Technical Statement from the 68th Greater Horn of Africa Climate Outlook Forum (GHACOF68)

19-20 August 2024, Nairobi, Kenya

1. The Climate Outlook Forum

The 68th Greater Horn of Africa Climate Outlook Forum (GHACOF68) was held from 19 to 20 August 2024, and organized by the IGAD Climate Prediction and Applications Centre (ICPAC) in collaboration with the National Meteorological and Hydrological Services (NMHSs) of the Greater Horn of Africa (GHA), the World Meteorological Organization (WMO), and other international partners. The forum reviewed and documented the progress and impacts of the June to September (JJAS) 2024 season, released the consolidated objective regional climate outlook for the October-December (OND) 2024 season, discussed the implications of the OND 2024 climate forecast, and developed advisories and management strategies for various climate-sensitive socio-economic sectors.

The GHA region includes Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan, Tanzania, and Uganda. Climate information users from the relevant socio-economic sectors, such as disaster risk management, agriculture and food security, livestock, water resources, health, conflict, and media, as well as NGOs, humanitarian organizations, and development partners, actively participated in the formulation of mitigation strategies.

2. Consolidated Objective Climate Outlook for the October to December 2024 Rainfall Season

October to December (OND) is an important rainfall season, particularly in the equatorial region of the GHA, where it contributes up to 70% of the annual total rainfall over parts of Kenya and Somalia. Analysis of global climate model predictions from nine Global Producing Centres (GPCs), customized for the GHA, indicates an increased likelihood of drier than usual conditions during OND 2024 in the eastern Horn of Africa, including southern Ethiopia, much of Somalia, eastern Kenya, and parts of central and southern Tanzania (Figure 1). The highest likelihoods for below-normal rainfall (probability = 55%) are indicated for southern Ethiopia and central and northern Somalia. Conversely, wetter-than-normal conditions are predicted for western parts of the region, including southeastern South Sudan, much of northern and eastern Uganda, western and northwestern Kenya, northern Tanzania, and parts of southern Burundi. In some areas, such as southwestern Ethiopia and South Sudan, central and southern Kenya, central and southern Uganda, eastern Rwanda, most parts of Burundi, and eastern and northwestern Tanzania, the forecast probabilities for above-, near-, and below-normal rainfall are equal at 33% thus each of the three categories are predicted to have an equal likelihood of occurring.

The probability for the lowest 20% and highest 20% of the climatology are given in Figure 2 indicating how dry and wet the upcoming season is likely to be. The results suggest a high chance (greater than 40%) that the season will fall within the lowest 20% of the climatology in areas such as southern Ethiopia, northern Somalia, and parts of central and southern Tanzania. On the other hand, in parts of northeastern Uganda and the cross-border areas of Uganda and South Sudan, there is a high chance (>40%) that the OND 2024 season will fall within the highest 20% of the climatology. In the remaining parts of the region, there is a low chance (<40%) of the season falling within either the lowest 20% or the highest 20% of the climatology.

An analysis of the probability of rainfall exceeding 300mm during the October to December 2024 season indicates a high likelihood (>70%) of exceeding this threshold in parts of western Kenya, southern Uganda, much of Rwanda and Burundi, and northwestern Tanzania (Figure 3). In contrast, there is a low likelihood (<30%) of exceeding 300mm in southern Ethiopia, northern and eastern Kenya, and Somalia. When comparing these probabilities with historical climatology, there is a reduced chance (up to 30%) of recording 300mm in southern Ethiopia, eastern Kenya, southern Uganda, and southern as well as central and eastern Tanzania. However, the chances of exceeding 300mm are higher than the climatological chance in western Kenya, northern and central Uganda, central Burundi, Rwanda, and northwestern Tanzania.

The predicted start dates of the October to December 2024 season based on 5 Global Climate Model forecasts that provide daily rainfall outputs are provided in Figure 4. The analysis indicates higher chances of early to normal onset dates over much of the western parts of the region including southwestern Ethiopia, much of southern South Sudan, Uganda, western Kenya, much of Burundi, Rwanda, and western as well as central Tanzania. The most spatially coherent areas with predicted enhanced chances for delayed onset are in southern Somalia, parts of southern and eastern Tanzania as well as central/western and northeastern South Sudan and eastern/central Kenya. However, isolated pockets with enhanced chances of delayed onset are also predicted in other areas.

Comparisons of the current tropical Sea Surface Temperature (SST) pattern and the observed and predicted evolution of the Nino3.4 index to analogous historical periods suggest that 2020 and 1983 share similarities with the May-July 2024 average tropical SST conditions and Nino3.4 index trajectory anticipated 2024, and in this sense may be considered analogue years (Figure 5).

Rainfall performance during OND in 2020 and 1983 shows drier-than-normal conditions over much of the region, consistent with the OND 2024 objective consolidated forecast. The below-normal rainfall observed in the identified analogue years over the eastern horn of Africa (both of which had La Niña active in OND) supports the likely influence of a developing La Niña in the objective forecast for OND 2024 (Fig. 5); however, the analogue-year rainfalls should not be considered replacements or alternatives to the objective forecast.

The consolidated objective temperature forecast (Figure 6) from 9 Global Producing Centres (GPCs) indicates an increased likelihood of warmer than average surface temperatures across the GHA. Probabilities of warmer-than-average temperatures are highest over the eastern side of the GHA with peak probabilities over eastern parts of Tanzania, Kenya, Ethiopia, Eritrea, Sudan, as well as for Djibouti and much of Somalia. Average to cooler-than-average conditions are expected over cross-border areas of Uganda, South Sudan, Ethiopia, and Kenya, as well as localized areas of northern Tanzania and western Sudan.

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 seasonal-average conditions are most probable over much of the western GHA regions that usually receive rain in the OND season, dry spells may occur in areas with an increased likelihood of above normal to near 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.

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 2024 initialized seasonal forecasts from 9 Global Producing Centres (GPCs) were utilized and processed using two calibration techniques (canonical correlation analysis and linear regression) to develop the OND 2024 seasonal climate outlook. The final consolidated forecast is obtained by averaging the forecasts generated by the two different approaches. The nine Global Climate Models used for producing the regional consolidated forecast are CanSIPS-IC4, CMCC, COLA-RSMAS-CCSM4, DWD, ECMWF, GFDL-SPEAR, Météo-France, NASA-GEOSS2S, and NCEP-CFSv2.

Forecast probability distributions are established objectively to indicate the likelihood of above-normal, normal, or below-normal rainfall for each zone. Above-normal rainfall is defined as the upper third of historical OND rainfall totals, below-normal as the lower third, and normal as the range between the upper and 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 OND 2024 for various zones within the GHA region are given in Figure 1 and Figure 6, 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 OND season. These factors were assessed using dynamical and statistical models. Equatorial SST conditions are near average in the central-west Pacific and below average in the eastern Pacific Ocean. The WMO and major GPCs have indicated that ENSO-neutral conditions are likely to persist over the next several months, with a 66% chance of La Niña developing between September and November and a 74% chance of it continuing through the Northern Hemisphere winter of 2024-2025. The Indian Ocean Dipole (IOD) index is currently neutral and is expected to remain in weak positive to neutral conditions in the coming months. IOD forecast skill has historically been low, and current model forecasts still indicate a wide range of possible outcomes.

The interannual variability of OND rainfall in Eastern Africa is strongly linked to SST anomalies in the tropical Pacific and Indian Oceans. La Niña events (tropical Pacific) and negative IOD (Indian Ocean) are typically associated with below-normal OND rainfall over parts of the GHA. While predictions show enhanced probabilities for below-normal rainfall in eastern parts of the GHA, the enhancement is relatively modest (55% compared to a 33% climatological chance) and this may reflect the short-lived nature and predicted uncertainty regarding the phase of the IOD. Updates on ENSO and IOD conditions will be provided regularly by the WMO and major climate centres.

The seasonal forecast was developed during the pre-COF68 climate capacity building workshop held at ICPAC from 13th to 17th of August 2024. During this workshop, regional scientists and national forecasters from ICPAC member states assessed the progress of the ongoing JJAS 2024 season and developed regional and national-level climate outlooks for the upcoming OND season using ICPAC's High-Performance Computing (HPC) cluster.

4. Probability Forecast of Rainfall for October to December 2024

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

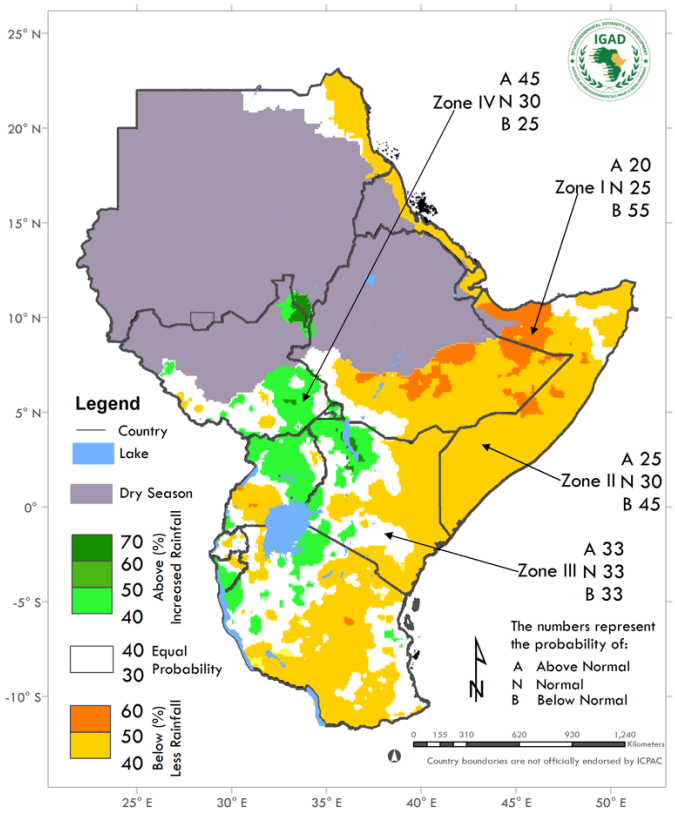

Figure 1. Probability forecast of rainfall for various zones within the GHA region for October to December 2024. Grey shading indicates regions where OND is climatologically a dry season.

Zone I: In this zone (dark orange), the below normal rainfall (drier) category has the most enhanced probability (55%). The probability for normal and above normal categories are 25% and 20%, respectively.

Zone II: In this zone (orange) also, the below normal rainfall (drier) category also has the highest probability (45%). The probabilities of the near normal and above normal categories are 30% and 25% respectively.

Zone III: In this Zone (white), the probabilities of below, normal, and above are equal at 33%. This equal probability zone is also considered a no-confidence zone.

Zone IV: In this zone (light green), the probabilities for the above normal category is the highest (45%). Probabilities for the normal and below normal categories are 30% and 25% respectively.

Note: In Fig 1, the 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, in 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 below-normal category. In the case of Zone-I (Fig. 1) for instance, there is 55% probability of rainfall occurring in the below-normal category, 25% probability of rainfall occurring in the near-normal category; and 20% probability of rainfall occurring in the above-normal category. It is emphasized that boundaries between zones should be considered as transition areas.

5. Probability for Lowest 20% and Highest 20% of Climatology

Figure 2 shows the probability for lowest 20% & highest 20% of climatology

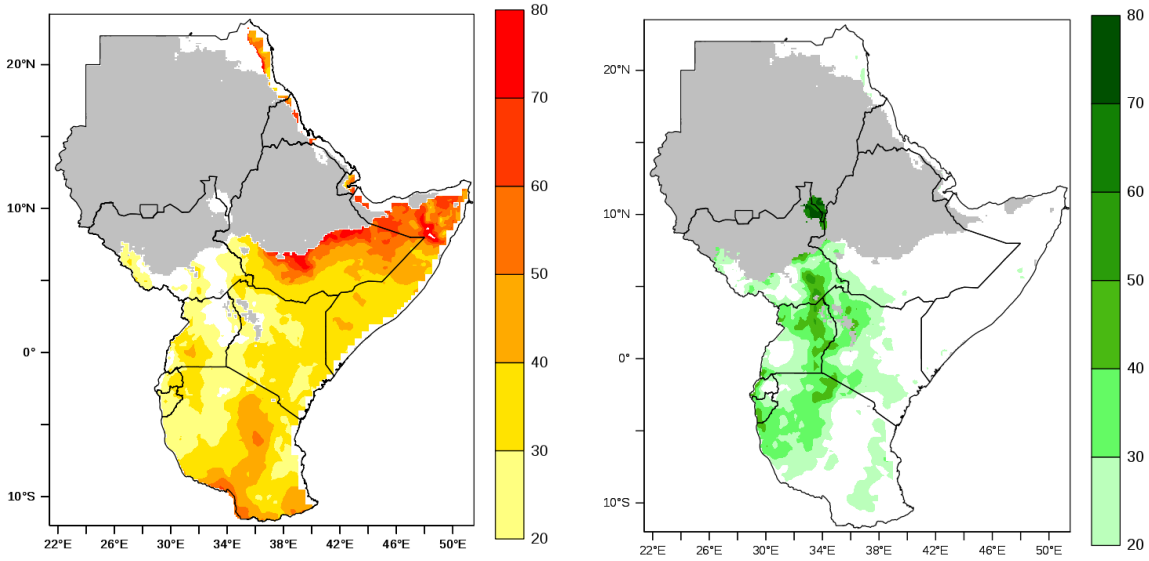

Figure 2: Probability for lowest 20% of climatology (left) and highest 20% of climatology (right).

6. Probability of Seasonal Rainfall Exceeding 300mm

The probability of rainfall exceeding user-relevant thresholds may be used to aid the management of risks in the food security and agriculture sectors. The probability of exceeding 300mm of seasonal rainfall during OND 2024 season is given in Figure 3.

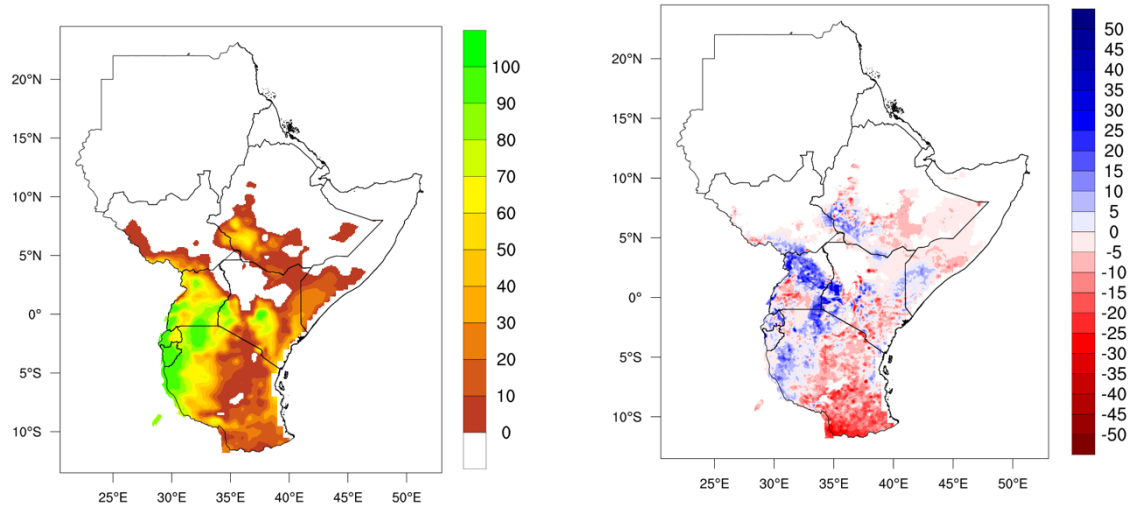

Figure 3: Probability of rainfall exceeding 300mm during OND 2024 (left) and the difference between these probabilities and historical climatology for the same period (right).

7. Probability Forecasts of the Start of OND 2024 Season and the Expected Average Onset Dates

The predicted most likely start dates of the October to December 2024 season as well as forecast probabilities for three categories of onset time (early/normal/late) are provided in Figure 4. 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.

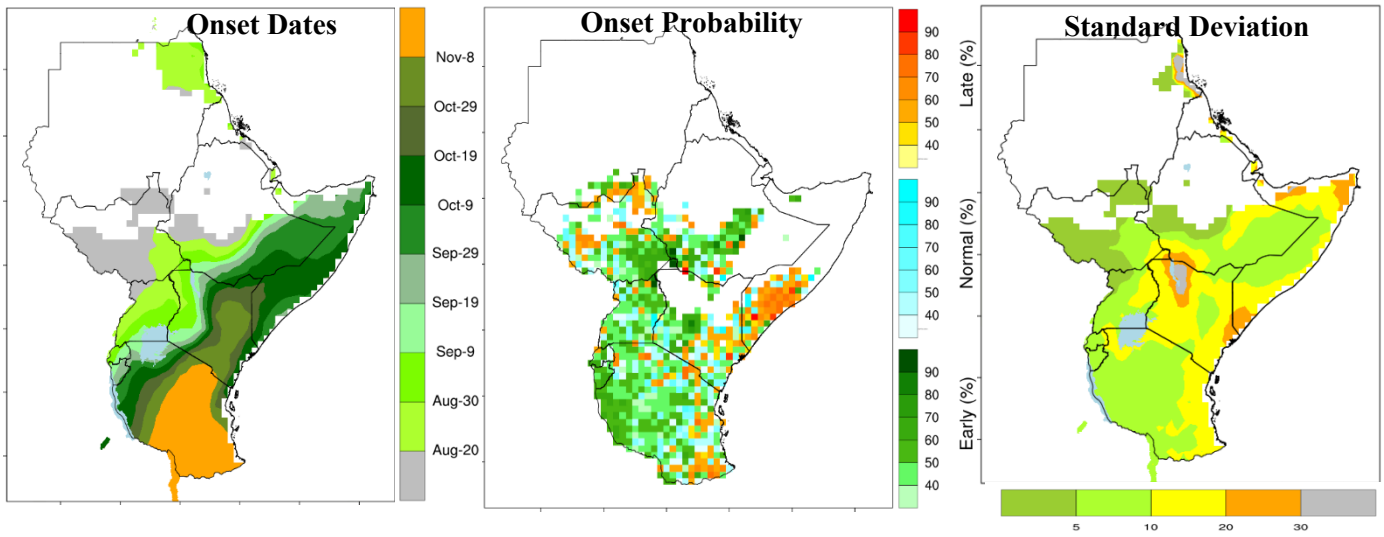

Figure 4: The map on the left indicates the most likely rainfall onset dates for the OND 2024 season from model ensemble mean values. The middle map indicates the forecast probabilities for three (tercile) categories of onset timing (early/normal/late). The map on the right shows the standard deviation of predicted onset dates from the different ensemble members (days), and is a measure of uncertainty in the ensemble mean values.

8. Analogue Years based on the Current Global SST Pattern and Nino3.4 Index Evolution

The selection of analogue years based on the Nino3.4 index is carried out by calculating the correlation and the mean difference between the combined observed and forecast evolution of Nino3.4 in the target year and the corresponding Nino3.4 index for the same period in previous years (Fig. 5). The evolution of the Nino3.4 index in the analogue years as well as the observed/predicted evolution in 2024 indicates a transition from El Nino to La Nina conditions.

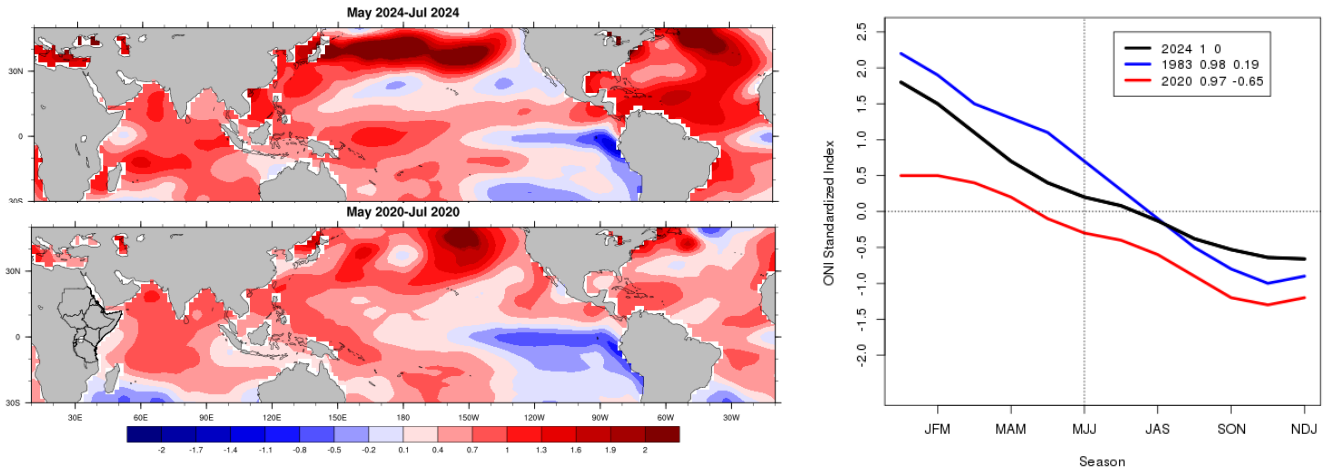

Figure 5: The plot on the left (top) shows the current (May - Jul 2024) pattern of SST anomalies over the tropical Oceans. The plot on the right shows the evolution of the Nino3.4 index extended by the predicted values (black) compared with the observed evolution for years which the evolution most closely matches that shown for 2024 (1983 and 2020). The closeness of the match is measured by the temporal correlation and the mean difference (given in the boxes). The May-July SST anomalies for one of the selected analogue periods (2020) are provided (left, bottom) for comparison with the May – July 2024 anomalies.

9. Probability Forecast of Temperature for October to December 2024

The temperature outlook for various zones within the GHA region is given in Figure 6 below.

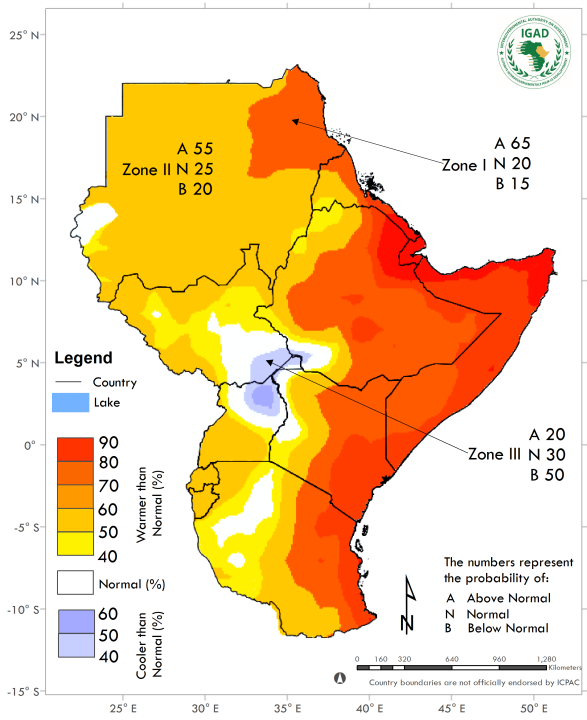

Figure 6: Probability forecast of mean surface temperatures for the OND 2024 season.

Zone I: In this Zone (dark orange), the above-average temperature (i.e., warmer) category is most likely at 65%. The probabilities for the near-average and below-average categories are 20% and 15% each.

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

Zones III: In this Zone (blue), the below-average temperature category has the highest probability (at 50%). The probabilities of the near-average and above-average categories are 30% and 20%, respectively.

10. Contributions

GHACOF 68 was organized jointly by the IGAD 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, CONFER and Down2Earth projects funded by the European Union, AICCRA-East Africa project funded by the World Bank, SCII project funded by the Swedish government, Emergency Locust Response Project (ELRP) funded by the World Bank, GIZ and The German Federal Foreign office under SCIDA III and Accelerating Implementation of Anticipatory Action Road map, Drought Watch system for Disaster Risk Reduction project funded by the European Union under the Joint Research Centre, PAStoral livelihoodS in the African Greater horn through Effective anticipatory action (PASSAGE) and WISER Kenya. 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, NORCE Norwegian Research Centre, NOAA CPC-International Desk and WMO Global Producing Centres (GPCs).

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