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UMLINDI
The Watchman

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INSTITUTE FOR SOIL, CLIMATE AND WATER

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

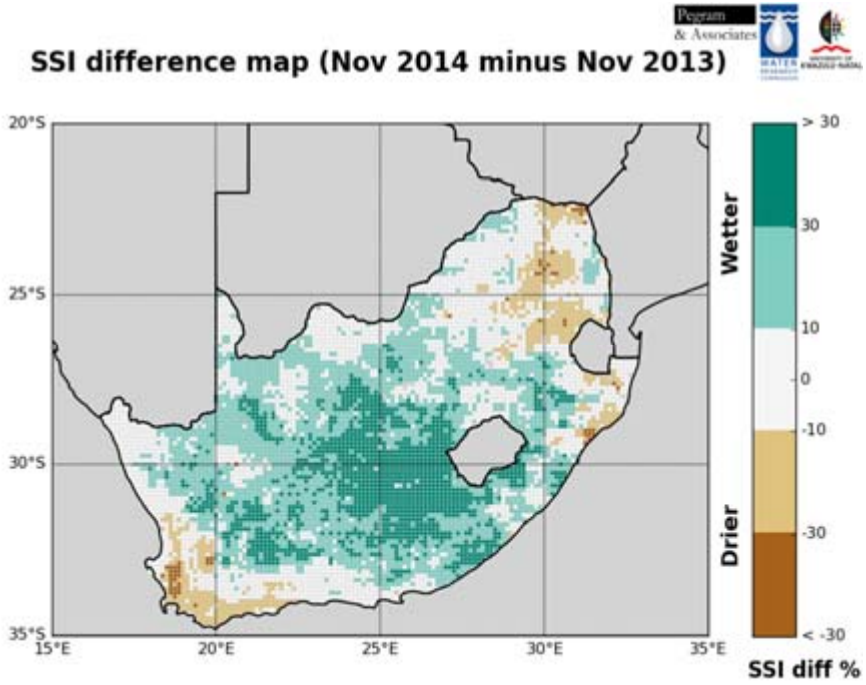
South African Weather Service

AMESD

126th Edition

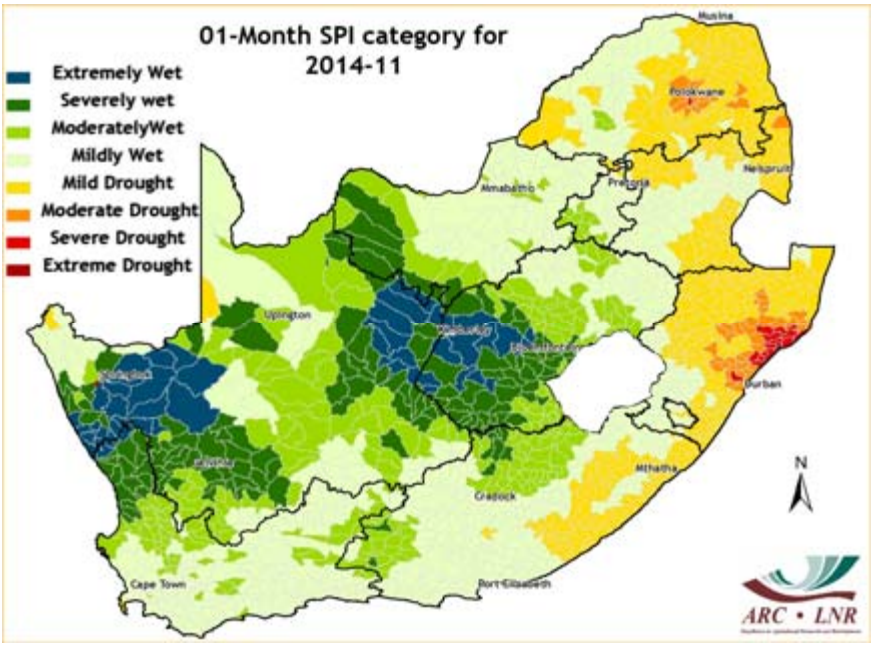
Images of the Month

Stronger start to summer rainy season over central South Africa



The current early summer is the first since 2010/11 with above-normal rainfall over most of the central interior. However, the eastern parts of the country received below-normal rainfall, indicating the first summer season since 2012/13 with a slow start. This situation is also reflected in the soil moisture map for November 2014 relative to November last year. The map (top) shows the difference in the calculated Soil Saturation Index which is defined as the percentage saturation of the soil store in the TOPKAPI hydrological model. The modelling is intended to represent the mean state in the root zone.

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.



The wet conditions reflected over the central parts started by the end of October, with several rainfall events resulting in extremely wet conditions for the month over parts of the central interior and the far western areas, as indicated by the Standardized Precipitation Index for November (bottom map).

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:

Widespread above-normal rainfall occurred over large parts of the interior during November 2014. Several upper air troughs and lows moving across South Africa, with ample amounts of tropical moisture from sources to the north, resulted in several large cloud bands developing during the month, causing a number of general rainfall events especially over the central interior. With the centres of the lows sometimes situated to the west of the country, even the winter rainfall area received some rain during certain events. Temperatures over the western interior were relatively low during the first two rainfall events, but gradually increased from the middle of the month with several hot days by the end. Hot conditions also developed over the northeastern parts with maximum temperatures exceeding 40° C by the 10th and 23rd.

Major rainfall events, all associated with sharp troughs or cut-off lows in the upper air, were spread fairly evenly. The first of these happened on the 1st to 4th when widespread rain occurred over the central interior, spreading eastwards before dissipating, with widespread rain also over the southwestern parts associated with the cut-off low. Dry conditions followed with a slow build up again from the 8th. With the build up of a trough in the west over the next few days, an extensive cloud band was established with widespread rain again over most of the summer rainfall area, reaching a maximum by the 12th. Another upper air trough followed shortly, causing scattered thundershowers by the 15th to 18th, mostly over the northeastern parts, followed by a period of anticyclonic circulation dominating across the country with little rain. The next upper air trough with major cloud band developed by the 23rd and again by the 26th over the central to northeastern parts, resulting in widespread thundershowers over the central to northeastern parts. The month ended with another sharp trough developing over the southern parts, resulting in thundershowers mostly over the northeastern areas, and followed again, as with the system during the middle of the month, by dry anticyclonic conditions. These dry conditions lasted until the 4th of December, after which more widespread rain and thundershowers occurred over the central to eastern parts.

Questions/Comments:
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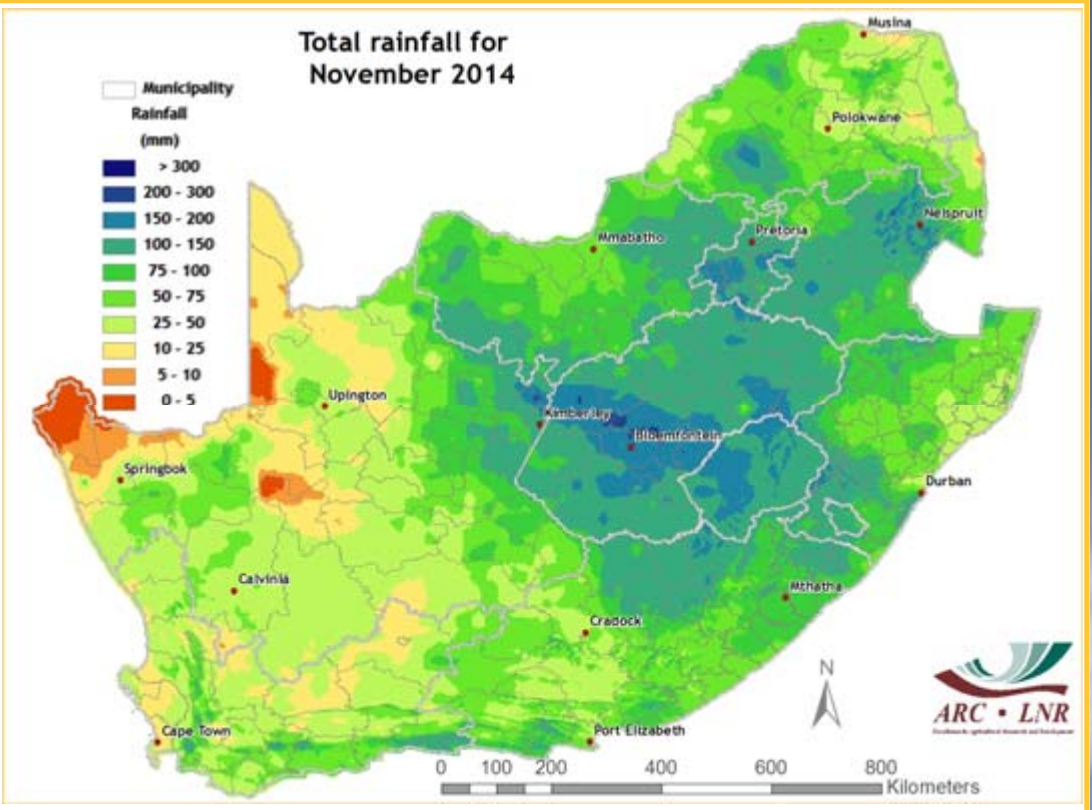

Figure 1

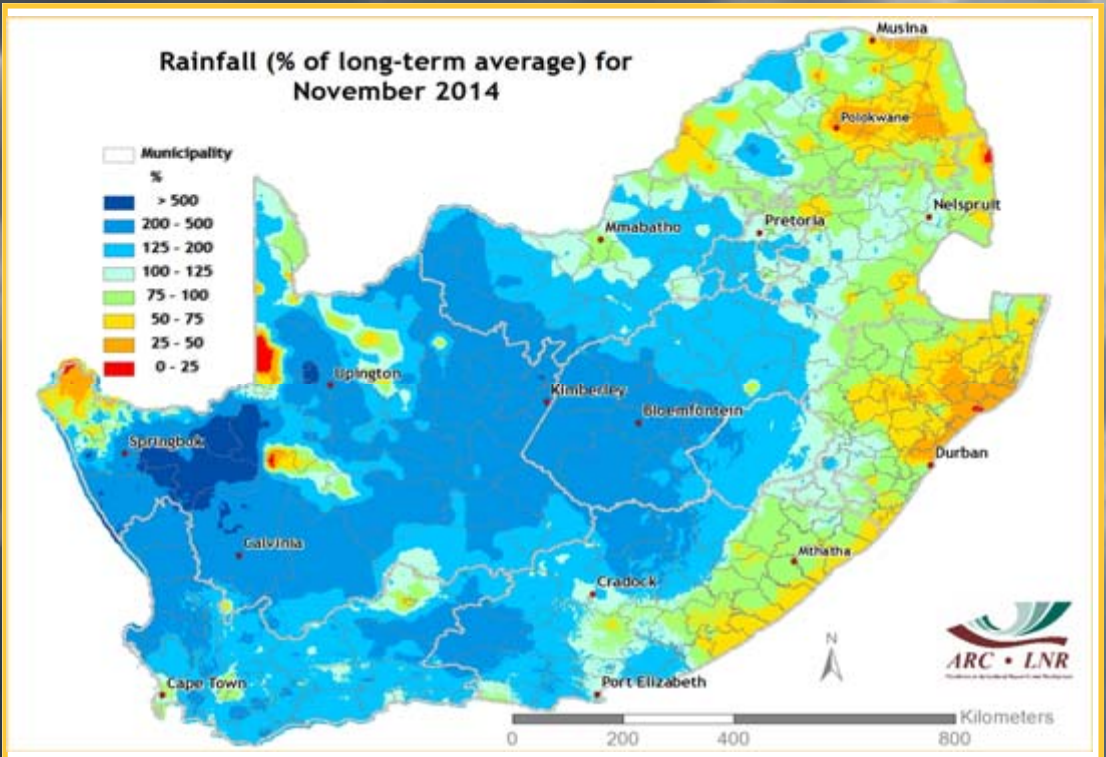

Figure 2

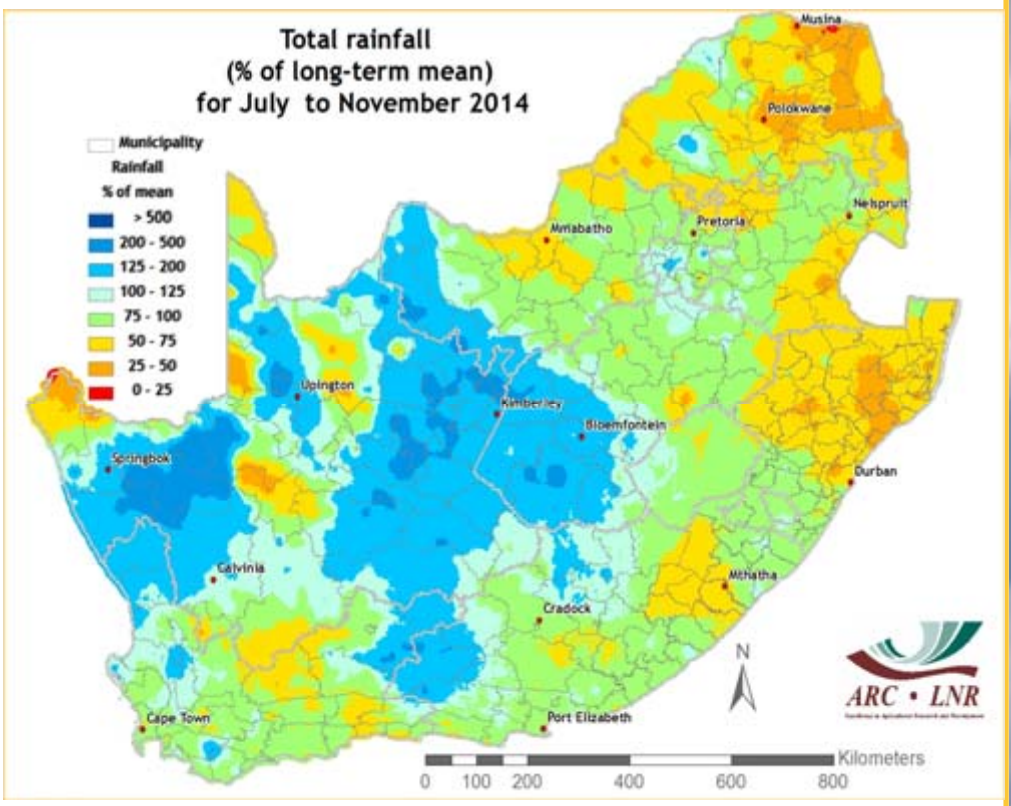

Figure 3

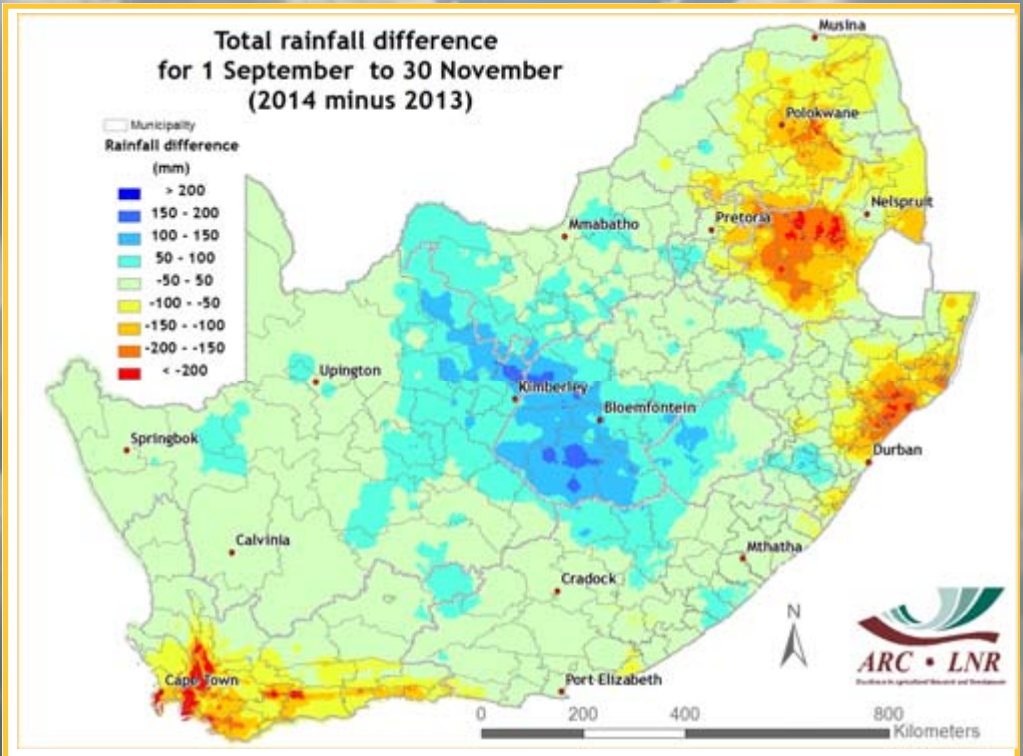

Figure 4

Figure 1:
While almost the entire country received rain during November, a large part of the central to eastern interior , covering almost the entire Free State, received in excess of 100 mm.

Figure 2:
The central to western parts of the country, including the winter rainfall area, received above-normal rain during November while the extreme northeastern and eastern peripheries received normal to below-normal rainfall.

Figure 3:
Since July, precipitation has been normal to above normal over much of the central to western interior and near normal over the winter rainfall area. Below-normal rainfall occurred over the northeastern half of the country, including much of the eastern maize production region.

Figure 4:
For September to November, total rainfall during the current summer was much lower than during 2013 over the winter rainfall area. The eastern parts of the maize production region also had a much weaker start to the summer rainfall season compared to last year. The central parts of the country, including parts of the western maize production region, received more rain than during the same period last year.

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 (Figures 5-8) indicate dry conditions over much of the eastern and northeastern-parts of the country at the shorter time scales (3-6 months). At the longer time scales (12 and 24 months), the winter rainfall area and northeastern parts of the country are moderately to extremely wet with moderate to severe drought conditions indicated over KwaZulu-Natal north-westwards into the central interior.

Questions/Comments:
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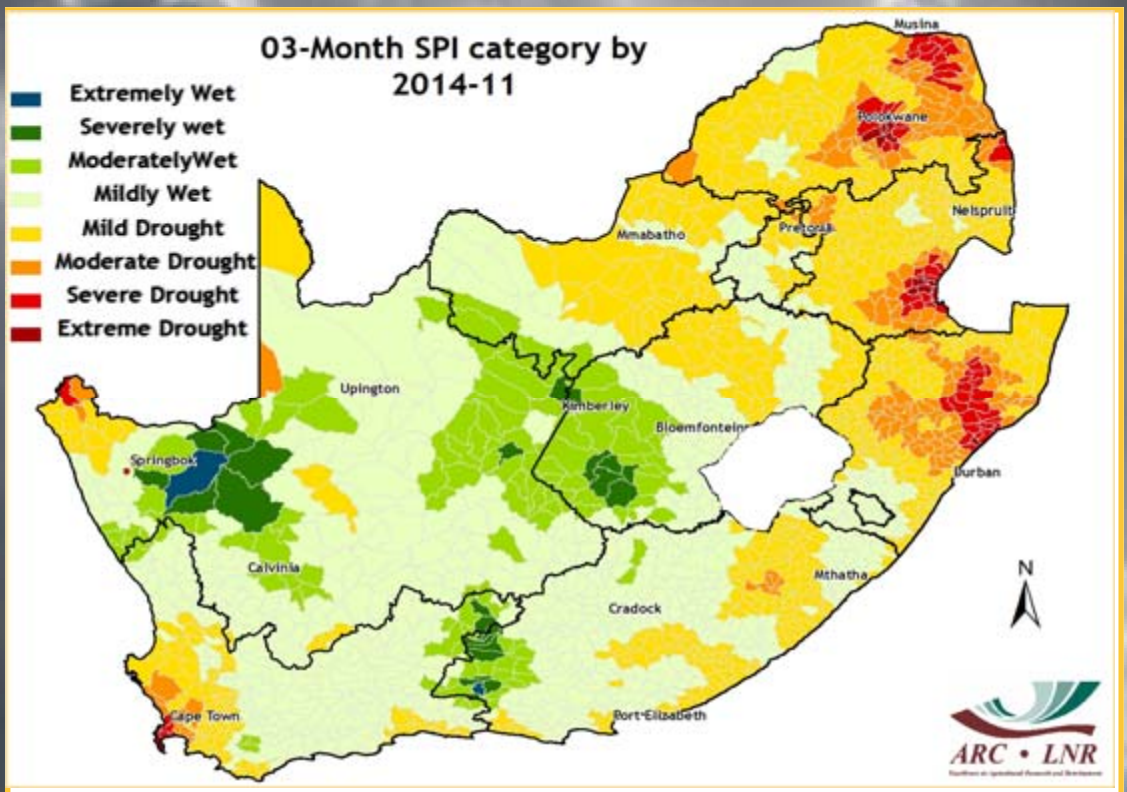

Figure 5

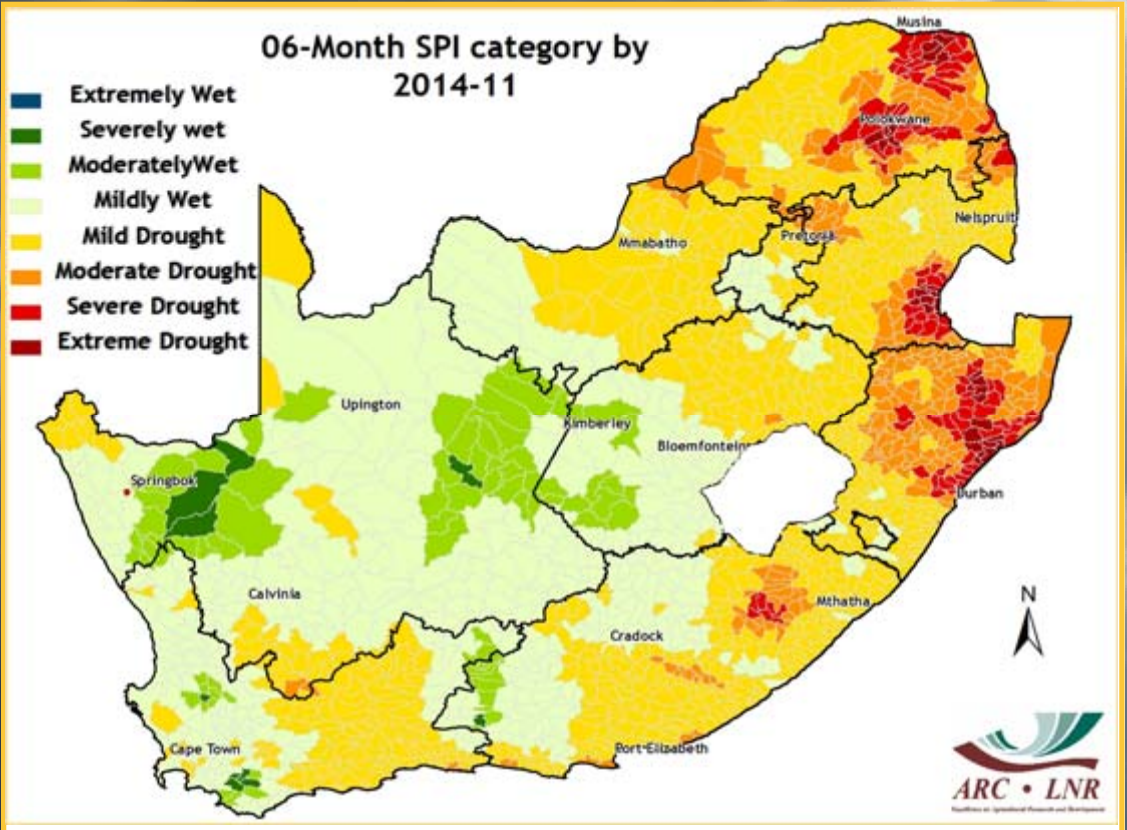

Figure 6

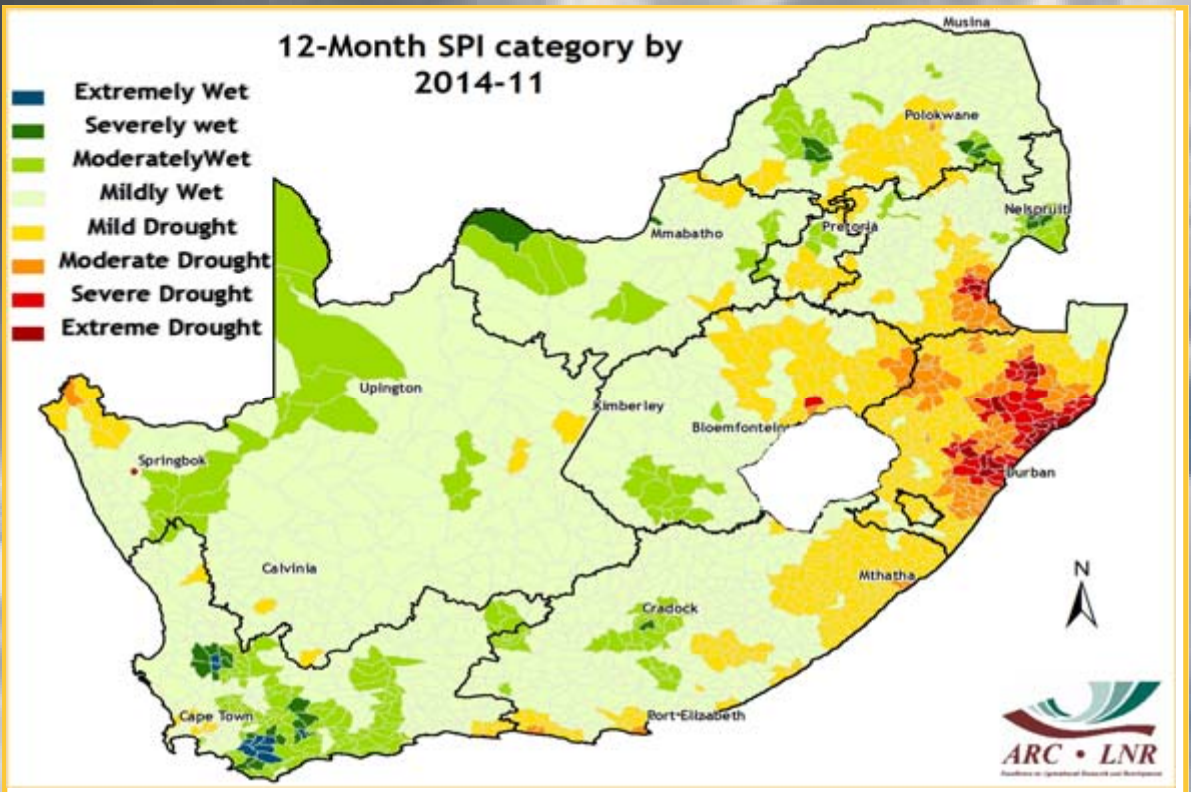

Figure 7

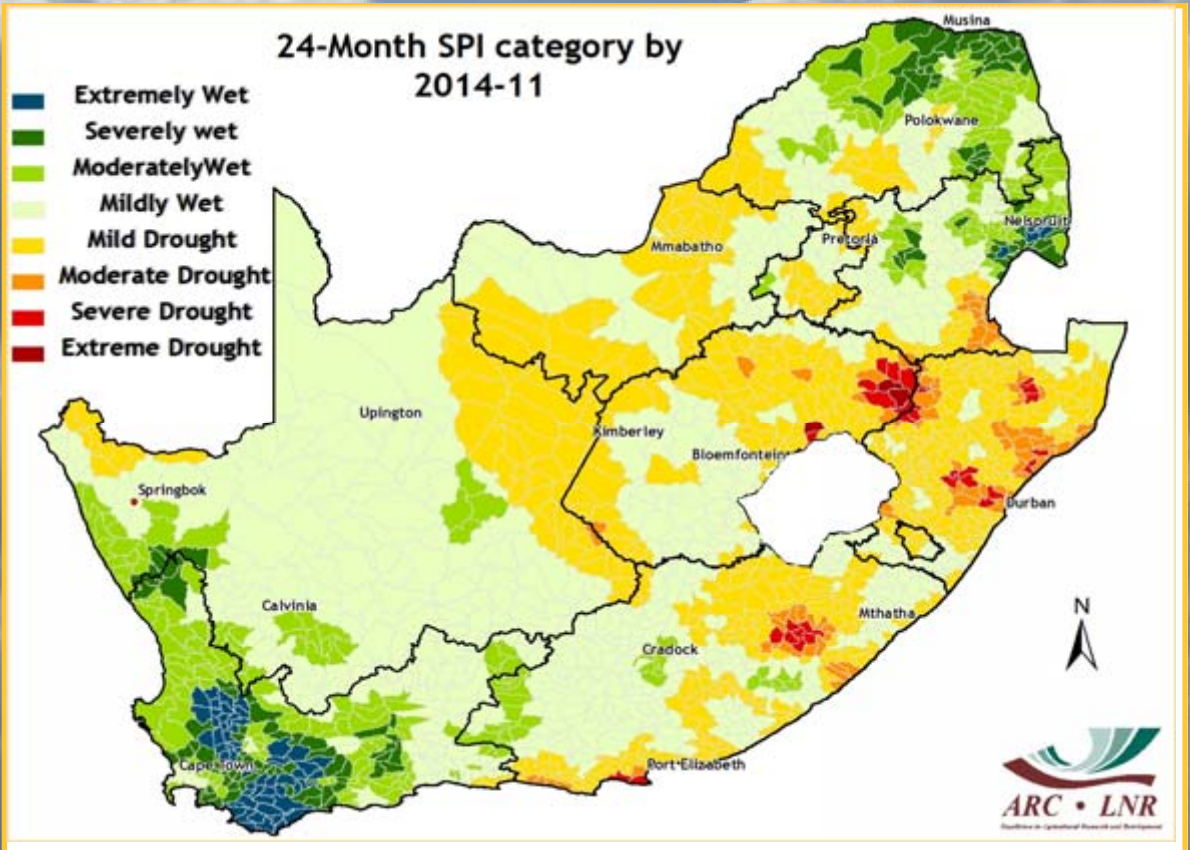

Figure 8

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.

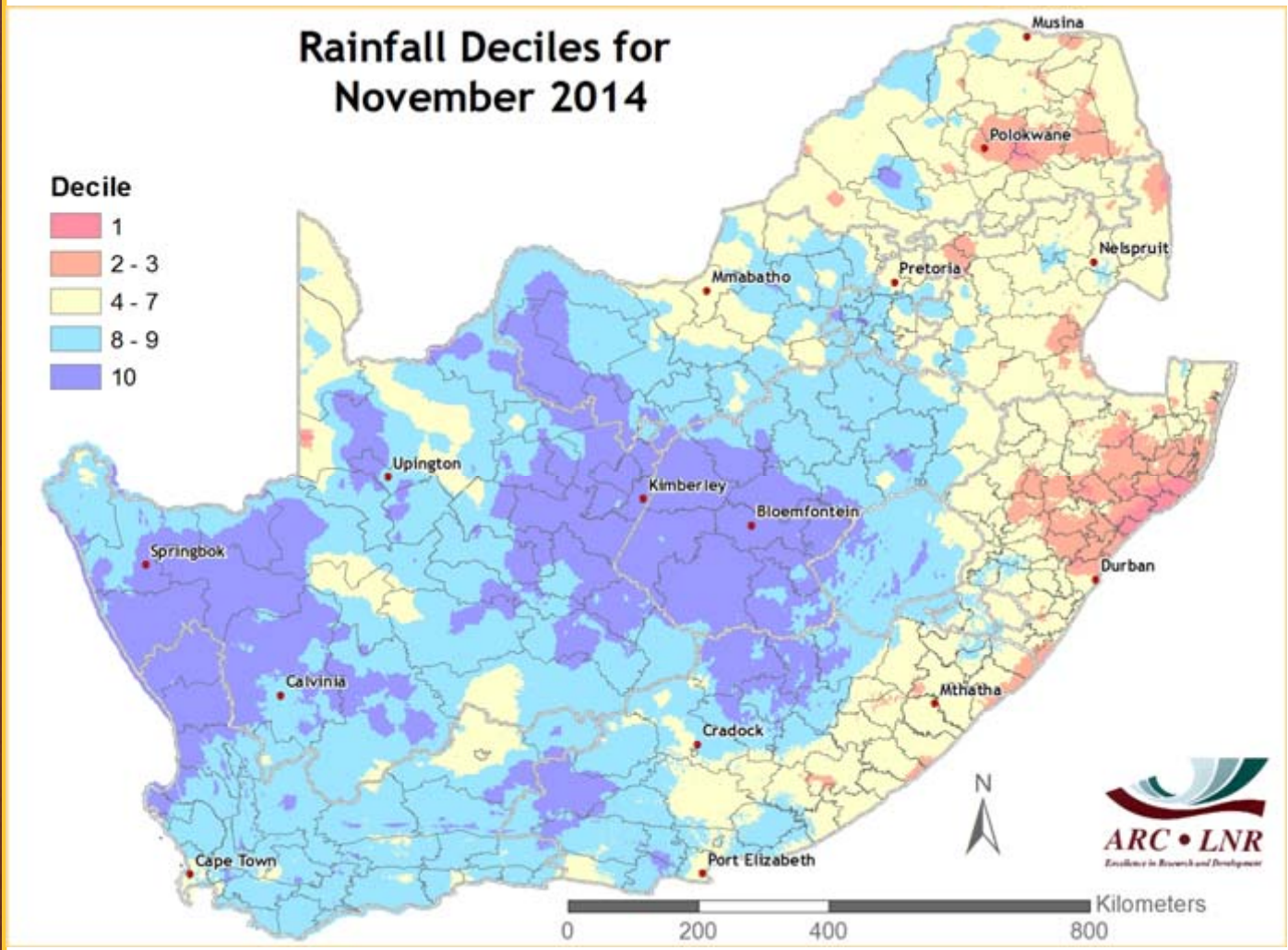

Figure 9

Figure 9:
Rainfall in November was abnormally high over the central to western parts of the country, including the winter rainfall area. An abnormally dry month was experienced over the northeastern coastal region of KwaZulu-Natal.

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

4. Water Balance

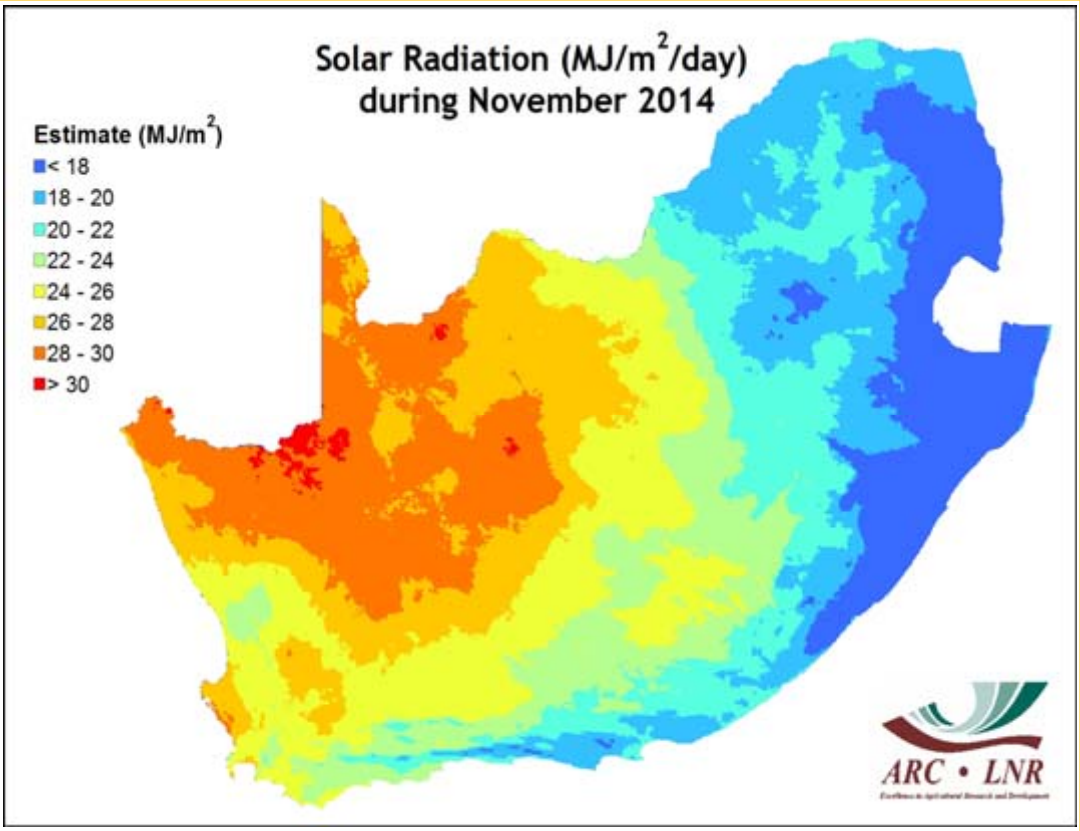

Figure 10

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:
The highest average daily solar radiation values were recorded over the northwestern interior with relatively low values over much of the central to eastern interior. The lowest values were recorded along the southern coastal areas and east of the eastern Escarpment.

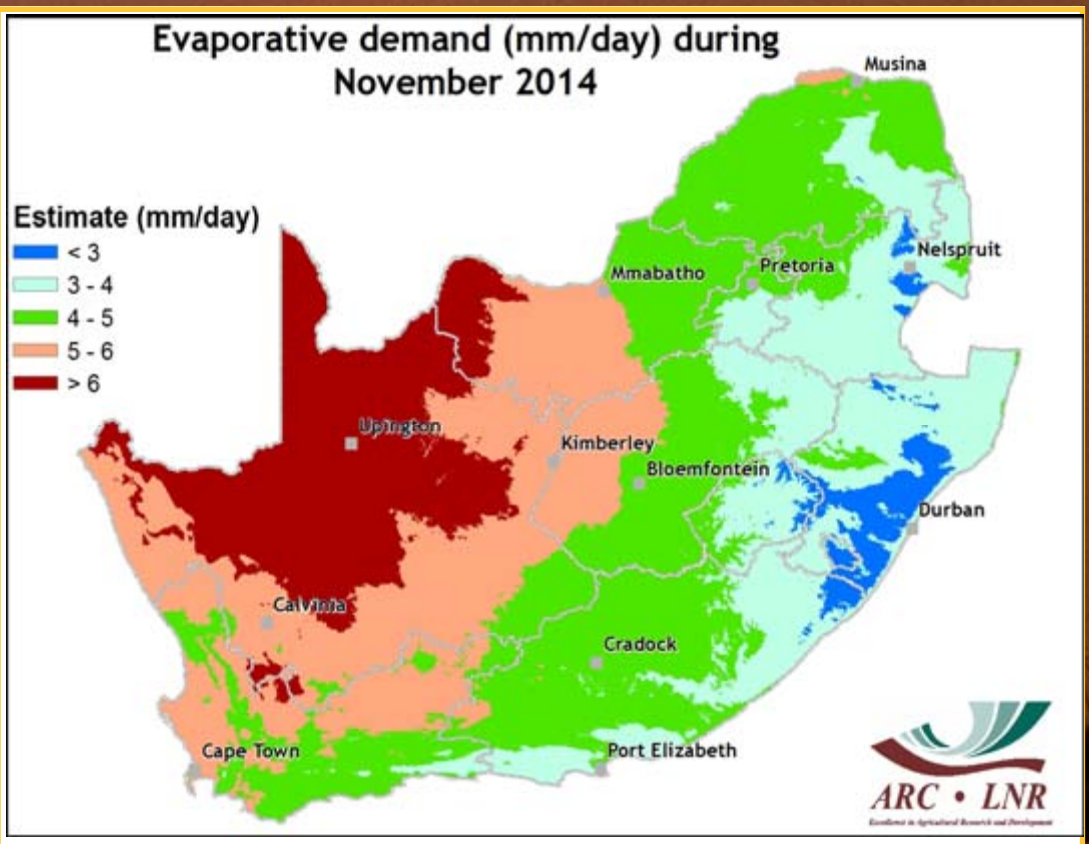

Figure 11

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 2-3 mm per day over the eastern Escarpment and the southern parts of KwaZulu-Natal to more than 6 mm/day over the northwestern interior.

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.

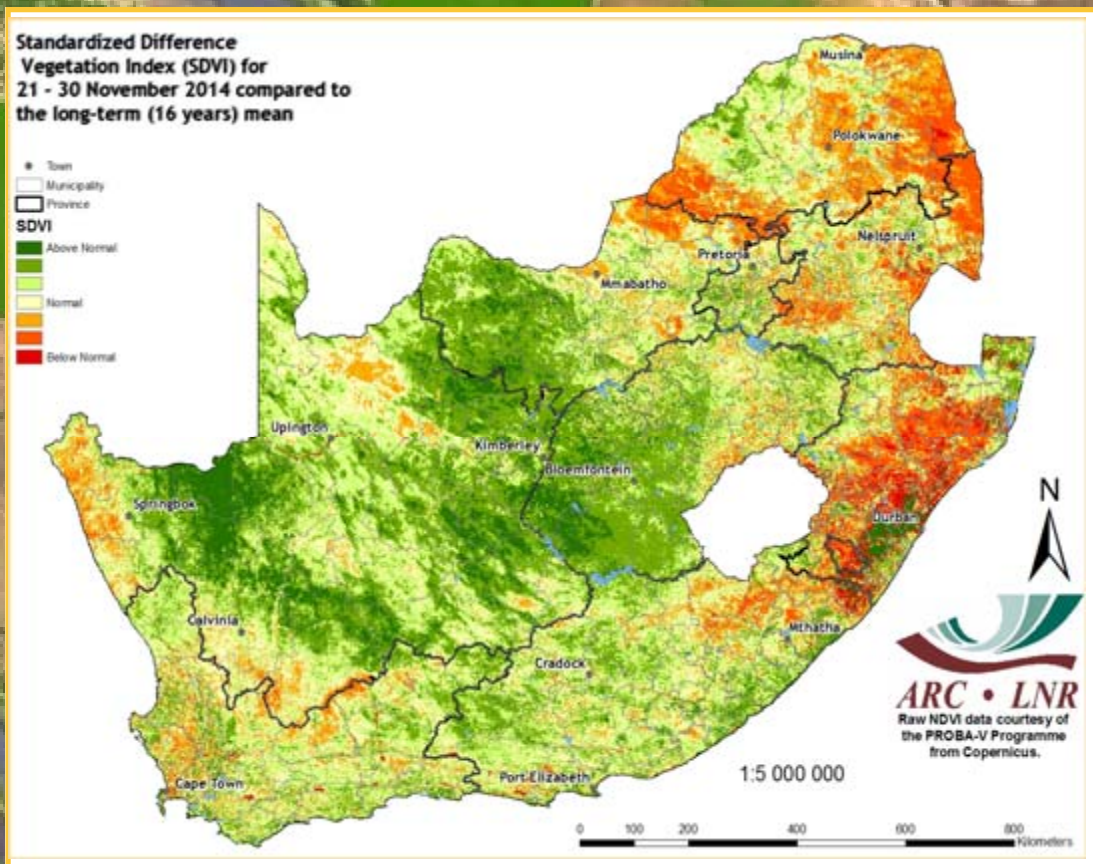

Figure 12

Figure 12:
Widespread above-normal rainfall over the interior has resulted in above-normal vegetation activity over the central to western parts of the country. Conditions towards the east are more mixed relative to the long-term average, with parts of the Lowveld and KwaZulu-Natal experiencing below-normal activity.

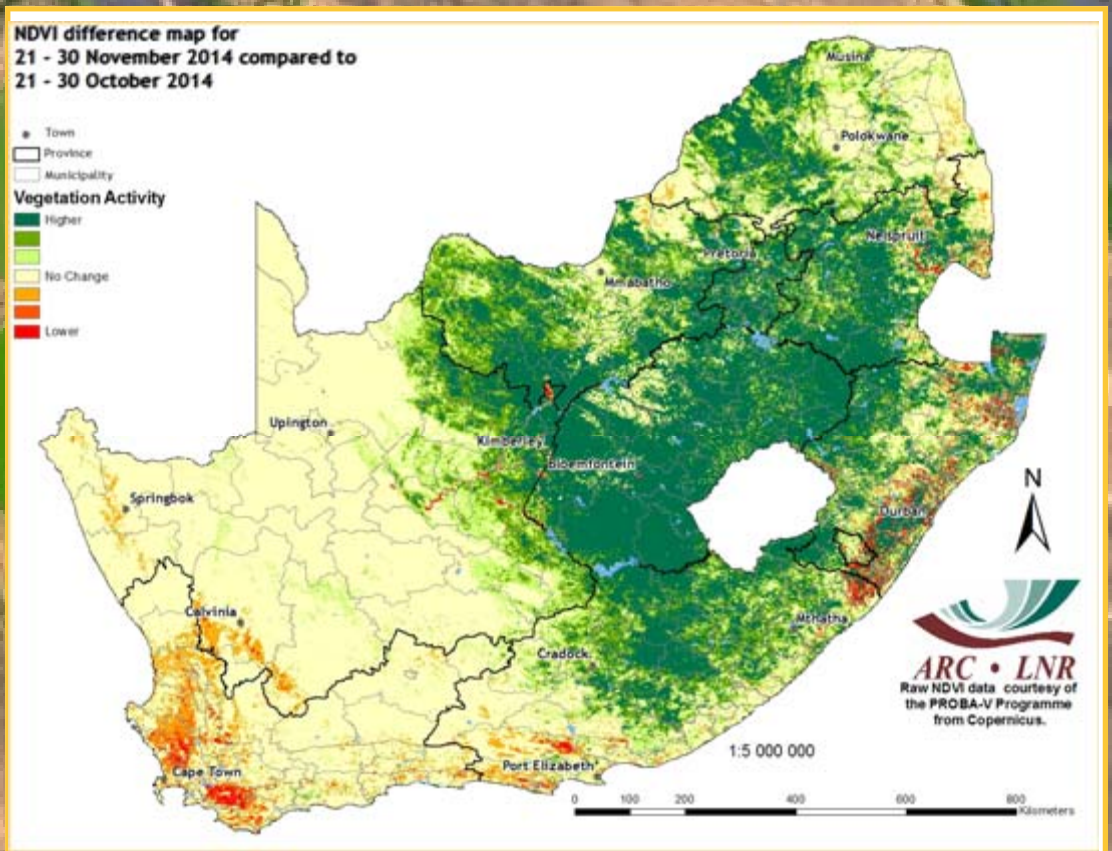

Figure 13

Figure 13:
Widespread summer rainfall resulted in large increases in month-on-month vegetation activity over most of the summer rainfall area while the decline in activity over the winter rainfall area continues.

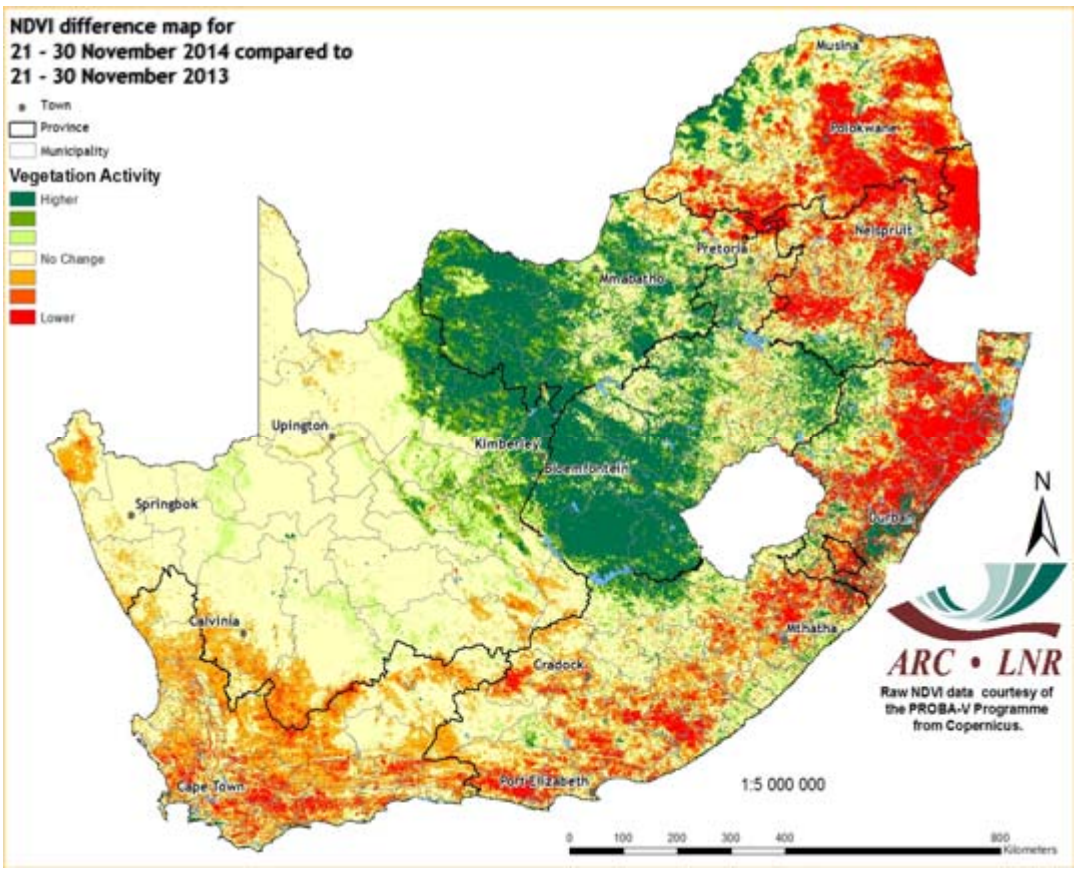

Figure 14

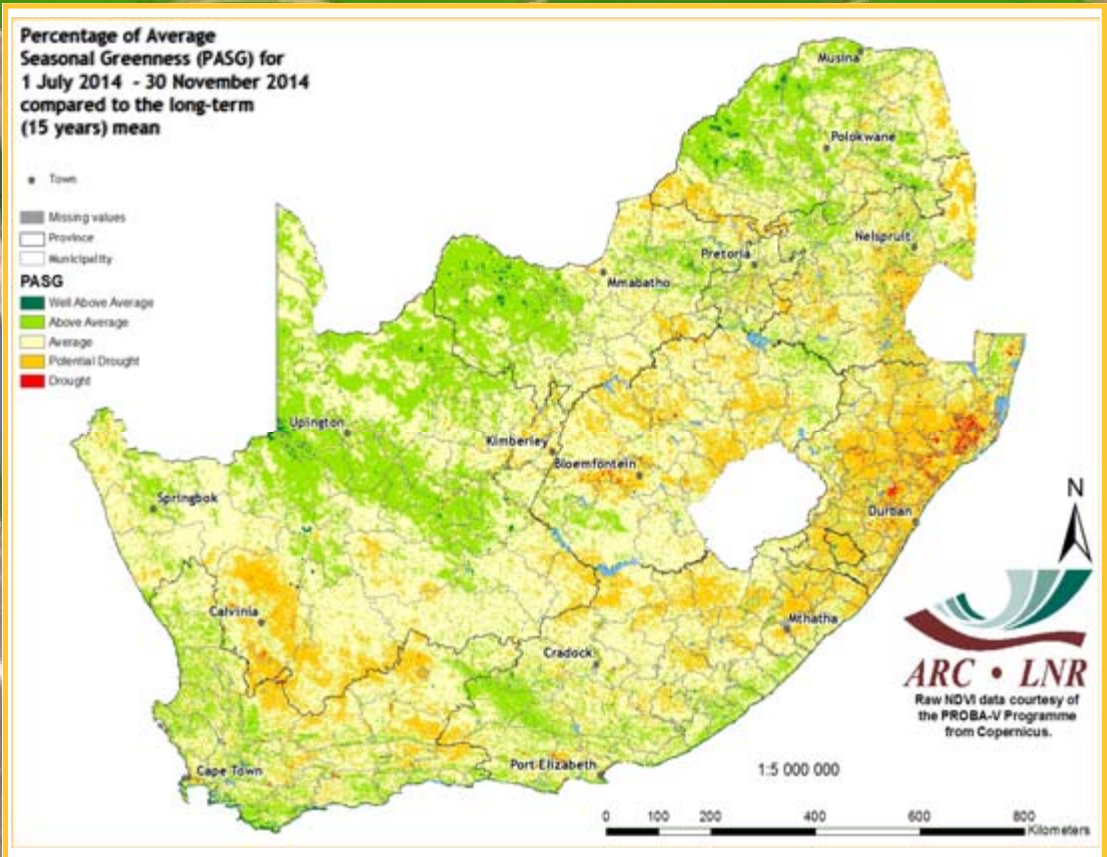

Figure 15

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 relative to the same time in 2013 shows that the summer rainfall season had a much stronger start over the central parts this year, but was weaker over the eastern parts. Activity is also lower than a year ago over the southern parts, including the winter rainfall area.

Figure 15:
Cumulative vegetation activity since July reflects a relatively wet January-March 2014 period over the northern parts of the country. Cumulative vegetation activity is still above normal over the winter rainfall area. Cumulative vegetation activity over the eastern parts, especially some parts of KwaZulu-Natal, is below normal and reflects the dry conditions since the end of the previous summer.

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.

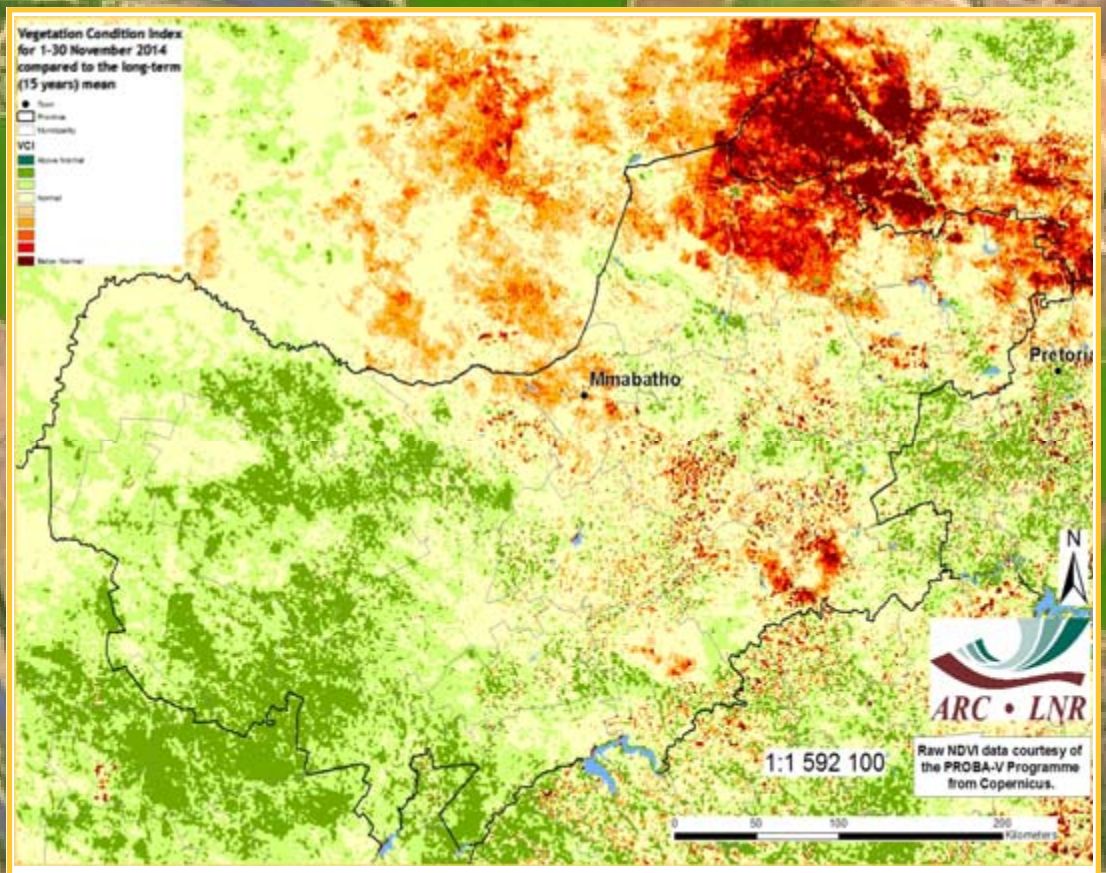

Figure 16

Figure 16:
The VCI map for November 2014 indicates below-normal vegetation activity over most of the northern and eastern parts of North West Province.

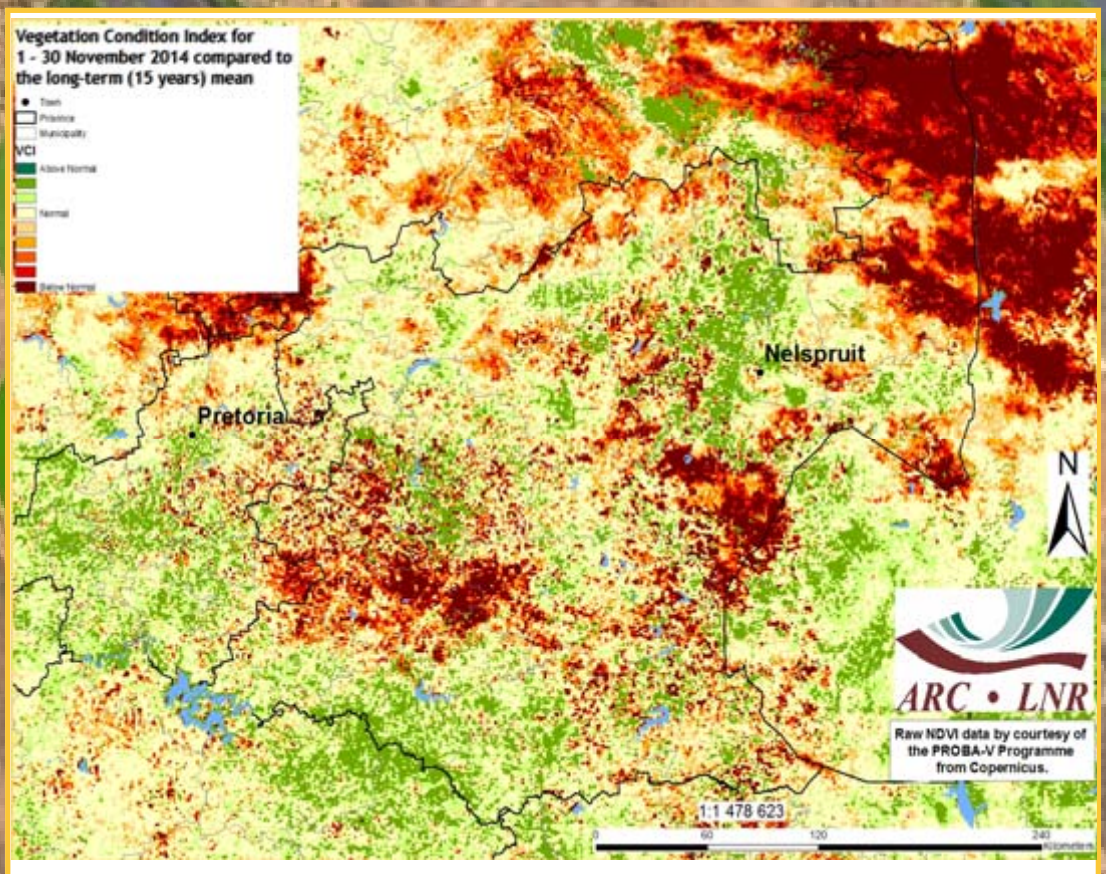

Figure 17

Figure 17:
The VCI map for November 2014 indicates below-normal vegetation activity over most of Mpumalanga.

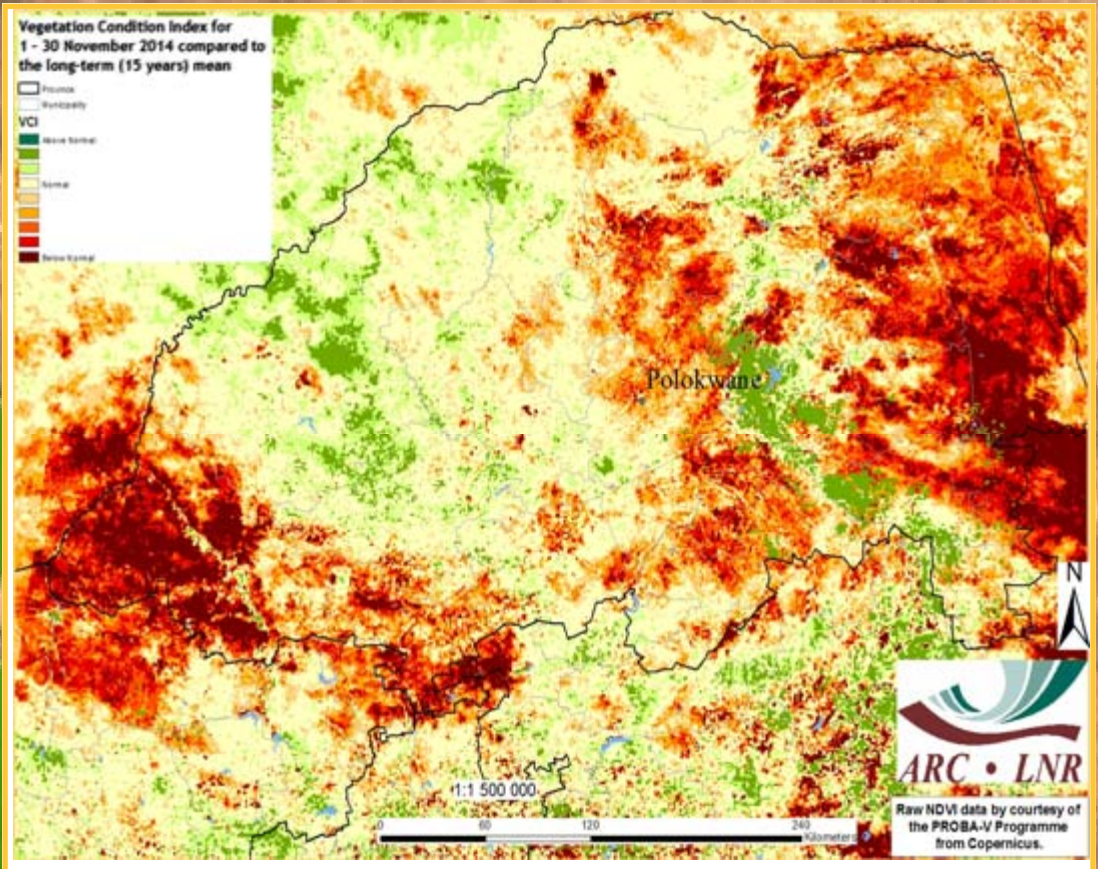

Figure 18

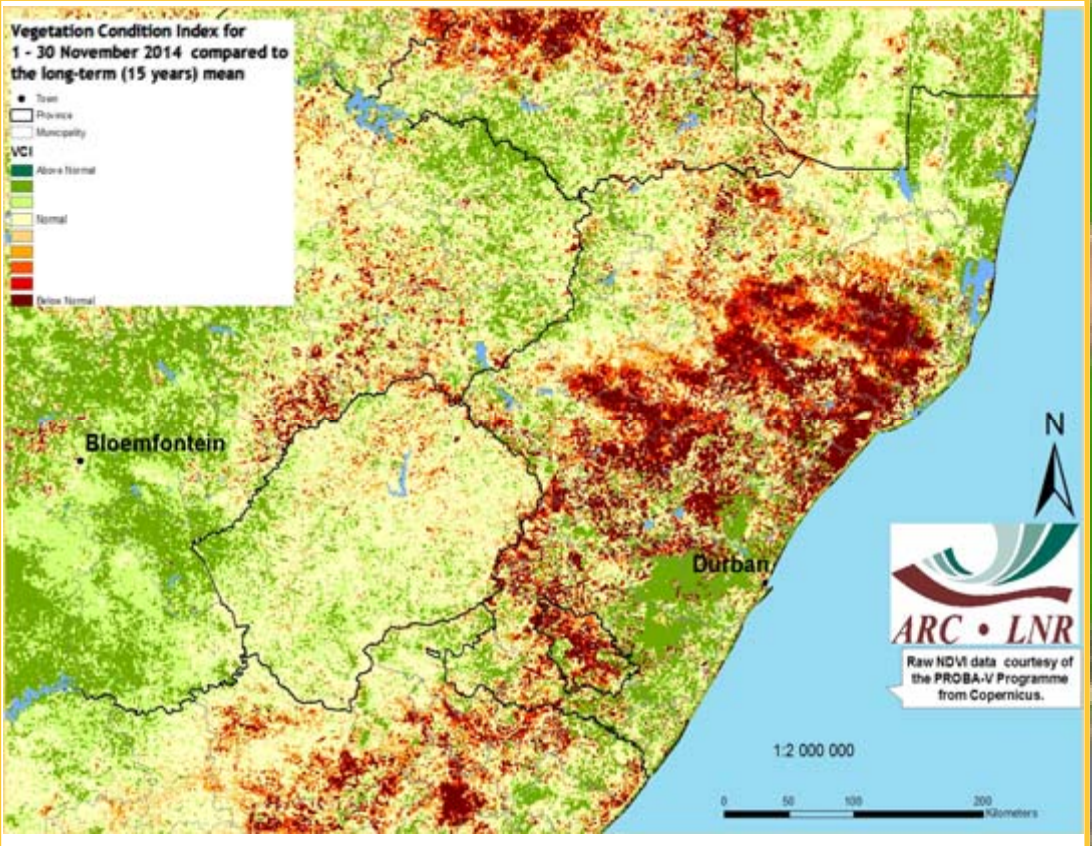

Figure 19

Figure 18:
The VCI map for November 2014 indicates below-normal vegetation activity over most parts of Limpopo.

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

Questions/Comments:
NkambuleV@arc.agric.za

7. Vegetation Conditions & Rainfall

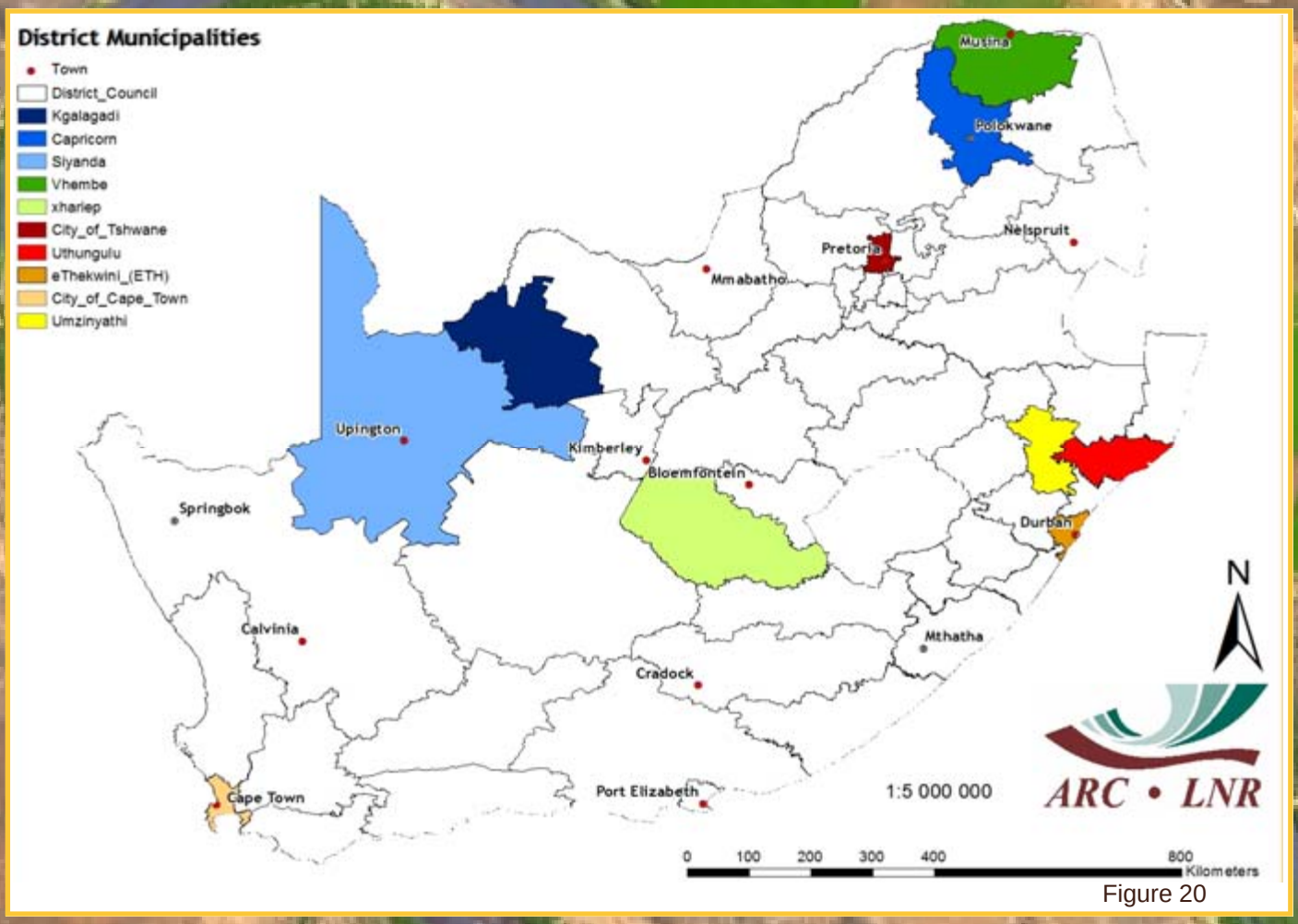

Figure 20

NDVI and Rainfall Graphs
Figure 20:
Orientation map showing the areas of interest for November 2014. 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.

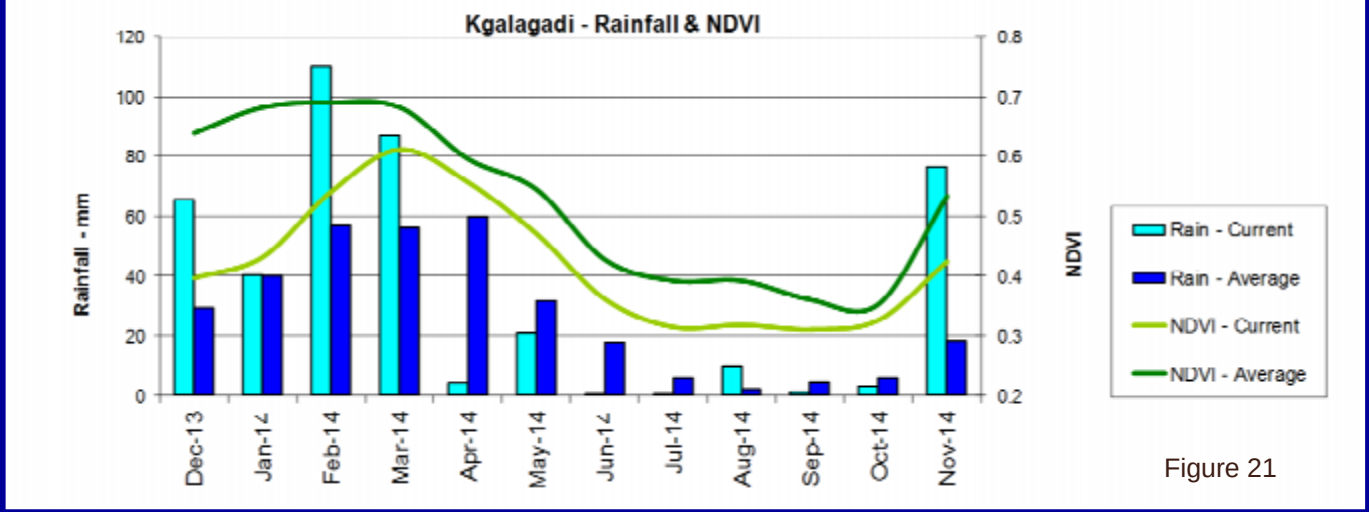

Figure 21

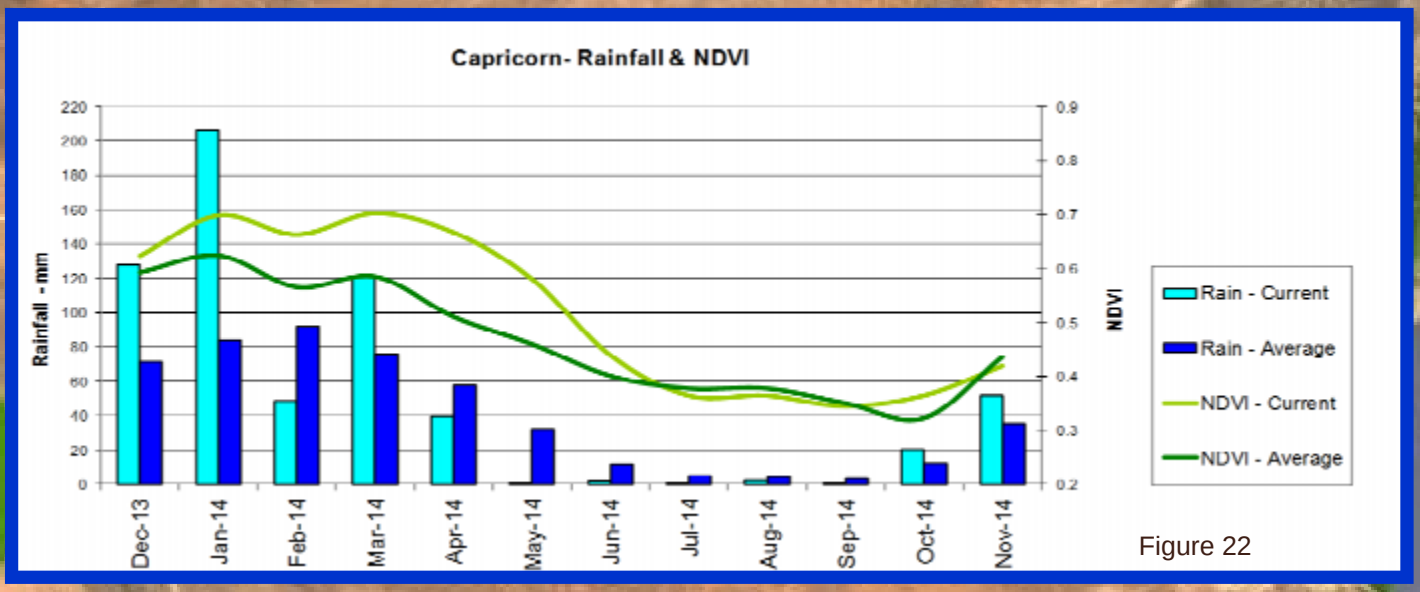

Figure 22

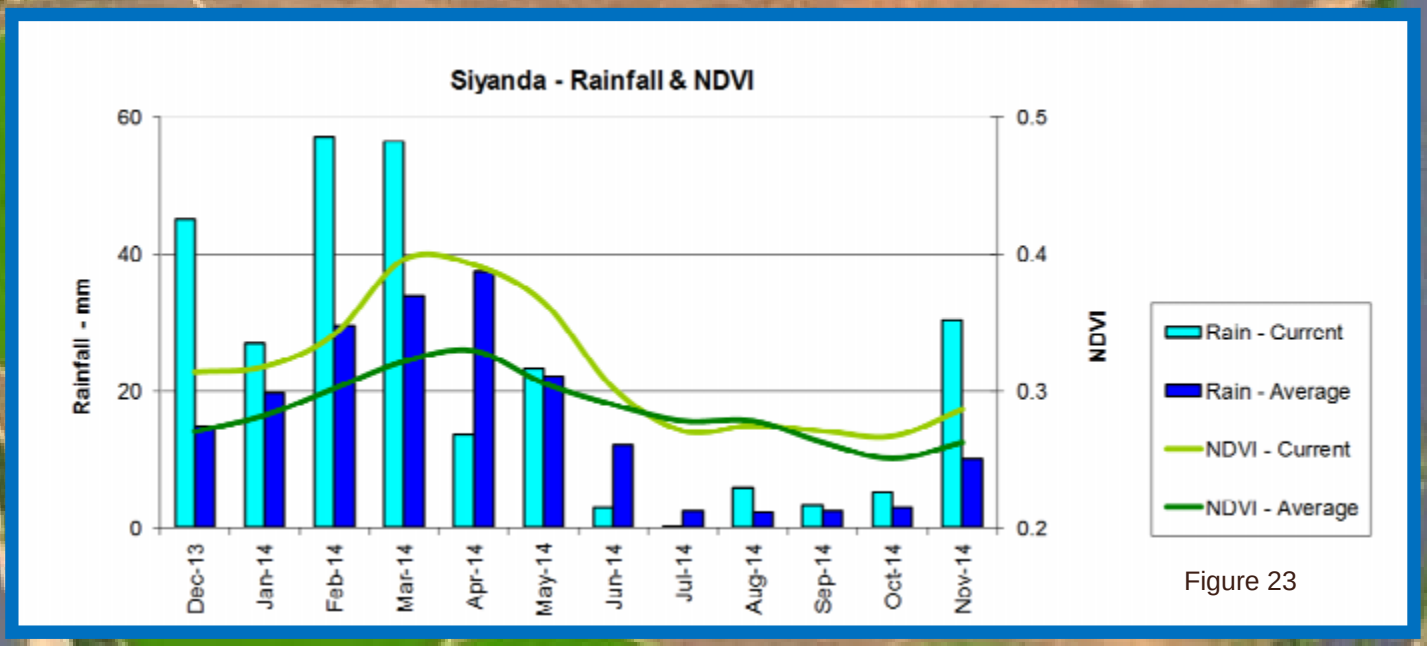

Figure 23

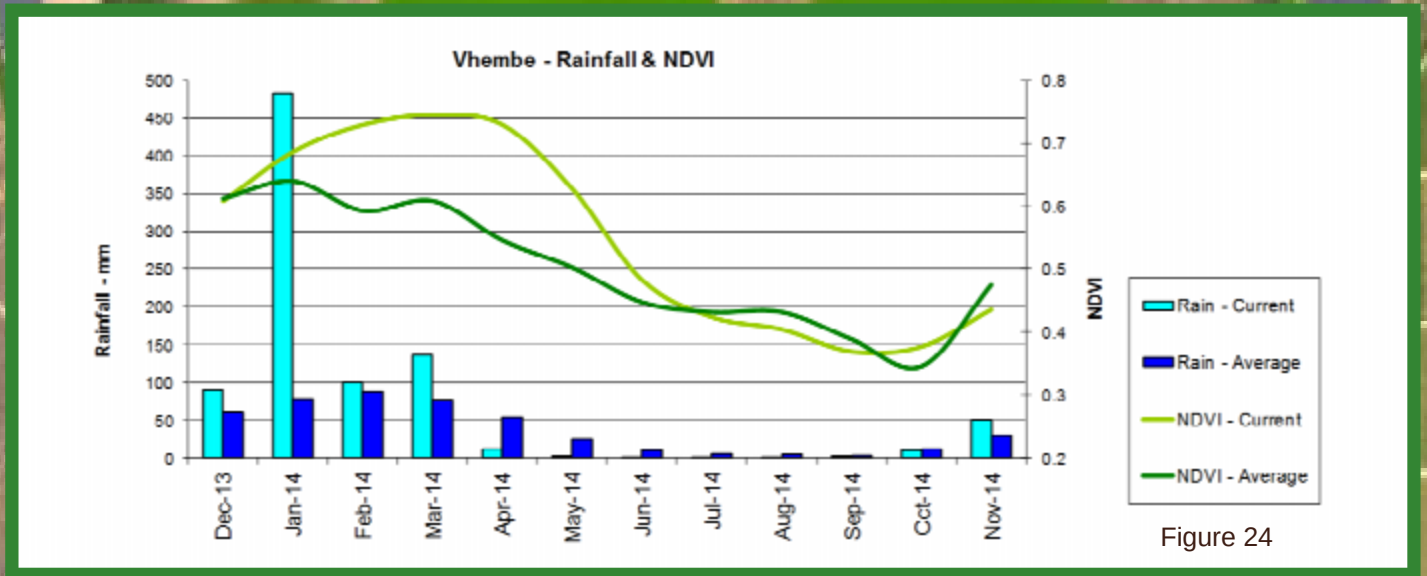

Figure 24

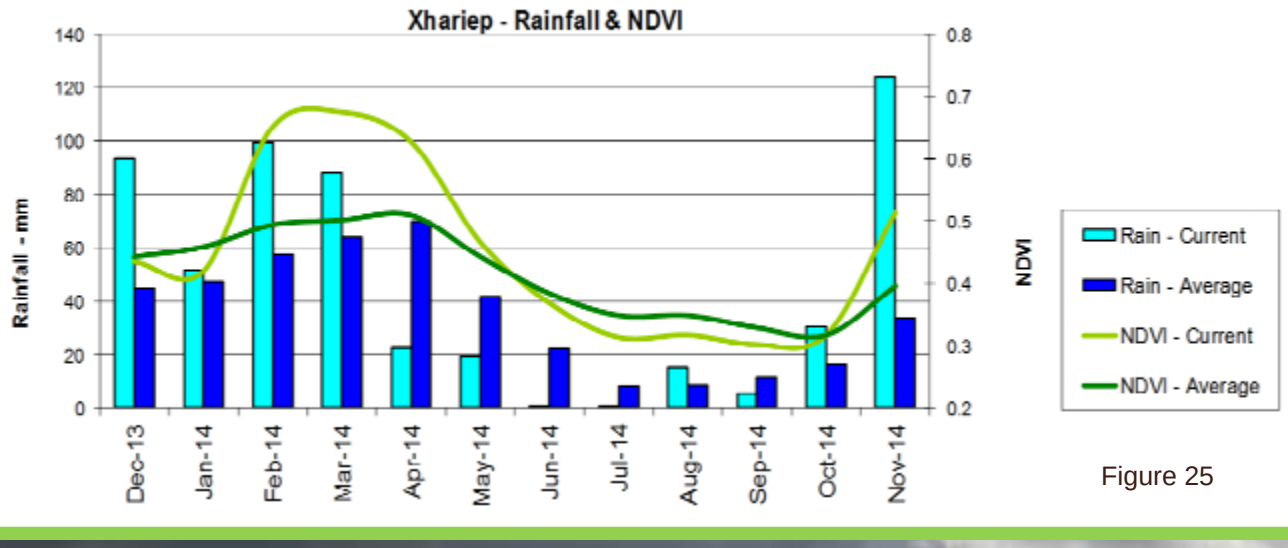

Figure 25

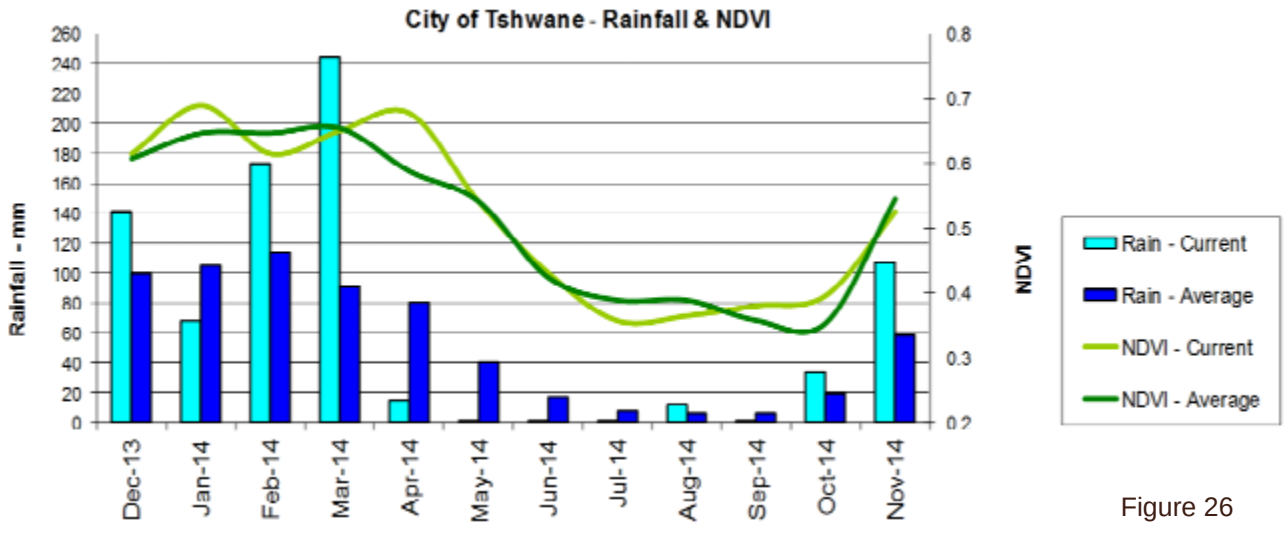

Figure 26

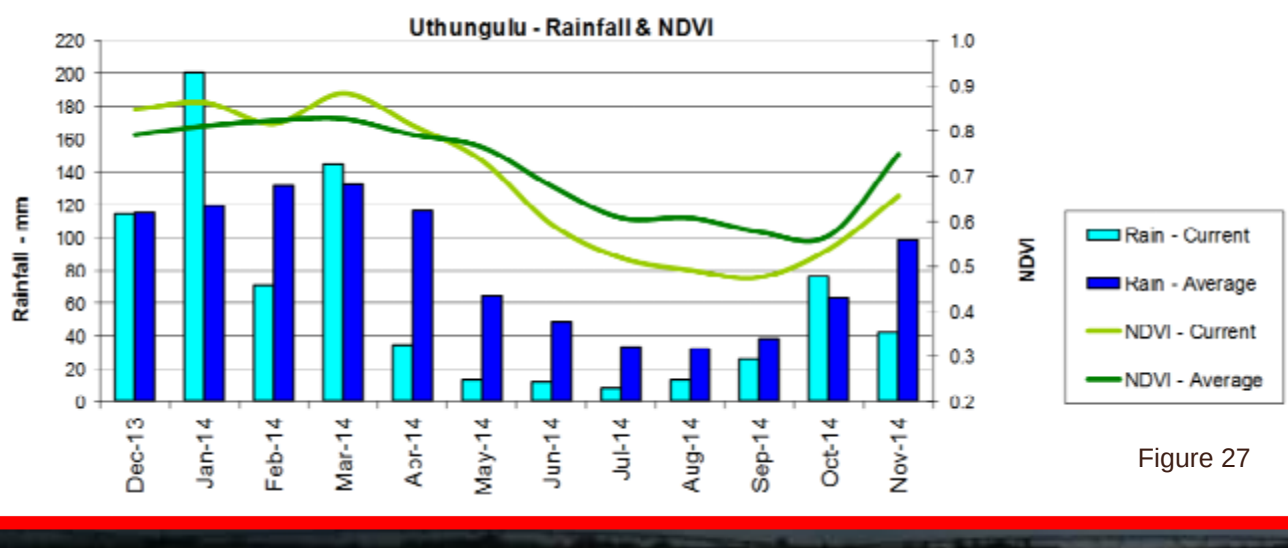

Figure 27

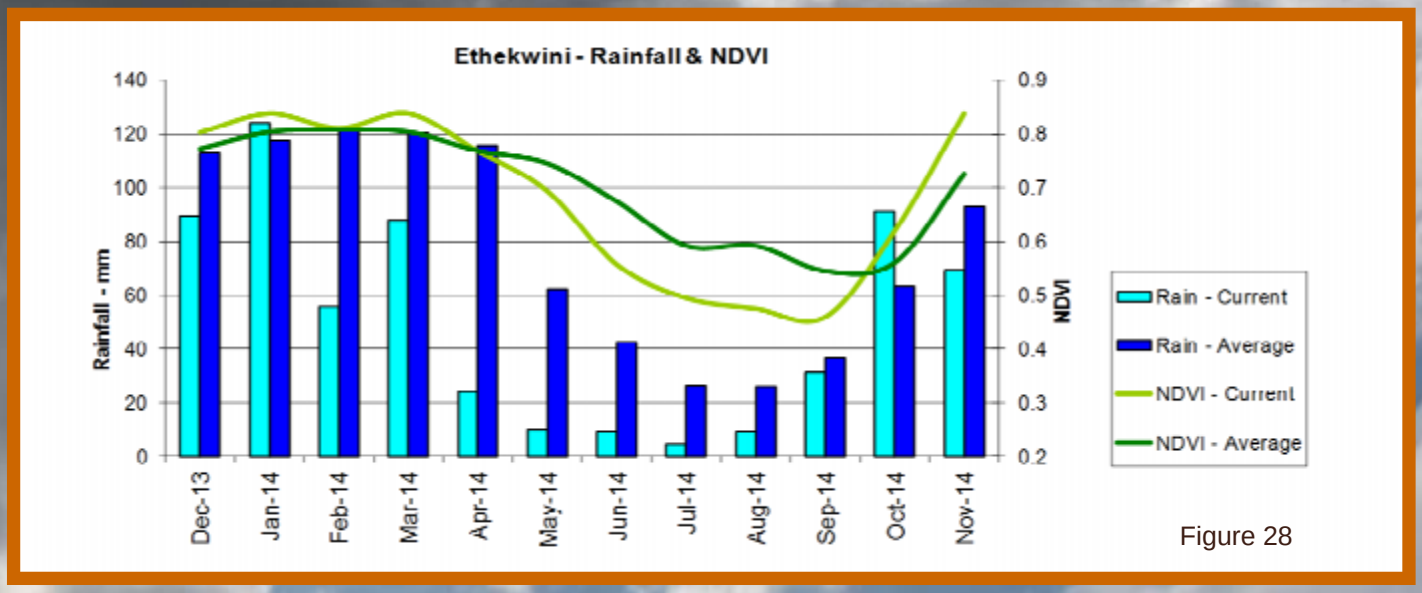

Figure 28

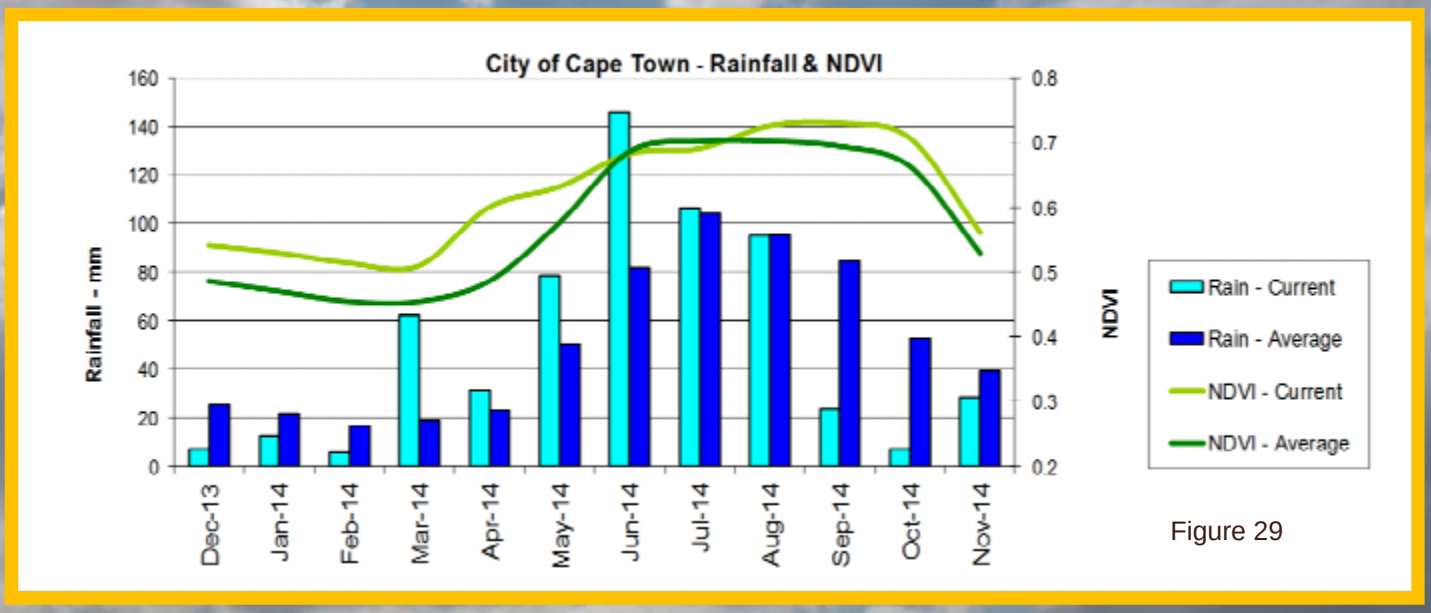

Figure 29

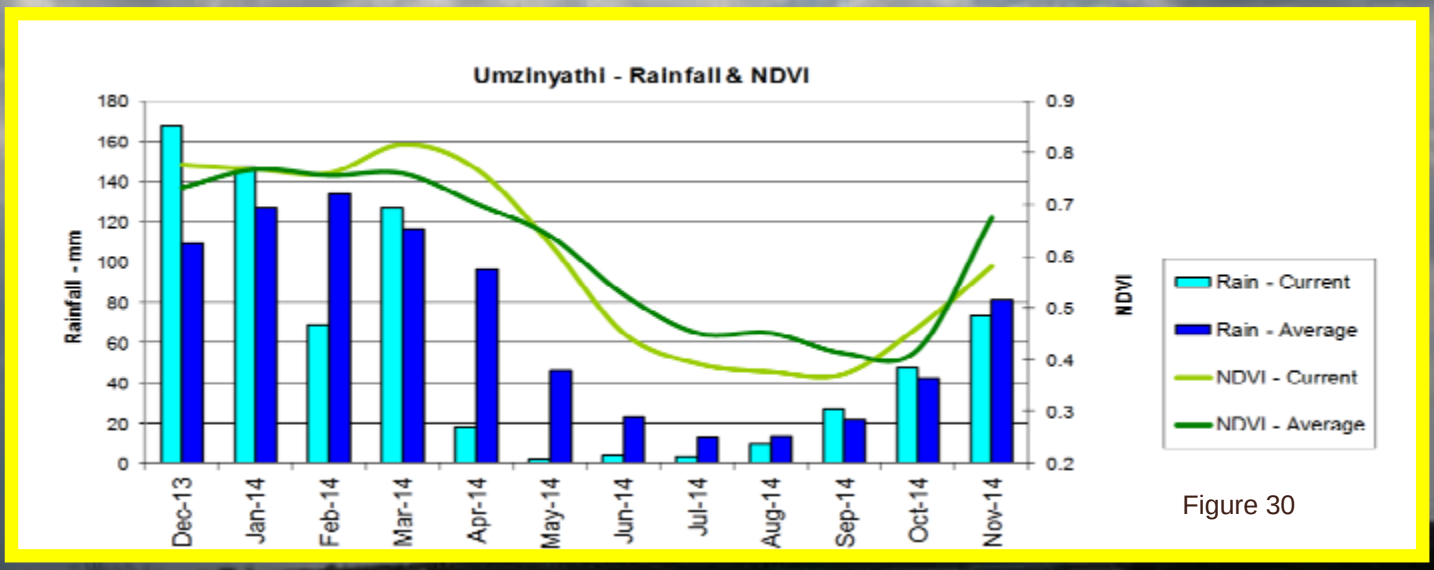

Figure 30

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

The Coarse Resolution Imagery Database (CRID)

NOAA AVHRR

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

MODIS

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

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

Datasets include:

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

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

VGT4AFRICA and GEOSUCCESS

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

ARC-ISCW has an archive of VEGETATION data dating from 1998 to the present. Other products distributed through VGT4AFRICA and GEOSUCCESS include Net Primary Productivity, Normalized Difference Wetness Index and Dry Matter Productivity data.

Meteosat Second Generation (MSG)

The ARC-ISCW has an operational MSG receiving station. Data from April 2005 to the present have been archived. MSG produces data with a 15-minute temporal resolution for the entire African continent. Over South Africa the spatial resolution of the data is in the order of 3 km. The ARC-ISCW investigated the potential for the development of products for application in agriculture. NDVI, LST and cloud cover products were some of the initial products derived from the MSG SEVIRI data. Other products derived from MSG used weather station data, including air temperature, humidity and solar radiation.

Rainfall maps

- Combined inputs from 450 automatic weather stations from the ARC-ISCW weather station network, 270 automatic rainfall recording stations from the SAWS, satellite rainfall estimates from the Famine Early Warning System Network: **http://earlywarning.usgs.gov** and long-term average climate surfaces developed at the ARC-ISCW.

Solar Radiation and Evapotranspiration maps

- Combined inputs from 450 automatic weather stations from the ARC-ISCW weather station network.
- Data from the METEOSAT Second Generation (MSG) 3 satellite via GEONETCAST: **http://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/GEONETCast/index.html**.

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

http://www.agis.agric.za