

# Seasonal forecasts

presented by:

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<https://tinyurl.com/ybrb3a72>



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# Seasonal Forecast Worx

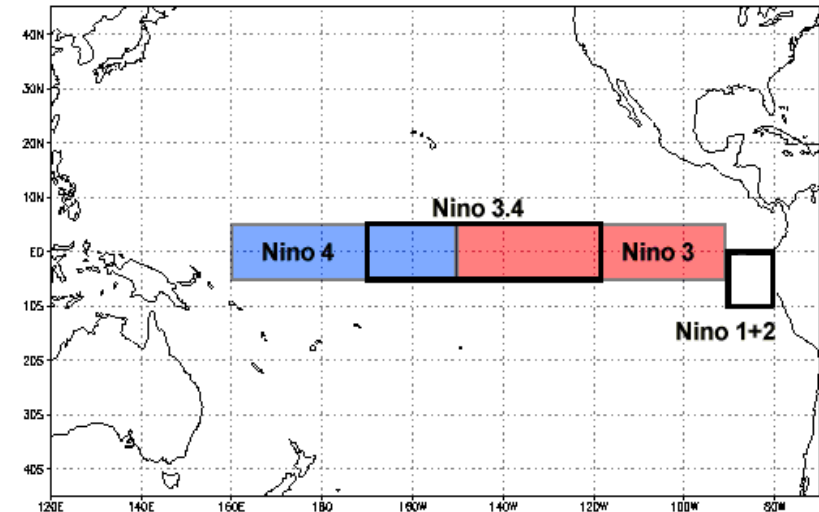
Latest Update: 12 November 2019

- 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>

# ENSO and Global SST Forecasts

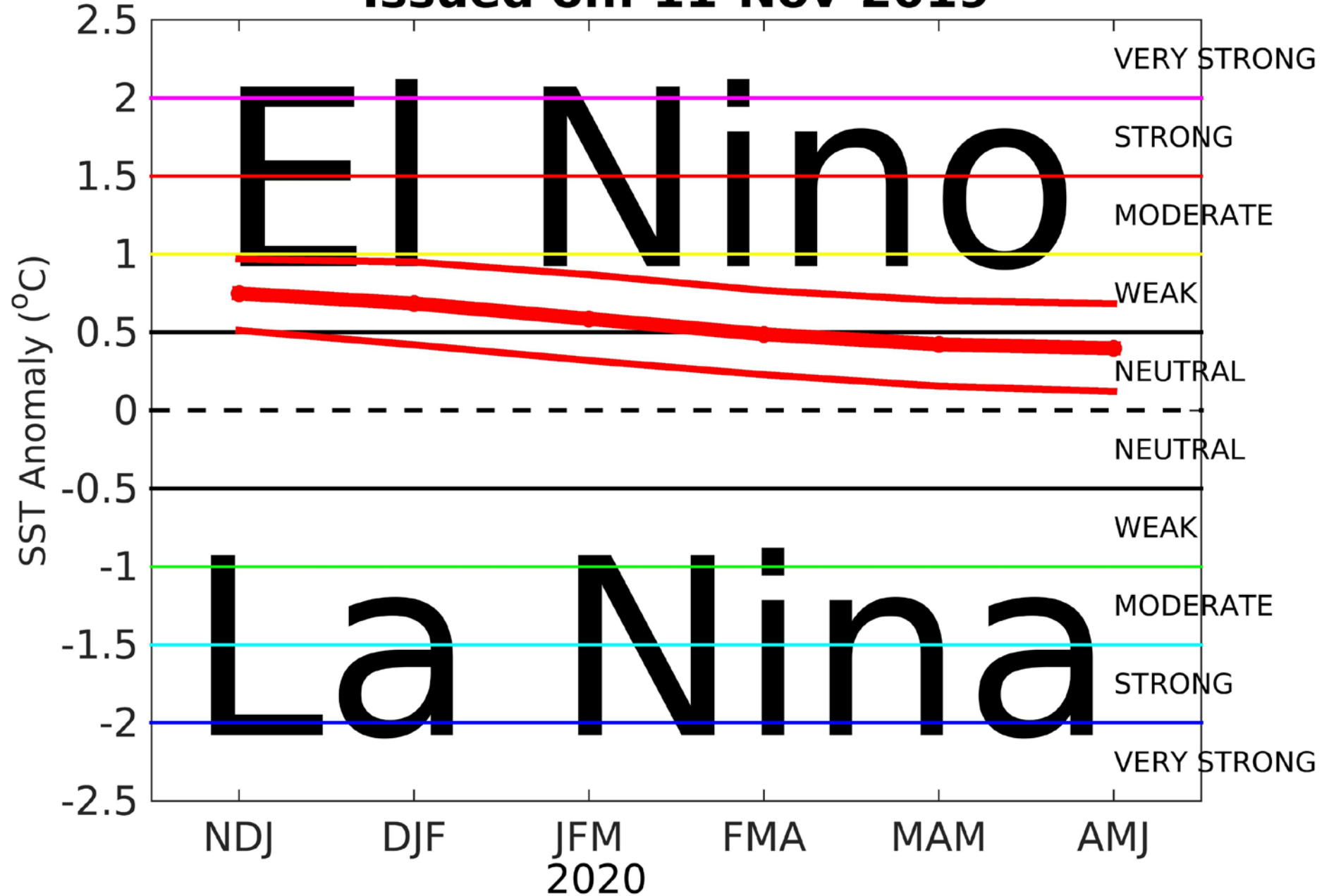
# Prediction Method

- 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



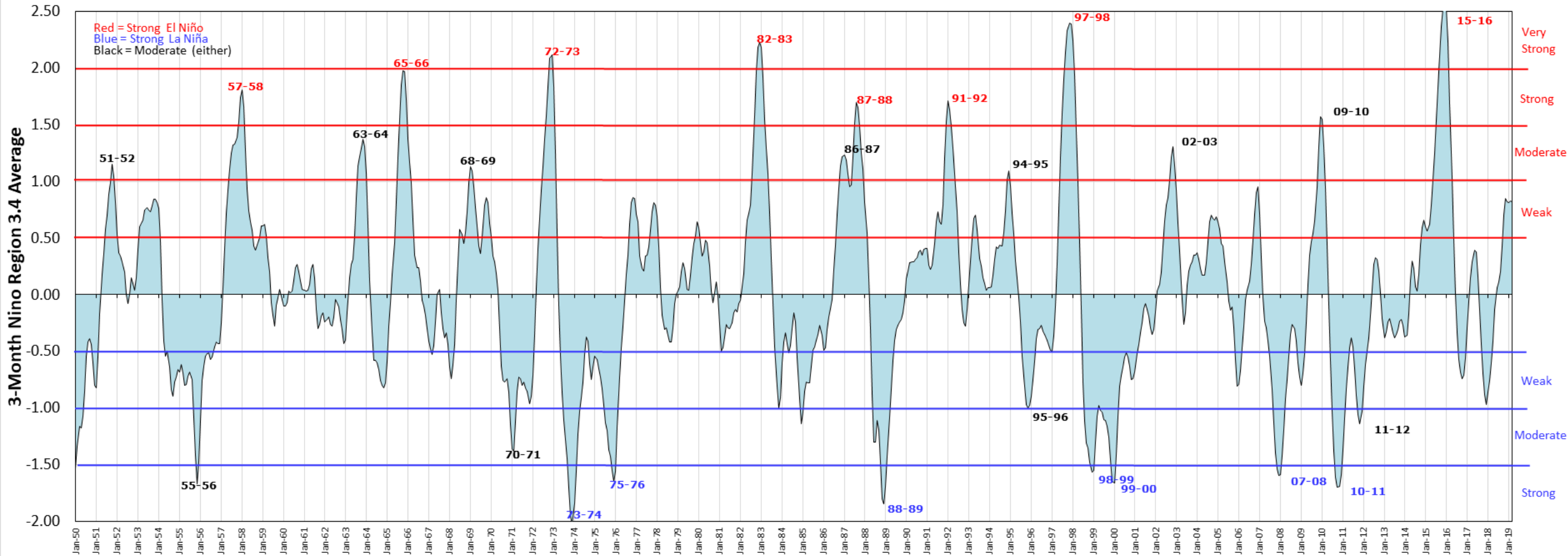
# CSiriMM Nino3.4 SST Forecast

Issued on: 11-Nov-2019



# Oceanic Niño Index (ONI)

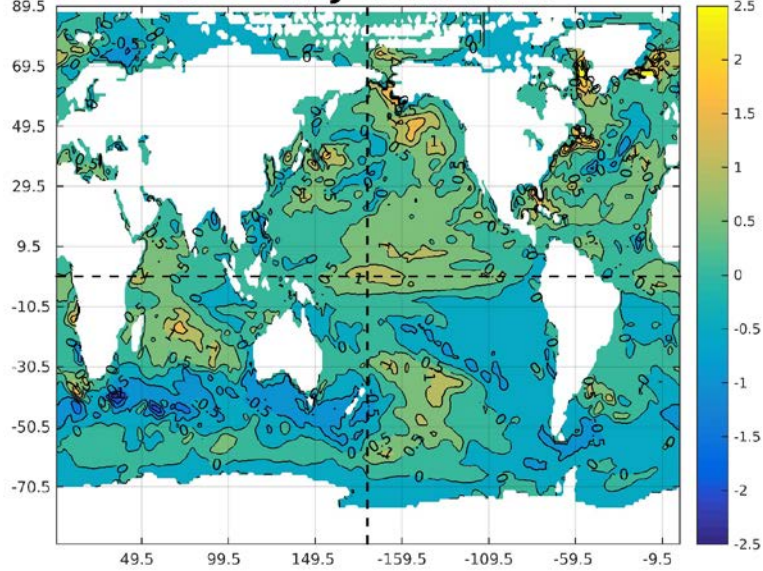
[http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/ensostuff/ensoyears.shtml](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml)



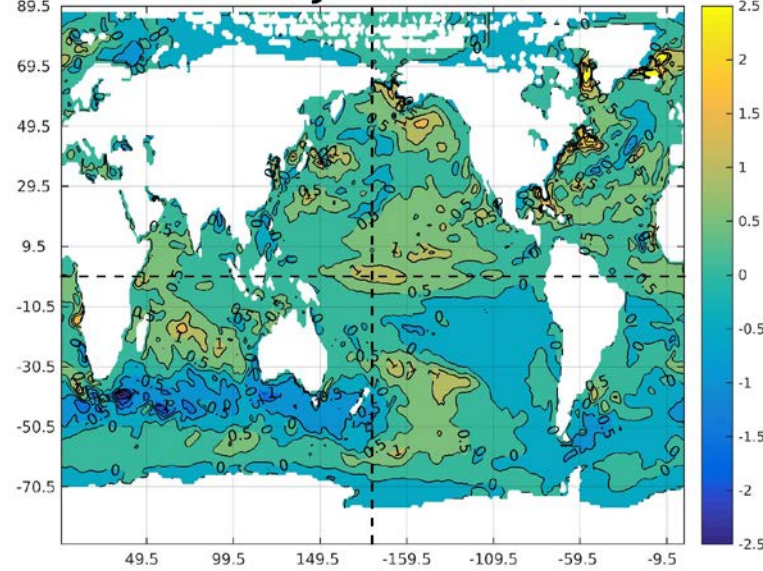


# SST anomalies

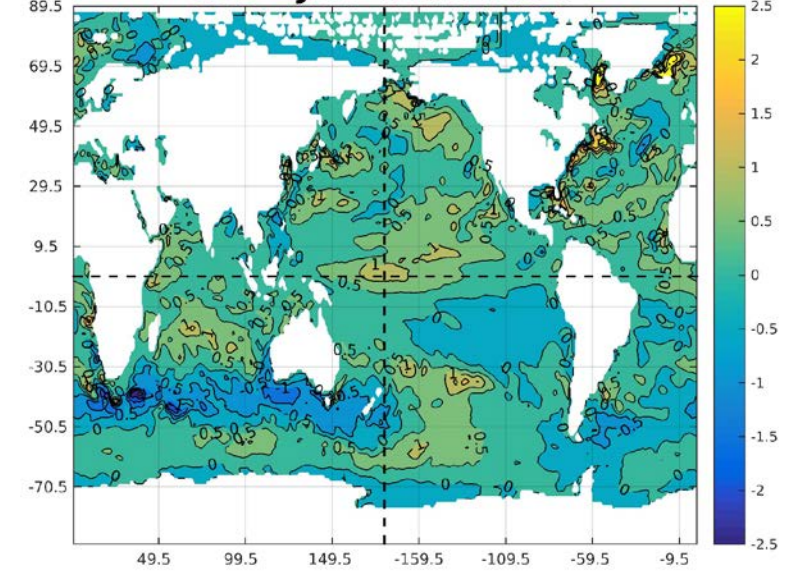
**SST NDJ IC:Nov2019**



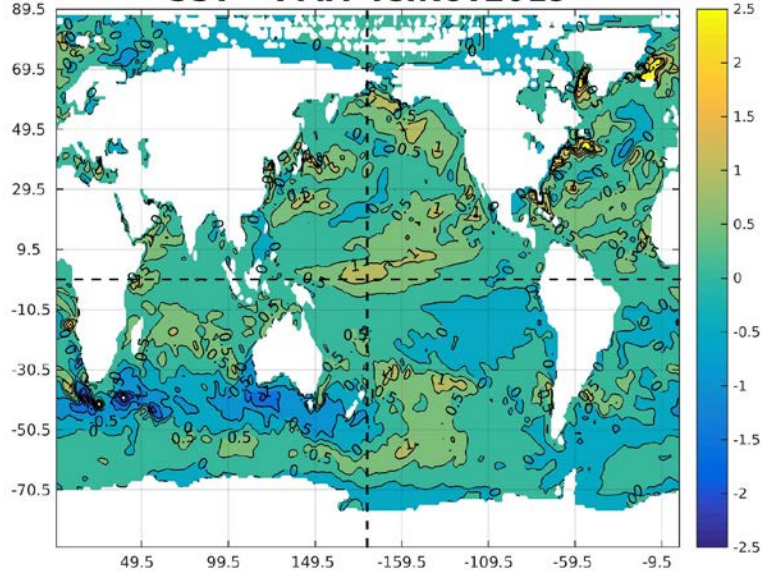
**SST DJF IC:Nov2019**



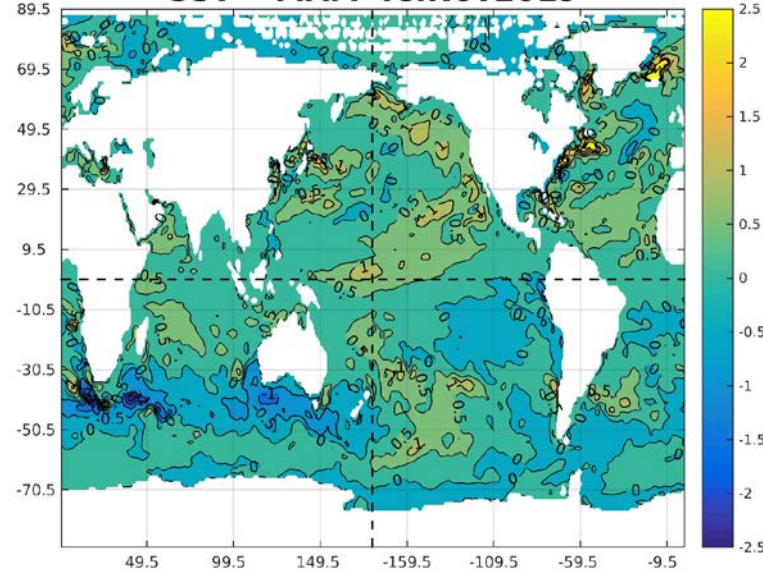
**SST JFM IC:Nov2019**



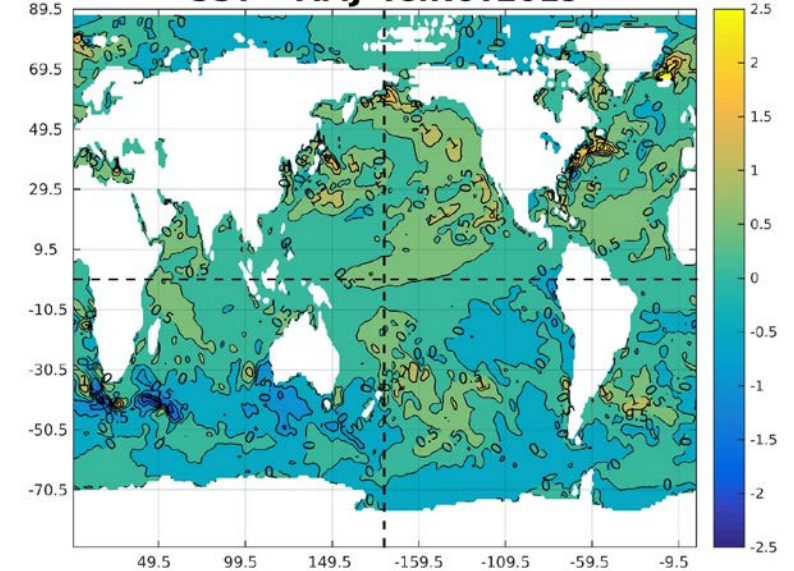
**SST FMA IC:Nov2019**



**SST MAM IC:Nov2019**



**SST AMJ IC:Nov2019**

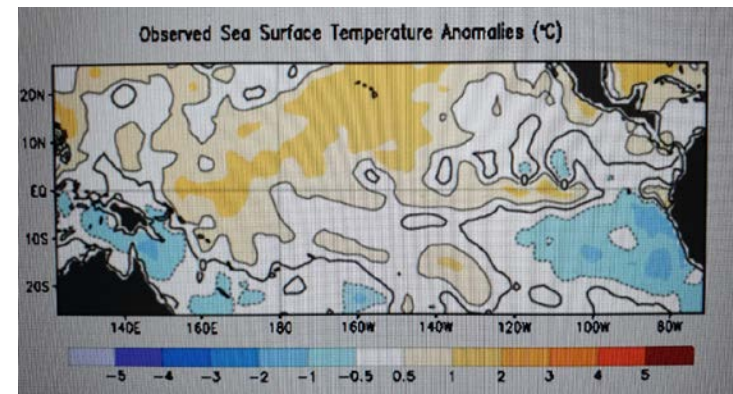




# Round-up: ENSO

- The sea-surface temperature (SST) forecasts continue to show a weak positive SST anomaly on the date line. This relatively warm sea area on the date line can lead to anomalous convection there that can in turn give rise to El Nino-like impacts over southern Africa.

The current observed SST anomalies are still just west of the dateline:



7-day average centred on 6 November 2019

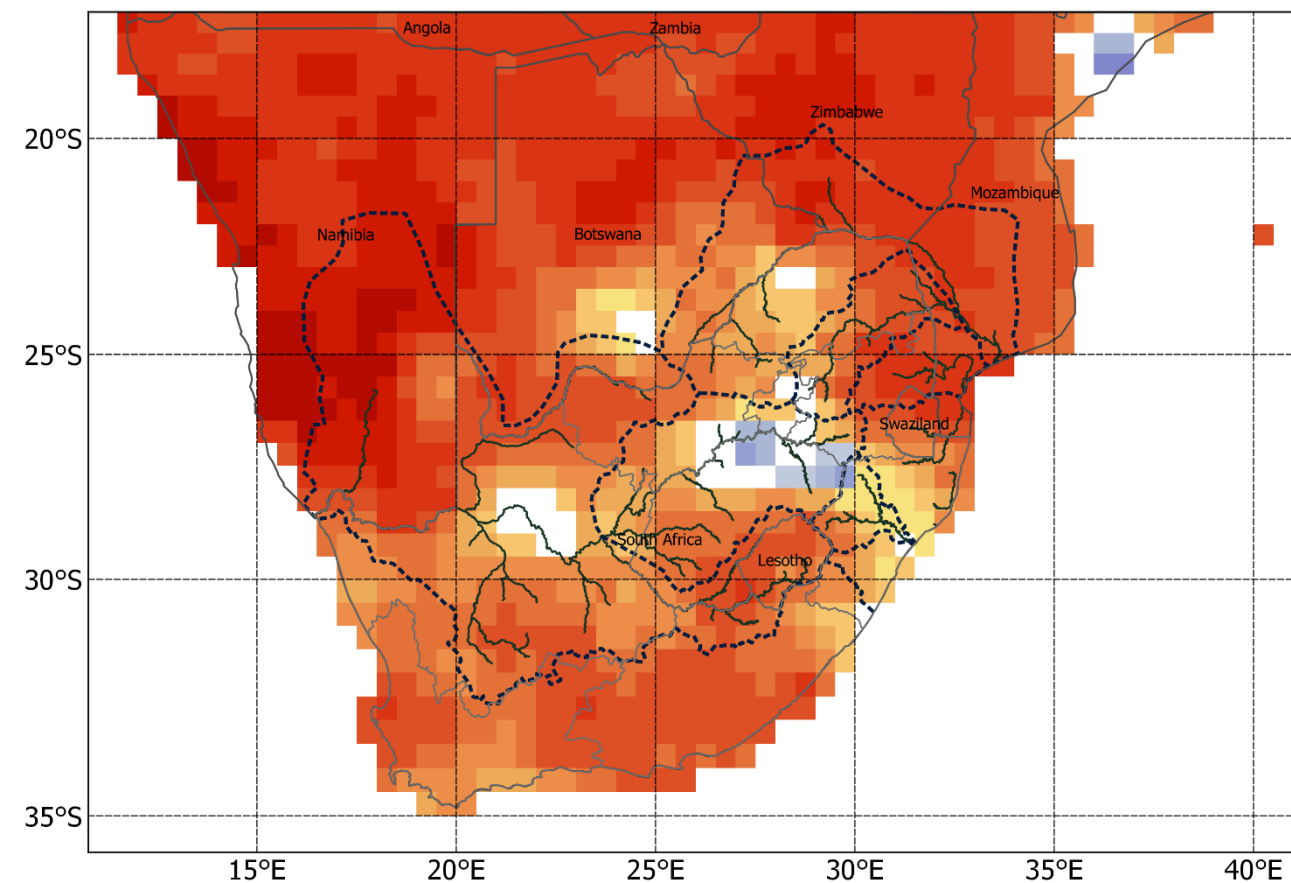


# Southern Africa Forecasts

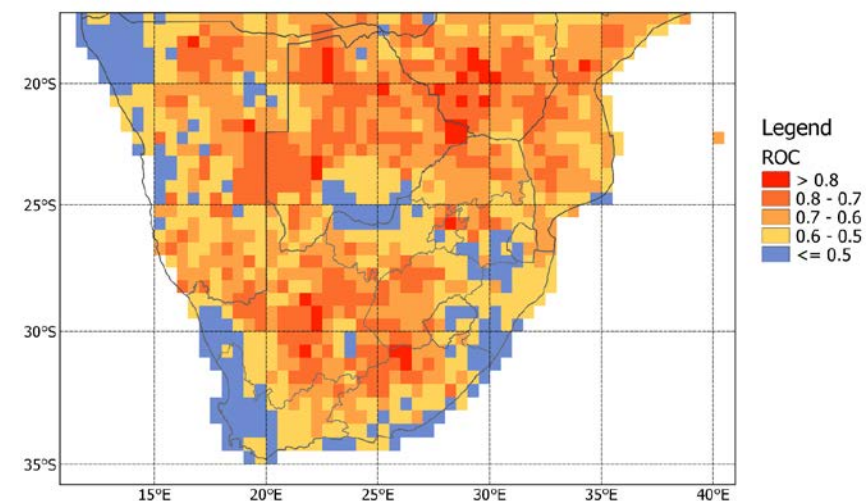
# Prediction Method

- 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 ( $0.5^{\circ} \times 0.5^{\circ}$ ) 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.

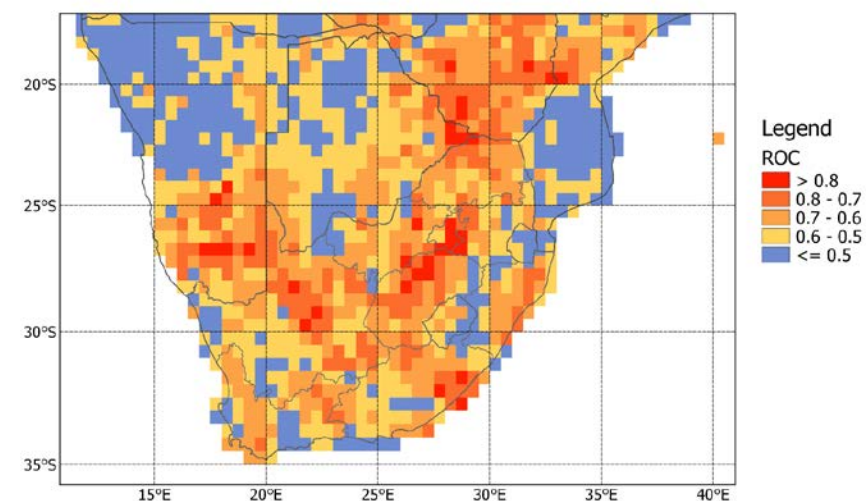
# NDJ 2019/20 Rainfall; ICs: Nov



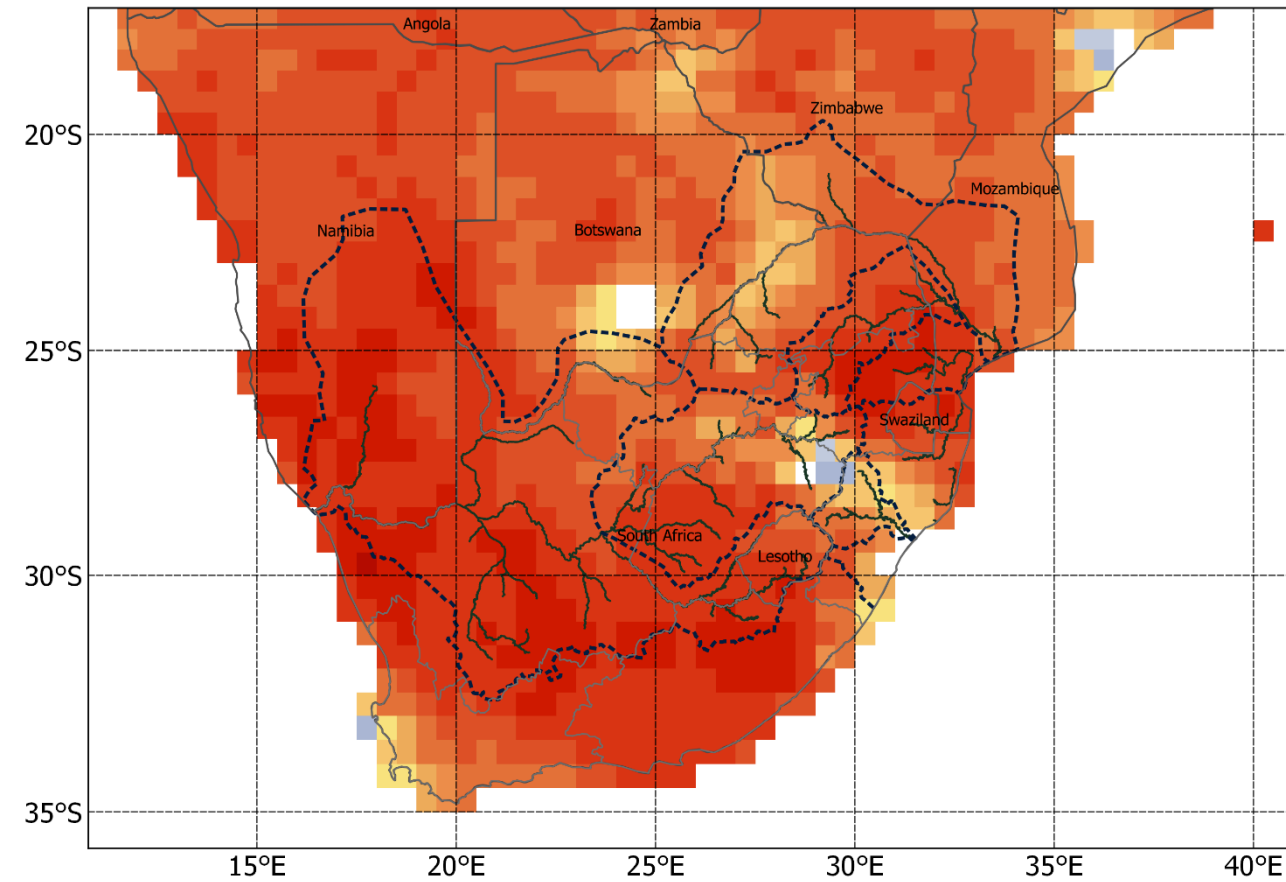
## ROC Area (Above-Normal): NDJ Rainfall



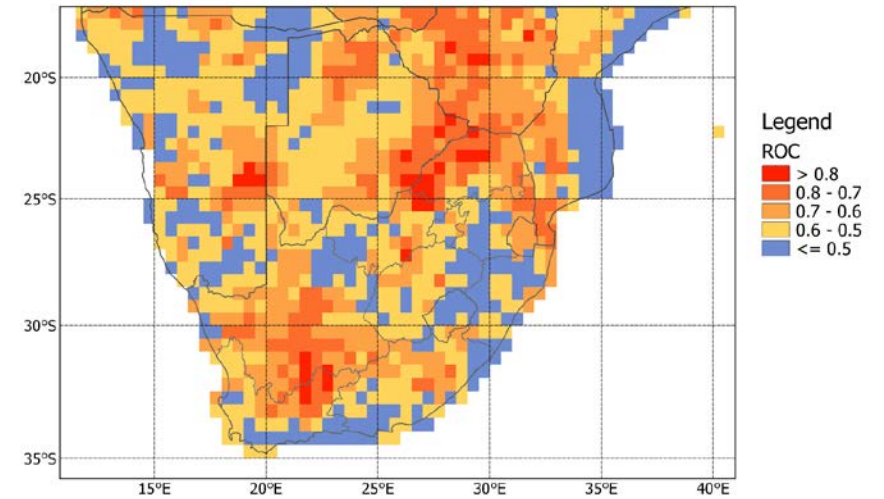
## ROC Area (Below-Normal): NDJ Rainfall



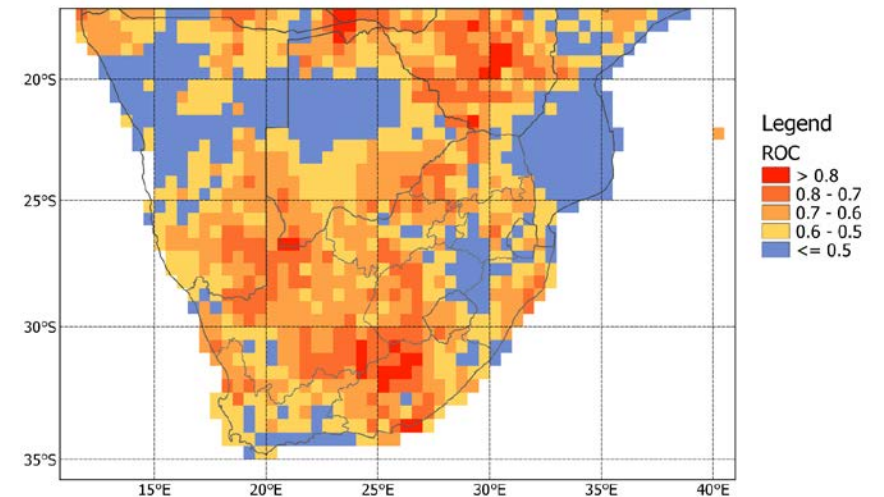
# DJF 2019/20 Rainfall; ICs: Nov



## ROC Area (Above-Normal): DJF Rainfall

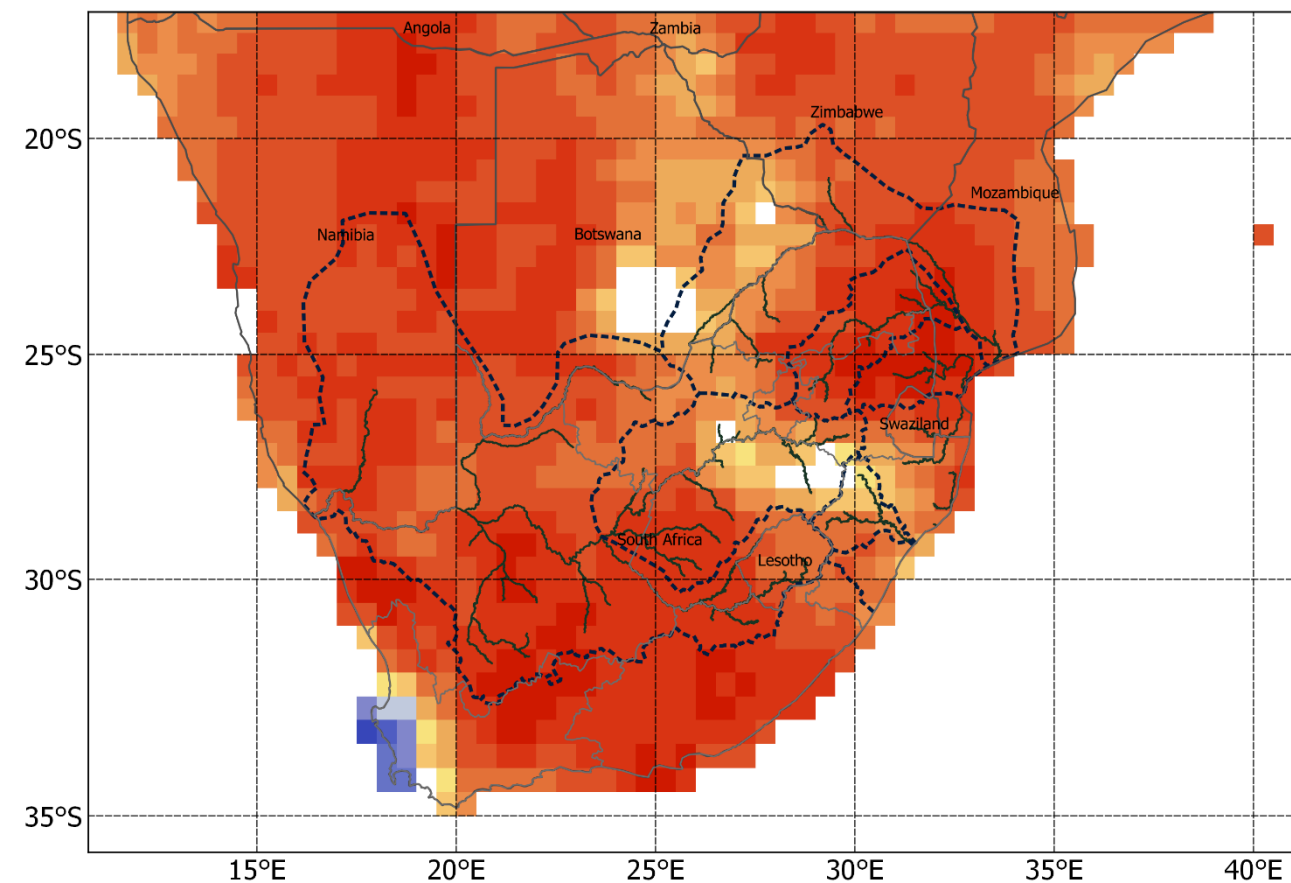


## ROC Area (Below-Normal): DJF Rainfall

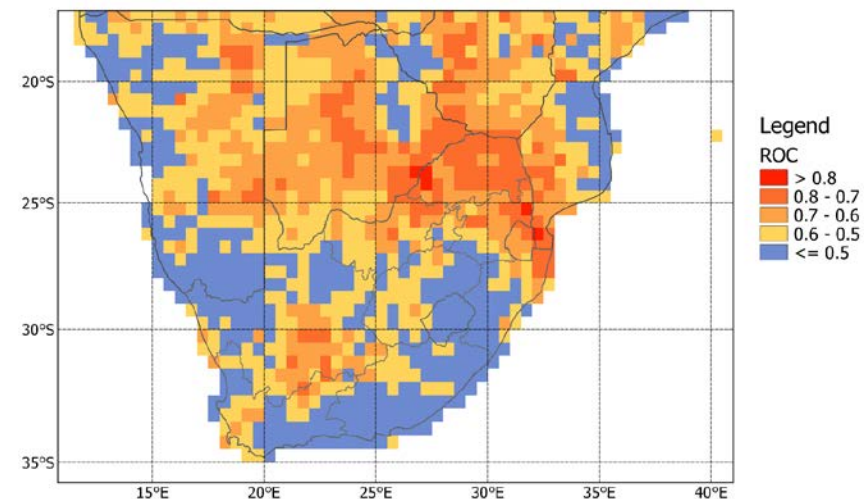




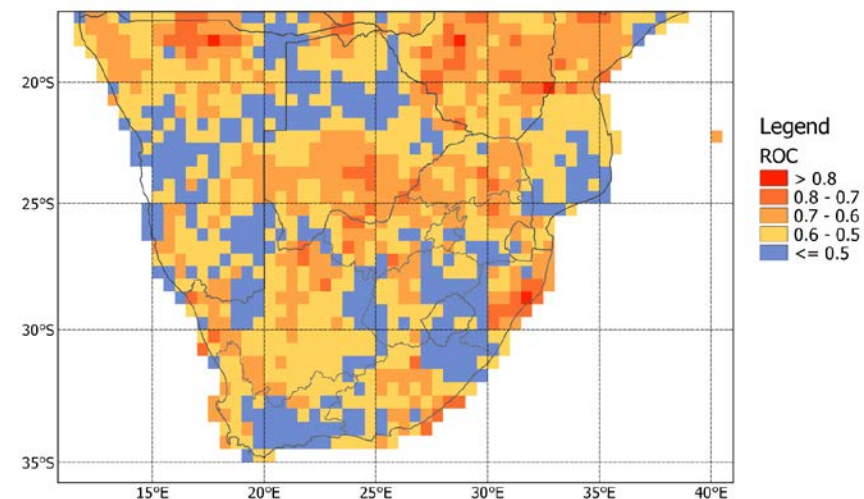
# JFM 2020 Rainfall; ICs: Nov



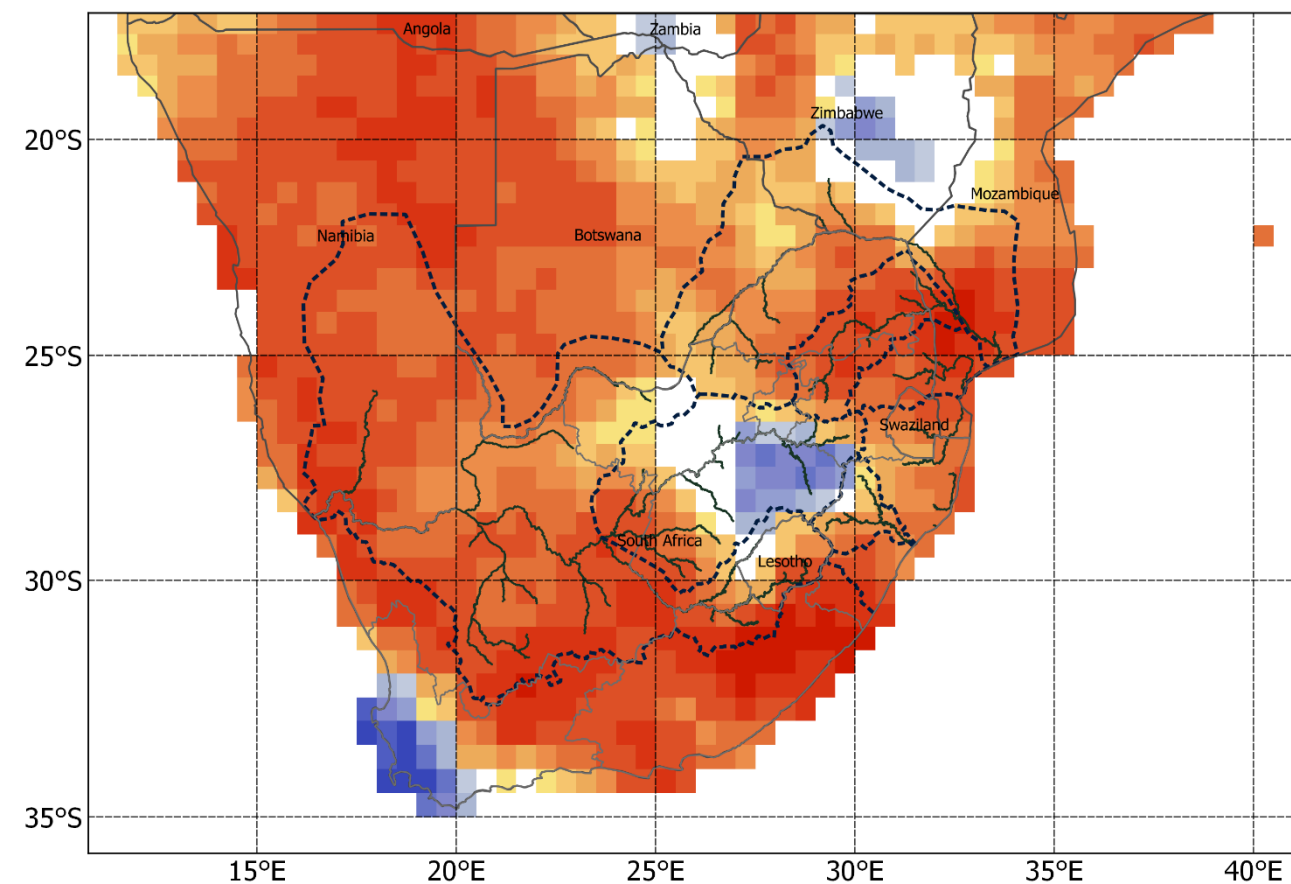
## ROC Area (Above-Normal): JFM Rainfall



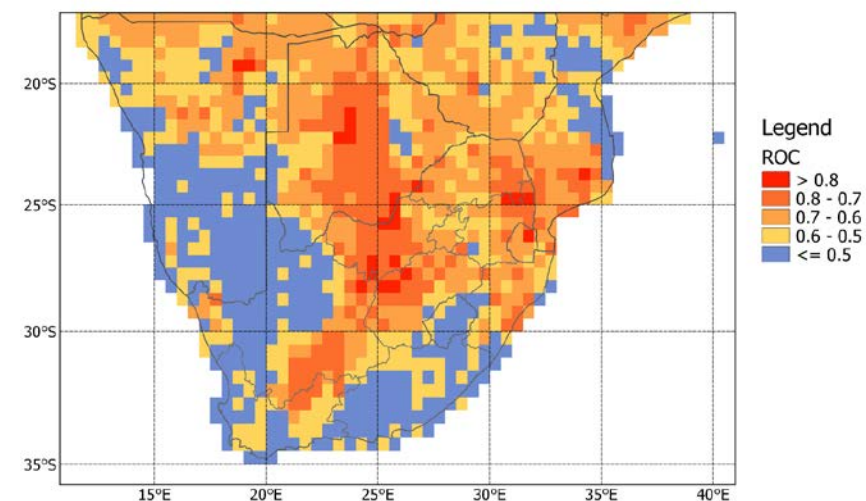
## ROC Area (Below-Normal): JFM Rainfall



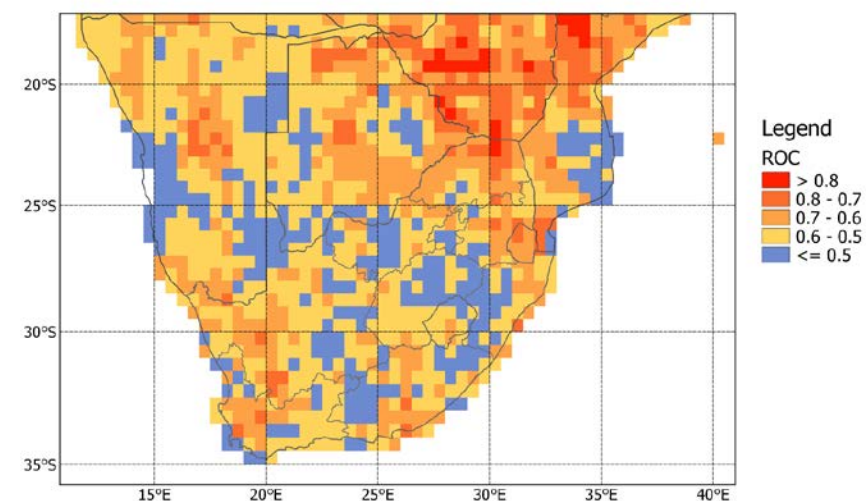
# FMA 2020 Rainfall; ICs: Nov



## ROC Area (Above-Normal): FMA Rainfall



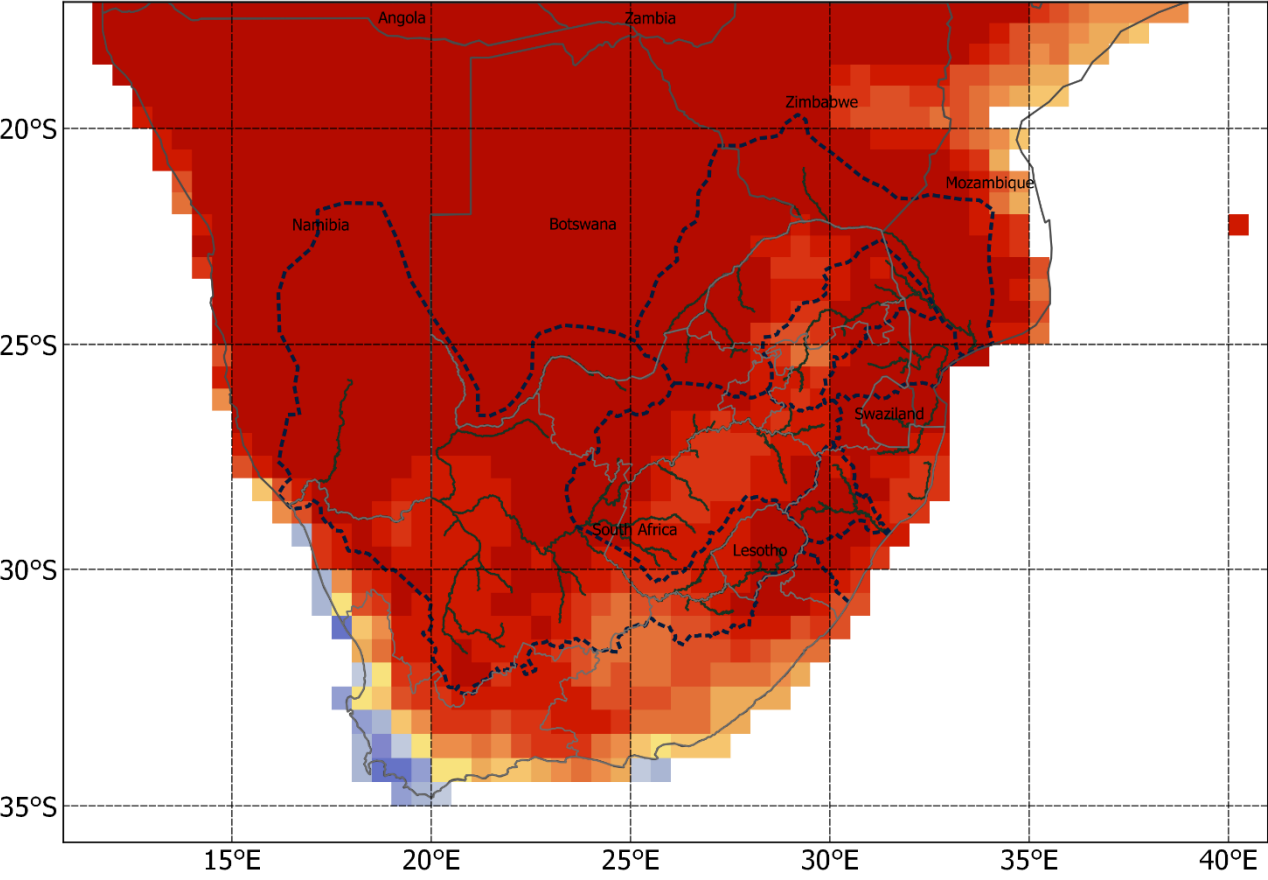
## ROC Area (Below-Normal): FMA Rainfall



# Round-up: SADC Rainfall

- Predominantly unfavourable rainfall conditions expected during the larger part of summer over the summer rainfall regions

# NDJ 2019/20 Max Temp; ICs: Nov



**Legend**

--- Catchment Area  
— Main Rivers

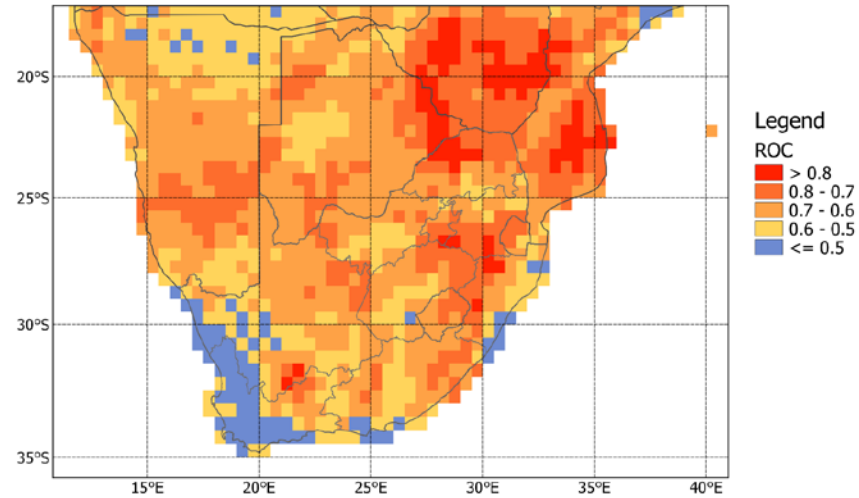
**Max Temp Prob**

>75	
70-75	
65-70	
60-65	
55-60	
50-55	
45-50	
40-45	
35-40	
35-40	
40-45	
45-50	
50-55	
55-60	
60-65	
65-70	
70-75	
>75	

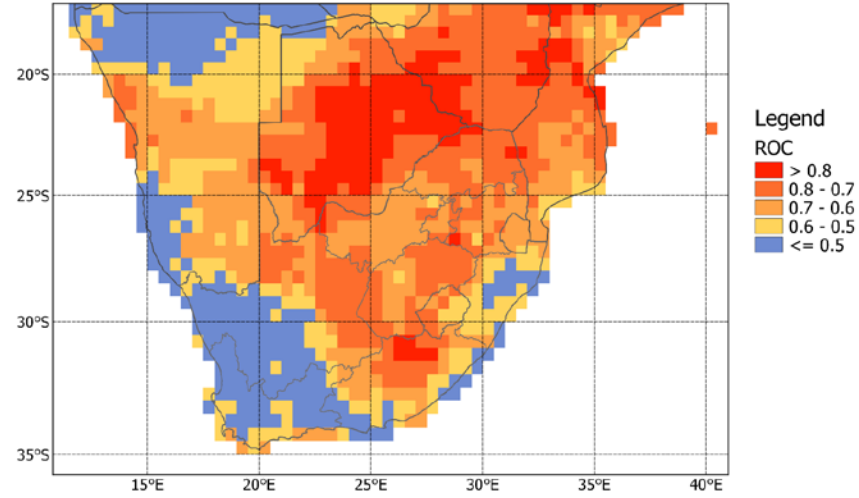
Above Normal

Below Normal

ROC Area (Above-Normal): NDJ Max Temp

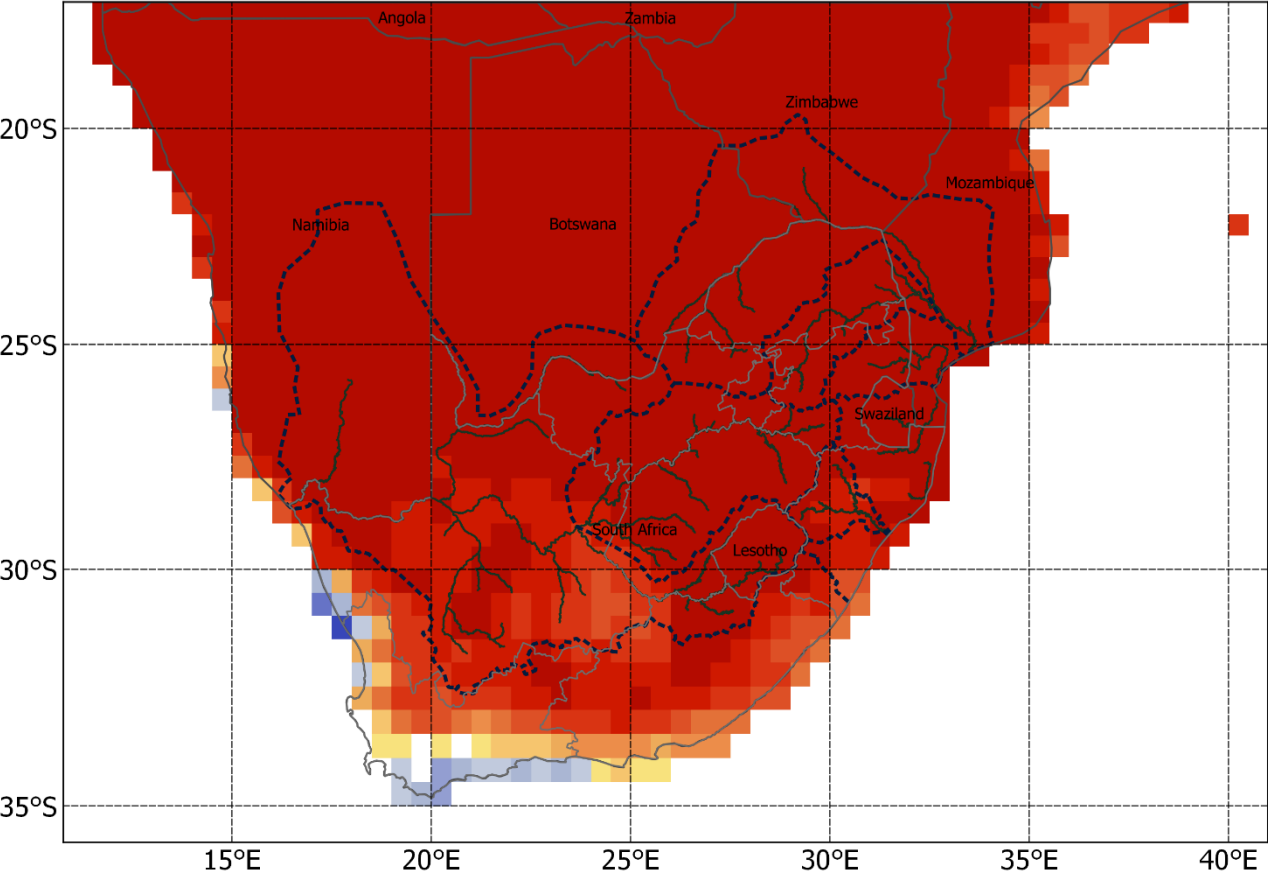


ROC Area (Below-Normal): NDJ Max Temp

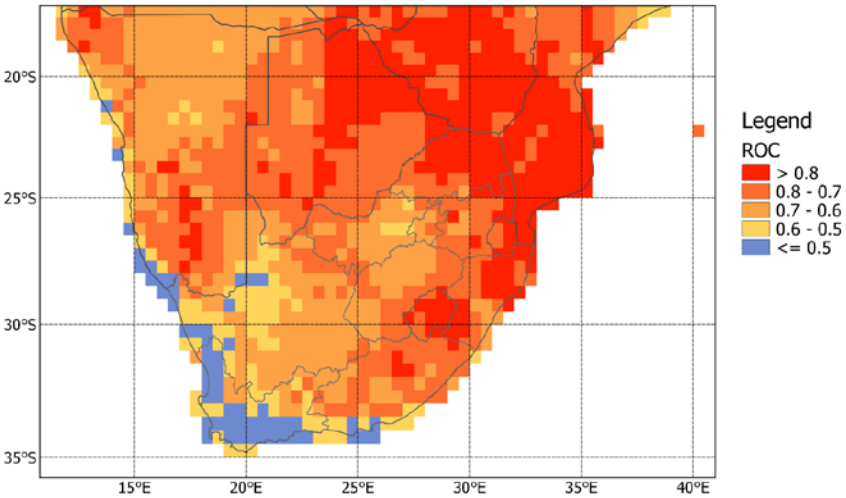




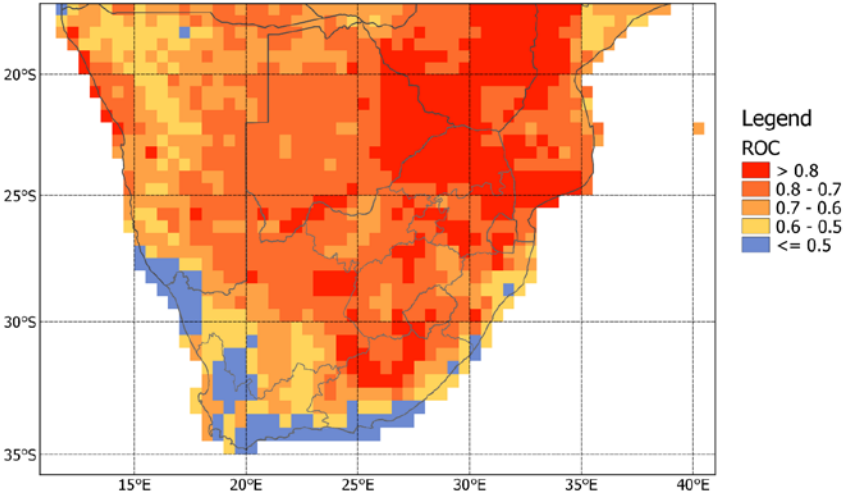
# DJF 2019/20 Max Temp; ICs: Nov



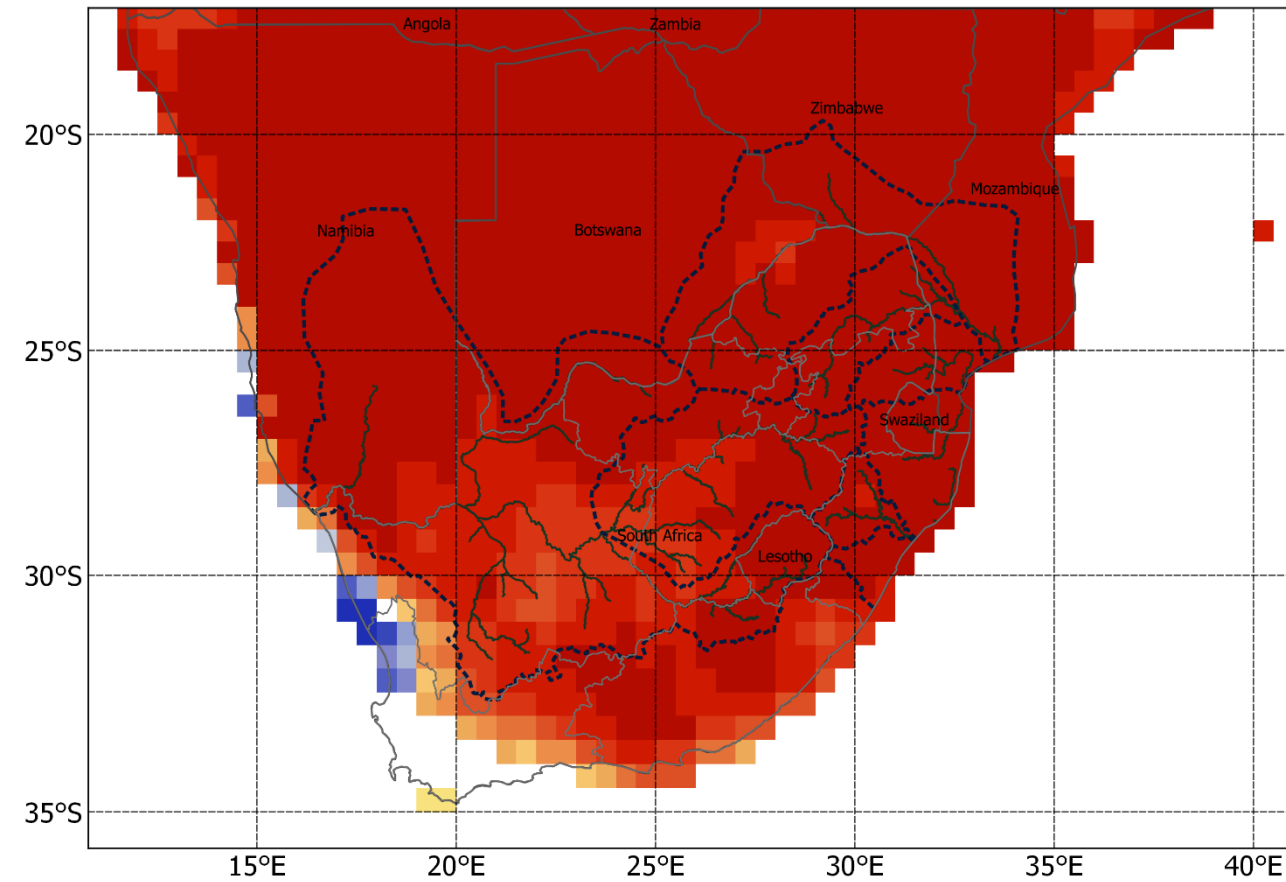
ROC Area (Above-Normal): DJF Max Temp



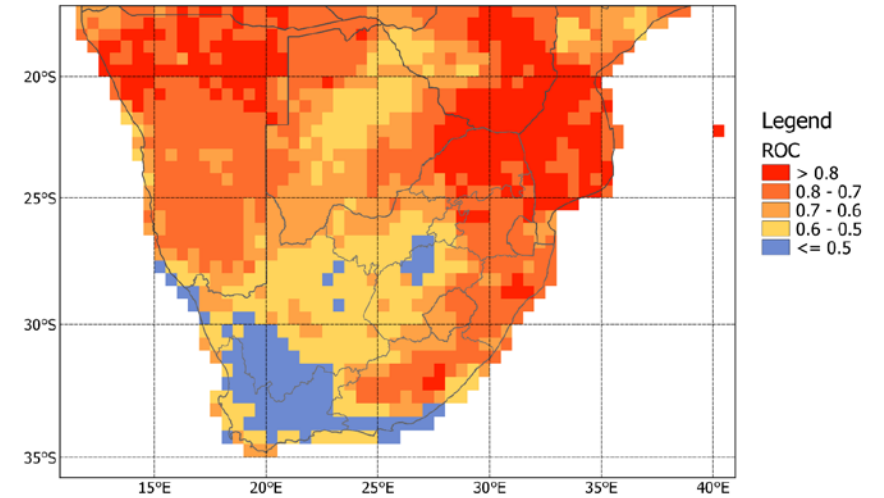
ROC Area (Below-Normal): DJF Max Temp



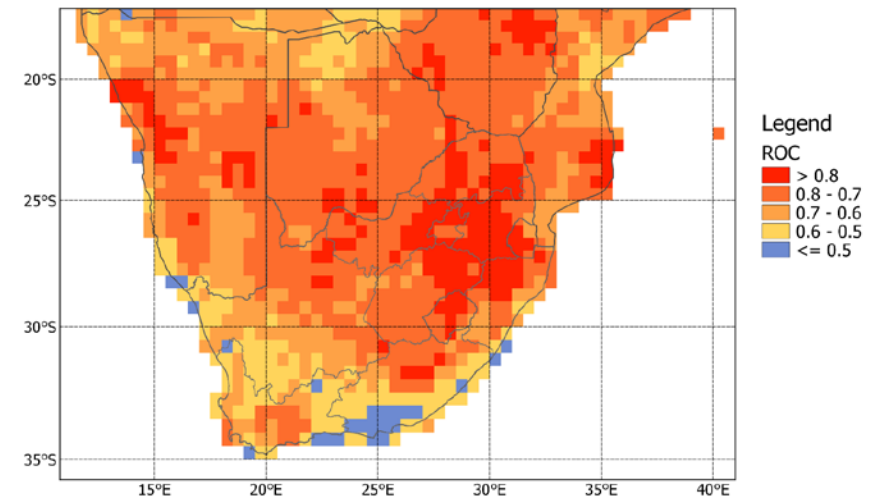
# JFM 2020 Max Temp; ICs: Nov



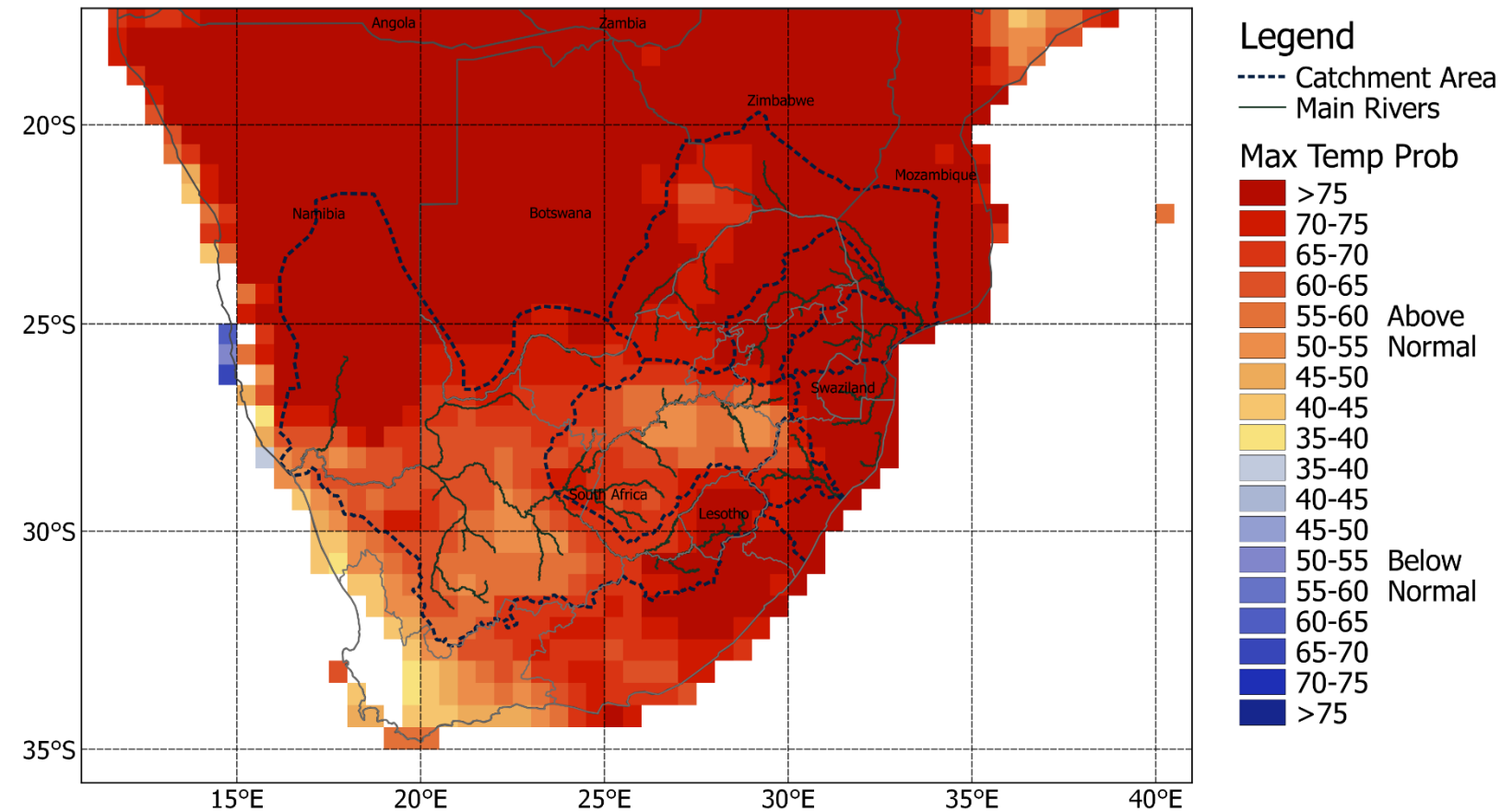
## ROC Area (Above-Normal): JFM Max Temp



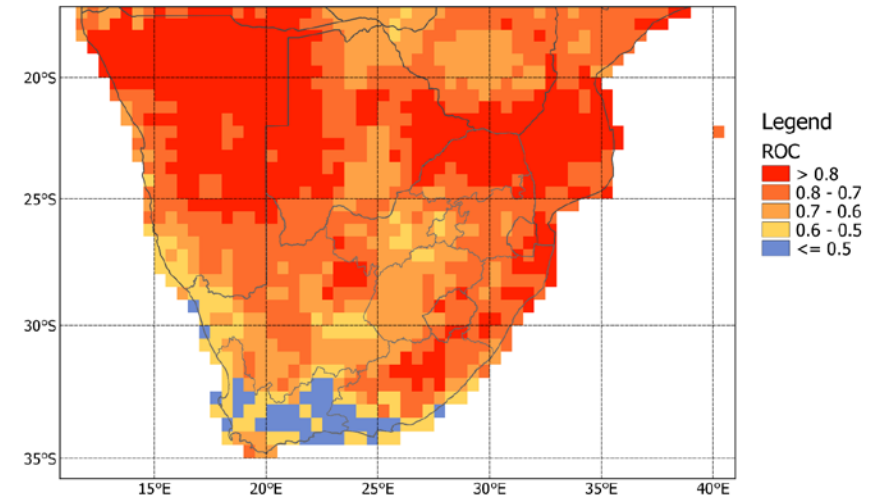
## ROC Area (Below-Normal): JFM Max Temp



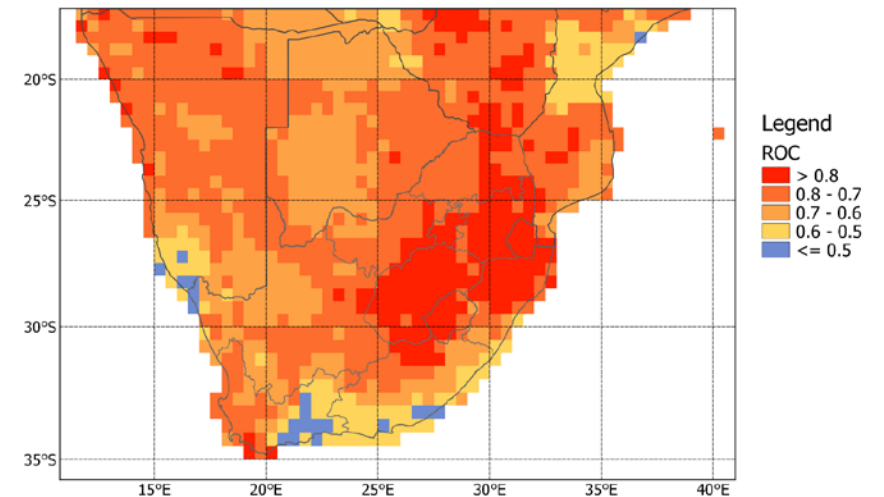
# FMA 2020 Max Temp; ICs: Nov



## ROC Area (Above-Normal): FMA Max Temp



## ROC Area (Below-Normal): FMA Max Temp



# Round-up: SADC Max Temp

- Predominantly high maximum temperatures are likely over the larger part of the forecast region.



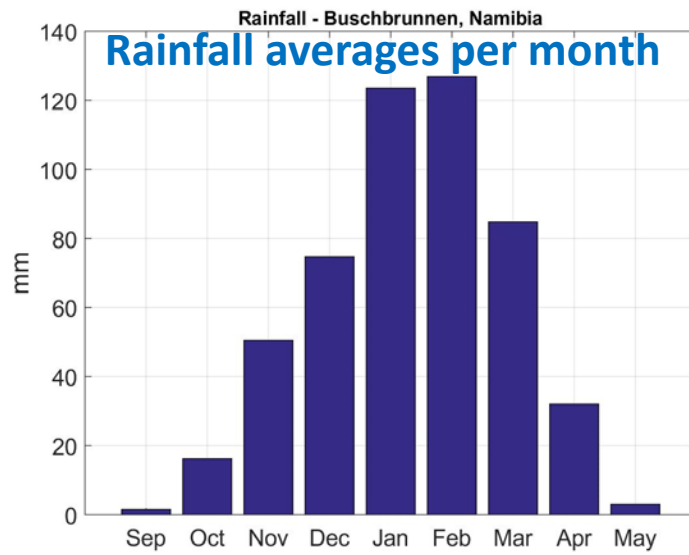
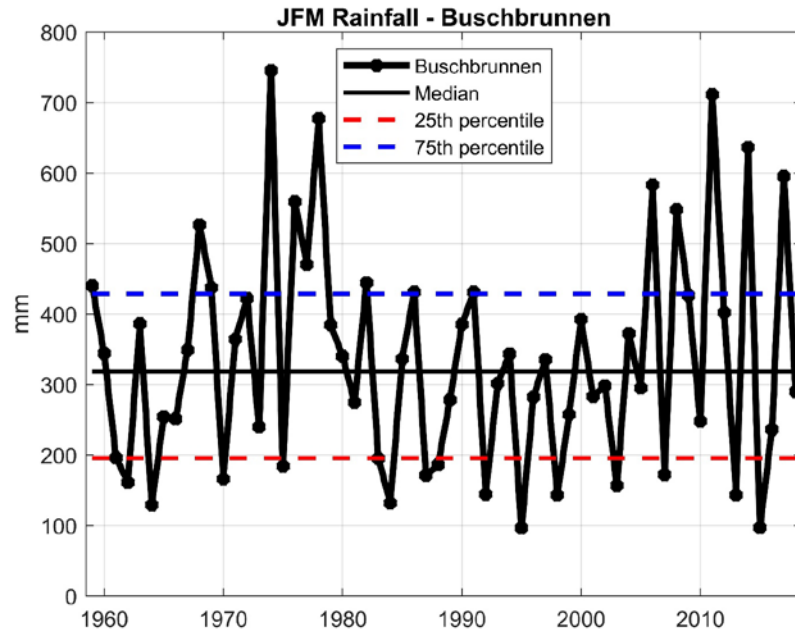
# Tailored Forecasts

1. Probability of exceedance Jan-Feb-Mar 2020 rainfall forecast for the farm Buschbrunnen near Grootfontein, Namibia
2. Probability of exceedance Dec-Jan-Feb 2019/20 inflow forecast for Lake Kariba, Zambia/Zimbabwe
3. Probabilistic three-category malaria forecast for Limpopo for Dec-Jan-Feb 2019/20

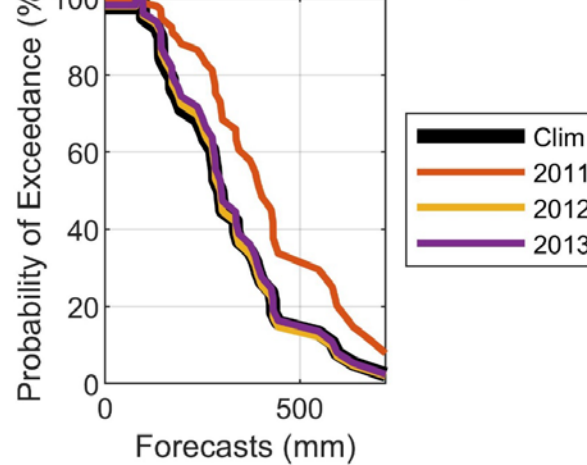
# Data and forecasts for the farm Buschbrunnen near Grootfontein, Namibia

Landman et al (2016)

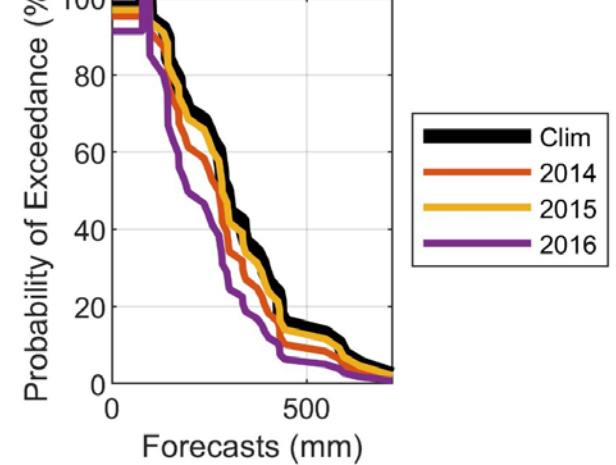
## JFM total rainfall as recorded by the farmer



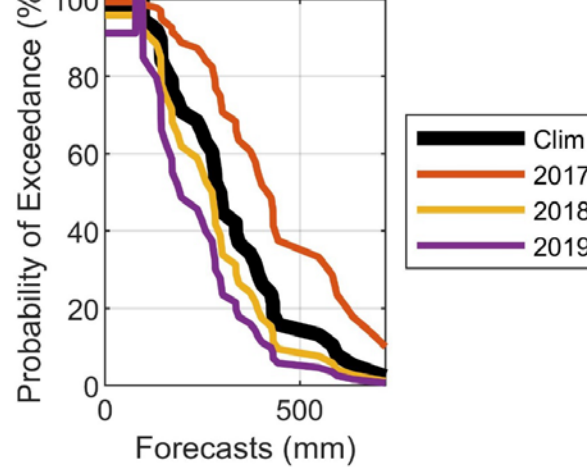
JFM Rainfall; ICs: Nov (GFDL)



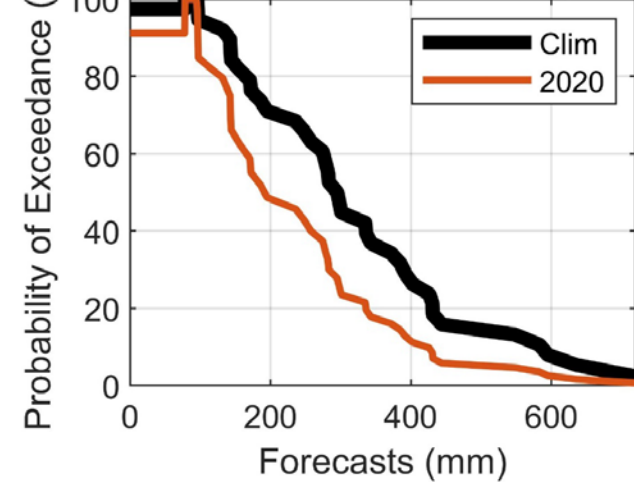
JFM Rainfall; IC: Nov (GFDL)



JFM Rainfall; IC: Nov (GFDL)



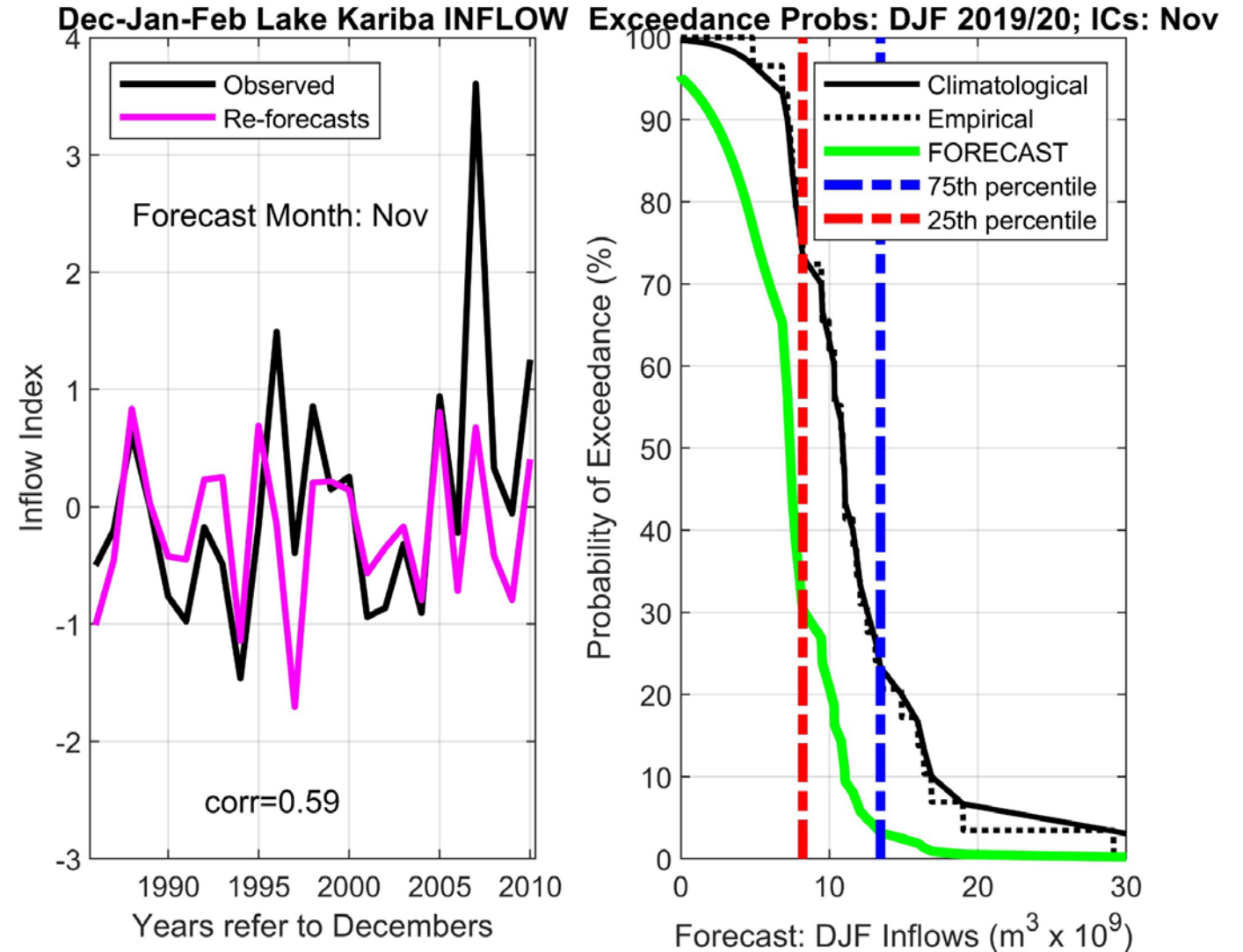
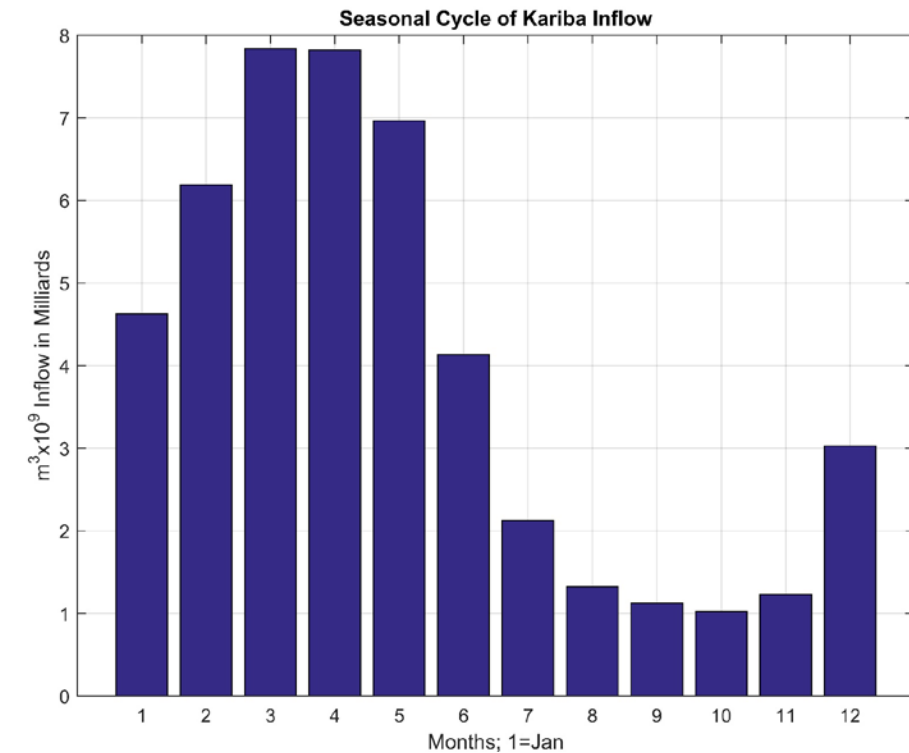
JFM 2020 Rainfall; ICs: Nov (GFDL)



Re-forecasts of JFM rainfall outcomes for 2011-2019, and real-time forecast for JFM 2020

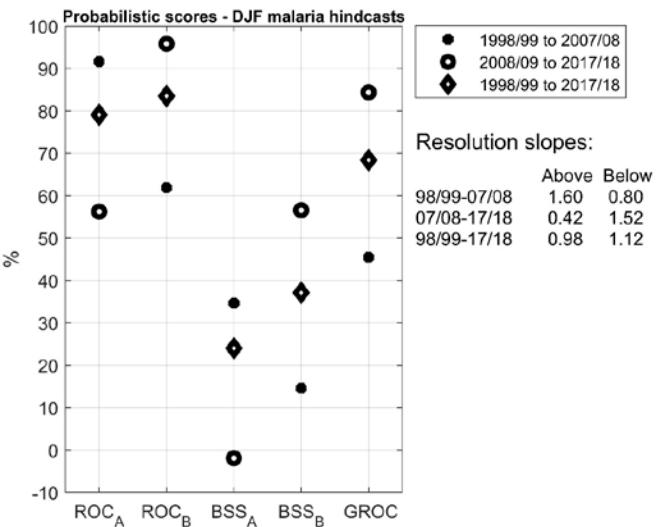
# Inflow forecast for Lake Kariba: onset season of DJF

Muchuru et al. (2016)

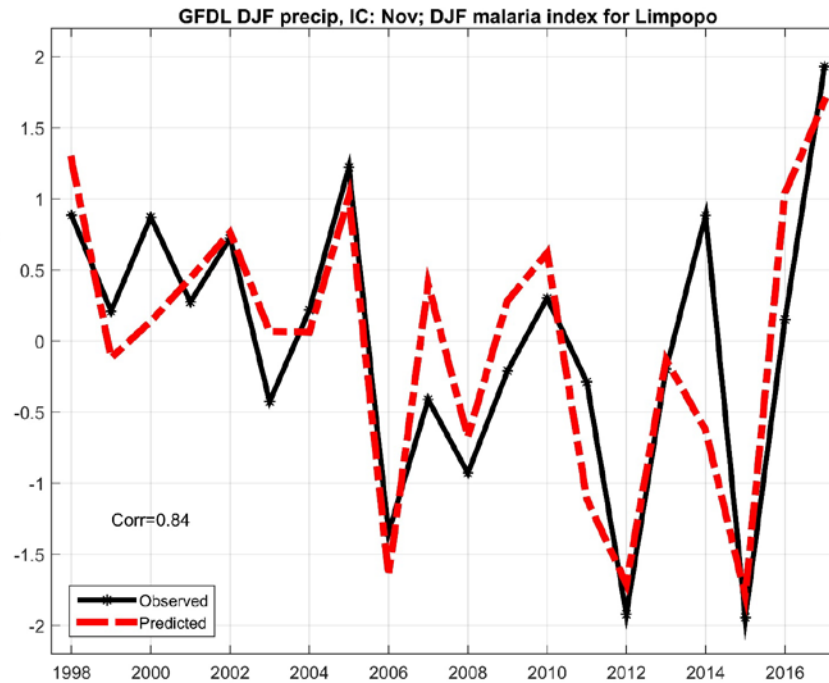


# Malaria forecasts (VERY experimental and unofficial)

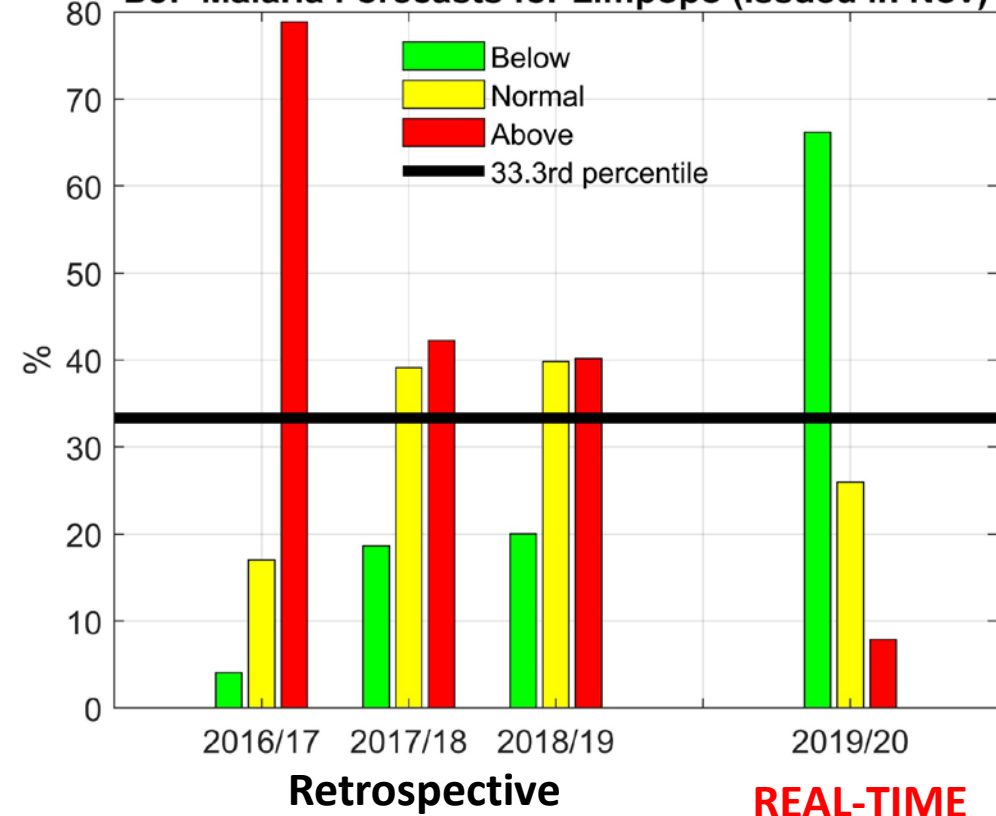
## Verification stats



## Hindcasts



## DJF Malaria Forecasts for Limpopo (Issued in Nov)

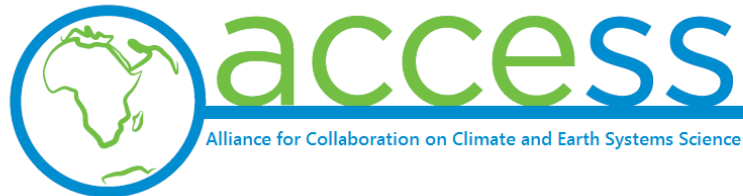




- Barnston, A.G. and Tippett, M.K., 2017: Do statistical pattern corrections improve seasonal climate predictions in the North American Multimodel Ensemble models? *Journal of Climate*, 30: 8335-8355. doi: 10.1175/JCLI-D-17-0054.1
- Harris, I., Jones, P. D., Osborn, T. J., and Lister, D. H., 2014: Updated 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