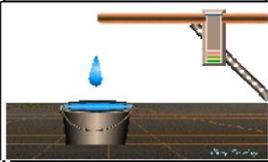


FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
MINISTRY OF WATER AND ENERGY
Ethiopian Meteorological Institute
DATA AND CLIMATOLOGY DIRECTORET

Some Applications of
Climate Information



Disaster Management



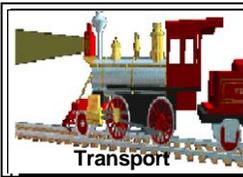
Water Resources
Management



Construction



Environment & Health



Transport



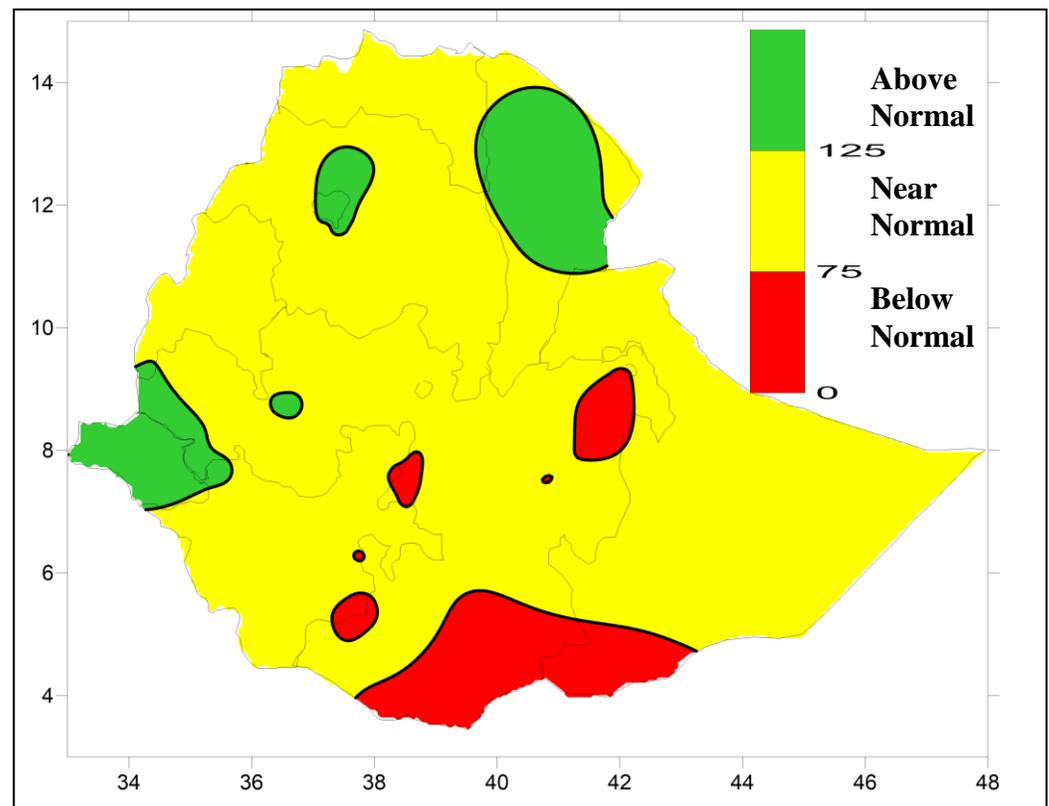
Recreation & Tourism

ANNUAL CLIMATE BULLETIN
For the year 2021

HIGHLIGHTS

The rainfall activity of the year 2021 was near normal over most parts of the country. However, northern Afar, Gambella and adjoining Oromia places and pocket areas of Oromia and Amahara had experienced above normal rainfall. A rainfall deficiency was the case over parts of south Oromia & Somlai and other pockets areas of Oromia.

Higher values of extreme maximum temperature values were recorded, mostly during the hot season (Belg) and in the first and last months of Kiremt. In particular, the extreme maximum temperature values had exceeded 42°C over Aysha, Chifra, Dalifagi, Dubti, Elidar, Fugnuido, Gambella, Metema, Mille and Semera. On the other hand, nights and early mornings were cold over the highlands of Ethiopia mostly during the dry season (Bega). In association with this, minimum temperature values below the freezing point (0°C) were recorded over Alemaya, Bati, Debre Berhan, Mehal Meda and Immi.



Percent of Normal Rainfall of the year 2021

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 Agency, 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 Agency 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 2021 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

The rainfall activity of the year 2021 was near normal over most parts of the country. However, northern Afar, Gambella and adjoining Oromia places and pocket areas of Oromia and Amahara had experienced above normal. A rainfall deficiency the case over parts of south Oromia & Somlai and other pockets areas of Oromia.

Higher values of extreme maximum temperature values were recorded, mostly during the hot season (Belg) and in first and last months of Kiremt . In particular, the extreme maximum temperature values had exceeded 42oC over Aysha, Chifra, Dalifagi, Dubti, Elidar, Fugnuido, Gambella, Metema, Mille and Semera. On the other hand, nights and early mornings were cold over the highlands of Ethiopia mostly during the dry season (Bega). In association with this, minimum temperature values below the freezing point (0oc) were recorded over Bekoji, Alemaya, Bati,, Debre Berhan, Mehal Meda and Immi.

2. Synoptic Situation

2.1 Surface

- The mean central pressure value of the Mascarene High was ranging from about 1018 hPa to 1026 hPa and it was centered between 30°S to 40°S latitudes and 45°E to 90°E longitudes.
- The mean central pressure value of the Azores High was ranging from about 1015 hPa to 1025 hPa and it was centered between 30° to 40°N and 10°W to 90°W.
- The mean central pressure value of the St. Helena High was ranging from about 1015 hPa to 1020 hPa and it was centered between 25°S to 38°S and 5°E to 50°W

2.2 Lower Troposphere (850 hPa Vector Wind)

In May in the last month the Belg season, strong cross-equatorial and south eastern flow of above 8 m/s was observed over northern & western Indian Ocean, Arabian Sea and the adjoining areas of the Horn of Africa. The cross equatorial flow further intensified during the Kiremt season and the speed of the average wind was 4 – 12 m/sec during the peak of the season. This cross equatorial flow weakened in the succeeding months and replaced by northwesterly flow in November and continues in December.

2.3 Middle Troposphere (500 hPa Geopotential Height)

The geopotential height values were dominantly above average over Northern Pacific during much of the year.

2.4 Upper Troposphere (200 hPa wind vector)

Strong upper tropospheric easterly flow, associated with the Tropical Easterly Jet (TEJ), was dominant over the tropical areas between West Africa and India during Kiremt of speed 25-30 m/s in September, while weak westerly flow (not more than 15 meters per second), associated with the Subtropical Westerly Jet, and prevailed over the subtropical areas during the rest of the year 2021.

2.5 ENSO conditions

The oceanic and sub-surface oceanic conditions across the central and eastern equatorial Pacific showed near average, weak La Niña to a moderate-strength La Niña condition during the year 2021 particularly over Niño 3.4 region.

Reference: Climate Diagnostics Bulletins published during the year 2021.

3. Weather

3.1 Temperature

Higher values of extreme maximum temperature values were recorded mostly during the hot season (Belg 2021) and in the first and last months of Kiremt, refer to Table 3.1.1 and Figure 3.1.1. In particular, the extreme maximum temperature values had exceeded 42°C over Aysha, Chifra, Dalifagi, Dubti, Fugnido, Gambella, Metema, Mille and Semera. On the other hand, nights and early mornings were cold over the highlands of the country in the dry season (Bega). See Table 3.1.2 and Figure 3.1.2. In association with this, minimum temperature values below the freezing point (0°C) were recorded over Alemaya, Bati, Debre Berhan, Mehal Meda and Immi.

Table 3.1.1 Annual Extreme Maximum Temperature Values in excess of 42°C in the year 2021

Station Name	Maximum Temperature	Month	Date
Aysha	43.5	Sep	21
Aysha	43.8	Aug	31
Aysha	44.5	Mar	31
Aysha	45	Jul	4
Aysha	48	Jun	17
Chifra	43	Jun	16
Dalifagi	43.1	May	30
Dalifagi	44.1	Jun	13
Dubti	43	May	31
Dubti	44	Jun	21
Elidar	43.8	Sep	16
Elidar	43.8	Jul	3
Elidar	43.8	Oct	4
Elidar	44.8	May	18
Elidar	46	Jun	24
Fugnuido	43.5	Mar	5
Gambella	43	Mar	1
Metema	44.3	Mar	20
Metema	43	Apr	7
Mille	44	Jun	14
Semera	43.8	Sep	18
Semera	44.6	May	15
Semera	45	Jun	6
Semera	45	Jul	9

Table 3.1.2 Annual Extreme Minimum Temperature Values less than 2°C during the year 2021

Station Name	Minimum Temperature	Month	Date
Adelle	1	Dec	11
Aleltu	1.8	Feb	9
Alemaya	-0.8	Dec	10
Alemaya	-0.8	Nov	30
Alemaya	0.2	Jan	27
Ambamariam	1.6	Jan	8
Arsi robe	1.4	Dec	10
Bati	-4.5	Jan	27
Bore	1.6	Sep	19
Chefa	1.8	Jan	27
Dangla	1.5	Dec	11
Debere Birhan	-2.8	Nov	23
Debere Birhan	1.8	Sep	28
Debere Birhan	-5.8	Dec	11
Debere Birhan	-0.4	Mar	25
Debere Birhan	-2.9	Jan	18
Debere Birhan	-0.4	Oct	22
Debre Tabor	1.2	Jun	30
Debre Zeit	1.6	Dec	12
Immi	-0.4	Feb	2
Jimma	1.8	Dec	11
Mehalmeda	-2.2	Dec	10
Mehalmeda	-0.5	Nov	18
Mille	0	Jul	21
Robe	0.4	Dec	21
Sawula	1.9	Jun	5
Wegeltena	1	Jan	19
Yitenora	1.4	Dec	13

3.2. Rainfall

The rainfall activity of the year 2021 was near normal over most parts of the country. However, northern Afar, Gambella and adjoining Oromia places and other pocket areas of Oromia and Amahara had experienced above normal rainfall. A rainfall deficiency is the case over parts of south Oromia & Somlai and other pockets areas of Oromia (Fig. 3.2.2). The year 2021 was drier than 2020 in most areas except few places (Fig. 3.2.3).

The annual total rainfall amount of the year 2021 exceeded 1500 mm over northwestern, western and southwestern parts of the country. In association with this, the annual total rainfall amount reported over **Nekemte** was as high as **2337.1 mm**. On the other hand, the annual total rainfall amount was below 500 mm over most of Afar and the southern and southeaster portions of Somali. Refer to Figure 3.2.1 and Table 3.2.2.

Table 3.2.1 Heavy fall in excess of 70 mm within 24 hours in the year 2021

Stations	Heavy Fall	Month	Dates
Abobo	87	Oct	5
Arsi Robe	81.2	Jul	7
Bahir Dar	79.8	Jul	4
Bahir dar met	79.6	Aug	16
Bore	70.3	Jun	25
Dadisa	92	Aug	15
Dadisa	71.5	Jun	6
Dire Dawa	82.9	May	2
Dire Dawa	80.5	Oct	9
Ejaji	70.6	Oct	1
Fugnuido	73	Oct	1
Gambella	84.9	Aug	10
Gololcha	73.5	Oct	9
Gondar A.P.	79.7	Jun	30
Indiber	71.1	Jun	20
Kachise	74	Aug	23
Maji	70.7	Jul	23
Mash	73.6	Jul	5
Mekanselam	87	Aug	20
Nekemt	92.2	Jul	8
Nekemte	104.2	Jun	2
Nekemte	71.4	May	7
Nifasmewcha	83	Jul	31
Sholagebya	86.2	Jul	24

Table 3.2.2 Annual total rainfall amount in excess of 1500 mm during the year 2021

Station Name	Annual rainfall amount in mm
Aira	1796.7
Alge	1907.8
Aman	2379.1
Arejo	2976.7
Bahir dar	1909.3
Bahir dar (airport)	1834.7
Bedelle	2037.2
Bure	1803
Chagni	1864.9
Chewka	1653.1
Chira	1907.4
Dangila	1966.9
Debre tabor	1692.5
Dilla	1757.7
Gatira	1927.7
Gidaayana	1955
Gimbi	2060.1
Gore	1875
Jimma	1776.3
Kachise	2069.3
Limugenet	1968
Majji	1516.2
Nejo	1728.6
Nekemte	2337.1
Shahura	1551.9
Shambu	1714.8
Tepi	1810.7
Wombera	1761.1

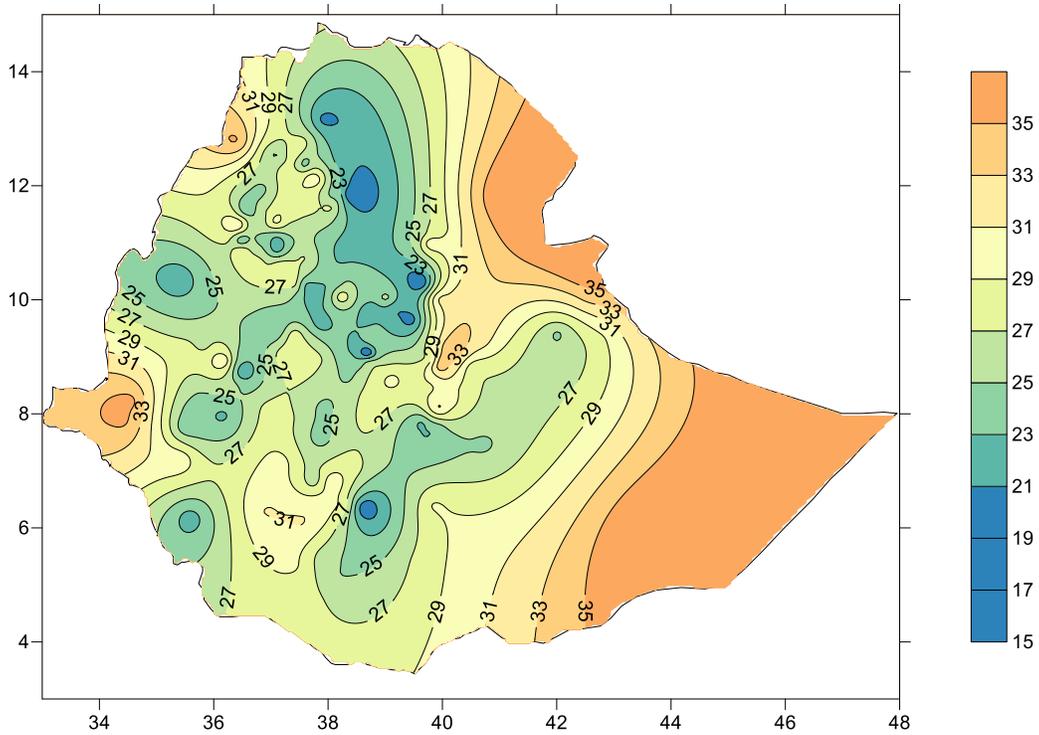


Figure 3.1.1 Mean Maximum temperature in °C for the year 2021

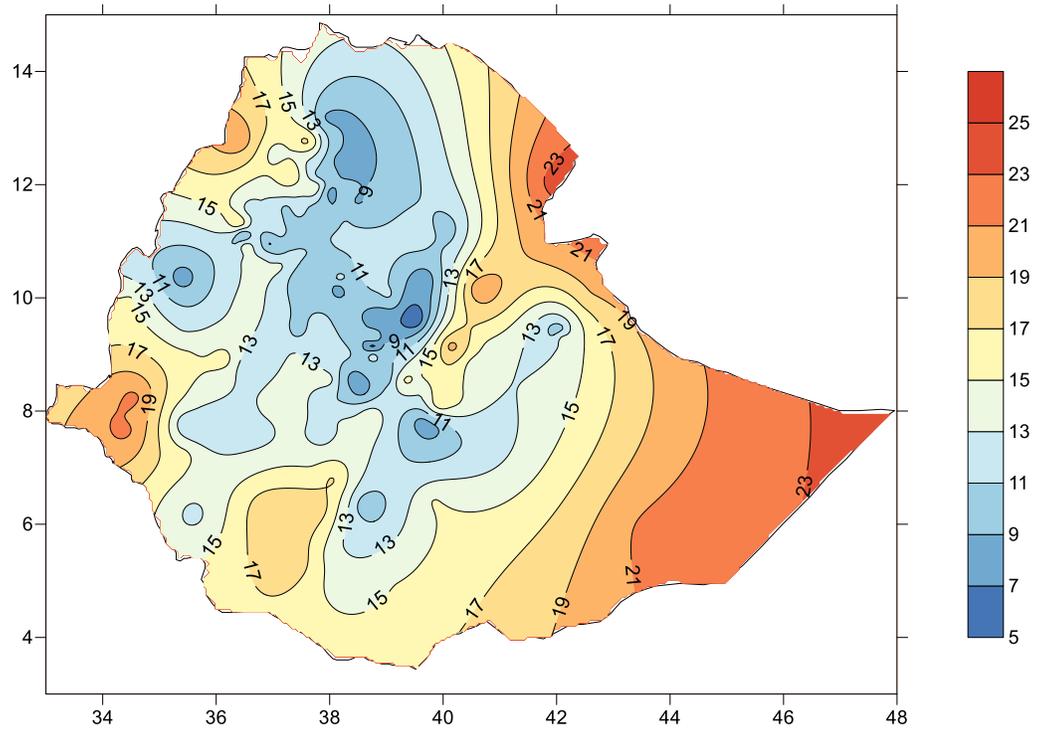


Figure 3.1.2 Mean minimum temperature in °C for the year 2021

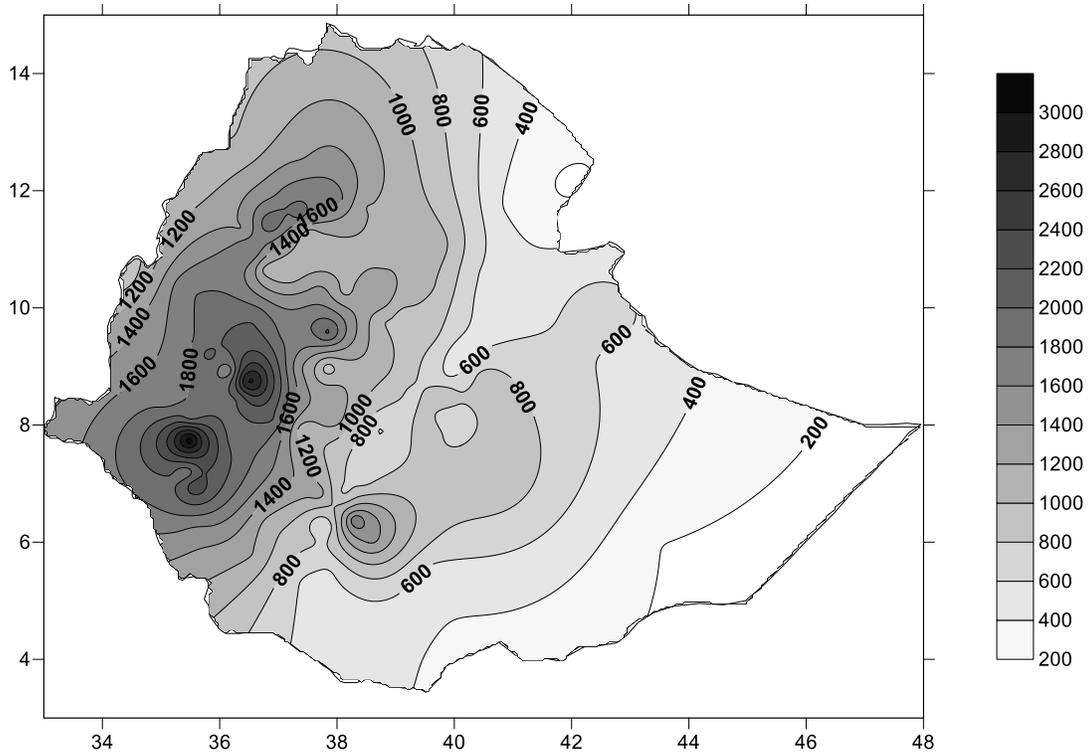


Figure 3.2.1 Annual total Rainfall amount in mm of the year 2021

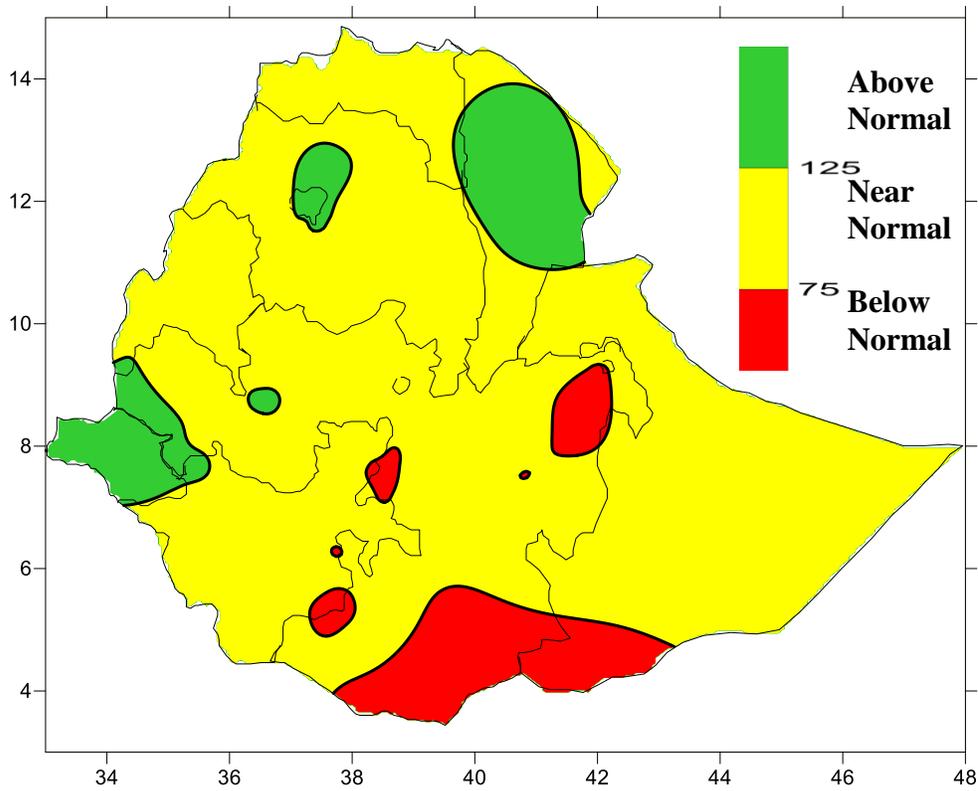


Figure 3.2.2. Percent of normal rainfall for the year 2021

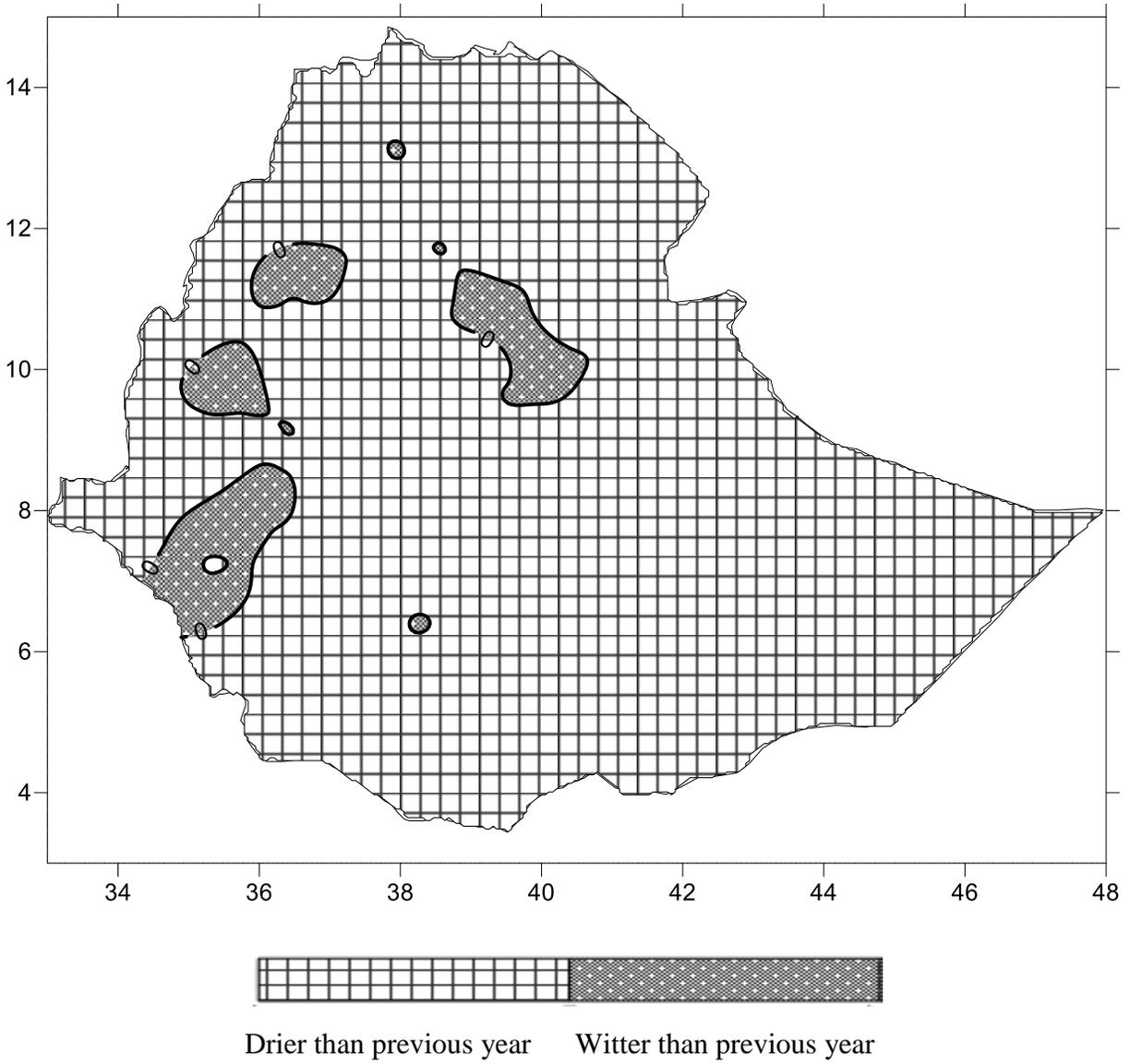
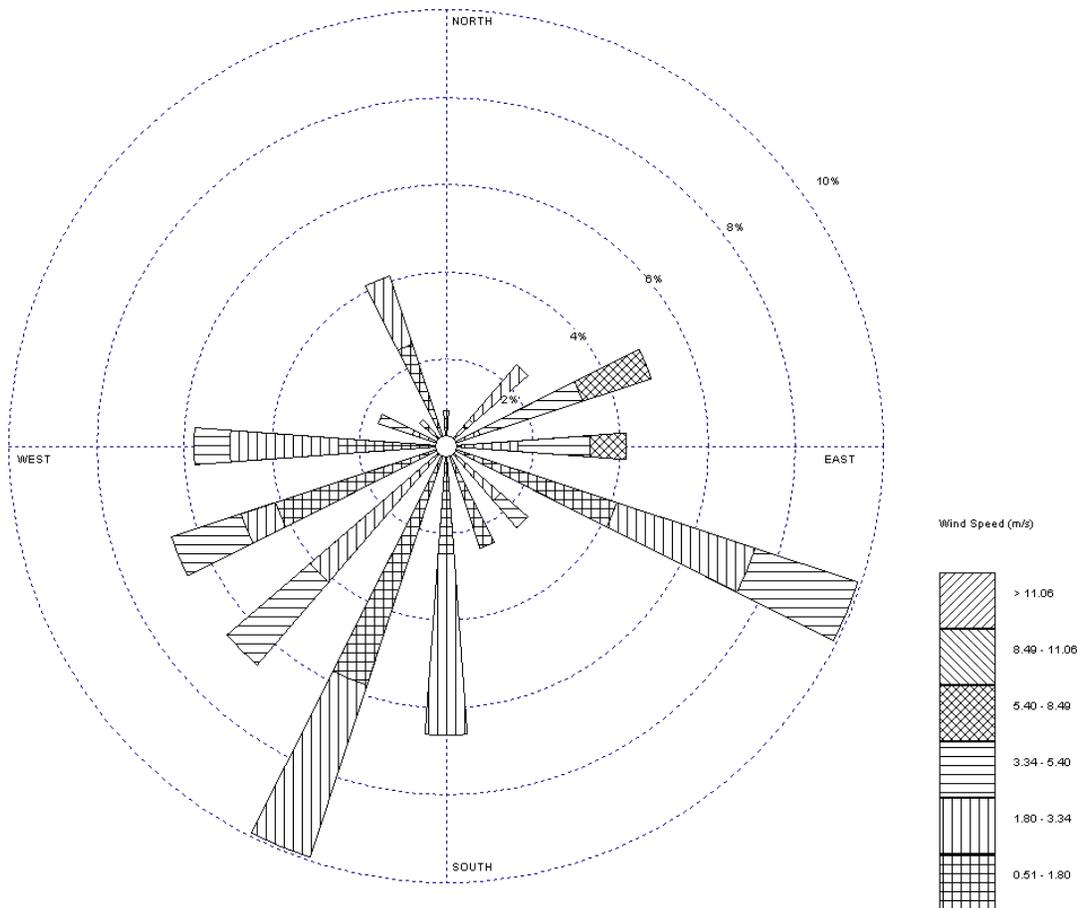


Figure 3.2.3 Annual Total Rainfall Amount of 2021 *minus* Annual Total Rainfall Amount of 2020

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 Addis Ababa Observatory, Mekele, Bahir Dar and Awassa.



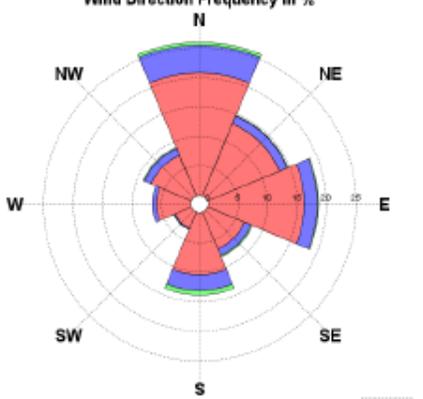
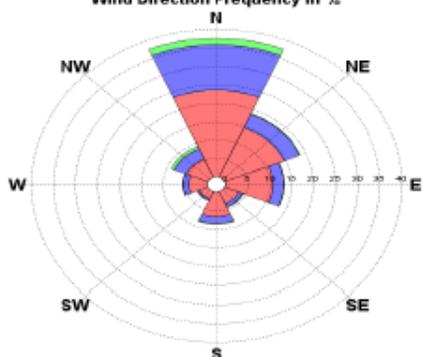
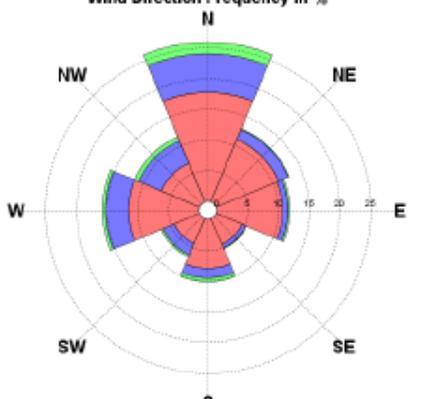
respectively.

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.

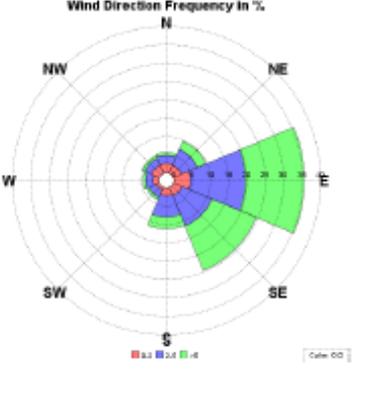
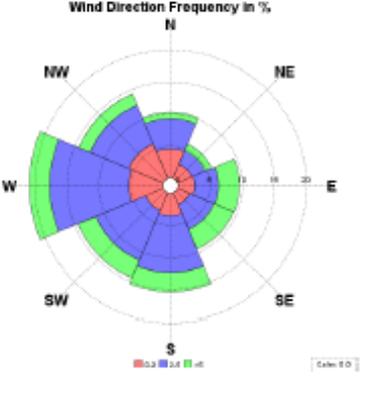
Table 3.3.1 WIND ROSE diagrams over selected stations showing the prevalent wind in the three seasons:

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

Station (Season) (a)	Based on long term data (1981-2010)
Awassa (Bega)	<p style="text-align: center;">Wind Direction Frequency in %</p>
Awassa (Belg)	<p style="text-align: center;">Wind Direction Frequency in %</p>
Awassa (Kiremt)	<p style="text-align: center;">Wind Direction Frequency in %</p>

Station (Season) (b)	Based on long term data (1981-2010)
Bahir Dar (Bega)	<p style="text-align: center;">Wind Direction Frequency in %</p>  <p style="text-align: center;">Gale: 0.0</p>
Bahir Dar (Belg)	<p style="text-align: center;">Wind Direction Frequency in %</p>  <p style="text-align: center;">Gale: 0.0</p>
Bahir Dar (Kiremt)	<p style="text-align: center;">Wind Direction Frequency in %</p>  <p style="text-align: center;">Gale: 1.0</p>

Station (Season) (c)	Based on long term data (1981-2010)
Mekele (Bega)	<p>Wind Direction Frequency in %</p> <p>This wind rose chart shows wind frequency by direction and speed for Mekele (Bega). The directions are labeled N, NE, E, SE, S, SW, W, and NW. The radial scale represents frequency in percent, with concentric circles at 10, 20, 30, 40, and 50. The legend indicates three wind speed categories: 0-2 (red), 2-4 (blue), and >4 (green). The dominant wind direction is East (E), with a frequency of approximately 45%. Other notable directions include East-South-East (SE) at ~35% and East-North-East (ENE) at ~25%. Wind speeds are generally higher in the East and SE directions.</p>
Mekele (Belg)	<p>Wind Direction Frequency in %</p> <p>This wind rose chart shows wind frequency by direction and speed for Mekele (Belg). The directions are labeled N, NE, E, SE, S, SW, W, and NW. The radial scale represents frequency in percent, with concentric circles at 10, 20, 30, 40, and 50. The legend indicates three wind speed categories: 0-2 (red), 2-4 (blue), and >4 (green). The dominant wind direction is East (E), with a frequency of approximately 40%. Other notable directions include East-South-East (SE) at ~30% and East-North-East (ENE) at ~20%. Wind speeds are generally higher in the East and SE directions.</p>
Mekele (Kirent)	<p>Wind Direction Frequency in %</p> <p>This wind rose chart shows wind frequency by direction and speed for Mekele (Kirent). The directions are labeled N, NE, E, SE, S, SW, W, and NW. The radial scale represents frequency in percent, with concentric circles at 10, 20, 30, 40, and 50. The legend indicates three wind speed categories: 0-2 (red), 2-4 (blue), and >4 (green). The dominant wind direction is West (W), with a frequency of approximately 35%. Other notable directions include West-North-West (WNW) at ~25% and West-South-West (WSW) at ~15%. Wind speeds are generally higher in the West and WNW directions.</p>

Station (Season) (d)	Based on long term data (1981-2010)
Addis Ababa Bole (Bega)	 <p>Wind Direction Frequency in %</p> <p>This wind rose chart for Addis Ababa Bole (Bega) shows wind frequency by direction. The cardinal directions are labeled: N (North), NE (Northeast), E (East), SE (Southeast), S (South), SW (Southwest), W (West), and NW (Northwest). The chart features concentric circles representing frequency percentages from 0 to 40. The dominant wind direction is East (E), with a frequency of approximately 35%. Other significant directions include East-Northeast (ENE) at ~25% and East-Southeast (ESE) at ~20%. A legend at the bottom indicates three wind speed categories: 0-2 (red), 2-4 (blue), and 4-6 (green). A scale of 0.5 is provided.</p>
Addis Ababa Bole (Belg)	 <p>Wind Direction Frequency in %</p> <p>This wind rose chart for Addis Ababa Bole (Belg) shows wind frequency by direction. The cardinal directions are labeled: N, NE, E, SE, S, SW, W, and NW. The dominant wind direction is East (E), with a frequency of approximately 30%. Other significant directions include East-Northeast (ENE) at ~20% and East-Southeast (ESE) at ~15%. A legend at the bottom indicates three wind speed categories: 0-2 (red), 2-4 (blue), and 4-6 (green). A scale of 0.5 is provided.</p>
Addis Ababa Bole (Kiremt)	 <p>Wind Direction Frequency in %</p> <p>This wind rose chart for Addis Ababa Bole (Kiremt) shows wind frequency by direction. The cardinal directions are labeled: N, NE, E, SE, S, SW, W, and NW. The dominant wind direction is West (W), with a frequency of approximately 30%. Other significant directions include West-Northwest (WNW) at ~25% and West-Southwest (WSW) at ~20%. A legend at the bottom indicates three wind speed categories: 0-2 (red), 2-4 (blue), and 4-6 (green). A scale of 0.5 is provided.</p>