Global Extreme Precipitation Event Hazard Preview

TAOS^{tm} Real Time Operations System
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Abstract

TAOS™ WX Global Analysis extreme precipitation events based the 20230919000000 00z forecast. This analysis was run using proc:gfs TAOS Version 24.1:ROCKY9:GCC11:2023:249:102 and includes precipitation hazards from tropical cyclones, winter storms, mid latitude cyclones, and other synoptic scale weather systems.

Return Periods in this report are based on climatology derived from the 2001-2022 NASA GPM/IMERG Level 3 data sets.

Report generated Tue Sep 19 08:53:10 AM UTC 2023 on cortex2 using GFS data downloaded on Tue Sep 19 03:31:59 AM UTC 2023.

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Chapter 1

Extreme Rain Forecast Day 1: 2023-09-19

Rainfall events with an expected return period of over 10 years based on the 00Z 20230919000000 forecast run.

Table 1.1: Extreme Rain Events forecast for 2023-09-19

admin1_name	*country*	*return_period*
Anhui	CHN	21.8
Chongqing	CHN	41.2
Henan	CHN	19.8
Hubei	CHN	21.8
Jiangsu	CHN	276.6
Conakry	GIN	98.3
Kindia	GIN	98.3
Gujarat	IND	500.0

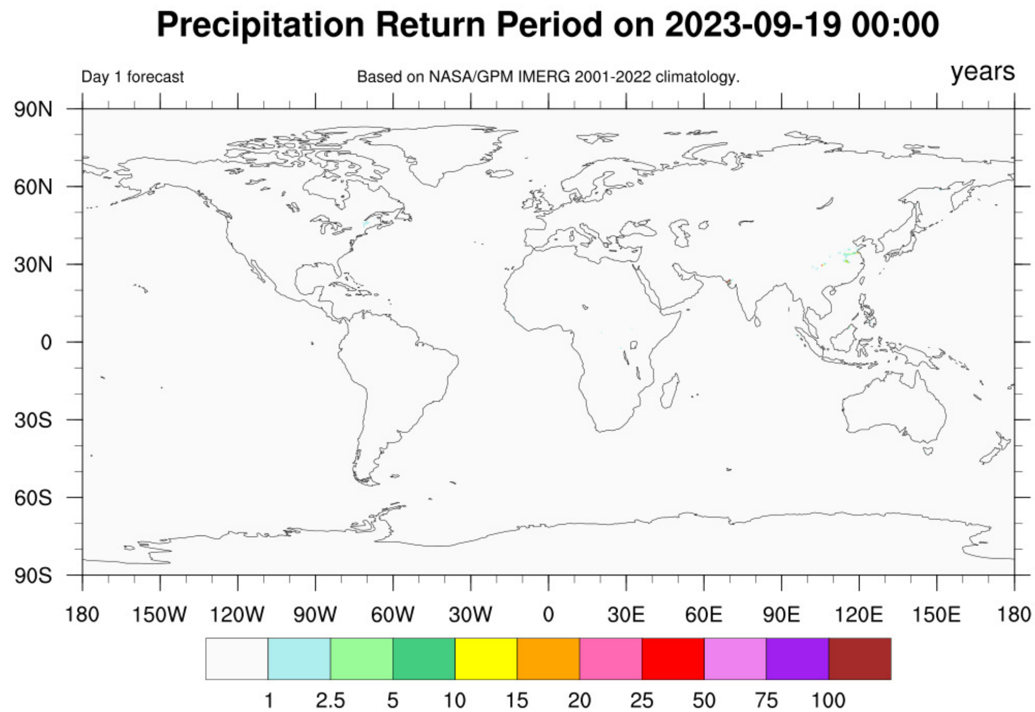

Figure 1.1: Extreme Rain Events for 2023-09-19

Chapter 2

Extreme Rain Forecast Day 2: 2023-09-20

Rainfall events with an expected return period of over 10 years based on the 00Z 20230919000000 forecast run.

Table 2.1: Extreme Rain Events forecast for 2023-09-20

admin1_name	*country*	*return_period*
Dhaka	BGD	31.1
Rangpur	BGD	53.1
Chongqing	CHN	40.3
Hubei	CHN	11.6
Sichuan	CHN	16.2
Sumatera Barat	IDN	24.8
Sumatera Utara	IDN	53.5
Assam	IND	31.1
Meghalaya	IND	31.1
Chin	MMR	12.8
Otago	NZL	18.9
Southland	NZL	19.3
West Coast	NZL	18.9

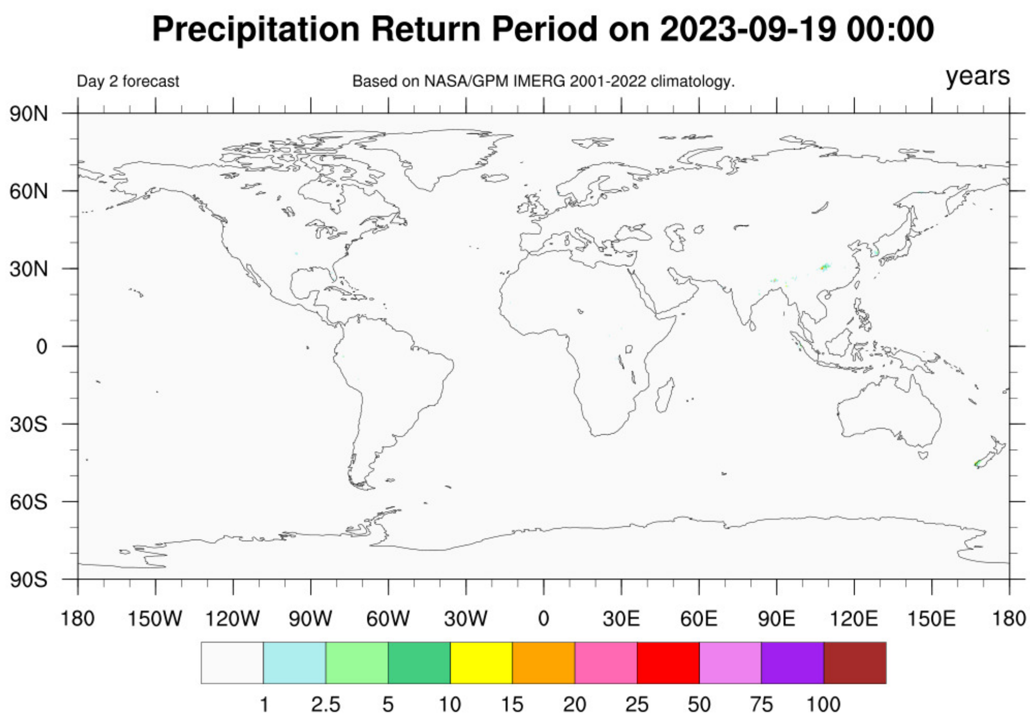

Figure 2.1: Extreme Rain Events for 2023-09-20

Chapter 3

Extreme Rain Forecast Day 3: 2023-09-21

Rainfall events with an expected return period of over 10 years based on the 00Z 20230919000000 forecast run.

Table 3.1: Extreme Rain Events forecast for 2023-09-21

admin1_name	*country*	*return_period*
Rangpur	BGD	14.5
Aceh	IDN	18.1
Jharkhand	IND	19.8
Canterbury	NZL	500.0
Otago	NZL	500.0
Southland	NZL	500.0
West Coast	NZL	500.0

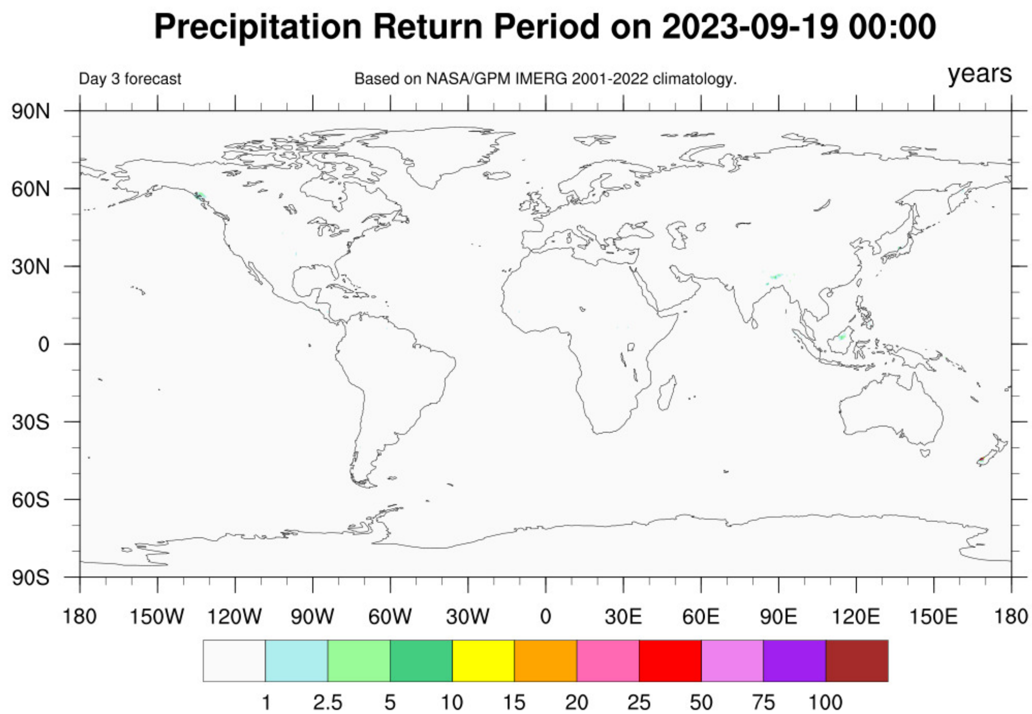

Figure 3.1: Extreme Rain Events for 2023-09-21

Chapter 4

Extreme Rain Forecast Day 4: 2023-09-22

Rainfall events with an expected return period of over 10 years based on the 00Z 20230919000000 forecast run.

Table 4.1: Extreme Rain Events forecast for 2023-09-22

admin1_name	*country*	*return_period*
British Columbia	CAN	20.5
Cuvette	COG	21.1
Cuvette-Ouest	COG	21.1
Riau	IDN	36.0
Bihar	IND	500.0
Marshall Islands entire country	MHL	18.8
Kedah	MYS	500.0
East Sepik	PNG	10.6
Satun	THA	24.0
Alaska	USA	13.5
North Carolina	USA	16.2

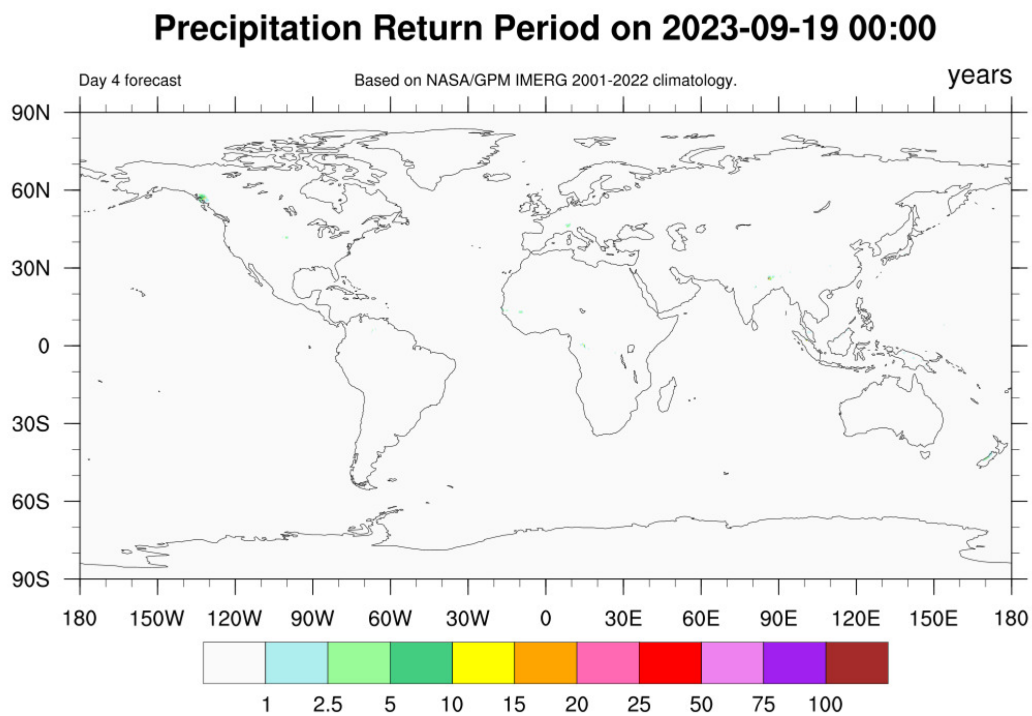

Figure 4.1: Extreme Rain Events for 2023-09-22

Chapter 5

Extreme Rain Forecast Day 5: 2023-09-23

Rainfall events with an expected return period of over 10 years based on the 00Z 20230919000000 forecast run.

Table 5.1: Extreme Rain Events forecast for 2023-09-23

admin1_name	*country*	*return_period*
Andaman and Nicobar	IND	16.2
Bihar	IND	11.1
Marshall Islands entire country	MHL	152.1
East	NPL	10.6
Satun	THA	58.8
Trang	THA	58.8
Delaware	USA	324.5
Maryland	USA	500.0
North Carolina	USA	43.4
Virginia	USA	332.3

5.1 Climatology Sources

Two main sources of precipitation climatology are analyzed here. The first is the NASA Global Precipitation Mission (GPM) Level 3 Late (IMERG) data

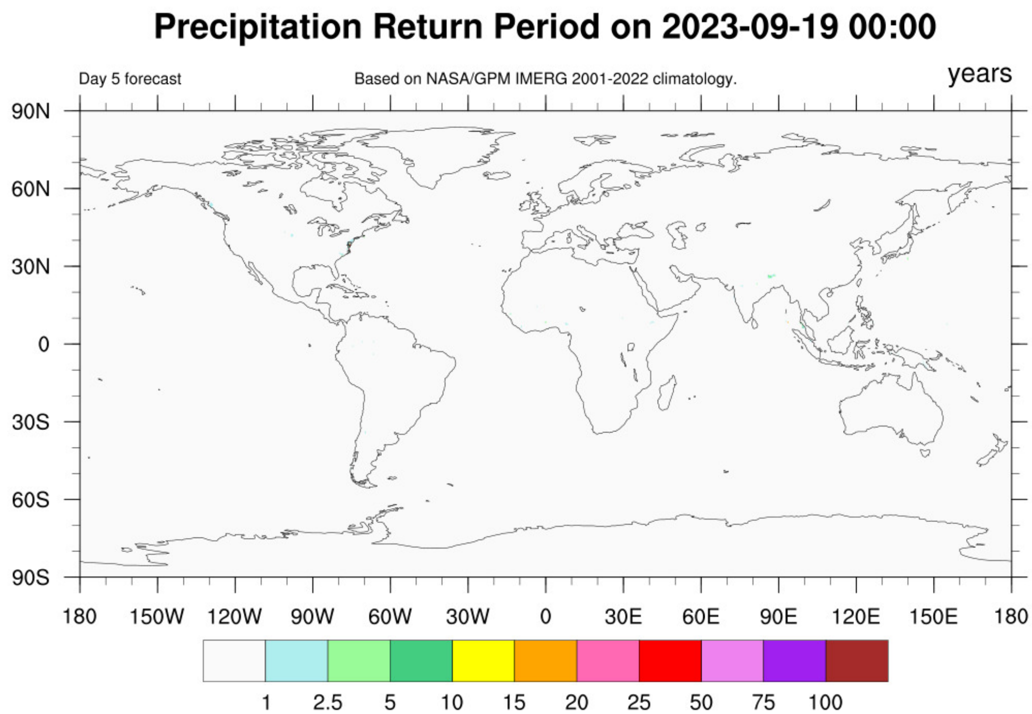

Figure 5.1: Extreme Rain Events for 2023-09-23

set that is also used for near real time analysis. It is called "late" because it is the last real time integration, delayed to include data downloaded by low earth orbiting satellites after then pass over ground stations the next day. Note that the GPM/IMERG data is considered to be a model rather than a direct observation, since it is a rainfall estimate based on various algorithms using microwave radar data and InfraRed satellite data to compute rainfall. However, it is often closer to model rainfall because it is an aerial average rather than a point source such as a rain gauge.

For longer term climatology reanalysis data sets are used. Several are available within the TAOS^{tm} system. The primary climatology is derived from the NCEP Climate Forecast System Version 2 (CFSv2). Other data sets available for analysis are from the European Centre for Medium Range Forecasting, and the Japan Meteorological Agency. These data sets are at different resolutions than either the underlying GFS or NASA GPM data. In all cases the data sets are resampled and scaled as appropriate to use the same 0.1 degree (6 nautical mile, 11.1 km) grid that the NASA GPM data uses.

5.2 Return Period Analysis

Here the return period is defined as the reciprocal of the probability of observing a specific more extreme effect in a single year. In these analysis the distribution of choice is the Weibull distribution, since it was found to have the best goodnes-of-fit across multiple sites. In brief, the steps are as follows:

1. Compute the maximum likelihood estimates (MLE) of the shape (alpha) and scale (beta) parameters.

2. Point estimates of return period values are computed by evaluating the inverse distribution function at the MLEs. For an n-year value, take p = 1 – (1/n)

3. Compute the asymptotic variances and covariances of the MLEs using the observed Fisher information matrix.

4. Compute the observed Fisher information matrix D as the inverse of the symmetric 2x2 matrix

5. Deconvolve the matrix to obtain the parameter estimates.

Reported return periods in most reports are limited to approximately four times the historical record. Therefore, the GPM data set is limited to 100 years, the CFS2 and JRA55 based climatologies are limited to 200 years. The raw output tables and data sets are not limited, however, caution is used in interpreting values beyond the reasonable limits of the analysis.