WEATHERSMART

NEWS

Scientific meteorological and climatological news from the South African Weather Service

August 2020

Historical trends in climate extremes in South Africa from a global perspective

Northern Cape coast dust storm after a passage of cold front

The Regional Training Centre's response to COVID-19

South African Weather Service ®

WEATHERSMART

NEWS

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Impact-Based
Severe Weather Warning System

WHAT IS IMPACT-BASED FORECASTING?

Severe weather is a regular occurrence across South Africa which often negatively affects humans. Due to the vast distribution of vulnerabilities across the country, the same weather hazard can result in different impacts in two areas, depending on the specific vulnerability of the area.

Impact-Based warnings combine the level of impact the hazardous weather conditions expected with the level of likelihood of those impacts taking place

Moving from

What the weather will be:
(Meteorological thresholds)
- 50mm in 24 hours - 35 knot winds

To

What the weather will do:
(Impact Warnings)
- Roads flooded - Communities cut off

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Message by the Acting Chief Executive Officer

Welcome to the WeatherSMART news edition of August 2020 in a year where the whole world is being affected in an unprecedented way by the COVID-19 pandemic.

The South African Weather Service continued to enhance its knowledge and share it with the public on various platforms, amongst which include the 6-monthly WeatherSmart scientific newsletter, incepted in 2016.

This edition covers the beautiful plum rains we experienced during December 2019, which brought great relief to the country's drought-stricken areas, as well as Historical Trends in Climate Extremes in South Africa from a Global Perspective where the South African contribution to the HadEX3 data set of extreme indices enabled the comparison of historical trends in temperature and rainfall extremes between the country and the rest of the world. From the results it is evident that, due to global warming, most of the globe experienced significant increases in warm extremes, with South Africa being no exception. An interesting perspective is taken on the Northern Cape Coast Dust storm in July 2020, after a passage of a cold front. The conclusion includes that knowledge of soil properties is important in the forecasting of dust storms, especially in the Northern Cape.

We also publish an extract form the article " FORECASTING SKILL OF MINIMUM AND MAXIMUM TEMPERATURES ON SUBSEASONAL-TO-SEASONAL TIMESCALES OVER SOUTH AFRICA" which appeared in the Earth and Space Science Journal, 2020 in this publication, for the interest of our technically-minded readers. Our WeatherSmart publication is concluded with an article by our Regional Training Centre, reflecting on providing scientific training during 2020 and the COVID-19 pandemic.

I hope you will enjoy the science shared with you in this issue.

Message by the editor

The year 2020 will be remembered as the year when the world was affected by the COVID-19 pandemic and when many workers had to adapt to a new normal by working from home. The South African Weather Service also had to adjust to this new normal, with many a task having been completed in our homes – at a dining room table, in the kitchen, or if more fortunate, at a dedicated office space. It is therefore a privilege to bring you our first "online only" version of the WeatherSMART newsletter. A great thank you goes to each contributor for making this edition possible.

Plum rains of 3 to 10 December 2019 over the north-eastern part of South Africa

by Jan H. Vermeulen, Jacqueline Modika and Elizabeth Webster

Sequence of events

It all started with a cold front that passed over the country on 3 December 2019, which brought 28 lowest maximum temperature records and some lowest minimum temperature records to the north-eastern provinces. Instabilities associated with the upper-air trough and ridging high behind the cold front, brought the University of Zululand 56 mm and Ermelo 54 mm of rain. Significant falls of 46 mm at Aliwal Noord and Bethlehem 34 mm also occurred.

A cut-off low which developed west of South Africa on 4 December 2019, resulted in heavy rain at Bronkhorstspruit and the Pretoria – University of South Africa (Unisa) rainfall station, which recorded 52 mm each A total of 57 mm was recorded at Machadodorp in Mpumalanga, while the Mafikeng Weather Office had 59 mm and Lichtenburg in the Northwest province received 94 mm of rain, which was a 26-year record, with the previous being 44 mm on 6 December 2004.

Significant rain continued on the 5th as the cut-off low moved to the Northern Cape with the following recorded: Pretoria - Unisa, Emalahleni - Witbank and Springbok received 22 mm each and 39 mm at Upington. Severe afternoon thunderstorms at Upington caused flooding at the Kgalagadi mall.

On 6 December 2019, the cut-off low weakened but remained stationary over the Northern Cape and still gave good rainfall with 22 mm at Tosca being the highest in the Northwest Province. On 7 December, a weak elongated cut-off low over the central interior gave the following significant rainfalls: 34 mm at Marken in Limpopo and 33 mm at Lichtenburg - Plaasverlies in Northwest. On this day, 9 mm were received at Pretoria-Unisa and Roodepoort- Kloofendal in Gauteng.

On the 8th a second upper trough, west of South Africa, merged with the remnants of the cut-off low, resulting in the following heavy falls: Irene 103 mm, Pretoria - Unisa 96 mm, Ermelo 97 mm, Potchefstroom 103 mm and Bethlehem 50 mm. As the system moved eastwards over the country, the following heavy falls were recorded on the 9th: Pretoria - Presidency 114 mm, Pretoria - Unisa 109 mm, Hartbeespoort Dam 89 mm and Punda Maria (Limpopo) 49 mm.

The rainfall for the period 3 to 9 December is indicated in Figure 1 below.

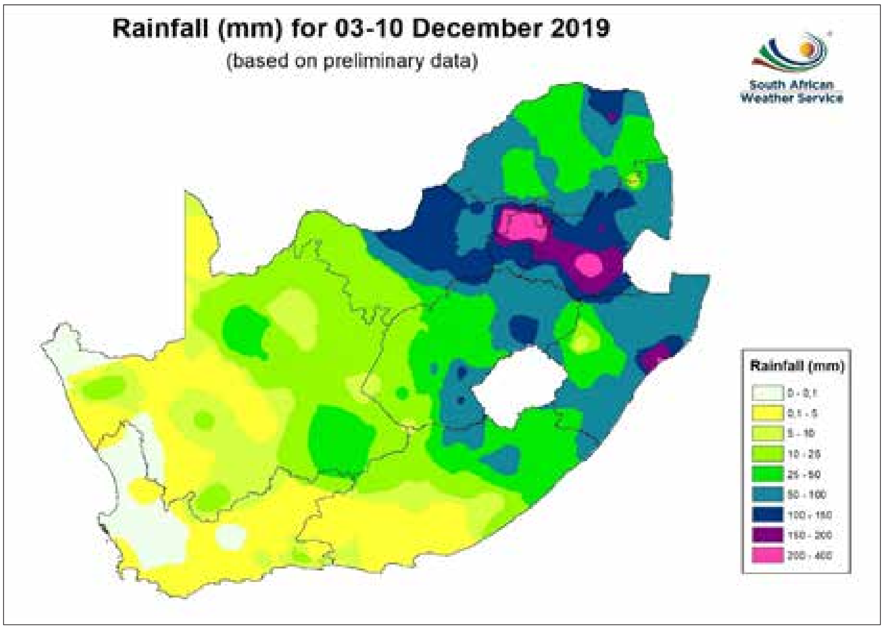


Figure 1: Total rainfall for 3 to 9 December 2019 over the RSA. (Climate Service)

Flooding of 8 – 9 December 2019:

Focusing on northern Gauteng (Tshwane) or the largest pink area in Figure 1, it is seen that this area received from 200 to 400 mm for 3 to 9 December; Pretoria - Unisa measured 205 mm for the 8th to the 9th. The Mountain View Automatic Rainfall Station in Pretoria reported 255 mm for the two days, with 190 mm as the highest rainfall the 9th. This day also had 51 mm hourly rain at 10:00, which indicates cloudburst intensity rainfalls. The highest 5-minute rainfall of 9.6 mm at 9:35 is equivalent to a 115 mm/h rainfall intensity. The highest 5-minute accumulated hourly rainfall was 59 mm at 9:45, so that the Mountain View event is a 59 % cloudburst. Rashoop's 135 mm in the Madibeng district of Northwest was the highest rainfall the 8th.

These two days' heavy rain, following on the preceding wet days, resulted in numerous flooding events all over the area, extending into the Northwest and Mpumalanga provinces. Examples are a) the Hennops River that flooded in Centurion on 9 December 2019, leading to the evacuation of the Centurion Hotel (see Figure 2) and b) the Pienaars River that flooded the same day at the Eerste Fabrieke settlement in Mamelodi (see Figure 3).

Figure 2: Flooded Centurion Hotel the morning of 9 December 2019. (SABC News Online – Twitter)

A trial Alert to the Gauteng Provincial Disaster Management was issued at 8:28 on the morning of 9 December by the SAWS Disaster Risk Reduction office. It was a level 6 orange warning, based on impacts for a high likelihood (greater than or equal to 80 % chance)

Figure 3: Eerste Fabrieke settlement flooded 9 December 2019 at Mamelodi. (News24)

of significant impacts over Gauteng. The level of the warning is an indication of the severity of the storm; 6 for this event. The highest level 10 (only red warning) means that there is a high likelihood of severe impacts to occur. This day's warning was: "The excessive rainfall will result in further flooding of roads, flooding of informal and low-lying formal settlements, with damages that can occur to property as well as bridges. Major traffic disruptions can be expected due to poor visibility and flooded roads. Some sinkholes can occur due to the heavy rain and there is a high risk and danger to life due to the flooding conditions."

Week's heavy rainfall and impacts:

The plum rains in Tshwane that happened in six and a half days and were followed by further rainfall during the rest of December 2019, resulted in 367 mm being the highest monthly rainfall observed in Pretoria - Moreleta Park for 9 years. The previous record for Moreleta Park was 337 mm in March 2014. The highest record for monthly rain for Pretoria was measured in January 1978 at 492 mm, recorded at the Purification Works.

The heavy rainfall event is called plum rains (Afrikaans: geelperskereën) because the extended period of heavy rainfalls occurred in summer. Summer being the season that the fruit ripens.

Other impacts of the plum rains are that several dams in the area overflowed, such as the Hartbeespoort, Roodeplaat, Bronkhorstspruit, Loskop, Rust der Winter and Grootdraai dams.

Historical Trends in Climate Extremes in South Africa from a Global Perspective

by Andries Kruger, Sifiso Mbatha & Sandile Ngwenya

Department: Climate Service

Introduction

The UK Met Office recently produced an updated global climate extremes dataset examining weather data from more than 36 000 weather stations across the globe, with periods ranging from as far back as 1901 up to 2018; to understand and quantify the historical change in climate extremes. This dataset is known as HadEX3 and contains the annual and monthly values of 29 indices of weather extremes (17 relating to temperature and 12 relating to precipitation). These indices have been developed by the WMO Expert Team on Climate Change Detection and Indices (ETCCDI) and have been utilised extensively in national and regional studies across the world for a number of decades.

Table 1: ETCCDI weather extreme index data included in the UK Met Office HadEX3 data set.

ETCCDI weather extreme index data included in the UK Met Office HadEX3 data set			
Index	**Name**	**Description**	**Units**
TXx	Hottest day	Monthly and annual maximum value of daily max temp	°C
TNx	Warmest night	Monthly and annual maximum value of daily min temp	°C
TXn	Coldest day	Monthly and annual minimum value of daily max temp	°C
TNn	Coldest night	Monthly and annual minimum value of daily min temp	°C
TN10p	Cool nights	Percentage of time when daily min temp < 10th percentile	%
TX10p	Cool days	Percentage of time when daily max temp < 10th percentile	%
TN90p	Warm nights	Percentage of time when daily min temp > 90th percentile	%
TX90p	Warm days	Percentage of time when daily max temp > 90th percentile	%
DTR	Diurnal temp range	Annual mean difference between daily max and min temp	°C
GSL	Growing season length	Annual (1st Jan to 31st Dec in NH, 1st July to 30th June in SH) count between first span of at least 6 days with TG > 5°C and first span after July 1 (January 1 in SH) of 6 days with TG < 5°C (where TG is daily mean temp)	days
ID	Ice days	Annual count when daily maximum temp <0°C	days
FD	Frost days	Annual count when daily minimum temp <0°C	days
SU	Summer days	Annual count when daily max temp >25°C	days
TR	Tropical nights	Annual count when daily min temp >20°C	days
WSDI	Warm spell duration index	Annual count when at least six consecutive days of max temp > 90th percentile	days
CSDI	Cold spell duration index	Annual count when at least six consecutive days of min temp < 10th percentile	days
ETR	Extreme temp range	TXx- TNn	°C
Rx1day	Max 1 day precipitation amount	Monthly and annual maximum 1 day precipitation	mm
Rx5day	Max 5 day precipitation amount	Monthly and annual maximum consecutive 5 day precipitation	mm
SDII	Simple daily intensity index	The ratio of annual total precipitation to the number of wet days (≥ 1 mm)	mm/day
R10mm	Number of heavy precipitation days	Annual count when precipitation ≥10 mm	days
R20mm	Number of very heavy precipitation days	Annual count when precipitation ≥ 20 mm	days
CDD	Consecutive dry days	Maximum number of consecutive days when precipitation < 1 mm	days
CWD	Consecutive wet days	Maximum number of consecutive days when precipitation ≥ 1 mm	days
R95p	Very wet days	Annual total precipitation from days > 95th percentile	mm
R99p	Extremely wet days	Annual total precipitation from days > 99th percentile	mm
PRCPTOT	Annual total wet day precipitation	Annual total precipitation from days ≥ 1 mm	mm
R95pTOT	Contribution from very wet days	100 * R95p / PRCPTOT	%
R99pTOT	Contribution from extremely wet days	100 * R99p / PRCPTOT	%

The development and initial analysis of HadEX3 have been published recently in a paper in the *Journal of Geophysical Research – Atmospheres* (Dunn et al., 2020). To this end, SAWS contributed the index values of 26 temperature and 71 rainfall stations, dating back to 1931 and 1921 respectively.

The only regions in the world not sufficiently covered by the extremes dataset are Antarctica and sub-Saharan Africa, which makes the South African contribution all the more important. In this article we compare some highlights of the initial extremes trend results for South Africa with the rest of the world, to obtain an idea of the relative severity of the hot extremes trends and possible drying trends that can be inferred from the defined indices. The trend analysis has been done for the period 1950-2018, which is consistent with the period that SAWS usually applies to determine the magnitudes of recent historical climate trends.

Temperature

All the temperature indices show global trends, which are generally consistent with the global warming trend due to climate change. For the indices based on daily maximum temperature, there has been a globally strong upward trend in hot days since the 1970s to the present figure of about 20 – 30 days per year on average. Over South Africa, the trend is comparable with most of the globe, with an average trend of about 2- 4 days per decade. In comparison, most of South America, Australia, Europe and Asia experienced much stronger upward trends (> 8 days per decade for northern South America), while, in contrast, there are almost no significant trends over large parts of the USA and southern South America.

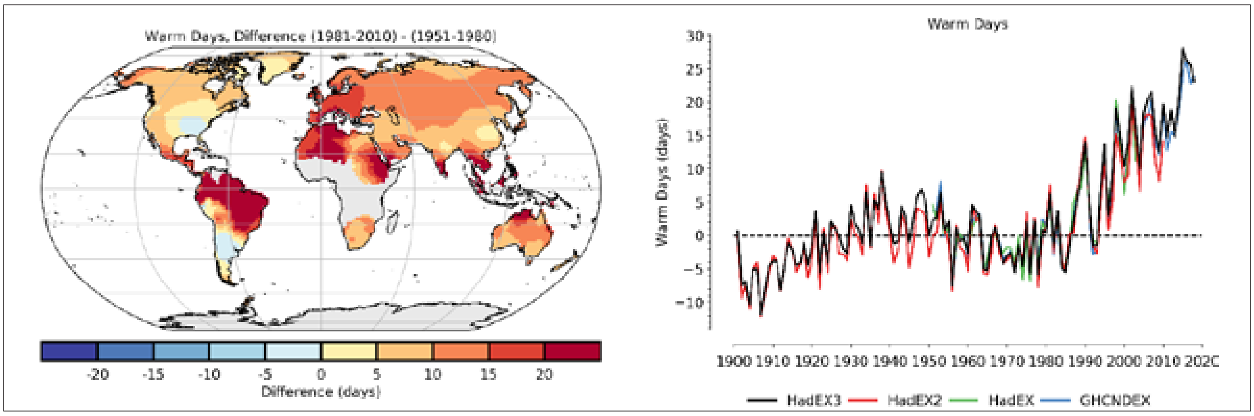


Figure 1: Difference in amount of warm days per year between the 1981-2010 and 1951-1980 periods (left) and estimated anomalies in the global mean number of warm days over the period 1900-2018, from the analysis of four global data sets, as indicated (right).

A similar magnitude trend, but only negative, is discernible for cool days, and in this instance most of Australia, Asia and Europe show trends within the same range as South Africa, but with large parts of North America showing weaker downward trends.

Changes in indices from the daily minimum temperatures are on average stronger than those from daily maximum temperatures. For cold nights (TN10p) we observe that the whole globe experienced decreases ranging from two to more than eight days per decade, with South Africa in the range of two to four.

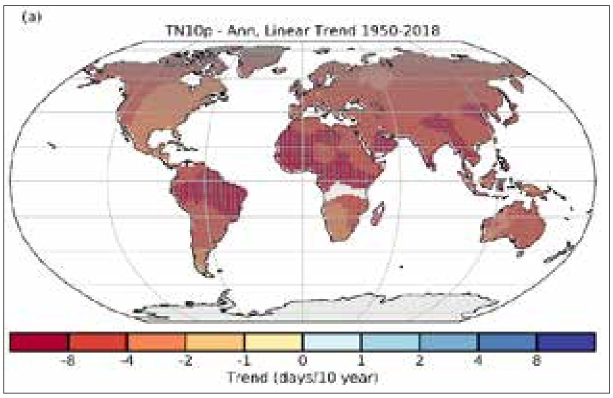


Figure 2: Trend in annual number of cold nights per decade (1950-2018), as estimated from the HadEX3 data set.

In tropical regions of South America, Northern Africa and through Asia, the numbers of warm nights (TN90p) have increased by more than eight days per decade, leading to a doubling since the late 1970s, to between 70 and 80 days per year during the recent decade. As is the case for the other extreme temperature indices, South Africa falls outside the regions that have experienced the largest trends.

In addition to percentile-based indices discussed above, there are also those based on the absolute annual extremes i.e. TXx, TNx, TXn and TNn, which indicate the hottest day, hottest night, coldest day and coldest night per year, respectively. In these instances, the index and trend magnitudes are calculated in °C instead of days. For example, the hottest night per year indicates a slight upward trend, which for most places in South Africa is not significant. However, in places like northern South America, northern Africa and large parts of Asia the trends are in excess of 0,25°C per decade. The most interesting indices of the four are probably the hottest day in the year (TXx) and the coldest night in the year (TNn). Trends in TXx vary a lot across the globe. South Africa experienced relatively moderate increasing trends up to 0,25°C per decade, while places in the north of South America and Canada had trends of more than 1°C per decade and other places, in contrast, experienced a decrease of more than -0,25°C per decade. Examining trends in TNn, it is noticeable that the trends are more uniformly positive than compared to TXx. South Africa experienced relatively small trends (0 to 0,5°C per decade) compared to most of the world, such as South America, Canada and Greenland, which experienced increases of more than 2°C per decade.

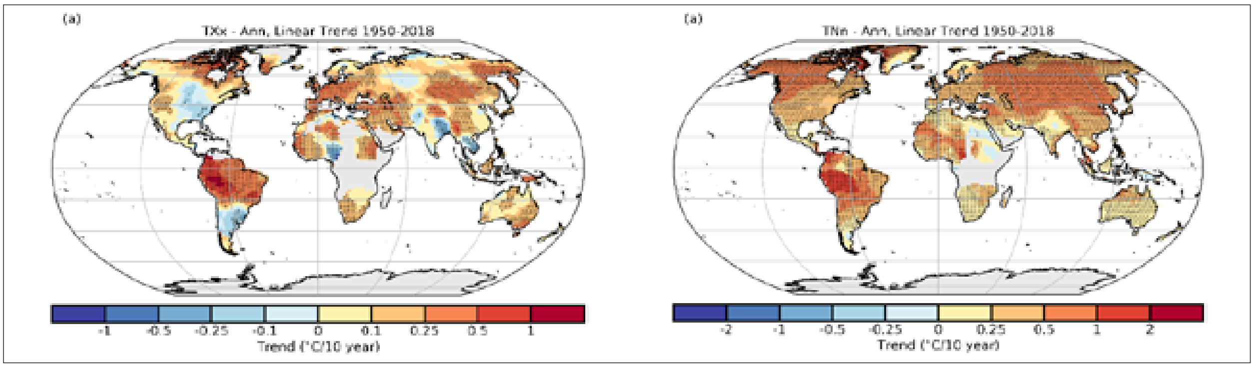


Figure 3: Trend in annual absolute maximum temperature (TXx) (left) and annual absolute minimum temperature (TNn) in °C/decade over the period 1950 – 2018.

Rainfall

One of the most critical indices for rainfall or precipitation is PRCPTOT, the annual total rainfall from daily rainfall totals equal or more than 1 mm. With the historical warming of the troposphere (the part of the atmosphere closest to the surface) an increase in precipitation is expected as a warmer atmosphere is theoretically able to contain more moisture. This expected upward trend is evident from the trend analysis, although many regions across the globe experienced a decrease in rainfall as opposed to the general trend.

Regions showing a drying trend over the last 70 years include Spain, the Sahel in North Africa, the north-eastern and extreme south-western parts of South Africa, large sections of South America and Asia as well as eastern Australia. Climate projections indicate this trend for South Africa to continue until at least the end of this century. However, the drying trend over parts of South Africa (-5 mm per decade in the north-east) is not as severe as for example the Sahel, significant parts of South America, northern India and eastern Australia, where drying trends in excess of -20 mm per decade are indicated. Some of these regions border climatologically natural dry areas, for example eastern Australia, and are therefore becoming increasingly vulnerable to desertification.

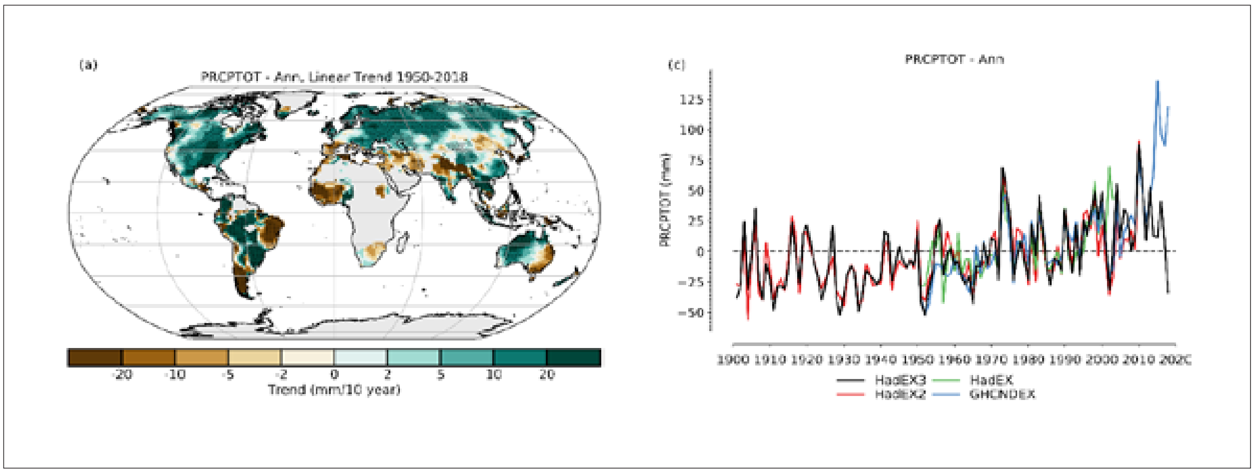


Figure 4: Trends in annual total rainfall from daily rainfall totals equal or more than 1 mm (PRCPTOT) in mm/decade over the period 1950 – 2018 (left), and estimated annual anomalies in the global mean of PRCPTOT over the period 1900 – 2018, estimated from four global data sets, as indicated (right).

One can also observe how South Africa compares to the rest of the world in terms of trends in extreme rainfall. R95pTOT indicates the percentage of annual rainfall forthcoming from very wet days. Globally, a general upward trend is evident. However, these trends are not always consistent with an upward trend in total rainfall, e.g. while the north-eastern parts of South Africa experienced progressively less rainfall, indications are that the rainfall has also become more extreme.

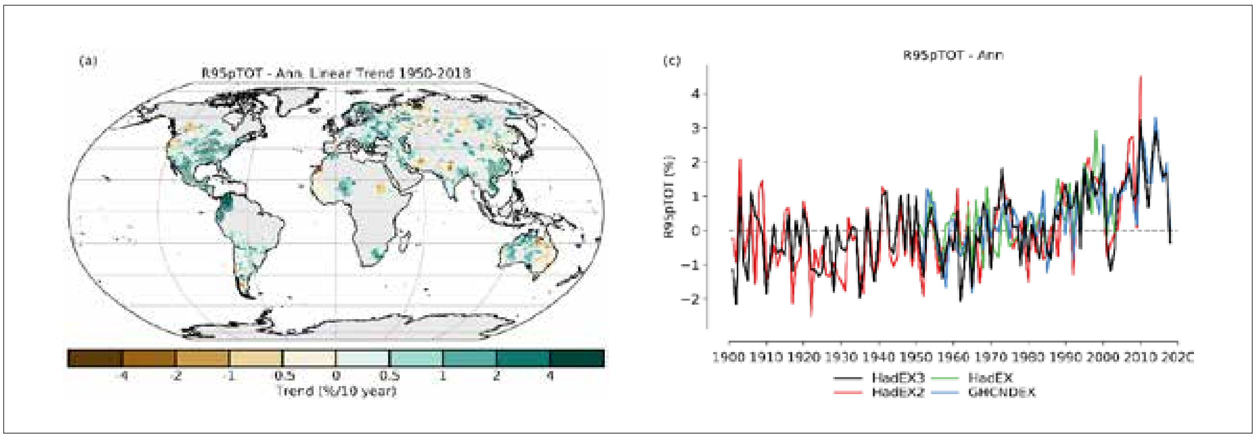


Figure 5: Trends in the annual percentage of very wet days (R95pTOT) in %/decade over the period 1950 – 2018 (left), and the estimated anomalies the global mean of R95pTOT over the period 1900 – 2018, estimated from four global data sets, as indicated (right).

It was noted that the rainfall over significant parts of South Africa and most of the globe has become more extreme in terms of rainy days being progressively wetter. However, of most concern is the number of extremely wet days (R99p) and the highest daily rainfall per year (RX1day), which may indicate whether some regions have become more prone to flash flooding and the accompanying socio-economic distress that may result from the occurrence of these events. For R99p, a somewhat stronger and more consistent upward trend is evident across all the global data sets, compared to other extreme indices such as R95pTOT. It is noticeable that the trends for R95TOT and R99p are quite similar, with the percentage contribution of very wet days to total annual rainfall increasing by about 1% per decade in the east of the country and increases of 4 mm per decade forthcoming from extremely wet days.

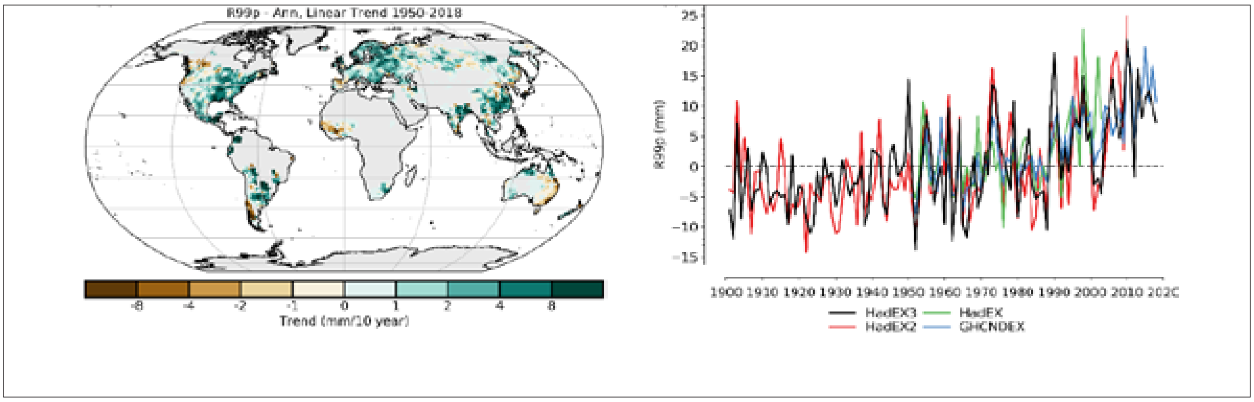


Figure 6: Trends in the annual precipitation from extremely wet days (R99p) in mm/decade over the period 1950 – 2018 (left), and the estimated anomalies the global mean of R99p over the period 1900 – 2018, estimated from four global data sets, as indicated (right).

Trends in RX1day are more varied across the globe, probably due to the fact that the index is calculated from only one day in a year and therefore prone to very high variability among annual values. Nevertheless, there is still a signal of a general upward trend globally, also over some of the northern-eastern parts of South Africa, where the annual maximum daily rainfall totals are trending upwards at a rate of more than 2 mm per decade.

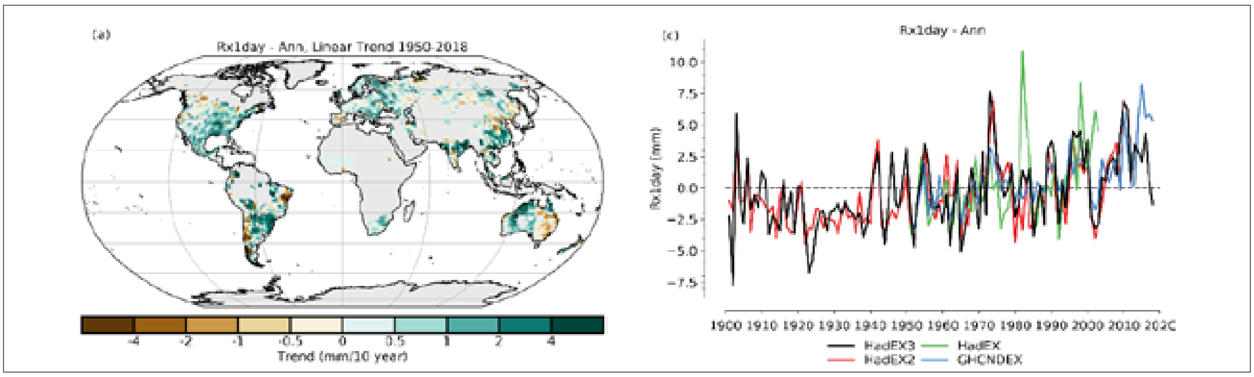


Figure 7: Trends in the annual maximum daily precipitation (RX1day) in mm/decade over the period 1950 – 2018 (left), and the estimated anomalies the global mean of RX1day over the period 1900 – 2018, estimated from four global data sets, as indicated (right).

Conclusions

The South African contribution to the HadEX3 data set of extreme indices enabled the comparison of historical trends in temperature and rainfall extremes between the country and the rest of the world. From the results it is evident that, due to global warming, most of the globe experienced significant increases in warm extremes, with South Africa being no exception. While the country has not experienced such large increases in temperature extremes which are comparable to other severely affected regions such as South America, northern Africa and Europe, one should also consider the socio-economic impacts of these increases, where developing countries usually struggle in various ways to cope with extremes in the weather and climate.

The above statement is arguably even more applicable to rainfall. It is noticeable that South Africa is part of a relatively smaller number of regions which experienced drying in some parts, in our case specifically the north-east and extreme south-west. While it rains less in these parts, there is a tendency, consistent with the general global trend, for extreme rainfall episodes to increase – so when it rains the rainfall tends to be more extreme. In this regard, the Climate Service department of the South African Weather Service endeavours to improve the information on current rainfall situations and continues to conduct research on detectable changes in the rainfall climate. Various research and development initiatives are underway, including an improvement of information on the current state of drought issued on a monthly basis, and research into the trends and variability of multiple-year weather and climate extremes.

Northern Cape Coast Dust storm after a passage of cold front

by Matshidiso Mogale

On 13 July 2020, an intense cold front made landfall over the south-western parts of the Western Cape and resulted in adverse weather impacts, especially associated with wind and waves.

This system occurred two days after the country experienced a series of intense cold fronts that resulted in heavy rain and flooding across most parts of the Western Cape.

On 15 July, a surface high pressure was dominating over the country (Figure 1) after the passage of the cold front while a surface trough developed along the West Coast. This resulted in strong to gale (25 -35 knots) force off-shore (north-easterly/ easterly) winds, gusting up to 40 knots along the coastal areas and the adjacent interior of Northern Cape.

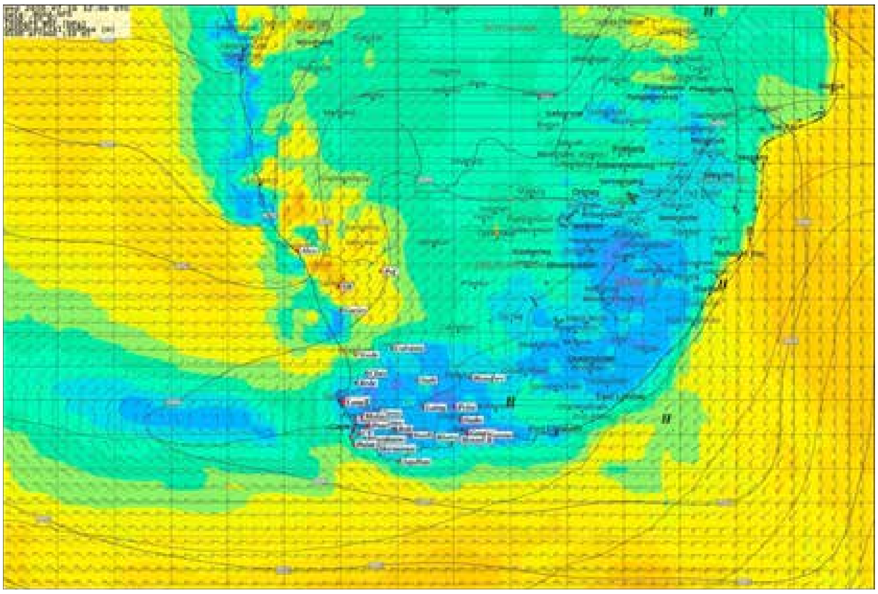


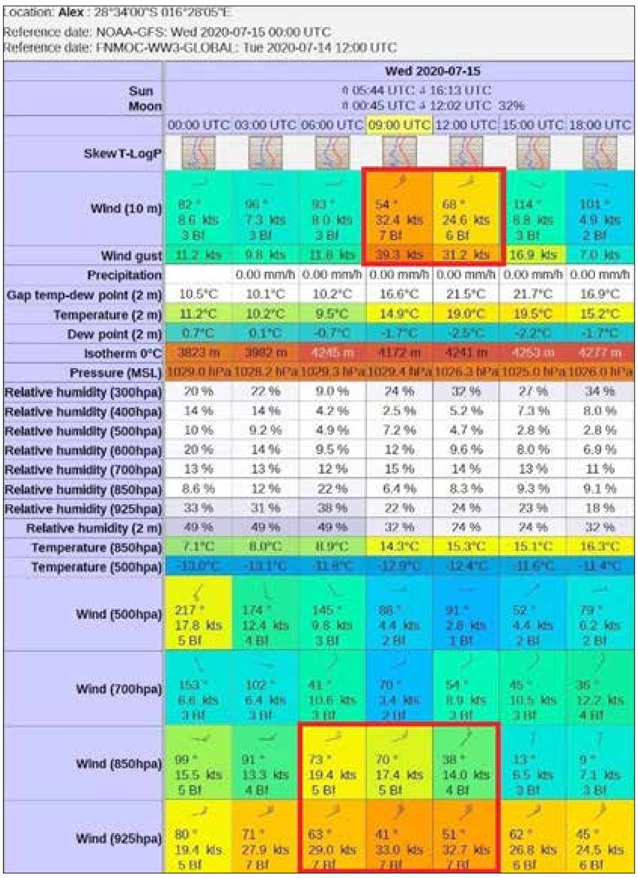
Figure 1: Mean Sea Level pressure showing surface high dominating over the country (source: GFS)

The meteotable of Alexander Bay indicated typical conditions favourable for the development of dust/sandstorm:

- Strong offshore uni-direction winds from the surface up to 850hPa (highlighted in red box, figure 2), strong enough to lift sand/soil particles in the air.
- The skew-t showed a stable profile, stability of the atmosphere would cause lifted particles to remain suspended in the air.

These conditions looked favourable for the development of sand/dust storms on 15 July but not convincing enough, because of the moisture considered still available in the soil after the recent two events of significant rainfall in the region.

Figure 3 shows rainfall accumulated in places over Northern Cape from 10 to 13 July. The challenge with this forecast was: "**Is one day of clear conditions after a rainfall event sufficient to allow the soil to dry enough in order to be lifted and sustained in the atmosphere?**"



Location: **Alex** : 28°34'00"S 016°28'05"E
Reference date: NOAA-GFS: Wed 2020-07-15 00:00 UTC
Reference date: FNMOC-WW3-GLOBAL: Tue 2020-07-14 12:00 UTC

	Wed 2020-07-15						
Sun	↑ 05:44 UTC ↓ 16:13 UTC						
Moon	↑ 00:45 UTC ↓ 12:02 UTC 32%						
	00:00 UTC	03:00 UTC	06:00 UTC	09:00 UTC	12:00 UTC	15:00 UTC	18:00 UTC
SkewT-LogP							
Wind (10 m)	82 ° 8.6 kts 3 Bf	96 ° 7.3 kts 3 Bf	93 ° 8.0 kts 3 Bf	54 ° 32.4 kts 7 Bf	68 ° 24.6 kts 6 Bf	114 ° 8.8 kts 3 Bf	101 ° 4.9 kts 2 Bf
Wind gust	11.2 kts	9.8 kts	11.8 kts	39.3 kts	31.2 kts	16.9 kts	7.0 kts
Precipitation		0.00 mm/h	0.00 mm/h	0.00 mm/h	0.00 mm/h	0.00 mm/h	0.00 mm/h
Gap temp-dew point (2 m)	10.5°C	10.1°C	10.2°C	16.6°C	21.5°C	21.7°C	16.9°C
Temperature (2 m)	11.2°C	10.2°C	9.5°C	14.9°C	19.0°C	19.5°C	15.2°C
Dew point (2 m)	0.7°C	0.1°C	-0.7°C	-1.7°C	-2.5°C	-2.2°C	-1.7°C
Isotherm 0°C	3823 m	3982 m	4245 m	4172 m	4241 m	4253 m	4277 m
Pressure (MSL)	1029.0 hPa	1028.2 hPa	1029.3 hPa	1029.4 hPa	1026.3 hPa	1025.0 hPa	1026.0 hPa
Relative humidity (300hpa)	20 %	22 %	9.0 %	24 %	32 %	27 %	34 %
Relative humidity (400hpa)	14 %	14 %	4.2 %	2.5 %	5.2 %	7.3 %	8.0 %
Relative humidity (500hpa)	10 %	9.2 %	4.9 %	7.2 %	4.7 %	2.8 %	2.8 %
Relative humidity (600hpa)	20 %	14 %	9.5 %	12 %	9.6 %	8.0 %	6.9 %
Relative humidity (700hpa)	13 %	13 %	12 %	15 %	14 %	13 %	11 %
Relative humidity (850hpa)	8.6 %	12 %	22 %	6.4 %	8.3 %	9.3 %	9.1 %
Relative humidity (925hpa)	33 %	31 %	38 %	22 %	24 %	23 %	18 %
Relative humidity (2 m)	49 %	49 %	49 %	32 %	24 %	24 %	32 %
Temperature (850hpa)	7.1°C	8.0°C	8.9°C	14.3°C	15.3°C	15.1°C	16.3°C
Temperature (500hpa)	-13.0°C	-13.1°C	-11.8°C	-12.9°C	-12.4°C	-11.6°C	-11.4°C
Wind (500hpa)	217 ° 17.8 kts 5 Bf	174 ° 12.4 kts 4 Bf	145 ° 9.8 kts 3 Bf	88 ° 4.4 kts 2 Bf	91 ° 2.8 kts 1 Bf	52 ° 4.4 kts 2 Bf	79 ° 6.2 kts 2 Bf
Wind (700hpa)	153 ° 6.6 kts 3 Bf	102 ° 6.4 kts 3 Bf	41 ° 10.6 kts 3 Bf	70 ° 3.4 kts 2 Bf	54 ° 8.9 kts 3 Bf	45 ° 10.5 kts 3 Bf	36 ° 12.2 kts 4 Bf
Wind (850hpa)	99 ° 15.5 kts 5 Bf	91 ° 13.3 kts 4 Bf	73 ° 19.4 kts 5 Bf	70 ° 17.4 kts 5 Bf	38 ° 14.0 kts 4 Bf	13 ° 6.5 kts 3 Bf	9 ° 7.1 kts 3 Bf
Wind (925hpa)	80 ° 19.4 kts 5 Bf	71 ° 27.9 kts 7 Bf	63 ° 29.0 kts 7 Bf	41 ° 33.0 kts 7 Bf	51 ° 32.7 kts 7 Bf	62 ° 26.8 kts 6 Bf	45 ° 24.5 kts 6 Bf

Figure 2: Alexander Bay meteotable (source: GFS)

Daily 24Hour rainfall from 06z synops	Data written in on day before it was measured												Un QC'ed data		
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Alexander Bay	x	x	0.2	x		x	x	x		x	9.6	0.2	x	0.2	x
Port Nolloth	x	x	x	x	x	x	x	x		3	19.8	x	0.6	x	x
Koiingnaas	x	x	x	x	x	x	x	x		2.4	8.2	0.8	0.6	1.6	#N/A
Garies	x	x	x	x	x	x	0.2	x		x	26.8	1	3	6.6	0.2
Springbok WO	x	x	x	x	x	x	x	x		0.2	35.8	0.2	3.5	7.1	0.6
Vioolsdrift	x	x	x	x	x	x	x	x		x		x	x	x	x
Calvinia	x	x	x	x	x	x	0.2	x	x	x	22.4	x	x	9.5	x
Sutherland	x	x	x	x	x	x	x	x	x	x	18.2	3.2	#N/A	#N/A	#N/A
Pofadder	x	x	x	x	x	x	x	x		x	8.8	x	x	x	x

Figure 3: Rainfall accumulation

Despite the moisture assumed still available in the soil, dust/sand storms were included in the public and marine forecast. The coastal forecast included a watch (due to low confidence) for reduced visibility due to blowing sand.

Observations

The Springbok METAR (Figure 5) shows strong to gale force north-easterly winds blowing throughout the day. These wind observations coincided with the onset of blowing dust/sand west of this area shown on 12Z Satellite image highlighted in blue circle (Figure 4).

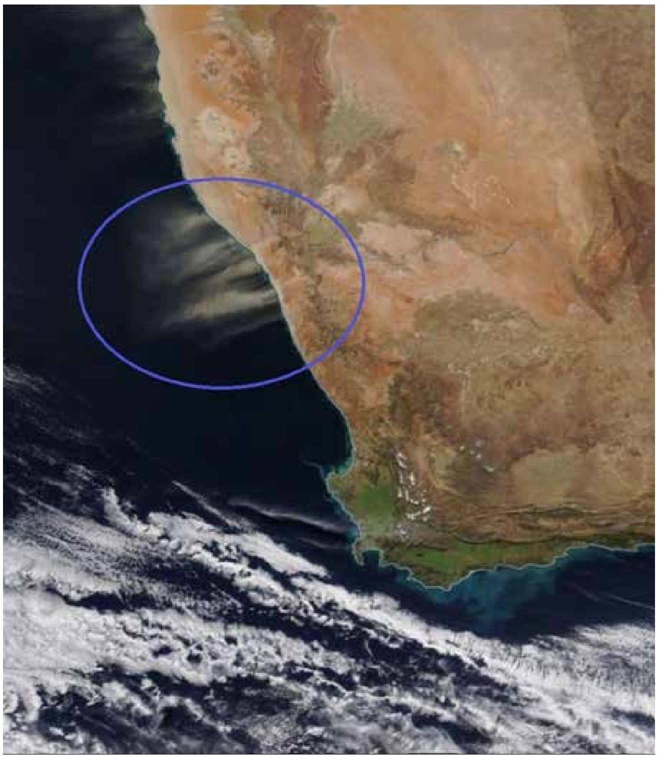


Figure 4: Visual satellite image showing dust storm in blue circle (source: MODIS)

```
Date: 2020-07-15 - Time: 12:00                              (Packtime: 2020-07-15 11:58)
FASB 151200Z 04036KT CAVOK 11/M03 Q1033=
Date: 2020-07-15 - Time: 13:00                              (Packtime: 2020-07-15 12:59)
FASB 151300Z 04025G39KT CAVOK 11/M02 Q1030=
Date: 2020-07-15 - Time: 13:00                              (Packtime: 2020-07-15 12:55)
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Date: 2020-07-15 - Time: 14:00                              (Packtime: 2020-07-15 13:59)
FASB 151400Z 04018G29KT CAVOK 11/M02 Q1031=
Date: 2020-07-15 - Time: 14:00                              (Packtime: 2020-07-15 13:55)
FASB 151400Z AUTO 04018G29KT //// // ////// 11/M02 Q1031=
Date: 2020-07-15 - Time: 15:00                              (Packtime: 2020-07-15 14:59)
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Date: 2020-07-15 - Time: 15:00                              (Packtime: 2020-07-15 14:55)
FASB 151500Z AUTO 06024G35KT //// // ////// 11/M03 Q1030=
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Date: 2020-07-15 - Time: 19:00                              (Packtime: 2020-07-15 18:55)
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FASB 152100Z AUTO 06016G30KT //// // ////// 10/M07 Q1032=
Date: 2020-07-15 - Time: 22:00                              (Packtime: 2020-07-15 21:55)
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Date: 2020-07-15 - Time: 23:00                              (Packtime: 2020-07-15 22:55)
FASB 152300Z AUTO 02022G34KT //// // ////// 10/M08 Q1031=
```

Figure 5: Springbok METARS

The observations also show that when the wind moderates, the dust/sand storm also subsides. This is proven by satellite images below which show invisible dust/sand storm (blue circle, Figure 6, A-C) between 17Z and 19Z when average wind speed was between 12 to 20 knots with no gust but as soon as the wind started gusting up to 30 knots at 21Z with an average wind of 15 knots, the dust/sand storm started to be visible again (blue circle, Figure 6, D).

As a result, this could possibly show that a wind direction and speed of north-easterly to easterly 15 knots gusting at 30 knots as well as an average surface wind of 25-30 knots are favourable for the development of this phenomena along the west coast.

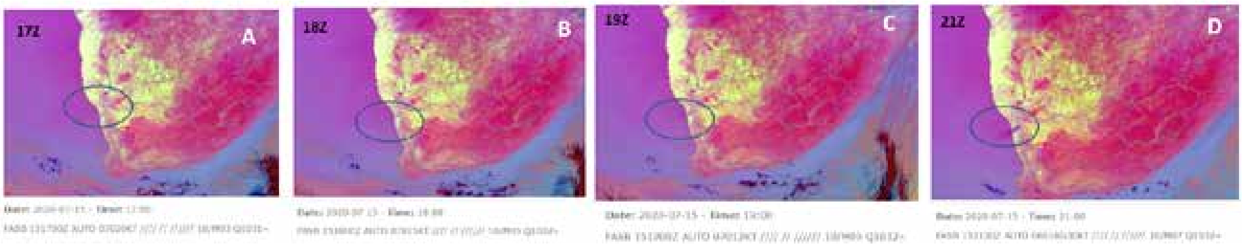

Figure 6: 24HR Day Microphysical satellite image Copyright (2020) EUMETSAT.

Interesting findings

The soil properties help to answer the question that almost cast down the dust/sand storm forecast:

“Is one day of clear conditions after a rainfall event sufficient to allow the soil to dry enough in order to be lifted and sustained in the atmosphere?”

Figure 7 shows the types of soil and it is noted that over the Northern Cape Province, the soil is mainly composed of sand-loamy-sand while Figure 8 shows soil zones, giving more details pertaining to soil properties.

According to Figure 9, Springbok and Kleinsee are located in different soil mapping units, 47 and 50 respectively. Figure 9 further shows where the blowing sand/dust storm was observed (yellow arrows).

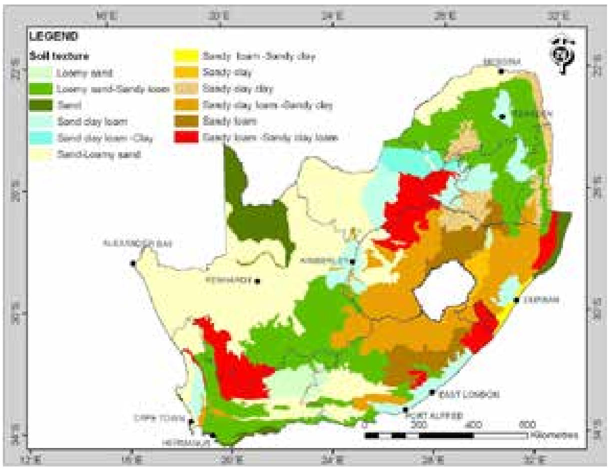

Figure 7: Soil types (source: SA Atlas of Agrohydrology & Climatology)

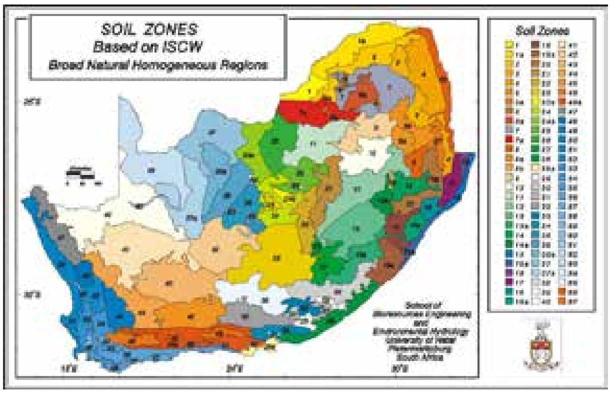

Figure 8: Soil zones (source: SA Atlas of Agrohydrology & Climatology)

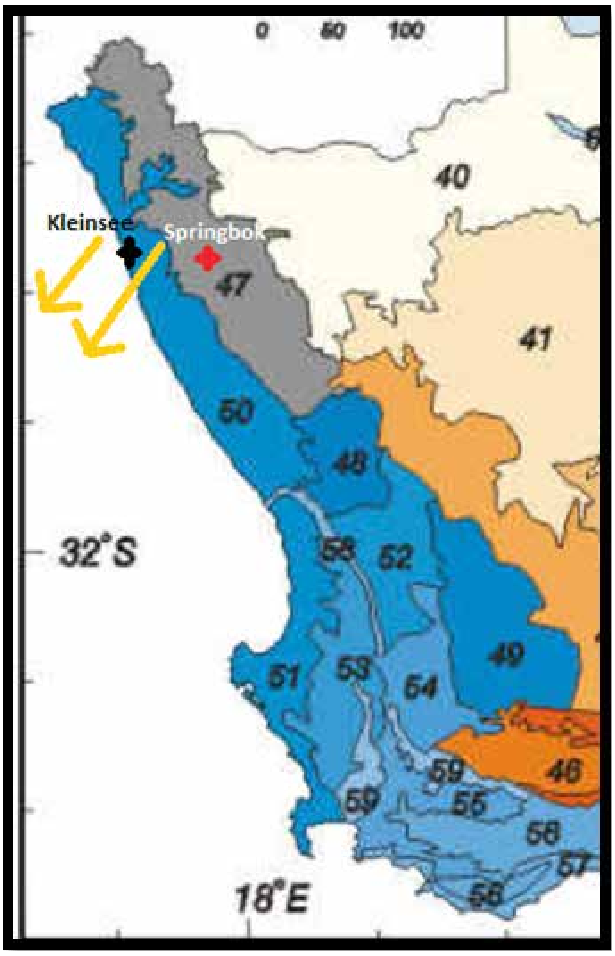

Figure 9: Soil zones (source: SA Atlas of Agrohydrology & Climatology)

According to soil property table (figure 10):

Soil mapping unit 47: composed of [90% sand, clay & loam] and [10% of sand & loam] and as a result has a very slow drainage rate index.

Soil mapping unit 50: composed of [55% sand & loam], [35% sand] and [10% sand, clay & loam] and as a result it has a medium drainage rate index.

These findings show that an area of soil mapping unit 47 was still moist due to very slow drainage rate index, which explains why Springbok did not report any dust storm from the METARS (Figure5) throughout the day even though the wind was favourable for this phenomena.

The opposite is true for an area of soil mapping unit 50: it has a medium drainage rate index which allowed the soil to dry fast and as a result blowing sand/a dust storm was observed in the area between Alexander Bay and Keinsee (west of Springbok).

Soil Mapping Unit	Soil Depth (mm)*				Texture Class*						Soil Form/Series*												Plant Available Water (mm)	Drainage Rate Index
	Range	%	Range	%	Class	%	Class	%	Class	%	Code	%	Code	%	Code	%	Code	%	Code	%	Code	%		
41	200-500	65	600-900	35	SaClLm	65	SaLm	35			Ms20	45	Oa46	25	Cv43	20	Hu43	5	Hu46	5			47	slow
42	450-900	70	100-400	30	ClLm	45	SaLm	30	SaClLm	25	Hu34	45	Hu44	13	Hu45	12	Ms10	10	Ms20	10	Oa44	5	64	slow
43	100-400	100			SaClLm	65	SaLm	35			Hu44	35	Ms10	28	Ms20	27	Sw10	10					28	slow
44	100-400	*65	400-800	20	SaClLm	90	SaCl	10			Ms10	25	Ms20	20	Hu46	20	Ro00	15	Sw20	10	Sw40	10	30	v.slow
45	200-500	65	500-1000	35	SaClLm	80	SaLm	20			Ms20	65	Gs24	20	Oa16	8	Oa26	7					48	v.slow
46	300-600	70	700-1200	30	SaClLm	55	ClLm	30	SaLm	15	Ms10	55	Hu34	30	Oa33	15							62	slow
46a	50-200	*45	400-900	5	SaClLm	90	SaCl	5			Ro00	50	Ms10	40	Sw10	5	Sw11	5					20	v.slow
47	50-300	*35			SaClLm	90	SaLm	10			Ro00	65	Ms10	25	Hu35	10							19	v.slow
48	100-400	85	400-900	10	SaLm	80	SaClLm	20			Hu35	35	Hu45	35	Ms10	15	Cv35	10	Ro00	5			36	medium
49	100-350	65	400-800	35	SaClLm	100					Hu36	25	Ms10	23	Gs16	22	Ms20	10	Ms22	10	Oa26	10	36	slow
50	600-1000	80	300-600	20	SaLm	55	Sa	35	SaClLm	10	Hu32	35	Hu35	25	Cv35	20	Fw22	10	Ms10	10			84	medium
51	> 900	85	500-900	15	SaLm	85	LmSa	8	ClLm	7	Fw10	35	Fw11	35	Hu23	15	Cv11	8	Cv14	7			93	medium
52	100-400	*60	400-900	30	SaClLm	60	SaLm	30	ClLm	10	Ms10	40	Hu33	20	Gs13	10	Cf11	10	Sw30	10	Ro00	10	40	slow
53	200-500	62	500-900	38	SaLm	38	SaClLm	35	SaCl	27	Ss24	28	Sw31	27	Hu13	20	Ms10	10	Kd21	8	Es41	7	43	slow
54	100-400	*60	400-900	20	SaClLm	80	SaLm	20			Ms10	40	Ro00	20	Gs13	10	Gs16	10	Sw30	10	Hu33	10	34	v.slow
55	50-200	100			SaClLm	93	SaLm	7			Ro00	85	Ms10	8	Gs14	7							19	v.slow
56	100-450	60	450-900	40	SaclLm	55	SaLm	25	SaCl	20	Ms10	30	Sw31	20	Gs23	15	Gs26	15	Cv33	10	Hu33	10	43	slow
57	900-900	85	400-900	15	SaLm	45	SaclLm	35	LmSa	20	Fw10	23	Fw11	22	Ms20	20	Kd20	15	Cv30	10	Cv31	10	85	slow
58	> 900	60	450-900	40	SaLm	73	ClLm	17	SaClLm	10	Gs14	20	Oa34	20	Cv34	18	Hu34	17	Du10	15	Pn34	15	85	medium
59	450-900	80	> 900	20	SaClLm	60	SaCl	20	SaLm	20	Sw41	20	Hu33	20	Oa36	20	Gs16	15	Cv36	15	Hu36	10	64	slow
60	450-900	100			SaClLm	78	SaCl	22			Sw30	23	Sw31	22	Ar36	20	Ss16	13	Ss26	12	Kd13	10	50	v.slow
61	> 900	80	450-900	20	SaClLm	80	SaLm	20			Oa26	20	Oa46	20	Cv43	20	Hu46	20	Va20	10	Va40	10	69	medium
62	>1000	100			SaLm	60	SaClLm	25	SaCl	15	Du10	60	Oa46	15	Oa47	15	Oa36	10					71	medium
63	> 900	60	450-900	40	SaLm	40	SaClLm	35	SaCl	25	Hu33	40	Va41	20	Hu36	10	Oa26	10	Oa46	10	Sw20	10	68	medium
64	> 900	75	100-200	25	SaCl	45	SaClLm	30	SaLm	25	Hu33	25	Hu36	20	Va41	20	Sw41	15	Sd21	10	Ms10	10	50	slow
65	400-900	100			Cl	60	SaClLm	25	SaLm	15	Ar40	30	Va41	15	Va42	15	Oa33	15	Rg10	15	Oa36		46	v.slow
66	400-900	55	> 900	45	SaCl	60	SaClLm	20	LmSa	10	Sd11	45	Gs18	20	Hu37	15	Bo41	10	Ar40	10			74	slow
67	> 900	65	400-900	35	SaCl	65	SaClLm	35			Ss16	20	Va31	18	Va41	17	Sw30	15	Hu36	15	Oa36	10	47	slow

* Note that percentages sometimes add to < 100 % when small percentages of subdominant classes, or significant areas of exposed rock (designated Ro00), are present

Figure 10: Soil property table (source: SA Atlas of Agrohydrology & Climatology)

Conclusion

The knowledge of soil properties is important for forecasting. In this particular case study, conditions were favourable for dust/sand storms after a rainfall event. Soil properties are thus important to consider in order to determine the areas likely to experience such a phenomena. A stable atmosphere, wind direction and speed are also important factors for forecasting sand and dust storms in South Africa.

References

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- South African Atlas of Agrohydrology & Climatology. 2001, Soils http:/planet.uwc.ac.za/NISL/Invasives/Assignments/GARP/atlas/atlas_183.htm [accessed 28 July 2020].

FORECASTING SKILL OF MINIMUM AND MAXIMUM TEMPERATURES ON SUBSEASONAL-TO-SEASONAL TIMESCALES OVER SOUTH AFRICA

by Steven Phakula, Willem Landman, Christien Engelbrecht and Thabo Makgoale

Extract from the full article which was published in the Earth and Space Science Journal, 2020

Abstract

Forecast skill of three subseasonal-to-seasonal models (S2S) and their ensemble mean outputs are evaluated in predicting the surface minimum and maximum temperatures at S2S timescales over South Africa. Correlation of anomaly and Taylor diagrams are used to evaluate the models. It is established that the models considered here have skill in predicting both minimum and maximum temperatures at S2S timescales to a certain extent. The correlation of anomaly indicates that the multi-model ensemble (MME) outperforms the individual models in predicting both minimum and maximum temperatures for the day 1–14, day 11–30, and full calendar month timescales during December months. Whereas, the Taylor diagrams suggest that the European Centre for Medium-Range Weather Forecasts model and MME performs better for the day 11–30 timescale for both minimum and maximum temperatures. In fact, the skill difference in terms of correlation of anomalies is small.

1. Introduction

For the past few decades National Meteorological and Hydrological Services including the South Africa Weather Service (SAWS) have been routinely issuing weather forecasts (0–7 days) and seasonal climate forecasts (3–9 months) for surface temperatures and rainfall. In between weather forecasting and seasonal climate predictions falls the intraseasonal or subseasonal timescale (10–60 days) that has been long neglected because this timescale is difficult to predict (e.g., Luo & Wood, 2006; Hudson et al., 2011; Li & Robertson, 2015; Olaniyan et al., 2018). Despite the challenges that come with subseasonal predictions, there is an increasing demand from the applications community for skilful forecasts on these timescale (2 weeks to 2 months), recently referred to as the S2S timescale. Accurate climate predictions at different timescales including subseasonal and seasonal are very crucial for decision makers in sectors such as agriculture, energy, and health, among others (e.g., Hudson et al., 2011; Tian et al., 2017). In particular, the forecasts for frequency or duration of precipitation and temperature extremes can be directly tailored to different applications need.

It is worth mentioning that scientific challenges around improving the predictive skill of S2S forecasts and quantifying their limitations and uncertainties remain and are areas of active research. These include design issues around initial conditions, model resolution, and downscaling, to mention a few. Addressing these challenges requires increased inclusion of quantitative information regarding uncertainty and forecast quality.

On the other hand, skilful S2S predictions are possible due to improvement of numerical prediction models, ensemble prediction techniques, and initialization (e.g., Black et al., 2017; Hudson et al., 2011; Vitart et al., 2008). This improvement created a window of opportunity to further improve the skill of S2S forecasts. Enhancing skill begins with understanding sources and limits of S2S predictability within the Earth system. There are potential sources of predictability for S2S timescale, including the Madden-Julian Oscillation (MJO), the state of El Niño Southern–Oscillation (ENSO), soil moisture, snow cover and sea ice, stratosphere-troposphere interaction, and tropical-extratropical teleconnections (e.g., Ichikawa & Inatsu, 2017; Kim et al., 2014; Vitart et al., 2017; Wang et al., 2016).

The objective of this study is to evaluate the skill of the model forecasts in predicting surface temperatures at S2S timescales over South Africa. Skilful S2S temperature forecasts at timescales considered in this study could be beneficial to decision makers in sectors such as agriculture in South Africa, as only weather forecasts and seasonal climate outlook are issued by SAWS. The remainder of the paper is organized as follows. Section 2 provides the data sources and the detailed description of methods used to evaluate the skill of S2S models. The results are presented in section 3, and, conclusions are summarized in section 4.

2. Data and Methods

Models data

The reforecasts (hindcasts) of the European Centre for Medium-Range Weather Forecasts (ECMWF; Vitart, 2014, Vitart et al., 2008), Meteo-France/Centre National de Recherche Meteorologues (CNRM; Voldoire et al., 2013), and the United Kingdom Meteorological Office (UKMO) models from the S2S project database (http://apps.ecmwf.int/datasets/data/s2s) are used. Table 1 provides detailed information of the three models of interest. Here we have chosen a 1.5° × 1.5° common grid resolution for all the models for the period 1998–2014. The individual model's reforecast for surface daily minimum temperatures (Tn) and maximum temperatures (Tx) data land are considered for the December months are used to calculate the first fortnight (d + 1 to d + 14 days) and day 11–30 (d + 11 to d + 30 days) averages as well as to calculate the full calendar month (d + 1 to d + 31 days) averages. The d is the start of reforecast dates. Day 1–14 (first fortnight) timescale is considered to check the influence of the first 7 days in the models, and this timescale has been explored in Australia (Hudson et al., 2011). The skill of the Predictive Ocean Atmosphere Model for Australia in predicting Tn and Tx for day 1–14 (first fortnight) and day 15–28 (second fortnight) was tested, and promising results were found. Day 11–30 is the extended-range weather forecasting timescale and form part of operational product suits at the SAWS, and the monthly calendar falls in the long-range timescale, which is within the definition of S2S timescale (2 weeks up to 2 months) (e.g., World Meteorological Organization, 2016; Viguad et al., 2017; Tian et al., 2017; Ford et al., 2018). The month December is chosen for exploring S2S predictability because it is one of the hottest summer months and most of the heat waves occur during summer months in South Africa (e.g., Herrings et al., 2018; Lyon, 2009). It is worth mentioning that this work is the first to be conducted on S2S temperature predictions in South Africa.

Table 1. The description of the three S2S model Forecasts

Model	Time range	Resolution	Rfc	Rfc size	Rfc freq	Rfc period
ECMWF	0-46 days	0.25° x 0.25°,L91	On the fly	11	Twice/ Week	Past 20 years
CNRM	0-61 days	~0.7° x 0.7°, L91	Fixed	15	Twice/ Month	1993-2014
UKMO	0-60 days	~0.5° x 0.5°, L85	On the fly	7	Four/ Month	1993-2016

Note. Time range in forecast lead time (days), resolution is longitude and latitude (°), and the number after L represents the number of vertical levels. Reforecast (rfc) are run using the actual forecast model but for the past several years on the same (or nearby) calendar day as the forecast. The reforecast is used to calibrate the actual forecast. Rfc size is the number members for reforecasts, rfc freq is how often (frequency) the forecast run, rfc period is the number of years the reforecasts are run (source: Vitart et al., 2017).

Reanalysis Data

The ECMWF Interim reanalysis (ERA-Interim; Dee et al., 2011) daily surface Tn and Tx data sets are used to calculate the day 1-14 and the day 11-30 averages as well as the full calendar month averages that match the model reforecasts data from 1998 to 2014. The reanalysis data are at the same resolution (1.5° × 1.5°) as the models. It is acknowledged that the ERA-Interim reanalysis might favour ECMWF in the model verification.

Verification Scores

Forecast verification is mostly performed to check if there is a strong relationship between the forecasts and the observations and if the results provide an accurate indication of how good or bad subsequent forecasts will be (Mason, 2008). Deterministic S2S verification is mostly assessed using CORA (correlation of anomalies), which measures the linear correspondence between the ensemble mean forecast and the observations (Hudson et al., 2011; Li & Robertson, 2015). The model forecasts and the observed anomalies are computed with respect to their own seasonally varying climatology, respectively. More importantly, the forecast anomalies are computed with respect to lead-dependent hindcast climatology. Here the CORA is used to measure a model's performance in predicting Tn and Tx over South Africa. Statistical significance of the CORA is tested at 95% confidence interval using random permutation method repeated 10,000 times. Another skill score considered is the Taylor diagrams (Taylor, 2001). The domain for the Taylor diagrams is 21–36°S and 15–35°E covering southern Africa. The diagrams provide a statistical way of graphically summarizing how well the modelled pattern (or a set of patterns) matches observations in terms of their correlation, their centred RMSE, and the amplitude of their variations (represented by their standard deviations) (Heo et al., 2013). The diagram is usually visualized as a series of points on a polar plot.

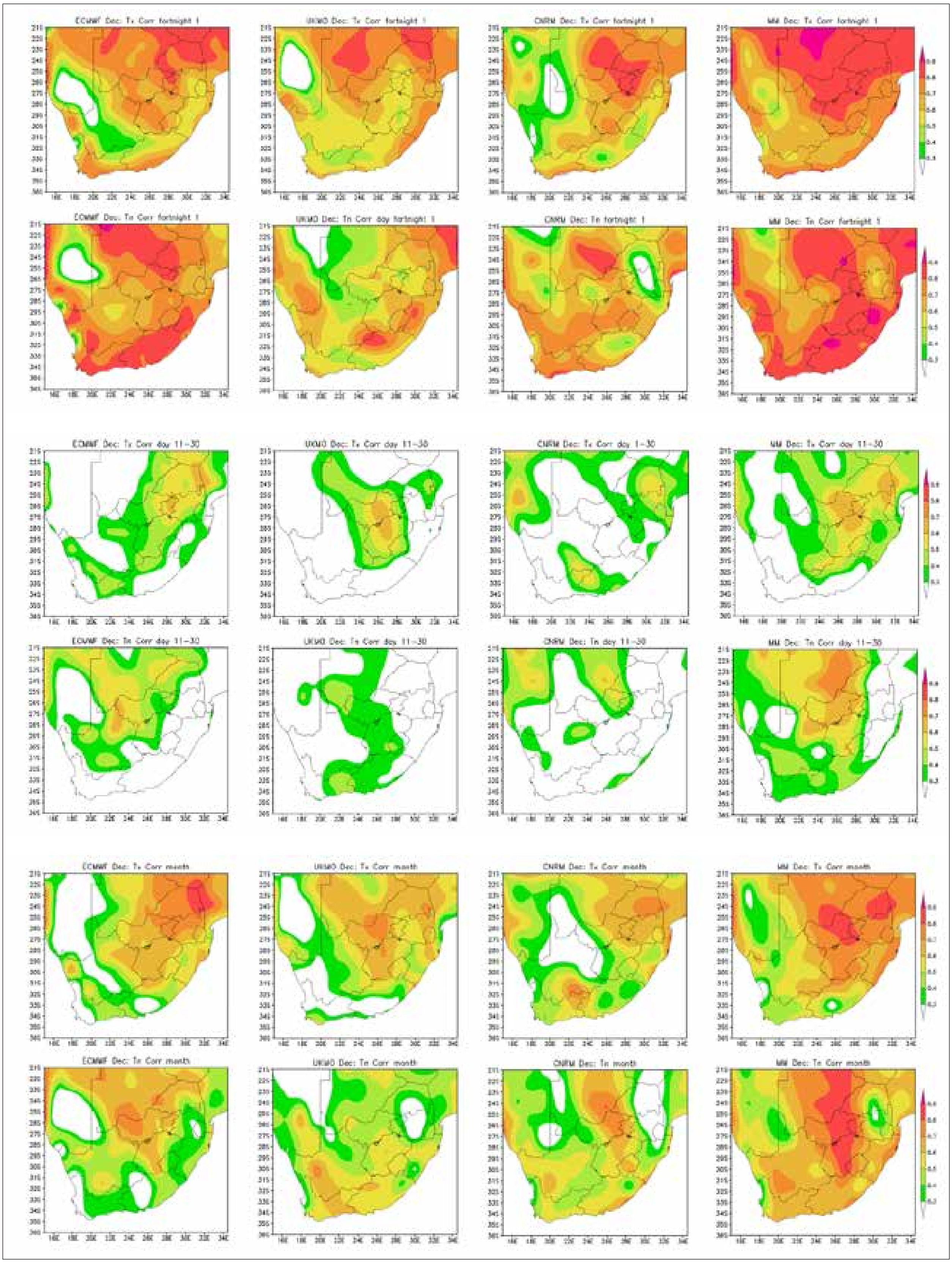

Figure 1. CORA of ECMWF, UKMO, CNRM, and Multi-Model ensemble for average maximum and minimum temperatures anomalies for December day 1-14 (2 top panels), day 11-30 (2 middle panels), and full calendar month (2 bottom panels) timescale from 1998-2014.

3. Results

CORA

The ECMWF, UKMO, and CNRM model outputs as well as the multi-model (the average ensemble mean of the three models), here referred to as MME, are evaluated against the Era-Interim reanalysis in predicting Tn and Tx at S2S timescales during December months over South Africa. The CORA maps show that all three models have skill in predicting both the Tn and Tx for the day 1–14, day 11-30, and calendar month timescale over South Africa (Figure 1). Moreover, the correlation is highest over the north eastern parts of the country for Tx and central to southern parts for Tn. It is evident that the MME improves the forecast skill for both the Tn and Tx. The skill over the eastern parts of South Africa could be linked to ENSO, as ENSO plays an important role on the S2S timescale, as a source of predictability. Furthermore, the skill over the same areas is found in seasonal prediction studies (e.g., Lazenby et al., 2014). However, it is clear that all the three S2S models exhibit relatively low skill in predicting both the Tn and Tx for the day 11–30 timescale, with forecast skill diminishing significantly as compared to predicting the day 1–14 timescale. Moreover, the ECMWF model outperforms the UKMO and the CNRM models for predicting the day 11–30 timescale. For the calendar month timescale the CORA indicates that all the individual models perform better compared to predicting the day 11–30. In general, the forecast skill for all models is concentrated over the eastern half of South Africa for the calendar month timescale. It is worth noting that the MME outperforms the individual models in predicting both the Tn and Tx for all the timescales.

Taylor Diagrams

Figure 2 show the Taylor diagrams of Tx (top panel) and Tn (bottom panel). The models are more skilful in predicting the day 1–14 and calendar month timescales as compared to the day 11–30, with correlation coefficient greater than 0.5 for Tx. The correlation is relatively low (less than 0.5) for the day 11–30 timescale, except for the ECMWF Tx forecasts. The MME outperforms all the individual models with a higher correlation coefficient of about 0.9 for the day 1–14 and calendar month timescales. The RMSE of MME is lower than all individual models in all forecasts; however, the correlation coefficient is relatively low for the day 11–30 timescale. With regard to evaluation of Tn, similar results are found as that of evaluating Tx forecasts. The models exhibit a general good performance for the day 1–14 and calendar months simulation and poor performance for the day 11–30 forecasts. Again the MME performs relatively well as compared to individual models with higher correlation coefficient and lower RMSE.

4. Conclusions

We can conclude from the results that the MME outperforms the individual S2S models considered here in predicting both Tn and Tx at S2S timescales considered here over South Africa. In fact, it was established that the MME for subseasonal forecasts generally improves on the individual model skill in most cases. For this reason, multi-model forecasting systems for extreme Tn and Tx at S2S timescales can be developed for South Africa.

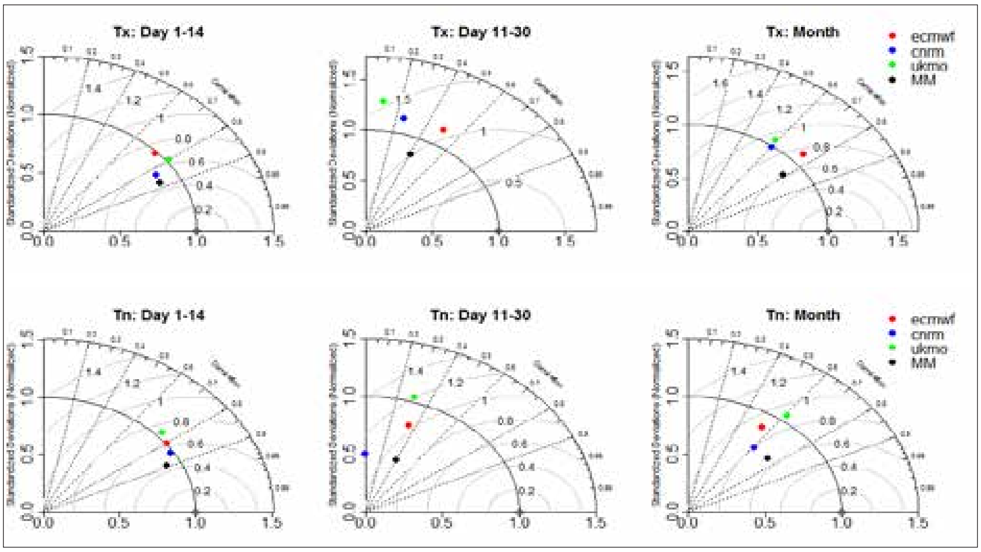

Figure 2. Taylor diagrams for area-averaged maximum (top panel) and minimum (bottom panel) temperatures for day 1-14, 11-30 and monthly maximum temperature for South Africa.

The Regional Training Centre's (RTC) response to COVID-19

by Coleen Rae

The 2020 training year was only one to two months old when the COVID-19 pandemic resulted in the level 5 lockdown. Huge changes were on the horizon, not only for the RTC Lecturers but also for all the students concerned.

It was immediately evident that the approach to be taken and the adaptation of the two courses would be slightly different for the Post Graduate Certificate in Forecasting and the National Certificate: Weather Observation courses.

Post Graduate Certificate in Forecasting Course	National Certificate: Weather Observation Course
Courses which required more practical, hands on delivery were rescheduled on the course schedule to later in July when it was hoped that lockdown levels would be reduced for students to return. This included some course exams. Certain subjects, which required more independent work without a lecturer, were brought forward, such as research and more theoretical subjects such as aviation and marine theory, until such time when other subjects could be delivered. AS all the Forecasting students had access to the internet, the RTC was able to make use of and became heavily dependent on its existing online Moodle platform.[1] The Lecturers started enhancing the existing theoretical subjects to be able to stand as stand-alone modules. The enhancement to the modules included voiceover presentations for use in the online courses on Moodle and involved the narration over PowerPoint presentations so that the student could follow explanations of the slides without having to be physically in class. WhatsApp groups were created to deliver material and to keep communications with students during the lockdown period. For practical forecast subjects, data files with all forecasting case studies were provided to the students onto their external hard drives so that they would be able to continue with the practical case studies at home if need be. Charts and any hardcopy material were also printed out for the students to be taken home in the event that they would not be able to return to the classroom. Microsoft Teams was also used as far as possible to explain practical concepts and provide feedback.	At the start of the lockdown, the roster was still being followed, focussing on the majority of the theoretical aspects of the course and leaving all the practical aspects for later in the year when the students could return to class. Initially, as not all of the students had access to the internet, communication was approached entirely via the WhatsApp group. Once Level 4 was announced and all students were able to have access to the internet, the Moodle platform was made use of for on-line assessments and for additional learning material to be added. Feedback was via memorandums being sent back to the students after assessments and then followed by telephonic feedback on an individual basis or via group calls. As a lot of learning material was being added to this WhatsApp group, it was found that it was becoming "lost" amongst all the chat, so an additional group was created where the Learners can post learning material. This worked very well and became a library of Met Technician lecture notes and guidance material . After the Forecasting lecturers' success in adding voice to their current course notes and presentations, the Met Technician Lecturers are now also in the process of doing the same, particularly with the practical modules. In addition to Moodle, Microsoft Teams were also used as a training platform with the benefit of the recorded sessions being made available for furture use when needed.

[1] http://moodle.weathersa.co.za/moodle/.

Opportunities for RTC forthcoming from the COVID-19 pandemic

1. An opportunity has been created for SAWS RTC to enhance their existing online courses. Material can be presented in a way that includes voice-over narrative and the product shared with students. Therefore, training of students could continue with both the lecturer and student at home.
2. This also provides a very good platform for CPD training in the future – reducing the overall cost of S and T for employees to spend time at Head Office for the training.
3. This format of delivery could also be used in the future for on-line courses making the option for more on-line commercial courses to be developed thereby enhancing the tenders for training to other National and SADC needs.
4. An opportunity has also been created to enhance the RTC BCP with a scenario for pandemics and to test more online working from home options as opposed to the old BCP which covered working from the University of Pretoria. During this pandemic, the University was also closed which did not make that option viable.

Meet the Authors

Jan H. Vermeulen

I am Jan Vermeulen, currently a Senior Forecaster at National Forecasting Centre (Ecopark) and have worked 38 years for SAWS. I am doing a PhD at Unisa titled: Forecasting extreme short-term rainfall in RSA for Disaster Risk Reduction purposes.

Jacqueline Modika

Ms Jacqueline Modika completed the National Diploma: Meteology in 2000, and the National Higher Diploma: Meteology 2002. She was appointed as Forecaster in 2003, Acting Manager: DDR for October - November 2019, and the Senior Manager: Forecasting (DRR) from October 2020. Ms Modika is one of four shift leaders in DRR.

She was also part of the 1st SAWS Woman Accelerated Leadership Program 2018/2019.

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.

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 duties include the creation and writing of general climate publications, climate change and variability research with historical data as input, ad hoc scientific projects of which the numbers have increased substantially in recent years, climate data and information requests, where advanced statistical analyses are required, drought monitoring, 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 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.

Sifiso Mbatha

Mr Sifiso Mbatha is a Climate Service Scientist: Climate Data. He joined SAWS as an intern in 2015 and was employed in July 2016 under the same unit. He completed his BSc degree in Physics and Geography in 2013 and further obtained his Climatology Honors in 2014 from the University of Zululand. Sifiso is currently enrolled with the University of Venda for his Master's degree, modelling the variability of convective activity over East Rand South Africa.

Sandile Ngwenya

Mr Sandile Ngwenya is a Scientist in Climate Services: Climate Data Research and Analysis. He joined the South African Weather Service in 2017. He holds a BSc degree in Geography and Hydrology and a BSc Honors degree in Climatology from University of Zululand; He recently obtained an MSc degree in Environmental Sciences from University of Venda.

Matshidiso Mogale

Miss Matshidiso Mogale is a determined dream chaser, budding environmentalist and well rooted positivist with a big heart and artistic flair. She holds a BSc Degree and Honours in Meteorology obtained from the University of Pretoria and she is a qualified weather forecaster currently based at the Cape Town weather office. She joined the Cape Town team in February 2019 and is looking forward to learn more, grow and with compassion make a difference in people's lives.

"***Begin with an end in mind***"

Coleen Rae

Ms Colleen Rae is the Qualification Manager: Meteorological Technicians within the SAWS Regional Training Centre, with 19 years' experience within the training environment which includes eight years as an Accredited Assessor and Moderator. Other experiences include Observations since 1976 to 1981 and 1987 to 1991, Forecasting from 1992 to 1996, Meteorological Trainer from 1997 to 1998 and Forecaster Trainer from 1999 to 2000.

Steven Phakula

Mr Steven Phakula is a Scientist within Climate Change and Variability group in Research department. He has a Masters and BSc honours degrees, both in Meteorology from the University of Pretoria, BSc in Mathematics and Statistics from the University of Limpopo. He is currently enrolled for PhD in Meteorology at the University of Pretoria. He has authored and co-authored few peer-reviewed journal publications and conference papers. He has experience in seasonal and seasonal-to-subseasonal predictions.

Christien Engelbrecht

Christien started her career in July 1998 as a weather forecaster at what was then the South African Weather Bureau. She extended her weather forecast experience to tropical Africa, while forecasting for United Nations operations in Kinshasa during 2003. She returned to South Africa in 2004 to commence with a MSc (Meteorology) and graduated in 2007. Although she started her MSc research on a full-time basis, she joined the Institute for Soil, Climate and Water of the Agricultural Research Council in May 2006. As a researcher at the Agricultural Research Council, she obtained the PhD (Meteorology) degree at the University of Pretoria and graduated in April 2016. At the ARC, she applied her skills in the analysis of climate model simulations towards an enhanced understanding of how various climate attributes may influence the agricultural sector in South Africa. This includes investigation of predictability attributes on agriculturally important timescales. In July 2019, Christien started to work in the Long-Range Prediction Group at the South African Weather Service, from where she will further contribute to produce climate forecasts to serve the agricultural community of South Africa.

Thabo Makgoale

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

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