

NOAA Atlas 15: Climate Informed NOAA Precipitation Frequency Atlas of the United States

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January 29, 2024

Acknowledgements: OWP HDSC Team, IBSS, RTI, Lago, CIROH, NC State, Univ. of Wisconsin, Univ. of Illinois, Penn State, Oregon State, DOT FHWA



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PREDICTION

NOAA Atlas 15: Climate Informed NOAA Precipitation Frequency Atlas of the United States

Overview

Sandra Pavlovic, NOAA/NWS Office of Water Prediction

Statistical Methodology and Historical Data Repository

Debbie Martin, RTI International

Climate Projections and Scientific Challenges

*Kenneth E. Kunkel, North Carolina Institute for Climate
Studies, North Carolina State Univ., Asheville, NC*

Extreme Precipitation

**2024 American Meteorological
Society Annual Meeting**

*Joint between the 38th Conference on
Hydrology and the 37th Conference on
Climate Variability and Change*



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PREDICTION

January 29, 2024

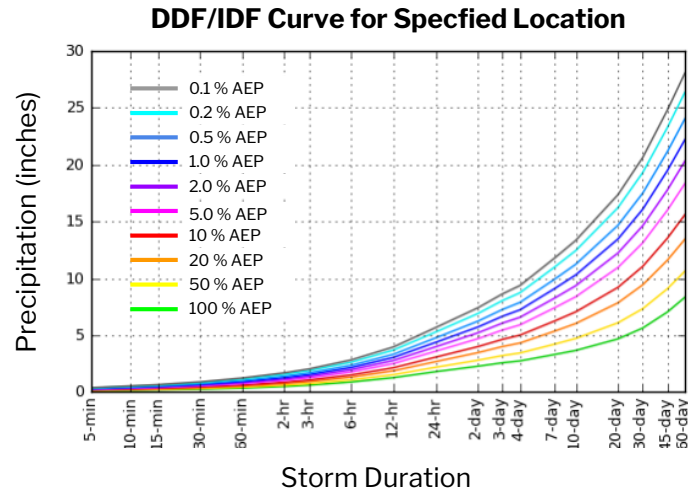


Cooperative Institute for Research to Operations in Hydrology

committed to advancing research and enhancing collaboration in support of NOAA's capacity to provide actionable water resource information for forecasts, watches, warnings and related product.

What are Precipitation Frequency Estimates?

- Precipitation amounts for a specified storm duration and an annual exceedance probability (or average annual recurrence interval).
- Precipitation **D**epth (or **I**ntensity) for a specified **D**uration and **F**requency (ARI or AEP).



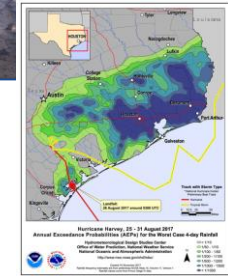
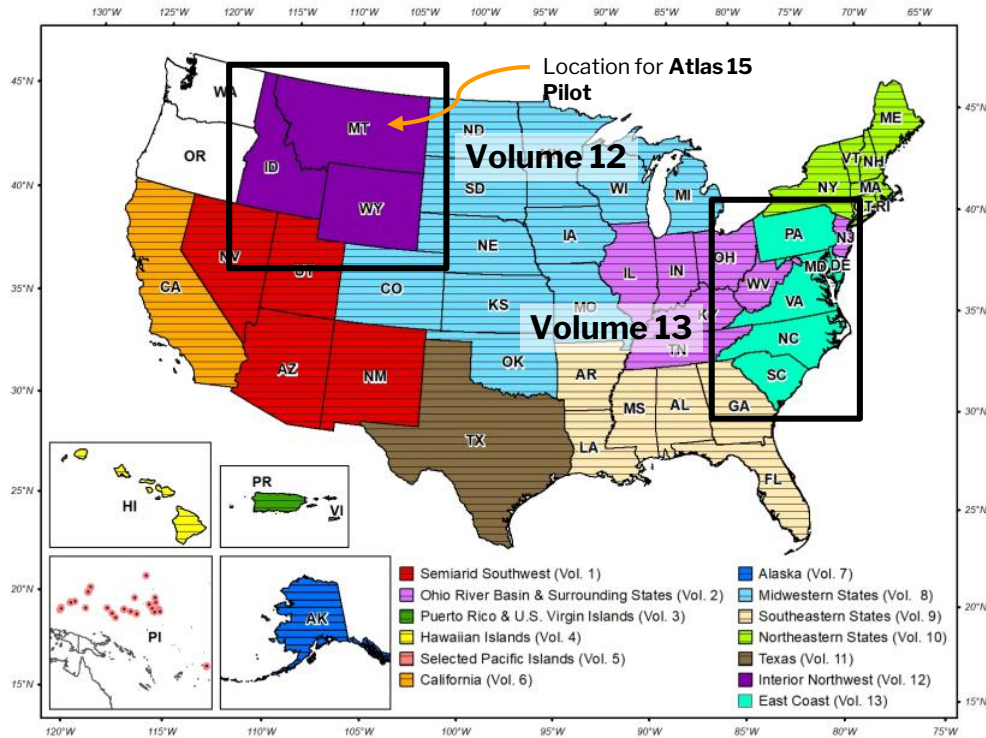
Depth-Duration-Frequency (DDF) curves

Intensity-Duration-Frequency (IDF) curves

How much precipitation would be expected for a storm event that is 10 days in duration and has a 1% chance of being observed?

How rare is it to observe 5 inches of precipitation over 2 days?

NOAA Atlas 14 Product Suite



Majority of built infrastructure leverages precipitation frequency data for design and planning under federal, state and local regulations

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

Volumes

- Volume 1 (2004): Semi arid Southwest
- Volume 11 (2018): Texas
- **Volume 12 (2024)** : Montana, Idaho, and Wyoming
- **Volume 13 (2025)**: Mid-Atlantic

Assumption: stationary statistics

NOAA Atlas 14: The Generation of Authoritative Data Requires a Rigorous Development Process and Quality Control

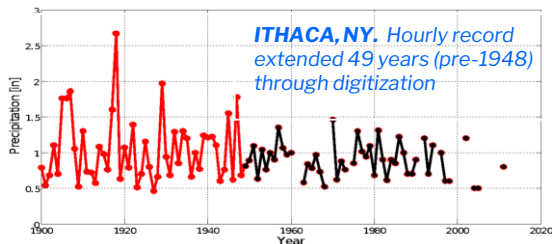
Data

- Period of record
- Missing data
- Quality Control
- Spatial Coverage

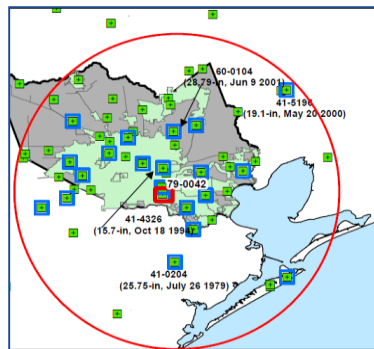
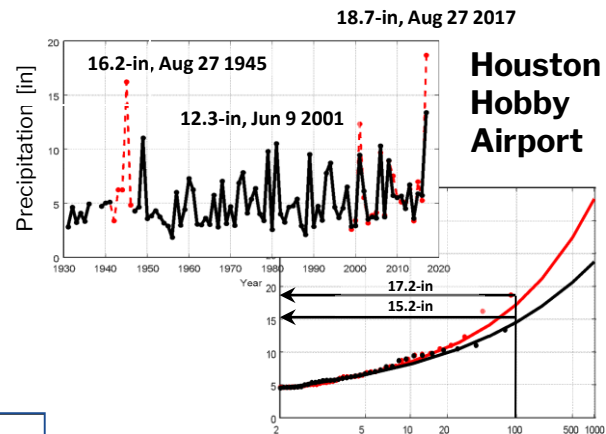
Methods

- Distribution selection
- Parameterization method
- Stationary vs non-stationary methodology
- Regionalization
- Interpolation
- Optimization & consistency checks

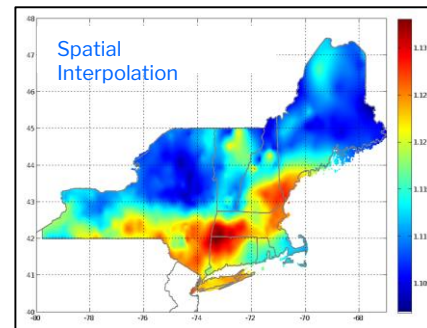
Missing data and digitization



1% AEP
1.6 vs 2.5 in

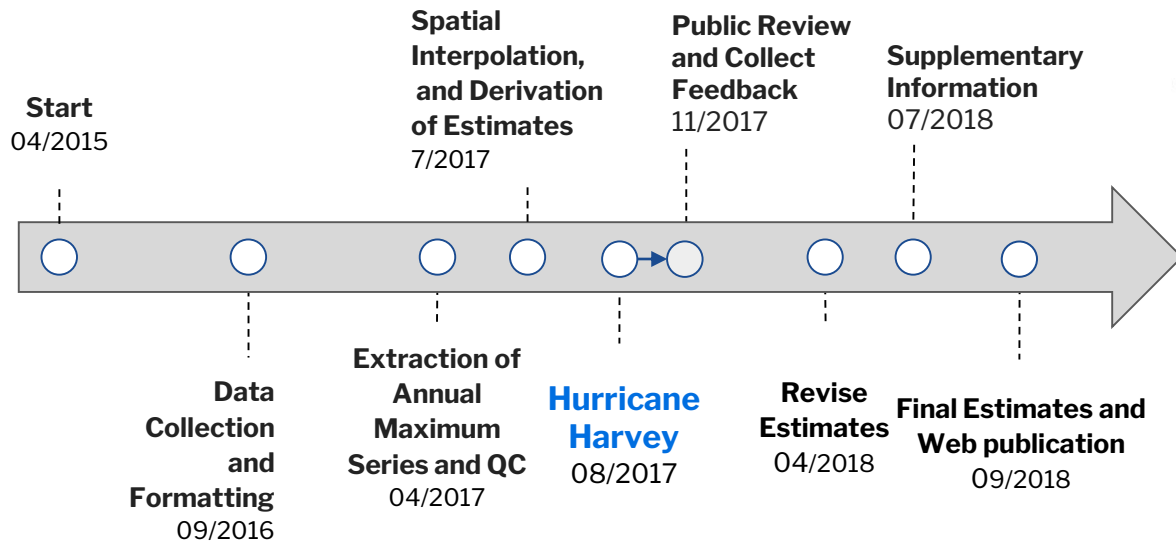


Regionalization



NOAA Atlas 14: The Generation of Authoritative Data Requires Public Review

During the production of Atlas 14 Volume 11 (Texas), the **quality control and public review process was essential** to delivering a reliable precipitation frequency product. Stakeholders deemed it necessary to include data from **Hurricane Harvey**, which **increased the product's value**.

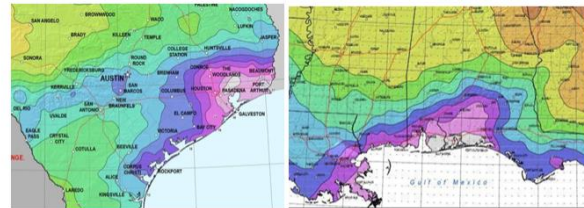


An excerpt from:

[Atlas 14 Volume 11 Appendix A.4. Peer review comments and responses](#)

6.3.8. There's absolutely no basis why Houston should be 17-18 while El Campo is 13-14. Or why Austin has a local maxima probably related to the high rain gage density there.

In fact, these spurious local maxima can be seen elsewhere too. For example, southern Alabama.



The only way to fix these issue would involve a substantial re-working of the whole method. The current method is simply: Precipitation Frequency Curve (PF) = function (gages within 50 or 100 miles around a gage of interest). Whereas the more rigorous method should be: PF Curve = function (gages within 50 or 100 miles, topography, distance from coastline, local/regional atmospheric enhancement). If you were to do that, the whole coast from Corpus Christ through Wilmington or Cape Hatteras would probably be 16+ inches for a 100-year 24-hour event, a significant increase over current values.

In NA14 we rely on regional frequency approaches to calculate estimates at one station. We use a so-called region-of-influence approach where each station has its own region with a potentially

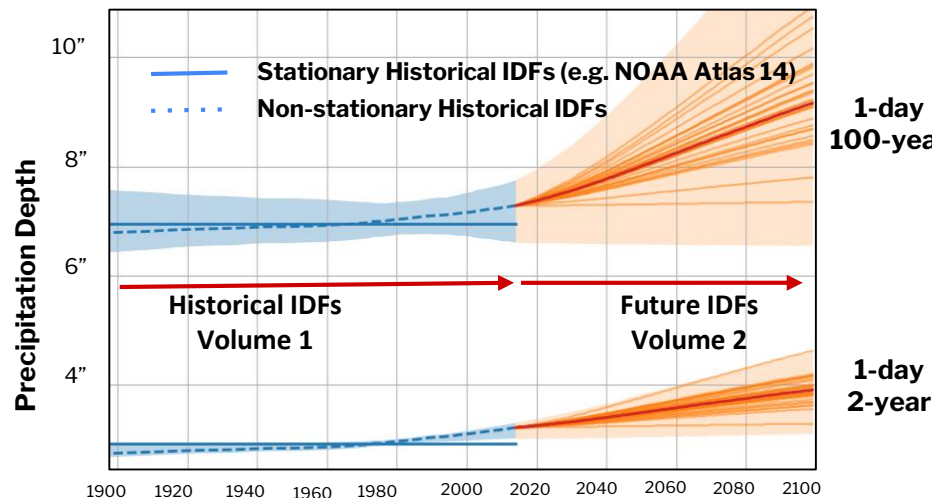
Public informed on development through
[HDSC Quarterly Progress Reports](#)

NOAA Atlas 15 Methodology Accounting for Nonstationarity

["Analysis Of Impact Of Nonstationary Climate On NOAA Atlas 14 Estimates: Assessment Report"](#)

Objective 1: Assess the suitability of state-of-the-science methodologies for nonstationary precipitation frequency analysis.

Objective 2: Evaluate downscaled global projections' ability to mimic extreme precipitation at the temporal and spatial scales needed for the engineering application.

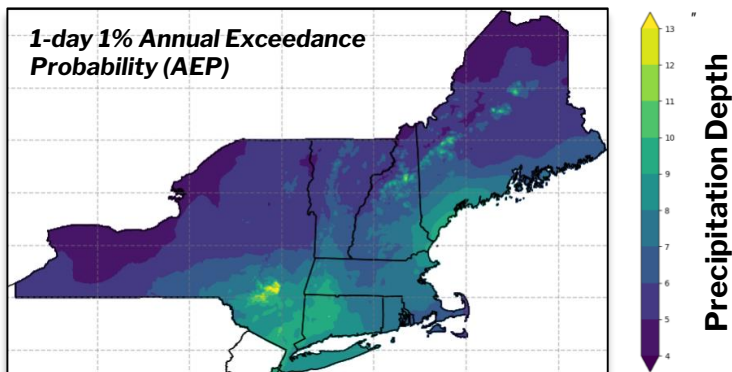


- Result of extensive, multi-year study conducted with Penn State University, University of Illinois Urbana-Champaign and University of Wisconsin-Madison
- Testing done for Atlas 14 Volume 10 project area (Northeastern States)
- Development of methodology conducted in coordination with, and funded by DOT FHWA

The NOAA Atlas 15 Product

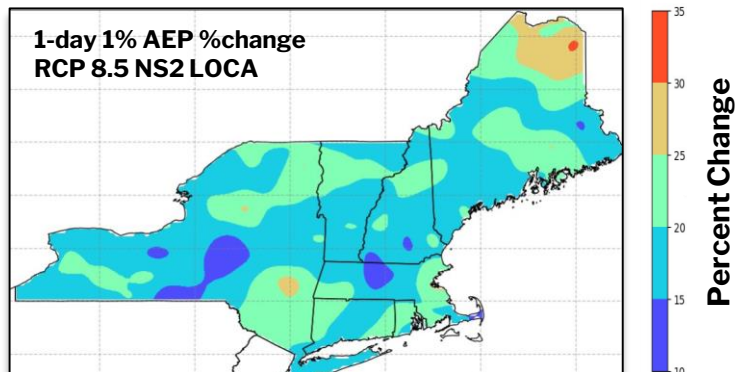
Volume 1: Based on historical gages and observed trends

- First-ever, nationally-consistent, precip frequency data that serves as the basis for Volume 2
- Integrated terrain information
- Accounts for trends in historical observations (when it exists)
 - Non-stationary trends represents a major enhancement from Atlas 14



Volume 2: Incorporates climate projection adjustment factors

- Future precipitation informed by global climate models, modeled non-stationary temporal changes
- Provides adjustment factors to Volume 1 to calculate future estimates



Note:
Derived from
Multiple
Models

Stakeholders and Partners - A Coordinated and Endorsed Path Forward

Plan for NOAA Atlas 15 has been presented to...

- Association of State Floodplain Managers (ASFPM)
- American Society of Civil Engineers (ASCE)



and federal partners on **January 18** during a technical workshop moderated by the DOT Federal Highway Administration (FHWA); **federal partners validated methodology.**



U.S. Department of Transportation
Federal Highway Administration



FEMA



— BUREAU OF —
RECLAMATION



U.S.NRC

The NWS issued a **Public Notification Statement (PNS)** on September 15, 2022, **soliciting public feedback** on NOAA Atlas 15 and the proposed national update; **90% validated proposal.**

Bipartisan Infrastructure Law (BIL): First Direct Federal Funding

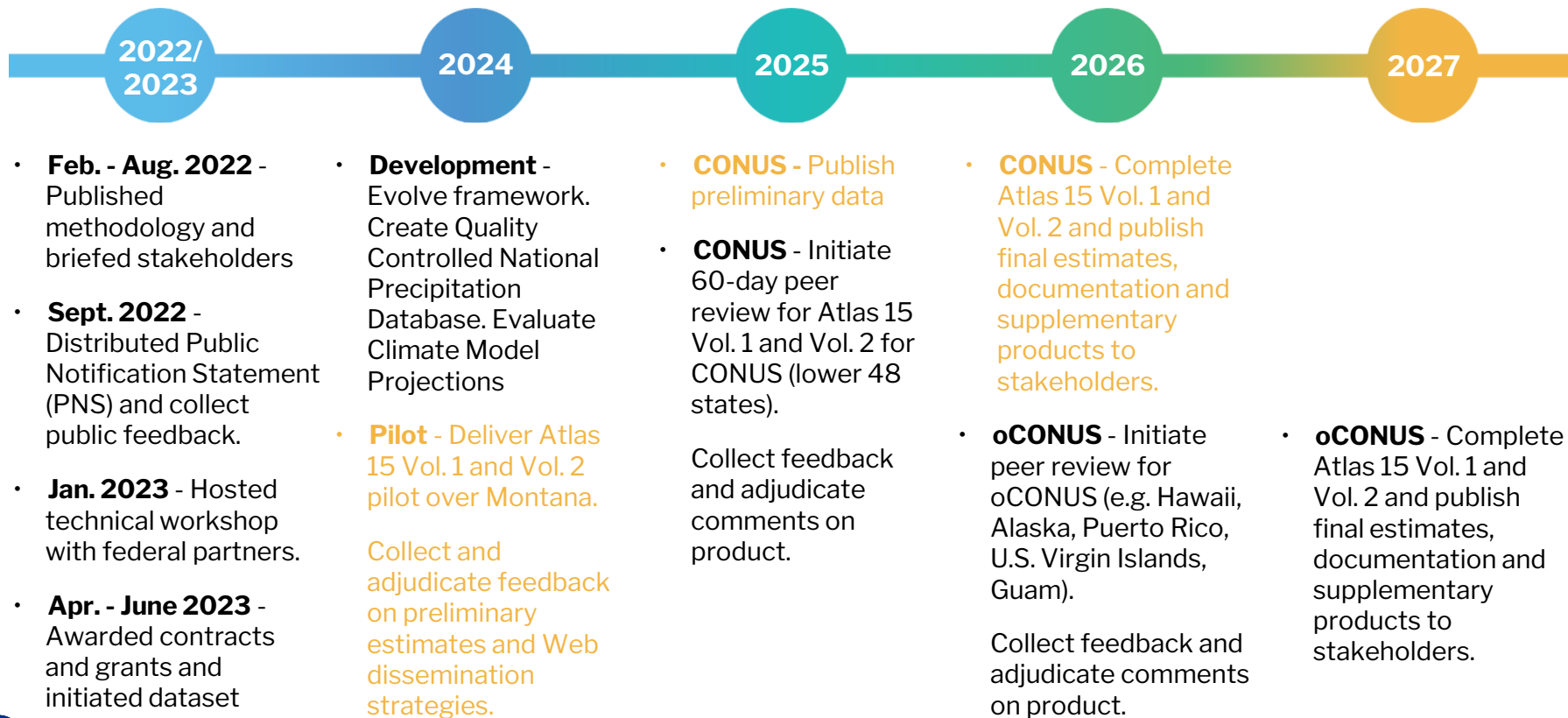
Bipartisan Infrastructure Law summary: "Shall be for coastal and inland flood and inundation mapping and forecasting, and next-generation water modeling activities, **including modernized precipitation frequency and probable maximum studies.**"

"To support the design, development, and operation of our nation's built infrastructure, from new power plants to transportation systems, NOAA **will update and revise precipitation frequency atlases for the United States that account for climate change...**"

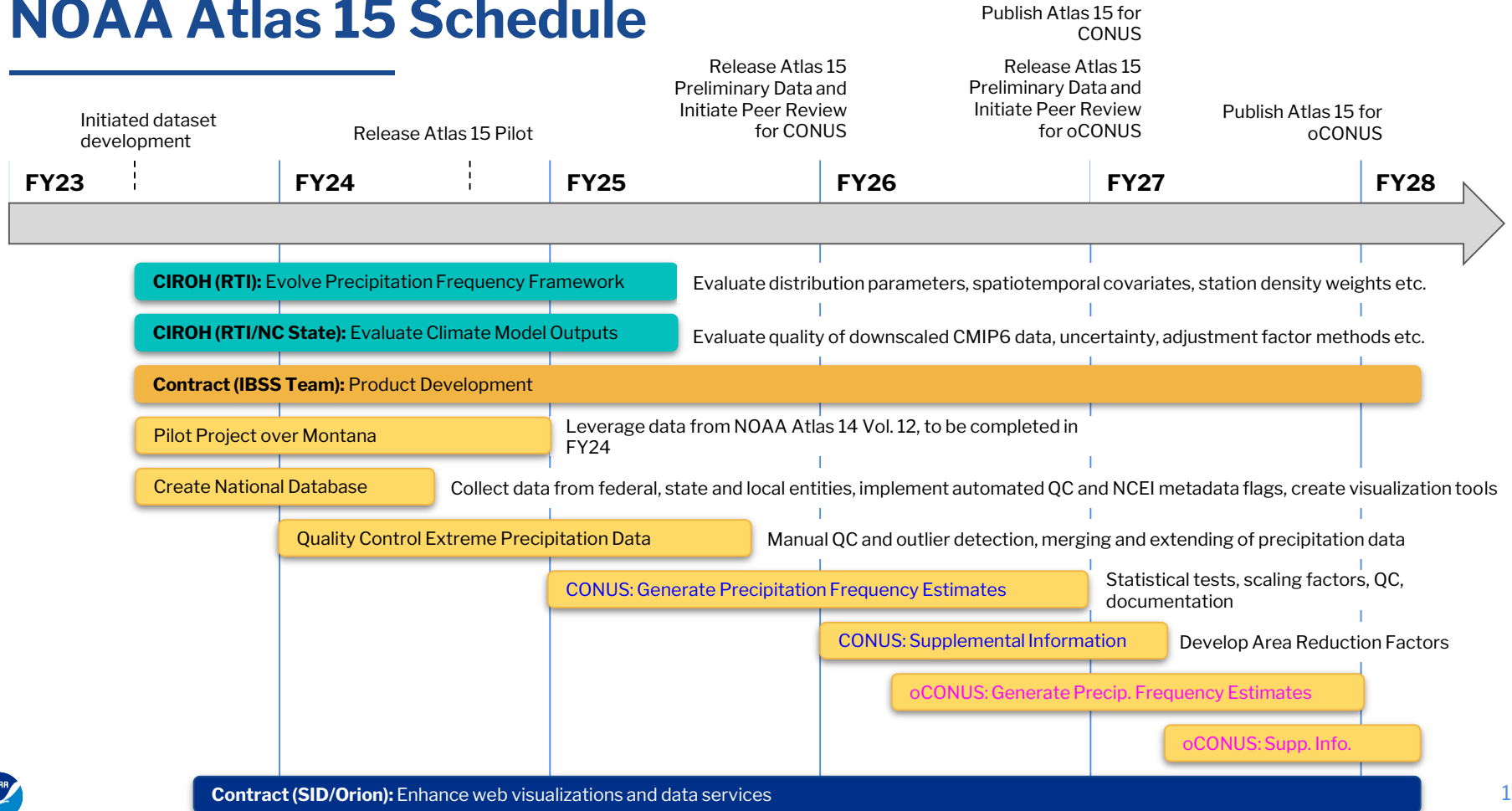


For the first time, NOAA now will apply a nationwide update for precipitation frequency data – a long standing and highly sought need for the future of our nation's infrastructure

NOAA Atlas 15 Road Map



NOAA Atlas 15 Schedule



NOAA Atlas 15 Pilot for Montana: Web

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

EXISTING **NEW**

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: AL

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 AL stations): [Select station]
c) By address: [Search]

2) Use map:
a) Select location: Move crosshair or double click
b) Click on station icon
c) Show stations on map

Location information:
Name: Nashville, Indiana, USA*
Latitude: 32.463°
Longitude: -86.455°
Elevation: 328 ft

Map: [Terrain] [Map]

Source: ESRI Maps
Source: USGS

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

PF tabular PF graphical Supplementary information

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

Duration	2	5	10	25	50	100	250	500	1000
1-min	0.443 (0.365-0.545)	0.515 (0.417-0.624)	0.617 (0.500-0.752)	0.763 (0.566-0.999)	0.913 (0.702-1.20)	1.08 (0.891-1.33)	1.28 (1.07-1.58)	1.51 (1.27-1.88)	1.75 (1.49-2.09)
15-min	0.657 (0.535-0.793)	0.752 (0.611-0.913)	0.904 (0.725-1.10)	1.03 (0.829-1.28)	1.20 (0.93-1.52)	1.41 (1.13-1.69)	1.65 (1.37-1.95)	1.93 (1.61-2.28)	2.25 (1.89-2.61)
30-min	0.802 (0.652-0.978)	0.916 (0.745-1.11)	1.10 (0.893-1.34)	1.26 (1.01-1.53)	1.47 (1.14-1.83)	1.72 (1.37-2.05)	2.01 (1.61-2.41)	2.34 (1.91-2.77)	2.72 (2.24-3.14)
60-min	1.15 (0.93-1.42)	1.32 (1.08-1.61)	1.60 (1.30-1.95)	1.92 (1.47-2.23)	2.26 (1.66-2.86)	2.69 (1.97-3.35)	3.12 (2.32-3.92)	3.54 (2.64-4.45)	4.04 (3.05-5.03)
1-hr	1.52 (1.24-1.83)	1.73 (1.41-2.05)	2.09 (1.63-2.55)	2.58 (1.92-3.33)	2.78 (2.10-3.51)	3.12 (2.36-3.87)	3.50 (2.64-4.36)	3.92 (2.95-4.89)	4.44 (3.35-5.53)
2-hr	1.85 (1.50-2.20)	2.14 (1.73-2.55)	2.56 (1.98-3.14)	3.05 (2.30-3.80)	3.46 (2.64-4.28)	3.88 (2.95-4.81)	4.33 (3.30-5.36)	4.75 (3.65-5.85)	5.24 (4.05-6.43)

Service: [] Home NWS Operations [Precipitation Frequency] More Water Information About Explore NWS Weather

National Precipitation Frequency Estimates

Current and projected precipitation frequency estimates for a given location (for fixed duration, Annual Exceedance Probability (AEP), scenario, and projected year).

Location Select: [Search Location] Base Map: [Topographic] Time Series: [Annual Maximum] Precipitation Type: [Depth] Units: [English] Confidence Interval: [90%] Annual Exceedance Probability: [1%] Duration: [60-min]

[Buena Vista, Colorado (39°35'59"N 105°0'39"W)]

Most Recent 2023 [Show stations in this area or click on a station]

Future Scenario: **SSP3-7.0** Projected Year: **2050** [LEARN MORE]

Chart Table Supplementary Info

Chart Type: Precipitation Depth x AEP with set Duration

60-min PF Estimates with 90% Confidence Intervals
Location: Buena Vista, CO Coordinates: 39°35'59"N 105°0'39"W Elevation: 3,261 ft

Precipitation Depth (in)

Confidence Intervals: [Most Recent] [Projected] [Added Prediction]

Legend: [Present] [Projected] [Added Prediction]

Precipitation Frequency Estimates Select/Unselect for download

Duration	AEP =	Most Recent (in)	SSP3-7.0 2050 (in)	SSP3-6.5 2050 (in)
60-min	100%	0.182 (0.142-0.232)	0.199 (0.142-0.232)	0.201 (0.142-0.232)
60-min	50%	0.222 (0.142-0.232)	0.268 (0.142-0.232)	0.284 (0.142-0.232)
60-min	20%	0.301 (0.142-0.232)	0.348 (0.142-0.232)	0.365 (0.142-0.232)
60-min	10%	0.377 (0.142-0.232)	0.467 (0.142-0.232)	0.481 (0.142-0.232)
60-min	4%	0.500 (0.142-0.232)	0.671 (0.142-0.232)	0.699 (0.142-0.232)
60-min	2%	0.608 (0.142-0.232)	0.874 (0.142-0.232)	0.912 (0.142-0.232)
60-min	1%	0.728 (0.142-0.232)	1.061 (0.142-0.232)	1.094 (0.142-0.232)
60-min	0.5%	0.862 (0.142-0.232)	1.261 (0.142-0.232)	1.297 (0.142-0.232)
60-min	0.25%	1.06 (0.142-0.232)	1.51 (0.142-0.232)	1.55 (0.142-0.232)
60-min	0.1%	1.22 (0.142-0.232)	1.71 (0.142-0.232)	1.75 (0.142-0.232)

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Acknowledgements - Technical Team

NOAA Atlas 14

- **NOAA** - Greg Fall
- **IBSS** - Austin Jordan, Sridhar Mantripragada
- **CIROH / RTI** - Michael St. Laurent, Carl Trypaluk, Dale Unruh
- **Oregon State** - Chris Daly

NOAA Atlas 15

- **IBSS / RTI / Lago** - Brian Beitler, Maria Bravo, Ryan Clare, Victoria Clear, Jacquelyn Crowell, Nestor Hernandez, Marcelo Lago, Jennifer Lake, Sydney Lybrand, Sanja Perica, Cody Polera, Kevin Sanchez, Alana Shuvalau, David Tedesco, Lynne Trabachino, Danielle White
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Thank You!



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<https://water.noaa.gov>