agriculture, forestry & fisheries
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REPUBLIC OF SOUTH AFRICA

UMLINDI
The Watchman

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INSTITUTE FOR SOIL, CLIMATE AND WATER

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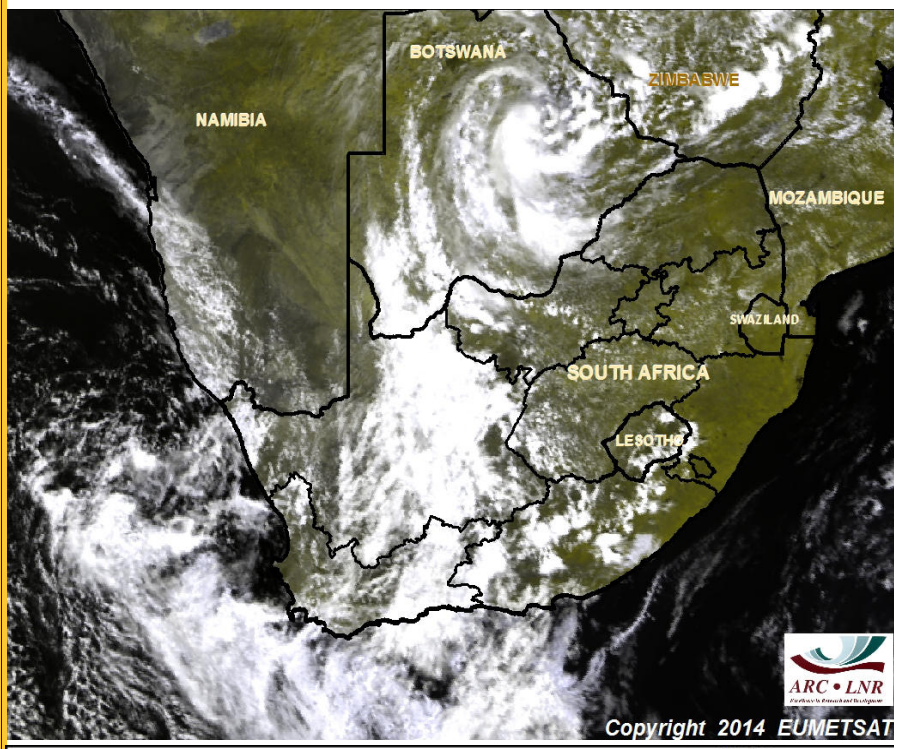
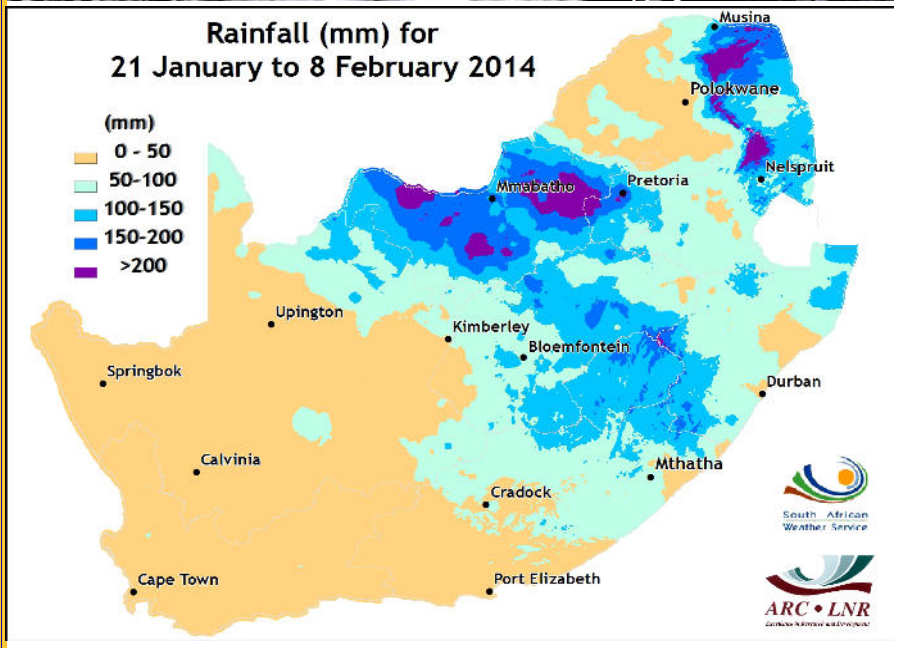
116th Edition

Image of the Month





Extreme event of early January

Widespread and heavy rain occurred during the early part of the month over both the northern parts of Limpopo and the southern and eastern winter rainfall area in the southwest. The MSG 3 visible colour composite of 5 January shows a tropical low over Botswana and a developing upper air low to the west of the winter rainfall area. During the next few days the low in the southwest intensified, resulting in widespread rain and flooding over parts of the Western Cape. Concurrently, the low in the north moved eastward across Limpopo resulting in heavy falls there. The system in the southwest (cut-off low) was similar to the one that resulted in the Laingsburg flood of 25 January 1981.

Widespread rain over the central parts

Most of January was hot and dry over the interior, causing distress over the drought-stricken region after widespread rain during December. During the critical late-January to early February period, however, conditions became very favourable for precipitation over the drought-stricken central interior due to the movement of a tropical low into central Botswana, with ample moisture resulting in widespread and heavy rain over especially the North West Province, lasting up to about 8 February (see map) during which time the low remained almost stationary over Botswana. This was the most significant rainfall event during late summer over the province since 2011 and may signal better conditions ahead. The map was constructed from data from the automatic weather station networks of the ARC-ISCW and the South African Weather Service. It shows that almost the entire North West received in excess of 100 mm of rain during the period, with large parts receiving more than 200 mm. **Questions/Comments:** *Johan@arc.agric.za*

1. Rainfall

Overview:

The month of January was characterized by a wet start over the northeastern and southwestern parts, followed by a relatively dry and hot period of about 2 weeks, and ended off wet again, especially over the central to northern summer rainfall area. The first few days were dominated by a tropical low pressure system over eastern Botswana, moving across the extreme northern parts of South Africa eastward while a cut-off low developed in the upper air over the winter rainfall region by the 5th. Both these systems were responsible for heavy rain with daily totals exceeding 50 mm or even 100 mm in their respective locations. The central parts of the country, however, did not receive much rain. The development of the low in the southwest also resulted in dry air moving into the western and central interior and also the low in the north moving out eastward, with sunny and hot conditions developing over the central parts. In fact, for most of the rest of the month, hot and dry conditions dominated much of the interior; with maximum temperatures regularly exceeding 35° to 40°C over especially over the central and western parts. During this period, however, an easterly flow kept conditions somewhat cooler in the east while isolated to scattered thundershowers developed there. Conditions started to change markedly from the 24th, with large amounts of moisture moving into the interior. Scattered thundershowers occurred over the northeastern interior from the 24th. By the 27th, a tropical low pressure system moved across Zimbabwe from the Indian Ocean and into Botswana, where it contributed to large amounts of tropical moisture over the southern African interior. This heralded the wet period over the drought-stricken central interior, with the wet conditions persisting until early February and even resulting in flood conditions over some parts of North West and surrounding provinces.

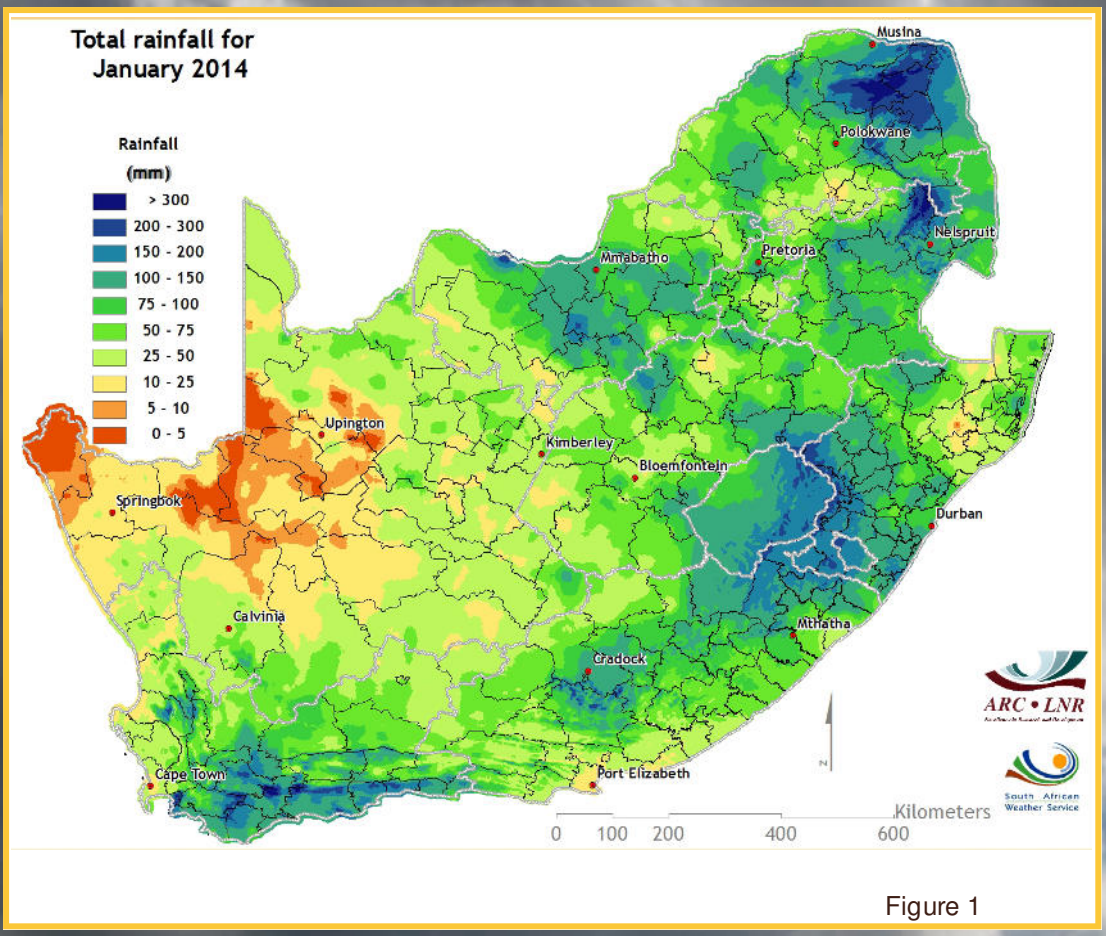
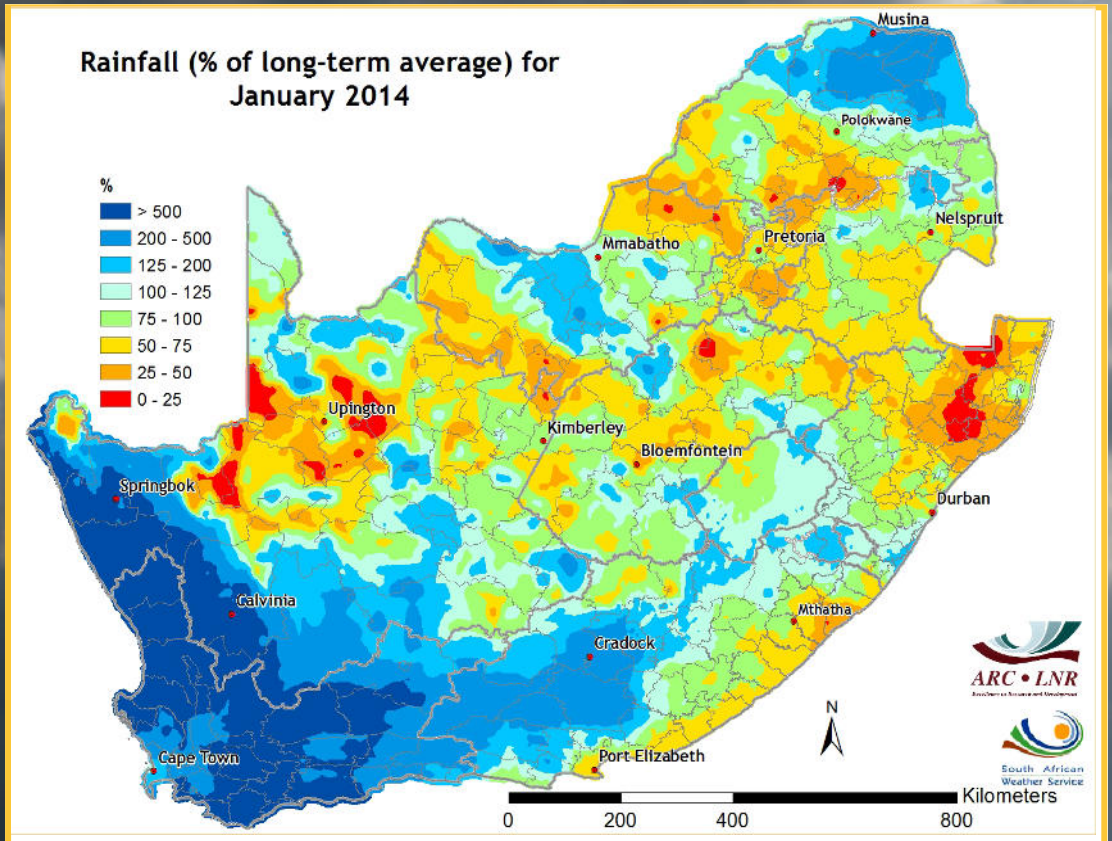


Figure 1



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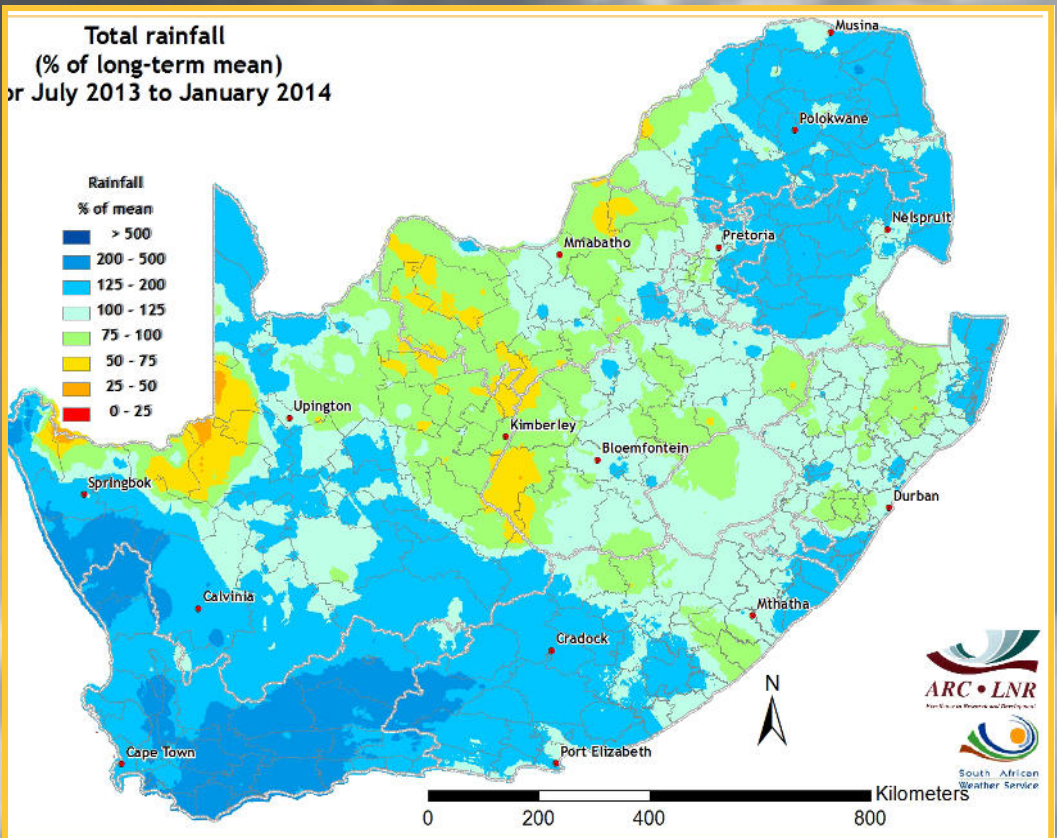

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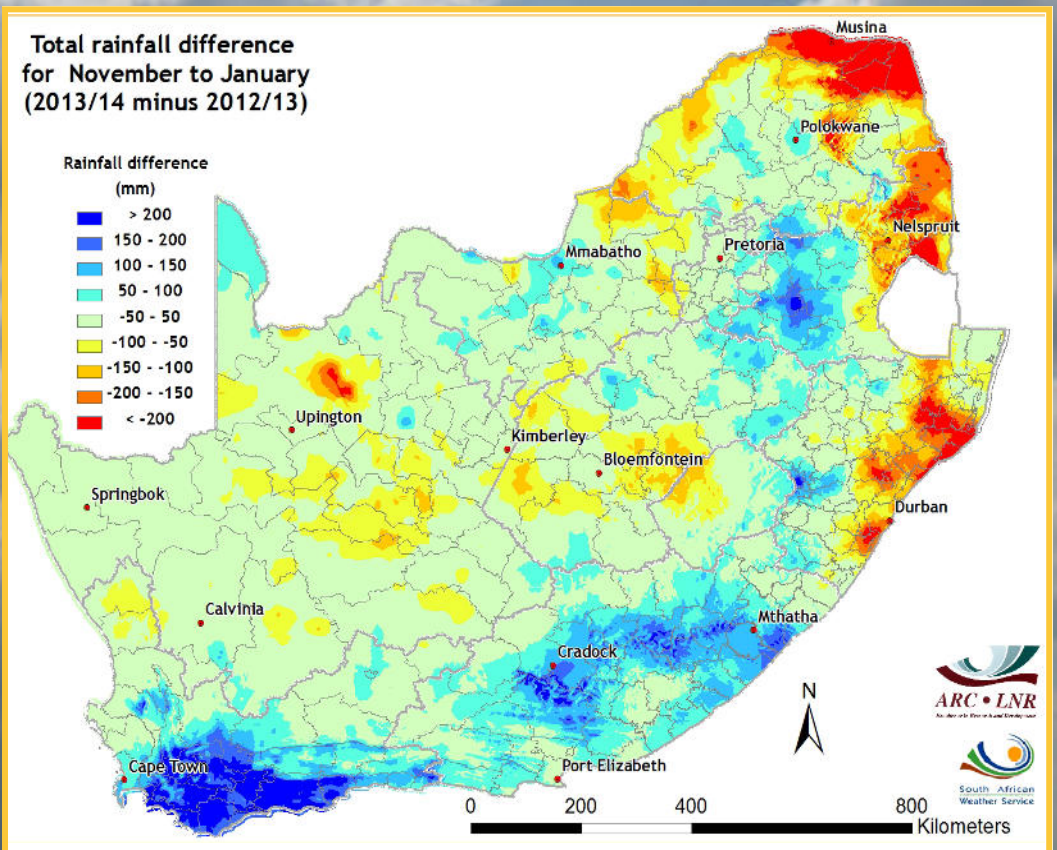

Figure 4

Figure 1:
Precipitation occurred across the entire country during January 2014 except for isolated areas in the northwestern Northern Cape. The highest falls (150 - 300 mm) were recorded along the eastern escarpment, especially towards Limpopo, as well as the mountains of the southern Cape. While some parts of the northeastern and central interior received in excess of 100 mm, large areas received less than 75 mm.

Figure 2:
Monthly rainfall was very much above normal over most of the winter rainfall area and into the western parts of the Eastern Cape. The central parts of North West and northeastern Limpopo also received above-normal rainfall. Rainfall was below normal over much of the Highveld, southern Limpopo and northern KwaZulu-Natal.

Figure 3:
The southern parts of the country, including much of the eastern winter rainfall area, were much wetter during November-January 2013/14 than in November-January 2012/13. The eastern and northern extremes of the country received much less rain than for the same 3-month period a year ago.

Figure 4:
Rainfall since July has been above normal over the western eastern and northeastern parts of the country. Parts of the central interior are still relatively dry, but the cumulative rainfall situation is showing signs of improvement with some areas over central North West and the central Free State reporting above-normal rainfall for the period.

Questions/Comments:
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2. Standardized Precipitation Index

Standardized Precipitation Index (SPI)

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 drought conditions over the central parts of the country have eased at the short time scale (3-6 months) due to widespread rain during December and late January. However, at a longer time scale the effect of a long dry period since 2012 is clearly visible with the SPI in some catchments being in the severe to extreme drought range, especially towards western North West and adjacent provinces. Due to two wet winters and unseasonal rain during the current summer over the winter rainfall area, the extremely wet category dominates there at all time scales.

Questions/Comments:
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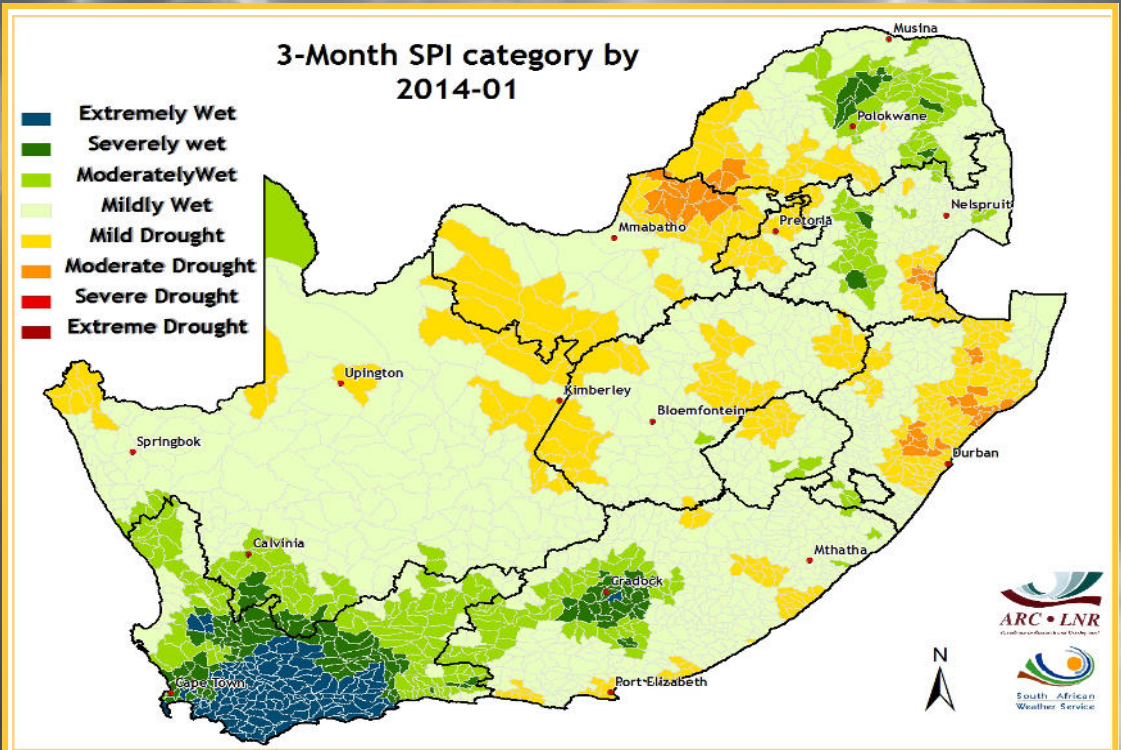

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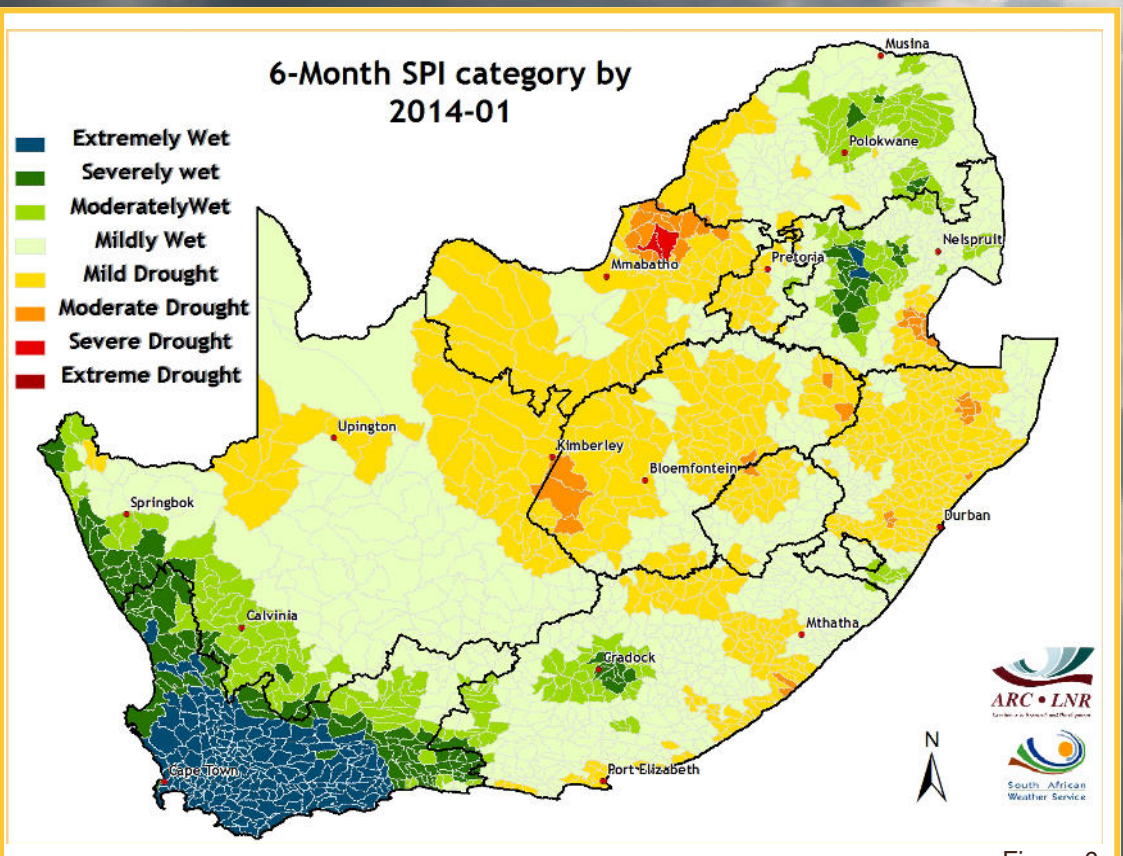

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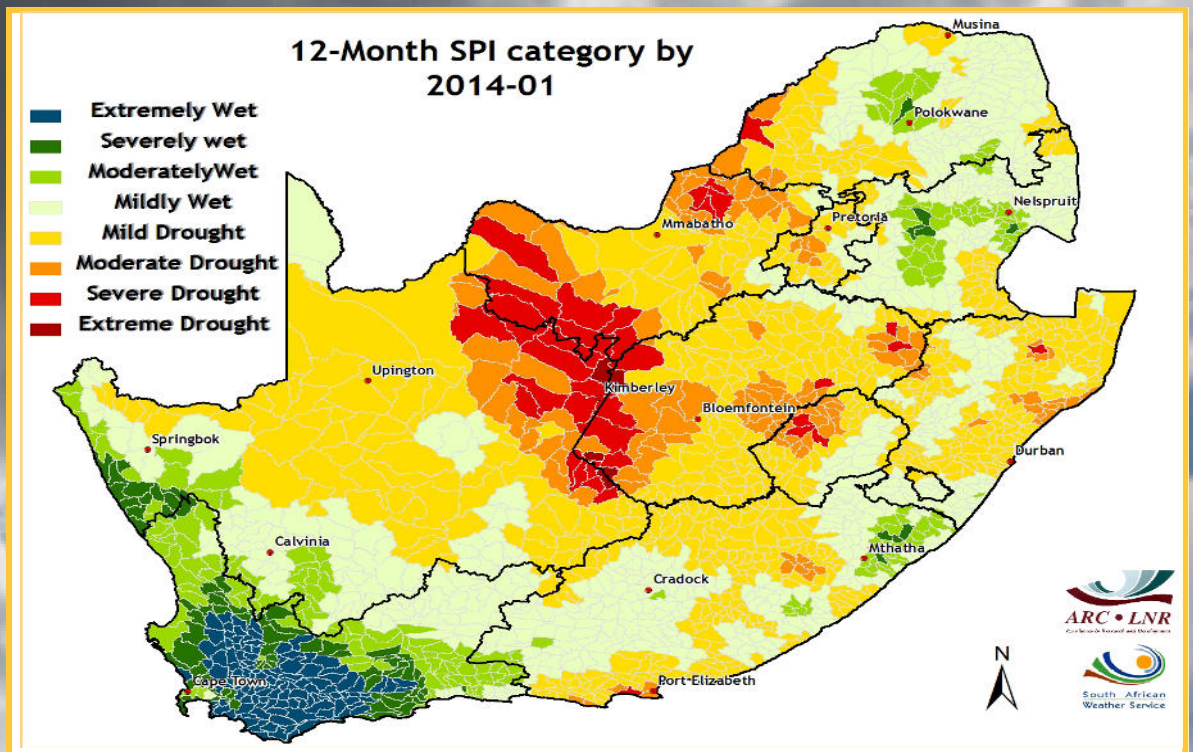


Figure 7

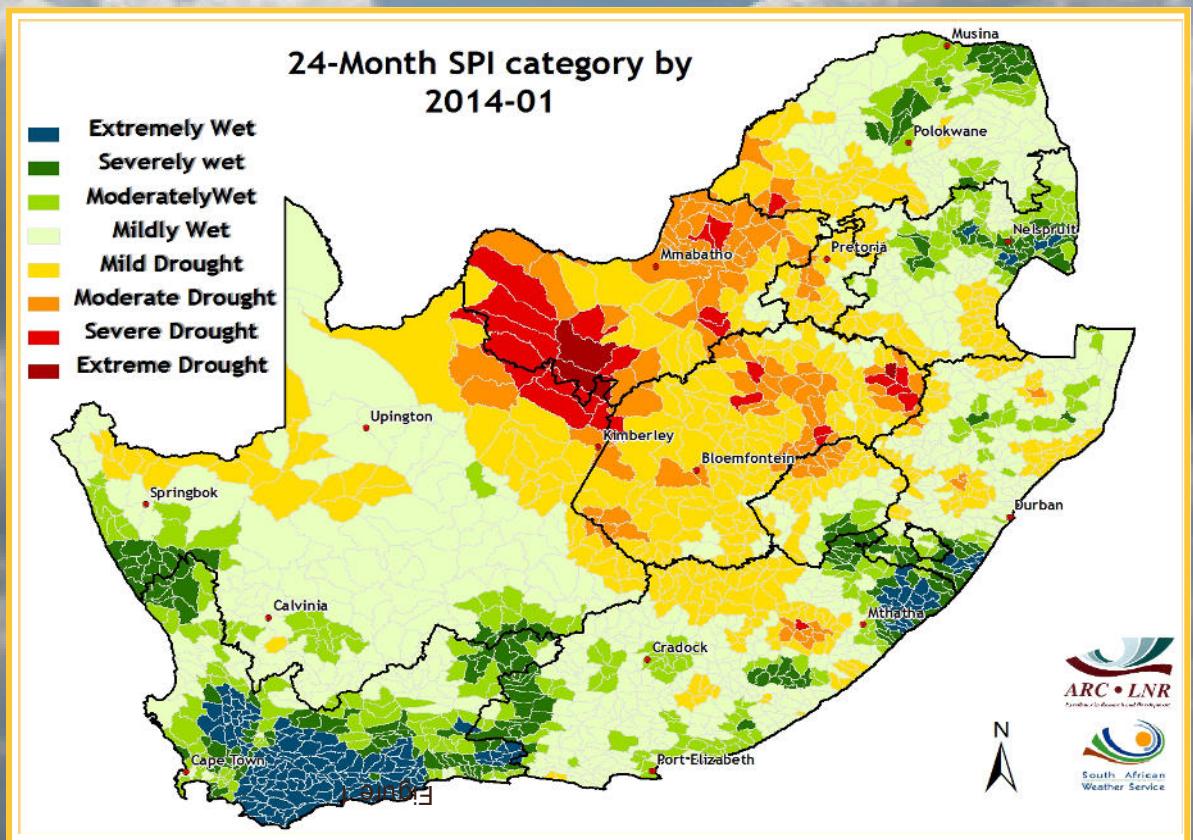


Figure 8

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.

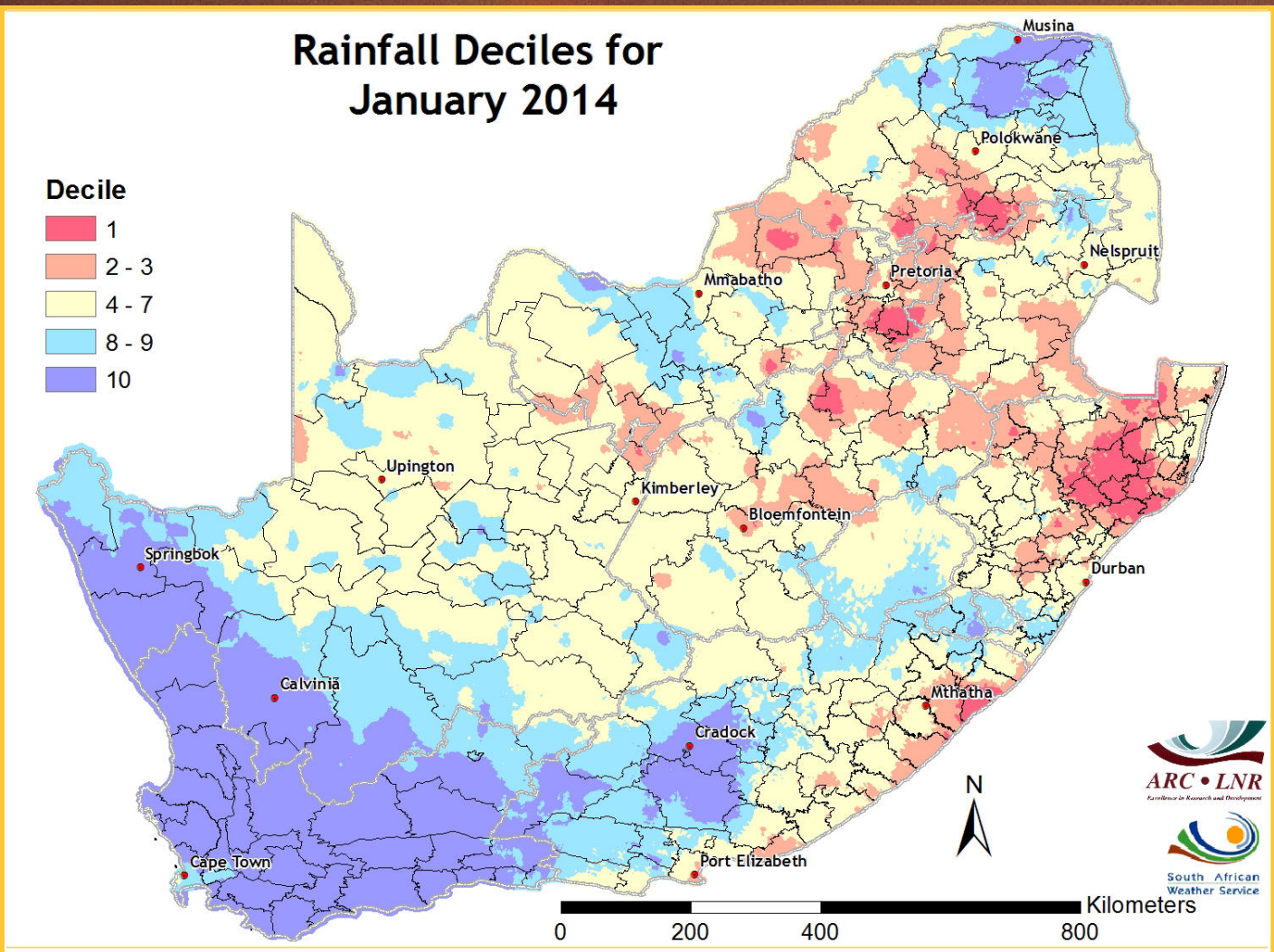


Figure 9

Figure 9:
The rainfall decile map for January indicates exceptionally wet conditions over the southwestern and extreme northeastern parts and exceptionally dry conditions over some parts of the northeastern interior and into northern KwaZulu-Natal.

4. Water Balance

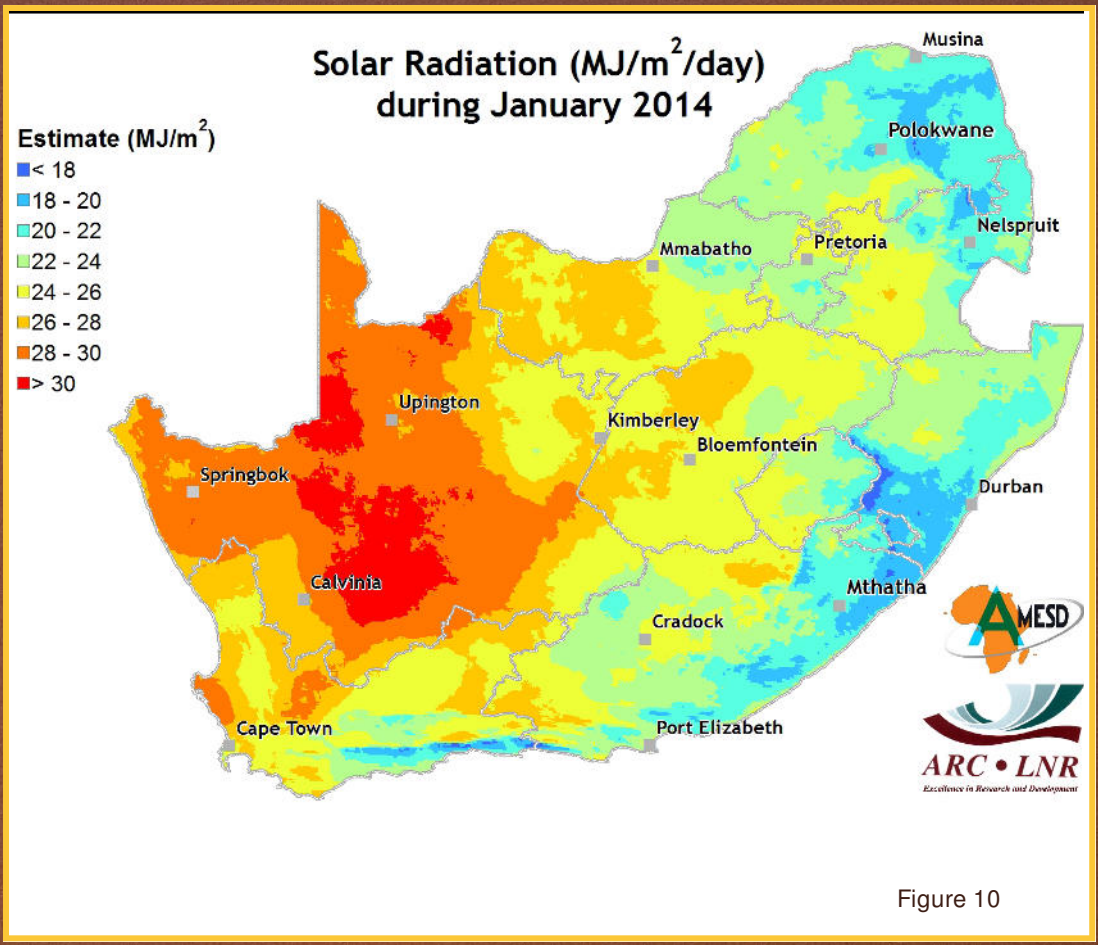


Figure 10

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:
Cloudy periods over the southern, eastern and northeastern parts resulted in relatively low average solar radiation values there, while the western interior was quite sunny.

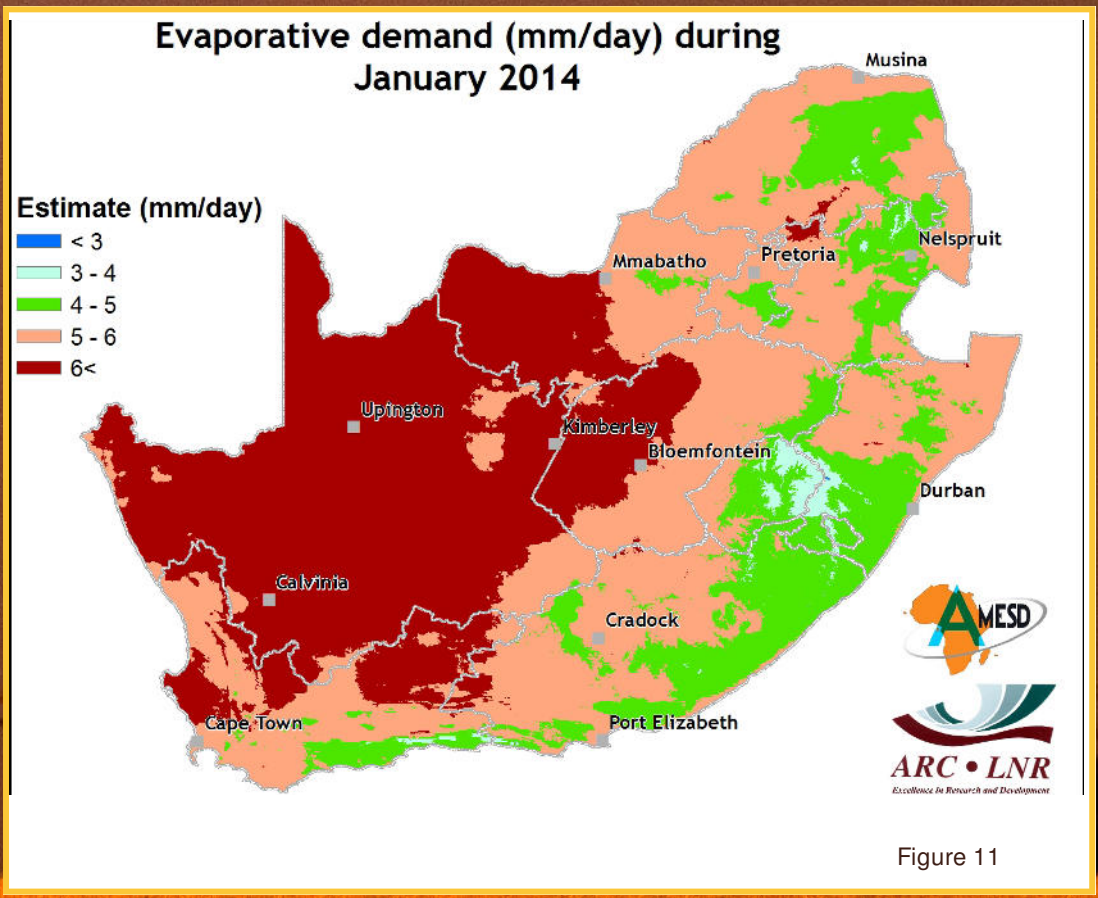


Figure 11

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:
As expected with cooler conditions and cloud cover dominating for most of the month over the eastern parts as opposed to hot and dry conditions in the west, there is an east-west gradient of increasing potential evapotranspiration across South Africa. Low values are also visible in the southern Cape mountains.

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.

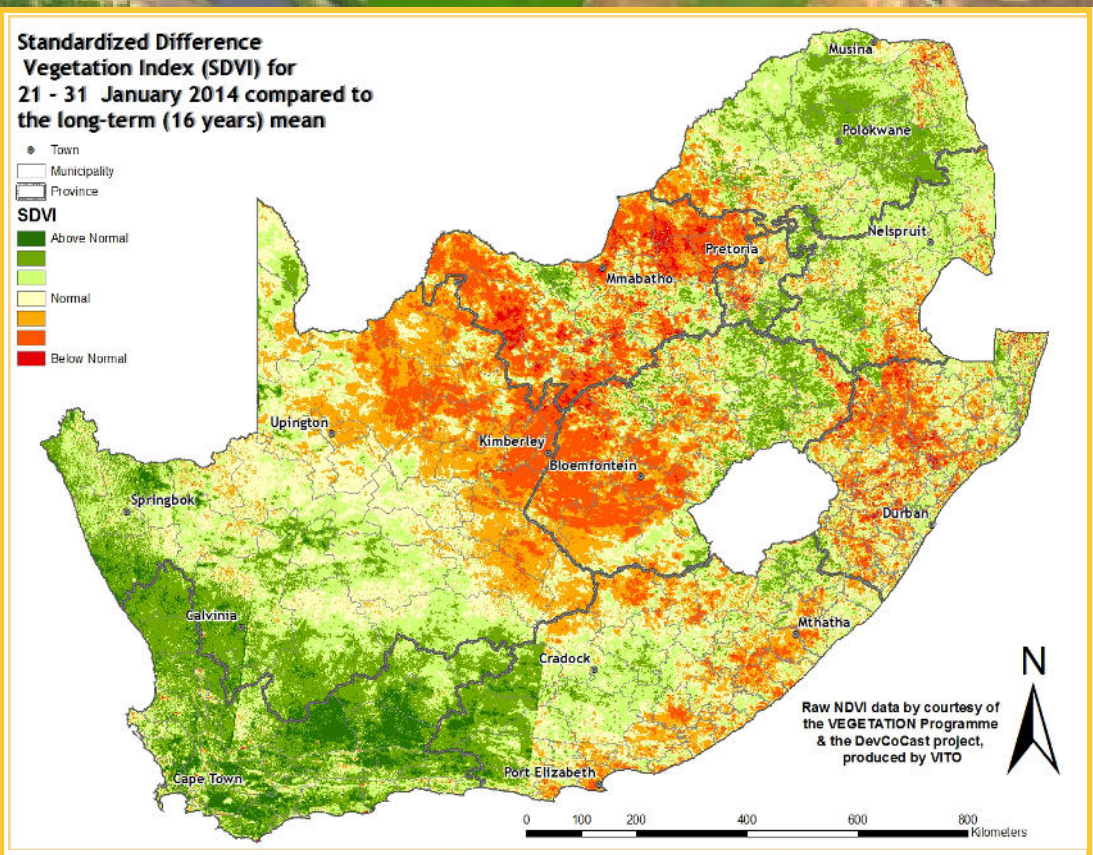


Figure 12

Figure 12:
Vegetation activity during January was above normal over the western and northeastern parts of the country, but remained below normal over most of the central areas. However, a band of above-normal vegetation activity from the northeastern Free State into central North West was the result of more widespread rain over those areas during late December and late January.

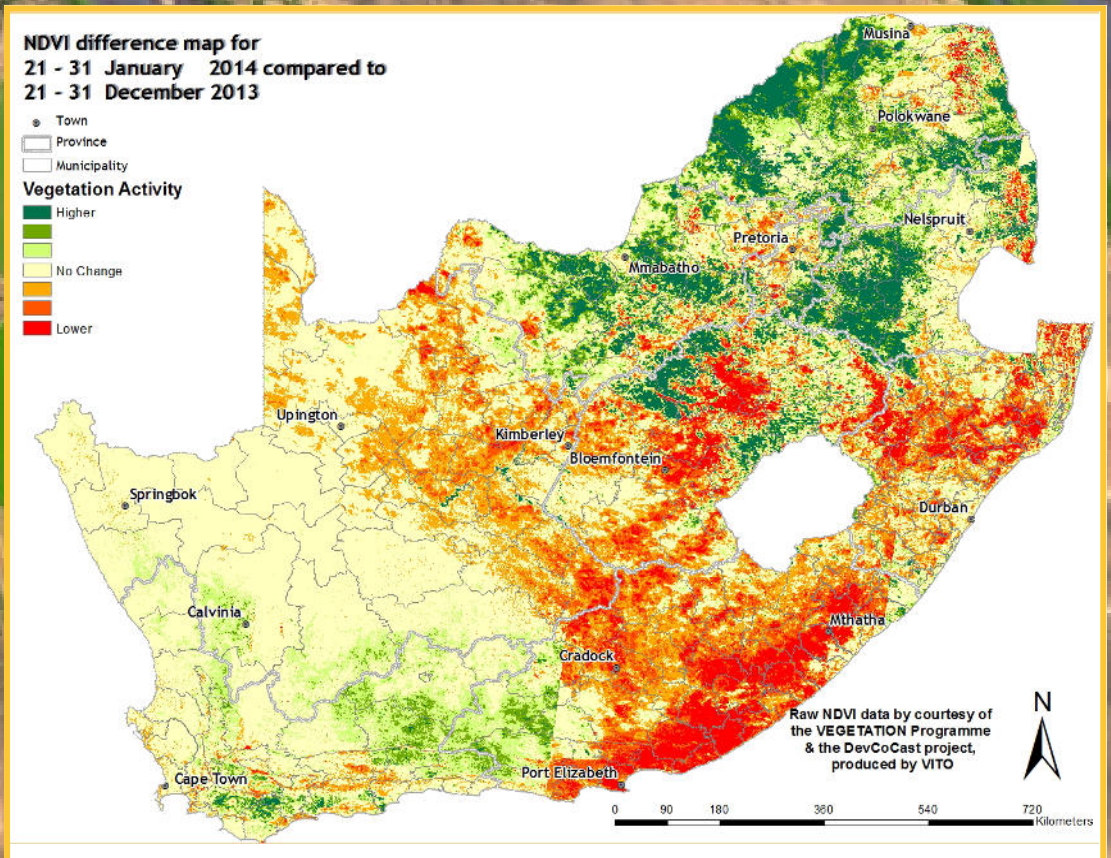
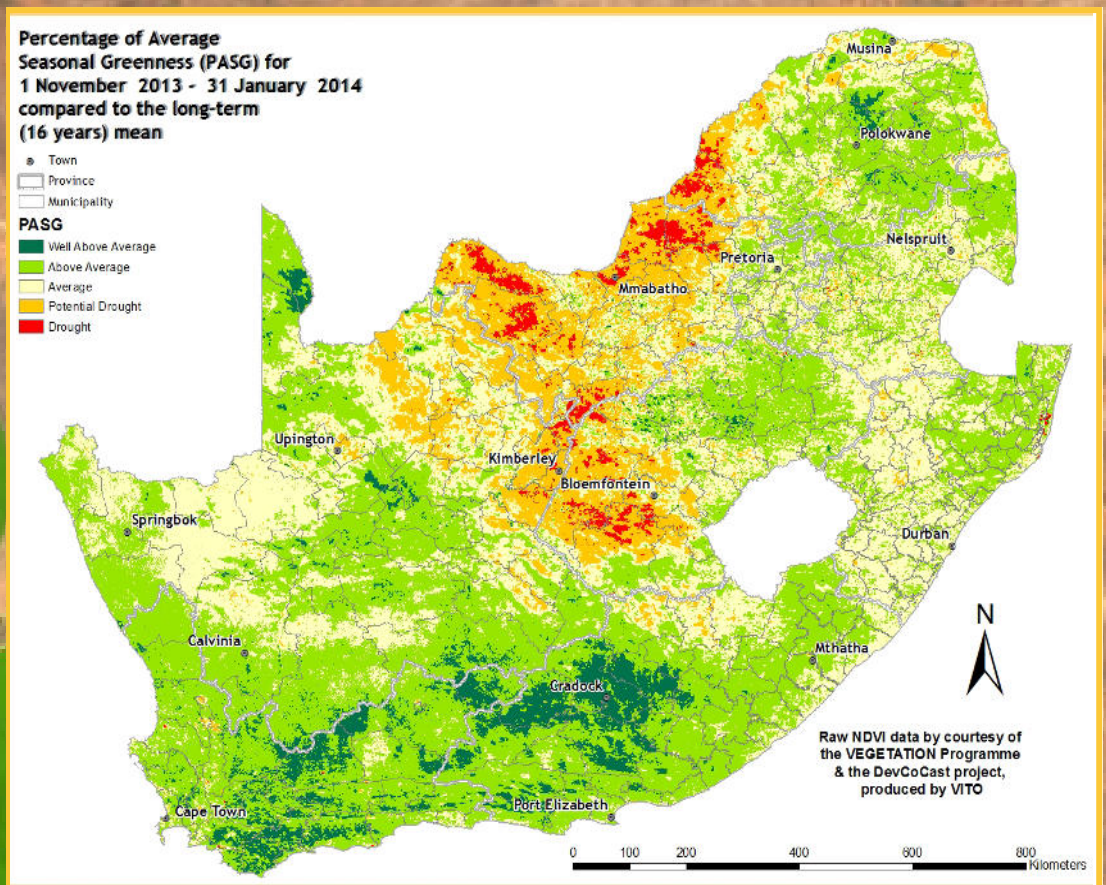


Figure 13

Figure 13:
Vegetation activity has improved over much of the northern parts of the country since late December. Activity has decreased over the southeastern parts.



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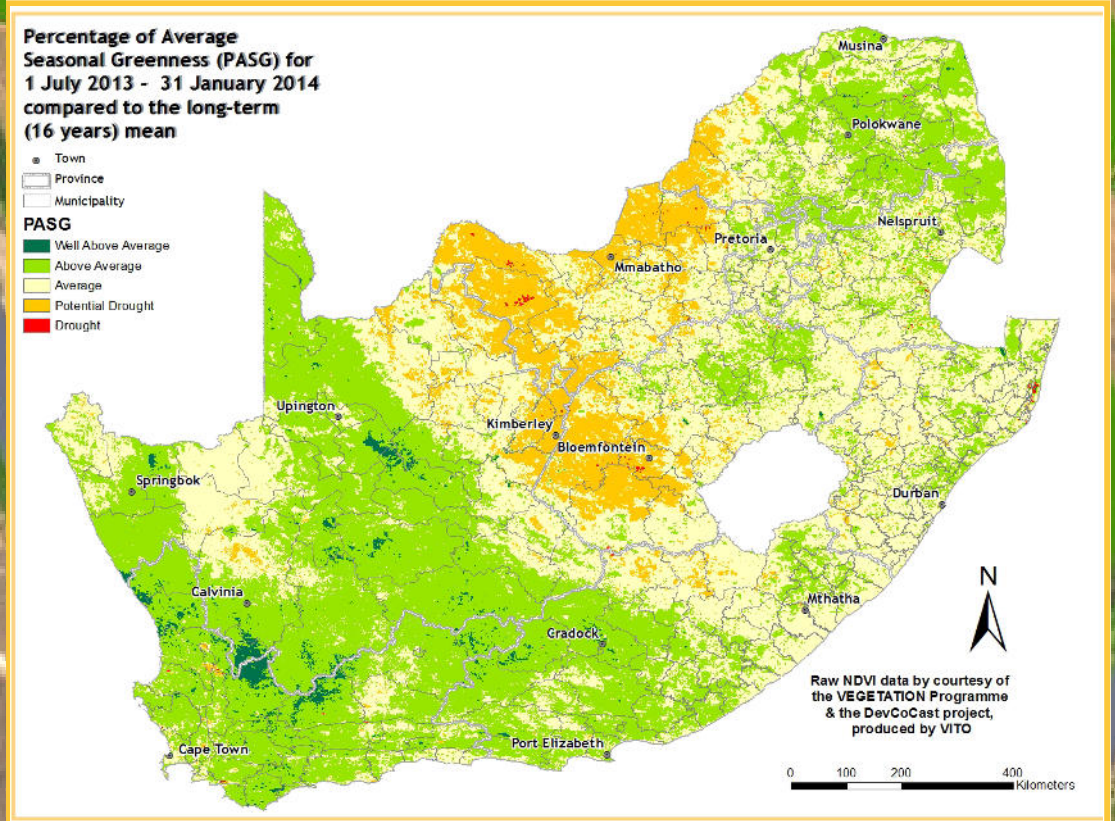

Figure 15

Vegetation Mapping
(continued from p. 6)

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 effects of the dry conditions since 2012 over the central parts are still noticeable in below-normal cumulative vegetation activity there since November 2013. Above-normal cumulative vegetation activity dominates the rest of the country, especially the southern parts.

Figure 15:
Considering the entire summer season so far, the effect of drought conditions over much of the central parts on cumulative vegetation activity is evident in the relatively low PASG values over that region, especially over western North West and the southwestern Free State.

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.

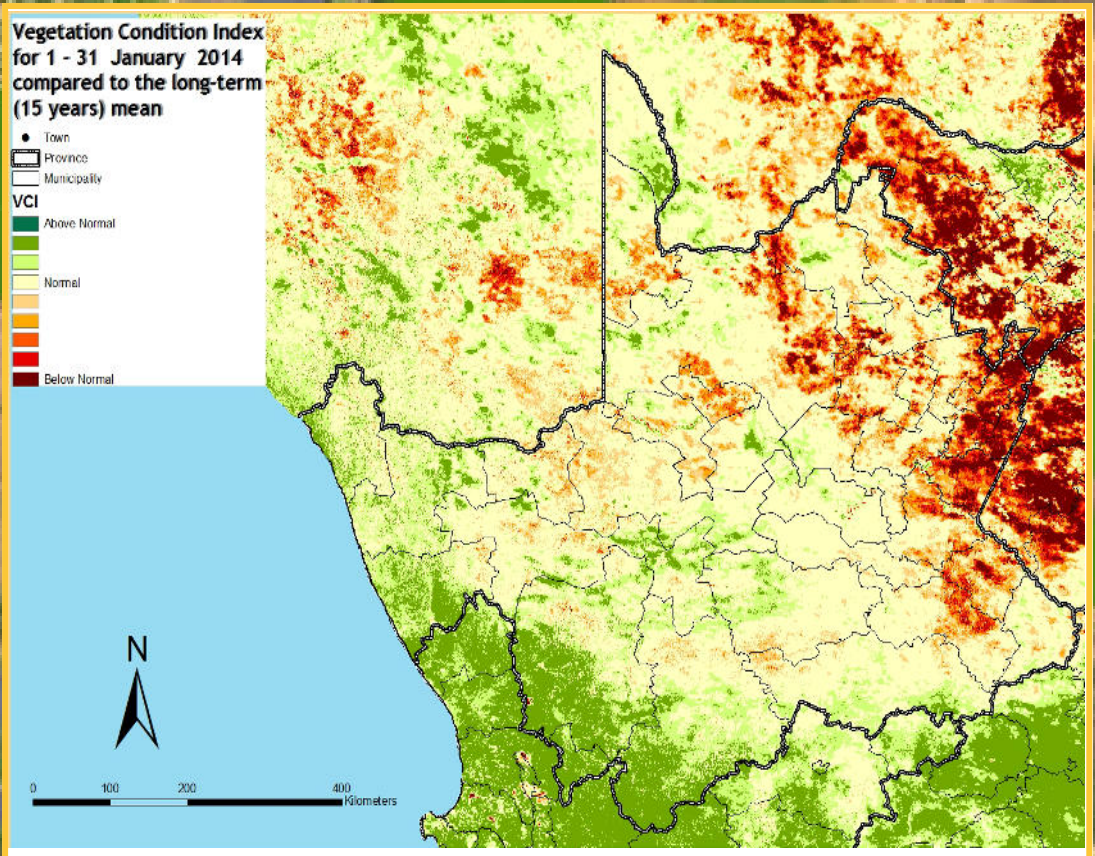


Figure 16

Figure 16:
The VCI map for January 2014 indicates below-normal vegetation activity over the eastern parts of the Northern Cape Province.

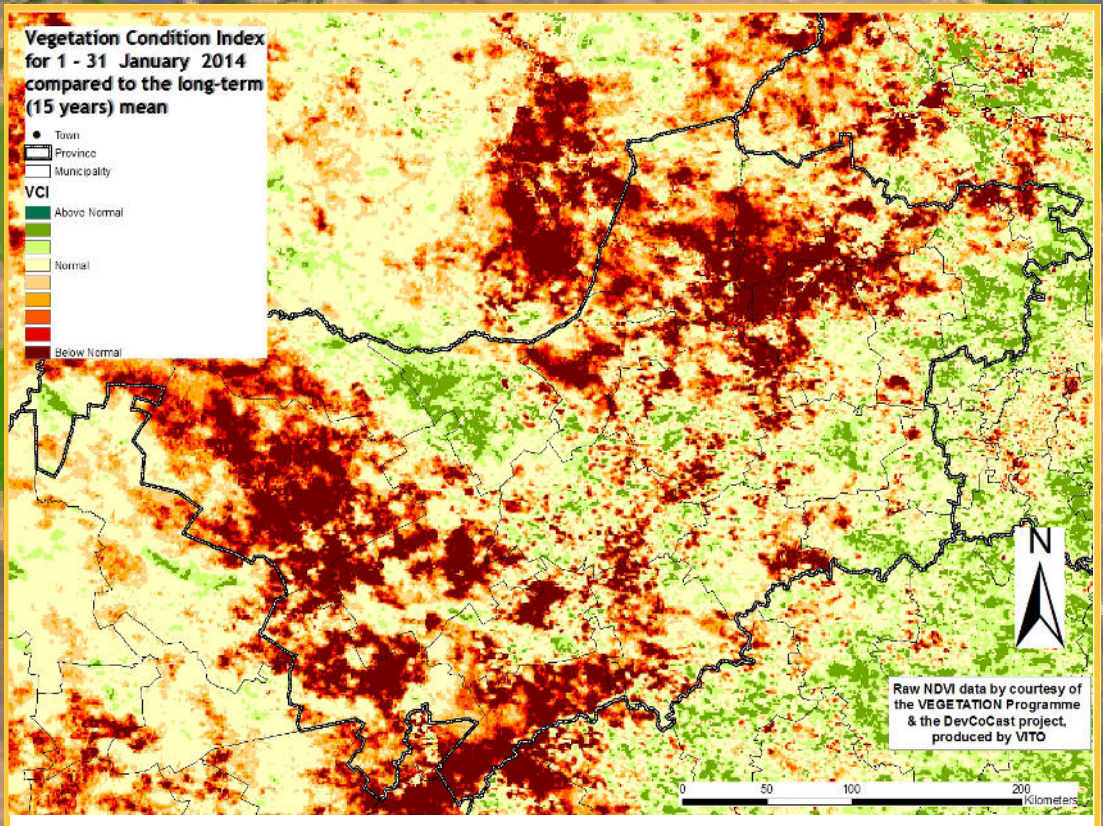


Figure 17

Figure 17:
The VCI map for January 2014 indicates below-normal vegetation activity over most parts of the North West Province.

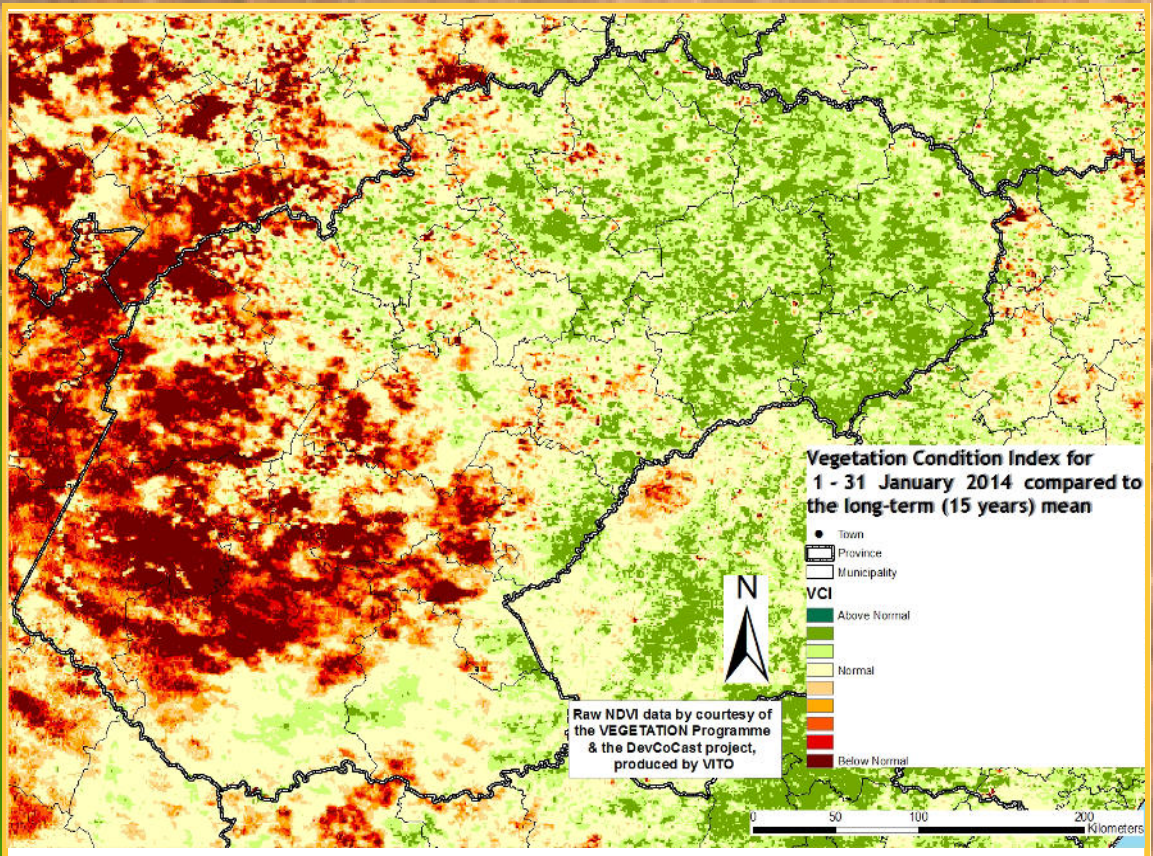


Figure 18

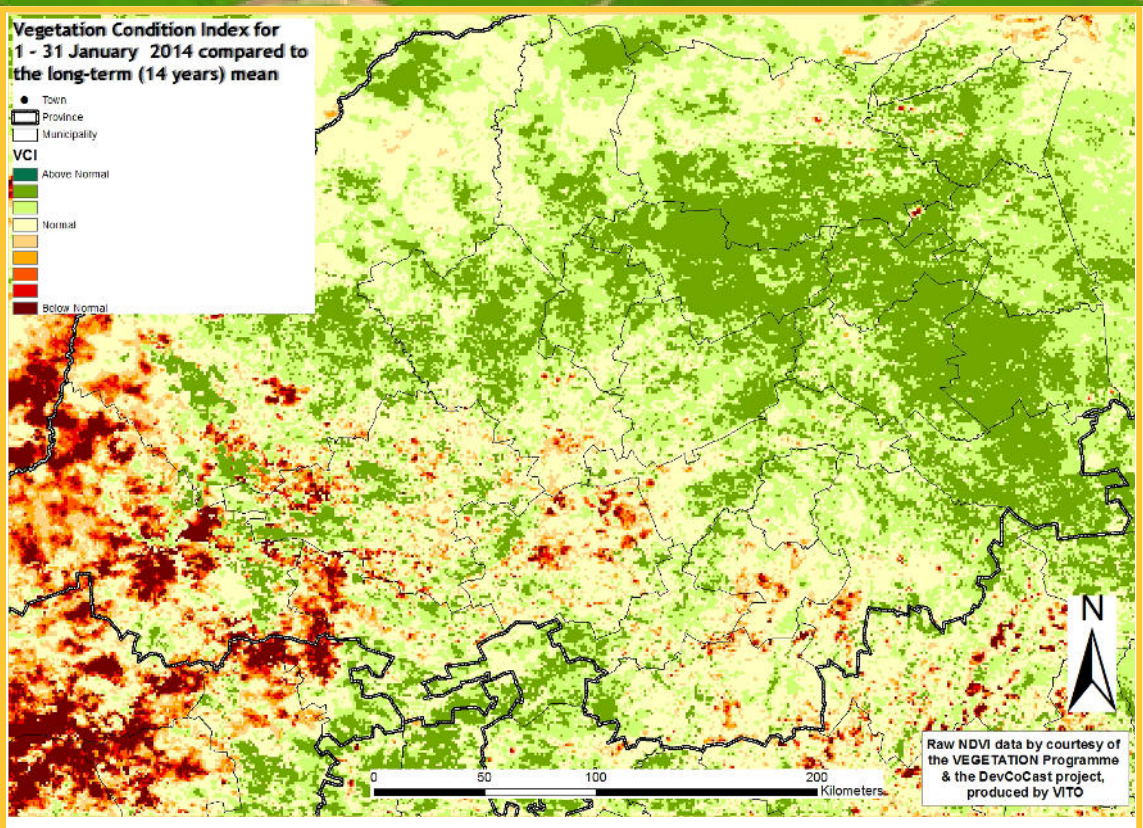


Figure 19

Figure 18:
The VCI map for January 2014 indicates below-normal vegetation activity over the southwestern parts of the Free State Province.

Figure 19:
The VCI map for January 2014 indicates below-normal vegetation activity over the extreme western parts of the Limpopo Province.

Questions/Comments:
NkambuleV@arc.agric.za

7. Vegetation Conditions & Rainfall

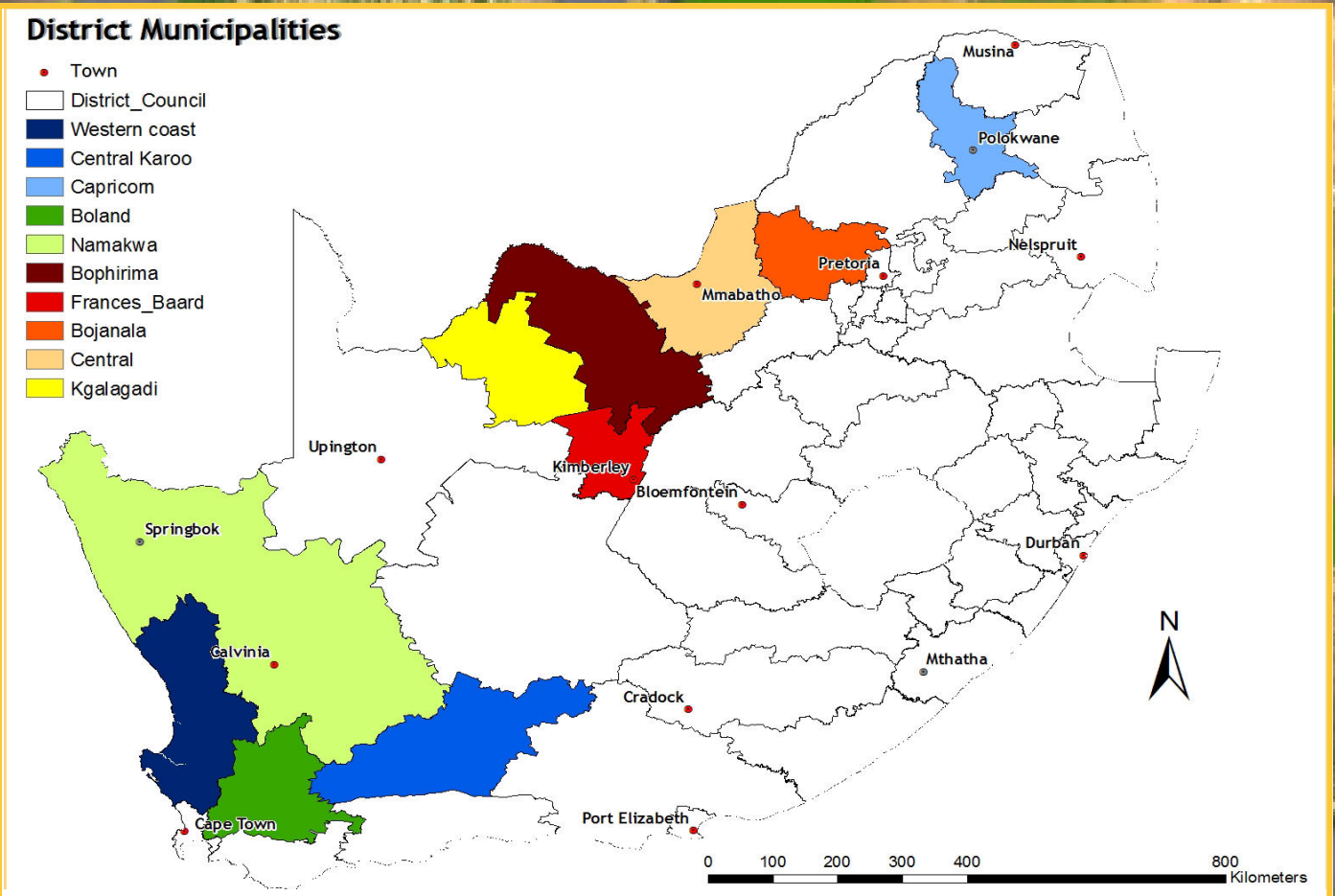


Figure 20

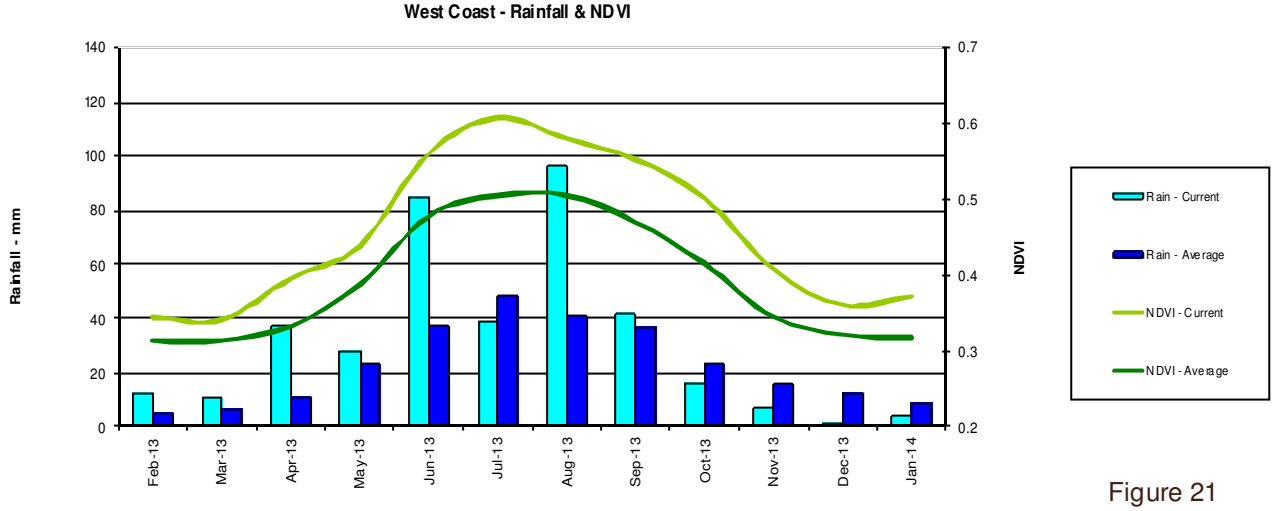
NDVI and Rainfall Graphs

Figure 20:
Orientation map showing the areas of interest for January 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.



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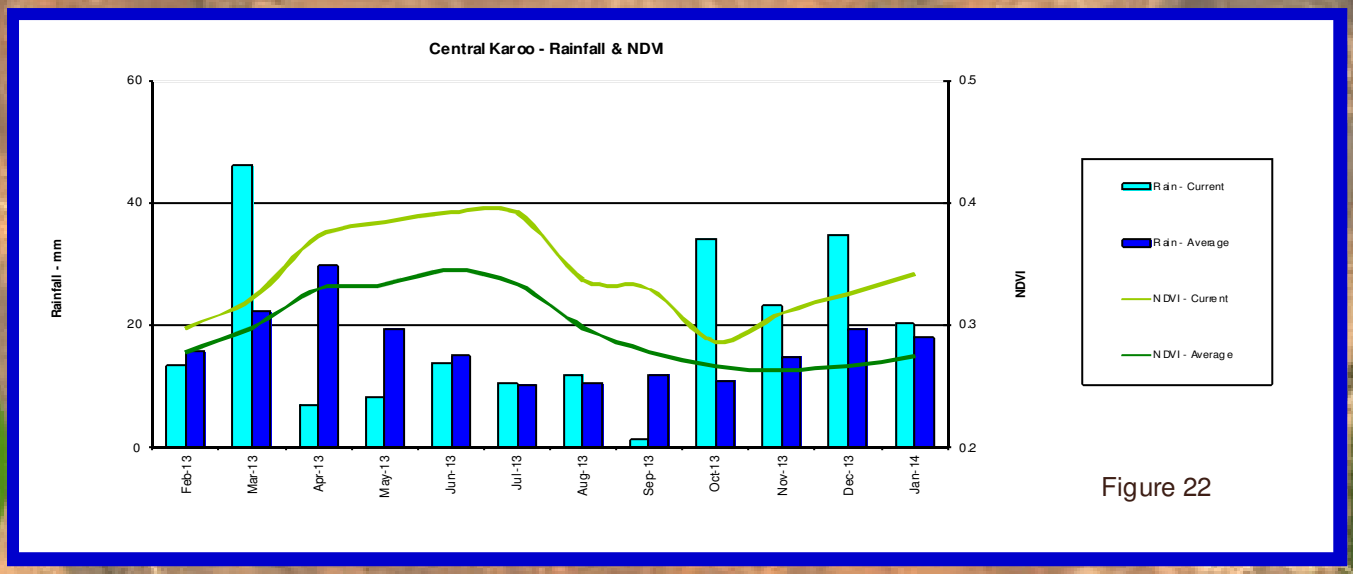

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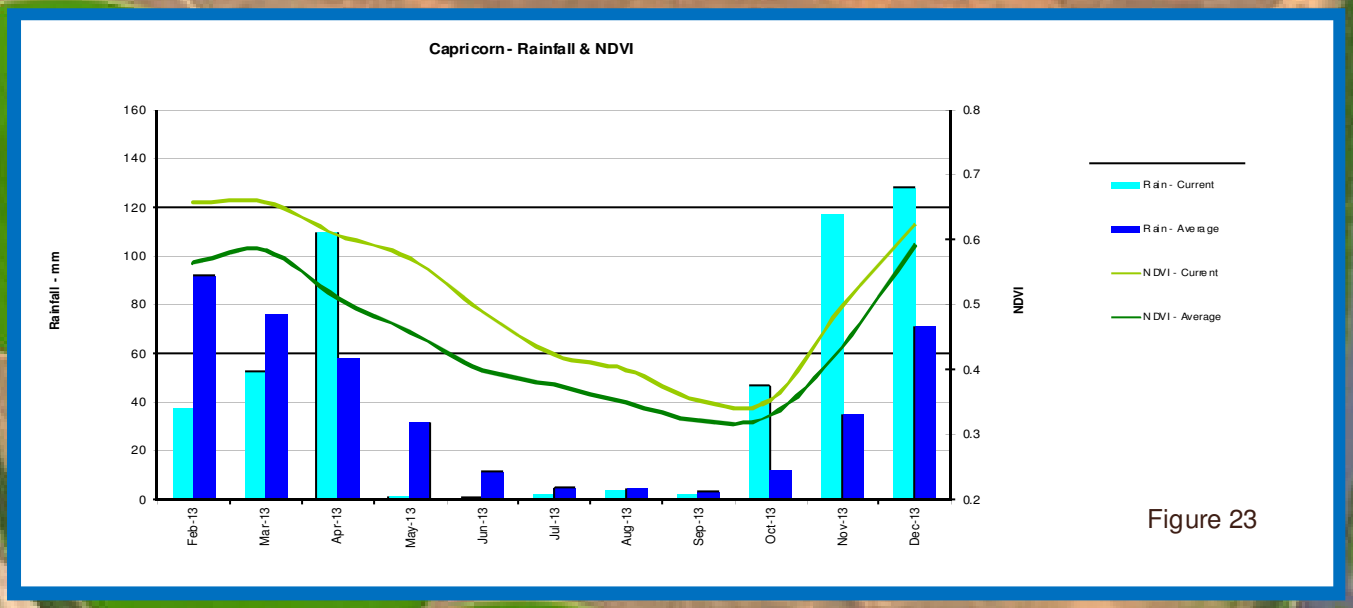

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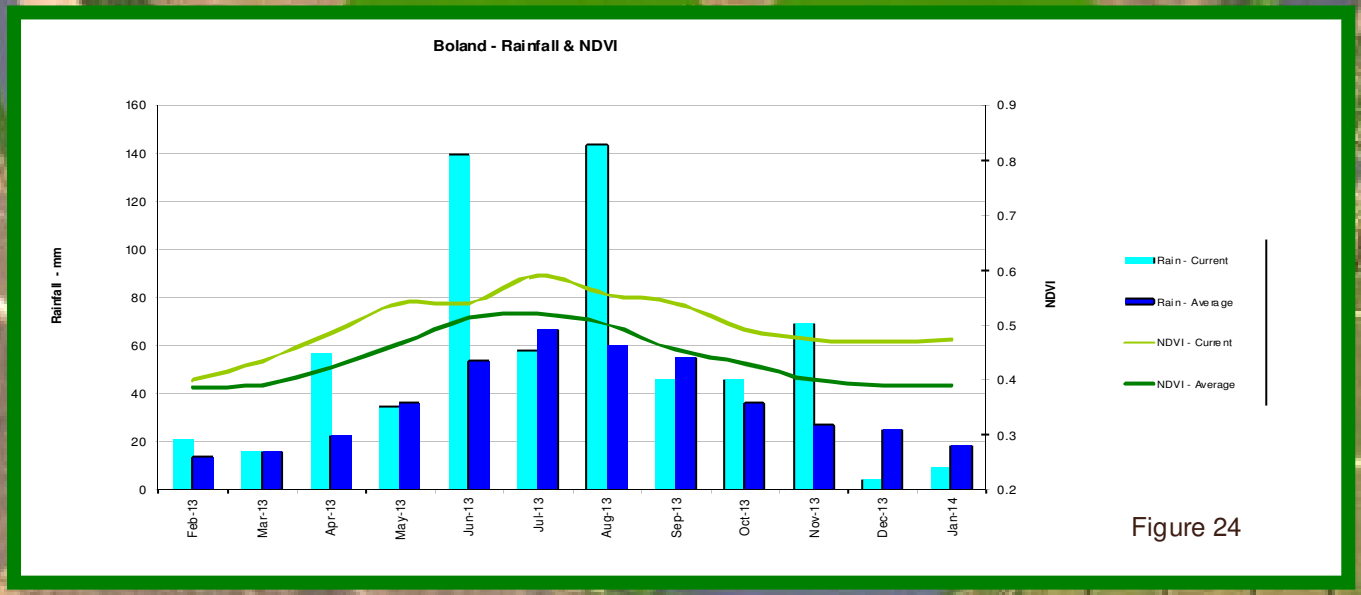

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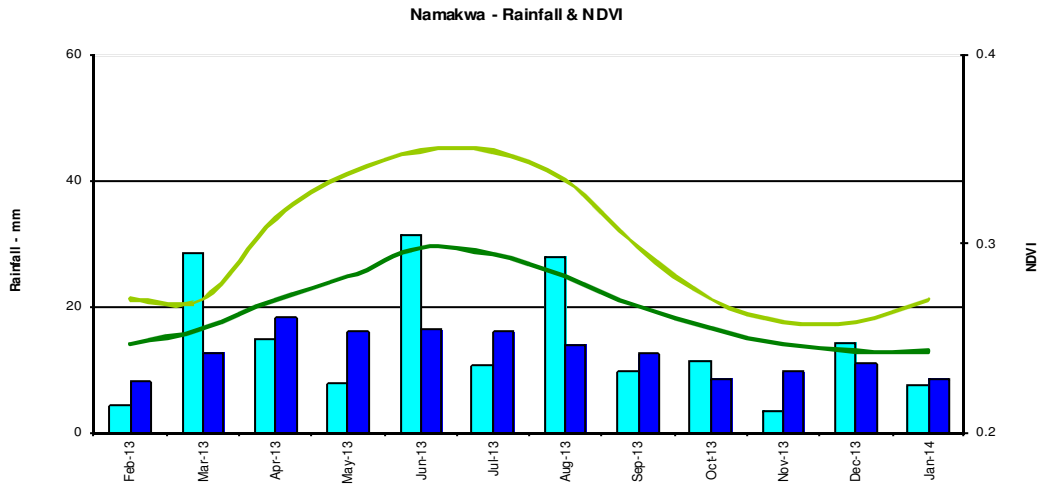

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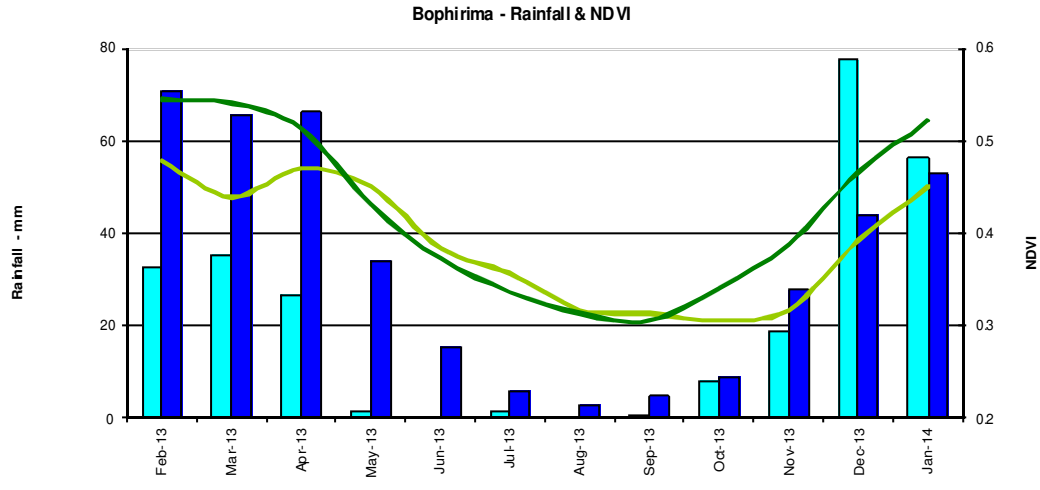
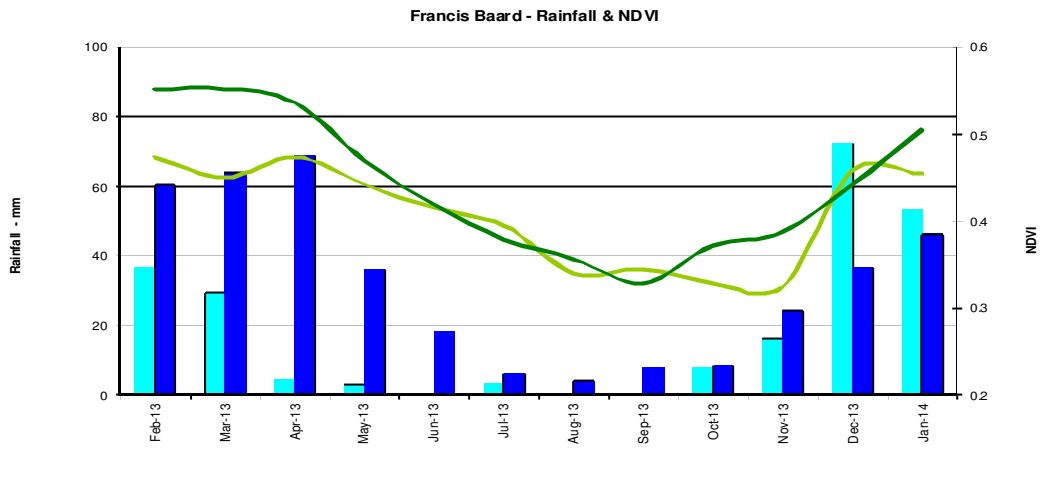


Figure 26



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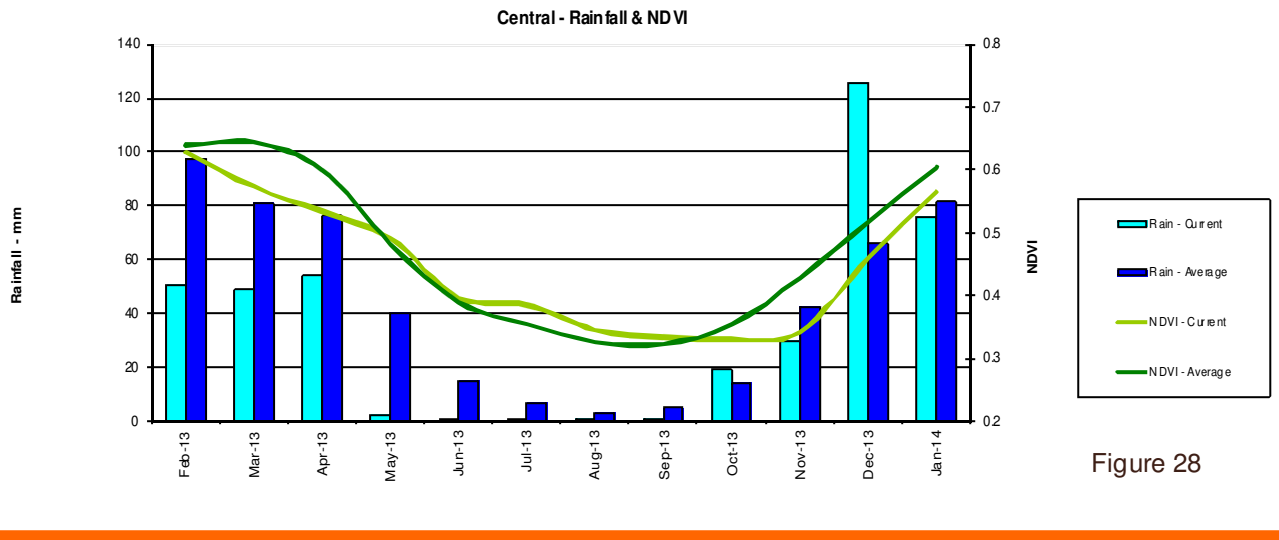

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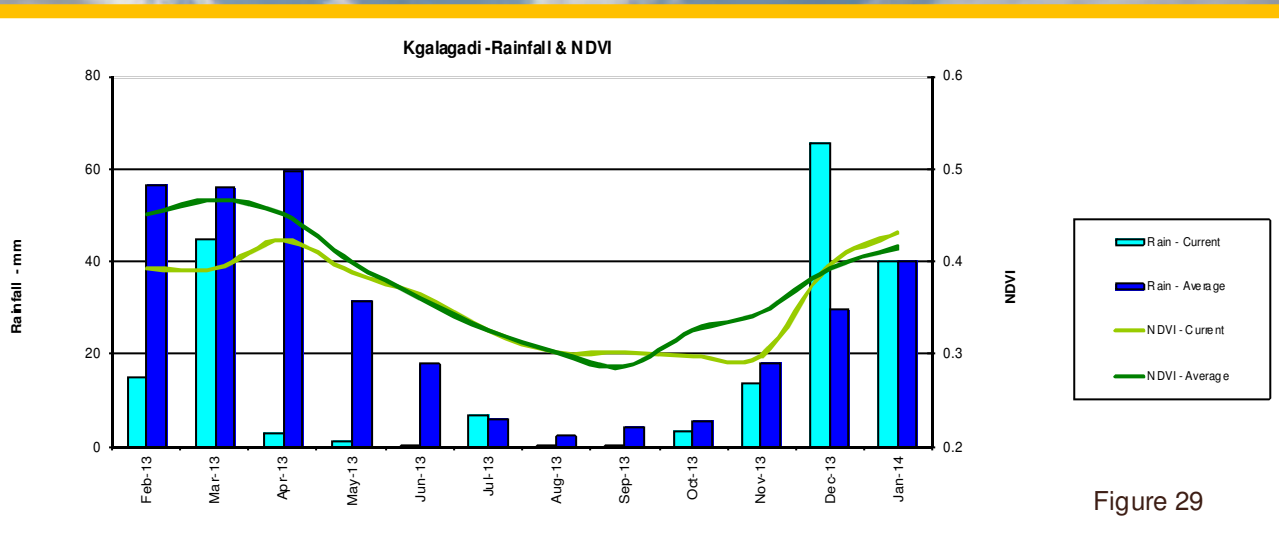

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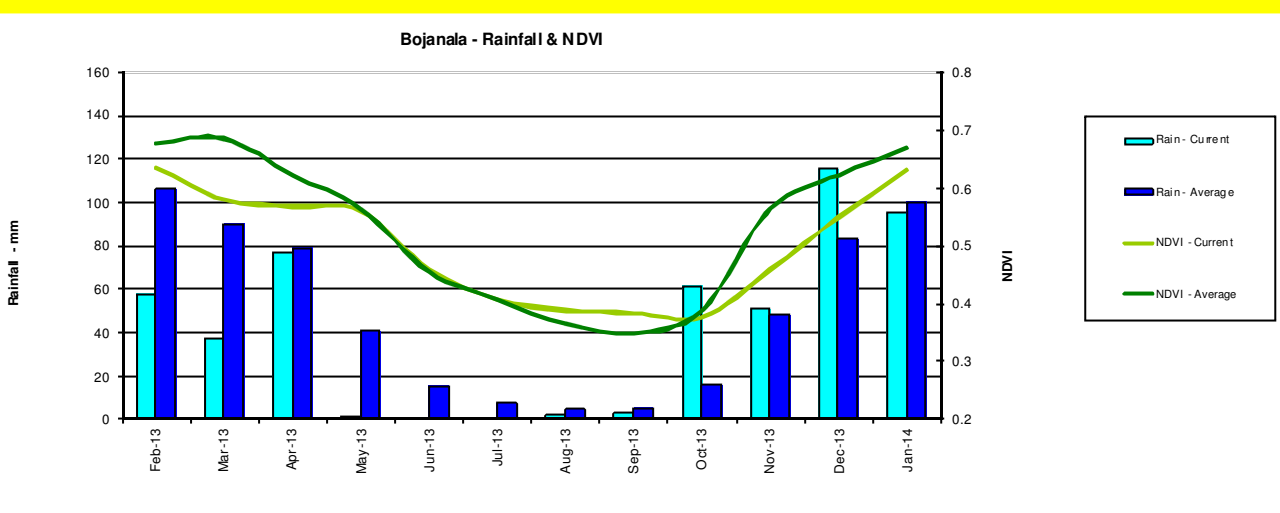

8. Fire Watch

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 between 1-31 January 2014 per province. Fire activity was higher in the Eastern Cape and Mpumalanga compared to the average for the same period for the last 13 years.

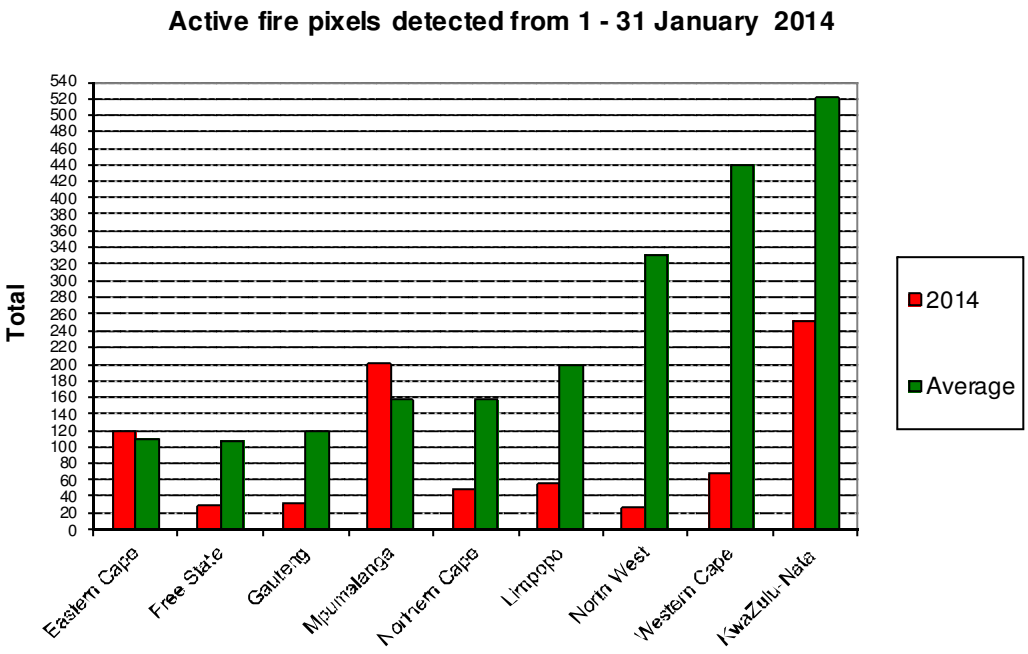

Figure 31

Figure 32:
The map shows the location of active fires detected between 1-31 January 2014.

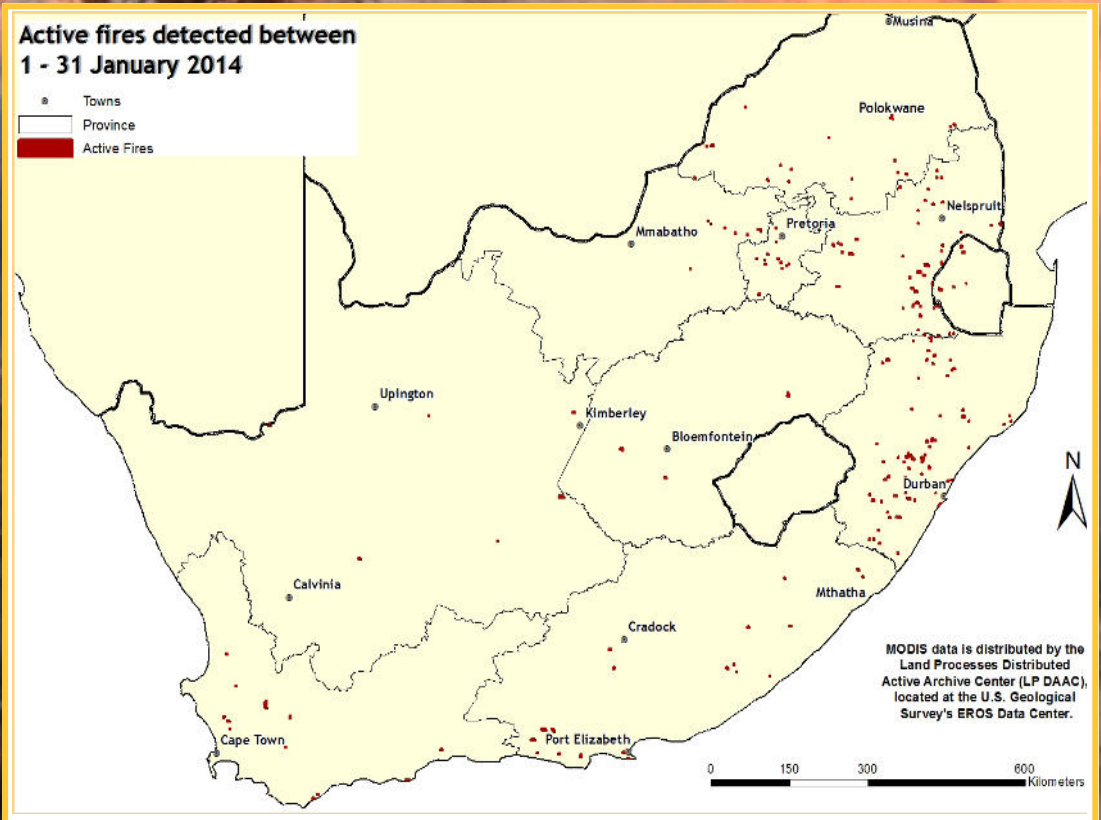

Figure 32

ARC-INSTITUTE FOR SOIL, CLIMATE AND WATER

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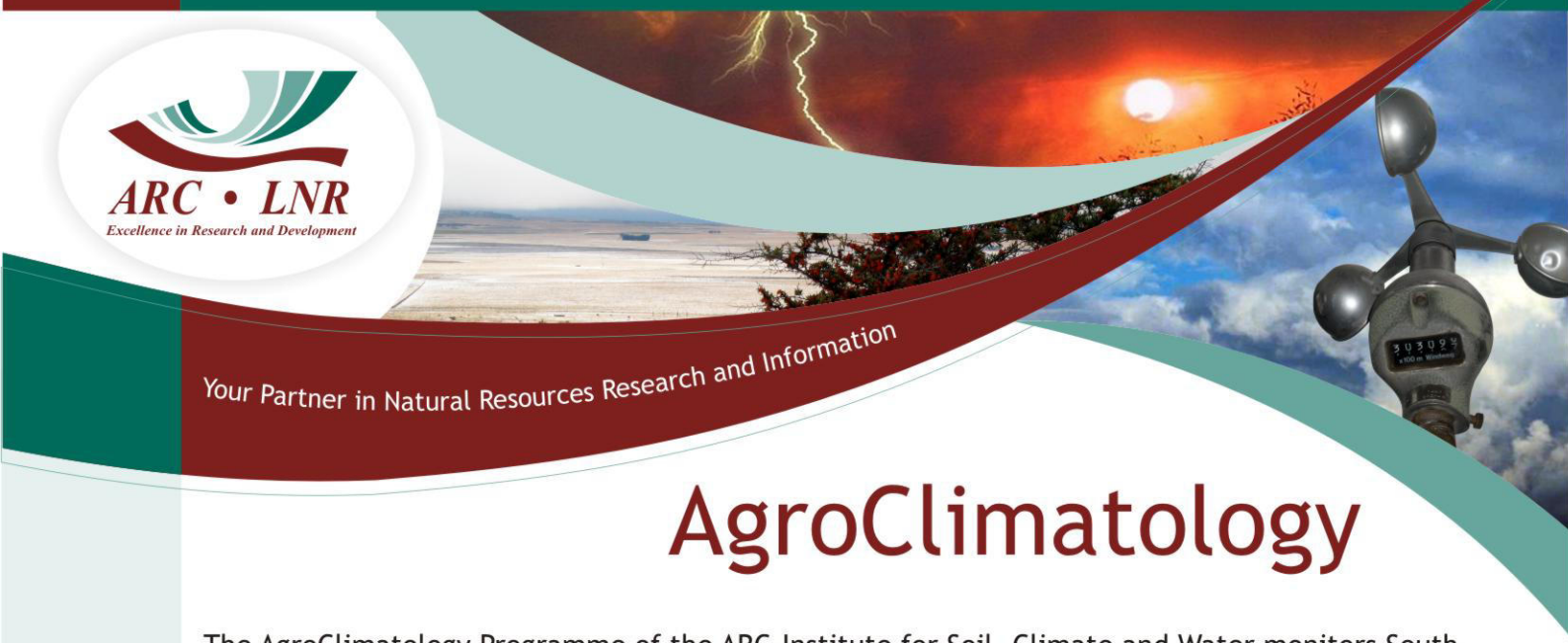

AgroClimatology

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 Normalised 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, Normalised 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.

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

http://www.agis.agric.za