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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

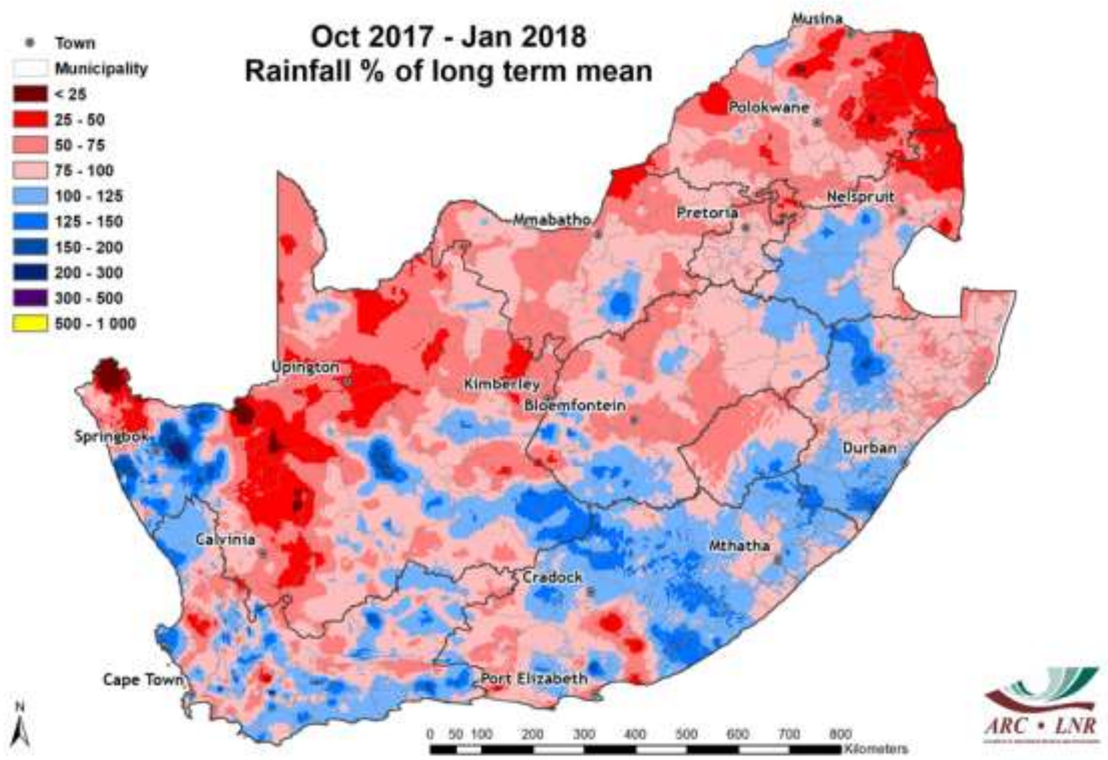
AMESD

164th Edition

Image of the Month

Weak La Niña brings irregular falls of rain

A weak La Niña event has persisted in the Pacific Ocean during most of the 2017/18 southern hemisphere summer. This means that in the central tropical Pacific Ocean, sea surface temperatures were about 0.5 °C below normal. Very few weak La Niña events, and the even weaker cold-neutral events, have in the past been associated with widespread rainfall over the summer rainfall region, and the current event seems to have been no exception. In fact, during the period October to January almost the entire northern half of South Africa experienced below-normal rainfall (see map below). In the eastern half of Limpopo the rainfall was less than 50% of the long-term average. Over many of the maize producing regions of the Free State and North West provinces, the onset of the rains occurred late and the totals for October to January were 25-50% below normal. Areas that received above-normal rainfall were confined to the southern parts of the country, including much of the eastern interior of the Eastern Cape and parts of the Cape south coast. Unfortunately rainfall was below normal in the drought-stricken Port Elizabeth and northern KwaZulu-Natal regions, but over the Cape folded mountains to the north of Cape Town, occasional unseasonal thunderstorms brought some welcome above-normal rainfall.



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:

After 2018 began with the passage of a frontal system over the far southern extremities of the country, dry and warm conditions prevailed over most areas during the first week of January. An exception occurred over the northeastern parts on the 2nd and 3rd where some rain fell and maximum temperatures were relatively cool as the result of a ridging high pressure system that followed behind the frontal system. This ridging high introduced surface circulation over the country that resulted in a quick recovery of maximum temperatures over the southwestern and southern parts. Over the southwestern parts of the Western Cape, maximum temperatures up to 40 °C occurred on the 3rd whilst extremely hot conditions occurred over large parts of the southern interior and some places along the Cape south coast on the 4th of January. Between Plettenberg Bay and Port Elizabeth, maximum temperatures up to 42 °C occurred. Once the influence of the ridging high in the northeast subsided and the upper-air circulation promoted large-scale subsidence, hot to very hot conditions set in over most of South Africa. A frontal system that neared the country as the first week of January ended brought a few light showers to the extreme southwestern parts. Conditions for the development of thundershowers over the interior became more favourable after the high pressure system that followed the frontal system ridged in over the northeastern parts of the country. This ridging high resulted in an influx of some surface moisture as well as the reinforcement of the surface trough over the western to central interior. This was maintained over the next week or so, whilst the upper air circulation was of such a nature that it aided in the development of thunderstorms over the central interior, aligned in a northwesterly to southeasterly aligned band, with the best rainfall occurring over the southeastern interior. Outside of this band, rainfall was extremely limited.

The best rainfall system of the month approached SA on the 20th. An upper-air trough that developed into a cut-off low pressure system on the 21st resulted in good rainfall over large parts of the country, particularly over the southern interior where the monthly rainfall totals were above normal. The cut-off low moved in over the southwestern parts on the 22nd and progressed in a southeasterly direction before it exited the country on the 23rd. A surface low accompanied the cut-off low pressure system. The above-normal rainfall along the west coast can be attributed to the flow caused by the surface low when it was situated just off the coast. The upper-air became zonal after the passage of the cut-off low before another trough neared the country on the 26th. This introduced favourable conditions for the development of thundershowers over the central and eastern interior which was aided by a well aligned surface trough that developed as a surface high pressure system ridged in over the northeastern parts of the country. During the remainder of January, atmospheric conditions were favourable for rainfall over the eastern parts but this was not enough to prevent the monthly rainfall over the eastern and northeastern parts of the country from being below-normal.

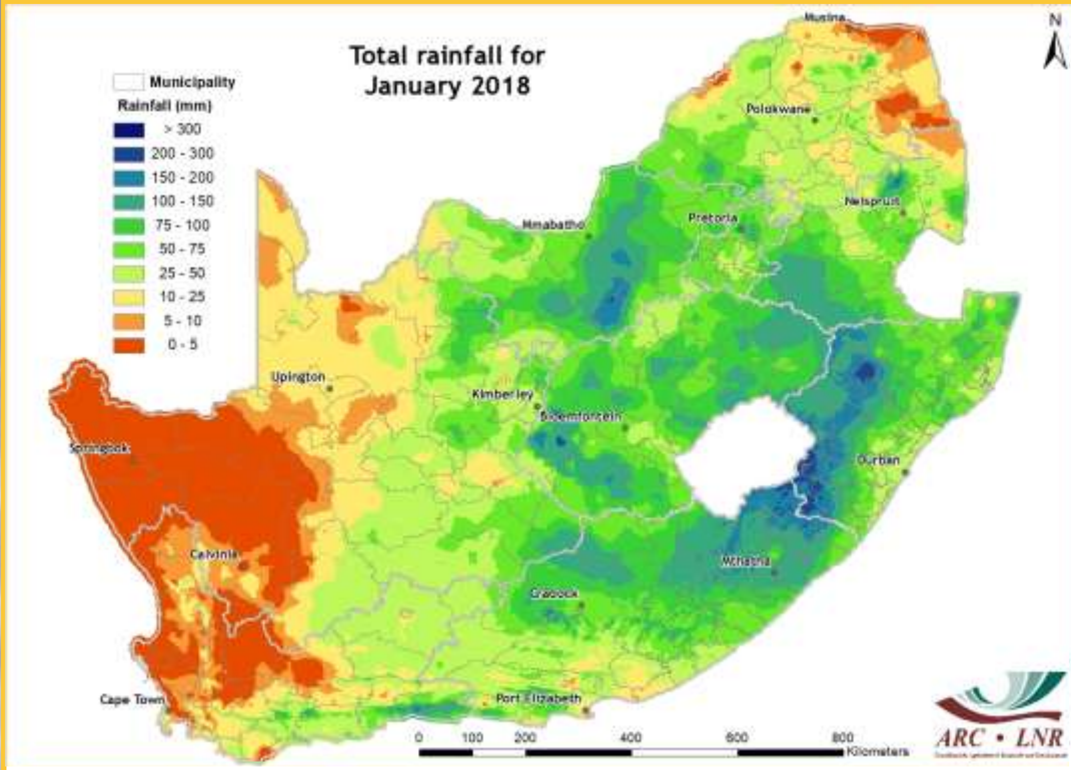


Figure 1

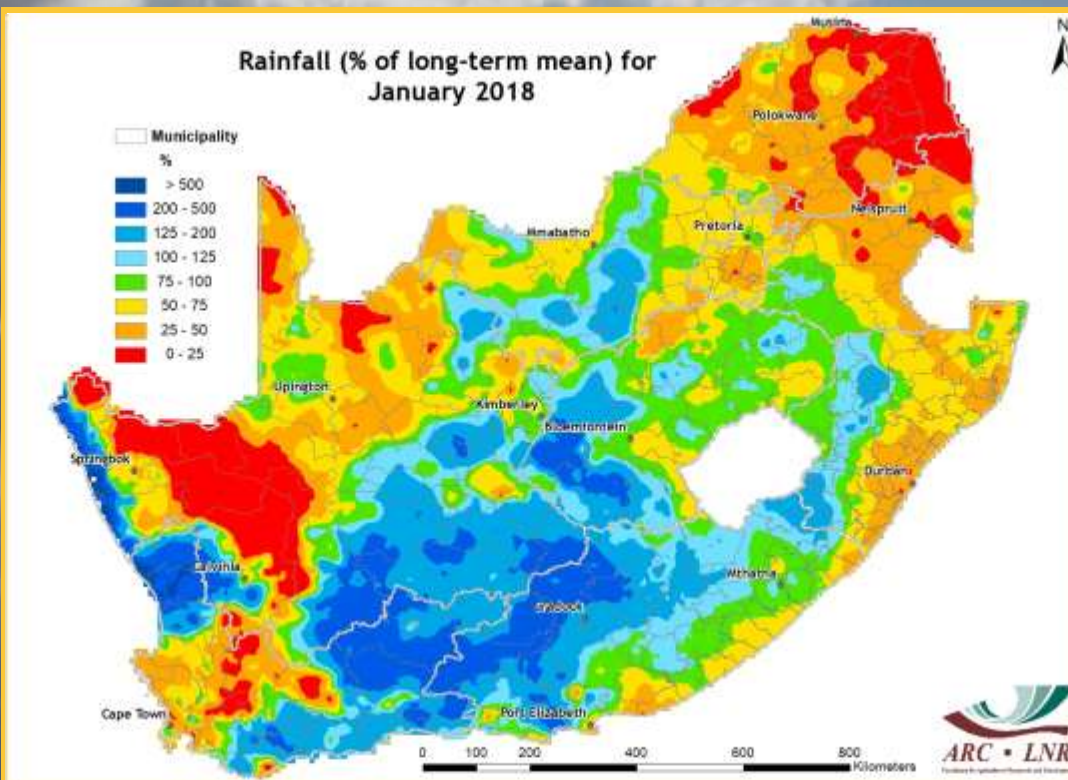


Figure 2

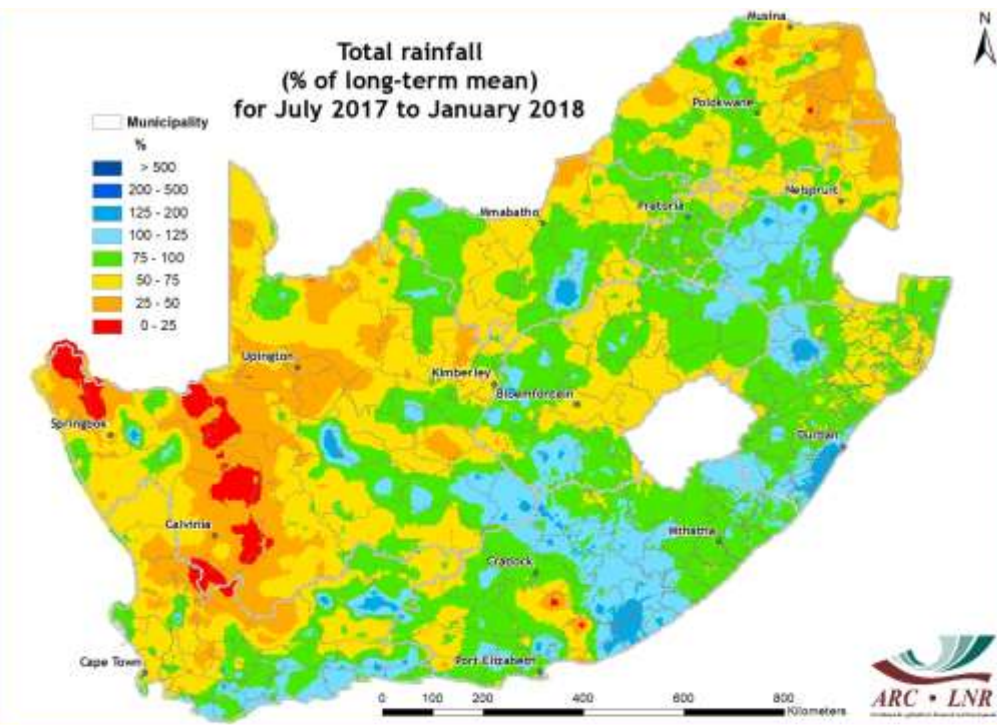


Figure 3

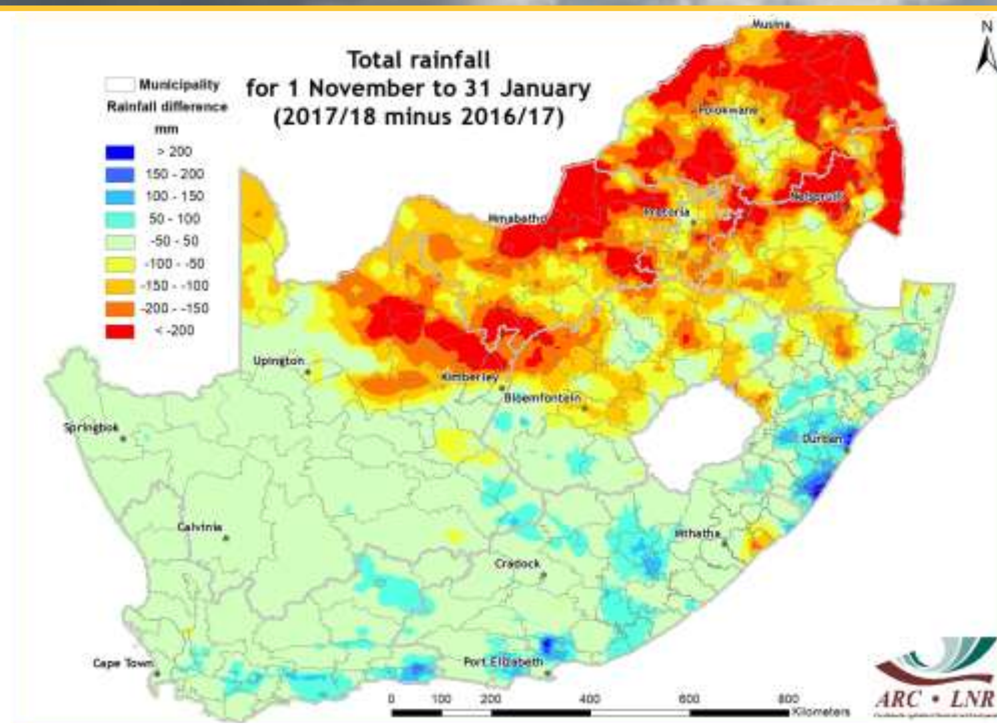


Figure 4

Figure 1:
Atmospheric circulation during January 2018 was of such a nature that rainfall was suppressed most of the time over the northeastern parts of the country, whilst thundershowers developed over the central to southeastern interior regions. Most of the rainfall over the southern interior occurred just after the 20th of January in association with a cut-off low pressure system.

Figure 2:
Above-normal rainfall occurred over the southern interior and extended to places along the Cape south coast. This above-normal rainfall can mostly be attributed to a cut-off low pressure system that developed on the 21st of January. Far below-normal rainfall occurred over the northeastern parts of the country whilst large parts of the eastern interior experienced below-normal rainfall.

Figure 3:
Over the past 7 months, 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 2017 and again during January 2018. Over the summer rainfall region, the eastern parts received mostly below-normal rainfall – mainly as a result of poor rainfall during January 2018.

Figure 4:
November 2017 to January 2018 was much drier than the corresponding period of a year ago over the northeastern parts of the country, extending westwards into the maize producing regions. Over the remainder of the country, only a few isolated areas received more rainfall during the current 3-month period compared to the corresponding period of a year ago.

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 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 improved from the 36-month to shorter time scales, except over the northeastern areas where a return to severe drought conditions is shown on the 6-month time scale. After the above-normal rainfall during January 2018 over the southern interior, relief from severe drought conditions can be seen on the 6-month time scale.

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

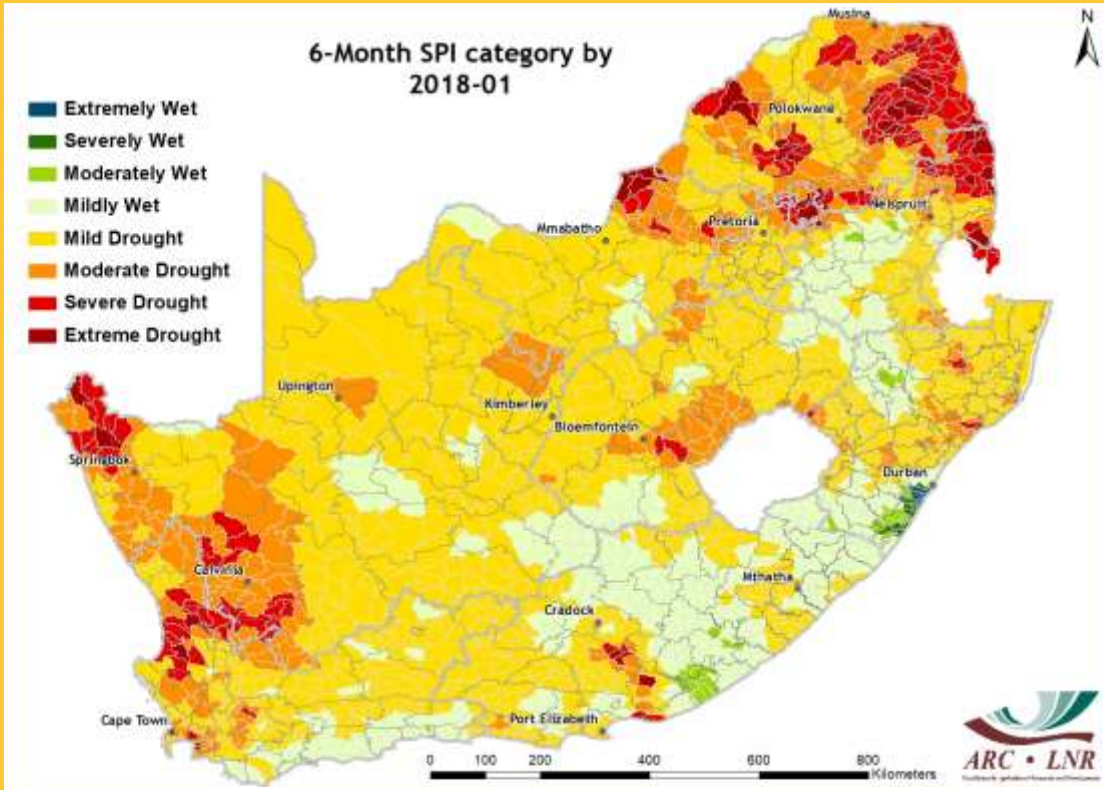


Figure 5

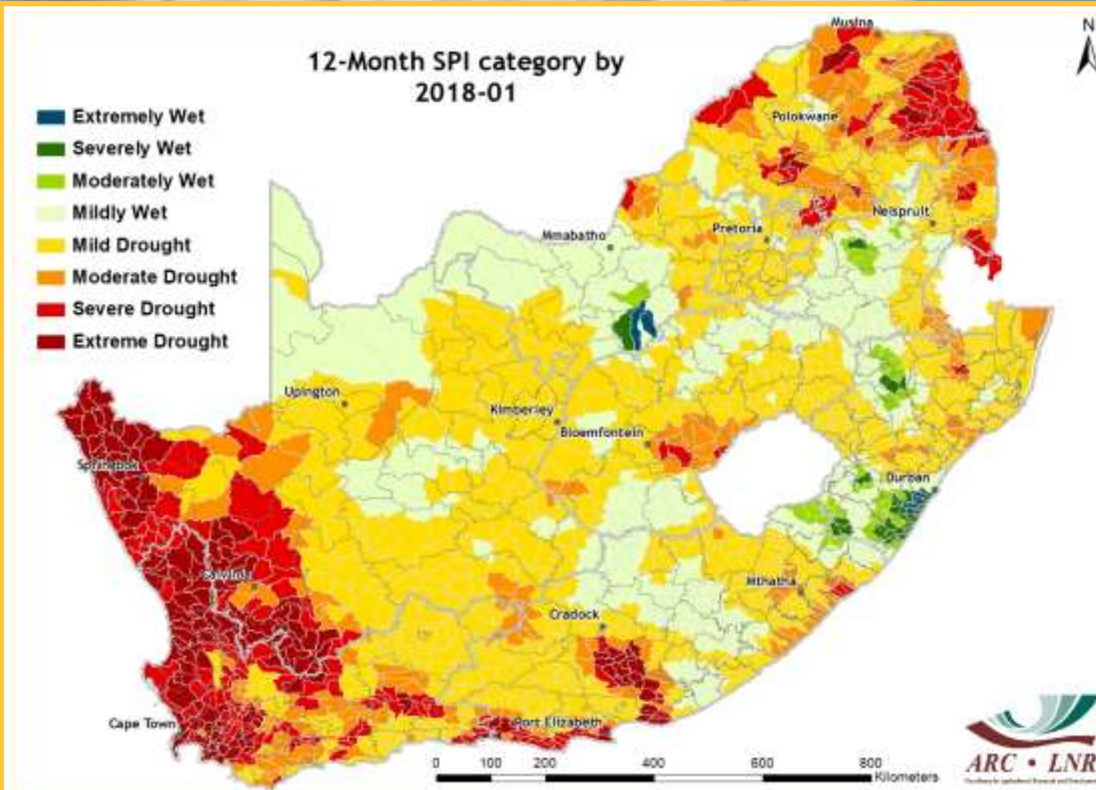


Figure 6

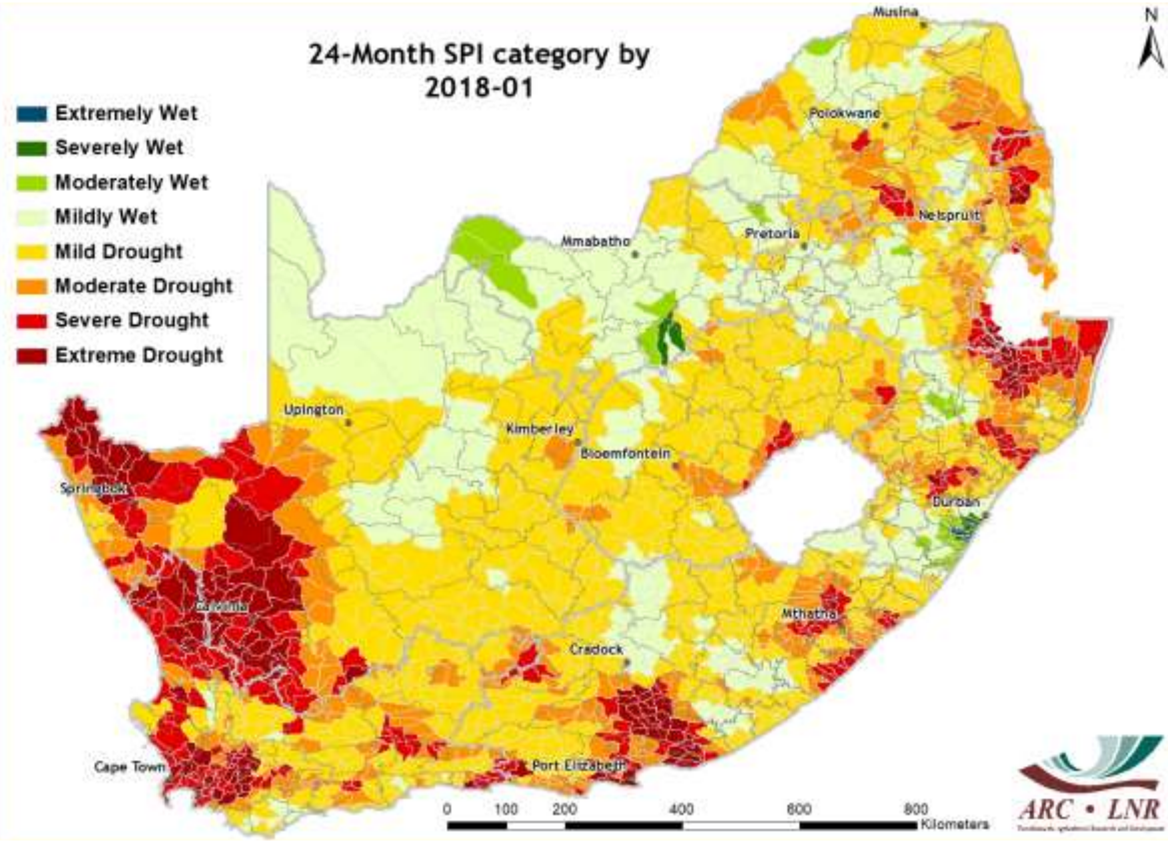


Figure 7

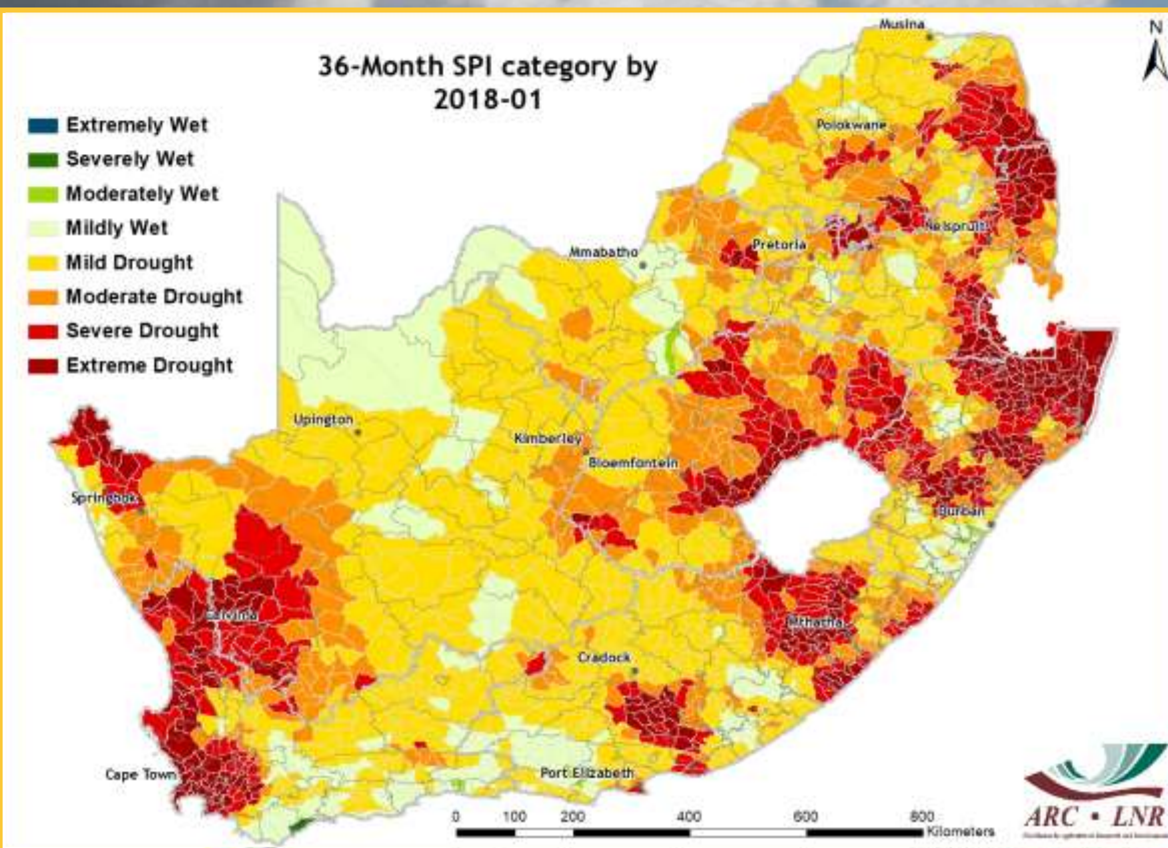


Figure 8

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.

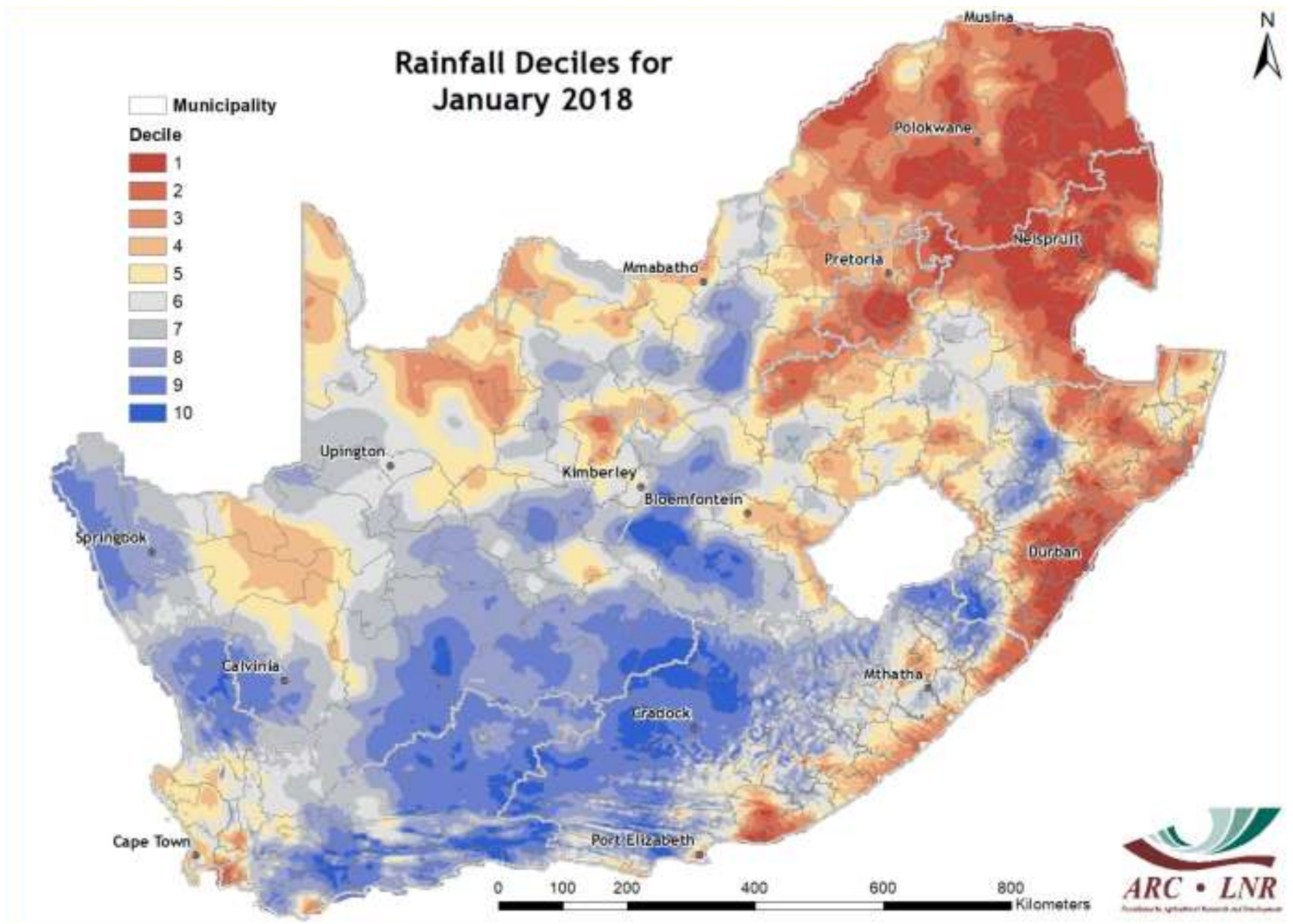


Figure 9

Figure 9:
Compared to historical rainfall totals during the month of January, January 2018 over the northeastern part of the country as well as along the eastern coastal belt experienced rainfall totals that fall within the drier January months. The southern interior and parts of the Cape south coast as well as areas over the west coast and adjacent interior experienced rainfall totals during January 2018 that compare well with the wetter historical January rainfall totals.

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.

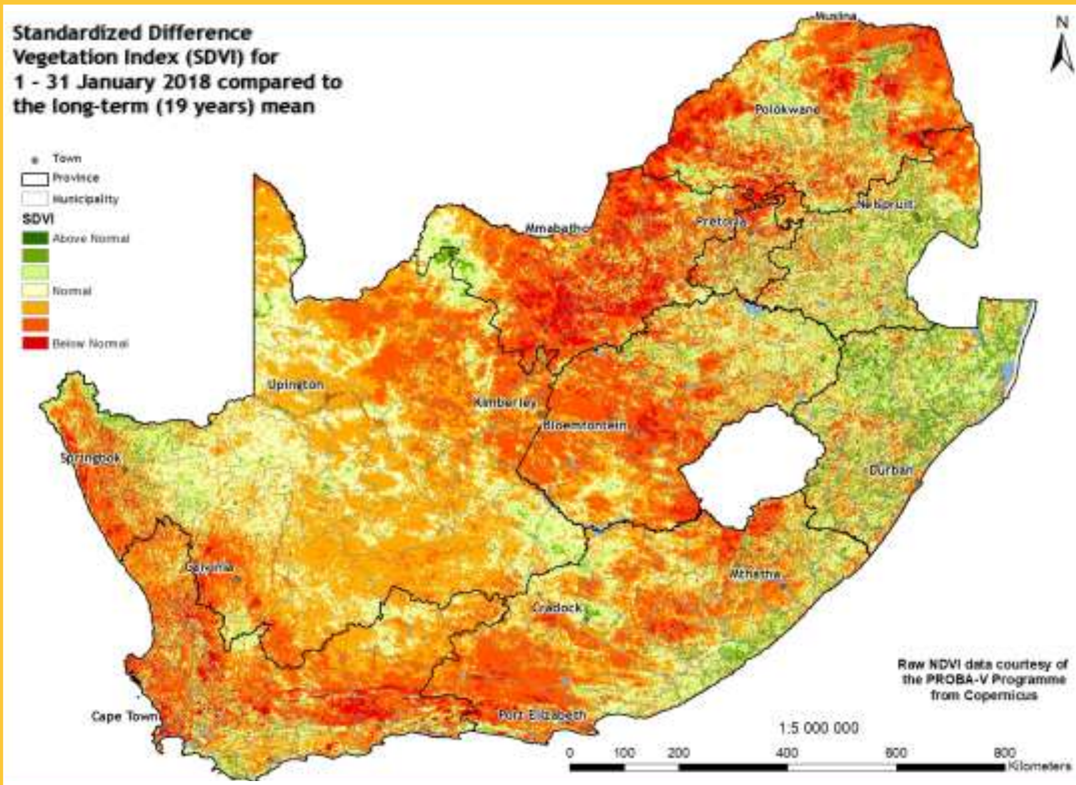


Figure 10

Figure 10:
The SDVI for January indicates above-normal vegetation activity over KwaZulu-Natal, Mpumalanga and isolated areas of the Northern Cape, Limpopo, Free State and Eastern Cape. Dry conditions were prevalent over most parts of the country. Below-normal vegetation activity was present in the Northern Cape, Western Cape, Eastern Cape, southern parts of Free State, North West and Limpopo.

Figure 11:
Below-normal vegetation activity occurred over most of the northern and northeastern parts of the country. These dry conditions were notable over the Free State, North West, Limpopo, Gauteng and the northern parts of the Northern Cape. However, above-normal vegetation activity occurred in small distinct areas of the Eastern Cape and KwaZulu-Natal.

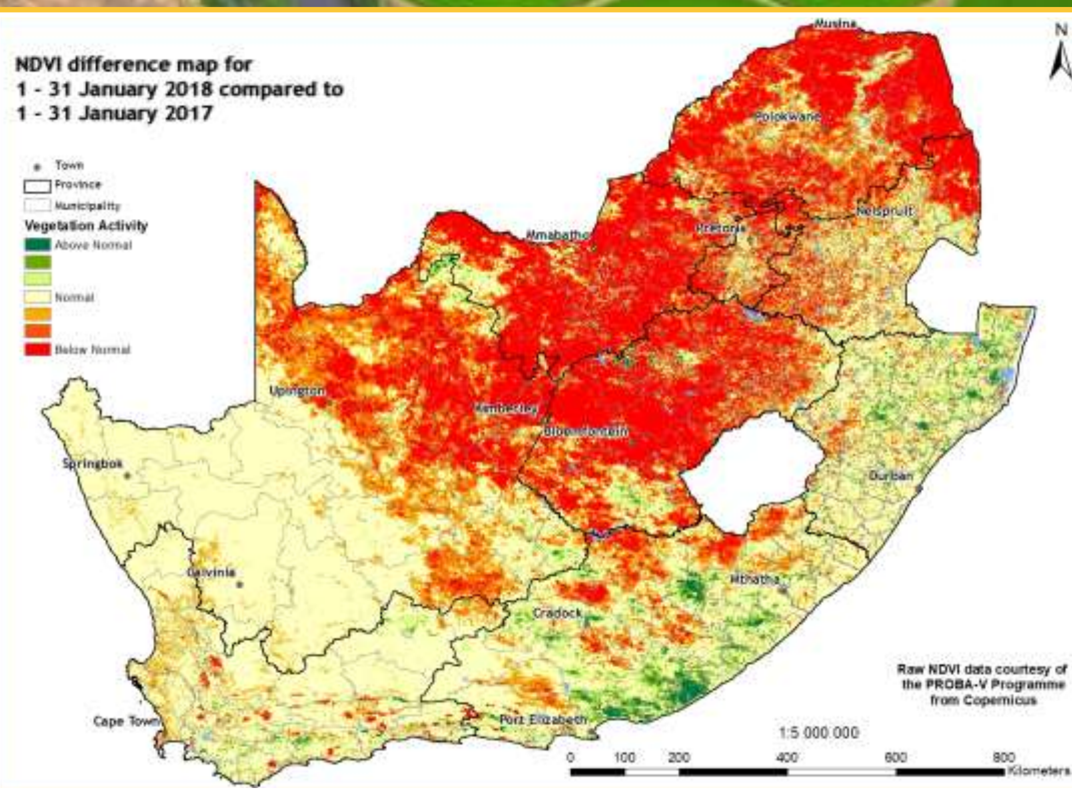


Figure 11

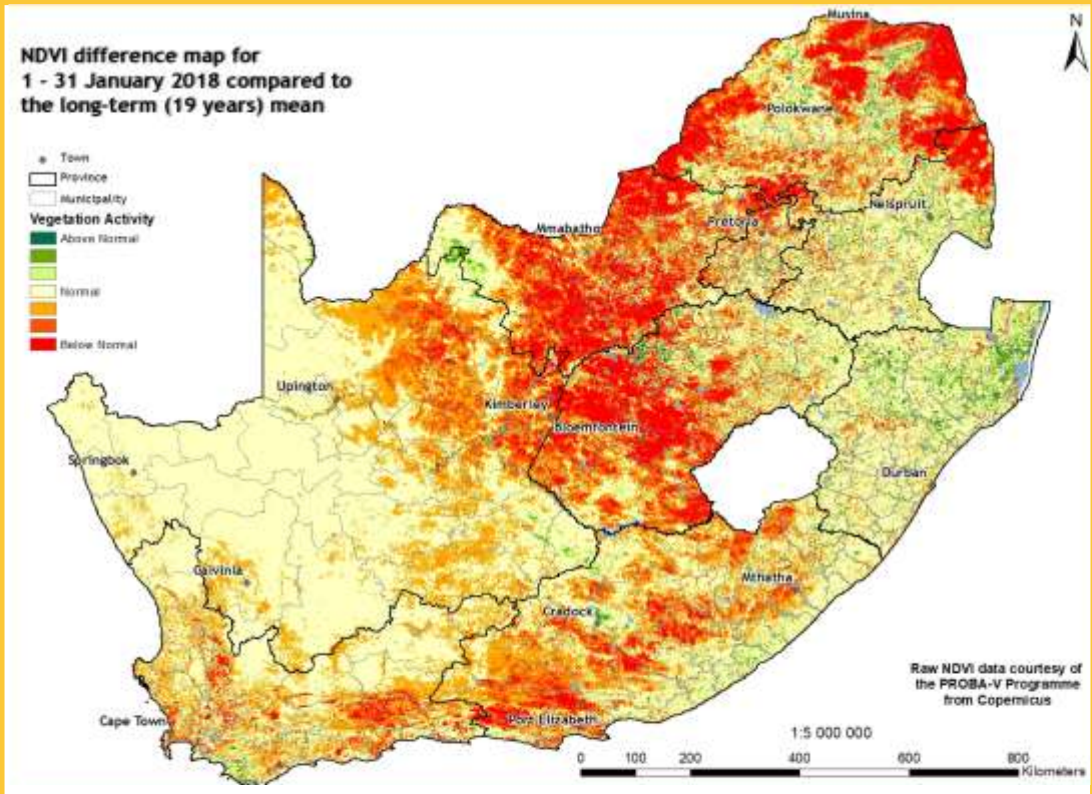


Figure 12

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

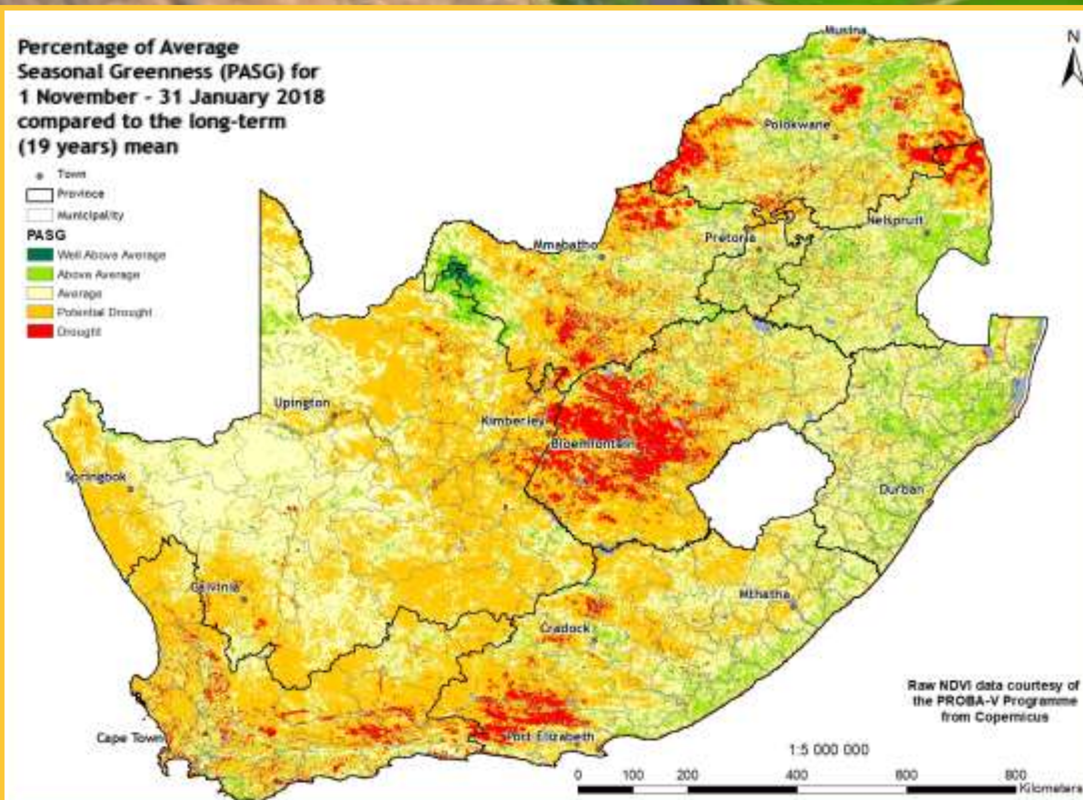


Figure 13

Figure 12:
Much of the Free State, North West and Limpopo experienced low vegetation activity during January. Isolated areas of the Northern Cape, Eastern Cape and Gauteng had a dry spell.

Figure 13:
Drought conditions are visible in the southwestern parts of the Free State and Eastern Cape. Distinct areas of the Western Cape, North West, Limpopo and Mpumalanga also exhibited dry conditions.

Questions/Comments:
MashabaZ@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.

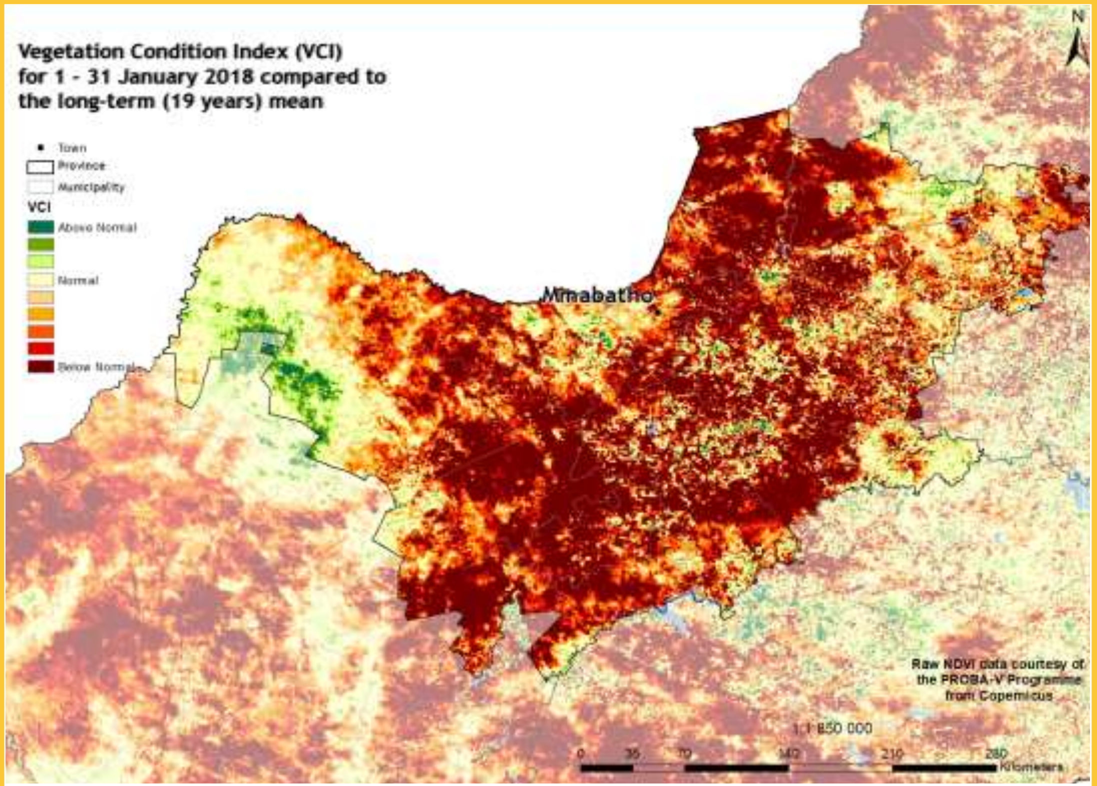


Figure 14

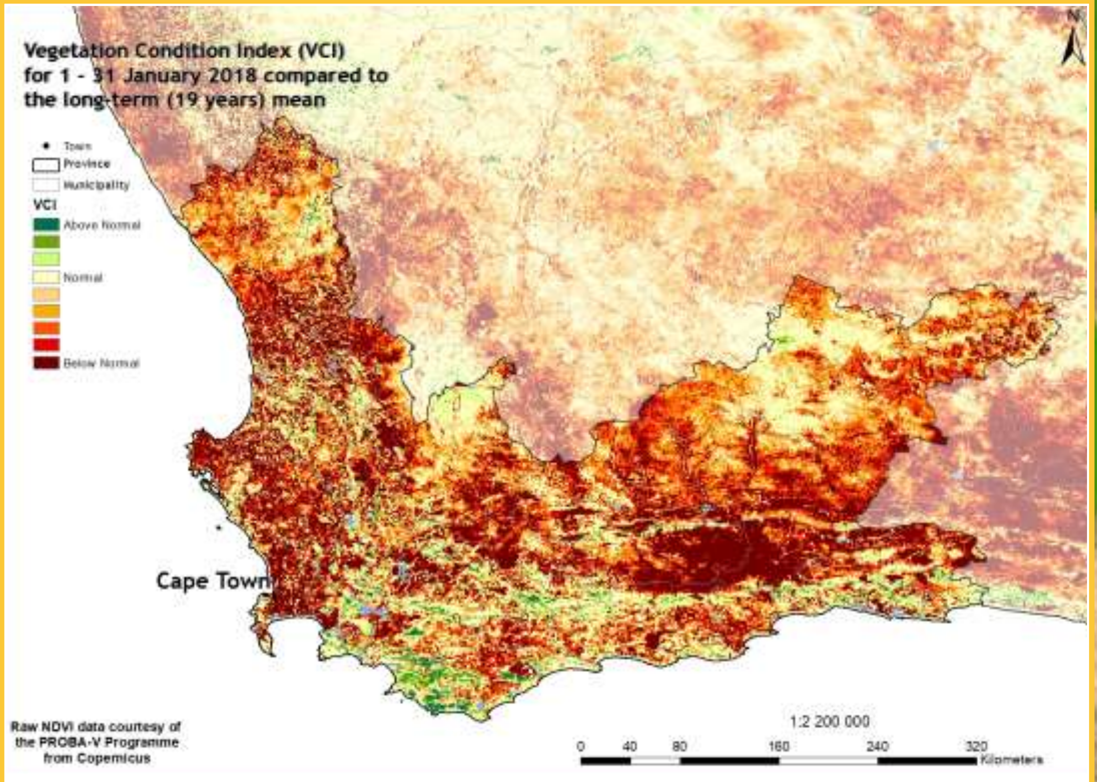


Figure 15

Figure 14:
The VCI map for January indicates extremely dry conditions over most of the North West Province.

Figure 15:
The VCI map for January indicates that dry conditions still prevail over much of the Western Cape.

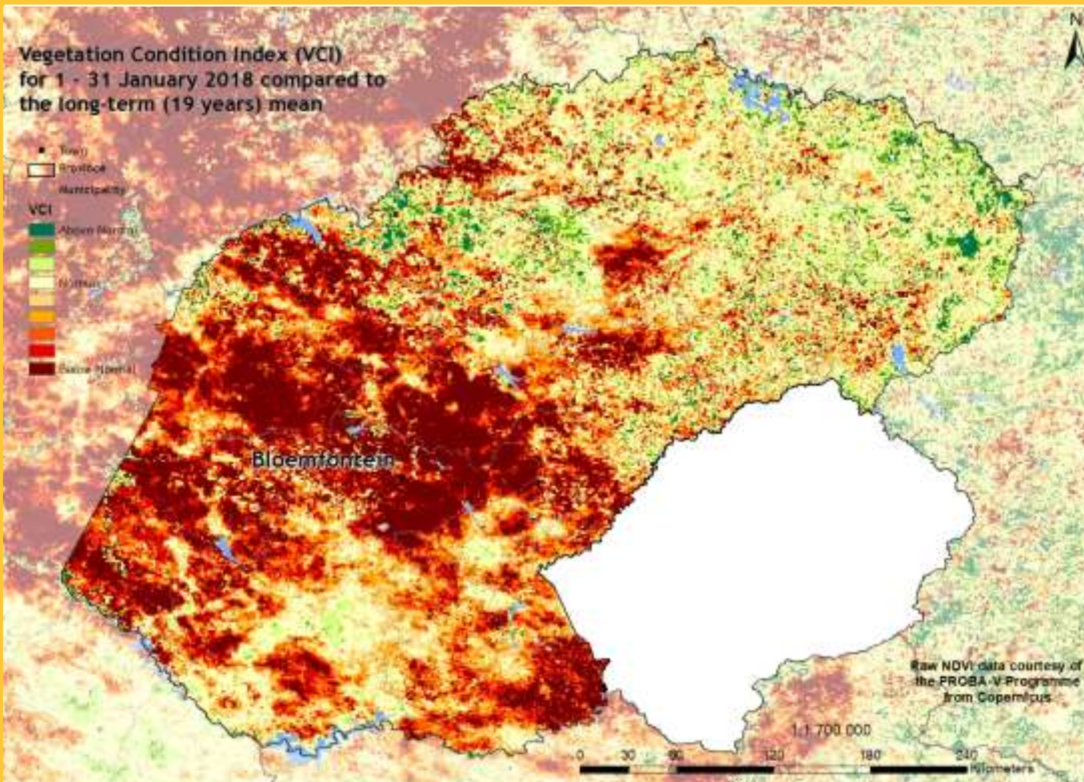


Figure 16

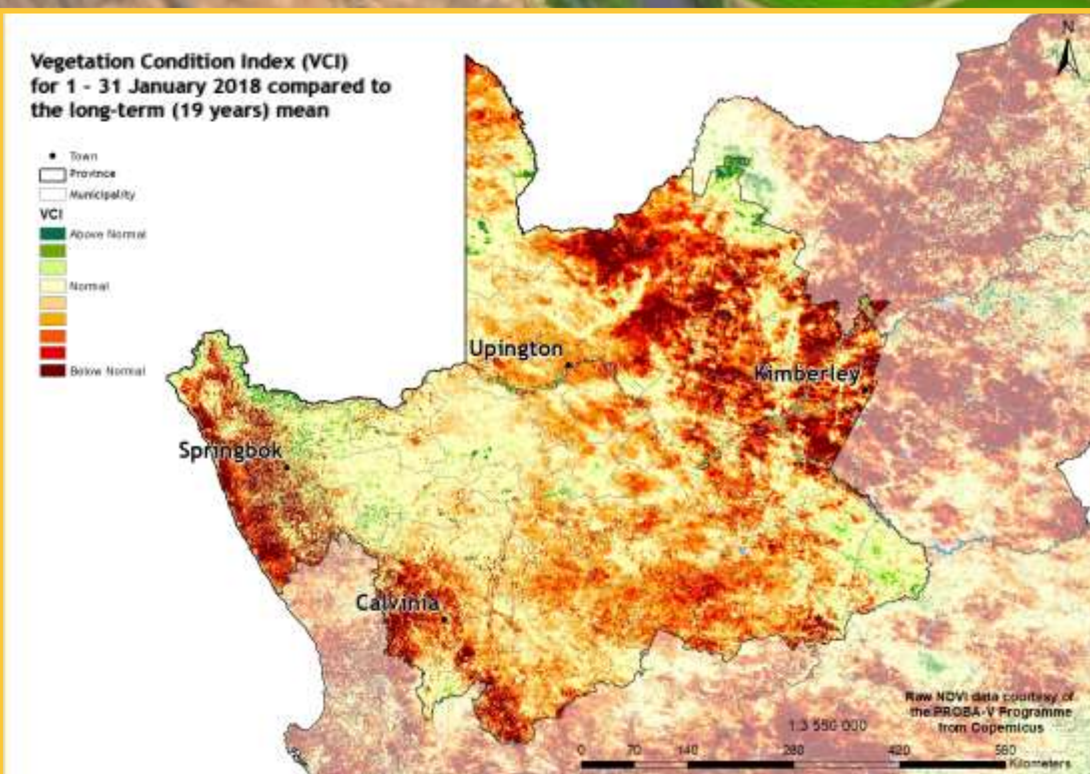


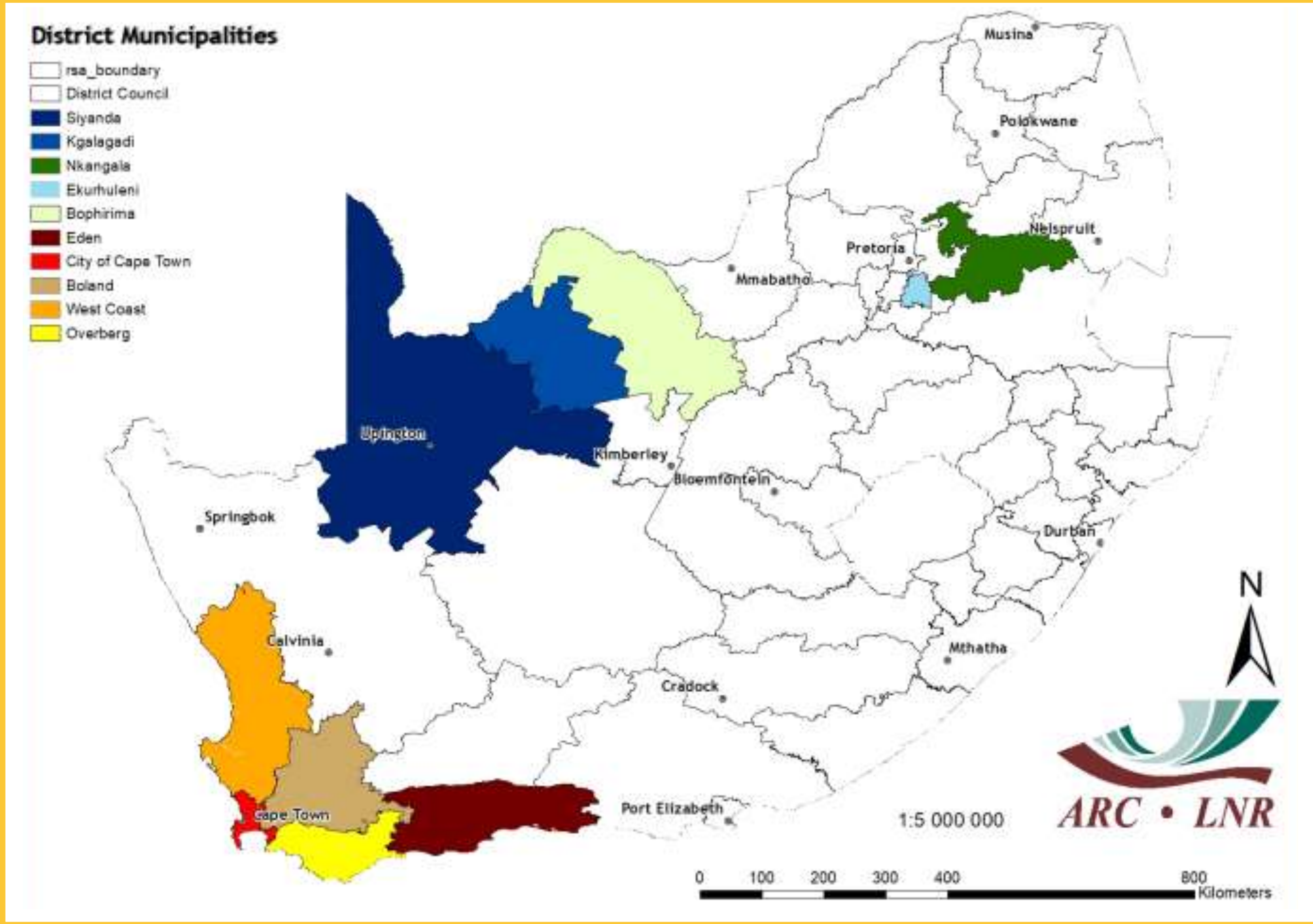
Figure 17

Figure 16:
The VCI map for January indicates below-normal vegetation activity over the western parts of the Free State.

Figure 17:
The VCI map for January indicates below-normal vegetation activity over the northeastern and southwestern parts of the Northern Cape.

Questions/Comments:
MashabaZ@arc.agric.za

6. Vegetation Conditions & Rainfall

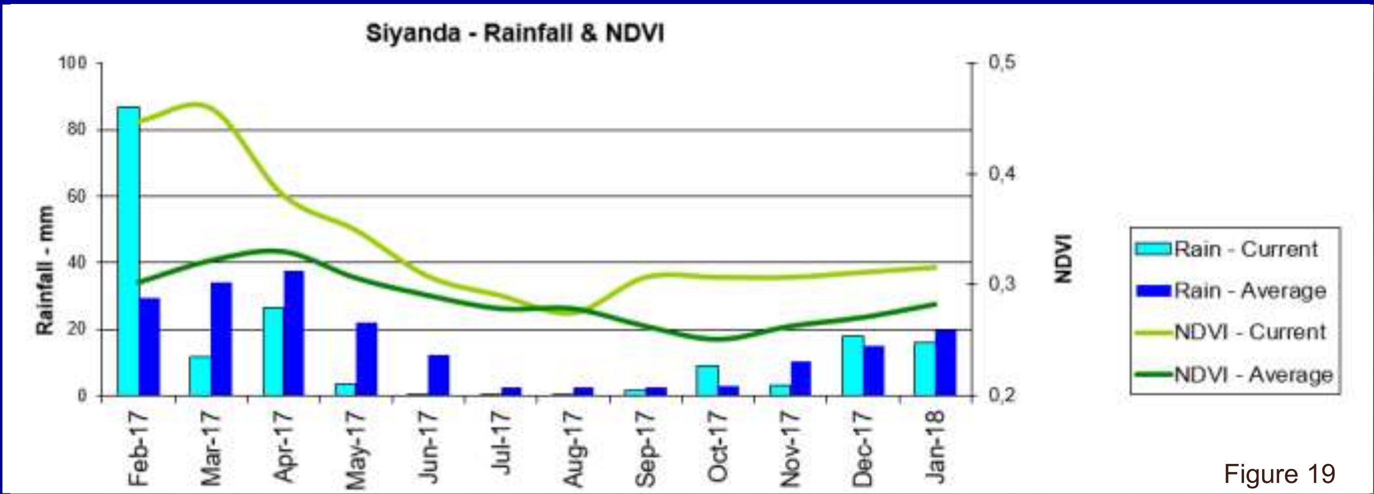


NDVI and Rainfall Graphs
Figure 18:
Orientation map showing the areas of interest for January 2018. The district colour matches the border of the corresponding graph.

Questions/Comments:
MashabaZ@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.



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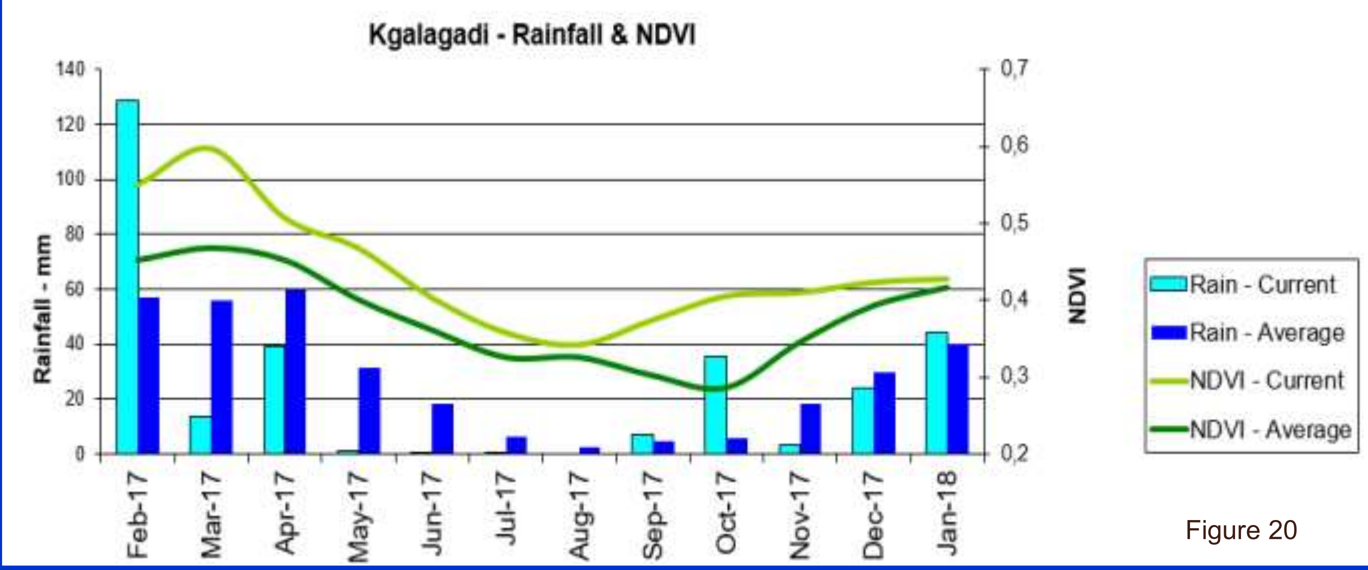

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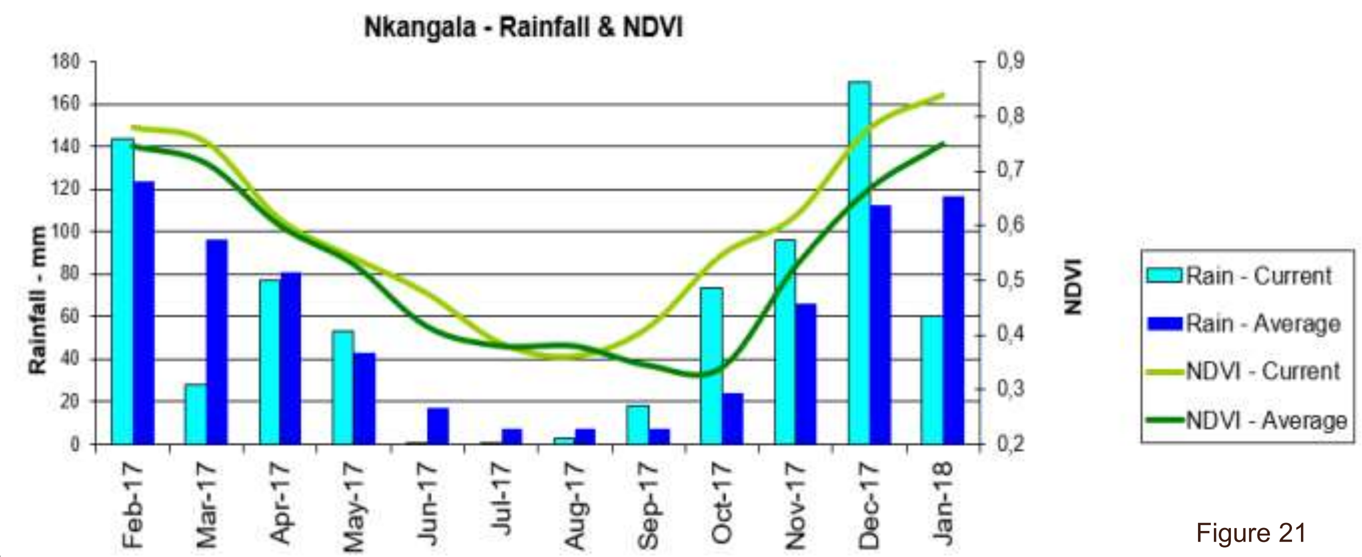

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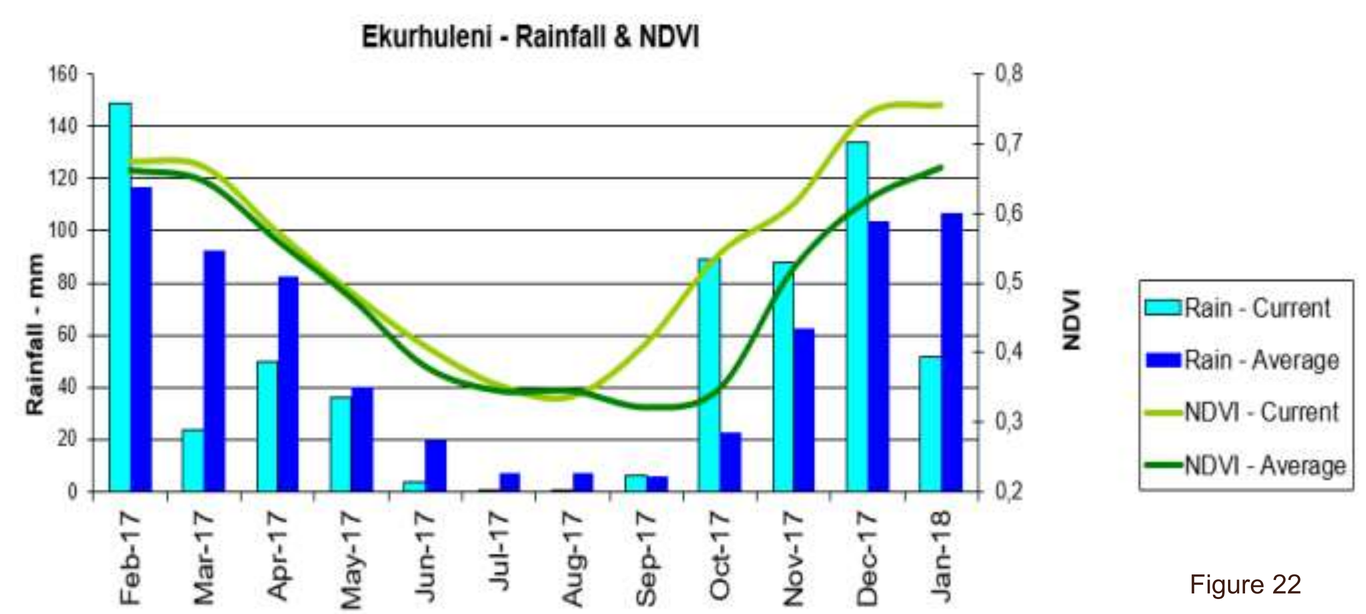

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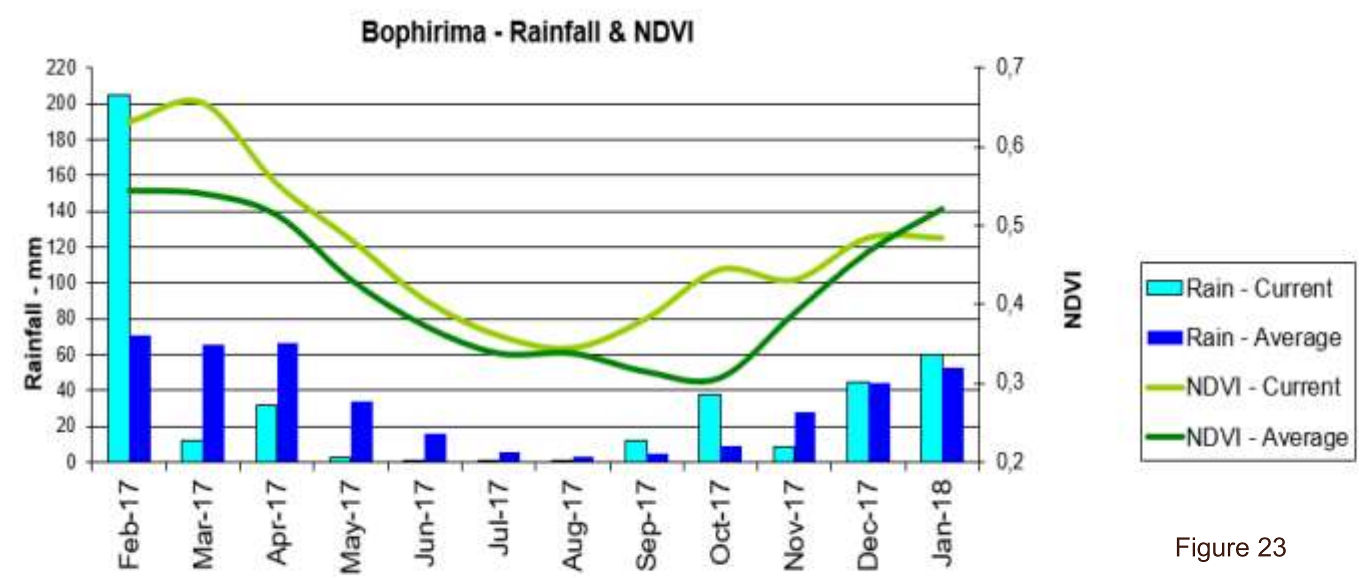

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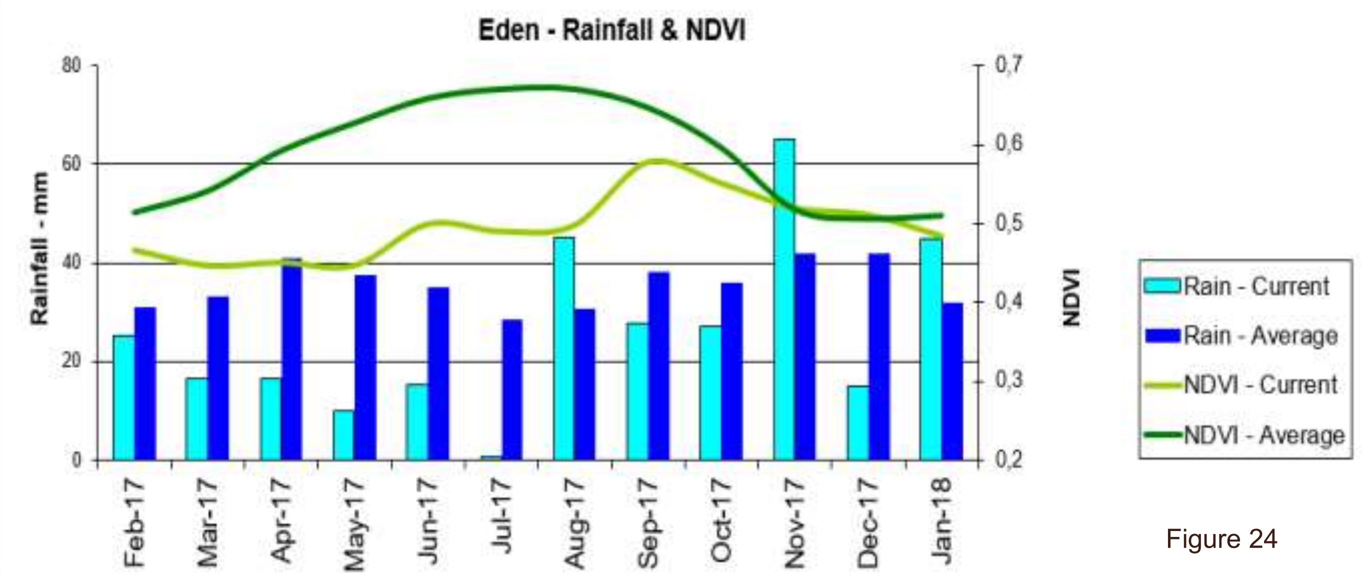

Figure 24

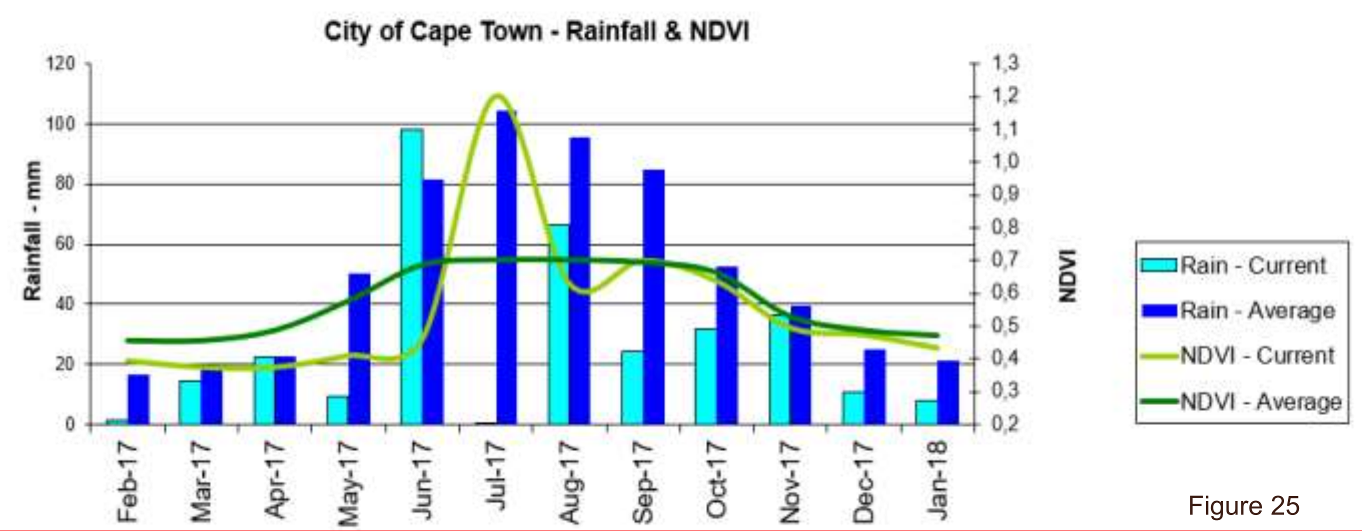

Figure 25

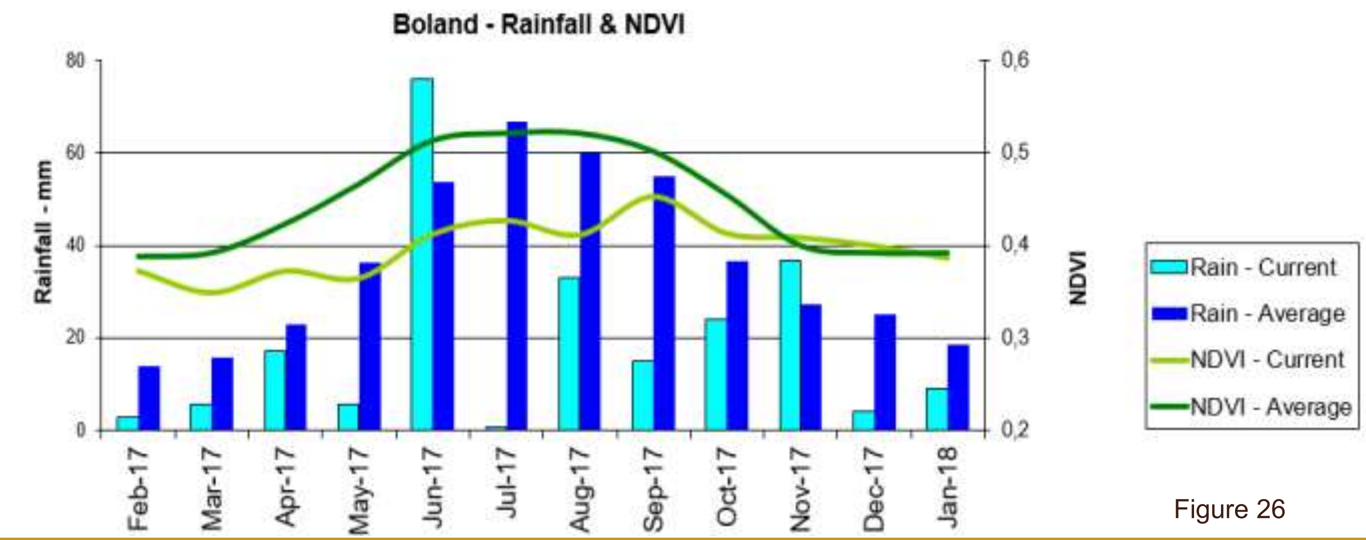

Figure 26

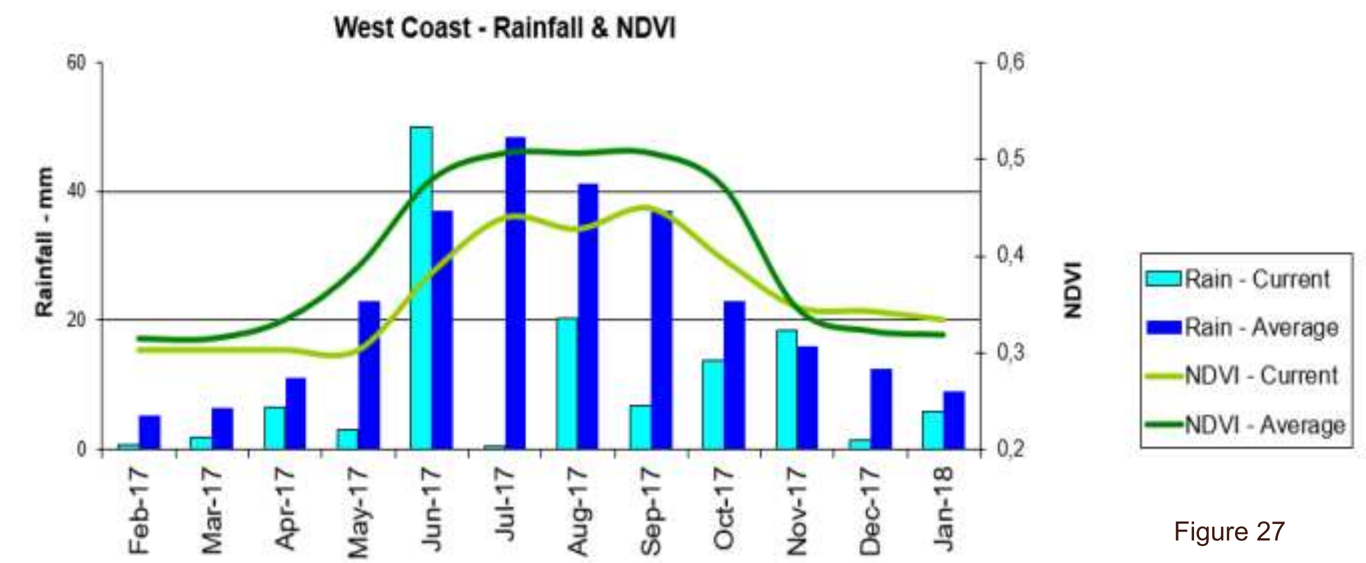

Figure 27

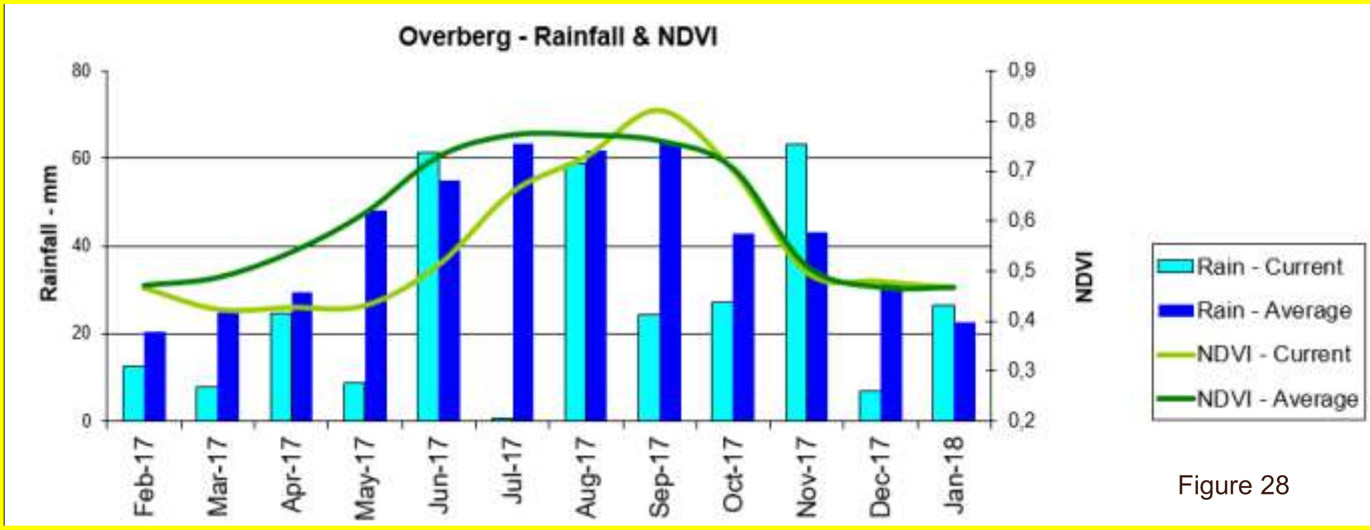

Figure 28

7. Fire Watch

PAGE 15

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 the month of January per province. Fire activity was higher in the Northern and Western Cape compared to the average during the same period for the last 18 years.

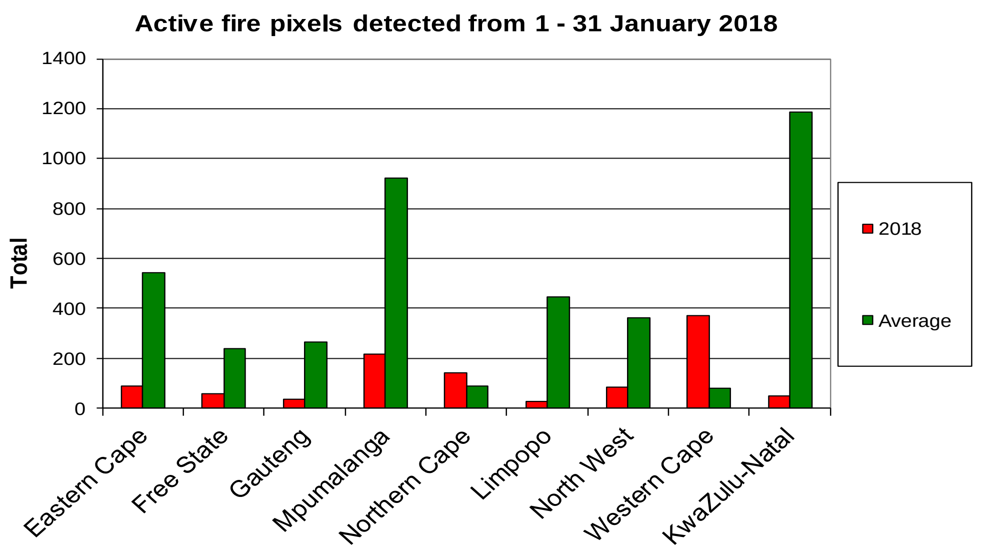

Figure 29

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

Questions/Comments:
MaakeR@arc.agric.za

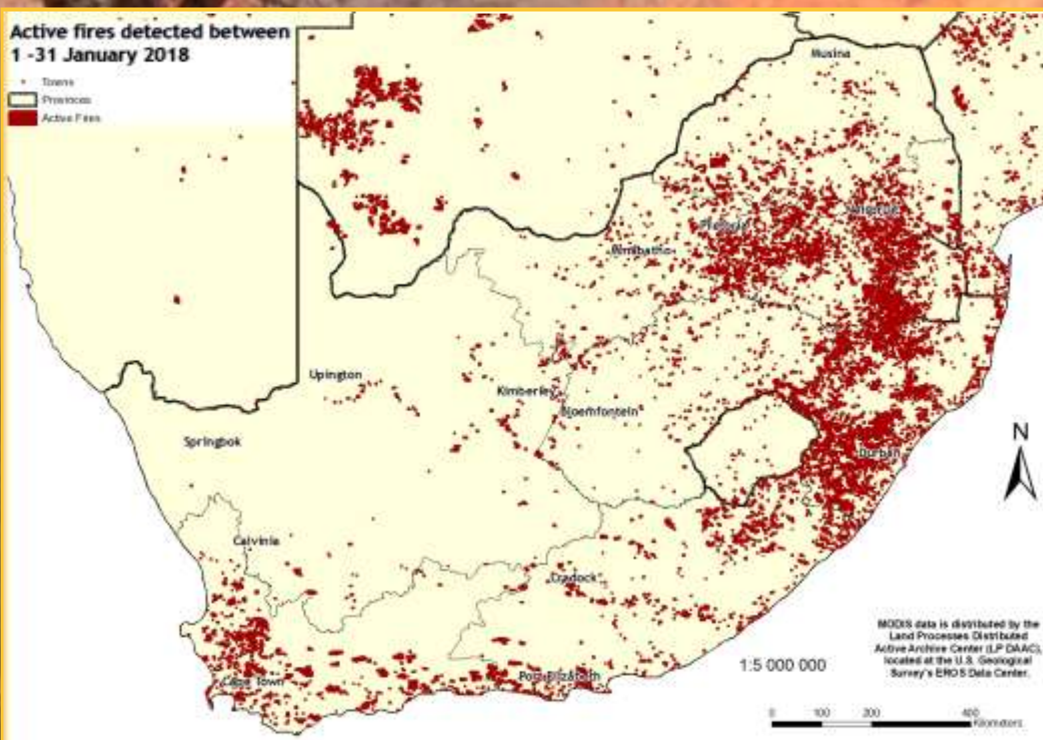

Figure 30

Agrometeorology

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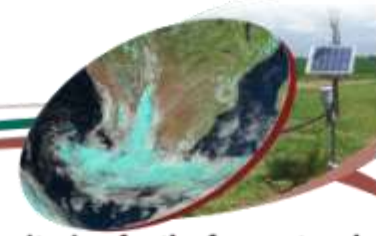

The programme focuses on the use of weather and climate information and monitoring for the forecast and prediction of the weather elements that have direct relevance on agricultural planning and the protection of crop, forest and livestock. The Agro-Climate Network & Databank is maintained as a national 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 Mitsuru Tsubo
Tel: 012 310 2502
E-mail: tsubom@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

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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

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

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For further information please contact the following:
Adolph Nyamugama – 012 310 2582, NyamugamaA@arc.agric.za
Adri Laas – 012 310 2518, AdriL@arc.agric.za

To subscribe to the newsletter, please submit a request to:
NyamugamaA@arc.agric.za

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

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