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UMLINDI
The Watchman

ISSUE 2015-05 | 15 MAY 2015

INSTITUTE FOR SOIL, CLIMATE AND WATER

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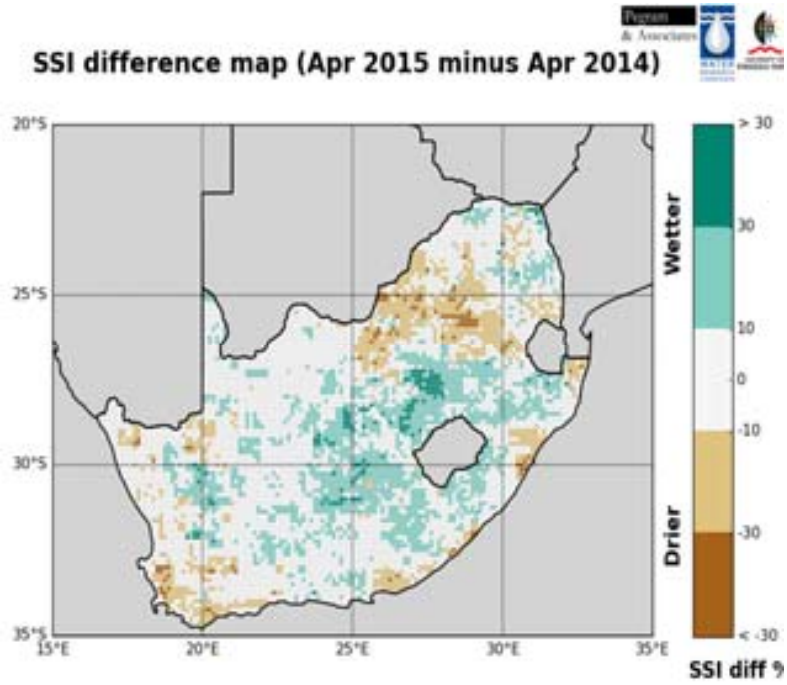
131st Edition

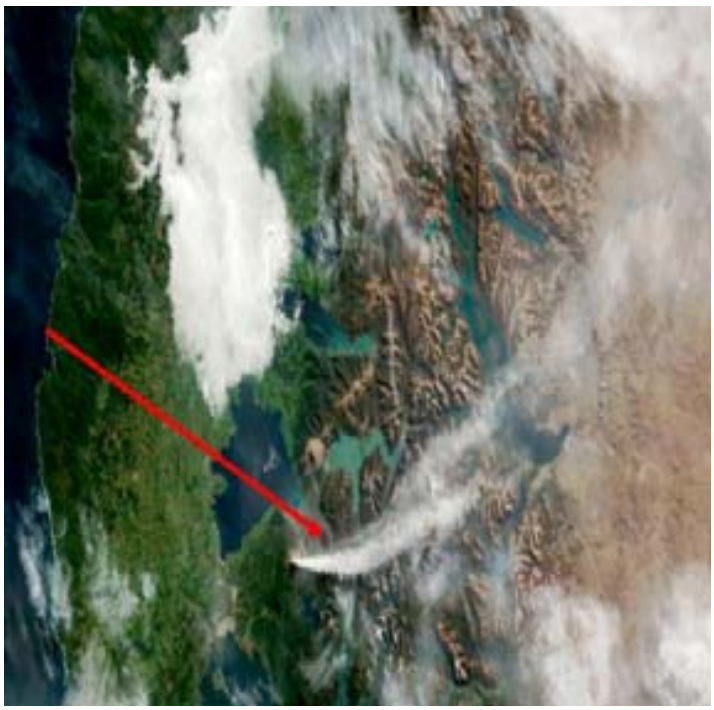
Images of the Month



Relatively low soil moisture indicated over winter rainfall region but high over the Free State

Planting season has commenced over the important grain production areas of the winter rainfall region. Very little rain has occurred over the Western Cape since the beginning of April, indicating a delayed start in the rainy season there. The difference in Soil Saturation Index (SSI) between April this year compared to last year (see map) indicates that soil moisture over this region (specifically the Swartland and Ruens) is relatively low, and at least lower than during April 2014.

Over the summer rainfall region, widespread rain returned to some parts from the second half of February, with above-normal rainfall persisting into April in some areas. The welcome rain had a positive impact on the soil moisture status by April, even when compared to April 2014 which followed a summer with very much above-normal rainfall over many areas. Large parts of the Free State may experience higher soil moisture going into winter this year. However, some of the northeastern areas, which were anomalously wet last year, are experiencing lower soil moisture. *(The SSI map is produced at the ARC-ISCW in collaboration with the University of KwaZulu-Natal Applications and Hydrology Group.)*



Large volcanic eruption in South America

The image is a natural-colour image taken around midday on April 24th by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite. It shows an ash and gas plume (indicated by the red arrow) from "Calbuco", a volcano in southern Chile. *(NASA Earth Observatory image courtesy of Joshua Stevens, using MODIS data from the LANCE/EOSDIS Rapid Response team at NASA Goddard.)*

During this major eruption, Calbuco spewed an ash cloud about 15 km into the sky, reaching even the lower stratosphere. The possible impact on South African weather patterns will have to be closely monitored during the next few months. Explosive events of sufficient magnitude may inject large amounts of aerosols into the upper atmosphere, affecting the climate system. Associated changes in the westerlies may have negative impacts on South African summer rainfall. The exact magnitude of the event and amount of sulphur dioxide (converted into sulphate aerosol) injected into the stratosphere will still have to be determined. However, the relatively high latitude at which the event occurred will somewhat lessen the potential impacts.

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:

After the relatively wet conditions during March over many areas in the east and northeast, rainfall anomalies during April remained fairly similar, with above-normal rain towards the northeast and southeast, and drier conditions over the central to western parts. The winter rainfall region received very little rain during the month, indicating a delayed start to the rainy season. Even though some frontal activity was experienced by the middle and end of the month, only light falls were recorded over the winter rainfall region for the most part. The first significant cold front moved into the central interior by the 15th and resulted in widespread frost over the central and southern parts.

A cut-off low situated over eastern Namibia / western Botswana dominated weather patterns during the first few days of the month, resulting in widespread rain and thundershowers over Botswana and eastern Namibia while some thundershowers invaded the Northern Cape and North West. A trough moved over the southern parts by the 3rd and formed a cut-off low over the southeastern parts, resulting in widespread rain and thundershowers over the Eastern Cape and surrounding southern and south-eastern South Africa. Due to upper air instability in the northeast, widespread showers and thundershowers also occurred over especially Limpopo and Mpumalanga. Conditions remained fairly favourable for the development of isolated to scattered thundershowers over the northeastern parts until the 10th due to the presence of upper air perturbations in the area and the development of a weak upper-air cut-off low over the extreme eastern parts. Most of the rain associated with this cut-off low occurred to the east of South Africa, although fairly widespread thundershowers also occurred as far west as eastern North West. An upper-air trough to the west also resulted in fairly widespread showers over parts of the Northern Cape by the 10th.

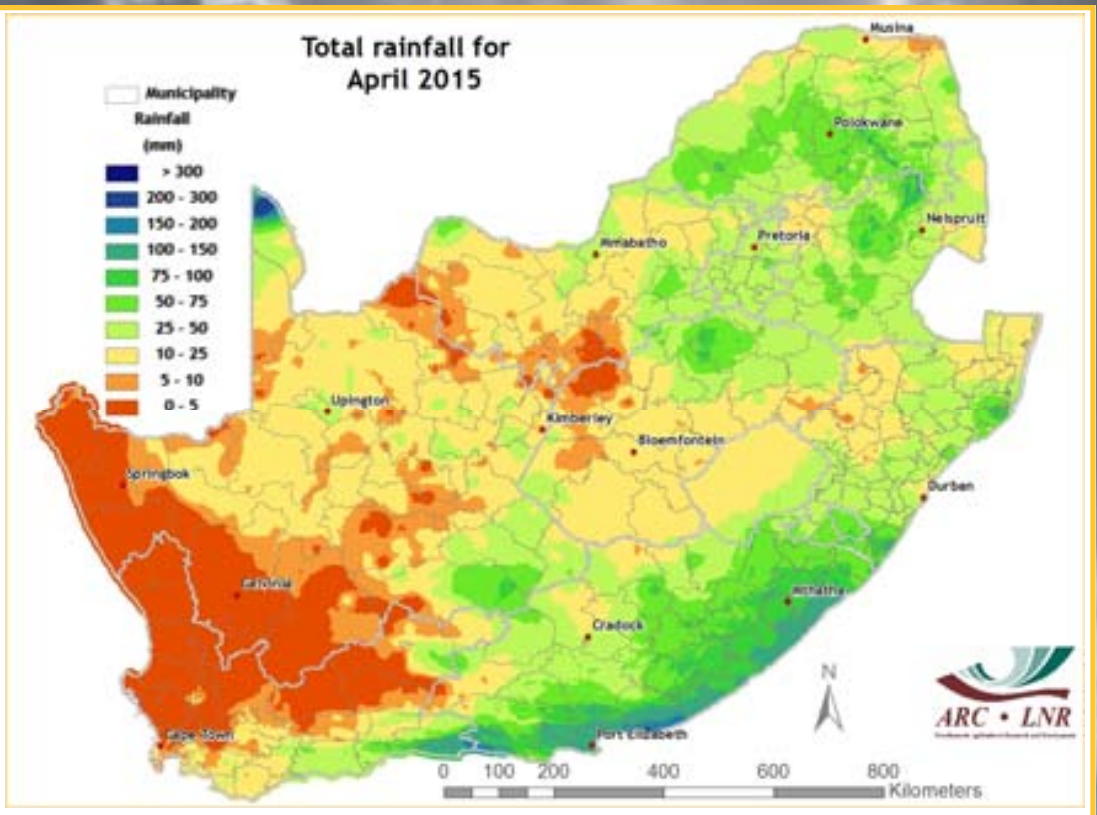


Figure 1

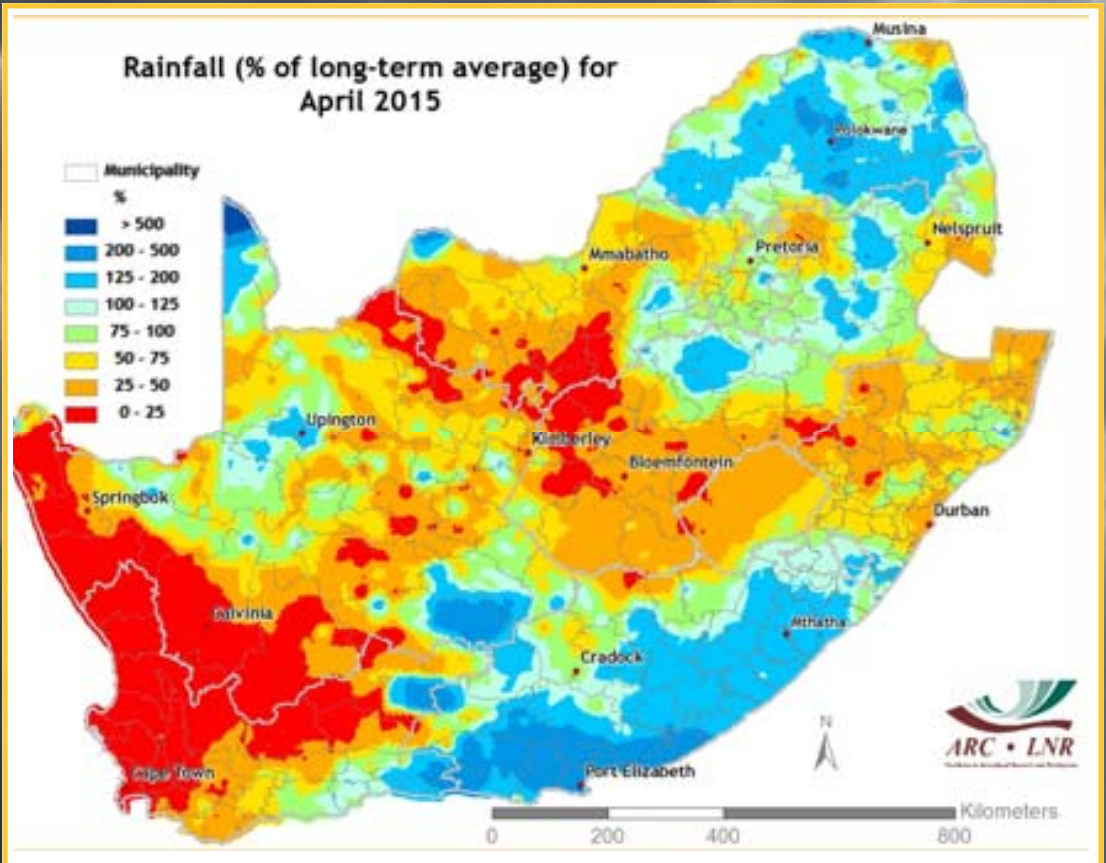


Figure 2

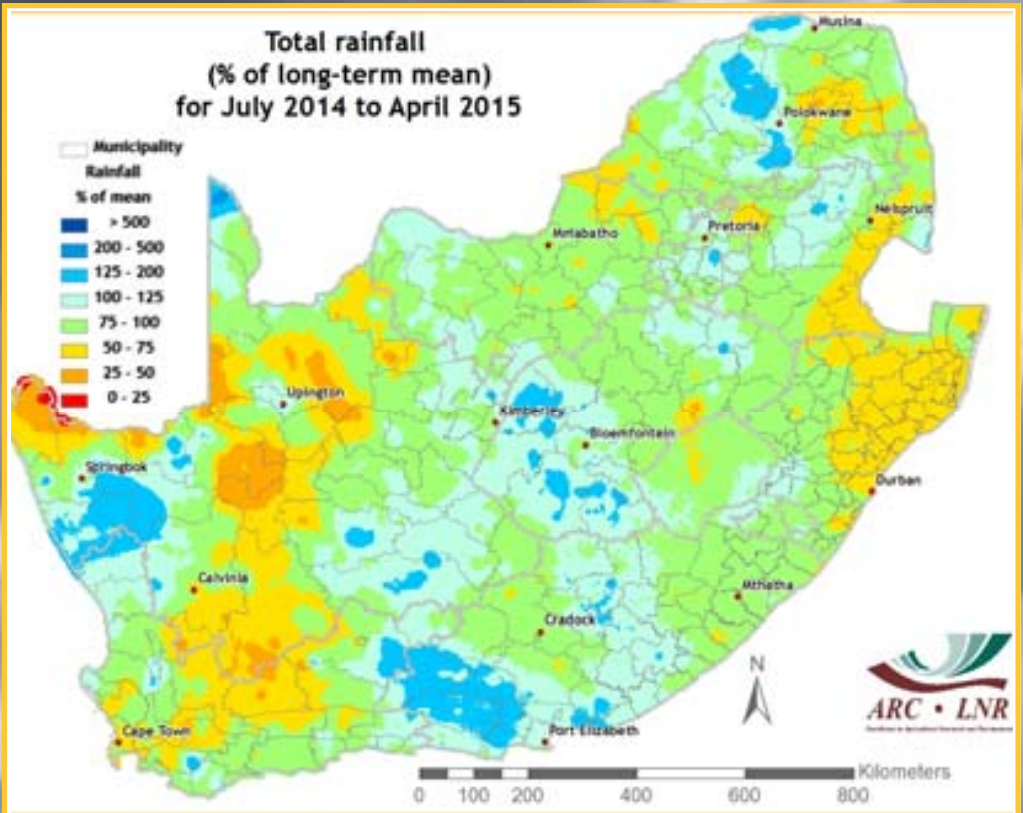


Figure 3

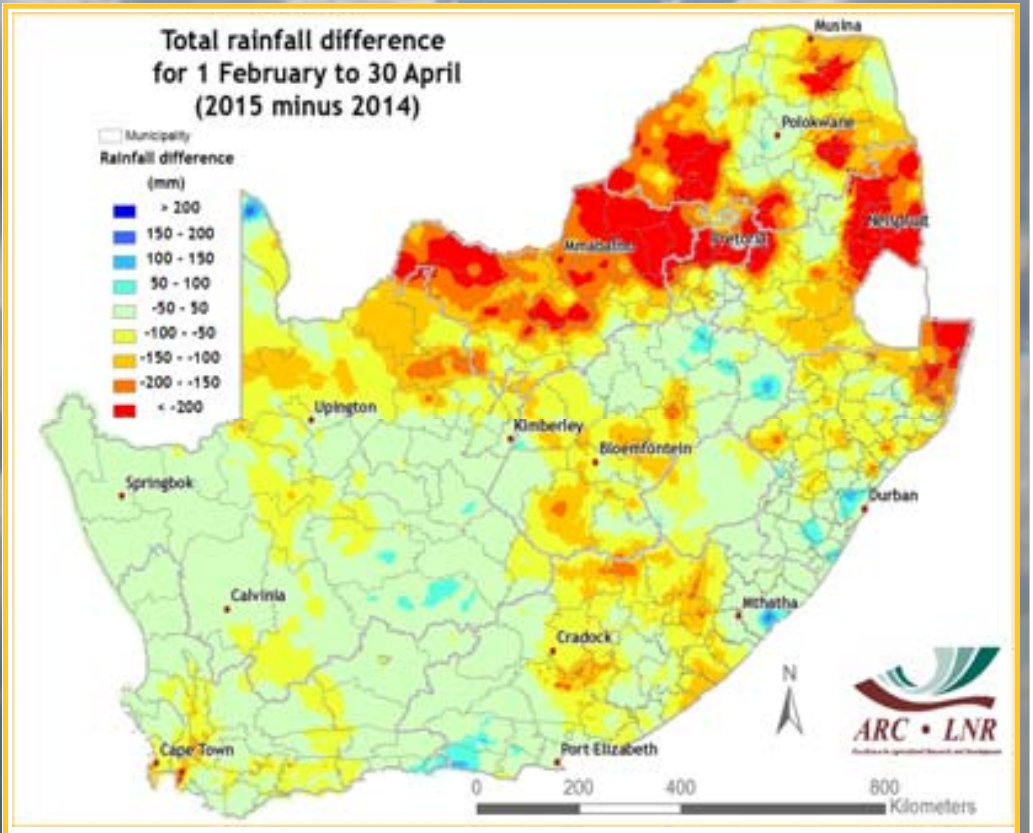


Figure 4

Widespread rain occurred over parts of the northeastern interior from the 15th to the 18th. This was associated with the development of an upper-air low over the south-eastern parts and a strong ridge towards the south, feeding cold air over the southern parts of the country and cool moist air over the eastern parts where scattered thunder-showers occurred. Some snow was even reported in the high-lying mountainous areas in the south and southeast. Widespread rain also occurred over the southern parts of the country due to the upper-air low and surface onshore flow. The cold air advected from the south resulted in the first widespread frost over the central parts of the country by the 16th. With upper air perturbations over the interior, isolated to scattered thundershowers remained in place over the eastern parts, especially until the 24th. A small number of storms over the Free State even became severe.

During the last few days of the month, a cold front moved over the western and southern to central parts. Some rain occurred over the winter rainfall region, but falls were light. As dry air invaded the interior, no rain was recorded over most of the country. The northern parts remained warm.

Figure 1:
Almost the entire country, except for the northern parts of the winter rainfall region, received some rain during April. Highest totals, exceeding 150 mm, were recorded along the southeastern coastal belt. Large parts of the Eastern Cape received in excess of 100 mm. Most of the northeastern interior received between 25 and 75 mm.

Figure 2:
Total rainfall during April was above normal over the northeastern interior and in the southeast where some areas received more than 200% of the long-term average. The winter rainfall region, western to central interior and KwaZulu-Natal received below-normal rainfall.

Figure 3:
Since July 2014, cumulative precipitation has been normal to above-normal over the central interior, isolated areas in the north-east and the northern parts of the winter rainfall region. The eastern parts of KwaZulu -Natal, eastern Mpumalanga and Limpopo as well as the central and southwestern parts of the Northern Cape received below-normal cumulative rainfall.

Figure 4:
Much of the north and northeast as well as the southwestern parts of the country received less rain in the 3-month period ending April 2015 than in 2014. Parts of the southern, central and southeastern interior received more rain than in 2014 for the same 3-month period.

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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 dominate the northern parts of KwaZulu-Natal and southern Mpumalanga at all time scales, with wet conditions indicated over the northeastern and southeastern parts of the country at the 3-12-month time scales and also the winter rainfall region at the 24-month time scale, while the rest of the country experiences mild to moderate drought.

Questions/Comments:
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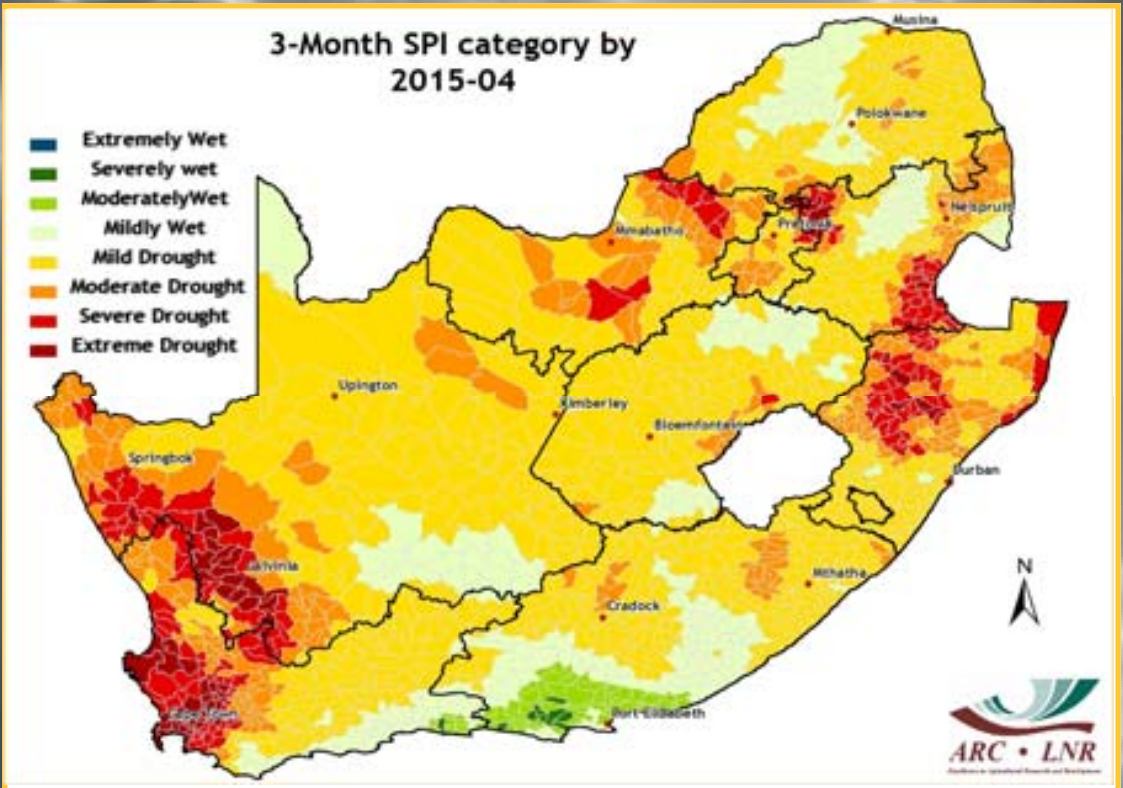

Figure 5

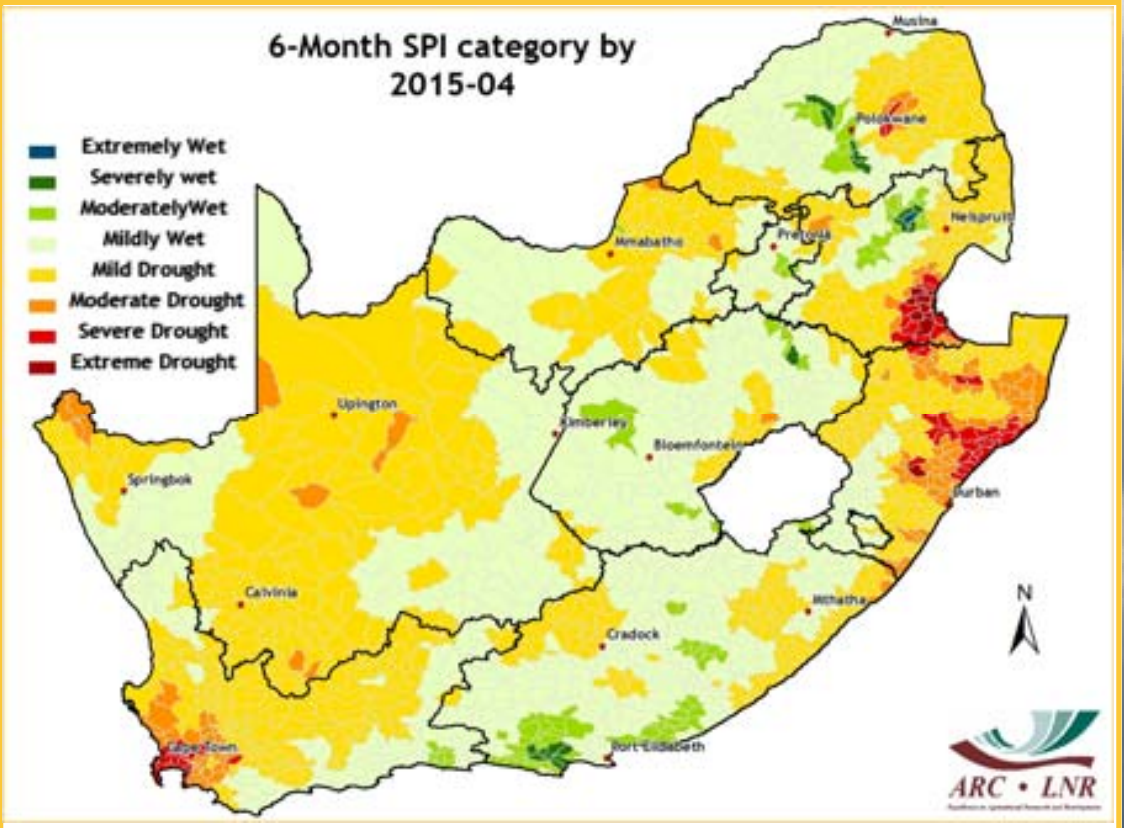

Figure 6

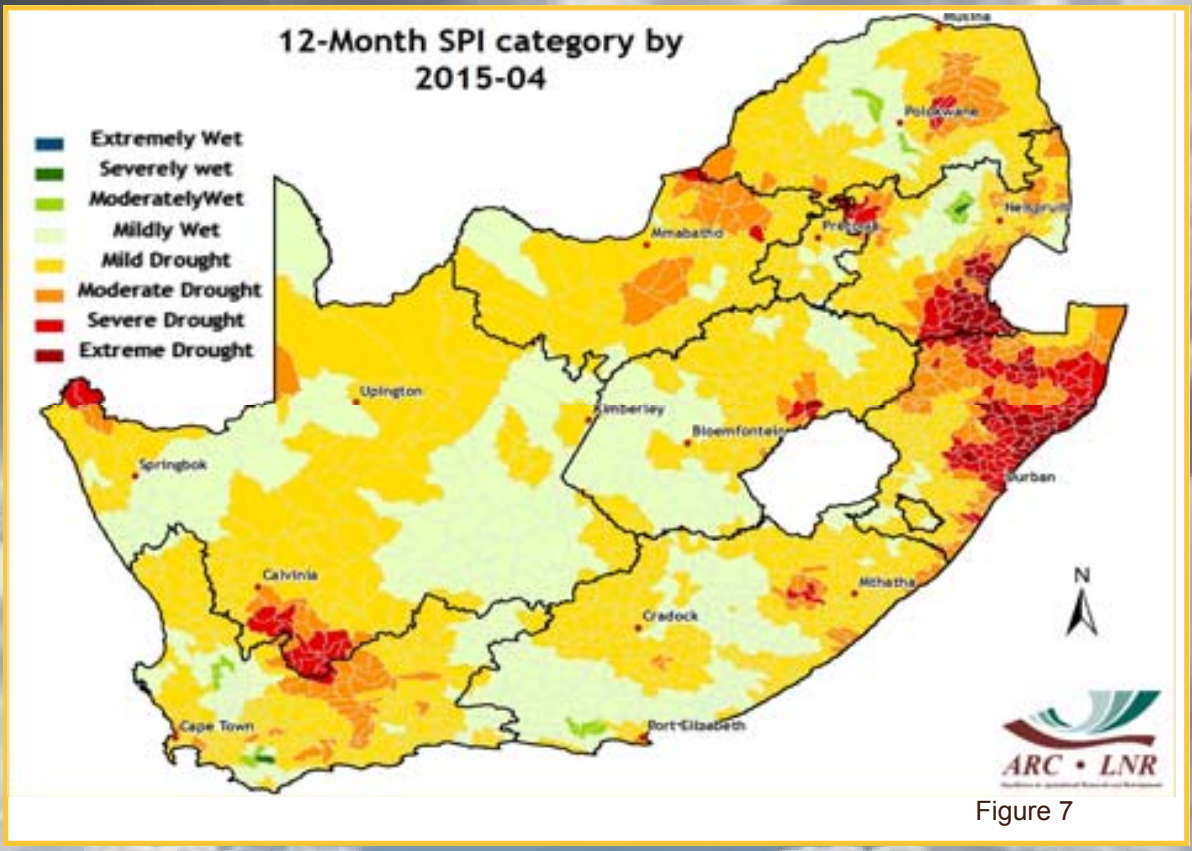

Figure 7

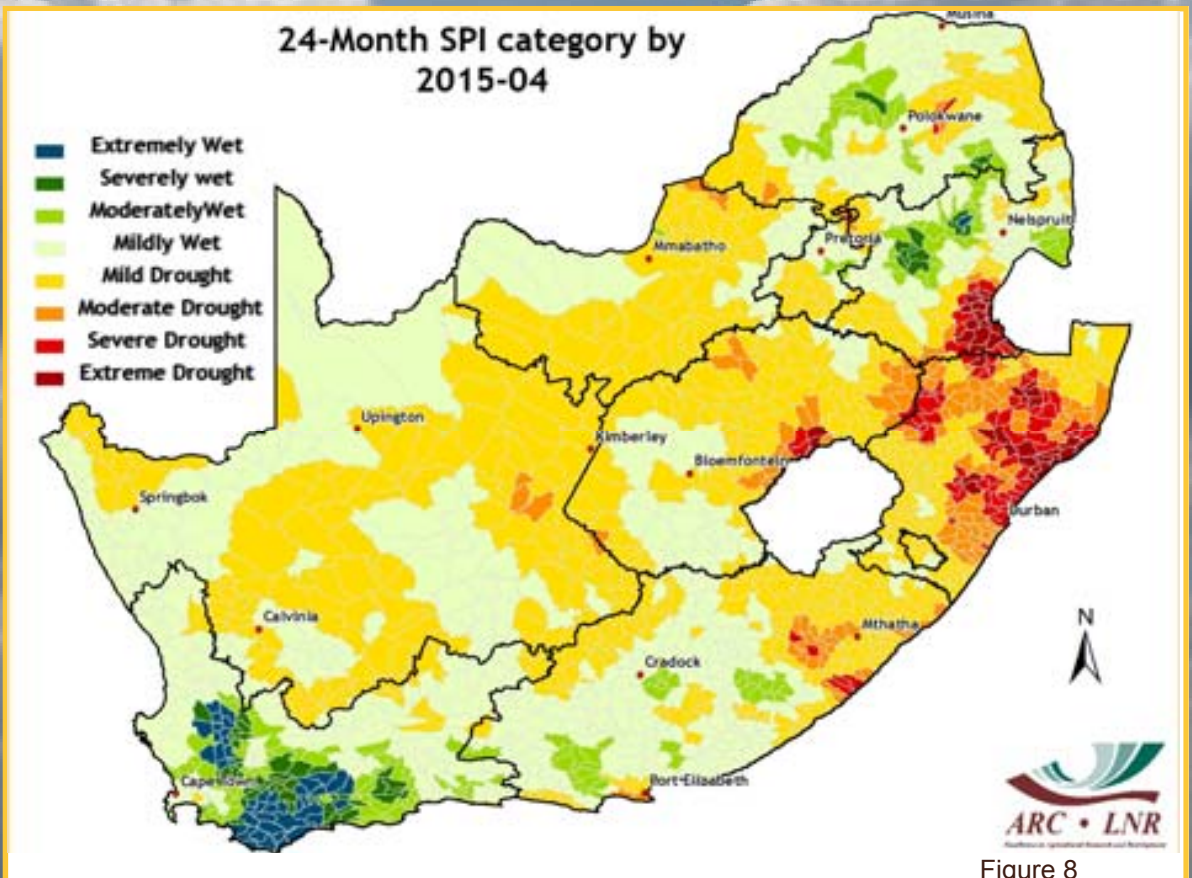

Figure 8

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.

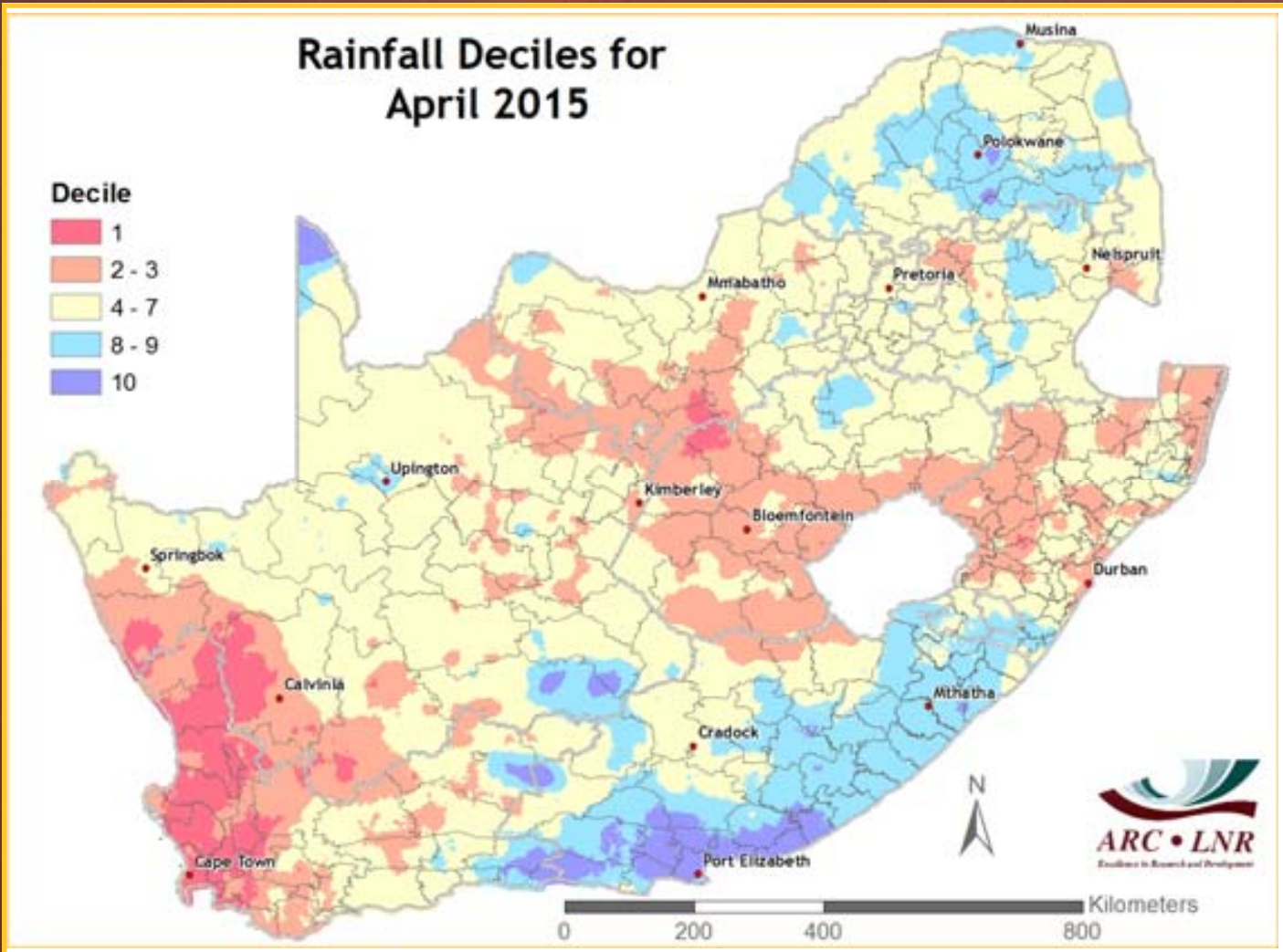

Figure 9

Figure 9:
Rainfall during April was abnormally high over parts of the Eastern Cape and to a lesser extent also the northeastern interior. The winter rainfall region and parts of the central interior were exceptionally dry.

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

4. Water Balance

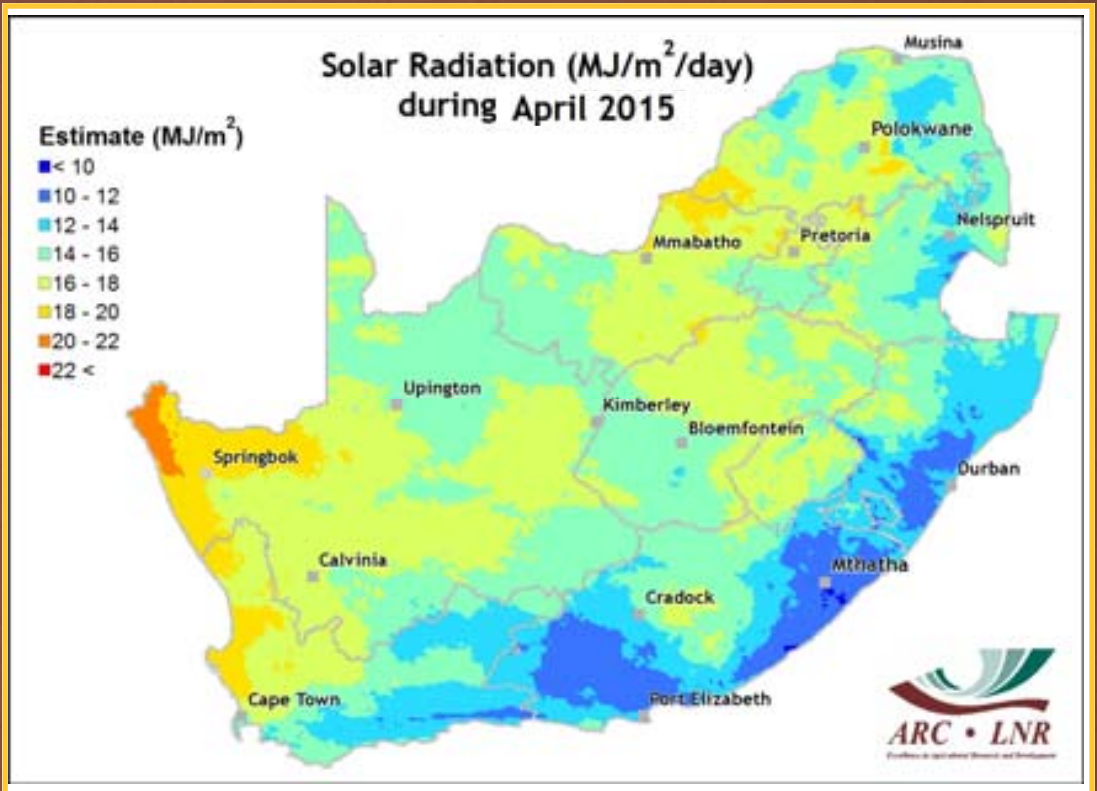

Figure 10

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 values were relatively low from central North West to KwaZulu-Natal, due to extensive cloud cover especially during the second half of the month. Solar radiation values remained low to the south and east of the Escarpment.

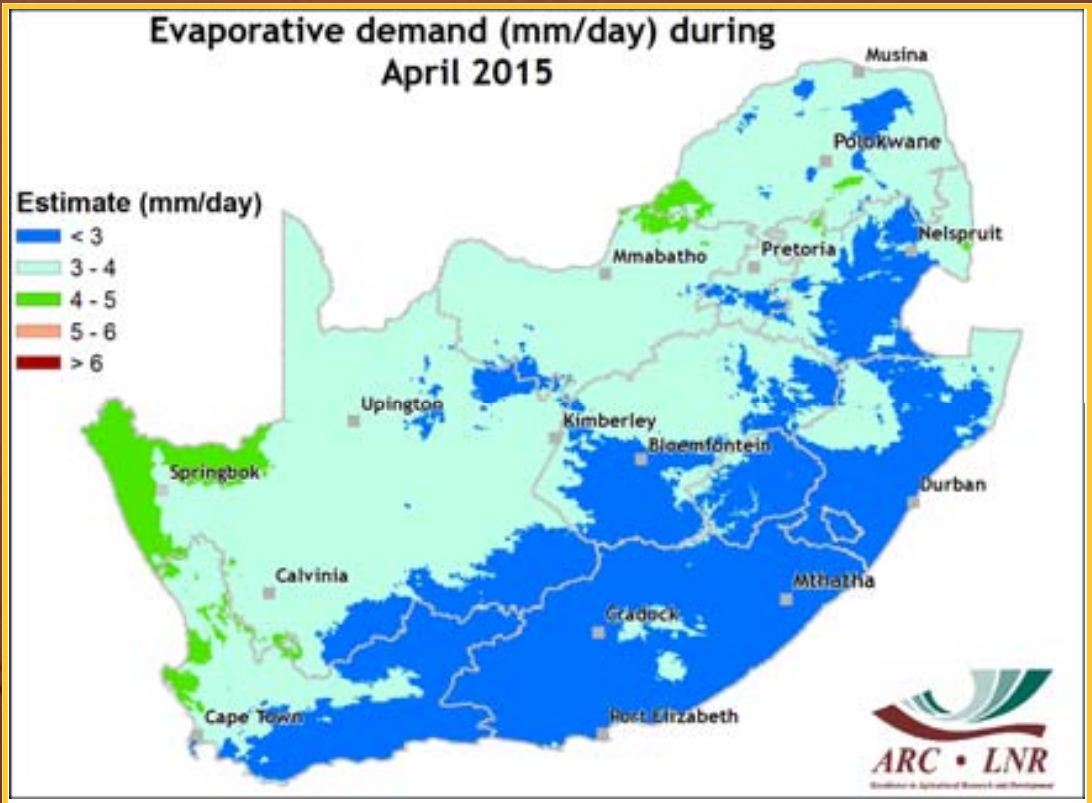

Figure 11

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:
Average daily evapotranspiration ranged from less than 3 mm/day over the southern and eastern areas to 4-5 mm/day in the extreme west .

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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.

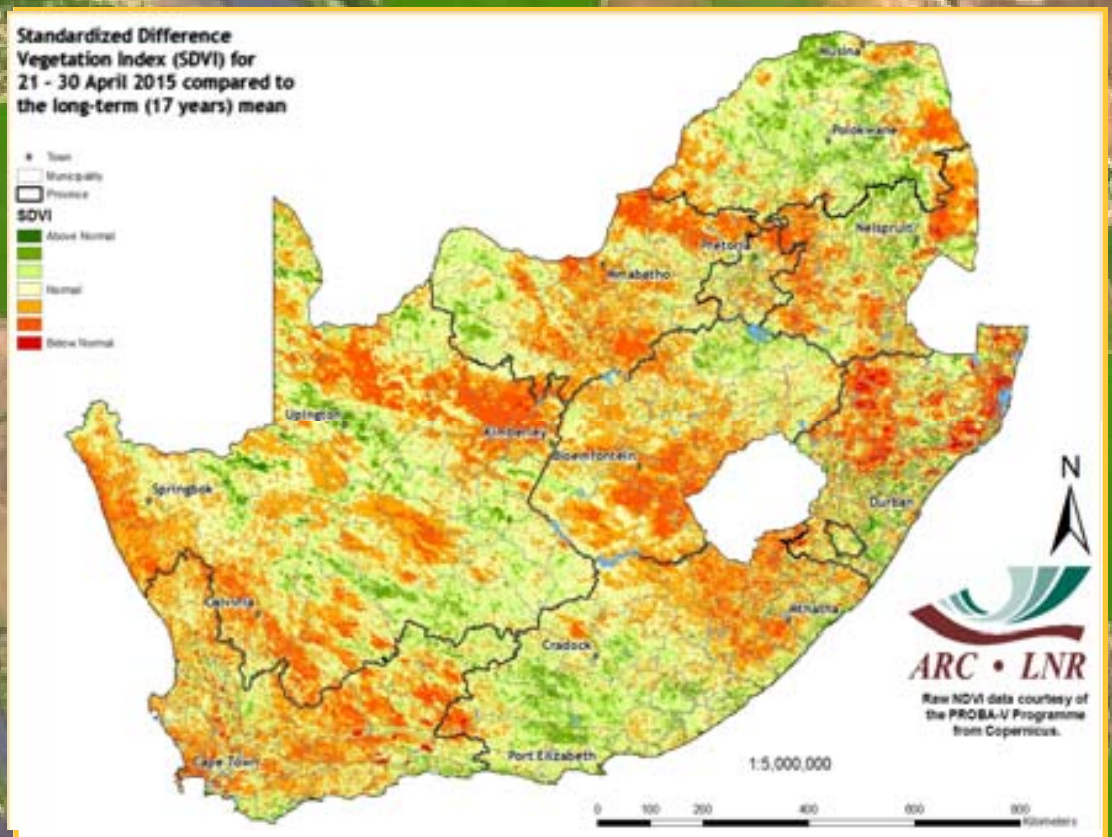

Figure 12

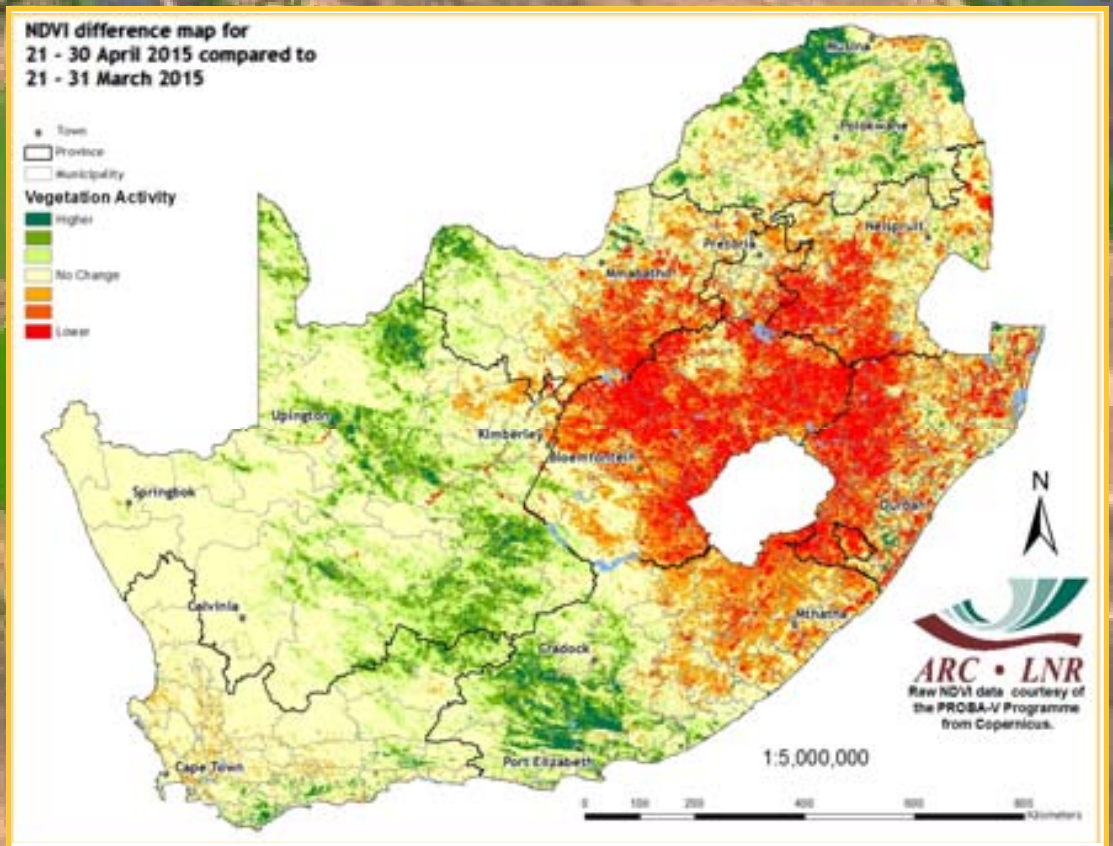

Figure 13

Figure 12:
The SDVI map shows drought stress over the winter rainfall region, western to central parts of the summer rainfall region, as well as the northwest-southeast stretching band from south-western Limpopo to northern KwaZulu-Natal. Above-normal vegetation activity is indicated over much of the southeastern and northeastern parts.

Figure 13:
The northern, northeastern and central interior experienced increased vegetation activity relative to March while activity decreased over most of the Highveld and towards the southeast. Some of the changes are related to low minimum temperatures experienced by the middle of the month.

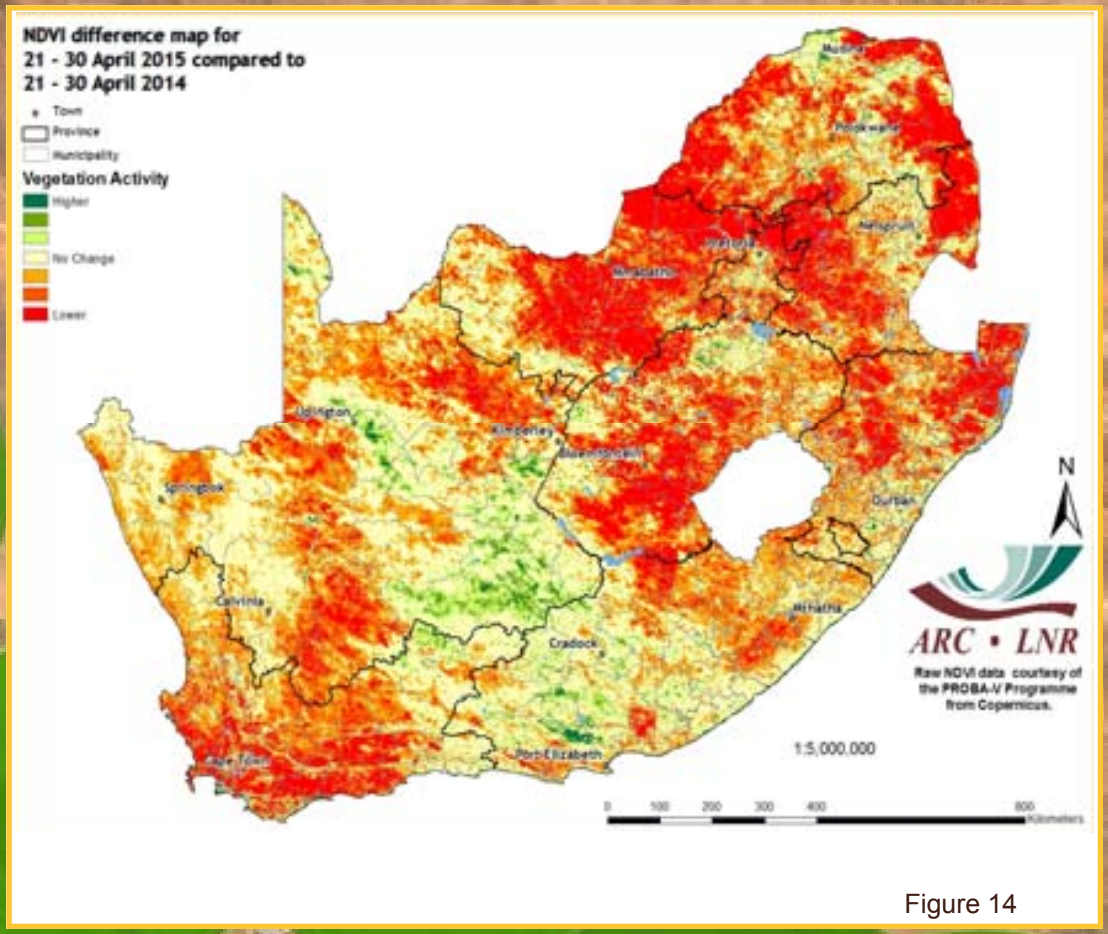

Figure 14

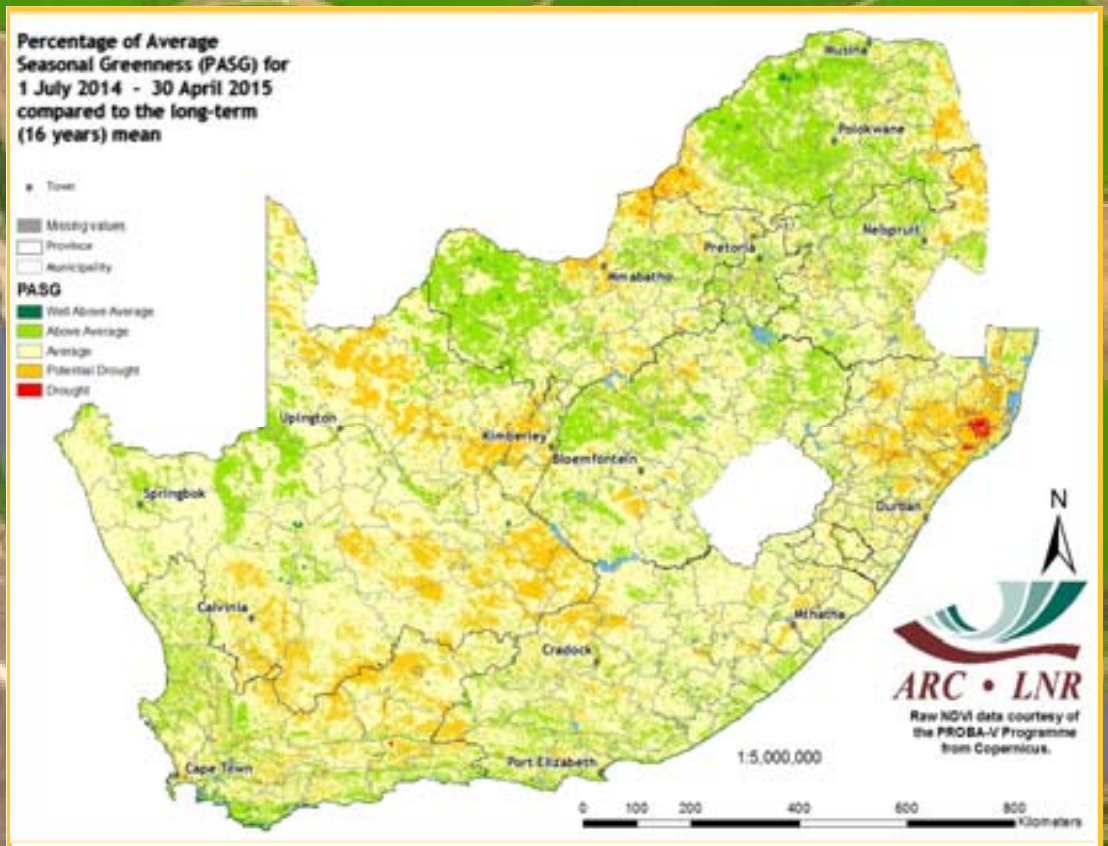

Figure 15

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
Summary: July to June

Figure 14:
Most of the northern and northeastern parts of the country as well as the winter rainfall region experienced less rain this year than in 2014, reflected by lower vegetation activity by the end of April 2015 relative to last year. Vegetation activity over the central to western summer rainfall region towards the southeast is higher this year.

Figure 15:
Cumulative vegetation activity is still above-normal over much of the interior due to wet conditions during November and December and again by late February to April in some places. Notable exceptions are the eastern parts of KwaZulu-Natal, eastern Mpumalanga, extreme southwestern Limpopo and southern parts of the Northern Cape.

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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.

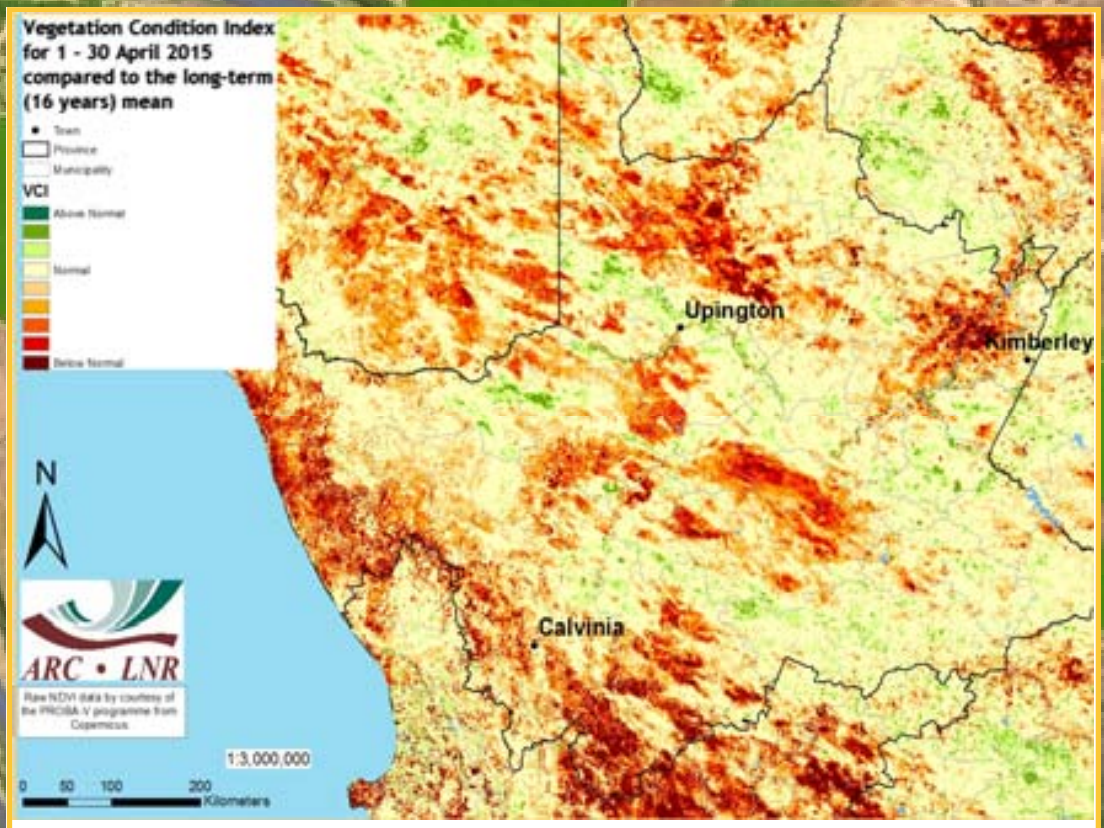


Figure 16

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

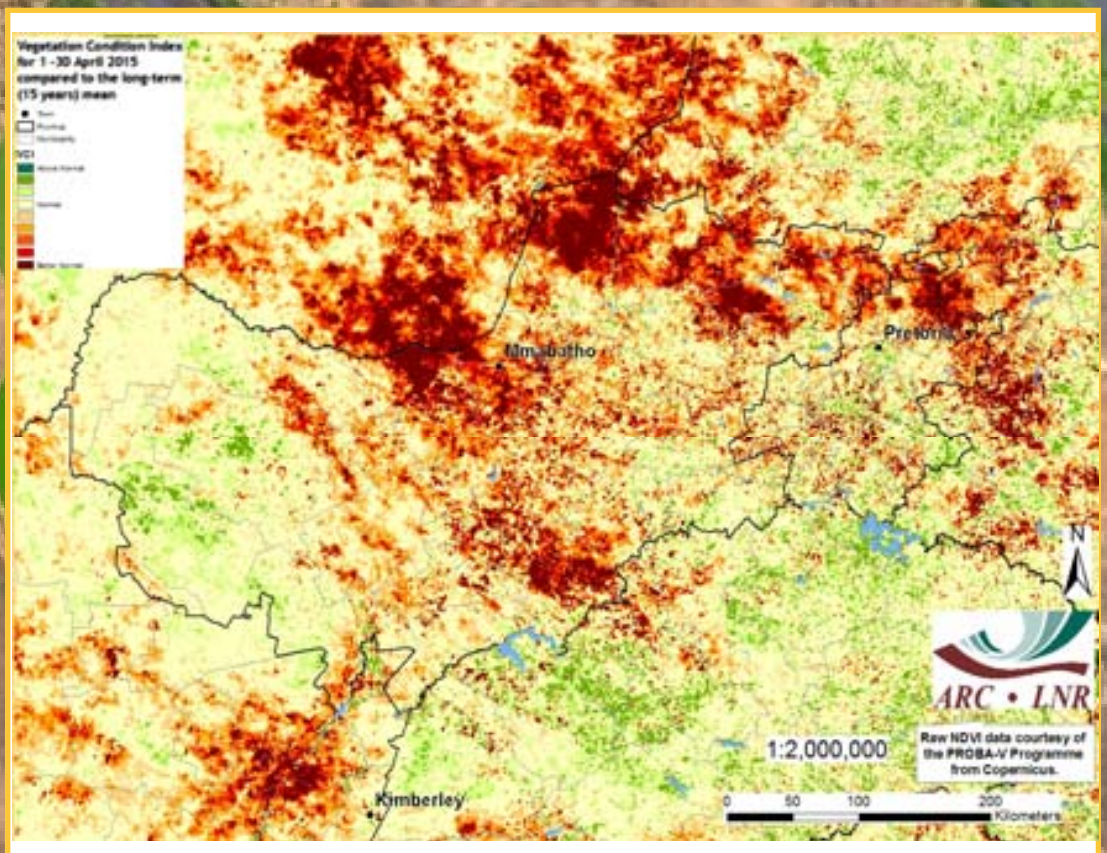
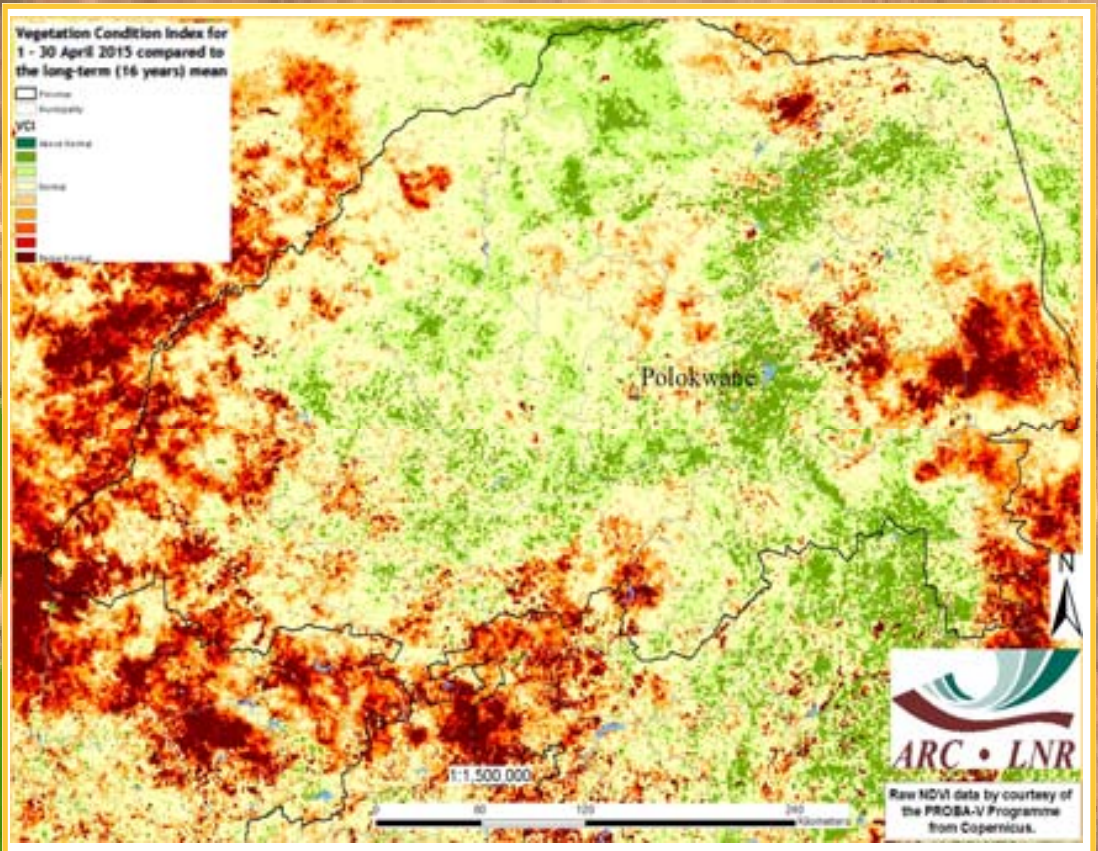


Figure 17

Figure 17:
The VCI map for April indicates below-normal vegetation activity over most parts of North West.



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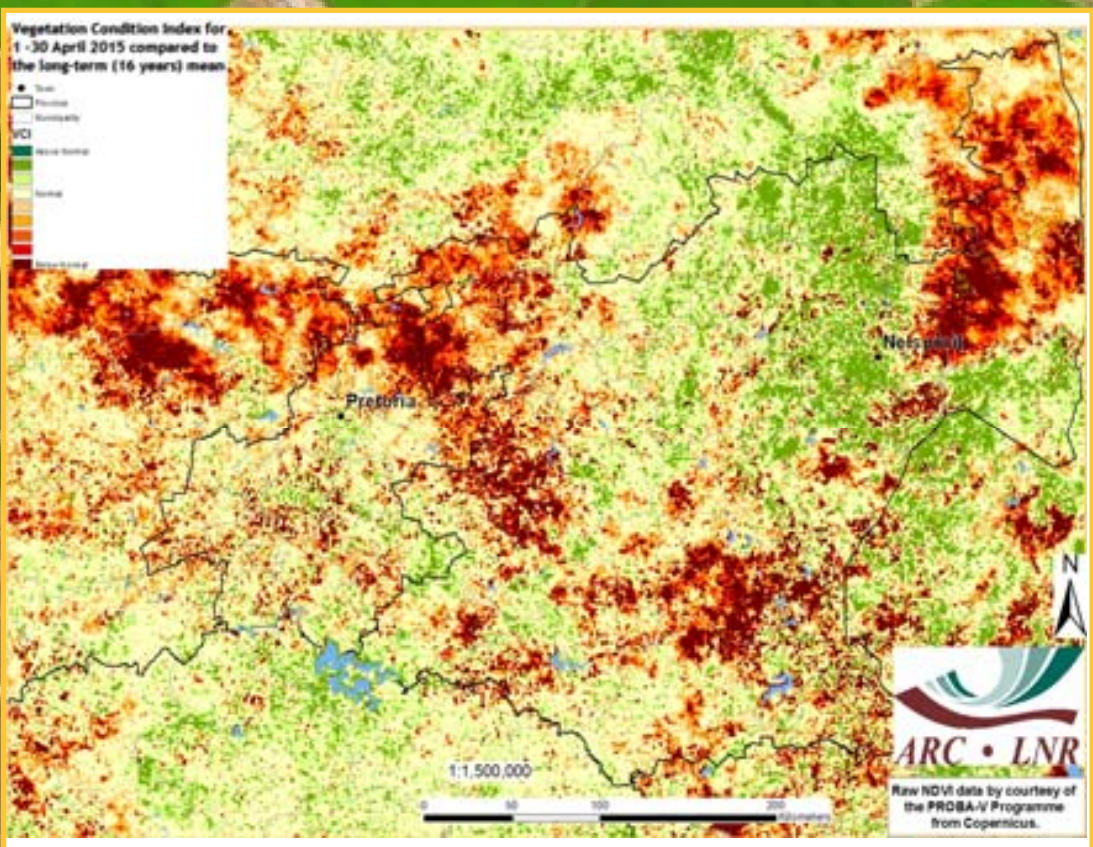

Figure 19

Figure 18:
The VCI map for April indicates below-normal vegetation activity over the western and eastern parts of Limpopo.

Figure 19:
The VCI map for April indicates below-normal vegetation activity over the western and eastern parts of Mpumalanga.

Questions/Comments:
NkambuleV@arc.agric.za

7. Vegetation Conditions & Rainfall

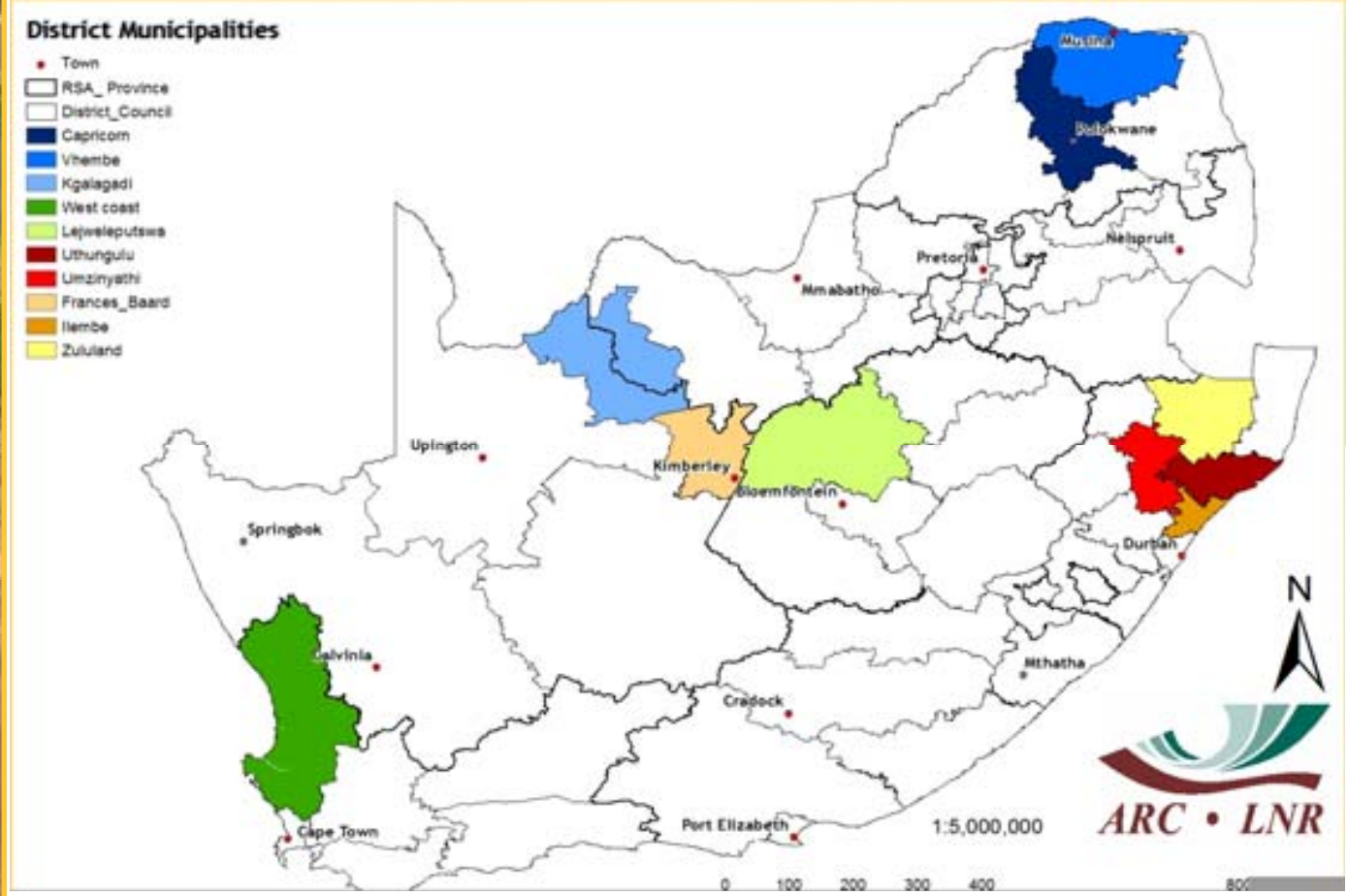

Figure 20

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

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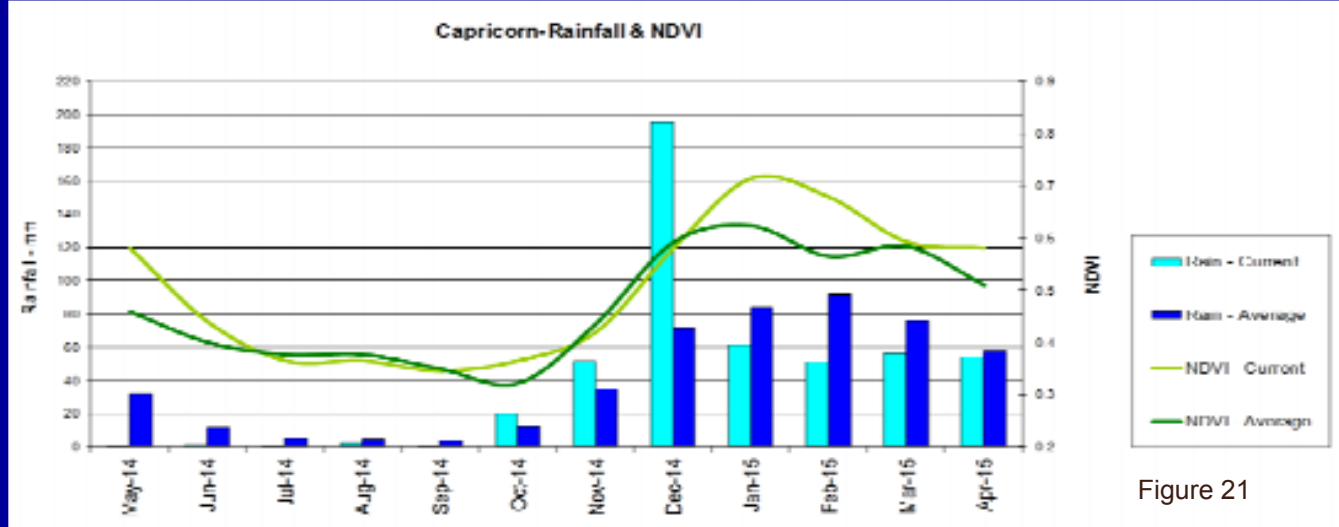
Figures 21-25:
Indicate areas with higher cumulative vegetation activity for the last year.

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



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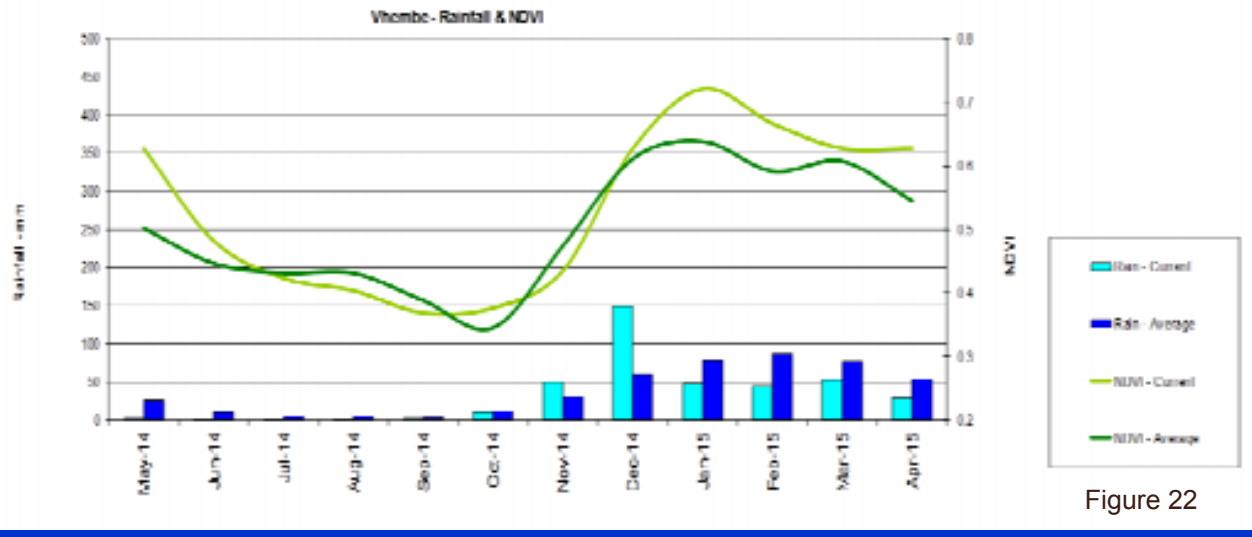

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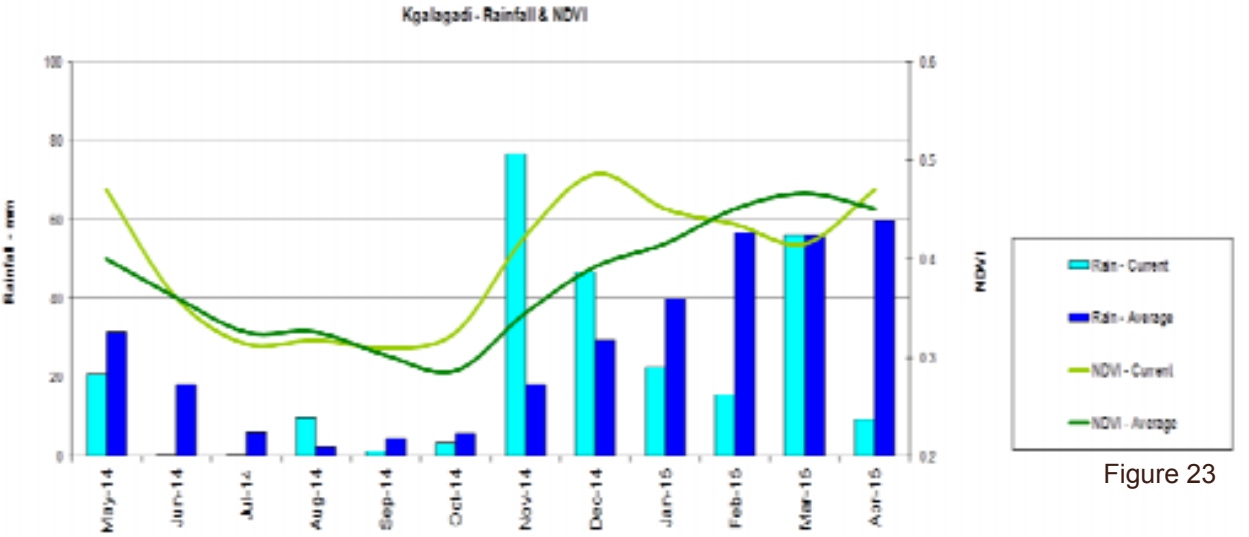

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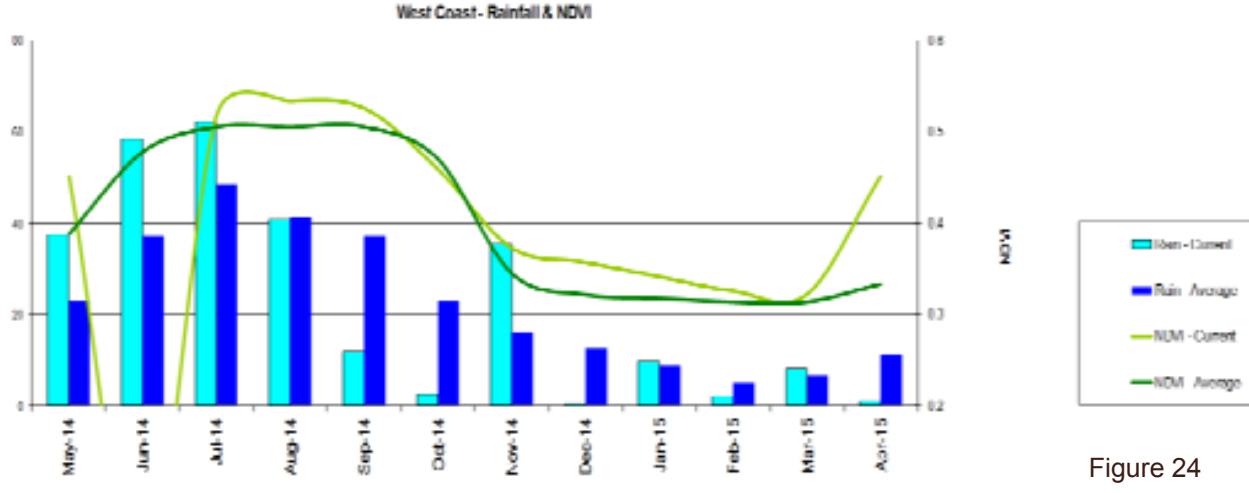


Figure 24

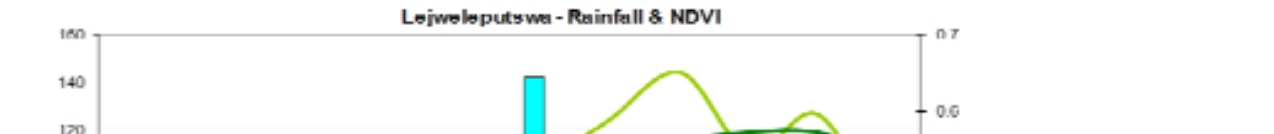


Figure 25

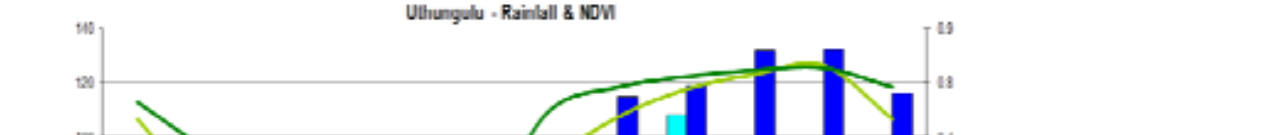
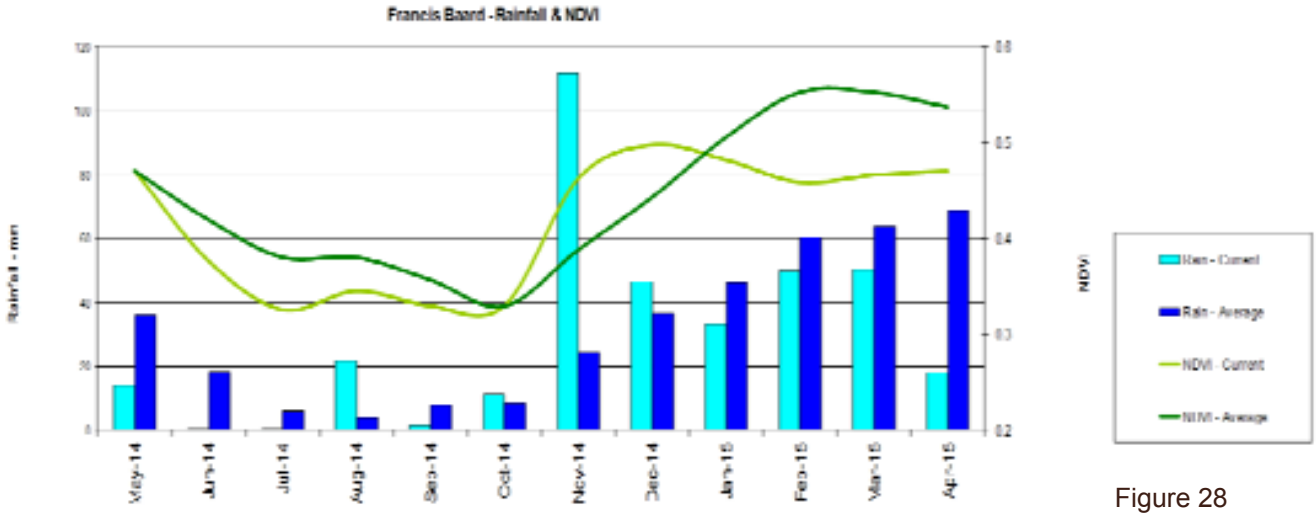


Figure 26

Figure 27



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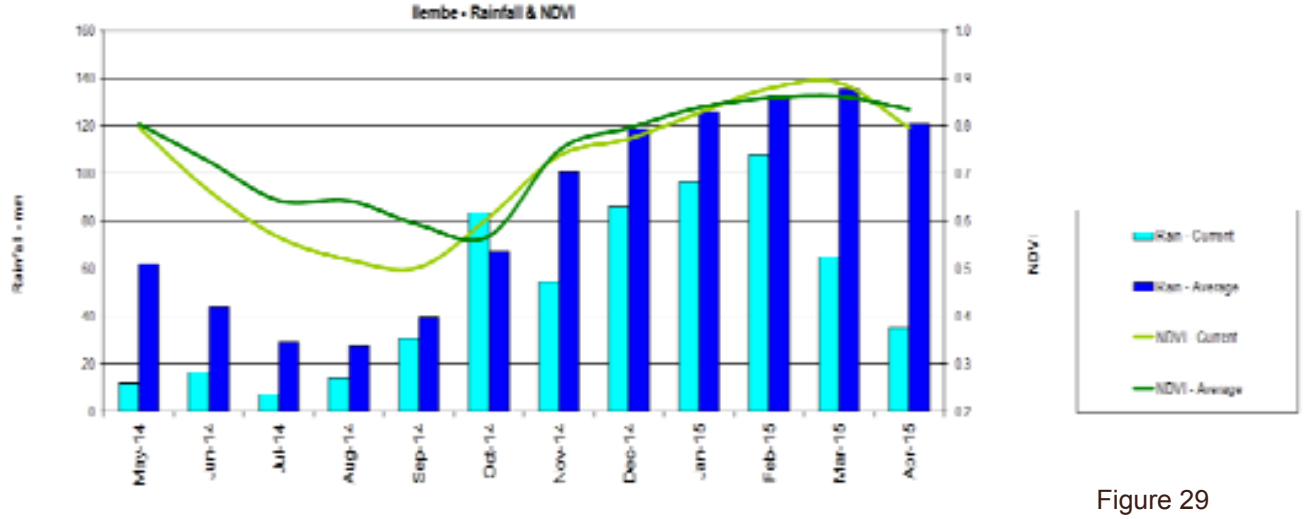


Figure 29

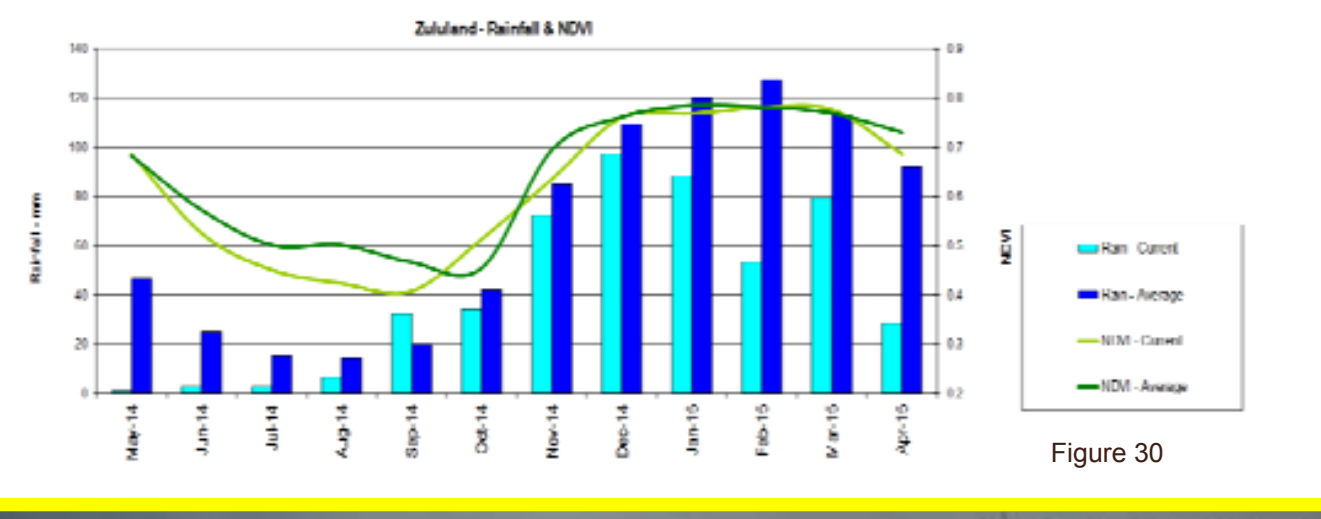


Figure 30

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 per province. Fire activity was higher in Mpumalanga, Northern Cape, Western Cape and KwaZulu-Natal compared to the average during the same period for the last 14 years.

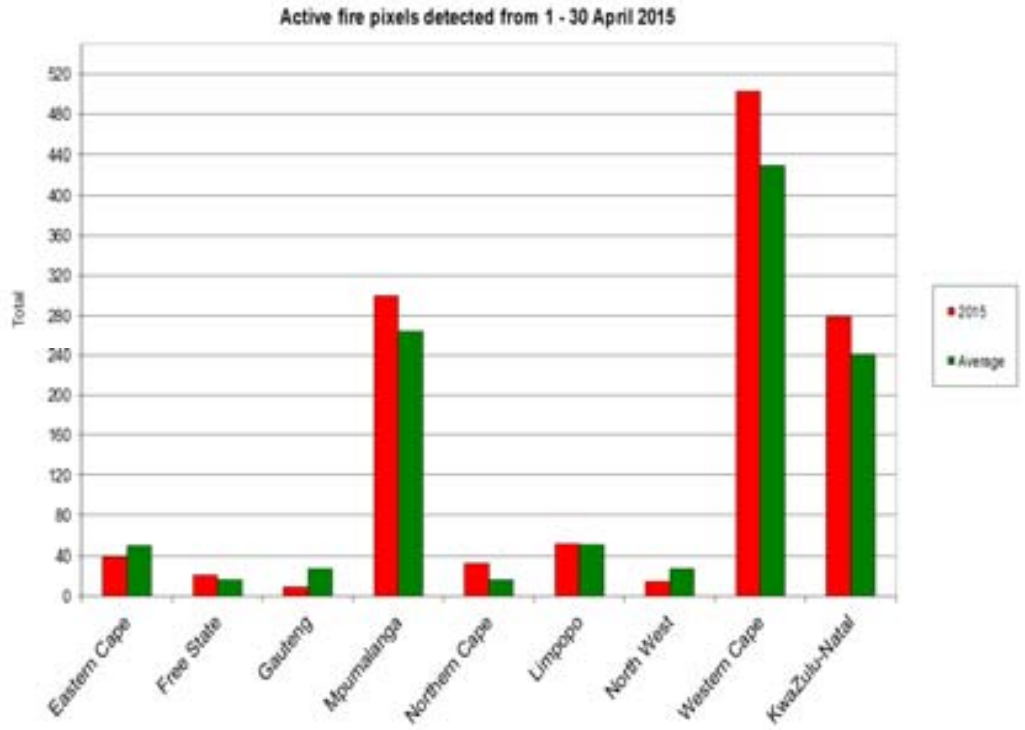


Figure 31

Figure 32:
The map shows the location of active fires detected between 1-30 April 2015.

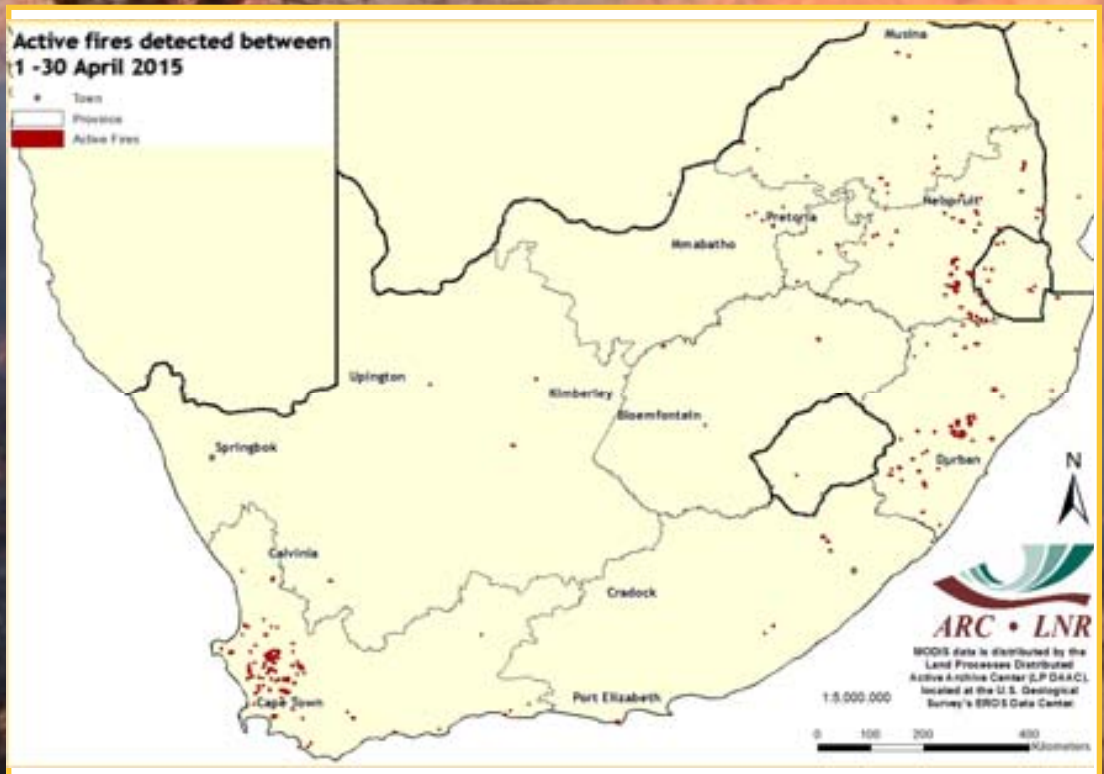


Figure 32

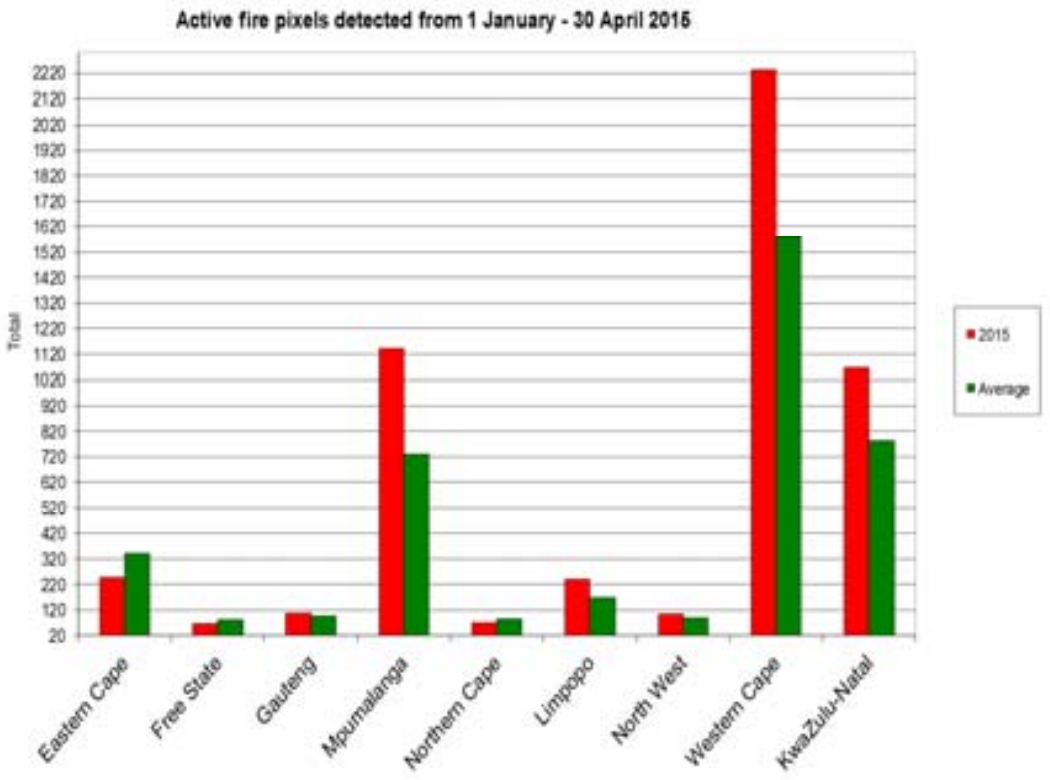


Figure 33

Figure 33:
The graph shows the total number of active fires detected between 1 January to 30 April 2015 per province. Fire activity was higher in Gauteng, Mpumalanga, Limpopo, North West, Western Cape and KwaZulu-Natal compared to the average during the same period for the last 14 years.

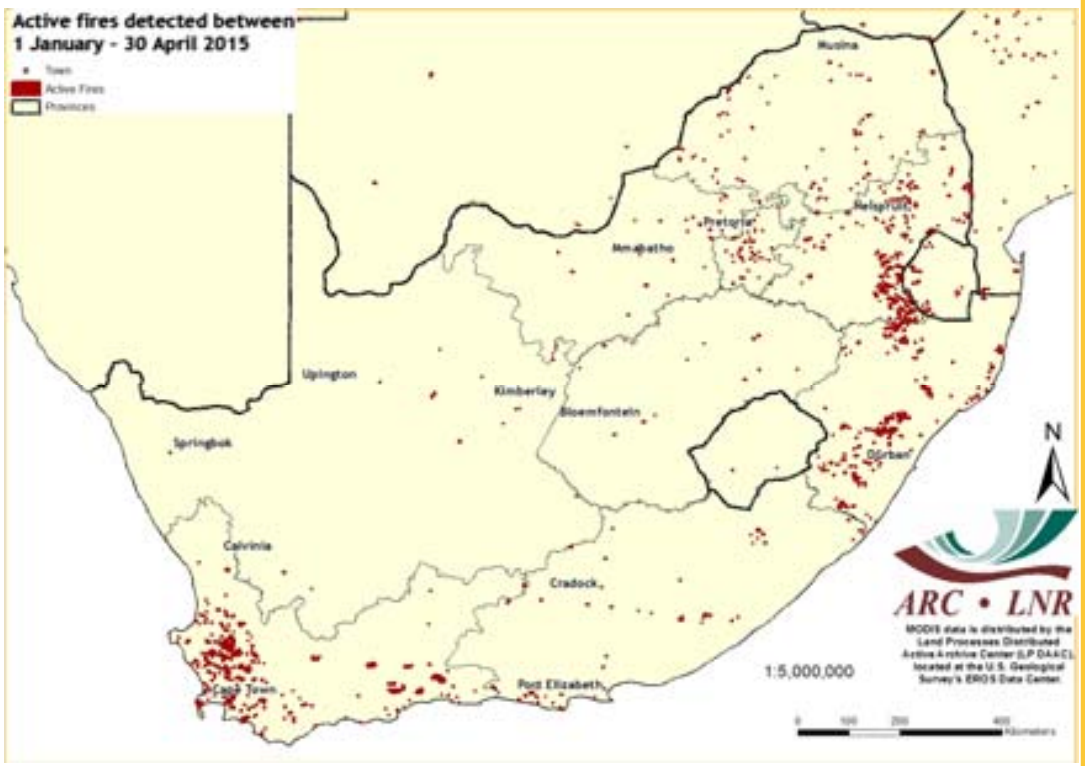
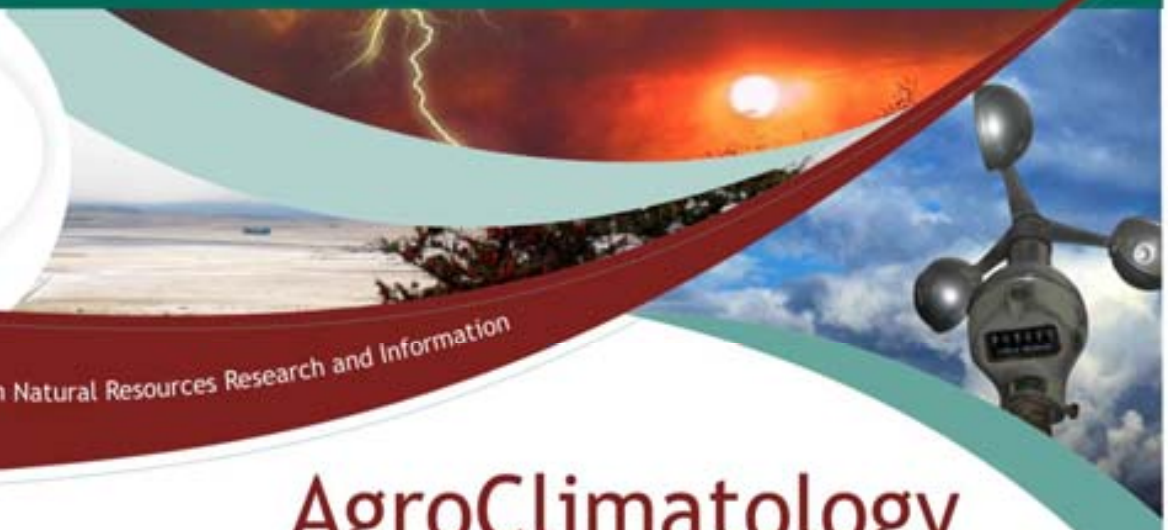


Figure 34

Figure 34:
The map shows the location of active fires detected between 1 January to 30 April 2015.

Questions/Comments:
NkambuleV@arc.agric.za

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.

For more information contact:
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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