatic rainfall recording stations from the South African Weather Service (SAWS), satellite rainfall estimates from the Famine Early Warning System Network: **http://earlywarning.usgs.gov** and long-term average climate surfaces developed at the ARC-NRE.

**Solar Radiation and Evapotranspiration maps**

- Combined inputs from 450 automatic weather stations from the ARC-NRE Soil, Climate and Water weather station network.
- Data from the METEOSAT Second Generation (MSG) 3 satellite via GEONETCAST: **http://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/GEONETCast/index.html**.

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## NATURAL RESOURCES AND ENGINEERING
## Soil, Climate and Water

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**Reneilwe Maake**
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**The operational Coarse Resolution Imagery Database (CRID) project of ARC-NRE is funded by the Department of Agriculture, Land Reform and Rural Development (DALRRD). Development of the monitoring system was made possible at its inception through LEAD funding from the Department of Science and Technology.**

For further information please contact:
*Reneilwe Maake – 012 310 2533,* MaakeR@arc.agric.za

To subscribe to the newsletter, please submit a request to:
**MaakeR@arc.agric.za**

***What does Umlindi mean?***
*UMLINDI is the Zulu word for "the watchman".*