WEATHERSMART

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

AUGUST 2018

South African Weather Service

WEATHERSMART NEWS

Scientific meteorological and climatological news from the South African Weather Service

AUGUST 2018

Publisher:
South African Weather Service

Address:
Eco Glades Block 1B
Corner Olievenhoutbosch and
Ribban Grand Street, Eco Park,
Centurion

Date of issue:
August 2018

Frequency:
6 Monthly

ISSN:
2414-8644

Editorial team:
Hannelee Doubell (Compiler and editor),
Musiiwa Denga (Assistant compiler and editor),
Hannes Rautenbach (Scientific writer and editor),
Kevin Rae (Scientific writer and editor),
Warren Joubert (Scientific writer and editor),
Michael Mengistu (Scientific writer and editor)

TABLE OF CONTENTS

Foreword by the SAWS CEO

It has been more than two years since the WeatherSMART News publication has been in existence. The enthusiasm, energy and zeal the South African Weather Service (SAWS) had in compiling the very first issue, is the very same passion which drives all other issues. SAWS continues to embody and personify its organisational vision of achieving an end-state where citizens are weather resilient and are able to use SAWS' information, products and services optimally.

With this in mind, we continue providing reliable weather information to citizens, communities and the business sector. A prime example of this would be the forecast of severe thunderstorms via social media platforms and other media streams earlier this year, forecasting which materialised into severe storms experienced in many parts of Gauteng. Due to the level of awareness and swift action, citizens were able to act accordingly, thereby avoiding a loss of life or damage to property even though numerous reports of heavy downpours, small hail and strong winds were received from the Pretoria area.

In this issue, we cover a wide spectrum of topics such as the significant weather of the past six months. This includes the severe thunderstorms in the Eastern Cape in April, a cut-off low which developed over the south western parts of the country in March, localised road flooding experienced across Gauteng and the cold front which affected the Western and Eastern Cape.

Adverse weather conditions affect millions of people on a daily basis, particularly in the aviation industry. Fog remains a major challenge for the aviation industry with the airports most prone to fog being O. R Tambo International (ORTIA), Kruger Mpumalanga International (KMIA), Cape Town International (CPTIA) and the George Airport. A discussion is provided on the complexity of forecasting this phenomenon and how the expertise and experience of SAWS forecasters continue to provide accurate forecasts to clients.

Acting CEO: Mr Mnikeli Ndabambi

In recent years, climate change has become a burning issue, with the South African Department of Environmental Affairs (DEA) on the forefront of international interventions to combat global warming. As a result, South Africa is actively involved in initiatives to provide guidance in terms of both mitigation and adaptation planning, and response in the light of increasing global temperatures. Not only did South Africa develop national mitigation and adaptation strategies, but a new climate change bill was also recently released for public comment. SAWS continues to be at the forefront on research on climate change. continuously making positive contributions towards solutions to this challenge.

This issue is filled with interesting and informative topics for the whole family. A detailed account of the past, present and future weather information and topics have been provided. I trust you will enjoy this issue as the SAWS team took pride in compiling it.

Significant weather over the past six months

- Kevin Rae, Wayne Venter, Mbavhi Maliage, Victoria Nurse

Thunderstorms on 9 January and 7 April 2018

A thunderstorm is a transient weather phenomenon characterised by the presence of thunder and lightning. Thunderstorms are usually associated with showers, which may be heavy at times. Moreover, thunderstorms are sometimes accompanied by one or more of these phenomena: large hail, tornadoes and/or damaging winds.

Thunderstorms can occur in any geographic location (except in the high latitudes of the Antarctic) but are most frequently encountered within the mid-latitudes where moist, warm, tropically-sourced air interacts with cooler polar or sub-polar air. Southern Africa is one of the most thunderstorm-prone regions in the entire world. This is especially true of the southern African Highveld and Drakensberg regions, particularly in the summer months, when thunder may be heard as many as two out of three days.

A severe thunderstorm is generally considered to be a thunderstorm associated with one or more of the following: strong, damaging winds of a non-tornadic ("straight line") nature, large hail with a diameter of 19mm or more (alternatively large amounts of small hail), localised flooding or flash-flooding as well as tornadoes (of any strength).

On 9 January 2018, the South African Weather Service issued a severe weather WATCH for severe thunderstorms over the northern parts of the country, as indicated in Figure 1. On the day in question, the atmosphere was highly unstable, while significant wind shear was also present within the lower to middle troposphere. Such conditions are typically favourable for longer-lived thunderstorms with an "organised" internal structure, capable of delivering significant amounts of rain, damaging hail and/ or strong winds of a damaging nature.

The forecast for severe thunderstorms was indeed realised on the afternoon of 9 January 2018, when reports of severe storms were received from many parts of Gauteng. In particular, a funnel cloud was observed over the East Rand (refer Figure 2). Thankfully, no significant damage or loss of life was reported, following this event. Thunderstorms also moved through the Pretoria, Gauteng region that afternoon, prompting SAWS to issue a warning via Twitter (Figure 3) and Short Message Services (SMSs). Numerous reports of heavy downpours, small hail and strong winds were subsequently received from the Pretoria area.

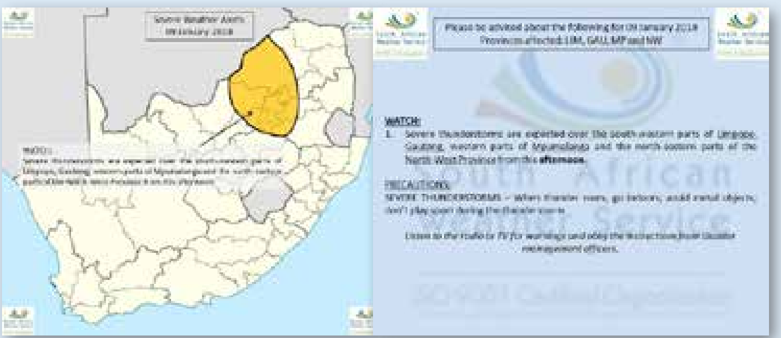


Figure 1:
Severe weather charts and alerts issued on the South African Weather Service Twitter account

Figure 2:
A funnel cloud observed at OR Tambo International Airport, in association with a thunderstorm (Gauteng Weather on Twitter) on 9 January 2018

Figure 3:
Severe thunderstorm warning issued by the South African Weather Service on Twitter for a severe thunderstorm which was observed over parts of Pretoria in the afternoon on 9 January 2018

Severe thunderstorms were also observed over parts of the Eastern Cape during 7 April 2018. During the afternoon a violent thunderstorm moved through the Mthatha area in the Eastern Cape, causing significant wind-related damage. Information available at the current time suggests these winds were not associated with a tornado but rather as a result of strong, unidirectional, "straight line" winds (commonly associated with the gust front of a thunderstorm or alternatively due to downburst-type winds from a collapsing thunderstorm). Widespread wind damage was recorded across the area while large hail was also implicated in some of the damage reports. Figure 4 below is illustrative of the extent and nature of the damage to buildings and infrastructure to some parts of Mthatha on 7 April 2018.

Figure 4:
Evidence of wind damage in the Mthatha area of the Eastern Cape Province on 7 April 2018 (Garth Sampson, Port Elizabeth Weather Office)

Cut-off low of 21 to 23 March 2018

A cut-off Low (COL) is a cold core low pressure system, located in the upper air (approximately 6 to 10 km above ground level) and is associated with widespread instability. A cut-off low evolves from a sharply-defined upper trough, when the equatorward section of the trough splits away from the parent trough and develops a cyclonic circulation, independent of (i.e. "cut off from") the westerly flow of the parent system, as can be inferred from Figure 5, below. Cut-off lows typically affect our weather on a synoptic scale and can linger over southern Africa, typically for two to three days.

Cut-off lows are considered to be one of the most significant rain-producing systems in South Africa, and have been resposible for a number of extreme weather events (including phenomena such as widespread bitter cold, heavy snow, severe storms or widespread heavy rain) in recent years. Some authors have suggested that as much as 10% of southern African rainfall can be attributed to cut-off lows.

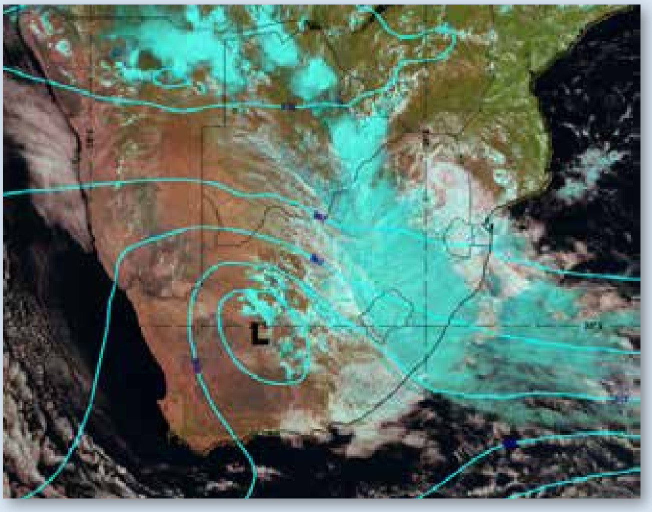


Figure 5:
Meteosat "day-natural" RGB false color satellite image for 22 March 2018, with 300 hPa isobars superimposed (Source: Eumetrain). © Eumetsat 2018

A cut off low developed over the south western parts of the country on 21 March 2018, affecting the central parts of the country the following day. Widespread and persistent heavy rain wreaked havoc across parts of Gauteng, Mpumalanga and Limpopo on 22 to 23 March.

This intense weather event, which extended over a 48-hour period, allowed heavy rainfall to fall across most of the eastern parts of the country with some areas recording in excess of 100 mm in a 24 hour period. The heavy rainfall led to flooding of roads as well as low lying areas, bridges and residences. Moreover, many motor vehicle accidents, power outages, sinkholes and partially-collapsed buildings added to the litany of reported incidents and associated impacts.

Table 1 (below) depicts total rainfall amounts in mm recorded in Gauteng for the weather event from 21 March at 08:00 SAST until 23 March 08:00 SAST.

Station Name	Rainfall Amount (mm)	Rainfall Amount (mm)	Total Rainfall (mm)
	21 March - 22 March	22 March - 23 March	
GAUTENG			
BOLEPI HOUSE	43	121	164
BRONKHORSTSPRUIT AWS	27	89	116
IRENE WO	27	122	149
JHB BOT TUINE	7	117	124
JOHANNESBURG INT WO	/	77	77
PRETORIA - PRESIDENCY ARS	57	141	198
PRETORIA UNISA	43	123	166
PRETORIA UNIVERSITY PROEFPLAAS	54	145	199
VEREENIGING	8	79	87
ZUURBEKOM	9	72	81

Table 1:
Accumulative rainfall amounts (mm) from 21 March 2018 at 08:00 SAST until 23 March 2018 at 08:00 SAST for the provinces of Gauteng, Mpumalanga and Limpopo (SAWS)

Figure 6: Left:
Flooding of railway underpass on Nellmapius Drive, Irene, Pretoria where the road was subsequently officially closed on 23 March 2018 (source: ENCA). ***Right:*** *A large sinkhole due to heavy rains on the R55 leading to Valhalla, Centurion, Pretoria on 23 March 2018 (source: Tshwane Metro Police – Twitter)*

Localised road flooding was experienced across most of Gauteng during this event. Motorists found it difficult to navigate flooded roads while numerous major traffic disruptions and motor vehicle accidents were reported. Many rivers burst their banks due to the heavy rain and there was associated overland runoff. Continuously rising waters and overflowing rivers near informal settlements close to Soshanguve, Ga-Rankuwa and Mamelodi prompted evacuations of vulnerable communities by Gauteng Provincial Disaster Management Centre

Cold front of 1 to 2 July 2018

Cold fronts are a common weather phenomenon over South Africa, especially in the winter months when frontal systems tend to be more intense and generally invade more extensively northwards over southern Africa. Cold fronts bring much-needed winter rainfall to the south-western and southern regions of the Western Cape. Not all cold fronts result in dramatic weather changes although the majority are associated with a significant drop in temperature, increasing windiness as well as some degree of rainfall.

A cold front associated with a steep upper air trough moved over southern Africa in the early hours of 1 July 2018. This was the first major winter system for the 2018 season that resulted in disruptive snowfall over the high-lying areas of the country (mostly over the Eastern Cape and Western Cape), as well as significant, widespread cooling over the country. Small hail occurred in association with the passage of this front over the Western Cape as seen in Figure 7 below. Hail is relatively uncommon for this province, especially in winter.

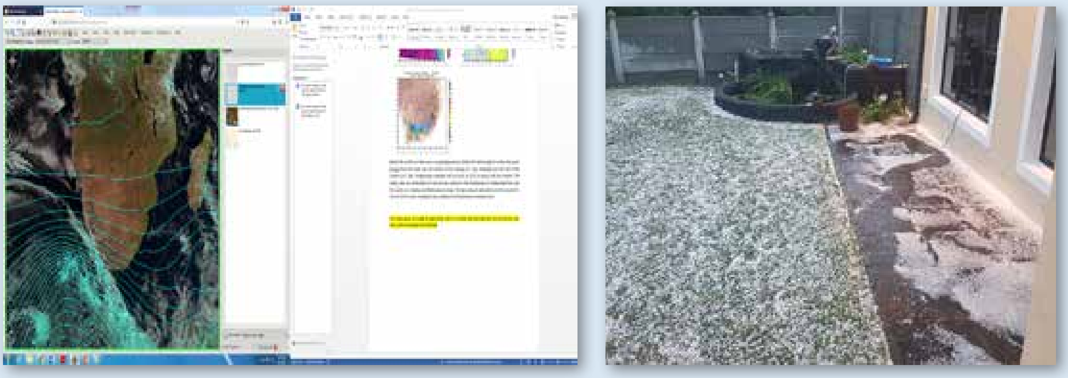


Figure 7: Left: *Meteosat "day natural" RGB of 14h00SAST, 2 July 2018, overlaid with 400 hPa NWP isolines of geopotential (source: Eumetrain).* ***Right:*** *Hail in Struisbaai, as the cold frontal band passed over the Western Cape (source: Twitter-Storm Report)*

Following the passage of the cold front, a strong ridge of high pressure introduced vast quantities of cold, dry, sub-polar air over much of the southern African interior on the evening of 2 July 2018, extending over the remainder of the country on 3 July 2018. Consequently, daytime temperatures dropped by as much as 10 °C in many places across southern Africa. The colder, drier air dominating the circulation over the interior of the country triggered the development of widespread severe frost conditions over the country on Tuesday as well as Wednesday morning. The high pressure system continued to dominate the circulation pattern for the remainder of the week, resulting in fine conditions, although daytime temperatures remained particularly cool for a few successive days.

Unexpected severe thunderstorm causes havoc over the north-eastern parts of South Africa on 27 May 2018

- Lebohang Melato, Mthobisi Nxumalo, Thuso Otukile, Isa Mlambo

Much of the rainfall received in the summer rainfall region results from well-developed thunderstorms. Thunderstorms are possible in the region from October to May; however, they tend to be destructive following dry periods. Kanyamazane and Skukuza are situated in the Lowveld of Mpumalanga. Storms with high rainfall rates tend to occur over the inland areas more frequently during the afternoon and early evening. This was the situation over the Lowveld areas of Mpumalanga on 27 May 2018.

A severe thunderstorm that left the communities of Kanyamazane in Mbombela and Skukuza devastated, occurred in the late afternoon to evening on Sunday, 27 May 2018 and caused massive damage to property. The storm had large hail, strong damaging winds and severe cloud to ground lightning as can be seen from the figures below:

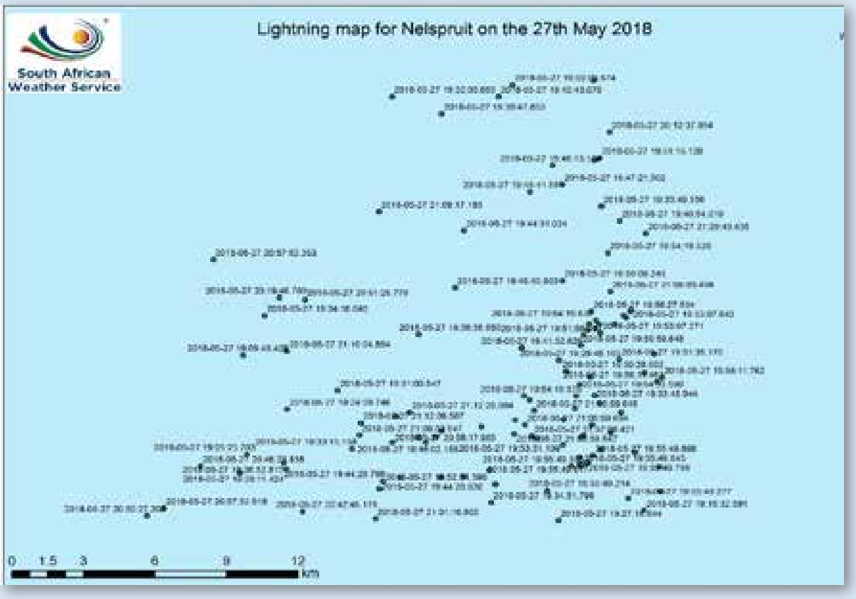


Figure 1:
Lightning map for Mbombela on the 27 May 2018

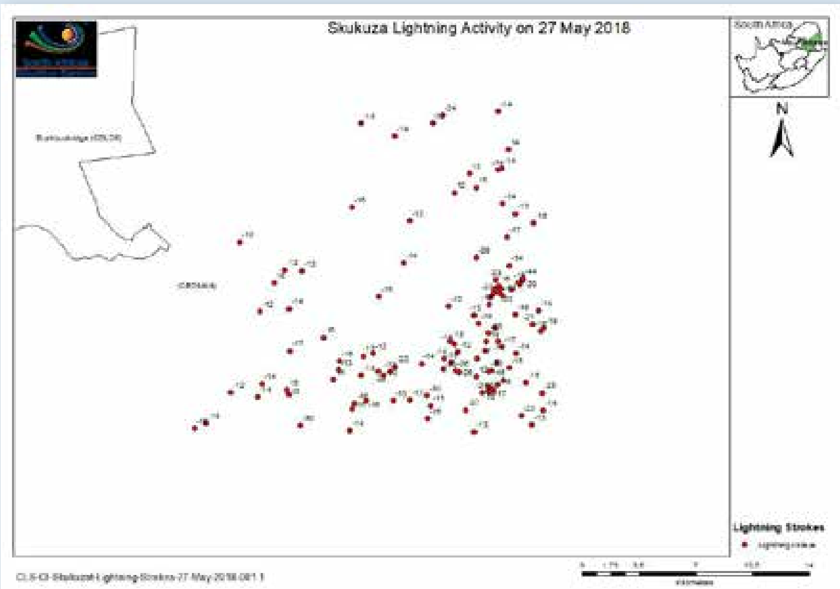


Figure 2:
Lightning map for Skukuza, 27 May 2018

Figure 1 and 2 show the lightning stiokes over Nelspruit and Skukuza over a radius of approximately 10 km. Although most of the values were negative, it should be noted that both negative and positive values have equal impact on humans, with the positive values having the greatest impact. Furthermore, the higher the value, the larger the impact it may have on humans. Values as large as 60 Kpas were recorded on this evening.

***Figure 3**:*
Pictures of hail and damages over Kanyamazane on 27 May 2018

A severe thunderstorm by definition is one that may result in one or more of the following:

- Large hail (diameter larger than R1.00 coin);
- Large amounts of small hail;
- Heavy rain, localised urban flooding or flash flooding;
- Excessive cloud to ground lightning;
- Damaging winds or wind gusts exceeding 100KM/H; and/ or
- A tornado

A severe weather event can be defined in two ways: either by the nature of its intensity or by the impact it has on society. Althouh, no excessive wind/ wind gusts were recorded, rainfall amount of 26.6 mm was measured within an hour over Skukuza. From the severe weather event of 27 May, it is clear that the event was extreme in both its nature and impact. However, the extent of impact incorporates the vulnerability factor of the community to weather hazards such as severe thunderstorms.

The month of May is considered autumn and, usually, forecasting models have some challenges during such transition periods (changes from one season to another)of 27 May 2018 was no exception as thundershowers were not forecaed for the escarpment and Lowveld areas of Mpumalanga. This region is, however, known for its local convective processes that result in thunderstorm activity. In 2016, South Africa experienced tornadoes in the middle of winter over the Highveld areas of Gauteng and Mpumalanga. With the climate changing, the commonly known dry periods and out-of-seasns months need equal attention to assess possibility of severe weather events.

Application of SAWS wind data in the update of design wind statistics for South Africa

- Andries Kruger

Wind constitutes the most important environmental loading factor in the design of the built environment in South Africa. Therefore, the design of wind speed statistics used in the country should be as reliable as possible. About a decade ago it became clear that the design statistics, based on the expected 1:50 year wind gust, used at the time, was overdue for an update, particularly as the availability of continuously measured wind data increased about seven-fold with the wide-spread implementation of Automatic Weather Station (AWS) technology by the South African Weather Service (SAWS) in the early 1990s (see Figure 1).

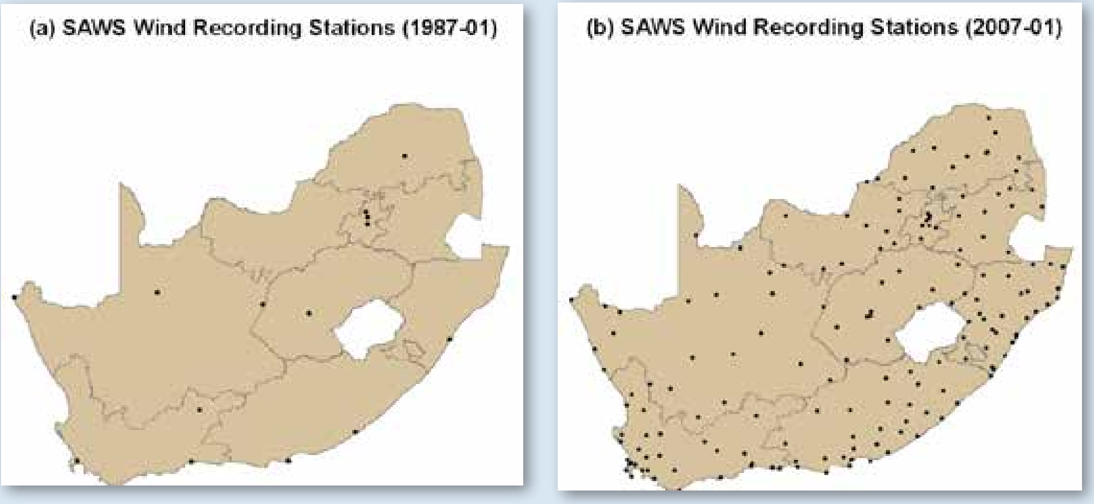


Figure 1:
Spatial distribution of climate stations which measures wind continuously in (a) January 1987, and (b) January 2007

With the new technology it became possible to place weather stations in remote areas, which was previously not possible, as the Dines anemograph used at the time to measure wind speed needed the daily exchange of wind charts and regular maintenance of the mechanical parts (Figure 2).

Figure 2.
Dines pressure tube anemograph (www.campbellsci.ca)

The increased spatial density of measurements not only provided an improvement in the representation of the wind climatology of South Africa, but also made it possible to study the actual nature of strong winds in more detail. Consequently, it was established that a large fraction of South Africa, especially close to the escarpment, experiences a mixed strong wind climate, meaning that annual wind gust maxima can be forthcoming from different weather systems; with the passage of cold fronts at the synoptic scale, and thunderstorms at the mesoscale, dominating (Figures 3 and 4). Specific statistical approaches for estimating extreme wind speeds, taking a mixed strong wind climate into account, were therefore applied.

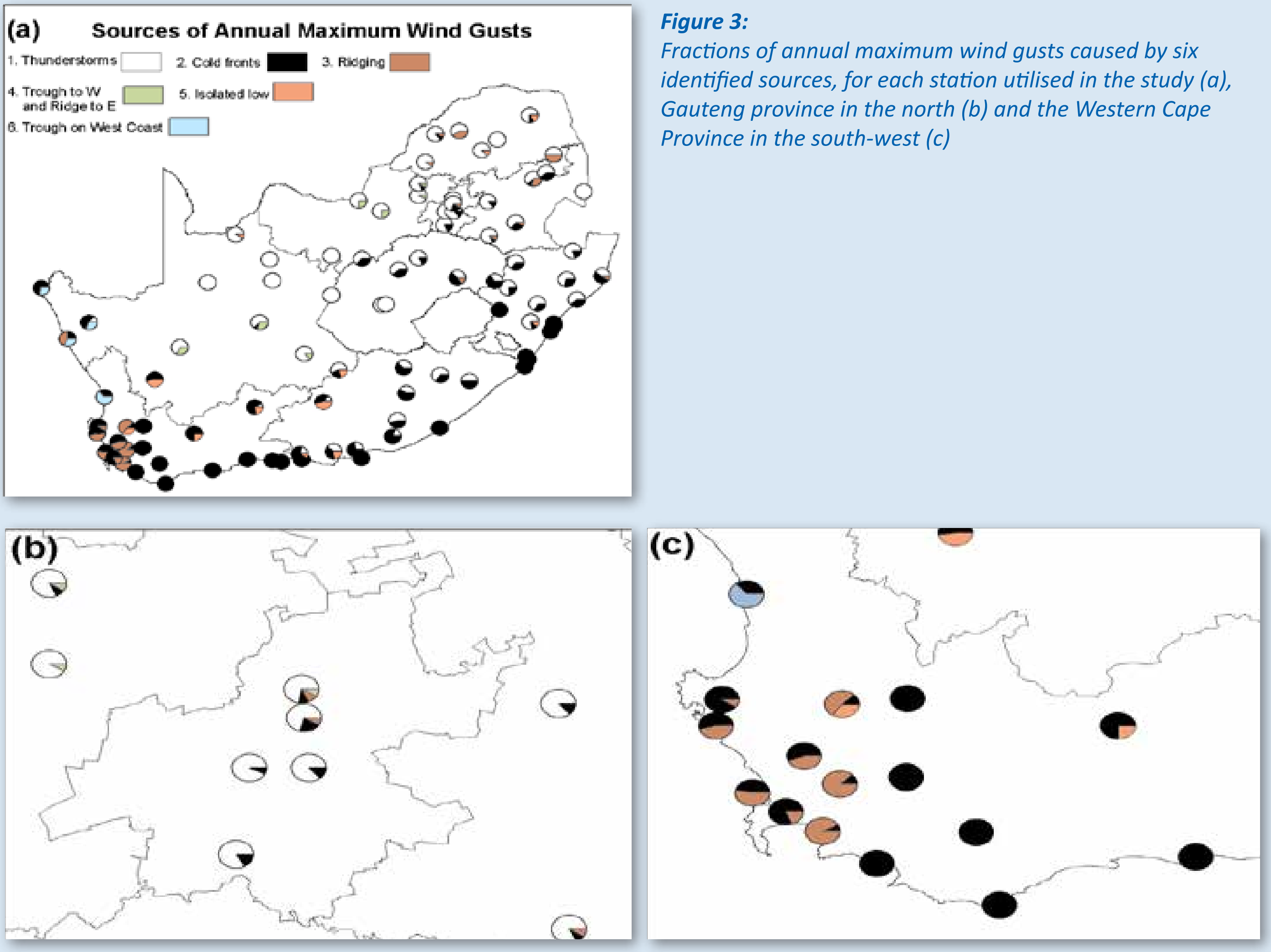


Figure 3:
Fractions of annual maximum wind gusts caused by six identified sources, for each station utilised in the study (a), Gauteng province in the north (b) and the Western Cape Province in the south-west (c)

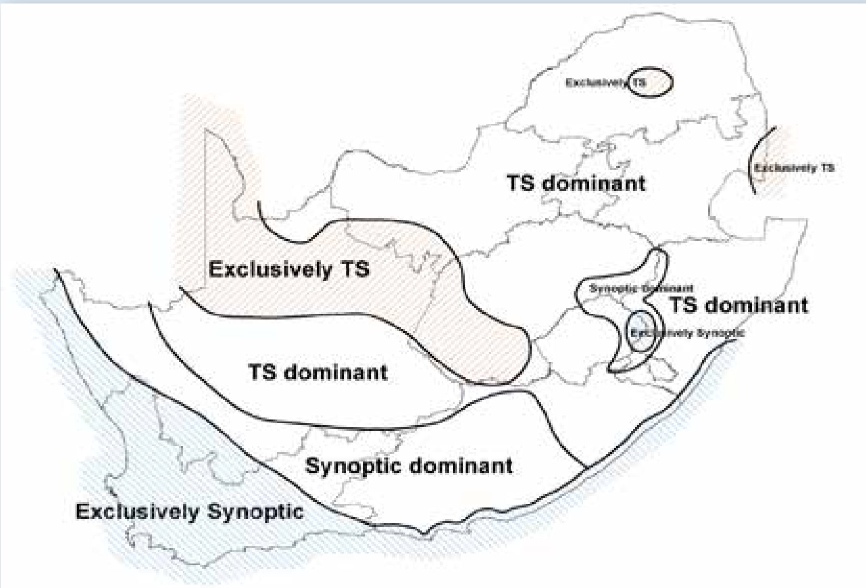


Figure 4:
Regions where the strong winds from thunderstorms (TS) and synoptic storms dominate

In December 2017, two significant papers appeared in the Journal of the South African Institute of Civil Engineering, co-authored by Dr A Goliger (formerly CSIR), Dr AC Kruger (SAWS) and Prof JV Retief (University of Stellenbosch). Firstly, a review of the historical development of the representation of the free field wind, used as input to design wind loading procedures for South Africa, was summarised, most importantly providing the motivation for the revision of the present design wind speed statistics. The second paper detailed the development of an updated fundamental basic wind speed map for the SANS 10160-3 design code.

The updated wind speed map differs from previous statistics in some important aspect.: Significantly, thit is the first time that data from Automatic Weather Stations (AWSs), which are considered to be much more reliable and accurate than the old Dines anemographs, were used in the estimation of the 1:50 year wind gust values that were used as the basis for the map. In addition, the use of the much higher spatial density of values provided for the motivation for the use of a smaller wind-speed interval (4m/s instead of 5m/s). Also, very significantly, the updated statistics are presented as a local municipal map with a design value assigned at local municipal level. The latter change in the statistics is advantageous as a means to access the reference value with its use in operational standardised design. Two maps were presented, the proposed map of the fundamental value of basic wind speed as the characteristic gust wind speed (based on estimations of the 1:50 year wind gust values from weather stations) (Figure), and, although structural dynamic effects are beyond the scope of SANS 10160-3, a map of the hourly mean characteristic or basic wind speed, derived from the 1:50 year hourly wind speeds estimated from measurements.

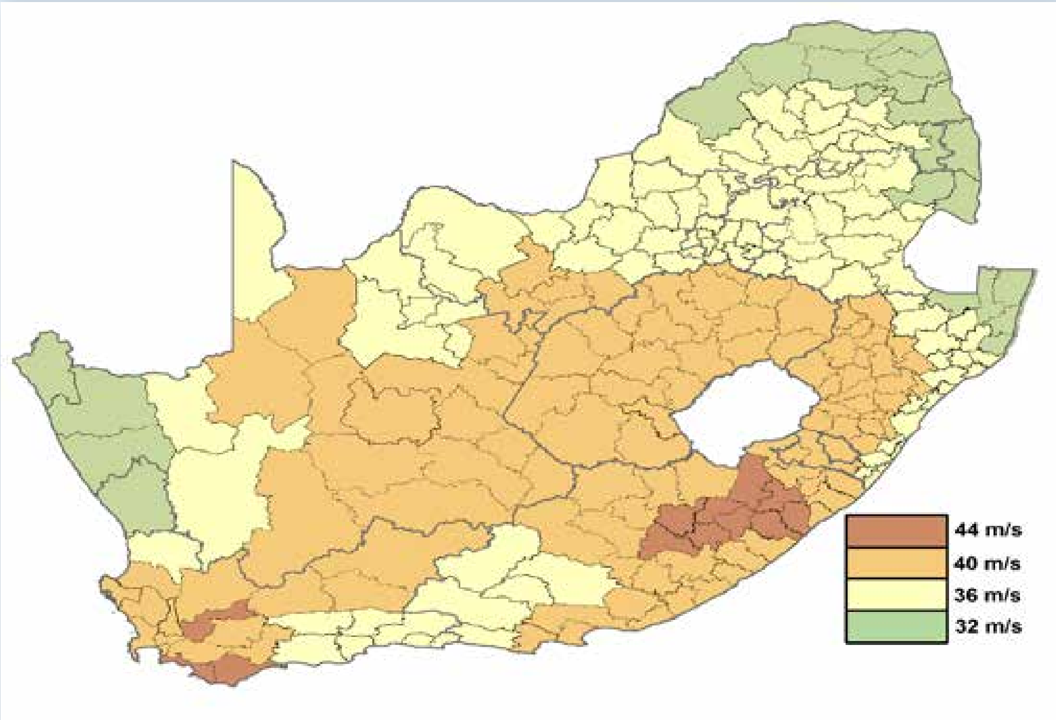


Figure 5:
Map of the fundamental wind speed assigned to local municipal level, as presented by Kruger, Goliger and Retief in the Journal of the South African Institution of Civil Engineering (December 2017 issue)

One should consider that it has been almost a decade since updated wind speed data has been utilised in the development of the updated wind design statistics. In this period there have been several developments which favour a further update of the statistics, i.e. the extension of the recording period of the AWS network, which leads to more accurate estimations of extreme wind statistics, and the extension of the network by additional weather stations accumulating sufficient data for extreme value analysis. In addition, the South African Weather Service's involvement in the Wind Atlas of South Africa (WASA) project (www.wasaproject.info), which includes the derivation of extreme wind statics from modelling, significantly improved the confidence in the delineation of the zones depicted in the map. With the extension of the WASA project, updated information and spatial extension of the project northwards, a wealth of new information will be forthcoming to incorporate in the development of the extreme wind statistics for design purposes.

New report card shows state of ocean observing system

- Johan Stander

A new Ocean Observing System report card provides a snapshot of ocean observations, which are critical to predict and manage extreme weather and coastal hazards as well as to monitor the state of our seas.

The report card highlights progress, priorities and shortcomings in ocean observations in an era of growing impacts on burgeoning coastal populations from sea level rise, as well as threats to marine ecosystems from pollution and climate change.

The report card was prepared by the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the World Meteorological Organization (WMO) and UNESCO's Intergovernmental Oceanographic Commission (IOC).

According to Mr David Legler, chair of the JCOMM Observations Coordination Group, significant progress has been made over the last few yeas, in weather and climate forecasts, in improved early warning systems at sea and on land, and in better scientific understanding of climate change and variability. Global ocean heat content, increasing ocean acidification and sea level rise can now be observed with unprecedented accuracy thanks to contributions and collaborations from many nations to support ocean observing systems.

The report card was scheduled to be presented during WMO's annual Executive Council sessions on 22 June devoted to ocean science and observations.

The Executive Council voiced WMO's commitment to the UN Decade for Ocean Science for Sustainable Development (2021-2030). Peter Haugan, Chair of UNESCO IOC, said the decade-long event would support the global agenda on sustainable development, disaster risk reduction and climate change. He said that societal outcomes included a safe ocean, a sustainable and productive ocean, and a transparent and accessible ocean.

"This is a once in a lifetime opportunity," he said. Potential major breakthroughs include mapping the entire ocean flood and process, creating an inventory of ecosystems and their functioning, and bolstering ocean observation systems in all basins.

"The increase in megacities on the coastline means that we are more exposed to coastal hazards and that we are also putting more stress on ocean health. Society needs ocean-based observations and information to support sustainable development, climate change adaptation and disaster risk reduction. Our challenge is to grow the global ocean observing system to meet those demands," said Johan Stander, President of JCOMM.

The ocean observing system is based primarily on satellite observations and in situ platforms, including ship-based weather stations, moored and drifting buoys, autonomous profiling floats, dedicated research vessels and tide gauges. It has developed significantly over the last few years thanks to new technologies based on autonomous platforms and improved sensors and telecommunications. But one of the greatest challenges is to secure sustained resources and fill observation gaps such as in the Arctic, the Southern Ocean, regional basins and the deep ocean below 2,000 meters.

Forecasting tropical cyclones and storm surges

Real-time observations, especially of upper ocean temperature and salinity are vital for forecasts on the development and intensification of tropical cyclones. This facilitates early warnings and better risk management.

The 2017 Atlantic hurricane season was one of the most destructive and costly on record. Accurate advance predictions that the season would be above average were based, in part, on ocean observations.

Gliders and air-deployed micro-floats provided higher density measurements ahead of hurricanes Irma and Jose, which helped to improve the forecast of storm intensity in the days and hours before they made landfall. Without the forecasts and warnings, the loss of life would have been even higher.

Aircraft forced to loop in sky as fog sets in over ORTIA

- Xolile Jele and Lebogang Makati

Fog is a common phenomenon thto causes considerable disruptions in the transport industry, particularly air and road transport. It is one of the greatest hazards in the aviation industry as airlines oose large amounts of money due to delays. In South Africa, the airports most prone to fog include O. R Tambo International (ORTIA), Kruger Mpumalanga International (KMIA), Cape Town International (CPTIA) and the George Airport. One of the largest aircraft incidents that South Africa encountered due to fog was in 2011, when two aircraft crashed just outside Tzaneen following their participation at the Tzaneen Airshow.

Fog is thought of as 'a cloud on the ground', but it is much more than this, given its very dynamics of formation, intensity, the nature of the droplets that it consists of, and its spatial extent and duration. Fog occurs for many different reasons and can be extremely elusive when it comes to predicting its exact occurrence. Will fog form? Where will it form? When will it form? How long will it persist? These are only a few of the many questions forecasters and aviators ask about fog.

As mentioned, fog is elusive, and predicting it becomts more difficult with the type of fog. There are two types that commonly affect us: Advection and Radiation fog. In this article, we discuss one case or advection fog that affected O.R Tambo International Airport in early winter of 2018.

ORTIA experienced disruptions on 4 June 2018 due to fog. Aircraft allegedly had to be diverted to other airports while other airlines had to loop in the sky for an extended period as seen from the FlightRadar24 image (Figure 1) taken in the early morning of 4 June.

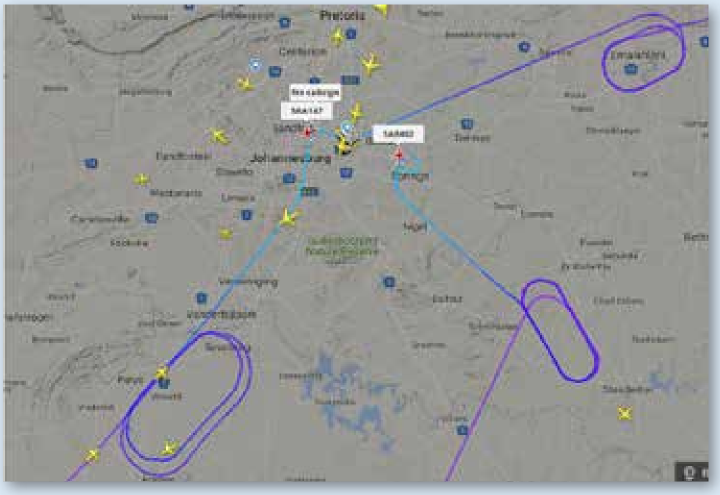


***Figure 1**:*

Flight Radar24 image showing different flights

***Figure 2**: O.R Tambo air site without fog*

***Figure 3**: O.R Tambo air site covered in fog. Picture taken by Ms Xolile Jele (Forecaster: OR Tambo International Airport)*

The visibility dropped to 100 m at ome point. Figure 2 shows normal visibility at O.R. Tambo, while Figure 3 shows fog at the airport on 4 June.

Some of the challenges that airlines experience following low cloud and poor visibility include having to manage flight backlogs in order to accommodate the flights which are diverted/delayed. Forecastr's workload increases as wel, due to phone calls from pilots, airlines and frustrated passengers needing information on the expected time for weather improvement, or for other purposes, as well as updating products on the aviation website (http://aviation.weathersa.co.za). At some airports such as KMIA, fog can persist for extended periods of time, clearing only in the early afternoon.

Despite the complexity of forecasting this phenomenon, forecasters are well-equipped and trained to understand its occurrence and thus continue to give accurate forecasts to clients.

Global Atmosphere Watch: Four decades of atmospheric trace gas measurements at Cape Point

- Warren R. Joubert (compiler)

South Africa's trace gas observatory at Cape Point, operated by the South African Weather Service (SAWS), has been monitoring ambient greenhouse gases (GHG) concentrations, e.g. carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and selected chlorofluorocarbons (CFCs) since the late 1970s. Highlights from a recent publication by *Labuschagne et al*, (2018)* reviewing the long term data records are summarised in this article.

Introduction

The SAWS GAW monitoring station is based within the Table Mountain National Park at the southern tip of the Cape Peninsula, approximately 60km south of Cape Town (Figure 1). Surrounded on three sides by the open ocean, and situated on top of a steep sided cliff (approximately 230 m above sea level) the station is ideally situated for monitoring the chemistry of the marine boundary layer. The GAW Station at Cape Point is one of 32 global GAW stations around the word, and is only one of three on the African continent (http://gaw.empa.ch/gawsis). The monitoring station was officially accepted into the World Meteorological Organization (WMO)'s Global Atmospheric Watch Program in early 1995. Through international coordination by the WMO, GAW providea coherent, high quality, open access atmospheric data which provides the backbone of global *in situ* atmospheric baseline observations, and contributes essential information to the validation of greenhouse gas flux estimates essential to national and international mitigation strategies.

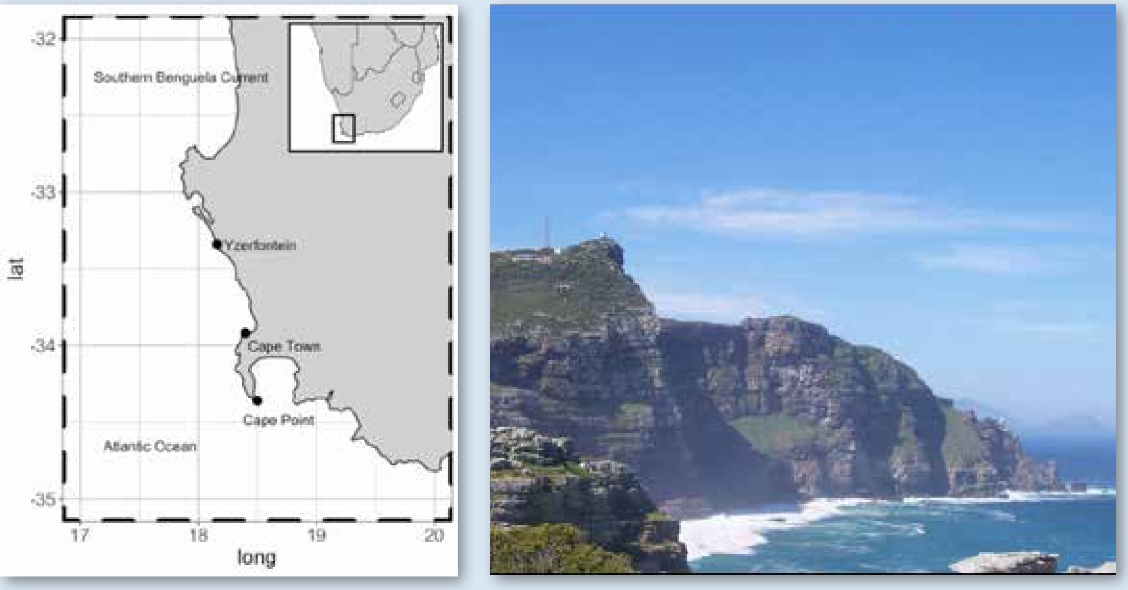


Figure 1a: *Map of Cape Point (34° 21′ S, 18° 29′ E) showing the proximity to Cape Town,* ***b****: View of the SAWS GAW monitoring station at Cape Point in relation to the coastal cliffs surrounding the site*

Meteorological conditions

The long-term time series trace gas measurements currently made at Cape Point, highlight the importance of this monitoring station to our global understanding of the atmosphere. The local meteorological conditions typically draw clean marine air from the southern Atlantic Ocean, which makes Cape Point an ideal baseline station to monitor key indicators of changes and trends in the atmosphere of the Southern Hemisphere. The clean marine air predominates during the austral spring to autumn (November to April) period during whien the Cape Peninsular is buffeted by strong south easterly to south westerly winds. During this period, the South Atlantic High Pressure system is situated to the SW of the sub-continent and is responsible for the advection of air towards Cape Point from a SE direction. During the austral winter, the weather at Cape Point is also largely dominated by passing cold fronts, often with accompanying rainfall, moving from west to east. The north westerly winds in winter drive polluted air from the city of Cape Town southwards, and this anthropogenic derived pollution is occasionally detected at the Cape Point monitoring station.

Chemical atmosphere monitoring

The primary focus of the Cape Point GAW programme has been to measure the most important long-lived greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and short-lived greenhouse gases e.g. surface ozone (O_3), on a sustainable, long-term basis. Initially, the monitoring station focused on the measurements of CO and four halocarbon species (e.g. $CFCl_3$, CF_2Cl_2, CH_3CCl_3 and CCl_4) in the atmosphere.

CO_2 is recognized as the most important anthropogenic, long-lived greenhouse gas in the atmosphere ach contributes more than 60% of total radiative forcing of the long-lived greenhouse gases (IPCC, 2013; WMO, 2017; Zhang et al., 2016; Campbell, 2017). Systematic measurements of the tropospheric CO_2 abundance started in 1958 at the Mauna Loa station in Hawaii and led to the, now famous, record for this gas (Keeling et al., 2009). The Cape Point CO_2 time series (1993-2017, Fig 2.), fluctuates between 1.5 and 2.8 ppm y^{-1} and shows rates similar to those reported by other global sites where a CO_2 growth rate was reported as 2.08 ppm yr^{-1} for 2005-2015 period and of 2.3 ppm yr^{-1} specifically for the 2014-2015 period.

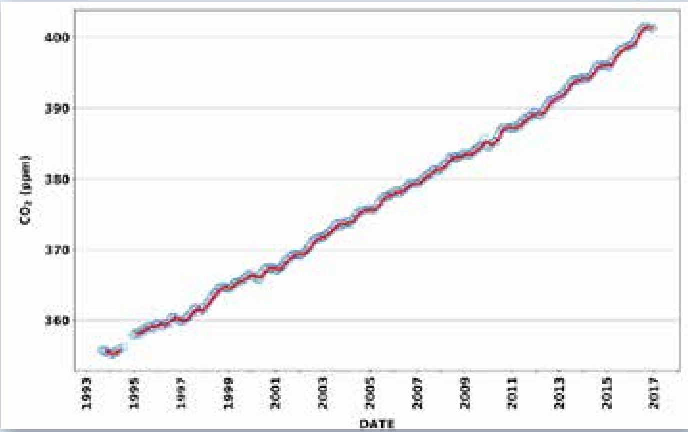


Figure 2:
Cape Point CO_2 time series (1993-2017) showing monthly means, moving average (red)

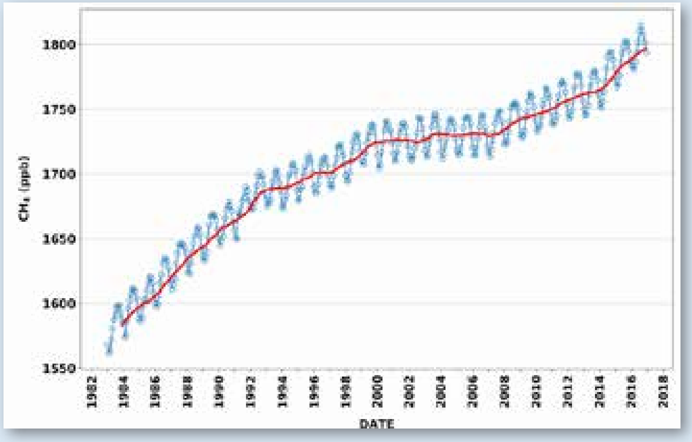


Figure 3:
Cape Point CH_4 monthly means (1983-2017) for BG data where the rRed line highlights the moving average and a strong seasonal cycle is observed

Tropospheric methane (CH_4) measurements have been conducted at Cape Point since 1983 (Figure 3). Although atmospheric CH_4 mole fractions have shown an overall upward trend since measurements began at Cape Point, the growth-rate has decreased from 12 ppb yr-1 in 1982 to 2 ppb yr^{-1} in 2003. The growth rate then stabilized and remained just above zero (near equilibrium state) for approximately 3 years. From October 2007 onwards, CH_4 mole fractions have increased again, reaching a growth rate by 2016 of about 11 ppb yr^{-1} which relates well to the global average of 9.0 ppb yr^{-1} for the years 2013 to 2015.

N_2O is present in lower concentrations in the atmosphere, however it has a global warming potential which is 280 - 300 times higher than that of CO_2. Globally, only half of the research stations within the network measure its concentrations on a continuous basis. A linear regression fit to the monthly mean N_2O mole fractions indicates a local growth rate of 0.72 ppb yr^{-1} at Cape Point over this 23-year period.

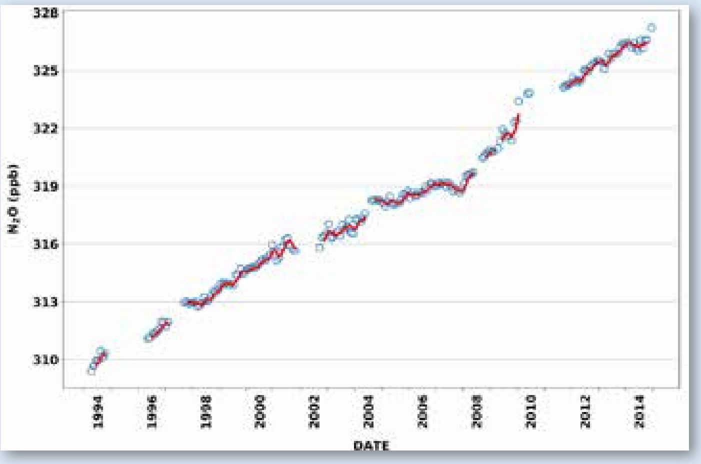


Figure 4:
Monthly means of N_2O at Cape Point from 1993 till December 2015

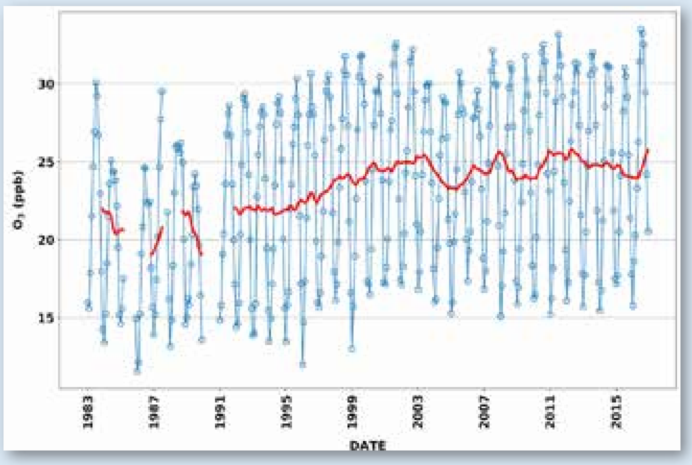


Figure 5:
O_3 time series of monthly means (1983-2017) and moving average (red)

Ozone (O3) plays an important role in controlling the chemical composition of the troposphere and consequently exerts a significant influence on global climate. Long term observations shows only a small increasing trend. However, strong seasonal variation is observed during the extended time series (Fig 5). The overall seasonal cycle of O3 in the marine atmosphere (low in NOx) is primarily driven by O3 photolysis, which is a function of the annual solar cycle. In winter, when the solar intensity is at its minimum, the photochemical breakdown of O3 is at a minimum, thus giving rise to the ozone maximum during austral winter and its minimum in summer.

The longest of the trace gas records at Cape point is that of carbon monoxide (CO), which has been fairly consistent over the period from 1978-2000, after whier a decreasing trend was observed (Fig 6). Since 2000, a declining trend was observed at Cape Point in-situ measurements. The reported decreasing trend may be relatto, *inter alia*, to a decrease in the occurrence of biomass burning, especially on the African continent, as well as economical drivers such as the global recession which has resulted in an overall decrease in industrial manufacturing practices.

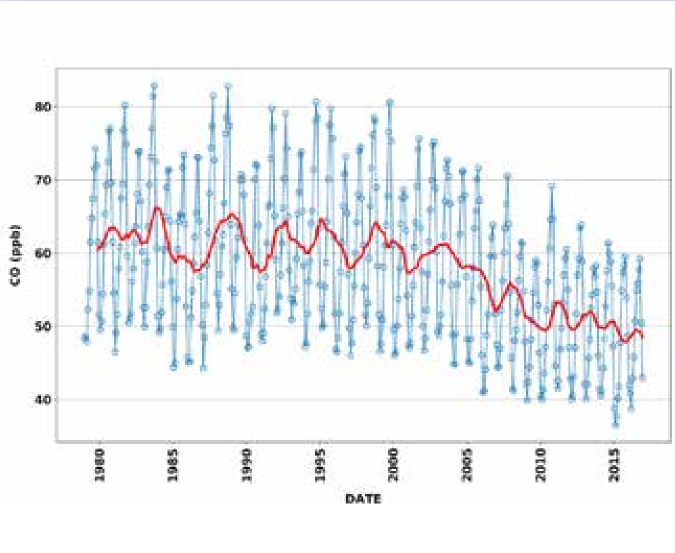


Figure 6:
CO time series of monthly means for Cape Point with monthly moving average shown in red (1979-2016)

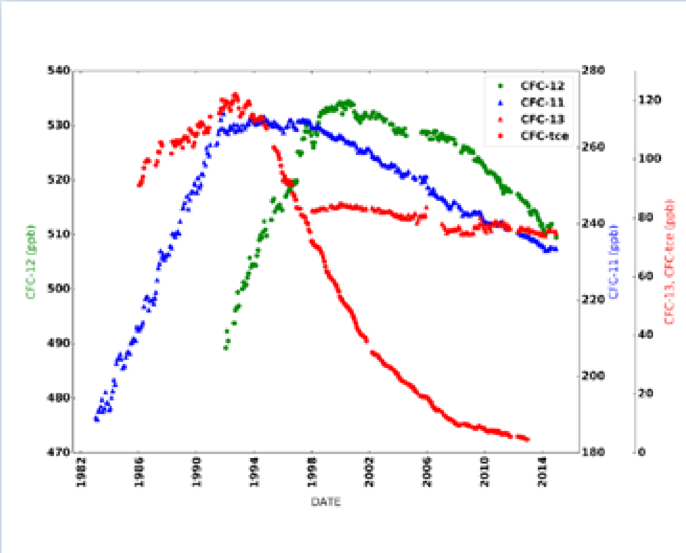


Figure 7:
Time series of filtered monthly means of halocarbons measured at Cape Point. Halocarbons measured include: CFC-11 (blue triangles), CFC-12 (green points), CFC-13 (red triangles), and TCE (red points)

In the early 1980s, it was discovered that the anthropogenically produced chlorofluoro-carbons (CFC) compounds used in refrigeration systems were resulting in the catalytic destruction of stratospheric O_3. The main halocarbons (including the classic CFCs) measured at Cape Point include: CFC-11, CFC-12, CFC-113, trichloroethylene (TCE) and CCl_4 have been made from 1979. To protect the Ozone layer, the most noteworthy impact is that of the Montreal Protocol of 1987d later amended in Kigali 2016), to globally phase out the ozone destroying CFC's. The subsequent observations show the decreasing trend in these chemicals within the atmosphere (Fig. 7).

In summary

The Cape Point GAW monitoring station has provided a platform for extensive climate change and trace gas measurement for the past four decades. This monitoring station is unique in receiving clean marine air from the Atlantic sector of the Southern Ocean and is able to monitor local anthropogenic contributions to the Southern Hemisphere Observations at Cape Point are consistent with other global research sites. The data reviewed here provides an insight into the climate change processes occurring in the atmosphere of the Southern Hemisphered especially from the Atlantic sector of the Southern Ocean. A combination of the climatology of the Cape peninsula and the position of the Cape Point GAW station, relative to the city of Cape Town, provides a unique opportunity to monitor both background and non-BG air masses and processes. In addition to contributing to a global understanding of the atmosphere for the past four decades, the Cape Point GAW station continues to provide an internationally recognised platform for growing the understanding of globally sensitive atmospheric chemicals.

*Labuschagne, C., B. Kuyper, E-G. Brunke, T. Mokolo, D. van der Spuy, L. Martin, E. Mbambalala, B. Parker, M. Anwar H. Khan, M. T. Davies-Coleman, D. E. Shallcross & W. R Joubert (2018): A review of four decades of atmospheric trace gas measurements at Cape Point, South Africa, Transactions of the Royal Society of South Africa. https://doi.org/10.1080/0035919X.2018.1477854.

Climate Change: Is it only a problem of the future or can SAWS resources already begin to facilitate climate resilience?

- Hannes Rautenbach and Elizabeth Webster

In recent years, climate change has become a burning issue, with the South African Department of Environmental Affairs (DEA) at the forefront of international interventions to combat global warming. As a result, South Africa is actively involved in initiatives to provide guidance towards both mitigation and adaptation planning and response in the light of increasing global temperatures. Not only did South Africa develop national mitigation and adaptation strategies, but a new climate change bill was also recently released for public commets. Most of these interventions require that Government on all levels (national, provincial and municipal) should prepare relevant climate change adaptation strategies thao need to be reviewed and updated on a regular basis. In future, it will also be required that businesses include climate change as an important performance indicator in annual reports. The Gauteng Province, for example, recently went into great depth to prepare a comprehensive climate change adaptation strategy, which is seen as an ongoing process in consultation with the people of Gauteng. Other provinces are also engaging in similar processes, and progress is reported on an annual basis to DEA.

With global warming as a central indicator of climate change, reliable future projections have been regarded as essential for climate change adaptation planning. That is why such projections formed an important part in the preparation of Long-Term Adaptation Scenarios (LTAS) for South Africa.

It is no wonder that most adaptation strategies are exclusively based on model-generated future projections, with little or no reference to observed climate trends. It is therefore generally assumed that climate change is "a problem of the futur", while, in reality, climate change might already be present in current climate variability, with climate anomalies such as floods and droughts beie reported on a regular basis all over the world. Although the increase in floods and droughts mighl be merely a perception encouragd by advances in communication technology and te, population growth associated with an increase in land occupation and greater awareness, the reality is that social society has always been exposed to extreme climate events, and is still being challenged by these events on an annual basis. Devastating impacts are especially being felt in vulnerable communities, in many cases becaure vulnerability is a result of ignorance to the realities of natural climate variability (Figure 1).

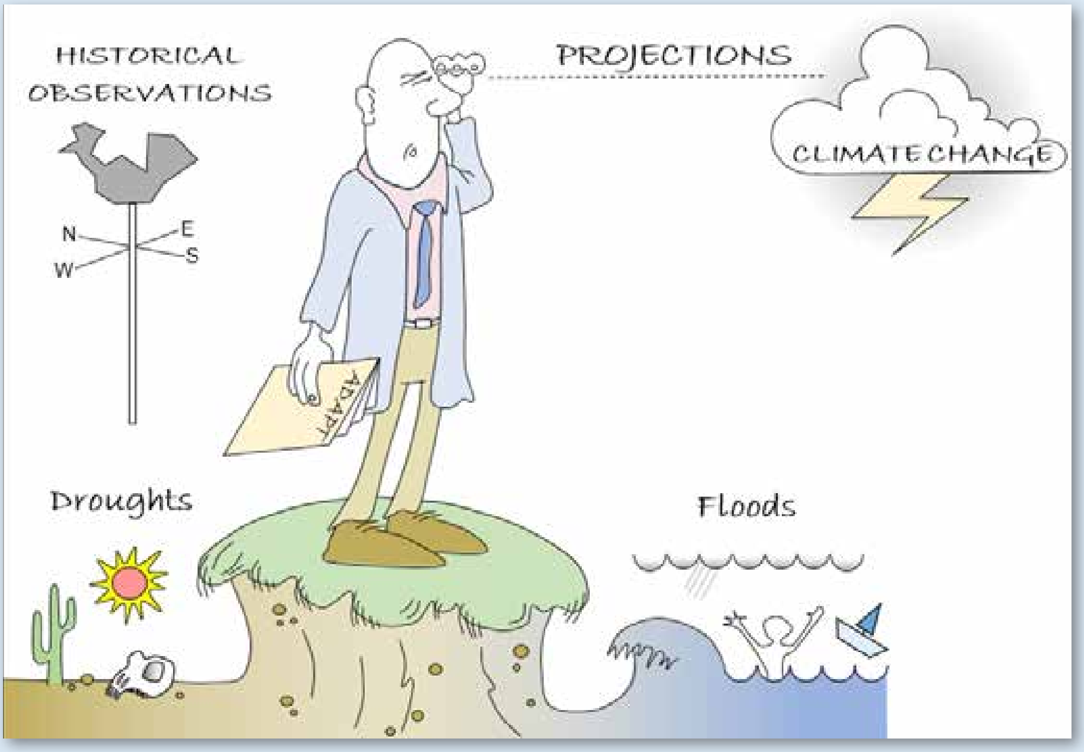


Figure 1:
Are we putting too much emphasis in framing climate change as "a problem of the future", while we ignore the realities of climate extremes in natural climate variability?

The South African Weather Service (SAWS), with its extensive observational infrastructure, can play a profound role in creating greater weather and climate variability awareness. An increase er knowledge by social society, not only about climate averages but especially about the upper and lower limits of previously observed climate extremes, can contribute significantly to climate risk assessment and, eventually, to much greater climate resilience (Figure 2). As far as climate extremes are concerned, SAWS is already informing the National and Provincial Disaster Management Centres on a regular basis about extreme weather and climate risks. This is currently being done on a weekly basis through presentations on the prevailing drought that are compiled by SAWS and sent to a National Joint Drought Coordination Committee, highlighting the expected country-wide weather conditions for the week as well as the recent weather. With the development of its weather forecasting and climate outlook capabilities, SAWS has made excellent progress over recent decades in the advancement towards the development of early warning products and services. The early warning services provided by SAWS are constantly being revised in accordance with global standards as SAWS is currently embarking on developing an Impact-Based Severe Weather Warning System. This will modify the current threshold-based weather warnings into user-oriented impact-based warnings. These warnings will be communicated in a non-scientific manner with the aim of reaching as many South Africans as possible.

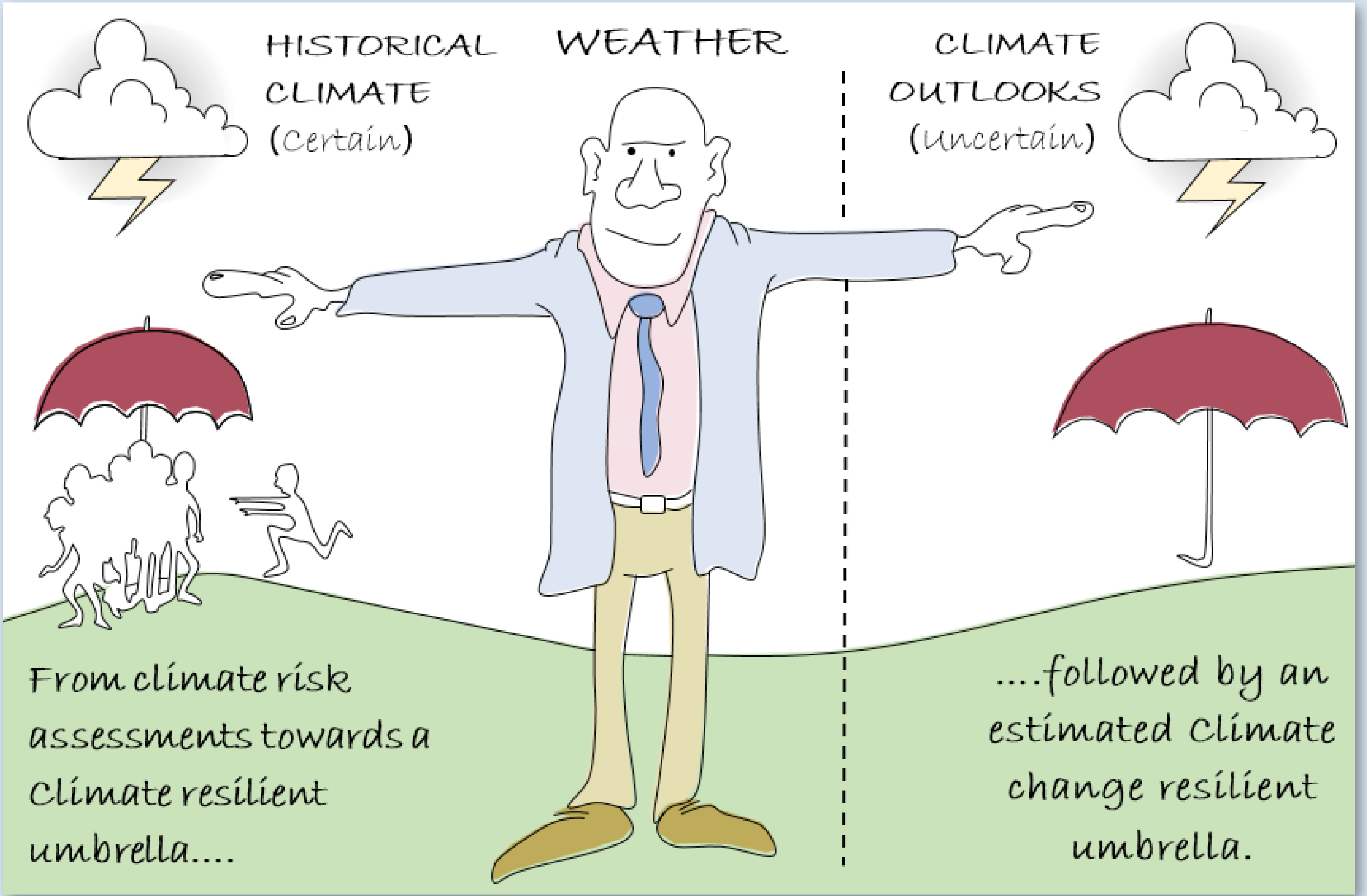


Figure 2:
The South African Weather Service (SAWS) can play a great role in climate risk assessment, which will contribute to greater climate resilience. This can already create a stronger basis for affective climate change adaptation.

With its traditional mandate to issuie short-term weather forecasts, SAWS is also advancins the provision of informative climate services. With the availability of long climate observational records, improved short-term weather forecasting capabilities, eventually linked to dedicated climate outlook services, SAWS can cover the entire spectrum of climate change and variability. With such a framework in place, SAWS can make an indispensable contribution, not only in creating greater climate resilience, but also in preparing a basis for more effective climate change adaptation planning.

The predicted, impact and observed inclement weather over the Western Cape Province during 1 to 2 July 2018

- Stephanie Landman, Michael Barnes, Bathobile Maseko, Elizabeth Webster

Following the past three years' dry conditions over the winter rainfall region of South Africa, the seasonal forecasts issued in April and May 2018, respectively, for the region were a bit more optimistic (even with less than ideal predictive skill see Figure 1).

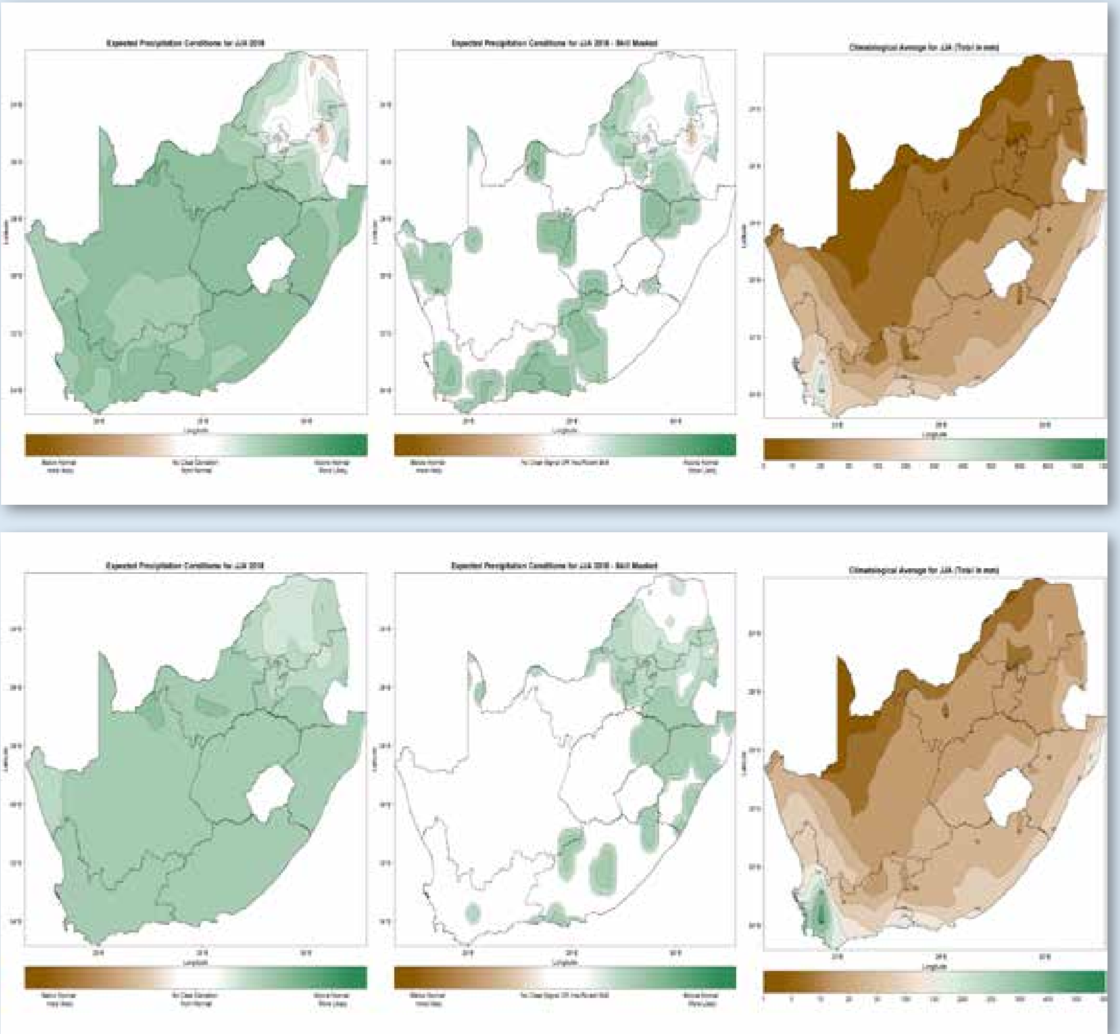


Figure 1: *Seasonal forecasts issued on a) April 2018 for June-July-August (JJA) 2018 seasonal precipitation prediction without skill taken into account, b) prediction skill masked out and issued on 28 May 2018 for JJA 2018 seasonal precipitation prediction c) without skill taken into account, d) prediction skill masked out*

The rainfall during the austral winter months is predominantly the result of the movement of mid-latitude low pressure systems over the southern and south-western parts of the country, resulting in cold and wet weather. The further north these systems occur, the larger the part of the country is affected by the cold weather. This was the case from 1 to 2 July 2018 when the cold front moved quite a bit north (Figures 2 a and b). This system resulted in high-impact events over the regions due to extreme cold, snow and high rainfall events. This event was well captured and predicted by numerical weather prediction models and the SAWS issued advisories and warnings in advance.

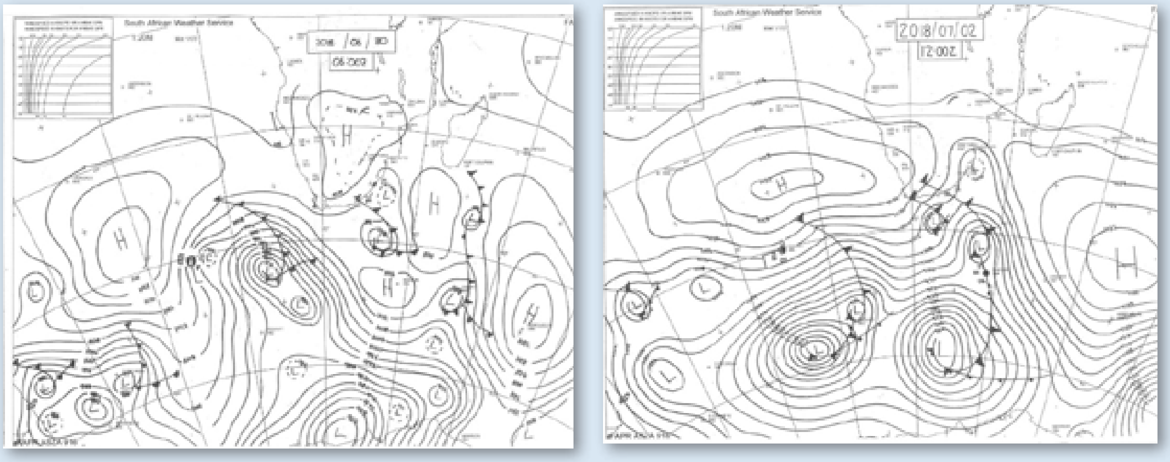
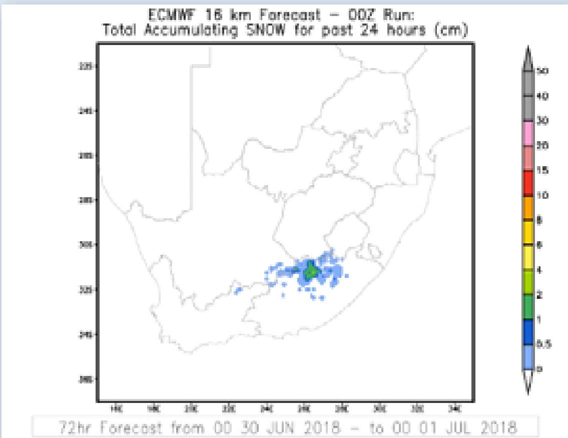


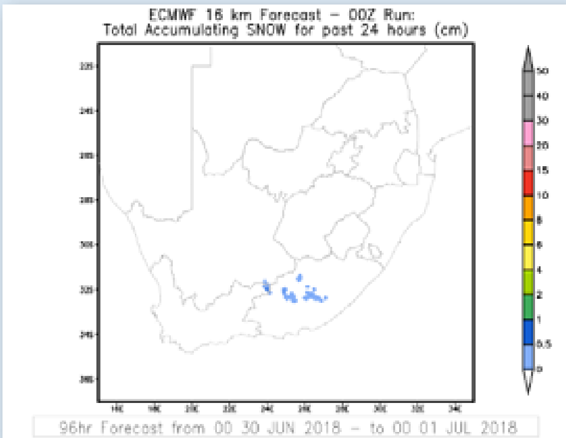
Figure 2: *Observed shipping charts for a) 06 Z on 30 June and 12 Z 2 July indicating the position of the cold front moving across the southern parts of the country*

Numerical Weather Prediction

The South African Weather Service (SAWS) uses the Unified Model (UM) for high resolution, short-range (1 - 3 days), operational numerical weather prediction (NWP). The UM is running at 4 km and 1.5 km configurations four times a day on SAWS' in-house high-performance computing system (Cray XC30). The output from these high resolution forecasts and global medium-range (3 – 10 days) forecasts, which we receive from the European Centre for Medium-Range Weather Forecasts (ECMWF; https://www.ecmwf.int/), provide objective guidance fto the operational forecasts on the expected conditions hours and days ahead. The forecasts are available to forecasters through in-house display systems which assist them in issuing the official public forecasts.

In this case, medium-range NWP models indicated chances of strong winds, snowfall and heavy rainfall over the high-lying areas of the western parts of the Western Cape and the southern interior of the Northern Cape (Figure 3). Forecasts generally remained consistent on the medium-range timescale with respect to the intensity of the system. NWP models indicated chances of snowfals in places over the high-lying areas of the Western and Northern Cape Provinces overnight on 1 July 2018 into the morning of 2 July 2018 (Figure 4), although snowfall accumulations varied between different medium-term systems. 20-40 mm Rainfall was also projected for the western parts of the Western Cape Province with up to 60-65 mm expected over the mountainous areas (Figure 5).





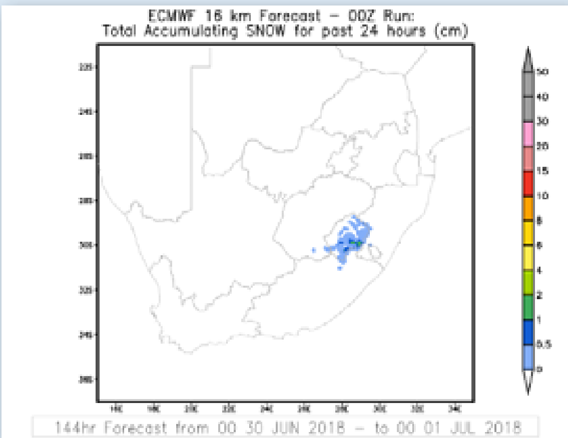


Figure 3 a – c:
Daily total snowfall accumulations predicted by ECMFW model from 3 to 6 days in advance

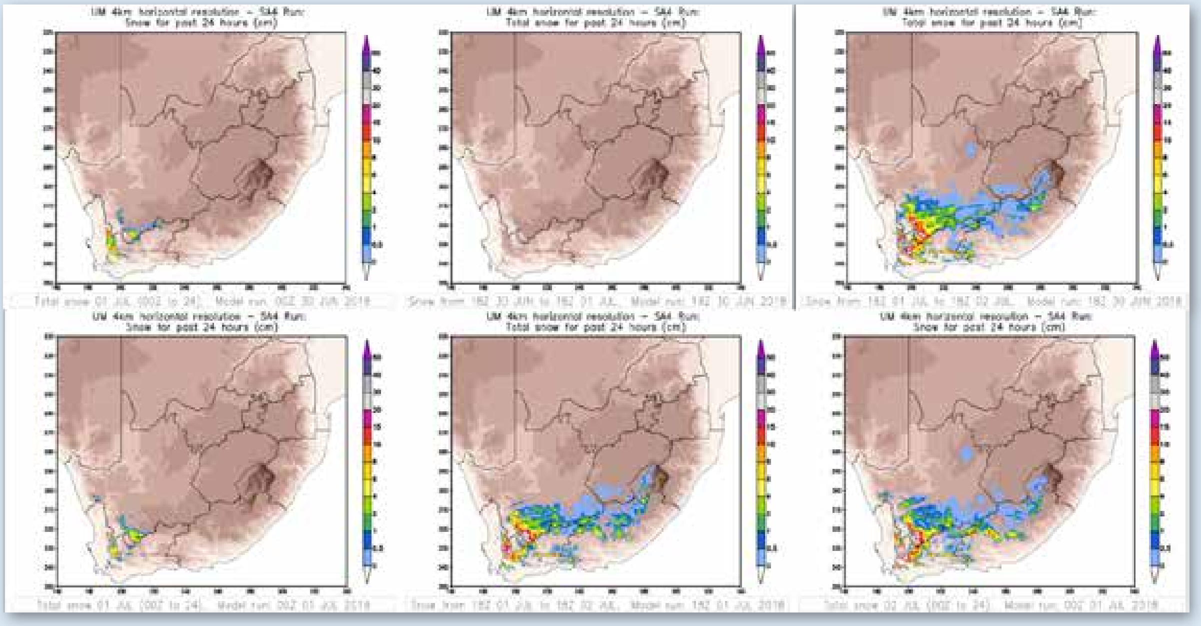


Figure 4
a – f: Daily total snowfall accumulations predicted by UM model from 30 June through to 2 July 2018

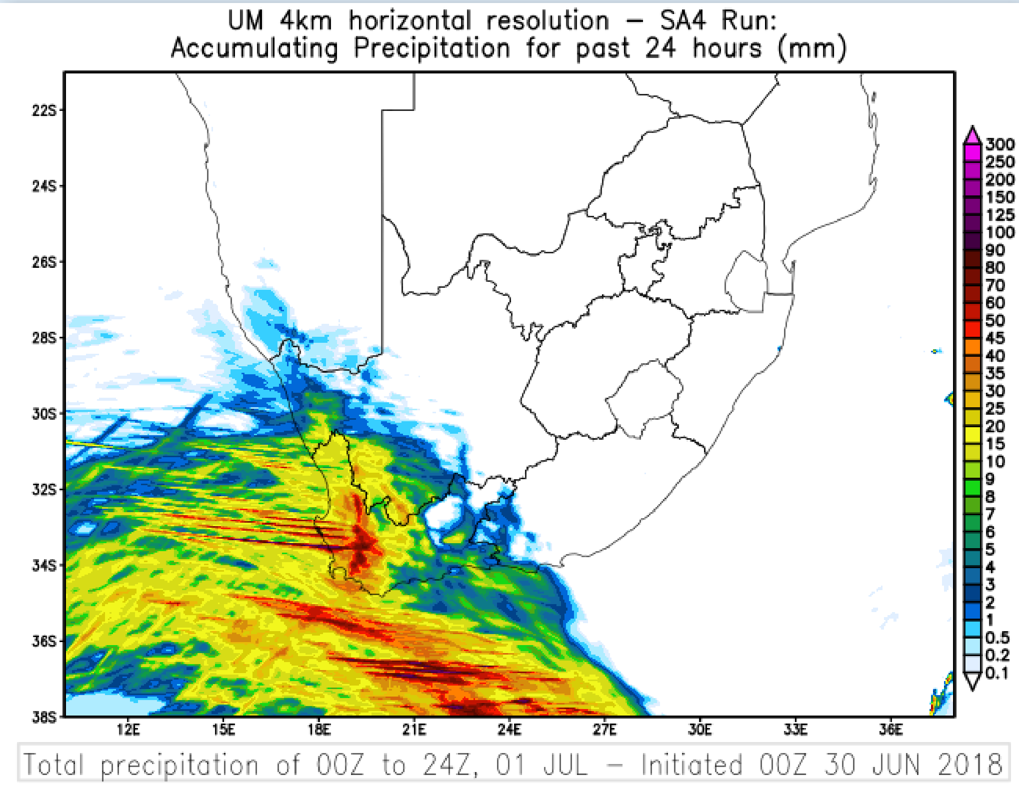
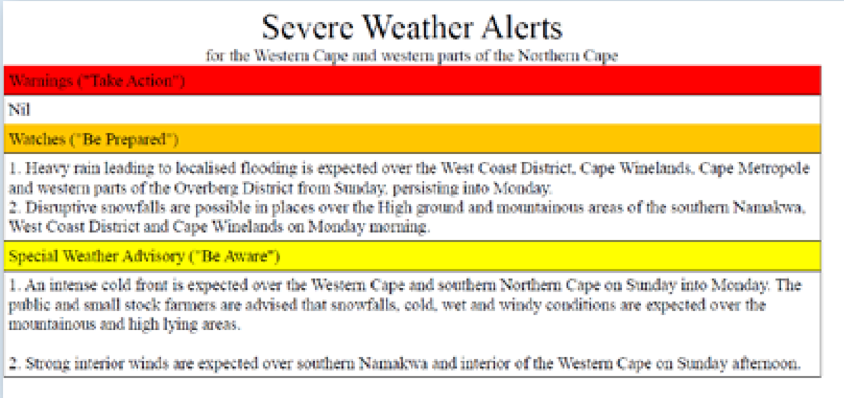


Figure 5:
Map indicating the expected 24-hour rainfall total for 1 July already predicted at 00Z on 30 July 201

The Official SAWS Forecasts:

As a result of the NWP forecasts for 1 and 2 July 2018 remaining relatively consistent up to 28 June 2018, the Cape Town Weather Office was able to issue an advisory for adverse cyclonic conditions resulting in snowfalls, very cold conditions strong winds, heavy rainfall and localised flooding for 1 and 2 July 2018 on 28 June 2018, 4 to 5 days before the event. The alert was issued for the entire Western Cape and southern parts of the Northern Cape and disseminated to all media houses and disaster management teams across the region. Rainfall forecasts remained consistent into 29 June 2018, 3 days before the event. Forecasters were therefore able to upgrade tan alert with respect to heavy rainfall and flooding to a watch on 29 June 2018. The aree expected to be affected was refined to the western parts of the Western Cape. NWP models also began to forecast greater amounts of snowfall throughout the western mountainous areas of the Western Cape and the southern parts of the Northern Cape. NWP suggested amounts of 10 – 20 cm of snowfall overnight on 1 June 2018 into 2 June 2018 with up to 30 cm in the mountainous areas. Freezing levels were projected to be extremely low at 3500 – 4000 ft above mean sea level. With extremely low freezing levels, and some mountain passes in the area not exceeding 3000 ft above mean sea level, together with the large amount of snow expected to fall over these areas, forecasters determined that snowfalls would likely be disruptive. The following alerts were issued on 29 June 2018:



Severe Weather Alerts
for the Western Cape and western parts of the Northern Cape

Warnings ("Take Action")

Nil

Watches ("Be Prepared")

1. Heavy rain leading to localised flooding is expected over the West Coast District, Cape Winelands, Cape Metropole and western parts of the Overberg District from Sunday, persisting into Monday.
2. Disruptive snowfalls are possible in places over the High ground and mountainous areas of the southern Namakwa, West Coast District and Cape Winelands on Monday morning.

Special Weather Advisory ("Be Aware")

1. An intense cold front is expected over the Western Cape and southern Northern Cape on Sunday into Monday. The public and small stock farmers are advised that snowfalls, cold, wet and windy conditions are expected over the mountainous and high lying areas.

2. Strong interior winds are expected over southern Namakwa and interior of the Western Cape on Sunday afternoon.

Figure 6:
Severe weather alerts issued by the Cape Town Weather Office on 29 June 2018 valid for 1 and 2 July 2018 for the Western Cape and Namakwa District of the Northern Cape

Alerts for heavy rainfall and flooding, as well as disruptive snowfalls, were further upgraded to warnings on 30 June 2018, 1 to 2 days before the event with NWP models, including our high resolution operational models (Figure 6), indicating similar forecasts to the medium range global models during the preceding days.

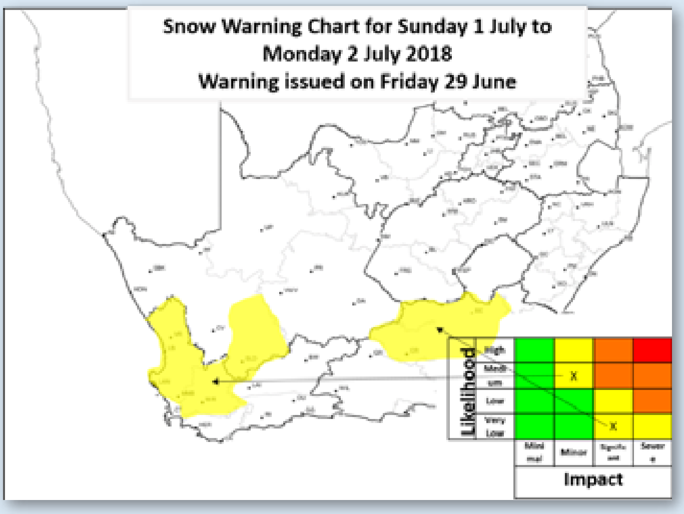
Impact forecasts of the snow event:

The South African Weather Service (SAWS) is currently developing a new Impact-Based (ImpB) Severe Weather Warning System (SWWS) which is being tested across the country during the running of pilot phases. These pilot phases are aimed at working with the local disaster managers to test the warning system ahead of implementation in early 2019.

This cold front system was the perfect opportunity to, once again, test the ImpB SWWS. Forecasters issued "heads-up" e-mails to the disaster managers on Friday 29 June, highlighting the expected weather conditions. Snow warnings were issued for the north-eastern parts of the Eastern Cape, where a very low likelihood of significant impacss was expected and the north-western parts of the Western Cape, extending into the southern Northern Cape where a medium likelihood of minor impacts was expected (Figure 7). The main impacts that were expected were difficult driving conditions due to icy roads, the closure of passes and danger to small stocks and crops in high-lying areas, especially over the Eastern Cape.

The forecasters in the Bloemfontein forecasting office issued a heads-up to their respective disaster managers, alerting them to the possibility of severe frost in places over the Free State.

There was a low likelihood of significant impacts as a result of rainfall expected over the western parts of the Western Cape (Figure 8), with the main impacts being flooding in the low lying areas, especially over the Cape Flats.



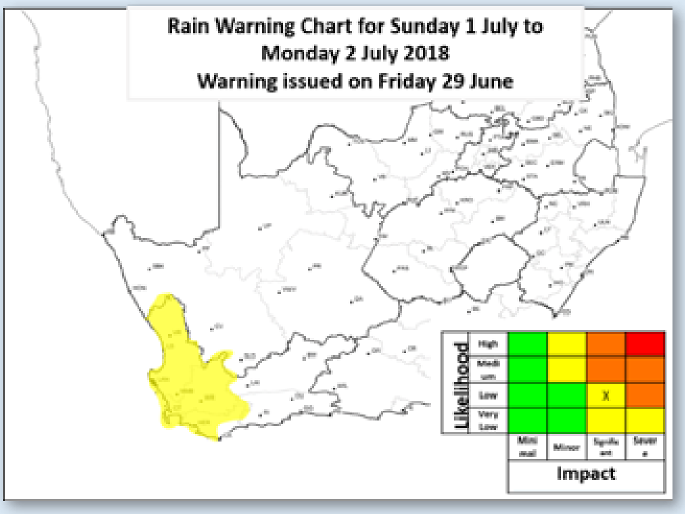


***Figure 7** (left):* Snowfall warning issued on Friday, 29 June, valid for Sunday into Monday (1 - 2 July)
***Figure 8** (right):* Rainfall warning issued on Friday, 29 June, valid for Sunday into Monday (1 - 2 July)

The forecasts were updated daily and constant communication was maintained with the local disaster managers. As a preventative action, the Western Cape Disaster Management Centre activated their Joint Operation Centre (JOC) in whire various representatives from the emergency divisions worked together to decide the most suitable response and actions that needed to be in place ahead of the inclement weather.

Reports of impacts were received from the local disaster managers as well as from the media. Many passes were closed and icy roads were experienced, which led to difficult driving conditions (Figure 9). Disaster managers reported cars that were stuck in the snow ad, requirng assistance to be towed out.

Figure 9:
Snow on the road on top of Swaarmoed Pass, Western Cape caused difficult driving conditions (source: Face-book, Snow Report, Trish Hugo).

Many impacts were also reported due to the rain that occurred, mainly in the western parts of the Western Cape. These included the flooding of homes (Figure 10) and streets (Figure 11), as well as the trailer of a tractor thas washed away and resulted in at least one death. Mudslides were also reported in Bainskloof, and the Huguenot Tunnel had to be closed.

Figure 10:
Flooding reported in City of Cape Town
(Source: Phando Jikelo/African News Agency/ANA)

Figure 11:
Flooding of roads in Sea Point
(Source: Twitter@LifeisSavage)

Overall, the feedback from the disaster managers has been very positive about the manner in which this weather event was handled and the warnings that were issued by the forecasters. The warnings accurately identified the hazards that occurred well in advance and wery communicated clearly and in an understandable way

Observations of the event:

The majority of the rainfall fell over the western parts of the Western Cape during 1 July 2018 into the morning of 2 July 2018, with 20 - 40 mm recorded over the majority of the City of Cape Town, the Cape Winelands District, the West Coast District and in eastern parts of the Overberg District (Figure 12). Heavy rainfall of 50 mm or more was also recorded in places over the mountainous areas. The highest 24-hour accumulation of 124 mm was recorded at Ceres.

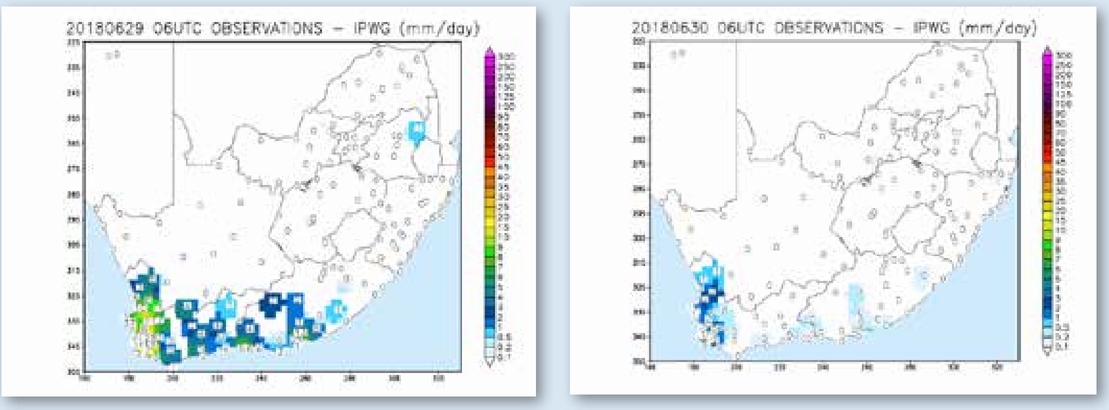


Figure 12 a –d:
Rainfall observations for 29 June to 2 July

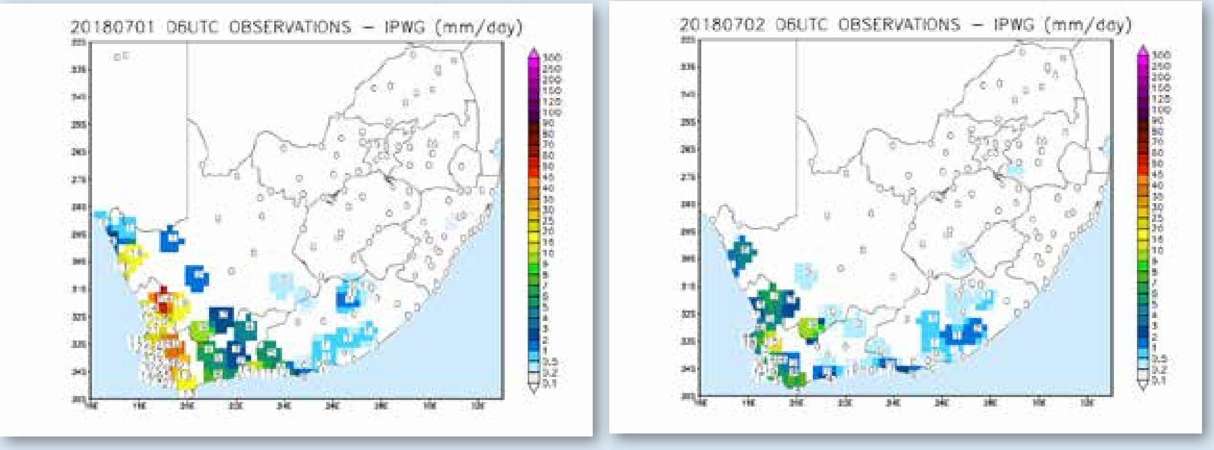


Figure 12 a –d: *Rainfall observations for 29 June to 2 July*

Figure 14:
Flooding in the City of Cape Town (Picture: Phando Jikelo, African News Agency/ANA)

Figure 13: *Berg River near the N7 (Picture: Franquin Petersen, West Coast Disaster Management Centre)*

The large amounts of rain recorded impacted vulnerable areas across the south-western Cape. In the Cape Winelands District, municipality officials reported that 6 people drowned attempting to cross the Jan du Toit river in the Rawsonville. Flooding of formal and informal settlements was also reported across the district. Mudslides were reported in the Bainskloof Pass. The City of Cape Town also received reports of impacts in the city. Multiple informal settlements including Khayalitsha, Phillipi and Macassar were flooded, and about 4000 homes were affected across the city.

Widespread snowfalls fell across the western parts of the Western Cape and southern parts of the Northern Cape overnight on Sunday 1 July 2018 into the morning Monday 2 July 2018 (Figure 15). The majority of high-lying areas also received snow during this time. This resulted in a number of passes being closed over the western parts of the country including the Gydo and Theronsberg passes in the Witzenberg District. Major traffic routes were also affected, with the HexRriver Pass on the N1 receiving significant snowfalls and reports of icy roads on Sir Lowrys Pass on the N2 leading to motor vehicle accidents.

Figure 15:
Snow over the south-western Cape (Picture: MODIS)

Several new climatological records were set across the Western Cape Province (Table 1). The most significant record broas the 18-year old record at Lindleyspoort with a minimum of -4.1 °C on the morning of 3 July 2018. Grabouw experienced 2 new extreme values with 65 mm for the highest daily rainfall (which was also the highest recorded for the period - Table 2) and 10.2 °C for minimum temperature. However, the lowest minimum temperature recorded during this period was at Buffelsfontein with -12.3 °C (morning of 4 July 2018). During this cold weather event, the minimum temperature at Buffelsfontein remained at around -10 °C and lower. In contrast, northern stations had maximum temperatures as high as 31.3 °C (Makatini Research Centre).

Parameter	Old	Old Date	New	New Date	Num of Year	Station
Lowest Minimum	6.5 °C	2015-07-14	6.1 °C	2018-07-01	7	PORT ST. JOHNS
Highest Daily Rain	49.0 mm	2015-07-17	65.0 mm	2018-07-01	3	GRABOUW
Highest Daily Rain	27.6 mm	2015-07-30	53.8 mm	2018-07-01	10	NIEUWOUDTVILLE
Highest Daily Rain	22.8 mm	2016-07-26	27.8 mm	2018-07-01	5	GARIES AWS
Lowest Maximum	11.0 °C	2015-07-24	10.2 °C	2018-07-02	3	GRABOUW
Lowest Maximum	11.6 °C	2015-07-20	10.9 °C	2018-07-02	5	SWELLENDAM
Lowest Maximum	11.4 °C	2016-07-28	9.9 °C	2018-07-02	5	PRINS ALBERT - SWARTRIVIER
Lowest Minimum	-4.0 °C	2000-07-21	-4.1 °C	2018-07-03	18	LINDLEYSPOORT
Highest Daily Rain	14.8 mm	2016-07-26	15.0 mm	2018-07-03	5	TSHANOWA PRIMARY SCHOOL

***Table 1:** Preliminary records broken during 1 to 2 July 2018*

Parameter	Value	Date	Station
Highest Max Temp	31.7 °C	2018-06-30	MBAZWANA AIRFIELD
Lowest Max Temp	13.1 °C	2018-06-30	SUTHERLAND
Highest Min Temp	15.9 °C	2018-07-01	TSHANOWA PRIMARY SCHOOL
Lowest Min Temp	-5.8 °C	2018-07-01	FRANKFORT - TNK
Maximum 24 Hour Rainfall	14 mm	2018-06-30	GRABOUW
Highest Max Temp	30.4 °C	2018-07-01	PORT ALFRED - AIRPORT
Lowest Max Temp	11.3 °C	2018-07-01	EXCELSIOR CERES
Highest Min Temp	17.3 °C	2018-07-02	RICHARDS BAY AIRPORT
Lowest Min Temp	-1.9 °C	2018-07-02	SUTHERLAND
Maximum 24 Hour Rainfall	65 mm	2018-07-01	GRABOUW
Highest Max Temp	31.3 °C	2018-07-02	MAKATINI RESEARCH CENTRE
Lowest Max Temp	2.5 °C	2018-07-02	SUTHERLAND
Highest Min Temp	17.4 °C	2018-07-03	RICHARDS BAY AIRPORT
Lowest Min Temp	-9.8 °C	2018-07-03	BUFFELSFONTEIN
Maximum 24 Hour Rainfall	18.2 mm	2018-07-02	CERES AWS
Highest Max Temp	23.1 °C	2018-07-03	MBAZWANA AIRFIELD
Lowest Max Temp	6.6 °C	2018-07-03	SUTHERLAND
Highest Min Temp	14.6 °C	2018-07-04	HOEDSPRUIT AIR FORCE BASE
Lowest Min Temp	-12.3 °C	2018-07-04	BUFFELSFONTEIN
Maximum 24 Hour Rainfall	16 mm	2018-07-03	TSHIVHASIE TEA VENDA
Highest Max Temp	27.7 °C	2018-07-05	PORT NOLLOTH
Lowest Max Temp	10.6 °C	2018-07-05	ERMELO WO
Highest Min Temp	15.4 °C	2018-07-06	KOINGNAAS
Lowest Min Temp	-11.9 °C	2018-07-06	BUFFELSFONTEIN
Maximum 24 Hour Rainfall	4.6 mm	2018-07-05	DURBAN SOUTH ATHLONE PARK

Table 2: The coldest, warmest and wettest observations from 30 June to 5 July 2018

The 50th Anniversary of the Port Elizabeth 1968 Floods: Remembering the event that changed the face of a city

- Garth Sampson

Going to bed on Saturday night 31 August 1968, nobody could imagine what they would wake up to the next morning. When the citizens of Port Elizabeth awoke to some light rain just after 7 am, they thought it was the perfect day to roll over, snuggle-up and have a good Sunday-morning snooze. The fact that most of the population remained indoors was one of the main reasons for the relatively low number of fatalities in a disaster of this proportion.

Just before 8 am, the heavens opened, like a storm of Biblical proportions. In just over 4 hours, between 07h40 and 12h00, a total of 352 mm rain was measured at the Port Elizabeth Airport. Although this is the officially-documented figure, the autographic rain gauge at the reservoir in Brunswick Road (Adcockvale) recorded 470 mm between 08h00 and 12h00.

This equated to a sustained rainfall intensity of 20 to 30 mm per 15-minute period over this 4 hour period. This turned roads and streets into raging rivers that caused wave upon wave of destruction. City fathers had no way of designing a storm water system that could even vaguely cope with this amount of water. Experts claim that this was a flood with a return value of more than 100 if not 1000 years (i.e. would only occur once in 100 if not 1000 years).

By the end of the day, the airport had recorded 429 mm and the Adcockvale Reservoir 552 mm. Experts claim that approximately 26 000 Mega liters of water was deposited over the city. That equates to almost the entire Churchill Dam (33 000 Mega liters) being poured over the city in four hours.

The following copy of the rainfall chart and the reproduction of that chart, for the period 07h30 to 12h30, paints a clearer picture of the actual intensity of the rain (note that the gauge syphons when it reaches 10 mm).

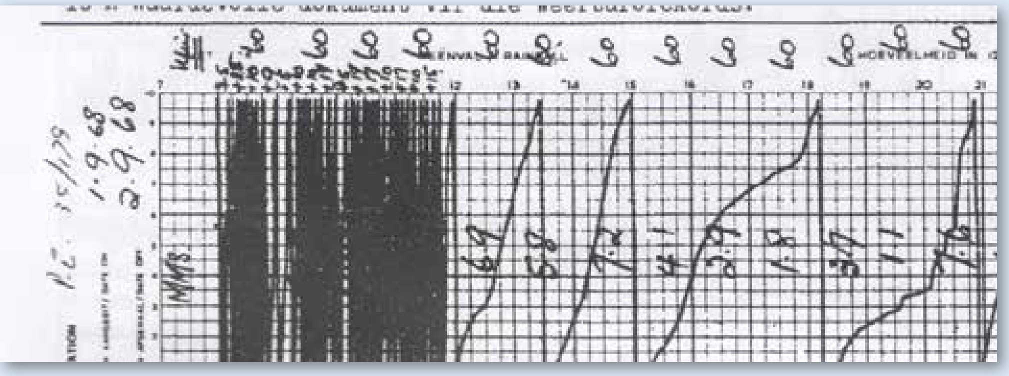


***Figure 1**:*
Rainfall chart 1 September 1968 (Port Elizabeth Airport)

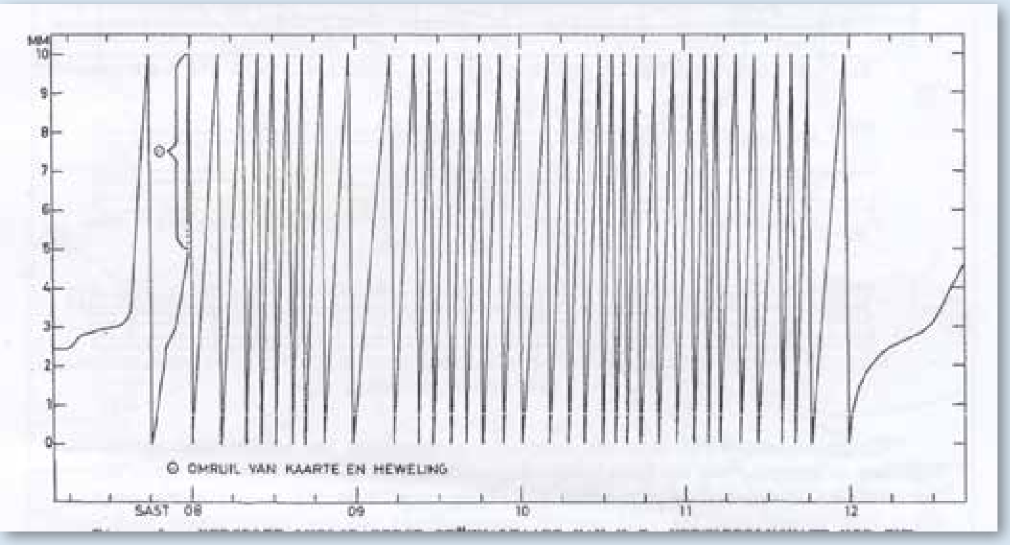


Figure 2:
Reproduction of 1 September 1968 Rainfall chart (Port Elizabeth Airport)

To put this into context, the following is a running total of the hourly rainfall:

09h00
By 09h00 a total of 82.9 mm of rain was measured (in one hour the rain exceeded Port Elizabeth monthly average rainfall of around 50 mm).

10h00
By 10h00 a total of 161.1 mm was measured (in two hours the rain exceeded the 24 hour rainfall total of 128 mm that was measured at the Port Elizabeth Airport during the devastating flood of 2 August 2006).

11h00
By 11h00 a total of 265.0 mm was measured (in three hours the rain exceeded the total 24 hour rainfall total of 224 mm, that was measured at the Port Elizabeth Airport, during the devastating flood of 25 March 1981).

12h00
By 12h00 a total of 352.0 mm was measured (in four hours the rain exceeded the monthly total of 309 mm that was measured at the Port Elizabeth Airport, for the entire month when flooding occurred in March 1981).

By comparison, the 1968 flood far exceeded other floods in so far as not only sustained extreme rainfall intensity is concerned, but also total rainfall. The graphic below shows the comparison between the rainfall intensities of the September 1968, March 1981, December 2004, May 2006 and August 2006 flooding events in Port Elizabeth, over a 5 hour period. It is clear that 1968 is by far the worst flood in living memory.

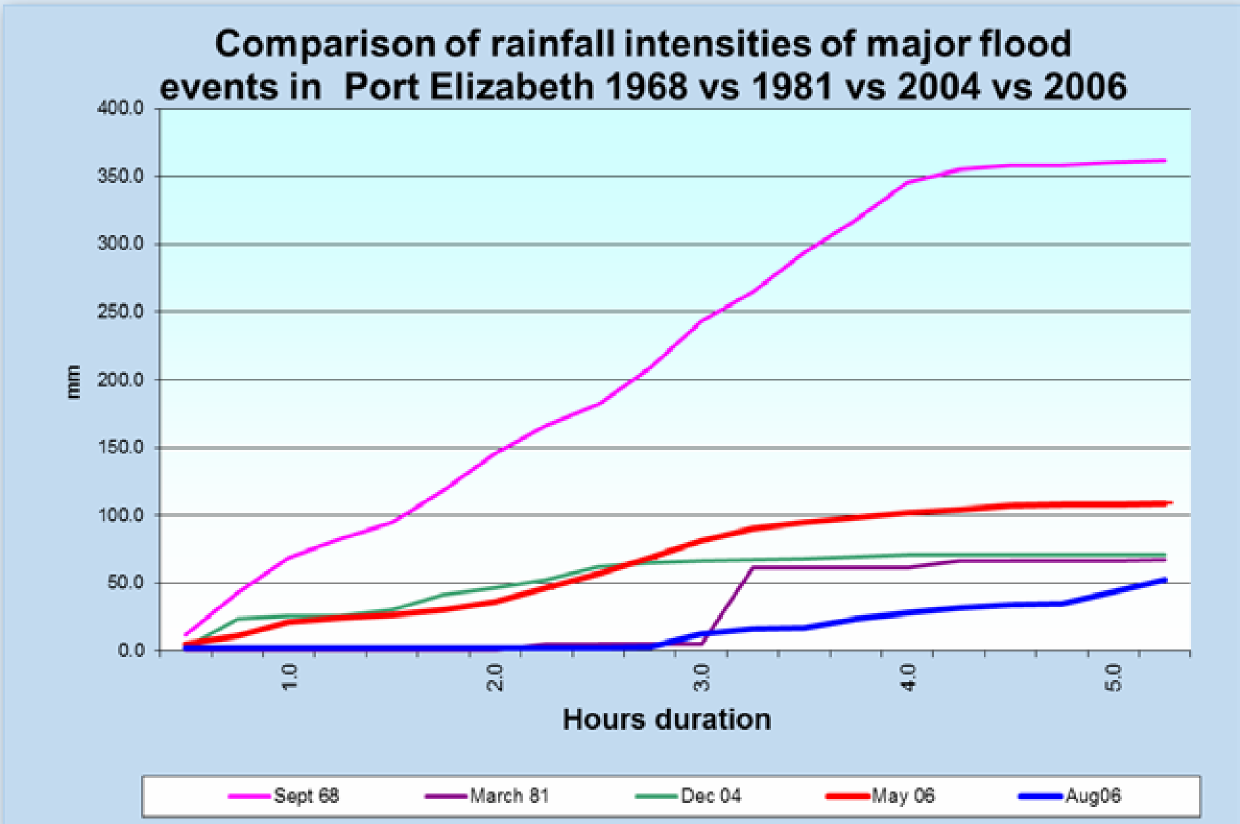


***Figure 3**:*
Port Elizabeth: Rainfall intensity of major floods in 1968, 1981, 2004 and 2006

It is interesting to note that a similar flood occurred in 1908 and was considered the worst flood at the time, during which the intensity and total rainfall varied in different parts of the city. In the South African Weather Service publication, Caelum, (which contains a record of severe weather events in South Africa), the entry for November 1908 states that "*The Baakens River flooded when a cloud burst struck between the farms of Messrs Parkins and Lovemore. At one stage the river rose 2 m in 5 minutes and in some places measured 7 m in depth*". It is interesting to note that the area referred to is the area between Lovemore Heights and Hunters retreat, which is now roughly the area of Sherwood and Lorraine. On that day in 1908, Emerald Hill only measured a total of 180 mm (52 and 158 mm) for the event. Photographic evidence shows that this figure was far exceeded.

The graphic below of the 1968 event shows that the majority of rainfall fell in the Sydenham/ North End area, which ties in with where the majority of the damage occured. Unconfirmed reports were published of a ship in the bay (just off the old North-End beach) recording in excess of 1000 mm.

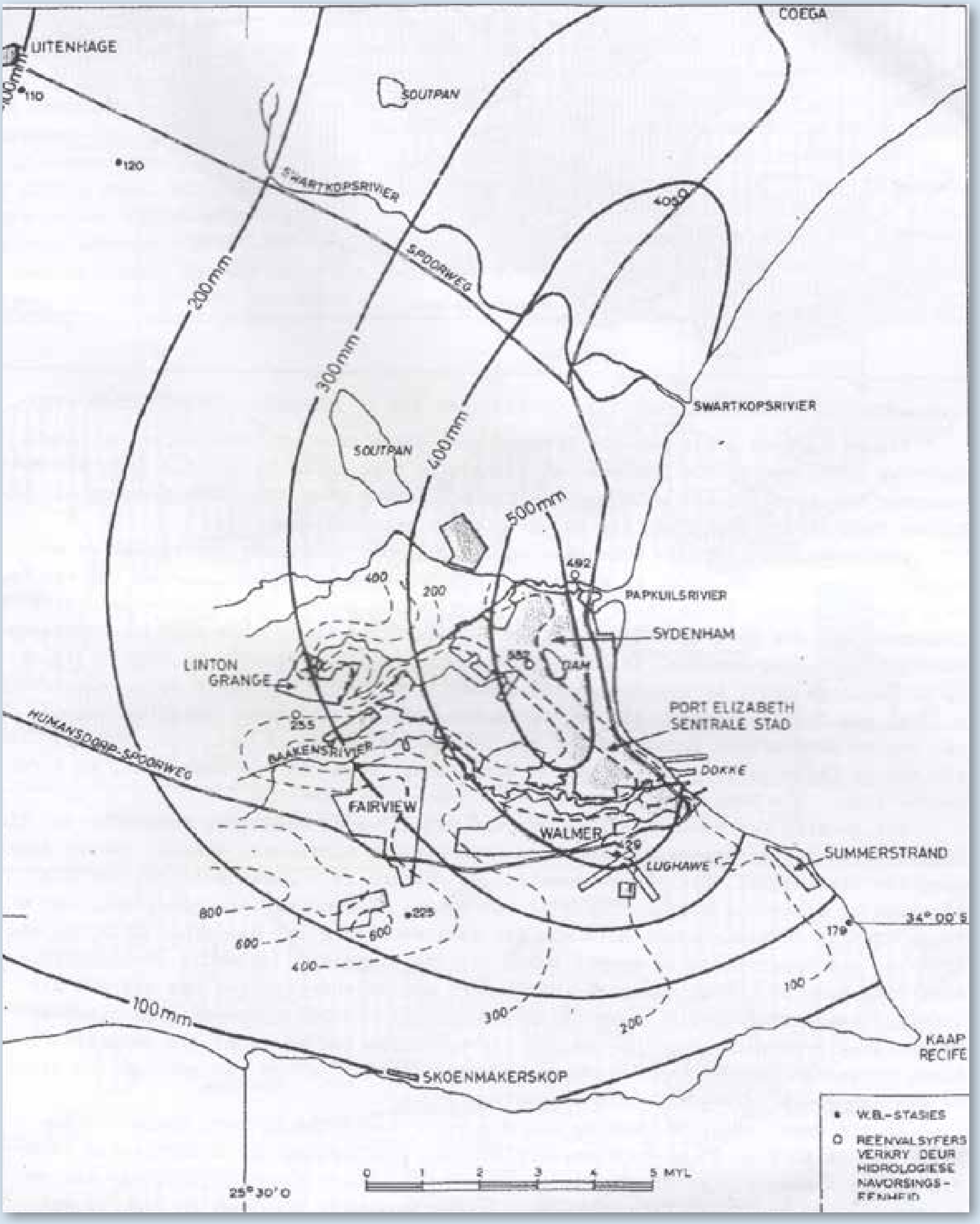


Figure 4: *Isohyet for Port Elizabeth 1 September 1968. Dotted lines are contours*

The consequences

At the time it was reported that the damage was estimated to be in the region of R 40 million. A projection of the rand value in 1993 (25th anniversary of the event) was put at R 604 million. A 2018 projection of the rand value is in excess of R5 billion. However, one must consider the size of the city at that time and the total population. In other words, if this had occurred in 2018, with the current population, that figure could be, at a conservative estimate, quadrupled.

It was amazing, considering that so much rain fell, that only nine people were reported to have died as a direct result of the flood (some reports claim the total was 11). Eight drowned and one was electrocuted while trying to repair a roof leak in a house in Central. The provincial hospital reported treating 55 patients at its casualty section.

Streets were flooded beyond belief, with numerous photographs showing only the top half of double decker buses visible in Main Street (now Govan Mbeki Street) in the North End/Sydenham area. Other photographs show people in canoes in 1st Avenue (now Langenhoven Drive) Newton Park. Even more photographs show the Baakens breaking its banks and engulfing all business premises and residences in its wake in the South End area. Motor cars are also seen washed up against the bridge over the Baakens at the entrance to the harbour, at the old bus sheds.

Although damage of varying degrees was reported from all parts of the city, extensive damage was caused to Albany Road, Brickmakers Kloof, Target Kloof and all areas in the Baakens Valley area. The most visible and memorable images are of the promenade, which was damaged beyond repair and sadly changed the face of the city's beachfront forever. This occurred when storm water flowed into the Shark River (the little stream in Happy Valley) and turned it into a raging torrent. This washed away the rugby fields at the Boet Erasmus Stadium (later known as Telkom Park and now being demolished). This, together with other debris, dammed up at the bridge over the Shark River (which, at the time, was all but closed to the sea). The bridge and surrounds were all washed away and/ or severely damaged. Gone forever from the face of Port Elizabeth were the bathing houses, the ice-cream parlour and restaurant.

Interesting anecdotes and the lighter side

A resident related that on the Saturday night she had made a large pot of curry. She claims that she and her late husband had some friends over and had a very late night, the drinks flowing freely after they had consumed the curry. They got to bed very late and were fast asleep when events unfolded. When she eventually awoke, the curry pot was floating past her bed, as her house was flooded to bed level.

There were many jokes doing the rounds at the time, such as the one of a coffin washed away from the Forest Hill Cemetery. It ended up in a chemist shop with its lid missing. The skeleton was holding up a note that read: Please do something to help my coughin". However, for all the laughter, Forest Hill Drive had a 10-metre-wide section missing and part of the cemetery washed away. Bones from the old plague cemetery nearby washed away and were later found by children. Their parents were naturally horrified when they brought these bones home.

A Motorist in Newton Park was amazed to see a canoeist traveling down 1st Avenue (now Langenhoven Drive).

Many fish (some as heavy as 3 kg) were washed out of the North End Lake and were caught by hand in Main Street (now Govan Mbeki Street).

Goldfish from the pond in St Georges were washed away and landed up in a pool under the Crusaders Rugby Club Pavilion.

Many exotic snakes were reported to have died at the city's snake park, when the heaters failed (due to no electricity) and the temperatures dropped to fatal levels for the snakes.

Twins were born in an ambulance that was bogged down, when part of Standford Road collapsed.

A family had to wait two weeks to bury their mother, as the North End Cemetery remained water logged. The sons went to the cemetery daily to check if the water level had dropped.

The famous heart surgeon, Dr Chris Barnard, sent a telegram of sympathy to the city. It read *"Distressed to hear of floods (stop) sympathy to people of Port Elizabeth (stop)"*

Offers of support were received as far afield as the mayor of Bulawayo. The Australian Trade Survey Commission to South Africa was marooned on the day in a beachfront hotel in the city. The leader of the delegation sent a note of sympathy and R 50 for the relief fund.

Even the Weather Office was affected, with a complete breakdown of communications at the Port Elizabeth Airport. All electronic equipment was affected, which resulted in no upper-air ascent for the day.

What can be done to minimize the effects of flooding?

The loss of life in the 1968 flood was far less than during any of the other major floods in the city. The main reason for this is that it occurred on a Sunday morning, while the others occurred on work days (weekday). In 1968, most people were either asleep, or preparing for church, when the rain started. Those who did decide to make the trip to church did not have to travel far as most people at the time attended a church within their suburb.

Staying indoors during times of flooding is the biggest factor that could save your life.

Although the 1968 event was not fully forecast, modern technology and know-how would have foreseen such an event and the population would have been warned well in advance. Schools and other institutions would usually be closed during such an event, thus keeping many people off the roads.

If it is raining heavily during a flooding event, rather delay or cancel your journey until the rain is over.

After the event, stay off roads as vehicles usually obstruct the workings of the emergency services and their vehicles.

Here is a list of precautions to take during flooding events:

- Listen to the radio or follow Twitter warnings to get the latest OFFICIAL warnings. Be advised to use authoritative pages, such as that of the SA Weather Service. There are numerous hoaxes and misinformation on various unofficial sites.
- As soon as you hear a warning of flooding in the city, make sure all gutters are clean of debris as well as areas around storm water drains. If you have water tanks, drop the level so that the water can not only be stored for later, but will also reduce flooding on your property.
- If you are outdoors, always avoid low lying areas, even if they are not already flooded at the time that you want to cross them. Low water crossings levels can rise rapidly. Rather wait until the rain has passed. Plan routes to avoid low lying areas, such as the 3rd Avenue Dip and Riverstone Road.
- Store water. Although there might be plenty around during the event, if water pipes are damaged, there could be a shortage of fresh water later.
- If the water level is rising and starting to flood a building, switch off the main electricity supply to avoid electrocution.
- Plastic sheets can prevent flood water seeping through airbricks.
- If the water level is rising, sand bags (plastic bags filled with soil) can be placed around doors.

Chill Units: Description and estimation using different models

- Michael Mengistu, Siphamandla Daniel, Thato Masithela, Cobus Olivier and Joël Botai

1. Introduction

Many fruit and nut trees cycle annually through different physiological phases to produce fruit. In order to avoid frost damage in Winter, such deciduous plants fall dormant and do not resume growth until Spring. This dormant Winter phase is an evolutionary advantage that protects fruit trees from cold weather damage by preventing the growth of cold-sensitive shoots and flowers in response to a Winter warm spell.

Perennial fruit trees break dormancy after a prescribed 'sum' of Winter conditions has passed and the tree has determined that Winter has finished and it can begin to flower in response to warmer temperatures. This sum (accumulation) of cold weather is known as winter chill. The Winter chill required to break dormancy differs by fruit type and variety. Therefore, matching Winter chill requirements to site conditions is important for orchard development. Chill units are required to stimulate growth, develop leaves and set fruits. Chill units are used to predict the end of the dormancy period, determine the time at which to begin cultivation practices, and identify potential growing locations. Different models are used to calculate chill units: the Chill hour model; the Richardson Chill model; the Daily Positive Utah model (Infruitec model); and the Dynamic'Erez model.

2. Chill Unit Accumulation Models
2.1 Chilling Hours Model

The Chilling Hours Model is the oldest method to quantify Winter chill that is still widely used and it considers all hours with temperatures between 0 and 7.2 °C as equally effective for Winter chill accumulation. The number of Chilling Hours at time t (CHt; t is measured in hours since the start of the dormancy season) can be calculated as:

$$CH_t = \sum_{i=1}^{t} T_{7.2}, \text{ with } T_{7.2} = \begin{cases} 0°C < T < 7.2°C & : 1 \\ else & : 0 \end{cases} \quad (1)$$

2.2 Utah Model (Richardson Chill Units Model)

The Utah Model was developed for peaches grown in areas with very cold winters in the United States but is now widely used in deciduous fruit growing areas worldwide. It contains a weight function, assigning different chilling efficiencies to different temperature arrays, including negative contributions by high temperatures. A few modified versions of the weight function exist. However, the weights from the original publication, as shown in Equation 2, are most widely used. The number of Utah Chill Units at time t (UCUt) can be expressed as:

$$UCU_t = \sum_{i=1}^{t} T_U, \text{ with } T_U$$

$$= \begin{cases} T \leq 1.4°C & : 0 \\ 1.4°C < T \leq 2.4°C & : 0.5 \\ 2.4°C < T \leq 9.1°C & : 1 \\ 9.1°C < T \leq 12.4°C & : 0.5 \\ 12.4°C < T \leq 15.9°C & : 1 \\ 15.9°C < T \leq 18.0°C & : -0.5 \\ T \geq 18.0°C & : 1 \end{cases} \quad (2)$$

The Utah model suggests that a full chill unit can be acquired when the temperature in an hour is between 2.4 and 9.2 °C. High temperatures ≥12.5 °C do not contribute to the chill accumulation, while temperatures below 1.5 °C are also not considered effective for chilling. Higher temperatures counteract the positive effects of chilling and negative chill units are applied when temperatures exceed a threshold of 16 °C.

2.3 Daily Positive Utah Chill Unit Model (DPCU) (Infruitec Model)

The Utah model was adopted by the South African deciduous fruit industry in the southern part of the Western Cape. However, South African researchers found the Utah Model to be inaccurate under South African conditions, especially in the warm deciduous fruit growing areas with high winter daytime temperatures greater than 20 °C. The high negative totals during warm Winter days led to inaccurate and negative Utah chill unit totals, even though adequate chilling was received by low chill trees. A modification of the Utah Chill Unit Model was proposed by South African researchers which is known as Daily Positive Utah Chill Unit Model (DPCU).

Chill units for each hour are summed up every 24 hours and, if the total for the 24 hours period is negative, the total chill unit for that day is counted as zero but, if the total is positive, it is added to the already accumulated chill units. These units were originally called "modified Utah chill units" or Daily Positive Utah Chill Units (DPCUs). This model has been found to give a more accurate estimation of Winter chilling in areas with mild to very cold winters.

2.4 Dynamic Model (Erez Model)

The Dynamic Model was originally developed for warm Winter areas in Israel. The model assumes that Winter chill results from a two-step process, in which an intermediate product is first formed in a process promoted by cold temperatures. Warm temperatures can destroy this intermediate product. As soon as a certain quantity of intermediate product has accumulated, it is irreversibly transformed into a Chill Portion, which can no longer be destroyed. The equations for the number of Chill Portions at time t (CPt) are:

$$x_i = \frac{e^{slp \cdot tetmlt \cdot \frac{T_K - tetmlt}{T_K}}}{1 + e^{slp \cdot tetmlt \cdot \frac{T_K - tetmlt}{T_K}}} \qquad inter_S = \begin{cases} t = t_0 & : 0 \\ t > t_0 \wedge inter_{E_{t-1}} < 1 & : inter_{E_{t-1}} \\ t > t_0 \wedge inter_{E_{t-1}} \geq 1 & : inter_{E_{t-1}} \cdot (1 - x_i) \end{cases}$$

$$x_s = \frac{a_0}{a_1} \cdot e^{\frac{e_1 - e_0}{T_K}}$$

$$ak_1 = a_1 \cdot e^{-\frac{e_1}{T_K}} \qquad delt = \begin{cases} t = t_0 & : 0 \\ t > t_0 \wedge inter_E < 1 & : 0 \\ t > t_0 \wedge inter_E \geq 1 & : x_i \cdot inter_E \end{cases}$$

$$inter_E = x_s - (x_s - inter_s) \cdot e^{-ak_1}$$

$$CP_t = \begin{cases} t = t_0 & : delt \\ t \geq t_0 & : delt + CP_{t-1} \end{cases} \tag{3}$$

The constants slp, tetmlt, a_0, a1, e_0 and e_1 are experimentally derived and were set to 1.6, 277, 139,500, 2.567×1018, 4,153.5 and 12,888.8, respectively, according to standard practice in horticultural applications.

The Dynamic model was based on the hypothesis that the level of dormancy completion depends on the level of a certain dormancy breaking factor. The Dynamic Model is currently the only model that explains experimental evidence from controlled temperature studies in Israel. The Dynamic model only considers the impact of high temperatures in influencing the production of an intermediate product, which is linked to time. Once a sufficient amount of the transitional product is formed a chill portion is irreversibly created, and cannot be reversed by high temperatures later in the season.

3 Long Term Chill Units Maps for South Africa

Chill Units were calculated using modelled hourly air temperature data computed using daily maximum and minimum observed air temperature data. Hourly air temperature data were simulated using an idealized daily temperature curve that uses a sine curve for daytime warming and a logarithmic decay function for night time cooling. Chill Units were then generated using the simulated hourly air temperature data and accumulated for the Winter months (1 May to 31 August) each year. Chill Units maps using the different chill accumulation models are generated using long-term daily maximum and minimum air temperature data (1979 to 2016) as shown in Figures 1 to 3.

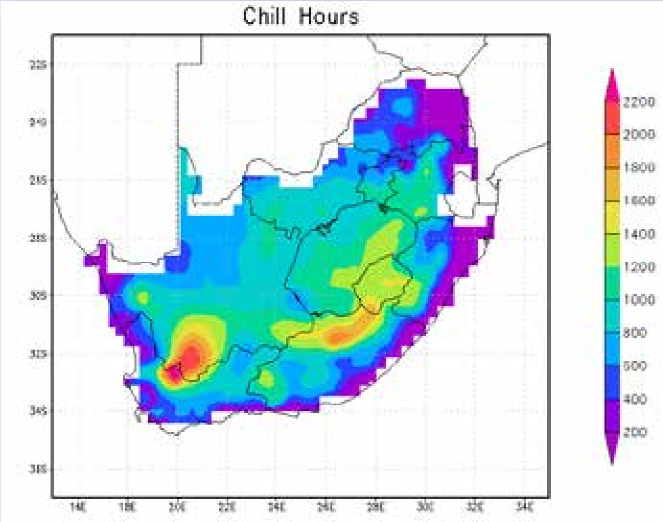


Figure 1:
Chill units calculated using the Chilling hours model (chill hours) Where the data is long term mean (1979 to 2016) accumulated for 1 May to 31 August

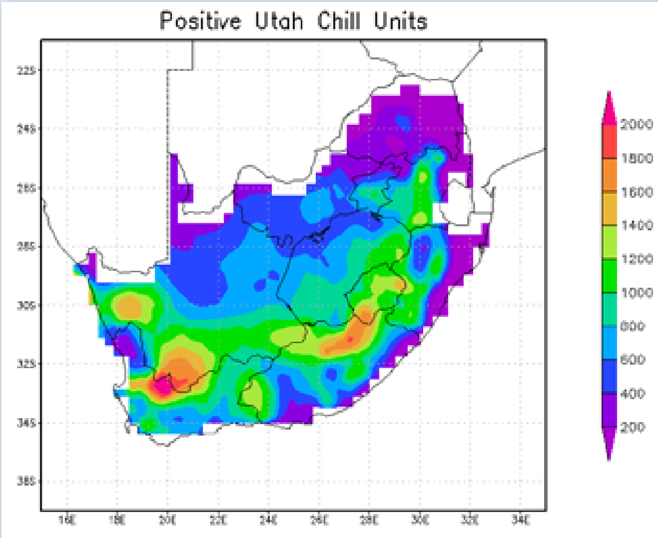


***Figure 2**:*
Chill units calculated using the Positive Utah Chill Units model (chill units) where the data is long term mean (1979 to 2016) accumulated for 1 May to 31 August

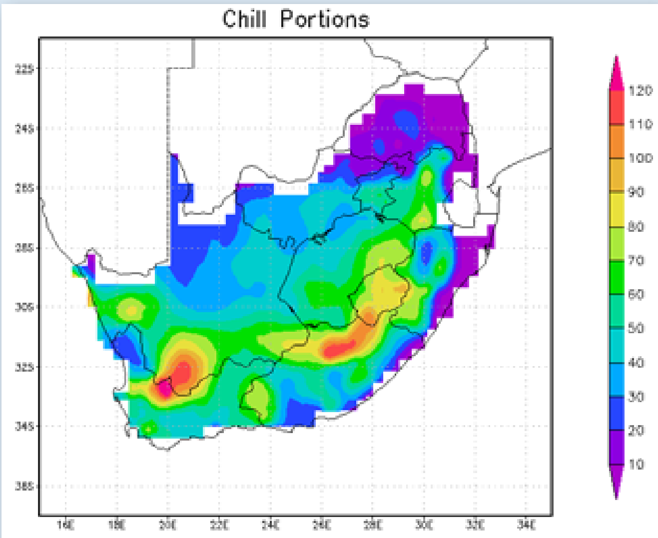


Figure 3:
Chill units calculated using the Dynamic Model (chill portions) where the data is long term mean (1979 to 2016) accumulated for 1 May to 31 August

4 Chill Units Forecasts

Chill units can also be calculated using the ECMWF model forecast of maximum and minimum air temperature. Chill units are calculated using modelled hourly air temperature data from the forecasted daily maximum and minimum air temperatures. Examples of chill units forecast maps generated using the simulated hourly air temperature data and accumulated for the forecast period are presented in Figures 4 to 6.

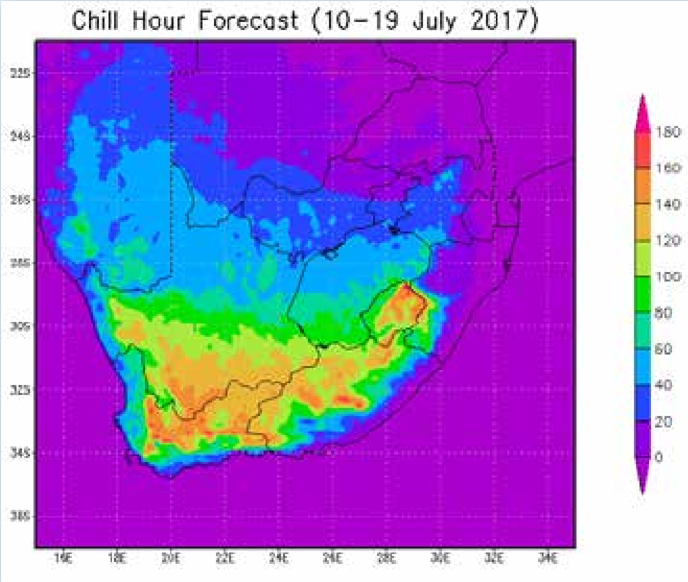


Figure 4:
Chill units forecast calculated using the Chilling hours model (chill hours)with data from the ECMWF model 10 day forecast accumulated for the period of 10 to 19 July 2017

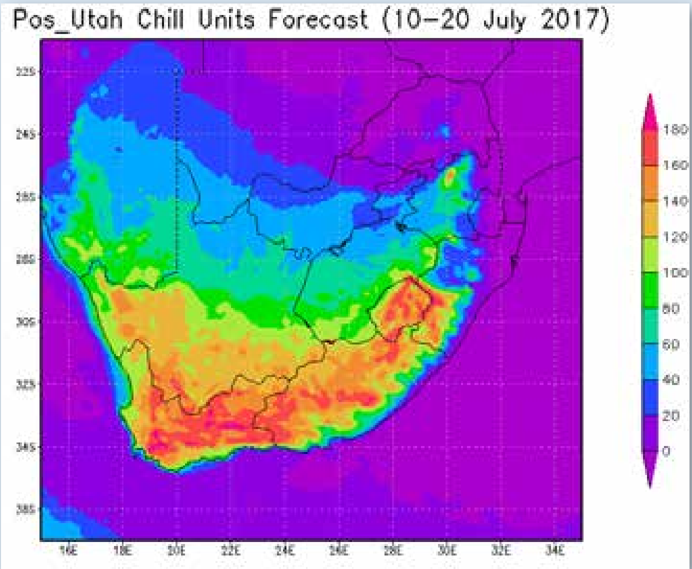


Figure 5:
Chill units forecast calculated using the Positive Chill Units Model (chill units) with data from the ECMWF model 10 day forecast accumulated for the period of 10 to 19 July 2017

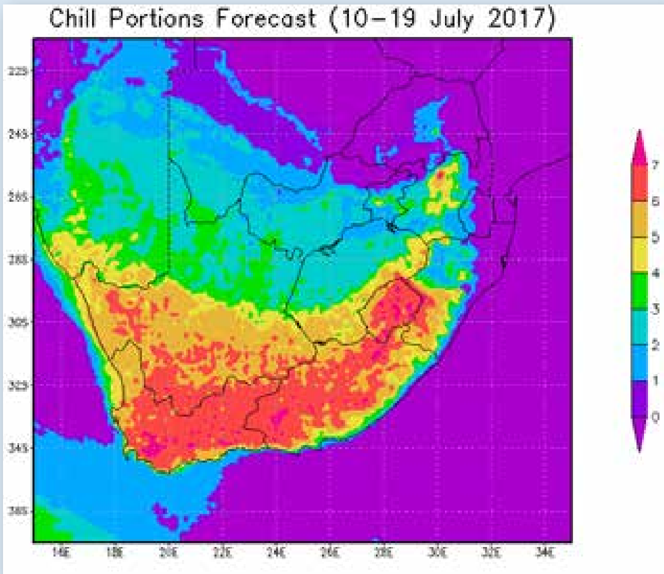


Figure 6:
Chill units forecast calculated using the Dynamic Model (chill portions with data from the ECMWF model 10 day forecast accumulated for the period of 10 to 19 July 2017

5 Summary

Several models of calculating chill units have been developed and used worldwide. The Chill Hours, Utah Chill Units, Positive Utah Chill Units, and the Dynamic models are the most commonly used models. Winter chill models are not equivalent, and the conversion factors between different Winter chill metrics vary substantially. It is very important to understand the method used to compute chill units and be cautious when comparing chill units. Therefore, data on chilling requirements should always be supplemented with information on the location, accumulation period and the method used.

Many studies showing extensive model comparisons do not recommend using the Chilling Hours and Utah Chill Units models, especially in warm climates. The Dynamic Model (Chill Portions) is the best model for most growing regions and seems much more reliable. A modification of the Utah Chill Unit model known as the Daily Positive Utah Chill Unit model (Infruitec model) was proposed by Linsley-Noakes *et al.* (1994) and was adopted by the South African deciduous fruit industry in the Western Cape. This model has been found to give a more accurate estimation of Winter chilling under South African conditions, especially in the warm deciduous fruit growing areas with high Winter daytime temperatures.

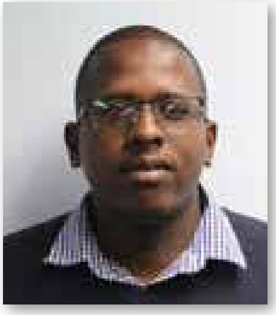
Meet the Authors

Mr Michael Barnes

Michael Barnes is a Scientist in the Marine Unit in the Cape Town weather office. Michael has worked for SAWS since 2016 when he started as a weather forecaster in the Cape Town office. He obtained is BSc(Meteorology) Honours degree from the University of Pretoria in 2014 for which he was placed on the Dean's List. His honours level research focused on numerical meteorology. Michael is currently enrolled for an MSc(Meteorology) degree at the University of Pretoria, where his research focus is atmospheric dynamics, studying cutoff development and upper tropospheric dynamical processes.

Dr Joel Botai

Dr Joel Botai is a Chief Scientist in charge of a team of 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 Joel 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 the supervision of post graduate students (MSc and PhDs).



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 Xolile Jele

Ms Xolile Jele is a forecaster based at the Aviation Weather Centre since 8 December 2014. She holds a BSc Natural Sciences and BSc Honours in Meteorology.

Dr Warren Joubert

Dr Warren R. Joubert is the Lead Scientist: Global Atmosphere Watch programme of SAWS. With a background in chemistry, he has gained valuable experience in carbon, nitrogen and oxygen dynamics between the ocean, atmosphere and biospheres. Prior to joining SAWS, he established a laboratory for measurements of dissolved carbon speciation in seawater and permanently installed continuous underway gas (CO_2 and O_2) analysis instruments on board the South African marine research vessel MV SA Agulhas II. As a part of this project, he has also participated in various oceanic research campaigns in the Southern Ocean and around the South African coastline, deploying and retrieving scientific instruments and conducting on-board measurements and experiments. He completed a PhD in Physical Oceanography at University of Cape Town in 2014 in which he investigated surface ocean primary productivity in the Atlantic Southern Ocean, using a variety of *in situ* observation techniques. These include isotopically labelled tracer experiments of nitrogen and utilizing continuous mass spectrometric techniques of noble gas ratios to oxygen for assessing the role ocean productivity dynamics. This work highlighted the importance of variability in the ocean mixed layer depth (which sets the surface irradiance and nutrient) in driving the variability in ocean productivity, particularly in the Sub-Antarctic Zone between Cape Town and Antarctica. Dr Warren has written and co-authored several peer-reviewed publications in international and local journals.

Dr Andries Kruger

Dr Andries Kruger is a Chief Scientist: Climate Data Analysis and Research in the Department: Climate Service of the South African Weather Service. His present and previous duites include the creation and writimg 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, and assisting in the quality control of climate data. In 2001, Dr Kruger obtained a PhD (Civil Engineering) degree at the University of Stellenbosch on the research topic “Wind Climatology and Statitsics of South Africa relevant to the Design of the Build Environment”. Before that, he obtained an MSc (Environmental and Geographical Science) degree at the University of Cape Town. He has published papers both locally and internationally, and authored a SAWS series of publications on the general climate of South Africa. He is widely recognised, both nationally and internationally, for his research, which involves advanced statistical analyses and interpretation of historical climate data.

Ms Stephanie Landman

Ms 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 became 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 a BSc (Honours) (Meteorology) course in applications of NWP on a part-time basis at the University of Pretoria, supervises BSc (Honours) students with their research projects on model evaluation issues and co-supervising MSc dissertations. At the Regional Training Centre (RTC) she trains 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 UKZN and will graduate in 2018.

Ms Lebogang Makgati

Ms Lebogang Makgati joined the South African Weather Service (SAWS) in March 2009 as a forecaster. She began at the Nelspruit Weather Centre and later moved to the National Forecasting Centre (NFC) based at the organisation’s head office. She became a Senior Forecaster in 2017 and moved to the Cape Town Weather Office in the same year. She holds an MSc qualification in Disaster Management from the University of the Free State and is currently a PhD candidate at the University of South Africa (UNISA).

Ms Bathobile Maseko

Ms Bathobile Maseko is a research scientist in the Nowcasting and Very Short-Range forecasting group at SAWS since 2011. She completed her BSc degree (Statistics and Geography) in 2008, and her BSc (Hons) in Meteorology in 2010 at the University of Pretoria. She is currently enrolled for MSc study at the North West University. Research in Nowcasting Forecasting includes working with radar, satellite and lightning data and products, as well as computer programming. She has attended and presented at the South African Society of Atmospheric Sciences (SASAS) national conferences in 2012 and 2013 and submitted extended peer-reviewed abstracts for these conferences. She is a co-author in a paper published in the South African Journal of Science (SAJS) in February 2015 titled 'Using satellite data to identify and track intense thunderstorms in South and southern Africa".

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 in the same unit in 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.

Ms Lebohang Melato

Ms Lebohang Melato is a scientist in the Climate Information section since January 2016, where the organisation interfaces with commercial clients and supplies climate data and reports as per clients request. She completed her BSc and BSc (Hons) degrees in Ocean and Environmental Science in 2012. Her MSc degree in Ocean and Climate Dynamics was completed in 2015, all three degrees were obtained at the University of Cape Town.

She is a co-author in a paper published in the PLOS ONE (Public Library of Science) Journal in August 2017 titled "A pivotal role for ocean eddies in the distribution of microbial communities across the Antarctic Circumpolar Current".

Dr Michael Mengistu

Dr Michael Mengistu is a Lead Scientist in Agrometeorology, applications research group at the South African Weather Service. 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, was a supervisor of postgraduate students, a lecturer of hydrology courses and a 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 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's research interests include agrometeorology, hydrometeorology, climate change impacts on agriculture and water resources, remote sensing and earth observation applications for water resource management and agriculture.

Mr Cobus Olivier

After completing his BSc Honours 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 extensively involved with Agriculture, Water resource managers as well as the media to communicate and help interpret the expected weather conditions.

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 a coordinator of the Meteorology Group at the University of Pretoria from 2003-2015, 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 2010-2014. Prof Rautenbach was also President of the South African Society for Atmospheric Sciences (SASAS) during 2005-2010, 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 46 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 Kevin Rae

Mr Kevin Rae is one of the Chief Forecasters in the Forecasting section at the South African Weather Service, a position he has held since 2008. Prior to his appointment as Chief Forecaster, Mr Rae spent 18 years 'on the bench' as an operational forecaster, based at the National Forecast Centre (NFC) in Pretoria. He first joined the South African Weather Service in 1981 as a meteorological technician and spent a year on Gough Island as Senior Meteorologist in the early 80s. Subsequently, a number of annual takeover and buoy-deployment voyages followed, including visits to the SANAP bases at Marion Island and SANAE iv (Antarctica), South Thule Island and Tristan da Cunha. Mr Rae's current duties include the development and implementation of short term forecasting-related indices, especially with respect to thunderstorm prediction. He is particularly passionate about striving to improve overall knowledge and understanding of the diverse ingredients which contribute to thunderstorm severity. His qualifications include an MSc in Meteorology (University of Pretoria) as well as a Higher Diploma in Meteorology.

Mr Garth Sampson

Mr Garth Sampson is the Client Liaison Officer for the Eastern Cape and is based in Port Elizabeth. He has been stationed at Port Elizabeth his entire career of more than 37 years. He therefore has a wide knowledge of the weather of the region and is most passionate about the severe weather events of the region. To this end he has collected a treasure trove of information, in the form of newspapers and other media, on these events. He has written numerous articles on severe weather events and co -authored a publication "Hell Season or Par for the Course: Tornadoes of the Eastern cape 1998/99". Garth holds a N.H. Diploma in Public management and administration, majoring in Statistics.

Mr Johan Stander

Mr Johan Stander is currently Managing Marine (full value chain) as well as the operational aspects of the Western and Northern Cape and is based in the most beautiful city of Cape Town. Mr Stander started working for the SAWS in 1982 as a weather observer before he started his studies in 1985, after which he became an operational forecaster and then moved into management. Mr Stander represents the SAWS and SA in various leadership positions and on expert teams at National and International levels and his position as Co-President of the World Meteorological Organisation (WMO) and Intergovernmental Oceanographic Commission of UNESCO (IOC-UNESCO), Joint Commission for Oceanography and Marine Meteorology (JCOMM), the only joint commission within the UN system, is most valuable for us as an Organisation and a Country.

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 contributor to SAWS' social media platforms.

Ms Elizabeth Webster

Ms Elizabeth Webster started working at the South African Weather Service in 2011, after completing her honours in Forecasting with a BSc in Meteorology at the University of Pretoria the year before. After a brief three-month period forecasting in the Port Elizabeth Weather Office, she returned to Pretoria where she worked as an operational forecaster in the National Forecaster Centre. From 1 July 2016, she joined Dr Eugene Poolman in the Disaster Risk Reduction division in the South African Weather Service, developing an Impact-Based Severe Weather Warning System for South Africa. This is a completely new way in which warnings will be issued, not using meteorological thresholds anymore, rather forecasting warnings based on the impact they will have on communities.

South African Weather Service

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)#

WEATHERSMART

AUGUST 2018

Head Office

Pretoria
Eco Glades Block 1 B
Eco Park
Centurion
0157
Tel: 012 367 6000

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

Follow us on Twitter:
@SAWeatherServic

Facebook:
@WeatherService

www.weathersa.co.za

South African Weather Service

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