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UMLINDI
The Watchman

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INSTITUTE FOR SOIL, CLIMATE AND WATER

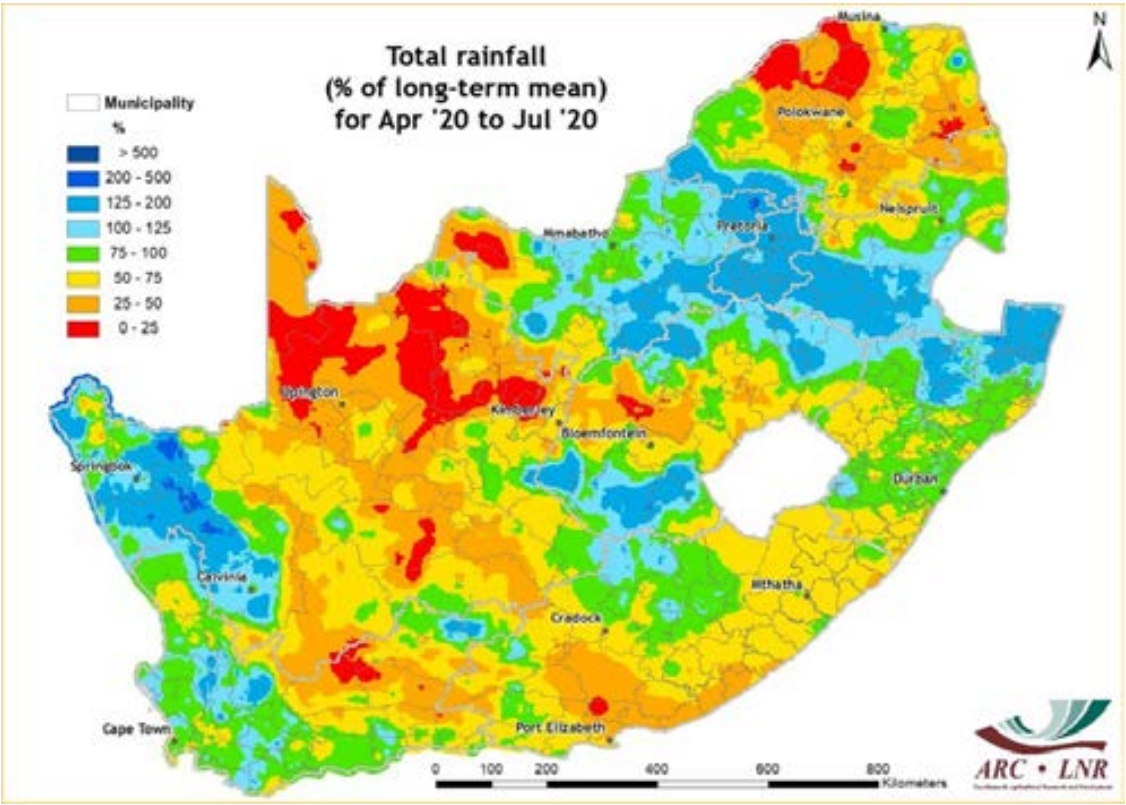
CONTENTS:

194th Edition

Image of the Month

Good rainfall observed in the winter rainfall region

After a weak start to the 2020 winter rainfall season, with the winter rainfall region recording up to 75 mm in April, the region welcomed the onset of its rainy season towards the end of May and more intensely during the early days of June. This was mainly due to the passage of numerous cold fronts over the southwestern parts of the country. These good rainfall conditions continued into July and were of critical importance for the dryland wheat production areas. The month started promisingly with heavy rain that resulted in localized flooding over some areas. However, no rainfall activity was observed between 17 and 26 July. Even so, the rainfall map for April-July 2020 (given as a percentage of the long-term mean) indicates near- to above-normal conditions over the winter rainfall region. This was an improvement of up to 100 mm considering the same period last year. Although significant rains were delayed at the onset of the season, this good rainfall implies positive prospects for winter crop production. It is evident that significant amounts of rainfall occurred over the surface water sources of the Western Cape, important for agricultural water storage. Meanwhile, the adjacent all-year rainfall region experienced below-normal rainfall during this period, raising drought risk concerns for agricultural activities in that area.



The Agricultural Research Council - Institute for Soil, Climate and Water (ARC-ISCW) 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.

1. Rainfall

Overview:

Following good rainfall over the winter rainfall region during May and June 2020, the month of July was also characterized by above-normal rainfall. This was mainly due to a series of frontal systems over the southwestern and western parts of the country. The first cold front made landfall on the evening of the 9th, followed by a second one on the 10th, causing widespread rainfall in the Western Cape. Some isolated areas in and around Cape Town recorded over 100 mm. Further to the north, areas over the west coast received above-normal rainfall. On the 11th, Port Nolloth and Springbok recorded 20 mm and 36 mm, respectively, with other areas towards the south of the Namakwa district recording up to 42 mm (Nieuwoudtville). Due to the movement of the cold fronts eastwards, cold and windy conditions were experienced over the Highveld and central interior, causing widespread morning frost as minimum temperatures dropped below zero. Snow was observed over the high-lying areas of the Eastern Cape, particularly around Barkly East. Meanwhile, the Lowveld remained fairly warm. Another strong cold front brought wet, windy and chilly weather during mid-July over the southwestern region of the country. These were the first significant rains over the all-year rainfall region, although the region recorded below-normal rainfall totals for the month.

One uncharacteristic feature of the climate during July 2020 was the occurrence of rainfall over some parts of the summer rainfall region. Above-normal rainfall occurred over the Vhembe District of the Limpopo Province during the beginning and towards the end of the month, while the Lowveld of Mpumalanga received rainfall on the 28th. This unseasonal rainfall also occurred along the KwaZulu-Natal coast around the 8th, 12th, 15th and again by the 27th and 28th. Other areas in the summer rainfall region remained dry, as expected. The month ended with dry conditions over the winter rainfall region, while rainfall activity was observed over the aforementioned areas of the summer rainfall region.

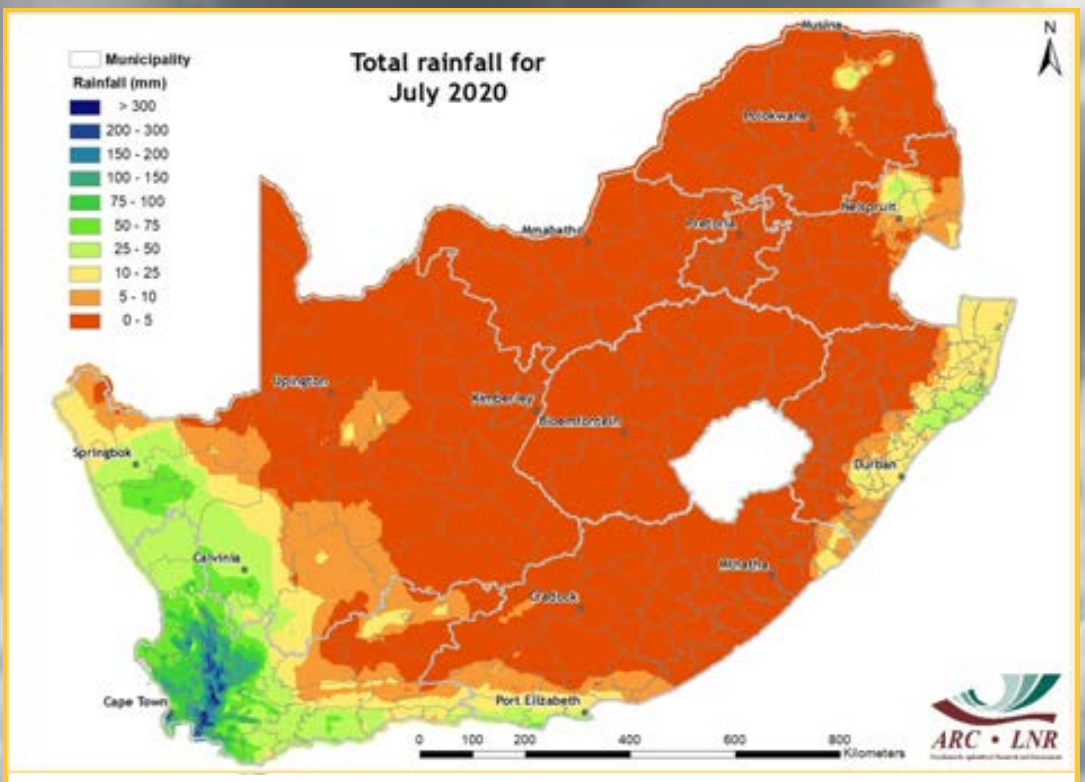


Figure 1

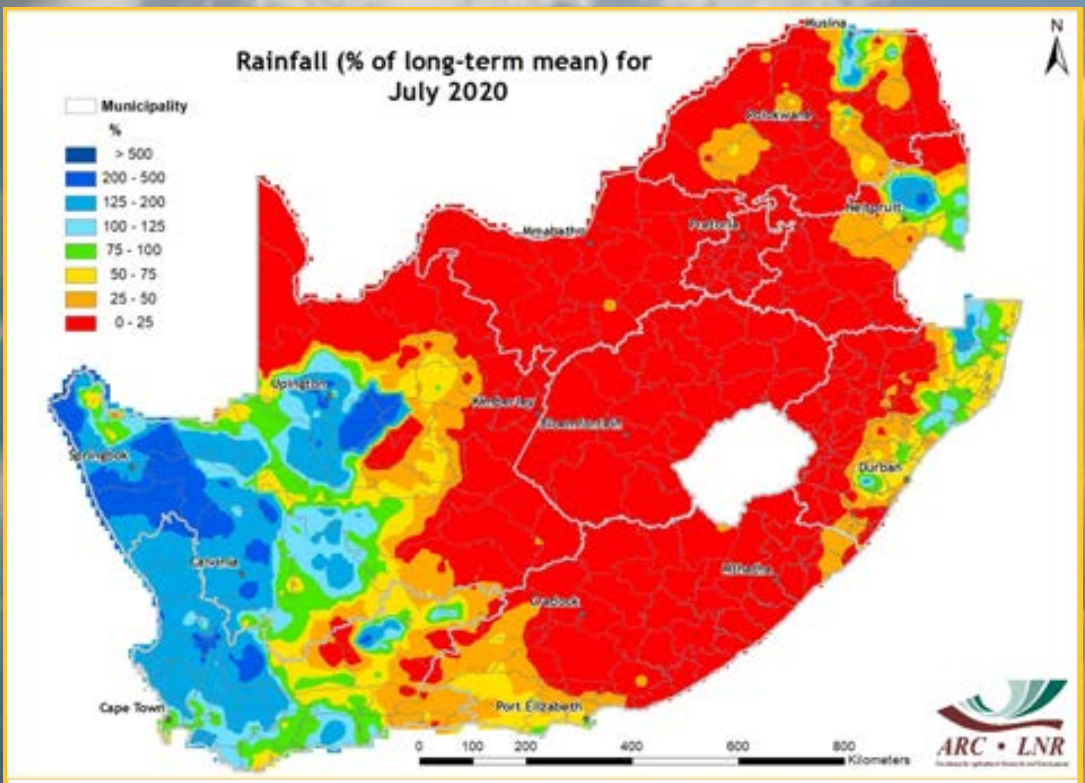


Figure 2

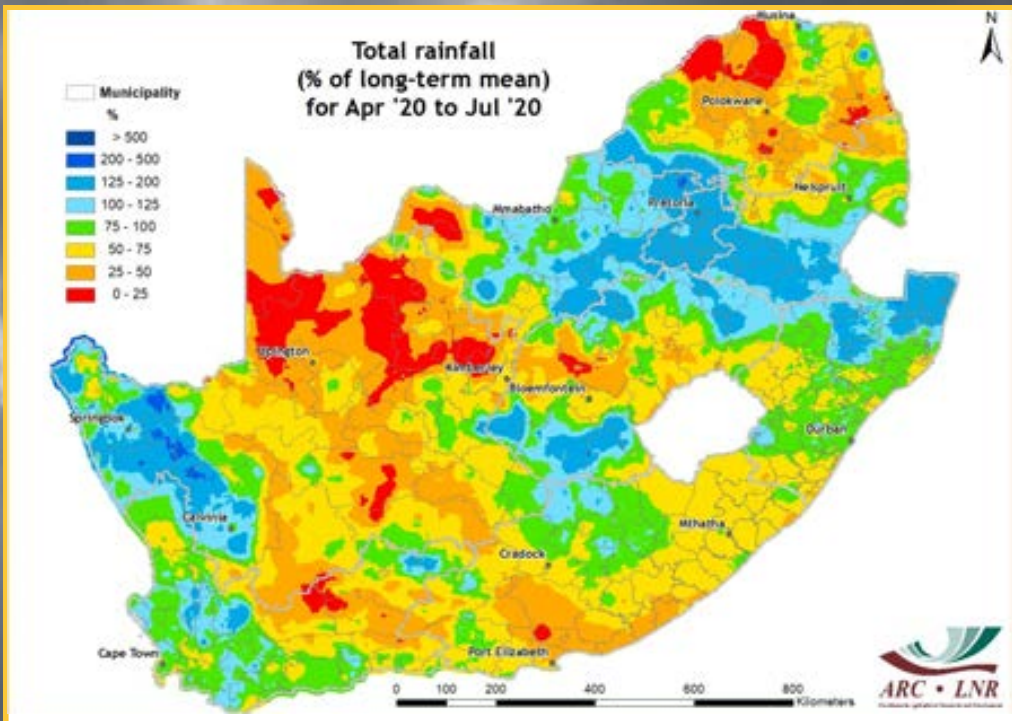


Figure 3

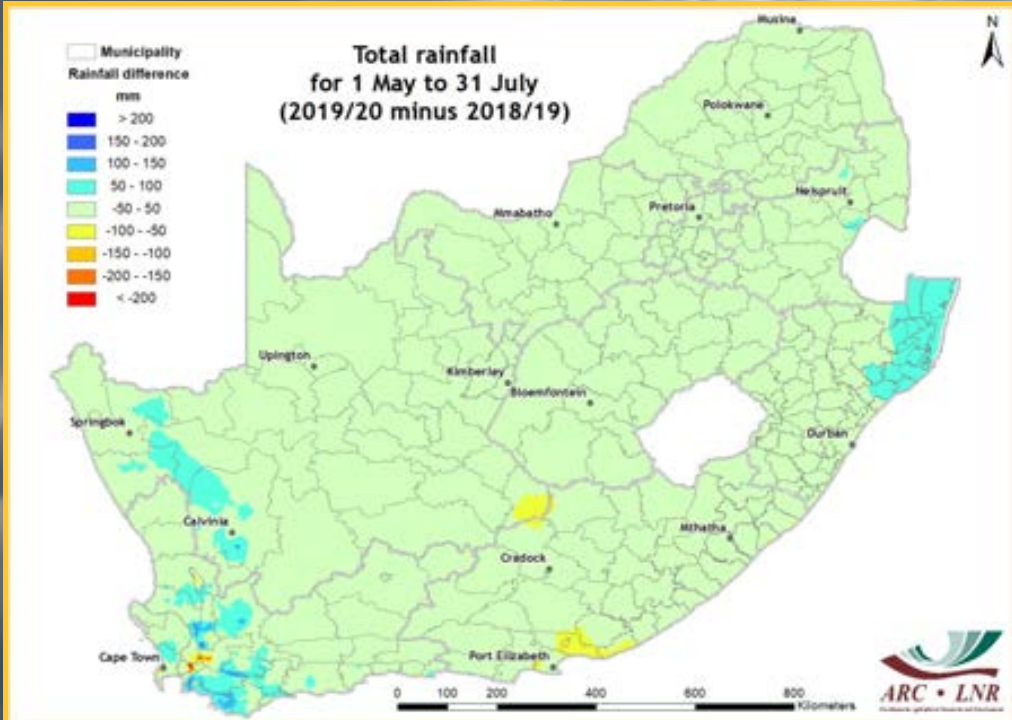


Figure 4

Figure 1:
Precipitation in July 2020 was concentrated over the winter rainfall region, as well as some areas of the summer rainfall region, including parts of the Limpopo, Mpumalanga and KwaZulu-Natal provinces.

Figure 2:
Several frontal systems resulted in above-normal rainfall conditions over the winter rainfall region in July, as well as over some parts of the summer rainfall region (Lowveld of Mpumalanga, Limpopo and northern KwaZulu-Natal). Below-normal rainfall conditions were observed over the rest of the country.

Figure 3:
Total rainfall for the period April-July 2020 indicates above-normal conditions over the winter rainfall region, greater parts of the Highveld and northern KwaZulu-Natal regions. Below-normal rainfall was observed over the rest of the country.

Figure 4:
The winter rainfall region and northern parts of KwaZulu-Natal received significantly more rain during May-July 2020 than in the same period last year. The rest of the country received normal rainfall conditions for the same period.

Questions/Comments:
MasuphaE@arc.agric.za
Johan@arc.agric.za

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 SPI), medium-term (12-month SPI) and long-term (24-month and 36-month SPI) drought conditions are shown in Figures 5-8. Given the 6-month map ending in July 2020, mild drought conditions prevailed over greater parts of the country. Moreover, the interior experienced mildly to moderately wet conditions, of which the latter were observed over the southern regions of the North West and Free State, as well as northern regions of the Eastern Cape. The 12-month SPI map shows mild to moderate drought over greater parts of the country, while moderate to severe drought conditions are visible on the 24-month SPI map over the Cape provinces, eastern Free State, parts of KwaZulu-Natal, Limpopo and Mpumalanga.

Questions/Comments:
MasuphaE@arc.agric.za
Johan@arc.agric.za

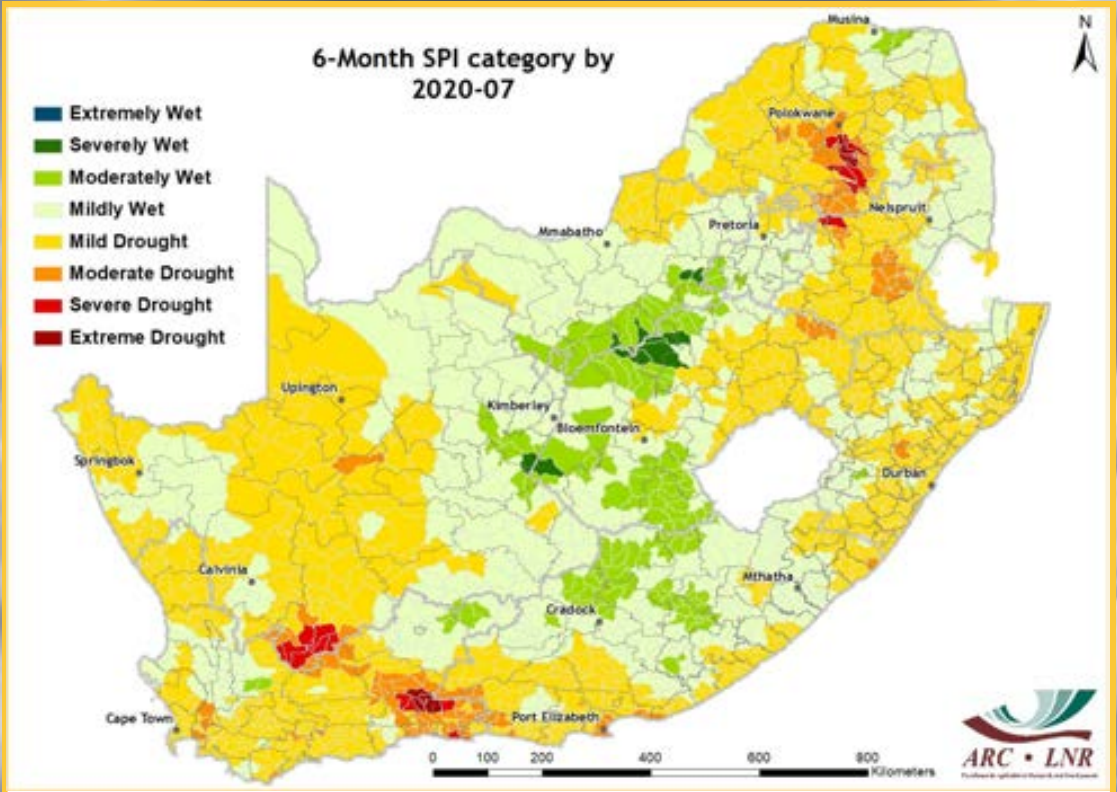


Figure 5

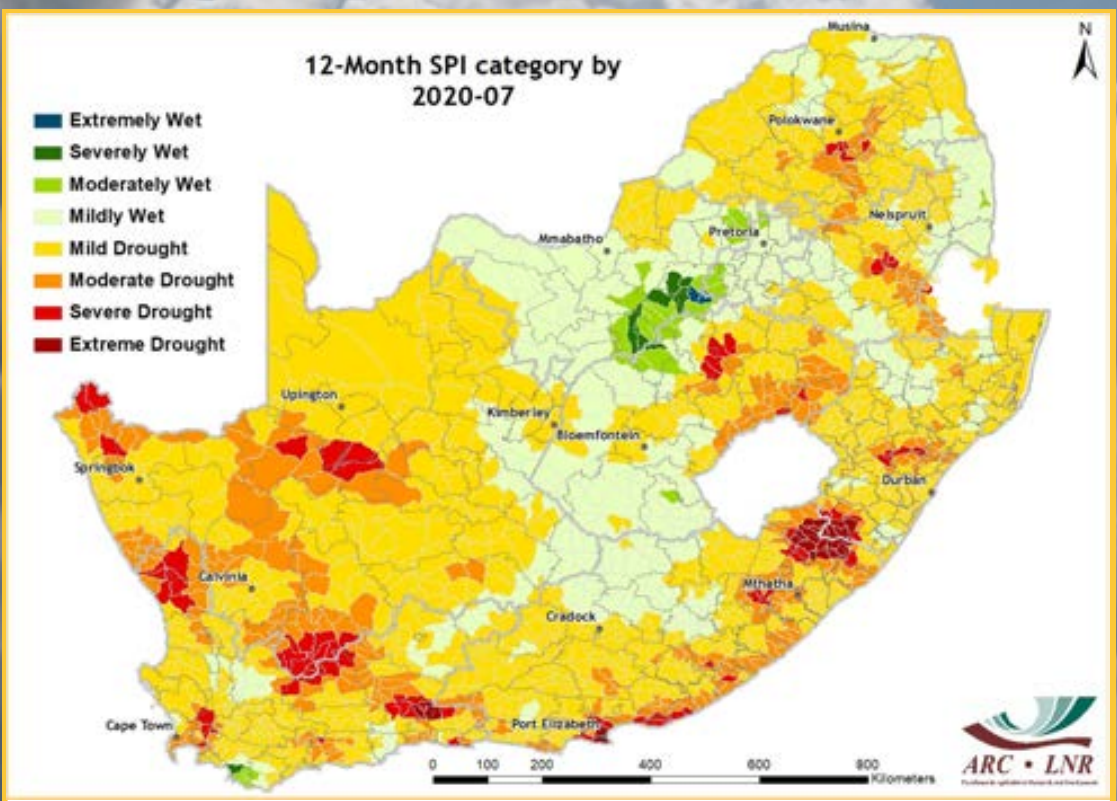


Figure 6

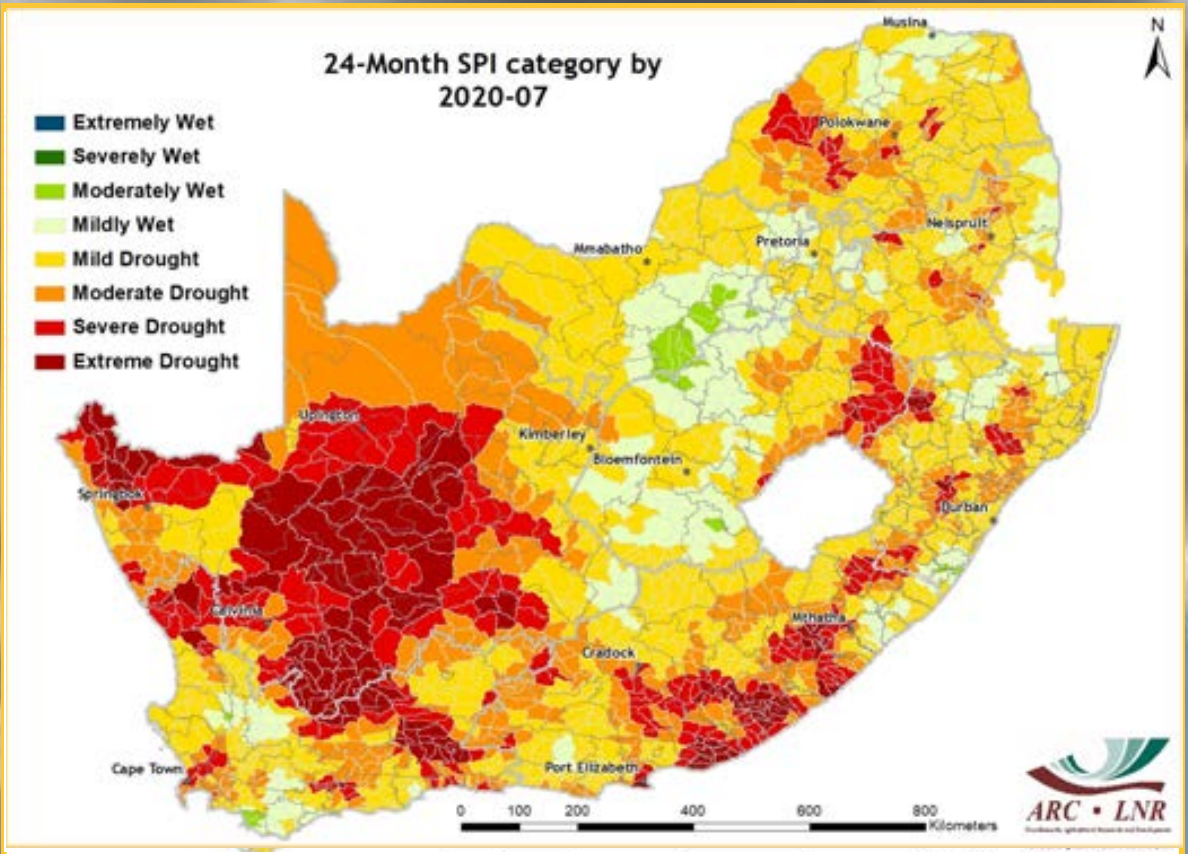


Figure 7

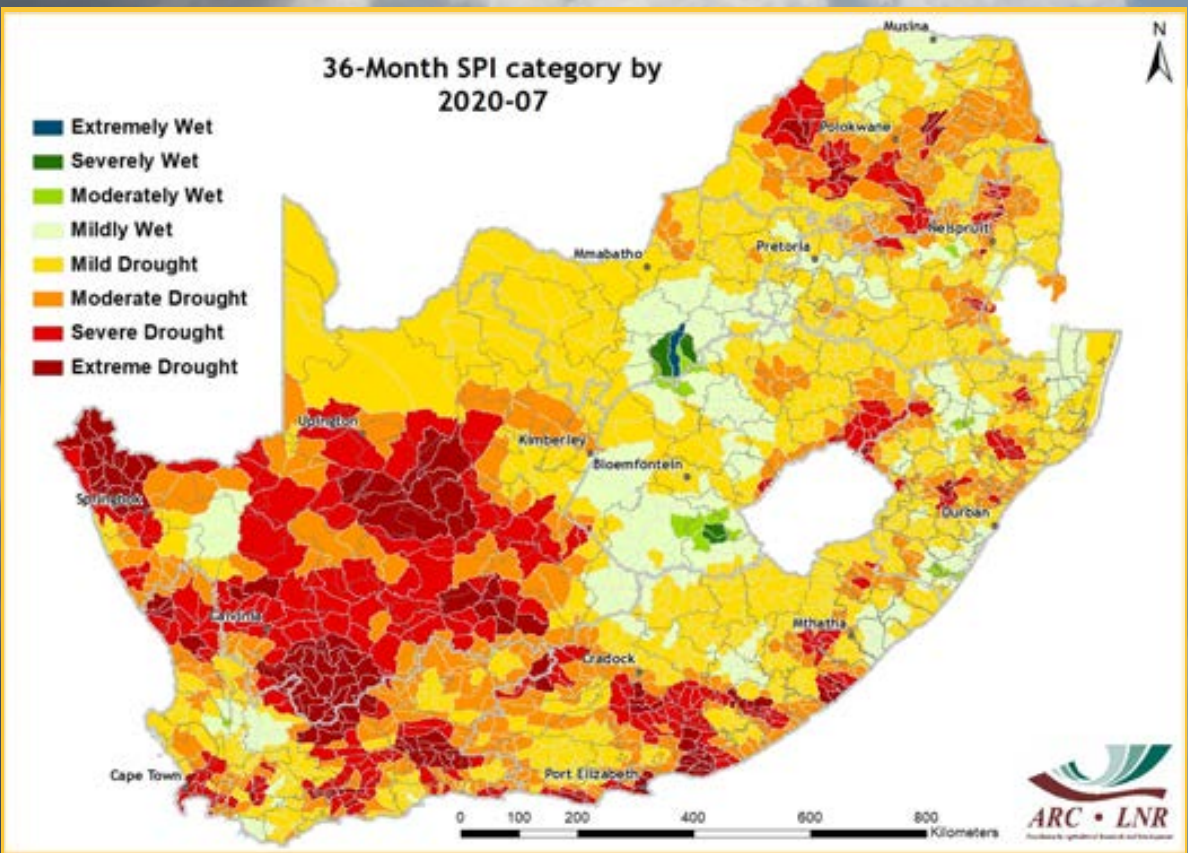


Figure 8

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.

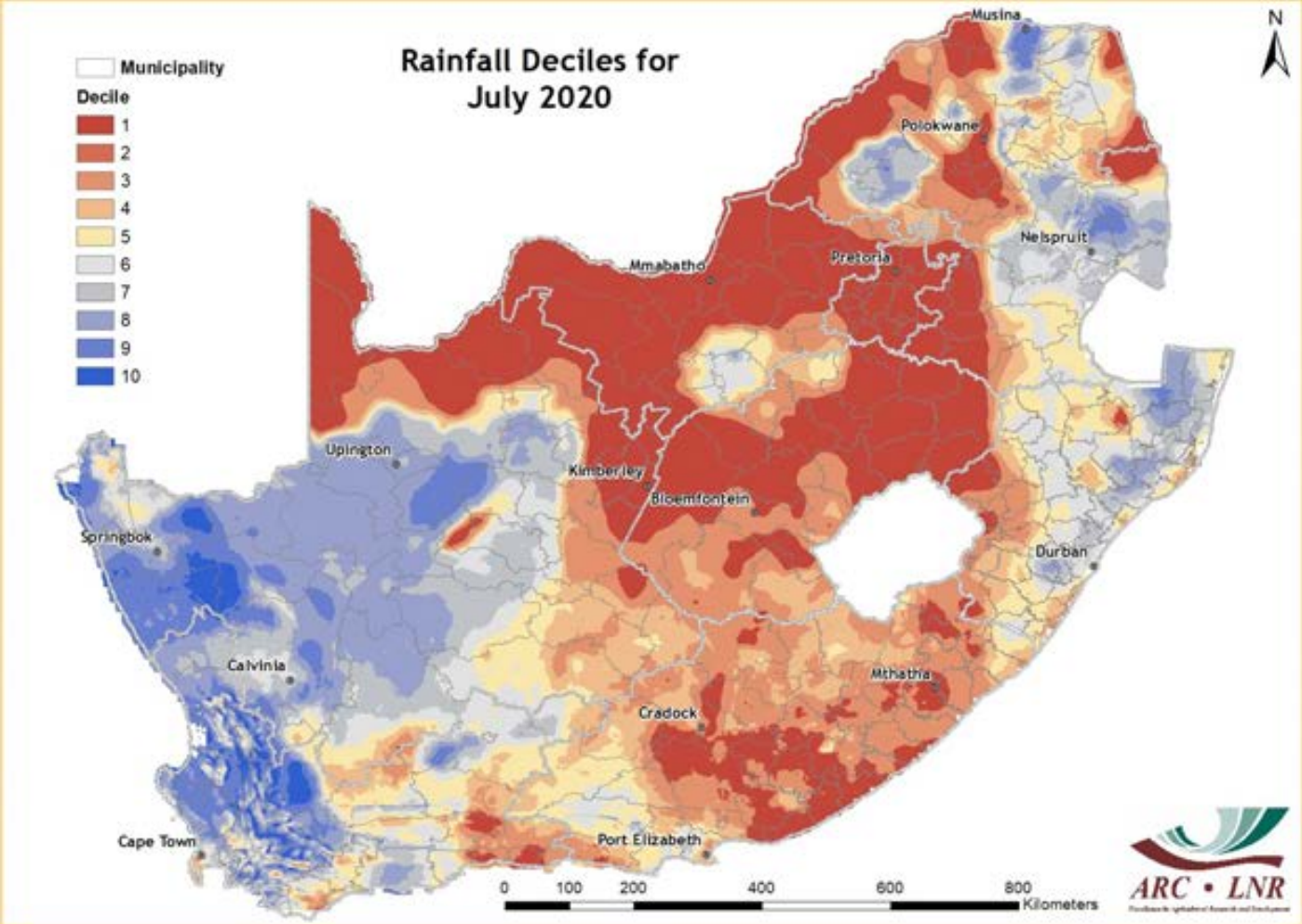


Figure 9

Figure 9:
The western half of the country and the far eastern regions experienced rainfall totals that compare well with the historically wetter July rainfall totals. Meanwhile, the northern regions as well as the interior and towards the Eastern Cape compared well with the historically drier July rainfall totals.

Questions/Comments:
MasuphaE@arc.agric.za
Johan@arc.agric.za

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.

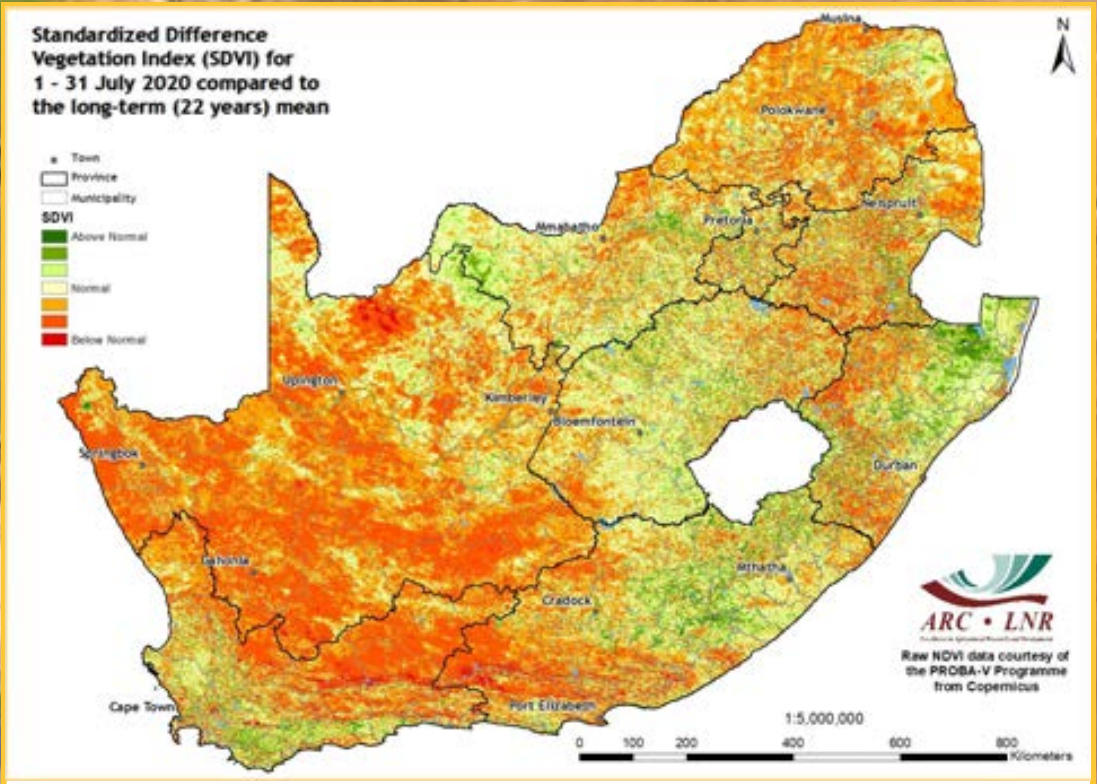


Figure 10

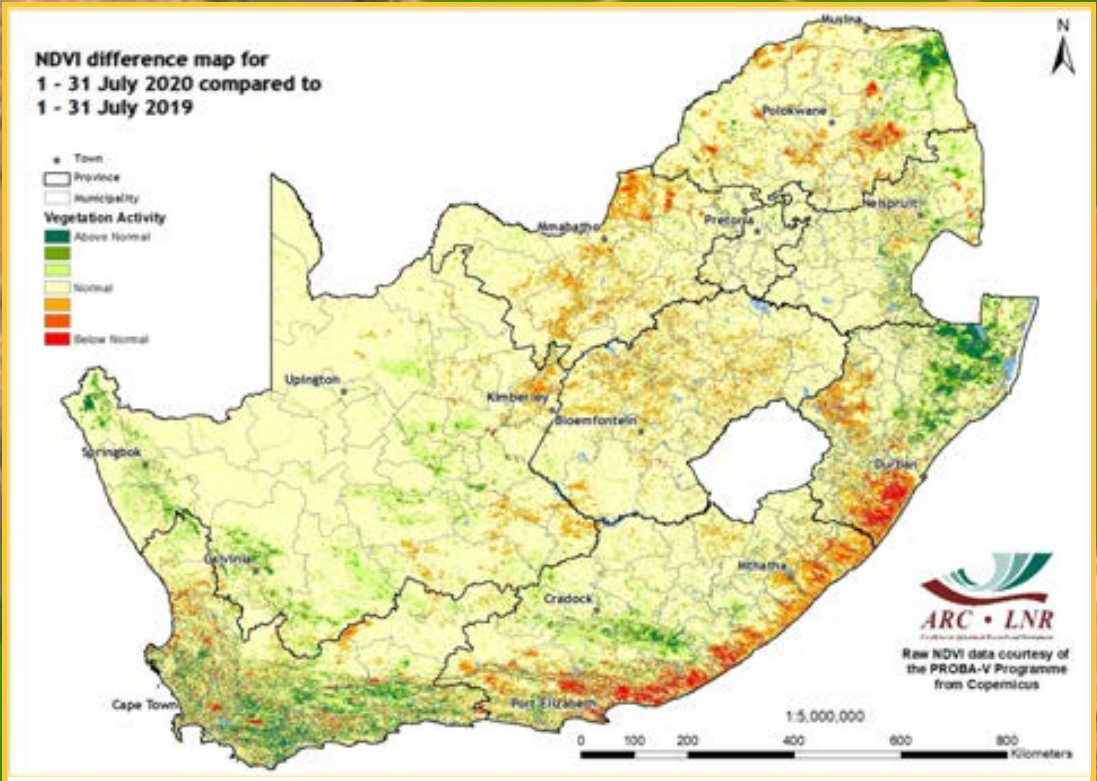


Figure 11

Figure 10:
Compared to the long-term average, the SDVI map for July 2020 shows that many parts of the country experienced poor vegetation conditions with patches of good vegetation activity over isolated areas.

Figure 11:
Compared to the same month last year, the NDVI difference map for July 2020 shows that normal to above-normal vegetation activity occurred over many areas in the country with pockets of below-normal activity over isolated areas.

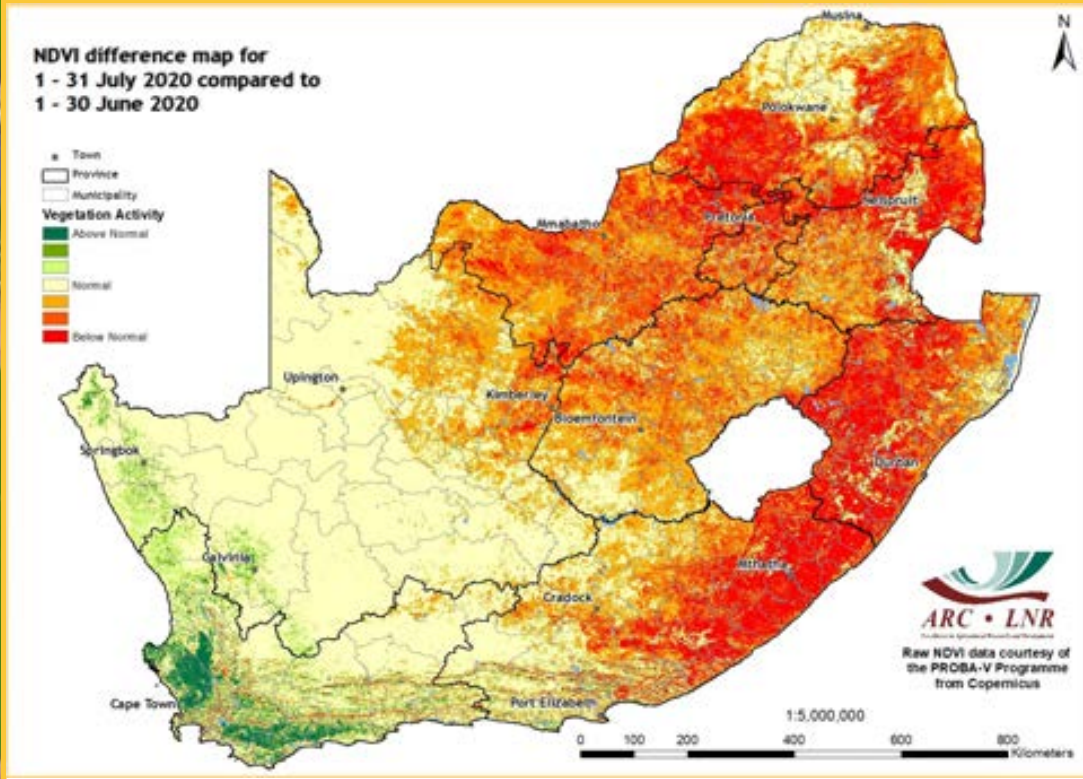


Figure 12

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

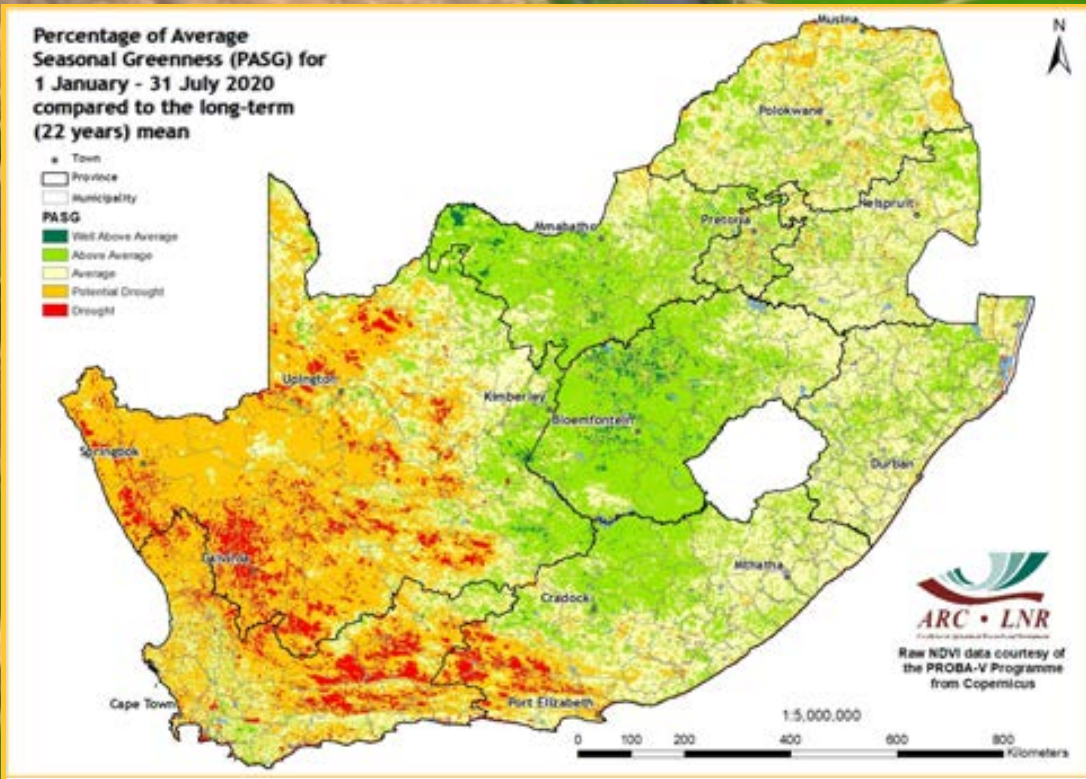


Figure 13

Figure 12:
Compared to the previous month, the NDVI difference map for July shows that the eastern half of the country experienced very poor vegetation conditions. In contrast, the western half was characterized by normal to above-normal vegetation activity.

Figure 13:
Cumulative vegetation conditions over a 6-month period compared to the long-term mean show that the eastern half of the country continues to experience high levels of seasonal vegetation greenness. Meanwhile, the western parts continue to experience low levels of seasonal vegetation greenness.

Questions/Comments:
MaakeR@arc.agric.za

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.

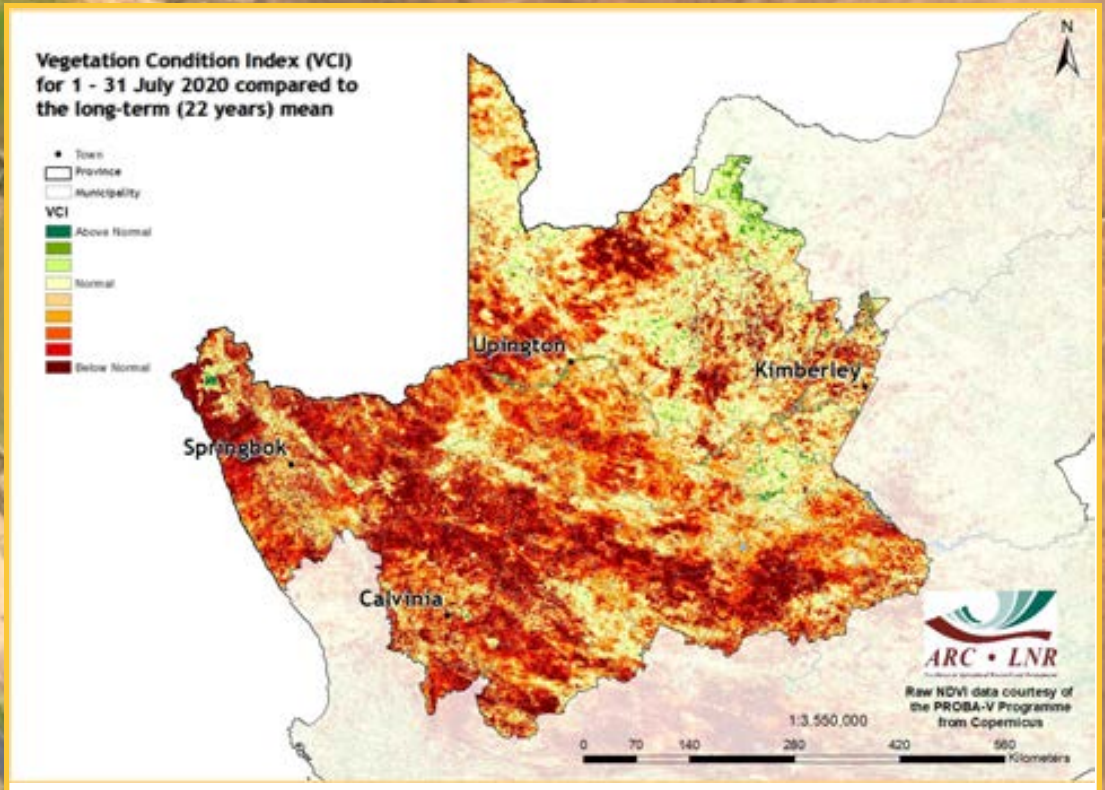


Figure 14

Figure 14:
The VCI map for July indicates that severe drought conditions continue to prevail in larger parts of the Northern Cape.

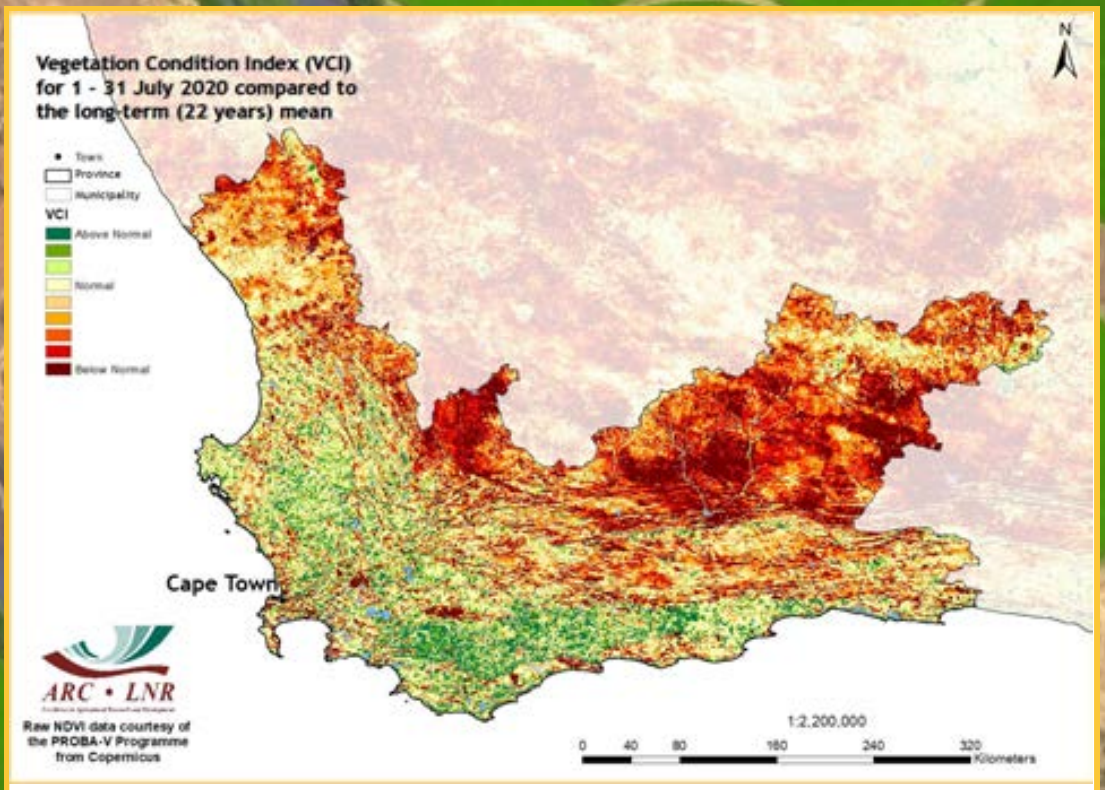


Figure 15

Figure 15:
The VCI map for July indicates that the Central Karoo, northern parts of the West Coast, as well as northeastern and western parts of the Eden District Municipality, continue to experience poor vegetation conditions. However, isolated areas in the western parts and the southern coastal areas of the Western Cape continue to experience pockets of good vegetation conditions.

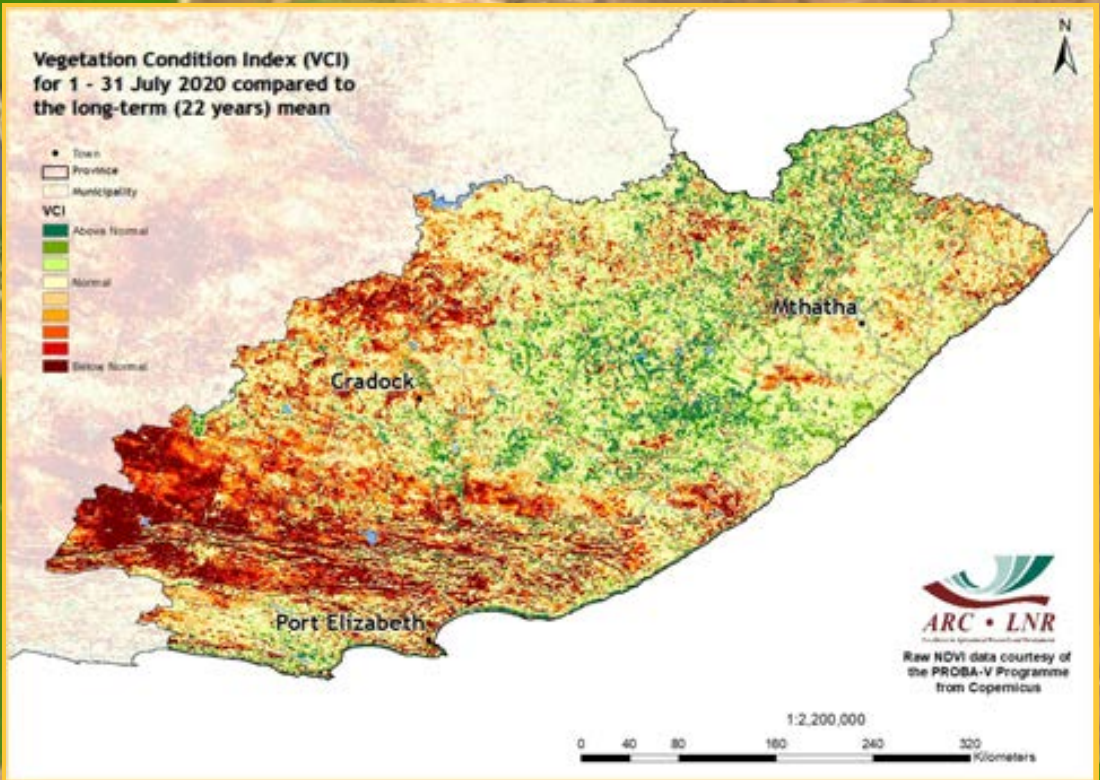


Figure 16

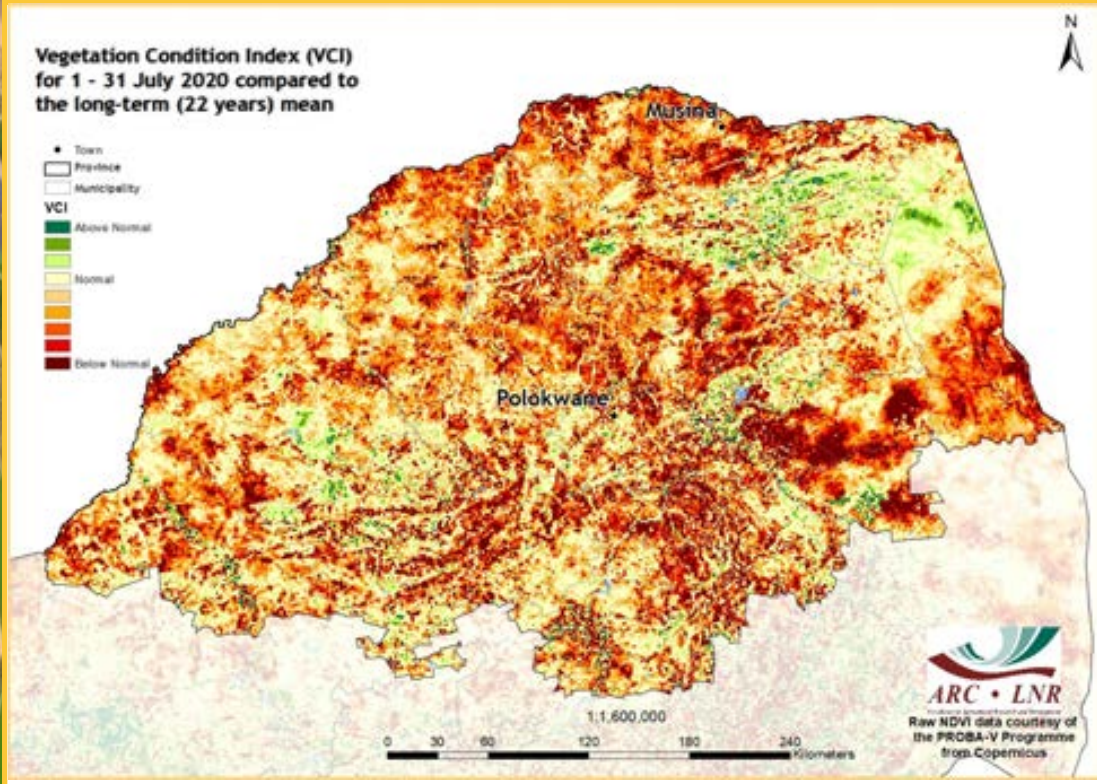


Figure 17

Figure 16:
The VCI map for July indicates that vegetation in the western half of the Eastern Cape remains extremely stressed, but pockets of good vegetation activity were experienced in the eastern half of the province.

Figure 17:
The VCI map for July indicates that poor vegetation activity continues to spread over greater parts of the Limpopo Province.

Questions/Comments:
MaakeR@arc.agric.za

6. Vegetation Conditions & Rainfall

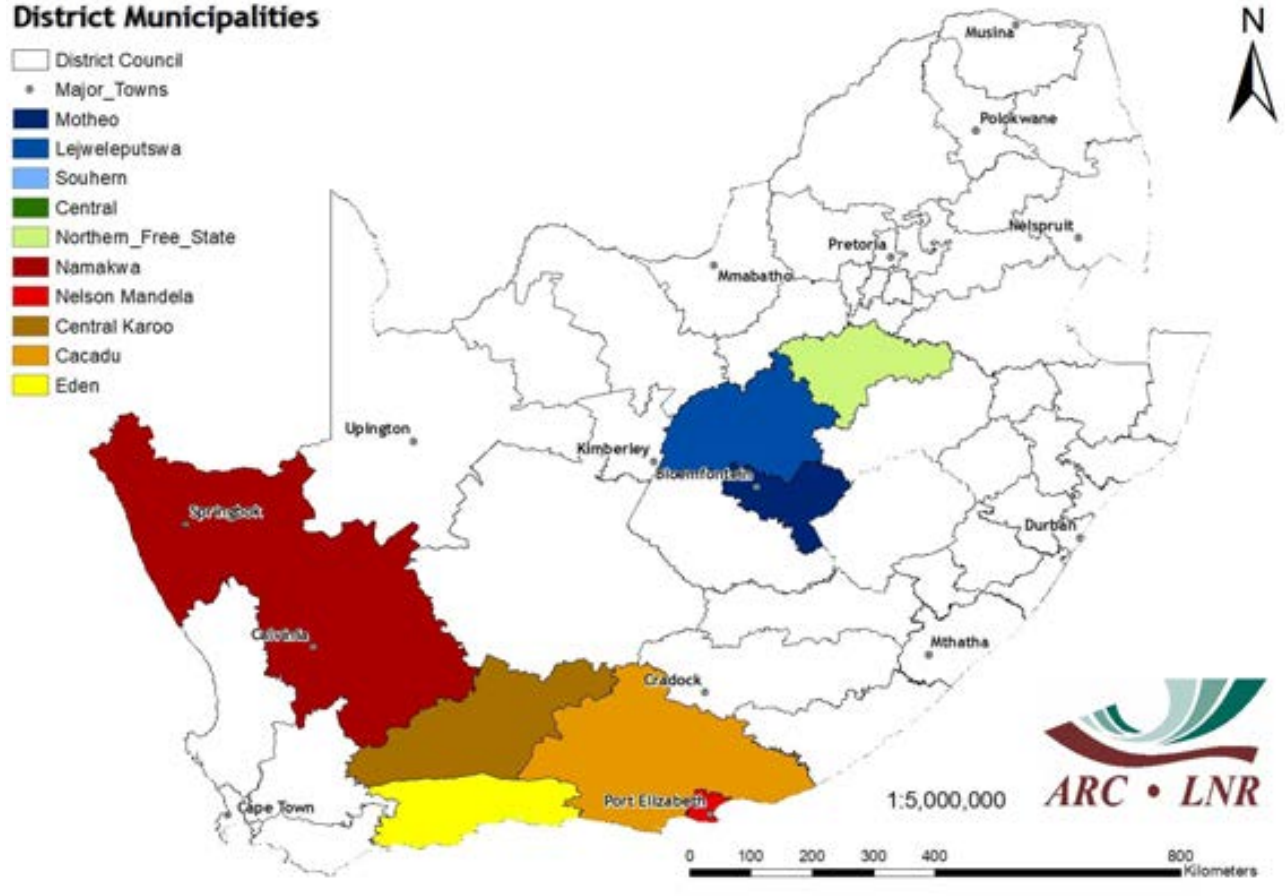


Figure 18

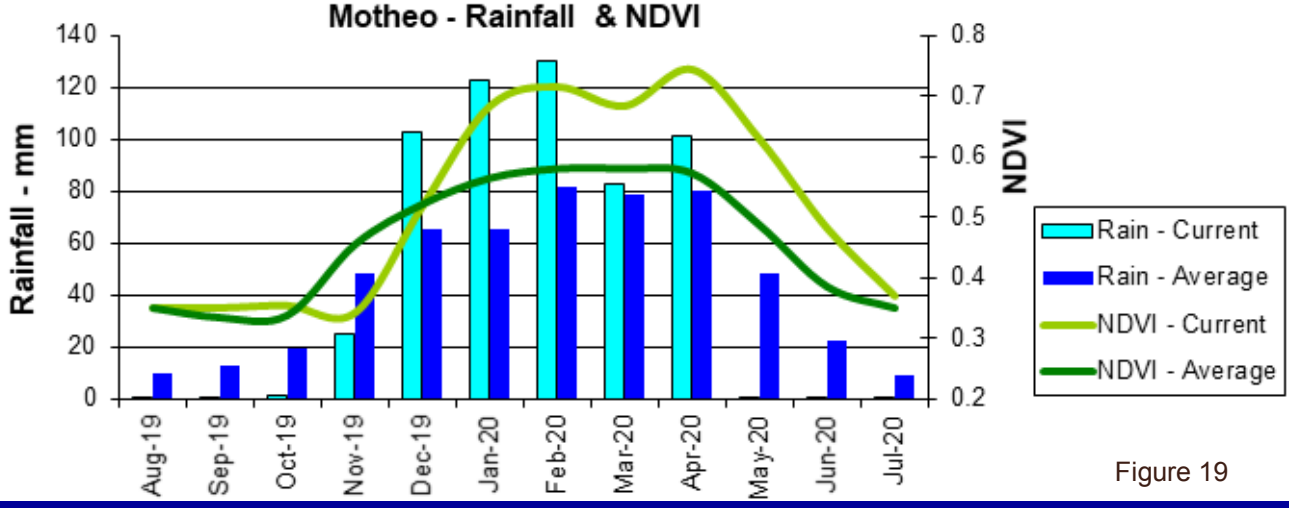
Rainfall and NDVI Graphs

Figure 18:
Orientation map showing the areas of interest for July 2020. The district colour matches the border of the corresponding graph.

Questions/Comments:
MaakeR@arc.agric.za

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.



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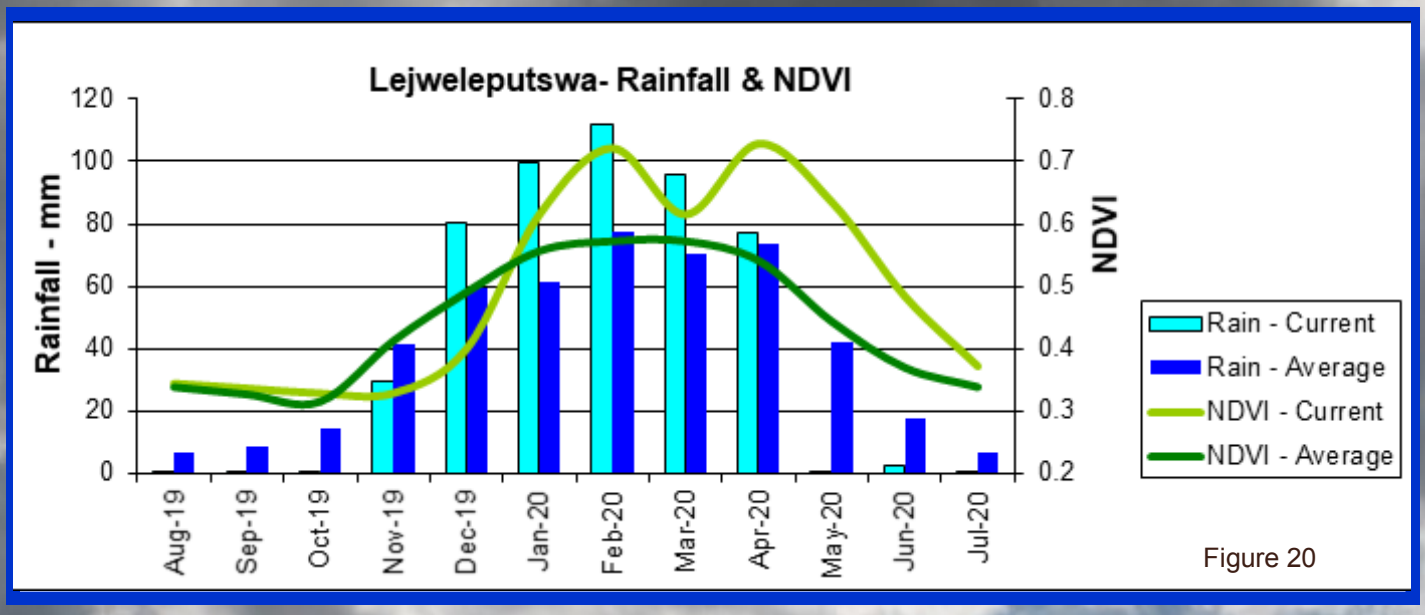

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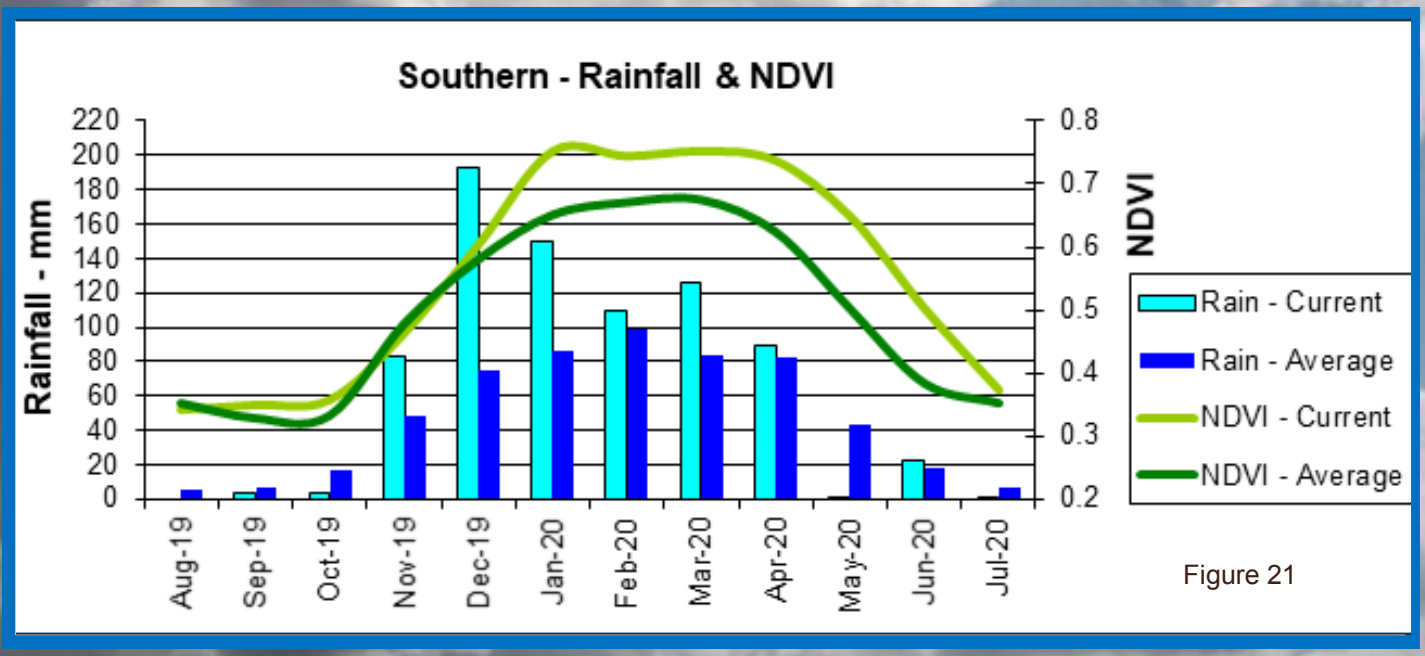

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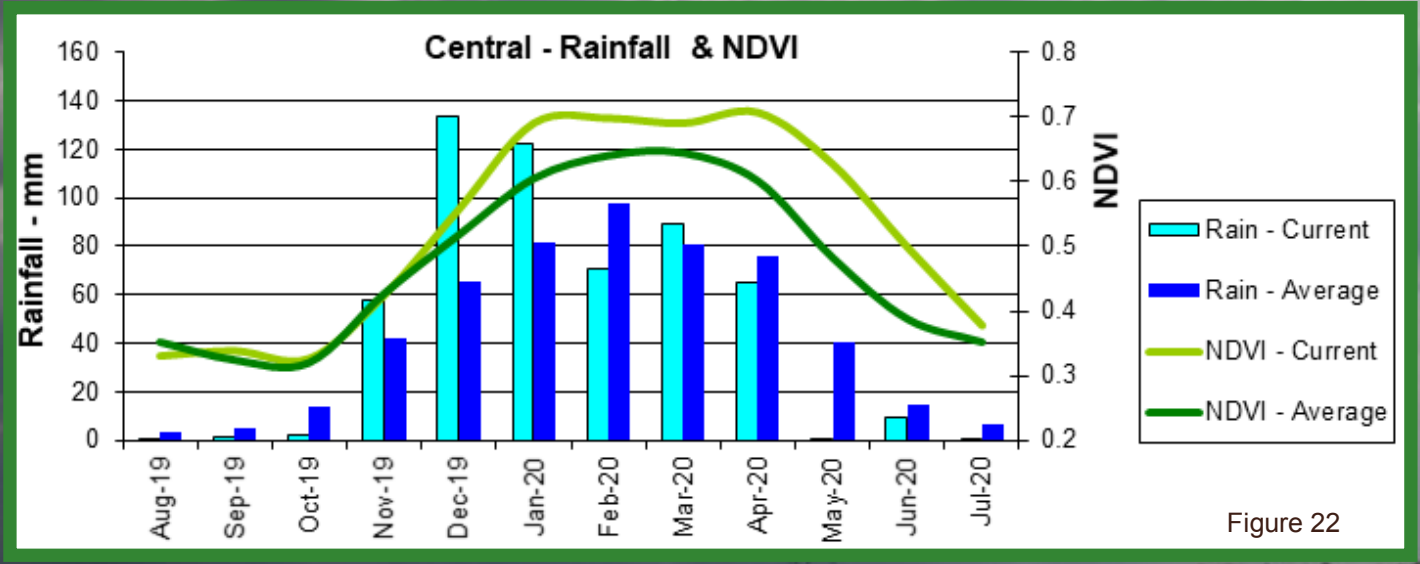

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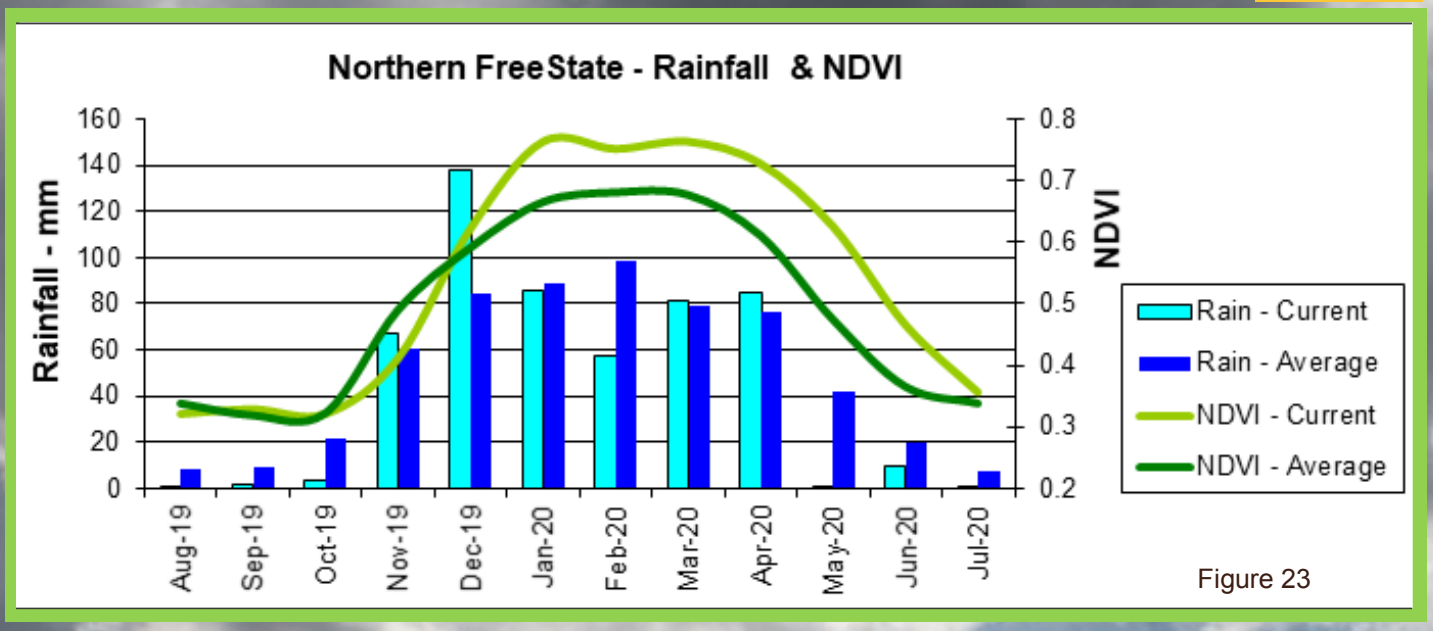

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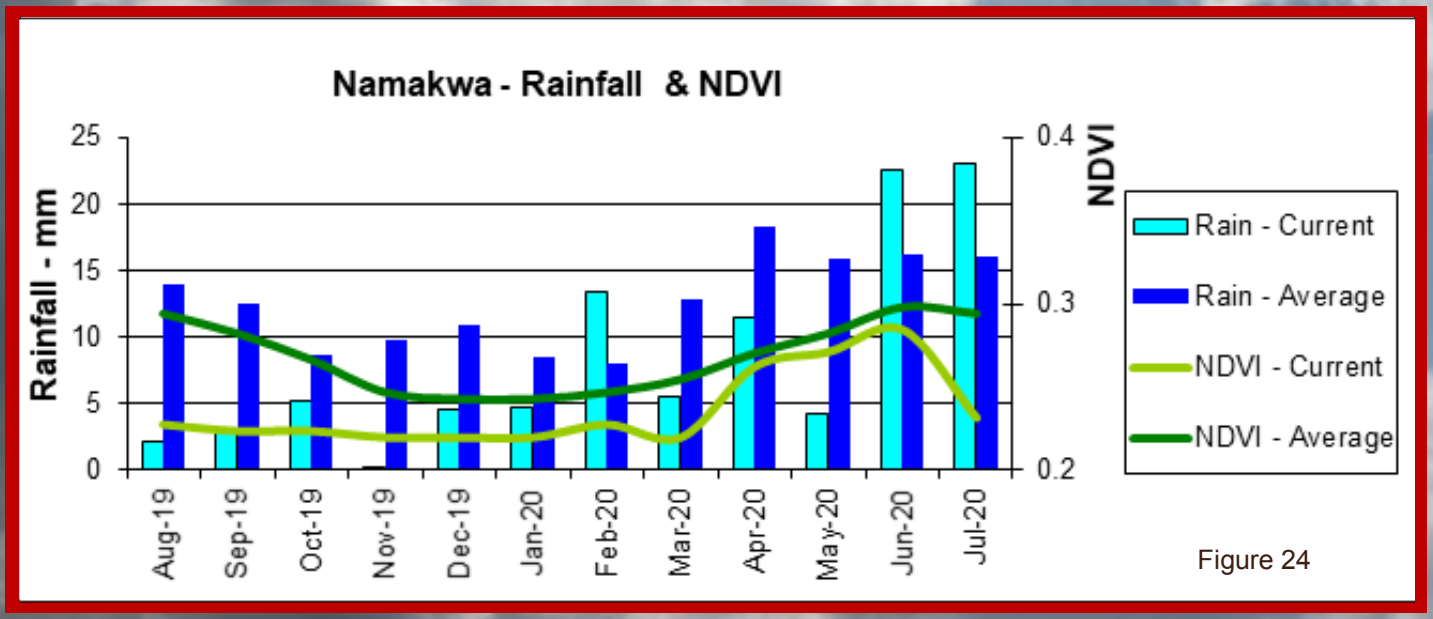
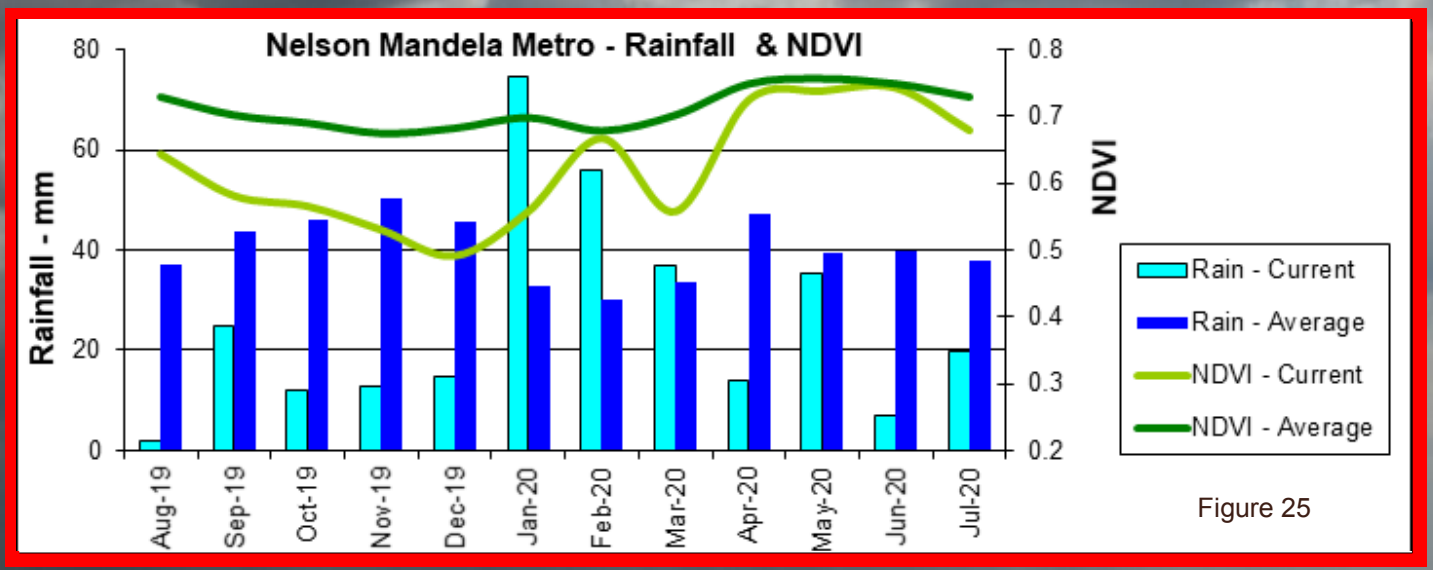


Figure 24



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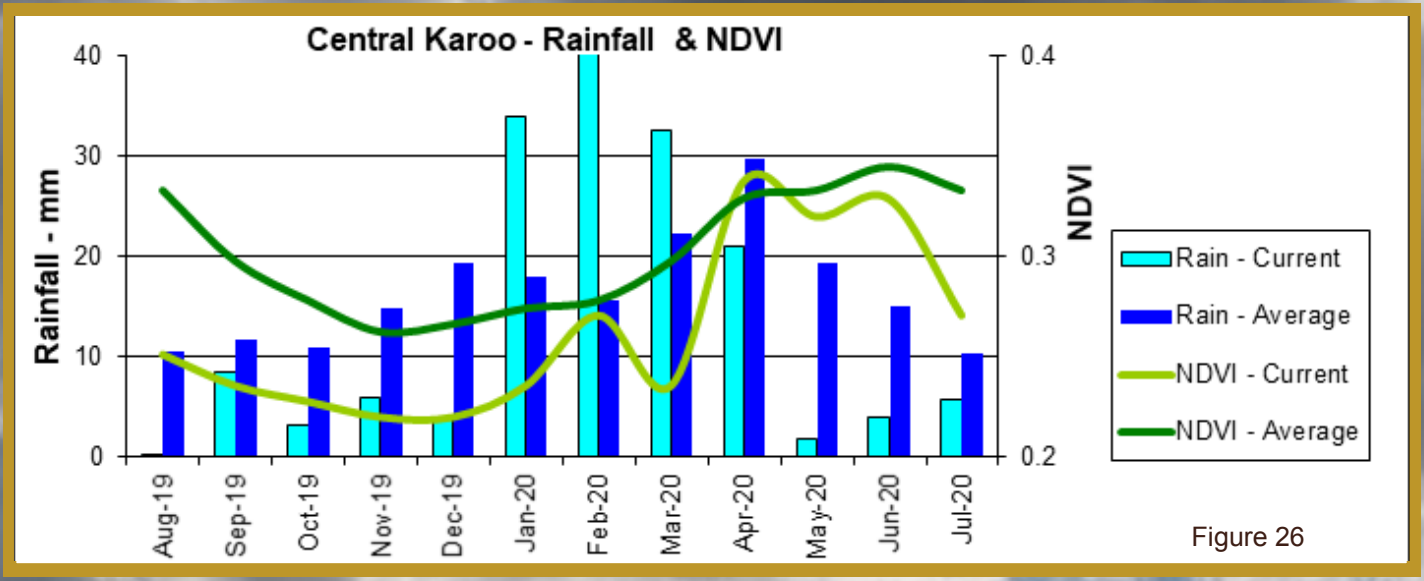

Figure 26

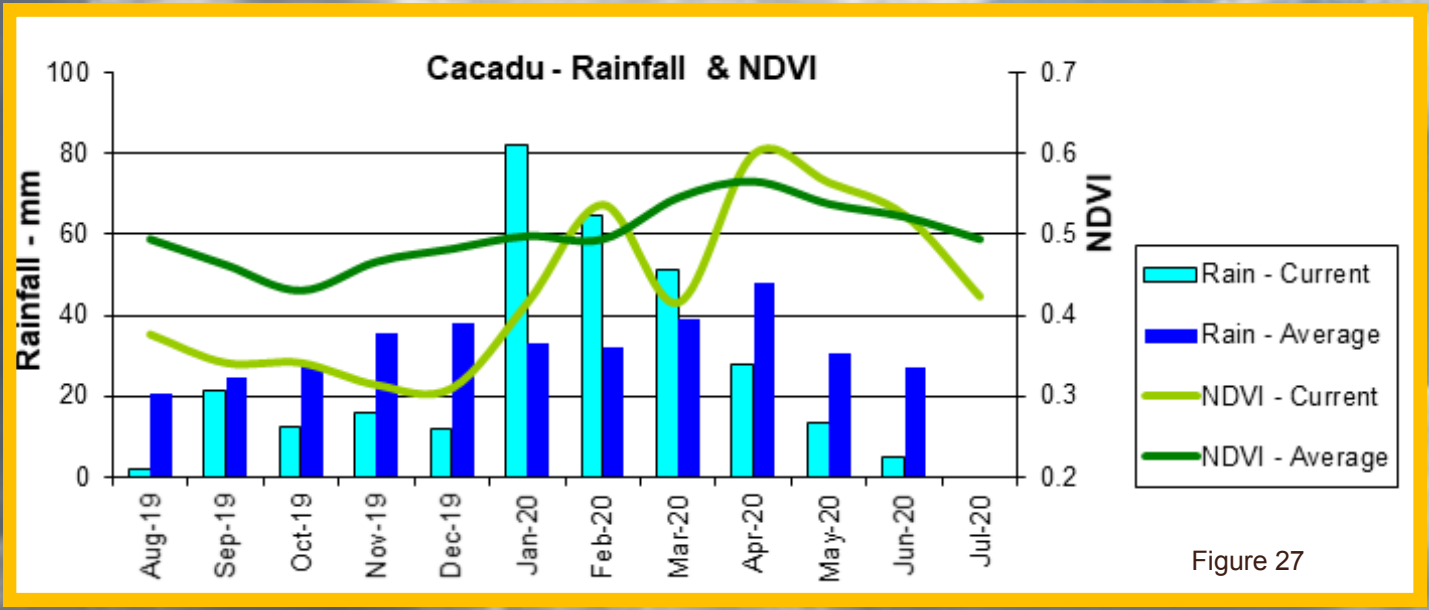

Figure 27

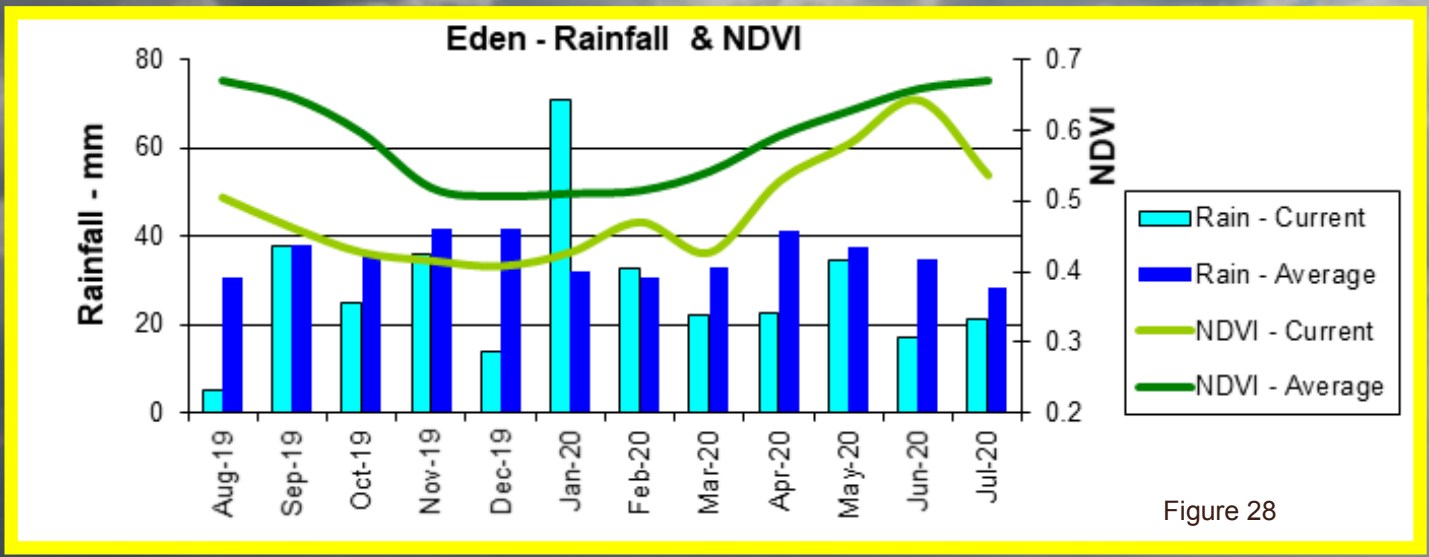

Figure 28

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 between 1-31 July 2020 per province. Fire activity was higher in all provinces except for the Northern Cape compared to the long-term average.

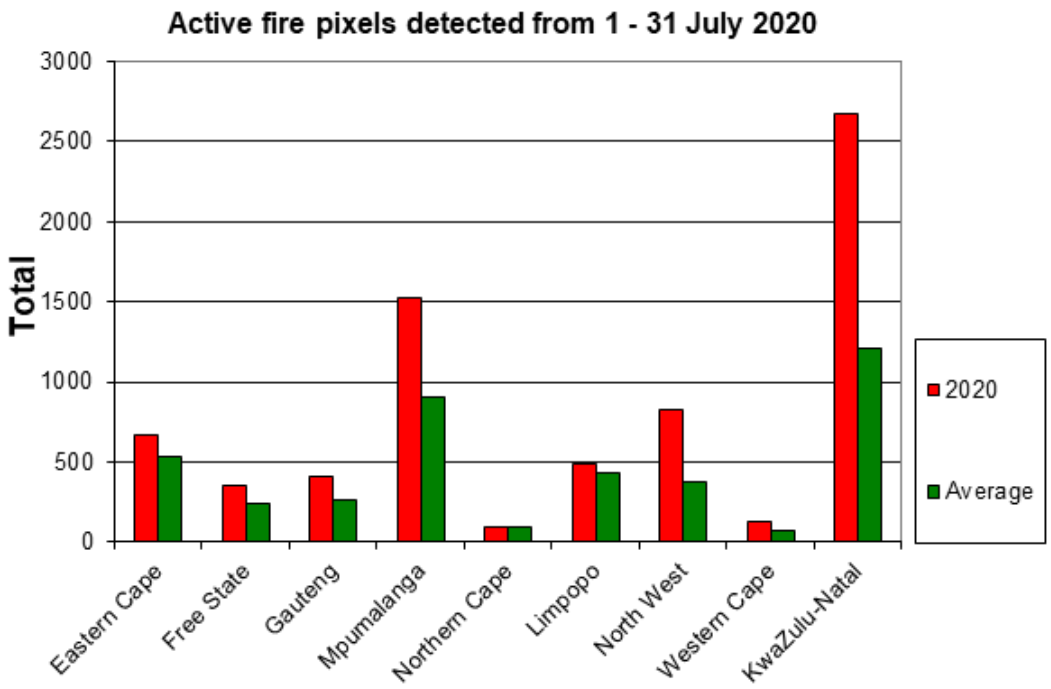

Figure 29

Figure 30:
The map shows the location of active fires detected between 1-31 July 2020.

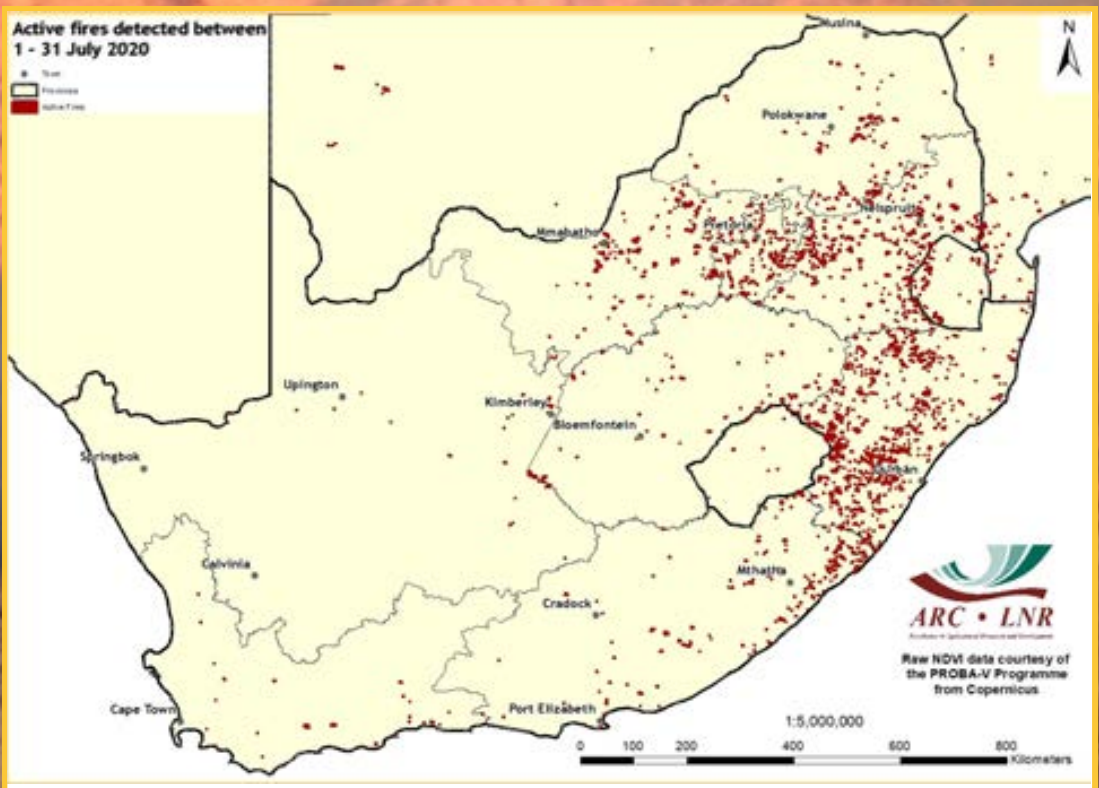

Figure 30

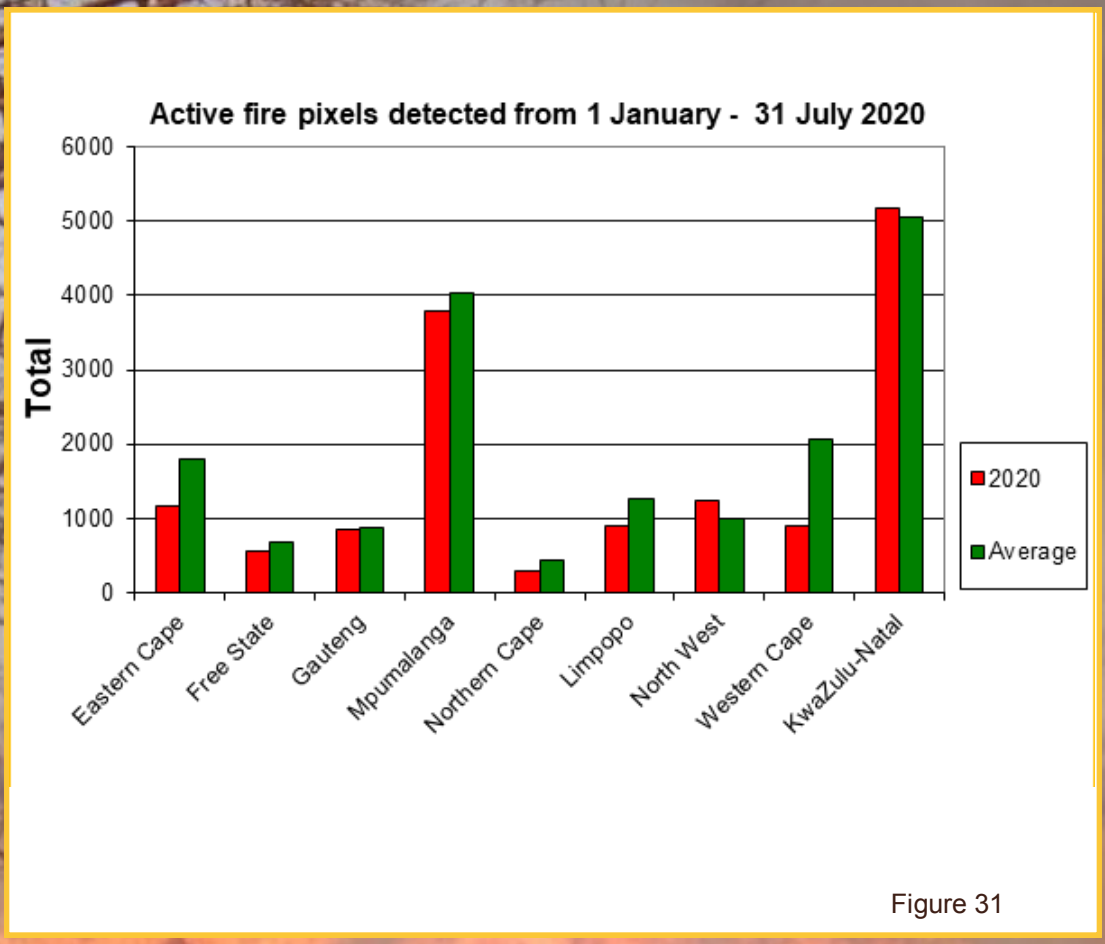

Figure 31

Figure 31:
The graph shows the total number of active fires detected between 1 January - 31 July 2020 per province. Fire activity was lower in all provinces, except for the North West and KwaZulu-Natal, compared to the long-term average.

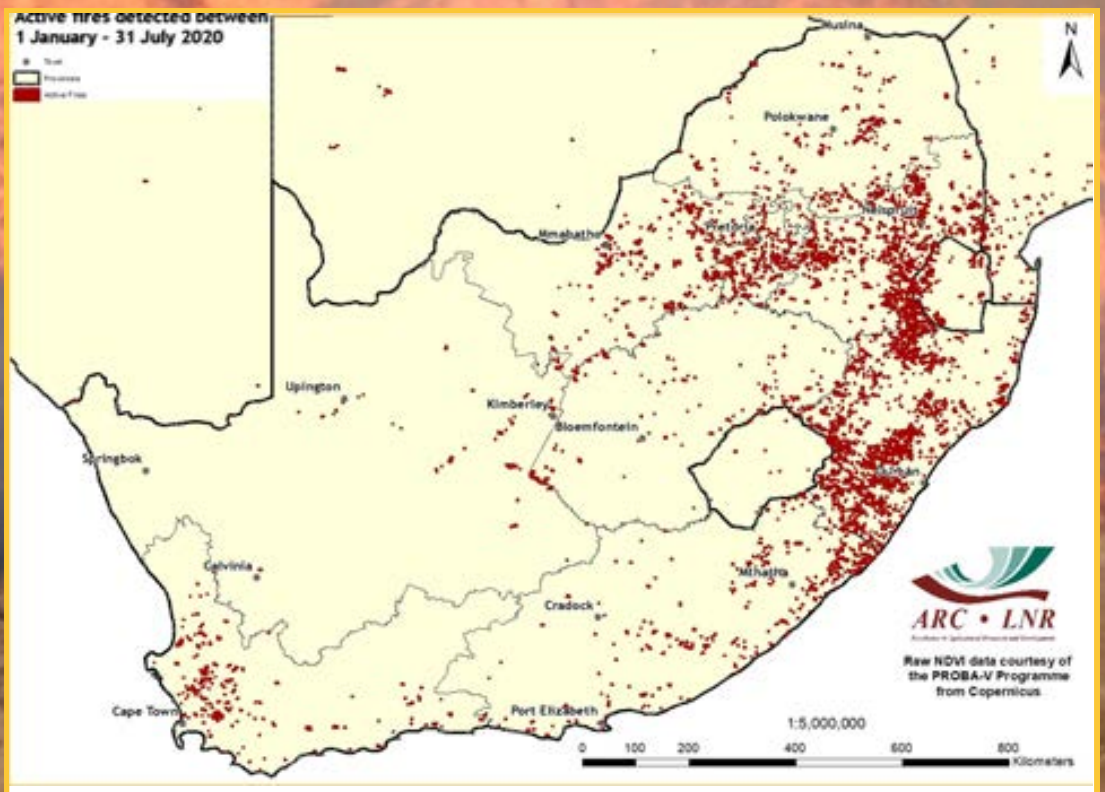

Figure 32

Figure 32:
The map shows the location of active fires detected between 1 January - 31 July 2020.

Questions/Comments:
MaakeR@arc.agric.za

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 4 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 2019.

The long-term map for July 2020 shows a continuation of the April, May and June patterns and conditions, with the majority of catchments across the entire country now showing water levels equivalent to 60-80% of the 4-year long-term maximum. Catchments in the Western Cape are, however, showing a general increase in water levels in July compared to June, whereas those in the Central Karoo region are showing a slight decline.

The comparison between July 2020 and July 2019 indicates higher water levels in the Karoo region this year but otherwise generally lower water levels in all other areas compared to 2019. A few small catchments scattered across the Western and Eastern Cape, as well as Limpopo, are now showing significantly lower water levels. This is similar to the pattern reported last month.

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:
mark.thompson@geoterraimage.com

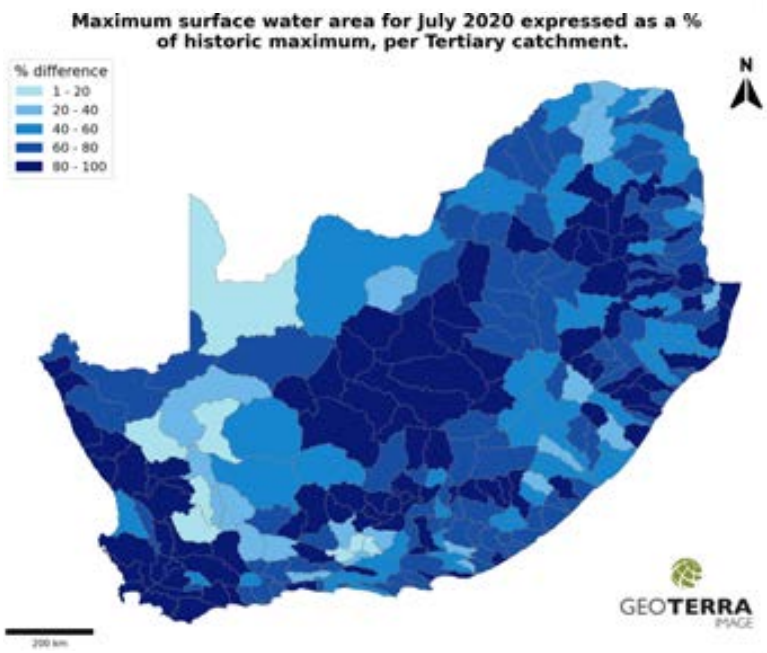

Figure 33

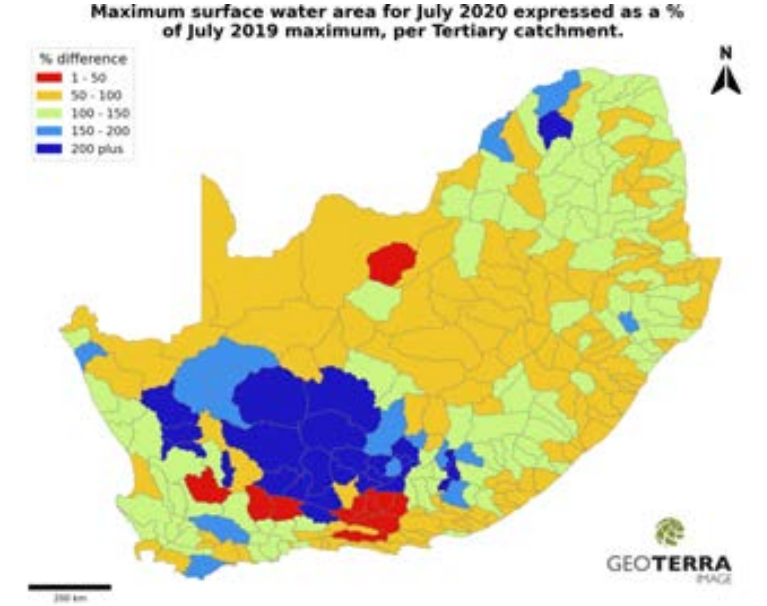

Figure 34

Agrometeorology

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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

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

Contact Person:
Dr Mokhele Moeletsi
Tel: 012 310 2537
E-mail: moeletsim@arc.agric.za

ARC-Institute for Soil, Climate and Water
600 Belvedere Street, Arcadia • Private Bag X79, Pretoria 0001
Tel: 012 310 2500 • Fax: 012 323 1157 • Website: www.arc.agric.za
For more information contact:
Adri Laas - Public Relations Officer • E-mail: adril@arc.agric.za

Geoinformation Science

ARC • LNR

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

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

Contact Person:
Dr George Chirima
Tel: 012 310 2672
E-mail: chirimaj@arc.agric.za

ARC-Institute for Soil, Climate and Water
600 Belvedere Street, Arcadia • Private Bag X79, Pretoria 0001
Tel: 012 310 2500 • Fax: 012 323 1157 • Website: www.arc.agric.za
For more information contact:
Adri Laas - Public Relations Officer • E-mail: adril@arc.agric.za

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 m^2 to 1 km^2) 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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Excellence in Research and Development

Institute for Soil, Climate and Water

Private Bag X79, Pretoria 0001,
South Africa
600 Belvedere Street, Arcadia, Pretoria, South Africa

Reneilwe Maake
Project Leader: Coarse Resolution Imagery Database (CRID)
Phone: +27(0) 12 310 2533
Fax: +27(0) 12 323 1157
E-mail: MaakeR@arc.agric.za

The operational Coarse Resolution Imagery Database (CRID) project of ARC-ISCW is funded by the National Department of Agriculture, Land Reform and Rural Development. 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 the following:
Reneilwe Maake – 012 310 2533, MaakeR@arc.agric.za
Adri Laas – 012 310 2518, AdriL@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".