

Seasonal forecasts

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<https://tinyurl.com/ybrb3a72>



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Seasonal Forecast Worx

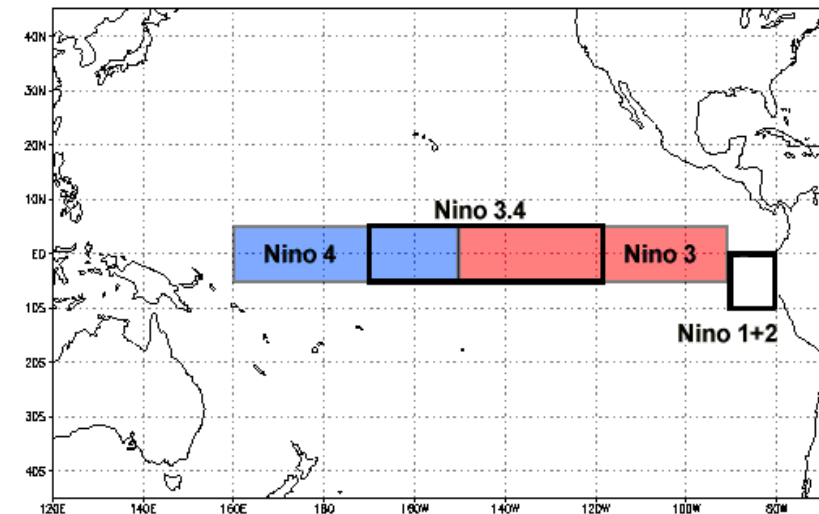
Latest Update: 11 March 2019

- 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>

ENSO and Global SST Forecasts

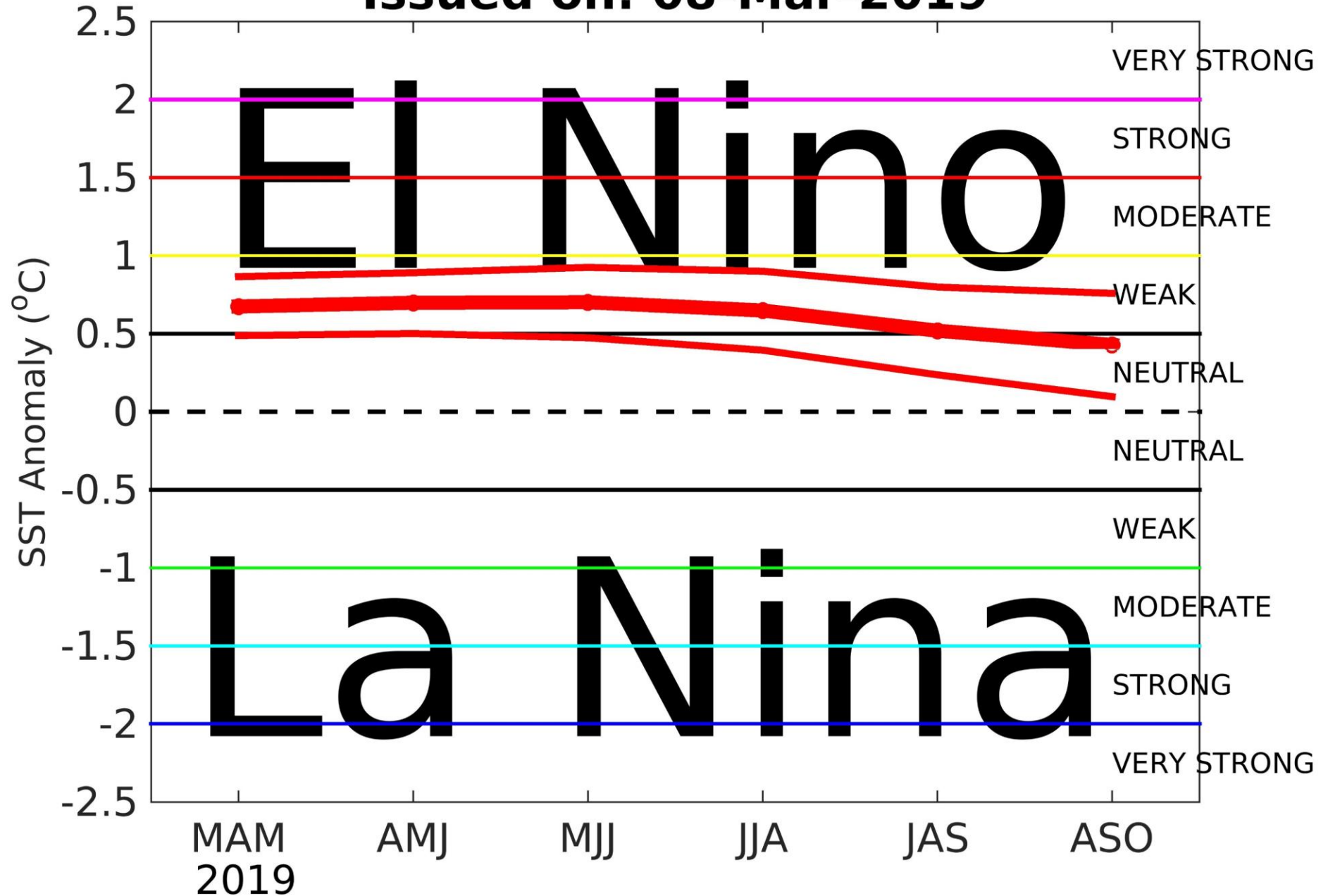
Prediction Method

- 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



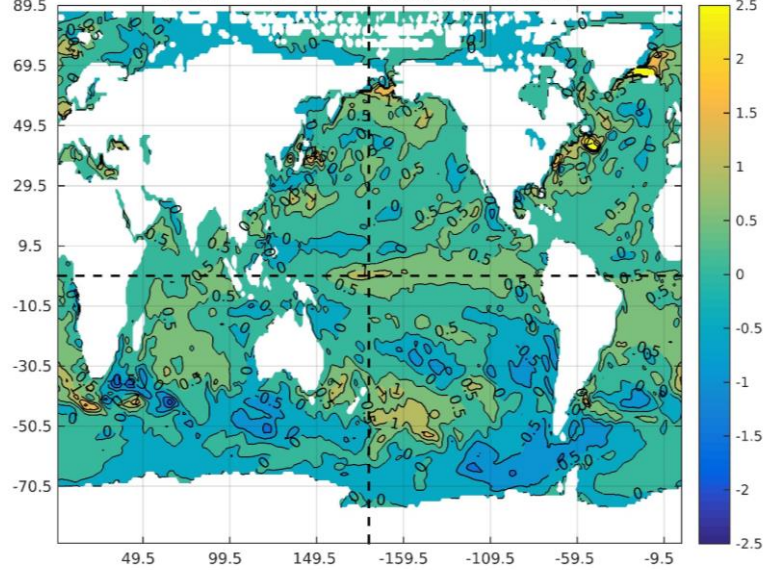
CSiriMM Nino3.4 SST Forecast

Issued on: 08-Mar-2019

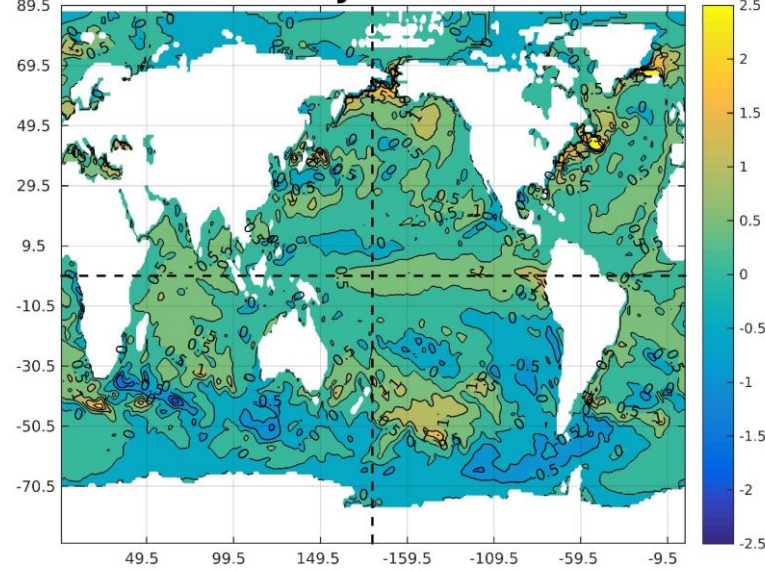


SST anomalies

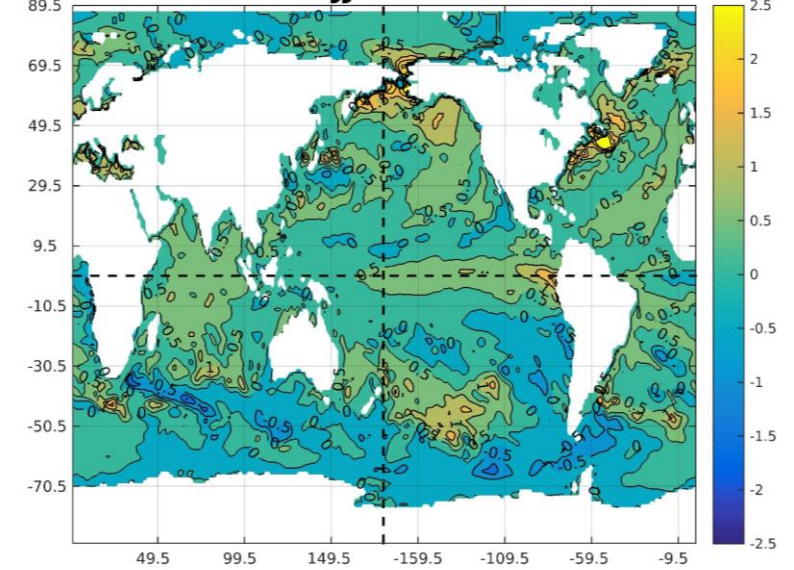
SST MAM IC:Mar2019



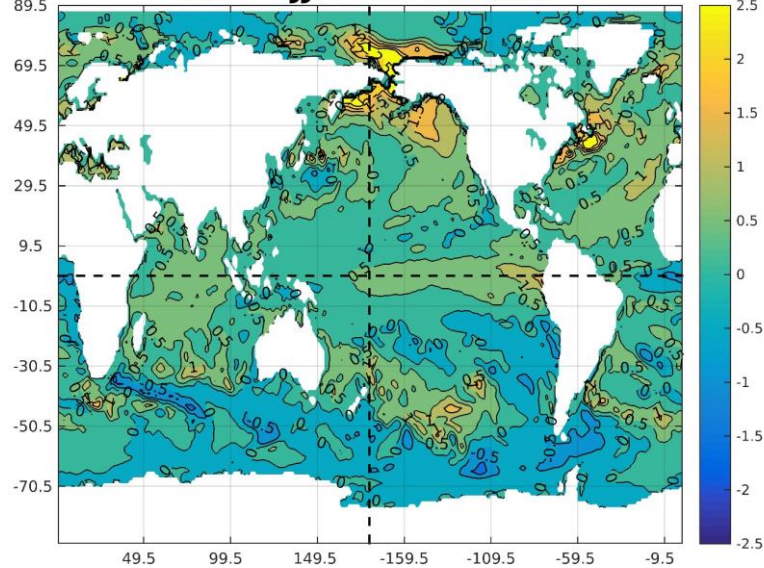
SST AMJ IC:Mar2019



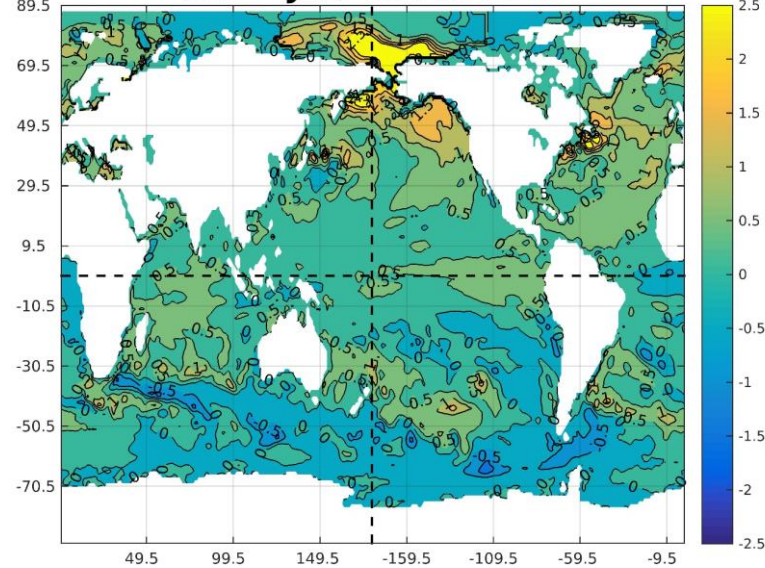
SST MJJ IC:Mar2019



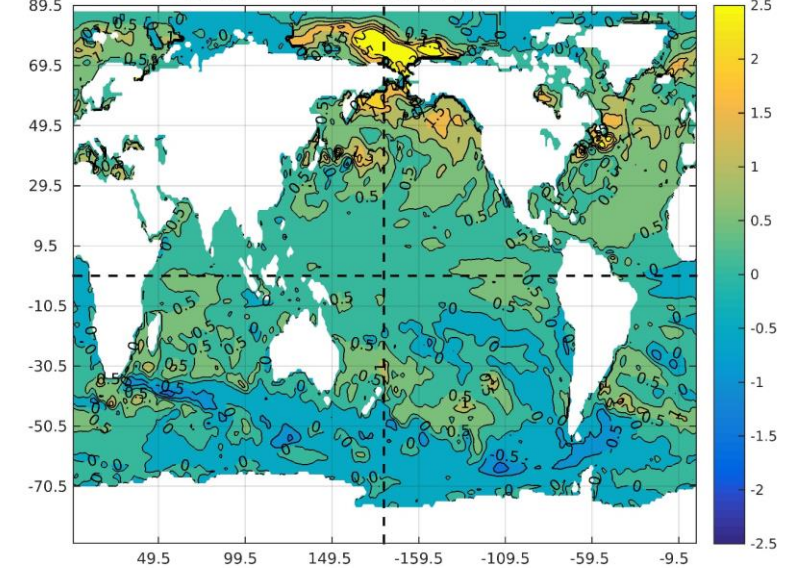
SST JJA IC:Mar2019



SST JAS IC:Mar2019



SST ASO IC:Mar2019



Round-up: ENSO

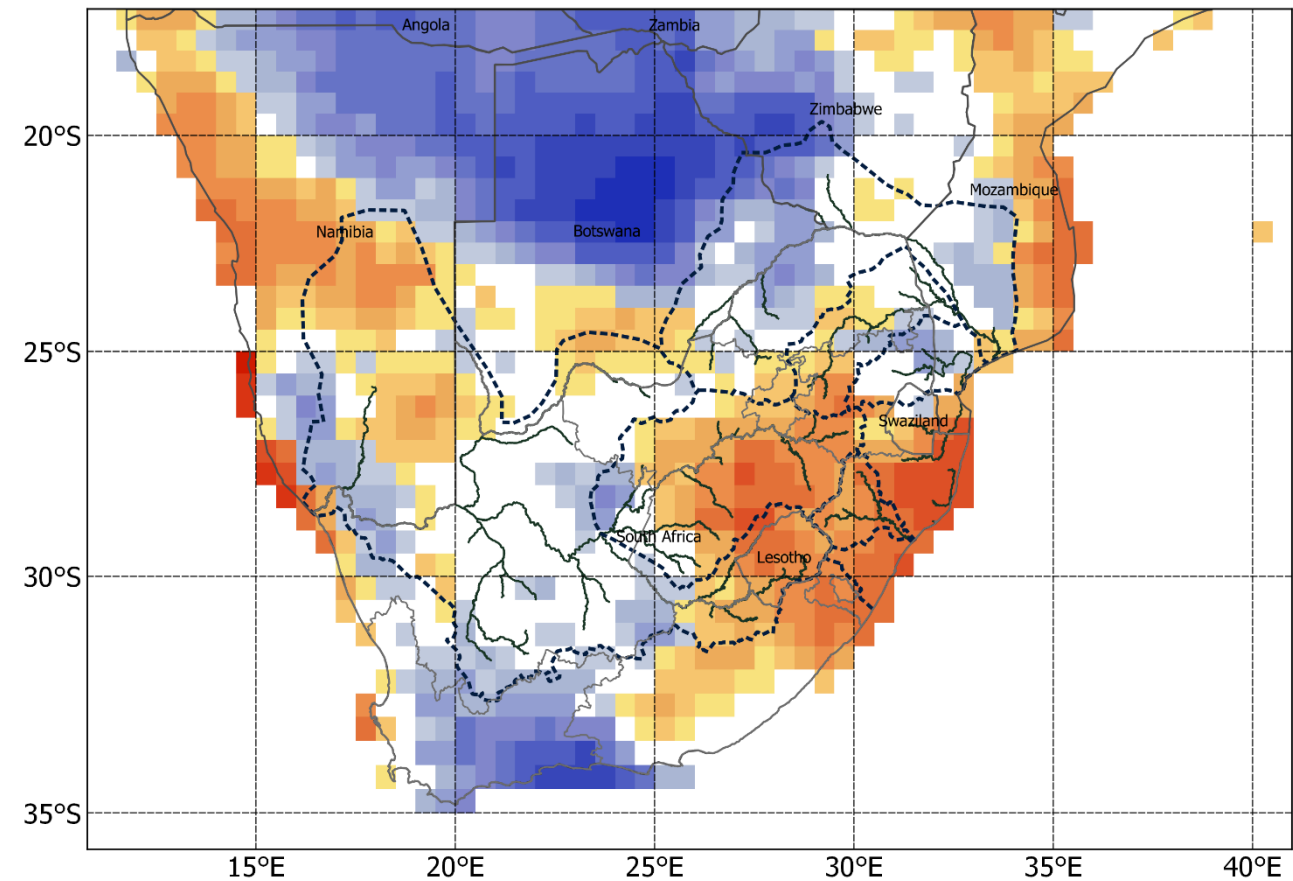
- Weak El Niño into early spring predicted.
- *From the CPC/IRI El Niño Watch in February: ...features are consistent with borderline, weak El Niño conditions... weak El Niño conditions are present and are expected to continue through the Northern Hemisphere spring 2019.*

Southern Africa Forecasts

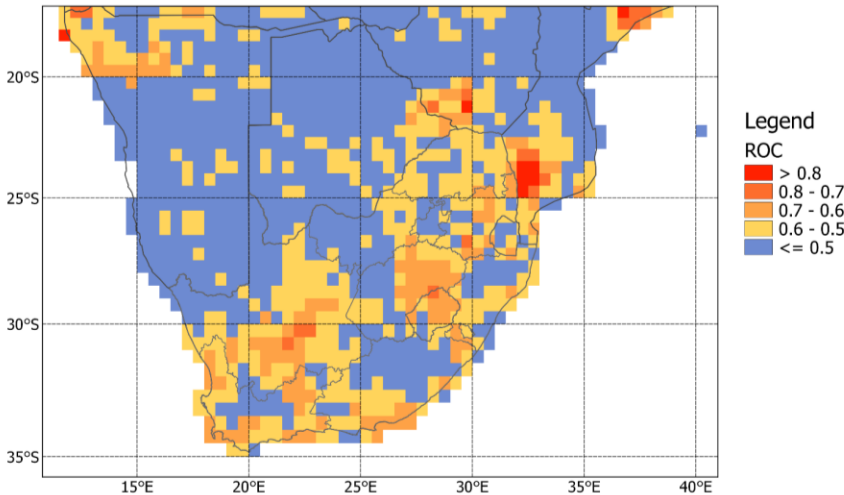
Prediction Method

- 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.

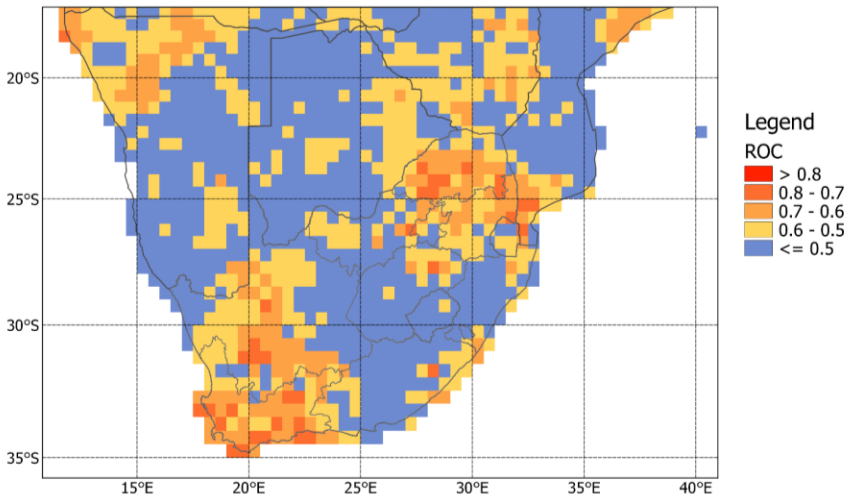
MAM 2019 Rainfall; ICs: Mar



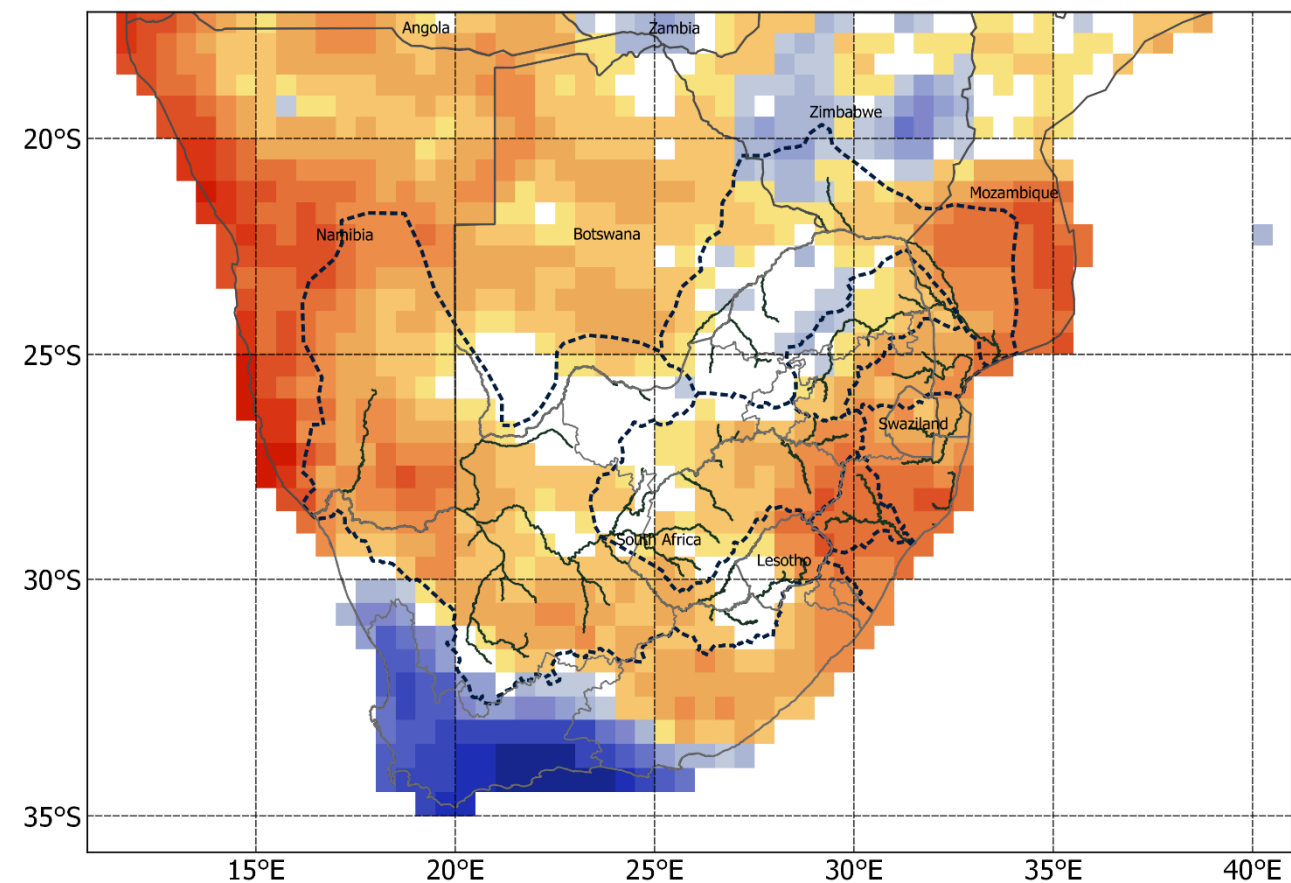
ROC Area (Above-Normal): MAM Rainfall



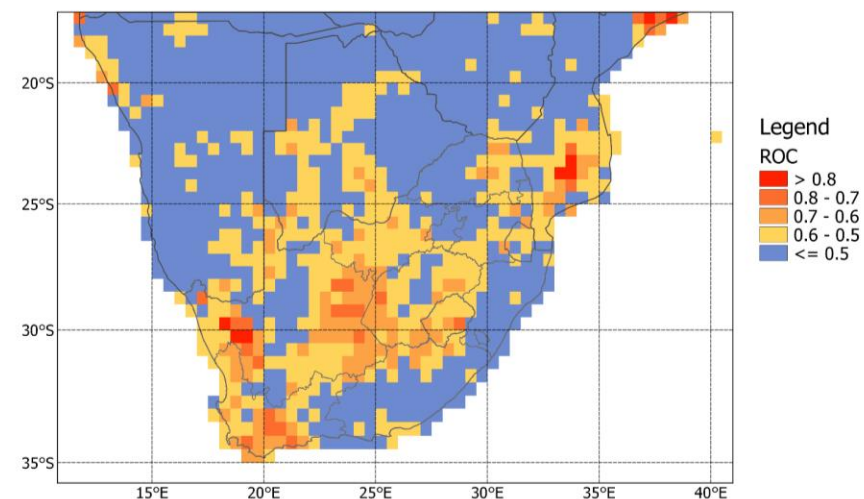
ROC Area (Below-Normal): MAM Rainfall



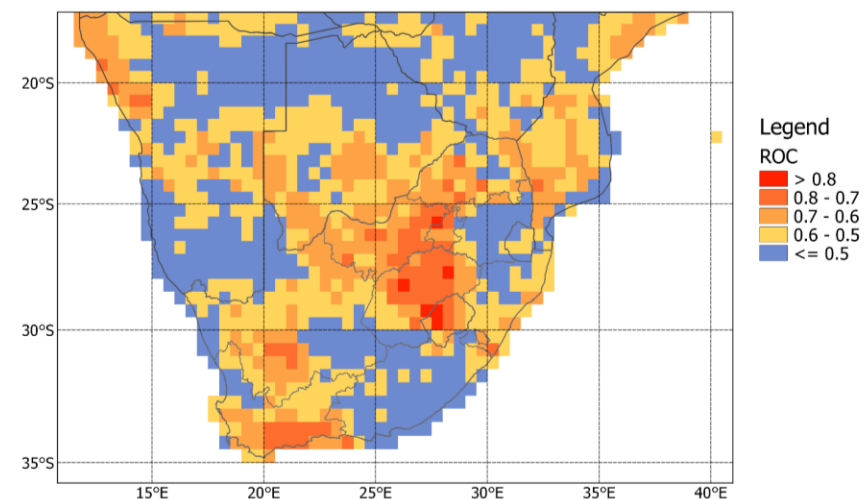
AMJ 2019 Rainfall; ICs: Mar



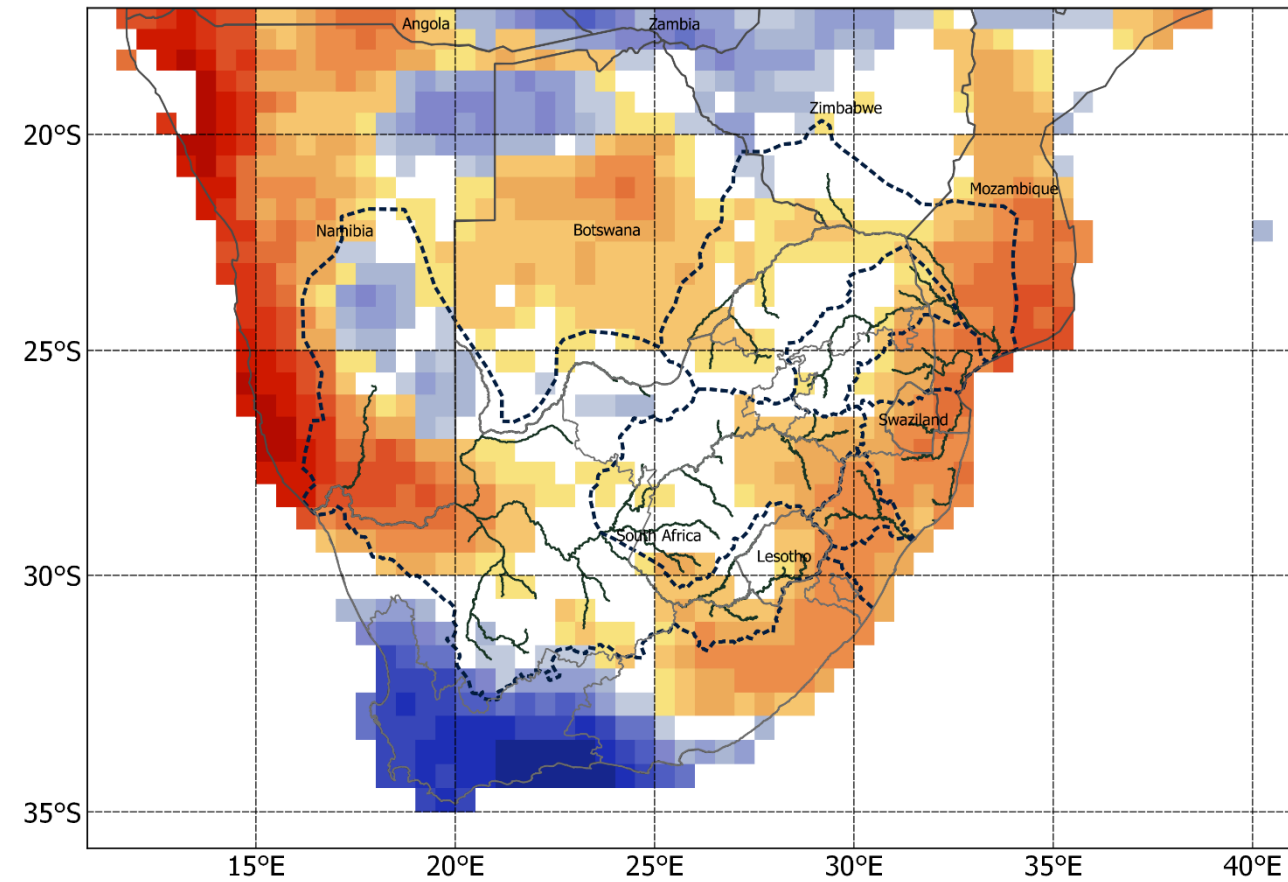
ROC Area (Above-Normal): AMJ Rainfall



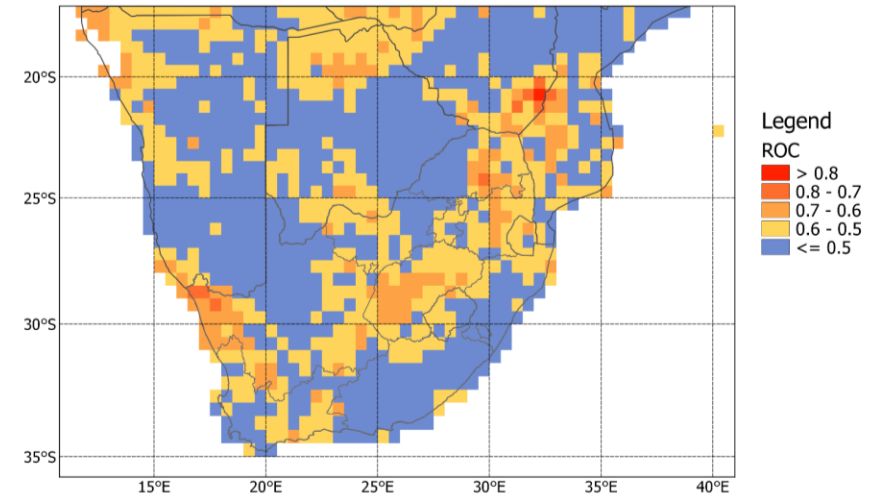
ROC Area (Below-Normal): AMJ Rainfall



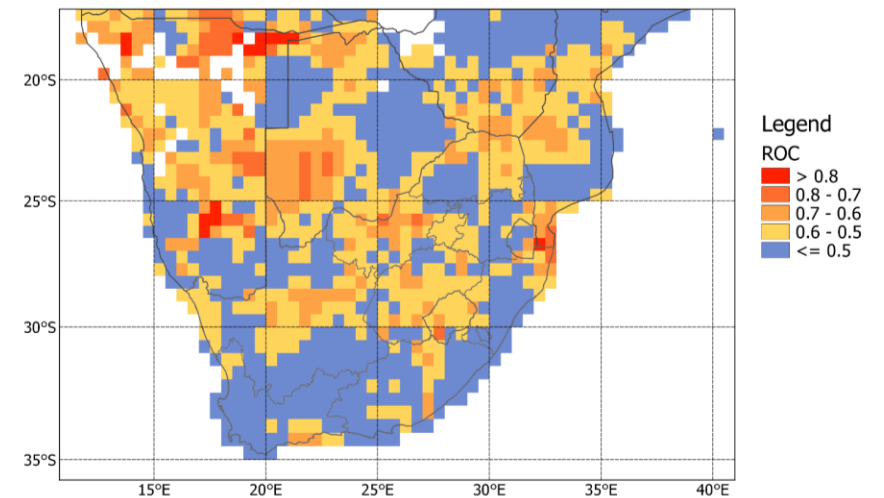
MJJ 2019 Rainfall; ICs: Mar



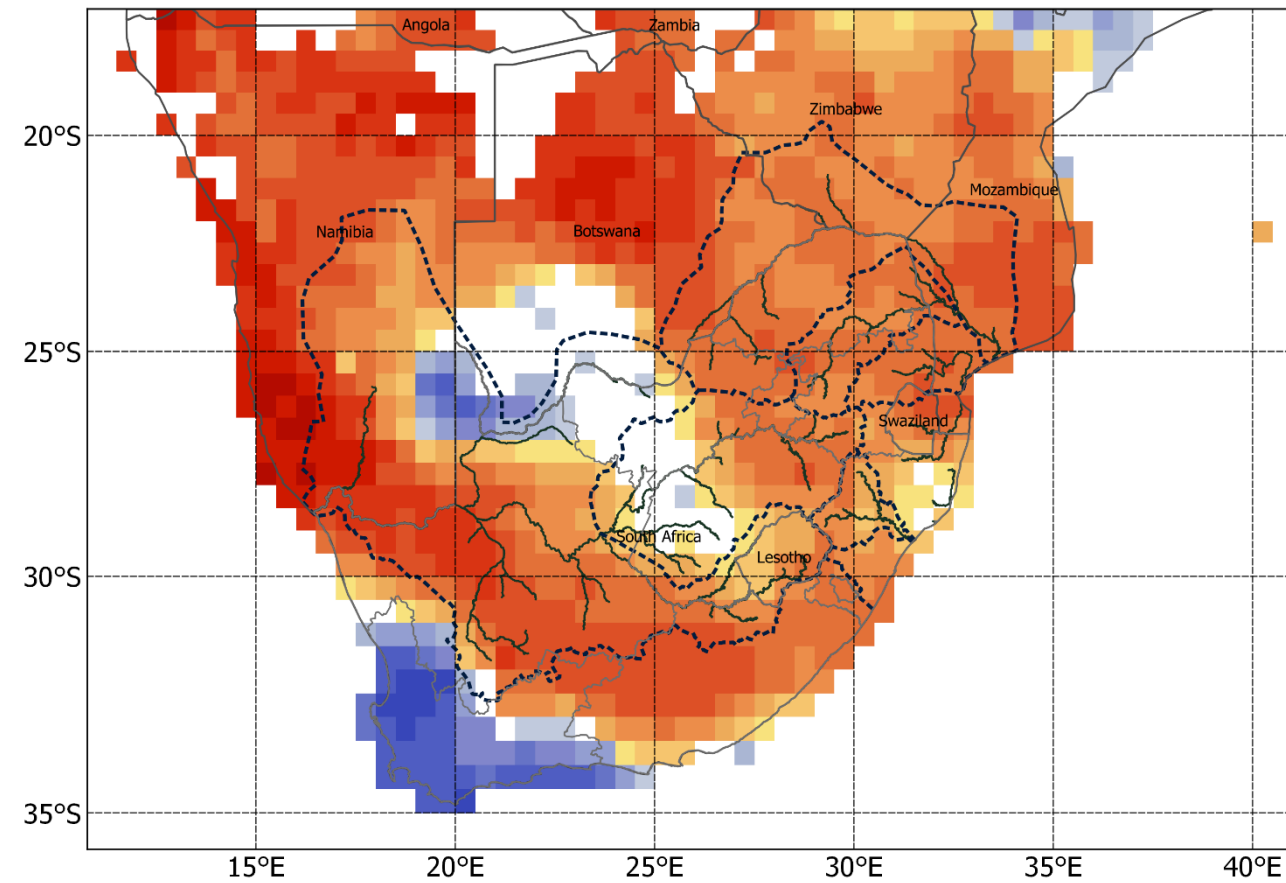
ROC Area (Above-Normal): MJJ Rainfall



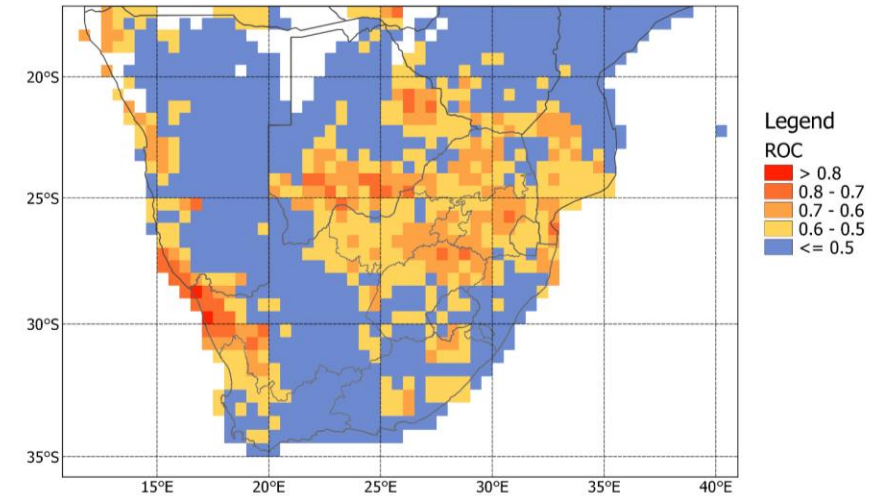
ROC Area (Below-Normal): MJJ Rainfall



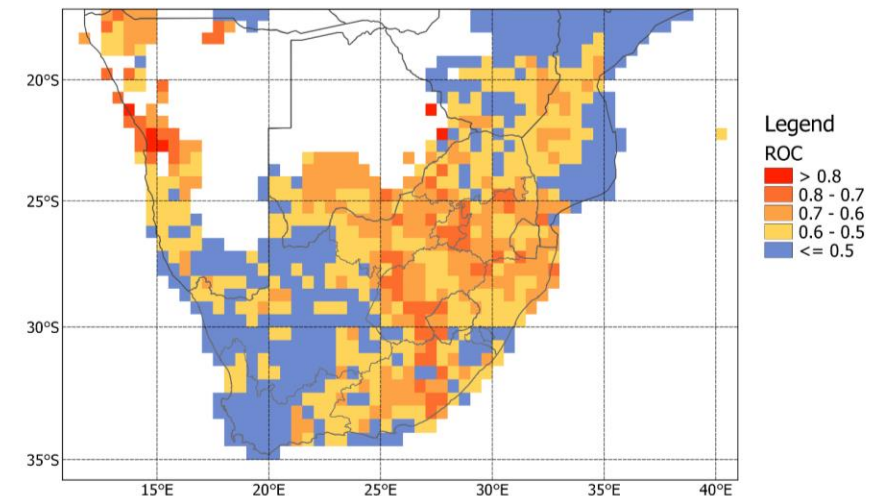
JJA 2019 Rainfall; ICs: Mar



ROC Area (Above-Normal): JJA Rainfall



ROC Area (Below-Normal): JJA Rainfall

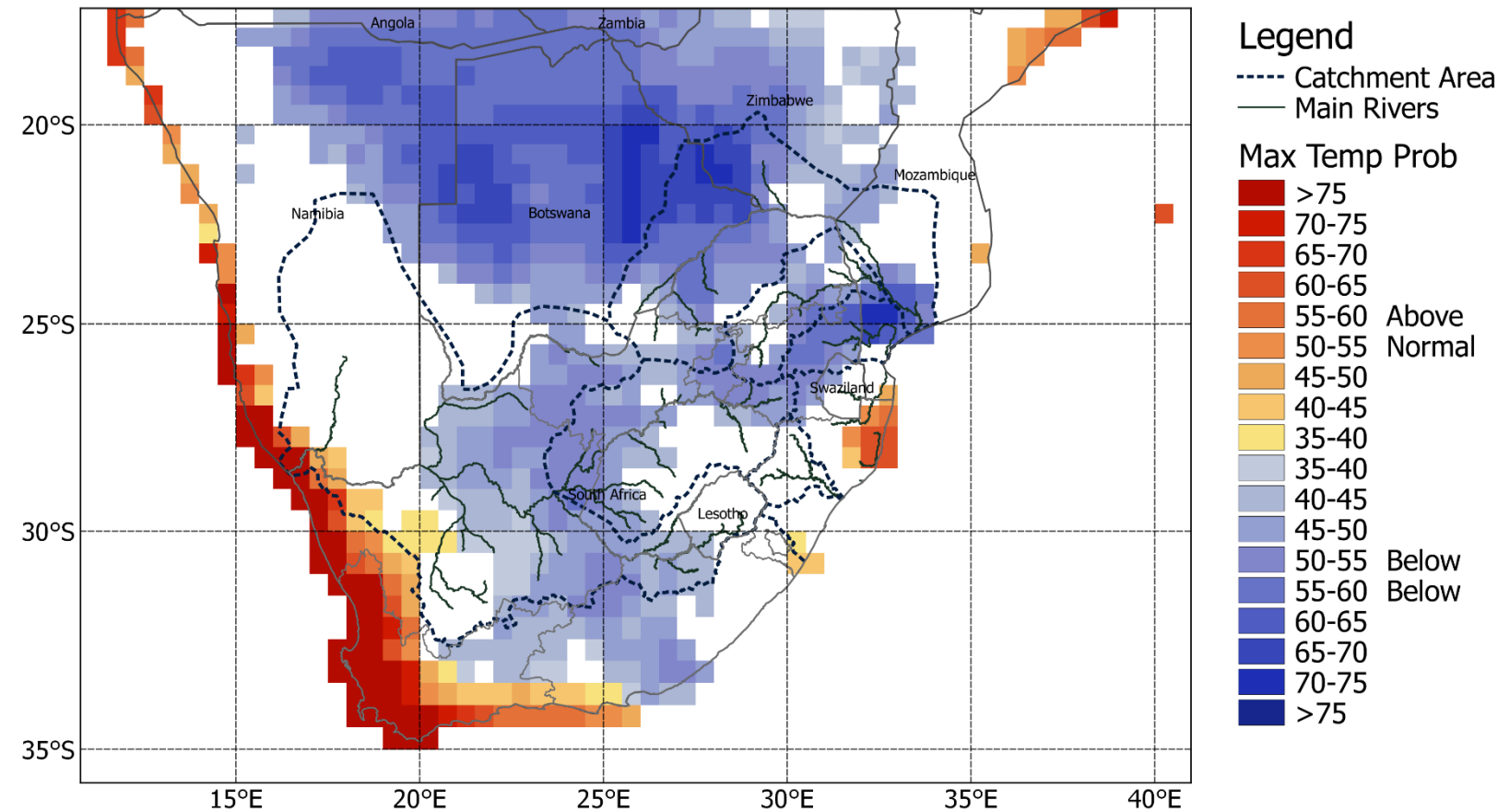


Blank areas on the ROC maps represent values of zero

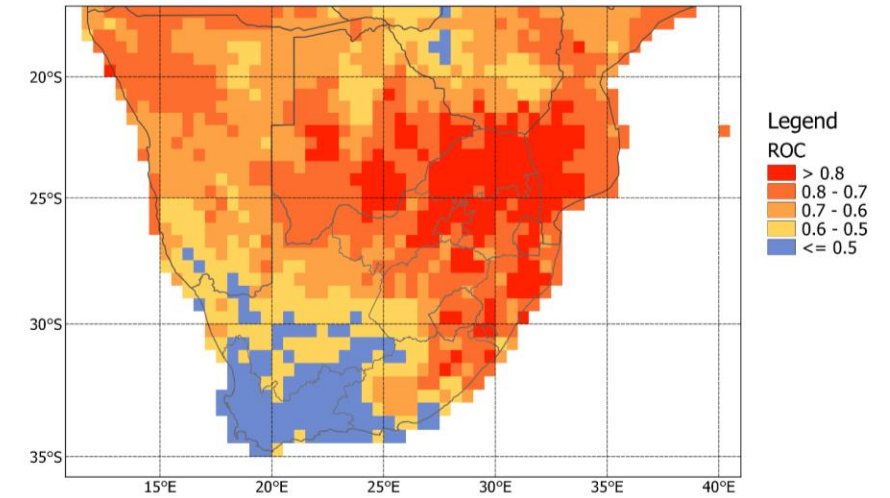
Round-up: SADC Rainfall

- Although weak El Niño conditions are present, the rainfall forecasts for autumn do not show a typical El Niño-type rainfall pattern of mainly below-normal rainfall totals.
- Enhanced probabilities for favourable rainfall outcomes are predicted over the southern and southwestern Cape areas for the larger part of the forecast period.

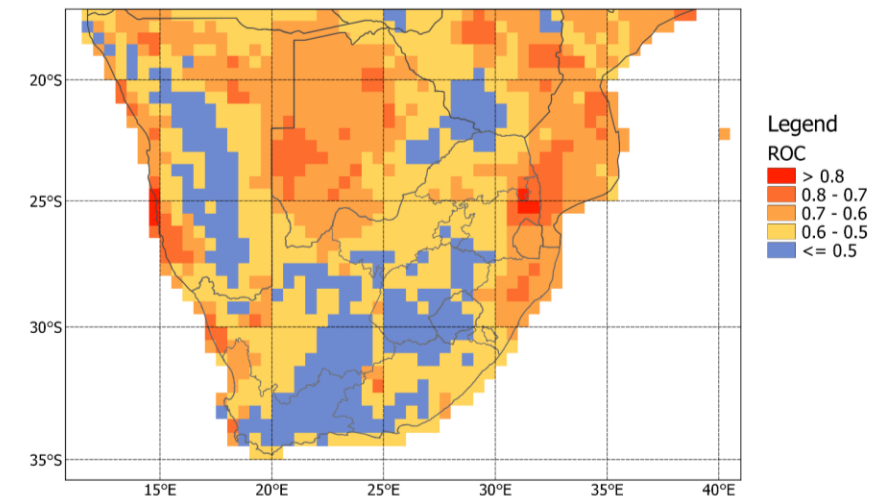
MAM 2019 Max Temp; ICs: Mar



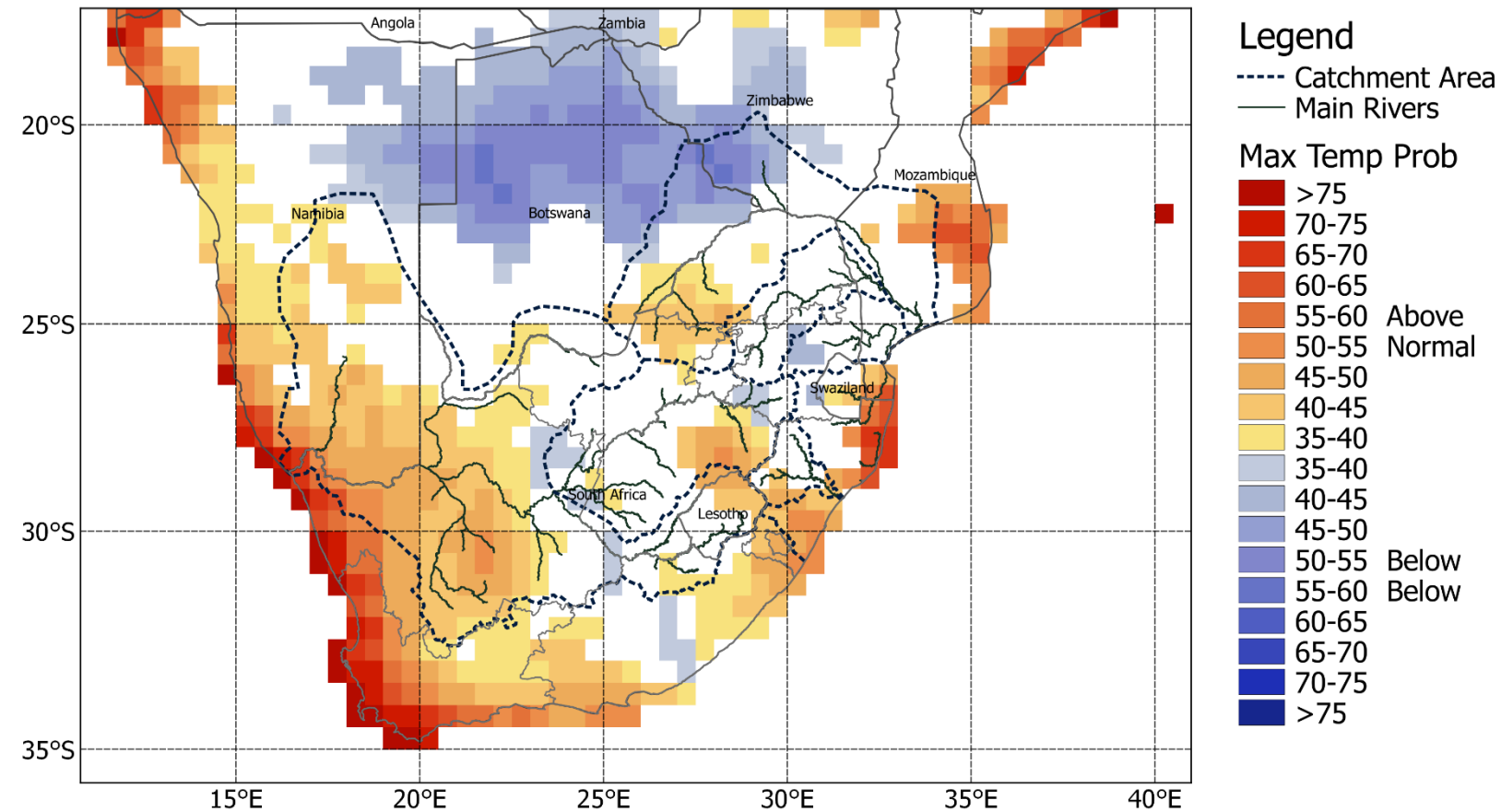
ROC Area (Above-Normal): MAM Max Temp



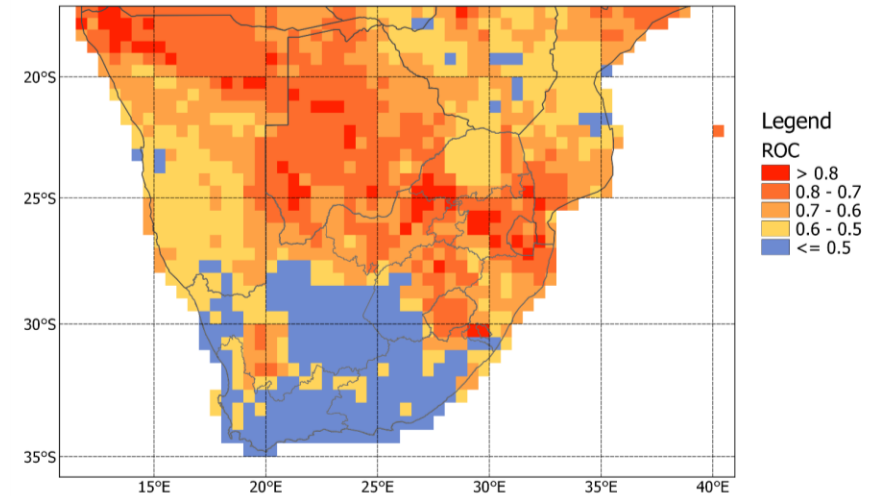
ROC Area (Below-Normal): MAM Max Temp



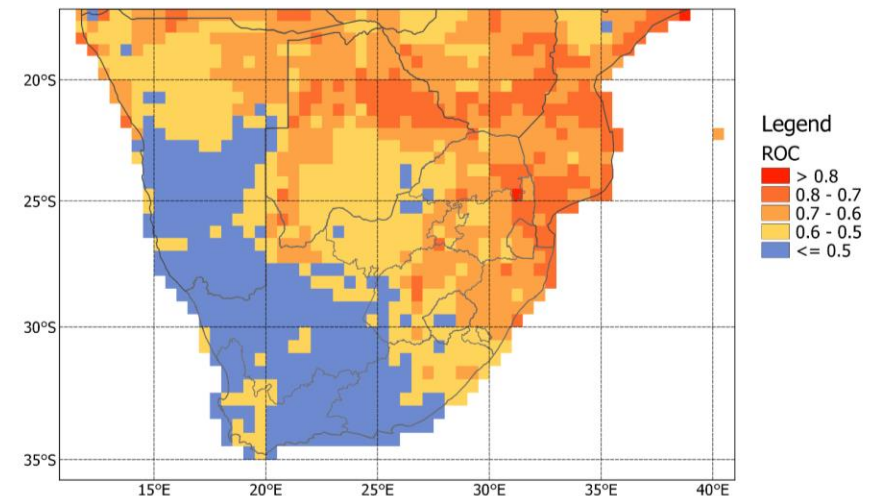
AMJ 2019 Max Temp; ICs: Mar



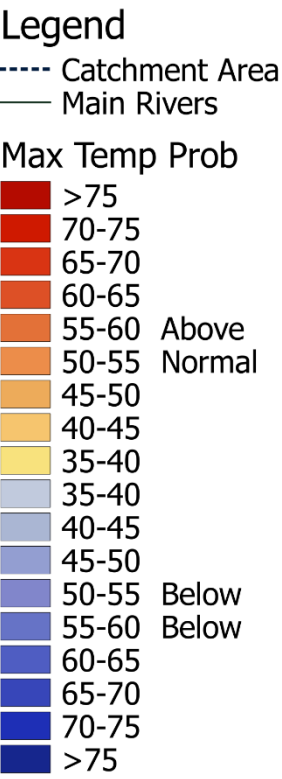
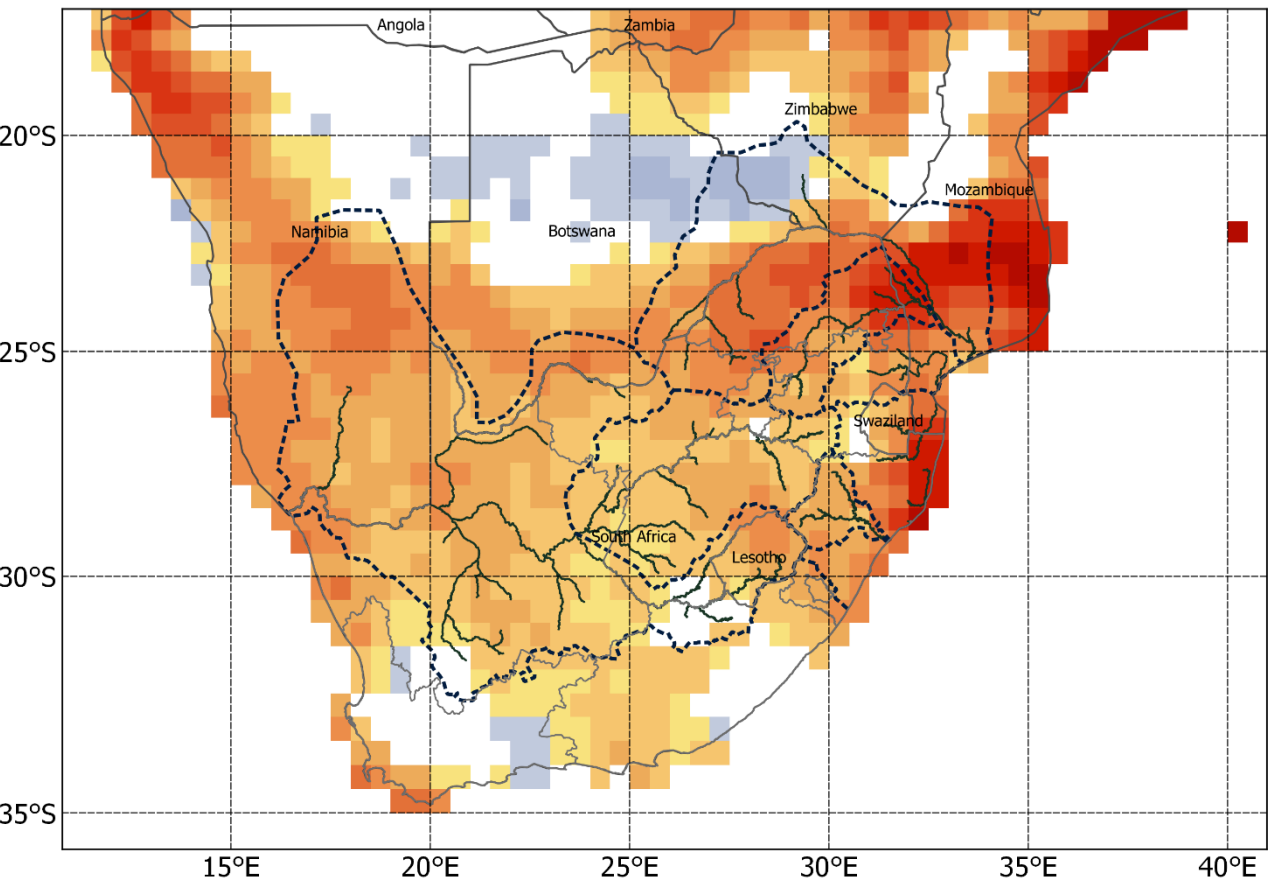
ROC Area (Above-Normal): AMJ Max Temp



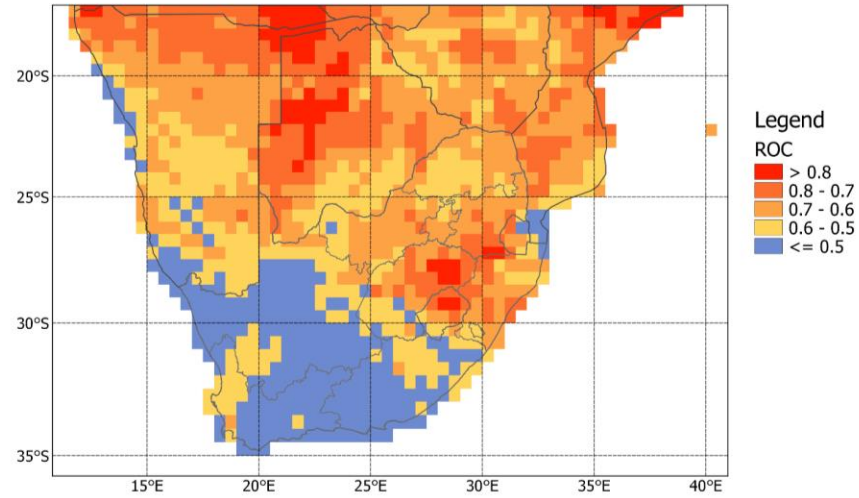
ROC Area (Below-Normal): AMJ Max Temp



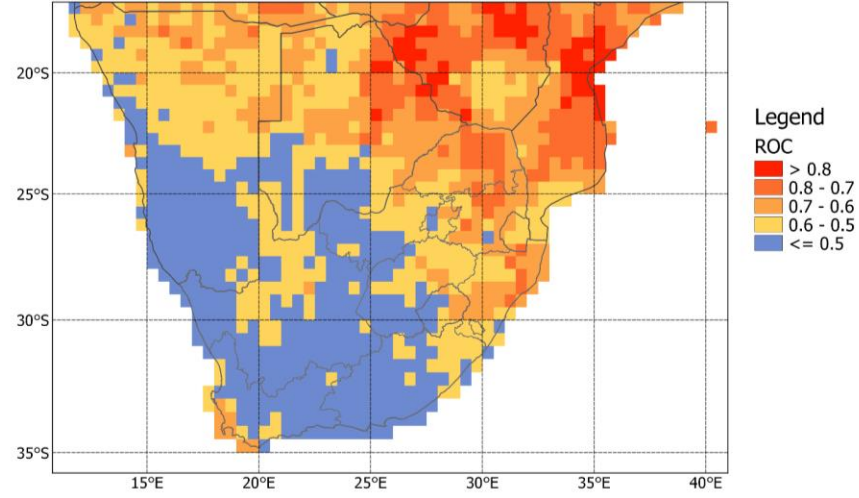
MJJ 2019 Max Temp; ICs: Mar



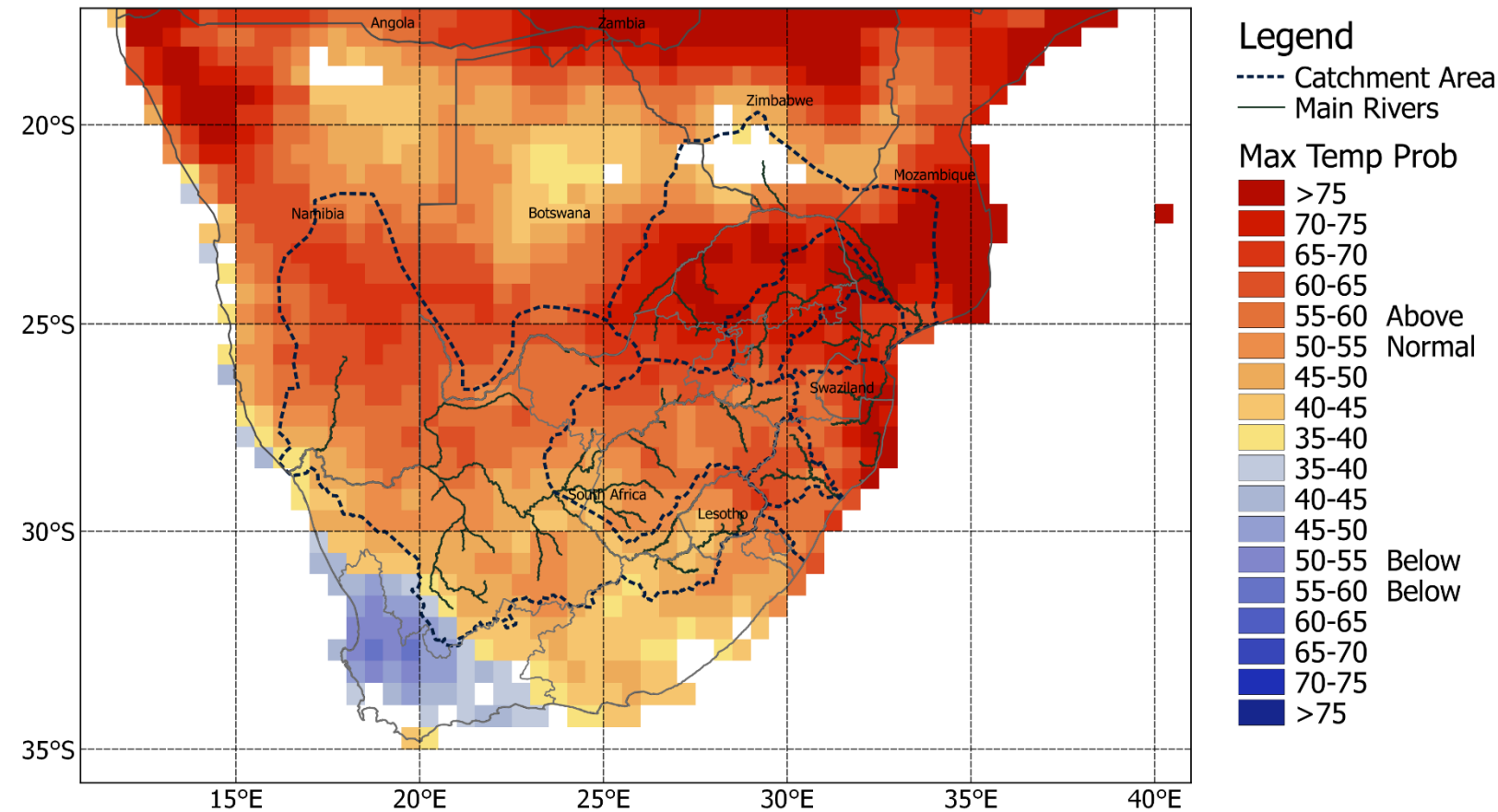
ROC Area (Above-Normal): MJJ Max Temp



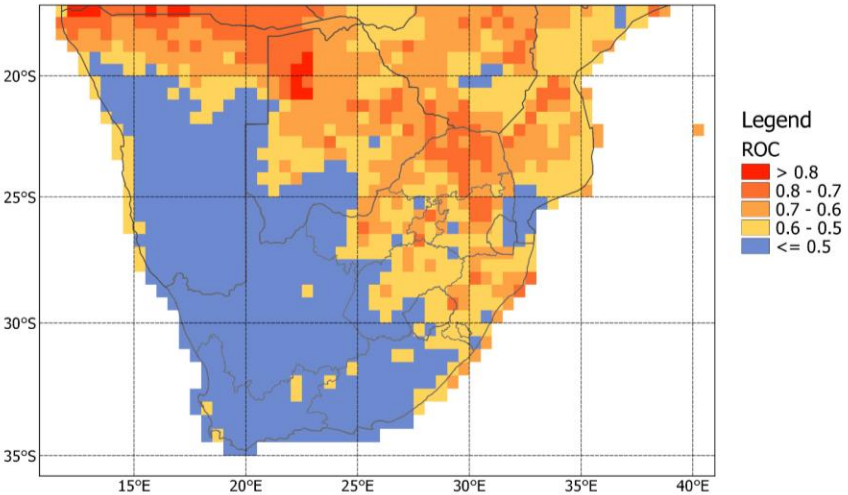
ROC Area (Below-Normal): MJJ Max Temp



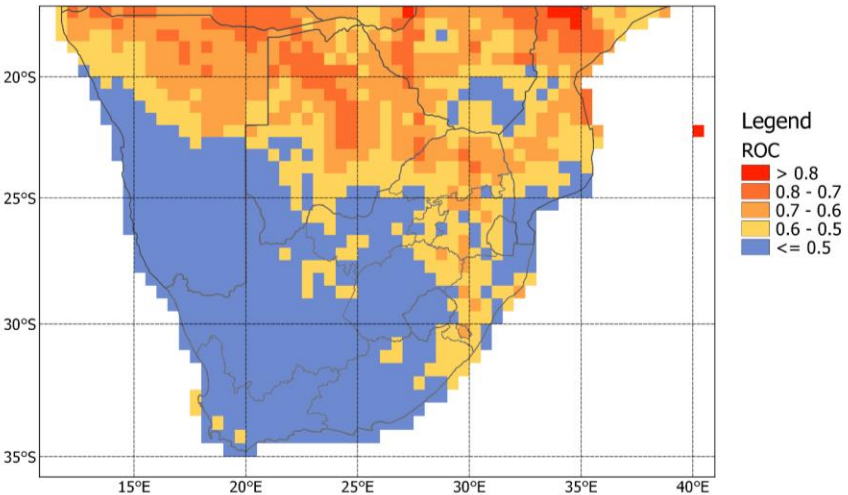
JJA 2019 Max Temp; ICs: Mar



ROC Area (Above-Normal): JJA Max Temp



ROC Area (Below-Normal): JJA Max Temp



Round-up: SADC Max Temp

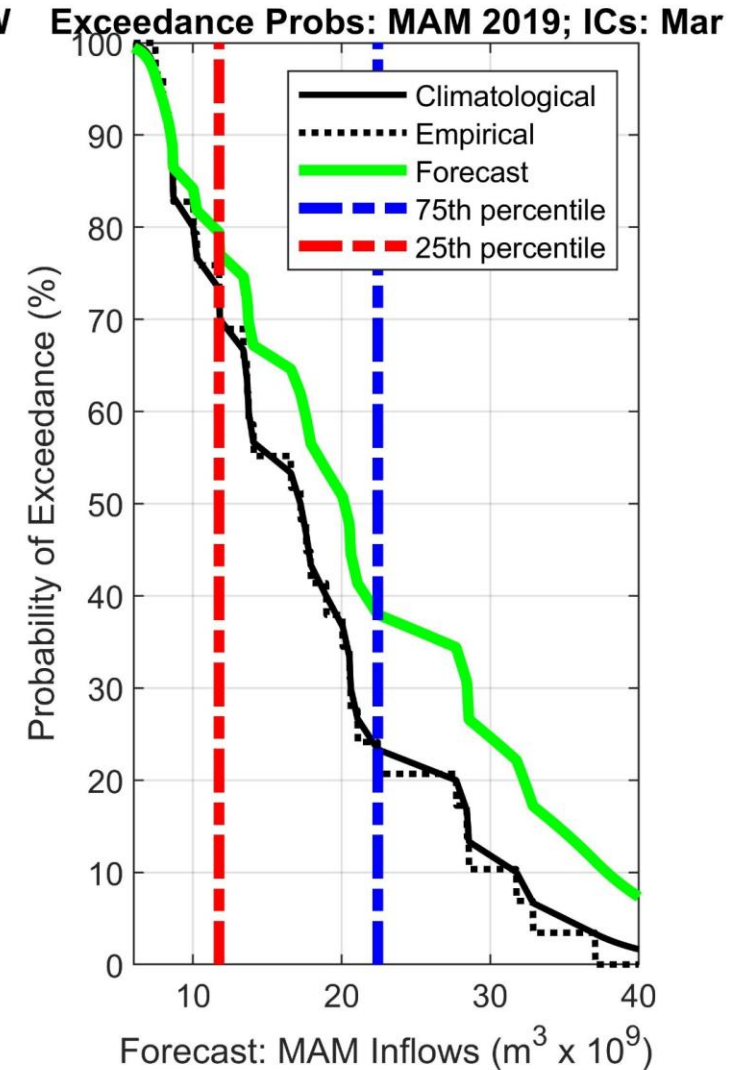
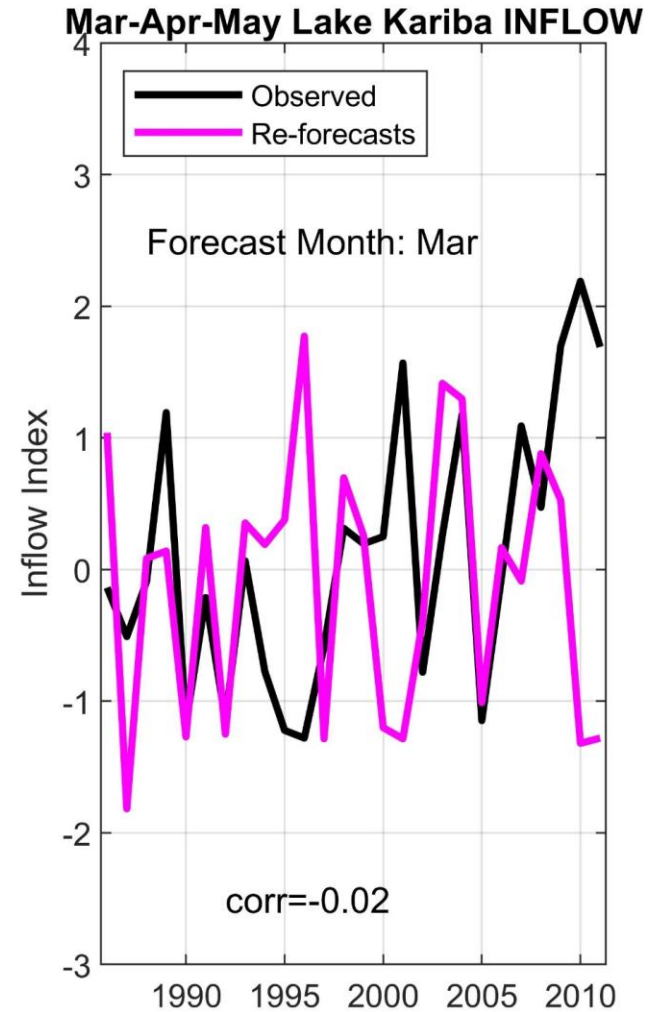
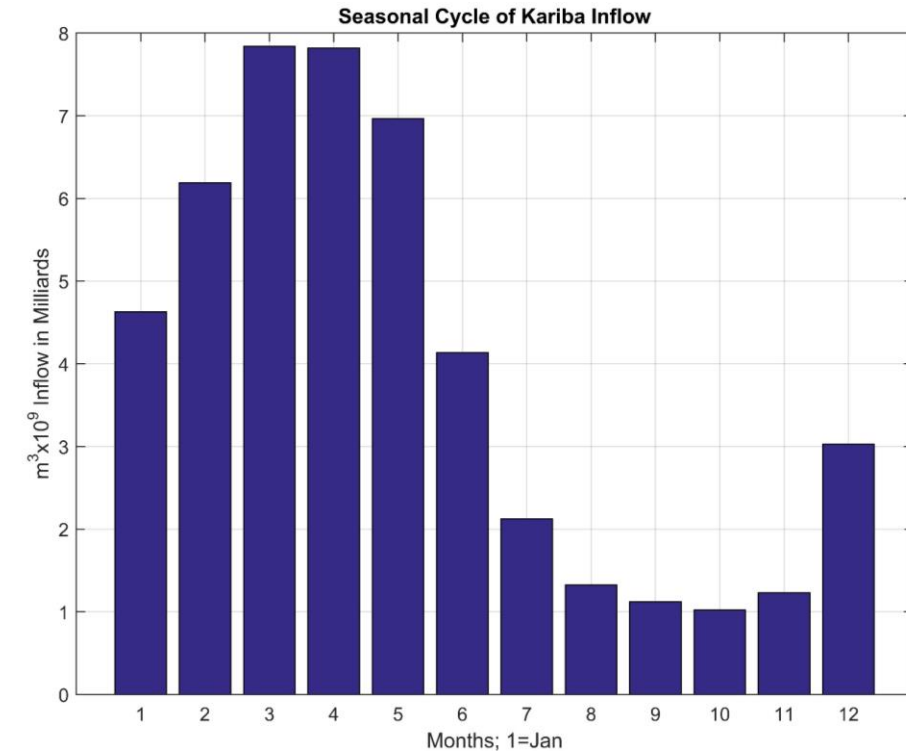
- Mainly cool (warm) maximum temperatures at first, replaced by predominantly high (low) maximum temperatures over the summer (winter) rainfall region.

Tailored Forecasts

1. Probability of exceedance Mar-Apr-May 2019 inflow forecast for Lake Kariba, Zambia/Zimbabwe

Inflow forecast for Lake Kariba: MAM

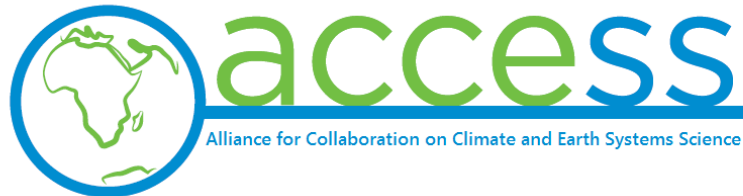
Muchuru et al. (2016)



- 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.

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- 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