

National Precipitation Frequency Standard

NOAA Atlas 14 and Beyond

Fernando Salas¹ and Sandra Pavlovic²

¹ Director, Geo-Intelligence Division | NWS Office of Water Prediction

² Technical Director, HDSC Team | NWS Office of Water Prediction

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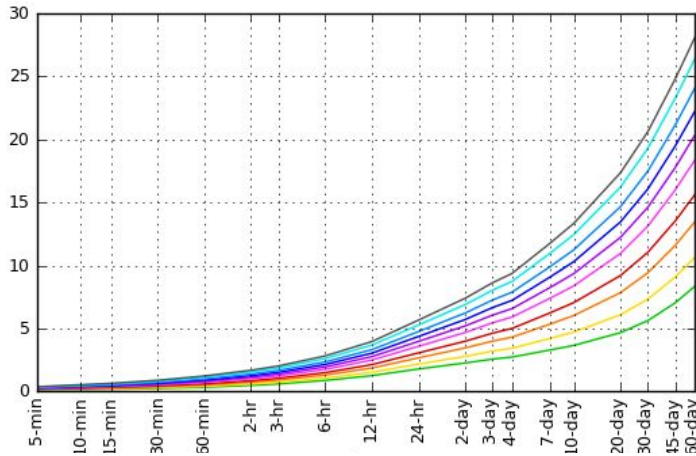
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Precipitation Frequency Estimates

- Precipitation amounts for a given duration and annual exceedance probability (or average recurrence interval).

Example: X precipitation over 24-hour period with 1% (1/100) probability to occur in given year.

- Precipitation **D**epth (or **I**ntensity) for a given **D**uration and **F**requency (ARI or AEP)



Depth-Duration-Frequency (DDF) curves
Intensity-Duration-Frequency (IDF) curves

Precipitation Frequency Applications

Infrastructure design and planning under federal, state, and local regulations

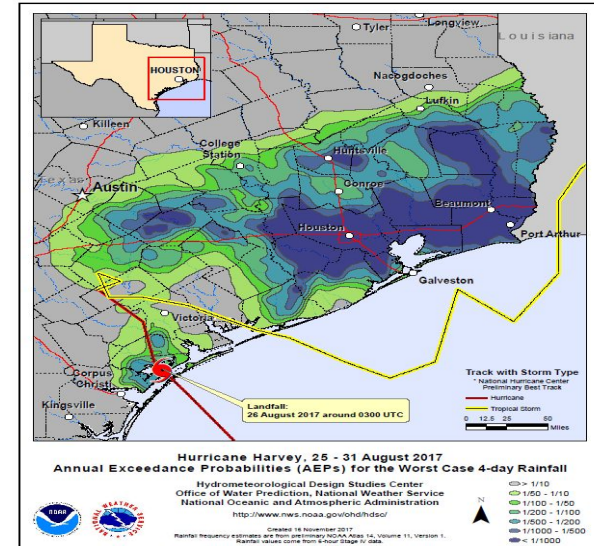
- Transportation
- Development and building codes

FEMA National Flood Insurance Program

Type of structure	Return period (years)
Highway culverts	
Low traffic	5-10
Intermediate traffic	10-25
High traffic	50-100
Highway bridges	
Secondary system	10-50
Primary system	50-100
Farm drainage	
Culverts	5-50
Ditches	5-50
Urban drainage	
Storm sewers in small cities	2-25
Storm sewers in large cities	25-50
Airfields	5-10

Comparing observed and forecasted precipitation with threshold precipitation to indicate flooding threats

Estimating severity of historic events



Precipitation Frequency Studies

Early 1950s

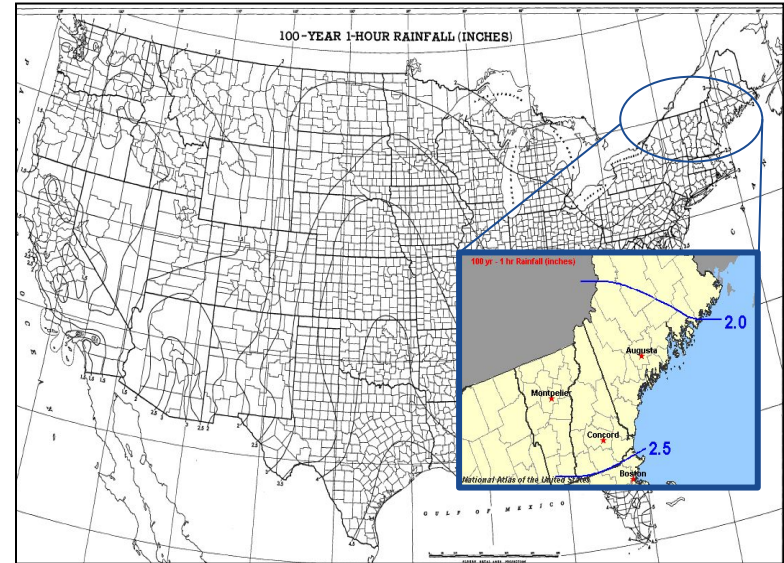
- NWS chosen to prepare IDF curves for federal government.
- NWS is independent.
- Does not regulate or design.

NWS Relevant Publications

- Technical Paper 40, 1961
- Technical Paper 49, 1964
- NOAA Atlas 2, 1973
- NOAA Atlas 14, 2004-2023

Today's De-facto National Standards

- Endorsed by federal water agencies.
- Referenced in many federal, state and local regulations.

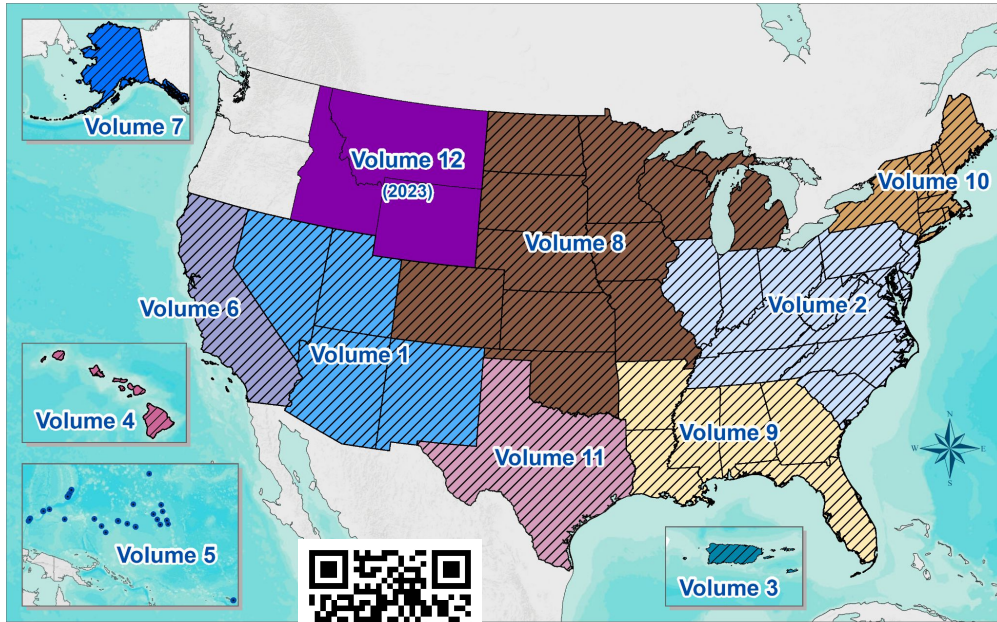


Technical Paper 40, 1961:

<https://www.weather.gov/media/owp/oh/hdsc/docs/TP40.pdf>

<https://www.weather.gov/gvx/TP40s.htm>

NOAA Atlas 14



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

Hydrometeorological Design Studies Center (HDSC)

- Since 2003, develops and updates precipitation frequency estimates for the United States and territories
- Part of Office of Water Prediction (NWS, NOAA)

Funding Approach

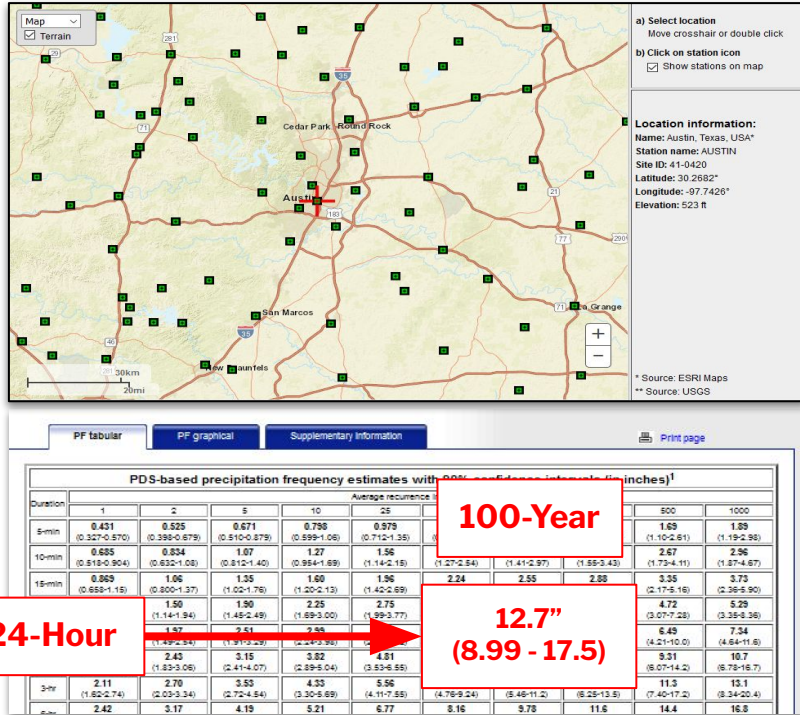
- Performed At Request Of And Funded By Users - not from NWS budget

Discontinuities at volumes' boundaries, and irregular update cycle creates issues for users

Volumes

- Volume 1 (2004): Semiarid Southwest
....
- Volume 11 (2018) : Texas
- Volume 12 (2023) : Montana, Idaho, and Wyoming

Volume Development (and enhancement to Technical Paper 40)



- from 5 minutes to 60 days
- recurrence intervals of 1 to 1000 years.
- confidence intervals
- high spatial resolution (~800 m)
- spatial interpolation (account for terrain, coastal proximity, etc.)
- numerous internal consistency checks
- regional approach that allows for the development of rare frequency
- denser rain gauge networks with longer periods of record, and extensive quality control
- online delivery: <https://hdsc.nws.noaa.gov/hdsc/pfds/>

Assumptions

- Assumes stationarity in data and methodology



Sources of Error

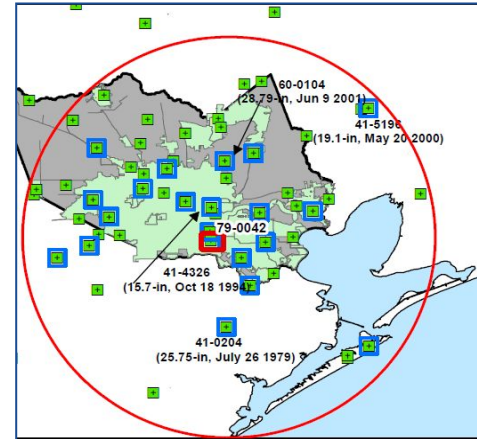
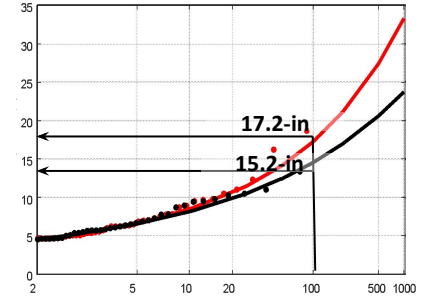
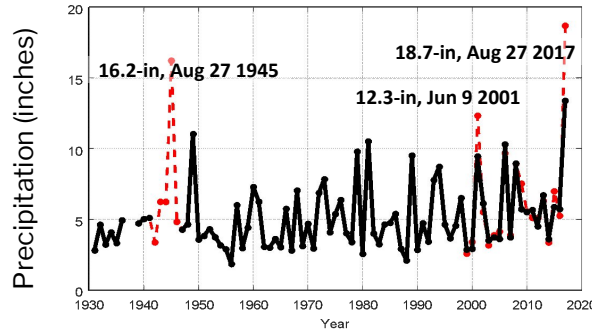
Data:

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

Methods:

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

Houston Hobby Airport

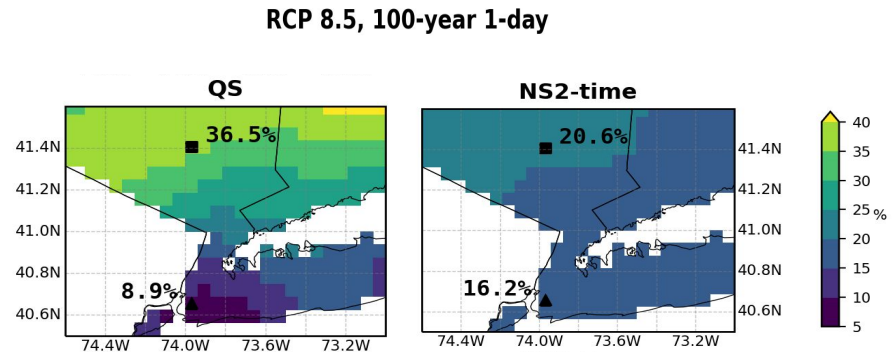
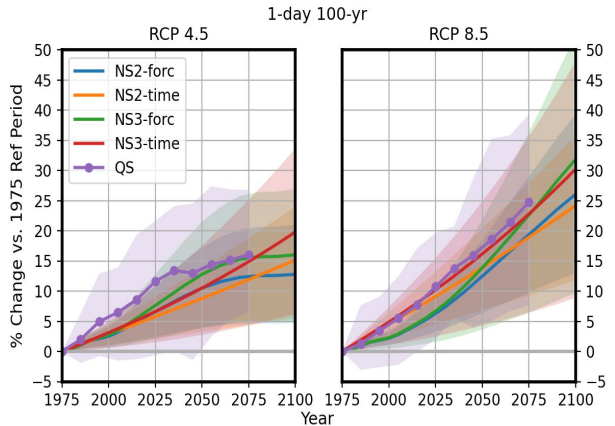


Preliminary 100-year
24-hour estimate: 17.6"

Nonstationarity Impact on NOAA Atlas 14

Proposed methodology: “Analysis Of Impact Of Nonstationary Climate On NOAA Atlas 14 Estimates: Assessment Report”

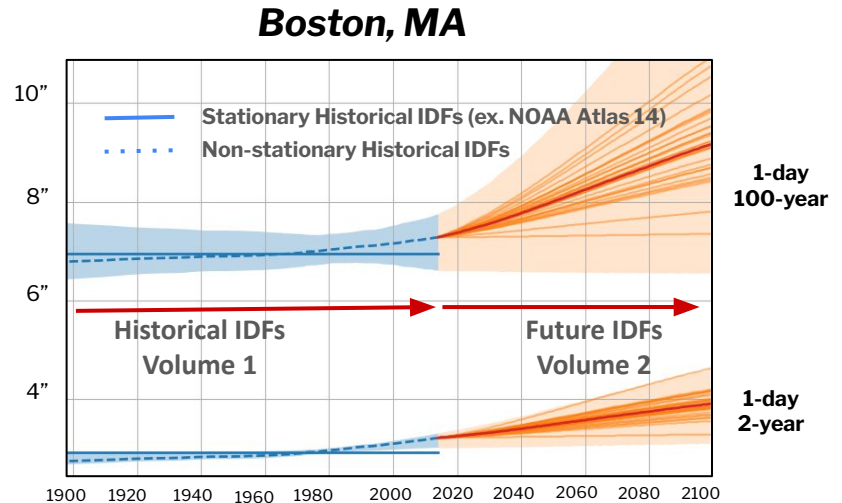
- Work done in collaboration with Penn State University, University of Illinois Urbana-Champaign and University of Wisconsin-Madison
- Testing done for Atlas 14 Volume 10 project area (Northeastern States)
- Funding provided by DOT FHWA



A National Analysis Accounting for Nonstationarity

Leverage support from the Bipartisan Infrastructure Law (BIL) FY22-26

- Leverage results and recommendations from the [Assessment Report](#)
- Develop a seamless spatial national analysis using a non-stationarity assumption with latest precipitation observations and climate projections
- Replaces current Atlas 14 estimates based on historical data (Historical IDFVs) for durations:
 - from 5 minutes to 60 days
 - recurrence intervals of 1 to 1000 years
- Add new product features to account for the future precipitation information (Future IDFVs)
- Atlas 15 to be delivered with robust web visualizations and data services



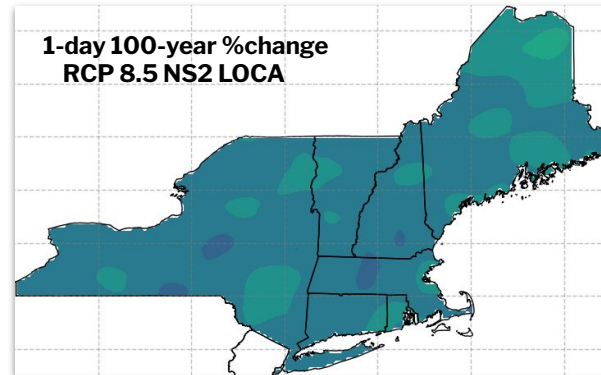
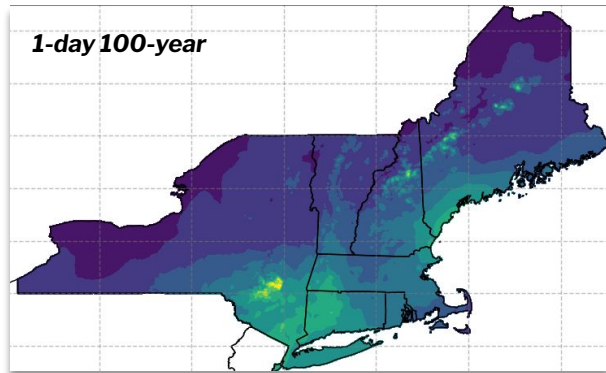
Moving Forward: NOAA Atlas 15

Volume 1: Based on historical gages and observed trends

- Integrated terrain information
- Models trend in historical observations (when it exists) to account for short-term non-stationary temporal changes
 - 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.



MULTI-MODELS

Additional Atlas Products

■ Areal Precipitation Frequency Estimates

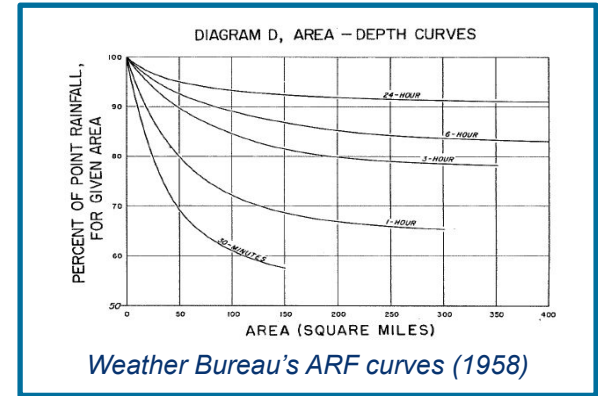
- BACKGROUND: Atlas 14 estimates are point estimates. ARFs are used to convert point precipitation to average precipitation over a watershed. Many ARF methods have been proposed, but Weather Bureau's ARF curves from 1958 are still commonly used.
- NEEDS: Derive regional ARFs and develop web tool to delineate watershed estimates.

■ Design Storm

- BACKGROUND: Atlas 14 provides precipitation frequency estimates for a given duration, but designers often need information on how precipitation is distributed in time and not just the total amount.
- NEEDS: Develop Atlas 15 design storm product with guidance on how to use the product.

■ Probable Maximum Precipitation (PMP)

- BACKGROUND: Probable Maximum Precipitation (PMP) estimates provide the maximum depth of precipitation over a given area and duration that is meteorologically possible. NWS studies done at request and funding of various federal agencies. All activities discontinued in 1999 due to lack of funding.
- NEEDS: Develop the new approach and PMP estimates in a changing climate





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Thank You!



Fernando Salas and Sandra Pavlovic



fernando.salas@noaa.gov
sandra.pavlovic@noaa.gov



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