

Updating Precipitation Intensity Data for New England: Status Report

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DCR

MA Water Resources Commission

October 10, 2013

Summary

- Uses for precipitation intensity data
- Historic Standard
- NRCC and NOAA Updates
- Comparing old to new data
- Future precipitation intensity models
- Current uses of data sets
- Discussion

Uses for Precipitation Intensity Data



Engineering design

Runoff calculations

Stormwater management systems

Dam design and management

Culvert design

Not = Flood Frequency
Not = Flood Maps

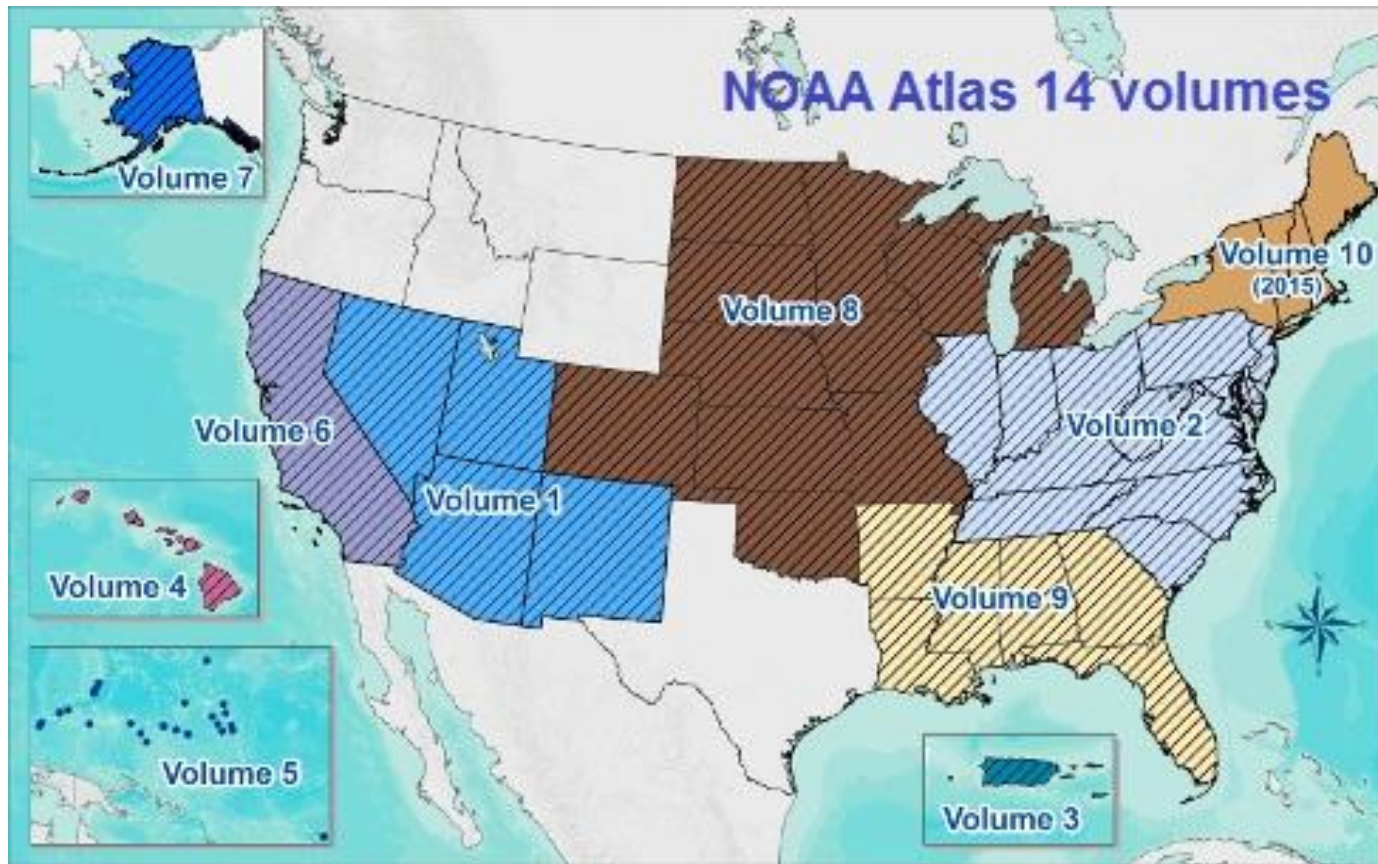
Streamflow recurrence equations for MA
are being updated by USGS

FEMA will subsequently update FIRMS

NOAA's US Atlas 14

Hydrometeorological Design Studies Center

- Precipitation Frequency Data Server

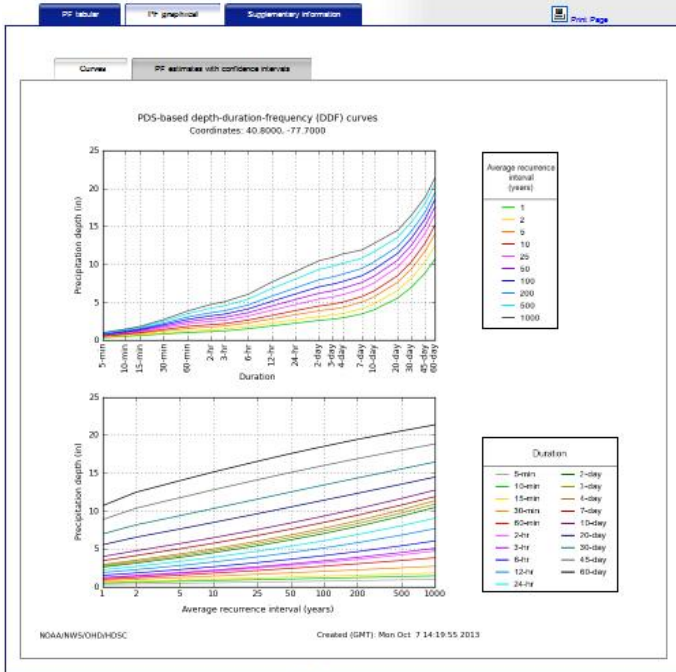


<http://dipper.nws.noaa.gov/hdsc/pfs/>

NOAA Atlas 14 Data



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



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	0.326 (0.292-0.366)	0.389 (0.347-0.437)	0.473 (0.423-0.531)	0.539 (0.480-0.603)	0.625 (0.553-0.698)	0.691 (0.609-0.771)	0.759 (0.664-0.845)	0.829 (0.721-0.921)	0.927 (0.797-1.03)	1.00 (0.854-1.11)
10-min	0.507 (0.453-0.569)	0.608 (0.542-0.683)	0.736 (0.657-0.825)	0.832 (0.741-0.931)	0.956 (0.846-1.07)	1.05 (0.923-1.17)	1.14 (1.00-1.27)	1.24 (1.08-1.38)	1.36 (1.17-1.51)	1.46 (1.24-1.62)
15-min	0.621 (0.555-0.695)	0.743 (0.663-0.835)	0.903 (0.807-1.01)	1.02 (0.911-1.15)	1.18 (1.05-1.32)	1.30 (1.14-1.45)	1.42 (1.24-1.58)	1.54 (1.34-1.71)	1.70 (1.46-1.89)	1.82 (1.55-2.02)
30-min	0.822 (0.735-0.923)	0.994 (0.888-1.12)	1.24 (1.11-1.39)	1.42 (1.27-1.59)	1.67 (1.48-1.86)	1.85 (1.63-2.07)	2.05 (1.79-2.28)	2.25 (1.95-2.50)	2.52 (2.17-2.80)	2.73 (2.33-3.03)
60-min	1.00 (0.897-1.13)	1.22 (1.09-1.37)	1.55 (1.39-1.74)	1.81 (1.61-2.02)	2.16 (1.92-2.41)	2.44 (2.15-2.72)	2.74 (2.40-3.05)	3.05 (2.65-3.39)	3.49 (3.00-3.87)	3.83 (3.27-4.26)
2-hr	1.14 (1.01-1.29)	1.39 (1.22-1.56)	1.76 (1.56-1.99)	2.06 (1.81-2.32)	2.49 (2.19-2.79)	2.85 (2.47-3.18)	3.22 (2.79-3.59)	3.63 (3.11-4.04)	4.23 (3.58-4.70)	4.72 (3.96-5.25)
3-hr	1.23 (1.10-1.38)	1.49 (1.33-1.67)	1.88 (1.67-2.11)	2.19 (1.95-2.46)	2.65 (2.34-2.95)	3.03 (2.66-3.36)	3.44 (3.00-3.82)	3.89 (3.36-4.30)	4.54 (3.87-5.02)	5.09 (4.30-5.62)
6-hr	1.52 (1.37-1.70)	1.83 (1.65-2.05)	2.28 (2.05-2.55)	2.68 (2.38-2.96)	3.20 (2.85-3.55)	3.65 (3.23-4.04)	4.13 (3.62-4.56)	4.65 (4.04-5.13)	5.42 (4.66-5.97)	6.06 (5.15-6.67)
12-hr	1.89 (1.71-2.10)	2.27 (2.05-2.52)	2.82 (2.54-3.13)	3.28 (2.95-3.63)	3.95 (3.52-4.36)	4.52 (4.00-4.97)	5.14 (4.51-5.64)	5.82 (5.06-6.36)	6.83 (5.85-7.45)	7.68 (6.50-8.37)
24-hr	2.25 (2.09-2.43)	2.70 (2.51-2.93)	3.36 (3.11-3.63)	4.04 (3.61-4.21)	4.69 (4.32-5.05)	5.36 (4.91-5.76)	6.09 (5.54-6.54)	6.89 (6.21-7.38)	8.07 (7.18-8.64)	9.05 (7.97-9.70)
2-day	2.61 (2.42-2.84)	3.13 (2.90-3.40)	3.88 (3.59-4.21)	4.51 (4.16-4.88)	5.42 (4.97-5.86)	6.20 (5.65-6.69)	7.05 (6.38-7.60)	7.97 (7.16-8.59)	9.33 (8.27-10.1)	10.5 (9.19-11.3)
3-day	2.78 (2.58-3.01)	3.32 (3.08-3.61)	4.11 (3.80-4.45)	4.76 (4.39-5.15)	5.71 (5.24-6.17)	6.52 (5.96-7.03)	7.39 (6.71-7.97)	8.34 (7.51-9.00)	9.74 (8.66-10.5)	10.9 (9.60-11.8)
4-day	2.94 (2.73-3.19)	3.52 (3.27-3.82)	4.34 (4.01-4.70)	5.02 (4.63-5.43)	6.01 (5.52-6.48)	6.84 (6.25-7.38)	7.74 (7.04-8.35)	8.72 (7.86-9.41)	10.2 (9.05-11.0)	11.4 (10.0-12.3)
7-day	3.46 (3.24-3.72)	4.13 (3.87-4.44)	5.03 (4.70-5.39)	5.75 (5.37-6.16)	6.77 (6.29-7.26)	7.61 (7.04-8.16)	8.50 (7.82-9.11)	9.44 (8.63-10.1)	10.8 (9.76-11.6)	11.9 (10.7-12.8)
10-day	4.01 (3.76-4.28)	4.75 (4.47-5.09)	5.71 (5.36-6.10)	6.48 (6.06-6.92)	7.55 (7.05-8.07)	8.43 (7.83-9.00)	9.34 (8.63-9.98)	10.3 (9.45-11.0)	11.7 (10.6-12.5)	12.7 (11.5-13.7)
20-day	5.55 (5.23-5.90)	6.54 (6.16-6.95)	7.63 (7.19-8.11)	8.49 (7.99-9.02)	9.64 (9.05-10.2)	10.5 (9.87-11.2)	11.4 (10.7-12.1)	12.3 (11.5-13.1)	13.5 (12.5-14.4)	14.5 (13.3-15.4)
30-day	6.97 (6.61-7.37)	8.17 (7.74-8.63)	9.39 (8.88-9.91)	10.3 (9.76-10.9)	11.6 (10.9-12.2)	12.5 (11.8-13.2)	13.4 (12.6-14.2)	14.4 (13.4-15.2)	15.6 (14.5-16.5)	16.5 (15.3-17.5)
45-day	8.86 (8.43-9.34)	10.4 (9.85-10.9)	11.8 (11.2-12.4)	12.8 (12.2-13.5)	14.1 (13.4-14.9)	15.1 (14.3-15.9)	16.0 (15.1-16.9)	16.9 (15.9-17.8)	18.0 (16.9-19.0)	18.8 (17.6-19.9)
60-day	10.7 (10.2-11.2)	12.5 (11.9-13.1)	14.0 (13.3-14.7)	15.1 (14.4-15.9)	16.5 (15.8-17.3)	17.6 (16.7-18.4)	18.5 (17.6-19.4)	19.4 (18.4-20.4)	20.6 (19.4-21.6)	21.4 (20.2-22.5)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parentheses 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 used PMP values. Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in csv format:

2010 NRCS/NRCC

Extreme Precipitation in New York and New England

Extreme Precipitation in New York & New England *An Interactive Web Tool for Extreme Precipitation Analysis*

About this Project

Data & Products

Daily Monitoring

Documentation

The climatology of very large precipitation events is a critical component of engineering design and regulations for structures and facilities that must withstand or protect against such events. These events can produce localized urban and widespread flooding with damage to property, degradation of water quality, and potential loss of life. On a national level, a comprehensive climatology of rainfall events has not been updated since the early 1960s

Past Extreme Rainfall Analyses

In New York and New England this is a concern as the current climatology excludes almost 50 additional years of data. The National Weather Service is using a regional approach to update the 1960s analysis with two climatologies completed for the southwestern and middle Atlantic regions of the U.S. The Mid-Atlantic analysis extends as far north as Pennsylvania and thus excludes New York and New England. In these states, several regional and state-specific extreme rainfall analyses were conducted in the 1990 and early 2000s, but even these analyses are over a decade old and differences in the data records used do not provide a consistent regional analysis of rainfall extremes.

Extreme Rainfall Since the 1960s

The previous climatologies have been based on the premise that the extreme rainfall series do not change through time. Therefore it is assumed that older analyses reflect current conditions. Recent analyses show that this is not the case, particularly in New York and New England where the frequency of 2 inch rainfall events has increased since the 1950s and storms once considered a 1 in 100 year event have become more frequent. Such storms are now likely to occur almost twice as often.

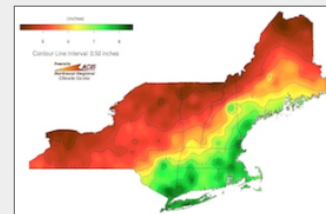


Project Mailing List

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Web Site Features

A number of features are included in this website to make it compatible with the NWS analysis for the Middle Atlantic region and to enhance its usability. The design of the site and its products have been reviewed by stakeholders with the U.S. Natural Resource Conservation Service (NRCS), various state agencies, and private engineering consulting firms. The site includes estimates of extreme rainfall for various durations (from 5 minutes to 10 days) and recurrence intervals (1 year to 500 years). These data are interpolated to a 30-second grid. Confidence intervals for these values are also included as are the partial duration rainfall series used in their computation. Regional extreme rainfall maps and graphic products are also available. Precipitation distribution curves can be generated for each grid either directly or from the USDA NRCS Win TR-20 software, eliminating the need to use a static Type II or Type III curve.



Version 1.12 Copyright 2010-2013.
This project is a joint collaboration between:

Northeast Regional Climate Center (NRCC)



Natural Resources Conservation Service (NRCS)

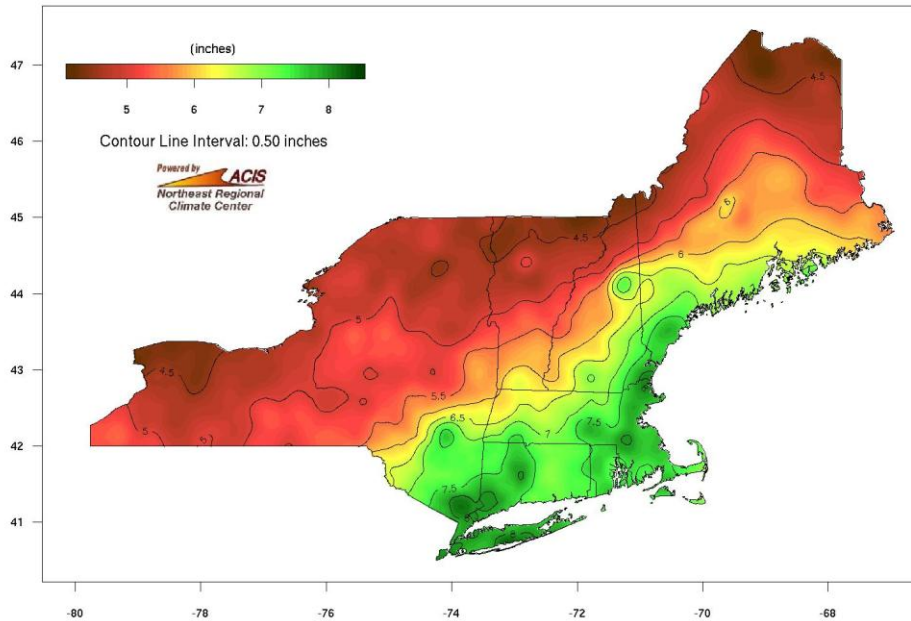


Contact: precip@cornell.edu

<http://precip.eas.cornell.edu>

NRCC Data

Extreme Precipitation Estimates 1day 100yr



Extreme Precipitation Tables

Northeast Regional Climate Center

Data represent point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	72.312 degrees West
Latitude	42.342 degrees North
Elevation	0 feet
Date/Time	Mon, 7 Oct 2013 10:30:59 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min	1hr	2hr	3hr	6hr	12hr	24hr	48hr	1day	2day	4day	7day	10day		
1yr	0.29	0.45	0.55	0.73	0.91	1.14	1yr	0.78	1.05	1.31	1.63	2.05	2.53	2.78	2.24	2.67	3.10	3.77	4.39	1yr
2yr	0.35	0.54	0.67	0.88	1.11	1.39	2yr	0.96	1.27	1.60	1.98	2.44	3.00	3.56	2.95	3.23	3.74	4.46	5.10	2yr
5yr	0.42	0.65	0.82	1.09	1.40	1.76	5yr	1.21	1.58	2.03	2.50	3.06	3.73	4.26	3.50	4.09	4.70	5.53	6.28	5yr
10yr	0.47	0.75	0.94	1.23	1.67	2.11	10yr	1.44	1.83	2.44	3.00	3.65	4.41	5.09	3.90	4.89	5.59	6.51	7.35	10yr
25yr	0.57	0.90	1.15	1.53	2.10	2.67	25yr	1.81	2.35	3.09	3.79	4.59	5.49	6.46	4.86	6.21	7.03	8.08	9.05	25yr
50yr	0.64	1.03	1.33	1.86	2.50	3.22	50yr	2.16	2.79	3.72	4.55	5.47	6.49	7.74	5.74	7.45	8.37	9.53	10.60	50yr
100yr	0.74	1.20	1.55	2.19	2.99	3.86	100yr	2.58	3.32	4.47	5.45	6.52	7.68	9.28	6.79	8.93	9.96	11.23	12.43	100yr
200yr	0.86	1.40	1.82	2.60	3.58	4.63	200yr	3.09	3.94	5.35	6.52	7.75	9.08	11.14	8.04	10.71	11.87	13.25	14.57	200yr
500yr	1.04	1.71	2.23	3.24	4.34	5.90	500yr	3.92	4.96	6.82	8.27	9.78	11.35	14.18	10.05	13.64	14.97	16.50	18.00	500yr

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min	1hr	2hr	3hr	6hr	12hr	24hr	48hr	1day	2day	4day	7day	10day		
1yr	0.24	0.37	0.45	0.60	0.74	0.87	1yr	0.64	0.85	1.06	1.36	1.74	2.38	2.52	2.10	2.42	2.80	3.44	3.93	1yr
2yr	0.34	0.52	0.64	0.86	1.07	1.25	2yr	0.92	1.22	1.43	1.84	2.35	2.89	3.24	2.56	3.12	3.62	4.31	4.95	2yr
5yr	0.38	0.58	0.72	0.99	1.26	1.48	5yr	1.09	1.45	1.67	2.15	2.71	3.41	3.90	3.02	3.75	4.34	5.11	5.85	5yr
10yr	0.41	0.65	0.78	1.09	1.41	1.66	10yr	1.22	1.62	1.87	2.41	3.01	3.88	4.50	3.43	4.33	4.97	5.79	6.62	10yr
25yr	0.46	0.70	0.88	1.25	1.65	1.92	25yr	1.42	1.88	2.19	2.78	3.45	4.56	5.43	4.03	5.22	5.98	6.89	7.83	25yr
50yr	0.50	0.76	0.95	1.36	1.83	2.13	50yr	1.55	2.08	2.44	3.09	3.80	5.18	6.25	4.58	6.01	6.90	7.86	8.90	50yr
100yr	0.54	0.82	1.03	1.48	2.03	2.35	100yr	1.76	2.30	2.75	3.45	4.20	5.88	7.24	5.20	6.96	7.97	9.00	10.13	100yr
200yr	0.58	0.88	1.11	1.61	2.25	2.58	200yr	1.94	2.52	3.04	3.79	4.63	6.70	8.36	5.93	8.04	9.25	10.30	11.57	200yr
500yr	0.65	0.97	1.24	1.81	2.57	2.88	500yr	2.22	2.82	3.48	4.30	5.25	7.97	10.16	6.00	8.36	9.57	10.73	12.10	500yr

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min	1hr	2hr	3hr	6hr	12hr	24hr	48hr	1day	2day	4day	7day	10day			
1yr	0.32	0.49	0.60	0.81	1.00	1.17	1yr	0.86	1.15	1.34	1.72	2.24	2.69	3.00	2.38	2.88	3.32	4.01	4.72	1yr	
2yr	0.36	0.56	0.69	0.94	1.16	1.36	2yr	1.00	1.33	1.53	1.97	2.52	3.13	3.51	2.77	3.38	3.90	4.63	5.30	2yr	
5yr	0.46	0.71	0.88	1.21	1.54	1.77	5yr	1.33	1.73	2.00	2.55	3.21	4.09	4.66	3.62	4.48	5.09	6.01	6.78	5yr	
10yr	0.56	0.85	1.06	1.48	1.91	2.18	10yr	1.65	2.13	2.47	3.12	3.87	5.02	5.78	4.44	5.56	6.24	7.30	8.16	10yr	
25yr	0.72	1.10	1.37	1.95	2.56	2.89	25yr	2.21	2.83	3.27	4.09	4.98	6.54	7.71	5.79	7.41	8.15	9.46	10.45	25yr	
50yr	0.87	1.33	1.65	2.37	3.20	3.60	50yr	2.76	3.52	4.05	5.04	6.03	8.02	9.58	6.00	8.21	9.08	11.49	12.55	50yr	
100yr	1.07	1.61	2.02	2.92	4.00	4.49	100yr	3.45	4.39	5.03	6.23	7.32	9.84	11.92	7.00	10.46	12.19	13.95	15.12	100yr	
200yr	1.30	1.96	2.49	3.60	5.02	5.60	200yr	4.33	5.45	6.25	7.72	8.89	12.05	14.82	8.00	12.25	14.89	16.92	18.18	200yr	
500yr	1.72	2.56	3.30	4.79	6.81	7.53	500yr	5.88	7.36	8.37	10.30	11.51	15.78	19.80	10.00	13.97	16.04	18.39	21.86	23.18	500yr

Old to New Comparison

TP-40 used ~200 data stations for the entire US!

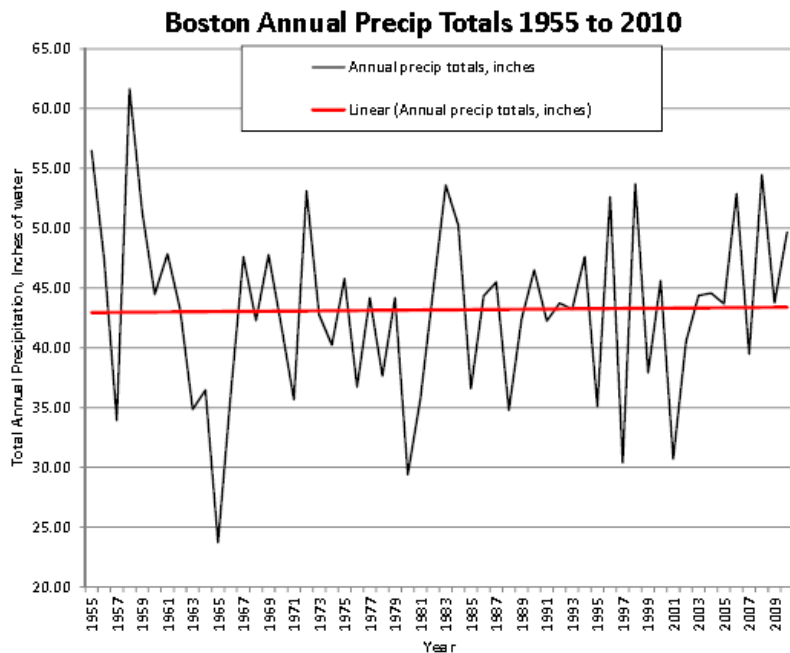
Effects of climate change difficult to tease out with data differences

Time frame of “lookback” period affects trend results

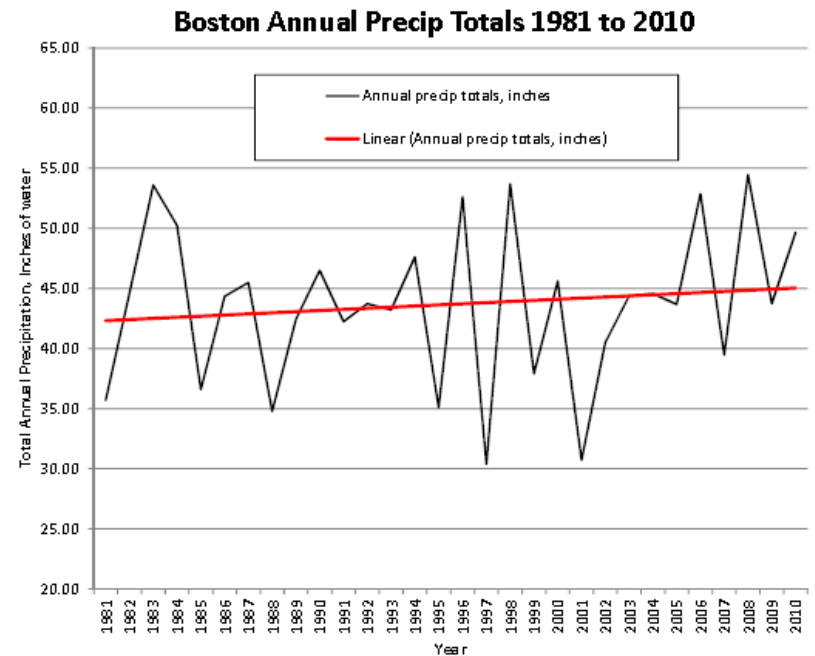
- 1960's Drought not included in TP-40

- 1955 Hurricanes flatten the trend in long-term analysis

Effect of time period on trend



Data from Smithsonian Institute, entered by Harlow A. Hyde, DeLand, FL, 2011



Data from Smithsonian Institute, entered by Harlow A. Hyde, DeLand, FL, 2011

NRCC to NOAA Atlas 14 Comparison

NRCC analyzed mid-Atlantic US area using their method and NOAA Atlas 14 method

Smaller storms (2-year):
NRCC values < NOAA Atlas 14
(NRCC underestimates smaller storms)

Larger storms (100-year)
NRCC values > NOAA Atlas 14

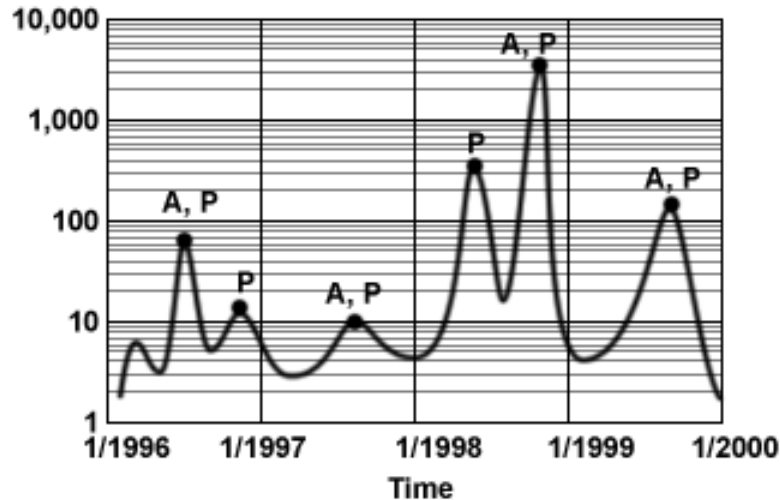
In both cases, results are within NRCC confidence intervals!

Differences in 2 methodologies

- NRCC Partial Duration Series (PDS):
 - Uses all precipitation events to calculate frequencies
- NOAA Atlas 14 Annual Maximum Series (AMS) with PDS
 - Uses a single value of maximum precipitation for each year– excludes some extreme events

Partial Duration Series vs Annual Maximum Series

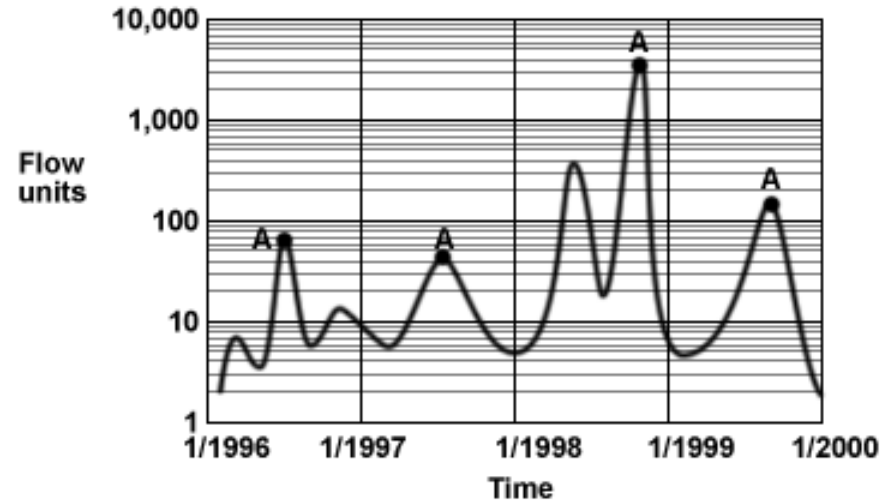
Partial Duration Series



A = Annual series member
P = Partial duration series member

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Annual Series



A = Annual series member

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Future Precipitation Intensity

- NRCC estimated future changes in NY state based on climate modeling
- Compared “current” (1970-1999) to “future” (2040 to 2069) and (2081 to 2100)
- Predict up to a 25% increase in small (2-year) storms
- Predict 10 to 30% increase in larger (100-year) storms

Use of the new Precipitation Intensity Data

TP-40 remains the Federal standard until NOAA Atlas 14 Update

- NRCC requires use of NRCC results
- Federal Highway projects use TP-40
- MA DCR Engineering requires use of NRCC
- DEP Stormwater uses TP-40

Additional Points/Issues

- Prudent engineering design includes consideration of NRCC values
- Engineering safety factors could be sufficient to cover the increases
- Unlikely small towns are using NRCC values in culvert design
- Use of new (higher) values will result in increased construction costs
- Adopt 2010 NRCC values temporarily or wait until 2015 for NOAA Atlas 14?
- Frequency of Updates?

Discussion

