

Rainfall sources for design

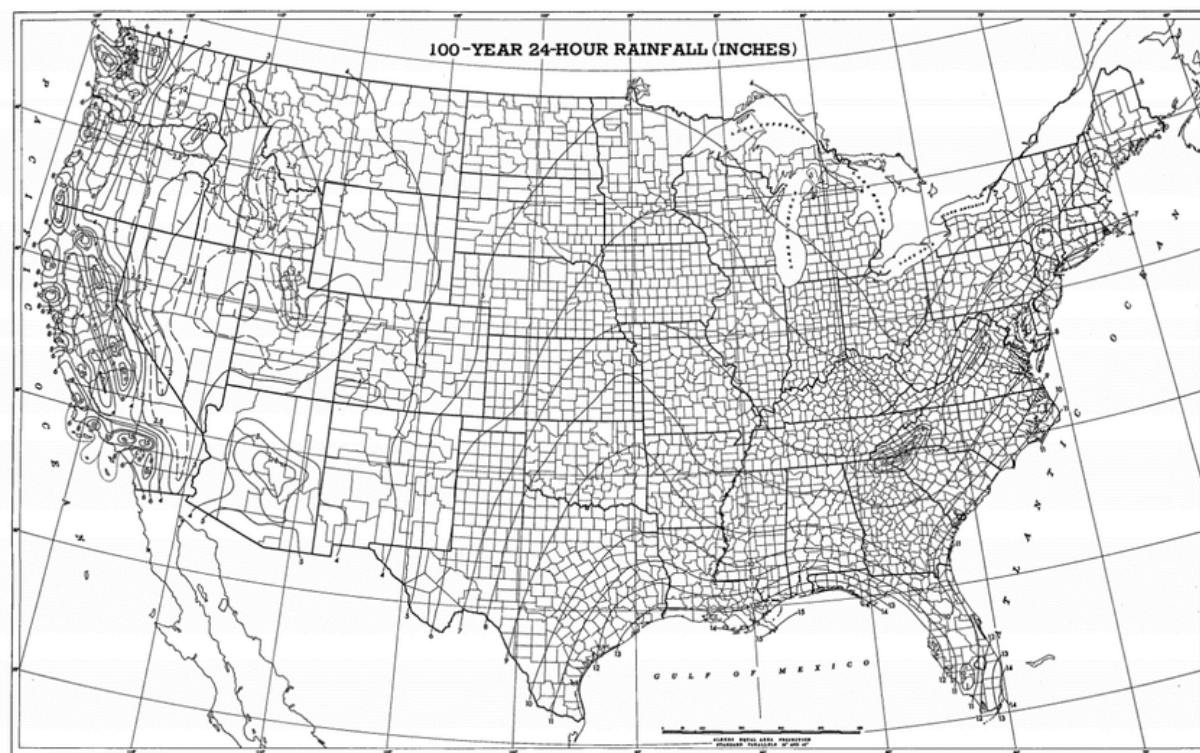
David Knipe

Division of Water

Projects requiring rainfall information

- Stormwater management (IDEM / local stormwater)
- Floodplain management (DNR and/or FEMA)
- Culvert / Bridge design (INDOT or local highway)
- Agriculture Applications (ditch maintenance or farm crossings)
- Septic / Sewer / CSO management (State / Local Dept Health)
- Dam Safety (DNR / USACE / FERC)

TP 40 (1961)



U.S. DEPARTMENT OF COMMERCE

WEATHER BUREAU

TECHNICAL PAPER NO. 40

RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and
Return Periods from 1 to 100 Years



WASHINGTON, D.C.
May 1961
Reprinted and Reprinted January 1963

Huff & Angel (1992)

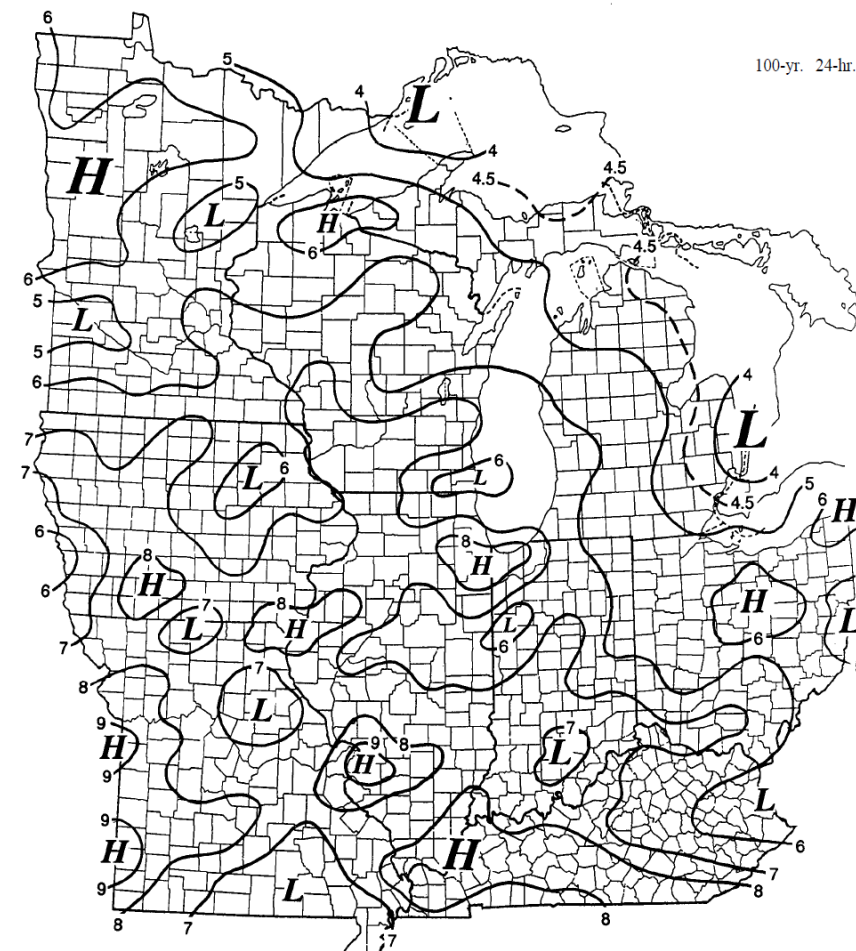
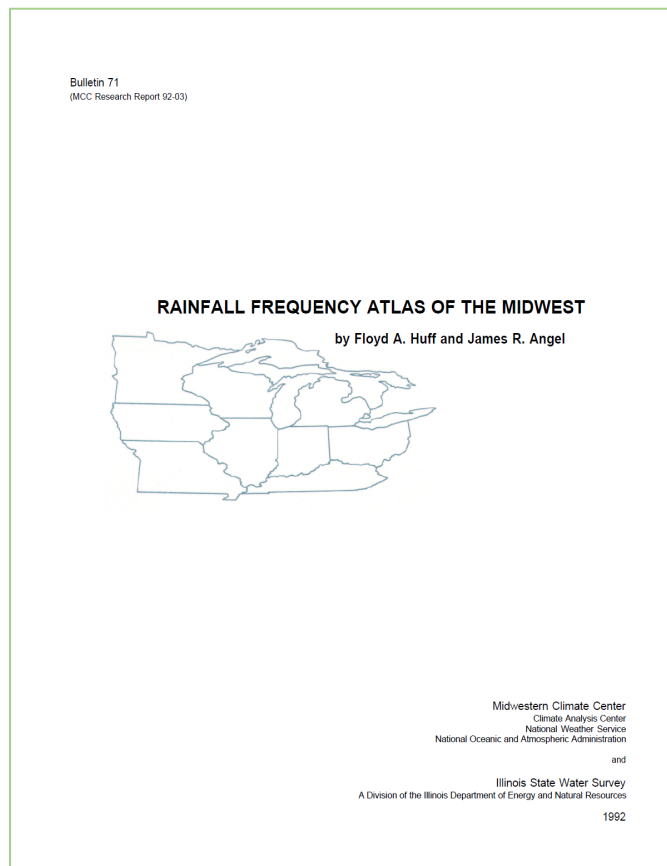


Figure 6. Concluded

Atlas 14

NOAA's National Weather Service
Hydrometeorological Design Studies Center
Precipitation Frequency Data Server (PFDS)

Home Site Map Organization Search ☒ NWS ☐ All NOAA Go

General Information
Homepage
Progress Reports
FAQ
Glossary

Precipitation Frequency
Data Server
GIS Grids
Maps
Time Series
Temporals
Documents

Probable Maximum
Precipitation
Documents

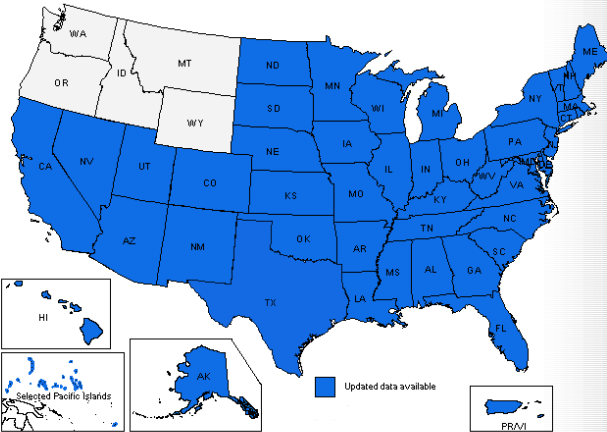
Miscellaneous
Publications
Storm Analysis
Record Precipitation

Contact Us
Inquiries

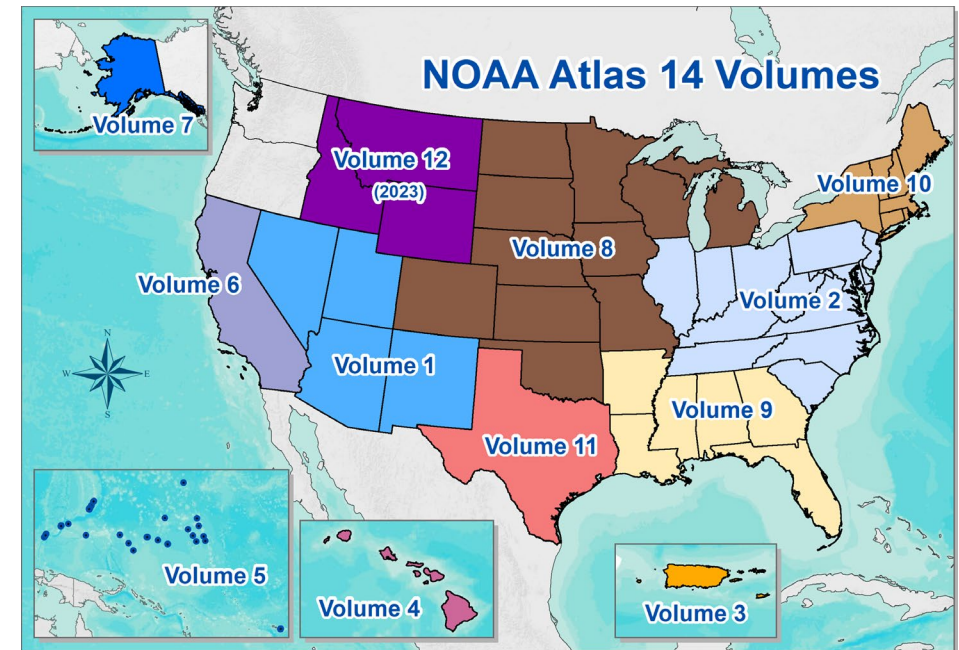
USA.gov

Precipitation Frequency Data Server (PFDS)

State:



The Precipitation Frequency Data Server (PFDS) is a point-and-click interface developed to deliver NOAA Atlas 14 precipitation frequency estimates and associated information. Upon clicking a state on the map above or selecting a state name from the drop-down menu, an interactive map of that state will be displayed. From there, a user can identify a location for which precipitation frequency estimates are needed.



Atlas 14


POINT PRECIPITATION FREQUENCY (PF) ESTIMATES WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION NOAA Atlas 14, Volume 2, Version 3

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: IN

Data description
Data type: Precipitation depth Units: English Time series type: Partial duration

Select location
1) Manually:
a) By location (decimal degrees, use "-" for S and W): Latitude: Longitude: Submit
b) By station (list of IN stations): Select station
c) By address Search

2) Use map (if ESRI interactive map is not loading, try adding the host: <https://js.arcgis.com/> to the firewall, or contact us at hdsc.questions@noaa.gov):

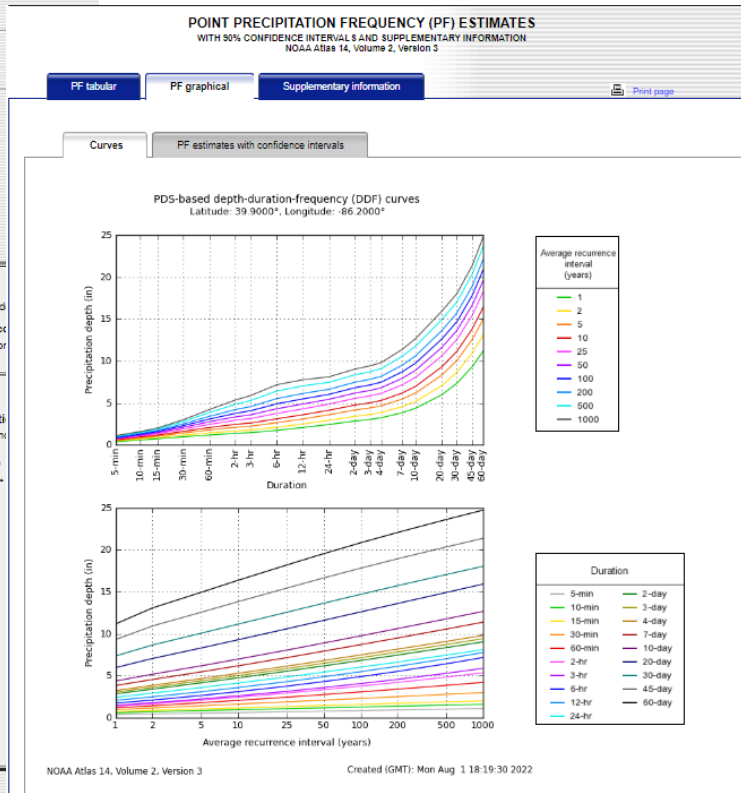


a) Select location
Move crosshair or d
b) Click on station icon
☐ Show stations or

Location information
Name: Indianapolis, IN
Latitude: 39.9000°
Longitude: -86.2000°
Elevation: 827.94 ft **

* Source: ESRI Maps
** Source: USGS


**POINT PRECIPITATION FREQUENCY (PF) ESTIMATES
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 2, Version 3**



PF tabular

PF graphical

Supplementary information

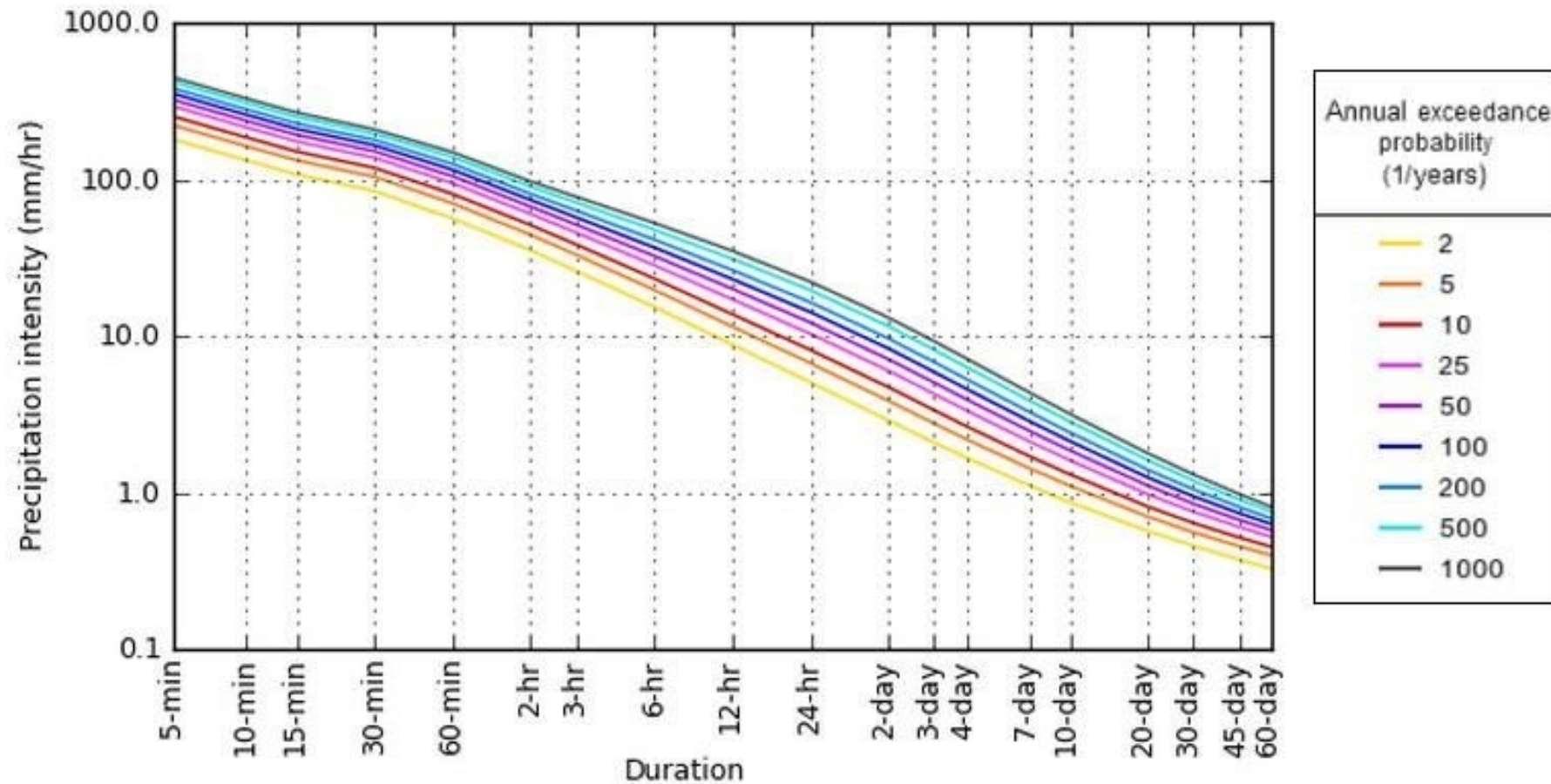
 [Print page](#)

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)¹

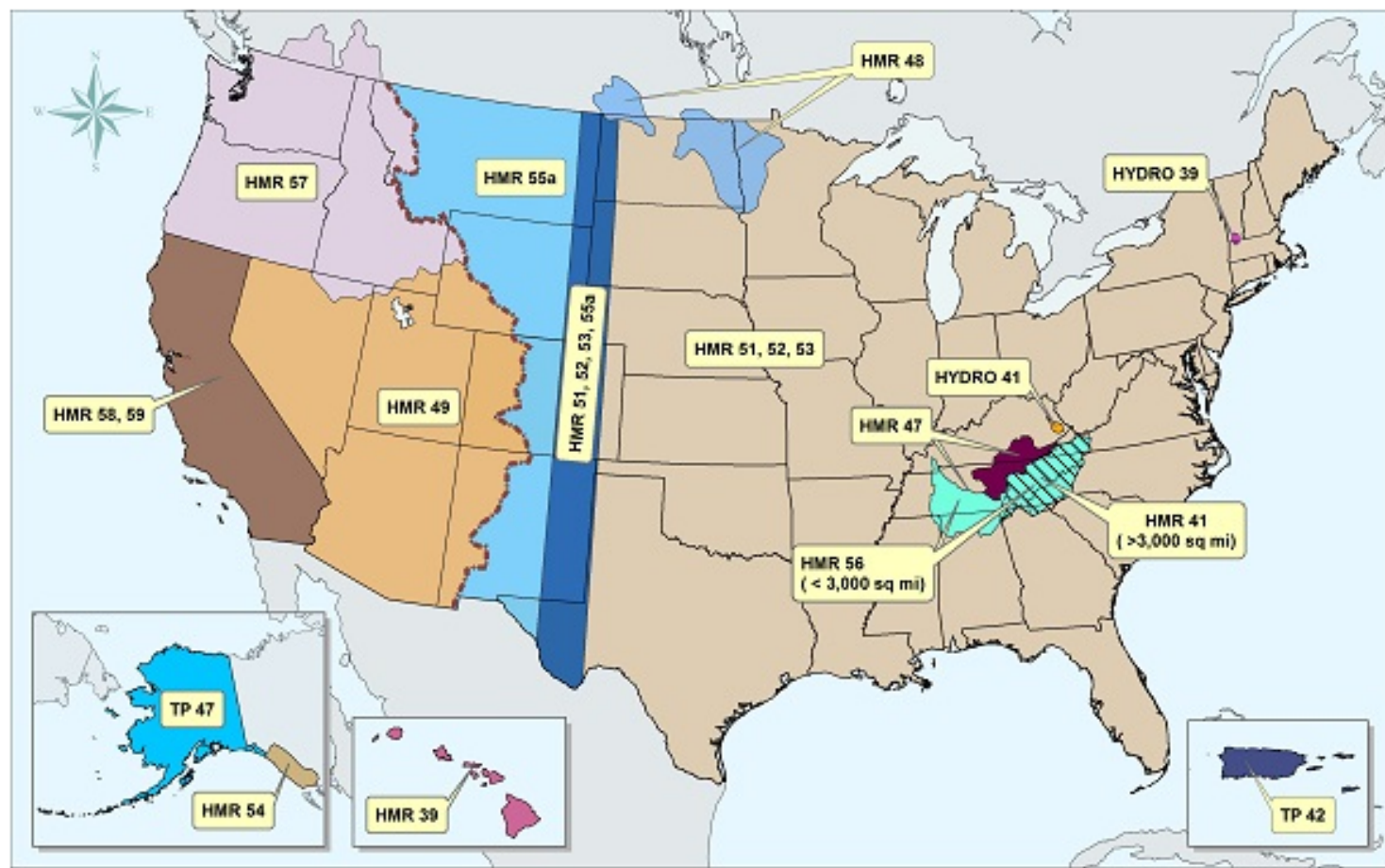
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.384 (0.347-0.428)	0.456 (0.413-0.508)	0.545 (0.492-0.603)	0.617 (0.555-0.682)	0.708 (0.633-0.783)	0.782 (0.693-0.887)	0.853 (0.750-0.947)	0.927 (0.807-1.03)	1.03 (0.880-1.15)	1.10 (0.932-1.24)
10-min	0.597 (0.539-0.662)	0.713 (0.644-0.789)	0.848 (0.755-0.938)	0.952 (0.856-1.05)	1.08 (0.988-1.20)	1.19 (1.05-1.31)	1.28 (1.13-1.43)	1.38 (1.20-1.54)	1.51 (1.29-1.80)	1.60 (1.36-1.81)
15-min	0.732 (0.651-0.811)	0.871 (0.788-0.955)	1.04 (0.939-1.15)	1.17 (1.05-1.29)	1.34 (1.20-1.48)	1.47 (1.30-1.63)	1.60 (1.40-1.77)	1.72 (1.50-1.92)	1.88 (1.61-2.11)	2.00 (1.70-2.26)
30-min	0.968 (0.875-1.07)	1.17 (1.05-1.29)	1.43 (1.29-1.58)	1.63 (1.45-1.80)	1.89 (1.69-2.09)	2.10 (1.88-2.33)	2.30 (2.02-2.58)	2.51 (2.19-2.80)	2.79 (2.39-3.13)	3.00 (2.54-3.39)
60-min	1.18 (1.07-1.31)	1.43 (1.29-1.58)	1.79 (1.61-1.98)	2.07 (1.88-2.26)	2.45 (2.19-2.71)	2.76 (2.45-3.08)	3.08 (2.71-3.42)	3.41 (2.97-3.80)	3.86 (3.31-4.41)	4.22 (3.57-4.75)
2-hr	1.39 (1.25-1.54)	1.68 (1.52-1.85)	2.11 (1.90-2.33)	2.46 (2.21-2.72)	2.94 (2.63-3.25)	3.35 (2.98-3.70)	3.77 (3.29-4.24)	4.21 (3.63-4.88)	4.84 (4.09-5.41)	5.36 (4.45-6.02)
3-hr	1.47 (1.33-1.64)	1.78 (1.61-1.97)	2.24 (2.02-2.48)	2.62 (2.35-2.90)	3.15 (2.81-3.48)	3.60 (3.17-3.98)	4.07 (3.55-4.51)	4.58 (3.93-5.09)	5.30 (4.46-6.04)	5.89 (4.87-6.84)
6-hr	1.74 (1.58-1.94)	2.11 (1.92-2.34)	2.66 (2.41-2.94)	3.11 (2.80-3.44)	3.76 (3.35-4.15)	4.31 (3.80-4.75)	4.90 (4.28-5.45)	5.52 (4.73-6.12)	6.43 (5.39-7.15)	7.18 (5.89-8.05)
12-hr	2.07 (1.89-2.29)	2.49 (2.28-2.75)	3.10 (2.82-3.41)	3.60 (3.27-3.96)	4.30 (3.87-4.72)	4.88 (4.34-5.35)	5.49 (4.84-6.03)	6.13 (5.33-6.78)	7.03 (5.90-7.82)	7.77 (6.50-8.89)
24-hr	2.44 (2.28-2.62)	2.93 (2.74-3.15)	3.61 (3.37-3.87)	4.14 (3.86-4.44)	4.86 (4.52-5.21)	5.44 (5.04-5.82)	6.03 (5.57-6.45)	6.63 (6.10-7.10)	7.46 (6.81-8.00)	8.11 (7.36-8.71)
3-day	2.85 (2.67-3.05)	3.41 (3.19-3.65)	4.17 (3.90-4.45)	4.76 (4.44-5.07)	5.55 (5.17-5.93)	6.18 (5.73-6.61)	6.82 (6.30-7.29)	7.47 (6.88-7.99)	8.36 (7.64-8.95)	9.04 (8.22-9.71)
7-day	3.05 (2.80-3.25)	3.64 (3.42-3.89)	4.42 (4.15-4.72)	5.03 (4.71-5.35)	5.85 (5.47-6.23)	6.50 (6.08-6.92)	7.15 (6.65-7.62)	7.82 (7.24-8.34)	8.73 (8.03-9.32)	9.43 (8.63-10.1)
30-day	3.24 (3.05-3.45)	3.87 (3.64-4.12)	4.67 (4.40-4.97)	5.30 (4.98-5.63)	6.15 (5.77-6.53)	6.81 (6.38-7.24)	7.49 (6.99-7.95)	8.17 (7.60-8.69)	9.09 (8.41-9.68)	9.81 (9.04-10.4)
45-day	3.84 (3.61-4.09)	4.56 (4.29-4.85)	5.47 (5.14-5.83)	6.19 (5.81-6.59)	7.17 (6.70-7.62)	7.93 (7.41-8.43)	8.71 (8.11-9.26)	9.50 (8.82-10.1)	10.6 (9.77-11.2)	11.4 (10.5-12.1)
60-day	4.38 (4.12-4.65)	5.19 (4.89-5.53)	6.19 (5.83-6.60)	6.99 (6.57-7.45)	8.06 (7.57-8.58)	8.90 (8.34-9.45)	9.76 (9.12-10.4)	10.6 (9.89-11.3)	11.8 (10.9-12.5)	12.7 (11.7-13.5)
10-day	5.98 (5.65-6.34)	7.06 (6.67-7.49)	8.31 (7.85-8.82)	9.30 (8.76-9.85)	10.6 (10.0-11.2)	11.6 (10.9-12.3)	12.6 (11.8-13.3)	13.6 (12.7-14.4)	14.9 (13.9-15.8)	15.9 (14.7-16.9)
20-day	7.36 (6.97-7.79)	8.67 (8.20-9.17)	10.1 (9.52-10.7)	11.2 (10.5-11.8)	12.6 (11.9-13.3)	13.7 (12.8-14.4)	14.7 (13.8-15.5)	15.7 (14.7-16.8)	17.1 (15.9-18.1)	18.0 (16.8-19.1)
30-day	9.32 (8.85-9.84)	10.9 (10.4-11.5)	12.6 (11.9-13.3)	13.8 (13.1-14.5)	15.5 (14.8-16.3)	16.7 (15.7-17.5)	17.8 (16.8-18.8)	18.9 (17.8-19.9)	20.3 (19.1-21.5)	21.4 (20.0-22.6)
45-day	11.2 (10.5-11.8)	13.1 (12.4-13.8)	15.0 (14.2-15.7)	16.4 (15.5-17.2)	18.2 (17.2-19.1)	19.6 (18.5-20.5)	20.8 (19.7-21.9)	22.1 (20.8-23.2)	23.6 (22.2-24.9)	24.7 (23.2-26.1)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

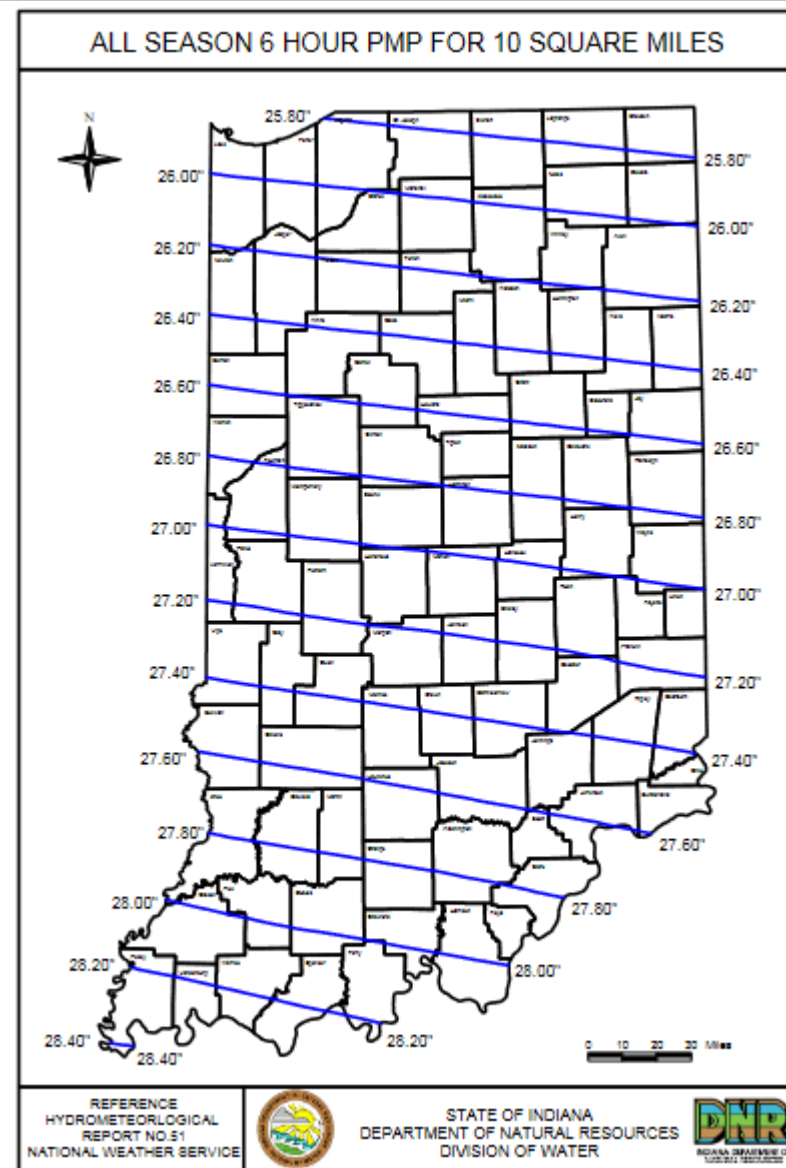
IDF curves from Atlas 14



Probable Maximum Precipitation

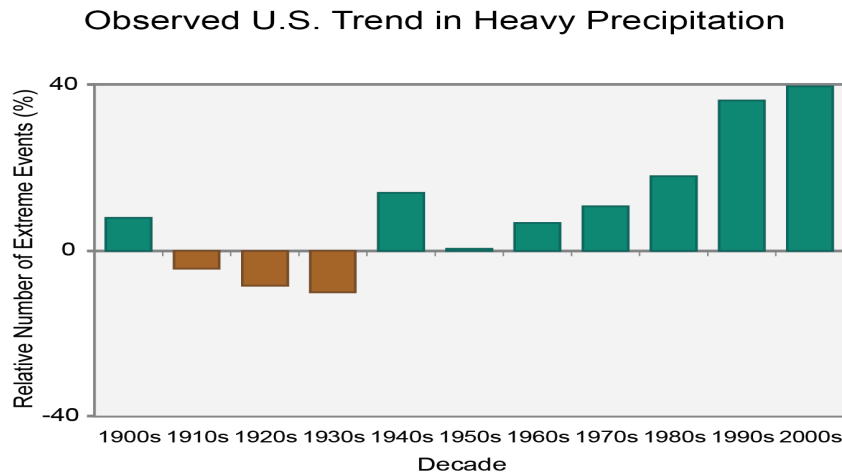


https://www.weather.gov/owp/hdsc_pmp



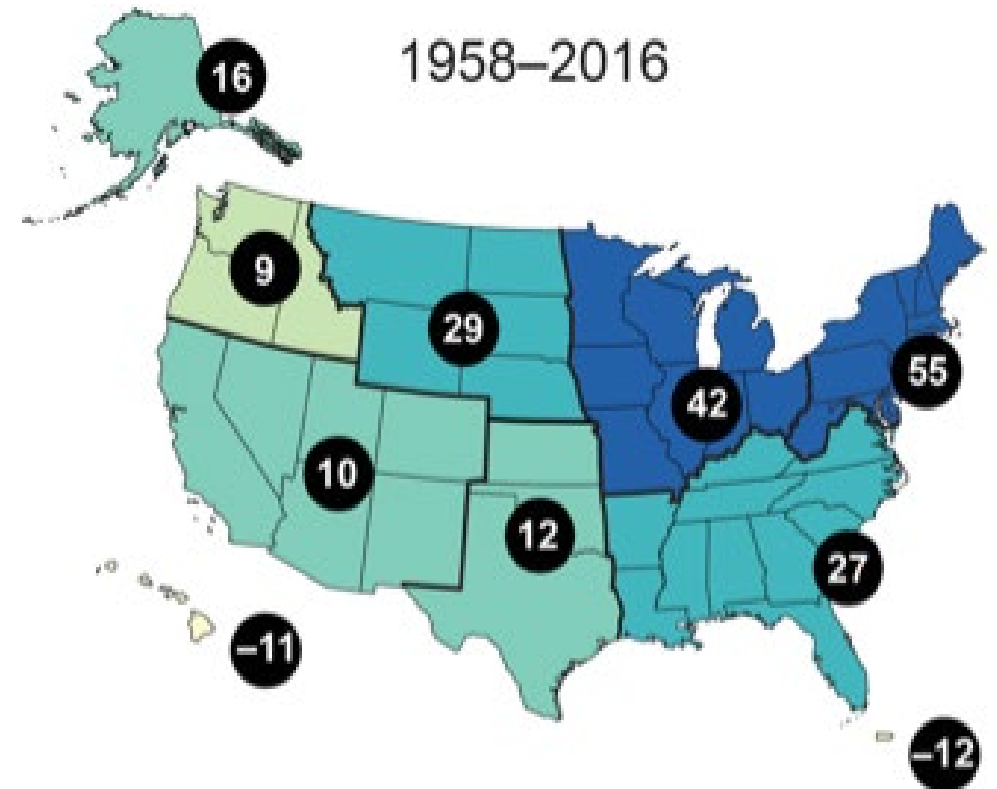
Changes in Rainfall Patterns

Observed Decadal Trend of Heavy Precipitation (2-day, 5-year RI) in Midwest (1901-2012 compared with 1901-1960)



Source: USGRP, 2014, Third National Climate Assessment (adapted from Kunkel et al. 2013)

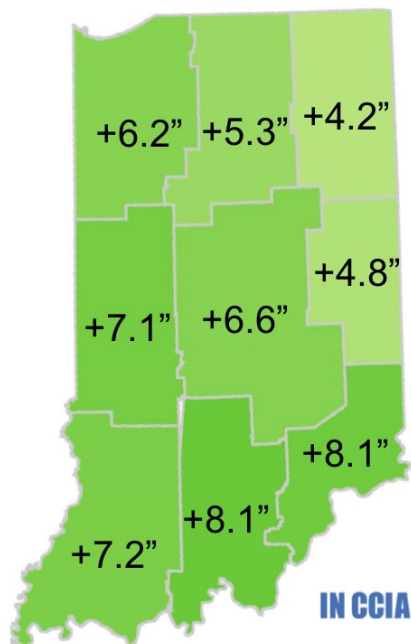
Observed % Change in Total Annual Precipitation Falling in the Heaviest 1% of Events (1958 – 2016)



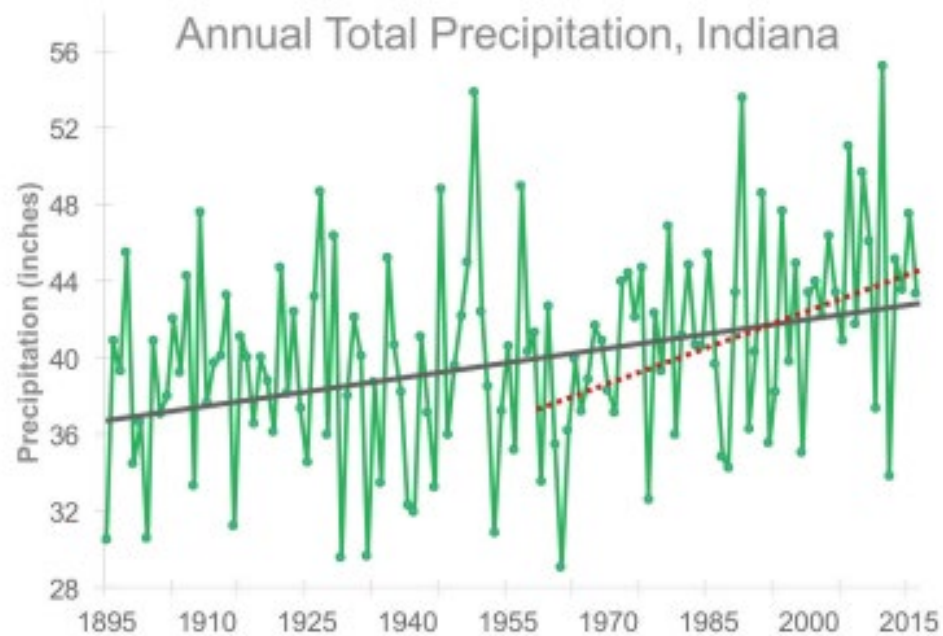
Source: USGRP, 2018, Fourth National Climate Assessment.

Changes in Rainfall Patterns

Annual Average Precipitation on the Rise



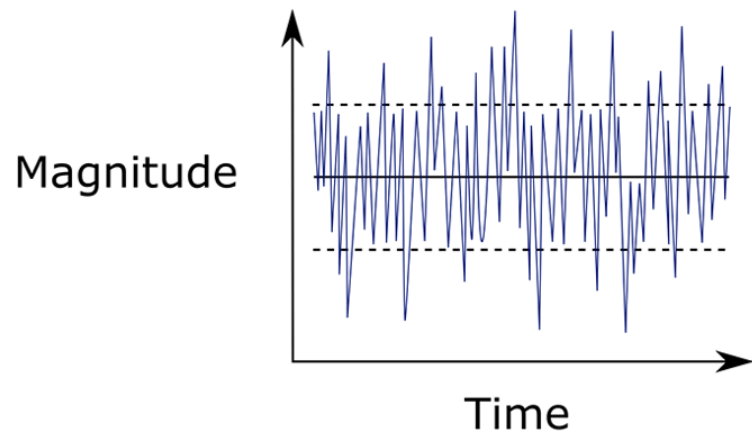
Change in annual average precipitation
based on linear trend between 1895 to 2019



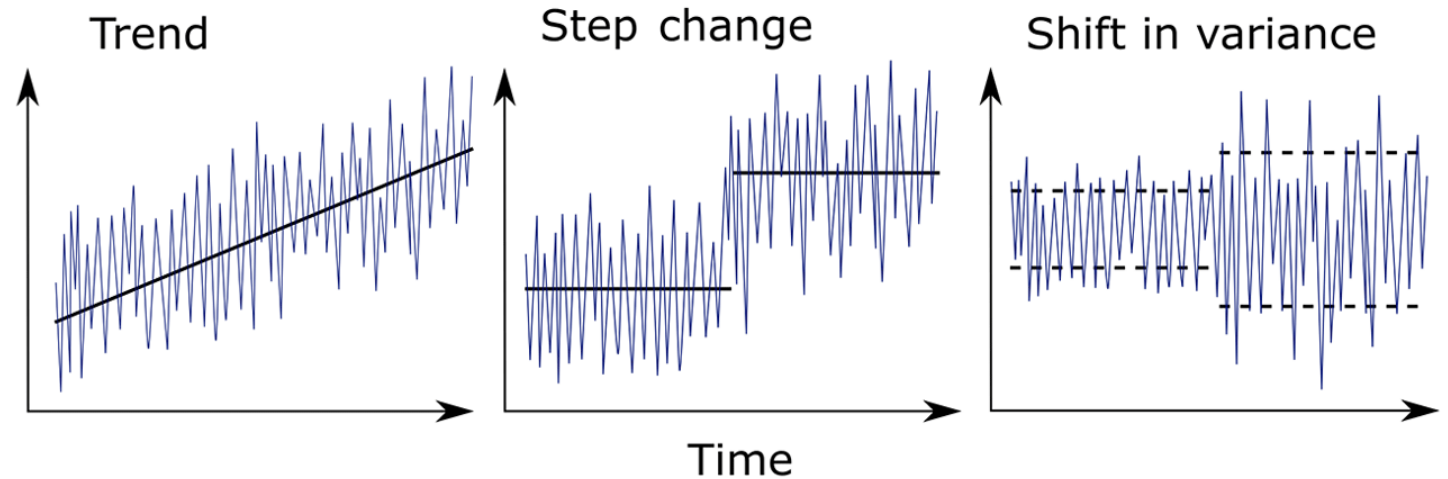
NOAA Climate at a Glance Database.

Nonstationary trends in rainfall

(a) Stationary

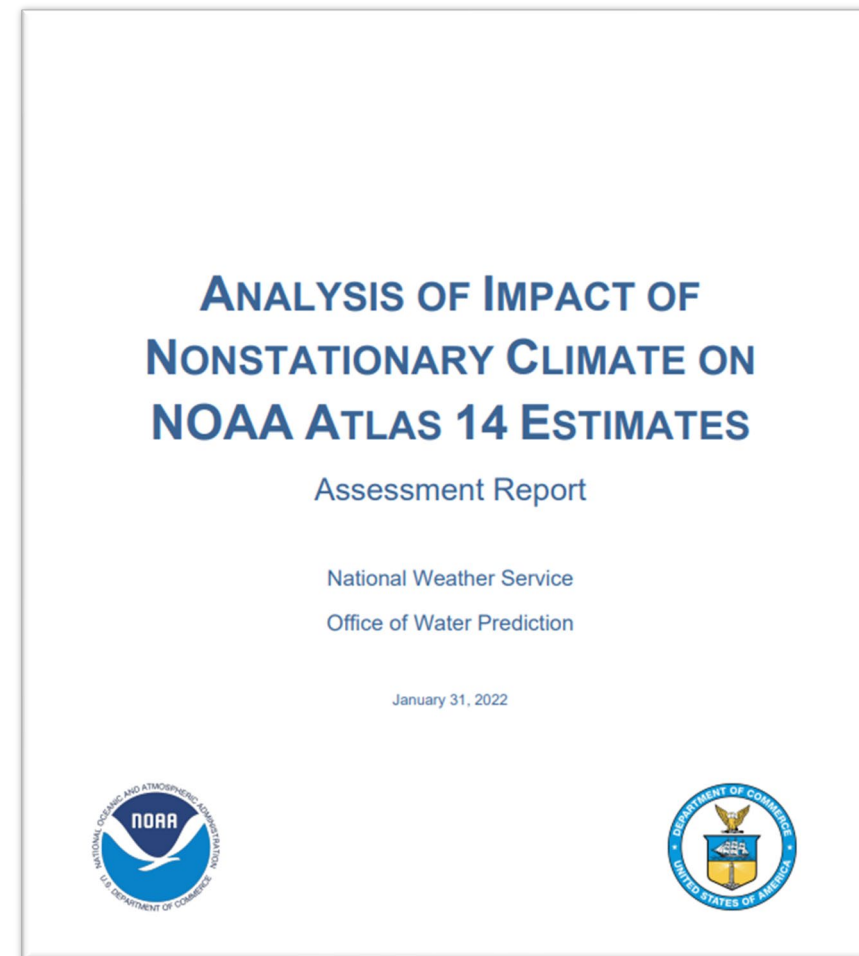


(b) Nonstationary



Nonstationary climate report from NOAA

- Teams from Penn State, University of Illinois, University of Wisconsin and NOAA
- Phase 1: Assess the suitability of state-of-the-science methodologies for nonstationary precipitation frequency analysis, identify the most suitable method relevant to NOAA Atlas 14, and test the proposed methodology on a pilot project area
- Phase 2: Evaluate the feasibility of incorporating downscaled climate projections into frequency analysis and, if applicable, to recommend which downscaled climate projections could be used for future products
- Recommendations will drive future studies and rainfall models



https://hdsc.nws.noaa.gov/hdsc/files25/NA14_Assessment_report_202201v1.pdf

New Legislation

- The FLOODS Act (S. 558) authorizes \$3.5 million/year from FY 2022-2030 for NOAA to update Atlas 14 nationwide.
- Passed the Senate Sept 2021, not acted on in the house yet.
- The "**Flood Level Observation, Operations, and Decision Support Act**" (HR 1438) has been introduced in the house, is similar to S. 558 but differing in details. This bill is awaiting likely action, either by itself or in conjunction with S. 558.
- The PRECIP Act (HR 1437 and S. 3053) is an authorization for a two year study by National Academy of Sciences / report to NOAA on updates and improvements to methodologies for calculation of Probable Maximum Precip.
- Passed the House in May, awaiting action in the Senate
- The Infrastructure Investment and Jobs Act (enacted November 2021) including an appropriation (\$492 million) to start working on Atlas 14 updates – Starting in the Northwest and Mid-Atlantic.

Rainfall sources for design

David Knipe

Division of Water