



**INSTITUTE
FOR SOIL,
CLIMATE
AND WATER**

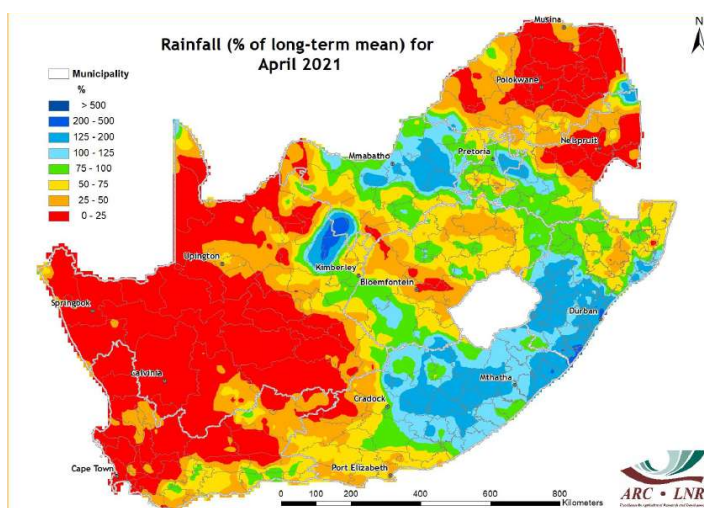
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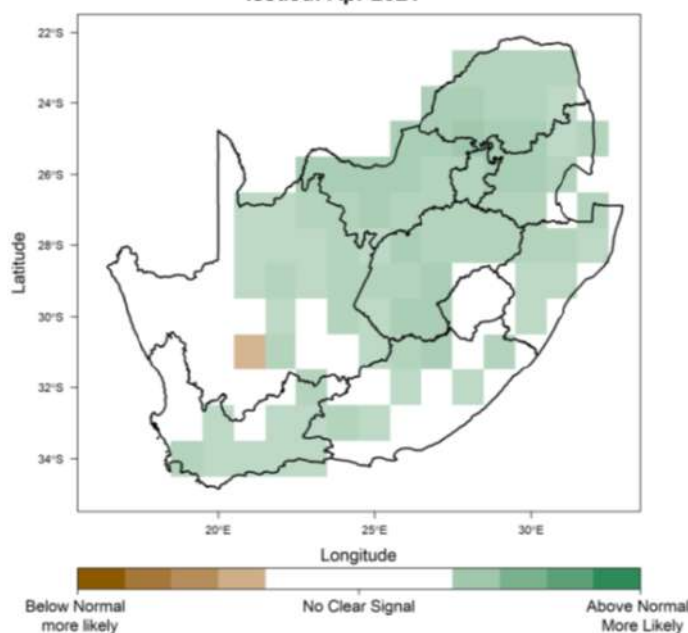
Images of the Month

Onset and outlook for 2021 winter rainfall season

The winter rainfall region experienced a weak start to its rainfall season, recording below-normal rainfall in April 2021 (see rainfall map) - the lowest for 5 years over this region. However, rainfall prospects should start to improve during the month of May over the southwestern parts of the country as frontal weather systems move in over this area. Moreover, the April 2021 seasonal forecast issued by the South African Weather Service predicts normal to above-normal rainfall conditions during the early winter (May-June-July) period (see map below right). This suggests a replenishment of soil water and favourable conditions for planting winter crops such as barley and wheat. Hence, an increase in intended planting area for the 2021 production season (compared to 2020) for wheat in the Western Cape, as reported by the Crop Estimates Committee. However, it is important to note that the outlook for rainfall remains uncertain during the remainder of the winter season. The seasonal forecast further predicts the occurrence of above-normal minimum and maximum temperatures over the entire country, thus supporting potential late onset of frost for the maize production areas and a concern for deciduous fruits as high temperatures during winter can alter the length of the dormancy period.



Expected Precipitation Conditions for MJJ 2021 Issued: Apr 2021



Source: South African Weather Service (SAWS), April 2021



203rd Edition

Overview:

April 2021 was dry over much of South Africa. With the winter season beginning, an evident decrease in total rainfall was notable over the western and northeastern parts of the country. Although dry conditions with total rainfall of 0 to 5 mm prevailed, some parts of the summer rainfall region received large amounts during the month, including the Highveld and southern KwaZulu-Natal, extending southwards to the Eastern Cape coast. These high rainfall totals compare well with those of historically wetter April months. Areas along the Garden Route and the southeastern coastal belt experienced similar conditions, with thick bands of clouds bringing in isolated showers that resulted in totals of up to 75 mm.

The month began with cool temperatures and heavy rains over Gauteng, southern parts of North West and the Western Cape. Towards mid-April, rainfall was confined to KZN, the Eastern and Western Cape, whilst light showers were observed over Limpopo. The last few days of the month were characterized by cold weather over the southern, central and eastern parts of the country, as well as widespread rainfall due to a cold front which made landfall on the 28th. Light snowfall was also observed over the Drakensberg and Maluti mountain regions.

1. Rainfall

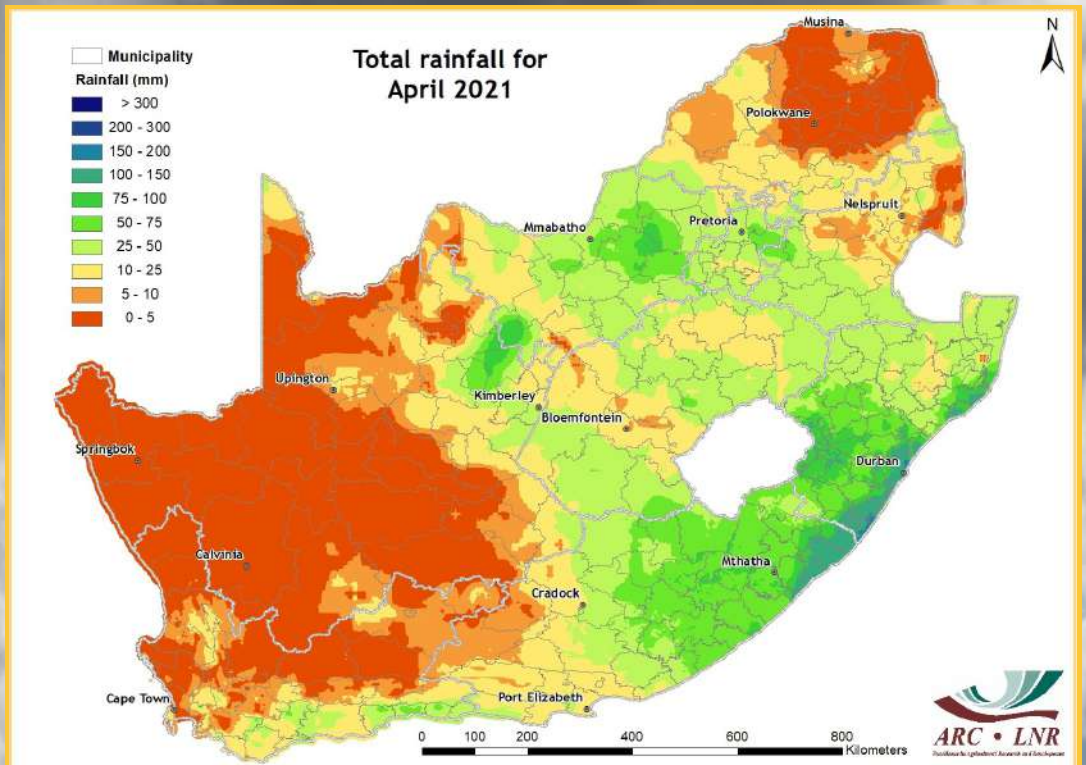


Figure 1

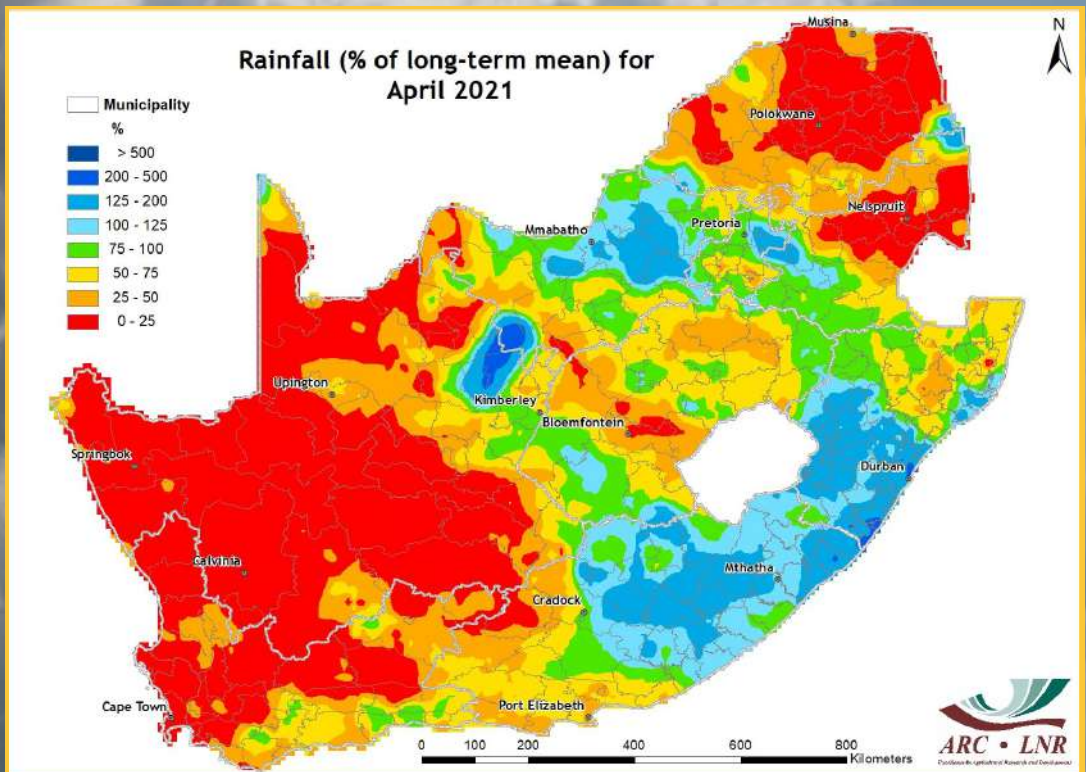


Figure 2

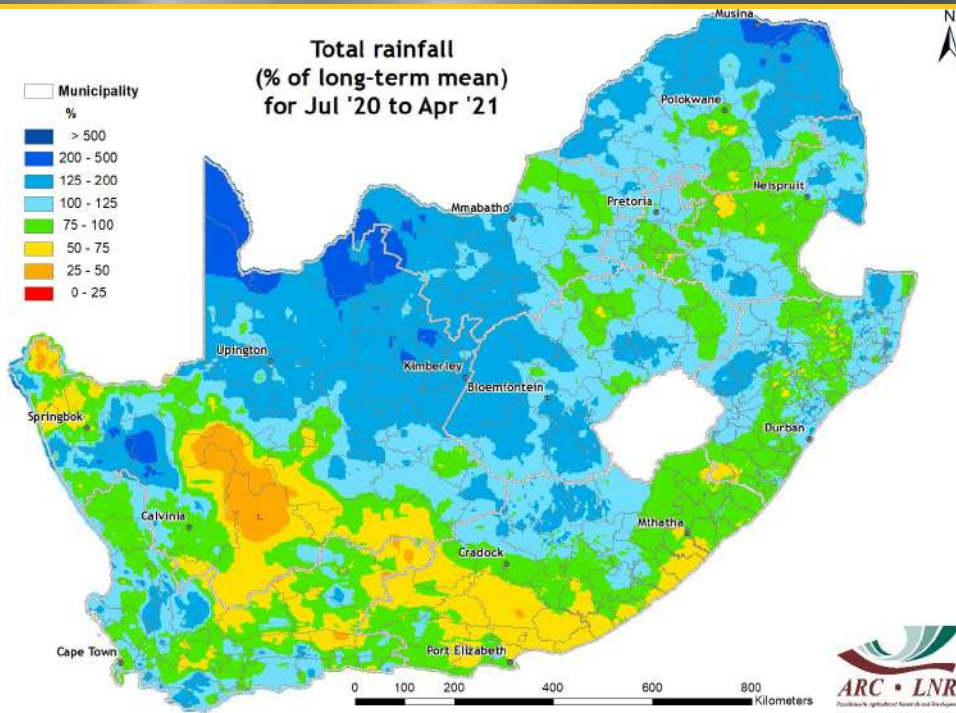


Figure 3

Figure 1:

Rainfall in April was confined to the interior, extending eastwards to the KwaZulu-Natal and Eastern Cape coasts. Rainfall was largely absent over greater parts of the Northern Cape, Limpopo, Mpumalanga and the Western Cape, but the all-year rainfall region recorded totals of up to 75 mm.

Figure 2:

Above-normal rainfall was observed over parts of the summer rainfall region, including North West, eastern Northern Cape, Gauteng, KZN and the Eastern Cape. Below-normal rainfall occurred over the northeastern parts of the country, in particular the Limpopo and Mpumalanga provinces. Similar conditions were notable over the western parts which poses a concern for the winter rainfall region.

Figure 3:

Rainfall totals for the period between July 2020 and April 2021 indicate that near- to below-normal conditions occurred over much of the Cape provinces, KZN and further north towards Mpumalanga and Limpopo. Meanwhile, above-normal rainfall occurred over the central provinces, greater parts of Limpopo and the southwestern parts of the country.

Figure 4:

When comparing rainfall during February to April 2021 with that of the previous year, areas that received more rain were isolated parts of KZN, Mpumalanga, Limpopo, North West and the Northern Cape (towards the Botswana border). Areas that recorded a difference of <-150 mm for the 3-month period include the central and southern interior as well as much of the Eastern Cape. The rest of the country received relatively the same amount of rainfall as last year.

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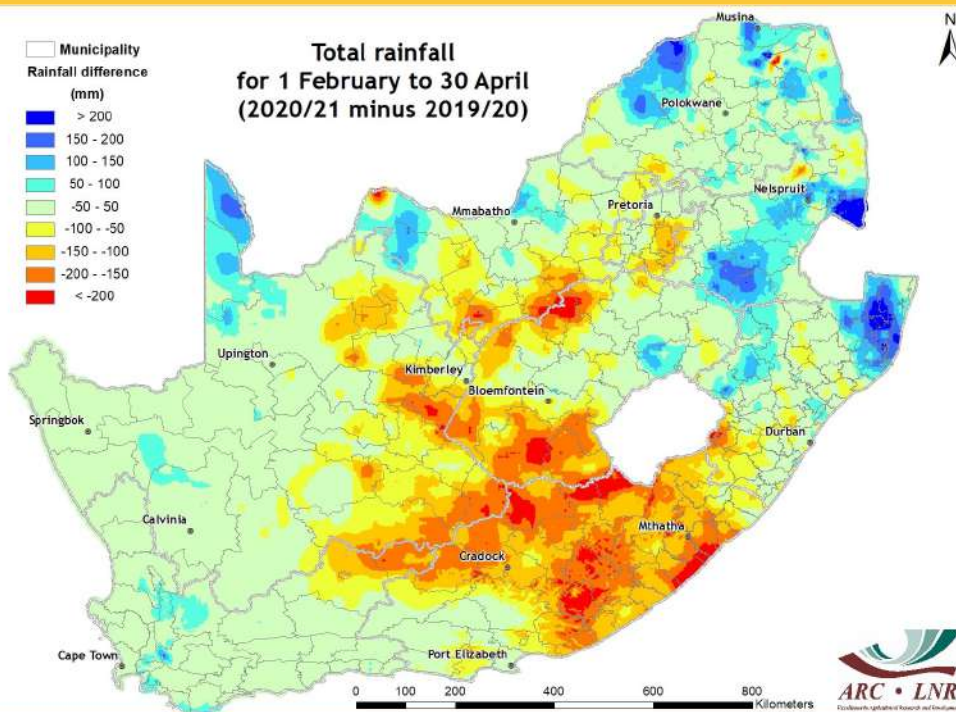


Figure 4

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 SPI), medium-term (12-month SPI) and long-term (24-month and 36-month SPI) drought conditions are shown in Figures 5-8. The 6-month SPI ending in April 2021 shows wet conditions over much of the summer rainfall region, with areas in central and southern Limpopo, extending towards the interior of Mpumalanga, reflecting mild to moderate drought. Severe to extreme drought can be observed over the Northern Cape coast and adjacent interior, as well as parts of the Eastern Cape south coast in the all-year rainfall region. The 12-month SPI shows prevailing moderate-severe wet conditions over the northern interior as well as the Lowveld of Limpopo. Moderate drought conditions are visible over parts of the eastern Highveld, KZN and intensifying towards the Eastern Cape and parts of the Karoo. The long-term SPI shows that the central to southeastern interior and parts of the Lowveld experienced mild to severe wet conditions, while moderate-severe drought is visible over western regions of the country, parts of the Eastern Cape, KZN and the interior of Limpopo and Mpumalanga.

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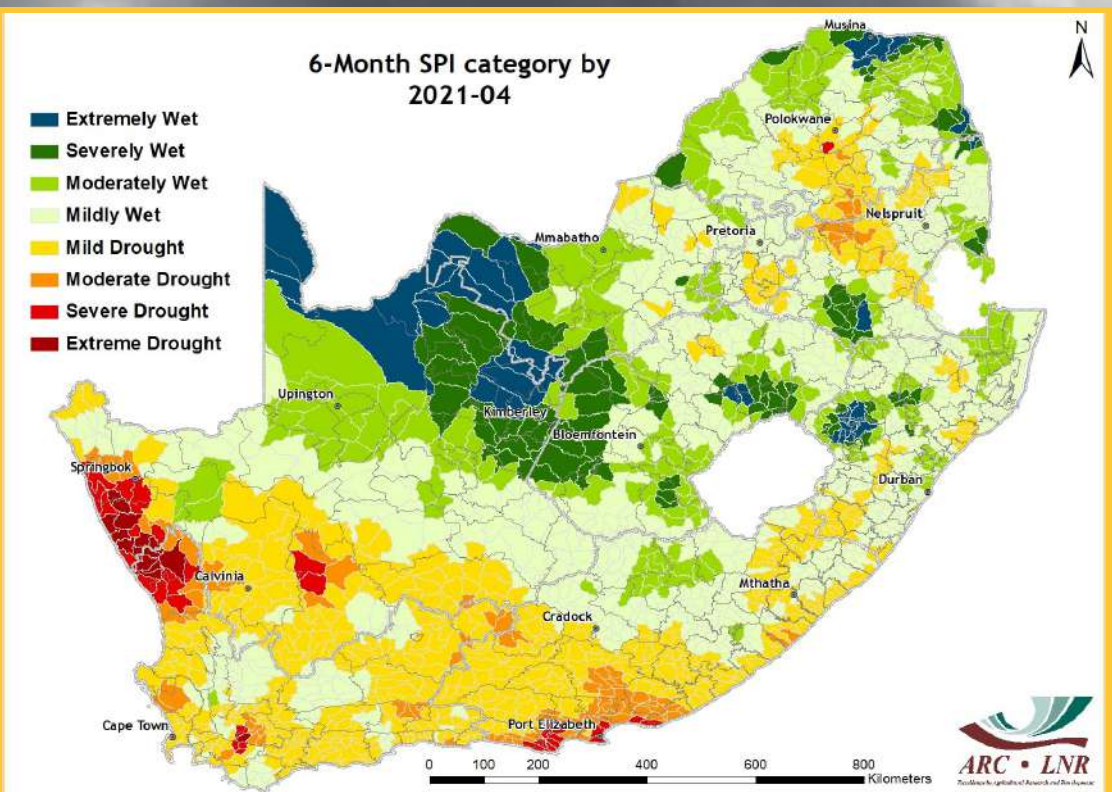


Figure 5

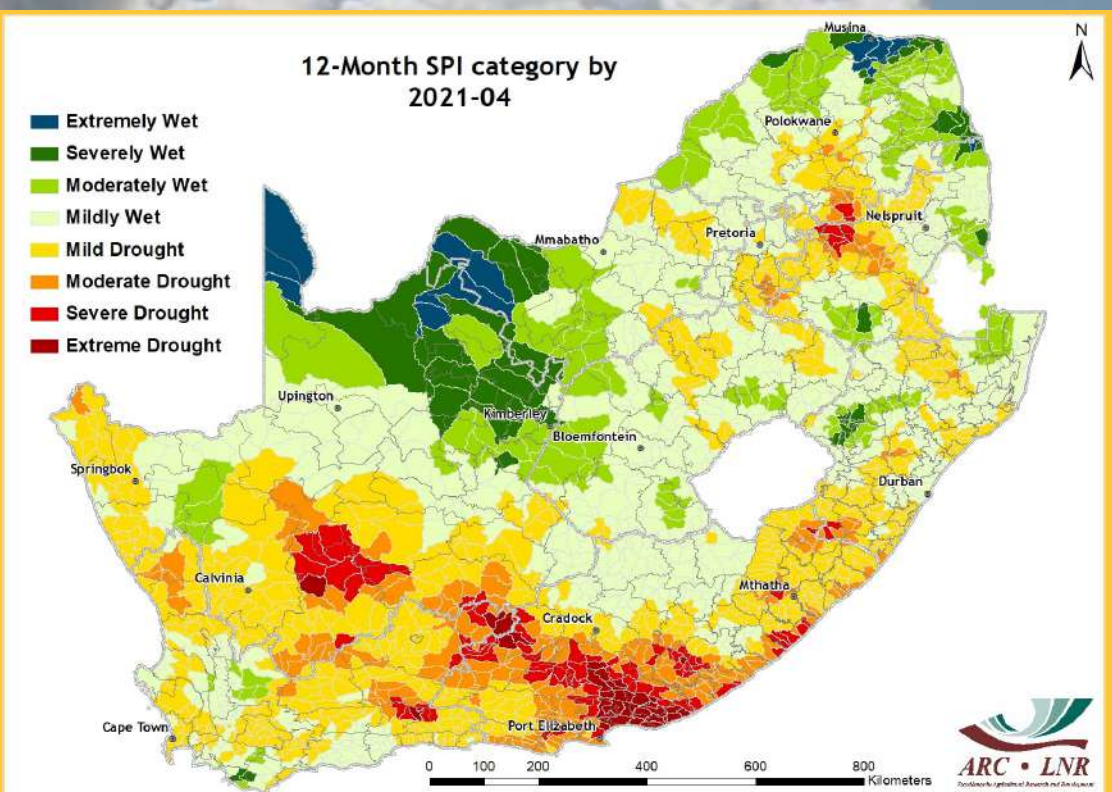


Figure 6

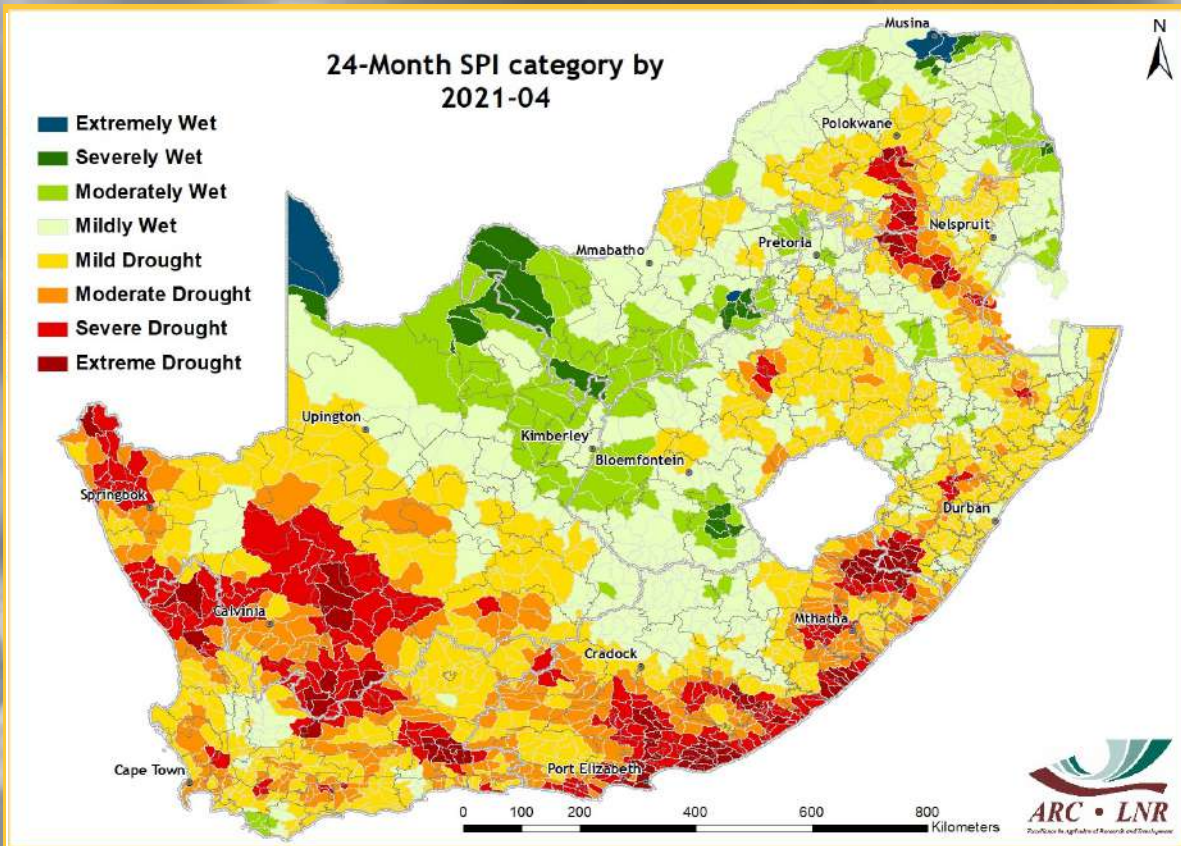


Figure 7

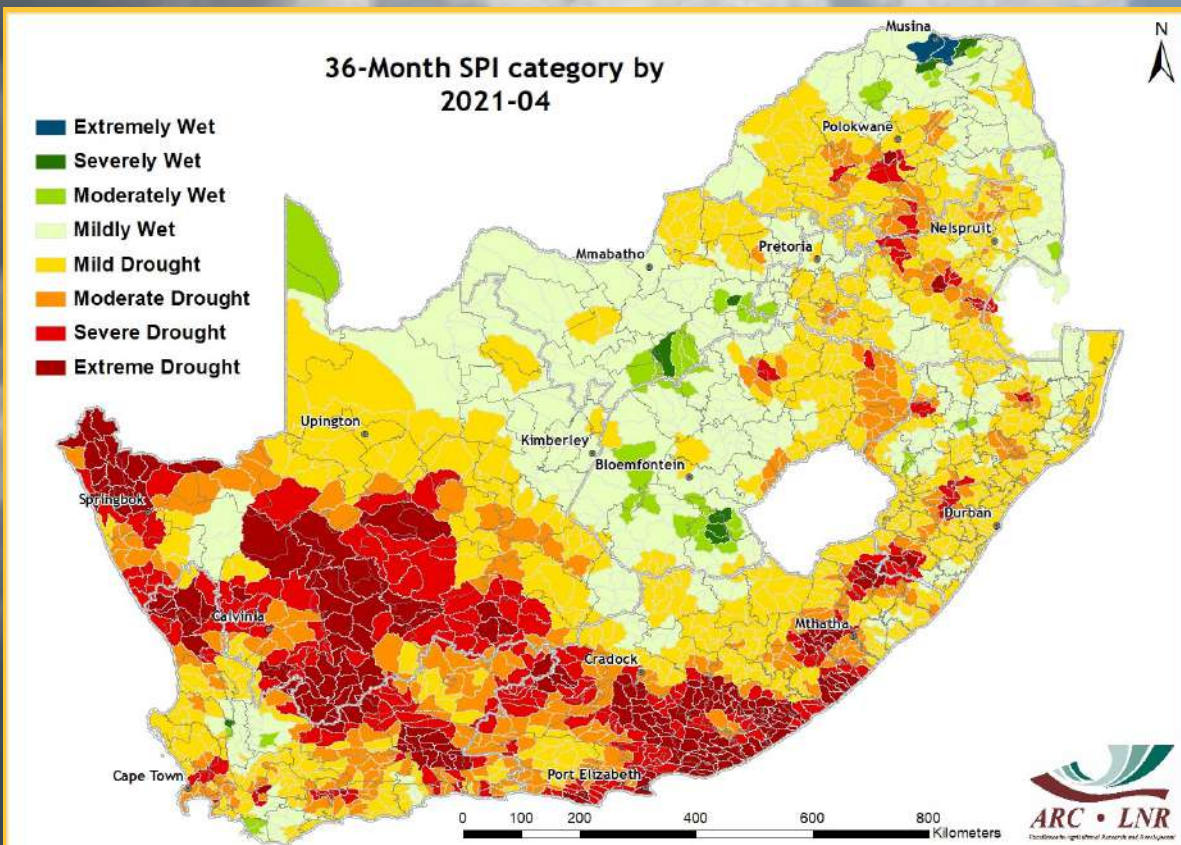


Figure 8

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.

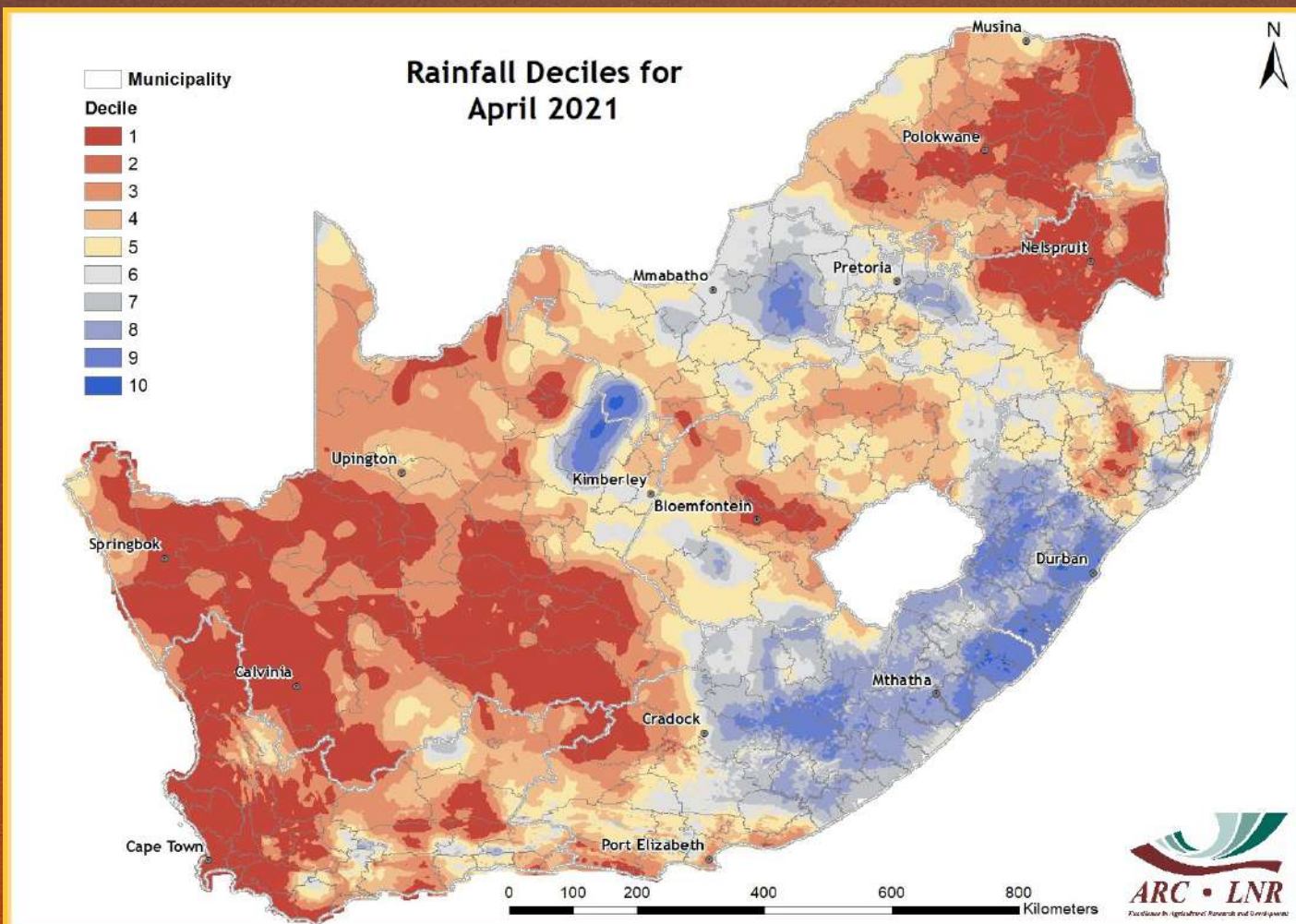


Figure 9

Figure 9:

Greater parts of the country experienced rainfall totals that compare well with historically drier April months. However, parts of the Highveld, KwaZulu-Natal and Eastern Cape experienced totals that compare well with the highest historical rainfall totals recorded in April.

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Vegetation Mapping

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

$$NDVI = \frac{(IR - R)}{(IR + R)}$$

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.

4. Vegetation Conditions

Standardized Difference Vegetation Index (SDVI) for 1 - 30 April 2021 compared to the long-term (22 years) mean

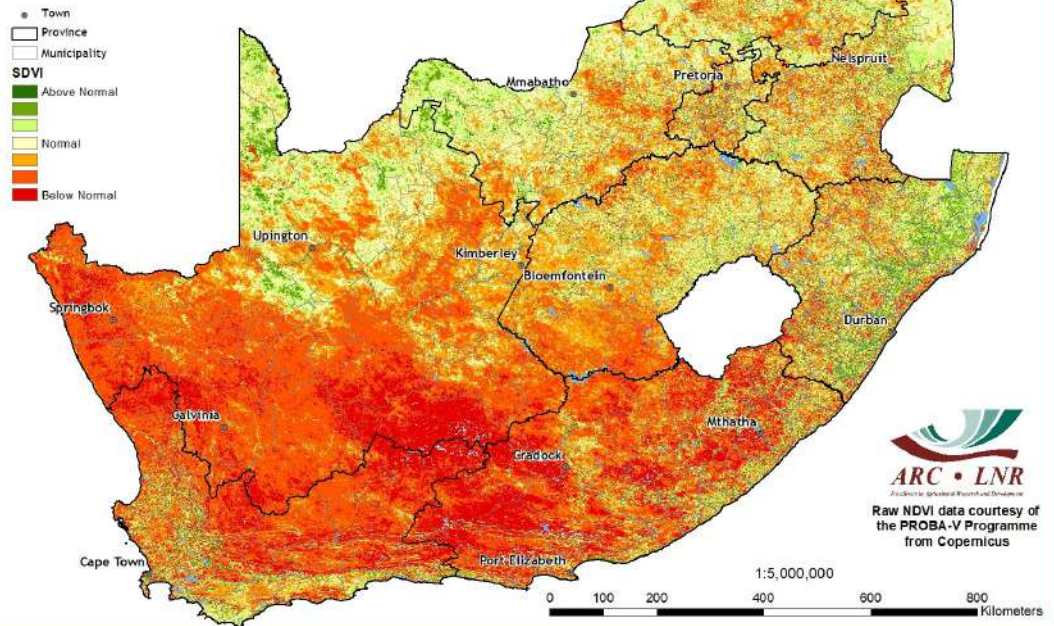


Figure 10

Figure 10:

Compared to the historical averaged vegetation conditions, the SDVI map for April 2021 shows that large parts of the country experienced below-normal vegetation activity.

Figure 11:

When comparing the NDVI difference map for April 2021 to the same month last year, it can be observed that the central interior experienced below-normal vegetation activity with pockets of above-normal activity on the outskirts of the country.

NDVI difference map for 1 - 30 April 2021 compared to 1 - 30 April 2020

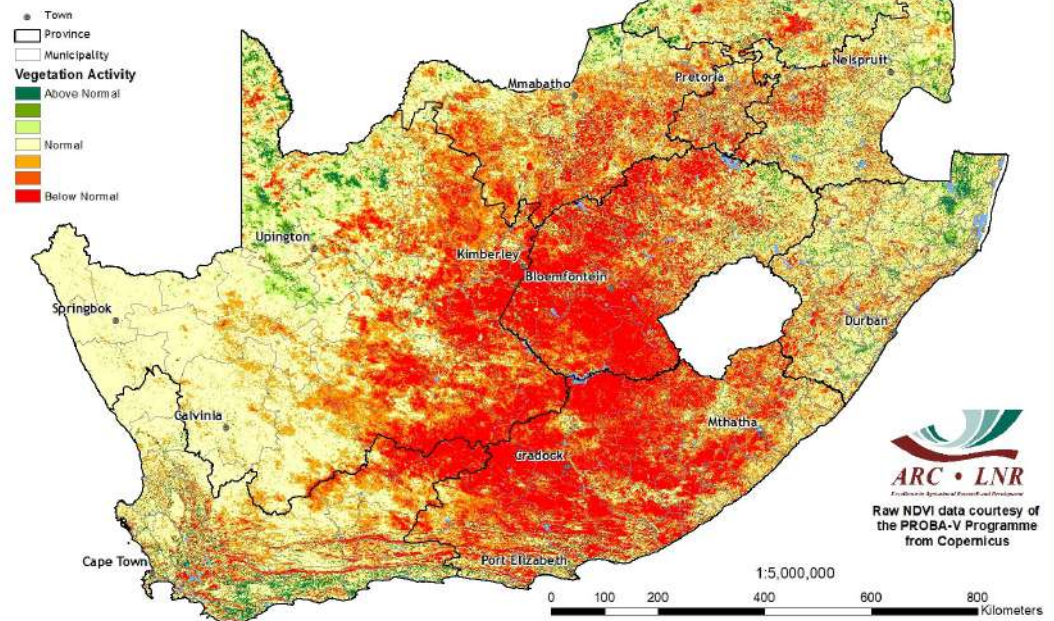
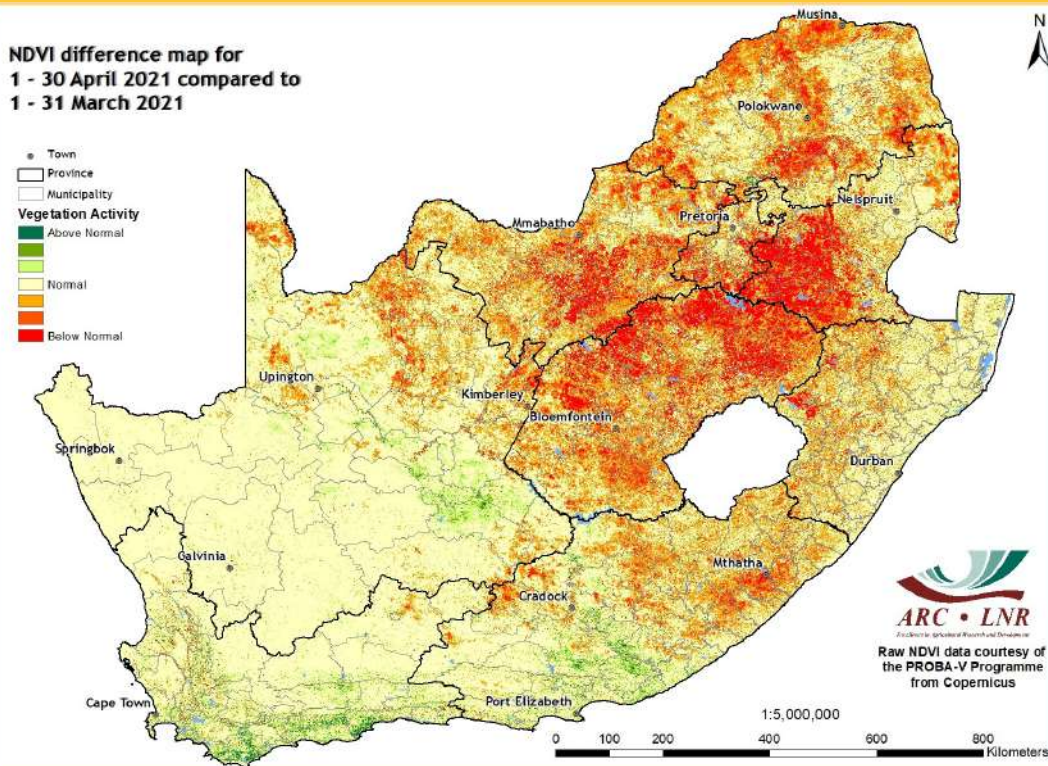


Figure 11



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

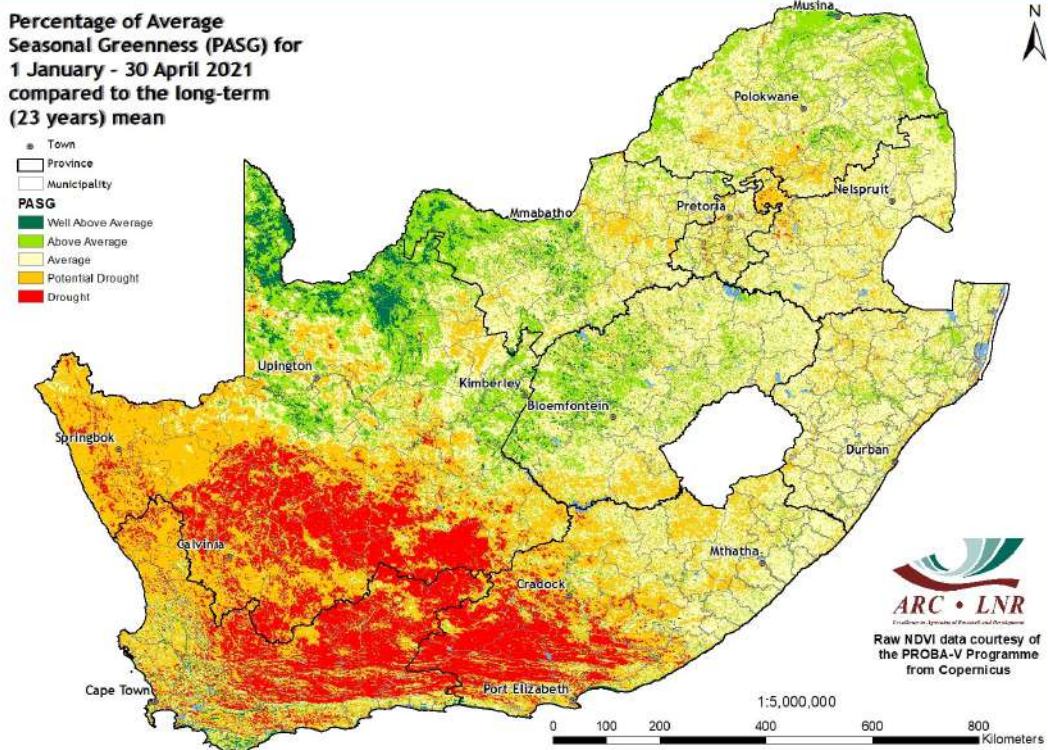


Figure 12:

Compared to the previous month, the NDVI difference map for April shows that the eastern half of the country experienced below-normal vegetation activity while the western half experienced normal vegetation activity.

Figure 13:

Cumulative vegetation conditions over a 4-month period compared to the long-term mean show that high levels of seasonal vegetation greenness remain dominant in the central and northern parts of the country. Meanwhile, the western parts continue to experience low levels of seasonal greenness.

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Figure 13

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.

Vegetation Condition Index (VCI) for 1 - 30 April 2021 compared to the long-term (22 years) mean

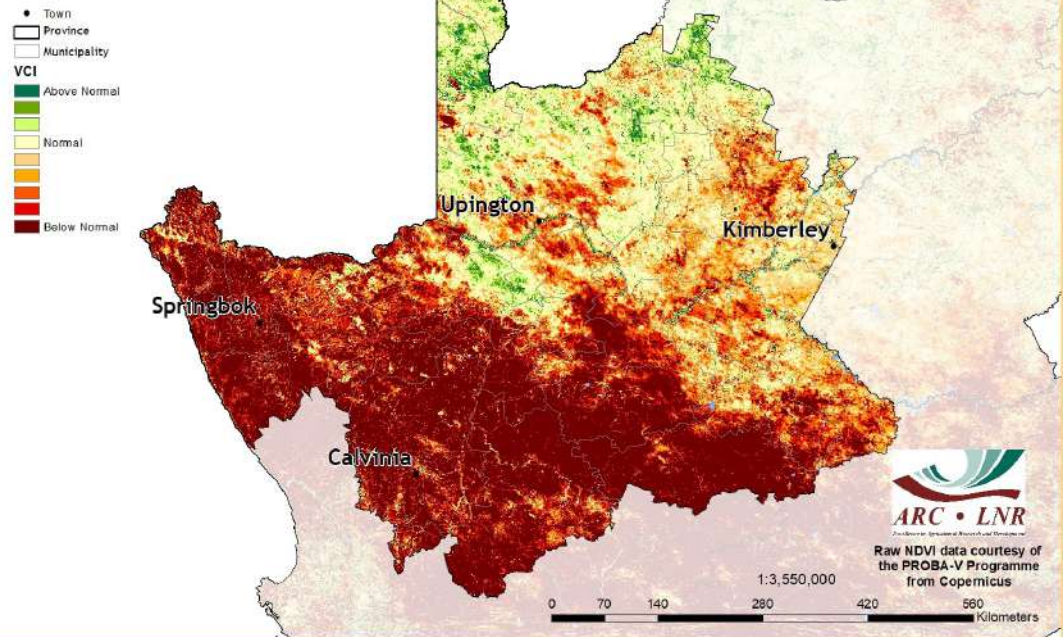


Figure 14

Figure 14:

The VCI map for April indicates that the far northeastern parts of the Northern Cape continue to experience improved vegetation conditions while the remaining areas are still severely affected by drought.

Figure 15:

The VCI map for April indicates that vegetation conditions in almost the entire Western Cape remain poor with only pockets of good vegetation conditions in isolated areas of the southern parts.

Vegetation Condition Index (VCI) for 1 - 30 April 2021 compared to the long-term (22 years) mean

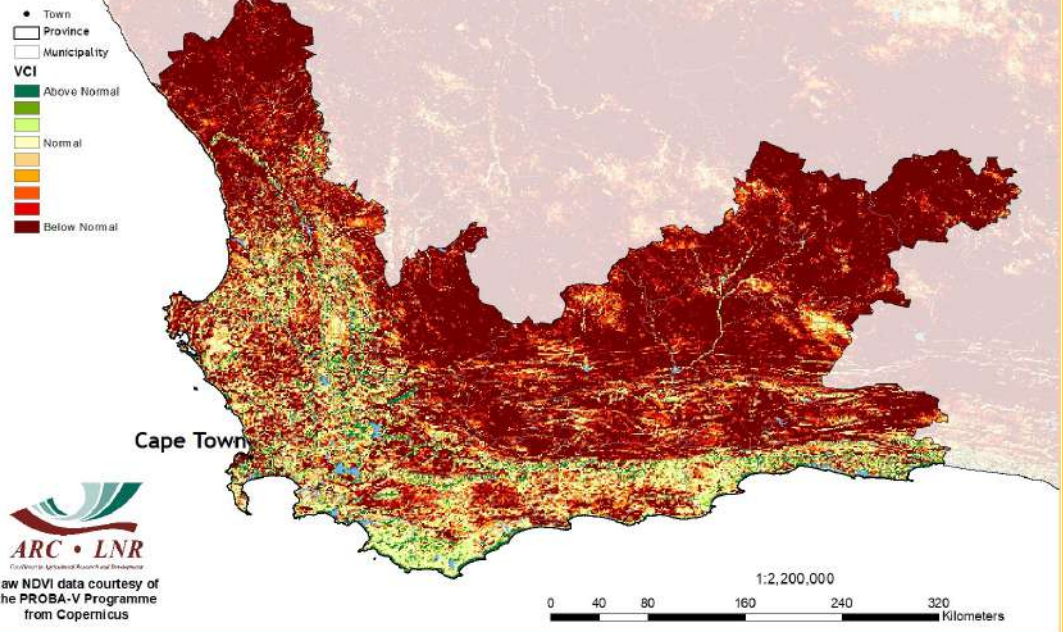


Figure 15

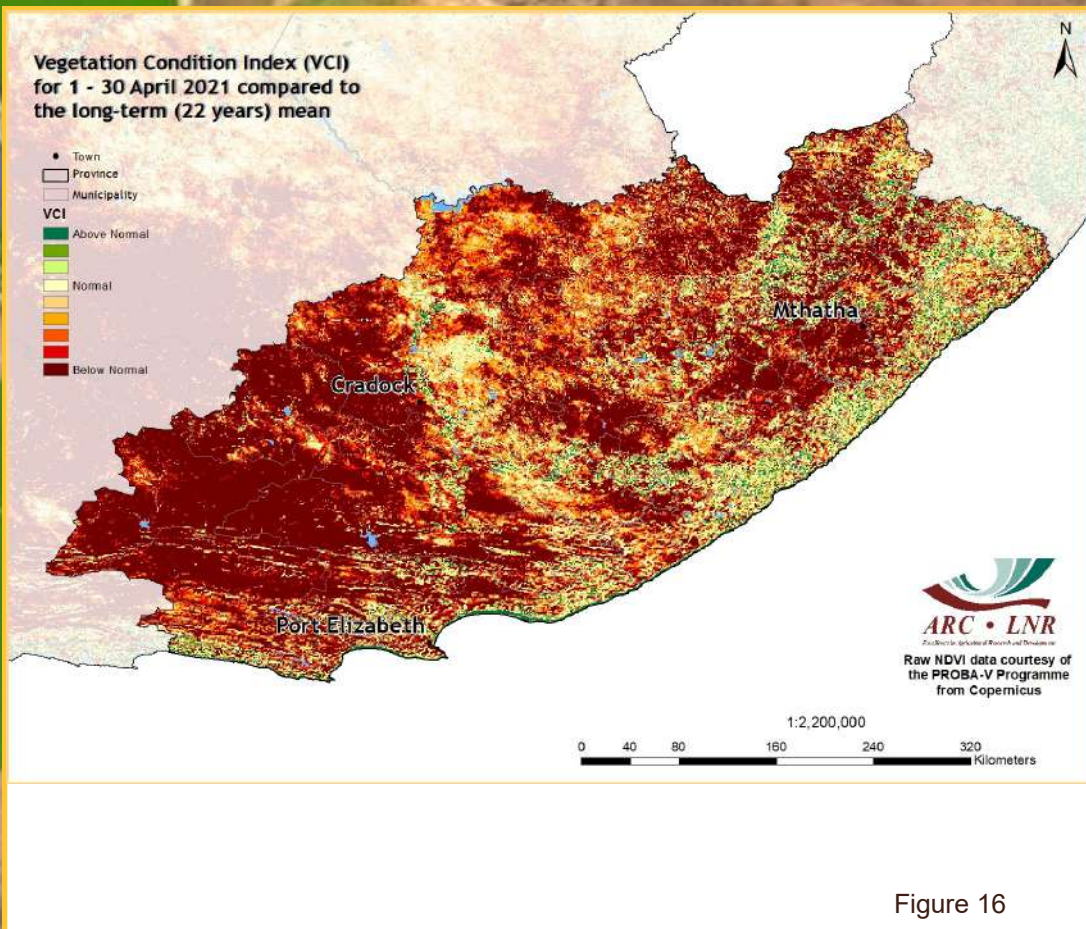


Figure 16

Figure 16:
The VCI map for April indicates that almost the entire Eastern Cape continues to experience poor vegetation conditions.

Figure 17:
The VCI map for April indicates that the southern and far northern parts of the Free State experienced relatively poor vegetation activity compared to other parts of the province.

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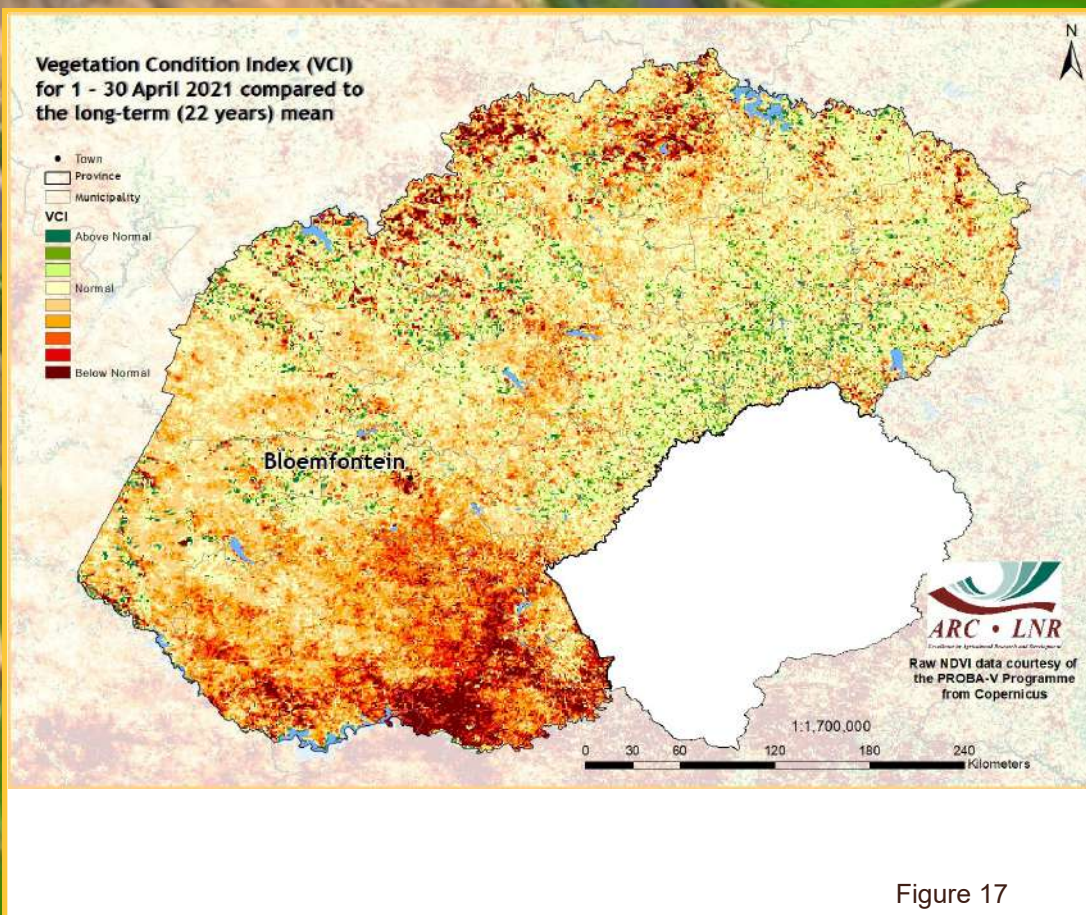


Figure 17

6. Vegetation Conditions & Rainfall

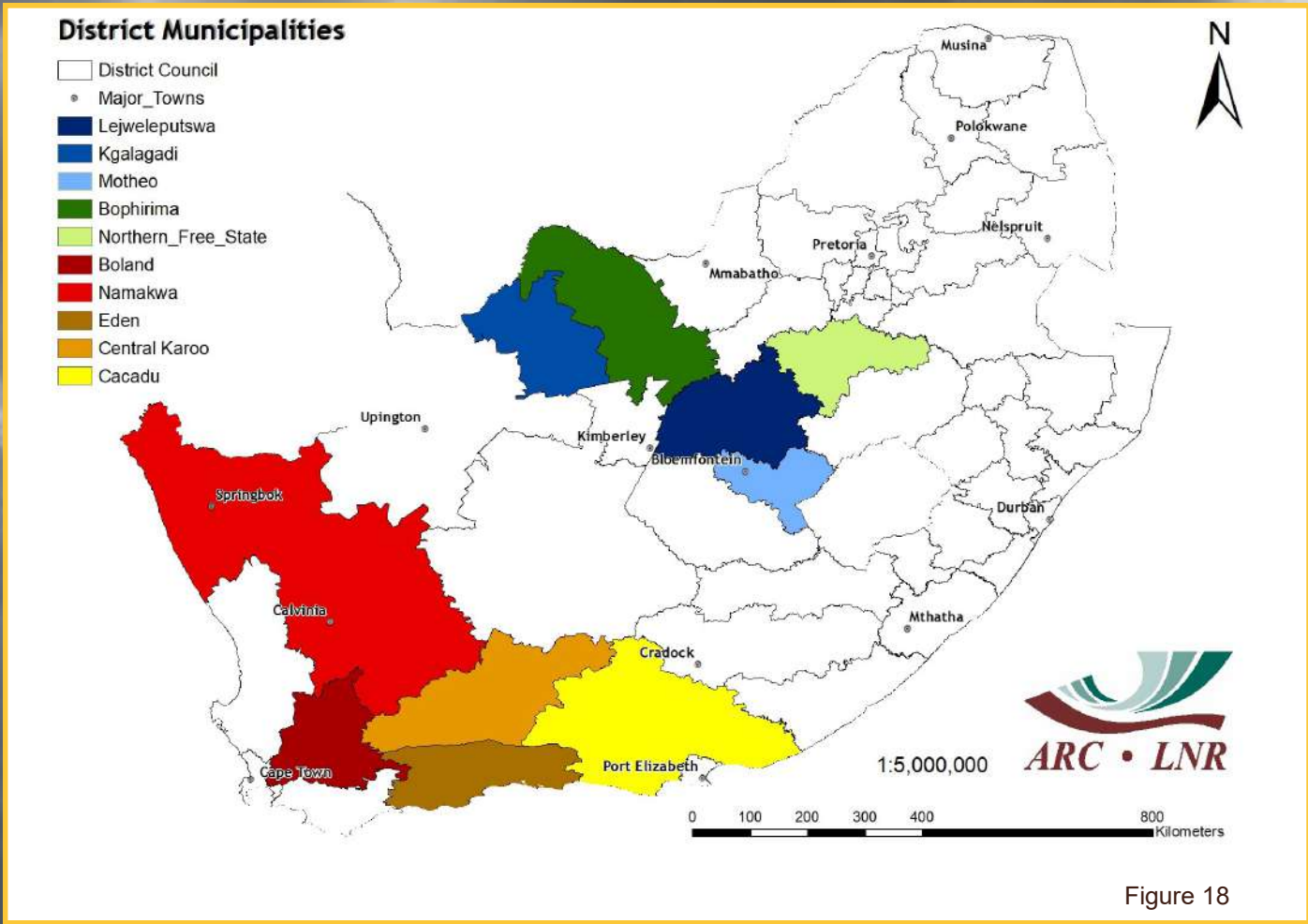


Figure 18

Rainfall and NDVI Graphs

Figure 18: Orientation map showing the areas of interest for April 2021. The district colour matches the border of the corresponding graph.

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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.

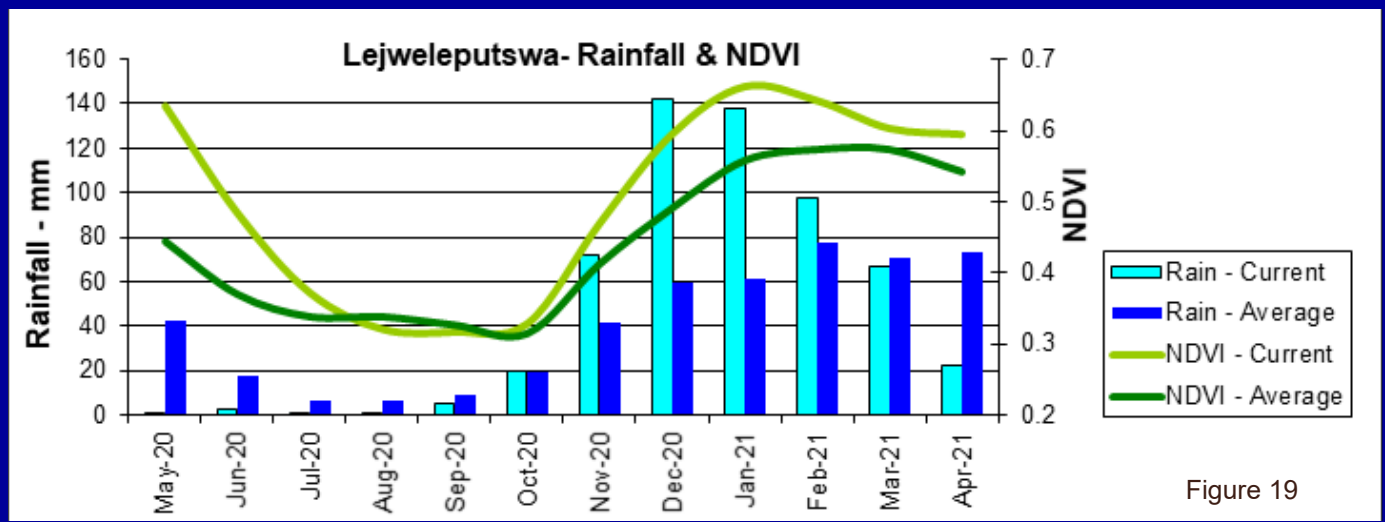
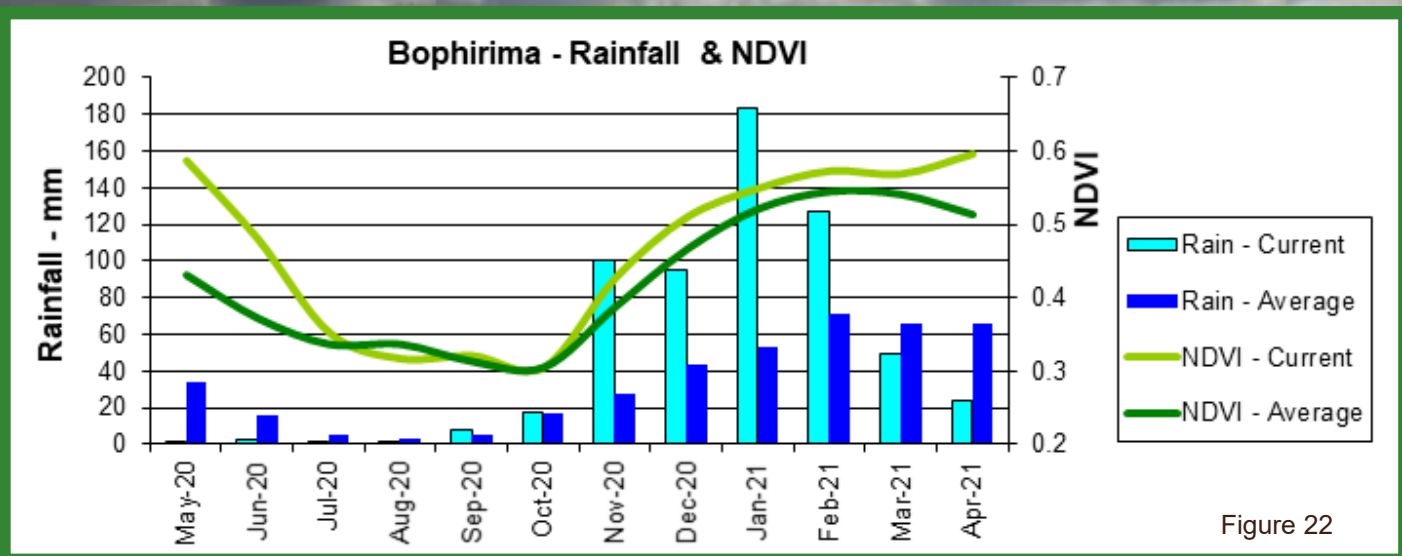
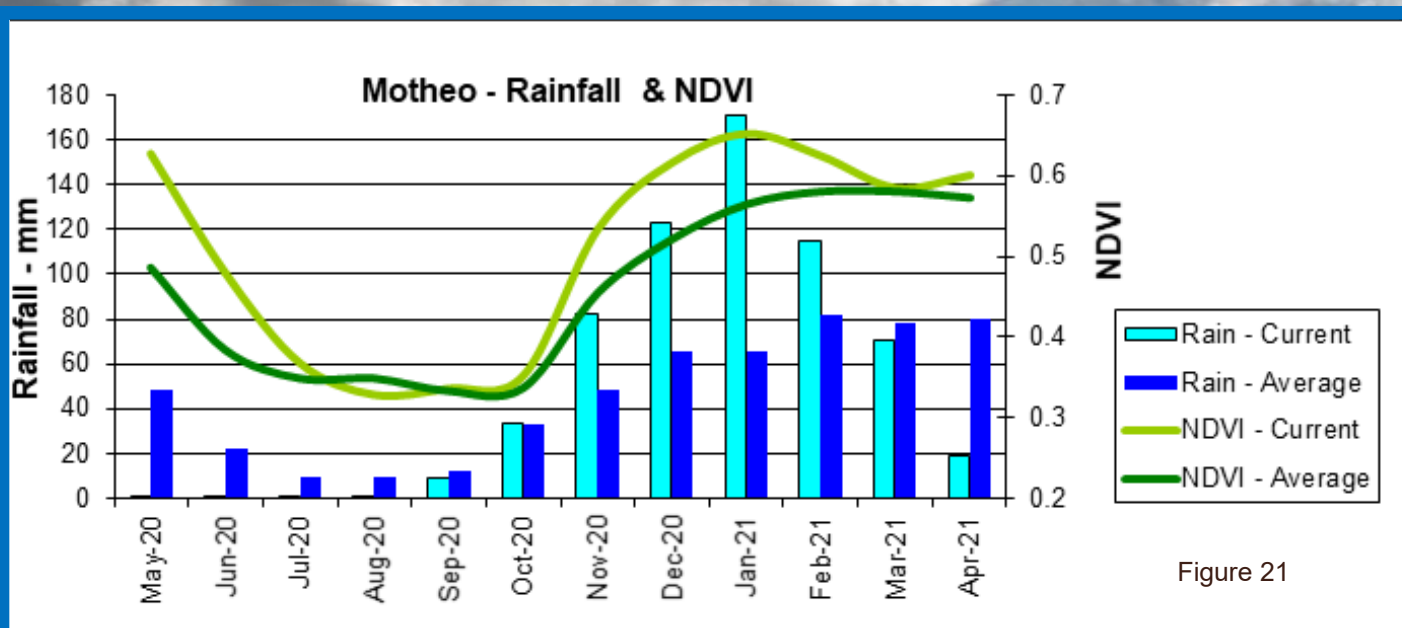
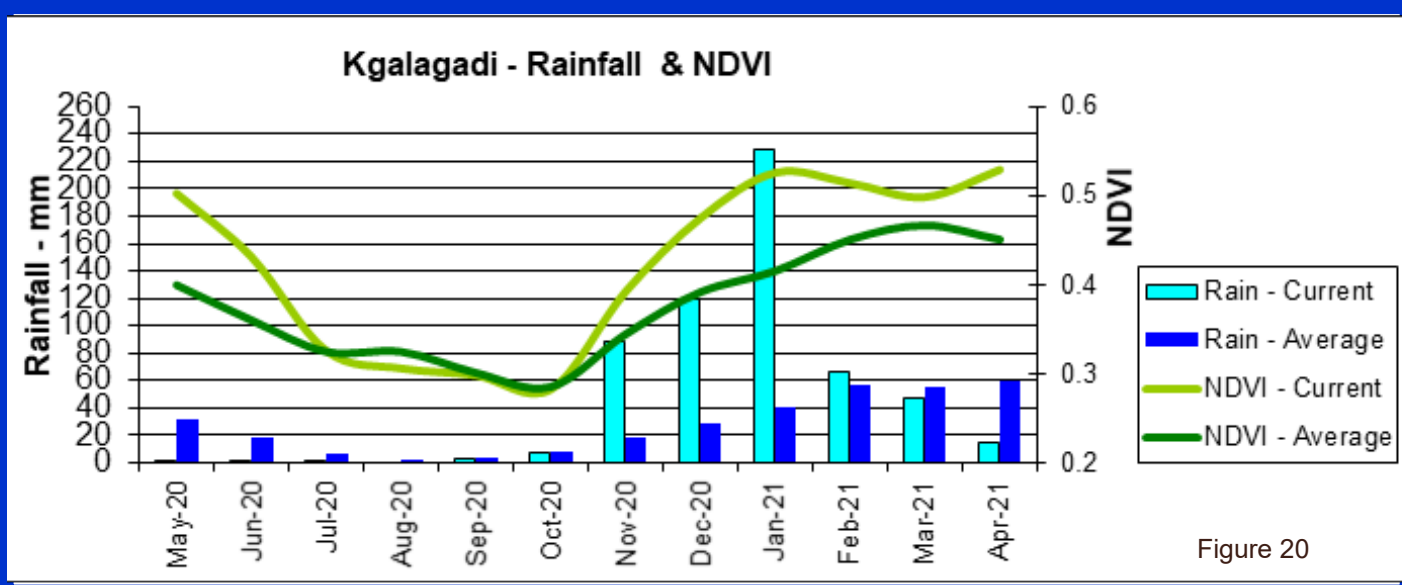


Figure 19



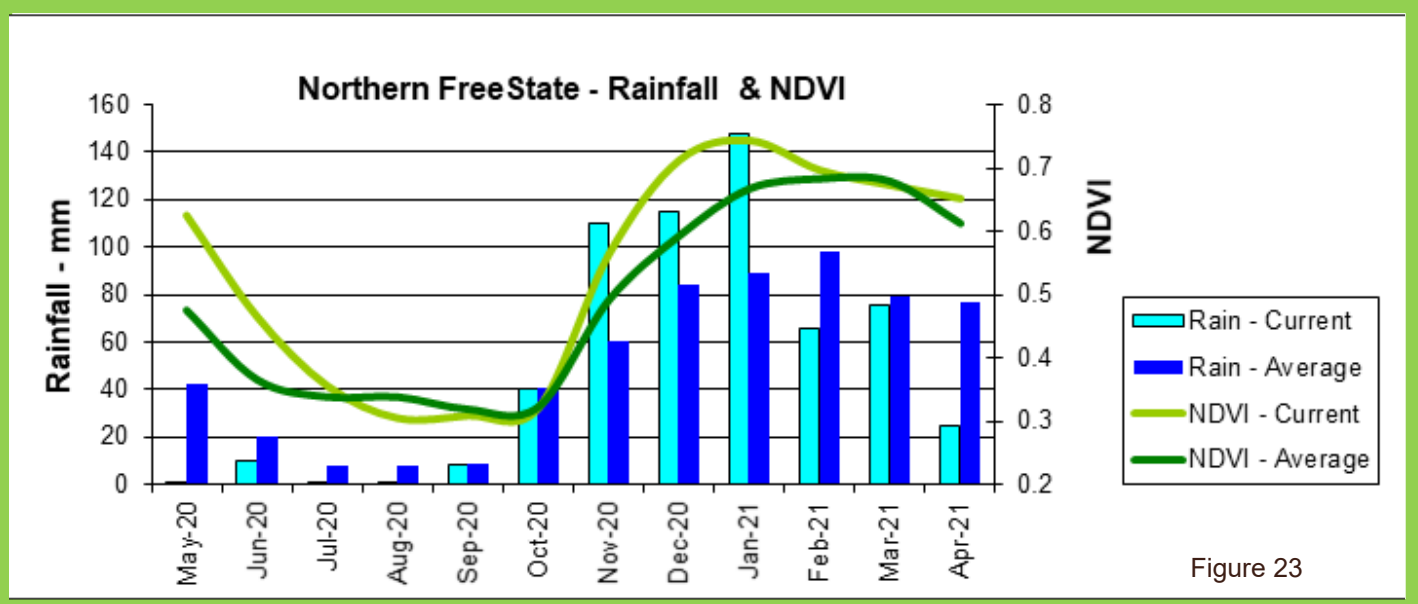


Figure 23

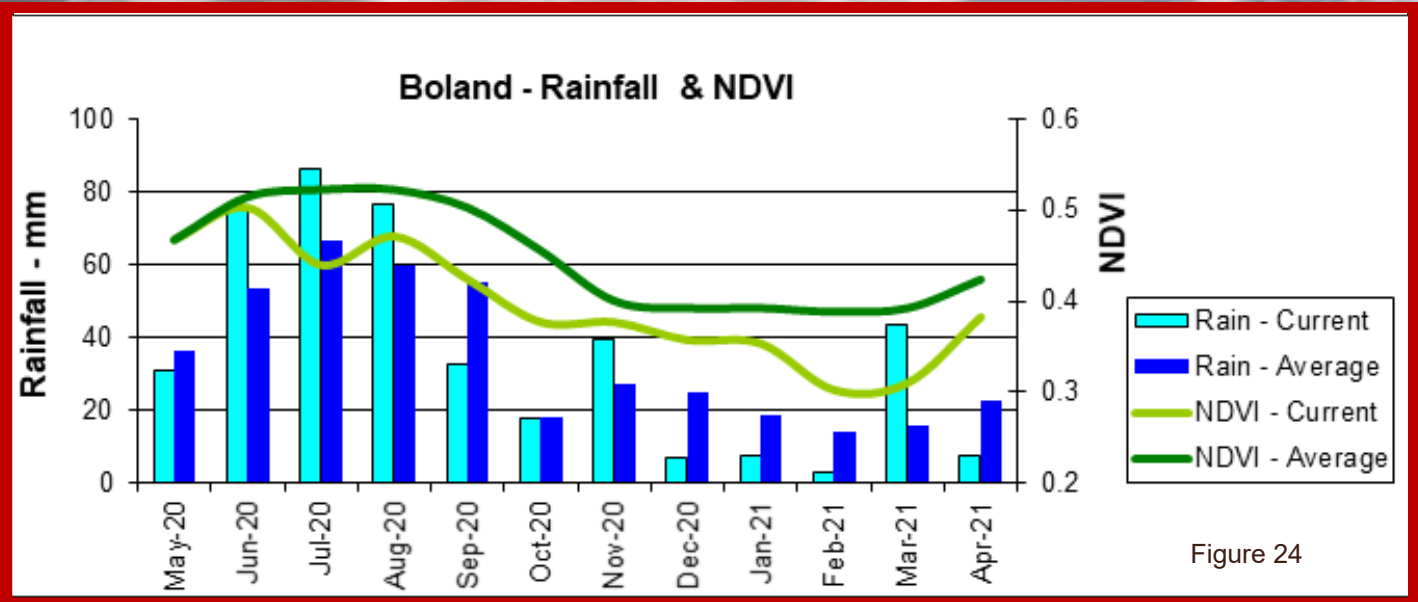


Figure 24

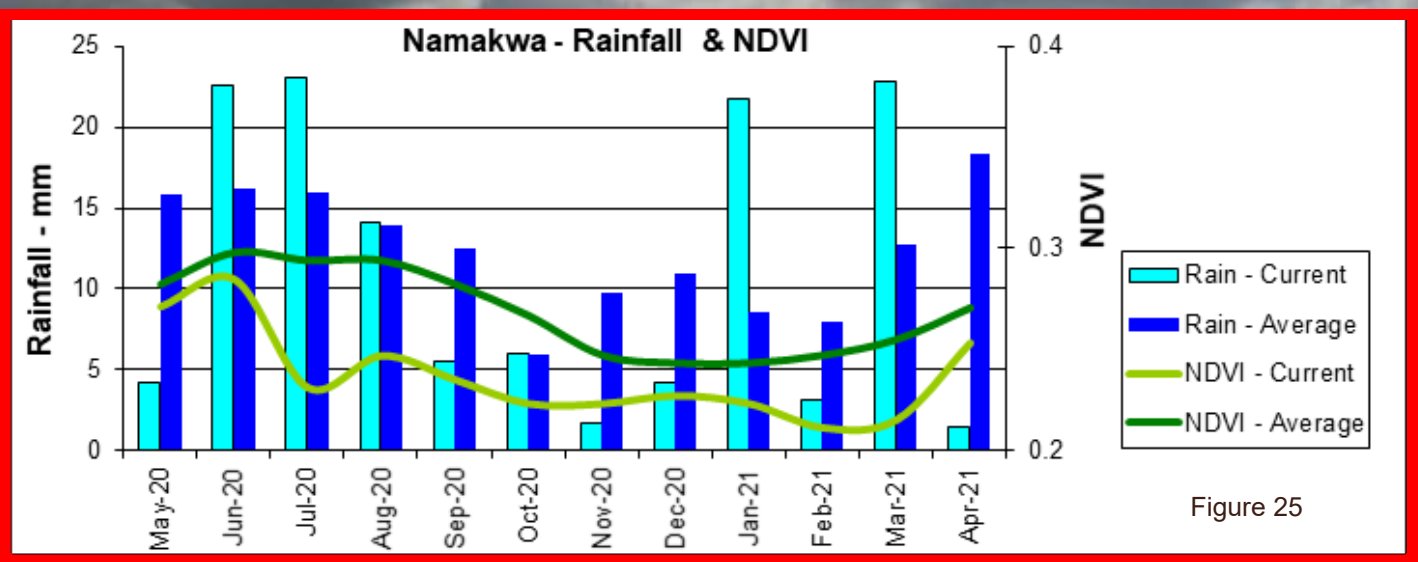
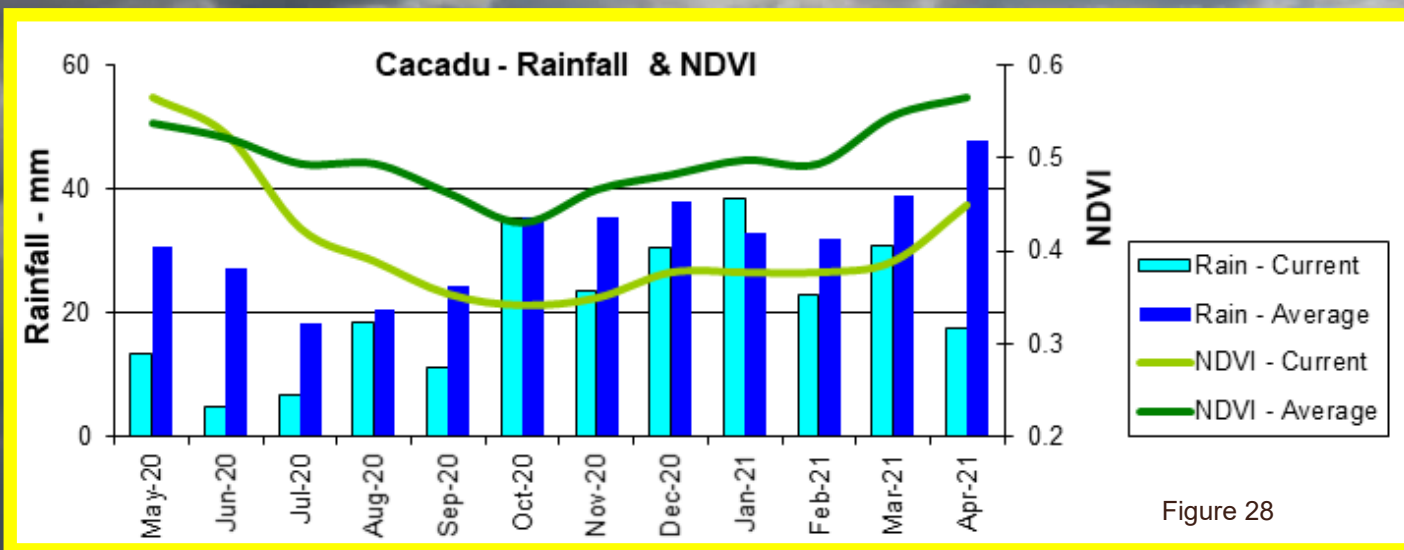
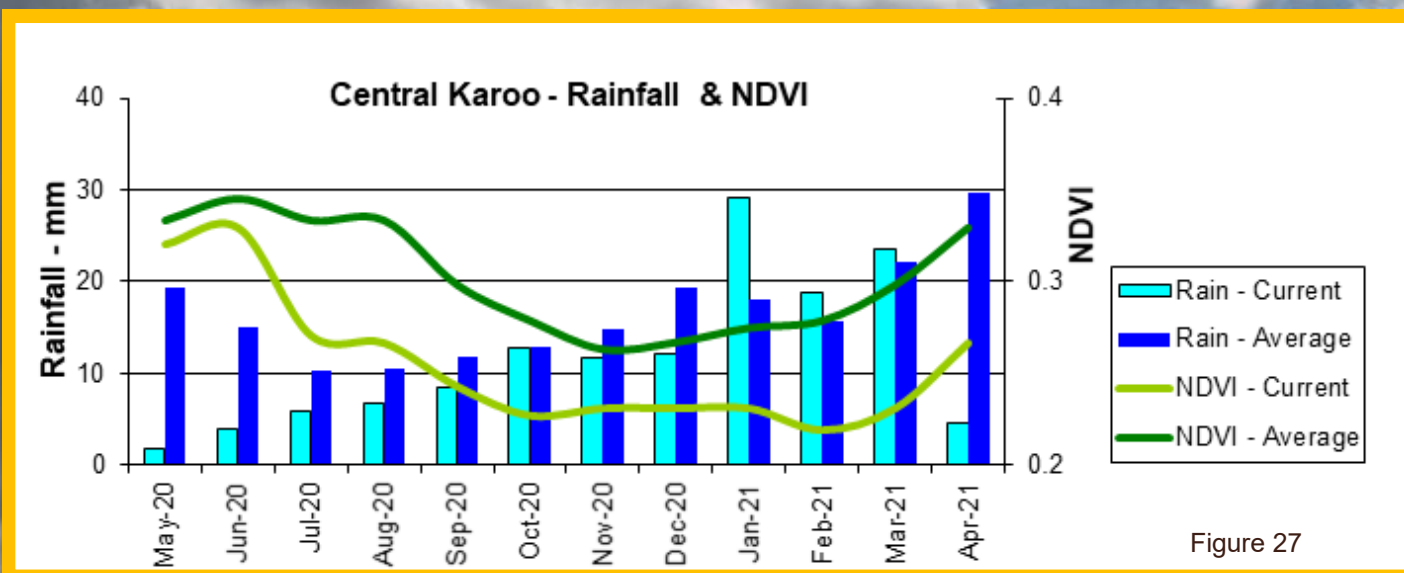
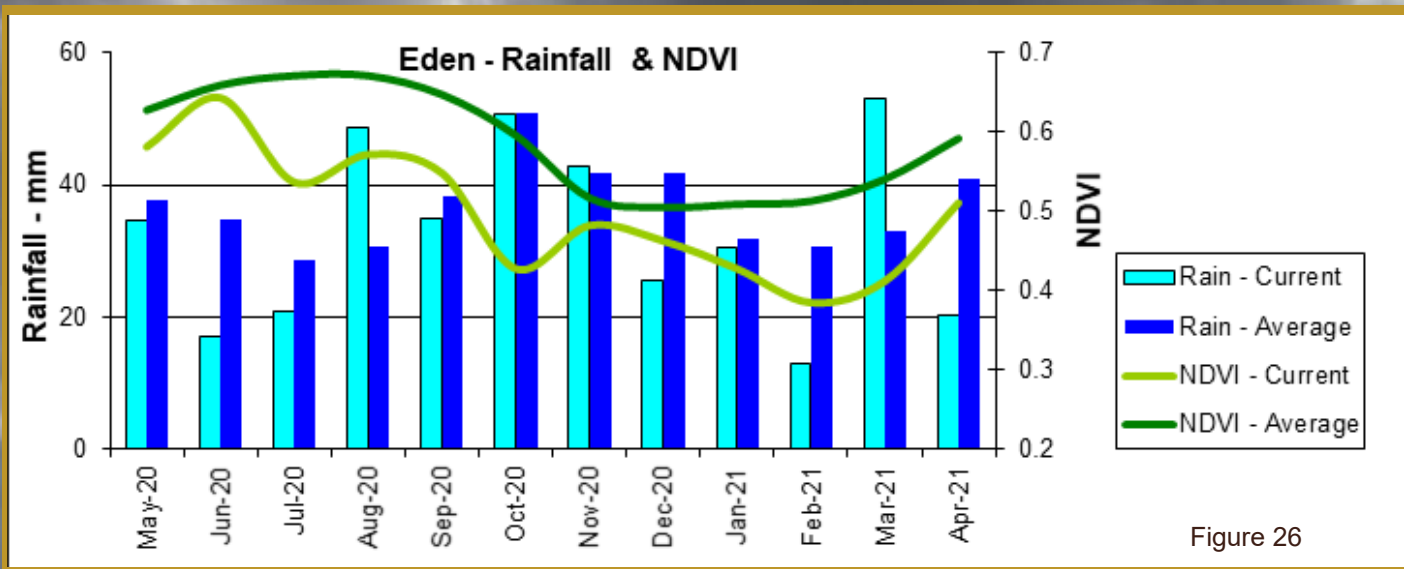


Figure 25



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 between 1-30 April 2021 per province. Fire activity was lower in all provinces except for the Western Cape compared to the long-term average.

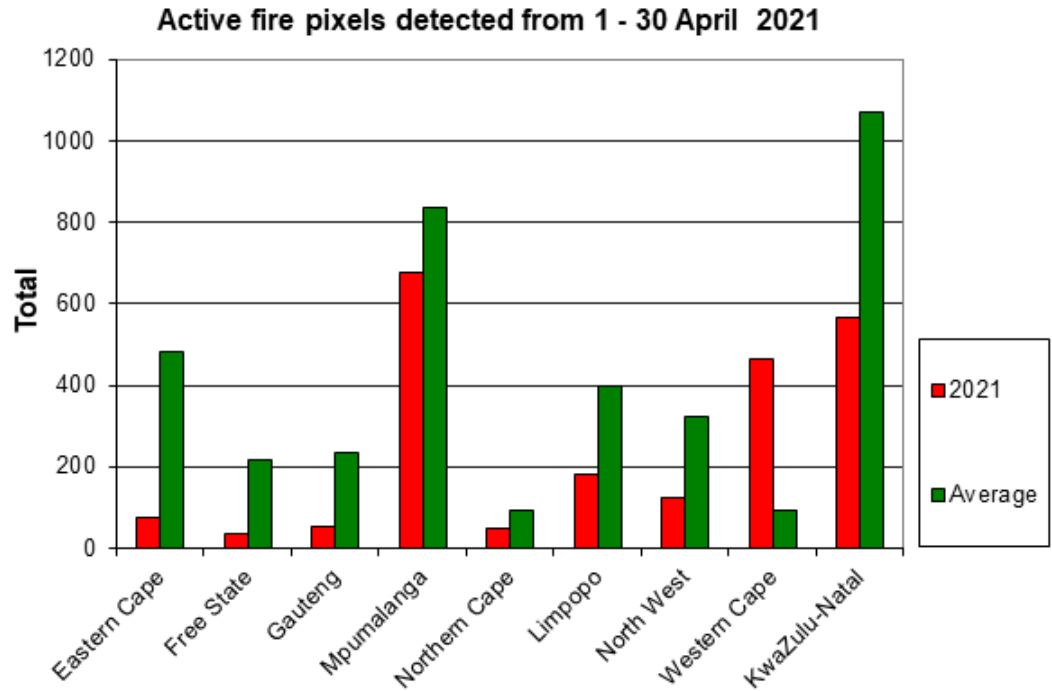


Figure 29

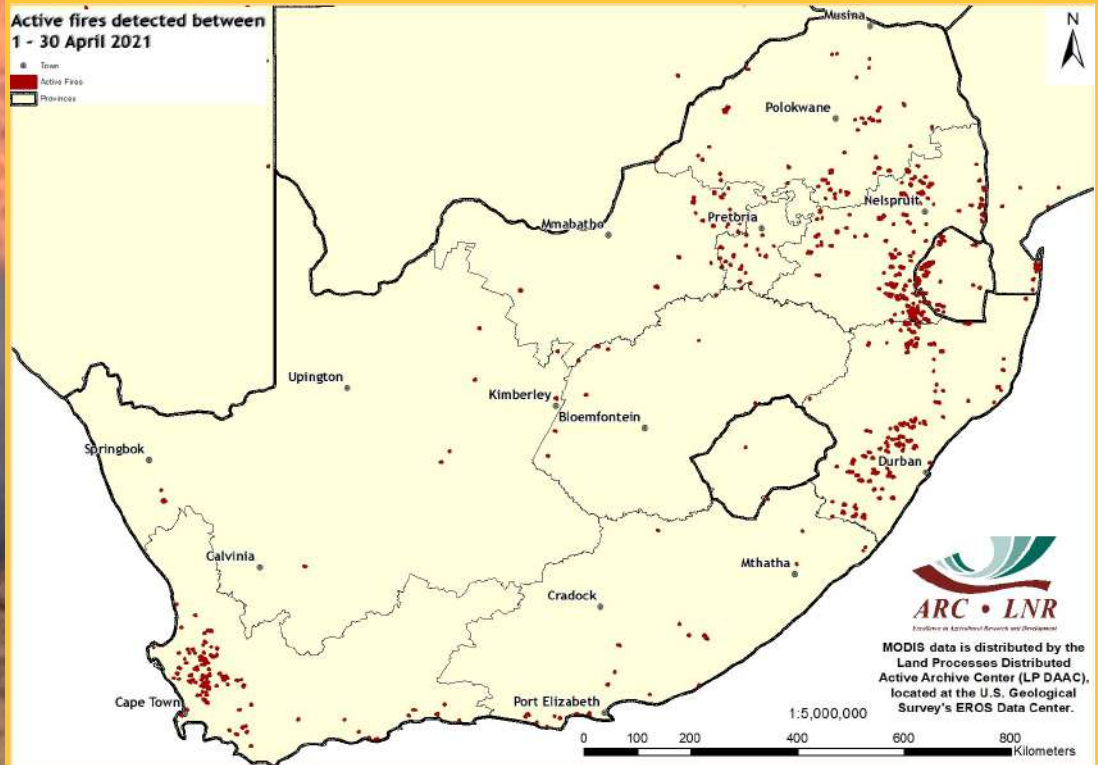


Figure 30:

The map shows the location of active fires detected between 1-30 April 2021.

Figure 30

Figure 31:
The graph shows the total number of active fires detected between 1 January and 30 April 2021 per province. Cumulative fire activity was lower in all provinces compared to the long-term average.

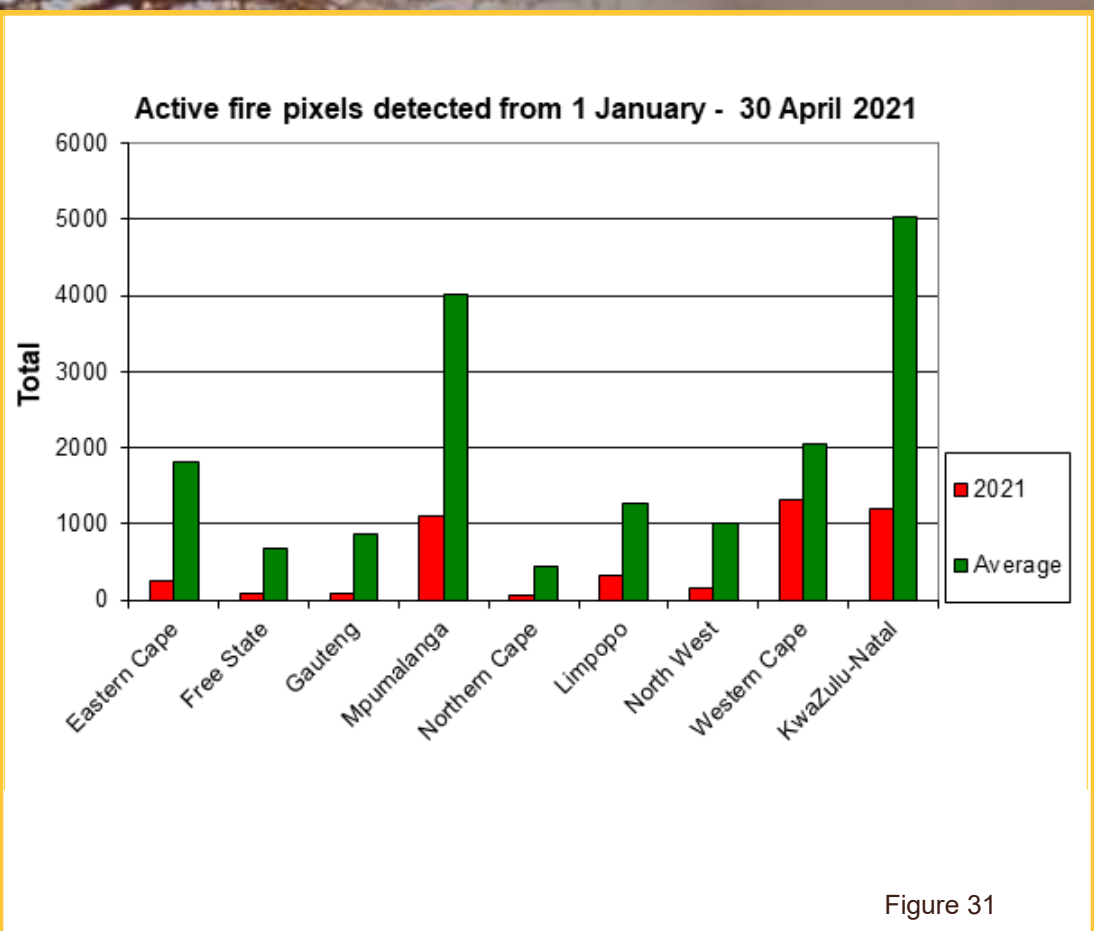


Figure 31

Figure 32:
The map shows the location of active fires detected between 1 January and 30 April 2021.

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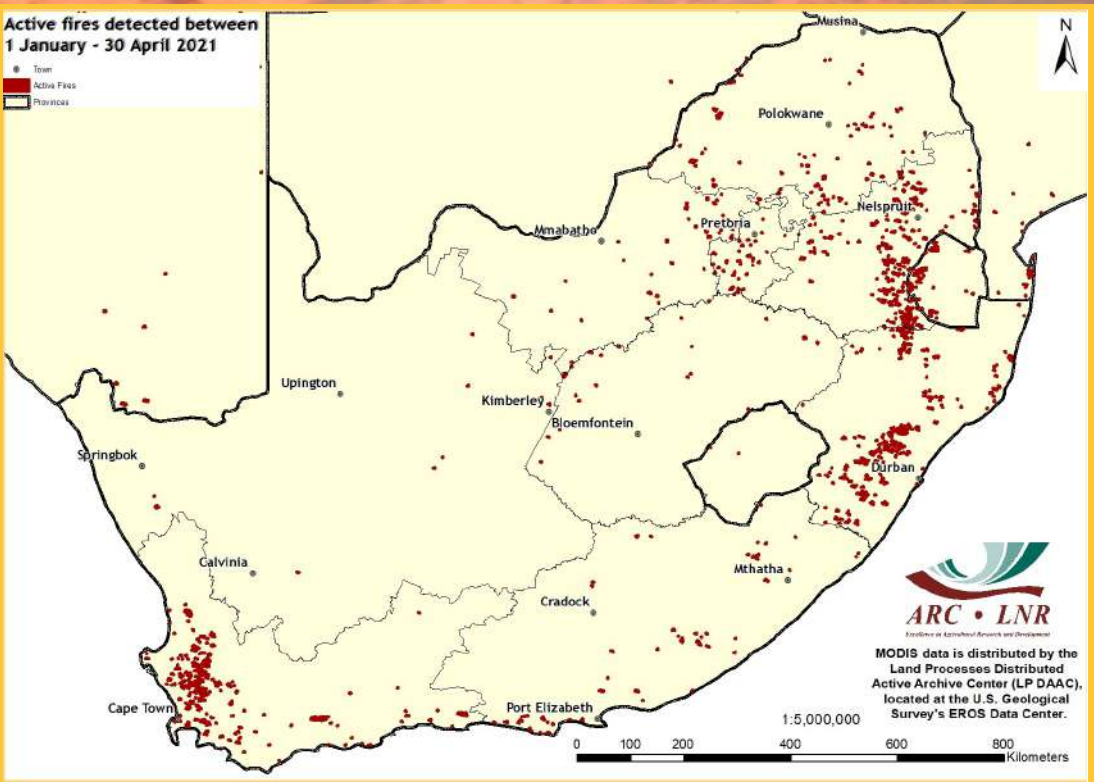


Figure 32

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 shows a comparison between the area of water available now and the maximum area of surface water recorded in the last 5 years. Values less than 100 represent 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 shows a comparison between the area of water available now and for the same month last year. On this map, values less than 100 represent 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, in 2020.

The long-term map for April 2021 shows very similar water patterns to the previous month, with the majority of the summer rainfall region catchments showing water levels equivalent to 80-100% of the 5-year, long-term maximum water. Eastern and central areas of Limpopo and Mpumalanga show higher water levels in April compared to March. Catchments in the central Karoo, Western Cape and western coastal region of the Eastern Cape continue to show much more variable and typically lower current water levels compared to long-term maximum values.

The comparison between April 2021 and April 2020 indicates a similar pattern to that recorded last month, with the majority of the country showing current water levels between 50% and 150% of the 2020 levels. Exceptions to this are the central Karoo, which is still showing significantly lower water levels, and a number of catchments bordering Botswana and Zimbabwe which are showing higher water levels in April 2021 compared to last year.

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>

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mark.thompson@geoterraimage.com

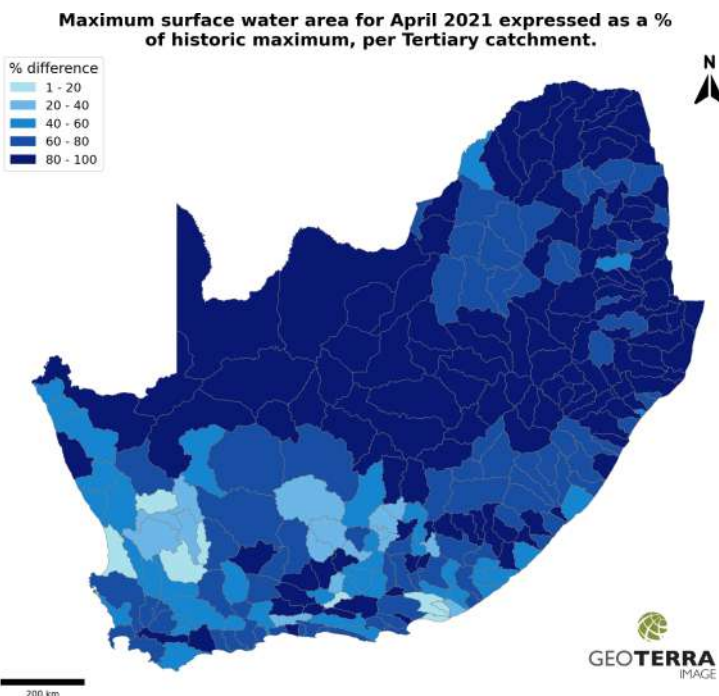


Figure 33

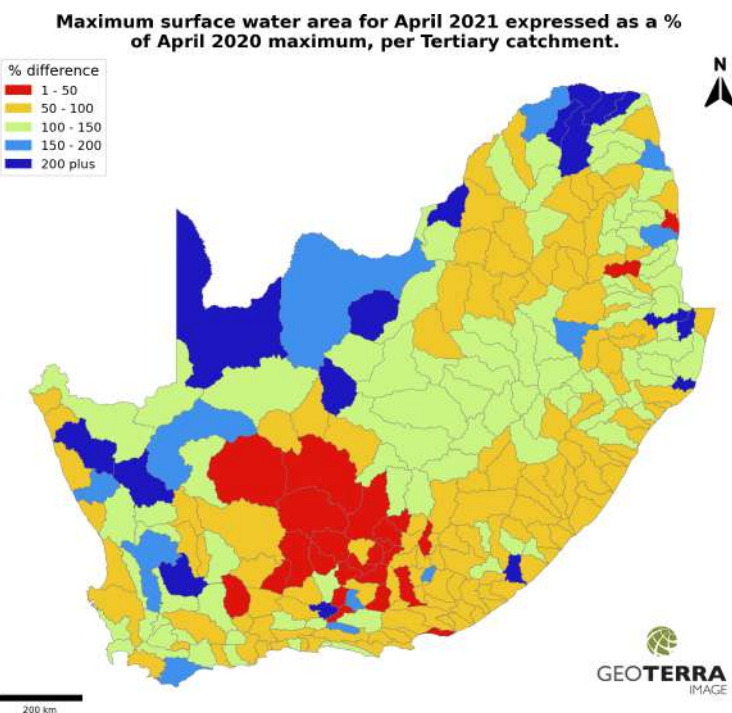


Figure 34

Agrometeorology



The programme focuses on the use of weather and climate information and monitoring for the forecast and prediction of the weather elements that have direct relevance on agricultural planning and the protection of crop, forest and livestock. The Agro-Climate Network & Databank is maintained as a national asset.

FOCUS AREAS

Climate Monitoring, Analysis & Modelling

- Analysis of climate variability and climate model simulation
- Use of crop modelling to assess the impact of climate on agriculture
- Development of decision support tools for farmers



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Climate Change Adaptation & Mitigation

- National greenhouse gas inventory in the agricultural sector
- Improvement of agricultural production technologies under climate change
- Adaptation and mitigation initiatives, e.g. biogas production in small-scale farming communities

Climate Information Dissemination

- Communication to farmers for alleviating weather-related disasters such as droughts
- Dissemination of information collected from weather stations
- Climate change awareness campaigns in farming communities

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Geoinformation Science



The programme focuses on applied Geographical Information Systems (GIS) and Earth Observation (EO)/Remote Sensing research and provides leadership in applied 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.

FOCUS AREAS

Decision Support Systems

- Spatially explicit information dissemination systems, e.g. Umlindi newsletter
- Crop and land suitability modelling/assessments
- Disease and pest outbreaks and distribution modelling
- Precision agriculture information systems



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Early Warning & Food Security

- Drought and vegetation production monitoring
- Crop estimates and yield modelling
- Animal biomass and grazing capacity mapping
- Global and local agricultural outlook forecasts
- Disaster monitoring for agricultural systems

Natural Resources Monitoring

- Land use/cover mapping
- Invasive species distribution
- Applications of GIS and EO on land degradation/erosion, desertification, hydrology and catchment areas
- Rangeland health assessments
- Carbon inventory monitoring

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The Coarse Resolution Imagery Database (CRID)

NOAA AVHRR

The ARC-ISCW 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 m² to 1 km²) and spectral resolution. The ARC-ISCW 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-ISCW 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)

The ARC-ISCW 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. The ARC-ISCW 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-ISCW weather station network, 270 automatic rainfall recording stations from the 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-ISCW.

Solar Radiation and Evapotranspiration maps

- Combined inputs from 450 automatic weather stations from the ARC-ISCW 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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What does Umlindi mean?
UMLINDI is the Zulu word for “the watchman”.

Disclaimer:

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