FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MINISTRY OF WATER AND ENERGY

Ethiopian Meteorological Institute

DATA AND CLIMATOLOGY LEAD EXECUTIVE

ANNUAL CLIMATE BULLETIN
For the year 2023

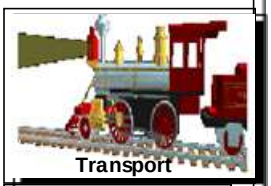
Some Applications of Climate Information

Disaster Management

Water Resources Management

Construction

Environment & Health



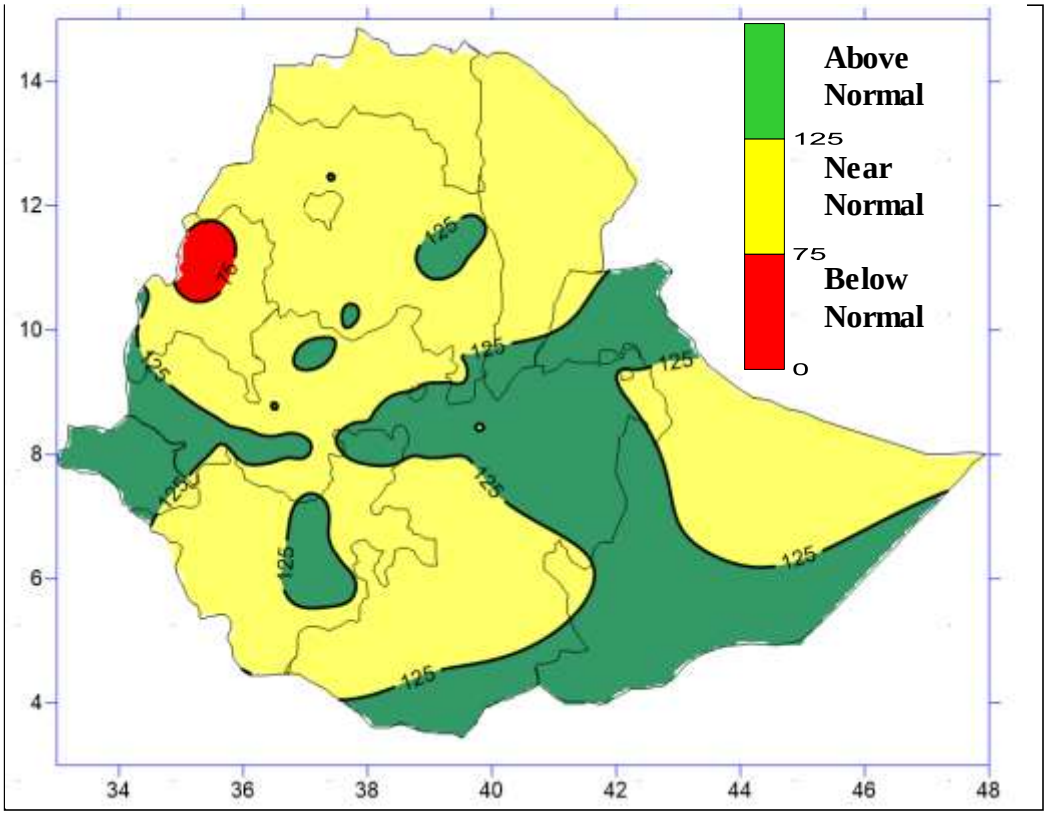
Transport

Recreation & Tourism

HIGHLIGHTS

Apart from some small area in Benishangul Gumuz, the rainfall activity was normal to above normal over the other areas for the year 2023. Much of Gambella, small portion of SNNPR, most parts of eastern Oromia, pocket area of Amhara, parts of western Oromia, much of Somali and adjoining parts of Afar had recorded above normal rainfall. Tigray, most of Afar, major portion of southern Oromia, most of Benishangul Gumuz, parts of eastern Gambella and most of Amhara experienced near normal rainfall.

Days remained hot at some low land places and the extreme maximum temperature values had exceeded 42°C. In particular, Abobo, Awah Arba, Aysha, Dubti, Elidar, Fugnido, Gambella, Gewane, Gode, Lare, Metema, Mille and Semera reported extreme maximum temperature in excess of 42°C. On the other hand, nights and early mornings were cold over the highlands of Ethiopia mostly during the dry season (*Bega*) and in *Belg* and *Kiremt* at some places. In connection with this, minimum temperature values below 2°C were recorded over Adelle, Alemaya, Adet, Ambamariam, Arsi Robe, Bore, Bui, Debre Birhan, Mehalmeda, Robe, Shola Gebeya and Wegeltena.



Percent of Normal Rainfall of the year 2023

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Foreword

This climate bulletin is prepared and disseminated by Ethiopian Meteorological Institute (EMI). It is aimed at providing climatological information to different services of the community involved in various socio-economic activities and giving some highlights about major synoptic situations.

The information contained in the bulletin is believed to assist planners, decision-makers and the community at large by providing details of the climatic conditions of the nation in a given period.

This bulletin differs from the other real time and near real time bulletins issued by the Institute, which for their input depend only on meteorological stations equipped with single side band radio for data transmission. Though this bulletin is not real time, published with a delay of at least two months, the information contained in this bulletin is based on data coming from a much larger number of meteorological stations. Moreover, the information contained in this bulletin is not sector-specific and a wide range of users can benefit from it.

The Institue disseminates monthly, seasonal and annual climatological bulletins in which all-necessary climatological information and significant climatic anomalies are highlighted.

We have a strong belief that various socio-economic activities related to planning disaster mitigation, water resources management, construction, environmental protection, transportation, recreation, tourism and others will be benefited most by the careful and continuous use of this bulletin. Meanwhile, your comments and constructive suggestions are highly appreciated to make the objectives of this bulletin a success.

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1. Introduction

1.1 General

In this bulletin the annual climate summary of the country for the year 2023 is presented. For convenience the climate summary of the year is done on seasonal basis.

From meteorological point of view, there are three seasons in Ethiopia; ***Belg, Kiremt*** and ***Bega***.

Belg is a short rainy period from **February to May** over much of the Belg-growing areas, whereas over the southwestern parts of the country it denotes the start of the long rainy season. Over the western parts of the country as well the rainy season starts during March/April. However over the northwestern parts of the country, this season is predominantly dry except for the month of May. Southern and southeastern parts of the country are expected to get their long rainy season during this time starting in March and peaking in April. The climate of the season is mostly hot and moist.

Kiremt is the period from **June to September.** It is the main rainy season in which the major food crops of the country are produced. The magnitude of rainfall is higher as compared to the other seasons for many parts of the country. Normally, the southern and the southeastern lowlands of the country receive little or no rain during this season, except for little amount of rainfall that occurs towards the end of the season.

Bega is the period from **October to January**. It is a harvesting season for various parts of Ethiopia. *Bega* is normally a dry season characterized by cool nights and early mornings over the highlands of northern, northeastern, central and eastern Ethiopia and by hot days over various parts of the country. It is also a short rainy season for places over southern, southeastern and southwestern parts of the country. Depending on the influences from mid-latitude rain-bearing systems, some places over central, northern and northeastern Ethiopia also receive occasional showers.

1.2 Summary

Apart from some small area in Benishangul Gumuz, the rainfall activity was normal to above normal over the other areas for the year 2023. Much of Gambella, small portion of SNNPR, most parts of eastern Oromia, pocket area of Amhara, parts of western Oromia, much of Somali and adjoining parts of Afar had recorded above normal rainfall. Tigray, most of Afar, major portion of southern Oromia, most of Benishangul Gumuz, parts of eastern Gambella and most of Amhara experienced near normal rainfall.

The *Belg* and *Kiremt* seasons of the year 2023 were the seasons with higher values of extreme maximum temperature. Days remained hot at some low land places and the extreme maximum temperature values had exceeded 42^{o}C. In particular, Abobo, Awah Arba, Aysha, Dubti, Elidar, Fugnido, Gambella, Gewane, Gode, Lare, Metema, Mille and Semera reported extreme maximum temperature in excess of 42^{o}C. On the other hand, nights and early mornings were cold over the highlands of Ethiopia mostly during the dry season (*Bega*) and in *Belg* and *Kiremt* at some places.

In connection with this, minimum temperature values below 2ºC were recorded over Adelle, Alemaya, Adet, Ambamariam, Arsi Robe, Bore, Bui, Debre Birhan, Mehalmeda, Robe, Shola Gebeya and Wegeltena (Table 3.1.1 and Table 3.1.2).

2. Synoptic Situation

2.1 Surface

- The mean central pressure value of the Mascarene High remained 1020 hPa and it was centered between 30°S to 36°S latitudes and 45°E to 112°E longitudes.
- The mean central pressure value of the Azores High was ranging from 1018 hPa to 1020 hPa and it was centered between 15° to 40°N and 18°W to 45°W.
- The mean central pressure value of the St. Helena High was ranging from about 1018 hPa to 1020 hPa and it was centered between 25°S to 38°S and 1°E to 15°W

2.2 Lower Troposphere (850 hPa Vector Wind)

In the year 2023, the wind at 850 hPa shifts its direction from southwesterly in January to northeasterly & southeasterly during *Kiremt* and finally to northwesterly in December. In terms of speed the lowest observed speed is less than 4 m/s and the highest is 12 m/s. The lowest occurred in June, July, October and November and the highest in January and December.

2.3 Middle Troposphere (500 hPa Geopotential Height)

The geopotential heights were below normal to near normal over Mediterranean and red Sea in January and December. While they were above normal to near normal over same places in March and May. Below-average heights over northern latitudes and above-average heights over the middle latitudes recorded in February. Anomalous above-average heights over Greenland and below-average heights over the North Atlantic Ocean detected in April. Above-average heights extending across Russia and Canada, and below-average heights over the North Atlantic Ocean and Scandinavia were the cases in October. The 500-hPa circulation during November featured above-average heights over the North Pacific Ocean, the western half of North America, Greenland, and most of Siberia, where a maxima in anomalies was recorded and below-average heights over the Laptev Sea and Scandinavia.

2.4 Upper Troposphere (200 hPa wind vector)

The upper-level westerly flow associated with the tropical westerly jet weakened and equatorial stronger easterly wind 15-30 m/s were dominate in most part of the horn of Africa in *Kiremt* 2023. On the other hand, the southwesterly and westerly wind associated with the subtropical northwesterly jet, had strengthened in January, December and the *Belg* season; while the upper level easterly flow associated with the tropical easterly jet weakened. Westerly wind with a speed of 15m/s -30m/s observed along the 15ºN parallel in February.

2.5 ENSO conditions

Weak La Niña prevailed and the oceanic and sub-surface oceanic conditions across the central and eastern equatorial Pacific were below-average in January and February. Above-average sea surface temperature began to appear in March and continued for the rest of the year. In April, May,

June, July, August, September, October, November and December the SST anomalies over Niño 3.4 region were 0.2, 0.5, 0.9, 0.9, 1.3, 1.5, 2.0, 2.1 and 2.0^{o}C respectively.

Reference: January to December 2022 Climate Diagnostics Bulletins. (https://www.cpc.ncep.noaa.gov/products/CDB/CDB_Archive_pdf/pdf_CDB_archive.shtml)

3. Weather

3.1 Temperature

The *Belg* and *Kiremt* seasons of the year 2023 were the season with higher values of extreme maximum temperature. Days remained hot at some low land places and the extreme maximum temperature values had exceeded 42^{o}C. In particular, Abobo, Awah Arba, Aysha, Dubti, Elidar, Fugnido, Gambella, Gewane, Gode, Lare, Metema, Mille and Semera reported extreme maximum temperature in excess of 42^{o}C.

On the other hand, nights and early mornings were cold over the highlands of Ethiopia mostly during the dry season (*Bega*) and in *Belg* and *Kiremt* at some places. In connection with this, minimum temperature values below 2^{o}C were recorded over Adelle, Alemaya, Adet, Ambamariam, Arsi Robe, Bore, Bui, Debre Birhan, Mehalmeda, Robe, Shola Gebeya and Wegeltena (Table 3.1.1 and Table 3.1.2).

Table 3.1.1 Annual Extreme Maximum Temperature Values in excess of 42^{o}C in the year 2023

Station Name	Maximum Temperature	Month	Date
Fugnuido	43	Feb	23
Gambella	43	Apr	9
Lare	43	Apr	7
Aysha	43	Jun	29,30
Dbubti	43	Aug	15
Mille	43	Aug	26
Gewane	43.4	Jun	26
Fugnuido	43.5	Mar	5
Aysha	43.5	Aug	30
Semera	43.6	Aug	26
Aysha	43.6	Sep	24
Gambella	43.8	Mar	6
Elidar	43.8	Jun	25
Mille	44	Jun	26,27
Semera	44	Jun	27,25
Mille	44	Jul	30

Station Name	Maximum Temperature	Month	Date
Mille	44	Sep	21
Semera	44	Sep	20
Gode	44	Dec	24
Gode	44.2	Sep	4
Gode	44.6	Apr	13
Elidar	44.8	Jul	31
Abobo	45	Jan	31
Awash Arba	45	Jun	24
Semera	45	Jul	7
Dubti	45.5	Jun	27
Aysha	45.5	Jul	2
Dubti	45.5	Jul	6
Metema	46	Apr	16

Table 3.1.2 Annual Extreme Minimum Temperature Values less than 2ºC during the year 2023

Stations	Extreme minimum temperature	Month	Date
Alemaya	-2.2	Feb	2
Debre Birhan	-2	Feb	5
Mehalmeda	-1.5	Jan	4
Alemaya	-1.4	Jan	20
Debre Birhan	-1.2	Jan	4
Ambamariam	0	Aug	1
Adelle	0	Nov	7
Mehalmeda	0.2	Nov	25
Adet	0.3	Jan	2
Bui	0.3	Dec	4
Debre Birhan	0.4	Nov	26
Wegeltena	0.5	Feb	9
Robe	0.5	Apr	2
Ayehu	0.5	Jun	8
Wegeltena	1	Jan	4
Mehalmeda	1	Feb	6
Bui	1	Oct	29
Bore	1	Nov	13
Sholagebaya	1	Dec	18

Arise Robe	1.5	Jan	4
Wegeltena	1.6	Nov	30

3.2. Rainfall

Apart from some small area in Benishangul Gumuz, the rainfall activity was normal to above normal over the other areas for the year 2023. Much of Gambella, small portion of SNNPR, most parts of eastern Oromia, pocket area of Amhara, parts of western Oromia, much of Somali and adjoining parts of Afar had recorded above normal rainfall. Tigray, most of Afar, major portion of southern Oromia, most of Benishangul Gumuz, parts of eastern Gambella and most of Amhara experienced near normal rainfall (Fig. 3.2.2).

The annual total rainfall amount of the year 2022 exceeded 1600 mm over northwestern, western; and was more than 2200 mm over western and southwestern parts of the country. In association with this, the annual total rainfall amount reported over Arjo was as high as 2609.6mm.

On the other hand, the annual total rainfall amount was below 500 mm over most of Afar and the southern and southeastern portions of Somali. Refer to Figure 3.2.1 and Table 3.2.2. The annual rainfall amount of 2023 is lower than the one for 2021 over parts of northern, western and southwestern, southeastern and pocket area of central Ethiopia (Fig. 3.2.3).

Table 3.2.1 Heavy fall in excess of 70 mm within 24 hours in the year 2023

Station Name	Rainfall in mm	Month	Date
Nefas mewucha	70	Apr	7
Dalifagi	70	Aug	20
MASHA	70.2	Oct	27
Gimbi	70.3	Jul	26
DUBTI	71	Mar	12
D/Tabor	71.9	Aug	1
Gelemso	72	May	25
Wereilu	72	May	28
Gore	72	Jun	16
D/BREHAN	72	Sep	15
LIMUGENET	72	Nov	4
GIDAAYANA	72	Dec	14
SHERKOLE	72.5	Jul	30
Limugenet	72.6	Oct	27
Jinka	72.8	Apr	16
GIDAAYANA	74	Sep	10
BORE	75	Apr	5
Ginir	75	Oct	12

Station Name	Rainfall in mm	Month	Date
Sirinka	75.2	Aug	1
Masha	76.4	Aug	30
GAMBELLA	76.6	Nov	5
SIRINKA	76.9	Mar	31
Bahir Dar Met	78.2	Jul	5
Sawula	78.8	May	4
Algie	80	Jun	30
GINIR	80	Nov	2
Assossa	80.1	Aug	15
MASHA	80.6	Sep	4
MASHA	80.6	Nov	18
Jinka	81.2	Oct	20
BORE	82	Mar	13
Gundomeskel	82	Aug	30
LARE	82.2	Sep	11
JIMMA	82.4	Jul	30
SIRINKA	83.5	Sep	1
Bure	84.6	Aug	23
Fugnuido	84.6	Aug	31
Arsi Robe	85.3	Apr	29
Arba Minch	86.7	Oct	19
GINIR	88	Sep	20
MOYALE	88.8	3	22
AYEHU	89	3	19
Bedelle	89	10	27
Nekemte	89.1	6	10
Bure	95.7	6	22
SAWULA	98.6	3	27
Hageremariam	100.6	5	4
CHIFRA	104	3	13
Bore	106	10	20
DALIFAGI	107.4	3	25
HAGEREMARIAM	107.4	11	7
SHAHURA	108.4	9	15
Bui	146	3	14
Ginir	160	4	30

Table 3.2.2 Annual total rainfall amount in excess of 1500 mm during the year 2023

Station Name	Annual rainfall amount in mm
Arejo	2609.6
Nekemte	2579.5
Masha	2411.0
Limugenet	2386.4
Gore	2266.7
Aman	2226.1
Bure	2207.2
Gimbi	2183.3
Bedelle	2158.5
Shambu	2126.2
Bore	1983.5
Chira	1979.3
Gidaayana	1973.1
Chagini	1822.1
Jimma	1799.6
Dangla	1787.4
Debere Markos	1768.2
Gelemso	1765.2
Indiber	1749.5
Debre Tabor	1731.2
Sawula	1728.3
Tepi	1675.7
Nejo	1668.9
Aira	1612.4
Bahir Dar	1606.2
Jinka	1561.7
Ghion	1535.2
Dilla	1522.6
Bui	1518.0
Addis Ababa Obs	1512.9

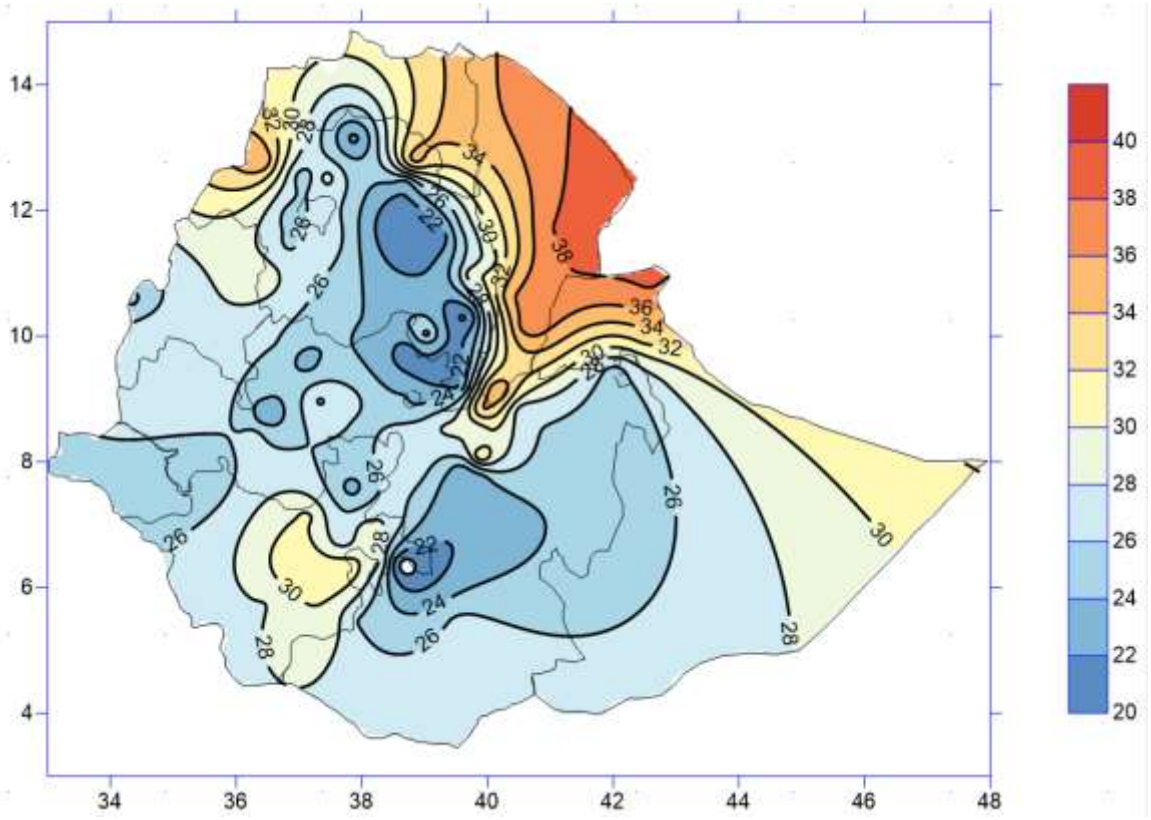


Figure 3.1.1 Mean Maximum temperature in ºC for the year 2023

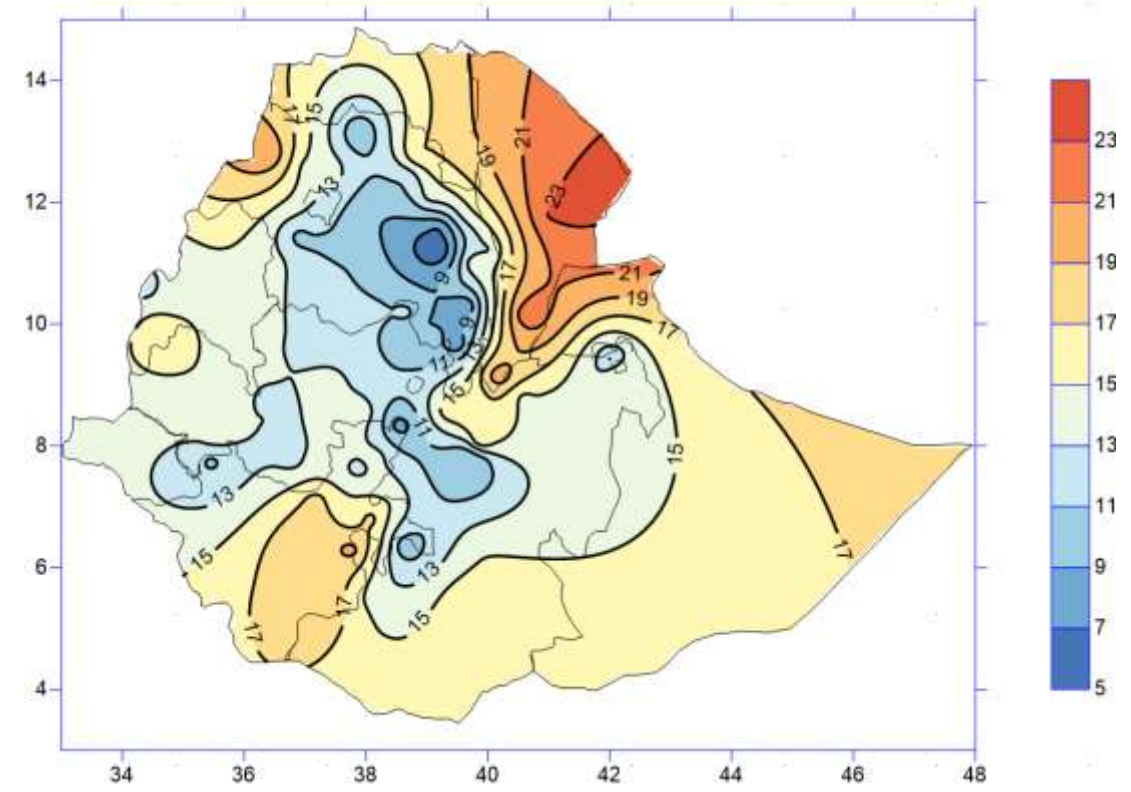


Figure 3.1.2 Mean minimum temperature in ºC for the year 2023

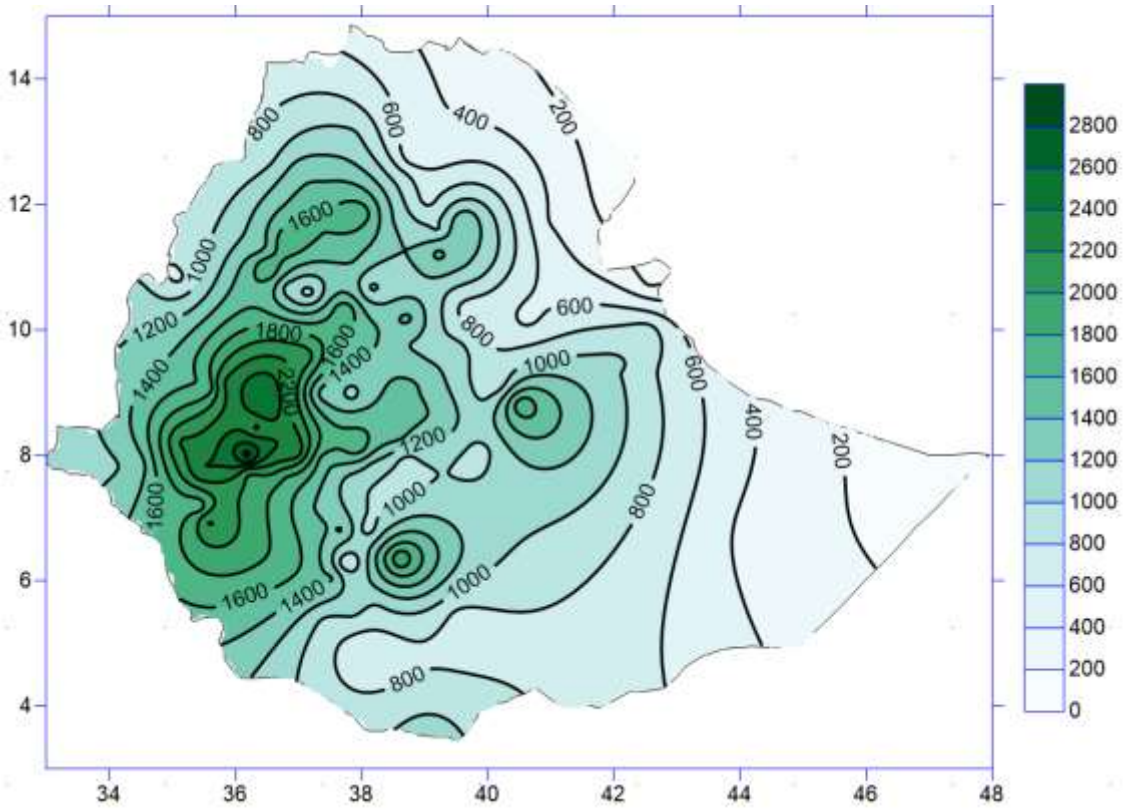


Figure 3.2.1 Annual total Rainfall amount in mm of the year 2023

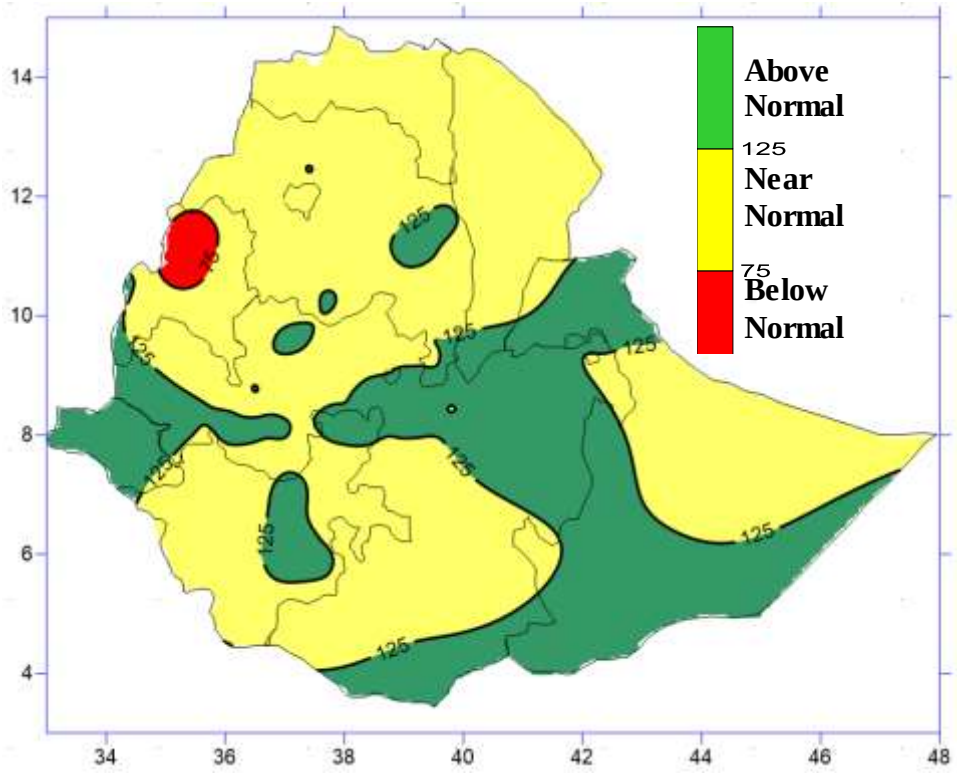


Figure3.2.2. Percent of normal rainfall for the year 2023

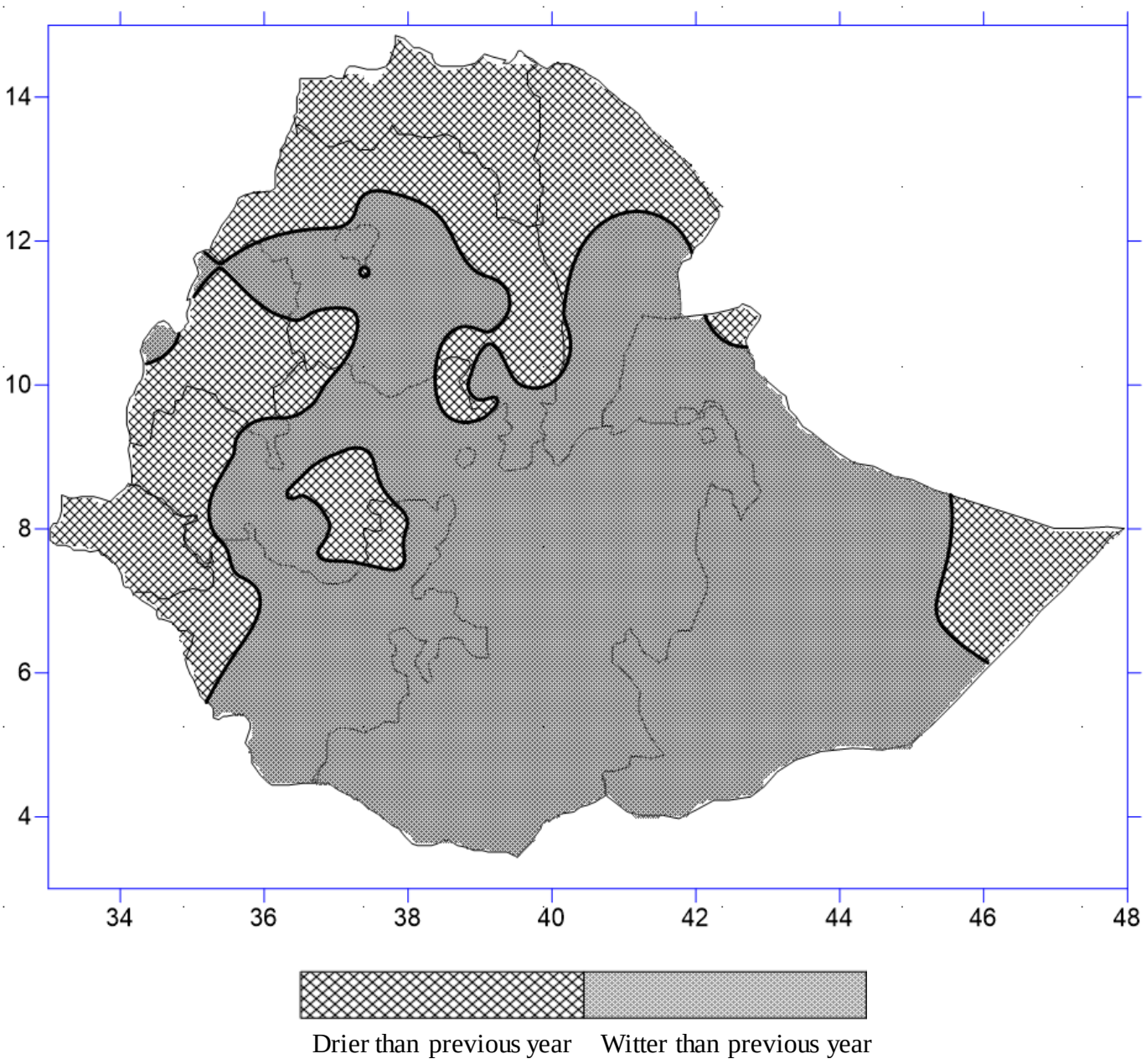


Figure 3.2.3 Annual Total Rainfall Amount of 2023 minus Annual Total Rainfall Amount of 2022

3.3 Wind

The ***WIND ROSE*** diagrams presented in table 3.3.1a to 3.3.1d show the wind conditions that prevailed during the three seasons for Awassa, Bahir Dar, Mekele and Addis Ababa Bole.

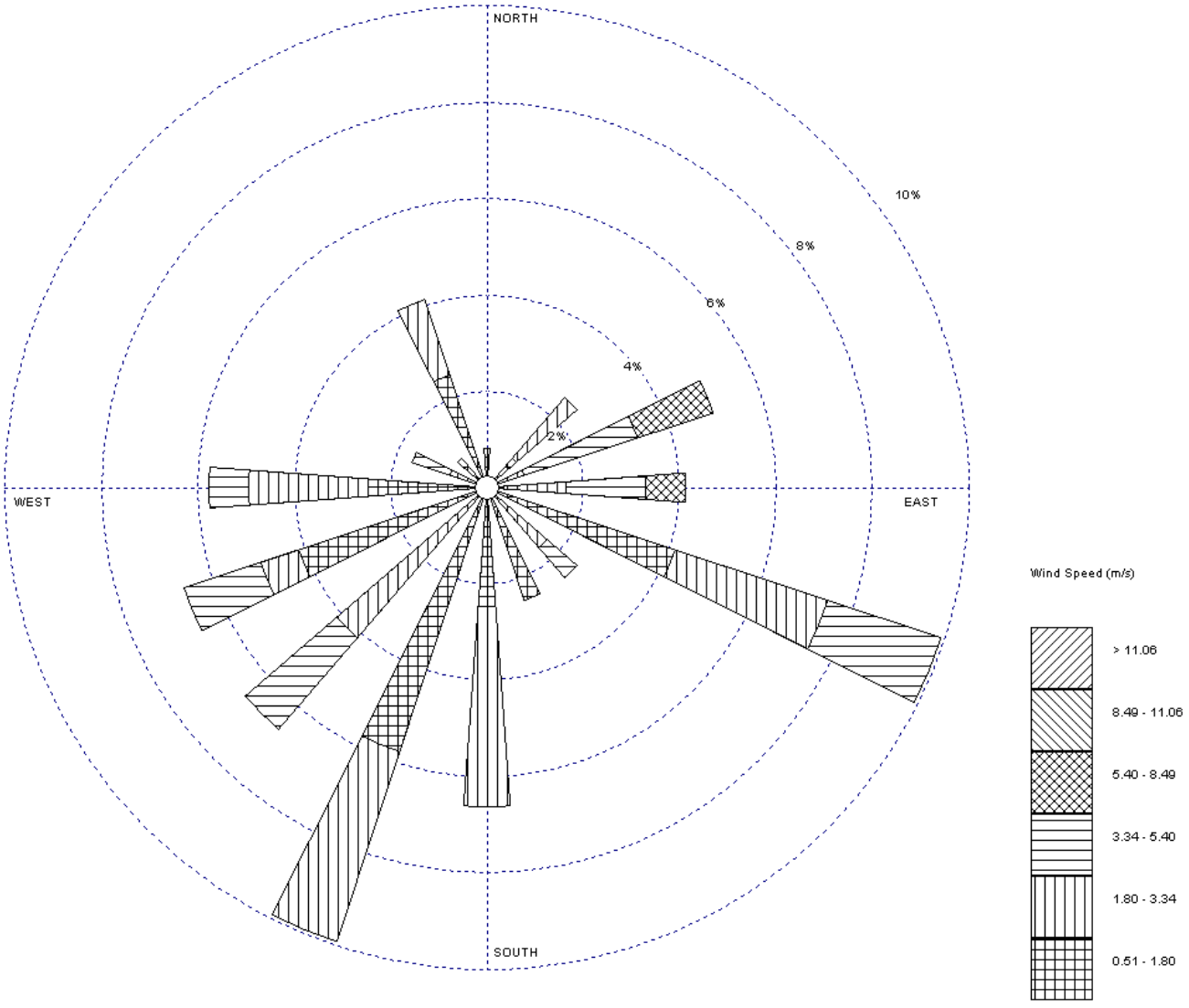
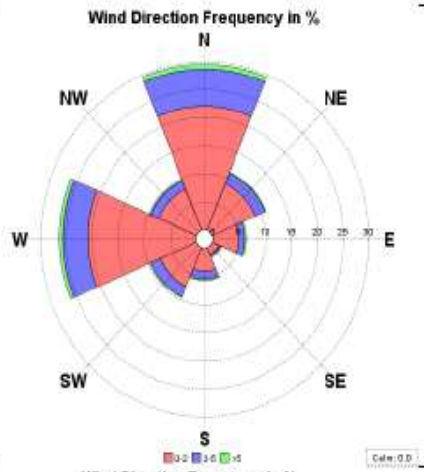
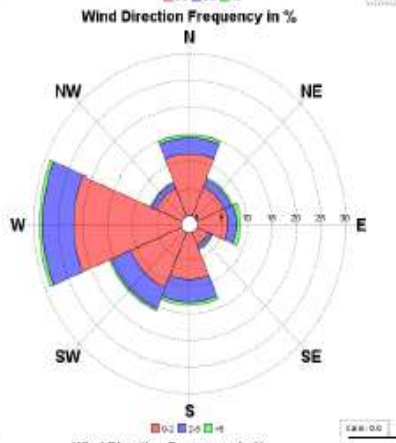
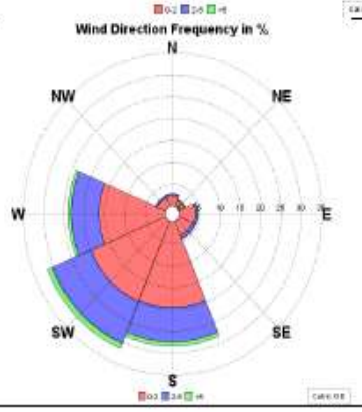
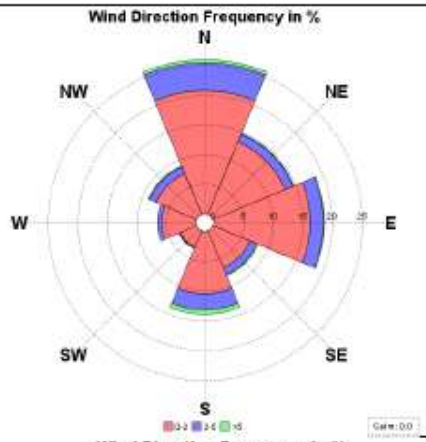
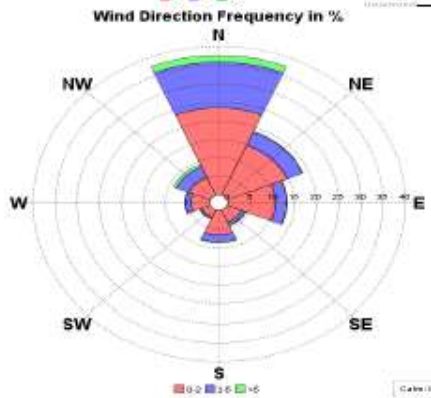
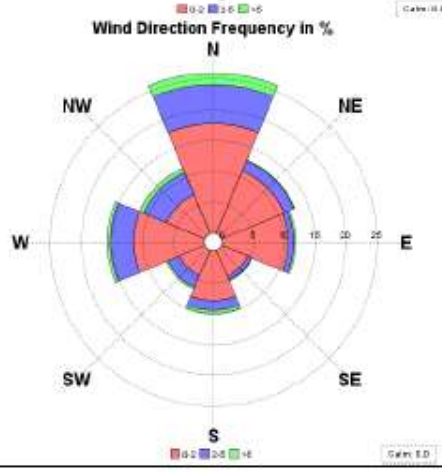


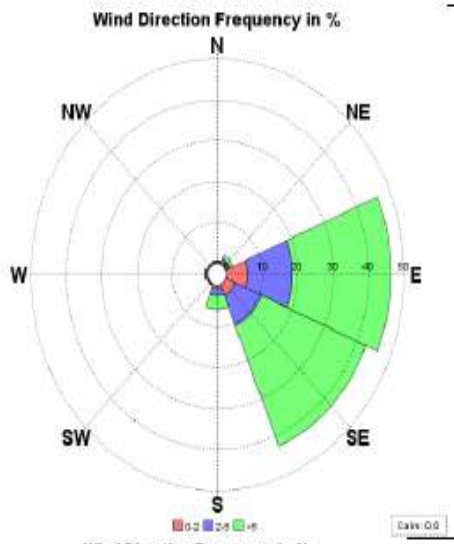
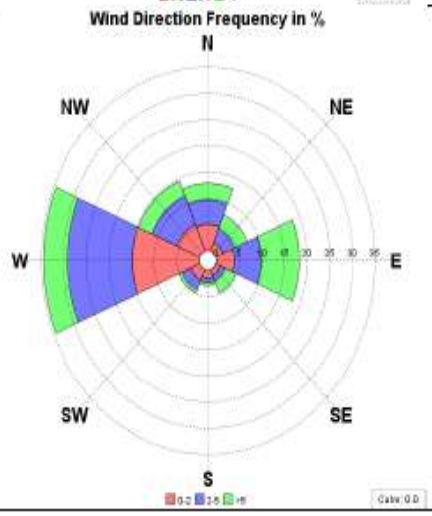
Figure 3.3.1 Sample wind rose diagram. The center on the diagram (where the head of each bar ends) represents a meteorological station into which the wind blows, while its tail shows where the wind comes from. The length of the bar is proportional to the frequency of the wind having a specific direction and speed range. The percentage points on the concentric circles can be used to make comparisons among the lengths of the bars and so as to easily identify the more prevalent direction. The shadings on the bar represent a specific speed range in meters per second as shown on the key.

Table 3.3.1 WIND ROSE diagrams over selected stations showing the prevalent wind in the three seasons:

a. Awassa, b. Bahir Dar, c. Mekele and d. Addis Ababa Bole

Station (Season) (a)	Based on long term data (1981-2010)
Awassa (Bega)	
Awassa (Belg)	
Awassa (Kiremt)	

Station (Season) (b)	Based on long term data (1981-2010)
Bahir Dar (Bega)	
Bahir Dar (Belg)	
Bahir Dar (Kiremt)	

Station (Season) (c)	Based on long term data (1981-2010)
Mekele (Bega)	
Mekele (Belg)	
Mekele (Kiremt)	

Station (Season) (d)	Based on long term data (1981-2010)
Addis Ababa Bole (Bega)	
Addis Ababa Bole (Belg)	
Addis Ababa Bole (Kiremt)