ARC • LNR
Excellence in Agricultural Research and Development

UMLINDI
The Watchman

ISSUE 2015-11 | 13 NOVEMBER 2015

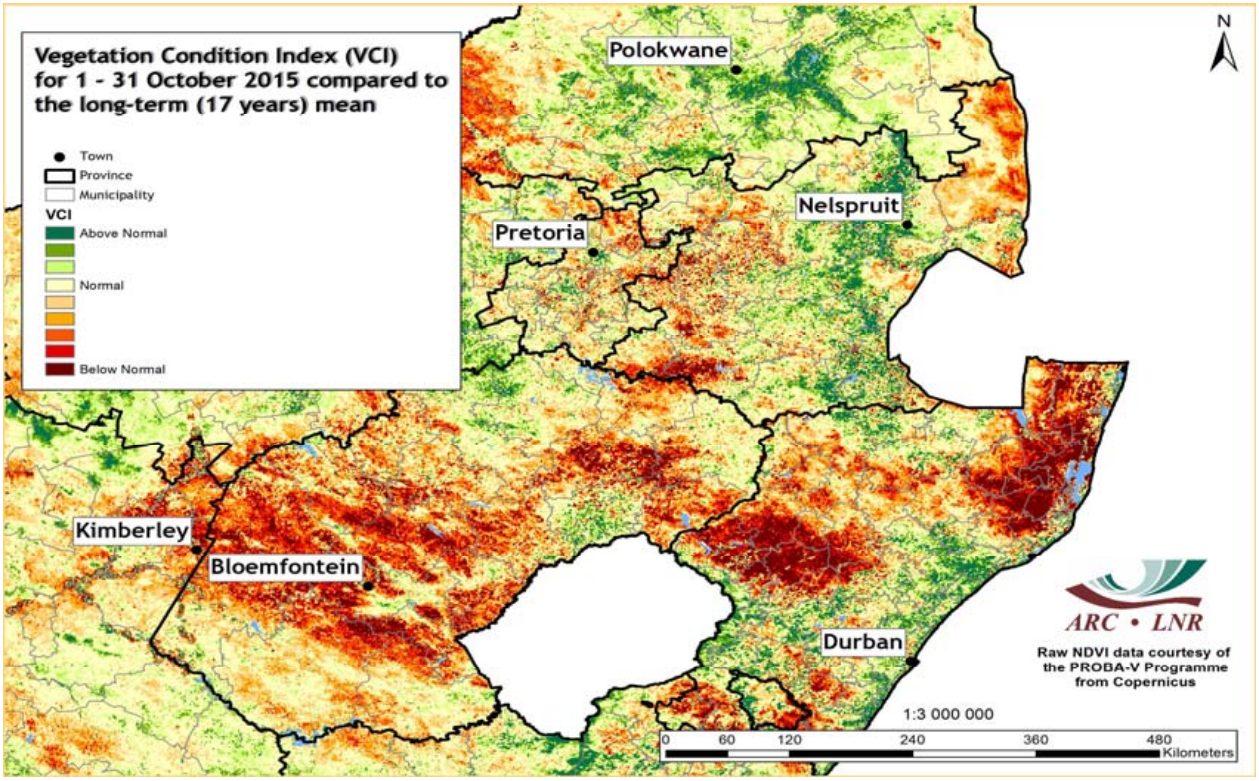
INSTITUTE FOR SOIL, CLIMATE AND WATER

CONTENTS:

137th Edition

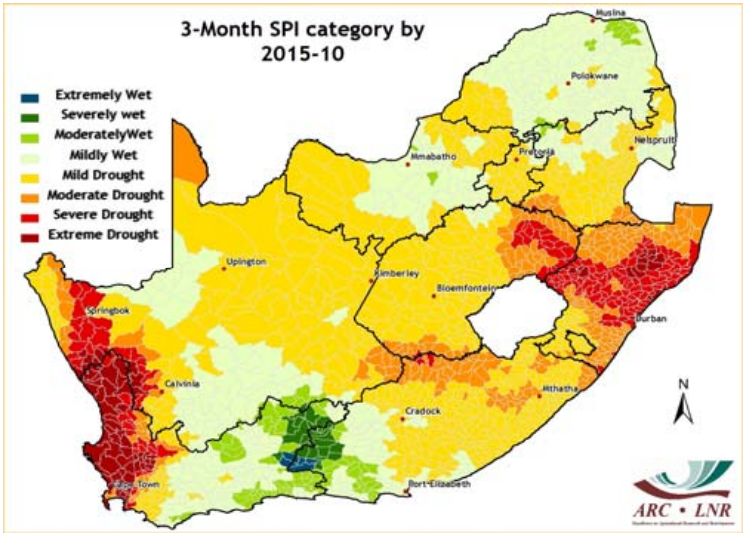
Images of the Month

Drought intensifies in some areas



The Vegetation Condition Index (VCI) map for October shows large areas of significant stress over northern and western KwaZulu-Natal, northeastern to western Free State and southwestern Mpumalanga. Some of the north-eastern provinces have been declared disaster areas. The drought over the northeastern parts of KwaZulu-Natal may affect the area more severely due to earlier dry conditions that occurred between 2004 and 2010.

The 3-month Standardized Precipitation Index (SPI) map for the country shows that late winter/ early spring was extremely dry over two distinct areas: the western to northern parts of the winter rainfall region in the west and central to northern KwaZulu-Natal and the northeastern Free State in the east. Drought in the west during late winter had a large negative impact on wheat production in the Swartland while the drought in the east during early spring exacerbates an existing 24-month drought over the region with both agricultural and hydrological impacts.



[Please note that some sections of the newsletter have been omitted this month due to circumstances beyond our control.]

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:

October 2015 was characterized by hot and dry weather over the summer rainfall region. Rainfall across the country was below normal, with the exception of isolated areas in Mpumalanga and Limpopo where one or two large thunderstorms made a difference. Above-normal maximum temperatures and relatively windy conditions resulted in the development and spread of wild fires on several occasions across the northern to western interior.

Very high temperatures occurred during the first 12 days of the month, with large areas experiencing maximum temperatures in excess of 5°C above the long-term average. These high temperatures meant that much of the earlier gains related to widespread rain in early September in the northeast were lost due to higher than normal potential evaporation.

The upper air was dominated, for the most part, by anticyclonic circulation, placing a damper on development of thundershowers over the interior. A few upper-air troughs or perturbations with surface moisture from the Indian Ocean anticyclone did result in some thundershowers over the interior. The most significant of these rainfall events occurred around the 1st, 14th and 26th of the month. An upper air trough by the 14th resulted in most of the precipitation over the central parts while the system by the 26th, which consisted of upper-air perturbations over the eastern parts and large amounts of moisture, resulted in most of the precipitation in the east. A cut-off low developing over Mozambique by the 30th only resulted in isolated showers and thundershowers in the far eastern parts of Mpumalanga and KwaZulu-Natal by the end of the month as its position that far east did not favour the development of thundershowers further west.

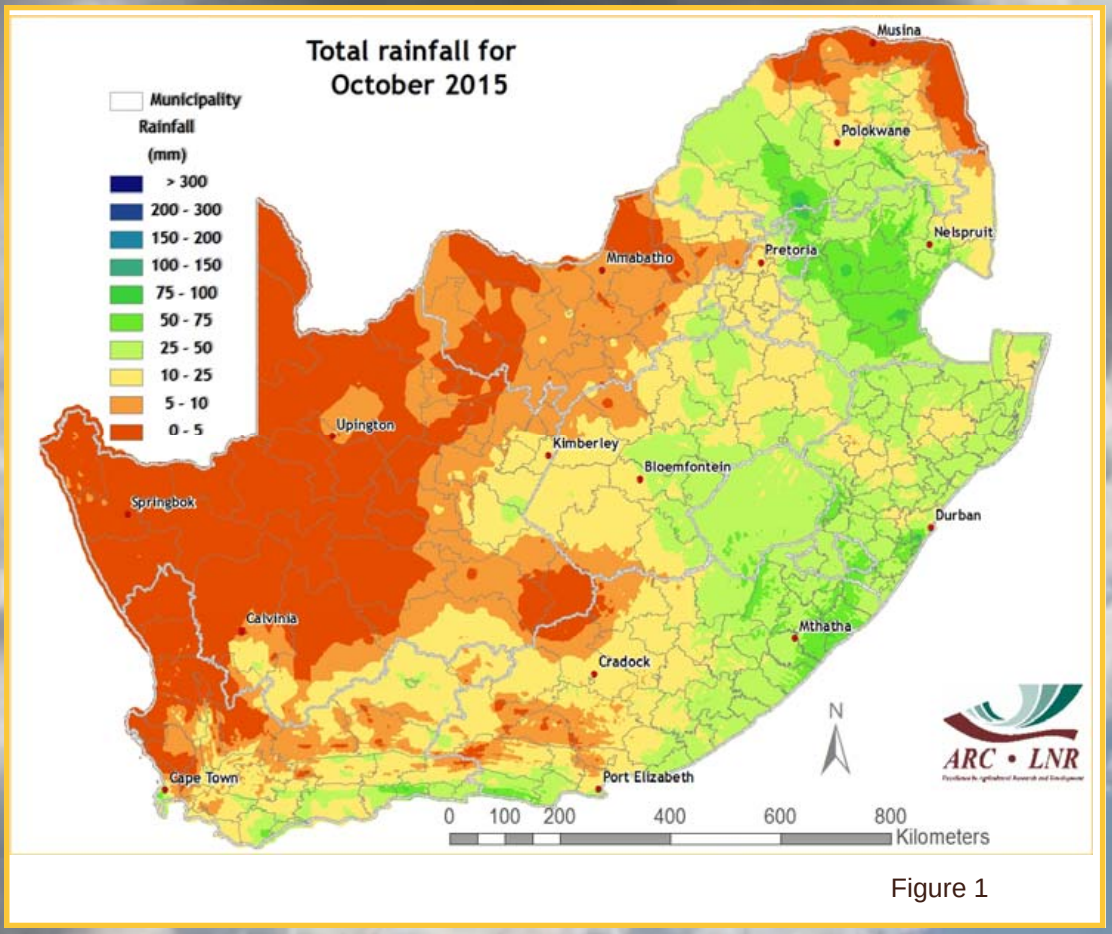


Figure 1

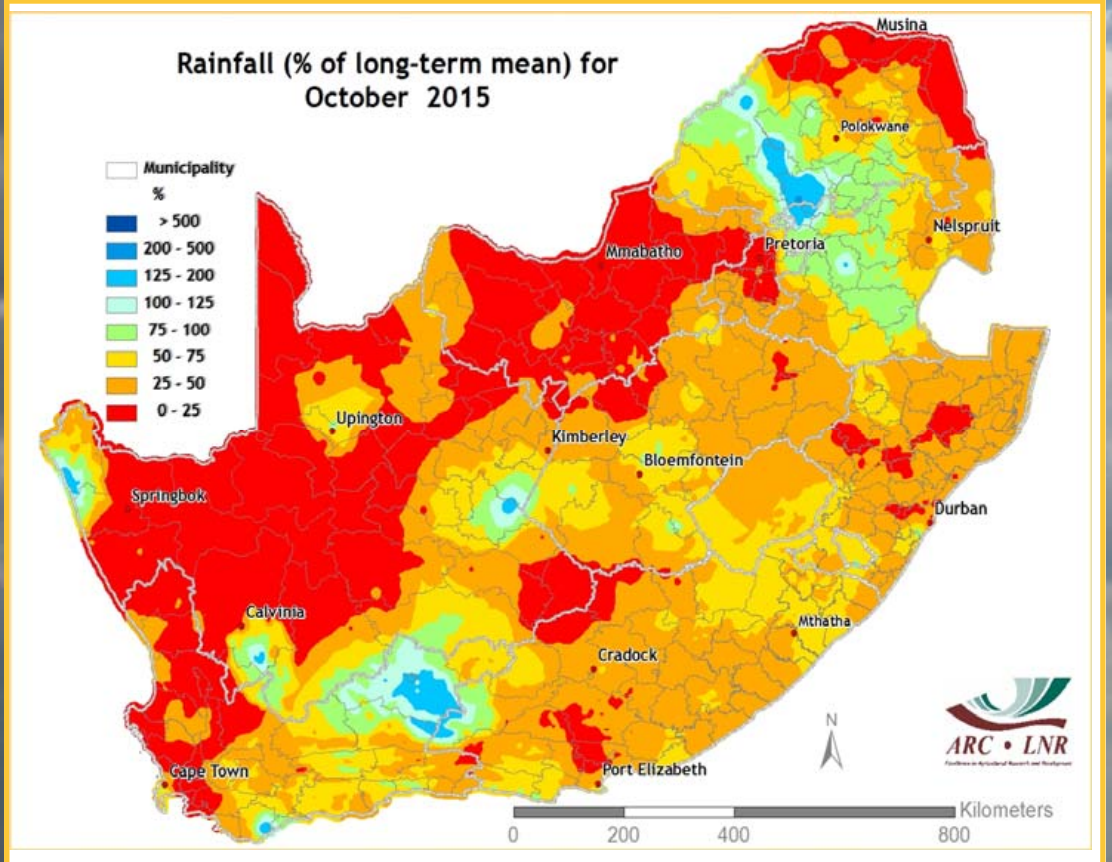


Figure 2

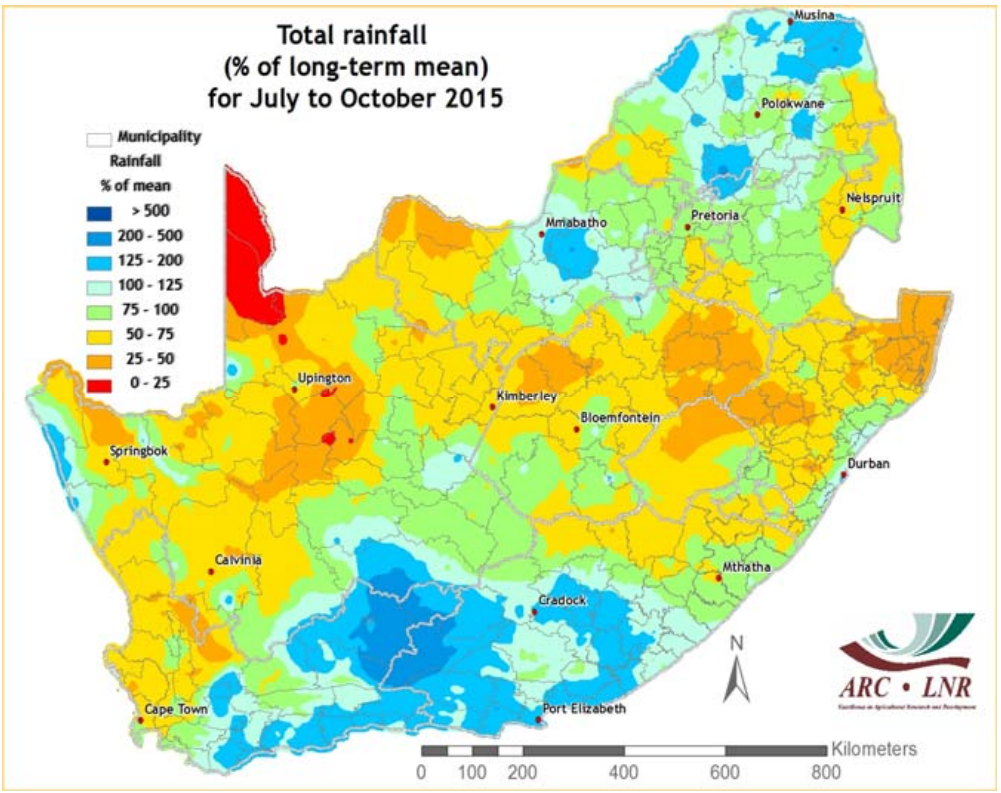


Figure 3

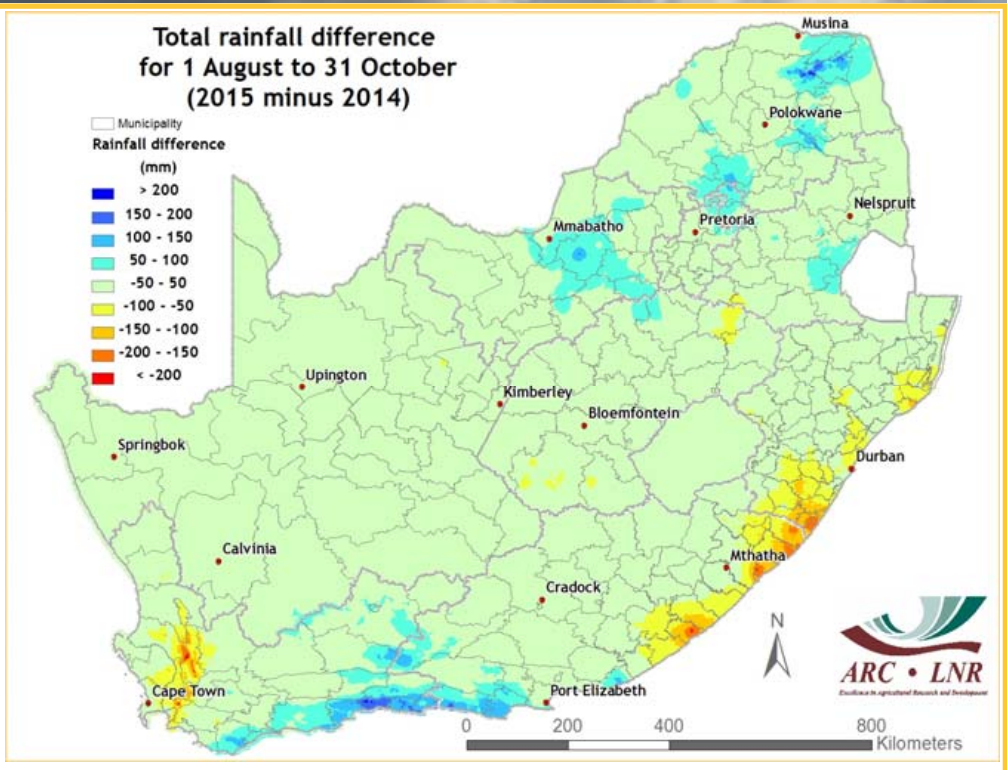


Figure 4

Hot and windy conditions developed towards the end of the month with a trough building over the southern parts and dry northwesterlies over the interior towards the north. Most of the rain over the southern parts of the country resulted from the development of a sharp upper-air trough over the southwestern parts into a cut-off low on the last day of the month, with a very strong Atlantic Ocean anticyclone to the southwest feeding cold air from the south into the country and resulting in widespread showers over the southern parts. This system was also responsible for the cold conditions over much of the interior by early November and even snow on the Drakensberg in the Eastern Cape and KwaZulu-Natal.

Figure 1:
The northwestern parts of the country remained dry while rainfall totals over the eastern and southern parts of the country ranged between 10 and 75 mm for the most part, with isolated areas in Mpumalanga and Limpopo receiving more than 75 mm for the month.

Figure 2:
Only the northeastern parts of the Western Cape and central Limpopo to northern Mpumalanga received normal to above-normal rainfall during the month while the rest of the country received less rain than normal. Most of the interior received less than 50% of the long-term average.

Figure 3:
Rainfall over the southern parts of the country, into the central parts of the Northern Cape, has been above normal since July. This also applies to the northern to northeastern parts. Rainfall was below normal over the northern parts of KwaZulu-Natal and the western parts of the winter rainfall region and northern parts of the Northern Cape.

Figure 4:
The western parts of the winter rainfall region and the Wild Coast experienced much less rain during August to October this year than for the same period last year while the Garden Route and the northeastern parts of the interior received significantly more rain.

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) show that severe to extreme drought conditions occur over the south-western parts of the winter rainfall region and north-eastern KwaZulu-Natal while much of the southern parts of the country are experiencing moderately to severely or extremely wet conditions at the shorter time scales (1 to 12 months). At the longer time scale (24 months), northern KwaZulu-Natal and southeastern Mpumalanga experience severe to extreme drought according to the SPI.

Questions/Comments:
Johan@arc.agric.za

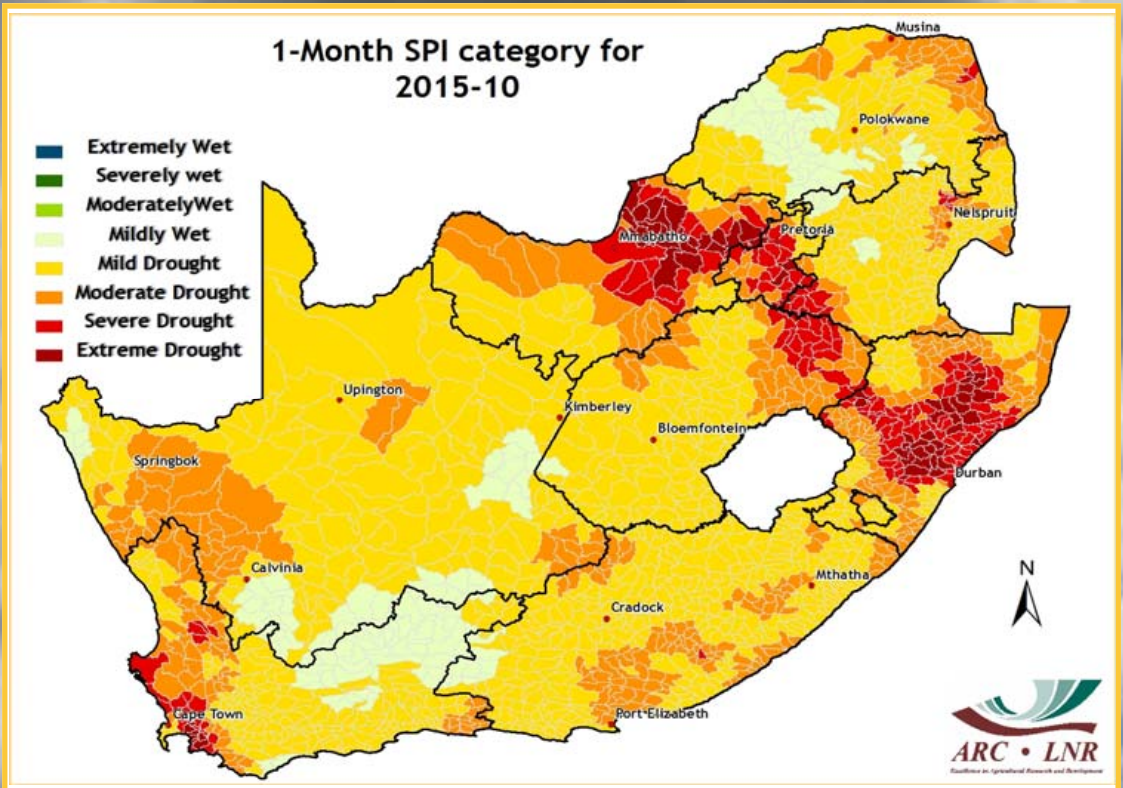


Figure 5

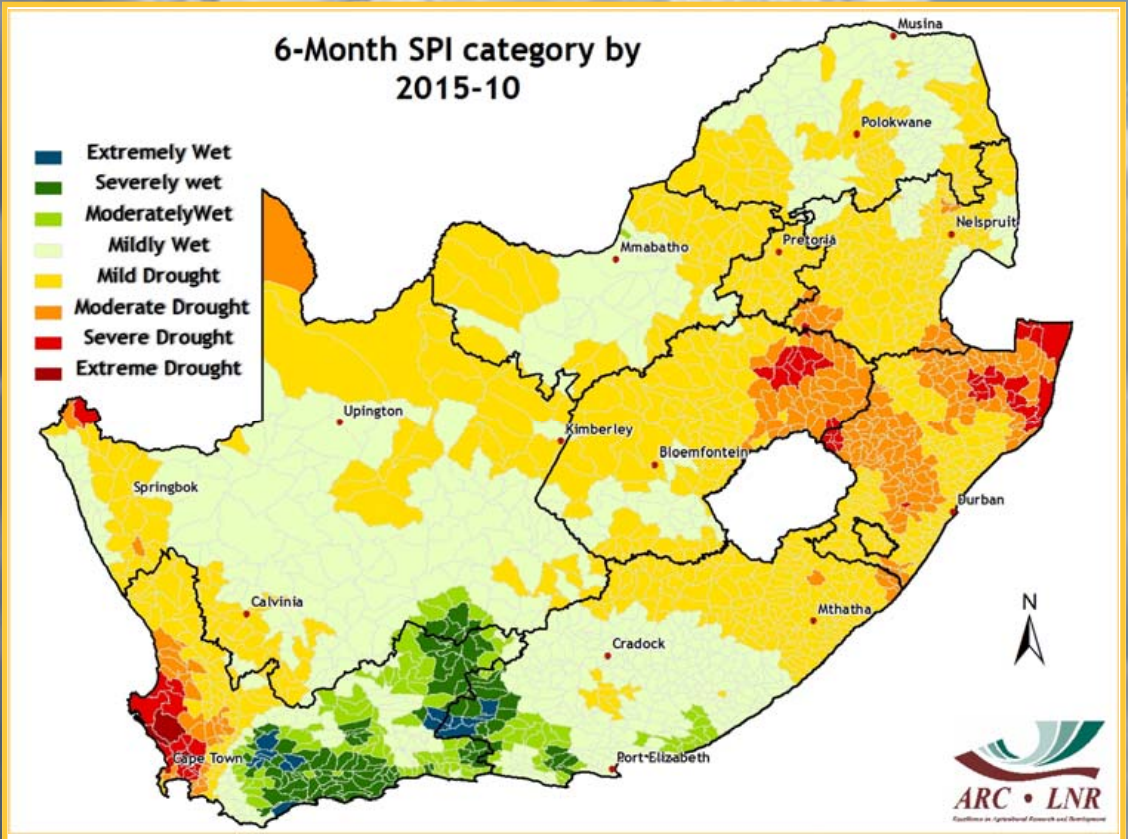


Figure 6

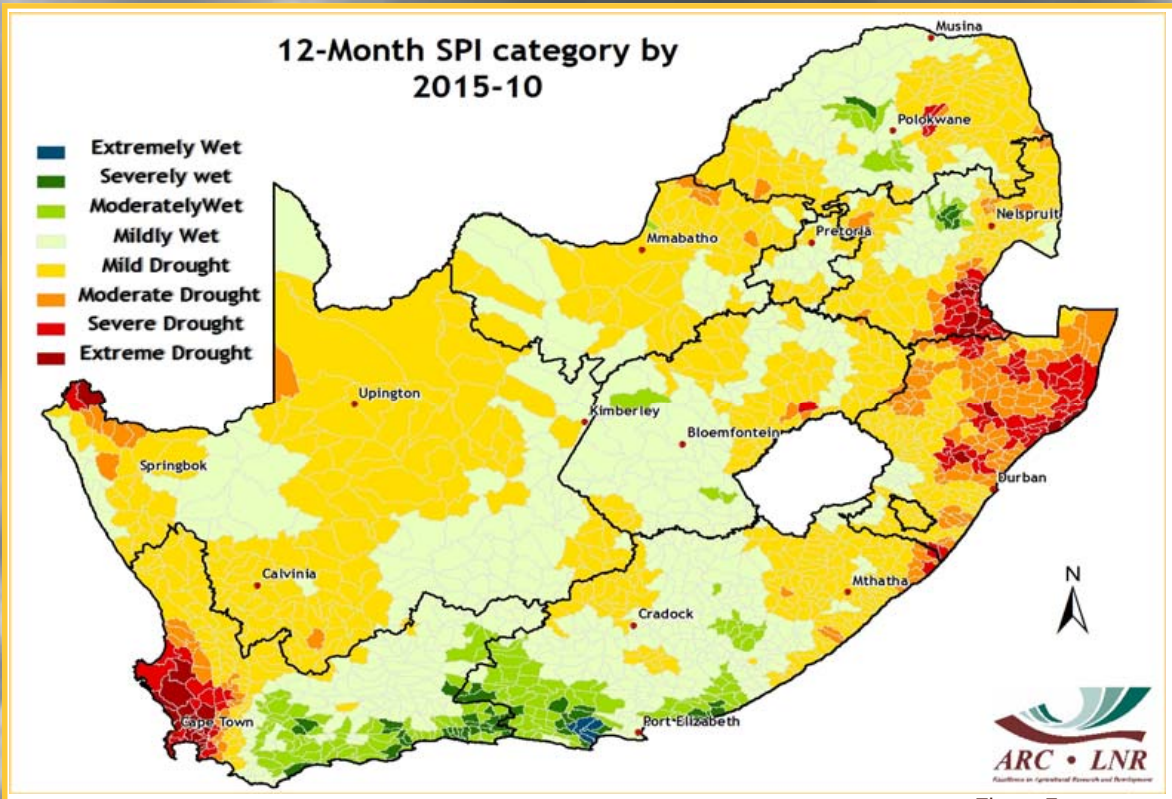


Figure 7

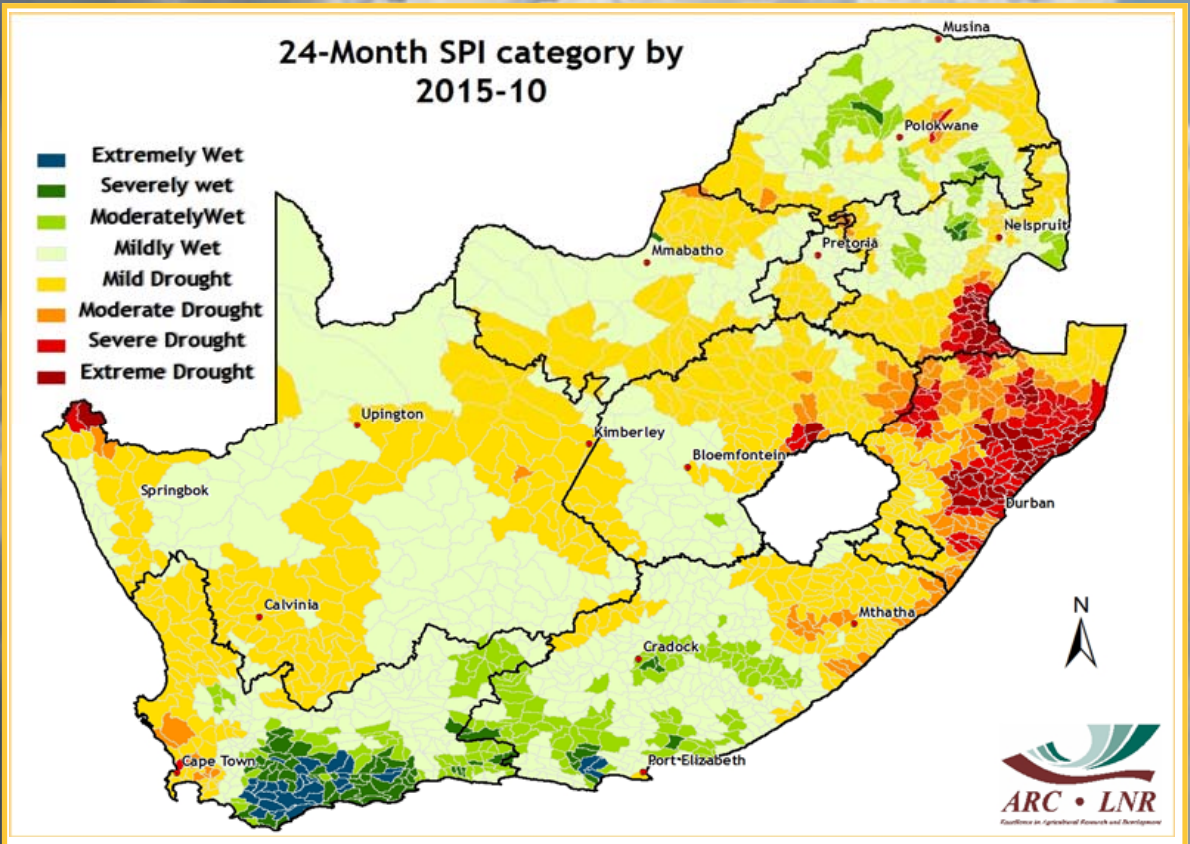


Figure 8

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.

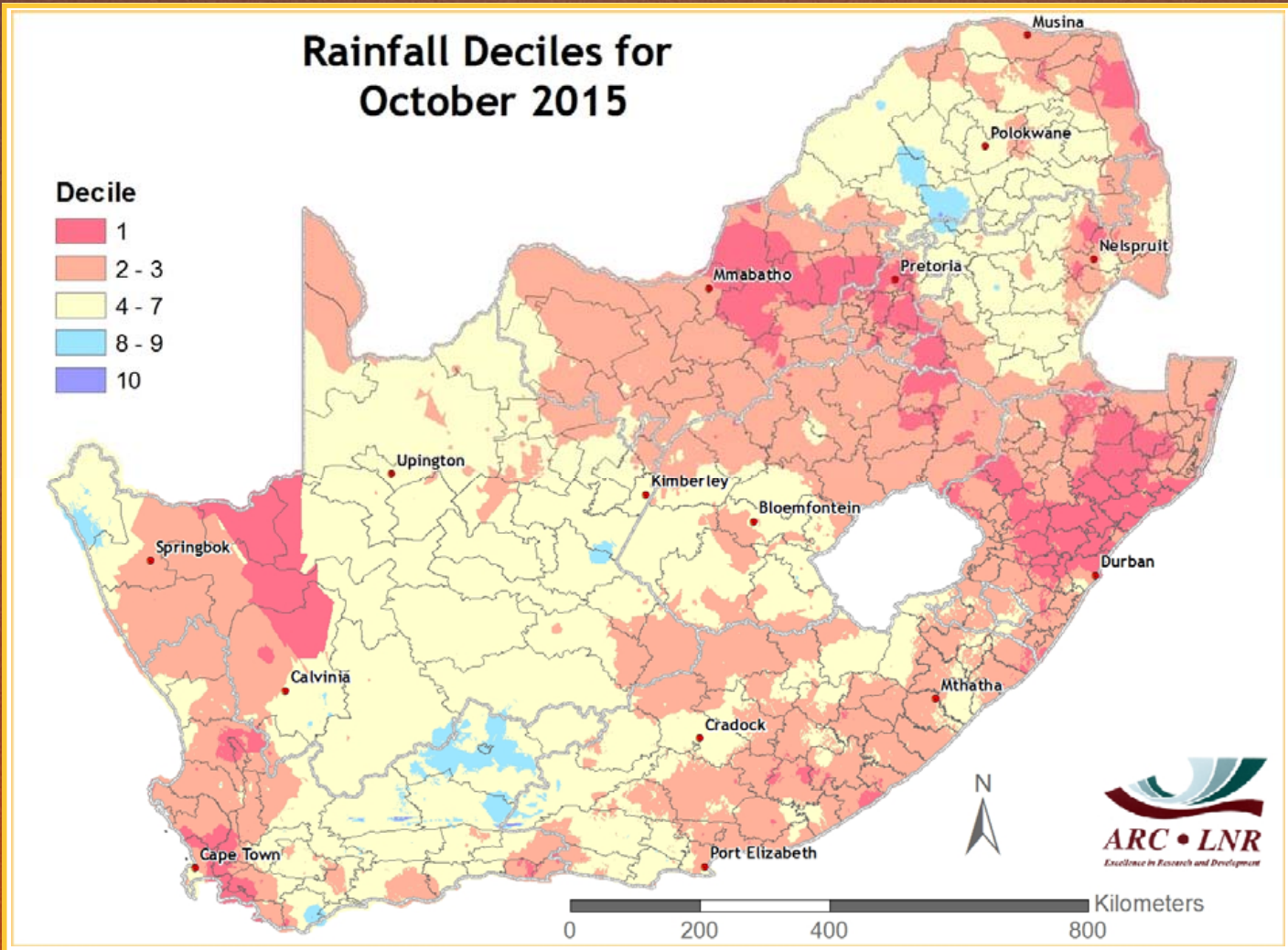


Figure 9

Figure 9:
October was exceptionally dry in a band from northeastern North West through Gauteng into central KwaZulu-Natal.

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

4. Vegetation Conditions

Vegetation Mapping

The Normalized Difference Vegetation Index (NDVI) is computed from the equation:

NDVI=(IR-R)/(IR+R)

where:
IR = Infrared reflectance &
R = Red band

NDVI images describe the vegetation activity. A decadal NDVI image shows the highest possible "greenness" values that have been measured during a 10-day period.

Vegetated areas will generally yield high values because of their relatively high near infrared reflectance and low visible reflectance. For better interpretation and understanding of the NDVI images, a temporal image difference approach for change detection is used.

The Standardized Difference Vegetation Index (SDVI) is the standardized anomaly (according to the specific time of the year) of the NDVI.

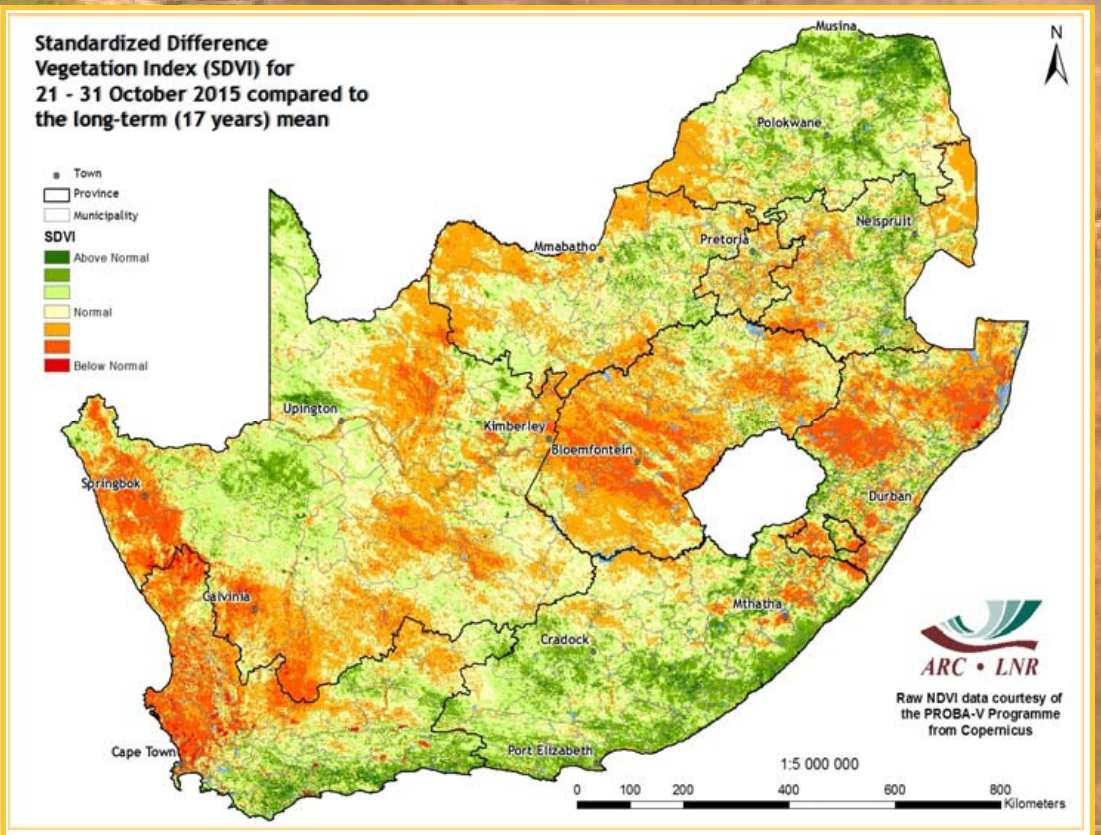


Figure 10

Figure 10:
The SDVI indicates drought stress over the northern parts of KwaZulu-Natal, central Free State and western to northern parts of the winter rainfall region, focusing on the Swartland.

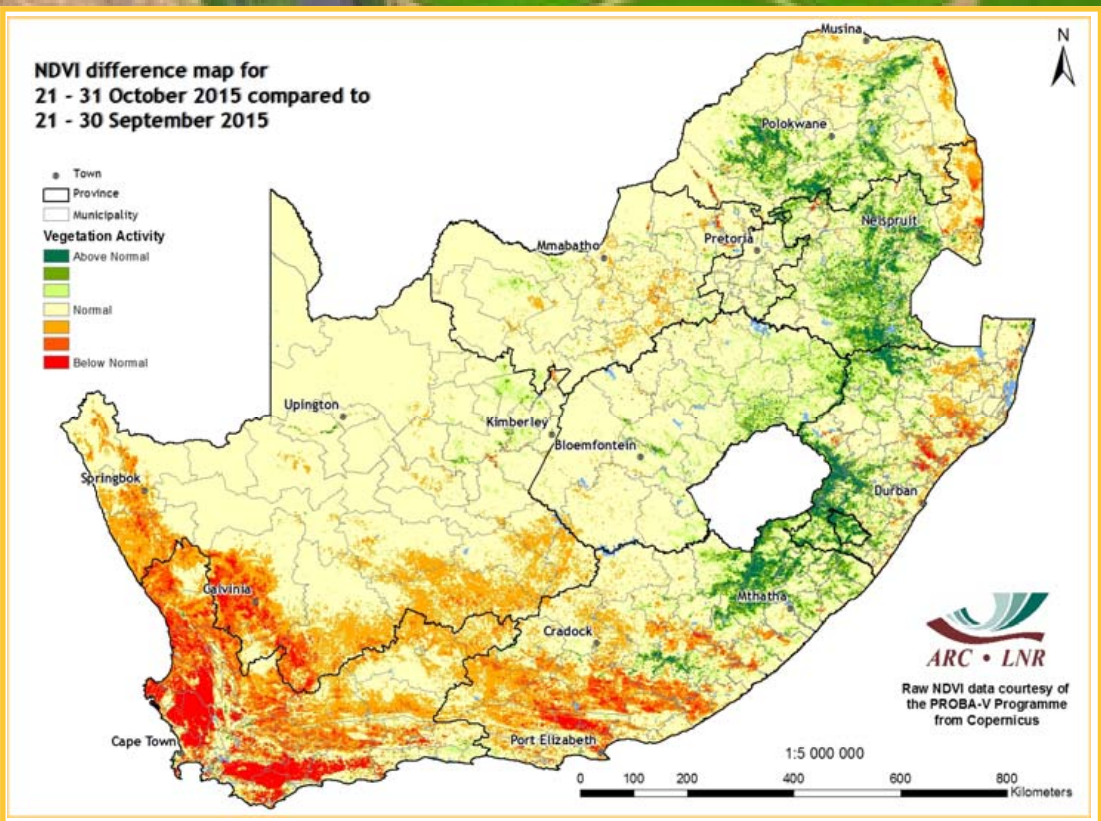


Figure 11

Figure 11:
Vegetation activity increased slightly mainly along the eastern Escarpment and Waterberg since September and decreased over the southwestern parts as well as eastern KwaZulu-Natal and the Lowveld of Mpumalanga and Limpopo.

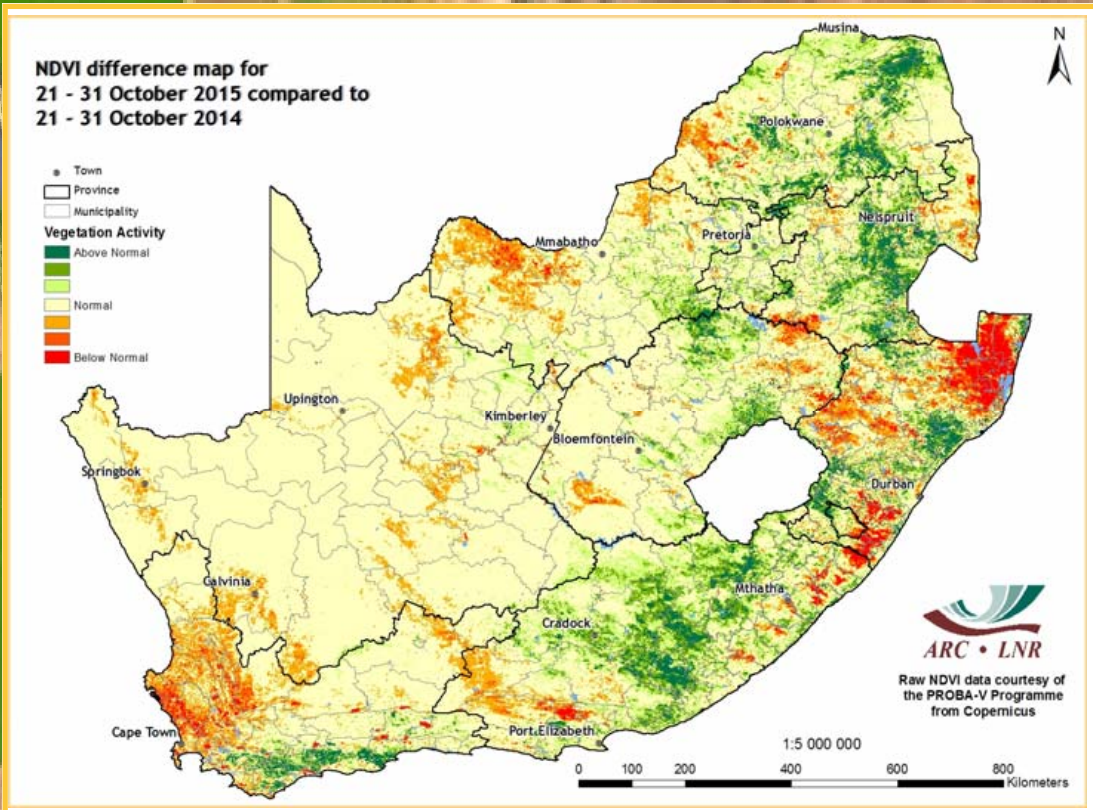


Figure 12

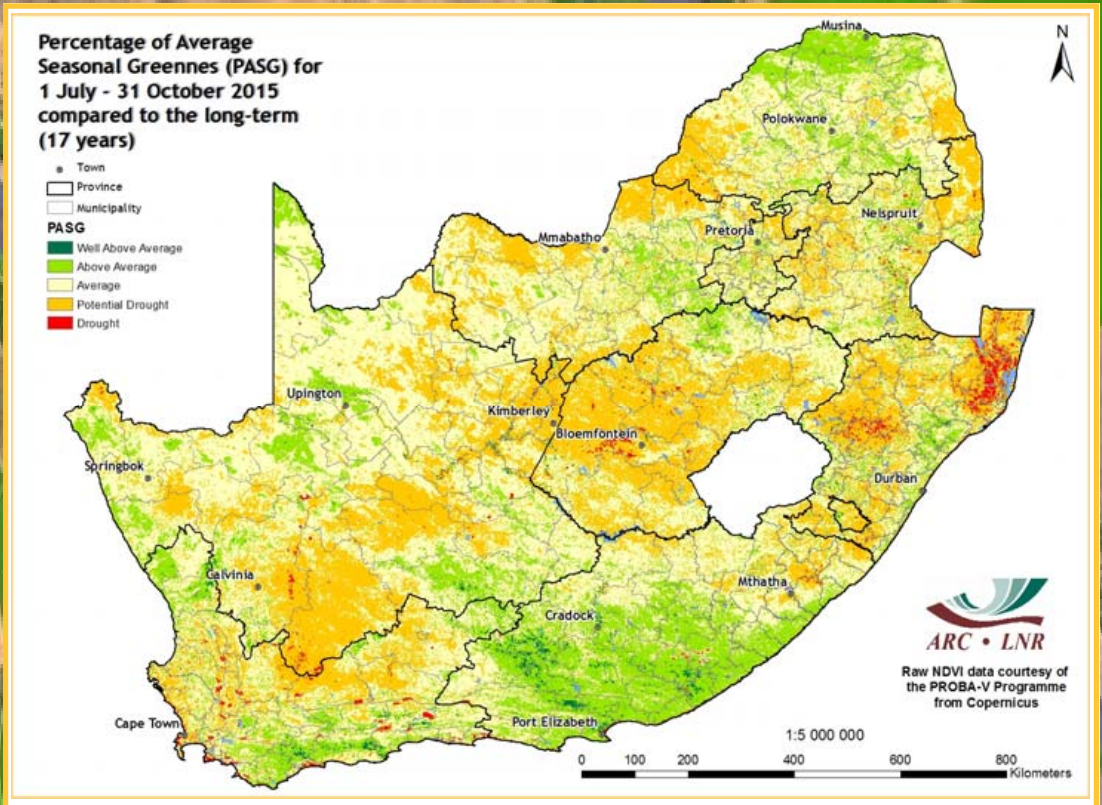


Figure 13

Vegetation Mapping
(continued from p. 7)

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 12:
Vegetation activity this year is higher over the southeastern to northeastern interior but lower over much of KwaZulu-Natal and the western winter rainfall region than in October 2014.

Figure 13:
Cumulative vegetation activity since July is above normal over the southern and southeastern parts as well as the northern parts of Limpopo. Large deficiencies are visible over northeastern and western KwaZulu-Natal and west of Bloemfontein in the Free State.

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

5. 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.

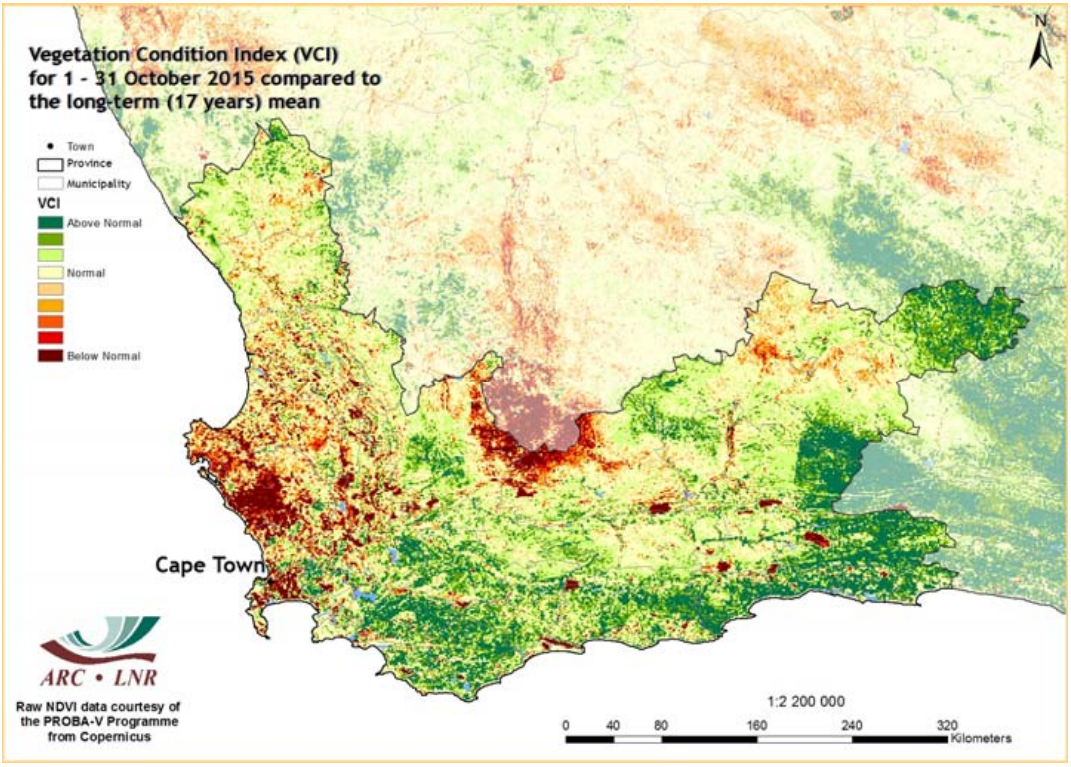


Figure 14

Figure 14:
The VCI map for October Indicates below-normal vegetation activity over the western parts and the northern interior of the Western Cape.

Figure 15:
The VCI map for October indicates below-normal vegetation activity over the western and northeastern parts of the Free State.

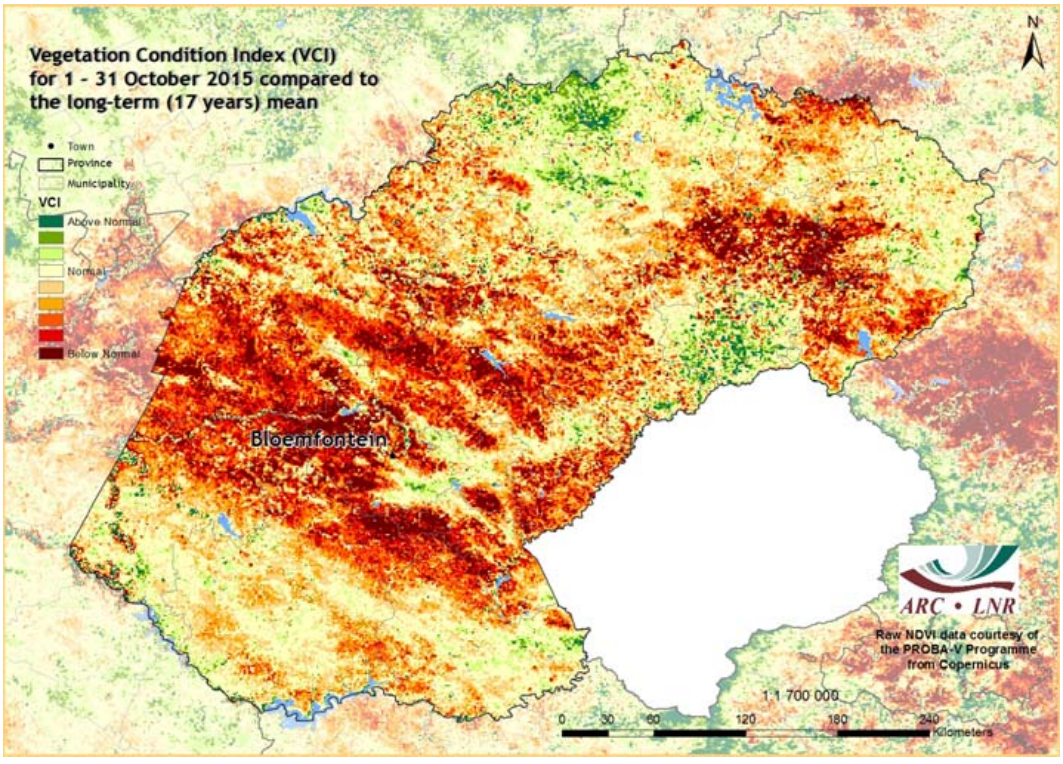


Figure 15

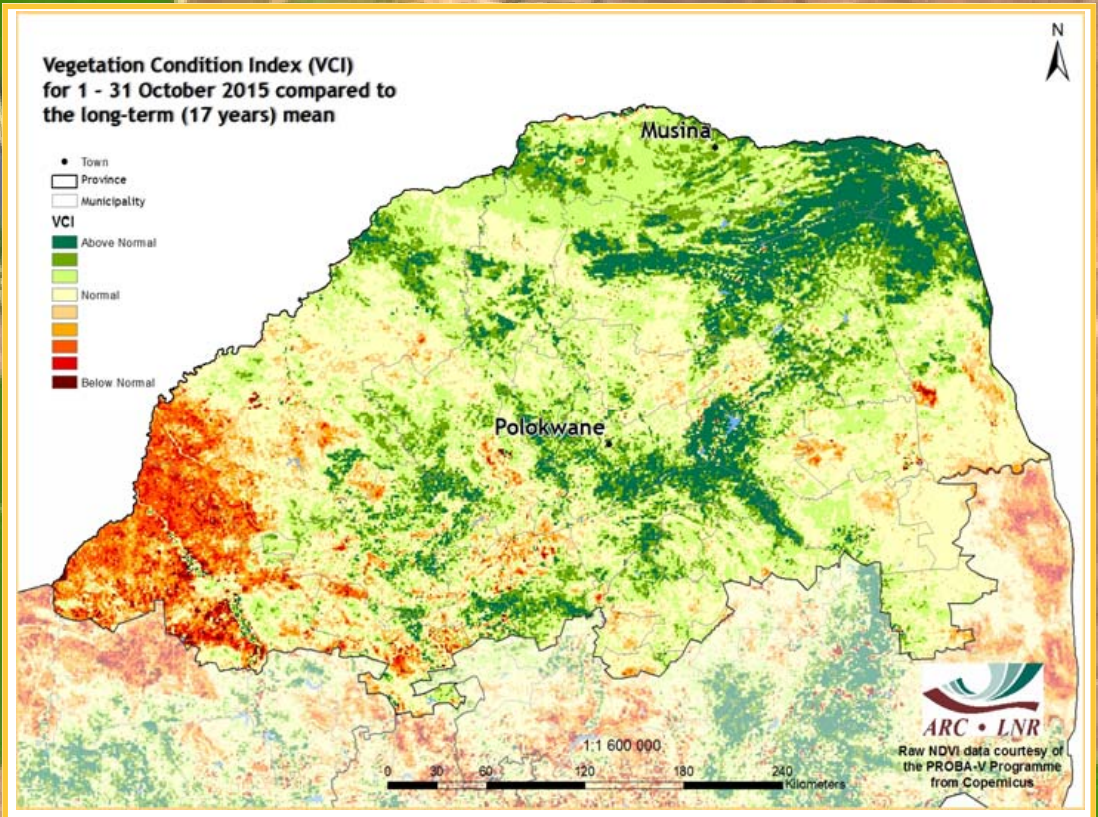


Figure 16

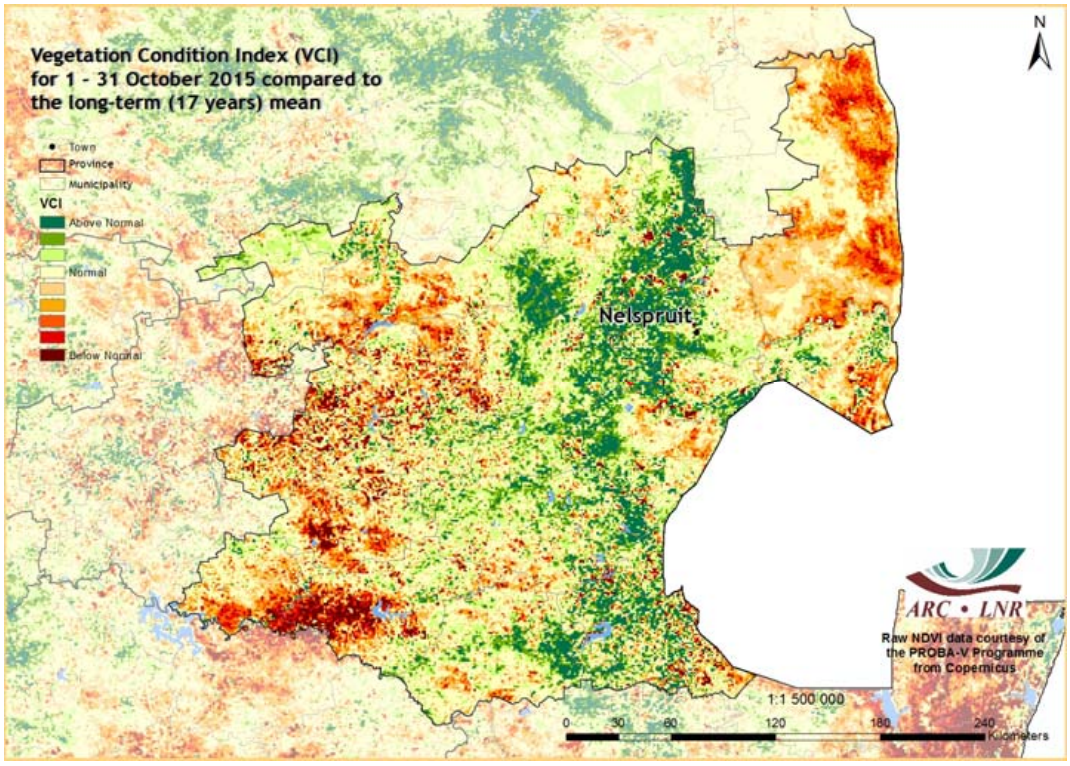


Figure 17

Figure 16:
The VCI map for October indicates below-normal vegetation activity over the southwestern parts of Limpopo.

Figure 17:
The VCI map for October indicates below-normal vegetation activity over the western Highveld and the Lowveld of Mpumalanga.

Questions/Comments:
NkambuleV@arc.agric.za

6. Soil Moisture

PAGE 11

Countywide soil moisture modelling by the University of KwaZulu-Natal Satellite Applications and Hydrology Group (SAHG)

Figure 18 shows the monthly averaged soil moisture conditions for October 2015. The colour scale ranging from brown to blue represents the Soil Saturation Index (SSI), defined as the percentage saturation of the soil store in the TOPKAPI hydrological model. The modelling is intended to represent the mean soil moisture state in the root zone. Figure 19 shows the SSI difference between October and September 2015, with the brown colours showing the drier and the green colours the wetter areas. Similarly, the year-on-year SSI difference for October is shown in Figure 20. Soil moisture estimates are lower over much of the eastern maize production region than during last year October. Over these areas, the planting window for maize is nearing its end.

The SSI maps are produced at the ARC-ISCW in a collaborative effort with the University of KwaZulu-Natal Applications and Hydrology Group, made possible by the WMO.

Questions/Comments:
sinclaird@ukzn.ac.za

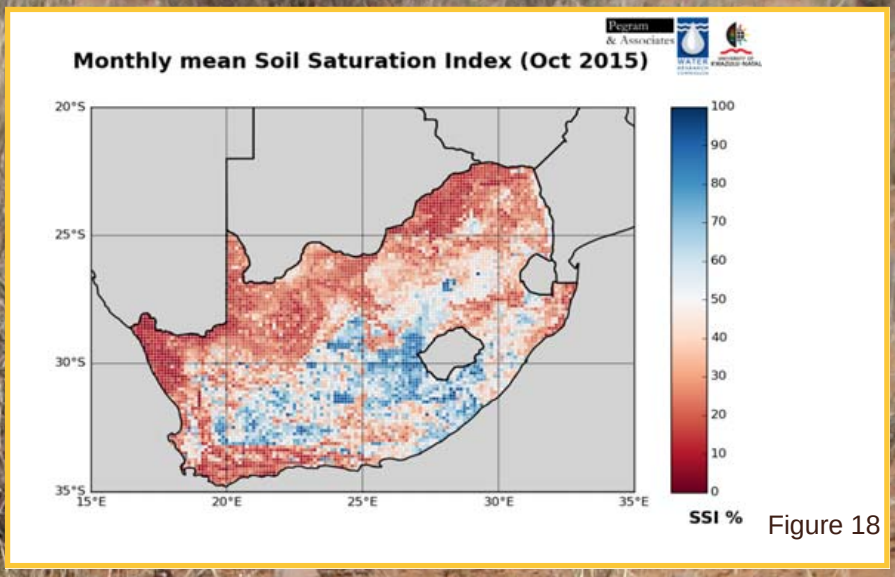


Figure 18

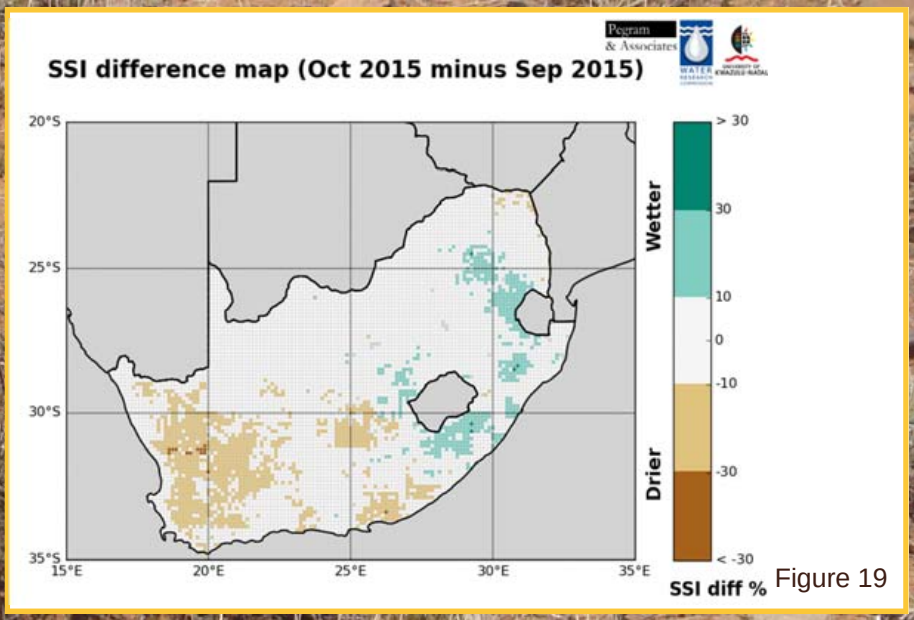


Figure 19

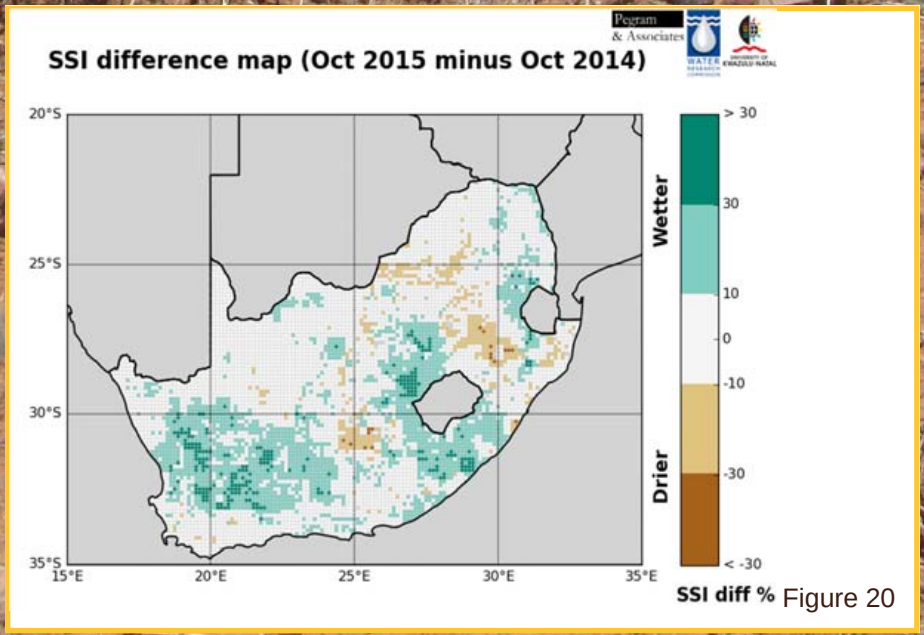
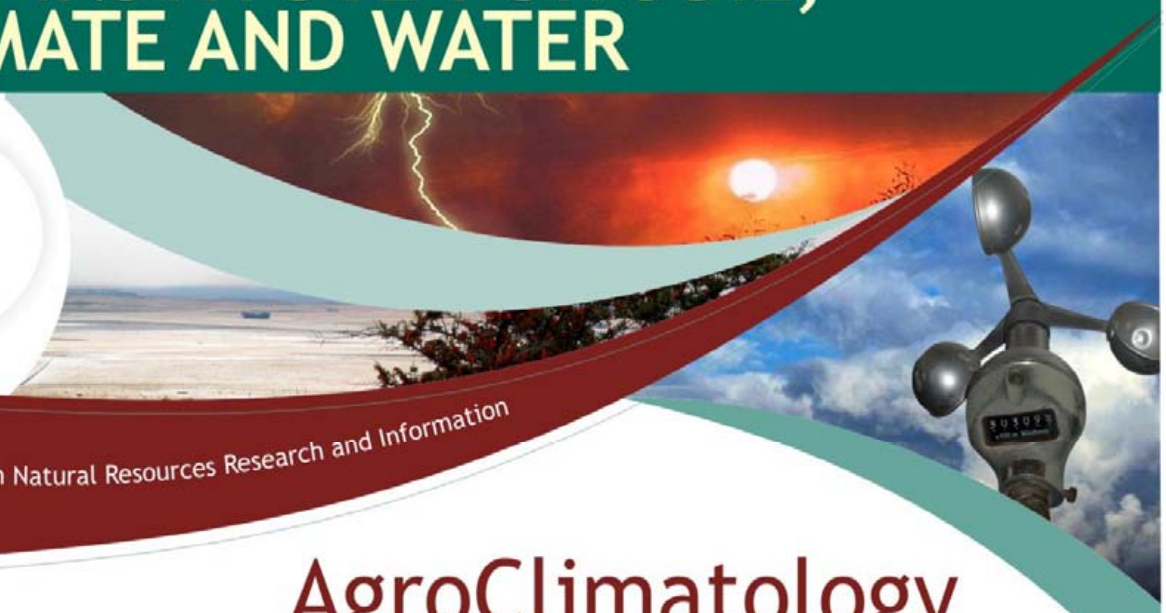


Figure 20

UNIVERSITY OF KWAZULU-NATAL

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

Private Bag X79, Pretoria 0001
Tel: 012 310 2500 • Fax 012 323 1157
E-mail: ISCWinfo@arc.agric.za
Website: www.arc.agric.za

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)
Phone: +27(0) 12 310 2533
Fax: +27 (0) 12 323 1157
E-mail: NkambuleV@arc.agric.za

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