Assessing the El Niño & La Niña phenomenon against rainfall in southern Africa

June 2026

El Niño and La Niña are natural opposing phenomena of the warm and cool phases of the El Niño-Southern Oscillation (ENSO) cycle in the tropical Pacific Ocean. Their effects on winds and sea surface temperatures disrupt global weather patterns, affecting everything from rainfall to global temperatures (NOAA 2024).

A "super" El Niño is developing

As we report on this, El Niño conditions are already developing and are being fueled by unusually warm sea surface temperatures in the tropical Pacific Ocean.

El Niño and La Niña periods are defined using the Relative Oceanic Niño Index (RONI) and categorized, according to thresholds, into Weak, Moderate, Strong or Very Strong events (National Centers for Environmental Prediction/Climate Prediction Center (NCEP/CPC) 2026). ENSO Neutral conditions imply that neither the El Niño nor the La Niña phenomenon were present.

For 2026, NOAA forecasters predict a "highly elevated chance" of a historically powerful or so called "super El Niño" event developing in 2026, with an 82% likelihood of its onset between May and July and a 96% chance of conditions continuing through the Northern Hemisphere winter of 2026-2027.

The El Niño is not a new phenomenon

The El Niño phenomenon was first described by Peruvian fishermen in the 1600s. However, Paleoclimatic research suggests that the ENSO pattern spans back thousands of years. The National Centers for Environmental Prediction (NCEP) Climate Prediction Center (CPC) of NOAA (National Oceanic and Atmospheric Administration) makes available Oceanic Niño Index (ONI) index-based data on the ENSO phenomena since 1950. Since 01 February 2026, the index is defined by the Relative Oceanic Niño Index (RONI).

The cold phase of the ENSO cycle, and essentially the opposite of the El Niño phenomenon, is dubbed the La Niña phenomenon, and was only officially identified in the 1980s, when scientists studied ocean temperatures.

El Niño means "the boy child" and La Niña "the little girl".

Impacts in southern Africa

In Southern Africa, El Niño episodes typically drive negative precipitation anomalies, characterized by reduced rainfall during the primary December-to-March crop-growing season, delayed onset of seasonal rains, prolonged mid-season dry spells, and elevated temperatures (Caj et al., 2025). However, these impacts remain highly variable across distinct sub-regions and temporal scales.

Accordingly, the El Niño in southern Africa generally leads to agricultural and hydrological droughts. Resulting in devastating effects on crop and livestock production, as well as water and food security. Conversely, the La Niña phenomenon generally brings a wetter than average rainfall season and cooler temperatures to southern Africa.

The ENSO cycle in the past 45 years

Figure 2 demonstrates, according to the respective quarterly values of the RONI, when, since 1981, El Niño and La Niña periods occurred and what their strengths were. Historic RONI records show that they may transcend beyond just one year, but on average (*Figure 1*) , El Niño lasts 3.4 quarters and La Niña 4 quarters.

RONI data suggest that very strong El Niño events, similar to the one expected for 2026/27, occurred in 1982/83, in 1991/92, in 1997/98 and finally in 2015/16.

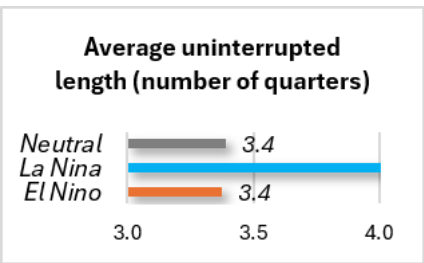


Figure 1: The average uninterrupted duration of El Niño, ENSO neutral and La Niña periods, by number of quarters.

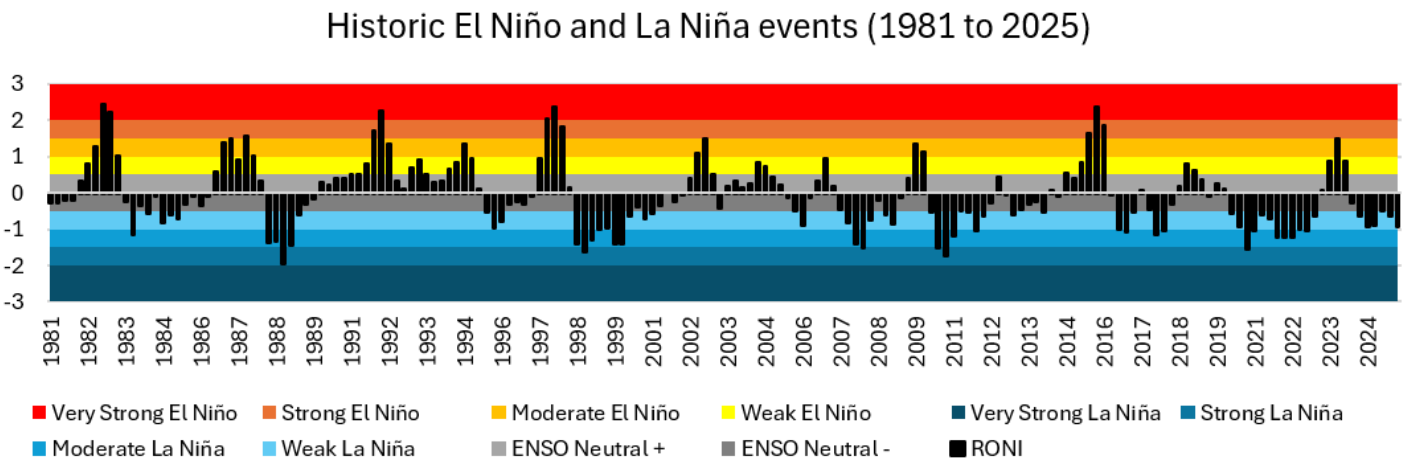


Figure 2: El Niño and La Niña periods are defined using the Relative Oceanic Niño Index (RONI) and categorized, according thresholds, into Weak, Moderate, Strong or Very Strong events.

Assessing quarterly El Niño and La Niña events in relation to rainfall

SASSCAL compared historic CHC (Climate Hazards Center) CHIRPS 3.0 monthly precipitation data from 1981 to 2025 to the NOAA Relative Oceanic Niño Index (RONI), to assess the impacts of different strengths of the El Niño and La Niña phenomena against historic rainfall seasons.

All analyses were conducted relative to the three quarters of the main rainfall season of southern Africa: OND (October-November-December), JFM (January-February-March) and AMJ (April-May-June).

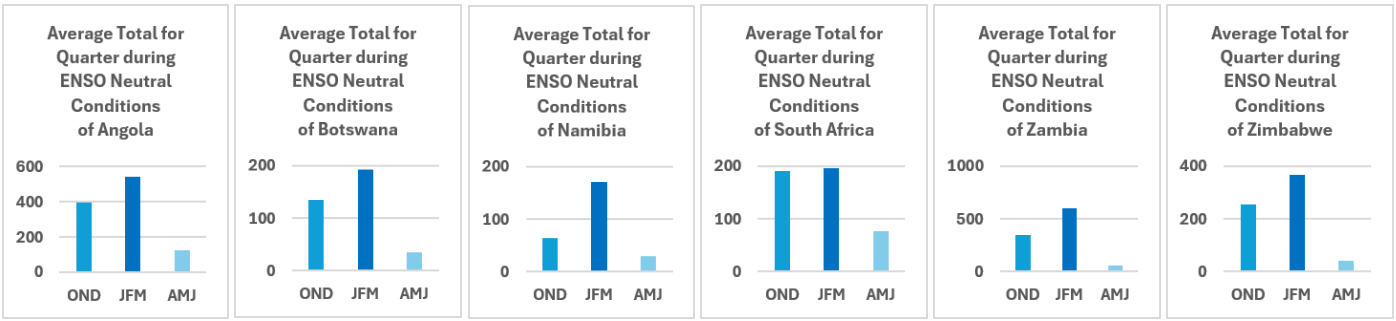
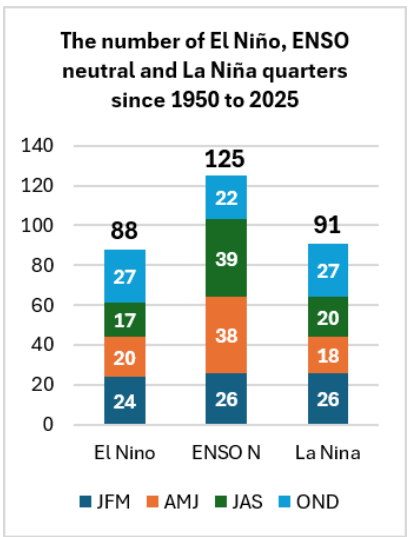


Figure 3: Average quarterly total by country during ENSO neutral conditions.



ENSO Neutral

The El Niño-Southern Oscillation (ENSO) phases are classified using the Relative Oceanic Niño Index (RONI). Periods exhibiting neither El Niño nor La Niña conditions are designated as ENSO-neutral. Crucially, an ENSO-neutral status signifies the absence of these distinct anomalies rather than the presence of climatological averages.

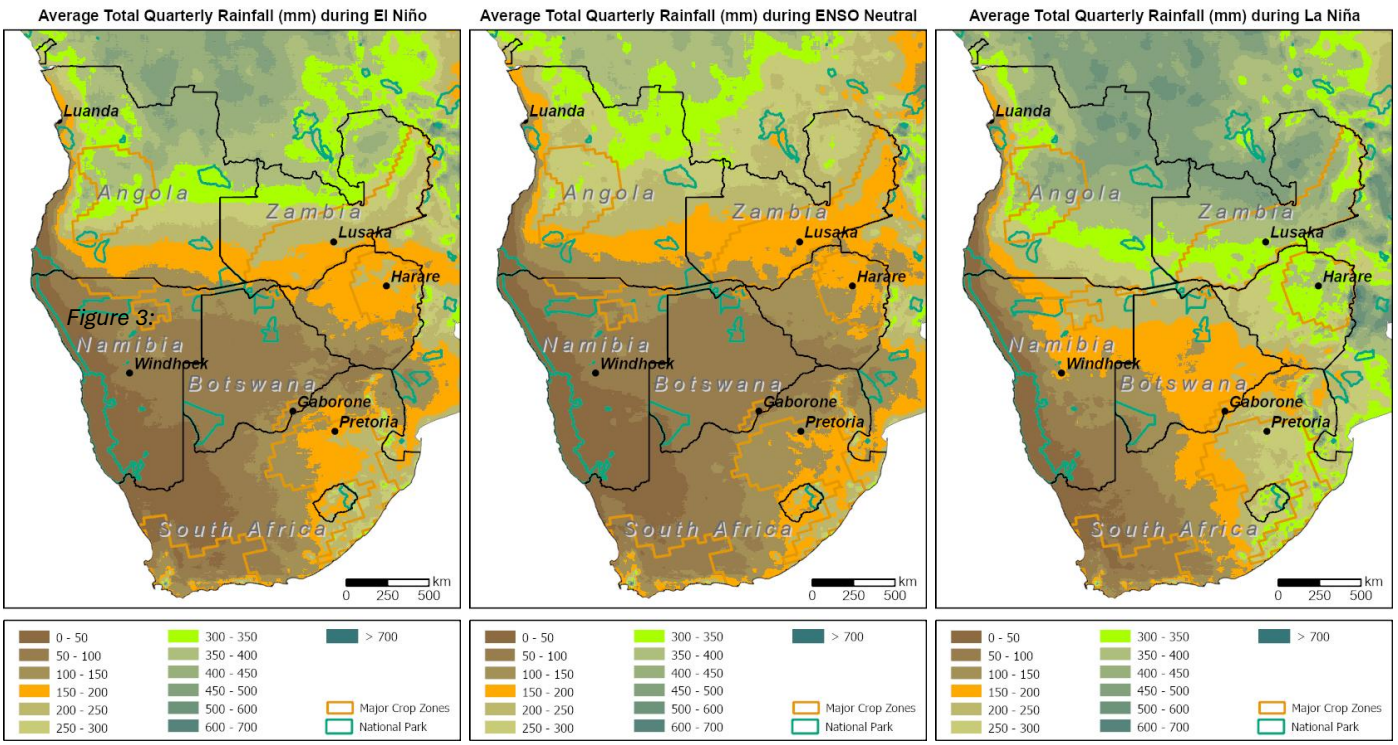
Since 1950, 45% of all quarters, implying JFM, AMJ, JAS or OND, are ENSO neutral, while 27% of all quarters encountered El Niño conditions and 28% of all quarters encountered La Niña conditions (*Figure 4*).

When are the El Niño and the La Niña most likely to occur?

The data suggests that both the El Niño and the La Niña are most likely to occur in JFM and OND, but both may very well occur in any quarter of the year (*Figure 4*).

Figure 4 (left): Number of historic El Niño, ENSO neutral and La Niña quarters.

Figure 5 (bottom): The average total quarterly rainfall distribution during El Niño, ENSO neutral and La Niña quarters.



The relevance of the quarterly rainfall

The OND quarter spells the start or the onset of the southern African rainfall season, while the JFM quarter brings the highest rainfall for most of southern Africa. AMJ is generally the quarter with the lowest total rainfall in southern Africa.

Depending on the onset of the rainfall season, staple crops such as maize and millet, are generally planted in the OND period in southern Africa. During the JFM period, maize and millet are in their critical flowering, pollination and grain-filling stages. In a region highly reliant on rain-fed crop production, OND and JFM are therefore crucial periods for the region's food security.

For livestock production, both the OND and JFM period are critical to ensure the necessary biomass production on the rangelands of southern Africa.

Furthermore, the quantity and quality of the grazing stockpiles influence the ability of the land to carry livestock through the dry winter months.

The AMJ quarter normally marks the end of the rainfall season for southern Africa. It coincides with grain-filling period of crucial crops and often still regenerates depleted crops before the onset of the dry winter months.

General impacts of El Niño and La Niña

The quarterly analysis of the rainfall quarters, during which, historically, El Niño events occurred, provides quantitative, temporal and spatial insight into the impact the phenomenon had on the actual rainfall from 1981 to 2025.

From this analysis, it is clear, that with the exception of Angola and Zambia, El Niño events spell drier climates and La Niña bring wetter climates for southern Africa.

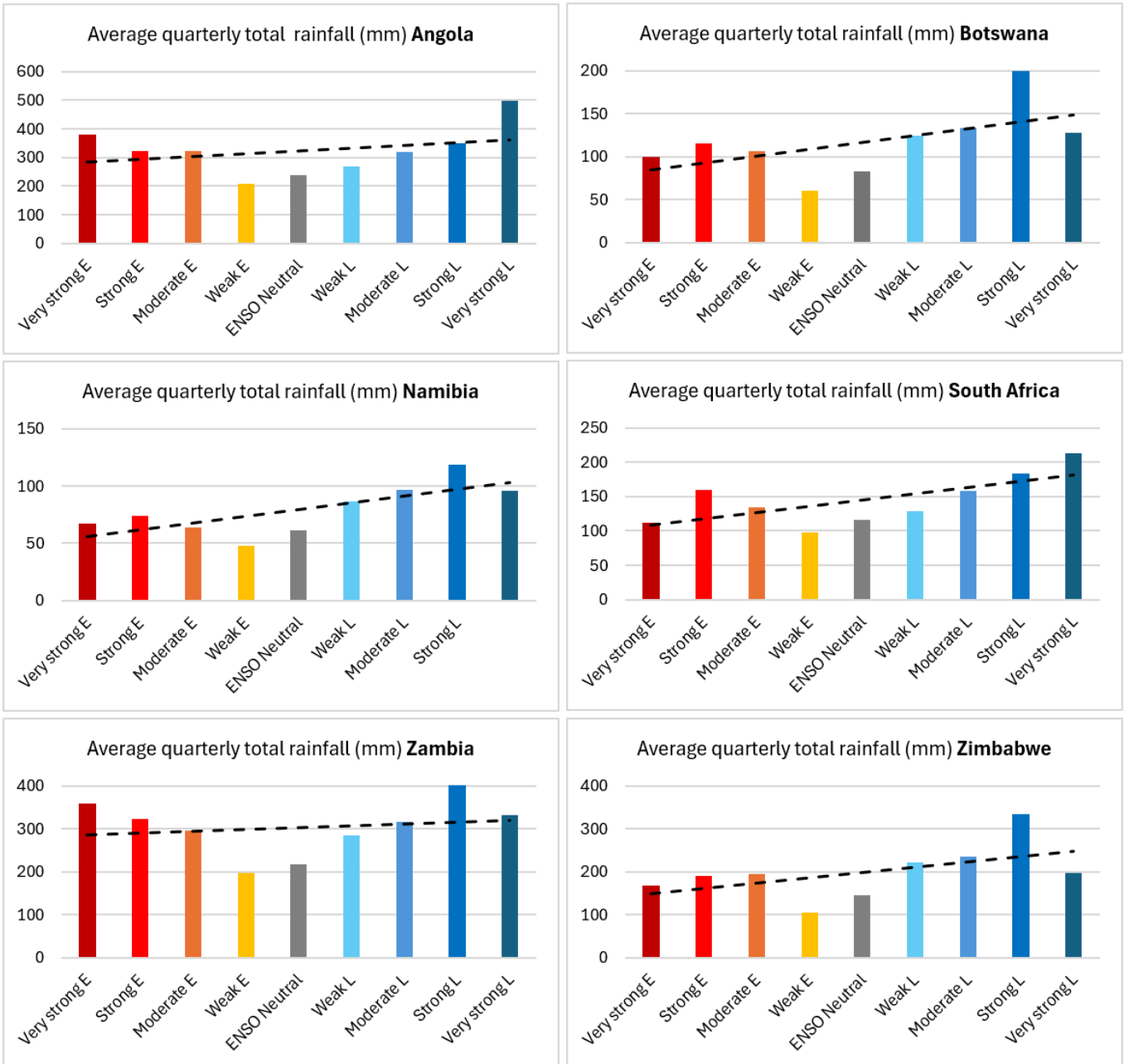


Figure 6: The country-based graphs representing the average quarterly total rainfall (mm) by different categories of severity of El Niño and La Niña from 1981 to 2025.

Impacts relative to rainfall quarter

With the exception of Angola and Zambia, southern Africa generally experiences lower rainfall during the El Niño phenomenon than under ENSO neutral conditions and under the La Niña phenomenon.

During the OND quarter, with exception of Angola and Zambia, the quarterly rainfall during El Niño is on average 5 % less than during ENSO neutral conditions, while it is 10% more during La Niña as opposed to ENSO neutral conditions.

During the JFM quarter, the main rainfall quarter for most of southern Africa, it is on average almost 20% less during El Niño than ENSO neutral, and almost 30 % more during La Niña than ENSO neutral conditions.

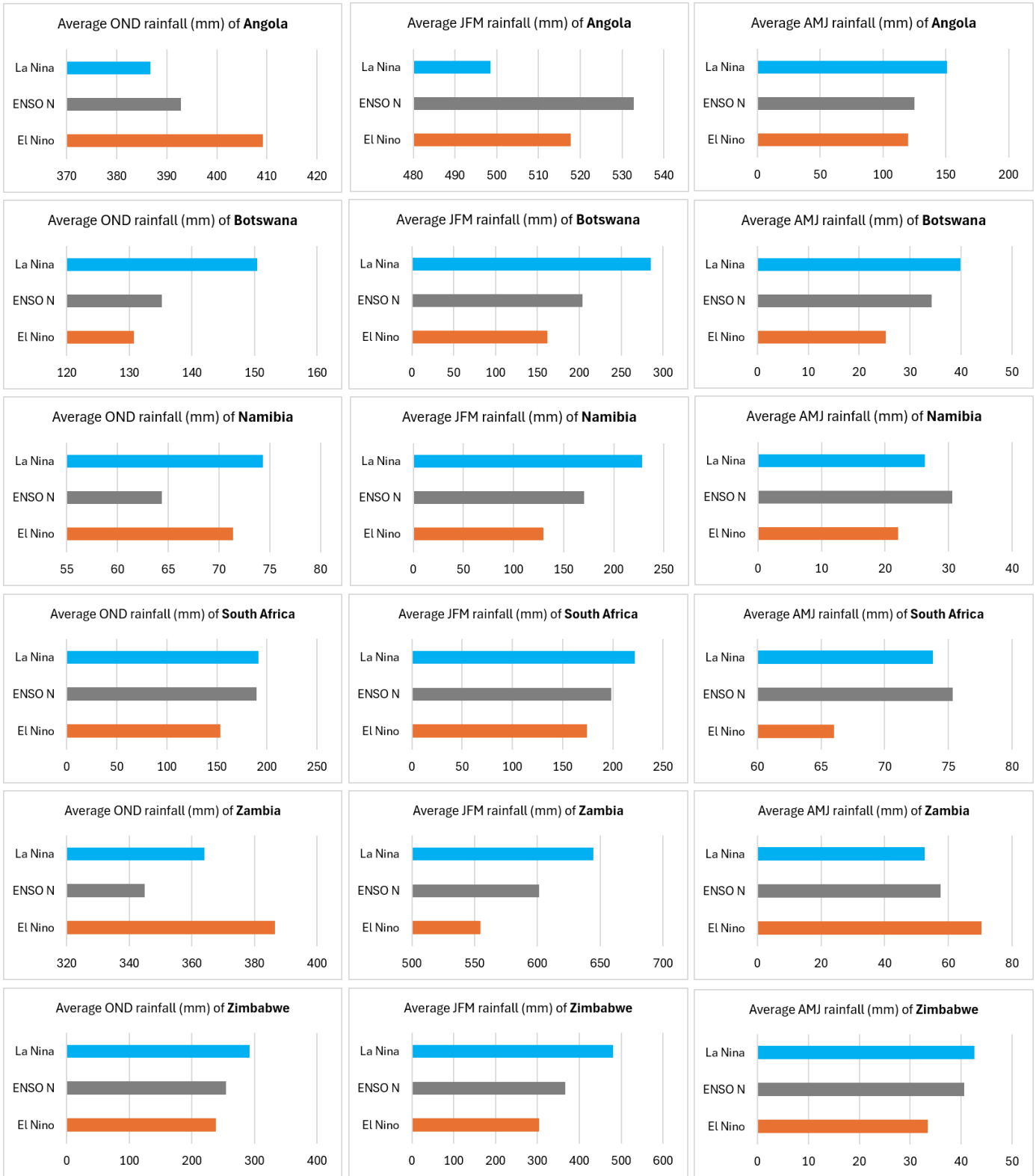


Figure 7: The country-based graphs representing the average quarterly total rainfall (mm) by the rainfall quarters OND, JFM and AMJ, from 1981 to 2025.

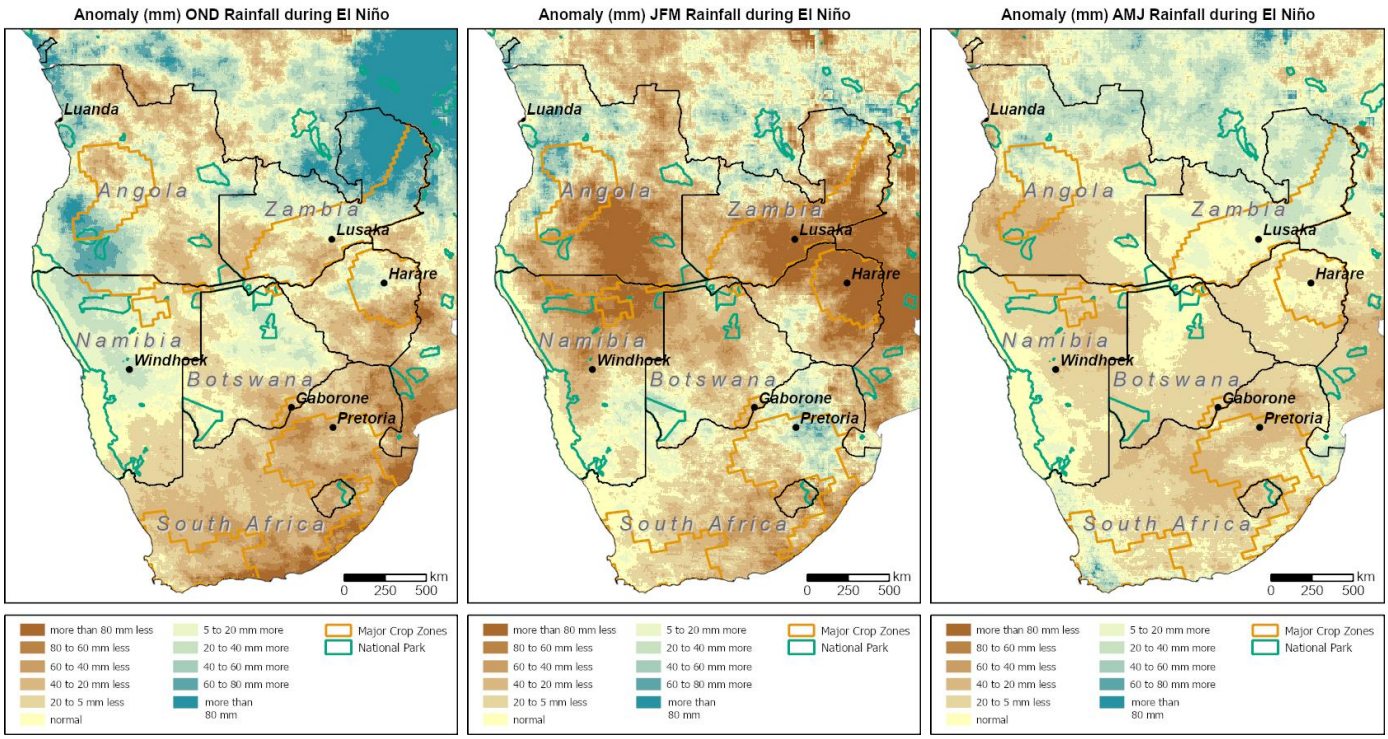


Figure 8: Anomaly from the ENSO neutral condition of the average quarterly rainfall total (mm) by rainfall quarter OND, JFM and AMJ for southern Africa, during El Niño conditions, from 1981 to 2025.

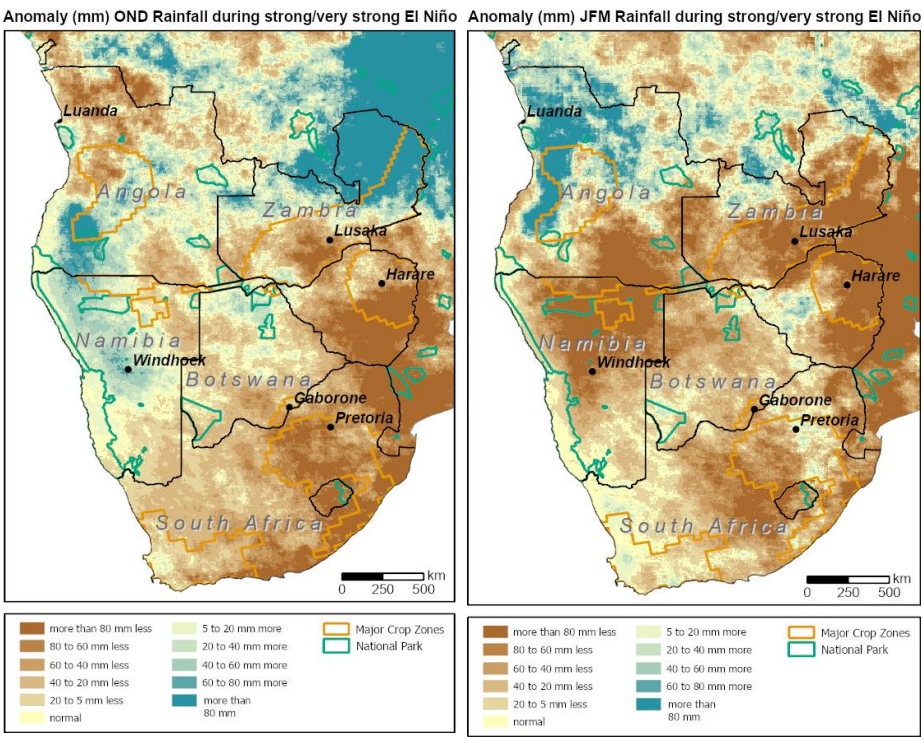
Spatial impacts during El Niño conditions

The spatial impacts during El Niño conditions vary considerably over southern Africa. During all three quarters of the rainfall season, large parts of southern Africa receive less rainfall than during ENSO neutral conditions. Yet, some parts, depending on the quarter at hand, are wetter than during ENSO neutral conditions.

In this line, while almost all of South Africa is drier during an OND El Niño, the central and north-western part of Namibia, the central and northern part of Botswana, the northern part of Zambia and the north-western and south-western part of Angola are wetter.

During the JFM El Niño, the rainfall data showed that almost all of southern Africa receives less rainfall than during an ENSO neutral cycle. Notably, especially the areas relying on rainfed agriculture are affected.

During the AMJ El Niño, the rainfall data suggests smaller deviations from the ENSO neutral cycle, but regardless, most of southern Africa is drier.



When only quarters during strong and very strong El Niño events are considered, the impact is notably enhanced, with the quarterly rainfall data suggesting much greater deviations from the ENSO neutral rainfall. Both positive and negative.

The forecast for the 2026/27 El Niño phenomenon is predicted to be an unusually strong or "super" event. The analysis of rainfall data from 1981 to 2025 suggests, that under enhanced ENSO conditions, the deviation from the rainfall during the El Niño as opposed to ENSO neutral conditions, is enhanced and the areas impacted by drier conditions are also larger.

Figure 9: Anomaly from the ENSO neutral condition of the average quarterly rainfall total (mm) by rainfall quarter OND and JFM for southern Africa, during only strong or very strong El Niño conditions, from 1981 to 2025.

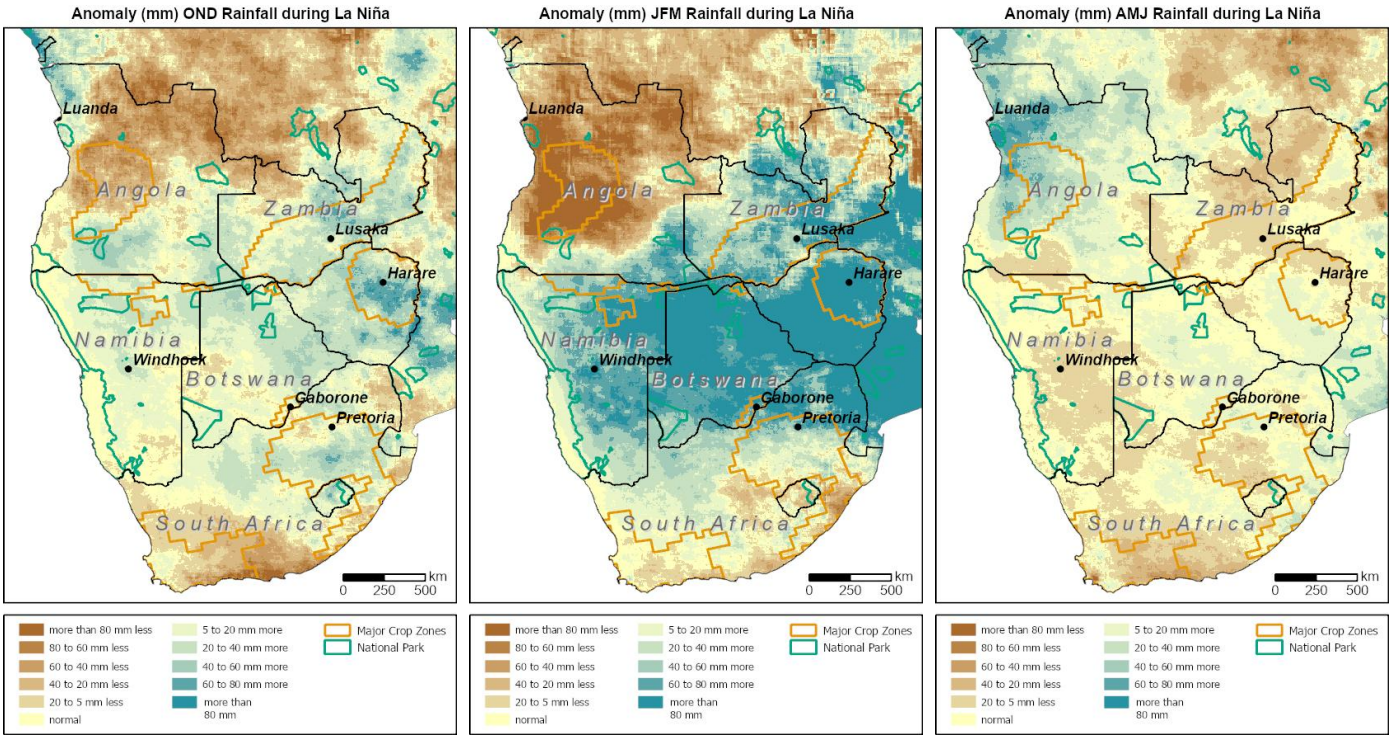


Figure 10: Anomaly from the ENSO neutral condition of the average quarterly rainfall total (mm) by rainfall quarter OND, JFM and AMJ for southern Africa, during El Niño conditions, from 1981 to 2025.

Spatial impacts during La Niña conditions

In a region experiencing multi-year and intensifying droughts, the La Niña phase provides critical hydrological relief. For rangeland systems, proactive agricultural management leverages this increased precipitation to accumulate sufficient forage, effectively bridging the subsequent dry season.

Precipitation data analysis from 1981 to 2025 indicates that La Niña episodes persist for a mean duration of approximately four quarters (one year), exhibiting a frequency comparable to El Niño events (*Figure 1*).

While La Niña mitigates moisture deficits across the arid and semi-arid zones of Botswana, Namibia, Zimbabwe, and South Africa, it simultaneously heightens flood risks and infrastructure vulnerability. Consequently, the eastern sub-regions of Southern Africa frequently contend with destructive flash floods during the La Nina events.

The spatial analysis for the rainfall quarters OND, JFM and AMJ does however also emphasise, that while the historically drier countries of southern Africa benefit from more rainfall, areas such as South Africa's western and southern Cape, large parts of Angola and even South Africa's west coast, struggle with drier periods during the La Niña phenomenon.

Notably, also, while Namibia and Zambia greatly benefit from a wetter OND and JFM during La Niña spells, both experience drier AMJ quarters during La Niña spells.

The way ahead

Notably, this analysis gives us insight into the trends during the past 45 years of the El Niño and the La Niña phenomenon. In a time, where our climate in southern Africa is changing, the analysis can only serve as a pre-emptive guideline.

In particular with a building "super" El Niño event, it is advisable that Botswana, Namibia, South Africa, Zambia and Zimbabwe put in place measures to bolster the likely effect on their food and water security.

References
1. NASA. 2024. El Niño.
2. NOAA. 2024. What are El Niño and La Niña?
3. NCEP/CPC, 2026. Public Information Statement Implementing a Relative Oceanic Niño Index effective February 1, 2026.
4. NOAA. 2026. El Niño/Southern Oscillation (ENSO) diagnostic discussion.
5. Caj et al. 2025. Climate Impacts of the El Niño-Southern Oscillation in Africa.

Data Source
1. CHC CHIRPS 3.0 monthly precipitation data
2. NOAA Relative Oceanic Niño index (RONI)