## WEATHER AND CLIMATE SERVICES DIVISION NATIONAL CENTER FOR HYDROLOGY & METEOROLOGY ROYAL GOVERNMENT OF BHUTAN



# RECORDS OF EXTREME WEATHER EVENTS

### IN BHUTAN

2020

## **About this Report**

The Extreme Weather Events report is an annual report that provides a summary of observations of the country's extreme weather. As the first of this series, this maiden issue contains an event of only September, 2017 to May, 2019 weather in the country. All computations contained in this report are based on Class A (Agro meteorological) stations owned and operated by the National Center for Hydrology and Meteorology, Royal Government of Bhutan.



Location of Agro-meteorological Stations

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#### Weather Events Records

The forecast from the WRF model was verified with the observation data for the extreme events in the country for the year 2016 to 2019. The study is done for the flash flood and heavy snowfall in the country.



Figure 1: Weather Events in Bhutan (2016-2019)

#### 1. Flash Flood, July, 2016

There was continuous heavy rain from 15th to 26th July 2016 over most parts of the country. Southern parts of the country received heavy to very heavy rainfall during these periods. Due to consistent heavy rain there were several flash floods and landslides reported from different parts of the country. A total of 72 families have been affected, damage to infrastructure and road communication disrupted in nine dzongkhags.

The major affected dzongkhags were Samtse, Chukha and Sarpang. The impact due to the swollen river was over the Sarpang town. More than 40 shopkeepers of Sarpang had to move to higher ground after the Sarpang River broke its banks and flooded the town. After two days of continuous downpour, the river started edging towards the town in the morning, almost washing away a two-storied house, located five metres away from the town towards the river.

The spatial map of the Bhutan (*Figure 1*) shows rainfall of more than 200 mm on 21st July over the southern parts of the country. The graph shows the comparison of WRF model forecasts with the observation data and the monsoon monitoring for July.



*Figure 2: Forecast from the WRF model as of 20<sup>th</sup> July, 2016 00:00 UTC run (left). Flood Analysis for Sarpang(Top Right). Monsoon monitoring for the month of July, 2016 (Bottom Right)* 

Overall, the WRF model was able to capture the rainfall variation over the period of the event. However, the model overestimated on 17th-18<sup>th</sup> July, then underestimated for a day followed by overestimating the next three days. On 23<sup>rd</sup> and 24<sup>th</sup> July, the WRF model underestimated the rainfall.

#### 2. Snowfall, March, 2017

The heavy snowfall occurred over the western, northern, central parts of the country while the southern part and eastern parts of the country received heavy rainfall on 11 March, 2017. The event occurred due to the strong western disturbance with moisture incursion from the Arabian Sea.

The weather event led to bad and unsafe road conditions. The east-west highway remained closed as roadblocks were reported at many places mainly along the passes. The Paro-Haa route via Chelela had also been closed due to heavy snowfall in Chelala.



*Figure 3: Forecast from the WRF model as of 7<sup>th</sup> March, 2017 18:00 UTC run (left).Snow Analysis for Thimphu and Bumthang, 2017 (Right).* 

The WRF model forecasted precipitation of 5 mm and above over the country. Due to the low temperature, the precipitation in the form of snow was observed over the northern, western and central parts of the country.

The case study for Thimphu and Bumthang was carried out to check whether the WRF model is able to capture the event. The graph shows the comparison of WRF model forecasts with the observation data for Thimphu and Bumthang



Figure 4: Thimphu valley covered in the blanket of snow (Source: <u>www.bbs.bt</u>) (left). National Weather and Flood Forecasting Centre, Thimphu(right)

The WRF model was able to capture the weather event. On daily analysis, the model was seen to be underestimating Thimphu whereas the model has performed well for Bumthang.

#### 3. Snowfall, December, 2018.

Towards the end of the year, the western, northern and central parts of the country with elevation above 2000 meters received snowfall. The snowfall occurred on 18 December, 2018 due to the peripheral effect from the cyclonic storm named "PHETHAI" that developed over the Bay of Bengal. There was good moisture incursion from Bay of Bengal that caused heavy snowfall over northern, western and central Bhutan.

Due to the weather, Bhutan Airlines and Drukair cancelled most of their scheduled flights. Even bus services plying through Dochula were also cancelled. The case study for Thimphu and Bumthang was carried out to check whether the WRF model is able to capture the event. The graph shows the comparison of WRF model forecasts with the observation data for Thimphu and Bumthang



*Figure 5: Forecast from the WRF model as of 15<sup>th</sup> December, 2018 18:00 UTC run(left). Snow analysis for Thimphu and Bumthang for December, 2018 (right).* 



*Figure 6 : Daily observation observed on 18th December, 2018(left). Thimphu Residents visiting Kuensel Phodrang (Source: Kuensel)(right)* 

The above graph (*Figure 6*) shows accumulated precipitation (24 hours) of 20 mm and above over the country. Snowfall of maximum depth of 12.9 cm was observed in Gasa meteorological station. Moderate rainfall was observed over the country.

The model was able to capture the weather event, however, on daily analysis, the model was seen to be over estimating the event for both Thimphu and Bumthang.

#### 4. Snowfall, January and February, 2019

Bhutan received several snowfall this year which was light snow/rain over the country. Most of these weather events occurred in the higher altitude of the country. First snow this winter was on 18 December, 2018. The snowfall occurred due to the peripheral effect from the cyclonic storm named "PHETHAI" developed over the Bay of Bengal. Following this event, western, central and northern parts of the country received light snowfall in the first two months of the year, 2019. This event occurred due to the western disturbance.

Date	Location	Quantity
18 Dec, 2018	Thimphu	2.00 cm (Depth)
	Paro	1.27cm (Depth)
	Haa	12.00 cm (Depth)
	Gasa	12.90 cm (Depth)
	Bumthang	6.80 cm (Depth)
9 Jan, 2019	Наа	0.20 mm (SWE Rainfall)
	Gasa	4.00 cm (Depth)
	Bumthang	0.20 mm (Depth)
8 Feb, 2019	Наа	3.70 cm (Depth)
9 Feb, 2019	Наа	2.80 cm (Depth)
25 Feb, 2019	Gasa	11.20 mm (SWE Rainfall)
26 Feb, 2019	Gasa	10.00 mm (SWE Rainfall)
27 Feb, 2019	Gasa	10.40 mm (SWE Rainfall)
28 Feb, 2019	Gasa	1.50 mm (SWE Rainfall)

The following table shows records of snowfall in the country.

#### 5. Flash Flood, April, 2019

On 29<sup>th</sup> April 2019, most of the stations over the country reported rainfall. Heavy rainfall was received mainly over the eastern parts of Bhutan. Deothang met station received the heaviest rainfall of 267 mm followed by Mongar with 37.4 mm and Lhuentse 35.2 mm (daily accumulation). There are reports of small flash floods in Lhuentse.

This was a convective rainfall which typically occurs for a short duration and over isolated places. The system is normal during the transition period from winter to summer.



Figure 7: Flash flood on Lekpagang chhu in Lhuntse.

#### 6. Landslide, July, 2019

Due to the continuous rainfall in July, a landslide led to the Artificial Lake Formation on 25th July, 2019 at Jigmecholingarea, Sarpang.

Comparison was made between the rainfall recorded from the hydromets stations in Sarpang for the month of July. All the stations in Sarpang: a) Bhur agromet station (Class A), b) Jigmecholing automatic weather station (AWS), c) Chuzergang automatic weather station (AWS) recorded rainfall throughout the month of July (2-28 July). The highest rainfall recorded was on 10th July with an average of 360.0mm from the 3 stations. The fourth week of July (21-25th) recorded an accumulated rainfall average rainfall of 485.3mm from the 3 stations.



*Figure 8: Daily rainfall from the three hydromet stations in Sarpang.* 

#### 7. Flash Flood, August, 2019

Continuous rainfall caused Flash flood on 7th August, 2019 morning at Kamichu area, Wangdue Phodrang. The flood led to swelling of Punatsangchhu and submerging of roads.

The swollen Phangruchhu stream in Jaroggang totally damaged a two-storied traditional house and washed away a concrete bridge connecting Athang Gewog Centre. The flash flood has also damaged the irrigation water channel of twenty households, drinking water supply of four households and about twenty acres of paddy field under Jaroggang-Dzawo chiwog in Athang Gewog.



Figure 9: Aftermath of the flash flood in Wangdue Phodrang.

#### 8. Windstrom, December, 2019

On 4th December, 2019, a strong windstorm was reported in parts of Thimphu and Gasa dzongkhag caused primarily by the westerly winds. The windstorm ripped off roofs of six houses and public structures in Naro and Lunana gewog.

There were no casualties due to the windstorm, but a one-storey house in Naro gewog collapsed completely when a tree fell on it rendering the inhabitants homeless. Similarly, in Lunana gewog it blew off the roof of Mandrelthang extended classroom. The windstorm was also experienced in other highland communities such as Soe and lingzhi gewogs, but no damage was reported.

The weather research and forecast (WRF) model forecasted gusty wind over the northern parts of the country with maximum intensity over lunana and Naro gewog regions on December 4 (UTC 7:00).



Figure 9 : Forecast from WRF Model on 02 Dec 2019, 18:00 UTC (Left) and Gewogs that experienced windstrom on 04 Dec 2019 (Right)

#### 9. Impact of Tropical cyclone 'AMPHAN'

The Cyclonic Storm 'AMPHAN' (pronounced as UM-PUN) in Bay of Bengal which landfall at 7:00 BST of 20th May 2020 across West Bengal – Bangladesh coasts between Digha (West Bengal) and Hatiya Islands (Bangladesh) caused moderate to heavy rain over southern and eastern parts of the country on 21-22 May, 2020. Rest of the places received light to moderate rain in the same period. The rainfall affected the transportation and agriculture in the country.



Figure 10 : Effect of cyclone "AMPHAN"

#### References

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