Seasonal forecasts

presented by:

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https://tinyurl.com/ybrb3a72

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Seasonal Forecast Worx

Latest Update: 15 January 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 for southern Africa?

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

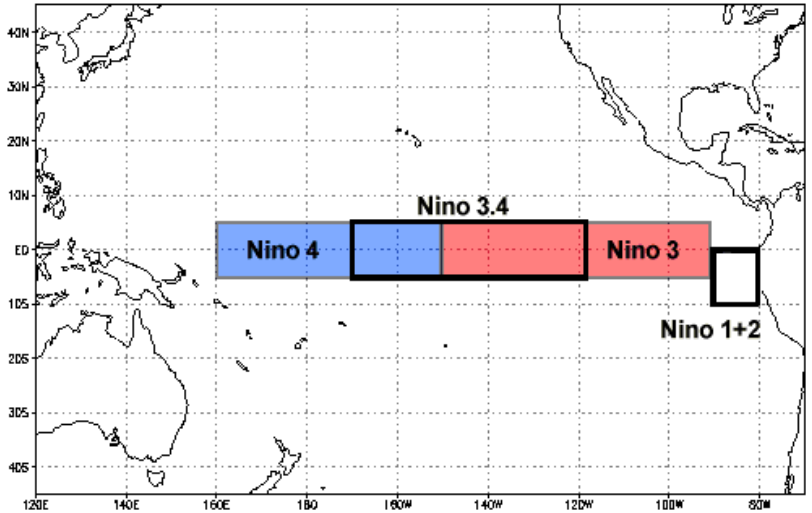
- For the official seasonal forecast for South Africa, visit the South African Weather Service website at http://www.weathersa.co.za/home/seasonal

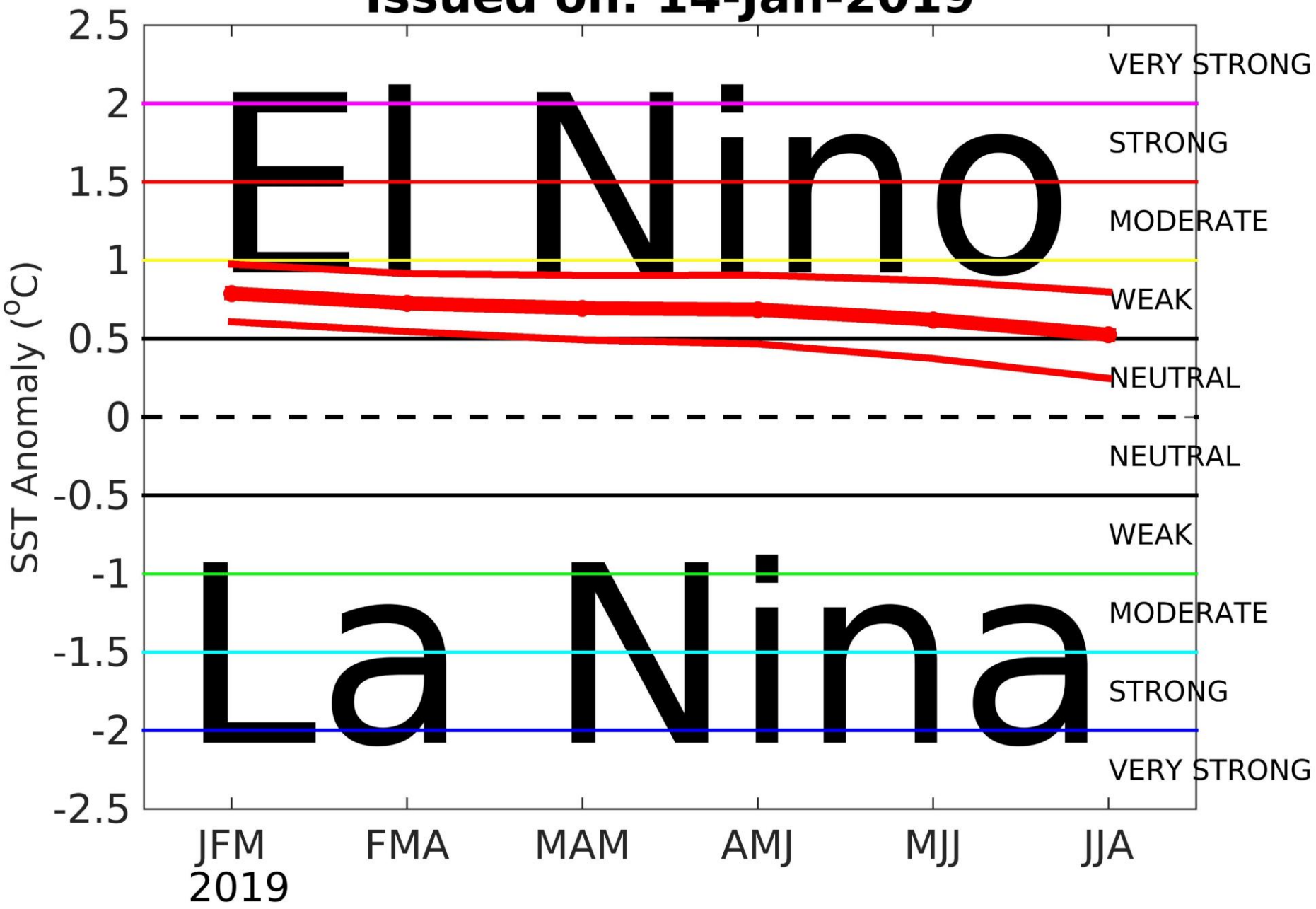
South African Weather Service
ISO 9001 Certified Organisation

ENSO and Global SST Forecasts

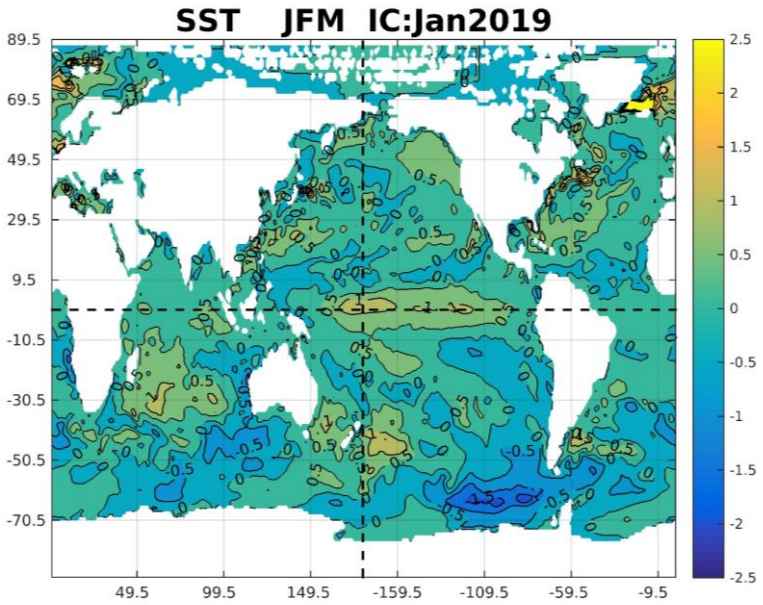
Prediction Method

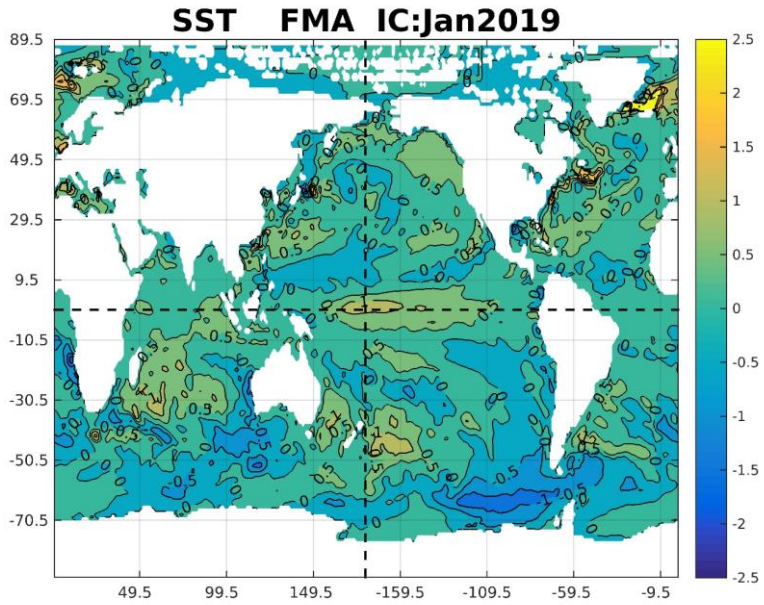
- Forecasts for global sea-surface temperature (SST) fields are obtained through a combination of NMME models and a linear statistical model that uses antecedent SST as predictor (Landman et al. 2011). Forecasts for the Niño3.4 area (see insert) are derived from the global forecasts.
- Three-month Niño3.4 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

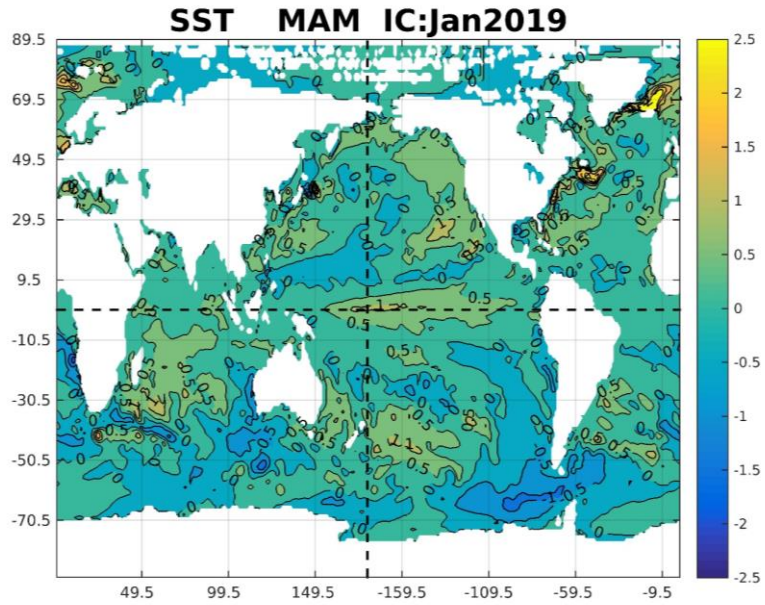


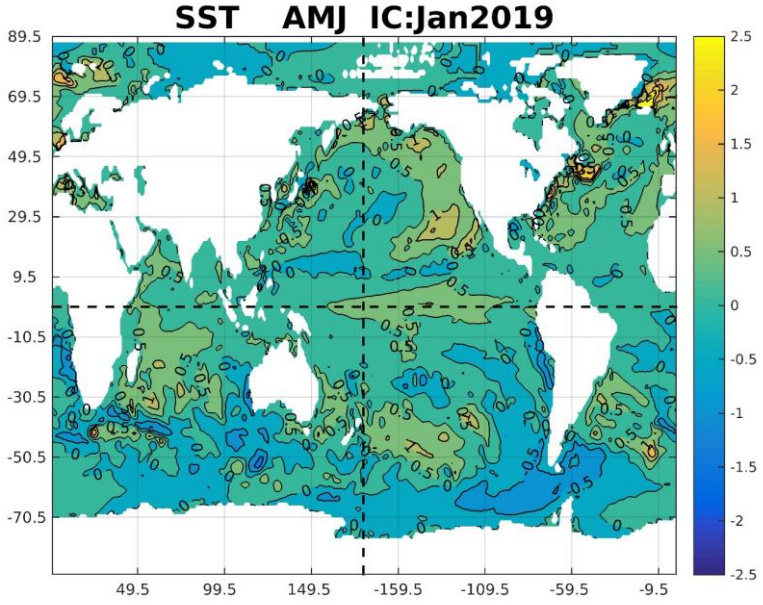

CSiriMM Nino3.4 SST Forecast
Issued on: 14-Jan-2019
SST Anomaly (°C)
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
El Nino
La Nina
VERY STRONG
STRONG
MODERATE
WEAK
NEUTRAL
NEUTRAL
WEAK
MODERATE
STRONG
VERY STRONG
JFM
2019
FMA
MAM
AMJ
MJJ
JJA

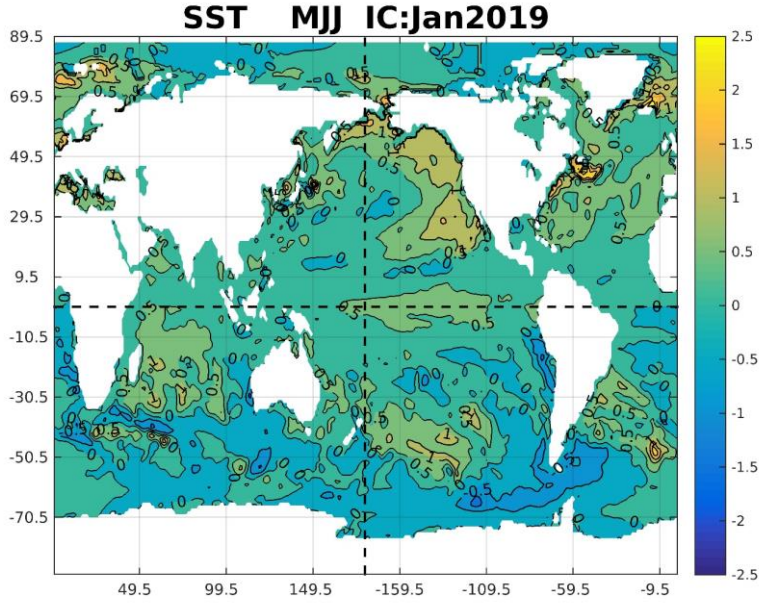
SST anomalies

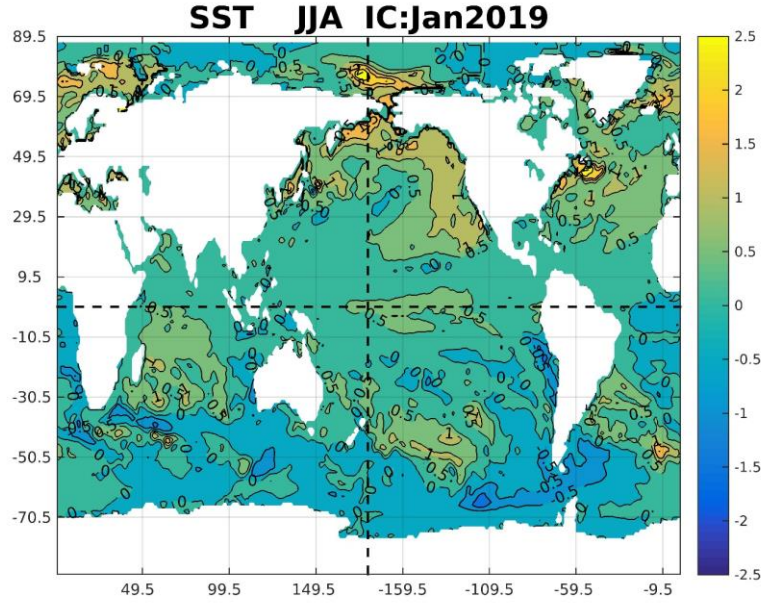












Round-up: ENSO

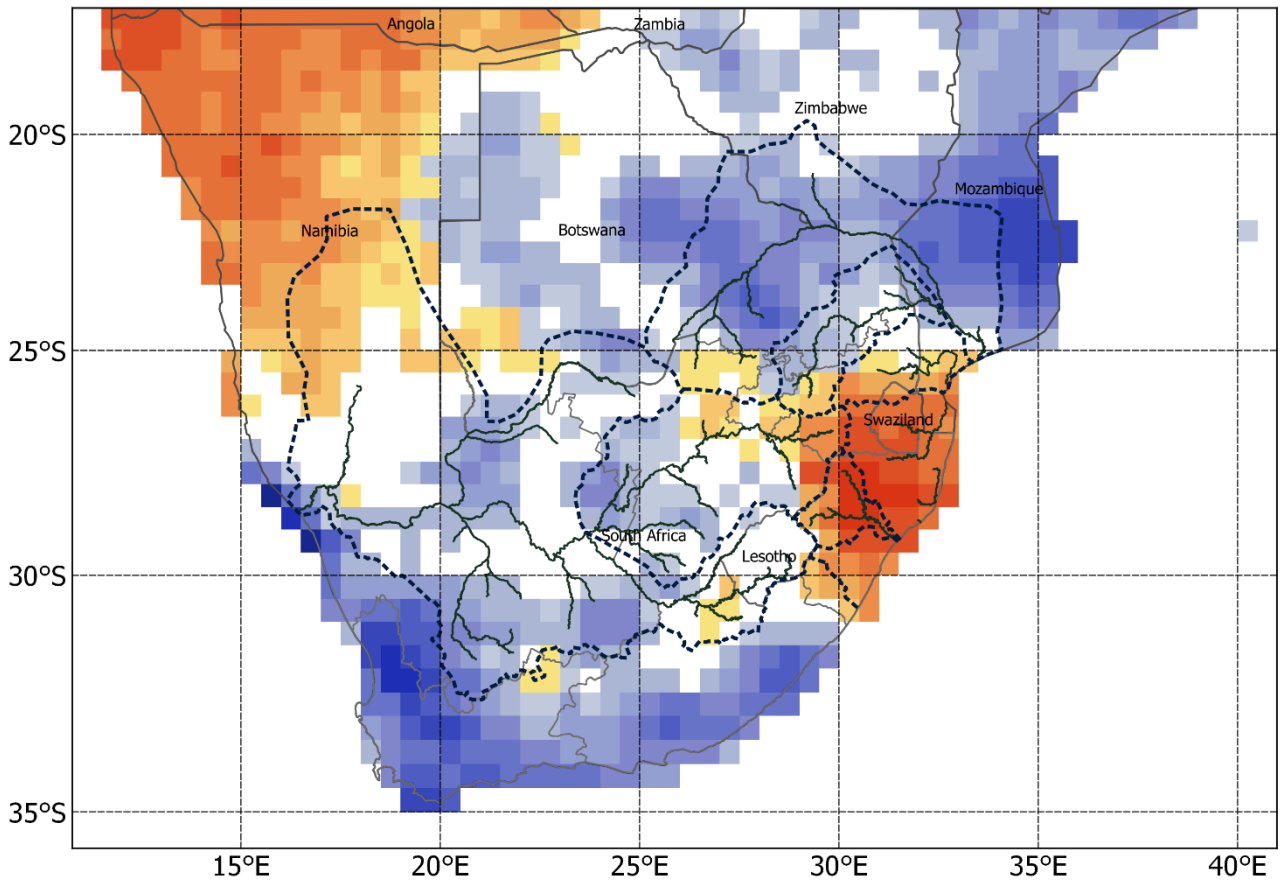
- Weak El Niño into winter

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.

JFM 2019 Rainfall; ICs: Jan



Legend

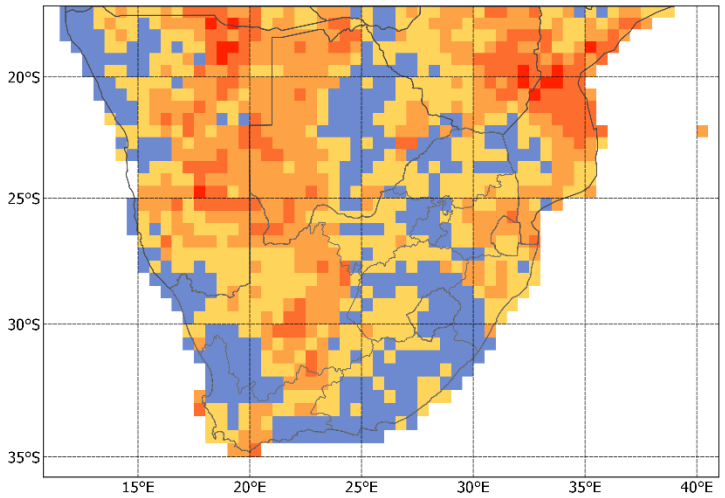
Catchment Area

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): JFM Rainfall

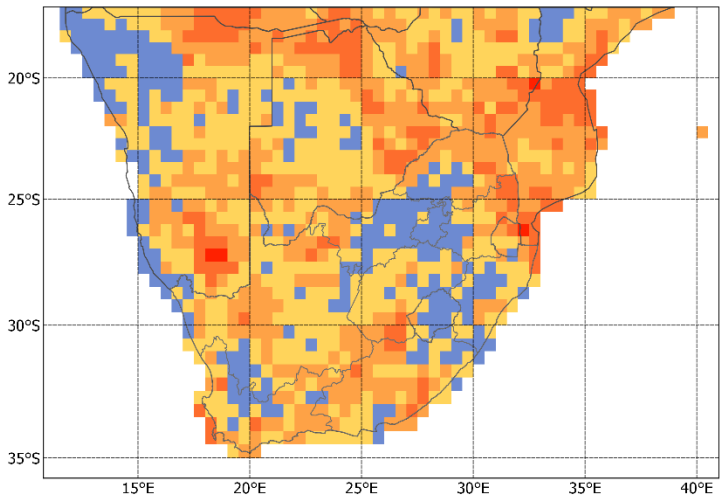


Legend

ROC

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

ROC Area (Below-Normal): JFM Rainfall



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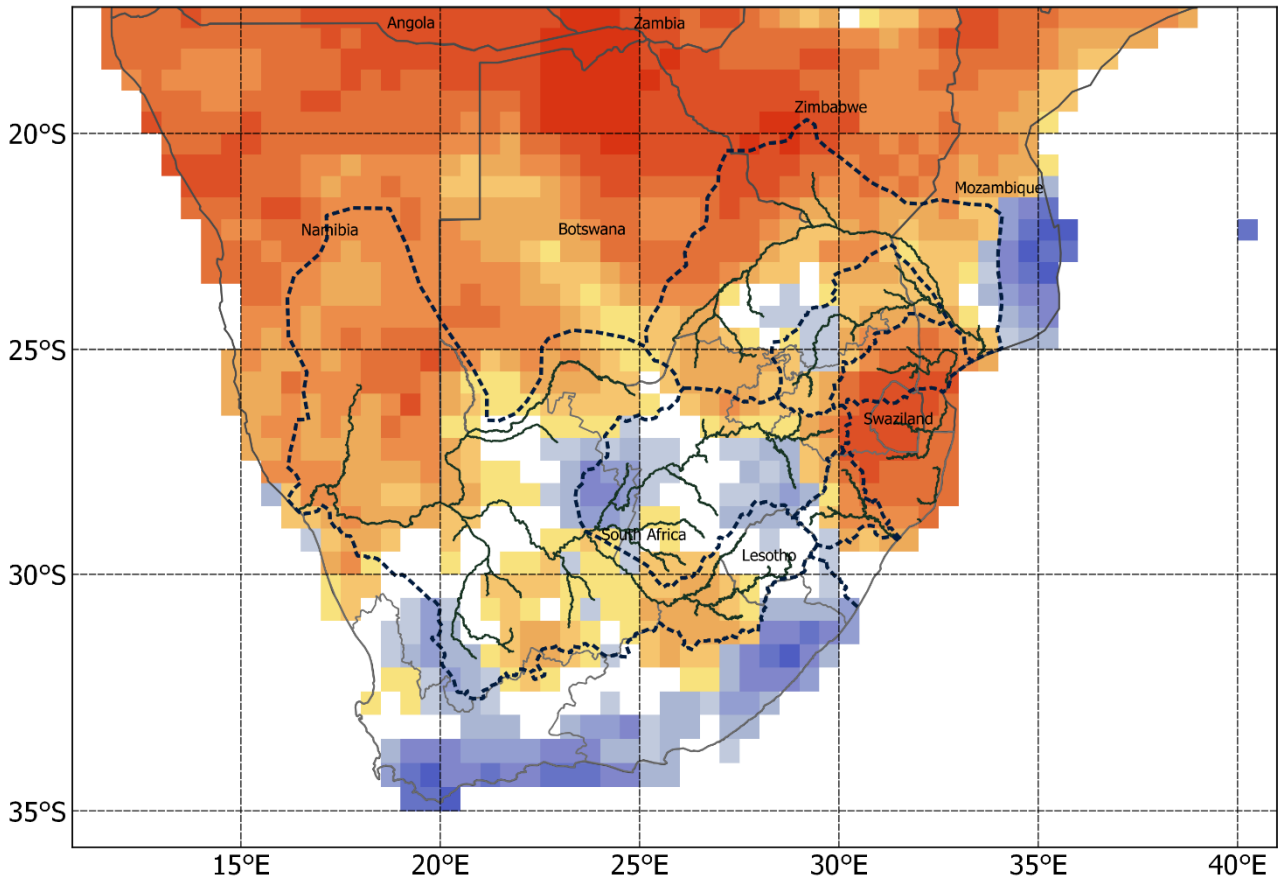
ROC

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

FMA 2019 Rainfall; ICs: Jan



Legend

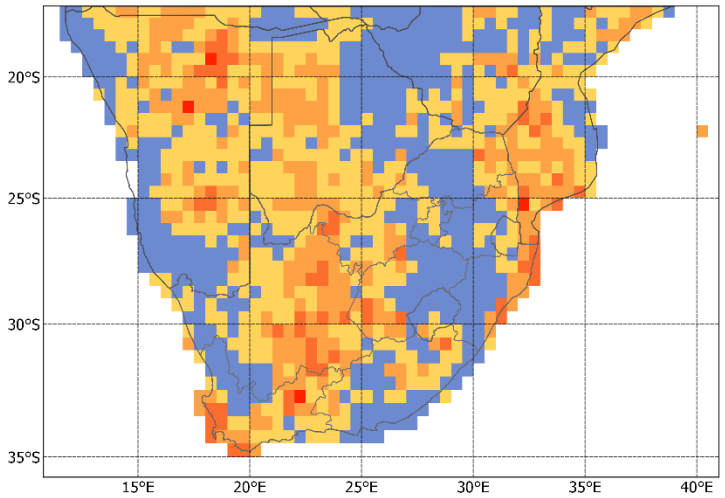
Catchment Area

Main Rivers

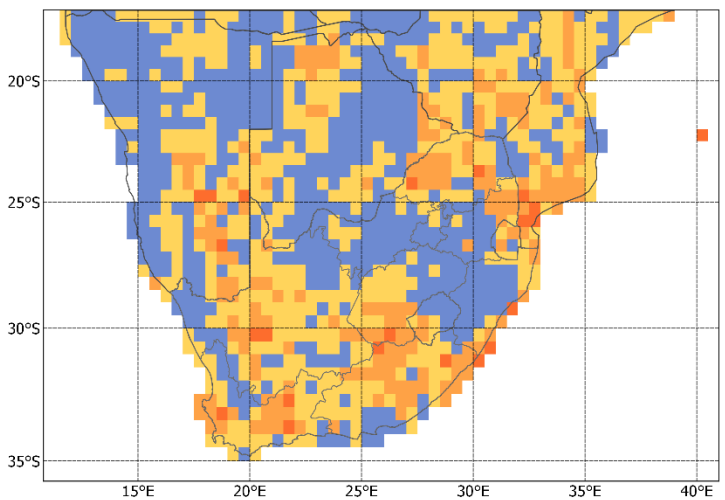
Rainfall Prob

>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	

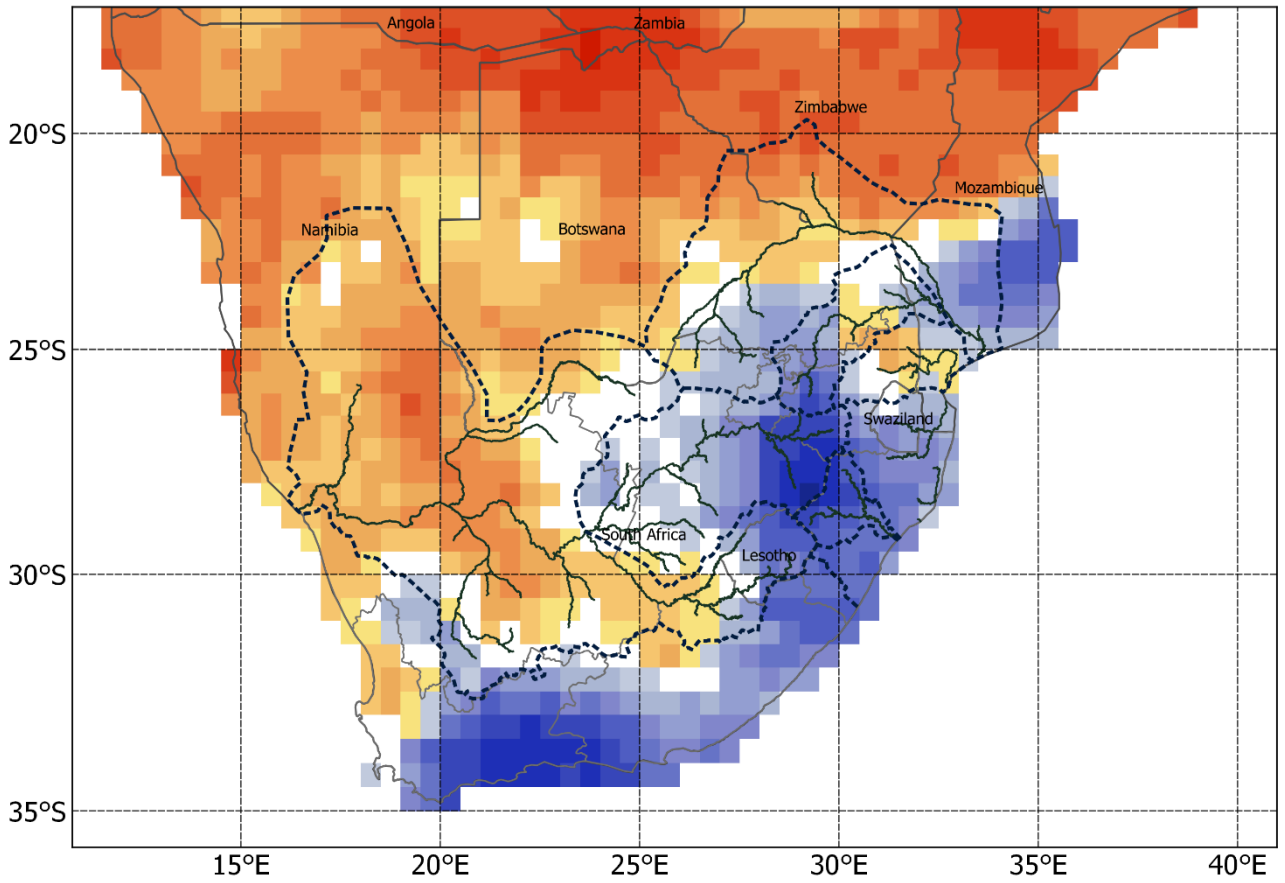
ROC Area (Above-Normal): FMA Rainfall



ROC Area (Below-Normal): FMA Rainfall



MAM 2019 Rainfall; ICs: Jan



Legend

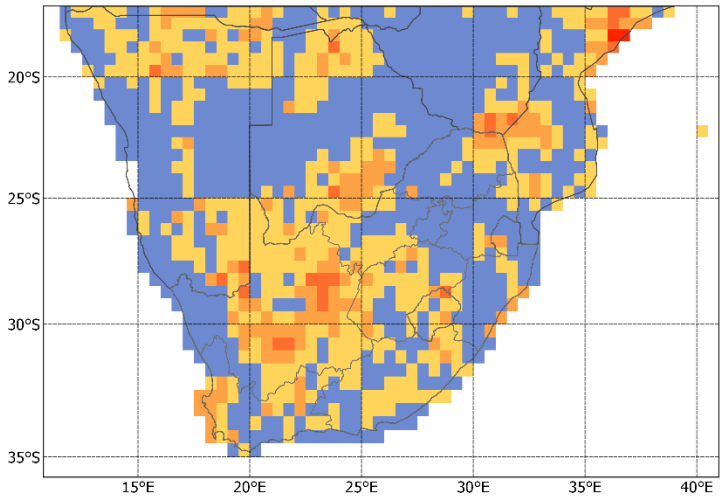
Catchment Area

Main Rivers

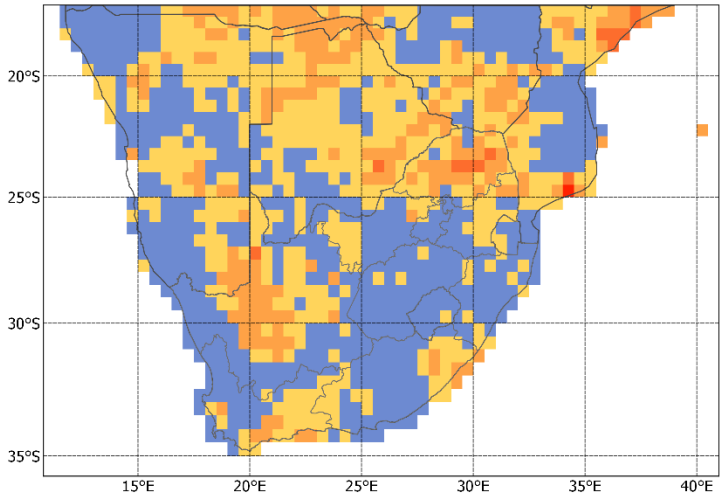
Rainfall Prob

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

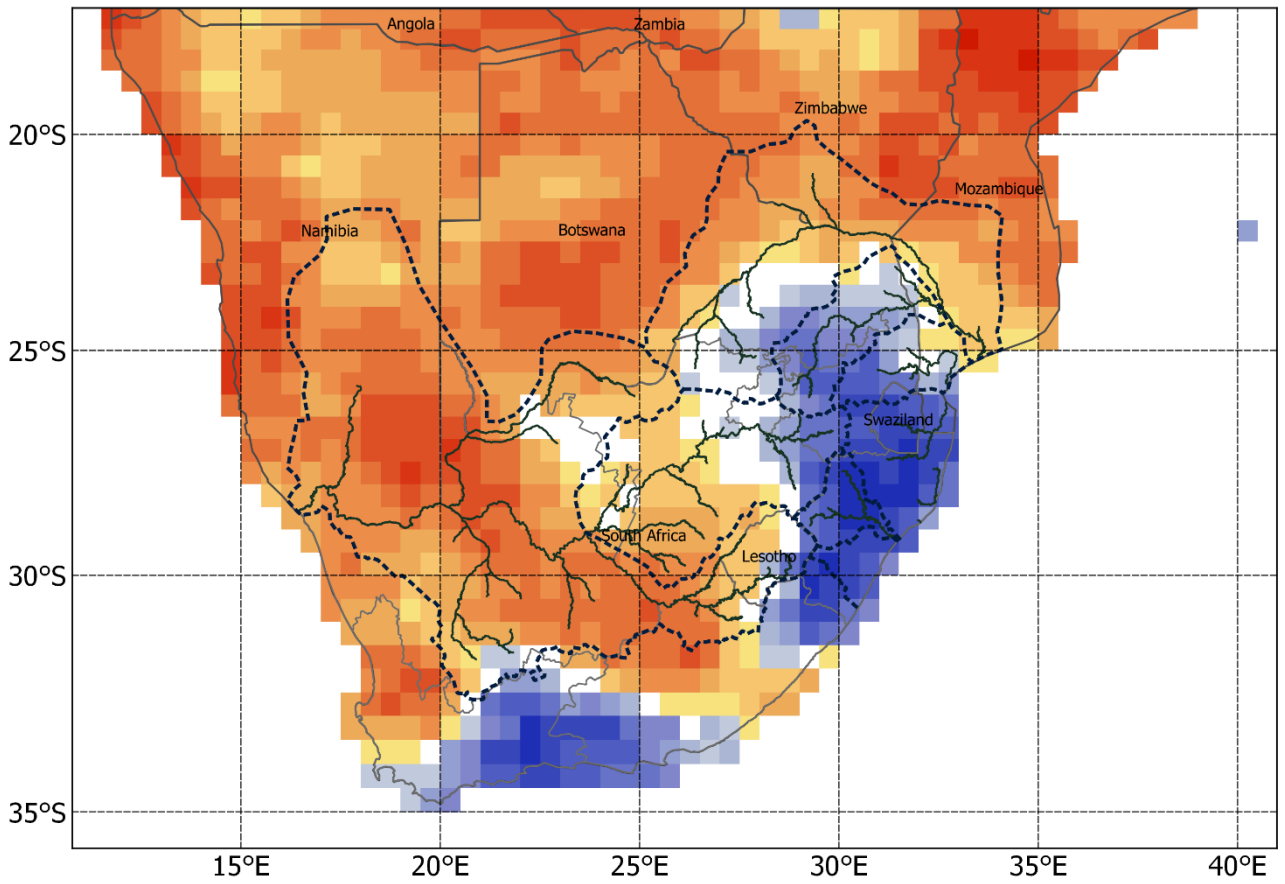
ROC Area (Above-Normal): MAM Rainfall



ROC Area (Below-Normal): MAM Rainfall



AMJ 2019 Rainfall; ICs: Jan



Legend

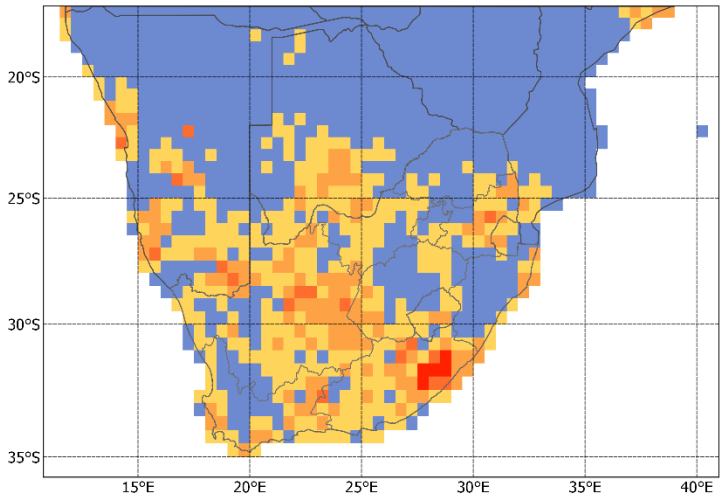
Catchment Area

Main Rivers

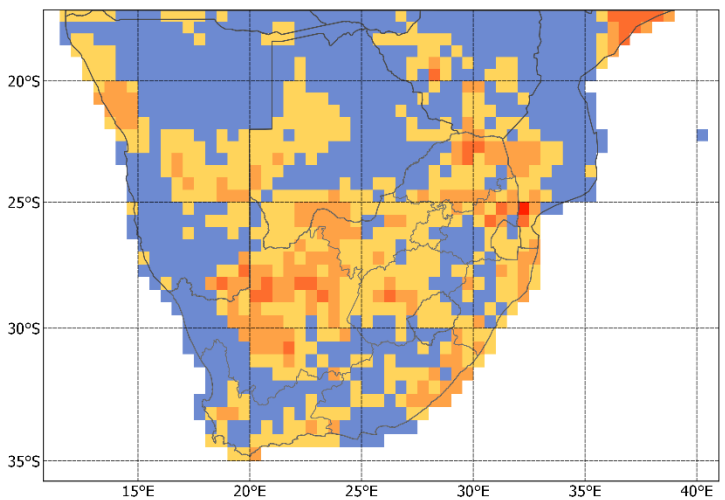
Rainfall Prob

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

ROC Area (Above-Normal): AMJ Rainfall



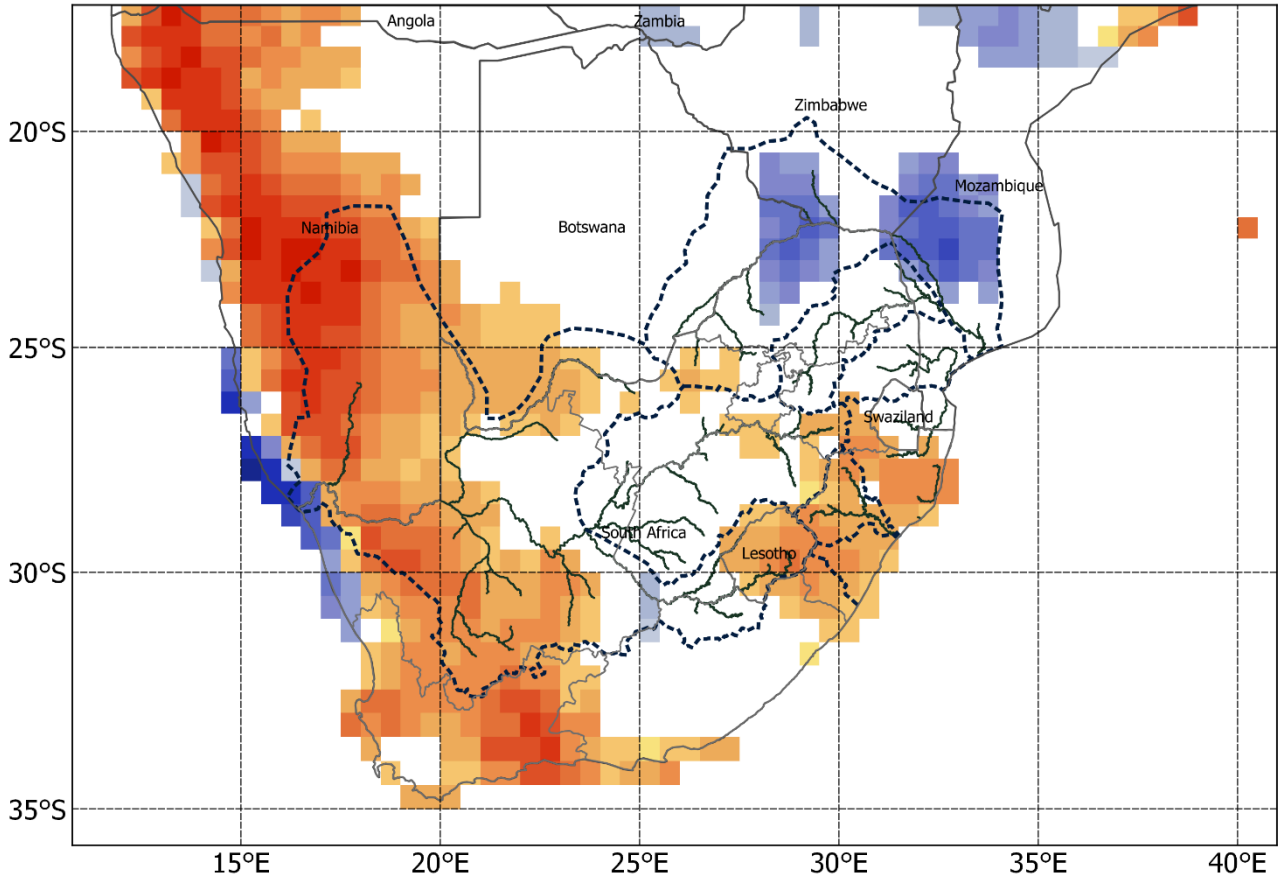
ROC Area (Below-Normal): AMJ Rainfall



Round-up: SADC Rainfall

- The forecasts do not show a typical El Niño-type rainfall pattern of mainly below-normal rainfall totals.
- Excerpt from CPC's ENSO advisory: …*weak El Niño conditions will emerge shortly. However, given the timing and that a weak event is favored, significant global impacts are not anticipated during the remainder of (Northern Hemisphere) winter, even if conditions were to form.*

JFM 2019 Max Temp; ICs: Jan



Legend

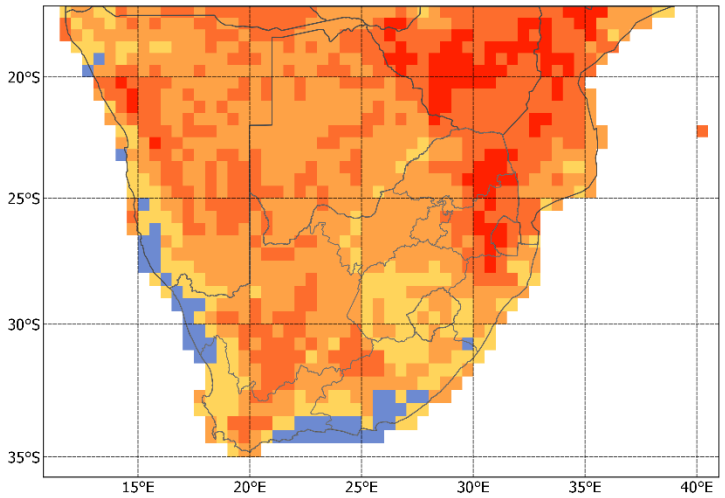
Catchment Area

Main Rivers

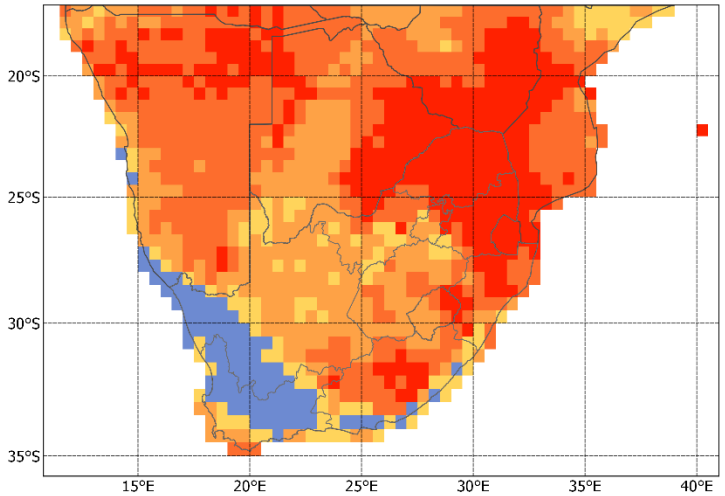
Max Temp Prob

>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	Below
60-65	
65-70	
70-75	
>75	

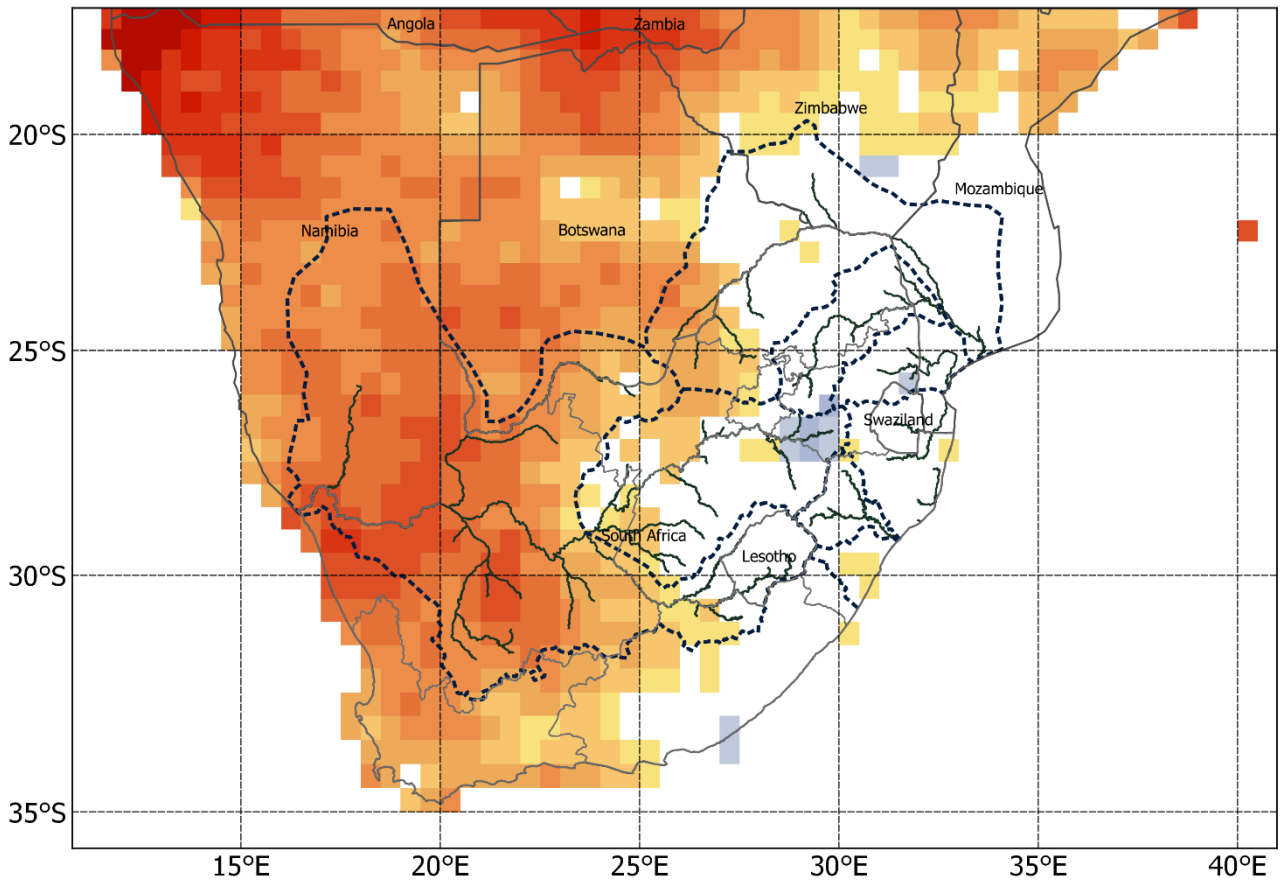
ROC Area (Above-Normal): JFM Max Temp



ROC Area (Below-Normal): JFM Max Temp



FMA 2019 Max Temp; ICs: Jan



Legend

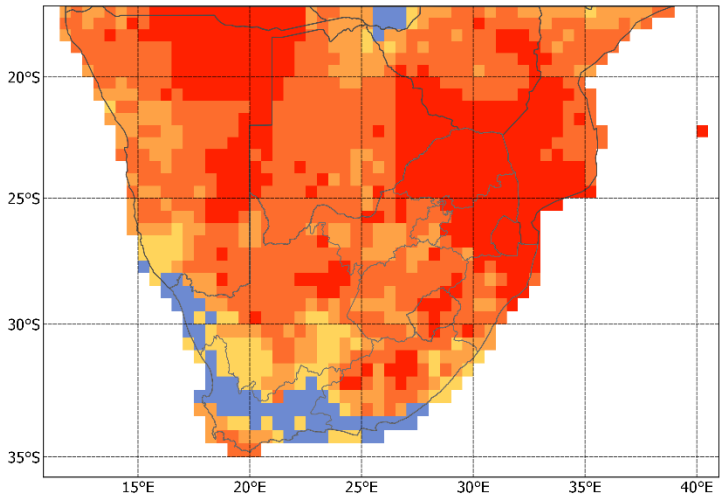
Catchment Area

Main Rivers

Max Temp Prob

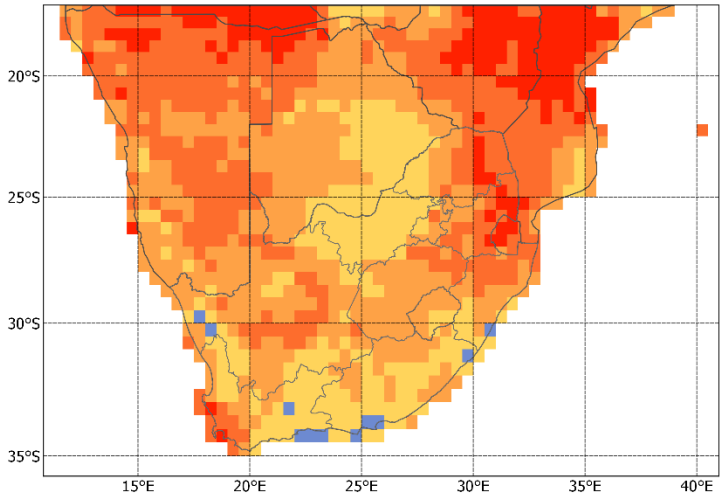
>75
70-75
65-70
60-65
55-60 Above
50-55 Normal
45-50
40-45
35-40
35-40
40-45
45-50
50-55 Below
55-60 Below
60-65
65-70
70-75
>75

ROC Area (Above-Normal): FMA Max Temp



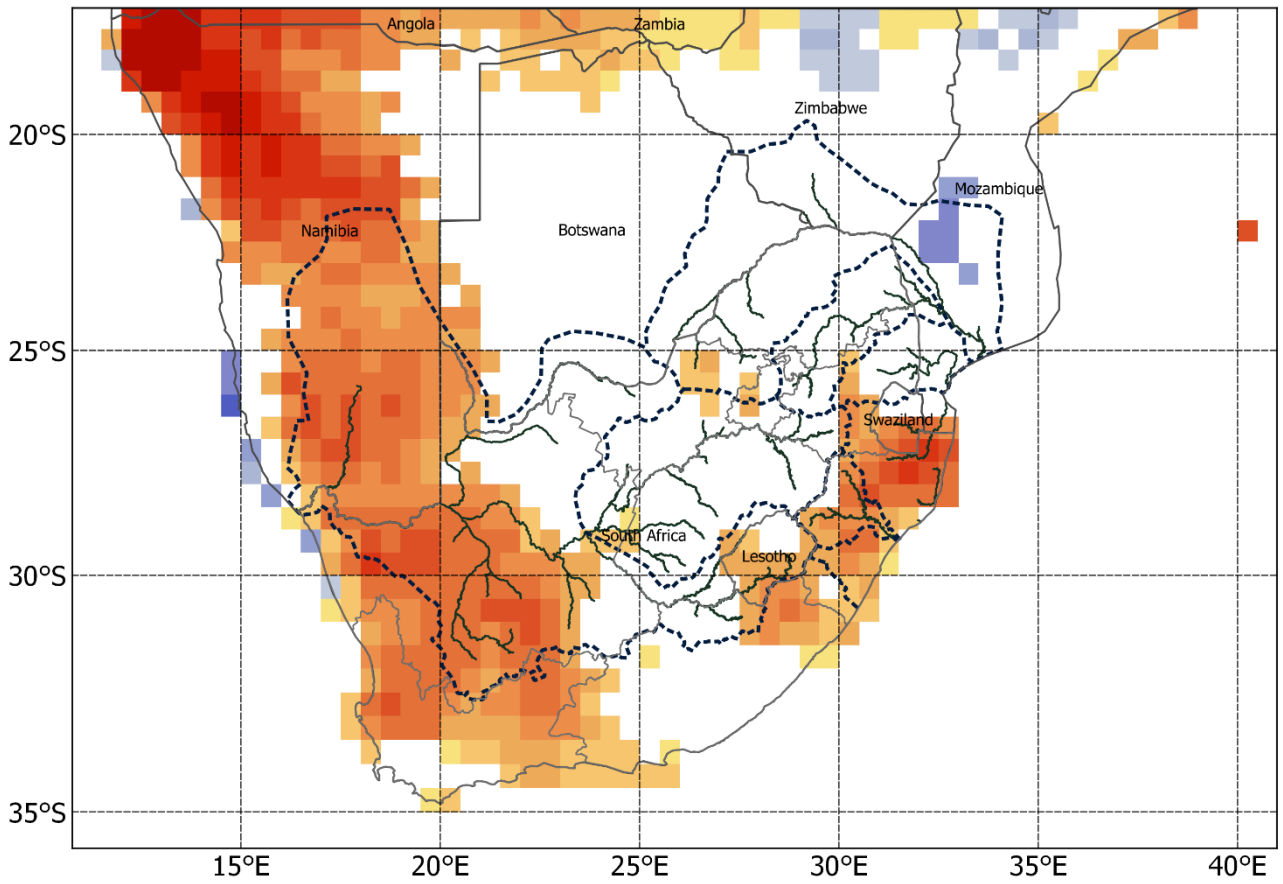
Legend
ROC
> 0.8
0.8 - 0.7
0.7 - 0.6
0.6 - 0.5
<= 0.5

ROC Area (Below-Normal): FMA Max Temp



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

MAM 2019 Max Temp; ICs: Jan



Legend

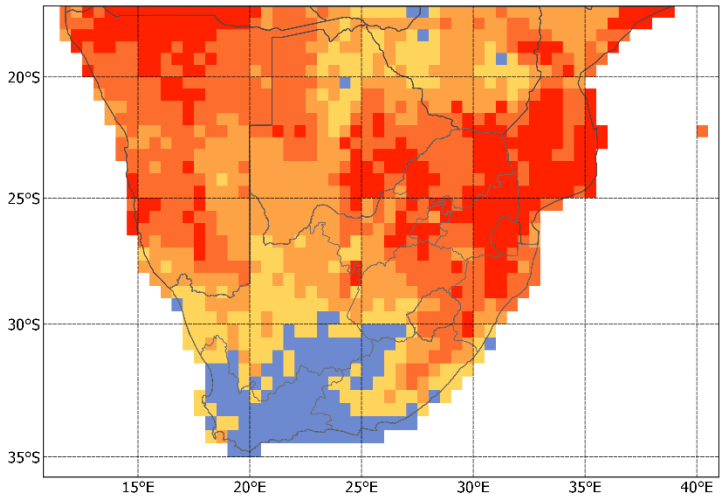
Catchment Area

Main Rivers

Max Temp Prob

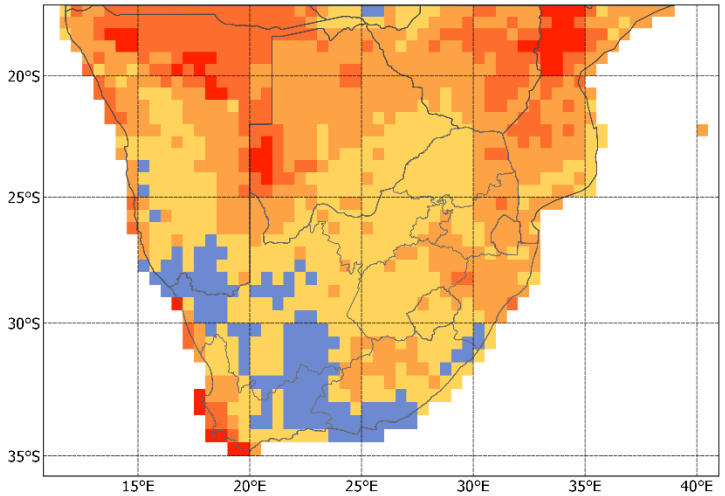
>75
70-75
65-70
60-65
55-60 Above
50-55 Normal
45-50
40-45
35-40
35-40
40-45
45-50
50-55 Below
55-60 Below
60-65
65-70
70-75
>75

ROC Area (Above-Normal): MAM Max Temp



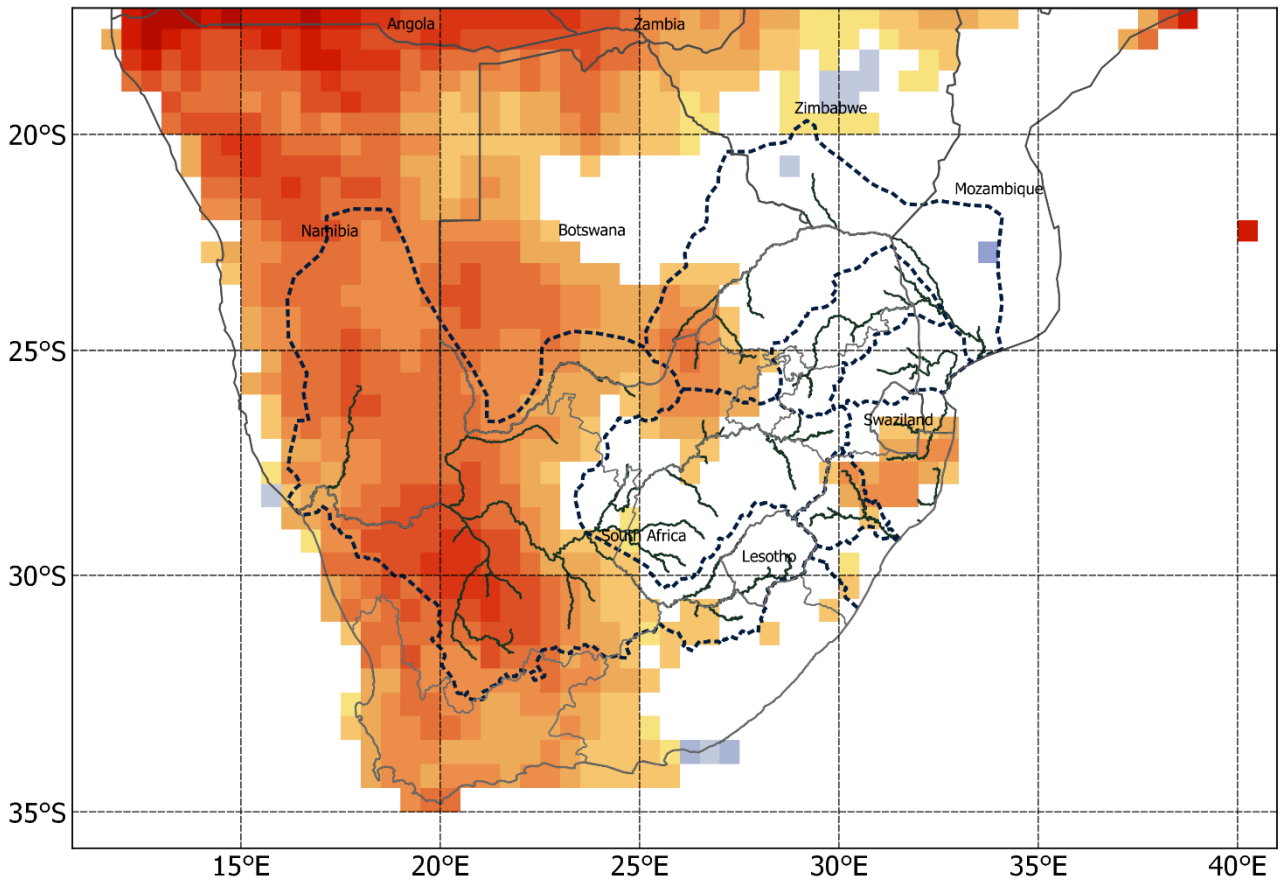
Legend
ROC
> 0.8
0.8 - 0.7
0.7 - 0.6
0.6 - 0.5
<= 0.5

ROC Area (Below-Normal): MAM Max Temp



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

AMJ 2019 Max Temp; ICs: Jan



Legend

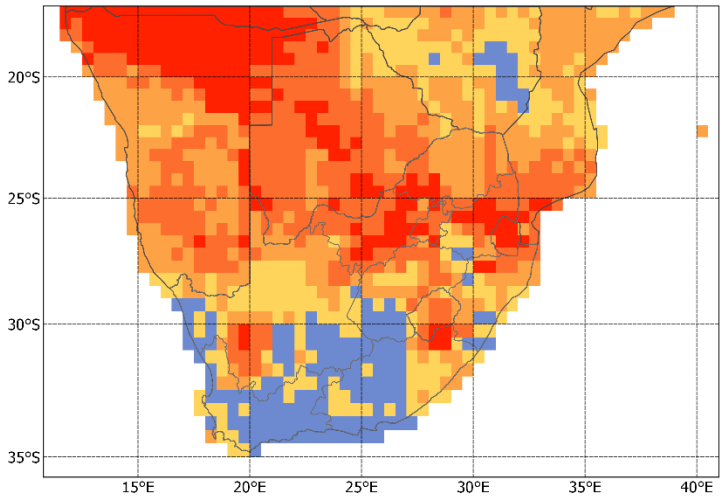
Catchment Area

Main Rivers

Max Temp Prob

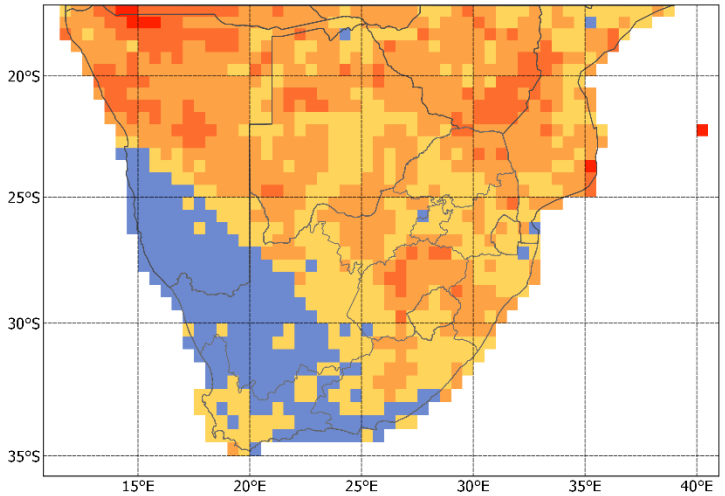
>75
70-75
65-70
60-65
55-60 Above
50-55 Normal
45-50
40-45
35-40
35-40
40-45
45-50
50-55 Below
55-60 Below
60-65
65-70
70-75
>75

ROC Area (Above-Normal): AMJ Max Temp



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

ROC Area (Below-Normal): AMJ Max Temp



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

Round-up: SADC Max Temp

- Predominantly high maximum temperatures are expected over the western half of the region.

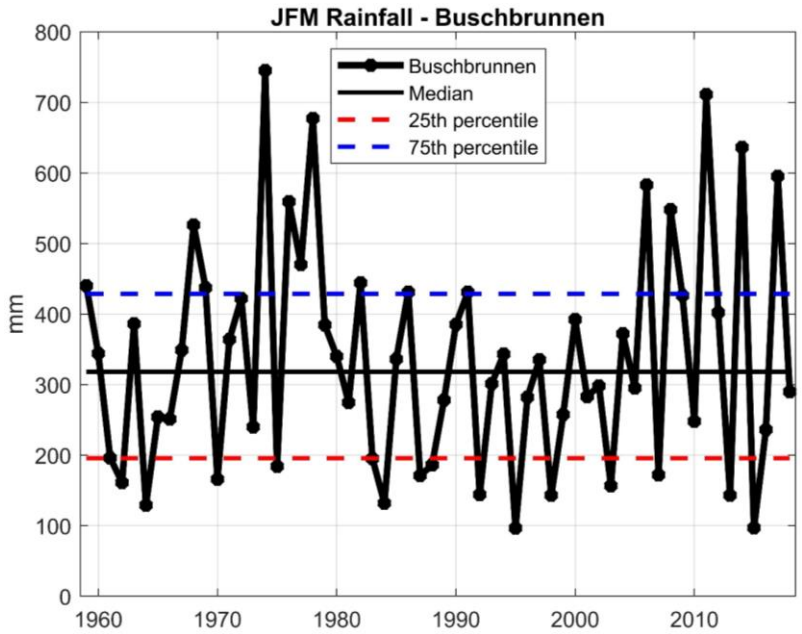
Tailored Forecasts

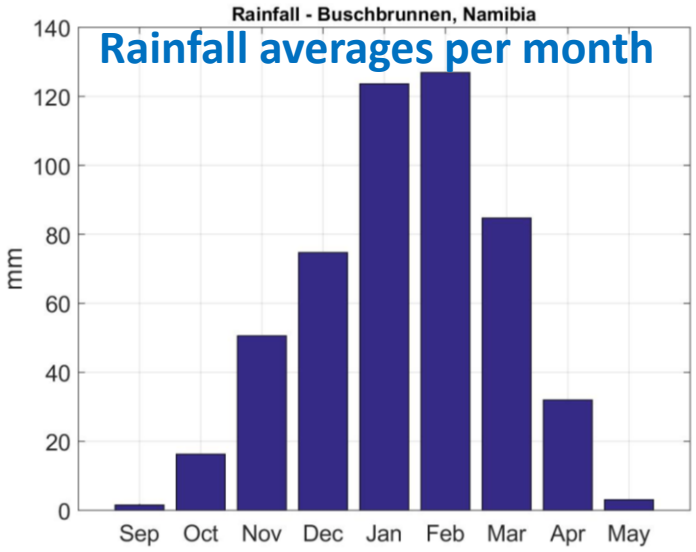
1. **Probability of exceedance Jan-Feb-Mar 2019 rainfall forecast for the farm Buschbrunnen near Grootfontein, Namibia**
2. **Probability of exceedance Mar-Apr-May 2019 inflow forecast for Lake Kariba, Zambia/Zimbabwe**
3. **Probabilistic three-category malaria forecast for Limpopo for Jan-Feb-Mar 2019**

Data and forecasts for the farm Buschbrunnen near Grootfontein, Namibia

Landman et al (2016)

JFM total rainfall as recorded by the farmer



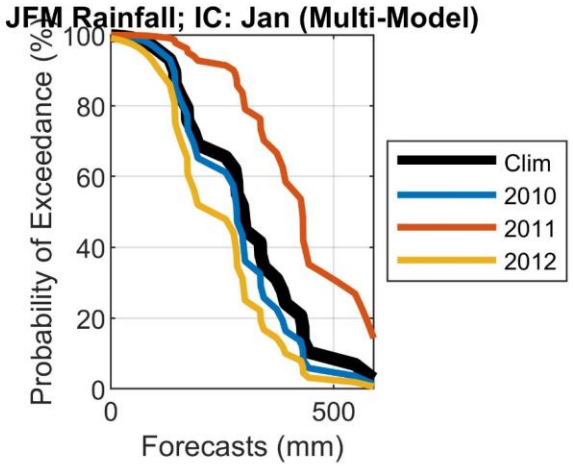


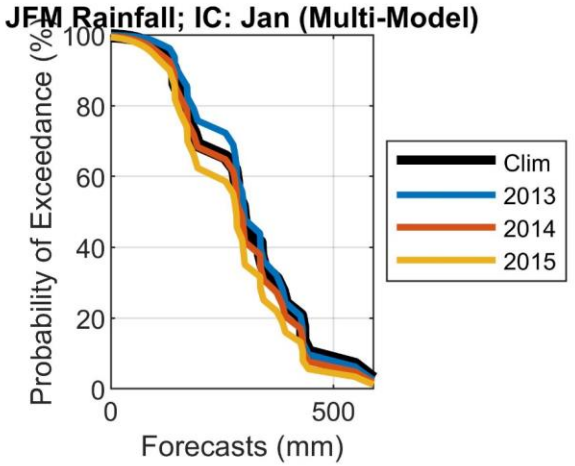
Rainfall averages per month

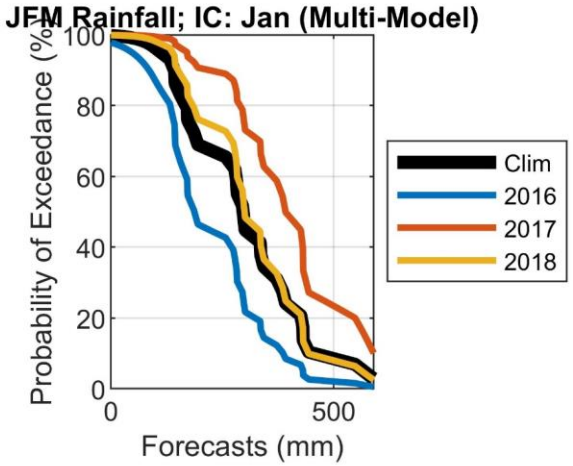
The multi-model:

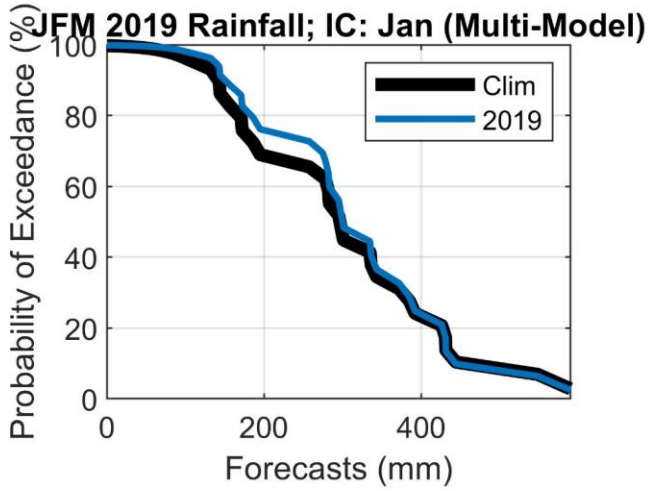
1. GFDL-CM2p5-FLOR-B01
2. COLA-RSMAS-CCSM4

Forecasts made in JANUARY





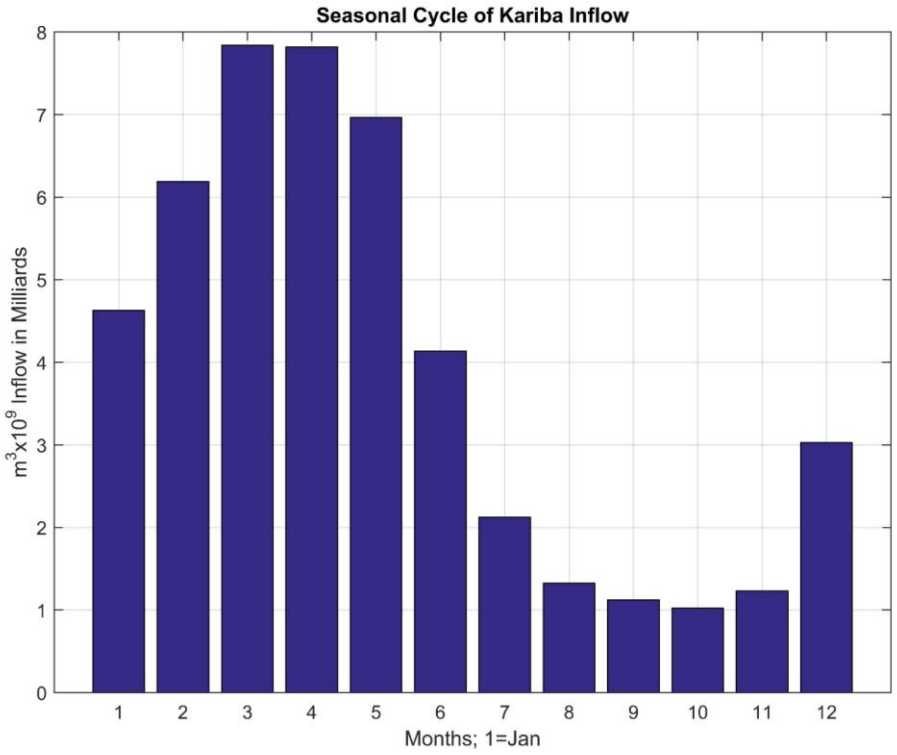


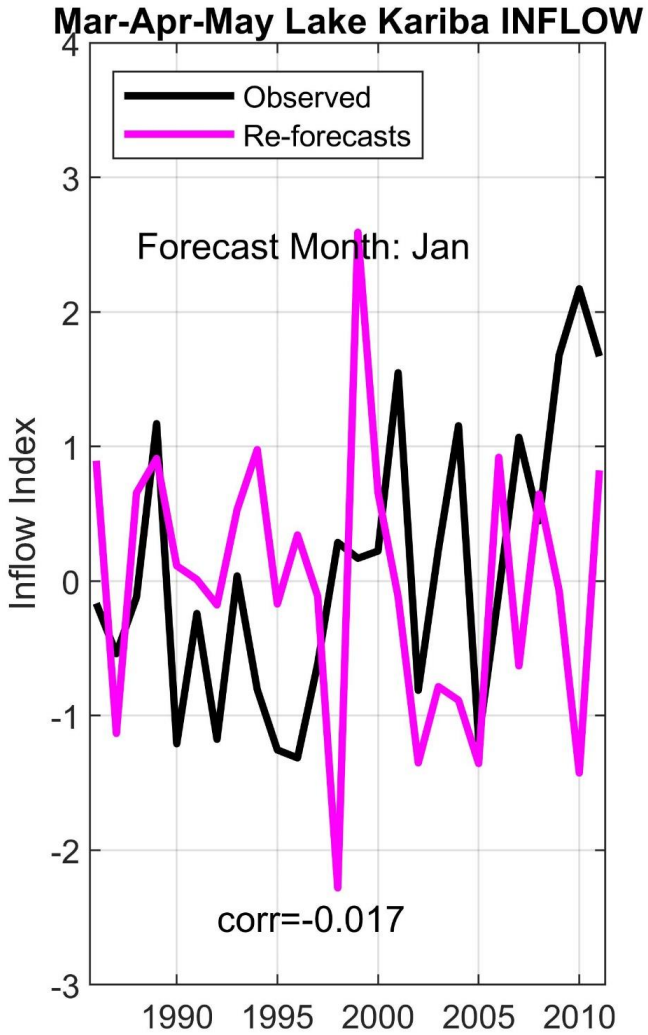


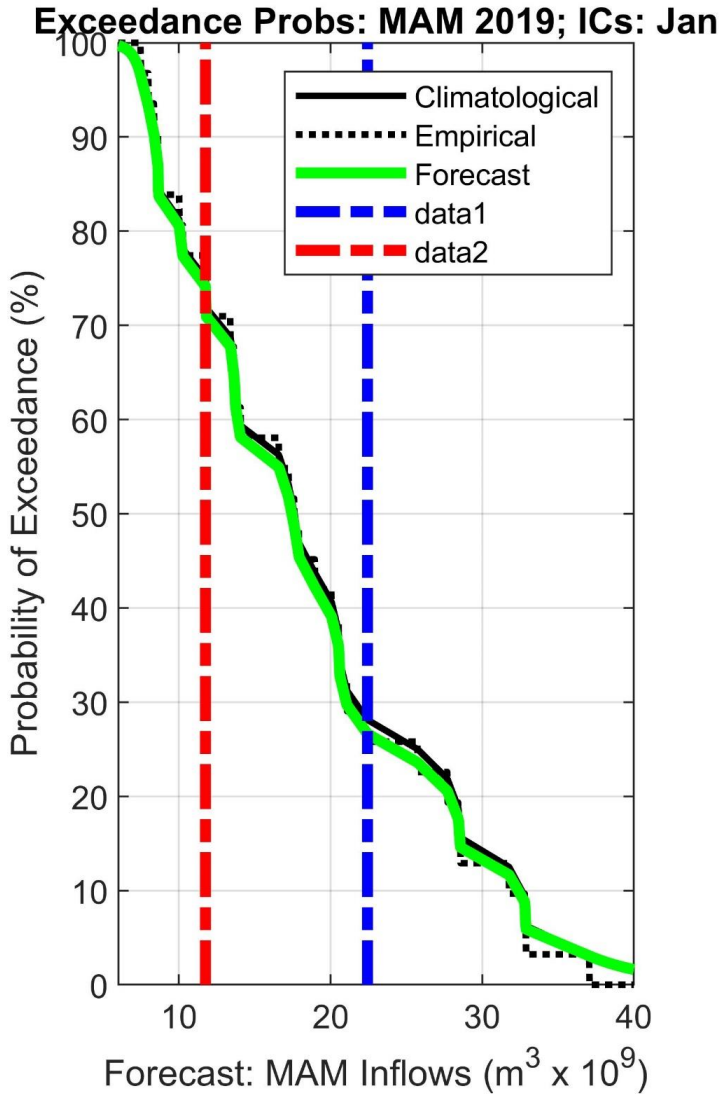
Re-forecasts of JFM rainfall outcomes for 2010-2018, and real-time forecast for JFM 2019

Inflow forecast for Lake Kariba: onset season of MAM

Muchuru et al. (2016)

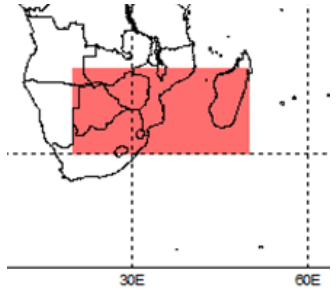


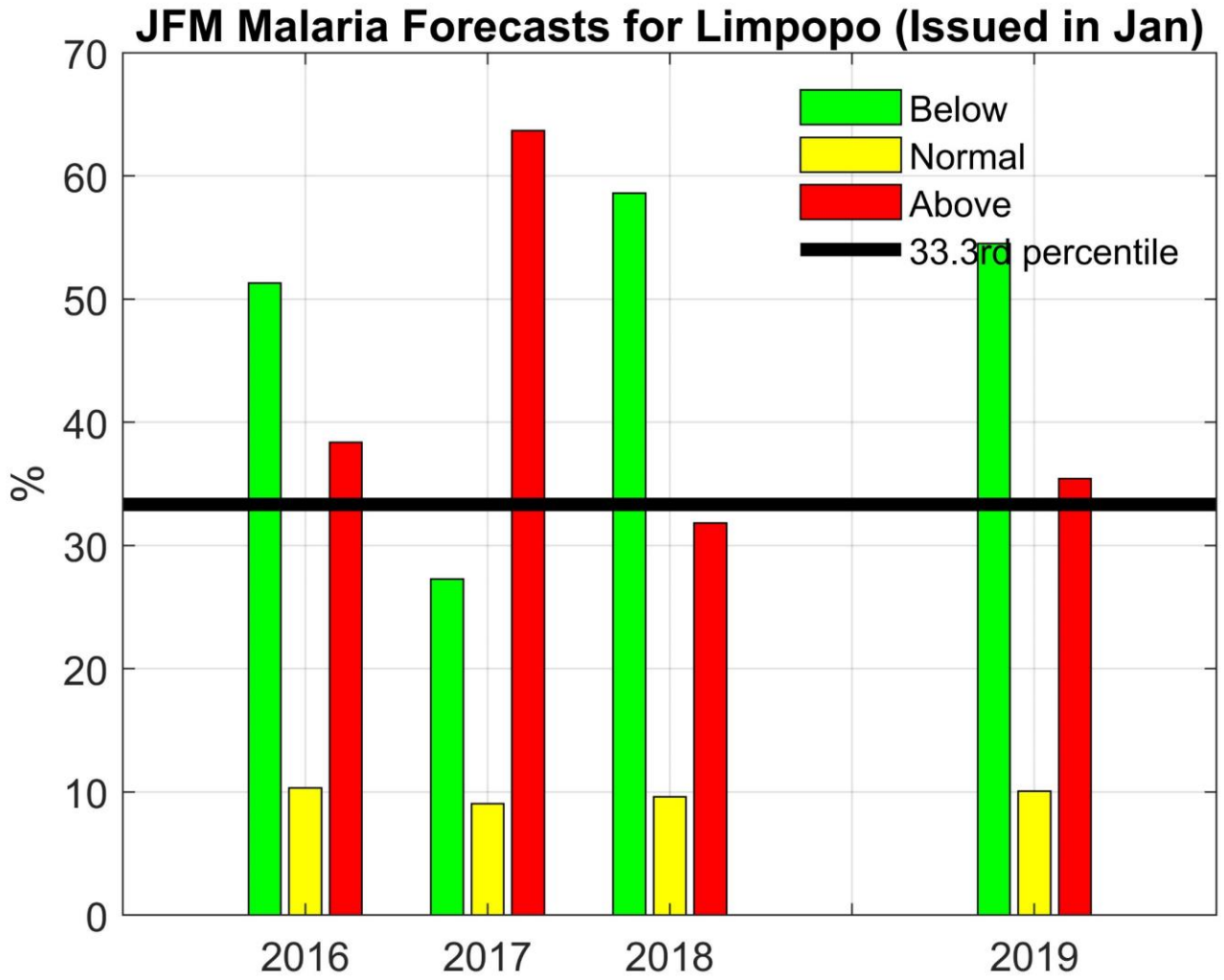




Malaria forecasts
(VERY experimental and unofficial)

Malaria cases for the Limpopo Province were obtained from their Department of Health. Taking the natural logs (ln) of the seasonal malaria data resulted in the data to become normally distributed (Lilliefors test shows that the transformed data are from a normal distribution). The seasonal rainfall hindcasts and the 2019 real-time forecast from the GFDL coupled model are statistically downscaled to JFM malaria values. The canonical modes of the rainfall forecasts (see insert showing the predictor area) are used in a multiple linear aggression model as predictors.





Retrospective **REAL-TIME**

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National Research Foundation

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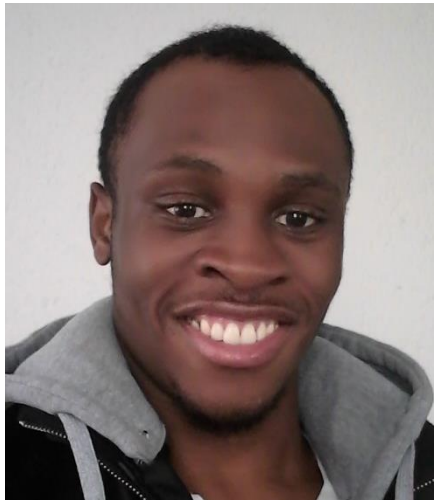
Student participation in forecast system development

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