ARC • LNR
Excellence in Agricultural Research and Development

UMLINDI
The Watchman

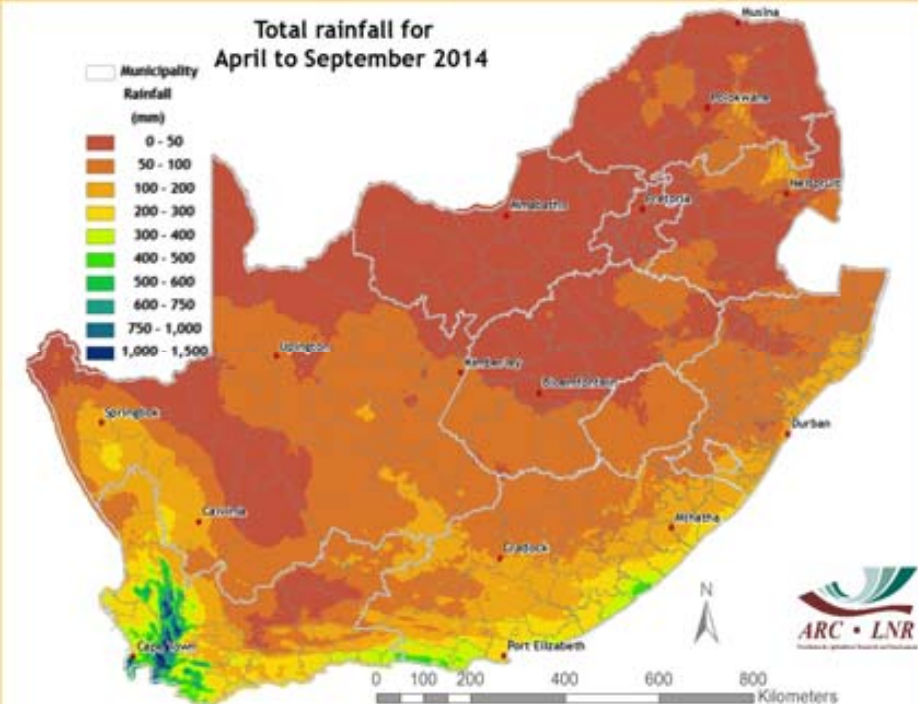
ISSUE 2014-10 | 14 OCTOBER 2014

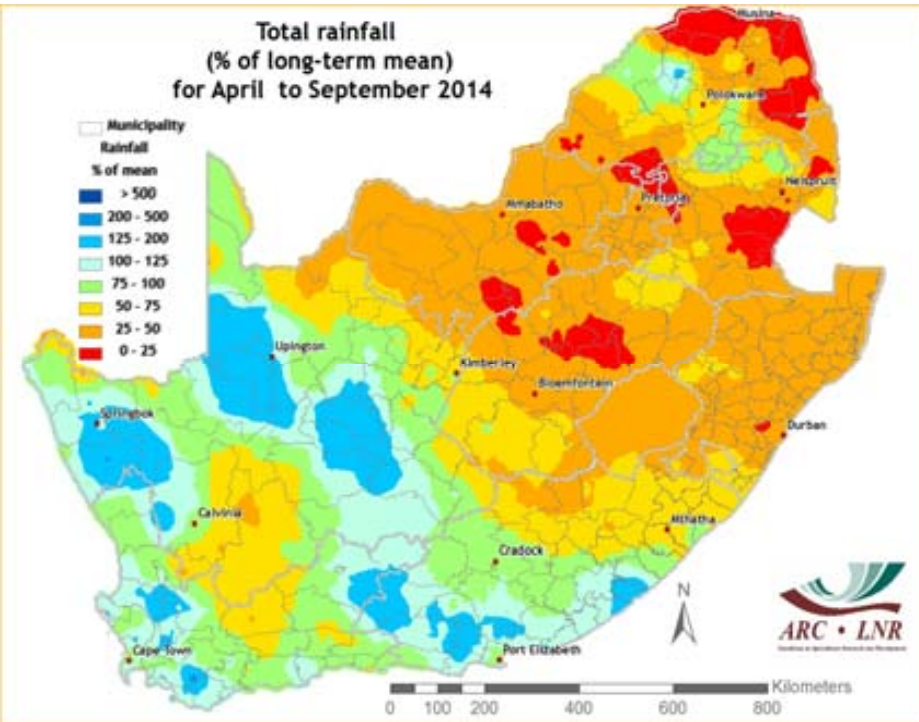
INSTITUTE FOR SOIL, CLIMATE AND WATER

CONTENTS:

124th Edition

Images of the Month





Normal to above-normal rainfall during winter over the winter rainfall area

The winter rainy season (April-September) this year was characterized by cumulative rainfall that did not exceed 50 mm over most of the northern parts of South Africa. The highest falls, exceeding 1000 mm in some places, were recorded over the mountainous southwestern winter rainfall area where orography enhances the effects of cold fronts and other rain producing systems (see first map). Rainfall over the important winter grain production region varied between 250 and 400 mm in total, resulting in near-normal to above-normal rainfall over much of these areas. In fact, normal to above-normal rainfall dominated much of southwestern South Africa (excluding parts of the southwestern Northern Cape) with below-normal rainfall over northeastern South Africa (see second map). The rainfall over the winter rainfall area was, however, concentrated more towards the early part of winter, with drier conditions towards the second half. The previous two winters (in 2012 and 2013) were characterized by above-normal rainfall over the winter rainfall area.

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:

Precipitation events during September 2014 were mainly concentrated towards the southern parts of the country. The main rain producing systems occurred in the second half of the month. The most significant frontal systems resulting in rainfall over the winter rainfall area resulted in widespread precipitation there from the 17th to 19th and again around the 26th.

Temperatures, especially minimum temperatures, tended to increase during the month especially over the northern parts. The lowest minimum temperatures happened during the beginning of the month following the significant cold front during late August and once again by the 18th to 20th over the southern parts of the country.

The month started with cool conditions and low minimum temperatures with widespread frost following the significant cold event by the end of August. Conditions warmed gradually with anticyclonic circulation dominating. Cold fronts remained far towards the west and south during much of the first 2 weeks of the month. By the 14th a strong cold front with an associated upper air trough moved into the southwestern parts of the country. Scattered showers occurred over the western interior moving into the Eastern Cape due to the trough while the front also resulted in widespread precipitation over the winter rainfall area. With moisture available due to a high pressure system to the southeast and slight upper air instability, some showers also occurred over the extreme northeastern parts by the 20th while conditions had cleared over the remainder of the country. Dry conditions dominated again from the 21st due to stable conditions until the 26th except for some showers in the west due to an upper air trough towards the west by the 23rd. From the 26th the movement of a cold front over the southern parts coupled with a sharp upper air trough developing into a low moving across the southern interior resulted in widespread precipitation over much of the southern parts of the country, with thundershowers (of which some were significant) developing over parts of the Highveld ahead of the low by the end of the month, while widespread rain occurred over the southeastern parts.

Questions/Comments:
Johan@arc.agric.za

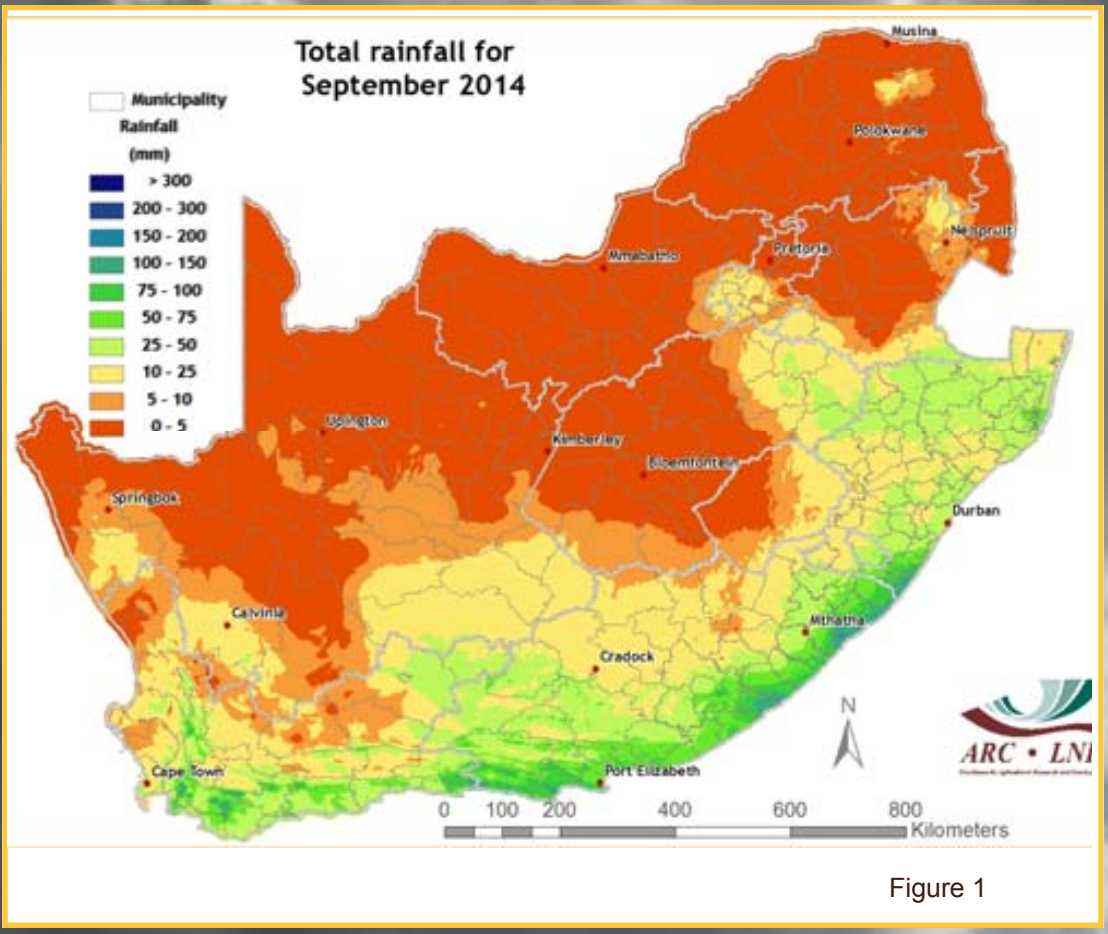


Figure 1

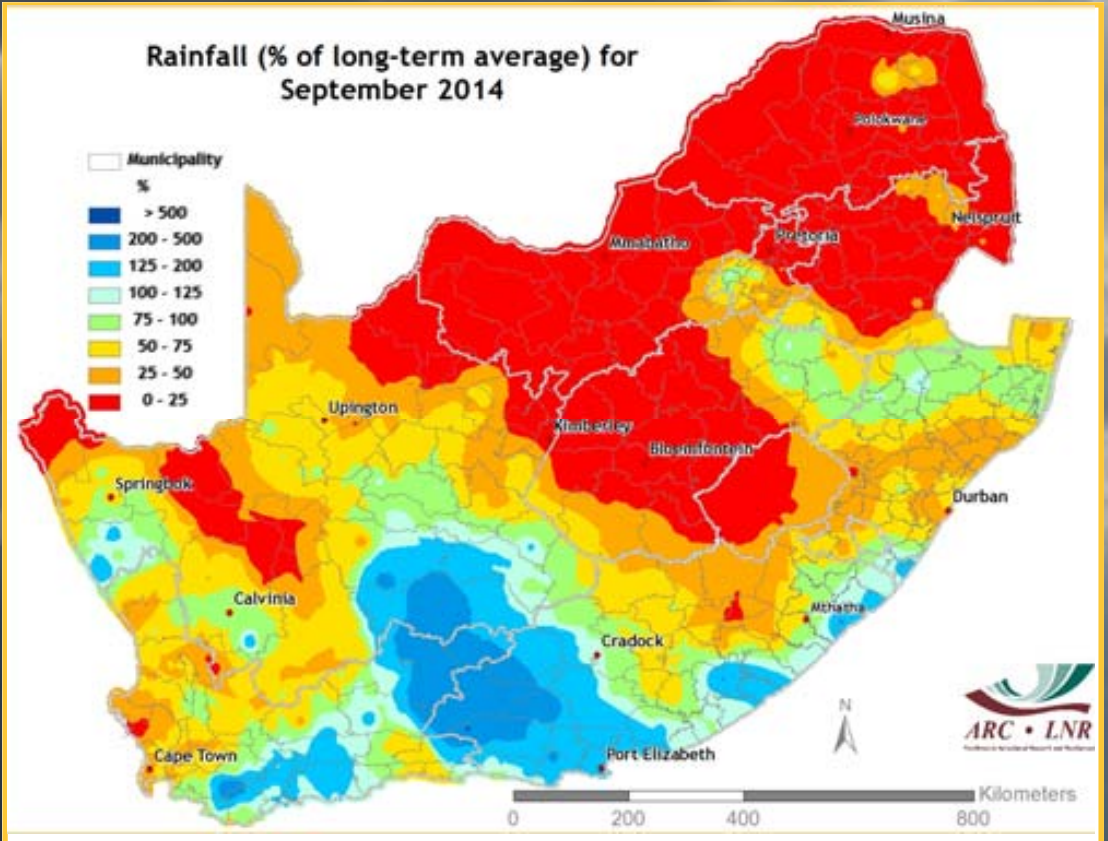


Figure 2

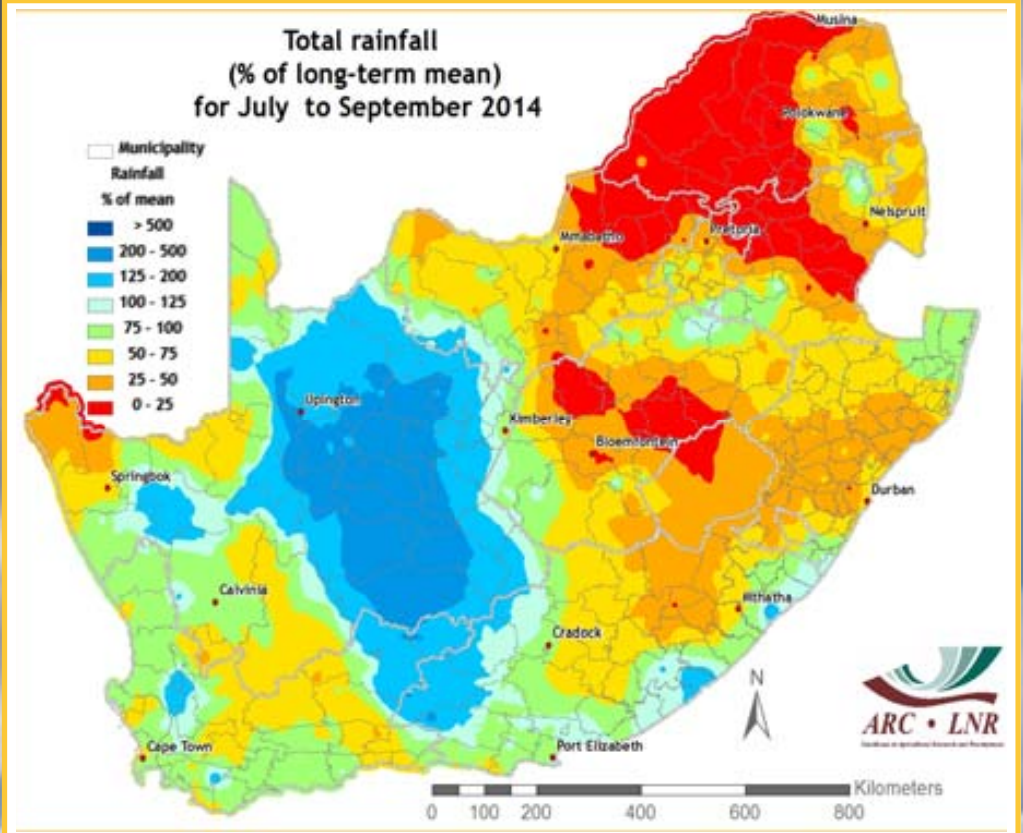


Figure 3

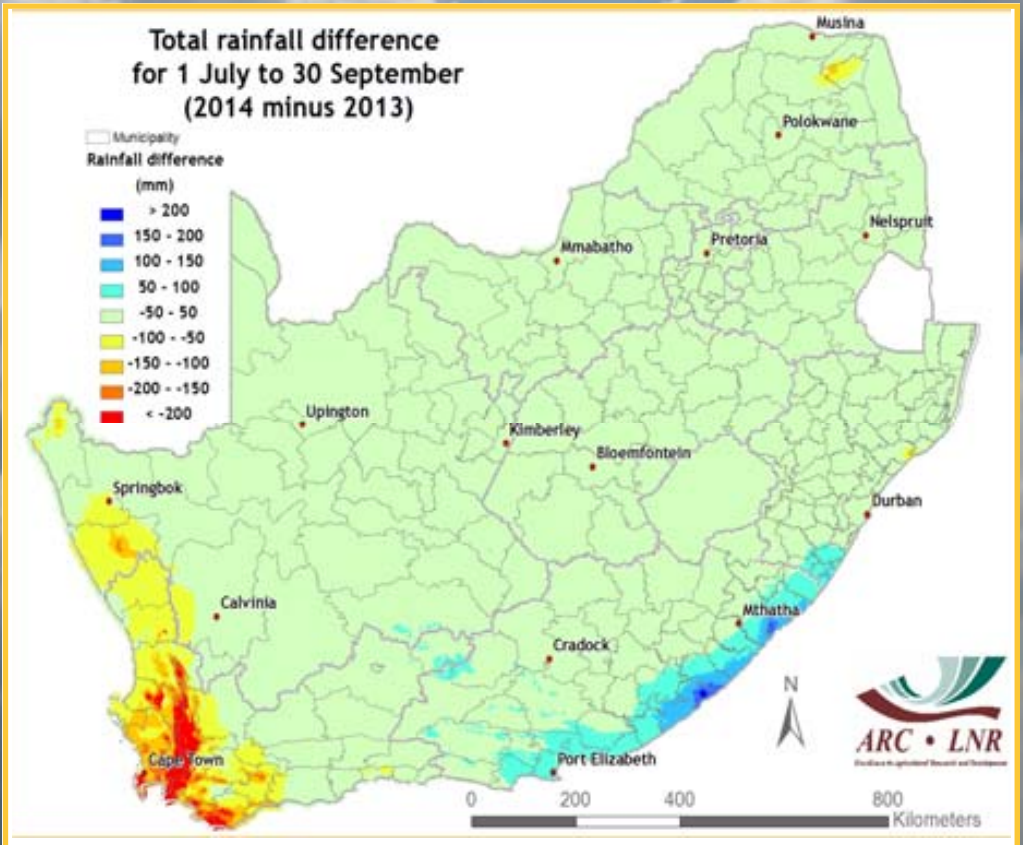


Figure 4

Figure 1:
Precipitation in September was concentrated over the southern and southeastern parts of the country as well as parts of the Highveld. Over the winter rainfall area, higher falls were recorded over the southwestern parts than over the Swartland in the west, in contrast to the situation during much of the 2014 winter. Rainfall totals exceeded 100 mm only over parts of the coastal belt of the Eastern Cape and southern KwaZulu-Natal.

Figure 2:
Above-normal rainfall occurred over much of the south of the country except for the western parts of the winter rainfall area. Below-normal rainfall dominated the rest of the country.

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 southwestern parts of the Northern Cape. Precipitation was also below normal over most of the northeastern half of the country.

Figure 4:
For July to September, which is the late winter season, the southwestern parts received much less rain than during 2013 while the southeastern coastal region was wetter this year.

Questions/Comments:
Johan@arc.agric.za

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 parts of the country at the shorter time scales (3-6 months), indicating anomalously dry conditions over those areas. 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 the central parts.

Questions/Comments:
Johan@arc.agric.za

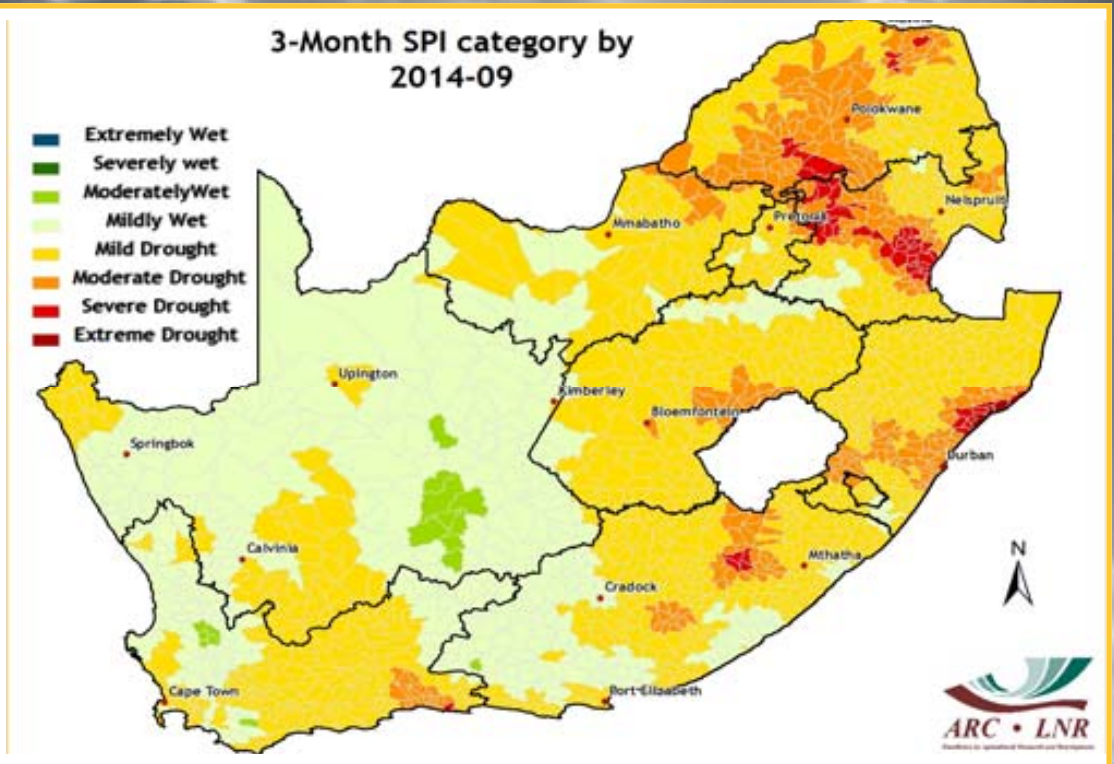


Figure 5

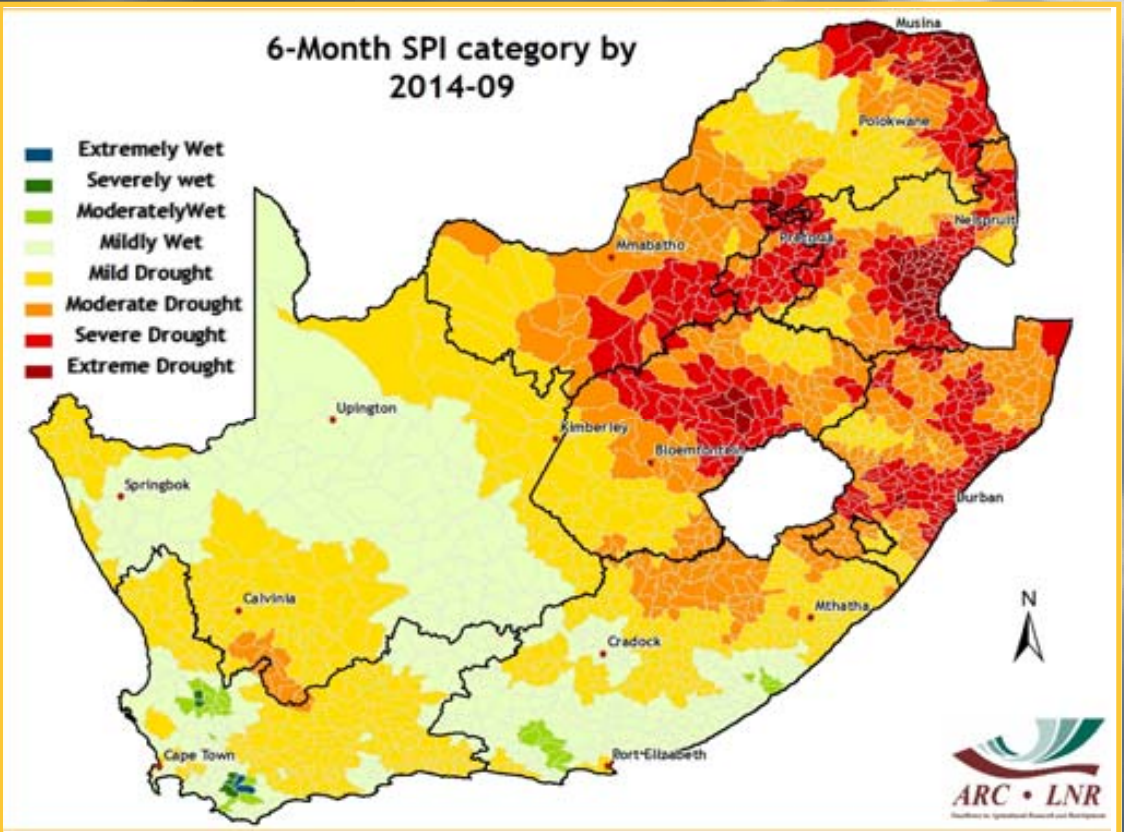


Figure 6

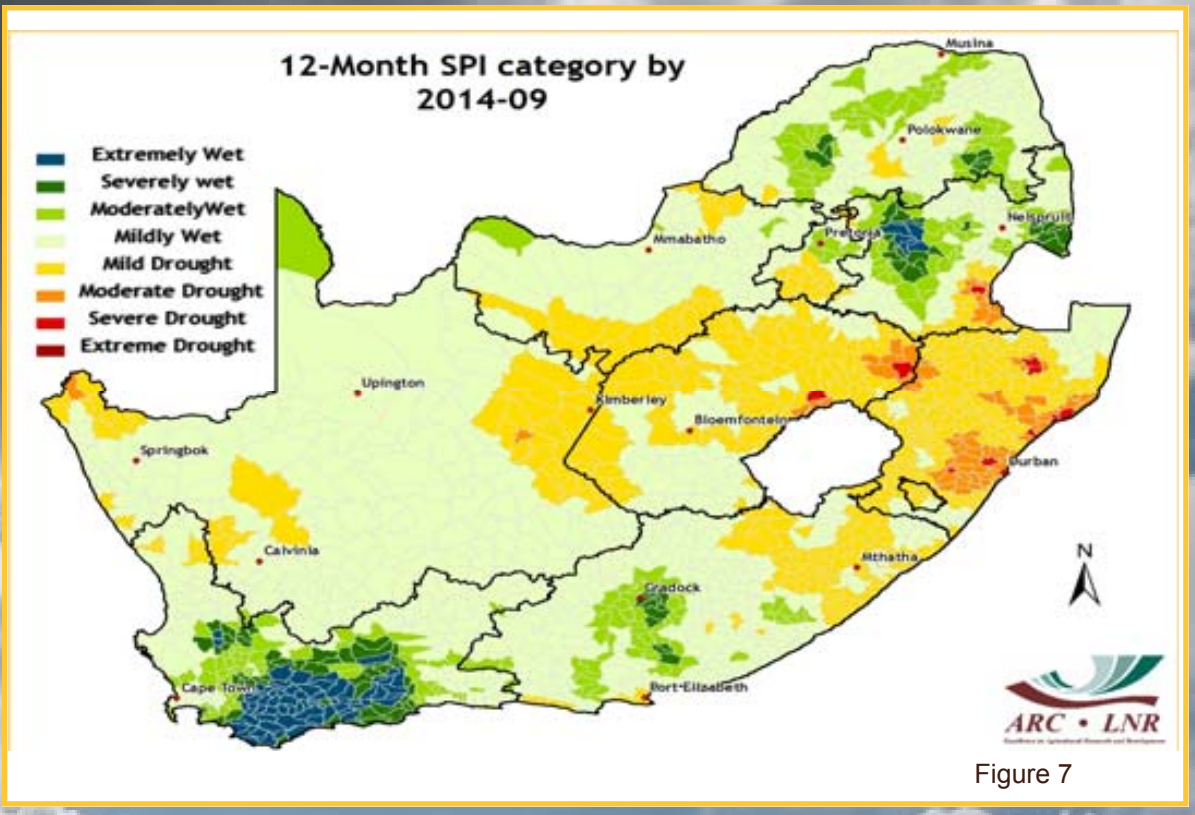


Figure 7

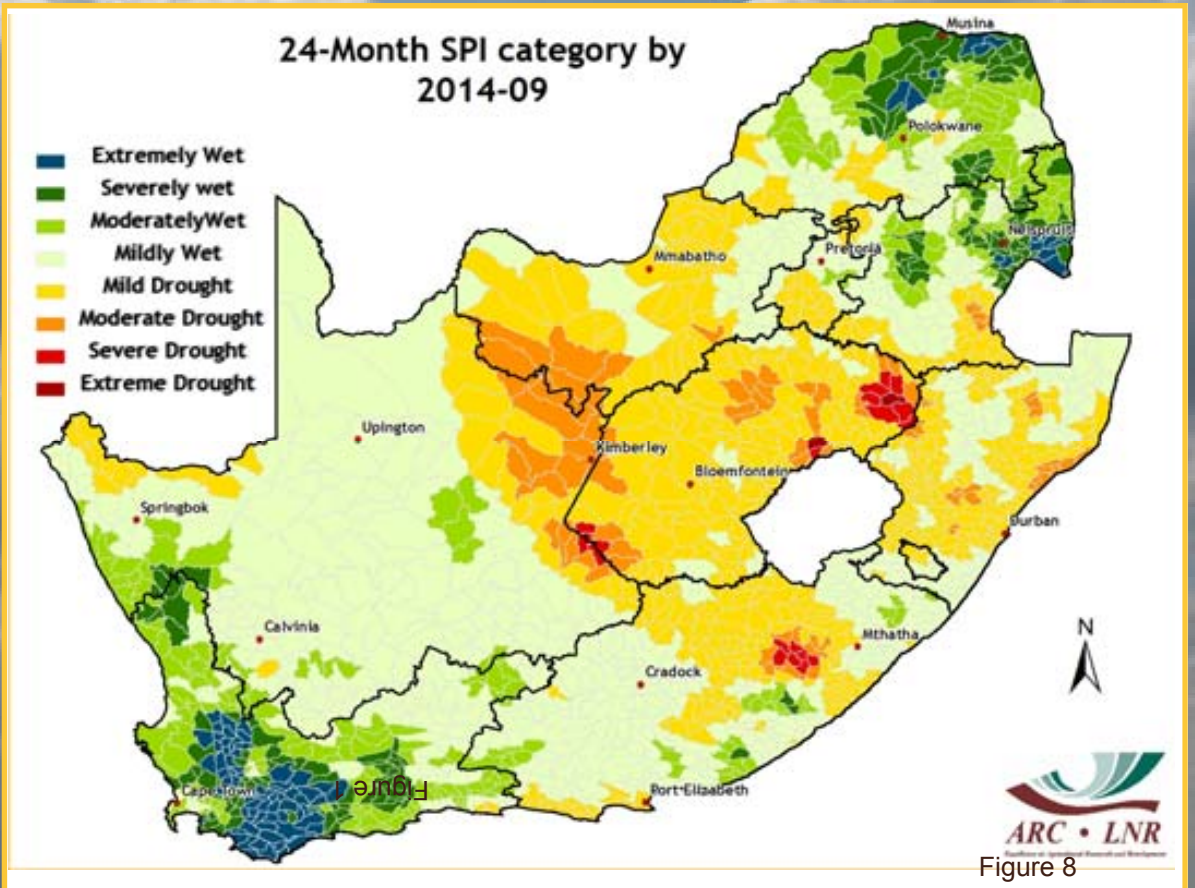


Figure 8

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.

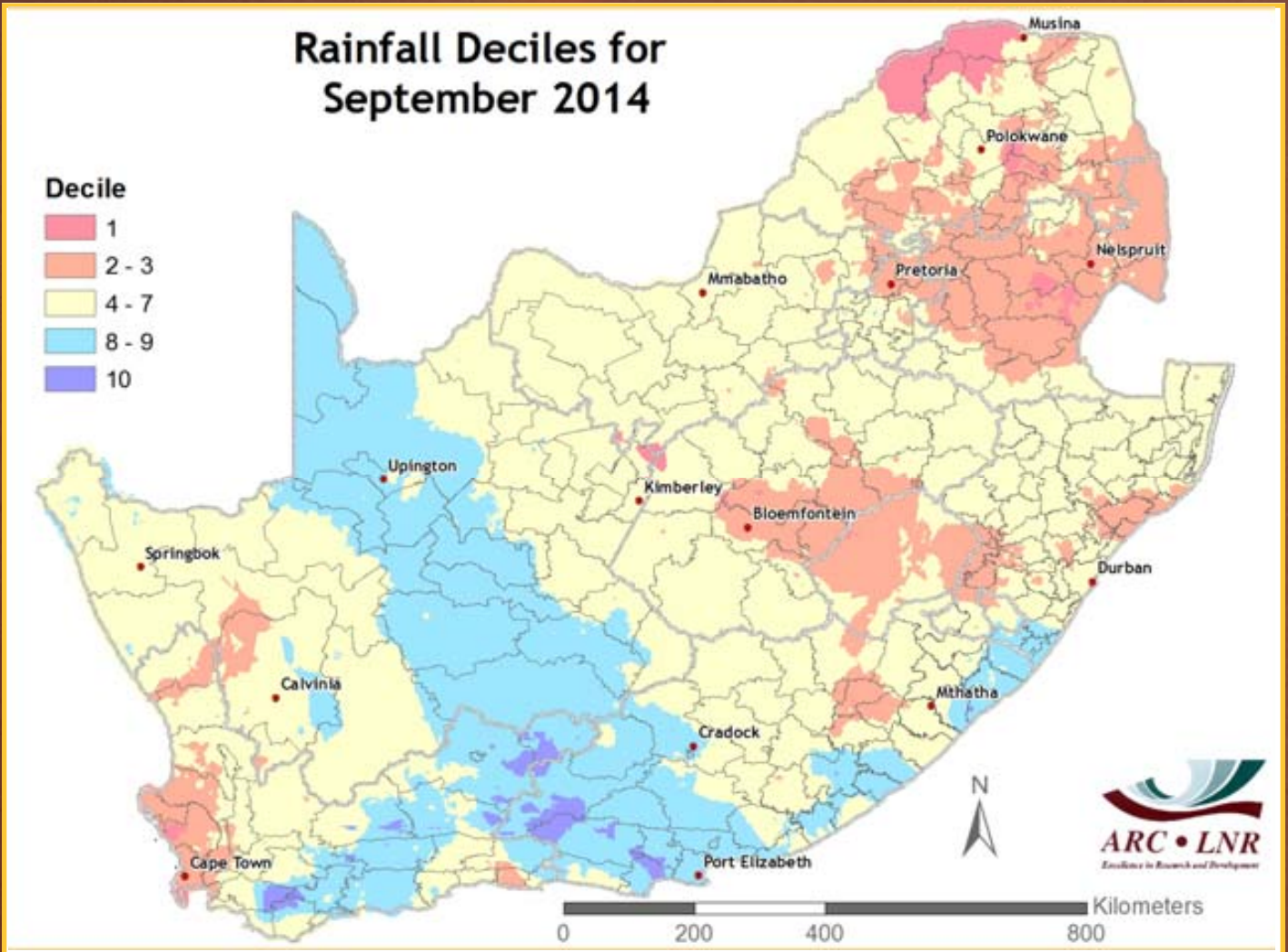


Figure 9

Figure 9:
Rainfall during September 2014 was abnormally high in a band stretching from the northern parts of the Northern Cape southeastwards into the Eastern Cape and eastern parts of the Western Cape. Dry conditions over the western parts of the winter rainfall area and much of the northeastern parts of the country are consistent with the situation experienced in the 10-30% of driest September months.

4. Water Balance

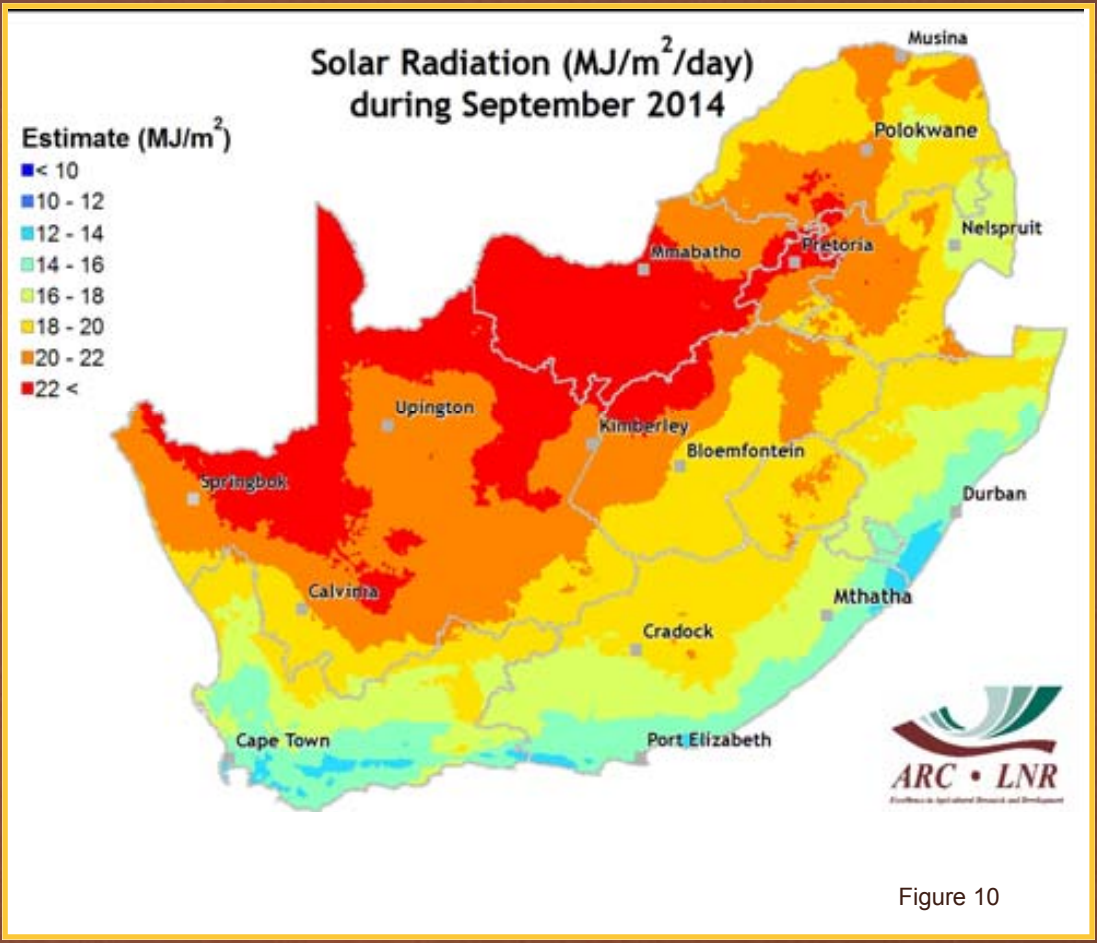


Figure 10

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 are increasing with summer approaching. The highest average daily values were recorded over the northern and northwestern parts of South Africa with relatively low values towards the south and especially along the coast due largely to frequent cloud cover associated with frontal activity or ridging high pressure systems.

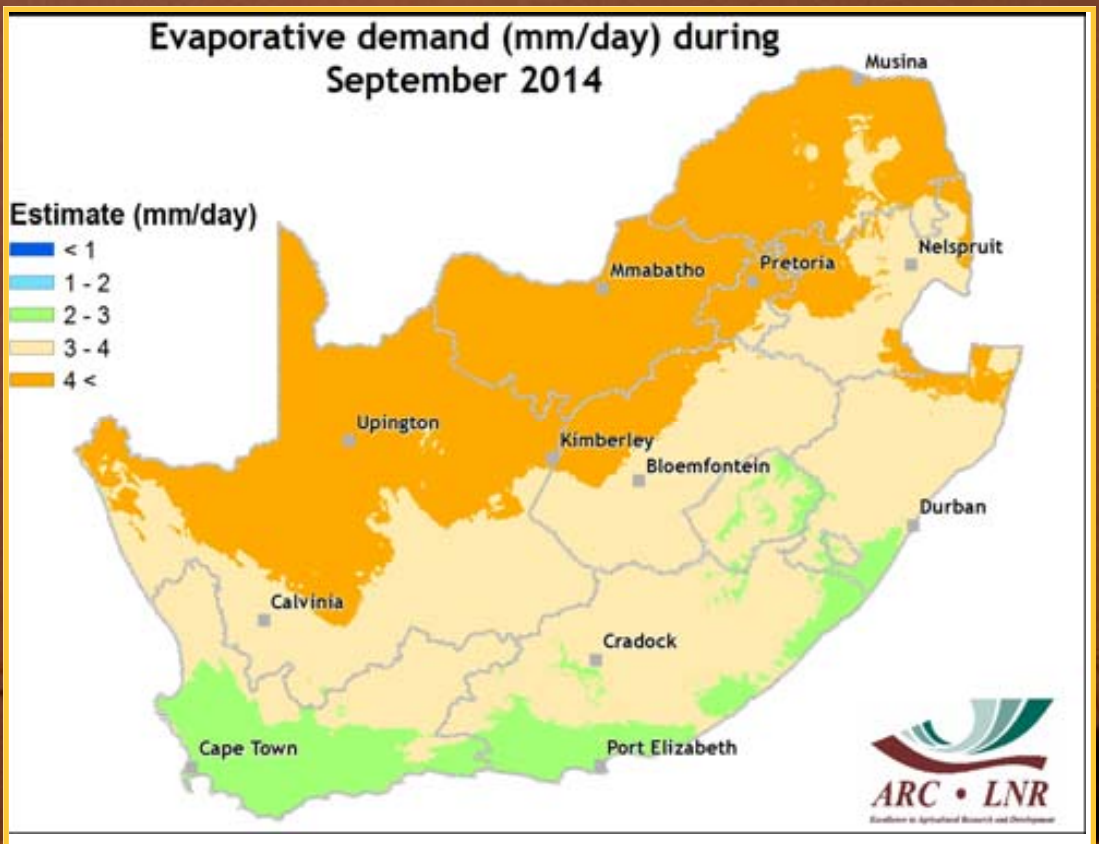


Figure 11

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 southern parts and especially along the coast to more than 4 mm per day over the warmer and drier northern parts of the country.

Questions/Comments:
Johan@arc.agric.za

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.

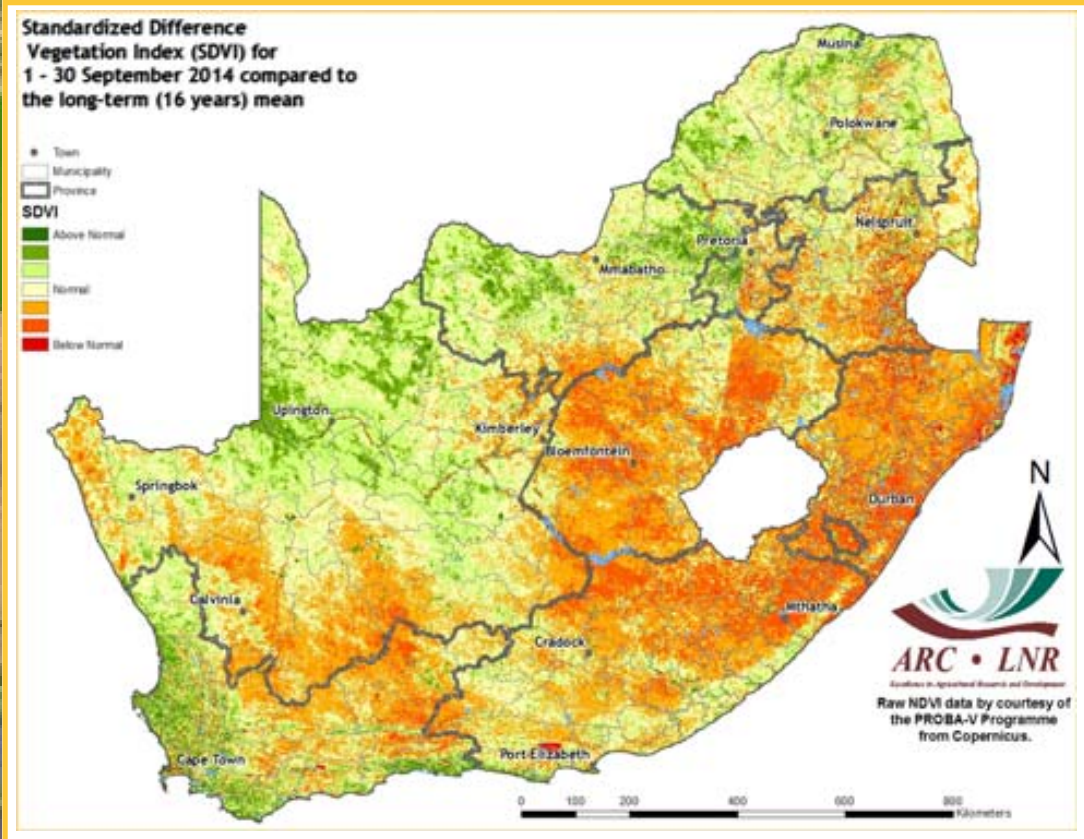


Figure 12

Figure 12:
Vegetation activity is above normal over the northern extremes, winter rainfall area and southeastern coastal belt. Below-normal vegetation activity dominates over the all -year rainfall areas of the Western Cape and Northern Cape as well as the eastern interior towards the eastern coastal area.

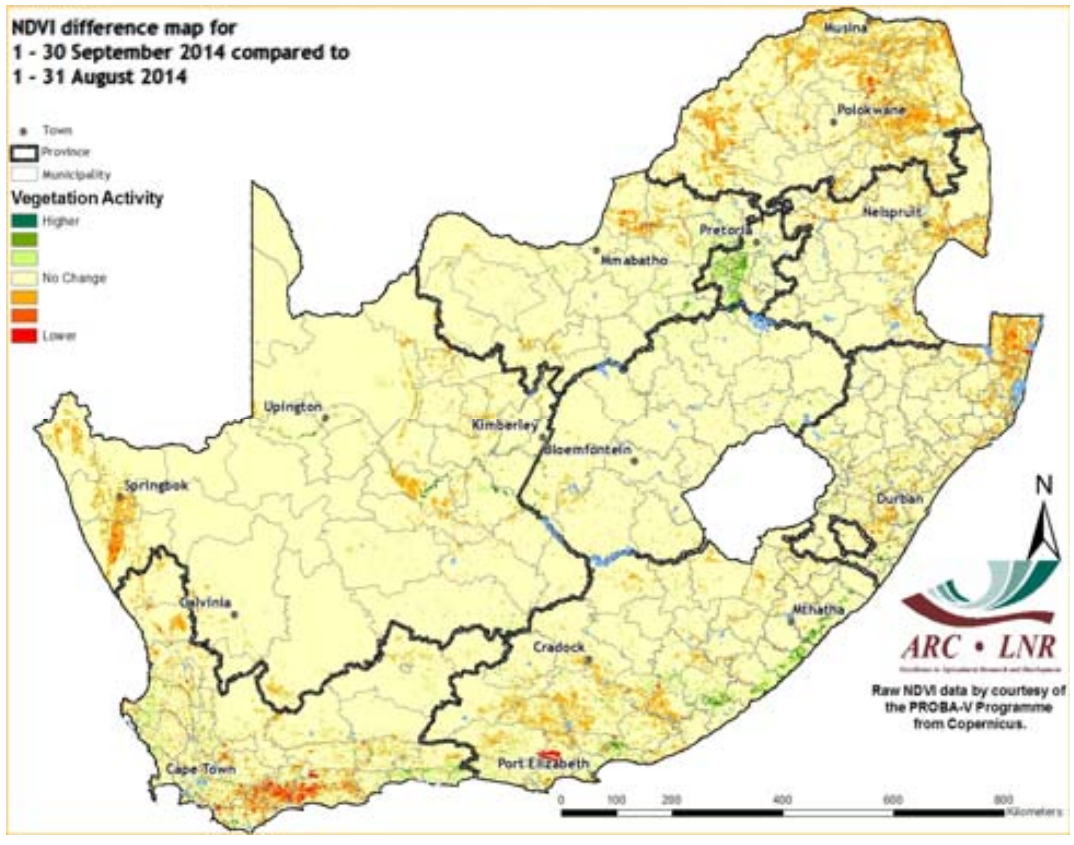


Figure 13

Figure 13:
Vegetation activity is increasing over parts of the Highveld and southeastern coastal region in response to rainfall during August and September. Large decreases in activity are visible over the eastern winter grain production region where rainfall was more concentrated towards early winter.

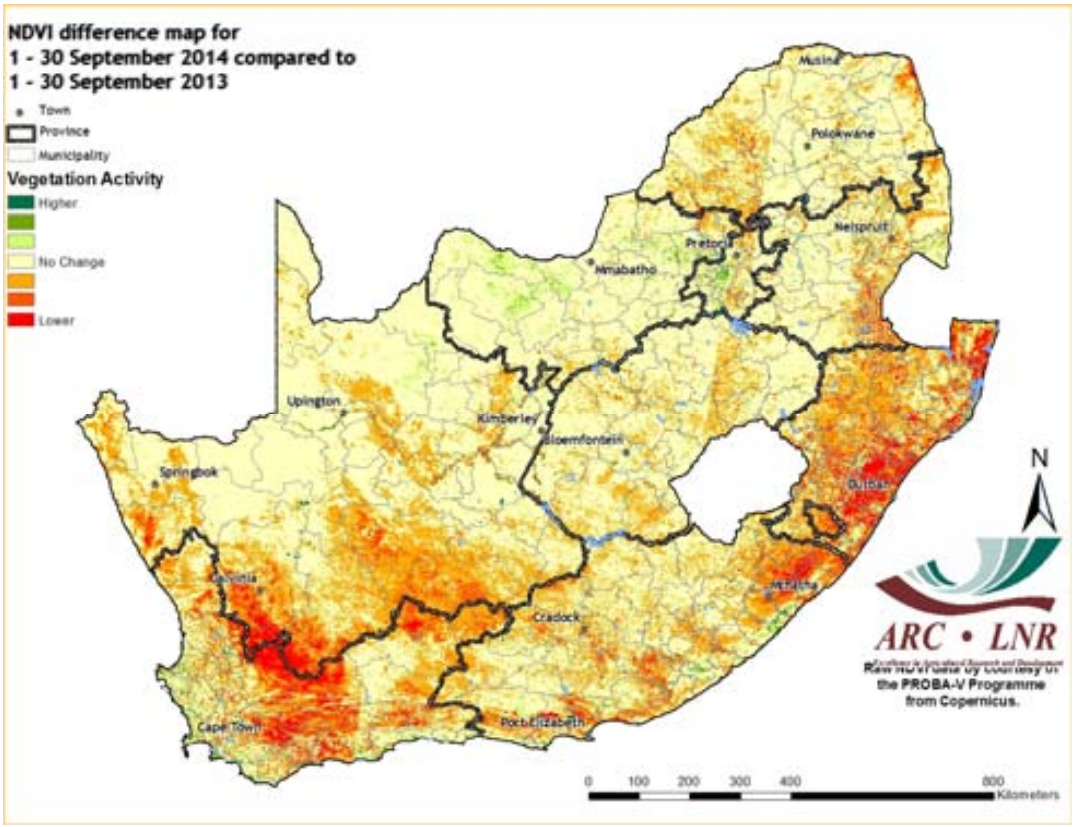


Figure 14

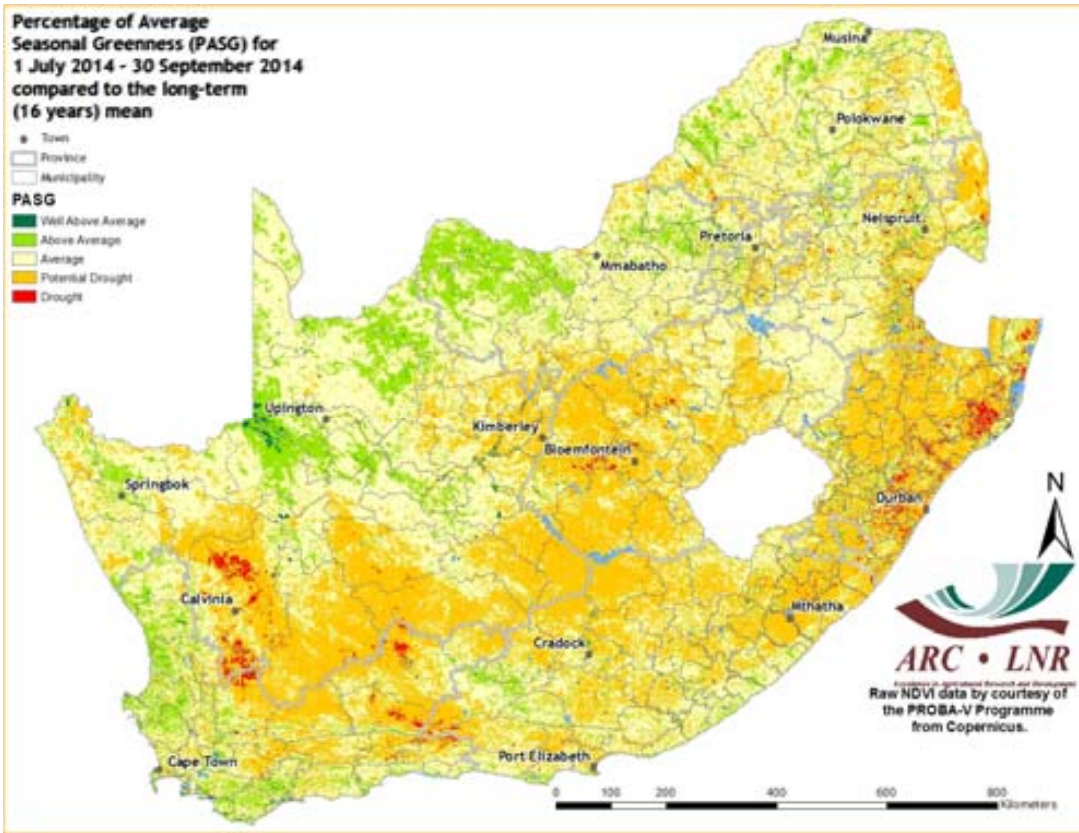


Figure 15

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:
The southwestern parts of the Northern Cape (all-year rainfall area) and much of KwaZulu-Natal are the two main focal points where vegetation activity is much lower than during September last year.

Figure 15:
Cumulative vegetation activity since July is below normal over much of the southern parts of the country (except the winter rainfall area) and above normal over the northern parts where the wet conditions during the previous late summer are still having a positive effect.

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

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.

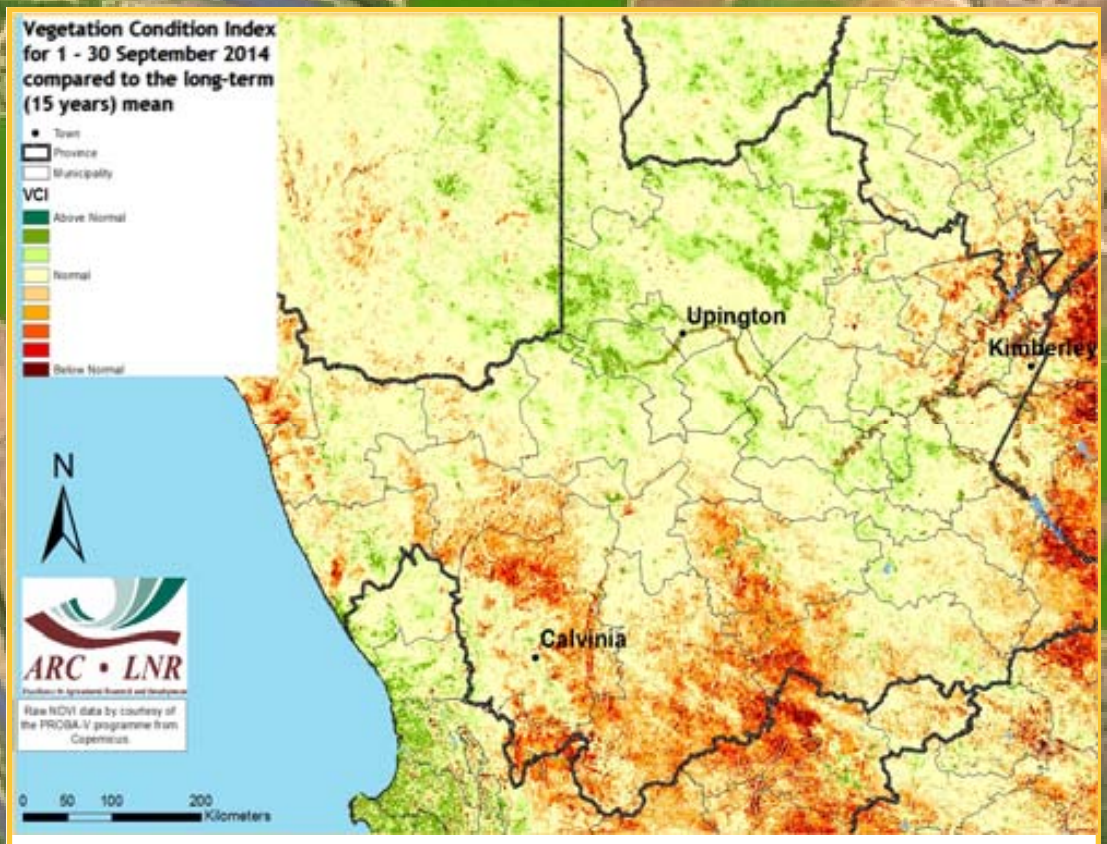


Figure 16

Figure 16:
The VCI map for September 2014 indicates below-normal vegetation activity over most of the Northern Cape, except for the northern parts.

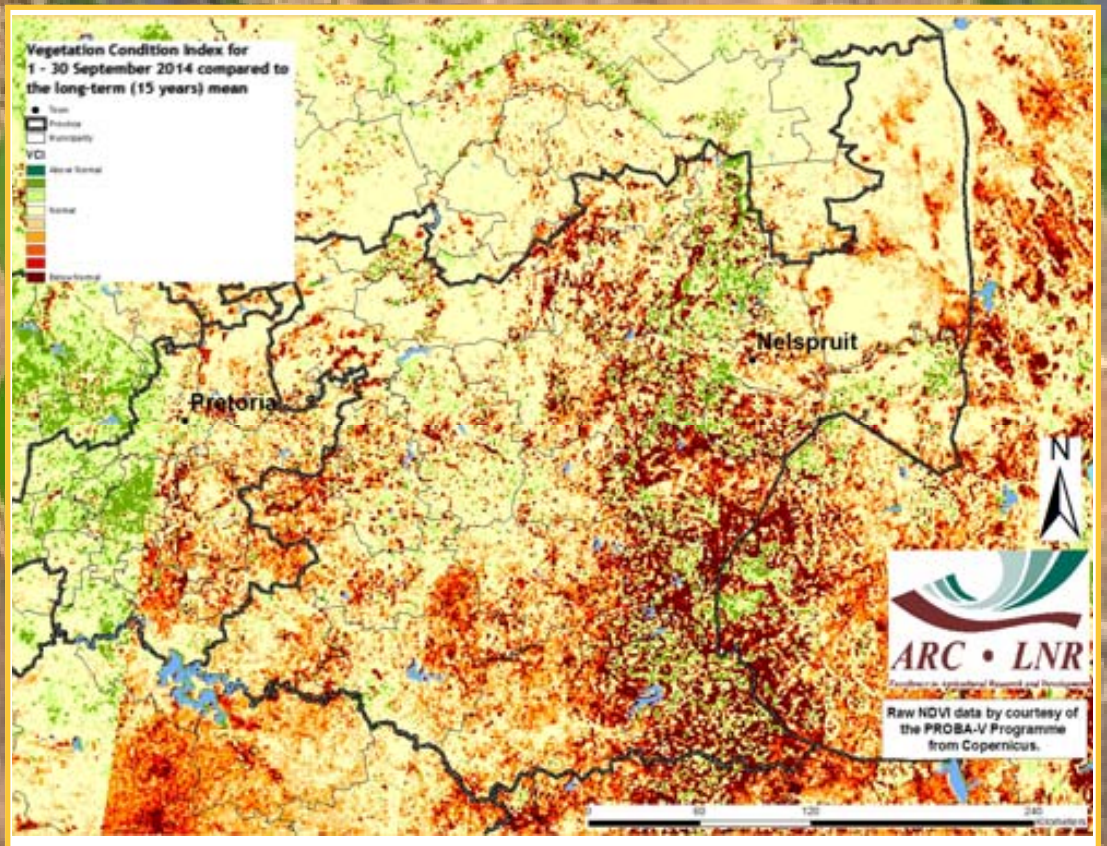


Figure 17

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

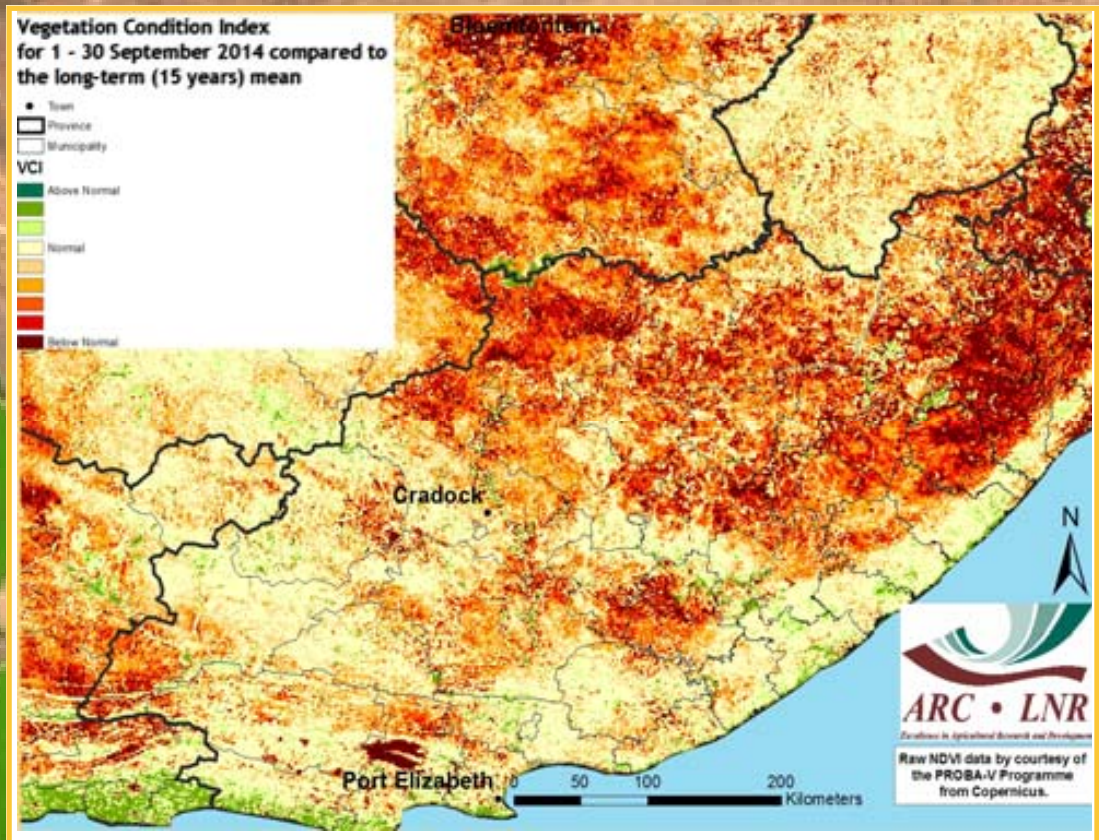


Figure 18

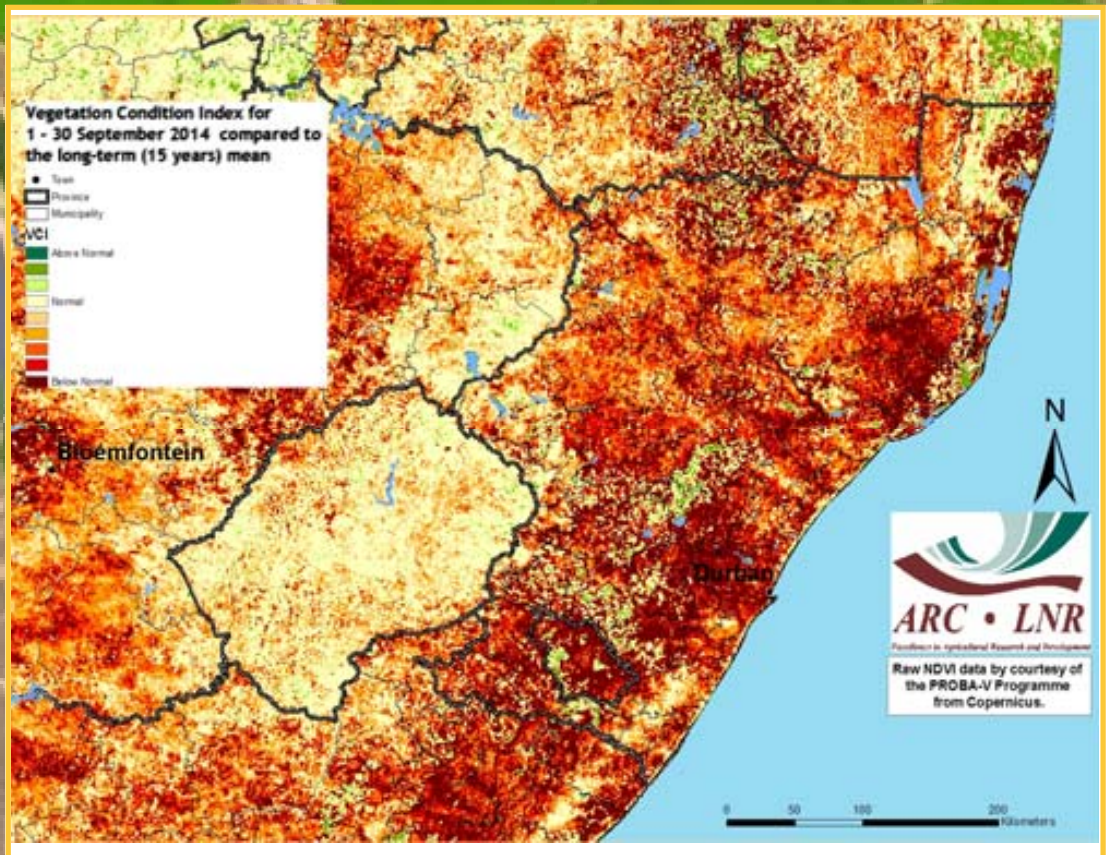


Figure 19

Figure 18:
The VCI map for September 2014 indicates below-normal vegetation activity over most of the Eastern Cape.

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

Questions/Comments:
NkambuleV@arc.agric.za

7. Vegetation Conditions & Rainfall

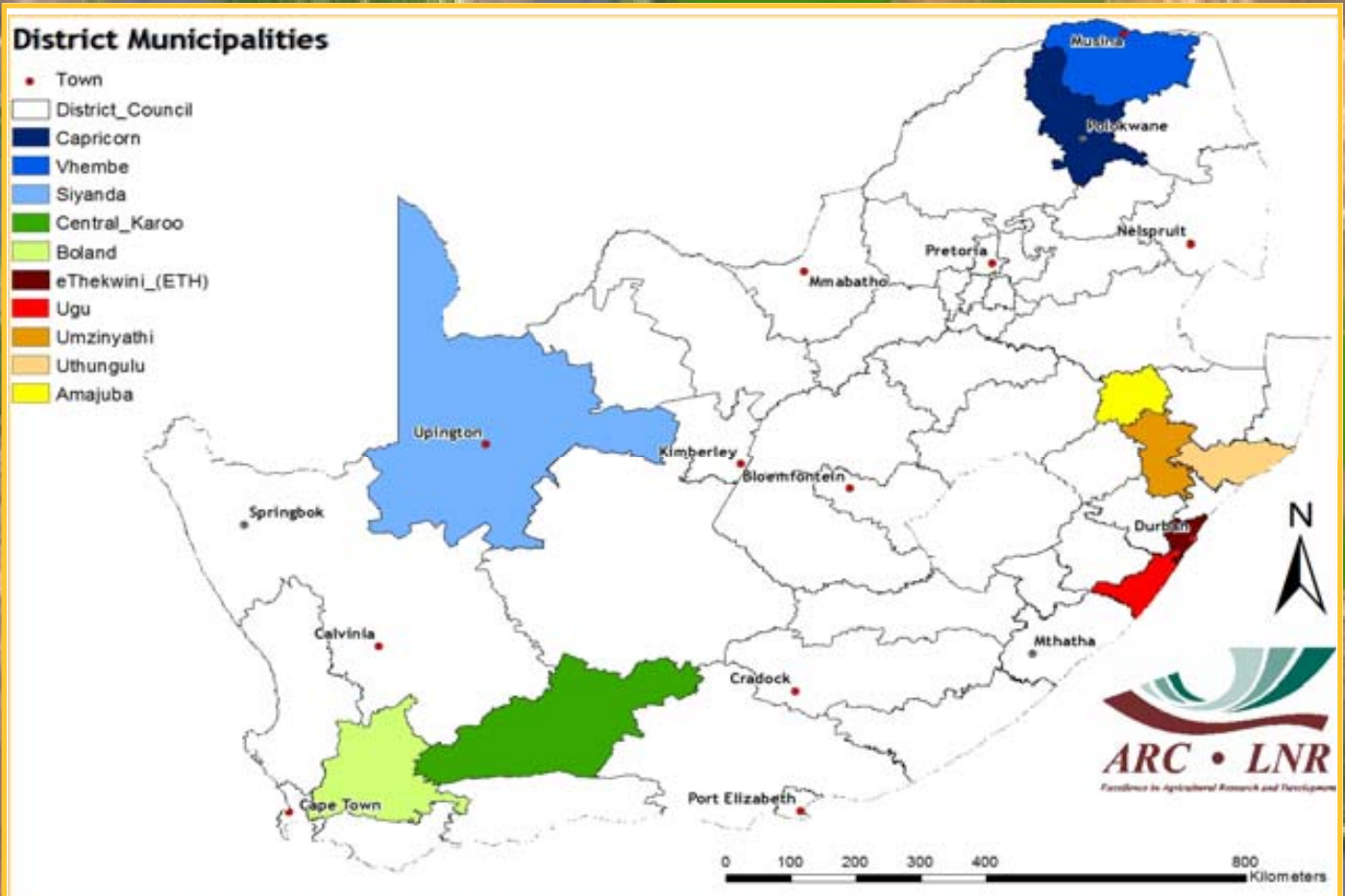


Figure 20

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

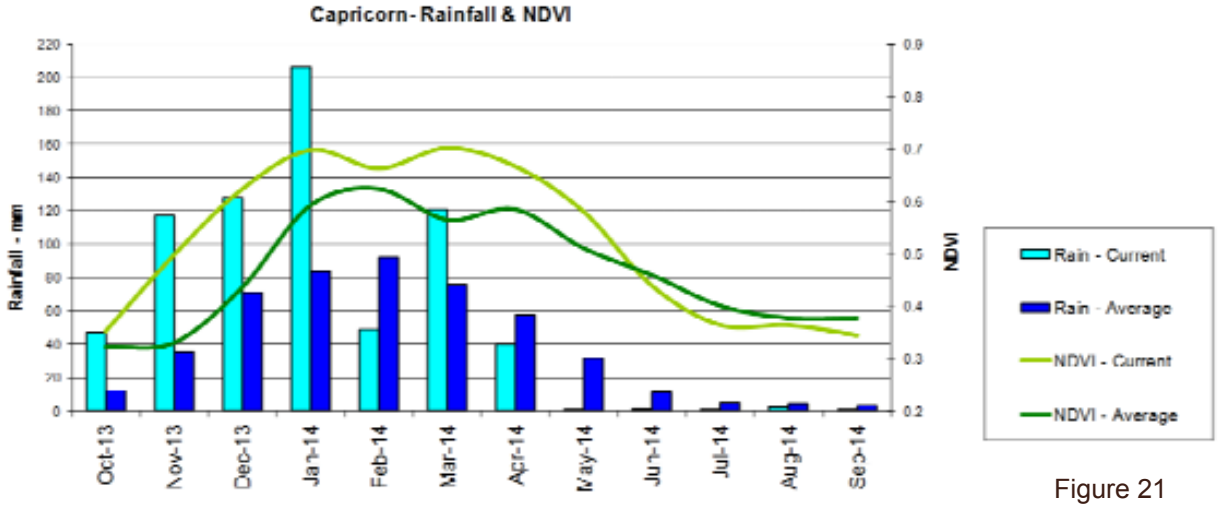


Figure 21

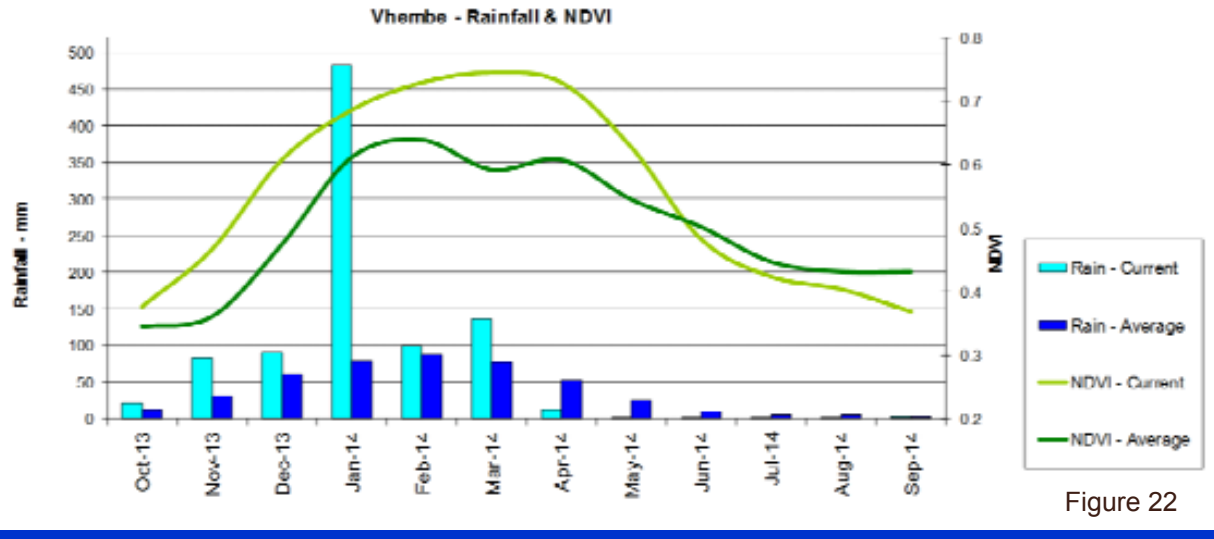


Figure 22

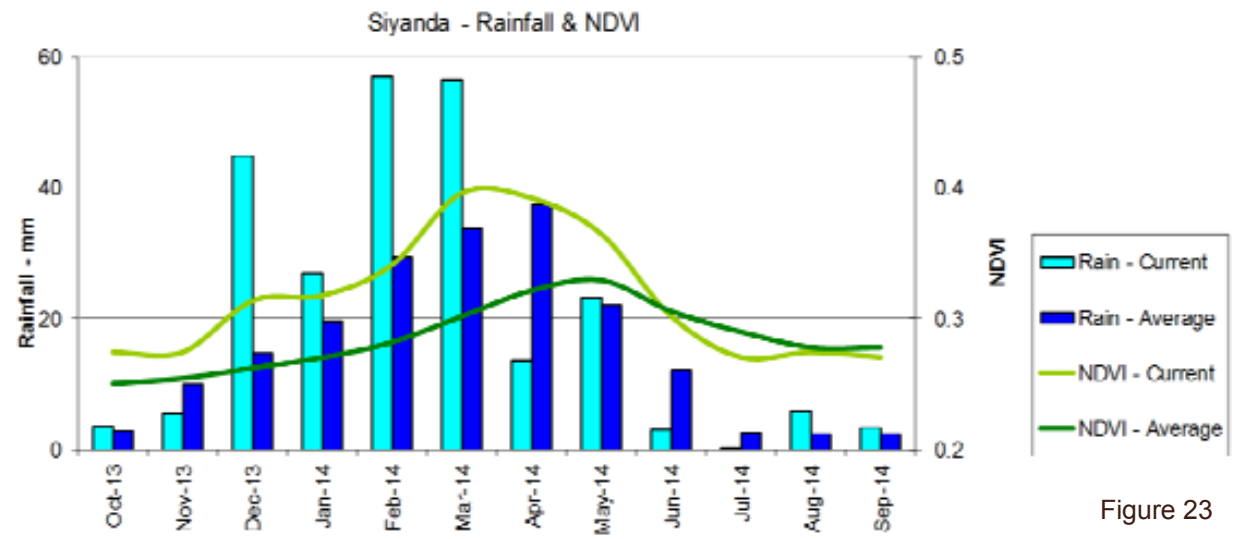


Figure 23

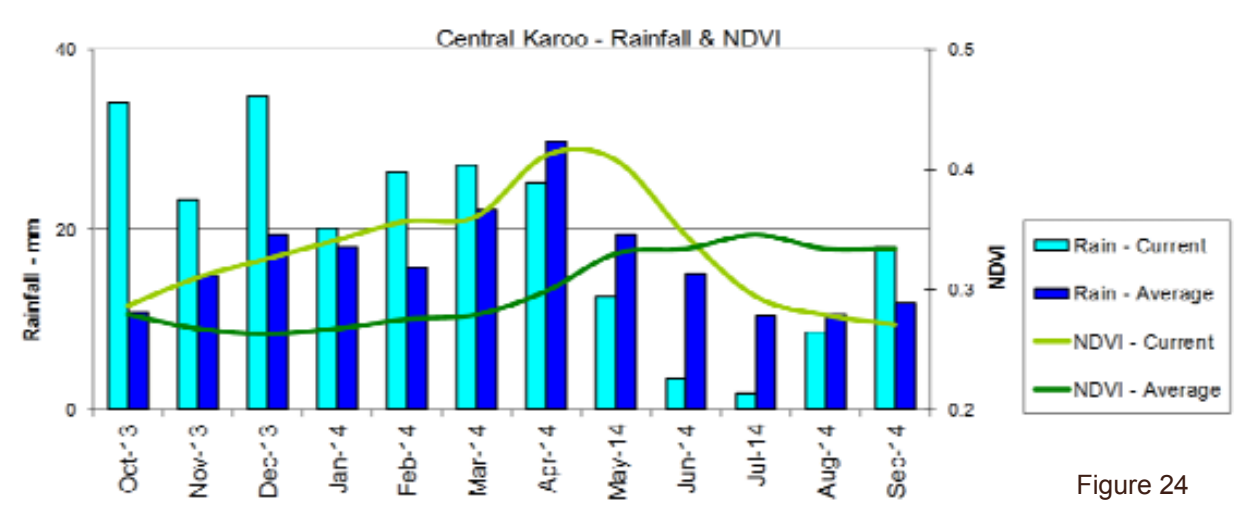


Figure 24

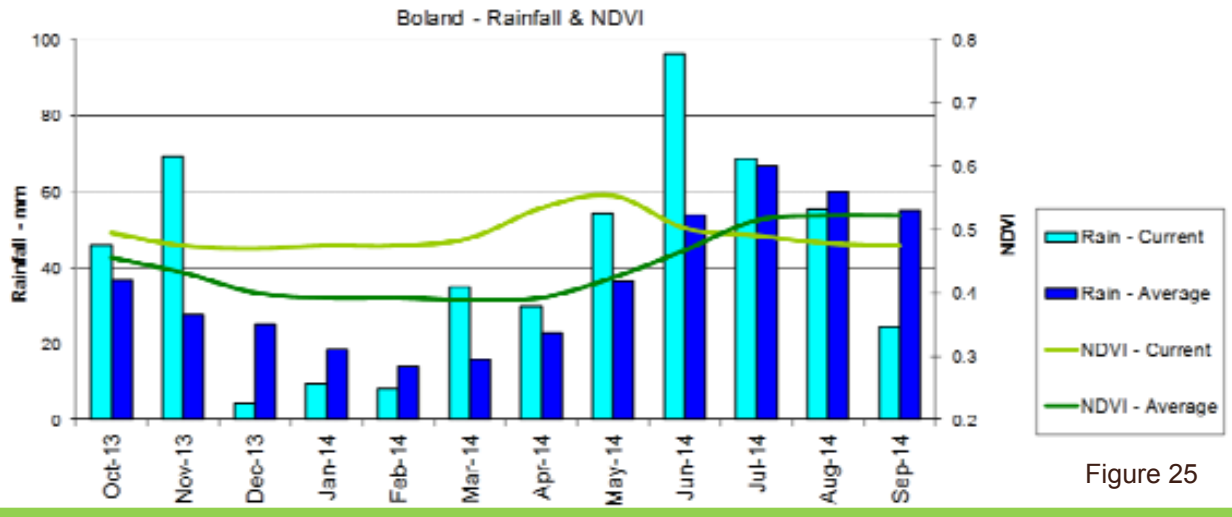


Figure 25

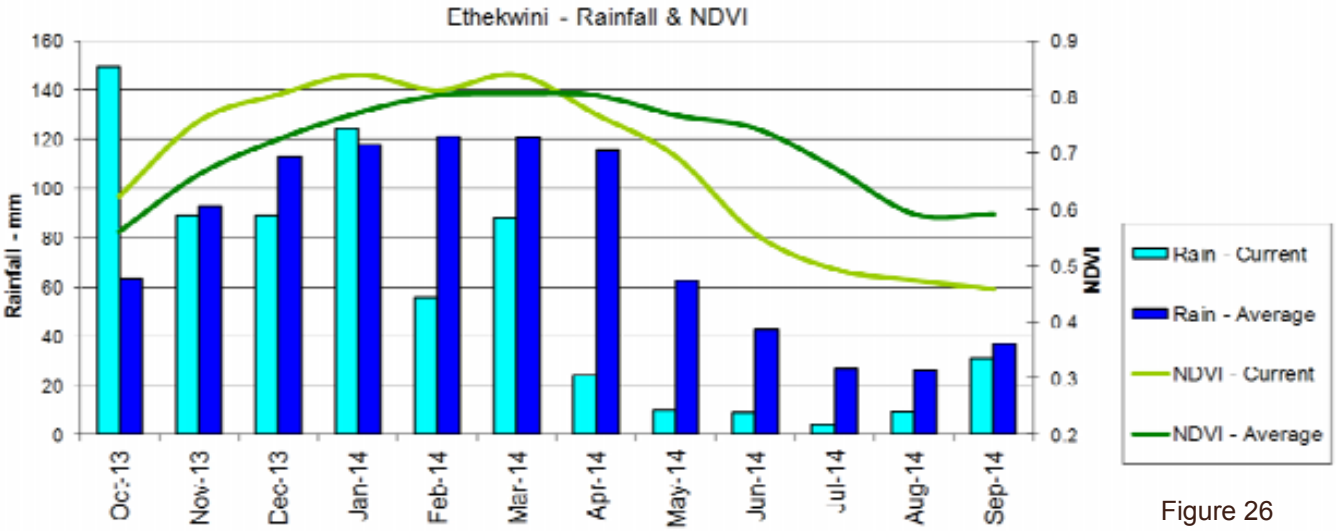


Figure 26

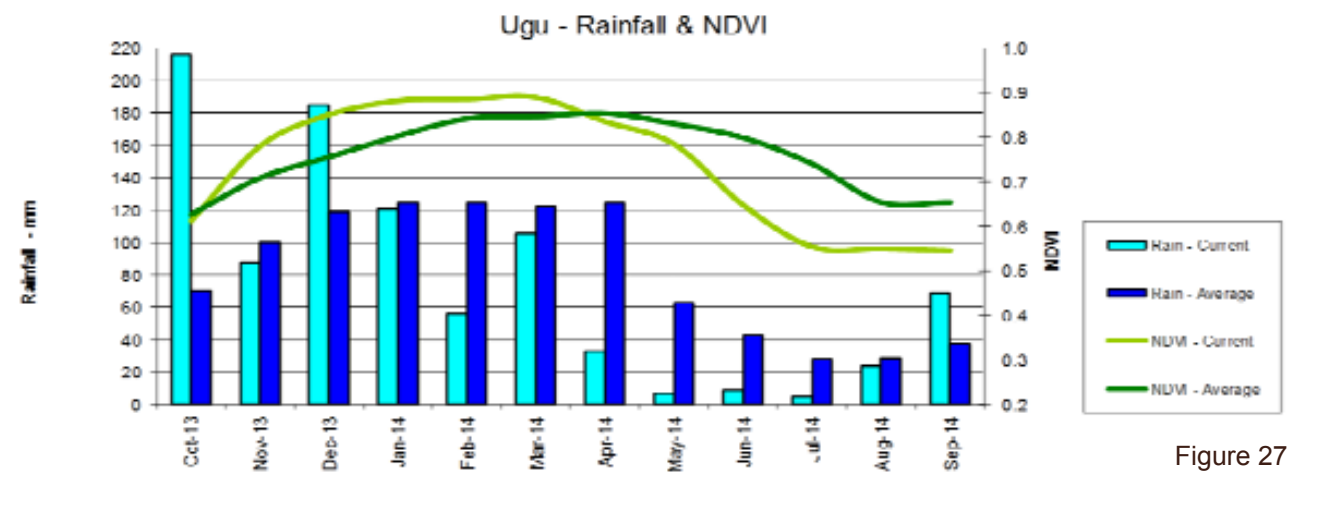


Figure 27

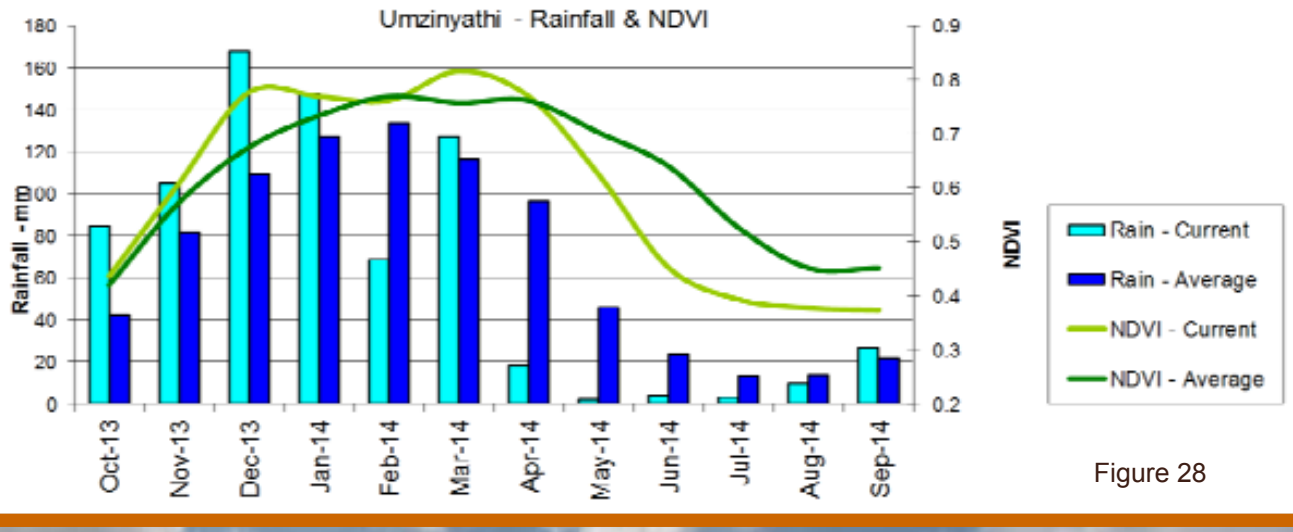


Figure 28

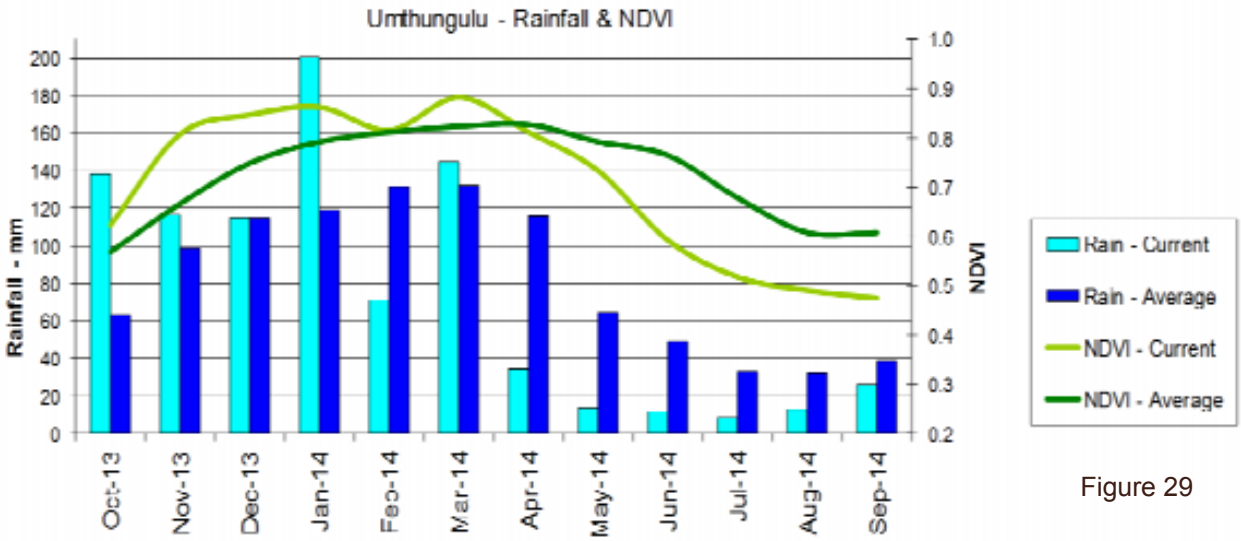


Figure 29

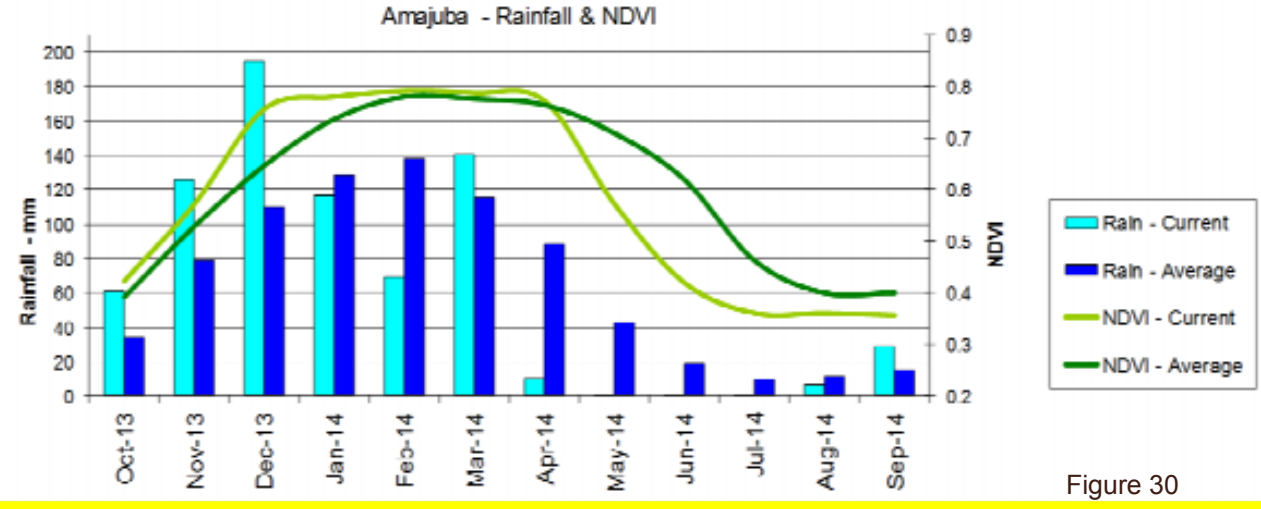


Figure 30

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 September per province. Fire activity was higher in Gauteng, Mpumalanga, Limpopo and the Western Cape compared to the average during the same period for the last 13 years.

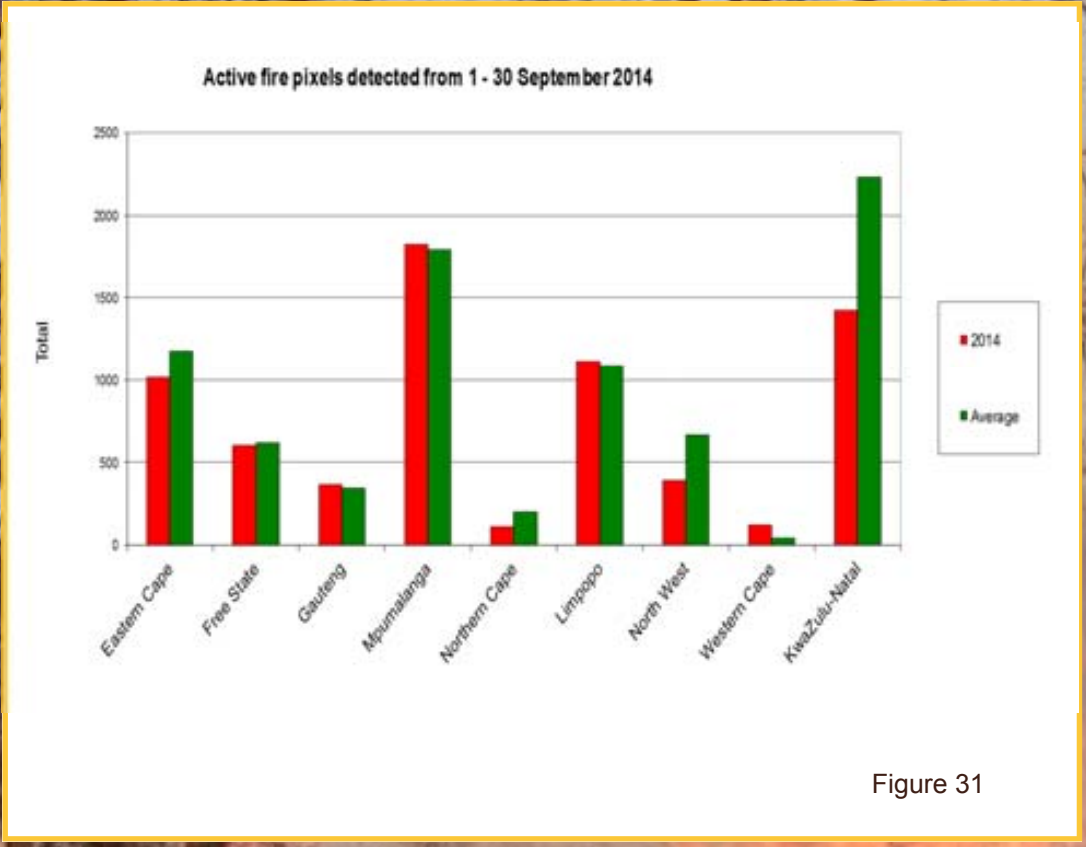


Figure 31

Figure 32:
The map shows the location of active fires detected in the month of September 2014.

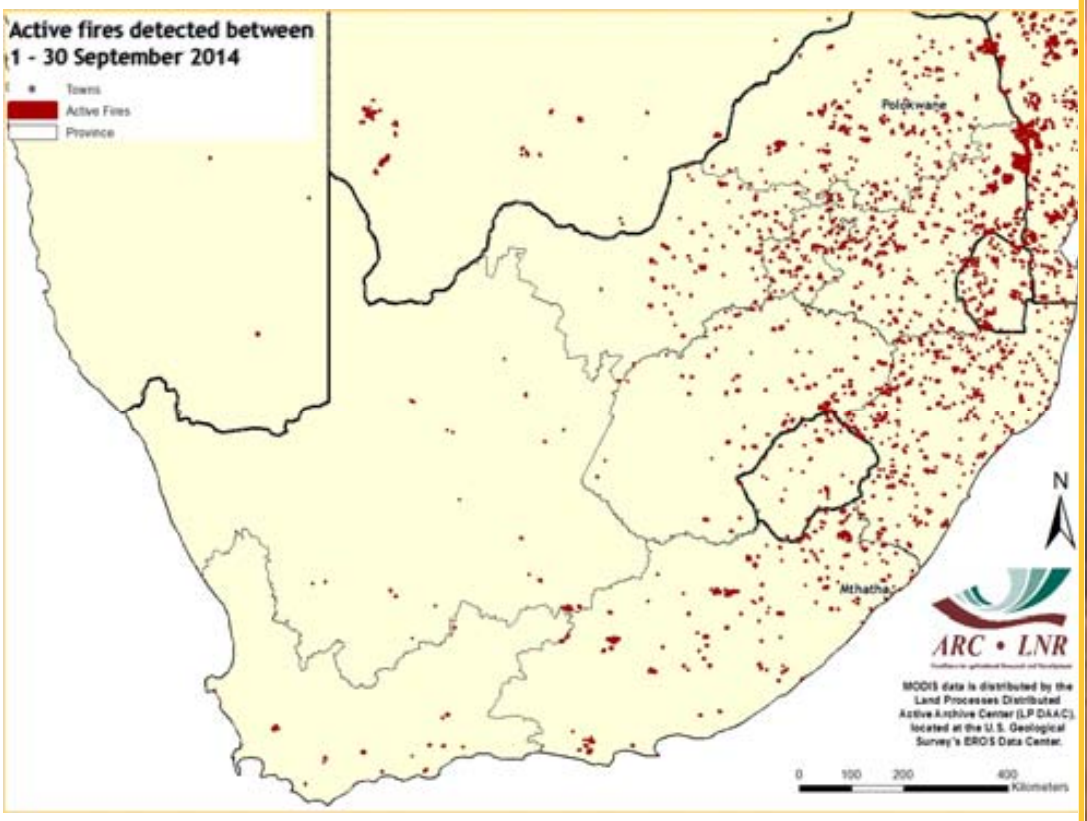


Figure 32

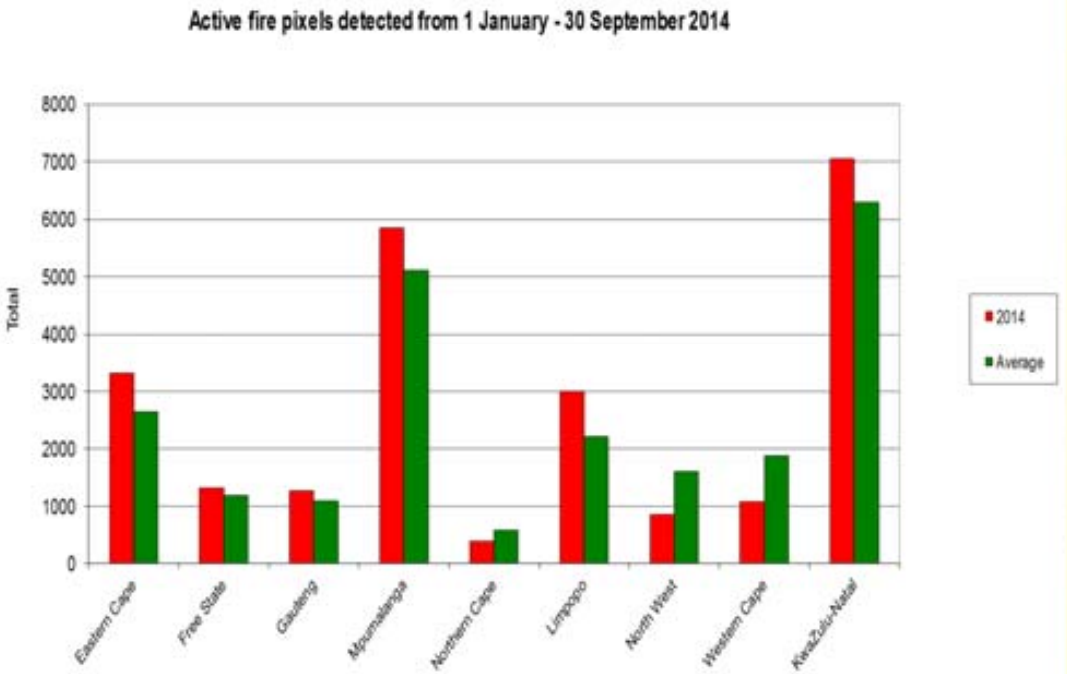


Figure 33

Figure 33:
The graph shows the total number of active fires detected from 1 January to 30 September per province. Fire activity was higher in the Eastern Cape, Free State, Gauteng, Mpumalanga, Limpopo and KwaZulu-Natal compared to the average during the same period for the last 13 years.

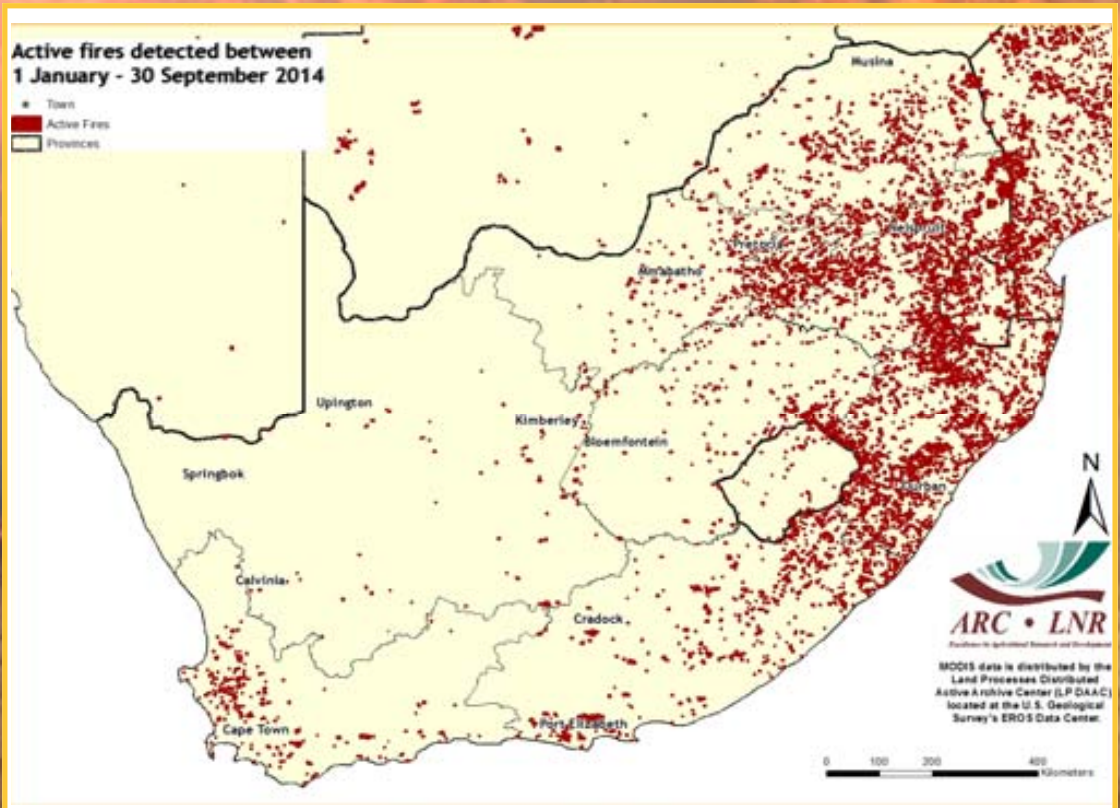


Figure 34

Figure 34:
The map shows the location of active fires detected from 1 January to 30 September 2014.

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 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**.

ARC • LNR
Excellence in Agricultural Research and Development

Institute for Soil, Climate and Water

Private Bag X79, Pretoria 0001,
South Africa
600 Belvedere Street, Arcadia, Pretoria, South Africa

Victoria Nkambule
Project Leader: Coarse Resolution Imagery Database (CRID)
Tel: +27 (0) 12 310 2533
Fax: +27 (0) 12 323 1157

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.

For further information please contact the following:
Dr Johan Malherbe – 012 310 2577, Johan@arc.agric.za
Adri Laas – 012 310 2518, iscwinfo@arc.agric.za

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