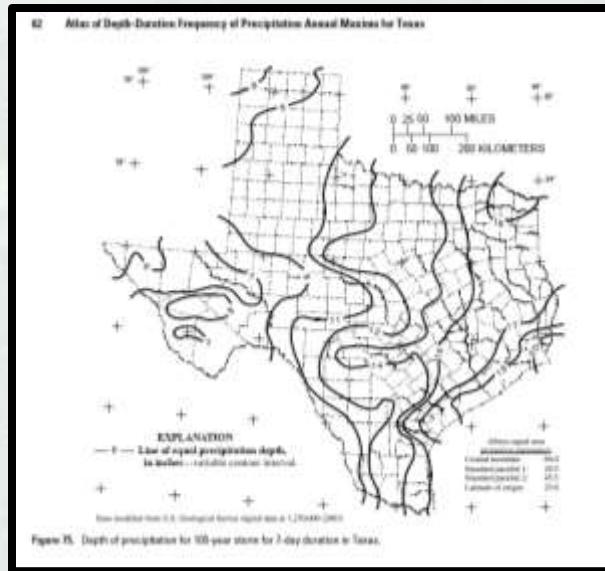


Updating Precipitation Frequency Estimates For Texas – NOAA Atlas 14



Max Strickler

817-886-1541

Maxwell.R.Strickler@usace.army.mil

Hydrologist

Water Management Section

Fort Worth District

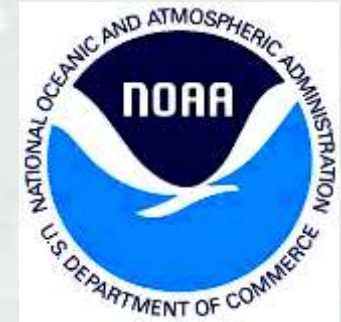
U.S. Army Corps of Engineers



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Precipitation Frequency Background

- **Early 1950s**
 - ▶ **NWS chosen to prepare IDF curves for fed gov't**
 - ▶ **NWS is independent**
 - **does not regulate or design**
- **Today's De-facto National Standards**
 - ▶ **endorsed by federal water agencies**
 - ▶ **referenced in many federal, state, and local regs**
 - ▶ **NWS has a proven track record**



Precipitation Frequency Estimate Uses

- **Used to design:**
 - ▶ Storm water run-off facilities
 - ▶ Size of detention basins and outlet structures
 - ▶ More accurately designed drainage for Texas roads and Highways
 - ▶ Bridges and Culverts
- **Modeling:**
 - ▶ Flood Risk Management studies
 - ▶ Flood plain mapping



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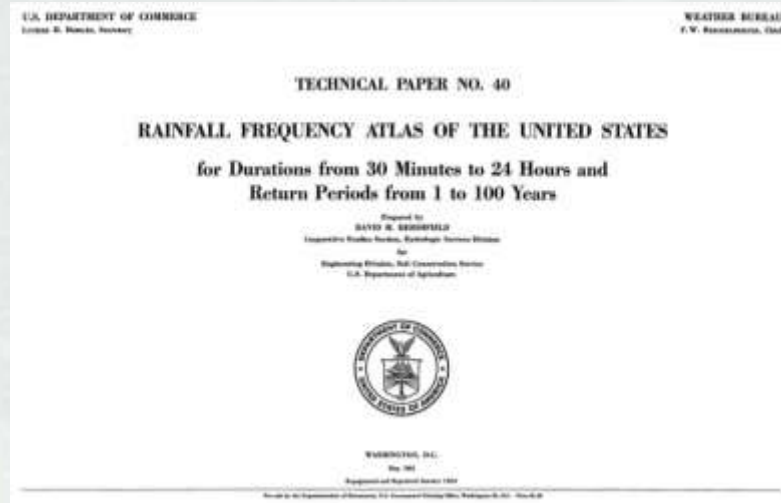
Available Precipitation Frequency Products

NOAA/NWS

NWS Technical Paper No. 40 (1961)

NWS Technical Paper No. 49 (1964)

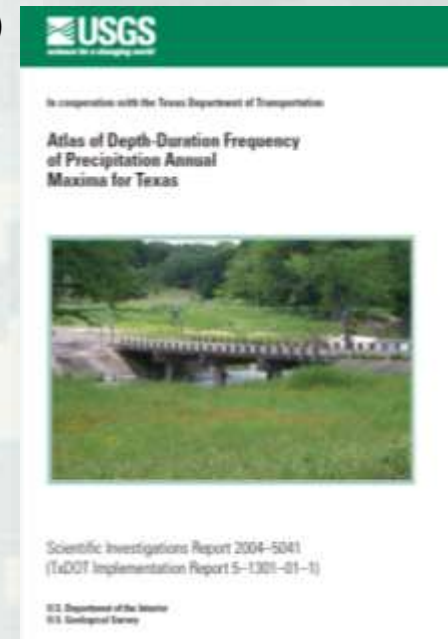
NWS Hydro-35 (1977)



USGS

Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas (2004)

Note: based on data from 1998 study (data from 1994)



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What Do We Gain?

- **More accurate, reliable and robust**
 - ▶ **more observing locations, longer period of record**
 - ▶ **better statistical methods**
 - ▶ **objective, high resolution spatial interpolation**
 - ▶ **peer review**
- **De-facto national standards**
 - ▶ **on behalf of Federal Government & agencies**
- **Consistency between states (equity)**
- **Web based electronic delivery**
 - ▶ **Precipitation Frequency Data Server**
 - ▶ **extensive documentation**

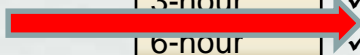


Duration and ARI coverages

- ❑ PFDS operates from a set of ASCII grids (30-arc sec resolution)

Duration	Average recurrence interval (ARI)									
	1	2	5	10	25	50	100	200	500	1,000
5-min	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10-min	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
15-min	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
30-min	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
60-min	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
24-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
20-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
30-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
45-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
60-day	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

**USGS
project
coverage**



NA14. Cartographic maps

PF tabular

PF graphical

Supplementary information

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Precipitation Frequency (PF)

PF Data Server

- PF in GIS Format
- PF Maps
- Temporal Distr.
- Time Series Data
- PFDS Perform.

PF Documents

Probable Maximum Precipitation (PMP)

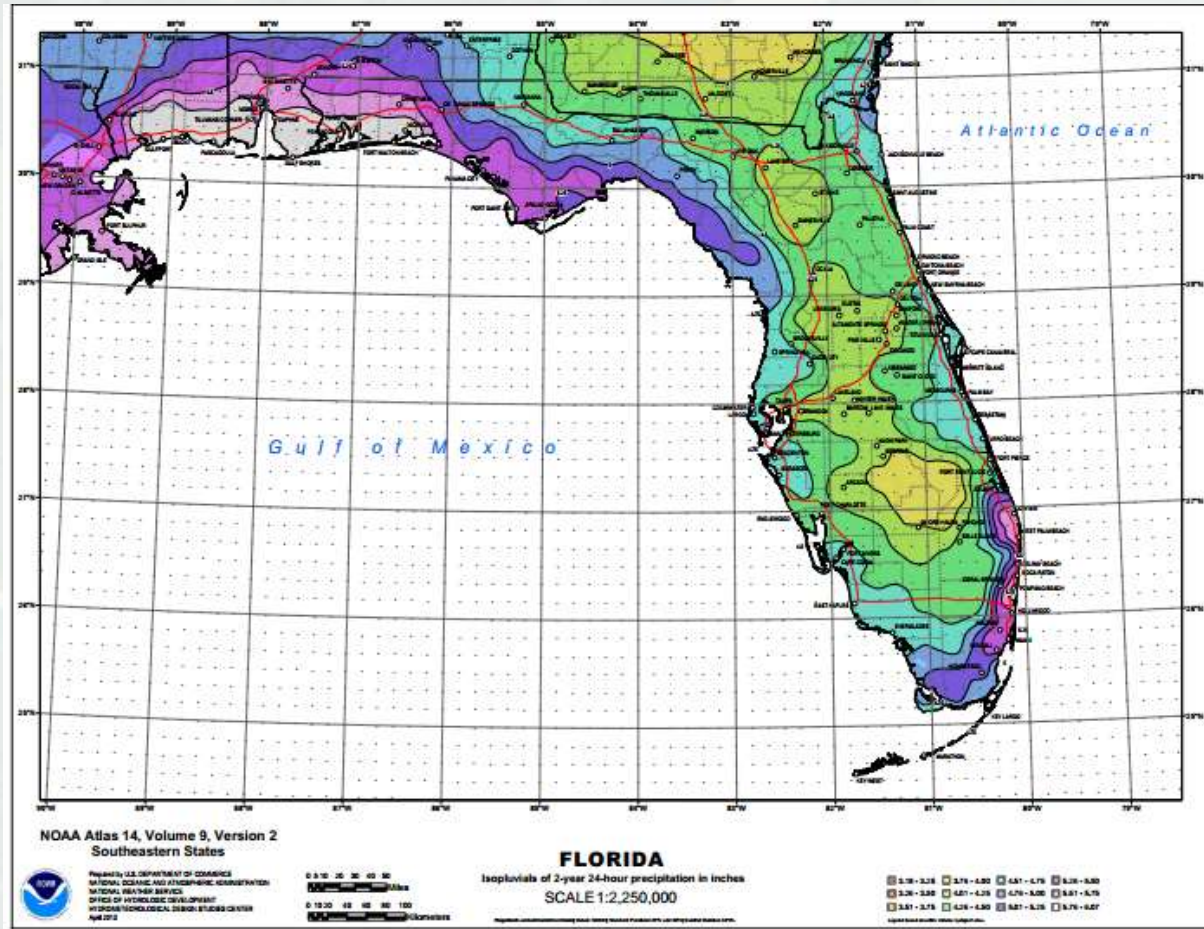
PMP Documents

Miscellaneous

Publications
AEP Storm Analysis
Record
Precipitation

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NA 14. PF estimates for a single location


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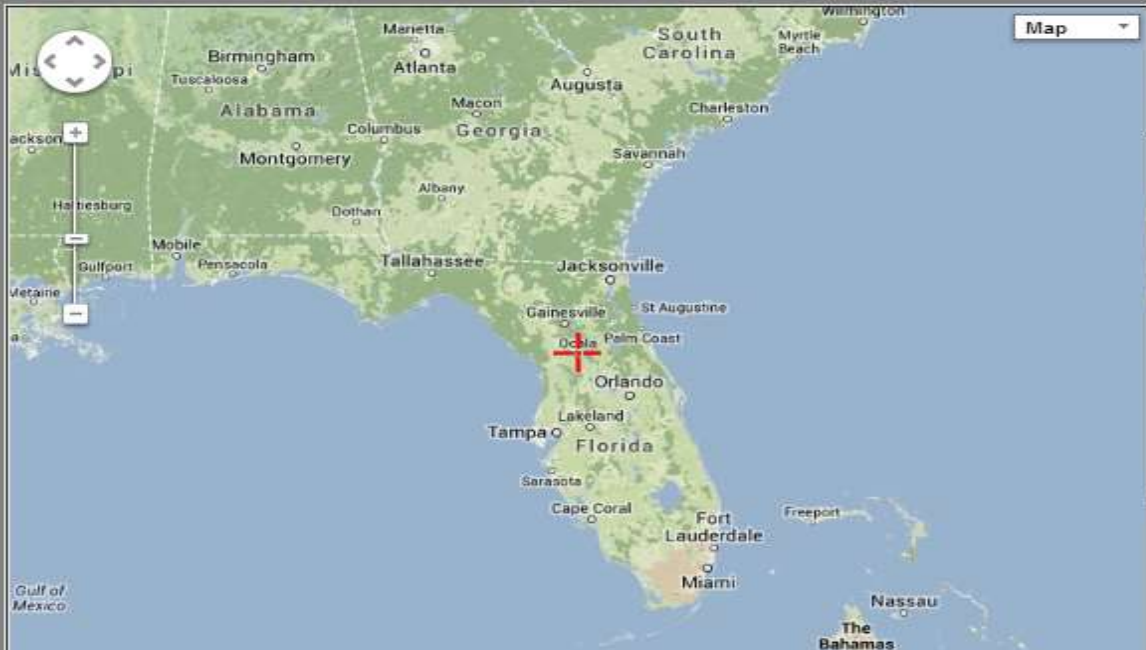
NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: FL

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 FL): select station

2. Use map:



Map

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

LOCATION INFORMATION:
Name: Ocala, Florida, US*
Latitude: 29.1889
Longitude: -82.1403
Elevation: 71 ft*

* source: Google Maps

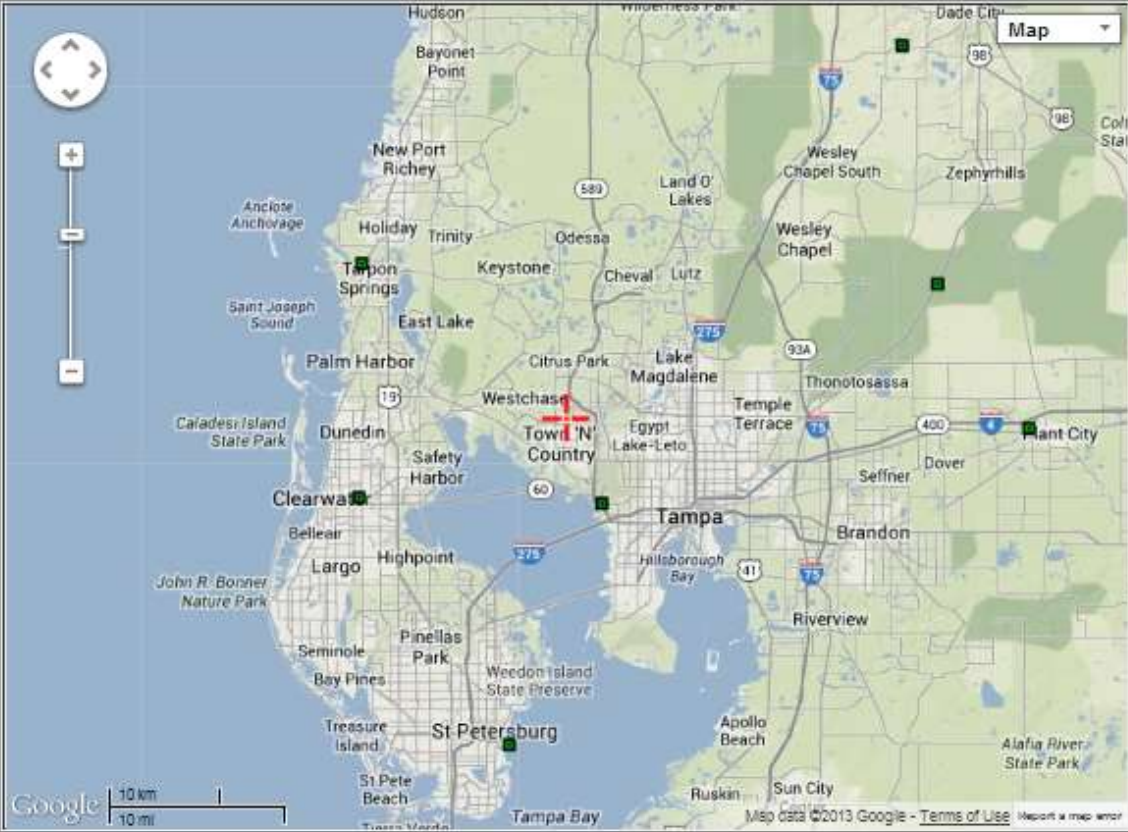


NA14. Zooming in...

- PFDS Perform. PF Documents
- Probable Maximum Precipitation (PMP) PMP Documents
- Miscellaneous Publications
- AEP Storm Analysis Record Precipitation
- Contact Us
- Inquiries
- List-server



2. Use map:



Map

a) Select location (move crosshair or double click)

b) Click on station icon (show stations on map)

LOCATION INFORMATION:
Name: Tampa, Florida, US*
Latitude: 28.0319
Longitude: -82.5715
Elevation: 18 ft*

* source: Google Maps

10 km
10 mi

Map data ©2013 Google - Terms of Use

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 9, Version 2



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NA14. ...retrieving PF estimate with confidence limits

PF tabular

PF graphical

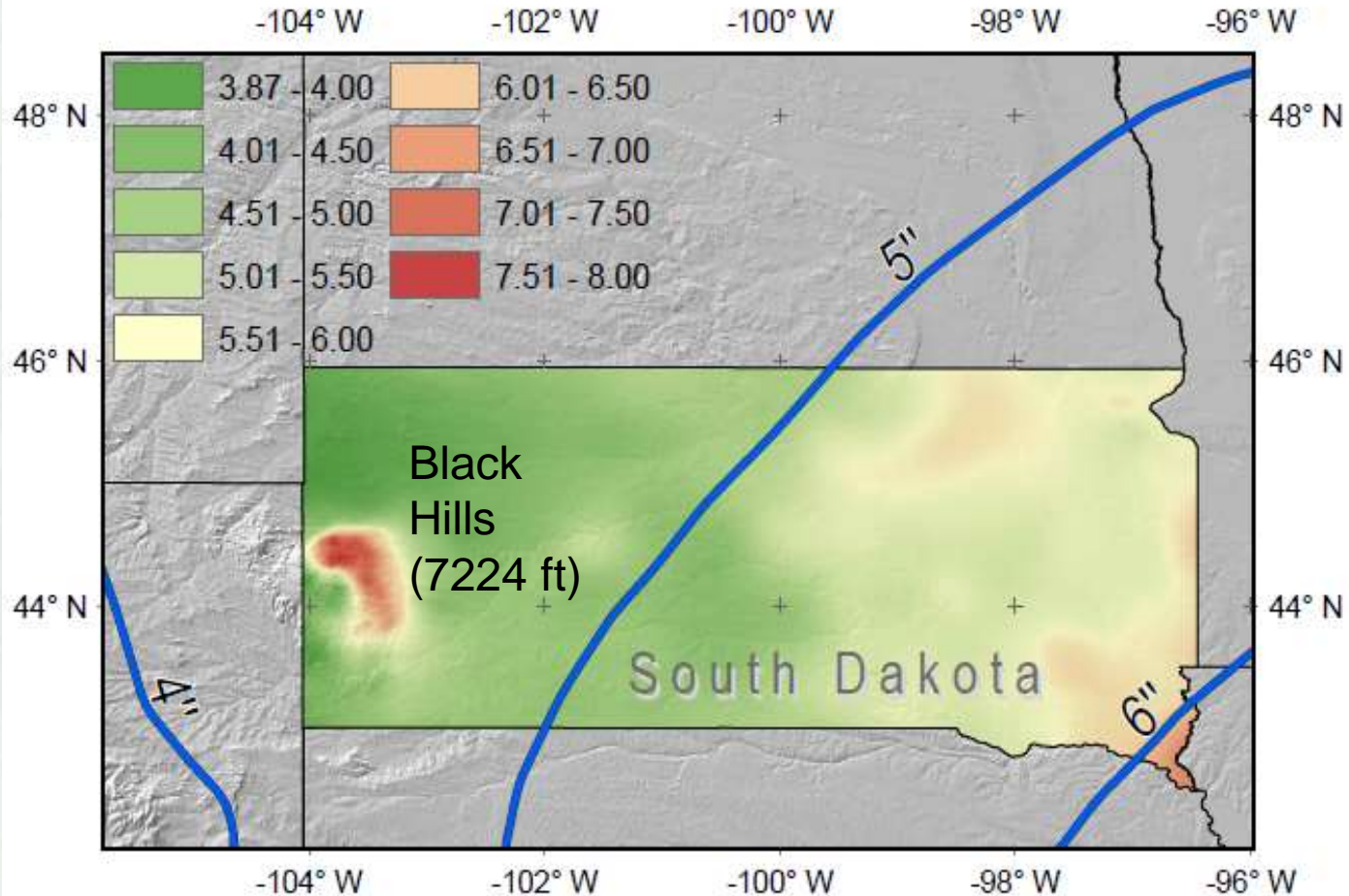
Supplementary information

 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	0.085 (0.065-0.113)	0.106 (0.080-0.143)	0.134 (0.100-0.184)	0.158 (0.116-0.220)	0.190 (0.137-0.270)	0.215 (0.152-0.310)	0.240 (0.167-0.351)	0.270 (0.186-0.401)	0.310 (0.209-0.470)	0.340 (0.226-0.522)
10-min	0.115 (0.088-0.153)	0.142 (0.108-0.191)	0.180 (0.134-0.247)	0.212 (0.156-0.295)	0.256 (0.184-0.364)	0.289 (0.205-0.417)	0.323 (0.225-0.473)	0.363 (0.250-0.539)	0.416 (0.280-0.630)	0.456 (0.303-0.701)
15-min	0.134 (0.103-0.178)	0.166 (0.126-0.224)	0.211 (0.157-0.289)	0.248 (0.182-0.345)	0.299 (0.215-0.425)	0.338 (0.239-0.487)	0.378 (0.264-0.553)	0.425 (0.292-0.631)	0.487 (0.328-0.738)	0.534 (0.355-0.820)
30-min	0.178 (0.136-0.237)	0.220 (0.167-0.296)	0.280 (0.208-0.384)	0.329 (0.241-0.458)	0.397 (0.285-0.564)	0.449 (0.318-0.647)	0.502 (0.350-0.735)	0.564 (0.388-0.838)	0.646 (0.435-0.978)	0.708 (0.470-1.09)
60-min	0.244 (0.187-0.325)	0.302 (0.229-0.407)	0.383 (0.285-0.525)	0.451 (0.331-0.628)	0.544 (0.391-0.772)	0.615 (0.436-0.887)	0.687 (0.471-1.01)	0.772 (0.531-1.15)	0.885 (0.597-1.34)	0.970 (0.644-1.49)
2-hr	0.340 (0.261-0.453)	0.420 (0.318-0.566)	0.534 (0.398-0.732)	0.628 (0.461-0.874)	0.758 (0.545-1.08)	0.858 (0.608-1.24)	0.977 (0.661-1.40)	1.08 (0.740-1.60)	1.23 (0.831-1.87)	1.35 (0.898-2.08)
3-hr	0.396 (0.304-0.527)	0.490 (0.371-0.660)	0.622 (0.463-0.853)	0.732 (0.537-1.02)	0.884 (0.636-1.26)	1.00 (0.708-1.44)	1.12 (0.771-1.63)	1.25 (0.862-1.86)	1.44 (0.969-2.18)	1.58 (1.05-2.42)
6-hr	0.578 (0.443-0.770)	0.715 (0.542-0.963)	0.908 (0.676-1.25)	1.07 (0.783-1.49)	1.29 (0.926-1.83)	1.46 (1.03-2.10)	1.63 (1.11-2.38)	1.83 (1.26-2.72)	2.10 (1.41-3.18)	2.30 (1.53-3.53)
12-hr	0.792 (0.607-1.05)	0.981 (0.744-1.32)	1.25 (0.928-1.71)	1.46 (1.07-2.03)	1.76 (1.27-2.50)	1.99 (1.41-2.83)	2.23 (1.55-3.23)	2.51 (1.74-3.73)	2.87 (1.94-4.35)	3.15 (2.09-4.84)
24-hr	1.06 (0.807-1.44)	1.31 (1.11-1.58)	1.66 (1.30-2.01)	1.94 (1.55-2.38)	2.33 (1.80-2.94)	2.73 (2.15-3.47)	2.97 (2.30-3.88)	3.38 (2.69-4.43)	3.83 (2.86-5.19)	4.20 (3.08-5.78)
2-day	1.35 (1.16-1.59)	1.65 (1.40-1.97)	2.08 (1.73-2.53)	2.43 (1.99-3.00)	2.93 (2.35-3.70)	3.41 (2.74-4.28)	3.89 (3.00-4.89)	4.39 (3.35-5.64)	4.97 (3.71-6.74)	5.49 (4.03-7.55)
3-day	1.55 (1.33-1.83)	1.88 (1.60-2.24)	2.36 (1.96-2.87)	2.76 (2.26-3.40)	3.33 (2.67-4.21)	3.81 (3.00-4.89)	4.33 (3.35-5.64)	4.93 (3.77-6.56)	5.77 (4.31-7.82)	6.40 (4.70-8.80)
4-day	1.71 (1.47-2.01)	2.06 (1.75-2.45)	2.57 (2.14-3.13)	3.00 (2.46-3.71)	3.63 (2.90-4.58)	4.15 (3.27-5.33)	4.71 (3.65-6.15)	5.40 (4.11-7.16)	6.30 (4.70-8.54)	6.99 (5.13-9.62)
7-day	2.06 (1.77-2.43)	2.48 (2.10-2.95)	3.08 (2.56-3.74)	3.57 (2.92-4.41)	4.29 (3.43-5.41)	4.88 (3.84-6.26)	5.51 (4.27-7.19)	6.27 (4.78-8.31)	7.27 (5.42-9.85)	8.02 (5.89-11.0)
10-day	2.33 (2.00-2.74)	2.79 (2.37-3.33)	3.45 (2.87-4.20)	3.99 (3.27-4.93)	4.76 (3.81-6.01)	5.39 (4.25-6.92)	6.06 (4.70-7.91)	6.84 (5.21-9.08)	7.88 (5.88-10.7)	8.66 (6.36-11.9)
20-day	3.19 (2.74-3.75)	3.82 (3.24-4.55)	4.68 (3.89-5.68)	5.35 (4.38-6.61)	6.29 (5.03-7.93)	7.02 (5.53-9.01)	7.78 (6.03-10.2)	8.60 (6.56-11.4)	9.69 (7.23-13.1)	10.5 (7.72-14.5)
30-day	3.99 (3.43-4.70)	4.78 (4.05-5.69)	5.83 (4.85-7.08)	6.63 (5.42-8.18)	7.70 (6.16-9.72)	8.53 (6.72-11.0)	9.37 (7.25-12.2)	10.2 (7.79-13.6)	11.3 (8.46-15.4)	12.2 (8.96-16.8)
45-day	5.03 (4.33-5.92)	6.03 (5.12-7.18)	7.32 (6.09-8.89)	8.26 (6.76-10.2)	9.49 (7.60-12.0)	10.4 (8.19-13.4)	11.3 (8.75-14.7)	12.1 (9.25-16.1)	13.3 (9.88-18.0)	14.1 (10.3-19.4)
60-day	5.78 (4.97-6.80)	6.96 (5.91-8.29)	8.41 (6.99-10.2)	9.43 (7.71-11.6)	10.7 (8.55-13.5)	11.6 (9.11-14.8)	12.4 (9.60-16.2)	13.1 (10.0-17.4)	14.1 (10.5-19.1)	14.8 (10.9-20.4)



GRID Files



24-hr 100-yr NA14 vs. TP40

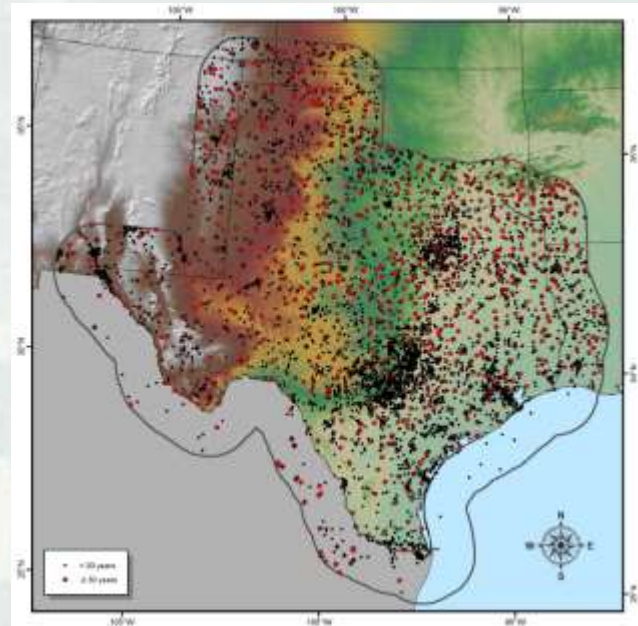


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Precipitation Datasets

Source of data and dataset: network name	Recording period
NCEI: Automated Surface Observing System (ASOS)	1-min
NCEI: DSI 3260	15-minute
NCEI: DSI 3240	1-hour
NCEI: Global Historical Climatology Network (GHCN)	1-day
NCEI: Quality Controlled Local Climatological Data (QCLCD)	1-hour
NCEI: Unedited Local Climatological Data (ULCD)	1-hour
City of Dallas ALERT Network	varying
Edwards Aquifer Authority	1-hour
Guadalupe-Blanco River Authority	6-min
Harris County Flood Control District's Flood Warning System	varying
Jefferson County Drainage District 6 ALERT Precipitation and Stream Level Network	varying
Lower Colorado River Authority Regional Meteorological Network	varying
Midwestern Regional Climate Center: CDMP 19th Century Forts and Voluntary Observers Database	1-day
National Atmospheric Deposition Program (NADP)	1-day
National Estuarine Research Reserve System (NERRS)*	15-minute, 1-hour
NWS Hydrometeorological Automated Data System	1-hour
Oklahoma Mesonet Observation Network*	5-min, 1-day
Sabine River Authority Precipitation Dataset	1-day
Servicio Meteorologico Nacional, Mexico	1-day
Tarrant Regional Water District (Greater Fort Worth area)/ Tarrant County Urban Flood Control Network	15-minute, 1-hour
Texas Commission on Environmental Quality: Air Quality Network*	1-hour
Texas Evapotranspiration Network	1-hour, 1-day
Texas Water Development Board	1-hour, 1-day
Titus County Fresh Water Supply District No. 1	1-day
U.S. Bureau of Reclamation: HydroMet	1-hour, 1-day
US Dept. of Agriculture (USDA): Agricultural Research Service (ARS)	varying
USDA, Forest Service: Remote Automated Weather Station (RAWS) Network	1-hour
USDA, National Resources Conservation Service (NRCS): Soil Climate Analysis Network (SCAN)*	1-hour
USGS Nation Water Information System (NWIS)	15-minute
West Texas Mesonet	1-min, 15-minute

Recording period	Number of stations
1-day	5,944
1-hour	3,150
15-minute, varying	1,361
TOTAL	10,455



Base Project Schedule

- **Data Collection and Initial Quality Control [DONE]**
- **Extraction of Annual Maximum Series and date reliability tests [FEBRUARY 2017]**
- **Regionalization and Frequency Analysis [APRIL 2017]**
- **Initial spatial interpolation of precipitation frequency (PF) estimates [JUNE 2017]**
- **Peer Review [AUGUST 2017]**
- **Revision of PF estimates [JANUARY 2018]**
- **PF estimates for partial duration, seasonality, temporal distributions [MARCH 2018]**
- **Web Publication [APRIL 2018]**



Current Financial Outlook

Current Partners

- Brazos River Authority
- City of Austin
- City of Fort Worth
- Harris County Flood Control District
- NCTCOG
- TxDOT
- U.S. Army Corps of Engineers

Budgeted cost of Project, FY15-FY18: \$1,577,138

Pooled Funds Raised so far: \$1,322,389

Remaining Funds Required: \$254,749



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Additional Precipitation Studies

- **Depth-Area-Duration**

- Helps relate precipitation frequency estimates from Atlas 14 to average storm volume, over different time intervals.
- Would be available on same web server as normal Atlas 14 PF estimates
- Cost: \$420K

- **Trend Analysis**

- In pre-planning stages, working with two groups from NOAA and North Carolina State University
- Working to bring them together to look at trend analysis, including climate change for PF estimates
- Initial scope estimates: \$550K+



NOAA Atlas 14:

<http://hdsc.nws.noaa.gov/hdsc/pfds/index.html>

Questions?

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