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UMLINDI
The Watchman

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INSTITUTE FOR SOIL, CLIMATE AND WATER

CONTENTS:

1. Rainfall	2
2. Standardized Precipitation Index	4
3. Rainfall Deciles	7
4. Vegetation Conditions	8
5. Vegetation Condition Index	10
6. Vegetation Conditions & Rainfall	12
7. Fire Watch	16
8. AgroClimatology	18
9 CRID	19
10. Contact Details	19

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

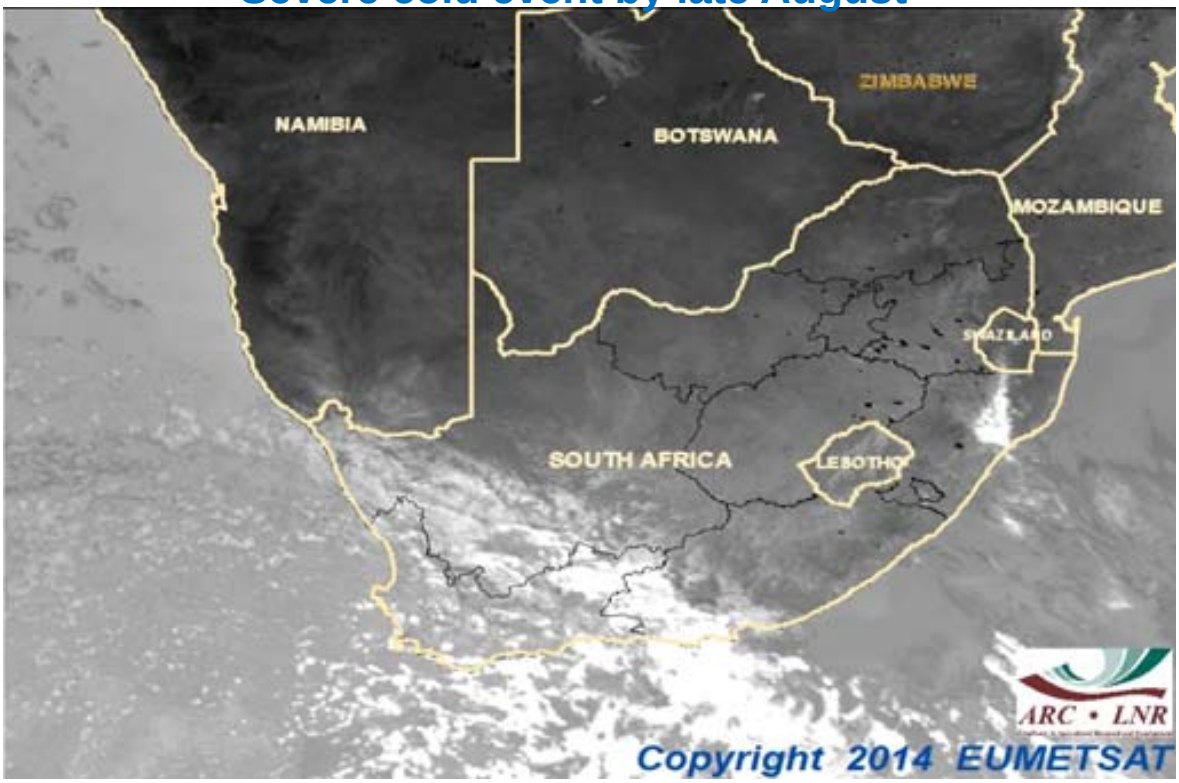
South African Weather Service

AMESD

123rd Edition

Image of the Month

Severe cold event by late August



August 2014 saw a number of interesting weather events. Several rainfall-producing systems over the interior during the first 22 days of the month resulted in above-normal rain over large parts of the interior, in between periods of relatively warm and spring-like weather. By the end of the month though, a very strong cold front moved across the country resulting in a significant drop in temperatures. Widespread frost occurred over most of the interior during the last days of the month, including areas as far north as the Limpopo Province. In some areas, such low temperatures by this late stage of winter resulted in negative impacts on agricultural activities sensitive to cold. The system was also responsible for widespread snow over the southern parts of the country, from the mountainous areas in the winter rainfall region in the southwest, through the Eastern Cape, southern Free State, Lesotho and southern and western KwaZulu-Natal. Snow falls over the interior were mainly light due to relatively dry conditions at the surface associated with this particular event. The image above is compiled from data from the short-wave infrared (SWIR) channel of the MSG3 satellite at 15:00 SAST on the 28th, with warmer regions shown here in darker and colder areas in lighter shades. The cold air invading the west is visible in the broken cloud mass covering the Western Cape, southwestern Northern Cape and western Eastern Cape. These areas were all experiencing cold conditions with rain or snow at the time of the image. Ahead of the cold front, warm, dry and windy conditions were very favourable for the development and spread of wild fires. These can be seen as dark spots over the northeastern and eastern parts of the country. As the system moved northeastwards during the following two days, the cold air spread over the entire country, with snow over many areas in the south, and the last widespread frost for the winter over most of the interior.

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: Circulation patterns during August 2014 were such that the western winter rainfall region and the central interior received above-normal precipitation with relatively dry conditions over the remainder of the country. Interestingly also, the lowest minimum temperatures over the interior occurred during the last 10 days of the month, with mild conditions and relatively frequent rain events dominating much of the interior during the first 20 days.

Several frontal systems moving into the country resulted in a fairly even temporal distribution of precipitation over much of the winter rainfall region. The main periods of precipitation were the 3rd to the 5th, 13th to 14th, 17th to 21st and 25th to 28th.

Associated with the frontal activity in the southwest, several upper air troughs developing into cut-off low pressure systems over the interior resulted in rain, also over the summer rainfall region. These systems resulted mostly in wet conditions during the first 20 days of the month, while they were mostly responsible for cold conditions during the last 10 days of the month. The first of these, associated with the first front, developed between the 6th and 9th days, moving across the central parts and resulting in scattered showers over parts of the Northern Cape and Free State. The second system developed from the 14th to the 17th day over the southwestern parts, with large amounts of moisture in the east resulting in the widespread showers over the central to eastern parts, contributing most of the rain over those areas. The next system responsible for rainfall over the interior resulted only in low rainfall amounts over some parts of the Free State, but the strong cold front ast the surface. Very low minimum temperatures with frost occurred over most parts from the 2th to 24th day.

(Continues on next page…..)

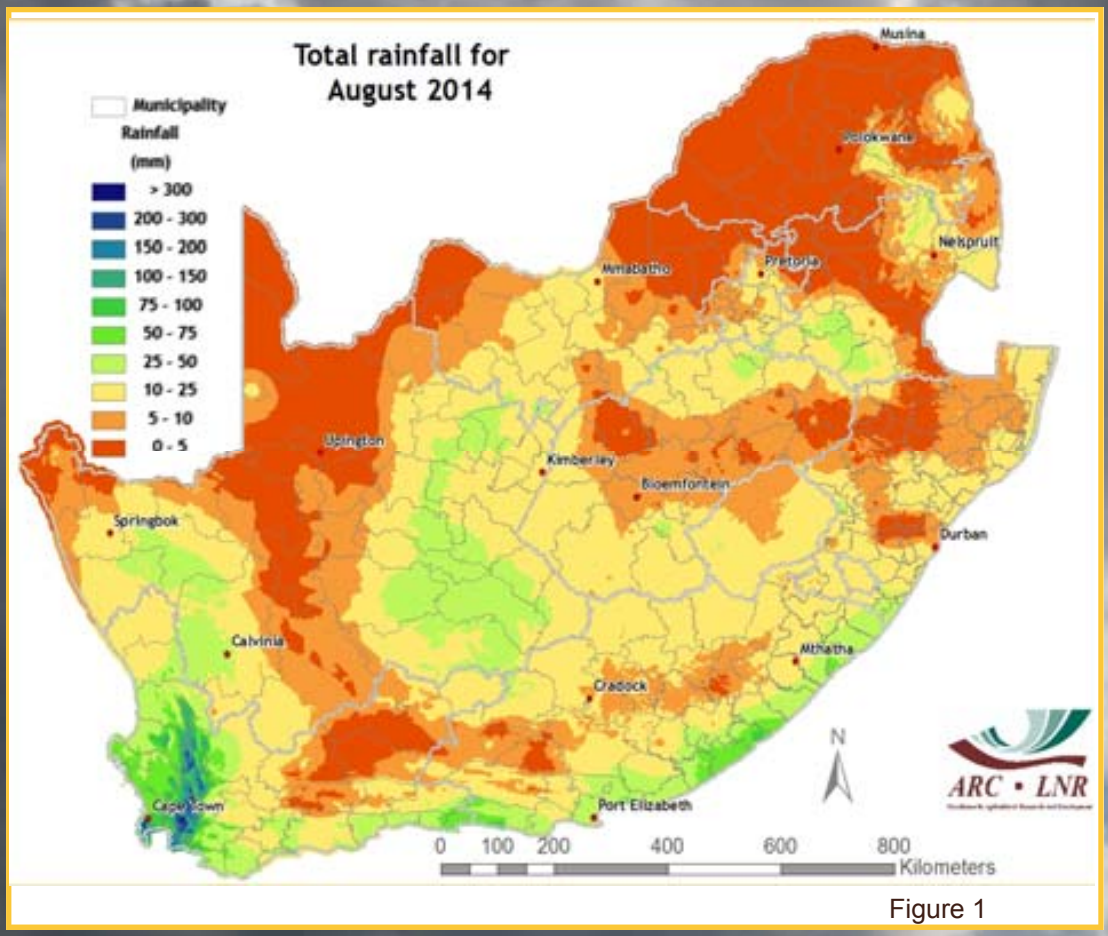


Figure 1

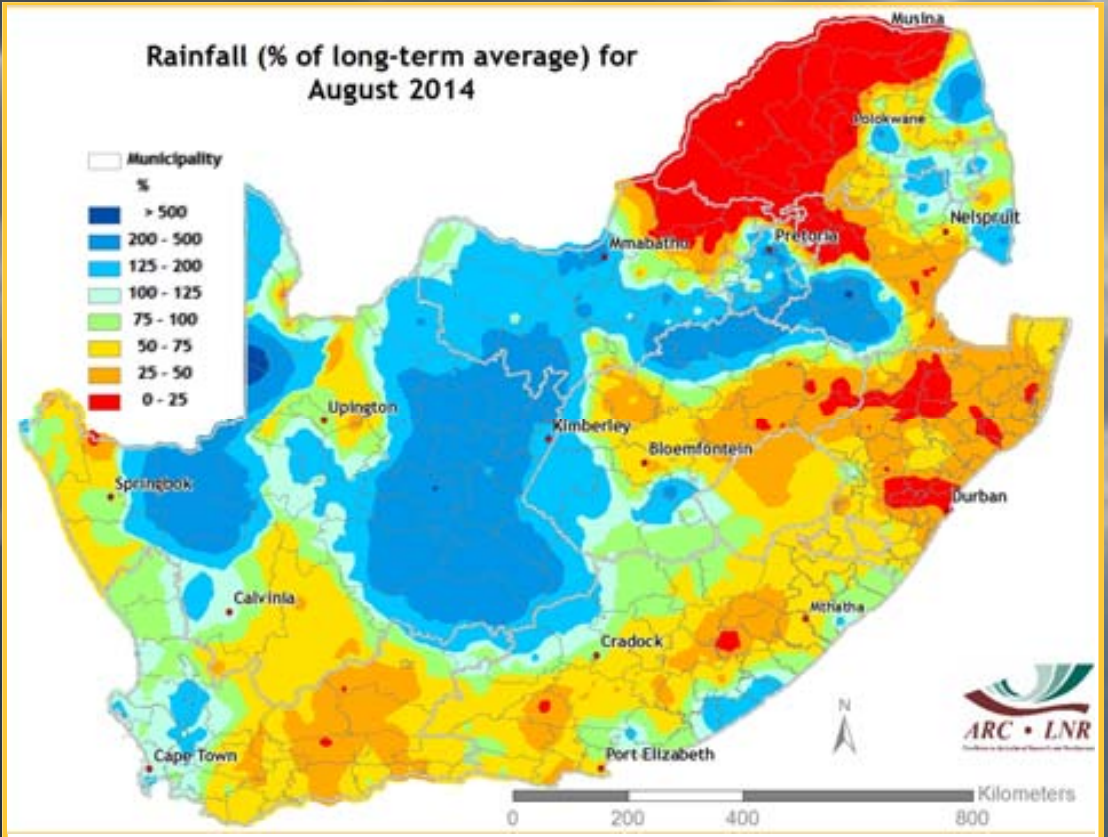


Figure 2

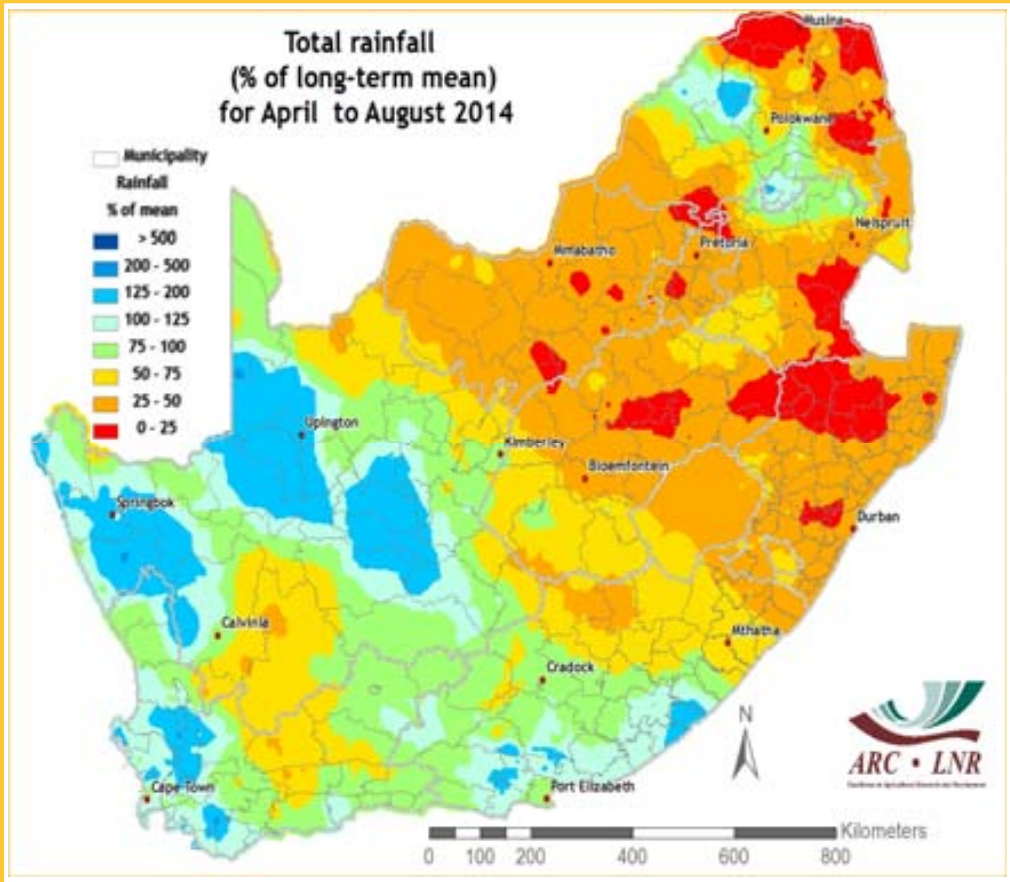


Figure 3

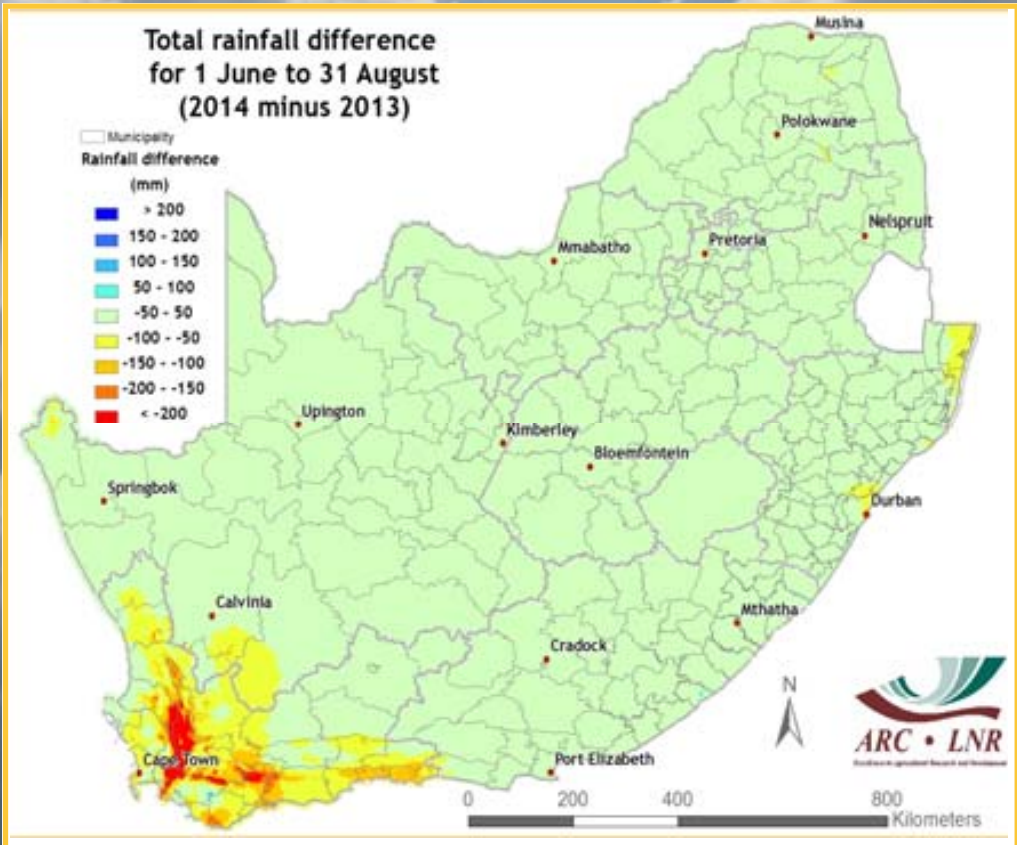


Figure 4

The last upper air trough moving across the country was perhaps associated with the most significant weather events for the month with snow and cold over much of the southern parts. Apart from windy and cold conditions, the interior remained relatively dry. The month ended with cold, dry conditions with frost over much of the interior.

Figure 1:
Large parts of the interior received 10-30m of rain during August. Higher falls were recorded over the winter rainfall area in the southwest including the western escarpment into the Northern Cape and along the coastal areas and adjacent interior of the Western Cape and Eastern Cape. No precipitation was recorded over the western parts of Limpopo and extreme northern North West and Mpumalanga.

Figure 2:
Rainfall was above-normal over much of the central parts of the country as well as Gauteng and parts of Mpumalanga. The western parts of the winter rainfall region also received above-normal rainfall. Rainfall totals were mainly below normal over the remainder of the country.

Figure 3:
Since April, precipitation distribution was such that normal to above-normal totals were recorded over the southwestern half of the country (except large parts of the western Karoo) while below-normal precipitation dominated in the northeast.

Figure 4:
The main feature of the difference map is a much lower rainfall indicated over most of the winter rainfall region this year compared to last year for June to August. While normal precipitation dominated during the current winter over these areas, very much above-normal precipitation occurred especially during July and August 2013 over this area.

Questions/Comments:
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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.

At the 3-month time scale (figure 5), the western einter rainfall area experienced normal to wetter-than-normal conditions, with the rest of the country, especially towards the east and south, experiencing a relatively dry winter. Towards the longer timescales, wet conditions over the southwest and northeast still dominate with moderate drought conditions at the 12-monthtime scale (figure 7) towards KwaZulu-Natal and at the 24-month scale (figure 8) over isolated parts of the central interior.

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.

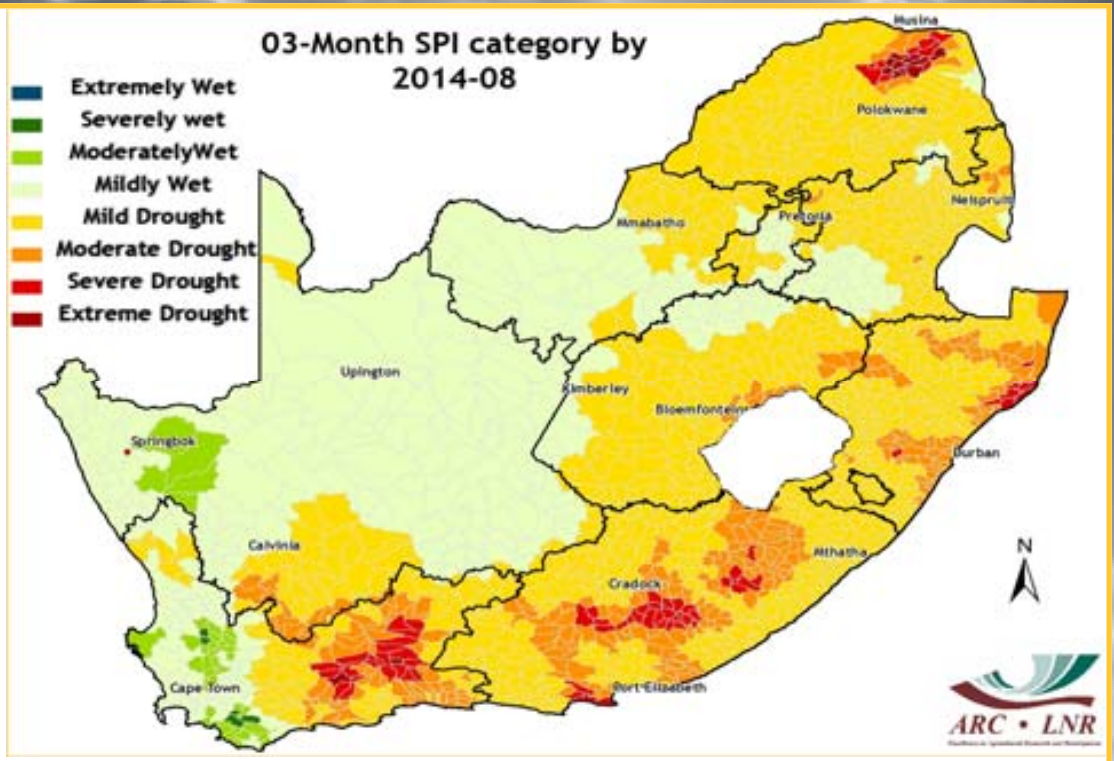

Figure 5

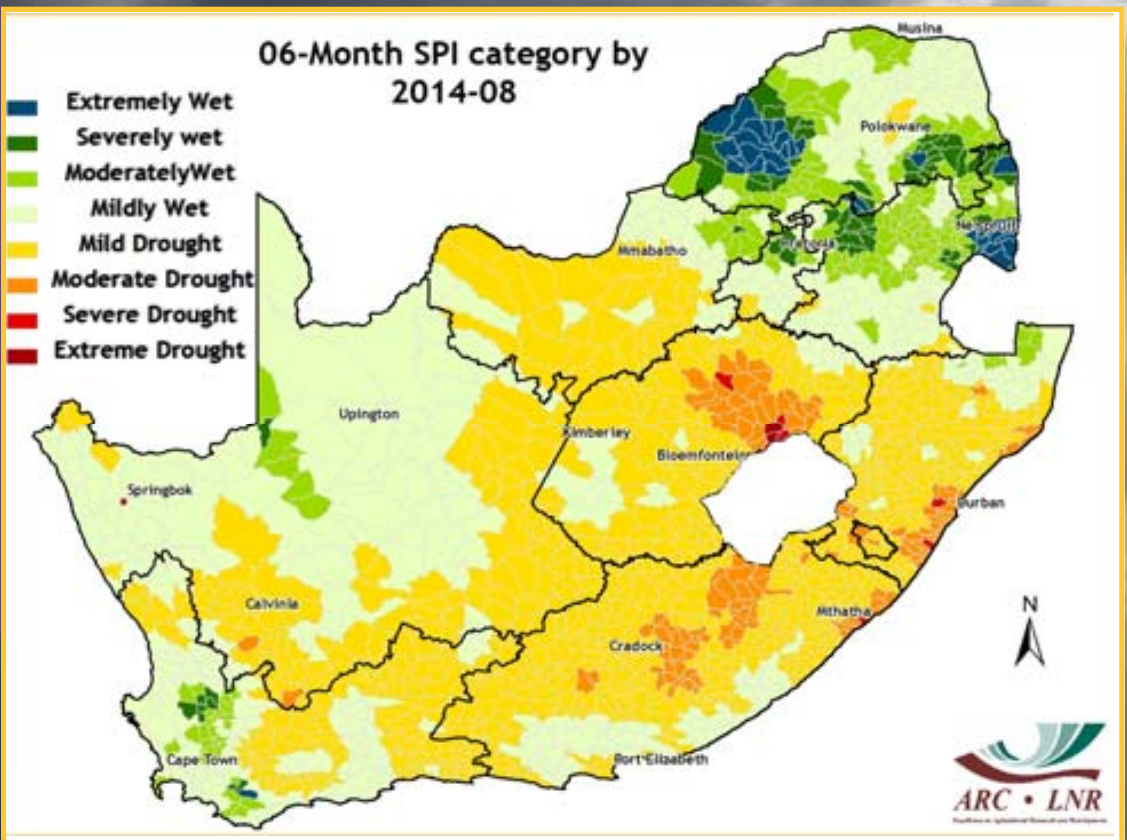

Figure 6

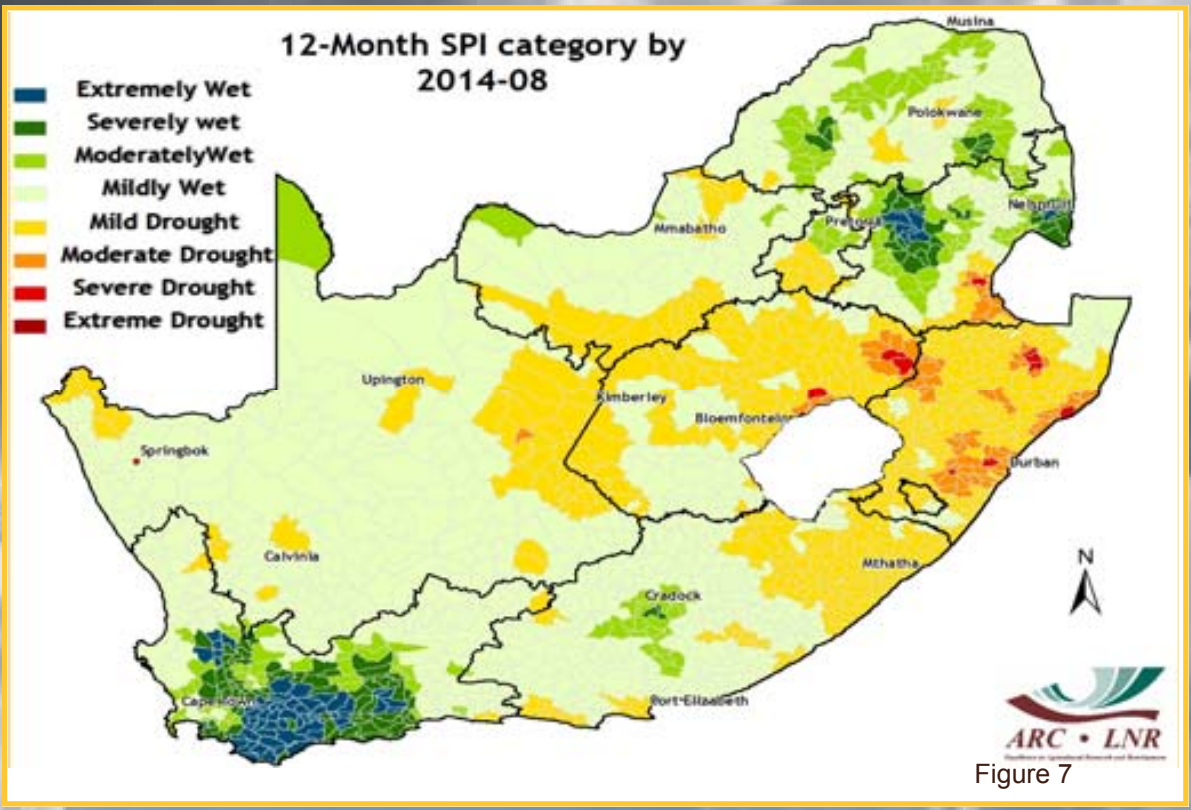

Figure 7

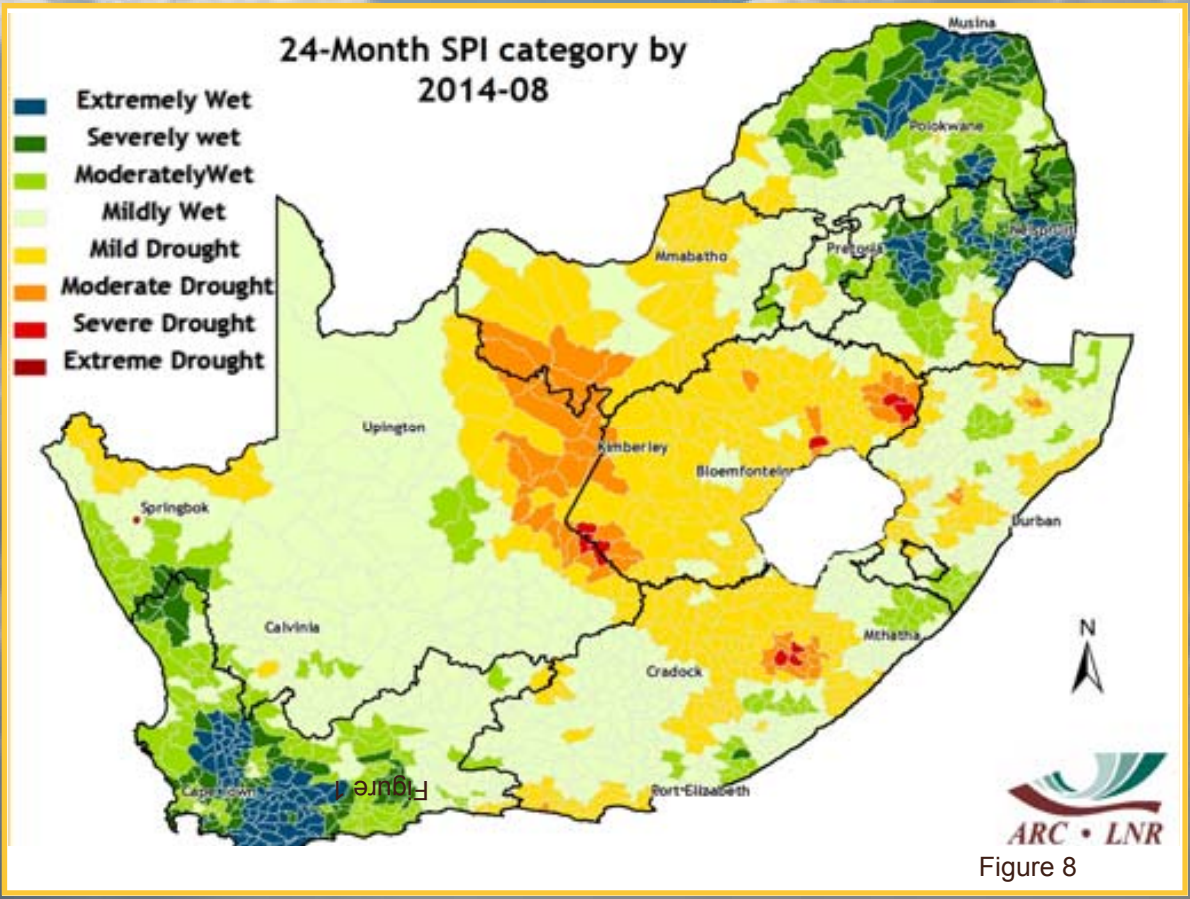

Figure 8

2. Standardized Precipitation Index

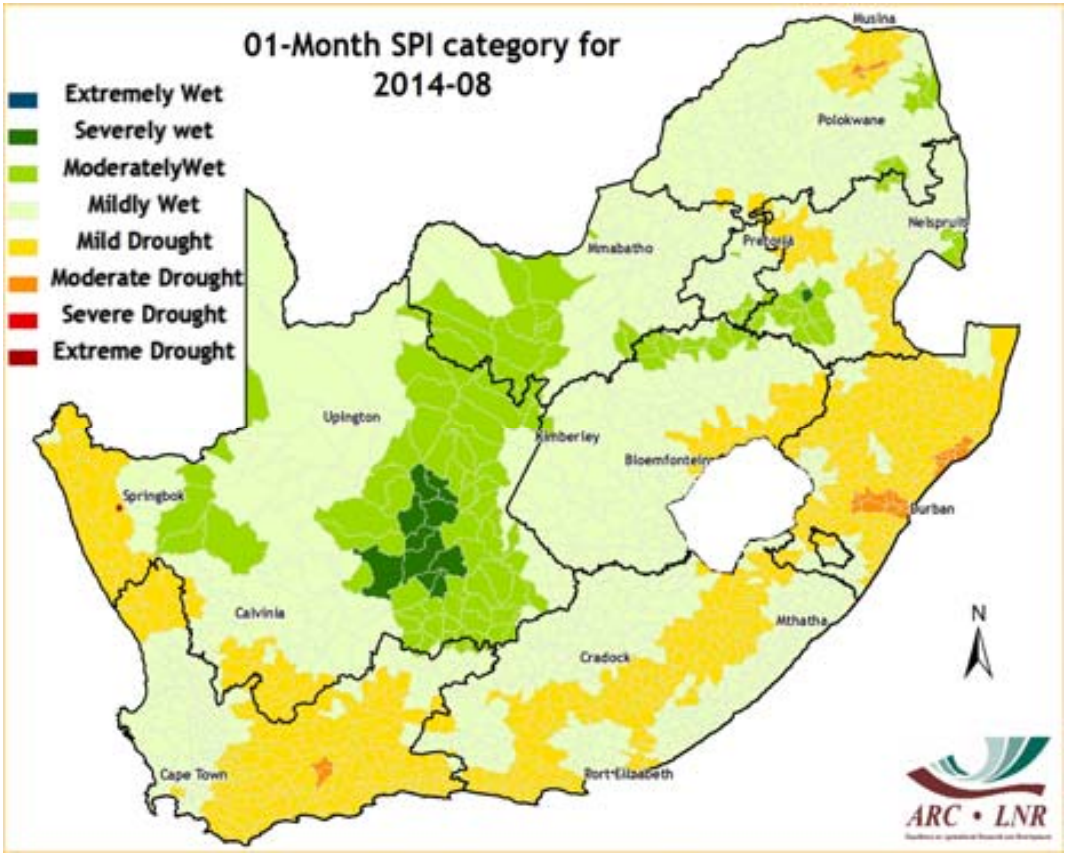

Figure 9

SPI continued….

The 1-month SPI (figure 9) shows that rainfall anomalies during August were for the most part in stark contrast to the anomalies that dominated during much of the last 3 years (figure 10).

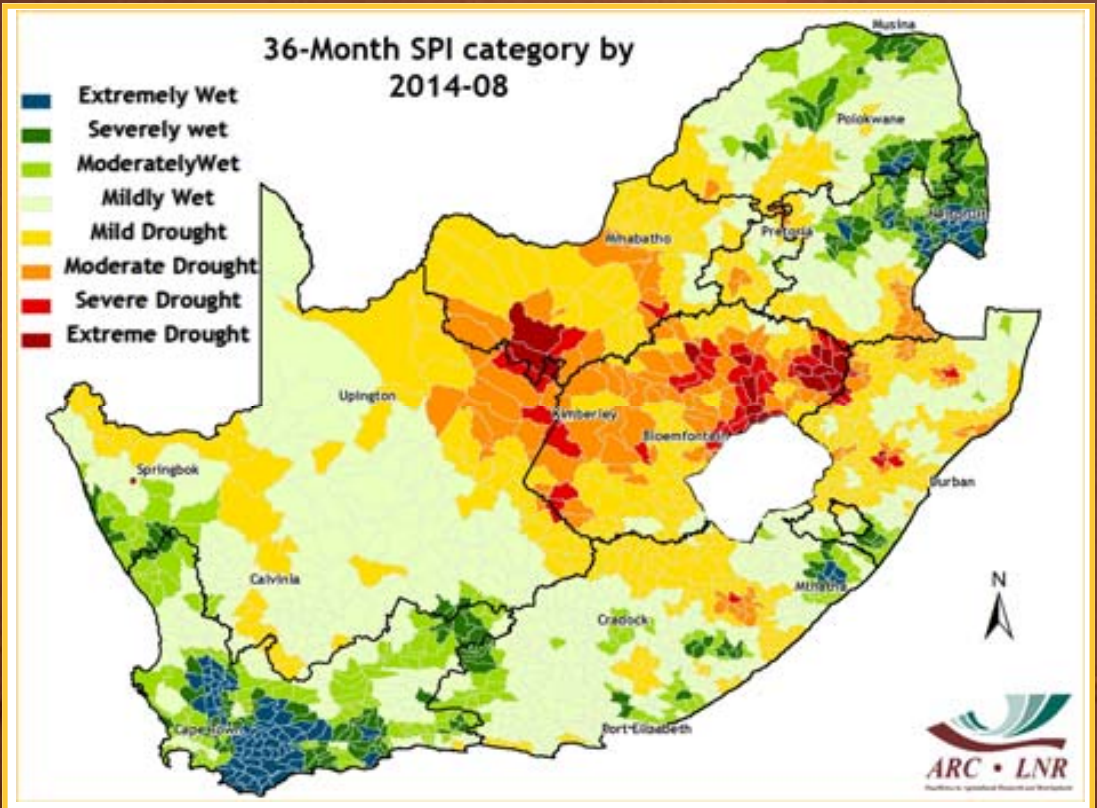

Figure 10

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.

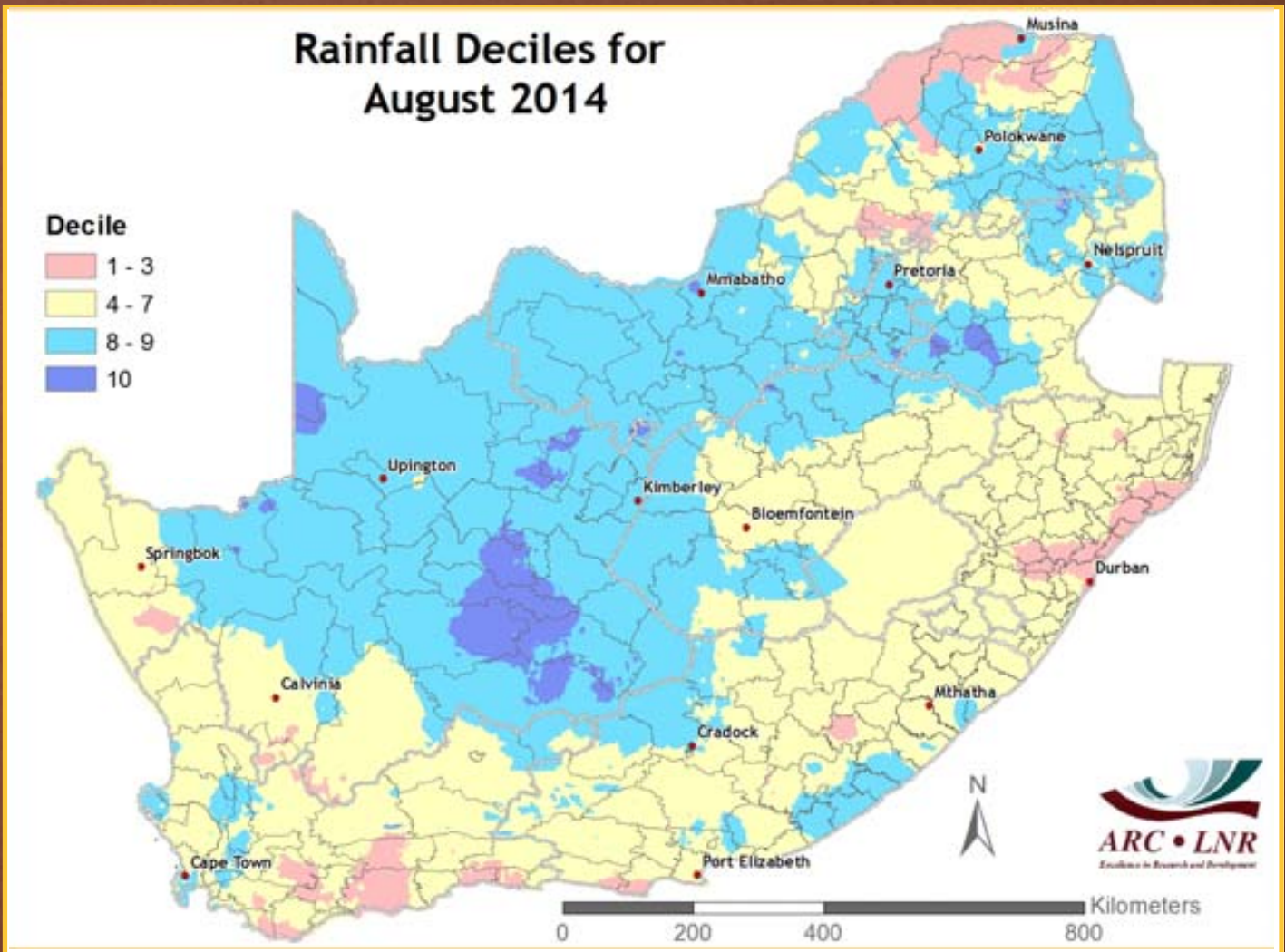

Figure 11

Figure 11: The rainfall events over the central interior resulted in totals that are extreme compared to the existing time series. The western parts of the winter rainfall area was relatively wet while the eastern parts of that area was relatively dry.

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 NDVI 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.

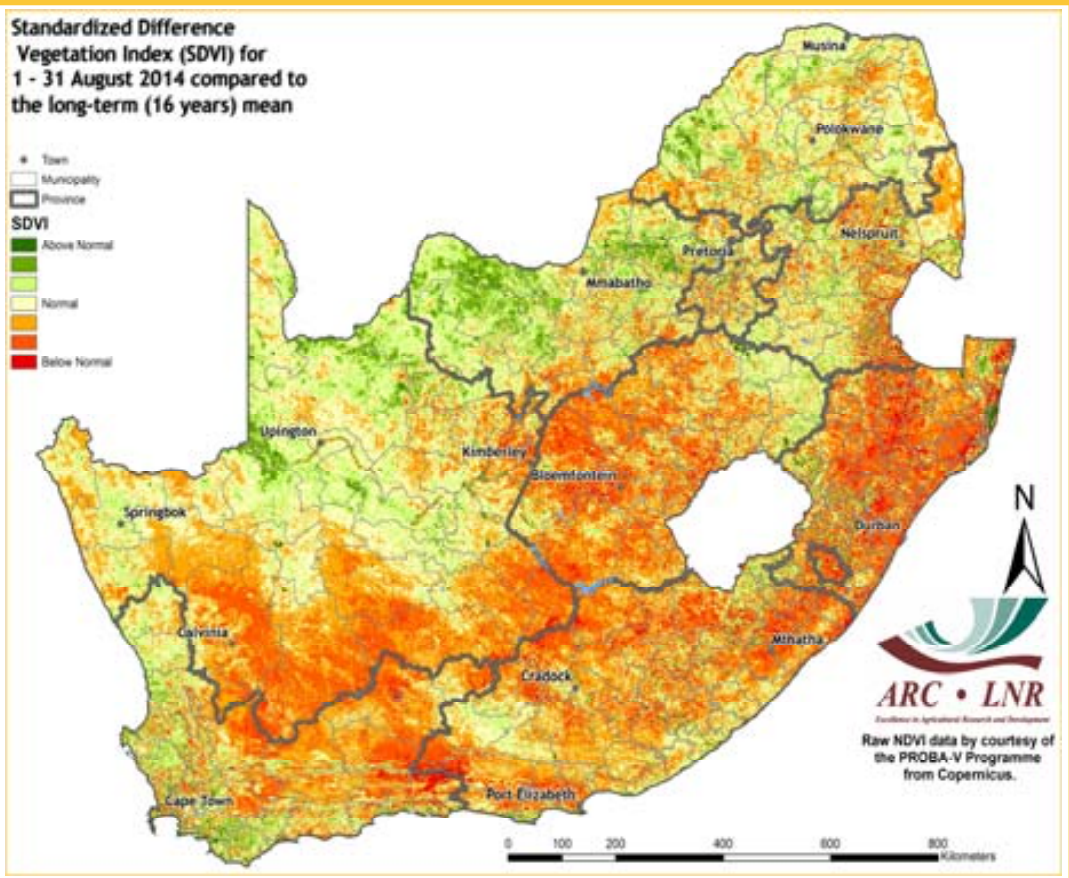

Figure 12

Figure 12:
Relatively dry conditions at the 3-monthly to 12-monthly time scale indicated in the rainfall maps together with a number of severe cold events are reflected in relatively low vegetation activity towards the east and southeast. Normal to above-normal vegetation activity dominated over the winter rainfall region and northern parts of the country.

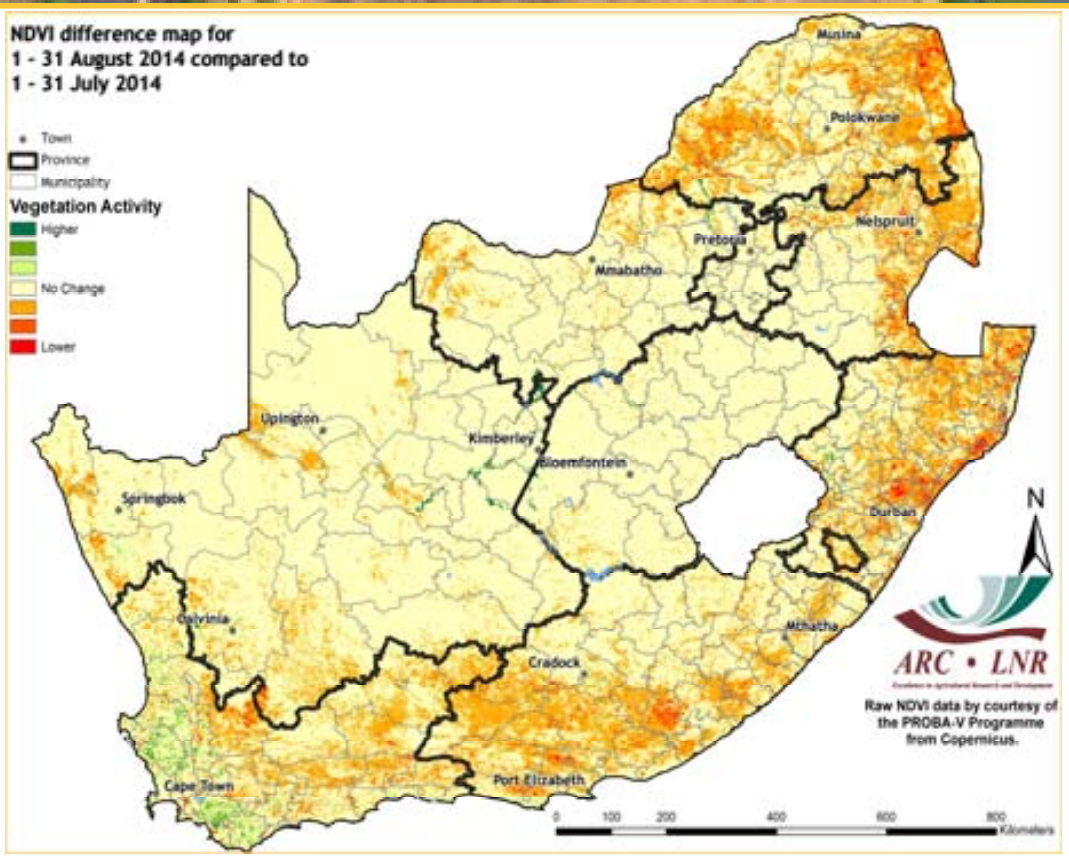

Figure 13

Figure 13:
Due to cold conditions recurring, there was liitle response during August to the rain over the central parts. Vegetation activity still decreased over the northeastern and eastern areas after relatively little precipitation during the winter. Vegetation activity again increased, albeit slightly, over parts of the winter rainfall grain production region.

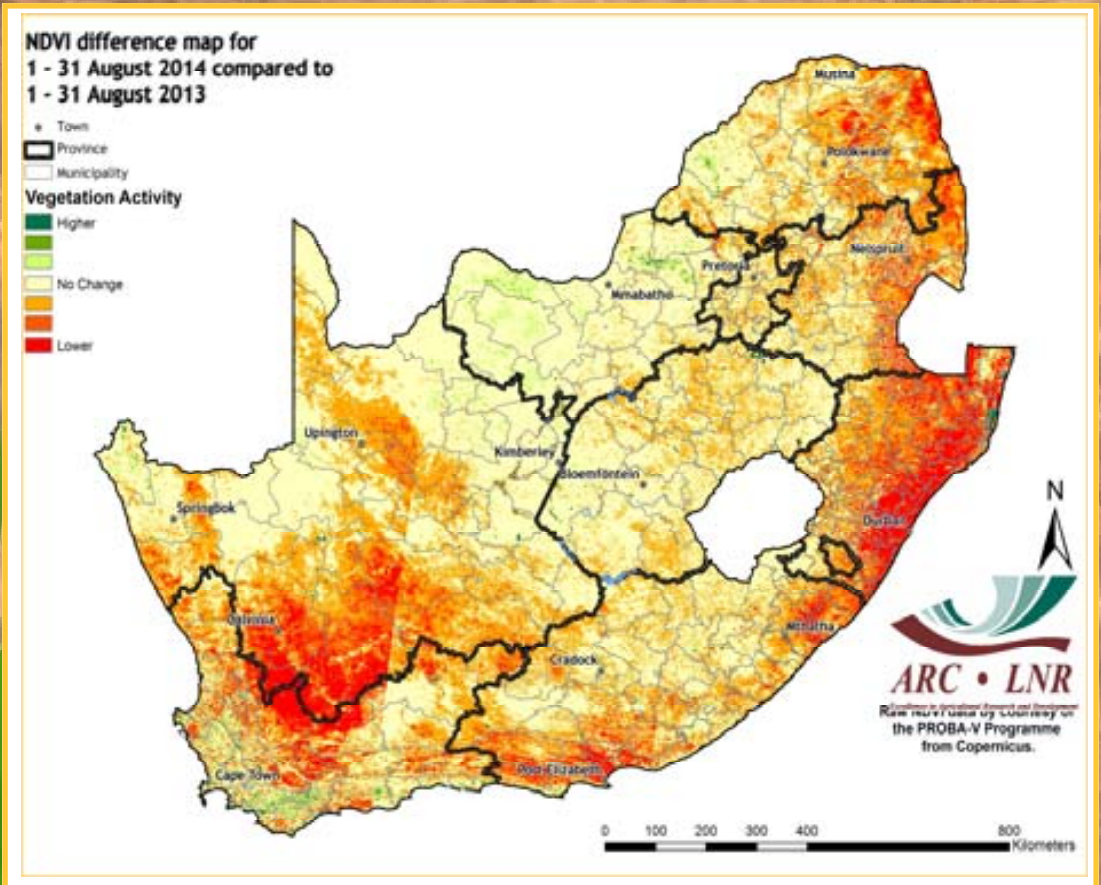

Figure 14

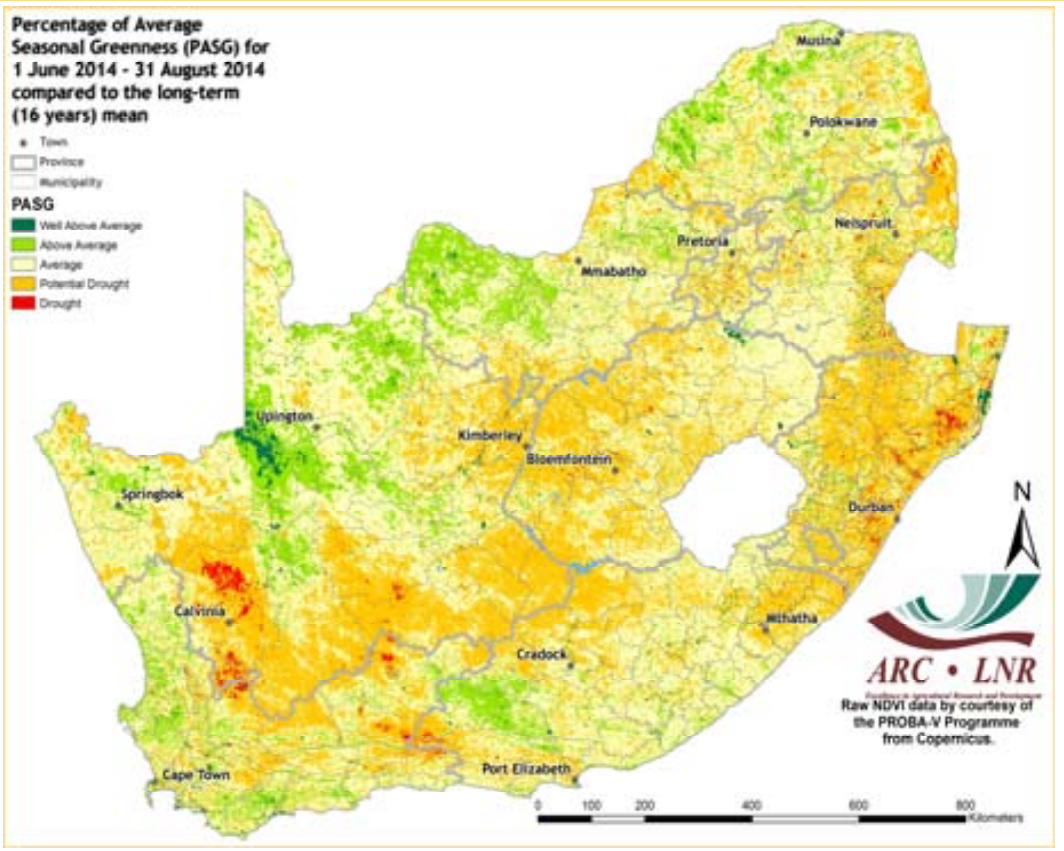

Figure 15

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:
Due mainly to drier conditions and in some instances lower minimum temperatures, vegetation activity over the southwestern interior and the far eastern and southeastern parts were lower during August 2014 than during August 2013.

Figure 15:
Cumulative vegetation activity since June shows the effects of a relatively wet winter over parts of the Northern Cape and winter rainfall region in the southwest, with relatively dry (and cold) conditions over the southwestern interior and the eastern parts.

Questions/Comments:
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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.

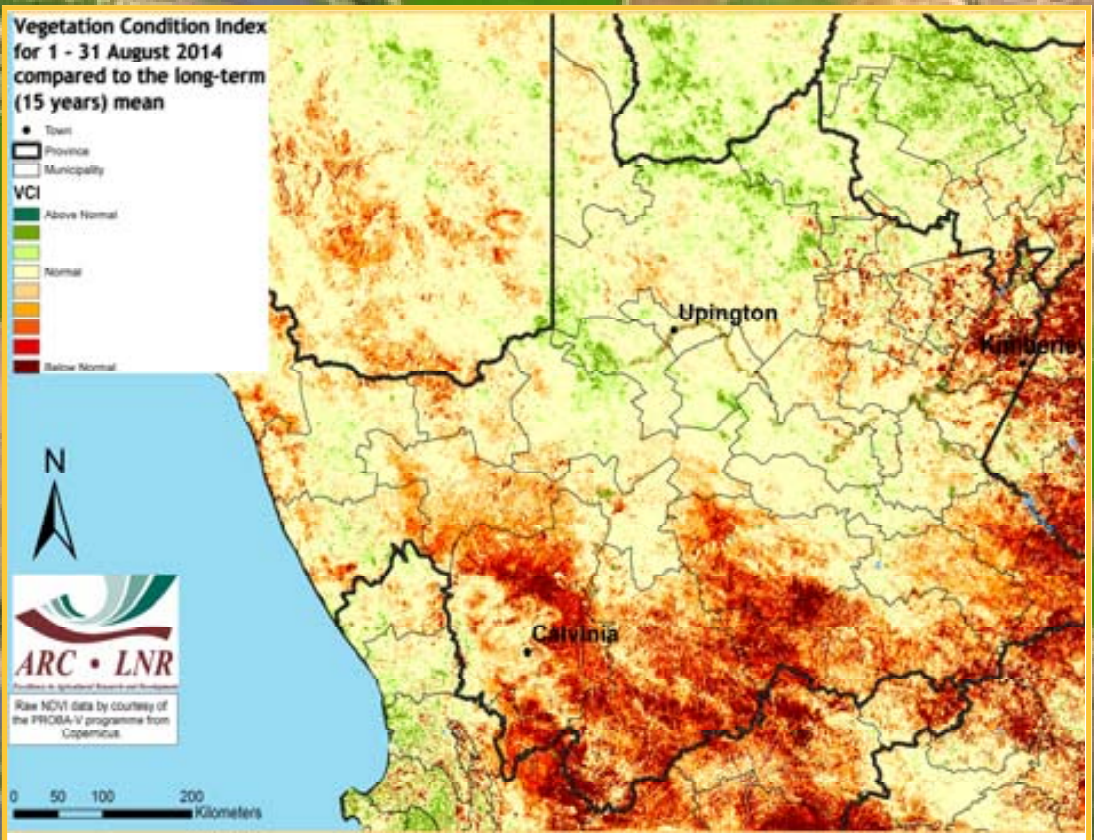

Figure 16

Figure 16:
The VCI map for August 2014 indicates below-normal vegetation activity over most parts of Northern Cape province.

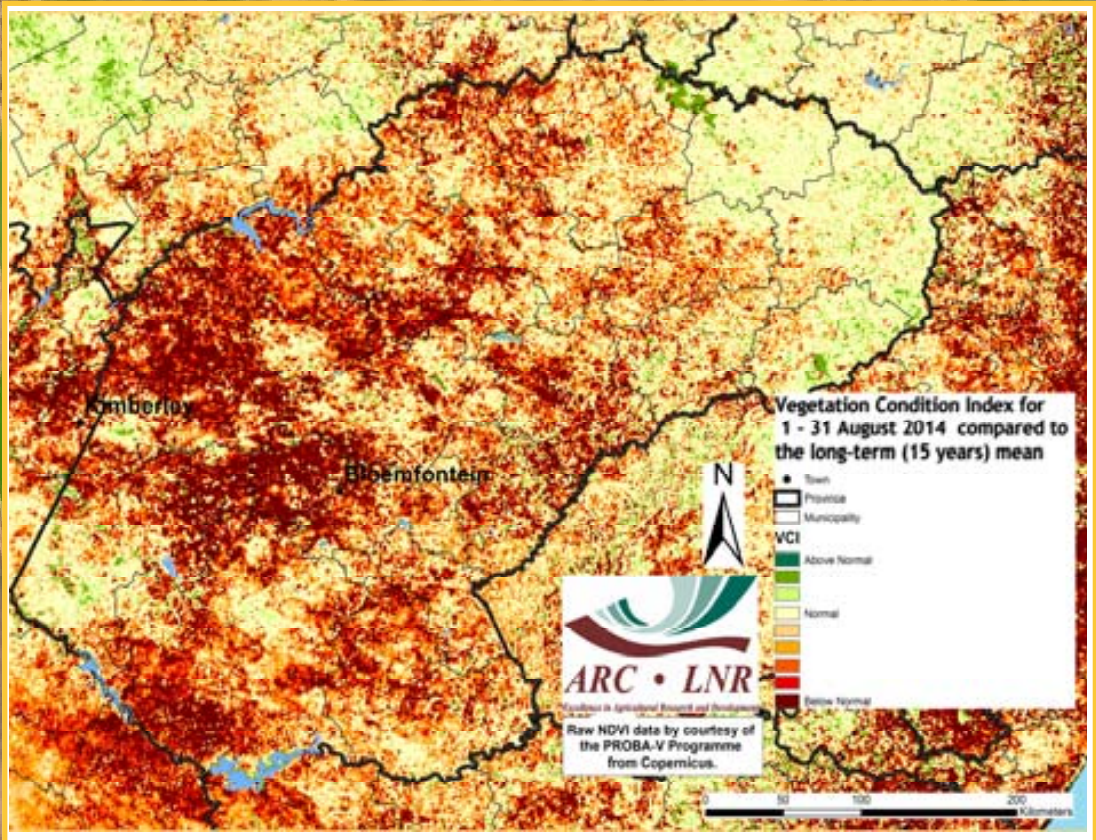

Figure 17

Figure 17:
The VCI map for August 2014 indicates below-normal vegetation activity over most parts of the Free State province.

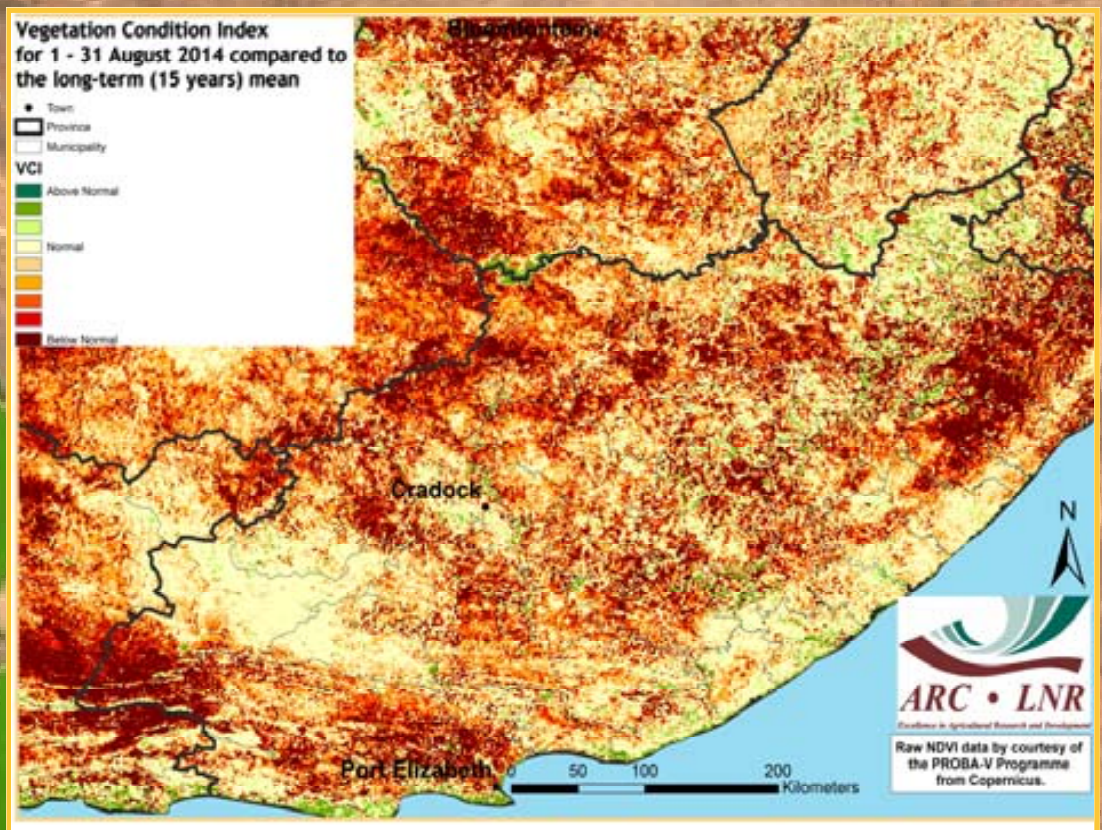

Figure 18

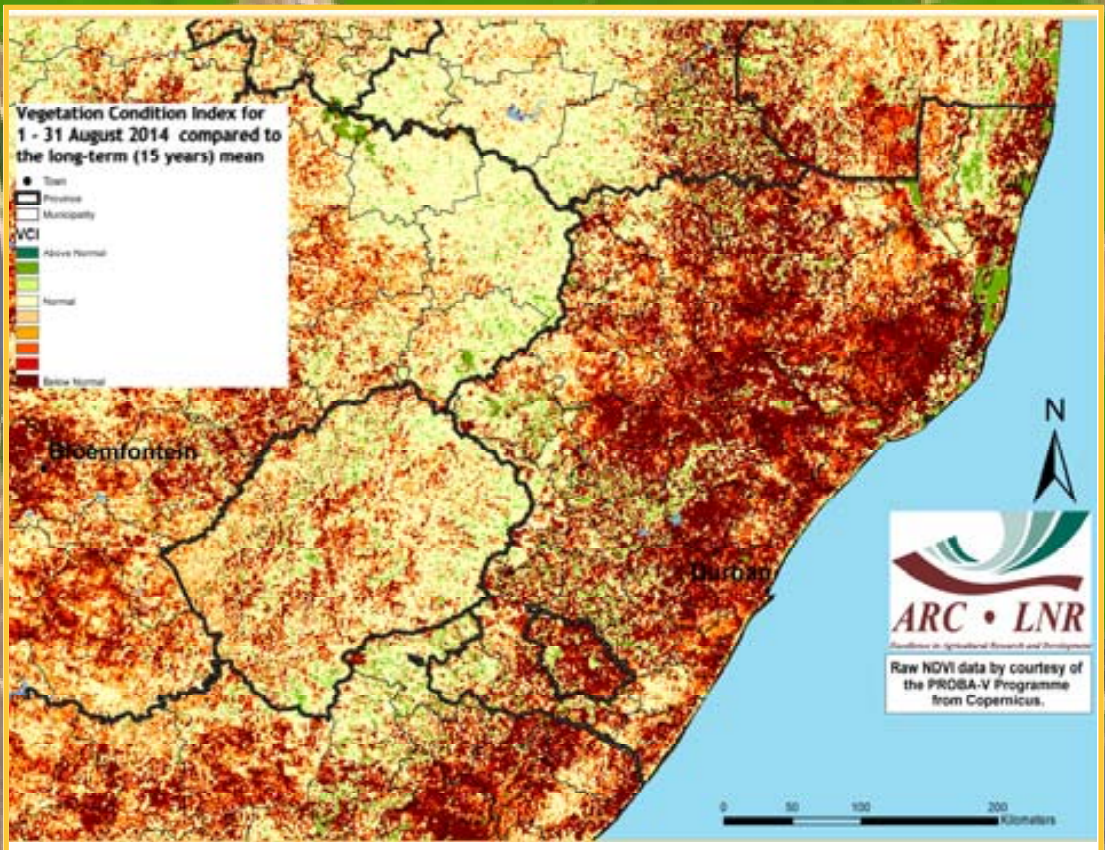

Figure 19

Figure 18:
The VCI map for August 2014 indicates below-normal vegetation activity over most parts of Eastern Cape province

Figure 19:
The VCI map for August 2014 indicates below-normal vegetation activity over most parts of KwaZulu-Natal province.

Questions/Comments:
NkambuleV@arc.agric.za

6. Vegetation Conditions & Rainfall

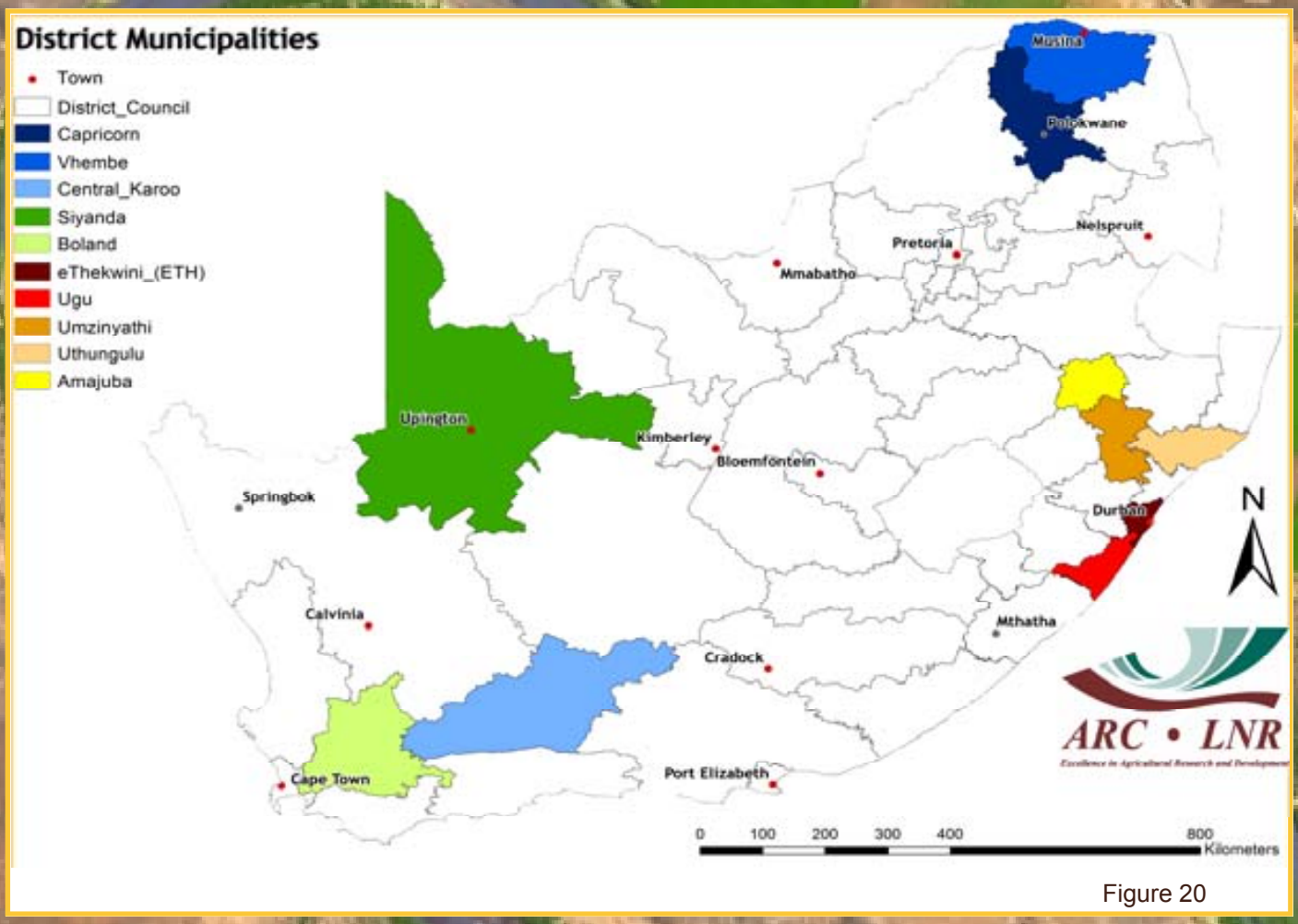

Figure 20

NDVI and Rainfall Graphs
Figure 20:
Orientation map showing the areas of interest for August 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.

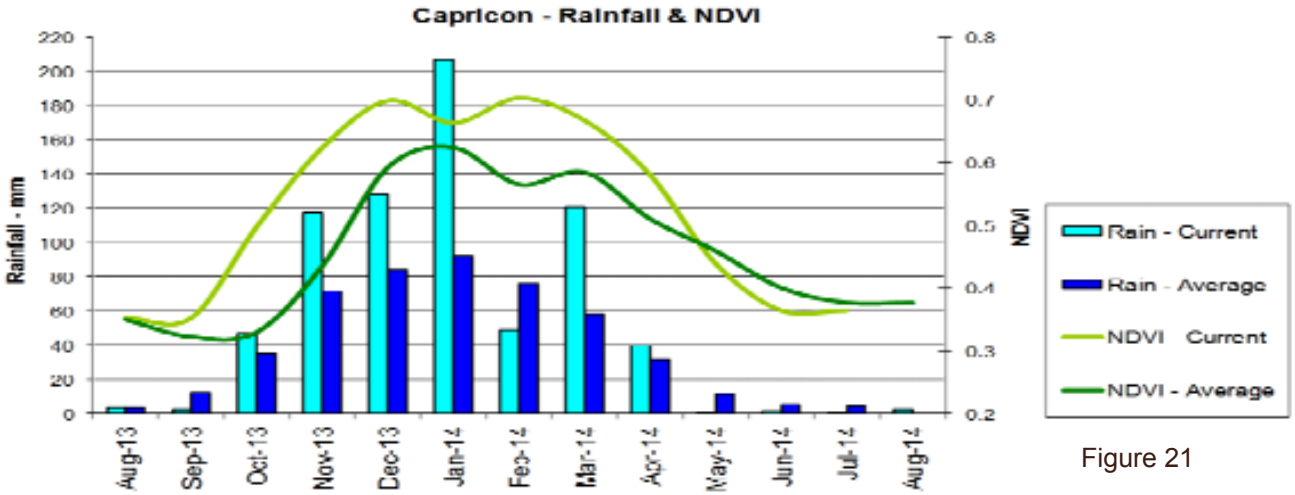

Figure 21

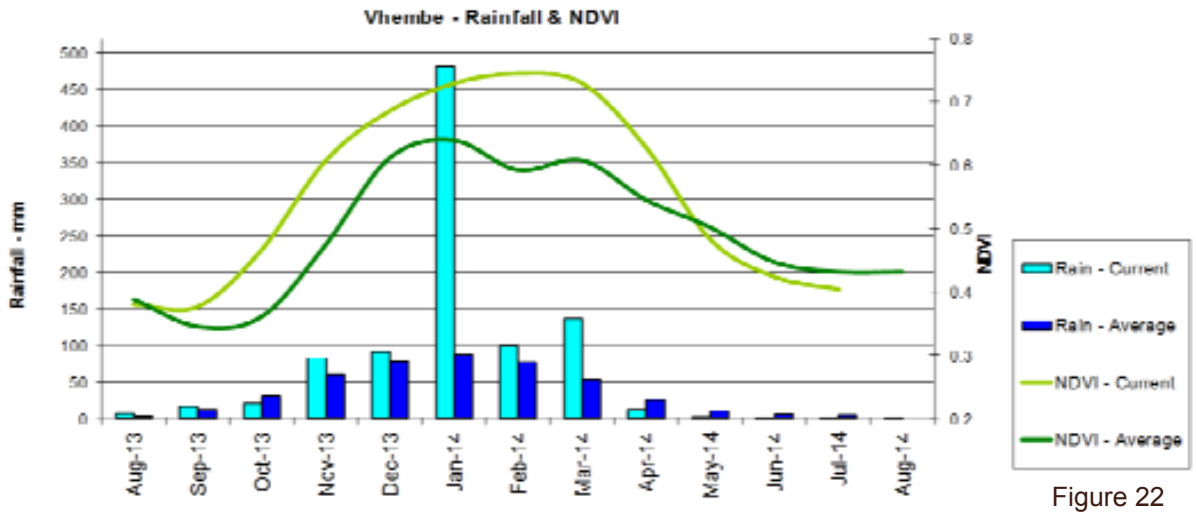

Figure 22

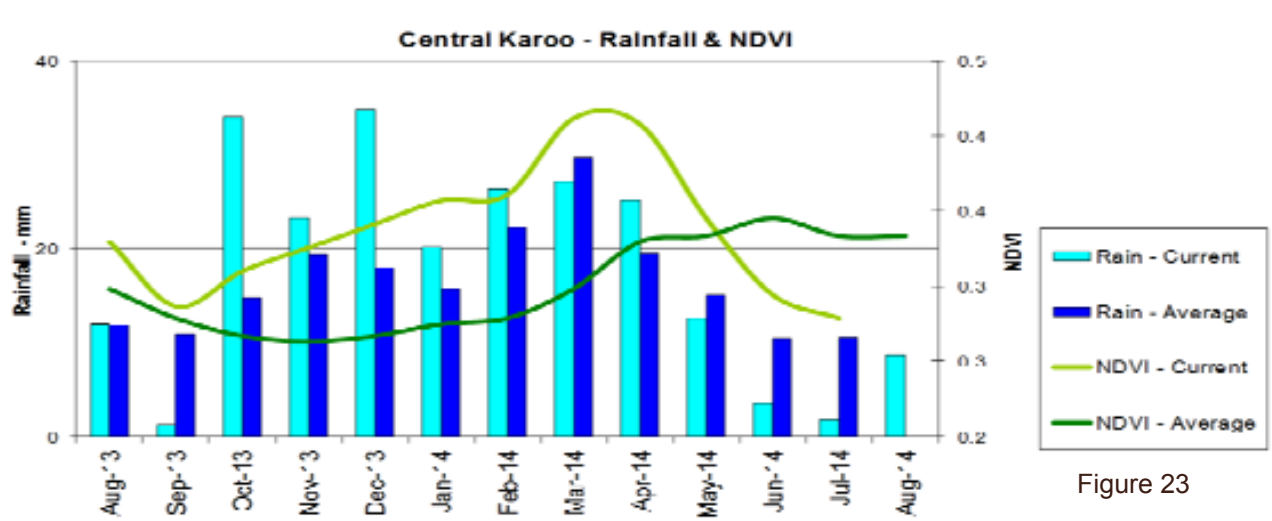

Figure 23

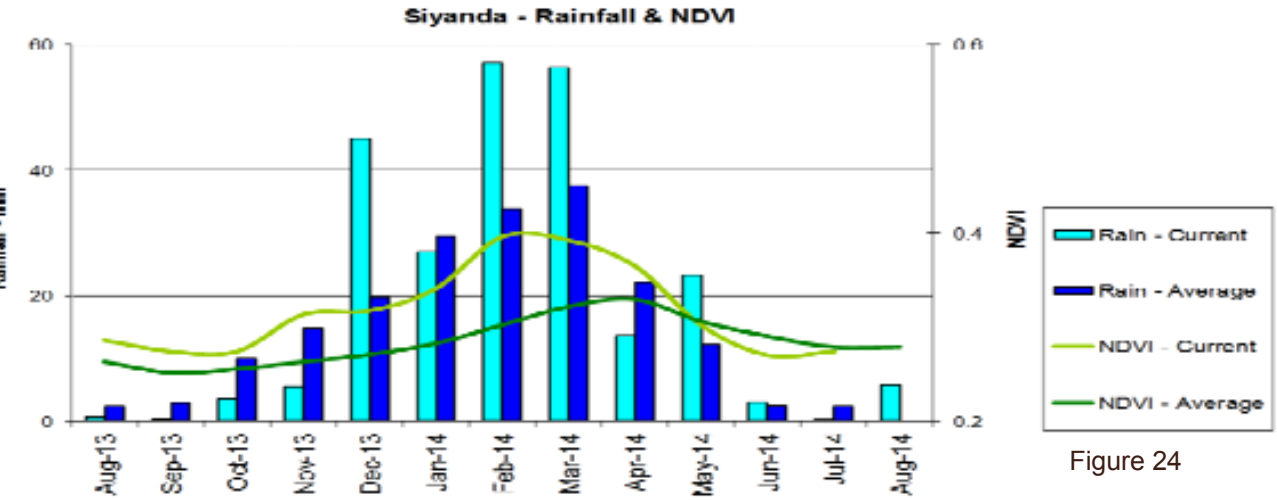

Figure 24

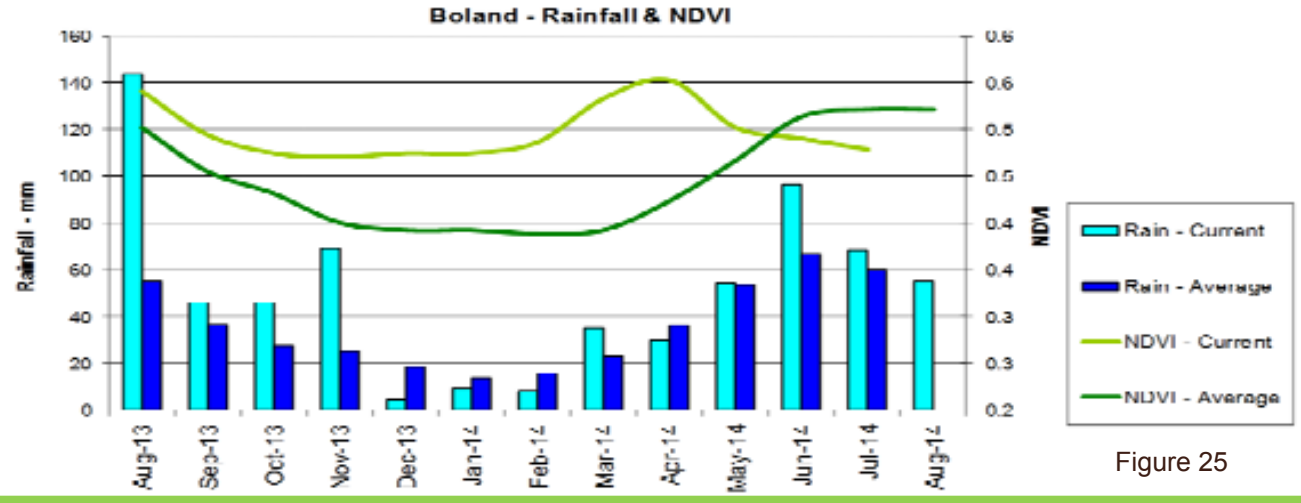

Figure 25

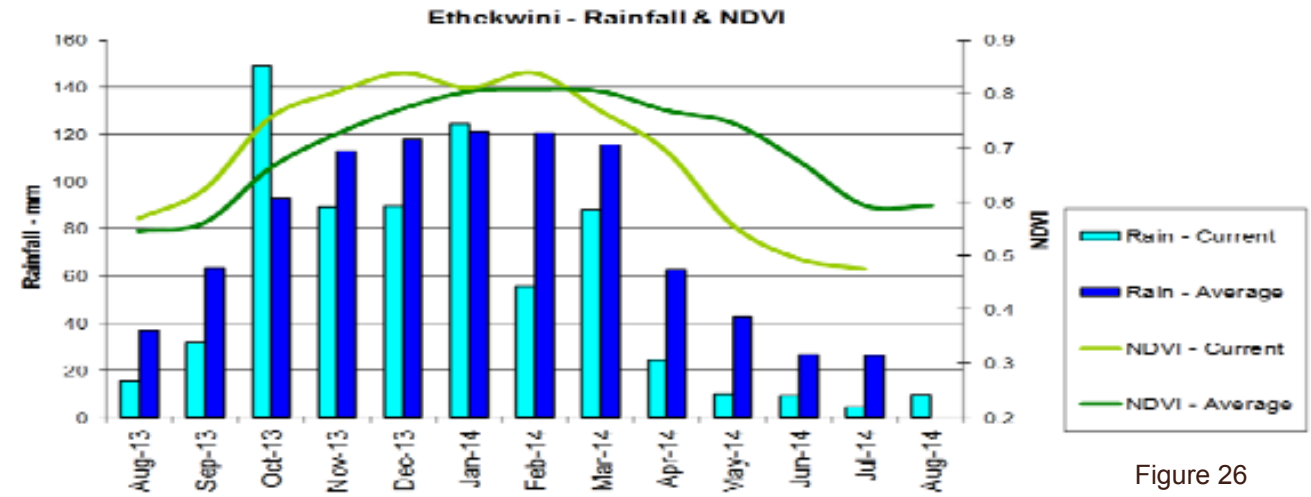

Figure 26

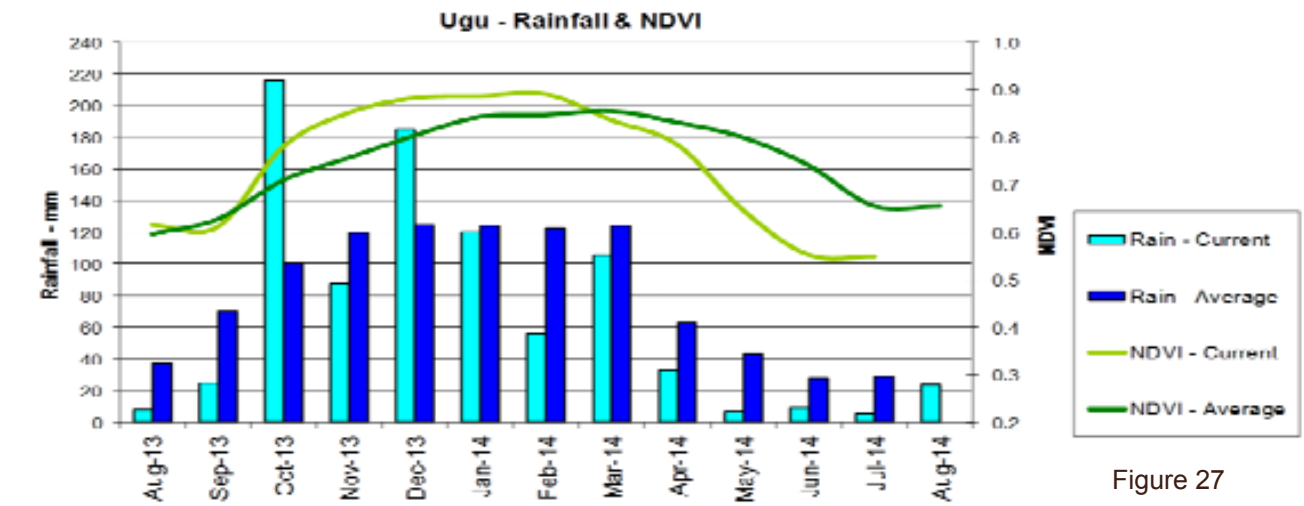

Figure 27

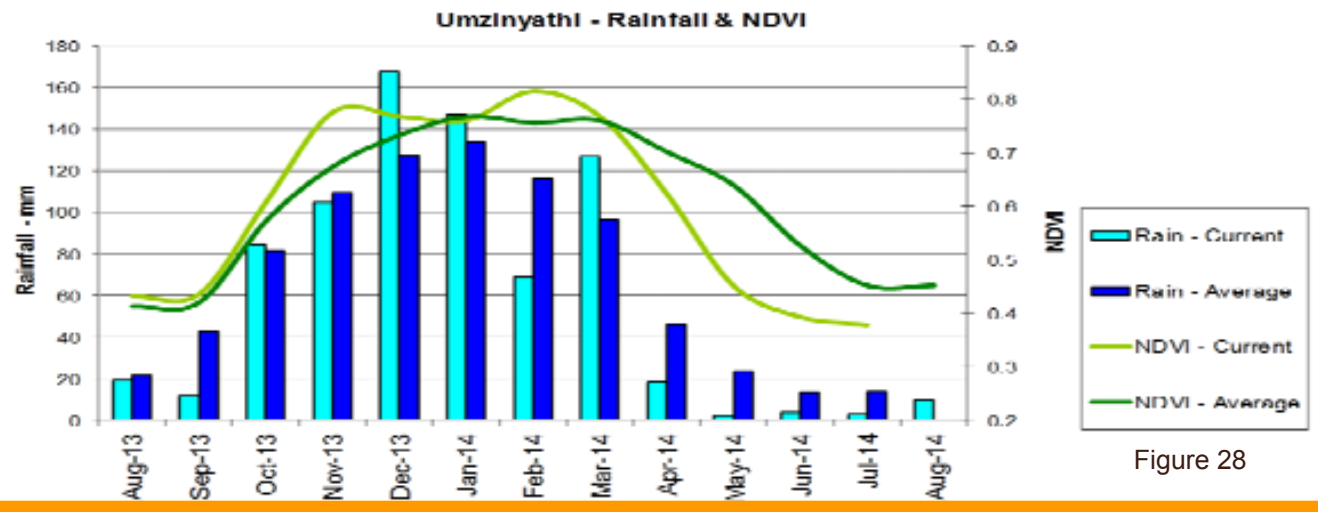

Figure 28

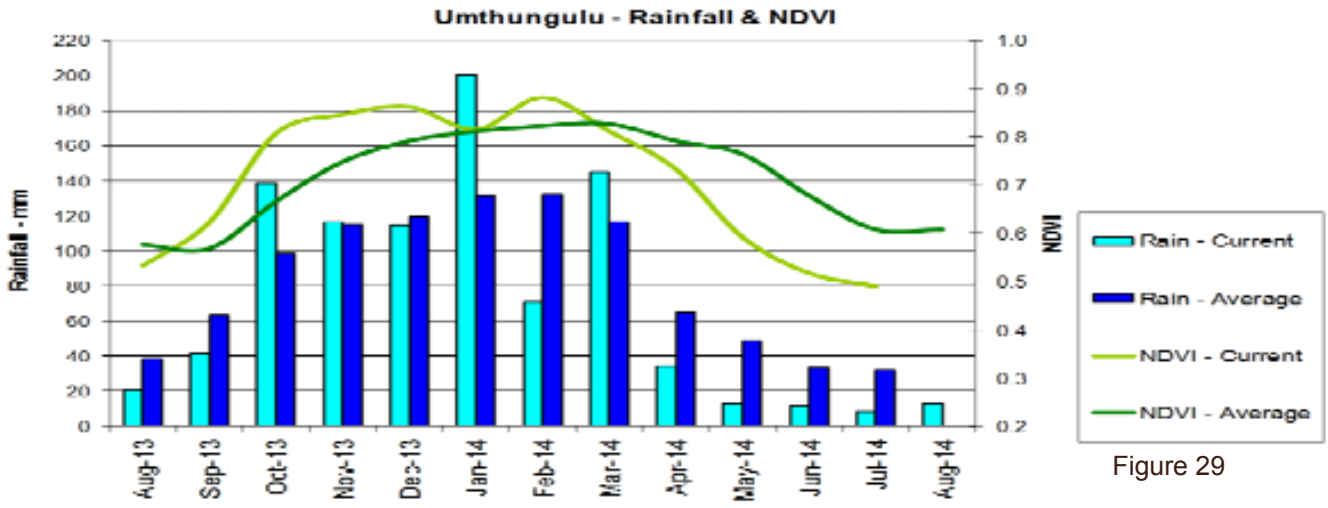

Figure 29

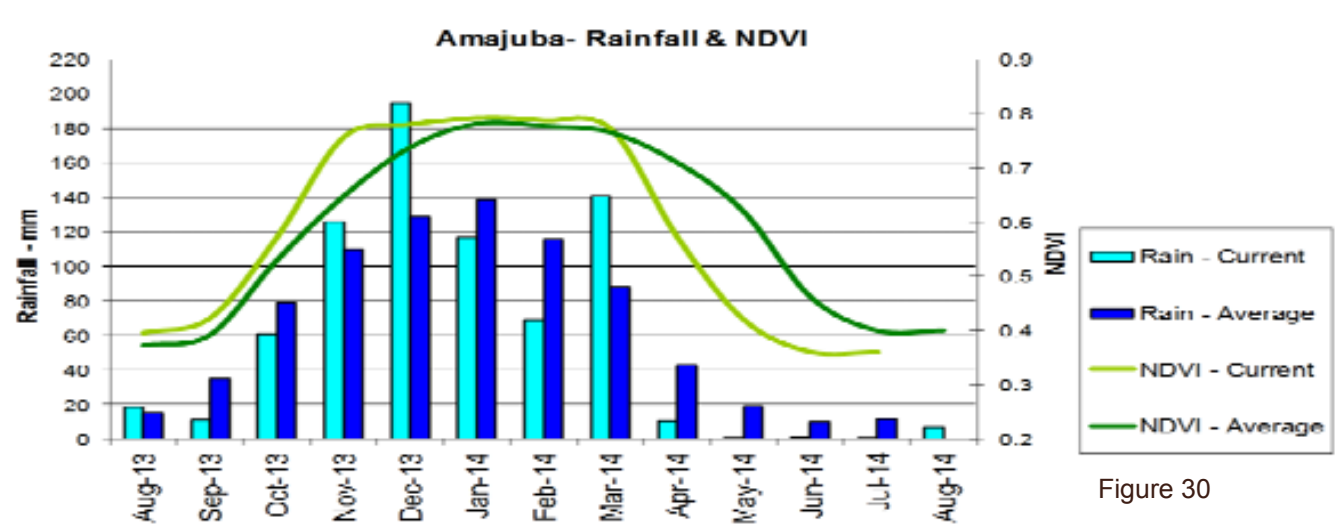

Figure 30

7. Fire Watch

Active Fires *(Provided when data is available)*

Forest and vegetation fires have temperatures in the range of 500º K (227º Celsius) to 1000º K (727º Celsius). 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 290º K (17º Celsius), 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 August per province. Fire activity was higher in Eastern Cape, Free State, Gauteng, Mpumalanga, Limpopo, Western Cape and KwaZulu-Natal, compared to the average for the same period for the last 13 years.

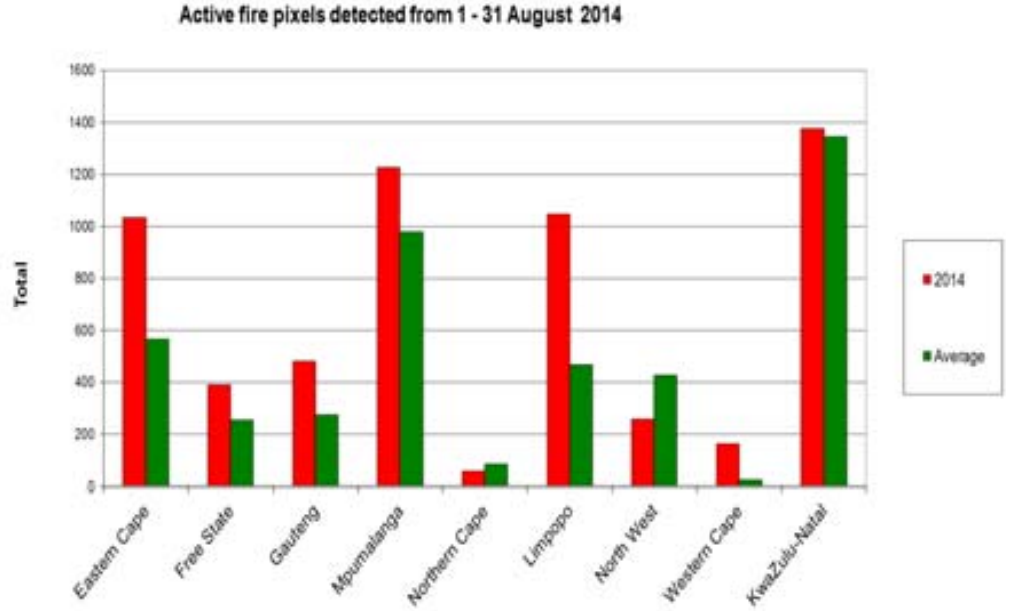

Figure 31

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

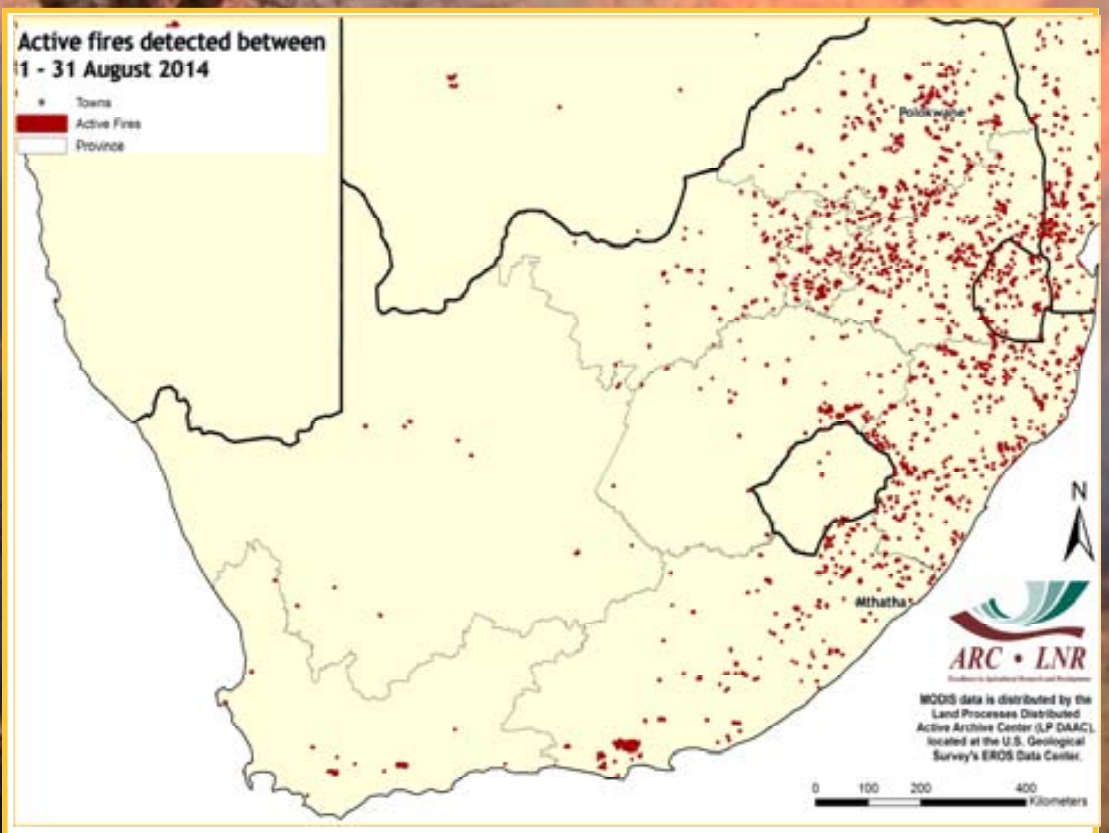

Figure 32

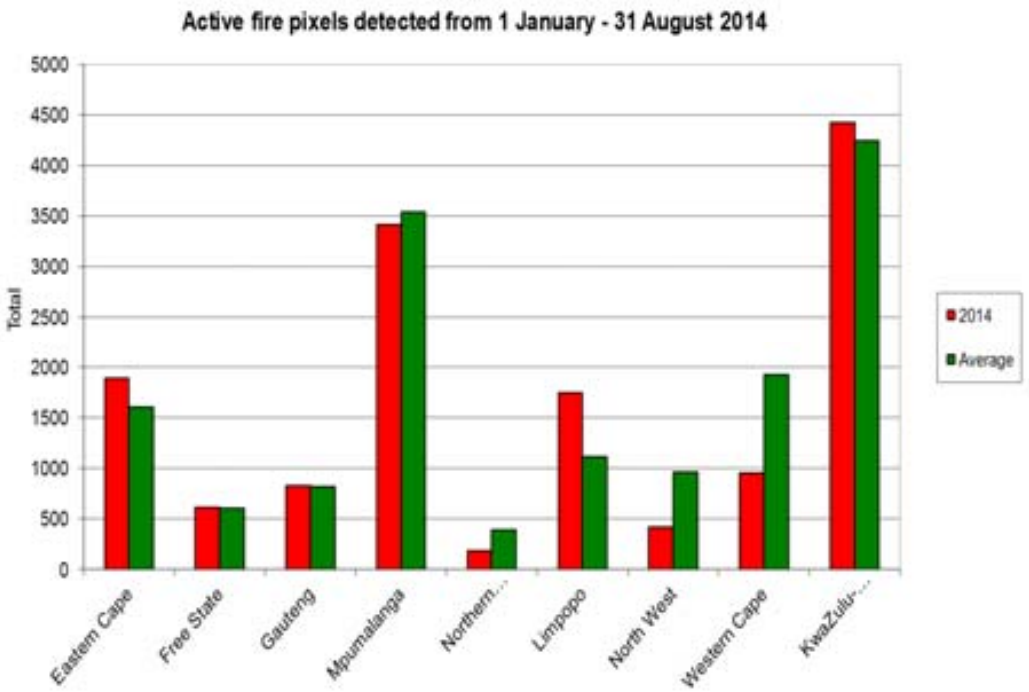

Figure 33

Figure 33:
The graph shows the total number of active fires detected from 1 January to 31 August per province. Fire activity was higher in KwaZulu-Natal, Eastern Cape and Limpopo province compared to the average for the same period for the last 13 years.

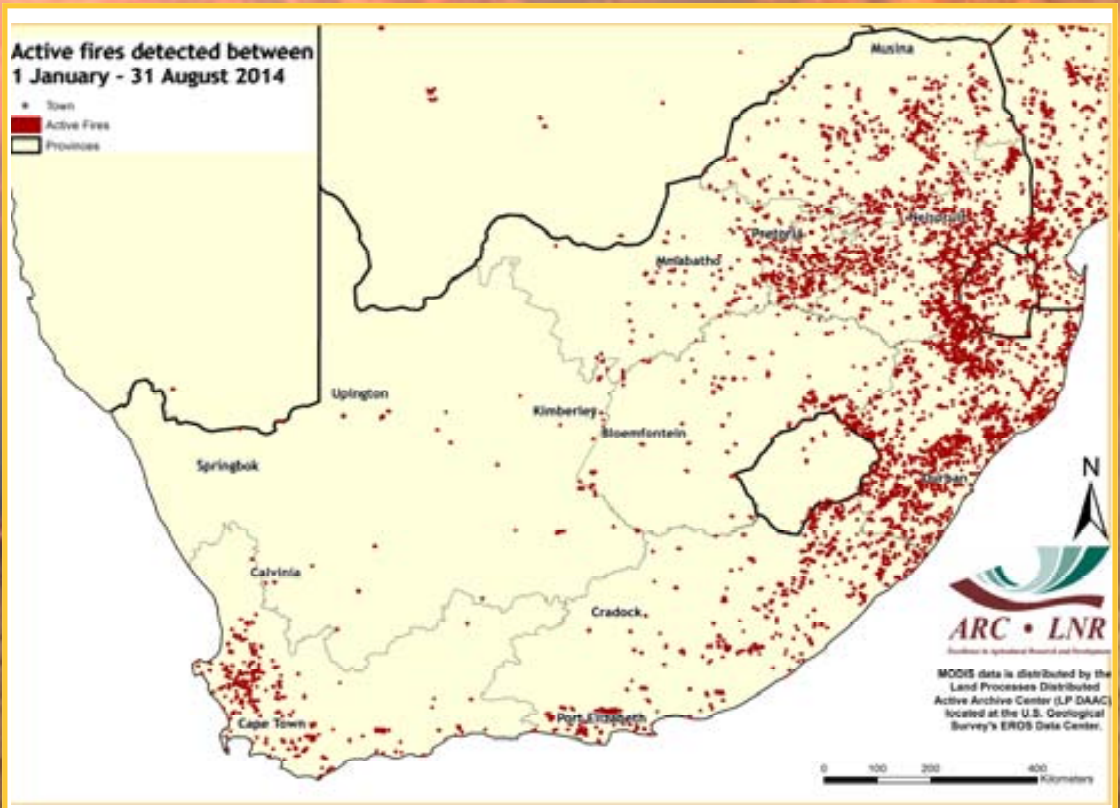

Figure 34

Figure 34:
The map shows the location of active fires detected from 1 January to 31 August 2014.

ARC-INSTITUTE FOR SOIL, CLIMATE AND WATER

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

http://www.agis.agric.za