Technical Statement from the 66th Greater Horn of Africa Climate Outlook Forum (GHACOF66)

20-21 February 2024 - Kampala, Uganda

1. Consolidated Objective Climate Outlook for the March to May 2024 Rainfall Season

March to May (MAM) constitutes an important rainfall season, particularly in the equatorial parts of the Greater Horn of Africa (GHA), where MAM rainfall contributes up to 60% of the total annual rainfall. Analysis of global climate model predictions from 9 Global Producing Centres (GPCs) customized for the GHA indicates that wetter than normal conditions are favoured over most parts the GHA region. Forecast probabilities for wetter than normal conditions are in the range 55-65% over an area including Kenya, Somalia, southern Ethiopia, South Sudan, Uganda, Burundi, Rwanda, Uganda and north-western Tanzania, with highest probabilities in central to western Kenya and in cross-border areas spanning Ethiopia, Kenya, and Uganda (Figure 1). On the other hand, forecast probabilities favour drier than normal conditions over parts of eastern Tanzania, western Ethiopia, western Eritrea and localised areas in western South Sudan.

Standardized Precipitation Index (SPI) analysis of observed and predicted precipitation for 3-, 9- and 15-month periods ending on 31 May 2024 indicates potential for long-term (9- and 15- month) rainfall surfeits to remain in the moderate to severely wet categories over Southern Ethiopia, Kenya, Somalia, Burundi and Tanzania (Figure 2). This results from the above normal rainfall totals observed for October to December 2023 (OND 2023) and March-May (MAM 2023) seasons, coupled with elevated chances of above normal rainfall for MAM 2024. The heightened rainfall recorded across much of the GHA during OND 2023 and the elevated forecast probabilities for above normal rainfall during MAM 2024, suggest a raised risk of flooding in flood-prone areas.

The predicted start of the MAM 2024 season, based on 5 Global Climate Model forecasts that provided daily outputs, is shown in Figure 3. There are high chances of early to normal onset over most parts of the GHA region except a few localized areas. Raised chances of an early onset is indicated in parts of northern and north-eastern Tanzania, eastern Rwanda, southern and western Uganda, western Kenya, southwestern Somalia and parts of south-central Ethiopia. On the other hand, higher chance for delayed onset is indicated over localized areas over central Kenya as well as parts of southern and north-western Ethiopia.

Examining analogue years using the current Sea Surface Temperature (SST) pattern across the tropics and the predicted evolution of the Nino3.4 index indicates that 2016 and 2010 closely resemble the conditions expected in 2024 (as shown in Figure 4). Rainfall performance during MAM in 2016 and 2010 shows wetter-than-normal conditions over much of the region, consistent with the objective consolidated forecast. The identification of analogue years based on recognized climate drivers offers additional information to users about the climate impacts observed in previous similar years.

The consolidated objective temperature forecast from 9 GPCs indicates an increased likelihood of warmer than

normal surface temperatures over the entire region (Figure 5). Probabilities for warmer than normal temperatures are most enhanced over Sudan, northern South Sudan, Ethiopia, Eritrea, Djibouti, Somalia and southern parts of Tanzania.

Whilst the MAM season contributes a larger fraction to the annual total for much of the GHA, seasonal anomalies are generally less predictable compared to other seasons. This is largely a consequence of the weak linkage between rainfall and global large-scale modes of variability such as El Nino Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD).

The outlook is relevant for seasonal timescales and for relatively large geographical areas. Local and month-to-month variations might occur as the season progresses. While wetter than usual conditions are most probable over much of the GHA region usually receiving rain in the MAM season, dry spells may occur in areas with an increased likelihood of near normal to above normal rainfall and vice versa. ICPAC will provide regional updates on a regular basis while the National Meteorological and Hydrological Services (NMHSs) will provide detailed national and sub-national climate updates.

2. The Climate Outlook Forum

The 66th Greater Horn of Africa Climate Outlook Forum (GHACOF66) was convened from 20th to 21st February 2024 by the IGAD Climate Prediction and Applications Centre (ICPAC) in collaboration with the National Meteorological and Hydrological Services (NMHSs) of IGAD Member States, the World Meteorological Organization (WMO), and other partners. The objective of the forum was to document and share the climate impacts across the region and formulate responses to the regional climate outlook for the March to May 2024 rainfall season over the GHA. The GHA region comprises Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan, Tanzania, and Uganda. The forum reviewed the state of the global climate system including the ENSO conditions, IOD, and SSTs over the Pacific and Indian Oceans, and considered their expected impacts on the GHA during March to May 2024 rainfall season. Climate information users from all relevant sectors (disaster risk management, agriculture and food security, livestock, health, water resources, and media) as well as NGOs and development partners actively participated in the formulation of mitigation strategies.

3. Methodology

In line with the recommendation of the World Meteorological Organization (WMO), ICPAC has implemented an objective seasonal forecast procedure to generate climate forecasts for the Greater Horn of Africa (GHA). February 2024 initialized seasonal forecasts from 9 Global Producing Centres (GPCs) were utilized and processed using three calibration techniques (canonical correlation analysis, linear regression, and logistic regression) to develop the MAM 2024 seasonal climate outlook. The final consolidated forecast is obtained by averaging the forecasts generated by the three different approaches.

Forecast probability distributions are established objectively to indicate the likelihood of above-, normal, or below-normal rainfall for each zone. Above-normal rainfall is defined as the upper third of historical MAM rainfall totals, below-normal as the lower third and normal as the range between the upper and the lower third of the rainfall totals. Climatology here refers to the historical series of observed weather conditions over the 30-year period (1991-2020). Forecast probability distributions for temperature are also established. The rainfall and temperature outlooks for MAM 2024 for various zones within the GHA region are given in Figure 1 and Figure 5, respectively.

Experts also examined the prevailing and predicted SSTs over the Pacific, Indian, and Atlantic Oceans as well as other global and regional climate factors that affect the rainfall evolution during the MAM season. These factors were assessed using dynamical and statistical models. SST conditions over the equatorial Pacific Ocean were warmer than average over the past few months. The World Meteorological Organisation (WMO) and major global producing centres have indicated an El Niño event to continue over the next few months and through the March-May season. The IOD is

currently in the neutral phase. The MAM rainfall interannual variability is weakly linked with the SST conditions in the tropical Oceans and the known large-scale modes such as ENSO, IOD and gradients in Pacific SST. ENSO and IOD are ocean-atmosphere phenomena associated with global atmospheric and oceanic circulation changes that influence regional climate conditions by modulating regional circulation patterns, especially monsoonal winds, upper-level and low-level winds. Their effects also are modulated by topography and large inland water bodies. Updates on the ENSO and IOD condition will be provided regularly by WMO and the major climate centres.

The seasonal forecast was developed during the pre-COF66 climate capacity building workshop held from 12th to 17th February 2024 at ICPAC in Nairobi, Kenya. During this workshop, regional scientists, and national forecasters from ICPAC Member States used ICPAC's High-Performance Computing (HPC) cluster and developed regional and national-level climate outlooks.

4. Rainfall Outlook for March to May 2024

The rainfall outlook for various zones within the GHA region is given in Figure 1 below:

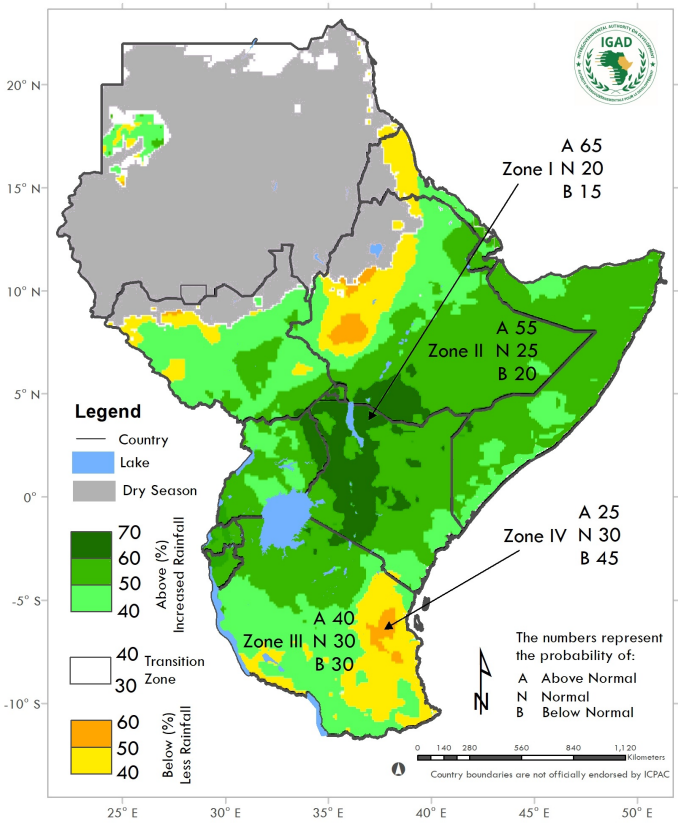

Figure 1. The rainfall outlook for various zones within the GHA region for March to May 2024.

Zone I: In this zone (dark green), the probability for the above normal (wetter) category is the highest (65%). Probabilities for the normal and below normal categories are 20% and 15%, respectively.

Zone II: In this zone (green), the above normal rainfall (wetter) category also has the highest probability. The probability for above normal category is 55%; the probabilities for the normal and below normal categories are 25% and 20%, respectively.

Zone III: In this zone (light green), the above normal rainfall (wetter) category has the highest probability (40%). The probabilities for the normal and below normal categories are 30% each.

Zone VI: In this zone (yellow/orange), the below normal rainfall (drier) category has the highest probability (with an area average of 45%). The probabilities of the near normal and above normal categories are 30% and 25% respectively.

Note: In Fig 1, numbers (next to A, N and B) for each zone indicate the probabilities of rainfall in each of the three categories, above-, near, and below-normal. For example, for Fig. 1, the top number (A) indicates the probability of rainfall occurring in the above-normal category; the middle number (N) is for near-normal and the bottom number (B) for below-normal category. In the case of Zone-I (Fig. 1) for instance, there is 65% probability of rainfall occurring in the above-normal category; 20% probability of rainfall occurring in the near-normal category; and 15% probability of rainfall occurring in the below-normal category. It is emphasised that boundaries between zones should be considered as transition areas.

5. Analysis of Longer-term Rainfall Surfeits/Deficits based on Standardized Precipitation Index (SPI)

The Standardized Precipitation Index (SPI) is a widely used measure enabling consistent comparison of rainfall deficits and surfeits on different timescales. It is frequently used to characterise meteorological droughts. Figure 2 shows the SPI calculated from predicted precipitation for March-May 2024 as well as from observed plus predicted precipitation for 9- and 15-month periods ending on 31 May 2024.

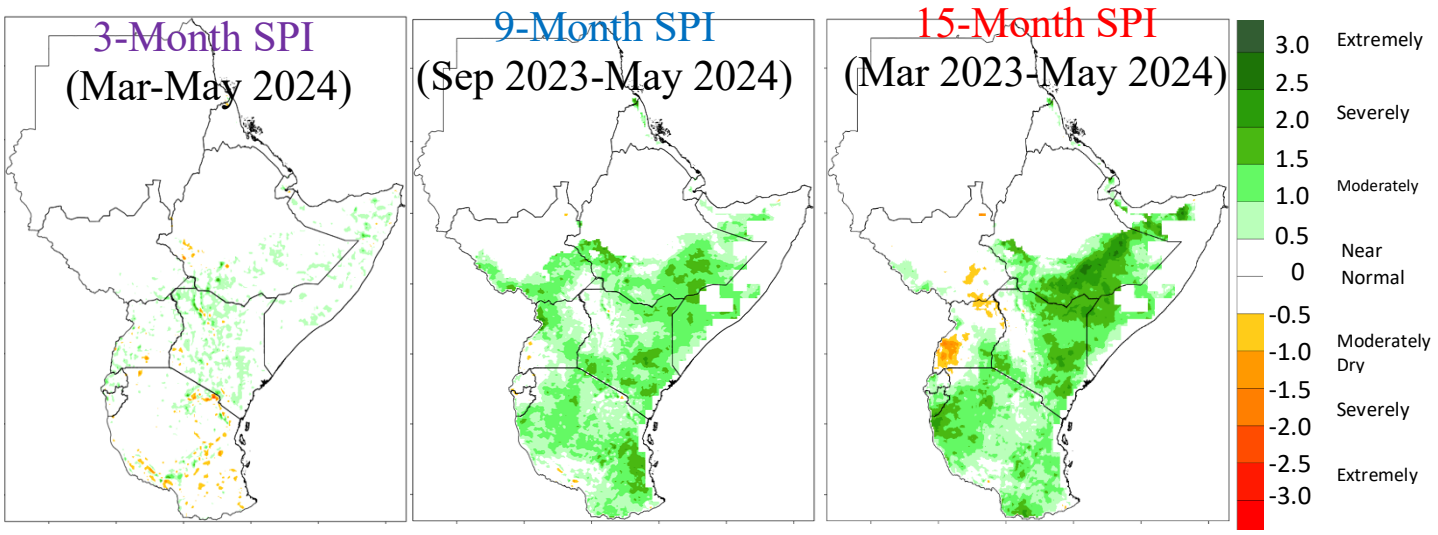

Figure 2: Standardized Precipitation Index (SPI) projections for the 3- (Mar-May 2024), 9- (Sep 2023 - May 2024) and 15- (Mar 2023-May 2024) month periods.

6. Probability Forecasts of the Start of MAM 2024 Season and the Expected Average Onset Dates

The predicted most likely start dates of the March to May 2024 season as well as forecast probabilities for three categories of onset time (early/normal/late) are provided in Figure 3. The forecast was generated by utilizing daily rainfall forecasts derived from five Global Climate Models (ECMWF, Météo-France, CMCC-Italy, DWD-Germany, ECCC-Canada) from the C3S Climate Data Store, incorporating a collective of 212 ensemble members.

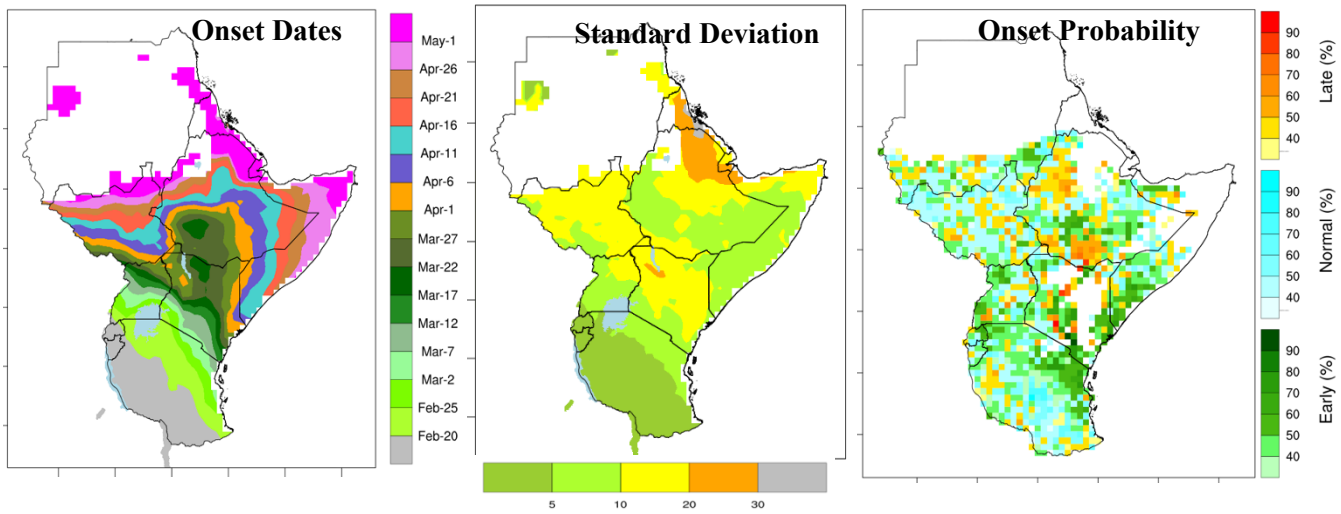

Figure 3: The map on the left indicates the most likely rainfall onset dates for the MAM 2024 season from model ensemble mean values. The middle map shows the standard deviation of predicted onset dates from the different ensemble members (days), and is a measure of uncertainty in the ensemble mean values. The map on the right indicates the forecast probabilities for three (tercile) categories of onset timing (early/normal/late).

7. Analogue Years based on the global SST pattern Nino3.4 indices

The selection of analogue years based on Nino3.4 index is carried out by calculating the correlation and the mean difference between the combined observed and forecast evolution of Nino3.4 of the target year and the corresponding Nino3.4 index for the same period in previous years (Fig. 4).

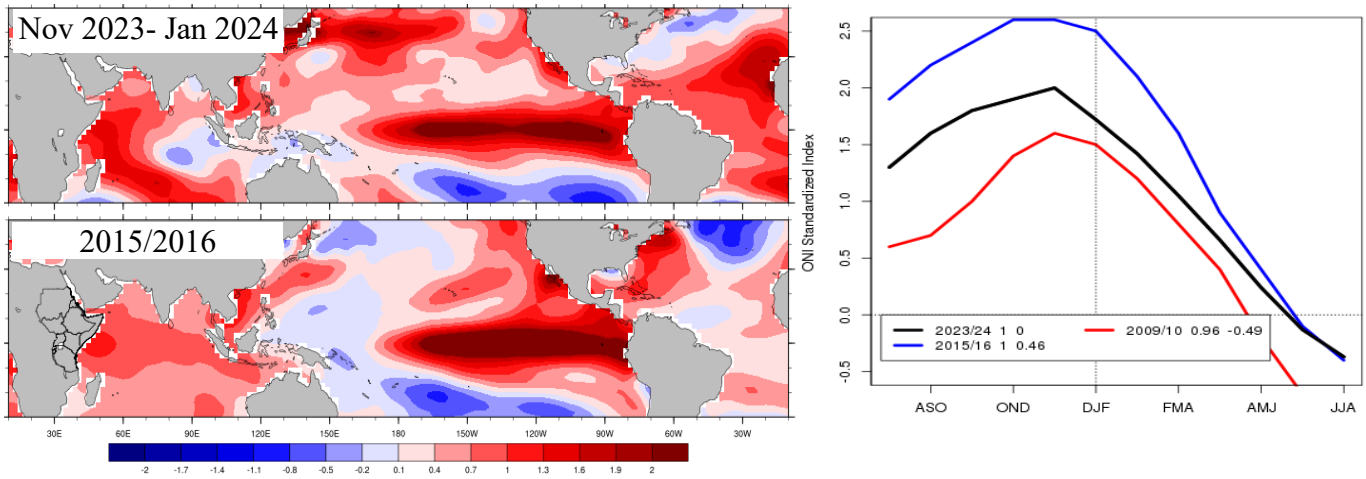

Figure 4: The plot on the left (top) shows the current (November 2023 - January 2024) pattern of SST anomalies over the tropical Oceans. The plot on the right shows the evolution of the Nino3.4 index extended by the predicted values (black) compared with the observed evolution for years in when the evolution most closely matches that shown for 2024. The closeness of match is measured by the temporal correlation and the mean difference (given in the boxes). The November-January SST anomalies for one of the selected analogue periods (2015/2016) is provided (left, bottom) for comparison with the November 2023 - January 2024 anomalies.

8. Temperature Outlook for March to May 2024

The temperature outlook for various zones within the GHA region is given in Figure 5 below.

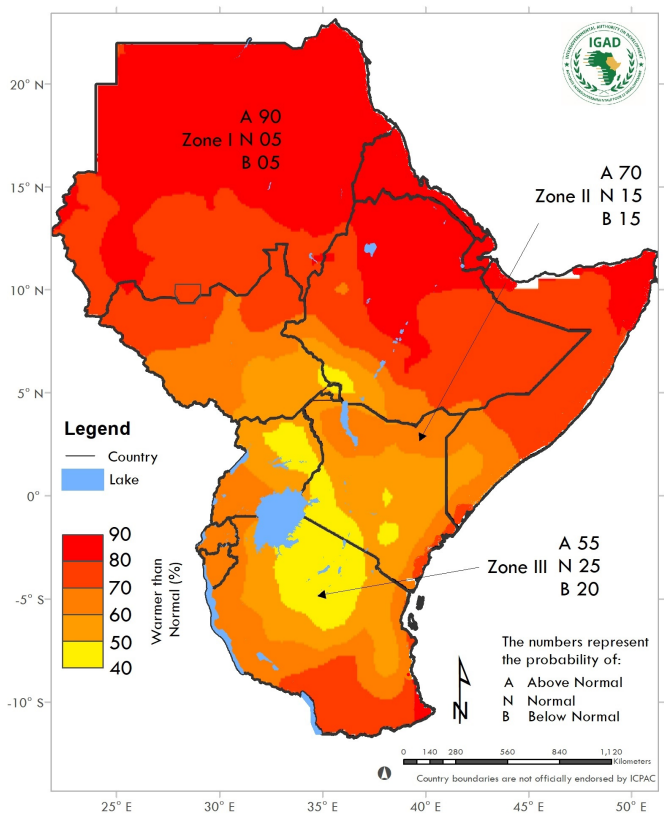

Figure 5: Probability forecast of mean surface temperatures for March to May 2024 season.

Zone I: In this Zone (red), the above normal mean temperature (i.e., warmer) category is most likely at 90%. The probabilities for the near normal and below normal categories are 5% and 5% each.

Zones II: In this Zone (dark orange) also, the above normal mean temperature category has the highest probability (at 70%). The probabilities of the normal and below normal categories are 15% and 15%, respectively.

Zones III: In this Zone (orange) also, the above normal mean temperature category has the highest probability (at 55%). The probabilities of the normal and below normal categories are 25% and 20%, respectively.

9. Contributions

GHACOF 66 was organized jointly by IGAD's Climate Prediction and Applications Centre (ICPAC) and National Meteorological and Hydrological Services (NMHSs) of the Greater Horn of Africa (GHA). The forum was supported by the ClimSA, CONFER and Down2Earth projects funded by the European Union, AICCRA-East Africa project funded by the World Bank, WISER-Africa funded by United Kingdom's FCDO, IGAD Support Platform on Forced Displacement and SCII projects funded by the Swedish government, Emergency Locust Response Project (ELRP) funded by the World Bank and the Pest Early Warning Systems funded by BMZ in partnership with TMG group and German Aerospace. Contributors to the regional climate outlook included representatives of NMHSs from GHA countries (Institut Géographique du Burundi, Météorologie Nationale de Djibouti, Ethiopia Meteorological Institute, Kenya Meteorological Department, Rwanda Meteorological Agency, National Hydro-Meteorological and Monitoring Service of Somalia; South Sudan Meteorological Service, Sudan Meteorological Authority, Tanzania Meteorological Agency and Uganda National Meteorological Authority) and climate scientists as well as other experts from national, regional, and international institutions and organizations: ICPAC, UK Met Office, NOAA CPC-International Desks and WMO Global Producing Centres (GPCs).

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