WEATHERSMART NEWS

Scientific meteorological and climatological news from the South Africa Weather Service

OCTOBER 2024

South African Weather Service

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South African Weather Service

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FOREWORD

Chief Executive Officer

The new edition of our WeatherSMART newsletter is here. As usual, it contains several articles which weather enthusiasts, scientists and the public at large, will find extremely interesting. The informative and eye-opening articles flowed from the pens of our knowledgeable and experienced meteorological and climate scientists.

Quite a few severe weather events occurred over the past few months. In this issue we deal with a good sample of these events that battered South Africa during that period. I am sure that this collection of research articles and scientific discussions will serve as fascinating reading and excellent reference material in future as well.

The disruptive rain in the Eastern Cape for the period 1 to 4 June 2024 was caused by a cold front and a well-developed cut-off low system. We frequently report on cut-off low systems as they are slow moving systems, which are literally cut off from the main system, bringing lots of rain. For this reason, these systems are intrinsically dangerous. While the rainfall in question brought welcome relief to that province's drought conditions, damage to property and loss of lives unfortunately also occurred. The South African Weather Service (SAWS) persistently informs the public well in advance about possible severe weather impacts on many media platforms and will continue to do so. This helps the public to prepare themselves and take actions that shields them from danger.

We also look at the weather in the Western and Northern Cape for the first seven months of 2024. The article provides a handy reflection on the adverse weather conditions observed from January to July 2024, specifically the drier and warmer conditions experienced until June, with the subsequent drastic change in weather in July. This obviously filled the dams, although severe damage was also experienced.

On the climate side, our scientists focused on a theme that is becoming increasingly important in our country: the spatial and temporal variation in long-term surface temperature trends and their expected implications. I encourage you to read this very insightful article. The concern about the effect of these climate variations on water resources is important to highlight. I fully support the additional research proposed by this article.

The aviation meteorological article reflects on the impact of thunderstorms on take-off data in the country, which is a summary of an article that was published in the Journal of Aviation, Aeronautics and Aerospace (Manuscript 1913). It concludes that, while thunderstorms have a significant impact on take-off data, this is not the only factor that influences the mentioned data and that additional research is required. This research is supported.

We also provide a perspective as contained in media reports associated with the most recent Eastern Cape cut-off low event of 21 and 22 October 2024 – yet another severe incident for the province – where the importance of heeding the weather forecast and *taking action* is evident. I cannot overemphasise the importance of listening to the weather forecast and *taking action* to ensure that lives and property are protected.

I commend the SAWS staff for their dedication to still find the time to compile comprehensive articles like these, in spite of other daily operational demands.

May you enjoy this newsletter and find the content valuable and informative.

Ishaam Abader
Chief Executive Officer

DISRUPTIVE RAIN AND SNOW BATTER THE EASTERN CAPE BETWEEN 1 AND 4 JUNE 2024

Nompumelelo Kleinbooi, Ayabonga Tshungwana, Kevin Ingram, Dr Ramontsheng Rapolaki, and Carla Ramjukadh

Introduction

A cold front passed south of the country on Friday evening, 31 May 2024. Behind the front, a well-developed cut-off low (COL) was situated just west of the country with a high-pressure system that was ridging in along the coast as seen in Figure 1. The combination of these systems resulted in an abundance of moisture at various levels of the atmosphere. The availability of moisture and onshore winds resulted in rain, showers, and thundershowers across the Eastern Cape.

Moreover, strong winds, and very rough to high seas were forecasted along the coast from Sunday evening, 2 June 2024. Low freezing levels were expected to set in and consequently aid in the development of snowfall over the high-lying areas of the province from Monday afternoon.

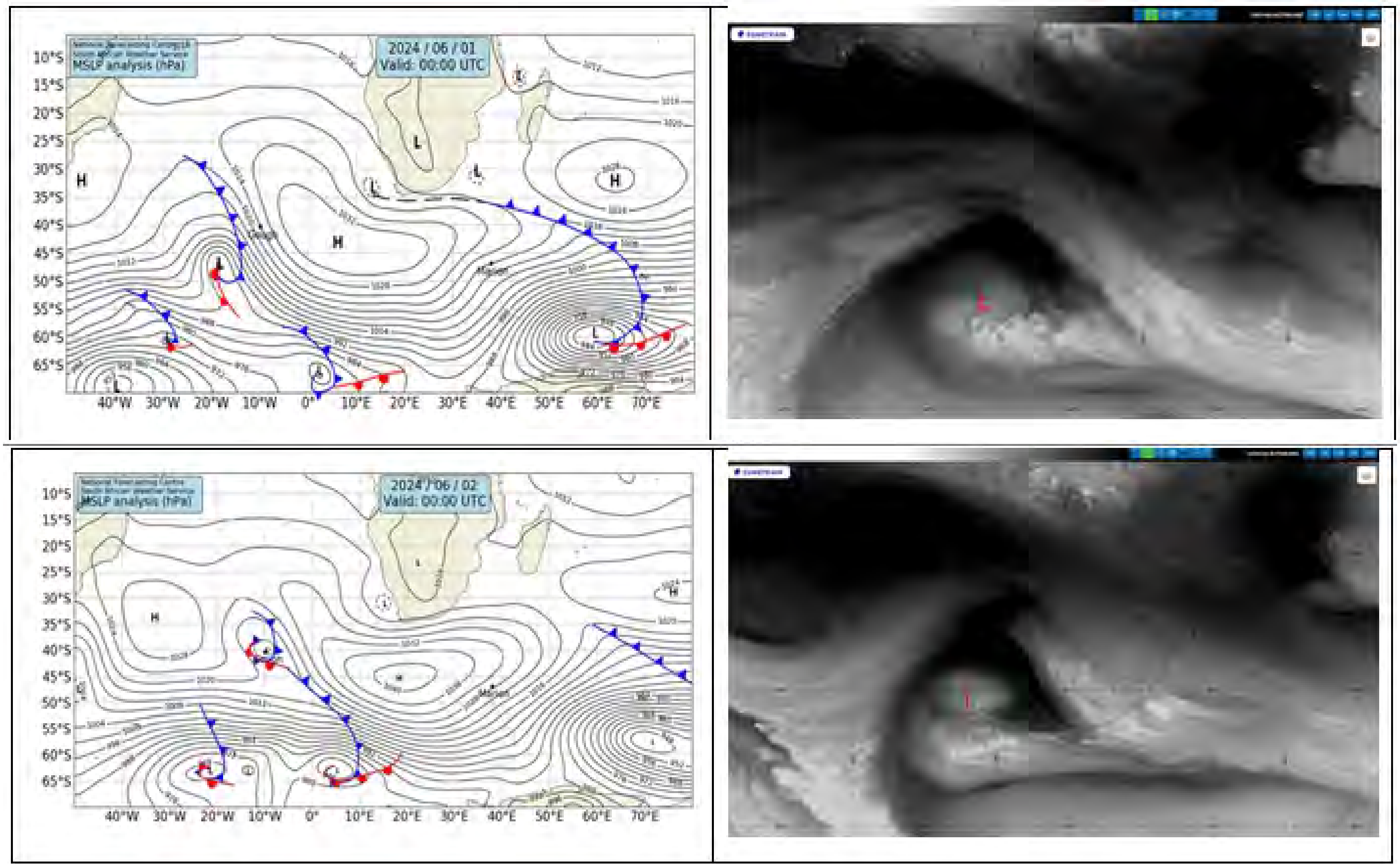


Figure 1: Dominant surface and upper-air weather systems for the 1 and 2 June 2024 at 00h00UTC.

Model parameters

This section covers some of the model output that was used in forecasting the weather for the period between 1 and 4 June 2024, the impact-based warnings that were issued, as well as the devastating impacts that occurred due to the COL and the associated surface systems.

Firstly, due to the Unified Model (UM) SA4km model parameters being predominantly used, it is vital to examine how the model compared to observations in the placement of the COL. On 1 June, UM placed the core of the COL much further west than where the system was observed at 00Z, as seen on Figure 2A and Figure 1 respectively. Muofhe et al. (2020) and Sharma et al. (2018) demonstrate that the UM SA4km often displaces the core of the COL westwards than where it is usually observed to be. In hindsight, this may have been the reason why the precipitation amounts were under-estimated along the South Coast up to East London on 1 to 2 June 2024.

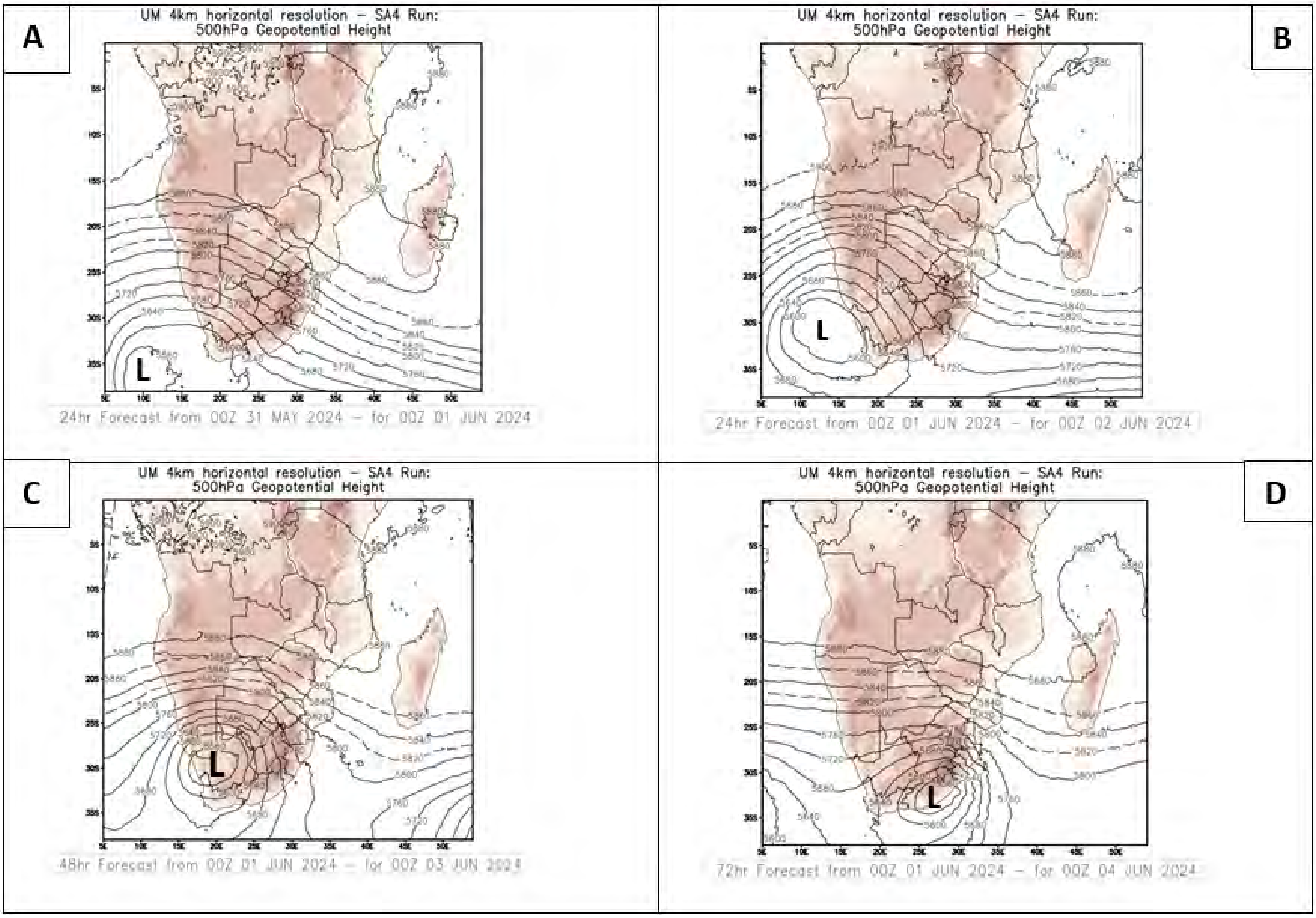


Figure 2*:* UM SA4km model placement of the COL at 00Z for: A) 1 June 2024, B) 2 June 2024, C) 3 June 2024 and D) 4 June 2024.

24hr Rainfall accumulations

The Global Forecast System (GFS) medium range forecasts of precipitation issued on the 29th of May 2024 at 00Z indicated rainfall accumulations of more than 50 mm along the South Coast and adjacent interior for the period between 1 June 00Z and 2 June 00Z, as seen on Figure 3F. Although this was still five days in advance, models were continually monitored, with the 24-hour GFS accumulations for the 1st of June constantly decreasing as the day approached.

On 31 May 2024, several models already indicated the COL over the west coast, and it was expected to move over the western interior of the country on 1 June 2024. The UM 00Z model run indicated precipitation across the province, with accumulations exceeding 100 mm in a 24-hour period as shown in Figure 3A - F. Based on the forecasted conditions, the Port Elizabeth weather office forecasters issued a yellow level 2 warning for disruptive rain (shown in Figure 4) because the rain was expected to persist for at least two days. Rainfall amounts of up to 100 mm can be seen in places along the coast, while accumulations of more than 200 mm were mainly expected over the ocean.

On 1 June, the UM SA4km, GFS and the European Centre for Medium-Range Weather Forecasts (ECMWF) model runs indicated much higher rainfall amounts for areas between Port Alfred and East London. As a result, the warning level was then upgraded for the area to an orange level 6 as seen on Figure 4. The warning area was further extended to include Port

St. Johns due to uncertainty of the rainfall amounts that were expected as well as the known vulnerabilities (poor water drainage) of the town. However, at that time, models indicated decreased rainfall amounts over the Nelson Mandela Bay Metro (NMBM), and thus it was decided for the Metro to not be included in the upgraded level 6 warning.

On 2 June, the warning was again updated due to the large amounts of rainfall that unexpectedly fell over NMBM. Amounts between 100 and 230 mm (within 24 hours) were recorded by the SAWS Automatic Weather Station (AWS) and Automatic Rainfall Station (ARS) network, and unofficial reports of up to 300 mm were seen circulating on social media.

The observed rainfall figures greatly exceeded the accumulations that were expected. Table 1 lists the accumulated rainfall on the 1^{st} and 2^{nd} of June, with more than 220 mm measured in places over NMBM. This amount of rainfall occurred in the span of hours as seen on Figure 5, which then greatly contributed to the devastating flooding and damage that occurred.

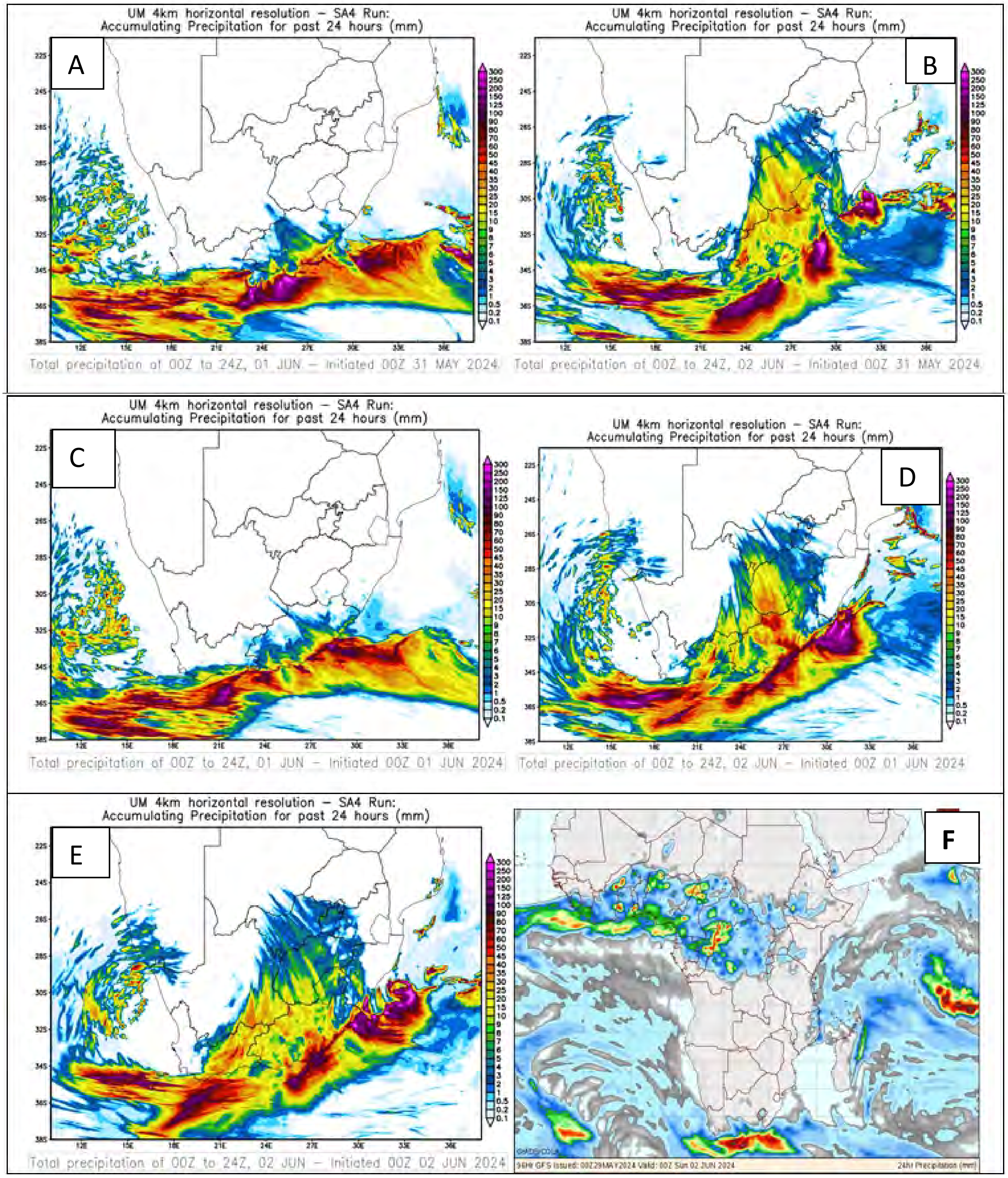


Figure 3: 24hr rainfall accumulation for UM SA4km model runs (A-E) and GFS (F) between 29 May and 2 June 2024.

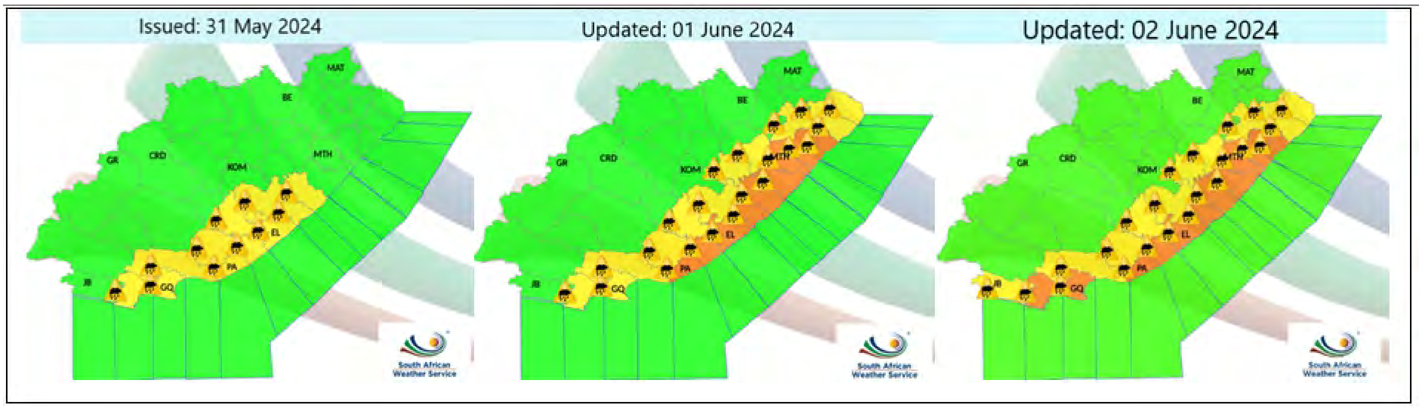


Figure 4: Disruptive rain warnings issued for the event.

Table 1: Lists the observed 24-hour rainfall accumulations for 1 to 3 June 2024; cells highlighted in orange indicate amounts between 40 and 50 mm, cells highlighted in red indicate rainfall amounts in excess of 50 mm, while the asterisks indicate that there was no data.

Jun-24					
Station Names		1	2	3	Total
Nelson Mandela Bay					
AWOS	Port Elizabeth Airport	36,6	25,6	3,4	65,6
ARS	3rd Ave Dip	34,0	36,6	1,0	71,6
ARS	Chetty	44,0	*	*	44,0
AWS	Coega Upper	21,0	216,2	2,4	239,6
ARS	Flower Reserve	22,0	134,6	87,4	244,0
ARS	St Albans	29,6	168,6	2,4	200,6
AWS	Uitenhage	29,0	226,8	*	255,8
MAN	Woodridge	47,5	111,5	19,6	178,6
Catchment					
AWS	Joubertina	6,8	32,6	2,4	41,8
ARS	Kareedouw	35,6	72,8	2,2	110,6
Other Towns					
AWS	Bisho/KWT	13,0	8,8	21,6	43,4
AWS	Cape St Francis	49,4	102,6	23,8	175,8
ARS	Bridle Drift Dam	57,0	*	101,0	158,0
AWS	East London	93,5*	83,0	62,0	145,0
AWS	Grahamstown	1,2	40,8	*	42,0
AWS	Mthatha	NIL	15,0	21,8	36,8
AWS	Komga	17,0	13,0	62,0	92,0
AWS	Port Alfred	10,2	107,2	13,4	130,8
AWS	Queenstown	11,0	3,0	26,0	40,0

Figure 5: Rainfall measured at the Uitenhage (Kariega) fire station on 1 and 2 June 2024.

24-hour snowfall accumulations

Snowfall accumulations were also expected to be extremely high over the north-eastern high ground of the Eastern Cape, especially along the southern Drakensberg. Overall, accumulations of 4 to 7 cm were expected over the high-lying areas of the Eastern Cape. However, the areas close to the Lesotho border, especially over Senqu and Elundini Local Municipalities (LM) were expected to receive between 20 and 50 cm of snowfall, as seen in Figure 6. A yellow level 2 warning for disruptive snow was then issued for the high-lying areas of the province, while an orange level 6 warning for disruptive snow was issued for parts of Joe Gqabi District Municipality (DM), Sakhisizwe LM, Emalahleni LM as well as parts of Enoch Mgijima LM.

The widespread snowfall occurred and resulted in slippery roads, traffic disruptions and numerous mountain pass closures; i.e Penhoek Pass, Barkley Pass and Nico Malan Pass. Additionally, due to the very high accumulations of snow that fell over Senqu LM and the mountains neighboring Lesotho, the snow was still observed a few weeks after the event, as seen in Figure 8.

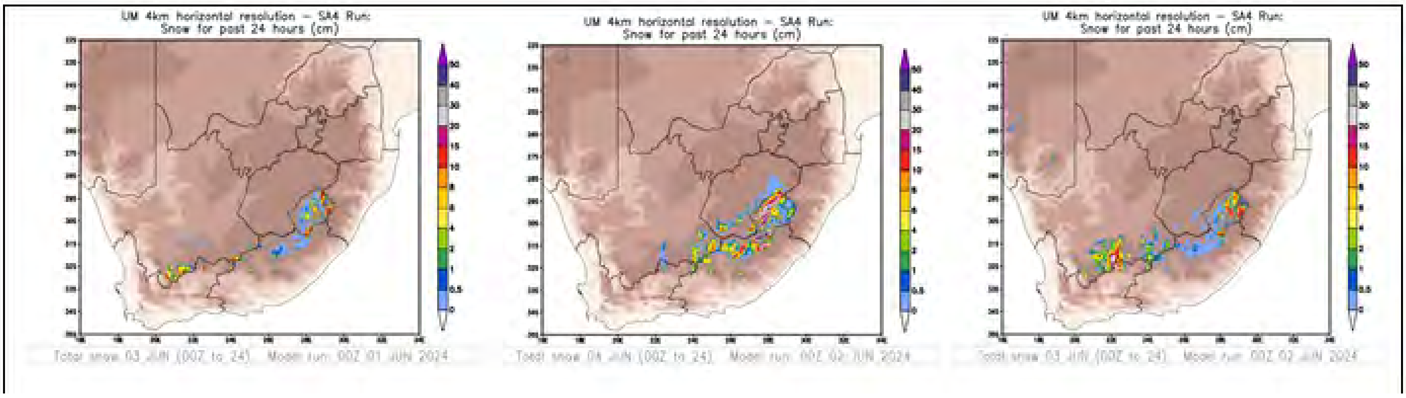


Figure 6: Expected snowfall accumulation for the Eastern Cape from 3 to 4 June 2024.

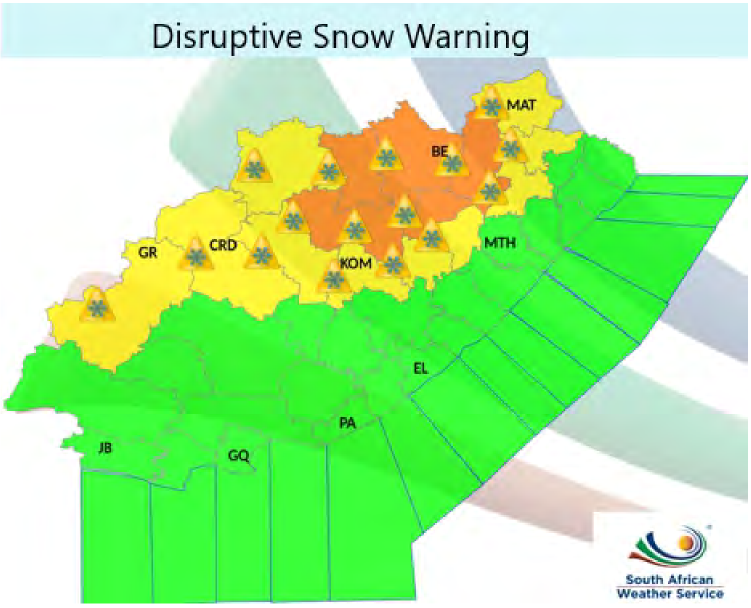


Figure 7: Disruptive snowfall warning Eastern Cape from 3 to 4 June 2024.

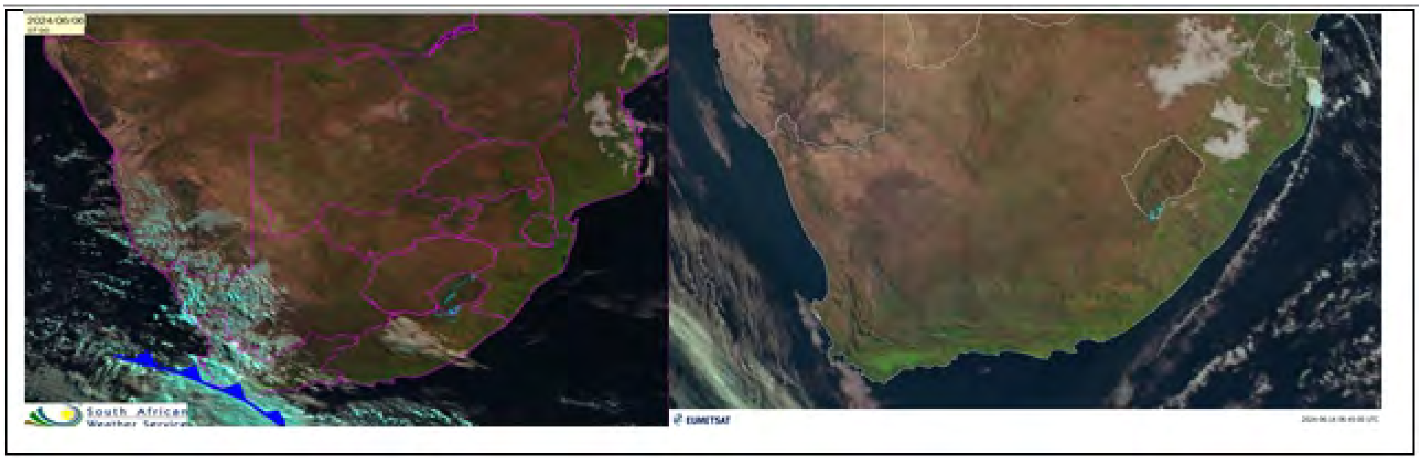


Figure 8: Snowfall visible on the Day Natural Colour RGB on 6 and 14 June 2024 respectively (Image courtesy of EUMETSAT and the SAWS Facebook Page).

Waves

The intense cold front was expected to result in strong to gale force winds that significantly enhanced wave heights to between 6 and 9 m, as shown in Figure 9 from the SAWS Wave and Storm Surge (SWaSS) model. These wave heights were expected between Plettenberg Bay and Port Alfred on 2 June 2024, spreading to Port Edward on 3 June 2024, with the wave direction predominantly easterly to south-easterly. Coastal damage was expected along the Eastern Cape coastline, where the Port Elizabeth weather office issued a yellow level 2 warning for damaging waves as well as port alerts for Port Elizabeth, Ngqurha and East London.

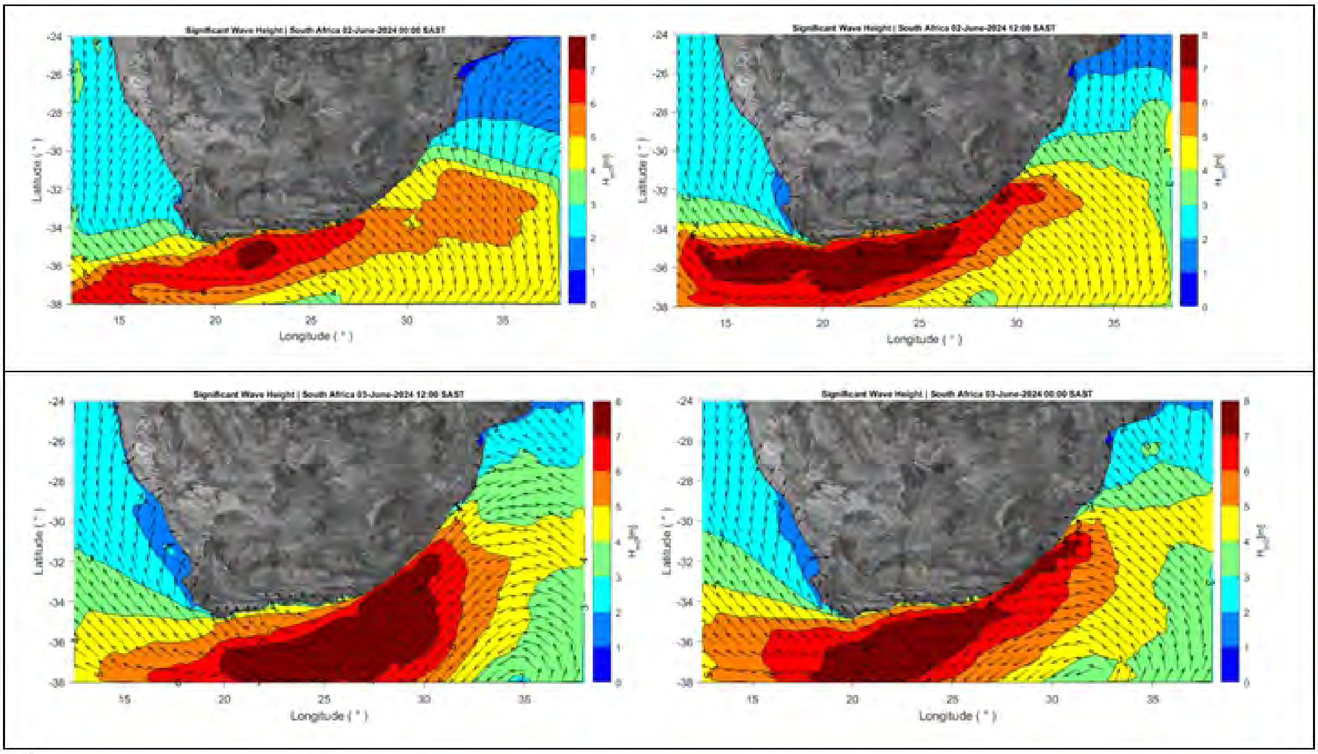
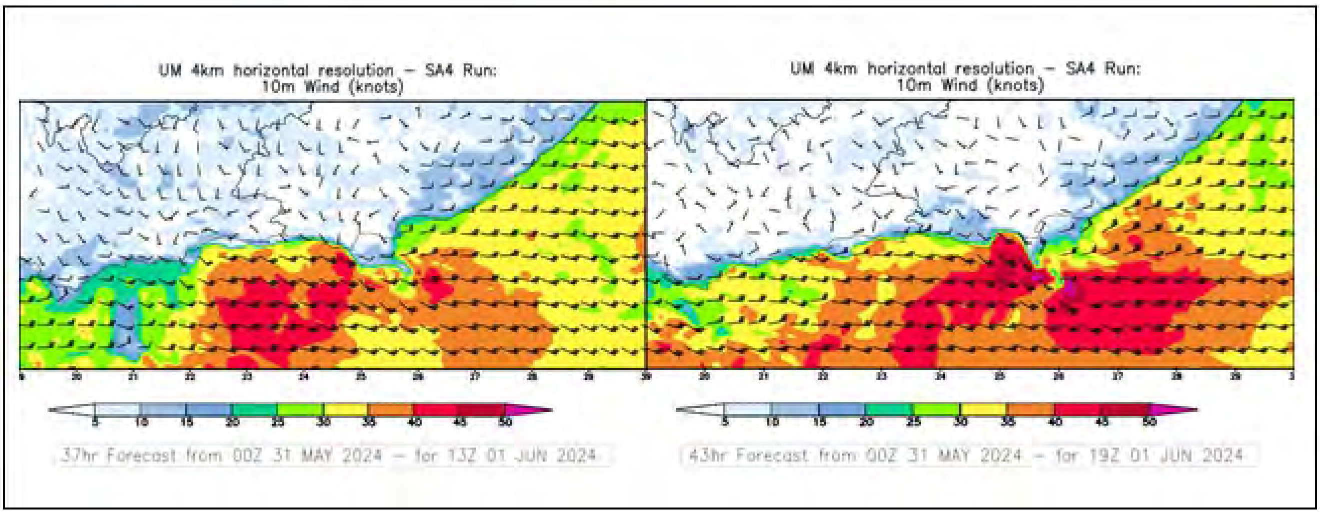


Figure 9: Expected wave heights along the Eastern Cape coastline from 2 to 3 June 2024.

Wind

Strong to Gale force winds were expected along the south coast of the Eastern Cape on 1 June 2024, spreading to east coast late morning on 2 June 2024. The direction of these winds was expected to be easterly to south-easterly as shown in Figure 10. A yellow level 2 warning for damaging winds was issued for areas along the coast due to how persistent the strong to Gale force winds were expected to be. In addition, port alerts for Port Elizabeth, Ngqurha and East London were sent as the winds were expected to disrupt port operations. No reports of damage were received for the strong winds along the coast.



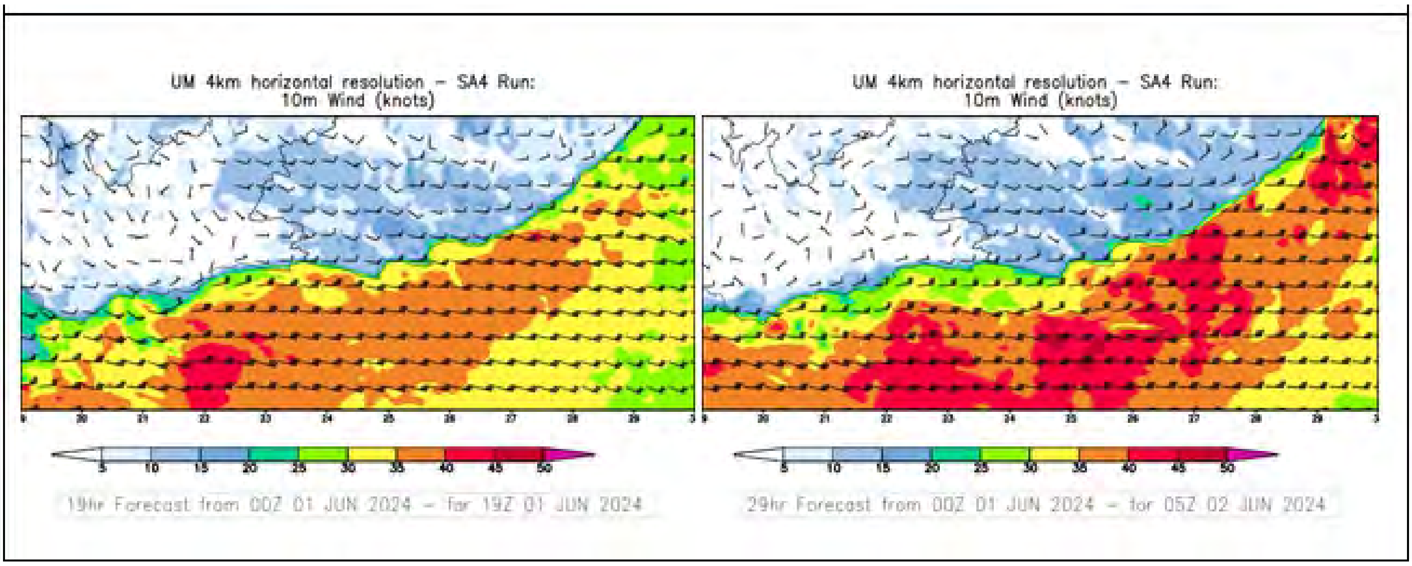


Figure 10: UM SA4km 10m windspeeds for parts of the Eastern Cape Coastline.

Observed impacts

Numerous impacts were observed across the province. These impacts were collected from various disaster management reports and media platforms (television, social media and print media). The impacts will be listed according to the parameters that caused them. It is important to note that some impacts may have been caused by more than one parameter.

Reported rainfall impacts:

- Damage and flooding of property and settlements (formal and informal) over numerous district municipalities of the Eastern Cape.
- Disruption and loss of livelihood: at least 3 949 people were affected and displaced over the Nelson Mandela Bay and Buffalo City Metro's alone.
- Danger to life (14 fatalities [at the time of writing this report], 11 from Nelson Mandela Bay Metro and three from Buffalo City Metro. Two people are still reported missing).
- Mud-based and makeshift houses collapsed.
- Flooded and damaged roads and bridges.
- Damage to structures and infrastructure (including and not exclusive to schools and clinics).
- Vehicle accidents.
- Overflowing rivers and dams (Nahoon River, Sundays River and Tiryville Dam).
- Mudslide and/or landslide (Blue Horizon Bay and R61 around Mlengana Pass).
- Disruptions due to sinkholes (Kariega and Makana LM).
- Power outages.
- Water disruptions and some pipelines washed away (KwaNobuhle).
- Port disruptions (waste and debris from Nahoon River flowed into the East London port).

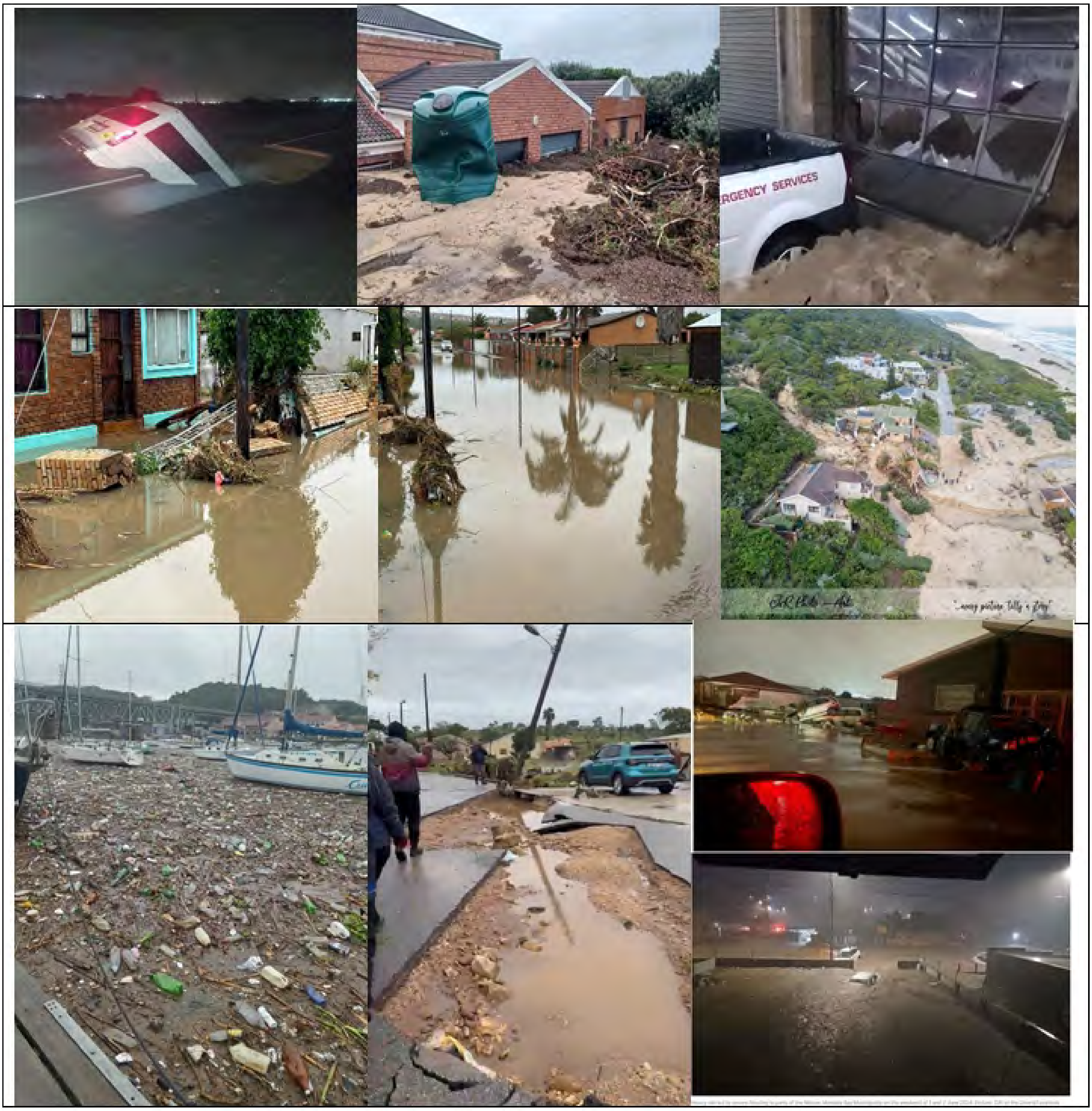


Figure 11: A collage showing rainfall impacts across Nelson Mandela Bay Metro and Buffalo City Metro.

Snowfall impacts:

- Pass closures (Penhoek Pass, Barkley Pass, Nico Malan Pass and etc)
- Slippery roads and road closures (R58, R61, N6 and R67)
- Traffic disruptions
- Some communities were temporarily cut off
- Crop and livestock losses

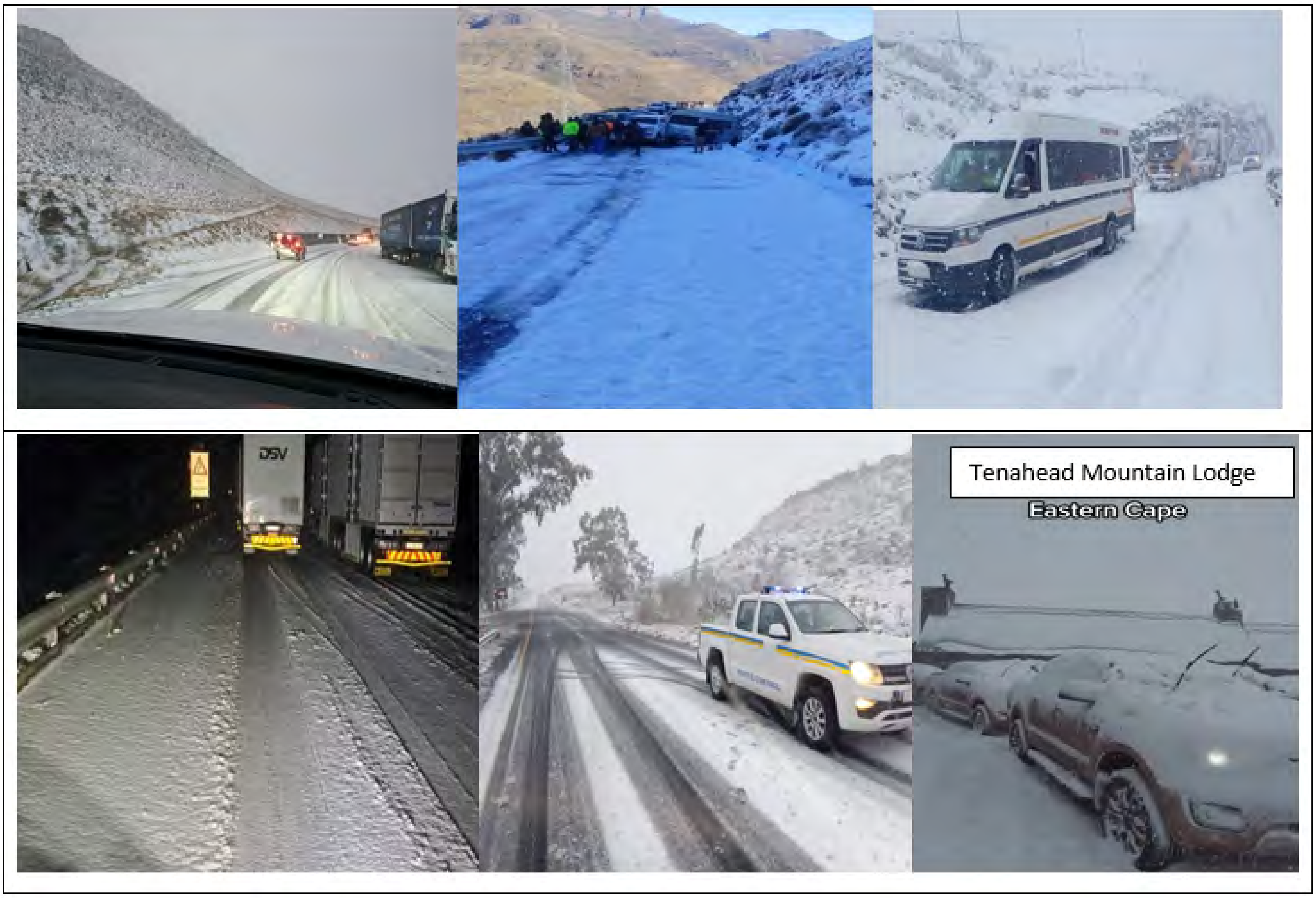


Figure 12: Snowfall impacts over the high lying areas of the Eastern Cape.

Waves impacts:

- Waves deposited rocks and resulted in traffic disruptions along the N2 between Colchester and Deal Party Sunday night into Monday morning.
- Vehicle vessel damaged on way to the Port of Port Elizabeth.
- Sailing yacht sunk with a jetty in East London.

Figure 13: Images of wave impacts in places along the South Coast.

CONCLUSION

The passage of the cold front, cut-off low and ridging high pressure system resulted in adverse weather conditions over the Eastern Cape. Consequently, significant rainfall impacts, including the loss of at least 14 lives occurred along the coast and adjacent interior between Cape St. Francis and East London between 1 June and 3 June 2024. Additionally, disruptive snowfall with notable impacts occurred over the north-eastern high ground between 3 and 4 June 2024, where major pass closures occurred with some communities temporarily cut-off.

Interestingly, similar weather systems resulted in significant rainfall impacts along the Wild Coast and adjacent interior from 1 to 3 June 2021, while disruptive snowfall occurred over the north-eastern high ground. Thus, it is important to consider significant impacts when a combination of the aforementioned systems is present.
Lastly, although the rainfall impacts were initially expected to be minor, the forecast was continuously evaluated against the latest observations and model outputs, which then resulted in the rainfall impacts being upgraded from minor impacts to significant impacts.

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South African Weather Service FaceBook Page: https://www.facebook.com/WeatherServic/

TimesLive Newspaper: https://www.timeslive.co.za/sunday-times-daily/news/2024-06-02-theyve-got-more-problems-in-the-city-east-london-skipper-loses-yacht-but-escapes-harm-in-flood-chaos/

A GLANCE AT THE FIRST SEVEN MONTHS OF 2024 WEATHER FOR WESTERN AND NORTHERN CAPE

Elani Heyneke, Kanyisa Makubalo, Lauren Smith, and Stacy Colborne

The western parts of South Africa which include the Western Cape and the Northern Cape (Namakwa) regions mostly receive rainfall in winter. Convective weather in late summer (March to May) is common over the north-eastern and extreme eastern regions of this focus area. The south-eastern Western Cape has a distinctive rainfall seasonality because it experiences rain all year round (Figure 1).

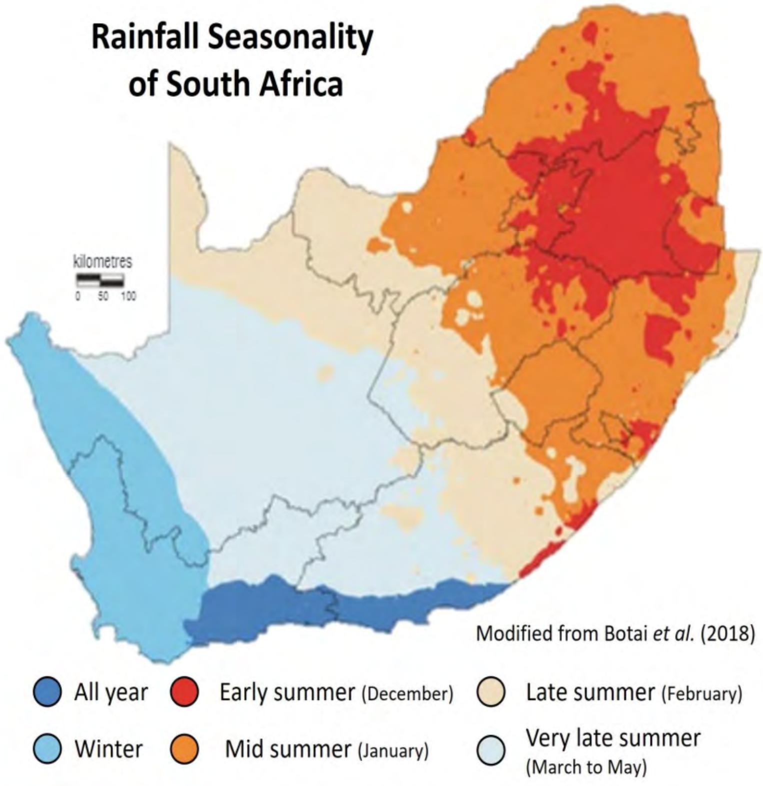

Figure 1: The rainfall seasonality of South Africa(Botai et al., 2018).

The aim of this article is to show the different adverse weather conditions that were observed over the Western Cape and the western part of the Northern Cape (Namakwa) during the first parts of 2024. The end of the late summer and start of the winter saw warmer than normal temperatures and below normal rainfall. However, there was a drastic change in the weather conditions during July, when below-normal temperatures and above-normal rainfall were observed. Nevertheless, the late summer was also expectational, especially during February.

February 2024

During the first week of February 2024, unseasonal severe thunderstorms were observed over the western interior of the Western Cape. On 2 February, there was a hailstorm near Citrusdal (Western Cape, (Figures 2 a) to e)) where the weight of the hail tore an agricultural netting. On 3 February, a Mesoscale Convective System (MCS) with estimated wind gusts of up to 100 km/h blew over several Eskom power lines near Laingsburg, resulting in electricity disruptions for large parts of the region (Western Cape, Figure 2 e) to h)). The MCS was classified as a rare event since these systems typically occur over the eastern parts of South Africa. Where there is an abundance of moisture from the southwestern Indian Ocean being advected into the interior (Heyneke et al., 2024).

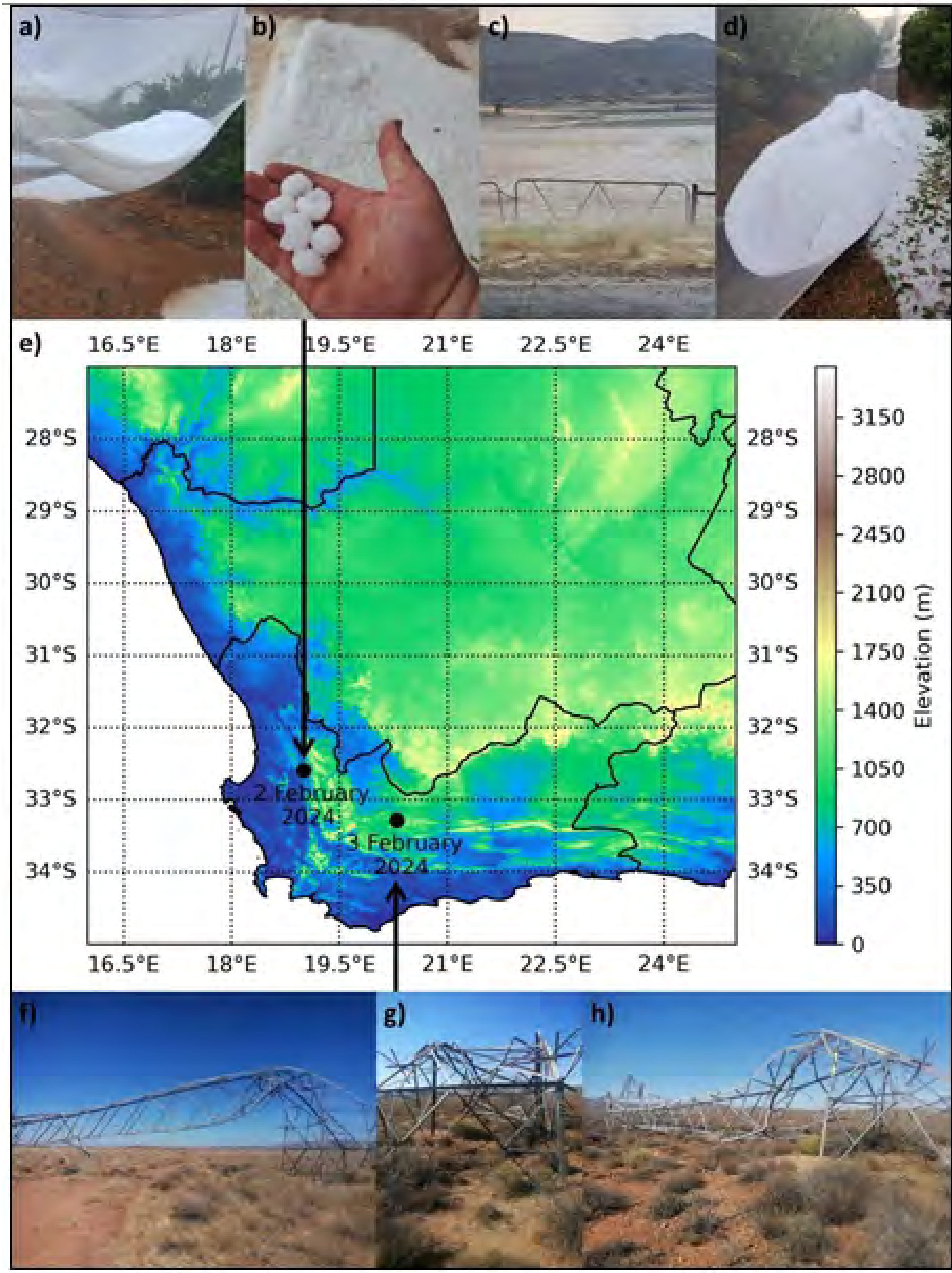

Figure 2: Damage from two separate severe thunderstorm systems over the Western Cape, with a) to d) from a hailstorm near Citrusdal (2 February 2024) and f) to h) from the MCS near Laingsburg (3 February 2024). e) An elevation map with the locations of the 2 and 3 February 2024 severe thunderstorm systems (Source: SAWS and Facebook, 2024).

April 2024

Between 6 and 9 April 2024, a cut-off low system (a low-pressure system that is cut off from the main westerly belt in the upper levels of the atmosphere) developed over the western parts of the country, following a series of heat waves and below-average rainfall over the majority of South Africa. These severe and adverse weather conditions had significant impacts across most of the provinces. The western parts of the country were affected between the 7th and the 8th with severe thunderstorms over the interior and heavy rain over the south-western parts, respectively (Figure 3).

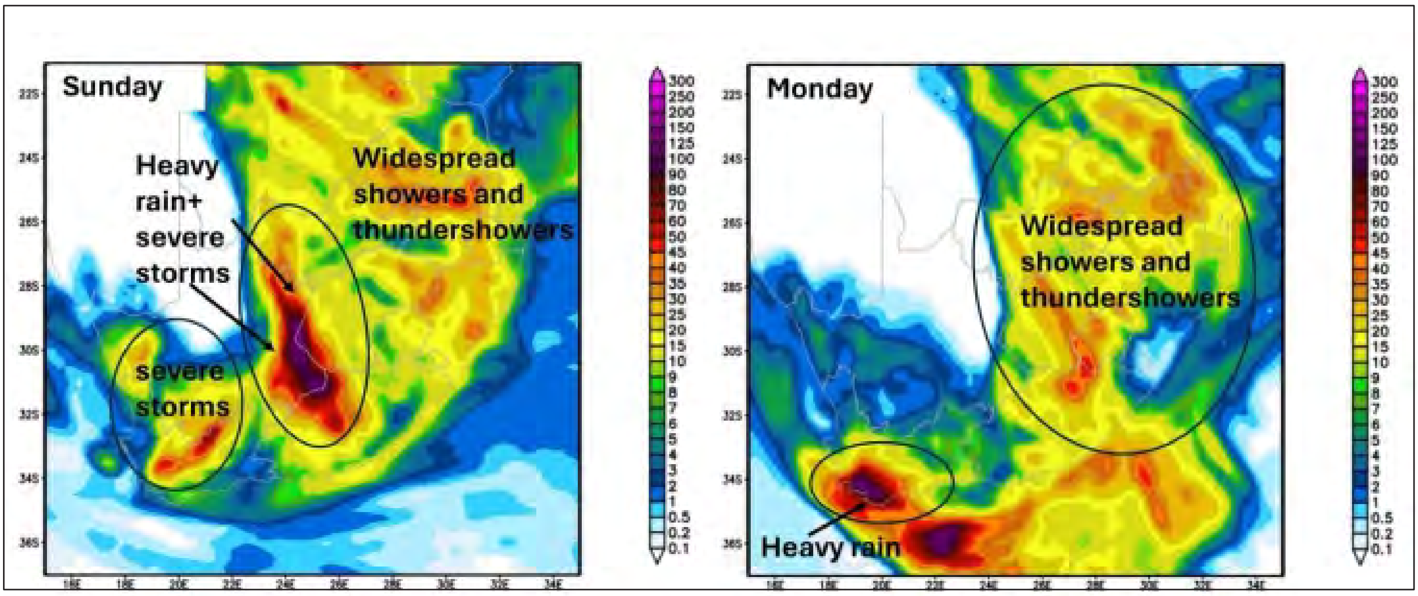

Figure 3: 24-hour rainfall accumulation for Sunday, 7 April (left) and Monday, 8 April (right) according to the Global Forecast System (GFS). Widespread showers and thundershowers were expected across most parts of the Western and Northern Cape (Source: GFS, 2024).

The South African Weather Service (SAWS) issued levels 4, 6, and 9 of disruptive rainfall impact-based forecast (IBF) warnings for most parts of the forecast region (Figure 4). As highlighted in Figure 5, the continuous rainfall and strong to gale force winds resulted in impacts of trees and high-sided vehicles blown over, road closures, flooding, electricity outages, storm surges, as well as school closures in the Overberg region (south-western parts of the Western Cape).

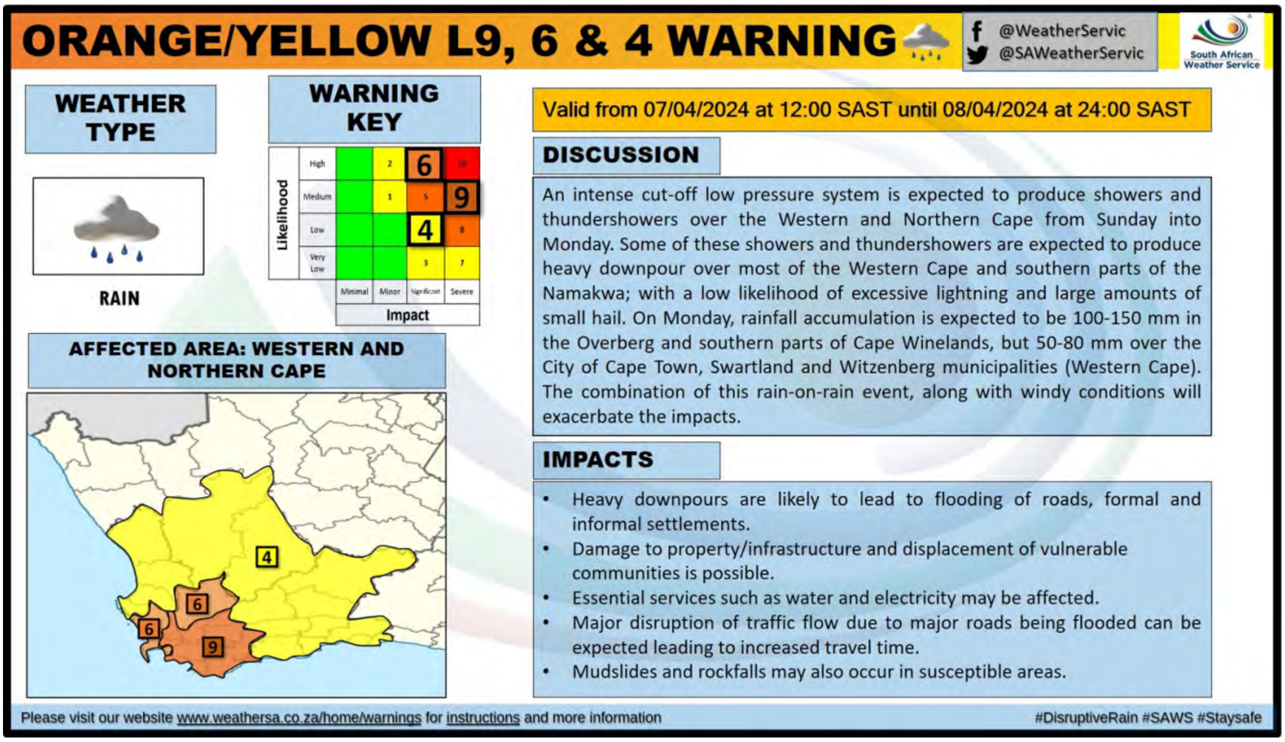

Figure 4: Impact based forecast (IBF) warning for disruptive rain on Sunday, 7 April and Monday, 8 April impacting the Northern and Western Cape provinces (Source: SAWS, 2024).

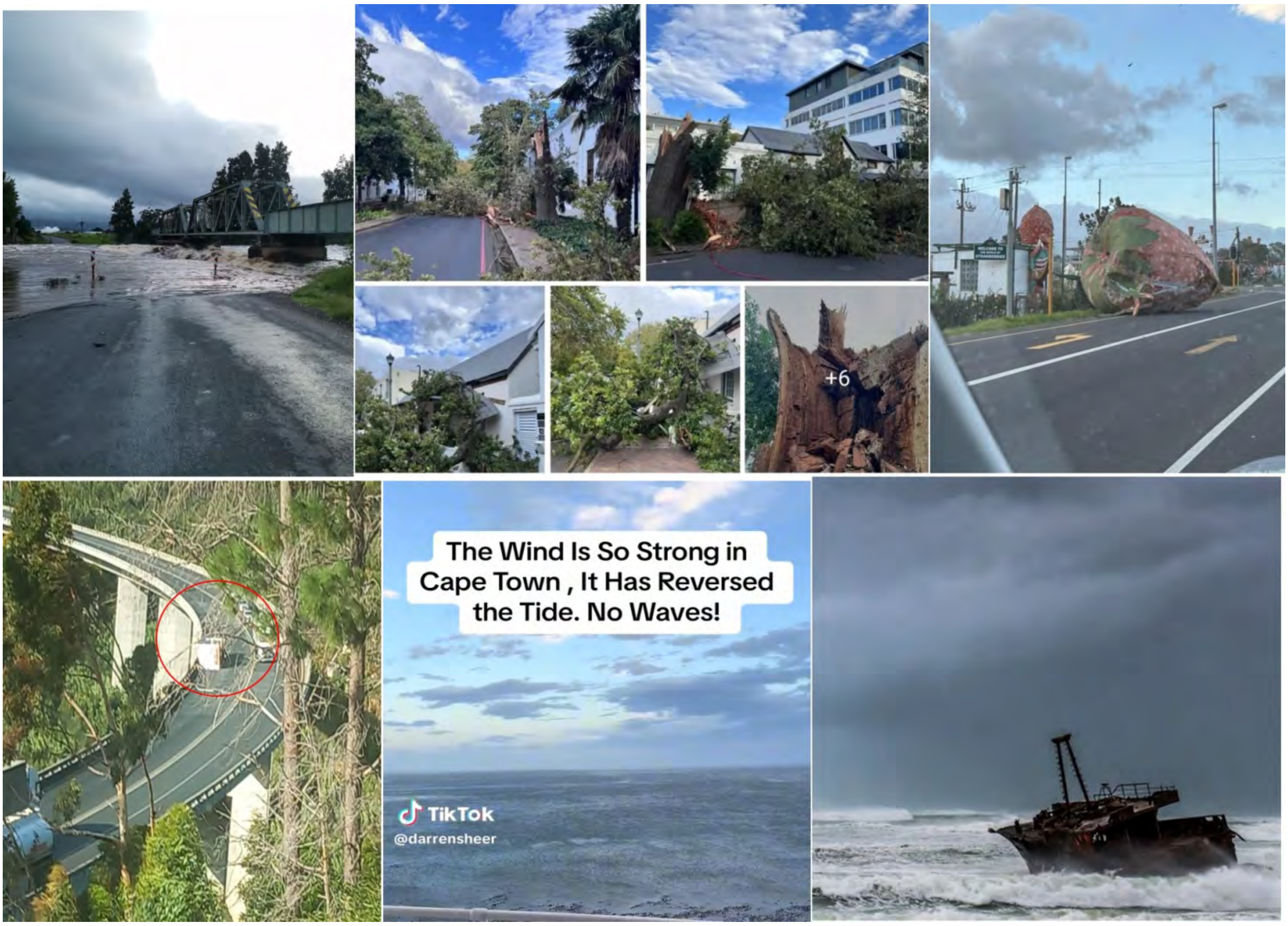

Figure 5: Impacts from the severe cut-off low system that affected the region on Sunday, 7 April and Monday, 8 April 2024. The top left is flooding in the Garden route, centre image is the wind impacts in the Stellenbosch, top right in the strawberry singe near Stellenbosch. Bottom right is a truck blown over in the road towards the Paarl tunnel and the centre indicates the wind impacts over the coastal shores while the right is the ocean impacted by the storm surge at Kalk Bay region (Source: Facebook, TikTok, 2024).

In addition, a negative storm surge was observed along the coastline of South Africa on 7 and 8 April 2024. A negative surge can occur when strong near-surface offshore winds along a coastline lead to a significant reduction in water levels. Furthermore, it can also occur when strong offshore winds coincide with a tidal low. These phenomena may severely restrict transportation along waterways and affect shoreline infrastructure, leading to potential economic losses.

June 2024

A cold, wet, and windy June came around with a significant change in weather taking place from 1 to 4 June 2024, following a comparatively dry and warmer-than-normal May. The first notable decrease in daytime temperatures was expected over those coming days across South Africa. Showers and thundershowers were to develop across most of the country, and snowfall over the high ground was expected. That was due to a cut-off low system that developed to the west of the country on 2 to 3 June 2024.

The cut-off low system had affected the western regions from 1 June 2024, where showers and rain were experienced over the eastern parts of the Western Cape. In addition, strong to gale-force winds and extremely choppy sea conditions with significant wave heights of 5,0 to 6,0 m were possible along the coastal strip. Offshore, 7,0 to 8,0 m significant wave heights were also expected. A chance of heavy 24-hour rainfall with accumulations of up to 50 mm was expected, and 100 mm in places to the far east was to be experienced. Several IBF warnings were issued: disruptive rain, wind, and waves, together with an advisory for wet, cold, and windy conditions (Figure 6).

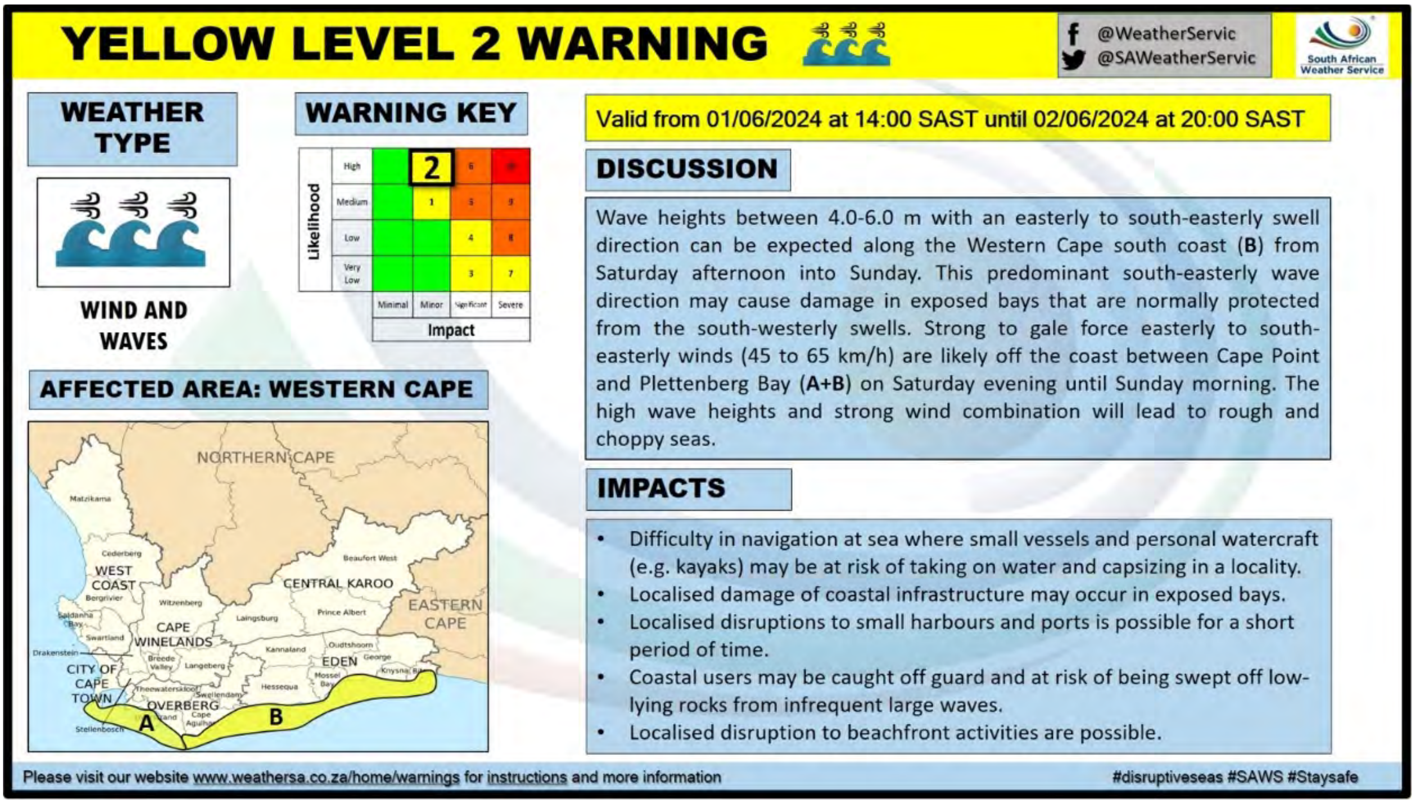

Figure 6: Impact based forecast (IBF) warning for wind and waves on Saturday, 1 June and Sunday, 2 June 2024 impacting the south-western and southern coastal region. (Source: SAWS, 2024)

July 2024

July 2024 was an exceptionally wet, windy, and cold month. A series of cold fronts affected the western region of South Africa as well as the rest of the country. The first significant system made landfall over the western parts on 7 July 2024, resulting in very wet, windy, and cold conditions coupled with significant impacts along the coastline. A positive storm surge (an abnormal rise of seawater, over and above predicted astronomical tides) was expected in places between Alexander Bay and Gqeberha, on Sunday, 7 July 2024 and Monday, 8 July 2024 (fig 7). The storm surge was due to the surface low pressure of the cold front being near the South African coastal regions as opposed to being south. The system intensified with rapid cyclogenesis, when the central low pressure deepens by a factor of 1 hPa per hour over a 12-hour period (EUMeTrain, 2017). As a result, an orange level 6 and yellow level 3 storm surge IBF warning (Figure 8) was issued highlighting flooding in low-lying areas and disruptions to beach front activities in that coastline during this period.

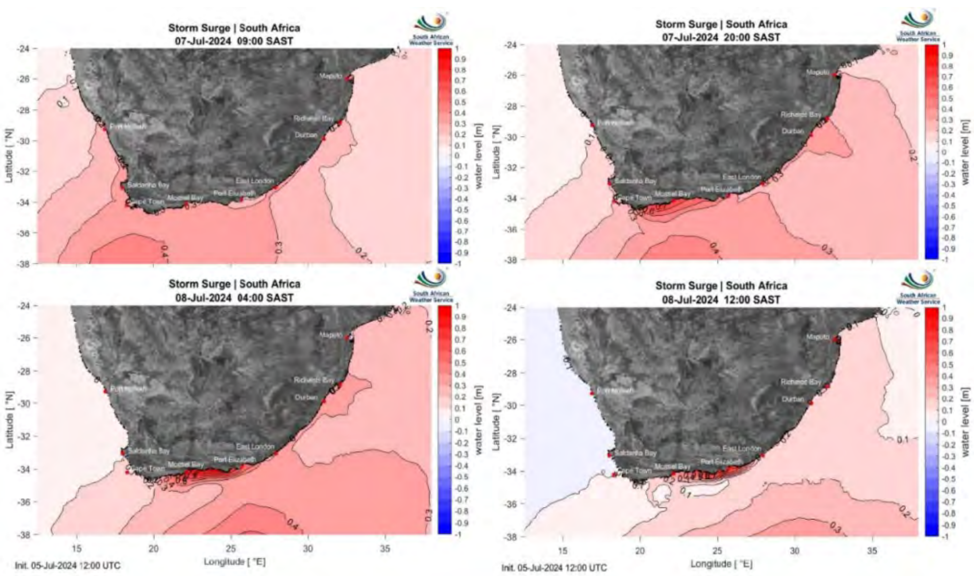

Figure 7: Regional map showing the forecasted storm surge along the south and south-east coastline for 7-8 July 2024 from 04h00 to 12h00 SAST. (Source: SAWS, 2024)

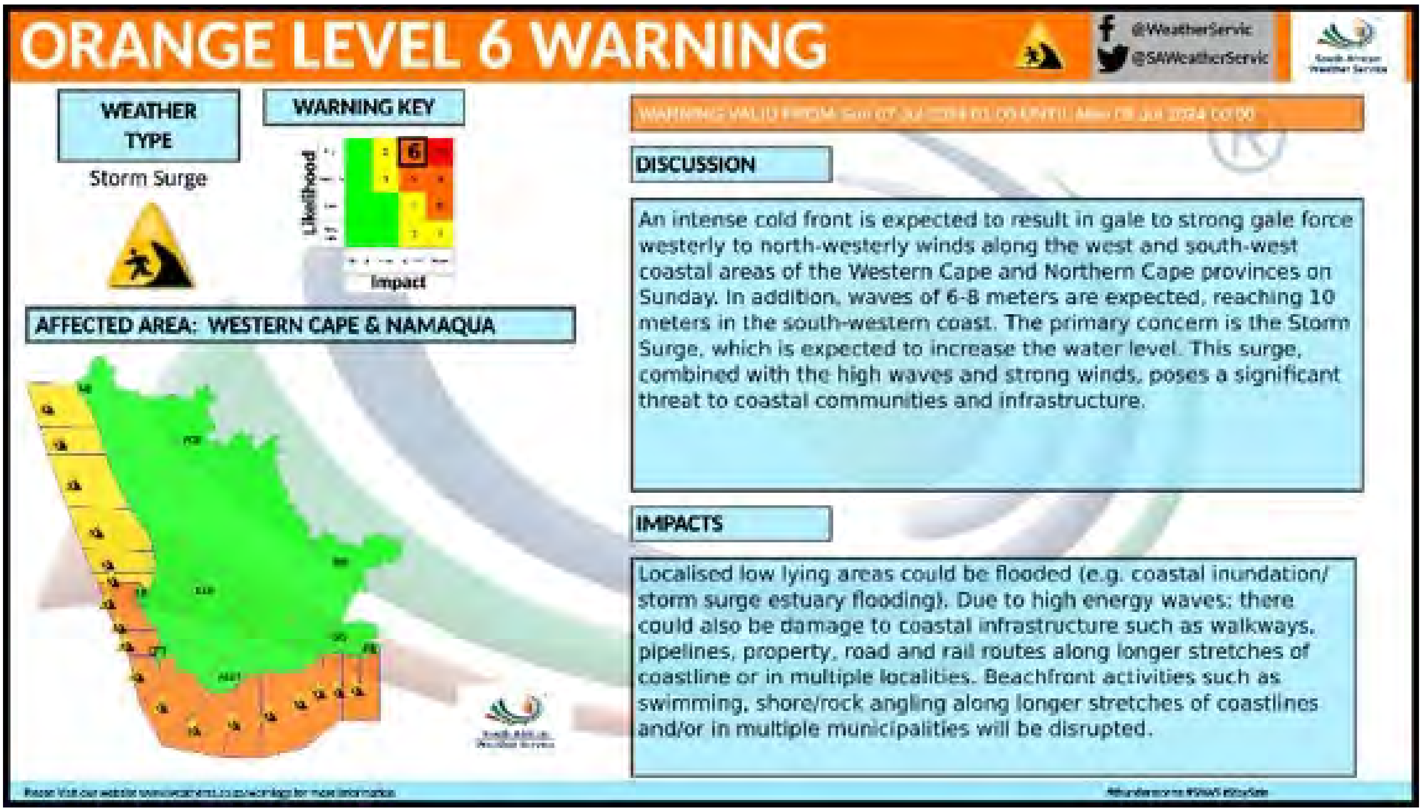

Figure 8: Orange Level 6 and Yellow Level 3 IBF warning for positive storm surge from Cape Columbine to Plettenberg Bay and Alexander Bay to Cape Columbine, respectively for Sunday, 7 July 2024 to Monday morning, 8 July 2024. (Source: SAWS, 2024)

In addition to the storm surge, the severe cold front was to bring wave heights of 6,0 to 8,0 m, potentially reaching up to 10,0 m in the south-west, along with gale to strong gale force north-westerly to westerly winds. As a result, a wind and waves IBF warning was also issued by the SAWS for the coastline between Alexander Bay and Plettenberg Bay for this period. Impacts of the storm surge and high seas along this coastline were reported. Other IBF warnings, inclusive of disruptive rain and snow together with damaging interior winds, were issued. The system then resulted in heavy rainfall and gale-force winds over much of the western parts of the Western Cape, where significant impacts of flooding of settlements, trees blown over, and disruptions of daily activities were reported. Figure 9 indicates some of the reported impacts across the Western Provinces during that period.

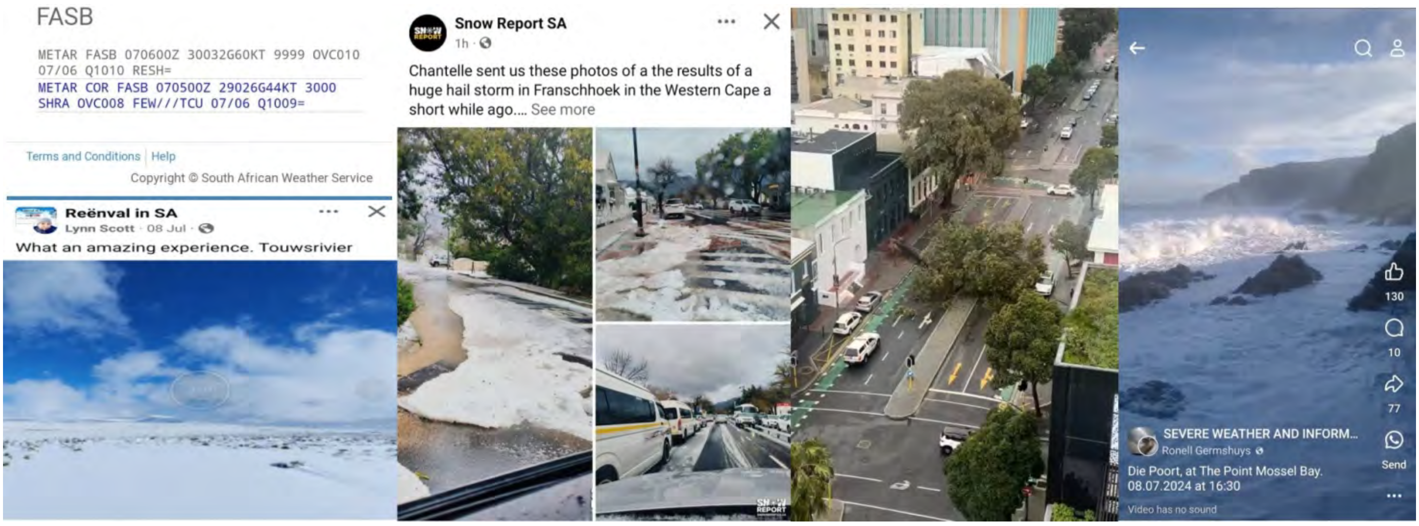

Figure 9: Some of the reported impacts across the Western Provinces for 7-8 July 2024. (Source: SAWS, Facebook and Tiktok, 2024)

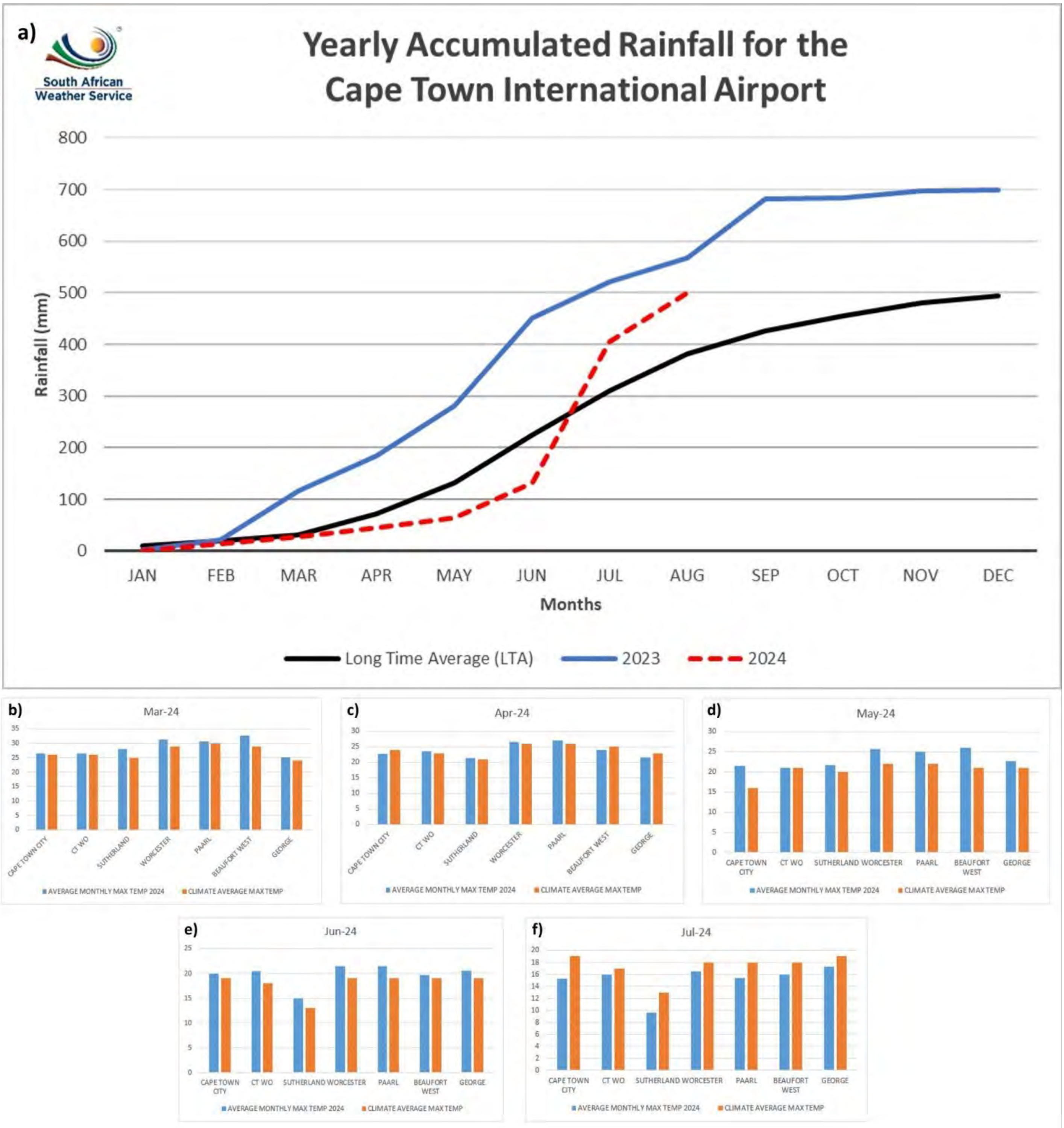

Figure 10: a) The yearly accumulated rainfall for the Cape Town International Airport for the long-term average (black line), 2023 (blue line), and January to August 2024 (dashed red line). b) to f) Comparison of average monthly maximum temperatures for 2024 against climate average maximum temperatures for different places over the Western Cape. (Source: SAWS, 2024)

The first half of 2024 over the western regions of South Africa was undoubtedly exceptional for both the marine and the public sectors. Severe weather conditions ranged from dangerous sea states to life- and livelihood-threatening conditions for the public, as well as difficult working conditions for the disaster managers. Since April, there have been exceptional weather impacts across the Western and Northern Cape. Record-breaking weather conditions were observed, with July being the most noteworthy month for the south-western parts of the country.

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SPATIAL AND TEMPORAL VARIATION IN LONG-TERM SURFACE TEMPERATURE TRENDS AND THEIR EXPECTED DIRE IMPLICATIONS IN SOUTH AFRICA

Andries Kruger and Charlotte McBride
Climate Service

INTRODUCTION

Some decades ago, the concept of "climate change" began to surpass "global warming" as the preferred term to use when global warming due to anthropogenic influences (mainly the release of greenhouse gases in the atmosphere) and its effects on the climate in general, is discussed. This is mainly because it has been recognised that the observed global warming over the last century has had profound effects on the climate in general, with changes to other climate parameters that have the potential to have far greater impacts than the general warming itself. One of the important effects of climate change is that the increases in surface temperatures are not uniform across the globe, but vary between regions, seasons and even on a sub-daily basis.

As stated above, it has been observed in many recent climatological studies that global warming does not only influence surface temperatures through a general long-term positive trend on a global scale. Surface temperature trends vary at regional and temporal scales (IPCC, 2021). The trend also does not stay near-constant through long observation periods, with sufficient evidence of an acceleration in warming during recent decades (for example, McBride et al., 2021). In this article we use "temporal scales" as the time scales from sub-daily (e.g. hourly) to daily, instead of the long-term trend variation of the trend magnitude through time.

Perhaps the most obvious evidence that the general warming is not near-constant on a daily basis is from a global study that concluded that since the 1950s, decreasing trends have been observed in the diurnal temperature range (DTR) (the difference between daily maximum and minimum temperature) across the globe, with almost half of the surface area exhibiting significantly negative trends. This means that over most of the globe, minimum temperatures rose faster than maximum temperatures (Sun *et al*., 2018).

Warming trends are also not near-constant over seasons, with some seasons exhibiting stronger warming than others (Kruger and Shongwe, 2004). Many studies show that these variations are also not uniform, i.e. one season does not in all cases warm faster compared to others but varies over different parts of the world.

Such variations in warming, as mentioned above, can be caused by a range of factors additional to global warming, such as long-term positive changes in cloudiness, precipitation, soil moisture, aerosols, terrestrial vegetation, and local urbanisation and associated dimming, which can cause decreases in DTR. On the other hand, a decrease in cloudiness and precipitation and increase in drought frequency can cause an increase in DTR (Sun et al., 2018). These factors, amongst others, can also cause the variations of warming observed between seasons.

Required data and methods

Taking South Africa as an example, research shows that long-term trends in DTR have significant regional spatial variations (MacKellar *et al*., 2014). However, no conclusions have yet been made as to the specific causes thereof. For example, one study shows that while in most cases trends in DTR and rain days are the opposite and the same as trends in cloud cover respectively, it is not always the case (Kruger, 2007). Other studies show evidence of negative trends of minimum temperature for some locations causing a gradual increase in DTR that can possibly be related to a reduction in nocturnal cloud cover or even more stable ambient atmospheric conditions (MacKellar *et al.*, 2014). All the long-term temperature trend analyses using actual measurements that have been published for South Africa used data sets of only between 20 and 30 weather stations (for example, Kruger and Nxumalo, 2016).

It can be argued that the reasons for the variance of temperature trends on sub-daily and seasonal bases can only be properly assessed with a much denser network of available stations. Since 1992, the South African Weather Service (SAWS) has initiated the deployment of automatic weather stations (AWSs) throughout South Africa in earnest; in the beginning mostly with the replacement of manual technology at key weather offices at the main airports. Throughout the remainder of the 1990s and early 2000s, the AWS network expanded at a relatively rapid pace. Currently, this initial spatial expansion of AWS technology lends itself to more detailed historical climate variability and trend assessments, due to the superior reliability of measurements, compared to manual measurements, as well as the relatively high resolution of measurements (five minutes versus once or a few times a day for manual stations).

For the purposes of this exploratory study, we considered the analysis period 1994 – 2023 to utilise the maximum number of weather stations, while considering the minimum required period for reliable long-term trend analysis, namely a climatological period of 30 years (WMO, 2018). The resolution of the data for this analysis is hourly, and weather stations with at least 90% data availability were selected. The stations did not undergo any changes in terms of position and type of temperature measurement instrumentation, and were routinely checked and calibrated, if necessary, according to World Meteorological Organization guidelines (WMO, 2018). Therefore, the eventual total of 53 relevant time series were expected to be near- or completely homogeneous (meaning that measurement variations are primarily due to climatological influences only).

In trend analysis, it is necessary to account for the features of the data sets used. For long-term climatological analysis, it cannot, for example, be assumed that the data used are normally distributed, that for example, annual deviations from the trend are normally distributed, or that the trend is close to constant over the full analysis period. Therefore, statistical methods that do not rely on these assumptions are preferred. In this case we used Sen's slope to estimate the long-term trend and the Mann-Kendall test to establish the statistical significance thereof.

Some preliminary results

Annual trends

Figure 1 presents the average trend of the surface temperature calculated on an annual basis, which includes all hours of the day. One can see that there are significant spatial variations in the annual trends, ranging from less than zero at places on the south-east coast to more than 0,06°C/year over most of North West, Gauteng and the western parts of Mpumalanga. A general observation is that surface warming is stronger in the north of the country, compared to the south. The average trend for all the stations is an increase of about 0,03°C/year, much stronger than the 0,017°C/year estimated for South Africa for the period 1951 – 2023 (see the SAWS Annual State of the Climate 2023 at https://www.weathersa.co.za/home/annualstateoftheclimate). This illustrates that the warming trend has been accelerating over recent decades, as is the concerning case for most parts of the world (IPCC, 2021).

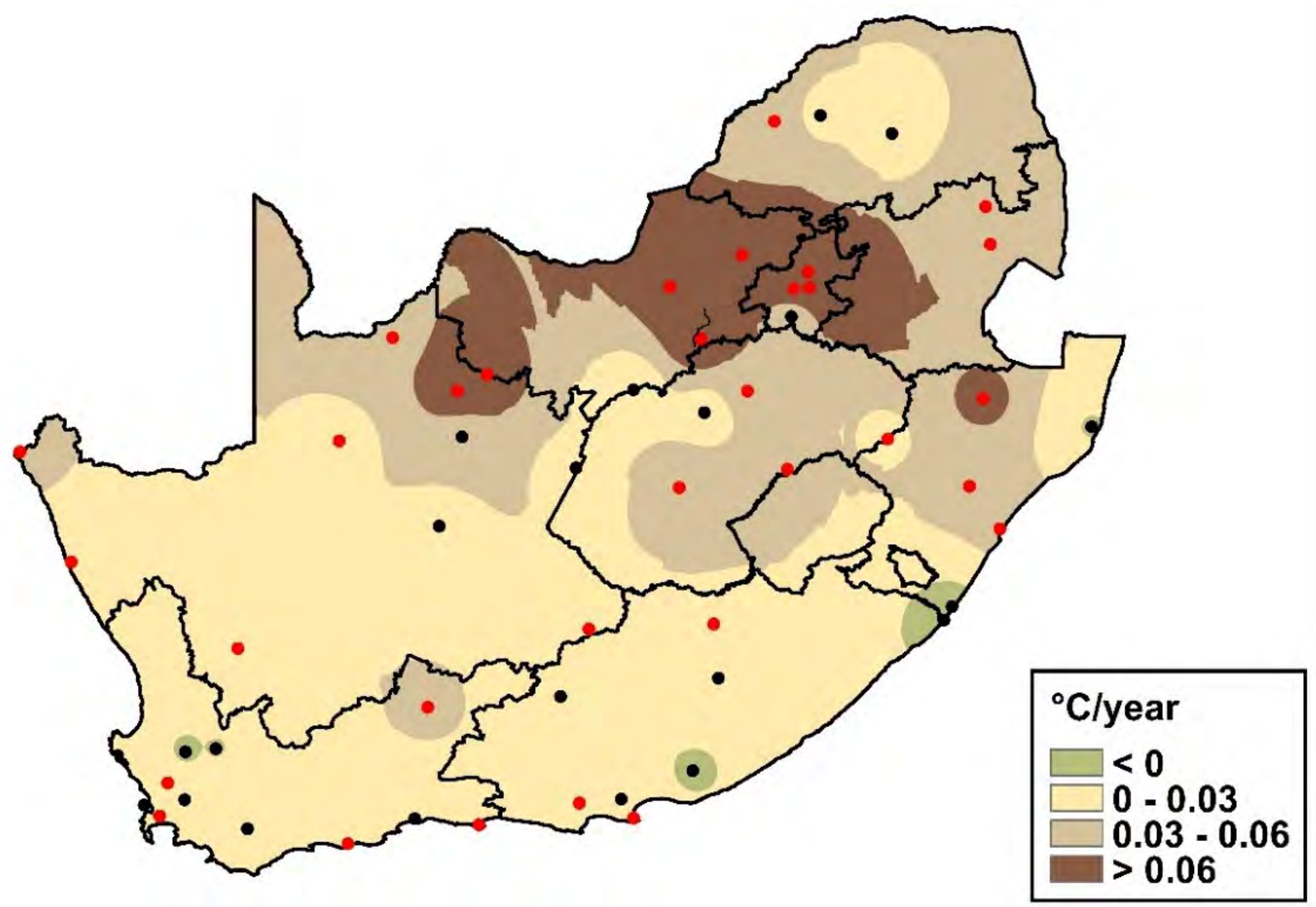
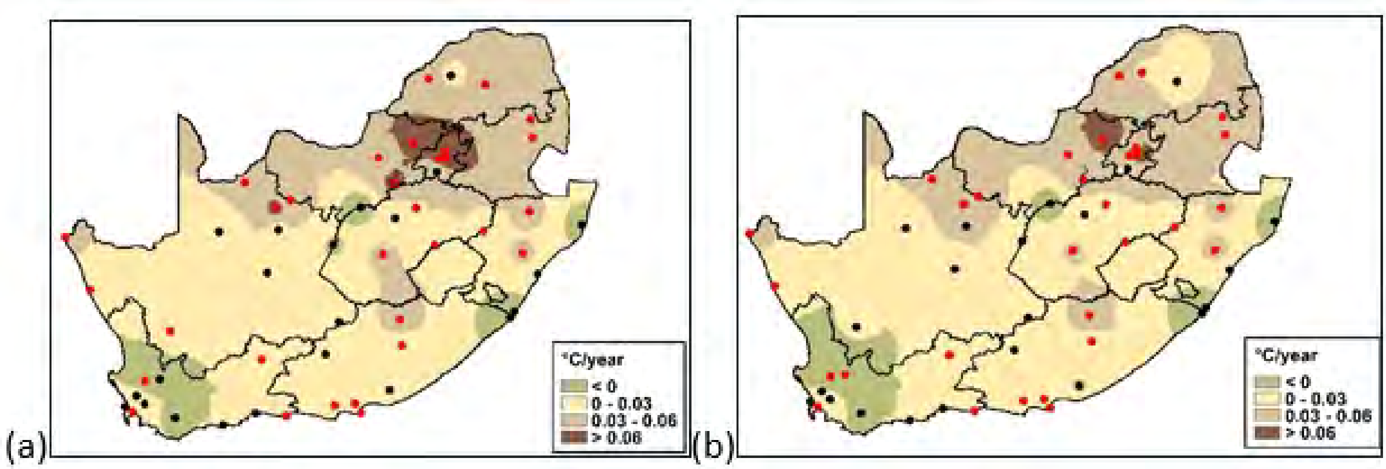


Figure 1. Average surface temperature trend over South Africa (1994 – 2003). Circles represent climate station locations: Red circles show statistically significant trends at the 95% confidence level.

Trends at specific hours

Figure 2 presents an analysis of the station trends over South Africa at (a) 00:00 SAST (midnight), (b) 06:00 SAST (morning), (c) 12:00 SAST (midday) and (d) 18:00 SAST (evening). We can see that although there is a similar pattern of stronger warming in the north compared to the south of South Africa, a clear difference is evident when, for example, the warming around midday (strongest warming) and midnight (least warming) are compared. Also, at midnight and the early morning, there are extensive regions of cooling in especially the Western and Eastern Cape. These trend variations have an impact on the trends in DTR, with further analysis showing that most parts of South Africa have experienced an increase in DTR, contrary to most regions in the world.



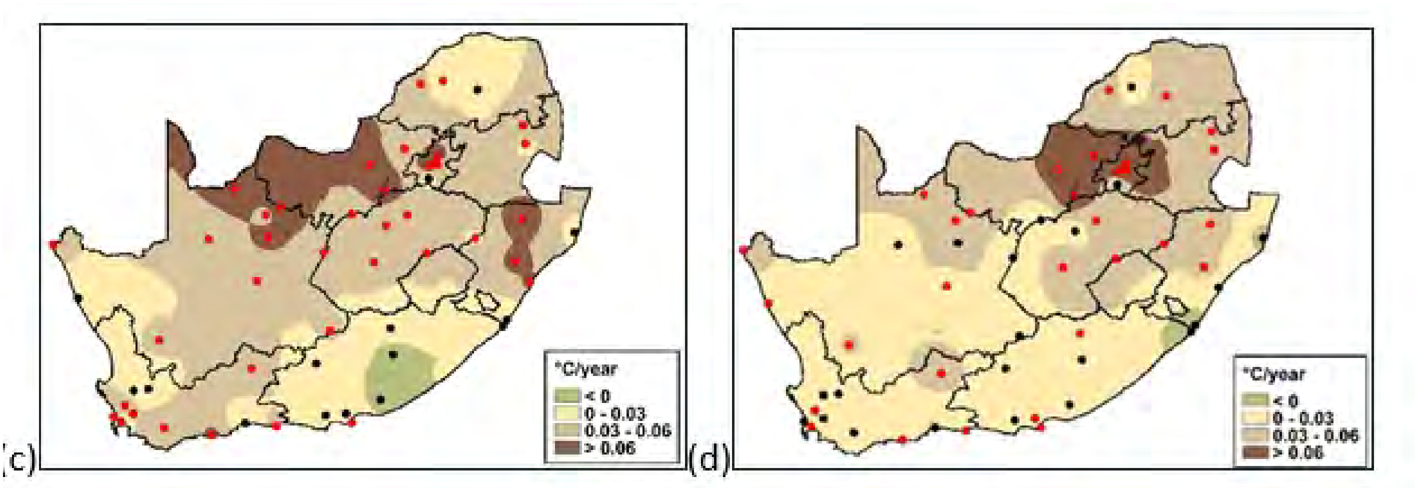


Figure 2: Annual average temperature trend at (a) 00:00 SAST, (b) 06:00 SAST, (c) 12:00 SAST and (d) 18:00 SAST for the period 1994 - 2023. Circles represent climate station locations: Red circles show statistically significant trends at the 95% confidence level.

Trends per season

Figure 3 presents the annual average trend per season for (a) December, January, February (DJF) (summer), (b) March, April, May (MAM) (autumn), (c) June, July, August (JJA) (winter) and (d) September, October, November (SON) (spring). Again, as with the analyses above, the stronger warming in the north is evident for all seasons. Also, the warming in the north is the strongest during the spring and, to a somewhat lesser extent during winter. Nevertheless, in summary, for all the stations, the trend shows a maximum in winter (June, July, August (JJA)) at 0,032°C/year, followed by spring (SON) at 0,030°C/year. On average, the weakest warming is in summer (DJF) and autumn at 0,021°C/year and 0,022°C/year, respectively.

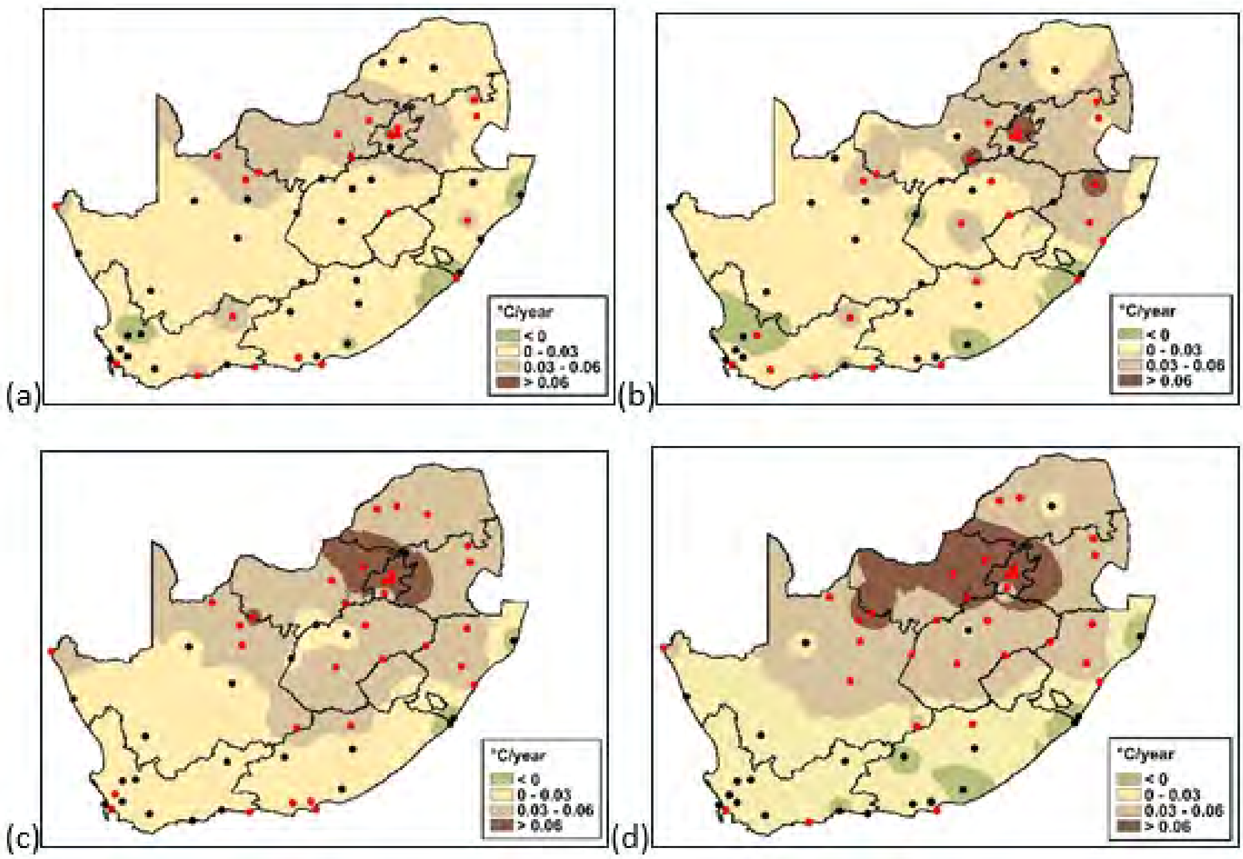


Figure 3. Annual average temperature trend during (a) DJF, (b) MAM, (c) JJA and (d) SON for the period 1994 - 2023. Circles represent climate station locations: Red circles show statistically significant trends at the 95% confidence level.

Summary and further research objectives

With the enhanced coverage of SAWS data compared to manual observations, it has become possible to do more detailed analyses of climate variability and trends at sufficiently high spatial resolutions. With the analysis of long-term temperature trends over the latest climatological period it was possible to illustrate how the trend magnitudes vary between different regions of the country, as well as hours and seasons.

There are many possible reasons for the observed temporal and spatial variations in temperature trends. Probably the most important question to address is why the warming is so much stronger in the north, especially over North West and Gauteng, than in the south. One of the possible reasons for this is the rapid urbanisation across Gauteng and the eastern parts of North West. However, there should be additional factors that play a role, as the strongest warming is around midday, whereas with most urban heat island studies warming is most pronounced at night and in the early morning hours. If the warming over this region continues at the current pace, it will have profound implications for many climate-sensitive sectors, of which health, water supply and agriculture are probably the most important. Considering that the water supply infrastructure of Gauteng is already under severe strain, a significant short- to medium-term increase in water demand will be unable to be met in time through upgrade and expansion of said infrastructure.

Another important observation is the cooling experienced in some parts of the country, especially during midnight and the early morning in autumn and spring in the southern and south-eastern parts. The cooling trend contrasts with the assumed warming trend, established in previous studies nationally and at the global scale.

To address the above and other variations in the trend, the application of statistical methods to summarise the vast number of hourly and seasonal trends in a sound manner, probably through multiple regression analysis, is suggested. Thereafter, analyses of long-term changes in additional data sets, such as precipitation, cloud cover and probably also general circulation patterns, should be examined to find explanations for the variability in observed trends. These studies will be of utmost importance to effectively adapt to current and future warming over South Africa.

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THE IMPACT OF THUNDERSTORMS ON TAKE-OFF DATA IN SOUTH AFRICA

Quinton Jacobs

The following article is a summary of an article that was published in the Journal of Aviation, Aeronautics and Aerospace, (Manuscript 1913). Aviation and meteorology are entwined as Aviation takes place in the atmosphere. For planes to take off, the prevailing weather conditions dictate the ability of planes to take off. Pressure and temperature play a major role, while the wind conditions determine which runway would be used, the crosswind components, and whether the plane can even take off at all – especially in the case of small planes.

The aviation industry is heavily dependent on forecast verification as this is the only way to determine the quality of the forecast products given to them. The accuracy of take-off data is very important for aircraft flight planning, as it dictates the number of passengers and fuel needed. Even the runway length is affected by these factors.

The International Civil Aviation Organization (ICAO) in their Annex 3 to the Convention on International Civil Aviation, requires very tight tolerances for the take-off data. In South Africa, as per the agreement with the South African Civil Aviation Authority, these tolerances are slightly relaxed to ±2 °C for temperature, 1 hPa for pressure, 5 kt for wind speed, and 40 ° for wind direction. The required accuracy level in South Africa is 90%.

Take-off data is provided for six airports in South Africa:

- OR Tambo Internation Airport
- Cape Town International Airport
- Durban King Shaka International Airport
- Lanseria Airport
- Bran Fischer International Airport (Bloemfontein)
- Dawid Stuurman International Airport (Gqeberha)

The study this article is based on aimed to determine the impact that thunderstorms have on the generated take-off data issued by forecasters for these six airports. The main reason for this study was the inability of the forecasters at the Bram Fischer International Airport (Bloemfontein) to maintain the required 90% accuracy.
Operational forecasted take-off data as well as the observed METAR and SPECI messages were analysed, and the days that thunderstorms occurred were separated from the days without thunderstorms. This gave twelve data sets – two each for the six stations where take-off data are done. All stations were individually evaluated as the climate of each station is unique and presents different challenges to the forecasters.

The data was evaluated using a 2x2 matrix, which is known as a binary evaluation as shown in table 1:

Table 1

2x2 Contingency Table (Jolliffe & Stephenson, 2012)

		Event Observed		
		Yes	No	Total
[illegible]	Yes	A	*B*	*a + b*
	No	*C*	*D*	*c + d*
	Total	*a + c*	*b + d*	*n = a + b + c + d*

False Alarms do not exist as the values are hit/miss. The period the data was evaluated for was January 2019 – March 2022. The system used for the verification was the AvianEval system which is used to do the monthly Aviation evaluation.

Results

The temperature is difficult to predict. Cape Town and OR Tambo have forecasted take-off data for a long time and have their methods of determining temperature fluctuations during the day. King Shaka is the most recently established airports and has limited climate data to work with. Gqberha and Bloemfontein have only been doing take-off data for about ten years, therefore such systems are not in place yet. Lanseria is also a recent addition to the take-off data list, but the system in place at OR Tambo seems to work for Lanseria as well.

It was found that numerical weather prediction models handle coastal conditions a lot better than the conditions in the interior. All three coastal stations showed accuracies of above 90% for days without thunderstorms. OR Tambo and Lanseria were also above 90%. Bloemfontein, however, was at 83,3%.

On days when thunderstorms occurred, Gqberha, Lanseria and King Shaka were above 90% accurate, but Cape Town and OR Tambo fell below 90%. It is interesting to note that Bloemfontein improved slightly to 83,8%, If one subtracts the days with thunderstorms from the days without, Bloemfontein, King Shaka, and Gqberha all had positive values. This means that the accuracy increased with thunderstorms. This is the only instance where days with thunderstorms outperformed the days without.

The QNH (sea-level pressure) is a value that gets rounded down. This can lead to misses for changes of less than 2 hPa. Again, the numerical weather prediction models let the interior stations down, whereas they performed well for the coastal regions.

For days without thunderstorms, all stations were above 90%, except OR Tambo and Lanseria with 87,3% and 89,9% respectively. With thunderstorms, the picture changed considerably. Only Cape Town and Gqberha were above 90%. It is also noteworthy that the region around Gqberha was experiencing a drought so the number of days with thunderstorms was low.

When comparing the difference between days without thunderstorms and days with thunderstorms, Bloemfontein dropped the most by 6,5%. All stations reported a drop of above 1,5%.

Wind direction is only considered when wind speed equals or exceeds 10 knots. Thus, there are correct rejections. Again, for days without thunderstorms, all stations were above 90%.

When days of thunderstorms were considered, the coastal stations were above 90%, whereas the interior stations all dropped below 90%. The drop was more than 1,8% for all stations with Bloemfontein dropping by 11,6%.

Wind speed is also only evaluated when above 10 knots. Days without thunderstorms were also above 90% for all stations. On days with thunderstorms only King Shaka and Gqeberha were above 90%. The drop in accuracy for all stations was 3,0% or more with Bloemfontein dropping by 4,5%.

It can therefore be concluded that thunderstorms do indeed have a significant impact on take-off data if one considers that the accuracy required is 90%. It is also safe to assume that thunderstorms are not the only contributing factor to why these targets are not always met. Further study is therefore required.

EASTERN CAPE CUT-OFF LOW FLOODING EVENT OF 21-22 OCTOBER 2024

Kevin Ingram, Pumla Msutu, and Hugh van Niekerk

A cut-off low was expected to affect the Eastern Cape from Monday, 21 until Wednesday, 23 October 2024. With the enduring impacts of the previous flooding event of 1 June 2024 still fresh in the minds of those concerned - having experienced between 100 and 300 mm rain in parts of the Nelson Mandela Bay Metro (NMBM) - the South African Weather Service (SAWS) initially issued a level 2 warning for the Eastern Cape South Coast up to Port Alfred over the weekend of 19 October, while a level 6 warning was issued for the East Coast. On Monday, 21 October, models started indicating very significant rainfall over the NMBM, which could range between 100 to 150 mm for the morning of the 22nd. The SAWS proactively raised the warning level for **Cape St Francis and eastwards to a level 6** as a sharp increase in rainfall was expected.

The SAWS was invited to a meeting with ward councilors, where the weather situation was explained and many questions from concerned councilors were answered. Councilors made a call to their constituencies to clean problematic storm water drains ahead of the flooding. While some stakeholders took action, it was evident that most only took action when the warning was upgraded to a level 6, leaving very little time to clean and unblock gutters, storm water pipes and other water ways.

This flood event saw rainfall figures of between **160 to 300 mm**, making it very similar to the event that occurred on the 1st of June, which was also caused by a cut-off low.

The unfortunate results of delayed action were many instances of flooding due to water ways in the city, resulting in flooding which caused significant infrastructure damage, loss of lives and property. The city manager reported on damage to electrical systems, road networks and municipal facilities. Many residents were also displaced with 4000 people having to be housed in community halls.

The impacts of this event indicate that the higher level of warning was appropriate, and that SAWS warnings are having an effect and are reaching the right ears, but reaction to the warnings are still lacking, especially towards the yellow weather warnings.

In a media report of the Herald of 24 October 2024, written by Andisa Bonani, the message was clear: While weather warnings issued in advance, were adequate precautions taken?


news Plett's township tapestry a tourism gem P3

news Severe staff shortages crippling Bay EMS P4

sport Chippa climb to third on the table Back page

The Herald

Schultz

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POLO
PUMA
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Men's Summer Range

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#MORE THAN A STADIUM

‘We warned you about flooding, but did you listen?’

Exasperated councillors say their pleas to clean drains before the heavy rains fell on deaf ears

'Every time there are storms, disaster management is caught sleeping'

Kariega residents pitch in to clean up the streets

Figure 1: Exasperated councilors say their pleas to clean drains before heavy rains fell on deaf ears.

One of the South African Weather Service's goals mission is to create a WeatherSMART nation. This means the public would be **S**afe, **M**ore informed, **A**lert, **R**esilient, by receiving information on **T**ime. While most of the requirements were met to ensure a such a WeatherSMART community during this event, the implementation of precautions need to be improved. In this regard, communication between the SAWS, Disaster Management, Municipalities, Councilors, and the media should continue. With climate change being a reality, more instances of severe weather, tremendously impacting the most vulnerable communities, has become part of our lives. Therefore, taking relevant precautions when weather alerts are issued should be a priority.

The SAWS will continue to engage stakeholders about severe weather warnings to ensure the protection of lives and property.

WHAT IS FLOODING?

A flood is an overflow of an expanse of water that submerges the land. The land (not usually covered by the water) is temporarily covered by water as the soil cannot absorb any more water because it is saturated.

HOW DOES FLOODING HAPPEN?

There are several ways in which flooding occurs:

- Rainfall over an area for several consecutive days
- Heavy rainfall or showers over an area which results in flash floods
- Failure of a dam's levee
- Tsunamis
- Burst of water mains and storm surges

TYPES OF FLOODS

There are three main types of floods:

- Flash flood – caused by very heavy rain
- River flood – caused by a levee failure
- Coastal floods – caused by storm surge or tsunamis

PROACTIVE MEASURES: Upon receipt of a warnings

- Make sure house gutters are clear of debris
- Ensure valuable items are raised above possible flood levels
- Dig channels round houses in informal settlements to channel water towards rivers or water canals
- Make sure that there are sufficient gaps in boundary walls to allow for the natural flow of excess water without causing a damming effect.
- Make sure as residents, you are aware of evacuation points such as churches or halls, not in low lying areas
- Municipalities should ensure that storm water drains and rivers courses are cleared of debris and fallen trees

SAFETY PRECAUTIONS

- Do not try and cross flooded rivers or lakes.
- **About 66 % of flood deaths occur in vehicles, and most happen when drivers make a single, fatal mistake trying to navigate through flood waters. Even 4x4 vehicles are not safe under these conditions.**
- Do not drink floodwater since it may be polluted.
- Stay away from collapsed power lines and cables after a flood as live electricity could still pass through them.
- Turn off the electricity during a flood, because water is a good conductor of electricity and could cause electrocution.
- Store away clean drinking water and food.
- Listen to weather reports and instructions of local disaster managers. If necessary, evacuate the area.

AFTER A FLOOD

- Listen for news reports to learn whether the community's water supply is safe to drink.
- Avoid floodwaters - water may be contaminated by oil, gasoline, or raw sewage. Water may also be electrically charged from underground or downed power lines.
- Avoid moving water.
- Be aware of areas where floodwaters have receded. Roads may have weakened and could collapse under the weight of a car.
- Stay away from downed power lines, and report them to the municipality's power department.
- Return home only when authorities indicate it is safe.
- Service damaged septic tanks, cesspools, pits, and leaching systems as soon as possible. Damaged sewage systems are serious health hazards.
- Clean and disinfect everything that got wet. Mud left from floodwater can contain sewage and chemicals.

MEET THE AUTHORS

Ms Stacy Colborne is a weather forecaster that is currently based in Cape Town. She has 15 years of experience in forecasting with 12 years in the Durban Weather Office while the rest of the 3 years she has been in the Cape Town Weather office. She holds an Honours degree in Meteorology. While she has been a scientist for most of her life, she has been a Christian who believes that with God, all this are possible her entire life. When out of the office, she enjoys sports and music.

Ms Stacy **Colborne**

Ms Elani Heyneke is a senior forecaster at the Cape Town Weather Office; however, she started her career in the Bloemfontein Weather Office in 2017. She always had a keen interest in weather and has been cloud watching from an early age - trying her best to predict the arrival time of the afternoon thunderstorms. Her passion is predicting severe weather events, with a focus on agrometeorology. She is currently enrolled as an M.Sc. (Meteorology) student at the University of Pretoria, studying South African squall lines over the central interior.

Ms Elani **Heyneke**

Mr. Kevin Andrew Ingram is a forecaster in Gqeberha, Eastern Cape. Kevin joined SAWS in 2018 and was stationed at the Bloemfontein forecasting office for 3 years until his move to the Eastern Cape. He obtained his degree and honours degree fin Meteorology from the University of Pretoria and completed the post graduate certificate in forecasting in Pretoria in 2017. He is experienced in aviation, marine and public forecasting, and his experience in two offices has given him valuable insight into South Africa's weather overall. His interests include carnivorous plants, gaming and severe weather.

Mr Kevin **Ingram**

Mr Quinton Jacobs completed his degree in Meteorology in 2000 and completed his Honours degree in forecasting in 2001. He joined the Oliver Tambo aviation weather office in February 2002, working as an Aviation Meteorologist for four years.

Quinton was promoted to Principal Meteorologist in 2006 and relocated to Gqeberha (formerly known as Port Elizabeth). In 2008 he was promoted to Senior Forecaster. During his time in Qgeberha Quinton achieved his Master's degree in aviation meteorology in 2015, where he focused on comparing the aviation forecasts issued by forecasters to raw model data.

Quinton was also an active member of the MeteoFactory product development team of the South African Weather Service, In 2017 Quinton joined the Bloemfontein office due to forecasters leaving SAWS. During his time in Bloemfontein, he developed a translation program for the Afrikaans translations of the national forecasts. Quinton also designed and implemented the social media warning images SAWS uses for its impact-based warnings.

In 2023 Quinton was promoted to Chief Forecaster in aviation returning to where his career started.

Mr Quinton **Jacobs**

Ms Nompumelelo **Kleinbooi**

Nompumelelo Kleinbooi is a weather forecaster who is currently based in Gqeberha. She completed her BSc undergraduate and honours degrees in Meteorology at the University of Pretoria in 2015 and 2016 respectively. In 2017, she completed a South African Weather Service (SAWS) forecasting internship programme offered by the Regional Training Centre (RTC). She specialises in aviation, public weather and marine forecasting. She is fascinated by severe weather, aeroplanes and nature.

Apart from weather forecasting, she also has interests in the climate variability of South Africa.

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 duties include the creation and writing of general climate publications, climate change and variability research with historical data as input, ad hoc scientific projects, climate data and information requests, where advanced statistical analyses are required, drought monitoring, and assisting in the quality control of climate data. Dr Kruger has a PhD (Civil Engineering) degree (University of Stellenbosch) on the research topic “Wind Climatology and Statistics 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.

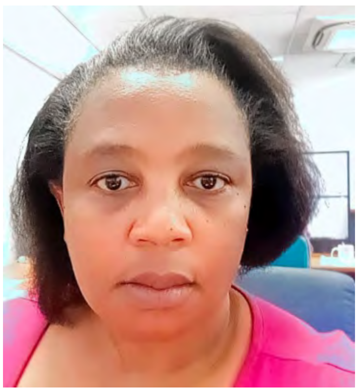
Dr Andries **Kruger**

Ms Kanyisa **Makubalo**

Ms Kanyisa Makubalo is a hard-working young scientist who enjoys being in spaces that seem greater than her, to rapidly grow and develop herself. She has been with SAWS for a little over 2 years and has already learnt so much and worked with great many scientists, including the ones she worked with in the above piece. She is grateful for every opportunity and is always welcoming for more opportunities and any extra work to further develop herself and assist her team of colleagues. Talk about a true young black excellence representative. In addition, she is currently enrolled for a Master's degree in Meteorology at the University of Pretoria, in which she will be assessing the predictability of medium-range forecasts using modern NWP models for the Western Cape during winter months.

Dr Charlotte McBride is a manager in the Climate Data Unit within the Climate Service Department. Her present duties include managing the quality of the climate data on the main climate database. She is passionate about data rescue activities, and her team is actively involved in manually capturing historical climate records to make them available electronically. She recently completed her PhD and thus also ventures into the world of academia from time to time. When not at work, she enjoys the outdoors and is probably in the Kruger National Park.

Dr Charlotte **McBride**



Ms Pumla **Msutu**

Ms Pumla Msutu is a forecaster in Gqeberha, Eastern Cape. Pumla joined the South African Weather Service in 2008. She has obtained a BSc Honours in Meteorology at the University of Pretoria and a BSc Honours in Applied Mathematics at the Nelson Mandela University. Pumla was born in Gqeberha. She has vast experience in public, marine and aviation forecasting. Some of her weather interests include heavy rain leading to flooding and severe thunderstorms.

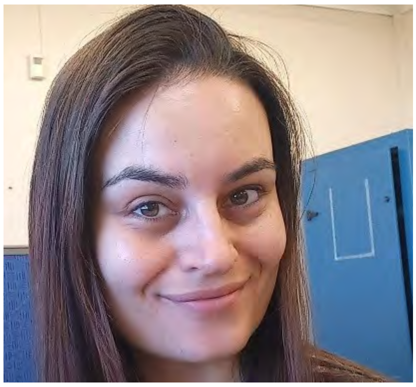
Ms Carla-Louise Ramjukadh is a dedicated scientist at SAWS Marine Services, based at the Cape Town Weather Office, where she contributes to innovative advances and products. Her current focus is on coastal vulnerability and hazards along the South African coastline, tackling critical environmental challenges and promoting sustainable early warning forecasting solutions.

Ms Carla-Louise **Ramjukadh**

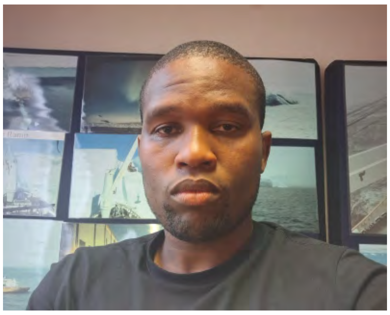
Dr Ramontsheng Rapolaki is a Lead Scientist in the South African Weather Service's Marine Research Unit and a Research Fellow in Geography at the University of the Free State. His work focuses on oceanic and atmospheric sciences, with a particular interest in extreme weather events, climate variability and change, and numerical modelling over southern Africa. He holds a PhD in Ocean and Atmospheric Science from the University of Cape, focusing on Lagrangian moisture sources and trajectories linked to extreme rainfall events.

Dr Ramontsheng **Rapolaki**

Ms Lauren Smith is a senior forecaster: marine, based at the Cape Town weather office. She began her career at the Aviation Weather Center, at OR Tambo international airport, where her passion for aviation ignited. Lauren has a love for severe weather forecasting and a special interest in aviation hazardous weather. She believes that teamwork makes the dream work. Lauren holds an MSc in Meteorology obtained at the University of Pretoria, 2022, focused on clear air turbulence forecasting over South Africa utilising the Convective Scale Ensemble Predication System.



Ms Lauren **Smith**



Mr Ayabonga Tshungwana obtained his first BSc degree at University of Fort Hare majoring with Physics, Mathematics and Applied Mathematics (2016).

He then obtained his BSc Meteorology at the University of Pretoria through a programme called "Bridging course (2017)" and obtained his BSc Honours in Meteorology at the same university in 2018. He completed the forecasting certificate at the South African Weather

Service in 2019 and started his career as a forecaster at the Gqeberha weather office in 2020.

Mr Ayabonga **Tshungwana**

Mr Hugh van Niekerk is a Regional Manager of the South African Weather Office (SAWS) in charge of the Eastern Cape. He boasts almost 42 years in service of the South African Weather Service and is a trained meteorologist. He started his career in January 1983 at the Durban Weather Office as an observer and studied through the then Pretoria Technicon to obtain a Higher Diploma in Meteorology. After working at various locations within SAWS he was posted to the Port Elizabeth (Gqeberha) Weather Office in 1998 as an Office Manager and then became Regional Manager for the Province.

During his time in SAWS he spent a year on Marion Island and specialised as an aviation forecaster.

Mr Hugh van **Niekerk**

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