## **Extreme events observed during June-October over the TP region**

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## Outline

Introduction

Extreme weather Theories/Methodologies

Global Extreme During 2024

Asia/TPRCC Extremes JJASO

**Regional Weather Extremes Record** 

Lesson we learn

# Introduction

Extreme weather events includes unexpected unusual weather conditions. It mean that weather is at the historical distribution. These types of extreme events based on a **location recorded** weather history.



## What does We Face?

Heavy Rains/River Flooding	Extreme Rainfall (Monsoon)
Torrential Rain/Flash Flooding	g Extreme Rainfall (Monsoon)
Urban Flooding	Extreme Rainfall (Monsoon)
GLOF/Snow-melt Flooding	Extreme Heat in May/June
Smog	Air pollution (Sep-Dec)
Droughts	eficient Rainfall (Winter & Monsoon)
Fog	y and Extreme Winters (Nov-Jan)
Snow Storm	Heavy Snow in Winters (Dec-April)
$\mathbf{D}_{2}$	$\mathbf{V}_{\mathbf{r}} = \mathbf{V}_{\mathbf{r}} + \mathbf{V}_{\mathbf{r}} + \mathbf{I}_{\mathbf{r}} + \mathbf{V}_{\mathbf{r}} + $

In Pakistan, more than 70% High Impact Weathers (Extreme Weather Events) are associated with Monsoon Season. Flash Floods, Floods & Urban Floods are frequent High Impact Weathers in Pakistan

## **Extreme Weather Theories/Methodologies**

**GEV** distribution



Statistical methods for studying the behavior of the tail distribution.

Distribution tail behavior indicates that in some cases the climate has a heavy-tail that is slowly declining tail of the distribution.

As a result the chances of extreme value generated was very big.

### Extreme is a very rare event

## **Extreme Weather Methods**

There are two methods:

- Block Maxima
- Peak Over
   Threshold



### Peak Over Threshold

- This method uses standard or threshold value.
- Data that exceeds standard or threshold value is the sample of extreme value.

### Generallized Pareto Distribution:

$$G(y) = 1 - \left(1 + \frac{\xi y}{\sigma}\right)^{-\frac{1}{\xi}}, \qquad \xi \neq 0$$

$$G(y) = 1 - \exp\left(-\frac{y}{\sigma}\right), \quad \xi = 0$$

Note:  $\sigma$ =scala parameter  $\xi$ = shape parameter

## Global Extreme Weather Events JJASO 2024

## **Global Watch**

06-09-2024

06-09-2024

05-09-2024

05-09-2024

05-09-2024

01-09-2024 29-08-2024

29-08-2024

29-08-2024

29-08-2024

27-08-2024

27-08-2024

27-08-2024

27-08-2024

27-08-2024

27-08-2024

27-08-2024

23-08-2024

litle	Date	
Vietnam: Adverse weather forecast	31-10-2024	Super Typhoon Yagi
Philippine Sea: Typhoon Kong-rey	31-10-2024	Morocco: Adverse Weather
Puerto Rico Flash Flood	31-10-2024	Ocean Heat Content in Gulf of Mexico
SPAIN FLOOD Alert	31-10-2024	High temperatures in Eastern Central Europe
South China Sea: Typhoon Krathon	03-10-2024	Heatwave in Hungary
Australia: High temperatures	03-10-2024	Brazil Forest Fires
US: High temperatures forecast	26-09-2024	Severe Weather in Spain(30 August
Gulf of Mexico: Hurricane Helene	26-09-2024	Flood warning for Brathay, Rothay, and Winster Rivers
Japan: High Temperatures Forecast	18-09-2024	Croatia Heat Wave
Tropical Storm Pulasan	18-09-2024	Australian Winter Warmth
		Antarctic Cold Wave
aiwan High Temperatures Forecast	18-09-2024	High Heat Index in Bandar-e Mahshahr (Iran)
IS: High Temperatures Forecast	09-09-2024	Typhoon in Western Japan
sulf of Mexico: Potential Tropical Cyclone	09-09-2024	Arctic Sea Ice Extent
roatia: Adverse Weather Forecast	09-09-2024	Mediterranean Heat Wave
leavy Rains in Mali	06-09-2024	Highest Sea Surface Temperature In the Persian Gulf
		Bangladesh Floods August 2024

# Global Extreme Weather Events during 2024

### Selected Significant Climate Anomalies and Events: June 2024

#### GLOBAL AVERAGE TEMPERATURE

**TROPICAL STORM ALBERTO** 

The first named storm of the Atlantic 2024

winds of 50 mph (80 km/h) before making

hurricane season peaked with sustained

landfall in northern Mexico, where heavy

inland rains led to flooding and reports

Heavy rainfall in El Salvador and

flooding and landslides that led

to widespread displacement and

neighboring countries caused

more than a dozen deaths.

of several deaths.

**EL SALVADOR** 

Jun 2024 global surface temperature ranked warmest since global records began in 1850, making it the 13th consecutive record-warm month.



### THE ARCTIC

CARIBBEAN

The Caribbean region and the Main

**Development Region for Atlantic** 

and Jan-Jun on record.

hurricanes had their warmest Jun

The Arctic had its seventh-warmest Jun and sixth-warmest Jan–Jun. Arctic sea ice extent for Jun was 12th lowest on record.

#### NORTH AMERICA

North America had its fourth-warmest Jun and second-warmest Jan–Jun on record.

### HURRICANE BERYL

Became the first Category 4 hurricane observed in the Atlantic Ocean during the month of Jun. Beryl made landfall in Carriacou, Grenada as a Category 4 hurricane and caused extensive and very severe damage across the Windward Islands before moving further into the Caribbean.

### SOUTH AMERICA

South America had its warmest Jun and warmest Jan–Jun on record.

### PANTANAL

More than 2500 wildfires were reported in the world's largest tropical wetlands in Jun, the most ever so early in the year.

### EUROPE

Europe had its second-warmest Jun and warmest Jan–Jun on record.

### GREECE

An early-season heat wave hit Greece in Jun, with multi-day temperature exceedances of 38°C (100°F) in many places. The extreme heat led to the deaths of several tourists.

### ASIA

Asia had its warmest Jun and fourth-warmest Jan–Jun on record.

### AFRICA

Africa had its warmest Jun and warmest Jan–Jun on record.

### GLOBAL OCEAN

Global ocean surface temperature hit a monthly record high for the 15th consecutive month in Jun.

#### SOUTH AFRICA

Heavy rainfall, strong winds and hailstorms affected southern and eastern South Africa in early Jun, causing river overflows and reports of at least 12 fatalities.

### SOUTHEASTERN CHINA

On top of deadly floods in Apr, more heavy rainstorms in Jun caused loss of homes, roadways and bridges, damage to crops and dozens of reported deaths and missing persons.

### BANGLADESH

Heavy monsoon rainfall in Bangladesh affected more than two million people in Jun. Flooding and landslides led to loss of life and damage to homes and infrastructure.

#### OCEANIA Oceania had its seventh-warmest Jan–Jun on record.

ANTARCTIC SEA ICE EXTENT Antarctic sea ice extent for Jun ranked second-lowest on record.

# **Global Extreme Weather Events during 2024**

### Selected Significant Climate Anomalies and Events: July 2024

MEDITERRANEAN

had its warmest Jul on record.

PERSIAN GULF

of 140°F or higher.

A series of heatwaves in several Mediterranean countries

Heat indices in parts of the Persian

Gulf region reached extreme levels in

Jul as temperatures exceeding 105°F

**TROPICAL STORM PRAPIROON** 

Severe Tropical Storm Prapiroon caused

damage in southern China and northern

floods and landslides that led to extensive

and Gulf water temperatures above

90°F led to feels-like temperatures

brought widespread temperature exceedances of 100°F and hundreds of deaths that were likely related to heat. Greece

### **GLOBAL AVERAGE TEMPERATURE**

Jul 2024 global surface temperature ranked warmest since global records began in 1850, making it the 14th consecutive record-warm month.



### THE ARCTIC

The Arctic had its third-warmest Jul and fifth-warmest Jan-Jul. Arctic sea ice extent for Jul was sixth lowest on record.

### EUROPE

Europe had its warmest Jul and warmest Jan-Jul on record.

### HURRICANE BERYL

Following a destructive landfall in Grenada in Jun, Beryl peaked in Jul as the earliest Category 5 hurricane on record. Beryl also made landfall on the Yucatan Peninsula and southeast Texas.

### AFRICA

Africa had its warmest Jul and warmest Jan-Jul on record.

### **ETHIOPIA**

Heavy rain in remote areas of southwestern Ethiopia led to landslides that killed more than 200 people and destroyed crops and homes.

### **GLOBAL OCEAN**

Global ocean surface temperature was second warmest for Jul, ending a streak of 15 consecutive monthly record highs.

Vietnam.

### ANTARCTIC SEA ICE EXTENT

The Antarctic tied as fifth-warmest Jul and sea ice extent for Jul ranked second lowest on record.

### NORTH AMERICA

North America had its second-warmest Jul and second-warmest Jan-Jul on record.

### CARIBBEAN

The Caribbean region and the Main Development Region for Atlantic hurricanes each had their warmest Jan-Jul on record.

### **SOUTH AMERICA**

South America had its warmest Jan-Jul on record.

#### PATAGONIA Extreme cold temperatures caused wildlife deaths in southern South America.

### damage in Taiwan and China.

ASIA

PHILLIPPINES

Asia had its warmest Jul and fourth-

Gaemi, a Category 4 equivalent typhoon,

caused significant flooding and wind

warmest Jan-Jul on record.

**TYPHOON GAEMI** 

Heavy rains associated with the southwest monsoon and Typhoon Gaemi triggered widespread flash floods, where more than 30 deaths were reported.

OCEANIA Oceania had its eighth-warmest Jan-Jul on record.

# Global Extreme Weather Events during 2024

### Selected Significant Climate Anomalies and Events: August 2024

### GLOBAL AVERAGE TEMPERATURE

Aug 2024 global surface temperature ranked warmest since global records began in 1850, making it the 15th consecutive record-warm month.



### THE ARCTIC

The Arctic had its fourth-warmest Aug, and fifth-warmest Jun–Aug and Jan–Aug on record. Arctic sea ice extent for Aug was fourth lowest on record.

#### NORTH AMERICA

North America had its third-warmest Aug and second-warmest Jun–Aug and Jan–Aug on record.

#### HURRICANE DEBBY

Peaked as a Category 1 hurricane with maximum sustained winds of 80 mph. It made landfall twice in the Big Bend region of Florida as a hurricane and as a tropical storm along the South Carolina coast, bringing flooding rains.

### CARIBBEAN

The Caribbean region and the Main Development Region for Atlantic hurricanes each had their warmest Jan–Aug on record.

### SOUTH AMERICA

South America had its warmest Jan–Aug, third-warmest Jun–Aug and sixth-warmest Aug on record.

EUROPE Europe had its warmest Aug, Jun–Aug and Jan–Aug on record. Countries with a recordwarm Aug included Spain and Austria.

AFRICA Africa had its third-warmest Aug and warmest Jun–Aug and Jan–Aug on record.

### **CENTRAL AFRICA**

A continuation of torrential rains in Chad and neighboring countries to the west caused flooding that affected more than 2 million people with hundreds of deaths and large-scale community displacement.

### **GLOBAL OCEAN**

Global ocean surface temperature was second warmest for Aug and Jun–Aug, and warmest on record for Jan–Aug.

### AUSTRALIA -

Only the fifth cyclone to develop in the

North Indian Ocean in Aug since 1981;

peaked as a moderate-strength tropical

storm. Heavy rains associated with the

storm led to severe flooding and dozens

Australia had its warmest Aug since national records began in 1910.

#### OCEANIA

Oceania had its warmest Aug and Jun–Aug and its second-warmest Jan–Aug on record.

### THE ANTARCTIC

The Antarctic had its second-warmest Aug and third-warmest Jun–Aug, and sea ice extent for Aug ranked second lowest on record.

### ARCTIC Aug was record warm in several locations

BANGLADESH

people.

of the Norwegian and Swedish Arctic.

Flooding associated with relentless

monsoon rains caused widespread

CYCLONE ASNA

of deaths in India.

destruction, led to more than 70

deaths and affected millions of

### ASIA

Asia had its second-warmest Aug, warmest Jun–Aug and fourth-warmest Jan–Aug on record.

### CHINA

Heavy rain in northeast China produced flooding that led to more than a dozen deaths and extensive damage to infrastructure.

### **TYPHOON SHANSHAN**

Peaked as a Category 4 equivalent typhoon with winds of 130 mph. Made landfall in Japan as a strong typhoon, causing several deaths and significant damage due to high winds and flooding rains.

### Please note: Material provided in this map was compiled from NOAA's State of the Climate Reports. For more information please visit: https://www.ncei.noaa.gov/access/monitoring/monthly-report/global/

## Global Extreme Weather Events during 2024

Selected Significant Climate Anomalies and Events: October 2024

### GLOBAL AVERAGE TEMPERATURE Oct 2024 global surface temperature ranked second warmest and Jan–Oct ranked warmest since global records began in 1850.





TPRCC Extreme Weather Events JJASO 2024

## Extreme Weather Summary TPRCC Regions



## Regional Extreme Events Over Kazakhstan

- Strong winds >30 m/s recorded, with 21 cases at Dostyk, Zhetysu region.
- Arys station recorded +44.3 ° C on September 8, highest in Turkestan region.
- Temperature anomalies >2 ° C in August, max 2.9 ° C in East.
- Heavy rainfall raised Kishi Almaty River to 295 cm on August 18.

Hydrometeorological Phenomenon	Details	Location	Date/Period	Key Data/Figures
Very Strong and Squally Wind	Maximum wind speed exceeding 30 m/s recorded at multiple stations.	Dostyk weather station (Zhetysu region)	June - October 2024	21 cases of strong winds recorded at Dostyk weather station (82.468333°E, 45.268889°N)
Intense Heat	Highest recorded temperature of +44.3°C.	Arys weather station (Turkestan region)	September 8, 2024	Temperature reached +44.3°C
Temperature Anomalies	Positive temperature anomalies observed.	Eastern, southern, southwestern Kazakhstan	August 2024	Significant positive anomaly of 2.9°C in East Kazakhstan, records broken at 21 stations
Freezing (Frosts)	Frosts occurred with air temperatures dropping to negative values at night.	Almaty region	September 28, 2024	Minimum temperature drop to -9.0°C at night
Atmospheric and Soil Drought	Droughts impacted large parts of Kazakhstan.	Southern, western, central, and eastern regions	June - October 2024	Atmospheric droughts lasted up to 79 days, soil droughts lasted up to 51 days
Increasing Water Content in Rivers	Hydrological events caused by heavy precipitation, rise in water levels.	East Kazakhstan, Almaty regions	August 18, 2024	Kishi Almaty river exceeded critical level (295 cm), heavy precipitation recorded at Shymbulak (37.1 mm)
Heavy Precipitation on Mountain Rivers	Increased water levels in mountain rivers due to heavy precipitation.	Kara Ertis, Turgen, Kaskelen, Aksu ↓s	August 2024	Dangerous water levels exceeded in mountainous regions

# **Extreme Events over NEPAL**

**Record-breaking 24-hour rainfall** in 25 stations across 14 districts.

Cloudburst Evidence

• Rivers exceeding historic flood levels

• Temperatures exceeded 40° C for several days.

Station/Event	Rainfall (mm)	Date	Remarks
Dodhara	624.0	July 8	Highest observed rainfall since 1947
Hanuman Nagar	573.6	July 8	10-minute moving average shows cloudburst (102 mm/hour)
Sundarpur	555.8	July 8	Highest observed rainfall since 1947
Hetauda	516.2	August 13, 2017	Previously recorded highest rainfall
Tistung (Makwanpur)	540.0	July 20, 1993	Recorded by Department of Soil Conservation
Kathmandu (5 stations)	New record precipitation	September 28, 2024	25 stations across 14 districts broke records
Lalitpur (5 stations)	New record precipitation	September 28, 2024	
Other districts	New record precipitation	September 28, 2024	Bhaktapur, Kavrepalanchowk, Arghakhanchi, etc.
Koshi, Bagmati, Narayani Basins	-	September 2024	Major flooding, rivers exceeded historic flood levels
Western Terai (multiple districts)	> 40°C	June 2024	Heatwaves observed; Kailali, Banke, Dang, Kapilbastu, Rupandehi, and Parsa impacted

## **Extreme Events over India**

DATE	DEATH	INJURED	MISSING	LIVESTOCK	DISTRICT (STATE/UT) AFFECTED
8, 28 Jul.	1	3		100	Kinnaur, Lahaul & Spiti (Himachal Pradesh)
5 Jul.	1	3			Poonch, Udhampur (Jammu & Kashmir)
5 Jul.	1				Shi-Yomi (Arunachal Pradesh)
1 Aug.	32		23		Kullu, Mandi, Shimla (Himachal Pradesh) On 31 July-1 August, heavy rainfall and strong winds affected three districts (Shimla, Mandi, and Kullu) of <b>Himachal Pradesh</b> state (northern India) causing severe weather-related incidents and triggering flash-floods that resulted in casualties and damage.
1, 9 Aug.	7	15	1		Champawat, Haridwar, Nainital (Uttarakhand)

## Summary of Weather-Related Events in Mongolia (June–October 2024)

Economic losses 617,589 Human life lost 102 Live Stock losses 2340 Houses Damaged 86

Event	Number of Incidents	Impacts	Estimated Damage (USD)
Heavy Rain-Induced Floods	70	<ul> <li>Affected 62 villages/districts across all</li> <li>21 provinces.</li> <li>628 livestock lost.</li> <li>58 small buildings/houses destroyed.</li> <li>98 human lives lost in water-related accidents.</li> </ul>	238,500
Forest-Steppe Fires	132	<ul><li> 1 human life lost.</li><li> 1,063 livestock lost.</li><li> 3 houses destroyed.</li></ul>	516,737
Lightning Strikes	13	<ul> <li>Occurred in 12 locations across 7 provinces.</li> <li>3 human lives lost.</li> <li>499 livestock lost.</li> </ul>	23,550
Strong Winds	36	<ul> <li>- 150 livestock lost.</li> <li>- 25 ↓ lses destroyed.</li> </ul>	617,589

## Summary of Extreme Events Over Pakistan



## **GLOF Events**



Naran kaghan Mahandri Babusar Road Flood 30 July 2024 #kaghanvalley #travel #adventure #flood

August 16, 2024 - Thame village, Khumbu, Nepal -Massive flood likely caused by GLOF. GLOF in Thame Village\_ Sequential Lake Outbursts Trigger Devastating Flood in Everest Region

## Lessons Learned from Extreme Weather Events (June–October 2024)

## For the Weather Department

- Early Warning Systems:
- Improve the accuracy and timeliness of severe weather forecasts to enable proactive responses.
- Data Collection and Sharing:
- Strengthen regional collaboration for monitoring meteorological parameters like rainfall, wind, and temperature anomalies.
- Technology Integration:
- Utilize advanced tools like satellite monitoring and AI-driven models for predicting events like flash floods and glacial lake outbursts.

### For Disaster Management Authorities

- <u>**Preparedness Plans:**</u> Develop and regularly update localized disaster preparedness and response plans.
- <u>**Community Engagement:**</u> Conduct public awareness campaigns to educate communities about evacuation protocols and emergency measures.
- <u>**Resource Allocation:**</u> Pre-position emergency resources (food, medical aid, and rescue teams) in vulnerable regions before peak monsoon periods.

## For Water Management Authorities

- **<u>Flood Management:</u>** Construct and maintain reservoirs, check dams, and embankments to mitigate flood risks.
- <u>**Rainwater Harvesting:**</u> Promote sustainable practices to utilize excessive rainfall, particularly in drought-prone areas.
- <u>Hydrological Monitoring:</u> Enhance monitoring of river basins to manage water flows and avoid breaches.
- <u>For the Government Policy Frameworks</u>: Establish stricter land-use policies to avoid construction in flood-prone and landslide-prone areas.
- <u>**Climate Resilience:**</u> Invest in infrastructure designed to withstand extreme weather conditions, such as elevated roads and climate-adaptive housing.
- <u>Financial Support</u>: Set up disaster insurance programs and funds to support affected populations and regions.

## For the General Public

- <u>Awareness and Training:</u> Familiarize communities with evacuation routes and first-aid measures in emergencies.
- **<u>Building Resilience:</u>** Encourage individuals to secure homes against strong winds, floods, and lightning strikes.
- <u>**Responsible Practices:**</u> Promote sustainable environmental practices, such as avoiding deforestation, which exacerbates flooding and landslides.

## Collaborative Action

- <u>**Regional Cooperation:**</u> Countries within shared geographic domains (e.g., Third Pole countries) should work collectively on cross-border disaster risk reduction strategies.
- <u>Research and Development:</u> Encourage research into climate anomalies, including temperature extremes, glacial lake outbursts, and soil droughts, for long-term planning and mitigation.

