ARC • LNR
Excellence in Research and Development

UMLINDI
The Watchman

ISSUE 2018-03 | 16 MARCH 2018

INSTITUTE FOR SOIL, CLIMATE AND WATER

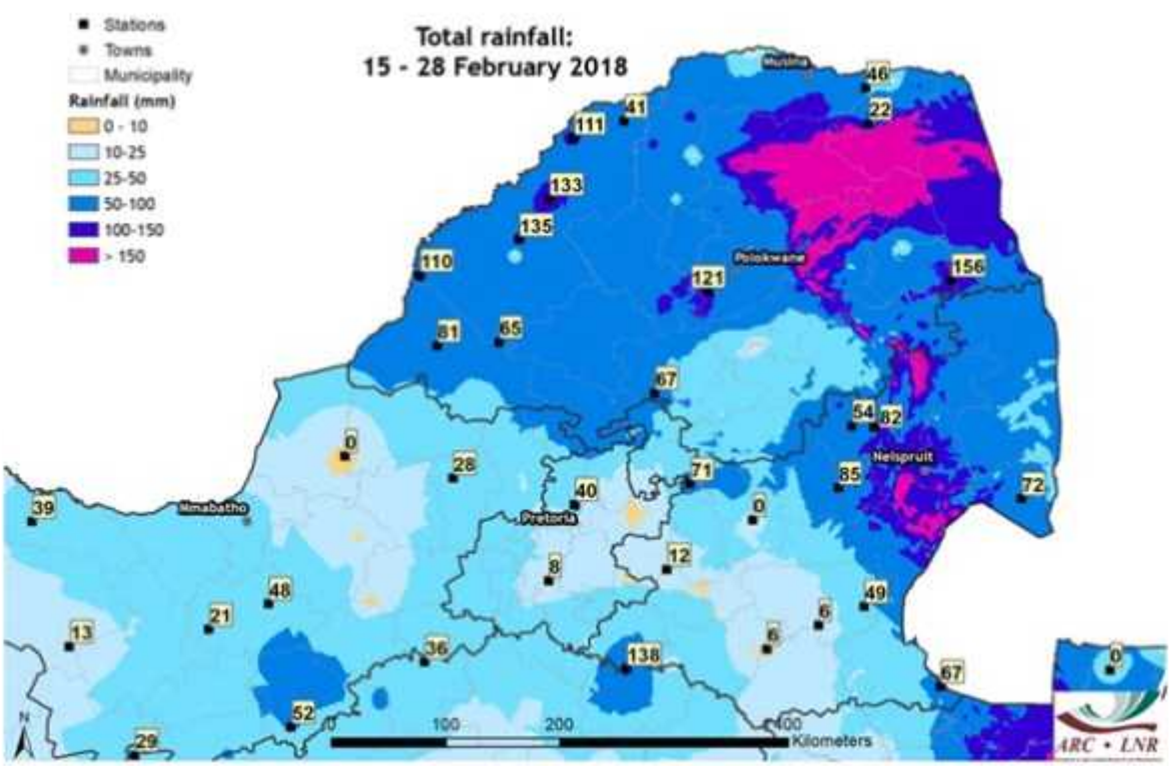
CONTENTS:

165th Edition

Image of the Month

Good rainfall over northeastern South Africa

Good rainfall occurred over the northeastern parts of the country from the 15th to the 21st of February 2018. An easterly wave that later on showed signs of rotation whilst moving westwards was responsible for this rain, which contributed half of the February rainfall total in large parts of Limpopo and eastern Mpumalanga. In some parts of Limpopo, up to 75% of the monthly rainfall occurred between 19-21 February. Over these areas in the northeast of the province, the 3-day totals exceeded 100 mm – much needed rainfall after an exceptionally dry January and a relatively dry November and December 2017. This tropical weather system weakened as a cold front and upper-air trough moved in over South Africa on the 23rd of February which influenced the weather over the country during the next few days. By the 26th, the remnants of the tropical weather system intensified to a tropical low that was situated over northeastern Botswana. By the end of the month, further good rainfall occurred over the far northeastern parts of South Africa in association with the tropical low pressure system (see map below).



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:

During the month of February 2018, large parts of the summer rainfall region received near-normal to above-normal rainfall. However, the areas that received above-normal rainfall were fragmented, with some areas over the western interior, the southern to southeastern interior, the central as well as the far northeastern parts of the country all receiving above-normal rainfall. In contrast the eastern higher ground areas over Mpumalanga and KwaZulu-Natal received below-normal rainfall.

Thunderstorms over the eastern and central parts of the country occurred in some areas at a regular frequency during the month. Moisture was regularly supplied by the frequent presence of a ridging high pressure system that was situated southeast to east of the country. The presence of tropical low pressure systems to the north of the country also contributed to the supply of moisture and hence rainfall over the eastern parts. The regions that benefited most from the ridging high pressure systems and tropical lows (particularly towards the end of the month) were the areas eastward of the eastern escarpment. Over these areas, rainfall totals of up to 240 mm occurred over the far northeastern parts of the country.

Good conditions for rainfall over the western and southern to southeastern interior were introduced by a cut-off low pressure system that developed just to the west of the country on the 12th of February. This system caused a good distribution of thunderstorms over the western parts of the country on the 13th, resulting in the isolated area of above-normal rainfall over the south-western Western Cape. Conditions remained favourable for thundershowers over the southern interior over the next few days, resulting in the above-normal rainfall over these areas. Around the 20th a tropical low to the north of South Africa produced good rainfall over the far northern to north-eastern parts of the country.

The change of seasons from summer to autumn became evident during the month of February with minimum temperatures that dropped sharply over the southern interior towards the end of the month after a cold front that made landfall on the 23rd moved in over the southern parts of the country. Compared to earlier in the month, enhanced radiative cooling occurred in the wake of the front as a result of drier air that was introduced by the frontal passage. In some isolated areas over the high ground in the southeastern parts of the country, reports of frost were received.

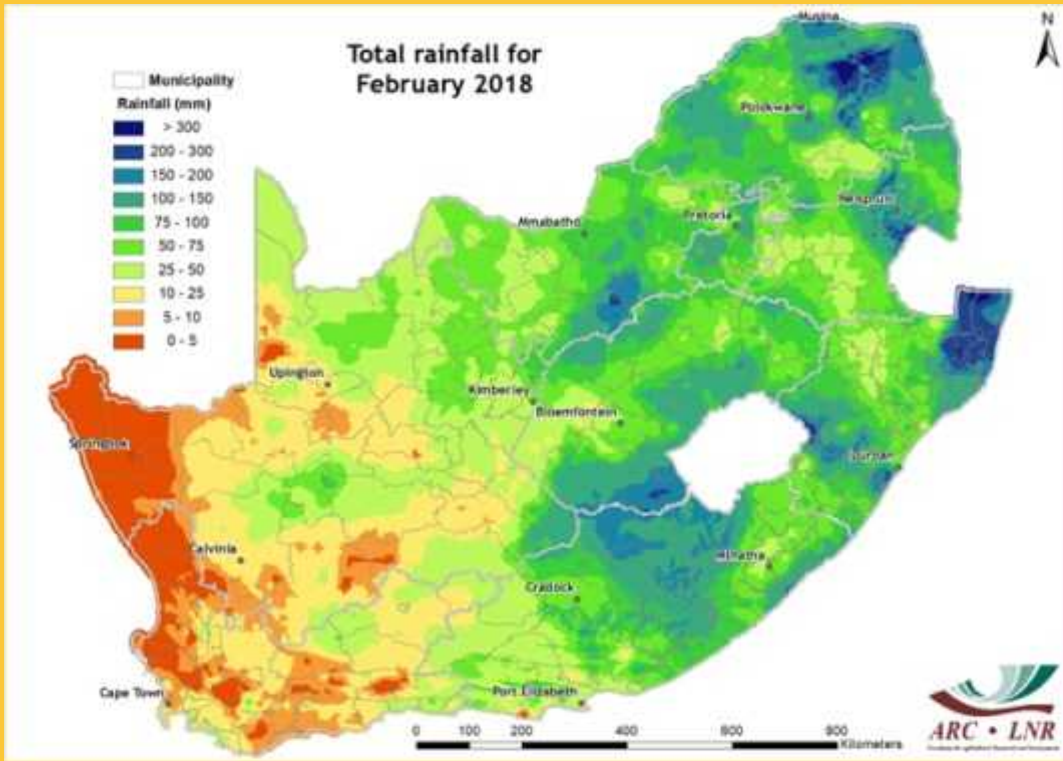


Figure 1

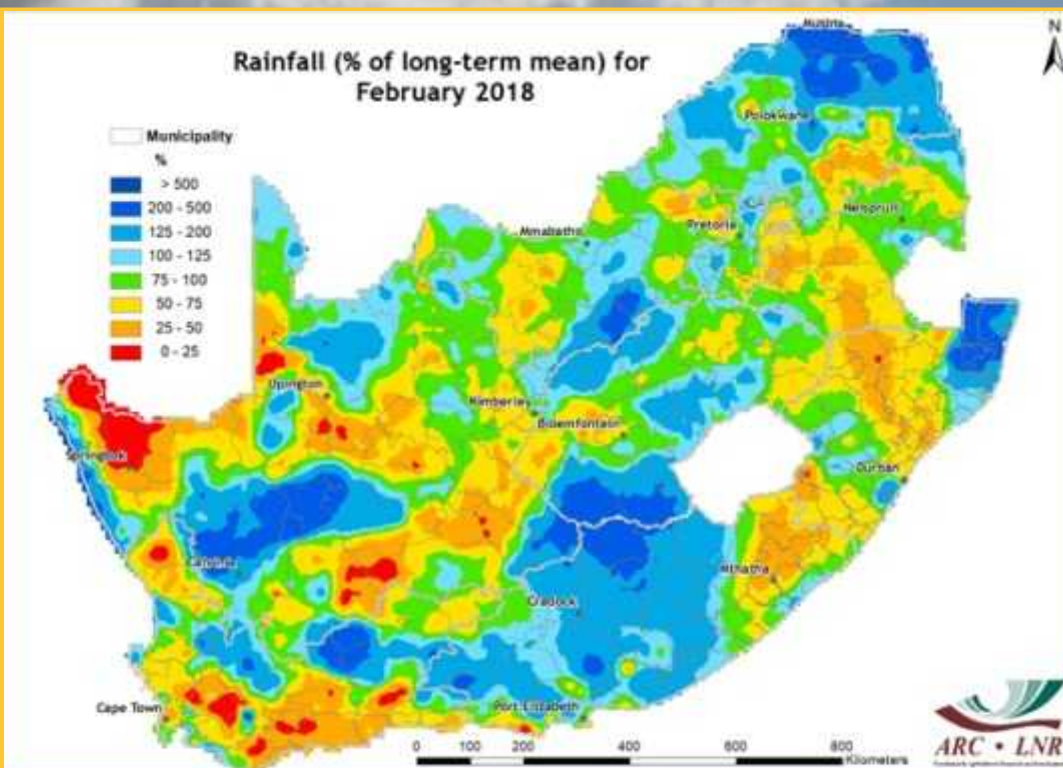


Figure 2

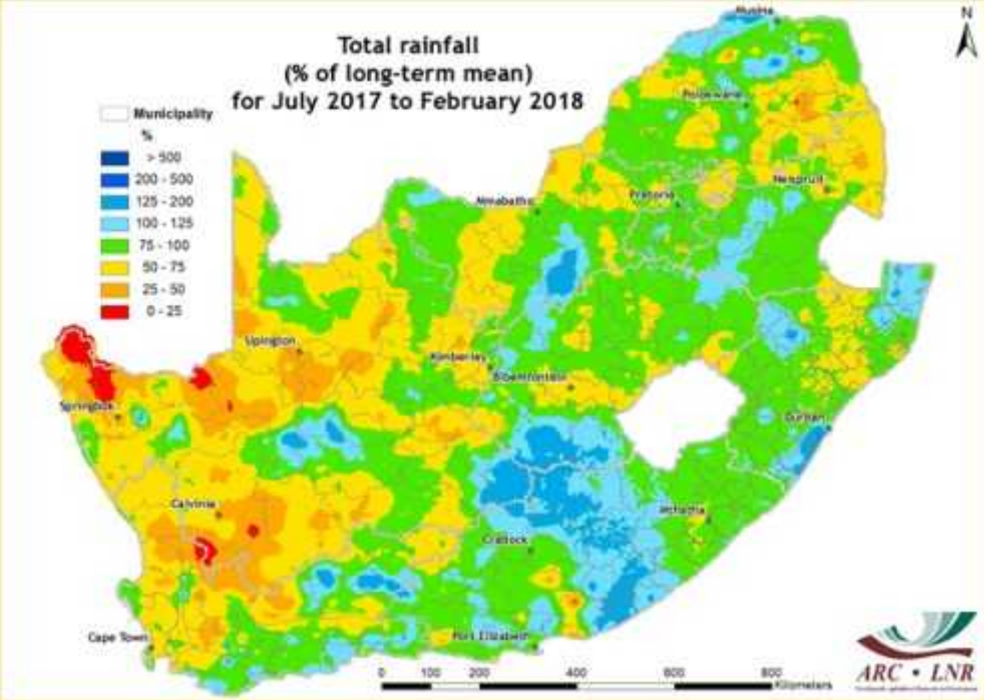


Figure 3

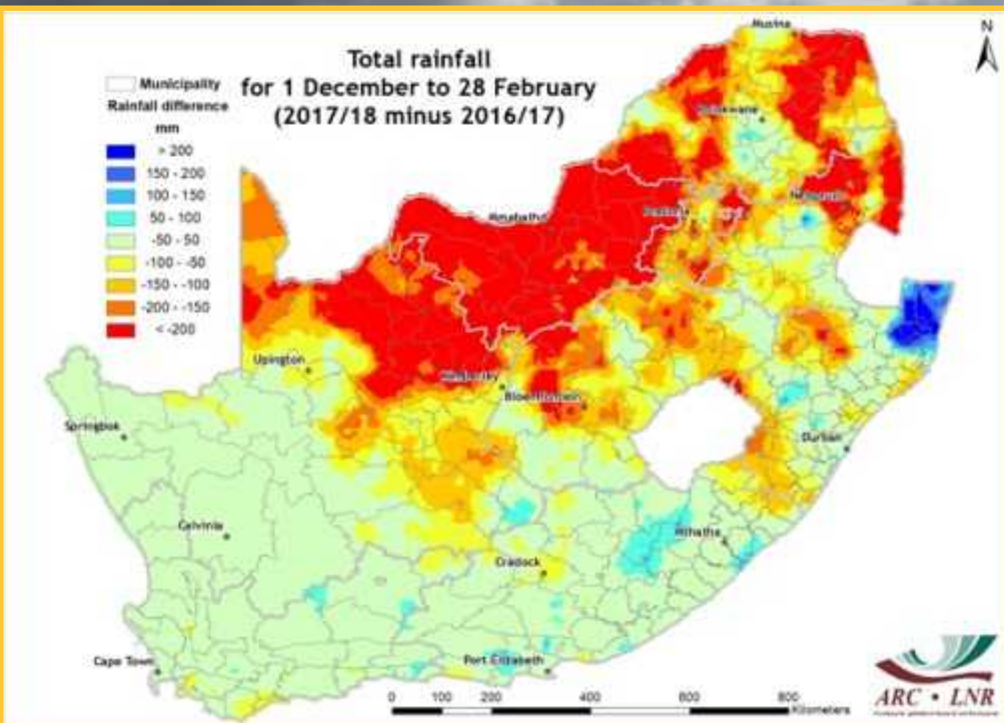


Figure 4

Figure 1:
The combination of ridging high pressure systems and the presence of tropical lows to the north of the country resulted in above-normal rainfall over the northeastern parts of the country. Rainfall totals of up to 240 mm occurred over northeastern Limpopo. Most of the remainder of the summer rainfall region received rainfall exceeding 50 mm, with some areas in central to southeastern South Africa receiving between 150-200 mm of rainfall.

Figure 2:
Above-normal rainfall occurred over parts of the western, central, southern and southeastern interior as well as over the far northeastern parts of the country. A cut-off low that developed towards the middle of the month contributed to the above-normal rainfall over the western, southern, southeastern and central parts. Tropical circulation was mostly responsible for the above-normal rainfall over northeastern South Africa.

Figure 3:
Over the past 8 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 and February 2018. Over the summer rainfall region, the eastern parts received near-normal rainfall over most areas. Interesting to note is that the Lowveld of Mpumalanga received below-normal rainfall, whilst areas over the Limpopo Lowveld received above-normal rainfall.

Figure 4:
December 2017 to February 2018 was much drier than the corresponding period a year ago over the northeastern parts of the country, extending westwards into the maize producing regions of North West and some parts of the Free State. Over the remainder of the country, apart from the extreme northern part of KwaZulu-Natal that received more rainfall during the current 3-month period, rainfall differences between the two years were small.

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 relief on the 6-month time scale compared to the 12-month time scale. After the above-normal rainfall during January and February 2018 over the southeastern 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

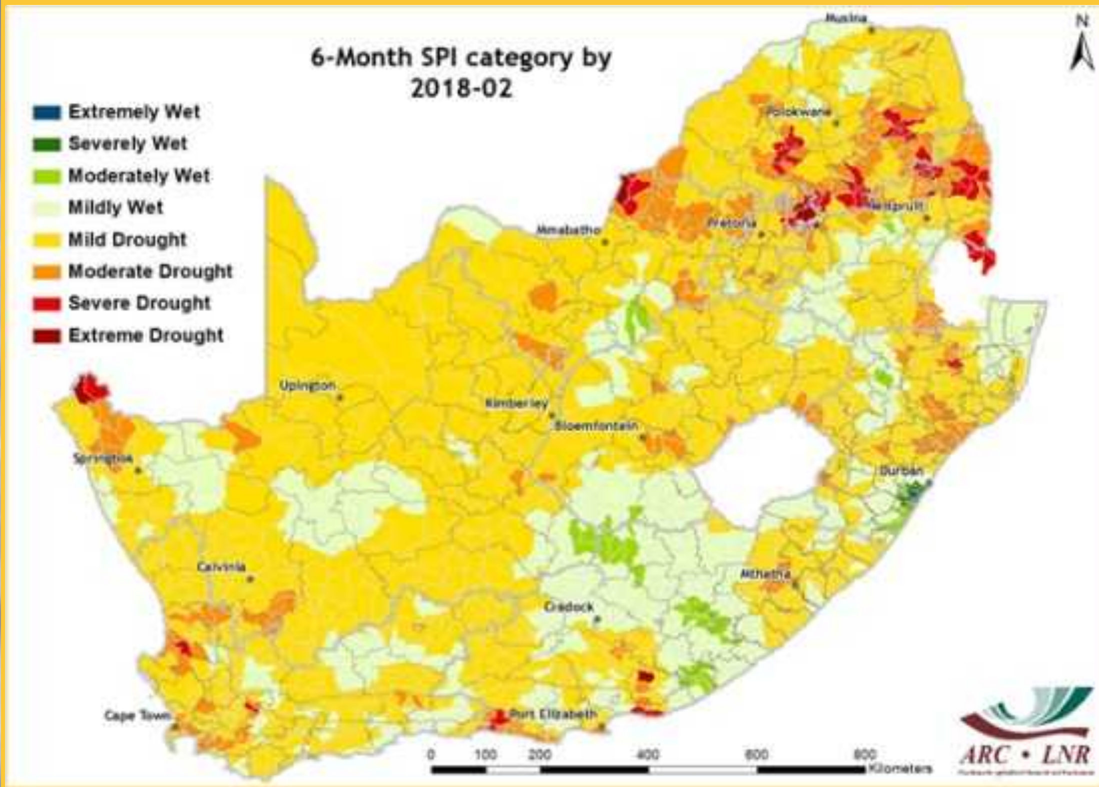


Figure 5

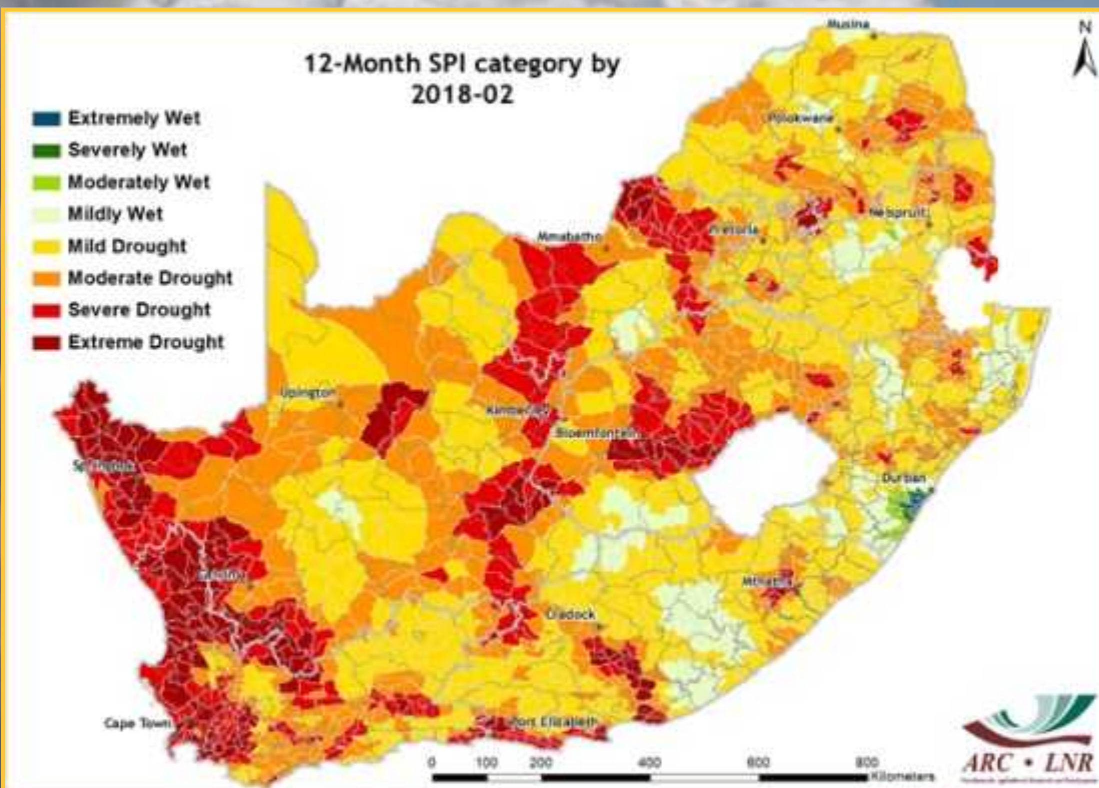


Figure 6

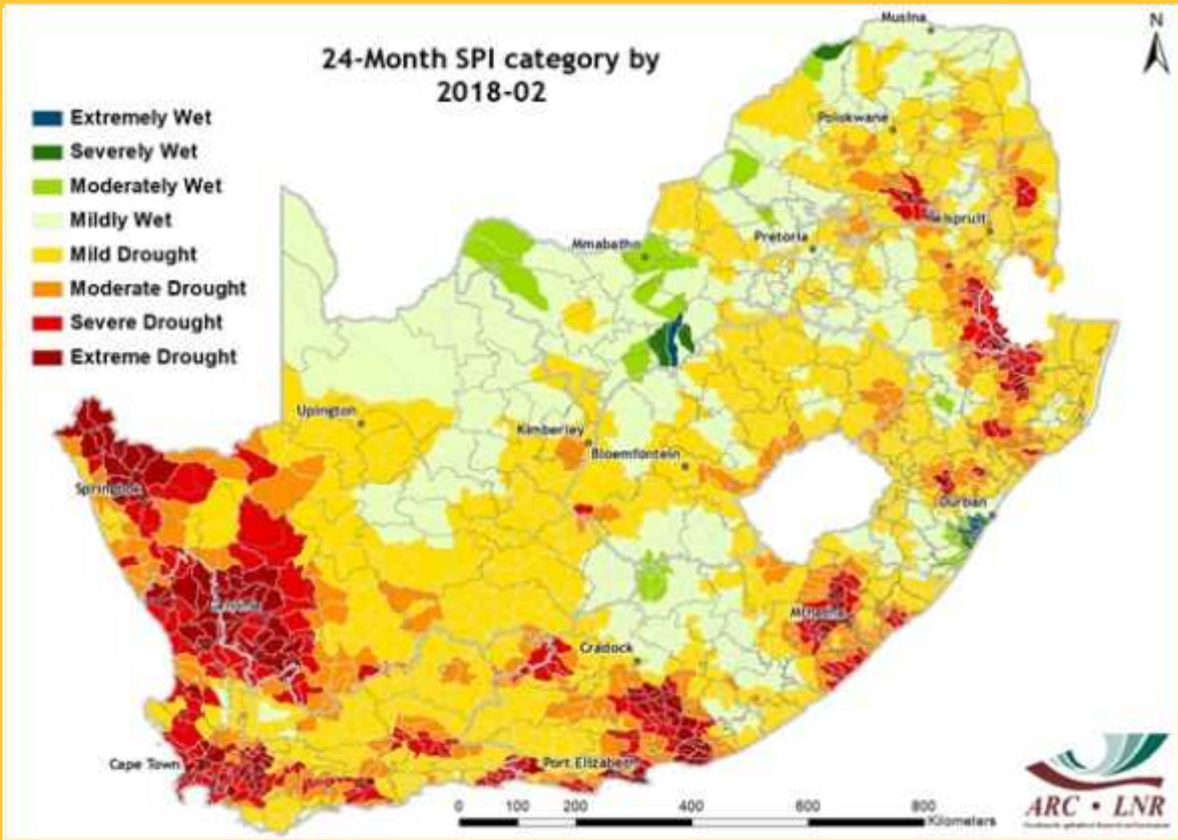


Figure 7

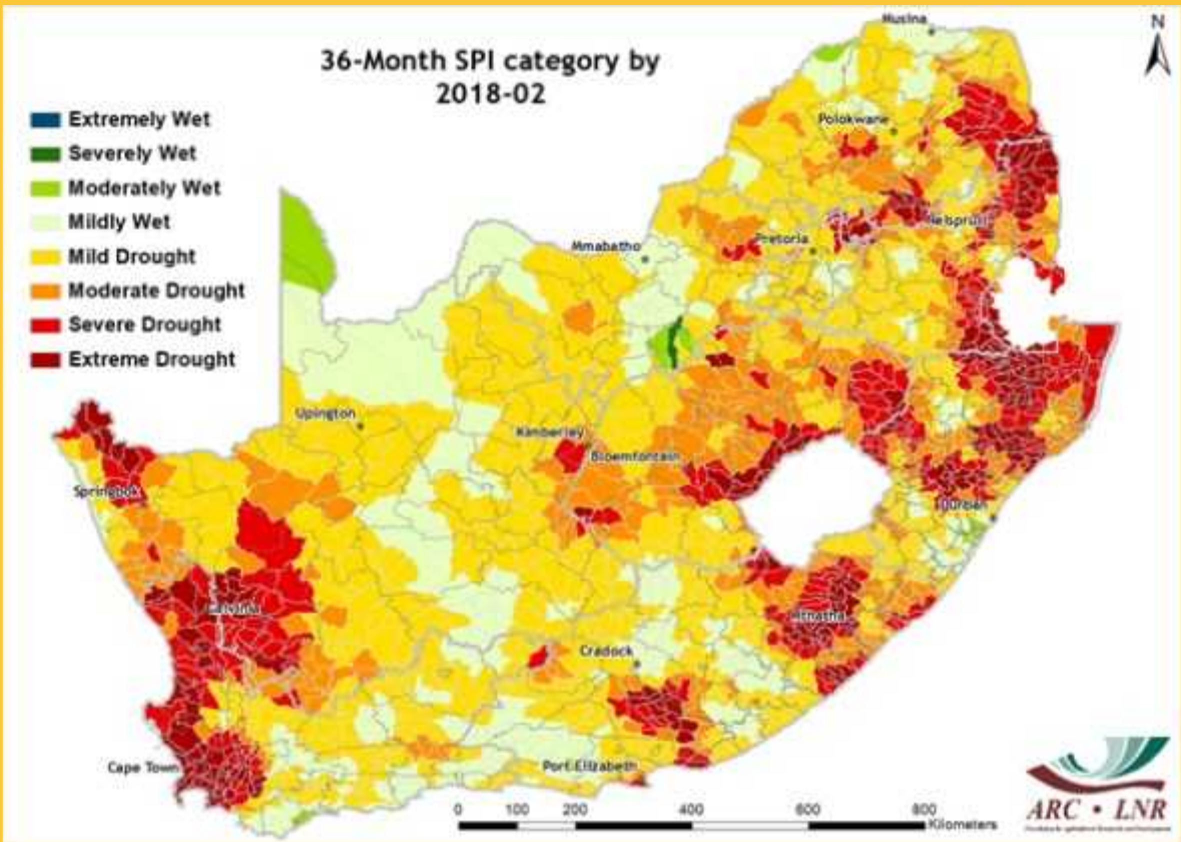


Figure 8

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.

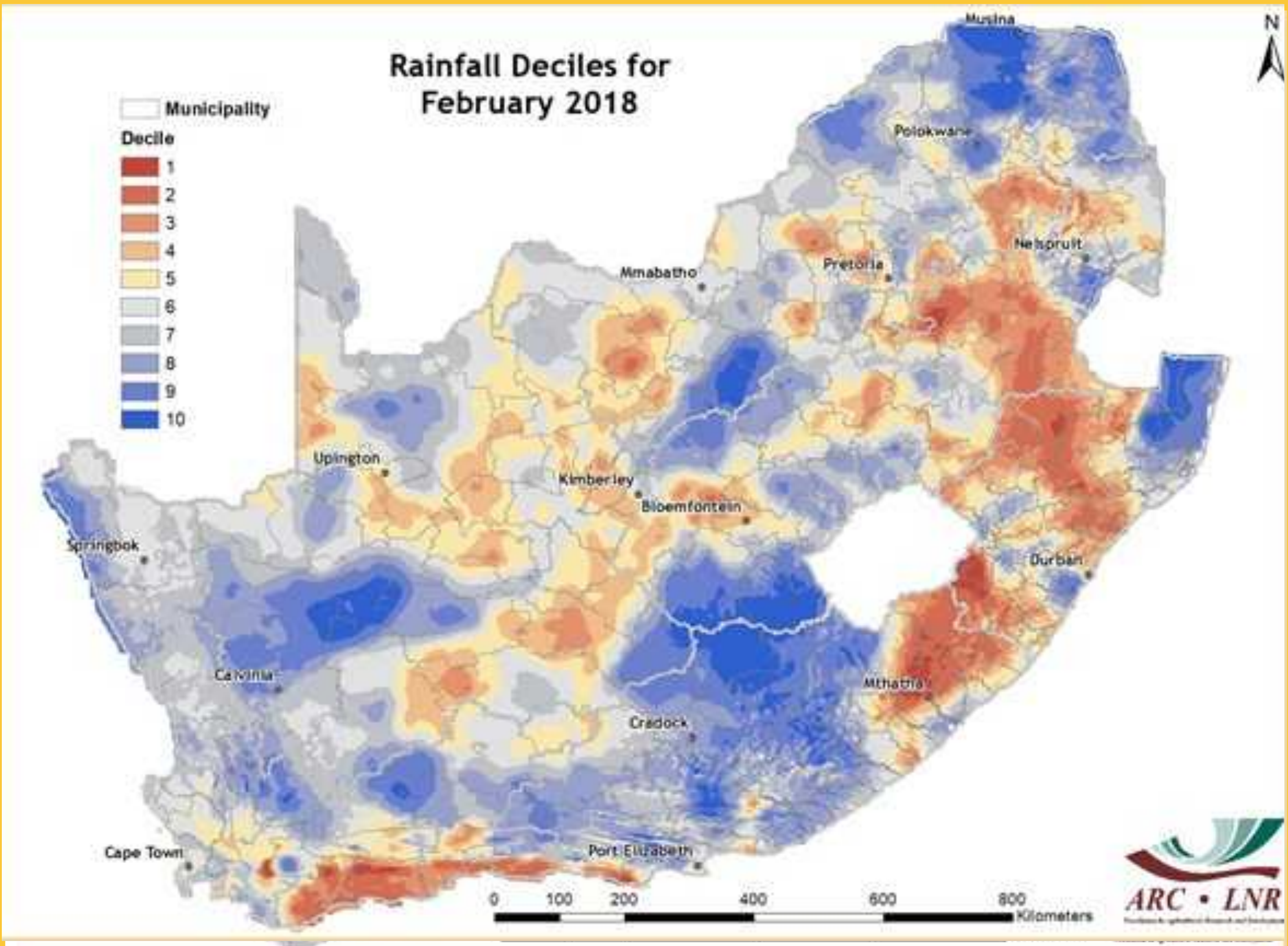


Figure 9

Figure 9:
Compared to historical rainfall totals during the month of February, February 2018 over the northeastern parts of the country as well as over the western and southern to southeastern interior experienced rainfall totals that fall within the wetter February months. Noteworthy are the February rainfall totals over the Cape south coast and parts of the eastern interior which compare well with drier February 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.

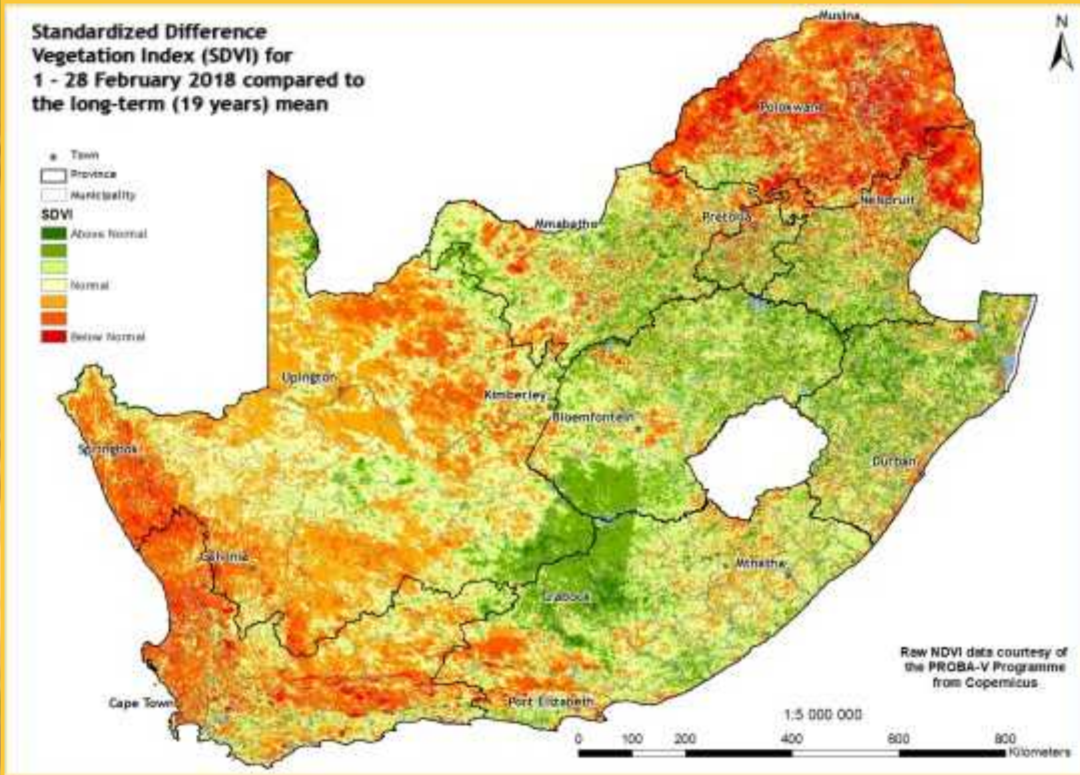


Figure 10

Figure 10:
Above-normal vegetation activity occurred over most parts in KwaZulu-Natal, Free State, Eastern Cape, and some isolated areas in North West and the lower lying areas of Mpumalanga. Extremely dry conditions were prevalent over much of Limpopo, Western Cape, Northern Cape, and some distinct areas in Eastern Cape and northeastern Mpumalanga.

Figure 11:
Distinct areas in KZN, Eastern Cape and isolated areas in the Free State and Mpumalanga experienced above-normal vegetation activity. Meanwhile, dry conditions occurred in Limpopo, northeastern Northern Cape, Free State, northeastern Mpumalanga and some distinct areas in the Western Cape.

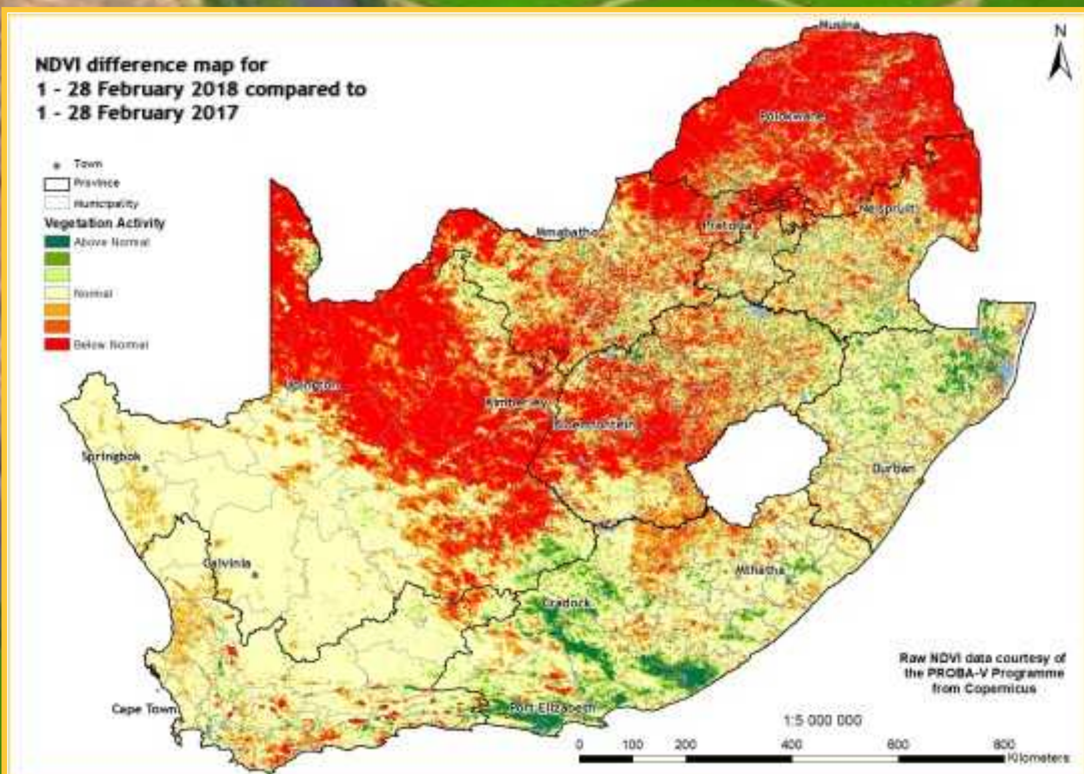


Figure 11

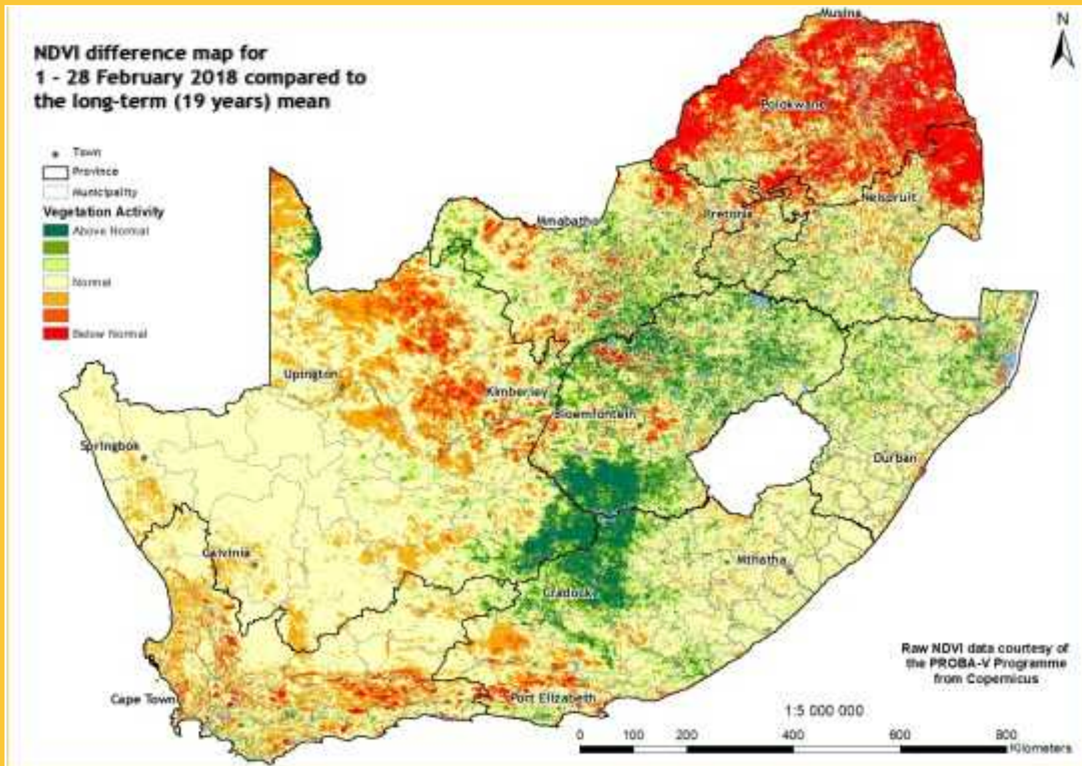


Figure 12

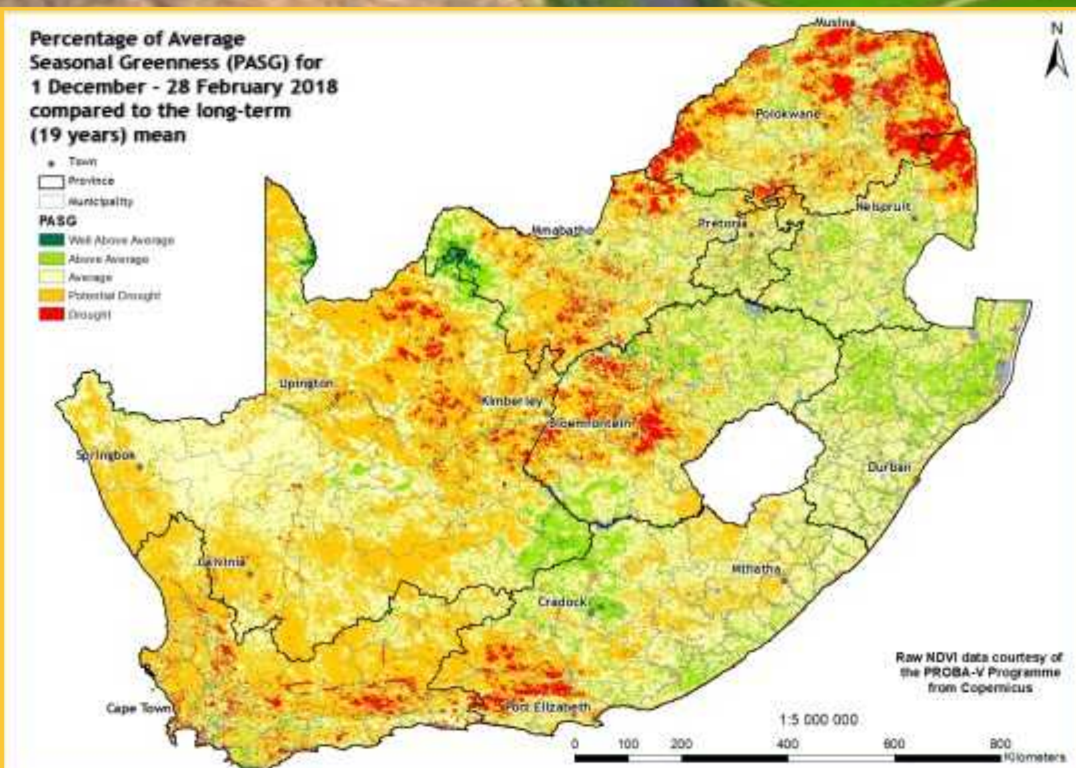


Figure 13

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 12:
Most areas in Limpopo, the northeastern parts of Mpumalanga, and some isolated areas in the upper Northern and Western Cape experienced below-normal vegetation activity. Distinct areas of the Eastern Cape, Free State, North West and KwaZulu-Natal experienced high vegetation activity during February.

Figure 13:
The PASG map for February indicates that above-average vegetation activity occurred over much of KZN, lower lying areas of Mpumalanga, and northeastern Gauteng. Dry spells hit isolated areas in Limpopo, Western Cape, Northern Cape, Free State, North West and northeastern parts of Mpumalanga.

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.

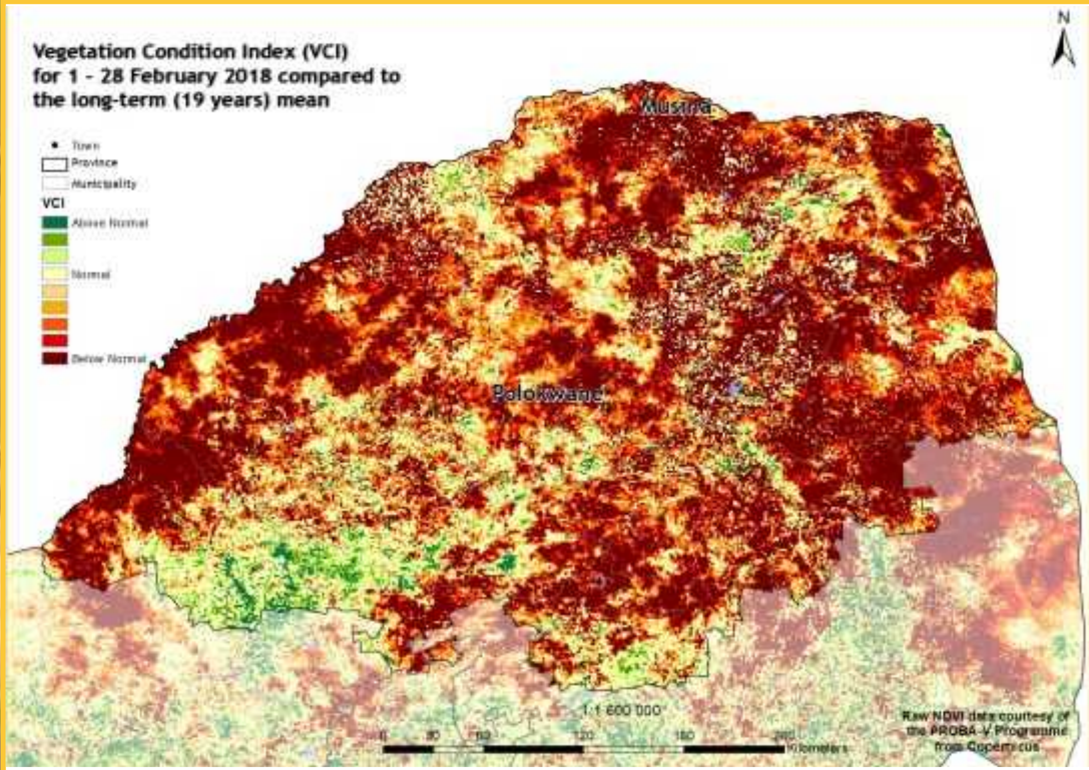


Figure 14

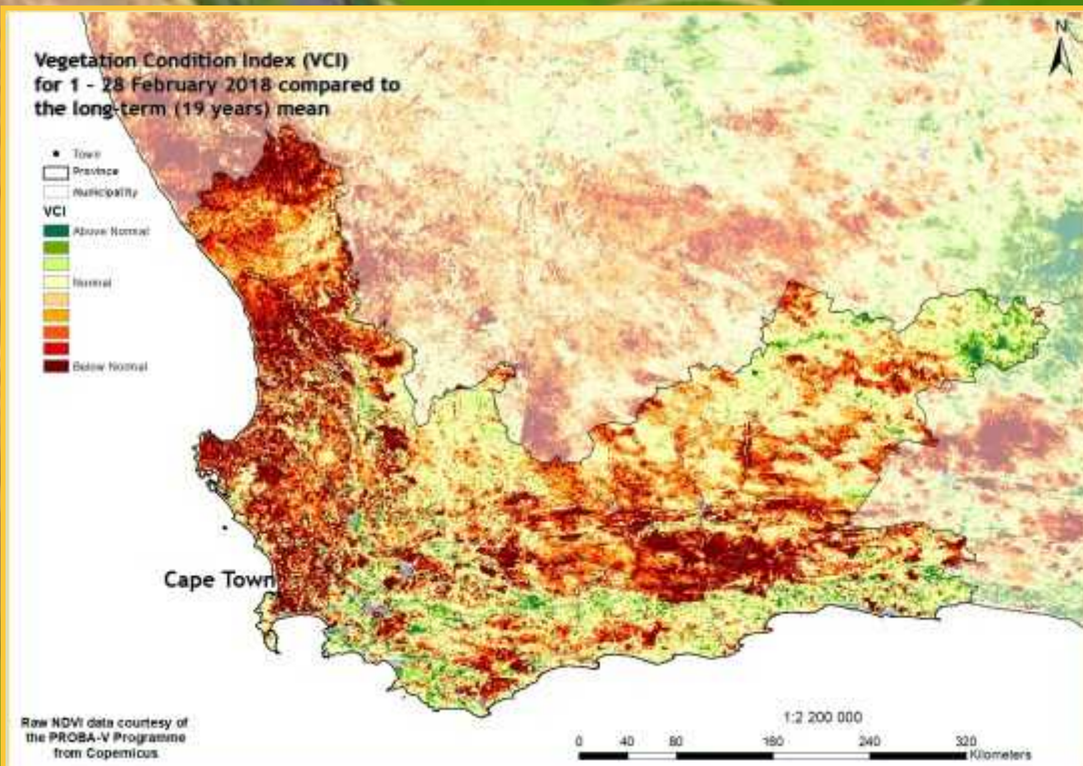


Figure 15

Figure 14:
The VCI map for February indicates below-normal vegetation activity over most of the Limpopo Province.

Figure 15:
The VCI map for February indicates that the majority of the Western Cape continued to experience dry conditions in February.

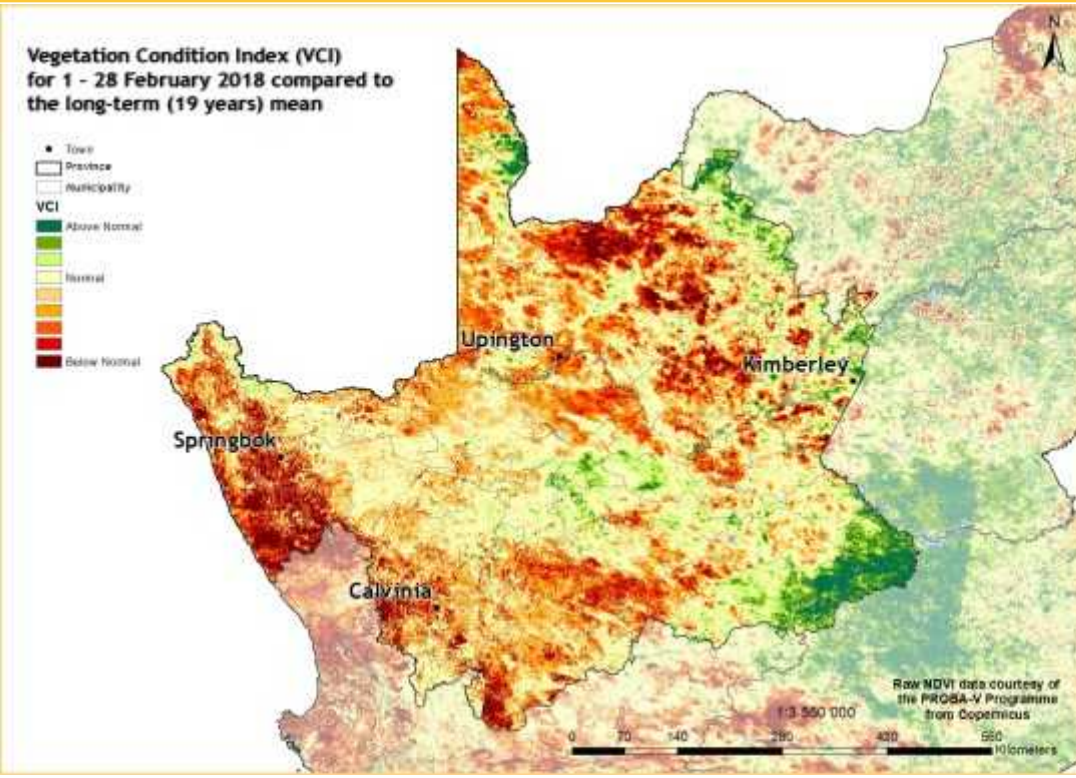


Figure 16

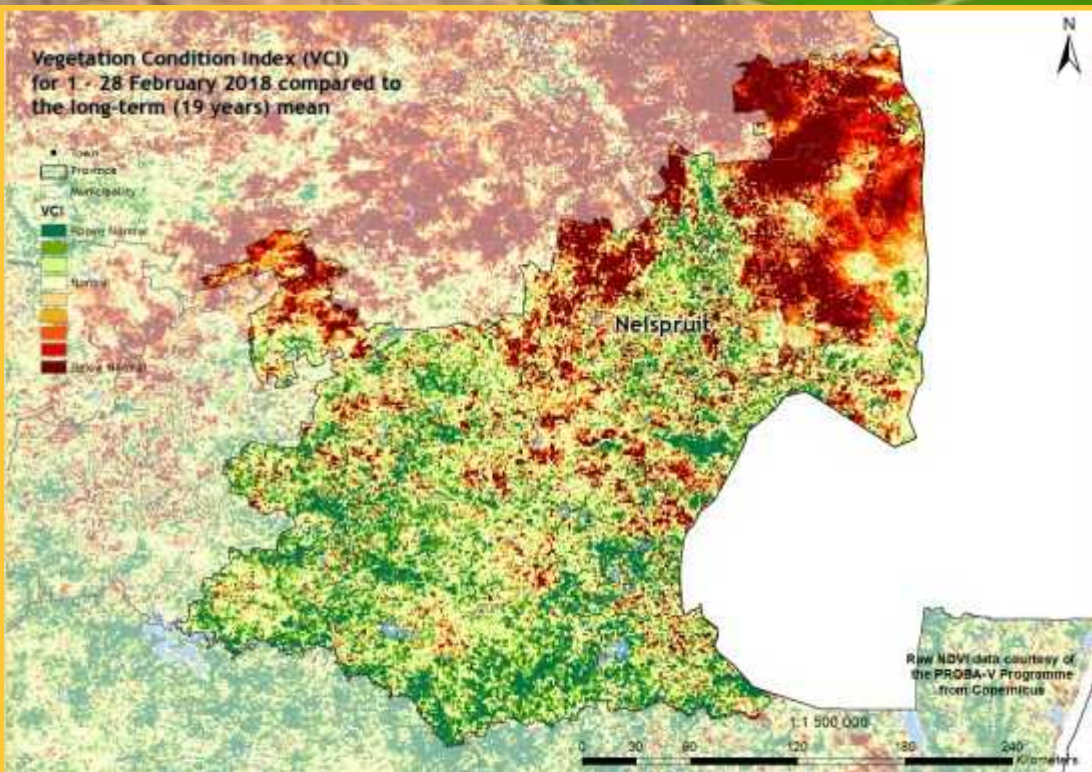


Figure 17

Figure 16:
The VCI map for February indicates low vegetation activity over most of the Northern Cape, except for the far eastern parts.

Figure 17:
The VCI map for February indicates below-normal vegetation activity over the northeastern parts of Mpumalanga.

Questions/Comments:
MaakeR@arc.agric.za

6. Vegetation Conditions & Rainfall

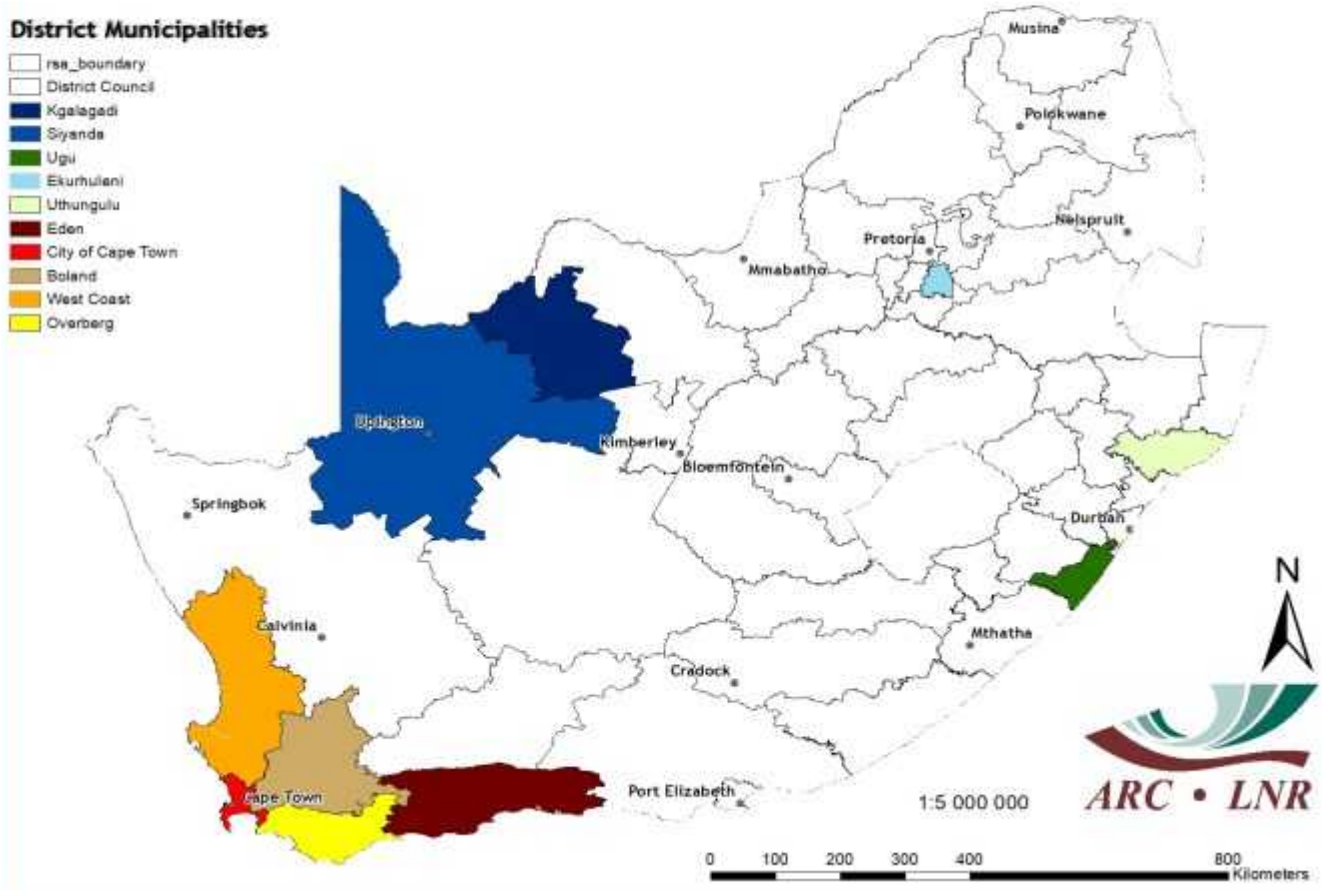


Figure 18

NDVI and Rainfall Graphs
Figure 18:
Orientation map showing the areas of interest for February 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.

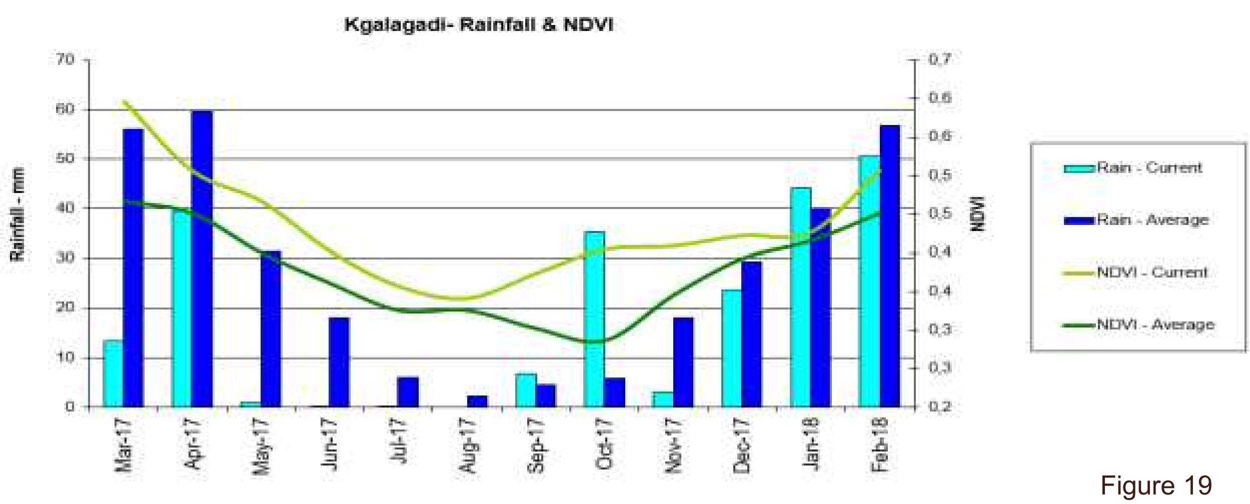


Figure 19

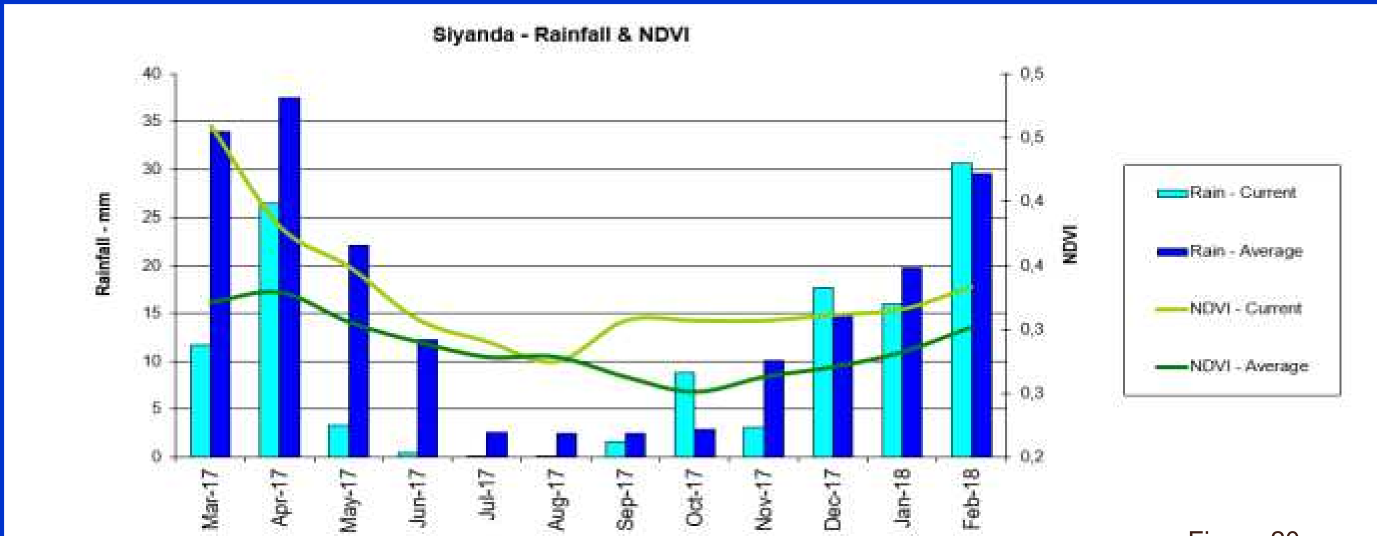


Figure 20

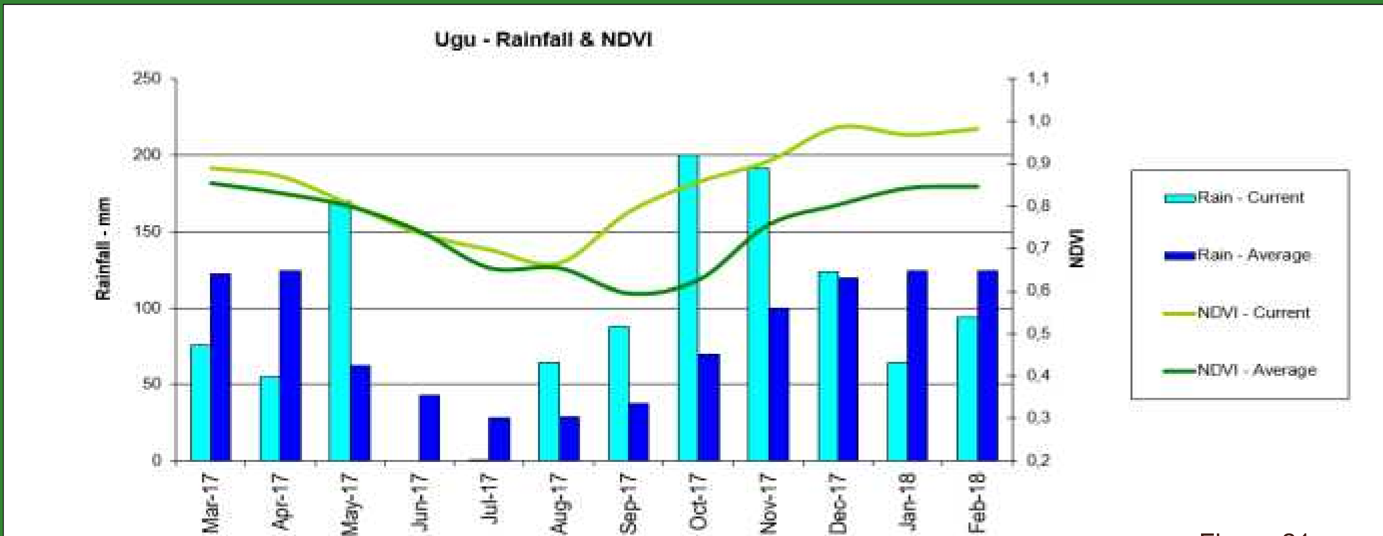


Figure 21

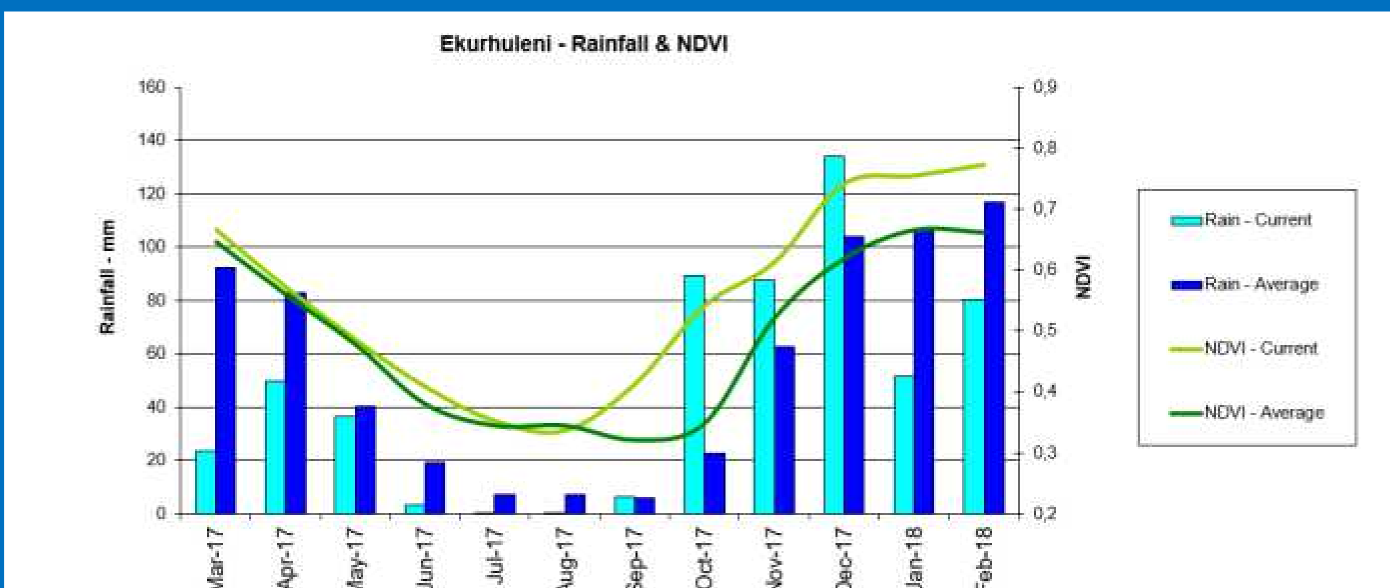


Figure 22

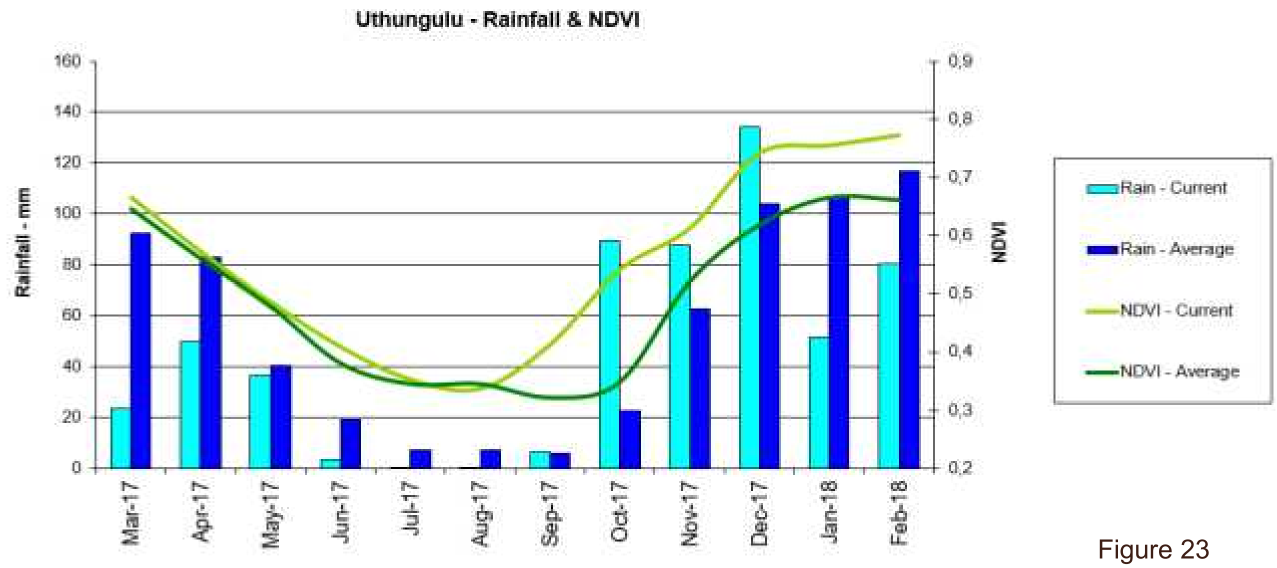


Figure 23

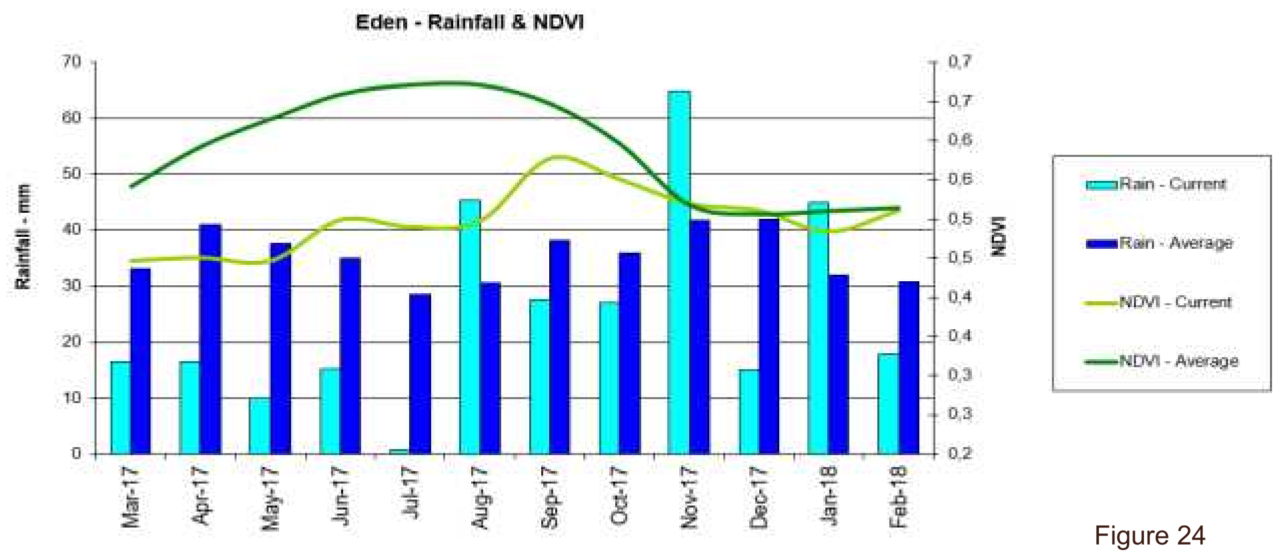


Figure 24

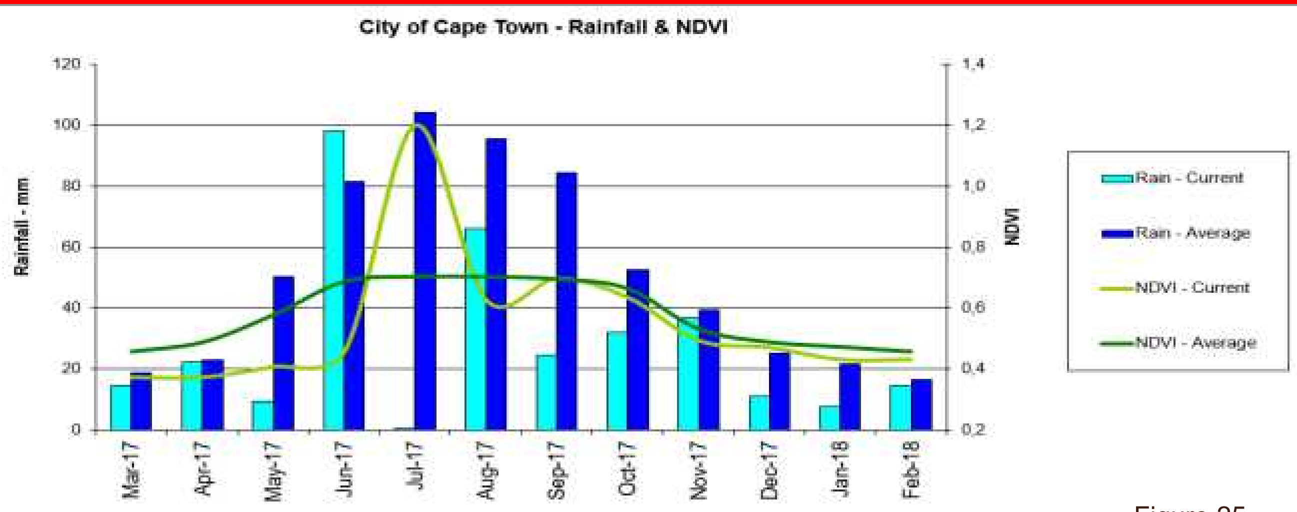


Figure 25

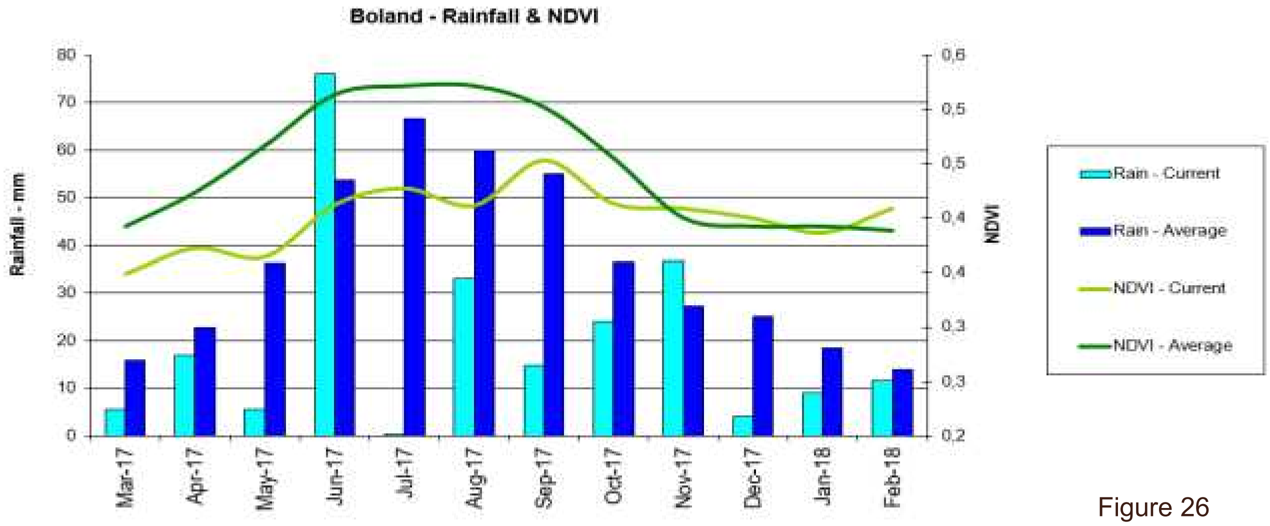


Figure 26

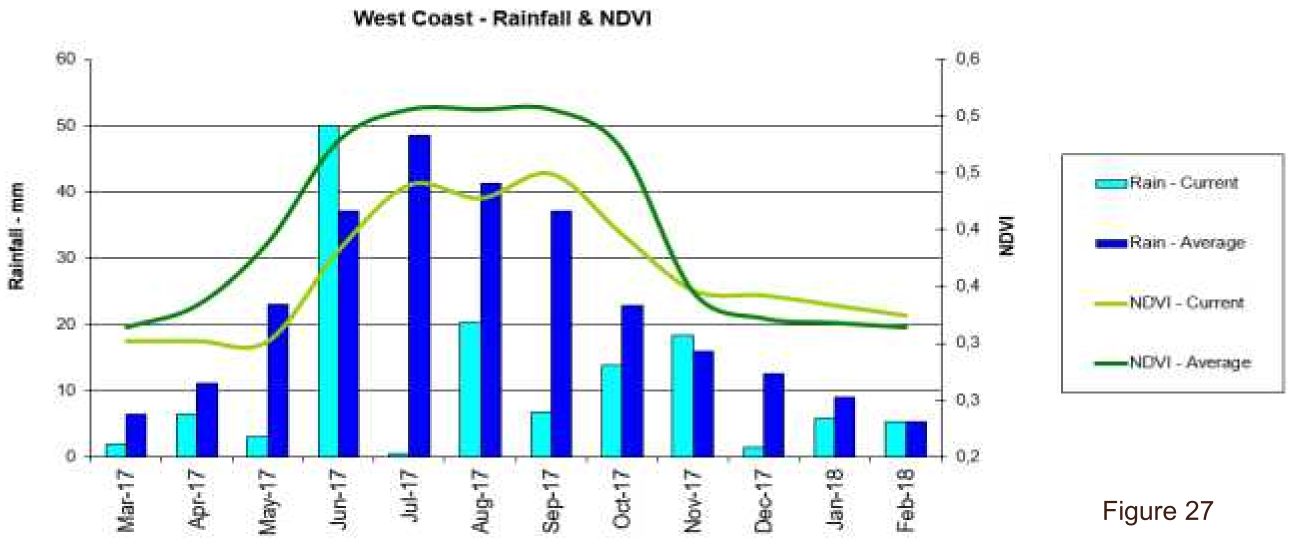


Figure 27

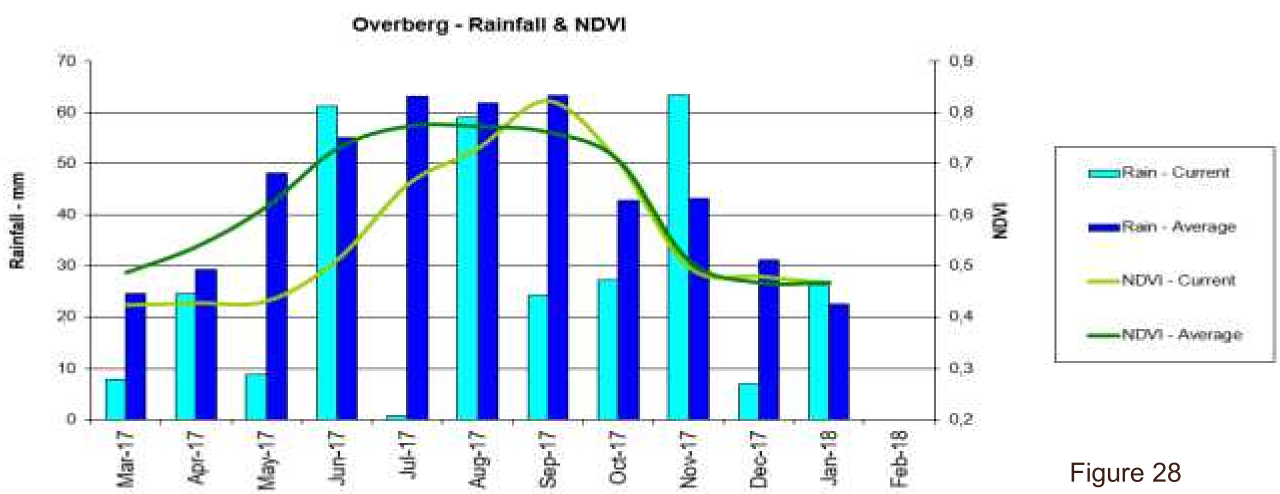


Figure 28

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 February per province. Fire activity was higher in the Western Cape compared to the average during the same period for the last 18 years.

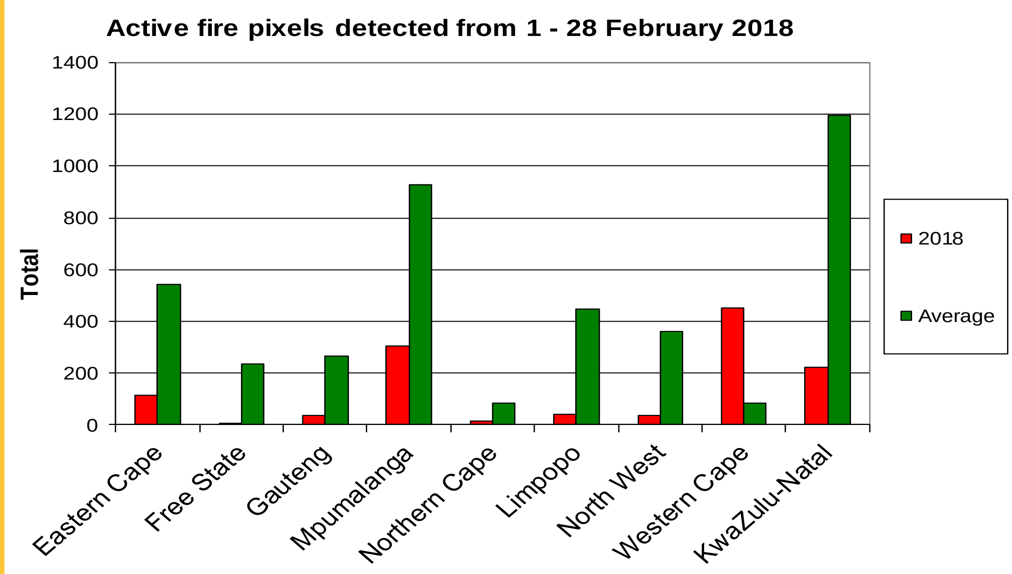


Figure 29

Figure 30:
The map shows the location of active fires detected between 1-28 February 2018.

Figure 30

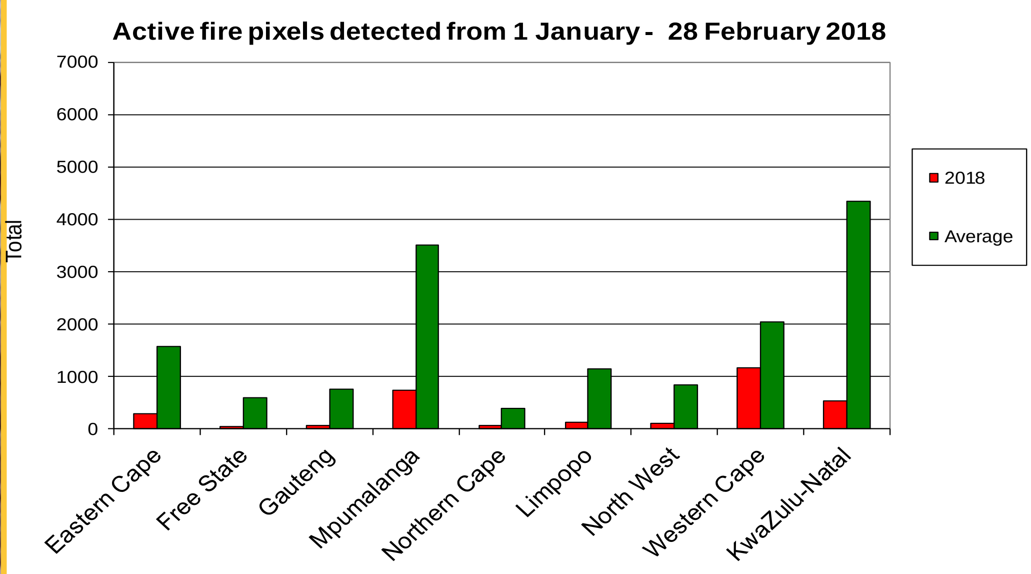


Figure 31

Figure 31:
The graph shows the total number of active fires detected from 1 January - 28 February per province. Fire activity was lower in all provinces compared to the average during the same period for the last 18 years.

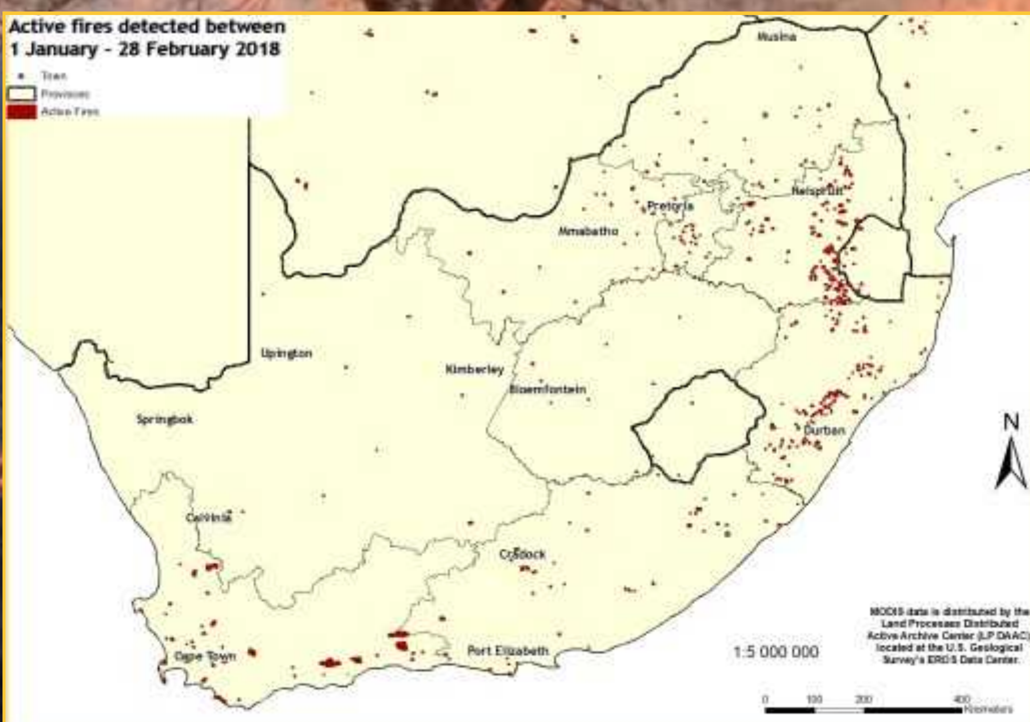


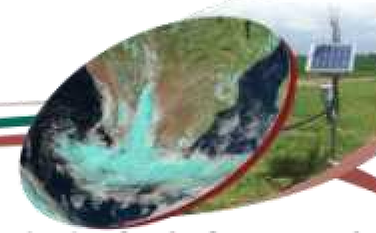
Figure 32

Figure 32:
The map shows the location of active fires detected between 1 January - 28 February 2018.

Questions/Comments:
MaakeR@arc.agric.za

Agrometeorology

ARC • LNR



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

ARC • LNR

The programme focuses on applied Geographical Information Systems (GIS) and Earth Observation (EO)/Remote Sensing research and provides leadership in applied GIS products, solutions, and decision support systems for agriculture and natural resources management. The Coarse Resolution Satellite Image Archive and Information Database is maintained as a national asset.

FOCUS AREAS

Decision Support Systems

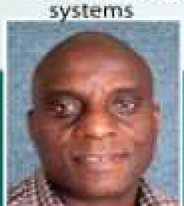
- Spatially explicit information dissemination systems, e.g. Umlindi newsletter
- Crop and land suitability modelling/assessments
- Disease and pest outbreaks and distribution modelling
- Precision agriculture information systems

Early Warning & Food Security

- Drought and vegetation production monitoring
- Crop estimates and yield modelling
- Animal biomass and grazing capacity mapping
- Global and local agricultural outlook forecasts
- Disaster monitoring for agricultural systems

Natural Resources Monitoring

- Land use/cover mapping
- Invasive species distribution
- Applications of GIS and EO on land degradation/erosion, desertification, hydrology and catchment areas
- Rangeland health assessments
- Carbon inventory monitoring



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

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

The Coarse Resolution Imagery Database (CRID)

NOAA AVHRR

The ARC-ISCW has an archive of daily NOAA AVHRR data dating from 1985 to 2004. This database includes all 5 bands as well as the Normalized Difference Vegetation Index (NDVI), Active Fire and Land Surface Temperature (LST) images. The NOAA data are used, for example, for crop production and grazing capacity estimation.

MODIS

MODIS data is distributed by the Land Processes Distributed Active Archive Center (LP DAAC), located at the U.S. Geological Survey's EROS Data Center. The MODIS sensor is more advanced than NOAA with regard to its high spatial (250 m^2 to 1 km^2) and spectral resolution. The ARC-ISCW has an archive of MODIS (version 4 and 5) data.

- MODIS v4 from 2000 to 2006
- MODIS v5 from 2000 to present

Datasets include:

- MOD09 (Surface Reflectance)
- MOD11 (Land Surface Temperature)
- MOD13 (Vegetation Products)
- MOD14 (Active Fire)
- MOD15 (Leaf Area Index & Fraction of Photosynthetically Active Radiation
- MOD17 (Gross Primary Productivity)
- MCD43 (Albedo & Nadir Reflectance)
- MCD45 (Burn Scar)

Coverage for version 5 includes South Africa, Namibia, Botswana, Zimbabwe and Mozambique.
More information:
http://modis.gsfc.nasa.gov

VGT4AFRICA and GEOSUCCESS

SPOT NDVI data is provided courtesy of the VEGETATION Programme and the VGT4AFRICA project. The European Commission jointly developed the VEGETATION Programme. The VGT4AFRICA project disseminates VEGETATION products in Africa through GEONETCast.

ARC-ISCW has an archive of VEGETATION data dating from 1998 to the present. Other products distributed through VGT4AFRICA and GEOSUCCESS include Net Primary Productivity, Normalized Difference Wetness Index and Dry Matter Productivity data.

Meteosat Second Generation (MSG)

The ARC-ISCW has an operational MSG receiving station. Data from April 2005 to the present have been archived. MSG produces data with a 15-minute temporal resolution for the entire African continent. Over South Africa the spatial resolution of the data is in the order of 3 km. The ARC-ISCW investigated the potential for the development of products for application in agriculture. NDVI, LST and cloud cover products were some of the initial products derived from the MSG SEVIRI data. Other products derived from MSG used weather station data, including air temperature, humidity and solar radiation.

Rainfall maps

- Combined inputs from 450 automatic weather stations from the ARC-ISCW weather station network, 270 automatic rainfall recording stations from the SAWS, satellite rainfall estimates from the Famine Early Warning System Network: **http://earlywarning.usgs.gov** and long-term average climate surfaces developed at the ARC-ISCW.

Solar Radiation and Evapotranspiration maps

- Combined inputs from 450 automatic weather stations from the ARC-ISCW weather station network.
- Data from the METEOSAT Second Generation (MSG) 3 satellite via GEONETCAST: **http://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/GEONETCast/index.html**.

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

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:
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”.

http://www.agis.agric.za

Disclaimer:
The ARC-ISCW and its collaborators have obtained data from sources believed to be reliable and have made every reasonable effort to ensure accuracy of the data. The ARC-ISCW and its collaborators cannot assume responsibility for errors and omissions in the data nor in the documentation accompanying them. The ARC-ISCW and its collaborators will not be held responsible for any consequence from the use or misuse of the data by any organization or individual.