

NOAA Atlas 14 : Activities and Plans

Mark Glaudemans, P.E.
Dr. Sanja Perica

Office of Water Prediction, National Weather Service, NOAA

Sandra Pavlovic¹, Michael St. Laurent¹, Carl Trypaluk¹, Dale Unruh¹
¹ University Corporation for Atmospheric Research

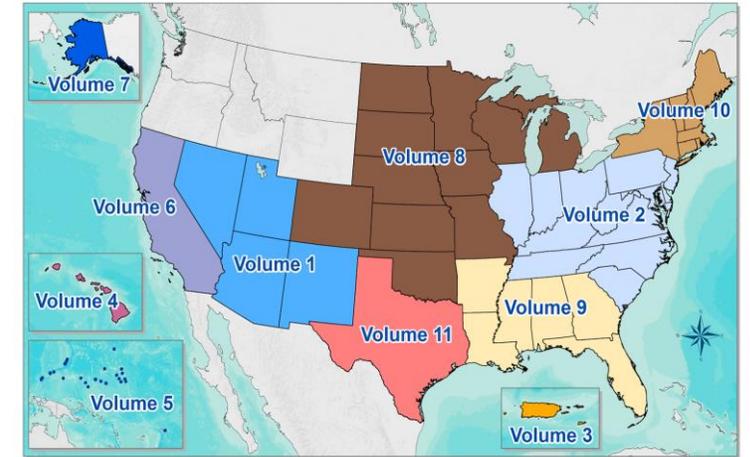
Extreme Precipitation in the Northeast
October 15, 2019



About NOAA Atlas 14 (NA14)

□ Hydrologic Design Studies Center (HDSC)

- Part of NOAA/NWS/Office of Water Prediction.
- Develops and updates precipitation frequency estimates for U.S. states and territories.

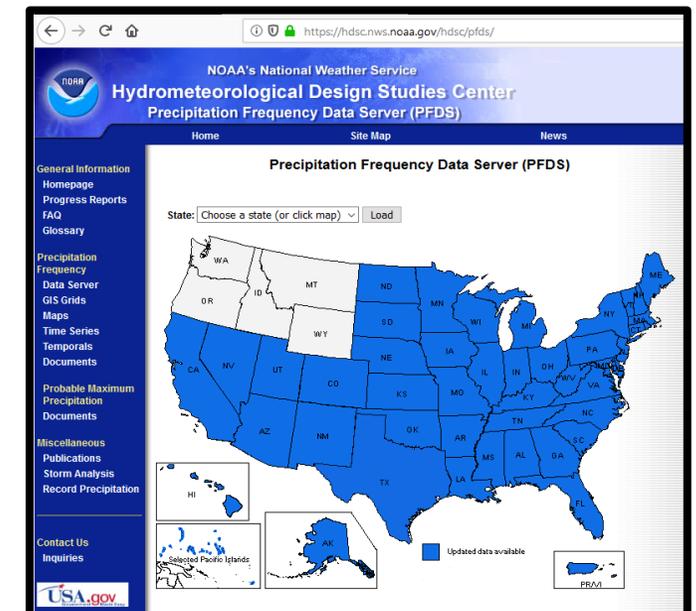


□ Atlas 14 Precipitation Frequency (PF) Studies

- PF estimates published as Volumes of NOAA Atlas 14 since 2004.
- Work performed at request of users and funded by users.

□ Precipitation Frequency Data Server (PFDS)

- Estimates (variety of formats) & supplementary information available from <https://hdsc.nws.noaa.gov/hdsc/pfds/index.html>.



NOAA Atlas 14 - Products for Selected Location



Hy

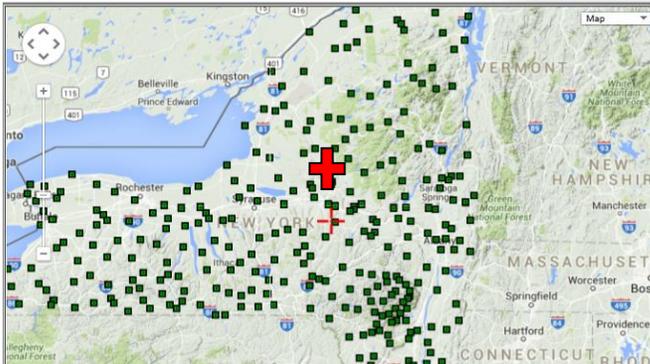
- General Information
- Homepage
- Progress Reports
- FAQ
- Glossary
- Precipitation Frequency Data Server**
- GIS Grids
- Maps
- Time Series
- Temporals
- Documents
- Probable Maximum Precipitation Documents
- Miscellaneous Publications
- Storm Analysis
- Record Precipitation
- Contact Us
- Inquiries

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: NY

DATA DESCRIPTION
Data type: precipitation depth Units: english Time series type: partial duration

SELECT LOCATION
1. Manually:
a) Enter location (decimal degrees, use "-" for S and W): latitude: longitude: submit
b) Select station (click here for a list of stations used in frequency analysis for NY): select station

2. Use map:



a) Select location (move crosshair or double click)
b) Click on station icon (show stations on map)

LOCATION INFORMATION:
Name: Westfield, New York, US*
Latitude: 42.92781°
Longitude: -75.15631°
Elevation: 1444 ft

PF tabular

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION NOAA Atlas 14, Volume 10, Version 2

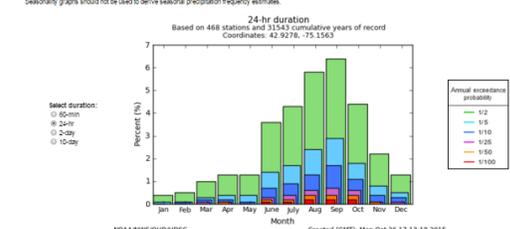
PF tabular PF graphical Supplementary information Print Page

Duration	PDS-based precipitation frequency estimates with 90% confidence intervals (inches) ¹										
	1	2	5	10	25	50	100	200	500	1000	
5-min	0.275 (0.215-0.348)	0.330 (0.258-0.417)	0.467 (0.365-0.590)	0.593 (0.462-0.751)	0.698 (0.540-0.887)	0.842 (0.632-1.10)	0.953 (0.701-1.27)	1.12 (0.76-1.55)	1.20 (0.815-1.66)	1.38 (0.903-1.96)	1.52 (0.970-2.18)
10-min	0.390 (0.305-0.492)	0.467 (0.365-0.590)	0.593 (0.462-0.751)	0.698 (0.540-0.887)	0.842 (0.632-1.10)	0.953 (0.701-1.27)	1.12 (0.76-1.55)	1.20 (0.815-1.66)	1.38 (0.903-1.96)	1.52 (0.970-2.18)	1.78 (1.14-2.57)
15-min	0.459 (0.359-0.579)	0.550 (0.429-0.694)	0.698 (0.543-0.884)	0.821 (0.636-1.04)	0.991 (0.743-1.30)	1.12 (0.825-1.49)	1.20 (0.89-1.55)	1.41 (1.02-1.78)	1.62 (1.13-2.06)	1.78 (1.23-2.30)	2.05 (1.46-2.64)
30-min	0.627 (0.490-0.792)	0.752 (0.587-0.950)	0.956 (0.744-1.21)	1.13 (0.871-1.43)	1.36 (1.02-1.78)	1.54 (1.13-2.05)	1.73 (1.23-2.30)	1.94 (1.32-2.66)	2.23 (1.46-3.17)	2.45 (1.57-3.53)	2.85 (1.81-4.11)
60-min	0.796 (0.622-1.00)	0.954 (0.745-1.21)	1.21 (0.945-1.54)	1.43 (1.11-1.81)	1.73 (1.29-2.26)	1.95 (1.44-2.60)	2.12 (1.56-2.81)	2.47 (1.68-3.41)	2.84 (1.86-4.03)	3.13 (2.00-4.50)	3.50 (2.24-5.00)
2-hr	0.997 (0.784-1.25)	1.19 (0.934-1.49)	1.50 (1.18-1.89)	1.76 (1.37-2.23)	2.12 (1.60-2.77)	2.40 (1.78-3.17)	2.70 (1.93-3.6)	3.03 (2.07-4.17)	3.50 (2.31-4.93)	3.86 (2.49-5.51)	4.35 (2.86-6.18)
3-hr	1.13 (0.895-1.42)	1.35 (1.06-1.68)	1.70 (1.33-2.13)	1.99 (1.55-2.50)	2.38 (1.81-3.10)	2.70 (2.01-3.55)	3.03 (2.23-4.06)	3.41 (2.33-4.66)	3.84 (2.60-5.53)	4.35 (2.86-6.18)	4.95 (3.24-7.00)
6-hr	1.41 (1.12-1.75)	1.67 (1.33-2.07)	2.10 (1.66-2.60)	2.45 (1.93-3.05)	2.93 (2.24-3.78)	3.31 (2.44-4.38)	3.68 (2.71-4.81)	4.17 (3.02-5.51)	4.83 (3.45-6.51)	5.32 (3.87-7.50)	6.00 (4.45-8.00)
12-hr	1.74 (1.31-2.15)	2.06 (1.65-2.54)	2.57 (2.05-3.18)	3.00 (2.38-3.72)	3.59 (2.76-4.59)	4.17 (3.11-5.41)	4.73 (3.51-6.21)	5.32 (4.01-7.00)	6.00 (4.45-8.00)	6.66 (4.95-8.80)	7.49 (5.51-10.00)
24-hr	2.11 (1.61-2.61)	2.44 (1.91-2.94)	3.04 (2.35-3.73)	3.53 (2.76-4.29)	4.21 (3.24-5.41)	4.95 (3.71-6.41)	5.63 (4.21-7.41)	6.32 (4.71-8.41)	7.11 (5.21-9.41)	7.91 (5.91-10.41)	8.81 (6.61-11.41)

Supplementary information

PF tabular PF graphical Supplementary information Print Page

- Document**
Click here for this volume's document.
- PF in GIS format**
Spatially interpolated precipitation frequency estimates (with upper and lower bounds of the 90% confidence interval) area available in GIS compatible format (ascii file). For default download click here.
Select Average recurrence interval: 2-year duration: 60-minute set: Precipitation frequency estimates: Submit
- PF cartographic maps**
Cartographic maps of precipitation frequency estimates were created for selected average recurrence intervals and durations. We recommend that these color maps are used as visual aids only. For default cartographic maps page click here.
Select Average recurrence interval: 2-year duration: 60-min Submit
- Temporal distributions**
Temporal distributions are provided for 6-hour, 12-hour, 24-hour, and 66-hour durations. The temporal distributions for the duration are expressed in probability terms as cumulative percentages of precipitation totals (see documentation for more information). To provide detailed information on the varying temporal distributions, separate temporal distributions were derived for four precipitation cases, defined by the duration quartile in which the greatest percentage of the total precipitation occurred.
Select duration: 24-hour Submit
- Seasonality analysis**
The seasonality graphs show the percentage of precipitation totals for a given duration that exceeded the precipitation frequency estimates for the duration and selected annual exceedance probabilities in each month for each region. The precipitation frequency estimates were derived from annual maximum series at each station in the region (as described in documentation). Results are provided for 60-min, 2-day, and 7-day durations and for annual exceedance probabilities of 1% (or 1-in-2), 1%, 1%, 1%, 1%, 1%, 1%, 1%, 1%, 1%. Seasonality graphs should not be used to derive seasonal precipitation frequency estimates.



Based on 468 stations and 33543 cumulative years of record
Coordinates: 42.9278, -75.1563

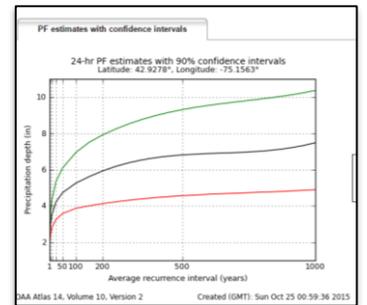
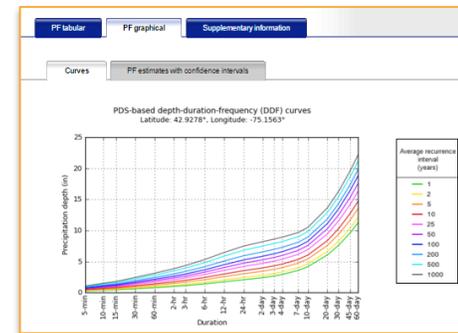
Select duration:
 60-min
 2-day
 7-day
 10-day

Annual exceedance probability:
 1/2
 1/10
 1/100
 1/1000
 1/10000

NOAA/NWS/OH/DHDC Created (GMT): Mon Oct 26 17:13:18 2015

- Rainfall frequency estimates**
NOAA Atlas 14 precipitation frequency estimates represent precipitation magnitude regardless of the type of precipitation. For some areas, where the contribution of snowfall to the total yearly precipitation amount is significant, a separate rainfall (liquid precipitation only) frequency analysis is done for durations between 1 and 24 hours in order to design projects relying on peak flows.
Rainfall (liquid precipitation only) frequency estimates for NOAA Atlas 14 Volume 10 project area will be provided for durations between 1 and 24 hours in addition to precipitation frequency estimates after NOAA Atlas 14 document is complete.
- Time-series data**
Annual maximum series precipitation data is available for download only for stations used in frequency analysis.
- Climate data source**
Precipitation frequency results are based on data from a variety of sources, but largely from the National Center for Environmental Information - NCEI (formerly National Climatic Data Center - NCDC). For more information about observing sites in the area, regardless of their data use used in this study, please visit NCEI's Climate Data Online.
For detailed information about the stations used in this study, please refer to NOAA Atlas 14 Document.
- Watershed information**
Click here to get the watershed information for this location from the U.S. Environmental Protection Agency's (EPA) site.

PF graphical



NOAA Atlas 14 - Products for Project Area

NOAA Hy

General Information
Homepage
Progress Reports
FAQ
Glossary

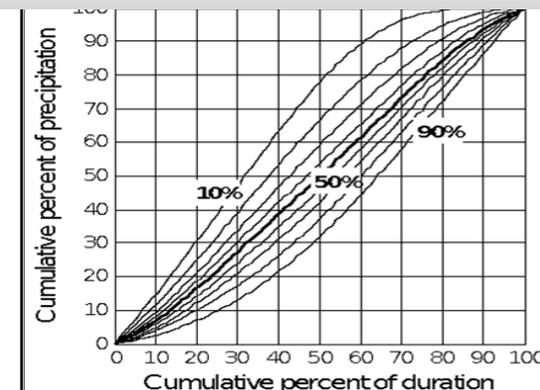
Precipitation
Frequency
Data Server
GIS Grids
Maps
Time Series
Temporals
Documents

Probable Maximum
Precipitation
Documents

Miscellaneous
Publications
Storm Analysis
Record Precipitation

Contact Us
Inquiries

- 30 arc-sec PF grids with confidence limits in GIS format for 5-min to 60-day; 1- to 1,000-year ARI
- Cartographic maps for selected durations and ARI
- Seasonality and temporal distributions
- AMS time series data
- Documentation, supplementary information



DOWNLOAD GIS DATA:

The files can either be downloaded 1) via pull-down menu, 2) by anonymous ftp or 3) via web browser. Ftp is recommended for multiple-file downloads. To obtain precipitation frequency estimates without downloading files, please visit the [PFDS interface](#).

1) Via pull-down menu:

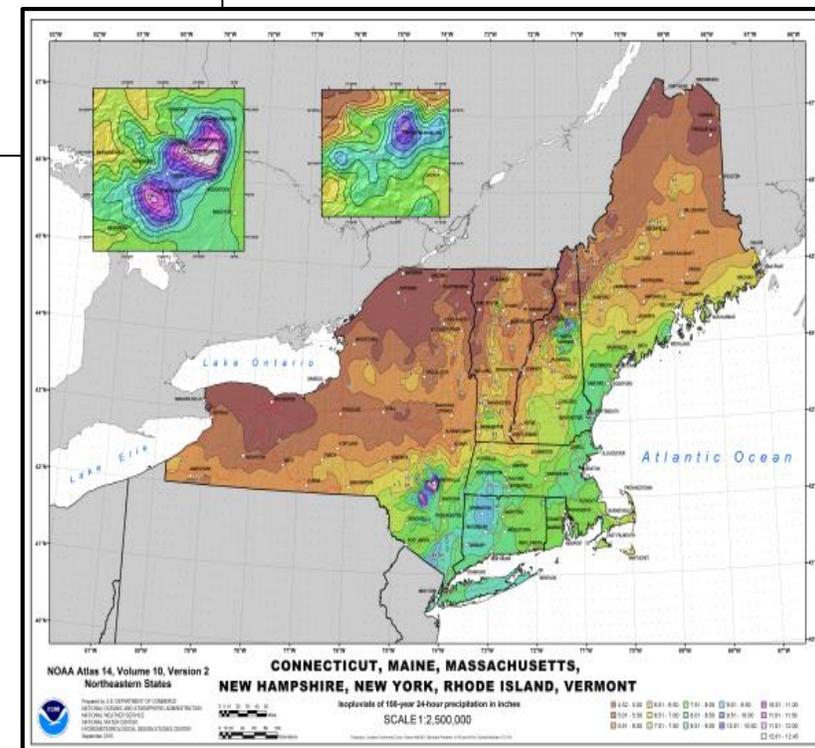
Region:
NOAA Atlas 14 Volume 7 (Alaska)

Type:
Precipitation frequency estimates

Series:
Partial duration series

Average recurrence interval:
2-year

Duration:
5-minute



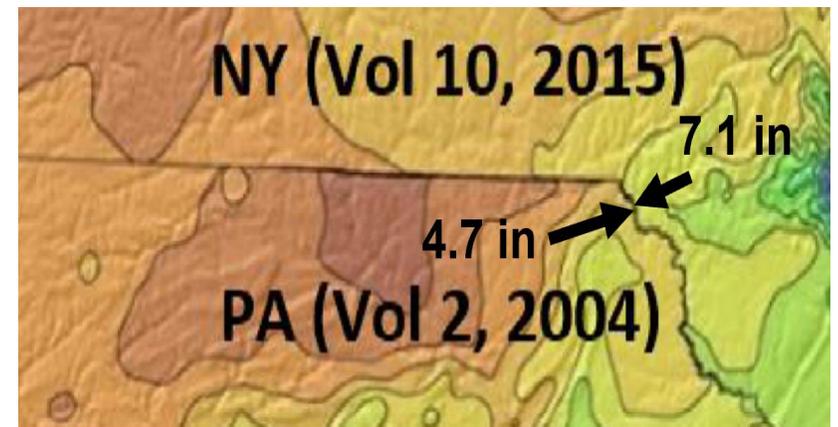
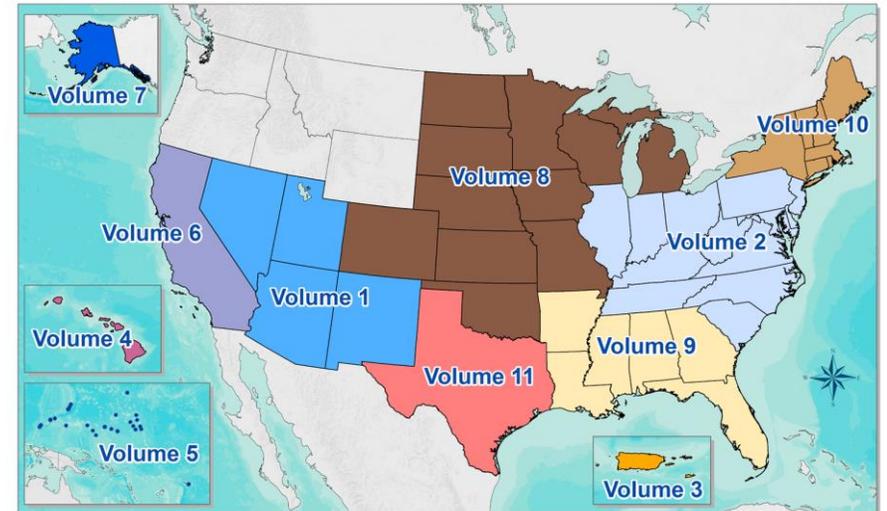
NOAA Atlas 14 – Enhancements and Process

□ Highest Priority:

- Complete Atlas 14 for five Northwestern States (ID, MO, OR, WA, WY)
- Department of Transportation FHWA Transportation Pooled Fund (TPF) Program solicitation #1490 for Volume 12 is: <https://www.pooledfund.org/Details/Solicitation/1490>
- *Current NWS estimates from 1973 (1hr - 24hr durations), 1964 (>24hr) and 1986 (<1 hr).*

□ Proposed Process:

- Simultaneously update estimates for contiguous US to avoid consistency issues at volumes' boundaries.
- Update estimates in 5- to 10-year cycles to incorporate latest precipitation data and apply modern methods.



Discrepancies in 100-year 24-hour estimates at boundary of Volumes 2 & 10

Atlas 14 – Extreme Precipitation Community

- ESEWG chartered in 2008 to... review and improve methods and data collection techniques used to develop design precipitation estimates for large storm events, including the Probable Maximum Precipitation (PMP)



- Part of Advisory Committee on Water Information (ACWI) Subcommittee on Hydrology (SOH): <https://acwi.gov>
- ACWI chartered by Department of Interior, United States Geologic Survey
- Advises federal government with representation from federal agencies, associations, academia, private industry, etc.

Extreme Storm Events Work Group - Proposal

“Extreme Rainfall Product Needs” Proposal

October 10, 2018

https://acwi.gov/hydrology/extreme-storm/product_needs_proposal_20181010.pdf

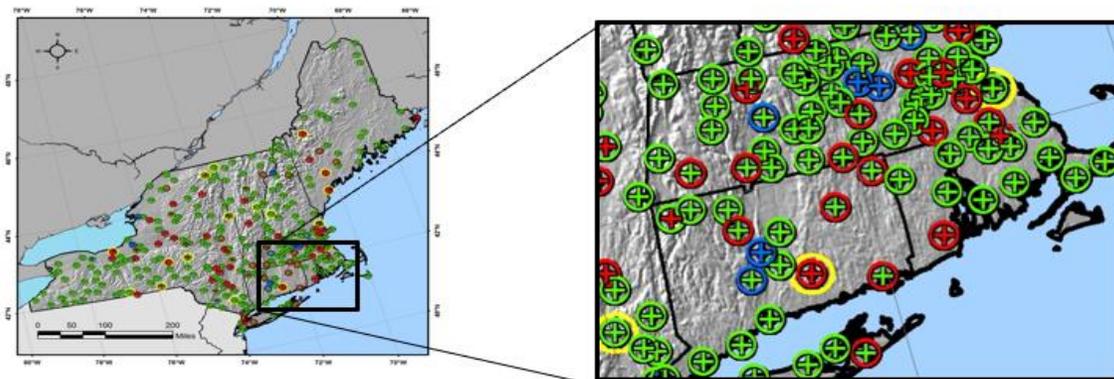
Recommendations for National Strategy [excerpts][NOAA focus]:

- 1) Atlas 14 Development:
 - a) extend Atlas 14 coverage to the five northwestern States
 - b) develop enhanced suite of products for whole country simultaneously
 - c) using improved methodology accounting for the non-stationary climate
- 2) Create archive of extreme precipitation events ... for use in the creation of Probable Maximum Precipitation (PMP) studies. ... data... would be available for use in the updating of the HMRs....
- 3) Create new and updated versions of the HMRs which include updated methodology ...
prepare a National Guidance Document for State-wide/Regional and Site-Specific PMP Studies.
[NOAA partnership on guidance document, pending national study of current needs and methods]

Atlas 14 Enhancements - Methodology

□ Current Atlas 14 methodology

- **Data used:** annual maximum series (AMS) extracted from historical rain gage observations
- **Method:** regional frequency analysis method; GEV distribution; L-moments parameterization
- **Atlas 14 does not address non-stationary climate:**
 - data assumed stationary
 - methods appropriate for stationary conditions
 - assumption tested using regional and at-site parametric & non-parametric tests (considering alternate tests and test datasets)

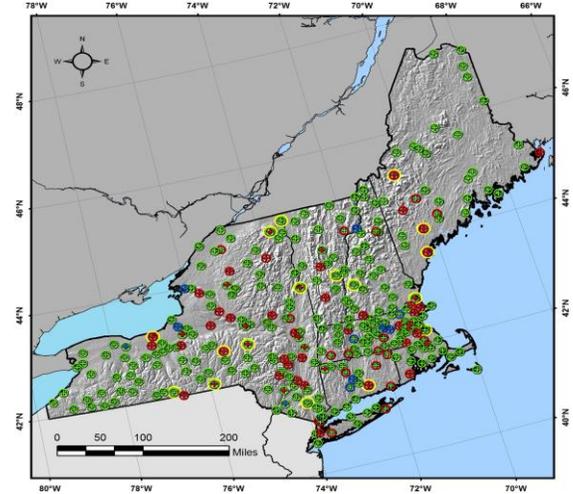


positive trend in mean
positive trend in variance
negative trend in mean
no trend in mean and variance

Atlas14 Enhancements – Non-Stationary “NA14” Method

□ General

- ✓ Developed non-stationary NA14 process that has ability to integrate future climate projection into precipitation frequency analysis.
- ✓ Testing done for NA14 Volume 10 project area (Northeastern States)
- ✓ Funding provided by DOT FHWA
- ✓ Work done in collaboration with Penn State University, University of Illinois Urbana-Champaign and University of Wisconsin-Madison.
- ✓ Study with recommendation for national implementation will be published by April 2020.



□ Datasets

- ✓ Historical rain gage data
- ✓ CMIP5 data (reanalysis + future under RCP 4.5 and RCP 8.5 scenarios).
- ✓ Downscaled CMIP5 precipitation data: LOCA, UW (University of Wisconsin).
NA-CORDEX & CMIP5 BCCAv2 considered, but not retained.

Atlas 14 Enhancements – Non-Stationary “NA14” Method

□ Major updates

- Developed non-stationary NA14 process that has ability to integrate future climate projections into precipitation frequency analysis and allows for different levels of complexity
- Partial Duration Series (PDS) data added as an alternative to AMS
- Changed distribution parameterization method
 - ✓ Regional method adjusted to work in non-stationary framework
 - ✓ Generalized maximum likelihood parameterization method replaced L-moments method;
 - ✓ Parameters allowed to vary in time, where type of trend and amount of variation are determined by products developed from CMIP5 datasets.

Atlas 14 Enhancements – Additional Products

□ **Areal Reduction Factors (ARFs)**

- Current: NWS ARF curves from 1950s assumed applicable for any location and ARI
- Proposed: Regional ARFs for a range of durations, areal sizes and frequencies,
On fly calculation of areal estimates for any selected location at the PFDS.

□ **Atlas 14 design storms**

- Current: NA14 temporal distribution curves - show range of possibilities, but no guidance
- Proposed: Set of hyetographs for any location, duration and frequency

□ **Confidence intervals**

- Current: 95% confidence limits for NA14 estimates; account for limited uncertainties
- Proposed: Confidence intervals of varying widths,
Improved methodology to address more sources of uncertainty
Guidance on using information in engineering design

Atlas 14 – Summary

- ❑ **Atlas 14 Volumes precipitation frequency estimates cover most of United States**

- ❑ **Immediate Plans are:**
 - **Initiate new Volume for Pacific Northwest states**
 - **Publish recommendations for non-stationary analysis**

- ❑ **Priorities are:**
 - **Develop national update for United States**
 - **Support federal efforts for PMP and supporting information**
 - **Establish sustained funding model**
 - **Future work dependent upon funding, including from local partners**

Conclusion

THANK YOU

Questions? Comments?

Hydrometeorological Design Studies Center (HDSC)
Office of Hydrology, National Weather Service, NOAA

Contact: HDSC.questions@noaa.gov

Mark.Glaudemans@noaa.gov

Sanja.Perica@noaa.gov

