Bhutan State of the Climate 2020

Weather and Climate Services Division
National Center for Hydrology and Meteorology
2021

Report
on
Bhutan State of the Climate 2020

National Center for Hydrology and Meteorology
Royal Government of Bhutan
2021

Prepared by:

Phuntsho Wangmo, WCSD, NCHM
Singay Dorji, WCSD, NCHM

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National Center for Hydrology and Meteorology (NCHM)
Royal Government of Bhutan
PO Box: 207
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Foreword

The National Center for Hydrology and Meteorology (NCHM) is the national focal agency responsible for studying, developing and providing services on meteorology, hydrology and cryosphere. The core mandates of the Center is to provide early warning information that helps the nation to protect lives and properties from the impacts of climate change and variability.

Changes in climate and its variation presents both risks and opportunities and it affects all aspects of domain. NCHM strives to deepen the scientific understanding of weather and climate, deliver climate services from national to local scales extending from seasons to years and decades to improve public information about the impacts of a changing climate. With the changing climate issues, the information on weather and climate has become vital in planning and management for different sectors. The planners, decision-makers and resource managers require information regarding future changes in climate and variability to better anticipate and to formulate adaptation policies/strategies in response to climate change impacts at various scales.

Moreover, Bhutan's economy is also dependent on climate sensitive sectors such as agricultural, hydropower and forestry. The precarious mountainous terrain coupled by climate change and variability, Bhutan is exposed to several hazards including flashfloods, GLOF (Glacial Lake Outburst Flood), landslides, cyclone induced storm, erratic rainfall and drought affecting the lives and livelihoods of the people. Therefore, NCHM will continue to provide a seamless suite of weather and climate services and facilitate efforts to identify and address the climate-related needs of planners and decision makers in various social and economic sectors.

(Karma Dupchu)
Director

Acknowledgement

"***Bhutan State of Climate 2020***" report was launched during the celebration of the World Meteorological Day on 23rd March, 2021. The Weather and Climate Services Division, National Center for Hydrology and Meteorology would like to thank the United Nations Development Program (UNDP) for funding the printing of the report. The funding and support by the UNDP for the celebration of the WMO day and Science Seminar is also gratefully acknowledged.

Contents

1. Introduction

The Bhutan State of Climate also called as Annual Climate Summary is an annual climate monitoring report that provides a summary of observations of the country's climate during a particular year. This edition is the fourth series and contains a summary of the year 2020 climate for Bhutan. All computations contained in this report are based on Class A stations (20 Agro-meteorological stations in each Dzongkhag) located across the country under the network of National Center for Hydrology and Meteorology, Royal Government of Bhutan. The planners and developers will require the information about the past, current and the future climate for effective planning, management and making sound decision, thus this report intends to provide the status of recent climatic condition for the country. This report contains only the basic statistics on climate indicators such as temperature and rainfall and its pattern in the year 2020 compared to the long-term average. The long term average/normal in the report is referred to the historical long-term average of climate data (temperature and rainfall) from 1996-2019.

2. Overview

2.1 Global Scenario: WMO State of the Global Climate 2020, Provisional Report

As per the World Meteorological Organization (WMO) Provisional Report on the State of Global Climate 2020, the global mean temperature for the year 2020 (January to October) was 1.2 ± 0.1 °C above the 1850–1900 baseline, used as an approximation of pre-industrial levels. The year 2020 is likely to be one of the three warmest years on record globally. The WMO assessment is based on five global temperature datasets as shown in figure below (Figure 1) and all five of those data sets currently place the year 2020 as 2nd warmest for the year to date when compared to equivalent periods in the past (January to October). However, the difference between the top three years is small and exact rankings for each data set could change once the year is complete. The spread of the five estimates for the January to October average is between 1.11 °C and 1.23 °C.

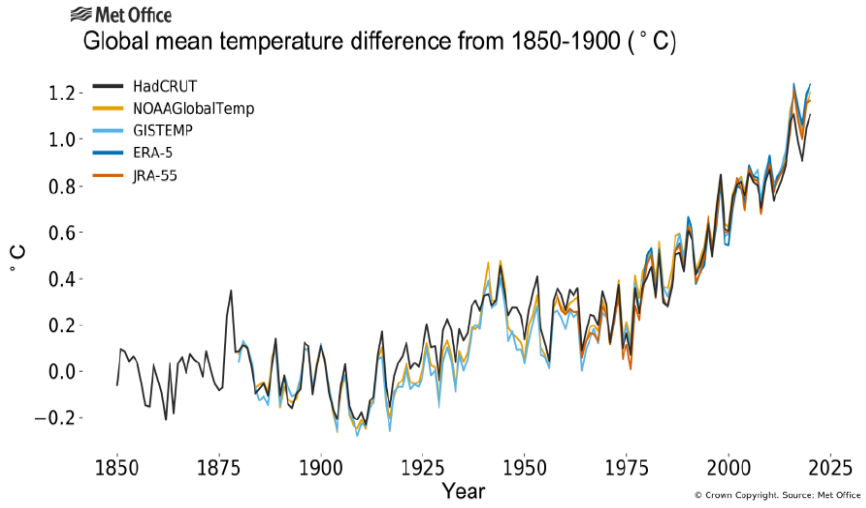


Figure 1: Global annual mean temperature difference from pre-industrial conditions 1850–1900 baseline for the five global temperature datasets.

Source: UK Met Office Hadley Centre

The warmest year i.e., 2016 on record to date began with a remarkably strong El Nino conditions, a phenomenon which contributes to higher global temperatures. Despite the neutral or comparatively weak El Nino conditions early in 2020, and developing La Nina conditions by late September, the warmth of the year 2020 is comparable to that of the 2016.

The global mean temperature in 2020 is on course to be one of the three warmest on record. The past six years, 2015–2020, are likely to be the six warmest on record. The last five-year (2016–2020) and 10-year (2011–2020) averages are also the warmest on record. Although the overall warmth of the year is clear, there were variations in temperature anomalies across the globe as showed in Figure 2.

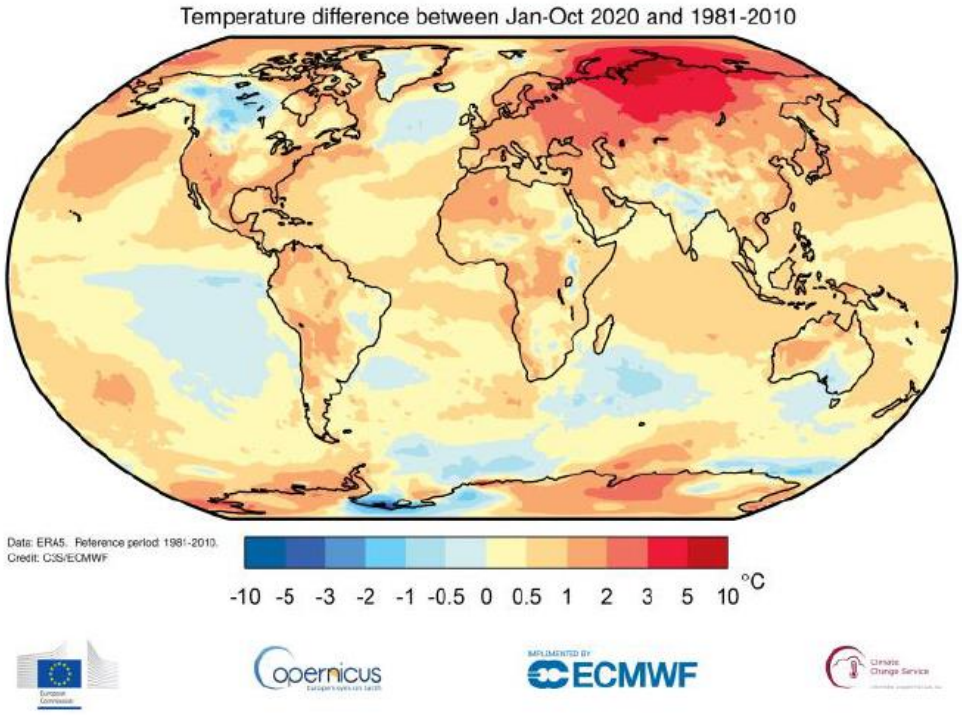


Figure 2: Temperature anomalies relative to the 1981-2010 long-term average from the ERA5 reanalysis for January to October 2020.

Source: European Centre for Medium-range Weather Forecasts (ECMWF), Copernicus Climate Change Service.

3. Climate Highlights of Bhutan - 2020

3.1 Location of the Class A meteorological stations

The report is based on 20 Class A meteorological stations and each Dzongkhag has one Class A met station.

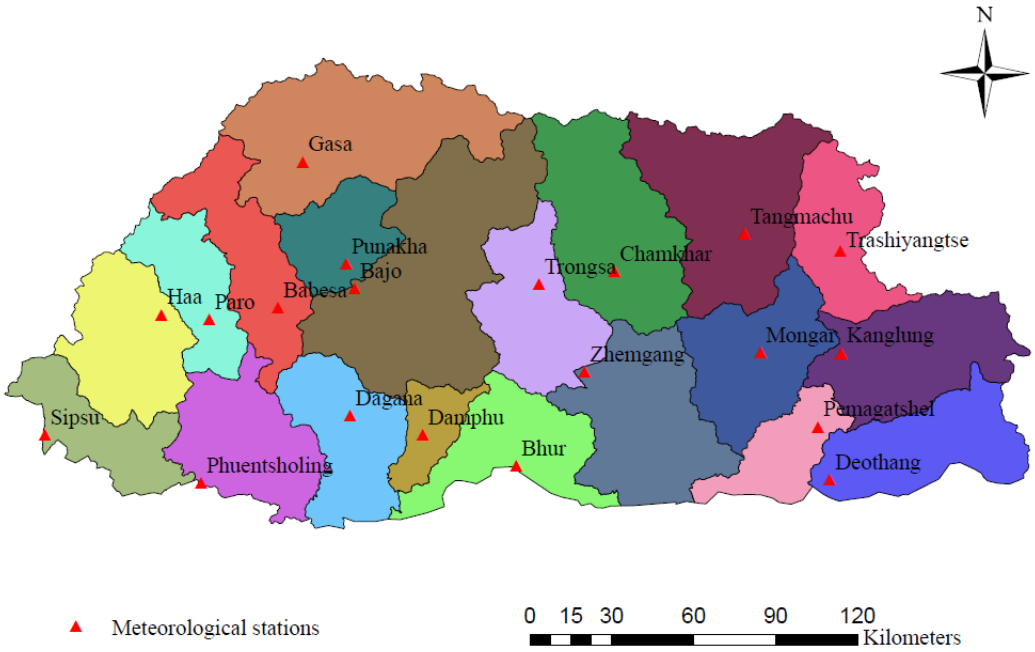


Figure 3: Location of Class A meteorological stations

3.2 Annual rainfall

The annual average rainfall (area average) was 2076.7 mm in 2020. The country as a whole received near normal to slightly above normal rainfall against the long term average. The highest 24-hour rainfall was recorded at Bhur with 512.1 mm. Gasa experienced the highest number of rainy days with 214 days (rainy days is defined as rainfall greater than or equal to 1mm). It is to be noted that a greater number of rainy days does not translate to more accumulated rain. However, the highest total annual rainfall was recorded at Bhur with 7220.3 mm followed by Sipsoo with 6324.2 mm.

3.3 Maximum and Minimum Temperature

The annual average maximum temperature was 22.0 ºC and minimum temperature was 11.8ºC. The highest daily maximum temperature was recorded at Punakha with 37.5ºC and the lowest daily minimum temperature was recorded at Haa with -12.0ºC. Haa experienced a greater number of days with the minimum temperature below or equal to zero with 127 days (minimum temperature <=0).

3.4 Monsoon

Bhutan experiences summer monsoon from June to September. Bhutan receive most of its annual rainfall during summer monsoon so, it is one of the predominant seasons of the year that influences much of the climate in Bhutan.

3.4.1 Rainfall

During the summer 2020, the country as a whole received near normal to slightly above normal rainfall. However, during months of July, August and September, most of the stations received slightly above normal rainfall against the long term average 1996-2019.

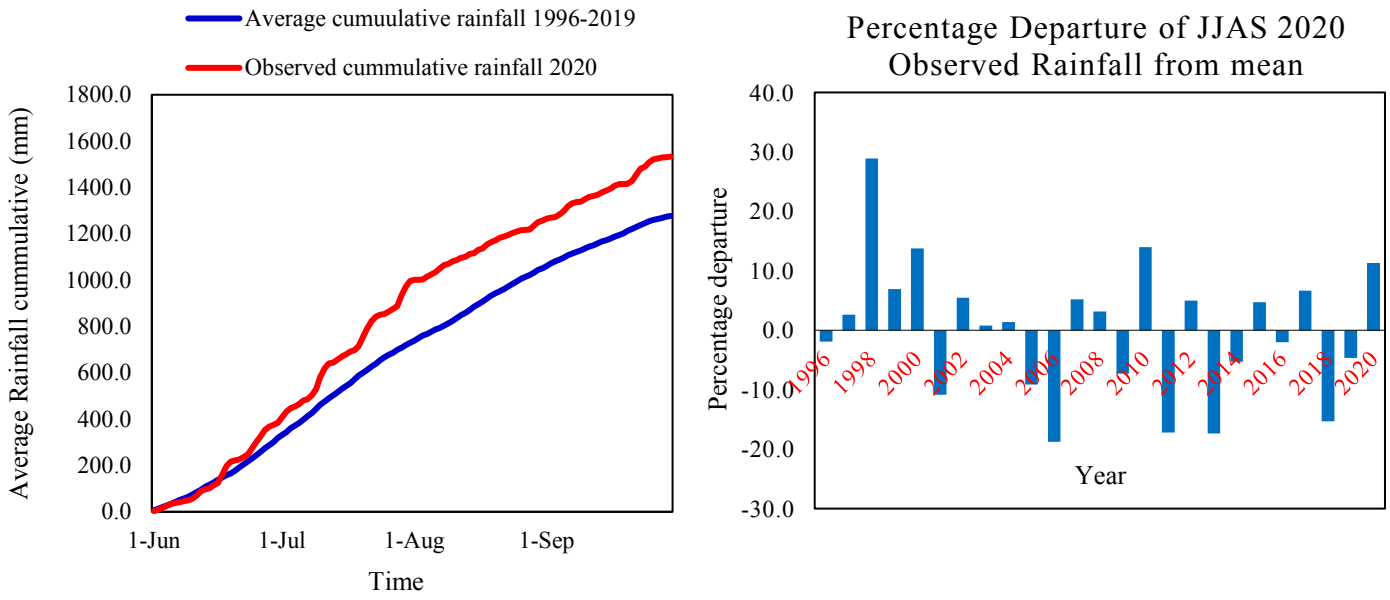


Figure 4: Observed rainfall of 2020 (JJAS) with long term average (1996 2019) [left] and percentage departure of observed JJAS rainfall from mean [Right]

3.4.2 Temperature

During the summer 2020, the country as a whole received near normal average temperature against the long term average 1996-2019.

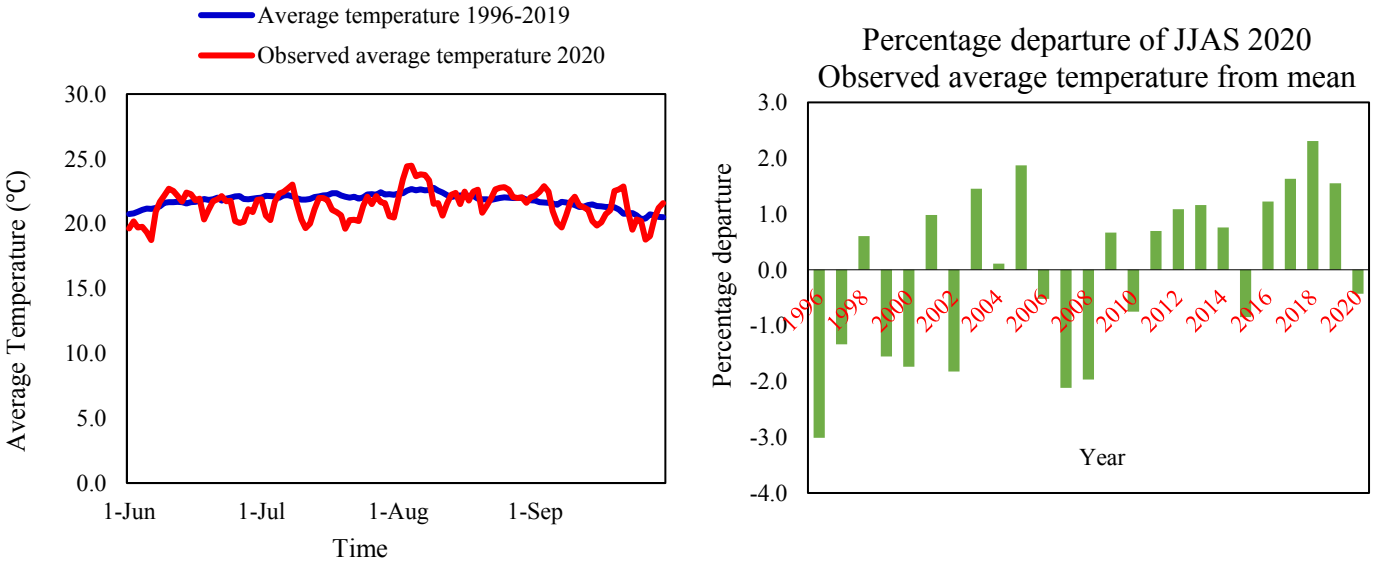


Figure 5: Observed average temperature of 2020 (JJAS) with long term average (1996-2019) [Left] and percentage departure of observed JJAS average temperature from the mean [Right]

4. Analysis of Temperature - 2020

4.1 Maximum Temperature

A monthly climate monitoring report is generated and the maps and extremes of monthly maximum temperature can be viewed and downloaded from *http://www.nchm.gov.bt/*. In this annual report, the maps for annual average/mean and season wise average maximum temperature are included. The annual and monthly extremes are also attached at the annexure.

4.1.1 Annual average maximum temperature

The following map (Figure 6) shows the spatial distribution of annual average maximum temperature during the year 2020. Meteorological stations such as Sipsu, Phuentsholing, Bhur, Tangmachu, Punakha and Bajo experienced higher annual average maximum temperature. Conversely, Haa, Gasa and Paro stations have recorded lower annual average maximum temperature.

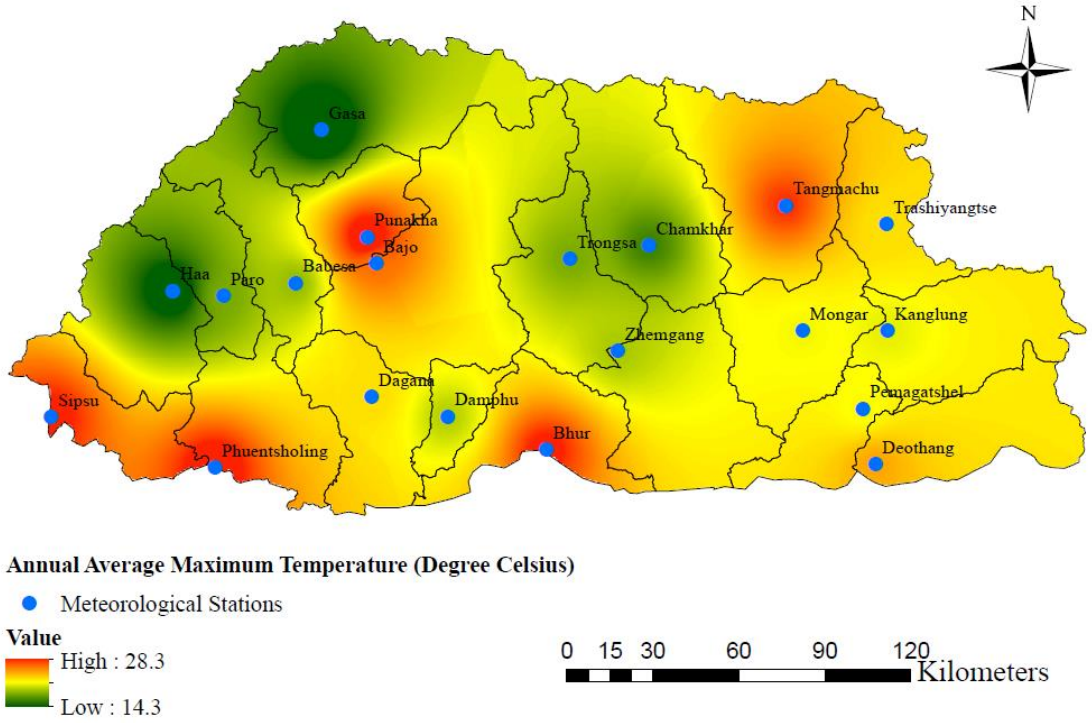


Figure 6: Spatial distribution of annual average maximum temperature in the year 2020

4.1.2 Seasonal average maximum temperature

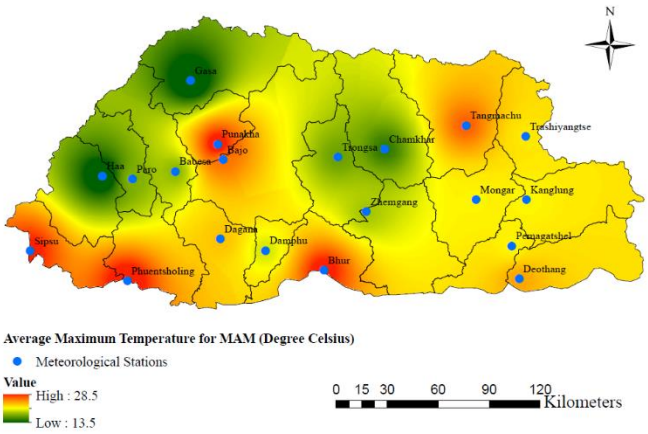
The spatial distribution for average maximum temperature across four seasons is mapped. In Bhutan based on the rainfall and temperature pattern, 12 months in a year are divided into four seasons.

i. Spring/ Pre-monsoon – March to May (MAM)
ii. Summer/Monsoon – June to September (JJAS)
iii. Autumn/Post-monsoon – October to November (ON)
iv. Winter/Monsoon – December to February (DJF)

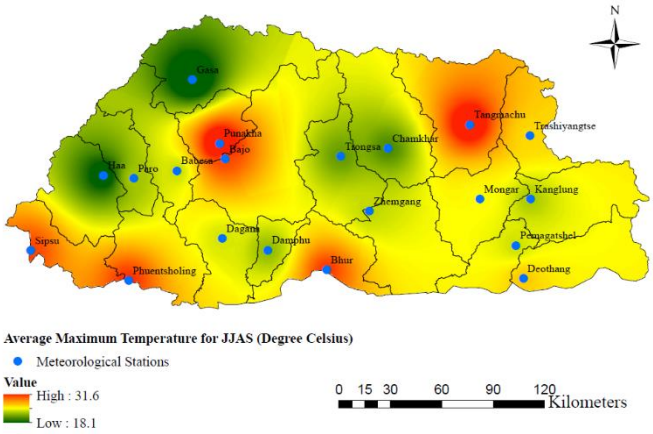
4.1.3 Seasonal spatial distribution average maximum temperature

The following maps (Figure 7) show the spatial distribution of average maximum temperature during different seasons.

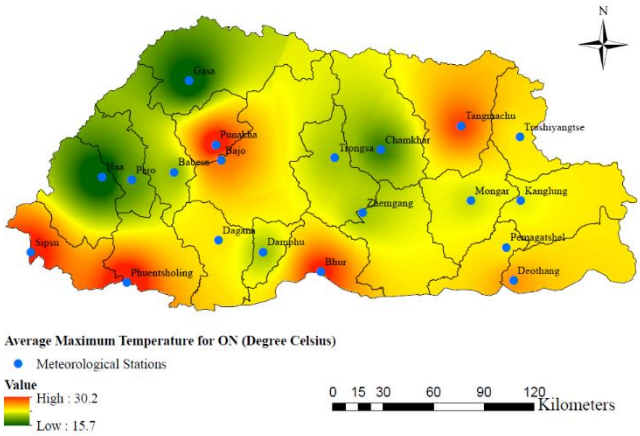
a) Spring/Pre-monsoon (March-May)



(b) Summer/Monsoon (June-September)



(c) Autumn/Post-monsoon (October-November)



(d) Winter/Monsoon (December-February)

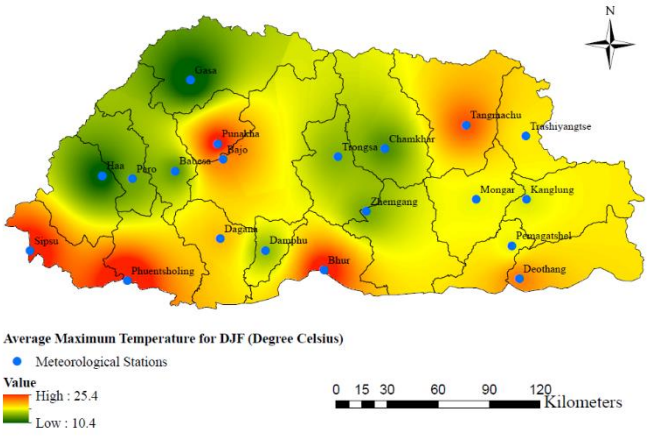


Figure 7: Spatial distribution of seasonal average maximum temperature in the year 2020

4.2 **Minimum Temperature**

A monthly climate monitoring report is generated and the maps and extremes of monthly minimum temperature can be viewed and downloaded from *http://www.nchm.gov.bt/*. In this annual report, the maps for annual average and season wise average minimum temperature are included.

4.2.1 Annual average minimum temperature

The following map (Figure 8) shows the spatial distribution of annual average minimum temperature during the year 2020. Meteorological stations such as Sipsu and Bhur experienced higher annual average minimum temperature. However, Haa, Paro, Babesa, Gasa and Chamkhar stations have experienced lower annual average minimum temperature.

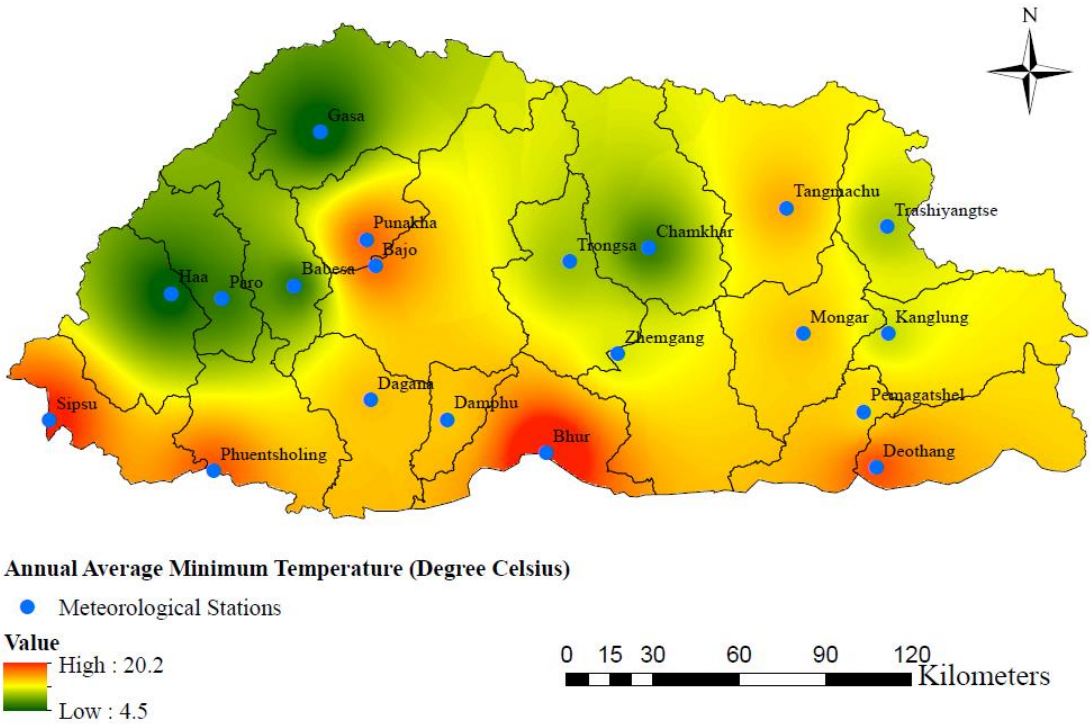
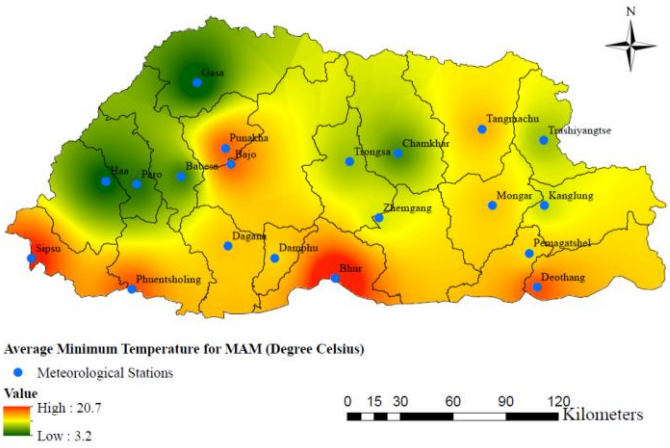


Figure 8: Spatial distribution of annual average minimum temperature in the year 2020

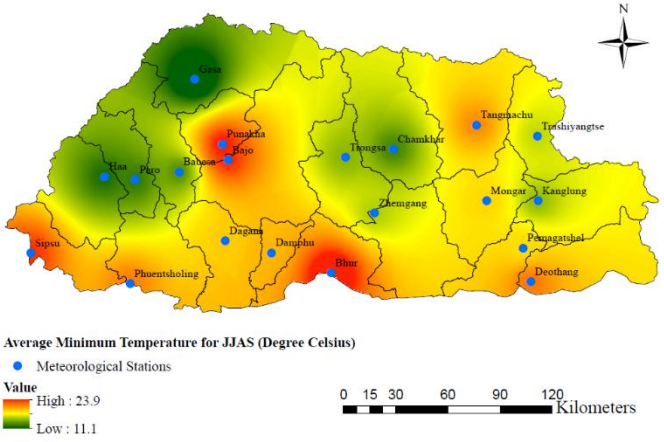
4.2.2 Seasonal spatial distribution of average minimum temperature

The following maps (Figure 9) show the spatial distribution of average minimum temperature during different seasons.

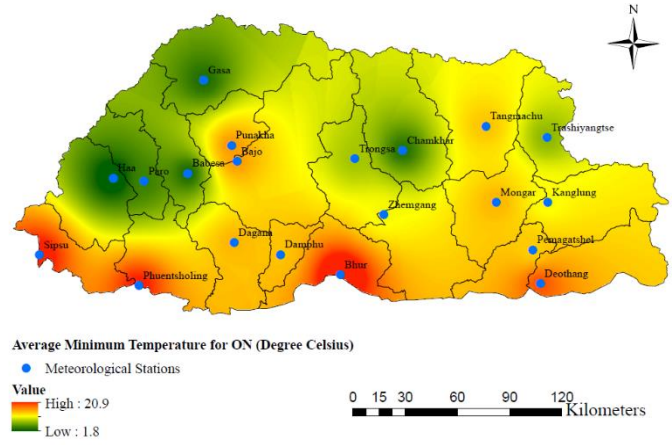
a) Spring/Pre-monsoon (March-May)



(b) Summer/Monsoon (June-September)



(c) Autumn/Post-monsoon (October-November)



(d) Winter/Monsoon (December-February)

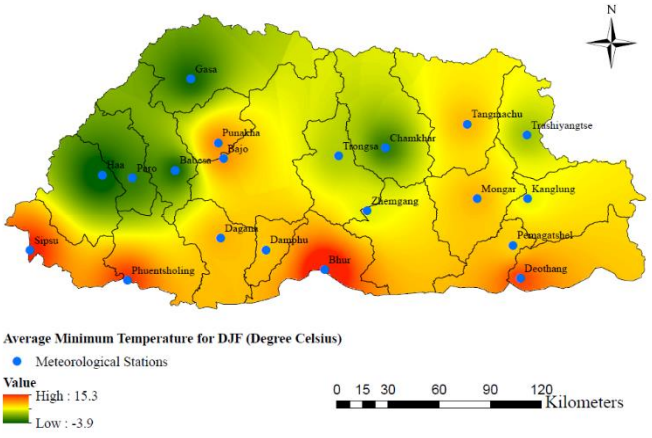


Figure 9: Spatial distribution of seasonal average minimum temperature in the year 2020

5. Analysis of Rainfall - 2020

A monthly climate monitoring report is generated and the maps and extremes of monthly rainfall can be viewed and downloaded from *http://www.nchm.gov.bt/*. In this annual report, the maps for annual accumulated/total and season wise total rainfall are included.

5.1 Annual Accumulated Rainfall

The following map (Figure 10) shows the spatial distribution of annual accumulated rainfall in the year 2020. Southern belt of the country received more rainfall compared to the other regions of the country.

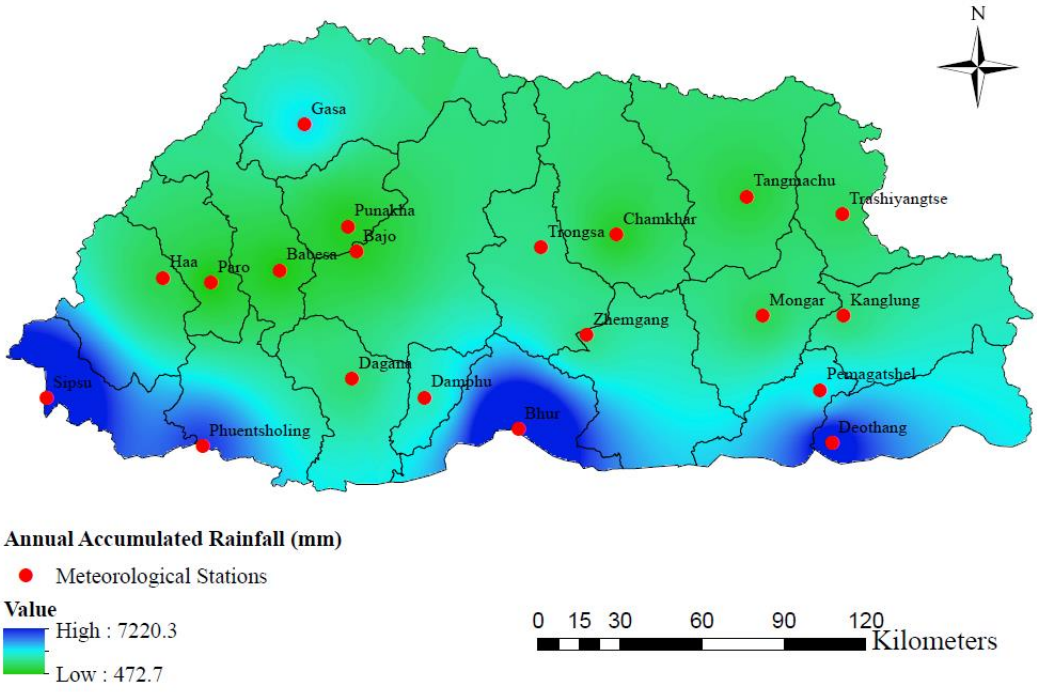
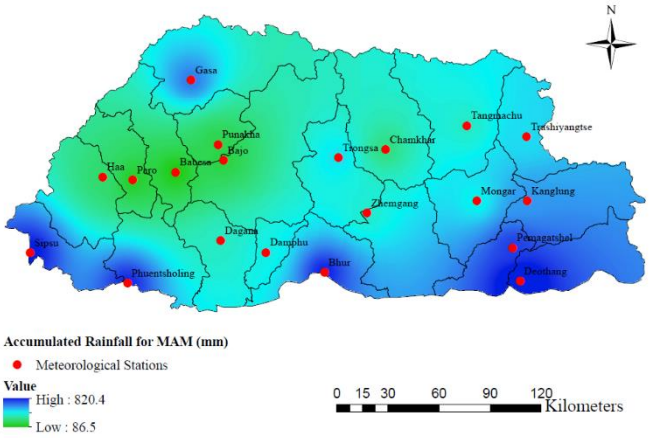


Figure 10: Spatial distribution of annual accumulated rainfall in the year 2020

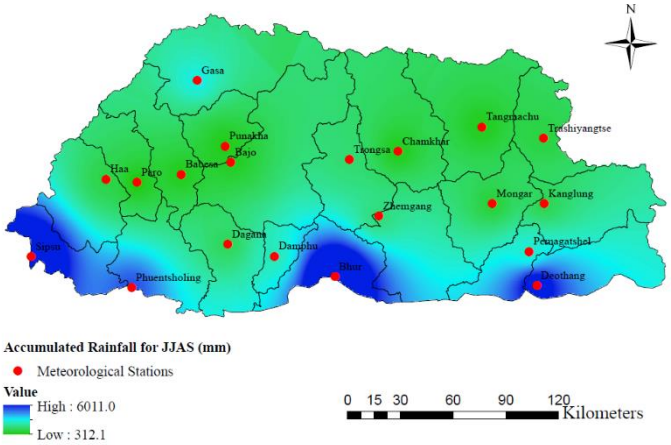
4.2 Seasonal spatial distribution of accumulated rainfall

The following maps (Figure 11) show the distribution of accumulated rainfall across different seasons in 2020.

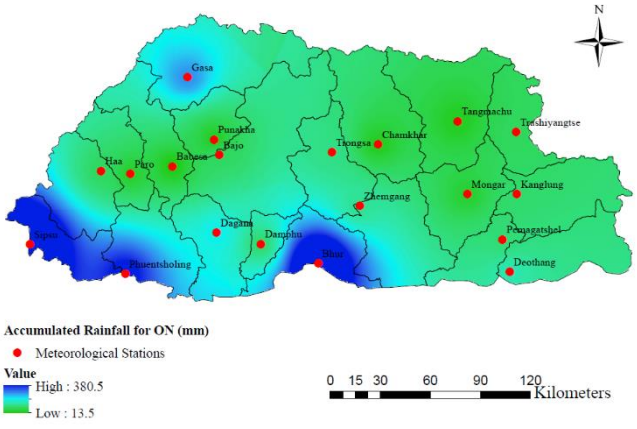
a) Spring/Pre-monsoon (March-May)



(b) Summer/Monsoon (June-September)



(c) Autumn/Post-monsoon (October-November)



(d) Winter/Monsoon (December-February)

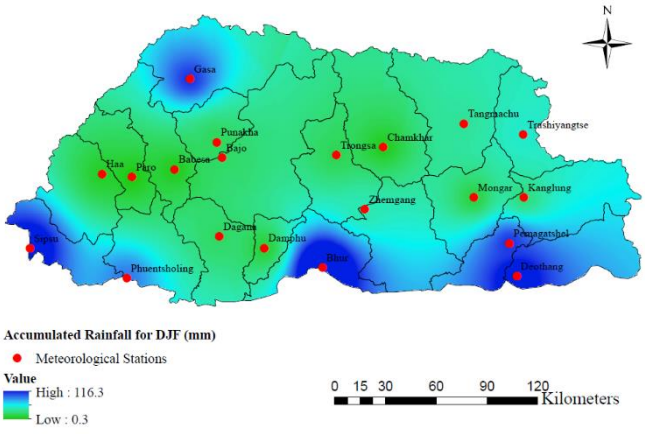
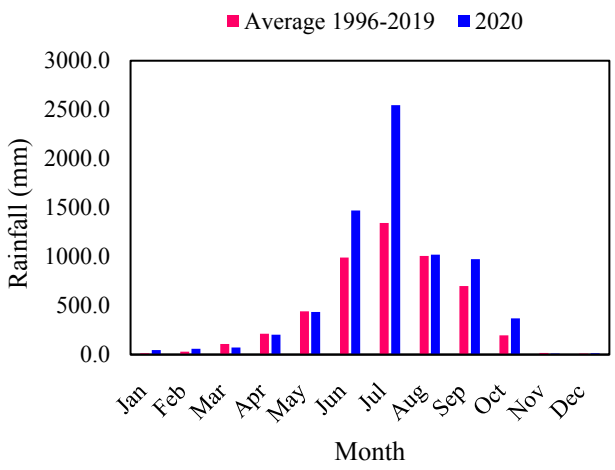


Figure 11: Spatial distribution of seasonal accumulated rainfall in the year 2020

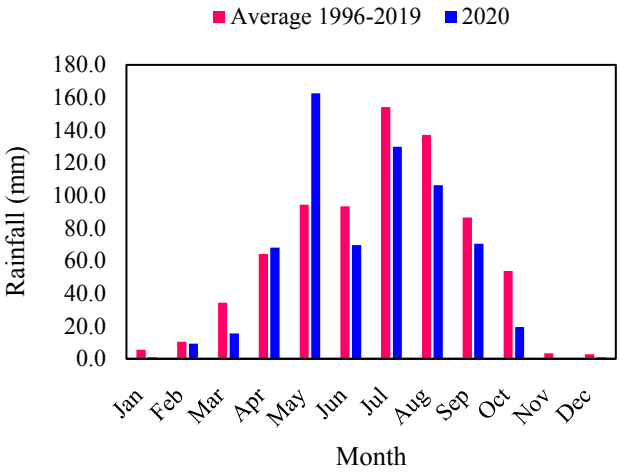
5.3 Comparison of monthly accumulated rainfall against long term average

The following figures show the comparison of monthly accumulated rainfall of the year 2020 with their long term average. Please note that the averaging period in each station varies based on the data availability.

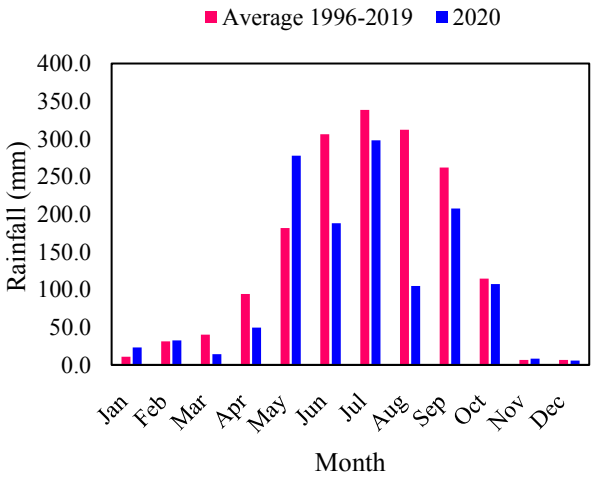
Bhur



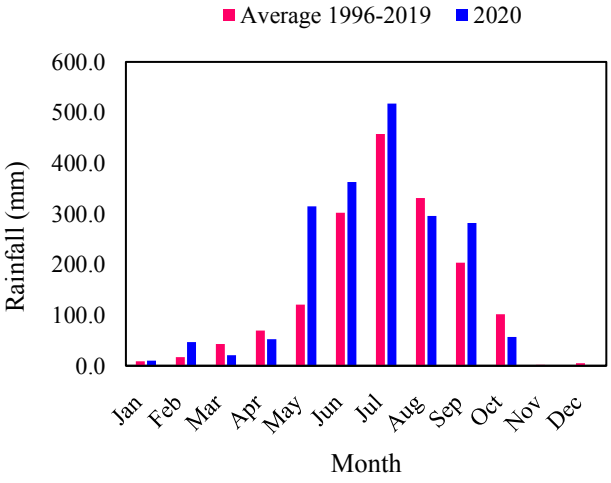
Chamkhar



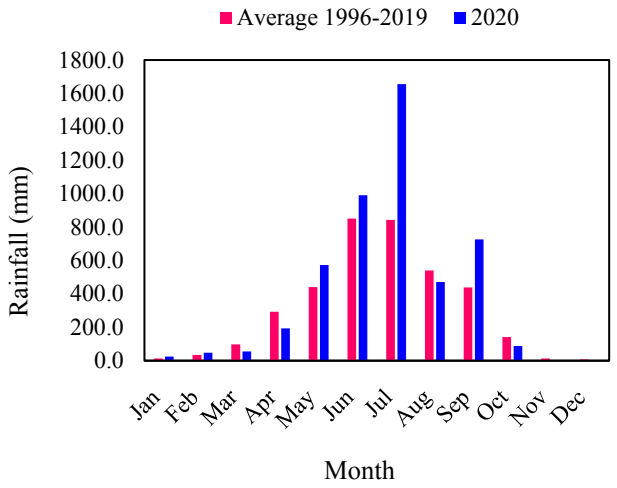
Dagana



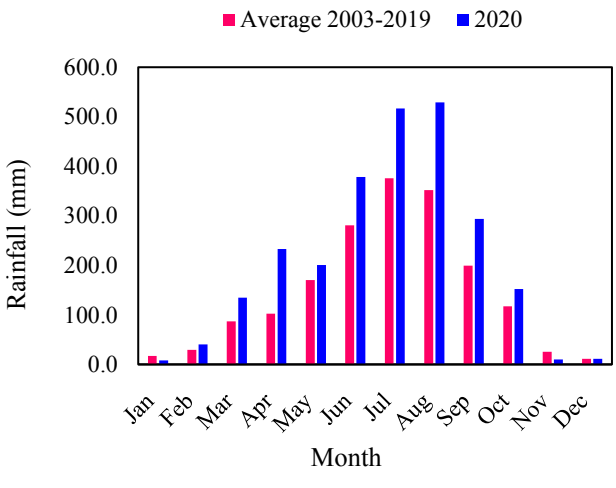
Damphu



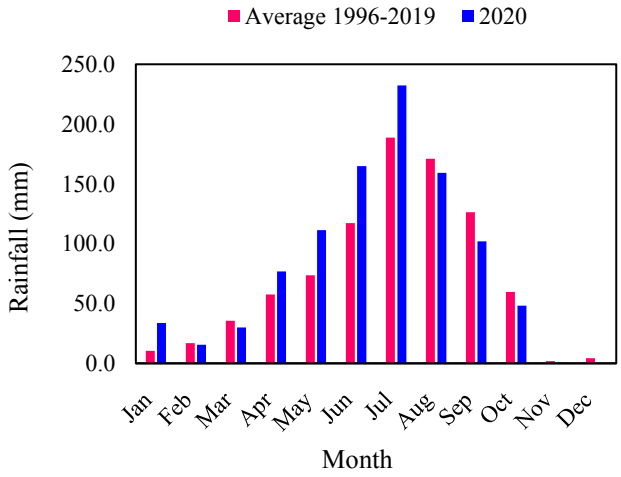
Deothang



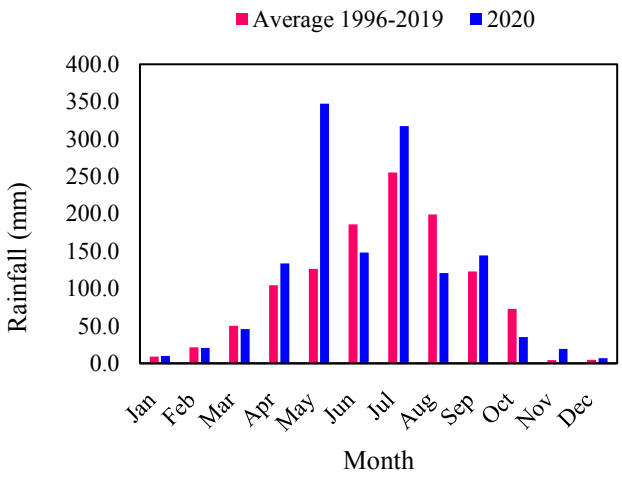
Gasa



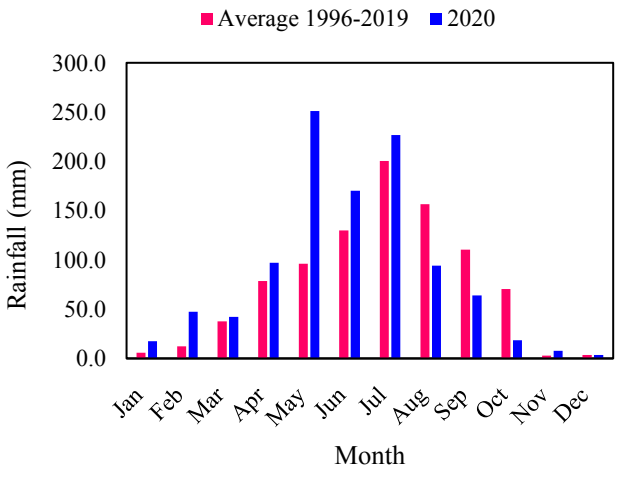
Haa



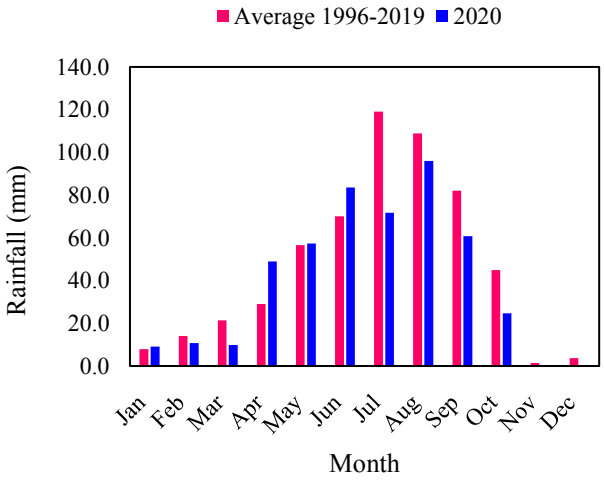
Kanglung



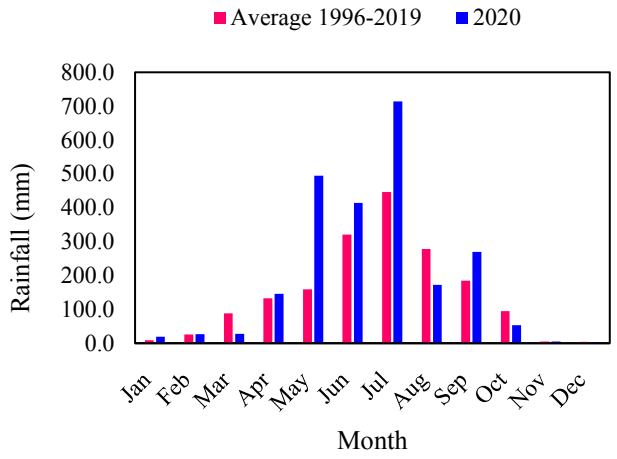
Mongar



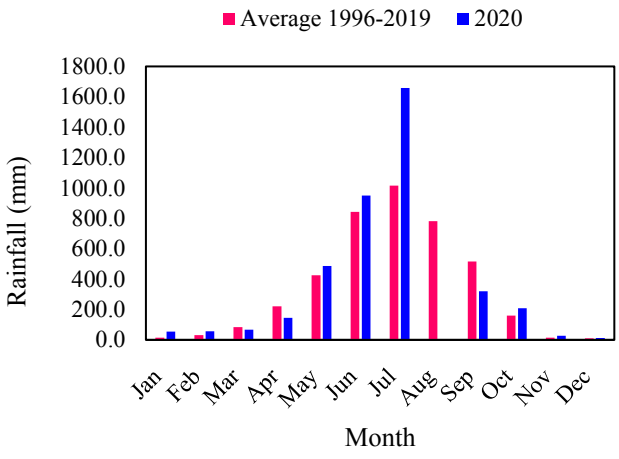
Paro



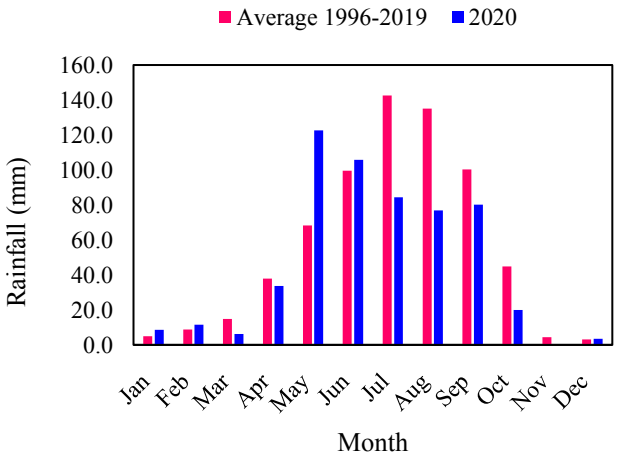
Pemagatshel



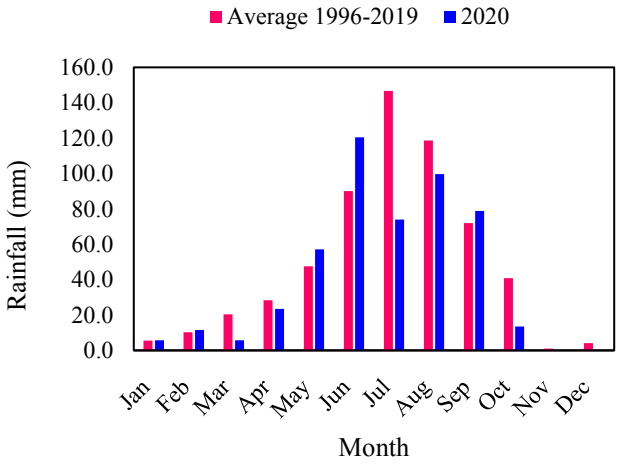
Phuentsholing



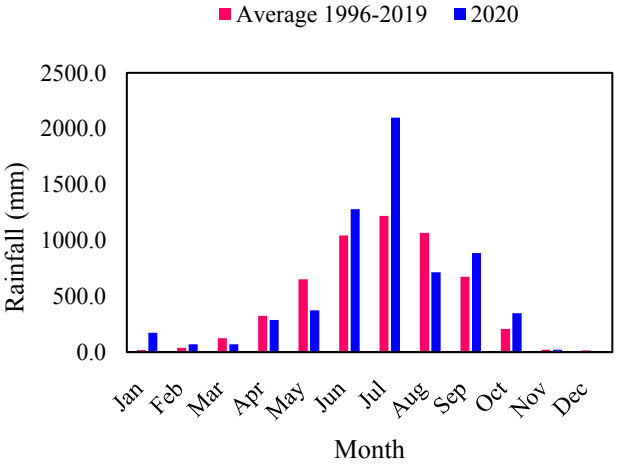
Punakha



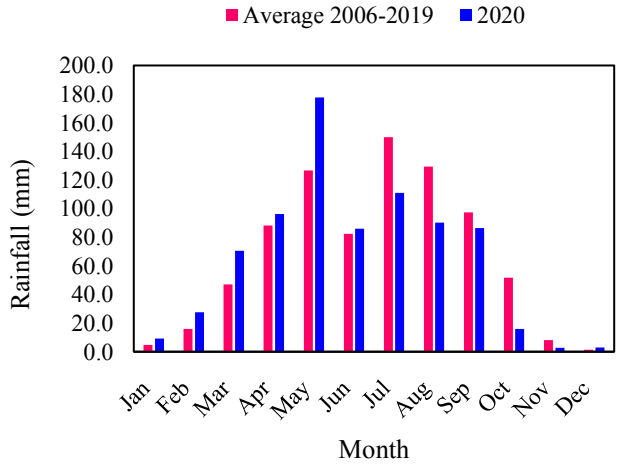
Simtokha/Babesa



Sipsu



Tangmachu



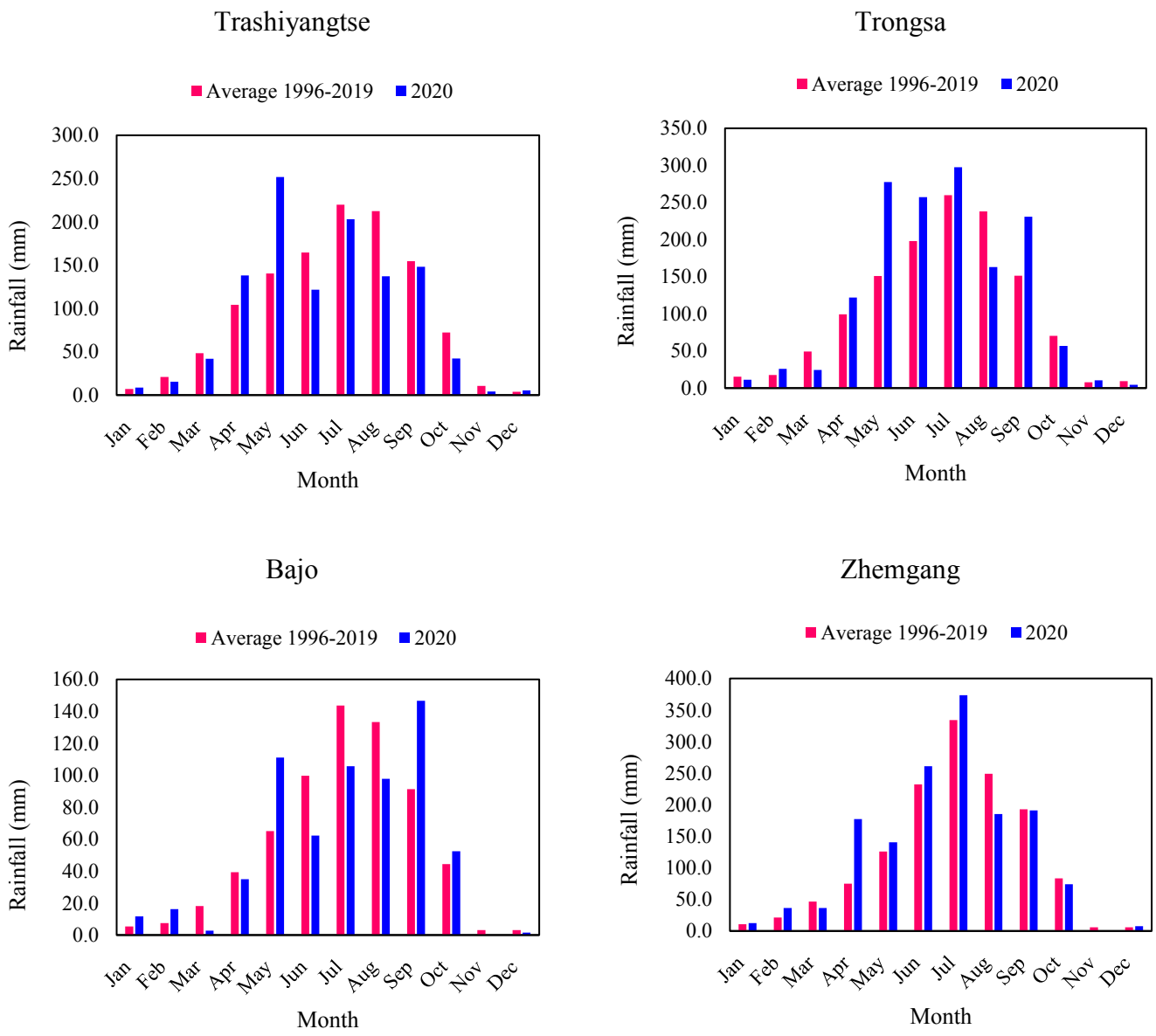


Figure 12: Comparison of total monthly rainfall of observed 2020 with long term average

6. Annual statistics - 2020

6.1 Station-wise annual averages

Station	Annual average maximum temp (℃)	Annual average minimum temp (℃)	Annual total rainfall (mm)	Number of days with Tmax>=30	No. of days with Tmin<=0	Number of days with rainfall>=1mm
Bhur	27.3	20.2	7220.3	97	0	163
Chamkhar	17.6	6.6	652.8	0	83	107
Dagana	22.4	13.2	1316.7	1	0	125
Damphu	20.2	12.9	1959.2	3	0	110
Deothang	23.9	16.5	4824.6	7	0	150
Gasa	14.3	4.5	2508.3	0	102	214
Haa	14.9	4.6	974.8	0	127	124
Kanglung	21.1	10.4	1348.4	0	1	139
Mongar	21.4	13.2	1039.9	5	0	114
Paro	19.0	6.4	472.7	0	99	76
Pemagatshel	21.4	12.5	2347.6	1	0	120
Phuentsholing	27.8	16.3	3988.1	101	0	135
Punakha	28.3	16.0	553.1	167	0	99
Babesa	19.5	6.3	490.1	0	102	85
Sipsu	27.2	17.9	6324.2	93	0	180
Tangmachu	26.6	13.8	776.8	112	0	123
Trashiyangtse	22.3	9.5	1117.8	3	31	148
Trongsa	19.0	9.3	1481.8	0	26	152
Bajo	25.1	15.6	643.0	58	0	92
Zhemgang	20.0	10.7	1494.2	1	1	143

7. Extreme records of temperature and rainfall - 2020

7.1 Annual Extreme records of temperature and rainfall

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	35.5	21st Sept	9	6th Jan	512.1	29th July
Chamkhar	26.5	3rd Aug	-11	26th Jan	57.1	21st May
Dagana	30	4th Aug	2	6th Jan, 26th Jan	84	21st May
Damphu	30	3rd Aug, 4th Aug, 5th Aug	1.5	7th Jan	188.4	20th May
Deothang	31	20th Sept	7	6th Jan	221.4	10th July
Gasa	24	5th Aug	-8	11th Jan	181	7th Aug
Haa	25	24th Aug	-12	6th Jan	36	15th Jun
Kanglung	29	11th June, 15th June	-1	6th Jan	103	21st May
Mongar	31	4th Aug	2	6th Jan	109.6	21st May
Paro	29	3rd Aug	-6	2nd Jan, 20th Jan, 26th Jan, 14th Mar	26	8th Aug
Pemagatshel	30.5	4th Aug	1	26th Jan	187	21st May
Phuentsholing	34	21st Sept, 17th Oct	7	3rd Jan, 6th Jan	220.8	22nd July
Punakha	37.5	4th Aug	2	1st Jan, 6th Jan, 25th Jan	28.4	20th May
Babesa	28.5	3rd Aug, 18th Aug, 28th Aug	-8.5	6th Jan	25	20th May
Sipsu	34	4th Aug, 5th Aug	8.5	5th Feb	288.4	10th July
Tangmachu	37	3rd Aug	1.5	6th Jan	49.6	26th May
Trashiyantse	31.5	20th Sept	-5	26th Jan	48.4	21st May
Trongsa	28.5	3rd Aug	-3.5	25th Jan	72	21st May
Bajo	34.5	4th Aug	2	1st Jan, 6th Jan, 25th Jan, 26th Jan	35.2	1st Sept
Zhemgang	30	4th Aug	-0.5	6th Jan	56.4	17th June

7.2 Monthly Extreme records of temperature and rainfall - 2020

January

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	24.0	1st Jan, 14th Jan, 15th Jan, 16th Jan, 17th Jan, 22nd Jan, 23rd Jan	9.0	6th Jan	18.4	6th Jan
Chamkhar	15.0	12th Jan	-11.0	26th Jan	0.5	4th Jan
Dagana	20.5	12th Jan	2.0	6th Jan, 26th Jan	17.8	3rd Jan
Damphu	17.0	14th Jan	1.5	7th Jan	8.0	4th Jan
Deothang	22.0	17th Jan	7.0	6th Jan	11.2	2nd Jan
Gasa	12.0	15th Jan	-8.0	11th Jan	5.4	19th Jan
Haa	12.0	16th Jan	-12.0	6th Jan	18.4	3rd Jan
Kanglung	18.0	13th Jan, 18th Jan	-1.0	6th Jan	4.8	4th Jan
Mongar	17.5	15th Jan	2.0	6th Jan	8.4	3rd Jan, 5th Jan
Paro	15.0	12th Jan, 13th Jan, 15th Jan, 16th Jan	-6.0	2nd Jan, 20th Jan, 26th Jan	5.2	3rd Jan
Pemagatshel	17.0	12th Jan, 13th Jan, 14th Jan, 15th Jan, 18th Jan, 19th Jan, 20th Jan	1.0	26th Jan	8.5	4th Jan
Phuentsholing	25.5	15th Jan, 19th Jan	7.0	3rd Jan, 6th Jan	46.5	31st Jan
Punakha	25.0	11th Jan	2.0	1st Jan, 6th Jan, 25th Jan	3.4	3rd Jan
Babesa	17.0	13th Jan	-8.5	6th Jan	1.7	8th Jan
Sipsu	25.0	18th Jan	8.5	6th Jan	102.6	30th Jan
Tangmachu	21.5	13th Jan, 14th Jan, 15th Jan, 16th Jan, 19th Jan, 20th Jan, 21st Jan	1.5	6th Jan	5.2	3rd Jan
Trashiyantse	19.0	25th Jan	-5.0	26th Jan	3.6	3rd Jan
Trongsa	17.0	12th Jan, 13th Jan	-3.5	25th Jan	4.8	3rd Jan
Bajo	22.0	11th Jan, 12th Jan, 13th Jan	2.0	1st Jan, 6th Jan, 25th Jan, 26th Jan	7.2	4th Jan
Zhemgang	16.5	13th Jan	-0.5	6th Jan	5.0	3rd Jan

February

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	28.0	25th Feb	12.0	4th Feb, 7th Feb	36.2	26th Feb
Chamkhar	16.5	28th Feb	-10.5	10th Feb	9.2	26th Feb
Dagana	23.0	23rd Feb, 29th Feb	3.0	2nd Feb, 5th Feb	20.0	25th Feb
Damphu	19.0	22nd Feb, 23rd Feb	2.5	5th Feb	26.8	25th Feb
Deothang	24.0	23rd Feb	8.0	3rd Feb	31.0	25th Feb
Gasa	12.5	14th Feb	-7.5	3rd Feb	10.1	19th Feb
Haa	14.5	28th Feb	-11.0	9th Feb	6.5	26th Feb
Kanglung	21.0	23rd Feb	1.0	3rd Feb, 5th Feb, 10th Feb	17.8	25th Feb
Mongar	22.0	23rd Feb	4.0	3rd Feb, 4th Feb	26.8	25th Feb
Paro	17.0	12th Feb, 13th Feb, 16th Feb, 28th Feb, 29th Feb	-3.0	6th Feb, 15th Feb, 16th Feb	4.2	26th Feb
Pemagatshel	21.5	29th Feb	1.5	3rd Feb	22.4	25th Feb
Phuentsholing	28.0	12th Feb, 24th Feb, 25th Feb, 29th Feb	10.0	1st Feb, 27th Feb	26.8	26th Feb
Punakha	27.5	29th Feb	3.5	10th Feb	5.6	26th Feb
Babesa	18.5	29th Feb	-7.0	2nd Feb, 9th Feb	4.8	25th Feb
Sipsu	28.0	29th Feb	9.0	5th Feb	26.0	24th Feb
Tangmachu	27.5	29th Feb	3.0	4th Feb, 10th Feb	12.2	26th Feb
Trashiyantse	25.0	29th Feb	-3.5	10th Feb	10.9	25th Feb
Trongsa	19.5	29th Feb	-1.5	9th Feb, 10th Feb	12.6	26th Feb
Bajo	24.5	29th Feb	2.5	10th Feb	7.0	26th Feb
Zhemgang	19.5	13th Feb	1.0	4th Feb, 8th Feb, 9th Feb	21.0	25th Feb

March

Station	Maximum temperature (°C)	Date of occurrence	Minimum temperature (°C)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	29.0	27th Mar, 28th Mar, 29th Mar, 30th Mar, 31st Mar	10.0	7th Mar	21.5	14th Mar
Chamkhar	22.0	29th Mar	-2.0	16th Mar, 17th Mar	5.7	14th Mar
Dagana	25.5	25th Mar, 27th Mar, 30th Mar	7.0	3rd Mar	4.6	5th Mar
Damphu	22.5	29th Mar	7.0	1st Mar, 3rd Mar, 8th Mar, 15th Mar	7.2	20th Mar
Deothang	26.0	27th Mar, 28th Mar, 31st Mar	12.0	4th Mar	34.8	3rd Mar
Gasa	18.5	31st Mar	-2.0	8th Mar, 17th Mar	24.4	21st Mar
Haa	18.5	28th Mar	-5.5	16th Mar	9.4	19th Mar
Kanglung	25.0	29th Mar	5.0	6th Mar	11.4	14th Mar
Mongar	24.0	26th Mar, 29th Mar, 31st Mar	8.0	1st Mar, 6th Mar	17.4	5th Mar
Paro	25.0	28th Mar	-6.0	14th Mar	3.8	19th Mar
Pemagatshel	25.5	25th Mar, 30th Mar, 31st Mar	6.0	1st Mar	9.8	3rd Mar
Phuentsholing	31.0	31st Mar	11.0	4th Mar	20.4	22nd Mar
Punakha	33.0	29th Mar	3.5	2nd Mar	2.2	3rd Mar
Babesa	25.5	29th Mar	-4.0	16th Mar	1.8	19th Mar
Sipsu	30.0	31st Mar	14.0	4th Mar, 7th Mar, 14th Mar	31.8	2nd Mar
Tangmachu	29.5	29th Mar	6.5	1st Mar	14.5	14th Mar
Trashiyantse	27.0	29th Mar, 30th Mar	1.5	1st Mar	17.7	14th Mar
Trongsa	23.0	29th Mar	2.5	16th Mar, 17th Mar	8.2	14th Mar
Bajo	28.0	29th Mar, 30th Mar	8.0	16th Mar, 17th Mar	1.8	23rd Mar
Zhemgang	21.5	30th Mar	5.0	5th Mar, 6th Mar	11.6	14th Mar

April

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	32.0	15th April	17.0	19th April, 22nd April	57.5	25th April
Chamkhar	23.0	14th April	1.5	14th April	9.9	2nd April
Dagana	28.5	14th April	10.0	10th April	8.8	9th April
Damphu	23.0	16th April	9.0	4th April, 5th April, 10th April	16.8	23rd April
Deothang	28.5	14th April	14.0	10th April, 24th April	48.0	29th April
Gasa	21.5	16th April	0.0	10th April	25.6	21st April
Haa	18.5	14th April	-1.5	5th April	20.3	9th April
Kanglung	26.5	14th April	7.5	10th April	16.0	27th April
Mongar	27.0	14th April	10.0	10th April, 22nd April	18.8	11th April
Paro	25.0	14th April	1.0	5th April, 10th April	14.6	9th April
Pemagatshel	26.0	14th April, 16th April	9.0	5th April	33.0	18th April
Phuentsholing	32.0	15th April	15.0	10th April	38.2	24th April
Punakha	34.0	14th April	11.0	10th April	7.4	9th April
Babesa	24.5	1st April	1.5	5th April	6.6	9th April
Sipsu	31.0	2nd April, 8th April, 12th April, 14th April	15.5	23rd April, 24th April	52.0	24th April
Tangmachu	31.0	14th April	10.0	15th April, 22nd April	24.5	16th April
Trashiyantse	28.0	15th April	5.5	5th April, 10th April, 13th April, 14th April, 15th April, 22nd April	19.8	30th April
Trongsa	23.5	14th April	3.5	10th April	22.7	18th April
Bajo	29.0	14th April	11.0	10th April	6.8	23rd April
Zhemgang	24.5	14th April	6.5	10th April	25.8	11th April

May

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	31.0	10th May, 11th May, 13th May, 14th May, 19th May	20.0	3rd May	91.0	14th May
Chamkhar	21.5	14th May	3.5	10th May	57.1	21st May
Dagana	27.5	10th May	11.5	8th May, 9th May	84.0	21st May
Damphu	24.0	19th May, 20th May, 1st May	11.5	5th May, 7th May	188.4	20th May
Deothang	28.5	12th May	16.0	7th May	141.7	21st May
Gasa	19.5	19th May, 21st May	0.5	5th May	31.2	22nd May
Haa	20.0	18th May	2.0	10th May	34.5	20th May
Kanglung	26.5	10th May, 29th May	9.5	8th May, 9th May	103.0	21st May
Mongar	26.0	2nd May, 3rd May, 10th May, 17th May, 29th May	11.0	8th May	109.6	21st May
Paro	24.0	9th May, 10th May, 18th May	5.0	29th May	23.0	20th May
Pemagatshel	26.0	9th May, 10th May	12.0	9th May	187.0	21st May
Phuentsholing	32.0	11th May	16.0	1st May, 2nd May, 3rd May, 4th May, 5th May, 6th May, 7th May, 8th May, 9th May, 11th May, 12th May, 13th May, 14th May, 15th May, 16th May	80.1	6th May
Punakha	34.5	10th May	13.5	9th May	28.4	20th May
Babesa	25.0	18th May	3.5	11th May	25.0	20th May
Sipsu	31.0	10th May, 12th May, 19th May	18.0	3rd May, 18th May	74.0	2nd May
Tangmachu	31.5	10th May	13.0	10th May, 28th May	49.6	26th May
Trashiyantse	27.5	10th May	6.0	9th May	48.4	21st May
Trongsa	22.5	10th May	7.0	29th May	72.0	21st May
Bajo	30.0	10th May	13.0	9th May	30.0	20th May
Zhemgang	24.5	10th May	9.0	9th May	36.1	20th May

June

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	32.0	12th June	21.0	5th June	178.8	18th June
Chamkhar	23.5	7th June, 10th June	11.0	7th June	25.1	17th June
Dagana	28.0	10th June, 11th June	15.0	2nd June	59.0	17th June
Damphu	25.5	11th June	16.5	2nd June	103.8	17th June
Deothang	29.0	10th June, 15th June	17.0	4th June	136.6	24th June
Gasa	21.5	11th June	8.5	1st June, 2nd June	42.8	8th June
Haa	22.0	15th June	9.0	6th June, 7th June	36.0	15th June
Kanglung	29.0	11th June, 15th June	13.0	1st June	39.8	26th June
Mongar	28.0	9th June, 10th June, 11th June, 15th June, 16th June	16.0	1st June, 2nd June, 3rd June	43.6	17th June
Paro	27.0	8th June, 9th June	12.0	1st June, 2nd June, 4th June, 6th June, 7th June	24.4	15th June
Pemagatshel	28.5	10th June	15.0	3rd June	68.4	26th June
Phuentsholing	33.0	11th June	19.0	3rd June	130.8	25th June
Punakha	36.0	14th June	20.5	1st June, 6th June	24.2	16th June
Babesa	27.5	10th June	11.0	1st June, 2nd June	20.0	20th June
Sipsu	32.0	10th June	19.0	1st June	165.4	24th June
Tangmachu	33.5	10th June	17.0	1st June	20.0	17th June
Trashiyantse	29.5	10th June	13.5	1st June	19.8	18th June
Trongsa	24.5	10th June	13.0	1st June	45.4	17th June
Bajo	32.5	9th June, 10th June, 11th June, 14th June	20.0	1st June, 6th June	23.6	17th June
Zhemgang	26.0	11th June	13.5	3rd June	56.4	17th June

July

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	31.0	7th July, 8th July, 9th July	22.0	10th July	512.1	29th July
Chamkhar	23.5	27th July	14.0	25th July	19.8	6th July
Dagana	26.0	6th July, 8th July, 15th July	17.0	25th July	39.4	23rd July
Damphu	25.5	8th July	18.5	14th July, 28th July	84.0	22nd July
Deothang	28.0	4th July	18.0	11th July, 12th July	221.4	10th July
Gasa	22.0	10th July	10.5	13th July	73.0	11th July
Haa	21.5	8th July, 16th July	12.5	6th July, 22nd July	20.9	6th July
Kanglung	26.5	5th July, 8th July, 14th July	15.0	14th July	40.8	11th July
Mongar	28.0	5th July, 14th July	18.0	4th July, 12th July, 13th July, 14th July, 17th July, 19th July, 21st July, 22nd July, 23rd July, 24th July, 30th July, 31st July	27.4	30th July
Paro	27.0	8th July	13.0	5th July, 12th July	14.0	21st July
Pemagatshel	28.0	25th July	17.0	1st July, 13th July	102.0	10th July
Phuentsholing	31.5	9th July	20.0	2nd July, 3rd July, 10th July, 11th July, 12th July, 20th July, 21st July	220.8	22nd July
Punakha	34.5	14th July	22.0	3th July, 4th July, 13th July, 20th July, 21st July, 23rd July	10.0	21st July
Babesa	26.5	8th July	14.0	6th July, 13th July, 22nd July	14.0	7th July
Sipsu	31.0	8th July	20.0	10th July	288.4	10th July
Tangmachu	33.5	6th July, 7th July, 8th July, 9th July, 14th July	20.0	1st July, 21st July, 22nd July, 31st July	36.0	8th July
Trashiyantse	28.0	5th July, 7th July	16.0	22nd July, 26th July	33.4	1st July
Trongsa	24.5	14th July	15.5	11th July, 13th July, 25th July	60.2	14th July
Bajo	31.5	6th July, 7th July	20.0	3rd July, 21st July	27.2	2nd July
Zhemgang	26.5	4th July, 14th July	16.0	4th July, 14th July, 20th July, 21st July, 22nd July, 24th July, 25th July	51.2	20th July

August

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	35.0	5th Aug	23.0	18th Aug, 21st Aug	276.0	18th Aug
Chamkhar	26.5	3rd Aug	7.5	27th Aug	17.8	19th Aug
Dagana	30.0	4th Aug	17.5	22nd Aug, 24th Aug, 28th Aug	19.6	30th Aug
Damphu	30.0	3rd Aug, 4th Aug, 5th Aug	18.0	22nd Aug, 24th Aug, 29th Aug	64.8	14th Aug
Deothang	30.5	4th Aug	20.0	15th Aug, 22nd Aug, 29th Aug	80.8	19th Aug
Gasa	24.0	5th Aug	8.0	27th Aug	181.0	7th Aug
Haa	25.0	24th Aug	9.5	28th Aug	29.1	19th Aug
Kanglung	27.5	4th Aug	15.5	15th Aug, 21st Aug, 22nd Aug, 28th Aug	20.8	16th Aug
Mongar	31.0	4th Aug	18.0	12th Aug, 23rd Aug, 28th Aug	17.4	8th Aug
Paro	29.0	3rd Aug	13.0	20th Aug, 26th Aug, 27th Aug, 28th Aug	26.0	8th Aug
Pemagatshel	30.5	4th Aug	17.5	21st Aug	33.6	16th Aug
Phuentsholing	N/A	N/A	N/A	N/A	N/A	N/A
Punakha	37.5	4th Aug	21.0	27th Aug	18.4	5th Aug
Babesa	28.5	3rd Aug, 18th Aug, 28th Aug	11.5	28th Aug	18.2	4th Aug
Sipsu	34.0	4th Aug, 5th Aug	21.0	30th Aug	90.8	6th Aug
Tangmachu	37.0	3rd Aug	20.0	20th Aug, 25th Aug, 27th Aug, 28th Aug, 29th Aug	28.4	31st Aug
Trashiyantse	31.0	2nd Aug	15.0	20th Aug	17.0	20th Aug
Trongsa	28.5	3rd Aug	12.5	20th Aug, 27th Aug	41.8	14th Aug
Bajo	34.5	4th Aug	21.0	10th Aug, 20th Aug, 22nd Aug	30.1	20th Aug
Zhemgang	30.0	4th Aug	15.5	15th Aug, 23rd Aug, 26th Aug	33.6	4th Aug

September

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	35.5	21st Sept	22.0	27th Sept, 28th Sept, 29th Sept	150.2	23rd Sept
Chamkhar	25.5	3rd Sept, 17th Sept	9.5	28th Sept	14.9	6th Sept
Dagana	28.0	19th Sept, 21st Sept	15.0	28th Sept	58.2	22nd Sept
Damphu	27.0	20th Sept	15.0	28th Sept	77.0	22nd Sept
Deothang	31.0	20th Sept	18.5	15th Sept	183.8	6th Sept
Gasa	23.5	22nd Sept	7.5	28th Sept	27.0	24th Sept
Haa	22.0	5th Sept	7.5	26th Sept	19.2	25th Sept
Kanglung	26.5	19th Sept	14.0	29th Sept	16.8	1st Sept
Mongar	30.0	2nd Sept, 19th Sept	16.0	28th Sept	11.6	22nd Sept
Paro	26.5	1st Sept, 19th Sept	12.0	20th Sept, 26th Sept, 27th Sept, 28th Sept	14.8	22nd Sept
Pemagatshel	29.5	20th Sept	17.0	29th Sept, 30th Sept	51.4	6th Sept
Phuentsholing	34.0	21st Sept	20.0	18th Sept, 22nd Sept, 23rd Sept, 24th Sept, 26th Sept, 27th Sept	78.6	23rd Sept
Punakha	35.5	1st Sept	19.0	26th Sept, 28th Sept	18.2	22nd Sept
Babesa	27.5	1st Sept	11.0	27th Sept, 28th Sept	18.8	22nd Sept
Sipsu	33.5	19th Sept	19.0	27th Sept	115.0	4th Sept
Tangmachu	34.5	19th Sept, 20th Sept	16.5	28th Sept, 29th Sept	26.6	1st Sept
Tyantse	31.5	20th Sept	15.0	21st Sept, 27th Sept, 28th Sept	33.0	1st Sept
Trongsa	27.5	19th Sept	10.5	28th Sept	48.5	22nd Sept
Bajo	32.0	3rd Sept	18.0	29th Sept	35.2	1st Sept
Zhemgang	28.5	20th Sept	12.5	28th Sept	41.6	22nd Sept

October

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	32.5	19th Oct	21.5	24th Oct	113.0	8th Oct
Chamkhar	23.0	5th Oct, 8th Oct, 10th Oct, 11th Oct, 13th Oct, 15th Oct	-0.5	31st Oct	13.9	25th Oct
Dagana	27.5	11th Oct, 18th Oct	11.5	27th Oct, 28th Oct	71.2	25th Oct
Damphu	26.5	30th Oct	11.0	29th Oct	24.8	25th Oct
Deothang	30.0	30th Oct	16.0	28th Oct	19.4	23rd Oct
Gasa	21.5	8th Oct, 9th Oct, 11th Oct, 12th Oct, 13th Oct	2.0	29th Oct	46.5	6th Oct
Haa	20.5	13th Oct	-1.0	29th Oct, 31st Oct	20.8	25th Oct
Kanglung	27.0	10th Oct, 18th Oct	10.0	28th Oct	23.4	24th Oct
Mongar	27.0	9th Oct, 10th Oct, 12th Oct, 18th Oct	12.0	29th Oct	9.4	24th Oct
Paro	28.0	15th Oct	2.0	28th Oct, 31st Oct	15.0	25th Oct
Pemagatshel	29.5	10th Oct	11.5	30th Oct	33.2	24th Oct
Phuentsholing	34.0	17th Oct	16.0	25th Oct	96.8	26th Oct
Punakha	34.5	13th Oct, 15th Oct, 16th Oct, 17th Oct	10.5	29th Oct, 30th Oct	7.0	25th Oct
Babesa	26.0	10th Oct	0.5	31st Oct	7.5	25th Oct
Sipsu	33.5	16th Oct	18.0	26th Oct	112.8	26th Oct
Tangmachu	32.0	8th Oct, 9th Oct, 16th Oct	10.0	29th Oct, 30th Oct, 31st Oct	6.0	3rd Oct
Tyantse	29.0	18th Oct	4.5	29th Oct	17.0	4th Oct
Trongsa	26.5	10th Oct	5.5	28th Oct, 29th Oct, 30th Oct	24.6	25th Oct
Bajo	31.0	10th Oct	10.5	31st Oct	32.0	1st Oct
Zhemgang	27.0	30th Oct	8.5	28th Oct	27.6	24th Oct

November

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	30.0	1st Nov, 2nd Nov, 3rd Nov	15.0	24th Nov	6.0	22nd Nov
Chamkhar	22.0	2nd Nov	-4.5	12th Nov, 13th Nov, 29th Nov	0.1	21st Nov
Dagana	25.5	1st Nov	7.5	22nd Nov, 24th Nov	8.2	21st Nov
Damphu	25.0	1st Nov	6.5	24th Nov	0.0	All days
Deothang	28.0	1st Nov, 22nd Nov, 25th Nov	10.0	13th Nov	0.0	All days
Gasa	18.0	3rd Nov	-2.0	25th Nov, 26th Nov	5.2	6th Nov
Haa	17.5	1st Nov	-6.0	23rd Nov, 26th Nov	0.4	4th Nov
Kanglung	25.5	1st Nov	4.5	23rd Nov, 25th Nov, 27th Nov	17.8	18th Nov
Mongar	25.0	2nd Nov, 3rd Nov	7.0	24th Nov, 25th Nov	4.6	18th Nov
Paro	21.5	1st Nov, 2nd Nov	-3.0	21st Nov, 23rd Nov, 25th Nov, 26th Nov, 28th Nov, 29th Nov, 30th Nov	0.0	All days
Pemagatshel	25.5	2nd Nov	6.5	23rd Nov, 25th Nov	3.8	18th Nov
Phuentsholing	32.5	2nd Nov	12.0	22nd Nov, 23rd Nov, 24th Nov	25.2	22nd Nov
Punakha	33.0	1st Nov, 2nd Nov	6.0	28th Nov, 29th Nov, 30th Nov	0.0	All days
Babesa	23.5	2nd Nov	-4.5	30th Nov	0.0	All days
Sipsu	31.0	1st Nov	14.0	23rd Nov, 26th Nov, 27th Nov, 28th Nov	10.6	21st Nov
Tangmachu	31.5	1st Nov	6.5	14th Nov, 15th Nov, 24th Nov, 25th Nov, 26th Nov, 27th Nov	2.6	19th Nov
Trashiyantse	26.0	1st Nov	0.5	25th Nov, 30th Nov	2.3	19th Nov
Trongsa	23.5	2nd Nov	1.5	25th Nov, 26th Nov	8.8	19th Nov
Bajo	29.0	1st Nov	7.0	11th Nov, 13th Nov, 14th Nov	0.0	All days
Zhemgang	22.0	1st Nov, 9th Nov, 13th Nov	5.5	22nd Nov, 26th Nov	0.0	All days

December

Station	Maximum temperature (℃)	Date of occurrence	Minimum temperature (℃)	Date of occurrence	24 hour Rainfall (mm)	Date of occurrence
Bhur	27.0	2nd Dec, 3rd Dec	12.5	26th Dec	13.0	6th Dec
Chamkhar	17.5	1st Dec, 2nd Dec	-9.0	31st Dec	0.8	6th Dec
Dagana	22.0	1st Dec	5.5	26th Dec, 31st Dec	3.2	4th Dec
Damphu	19.5	1st Dec	4.0	23rd Dec	0.0	All days
Deothang	26.0	1st Dec	8.0	19th Dec	0.0	All days
Gasa	16.0	1st Dec	-5.5	26th Dec	6.0	7th Dec
Haa	16.5	23rd Dec	-10.5	29th Dec, 30th Dec	0.3	4th Dec
Kanglung	20.5	1st Dec	2.5	27th Dec, 29th Dec	5.6	6th Dec
Mongar	21.0	1st Dec	5.0	19th Dec	3.6	6th Dec
Paro	16.0	1st Dec, 12th Dec, 13th Dec, 15th Dec	-5.5	18th Dec, 26th Dec, 30th Dec	0.0	All days
Pemagatshel	21.0	1st Dec	3.5	19th Dec	2.0	6th Dec
Phuentsholing	28.5	2nd Dec	10.0	18th Dec, 21st Dec, 22nd Dec, 27th Dec, 28th Dec, 29th Dec	10.2	5th Dec
Punakha	29.5	1st Dec	3.5	31st Dec	2.4	6th Dec
Babesa	17.0	1st Dec, 15th Dec, 28th Dec	-6.5	19th Dec, 24th Dec, 28th Dec	0.0	All days
Sipsu	27.5	1st Dec	11.0	18th Dec, 19th Dec, 20th Dec, 22nd Dec, 25th Dec, 27th Dec, 29th Dec, 31st Dec	6.6	4th Dec
Tangmachu	24.5	1st Dec, 4th Dec, 5th Dec	3.5	24th Dec, 25th Dec, 27th Dec, 31st Dec	1.6	5th Dec
Trashiyantse	21.0	1st Dec	-2.0	31st Dec	2.4	6th Dec
Trongsa	18.5	1st Dec	-1.5	25th Dec, 31st Dec	3.8	7th Dec
Bajo	24.0	1st Dec	4.0	24th Dec, 25th Dec, 27th Dec, 31st Dec	1.2	6th Dec
Zhemgang	18.0	1st Dec, 11th Dec	2.0	25th Dec, 29th Dec	6.8	6th Dec

8. References

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