What do those Atlas 14 Statistics Mean?

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Released September 2018

Texas last US area added (started in 2004)

Rainfall Gage Data → Depth-Duration Statistics

Report describing methodology → → → → →

Precipitation Frequency Data Server (PFDS)
- https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=tx

NOAA Atlas 14, Volume 11 (Version 2.0)

Annual Maximum and Partial Duration Statistics

- Annual Maximum
  - Annual Exceedance Probability (AEP, 1% Chance)
  - Highest value within duration during year

- Partial Duration
  - Average Return Interval (ARI, 100-year)
  - Theoretically uses all large values
  - Calc from AM series using Langbein's Formula
Langbein’s Formula

- \( AEP = 1 - e^{-1/ARI} \)
- Less than 25-yr, ARI > AEP
- \( ARI \neq \frac{1}{AEP} \)

Precipitation Frequency Data Server (PFDS)

- Select any location
- Get rainfall statistics

Depth Duration  HEC-HMS  Balanced Hyetograph

- Centered around most intense duration
Balanced Hyetograph

SCS (Type I, II, IIa, III)

Atlas 14 Temporals

“Huff Curves”

What do the Temporals/Huff Curves mean?

Time to read the report...
**Temporal Distributions/Huff Curves**
- Grouped by Region
- Greater than 2-year storm
- Cumulative depth percentage
- Grouped by quartile with largest percentage of rainfall
- Percentages at various durations
- About 40,000 storms total

**Interpreting Temporal Distribution**
- 10% of cases:
  - 90% of rainfall in 1.25 hrs
  - 50% of rainfall in 0.55 hrs
- 90% of cases:
  - 50% of rainfall in 2.1 hrs

50% of Rainfall in first ¼ hour:
Storm Realizations

Storm temporal distribution

Follows statistics of the rainfall

Build a balanced storm

- Balanced Storm
- Start with 5-min depth
- Add 15-min around it
- Add remainder of 1-hr

HEC-HMS has much more sophisticated alternating block balanced storm methods. This is just an example.
Build an unbalanced storm

- Unbalanced Storm
- Start with 5-min depth random
- Add 15-min anywhere
- Add remainder of 1-hr

\[ d_{15} = 1 \text{ min} \]
\[ 3 \text{ bins} = 1.18 \]
\[ = 0.39 \]

\[ d_{60} = 1 \text{ hr} - 15 \text{ min} - 5 \text{ min} \]
\[ 8 \text{ bins} = 2.24 - 1.18 - 0.59 \]
\[ = 0.06 \]

Too much unbalancing won't work

- Unbalanced Storm
- Start with 5-min depth
- Add 15-min
- Add remainder of 1-hr
- Add remainder of 2-hr

\[ d_{15} = 1 \text{ min} \]
\[ 3 \text{ bins} = 1.18 \]
\[ = 0.39 \]

\[ d_{60} = 1 \text{ hr} - 15 \text{ min} - 5 \text{ min} - 15 \text{ min} - 5 \text{ min} \]
\[ 8 \text{ bins} = 2.24 - 1.18 - 0.59 \]
\[ = 0.06 \]

HCFC/Harris County Flood Warning System
Rain Gage Data

1987 to 2013 5-Minute Rainfall Data
69 gages in 1987
120 gages as of 2013
188 gages as of 2022
HarrisCountyFWS.org
TS Allison – Gage 1600
- AEP/ARI varies massively

<table>
<thead>
<tr>
<th>Duration</th>
<th>Rainfall</th>
<th>1/AEP</th>
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<tbody>
<tr>
<td>24-hr</td>
<td>28.51</td>
<td>822.0</td>
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<tr>
<td>12-hr</td>
<td>28.35</td>
<td>&gt; 1000</td>
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<td>6-hr</td>
<td>21.16</td>
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<td>2-hr</td>
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<td>1-hr</td>
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<td>30-min</td>
<td>2.66</td>
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<tr>
<td>15-min</td>
<td>1.50</td>
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<tr>
<td>5-min</td>
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</table>

Greens Bayou @ Mount Houston Parkway

Hurricane Ike – Gage 1040
- AEP/ARI varies significantly

<table>
<thead>
<tr>
<th>Duration</th>
<th>Rainfall</th>
<th>1/AEP</th>
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<tbody>
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<td>24-hr</td>
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<tr>
<td>5-min</td>
<td>0.90</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Spring Creek @ FM 2978

Is the 5-min Annual Max always inside the 24-hr Annual Max?

- ~25 years of HCFCD Gage Data
- Annual Maximum 5-Minute Rainfall
- 5-Minute Max inside 24-hr Annual Max Window
- 24% Equal to Annual Maximum
- Lowest is 4% of the Annual Maximum
- Average is 70% of Annual Maximum
**Max 1-Hr Within 24-Hr Storm**
- 45% Equal to Annual Maximum
- More points closer to the Annual Maximum
- Lowest is 18% of the Annual Maximum
- Average is 83%

**Max 12-Hr Within 24-Hr Storm**
- 80% Equal Annual Maximum
- Lowest is 55% of Annual Maximum
- Average Ratio is 97%

**Ratio of Maximum within Annual Maximum 24-hr Storm to Annual Maximum**
3/22/22

5-Min Max Within 24-Hr Max vs “Balanced Storm” 5-Min Rainfall

- Max 24-Hr Rainfall ➔ AEP
- Find 5-Min Depth at that AEP
  ➔ (‘Balanced Storm’ depth)
- Max 5-Min within 24-Hr storm / Balanced Storm Depth
- Most are less than the ‘Balanced Storm’

Storm Realizations

- Interior duration AEPs don’t match
- Not always centered/balanced
- Storms created should follow ‘Huff’ curves

Conclusions

Read the report.
Balanced Storms as created by HEC-HMS are atypical
Realizations of storms vary in “internal” depths and temporal pattern
Realizations should follow the Huff curves
Thank you.