ARC • LNR
Excellence in Research and Development

UMLINDI
The Watchman

ISSUE 2018-08 | 17 AUGUST 2018

INSTITUTE FOR SOIL, CLIMATE AND WATER

CONTENTS:

agriculture, forestry & fisheries
Department: Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

South African Weather Service

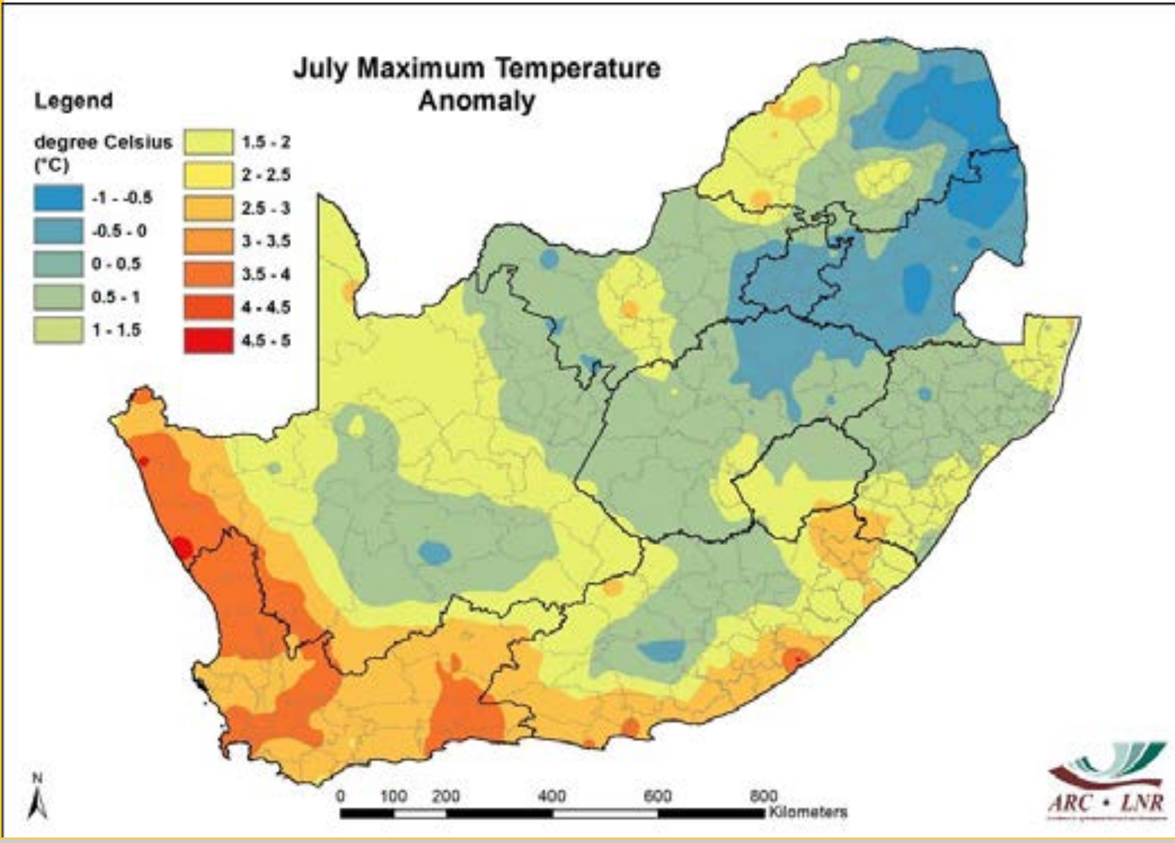
AMESD

170th Edition

Image of the Month

A hotter than normal July over western and southern South Africa

Anomalous circulation patterns resulted in above-normal maximum temperatures during July 2018 over the western and southern parts of the country, whilst cooler than normal conditions occurred over the northeastern parts. A stationary high pressure system was anchored to the east of the country for a few days by the end of the first week of July and again for almost the entire second half of the month. This pressure pattern resulted in surface flow that promoted warm conditions over the western and southern parts of the country. Over large areas over the western parts, the maximum temperature during July 2018 was 3˚C higher than normal, whilst over the entire all-year rainfall region it was at least 2˚C above normal (see map below). In addition to the warming associated with the airflow, frontal systems were also mostly prevented from making landfall. Only on about two occasions were they able to pass over the western and southern parts of the country. Apart from the intensity of the high pressure system that was anomalously strong, the duration of this system and the static nature of it was quite out of the ordinary.



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, Forestry and Fisheries (DAFF).

1. Rainfall

Overview:

The frequent arrival of frontal systems and consequent rainfall over the far southwestern parts of the country during April, May and June came to a halt in July 2018. Only about 50% of the normal rainfall occurred over the catchment regions important for water storage in the main dams over the southwestern part of the Western Cape. Since July is one of the main rainfall months over the winter rainfall region, the failure of adequate rains during this month is noteworthy. Some of the more northerly parts of the region did receive above-normal rainfall, extending eastwards over the adjacent summer rainfall region located over the western interior. Some other isolated areas over the summer rainfall region (mostly the northern central parts) also received above-normal rainfall during July. However, over the drought stricken all-year rainfall region it was yet another dry month with below-normal rainfall, apart from a small strip along the coast and adjacent interior over the central parts of this region where near-normal rainfall occurred.

The atmospheric circulation during July 2018 was uncharacteristic of typical July months, being characterized by the frequent occurrence of anomalously high pressure located just to the east of the country. This resulted in very few frontal systems making landfall. The month started promisingly with the passage of a cold front over the southwestern parts of the country. However, this proved to be the dominant rainfall producing system over the winter rainfall region for the entire month of July. By the end of the first week of the month, the circulation was dominated by a strong high east of the country. Although this resulted in some rainfall over the northeastern parts, warm and dry conditions prevailed over the winter as well as the all-year rainfall regions. By mid-month, a change in the circulation pattern occurred when a well developed upper-air system that was accompanied by a cold front passed over the southern parts of the country, with a ridge following in its wake. However, rainfall over the winter and all-year rainfall regions was limited, although good rains occurred over the interior of the country. The latter part of the month was dominated by an anomalously strong high pressure pattern that was stationary to the east of the country, resulting in limited rainfall. This pattern was mostly responsible for the above-normal temperatures that occurred in July over the western and southern parts of the country, whilst anomalously cool conditions occurred over the far eastern parts.

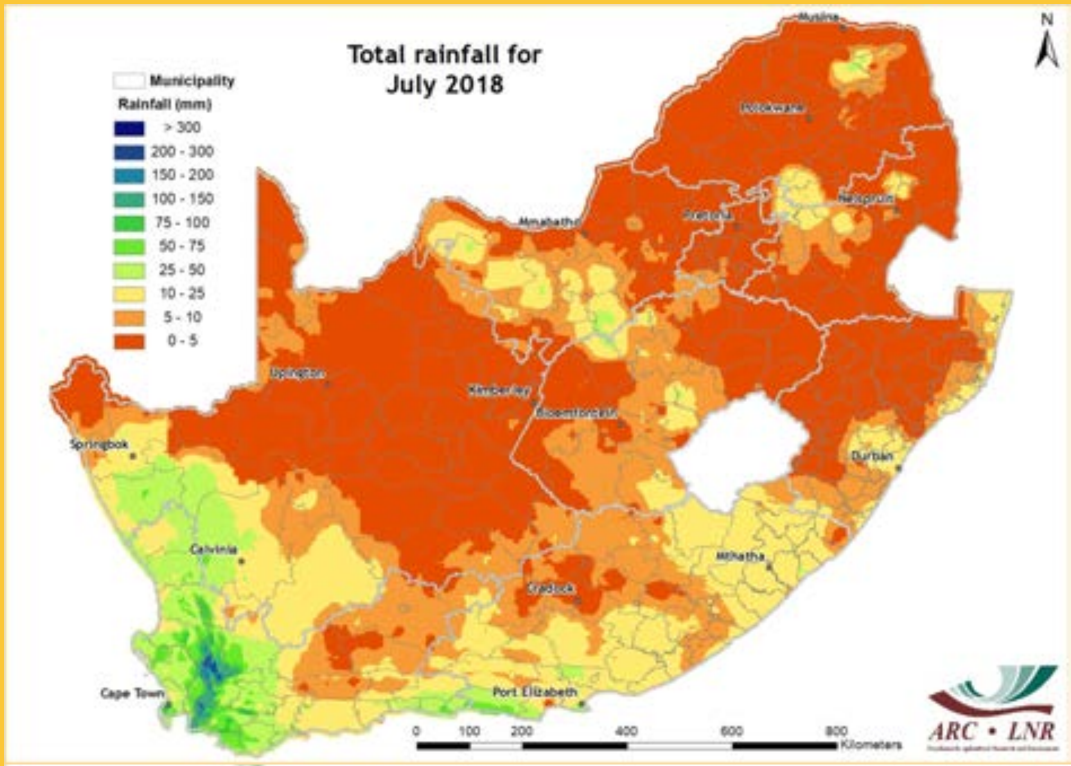


Figure 1

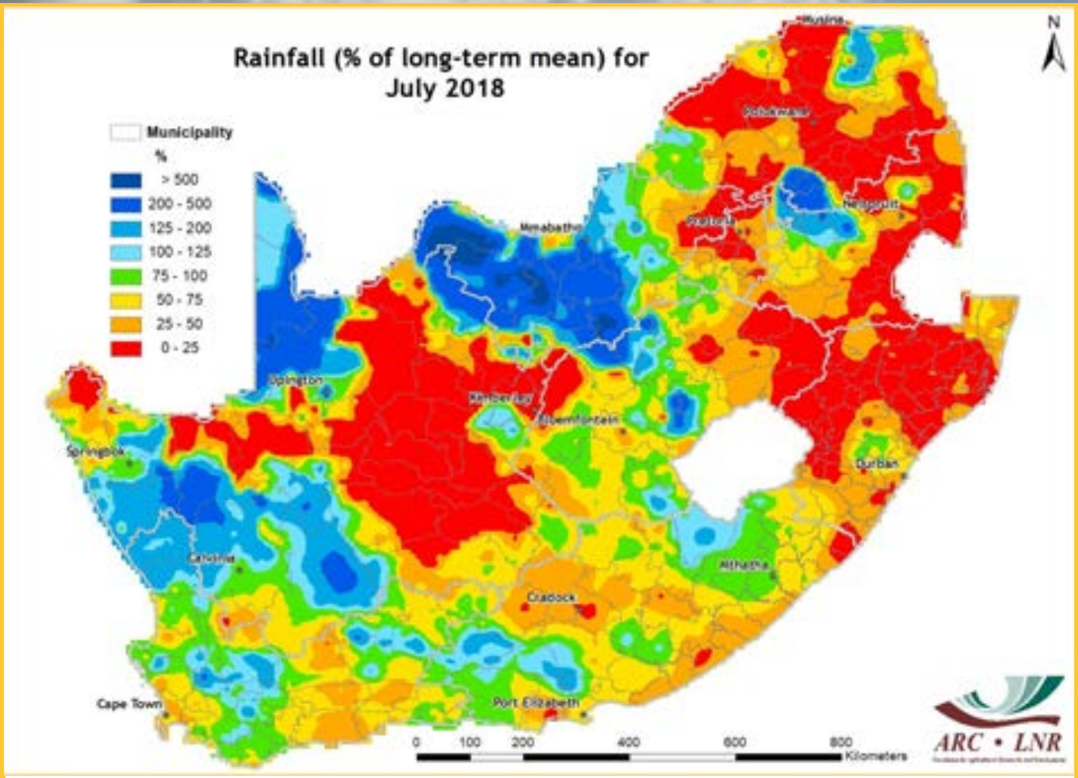


Figure 2

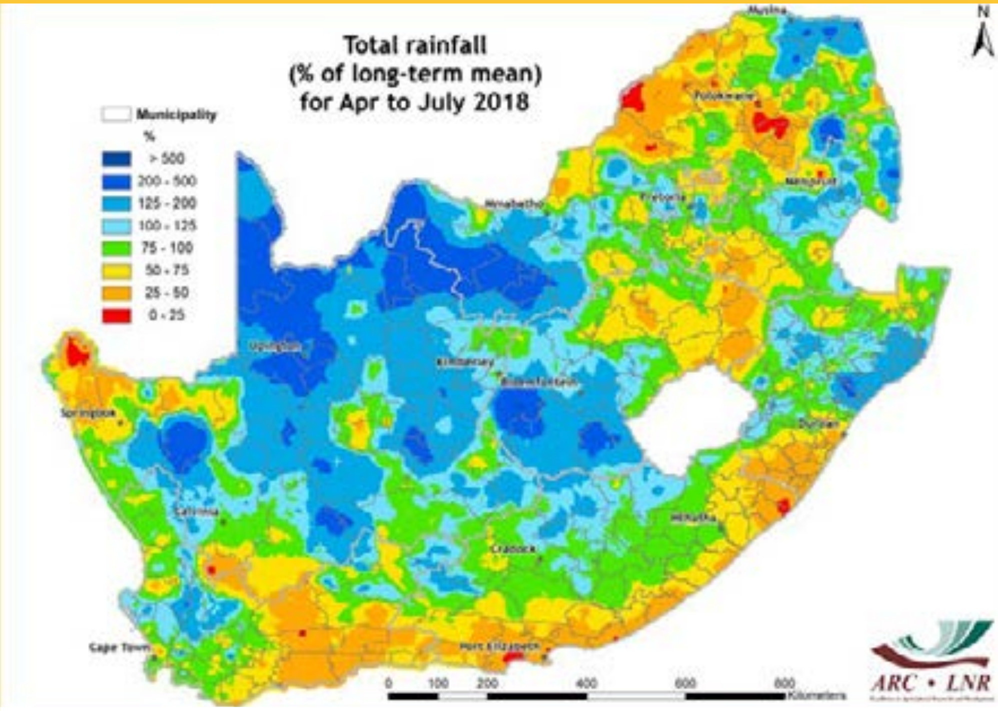


Figure 3

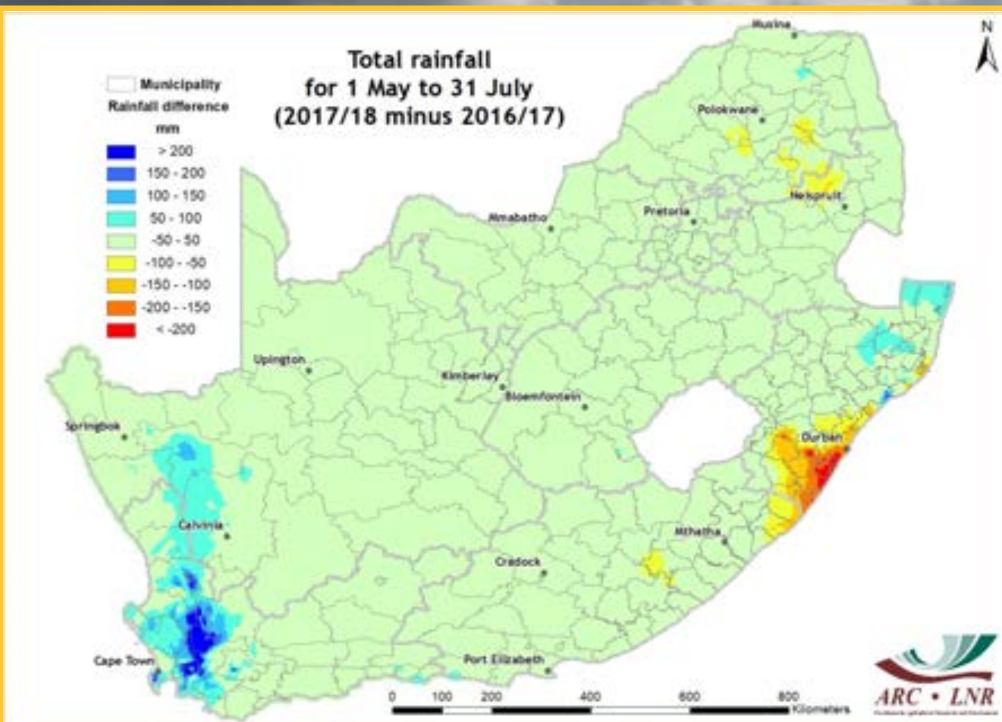


Figure 4

Figure 1:
Rainfall producing weather systems over the winter rainfall region as well as over the all-year rainfall region were scarce during July 2018. A frontal passage at the beginning of the month was responsible for almost all the rain over the southwestern parts of the country, whilst a passing front followed by a ridging high resulted in most of the rainfall over the all-year rainfall region during mid-July. Over the interior, good rainfall occurred for this time of the year in association with the weather system that occurred around the middle of the month.

Figure 2:
Over the winter rainfall region, above-normal rainfall occurred over the northern parts along the west coast, whilst below-normal rainfall occurred over the south-western parts of this region. Below-normal rainfall occurred also over most of the all-year rainfall region. Isolated areas of above-normal rainfall occurred over the interior of the country in association with the passage of an upper-air system. Over the far northeast of the country, isolated areas of above-normal rainfall occurred as a result of the anomalous high pressure to the east of the country at the start of the month.

Figure 3:
During the autumn and winter of 2018 so far, large parts of the summer rainfall region received above-normal rainfall, especially over parts of the northern central interior as well as eastwards of the eastern escarpment over the northeastern parts of the country. Over the winter rainfall region a mixed signal can be seen, which is indicative of the absence of strong and frequent rainfall producing weather systems. The far southwestern parts of the winter rainfall region experienced near-normal conditions with above-normal rainfall further northwards on the boundary of the winter and summer rainfall regions. The all-year rainfall region experienced very dry conditions during this 4-month period.

Figure 4:
Compared to the corresponding period during 2017, improved rainfall conditions occurred during 2018 over the mountainous regions of the far southwestern parts of the country. The southern KwaZulu-Natal coast and adjacent interior received less rainfall this year compared to 2017.

Questions/Comments:
EngelbrechtC@arc.agric.za
Philip@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.

At the 36-month time scale, drought conditions occurred over many parts of the country, but in particular over the winter rainfall region, the Port Elizabeth and surrounding areas as well as over areas in the east of the country where severe to extreme drought conditions occurred. Relief from the severe drought conditions occurred over the central to southeastern parts on the 24-month time scale, whilst drought conditions over the southwest intensified and extended eastwards along the Cape south coast. The 12-month SPI indicates that drought conditions deteriorated slightly over the northeastern parts of the country compared to the 24-month SPI, whilst the intensity of the drought over the southwestern parts eased somewhat. The 6-month SPI indicates mildly to moderately wet conditions over the central to southeastern parts of the country. An improvement from the drought conditions over the far western parts is also visible on the 6-month time scale, whilst drought conditions over the Cape south coast became more severe.

Questions/Comments:
EngelbrechtC@arc.agric.za
Philip@arc.agric.za

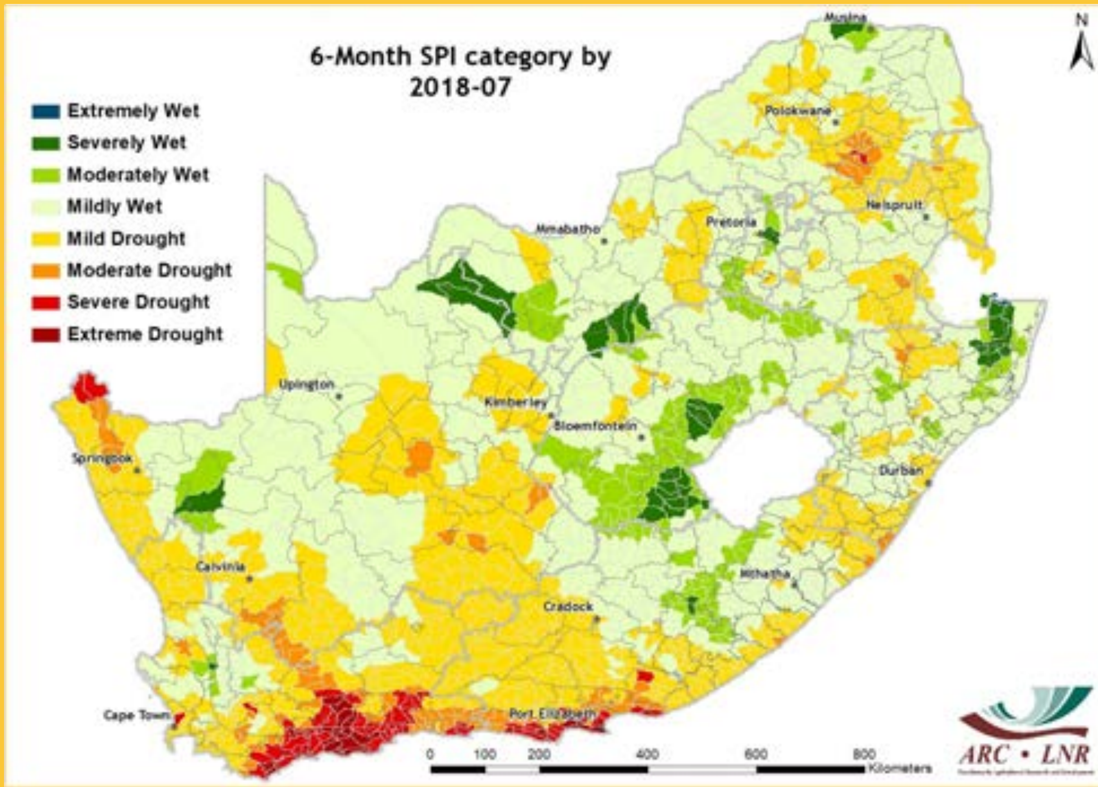


Figure 5

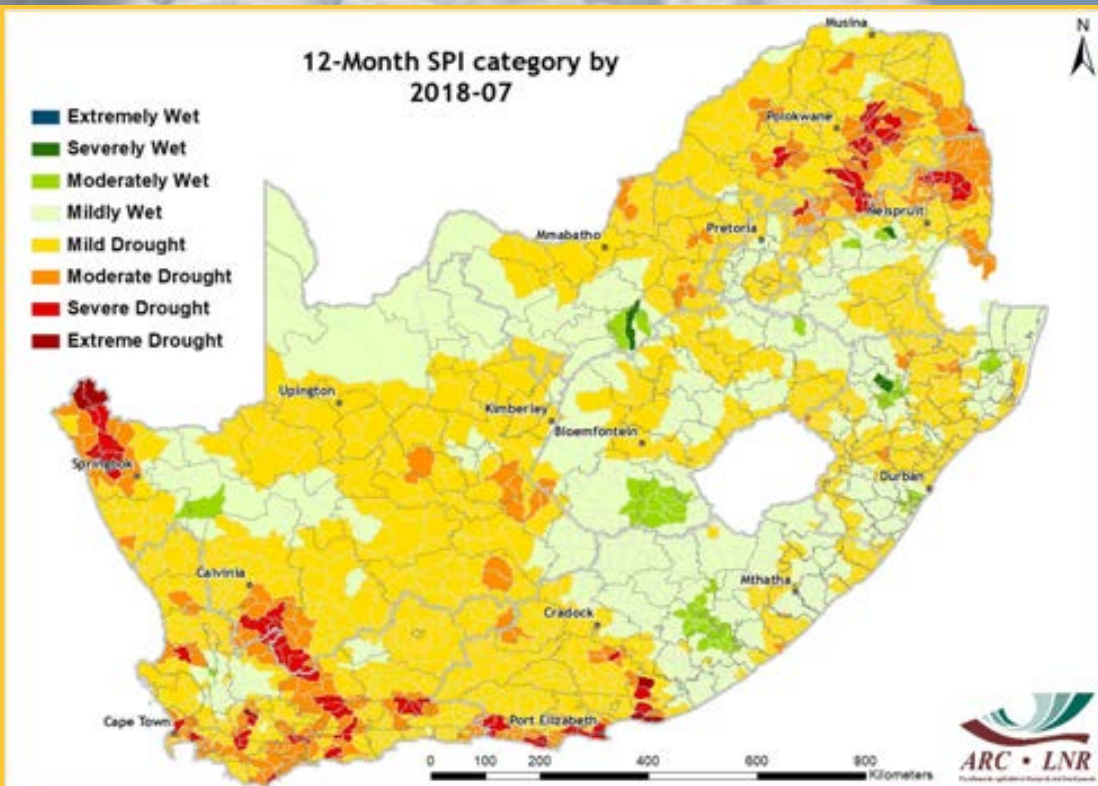


Figure 6

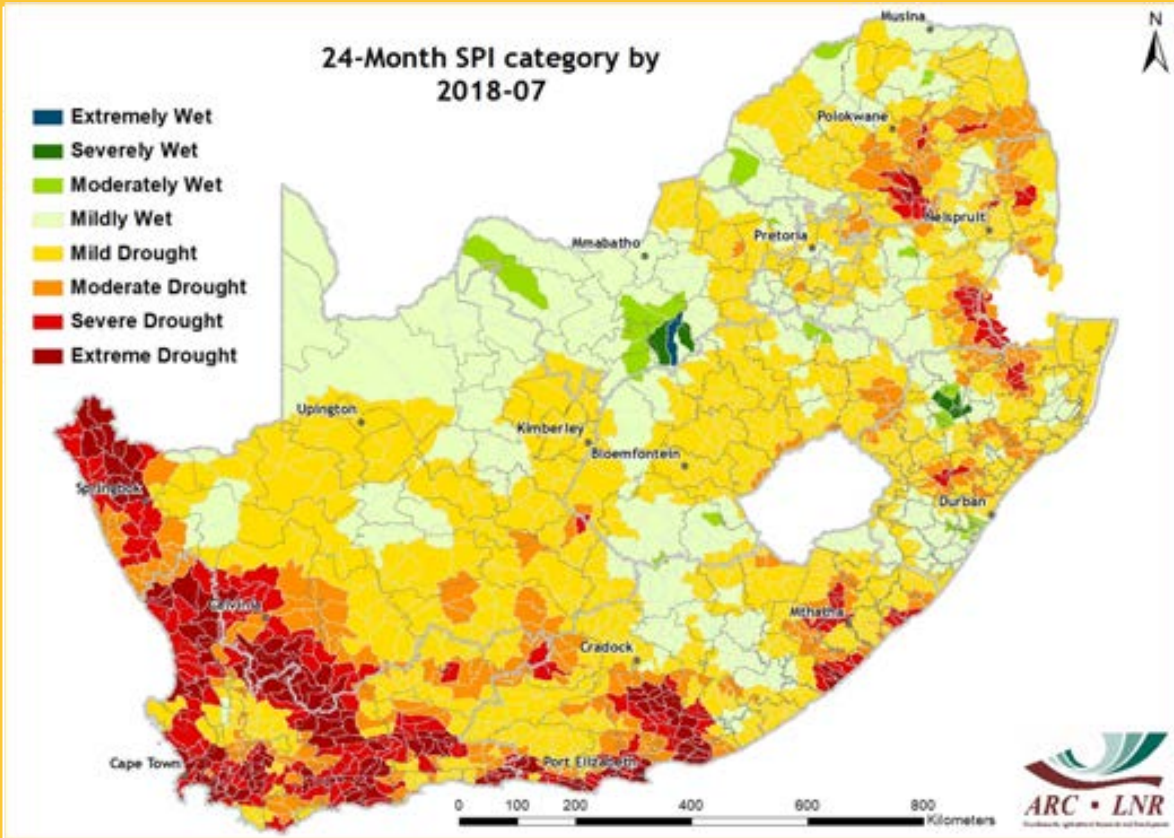


Figure 7

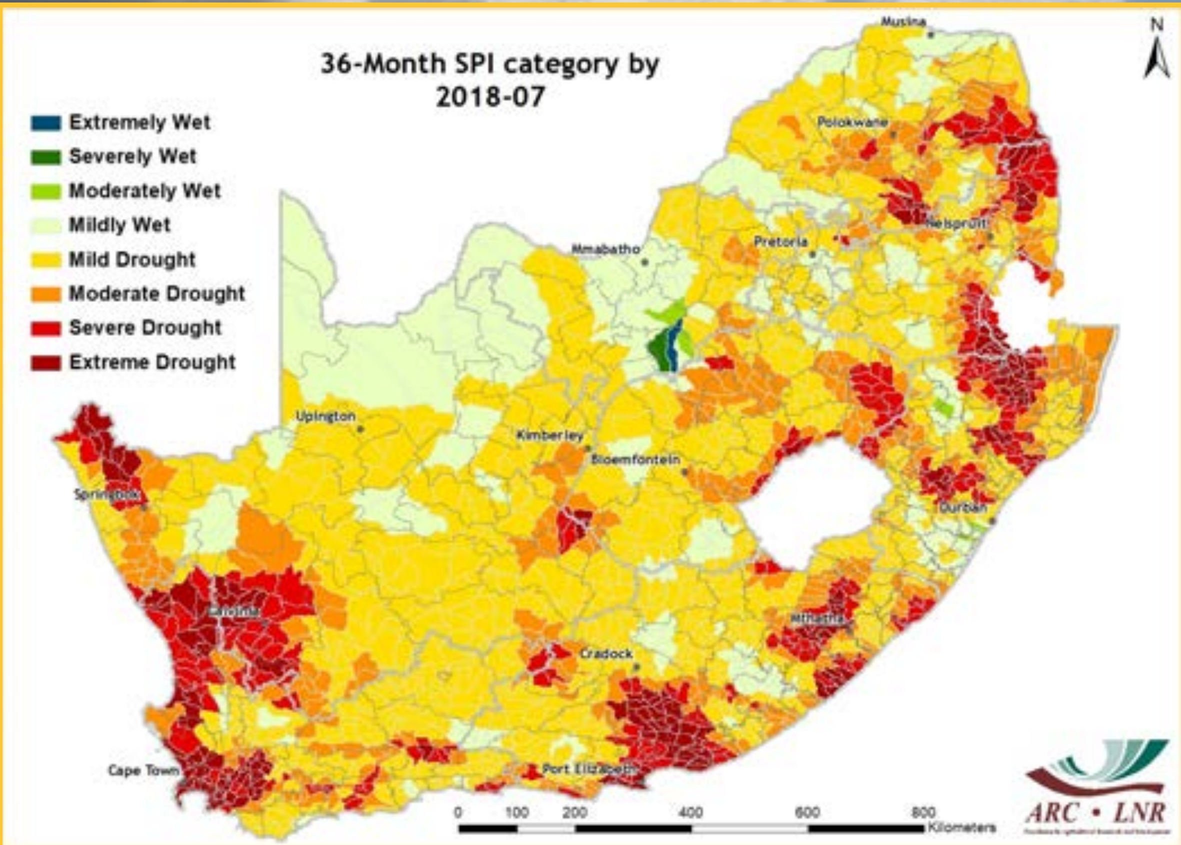


Figure 8

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.

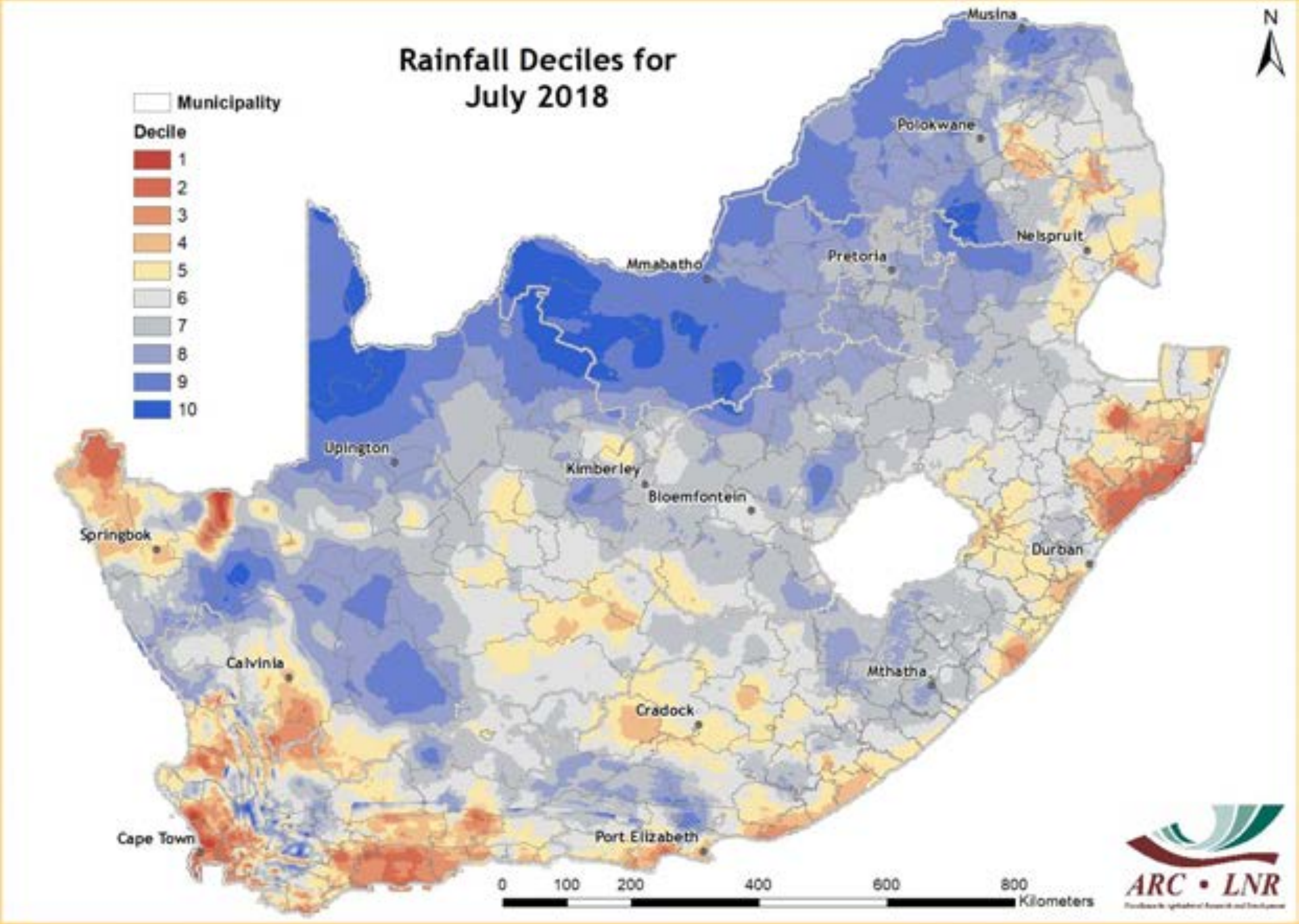


Figure 9

Figure 9:
Rainfall totals during July 2018 over the far southwestern parts of the country fall within the dry July months compared to historical rainfall totals, extending eastwards over large parts of the all-year rainfall region and further northwards along the eastern coastal belt. Large parts of the interior experienced July rainfall totals comparative to historical wet July months.

Questions/Comments:
EngelbrechtC@arc.agric.za
Philip@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.

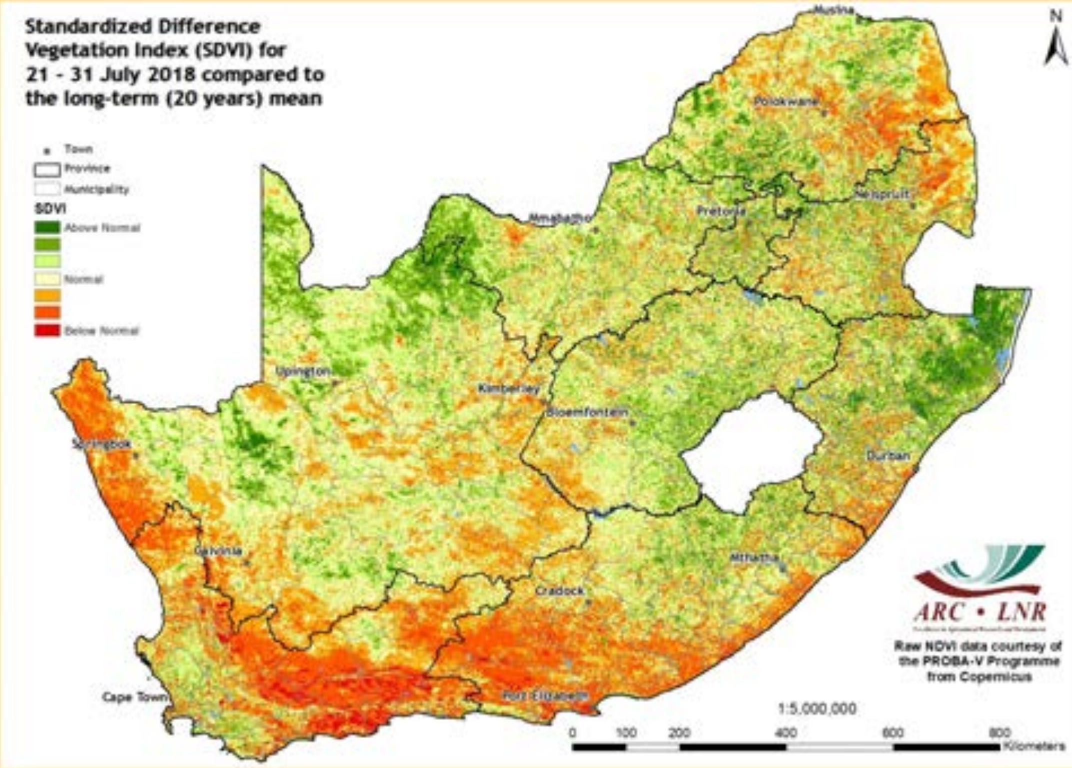


Figure 10

Figure 10:
Compared to the long-term mean, the country’s interior experienced above-normal vegetation activity for the last 10 days of July as indicated on the SDVI map, while the Western Cape, south-western Eastern Cape and some distinct areas in Limpopo, Northern Cape and Mpumalanga, experienced below-normal vegetation activity.

Figure 11:
Compared to the same month last year, the July NDVI map shows that major parts of the country experienced normal vegetation activity. Pockets of poor vegetation activity can be observed in some isolated areas of the country, particularly in Limpopo, Mpumalanga, KZN and the Western and Eastern Cape, compared to July 2017.

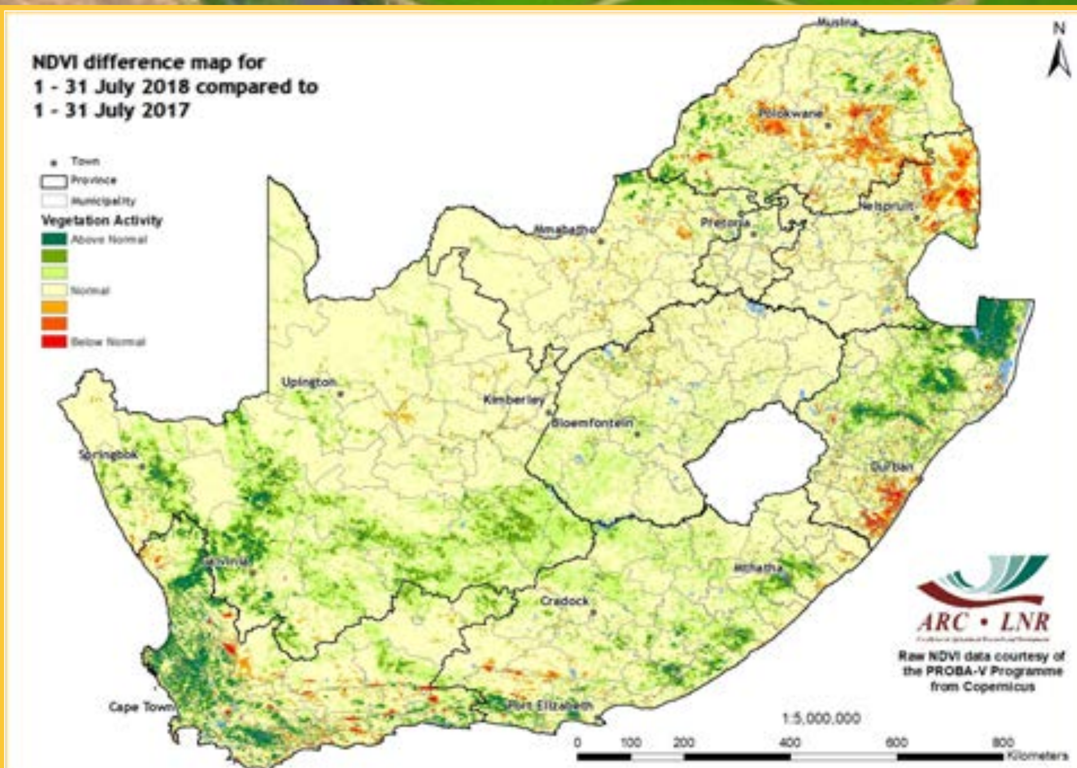


Figure 11

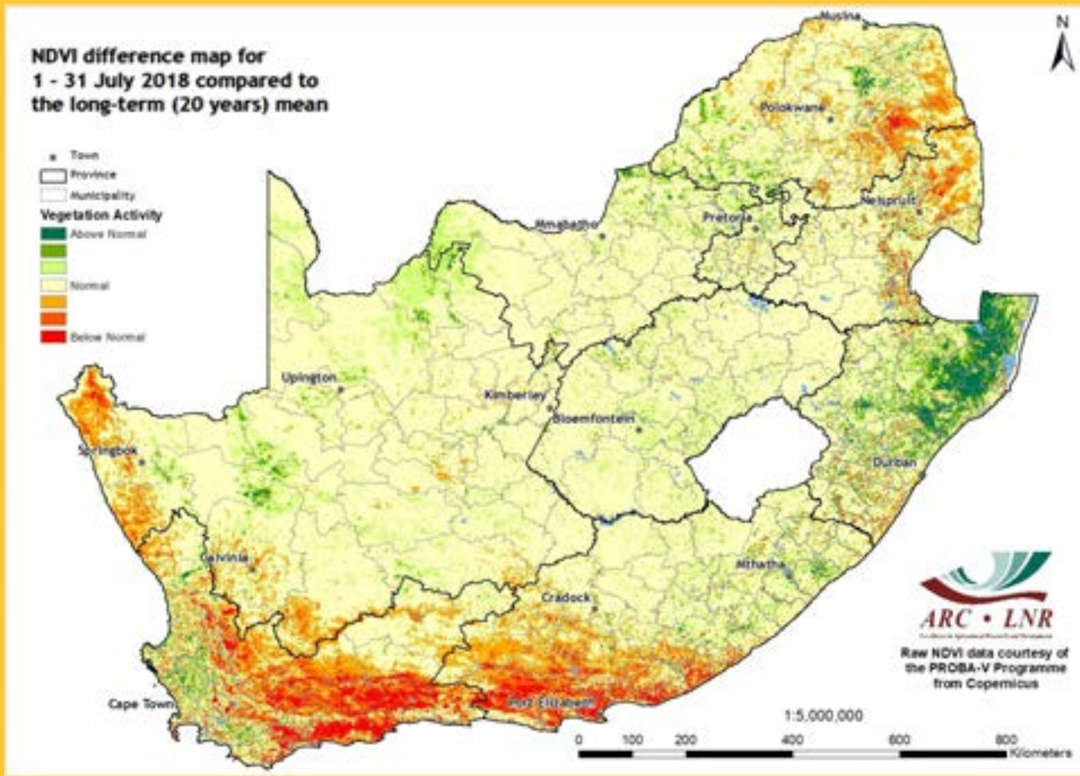


Figure 12

Vegetation Mapping

(continued from p. 7)

Interpretation of map legend

NDVI 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

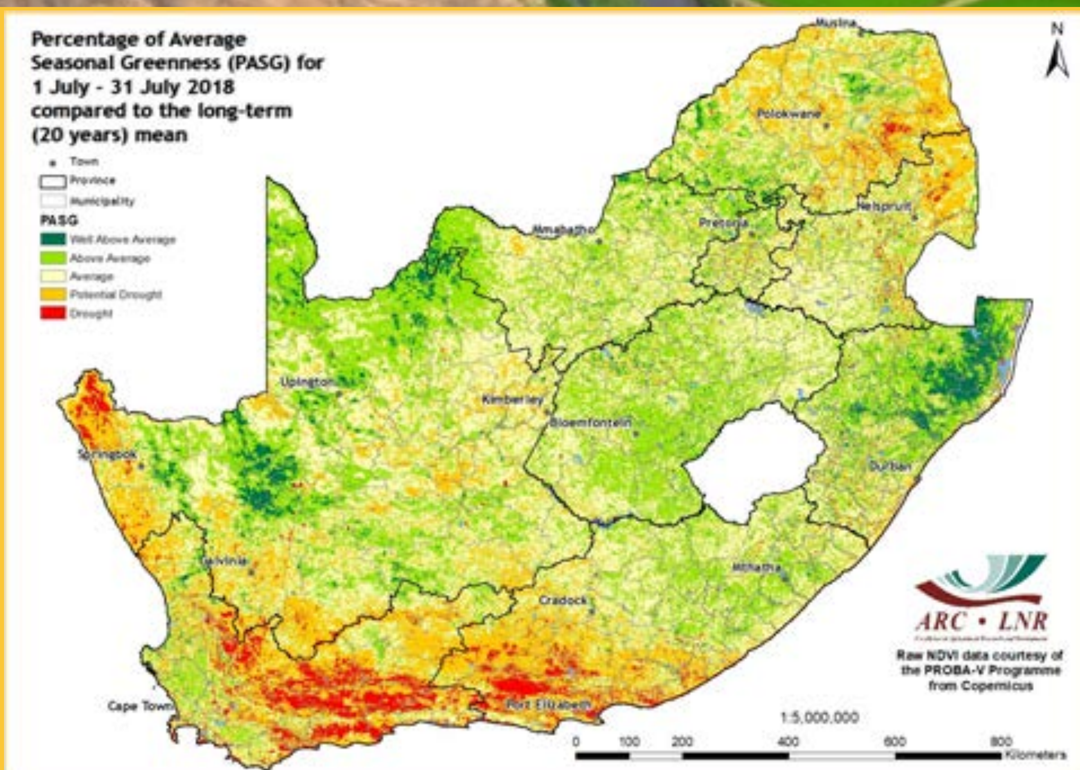


Figure 13

Figure 12:
The July NDVI difference map shows that the country's interior continues to experience normal vegetation activity while the coastal regions and some isolated areas in Limpopo and Mpumalanga continue to experience below-normal vegetation activity compared to the long-term mean.

Figure 13:
The prolonged dry period continues to stress cumulative vegetation activity over much of the southwestern and northern parts of the country. Meanwhile, pockets of above-average cumulative vegetation activity can be observed in isolated areas of KZN and the Northern Cape.

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.

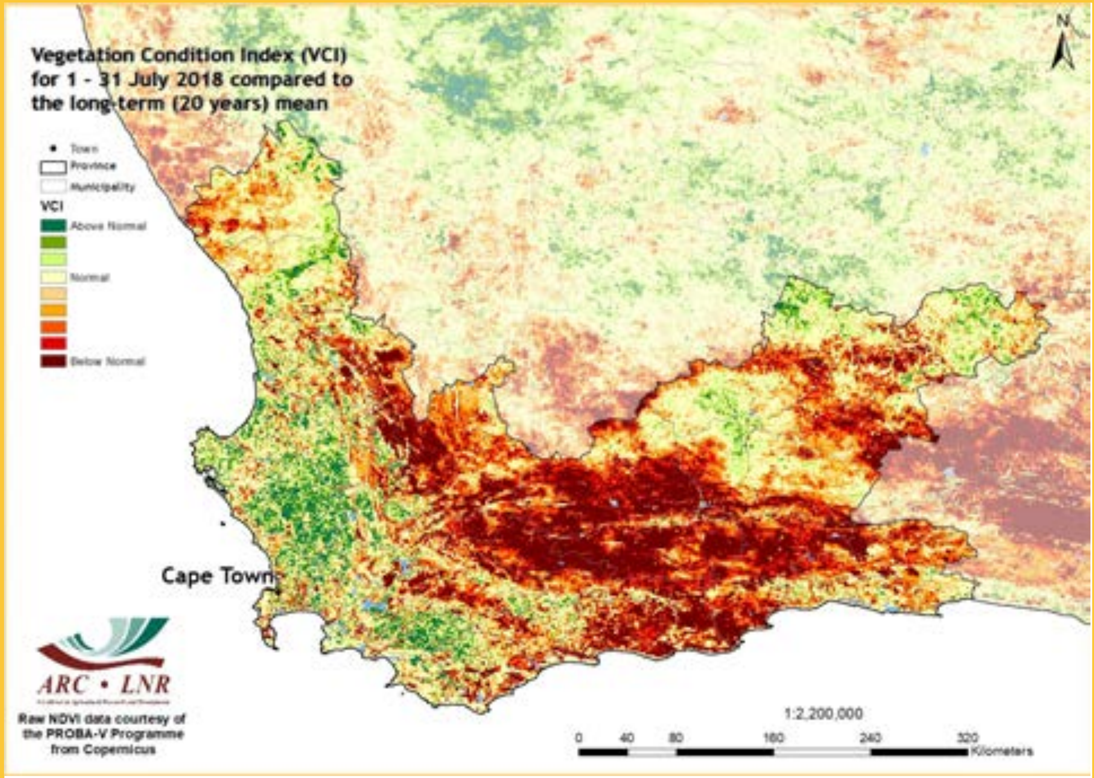


Figure 14

Figure 14:
The VCI map for July indicates that dry conditions persist in the Western Cape, particularly over much of Eden and the lower parts of the Central Karoo district where below-normal vegetation activity remains. The map also shows pockets of good vegetation activity in isolated areas of the west coast, as well as the northern and far northeastern parts of the Beaufort West municipality.

Figure 15:
In response to the dry spell the vegetation condition remains poor over much of the western region of the Eastern Cape, but the opposite can be observed in the Amatola and Stormberg areas as well as the Wild Coast and Berg regions where vegetation activity remains above normal.

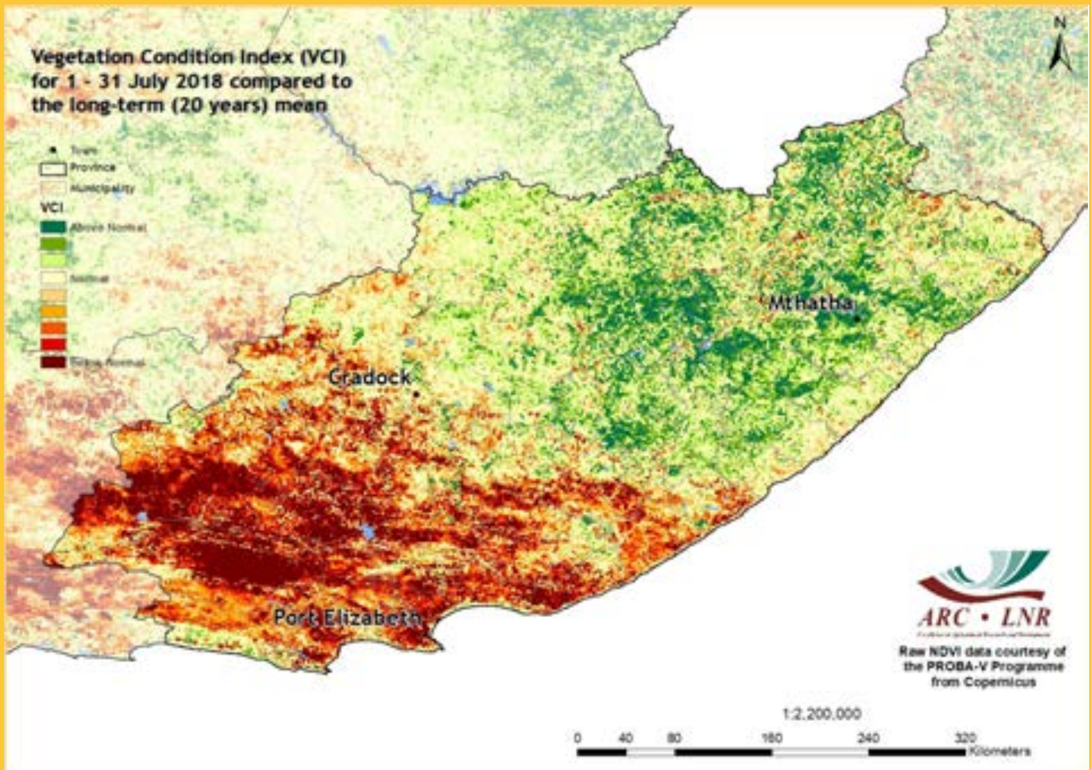


Figure 15

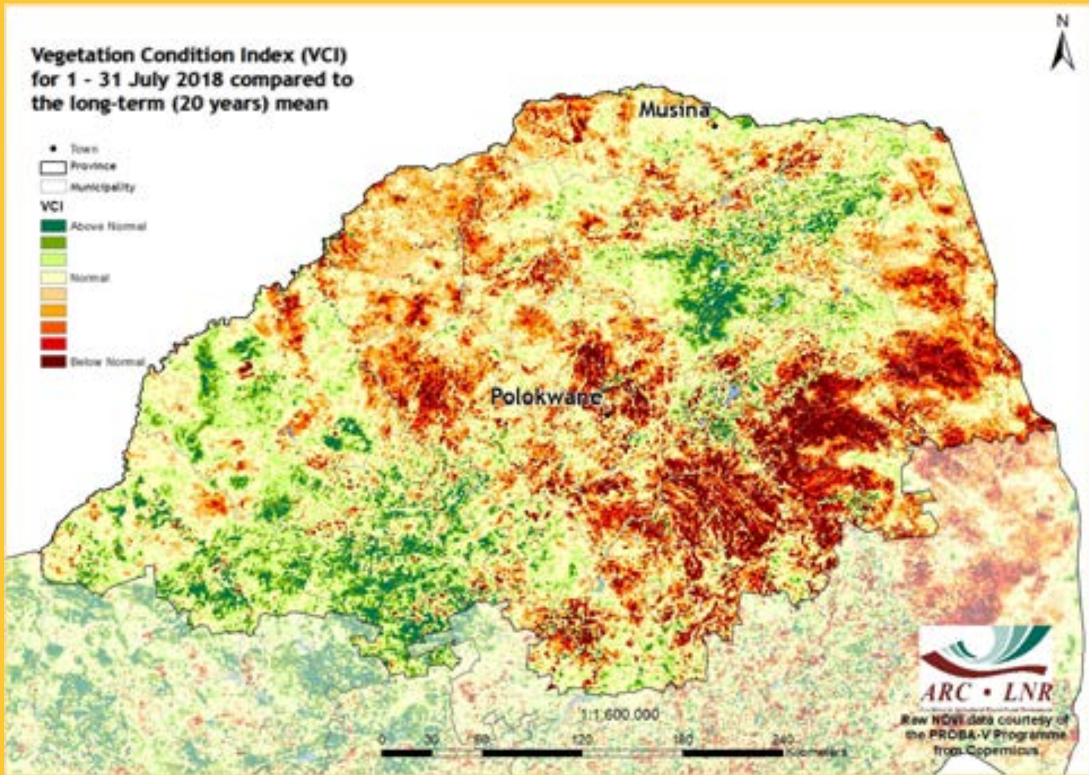


Figure 16

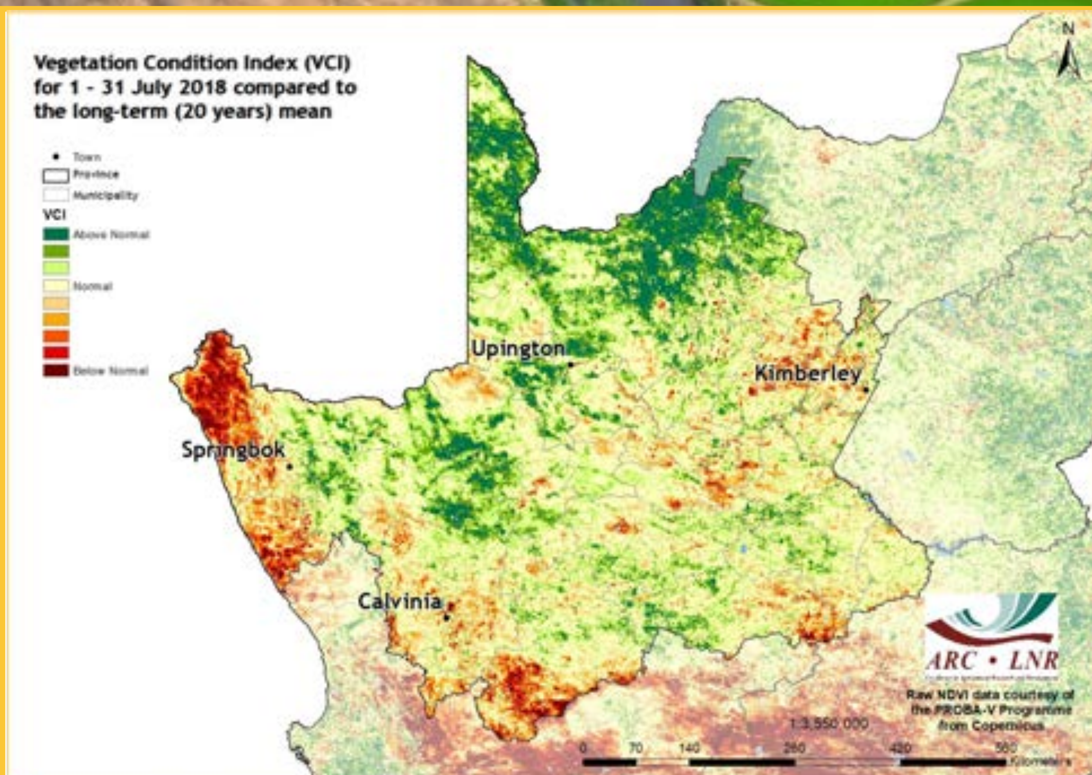


Figure 17

Figure 16:
The VCI map for July shows that due to the persistent drought, below-normal vegetation conditions outweigh good vegetation conditions across the Limpopo province.

Figure 17:
The lessened dry conditions over much of the Green Kalahari, Kalahari and the Diamond region of the Northern Cape continue to promote good vegetation conditions, with the exception of the Namaqua region where below-normal conditions persist.

Questions/Comments:
MaakeR@arc.agric.za

6. Vegetation Conditions & Rainfall

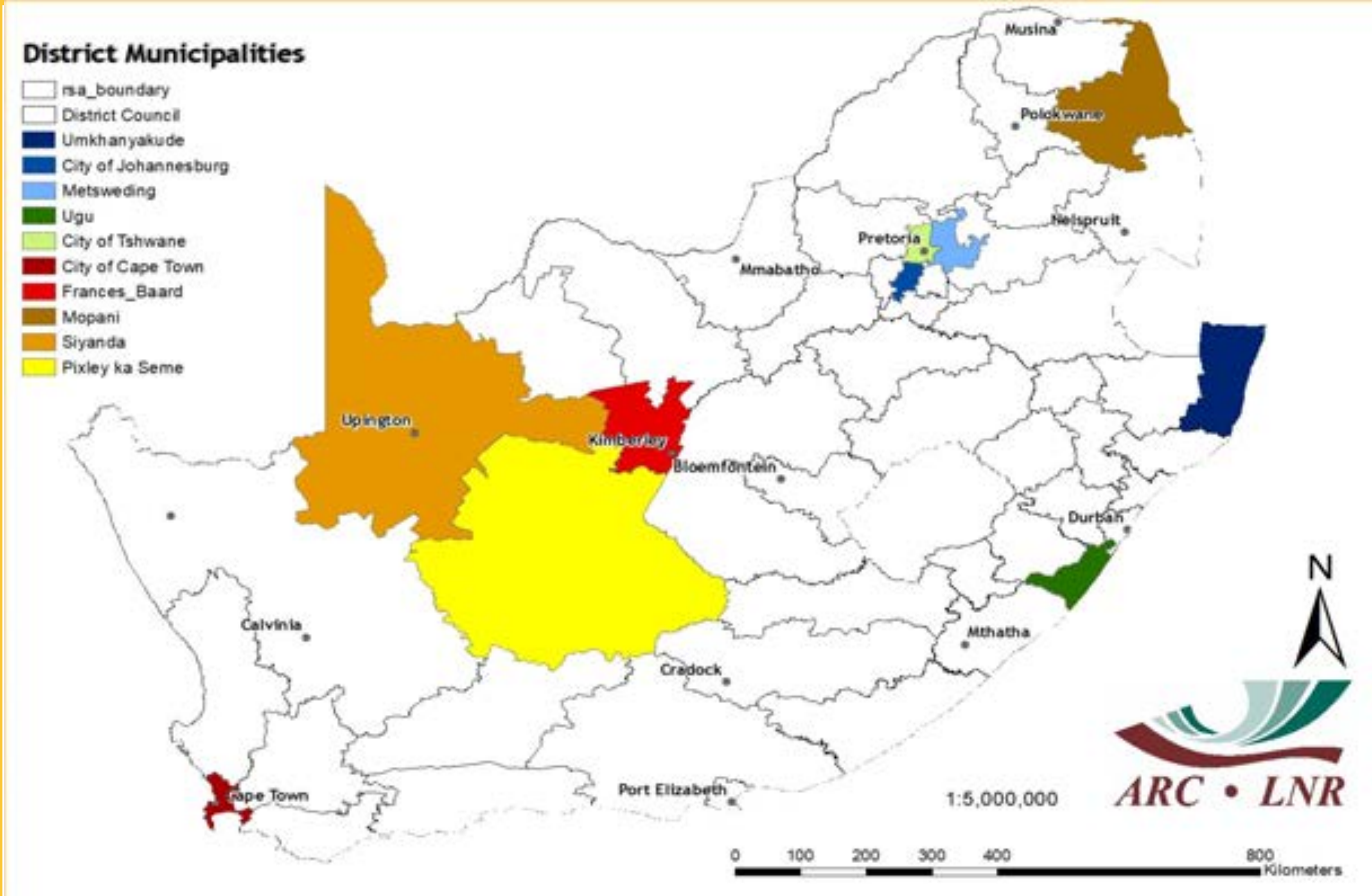


Figure 18

NDVI and Rainfall Graphs
Figure 18:
Orientation map showing the areas of interest for July 2018. The district colour matches the border of the corresponding graph.

Questions/Comments:
MaakeR@arc.agric.za / FergusonJ@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.

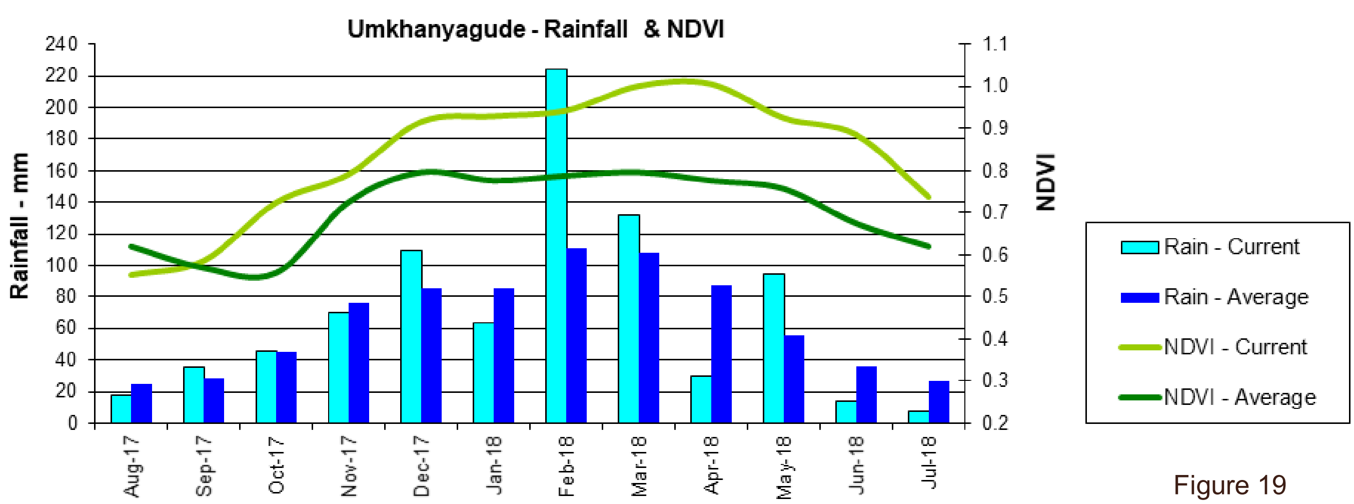


Figure 19

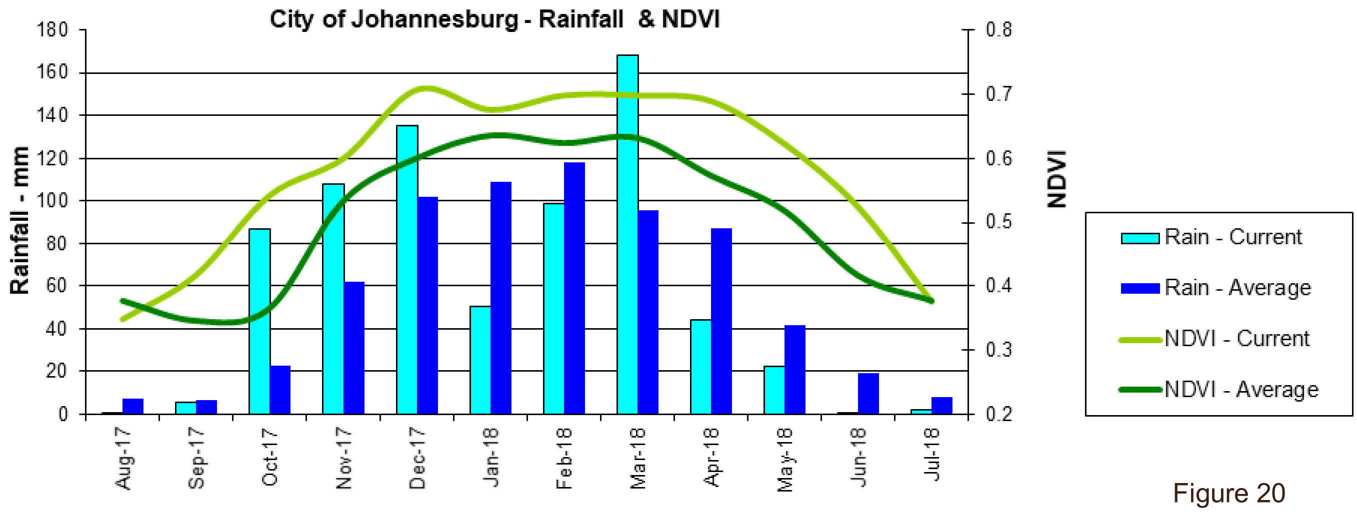


Figure 20

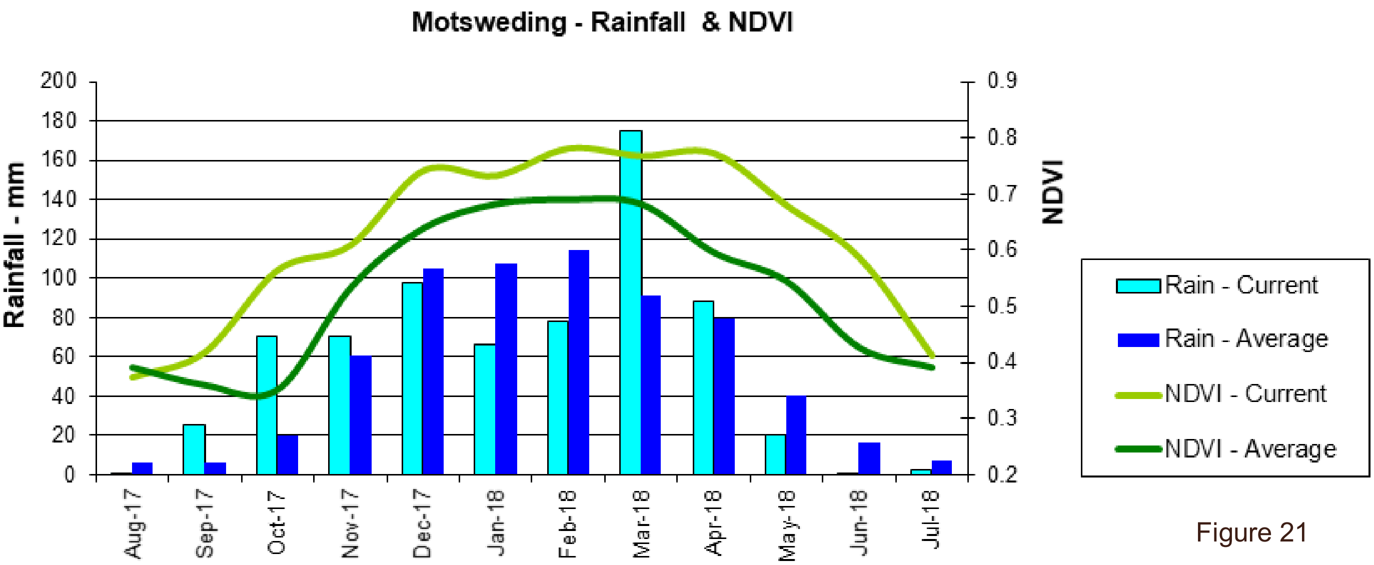


Figure 21

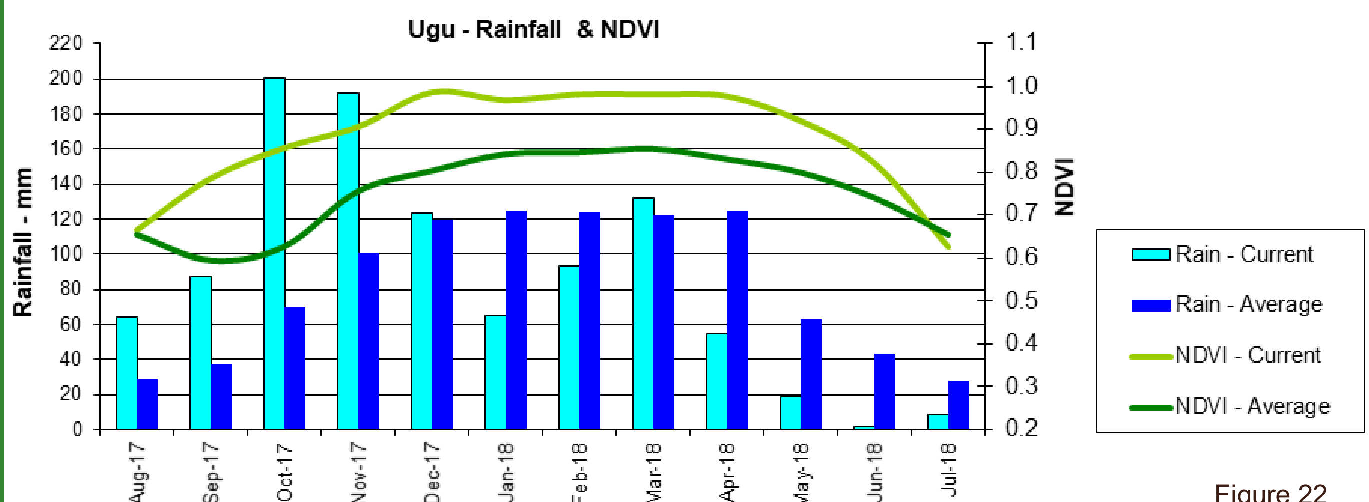


Figure 22

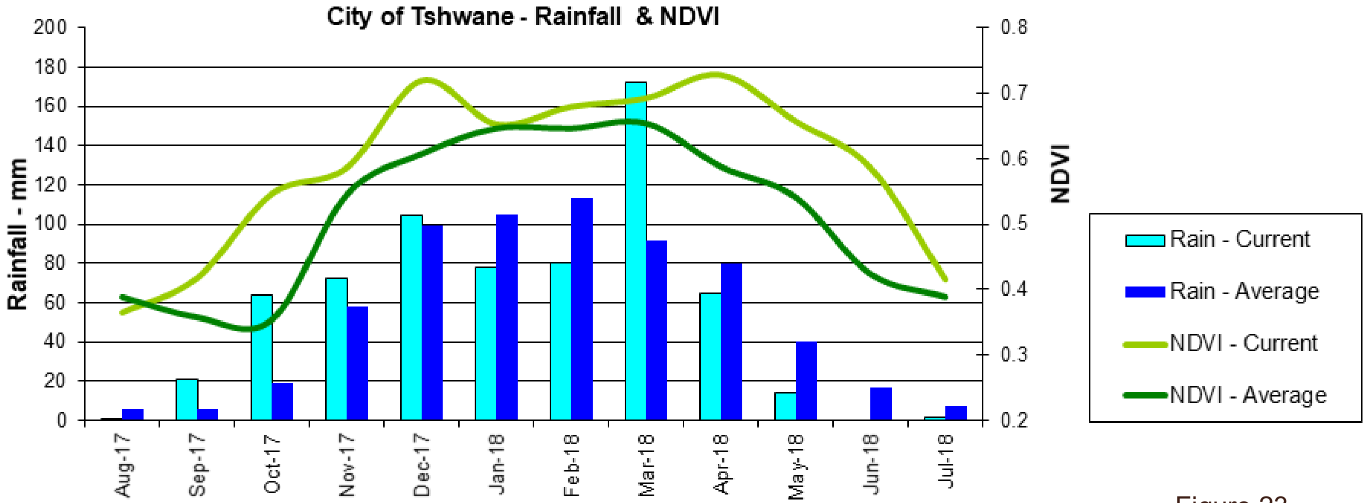


Figure 23

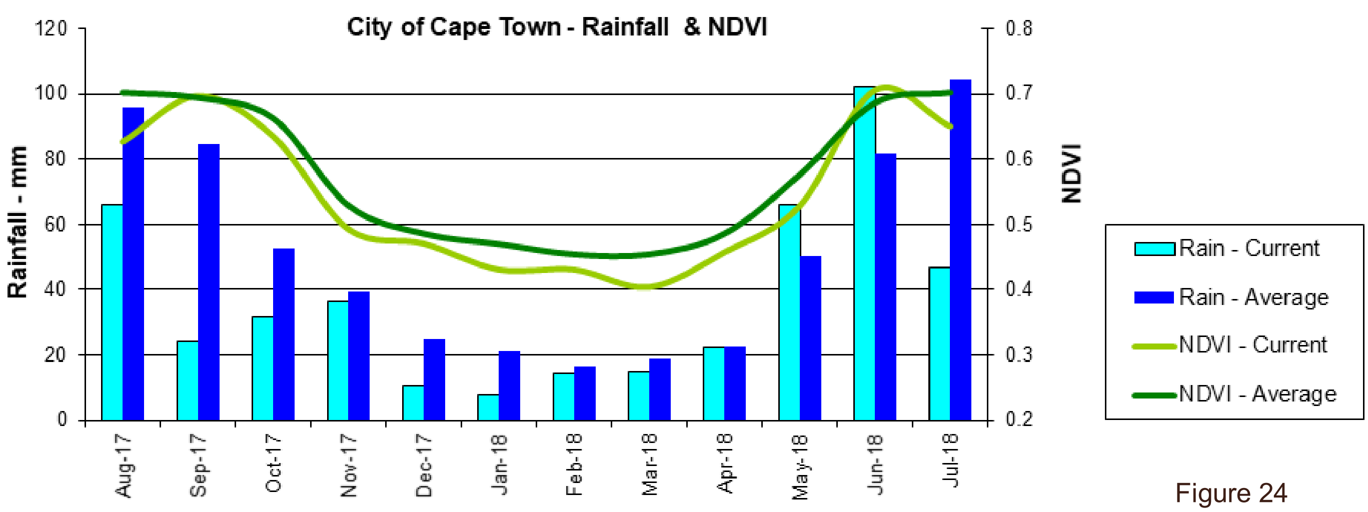


Figure 24

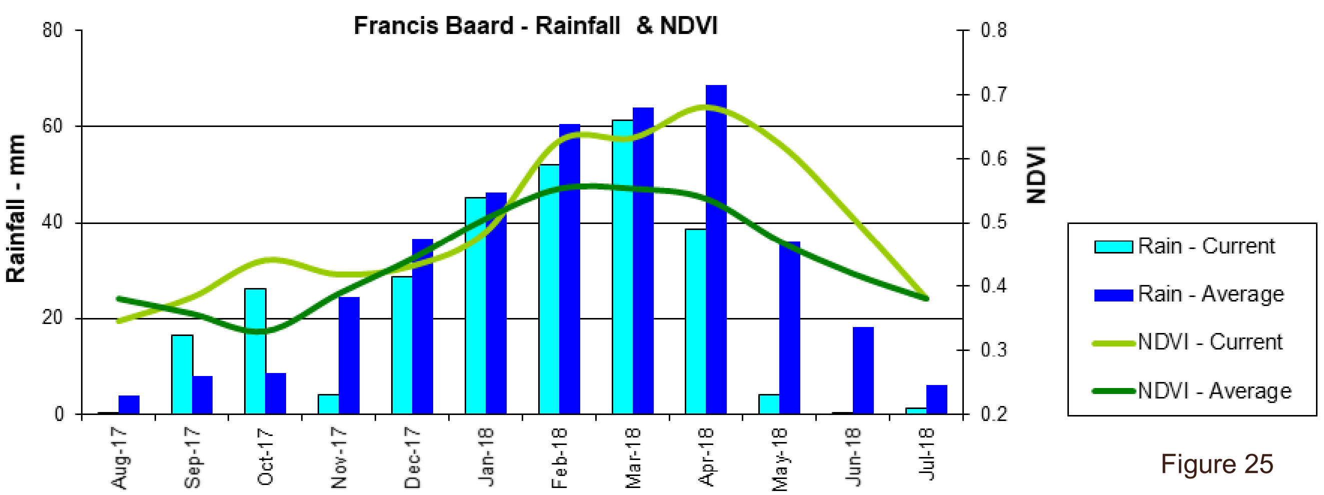


Figure 25

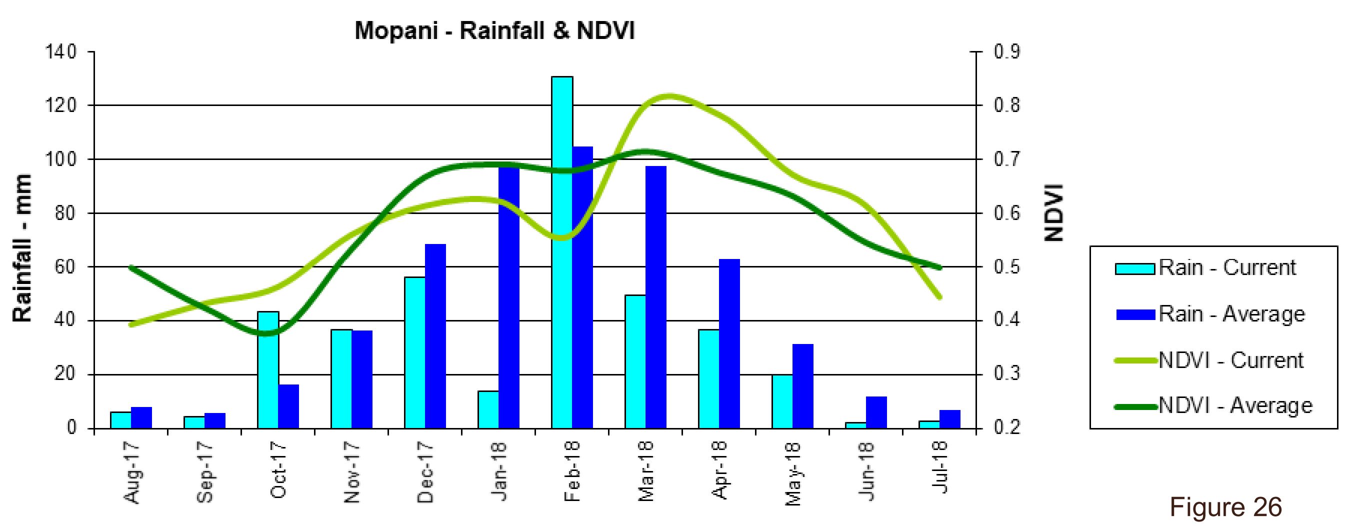


Figure 26

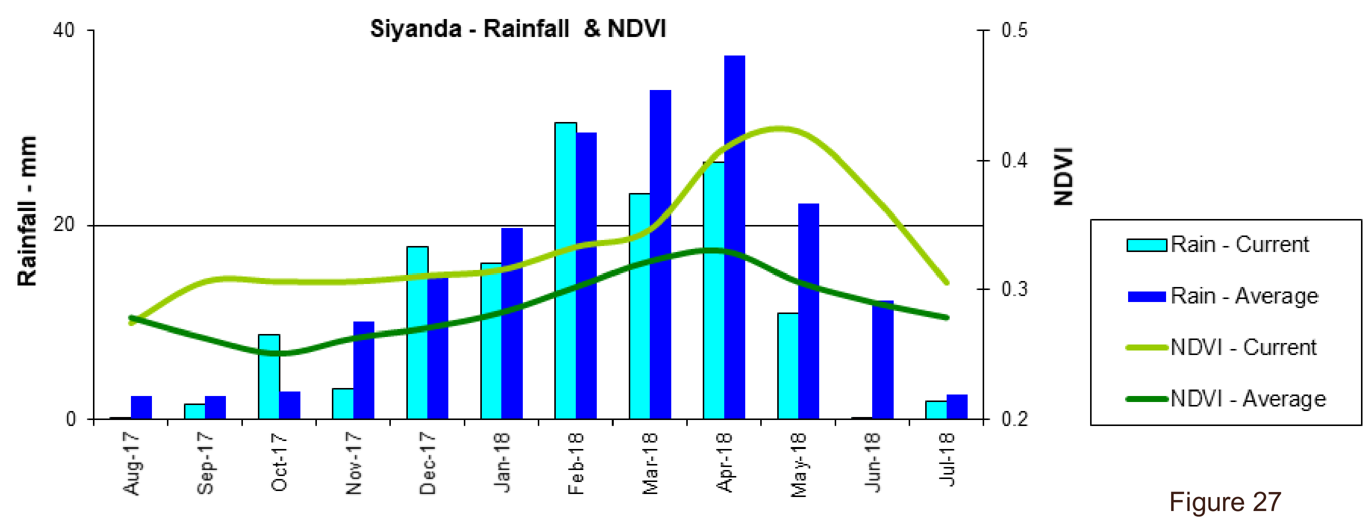


Figure 27

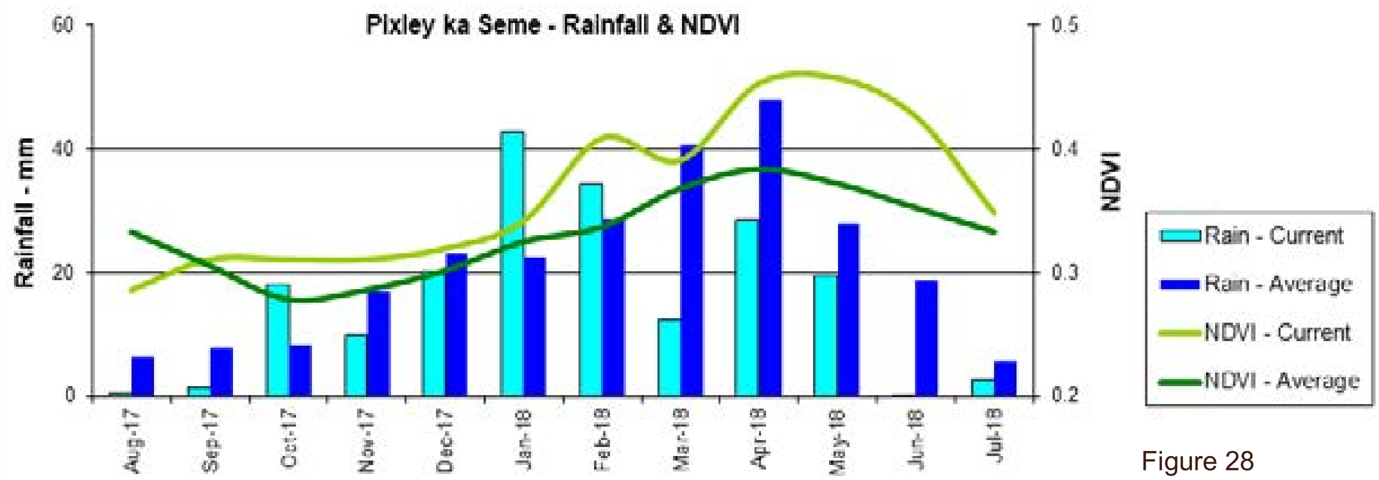


Figure 28

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 during July 2018 per province. Fire activity was higher in Gauteng, Mpumalanga, Northern Cape, Western Cape and KwaZulu-Natal compared to the average during the same period for the last 18 years.

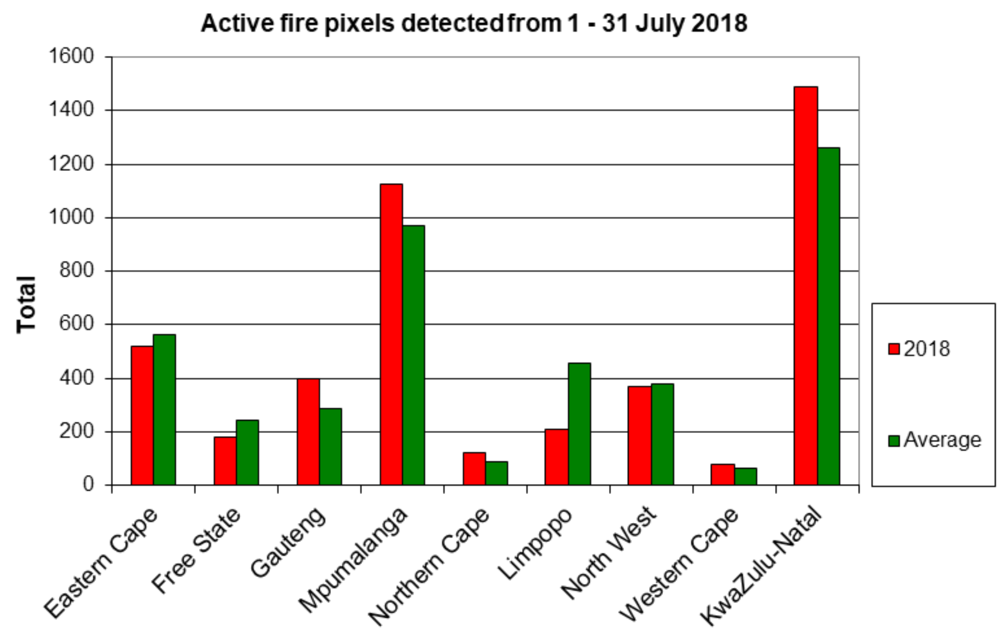


Figure 29

Figure 30:
The map shows the location of active fires detected between 1-31 July 2018.

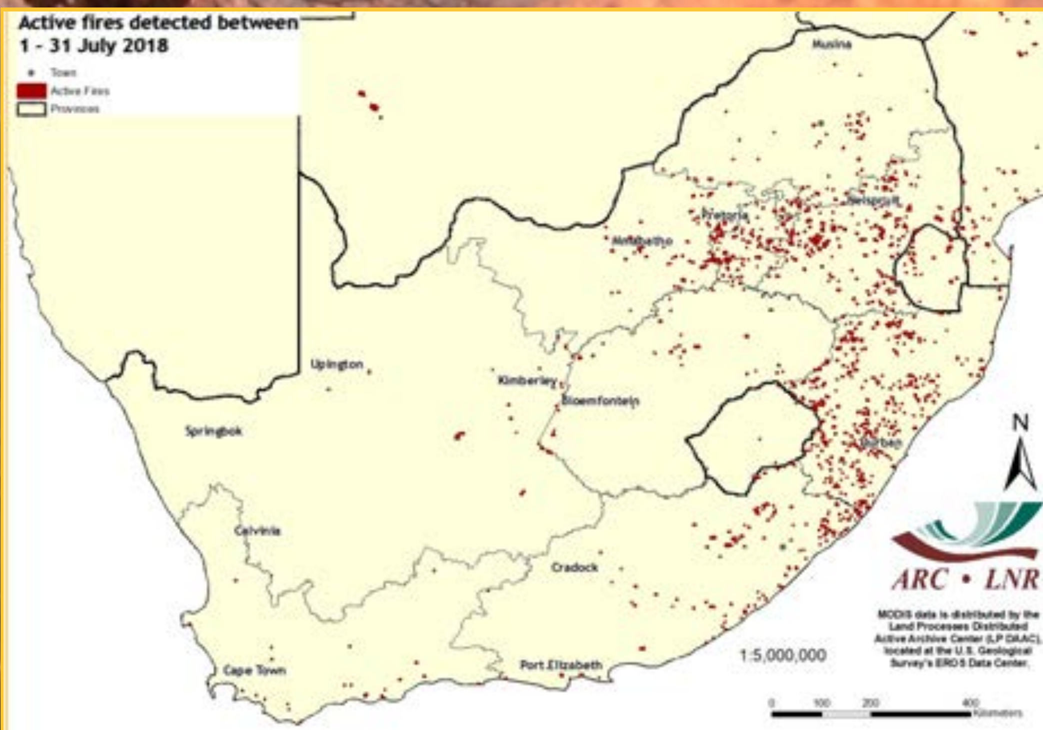


Figure 30

PAGE 16

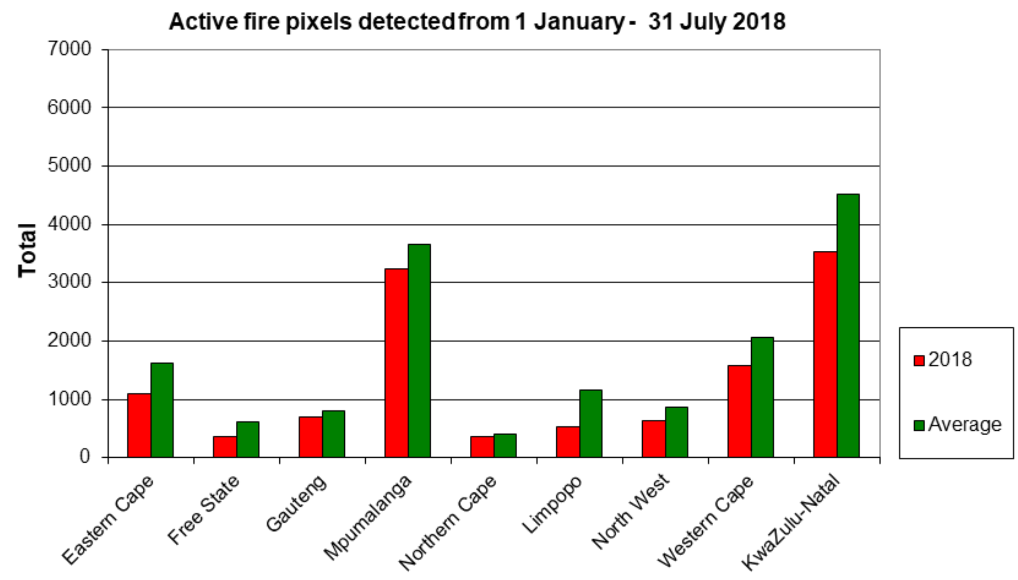


Figure 31

Figure 31:
The graph shows the total number of active fires detected from 1 January - 31 July 2018 per province. Fire activity was lower in all provinces compared to the average during the same period for the last 18 years.

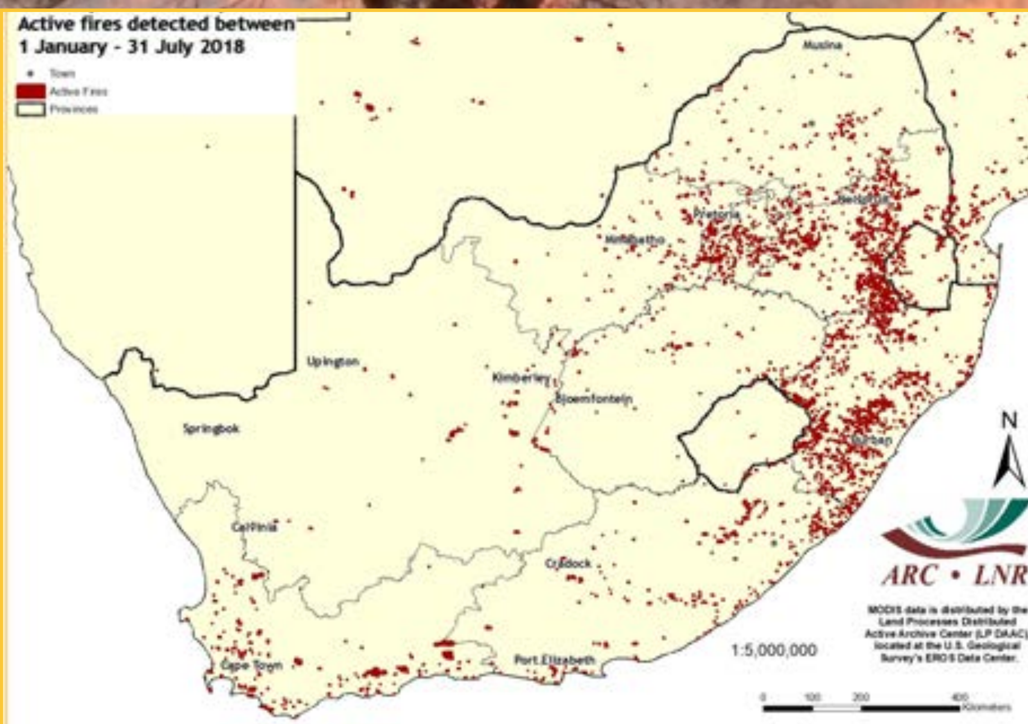
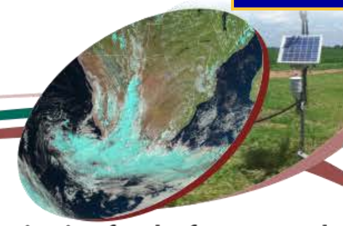


Figure 32

Figure 32:
The map shows the location of active fires detected between 1 January - 31 July 2018.

Questions/Comments:
MaakeR@arc.agric.za

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

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

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**.

ARC • LNR
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, Forestry and Fisheries. 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”.