

Weather and Climate in South Africa – Analysis and projections

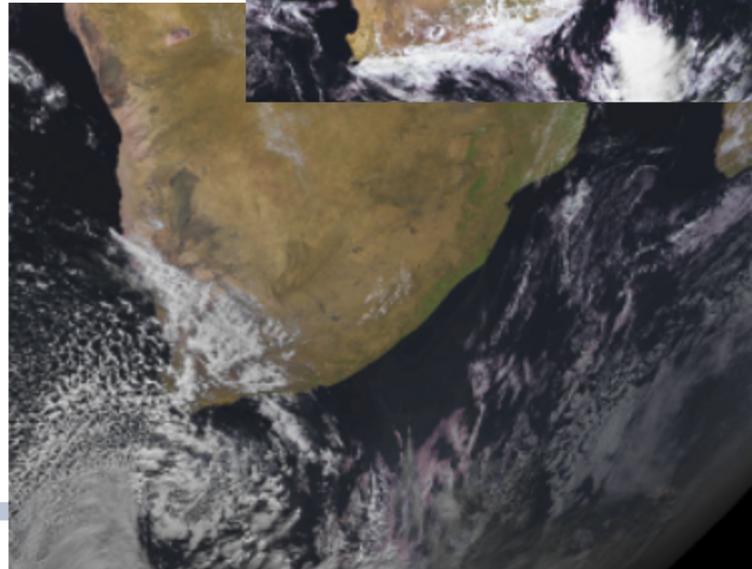
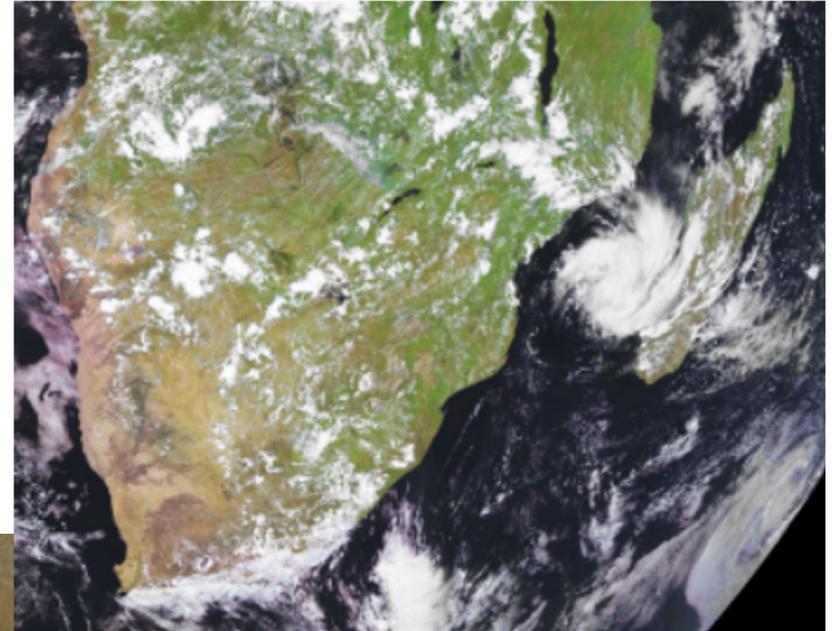
Presidential Climate Commission

17 November 2023

SAEON and SAWS teams

Weather Systems Influencing South Africa

- Influenced by tropical, subtropical and mid-latitude systems
- Tropical cyclones – landfall along the east coast
- Subtropical high pressure systems – transport moisture into SA
- Mid-latitude systems – northward migration in winter
- Warmer Indian ocean and cooler Atlantic ocean
- Topography



Early Warnings

23 March 2022 | Climate and Environment

The UN set an ambitious five year deadline on Wednesday for countries to ensure that citizens worldwide are protected by warning systems against extreme weather and climate change, the UN chief announced, marking World Meteorological Day



2022 report

- 110 million directly affected
- 5000 fatalities
- Over US\$8.5 billion in damages
- Droughts – lead in deaths & people affected
- Floods lead in economic damages



Investing in early warnings and early actions is a priority for saving lives, promoting economic development, valuing development gains and livelihoods, protecting the environment, and reducing the cost of disaster responses.

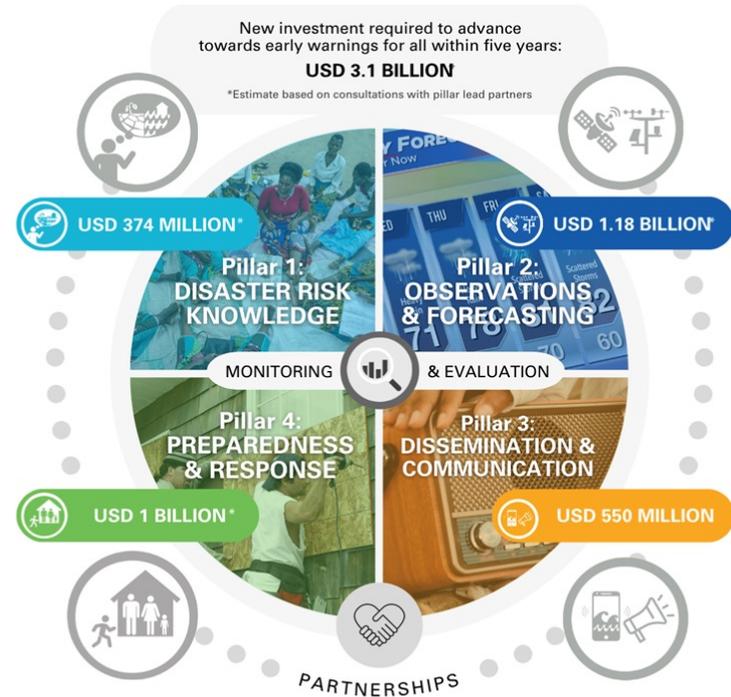
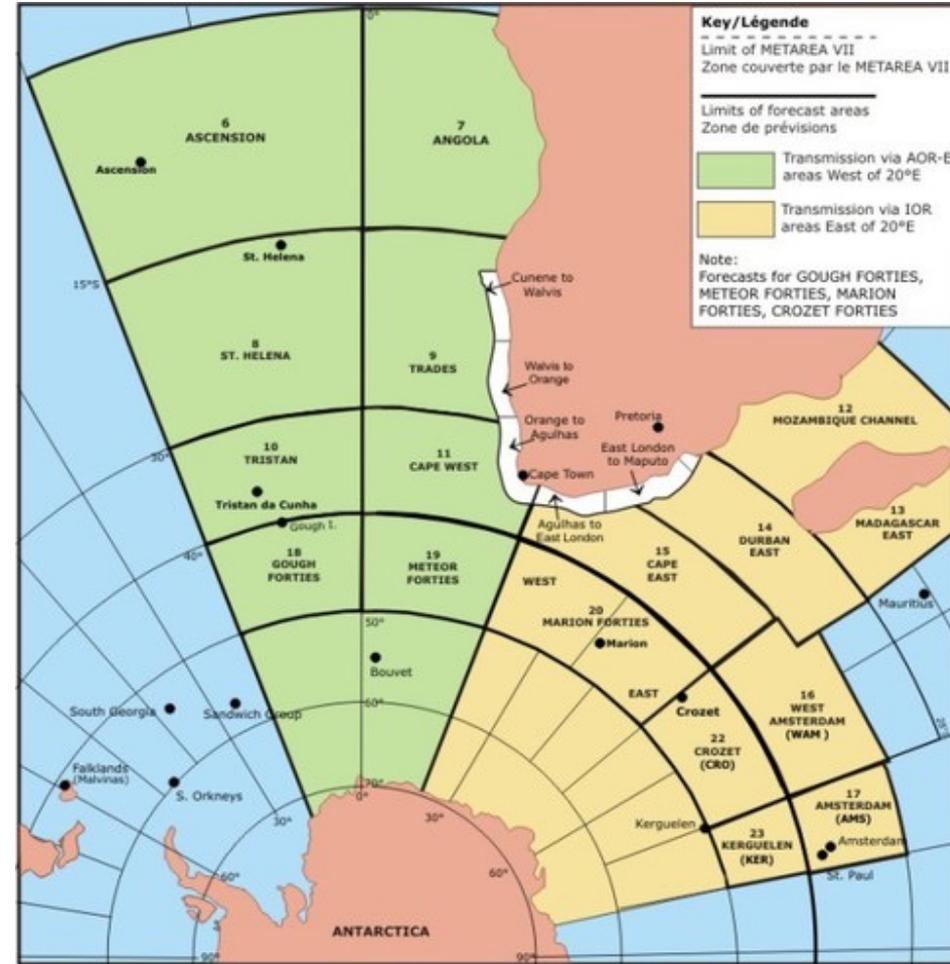
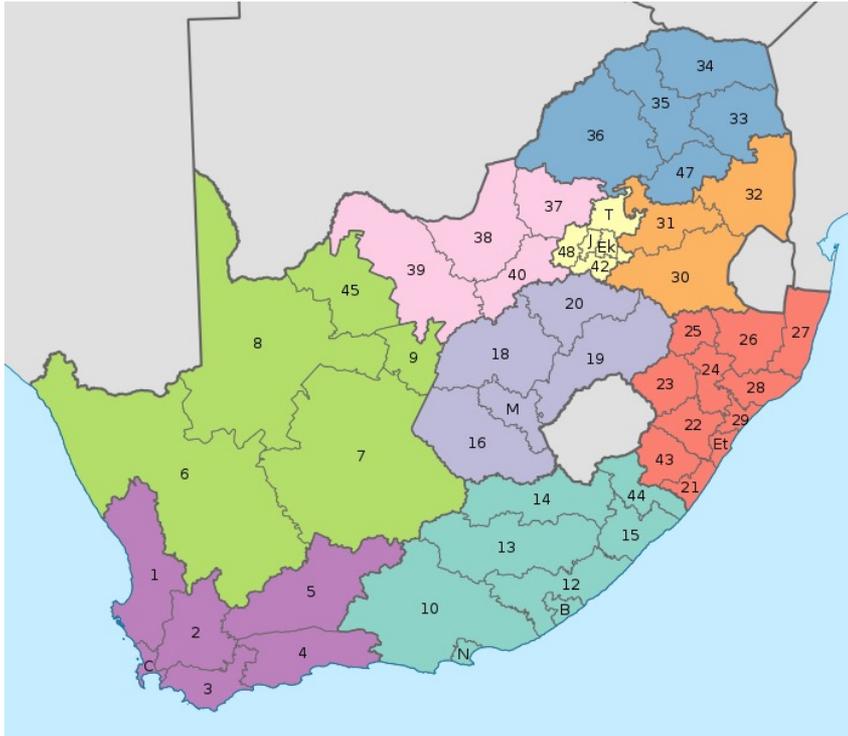


Figure 1: Budget overview for the four Pillars of the Early Warnings for All Initiative

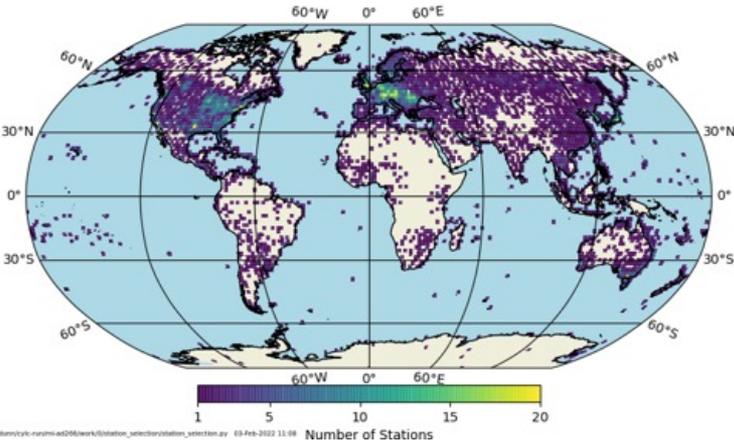
<https://public.wmo.int/en/media/press-release/early-warnings-all-action-plan-unveiled-cop27>

South Africa – region of interest



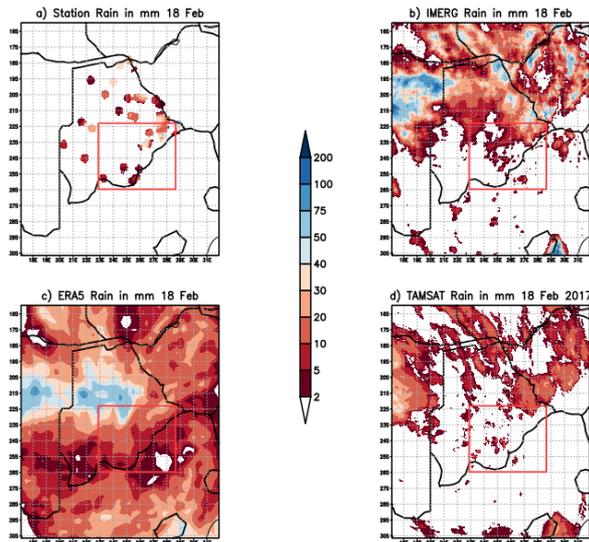
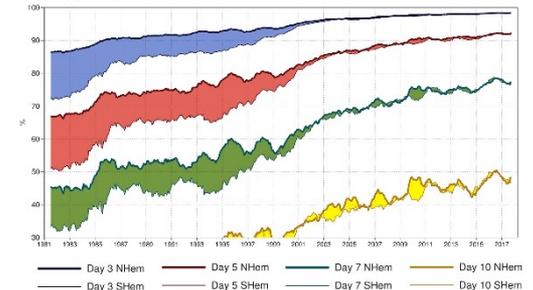
Observations

Stations reporting at least 6hly



- Improvements in forecast skill in southern hemisphere with introduction of satellite information
- Disparities still exist in remote sensing products

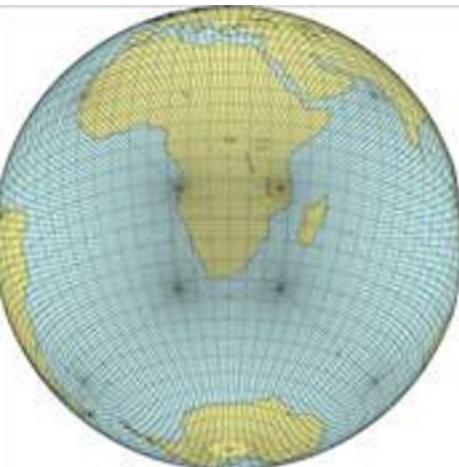
- IMERG
- TAMSAT
- ERA5



- Ground truth only from ground observations

Weather and Climate Numerical Modelling

- Weather forecasting and climate predictions beyond 2 hours rely on the use of numerical models
- Different components of the earth system should be represented
- Expensive computationally and therefore require supercomputers



$$\frac{DV}{Dt} = -\frac{1}{\rho} \nabla p - f k \times V - gk + F$$

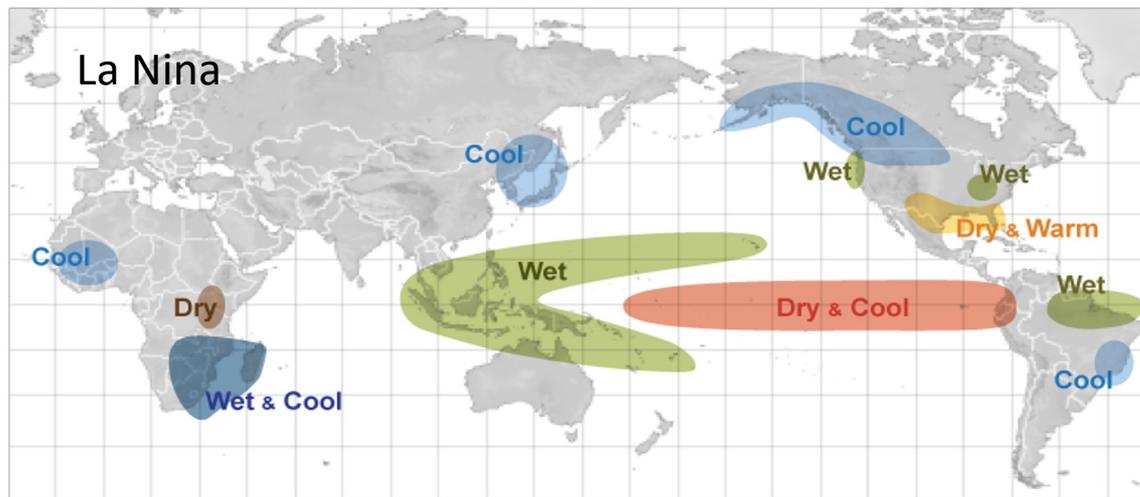
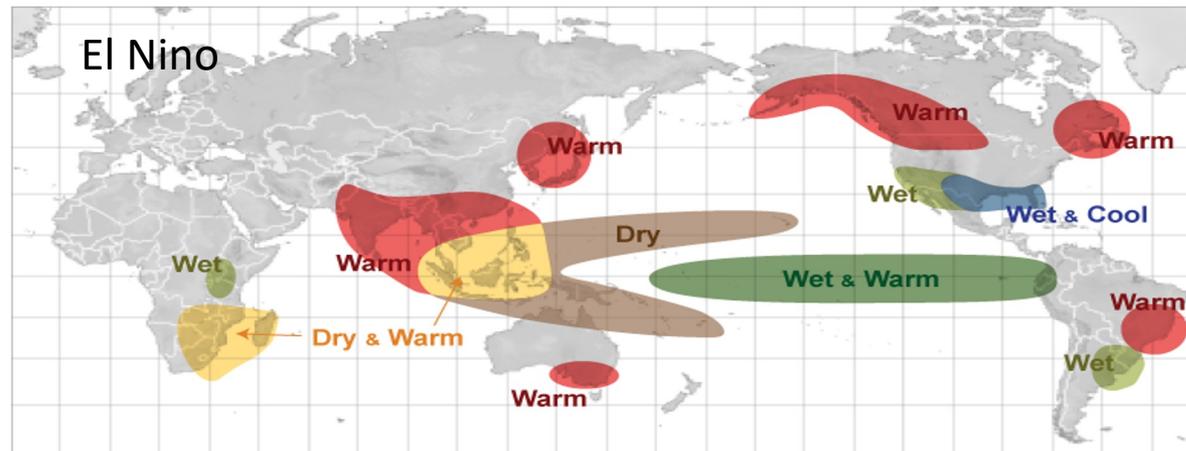
$$\frac{D\rho}{Dt} = -\rho \nabla \cdot V$$

$$c_p \frac{DT}{Dt} - \alpha \frac{Dp}{Dt} = 0$$



El Nino Southern Oscillation (ENSO)

- December to February (DJF) impacts



https://www.noaa.gov/jetstream/enso_impacts

ENSO Forecasts

SST Anomalies (°C)
 01 NOV 2023

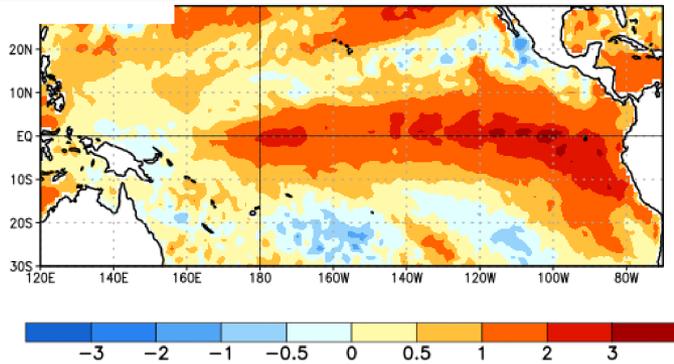
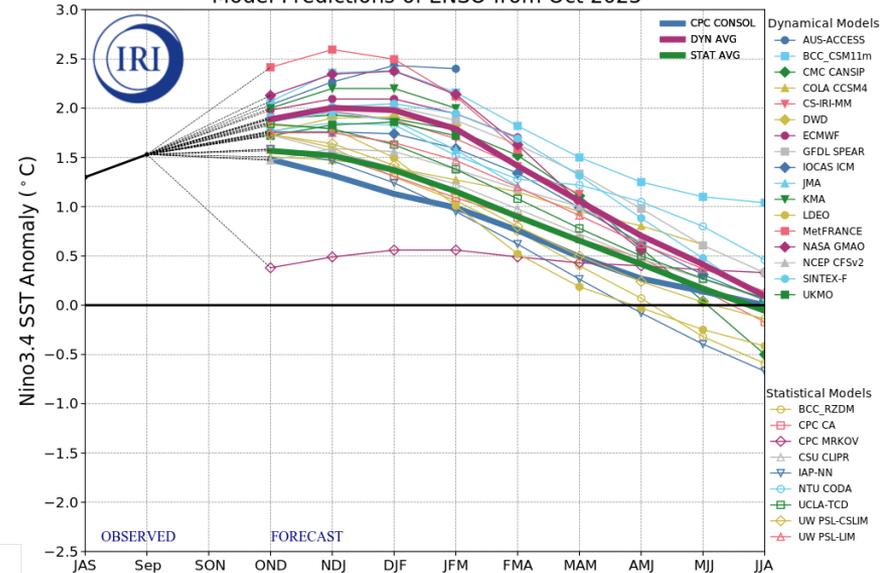


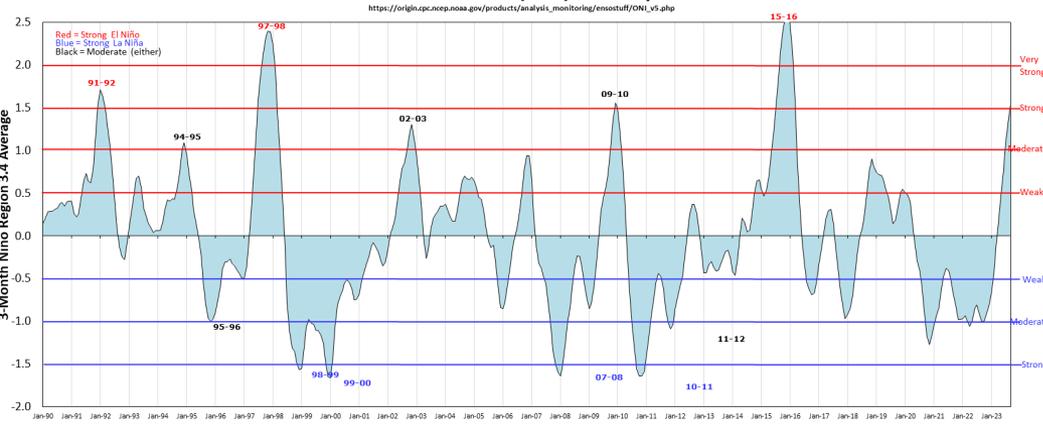
Figure 1. Average sea surface temperature (SST) anomalies (°C) for the week centered on 1 November 2023. Anomalies are computed with respect to the 1991-2020 base period weekly means.
https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-cpc_update

Model Predictions of ENSO from Oct 2023



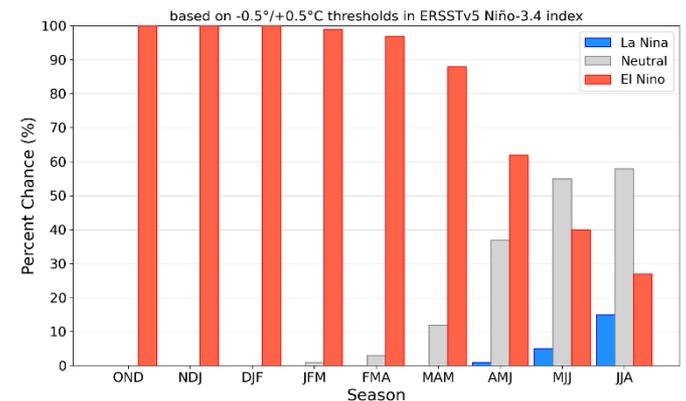
https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-cpc_plume

Oceanic Niño Index (ONI) - 1990-present



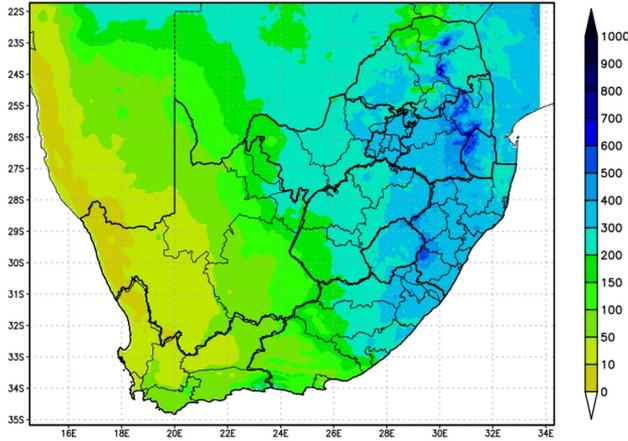
<https://ggweather.com/enso/oni.htm>

Official NOAA CPC ENSO Probabilities (issued Nov. 2023)

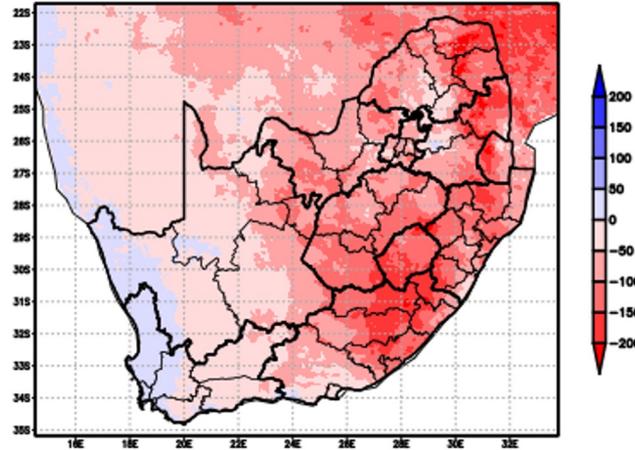


Very Strong EL Nino Years

Average DJF rainfall

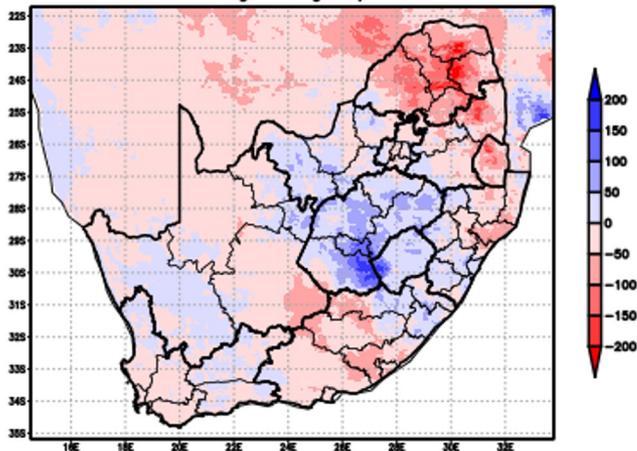


Rainfall during strong 82/83 El Nino

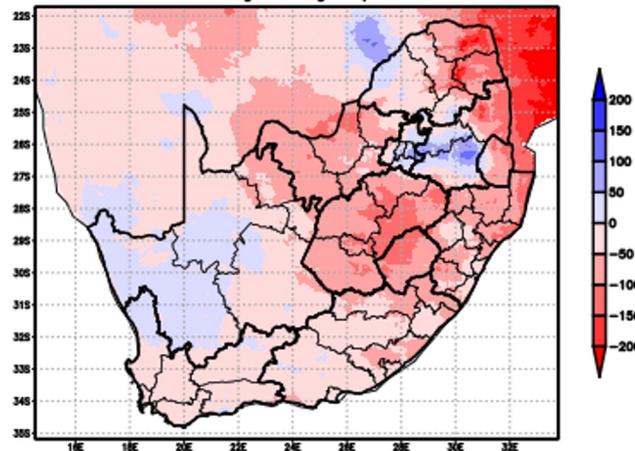


- Impacts of El Nino stronger during 82/83 and 15/16 summer seasons
- 97/98 was a normal rainfall year in SA

Rainfall during strong 97/98 El Nino

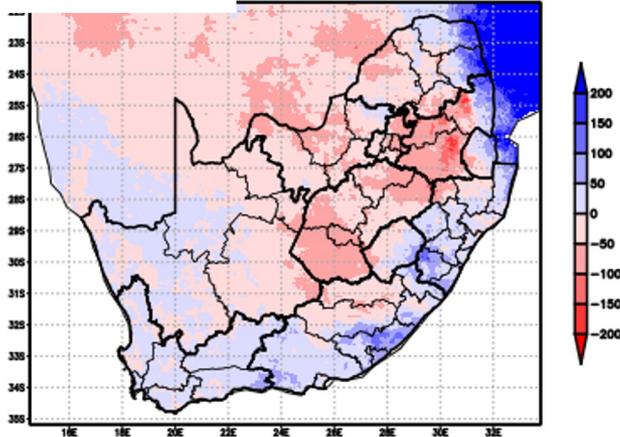


Rainfall during strong 15/16 El Nino

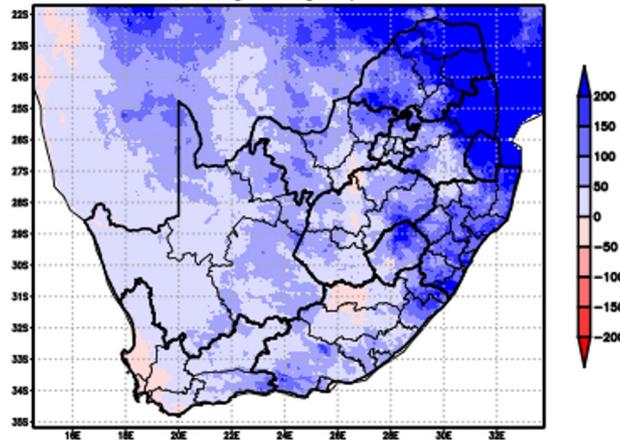


Strong La Nina Year

strong 98/99 La Nina

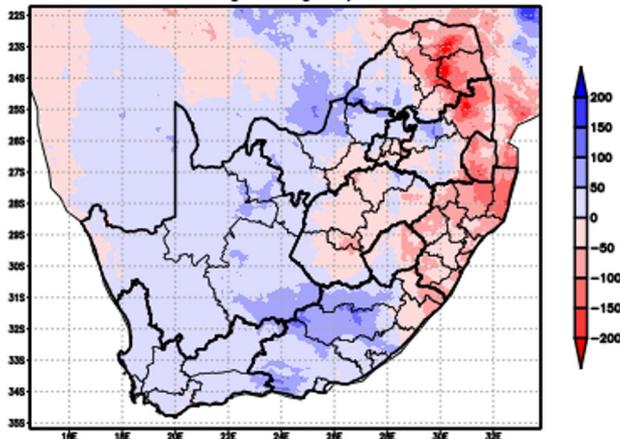


Rainfall during strong 99/00 La Nina

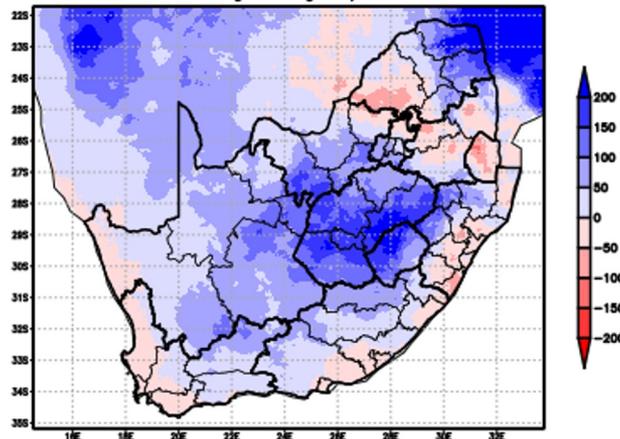


- Each year is different but La Ninas are generally associated with above normal rainfall

Rainfall during strong 07/08 La Nina



Rainfall during strong 10/11 La Nina



SAWS Seasonal Prediction System

November-December-January

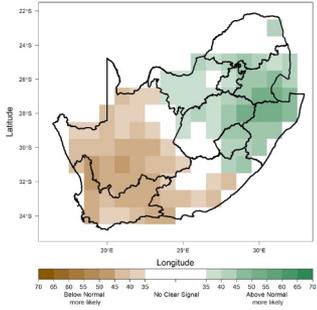
December-January-February

January-February-March

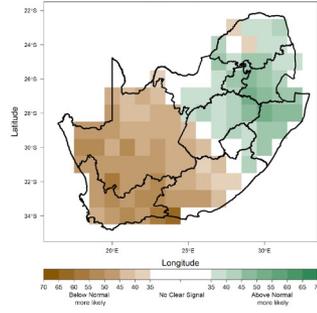
Below-normal Above-normal

RAINFALL

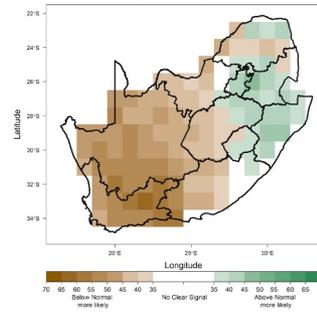
Expected Precipitation Conditions for NDJ 2023/24
Issued: Oct 2023



Expected Precipitation Conditions for DJF 2023/24
Issued: Oct 2023



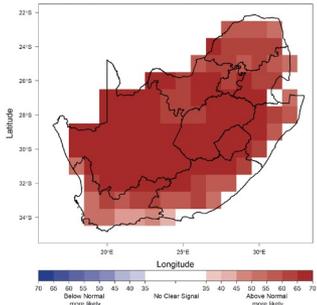
Expected Precipitation Conditions for JFM 2024
Issued: Oct 2023



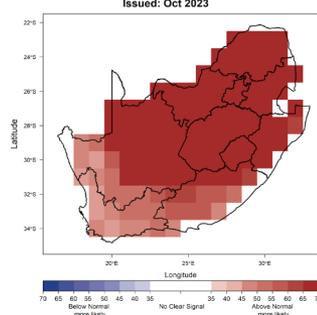
Above-normal rainfall over the eastern parts of the country (but mostly with low-probabilities) is predicted, with below-normal rainfall predicted over the western parts of the country.

Max Temp

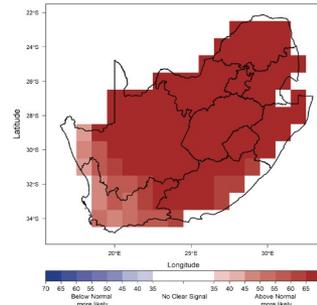
Expected Max Temp Conditions for NDJ 2023/24
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Expected Min Temp Conditions for DJF 2023/24
Issued: Oct 2023



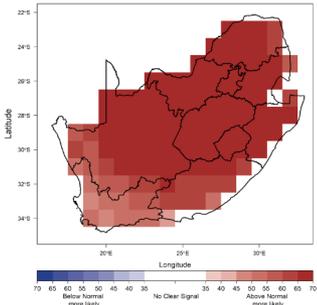
Expected Min Temp Conditions for JFM 2024
Issued: Oct 2023



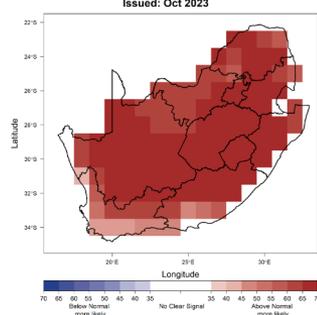
Above-normal maximum and minimum temperatures are predicted.

Min Temp

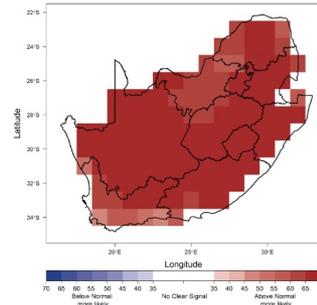
Expected Min Temp Conditions for NDJ 2023/24
Issued: Oct 2023



Expected Max Temp Conditions for DJF 2023/24
Issued: Oct 2023



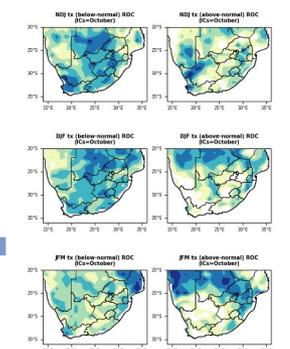
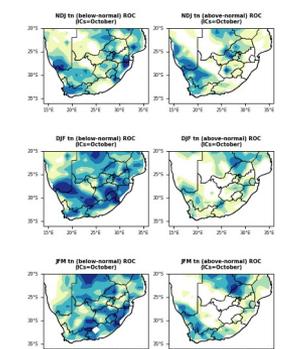
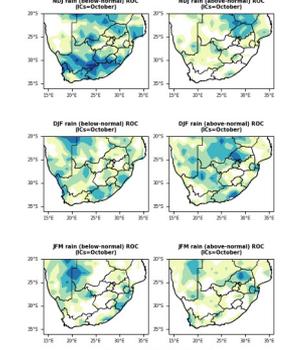
Expected Max Temp Conditions for JFM 2024
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Rainfall Skill

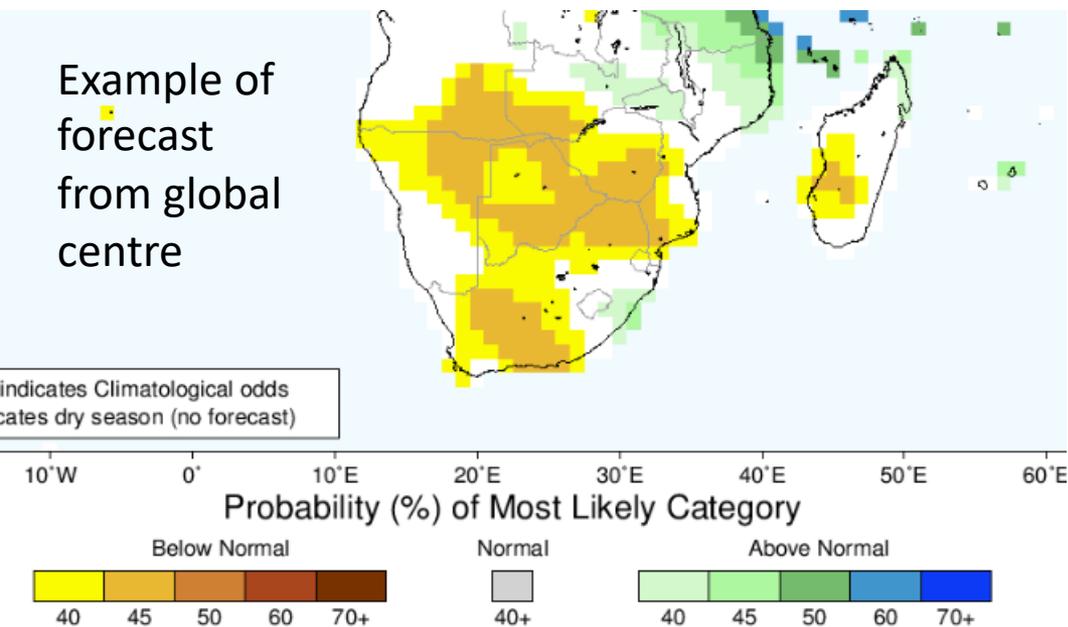
Max Temp Skill

Min Temp Skill



Concluding Remarks

Example of forecast from global centre



- Basic elements of forecasting systems – observation network and super computers
- Other planned works
 - Literature review to capture latest published work on SA climate
 - Update Climate change projections
 - Publish results on the South African Risk and Vulnerability Atlas (SARVA)

- Forecasts updated regularly as data comes in
- State of ENSO and other modulators monitored regularly
- Updates will be provided to the PCC on a quarterly basis

Thank you