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INSTITUTE FOR SOIL, CLIMATE AND WATER

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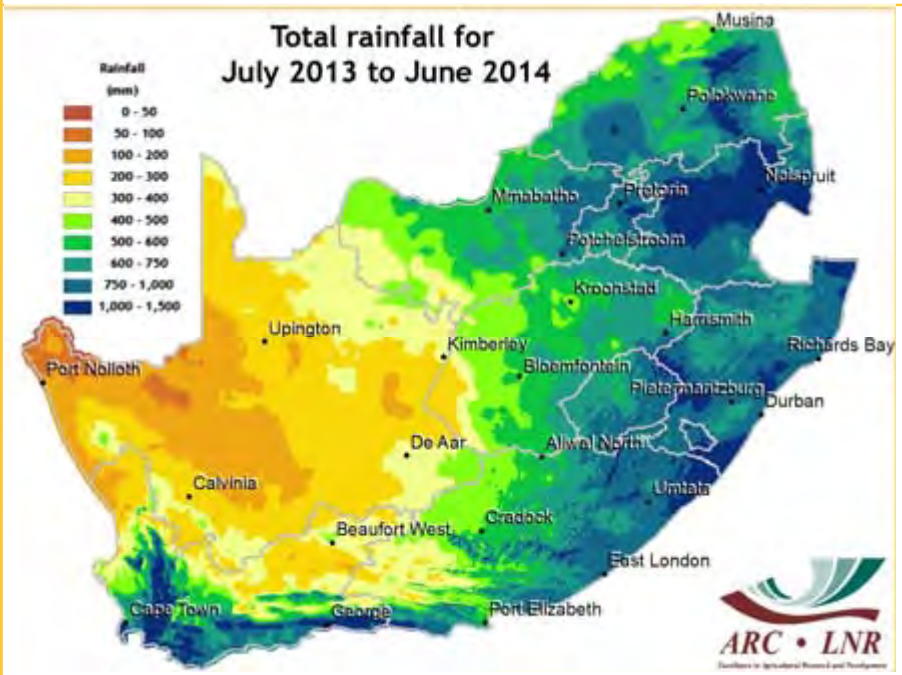
agriculture, forestry & fisheries
Department: Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

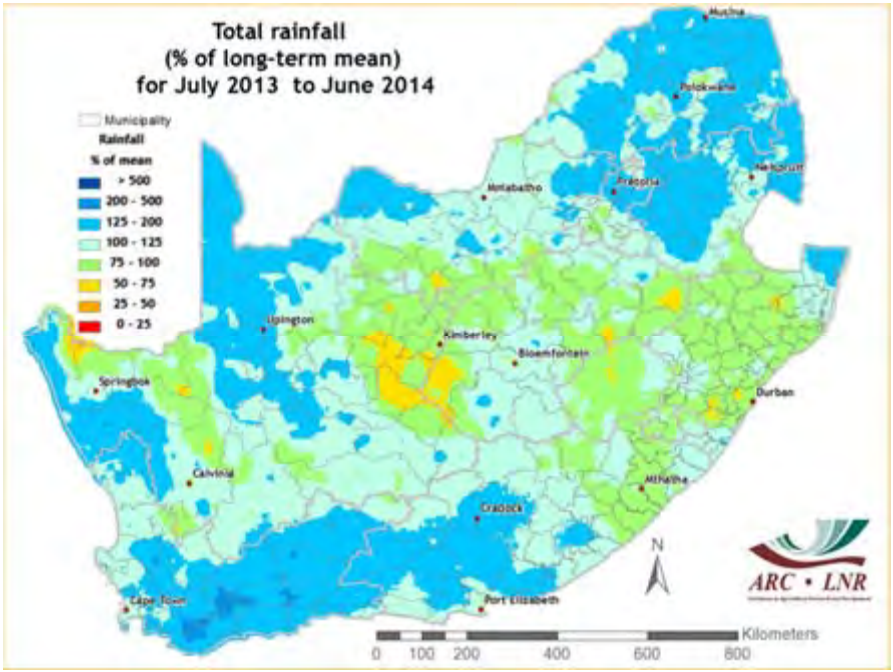
South African Weather Service

AMESD

121st Edition

Images of the Month





2013/14 Summer Rainfall Season

The first map shows the total rainfall for the period 1 July 2013 to 30 June 2014. Large parts of Mpumalanga, the eastern Escarpment and the mountainous areas in the south and southwest received in excess of 1000 mm of rain in total. Over the interior, the 500 mm isohyet is located over the western Free State and into western North West. Conditions during the 2013/14 summer season have been more favourable for crop production. Positive contributing factors were the very wet conditions during February and March over much of the interior, associated largely with a tropical low over Botswana, and a relatively mild and dry April-May period. The persistence of the tropical low over Botswana was in stark contrast to conditions during the late summers of 2011 to 2013. Over the summer grain production region, negative climatic factors included frequent hail storms during October and November 2013 in the northeast, a relatively late start to the rainy season over the central interior (western maize production region) and hot and dry conditions during much of January together with a relatively long midsummer drought during January and February over parts of Mpumalanga.

The second map shows that, compared to the long-term average, much of the northern, northeastern and western interior as well as the winter rainfall area received above-normal rainfall. Some areas over the eastern Northern Cape, far western Free State and parts of northern and central KwaZulu-Natal received normal to below-normal rainfall.

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:

The summer rainfall area was mostly dry during June 2014. Cold fronts regularly moved into the country, however, keeping it wet over the winter rainfall area with low minimum temperatures over the interior. After plummeting during the early part of the month, minimum temperatures remained relatively low during June, recovering somewhat towards the end of the month.

Frontal systems, some with upper-air support, were responsible for widespread and sometimes significant precipitation events over the winter rainfall area, spread fairly evenly throughout the month. The most significant of these events were concentrated around the 5th, 9th, 14th, 18th and 25th.

The system that moved across South Africa by the 5th had a very strong cooling effect over the entire country, bringing widespread frost and cold weather, together with snow over many of the southern to southeastern high lying areas. It was also associated with the development of a deep low over the interior, supporting the occurrence of snow over some areas towards the southern interior. A second system that crossed the country by the 9th again resulted in rain and snow over the southwestern and southern parts and reinforced low temperatures across the interior. The pattern was repeated by the 15th, 19th and 25th. However, with stronger upper air support by the 25th in the form of a sharp upper air trough, precipitation also occurred over parts of the central to northern Northern Cape. As the upper air trough moved across the northern parts during the next few days, some light showers occurred over parts of the northeastern interior. Some rain also occurred over eastern KwaZulu-Natal due to an onshore flow during this period.

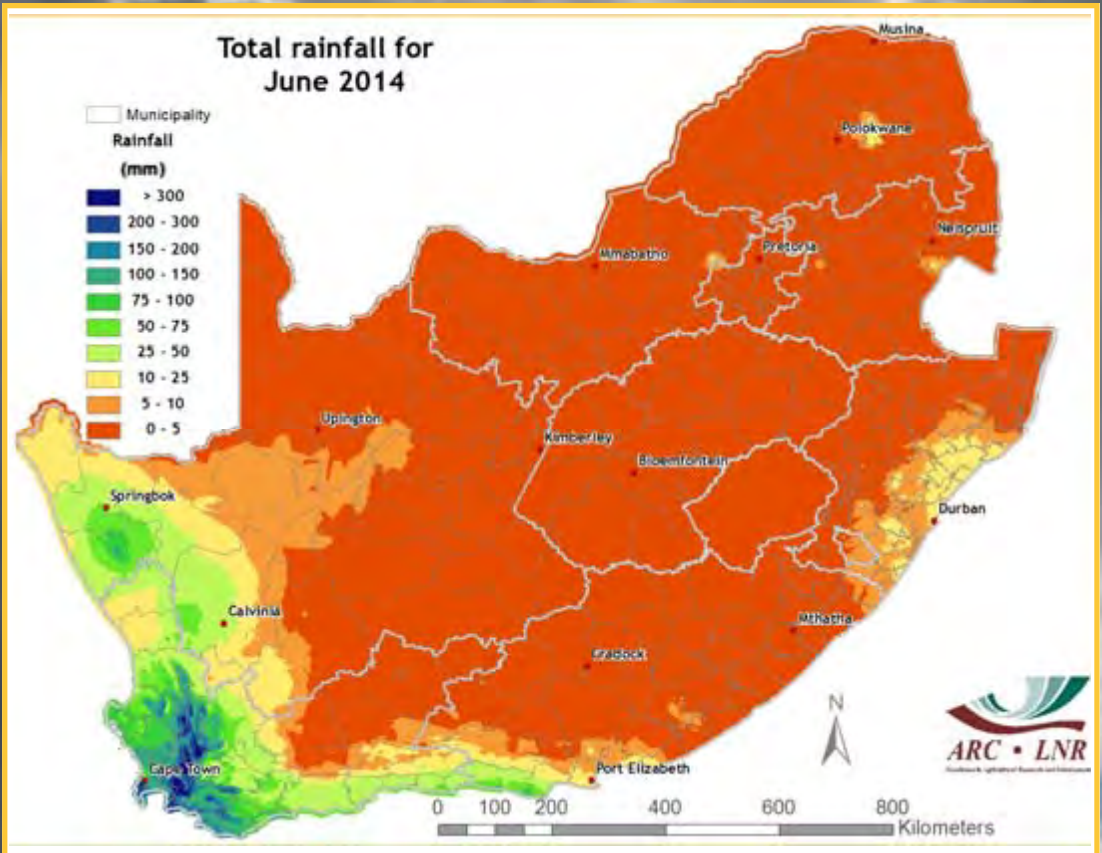


Figure 1

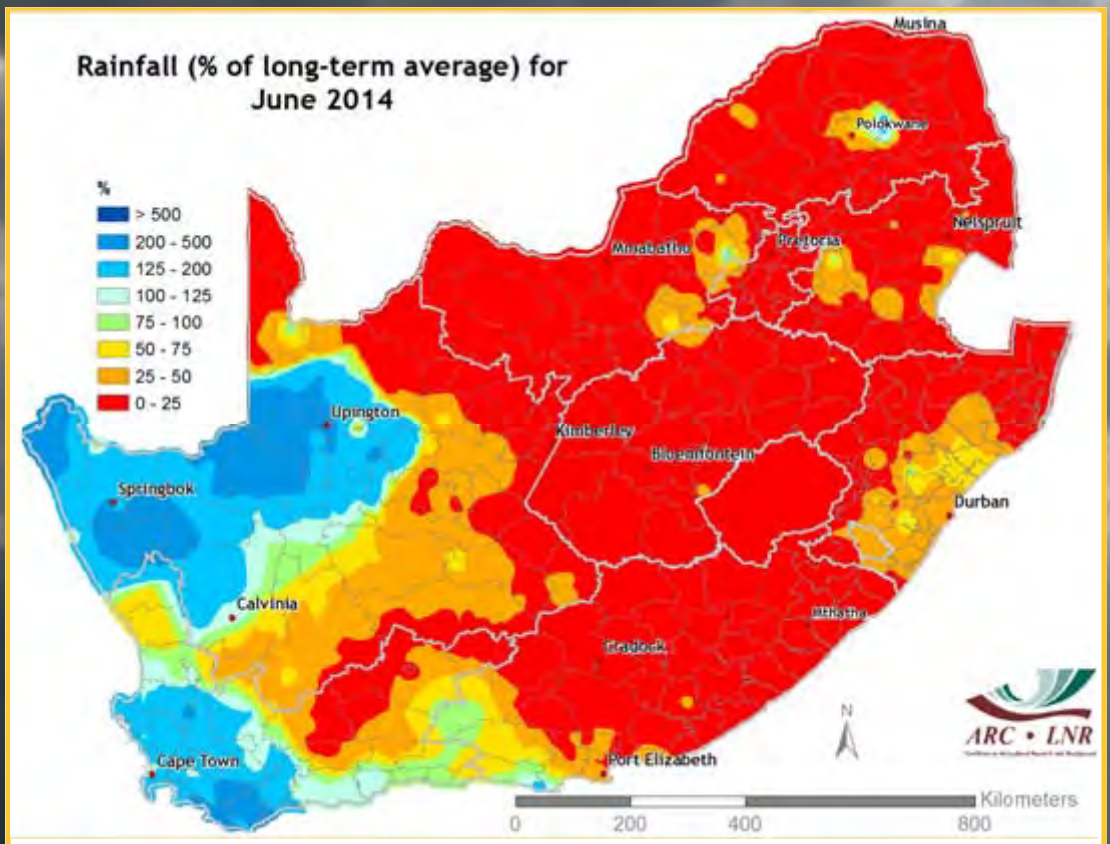


Figure 2

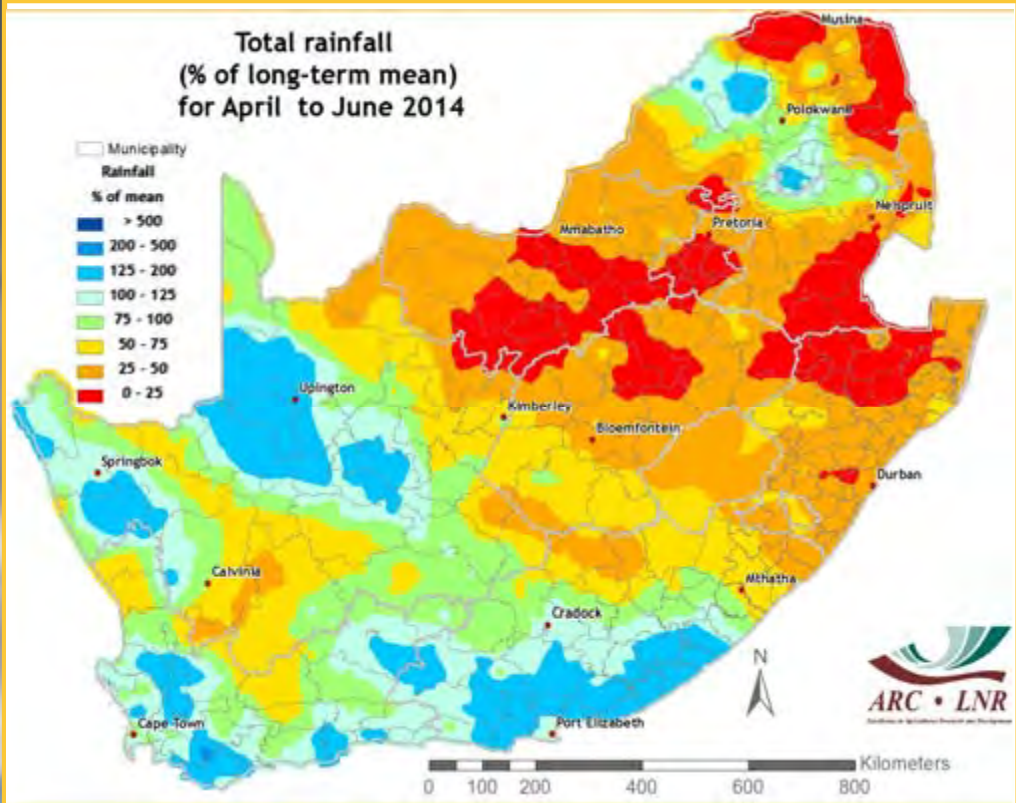


Figure 3

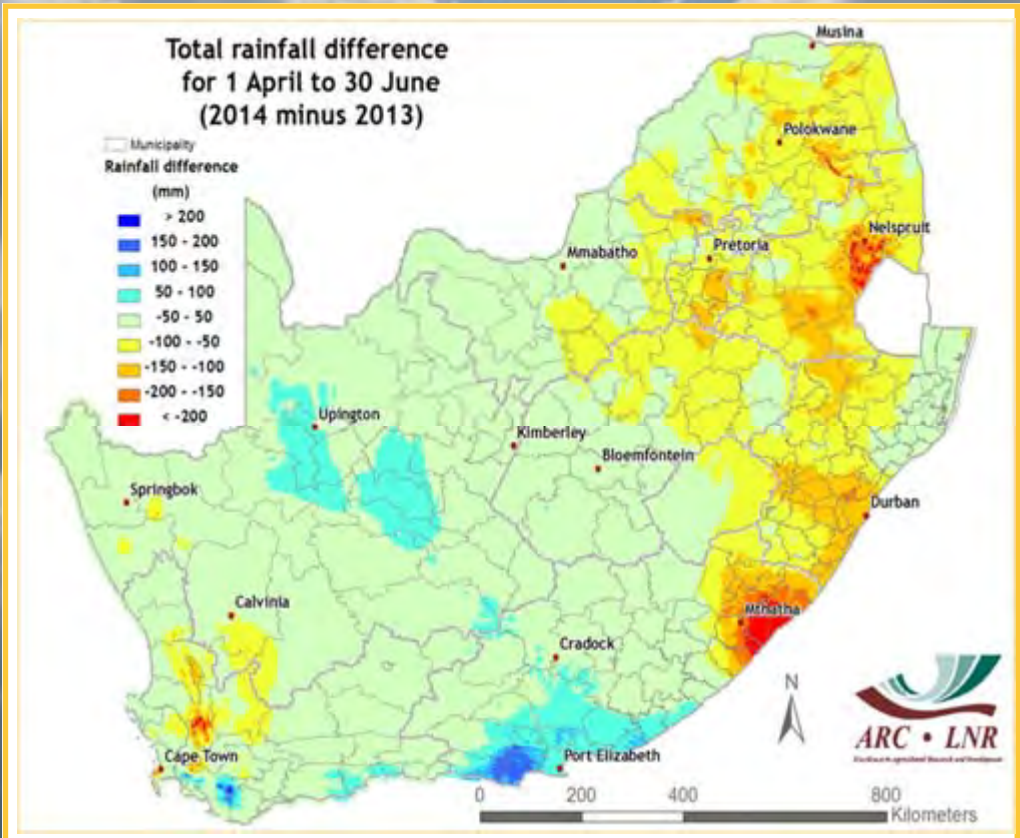


Figure 4

Figure 1:
Precipitation in June was mostly concentrated over the winter rainfall area. Much of the Swartland received between 75 mm and 150 mm. The highest falls, exceeding 200 mm, were confined to the southwestern mountainous region. Along the Garden Route, falls generally did not exceed 75 mm. The summer rainfall area was mostly dry, except for isolated areas with relatively light falls in the northeast. Eastern KwaZulu-Natal received some rain. Rain also occurred somewhat deeper into the interior over the western and northern parts of the Northern Cape.

Figure 2:
Rainfall was above normal over most of the winter rainfall area and into the central parts of the Northern Cape.

Figure 3:
Since April, precipitation has been above normal over much of the southwestern half of South Africa, including the winter rainfall area. Except for parts of Limpopo, precipitation was below normal over the northeastern half of the country.

Figure 4:
While the central and southern parts received somewhat more rain this year in the April-June period, less rain occurred over the eastern and northeastern parts as well as the northern winter rainfall area than in 2013.

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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 that most of the winter rainfall area is wet to extremely wet at all time scales considered. The northeastern interior is wet on time scales of 6 months and longer. At the 12 and 24-month time scales, there are still indications of dry conditions over the central interior, despite the wet conditions that occurred during late summer as indicated by the 6-month SPI. At the shorter time scales, the eastern parts are indicated to be relatively dry.

Questions/Comments:
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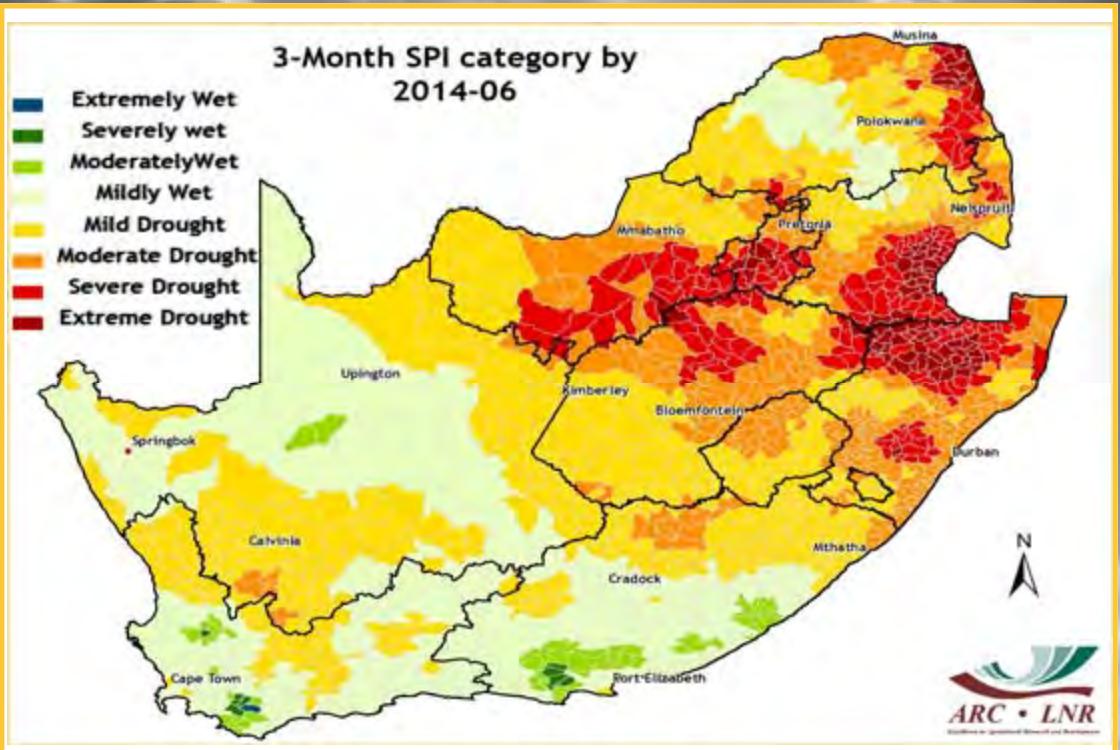

Figure 5

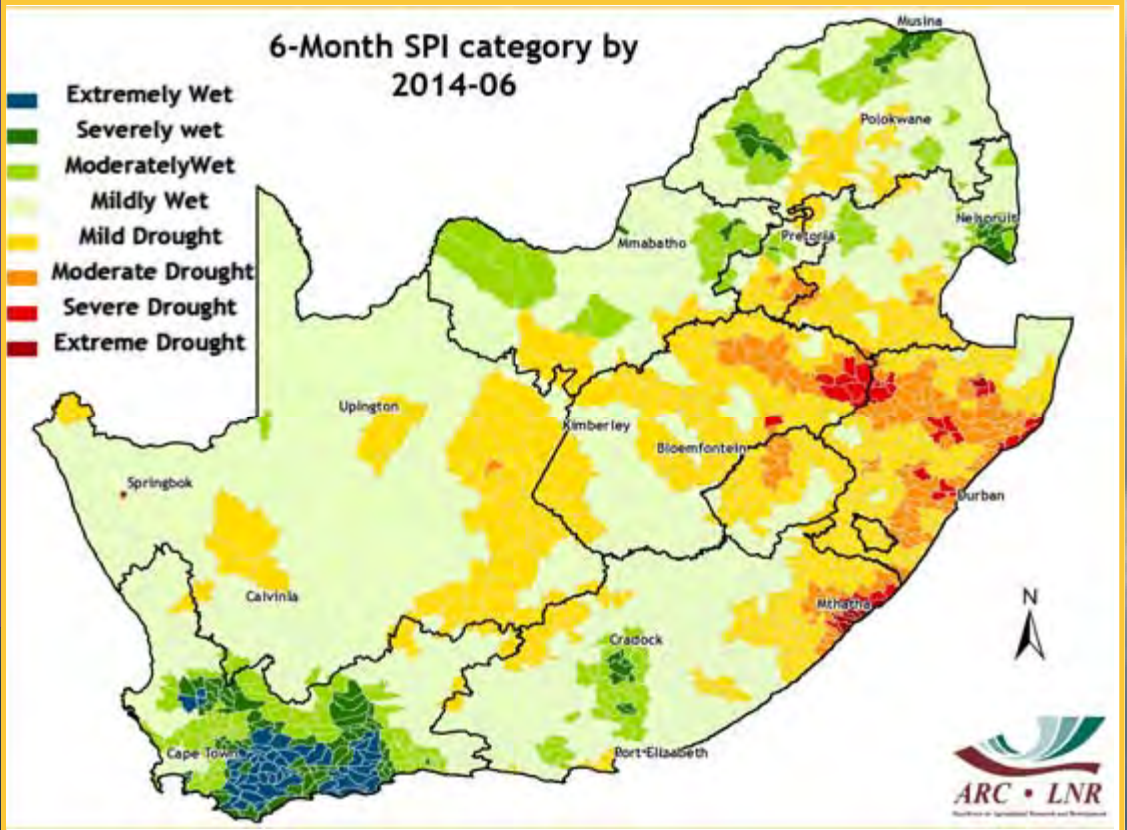

Figure 6

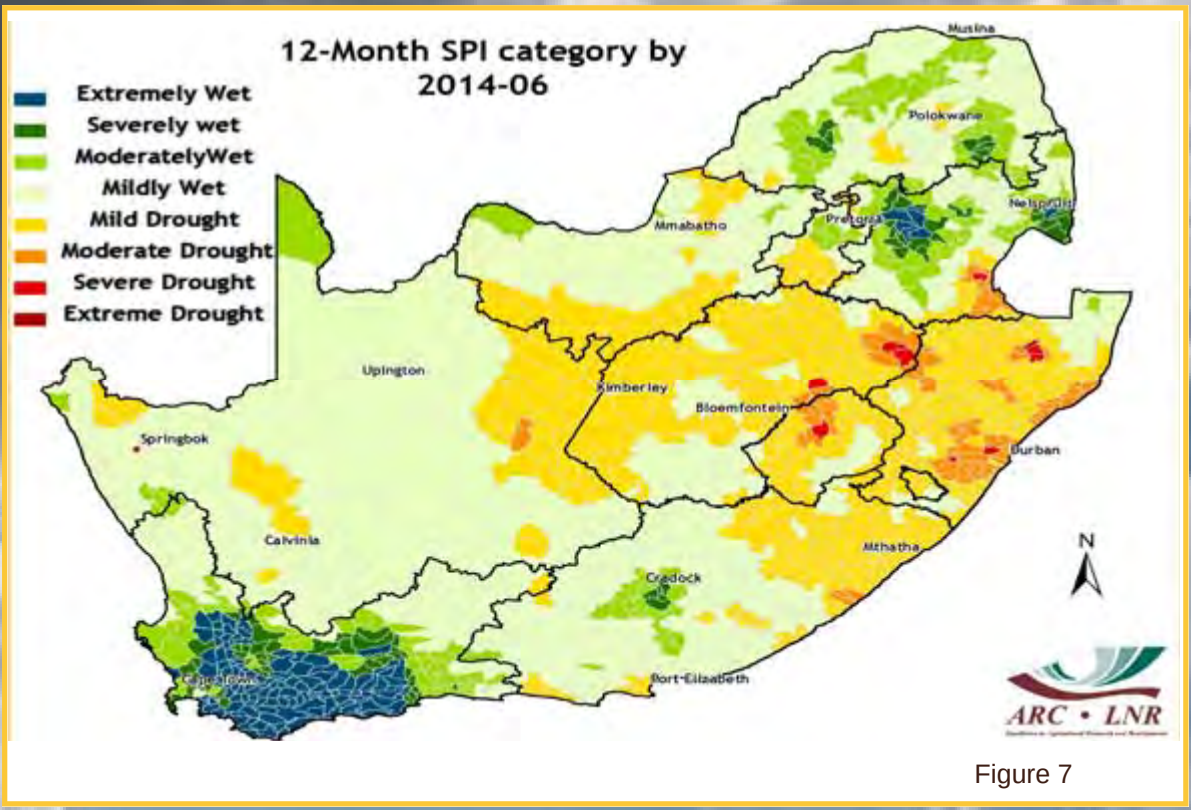

Figure 7

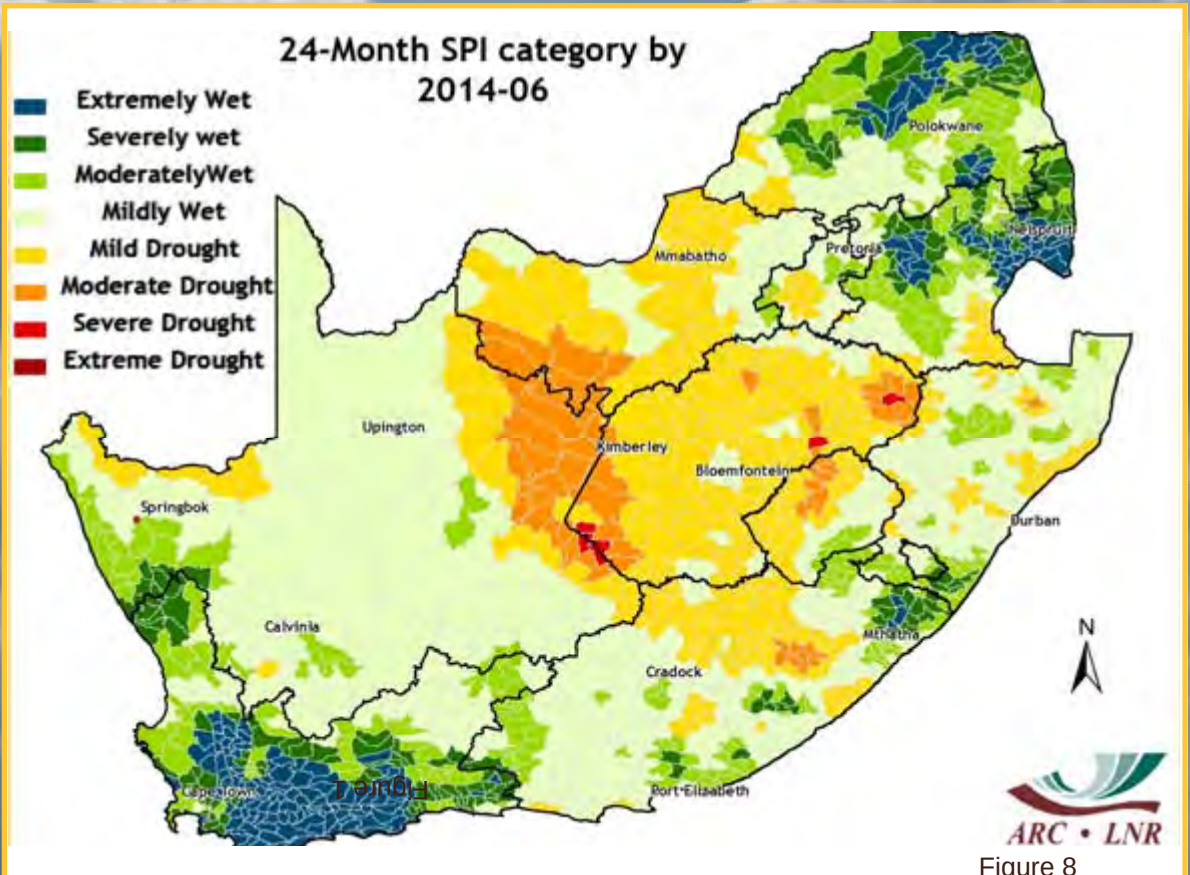

Figure 8

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.

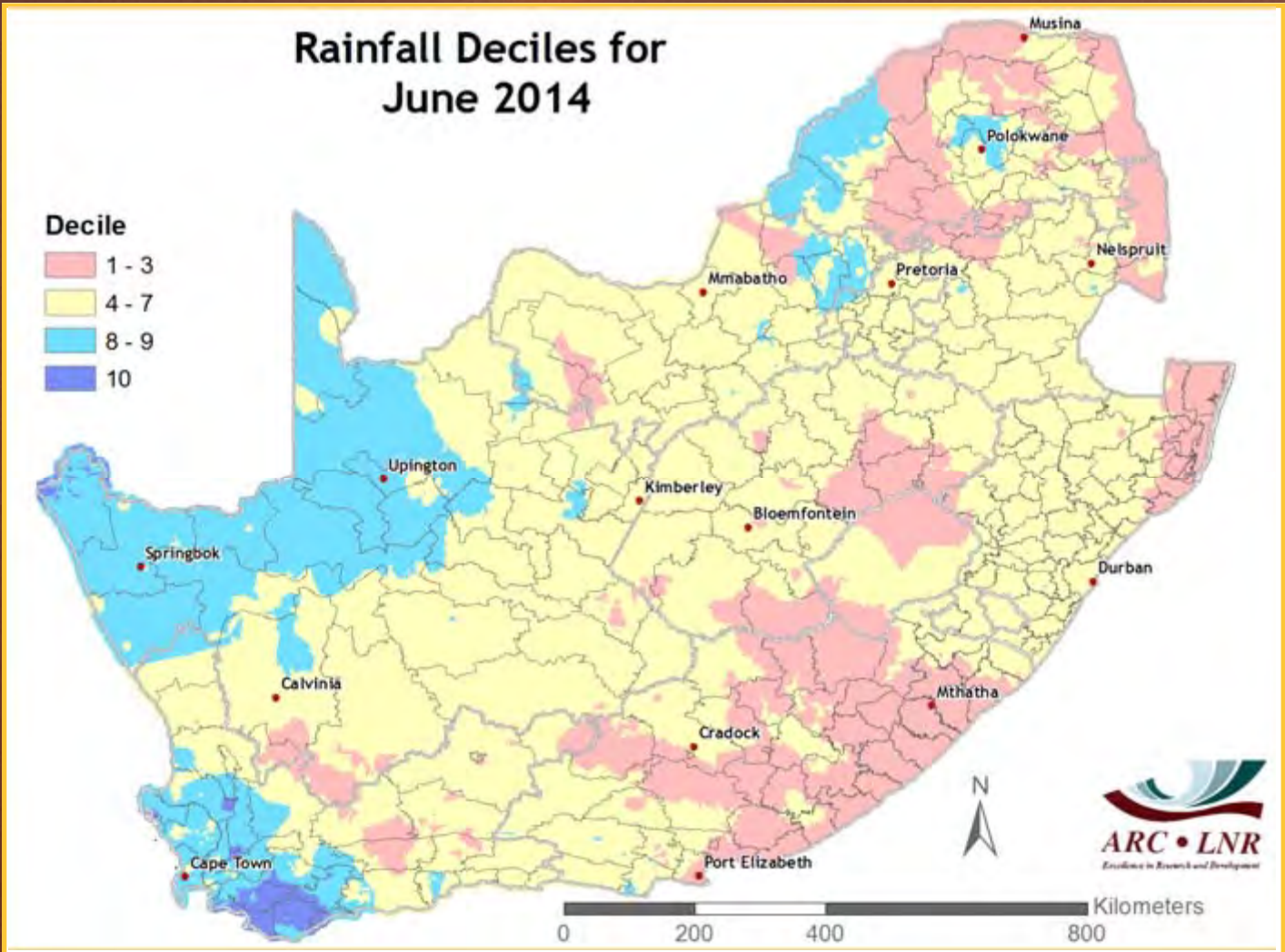

Figure 9

Figure 9:
The rainfall decile map shows that parts of the southwestern winter rainfall area were exceptionally wet during June. Over the northeastern parts of the country, where winter rainfall is on average very low, the indication of relatively dry conditions for the month doesn't bear much weight.

4. Water Balance

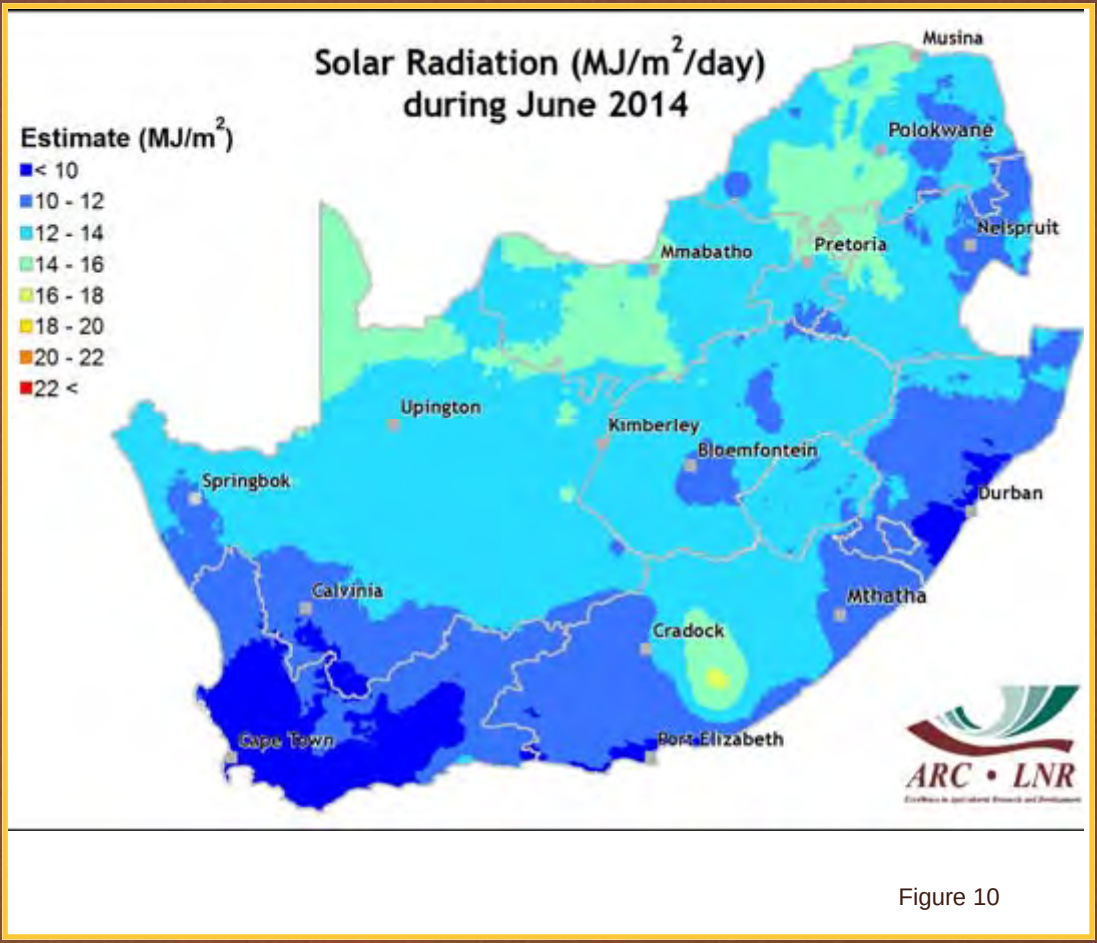

Figure 10

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 lowest daily average solar radiation values occurred over the winter rainfall area as well as the eastern parts of KwaZulu-Natal. Cloud cover over both these regions was more dominant than over the rest of the country.

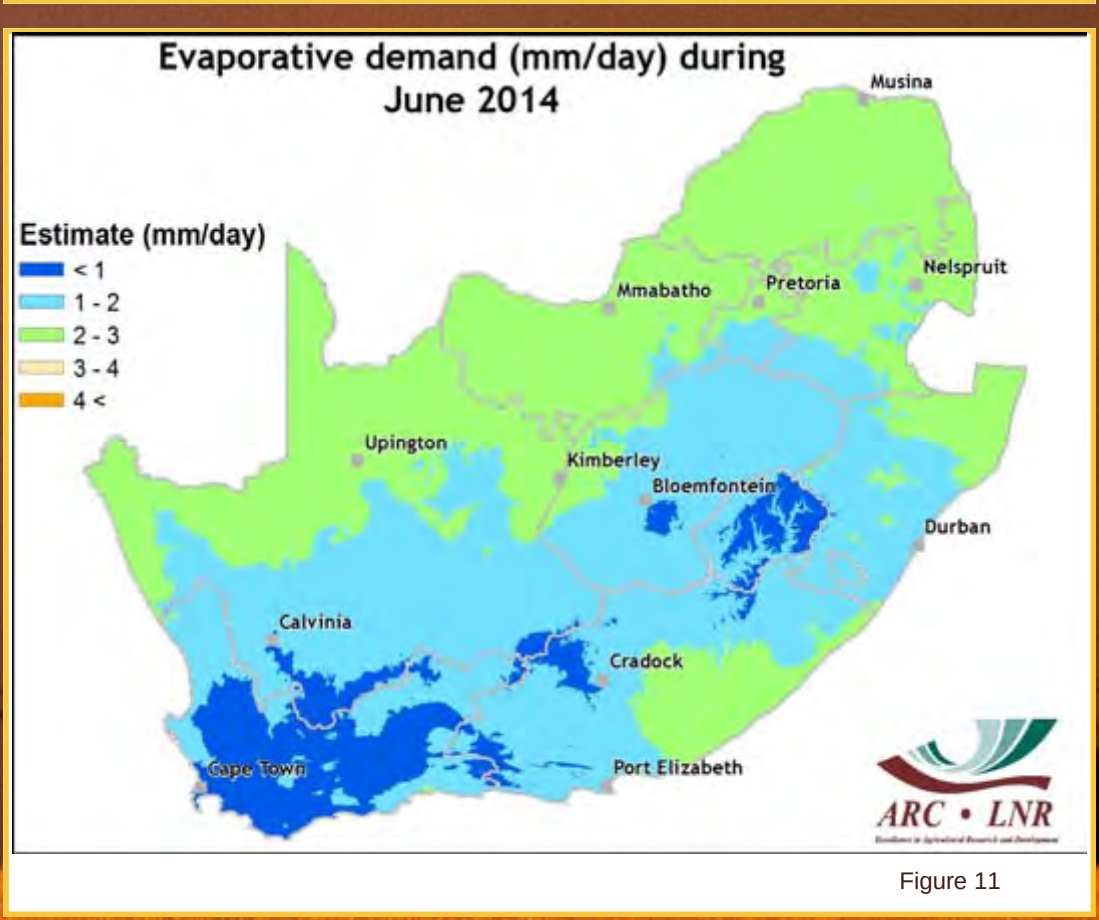

Figure 11

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:
PET was lower than during the previous month. The lowest values occurred over the south-western parts, where lower temperatures, cloudy periods and higher relative humidity due to frontal systems moving across the area resulted in lower evapotranspiration.

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5. Vegetation Conditions

N.B. From 1 June 2014 the SPOT/VGT sensor was replaced by the PROBA-V sensor

Disclaimer:
A preliminary quality assessment of PROBA-V NDVI version 2 products, focusing on comparison with SPOT/VGT NDVI version 2 products and applied on a few dekads, shows the following:
The NDVI computed from PROBA-V is consistent with the NDVI from SPOT/VGT. Notwithstanding the efforts made to guarantee the consistency between both sensors, small differences can be observed due to the inherent sensor dependency of the NDVI. It is advised, especially to users who compute NDVI anomalies, to consider this fact. It is good practice to confirm their analysis by e.g. converging evidence from several biophysical parameters (e.g. rainfall, MetOp-S10 NDVI from LSA-SAF).

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.

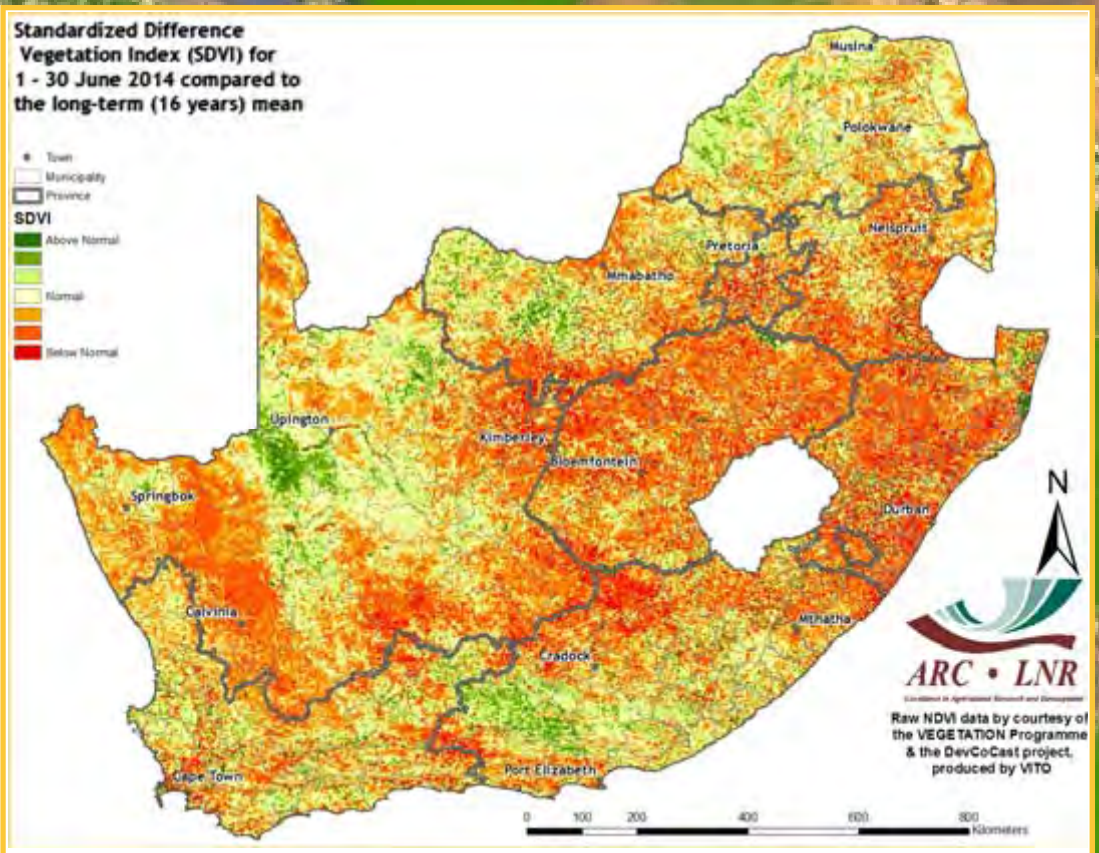

Figure 12

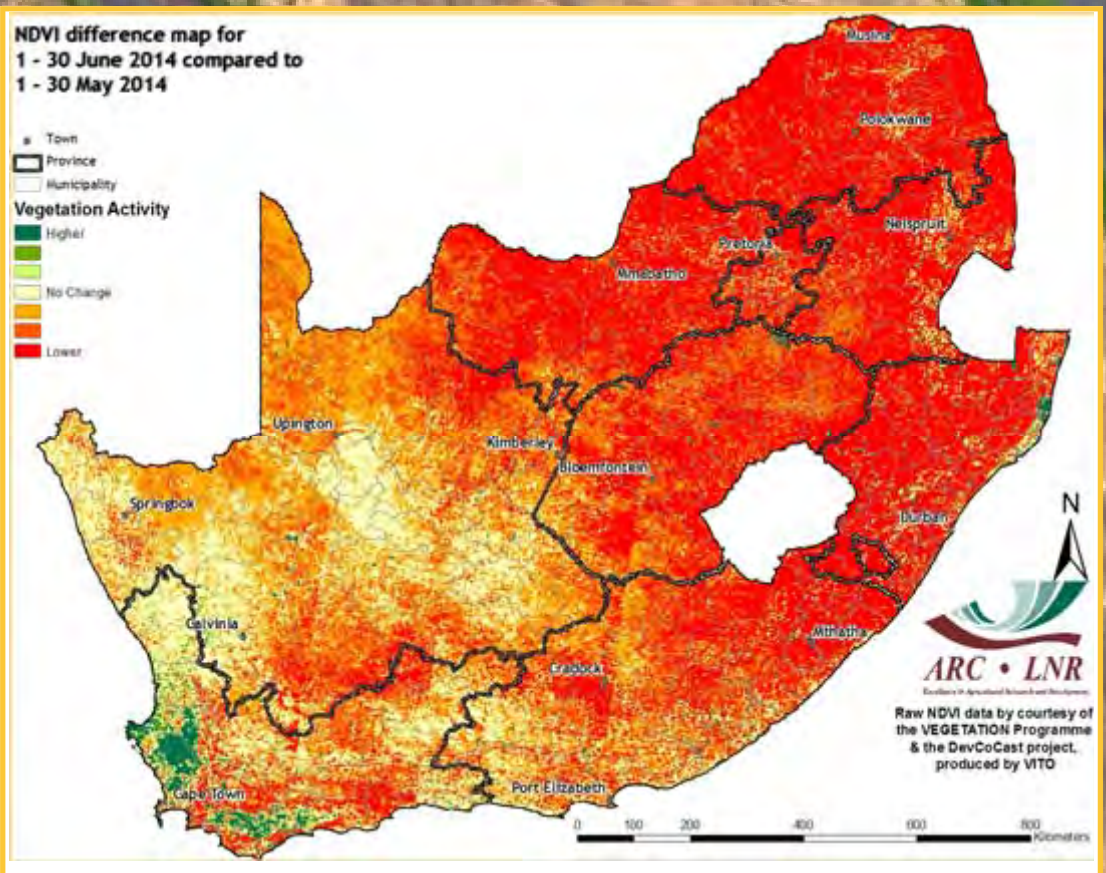

Figure 13

Figure 12:
Relatively dry conditions at the 3-monthly to 12-monthly time scale indicated in the rainfall maps are also reflected in relatively low vegetation activity over especially some parts of KwaZulu-Natal and isolated areas in the Free State. Vegetation activity is near normal over the winter rainfall area.

Figure 13:
While vegetation activity has decreased during the past month over much of the country, parts of the important grain production region in the southwest show a large increase in activity, partially attributed to emergence of crops.

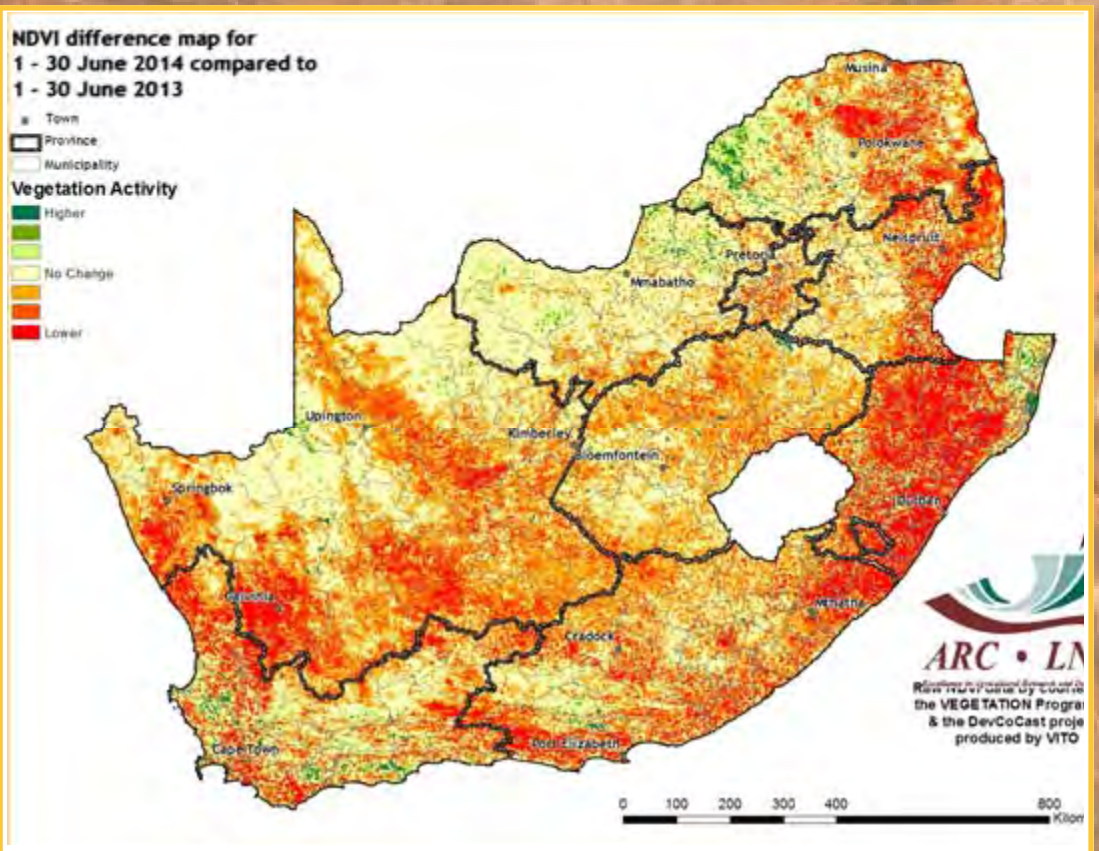

Figure 14

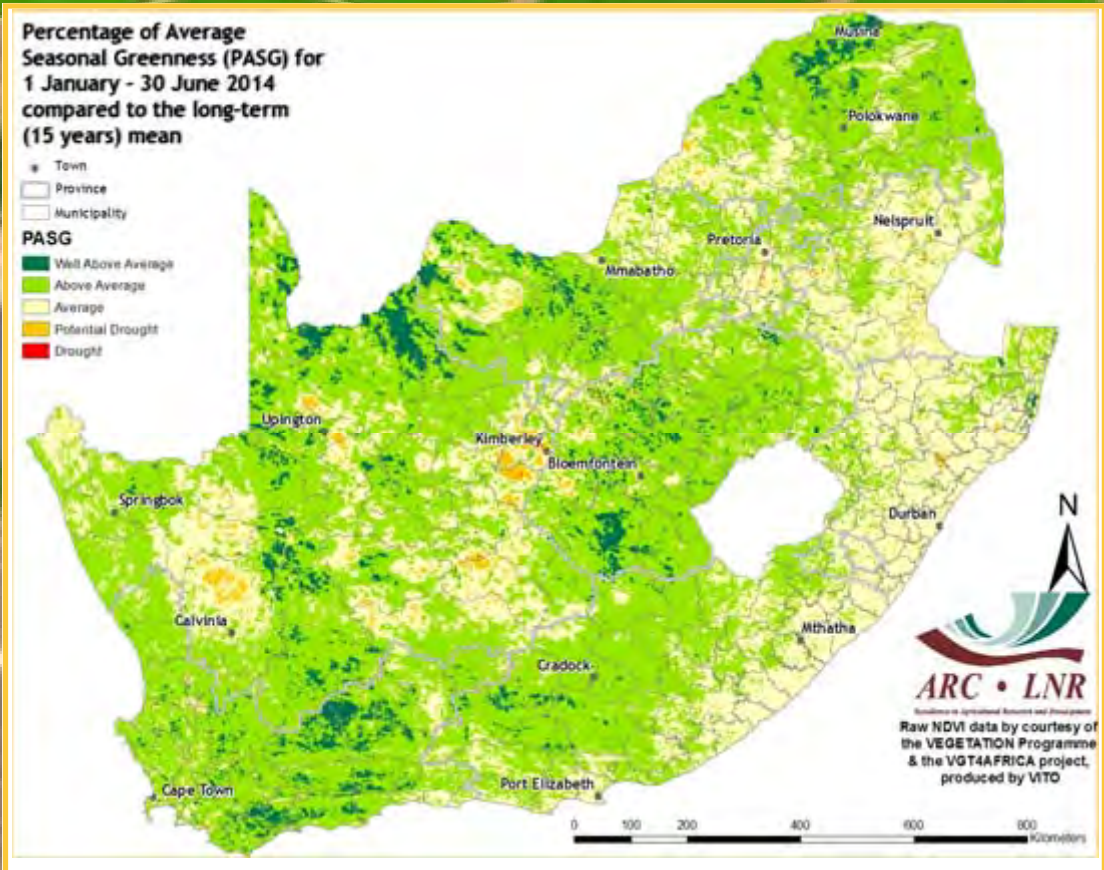

Figure 15

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 is higher than during June 2013 over some areas over northern South Africa and the winter rainfall area, but lower over especially KwaZulu-Natal and into the Lowveld in the northeast.

Figure 15:
Cumulative vegetation activity since January has been above normal over most of South Africa. Exceptions are small areas over the extreme eastern Northern Cape where activity is below normal and the southern parts of Mpumalanga, large parts of KwaZulu-Natal and the eastern parts of the Eastern Cape where cumulative activity has been near normal.

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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.

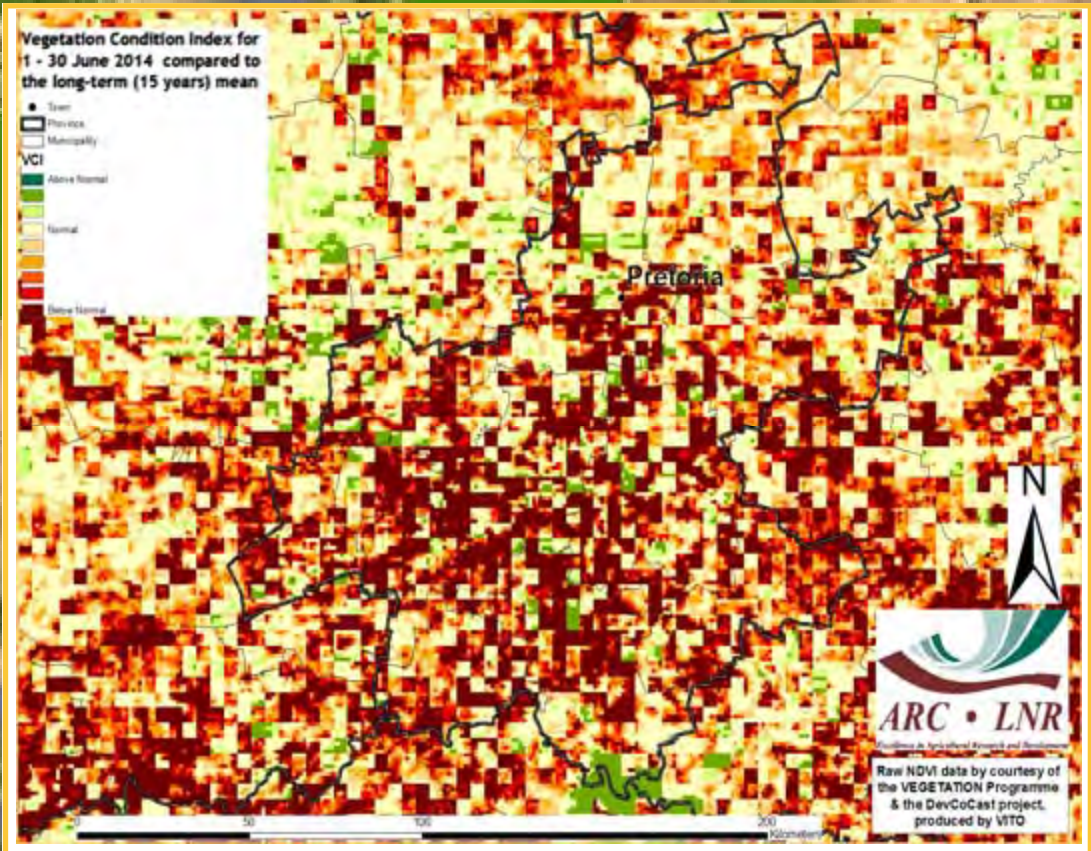


Figure 16

Figure 16:
The VCI map for June indicates below-normal vegetation activity over most parts of Gauteng.

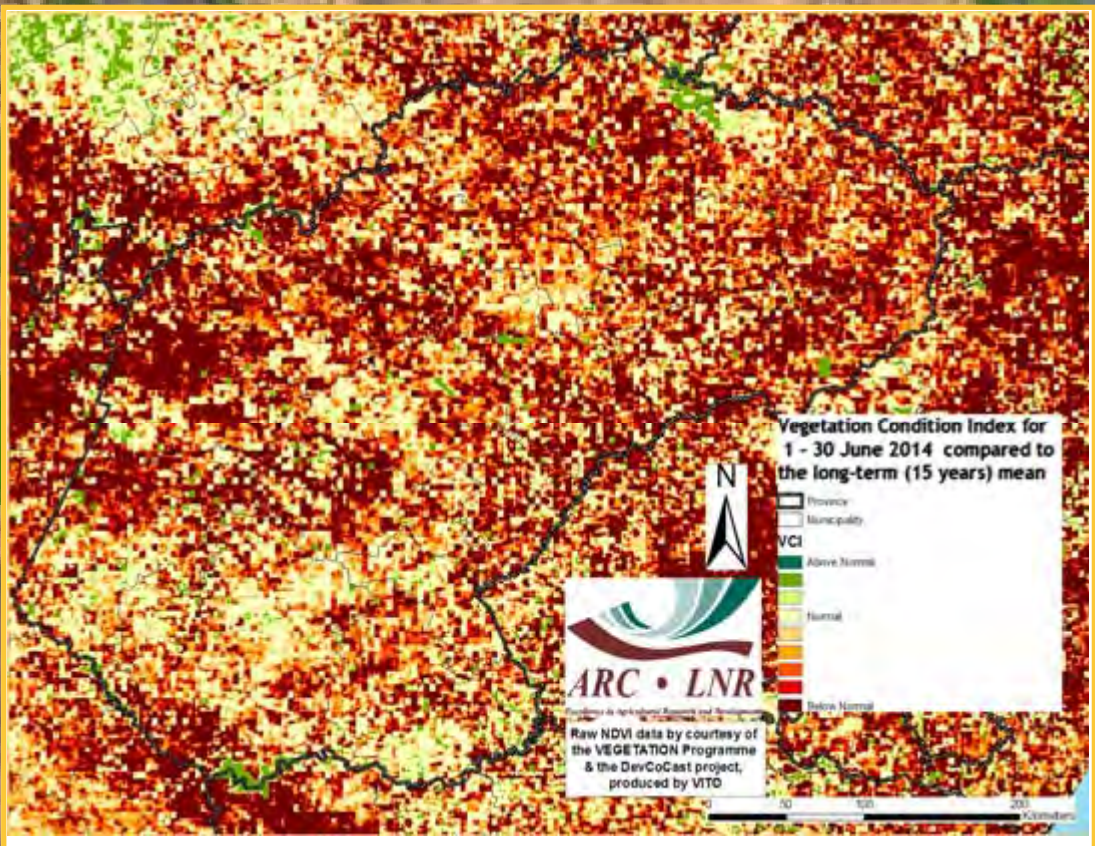
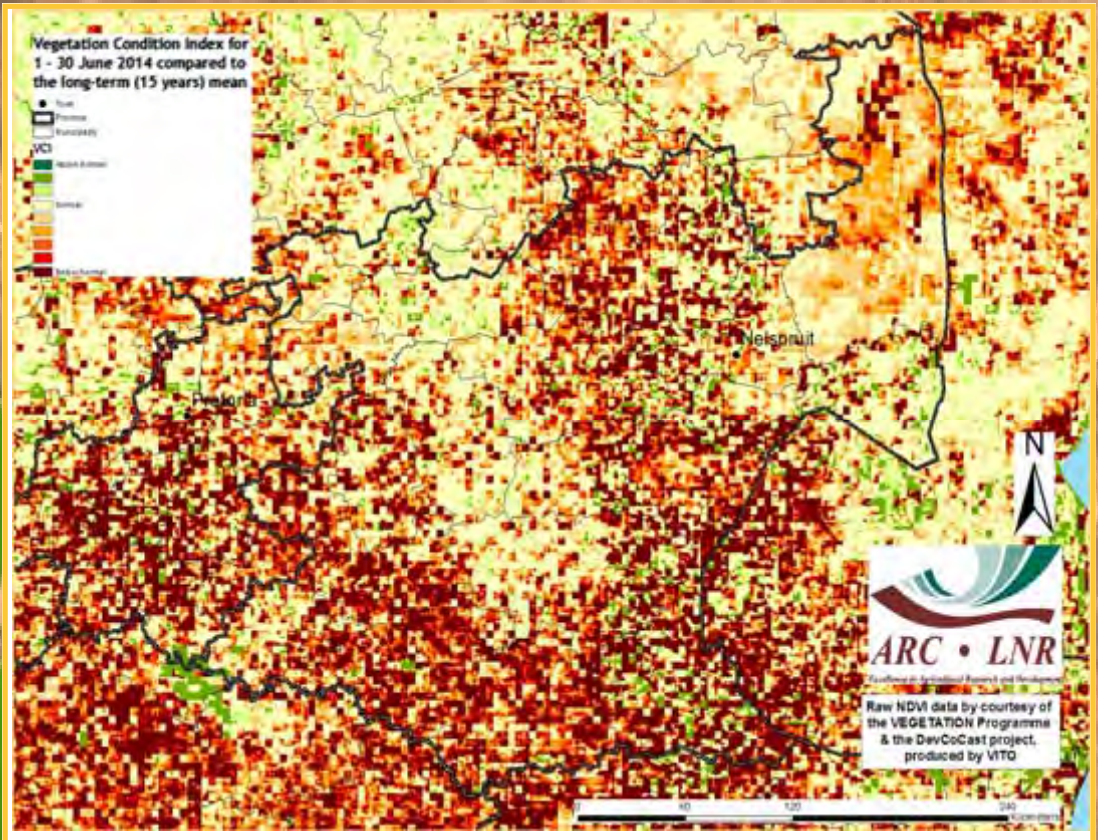


Figure 17

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



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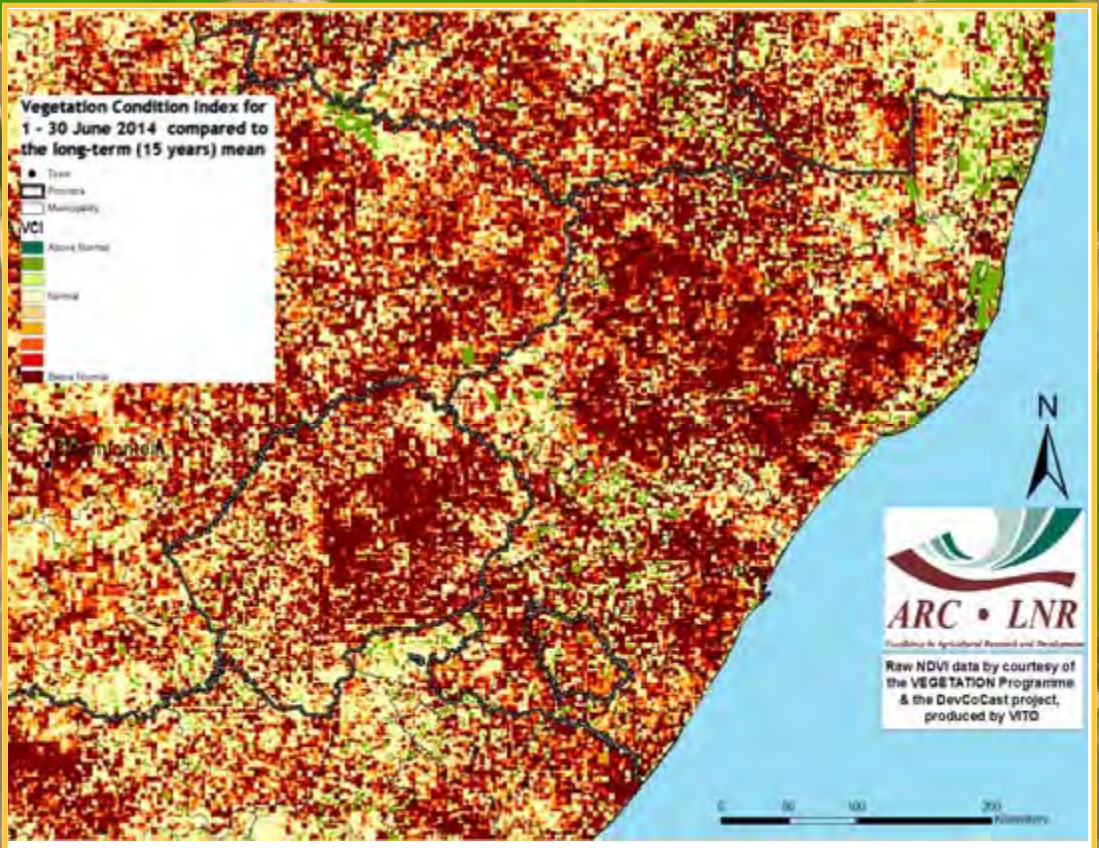

Figure 19

Figure 18:
The VCI map for June indicates below-normal vegetation activity over most parts of Mpumalanga.

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

Questions/Comments:
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7. Vegetation Conditions & Rainfall

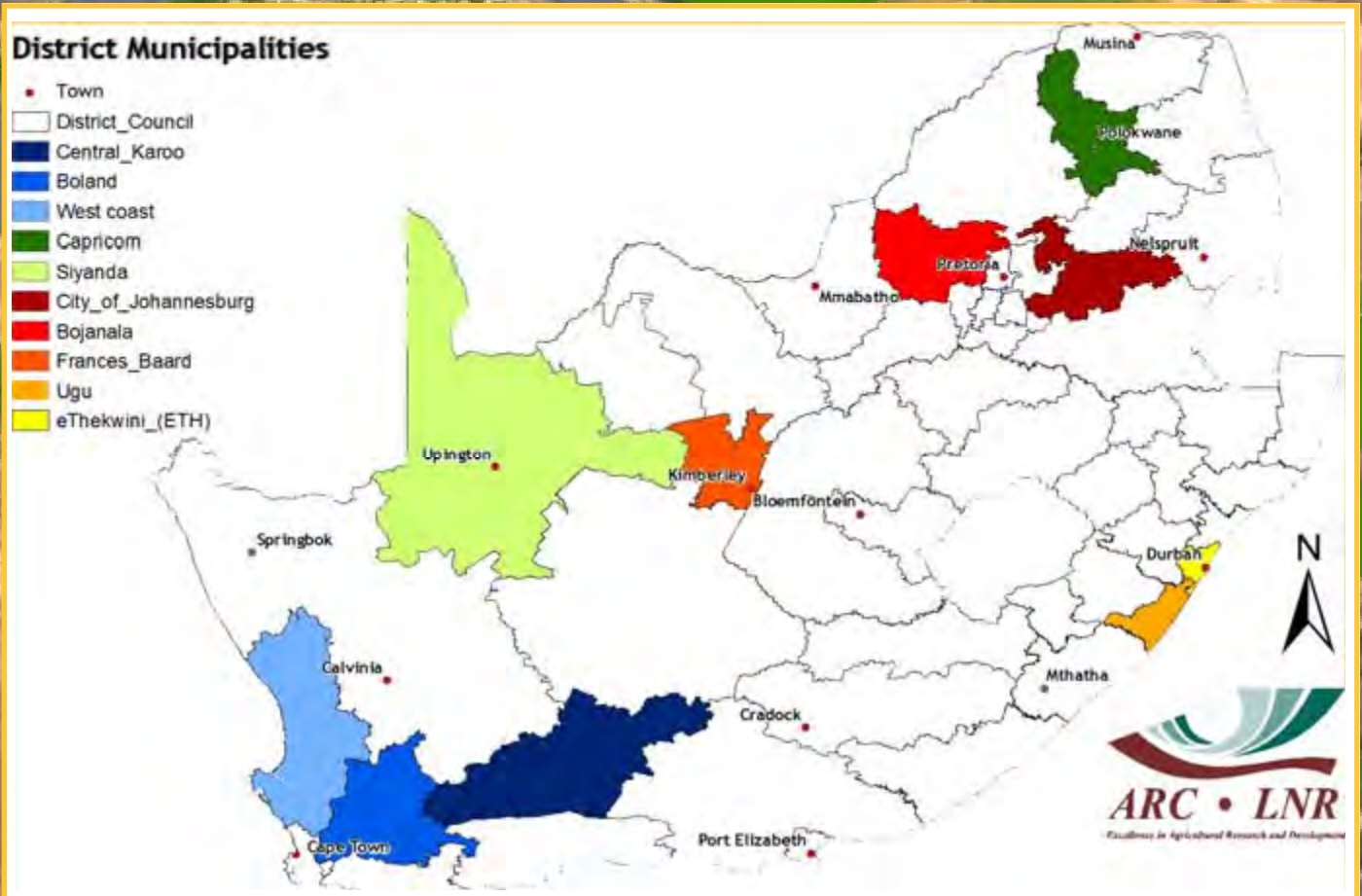

Figure 20

NDVI and Rainfall Graphs
Figure 20:
Orientation map showing the areas of interest for June 2014. The district colour matches the border of the corresponding graph.

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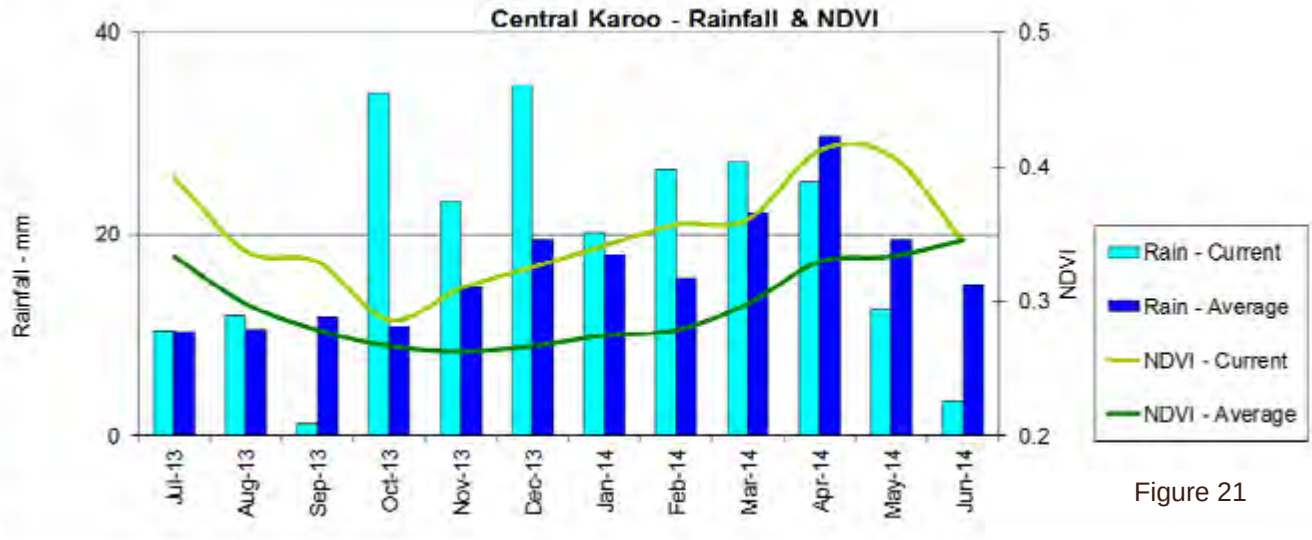
Figures 21-25:
Indicate areas with higher cumulative vegetation activity for the last year.

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



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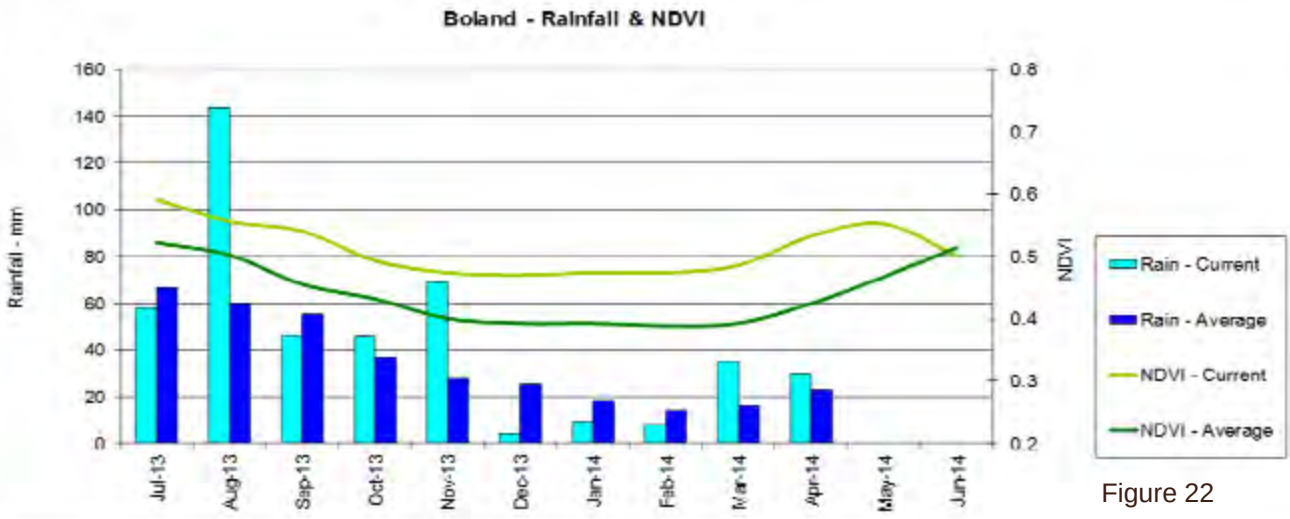

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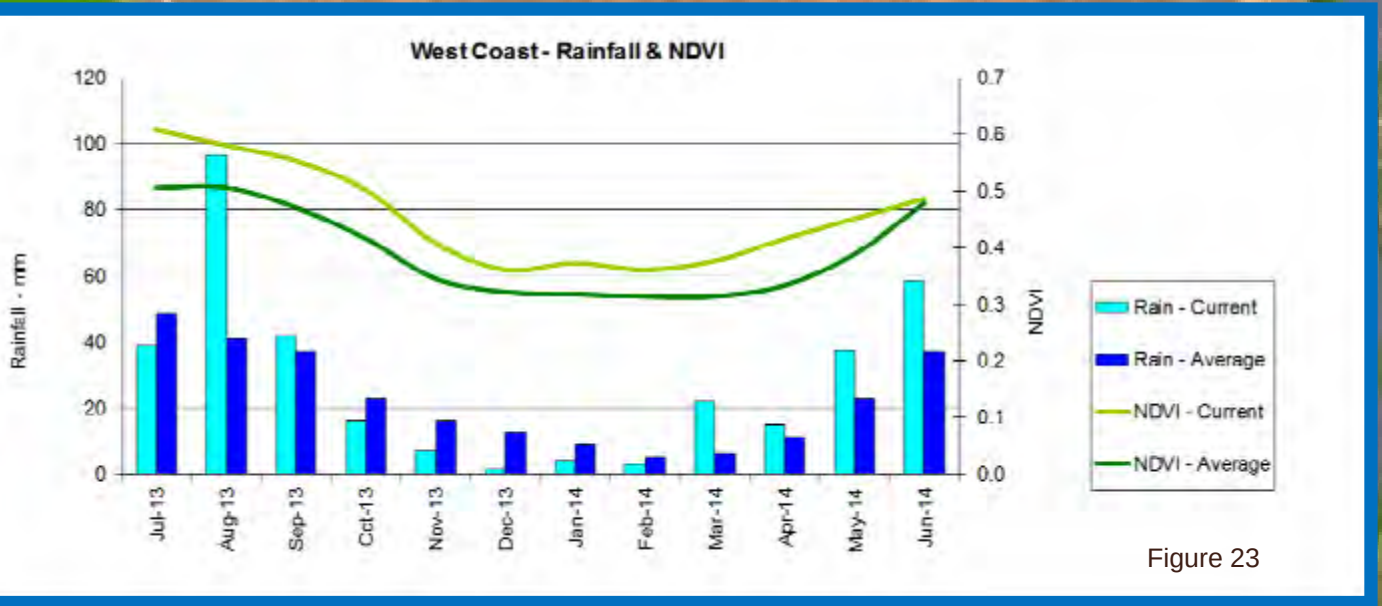

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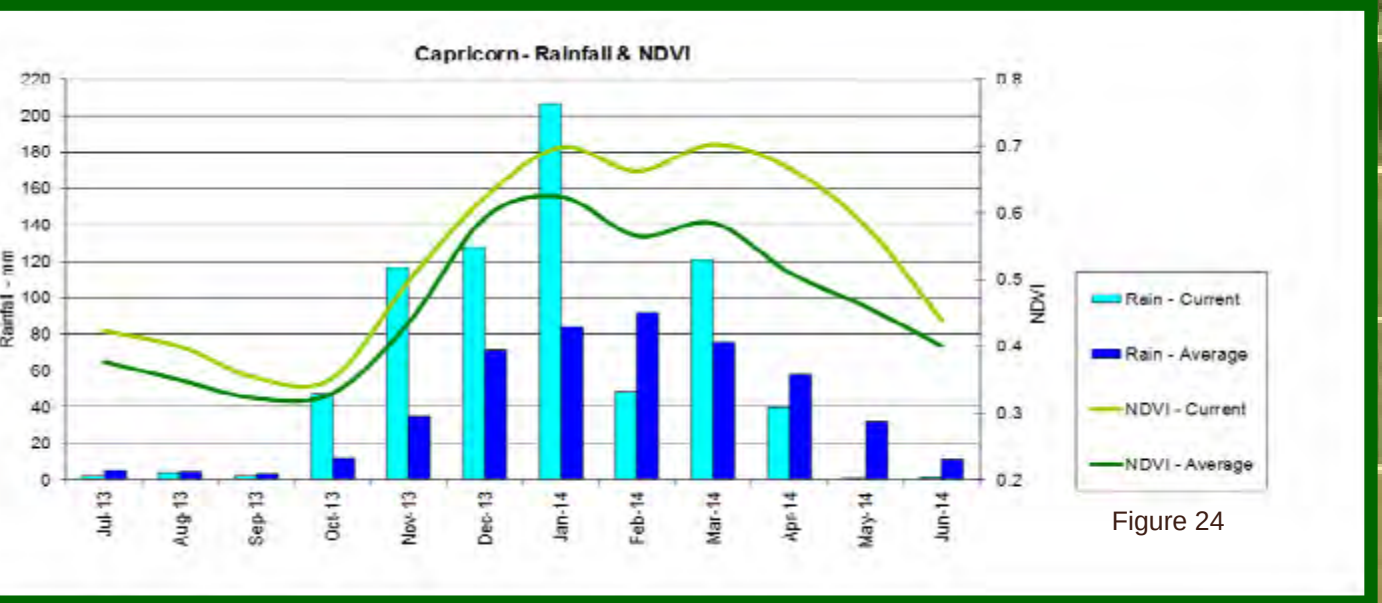

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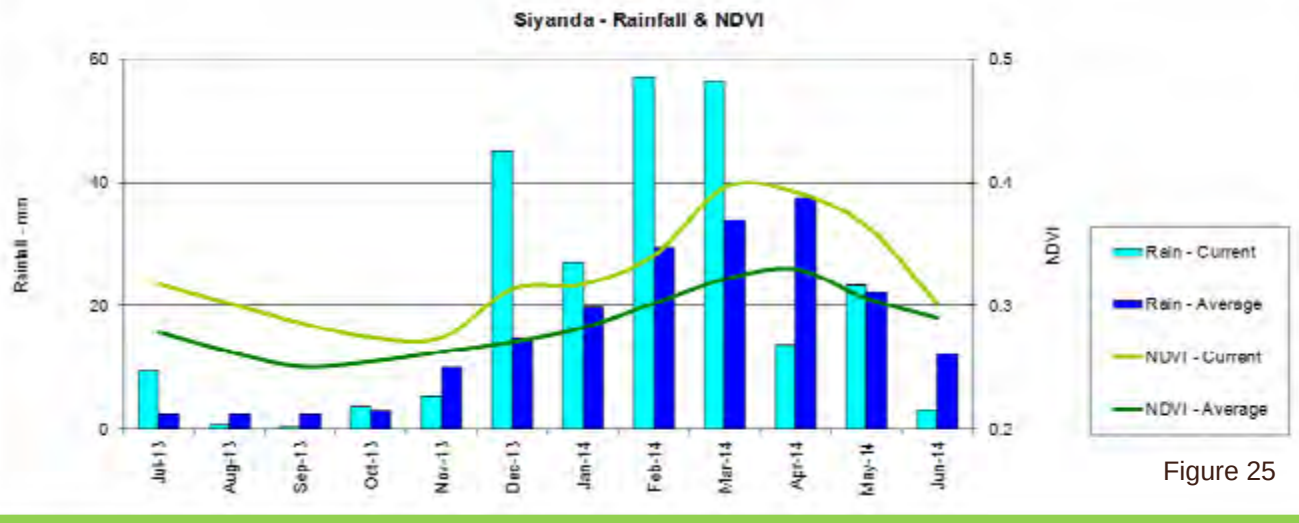


Figure 25

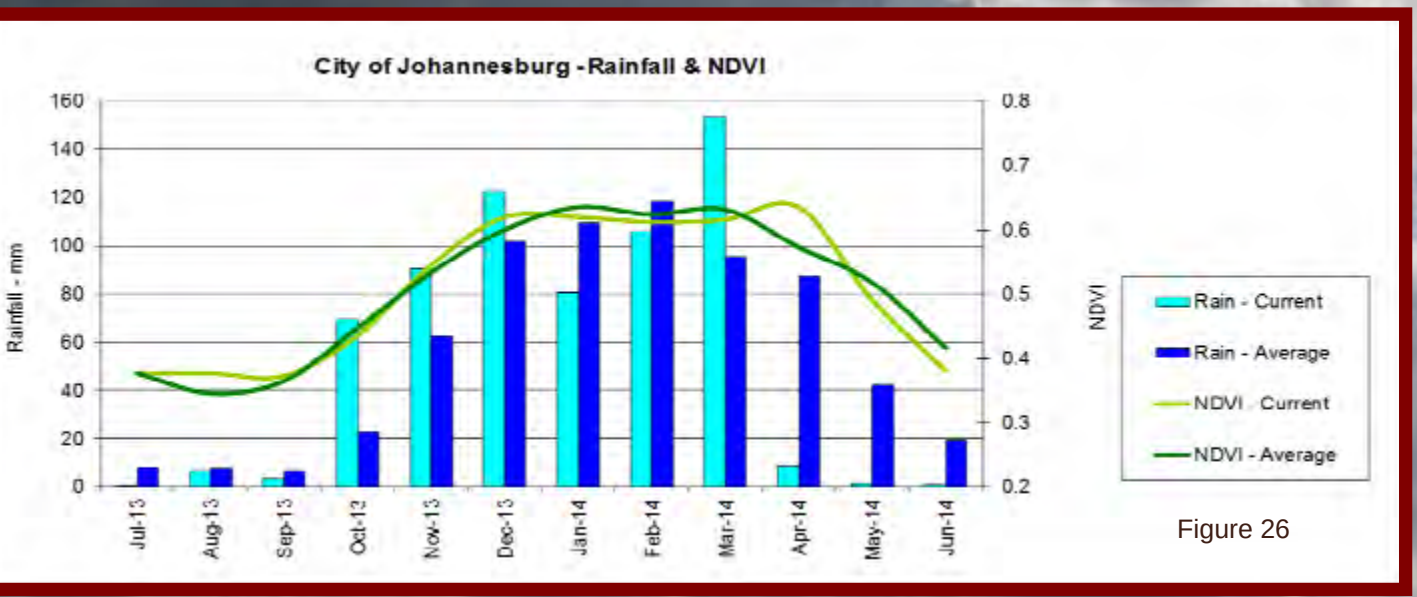
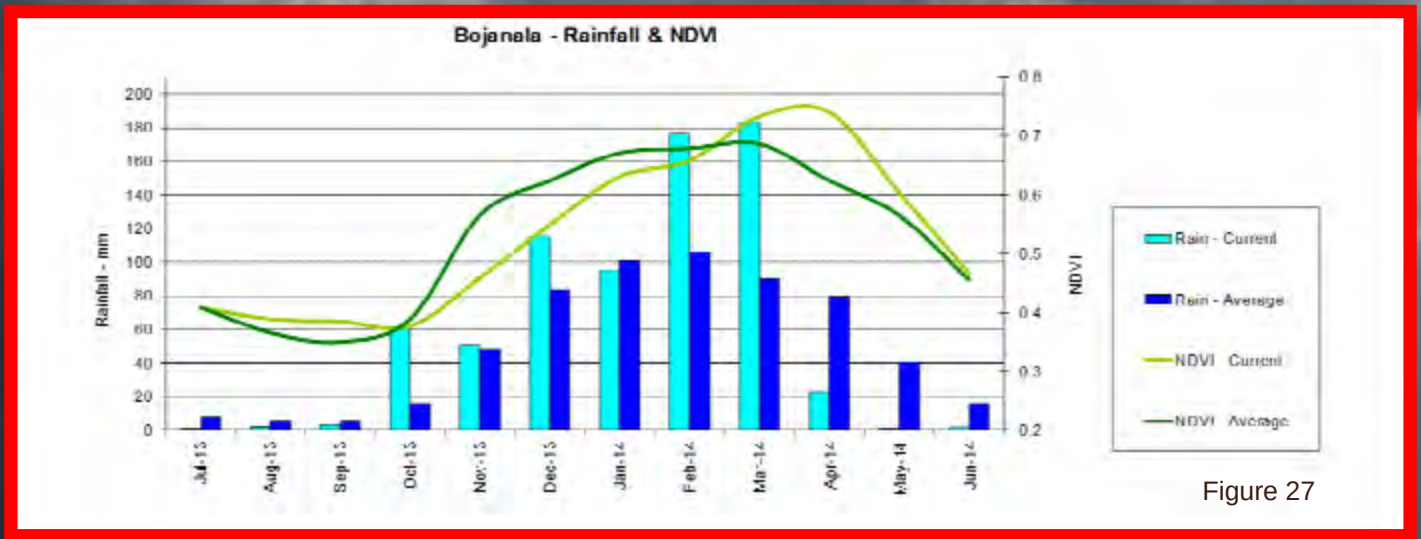


Figure 26



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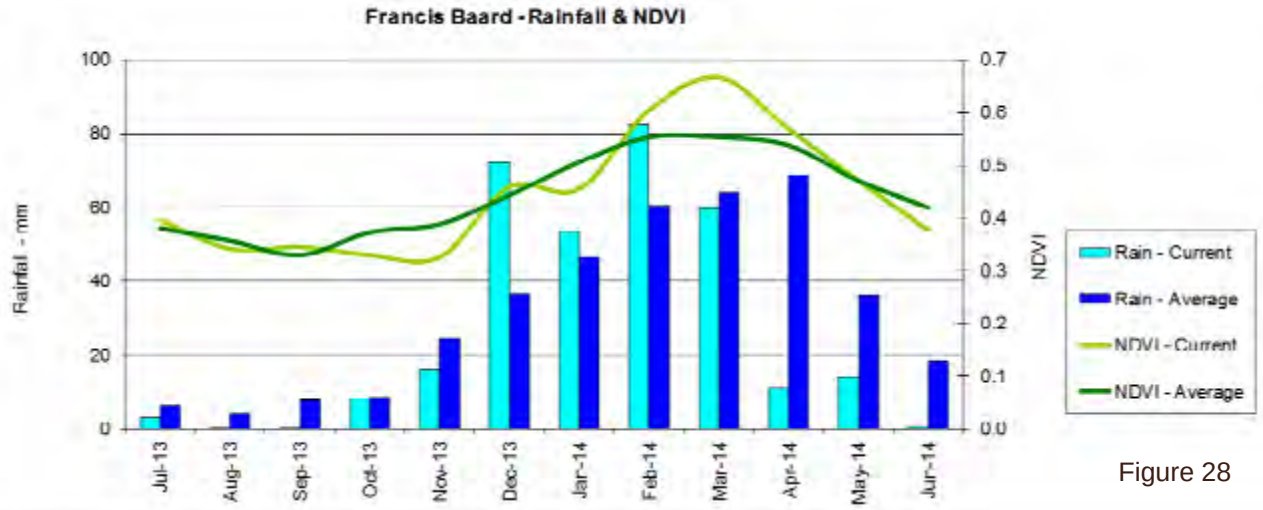

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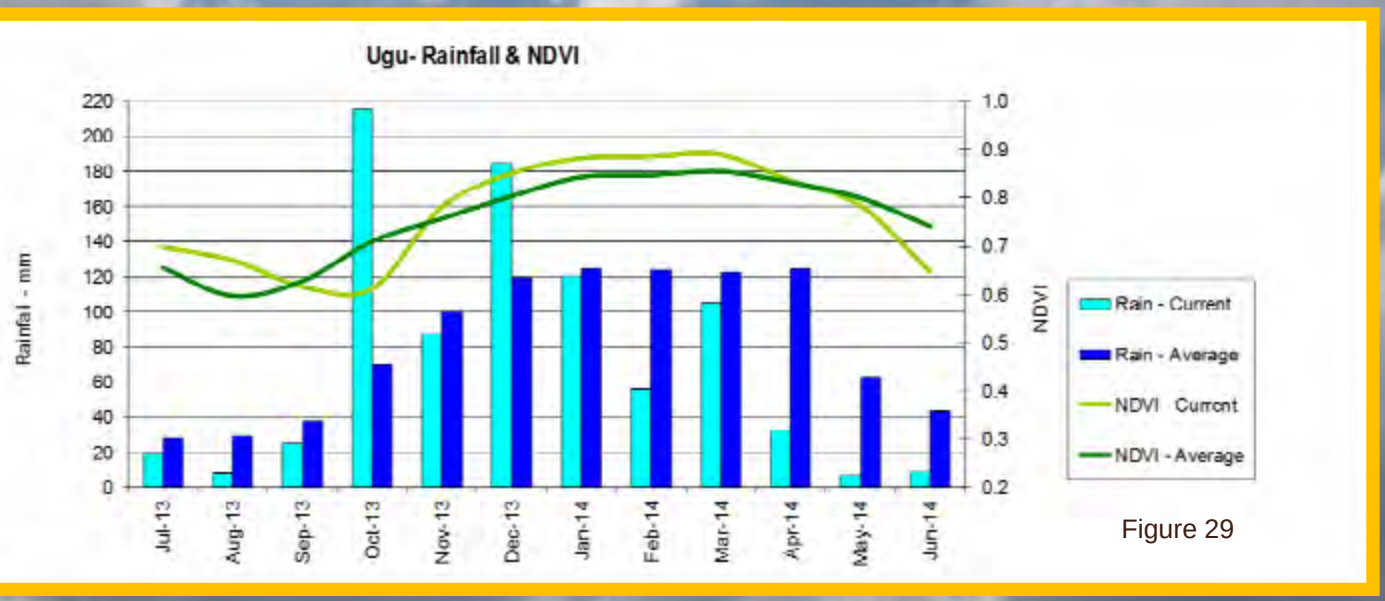

Figure 29

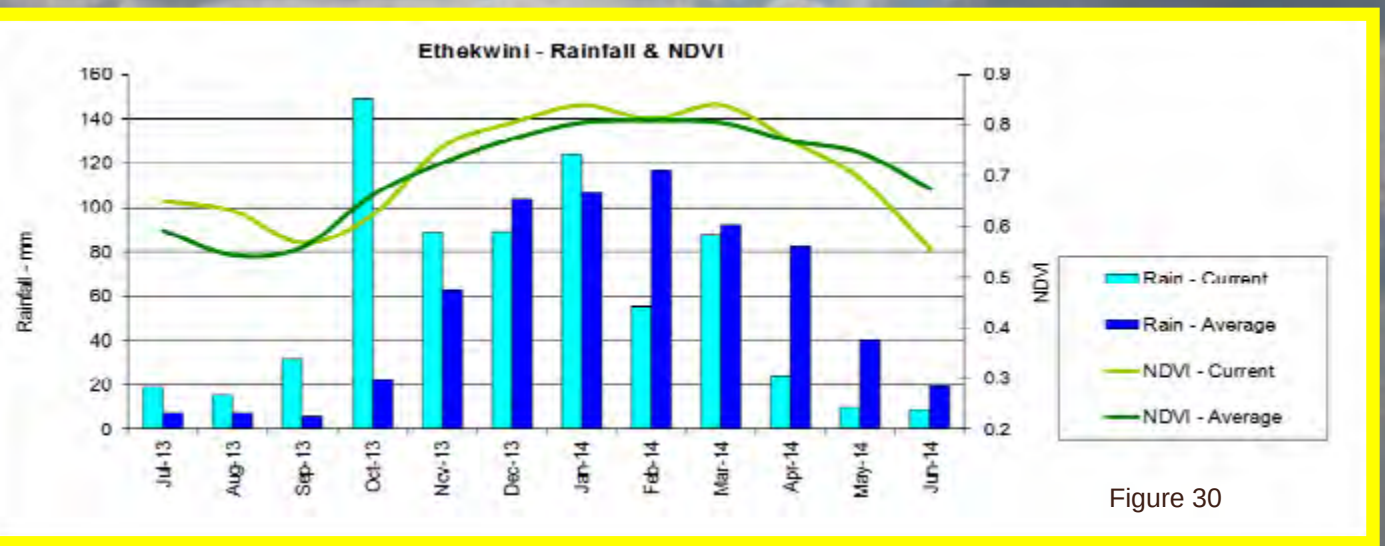

Figure 30

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:
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