Seasonal forecasts
presented by:

Seasonal Forecast Worx

Latest Update: 10 December 2018
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.

• 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-Dec-2018

El Nino

La Nina
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: Dec

Legend
- **Catchment Area**
- **Main Rivers**

Rainfall Prob
- >75
- 70-75
- 65-70
- 60-65
- 55-60
- 50-55
- 45-50
- 40-45
- 35-40
- 30-35
- 25-30
- 20-25
- 15-20

Above Normal
- 55-60
- 50-55
- 45-50
- 40-45
- 35-40
- 30-35
- 25-30
- 20-25

Below Normal
- 15-20
- 10-15
- 5-10
- 0-5

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

ROC Area (Above-Normal): JFM Rainfall

ROC Area (Below-Normal): JFM Rainfall
MAM 2019 Rainfall; ICs: Dec

Legend
- Catchment Area
- Main Rivers

Rainfall Prob
- >75
- 70-75
- 65-70
- 60-65
- 55-60
- 50-55
- 45-50
- 40-45
- 35-40
- 45-50
- 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
Round-up: SADC Rainfall

• Dry conditions are expected over the larger part of the summer rainfall regions.
• More favourable rainfall conditions are expected over the winter rainfall regions and some areas of the far western parts.
Round-up: SADC Max Temp

• Predominantly high maximum temperatures are expected
1. Probability of exceedance Jan-Feb-Mar 2019 rainfall forecast for the farm Buschbrunnen near Grootfontein, Namibia
2. Probability of exceedance Dec-Jan-Feb 2018/19 inflow forecast for Lake Kariba, Zambia/Zimbabwe
3. Probabilistic three-category malaria forecast for Limpopo for Dec-Jan-Feb 2018/19
Data and forecasts for the farm Buschbrunnen near Grootfontein, Namibia

Landman et al (2016)

JFM total rainfall as recorded by the farmer

JFM Rainfall - Buschbrunnen

Rainfall averages per month

Rainfall - Buschbrunnen, Namibia

Forecasts made in DECEMBER

The multi-model:
1. GFDL-CM2p5-FLOR-B01
2. COLA-RSMAS-CCSM4

Re-forecasts of JFM rainfall outcomes for 2010-2018, and real-time forecast for JFM 2019
Inflow forecast for Lake Kariba: onset season of DJF
Muchuru et al. (2016)
Dec-Jan-Feb (DJF) malaria cases for the Limpopo Province were obtained from their Department of Health. Taking the natural logs (ln) of the DJF 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 2018/19 real-time forecast from the GFDL coupled model are statistically downscaled to DJF 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.


• 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


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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