Statement from the 65th Greater Horn of Africa Climate Outlook Forum (GHACOF65)

22 August 2023; Nairobi, Kenya

1. Consolidated Objective Climate Outlook for October to December 2023 Rainfall Season

October to December (OND) constitutes an important rainfall season, particularly in the equatorial parts of the Greater Horn of Africa (GHA), where OND contributes 20-70% of the annual total rainfall. Analysis of global climate model predictions from 9 Global Producing Centres (GPCs) customised for the GHA indicates a heightened likelihood of experiencing more abundant rainfall (above normal rainfall) over almost all of the region from October to December 2023 (Figure 1). Notably, there is an exceptionally high forecast probability (>80%) of experiencing wetter than normal rainfall conditions in the eastern parts of the region, encompassing southern Ethiopia, eastern Kenya, and southern Somalia. On the other hand, for isolated areas of south-western Uganda and south-western South Sudan, probabilities favour drier than average (below-normal) conditions.

The potential severity of rainfall surfeits/deficits may be assessed using the Standardized Precipitation Index (SPI). An SPI analysis of predicted precipitation for October to December 2023 indicates the potential for moderate to severe wet conditions over southern Ethiopia, eastern Kenya, and southern Somalia and moderately wet conditions over other regions with a higher probability of above-normal totals (Figure 2). As a result of the observed above-average rainfall experienced across much of the Greater Horn of Africa during March to May 2023 (MAM 2023), elevated rainfall during October to December 2023 (OND 2023), as favoured by the forecast, may potentially contribute to flooding in areas prone to floods.

The predicted start dates of the October to December 2023 rainfall season based on 3 Global Climate Model forecasts are provided in Figure 3. Over eastern Kenya and southern Somalia, where probabilities of above-normal seasonal totals are highest, and over parts of eastern Tanzania, analysis of daily predicted rainfall indicates a raised chance of early onset. In contrast, probabilities favour a normal or delayed start to the season over parts of northern Somalia, western Kenya, Uganda, southern South Sudan, Rwanda, Burundi, and north-western Tanzania. In most of these regions, above-normal seasonal totals are also favoured (Fig. 1) but with lower probability.

Identifying historical years when the main global climate influences on GHA rainfall were similar to those expected this year (an analogue year analysis) can aid in understanding the forecast. This is especially pertinent this year due to the notably elevated likelihood of above-average rainfall, mostly in the eastern parts of the region. An analogue year analysis based on the present and predicted evolution of the Nino3.4 and IOD indices indicate that 1997 and 2006 are the closest matches to 2023 (as shown in Figure 4). Analysing the observed rainfall patterns between 1997 and 2006 shows wetter-than-normal conditions across most of the GHA.

The consolidated objective temperature forecast (Figure 5) from 9 Global Producing Centres (GPCs) indicates an increased likelihood of warmer-than average surface temperatures for almost all parts of the GHA. Probabilities of

warmer than average temperatures are most enhanced over Djibouti, Eritrea, northern Ethiopia, northern Somalia, and parts of coastal Tanzania. In contrast, over certain isolated parts of eastern Kenya and the bordering areas between Kenya and Somalia, probabilities favour cooler-than-normal conditions. These latter areas are within the region with the highest probabilities for above-normal rainfall.

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 that usually receives rain in the OND 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 regularly, while the National Meteorological and Hydrological Services (NMHSs) will provide detailed national and sub-national climate updates.

2. The Climate Outlook Forum

The 65th Greater Horn of Africa Climate Outlook Forum (GHACOF 65) was convened on 22nd August 2023 by the IGAD Climate Prediction and Applications Centre (ICPAC) and Kenya Meteorological Department (KMD) in collaboration with the National Meteorological and Hydrological Services (NMHSs) of IGAD Member States, World Meteorological Organization (WMO), and other partners to document and share the climate impacts across the region and formulate responses to the climate outlook for the October to December 2023 rainfall season. The GHA region comprises Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan, Tanzania, and Uganda. Climate information users from six sectors (disaster risk management, agriculture and food security, water resources and energy, health, livestock, and media), NGOs, and development partners actively participated in the formulation of national-level impact mitigation strategies for their sectors based on climate prediction. GHACOF 65 was preceded by sectoral co-production meetings on 21st August 2023.

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). August 2023 initialized seasonal forecasts from nine Global Producing Centres (GPCs) were utilized and processed using three calibration techniques (canonical correlation analysis, linear regression, and logistic regression) to develop the OND 2023 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, below-normal as the lower third and the normal as the range between the upper and the lower third of the rainfall amounts. Climatology here refers to weather conditions averaged over 30 years (1991-2020). Probability distributions for temperature are also established. The rainfall and temperature outlooks for October to December 2023 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 and other global and regional climate factors affecting rainfall evolution during the OND season. These factors were assessed using dynamic 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 that an El Niño event is now underway, and it is predicted (with more than 90% probability) to continue and strengthen

over the next few months and through the October-December season. The OND rainfall interannual variability is strongly linked with the SST conditions in the eastern and central equatorial Pacific, where wetter than normal conditions typically occur during the El Niño and below-average rainfall is typical during the La Niña years.

Furthermore, global models further indicate the development of a positive phase of the IOD, which is also known to favour above-normal rainfall during the short-rains (October to December - OND) season. 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 and 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 PreCOF65, a one-week climate capacity-building workshop from the 14th to the 18th of August, 2023. 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 October to December 2023

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

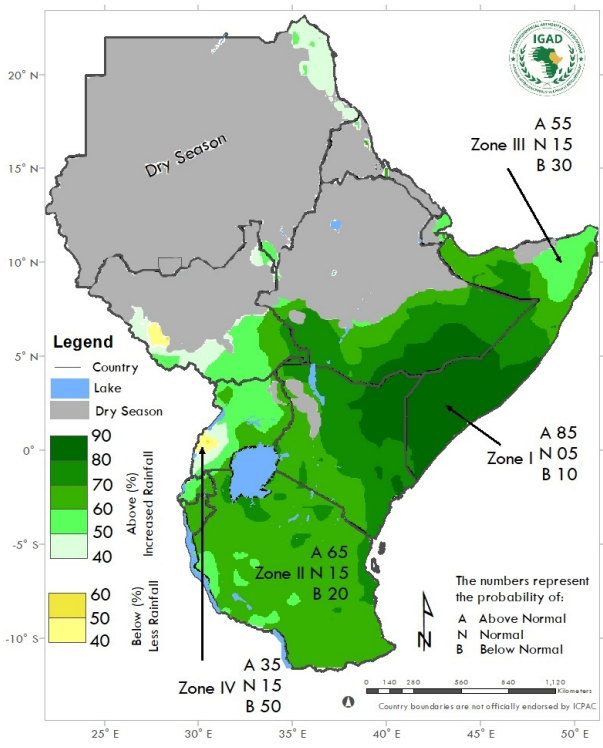

Figure 1. The rainfall outlook for various zones within the GHA region for October to December 2023.

Zone I: In this zone (dark green), the probability for the above-normal category is the highest (85%). Probabilities for the normal and below-normal categories are 5% and 10%, respectively.

Zone II: In this zone (green), the above-normal rainfall (wetter) category also has the highest probability. The probability varies with location and can be read from the legend. For the most widespread green shade, the probability for above normal category is 65%; the probabilities for the normal and below-normal categories are 15% and 20%, respectively.

Zone III: In this zone (light green), the above-normal rainfall (wetter) category has the highest probability (55%). The probabilities for the normal and below-normal categories are 15% and 30%, respectively.

Zone II: In this zone (yellow), the below-normal rainfall (drier) category has the highest probability (50%). The probabilities of the near normal and above normal categories are 15% and 35%, respectively.

Note: In Fig 1, numbers (next to A, N and B) for each zone indicate the rainfall probabilities 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) is for the below-normal category. In the case of Zone-I (Fig. 1), for instance, there is an 85% probability of rainfall occurring in the above-normal category, a 5% probability of rainfall occurring in the near-normal category, and a 10% probability of rainfall occurring in the below-normal category. It is emphasised that boundaries between zones should be considered as transition areas.

5. Precipitation-based Drought Outlook based on Standardized Precipitation Index (SPI)

The SPI is a measure of how dry or wet a region is and is used to characterise meteorological droughts. Figure 2 shows the SPI values for October-December 2023.

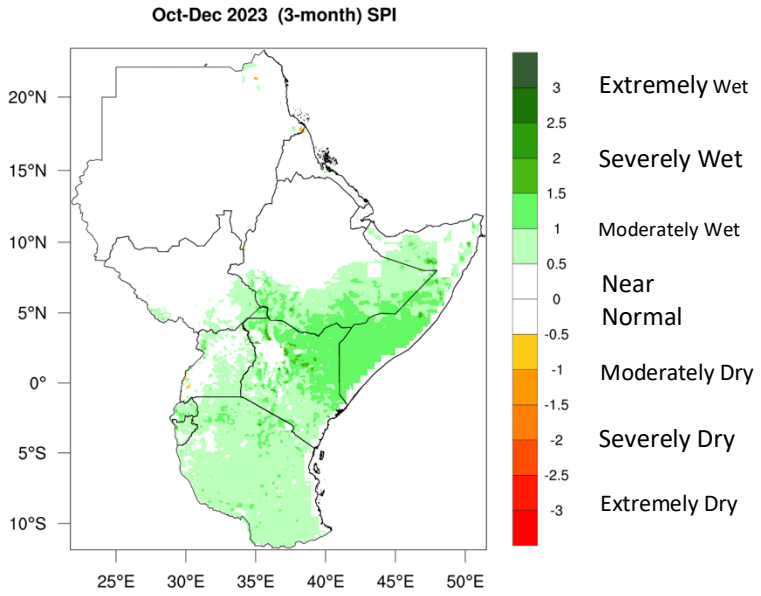

Figure 2: Predicted Standardized Precipitation Index (SPI) forecast for October-December 2023.

6. Probability Forecasts of the Start of OND 2023 Season and the Expected Average Onset Dates

The predicted start dates of October to December 2023 season and their probability outlook are provided in Figure 3. The forecast was generated by utilizing daily rainfall forecasts derived from three Global Climate Models (namely ECMWF, Mateo-France, and ECCC-Canada) from the C3S Climate Data Store, incorporating a collective of 112 ensemble members.

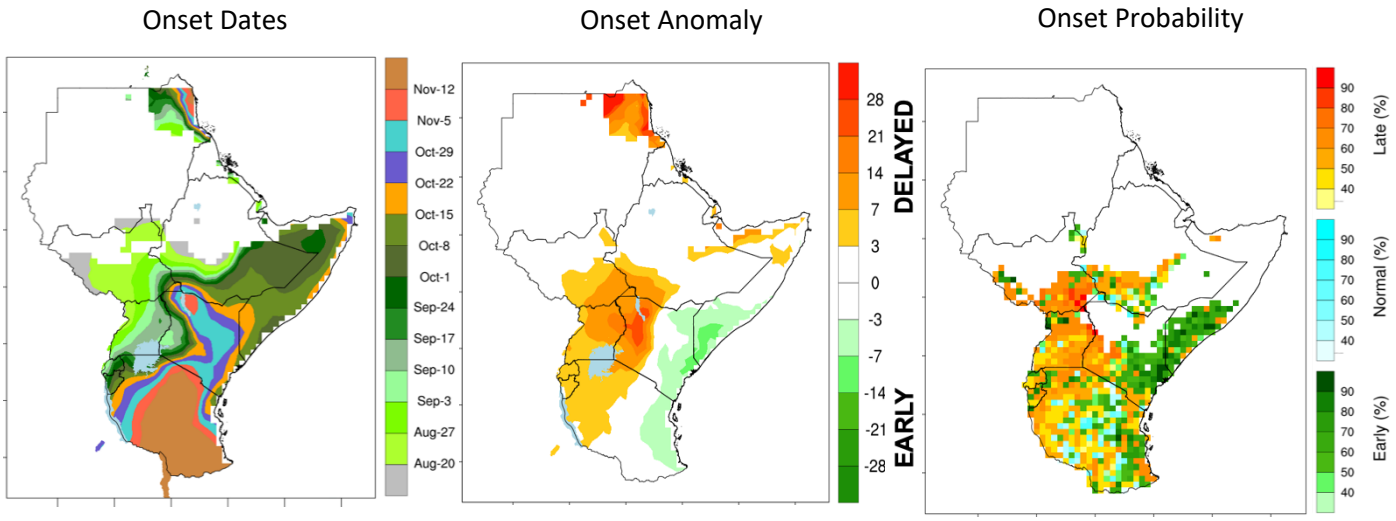

Figure 3: The map on the left indicates the rainfall onset dates from the model ensemble mean values. The middle map shows the predicted onset date anomaly (days), and the map on the right indicates the probabilities of the start of the rainfall season in each of the three categories, early-, normal-, and late.

7. Analogue Years based on the Nino3.4 and IOD Indices

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

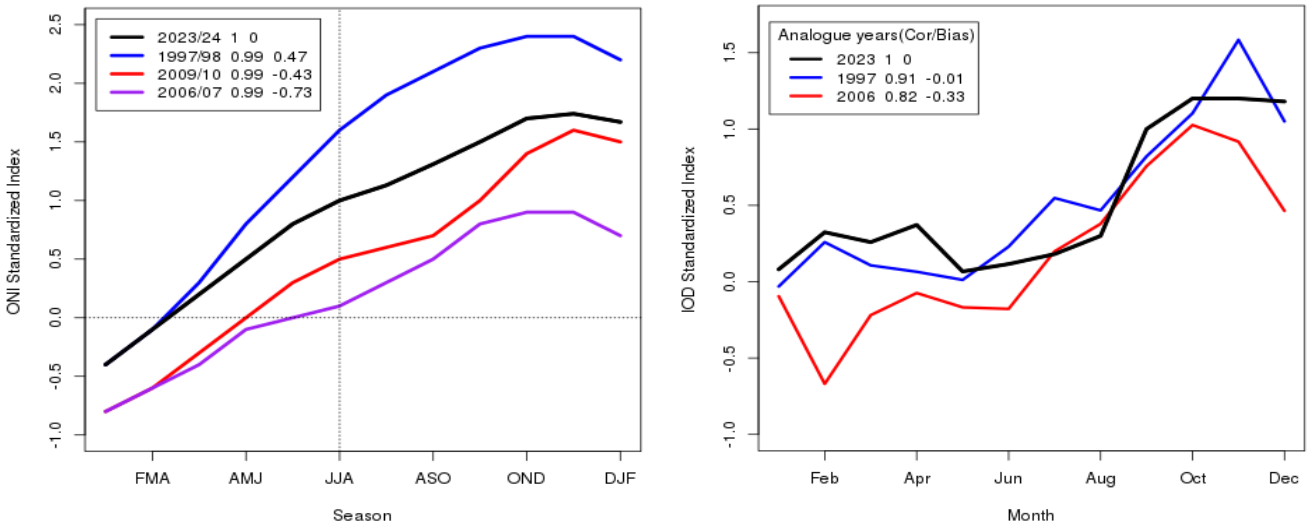

Figure 4: The plot on the left shows the recent evolution of the Nino3.4 index extended by the predicted values (black) compared with the observed evolution for years when the evolution most closely matches that shown for 2023. The closeness of the match is measured by the temporal correlation and the mean difference (given in the boxes). The plot on the right shows corresponding information for the IOD index.

8. Temperature Outlook for October to December 2023

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

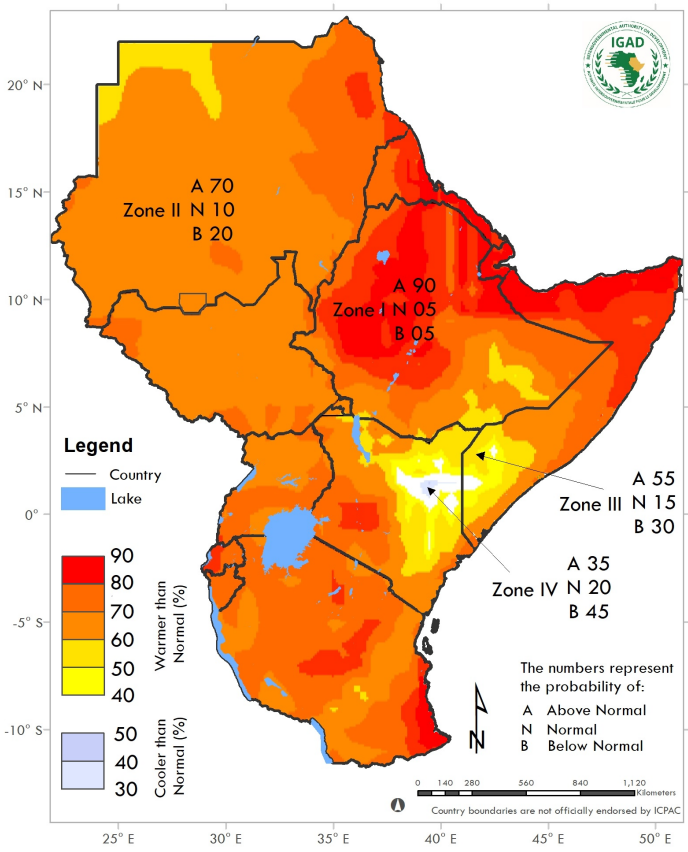

Figure 5: Probability forecast of mean surface temperatures for October to December 2023

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), the above-normal mean temperature category also has the highest probability (at 70%). The probabilities of the normal and below-normal categories are 10% and 20%, respectively.

Zones III: In this Zone (Orange), the above-normal mean temperature category also has the highest probability (at 55%). The probabilities of the normal and below-normal categories are 15% and 30%, respectively.

Zones VI: In this Zone (light blue), the below-normal mean temperature category has the highest probability (at 45%). The probabilities of the normal and above-normal categories are 20% and 35%, respectively.

Contributors

GHACOF 65 was organised jointly by IGAD's Climate Prediction and Applications Centre (ICPAC) and the National Meteorological and Hydrological Services (NMHSs) of the Greater Horn of Africa (GHA). The forum was supported by the ClimSA and CONFER projects funded by the European Union, the AICCRA-East Africa project funded by the World Bank, and the SCII project funded by the Swedish government. 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, South Sudan Meteorological Department, Sudan Meteorological Authority, Somalia 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 organisations: ICPAC, UK Met Office, NOAA CPC-International Desks and WMO Global Producing Centres (GPCs).