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UMLINDI
The Watchman

ISSUE 2017-09 | 18 SEPTEMBER 2017

INSTITUTE FOR SOIL, CLIMATE AND WATER

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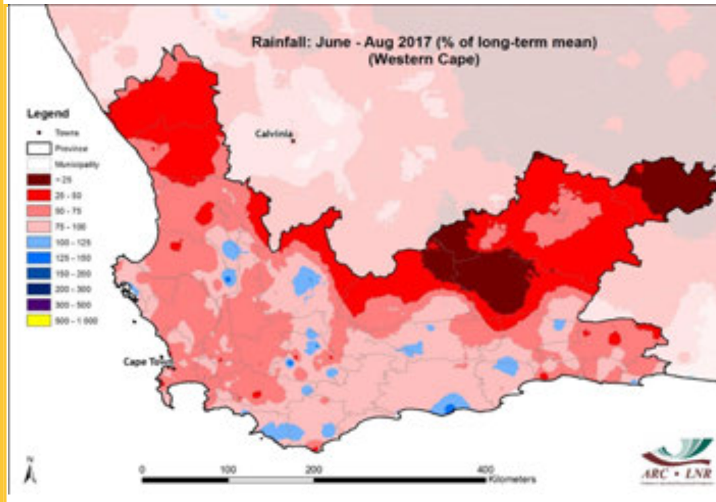
agriculture, forestry & fisheries
Department: Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

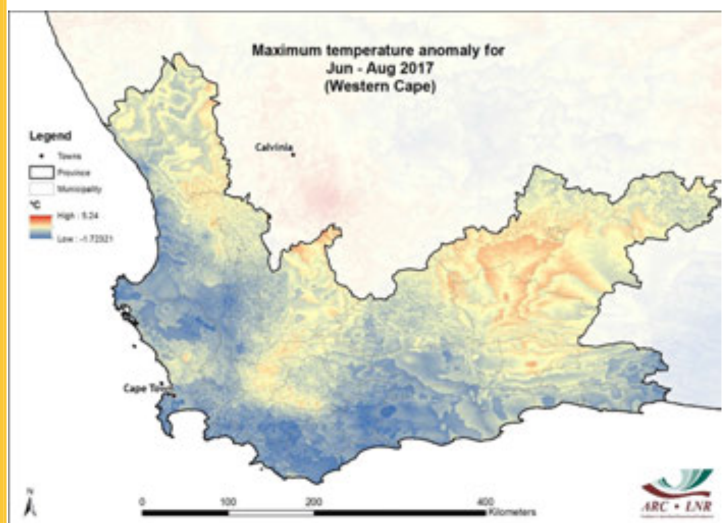
South African Weather Service

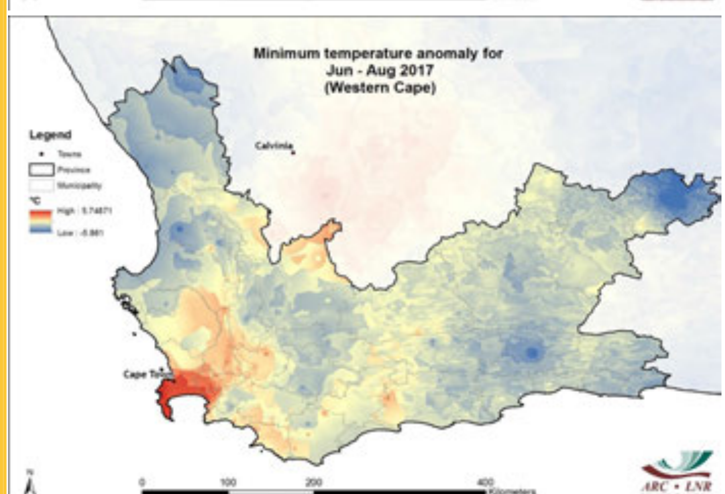
AMESD

159th Edition

Images of the Month







Mostly dry conditions during the peak winter months over the Western Cape

The 2017 rainy season in the Western Cape is nearing its end, but the rainfall during the June-July-August period was not enough to bring an end to the drought experienced over this area. Below- to near-normal rainfall occurred over most of the province during this 3-month period (top figure). During this time, frontal systems swept regularly over the southwestern parts of the country, but were mostly weak with limited upper-air support, resulting in reduced rainfall figures. The nature of the frontal systems resulted in predominantly westerly to southwesterly winds and caused maximum temperatures to be cooler than normal over most of the Western Cape (middle figure). The northern parts of the province experienced warmer than normal maximum temperatures, likely to be the result of the frontal systems that mostly slipped southeastwards after making landfall. In association with this general pattern, cooler than normal minimum temperatures occurred over most of the interior of the province (bottom figure), likely due to the more frequent absence of clouds. Over the far southwestern parts of the Western Cape, minimum temperatures were warmer than normal, specifically over Cape Town and surrounding areas where they were up to 5˚C higher than normal, likely due to reduced radiative cooling in the presence of the eastward passing frontal cloud bands.

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).

Overview:
Normal to above-normal rainfall occurred along the Cape south coast, the southern parts of the east coast and adjacent interior, and over the eastern parts of Limpopo in August 2017. Along the Cape south coast, the regular passage of frontal systems around the 1st, 5th, 10th, 15th, 21st and 29th brought rain to the region. Over the Port Elizabeth area and further eastwards, the system around the 15th developed into a cut-off low associated with a well positioned ridging high pressure system that resulted in good falls of rain. Up to 90 mm and 130 mm occurred in the Port Elizabeth area and to the south of Durban respectively. The frontal system around the 5th intensified as it progressed eastwards with a closed low that developed south-east of the subcontinent, also resulting in good rainfall over the Port Elizabeth area. The rainfall over the eastern parts of Limpopo occurred around the 28th in the presence of a ridging high pressure system, with the highest rainfall figures subsequently occurring along the escarpment areas.

Even in the presence of frontal systems arriving regularly over the southwestern parts of the country, below-normal rainfall occurred over most of the drought stricken Western Cape. It is specifically the areas that rely on winter rainfall over the far western part of this province that received rainfall less than half of the long-term average for August. Over these parts the rain day totals were small and the frequency of rain days was less than normal for the month. Further eastwards over the more mountainous areas of the Western Cape, the number of rain days were near or even above normal at some stations, but with the highest rain day totals limited to 25 mm, resulting in the below-normal rainfall. On most occasions the upper-air support accompanying the frontal systems was weak, resulting in the limited rainfall. Better developed upper-air troughs accompanied the frontal systems that occurred around the 15th (when the cut-off low developed) and the 21st. These systems moved far inland and caused notable drops in both the maximum and minimum temperatures. In general, minimum temperatures were below normal over the country, except in the north-east where above-normal minimums occurred. Maximum temperatures were mostly near normal during the month of August, except over the southeastern parts of the country where below-normal maximums occurred.

1. Rainfall

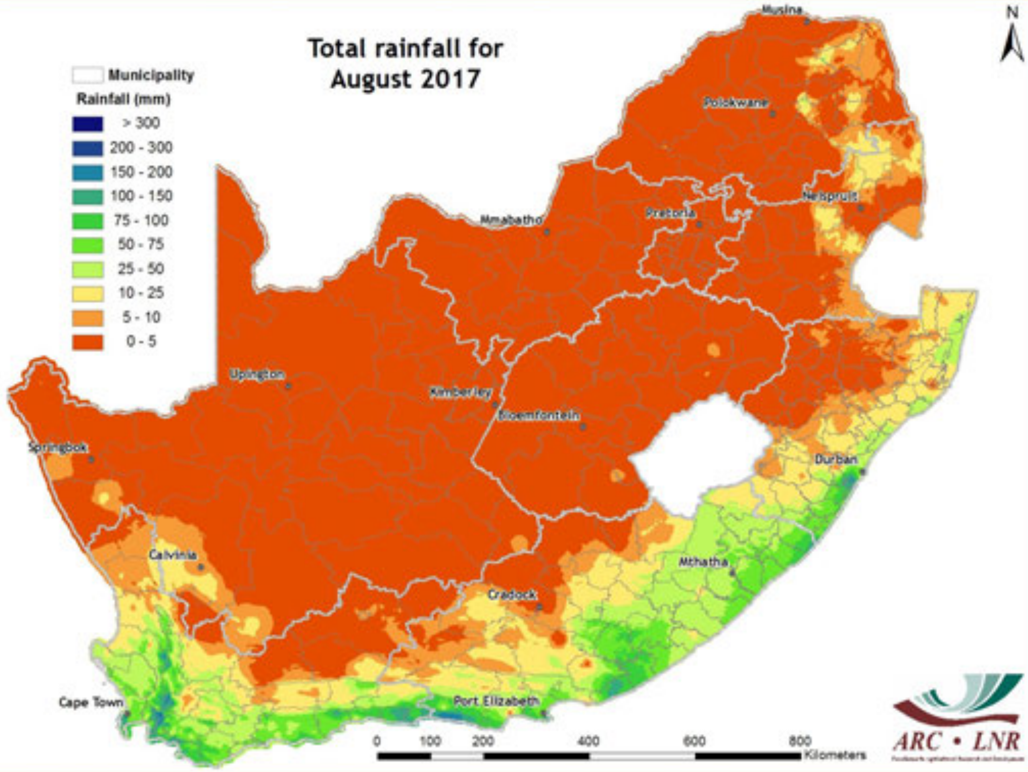
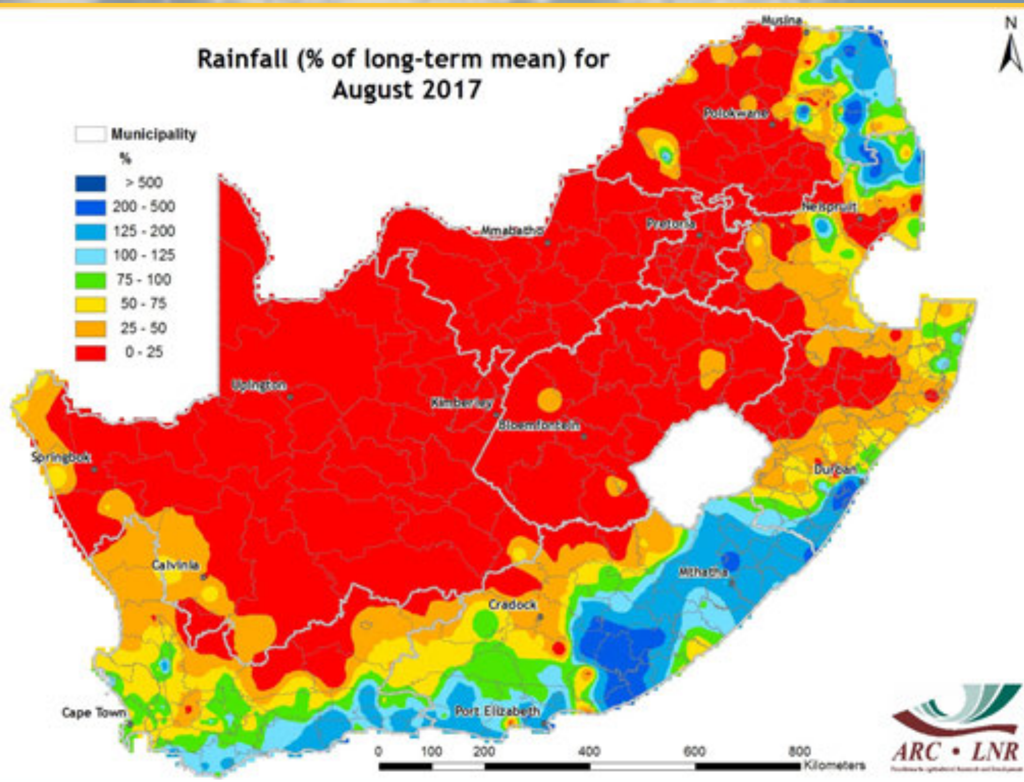


Figure 1



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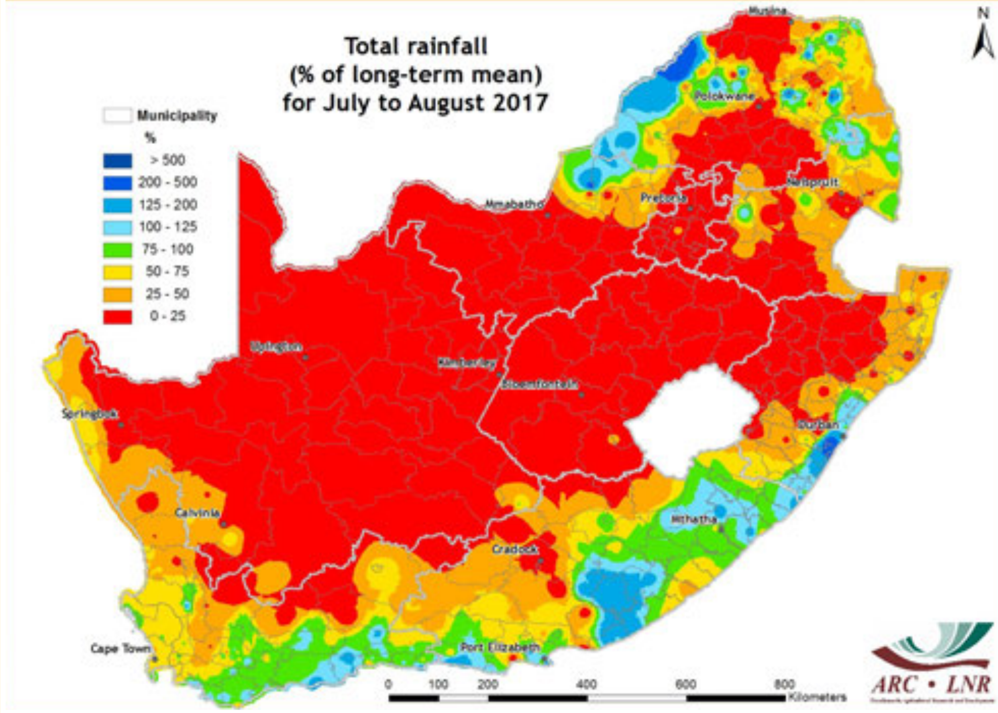

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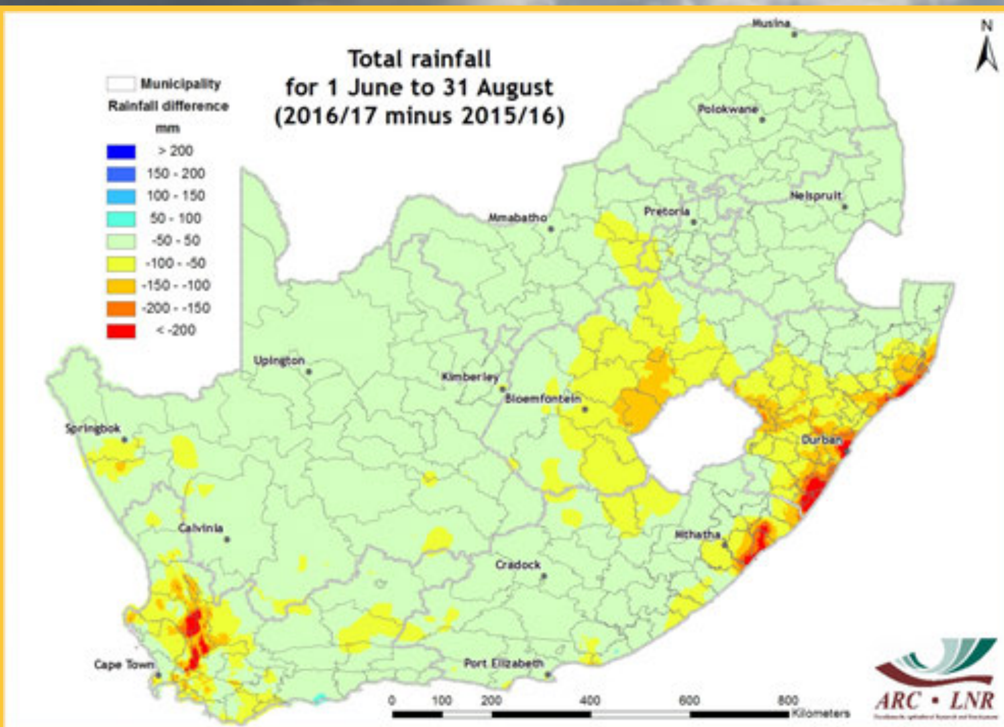

Figure 4

Figure 1:
Rainfall totals for the month of August were generally below 50 mm over the Western Cape, reaching 150 mm over the mountainous areas. Almost the entire southern and eastern coastal belts received rainfall totals of at least 25-50 mm, reaching 150 mm in some areas.

Figure 2:
Normal to above-normal rainfall occurred along the Cape south coast and adjacent interior, extending to the southern parts of the KwaZulu-Natal coast. Normal to above-normal rainfall also occurred over the eastern parts of Limpopo.

Figure 3:
Over the past two months, near- to above-normal rainfall occurred over the southern to southeastern coastal belts as well as over some isolated areas in the northeast of the country. The western parts of the Western Cape received mostly below-normal rainfall.

Figure 4:
Compared to June-August 2016, the corresponding 3-month period during 2017 received less rainfall. The western part of the Western Cape received up to 200 mm less rainfall in 2017 than during the corresponding 2016 period. The KwaZulu-Natal coast also received less rainfall during 2017 compared to the same period in 2016.

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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.

At all the time scales, severe to extreme drought conditions are present over the winter rainfall region, expanding spatially from the long to short time scale. The severe drought conditions expand eastwards over the southwestern parts of the country and over the Cape south coast from the longer to shorter time scales. At the longer time scales, severe to extreme drought conditions are present over the eastern seaboard and adjacent interior regions, gradually recovering towards the shorter time scale.

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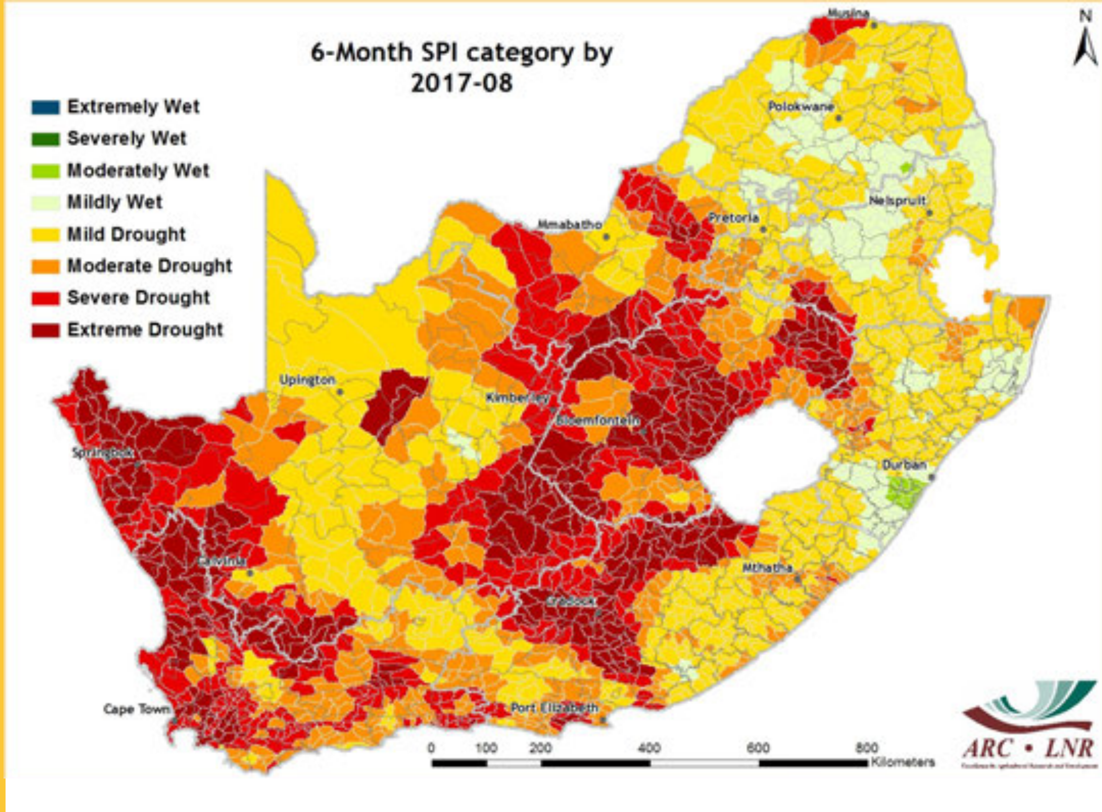


Figure 5

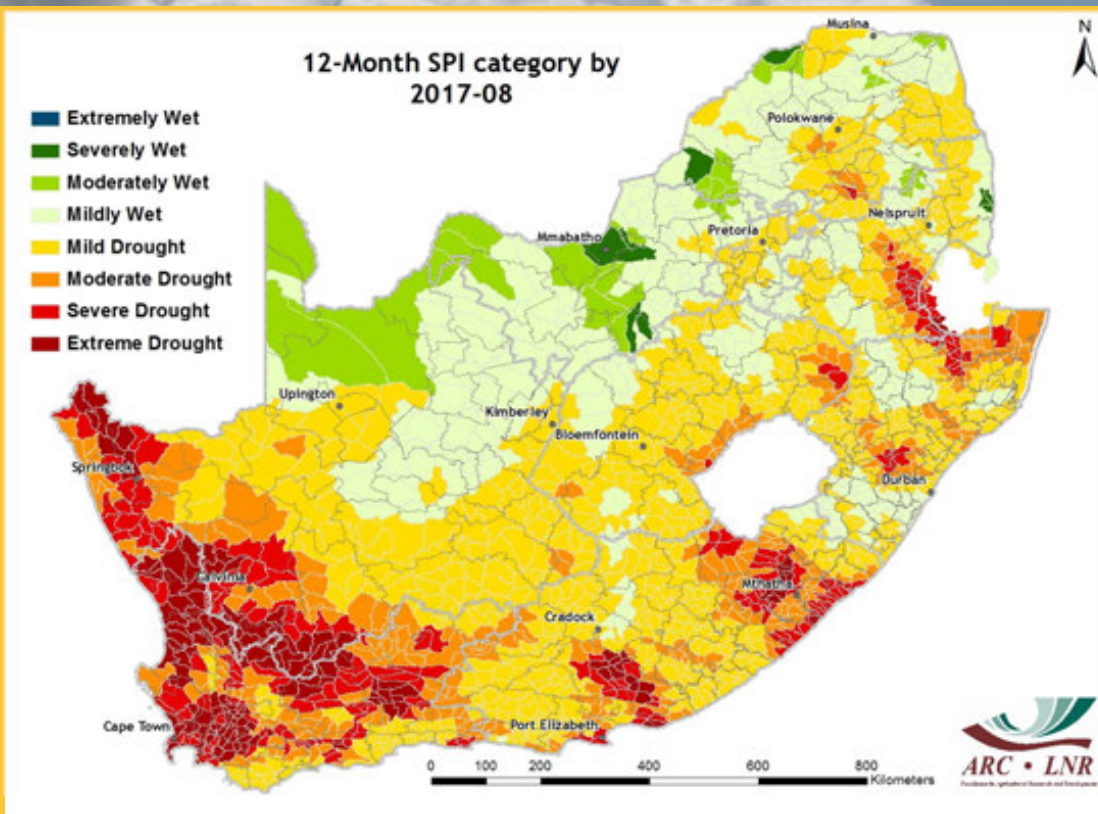
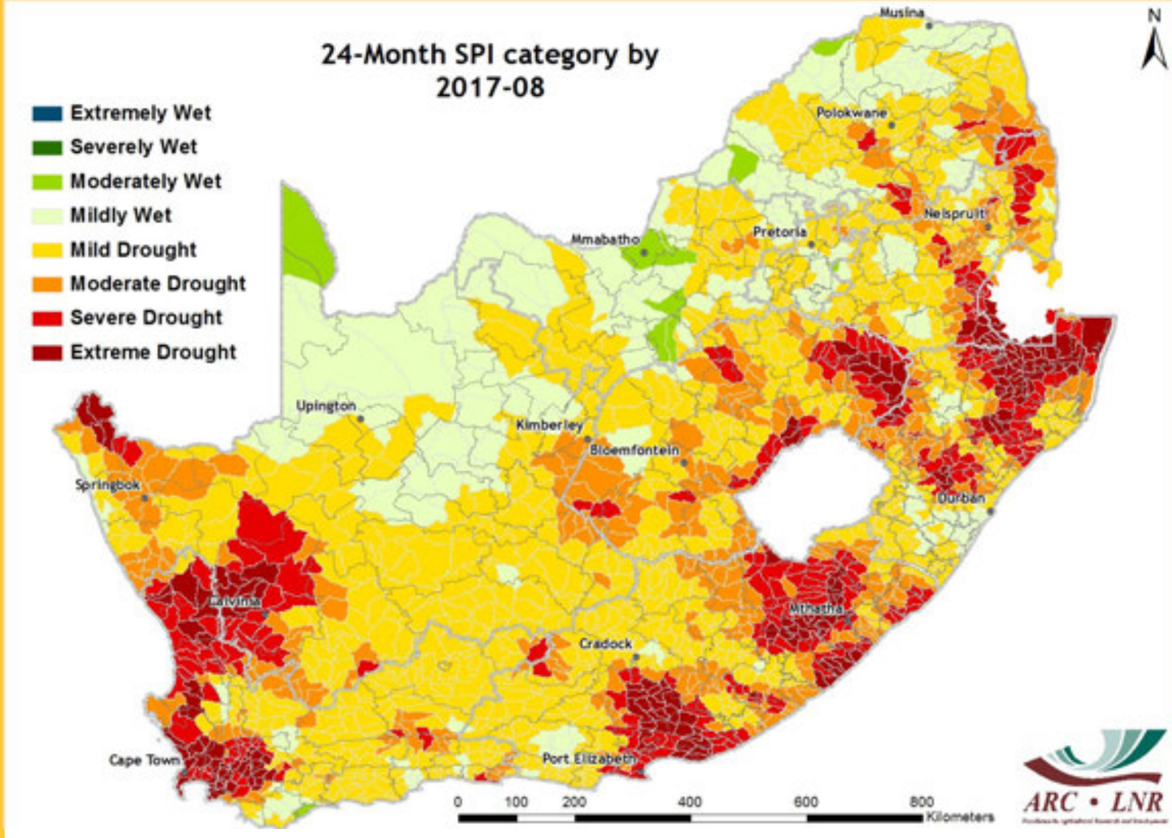


Figure 6



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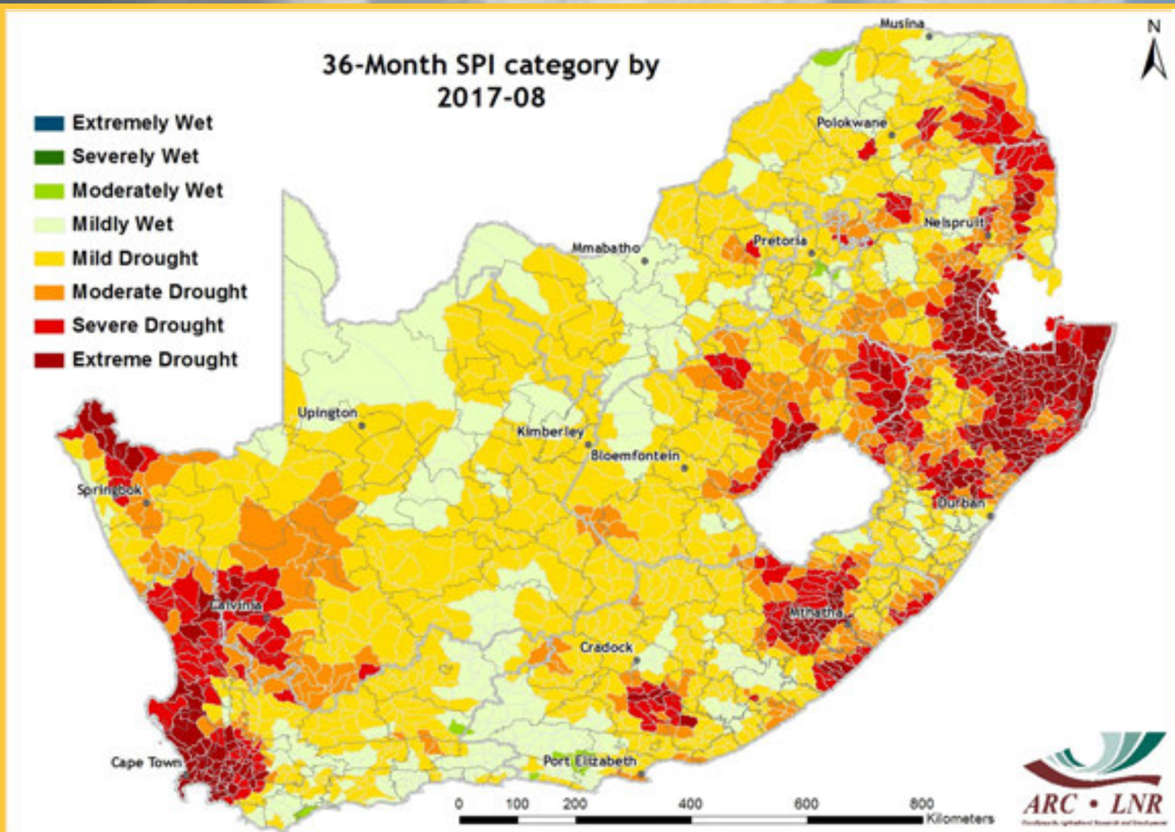

Figure 8

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.

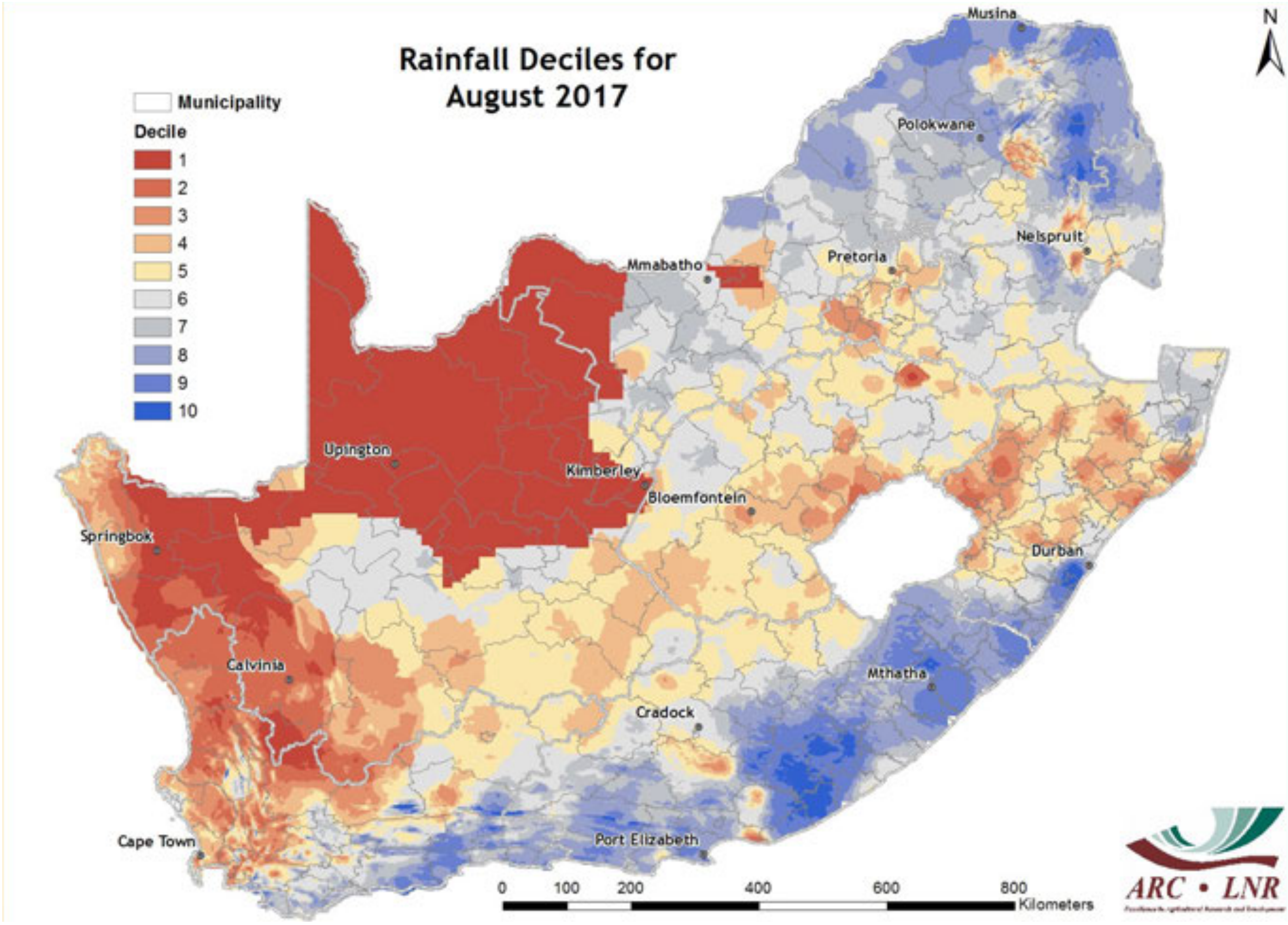

Figure 9

Figure 9:
Compared to historical rainfall totals during the month of August, August 2017 over most of the winter rainfall region compares well with the drier August months. However, over some areas along the southern and southeastern coastal belts, August 2017 falls within the wet August months.

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4. Water Balance

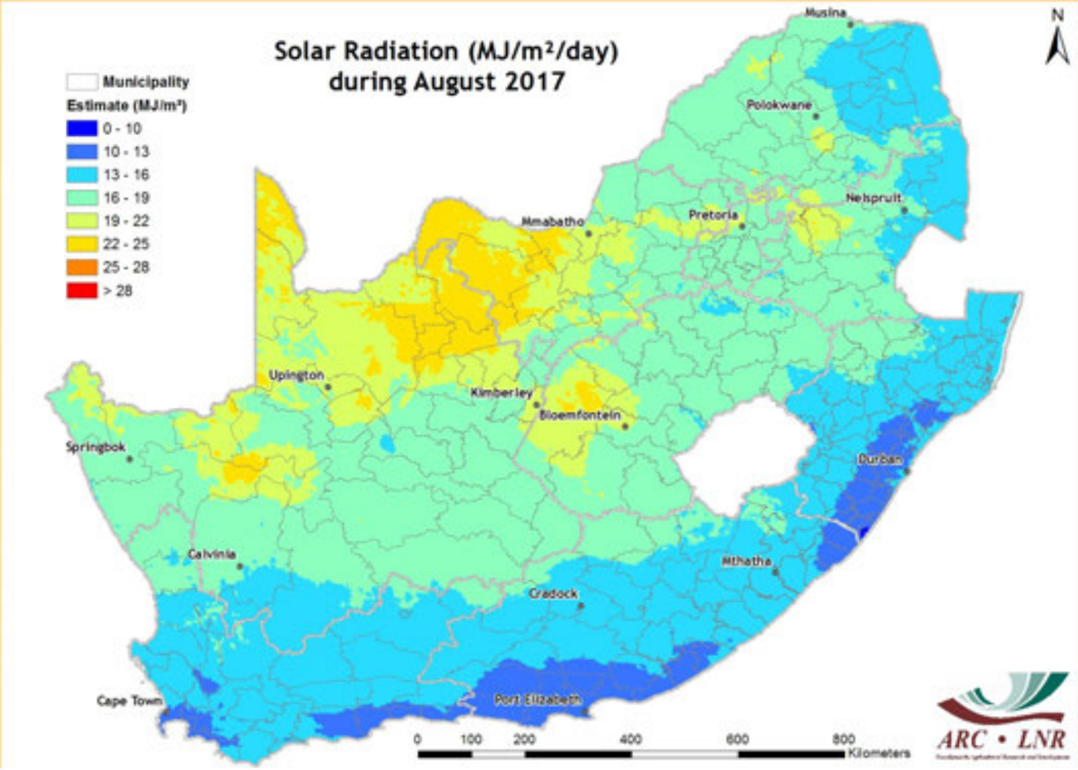

Figure 10

Solar Radiation

Daily solar radiation surfaces are created for South Africa by combining *in situ* measurements from the ARC-ISCW automatic weather station network with 15-minute data from the Meteosat Second Generation satellite.

Figure 10:
The lowest solar radiation values occurred over the southern and eastern coastal belts, with increasing values further north. The highest values are located over the northern parts of the country, to the south of Botswana.

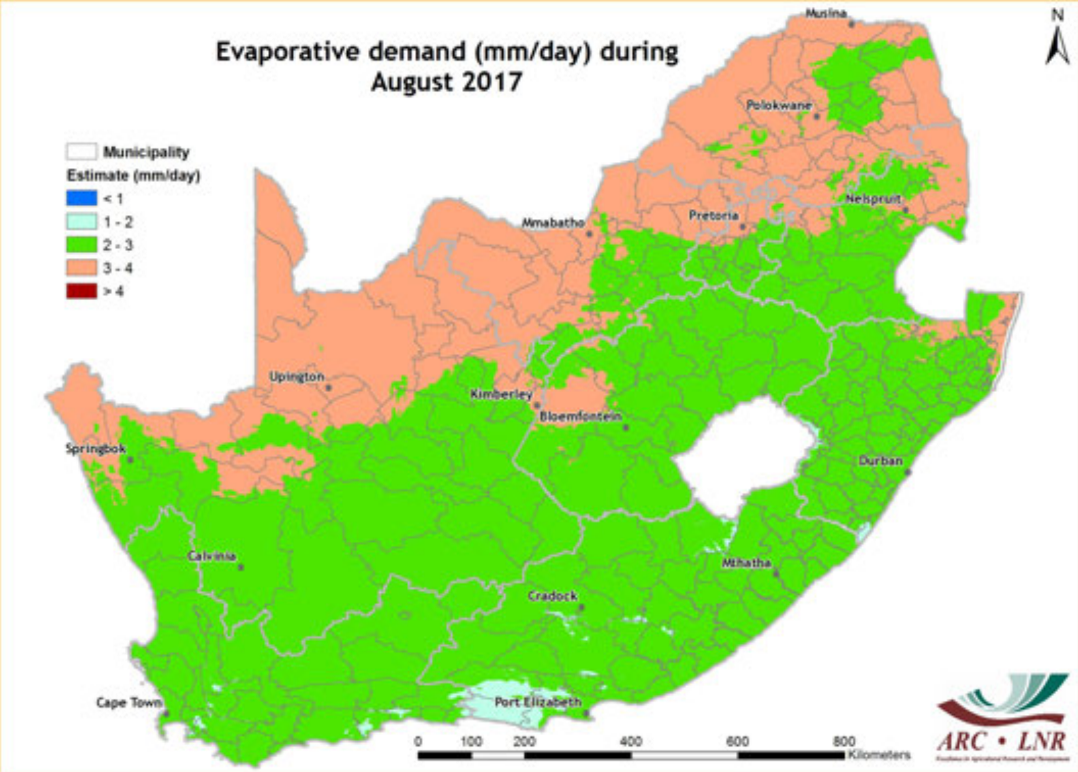

Figure 11

Potential Evapotranspiration

Potential evapotranspiration (PET) for a reference crop is calculated at about 450 automatic weather stations of the ARC-ISCW located across South Africa. At these stations hourly measured temperature, humidity, wind and solar radiation values are combined to estimate the PET.

Figure 11:
The evaporative demand was less than 3 mm/day over most of the country, with a slightly higher demand over the far northern and northeastern parts.

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5. 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.

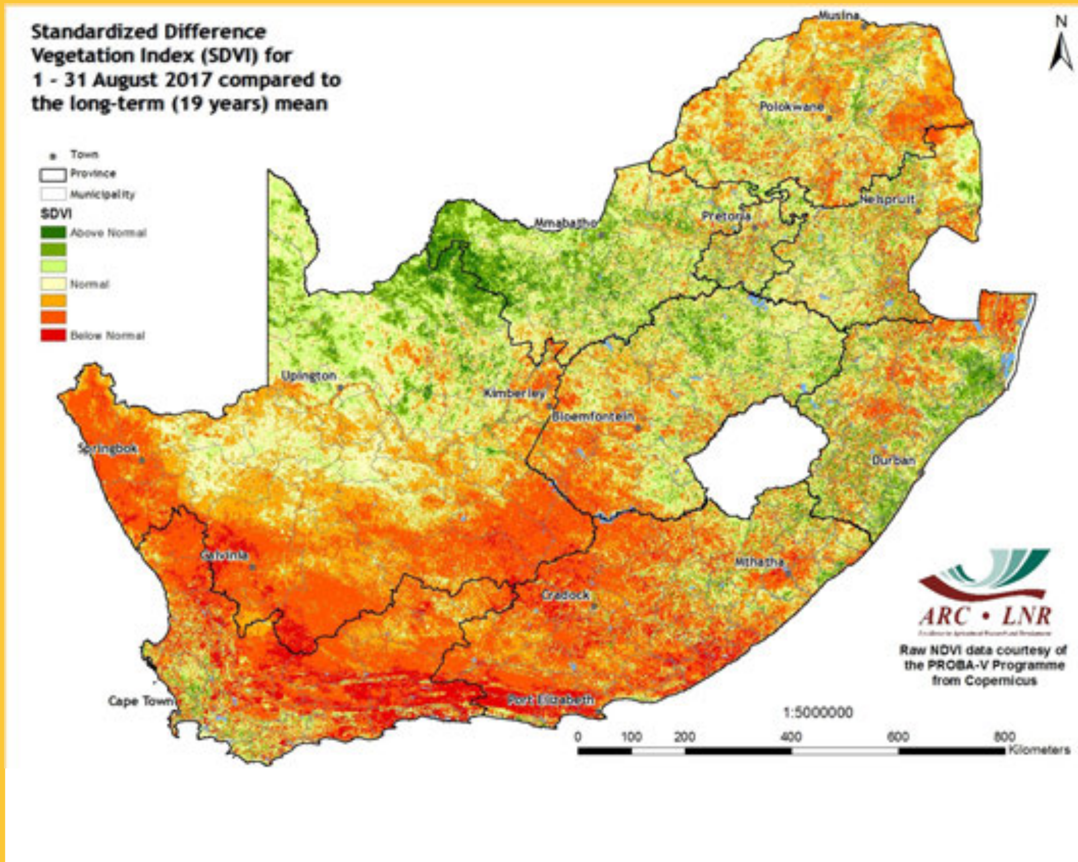

Figure 12

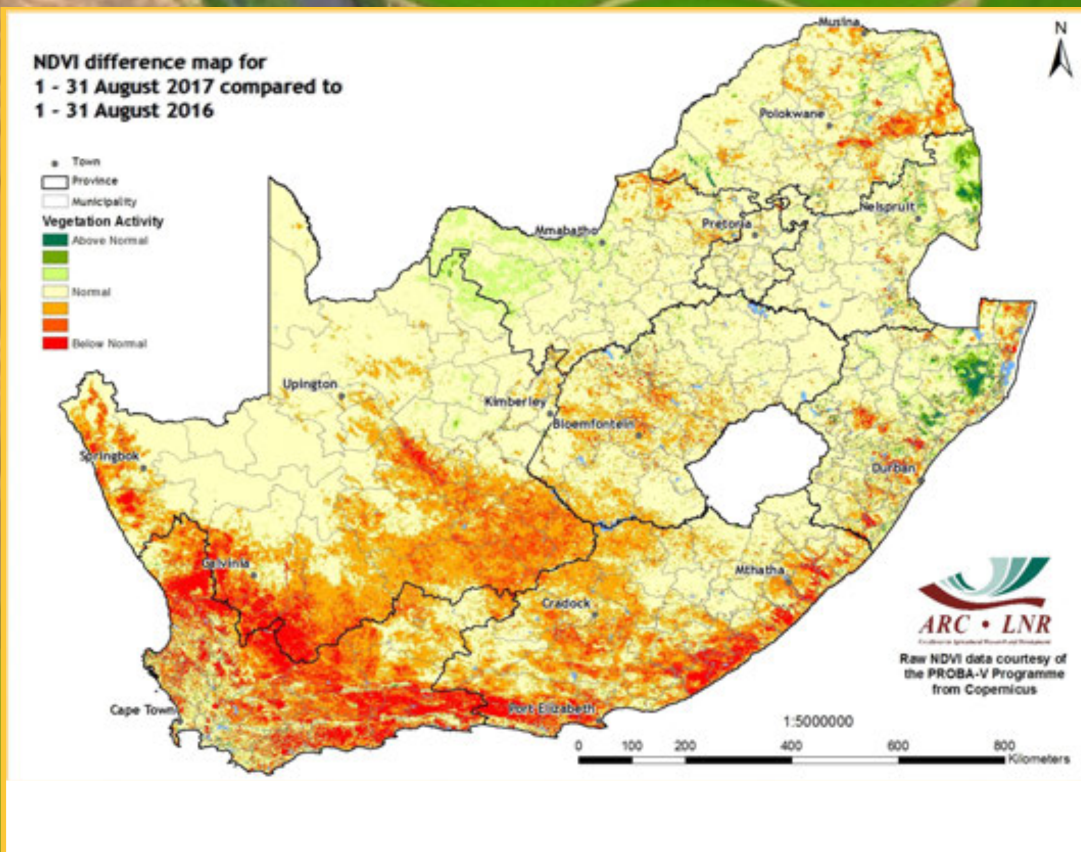

Figure 13

Figure 12:
The SDVI for August indicates above-normal vegetation activity over much of the interior, North West and KwaZulu-Natal region, as well as dry conditions over much of the Northern Cape, Eastern Cape and the Western Cape winter rainfall region.

Figure 13:
Vegetation activity is lower over the southern and far western parts of the Northern Cape, greater Karoo regions, central Free State and Western Cape. Much of the Eastern Cape, southwest and northeast of KwaZulu-Natal, Lowveld areas of Limpopo and northeastern North West also experienced dry conditions.

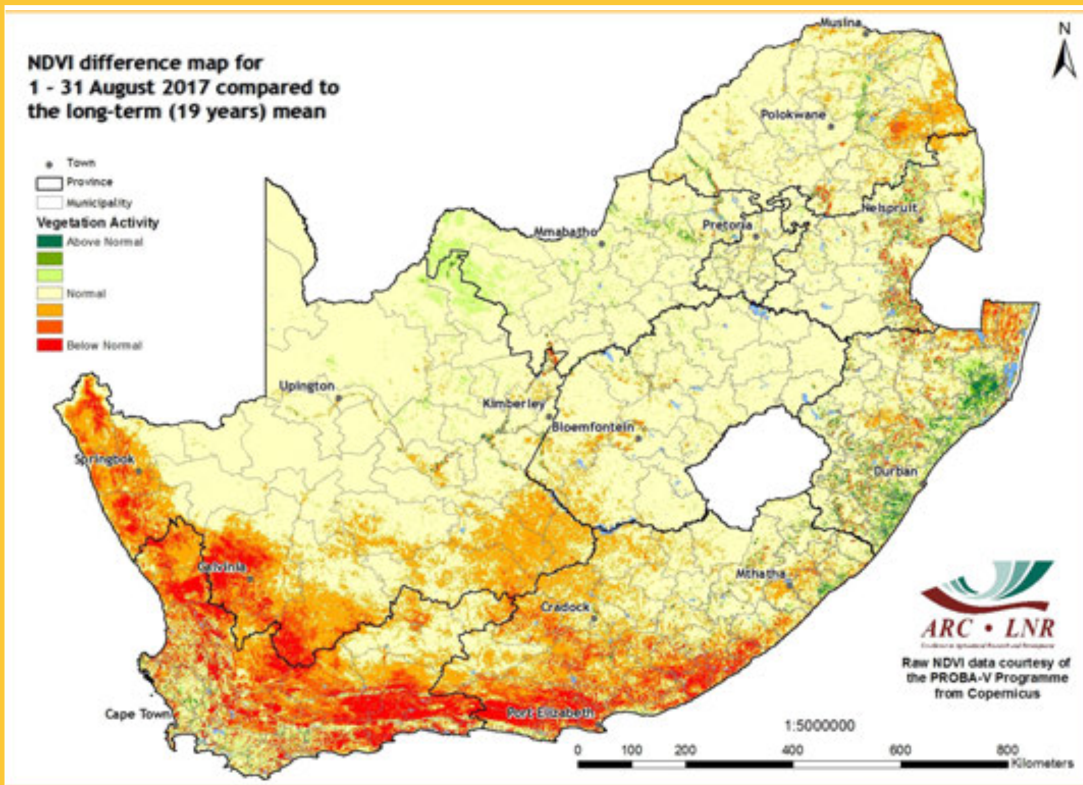

Figure 14

Vegetation Mapping
(continued from p. 8)

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

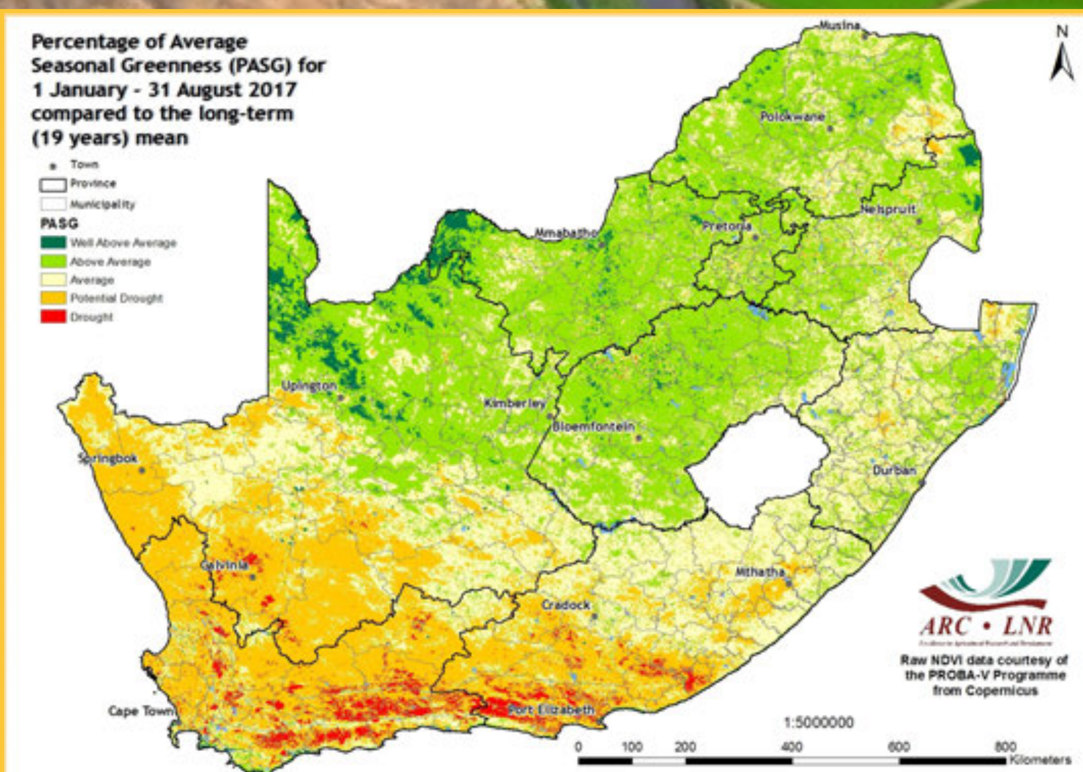

Figure 15

Figure 14:
Vegetation activity for August was lower along the west and south coast, central Eastern Cape and southern parts of the Northern Cape. However, the KwaZulu-Natal coast and adjacent interior experienced an increase in vegetation activity.

Figure 15:
Cumulative vegetation activity was well above average in North West, Gauteng, Free State, Limpopo, Mpumalanga and northern parts of the Northern Cape. The southwestern parts of the country continue to experience potential drought conditions.

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6. 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.

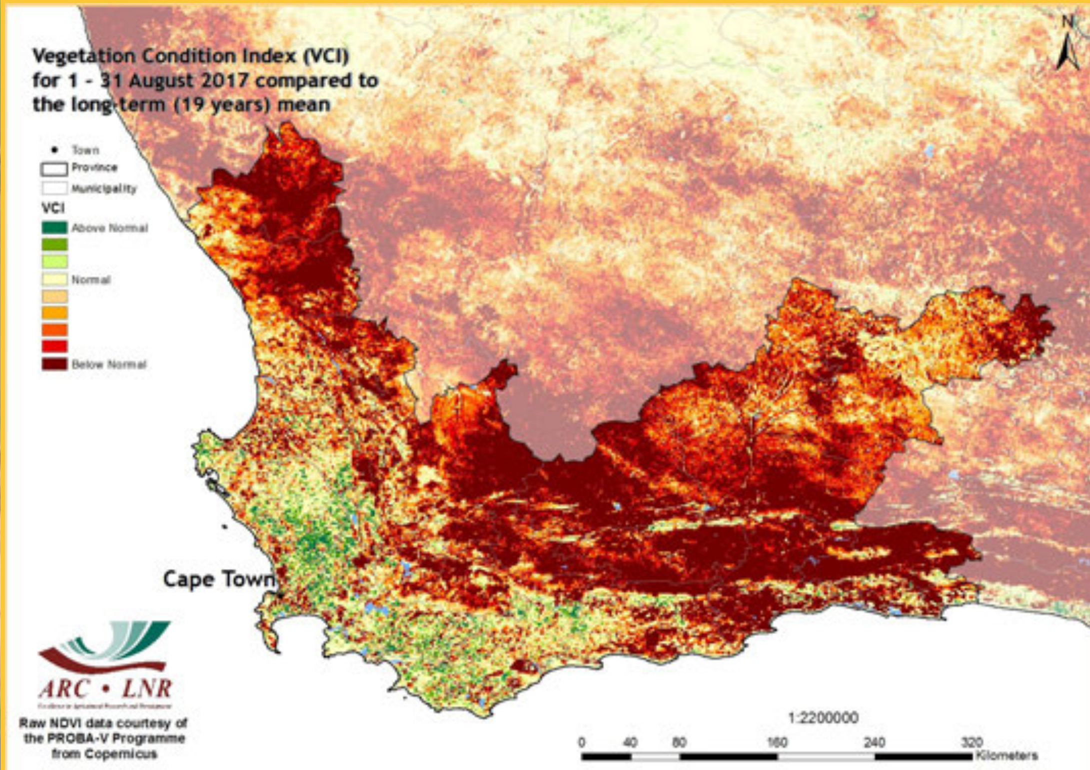
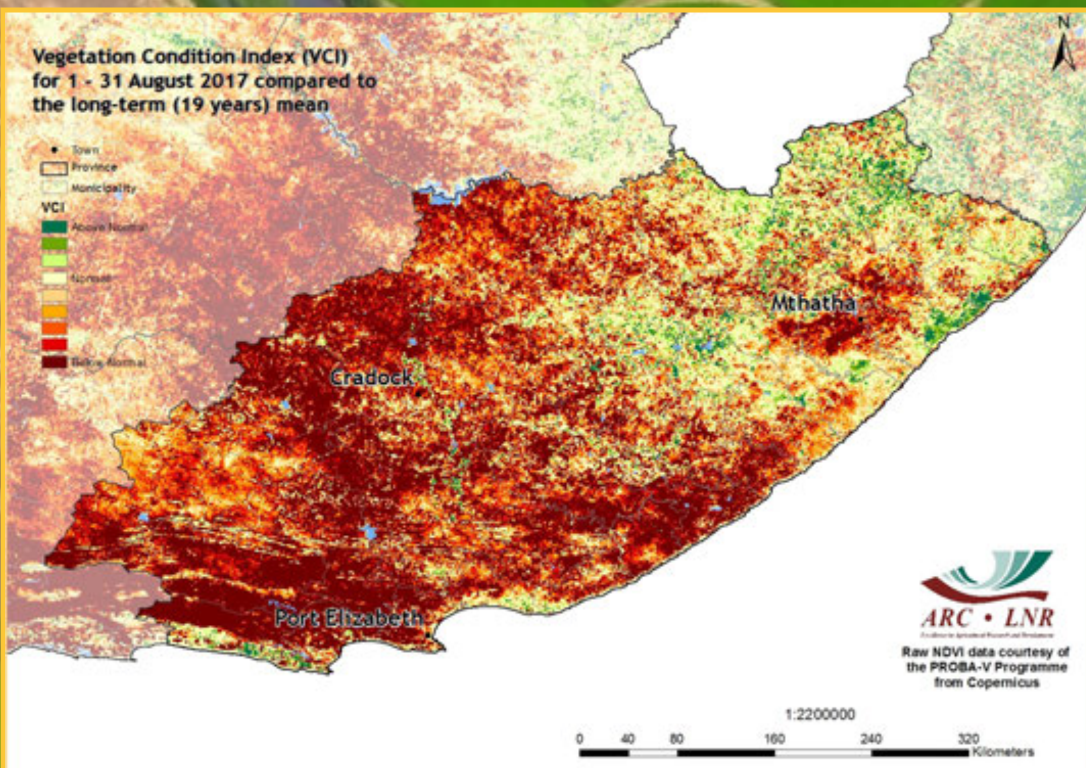


Figure 16

Figure 16:
The VCI map for August indicates below-normal vegetation activity over most parts of the Western Cape.

Figure 17:
The VCI map for August indicates below-normal vegetation activity over most parts of the Eastern Cape.



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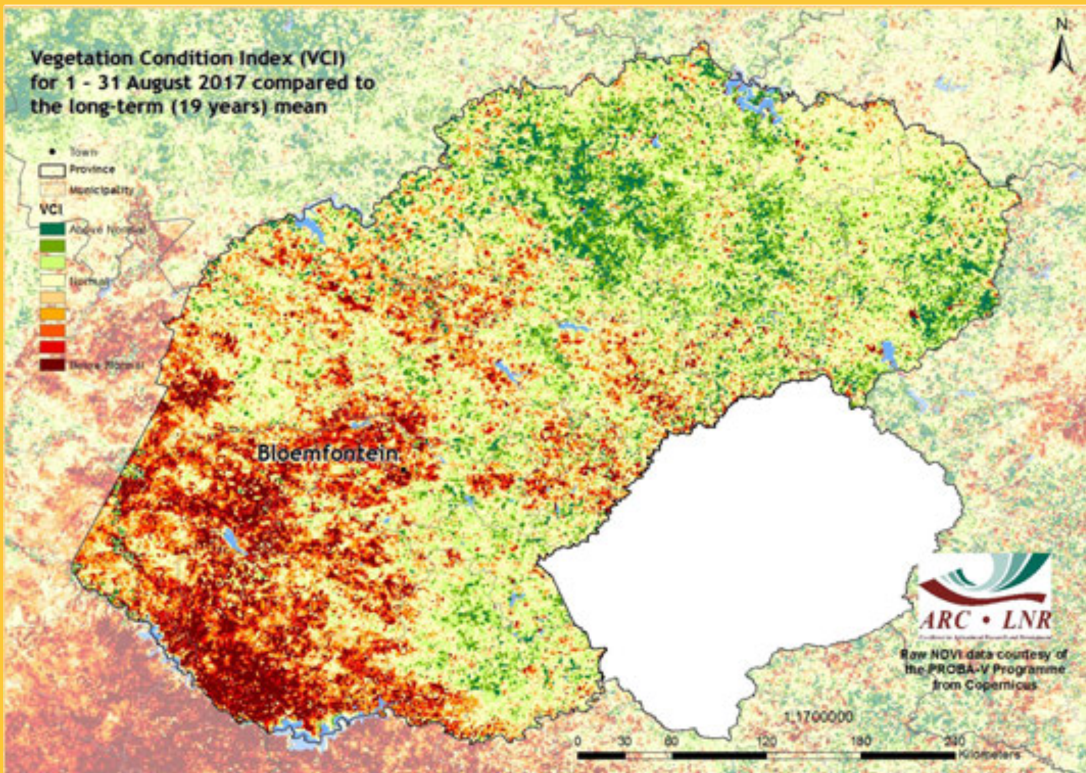

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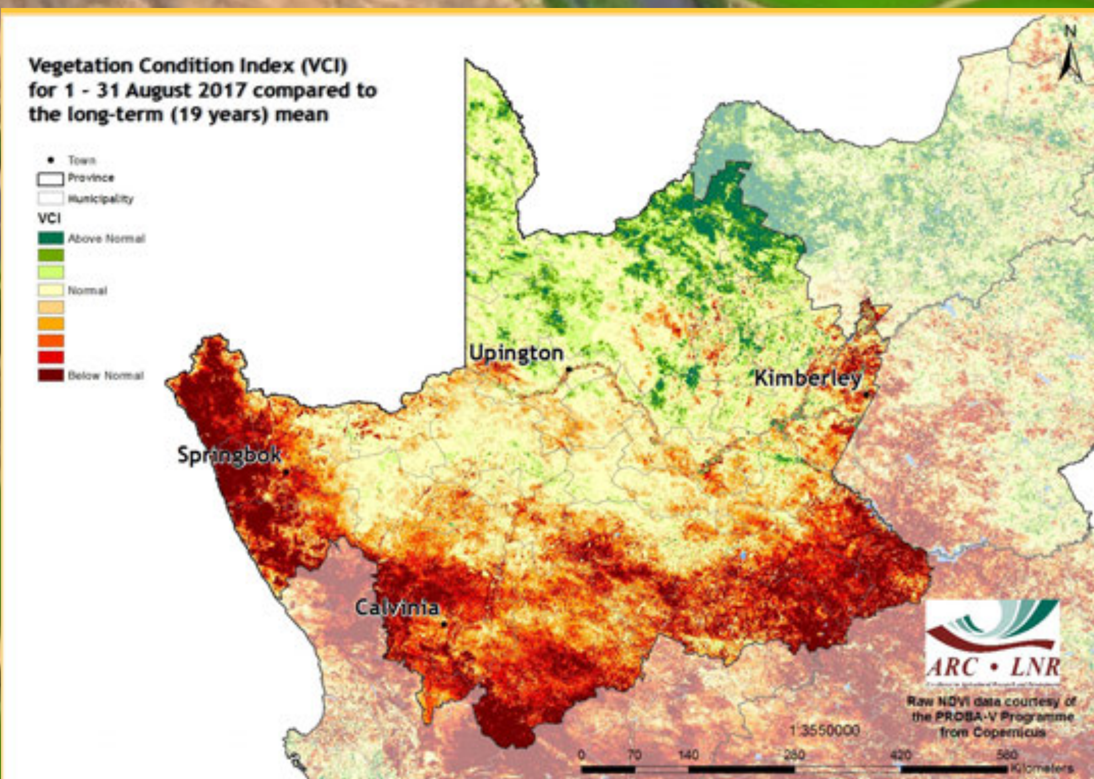

Figure 19

Figure 18:
The VCI map for August indicates below-normal vegetation activity over the interior and western parts of the Free State.

Figure 19:
The VCI map for August indicates below-normal vegetation activity over the southern parts of the Northern Cape.

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7. Vegetation Conditions & Rainfall

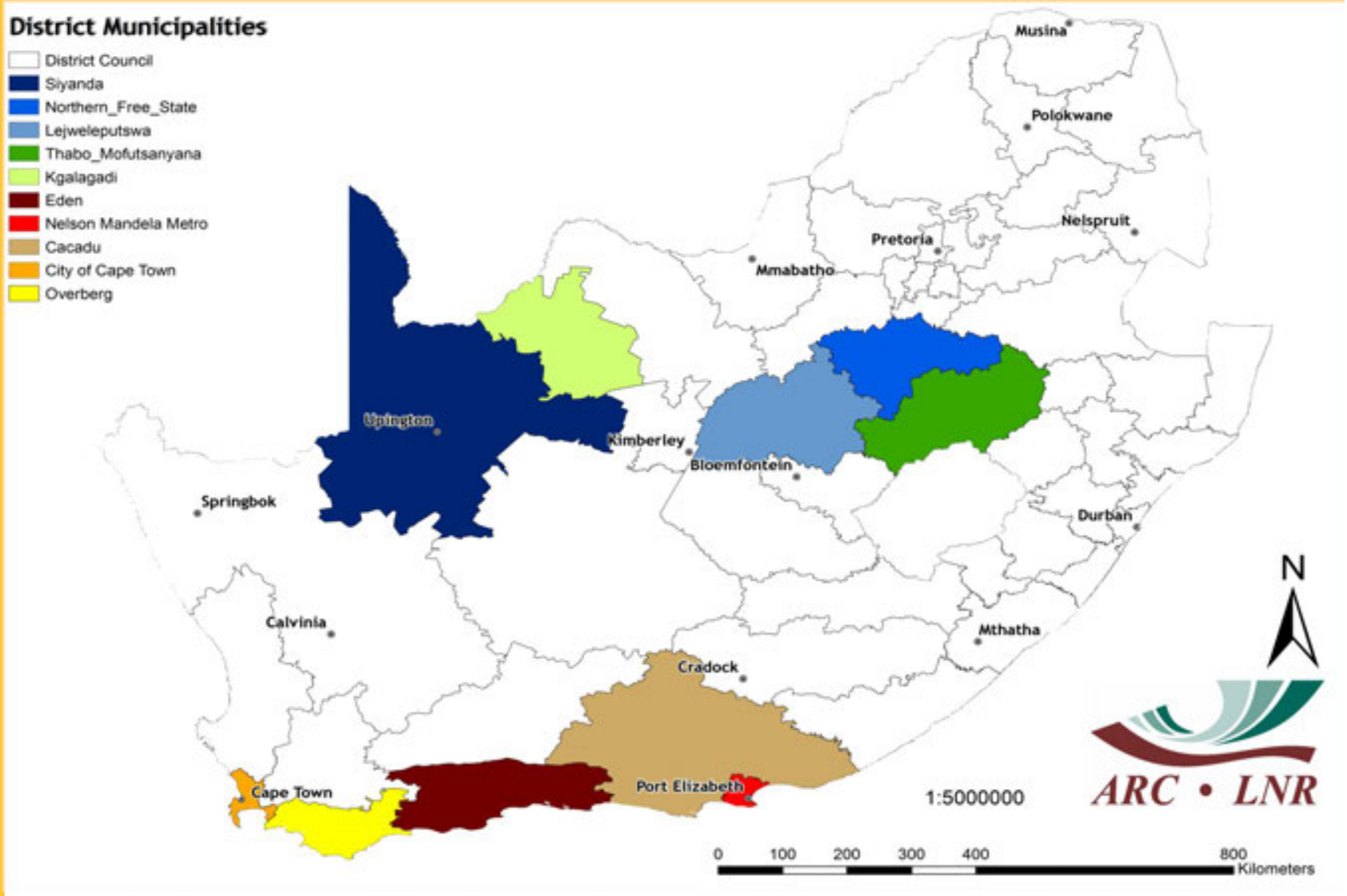

Figure 20

NDVI and Rainfall Graphs
Figure 20:
Orientation map showing the areas of interest for August 2017. The district colour matches the border of the corresponding graph.

Questions/Comments:
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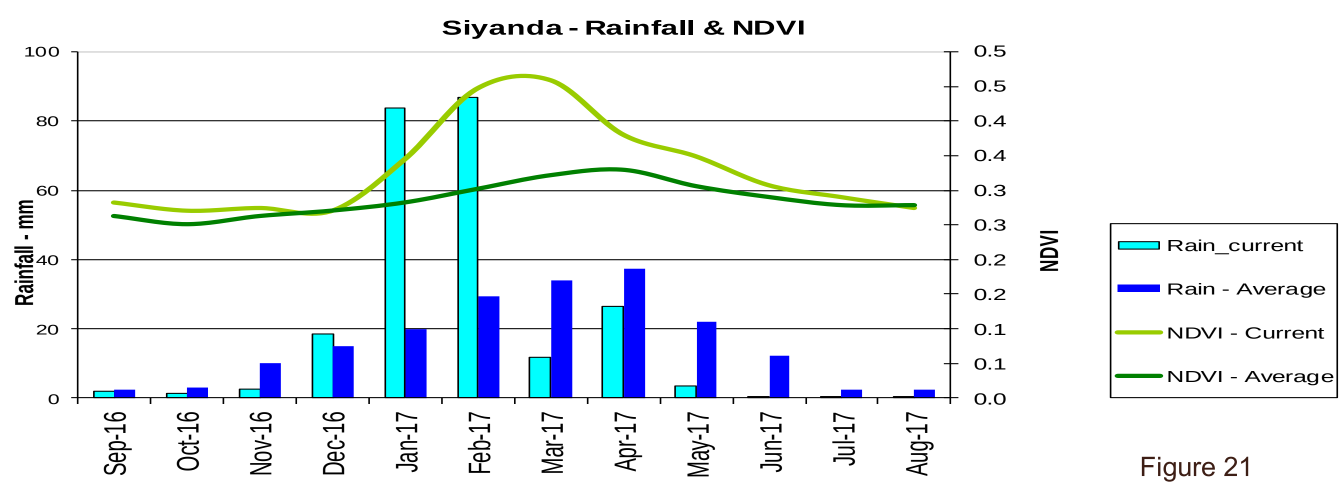
Figures 21-25:
Indicate areas with higher cumulative vegetation activity for the last year.

Figures 26-30:
Indicate areas with lower cumulative vegetation activity for the last year.



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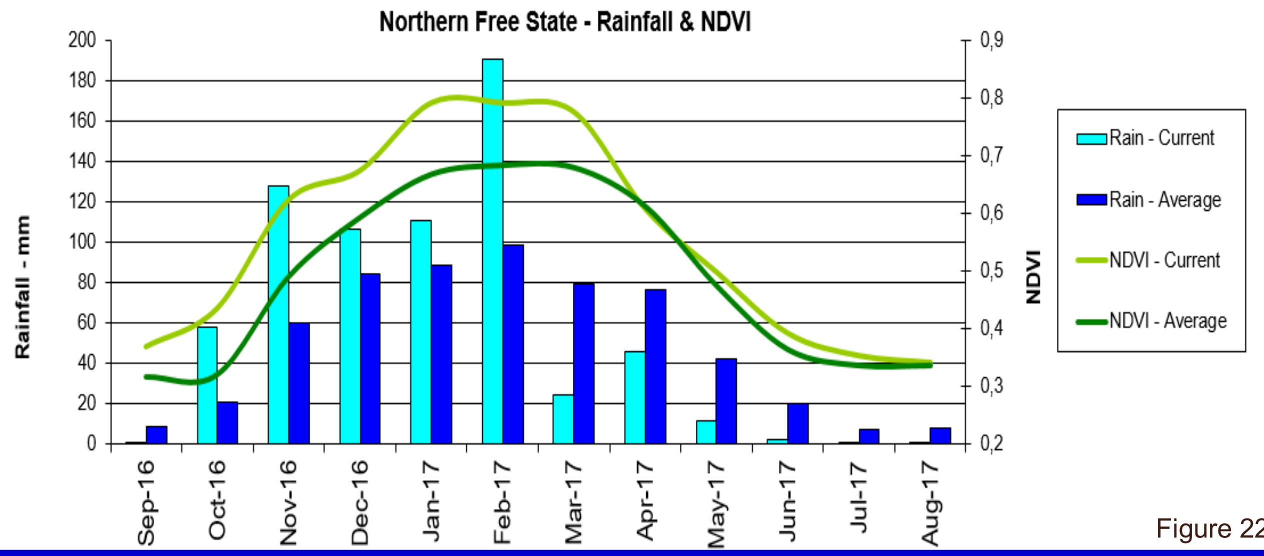

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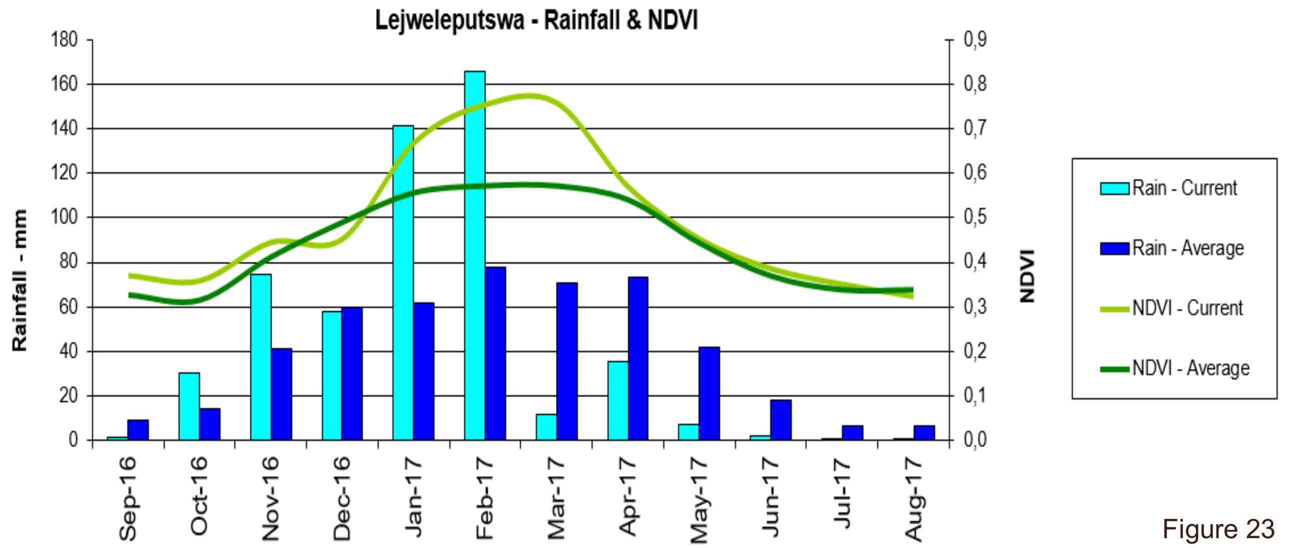

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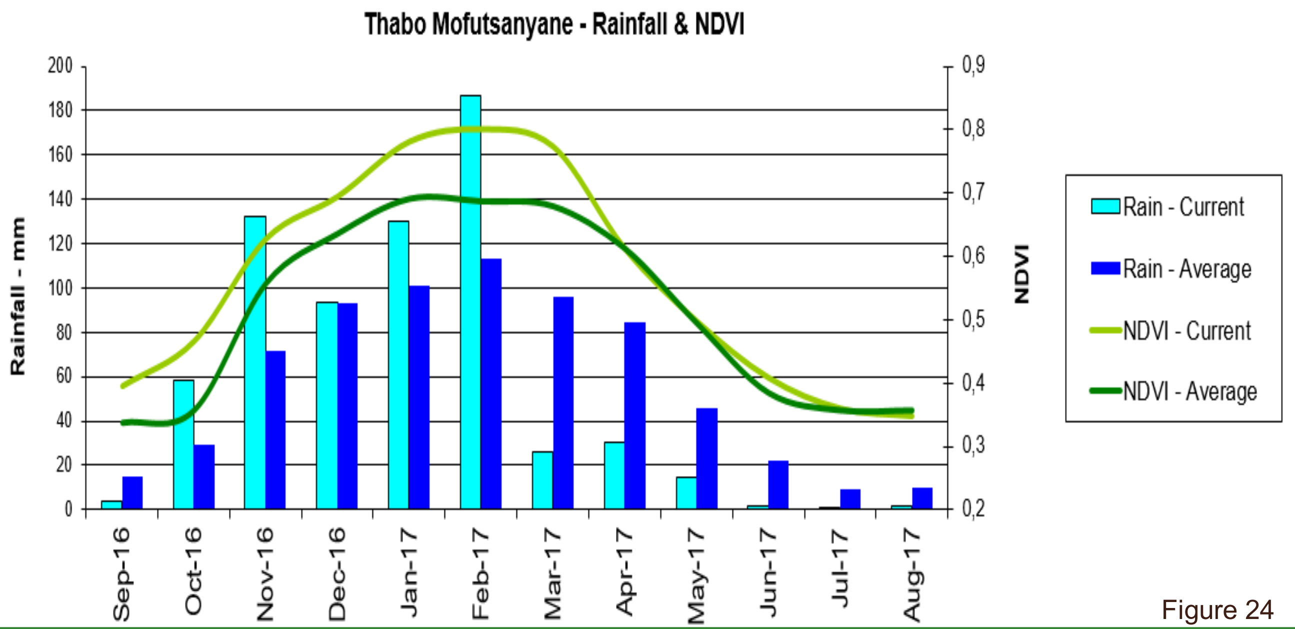

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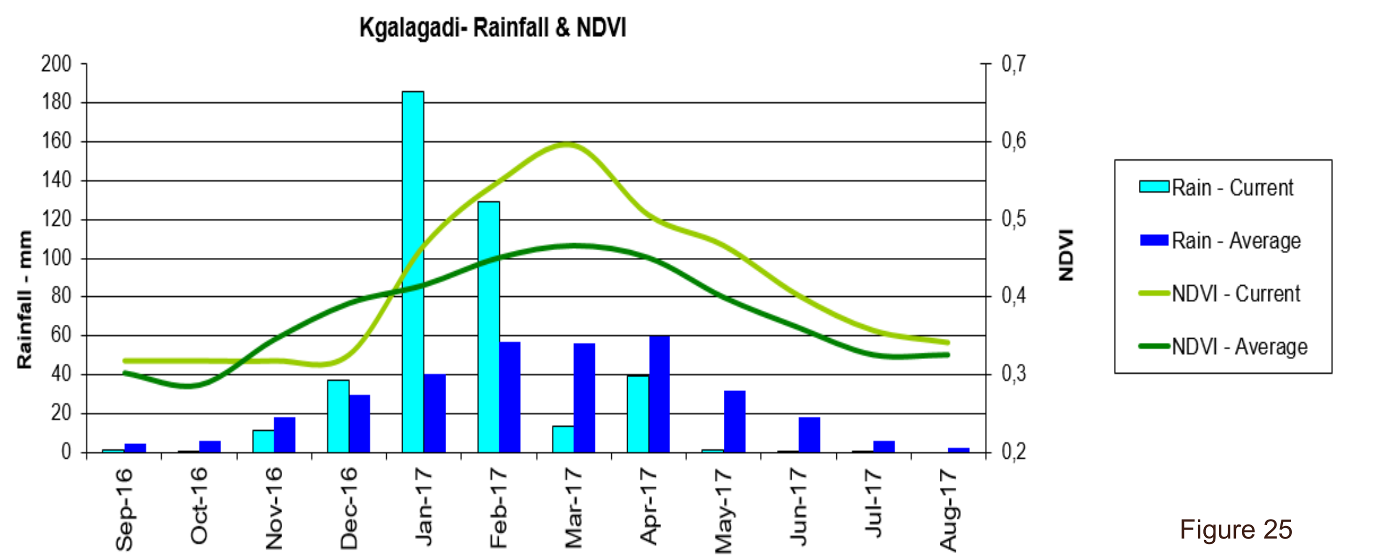

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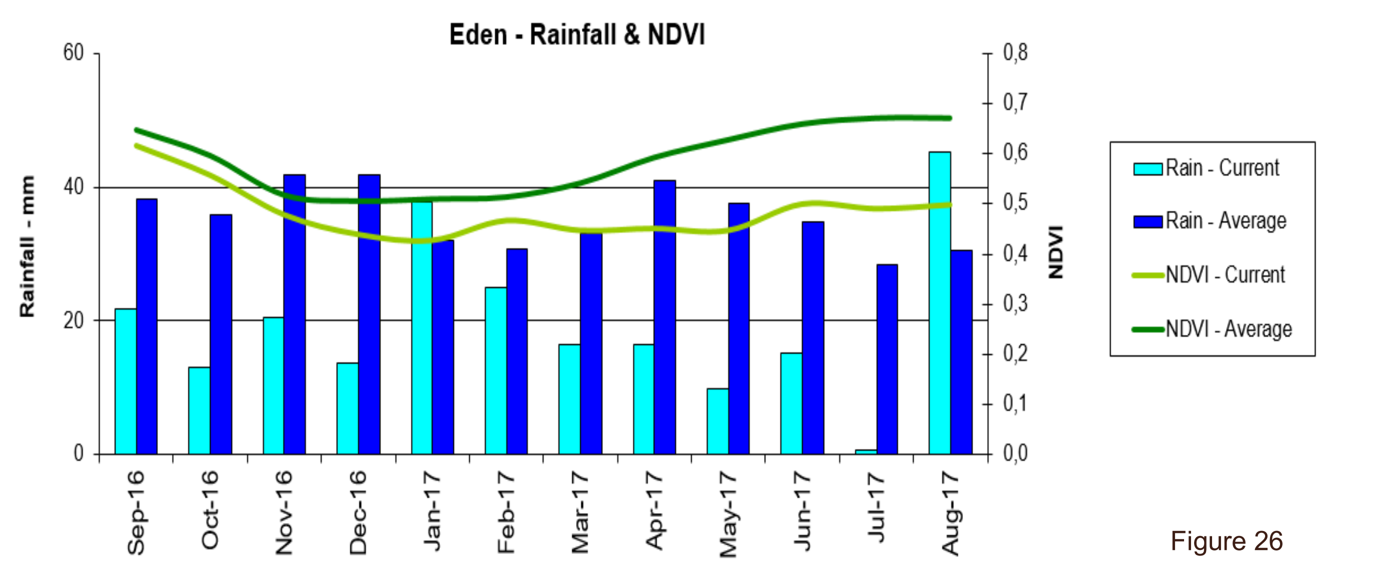

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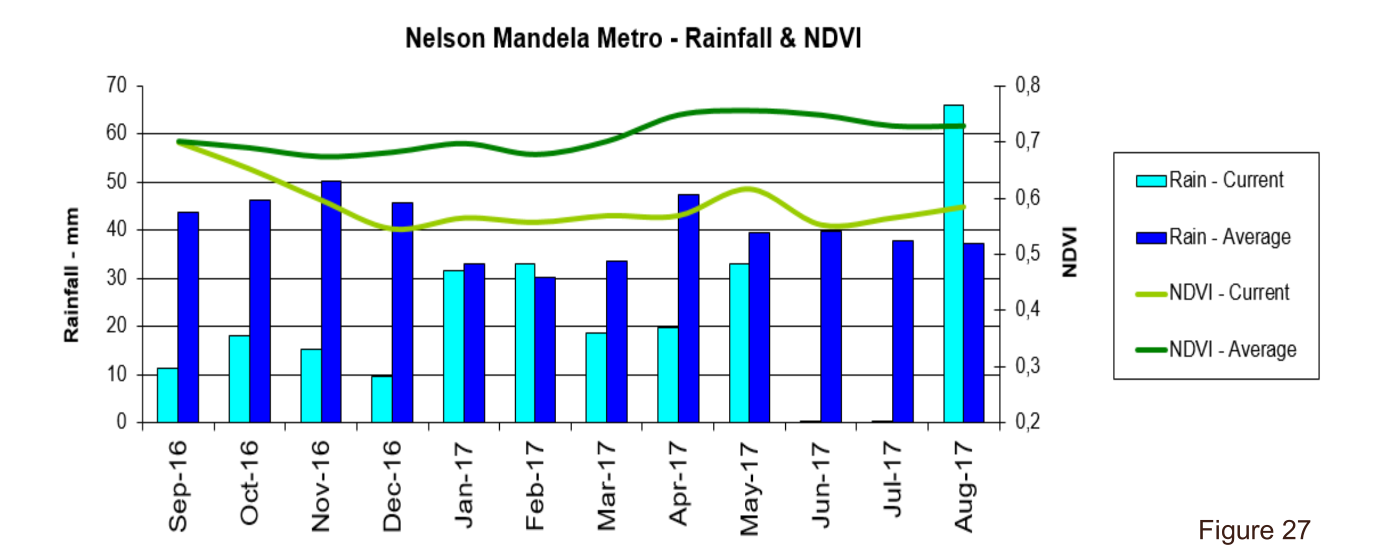

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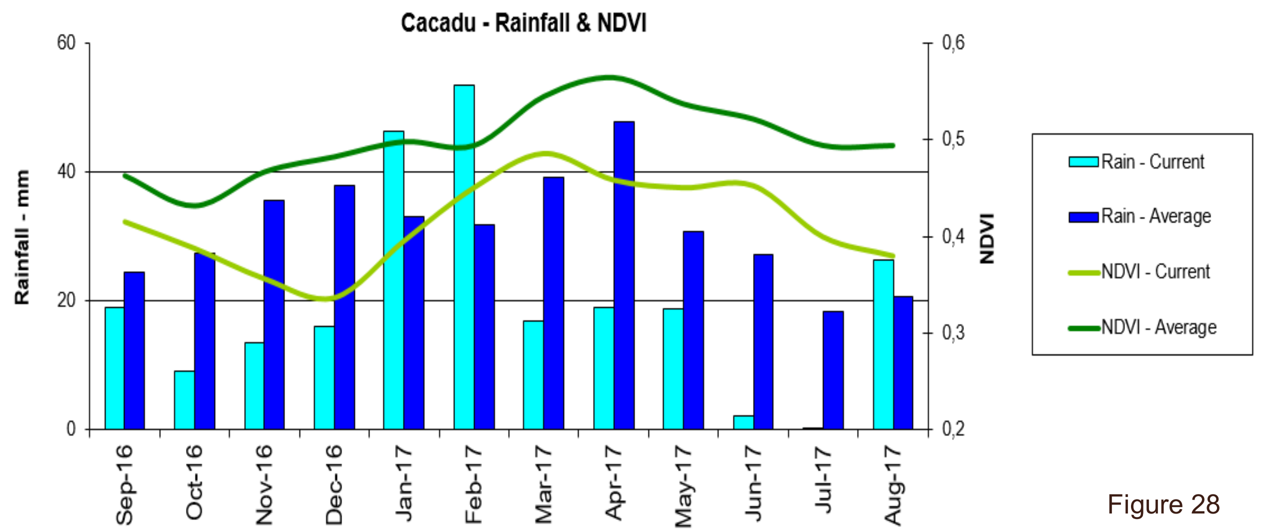

Figure 28

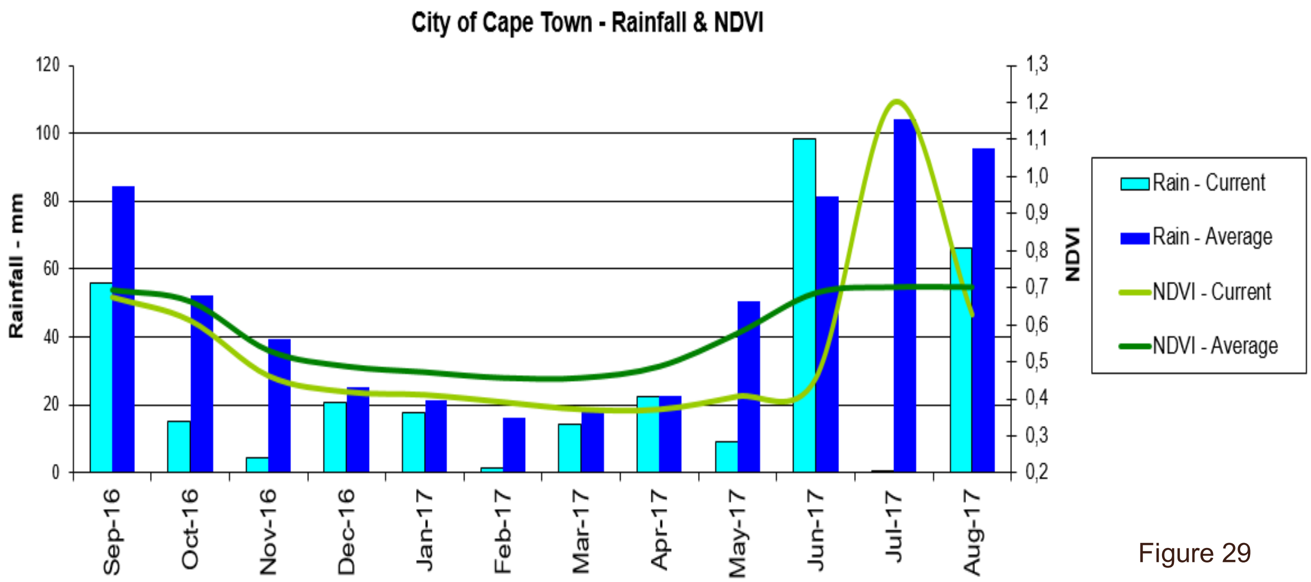

Figure 29

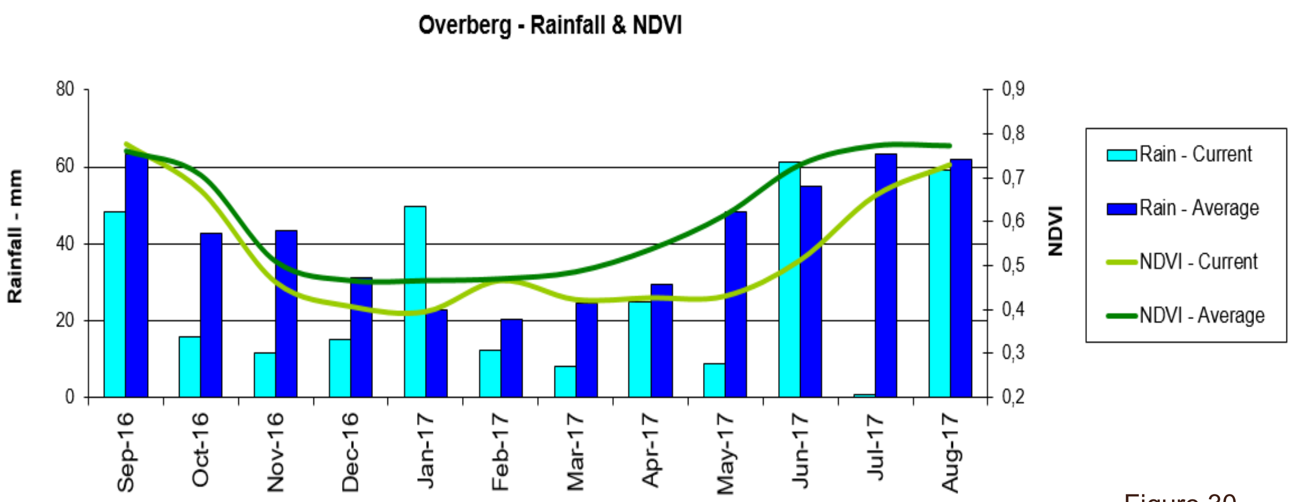

Figure 30

8. Fire Watch

PAGE 16

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 during the month of August per province. Fire activity was higher in all provinces compared to the average during the same period for the last 17 years.

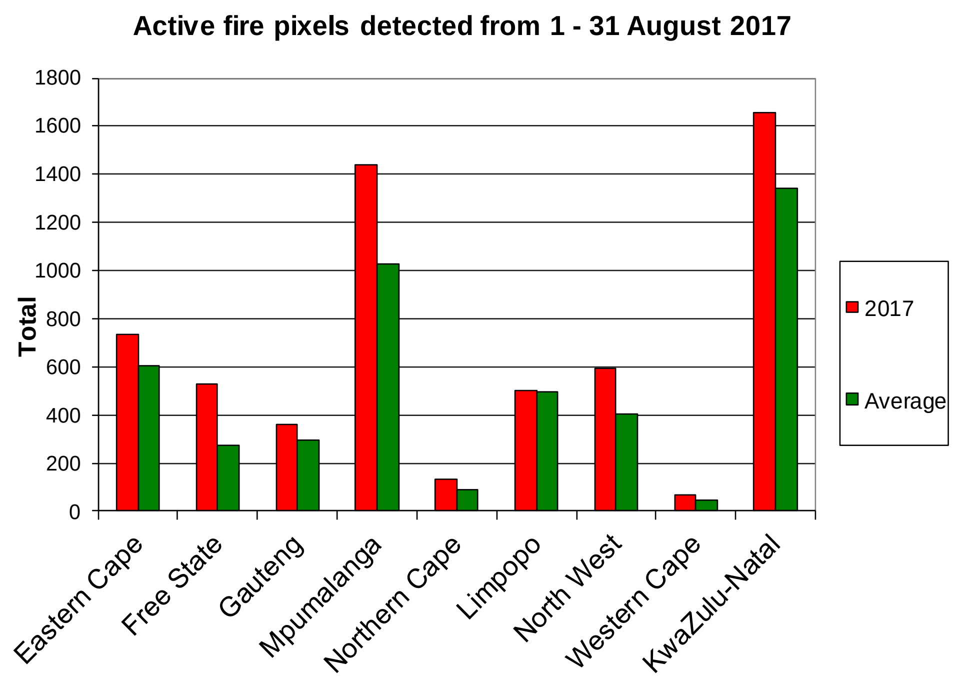

Figure 31

Figure 32:
The map shows the location of active fires detected between 1-31 August 2017.

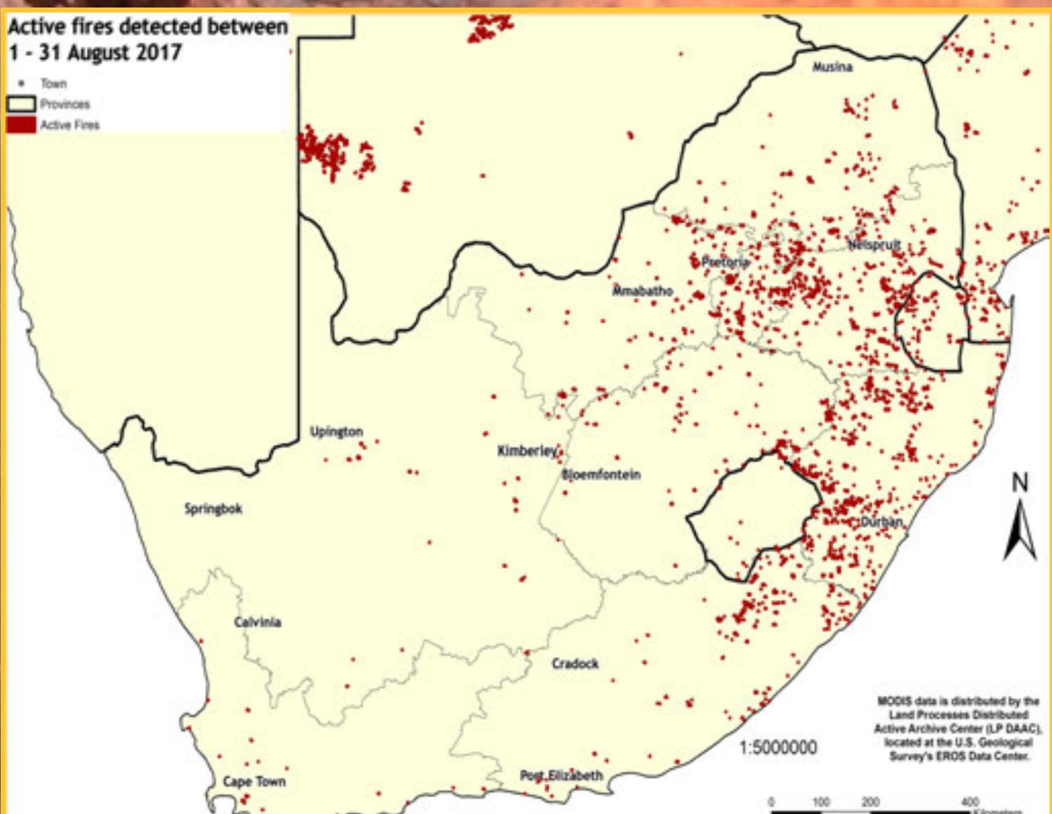

Figure 32

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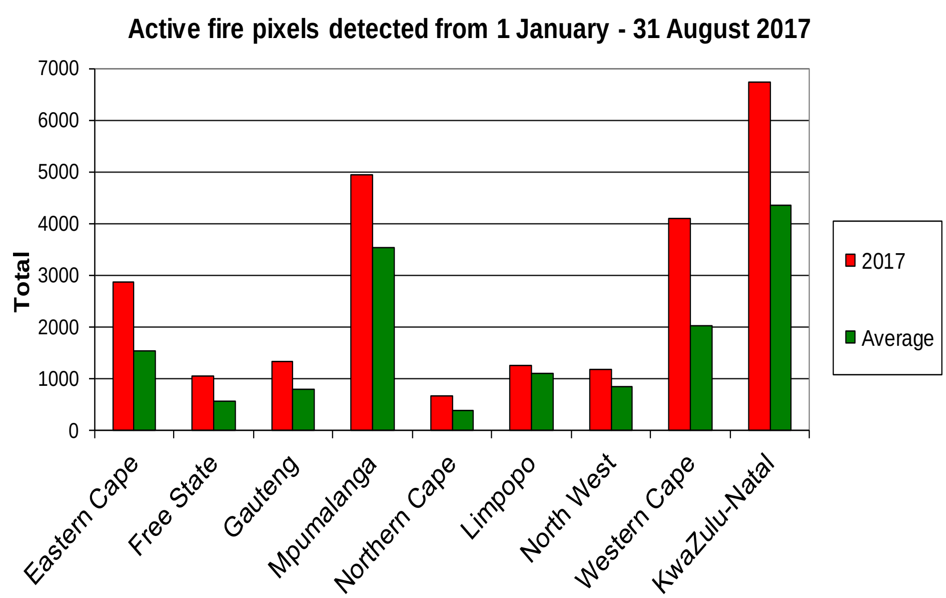

Figure 33

Figure 33:
The graph shows the total number of active fires detected from 1 January - 31 August 2017 per province. Fire activity was higher in all provinces compared to the average during the same period for the last 17 years.

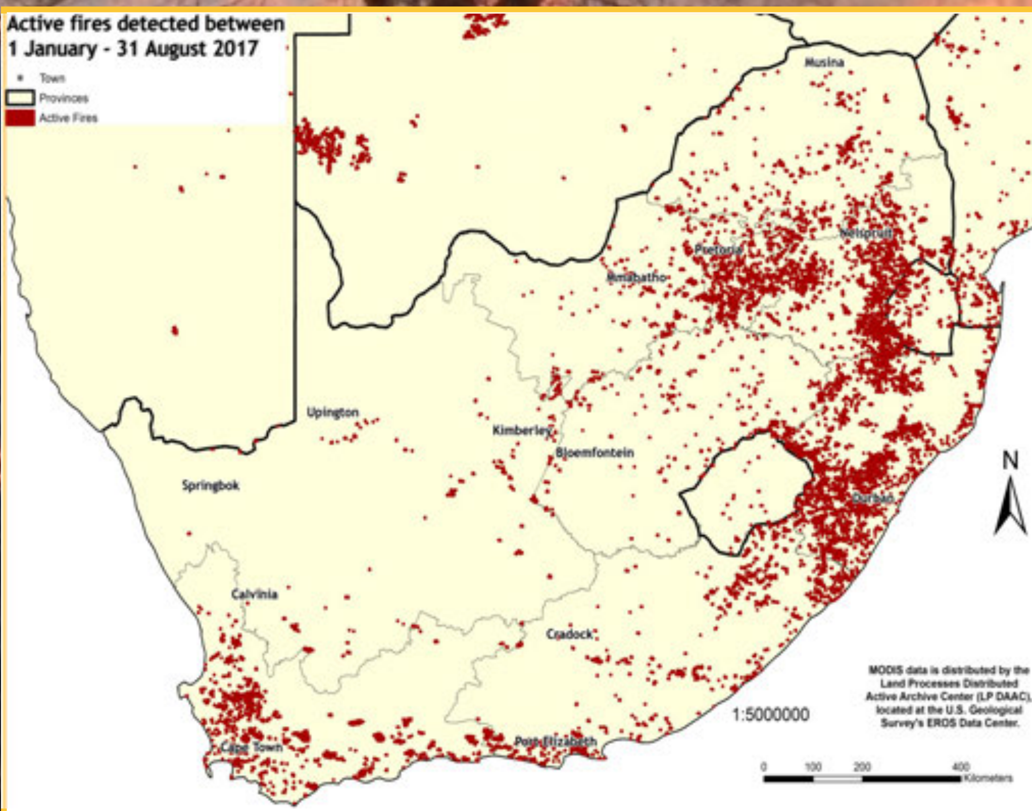

Figure 34

Figure 34:
The map shows the location of active fires detected between 1 January - 31 August 2017.

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Agrometeorology

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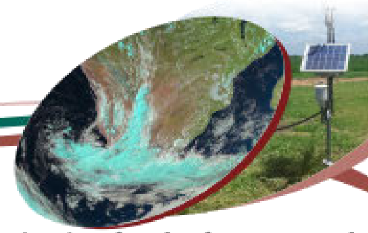

The programme focuses on the use of weather and climate information and monitoring for the forecast and prediction of the weather elements that have direct relevance on agricultural planning and the protection of crop, forest and livestock. The Agro-Climate Network & Databank is maintained as a national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

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Geoinformation Science

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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

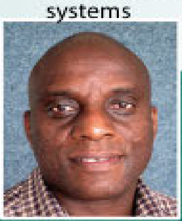
- Spatially explicit information dissemination systems, e.g. Umlindi newsletter
- Crop and land suitability modelling/assessments
- Disease and pest outbreaks and distribution modelling
- Precision agriculture information systems

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



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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 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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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.

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

http://www.agis.agric.za