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UMLINDI
The Watchman

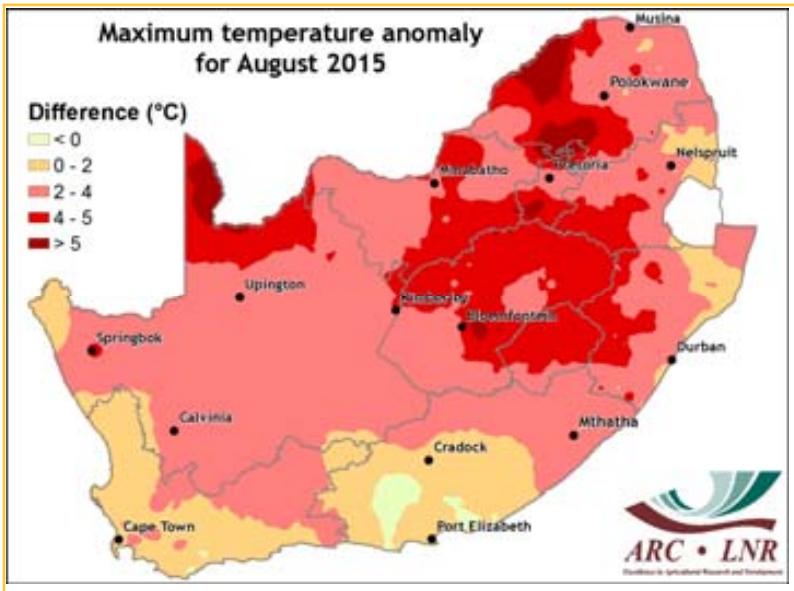
ISSUE 2015-09 | 14 SEPTEMBER 2015

INSTITUTE FOR SOIL, CLIMATE AND WATER

CONTENTS:

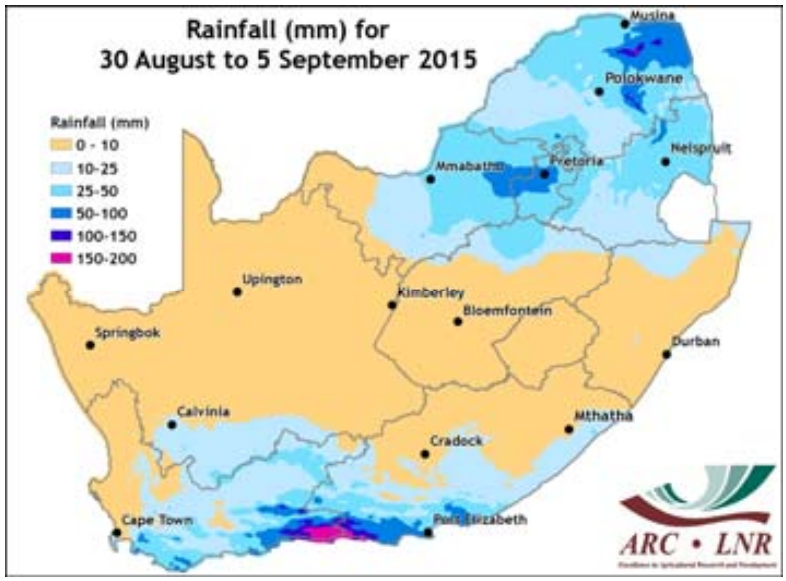
135th Edition

Images of the Month



A warm August

August 2015 was unseasonably warm over much of the interior. The only areas where average maximum temperatures didn't exceed the long-term mean were small parts of the Eastern and Western Cape provinces. Positive anomalies in the average maximum temperature for the month exceeded 5°C over parts of Limpopo, Gauteng, the Free State and Northern Cape. Anticyclonic circulation patterns over the interior resulted in sunny to partly cloudy conditions with a northerly component to the wind leading to hot conditions. Cold fronts influenced the southern and south-western parts of the country fairly regularly. Regular ridging of the Atlantic Ocean anticyclone to the south of the country behind cold fronts resulted in cool and moist conditions over the southern parts especially towards the middle and end of the month, keeping maximum temperatures for the month as a whole in the normal ranges over those areas. The map (above) shows the maximum temperature anomaly for August 2015. It is an interpolation of temperature data collected through the ARC-ISCW automatic weather station network, consisting of 400 operational stations across the country.



Early spring rain over many areas

An outstanding feature during the end of August and beginning of September was widespread rain and thundershowers over the southern and north-eastern parts of the country (bottom map). Widespread rain with heavy falls occurred as a frontal system moved over the southern parts of the country, followed by a strong onshore flow from the Atlantic Ocean Anticyclone and upper air low over the area. Heavy falls occurred by 30 and 31 August along the Garden Route. The strong influx of cold air from the south caused another cut-off low to develop over the interior, resulting in widespread rain and thundershowers in the northeast from the 3rd to the 5th of September as the Atlantic Ocean Anticyclone ridged around the country and large amounts of moisture flowed into the interior from the east. While many areas received in excess of 25 mm, totals during the 3-day period over parts of North West, Gauteng and Limpopo exceeded 50 mm. Cut-off low pressure systems, such as the one responsible for the widespread rain in early September, may result in precipitation over the interior during any time of the year, but are most common during spring and autumn. The map is an interpolation of rainfall data collected through the ARC-ISCW automatic weather station network.

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:

Warm and dry conditions characterized August over the northern parts of the country while several rainfall events resulted in above-normal rainfall over the southern parts and southwestern interior. Cold fronts resulted in some rain over the western winter rainfall region where the most pronounced events happened around the 3rd, 13th, 24th and 30th. Circulation patterns during the month were such that the southern parts of the country and the traditionally dry southwestern interior received above-normal rainfall, with totals exceeding those of the traditionally wetter western parts of the winter rainfall region. Over the northern parts of the country, where temperatures were above normal, maximum temperatures were high throughout the month while minimum temperatures experienced a steady rise during the course of the month. Sub-zero minima were confined to the first half of the month over the central interior.

The first few days of the month were characterized by dry westerlies dominating with light showers over the winter rainfall region and no precipitation over the interior. Lowest minimum temperatures occurred during this period. An upper air trough deepening over the eastern parts together with a surface onshore flow resulted in some thundershowers over the far-eastern parts by the 11th. During the remainder of the month, several frontal systems resulted in some rain and showers over the southwestern and southern parts of the country whilst anticyclonic circulation patterns kept the rest of the country warm and dry.

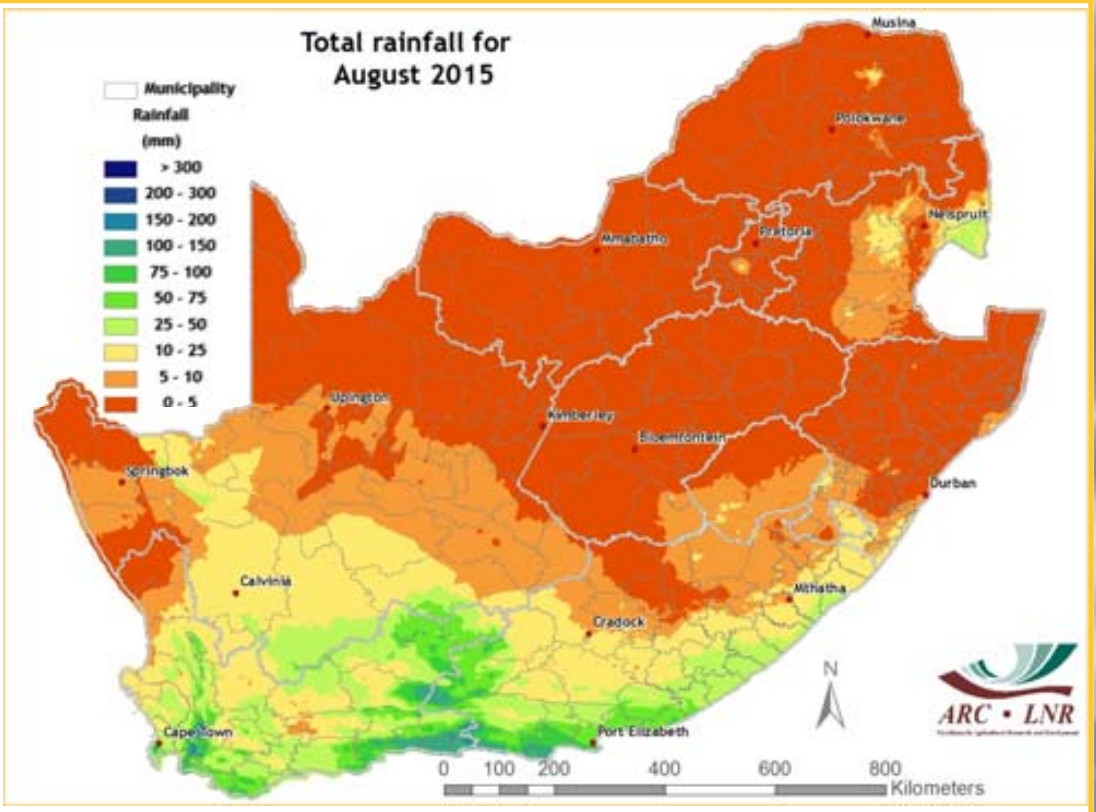
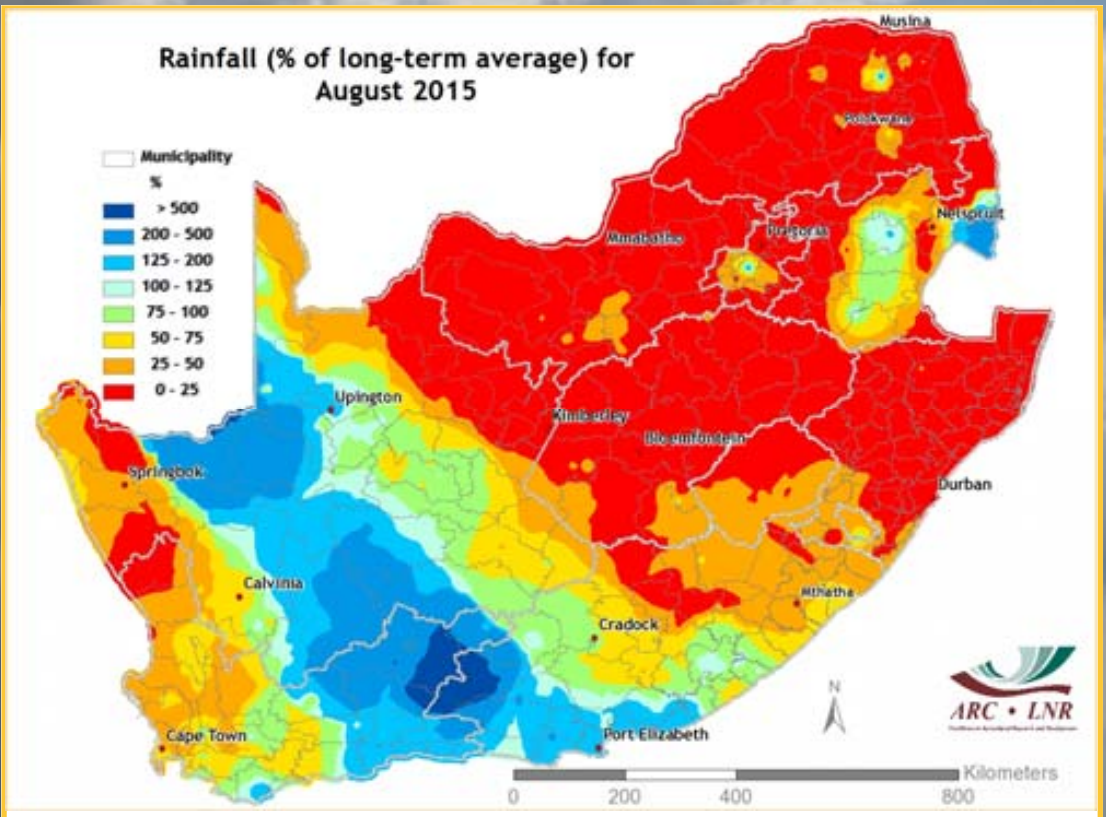


Figure 1



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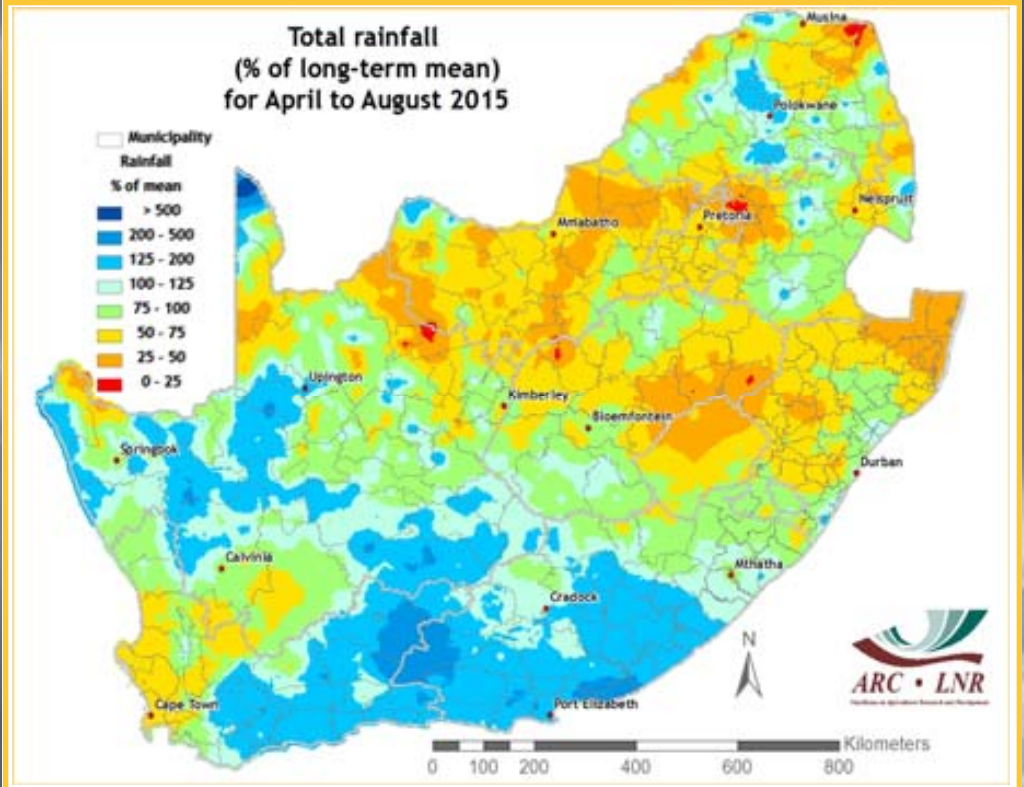

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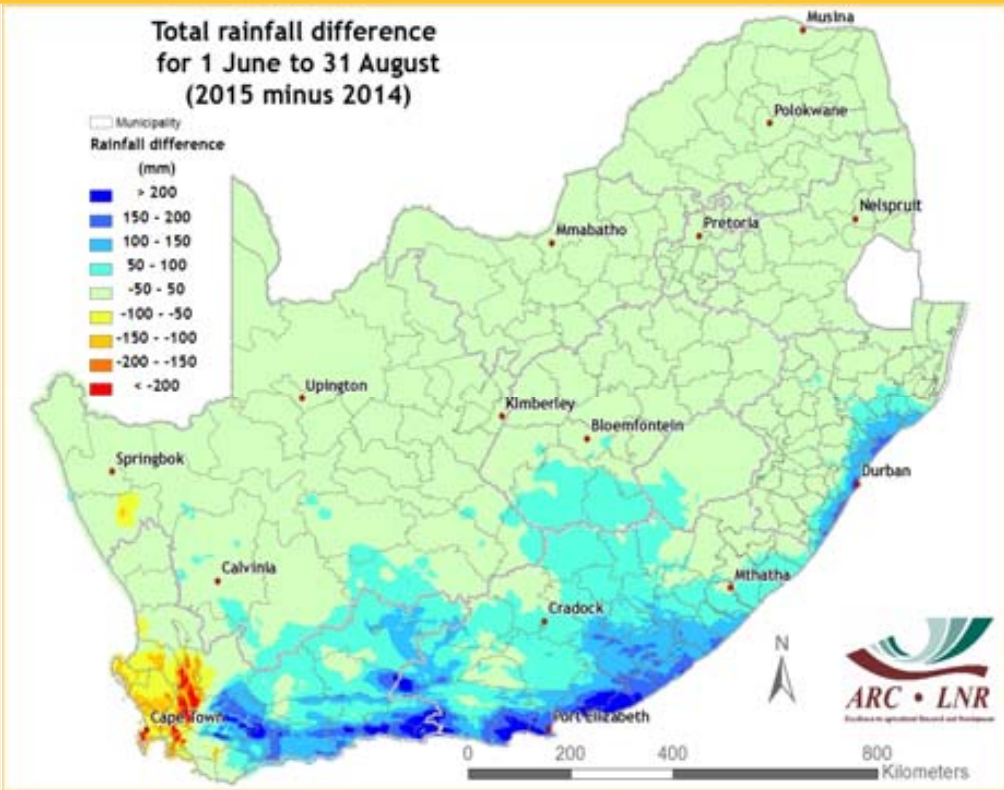

Figure 4

Towards the end of the month, upper-air lows deepening over the southwestern parts resulted in showers and thundershowers over the southwestern interior and southern coastal regions. A large anticyclone over the Indian Ocean advected moisture over the interior, resulting in fairly favorable conditions for thundershowers over the southern and southwestern parts with upper-air support in that region. By the end of the month, an intense upper-air low pressure system developed over the southwestern parts with a strong Atlantic Ocean Anticyclone ridging to the south of the country. The combination of systems resulted in widespread heavy rain over the southern parts by the 30th and 31st. The strong ridging anticyclone also heralded a wet period that was to follow over the northeast by early September.

Figure 1:
Rain was confined to the southern half of the country while the northern parts were predominantly dry except for parts of Mpumalanga and the surrounding provinces. The highest totals (exceeding 150 mm) were recorded along the Garden Route and the Boland.

Figure 2:
A band from southern Namibia into the southeastern parts of South Africa received above-normal rainfall during August while the rest of the country mostly received below-normal rainfall.

Figure 3:
Cumulative rainfall since April is above normal over many of the southern and western parts, excluding the southwestern part of the winter rainfall region. Below-normal rainfall occurred over most of North West, northwestern and eastern Free State and northern KwaZulu-Natal.

Figure 4:
The western parts of the winter rainfall region experienced much less rain during June to August this year than for the same period last year while the southern to eastern coastal areas and adjacent interior received significantly more rain.

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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 (Figure 5-8) show that severe to extreme drought conditions occur over the south-western parts of the winter rainfall region and isolated areas in Mpumalanga and northeastern KwaZulu-Natal while much of the southern parts of the country experiences moderately to severely or extremely wet conditions. At the longer time scales, severe drought occurs over a large part of northern KwaZulu-Natal and southeastern Mpumalanga. At the 24-month time scale, moderately to severely wet conditions occur over the southern and northeastern parts of the country.

Questions/Comments:
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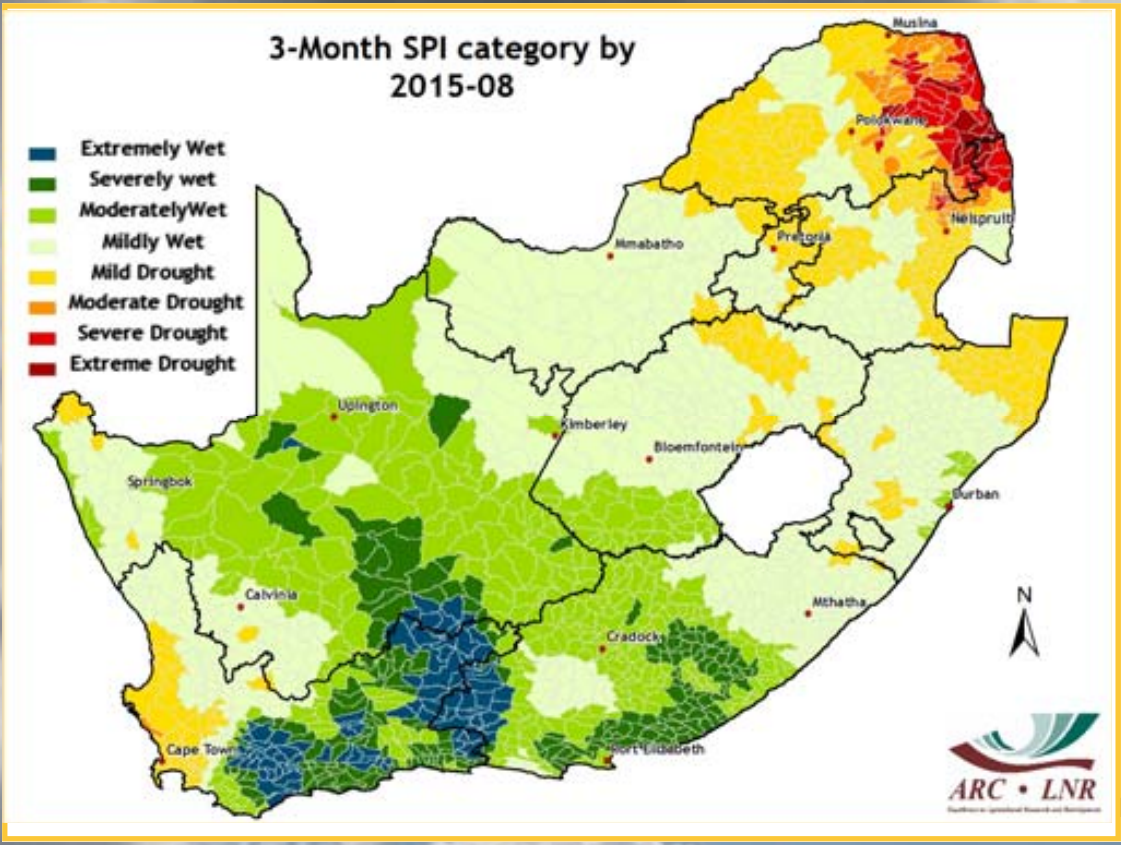

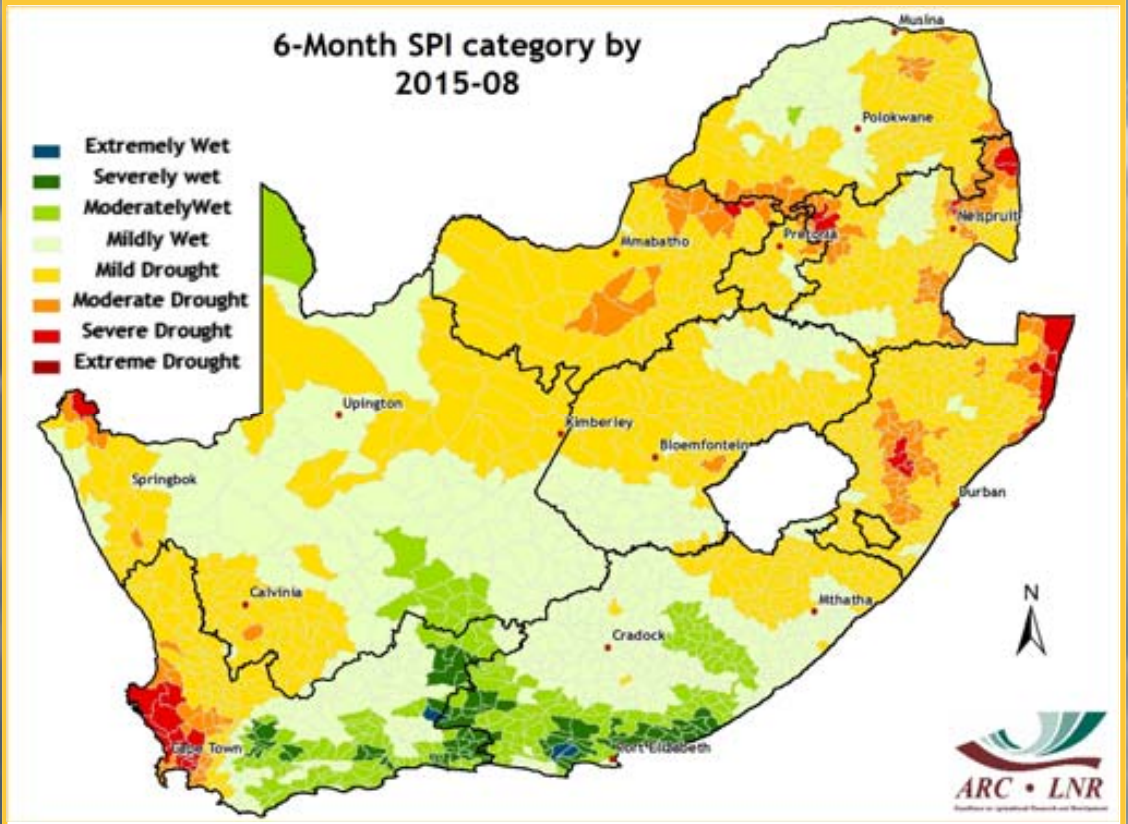

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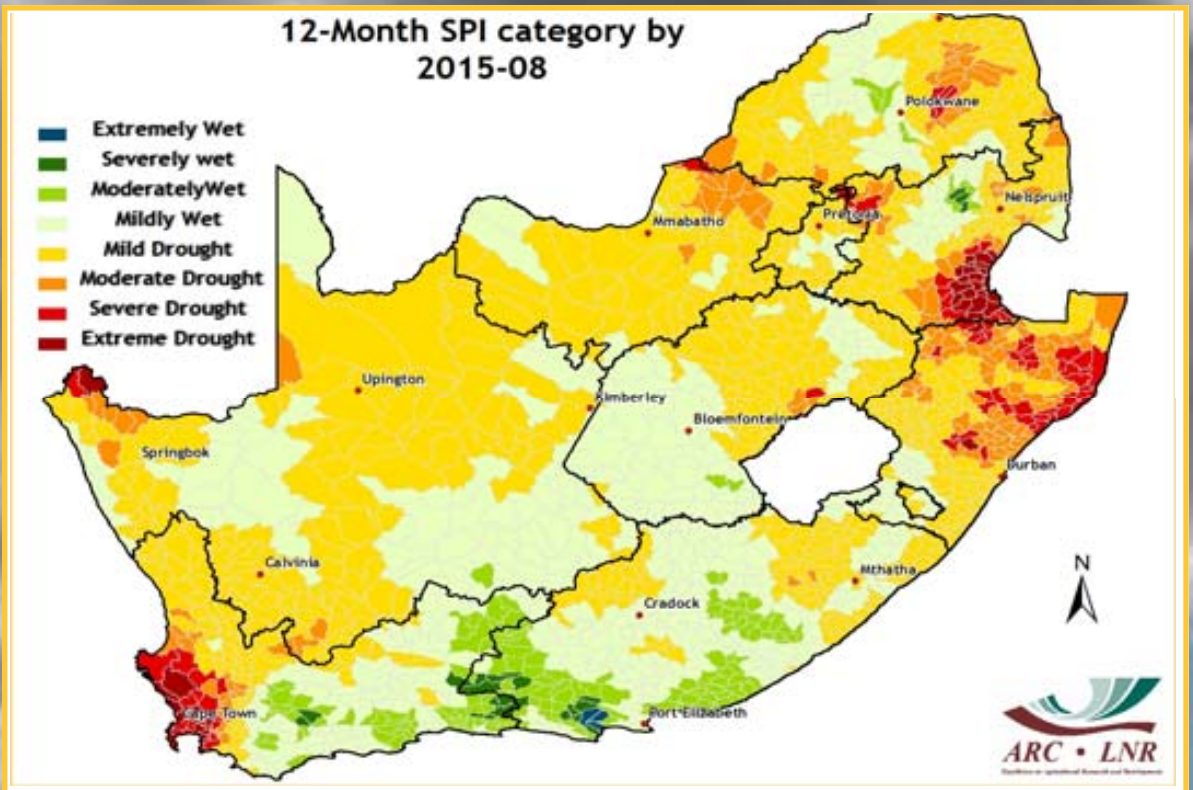

Figure 7

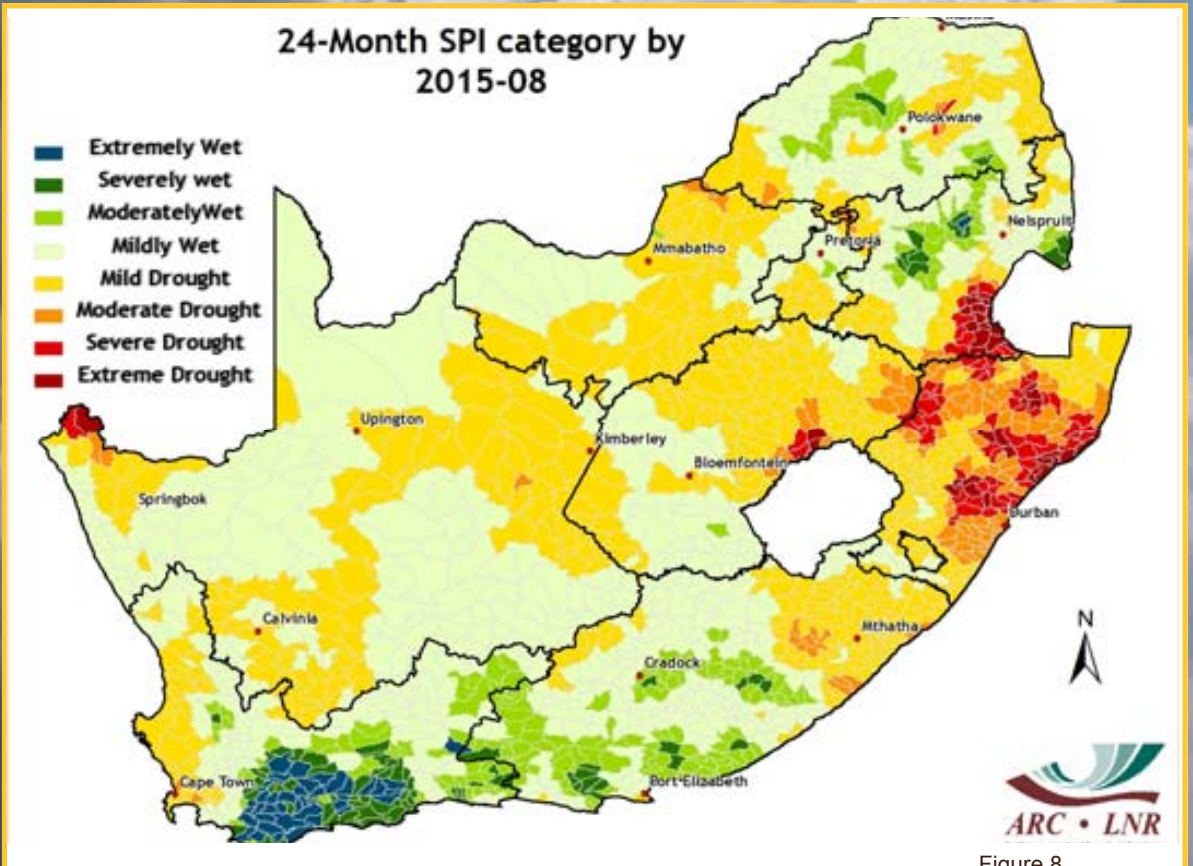

Figure 8

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.

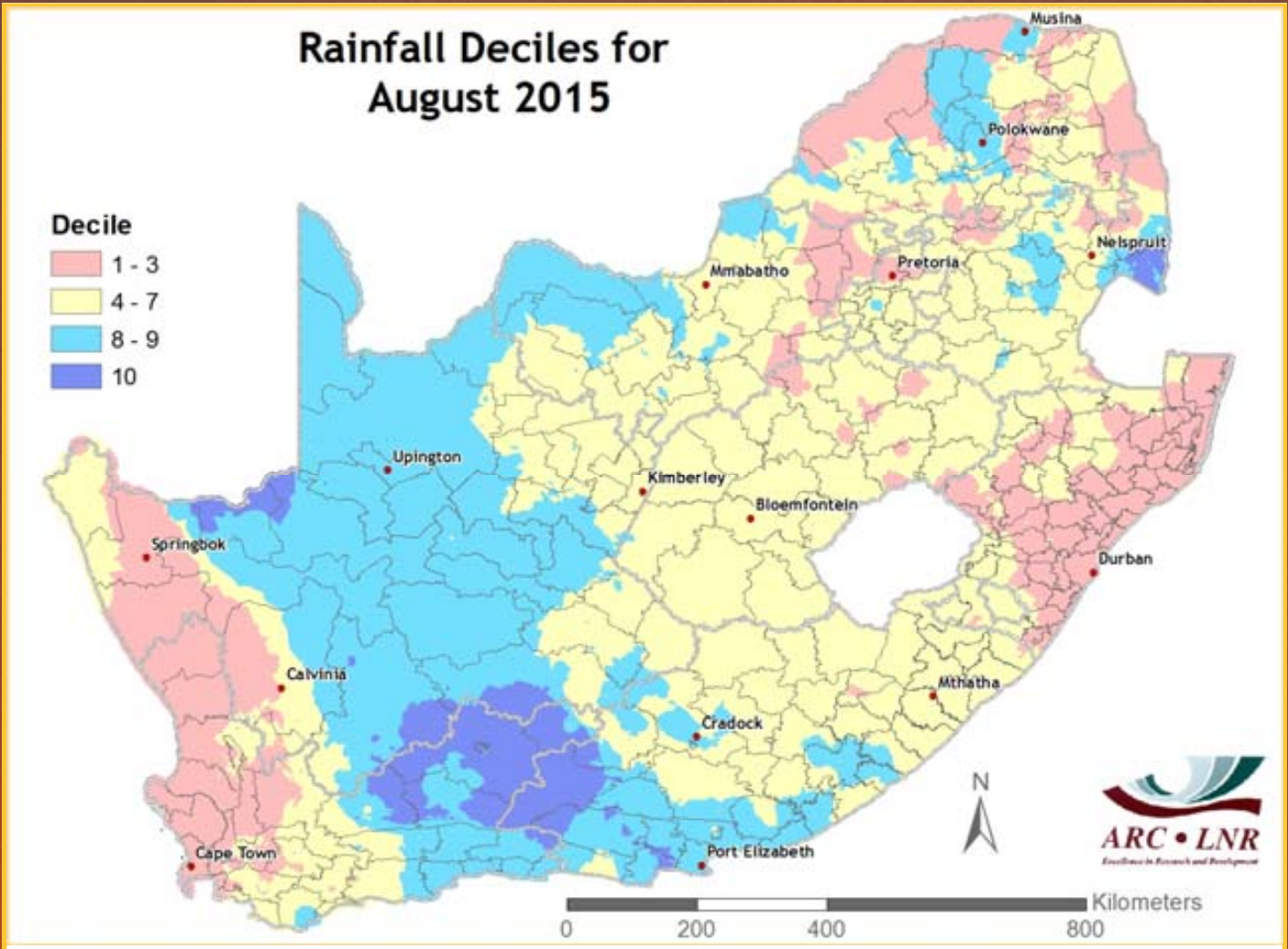

Figure 9

Figure 9:
In the band of above-normal rainfall from southern Namibia southeastwards, the Karoo and areas near the Orange River were exceptionally wet. The western parts of the winter rainfall region was anomalously dry.
Questions/Comments: *Johan@arc.agric.za*

4. Water Balance

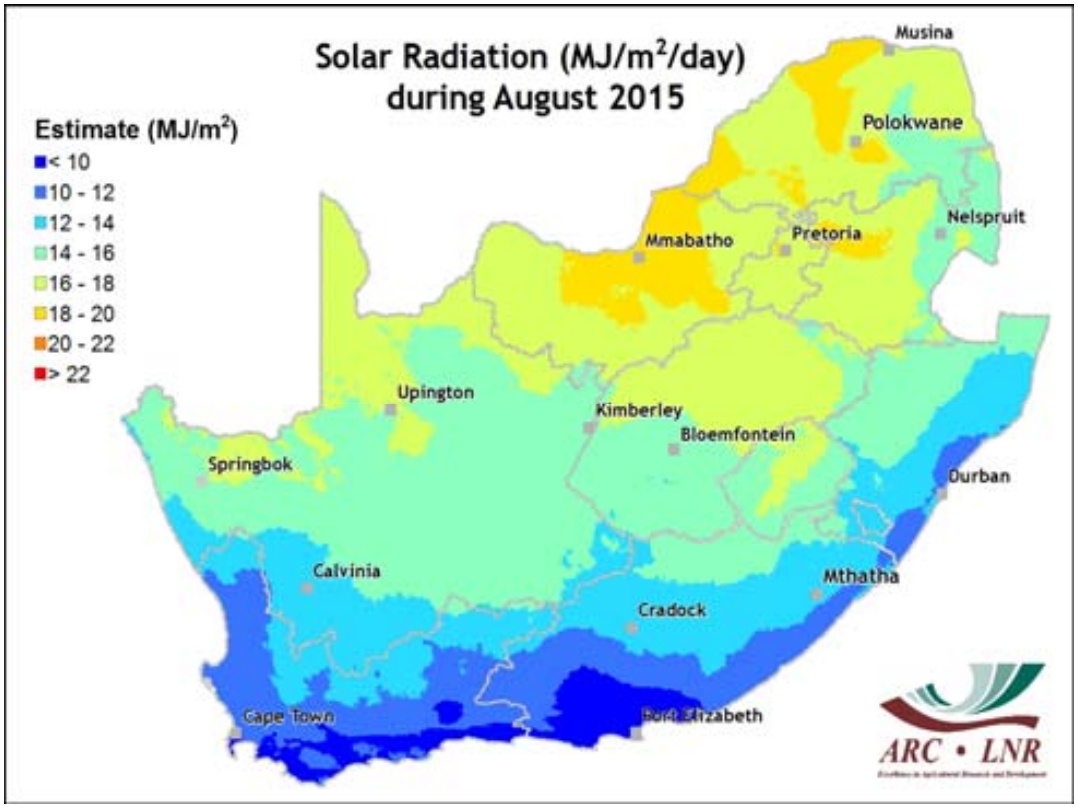

Figure 10

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:
Solar radiation measurements and estimates remained low during August over the southern parts, but increased markedly over the northern parts where sunny conditions dominated.

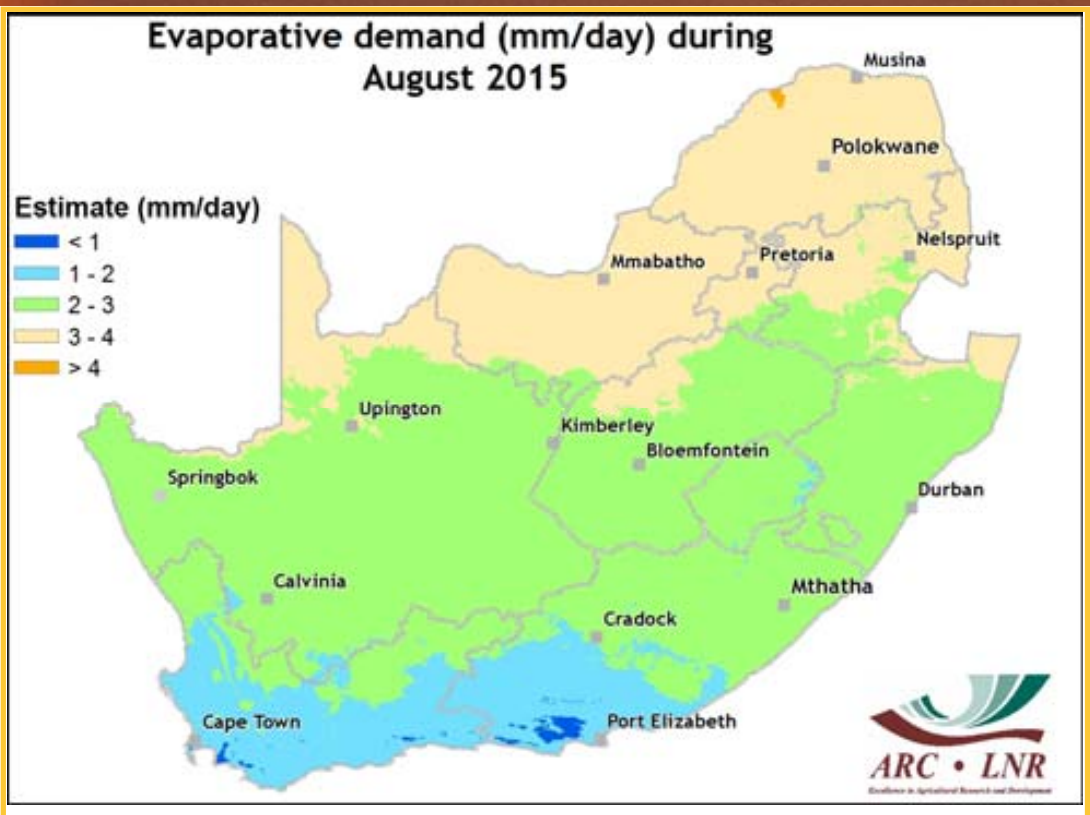

Figure 11

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 evapotranspiration remained low in the south but exceeded 3 mm per day over the northern 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.

The Standardized Difference Vegetation Index (SDVI) is the standardized anomaly (according to the specific time of the year) of the NDVI.

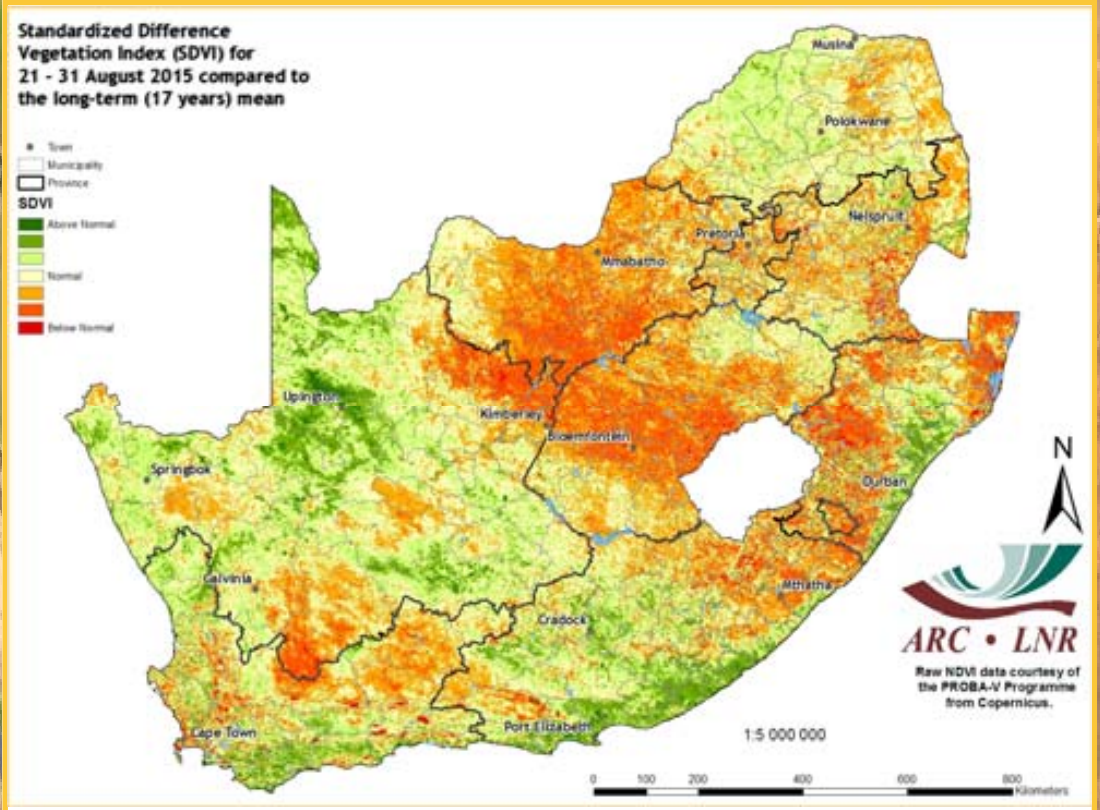

Figure 12

Figure 12:
The SDVI indicates drought stress over the northern parts of KwaZulu-Natal, southern North West and some of the southwestern parts of the Northern Cape. The southern to southeastern parts of the country, central to northwestern Northern Cape as well as the coastal areas and adjacent interior of KwaZulu-Natal experience above-normal vegetation activity.

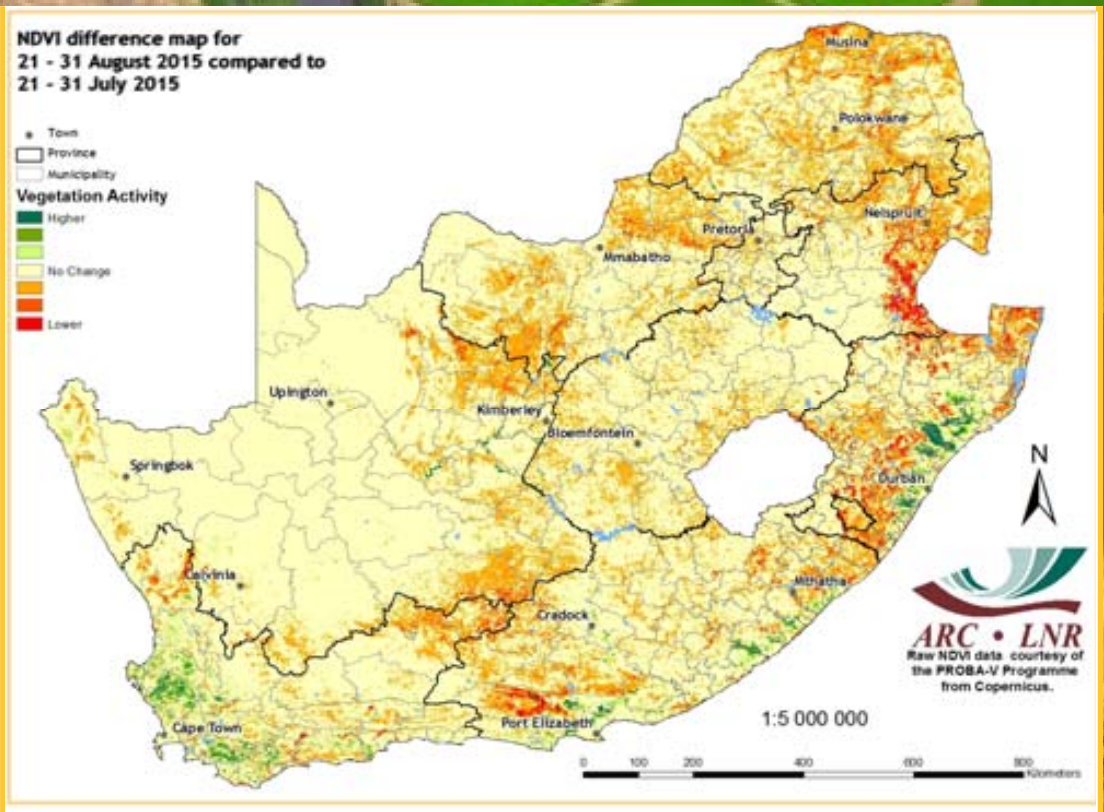

Figure 13

Figure 13:
Vegetation activity increased somewhat over the southwestern winter rainfall region as well as along the eastern and southeastern coastal belt where above-normal rainfall occurred during late July.

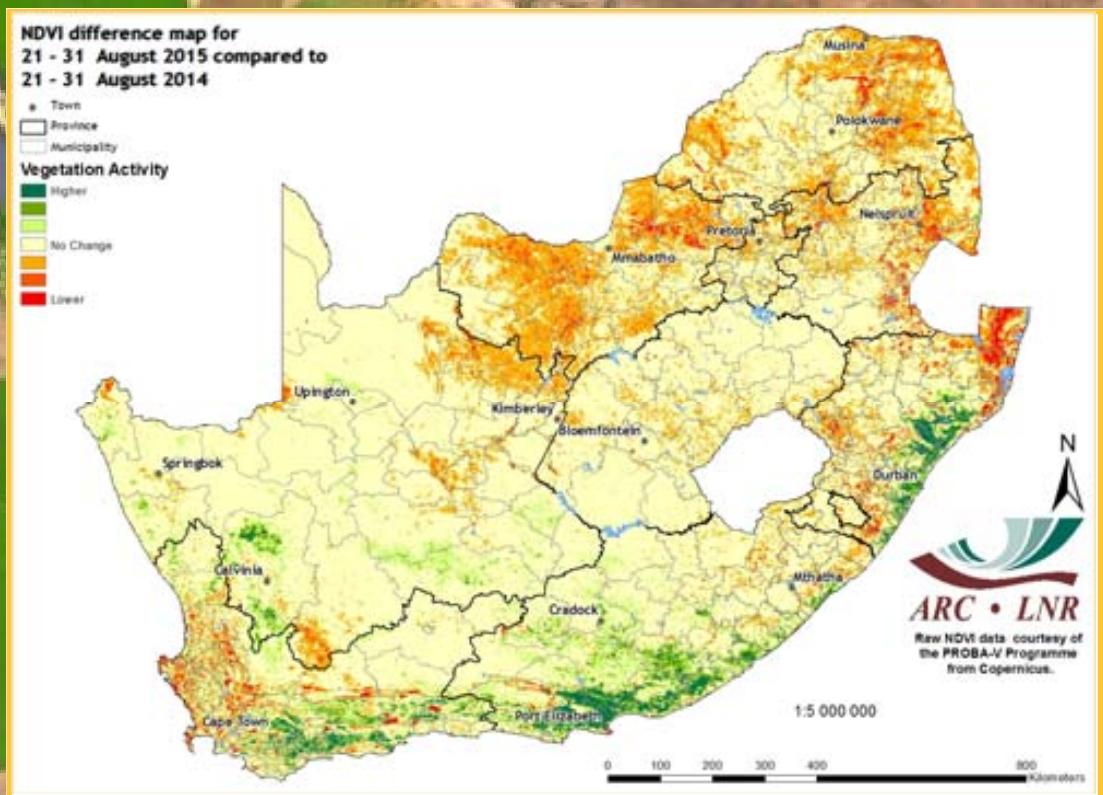

Figure 14

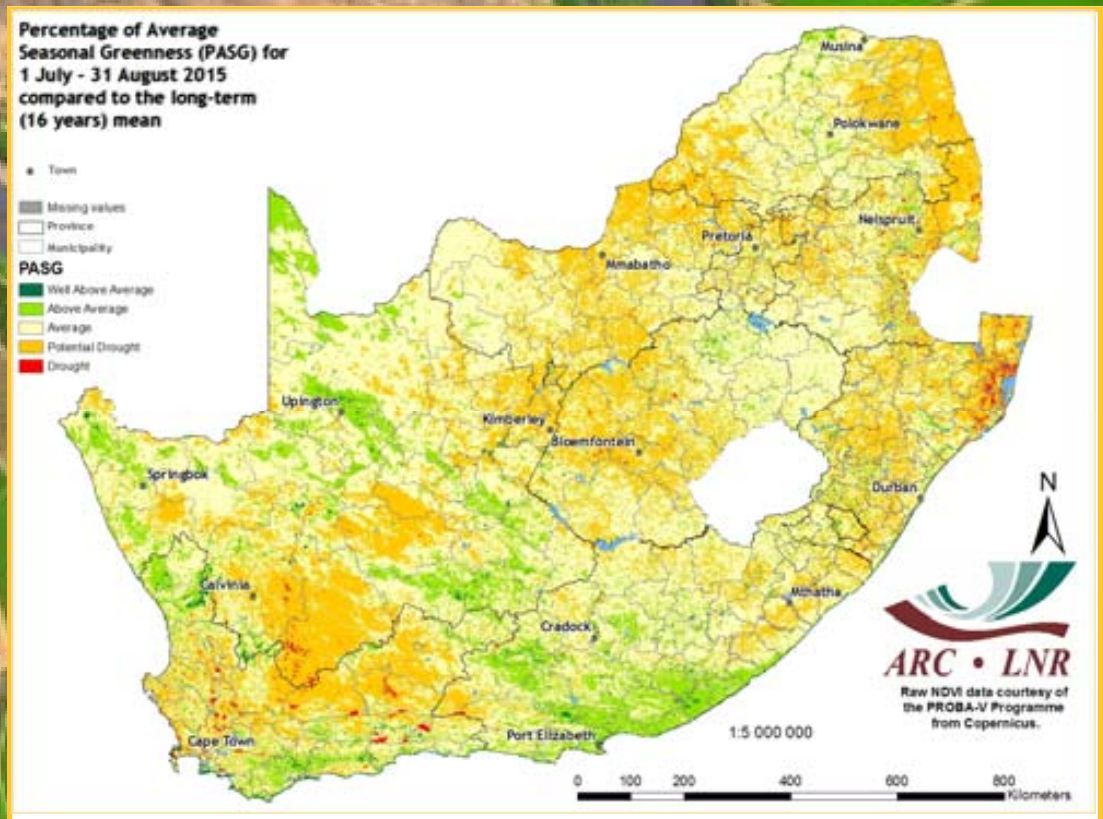

Figure 15

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:
Vegetation activity this year is higher over the southern parts and the coastal belt and adjacent interior of KwaZulu-Natal relative to last year but lower over the northern interior where the late summer was drier in 2015 than in 2014.

Figure 15:
Cumulative vegetation activity is above normal over the southern and southeastern parts as well as parts of central to northern and northwestern Northern Cape. Cumulative vegetation activity over the northern parts of the Western Cape into the western parts of the province is below normal.

Questions/Comments:
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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.

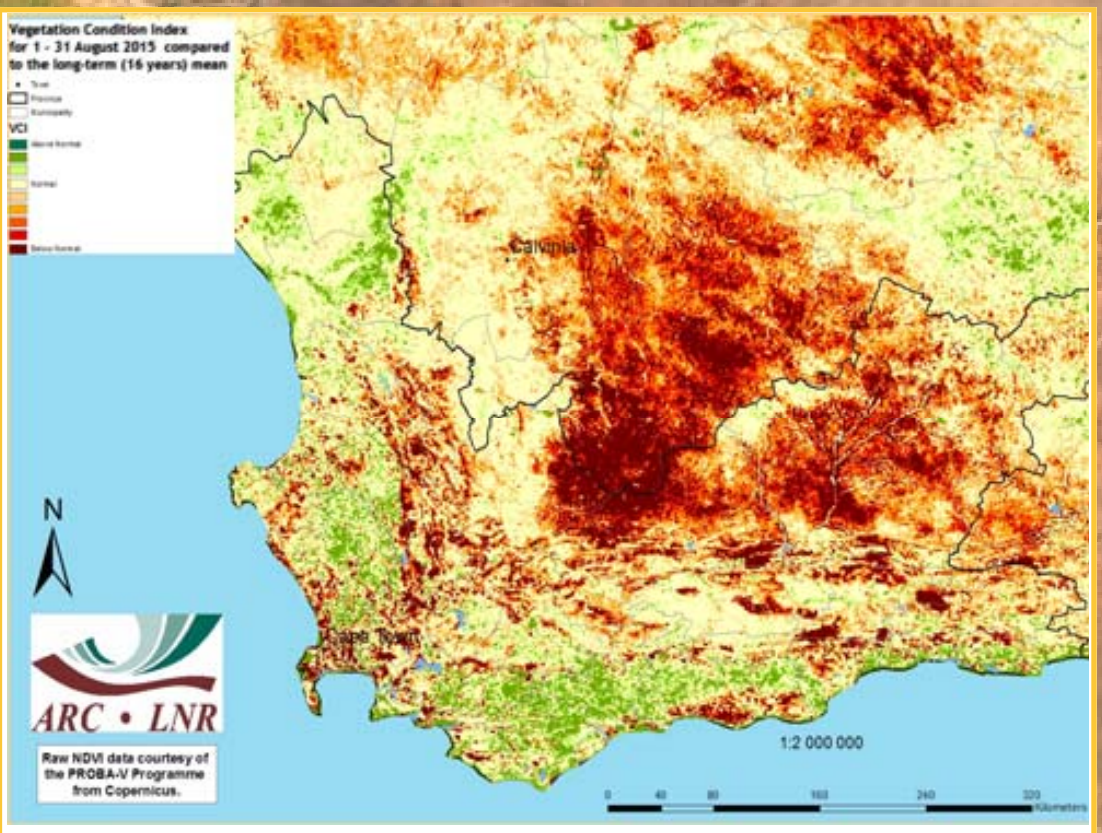


Figure 16

Figure 16:
The VCI map for August Indicates below-normal vegetation activity over the interior of the Western Cape and above-normal vegetation activity over the Ruens and the Swartland as well as further north along the West Coast.

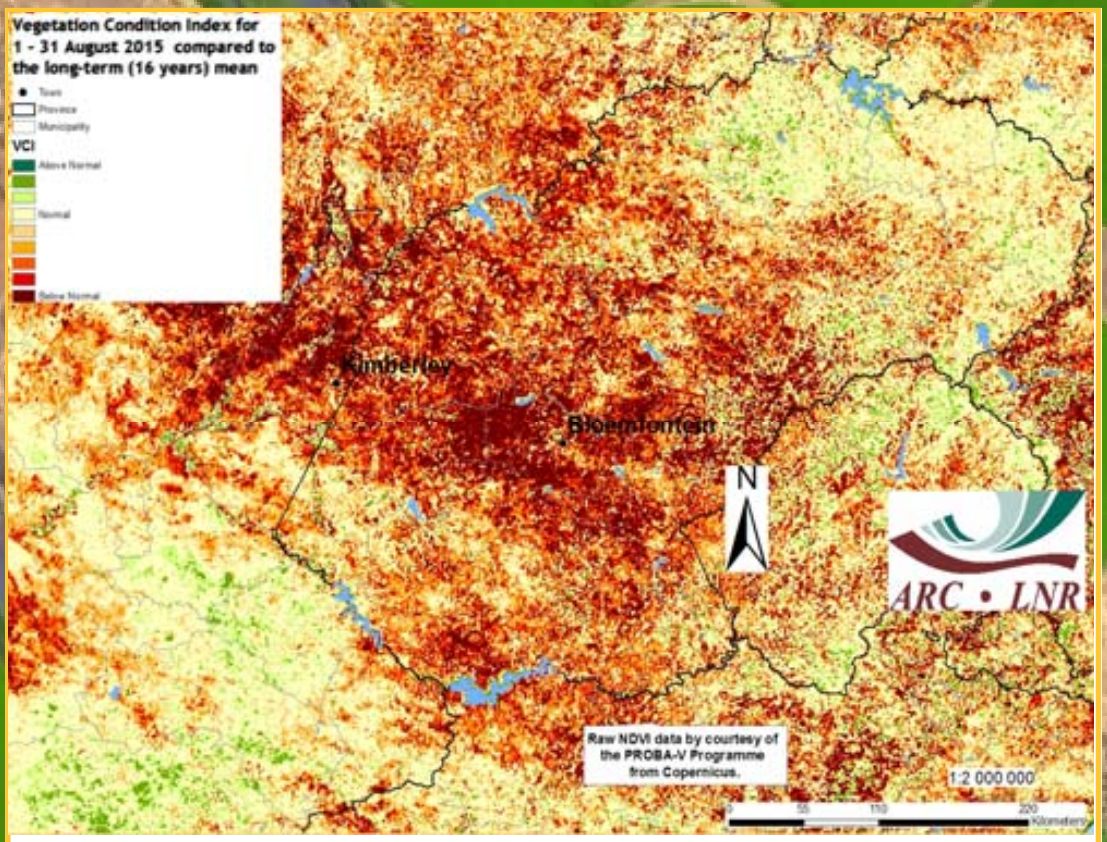
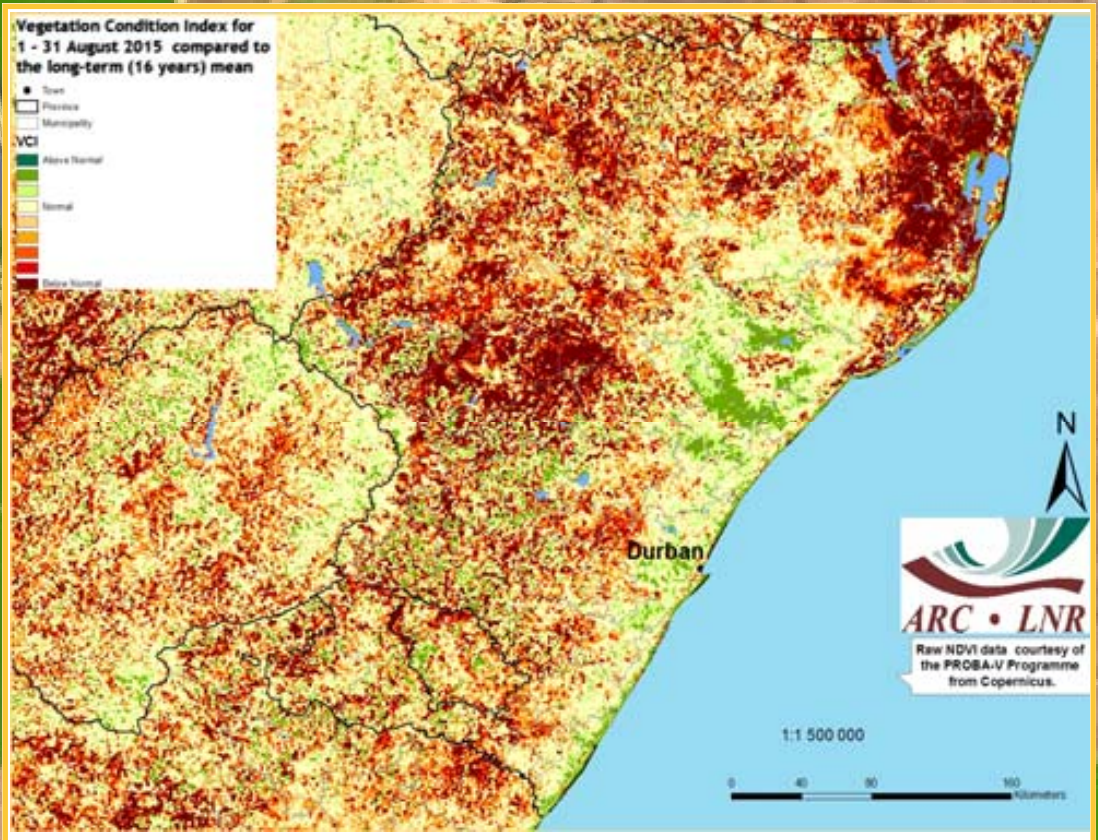


Figure 17

Figure 17:
The VCI map for August indicates below-normal vegetation activity over the central to northwestern Free State province.



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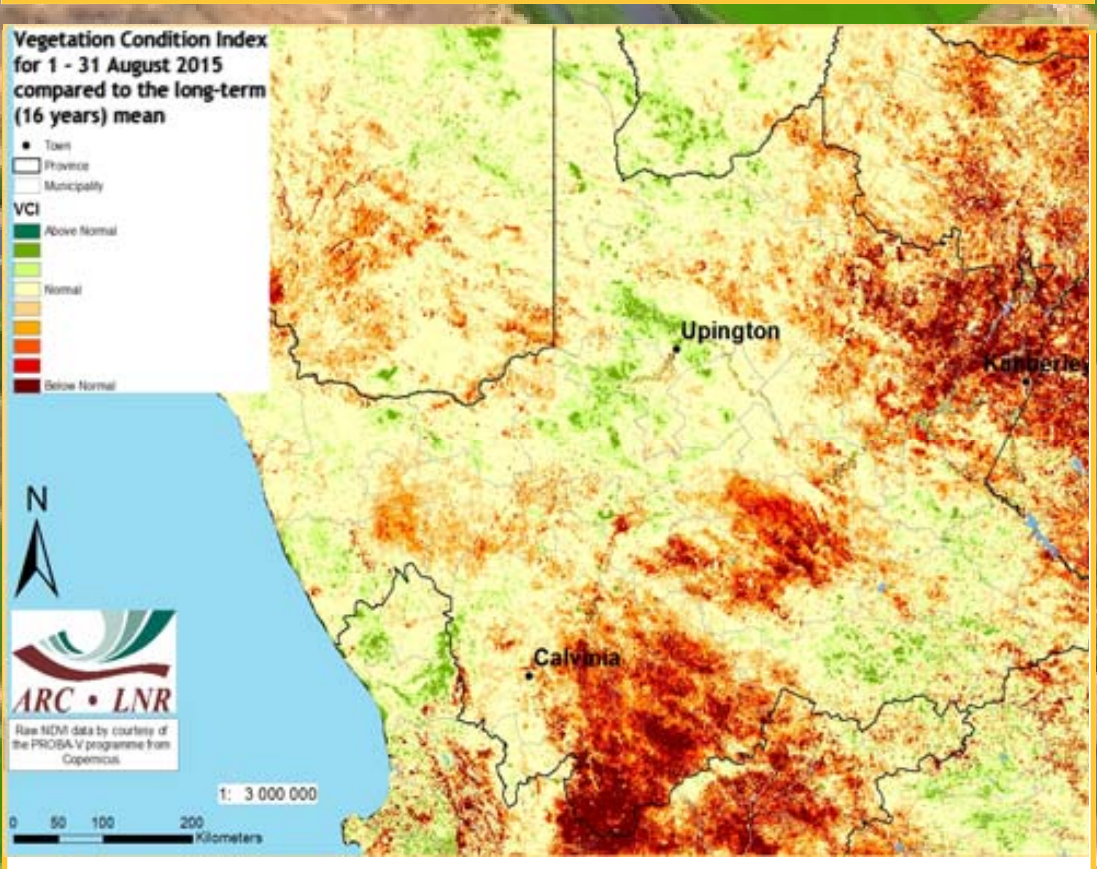

Figure 19

Figure 18:
The VCI map for August indicates below-normal vegetation activity over northeastern and western KwaZulu-Natal.

Figure 19:
The VCI map for August indicates below-normal vegetation activity over the southwestern and northeastern parts of the Northern Cape province.

Questions/Comments:
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7. Vegetation Conditions & Rainfall

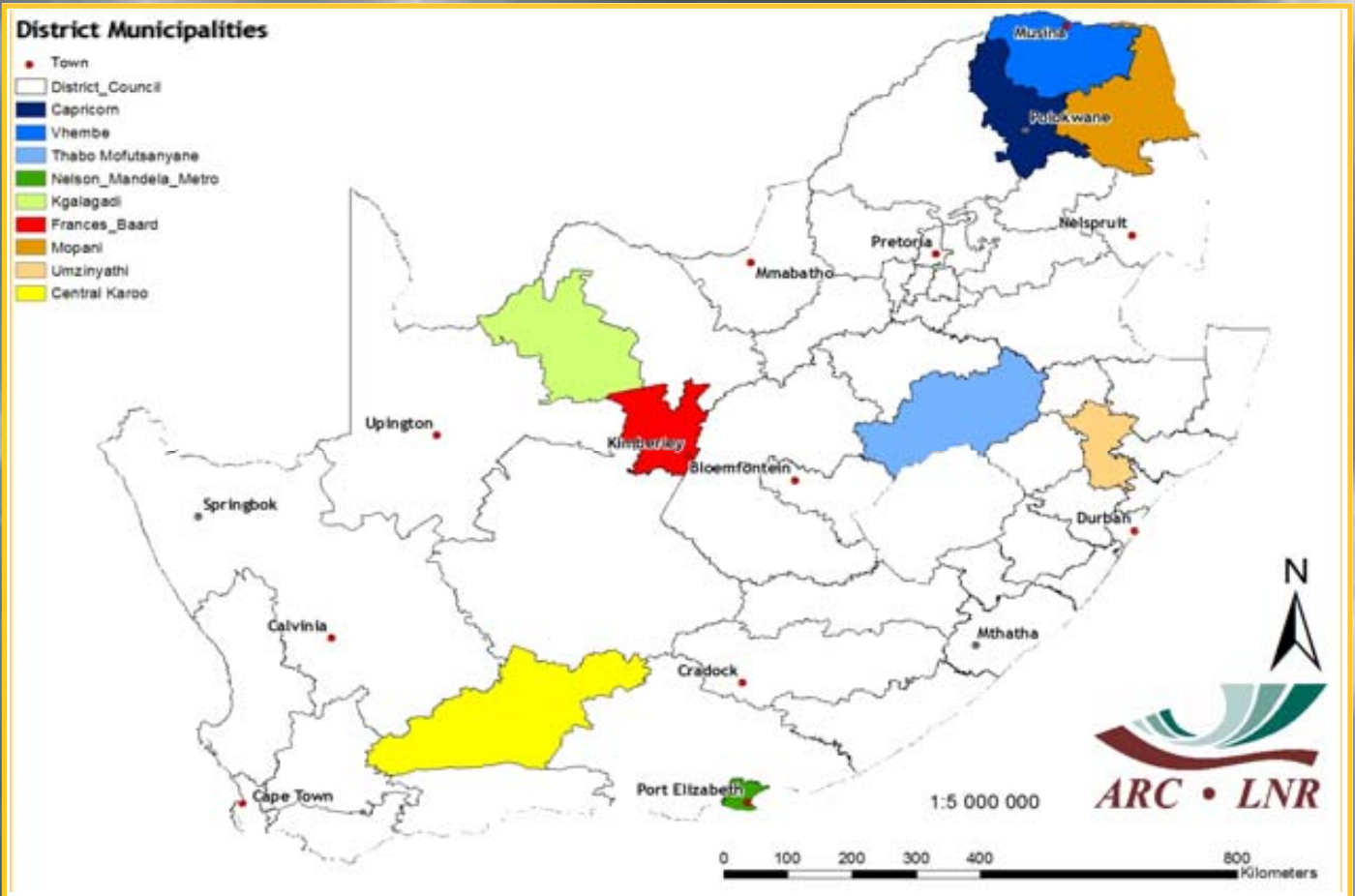

Figure 20

NDVI and Rainfall Graphs
Figure 20:
Orientation map showing the areas of interest for August 2015. The district colour matches the border of the corresponding graph.

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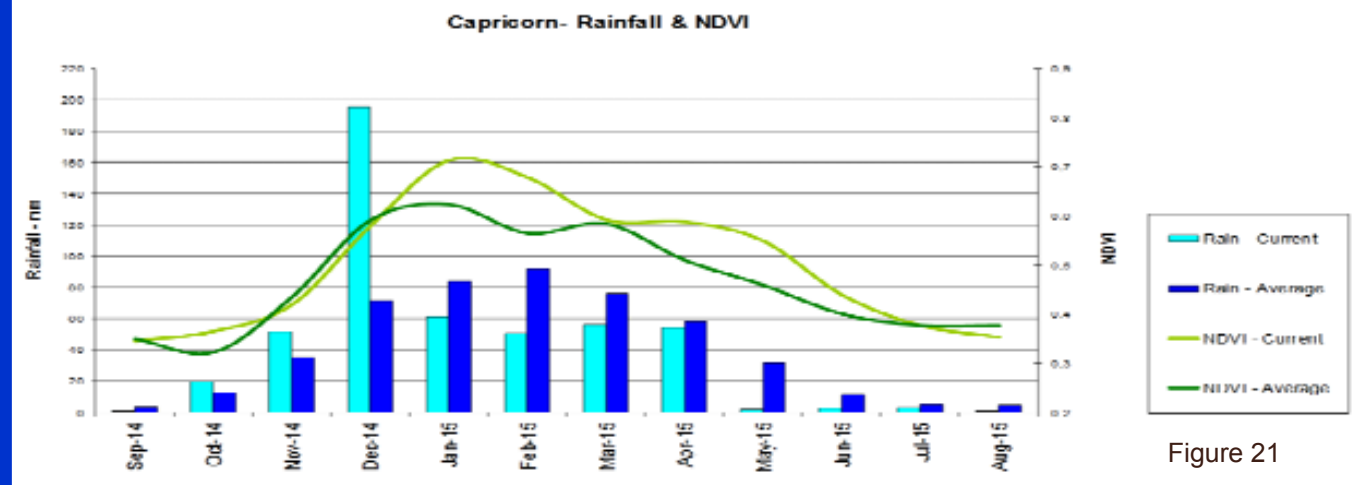
Figures 21-25:
Indicate areas with higher cumulative vegetation activity for the last year.

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



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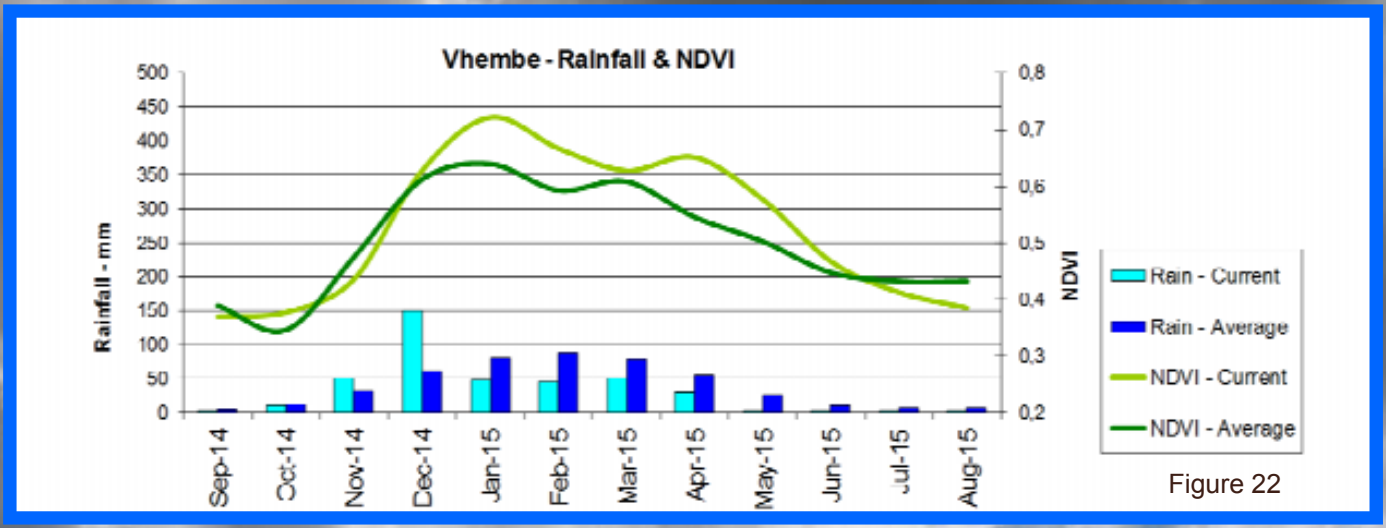

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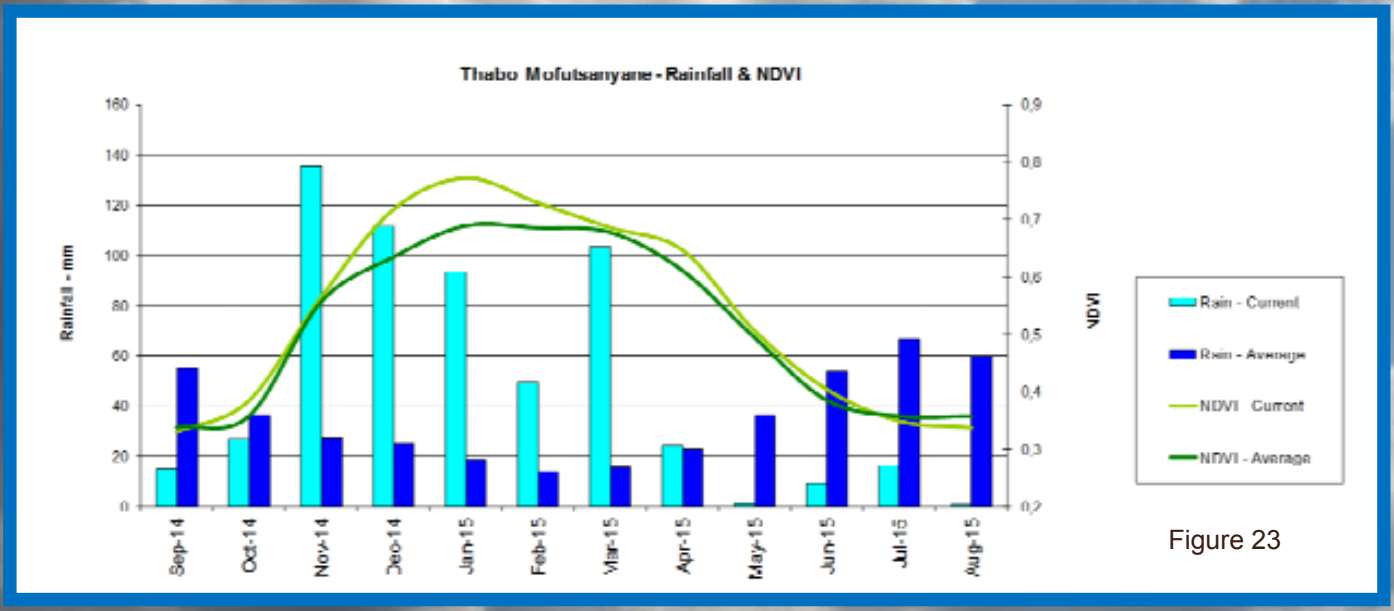

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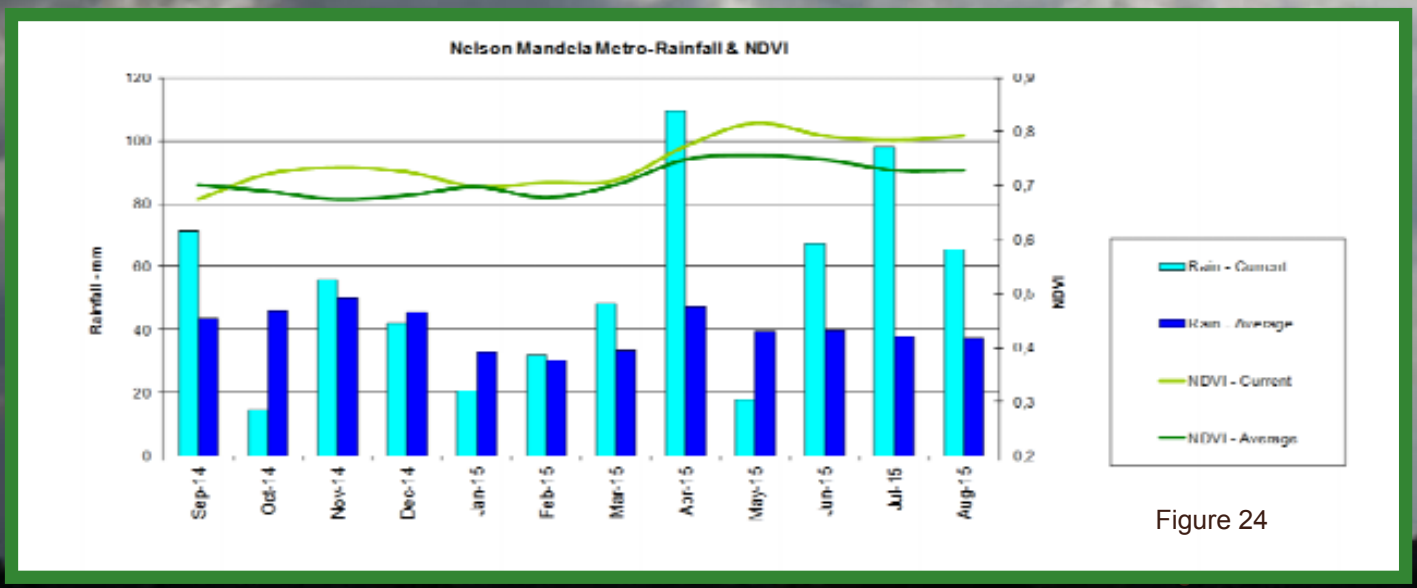

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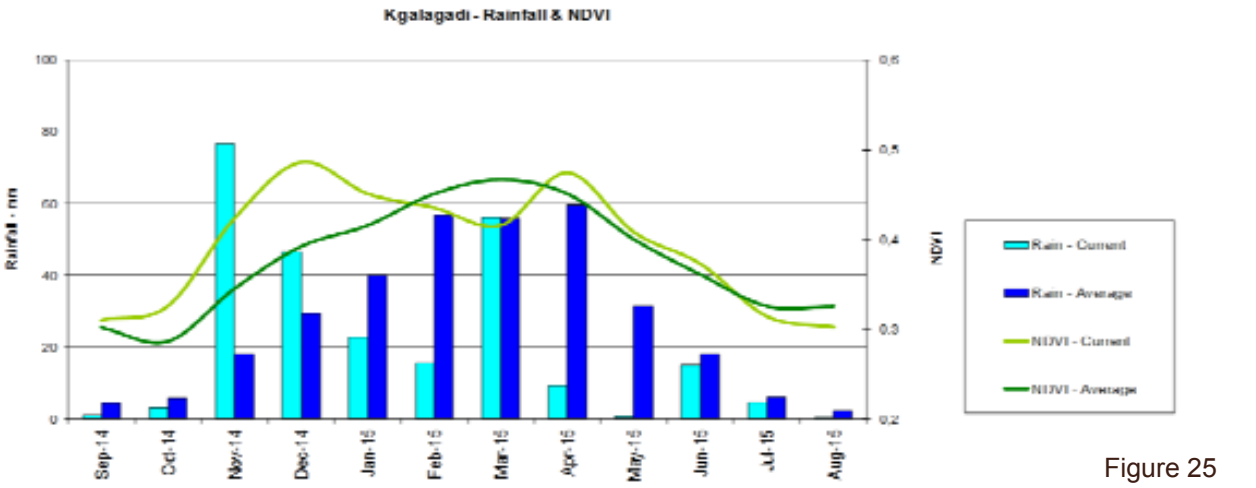


Figure 25

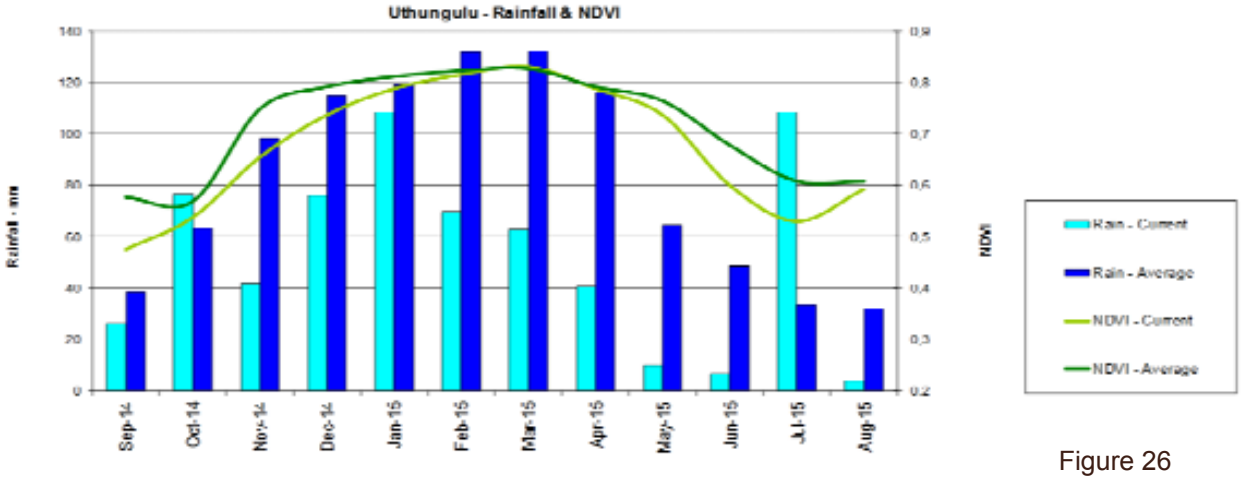
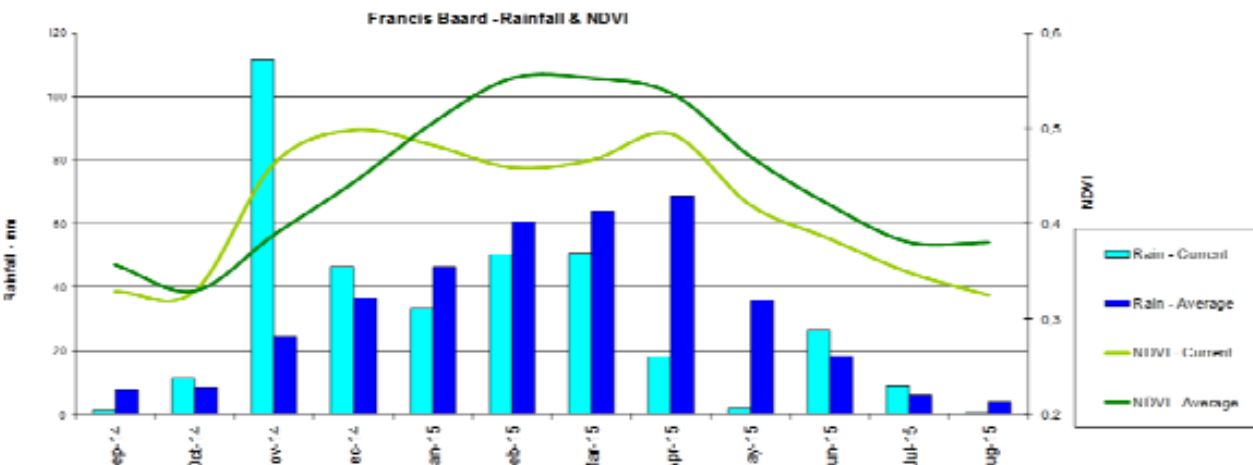


Figure 26



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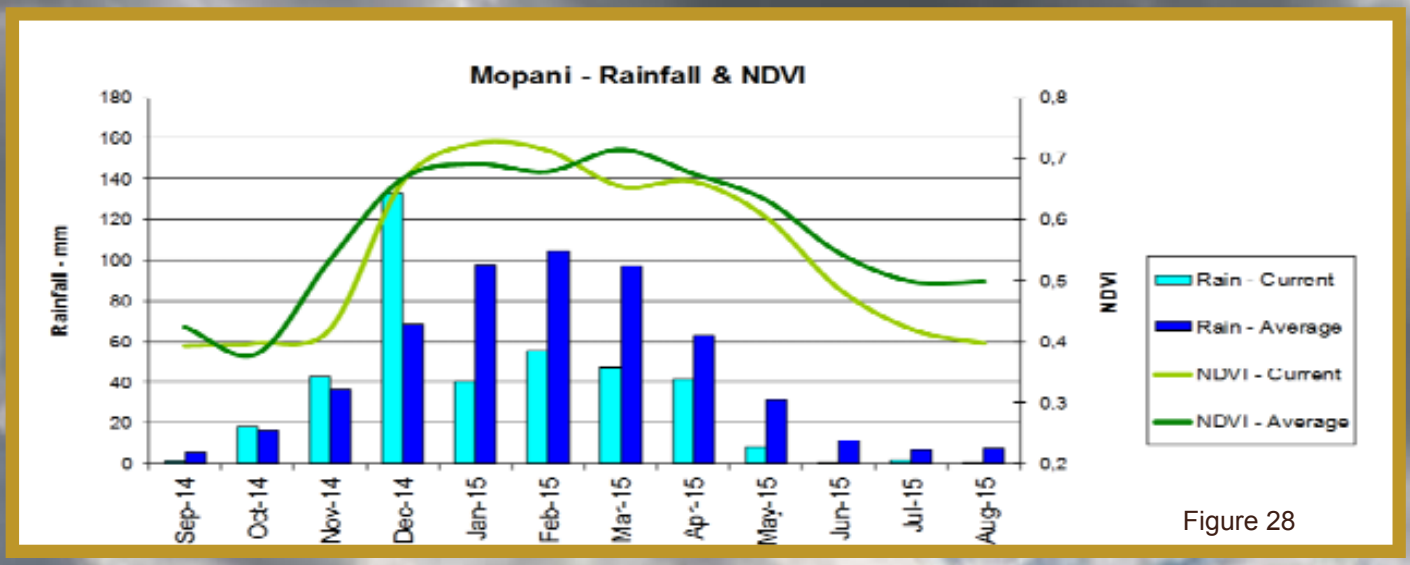

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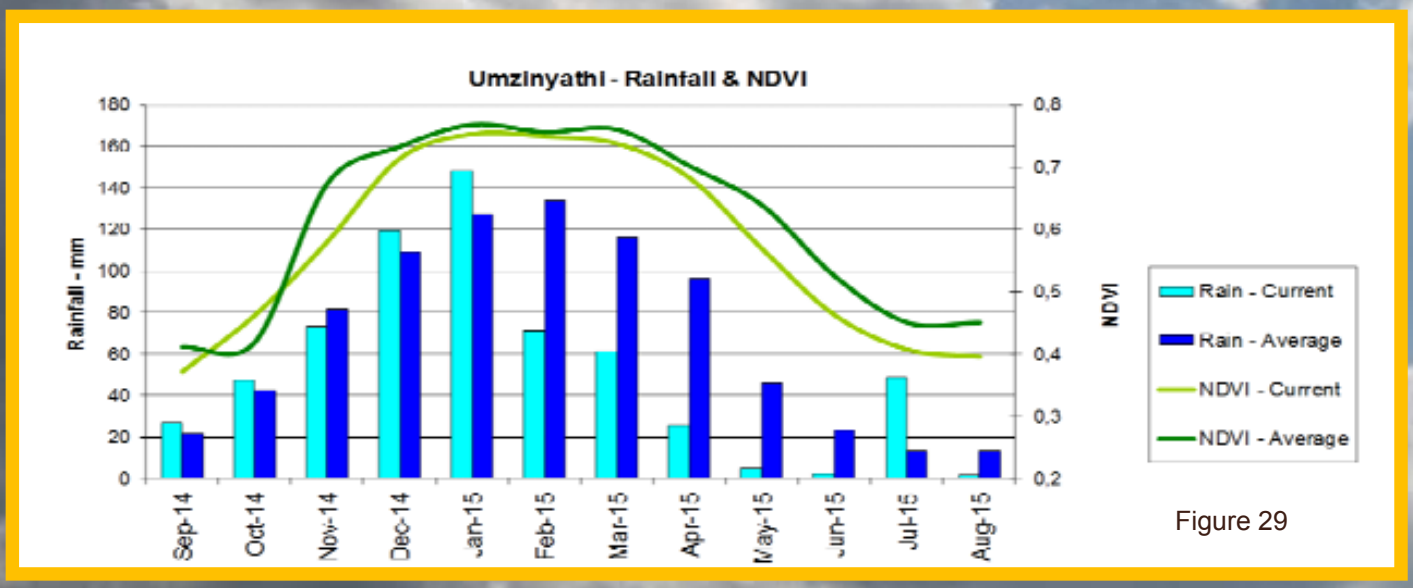

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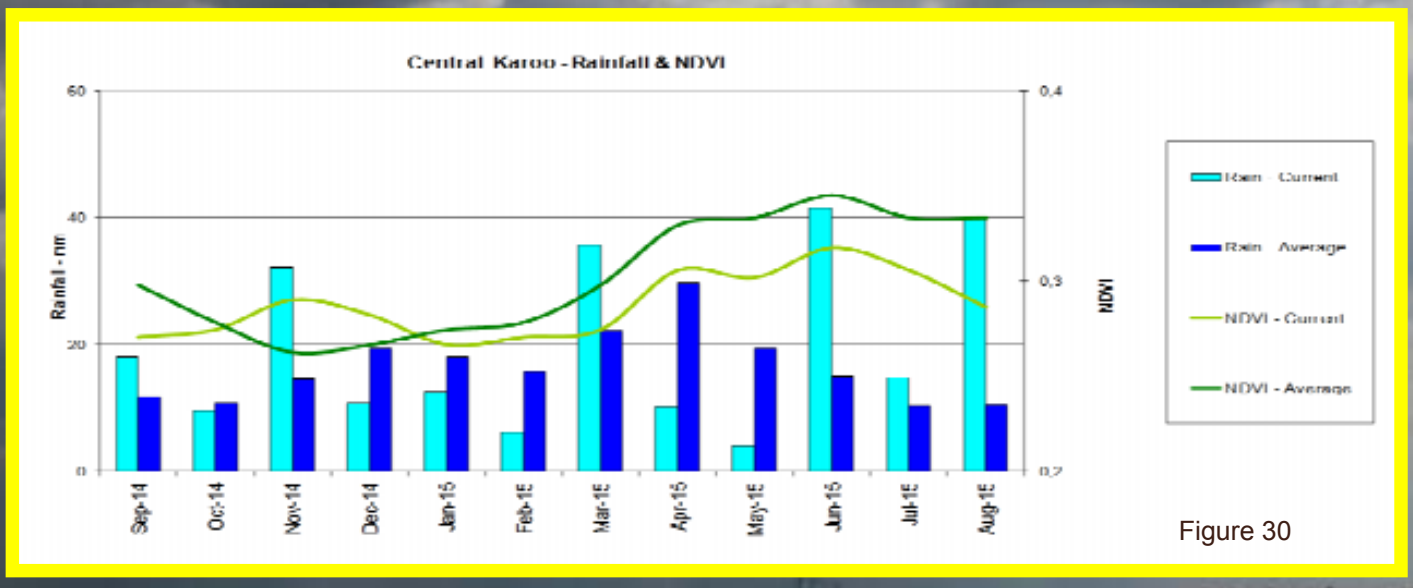

Figure 30

8. Soil Moisture

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Countywide soil moisture modelling by the University of KwaZulu-Natal Satellite Applications and Hydrology Group (SAHG)

Figure 31 shows the monthly averaged soil moisture conditions for August 2015. The colour scale ranging from brown to blue represents the Soil Saturation Index (SSI), defined as the percentage saturation of the soil store in the TOPKAPI hydrological model. The modelling is intended to represent the mean soil moisture state in the root zone. Figure 32 shows the SSI difference between August and July 2015, with the brown colours showing the drier and the green colours the wetter areas. Similarly, the year-on-year SSI difference for August is shown in Figure 33.

The year-on-year and month-on-month SSI differences are in agreement with rainfall and vegetation trends observed elsewhere in the newsletter, related to wet and cooler conditions in the south.

The SSI maps are produced at the ARC-ISCW in a collaborative effort with the University of KwaZulu-Natal Applications and Hydrology Group, made possible by the WMO.

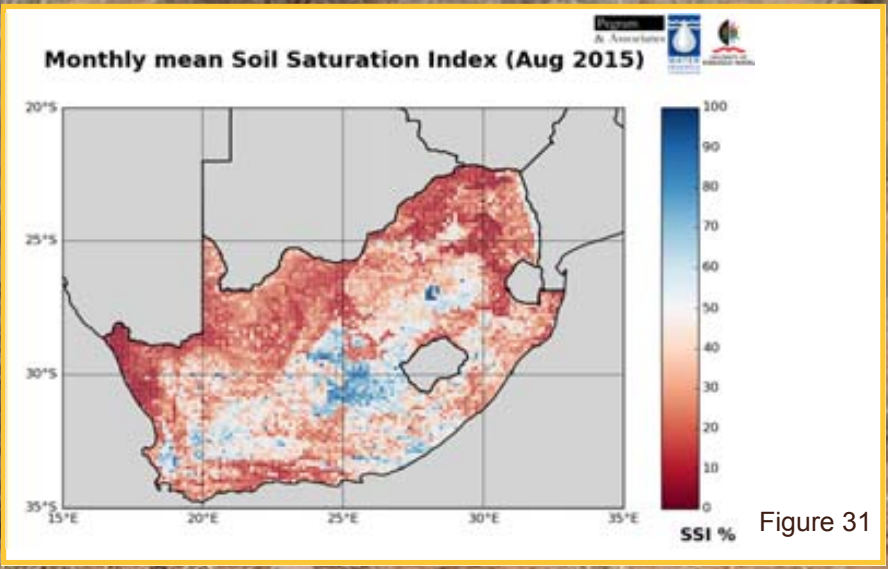

Figure 31

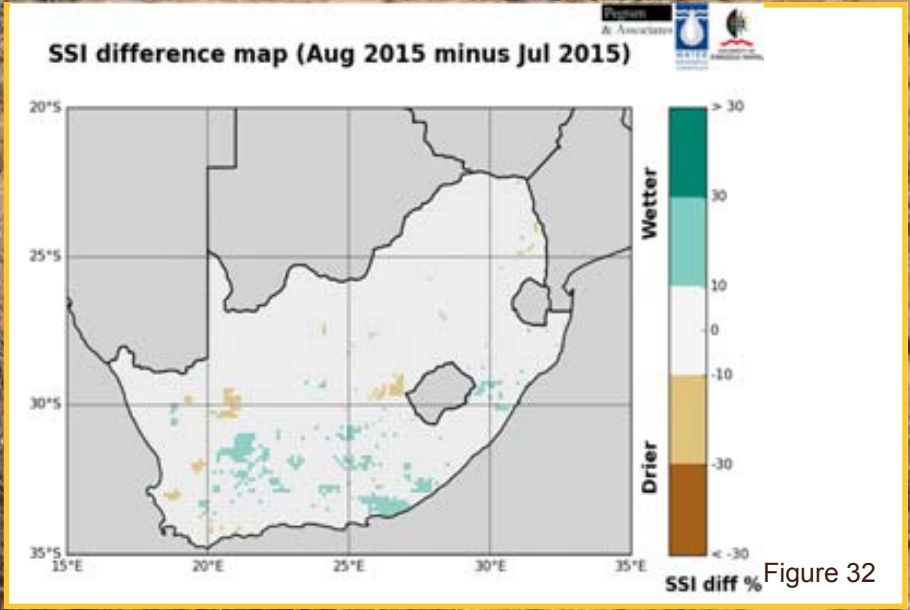

Figure 32

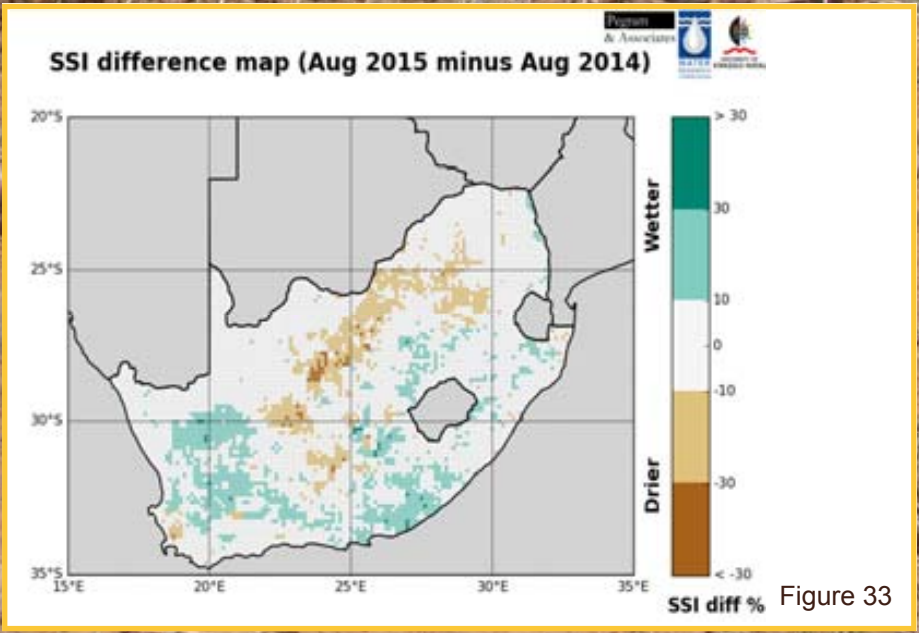

Figure 33

UNIVERSITY OF KWAZULU-NATAL

9. 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 34:
The graph shows the total number of active fires detected in the month of 31 August 2015 per province. Fire activity was higher in Gauteng, Free State, and the Western Cape province compared to the average during the same period for the last 14 years.

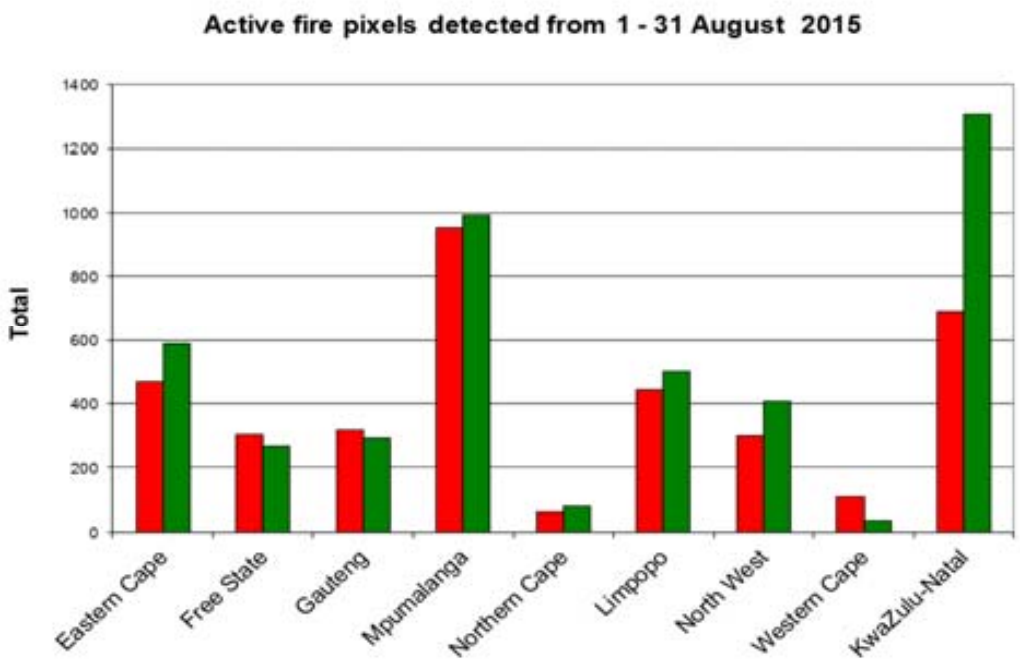

Figure 34

Figure 35:
The map shows the location of active fires detected between 1-31 August 2015.

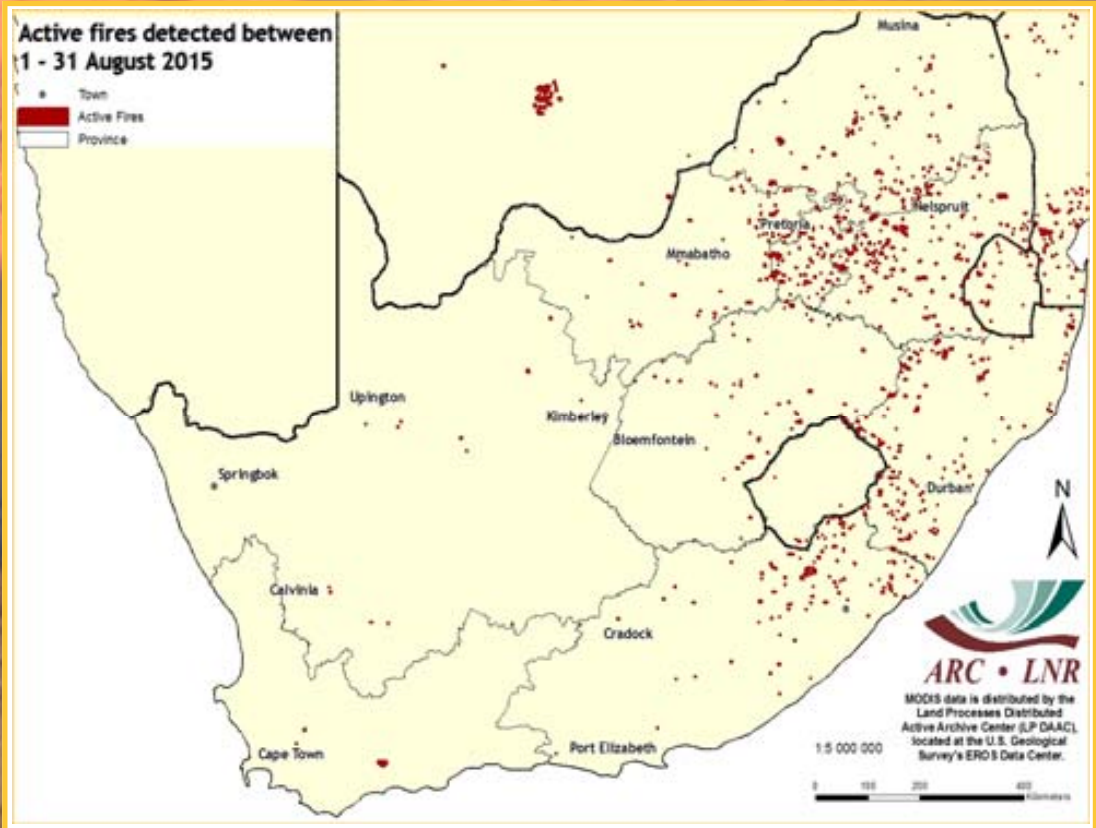

Figure 35

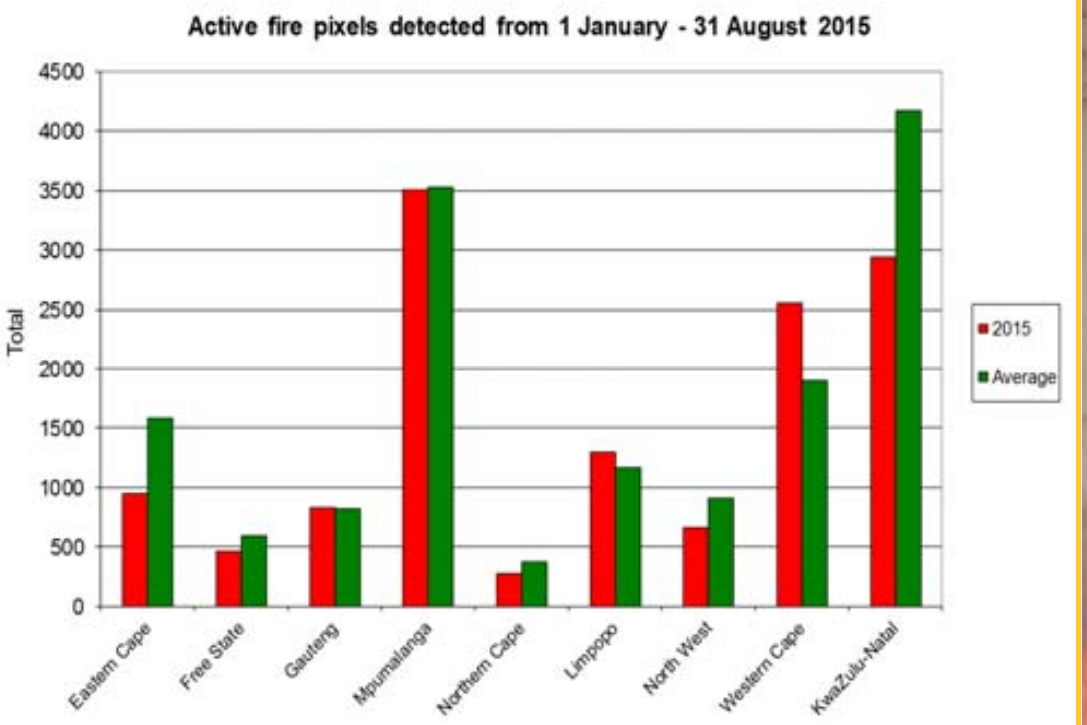

Figure 36

Figure 36:
The graph shows the total number of active fires detected between 1 January to 31 August 2015 per province. Fire activity was higher in Gauteng and Limpopo compared to the average during the same period for the last 14 years.

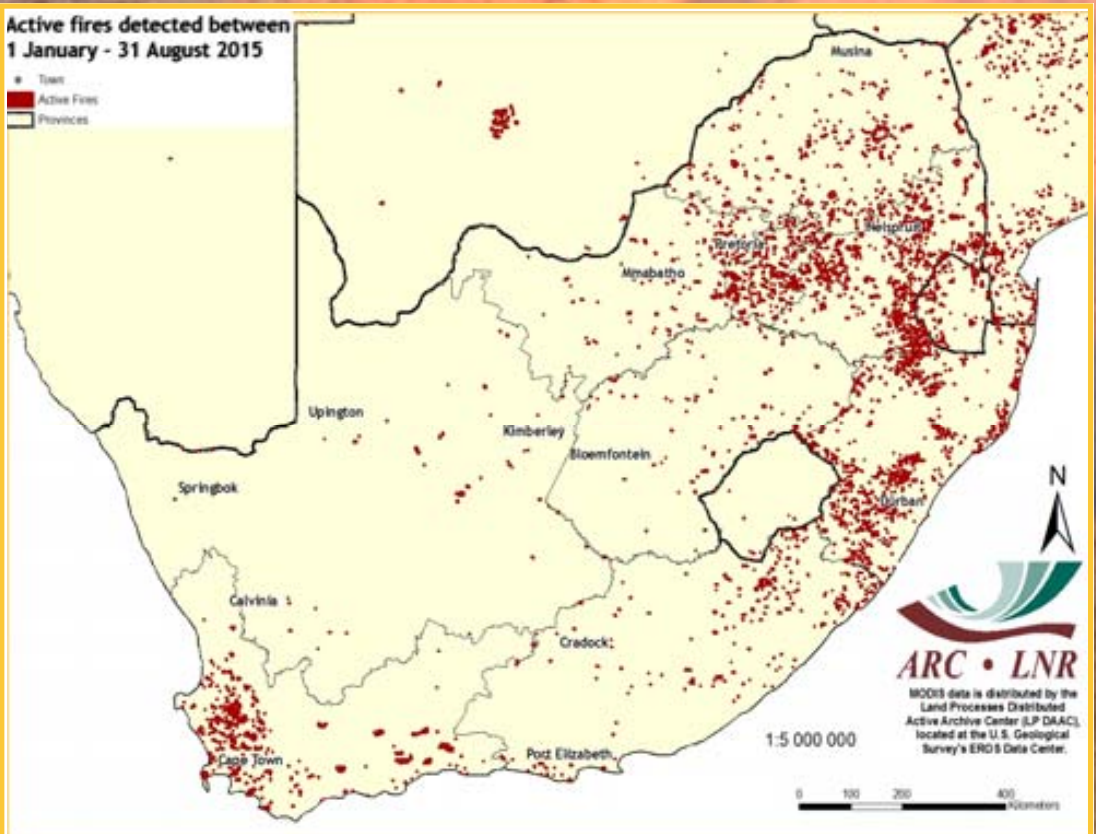

Figure 37

Figure 37:
The map shows the location of active fires detected between 1 January to 31 August 2015.

Questions/Comments:
NkambuleV@arc.agric.za

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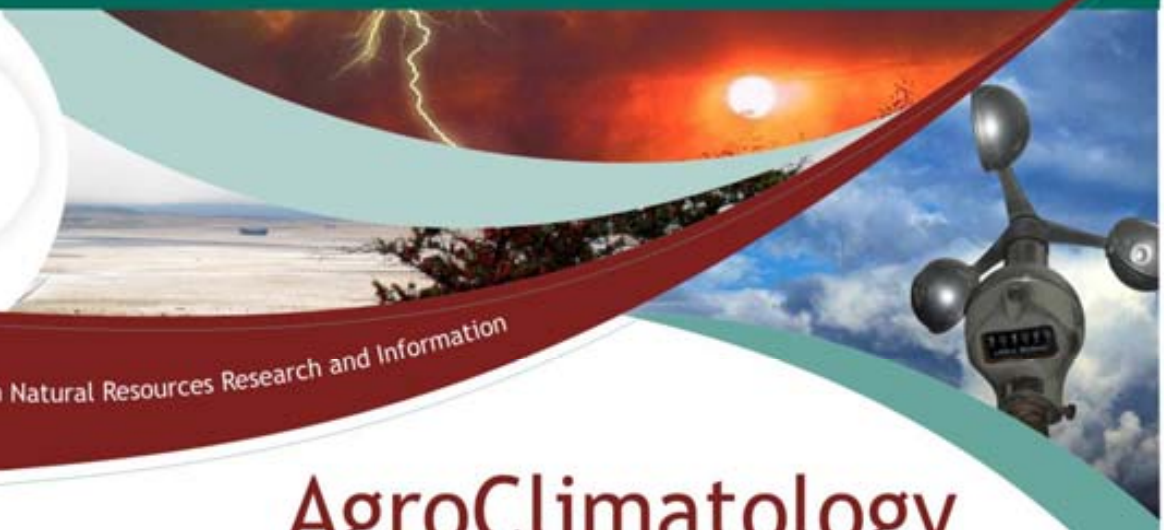

Your Partner in Natural Resources Research and Information

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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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