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CONTENTS:

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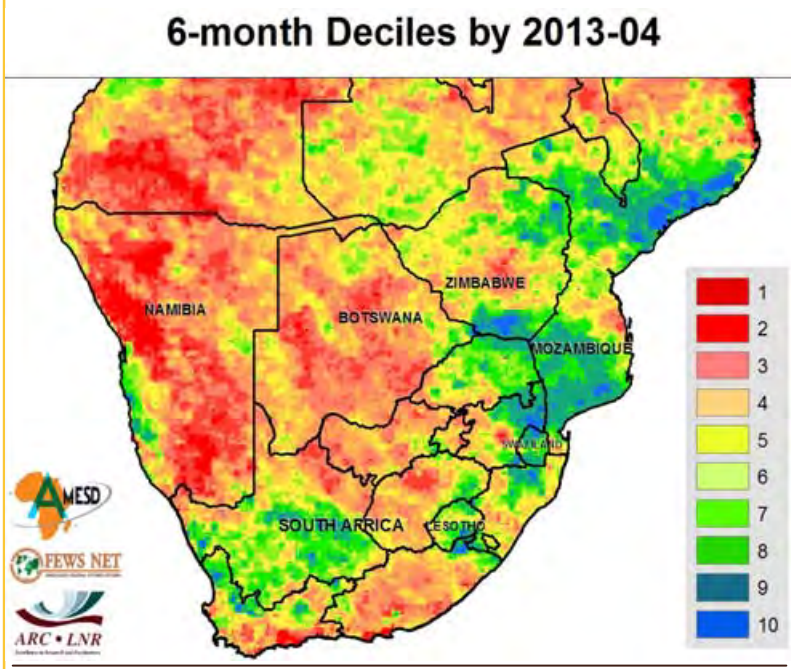
South African Weather Service

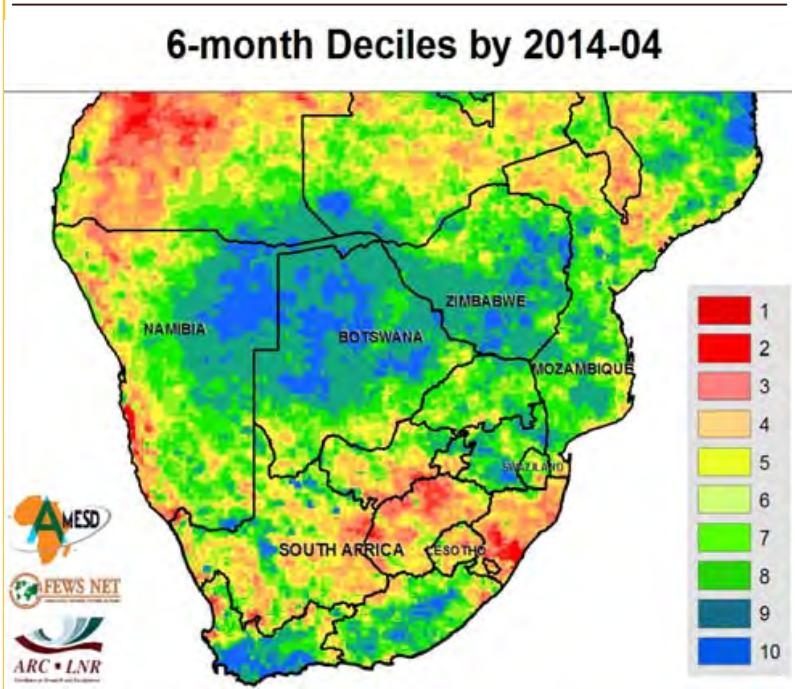
AMESD

119h Edition

2013/14 rainfall - a large improvement to the previous summer across much of southern Africa

November to April constitutes the brunt of the summer rainfall season across much of southern Africa, especially towards the west and southwest. Agricultural activities are to a large extent reliant on sufficient rainfall during this period. The 6-month rainfall decile maps show that conditions during much of the 2013/14 summer were more favourable than during 2012/13. The red on the maps (deciles 1, 2 and 3) represents areas where the rainfall did not exceed that recorded during the driest 30% of the years since 1980. The blue areas (deciles 9 and 10) are those where the rainfall equalled or exceeded that measured during the wettest 20% of those years.





The wet conditions during much of the December-March period over South Africa this summer were to a large extent associated with active tropical lows from Zimbabwe to northern Namibia. Much of the same area was anomalously dry during 2012/13. The wetter conditions during late summer across northern and central South Africa, coupled with a lack of extreme cold outbreaks during April, have resulted in a much more positive outlook for maize production over the western maize production area as opposed to last year when dry conditions had an adverse impact on yields.

The rainfall decile maps were created using a drought monitoring system developed for the African Monitoring of Environment for Sustainable Development (AMESD) project by the ARC-ISCW. Data used are satellite and rainfall station derived rainfall estimates available from the Famine Early Warning Systems Network (FEWS NET).

Questions/Comments:
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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:

Rainfall during April 2014 was very much above normal over the southern parts of the country while dry conditions dominated over the central interior. The western parts of the winter rainfall area, however, did not benefit much and were relatively dry. Temperatures remained fairly high during the month, with lower minimum temperatures and some frost over the southern and central parts around the 2nd and more significantly from the 23rd to the 27th. Most of the rainfall over the southern parts was associated with upper air cut-off low pressure systems also during these two periods, with which the colder conditions over the interior were associated.

Rainfall over the southern parts was in association with strengthening upper air troughs and cut-off lows resulting in heavy falls over especially the mountainous areas. The first cut-off low moved over the southern parts during the first few days of the month, resulting in widespread rain, while the surface cold front in association with the system resulted in relatively low minimum temperatures with isolated areas as far north as the northwestern Free State experiencing light frost. The upper air trough also resulted in fairly widespread thundershowers over parts of Limpopo and the adjacent regions around the 4th and 5th.

An upper air low developing towards the north over northern Botswana and moving into Namibia, together with a surface flow dominating from the east, resulted in thundershowers over parts of Namibia and Botswana, also affecting the northern parts of the Northern Cape by the 13th with isolated stations recording significant falls. The dominating flow from the east and upper air system to the northwest supported the flow of relatively large amounts of moisture over the northern and eastern parts and the second period of relatively widespread showers and thundershowers over the northeastern parts was experienced as an upper air low developed over the northeastern parts by the 16th and 17th.

From the 21st to the 25th, the development and strengthening of a second cut-off low over the southern parts resulted in widespread rain over much of the southern and central parts, with heavy falls especially over the southeastern parts, including much of the Eastern Cape. Colder conditions with frost in some places especially over the Free State and further south also started to dominate most of the interior from the 23rd as there was a surface influx of cold air associated with the low strengthening in the southeast. As the system in the southeast moved out, sunny and dry conditions returned, with a recovery in temperatures across the country.

Rainfall over the northeastern parts occurred in the form of thundershowers in association with strengthening upper air troughs over the region. The northeastern interior also sometimes benefitted from the effect of upper troughs strengthening especially towards the east.

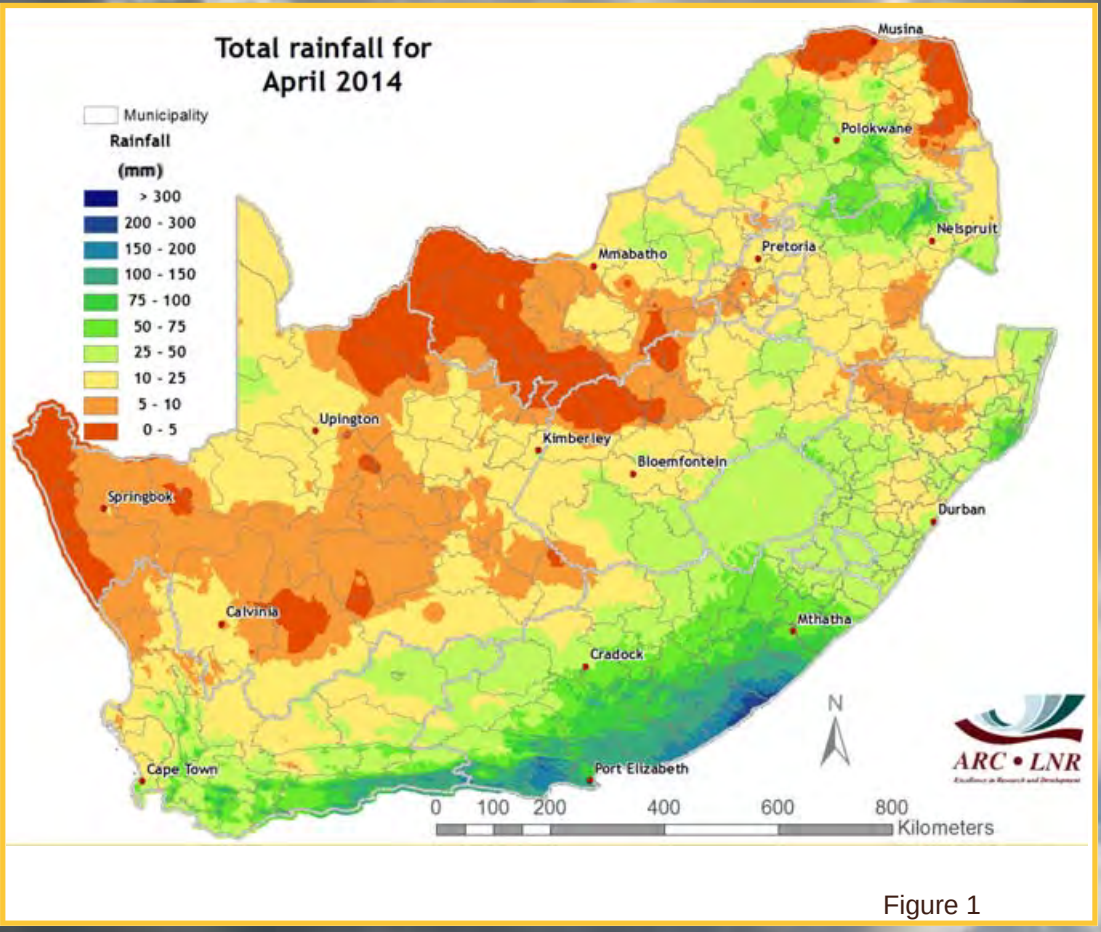

Figure 1

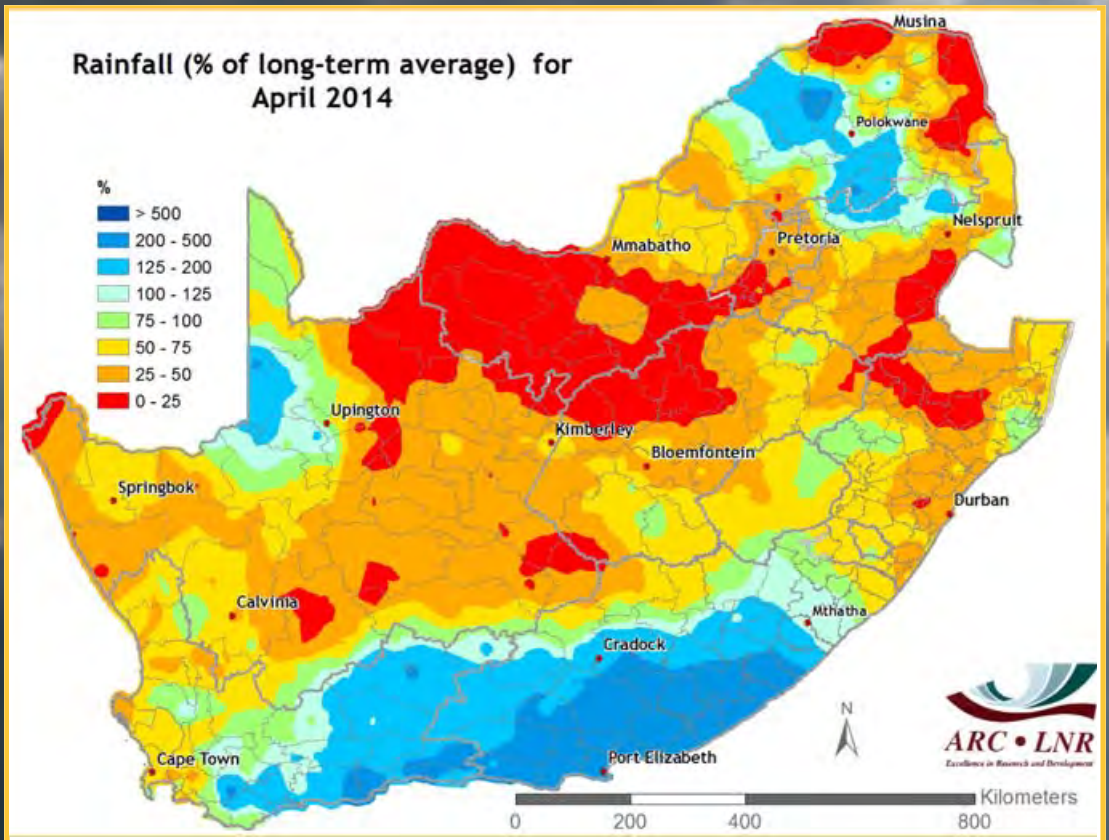

Figure 2

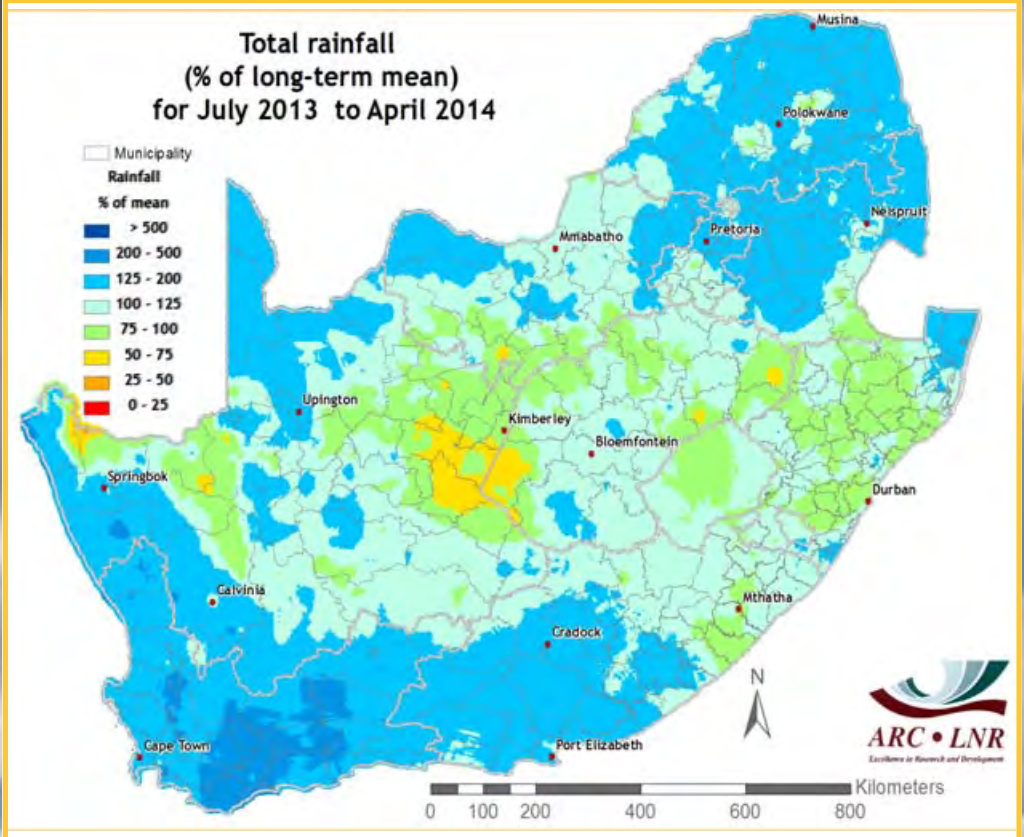

Figure 3

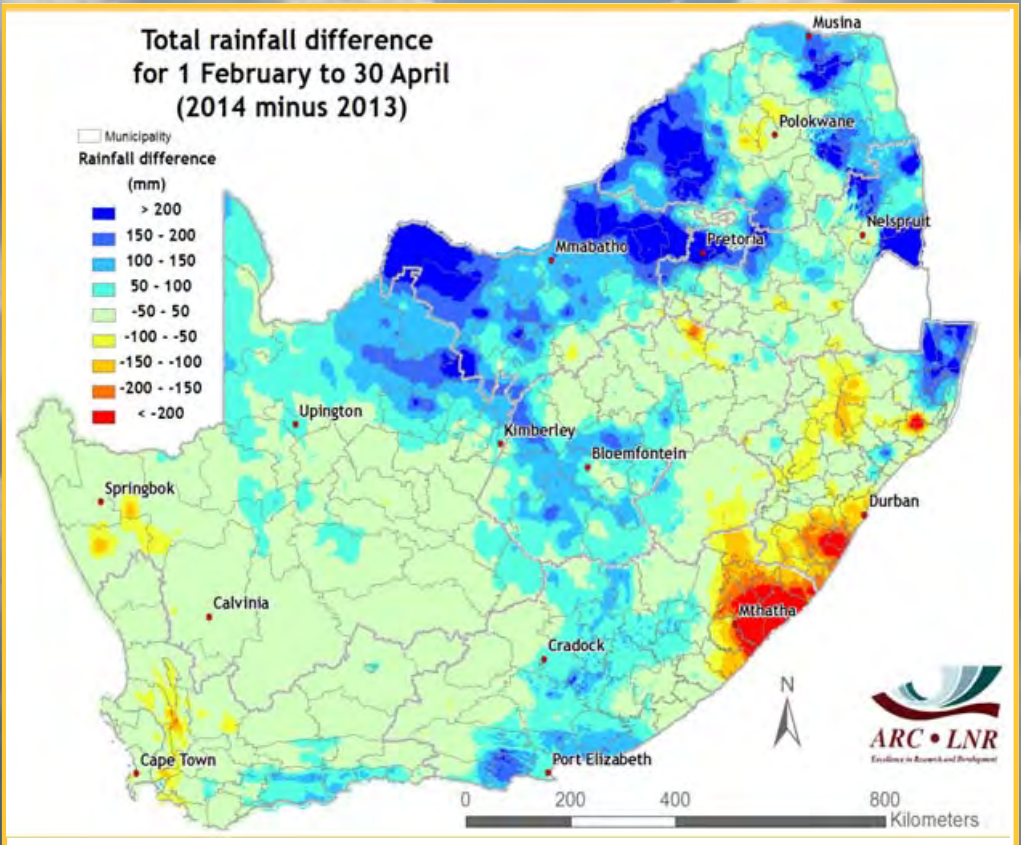

Figure 4

Figure 1:
Relatively high rainfall totals were recorded over the southern to south-eastern parts of the country during April, with some areas receiving more than 150 mm. The western parts of the winter rainfall area received very little rainfall with falls generally not exceeding 25 mm. Large parts of Limpopo received more than 25 mm or even more than 50 mm. The central parts of the country were relatively dry for this time of the year, with no rain recorded over parts of western and central North West.

Figure 2:
Rainfall was above normal over much of the southern and south-eastern parts as well as over parts of Limpopo and the northwestern Northern Cape. Below-normal rainfall occurred over much of the central interior and towards northern KwaZulu-Natal as well as the western parts of the winter rainfall area.

Figure 3:
Above-normal rainfall occurred over most of the country during the period July 2013 to April 2014. The largest positive deviations occurred over the southwestern parts of the country. A west-east stretching band, covering much of the eastern Northern Cape across the northern Free State and into central KwaZulu-Natal, received normal to below-normal rainfall.

Figure 4:
Much of the central, northern and northeastern summer rainfall area as well as the southern coastal areas and adjacent interior received more rain this year during the February-April period compared to last year, but the western winter rainfall region and the southern parts of KwaZulu-Natal as well as the north-eastern Eastern Cape were drier than last year.

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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.

The current SPI maps (Figures 5-8) indicate that drought conditions over the central parts of the country and especially towards the north have been replaced by anomalously wet conditions at the short time scale (3-6 months) due to widespread rain since December over many parts. At longer time scales (12-24 months), drought conditions are still in place over much of the central interior due to the earlier extended dry period while much of the northeastern parts of the country and the winter rainfall area remain exceptionally wet.

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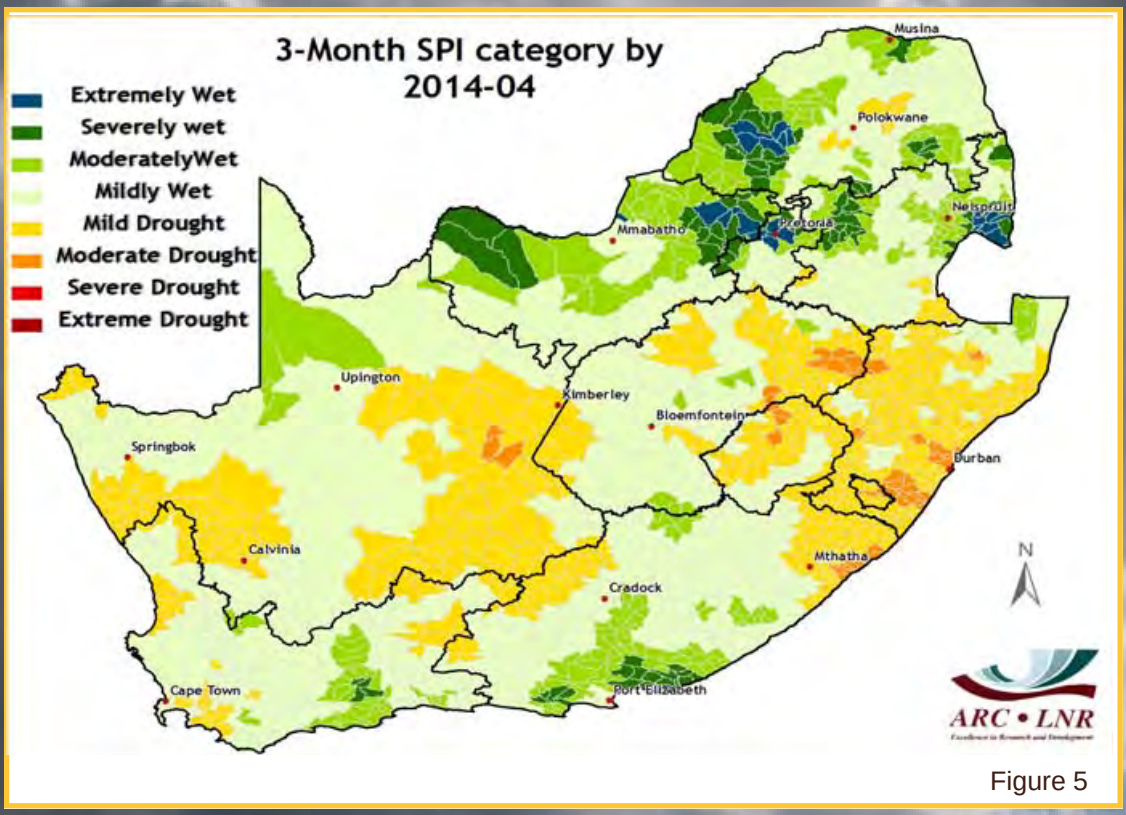

Figure 5

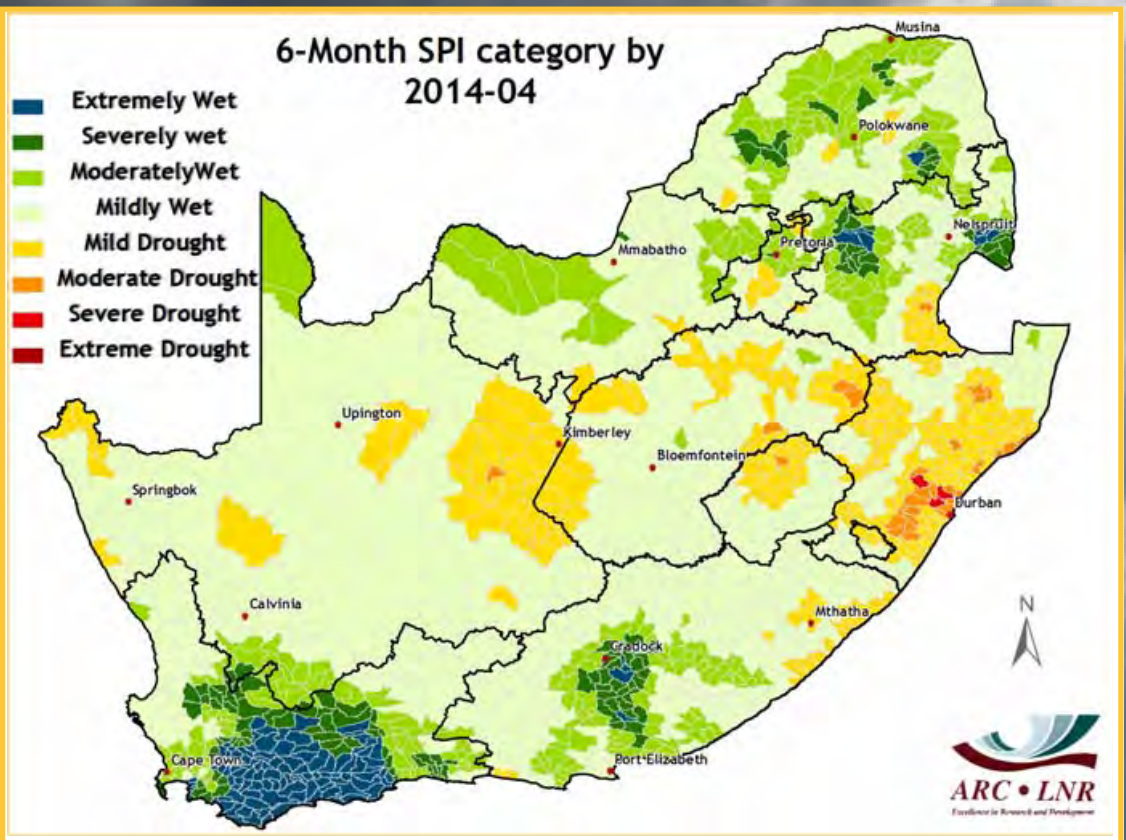

Figure 6

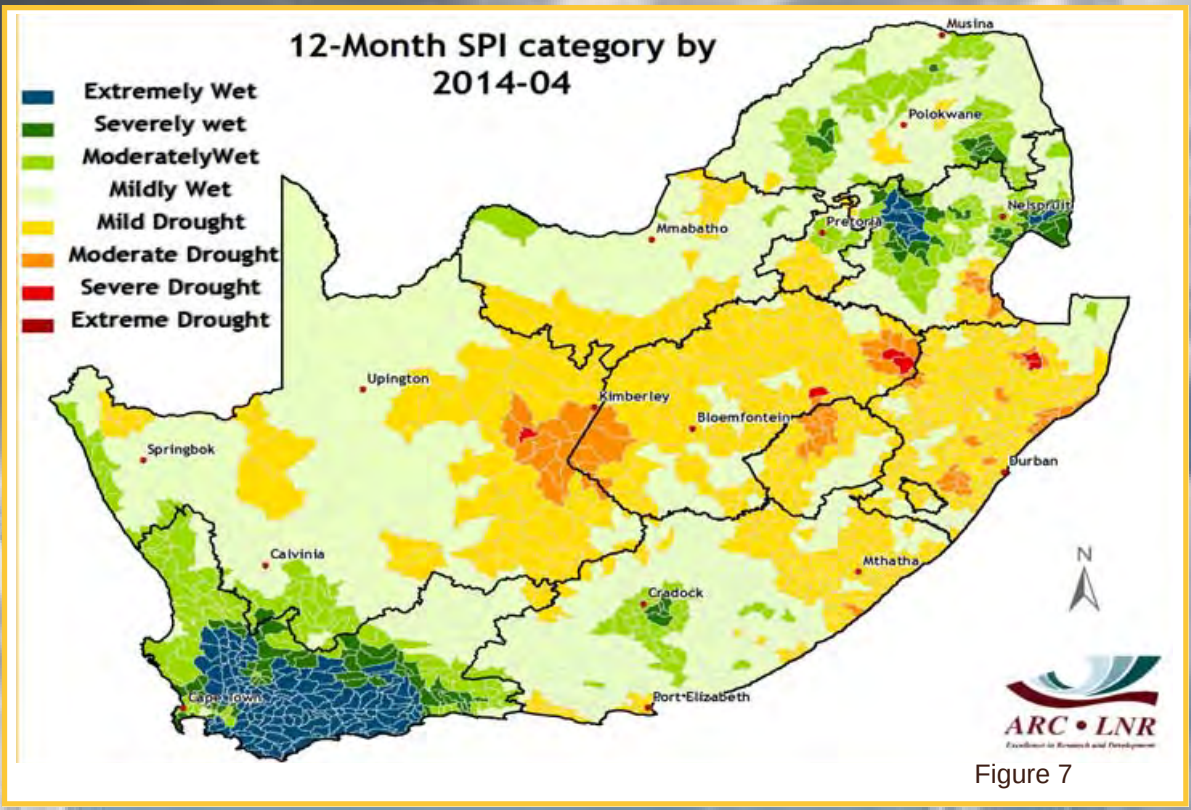

Figure 7

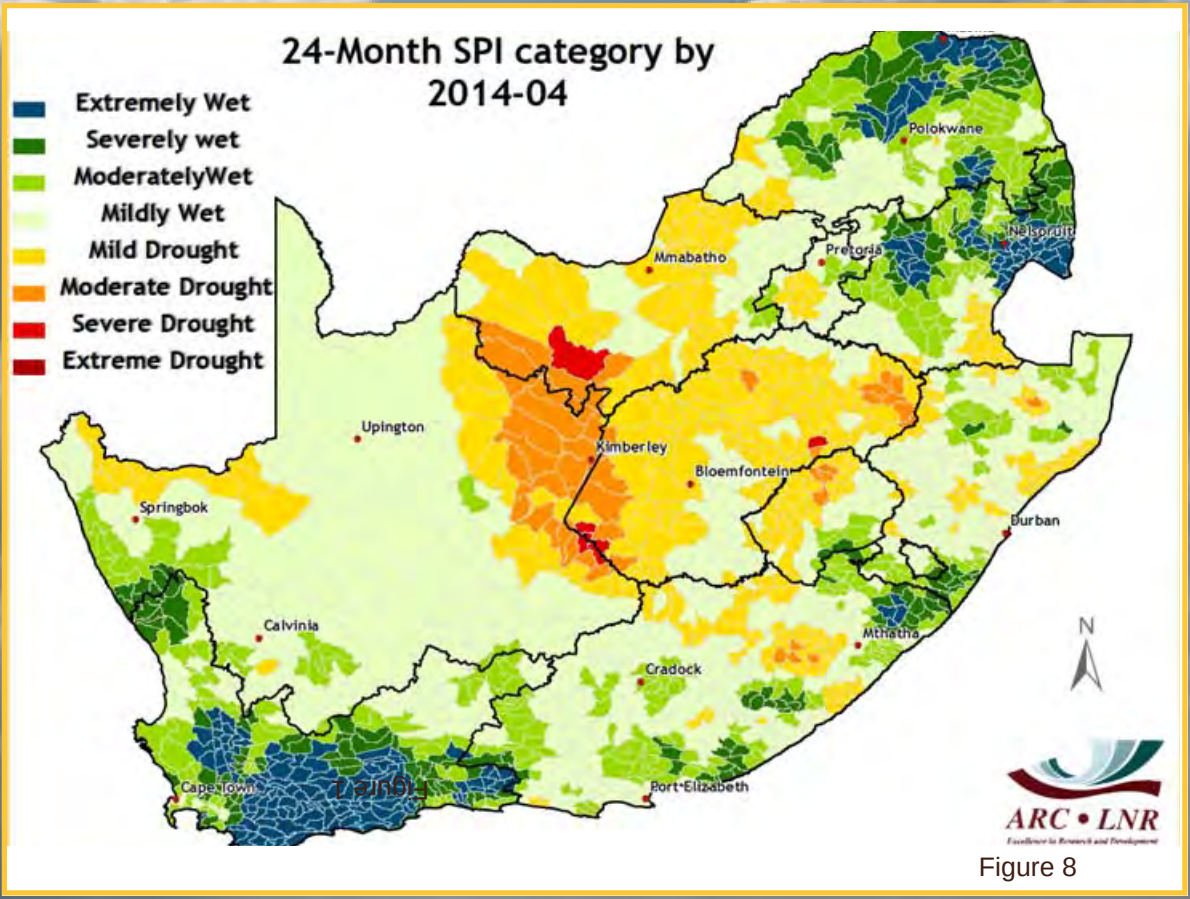

Figure 8

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.

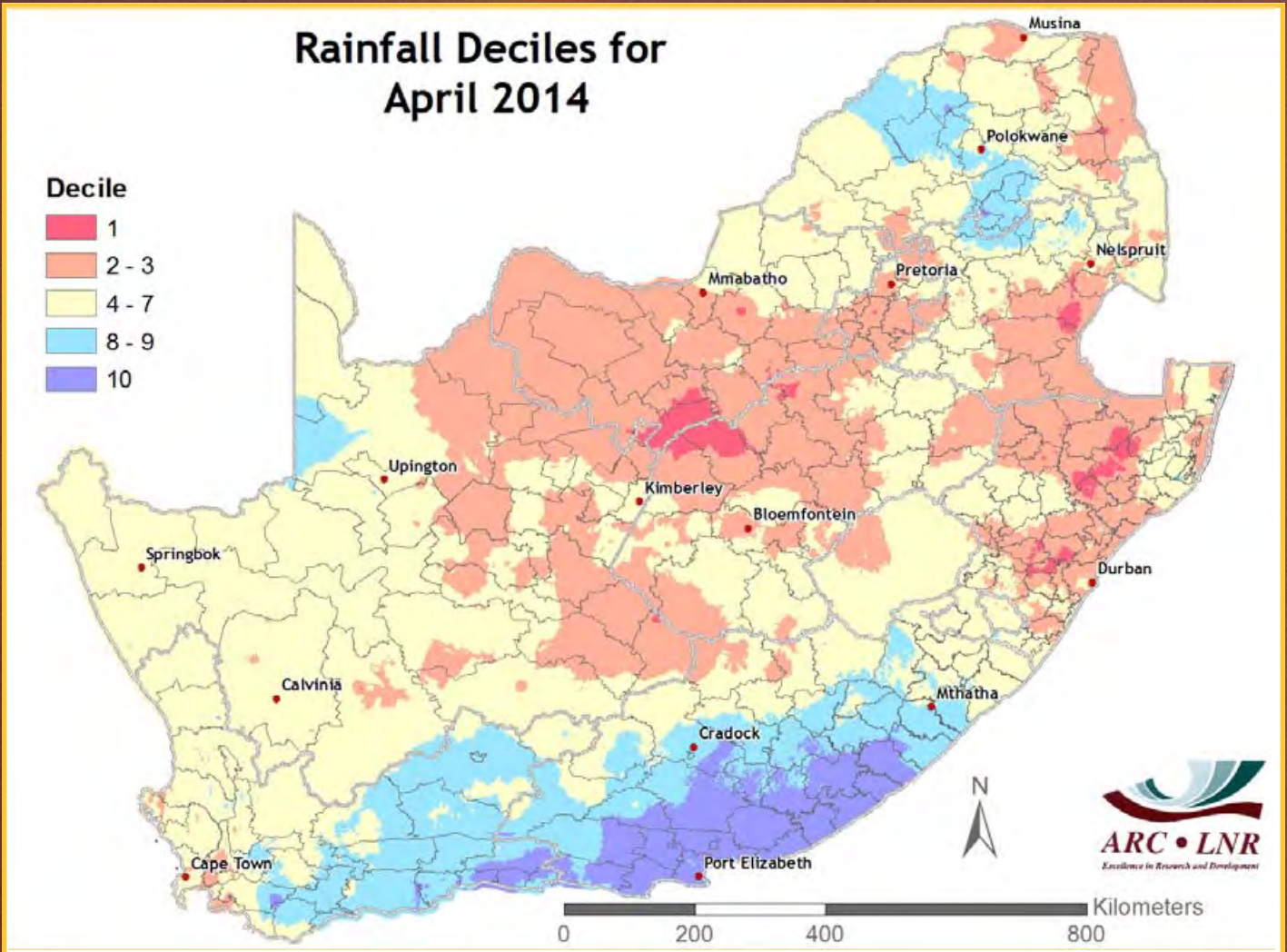

Figure 9

Figure 9:
The decile map indicates that April was exceptionally wet over the southeastern parts of the country, where rainfall was below normal during the previous month. The decile value of 10 indicates that rainfall there during April was equal to or exceeded that only experienced during the 10% wettest of April months on record, and possibly the highest on record in some places.

4. Water Balance

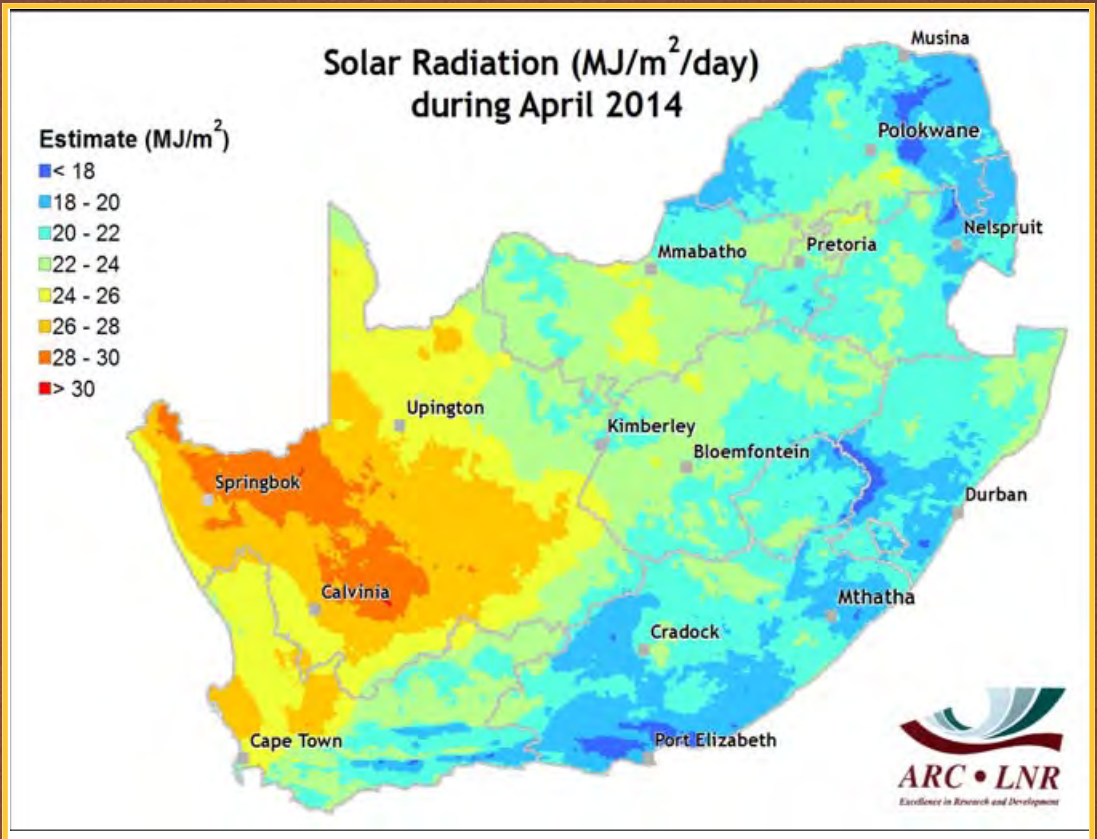

Figure 10

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:
Cloudy conditions over the eastern and southern to southeastern areas, associated with an easterly flow and movement of cut-off low pressure system over the southern parts, resulted in relatively low solar radiation values there while high values were reached over the western parts.

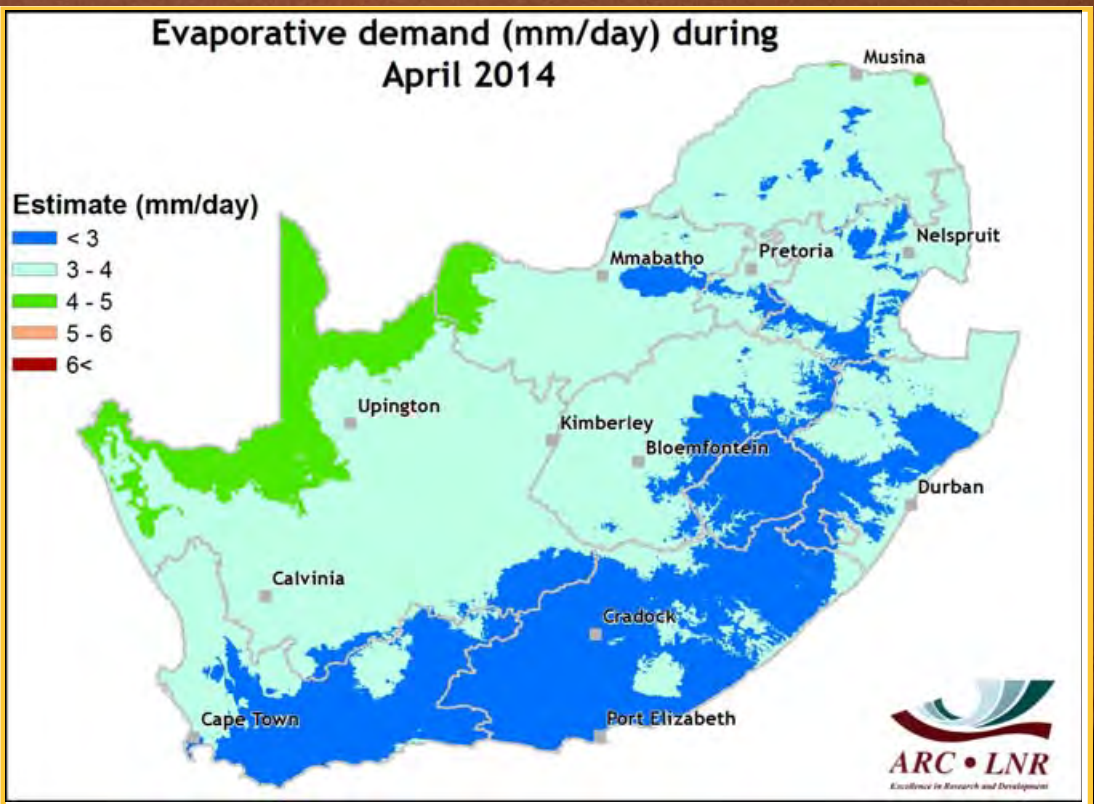

Figure 11

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:
Potential evaporation was low over the southeastern parts, increasing to higher values over the northwestern parts of the country, reflecting the effect of lower temperatures, higher cloud cover and higher relative humidity and a sharper angle of incident solar rays over the southeastern parts as opposed to the northweastern 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.

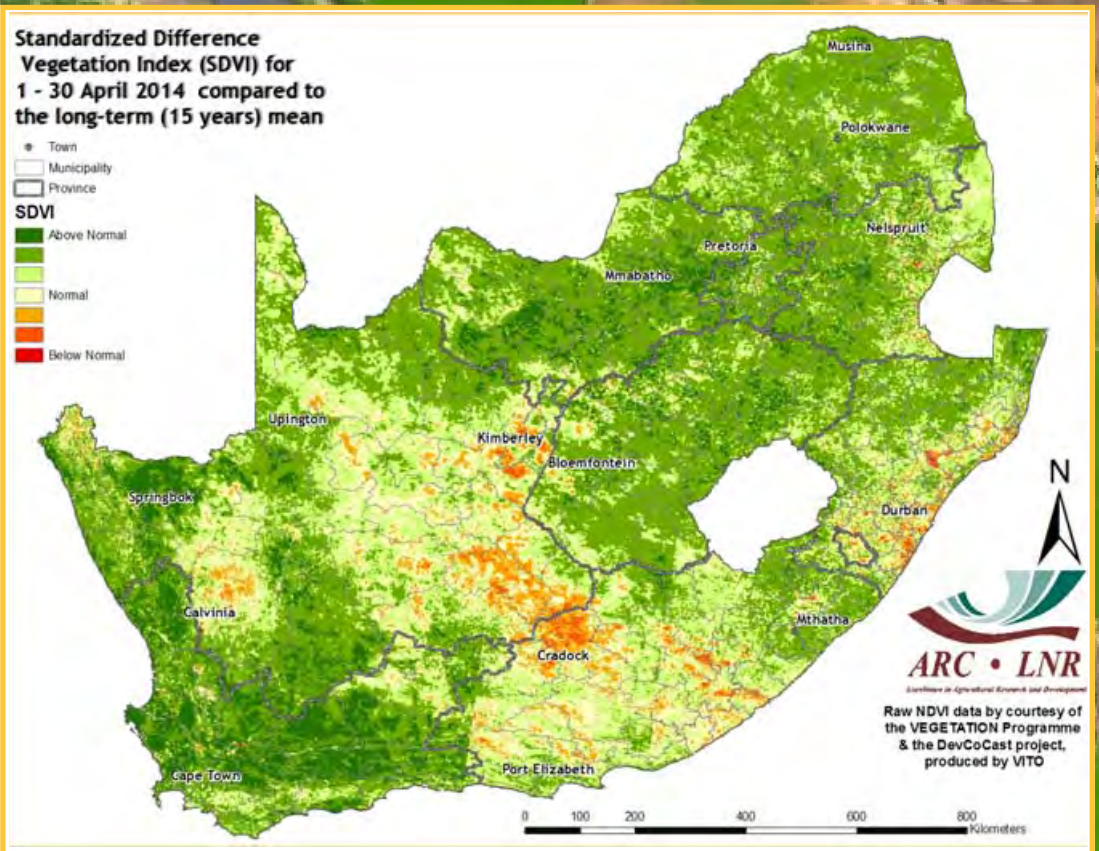

Figure 12

Figure 12:
Vegetation activity is above normal over most of the country except for much of the eastern parts of the Northern Cape, northwestern Eastern Cape and isolated parts of eastern KwaZulu-Natal.

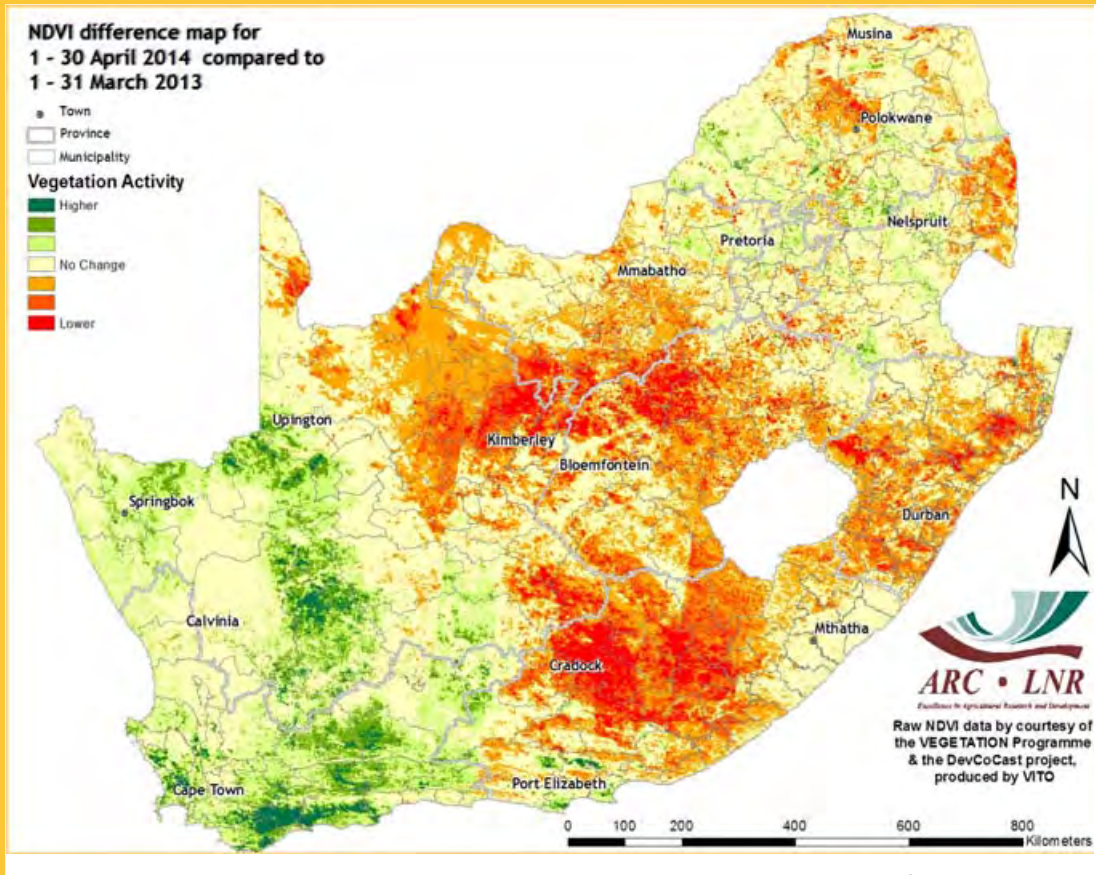

Figure 13

Figure 13:
As dry conditions dominated much of the interior during April, with lower minimum temperatures, vegetation activity diminished quite sharply over much of the central to eastern parts. Vegetation activity is on the increase over much of the western interior and parts of the winter rainfall area where widespread showers occurred towards the end of March. The effect of widespread rain during especially late April over the southeastern parts will only be noticed early in May and is therefore not reflected on this map.

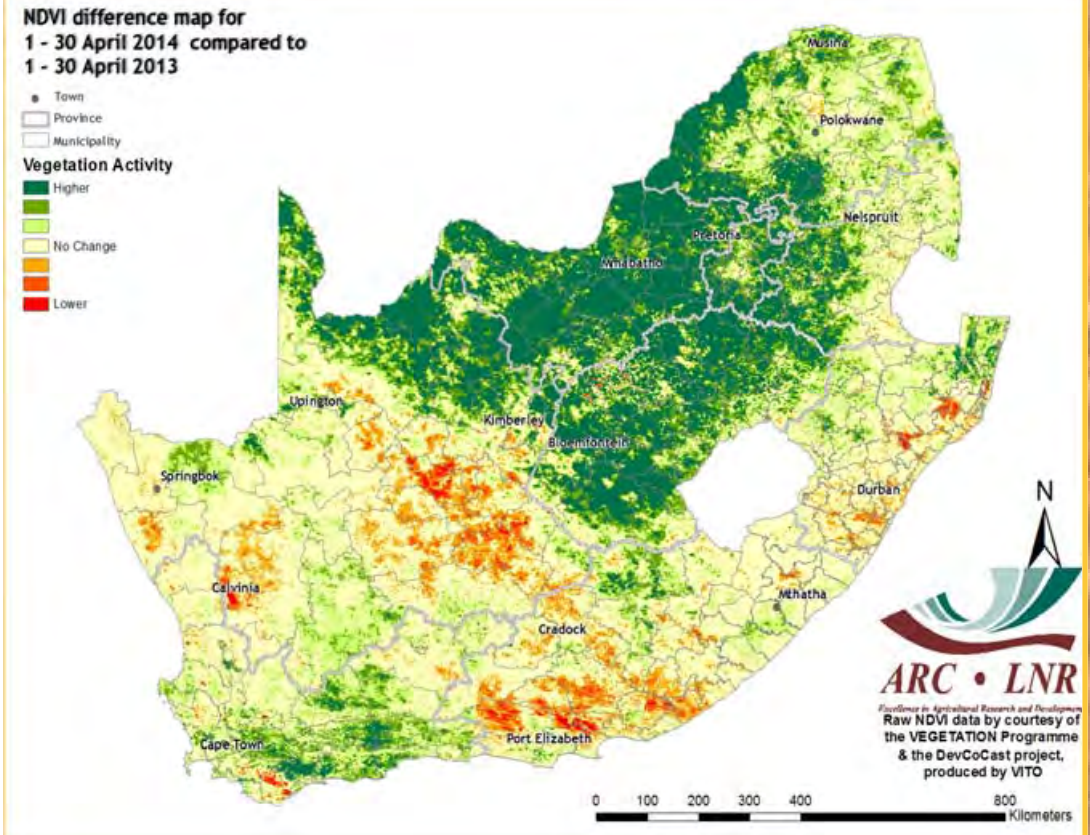

Figure 14

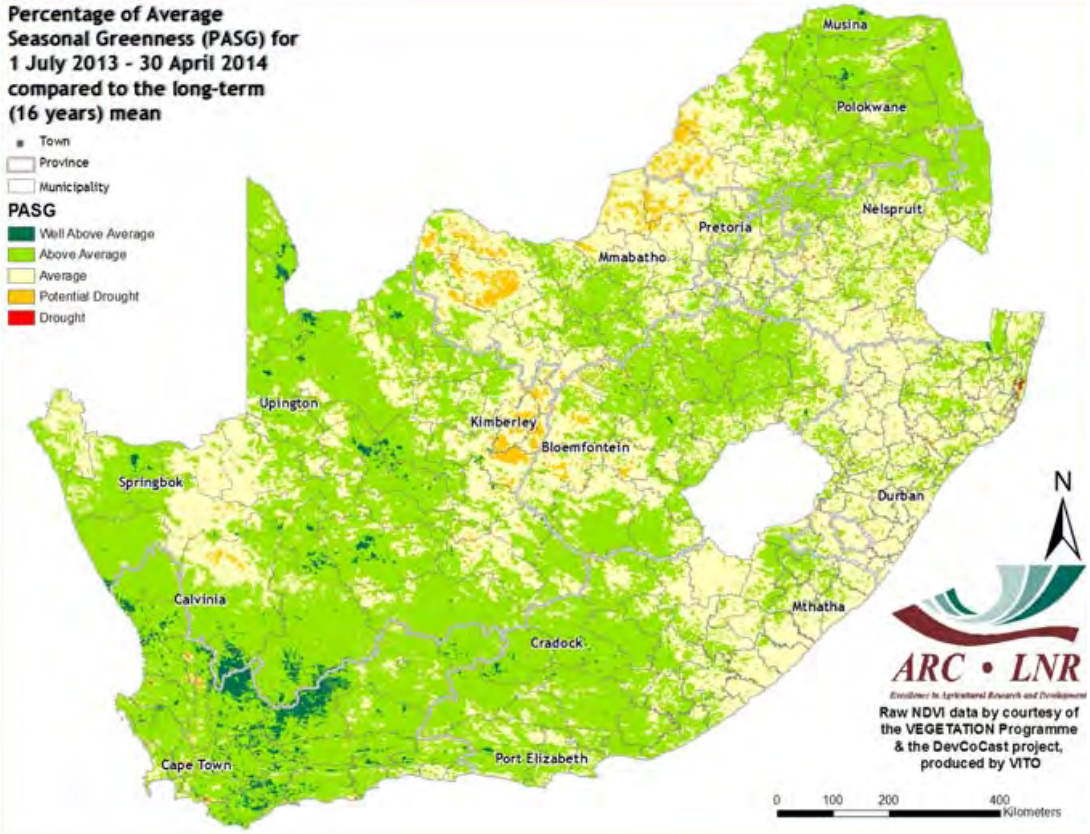

Figure 15

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:
The central and northern parts of the country experienced much higher vegetation activity than in April 2013 when drought conditions dominated much of the central interior. Vegetation activity is somewhat lower than in April 2013 over the eastern parts of the Northern Cape and surrounding areas.

Figure 15:
While cumulative vegetation activity is above normal over much of the country, the effect of dry conditions during the previous summer and during the early part of the current summer is still visible over the central interior where the PASG is below normal.

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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.

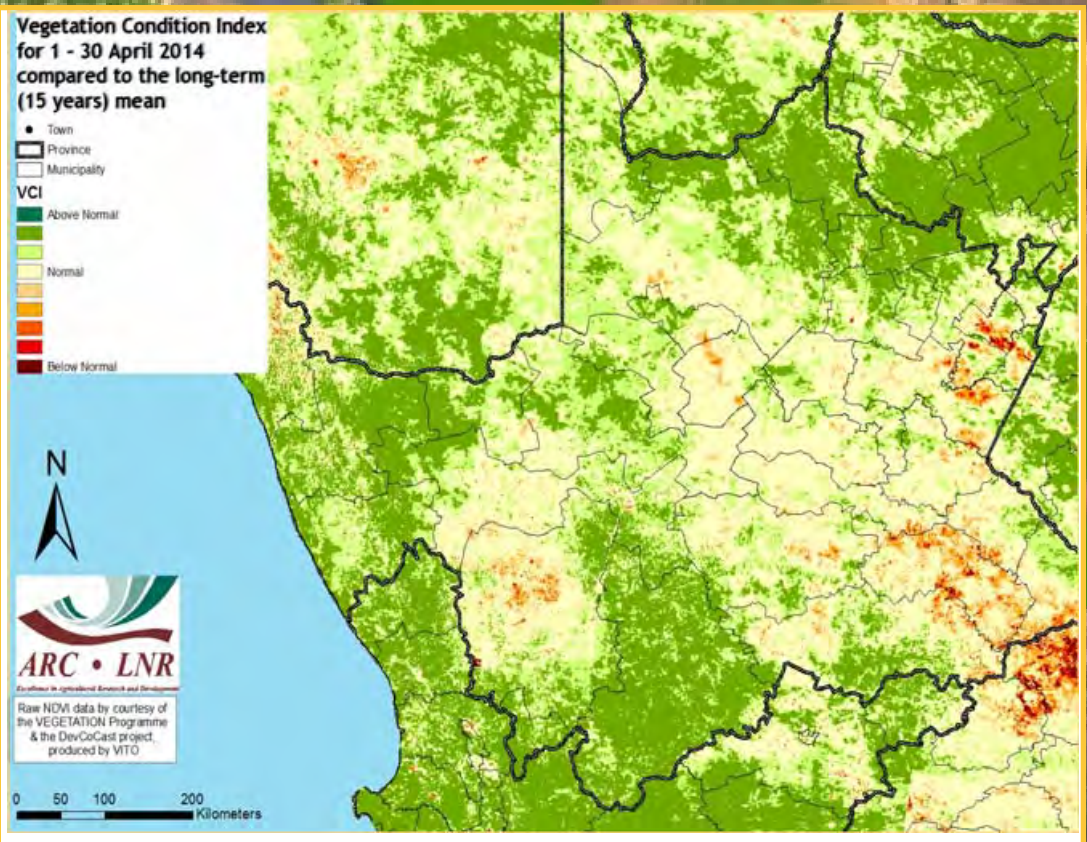
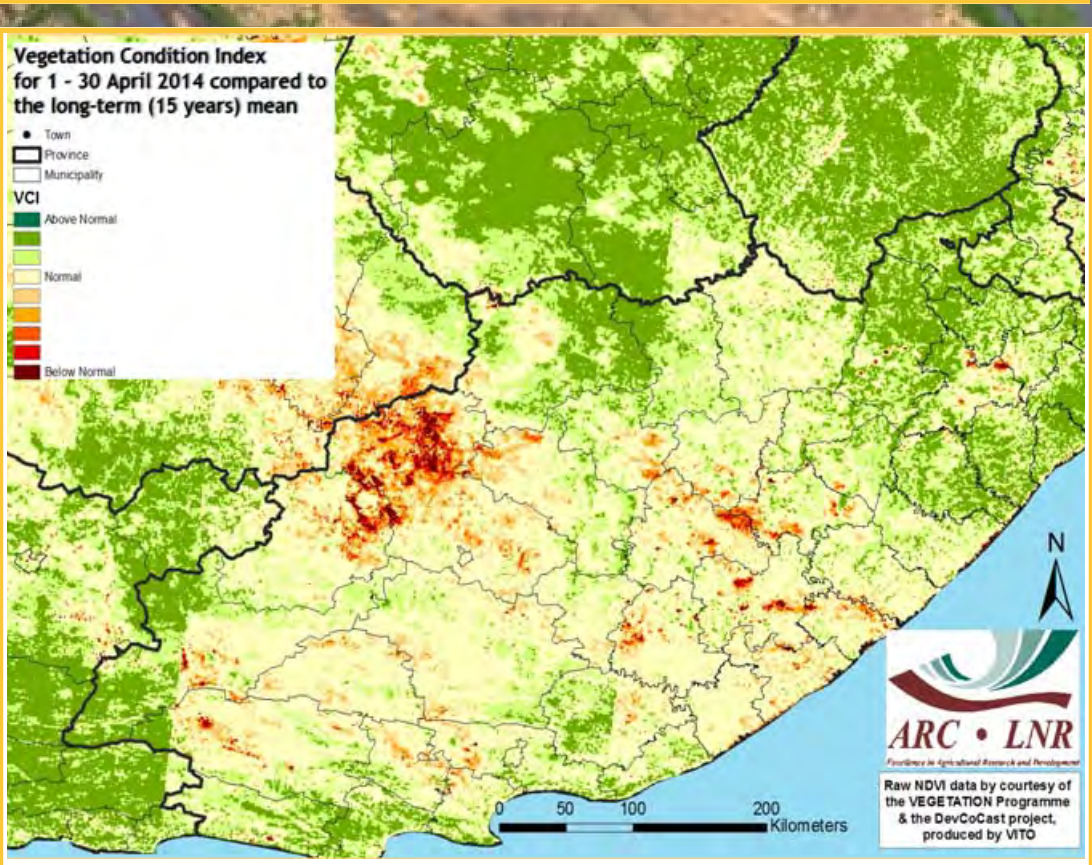


Figure 16

Figure 16:
The VCI map for April 2014 indicates below-normal vegetation activity especially over the eastern parts of the Northern Cape Province.

Figure 17:
The VCI map for April 2014 indicates both normal and below-normal vegetation activity over most parts of the Eastern Cape Province.



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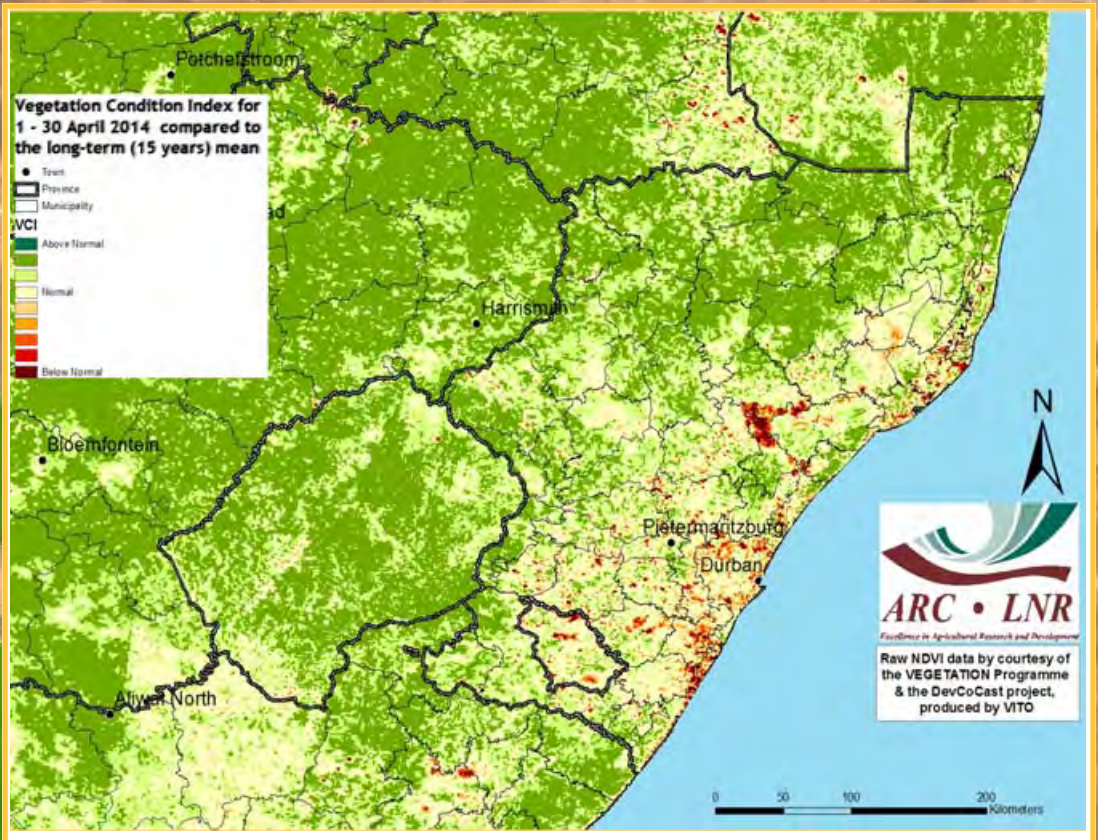

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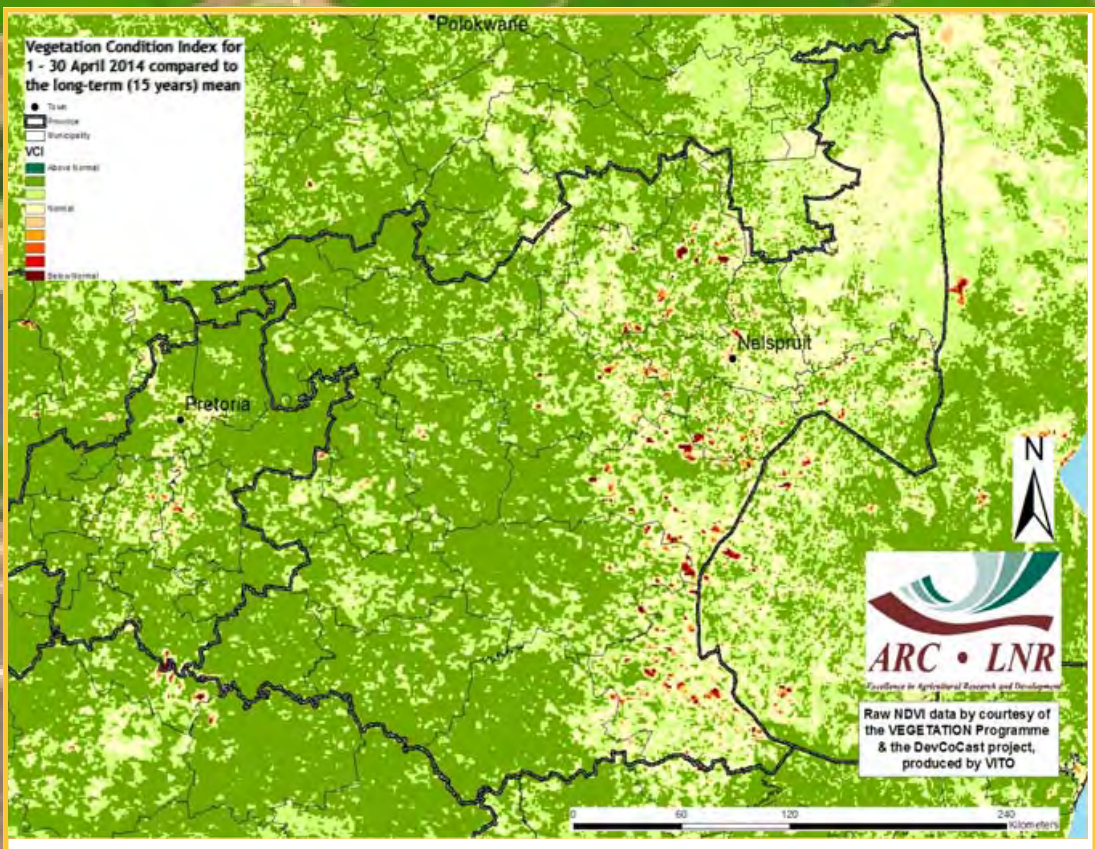

Figure 19

Figure 18:
The VCI map for April 2014 indicates below-normal vegetation activity over the southeastern and southern parts of the KwaZulu-Natal Province.

Figure 19:
The VCI map for April 2014 indicates below-normal vegetation activity over the southeastern parts of the Mpumalanga Province.

Questions/Comments:
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7. Vegetation Conditions & Rainfall

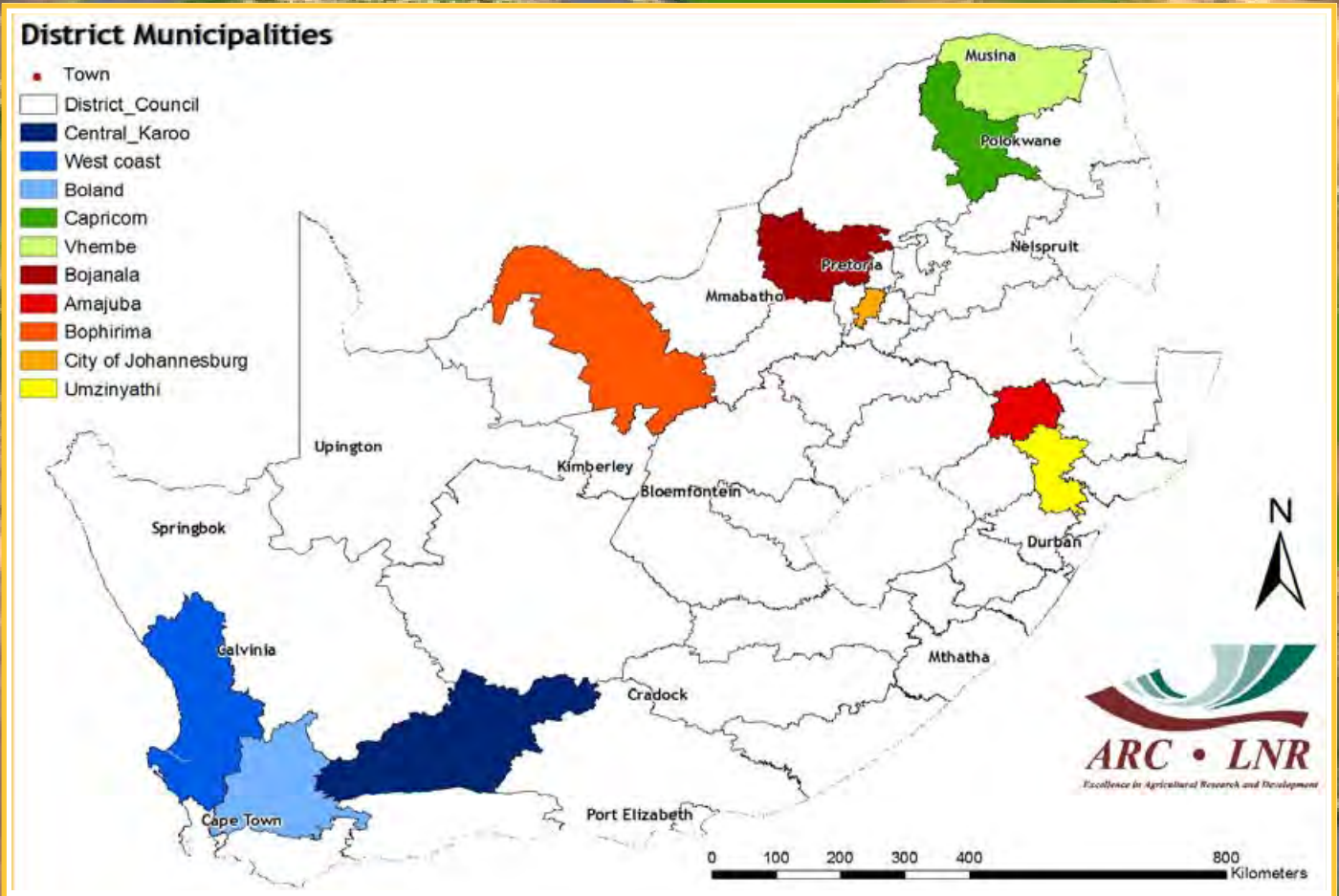

Figure 20

NDVI and Rainfall Graphs
Figure 20:
Orientation map showing the areas of interest for April 2014. The district colour matches the border of the corresponding graph.

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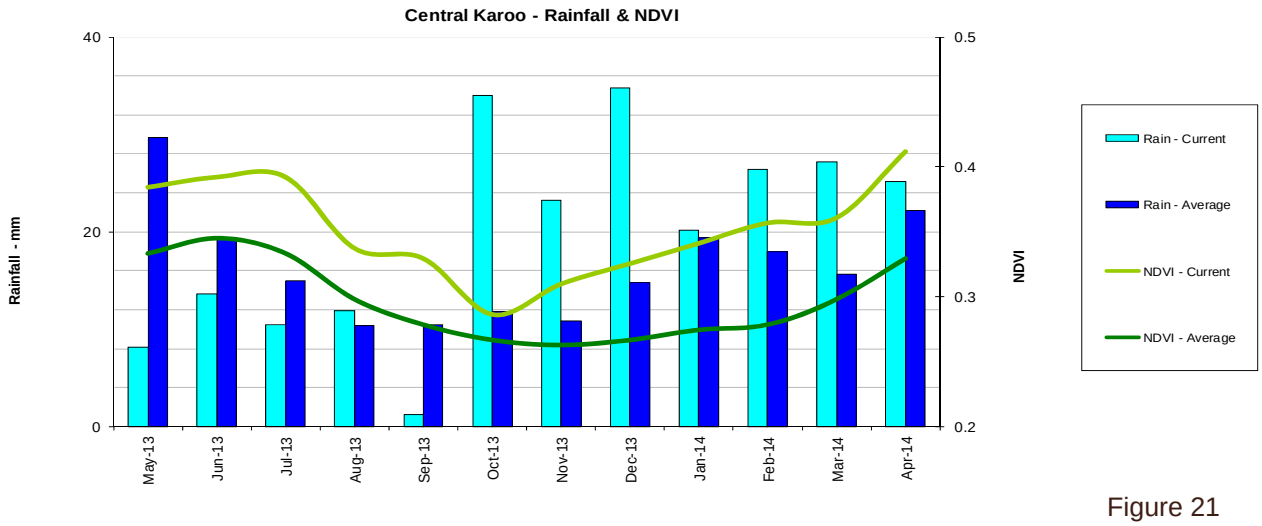
Figures 21-25:
Indicate areas with higher cumulative vegetation activity for the last year.

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



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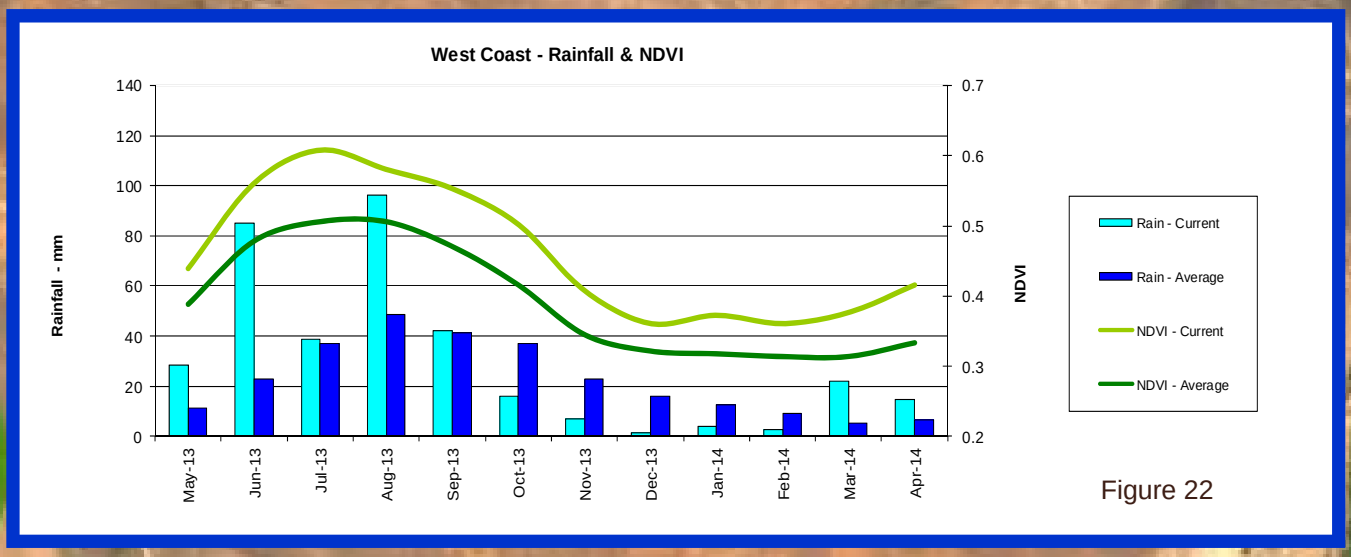

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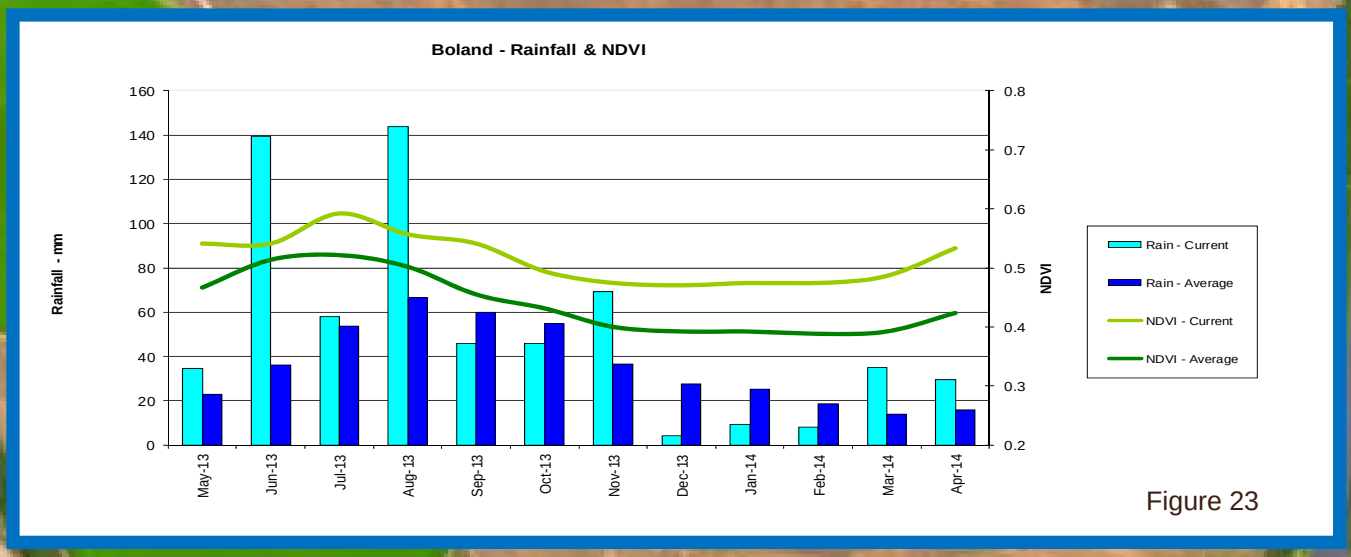

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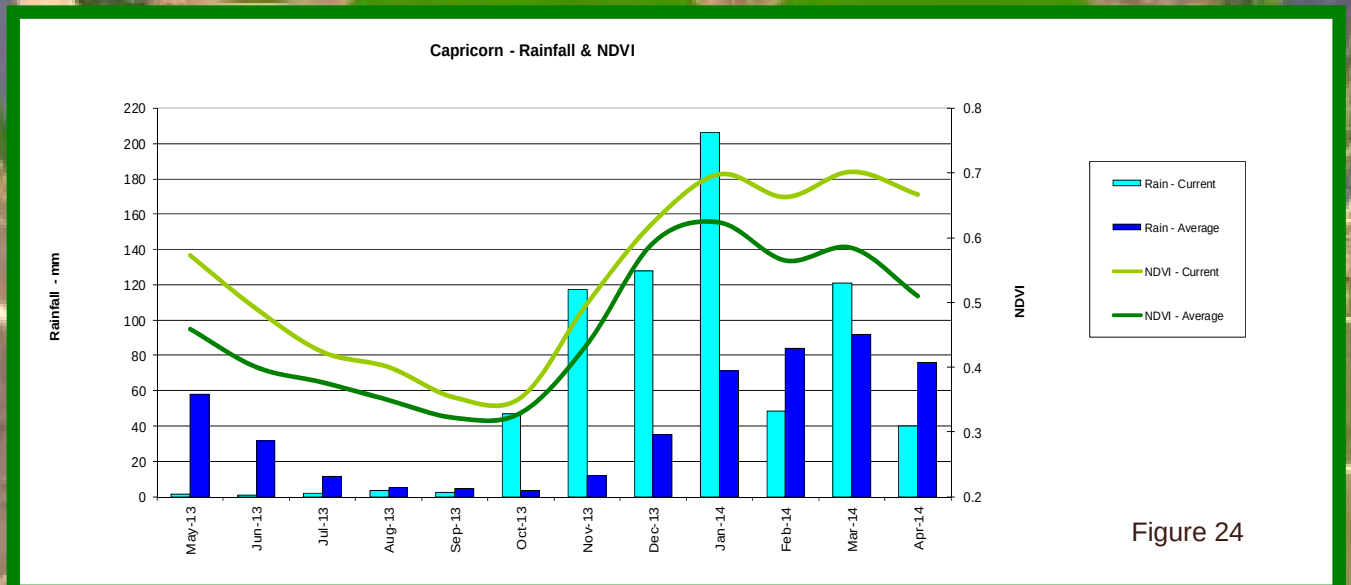

Figure 24

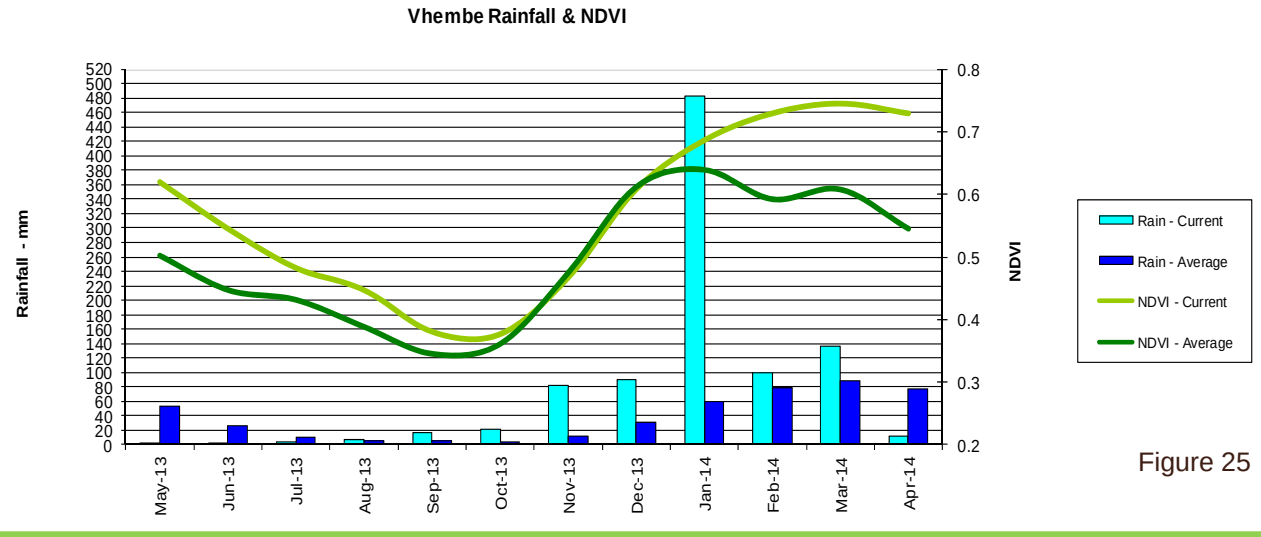

Figure 25

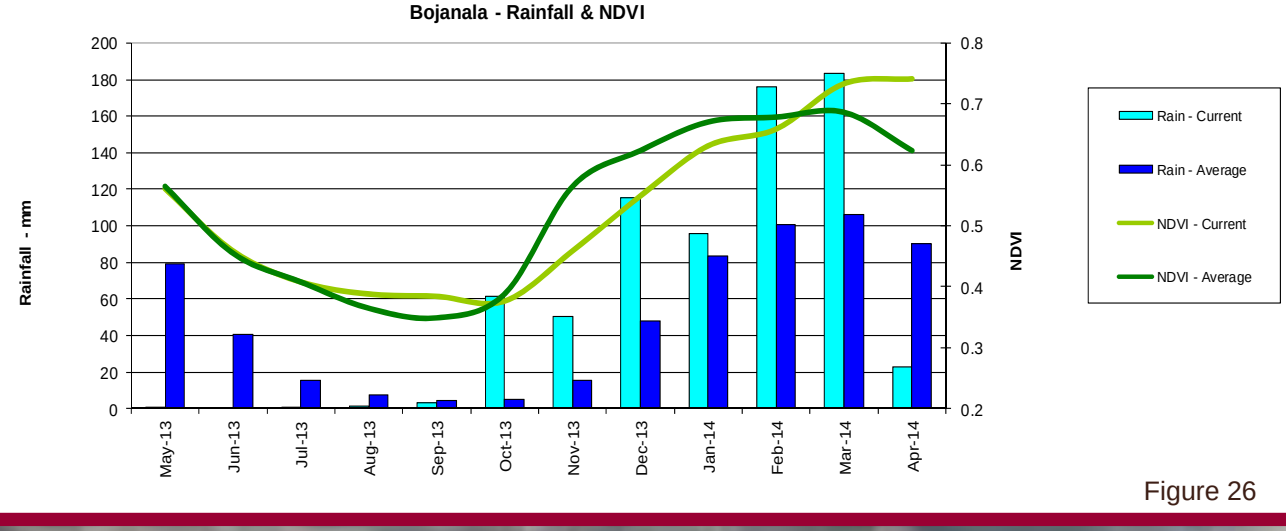

Figure 26

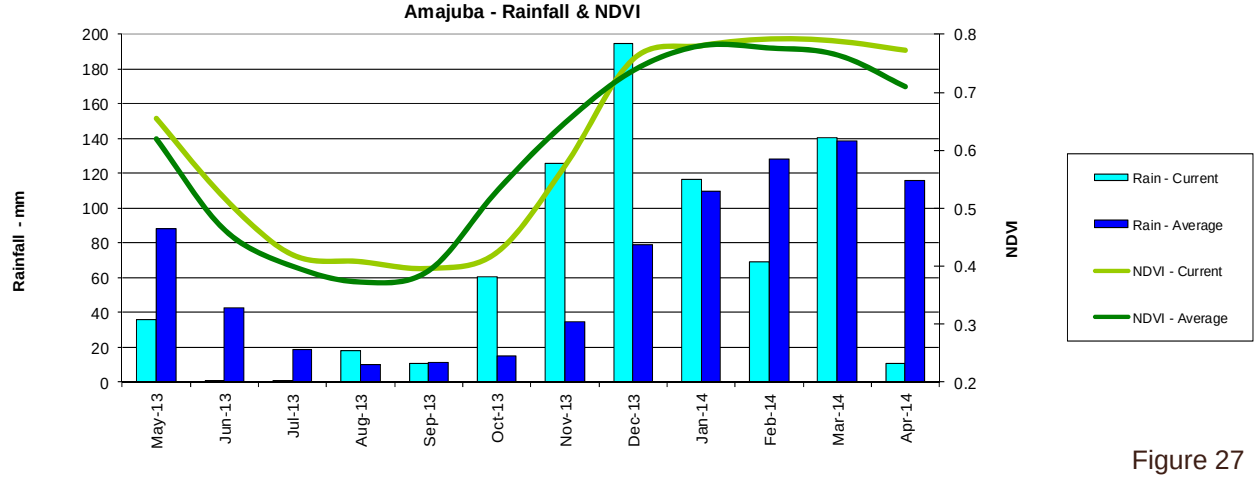

Figure 27

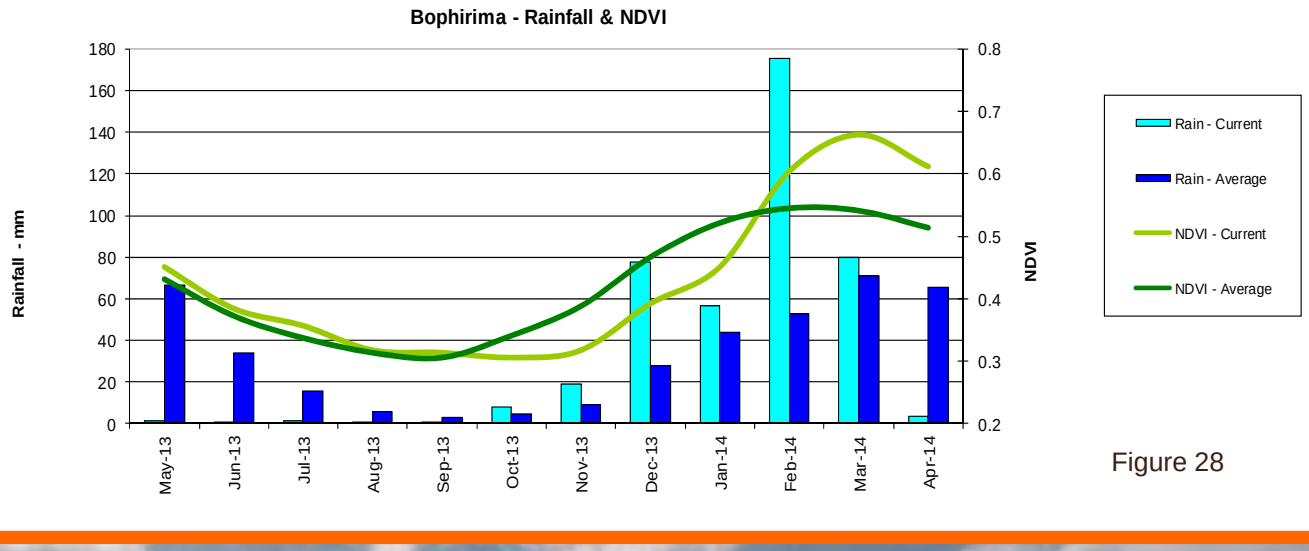

Figure 28

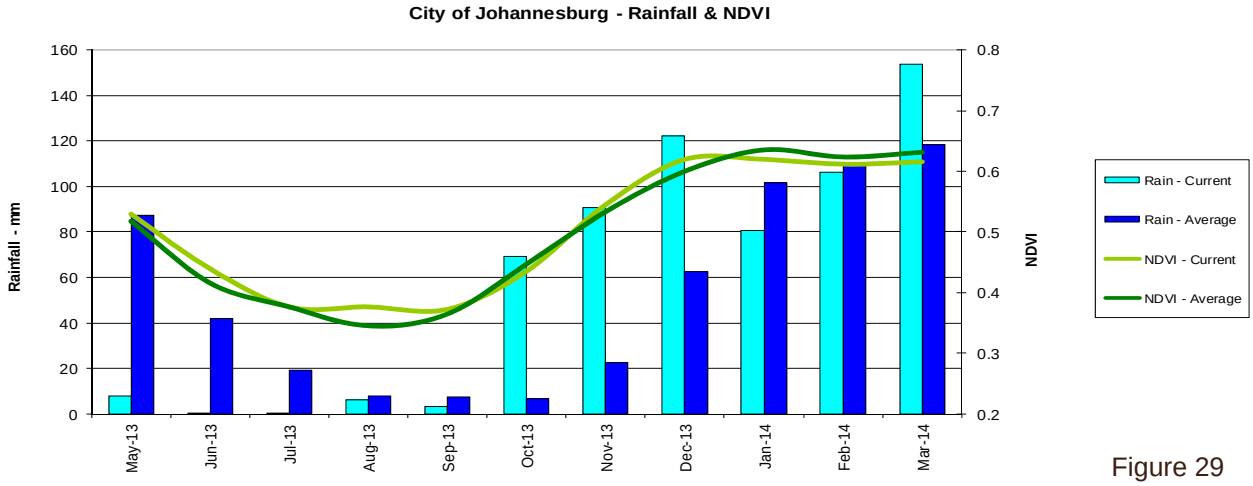

Figure 29

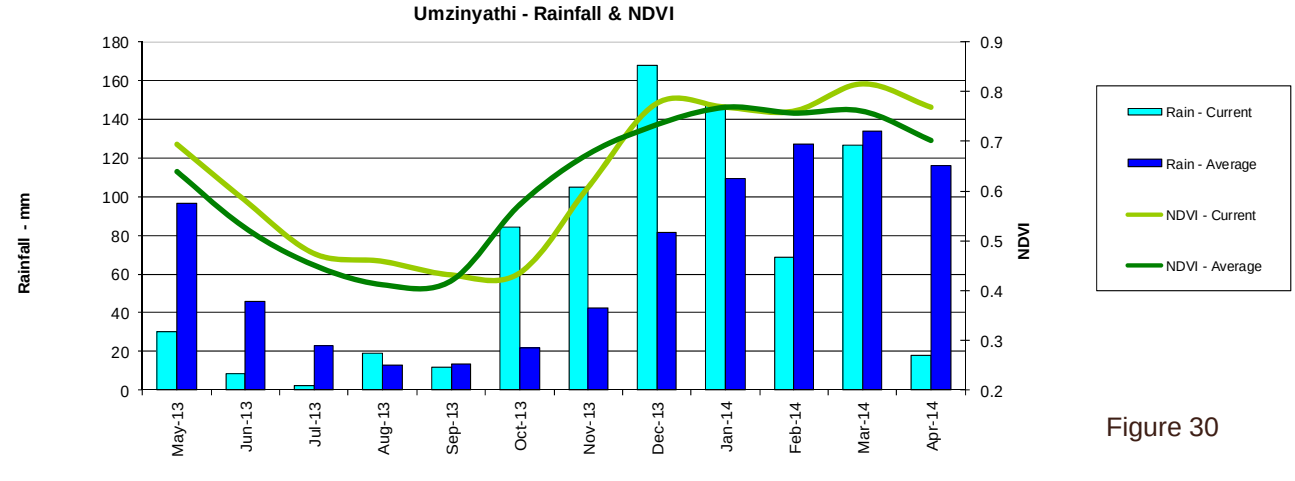

Figure 30

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 in the month of April 2014 per province. Fire activity was higher in the Eastern Cape, Free State, Gauteng, Mpumalanga, Northern Cape and Limpopo compared to the average for the same period for the last 13 years.

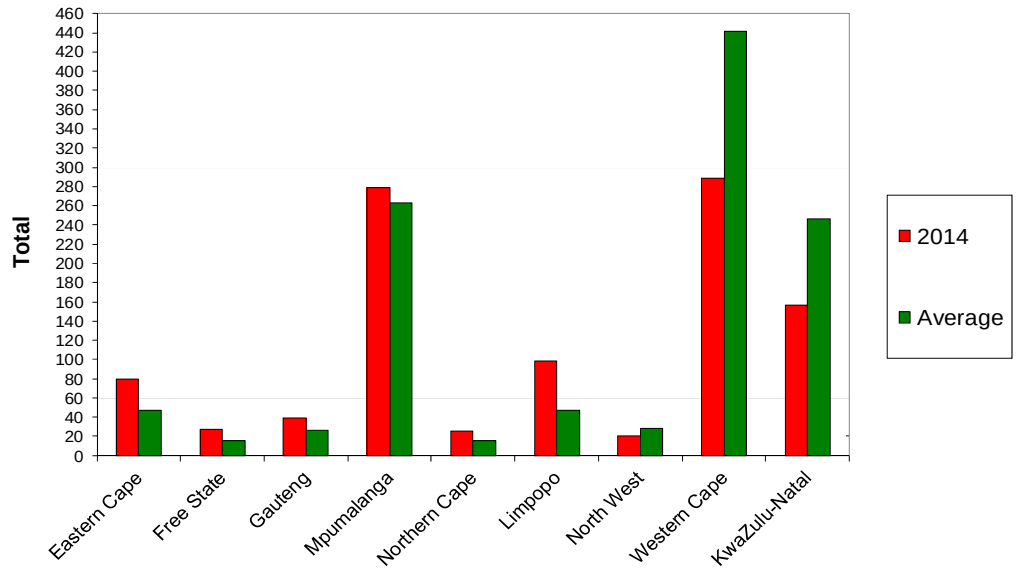

Figure 31

Figure 32:
The map shows the location of active fires detected in month of April 2014.

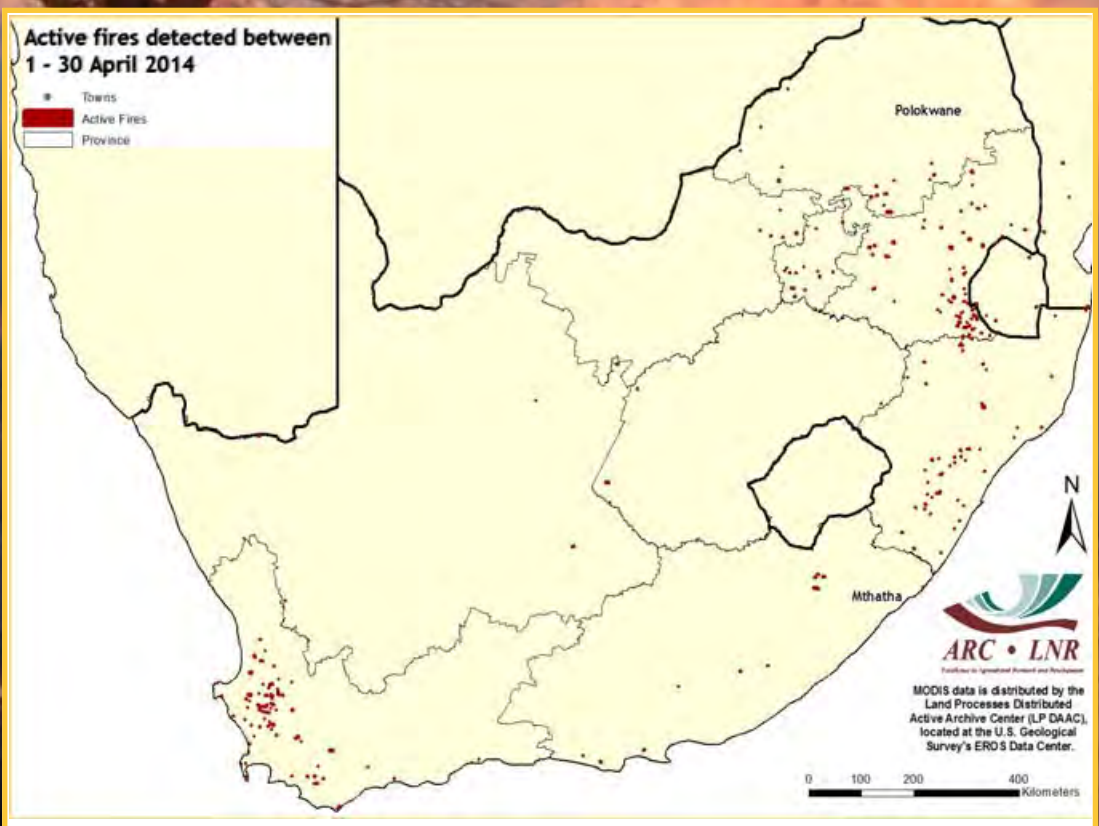

Figure 32

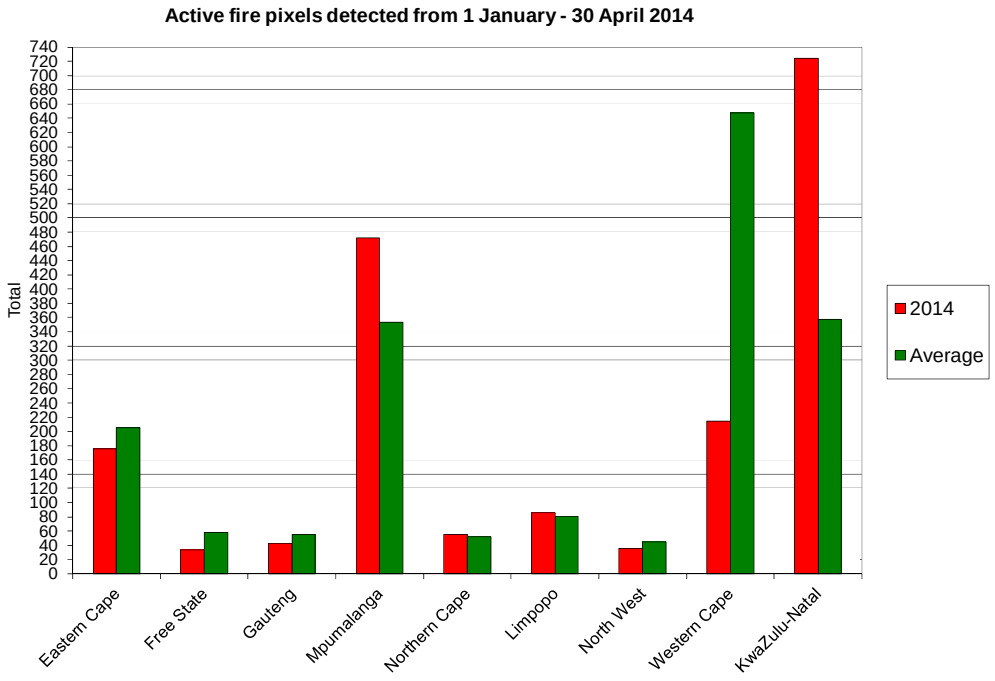

Figure 33

Figure 33:
The graph shows the total number of active fires detected from 1 January to 30 April 2014 per province. Fire activity was higher in Mpumalanga, Northern Cape, Limpopo and KwaZulu-Natal compared to the average for the same period for the last 13 years.

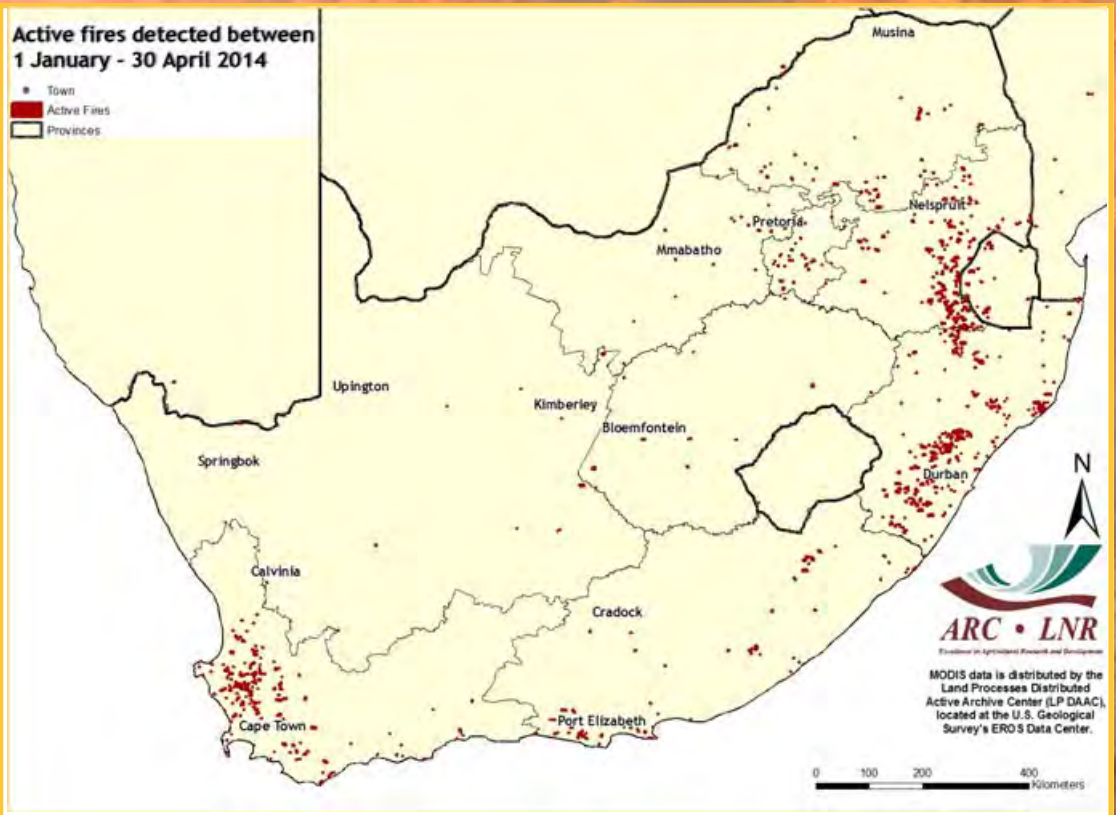

Figure 34

Figure 34:
The map shows the location of active fires detected from 1 January to 30 April 2014.

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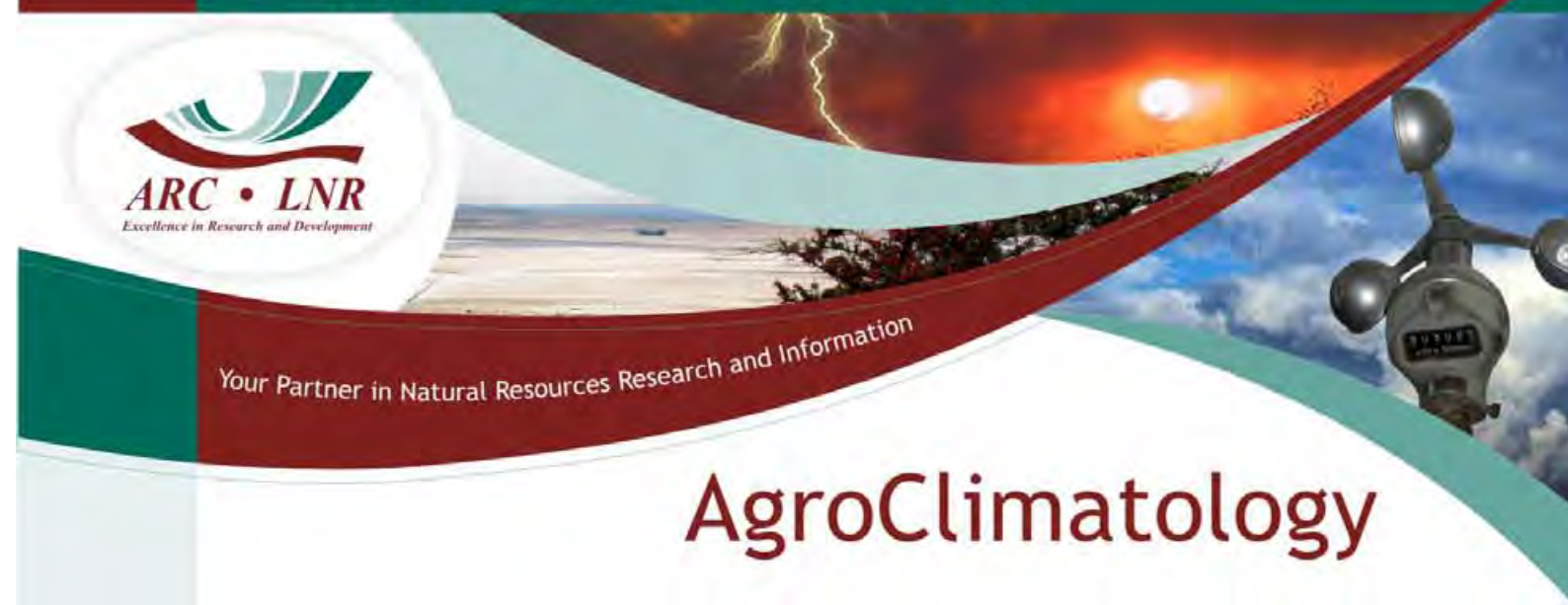

AgroClimatology

The AgroClimatology Programme of the ARC-Institute for Soil, Climate and Water monitors South Africa's weather and supports the country's agricultural sector through timely provision of weather and climate information.

Since its inception at Bien Donné in the Western Cape in 1940, the Programme has evolved to become a leading arm of the ARC and currently has the capacity to maintain a large country-wide weather station network comprising over 500 automatic weather stations and a small number of mechanical weather stations. The data from all the stations is loaded onto a web-enabled databank from which various climate information products can be derived.

The weather station network and databank constitute a National Asset whose maintenance is largely funded by government through a parliamentary grant that is annually disbursed for this purpose.

Products and Services

Climate-related services and information are available from the Institute's offices in Pretoria (Tel: 012 310 2500), Potchefstroom (Tel: 018 299 6349) and Stellenbosch (Tel: 021 809 3100).

From the web-enabled databank, hourly, daily, monthly, yearly or long-term data can be requested for the following measured elements:

- Temperature
- Rainfall
- Wind speed (including gusts) and direction
- Radiation
- Humidity

Value-added information on evapotranspiration, cold and heat units, and Powdery and Downy Mildew disease indicators is available and various spatial interpretations can be conducted for interested users upon request.

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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 in its inception through LEAD funding from the Department of Science and Technology.

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

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

http://www.agis.agric.za