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UMLINDI
The Watchman

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INSTITUTE FOR SOIL, CLIMATE AND WATER

CONTENTS:

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

South African Weather Service

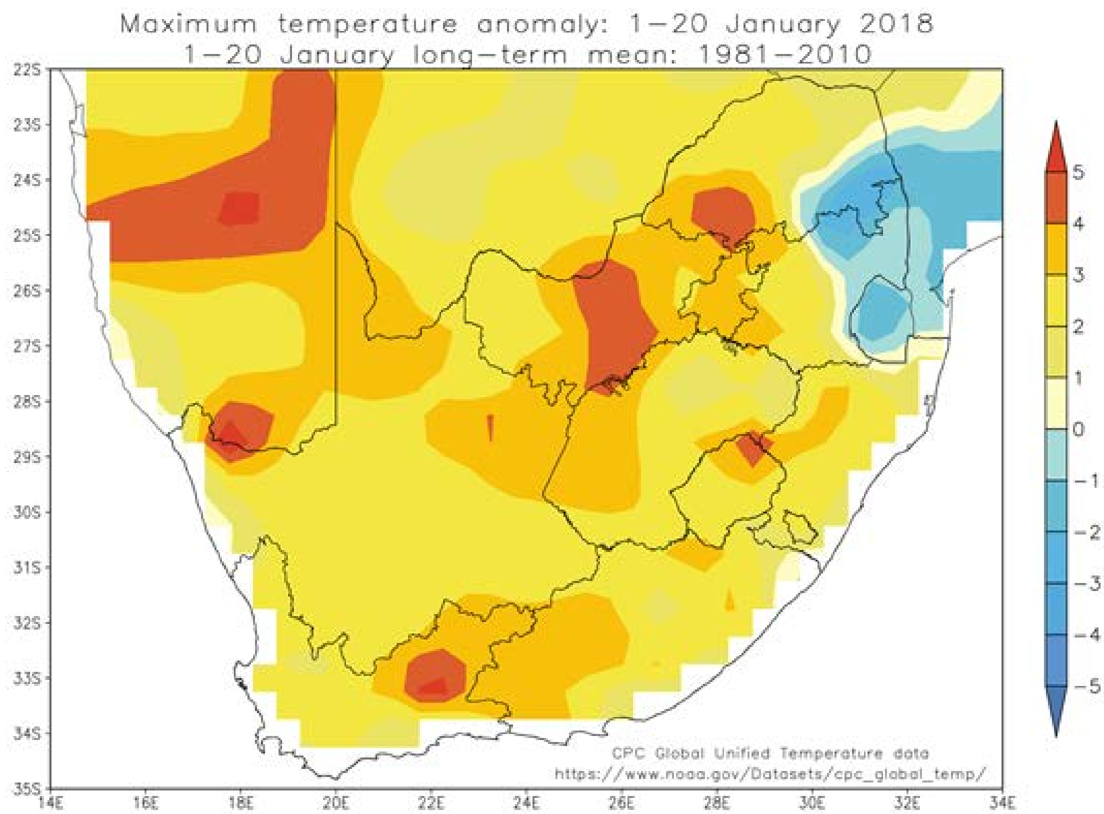
AMESD

163rd Edition

Image of the Month

A hot and dry start to 2018

December 2017 commenced with good rainfall over the eastern parts of the country as a wet spell that began at the end of November continued into the first week of December. After this wet spell, dry and anomalously warm conditions set in for the rest of December. Except for the area east of the eastern escarpment, the remainder of the country experienced warmer than normal conditions. Over parts of the maize producing regions, maximum temperatures during December were 2˚C higher than normal. The hot and dry conditions continued into January 2018. During the first week of January, heatwave conditions occurred over most of the maize producing regions. The average maximum temperature during 1-20 January 2018 was up to 4˚C higher than normal over parts of the maize producing regions (see temperature anomaly map below). During this same time, rainfall was very limited with a large number of consecutive dry days.



We apologise for the late publication of this edition of Umlindi due to technical issues beyond our control.

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:

Apart from normal to above-normal rainfall that occurred over the eastern high ground of the country, December 2017 was generally warm and dry. The month began promisingly over the summer rainfall region as the wet spell that started towards the end of November continued into the first week of December. During this time, the surface trough was well developed over the western interior and facilitated the southward movement of tropically sourced air, resulting in the development of thundershowers over large parts of the summer rainfall region. A frontal system made brief landfall on the 2nd and brought little rain to the far southwestern parts of the country, whilst the associated upper-air trough enhanced the southward flow of tropically sourced moisture and aided in the thunderstorm activity that took place over large parts of the interior. Good falls of rain occurred over the eastern interior, particularly on the 6th as a strong surface ridge that followed the frontal system caused a further influx of low-level moisture. Large areas over North West, western Limpopo and the northwestern Free State received up to 60% of the December rainfall during this period.

The second 10-day period of December was characterized by diminished convective activity over most of the interior with rainfall mostly confined to the east of the eastern escarpment. A frontal system made landfall on the 13th and brushed along the coastal areas as it moved eastwards. By the 15th, a relatively strong high pressure system ridged in over the eastern parts of the country and fostered a more pronounced surface trough over the western interior that resulted in northwest-to-southeast aligned convective activity over the central interior that had a weak link with another frontal system that passed to the south of the country. Over the next few days, atmospheric conditions suppressed rainfall activity over most of the northeastern parts, in particular over the western maize producing regions where it was also very hot.

Relative to mid-December, increased rainfall activity occurred during the last 10 days of the month. Tropical circulation to the north of South Africa resulted in rainfall over the far northeastern parts of Limpopo around the 23rd. This area received most of its December rainfall (up to 60%) during this event. The last week of the month was introduced with a frontal system that made landfall and moved along the Cape south coast on the 25th, with a surface ridge in its wake that ridged in over the northeastern parts of the country by the 27th. The last few days of December were characterized by the development of thundershowers over the eastern areas, whilst 2017 concluded with a frontal system that reached the Cape.

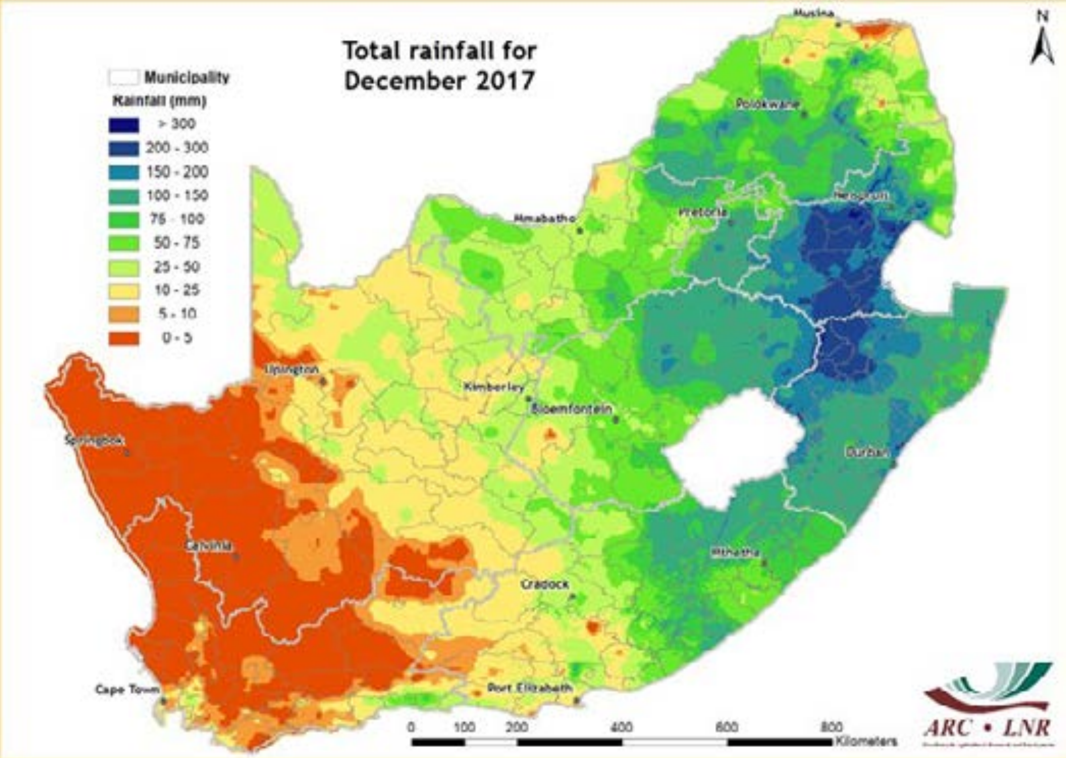


Figure 1

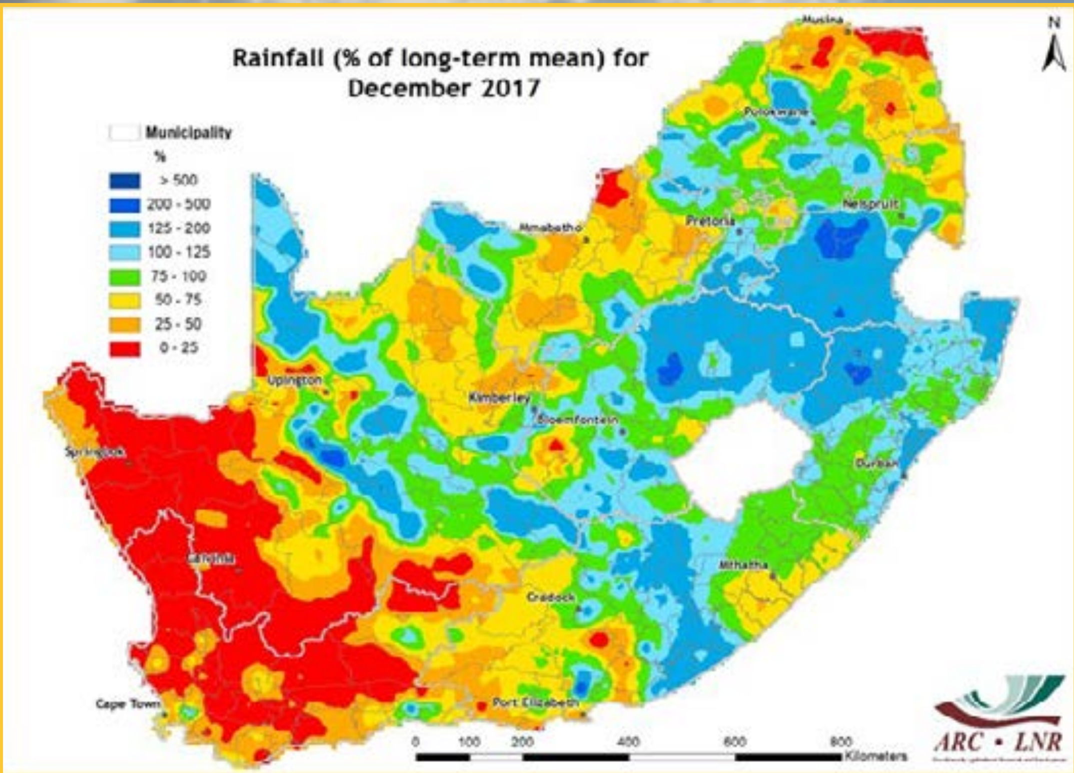
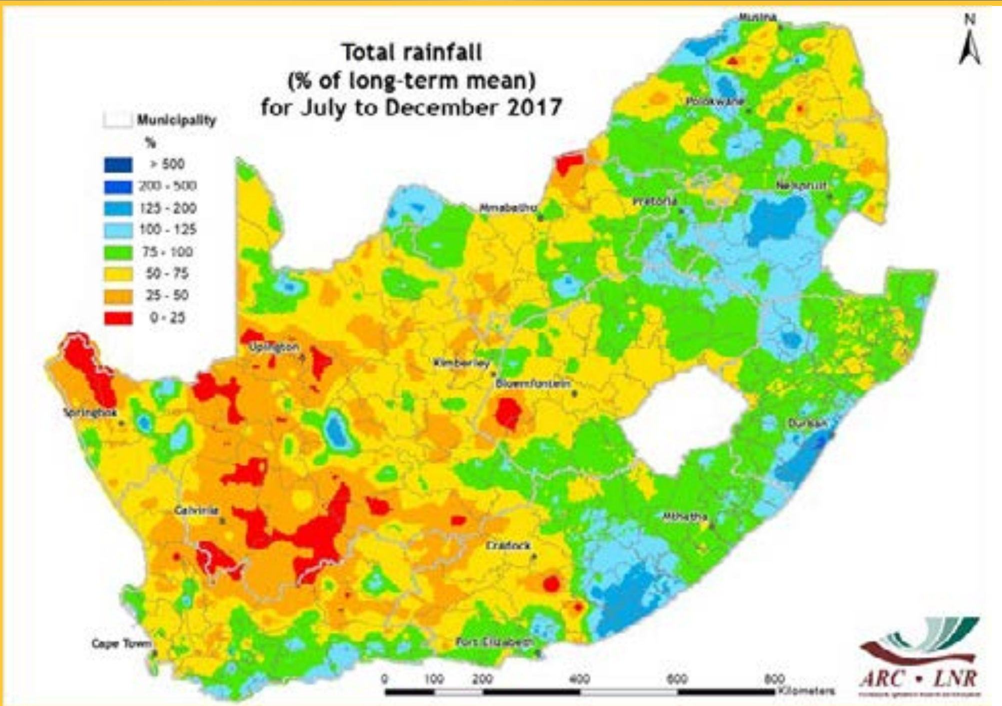


Figure 2



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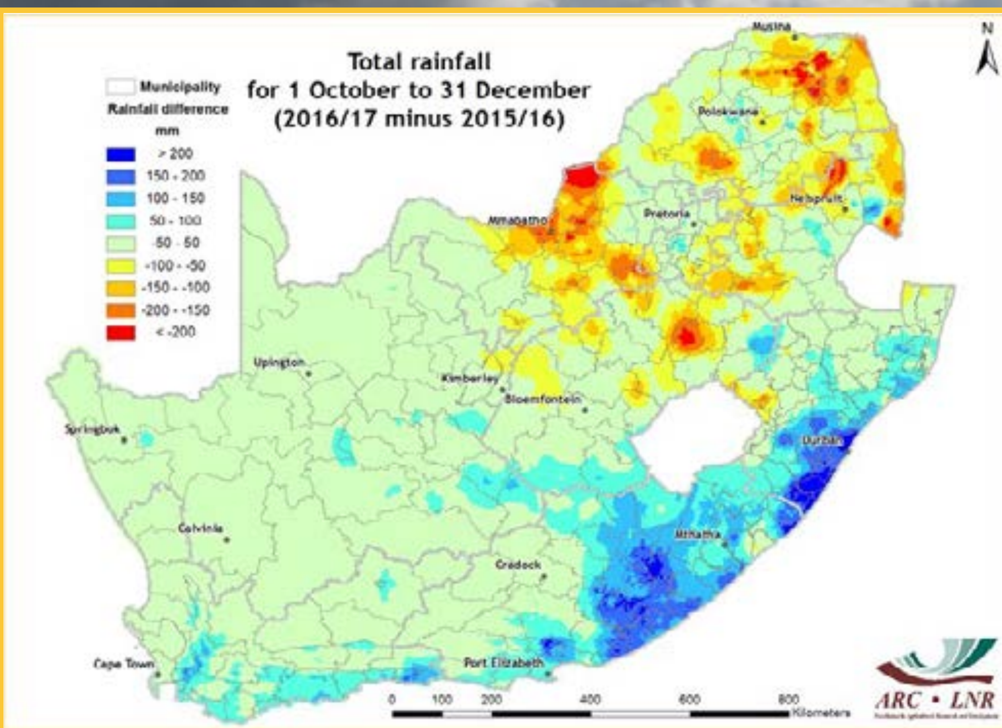

Figure 4

Figure 1:
In the absence of strong synoptic weather systems, rainfall during December 2017 over the summer rainfall region was mostly concentrated over the eastern higher ground where thunderstorms developed on most days. Over these areas, rainfall totals exceeding 200 mm occurred.

Figure 2:
Normal to above-normal rainfall occurred over the eastern interior of the country as well as over isolated areas over the central to southeastern interior. Over the latter areas, rainfall was very patchy in nature – an indication of the absence of good rain producing synoptic systems during the month of December.

Figure 3:
During the latter half of 2017, normal to slightly above-normal rainfall occurred along the Cape south coast and adjacent interior. It may be noted that this rainfall fell mostly during spring. Over the summer rainfall region, the eastern parts received normal to above-normal rainfall.

Figure 4:
October to December 2017 was wetter than the corresponding period last year along the Cape south coast, extending to the east coast and its adjacent interior where some places received 200 mm more rain during this 3-month period in 2017 compared to 2016. In contrast, isolated areas over a large part of eastern and northeastern South Africa received 100-200 mm less rain during October to December 2017 compared to the corresponding 2016 period.

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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 most time scales, severe to extreme drought conditions are present over most of the winter rainfall region, with some relief on the 6-month time scale compared to the 12-month time scale. Over the eastern parts of the country, severe to extreme drought conditions improve from the 26-month to 12-month time scales, whilst severe drought conditions are visible at the short time scale over parts of the southern and central interior. It is worth noting that isolated areas over the northeastern parts experienced a worsening of drought conditions at the short time scale.

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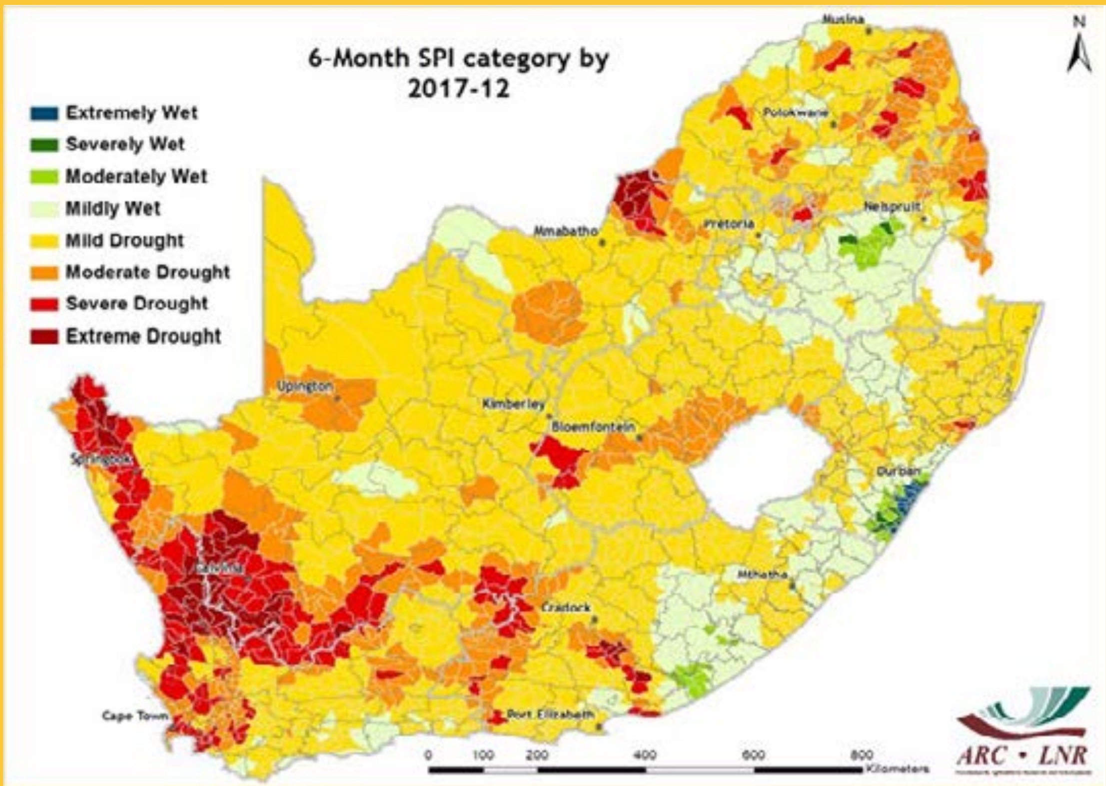
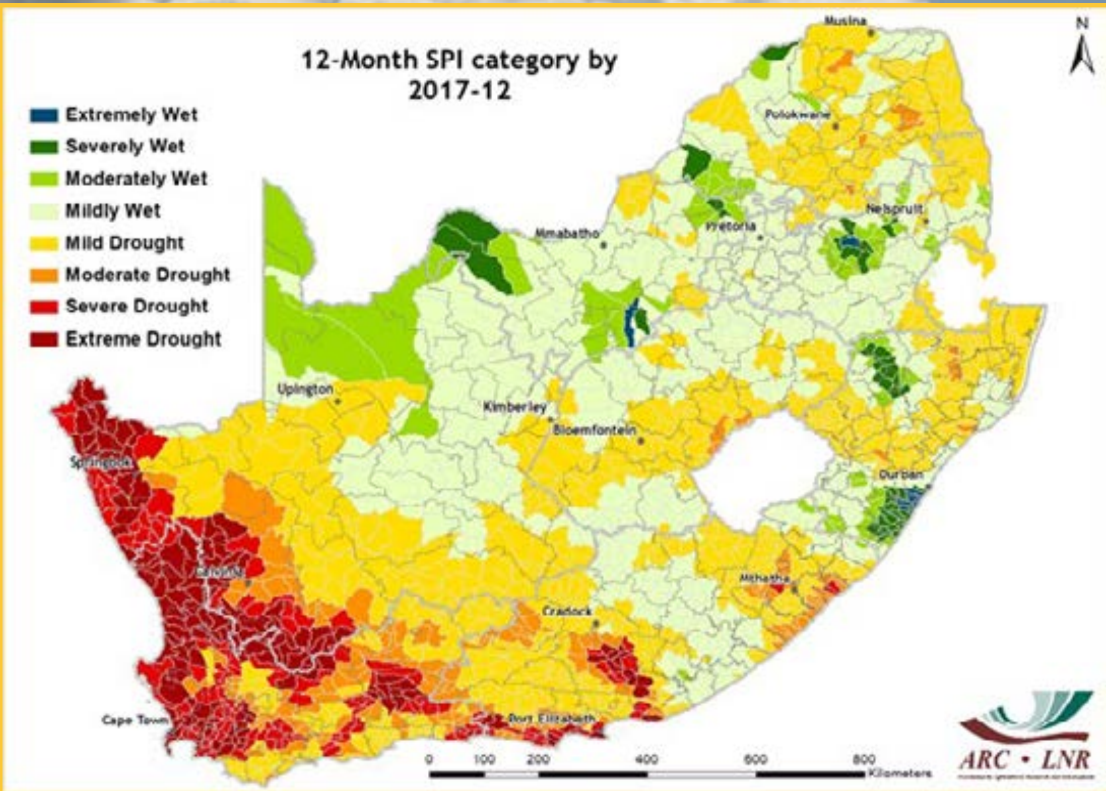


Figure 5



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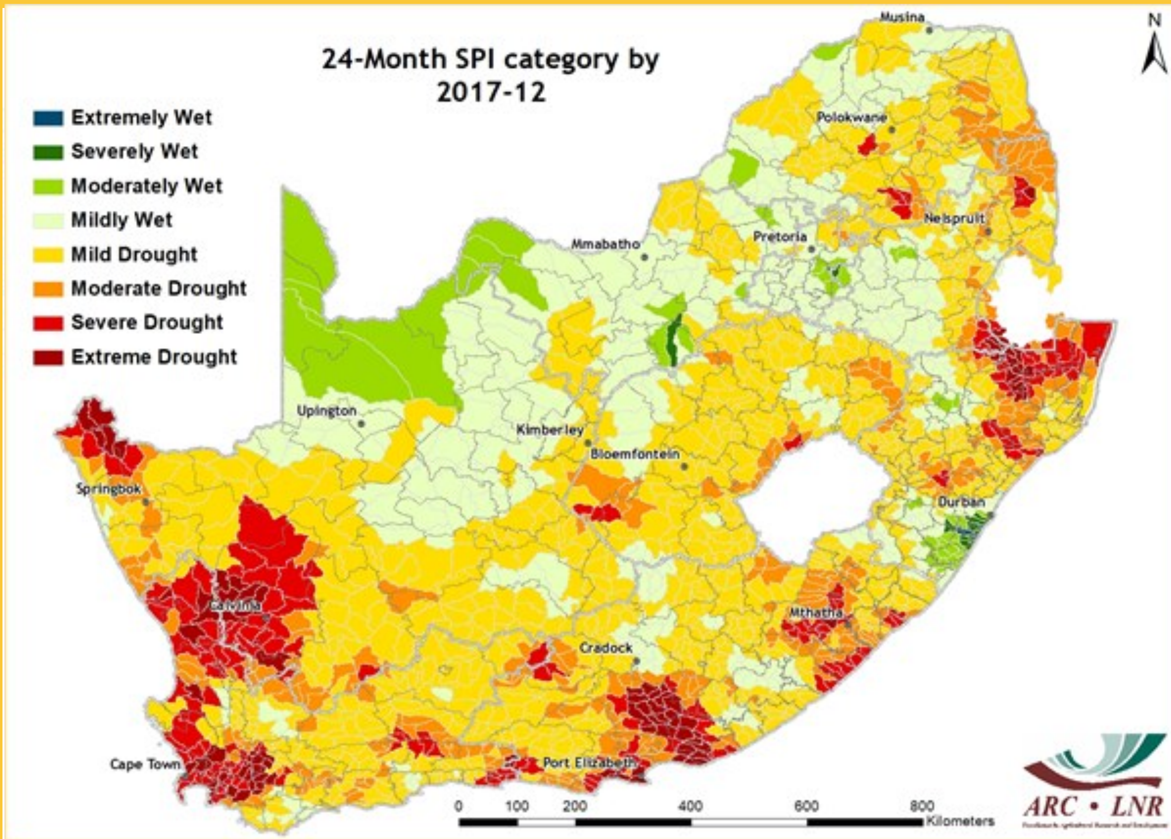

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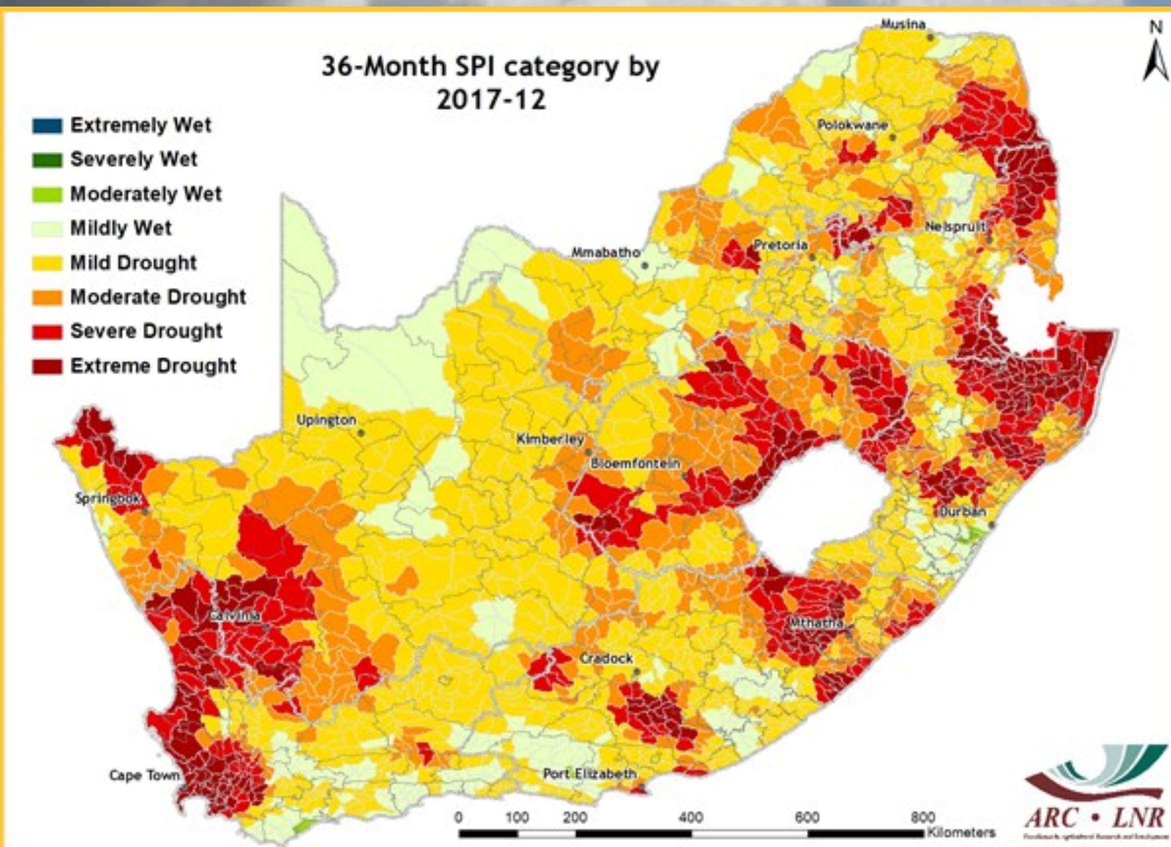

Figure 8

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.

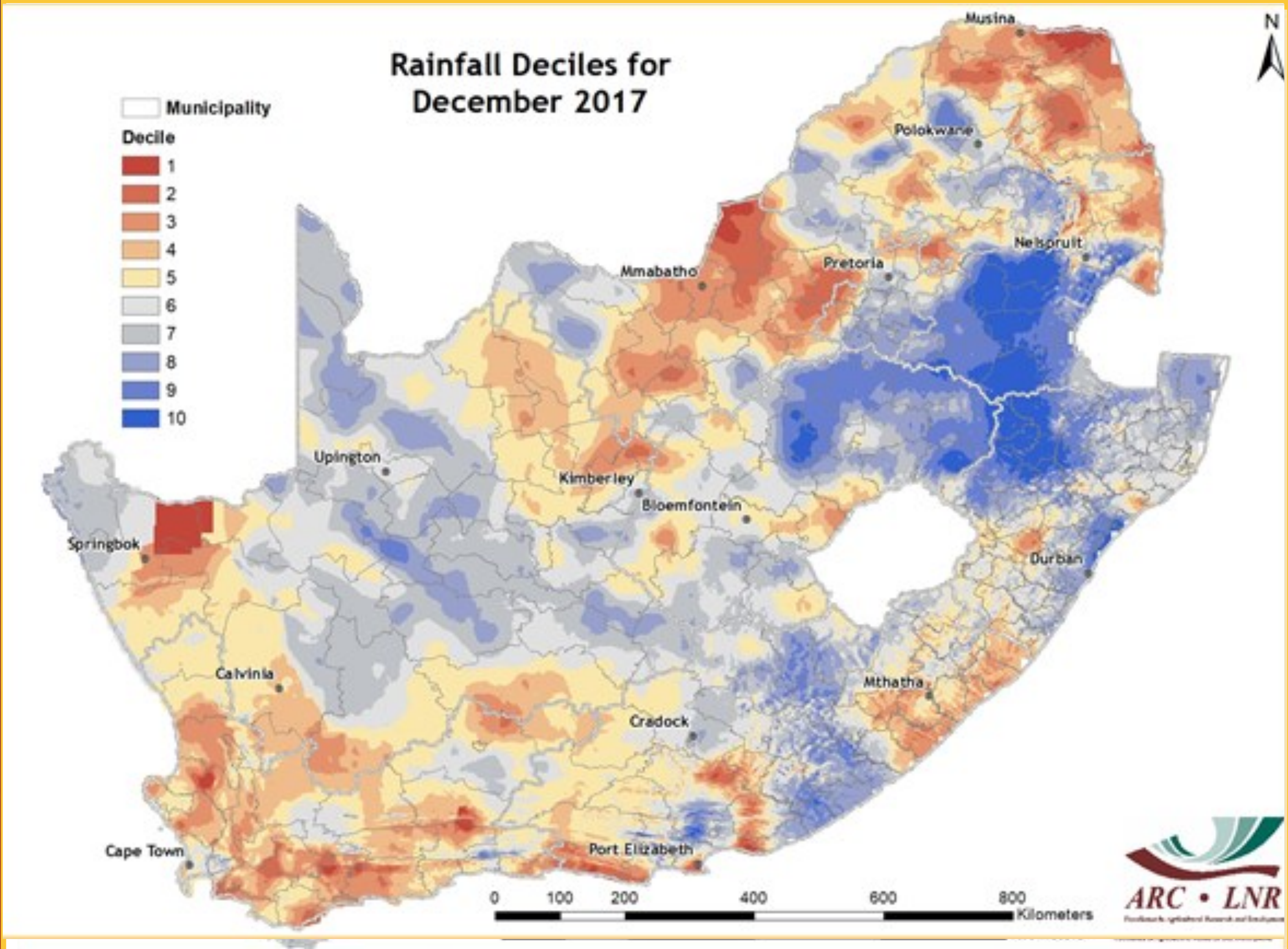

Figure 9

Figure 9:
Compared to historical rainfall totals during the month of December, December 2017 over the eastern high ground compared well to the wetter December months. Parts of the western maize producing region as well as most areas over the southwestern parts of the country compared well with drier December months.

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4. Water Balance

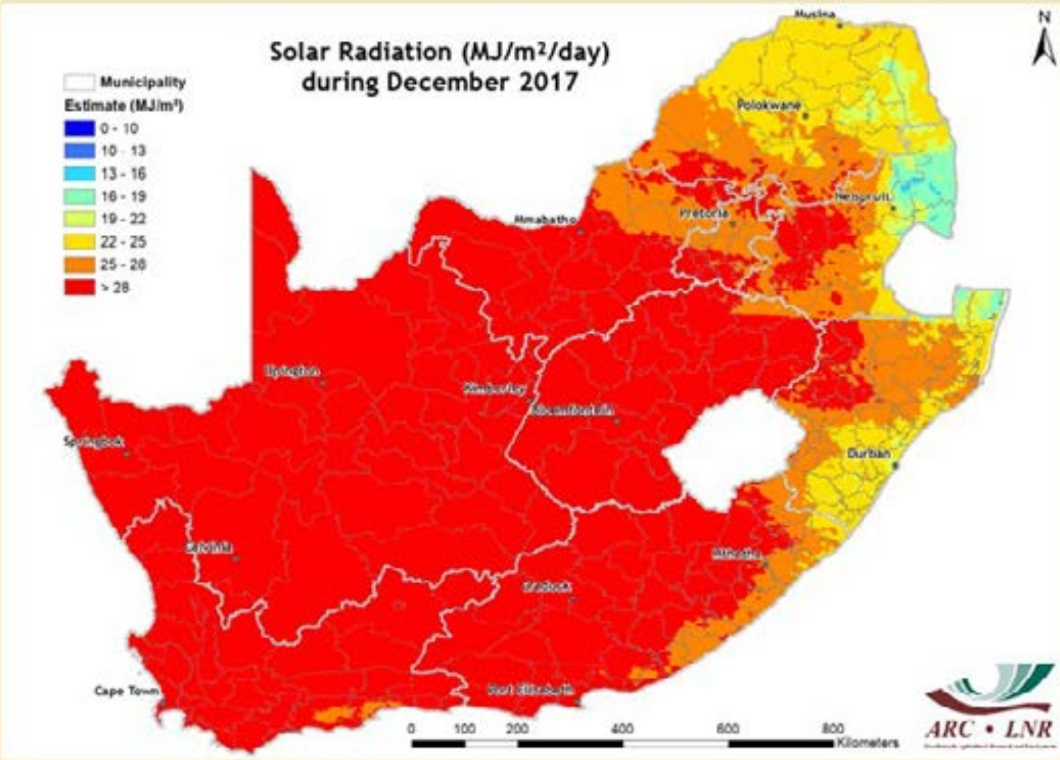

Figure 10

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 spatial pattern of the solar radiation during December 2017 is quite similar to that of November. The lowest solar radiation values occurred east of the eastern escarpment. Increasing solar radiation values occurred from east to west over the eastern parts of the country.

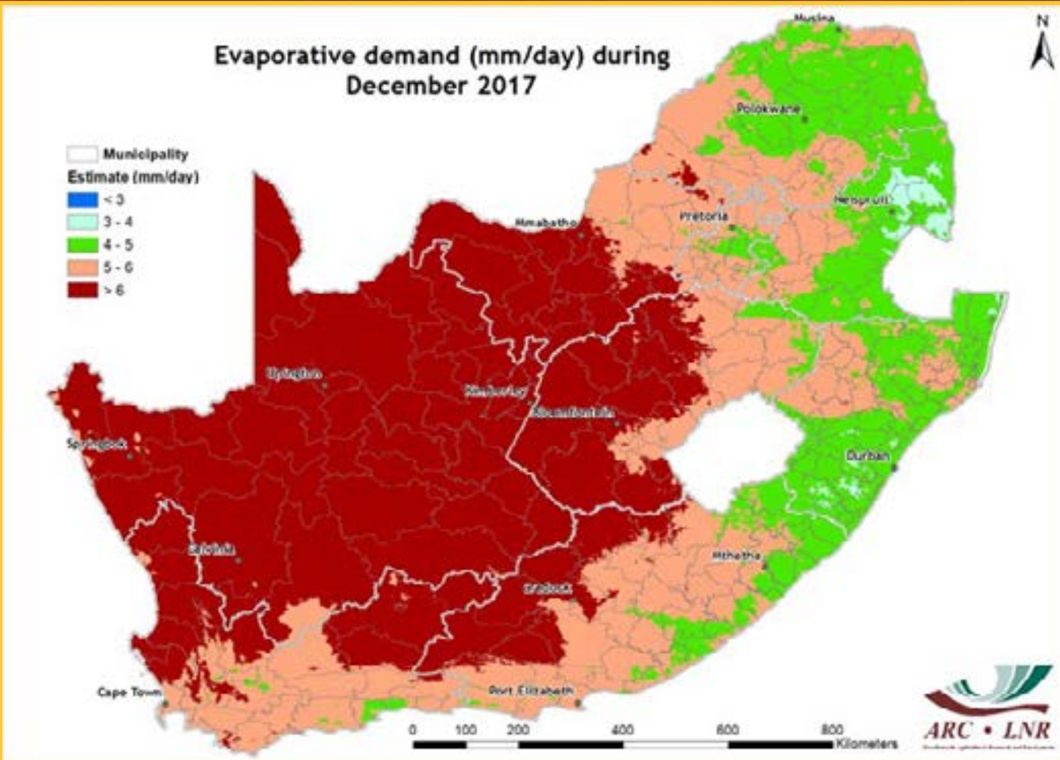

Figure 11

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 the lowest east of the eastern escarpment. Compared to November 2017, an increased evaporative demand occurred over the southern coastal belt of the country during December.

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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.

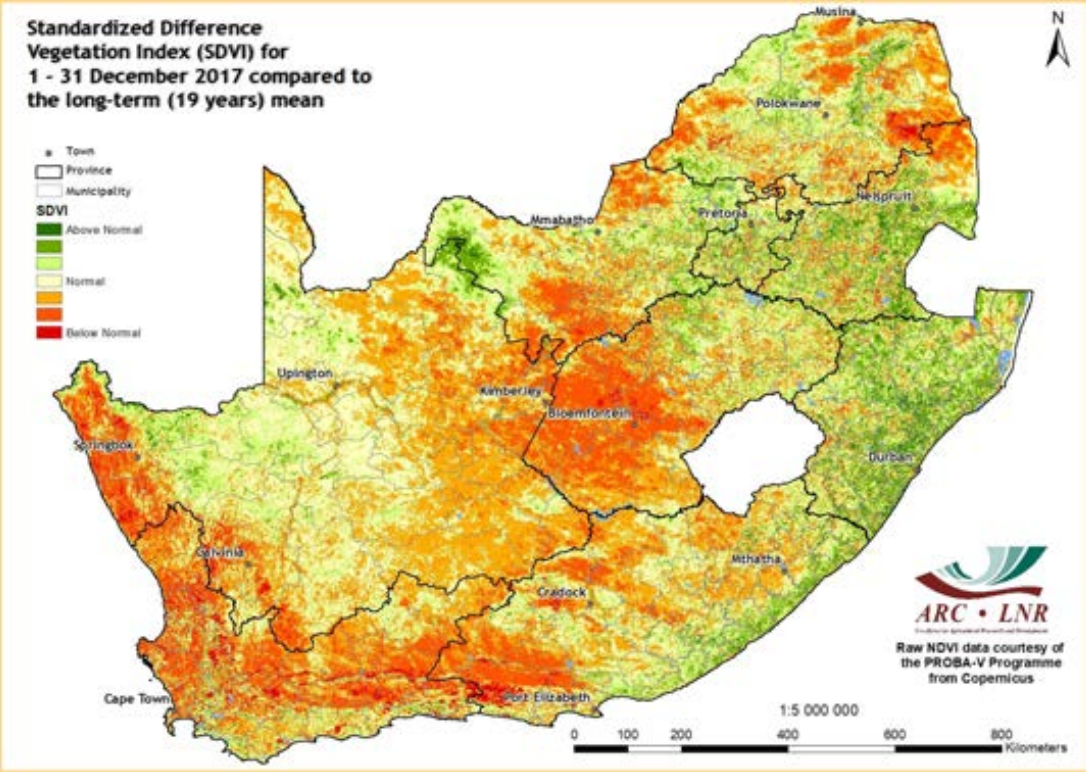


Figure 12

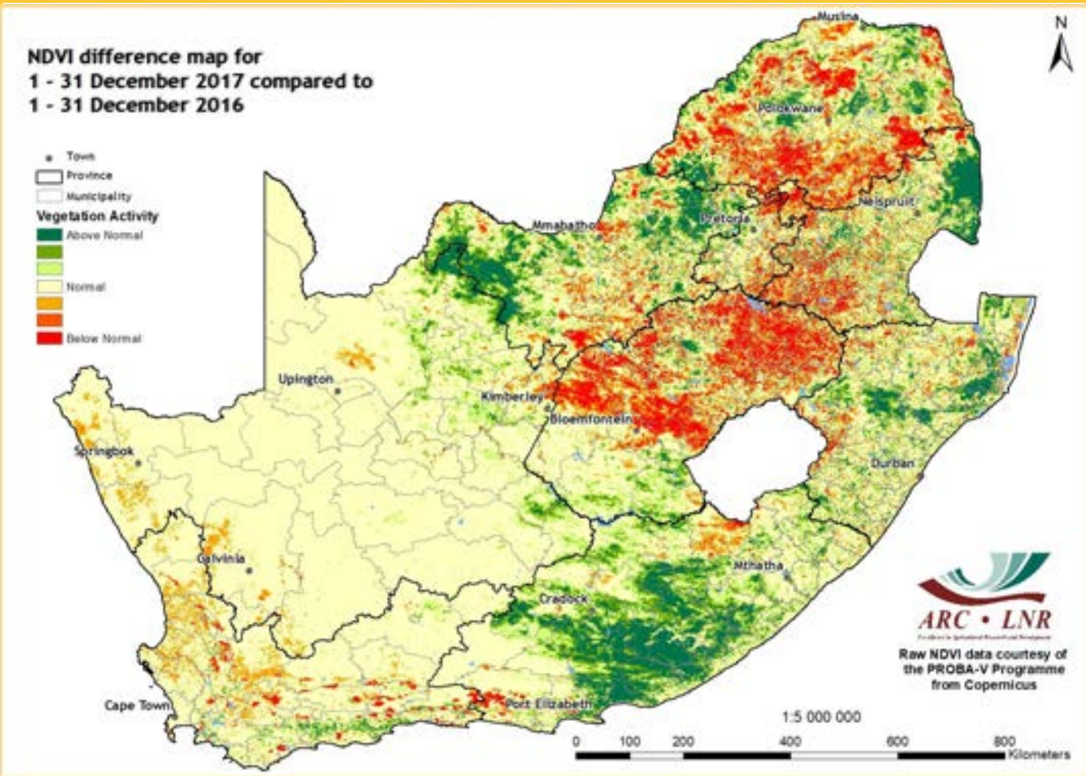
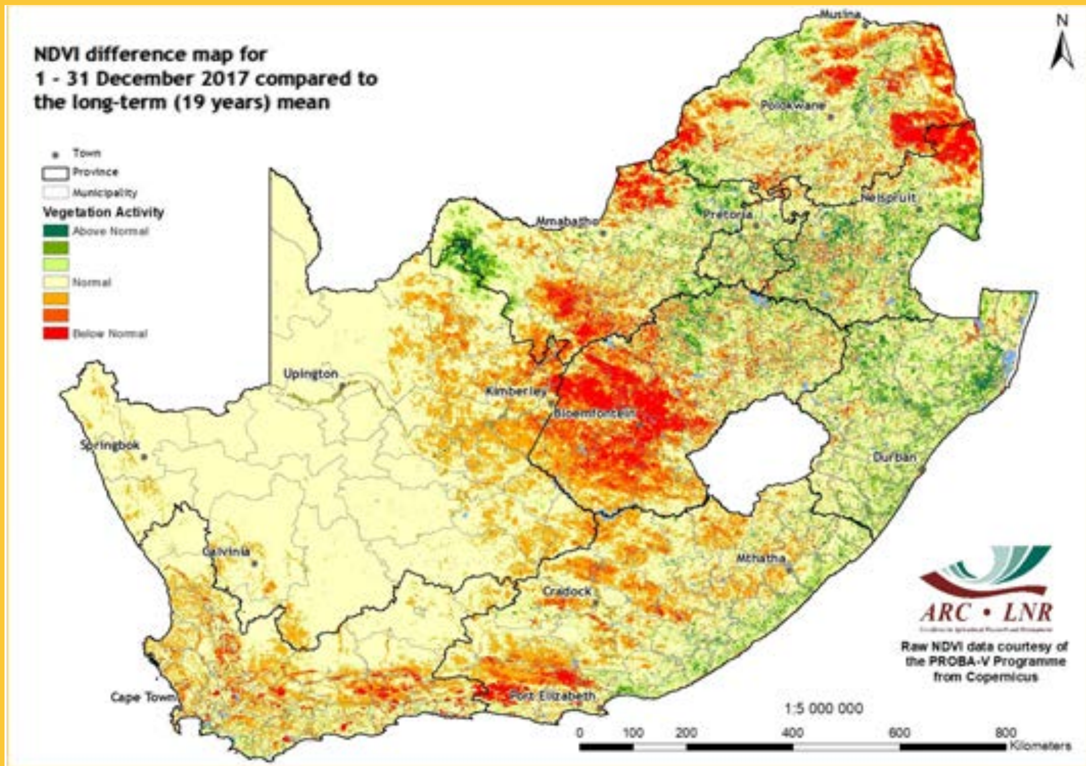


Figure 13

Figure 12:
The SDVI map for December indicates above-normal vegetation activity over most of KwaZulu-Natal, Mpumalanga, Gauteng and isolated areas of Limpopo, North West, Free State and Northern Cape. Extremely dry conditions can be observed over the Western Cape and Free State. Isolated areas of the Northern Cape, North West, Eastern Cape and Limpopo also experienced dry conditions.

Figure 13:
Most parts of the Eastern Cape and isolated areas in North West, Mpumalanga, Limpopo and KZN experienced above-normal vegetation activity. Meanwhile, dry conditions hit most of the Free State, Limpopo and some areas of Mpumalanga and Gauteng. Most of the Northern Cape and isolated areas in Western Cape had normal vegetation activity.



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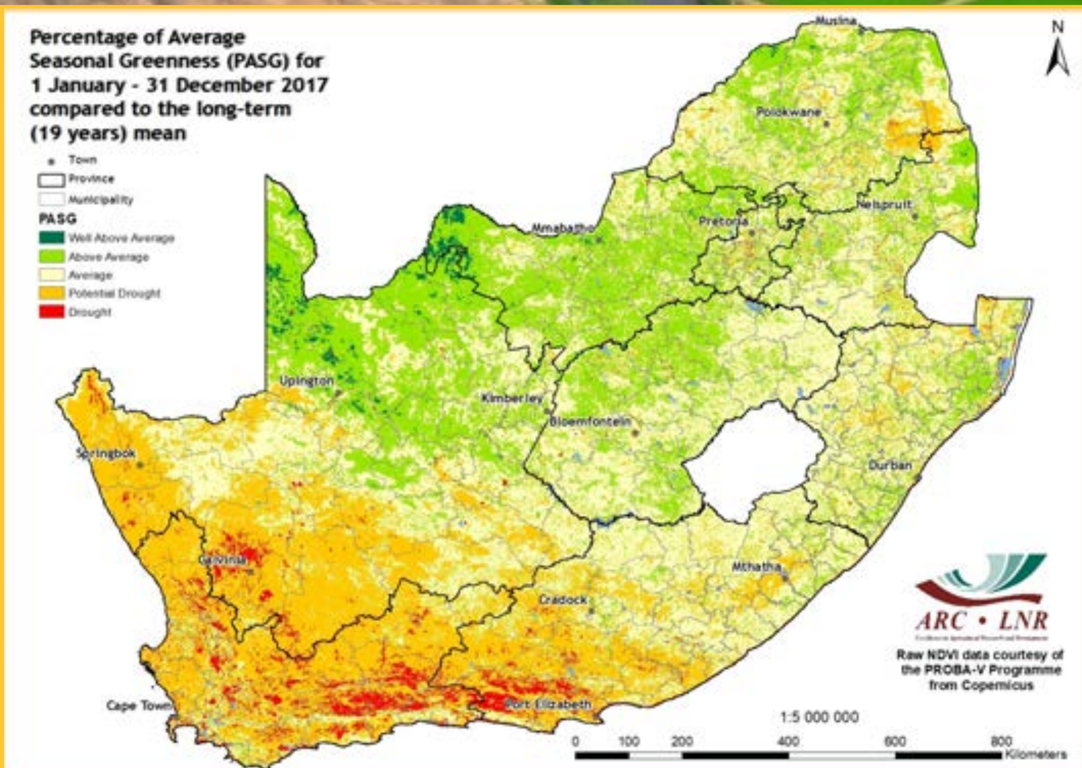

Figure 15

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 14:
Much of the Free State and some distinct areas of Limpopo, North West and Eastern Cape experienced low vegetation activity during December.

Figure 15:
The PASG map for December indicates that above-average vegetation activity occurred over much of North West, northern parts of the Northern Cape, as well as some isolated areas in Free State, Mpumalanga, Limpopo and Gauteng. Dry spells hit isolated areas in the Western Cape and southern parts of Northern and Eastern Cape.

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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.

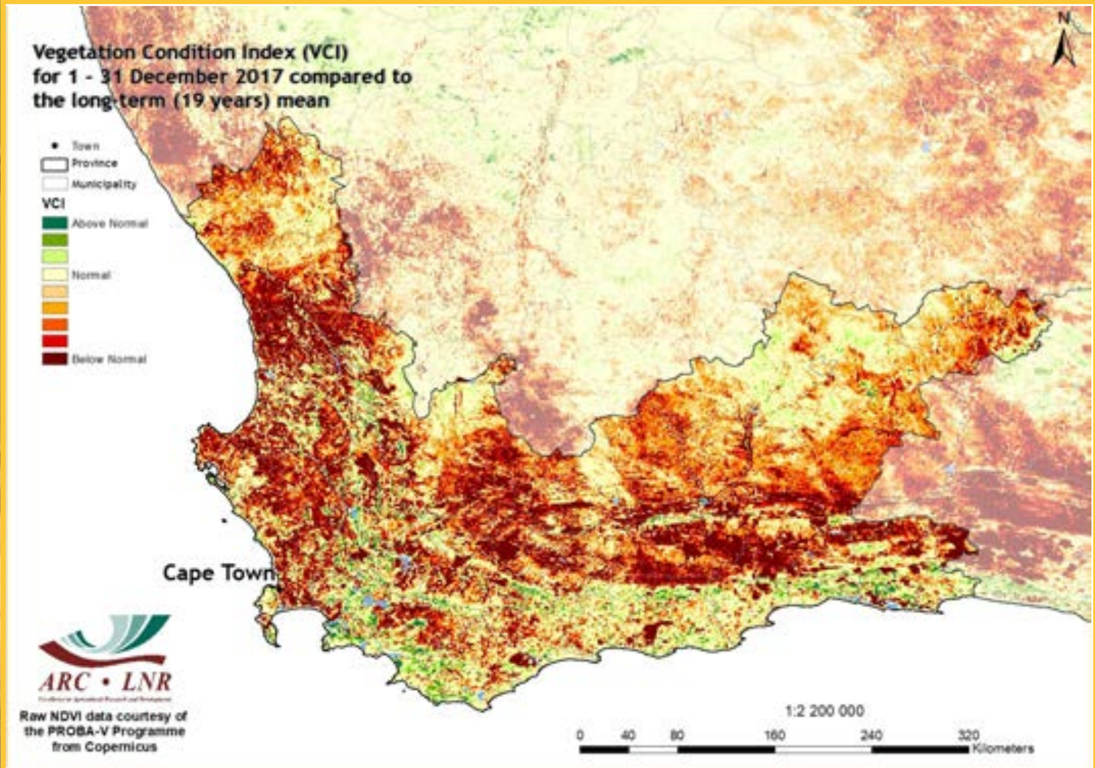


Figure 16

Figure 16:
The VCI map for December indicates that dry conditions were still present over much of the Western Cape.

Figure 17:
The VCI map for December indicates below-normal vegetation activity over much of the Free State, especially in the southwest.

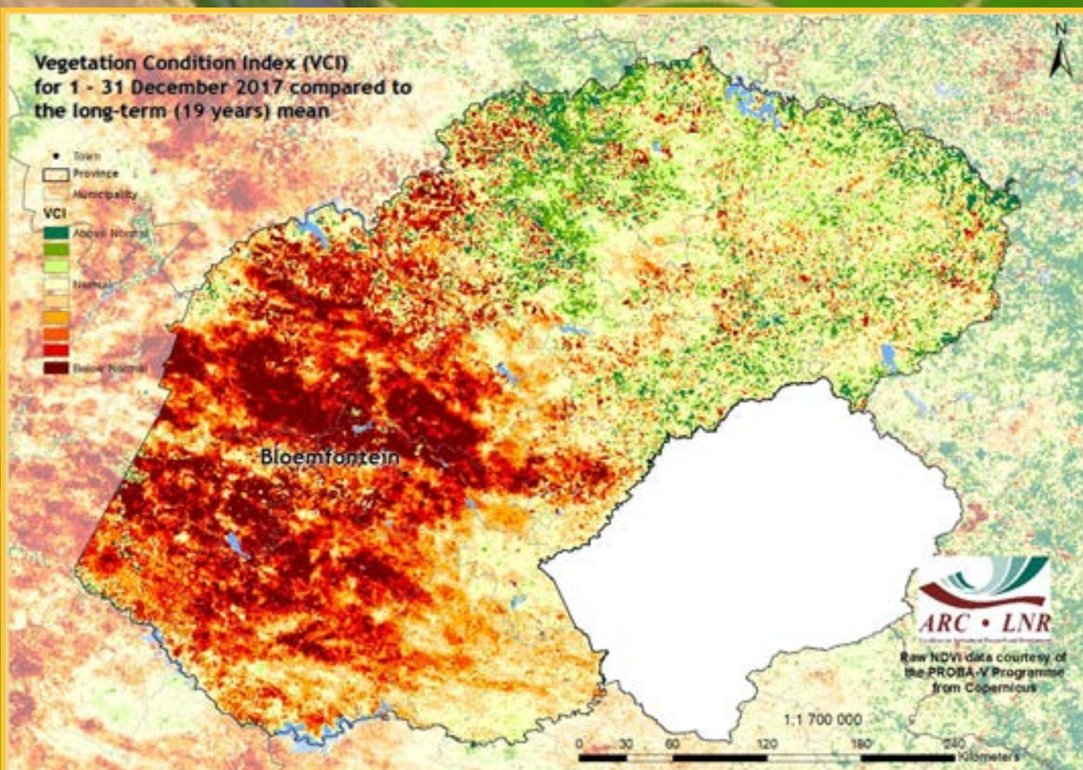
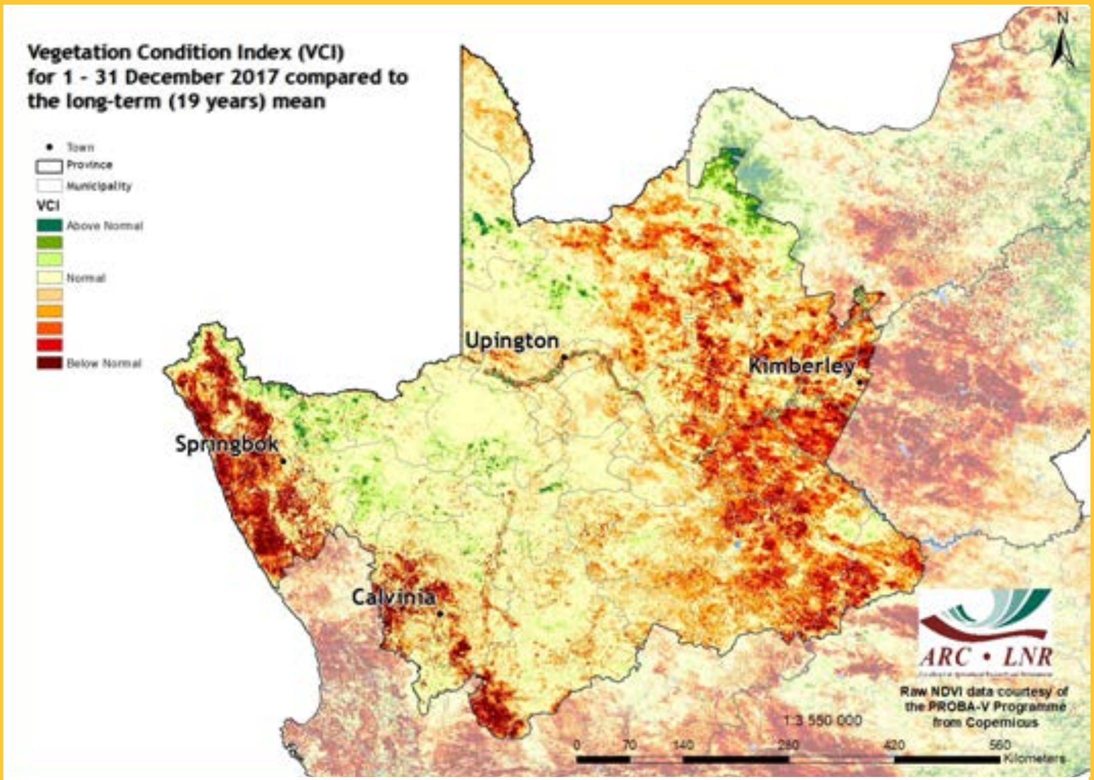


Figure 17



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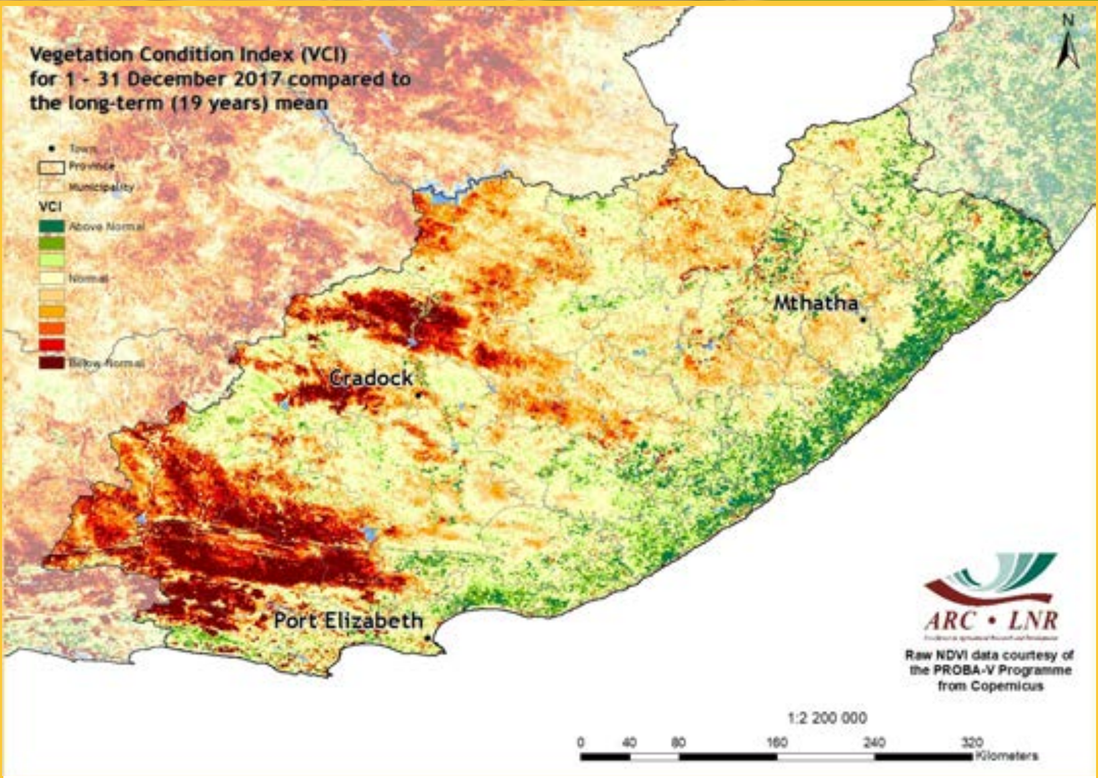

Figure 19

Figure 18:
The VCI map for December indicates low vegetation activity in the western, eastern and southwestern parts of the Northern Cape.

Figure 19:
The VCI map for December indicates below-normal vegetation activity over the southwestern and northwestern parts of the Eastern Cape province.

Questions/Comments:
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7. Vegetation Conditions & Rainfall

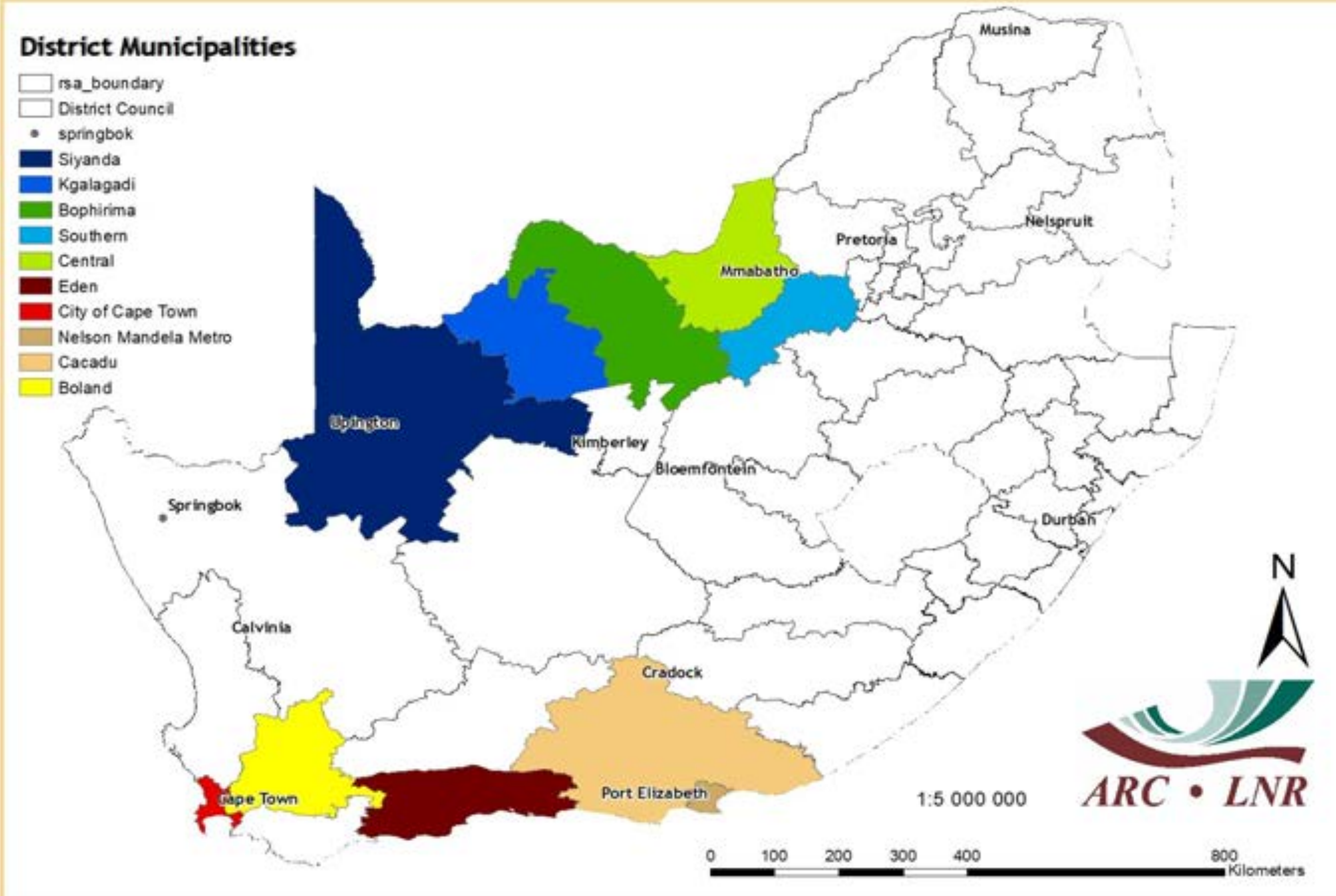

Figure 20

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

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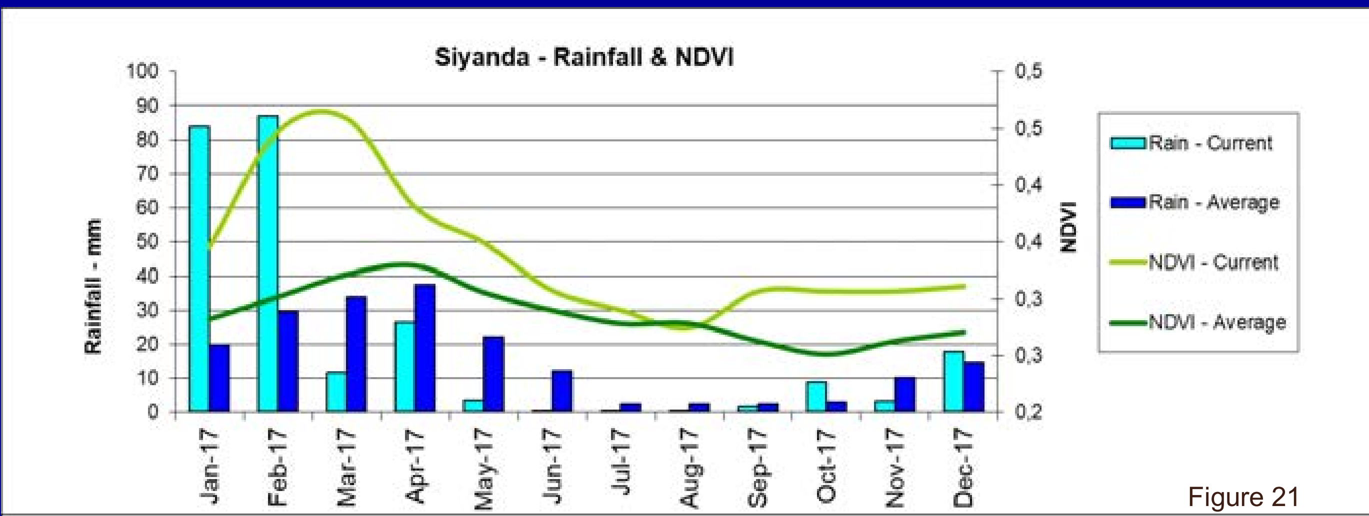
Figures 21-25:
Indicate areas with higher cumulative vegetation activity for the last year.

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



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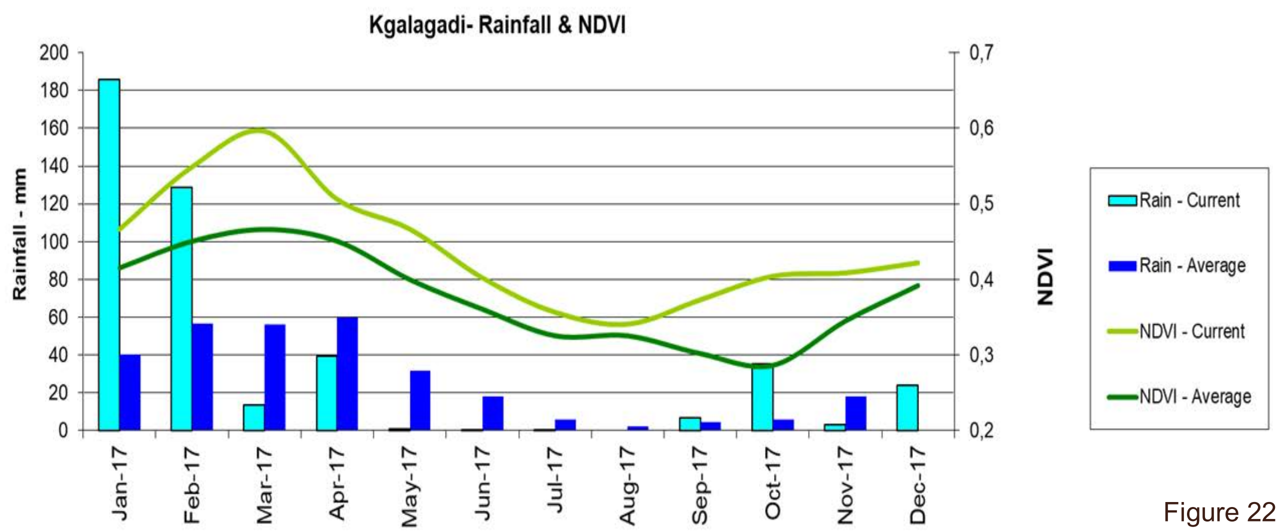

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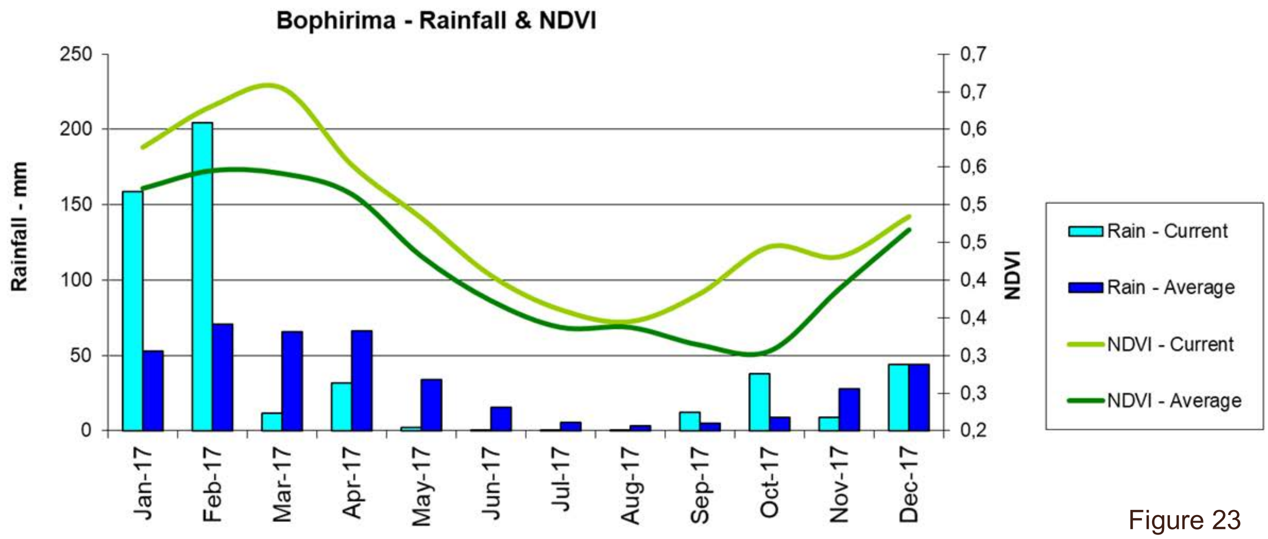

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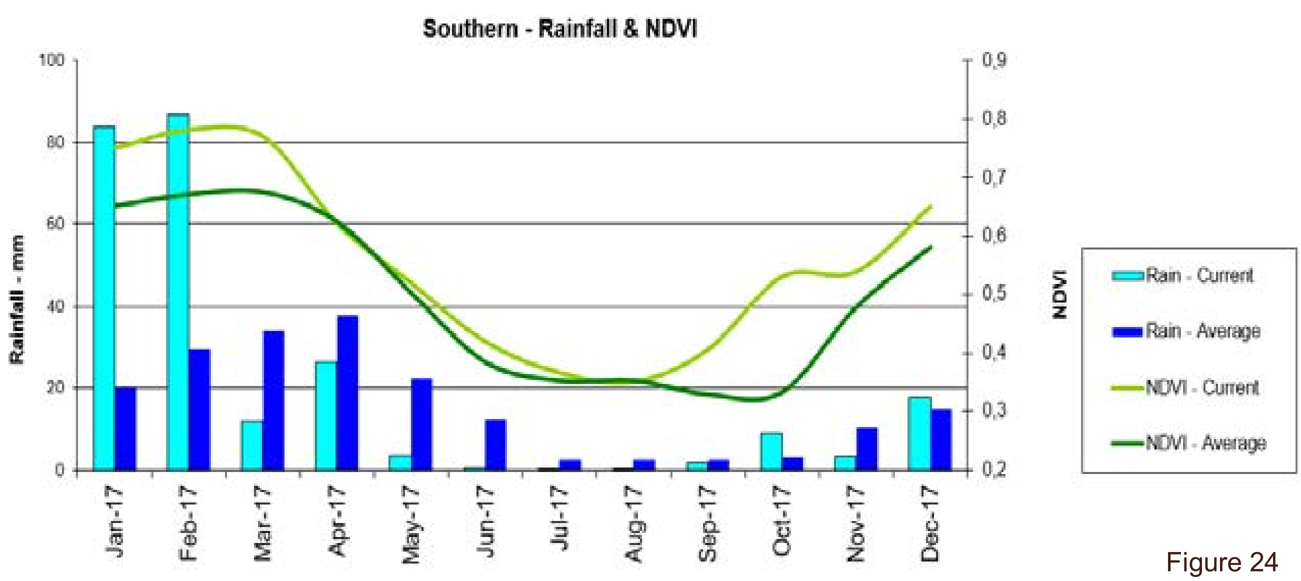

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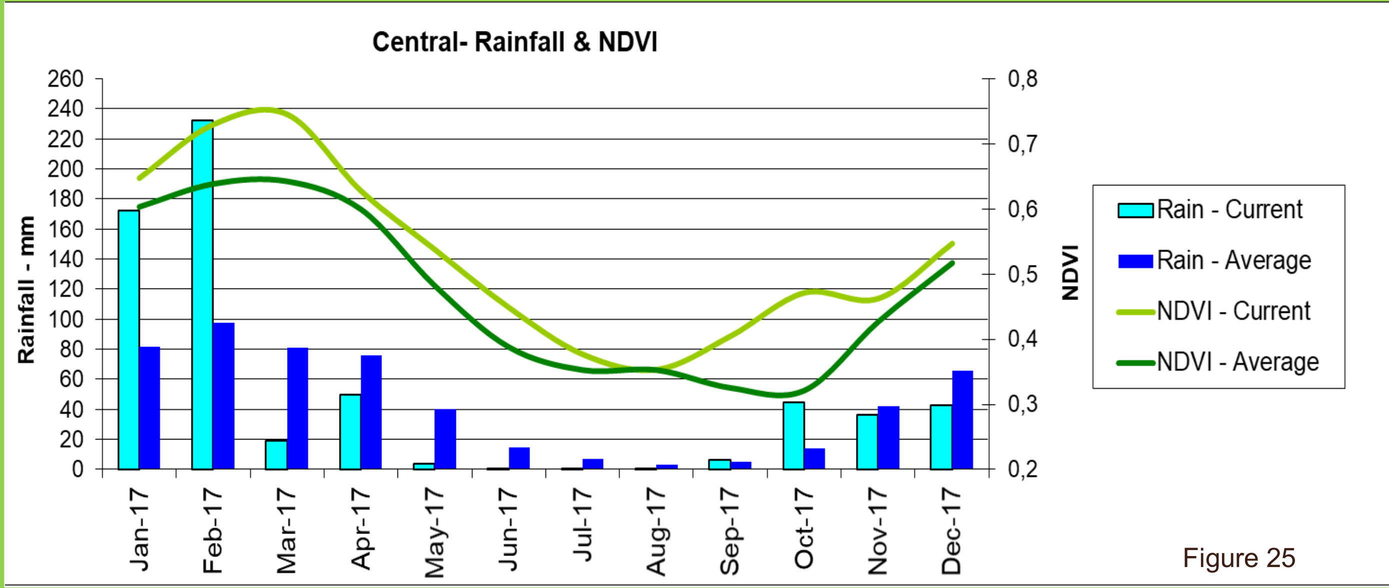

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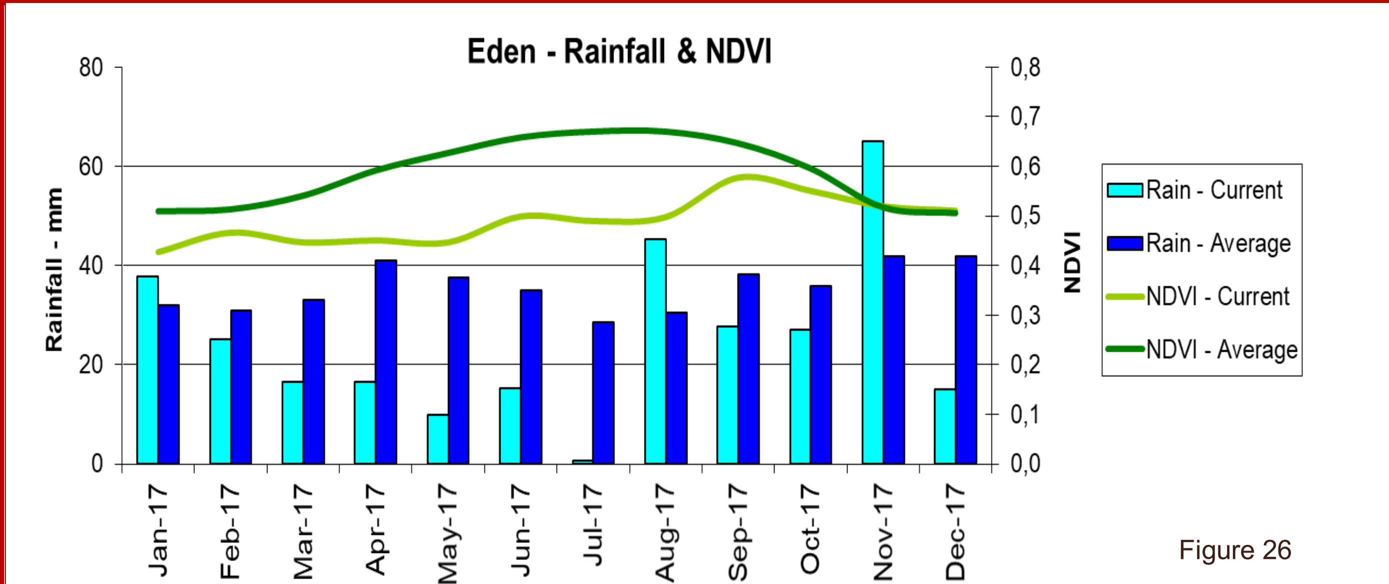

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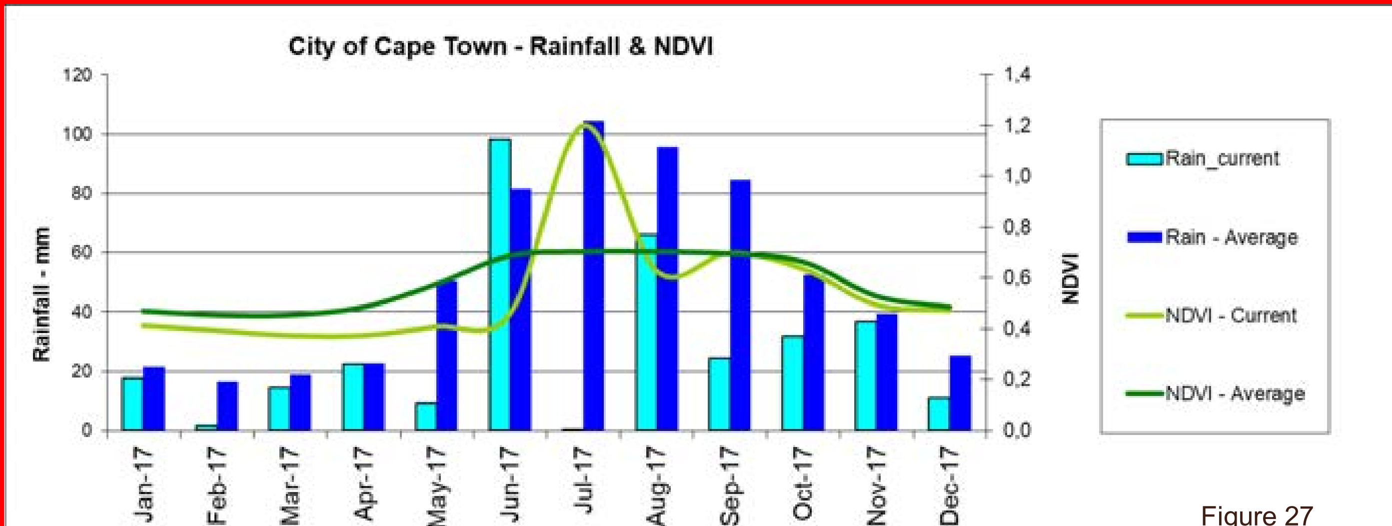

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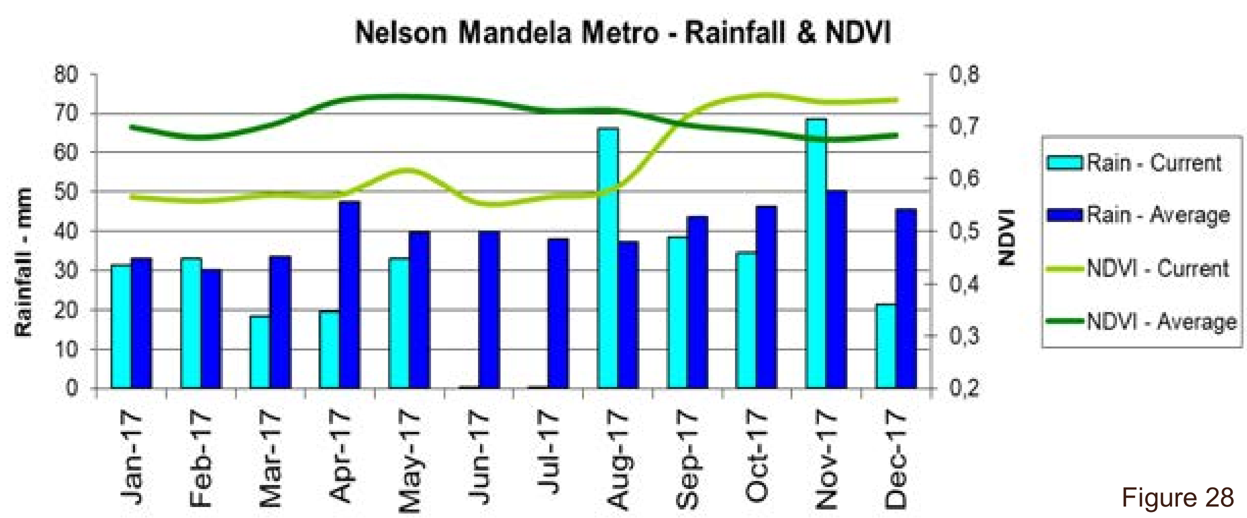

Figure 28

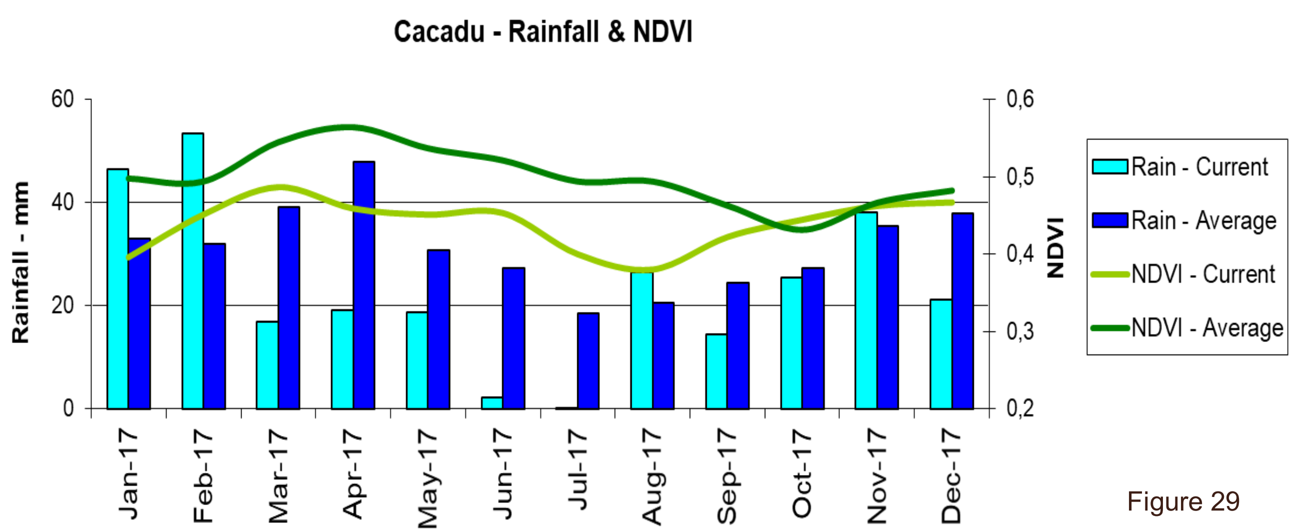

Figure 29

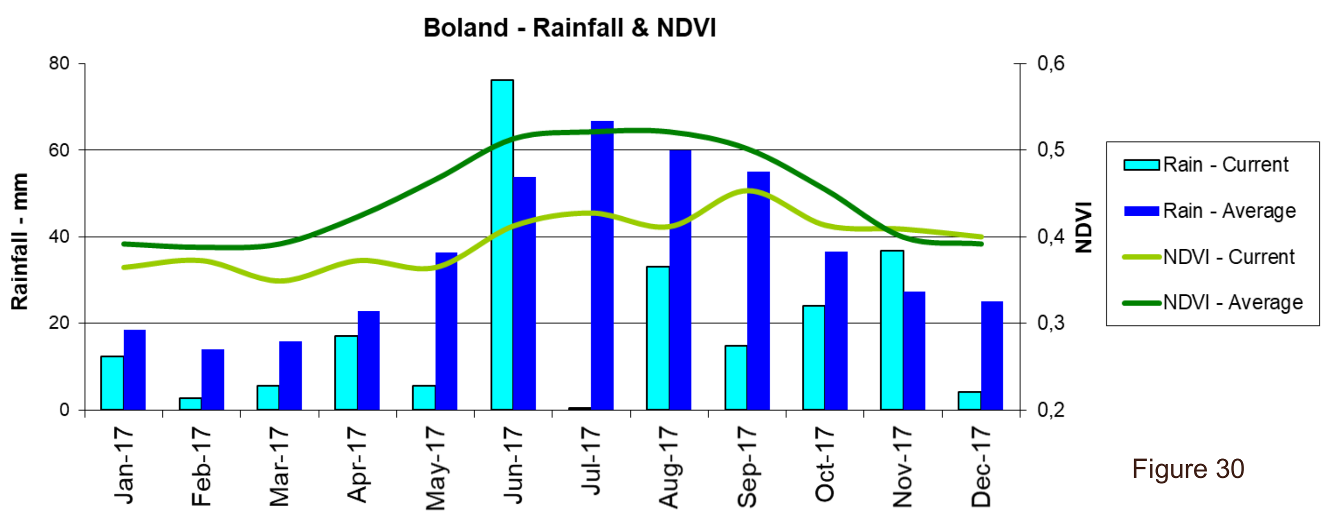

Figure 30

8. Fire Watch

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 December per province. Fire activity was higher in the Northern and Western Cape compared to the average during the same period for the last 17 years.

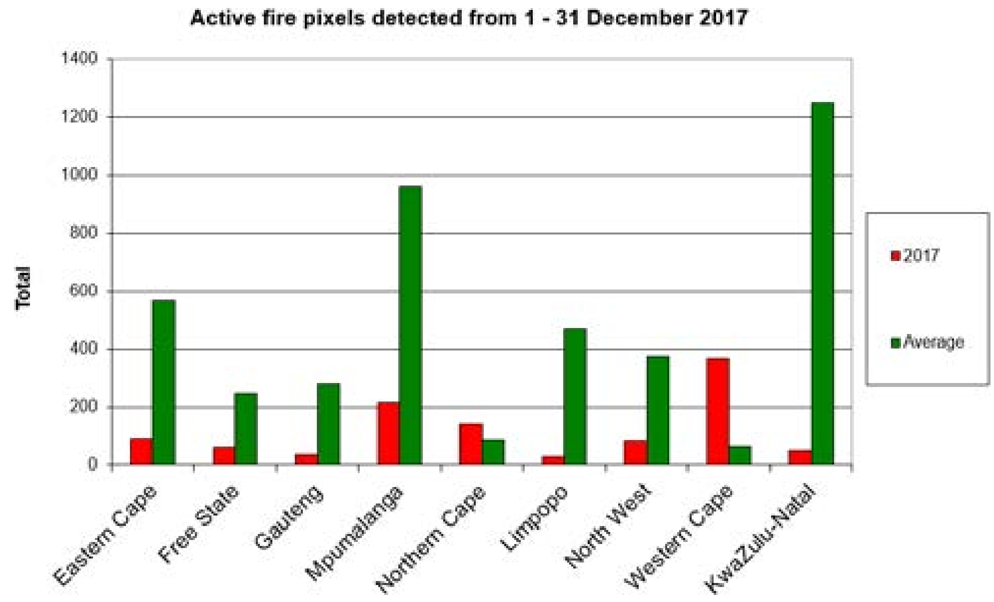

Figure 31

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

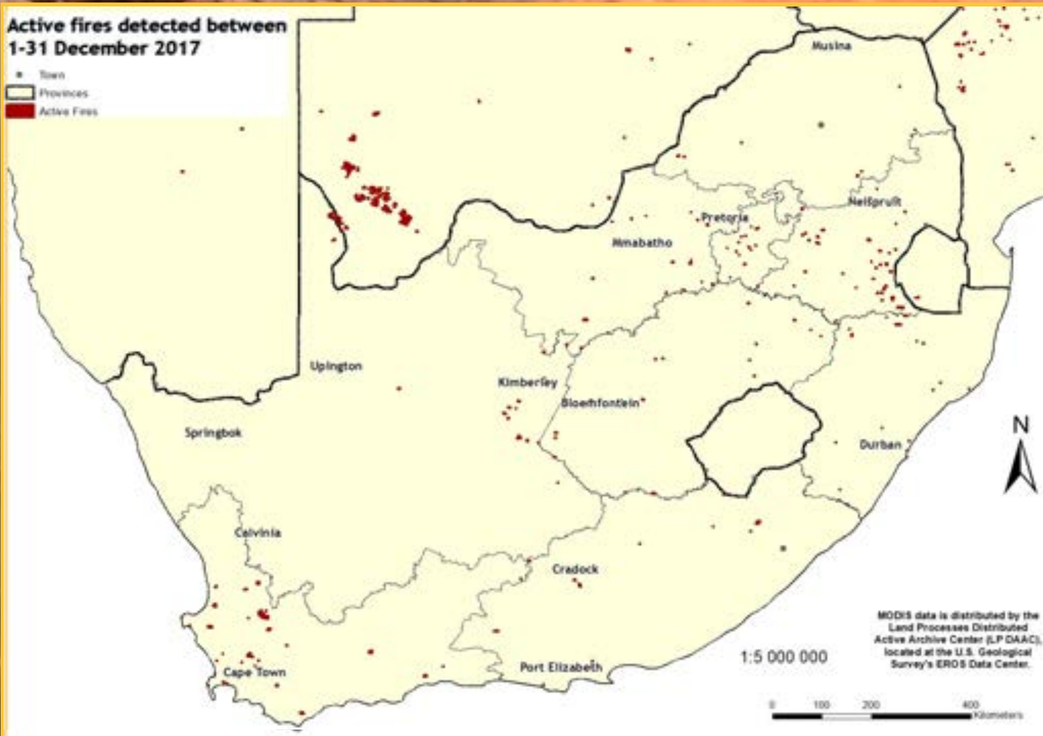

Figure 32

PAGE 17

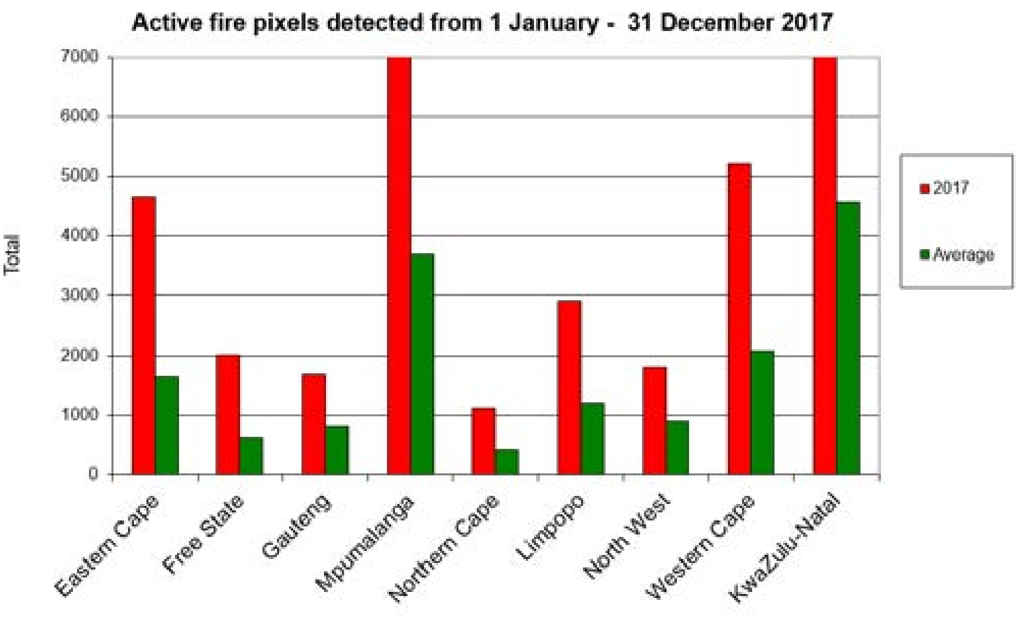

Figure 33

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

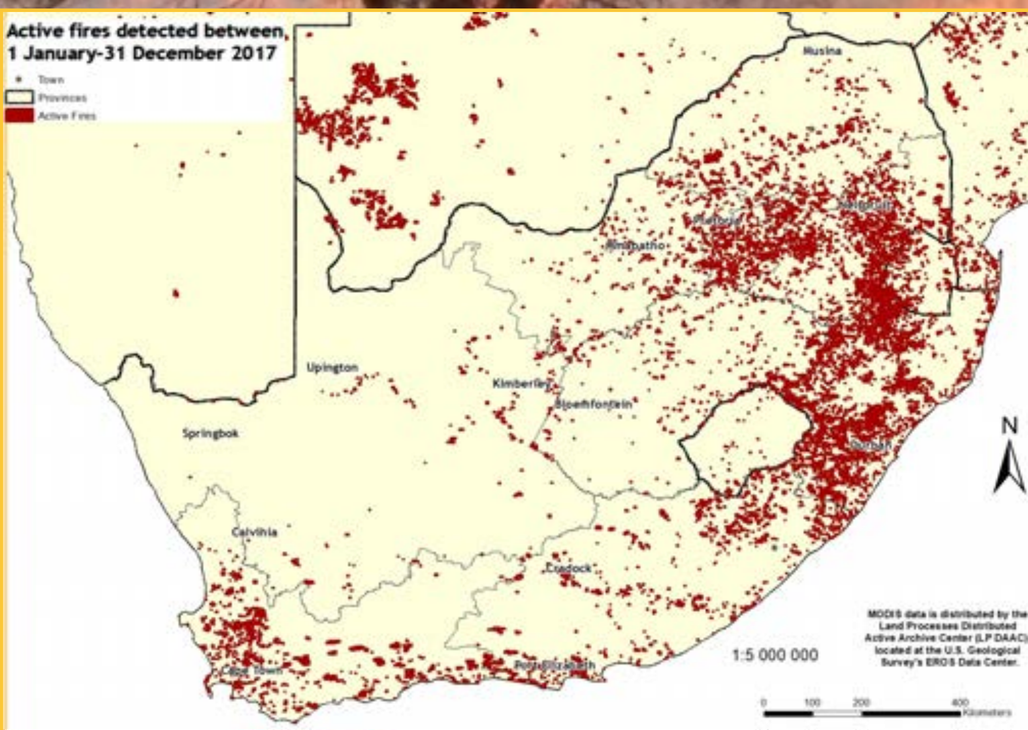

Figure 34

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

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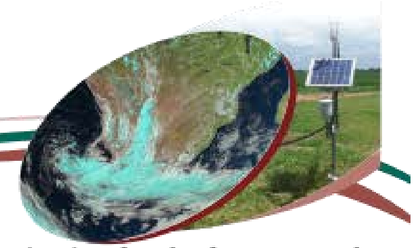
Agrometeorology



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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

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

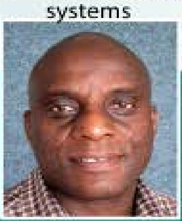
- Spatially explicit information dissemination systems, e.g. Umlindi newsletter
- Crop and land suitability modelling/assessments
- Disease and pest outbreaks and distribution modelling
- Precision agriculture information systems

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



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

http://www.agis.agric.za

Disclaimer:
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