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INSTITUTE FOR SOIL, CLIMATE AND WATER

CONTENTS:

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

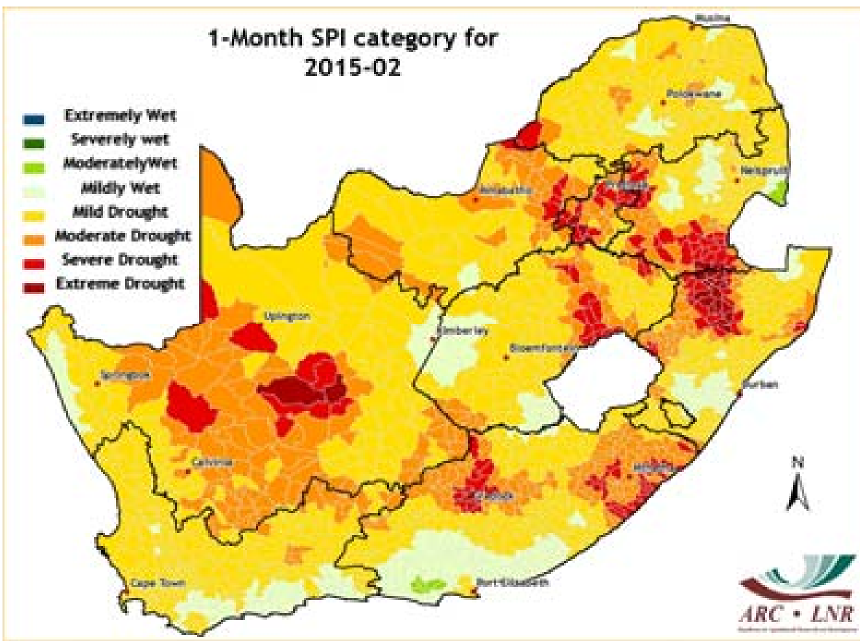
South African Weather Service

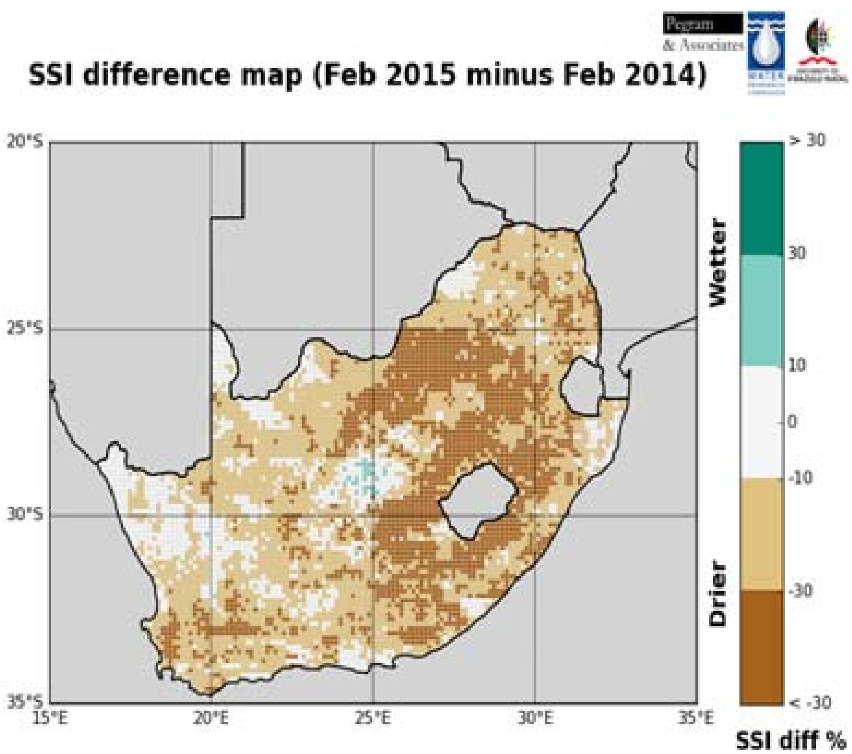
AMESD

129th Edition

Images of the Month

Dry conditions during February





Hot and dry conditions during especially the first half of February had negative impacts on agricultural activities in the summer rainfall area. The western and eastern maize production regions were adversely affected by maximum temperatures soaring into the high 30s and a general lack of precipitation, especially over the central parts of the country. The Standardized Precipitation Index (SPI) for February indicates severe drought conditions especially from eastern North West into southern Mpumalanga, covering important grain producing areas. Rainfall conditions improved towards the middle and end of the month, resulting in total rainfall being near normal over some central parts of South Africa.

The Soil Saturation Index, indicating the relative soil water content, is much lower than in February 2014, reflecting the deficient rainfall and high evaporation especially over some central summer rainfall areas during this season compared to 2013/14 by the month of February. The modelling of soil moisture is performed by the University of KwaZulu-Natal Applications and Hydrology Group. Supported by the WMO, the system and algorithms developed by the UKZN have been replicated at the ARC-ISCW, where the developing archive will be utilized in the expansion of the suite of drought monitoring products provided in near-real time. The SSI maps will be published in the newsletter in future.

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:

February 2015 will be remembered as a very hot and dry month for the most part. Maximum temperatures exceeding 35°C were recorded on several days during the first half of the month over large parts of the interior, including the western maize production region. After the 15th, the hot and dry conditions over especially the central parts gave way to improved conditions with several rainfall-producing weather systems developing towards the end of the month. By the end of February , total rainfall over some of the central areas was near-normal due to these rainfall events, but that does not reflect the extreme dry conditions that dominated the central parts during the first half of the month. Conditions over the northeastern parts were slightly more favourable, with rainfall events distributed more evenly through the month and some areas also receiving near-normal rainfall in total.

Since the beginning of February, several upper-air and surface lows developed directly to the south and southeast of the country, resulting in recurrent advection of dry air from the west over the interior, with anticyclonic conditions aloft, leading to dry and hot weather over most parts, especially the central interior. Tropical depressions active during the month in the Mozambique Channel and parts of Mozambique confined much of the regional activity to areas northeast of South Africa.

During the first few days of the month, while anticyclonic circulation patterns dominated the central parts, isolated to scattered thundershowers occurred over the northeastern parts, especially around the 7th, due to upper air perturbations and surface moisture over the northeast. The favoured area for precipitation slowly progressed westwards over the northern parts. Showers also occurred over the southern areas due to the presence of an upper air low over those areas and towards the south. During this period a tropical depression developed over the Mozambique Channel, slowly moving southwards, enhancing the dry conditions over the interior.

The development of an upper air low to the south facilitated some thundershower development over the central parts by the 12th and 13th, moving eastwards with heavy falls over southeastern Mpumalanga by the 14th.

From the 16th, the development of a weak upper air cut-off low over the interior resulted in scattered thundershowers over the central and eastern parts. Another upper air trough resulted in further showers, mainly over the southern interior and KwaZulu-Natal by the 21st.

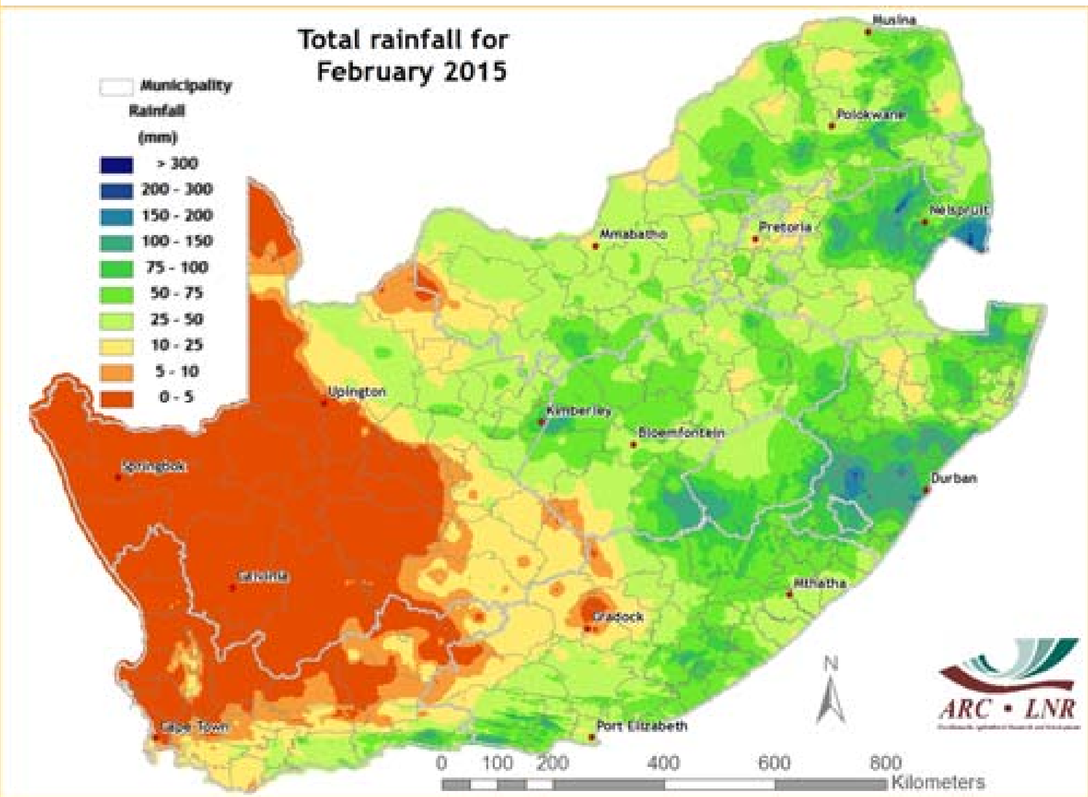


Figure 1

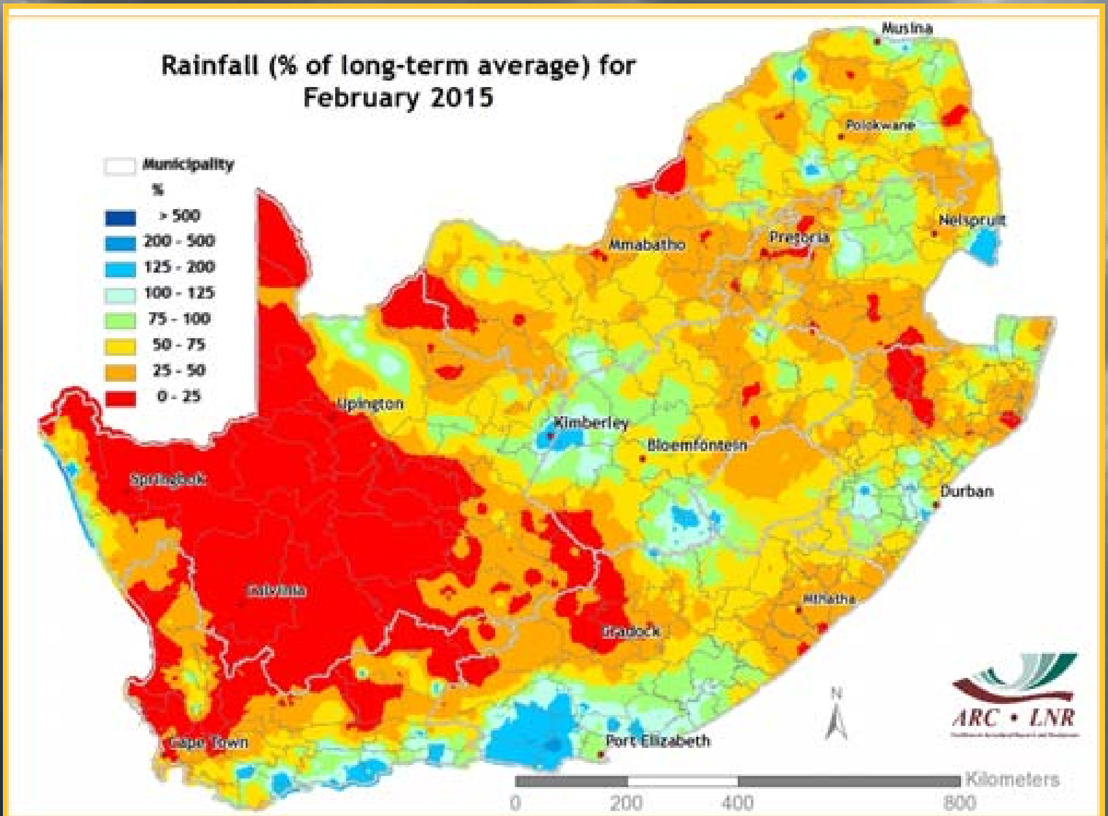


Figure 2

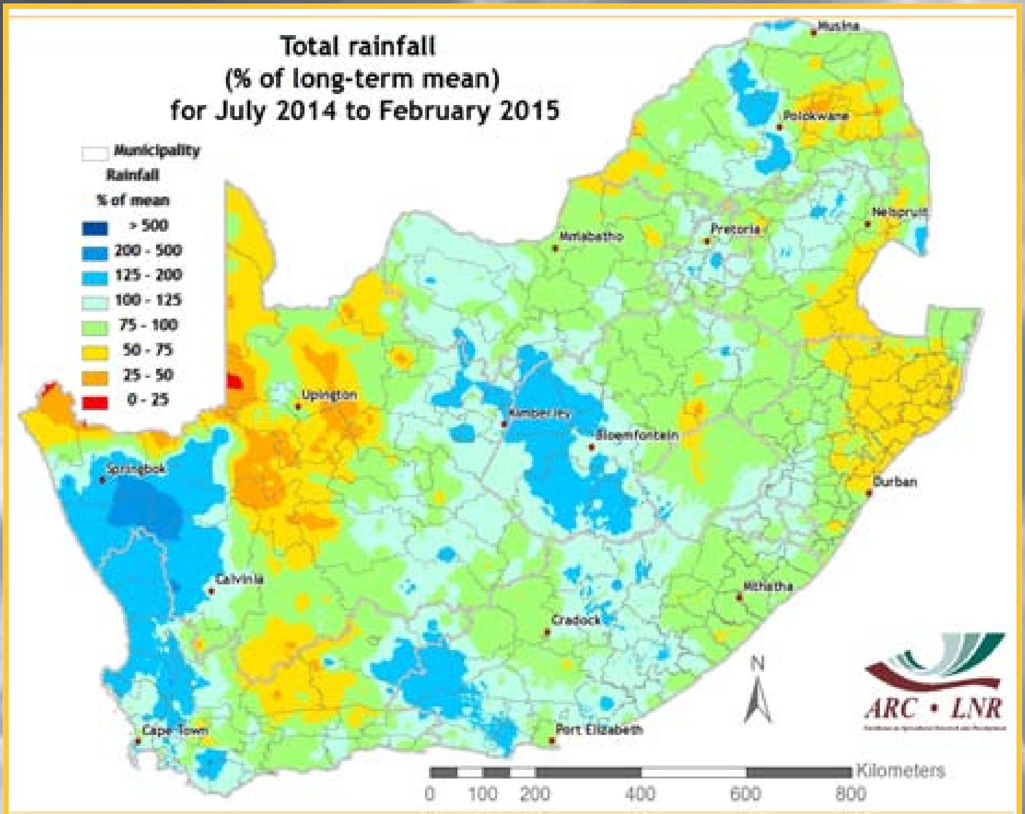


Figure 3

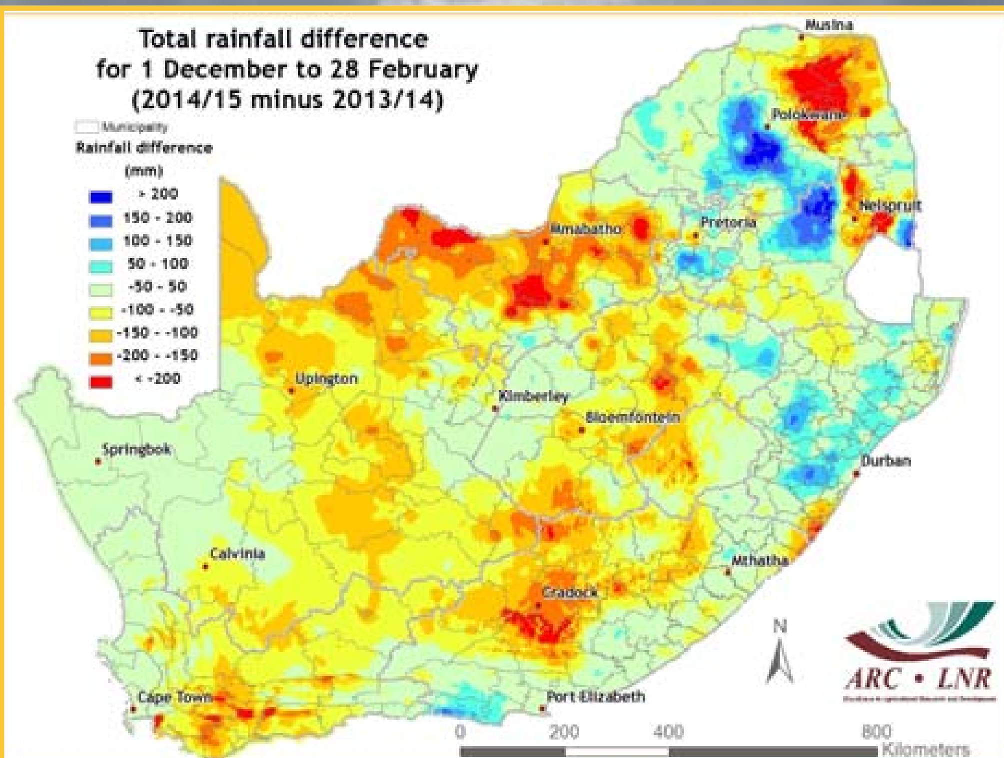


Figure 4

From the 23rd, conditions became more favourable for scattered thundershowers, with upper air perturbations moving across the interior and moisture from the Indian Ocean. Some storms became severe, and there were isolated reports of heavy falls over the central parts by the 24th. By the end of the month, the area of precipitation relocated to the eastern and northeastern areas with cloudy and cool conditions accompanied by thundershowers over parts of KwaZulu-Natal, Mpumalanga and Limpopo. Conditions cleared by early March.

Figure 1:
The western parts of the country were mostly dry during February. Rain was recorded from the central interior northward and eastwards as well as along the Garden Route. Most of the interior received less than 50 mm in total. However, isolated areas that received in excess of 100 mm were the Kimberley area, extreme southeastern Free State, southern parts of KwaZulu-Natal, northern to southeastern Mpumalanga and the Escarpment of Limpopo.

Figure 2:
While most of the country received below-normal rain during February, isolated areas received above-normal rainfall. Most noteworthy of these were the southern extremes (including the Garden Route) and a belt from Kimberley in the Northern Cape though the southern Free State and into southern KwaZulu-Natal, as well as small areas of Mpumalanga and Limpopo.

Figure 3:
Since July 2014, cumulative precipitation has been above normal over the central interior, isolated areas in the northeast and the northern parts of the winter rainfall area. 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:
Most of the central parts and the extreme northeast received less rain in the 3-month period ending February 2015 than in 2013/14. From central Limpopo to southern KwaZulu-Natal some areas received more rain this summer.

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.

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 drought conditions dominate parts of the Northern Cape and to a greater degree the northern parts of KwaZulu-Natal and southern Mpumalanga at all time scales, with wet conditions indicated over the northeastern and southwestern parts at the 12-24-month time scales

Questions/Comments:
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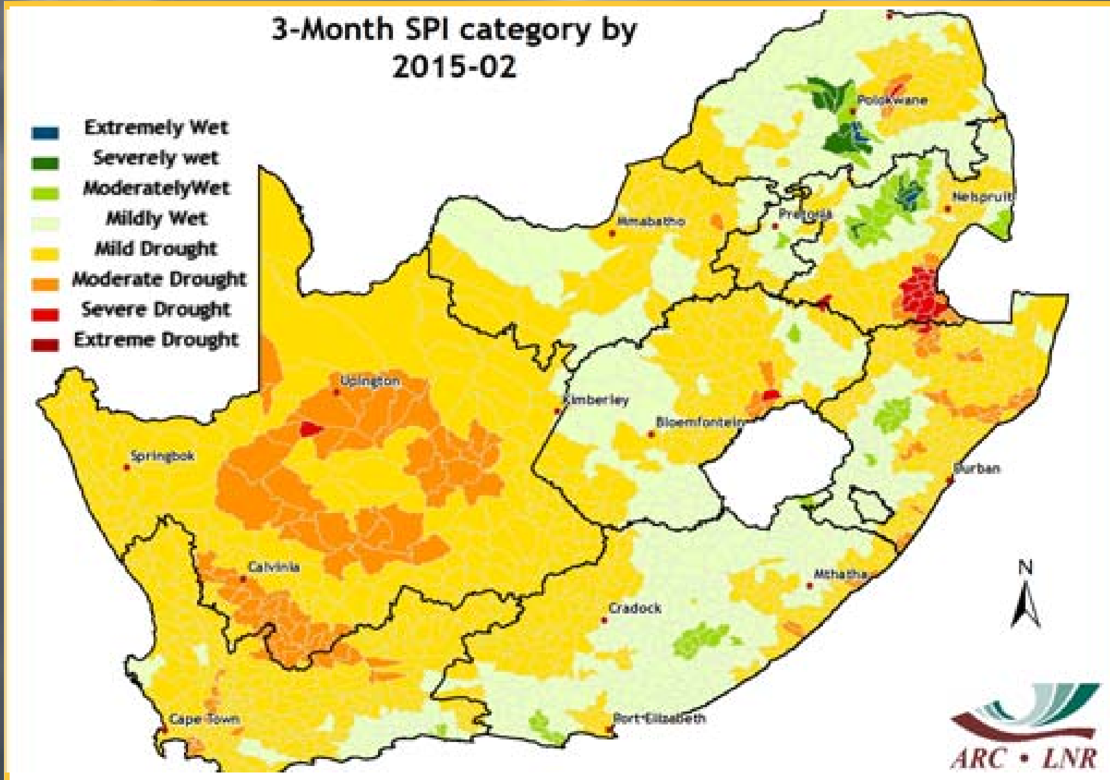
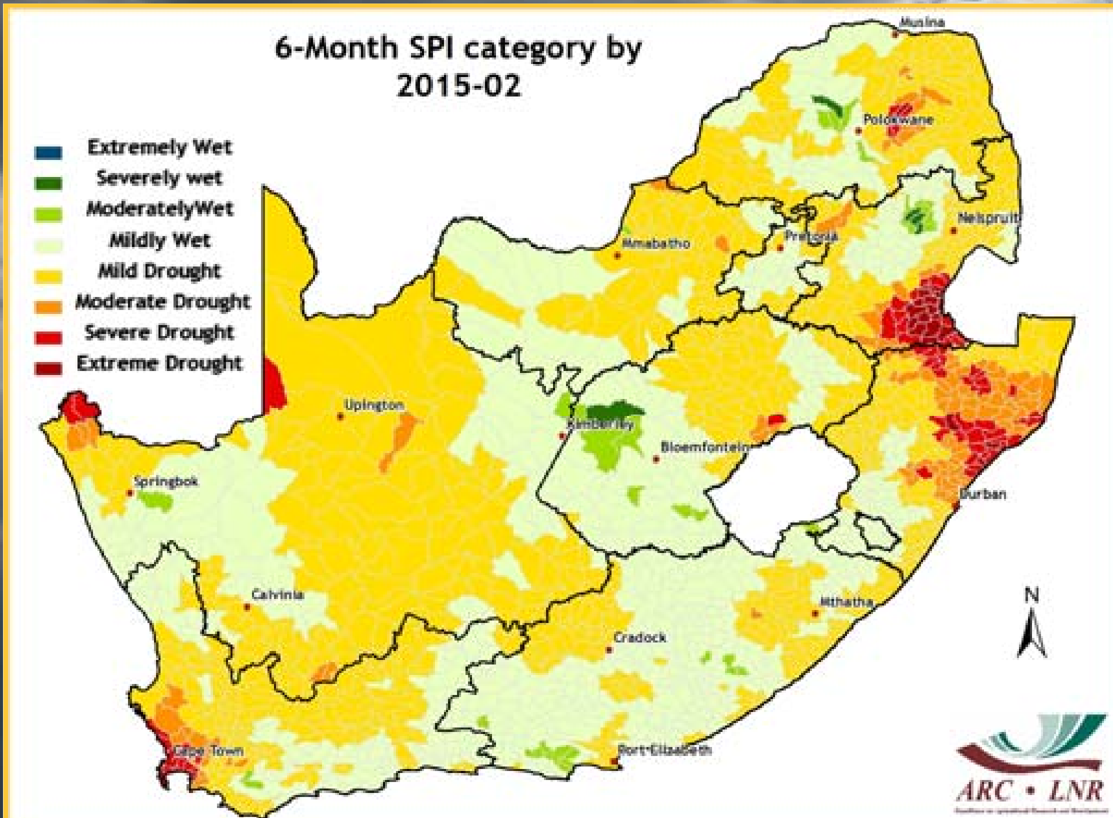


Figure 5



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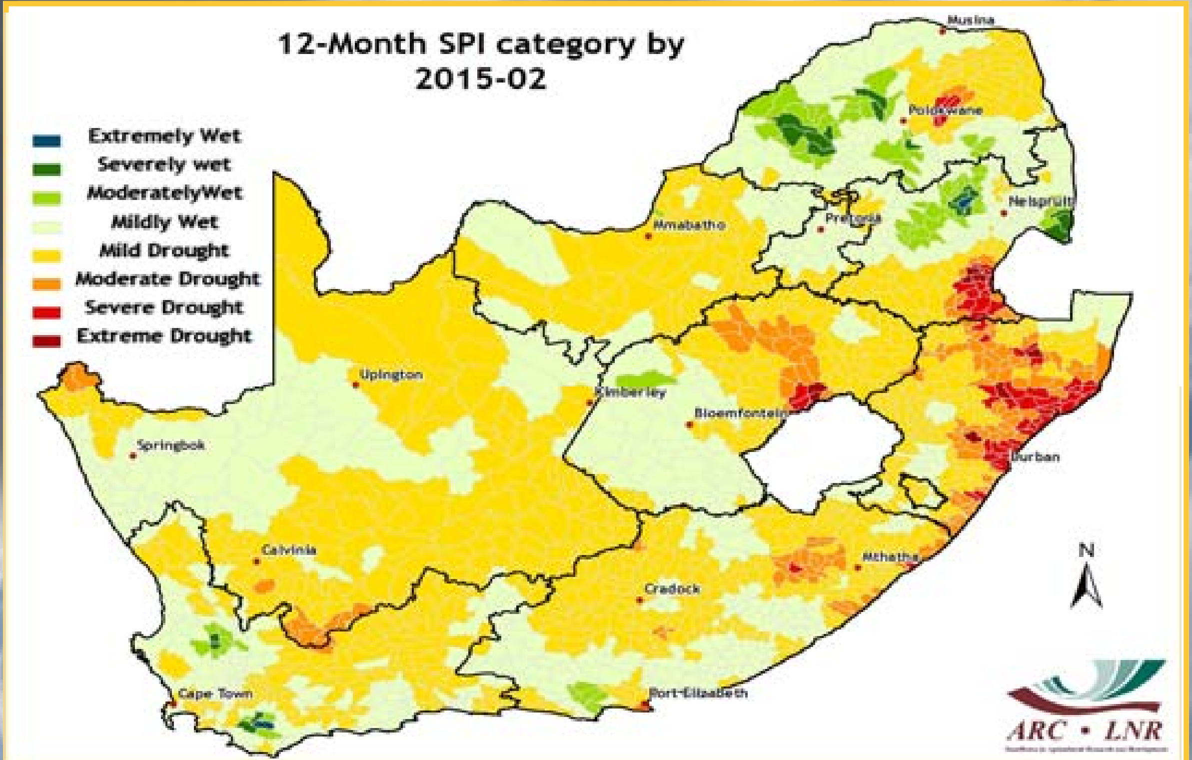

Figure 7

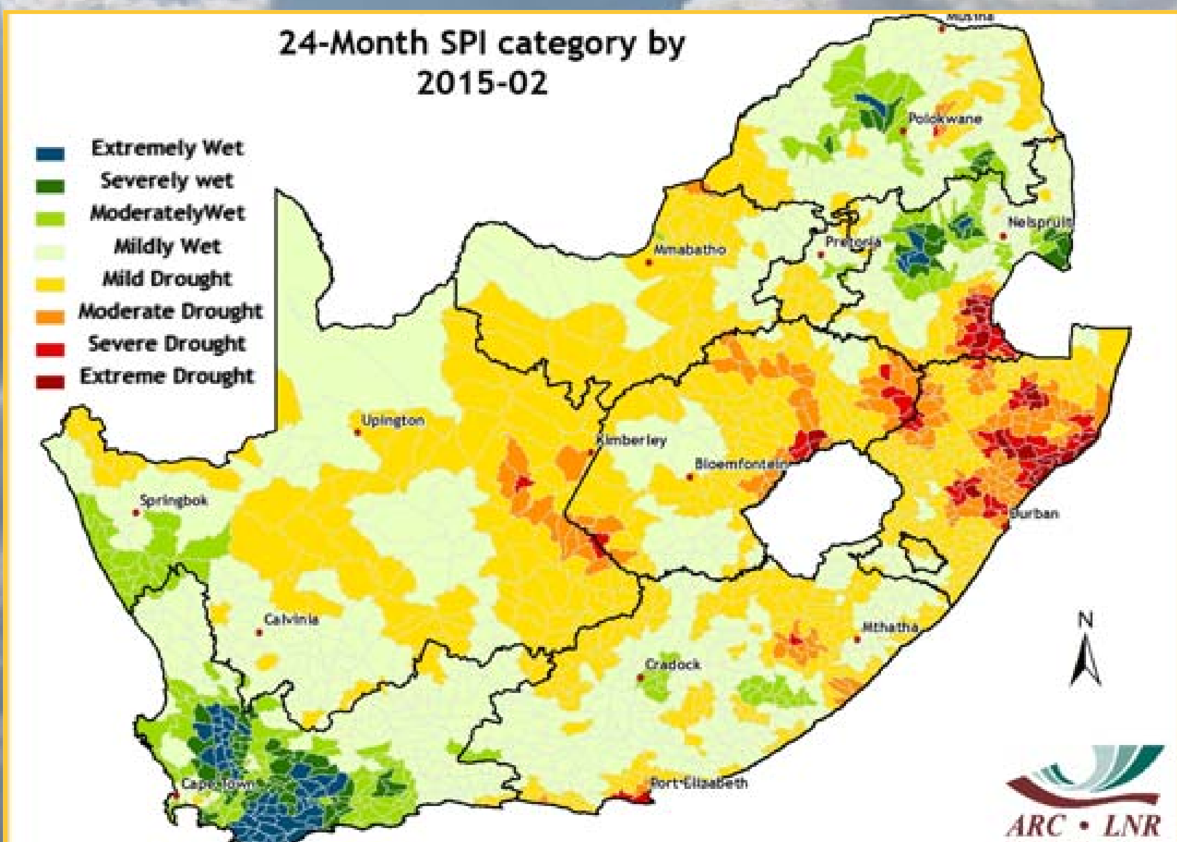

Figure 8

3. Rainfall Deciles

Deciles are used to express the ranking of rainfall for a specific period in terms of the historical time series. In the map, a value of 5 represents the median value for the time series. A value of 1 refers to the rainfall being as low or lower than experienced in the driest 10% of a particular month historically (even possibly the lowest on record for some areas), while a value of 10 represents rainfall as high as the value recorded only in the wettest 10% of the same period in the past (or even the highest on record). It therefore adds a measure of significance to the rainfall deviation.

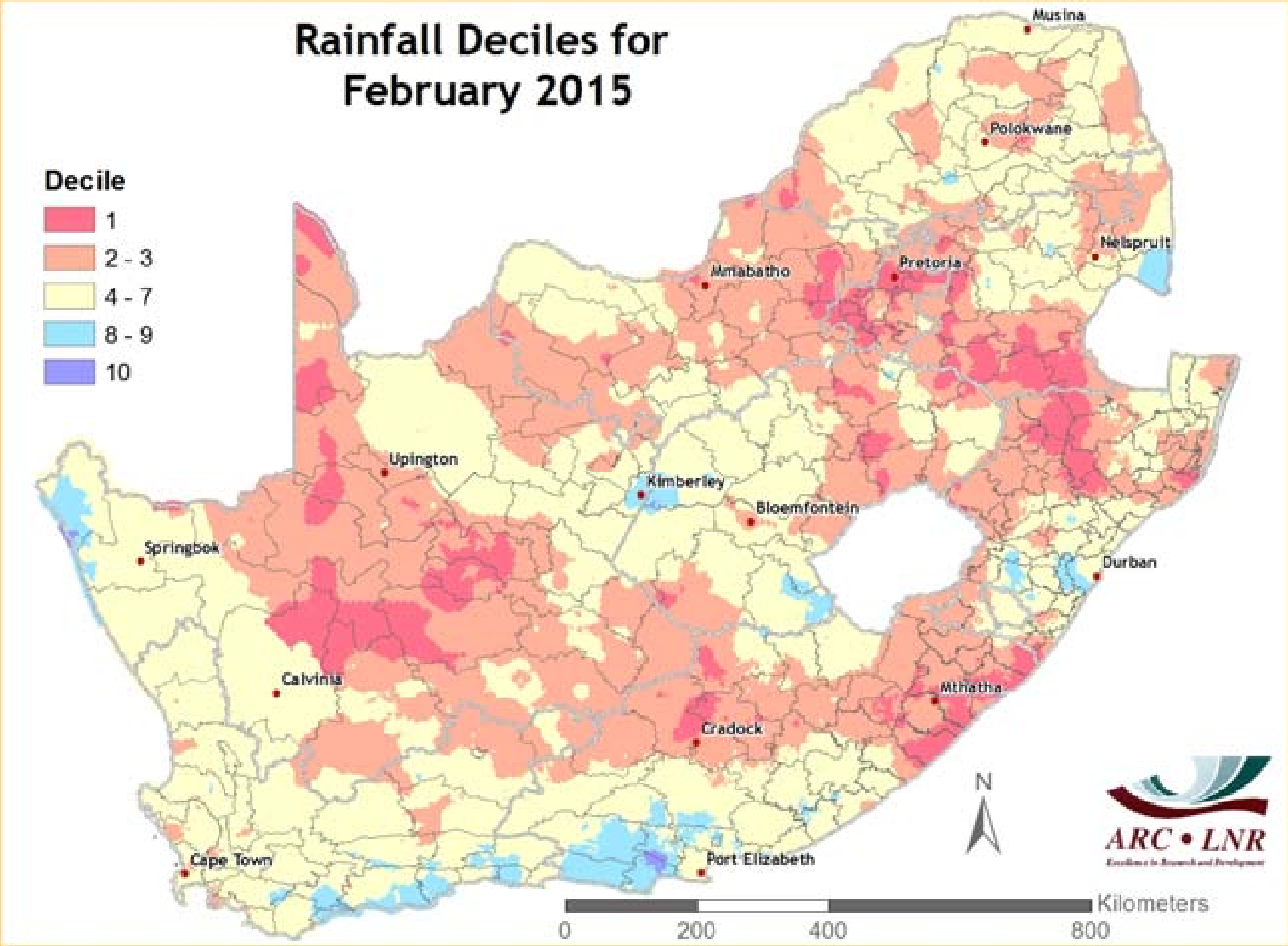

Figure 9

Figure 9:
Rainfall during February was abnormally low in a belt from southwestern Limpopo through northern Gauteng and southern Mpumalanga into northwestern KwaZulu-Natal as well as over parts of the central Northern Cape towards the northern coastal region of the Eastern Cape.

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

4. Water Balance

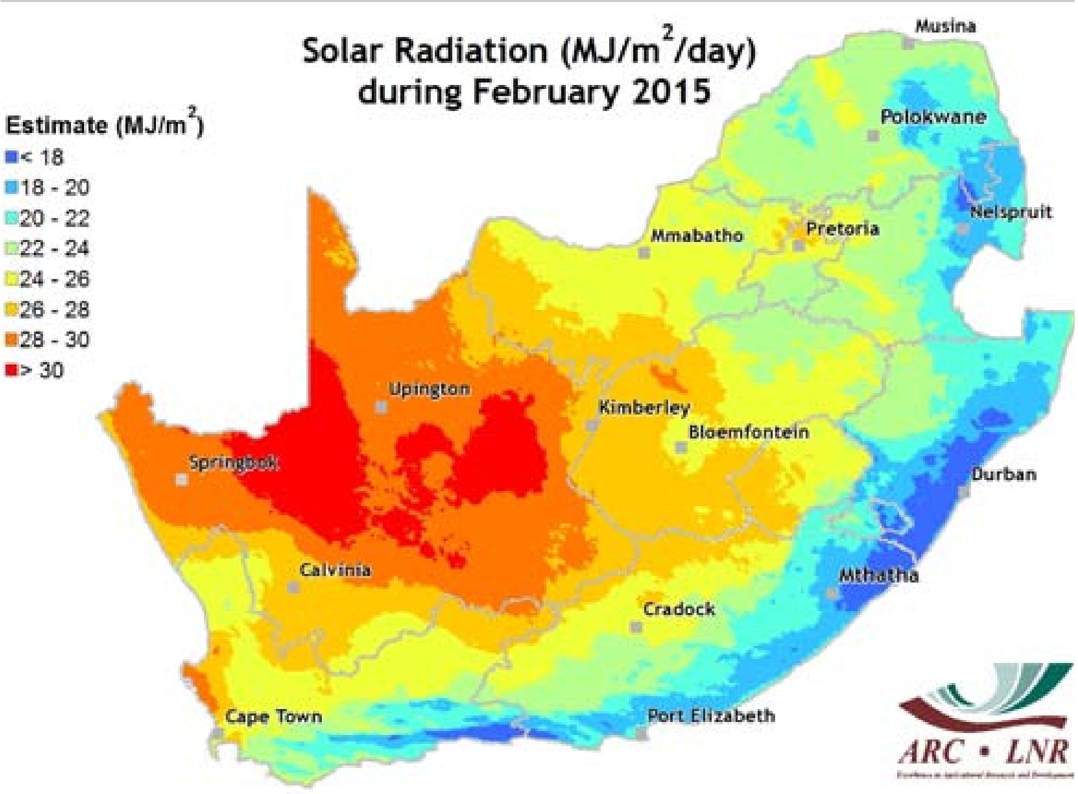

Figure 10

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 high over especially the northwestern parts of the country. Cloud cover resulted in low values along the southern and eastern coastal belts.

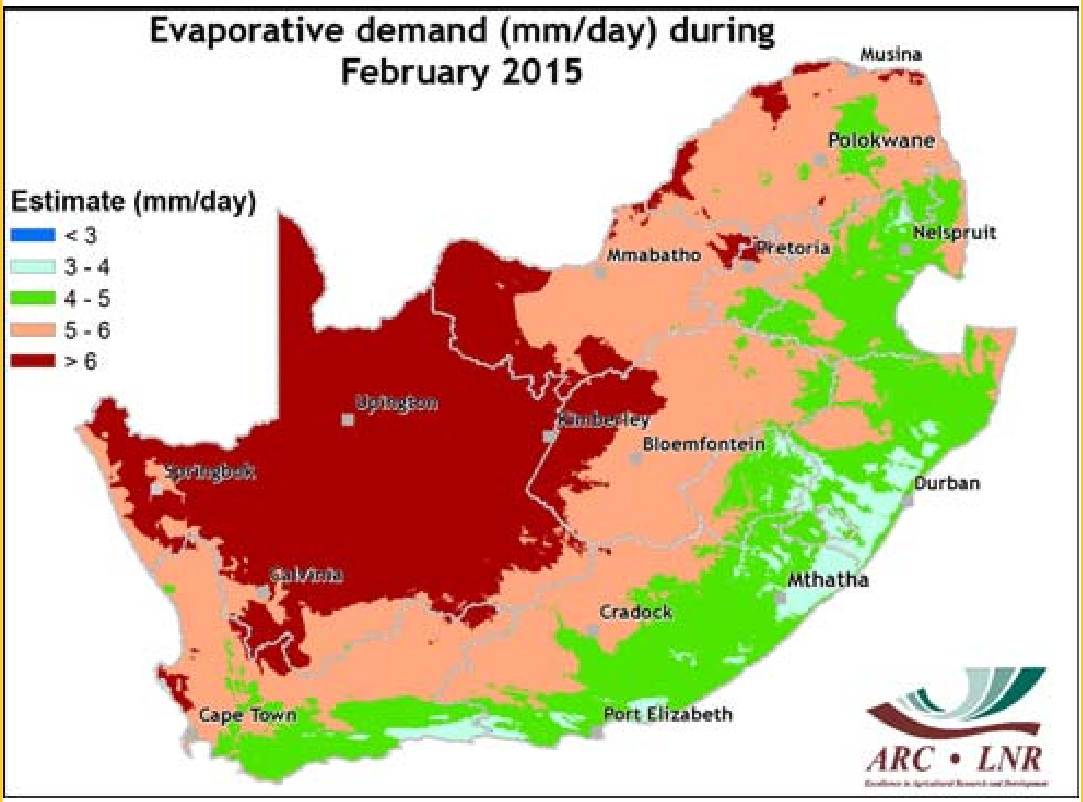

Figure 11

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 3-5 mm/day over the southern and eastern coastal areas and adjacent interior, increasing to more than 6 mm/day over much of the Northern Cape and parts of the Limpopo River Valley as well as the extreme western parts of the winter rainfall area.

Questions/Comments:
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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.

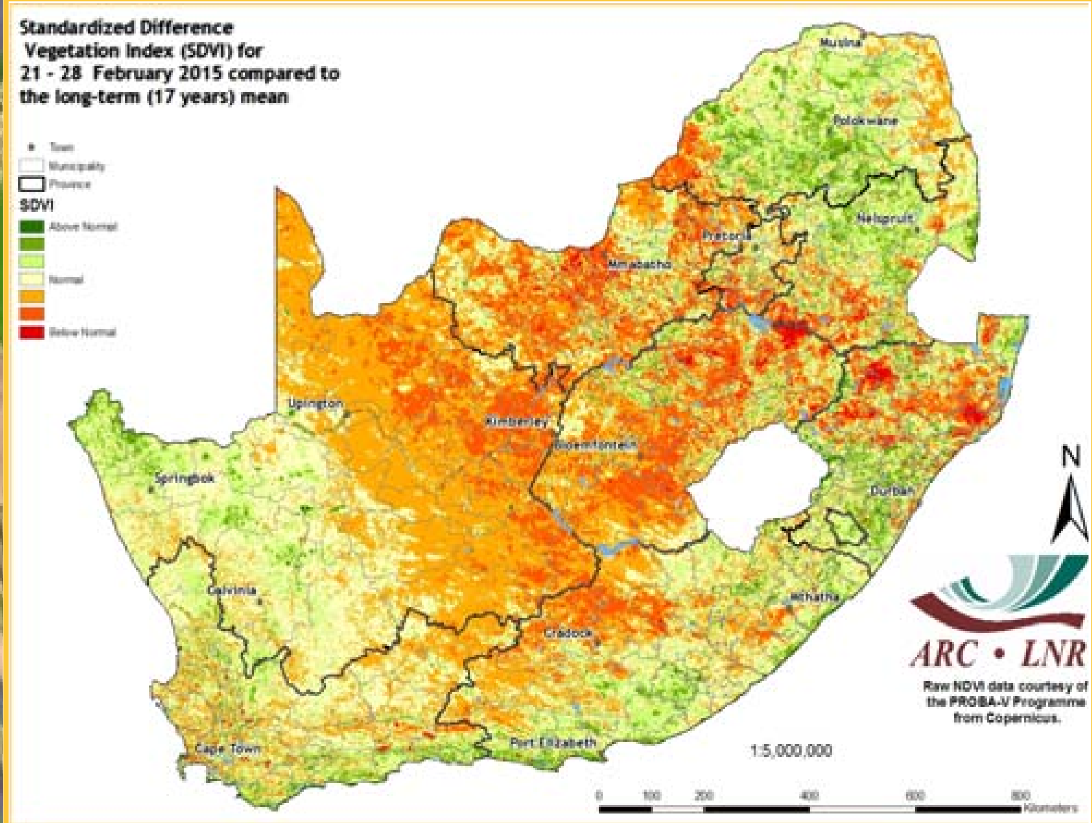

Figure 12

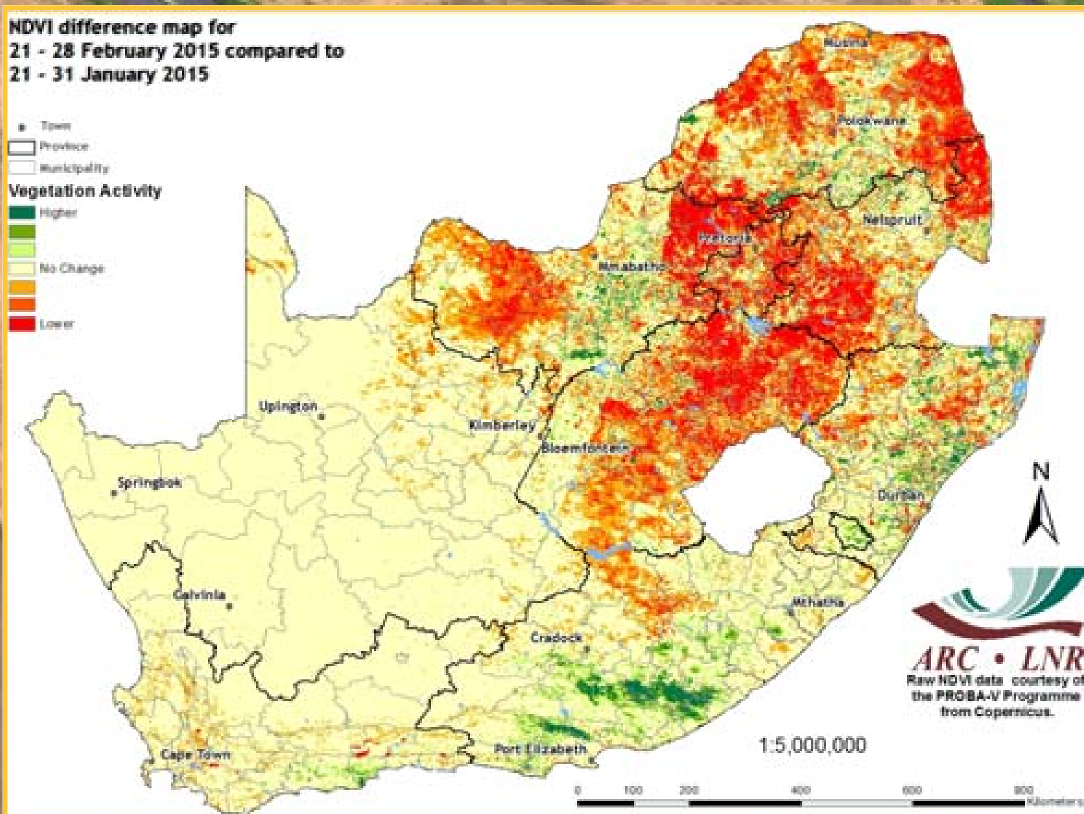

Figure 13

Figure 12:
The SDVI shows drought stress over the western parts of the summer rainfall area, as well as a band stretching northwest-southeast from southwestern Limpopo to northern KwaZulu-Natal where rainfall was extremely deficient.

Figure 13:
Dry conditions during early to mid-February resulted in large decreases in vegetation activity over much of the interior, including the important grain production regions.

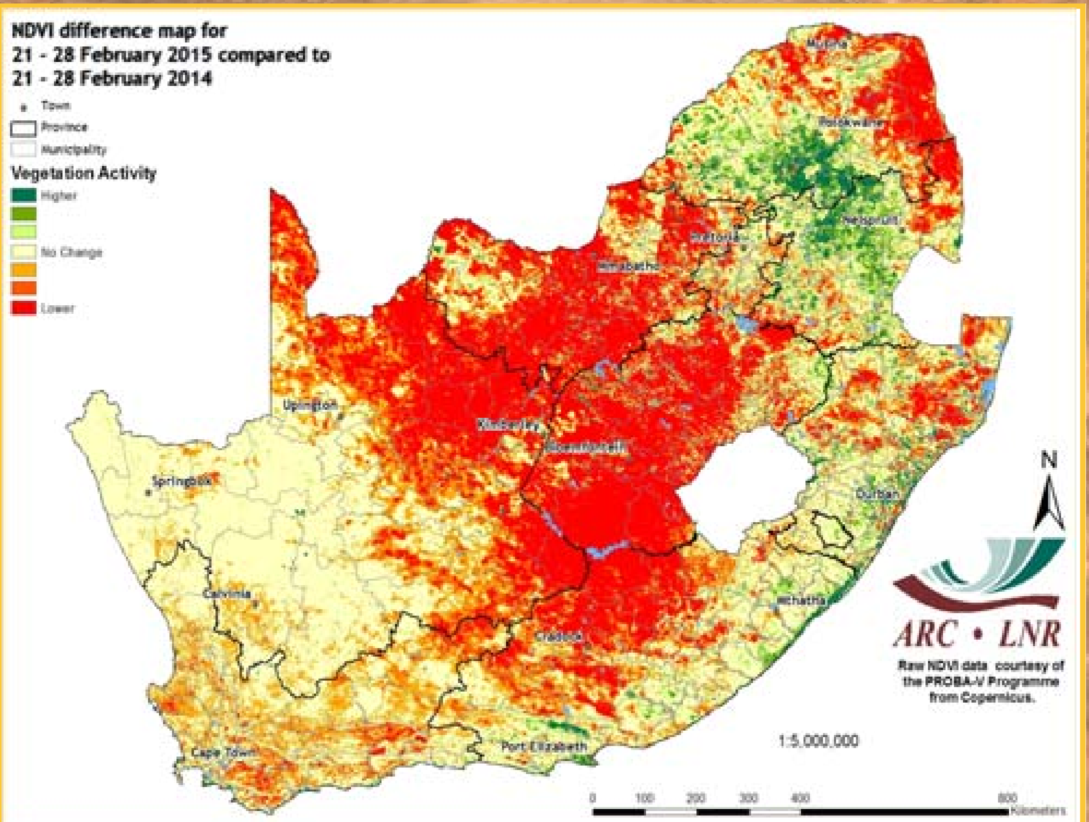

Figure 14

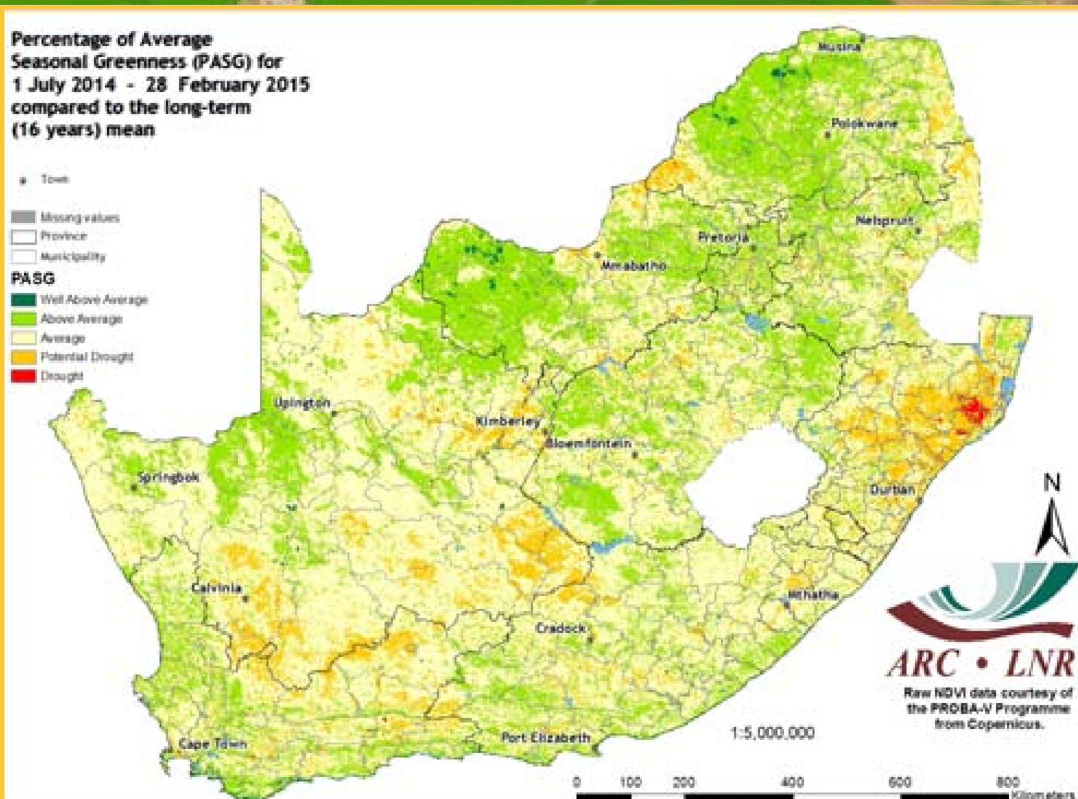

Figure 15

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:
In a clear reflection of the rainfall difference between this summer and the previous summer during the December-February period, vegetation activity is much lower over the central parts and northeastern extremes by the end of February this year compared to last, while higher activity is noted from the central to western Limpopo towards western and southern KwaZulu-Natal.

Figure 15:
Cumulative vegetation activity is still above normal over much of the interior due to wet conditions during November and December. One notable exception is the eastern parts of KwaZulu-Natal where drought conditions dominate at several time scales.

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.

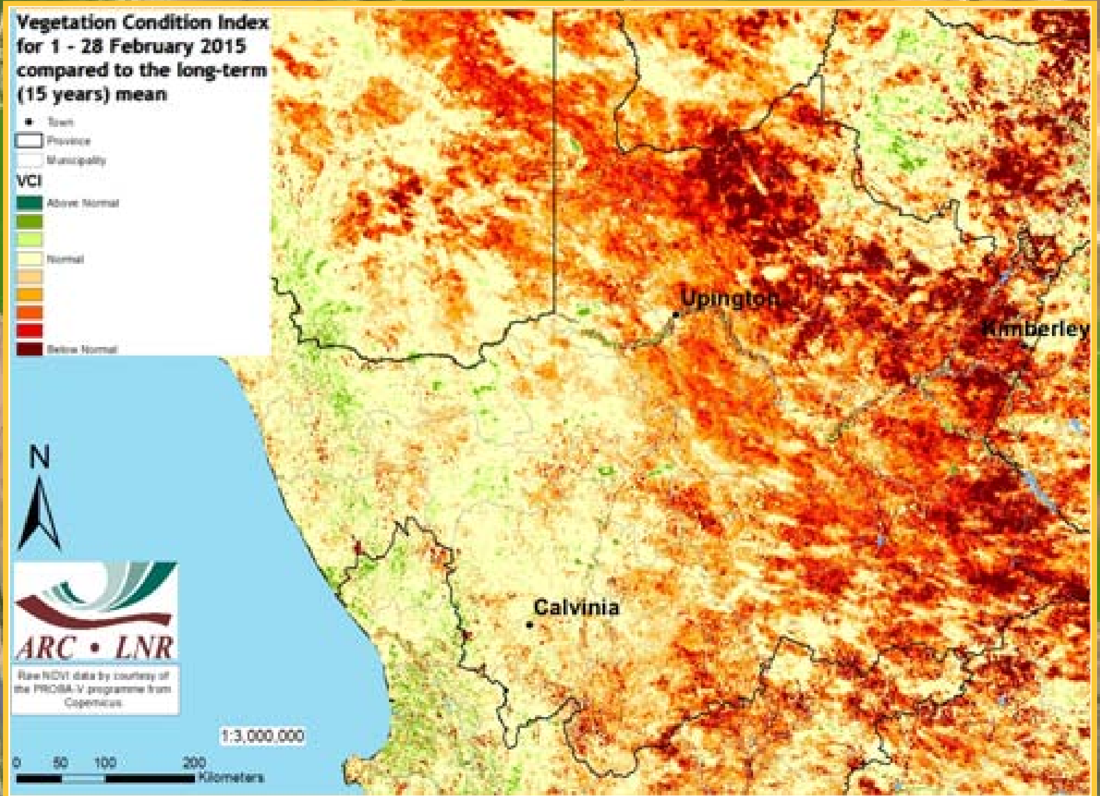


Figure 16

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

Figure 17:
The VCI map for February indicates below-normal vegetation activity over the central to northeastern parts of KwaZulu-Natal.

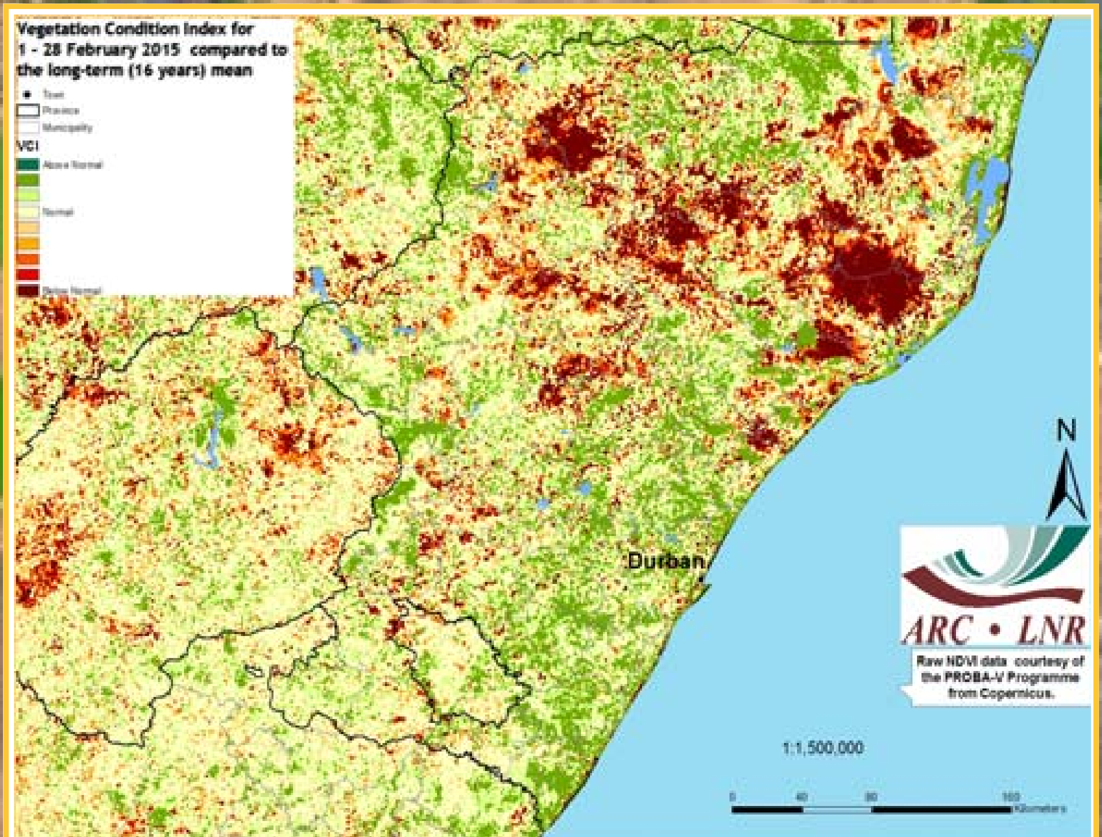
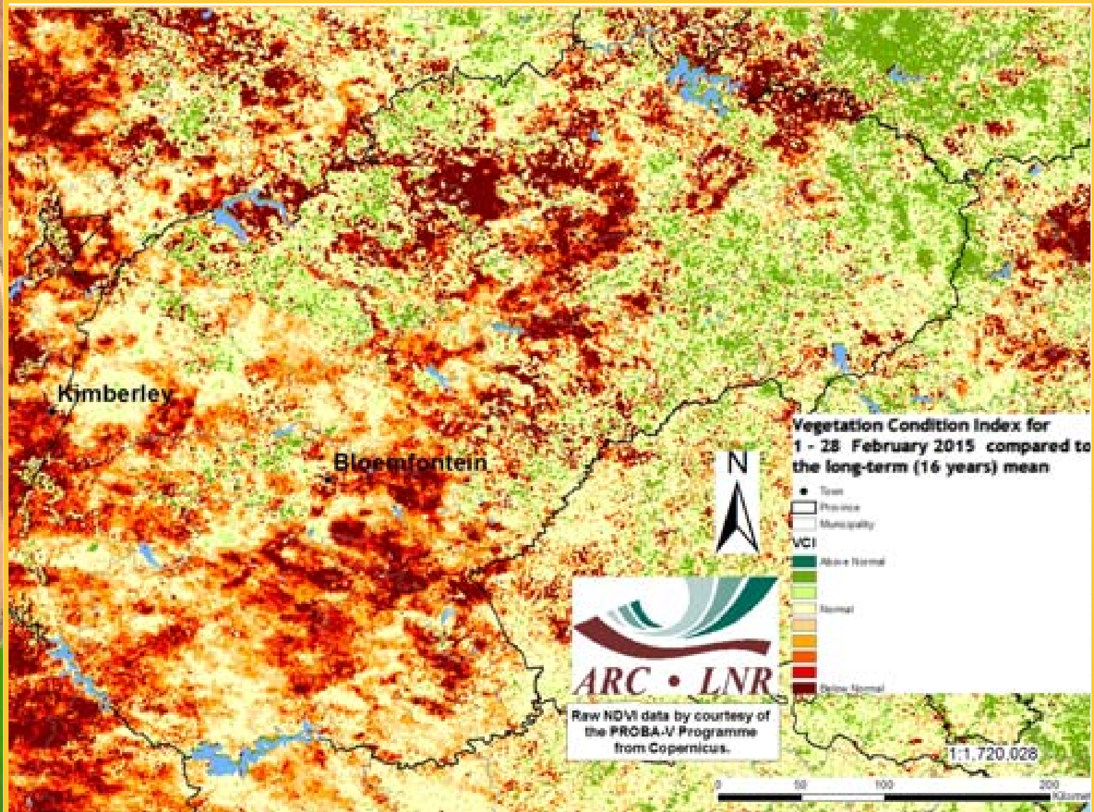


Figure 17



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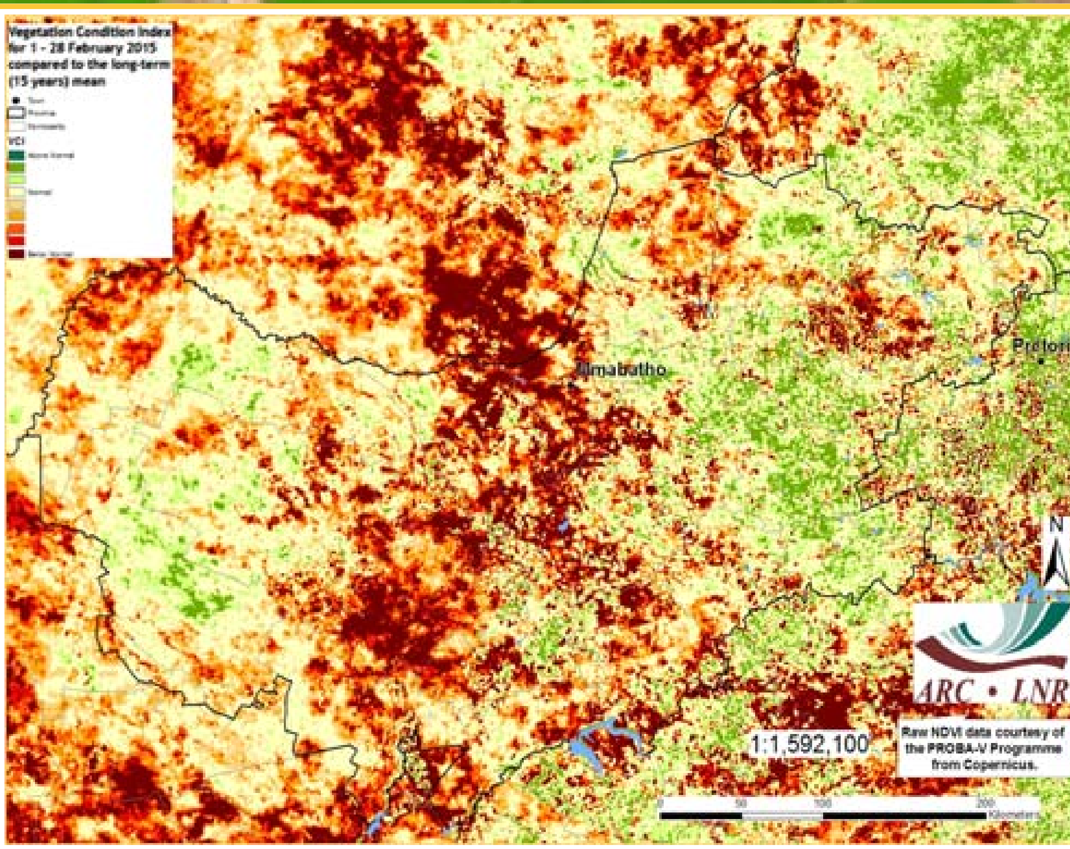

Figure 19

Figure 18:
The VCI map for February indicates below-normal vegetation activity over most parts of the Free State.

Figure 19:
The VCI map for February indicates below-normal vegetation activity over most parts of North West.

Questions/Comments:
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7. Vegetation Conditions & Rainfall

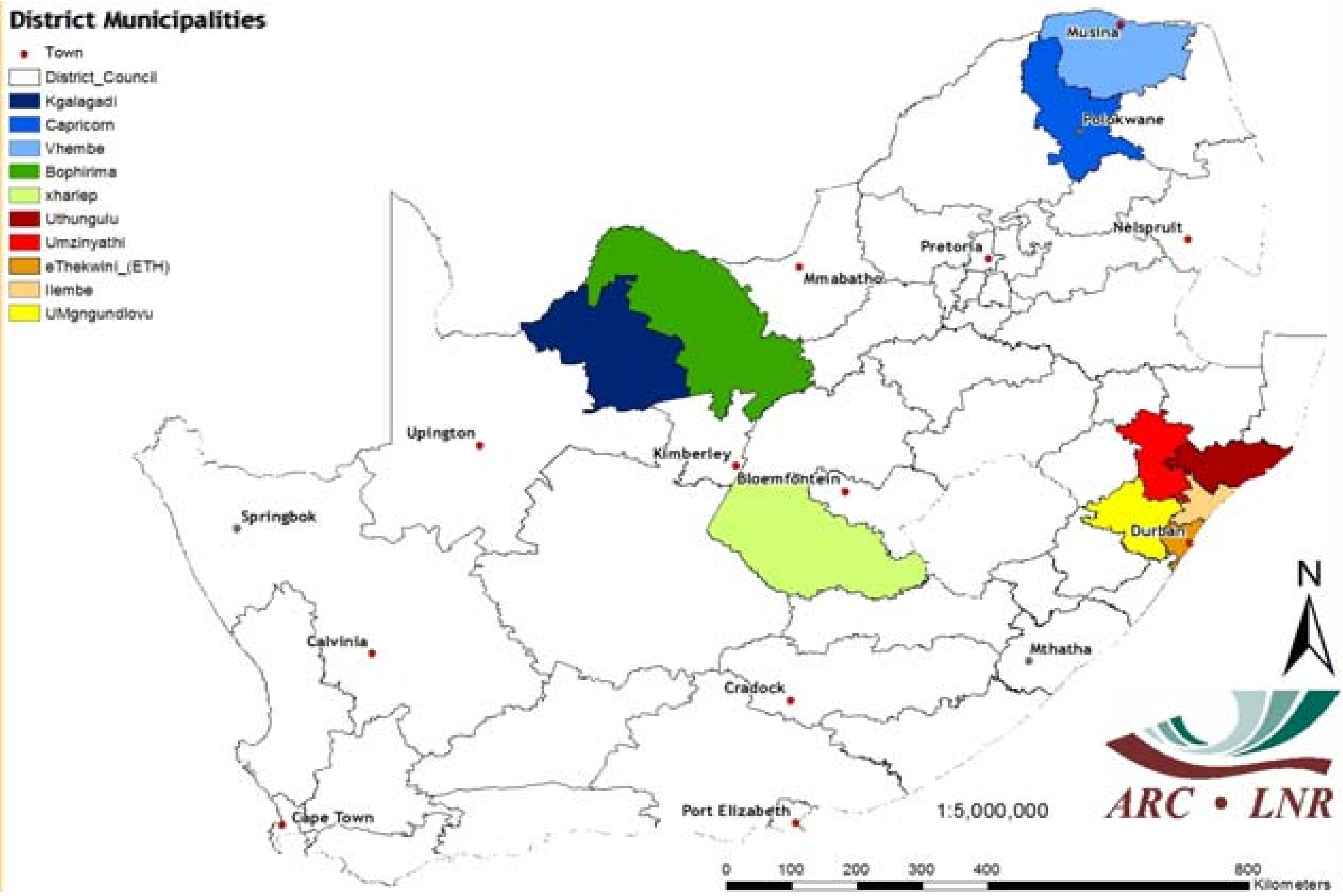


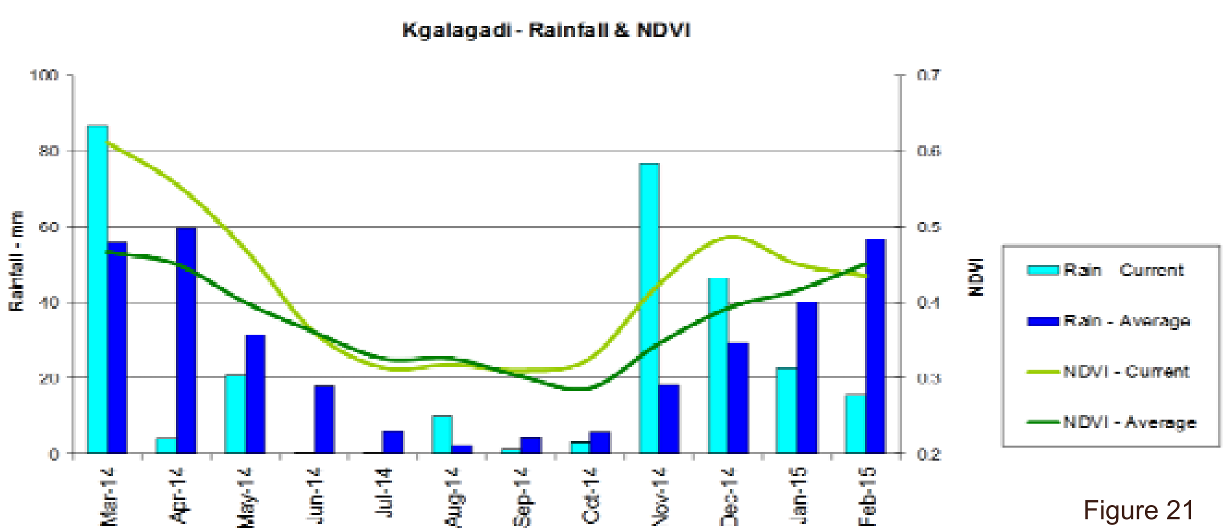
Figure 20

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

Questions/Comments:
Johan@arc.agric.za; NkambuleV@arc.agric.za

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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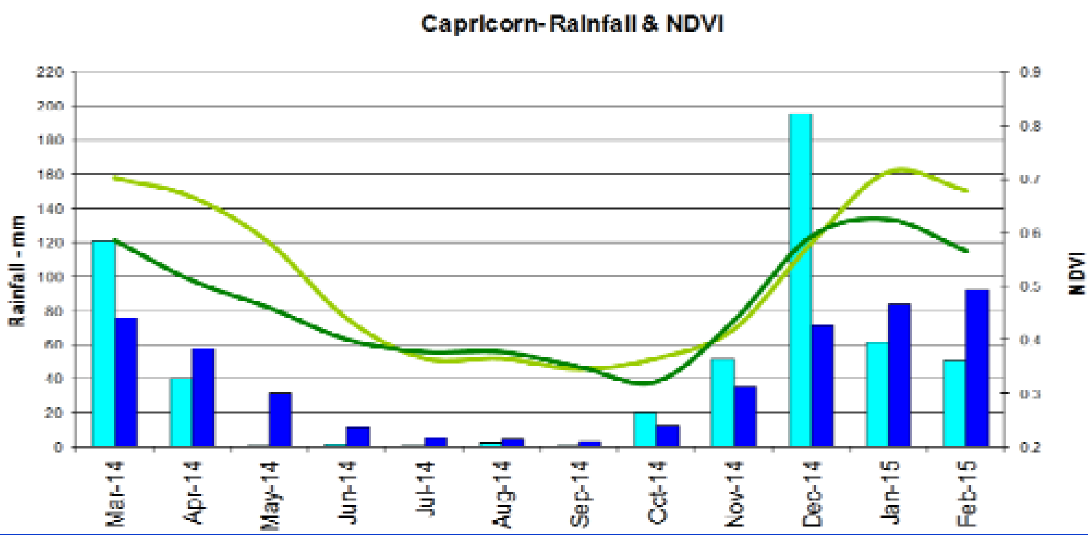

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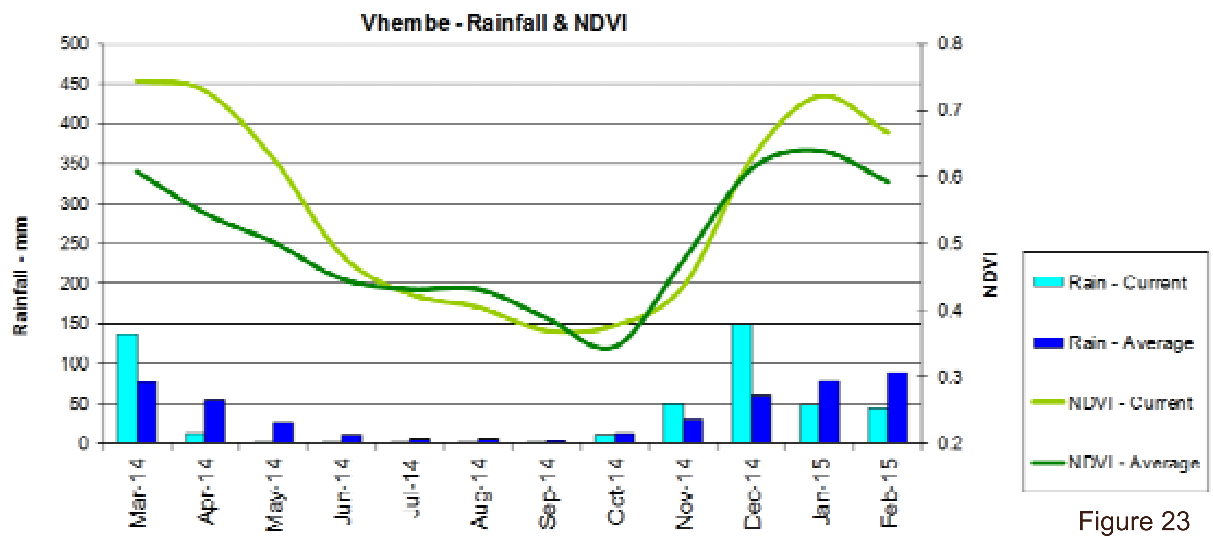

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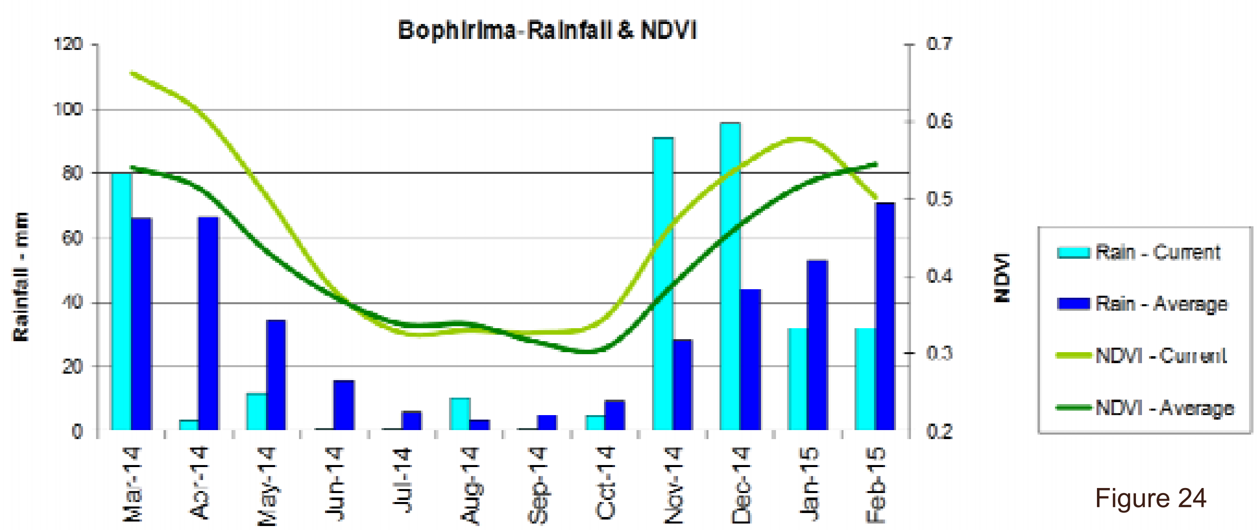

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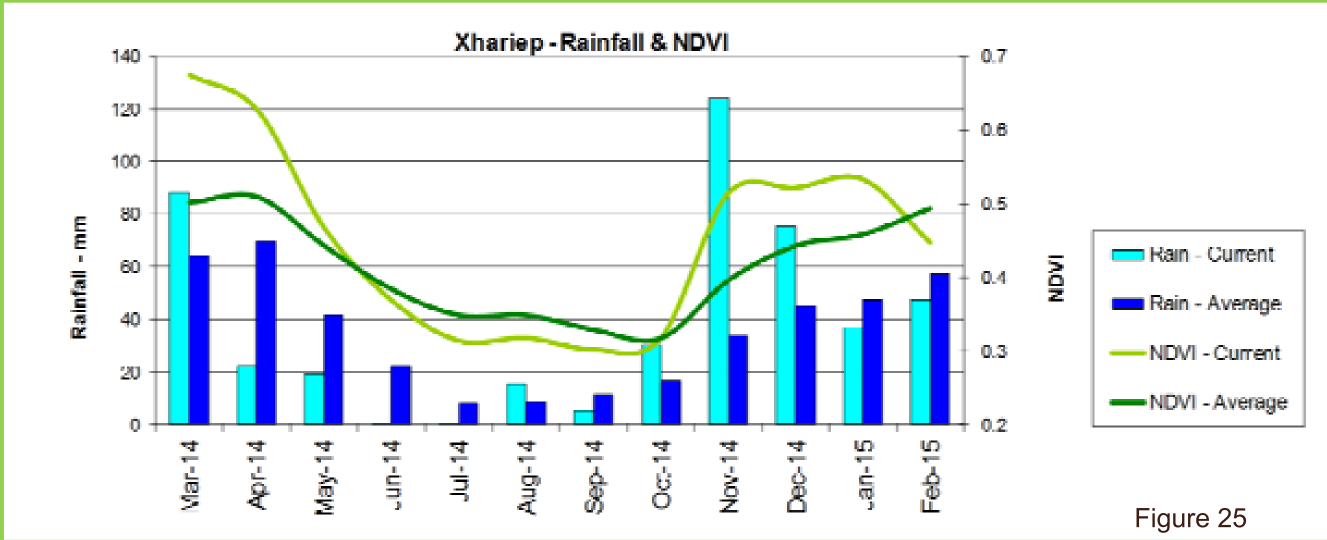

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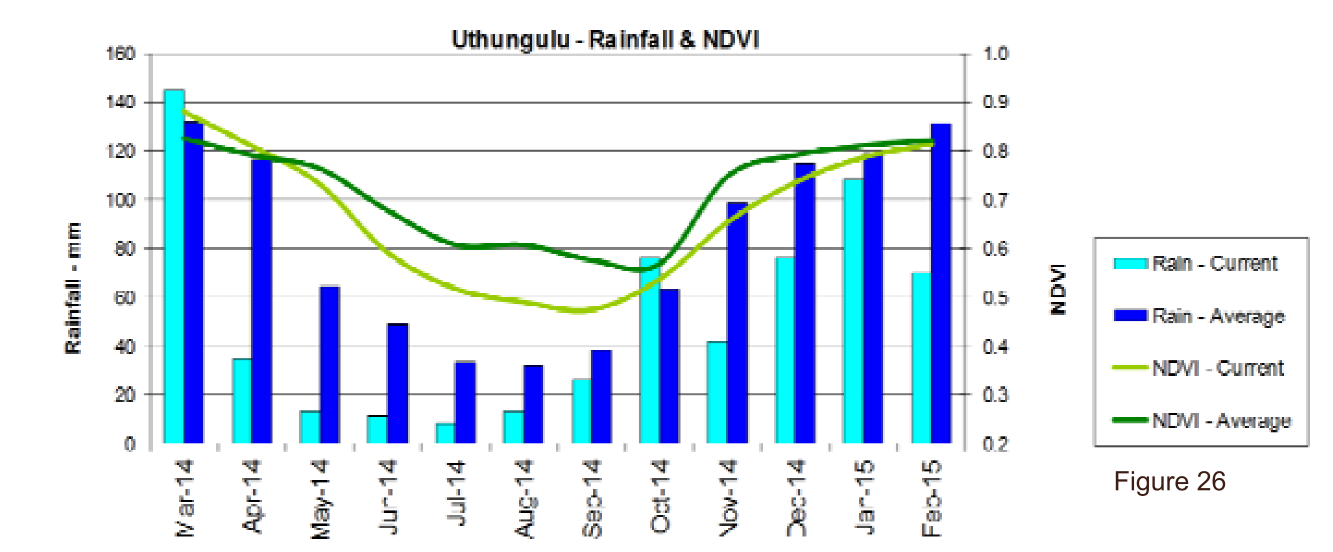

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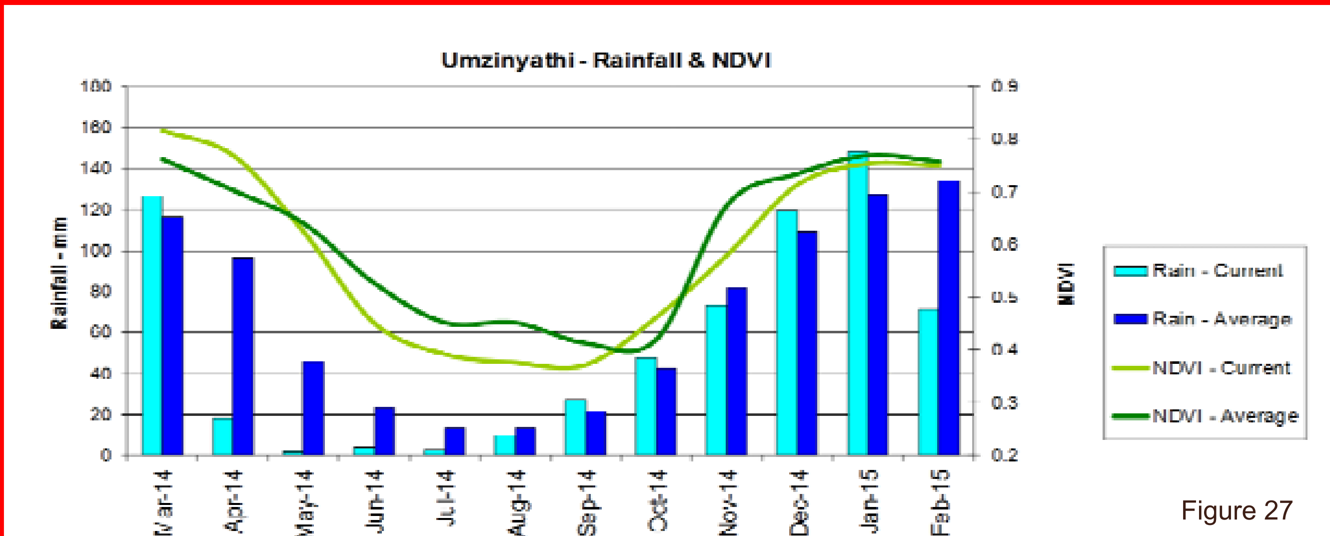

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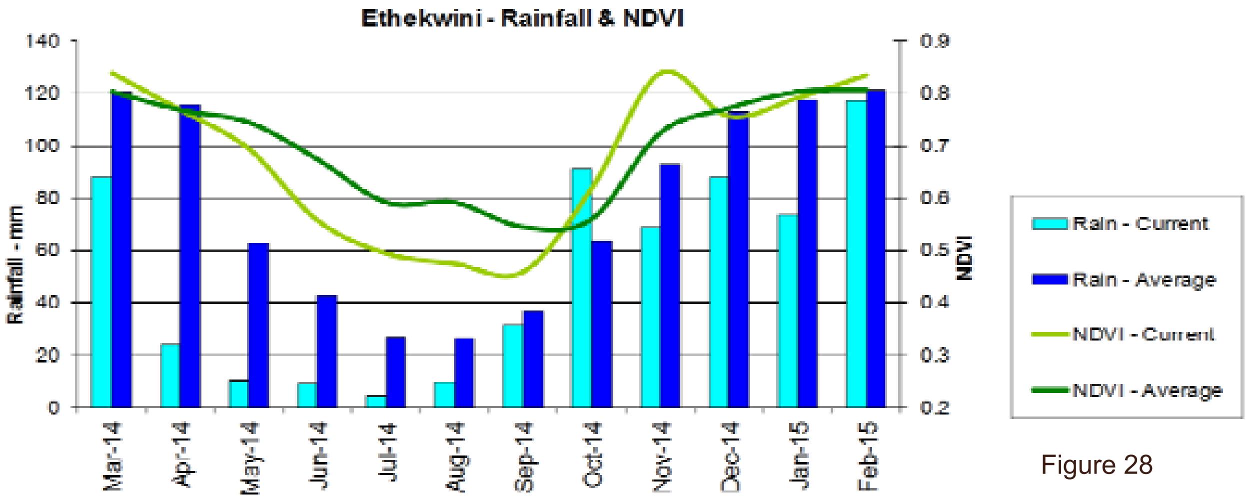

Figure 28

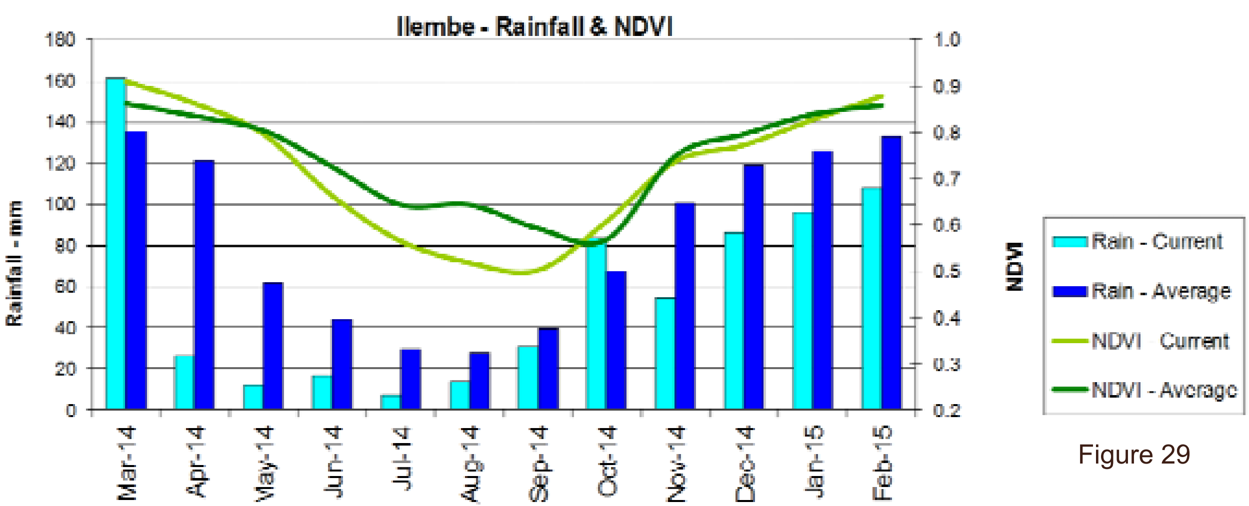

Figure 29

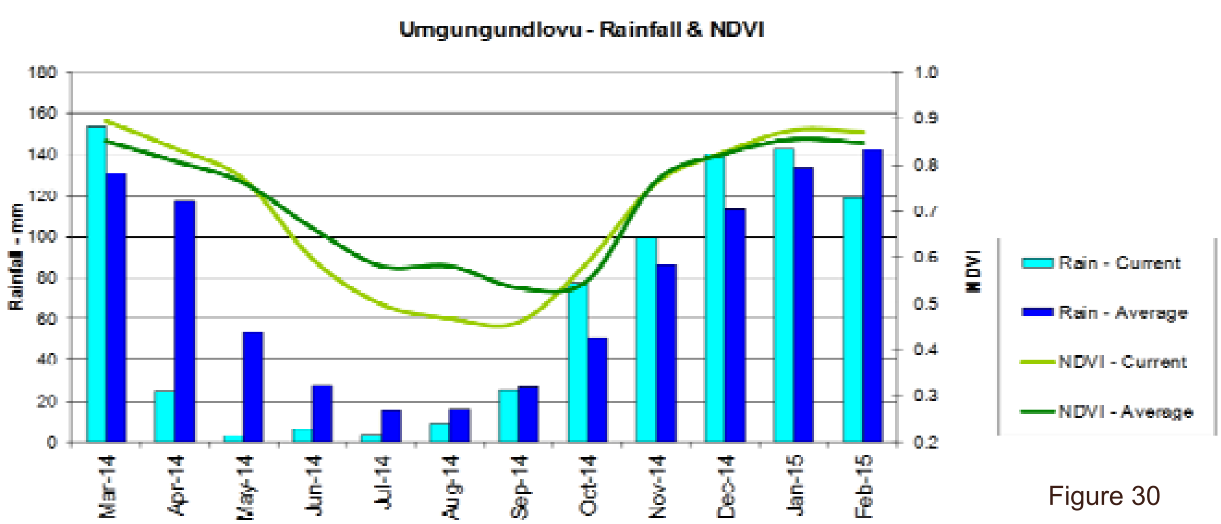

Figure 30

8. Fire Watch

Active Fires *(Provided when data is available)*

Forest and vegetation fires have temperatures in the range of 500 K (Kelvin) to 1000 K. According to Wien's Displacement Law, the peak emission of radiance for blackbody surfaces of such temperatures is at around 4 μm. For an ambient temperature of 290 K, the peak of radiance emission is located at approximately 11 μm. Active fire detection algorithms from remote sensing use this behaviour to detect "hot spot" fires.

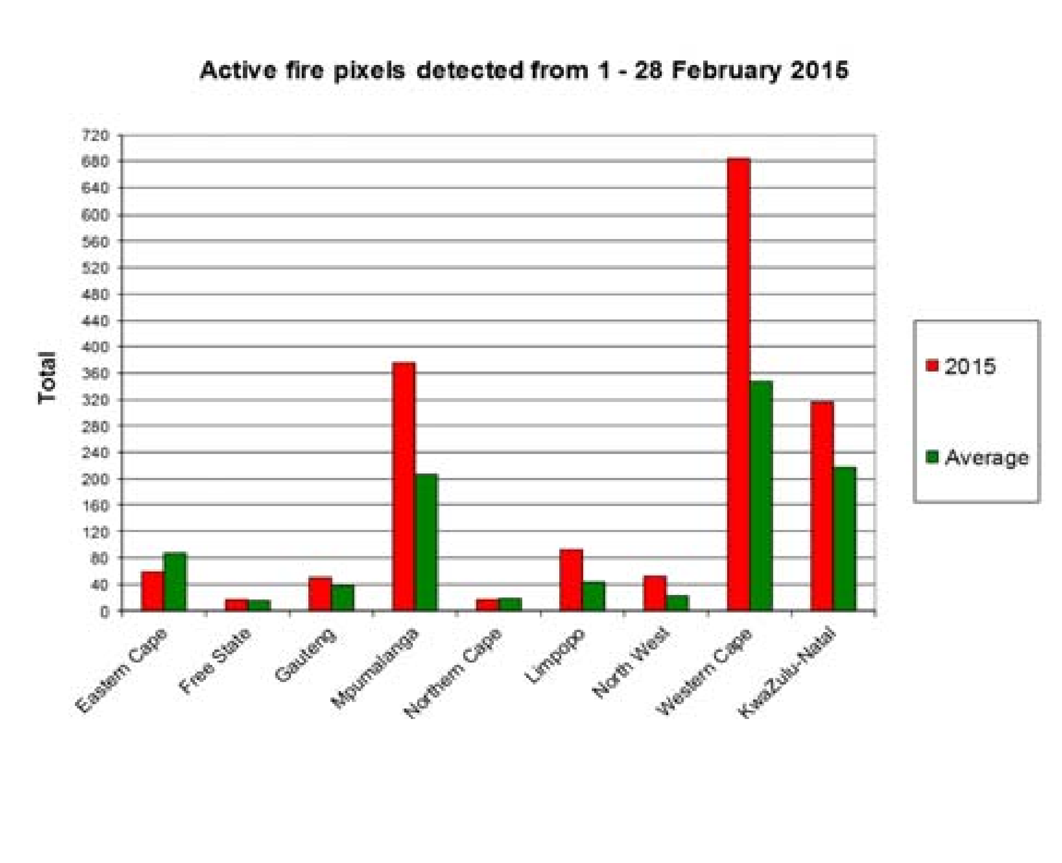

Figure 31

Figure 31:
The graph shows the total number of active fires detected in the month of February 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.

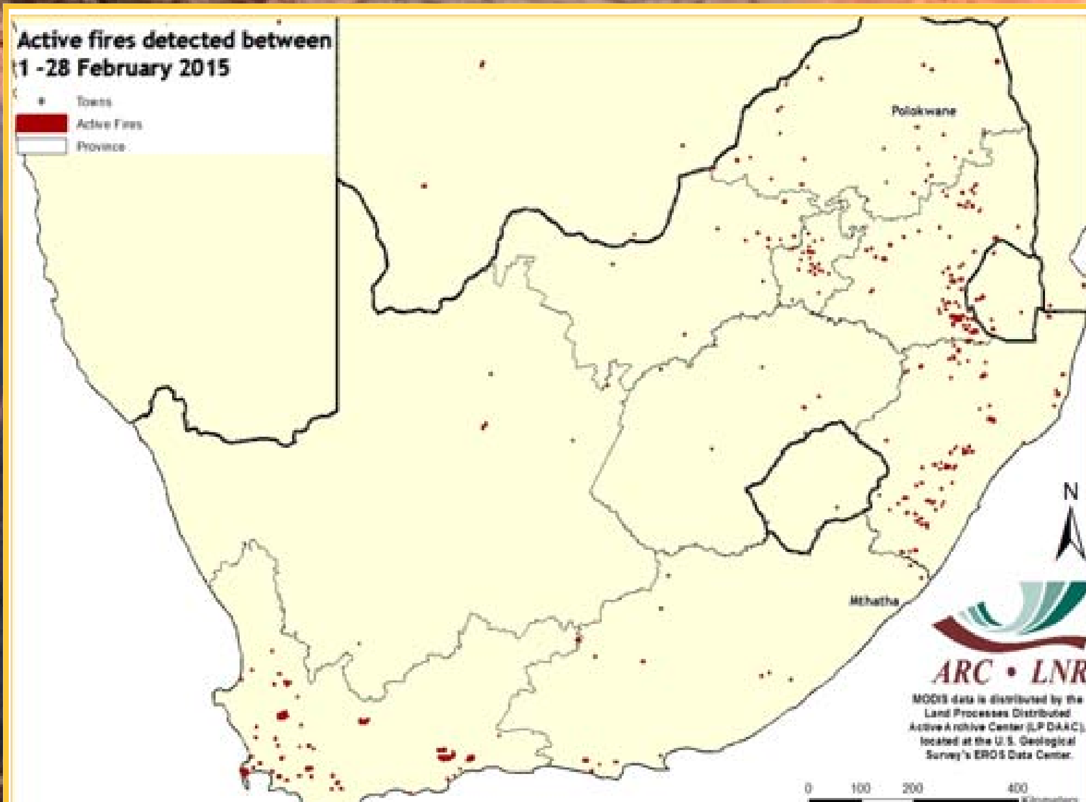

Figure 32

Figure 32:
The map shows the location of active fires detected between 1-28 February 2015.

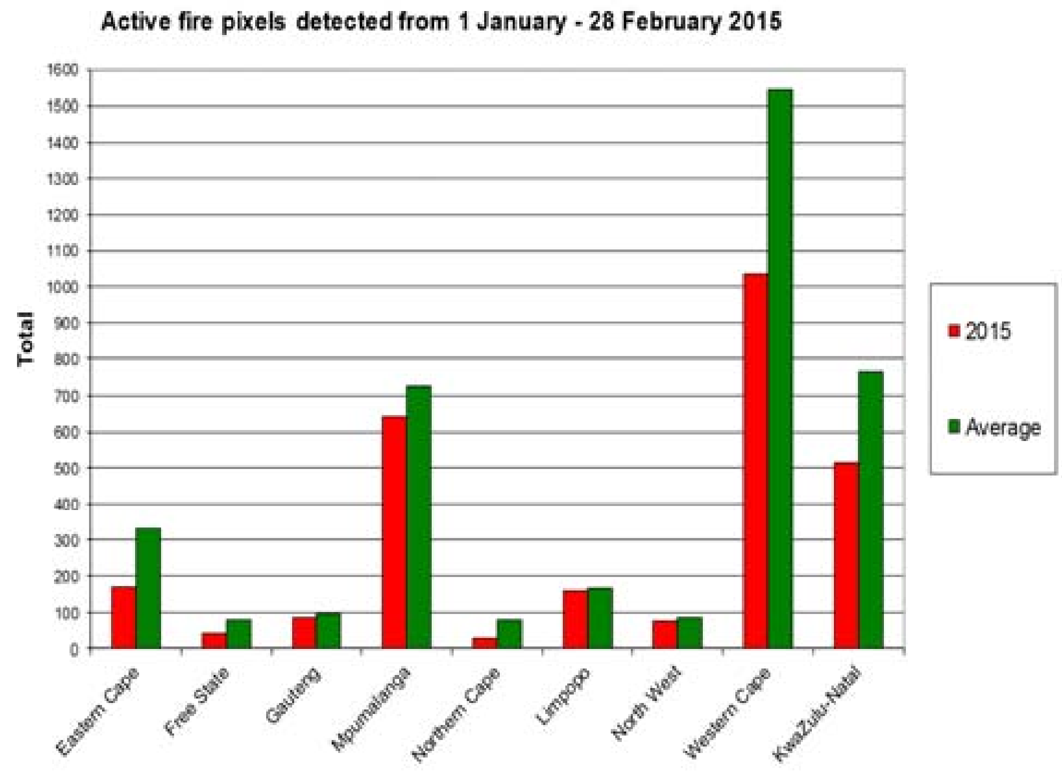

Figure 33

Figure 33:
The graph shows the total number of active fires detected between 1 January to 28 February per province. Fire activity was lower in all provinces compared to the average during the same period for the last 14 years.

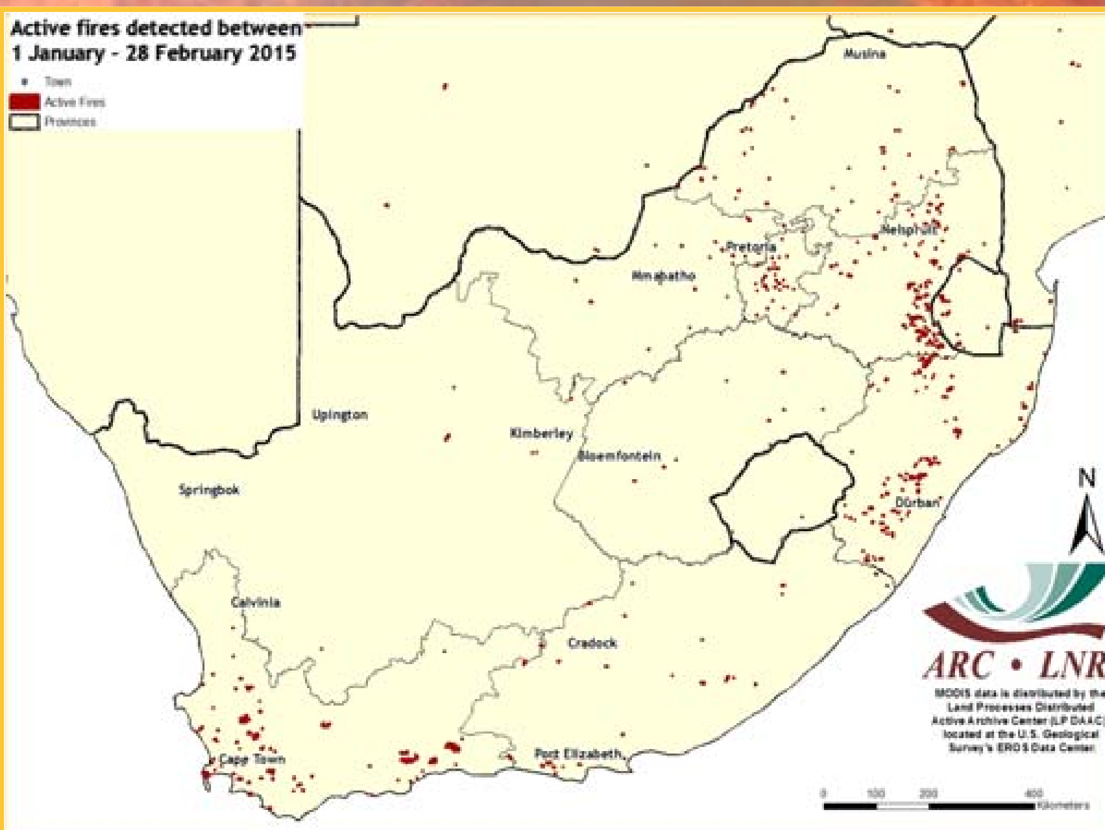

Figure 34

Figure 34:
The map shows the location of active fires detected between 1 January to 28 February 2015.

Questions/Comments:
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ARC-INSTITUTE FOR SOIL, CLIMATE AND WATER

ARC • LNR
Excellence in Research and Development

Your Partner in Natural Resources Research and Information

AgroClimatology

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

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

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

Products and Services

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

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

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

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

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

The Coarse Resolution Imagery Database (CRID)

NOAA AVHRR

The ARC-ISCW has an archive of daily NOAA AVHRR data dating from 1985 to 2004. This database includes all 5 bands as well as the Normalized Difference Vegetation Index (NDVI), Active Fire and Land Surface Temperature (LST) images. The NOAA data are used, for example, for crop production and grazing capacity estimation.

MODIS

MODIS data is distributed by the Land Processes Distributed Active Archive Center (LP DAAC), located at the U.S. Geological Survey's EROS Data Center. The MODIS sensor is more advanced than NOAA with regard to its high spatial (250 m^2 to 1 km^2) and spectral resolution. The ARC-ISCW has an archive of MODIS (version 4 and 5) data.

- MODIS v4 from 2000 to 2006
- MODIS v5 from 2000 to present

Datasets include:

- MOD09 (Surface Reflectance)
- MOD11 (Land Surface Temperature)
- MOD13 (Vegetation Products)
- MOD14 (Active Fire)
- MOD15 (Leaf Area Index & Fraction of Photosynthetically Active Radiation
- MOD17 (Gross Primary Productivity)
- MCD43 (Albedo & Nadir Reflectance)
- MCD45 (Burn Scar)

Coverage for version 5 includes South Africa, Namibia, Botswana, Zimbabwe and Mozambique.
More information:
http://modis.gsfc.nasa.gov

VGT4AFRICA and GEOSUCCESS

SPOT NDVI data is provided courtesy of the VEGETATION Programme and the VGT4AFRICA project. The European Commission jointly developed the VEGETATION Programme. The VGT4AFRICA project disseminates VEGETATION products in Africa through GEONETCast.

ARC-ISCW has an archive of SPOT-VEGETATION and ProbaV 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