WEATHERSMART

NEWS

Scientific meteorological and climatological news from the South African Weather Service

AUGUST 2017

South African Weather Service

ISO 9001 Certified Organisation

WEATHERSMART NEWS

Scientific meteorological and climatological news from the South African Weather Service

AUGUST 2017

Publisher:
South African Weather Service

Address:
442 Rigel Avenue South
Erasmusrand
Pretoria
0181

Date of issue:
August 2017

Frequency:
6 Monthly

ISSN:
2414-8644

Editorial team

Hannelee Doubell (Compiler and editor)

Musiiwa Denga (Assistant compiler and editor)

Hannes Rautenbach (Scientific editor and writer)

Elsa de Jager (Scientific editor and writer)

Katlego Ncongwane (Scientific editor and writer)

Nosipho Zwane (Scientific editor and writer)

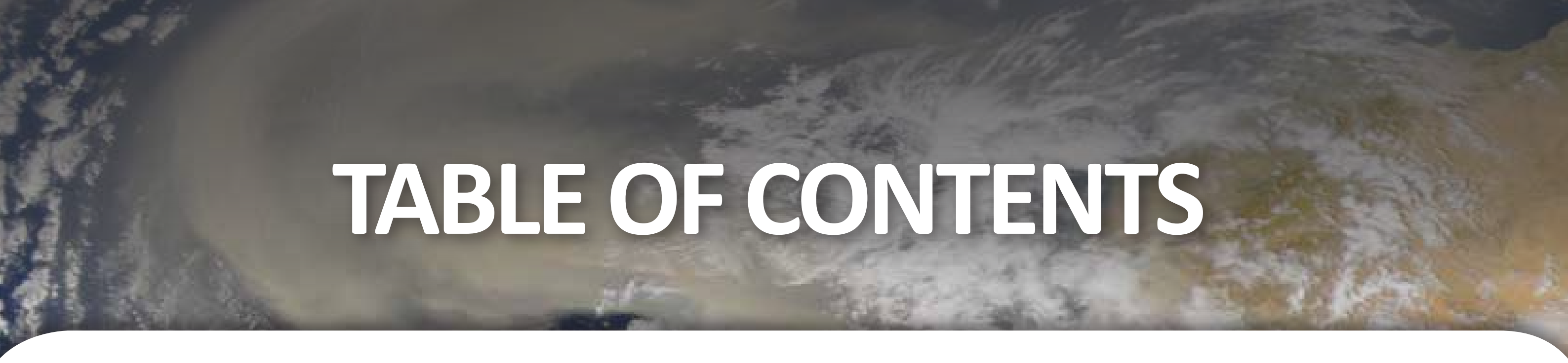


TABLE OF CONTENTS

FOREWORD BY THE CHIEF EXECUTIVE OFFICER

Mr Jerry Lengoasa

As new Chief Executive Officer of the South African Weather Service since May this year, I encounter a number of jewels of the South African Weather Service on a daily basis.

The WeatherSMART newsletter, launched in February 2016, is definitely one of SAWS' jewels, as it provides a valuable record and insight about the organisation's weather and climate-related work over the past six months. This newsletter is not a report, but reflects on relevant and interesting weather and climate matters that have a great deal of public appeal.

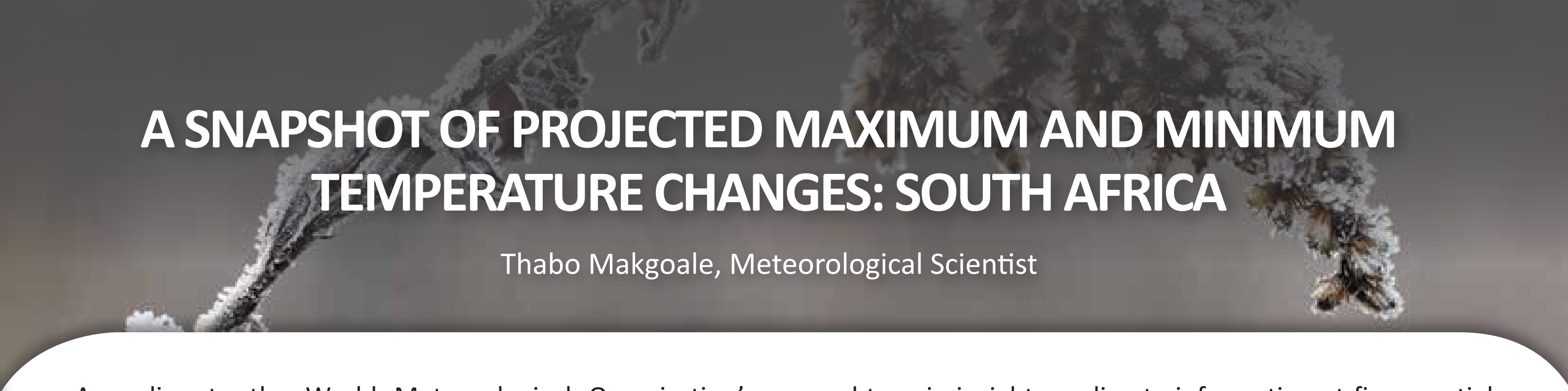
We share with you a snapshot of projected maximum and minimum temperature changes, indicating how different regions might experience changes of varying magnitude.

One of the most important themes during the past months was the drought. While the drought over the interior was mostly broken during the rain of February 2017 (reported in our previous newsletter), the Cape Provinces struggled with the continued drought – in spite of some rain that fell during this period. Unfortunately, the Cape storms of June did not bring so much relief in terms of rain, but caused major damage and were also exacerbated to the Knysna fires. The same could be said of weather systems in July and August, which brought some rain but not enough to alleviate the dire situation in the western parts of the country.

We reflect on the well-known fact that 2015 was the driest year on record for South Africa and provide updated graphs until December 2016, which show where South Africa stands in terms of its rainfall deficit over the past few years.

Agriculture is one of the key weather sensitive sectors in South Africa and climate change poses a risk to agricultural sustainability, as this sector is particularly sensitive to shifts in temperature and rainfall patterns. The article about our knowledge sharing and exchange initiative with support from the Limpopo Department of Agriculture and Rural Development (LDARD), demonstrates the role of the South African Weather Service in creating weather and climate resilience through promoting sustainable climate smart farming that will eventually result in knowledge transfer to more than 3000 smallholder farmers in the province through the extension officers.

I trust that you find this newsletter informative.



A SNAPSHOT OF PROJECTED MAXIMUM AND MINIMUM TEMPERATURE CHANGES: SOUTH AFRICA

Thabo Makgoale, Meteorological Scientist

According to the World Meteorological Organization's global analysis, the year 2016 was the warmest year on record. In South Africa, a number of highest maximum temperatures were recorded at various weather stations, mainly due to intense heat waves. Such extreme and unusually warm conditions are likely to increase in future in magnitude and frequency with global warming, and might lead to different secondary impacts. For example, agricultural activities and production are vulnerable to changes in daily maximum and minimum temperatures, which might influence accumulated chill, growing degree days, evapotranspiration and photosynthesis.

In previous studies on historical trends in surface temperatures in South Africa, a warming trend of approximately 0.17 °C per decade has been detected over the past decades. These results agree well with international findings on global temperature trends. Alarming is that such trends are also associated with an increase in extreme warm events and a general decrease in extreme cold events in South Africa. However, different regions might experience changes of varying magnitude. Projections of future maximum and minimum temperatures at a regional or local scale therefore deserve more attention.

The most common approach for examining future changes in maximum and minimum temperature is by using Global Climate Models (GCMs). GCMs can be very helpful in generating future outlooks. However, their coarse resolution (generally in the order or 100 km x 100 km) makes it difficult to conduct regional or local scale analysis. In order to improve on the resolution of GCM simulations, and to gain insight on climate information at finer spatial scales, downscaling techniques have been developed, which can be achieved through either statistical or dynamical downscaling.

Projected Greenhouse Gas Concentrations

Maximum and Minimum temperature projections that are presented in this article are based on selected projected greenhouse gas concentration pathways. These pathways are the product of an innovative collaboration between integrated assessment modelling, climate modelling and impact analysis. They are defined by the Inter-government Panel on Climate Change as "Representative Concentration Pathways (RCPs)". In the most recent climate change assessment report, four RCPs were defined, namely the RCP2.6, RCP4.5, RCP6.0 and RCP8.5, or a radiative forcing of +2.6, +4.5, +6.0 and +8.5 $W.m^{-2}$ that will be added to the atmosphere by the year 2100. In this article, only RCP8.5, which is regarded as "business as usual", will be considered.

Modelling Approach

Historical and projected simulations from nine GCMs, as listed in Table 1, were used in the analysis. Note that output from these GCMs is in a relative coarse resolution. Dynamical downscaling to a finer resolution of 0.44°×0.44° (± 50km x 50km) was achieved using the Rossby Centre Regional Atmospheric Model (known as the RCA4 model) from the Swedish Meteorological and Hydrological Institute (SMHI). In short, the 9 GCMs in Table 1 provided boundary input to the RCA4.

Model name	Institute/Country	Resolution	Literature
CanESM2m	CCCMa (Canada)	2.8° × 2.8°	Arora *et al*., (2011)
CNRM-CM5	CNRM-CERFACS (France)	1.4° × 1.4°	Voldoire *et al*., (2013)
CSIRO-MK3	CSIRO-QCCCE (Australia)	1.9° × 1.9°	Rotstayn *et al*., (2013)
IPSL-CM5A-MR	IPSL (France)	1.9° × 3.8°	Hourdin *et al*., (2013)
MIROC5	AORI-NIES-JAMSTEC (Japan)	1.4° × 1.4°	Watanabe *et al*., (2011)
HadGEM2-ES	Hadley Centre (UK)	1.8° × 1.2°	Collins *et al*., (2011)
MPI-ESM-LR	MPI – M (Germany)	1.9° × 1.9°	Ilyina *et al*., (2013)
NorESMI-M	NCC (Norway)	1.9° × 2.5°	Tjiputra *et al*., (2013)
GFDL-ESM2M	GFDL (USA)	2.0° × 2.5°	Dunne *et al*., (2012)

Table 1: CMIP5 GCMs used as boundary condition for high resolution simulations of approximately 0.44° × 0.44° using the RCA4 Regional Climate Model (RCM).

VERIFICATION AGAINST OBSERVATIONS

Before model projections can be generated, it is advisable to first verify output from historical simulations of such a model with observations. This serves as an indication of how well the model performs in simulating the climate system. In this article, Taylor Diagrams were used to assess model skill. A Taylor Diagram graphically synthesises a number of statistics that summarises how closely climate models match observations. These statistics include the correlation (R), Root Mean Square Error (RMSE) and standard deviation. Maximum and minimum temperature time series data were obtained from SAWS station data positioned in the 9 provinces of South Africa (one station point per province). These were compared to the historical model data. Figure 1 demonstrates the results of the maximum temperature evaluation (a similar verification has been done for minimum temperatures). The results indicate that the pattern correlation between SAWS station observations and model data was acceptable with good correlations (Taylor Diagrams are not explained in detail here – it is recommended that interested readers should consult literature.

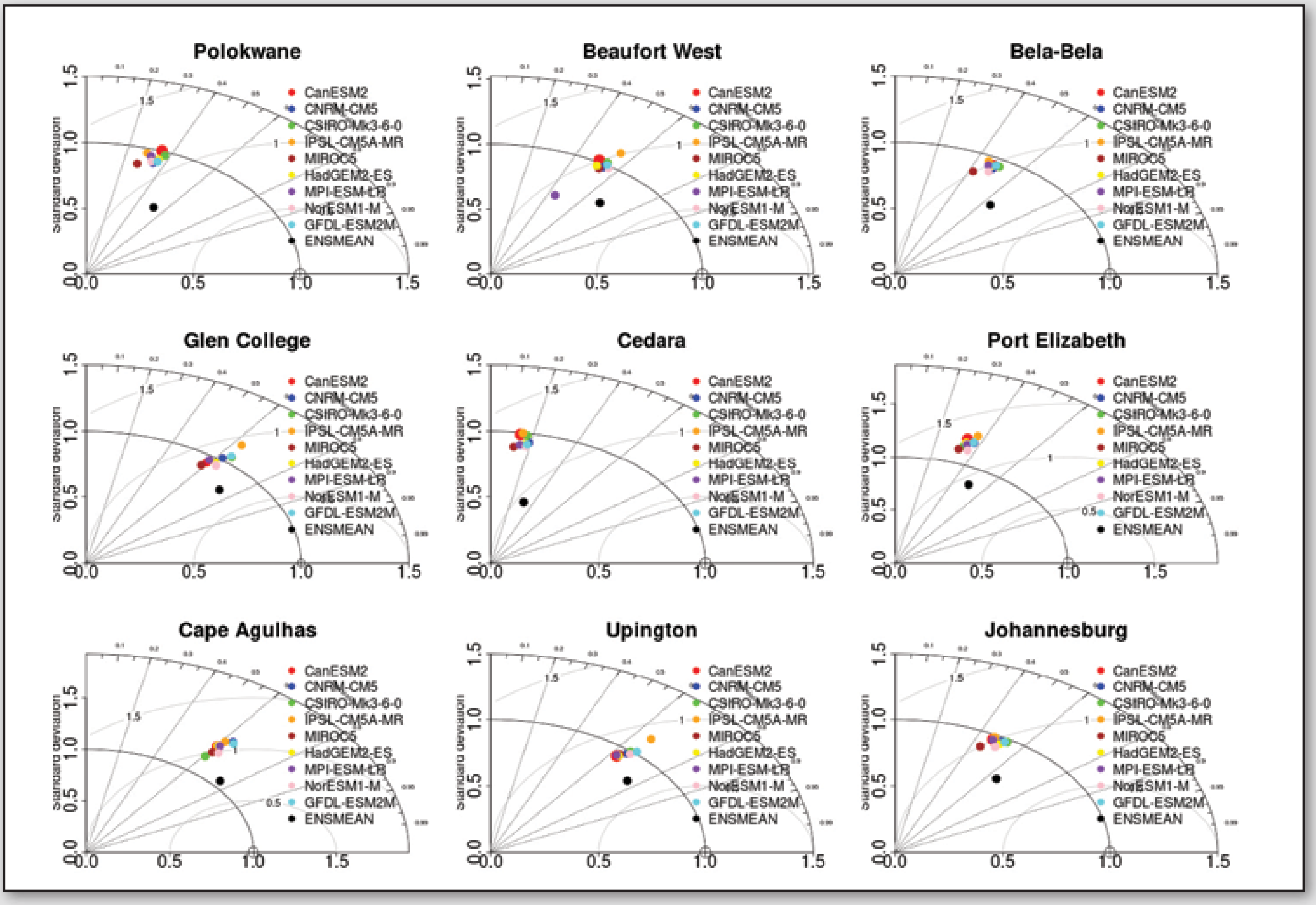


Figure 1: Taylor Diagrams displaying a statistical comparison of daily maximum temperature (°C) between SAWS station data and individual models. The mean of RCMs simulations are represented by a black dot, while the coloured dots represents individual models.

PROJECTIONS

Projected maximum and minimum temperatures under conditions of the RCP8.5 pathway are explored for the two 30–year periods 2036 to 2065 (near future) and 2066 to 2095 (far future). Changes are expressed relative to the baseline period 1976 to 2005. Results indicate that South Africa is likely to experience maximum temperature increases of 0.8°C to 1.2°C, on average, for near future period and 1.2°C to 1.6°C for the far future period (Figures 2 and 3).

Seasonal maximum temperatures for near future period is projected to increase by about 0.6°C to 1.60°C for the December-January-February (DJF), March-April-May (MAM) and June-July-August (JJA) seasons (Figure 2). A slightly higher maximum temperature change of about 0.8°C to 1.2°C is projected for September-October-November (SON). Projected increase for the far future period indicates that maximum temperature might increase by about 1.0°C to 1.4°C for DJF and 1.2°C to 1.6°C for MAM, JJA and SON (Figure 3).

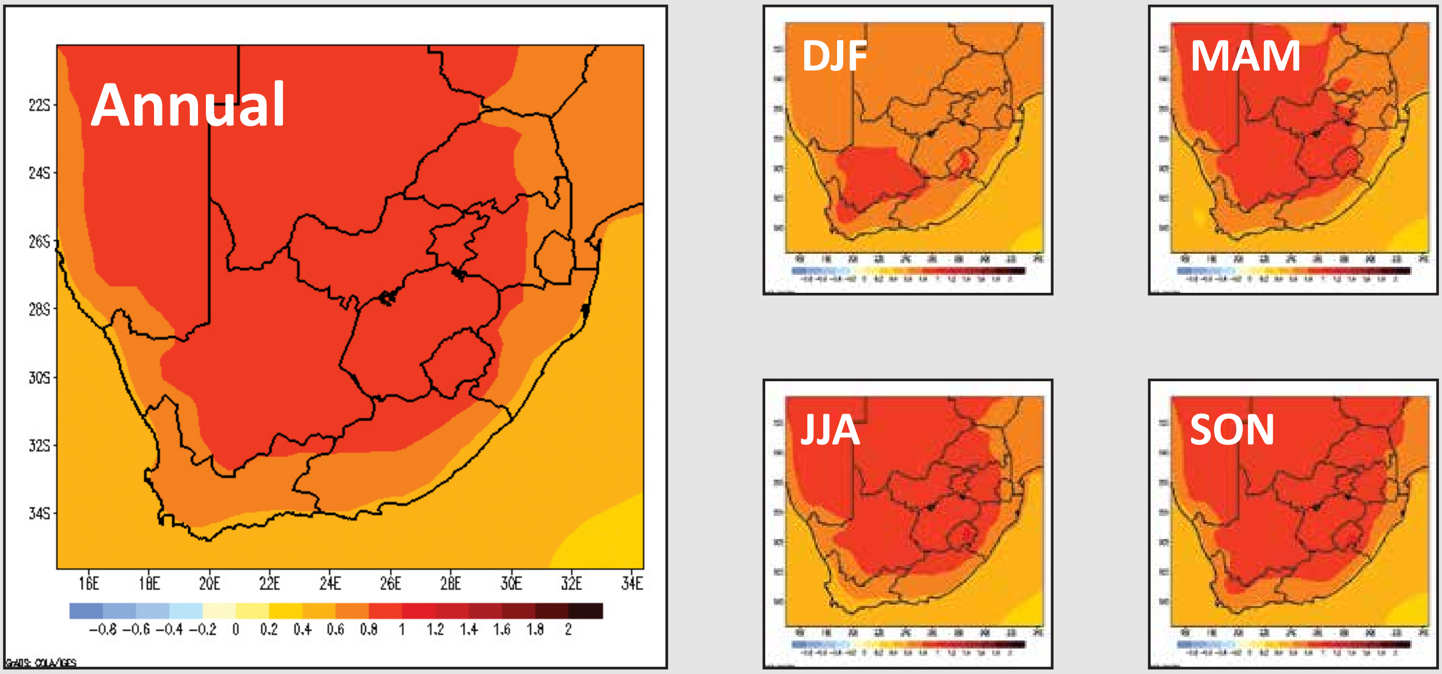


Figure 2: Ensemble means of annual (left) and seasonal (December – January – February: DJF, March-April-May: MAM, June-July-August: JJA and September-October-November: SON) maximum temperature projections (°C) for 2036 to 2065, relative to 1976 to 2005, under conditions of the Representative Concentration Pathway (RCP) 8.5 (business as usual) and as simulated by the RCA4 Regional climate model forced by nine global models.

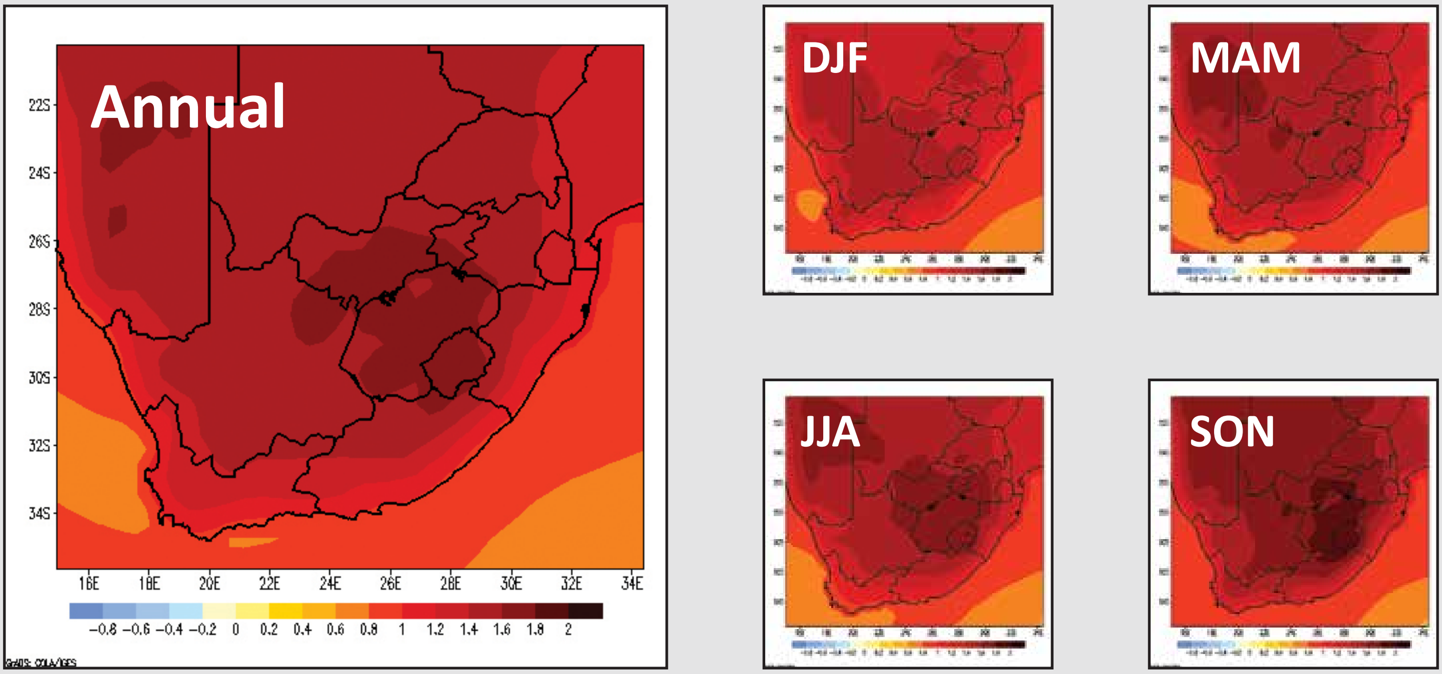


Figure 3: Ensemble means of annual (left) and seasonal (December – January – February: DJF, March-April-May: MAM, June-July-August: JJA and September-October-November: SON) maximum temperature projections (°C) for 2066 to 2095, relative to 1976 to 2005, under conditions of the Representative Concentration Pathway (RCP) 8.5 (business as usual) and as simulated by the RCA4 Regional climate model forced by nine global models.

In terms of minimum temperature changes, an annual increase of 0.5°C to 0.7°C are projected for the *near future*, and 0.9°C to 1.1°C for the *far future* (Figures 4 and 5) Increases of about 0.5°C to 0.7°C is projected for all the seasons in the *near future*. For the *far future,* increases of about 0.7°C to 0.9°C are projected for DJF and 0.7°C to 1.1°C are projected for the seasons MAM, JJA and SON.

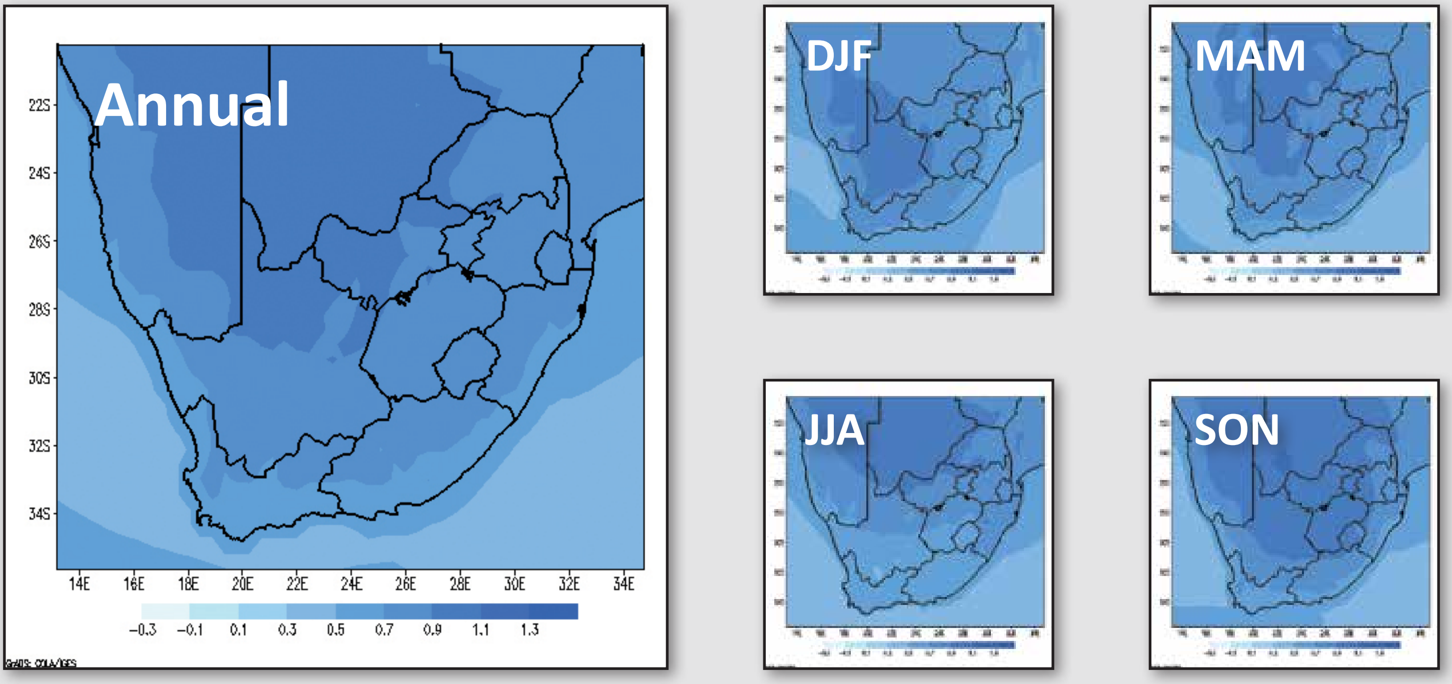


Figure 4: Ensemble means of annual (left) and seasonal (December – January – February: DJF, March-April-May: MAM, June-July-August: JJA and September-October-November: SON) minimum temperature projections (°C) for 2036 to 2065, relative to 1976 to 2005, under conditions of the Representative Concentration Pathway (RCP) 8.5 (business as usual) and as simulated by the RCA4 Regional climate model forced by nine global models.

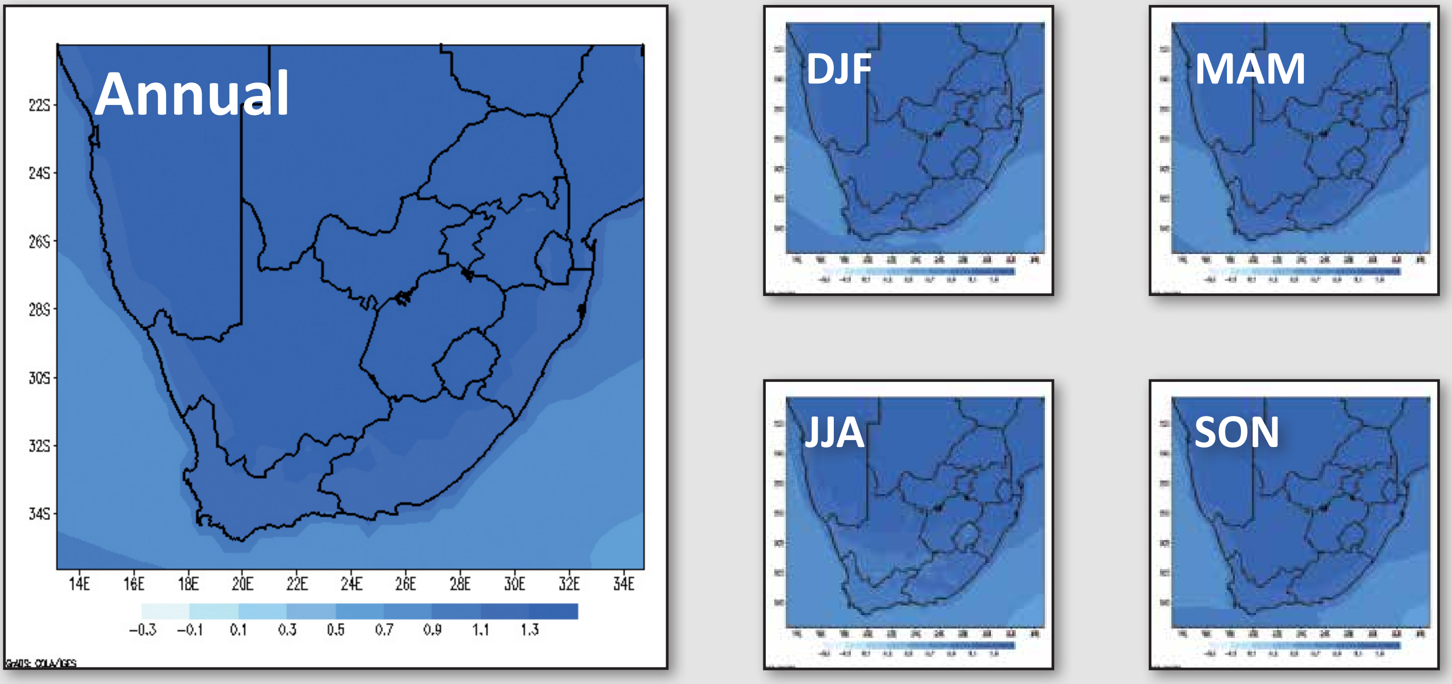


Figure 5: Ensemble means of annual (left) and seasonal (December – January – February: DJF, March-April-May: MAM, June-July-August: JJA and September-October-November: SON) minimum temperature projections (°C) for 2066 to 2095, relative to 1976 to 2005, under conditions of the Representative Concentration Pathway (RCP) 8.5 (business as usual) and as simulated by the RCA4 Regional climate model forced by nine global models

Conclusions

Climate modelling suggests a general increase in average maximum and minimum temperatures towards the end of the 21st century in South Africa under a business as usual greenhouse gas emission pathway. Increases appear to be higher in the interior than along the coast. Warming in spring, winter and autumn is projected to be greater than warming in the summer season.

COMMUNICATING WEATHER, CLIMATE AND AGRO-METEOROLOGICAL APPLICATIONS TO AGRICULTURAL EXTENSION OFFICERS IN THE LIMPOPO PROVINCE

Joël Botai, Hannes Rautenbach, Michael Mengistu, Absolom Mfumadi, Lucky Ntsangwane, Katlego Ncongwane, Nosipho Zwane, Thabo Makgoale, Thato Masilela, Jaco de Wit and Sphamandla Daniels

Agriculture is regarded as one of the key sectors in South Africa that is sensitive to weather and climate, as farming operations and agricultural production is considerably influenced by weather and climate patterns. In addition, climate change poses a risk to agricultural sustainability, since it might entail changes in temperature and shifts in rainfall patterns. As a matter of fact, it is anticipated that climate change might have a direct impact on the agricultural production of developing countries in Africa, which are also regarded as the most vulnerable in the world due to low adaptive capacity.

The Department of Environmental Affairs (DEA) and the Department of Agriculture, Forestry and Fisheries (DAFF) have therefore identified capacity building in the agricultural sector as a key component of climate change adaptation. Adaptive capacity, according to the World Meteorological Organization (WMO) and Intergovernmental Panel on Climate Change (IPCC), entails creating information through research, data collection, monitoring and creating awareness; and supporting social structures (organisational development, working in partnership, institutions) and supporting governance (regulations, legislation and guidance) needed as a foundation for delivering adaptation actions against climate change.

For this very purpose the South African Weather Service (SAWS), with support from the Limpopo Department of Agriculture and Rural Development (LDARD), engaged in a knowledge sharing and exchange initiative with agricultural extension officers in the Limpopo Province during early March 2017. This initiative was presented in the form of training sessions, with weather, climate and agro-meteorological applications being the main topics of discussion. The training was targeted at agricultural extension officers in the Sekhukhune, Mopani, Vhembe, Capricorn and Waterberg District Municipalities in the Limpopo Province of South Africa (Figure 1). The training aimed at creating weather and climate resilience, on the longer term, through promoting sustainable climate smart farming: an approach that helps to guide actions needed to transform and reorient agricultural systems to effectively support the development and ensure food security under conditions of climate variability. It is expected that the training will eventually result in knowledge transfer to more than 3000 smallholder farmers in the province through the extension officers.

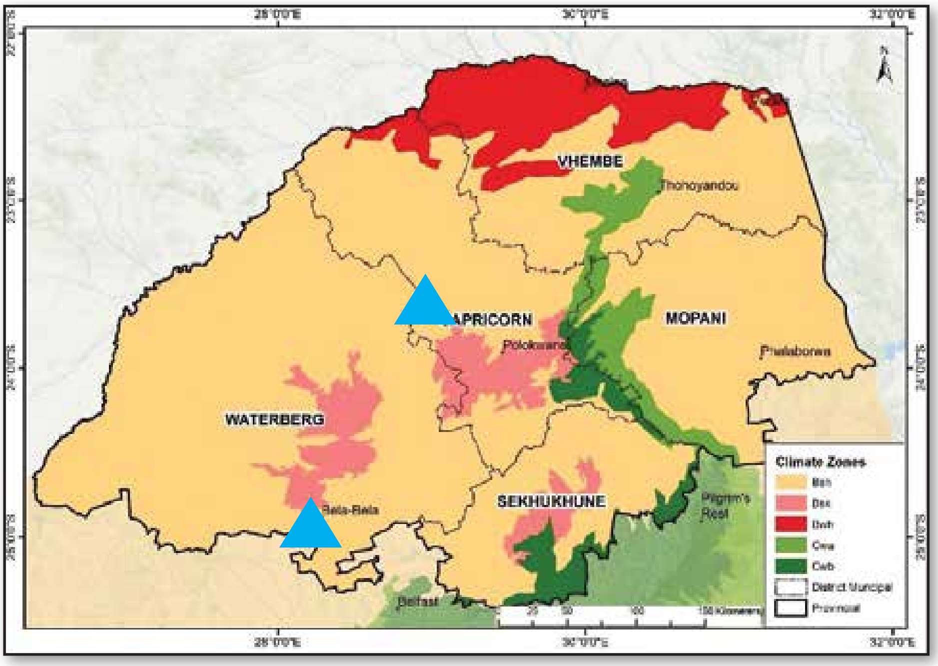


Figure 1: A map of the District Municipalities in the Limpopo Province, with the locations where the training took place (blue triangles).

Limpopo's Agriculture and Rainfall in a Nutshell

As indicated in Figure 1, the Limpopo Province covers an area of 12.46 million hectares, of which 9.24 million hectares are utilised as farmland. The province is one of South Africa's prime agricultural regions noted for the production of horticultural crops, cereals and livestock. The province has three distinct climatic regions, namely the Lowveld region (with an arid to semi-arid climate); the middle and Highveld region (with a semi-arid climate); and the escarpment region (with a sub-humid climate).

Apart from other climatic variables such as near-surface temperatures and moisture, rainfall is regarded as essential for prosperous agricultural practices. Most of the rain occurs during the austral summer months between November and March. A time series of area averaged annual rainfall totals across the Limpopo Province for the period 1904 to 2016 is presented in Figure 2. The average rainfall is estimated as 630 mm per year, but with large spatial variability between the dry north, the wetter mountainous regions that are mostly found along the eastern escarpment, and savannah in the central and southern parts of the province. The rainfall records indicate a relatively small negative rainfall trend of approximately -35 mm (-6%) over the period 1904 to 2016. It is obvious that this trend is attributed to the high rainfall years that occurred at the beginning of the rainfall record (between 1904 and 1920).

Climate change projections indicated that the annual total rainfall might continue to decrease into the future (Figure 3) with percentage changes of up to -15% towards the period 2066 to 2095. This drying is also projected for most seasons, with the exception of December where an increase of around +5% is indicated in the eastern parts of the province.

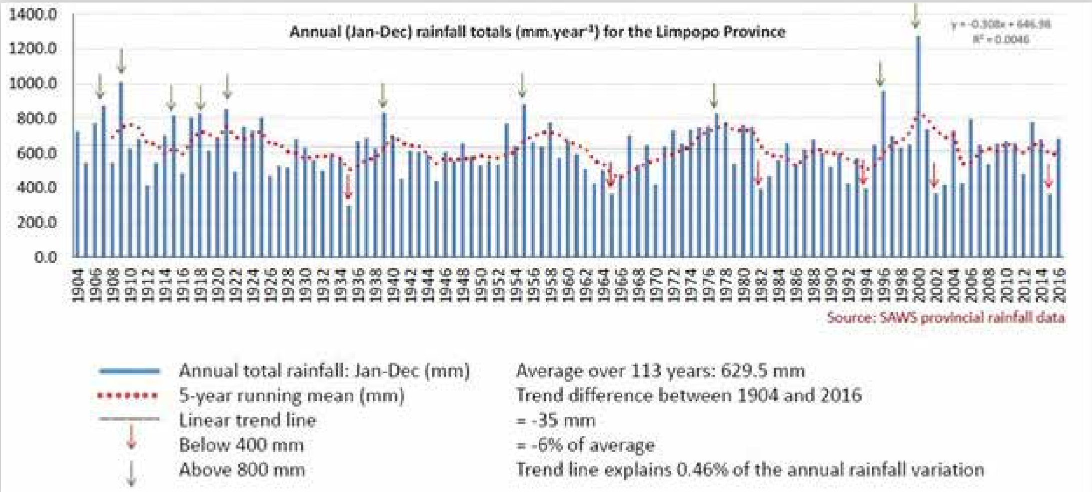


Figure 2: Area averaged annual rainfall totals of the Limpopo Province between 1904 and 2016 (Source: SAWS Provincial Rainfall).

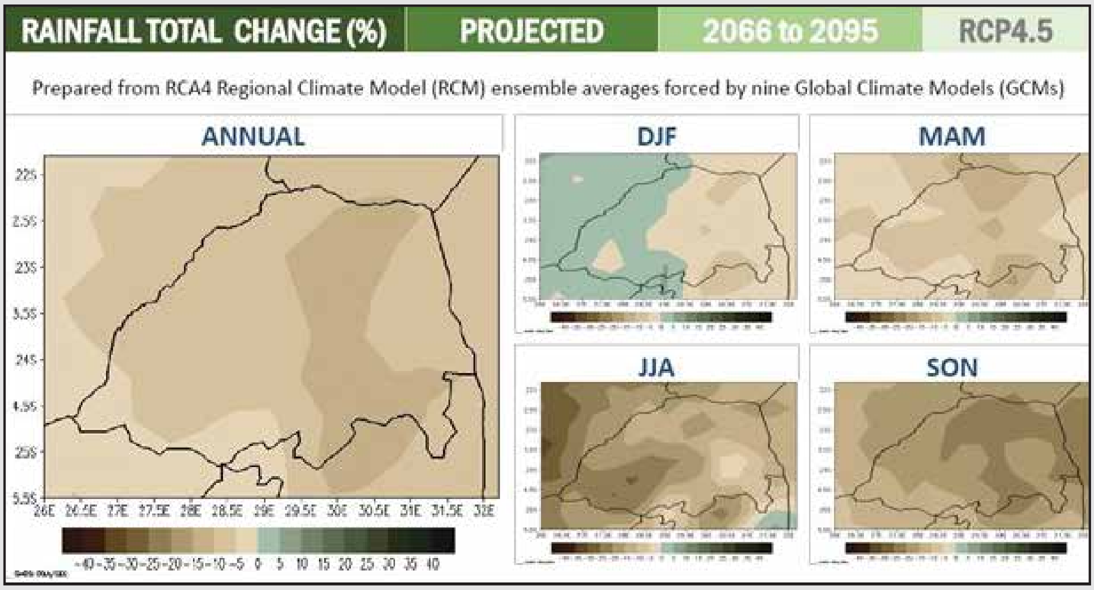


Figure 3: Percentage (%) change towards 2066 to 2095 in annual and seasonal rainfall totals under a medium Greenhouse Gas pathway, as obtained from the SAWS Climate Change Reference Atlas.

Training Programme

SAWS, in collaboration with Hilltop Trading 208 (operating as VicMat consultants) was commissioned by LDARD to present the training between 7 and 10 March 2017. The training was carried out by a team of qualified scientists from the SAWS Research and Development Department, based at the SAWS headquarters in Pretoria, and was presented concurrently in two separate locations in the Vhembe District Municipality (at the Madzivhandile Agricultural College close to Thohoyandou) and the Sekhukhune District Municipality (Lebowakgomo that is located at about 45 km southeast of Polokwane) – see triangles in Figure 1.

Purpose of the Training

The overall purpose of the training was to share and disseminate knowledge on weather, climate and agro-meteorological theory and applications through participatory teaching (Figure 4). The topics covered included: the weather and climate of South Africa; climate change trends and projections; agro-meteorological applications; and a demonstration of the HydroNet platform.

Training Outcomes

Based on the feedback from participants, the training was not only found to be aligned with the expected tasks to be performed by extension officers, but also added to their knowledge pool. Participants indicated that the information shared during the training sessions was applicable and that new knowledge gained will be shared with farmers. Furthermore, participants indicated that they will make a bigger effort in communicating changes in climate-agricultural conditions with users along the entire value chain. In feedback it was found that Indigenous Knowledge (IK) still plays an important role in the social structures of small-scale farmers, but that IK could be aligned to the new knowledge communicated during the training.

Figure 4: Ms. Nosipho Zwane (left) and Dr Michael Mengistu (right) in discussion with extension officers during the training sessions.

Everybody agrees that the training was a great success, and LDARD has already indicated that similar events should again take place in future in partnership with SAWS.

SAWS CLIMATE CHANGE AND VARIABILITY RESEARCHERS ON THE HEELS OF MALARIA

Abiodun Adeola, Lead Scientist: Climate Change and Variability & Hannes Rautenbach,
Chief Scientist: Climate Change and Variability

The life cycle of the malaria parasite, which is transmitted by the bite of an infected female Anopheles (vectors) to infect people, is primarily driven by weather, climate and environmental conditions. Globally, it is estimated that about 3.3 billion people in 97 countries and territories are at risk of being infected with malaria, out of which 1.2 billion are at high risk of being infested with malaria in a year. According to the World Health Organisation (WHO), the malaria burden is heaviest in the sub-Saharan African region, where an estimated 90% of all malaria deaths occur, and in children aged under 5 years, who account for 78% of all deaths. It is estimated that malaria kills an African child every 30 seconds. This is largely due to deteriorating health systems, growing drug and insecticide resistance, climate change and variability and population migration.

In South Africa, about five million people (representing 10% of the total population) live in malaria endemic areas. The low altitude areas (below 1000 m above mean sea level) of the northern and eastern parts of the country, bordering Mozambique and Zimbabwe, are regarded as the malaria endemic regions of the country. Hence, malaria is endemic in three provinces, namely Limpopo, Mpumalanga and KwaZulu-Natal. In addition, a few major occurrences are occasionally sighted in the Northern Cape and North West provinces - mostly along the Orange and Molopo Rivers - as a result of the provision of suitable breeding habitats for mosquitoes to survive.

As a result of its dependence on the weather and local climates, malaria transmission follows a markedly seasonal pattern and experiences distinct inter-annual fluctuations leading to periodic epidemics. Generally, notifications increase during the period September to May, with peaks in the rainy months of December and January. According to the National Department of Health, the peak of malaria infection cases or uptakes at health facilities usually occur in April, and decline by June. Due to the heavy rainfall witnessed in the early part of 2017, a sudden rise in malaria cases in the endemic areas have been reported in South Africa. More specifically, over 600 cases of malaria infections have been confirmed in the Limpopo Province by the end of April 2017, where most cases occurred in the Vhembe and Mopani Districts Municipalities.

In support of the South African Weather Service mandate, a team of researchers from SAWS (Prof. Hannes Rautenbach and Dr. Abiodun Adeola) have established close ties with malaria experts from the University of Pretoria's Institute for Sustainable Malaria Control (UP ISMC), which is located in the university's Faculty of Health. The research contribution from SAWS focusses on looking at the impact of environmental drivers on malaria outbreaks.

These drivers firstly include land-use, vegetation and standing surface water variability, which can be detected by satellite remote sensing, and secondly include weather and climate variability. Different indices which can be obtained from satellite images include the Normalised Differenced Vegetation Index (NDVI), Normalised Water Difference Index (NDWI) and Soil Moisture Index (SMI), which are all proven environmental variables that have a relationship with malaria incidences. Meteorological variables like temperature, rainfall, relative humidity and wind can also be linked to the behaviour of the malaria vector (mosquito). Malaria mosquitos, for example, are more active during periods with temperatures of between 16 °C and 33 °C, which create favourable conditions for malaria parasite transmission to humans through the bite of an infected Anopheles mosquito. Malaria outbreaks then also usually occur after good rains, which create breading sites in which malaria larva flourish in stationary surface water pools. Such sites are limited or disappear during dry periods. There is also evidence that relative humidity and winds might contribute to malaria vector activities.

Apart from weather and climate variability, climate change also poses a risk through changes in the frequency and location of malaria outbreaks. Increased temperatures, as a result of Global Warming, might create more favourable conditions for mosquito activities, while increased levels of relative humidity as a result of increased evaporation might have the same consequence. In contrast, drier conditions might reduce malaria incidence, especially if stationary surface water pools could evaporate before the larva develops to mosquitoes. All these factors are indicative of the importance of weather and climate as early warning indicators for the risk of malaria outbreaks.

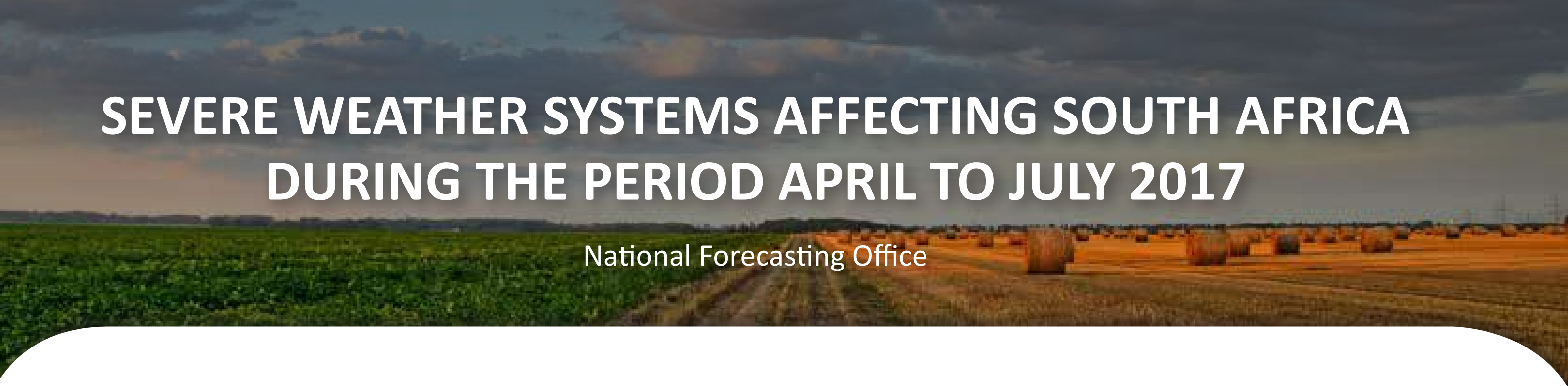
At the beginning of May 2017, a malaria expert team from France visited South Africa on a fact finding mission. Their visit coincided with the 37th International Symposium on Remote Sensing of the Environment (ISRSE-37) that was hosted by the South African National Space Agency (SANSA) between 8 and 12 May 2017 in Pretoria, South Africa. Experts from the UP-ISMC and SAWS joined the French team on a 4-day visit to the Vhembe District Municipality in the Limpopo Province, where different rural settlements were visited and a strategic planning workshop on collaborative research took place at the Mountain Inn Hotel in the Soutpansberg. The workshop particularly focused on sourcing first-hand information for developing a collaborative research framework with the longer-term aim to address the persistence of the malaria vector in the Limpopo River Valley.

The research team with experts from SAWS, the UP-ISMC, the Aix-Marseille University (France), and the Institut de Recherche pour le Développement – IRD (La Reunion) are committed to collaborating in future with the objective to eventually eliminate malaria in the Limpopo River Valley. Research from SAWS will include the development of early warning systems using both satellite and observational data. It is also anticipated to erect a number of Automatic Weather Stations (AWSs) at strategic locations along the borders between South Africa, Botswana and Zimbabwe, which will eventually become part of the SAWS AWS network. Various meetings with the South African Director of the Southern African Science Service Centre for Climate and Adaptive Land Management (SASSCAL), hosted by the South African National Research Foundation (NRF), have recently taken place to explore resources for establishing such an AWS network, especially in the light that the northern borders of South Africa are poorly covered by weather stations. In addition, SAWS plans to initiate an extensive climate reconstruction modeling research initiative aimed at creating fine resolution reanalysis climate fields for the Limpopo River Valley. This will not only assist in studying local climate-malaria relationships but will also contribute to the development of local early warning systems. During the modeling research, both satellite and ground station data will be used for further model verification and improvement research.

Since malaria transmission is influenced by several inter-linking factors such as climate, environment, socio-economy, demography and even population migration, a research team that consists of experts from different disciplines is essential. In this team, the SAWS researchers from the Climate Change and Variability Unit in the Research Department will play an important role in contributing to the ultimate objective, namely striving for malaria elimination in 2020.

Front row from left to right: Prof Riana Bornman (University of Pretoria Institute for Sustainable Malaria Control - UP ISMC), Prof Jean Gaudart (Aix-Marseille University, France), Dr Bernice Harris (UP ISMC), Ms Temitope Adebayo (UP ISMC), Dr Vincent Herbreteau (Institut de Recherche pour le Développement – IRD, La Reunion), Prof Hannes Rautenbach (South African Weather Service – SAWS & UP ISMC).

Back row from left to right: Dr Ignatius Venter (Postdoctoral Fellow: UP ISMC), Dr Taneshka Kruger (UP ISMC), Dr Abiodun Adeola (SAWS) Dr Vincent Achard (Aix-Marseille University), Prof Leo Braack (UP ISMC).



SEVERE WEATHER SYSTEMS AFFECTING SOUTH AFRICA DURING THE PERIOD APRIL TO JULY 2017

National Forecasting Office

Two significant weather systems affected the country in May and June 2017. The first was a cold front and a cut-off low that occurred from 12 to 14 May, while the second was an intense cold front, affecting the country from 6 to 8 June 2017. Both systems caused significant weather conditions including very cold temperatures, disruptive snow, heavy rain and flooding, high wave heights, a storm surge as well as gale force winds over the interior and along the west and south coasts of the country.

The Cold Front of 14 to 16 May 2017

A combination of a cold front and cut-off low affected the country from 12 to 14 May 2017, causing very cold conditions over the eastern half of the country, with the worst drop in maximum temperatures experienced over the eastern interior (Table 1) and heavy rainfall leading to flash flooding over the eastern and northern parts of KwaZulu-Natal (Table 2). Maximum temperatures that reached a new record low on 13 May 2017 are indicated in Table 1. Snow was also reported over the Drakensberg, with over 50 cm of snow recorded in places. All roads leading to the Drakensberg were eventually closed due to heavy snowfalls (See Image 1).

Parameter	Old Record	Old Date	New Record	New Date	Number of Years	Station
Lowest Maximum	7.8	2011-05-26	6.3	2017-05-12	11	KOKSTAD
Lowest Maximum	13.3	2012-05-09	12.4	2017-05-13	8	HARTEBEESPOORT DAM
Lowest Maximum	13.8	2010-05-30	12.5	2017-05-13	8	BRONKHORSTSPRUIT AWS
Lowest Maximum	8.7	2007-05-22	7.9	2017-05-13	24	BLOEMHOF
Lowest Maximum	18.1	2011-05-26	16.1	2017-05-13	12	PENNINGTON SOUTH
Lowest Maximum	17.5	2013-05-10	16.6	2017-05-13	8	KING SHAKA INT. AIRPORT WO
Lowest Maximum	12.2	2000-05-03	9.8	2017-05-13	25	VRYHEID
Lowest Maximum	7.7	2006-05-20	7.4	2017-05-13	13	BELFAST
Lowest Maximum	15.3	2011-05-26	14.3	2017-05-13	9	WONDERBOOM AIRPORT
Lowest Maximum	13.9	2010-05-30	12.7	2017-05-13	8	KRUGER MPUMALANGA INT. AIR.
Lowest Maximum	20.4	2016-05-01	19.5	2017-05-13	7	GIYANI

Table 1*:* Lowest maximum temperature records reached across the country from 12 to14 May 2017

Rainfall figures greater than 100 mm occurred at Richards Bay Airport, Virginia, Mandini, and Charters Creek from 13 to 14 May 2017 (Table 2), leading to flash flooding in places over KwaZulu-Natal where more than 200 residents had to be evacuated (Image 1). A 40-year old teacher died after his car was swept away in a flooded river in the Umzinyathi District.

Parameter	Old Record	Old Date	New Record	New Date	Number of Years	Station
Highest Daily Rain	71.6	2016-05-08	108.4	2017-05-13	15	RICHARDS BAY AIRPORT
Highest Daily Rain	64.6	2011-05-07	78.4	2017-05-14	12	PENNINGTON SOUTH
Highest Daily Rain	94.6	2000-05-23	116	2017-05-14	23	VIRGINIA
Highest Daily Rain	55.8	2016-05-07	93.6	2017-05-14	8	KING SHAKA INT. AIRPORT WO
Highest Daily Rain	88.2	1987-05-21	133	2017-05-14	30	MANDINI
Highest Daily Rain	71.6	2016-05-08	121	2017-05-14	15	RICHARDS BAY AIRPORT
Highest Daily Rain	86.8	2005-05-19	125.4	2017-05-14	23	CHARTERS CREEK

Table 2*:* Highest daily rainfall records reached across the country from 13 to 14 May 2017

The Cold Front of 6 June to 8 June 2017

An intense cold front affected the country from 6 to 8 June 2017. Minimal damage was caused by the rainfall experienced, with a few rainfall stations reporting more than 50 mm of rain over a 24 hour period. However, the wind speed associated with the front averaged 70-90 km/h along the coast and 60-80 km/h over the interior of the Western Cape, gusting 100 to 120 km/h in some places. Figure 3 below indicates wind speed and gust at Cape Point on 6 June in the evening to 7 June in the evening.

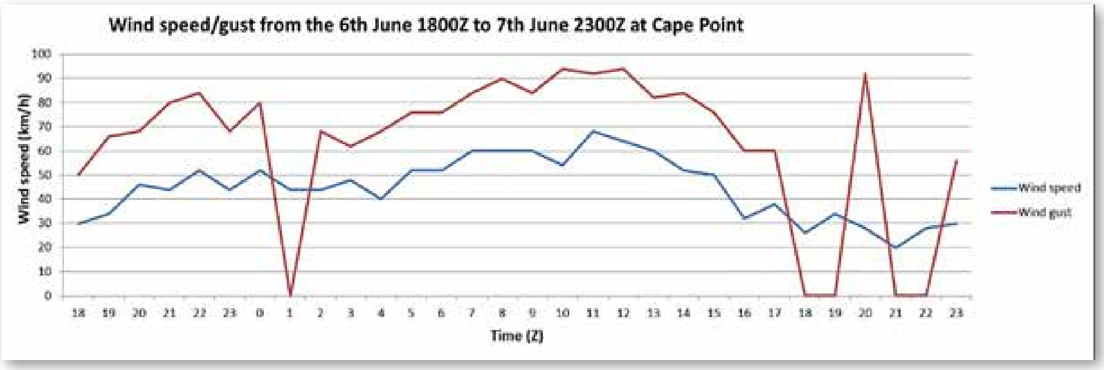


Figure 3: Wind speed and gusts at Cape Point from the evening of 6 June to 7 2017

The Overberg and Cape Town Metropolitan districts experienced power outages (it is estimated that 46 000 households were without power) because power lines were blown over. Furthermore, road closures occurred due to trees blown over and road flooding. Shacks in informal settlements were blown away or destroyed by trees falling over in Imizamu Yethu, Hout Bay and Macassar Village. Four people died in Kraaifontein after their house caught fire from lightning, and one more in Lavender Hill after the house collapsed. The Western Cape Education Department ordered all schools to be closed on 7 June and that eventually proved to be a very good decision. The department later reported that 170 schools were damaged, with costs for repairs and replacements estimated to be well over R124 million.

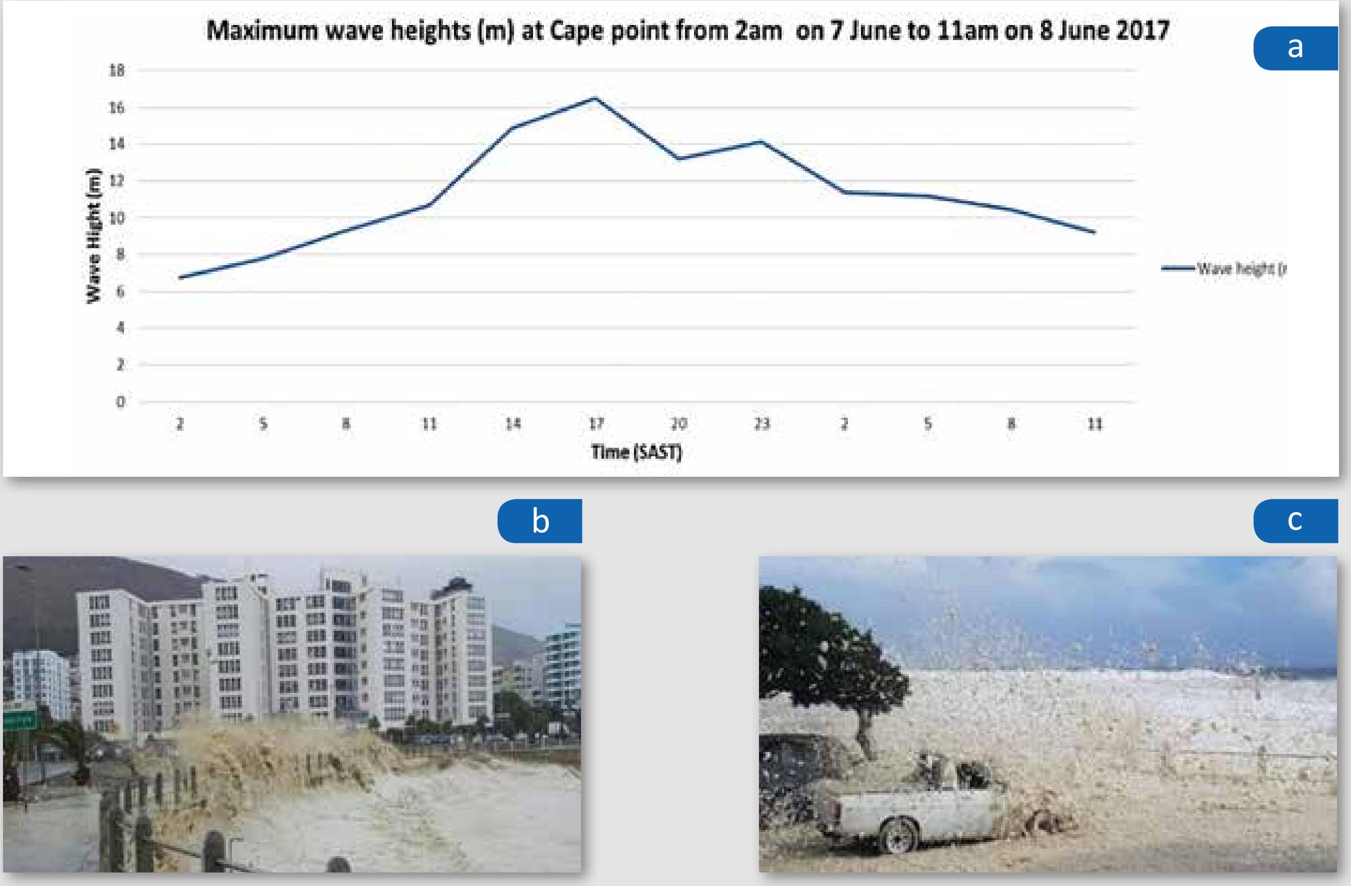


Figure 5: (a) Maximum wave heights in meters (m) from 7 June to 8 June, b) destructive waves at Promenade in Cape Town, (Twitter) and, (c) Sea point Pavilion

Furthermore, wave heights reached 10 m, peaking at 16 m on 7 June, persisting throughout the whole day into the early hours of 8 June. Figure 5 above indicates the maximum wave heights at Cape Point that occurred from the morning of 7 June until the morning of 8 June as well as destructive waves along the coast. Coastal areas of the City of Cape Town including Cape Point, Three Anchor Bay, Kleinmond Harbor and Sea Point were also damaged by destructive waves. Two large ships broke their mooring lines in Cape Town Harbor. The George Airport was also temporarily closed due to the strong winds.

Strong winds further fueled runaway fires along the south coast of the Western Cape in Knysna, as well as in Port Elizabeth in the Eastern Cape. The fires were difficult to contain, with the strong winds causing them to spread uncontrollably for more than 100 km. Any efforts made to put out the fire and conduct rescue missions in Knysna and Port Elizabeth were nearly impossible with winds gusting over 90 km/h. Over 600 homes were destroyed and nine people died in Knysna, with the estimated damage amounting to well over R4 billion. In Port Elizabeth, an elderly woman was killed in the fire, while her husband died later due to his injuries. Figure 6 shows the extent of the fires, as well as the damage from it.

Figure 6: Collage of damage caused by Knysna and Port Elizabeth fires. Top left is an aerial view of Knysna as the fire occurred, while top left and bottom right images show damaged property in Paradise, Knysna after the fires. Bottom right shows the Woodridge College burning while firefighters struggle to put the fire out (News24)

THE LOW LEVEL WIND SHEAR OVER UPINGTON ON 5 JULY 2017 – THE IMPORTANCE OF FORECASTER SKILLS

Elani Claassen, Tumi Phatudi and Tonie Rossouw

Wind shear can have a detrimental effect on the safety of aircraft during take-off or landing and is one of the significant weather phenomena to ensure aviation safety in South Africa. Wind shear is defined as a rapid, drastic change in wind speed and/or direction. This is a phenomenon that is most common during convective activities such as thunderstorms during summer, but research has shown it can also occur in clear skies when associated with clear-air turbulence during winter season especially over the western and southern parts of South Africa.

The Upington airport

The Upington airport is situated about 2.5 km northeast of the town. The altitude of the airport is about 840 m above mean sea level (2 800ft). It is positioned on a flat surface with no high mountains in the vicinity. The average temperature in winter is 21 °C and in summer 34 °C. Upington has the longest runway in South Africa, because of the hot conditions causing less dense air. This office has been operational since 1956. Figure 1 below shows the position of the airport as well as the altitude of the runways (Runway 17 and Runway 35).

Wind shear on 5 July 2017

On the morning of 5 July 2017, the dominating weather system was a surface high-pressure situated over the interior, resulting in clear to fine conditions (CAVOK ≡ Ceiling And Visibility OK) in places such as Upington. The cross section over Upington in Figure 2 below shows significant change in vertical wind speed and direction from the surface to about 4000 ft that morning. This cross section shows modelled moisture, temperature, wind speed and direction. Figure 2 was also used to compare actual wind speed and direction at the surface (which was 09001kt at 0300Z) with the modelled ones. The airport is at about 2 800 ft (surface) and wind shear was evaluated until 3 800 ft, this was to calculate wind shear per 1 000ft. The black highlighted barb is the modelled wind speed and direction at 0300Z at a 1 000 ft above ground level which was 340° (NNW'ly) at 25 knots.

There was a strong surface-temperature inversion, which was observed from the midnight upper-air ascent that caused low-level wind shear over Upington. (See Figure 3 to the left). The low-level wind profile in Figure 3 (to the right) indicates the lower level of the atmosphere highlighted in the red box from the observed upper-air profile on the left.

The cross section correlated well with the midnight upper-air ascent (Figure 3) in terms of the wind speed and direction at a 1 000 ft above ground level at 0000Z (Figure 2). The observed wind speed and direction at 0000Z at a 1 000 ft above ground level was 11 ° at 12 knots (highlighted by the black circle in Figure 3 (right), the modelled wind speed and direction on the cross section at the same time and height was 10 ° at 15 knots. However, at 0300Z the observed wind was very calm (1 knot), coming from the east. Thus, the model over-forecasted the surface wind speed as well as the direction at 0300Z. The METAR was as follows:

FAUP 050300Z **09001KT** CAVOK 06/M07 Q1024 NOSIG=

Figure 1: The height of the weather station at Upington and the orientation of the runways.

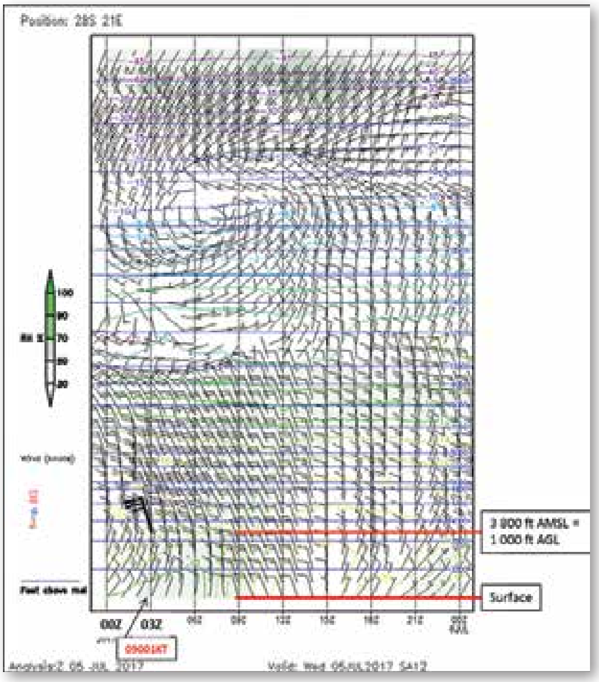


Figure 2: The cross section for Upington for 5 July 2017 derived from the Unified SA12 km model 0000Z analysis, the black highlighted barb is the modelled wind speed and direction at 0300Z a 1 000 ft above ground level.

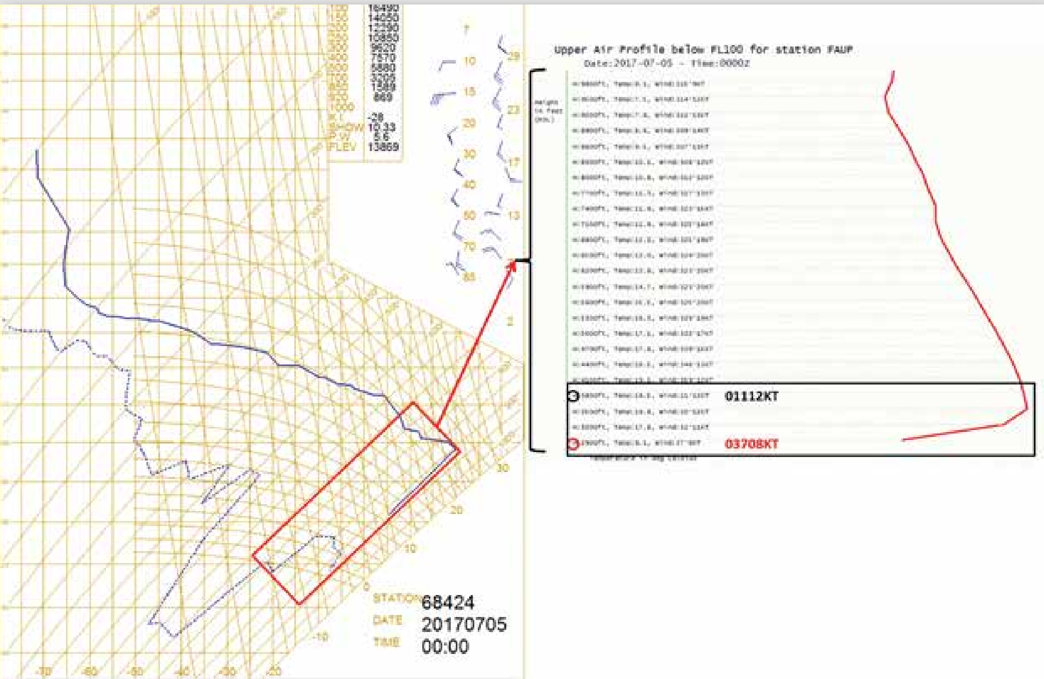


Figure 3: The low-level wind and temperature profile over Upington at 0000Z upper-air ascent for 5 July 2017.

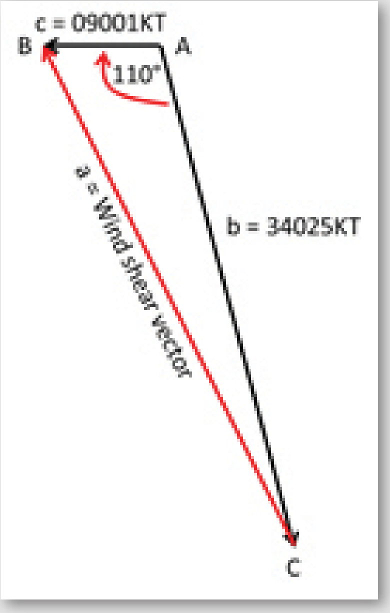


Figure 4: The calculation of wind shear by making use of trigonometry.

Where,

FAUP = Upington International Airport

050300Z = Day of the month (05) and the time (0300Z)

09001KT = Easterly wind (090) at 1 knot (01KT)

CAVOK = Ceiling and visibility is OK

06/M07 = Temperature at that time (6 °C) / Dew-point temperature at that time (-7 °C)

Q1024 = QNH (pressure reduced to mean sea level) (1024 hPa)

NOSIG = No significant change in weather expected in the next 2 hours

The low-level wind shear was determined between the surface and a 1 000 ft above the surface as shown in Figure 2 between the red lines. The modelled wind speed at 3 800 ft (above mean sea level which is a 1 000 ft above ground level) was at 25 kt (the highlighted black barb in Figure 2), coming from the northwest. There was a difference of 24 kt in the wind speed per 1 000 ft. Taking into consideration that the model was over-forecasting the wind speed at the surface, the intensity of the low-level wind shear was marked down as moderate by making use of the turbulence thresholds. The low-level wind shear warning was calculated and the warning was issued for the airport as follows:

FAUP WS WRNG 1 VALID 050305/050405 MOD WS APCH RWY17

SFC WIND: 090/01KT

1000FT-WIND: 340/25KT=

Where,

FAUP = Upington airport

WS = Wind Shear

WRNG 1= Warning number 1

VALID 050305/050405 = Valid on the 5th at 0305Z until 0405Z

$$a = \sqrt{b^2 + c^2 - 2bc \cos A}$$

MOD WS APCH RWY17 = Moderate wind shear on approaching runway 17

$$\begin{aligned} a &= \sqrt{(25)^2 + (1)^2 - 2(25)(1)\cos(110)} \\ &= \sqrt{656 - (-17)} \\ &= \sqrt{673} \\ &= 25.9 \approx 26 \end{aligned}$$

SFC WIND: 090/01KT = Easterly surface (090) at 1 knot (01KT)

1000FT-WIND: 340/25KT= = 1 000 ft above ground level wind coming from the north (340) at 25 knot (25KT)

According to the International Civil Aviation Organization (ICAO, 2005), the manual on low-level wind shear demonstrated that wind shear can be calculated by making use of Pythagoras theorem. Figure 4 shows the wind profile at 3 800 ft marked AC as *b=34025 kt* and the surface wind profile marked AB as *c=09001 kt*. Wind shear vector was calculated by finding the value of *a*.

The formula for wind shear vector *a* can be calculated as the following:

Where A = 110° (which is the sum of the wind direction at 1 000 ft AGL and the surface). When calculating low-level wind shear using this method, the direction of the wind is important.

Thus,

The wind shear intensity according to the Manual is 26÷10 which is 2.6 kt per 1 000 ft, thus it is light referring to Table 1 which is showing the intensity criteria from low-level wind shear.

Intensity	**Per 100 feet**
Light	0 to 4 kt
Moderate	5 to 8 kt
Strong	9 to 12 kt
Severe	> 12 kt

Table 1: The intensity criteria of wind shear from the manual on low level wind shear.

When the wind direction at a 1 000 ft AGL and surface sum up to 180° (*cos(180°)* is -1), the negative value below the square root will become positive, thus wind shear wind will be greater. It is known that if the difference in wind speed at the surface and 1 000ft AGL is at least 6 kt, wind shear intensity will be present. Moreover, it was discovered that by using of theorem of Pythagoras and trigonometry, the intensity of wind shear can be greater at the low level when the wind direction sum to 180°.

Conclusion

Observing wind shear at smaller airports like Upington can be difficult due to few upper-air ascents in South Africa and the fact that we do not have access to Low-Level Wind Shear Alert System (LLWAS) and AMDAR data (which is only available at the major airports). Although aviation forecasters are trained to determine whether a phenomenon such as wind shear is significant or not, the challenge still remains and also in other parts of Africa. It is clear that local weather knowledge from the air traffic controller, weather observer and forecaster is vital for detecting and forecasting weather phenomena at the aerodrome.

RAINFALL CONDITIONS FOLLOWING 2015 AS THE DRIEST YEAR ON RECORD

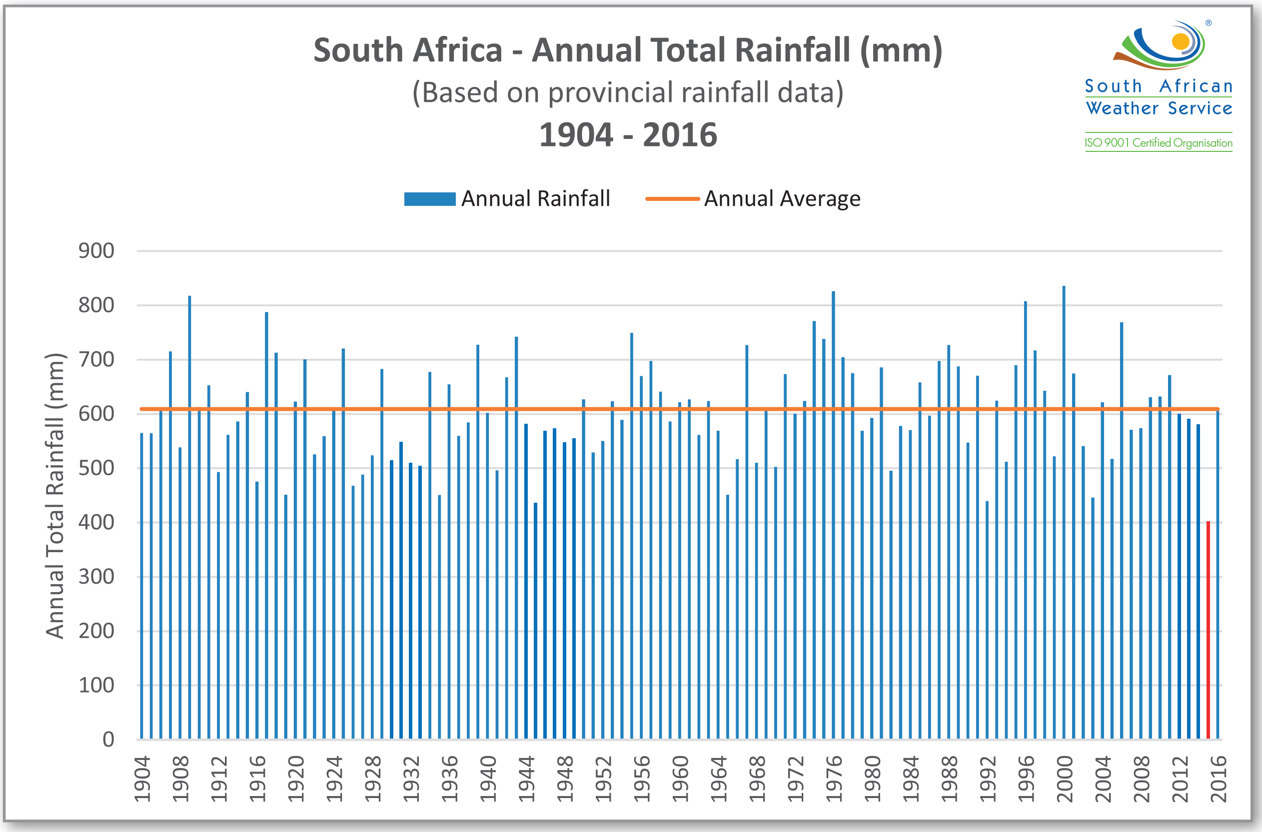
Elsa de Jager, Unit Manager: Climate Information

It is a well-known fact that 2015 was the driest year on record for South Africa. Four of the nine provinces also experienced their driest year, viz. Free State, Gauteng, Mpumalanga and North-West. For KwaZulu-Natal and the Limpopo Province, 2015 was their second driest year on record, while the Northern Cape experienced its fifth driest year. The situation improved dramatically for most of South Africa during 2016. However, the continued below-normal rainfall that occurred in both the Western Cape and Eastern Cape worsened during 2016, as can be seen in the ranking of the annual total rainfall for 2016 in the last column of Table 1 below.

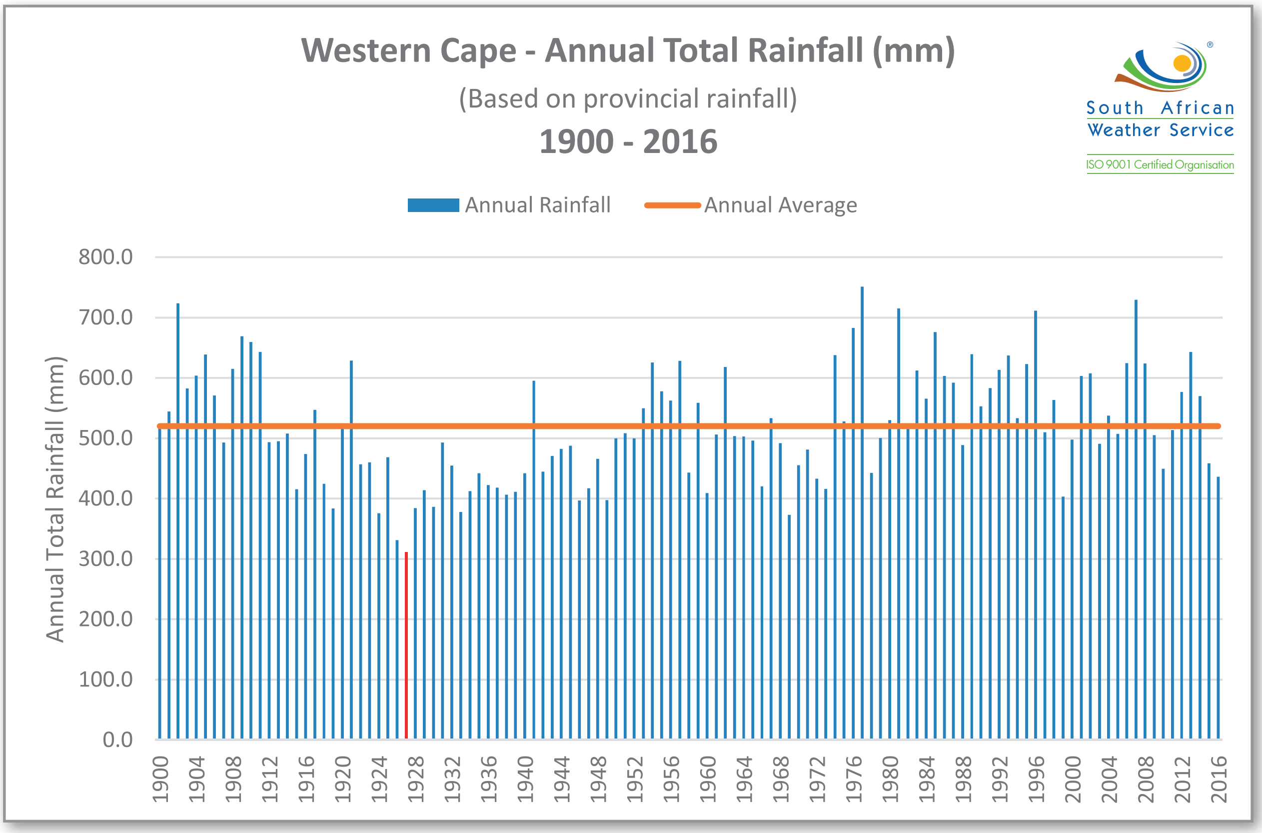
Ranking of Annual Total Rainfall for the respective data records per Province and for South Africa (Total number of years indicated in brackets)

	Ranking of 2015		Ranking of 2016
Free State (116 years)	1	Free State (117 years)	65
Gauteng (116 years)	1	Gauteng (117 years)	107
Mpumalanga (112 years)	1	Mpumalanga (113 years)	45
North-West (116 years)	1	North-West (117 years)	70
KwaZulu-Natal (116 years)	2	KwaZulu-Natal (117 years)	43
Limpopo (112 years)	2	Limpopo (113 years)	79
Northern Cape (116 years)	5	Northern Cape (117 years)	22
Western Cape (116 years)	34	Western Cape (117 years)	25
Eastern Cape (116 years)	79	Eastern Cape (117 years)	48
South Africa (112 years)	1	South Africa (113 years)	59

Table 1: Ranking of Annual Total Rainfall for the respective Data Records per Province and for South Africa

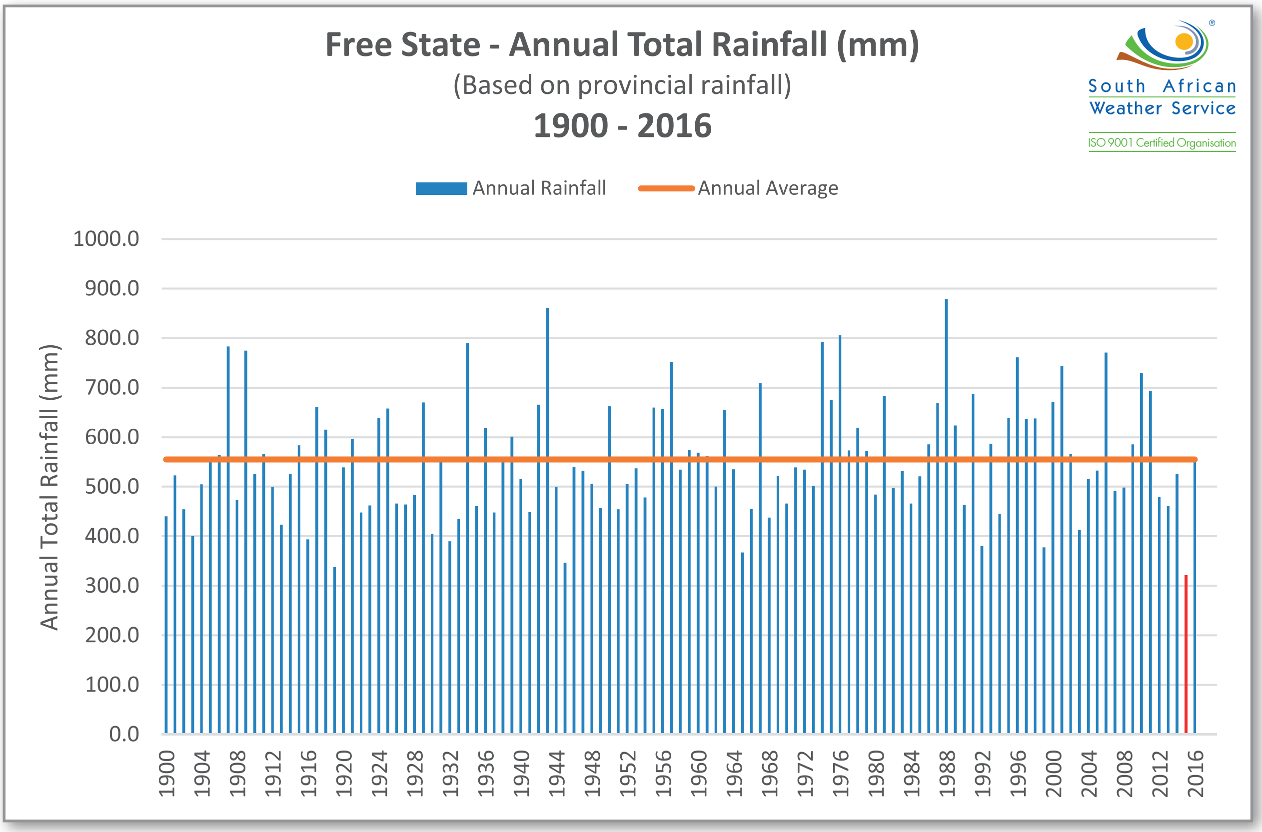


Graph 1: South Africa – Annual Total Rainfall (1904 - 2016)



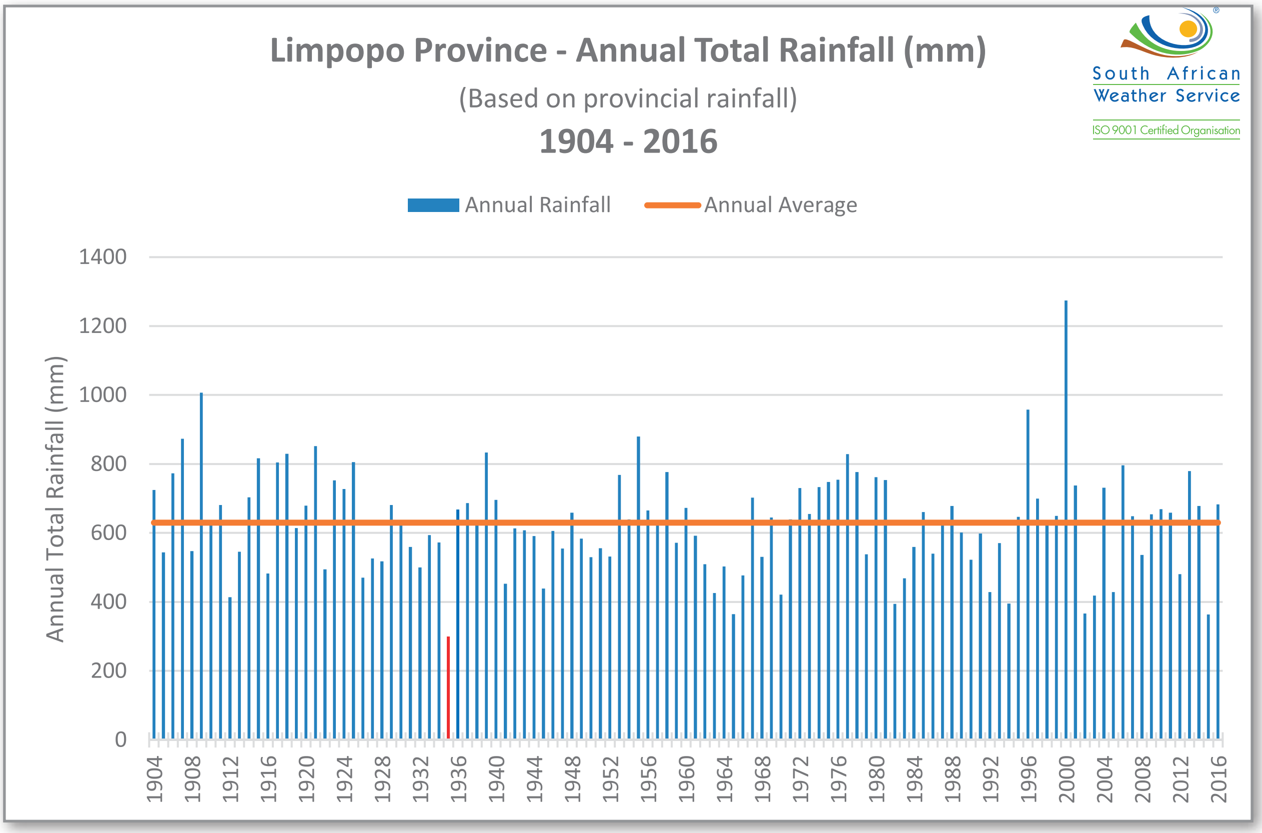
Graph 2: Western Cape – Annual Total Rainfall (mm)

The Western Cape experienced its lowest annual rainfall during 1927 with an average of 311 mm. It was during a period from 1922 to 1940 when on average for the province below-average rainfall occurred in 19 consecutive years. Although during both 2015 and 2016 below-average rainfall occurred, 2015 was the 34th driest year and 2016 the 25th driest year.



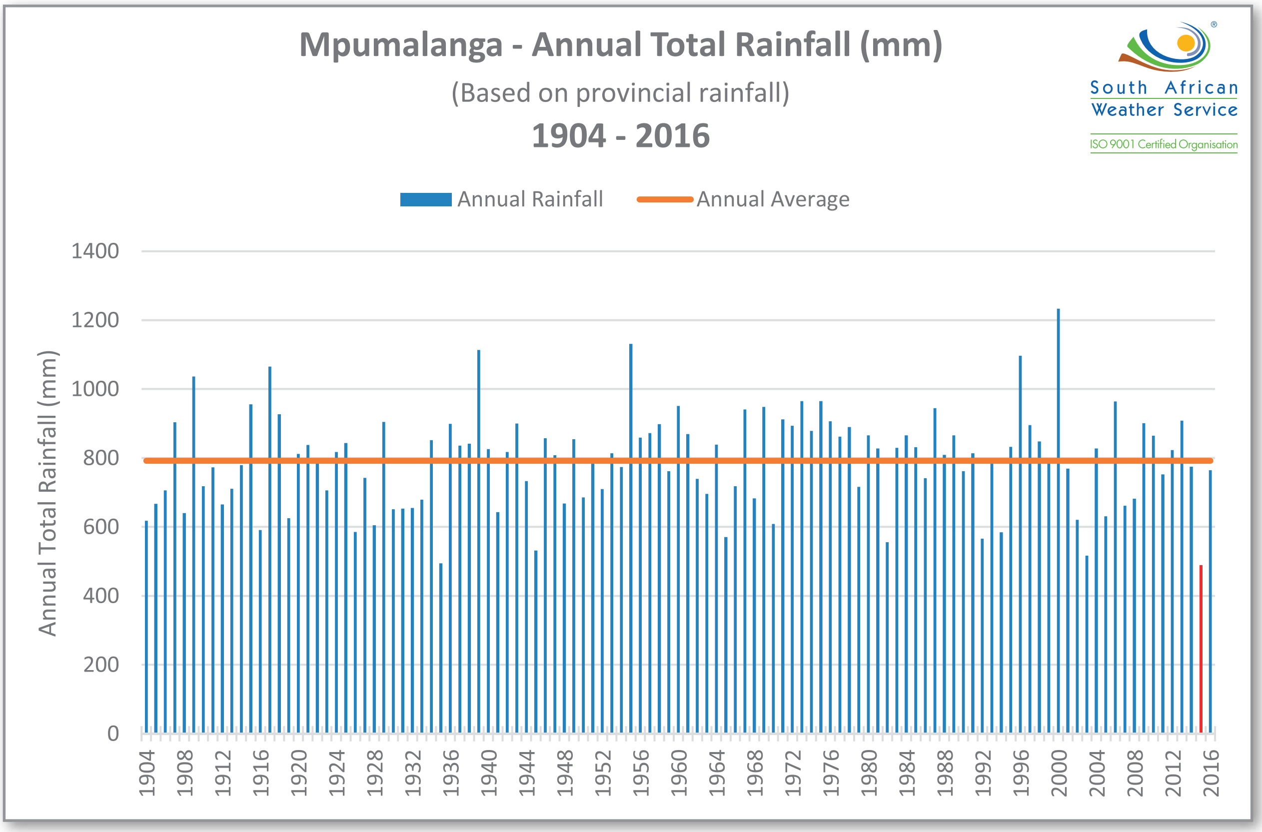
Graph 3: Free State – Annual Total Rainfall (mm)

In the Free State, the driest year on record occurred during 2015 when an average of only 321 mm occurred. Although the Free State experienced below-average rainfall since 2012, and 2015 was ranked the driest, the widespread rainfall that occurred during 2016 improved the conditions and 2016 ranked as 65th driest.



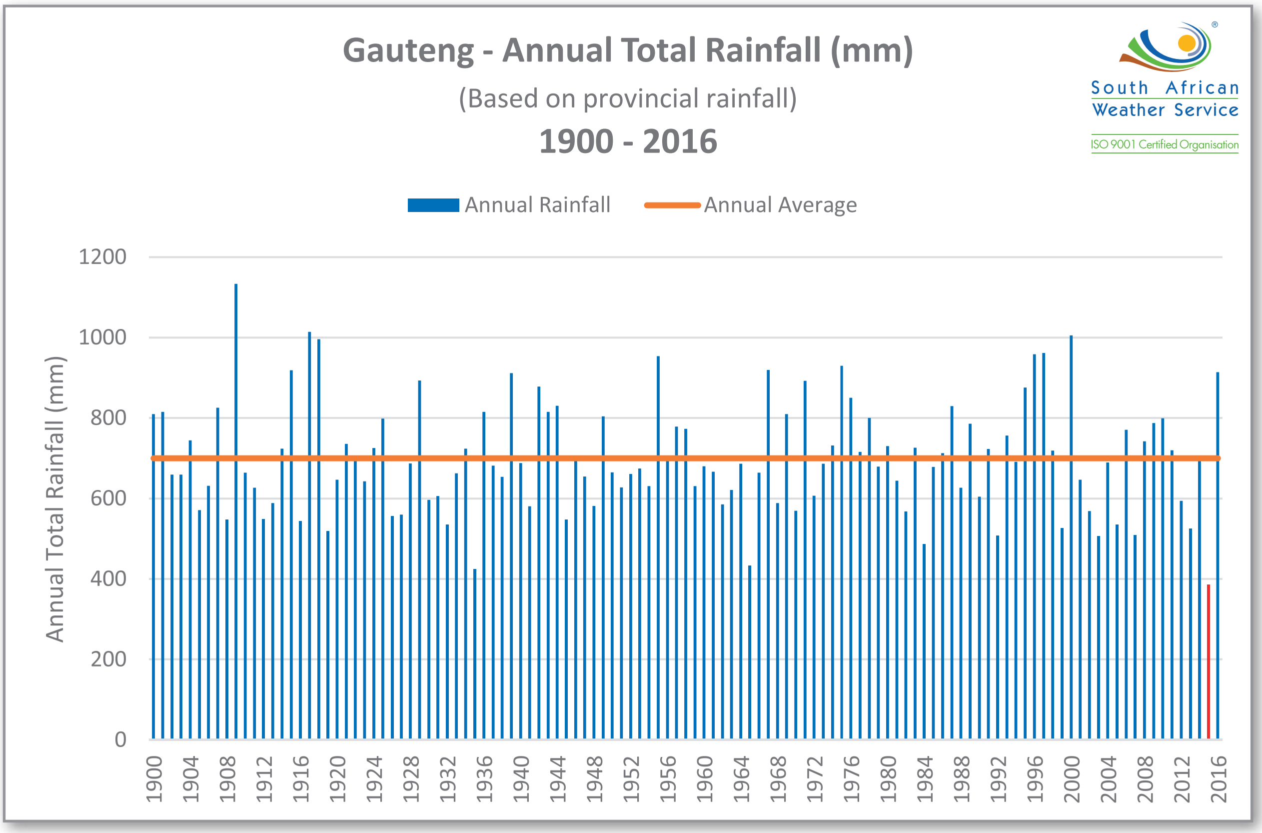
Graph 4: Limpopo Province – Annual Total Rainfall (mm)

In the Limpopo Province, 2015 ranked as the 2nd driest year with 364 mm, while the driest year was 1935 with only 300 mm of rainfall. During 2016 above-average rainfall occurred ranking 2016 as the 35th wettest year.



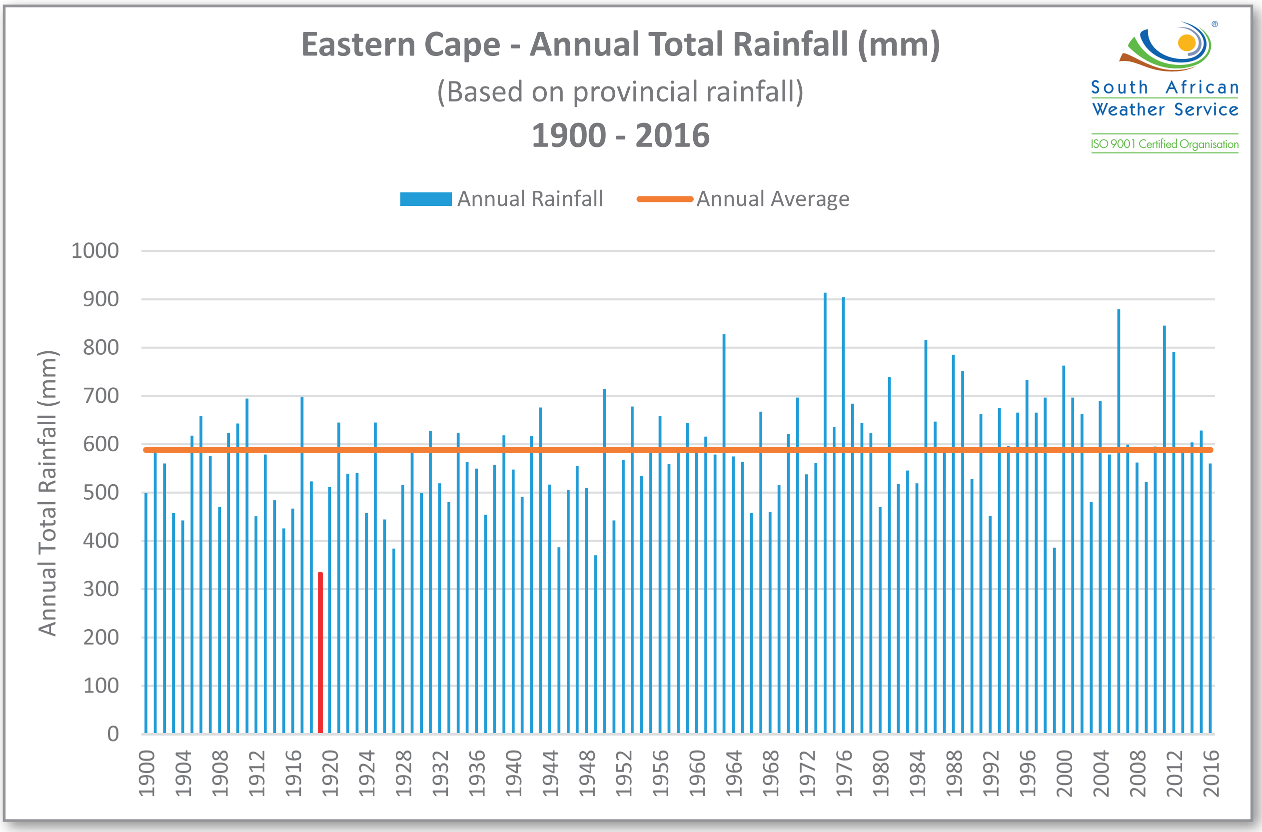
Graph 5: Mpumalanga – Annual Total Rainfall (mm)

Mpumalanga was one of the 4 provinces that experienced their driest year on record during 2015 with only 489 mm. The average rainfall for 2016 (764 mm) was also below the annual average of 792 mm, but ranked as the 45th driest year.



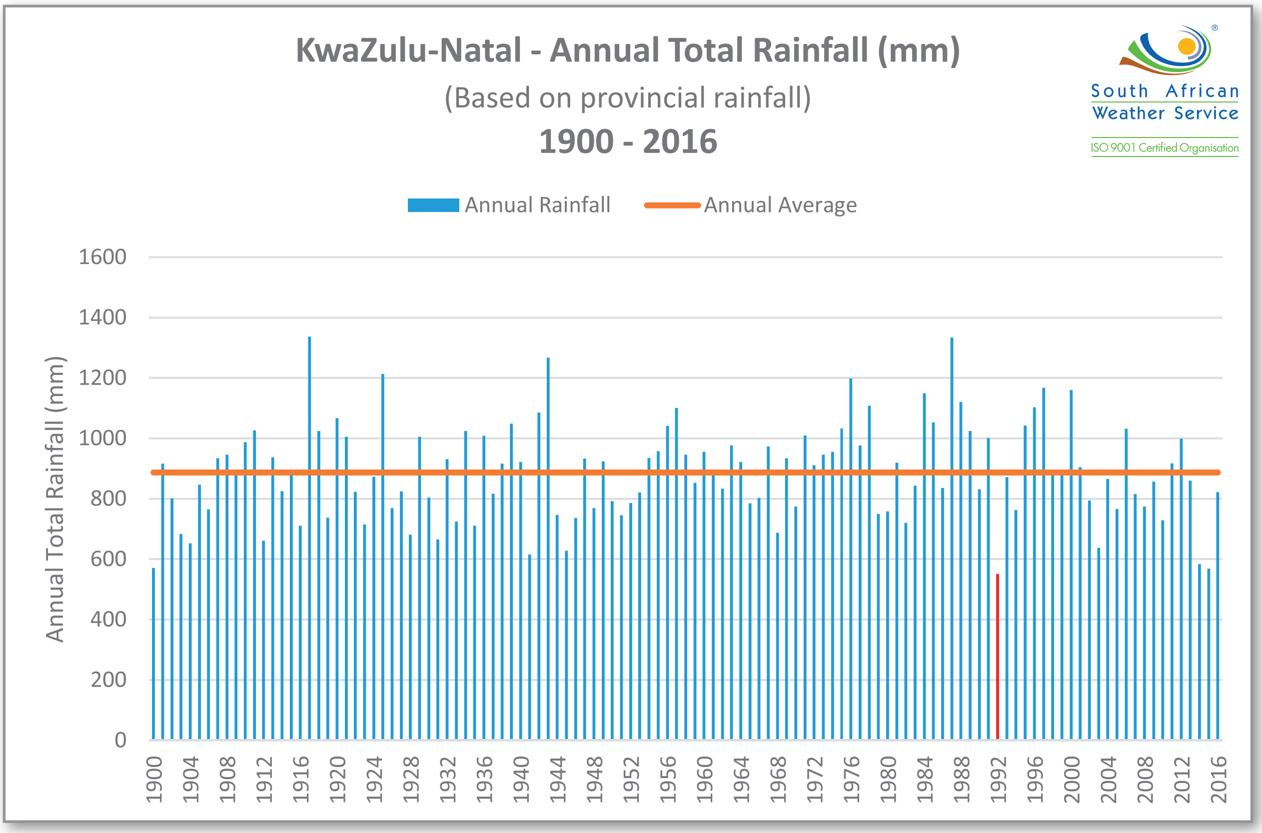
Graph 6: Gauteng - Annual Total Rainfall (mm)

Gauteng was another province that experienced its driest year in 2015 with only 386 mm of rain. In contrast, the average rainfall during 2016 was 914 mm, which ranks 2016 as the 11th wettest year on record for Gauteng.



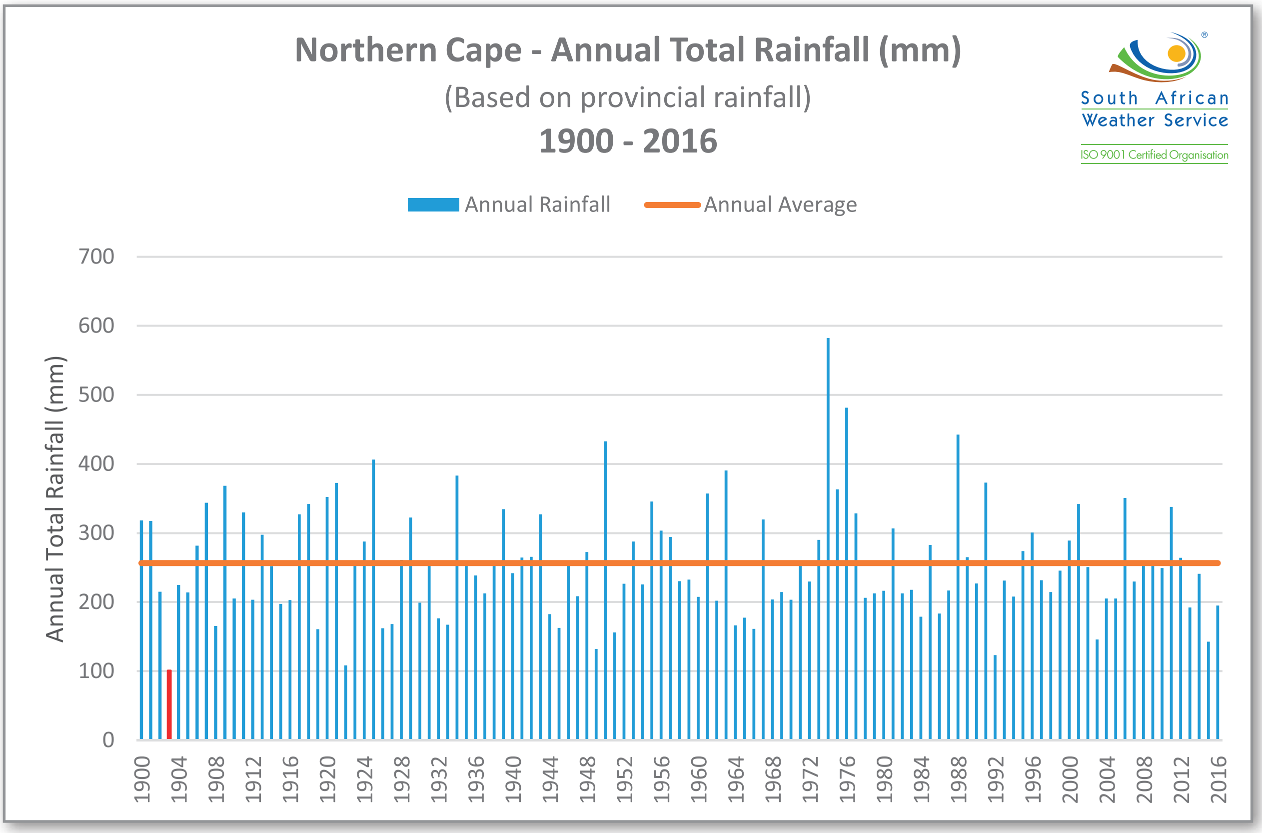
Graph 7: Eastern Cape – Annual Total Rainfall (mm)

In the Eastern Cape, the driest year was in 1919 with an average of only 333 mm. From 2010 the Eastern Cape actually experienced average to above-average rainfall for about 7 consecutive years, with 2016 the driest year in this period, but only ranking the 48th driest year.



Graph 8: KwaZulu-Natal – Annual Total Rainfall (mm)

Although KwaZulu-Natal experienced its driest year in 1992, 2014 and 2015 ranked respectively as the fourth driest and second driest years. However, 2016 with an average of 822 mm rain is ranking as only the 43rd driest year.



Graph 9: Northern Cape – Annual Total Rainfall (mm)

The Northern Cape had its driest year more than a century ago in 1903. However, during the last four years rainfall was below the annual average of 256 mm, with 2015 the driest of the four years, ranking as the fifth driest on record and 2016 ranking as the 22nd driest.

FEEDBACK AND INSIGHT FROM A RECENT ACCESS WORKSHOP ON THE STATE OF THE WINTER RAINFALL REGION DROUGHT

Marc de Vos, Scientist: Marine Research and Cobus Olivier, Scientist: Prediction Research

On Monday, 15 May 2017, the Alliance for Collaboration on Climate and Earth System Science (ACCESS) held a summit which brought together key scientific entities in light of the severe drought threatening water security in the south-western Cape region. The specific focus of the summit was South Africa's seasonal forecasting capabilities for the country's winter rainfall region. Naturally, municipalities, industries and communities look to the scientific community for guidance during crises such as these, and this summit aimed to arrive at a consensus of what the scientific community knows, doesn't know, and where to focus its efforts.

A range of experts presented current work related to the state of seasonal prediction and its limitations. Naturally, a key focus area was the confidence in or skill estimate associated with each prediction system. Unfortunately, it became clear that due to the relatively more complex nature of the physics and chemistry which govern the winter rainfall region's weather, many numerical models are unable to produce forecasts with any appreciable level of skill. Numerous complex physical and chemical phenomena remain poorly understood, or too chaotic, and are therefore insufficiently represented by models. These might include phenomena such as the orographic effects associated with mountain micro climates (near to which numerous important catchments are located), and even complex chemical interactions involving ozone and carbon dioxide above the southern ocean, as postulated by Dr. Pedro Monteiro, a southern ocean expert. It is thought that these factors pose greater challenges to seasonal predictions for the winter rainfall region than those faced by predictions for the summer rainfall region, where processes are relatively well understood and predictable at the seasonal timescale.

At the *seasonal* scale (months to years) there was some disagreement between various seasonal forecasting centres as to whether to expect above or below normal rainfall this winter (as well as how much confidence to place in the forecasts). The latest South African Weather Service (SAWS) seasonal prediction, from the Seasonal Climate Watch, indicated that there was no usable information with which to make a confident prediction either way for the Western Cape. It supported the position that measures be put in place to mitigate against the persistence and possible worsening of the current drought.

At the *climate* scale (decades to centuries), there is good agreement that the south Western Cape region can expect progressively drier winter seasons. A key driver of this is a likely poleward shift of the westerly wind belt, resulting in the blocking of the movement of rain-bearing cold fronts to the region. This should inform decision making in concert with the clearly established *decadal* mode of alternating wetter and drier winters – an existing feature of the Western Cape climate.

Furthermore, the current drought was shown to be historically severe in some (but not all) areas within the Western Cape. Whilst similarly severe droughts have occurred in the past, current data analysis reveals even lower rainfall and stream flow than were associated with such previous events, with implications for wild fires in the province.

The workshop also drew engagement from city representatives and suggested that they provide the scientific community with some possible scenarios and associated management responses. It is hoped that this would help in focusing outcome-based research, which would be directly applicable as a decision-support tool. It was also resolved to enhance cooperation between key scientific players and to involve more stakeholders in attempting to crystallise what we need to know, and how to arrive at that knowledge.

Finally, it was impressed upon the scientific role players that our country's collective climate observation base is smaller than what it was during the 90's. Experts stressed the critical value of the continued collection of comprehensive climate data, without which trends cannot be robustly identified, or complex models initialised and ground-truthed. This is yet another vein in which the vital role played by the South African Weather Service can be clearly seen. The work being done by our organisation on a daily basis makes a real difference to the understanding of our future environment. In the context of climate change, the effects of which we are seeing already, there are currently few more worthwhile pursuits.

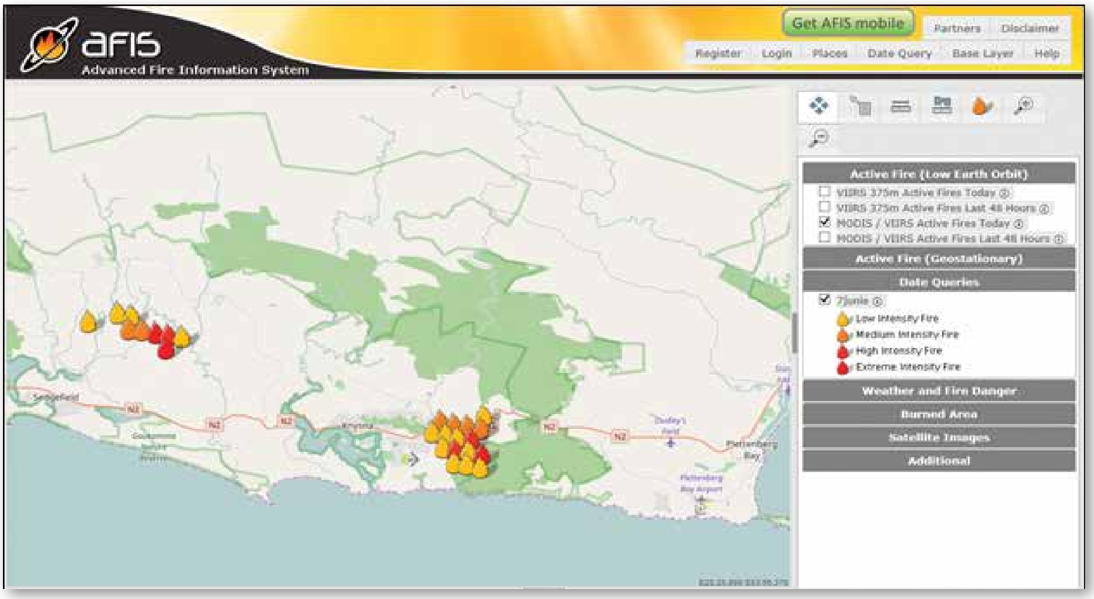
THE KNYSNA FIRES - METEOROLOGICAL CONDITIONS CONDUCIVE TO RUNAWAY FIRES AND RELATED WARNINGS

Andries Kruger, Chief Scientist: Climate Data Analysis and Research, Stephanie Landman, Lead Scientist: Numerical Weather Predictions, and Louis van Hemert, Senior Scientist: Numerical Weather Prediction

On 7 June 2017, a cold front reached the south-western Cape, with wind speeds higher than 120 km/h in some places as reported by *VOCFM* radio. Wave heights of 9 to 12 metres were recorded between Cape Columbine and Cape Agulhas. This mid-latitude storm became known colloquially as the Cape Storm due to its unusual size and associated wind speeds. According to *The Citizen* of 9 June 2017, the storm caused eight deaths, damaged 135 schools and flooded around 800 homes in the City of Cape Town. While rainfall figures in the order of 50 mm were recorded in some places around the city, it had no major effect on the drought experienced in the south-western Cape.

However, on the day after the storm, the strong winds (reported to be as high as 50 km/h) that reached places in the southern Cape, fueled a large number of fires on the outskirts of Knysna and surrounding areas which persisted for an appreciable period of time, as reported by *Eye Witness News* from 7 June onwards. *Business News* and *News24* reported that seven people were killed and about 10 000 displaced. In addition, 600 structures in Knysna and Plettenberg Bay were destroyed. Deployment of fire fighters was the largest ever in South Africa. Damage was estimated to be in the order of R4 to 5 billion (see *https://en.wikipedia.org/wiki/Cape_Storm_(2017)* for additional information and references).

The Advanced Fire Information System (AFIS) developed by the CSIR is a satellite-based fire information tool that provides near real time fire information to users (http://www.afis.co.za). Figure 1 below shows the fires that were detected by the system in the Sedgefield to Plettenberg Bay area on 7 June 2017.



☐ VIIRS 375m Active Fires Today
☐ VIIRS 375m Active Fires Last 48 Hours
☑ MODIS / VIIRS Active Fires Today
☐ MODIS / VIIRS Active Fires Last 48 Hours
☑ 7June

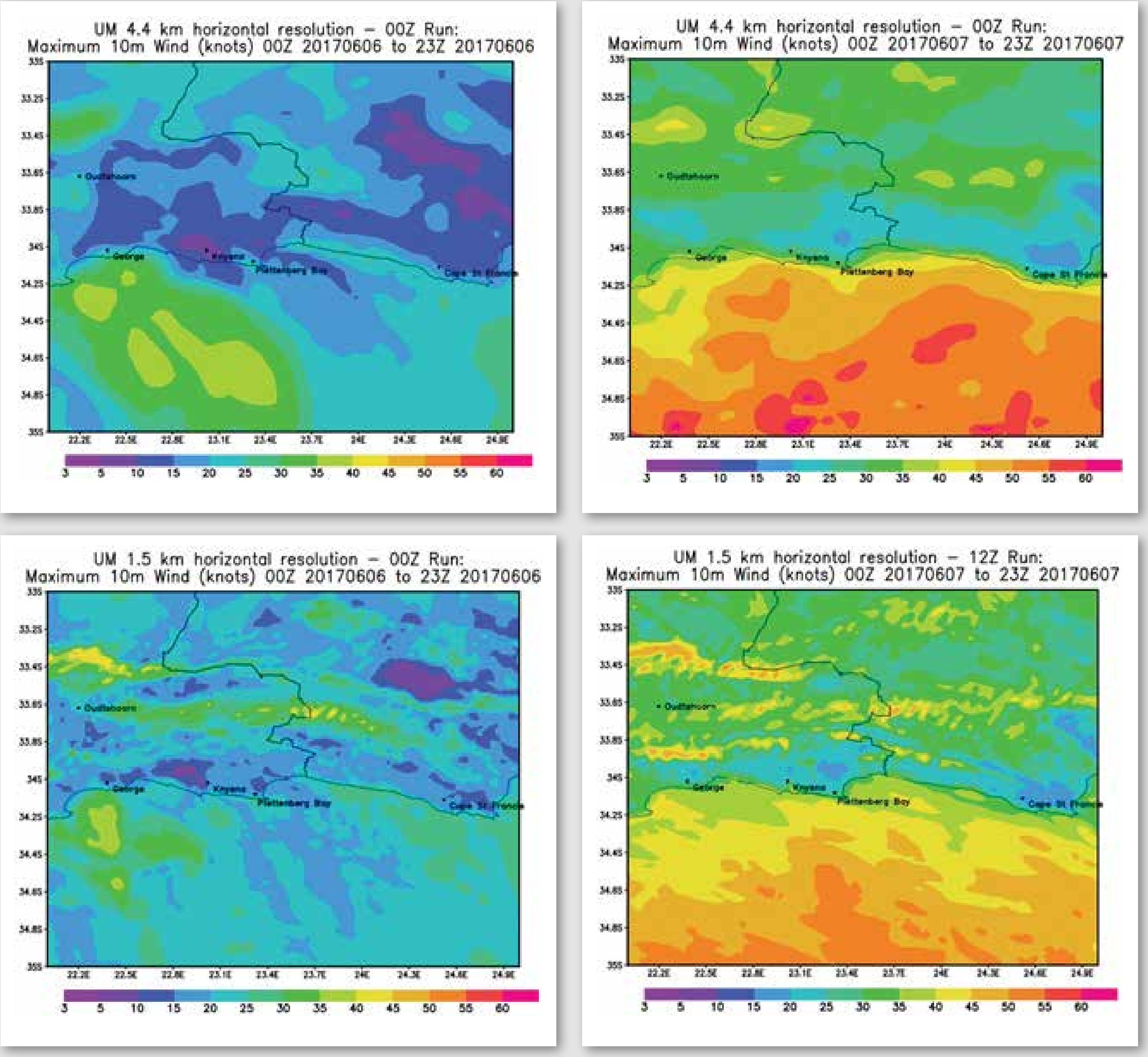
Figure 1: Fires that were detected on 7 June 2017 (information retrieved on 5 July 2017). Whatever the initial cause(s of the fires, an environment conducive to the spread of veld fires allowed for them to spread so rapidly in the manner which they did.

In this short article we discuss the high-resolution modelling for the region worst affected by the fires, the Fire Danger Index estimated from the measurements of Automatic Weather Stations (AWS) and the associated warnings issued by the South African Weather Service (SAWS), for the period 6 - 9 June 2017.

Modelling expected conditions conducive to fires

The locally-run Unified Model at convective-scale resolution forecasts (4.4 and 1.5 km grid spacing respectively) for the period 6 to 7 June 2017 are shown in Figure 2 below. These forecasts were available to the forecasters as a guide to the expected weather conditions for the coming two days, starting with the first forecast updated at 09:00 SAST. The 1.5 km configuration has a lead time of only 36 hours, so for day 2 the 12Z update run was used.

These model outputs reflect the spatial distribution of daily maximum wind speed and temperature predicted over the 2 days. It can be seen that a substantial increase in maximum wind speeds was predicted on the 6th for the following day, viz the 7th, especially at George and Knysna. Therefore, the model outputs for wind speed indicated more favourable conditions for the spread of veld fires.



UM 4.4 km horizontal resolution – 00Z Run: Maximum 10m Wind (knots) 00Z 20170606 to 23Z 20170606

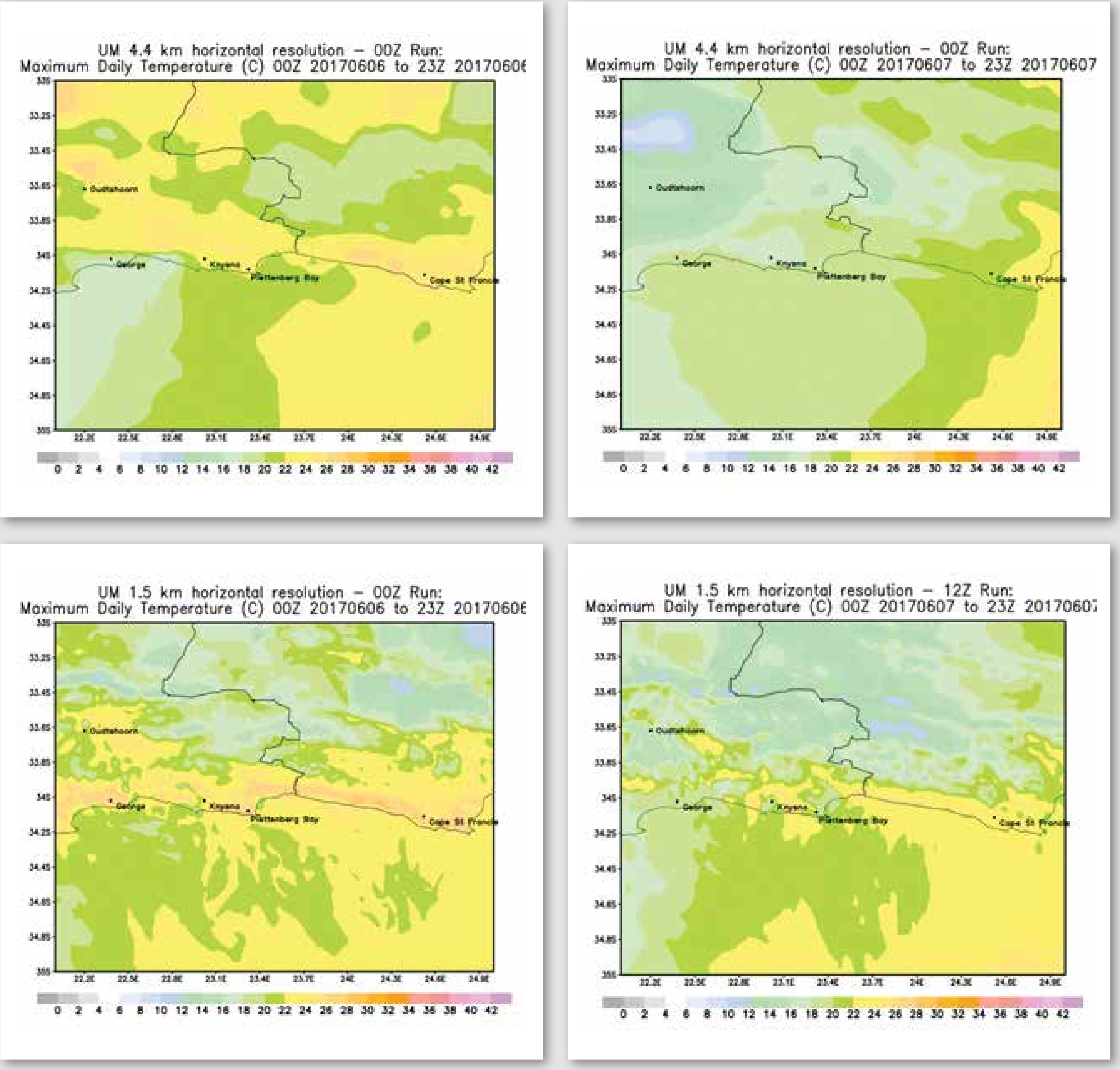
UM 4.4 km horizontal resolution – 00Z Run: Maximum 10m Wind (knots) 00Z 20170607 to 23Z 20170607

UM 1.5 km horizontal resolution – 00Z Run: Maximum 10m Wind (knots) 00Z 20170606 to 23Z 20170606

UM 1.5 km horizontal resolution – 12Z Run: Maximum 10m Wind (knots) 00Z 20170607 to 23Z 20170607

Figure 2: The Unified Model wind forecasts for both the 4.4 km and 1.5 km configurations, initialised at 00Z and 12Z, indicating the likely magnitudes of the maximum wind speed over the following 24-hour period (20 knots is roughly 40 km per hour (1.8 times knots).

Contrary to the increase in wind speed on day two, the 1.5 m above ground level temperatures decreased on day two. It is seen in the model forecasts that cooler conditions were predicted for the following day. In Knysna the temperature decreased from 23 to 17 °C the following day; indicating a cooling of around 6 °C. Therefore, from a temperature perspective, the likelihood of veld fires decreased from 6 to 7 June. For the effective forecasting of fire danger, it is important to combine all meteorological factors into an equation or procedure with an output index value, which will indicate the likelihood of veld fires.



UM 4.4 km horizontal resolution – 00Z Run: Maximum Daily Temperature (C) 00Z 20170606 to 23Z 2017060

UM 4.4 km horizontal resolution – 00Z Run: Maximum Daily Temperature (C) 00Z 20170607 to 23Z 20170607

UM 1.5 km horizontal resolution – 00Z Run: Maximum Daily Temperature (C) 00Z 20170606 to 23Z 2017060

UM 1.5 km horizontal resolution – 12Z Run: Maximum Daily Temperature (C) 00Z 20170607 to 23Z 2017060

Figure 3: The Unified Model maximum 1.5 m (level above the ground) temperature forecasts for both the 4.4 km and 1.5 km configurations, initialised at 00Z and 12Z, indicating the likely magnitudes of the maximum temperature over the following 24-hour period.

The Fire Danger Index

The Fire Danger Index (FDI) has been used by SAWS for many years. The FDI refers to the risk or likelihood of a fire becoming a runaway fire, usually rapidly spreading due to a strong wind. Key factors that increase the fire danger are strong winds, high temperature, low relative humidity and prolonged dry conditions (dry vegetation).

The estimation procedure for the FDI applied by SAWS takes all the above parameters into account and is used to forecast runaway fire danger potential. First developed by M. Laing in Zimbabwe (then Rhodesia) in 1968, it is called the Lowveld FDI. While other indices have been developed and used, SAWS reverted to the Lowveld FDI due to its ease of use and popularity among users. The Lowveld FDI uses temperature, relative humidity, wind speed and rainfall history as input. The FDI gives a value of between 1 and 100 which indicates the following:

ALERT STAGES/COLOUR CODES	FDI	FIRE DANGER
BLUE	0 - 20	LOW
GREEN	21 - 45	MODERATE
YELLOW	46 - 60	DANGEROUS
ORANGE	61 - 75	VERY DANGEROUS
RED	76 - 100	EXTREMELY DANGEROUS

Table 1*:* The Fire Danger Index (FDI)

Estimation of the FDI from weather station measurements

SAWS has a range of observation stations in the southern Cape. For the purpose of the article, we analysed the estimated FDI from the measurements of the stations in the region where most fires occurred, i.e. from George to Cape St Francis, including the stations close to some of the worst hit locations close to Knysna and Plettenberg Bay. Presented in figure 5 below, one can see that the worst fire danger was from about midday on 6 June to the evening of the 7th, primarily due to high temperatures on the 6th and a combination of high temperatures and wind speeds on the 7th.

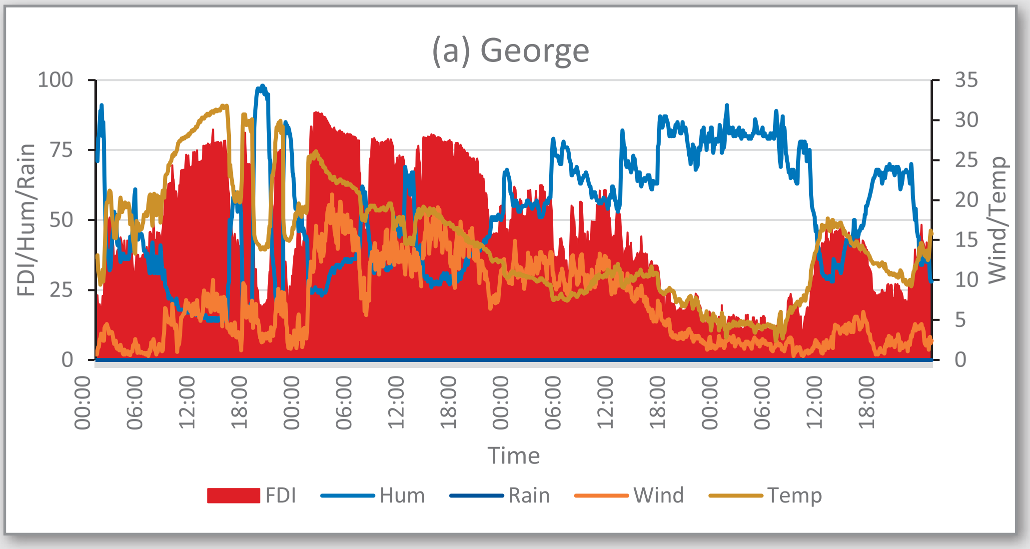


Figure 5a

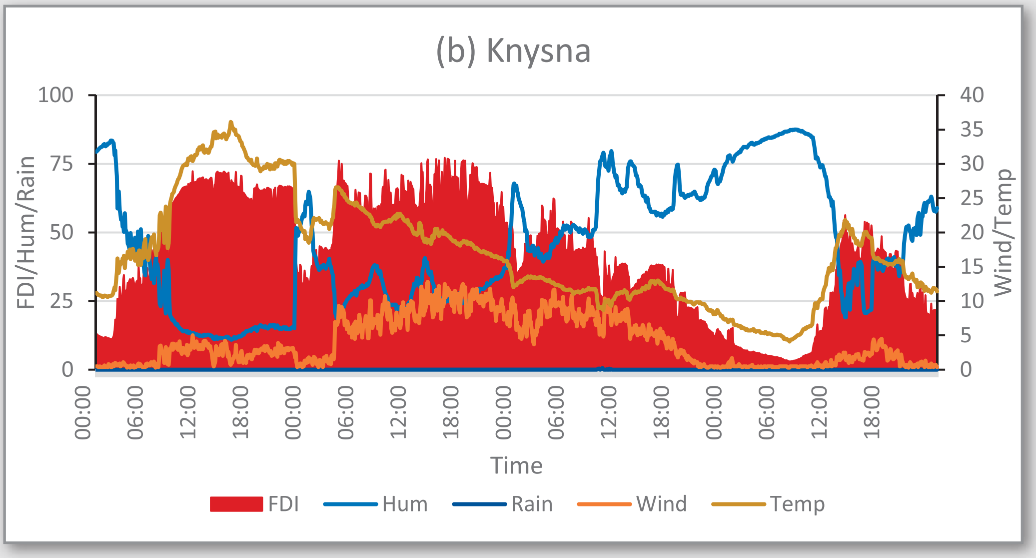


Figure 5b

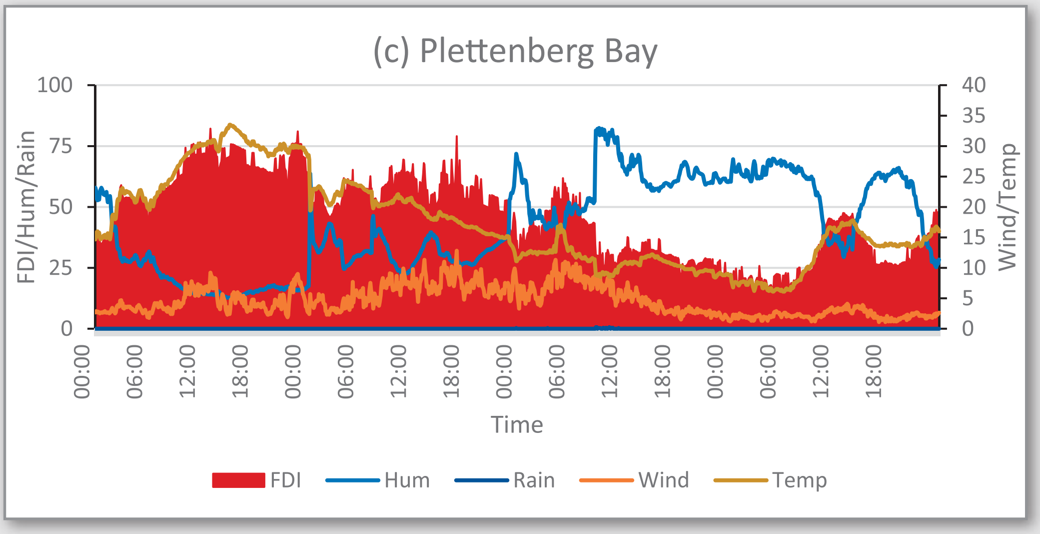


Figure 5c

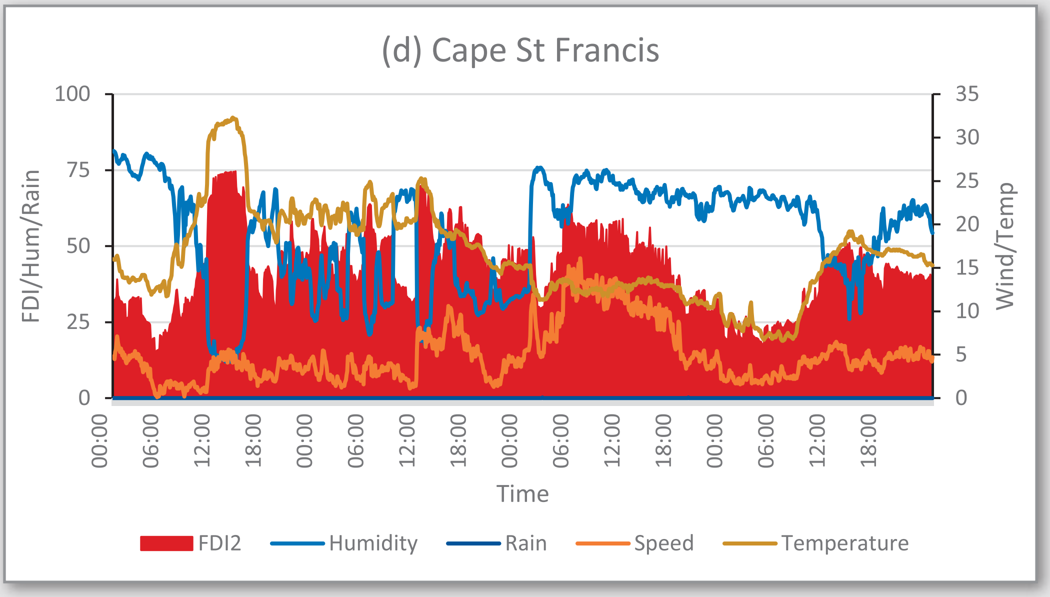


Figure 5d

Figure 5: The FDI and associated parameters (Relative Humidity (%), Rainfall (mm), Wind (m/s) and Surface Temperature (°C)) for (a) George, (b) Knysna, (c) Plettenberg Bay and (d) Cape St Francis, over the period 6 to 9 June 2017.

Forecasts of Fire Danger

SAWS uses expected weather conditions from weather forecasting models to estimate daily FDI forecasts. These forecasts are adjusted by the weather forecasters by considering factors such as model accuracy, current weather and environmental conditions of the areas for which extremely dangerous fire conditions (FDI > 75) are forecasted. Then the possible warnings are disseminated to the government, fire protection agencies and the public. Most users of FDI forecasts are in the north-eastern Lowveld, KwaZulu-Natal and Western Cape, but forecasts (values) and warnings are disseminated for the whole of South Africa.

The weather watches included in the SAWS forecasts show that from 5 June, and repeated on the 6th, extremely high fire danger conditions were expected over the Western Cape and Northern Cape, excluding the western coast, but spreading to the interior of the Eastern Cape and the western Free State. From 6 June and onwards, the fire danger warnings also included regions further east, as the cold front with accompanying strong winds moved eastwards.

From the evidence above, it can be concluded that the fire danger forecasts for the recent Knysna fires disaster were in line with what happened, and that such disaster prevention should now be focusing more on local scale fire protection planning and preparation, for example having more or improved fire breaks/walls to prevent so many buildings from being destroyed, or at least slow down such runaway fires.

A SIGNIFICANT COLD FRONT AFFECTING THE COUNTRY IN JULY 2017

Wayne Venter, Forecaster

A significant cold front with an upper-air trough made landfall late on Saturday evening, 15 July 2017. This front brought widespread rainfall (although not necessary great amounts), widespread disruptive snowfall, very cold temperatures, black frost over the interior and some strong winds across most parts of the country.

The cold front was situated south-west of Cape Town on Saturday and strengthening in Figure 1 below.

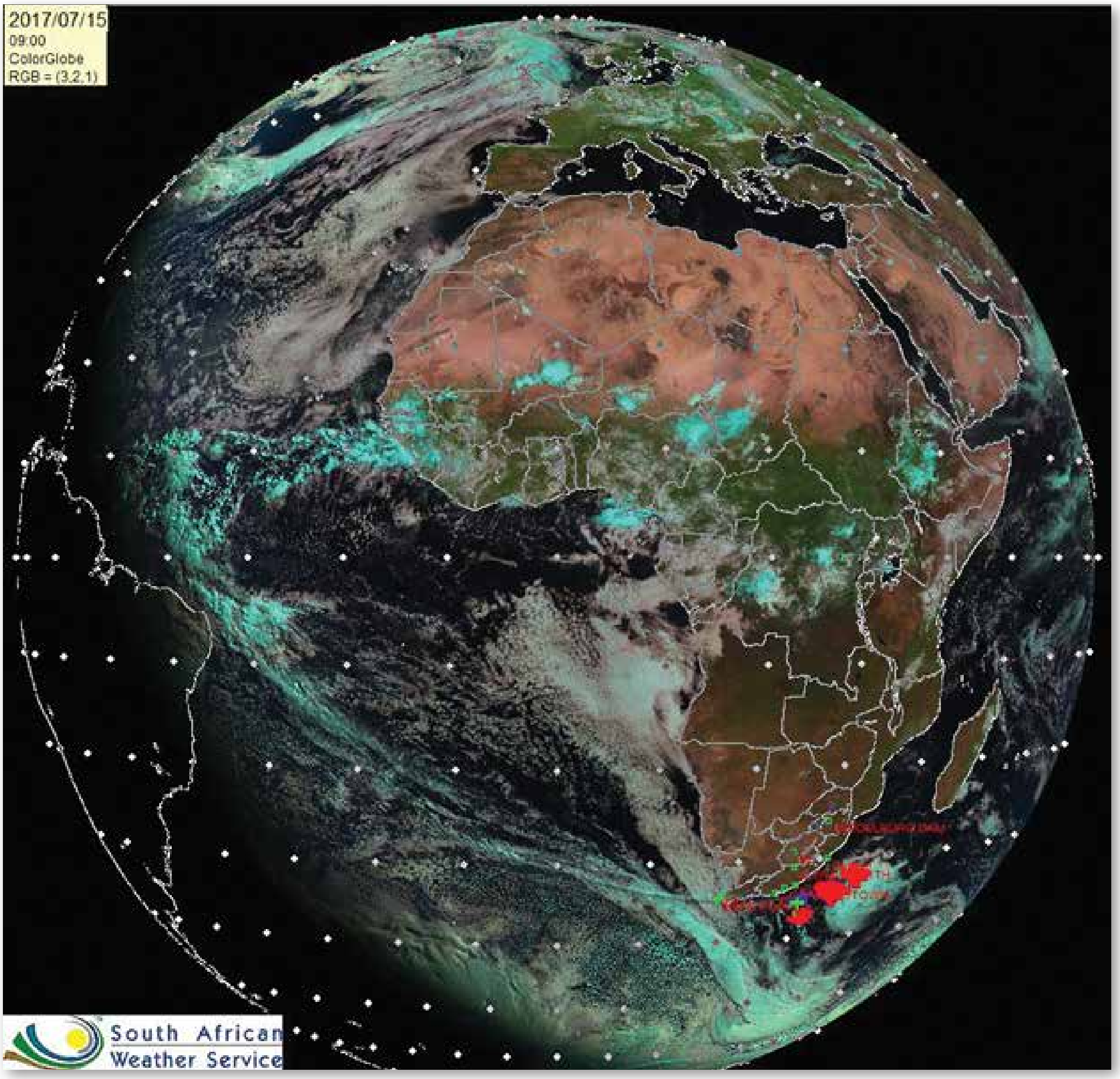
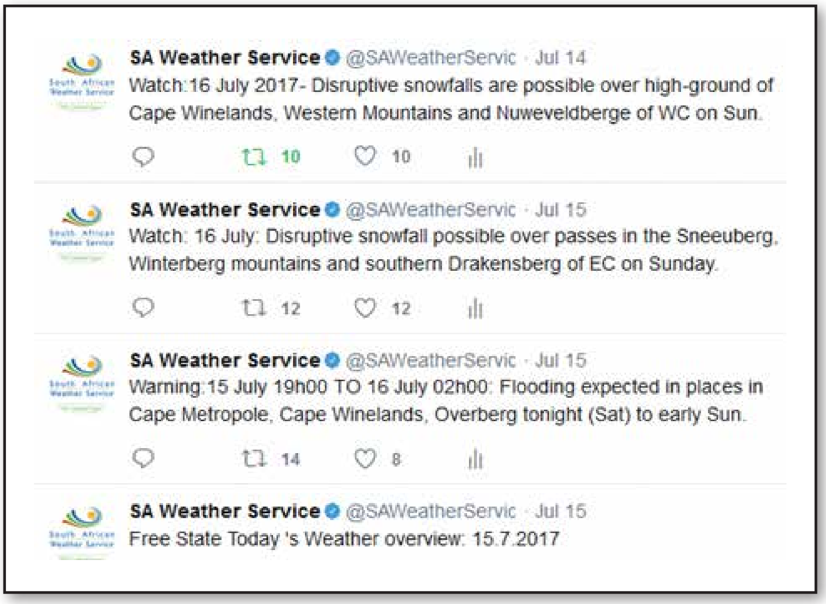


Figure 1: Satellite image showing the cold front south-west of the country on Saturday, 15 July 2017 at around 11h00 SAST (Source: Eumetsat).

Two days prior to this, a special weather advisory was issued by the Cape Town office which indicated very cold conditions, snow on the mountains and possible localised flooding in places. On the 14 July 2017, the special weather advisory was upgraded to watches and issued on our social media account as shown in Figure 2 below.



SA Weather Service @SAWeatherServic · Jul 14
Watch:16 July 2017- Disruptive snowfalls are possible over high-ground of Cape Winelands, Western Mountains and Nuweveldberge of WC on Sun.

SA Weather Service @SAWeatherServic · Jul 15
Watch: 16 July: Disruptive snowfall possible over passes in the Sneeuberg, Winterberg mountains and southern Drakensberg of EC on Sunday.

SA Weather Service @SAWeatherServic · Jul 15
Warning:15 July 19h00 TO 16 July 02h00: Flooding expected in places in Cape Metropole, Cape Winelands, Overberg tonight (Sat) to early Sun.

SA Weather Service @SAWeatherServic · Jul 15
Free State Today 's Weather overview: 15.7.2017

Figure 2: Special weather advisories were upgraded to watches and warnings and can be viewed on our Twitter account.

The cold front was fast approaching the south-western parts of the country on Saturday afternoon, 15 July 2017 as can be seen in Figure 3 below.

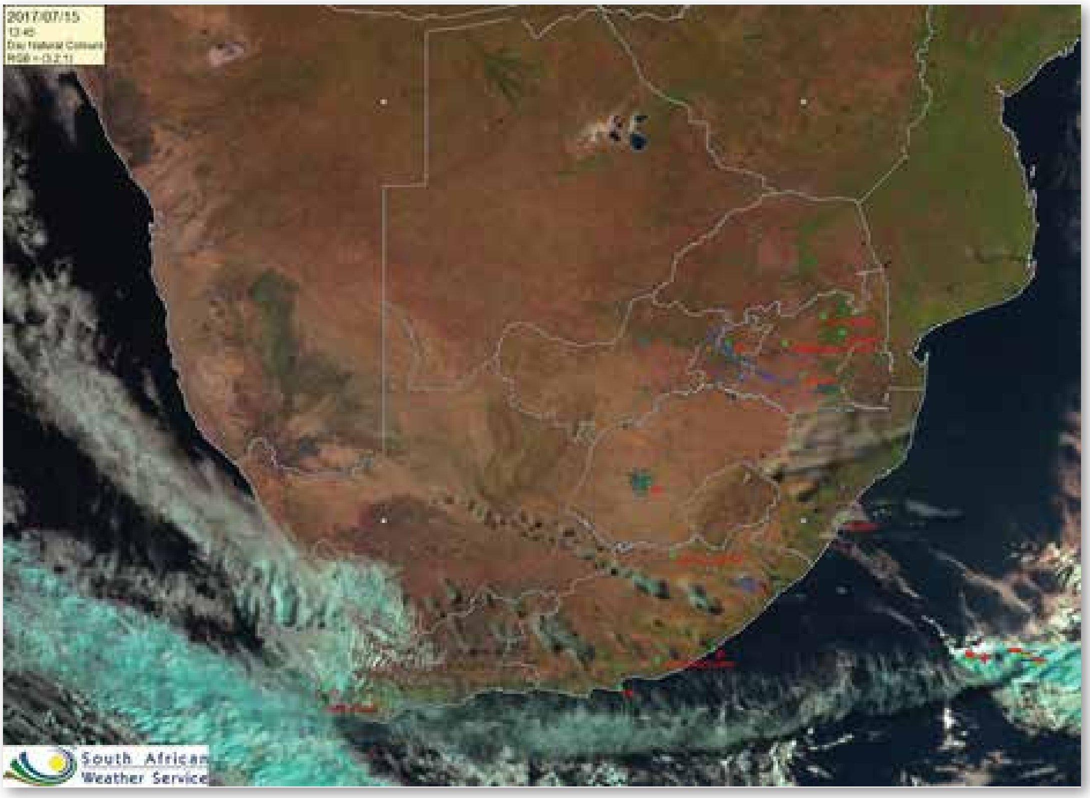


Figure 3: Cold front just south-west of Cape Town at around 15h45 SAST on Saturday, 15 July 2017.

The cold front made landfall in the evening in the Cape Town area and was moving at a very fast speed. Widespread rainfall occurred across the Western Cape on Saturday evening into the morning of Sunday, 16 July 2017. Freezing levels (in other words the level where snow can be expected) with this system were very low and between 1200 and 1400 m above sea level resulting in snowfall across most of the mountains in the Western and Eastern Cape and also on the southern high ground of the Northern Cape. Due to the relatively low freezing levels, some towns in the Northern and Eastern Cape such as Sutherland and Richmond in the Northern Cape and Rhodes and the Hogsback area in the Eastern Cape also received some snow. Disruptive snowfall occurred on mountains in the Western Cape and western mountains of the Eastern Cape on Sunday.

By Sunday morning the cold front was already moving into the Eastern Cape, leaving behind cold air across the Western Cape and Northern Cape. In Figure 5 below, the cold front can be seen over the western parts of the Eastern Cape and southern and central parts of the Northern Cape with clearance already taking place in the Western Cape.

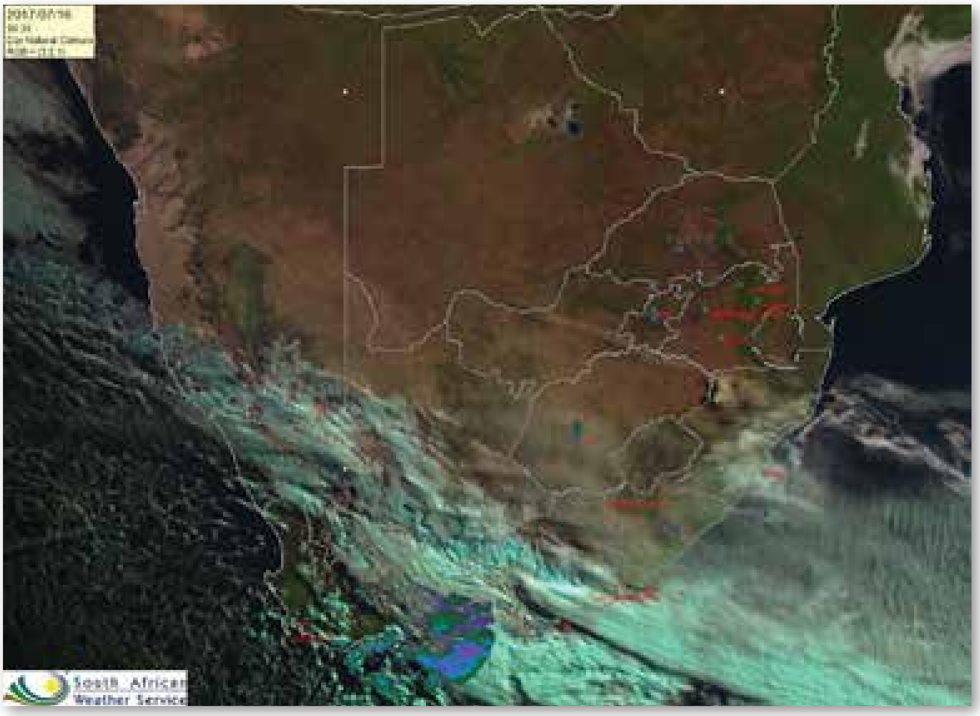
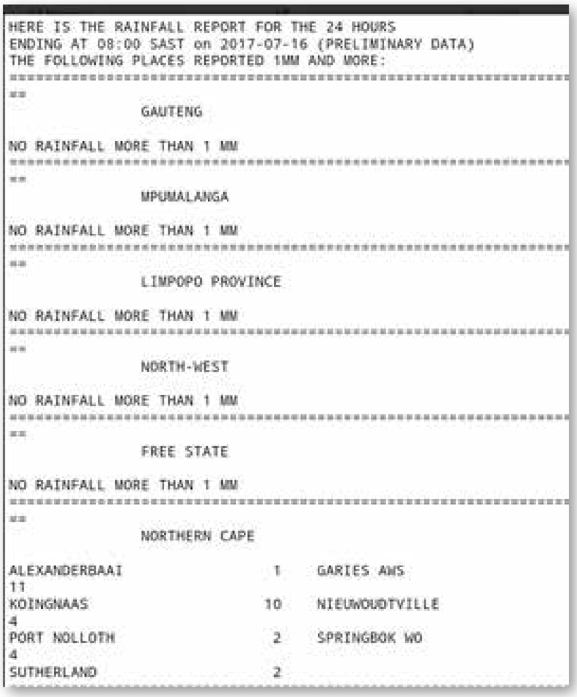
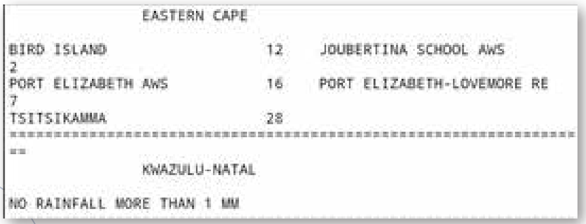


Figure 5: Satellite image showing the position of the cold front (source: Eumetsat) at around 8:30 on Sunday, 16 July 2017 morning.

Due to the passage of the front, watches were issued for gale force winds along the south-east coasts with winds that could reach 65 k/h. Rainfall amounts due to this system were extensive in the Western Cape. The rainfall figures observed at 08:00 SAST on Sunday (16 July 2017) are shown in Figure 6 below.



```
HERE IS THE RAINFALL REPORT FOR THE 24 HOURS
ENDING AT 08:00 SAST on 2017-07-16 (PRELIMINARY DATA)
THE FOLLOWING PLACES REPORTED 1MM AND MORE:
==================================================================
==
                   GAUTENG

NO RAINFALL MORE THAN 1 MM
==================================================================
==
                   MPUMALANGA

NO RAINFALL MORE THAN 1 MM
==================================================================
==
                   LIMPOPO PROVINCE

NO RAINFALL MORE THAN 1 MM
==================================================================
==
                   NORTH-WEST

NO RAINFALL MORE THAN 1 MM
==================================================================
==
                   FREE STATE

NO RAINFALL MORE THAN 1 MM
==================================================================
==
                   NORTHERN CAPE

ALEXANDERBAAI                    1    GARIES AWS
11
KOINGNAAS                       10    NIEUWOUDTVILLE
4
PORT NOLLOTH                     2    SPRINGBOK WO
4
SUTHERLAND                       2
```



```
                   EASTERN CAPE

BIRD ISLAND                     12    JOUBERTINA SCHOOL AWS
2
PORT ELIZABETH AWS              16    PORT ELIZABETH-LOVEMORE RE
7
TSITSIKAMMA                     28
==================================================================
==
                   KWAZULU-NATAL

NO RAINFALL MORE THAN 1 MM
```

```
                 WESTERN CAPE

ATLANTIS                        13    BEAUFORT-WES
1
CAPE AGULHAS                     9    CAPE COLUMBINE
12
CAPE POINT                      23    CAPE TOWN - ROYAL YACHT CL
12
CAPE TOWN SLANGKOP              11    CERES AWS
16
CLANWILLIAM                      3    CT-AWS
19
EXCELSIOR CERES                  5    FRANSCHHOEK ARS
17
GEELBEK                         16    GEORGE WITFONTEIN
11
GRABOUW                         25    HERMANUS
26
JONKERSHOEK                     50    KIRSTENBOSCH
40
KNYSNA                          17    KNYSNA - KLEINGRYSBOS ARS
8
LADISMITH                       17    LAINGSBURG
1
LAMBERTSBAAI NORTIER            16    LANGEBAANWEG AWS
17
LANGGEWENS                      13    MALMESBURY
12
MOLTENO RESERVOIR               19    MONTAGU - BADEN ARS
14
MOSSEL BAY                       7    PLETTENBERGBAAI
19
PORTERVILLE                      8    REDELINGSHUYS-AWS
11
RIVERSDALE                       8    ROBBENEILAND
13
ROBERTSON                       17    S A ASTRONOMICAL OBSERVATO
15
STILBAAI                        29    STRAND
22
STRUISBAAI                      12    SWELLENDAM
21
TULBAGH - OBIQUA  ARS           15    TYGERHOEK
17
VILLIERSDORP-SOS ARS            22    VREDENDAL
2
WELLINGTON                      17    WORCESTER-AWS
6
```

Figure 6: Rainfall figures recorded at 08:00 SAST on Sunday, 16 July 2017.

The front lost significant intensity across whilst moving eastwards, resulting in cold air to spread over much of the interior on Sunday afternoon into Monday, 17 July 2017. This resulted in a special weather advisory for black frost in places over the central interior on Monday morning and was also included on social media. In Figure 7 below a black frost map was issued on social media showing very cold minimum temperatures.

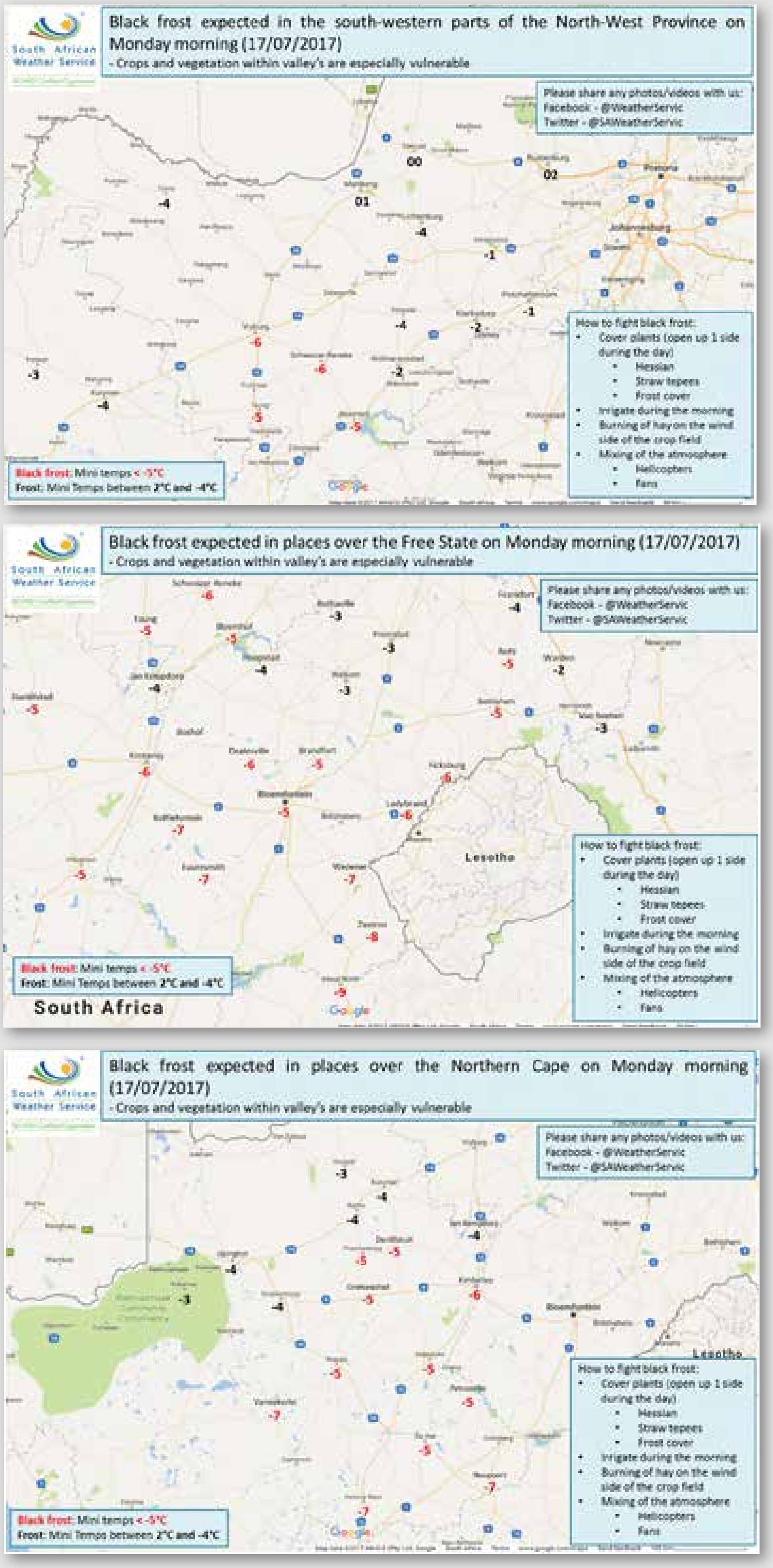


Figure 7: Black frost maps for Monday, 17 July 2017, when the front had passed.

On Monday morning, 17 July 2017, frost and snowfall were evident across the southern and central parts of the country as indicated in Figure 8 below. The light cyan color indicates widespread frost over the southern and central parts of the Free State and northern Eastern Cape, with the brighter cyan along the mountains of the Western and Eastern Cape Provinces showing snowfall.

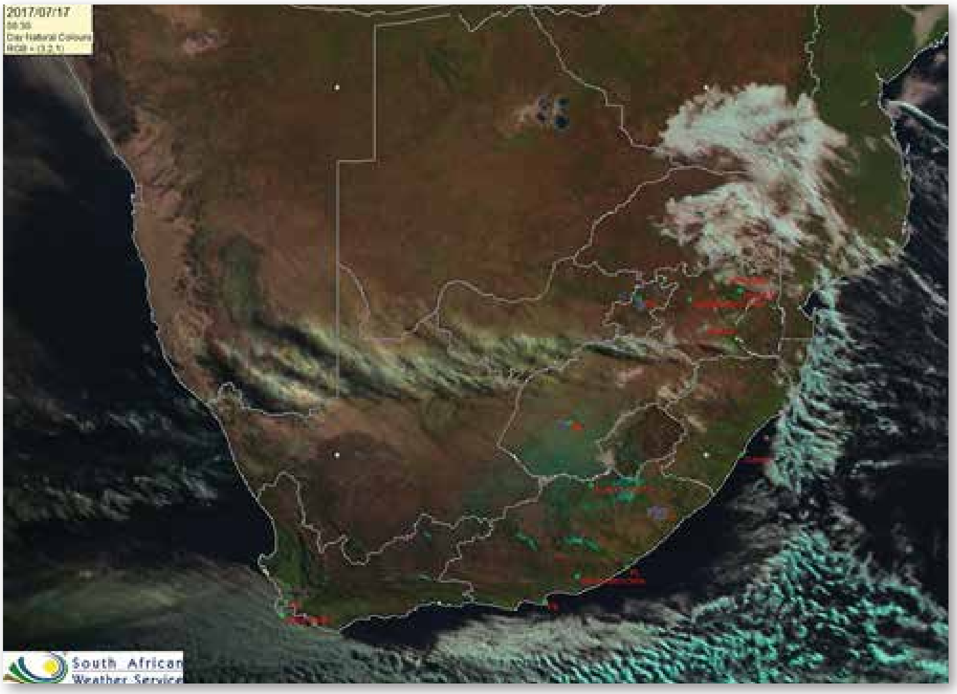


Figure 8: Satellite image showing snowfall and frosty conditions on Monday morning, 17 July 2017 (source: Eumetsat).

On Monday, these incredible photos were taken from the air of the Swartberg Mountains in the Western Cape near Oudtshoorn showing the snowfall. Photo credits Miranda Mattijs and Bart Tweelinckx from Oudtshoorn.

DUST STORMS EXPERIENCED OVER PARTS OF THE EASTERN INTERIOR IN AUGUST

Wayne Venter, Forecaster

On the evening of 21 August 2017, a significant cold front made landfall in the Western Cape, resulting in widespread rainfall in places which persisted into the morning of the 22nd. The cold front moved quickly into the central interior of the country during the day, with a strong high pressure behind it. Ahead of the surface cold front, strong winds were expected over much of the central and eastern interior with winds of 30 to 35 km/h gusting to 40 to 45 km/h in places.

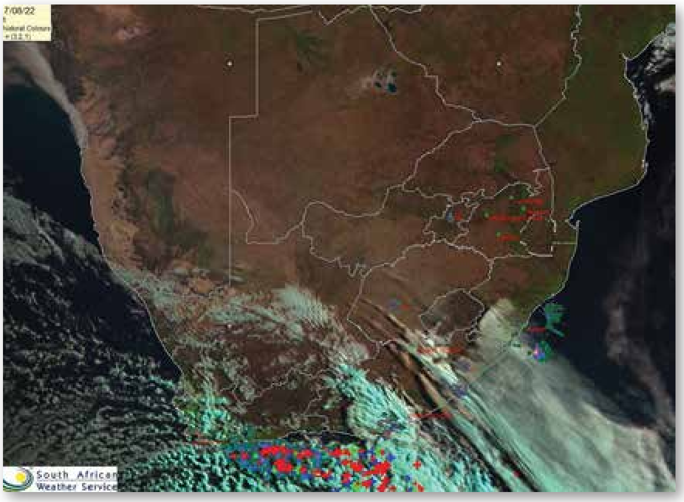


Figure 1: Cold front located over the central interior of the country as indicated by the Day and Natural colors RGB (Eumetsat).

The South African Weather Service issued a warning for high fire danger conditions due to the windy, dry and warm weather ahead of the front and a special weather advisory for strong interior winds ahead of the cold front in a similar area. During the afternoon of 22 August, the cold front was positioned over the central parts. Winds turned rapidly from north-westerly to south-westerly where the front was located. Winds increased in a band ahead of the surface front as it moved rapidly east. Strong winds were reported at many weather stations in the interior. Due to agricultural and mine activity in the Vaal area as well as extreme eastern Free State and southern Gauteng, strong winds allowed for dust to be transported with the cold front. This caused widespread dusty conditions across the eastern interior as seen in the satellite picture below.

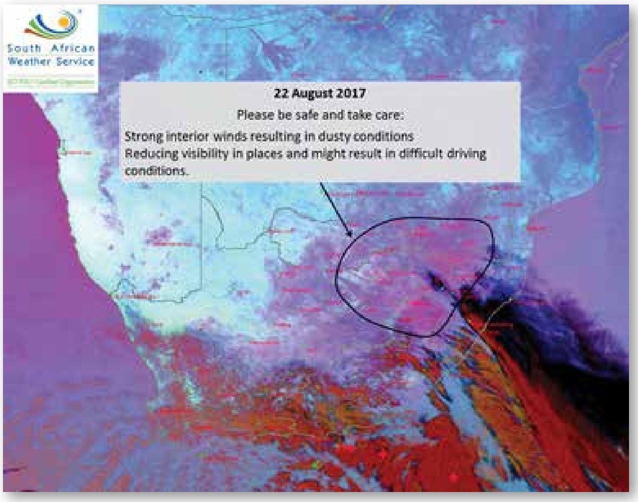
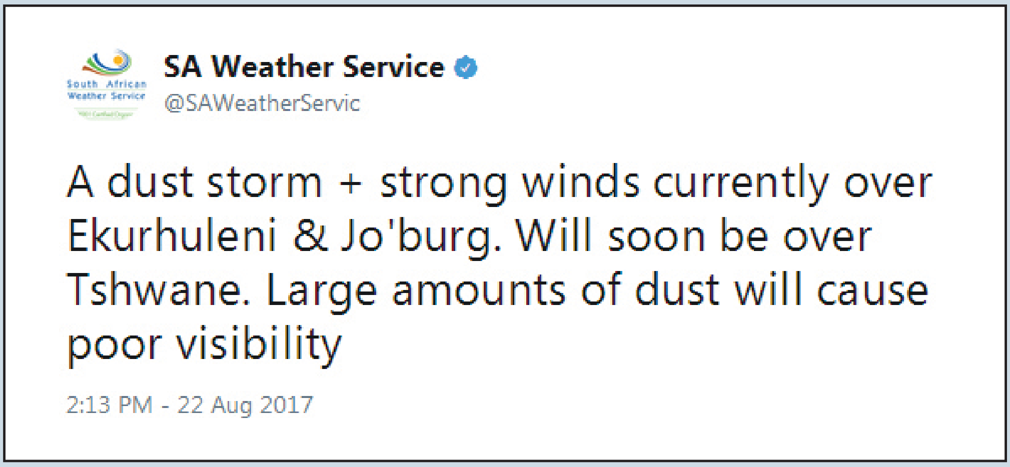


Figure 2: Pink color on the 24-hour microphysical indicated where the dust was observed by satellite and encircled (Eumetsat).

The South African Weather Service issued a warning for reduced visibility due to dust and blowing sand in many areas, including the Gauteng Province, which continued into the early evening when the winds died down due to the passage and weakening of the surface cold front.



SA Weather Service
@SAWeatherServic

A dust storm + strong winds currently over Ekurhuleni & Jo'burg. Will soon be over Tshwane. Large amounts of dust will cause poor visibility

2:13 PM - 22 Aug 2017

Figure 3: SAWS warning released on various social media accounts including on Twitter.

Many observations from the public were sent to SAWS' media accounts including the SAWS Twitter account. The following photographs show the extent of the dust that was observed by many South Africans in the eastern provinces due to the strong winds.

USSD (Unstructured Supplementary Service Data) is widely used for services such as account balance, cell phone airtime recharge and other banking services. The South African Weather Service, in partnership with technology provider Afrigis, has developed a USSD weather forecasting service that delivers weather forecasting to the mobile handset regardless of the model. The service is location based, meaning that the service is able to pick up your current location and pushes the weather forecast instantly to your mobile handset. The service has three menus to choose from:

1. Area – a user can browse any area in South Africa which he or she wishes to get the weather forecasting from
2. Date – user may select a future date up to seven days ahead for any area for which a weather forecast is required
3. SMS - weather forecast is sent to the user handset by SMS

USSD FOR ALL TYPES OF HANDSETS

This service is easy to access, user simply dial *120*7297(SAWS)# and Dial button to view the weather forecast of the current location.

The associated cost is 20c per 20 second interval. The service is targeted at all users especially those with feature phones, commuters, farmers, a traveler, sport person for outdoor activity and mostly those who wishes to view occasional weather forecast.

simply dial
*120*7297(SAWS)#

MEET THE AUTHORS

Dr Abiodun Adeola

Dr Abiodun Adeola is a Lead Scientist: Climate Change and Variability in Research Department of the South African Weather Service (SAWS). He joined SAWS in January 2017. Since his appointment, Dr Abiodun has been busy with the development of a focused research on the impacts of weather, climate and its variability on environmental health with a major focus on malaria, cholera and diarrhea using historical climate data coupled with remote sensing data. To this end, he has written and submitted a number of project/research proposals in collaboration with various research and academic institutions which includes the Institute for sustainable malaria control, University of Pretoria. As part of his duties, Dr Abiodun since joining SAWS till date has submitted 3 (authored and co-authored) research papers to high impact factors journals for publication. He is actively involved in capacity building through support and supervision of post graduate students (MSc). Dr Abiodun obtained his PhD in Geoinformatics in 2016 at the University of Pretoria (UP), he graduated with a MSc degree in Geographic Information System in 2010 and BSc degree in Geography in 2007 both at the University of Ibadan (UI), Nigeria. He worked as a part time lecturer in Department of Geography, Geoinformatics and Meteorology, UP (2012-2014 & 2015-2016). He is a registered Professional GIS Practitioner with the South African Geomatics Council, a member of the American Association of Geographers, and a member of African Association of Remote Sensing of the Environment. Till date, he has published more than 10 scientific papers in accredited science journals and presented more than 15 talks at local and international conferences.

Dr Joël Botai

Dr Joël Botai is a Chief Scientist in charge of a team of senior scientists conducting research and developing weather and climate information dissemination systems in support of four strategic application sectors i.e., Hydrometeorology, Agrometeorology, Health and Energy. Dr Botai has a multi-disciplinary academic background with a vast experience in cross-cutting research areas, including earth and atmosphere sciences. He has been involved in various national and international research projects focusing on geodynamic processes mimicking earth-atmosphere interactions and the resultant impacts to society and the environment. Dr Joël Botai has authored and co-authored more than twenty peer reviewed journal publications and presented at various national and international workshops and conferences. Dr Botai is currently an extra-ordinary staff member at the University of Pretoria and has been actively involved in capacity building, especially supervision of post graduate students (MSc and PhDs).

Ms Elani Classen

Ms Elani Claassen is a forecaster in the Bloemfontein Office, she studied BSc in Meteorology and BSc and Honours in Meteorology at the University of the Pretoria. She was in training (RTC) in 2016 and joined the Weather Service in January this year (2017).

Mr Siphamandla Daniel

Mr Siphamandla Daniel is a Research Scientist in Agrometeorology: Application Research unit of the South African Weather Service. He graduated in 2014 with a Bachelor of Science majoring in Environmental Sciences and completed his Bachelor of Science Honours degree Specialising in Agrometeorology in 2015, both obtained from the University of Free State. He joined SAWS in 2016 as an intern in Agrometeorology: Research and Development and was employed as an Agrometeorologist within the same department in 2017. He has a background in Environmental Science, Climate change and its impact on the Agricultural sector.

Ms **Elsa de Jager**

Ms Elsa de Jager heads SAWS' Climate Information section where the organisation interfaces with clients and supplies climate data. Her career at the organisation started on 2 January 1975. She is the first female in South Africa to have completed the BSc Meteorology degree offered at the University of Pretoria. One of the highlights of her career was to be the Training Officer responsible for transferring knowledge and skills to so many people who qualified themselves as Meteorological Technicians. She still has a passion for transferring skills.

Mr Marc de Vos

Mr Marc de Vos has a background in physical oceanography, having graduated with his MSc in Ocean and Climate Science from the University of Cape Town in 2016. He currently works as a Marine Scientist in the Marine Research Section of the Cape Town Weather Office. There, he directs and facilitates aspects of SAWS's marine meteorological and oceanographic research, including participation in research cruises and collaboration with marine research partners. Marc holds senior leadership positions at the National Sea Rescue Institute, and has a particular passion for marine metrology as it affects maritime operations and search and rescue.

Mr Jaco de Wit

Mr Jaco de Wit is a Research Scientist in the hydrometeorology field which forms part of the applications research group at the South African Weather Service. He started in 2016 as a research intern in the organisation and was absorbed into a permanent position in the research department in May 2017. He obtained a BSc (Meteorology) degree in 2014 and his BSc HONS (Meteorology) in 2015 from the University of Pretoria. Some of his duties include partaking in applications research dealing with hydrometeorology and water sector issues which arise from weather and climate sensitive variability and change and researching solutions to the various public and private issues regarding that. He is also in charge of the "State of Dams" database which is used to track current drought status and water availability throughout South Africa. He is planning on starting his MSc in 2018.

Dr Andries Kruger

Dr Andries Kruger is Chief Scientist: Climate Data Analysis and Research in the Department: Climate Service of the South African Weather Service. His present and previous duties include the creation and writing of general climate publications, climate change and variability research with historical data as input, ad hoc scientific projects of which the numbers have increased substantially in recent years, climate data and information requests, where advanced statistical analyses are required, drought monitoring, as well as assistance in the quality control of climate data. In 2011, Dr Kruger obtained a PhD (Civil Engineering) degree at the University of Stellenbosch, with research topic "Wind Climatology and Statistics of South Africa relevant to the Design of the Build Environment". Before that, he abtained an Msc (Environmental and Geographical Science) degree at the University of Cape Town. He published papers both locally and internationally, and authored a SAWS series of publications on the general climate of South Africa as well. He is widely recognised, both nationally and internationally, for his research, which mainly involves advanced statistical analyses and interpretation of historical climate data.

Ms Stephanie Landman

Stephanie Landman has been working as a Meteorologist for almost 15 years. She started her career as a weather observer at the Bethlehem Weather Office (METSYS) after which she joined the short-term insurance industry for a number of years. Returning to atmospheric sciences, she was a Scientific Consultant in Air Quality at Bohlweki Environmental before she re-joined the South African Weather Service in 2008 where she has since been appointed to Lead Scientist in Numerical Weather Prediction (NWP). She completed her MSc (Meteorology) degree at the University of Pretoria in 2012 with the research topic of determining the skill in multi-model short-range ensemble prediction systems over South Africa. Her main area of interest is in post-processing of NWP data, including the development and implementation of prediction systems for short-range forecasting. She also teaches on a part-time basis at the University of Pretoria a BSc (Honours)(Meteorology) course in applications of NWP, supervises BSc (Honours) students with their research projects on model evaluation issues as well as co-supervising MSc dissertations. At the Regional Training Centre she teaches the forecast interns on the use of NWP for practical forecasting as well as applying model output statistics to forecasts. She is currently enrolled for her PhD at the University of Kwa Zulu Natal and will graduate in 2018.

Mr Thabo Makgoale

Mr Thabo Makgoale is a Research Scientist in the Climate Change and Variability research at SAWS since 2015. His career involves exploring the theory of climate change and then goes into the question of predictability, cross scale relationships and feedbacks in the climate system, the tools and techniques of prediction, and translation of predictions into the user community including impacts and vulnerability analyses. He has been involved in national research projects focusing on the impact of climate change on extreme weather events and water resources and participated in national and international science conferences. He has background in Climate Modelling, Climate Change & Predictability, Ocean Modelling, Ocean & Atmosphere Dynamics, and Marine Systems. He graduated with a BSc degree in Ocean and Atmospheric Sciences in 2012 at University of Cape Town (UCT) and BSc (Hons) in Atmospheric Sciences in 2013 through Climate System Analysis Group – UCT. He is currently enrolled for MSc study at North West University.

Ms Thato Masithela

Miss Thato Masithela is a Research Scientist in the Agrometeorology. She joined SAWS in 2016 as an intern in agro-meteorology and was employed within the same unit this year May 2017. She completed her B.Sc degree in Soil Science and agrometeorology in 2013 and pursued her Honours degree in Soil Science in 2014 with the University of the Free State.

Dr Michael Mengistu

Dr Michael Mengistu was appointed as a Senior Scientist: Agrometeorology in October 2015. He is leading the Agrometeorology applications research group at SAWS. Dr Mengistu was a research fellow in Hydrometeorology and Postdoctoral researcher at the University of KwaZulu-Natal (UKZN) from 2010 to 2015. During this period he served as a coordinator of the WaterNet Masters course programme at UKZN, supervisor of postgraduate students, lecturer of hydrology courses and researcher and principal investigator on various Water Research Commission (WRC) funded projects. Prior to that he also served as a Post-Doctoral researcher from 2008 to 2010 with the Hydrosciences research group, NRE, Council for Scientific and Industrial Research (CSIR), South Africa. Dr Mengistu obtained his PhD (Agrometeorology) degree in 2008 from UKZN. In 2003, he graduated with an MSc (Agricultural and Environmental Instrumentation) Agrometeorology from the University of Natal. He has currently published several scientific papers in accredited journals, a number of scientific reports and presented many conference papers nationally and internationally. He is a reviewer of many national and international journal articles. Dr Mengistu research interest includes agrometeorology, hydrometeorology, climate change impacts on agriculture and water resources, remote sensing and earth observation applications for water resource management and agriculture.

Mr Absolom Mfumadi

Mr Absolom Mfumadi is a Business Development Manager within Commercial department, his role entails identifying lucrative new business to take both existing and newly developed products & services to various markets in order to generate revenues for the organisation. He carries a BPhil Hons Degree in Marketing.

Ms Katlego Ncongwane

Ms Katlego Ncongwane is a Senior Scientist leading the Health Application Group within the Research Department of the South African Weather Service (SAWS) since 2016, responsible for developing product and services such as early warning systems for infectious diseases (including Malaria, Pneumonia, Dengue fever and Cholera) and heat-health in support of communities. Ms Katlego Ncongwane has research experience in ozone, shortwave (solar) and UV radiation research and has managed the scientific aspects of SAWS UV and solar radiation networks, responsible for the monitoring of stations in the two networks, data quality assurance and control as well as sensor calibration. Ms Katlego Ncongwane holds two Masters Degrees, an MSc in Physics from the University of Kwa-Zulu Natal (2015) and MPhil in Sustainable Development Planning and Management (2010) from the University of Stellenbosch. Ms Katlego Ncongwane is currently pursuing her PhD in Environmental Science with the University of Kwa-Zulu Natal.

Mr Lucky Ntsangwane

Lucky Ntsangwane is a Research Manager at the South African Weather Service where he is involved in research projects related to solar energy research and applications, climate change and variability, and their socio-economic impacts, particularly in South Africa. He is responsible for climate change and variability research, air quality modelling and forecasting, applications and the Global Atmosphere Watch program. At present, he is a member of the South African Society for Atmospheric Sciences (SASAS), the National Association for Clean Air (NACA) and HIOC. He completed a NEPAD funded project which aimed at developing capacity and capability of agricultural extension officers and farmers in their use and application of climate change information.

Mr Kobus Olivier

After completing his B.Sc. Hons in Meteorology at the University of Pretoria, Cobus started working at the South African Weather Service in 2008. He has been working with the Long-Range Forecasting Group for the duration, where they produce seasonal forecasts on a monthly basis. The group investigates important climate drivers, such as ENSO, to better understand the potential impact on the coming seasons weather conditions. The group is also extensively involved with Agriculture, Water resource managers as well as the media, to communicate and help interpret the expected weather conditions.

Ms Tumi Phatudi

Ms Tumi Phatudi is a Forecaster in the Bloemfontein office who studied BSc in Physics and Agrometeorology and BSc. Hons in Agrometeorology at the University of the Free State. She joined the Weather Service in 2016 after being in the Regional Training Centre (RTC) in 2015.

Prof Hannes Rautenbach

Prof Hannes Rautenbach was appointed as Chief Scientist: Climate Change and Variability at SAWS in 2016. He graduated with a Bsc degree in Meteorology in 1987 and Meteorology in 1999 at the University of Pretoria (UP). He served as coordinator of the Meteorology Group at the University of Pretoria from 2003 to 2015, and became head of the Department of Geography, Geoinformatics and Meteorology (GGM) in 2006, a position that he held until 2014. During this period he also served as Director: UP Water Institute between 2010 and 2014. Prof Rautenbach was also President of the South African Society for Atmospheric Sciences (SASAS) during 2005 to 2010, and still serves on the Board of the National Association of Clean Air (NACA). He served on various bodies that evaluate research and was leader of various research projects at, amongst others, the Water Research Commission (WRC) and the National Research Foundation (NRF). He has currently published more than 45 scientific papers in accredited science journals and presented more than 100 talks at national and international conferences. He is currently rated as a C2 scientist by the NRF.

Mr Tonie Rossouw

Tonie Rossouw is a senior forecaster in the Bloemfontein office who obtained a Higher Diploma in Meteorology at Pretoria Technikon (now University of the Pretoria). He was later trained as a forecaster after starting his career as a meteorological technician. He has been with the Weather Service for more than 40 years now.

Mr Louis van Hermert

Mr Louis van Hemert is a Senior Scientist in the Research Section of the South African Weather Service. He obtained a Meteorology degree in 1981 at the University of Pretoria, and has been employed by the SAWS for more than 20 years. He is currently part of a team that maintain the operational Unified Model suites that run at SAWS, and is also involved in the development of products for forecasters and clients.

Mr Wayne Venter

Mr Wayne Venter is a Forecaster at the Pretoria Head Office where he started in January 2016. He did his honours degree in Meteorology at the University of Pretoria and he has a particular interest in severe weather and the impacts thereof. He is an active supporter and contributer to SAWS' social media platforms.

Ms Nosipho Zwane

Ms. Nosipho Zwane is a Research Scientist at the South African Weather Service since 2014. She began specialising in Climate Change and recently moved to Application Research under the Energy Unit. She completed her BSc degree with a double major in Environmental and Geographical Science and Ocean and Atmosphere Science in 2012 (University of Cape Town). In 2013 she completed her BSc Honours in Ocean and Atmosphere Science (University of Cape Town). She is currently enrolled for MSc Meteorology at the University of Pretoria.

Head Office

Pretoria
442 Rigel Avenue South
Erasmusrand
0181
Tel: 012 367 6000

Weatherlines: Dial *120*7297#
Tel: + 27 (0) 12 367 6000

Follow us on Twitter:
@SAWeatherServic

www.weathersa.co.za

South African
Weather Service

ISO 9001 Certified Organisation

WEATHERSMART NEWS Scientific meteorological and climatological news from the South African Weather Service

Regional Offices

Bloemfontein
Weather Office
Maselspoort Road
Bram Fisher International Airport
Private Bag X20562
Bloemfontein
9300
Tel: 051 433 3281

Cape Town International
Weather Office
ATNS Tower
Tower Street
Cape Town International Airport
PO Box 21
Cape Town International Airport
7525
Tel: 021 934 0749/0831

King Shaka International
Weather Office
Ground Floor
ATNS Building
King Shaka International Airport
PO Box 57733
King Shaka International Airport
4407
Tel: 032 436 3820/3812

OR Tambo International
Aviation Weather Centre
Room N161
3rd Floor
OR Tambo International Airport
PO Box 1194
Kempton Park
1627
Tel: 011 390 9329/9330

Port Elizabeth
Weather Office
Roof Top
Departures Hall
Port Elizabeth Airport
Private Bag X5991
Walmer
Port Elizabeth
6065
Tel: 041 581 0403/8587