Seasonal forecasts

presented by:

Tel: +27(82)644-5304
Willem.Landman@up.ac.za

https://tinyurl.com/ybrb3a72

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Seasonal Forecast Worx

Latest Update: 10 September 2019

- The seasonal forecasts presented here by **Seasonal Forecast Worx** are based on forecast output of the coupled ocean-atmosphere models administered through the North American Multi-Model Ensemble (NMME) prediction experiment (http://www.cpc.ncep.noaa.gov/products/NMME/; Kirtman et al. 2014). NMME real-time seasonal forecast and hindcast (re-forecast) data are obtained from the data library (http://iridl.ldeo.columbia.edu/) of the International Research Institute for Climate and Society (IRI; http://iri.columbia.edu/).
- NMME forecasts are routinely produced and are statistically improved and tailored for southern Africa and for global sea-surface temperatures by employees and post-graduate students in the Department of Geography, Geoinformatics and Meteorology at the University of Pretoria (http://www.up.ac.za/en/geography-geoinformatics-and-meteorology/). Statistical post-processing is performed with the CPT software (http://iri.columbia.edu/our-expertise/climate/tools/cpt/).
- Why do we apply statistical methods to climate model forecasts?

  "…statistical correction methods treating individual locations (e.g. multiple regression or principal component regression) may be recommended for today's coupled climate model forecasts". (Barnston and Tippett, 2017).
- Why do we not use just a single model in our forecasts?

  "…multi-model forecasts outperform the single model forecasts…" (Landman and Beraki, 2012).

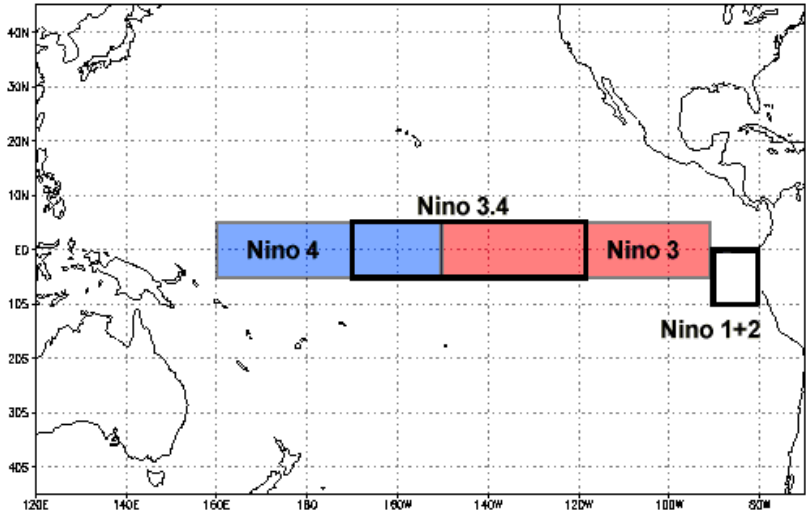
- For the official seasonal forecast for South Africa, visit the South African Weather Service website at http://www.weathersa.co.za/images/data/longrange/gfcsa/scw.pdf

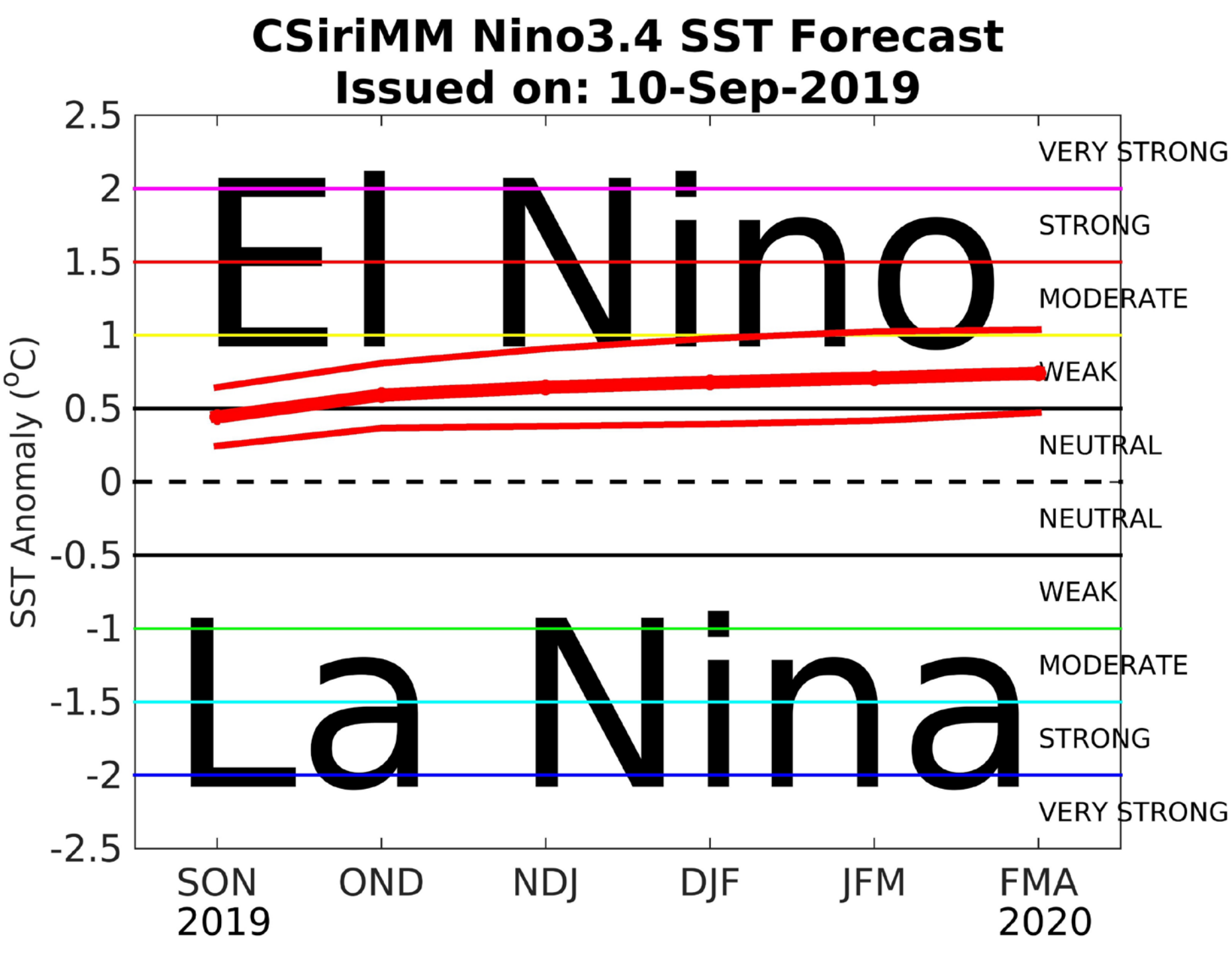
South African Weather Service
ISO 9001 Certified Organisation

ENSO and Global SST Forecasts

Prediction Method

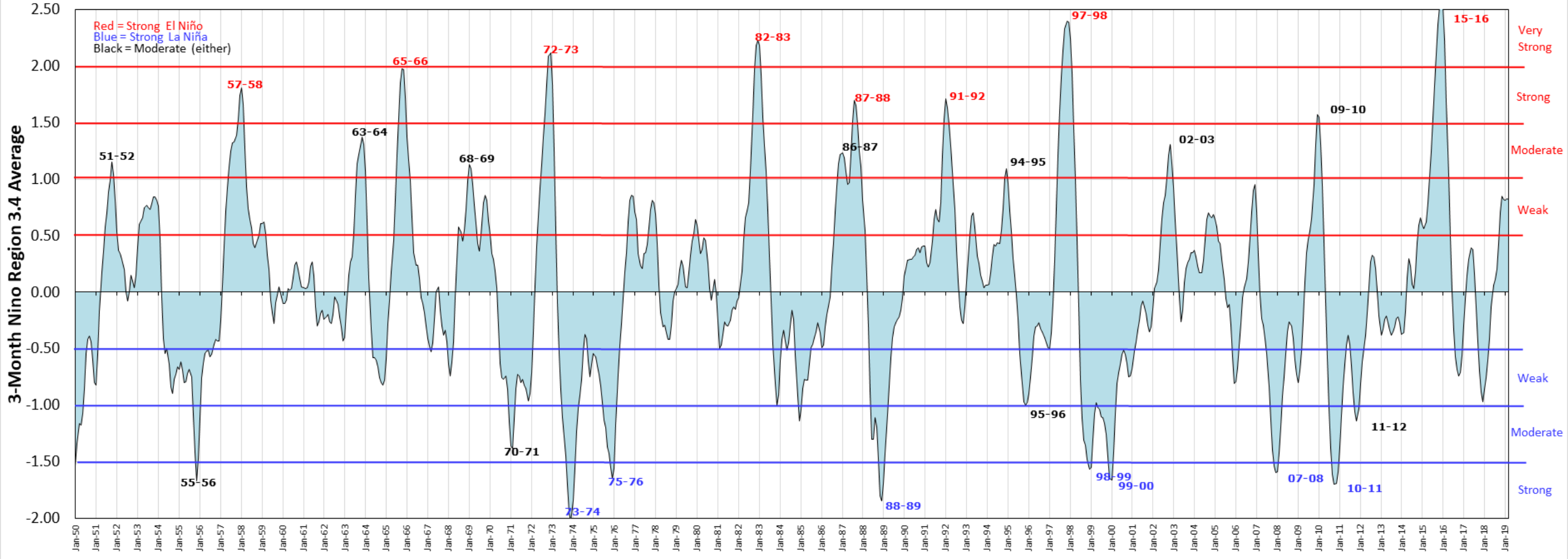
- Forecasts for global sea-surface temperature (SST) fields are obtained through a combination of NMME models and a linear statistical model that uses antecedent SST as predictor (Landman et al. 2011). Forecasts for the Niño3.4 area (see insert) are derived from the global forecasts.
- SST forecasts from the NMME models are variance and bias corrected.
- Three-month Niño3.4 SST forecasts are produced for three categories:
  - **El Niño:** SST above the 75th percentile
  - **La Niña:** SST below the 25th percentile
  - **Neutral:** Neither El Niño nor La Niña



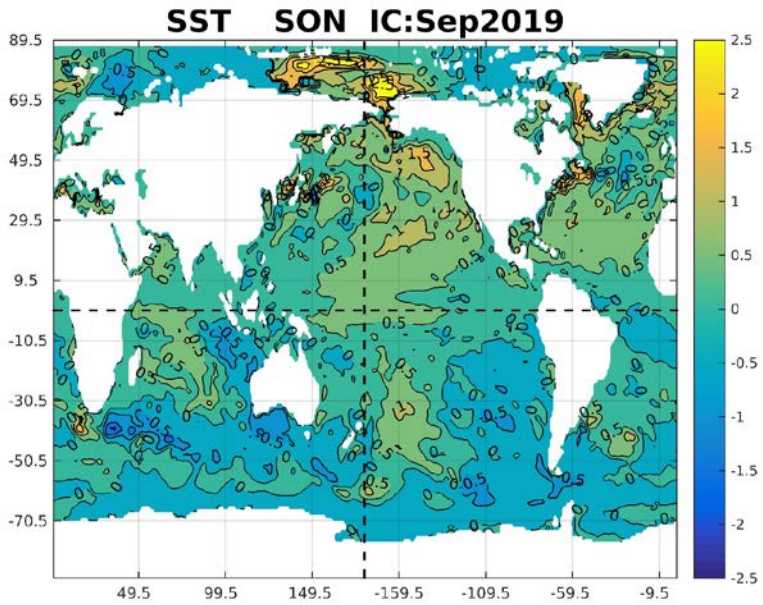

CSiriMM Nino3.4 SST Forecast
Issued on: 10-Sep-2019
SST Anomaly (°C)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
El Nino
La Nina
VERY STRONG
STRONG
MODERATE
WEAK
NEUTRAL
NEUTRAL
WEAK
MODERATE
STRONG
VERY STRONG
SON
2019
OND
NDJ
DJF
JFM
FMA
2020

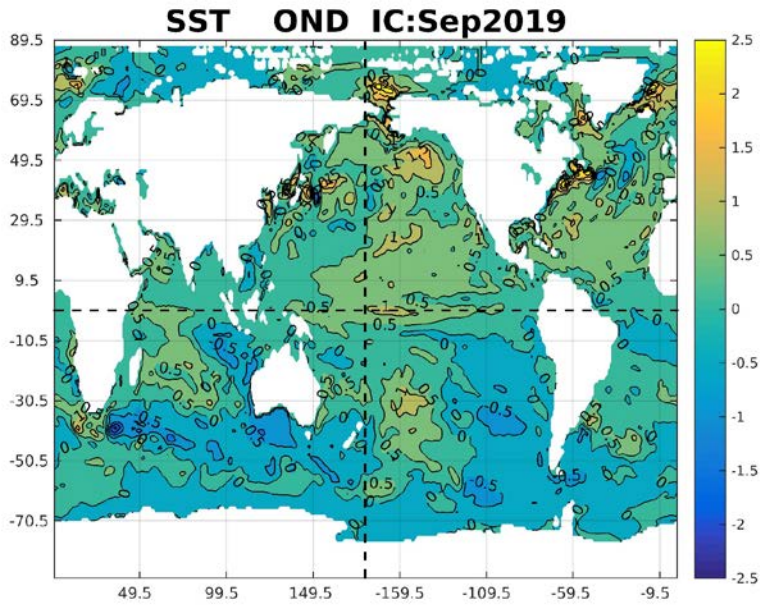
Oceanic Niño Index (ONI)

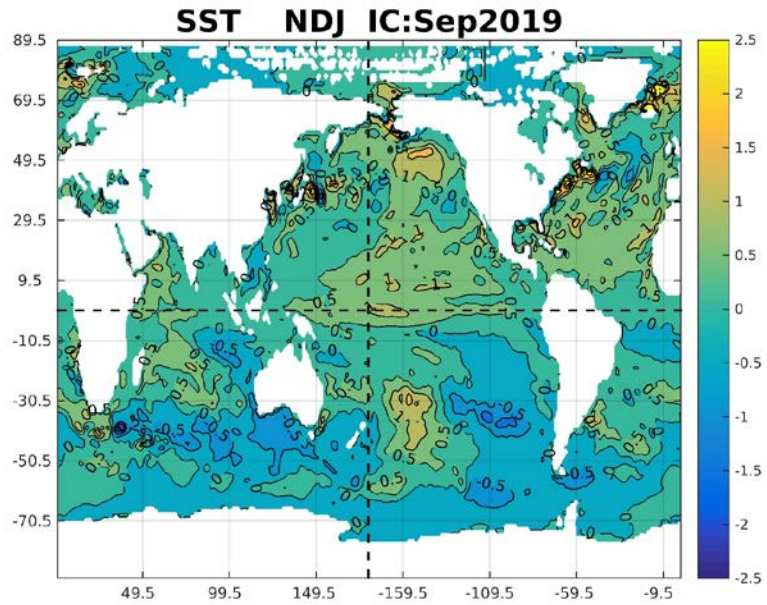
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml

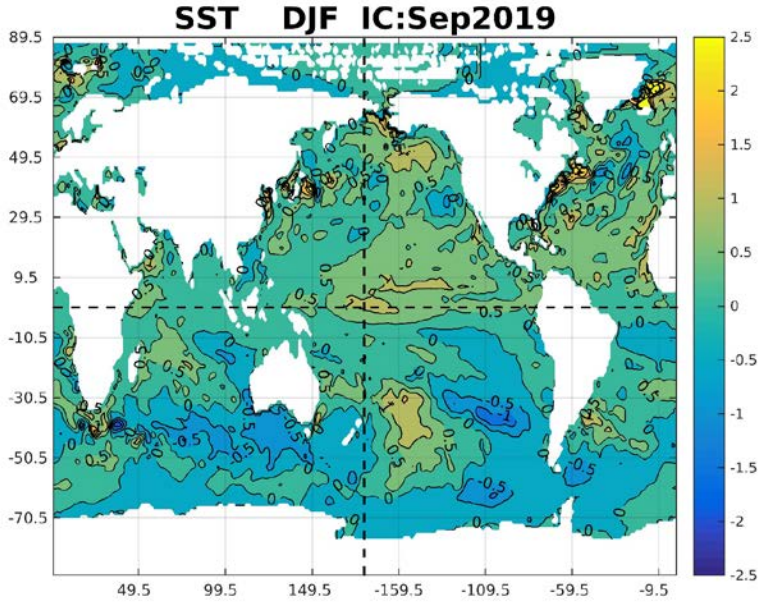


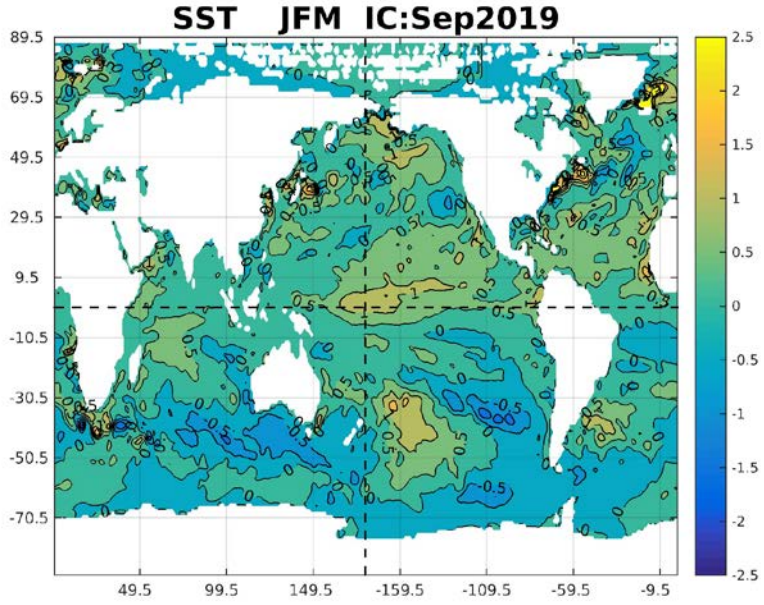
SST anomalies

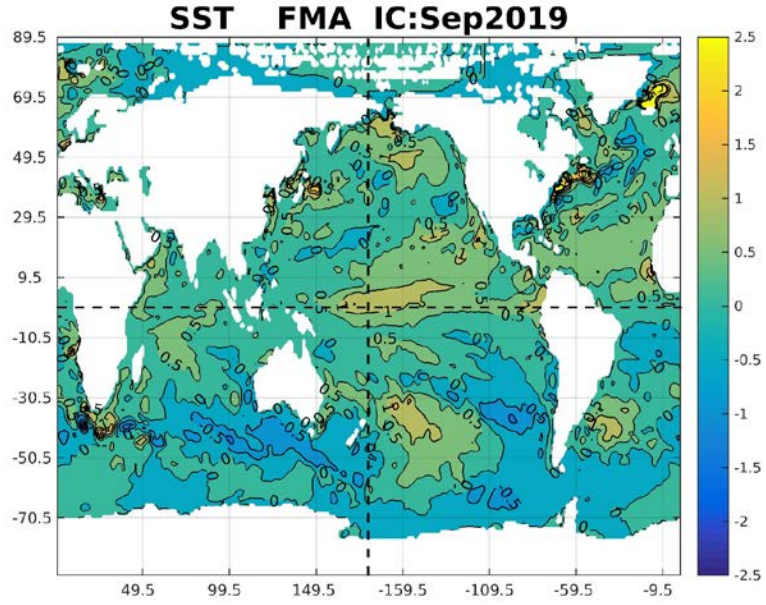












Round-up: ENSO

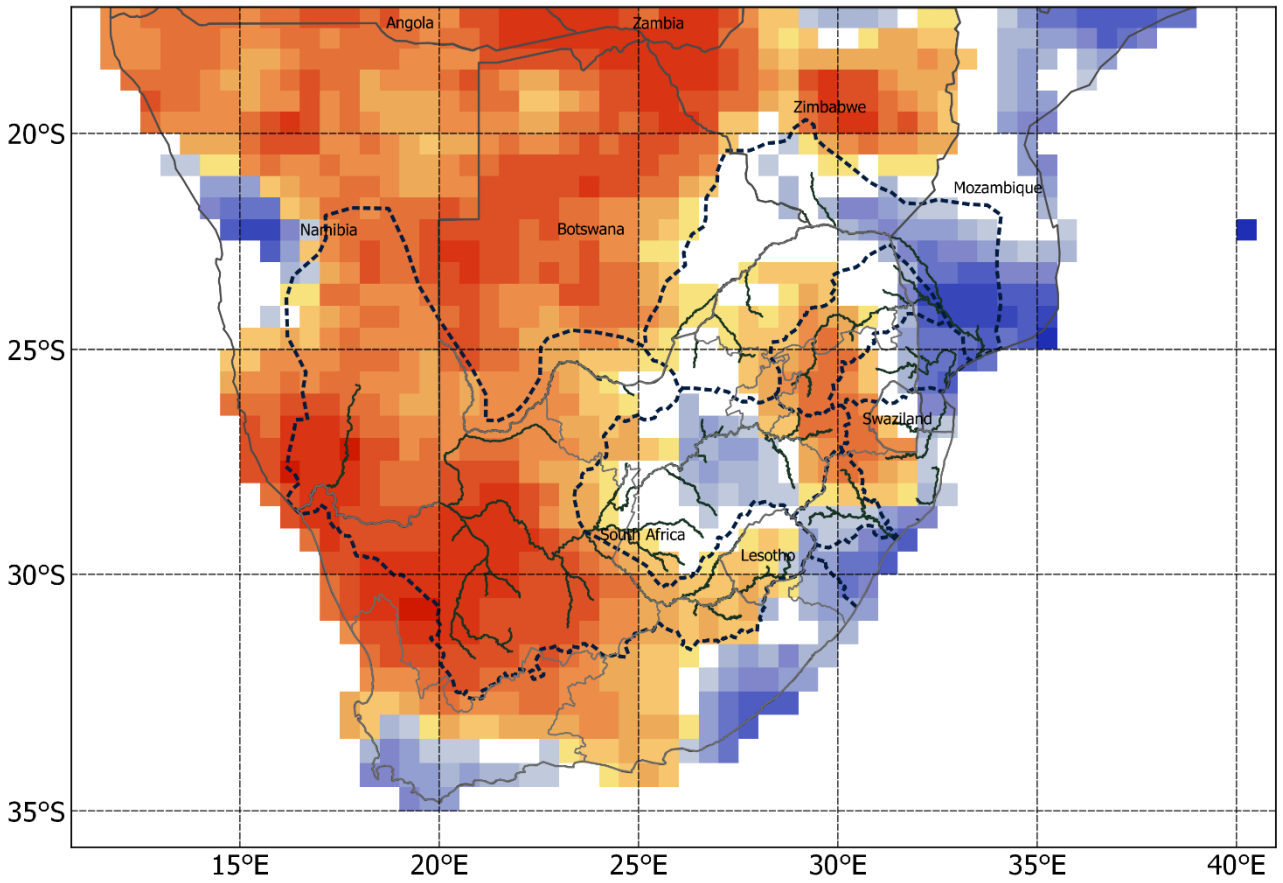
- Predicted warming of central Pacific Ocean SST suggests a weak El Niño event towards summer.
- *From the CPC/IRI El Niño Watch in August: El Niño has transitioned to ENSO-neutral, which is most likely to continue through Northern Hemisphere winter 2019-20 (50-55% chance).* [This statement disagrees with the UP forecast]

Southern Africa Forecasts

Prediction Method

- Three-month seasons for seasonal rainfall totals and average maximum temperatures of NMME ensemble mean forecasts are interpolated to Climatic Research Unit (CRU; Harris et al. 2014) grids (0.5°x0.5°) by correcting the mean and variance biases of the NMME forecasts. Probabilistic forecasts are subsequently produced from the error variance obtained from a 5-year-out cross-validation process (Troccoli et al. 2008). Forecasts cover a 6-month period.
- Forecasts are produced for three categories:
  - **Above:** Above-normal ("wet" / "hot", rainfall totals / maximum temperatures higher than the 75th percentile of the climatological record)
  - **Below:** Below-normal ("dry" / "cool", rainfall totals / maximum temperatures lower than the 25th percentile of the climatological record)
  - **Normal:** Near-normal ("average" season)
- Verification:
  - ROC Area (Below-Normal) – The forecast system's ability to discriminate dry or cool seasons from the rest of the seasons over a 32-year test period. ROC values should be higher than 0.5 for a forecast system to be considered skilful.
  - ROC Area (Above-Normal) – The forecast system's ability to discriminate wet or hot seasons from the rest of the seasons over a 32-year test period. ROC values should be higher than 0.5 for a forecast system to be considered skilful.

SON 2019 Rainfall; ICs: Sep



Legend

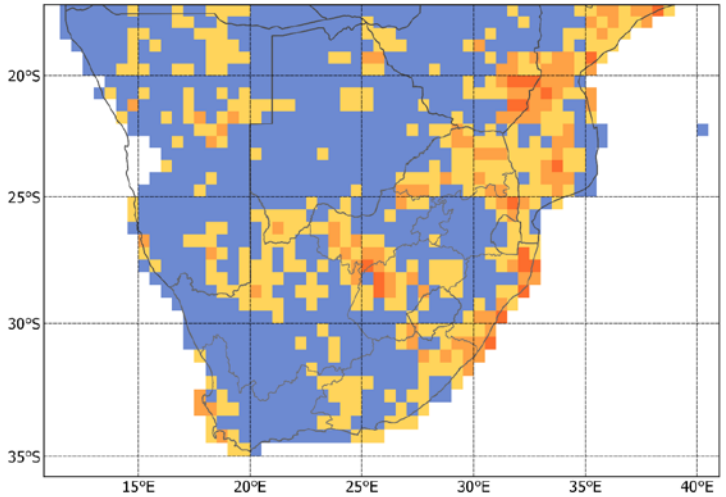
Catchment Area

Main Rivers

Rainfall Prob

>75	
70-75	
65-70	
60-65	
55-60	
50-55	Above
45-50	Normal
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	Below
55-60	Normal
60-65	
65-70	
70-75	
>75	

ROC Area (Above-Normal): SON Rainfall

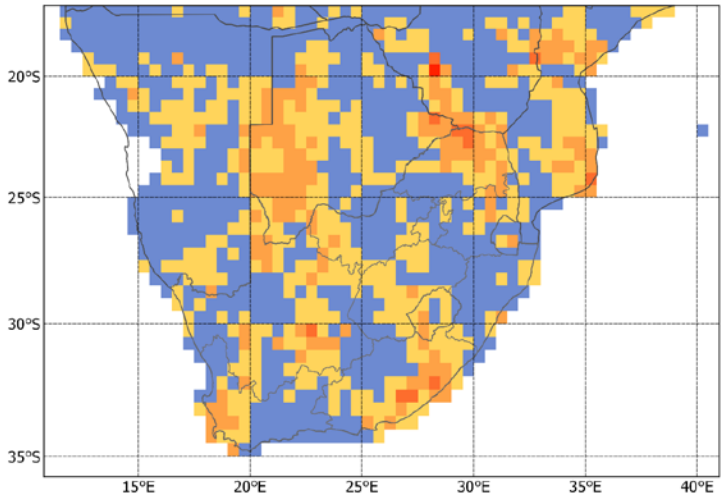


Legend

ROC

> 0.8
0.8 - 0.7
0.7 - 0.6
0.6 - 0.5
<= 0.5

ROC Area (Below-Normal): SON Rainfall

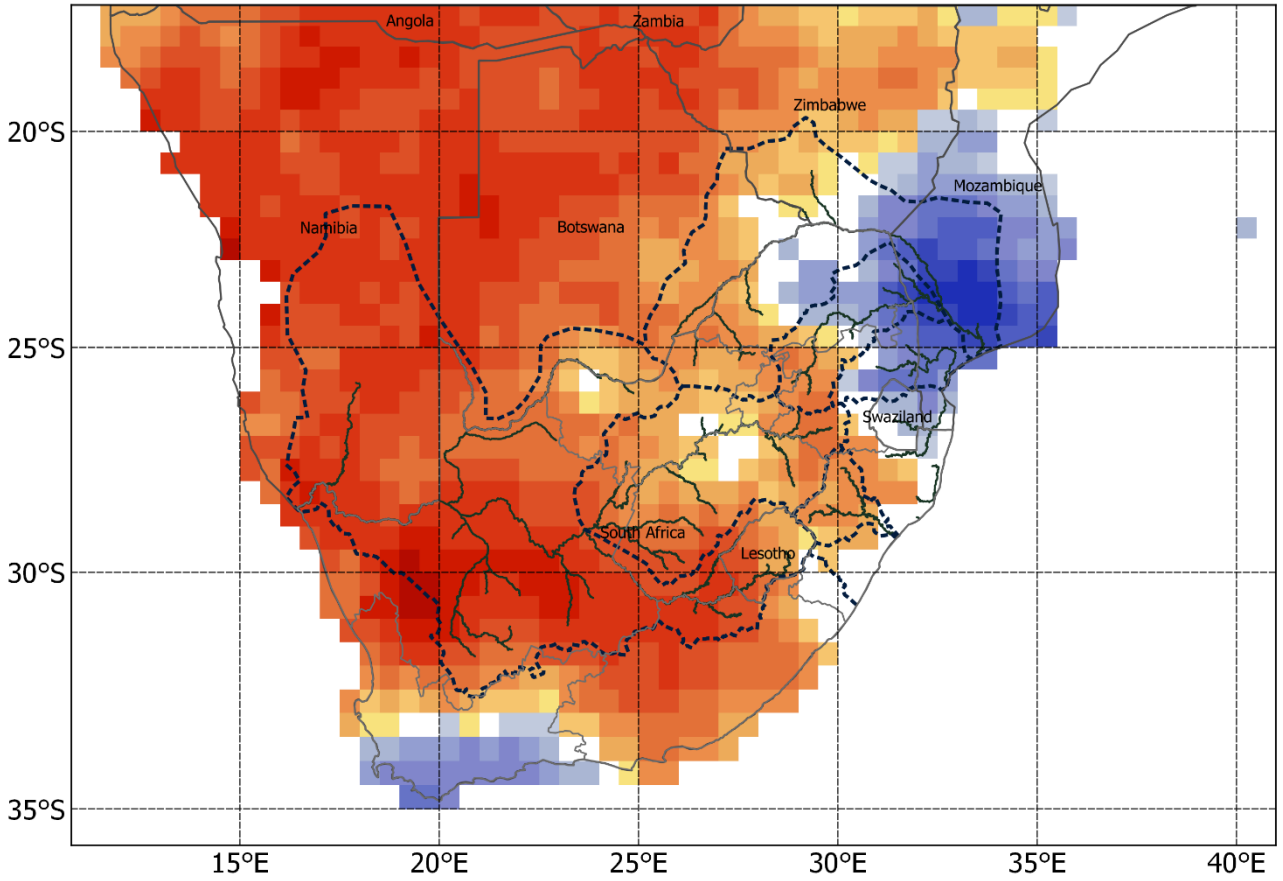


Legend

ROC

> 0.8
0.8 - 0.7
0.7 - 0.6
0.6 - 0.5
<= 0.5

OND 2019 Rainfall; ICs: Sep



Legend

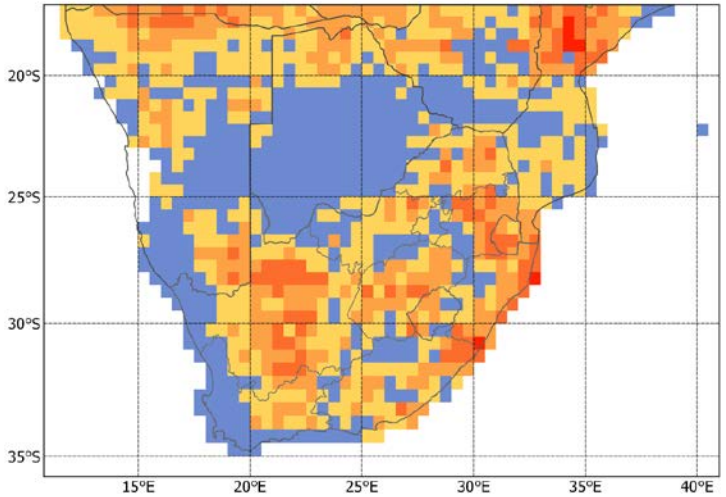
Catchment Area

Main Rivers

Rainfall Prob

>75	
70-75	
65-70	
60-65	
55-60	
50-55	Above
45-50	Normal
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	Below
55-60	Normal
60-65	
65-70	
70-75	
>75	

ROC Area (Above-Normal): OND Rainfall

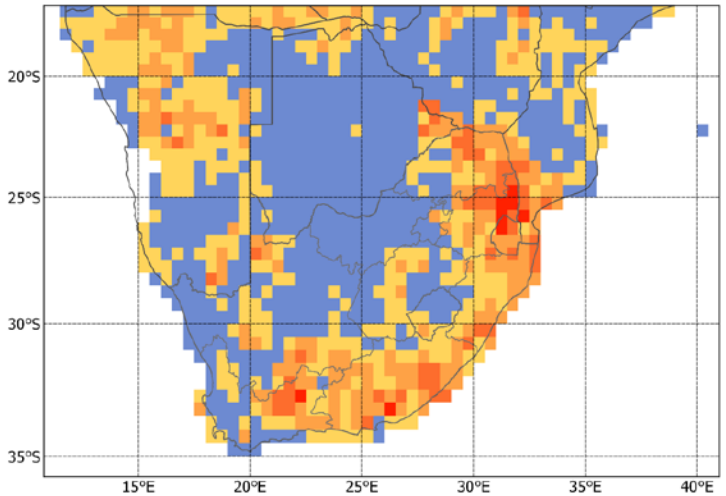


Legend

ROC

> 0.8
0.8 - 0.7
0.7 - 0.6
0.6 - 0.5
<= 0.5

ROC Area (Below-Normal): OND Rainfall

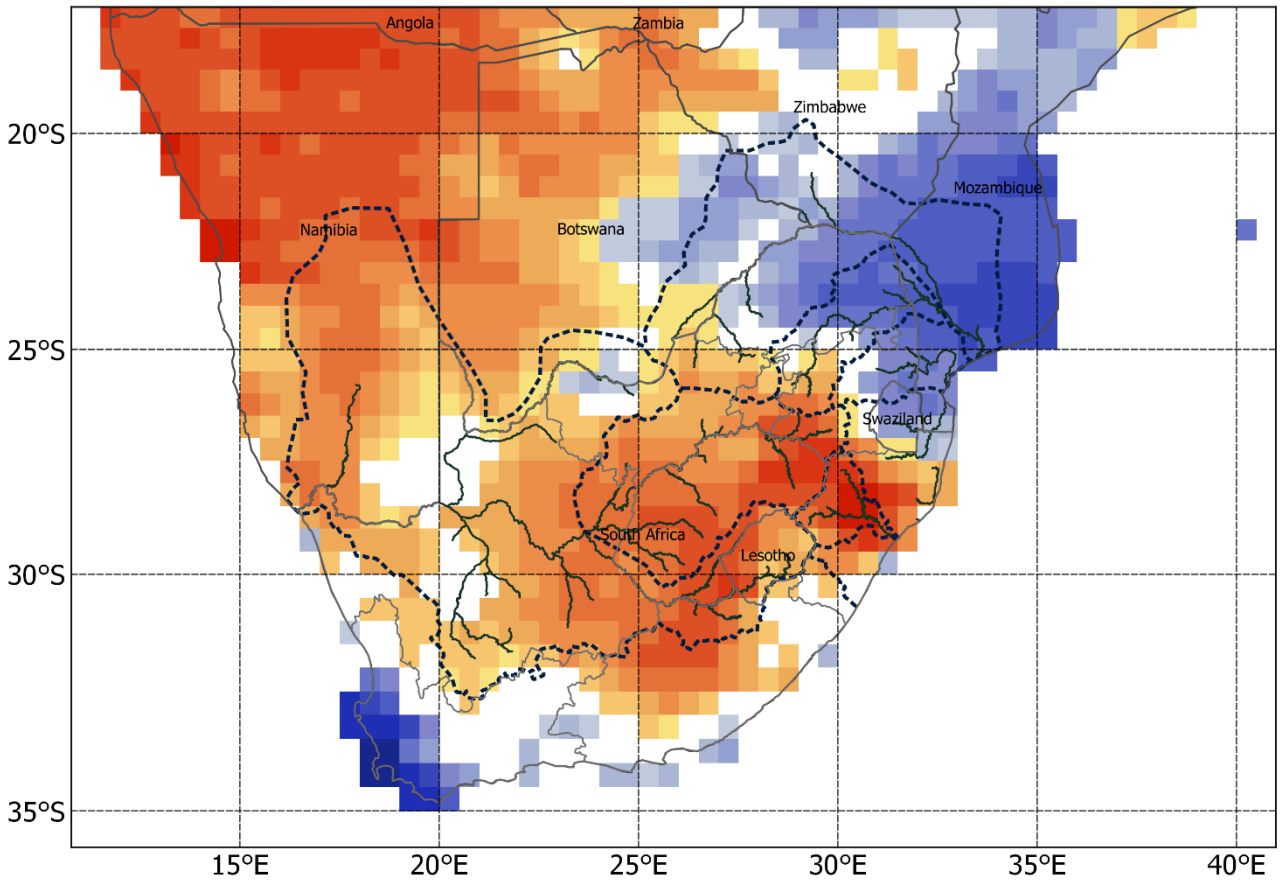


Legend

ROC

> 0.8
0.8 - 0.7
0.7 - 0.6
0.6 - 0.5
<= 0.5

NDJ 2019/20 Rainfall; ICs: Sep



Legend

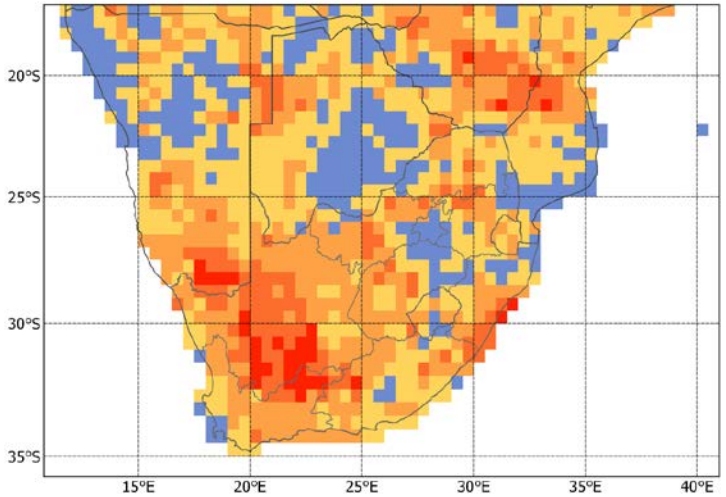
Catchment Area

Main Rivers

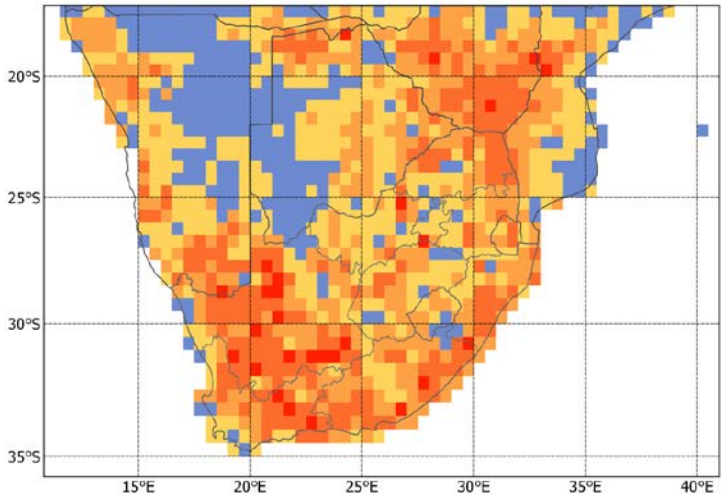
Rainfall Prob

>75	
70-75	
65-70	
60-65	
55-60	
50-55	Above
45-50	Normal
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	Below
55-60	Normal
60-65	
65-70	
70-75	
>75	

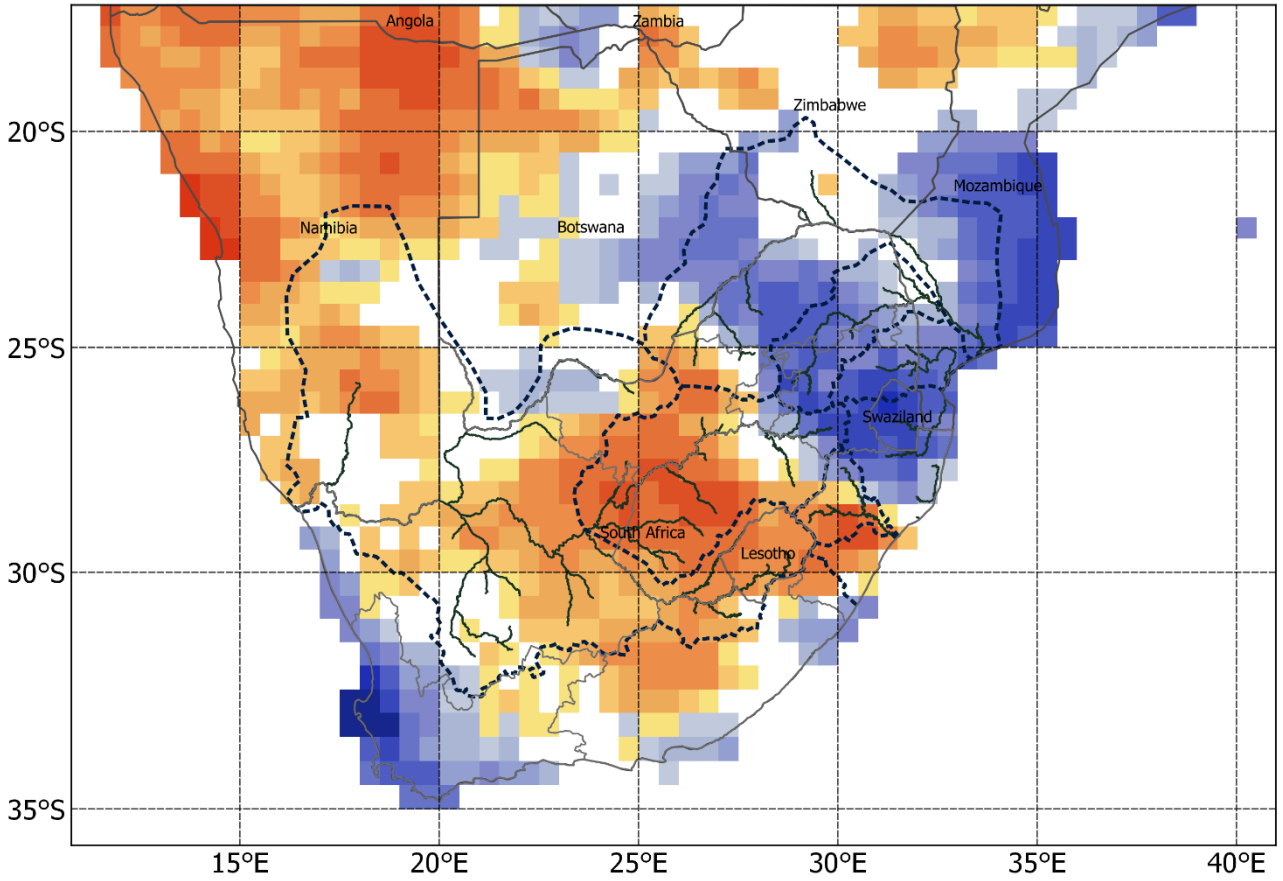
ROC Area (Above-Normal): NDJ Rainfall



ROC Area (Below-Normal): NDJ Rainfall



DJF 2019/20 Rainfall; ICs: Sep



Legend

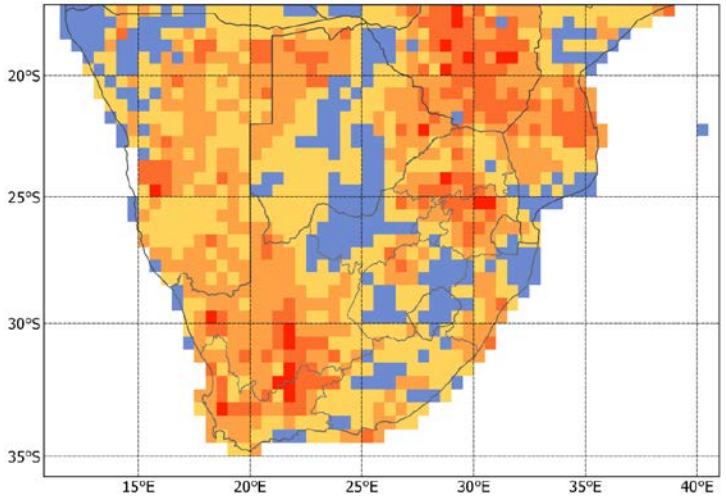
Catchment Area

Main Rivers

Rainfall Prob

>75	
70-75	
65-70	
60-65	
55-60	
50-55	Above
45-50	Normal
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	Below
55-60	Normal
60-65	
65-70	
70-75	
>75	

ROC Area (Above-Normal): DJF Rainfall

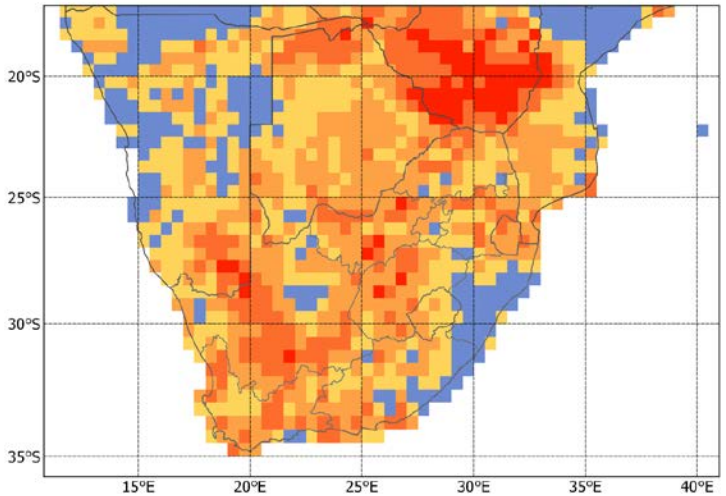


Legend

ROC

> 0.8
0.8 - 0.7
0.7 - 0.6
0.6 - 0.5
<= 0.5

ROC Area (Below-Normal): DJF Rainfall



Legend

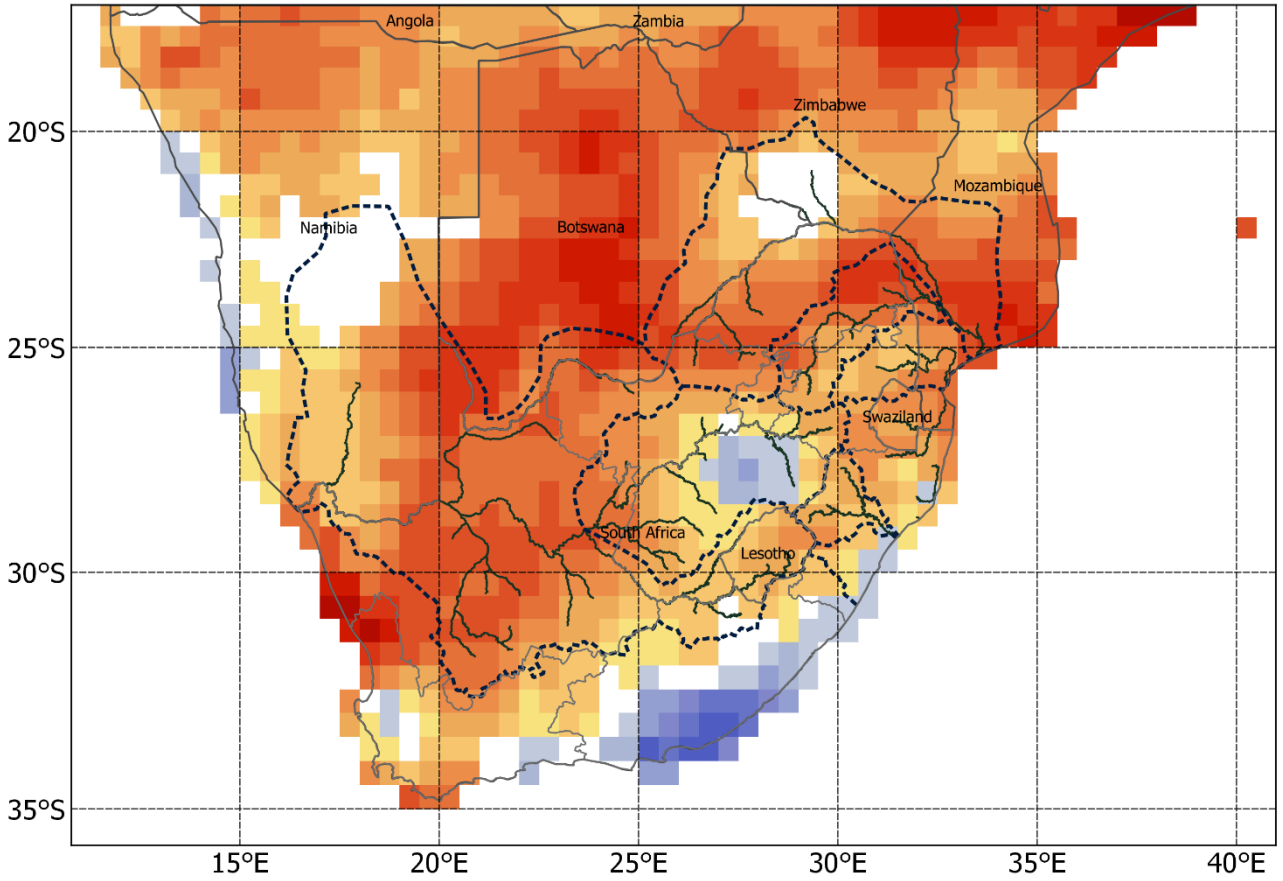
ROC

> 0.8
0.8 - 0.7
0.7 - 0.6
0.6 - 0.5
<= 0.5

Round-up: SADC Rainfall

- Enhanced chances for favourable rainfall outcomes expected over the north-eastern (summer rainfall region), southern (all-year region) and south-western parts (winter rainfall region).
- The remainder of the region is expected to experience dry conditions.

SON 2019 Max Temp; ICs: Sep



Legend

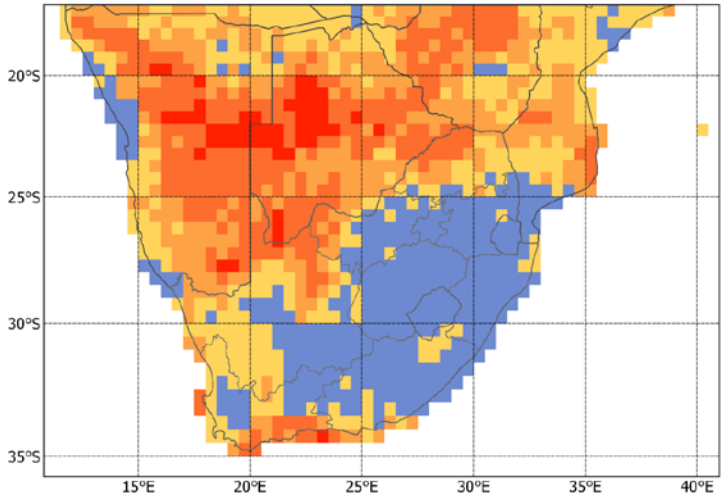
Catchment Area

Main Rivers

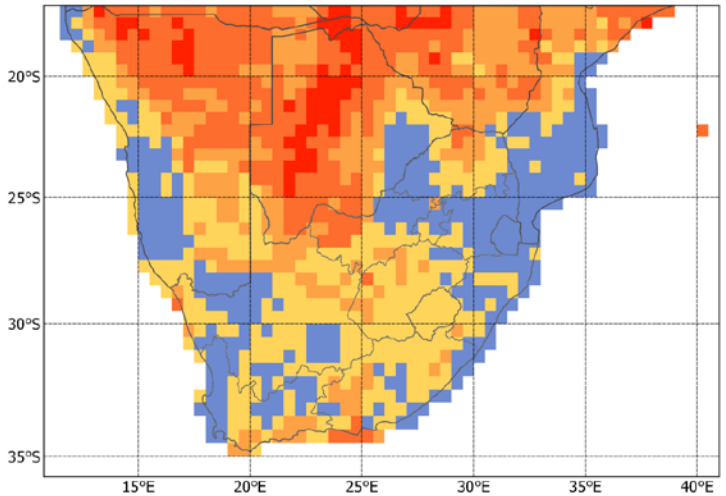
Max Temp Prob

>75	
70-75	
65-70	
60-65	
55-60	Above
50-55	Normal
45-50	
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	Below
55-60	Normal
60-65	
65-70	
70-75	
>75	

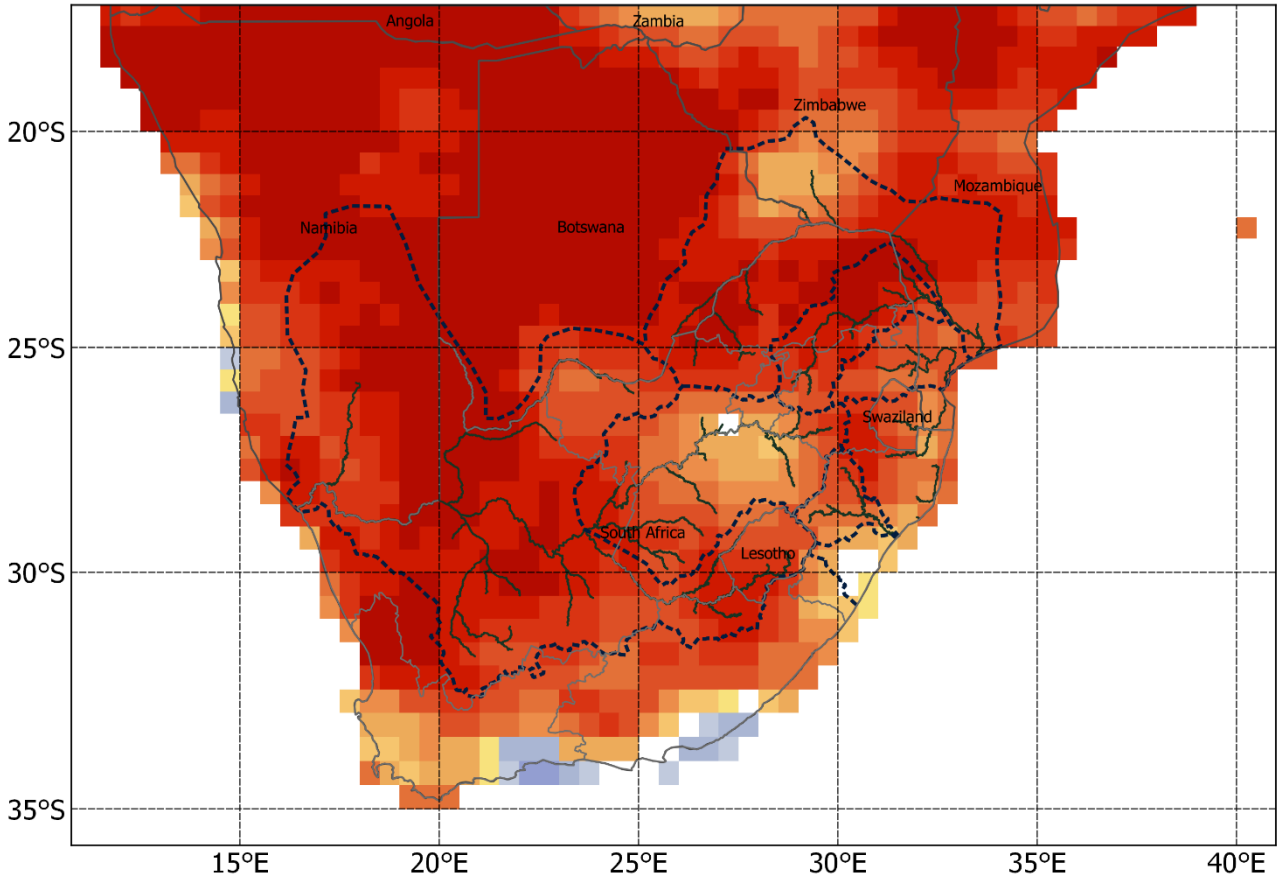
ROC Area (Above-Normal): SON Max Temp



ROC Area (Below-Normal): SON Max Temp



OND 2019 Max Temp; ICs: Sep



Legend

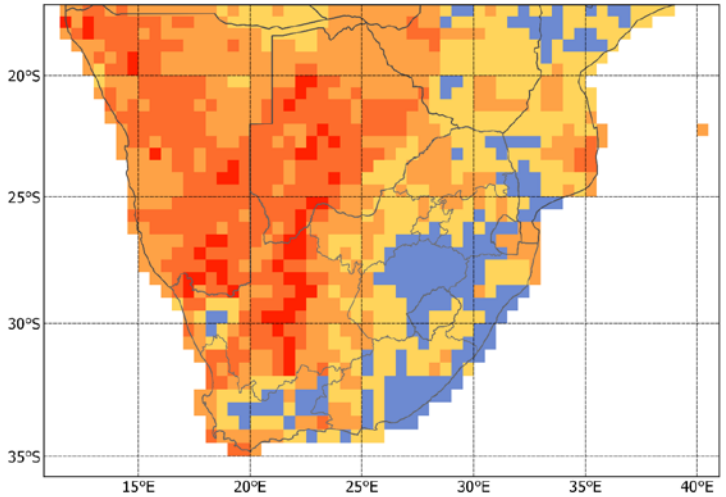
Catchment Area

Main Rivers

Max Temp Prob

>75	
70-75	
65-70	
60-65	
55-60	Above
50-55	Normal
45-50	
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	Below
55-60	Normal
60-65	
65-70	
70-75	
>75	

ROC Area (Above-Normal): OND Max Temp



Legend

ROC

> 0.8

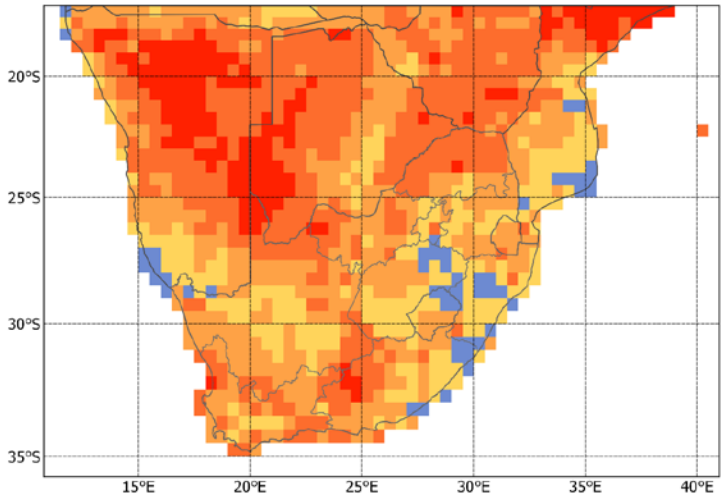
0.8 - 0.7

0.7 - 0.6

0.6 - 0.5

<= 0.5

ROC Area (Below-Normal): OND Max Temp



Legend

ROC

> 0.8

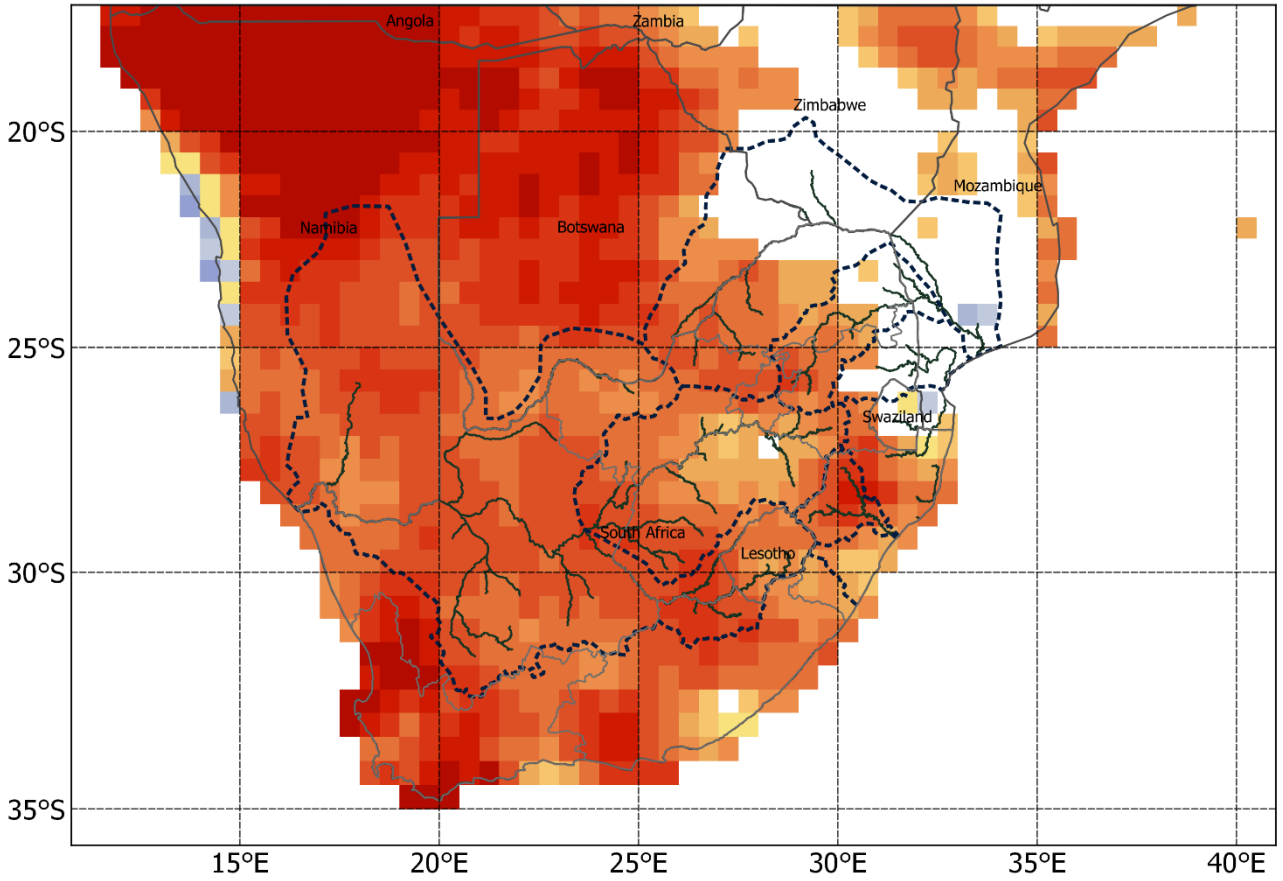
0.8 - 0.7

0.7 - 0.6

0.6 - 0.5

<= 0.5

NDJ 2019/20 Max Temp; ICs: Sep



Legend

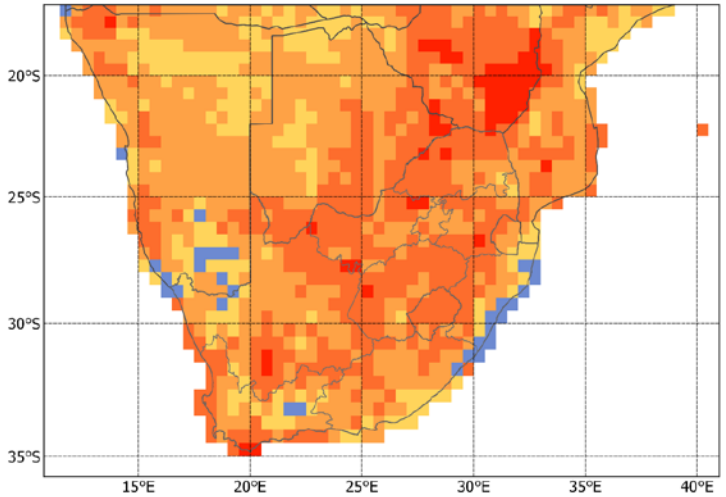
Catchment Area

Main Rivers

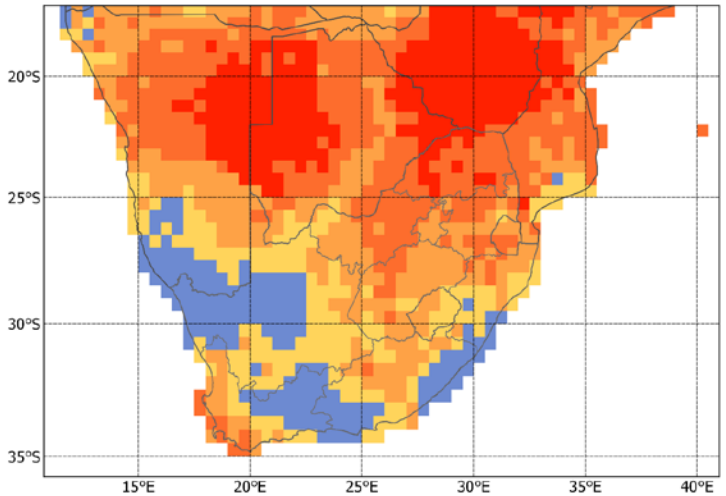
Max Temp Prob

>75	
70-75	
65-70	
60-65	
55-60	Above
50-55	Normal
45-50	
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	Below
55-60	Normal
60-65	
65-70	
70-75	
>75	

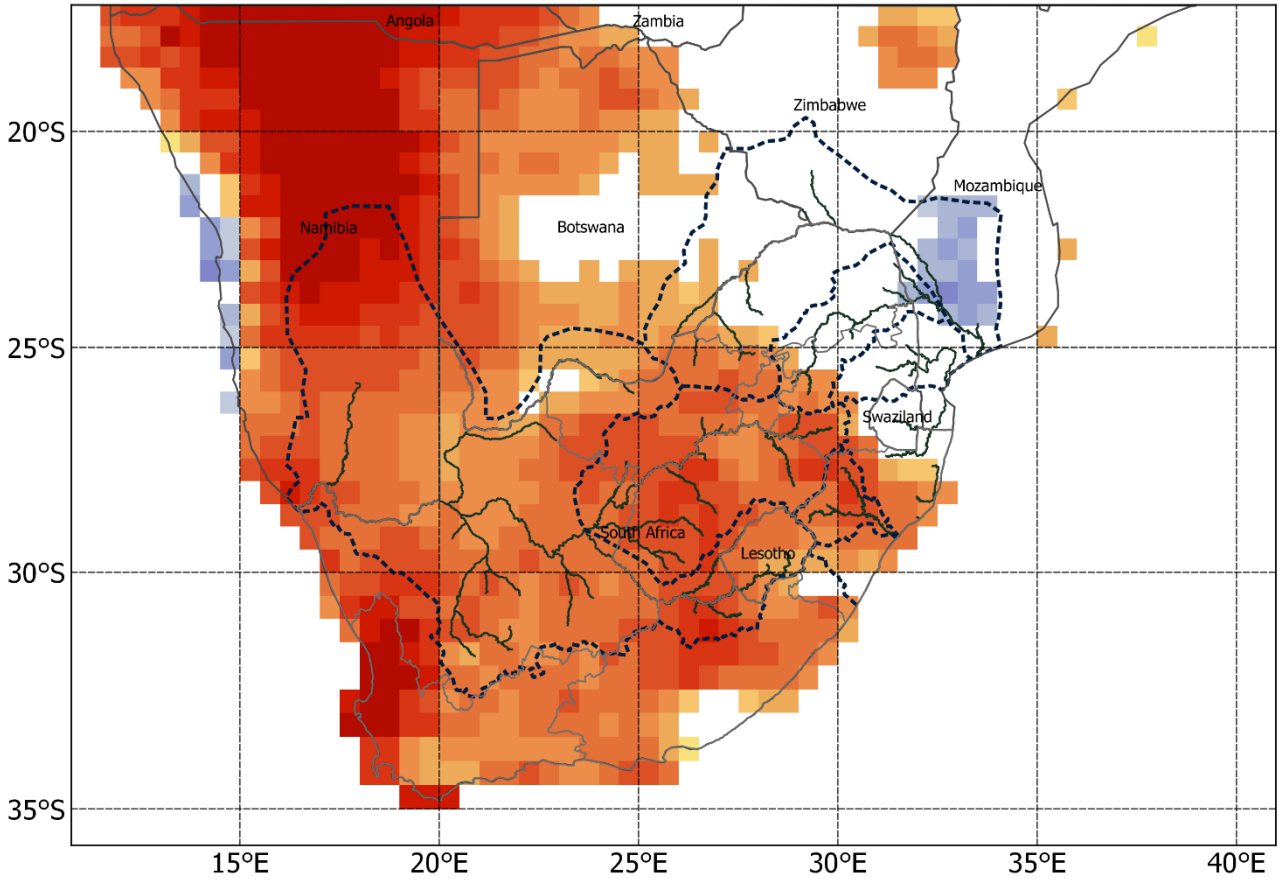
ROC Area (Above-Normal): NDJ Max Temp



ROC Area (Below-Normal): NDJ Max Temp



DJF 2019/20 Max Temp; ICs: Sep



Legend

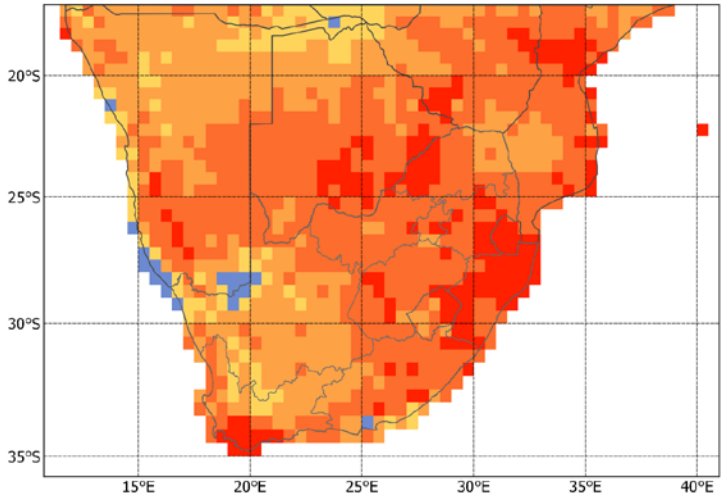
Catchment Area

Main Rivers

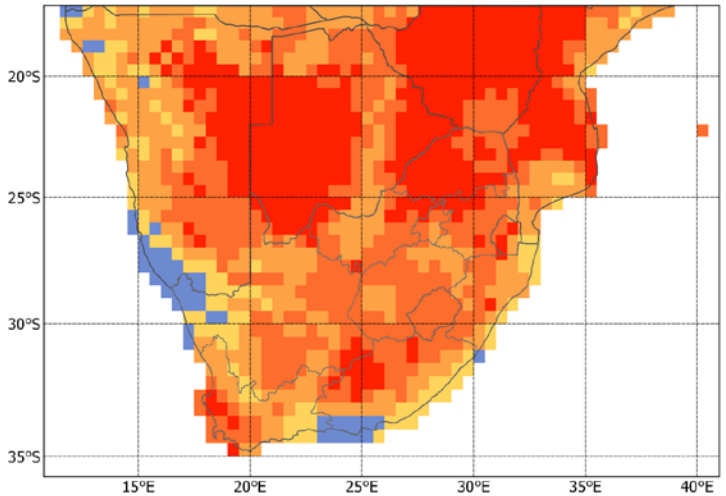
Max Temp Prob

>75	
70-75	
65-70	
60-65	
55-60	Above
50-55	Normal
45-50	
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	Below
55-60	Normal
60-65	
65-70	
70-75	
>75	

ROC Area (Above-Normal): DJF Max Temp



ROC Area (Below-Normal): DJF Max Temp



Round-up: SADC Max Temp

- Cool maximum temperatures are likely along the southern coastal parts during spring.
- High maximum temperatures may be expected during mid-summer over the larger part of the forecast region.

References

- Barnston, A.G. and Tippett, M.K., 2017: Do statistical pattern corrections improve seasonal climate predictions in the North American Multimodel Ensemble models? Journal of Climate, 30: 8335-8355. doi: 10.1175/JCLI-D-17-0054.1
- Harris, I., Jones, P. D., Osborn, T. J., and Lister, D. H., 2014: Updated high-resolution grids of monthly climatic observations - the CRU TS3.10 Dataset. International Journal of Climatology, 34: 623-642. doi: 10.1002/joc.3711
- Kirtman, B. P. and Co-authors 2014: The North American Multimodel Ensemble: Phase-1 seasonal-to-interannual prediction; Phase-2 toward developing intraseasonal prediction. Bulletin of the American Meteorological Society. 95, 585–601. doi: http://dx.doi.org/10.1175/BAMS-D-12-00050.1
- Landman, W.A., and Beraki, A., 2012: Multi-model forecast skill for midsummer rainfall over southern Africa. International Journal of Climatology, 32: 303-314. doi: 10.1002/joc.2273.
- Landman, W.A., Archer, E. and Tadross, M., 2016: Decision-relevant information on seasonal time scales – the case of a farm in northern Namibia. Conference Proceedings of the 32nd Annual Conference of the South African Society for Atmospheric Science, Cape Town, 31 October to 1 November 2016, pp 69-72. ISBN 978-0-620-72974-1.
- Landman, W.A., DeWitt, D., and Lee, D.-E., 2011: The high-resolution global SST forecast set of the CSIR. Conference Proceedings of the 27th Annual Conference of South African Society for Atmospheric Sciences, 22-23 September 2011, Hartbeespoort, North-West Province, South Africa. ISBN 978-0-620-50849-0
- Landman, W.A., DeWitt, D. Lee, D.-E., Beraki, A. and Lötter, D., 2012: Seasonal rainfall prediction skill over South Africa: 1- vs. 2-tiered forecasting systems. Weather and Forecasting, 27: 489-501. DOI: 10.1175/WAF-D-11-00078.1
- Muchuru, S., Landman, W.A. and DeWitt, D., 2016: Prediction of inflows into Lake Kariba using a combination of physical and empirical models. International Journal of Climatology, 36: 2570–2581, DOI: 10.1002/joc.4513.
- Troccoli, A., Harrison, M., Anderson, D.L.T. and Mason, S.J., 2008: Seasonal Climate: Forecasting and Managing Risk. NATO Science Series on Earth and Environmental Sciences, Vol. 82, Springer, 467 pp.

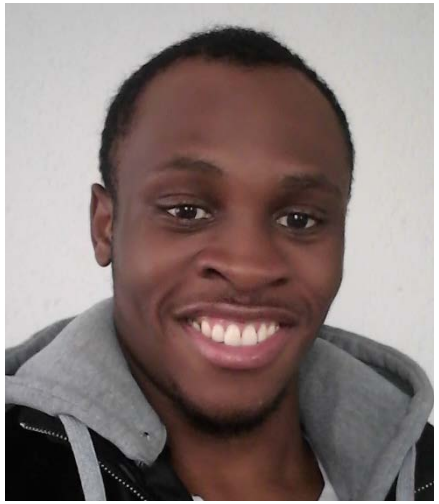
Financial support from…

- The National Research Foundation through the Incentive Funding for Rated Researchers

- ACCESS (Alliance for Collaboration on Climate and Earth System Science) through the project “Investigating predictability of seasonal anomalies for societal benefit”

Student participation in forecast system development

Stephanie Hinze, BSc (Honours)(Meteorology):
Statistical downscaling using large and high-resolution data sets, forecast displays for SADC rainfall and maximum temperatures, forecast verification



Surprise Mhlongo, BSc (Honours)(Meteorology):
Improving on SST forecast system through pattern correction, correlation vs covariance approaches, forecast output combination (multi-model approaches), mean and bias correction, and correct for skill