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UMLINDI
The Watchman

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INSTITUTE FOR SOIL, CLIMATE AND WATER

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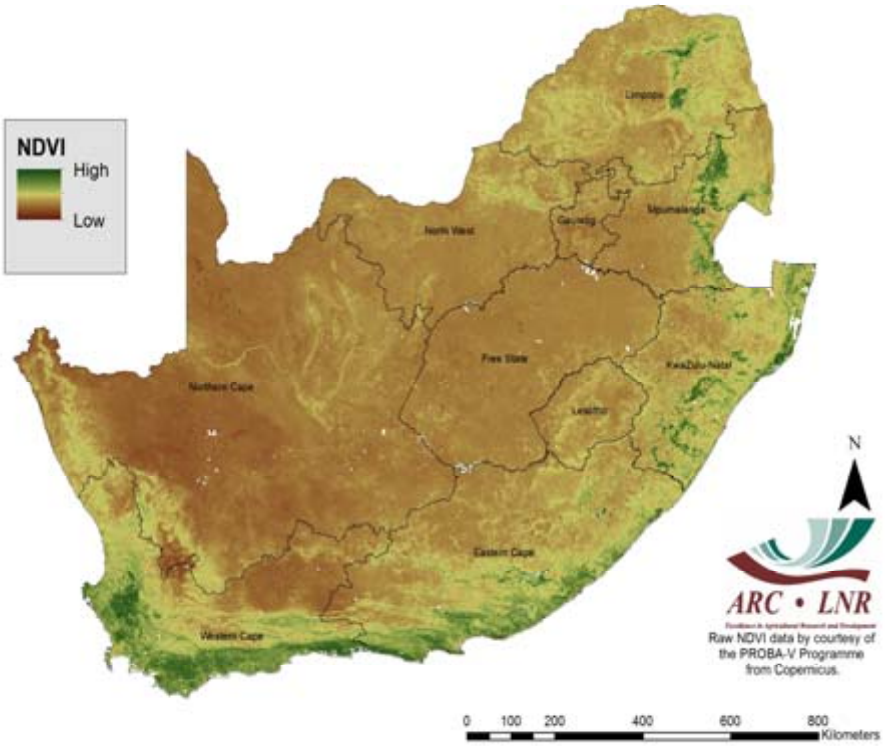
agriculture, forestry & fisheries
Department: Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

South African Weather Service

AMESD

122nd Edition

Image of the Month



The PROBA-V VEGETATION synthesis product

This image is the first monthly maximum NDVI composite of the PROBA-V VEGETATION synthesis product made at the ARC-ISCW, created from the 10-day maximum composite (S10) NDVI product developed and provided by VITO (Flemish Institute for Technological Research – http://www.vito.be) via Copernicus (the European Earth Observation programme). The image shows the areas of higher vegetation activity during July 2014 in green covering most of the winter rainfall area, southern and eastern coastal areas as well as the Escarpment in the northeast. The dry and cold conditions during winter resulted in very low vegetation activity over the interior, shown in brown.

With an existing archive of about 15 years of SPOT VEGETATION NDVI data, efforts have been made during the development of the sensor and compositing procedure to obtain optimal consistency between the PROBA-V (1 km) and SPOT-VGT products. Developed by a Belgian consortium, the PROBA-V satellite mission is intended to bridge the gap between the vegetation monitoring data available through the SPOT VEGETATION programme and the future Sentinel 3 satellites to be launched by the European Space Agency as part of the ongoing monitoring of global vegetation through remote sensing (http://proba-v.vgt.vito.be/).

While an effort has been made to assure compatibility between PROBA-V and SPOT VEGETATION NDVI data, the products at the ARC-ISCW will be closely monitored to ensure the correct inclusion into the existing archive of vegetation monitoring data.

Questions/Comments: *Johan@arc.agric.za*

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:

The winter rainfall area received normal to above-normal rainfall during July 2014, consistent with the situation during June, but once again rainfall was largely absent over the summer rainfall area. Minimum temperatures over the interior remained relatively low, following the severe cold outbreaks during June.

Frontal systems were responsible for a number of precipitation events over the winter rainfall area, spread fairly evenly throughout the month. The most significant of these events were concentrated around the 5th, 17th and 25th. These systems also resulted in low minimum temperatures over the interior. Due to unfavourable upper air conditions and/or dry surface conditions, typical to mid-winter, most of the interior remained dry during the month while precipitation due to the frontal activity was confined to the western and southwestern parts. Particularly the system around the 5th resulted in sub-zero minimum temperatures over much of the interior. The lowest temperatures over the country were recorded by the 8th, whereafter there was a steady increase in especially minimum temperatures towards the end of the month.

The most significant weather events were the frontal systems with upper air support that moved into the country by the 5th and the 25th. While both resulted in widespread precipitation in the southwest, a relatively strong influx of moisture together with upper air instability resulted in some showers also over the extreme eastern parts by the 8th during the first of these events. The system was also responsible for the lowest minimum temperatures as it moved across the country with southerly winds feeding cold air into the interior. The other strong system backed by a sharp upper air trough moved into the western parts of the country by the 25th. While conditions over the interior again remained dry, some showers did occur over the extreme eastern parts. An upper air low developed by the 28th over Botswana on the northern edge of the system. While partly cloudy to cloudy conditions dominated over the northeastern parts of the country during this period, no precipitation was recorded. The low did, however, result in some unseasonal showers over central Botswana during the last few days of the month, while minimum temperatures continued to increase slowly across South Africa.

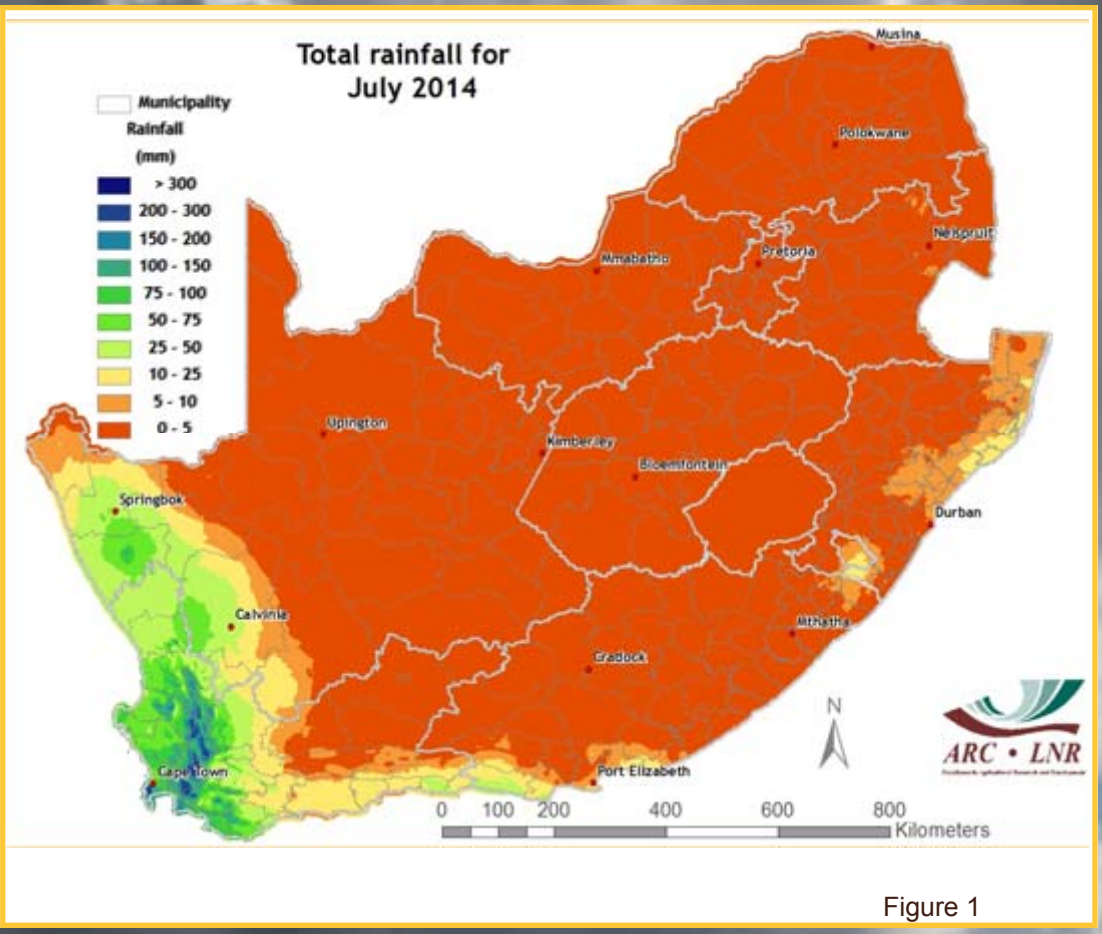


Figure 1

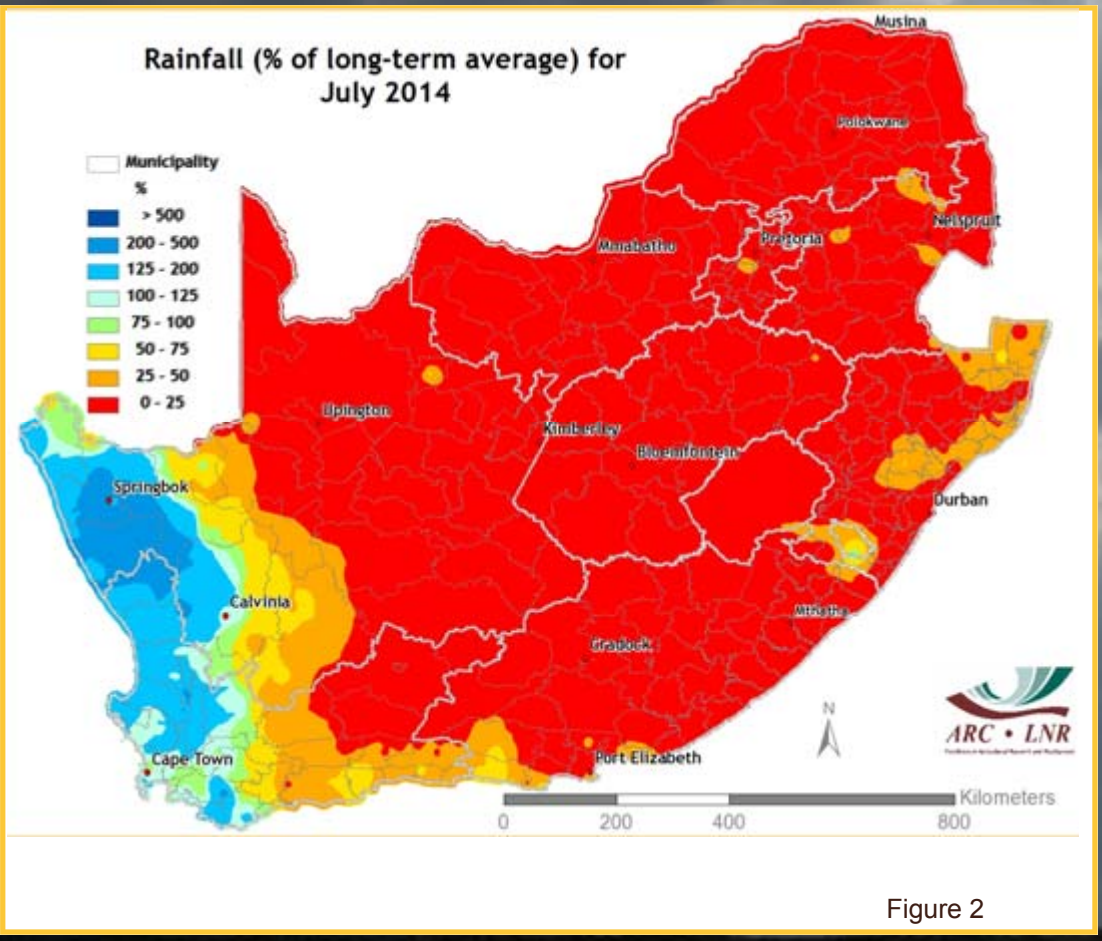
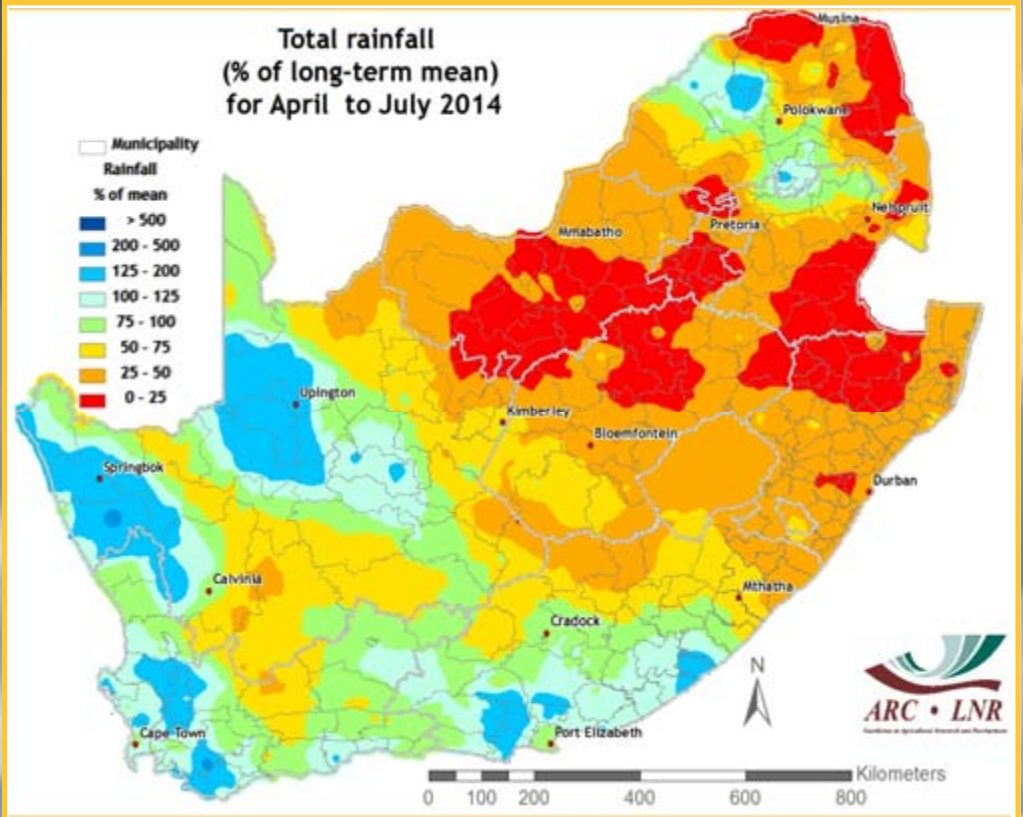


Figure 2



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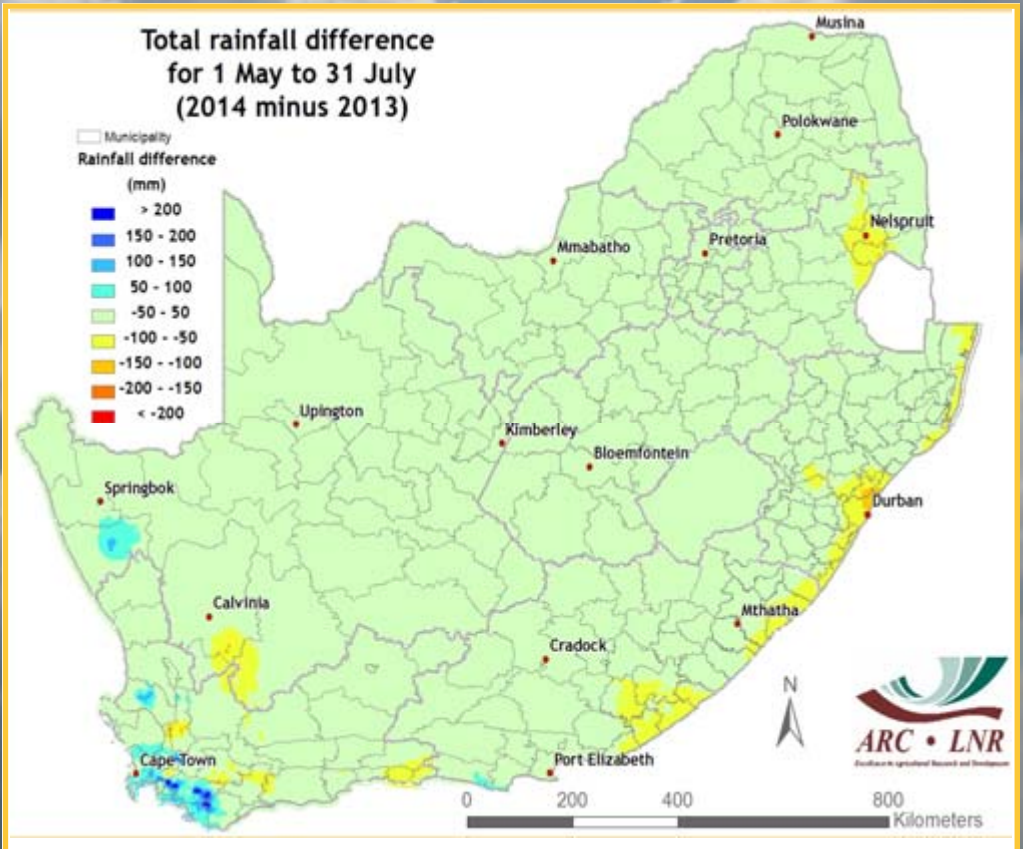

Figure 4

Figure 1:
Precipitation in July was again concentrated over the winter rainfall area and to a lesser extent also along the coastal regions in general and the adjacent interior. The interior was mostly dry.

Figure 2:
Rainfall was above normal over especially the western parts of the winter rainfall area and near normal over the rest of the winter rainfall area. Below-normal rainfall occurred over the rest of the country.

Figure 3:
Since April, precipitation has been above normal over much of the southwestern half of South Africa, including the winter rainfall area. Except for parts of Limpopo, precipitation was below normal over the northeastern half of the country.

Figure 4:
For May to July, the southwestern parts received more rain so far this year while the southern and eastern coastal areas received less rain than during the same period 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 most of the winter rainfall region is still wet to extremely wet at all time scales considered. Most of the eastern parts of South Africa have so far experienced a dry winter as indicated by the 3-month SPI. The northeastern interior is wet on time scales of 6 months and longer following two wet summers. At the 12-month and especially 24-month time scale, there are still indications of dry conditions over the central interior, despite the wet conditions that occurred during late summer 2013/14 .

Questions/Comments:
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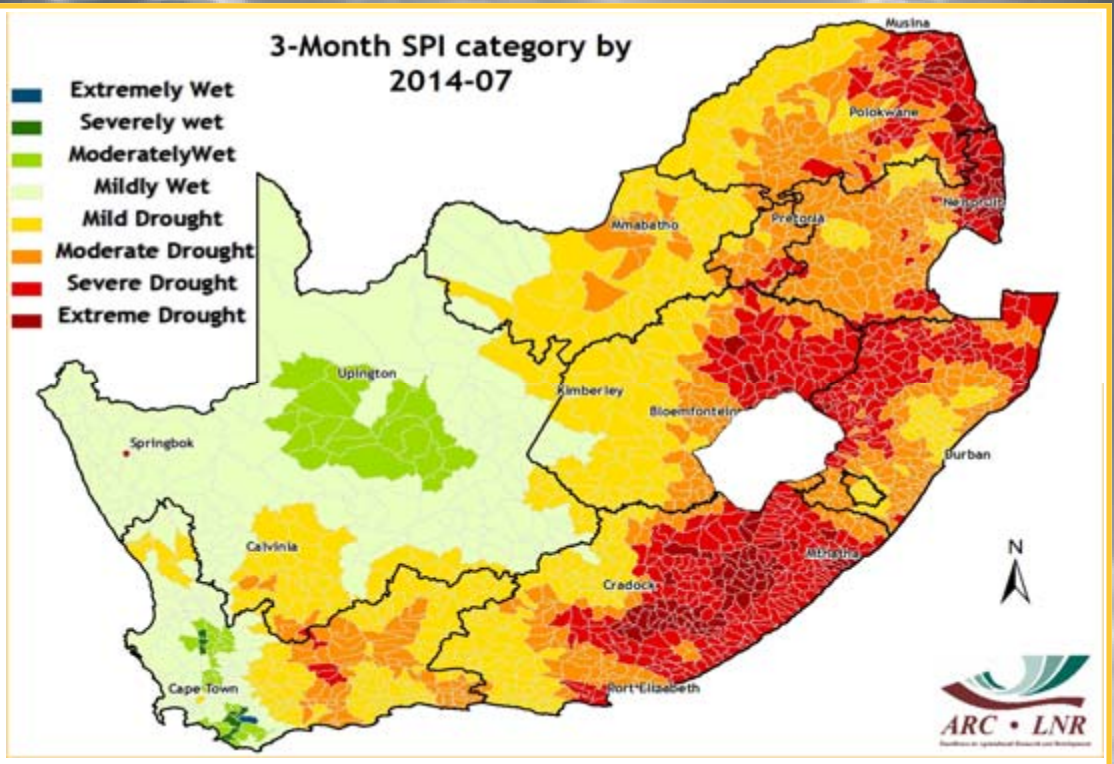
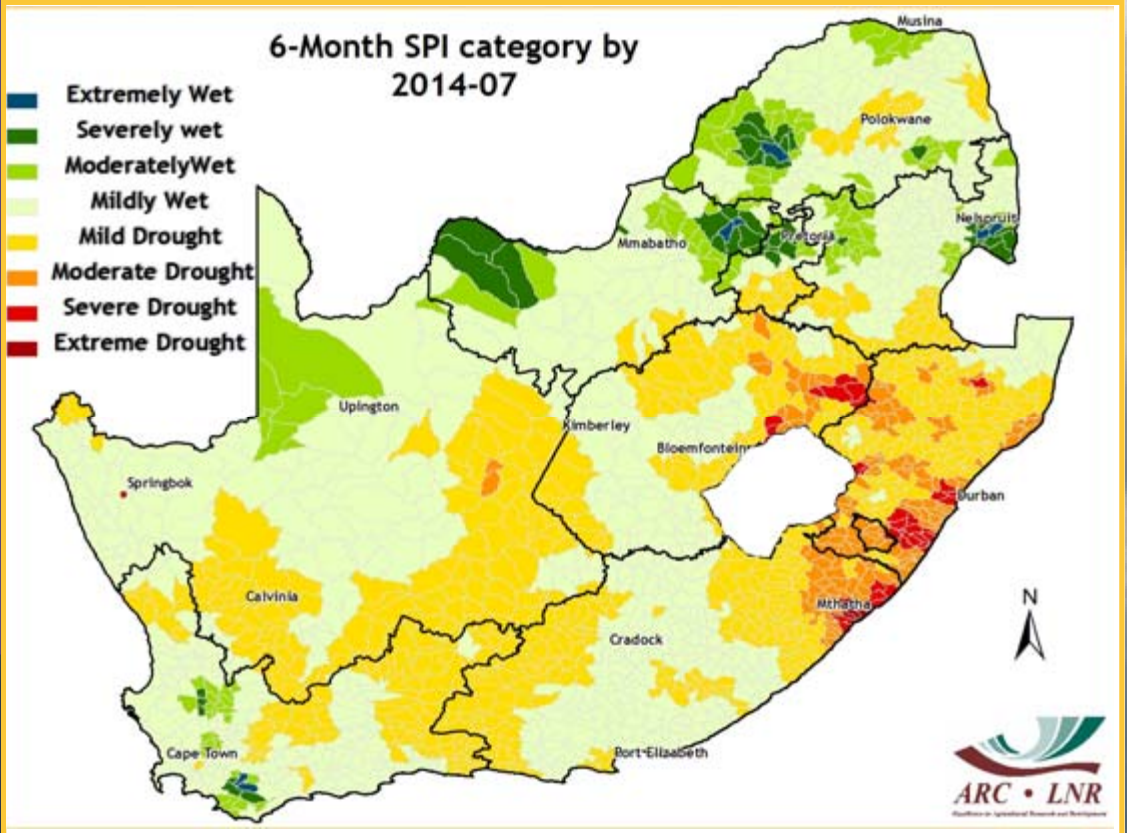


Figure 5



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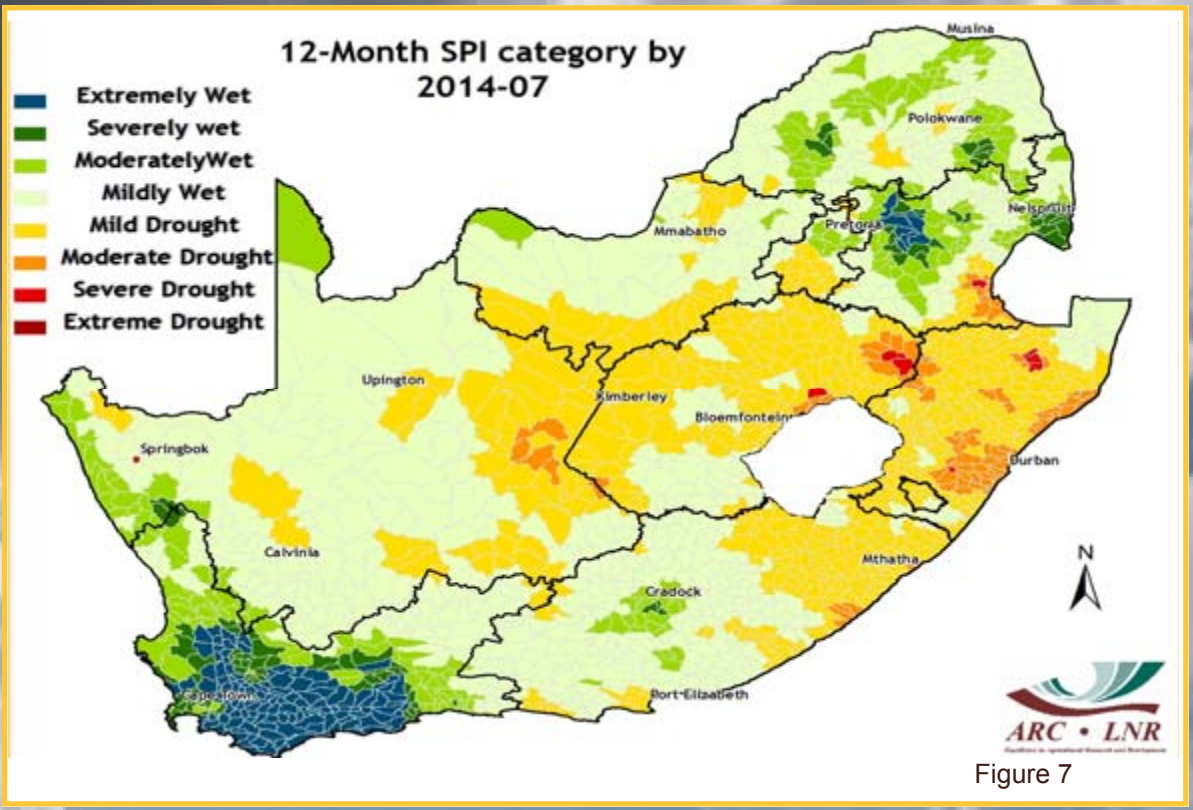

Figure 7

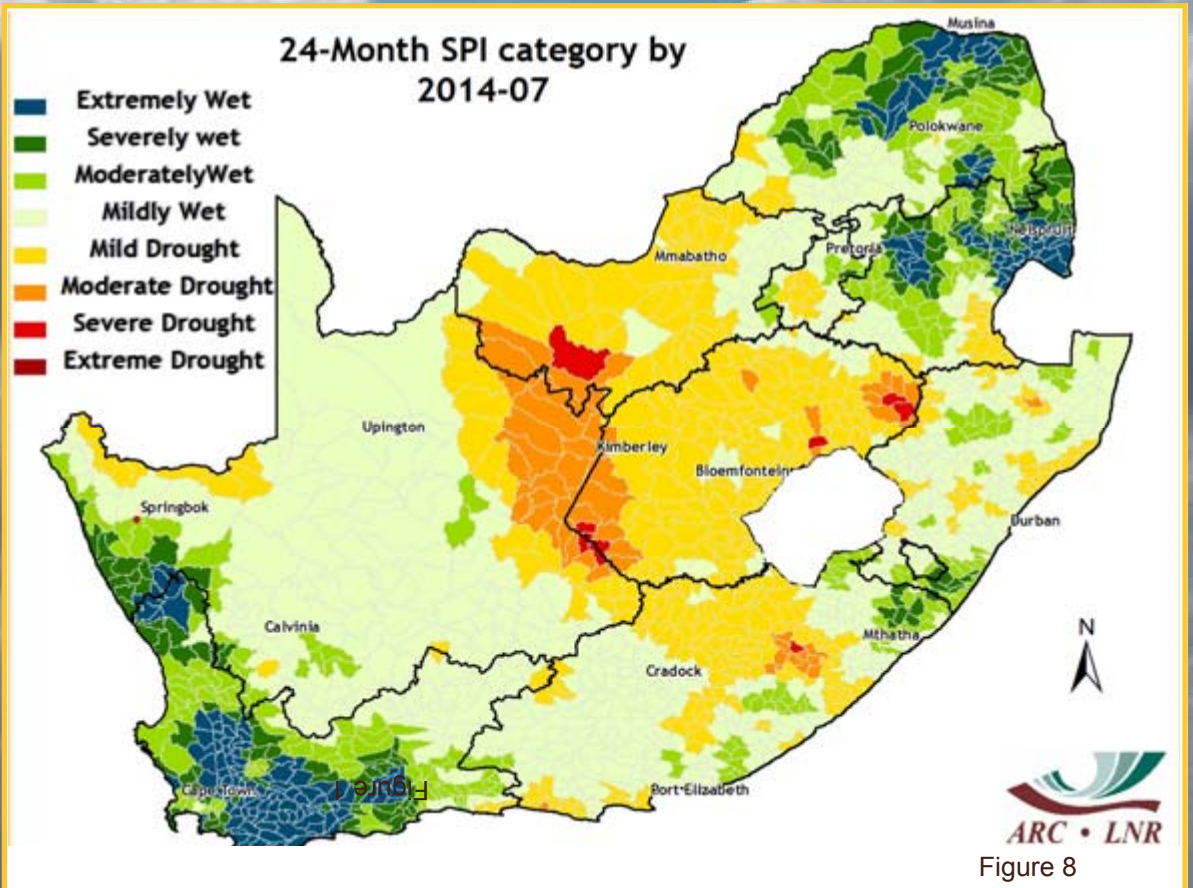

Figure 8

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.

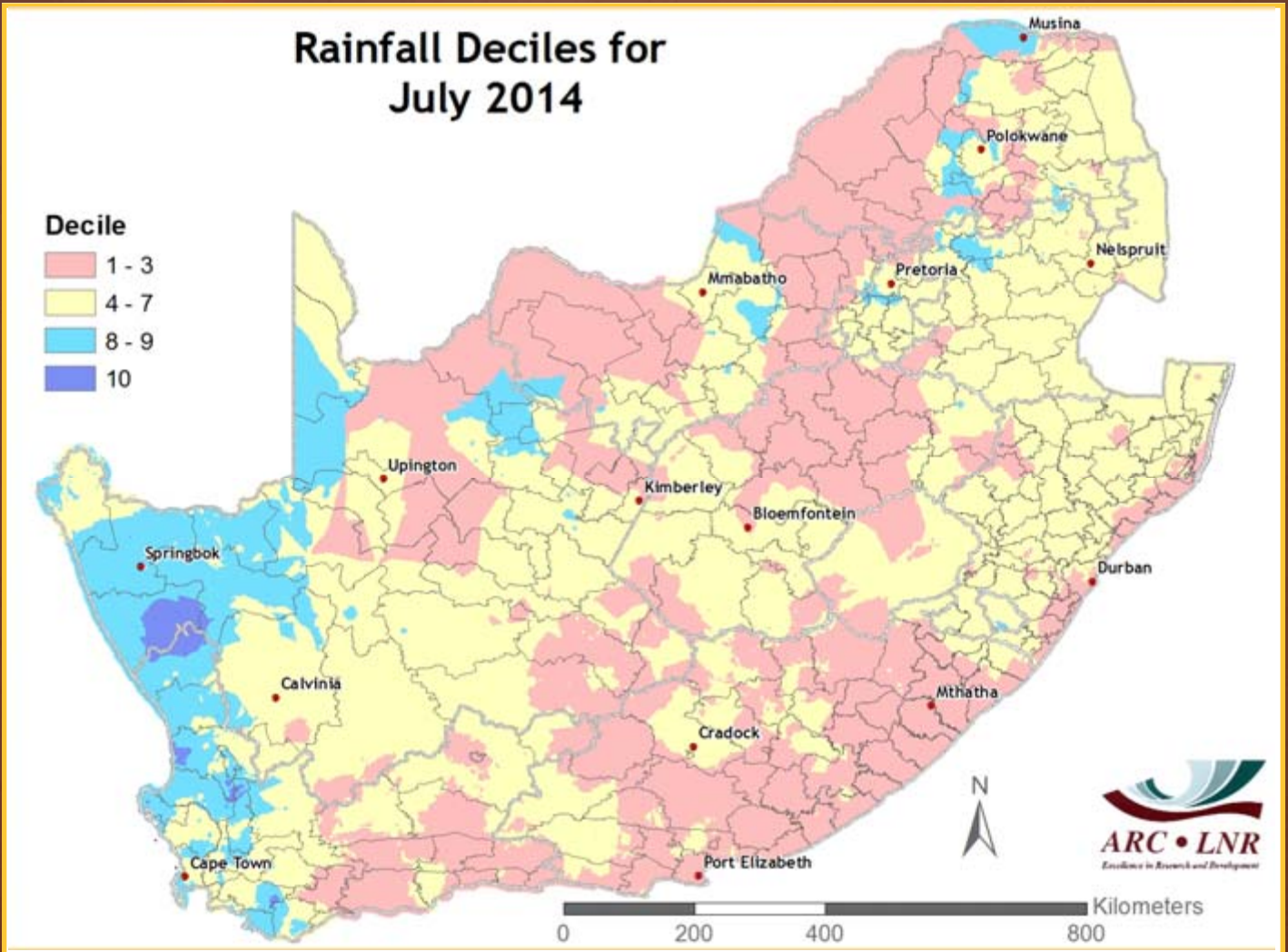

Figure 9

Figure 9:
While dry conditions indicated over the interior in July do not carry much weight due to the low average rainfall there during the winter months, above-normal rainfall indicated over the southwestern parts (winter rainfall area) is of importance as it may support a positive outlook for winter grain yields.

4. Vegetation Conditions

Disclaimer

A preliminary quality assessment of PROBA-V NDVI version 2 products, focusing on comparison with SPOT-VGT NDVI version 2 products and applied on a few dekads, shows the following:

The NDVI computed from PROBA-V is consistent with the NDVI from SPOT-VGT. Notwithstanding the efforts made to guarantee the consistency between both sensors, small differences can be observed due to the inherent sensor dependency of the NDVI. It is advised especially to users who compute NDVI anomalies to consider this fact. It is good practice to confirm their analysis by e.g. converging evidence from several biophysical parameters (e.g. rainfall, MetOp-S10 NDVI from LSA-SAF).

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.

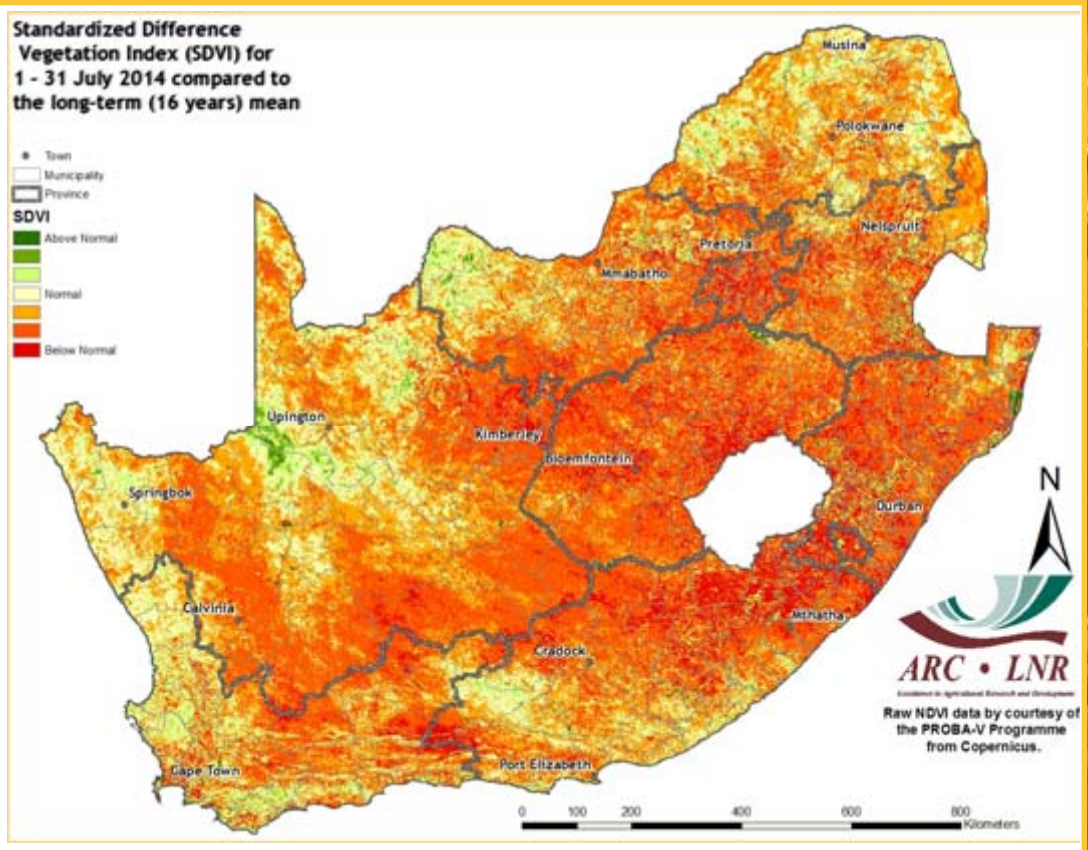

Figure 10

Figure 10:
Relatively dry conditions at the 3-monthly to 6-monthly time scale indicated in the rainfall maps together with the extremely low minimum temperatures recorded in June may be responsible for the relatively low vegetation activity indicated over much of the central to eastern interior. Vegetation activity is near normal over the winter rainfall area.

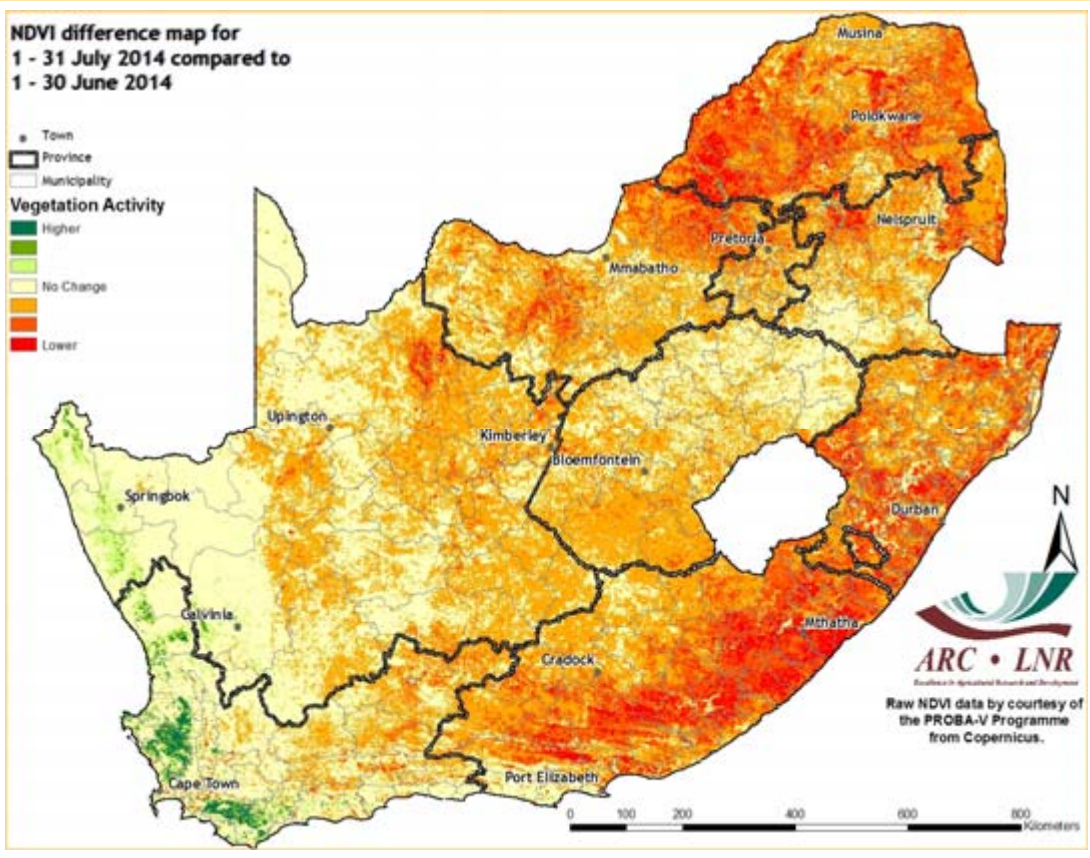

Figure 11

Figure 11:
While vegetation activity has decreased during the past month over much of the country, parts of the important grain production region in the southwest and further north along the west coast and adjacent interior experienced an increase in vegetation activity.

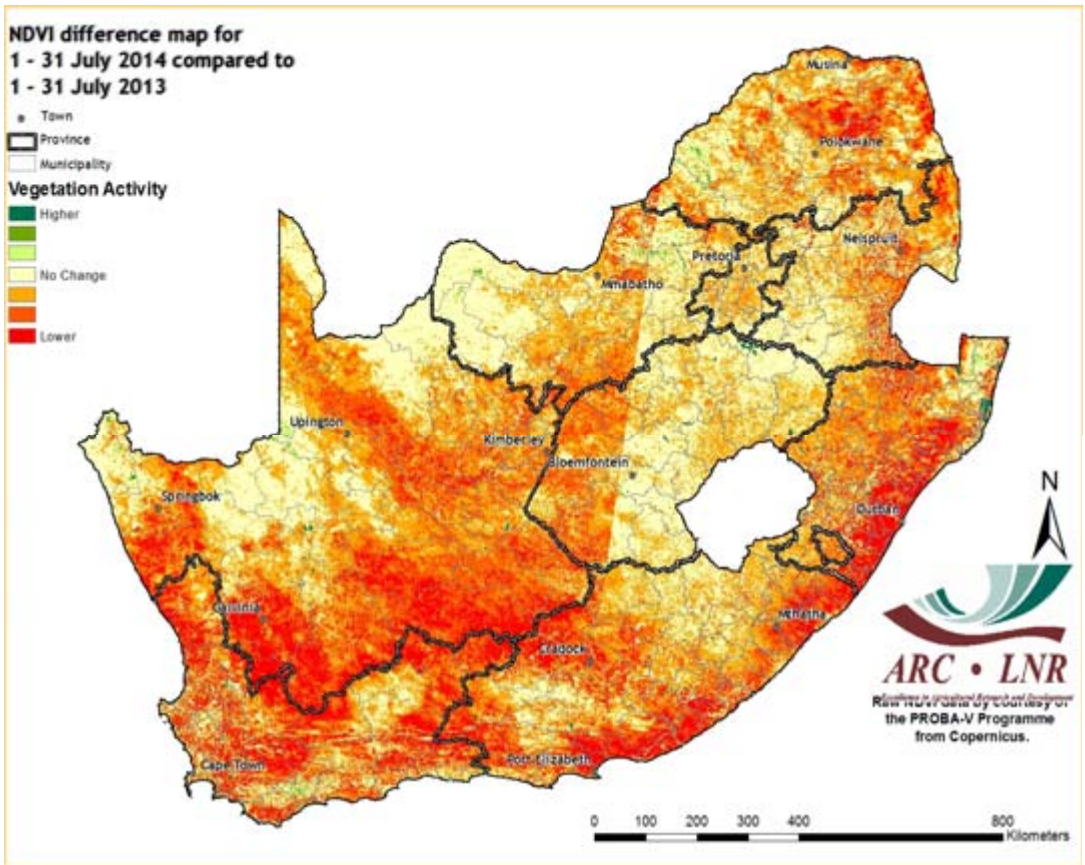

Figure 12

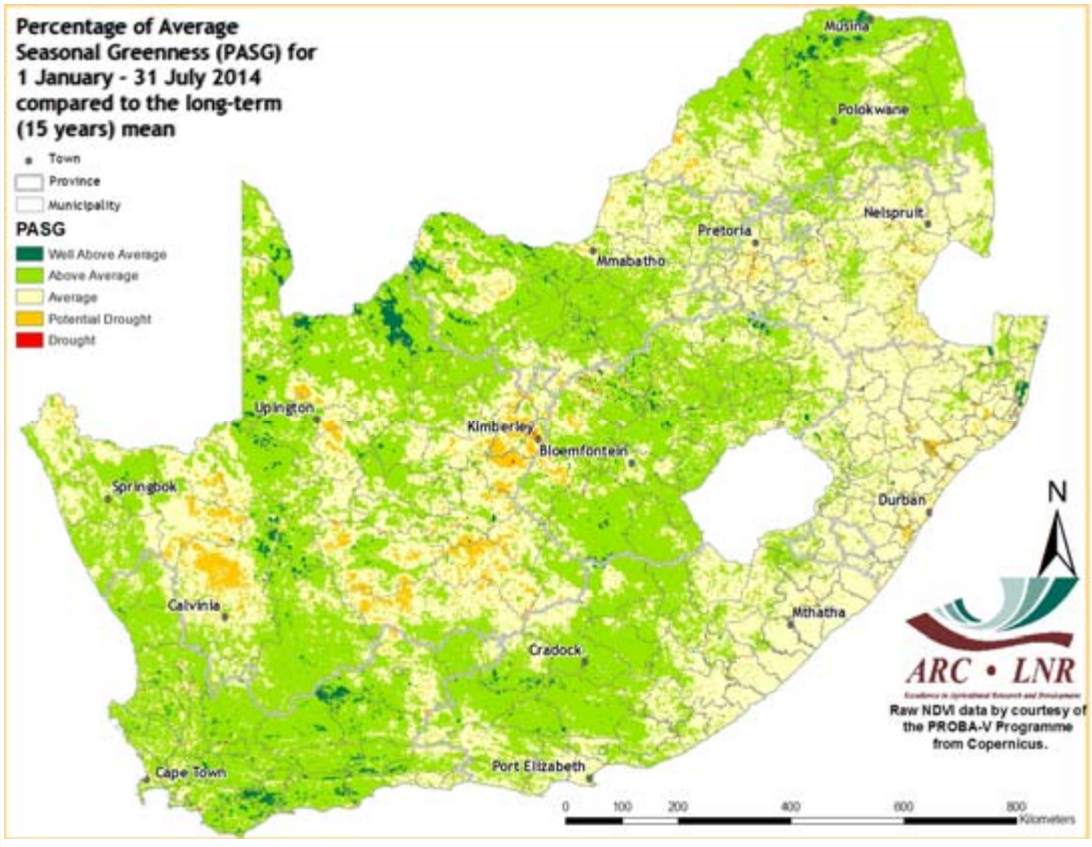

Figure 13

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:
Large parts of the country experienced lower vegetation activity than a year ago. This may in some areas be related to lower minimum temperatures during the current winter rather than lower rainfall during the previous months.
Comparison of the PROBA-V and SPOT VEGETATION NDVIs is currently being done at the ARC-ISCW to ascertain to what extent the relatively low values currently may be linked to the change in satellite sensor.

Figure 13:
Cumulative vegetation activity since January has been above normal over most of South Africa due to wet conditions during late summer. Exceptions are small areas over the extreme eastern Northern Cape and the southern parts of Mpumalanga, parts of KwaZulu-Natal and the eastern parts of the Eastern Cape.

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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.

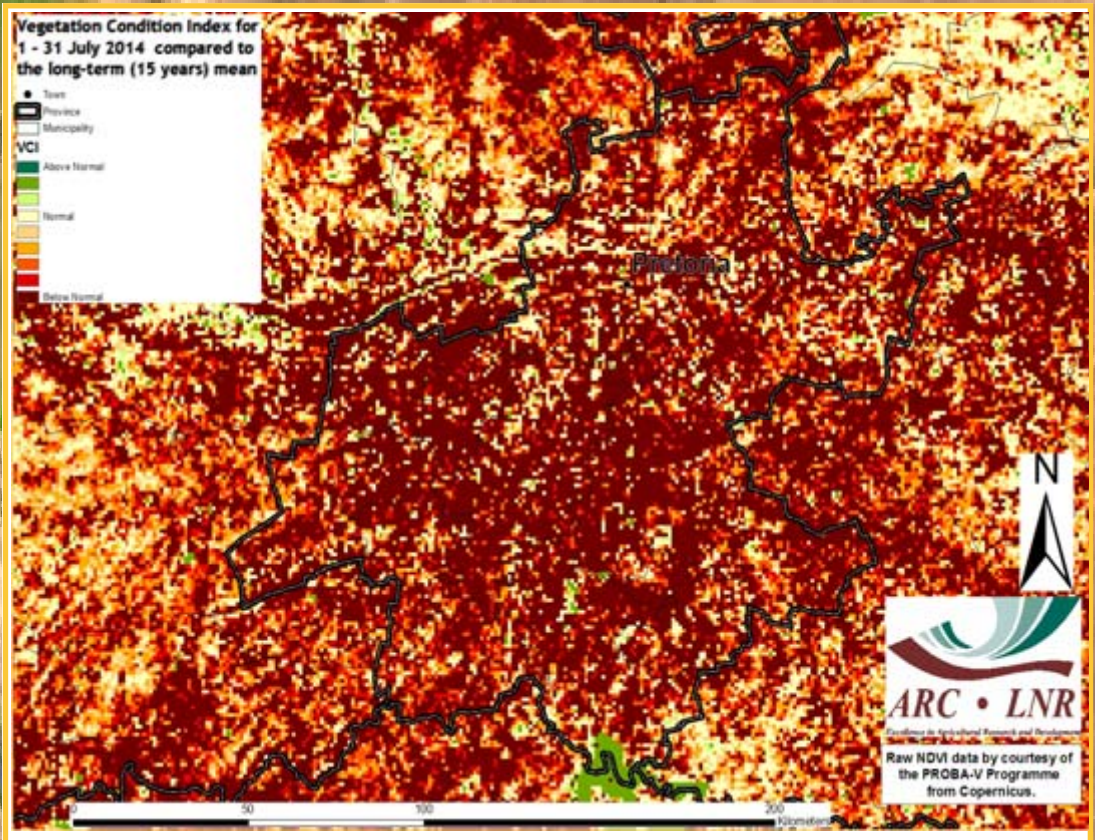

Figure 14

Figure 14:
The VCI map for July indicates below-normal vegetation activity over most parts of Gauteng.

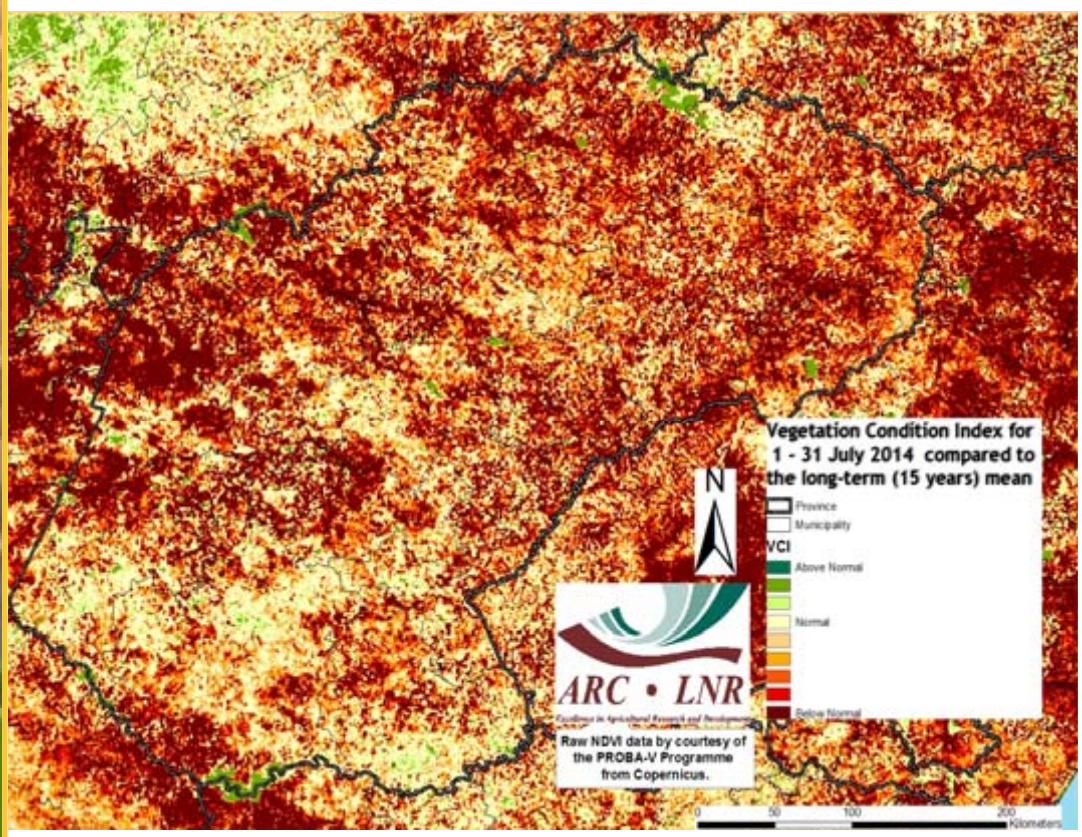

Figure 15

Figure 15:
The VCI map for July indicates below-normal vegetation activity over most parts of the Free State.

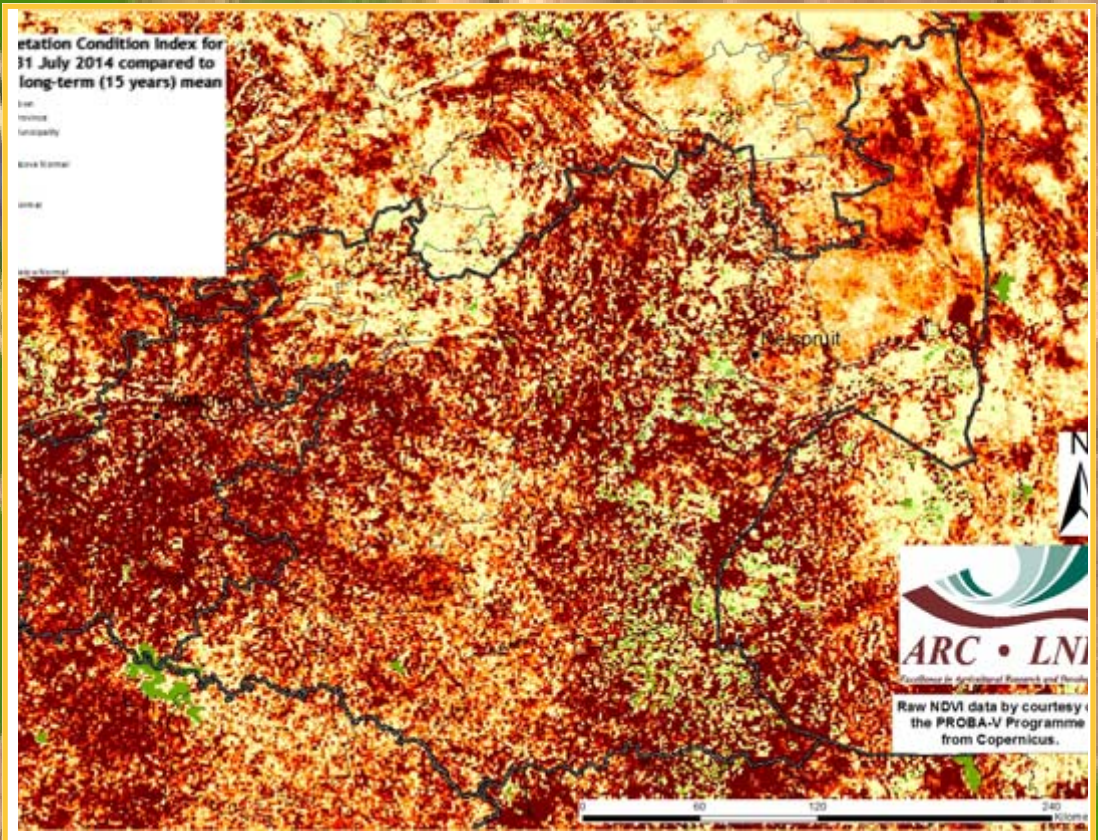

Figure 16

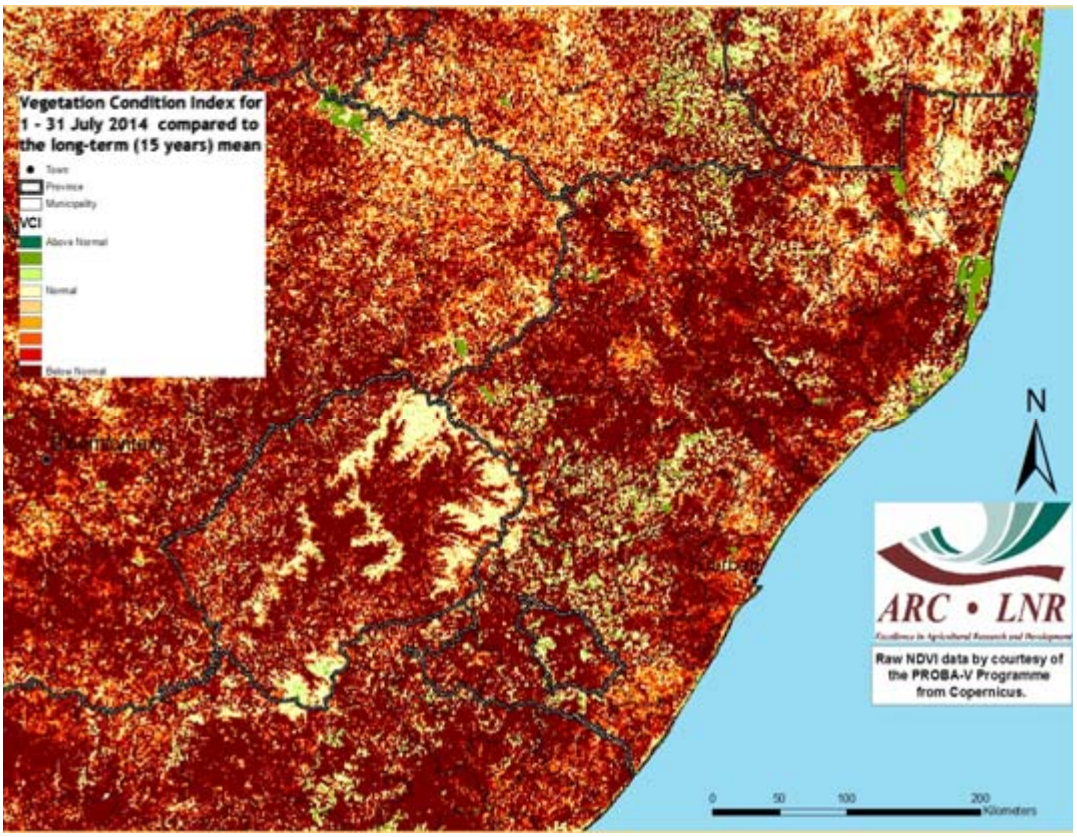

Figure 17

Figure 16:
The VCI map for July indicates below-normal vegetation activity over most parts of Mpumalanga.

Figure 17:
The VCI map for July indicates below-normal vegetation activity over most parts of KwaZulu-Natal.

Questions/Comments:
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6. Vegetation Conditions & Rainfall

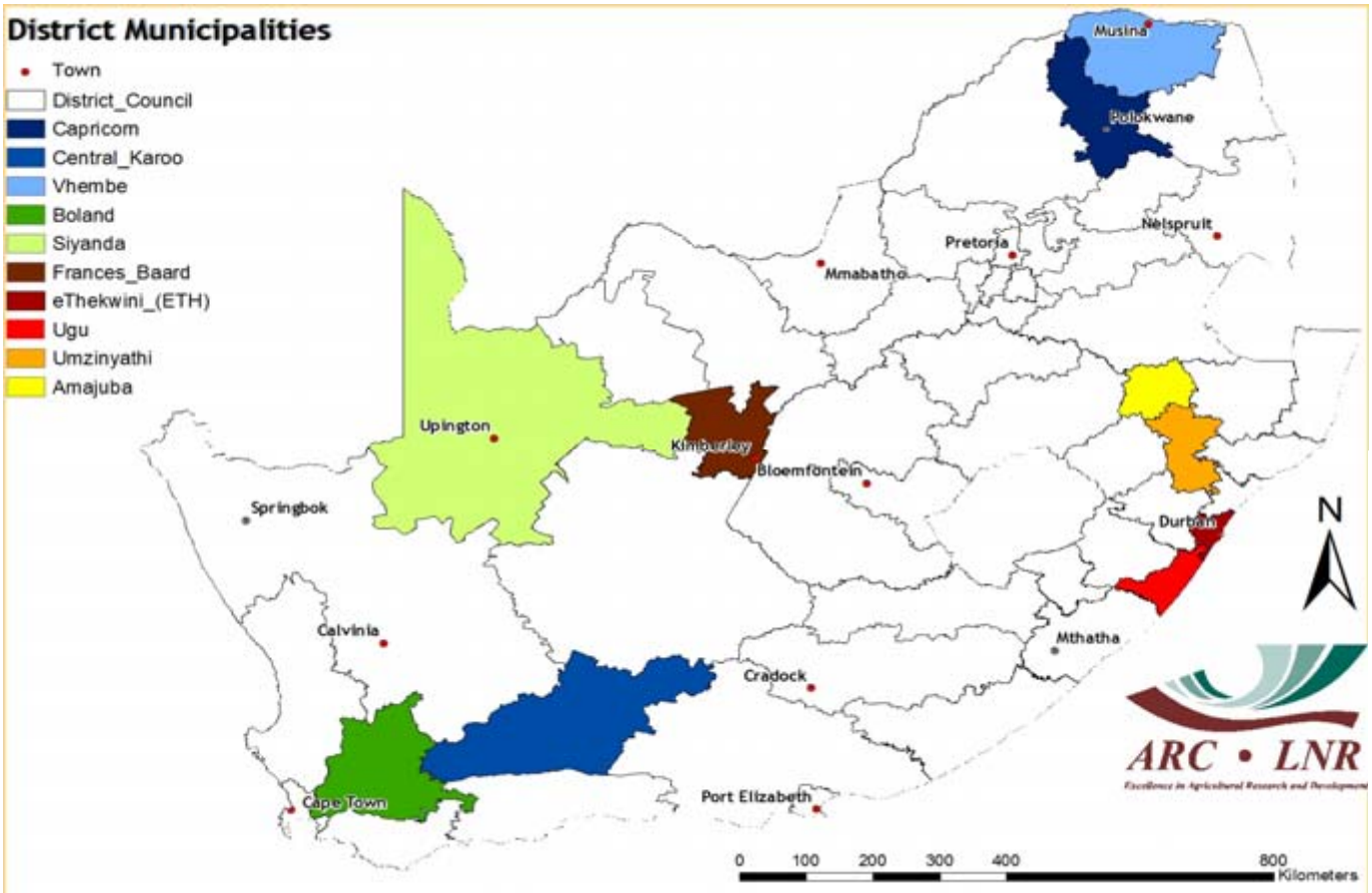

Figure 18

NDVI and Rainfall Graphs
Figure 18:
Orientation map showing the areas of interest for July 2014. The district colour matches the border of the corresponding graph.

Questions/Comments:
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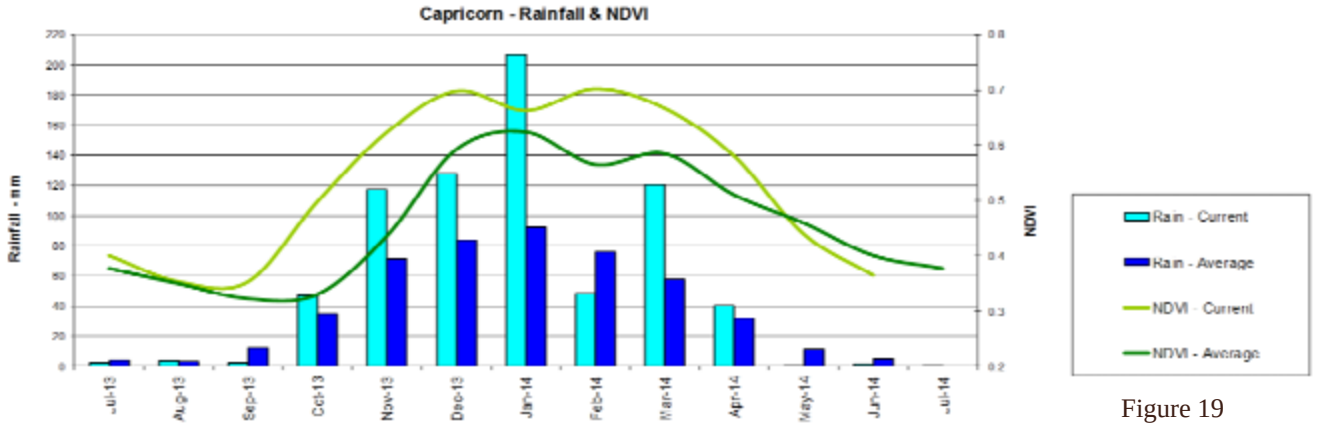
Figures 19-23:
Indicate areas with higher cumulative vegetation activity for the last year.

Figures 24-28:
Indicate areas with lower cumulative vegetation activity for the last year.



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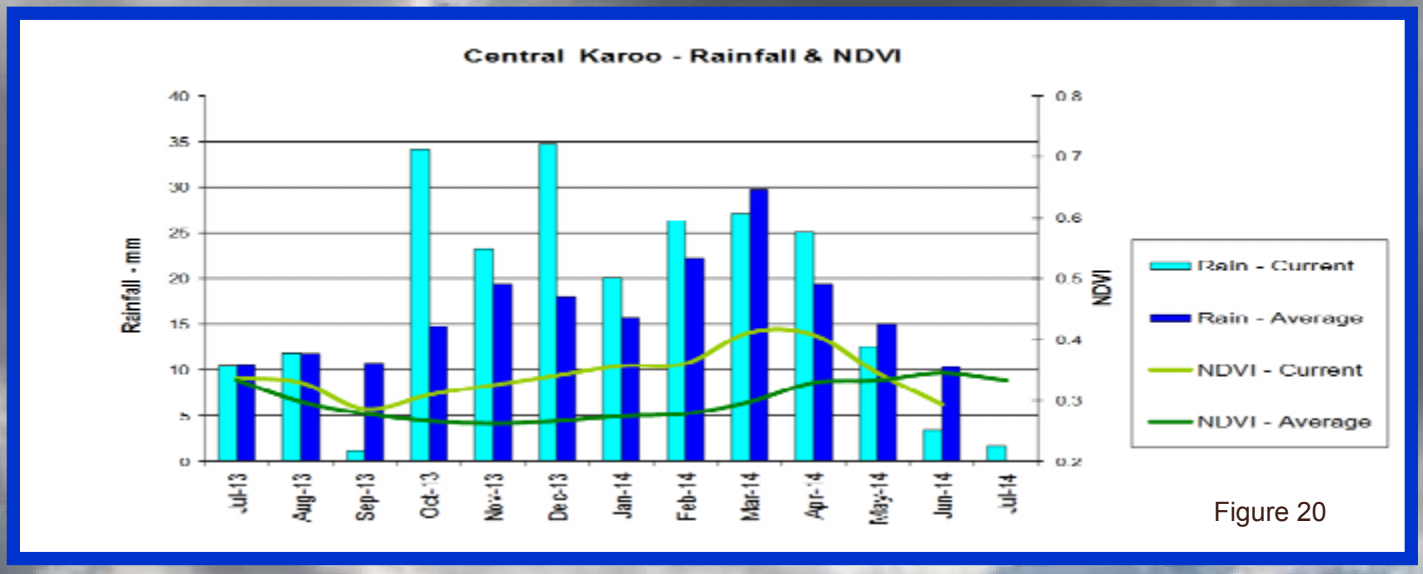
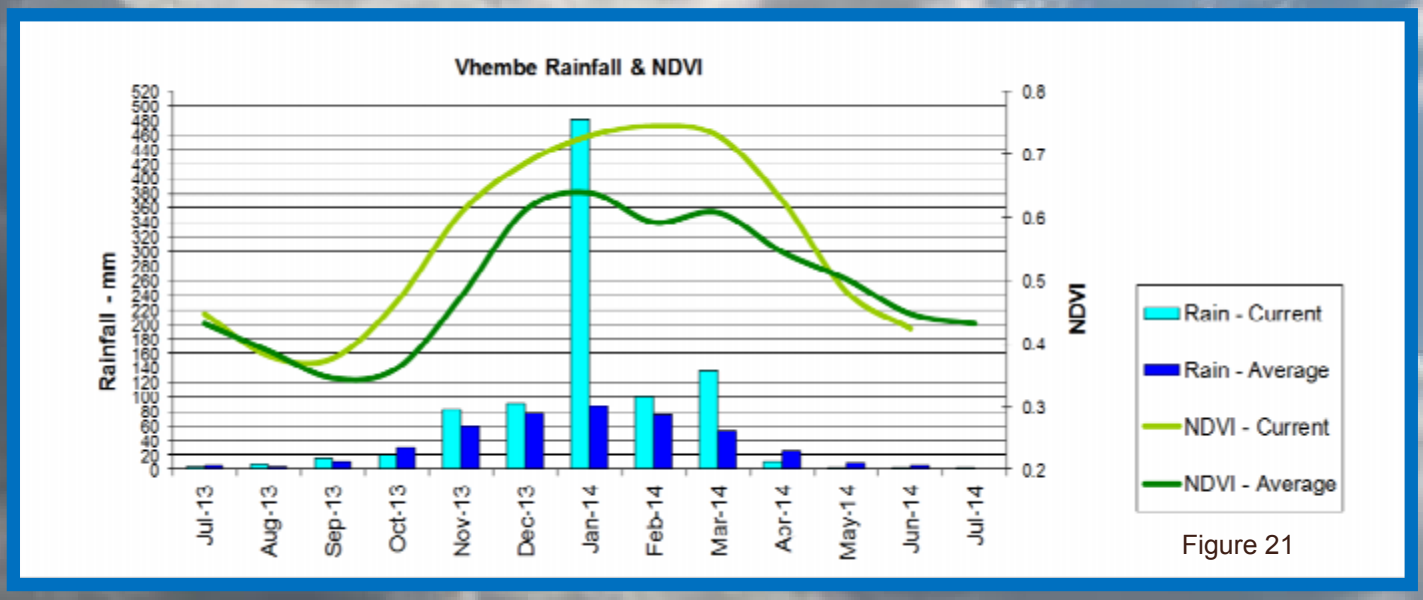


Figure 20



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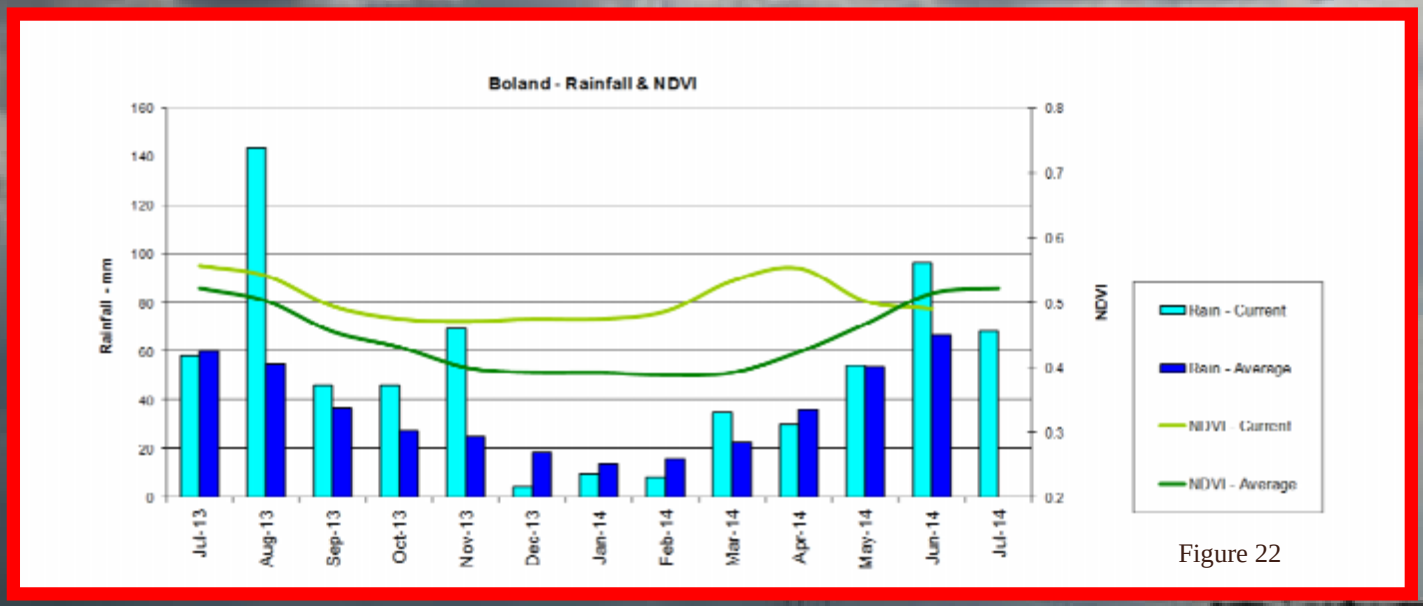

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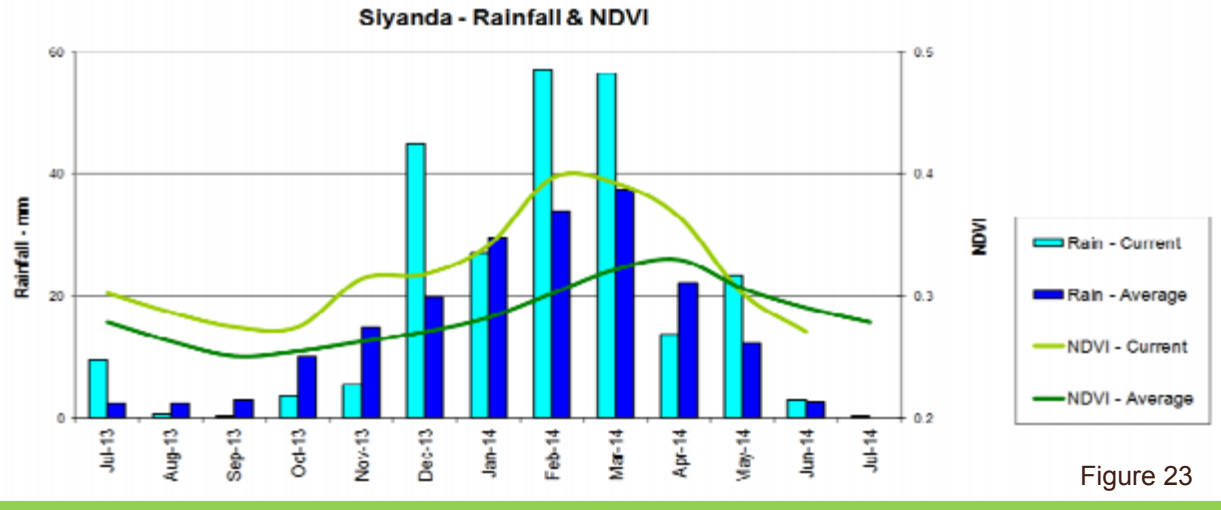


Figure 23

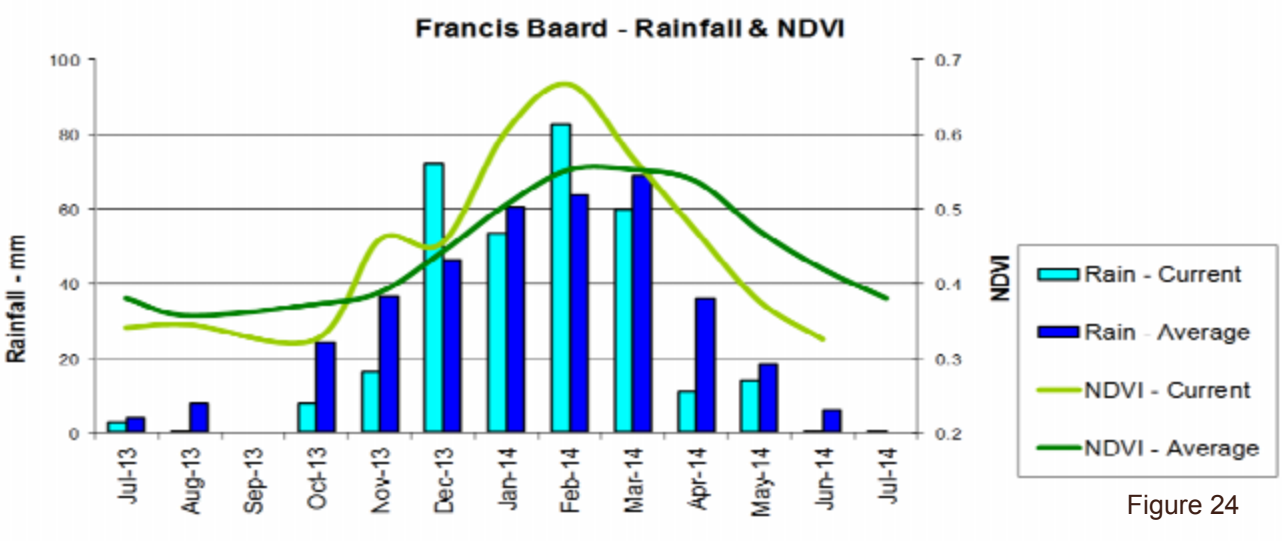


Figure 24

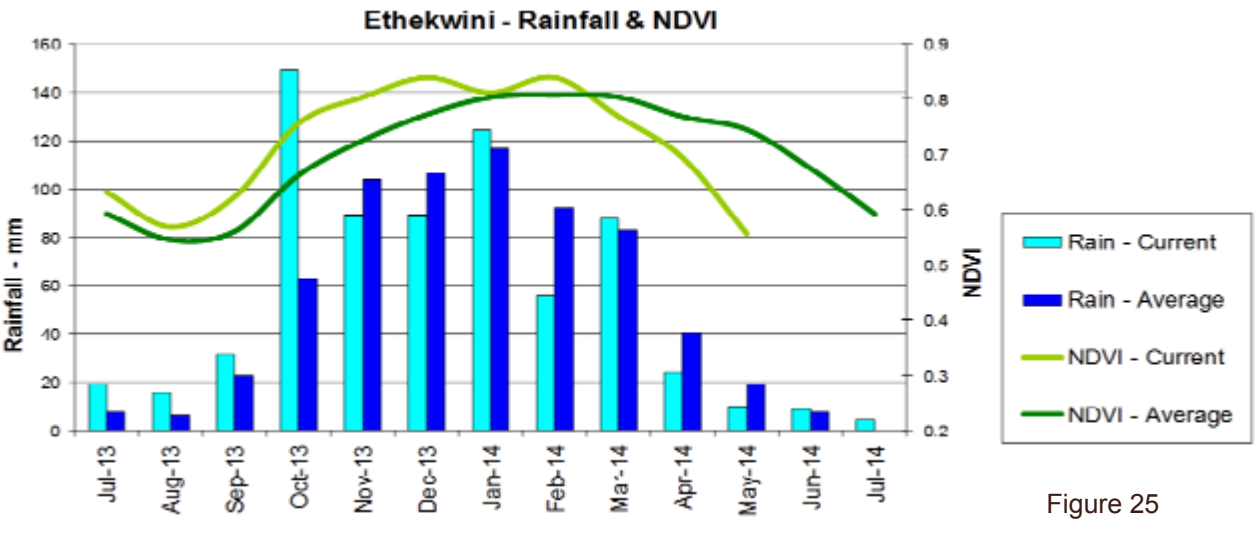
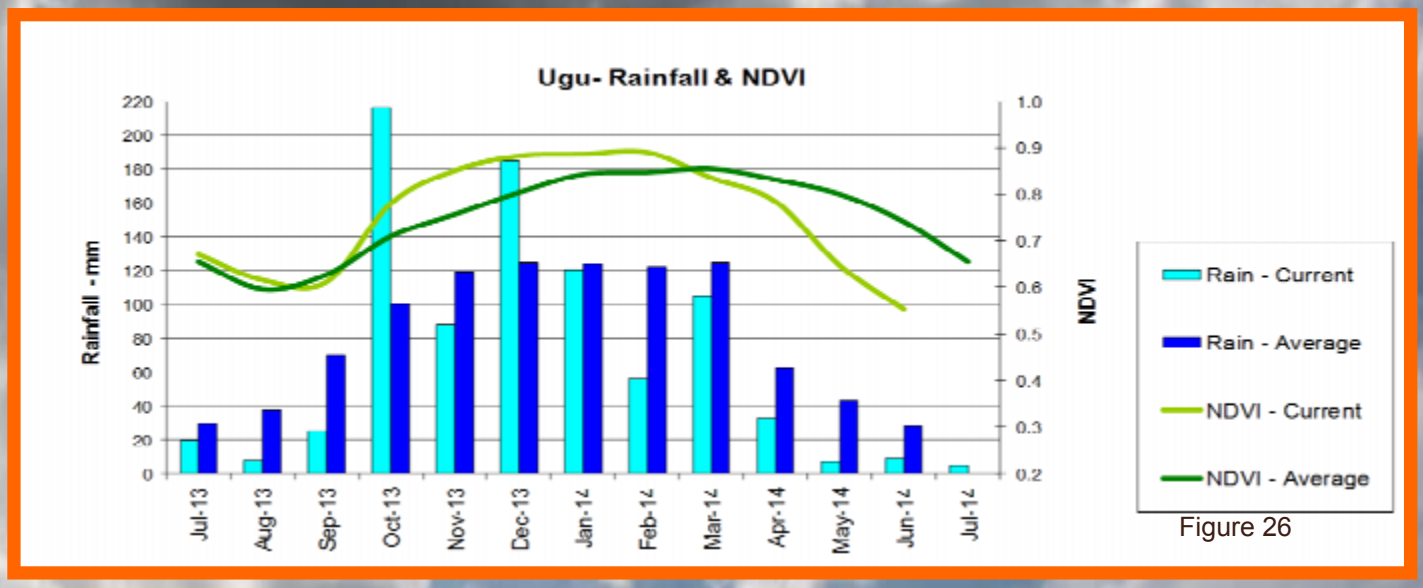


Figure 25



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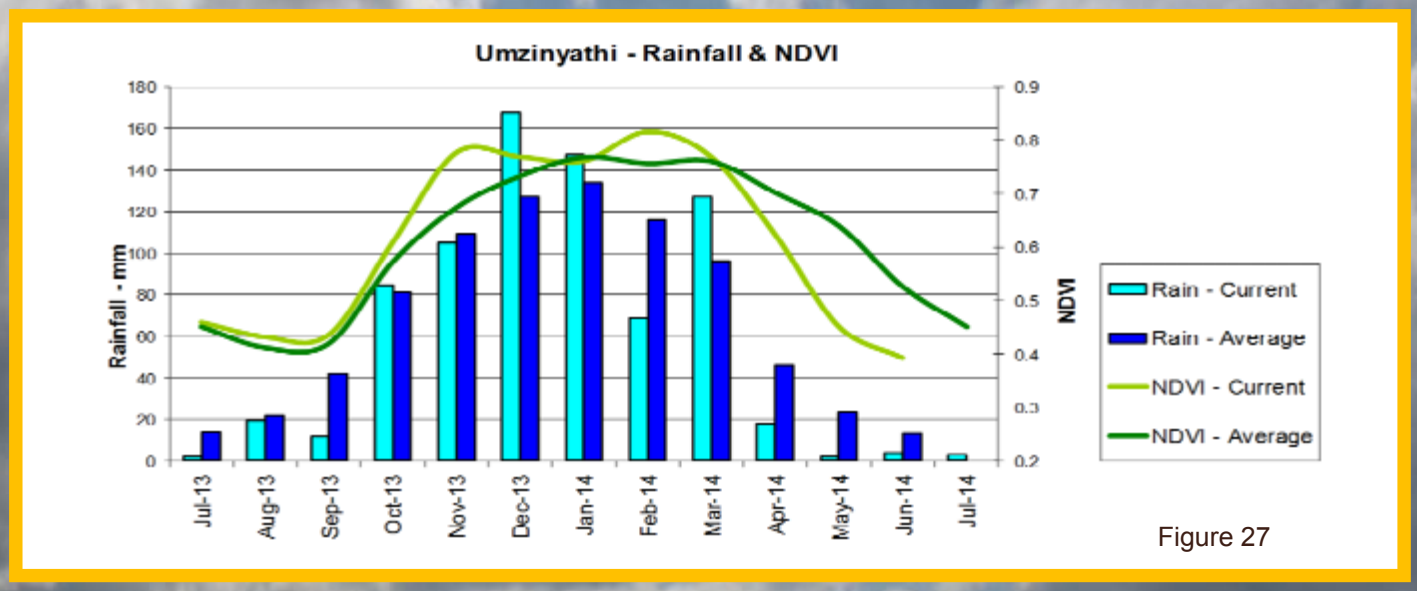

Figure 27

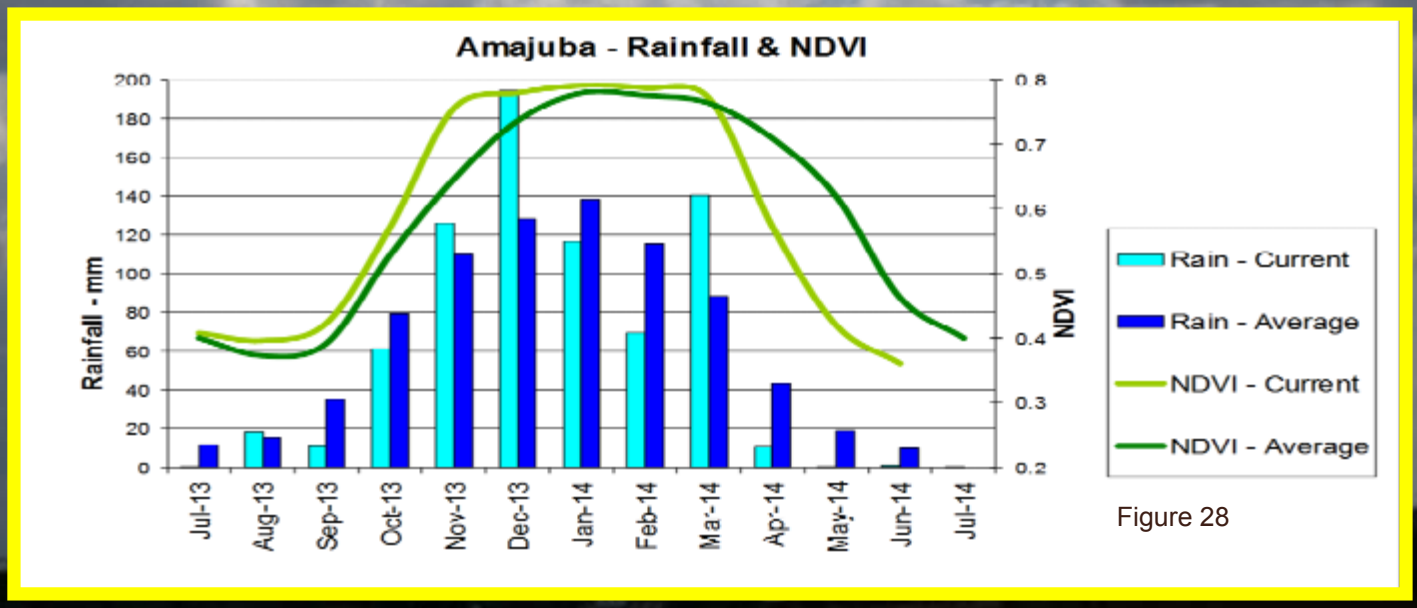

Figure 28

7. 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 29:
The graph shows the total number of active fires detected in the month of July 2014 per province. Fire activity was higher in Eastern Cape, Limpopo and KwaZulu-Natal compared to the average for the same period for the last 13 years.

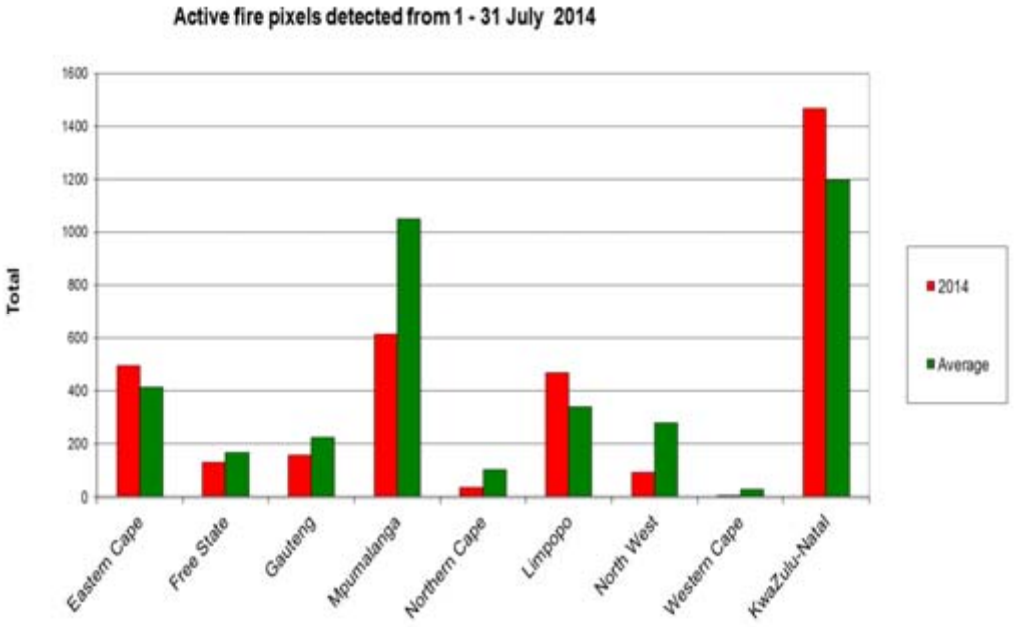

Figure 29

Figure 30:
The map shows the location of active fires detected in the month of July 2014.

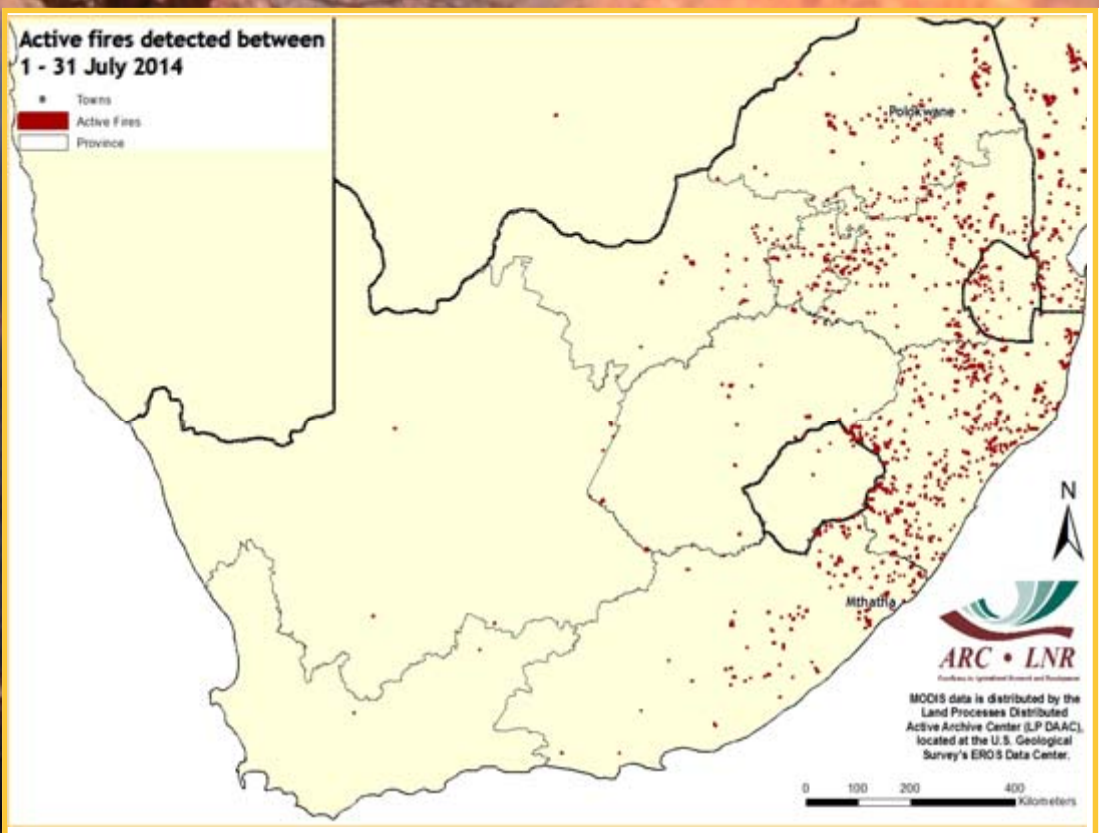

Figure 30

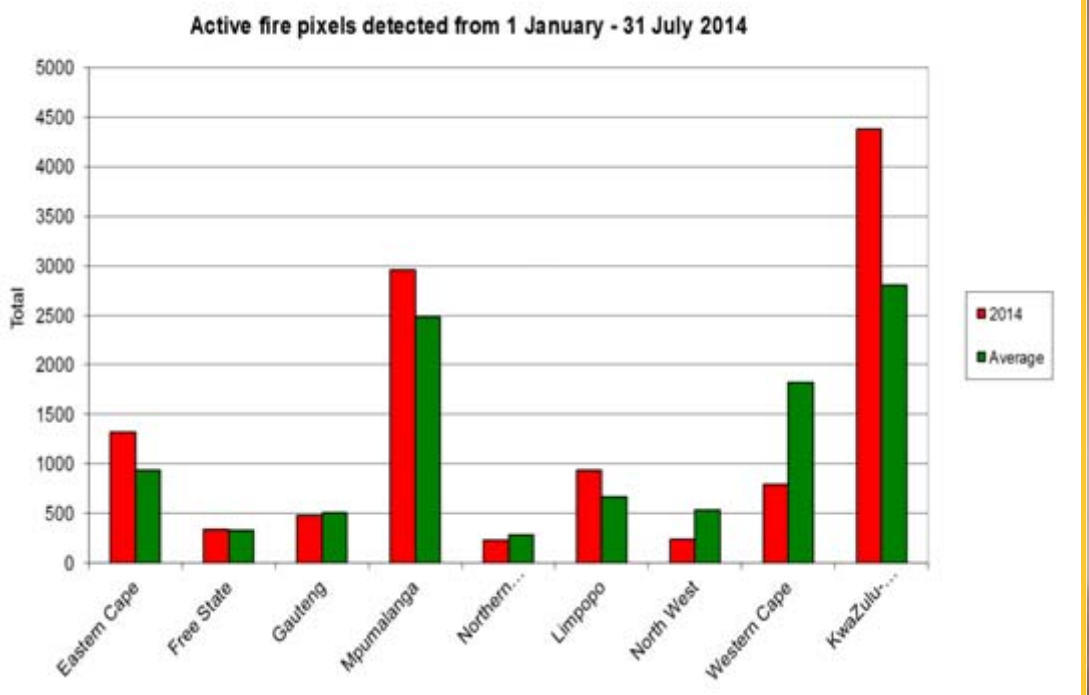

Figure 31

Figure 31:
The graph shows the total number of active fires detected from 1 January to 31 July per province. Fire activity was higher in the Eastern Cape, Mpumalanga, Limpopo and KwaZulu-Natal compared to the average for the same period for the last 13 years.

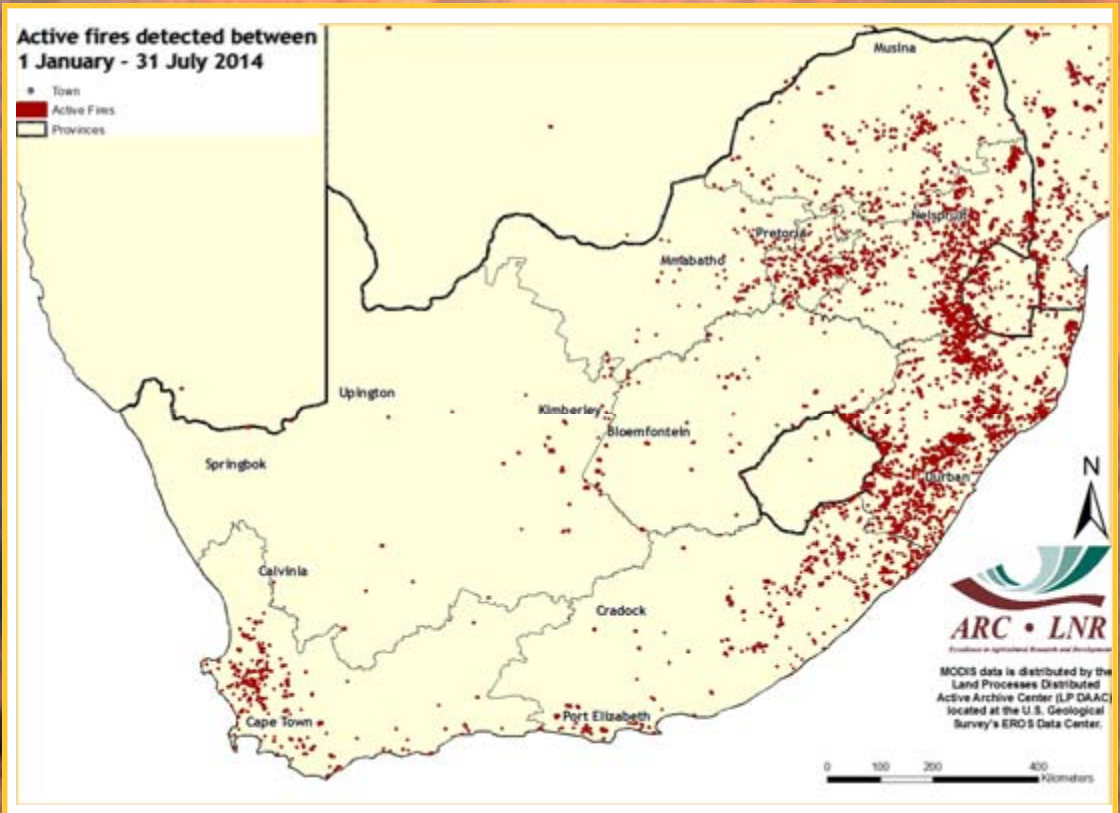

Figure 32

Figure 32:
The map shows the location of active fires detected from 1 January to 31 July 2014.

ARC-INSTITUTE FOR SOIL, CLIMATE AND WATER

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Excellence in Research and Development

Your Partner in Natural Resources Research and Information

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.

For more information contact:
Mr. Chris Kaempffer
E-mail: ChrisK@arc.agric.za
Tel: 012 310 2560

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