Frequency Distributions of Heavy Precipitation in Illinois: Updated Bulletin 70

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Rainfall frequency sources TP-40, ISWS Bulletin 70, NOAA Atlas 14



Illinois

Observed Number of Extreme Precipitation Events







CLIMATE SCIENCE SPECIAL REPORT

- Volume I of the NCA4
- Precipitation will continue to increase (medium confidence)
- Heavy precipitation events will increase in frequency and amounts (high confidence)

https://science2017.globalchange.gov/



Our Solution to Observed Changes

- Use 1948-2017 data to better represent the current, wetter climate
- Three times as many stations are available from 1948 onward
- Include a Bulletin 70 style adjustment by giving more weight to the second half of the record

L-Moments Software



Figure 4.6.3. Probability plots for selected distributions for 1-day AMS at station Nowata (34-6485) in Oklahoma.

Daily Precipitation Stations 1948-2017



Hourly Precipitation Stations 1948-2017





Similar to Bulletin 70

- Same 10 regions
- Return Period from 2 years to 500 years
- Durations of 1 hour to 10 days
- Designed to take into account observed climate change

10 Regions in Illinois



Process

- Obtained and QC'd the data
- Selected stations based on availability and length of record
- Calculated the expected precipitation at selected return period for 1 to 10 days using Lmoments

Process

- Adjusted the results from the annual maximum series into a partial duration series using a standard approach (Langbein's equation (1949))
- Converted the constrained to unconstrained using standard conversions

Table 1 Conversion from Constrained to Unconstrained Precipitation Adopted in this Study

From	1 day	2 days	3 days	5 days	10 days
То	24 hours	48 hours	72 hours	120 hours	240 hours
Conversion factor	1.13	1.04	1.02	1.01	1.00

Process ...

 Averaged the station frequency values into a regional frequency analysis (RFA)



Process

 Calculate the less than 24 hour durations using conversion factors due to limitations of hourly data

Storm Duration (hours)	RFA 1948-2017	Bulletin 70	Atlas 14	Adopted
1	0.42	0.47	0.47	0.47
2	0.56	0.58	0.57	0.58
3	0.64	0.64	0.63	0.64
6	0.76	0.75	0.75	0.75
12	0.87	0.87	0.86	0.87
18	0.94	0.94	N/A	0.94

Table 2 X-hr:24-hr Ratios

Adjustment for Non-Stationarity

Ratio of the 1983-2017 RFA divided by the 1948-1982 RFA

Table 3 Temporal Trend Adjustment Factors for 10 Sections

	Climatic section	24 hrs	48 hrs	72 hrs	120 hrs	240 hrs	Average
1	Northwest	1.07	1.07	1.03	1.05	1.12	1.07
2	Northeast	1.06	1.12	1.13	1.18	1.21	1.14
3	West	1.00	0.96	0.91	0.92	1.02	0.96
4	Central	1.02	0.94	0.94	0.97	1.08	0.99
5	East	0.99	0.94	0.92	0.96	1.02	0.97
6	West Southwest	0.99	0.97	0.98	1.02	1.10	1.01
7	East Southeast	1.05	0.97	1.02	1.01	1.12	1.03
8	Southwest	1.11	1.09	1.10	1.13	1.26	1.14
9	Southeast	1.07	1.09	1.04	1.03	1.09	1.06
10	South	0.96	1.02	1.06	1.03	0.99	1.01



New Tables

Table 5 Rainfall Frequencies

Rainfall (in	ches) for	given rea	currence in	nterval
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Storm	Section	2-year	5-year	10-year	25-year	50-year	100-	500-
code	code						year	year
1	1	5.48	6.86	7.98	9.55	10.84	12.14	15.65
1	2	5.60	7.09	8.25	9.90	11.26	12.65	16.00
1	3	5.62	7.00	8.10	9.60	10.65	11.64	13.99
1	4	5.46	6.87	8.04	9.53	10.55	11.50	13.65
1	5	5.50	6.84	7.90	9.35	10.45	11.55	13.96
1	6	6.00	7.38	8.47	9.95	10.99	11.95	14.08
1	7	6.57	7.86	8.90	10.20	11.20	12.06	13.95
1	8	6.75	8.18	9.30	10.80	11.95	13.10	15.95
1	9	7.06	8.30	9.22	10.37	11.21	11.96	13.75
1	10	6.36	7.65	8.76	10.40	11.66	12.96	16.20

Sample of the 240 hour (10-day) storm

Confidence Intervales

Table 6 Precipitation Frequency Estimates (in inches) with 90% Confidence Intervals (continued)

Storm Code	Section Code	Recurrence interval						
		2-year	5-year	10-year	25-year	50-year	100-year	500-year
5	1	3.34 (3.00 -	4.22 (3.79 -	5.03 (4.50 -	6.20 (5.51 -	7.20 (6.34 -	8.25 (7.20 -	10.84 (9.16 -
5	2	3.69) 3.34 (3.00 -	4.68) 4.30 (3.85 -	5.61) 5.15 (4.60 -	6.99) 6.45 (5.71 -	8.21) 7.50 (6.59 -	9.54) 8.57 (7.46 -	13.00) 11.24 (9.48 -
		3.69)	4.77)	5.73)	7.26)	8.55)	9.93)	13.63)

Old and New 100-Yr, 24-Hour Storm







New vs Bulletin 70 Differences in inches



Figure 19 Differences in inches between this study and Bulletin 70 for a 24-hour duration and 2-, 5-, 10-, 25-, 50-, and 100-year frequencies for 10 sections in Illinois. Positive numbers denote an increase and negative numbers show a decrease compared with Bulletin 70.

New vs NOAA Atlas 14 Differences in inches



Figure 29 Differences in inches between this study and NOAA Atlas 14 for a 24-hour duration and 2-, 5-, 10-, 25-, 50-, and 100-year frequencies for 10 sections in Illinois. Positive numbers denote an increase and negative numbers show a decrease compared with Atlas 14.

Link To Report

http://hdl.handle.net/2142/103172