

NOAA Atlas 14 Precipitation Frequency Atlas of the U.S.

(updated 4/20/25)

What is it?

A database of precipitation frequency estimates across the United States. Precipitation frequency estimates (for a given location) include precipitation depth (or accumulated amount) and precipitation intensity for a specific time duration that has a certain frequency of occurrence. For precipitation frequency, the data set provides the following:

- **Annual Exceedance Probability (AEP, “1-in-N event”)** This is the probability of exceeding a certain amount of precipitation for a specified duration at least once in a given year. Example: The AEP of 1-in-100 means that there is a 1% chance of the amount being exceeded at least once in a given year.
- **Average Recurrence Interval (aka Return Period, “N-year event”)** This is the average time between precipitation events exceeding a certain magnitude for a specified duration. Example: 100-year amount on average occurs every 100 years.

Flood Frequency Terms

Average Recurrence Interval (ARI)

- Average time between floods of a certain size
- Large, infrequent floods have higher ARIs than smaller floods]
- A 200 year ARI flood will occur, on average, every 200 years
- A 200 year ARI flood has a 1-in-200 chance of occurring in a given year

200 year ARI or 0.5% AEP
are different ways to describe the
SAME event

Annual Exceedance Probability (AEP)

- Probability of a certain size flood in a single year
- AEP is the inverse of ARI
- 200 year ARI = 1-in-200 chance of occurring in a given year = $1/200 = 0.005 \times 100 = 0.50\%$ AEP



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Data Utility & Data Access: <https://hdsc.nws.noaa.gov/pfds/>

The data is used for designing, building and operating infrastructure to withstand heavy precipitation and flood forces. Such projects include stormwater management systems, construction site sediment control, culverts, roads, bridges and wastewater treatments plants. The data has also been used in flood plain mapping and regulation of floodplain development.

Atlas Project

- ➔ Locations specific precipitation frequency estimates (1 in XXXX year flood)
- ➔ Can help with flood water mitigation projects

ATLAS 14

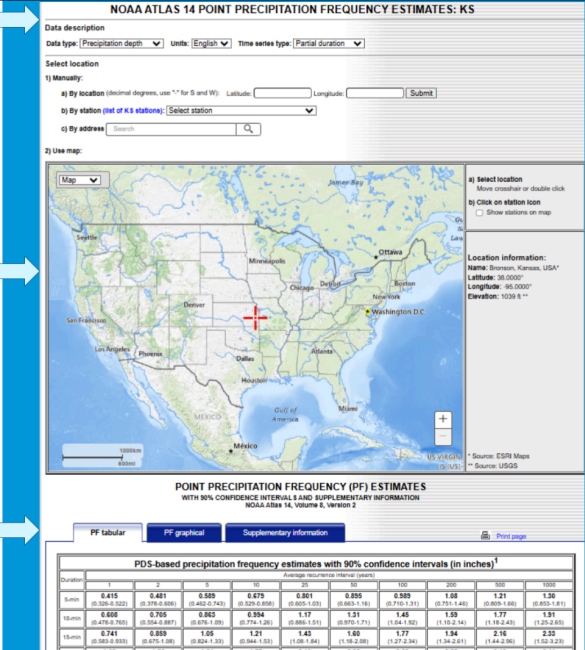



https://hdsc.nws.noaa.gov/pfds/pfds_map_cont.html

Data Request

Choose Location

Output





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Data Error Source Considerations

The data used to compile the extensive database can create output errors including period of record length over which data was collected for a particular site, quality control measures, missing data and spatial coverage of data networks.

Atlas 14 Data Access Job Sheet

1. Go to homepage <https://hdsc.nws.noaa.gov/pfds/>
2. Click on State or Select State Name.
3. At the top of the page under 'Data Description', choose your data type, units & time series type. Details for options are below:

Data Type

Precipitation Depth: Total accumulated rainfall measured in inches over a specific time period for a given location.

Precipitation Intensity: The measured depth of rainfall divided by the time duration (in hours) over which the rainfall occurred. Example: If 2 inches of rain (depth) was measured in 15 minutes (time duration), then the intensity would be 8 inches/hour (2 inches / 0.25 hrs = 8 inches/hr)

Time Series Type

Partial Duration Series (PDS): Time series that includes all precipitation amounts for a specified duration at a given station above a pre-defined threshold regardless of year; it can include more than one event in any particular year. Preferred use for smaller events.

Annual Maximum Series (AMS): Time series of the largest precipitation amounts in a continuous 12-month period (calendar or water year) for a specified duration at a given station. Preferred for extreme events.

4. On the map, click & drag the crosshair to your point of interest. Below the map, there will be 3 tabs with Depth-Duration-Frequency (DDF) estimates in both tabular and graphical form. The tabs are:
 - a. **PF Tabular:** Provides DDF (Depth-Duration-Frequency data if you chose Precipitation Depth as your data type) or IDF (Intensity-Duration-Frequency if you chose Precipitation Intensity as your data type) data. The numbers in parenthesis are precipitation frequency estimates at lower and upper bounds of the 90% confidence interval (5th & 95th percentiles are the tails of the data distribution). The bold number is the median.
 - b. There are 4 different combinations of data you can choose from, including Precipitation Depth or Precipitation Intensity for Data Type and Partial Duration or Annual Maximum for Time Series Type. Examples of each follow:

Data Type: Precipitation Depth

Time Series Type: Partial Duration

Data Description Parameters:

Data Type: **Precipitation Depth** (Accumulation) Time Series Type: **Partial Duration**

PF tabular

PF graphical

Supplementary information

PDS-based precipitation frequency estimates with 90% confidence interval							
Duration	Average recurrence interval (years)						
	1	2	5	10	25	50	100
5-min	0.545 (0.447-0.666)	0.627 (0.514-0.767)	0.760 (0.620-0.932)	0.868 (0.704-1.07)	1.01 (0.790-1.29)	1.12 (0.856-1.45)	1.23 (0.905-1.64)
10-min	0.798 (0.654-0.975)	0.919 (0.752-1.12)	1.11 (0.908-1.36)	1.27 (1.03-1.57)	1.48 (1.16-1.88)	1.65 (1.25-2.13)	1.80 (1.32-2.40)
15-min	0.973 (0.798-1.19)	1.12 (0.917-1.37)	1.36 (1.11-1.66)	1.55 (1.26-1.91)	1.81 (1.41-2.30)	2.01 (1.53-2.59)	2.20 (1.62-2.92)
30-min	1.44 (1.18-1.76)	1.67 (1.35-2.04)	2.04 (1.62-2.54)	2.33 (1.86-2.91)	2.74 (2.18-3.41)	3.04 (2.45-3.74)	3.34 (2.65-4.12)
60-min	1.92 (1.57-2.34)	2.26 (1.81-2.81)	2.74 (2.21-3.33)	3.11 (2.51-3.79)	3.59 (2.91-4.37)	4.07 (3.33-4.92)	4.55 (3.75-5.45)
2-hr	2.40 (1.98-2.90)	2.81 (2.29-3.33)	3.34 (2.74-3.94)	3.81 (3.14-4.48)	4.37 (3.62-5.12)	4.92 (4.11-5.73)	5.45 (4.55-6.35)
3-hr	2.68 (2.23-3.23)	3.09 (2.57-3.61)	3.62 (3.02-4.22)	4.09 (3.42-4.76)	4.65 (3.89-5.41)	5.19 (4.37-6.01)	5.73 (4.83-6.63)
6-hr	3.14 (2.63-3.75)	3.55 (2.97-4.25)	4.34 (3.62-5.21)	5.10 (4.22-6.15)	6.30 (5.11-8.06)	7.34 (5.78-9.51)	8.50 (6.43-11.3)
12-hr	3.57 (3.02-4.24)	4.15 (3.50-4.93)	5.24 (4.40-6.23)	6.26 (5.23-7.49)	7.85 (6.41-9.96)	9.22 (7.30-11.8)	10.7 (8.17-14.1)

1.55" = Median

(1.26-1.91) = 90 percent confidence range

1.26" = 5th percentile

1.19 = 95th percentile

Interpretation

Rainfall accumulation of 1.55" in 15 minutes has a recurrence interval of 10 years at this location.



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Data Type: Precipitation Depth

Time Series Type: Annual Maximum

Data Description Parameters:

Data Type: **Precipitation Depth** (Accumulation) Time Series Type: **Annual Maximum**

PF tabular

PF graphical

Supplementary information

AMS-based precipitation frequency estimates with 90% confidence interval							
Duration	Annual exceedance probability (1/years)						
	1/2	1/5	1/10	1/25	1/50	1/100	
5-min	0.586 (0.480-0.716)	0.743 (0.607-0.911)	0.860 (0.697-1.06)	1.01 (0.787-1.28)	1.12 (0.855-1.45)	1.23 (0.904-1.64)	
10-min	0.858 (0.703-1.05)	1.09 (0.888-1.33)	1.26 (1.02-1.55)	1.48 (1.15-1.88)	1.64 (1.25-2.12)	1.80 (1.32-2.39)	
15-min	1.05 (0.857-1.28)	1.33 (1.08-1.63)	1.54 (1.25-1.89)	1.80 (1.40-2.29)	2.00 (1.53-2.59)	2.20 (1.62-2.92)	
30-min	1.55 (1.27-1.90)	1.99 (1.62-2.44)	2.31 (1.88-2.85)	2.73 (2.12-3.46)	3.03 (2.31-3.91)	3.34 (2.45-4.42)	
60-min	2.05 (1.68-2.51)	2.59 (2.12-3.18)	3.02 (2.45-3.72)	3.61 (2.83-4.62)	4.07 (3.11-5.30)	4.55 (3.35-6.08)	
2-hr	2.55 (2.11-3.09)	3.09 (2.57-3.61)	3.62 (3.02-4.22)	4.09 (3.42-4.76)	4.65 (3.89-5.41)	5.19 (4.37-6.01)	
3-hr	2.84 (2.36-3.43)	3.34 (2.79-3.99)	3.81 (3.14-4.48)	4.37 (3.62-5.12)	4.92 (4.11-5.73)	5.45 (4.55-6.35)	
6-hr	3.34 (2.79-3.99)	3.81 (3.14-4.48)	4.37 (3.62-5.12)	4.92 (4.11-5.73)	5.45 (4.55-6.35)	6.01 (5.01-7.01)	
12-hr	3.85 (3.25-4.57)	4.37 (3.62-5.12)	4.92 (4.11-5.73)	5.45 (4.55-6.35)	6.01 (5.01-7.01)	6.63 (5.53-7.73)	

3.61" = Median

(2.83-4.62) = 90 percent confidence range

2.83" = 5th percentile

4.62 = 95th percentile

Interpretation

60 minute rainfall accumulation of 3.61" is a 1 in 25 year event at this location, or has a 4% chance of occurrence in any given year.



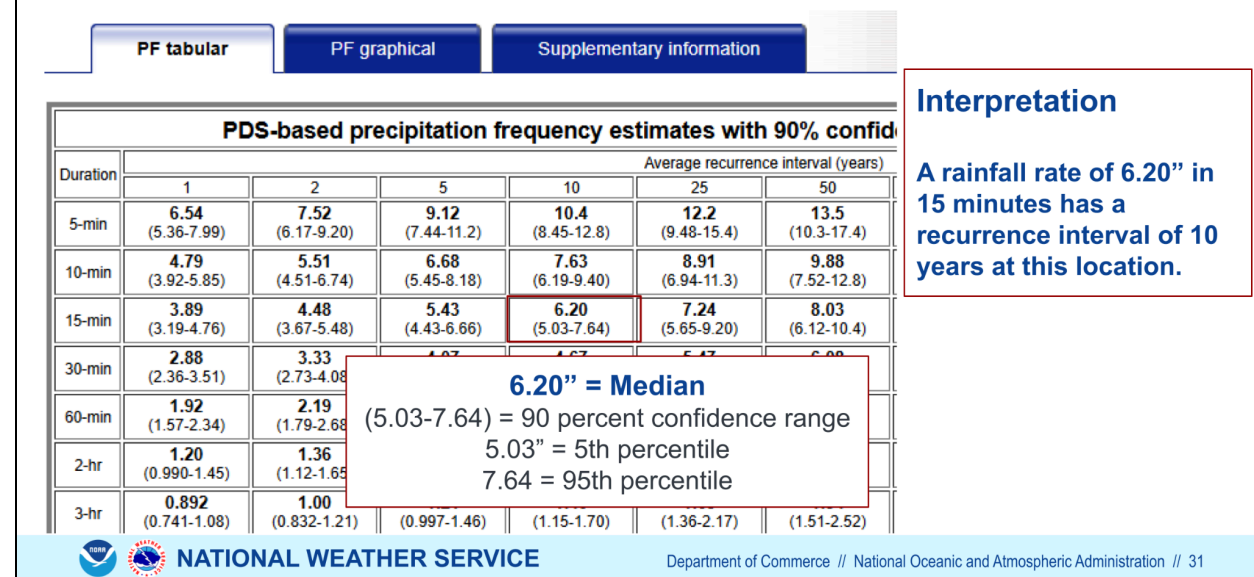
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Data Type: Precipitation Intensity Time Series Type: Partial Duration

Data Description Parameters:

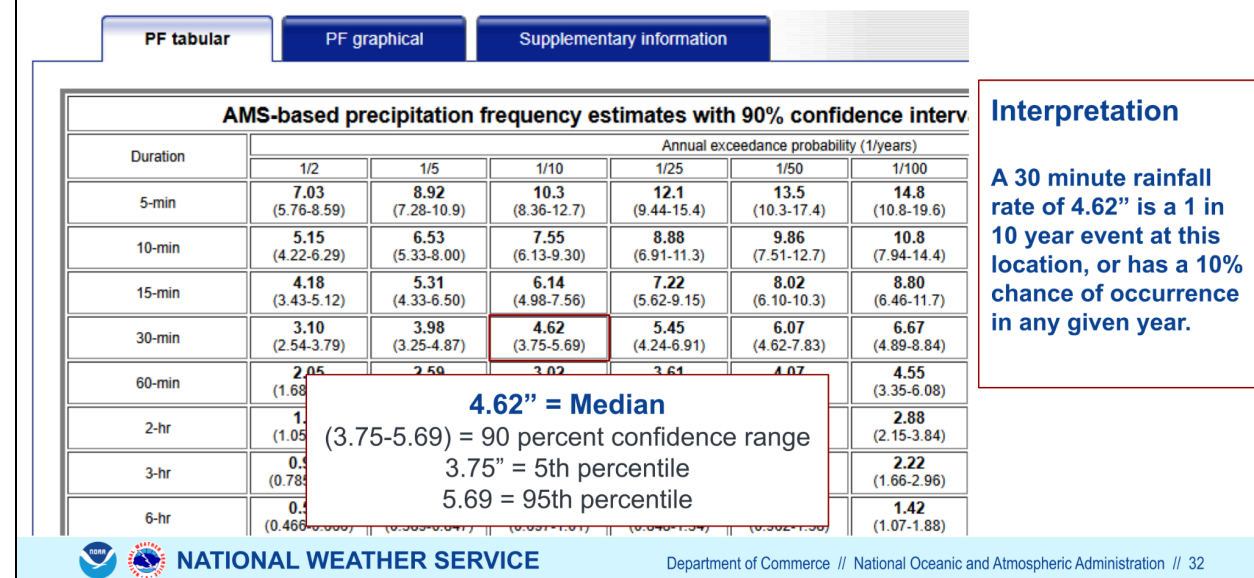
Data Type: **Precipitation Intensity** (Hourly Rate) Time Series Type: **Partial Duration**



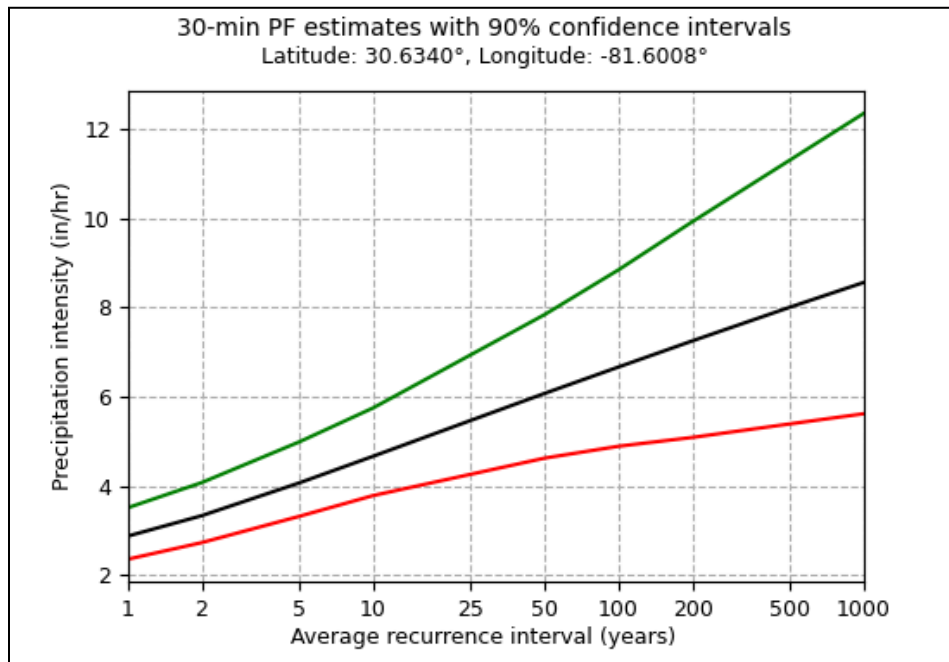
Data Type: Precipitation Intensity Time Series Type: Annual Maximum

Data Description Parameters:

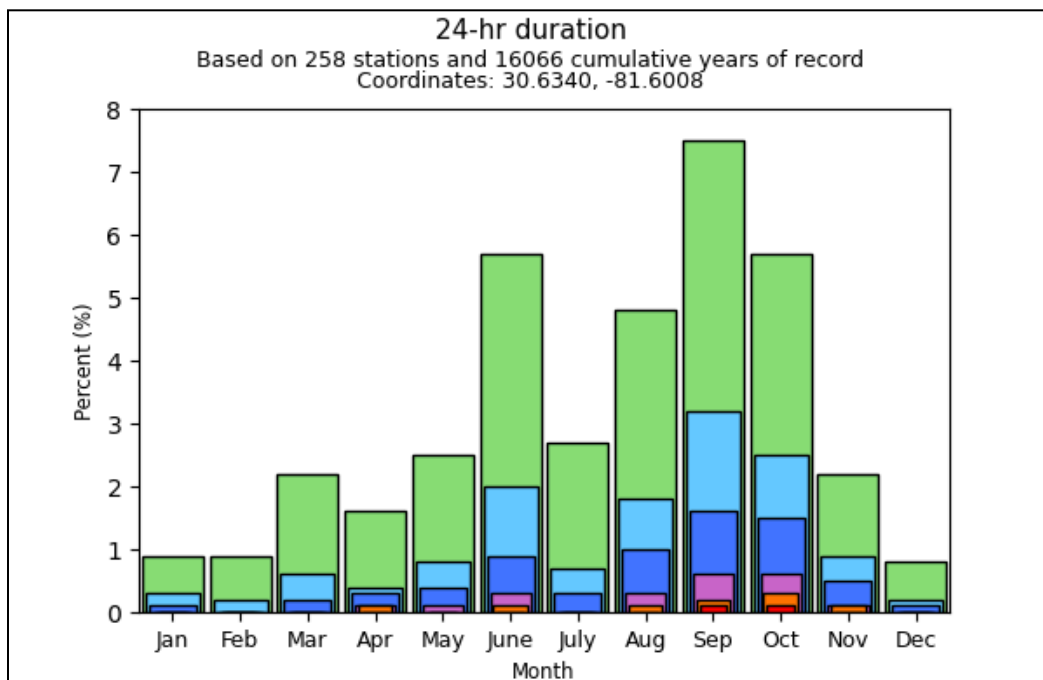
Data Type: **Precipitation Intensity** (Hourly Rate) Time Series Type: **Annual Maximum**



- c. **PF Graphical:** Shows table data as depth-duration-frequency curves. Has an option to display curves for upper & lower bounds of confidence intervals.



- d. **Supplementary Info:** Links to more data, including documentation, time series data and seasonality graphics for that given location.



5. At the bottom of the page you can download tabular data in CSV format. For more detailed information and GIS services, refer to the table on the left side of the website: <https://hdsc.nws.noaa.gov/pfds/>

Q & A

Question: People have various interpretations of the intent of the tables, an "event duration" and applicability to single isolated rain events (e.g., an afternoon thunderstorm) vs a finite period of time during the event (e.g., five minutes of torrential rain during a storm), or a string of days with rain every afternoon; whether the rain is in a single "system" that begins and ends, or in a series of systems that occur over 60 days, since there is a row with the 60-day duration estimates in the tables.

Answer: The data is independent of the context of the weather event. The data does not account for the cause of the precipitation, i.e., whether the rainfall is from a single thunderstorm that impacted the location 1 time in a given 24 hour period or a series of heavy showers that impacted the site several times in one day, for example, if you are looking at 24 hr data.

Question: What is the difference between the ways that the tables are generated based on frequency analyses of "partial duration series" vs "annual maxima series"?

Answer: Partial Duration Series (PDS): Time series that includes all precipitation amounts for a specified duration at a given station above a predefined threshold regardless of year; it can include more than one event in any particular year. Preferred use for smaller events. **Annual Maximum Series (AMS):** Time series of the largest precipitation amounts in a continuous 12-month period (calendar or water year) for a specified duration at a given station. Preferred for extreme events. Note that for the rarest events, the average recurrence intervals are roughly equal to the inverse of the annual exceedance probabilities (e.g. an event with an annual exceedance probability of 1/100 will roughly equal the event with a 100 year average recurrence interval).

Resources

YouTube Project Video: [NOAA Atlas 14 Precipitation Frequency Atlas of the U.S](#)

Project Term Glossary: https://www.weather.gov/owp/hdsc_glossary

Web: <https://www.weather.gov/owp/hdsc>

Questions/Comments: HDSC.questions@noaa.gov