

## **New Jersey Storm List Appendix F**

This appendix contains all the storm data used to develop PMP depths in this study. Information is provided representing the SPAS analyzed data, the information used to locate the storm representative dew point/SST location, and other pertinent information regarding the In-place storm representative dew point and rainfall. The adjustments applied to each storm to each grid point to calculate the TAF over the entire domain are contained in the PMP Tool database.

In this appendix, daily synoptic weather maps are provided for a period starting a few days before the storm and continuing to a few days after the storm. Daily weather maps covering the period from 1871 through 2002 are from the U.S. Daily Weather Maps Archive, [NOAA Climate Database Modernization Program \(CDMP\)](#), National Climatic Data Center, Asheville, NC, and the NOAA Central Library Data Imaging Project. Daily synoptic weather maps from 2002 through 2014 are from the NOAA Weather Prediction Center Daily Weather Maps web page, <https://www.wpc.ncep.noaa.gov/dailywxmap/index.html>.

For all storms which had a USACE Storm Studies analysis previously completed, those pertinent data sheet pages are included. These data came from the USACE Storm Rainfall in the United States, Depth-Area-Duration Data files (USACE, 1973). In addition, there are several storms which include a hand drawn transposition limit map complete by the NWS. These maps were recovered from the Hydrometeorological Design Studies Center office in Silver Spring, MD and are archived on AWA's server. Descriptions of transposition limits of key storms are contained in several HMRs (e.g., HMR 52 Figure 26 and HMR 53 Table 2 (Ho and Reidel, 1980)).

**Table F.1 Short storm list used for PMP Development. Total Rainfall is the location with the largest rainfall accumulation for the total storm duration.**

SPAS_ID	Storm Name	State	Latitude	Longitude	Year	Month	Day	Maximum Total Rainfall (in)	Storm Rep Analysis Duration	Storm Rep Dew Point/SST	In Place Max Dew Point/SST Rounded	In Place Max Factor	Storm Adjustment Date	Storm Representative Latitude	Storm Representative Longitude	Moisture Inflow Vector
SPAS_1339_1	WELLSBORO	PA	41.7042	-77.2292	1889	5	30	10.11	24	77.00	81.00	1.21	15-Jun	34.00	-76.00	SSE @ 535
SPAS_1339_2	WELLSBORO	PA	40.9042	-78.5958	1889	5	30	8.99	24	77.00	81.00	1.21	15-Jun	34.00	-76.00	SSE @ 536
SPAS_1339_3	WELLSBORO	PA	40.3958	-76.9292	1889	5	30	9.19	24	77.00	81.00	1.21	15-Jun	34.00	-76.00	SSE @ 537
SPAS_1566_1	PATERSON	NJ	40.9375	-74.1375	1903	10	8	15.96	24	72.50	78.00	1.30	25-Sep	37.50	-72.50	SE @ 250
SPAS_1514_1	VADE MECUM	NC	36.3125	-80.2792	1908	8	23	17.97	24	82.50	85.00	1.11	15-Aug	31.00	-78.20	SSE @ 385
SPAS_1255_1	PITTSFIELD	MA	42.4625	-73.2540	1948	12	28	12.58	24	70.00	73.50	1.19	15-Dec	37.00	-65.00	SE @ 575
SPAS_1680_1	WEST SHOKAN	NY	42.0042	-74.3958	1955	10	14	20.27	24	78.00	81.50	1.19	1-Oct	35.00	-71.00	SSE @ 500
SPAS_1533_1	MONTABELLO	VA	37.8125	-79.1625	1985	11	1	22.56	24	76.50	79.50	1.17	17-Oct	35.00	-73.00	ESE @ 395
SPAS_1201_1	HALIFAX	VT	42.7699	-72.7500	2005	10	7	15.40	24	80.00	82.50	1.13	24-Sep	32.00	-67.00	SSE @ 808
SPAS_1047_1	TAMAQUA	PA	41.6750	-75.3750	2006	6	26	12.26	24	70.50	76.00	1.31	10-Jul	40.10	-74.70	SSE @ 115
SPAS_1041_1	NORWALK	CT	41.1016	-73.4401	2007	4	15	9.44	24	71.00	73.50	1.13	1-May	34.00	-72.00	SSE @ 495
SPAS_1350_1	NEW BERN	NC	35.1750	-77.2150	2010	9	27	23.44	24	81.50	84.00	1.11	15-Sep	30.00	-73.00	SE @ 435
SPAS_1298_1	HARRISBURG	PA	39.9850	-76.4950	2011	9	4	18.32	24	81.50	84.00	1.11	20-Aug	33.00	-74.00	SSE @ 500
SPAS_1629_1	HECTOR	NY	42.5042	-76.7958	1935	7	6	14.27	24	81.00	83.00	1.11	15-Jul	35.00	-74.75	SSE @ 529
SPAS_1340_1	BIG MEADOWS	VA	38.5458	-78.4042	1942	10	12	19.77	24	78.00	81.50	1.19	1-Oct	34.00	-70.00	ESE @ 835
SPAS_1275_2	MONTGOMERY DAM	PA	40.6050	-76.4650	2004	9	18	8.80	12	72.00	77.50	1.32	1-Sep	40.64	-82.30	W @ 305
SPAS_1547_1	CATSKILL	NY	42.1842	-73.8688	1819	7	27	18.23	6	72.50	78.50	1.13	15-Jul	40.75	-72.95	SSE @ 110
SPAS_1489_1	JEWELL	MD	38.7290	-76.5710	1897	7	26	15.88	12	71.50	80.50	1.50	10-Aug	38.00	-73.50	E @ 175
SPAS_1534_1	EWAN	NJ	39.6875	-75.1807	1940	9	1	24.30	6	76.00	81.50	1.29	15-Aug	37.27	-74.47	SSE @ 175
SPAS_1406_1	RAPIDAN	VA	38.4150	-78.3350	1995	6	27	28.39	6	82.00	84.00	1.09	10-Jul	33.50	-77.00	SSE @ 350
SPAS_1818_1	ATLANTIC CITY	NJ	39.5050	-74.4350	1997	8	20	14.28	24	78.00	81.50	1.17	6-Aug	37.00	-75.00	SSW @ 176
SPAS_1017_1	SPARTA	NJ	41.0300	-74.6400	2000	8	11	16.70	12	68.00	77.00	1.50	15-Aug	41.17	-73.44	ENE @ 65
SPAS_1040_1	TABERNACLE	NJ	39.8812	-74.6895	2004	7	13	15.63	6	74.00	79.50	1.29	30-Jul	38.34	-75.34	SSW @ 110
SPAS_1049_1	DELAWARE COUNTY	NY	42.0100	-74.9000	2007	6	19	11.69	6	71.00	77.50	1.39	1-Jul	41.43	-74.90	S @ 40
SPAS_1415_1	ISLIP	NY	40.8050	-73.0650	2014	8	13	14.23	24	76.50	80.00	1.18	15-Aug	38.50	-73.00	S @ 160
SPAS_1700_1	ELLCOTT CITY	MD	39.2650	-76.7550	2018	5	27	14.22	6	73.50	77.00	1.18	10-Jun	38.41	-77.69	SW @ 78
SPAS_1565_1	PATERSON	NJ	40.8875	-74.0958	1882	9	20	17.88	24	80.00	83.00	1.15	7-Sep	35.00	-69.00	SE @ 490
SPAS_1299_1	ALTA PASS	NC	35.8792	-81.8708	1916	7	13	24.90	24	81.50	84.00	1.13	30-Jul	32.00	-75.00	SE @ 476
SPAS_1517_2	MONCURE	NC	35.6042	-79.0708	1929	9	29	11.55	24	80.00	84.50	1.22	15-Sep	31.00	-78.00	SSE @ 325
SPAS_1490_1	EASTON	MD	38.8625	-76.0708	1935	9	4	17.00	24	80.50	83.00	1.12	20-Aug	35.00	-73.00	SSE @ 315
SPAS_1341_1	BUCK	CT	41.5542	-72.6542	1938	9	17	18.06	24	80.00	83.50	1.17	5-Sep	32.00	-70.00	SSE @ 675
SPAS_1567_1	TUCKERTON	NJ	39.6790	-74.2710	1939	8	19	18.07	24	81.00	83.00	1.09	15-Aug	35.50	-72.50	SSE @ 305
SPAS_1243_1	WESTFIELD	MA	42.1961	-72.8246	1955	8	17	18.93	24	75.00	77.00	1.11	15-Aug	40.20	-74.25	SSW @ 155
SPAS_1679_1	SLIDE MOUNTAIN	NY	42.0208	-74.3958	1955	8	11	15.20	24	73.00	76.00	1.17	5-Aug	40.80	-73.20	SE @ 105
SPAS_1491_1	TYRO	VA	37.8125	-79.0042	1969	8	19	27.23	12	77.50	79.50	1.10	5-Aug	36.08	-79.95	SW @ 130
SPAS_1276_2	ZERBE	PA	40.5375	-76.6208	1972	6	18	18.79	24	78.00	80.50	1.12	5-Jul	36.00	-67.00	ESE @ 610
SPAS_1552_1	SOUTHPORT	NC	34.0050	-77.9950	1999	9	14	24.30	24	78.00	83.00	1.25	1-Sep	35.00	-72.00	NE @ 350
SPAS_1552_2	YORKTOWN	VA	37.2750	-76.5550	1999	9	14	19.22	24	78.00	83.00	1.25	1-Sep	35.00	-72.00	SE @ 300
SPAS_1552_3	POMPTON LAKE	NJ	40.9950	-74.2850	1999	9	15	14.62	24	78.50	82.50	1.20	1-Sep	36.33	-72.00	SE @ 345
SPAS_1552_4	CAIRO	NY	42.2950	-74.0050	1999	9	15	11.71	24	78.50	82.50	1.20	1-Sep	36.33	-72.00	SE @ 300
SPAS_1535_2	UPPER SHERANDO	VA	37.9125	-79.0292	2003	9	17	20.22	24	80.50	83.00	1.14	3-Sep	36.50	-70.50	E @ 480
SPAS_1551_1	RICHMOND	VA	37.7050	-77.3750	2004	8	30	14.38	6	81.00	83.00	1.09	15-Aug	34.75	-72.50	SE @ 340
SPAS_1224_1	MAPLECREST	NY	42.3000	-74.1600	2011	8	27	22.91	12	81.50	83.50	1.10	15-Aug	34.00	-72.00	SSE @ 585
SPAS_1669_1	EVERGREEN	NC	34.4550	-78.8650	2016	10	6	19.12	24	82.50	84.00	1.07	22-Sep	30.50	-77.00	SSE @ 295
SPAS_1891_1	HURRICANE IDA	PA	39.9750	-75.6650	2021	8	31	10.29	6	78.00	80.00	1.09	18-Aug	37.00	-76.70	SSW @ 215



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## General Storms

## Storm Precipitation Analysis System (SPAS) For Storm #1339\_1 SPAS Analysis

**General Storm Location:** Wellsboro, PA region, caused the Johnstown Flood

**Storm Dates:** May 29 (0600) - June 3 (0500), 1889

**Event:** Flash Flood Event

### DAD Zone 1

**Latitude:** 41.7042

**Longitude:** -77.2292

**Max. Grid Rainfall Amount:** 10.11"

**Max. Observed Rainfall Amount:** 9.80"

**Number of Stations:** 176 (33 Daily, 5 Hourly, and 138 Supplemental)

**SPAS Version:** 9.5

**Basemap:** Monthly Weather Report Isohyetal Grid

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

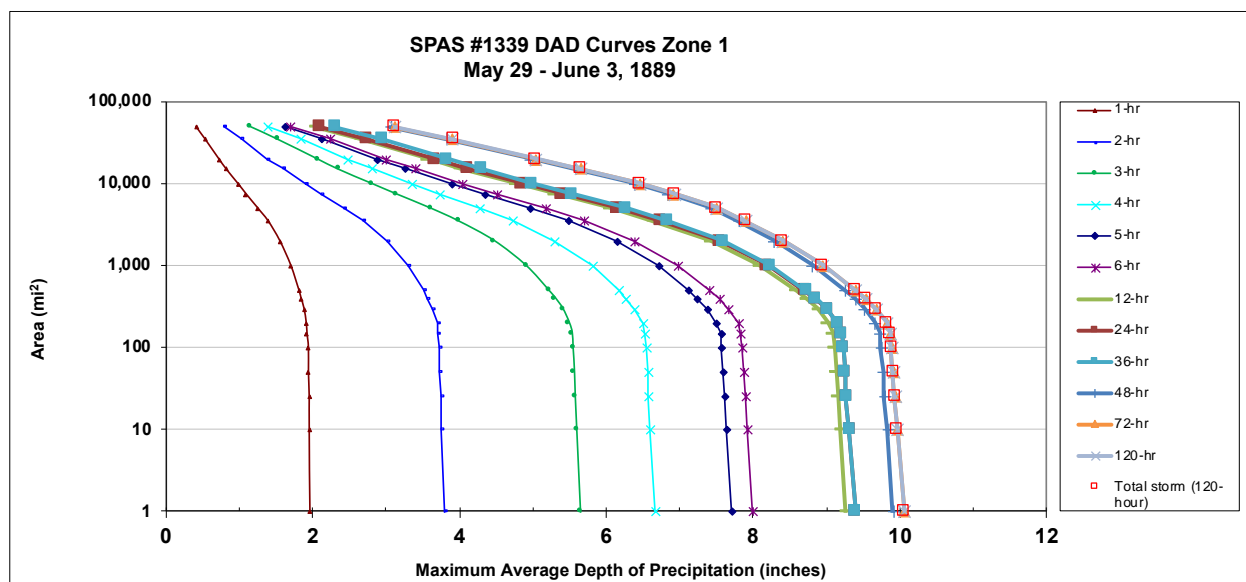
**Radar Included:** No

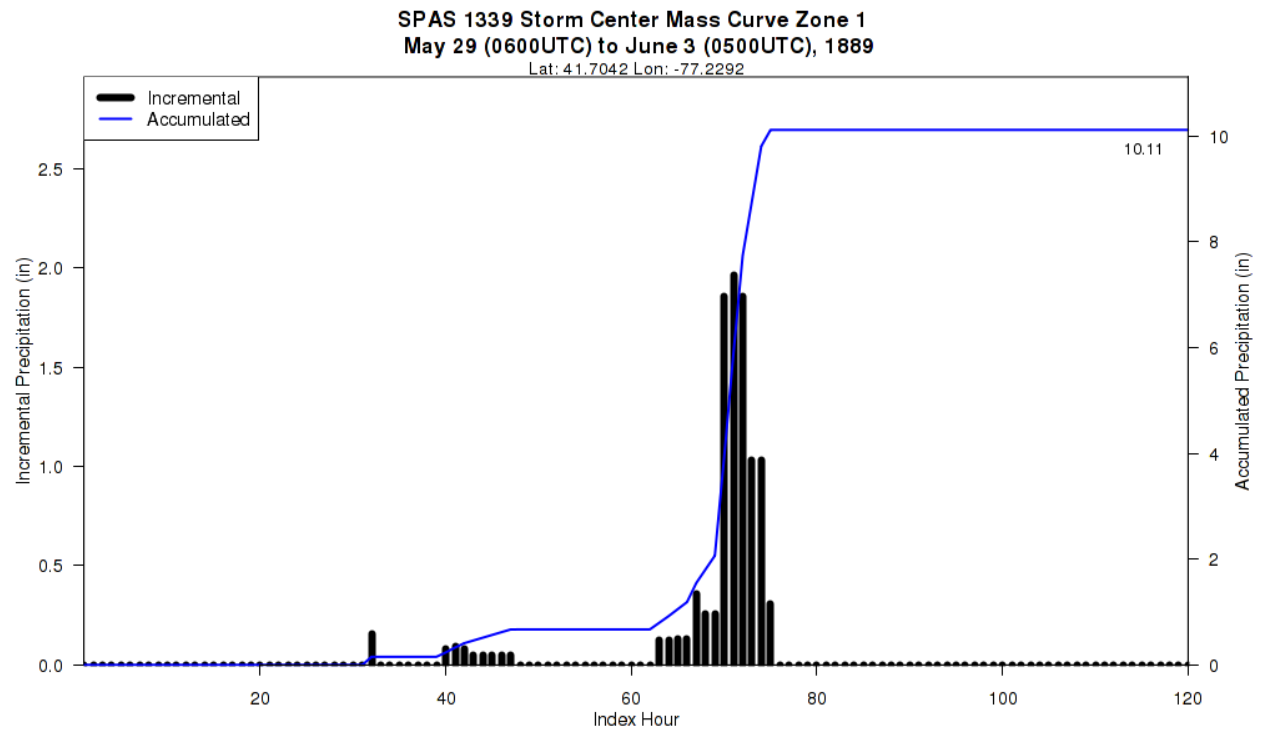
**Depth-Area-Duration (DAD) analysis:** Yes

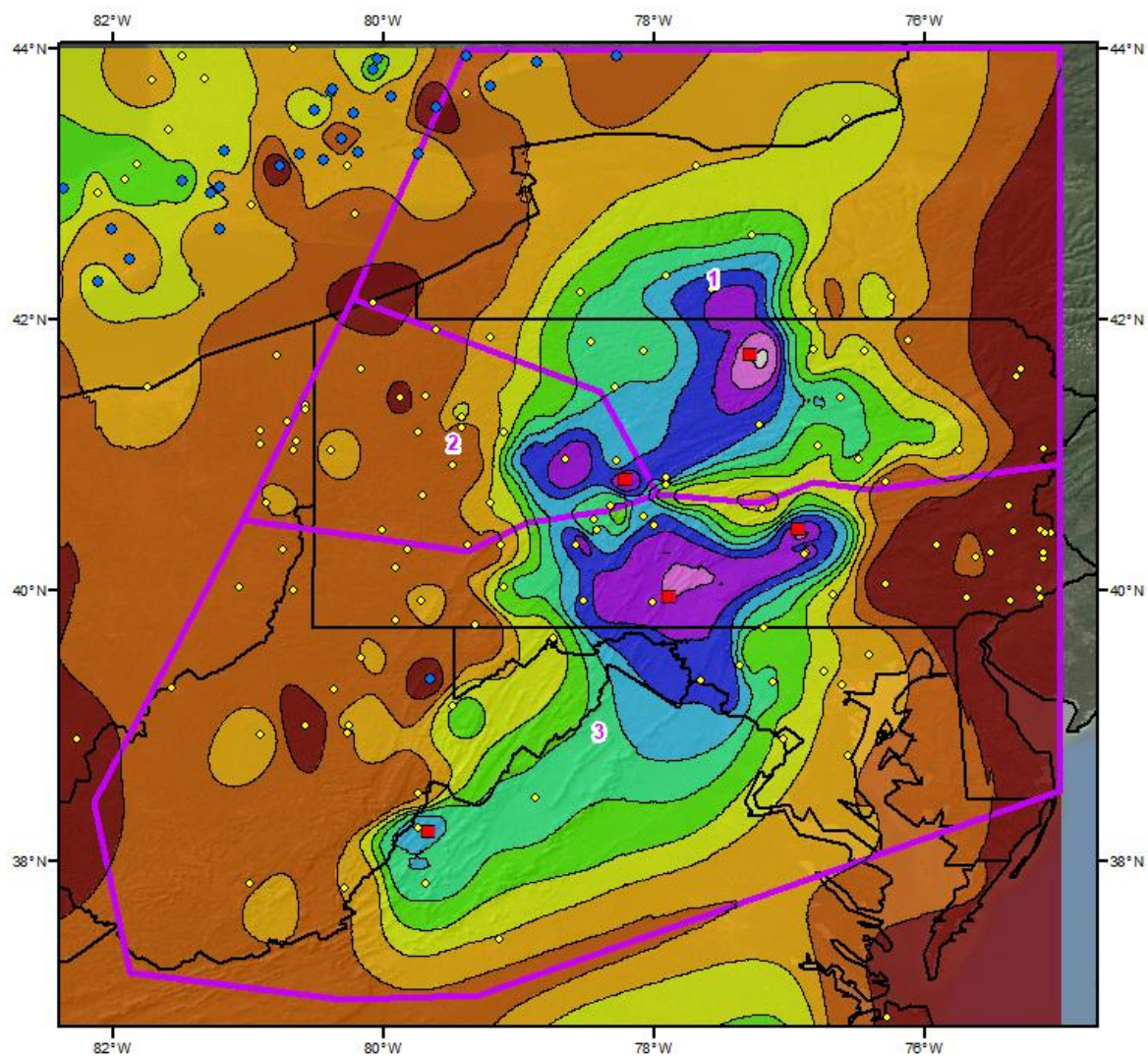
**Reliability of results:** This analysis was based on hourly data, daily data, and supplemental station. We have a high degree of confidence in the station based storm total results, the spatial pattern is dependent on the basemap, and the timing is based on hourly stations. The timing of rainfall accumulation at sub daily timescales is uncertain because of the lack of hourly data available for the storm. The mass curve represents our best evaluation based on USACE analyses and bucket survey reports.

SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1339_1	-77.2292	41.7042	1,842	1,800	15-Jun	77.00	3.14	0.47	76	2.670	80.91	81.0	3.77	0.54	84	3.230	1.210

Storm 1339 <b>Zone 1</b> - May 29 (0600 UTC) - Jun. 03 (0500 UTC), 1889													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
areasqmi	Duration (hours)												
	1-hr	2-hr	3-hr	4-hr	5-hr	6-hr	12-hr	24-hr	36-hr	48-hr	72-hr	120-hr	Total
0.4	1.96	3.81	5.66	6.69	7.72	8.03	9.30	9.42	9.42	9.94	10.09	10.09	10.09
1	1.95	3.79	5.64	6.67	7.70	8.00	9.27	9.39	9.39	9.91	10.06	10.06	10.06
10	1.94	3.76	5.59	6.60	7.64	7.92	9.19	9.31	9.31	9.83	9.97	9.97	9.97
25	1.94	3.74	5.57	6.58	7.61	7.89	9.16	9.27	9.27	9.79	9.93	9.93	9.93
50	1.93	3.73	5.56	6.56	7.59	7.87	9.13	9.25	9.25	9.77	9.91	9.91	9.91
100	1.93	3.72	5.54	6.54	7.57	7.85	9.11	9.23	9.23	9.74	9.88	9.88	9.88
150	1.91	3.71	5.53	6.53	7.56	7.83	9.09	9.21	9.21	9.73	9.87	9.87	9.87
200	1.90	3.70	5.49	6.50	7.49	7.80	9.02	9.15	9.15	9.66	9.82	9.82	9.82
300	1.87	3.63	5.40	6.39	7.38	7.67	8.89	9.00	9.01	9.52	9.67	9.67	9.67
400	1.83	3.57	5.30	6.27	7.24	7.53	8.72	8.84	8.85	9.38	9.53	9.53	9.53
500	1.80	3.51	5.21	6.17	7.12	7.41	8.59	8.70	8.72	9.25	9.39	9.39	9.39
1,000	1.69	3.30	4.90	5.80	6.70	6.97	8.08	8.19	8.22	8.80	8.94	8.94	8.94
2,000	1.54	3.01	4.47	5.29	6.14	6.37	7.42	7.53	7.58	8.28	8.40	8.40	8.40
3,500	1.38	2.68	3.98	4.72	5.47	5.69	6.63	6.74	6.83	7.80	7.89	7.89	7.89
5,000	1.24	2.42	3.60	4.28	4.96	5.16	6.04	6.14	6.25	7.42	7.50	7.50	7.50
7,500	1.08	2.11	3.13	3.73	4.33	4.51	5.29	5.39	5.52	6.84	6.91	6.92	6.92
10,000	0.97	1.89	2.80	3.34	3.88	4.04	4.76	4.85	4.97	6.37	6.45	6.45	6.46
15,000	0.81	1.58	2.34	2.80	3.26	3.39	4.02	4.11	4.30	5.57	5.64	5.64	5.64
20,000	0.71	1.39	2.06	2.47	2.88	3.00	3.57	3.65	3.83	4.96	5.02	5.03	5.04
35,000	0.52	1.02	1.51	1.82	2.12	2.22	2.66	2.73	2.95	3.83	3.89	3.90	3.92
49,524	0.40	0.78	1.15	1.38	1.62	1.69	2.04	2.09	2.30	3.06	3.10	3.11	3.12







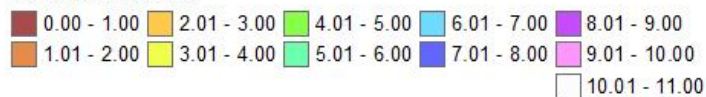
**Total Storm (120-hr) Precipitation (inches)**  
**May 29 (0600 UTC) - June 3 (0500 UTC), 1889**  
**SPAS 1339 - Wellsboro, PA**

#### Gauges

- Daily
- Hourly
- Supplemental



#### Precipitation (inches)



7/11/2014



DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS

**STORM STUDIES - PERTINENT DATA SHEET (REV.)**

Storm of 30 May- 1 June 1889

Assignment SA 1-1

Location Pa., Md., Va., W. Va.

Study Prepared by:

Middle Atlantic Division

Baltimore District Office

Part I Reviewed by H. M. Sec. of  
Weather Bureau, 7/15/41Part II Approved by Office, Chief  
of Engineers for Distribution  
of Factual Data, 3/29/43Remarks: Center at  
Wellsboro, Penna.

Dewpt. 65° - Ref. Pt. 200° S

Grid D-6

**DATA AND COMPUTATIONS COMPILED****PART I**

Preliminary isohyetal map, in 1 sheet, scale 1:2,500,000

Precipitation data and mass curves:

(Number of Sheets)

Form 5001-C (Hourly precip. data) ----- -

Form 5001-B (24-hour " " " " ) ----- 22

Form 5001-D ( " " " " " ) ----- -

Misc. precip. records, meteorological data, etc. ----- -

Form 5002 (Mass rainfall curves) ----- 22

**PART II**

Final isohyetal maps, in 1 sheet, scale 1:2,500,000

Data and computation sheets:

Form S-10 (Data from mass rainfall curves) ----- 3

Form S-11 (Depth-area data from isohyetal map) ----- 1

Form S-12 (Maximum depth-duration data) ----- 5

Maximum duration-depth-area curves ----- 1

Data relating to periods of maximum rainfall ----- 1

**MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES**

Area in Sq. Mi.	Duration of Rainfall in Hours										
	6	12	18	24	30	36	48	60			
10	7.4	8.6	9.1	9.2	9.2	9.7	9.8	9.8			
100	7.2	8.3	8.9	9.0	9.0	9.6	9.6	9.6			
200	7.1	8.2	8.7	8.8	8.8	9.3	9.4	9.4			
500	7.0	8.0	8.5	8.6	8.6	9.0	9.1	9.1			
1,000	6.7	7.7	8.2	8.3	8.3	8.7	8.8	8.8			
2,000	5.8	6.5	7.7	7.8	8.0	8.4	8.6	8.5			
5,000	3.9	4.9	6.4	6.8	7.5	8.0	8.1	8.1			
10,000	2.8	4.0	5.0	5.7	7.0	7.6	7.7	7.7			
20,000	2.1	3.2	4.0	4.7	6.3	6.8	7.0	7.0			
50,000	1.4	2.4	3.1	3.6	4.8	5.4	6.6	5.6			
82,000	1.0	1.8	2.4	2.8	3.7	4.1	4.4	4.4			

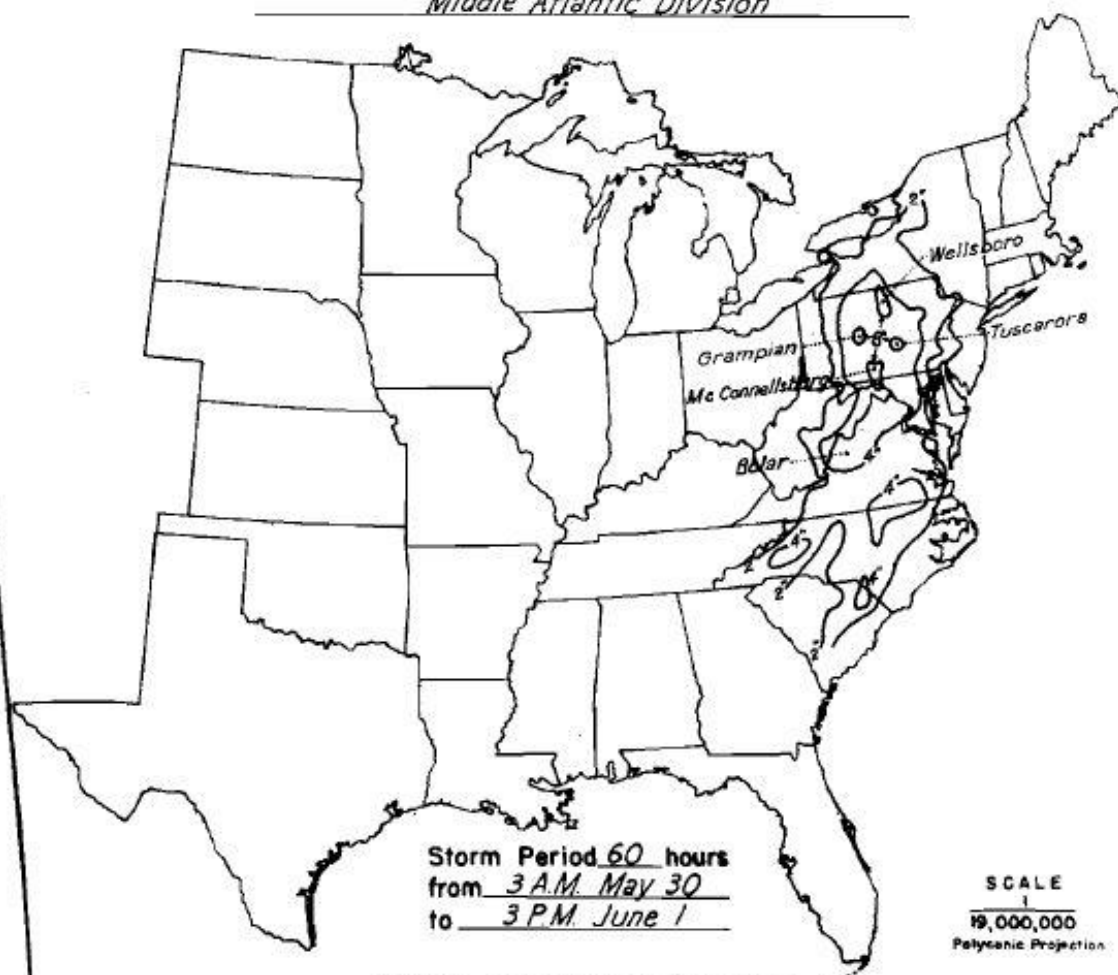
Form S-2

PART OF THE ARMY

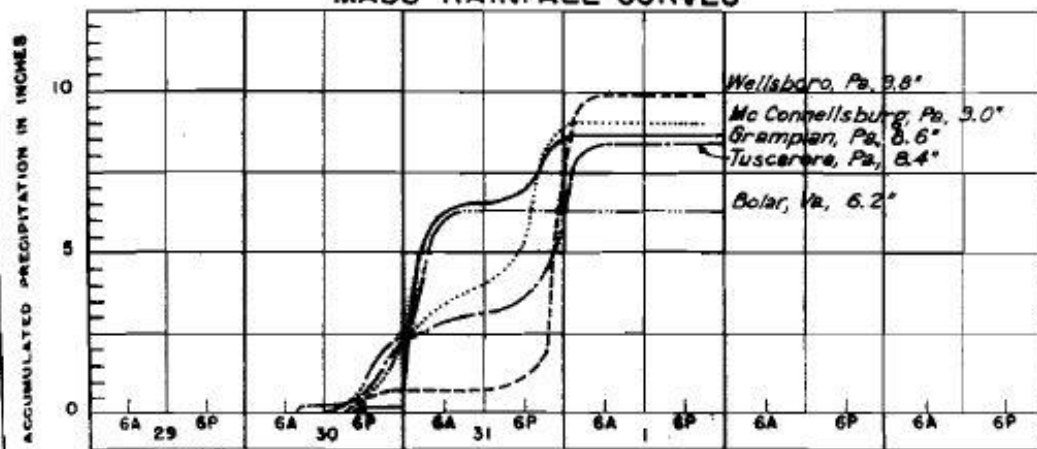
CORPS OF ENGINEERS

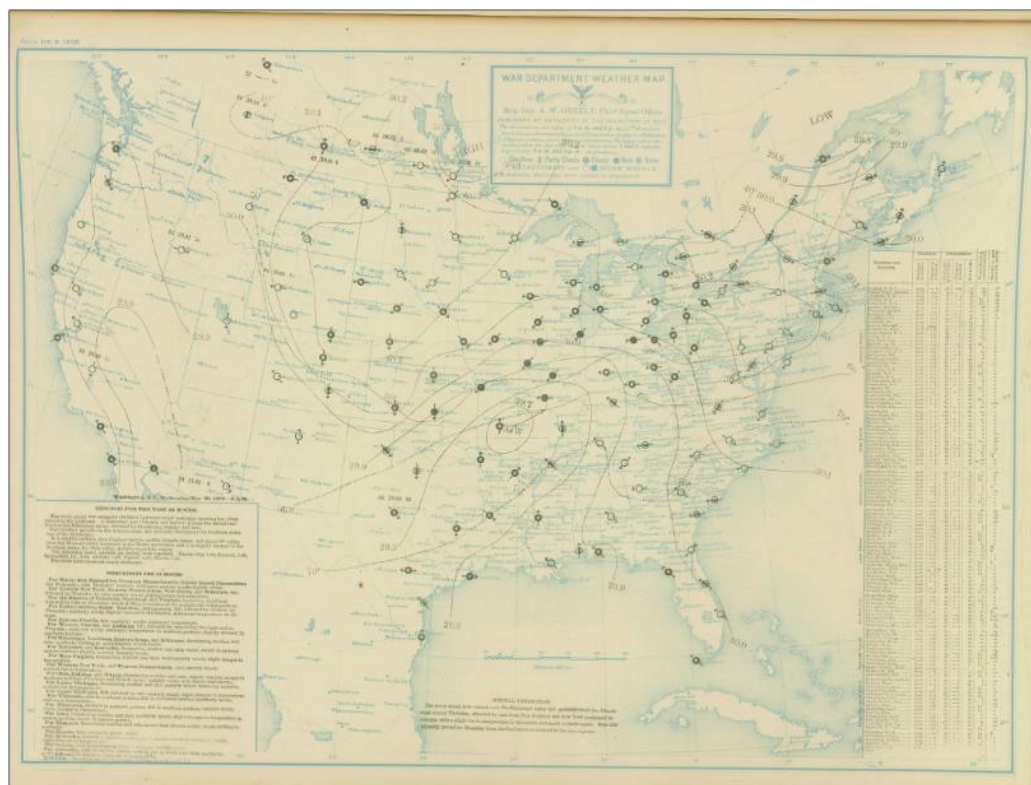
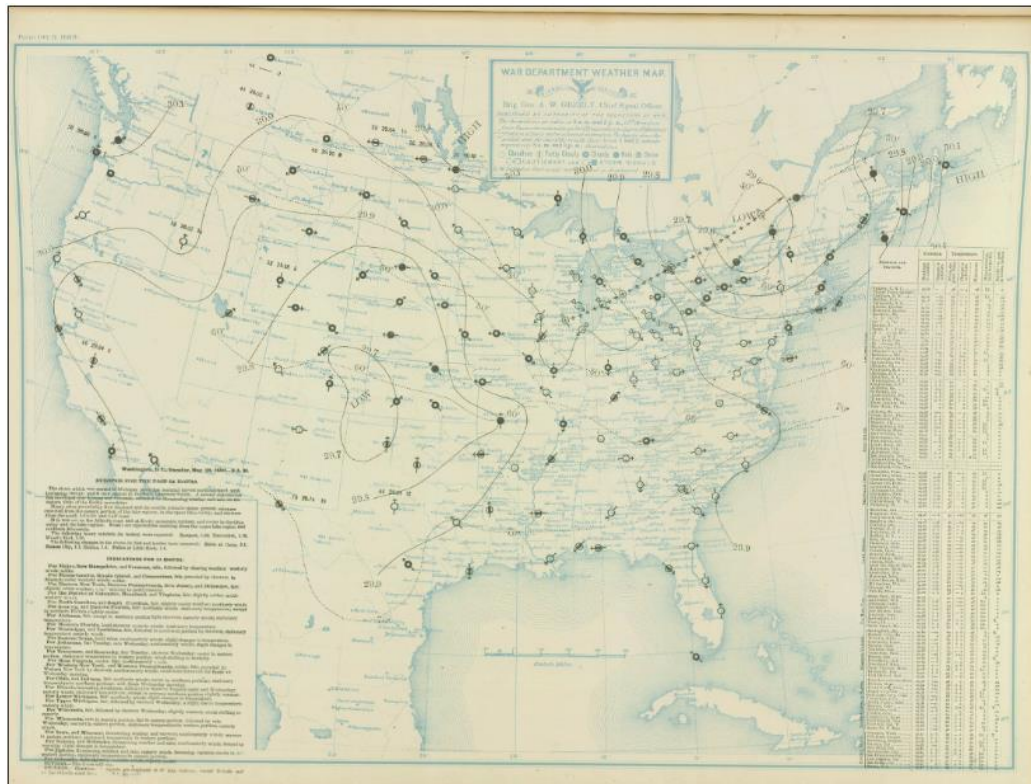
## STORM STUDIES - ISOHYETAL MAP

Storm of May 30 - June 1, 1889 Assignment SA-1-1  
 Study Prepared by: Baltimore, Md. District  
Middle Atlantic Division

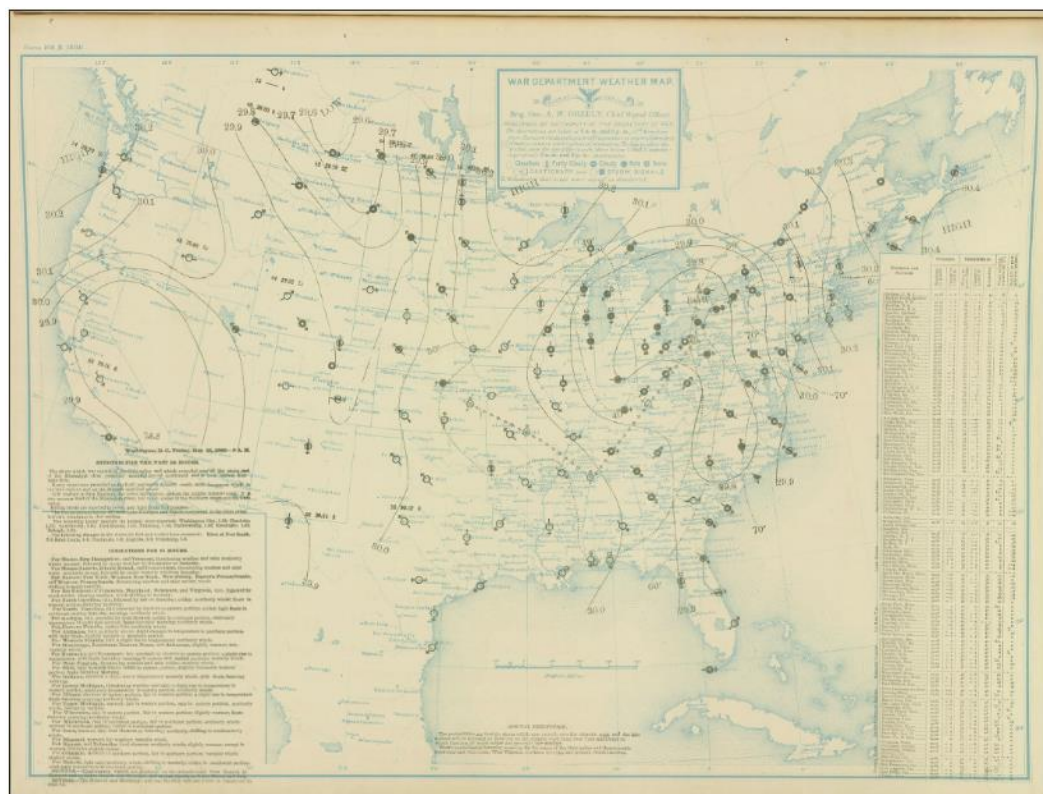
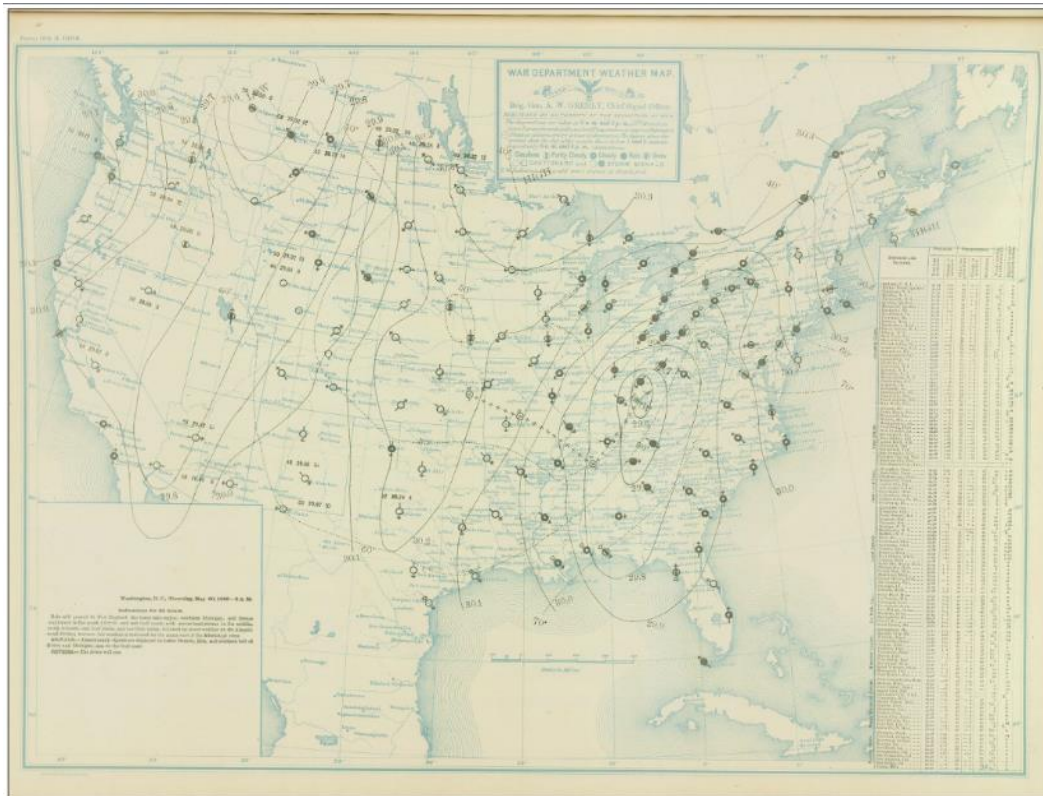


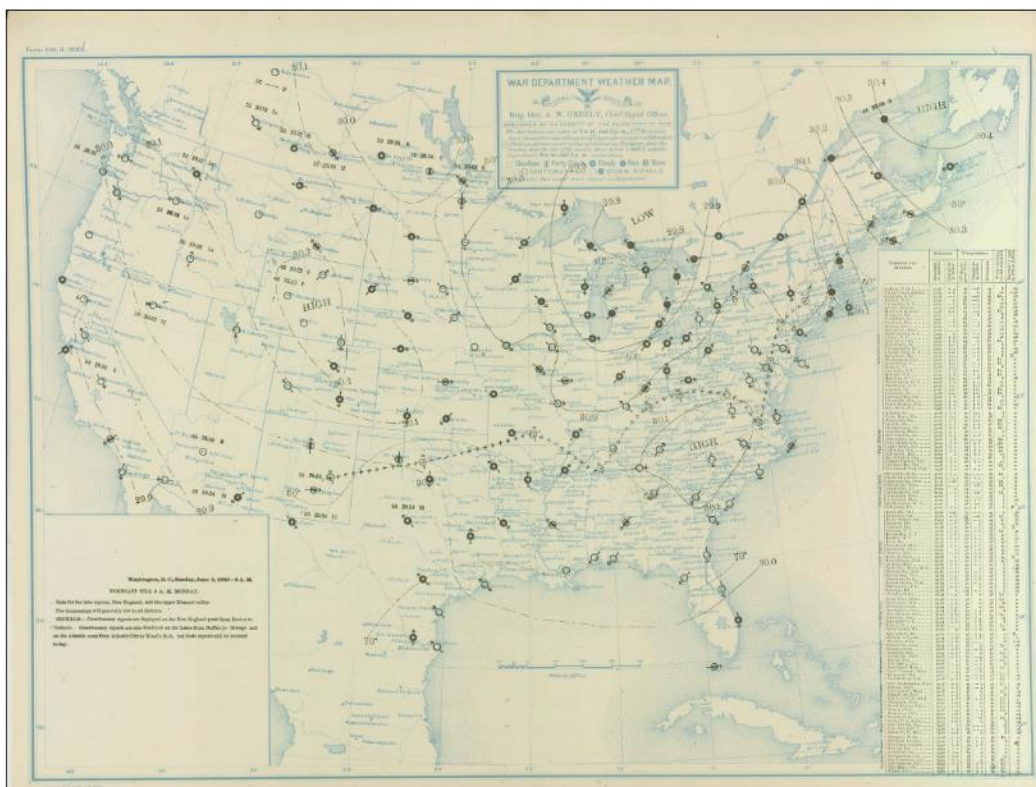
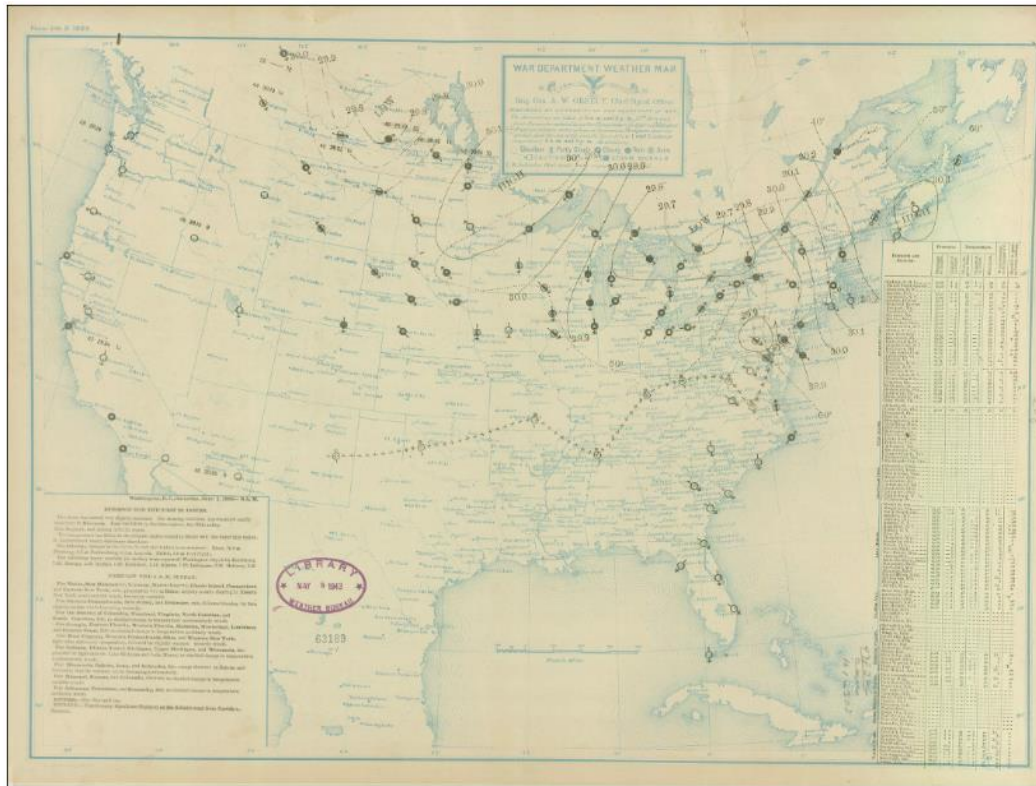
## MASS RAINFALL CURVES



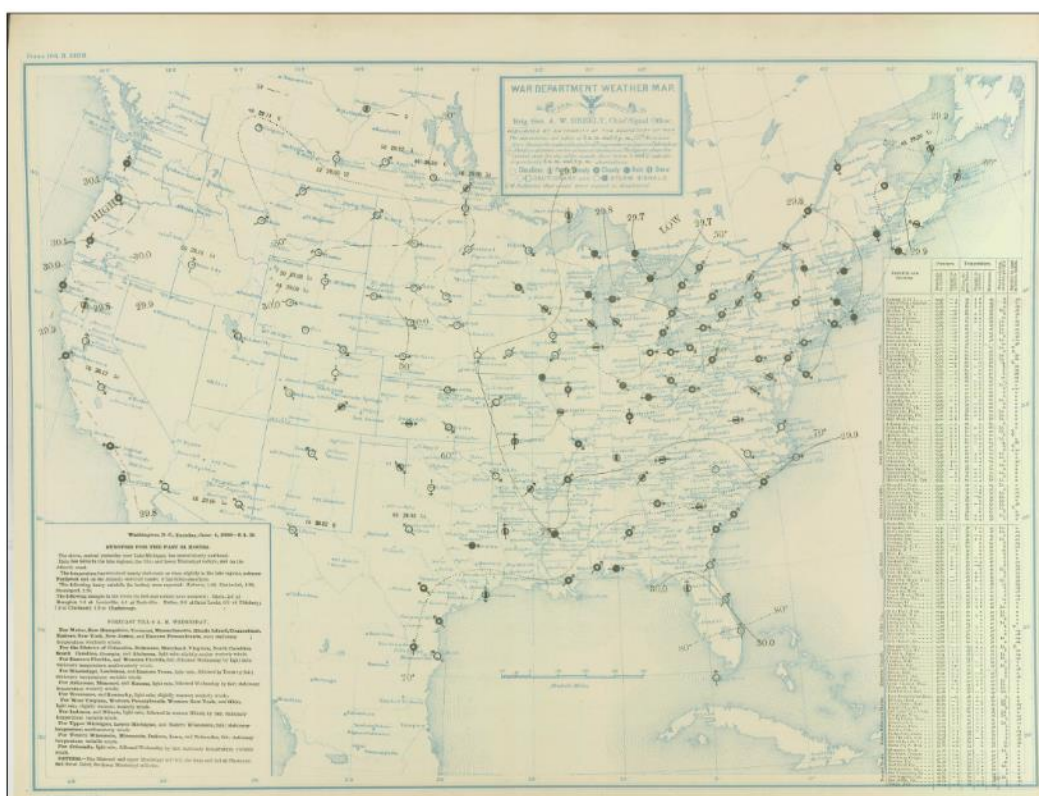
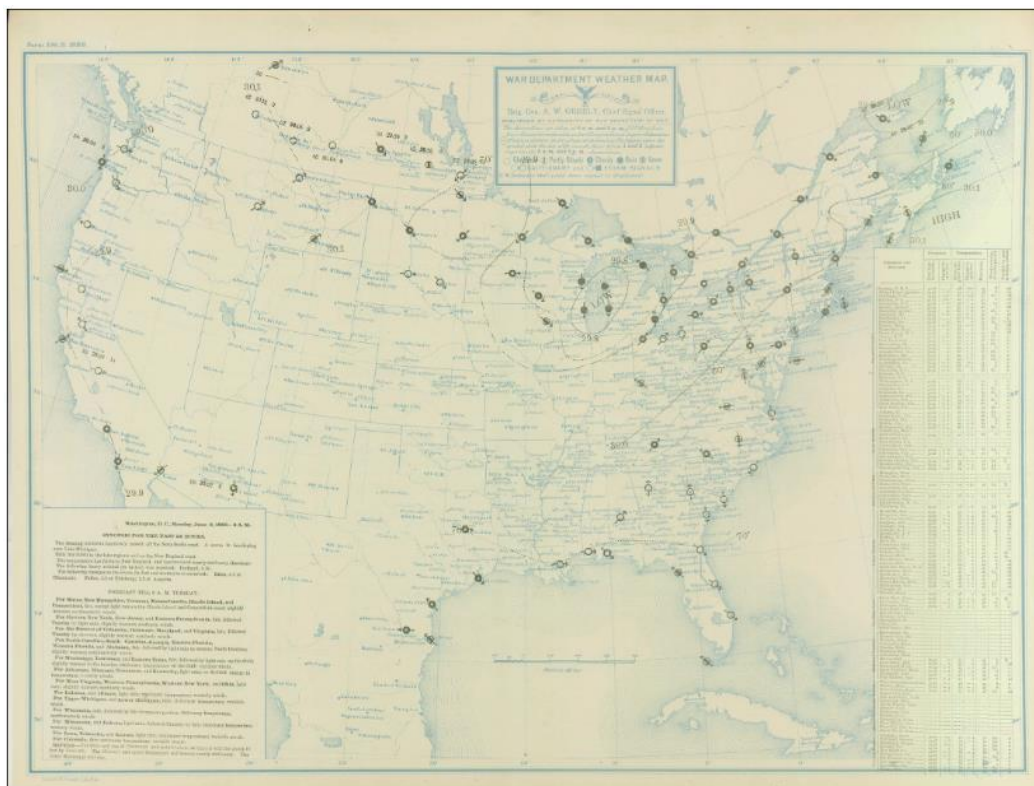




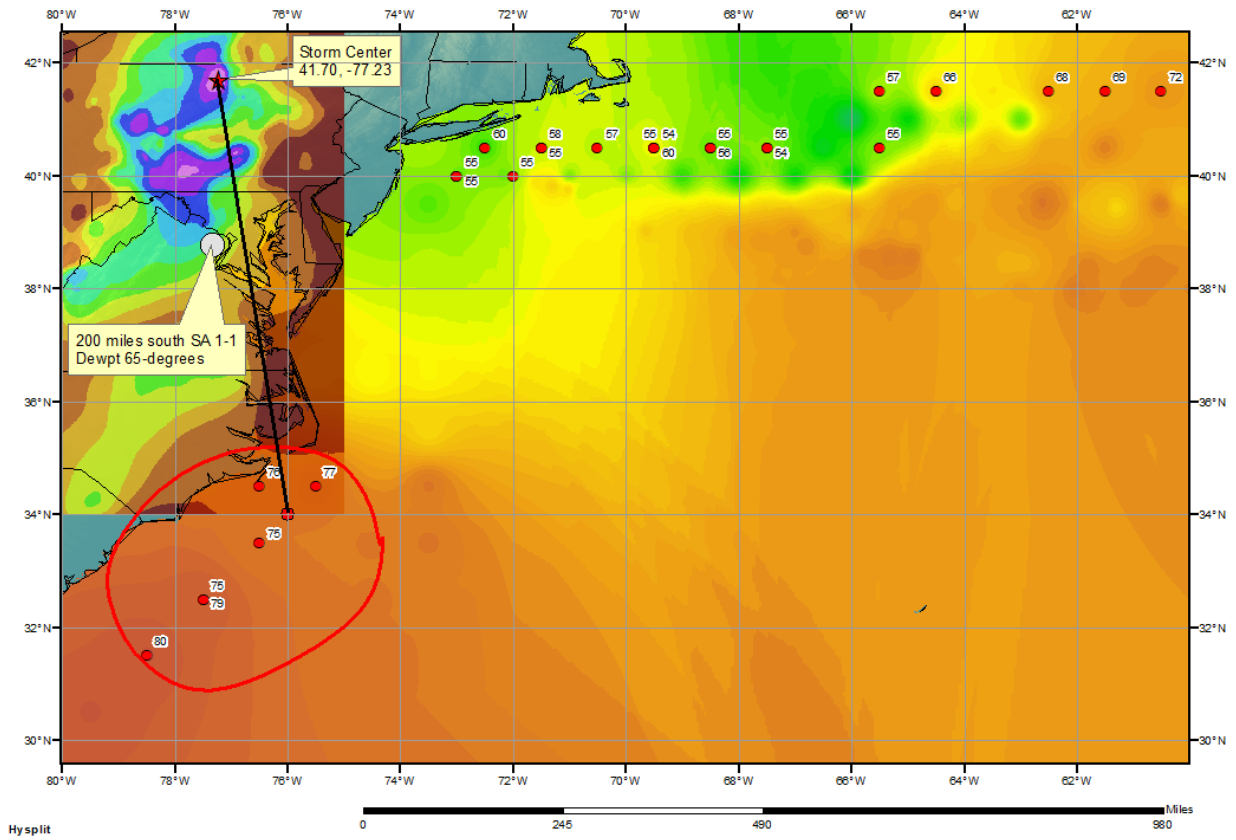






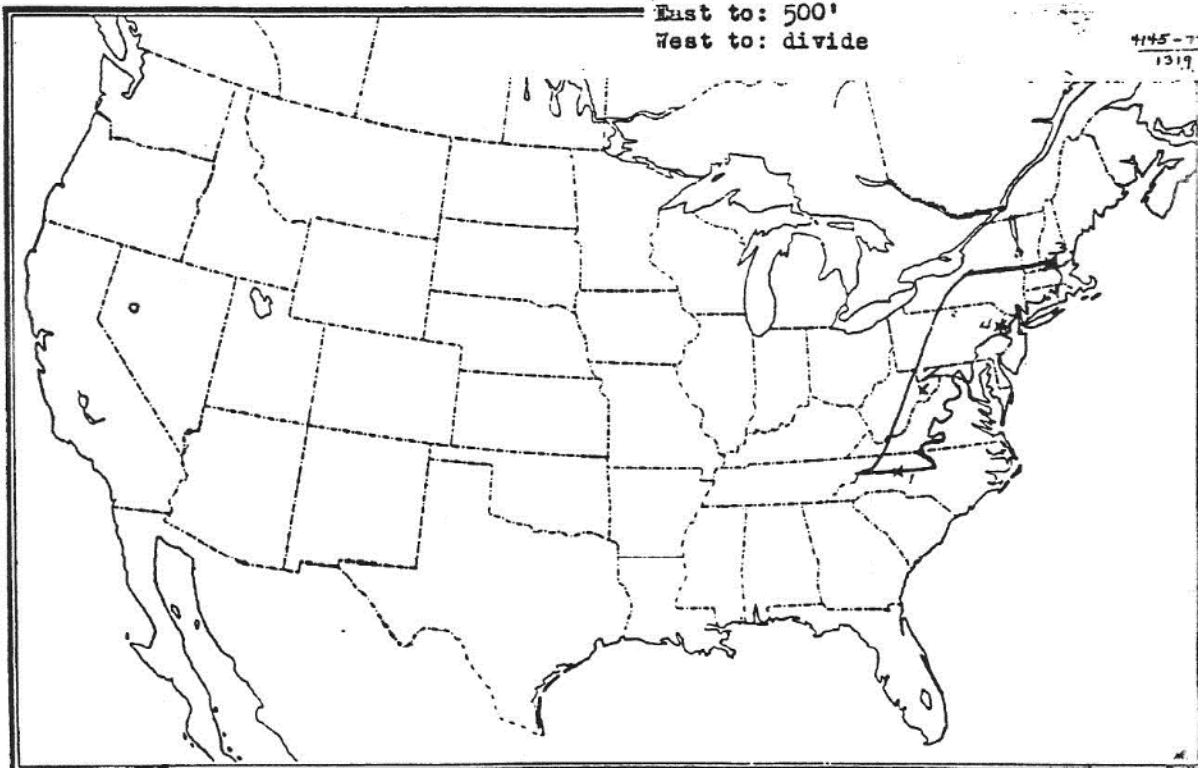


# SPAS 1339 Wellsboro, PA Storm Analysis May 31, 1889



SA 1-1..May 30-June 1, 1889..Wellsboro  
12-hr. Ptd 65(31st)..200 S. to 76, 56  
North to: 43  
South to: 34  
East to: 500'  
West to: divide

445-771  
1319





## Storm Precipitation Analysis System (SPAS) For Storm #1339\_2 SPAS Analysis

**General Storm Location:** Wellsboro, PA region, caused the Johnstown Flood

**Storm Dates:** May 29 (0600) - June 3 (0500), 1889

**Event:** Flash Flood Event

### DAD Zone 1

**Latitude:** 40.9042

**Longitude:** -78.5958

**Max. Grid Rainfall Amount:** 8.99"

**Number of Stations:** 176 (33 Daily, 5 Hourly, and 138 Supplemental)

**SPAS Version:** 9.5

**Basemap:** Monthly Weather Report Isohyetal Grid

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

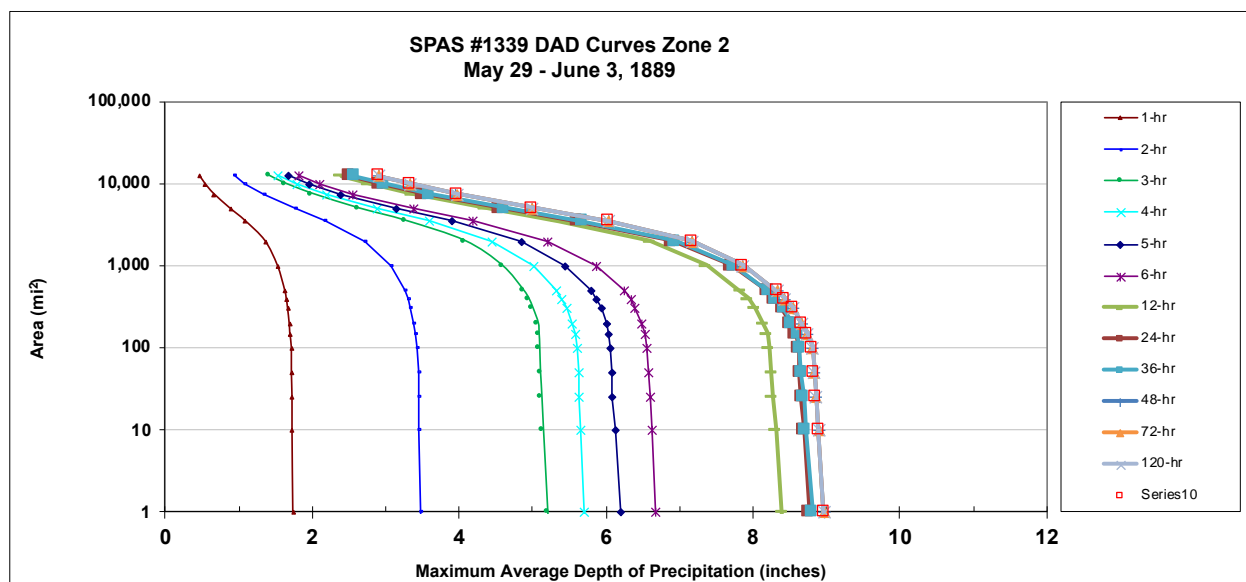
**Radar Included:** No

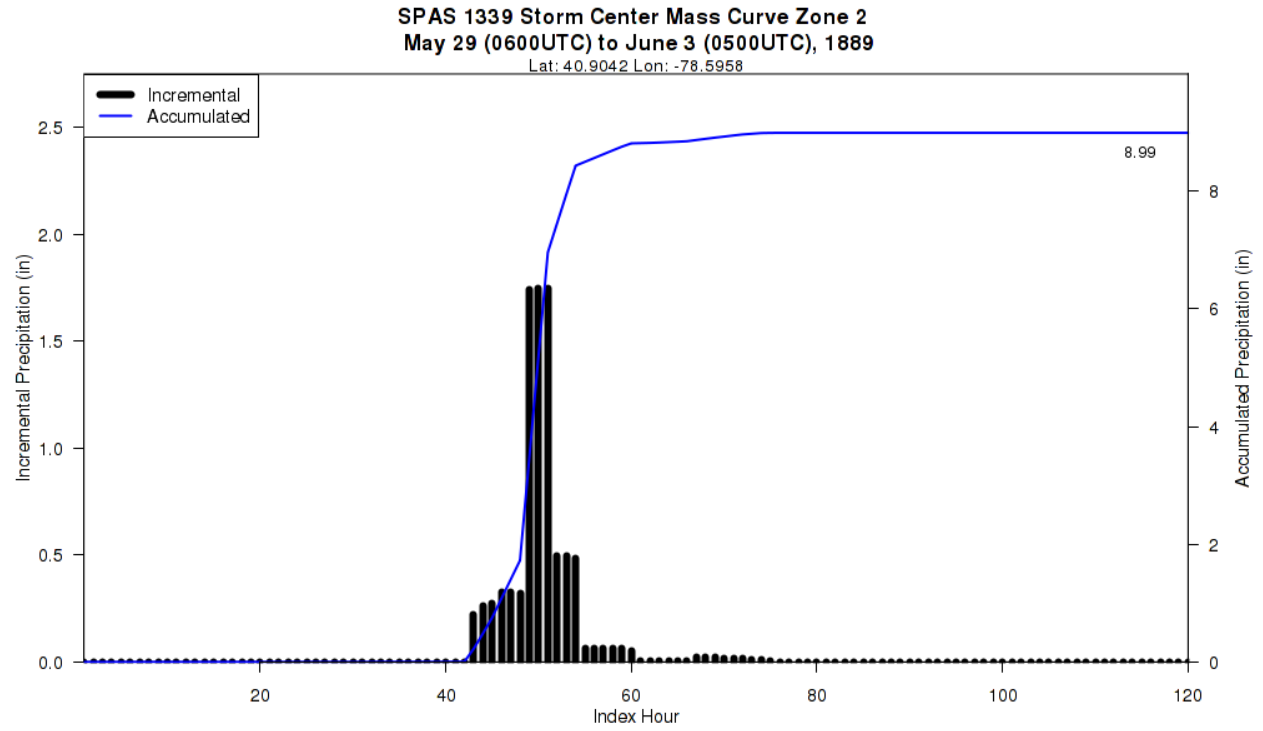
**Depth-Area-Duration (DAD) analysis:** Yes

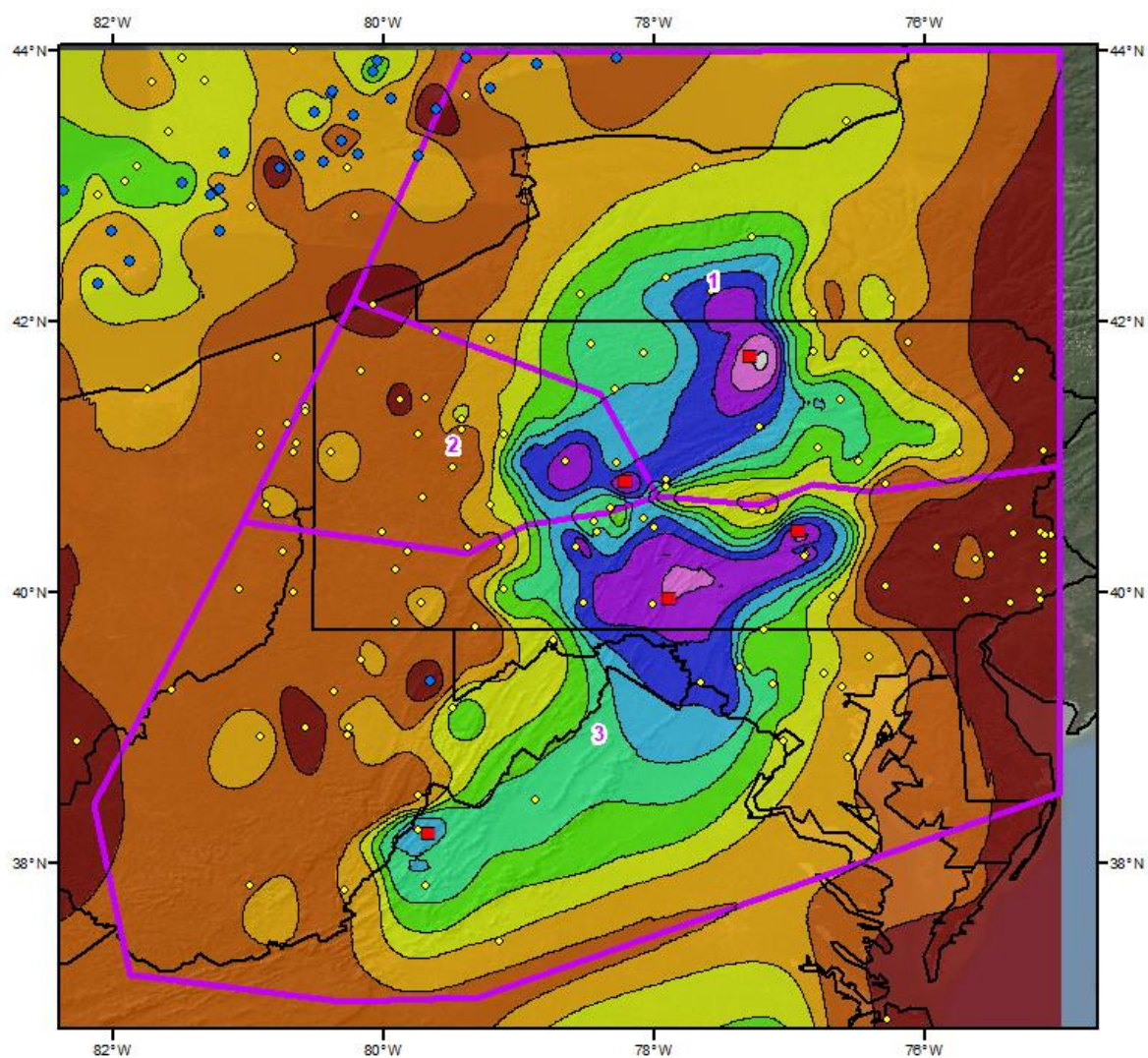
**Reliability of results:** This analysis was based on hourly data, daily data, and supplemental station. We have a high degree of confidence in the station based storm total results, the spatial pattern is dependent on the basemap, and the timing is based on hourly stations. The timing of rainfall accumulation at sub daily timescales is uncertain because of the lack of hourly data available for the storm. The mass curve represents our best evaluation based on USACE analyses and bucket survey reports.

SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1339_2	-78.5958	40.9042	1,562	1,600	15-Jun	77.00	3.14	0.42	76	2.720	80.91	81.0	3.77	0.48	84	3.290	1.210

Storm 1339 <b>Zone 2</b> - May 29 (0600 UTC) - Jun. 03 (0500 UTC), 1889													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
areasqmi	Duration (hours)												
	1-hr	2-hr	3-hr	4-hr	5-hr	6-hr	12-hr	24-hr	36-hr	48-hr	72-hr	120-hr	Total
0.4	1.75	3.49	5.22	5.73	6.21	6.70	8.43	8.80	8.84	8.99	8.99	8.99	8.99
1	1.74	3.48	5.20	5.71	6.19	6.68	8.40	8.77	8.81	8.97	8.97	8.97	8.97
10	1.73	3.46	5.14	5.66	6.12	6.62	8.31	8.69	8.72	8.89	8.89	8.89	8.89
25	1.73	3.45	5.12	5.63	6.09	6.60	8.27	8.66	8.69	8.86	8.86	8.86	8.86
50	1.72	3.44	5.10	5.62	6.07	6.58	8.25	8.64	8.66	8.83	8.83	8.83	8.83
100	1.72	3.43	5.09	5.60	6.05	6.56	8.22	8.62	8.64	8.81	8.81	8.81	8.81
150	1.70	3.40	5.08	5.58	6.04	6.53	8.20	8.57	8.61	8.74	8.74	8.74	8.74
200	1.69	3.38	5.07	5.54	6.02	6.48	8.14	8.50	8.53	8.66	8.66	8.66	8.66
300	1.67	3.34	5.00	5.47	5.94	6.40	8.03	8.40	8.42	8.55	8.55	8.55	8.55
400	1.65	3.30	4.94	5.40	5.87	6.33	7.94	8.29	8.32	8.43	8.43	8.43	8.43
500	1.63	3.26	4.87	5.33	5.79	6.24	7.83	8.19	8.21	8.33	8.33	8.33	8.33
1,000	1.53	3.06	4.58	5.01	5.44	5.87	7.37	7.70	7.73	7.86	7.86	7.86	7.86
2,000	1.36	2.72	4.07	4.45	4.84	5.21	6.59	6.89	6.94	7.17	7.17	7.17	7.17
3,500	1.09	2.18	3.27	3.58	3.89	4.19	5.35	5.60	5.67	6.04	6.04	6.04	6.04
5,000	0.88	1.76	2.62	2.88	3.13	3.37	4.34	4.54	4.62	5.00	5.00	5.00	5.00
7,500	0.66	1.33	1.99	2.19	2.38	2.56	3.35	3.50	3.59	3.95	3.96	3.96	3.96
10,000	0.54	1.09	1.62	1.79	1.95	2.10	2.76	2.90	2.97	3.32	3.32	3.32	3.33
12,432	0.47	0.93	1.40	1.54	1.68	1.81	2.39	2.51	2.57	2.90	2.90	2.90	2.91



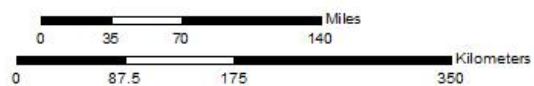




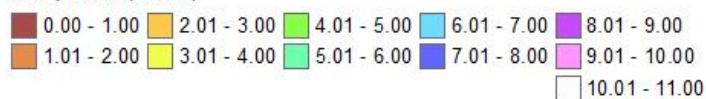
**Total Storm (120-hr) Precipitation (inches)**  
**May 29 (0600 UTC) - June 3 (0500 UTC), 1889**  
**SPAS 1339 - Wellsboro, PA**

#### Gauges

- Daily
- Hourly
- Supplemental



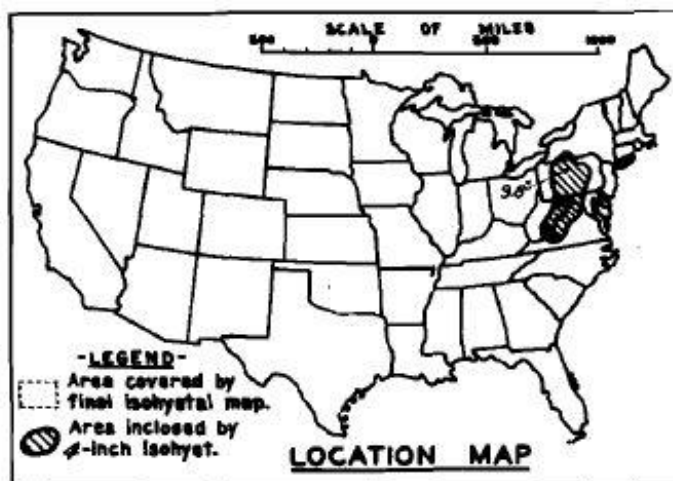
#### Precipitation (inches)



7/11/2014

DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS

**STORM STUDIES - PERTINENT DATA SHEET (REV.)**

Storm of 30 May- 1 June 1889

Assignment SA 1-1

Location Pa., Md., Va., W. Va.

Study Prepared by:

Middle Atlantic Division

Baltimore District Office

Part I Reviewed by H. M. Sec. of  
Weather Bureau, 7/15/41Part II Approved by Office, Chief  
of Engineers for Distribution  
of Factual Data, 3/29/43Remarks: Center at  
Wellsboro, Penna.

Dewpt. 65° - Ref. Pt. 200° S

Grid D-6

**DATA AND COMPUTATIONS COMPILED****PART I**

Preliminary isohyetal map, in 1 sheet, scale 1:2,500,000

Precipitation data and mass curves:

(Number of Sheets)

Form 5001-C (Hourly precip. data) ----- -

Form 5001-B (24-hour " " " " ) ----- 22

Form 5001-D ( " " " " ) ----- -

Misc. precip. records, meteorological data, etc. ----- -

Form 5002 (Mass rainfall curves) ----- 22

**PART II**

Final isohyetal maps, in 1 sheet, scale 1:2,500,000

Data and computation sheets:

Form S-10 (Data from mass rainfall curves) ----- 3

Form S-11 (Depth-area data from isohyetal map) ----- 1

Form S-12 (Maximum depth-duration data) ----- 5

Maximum duration-depth-area curves ----- 1

Data relating to periods of maximum rainfall ----- 1

**MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES**

Area in Sq. Mi.	Duration of Rainfall in Hours										
	6	12	18	24	30	36	48	60			
10	7.4	8.6	9.1	9.2	9.2	9.7	9.8	9.8			
100	7.2	8.3	8.9	9.0	9.0	9.6	9.6	9.6			
200	7.1	8.2	8.7	8.8	8.8	9.3	9.4	9.4			
500	7.0	8.0	8.5	8.6	8.6	9.0	9.1	9.1			
1,000	6.7	7.7	8.2	8.3	8.3	8.7	8.8	8.8			
2,000	5.8	6.5	7.7	7.8	8.0	8.4	8.5	8.5			
5,000	3.9	4.9	6.4	6.8	7.5	8.0	8.1	8.1			
10,000	2.8	4.0	5.0	5.7	7.0	7.6	7.7	7.7			
20,000	2.1	3.2	4.0	4.7	6.3	6.8	7.0	7.0			
50,000	1.4	2.4	3.1	3.6	4.8	5.4	5.6	5.6			
82,000	1.0	1.8	2.4	2.8	3.7	4.1	4.4	4.4			

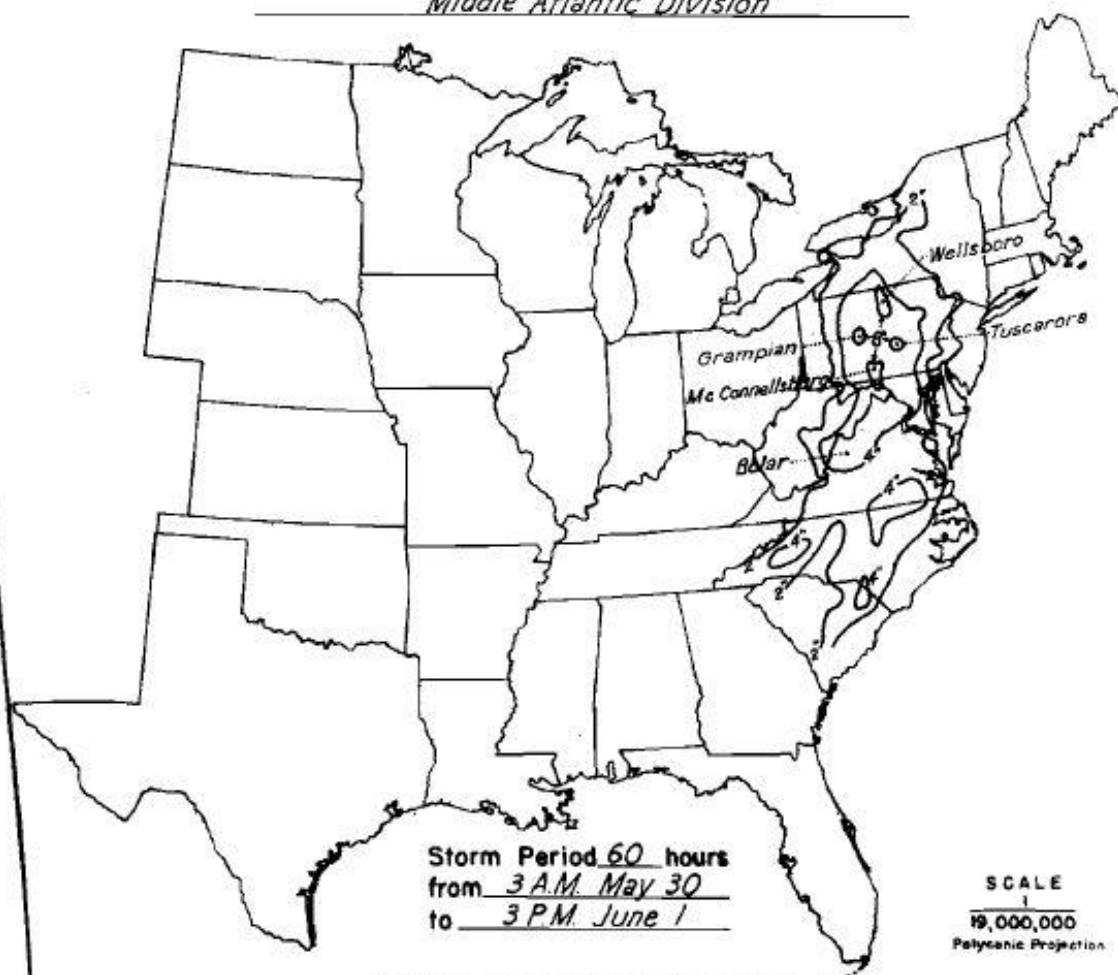
Form S-2

PART OF THE ARMY

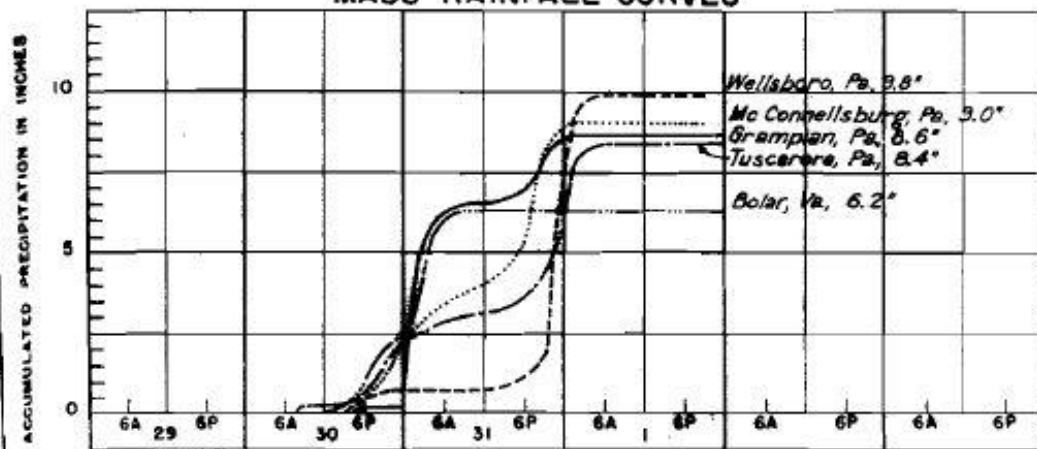
CORPS OF ENGINEERS

## STORM STUDIES - ISOHYETAL MAP

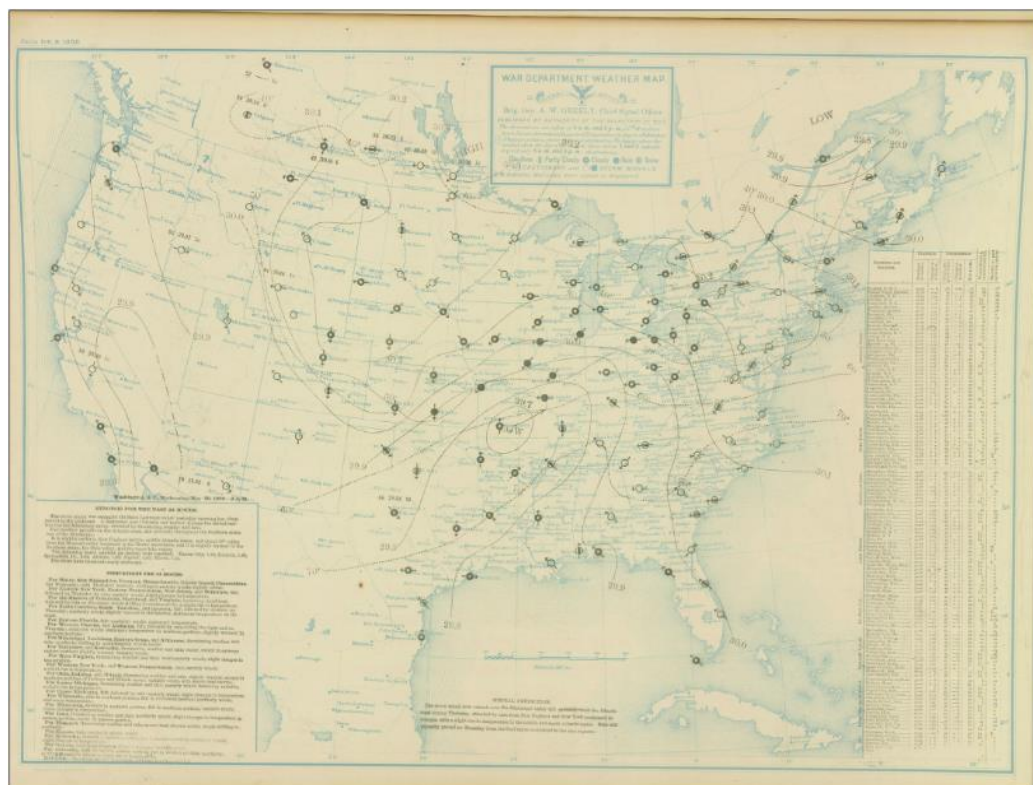
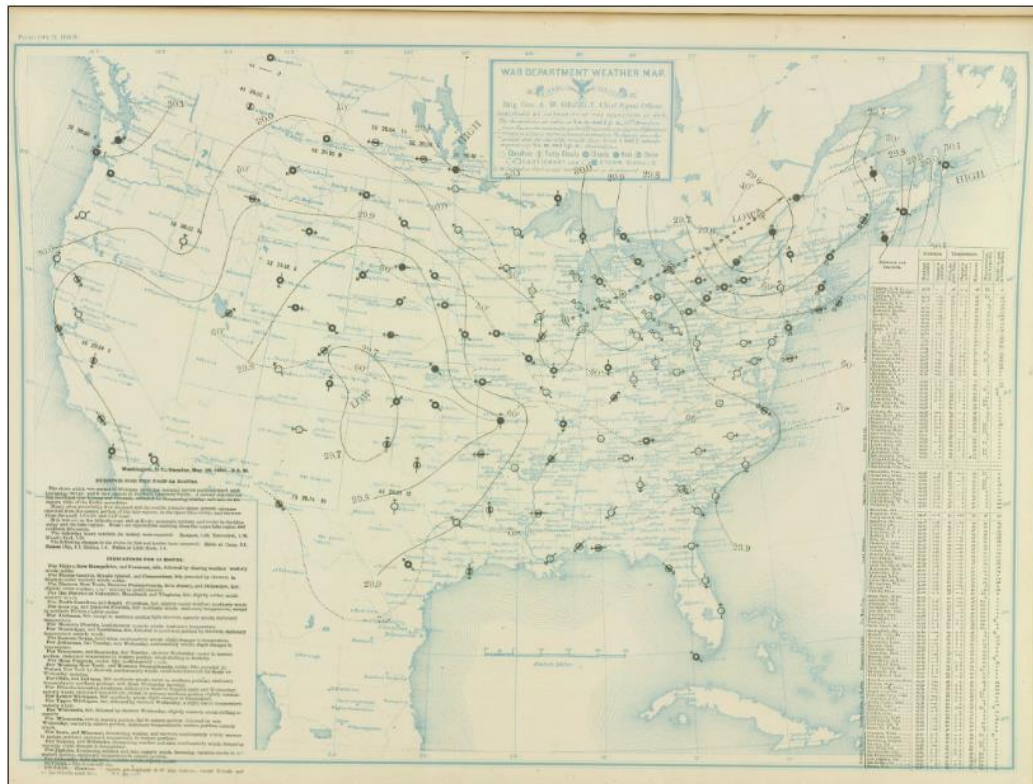
Storm of May 30 - June 1, 1889 Assignment SA-1-1  
 Study Prepared by: Baltimore, Md. District  
Middle Atlantic Division

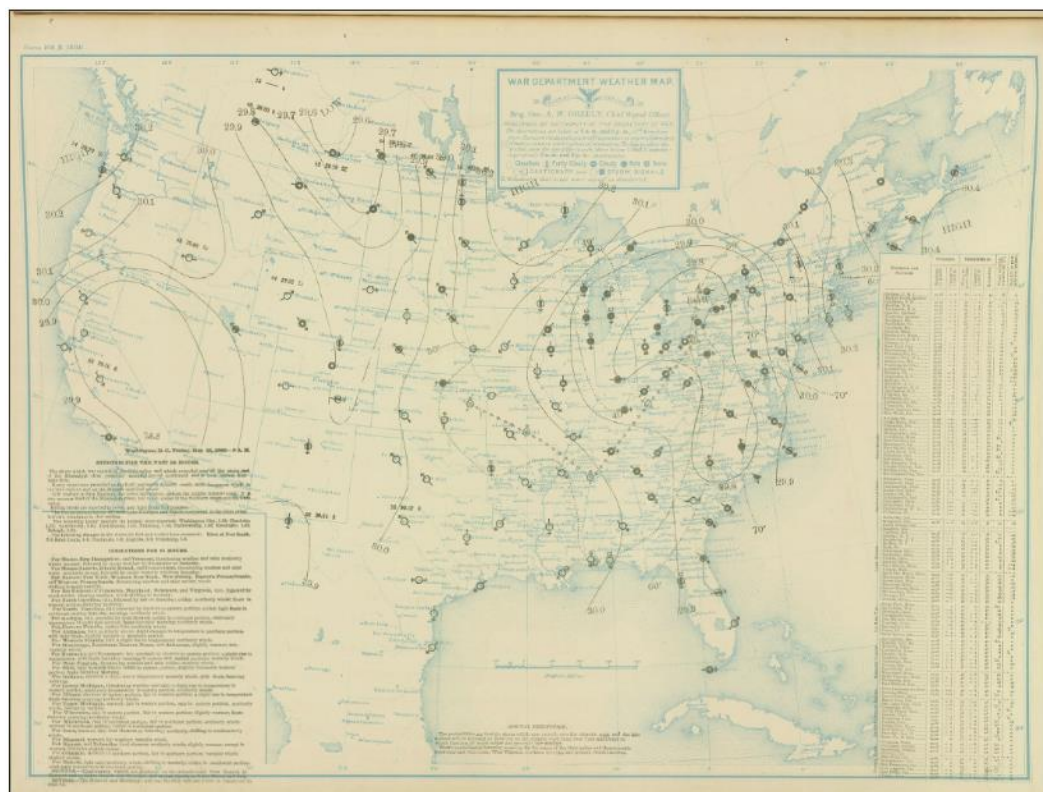
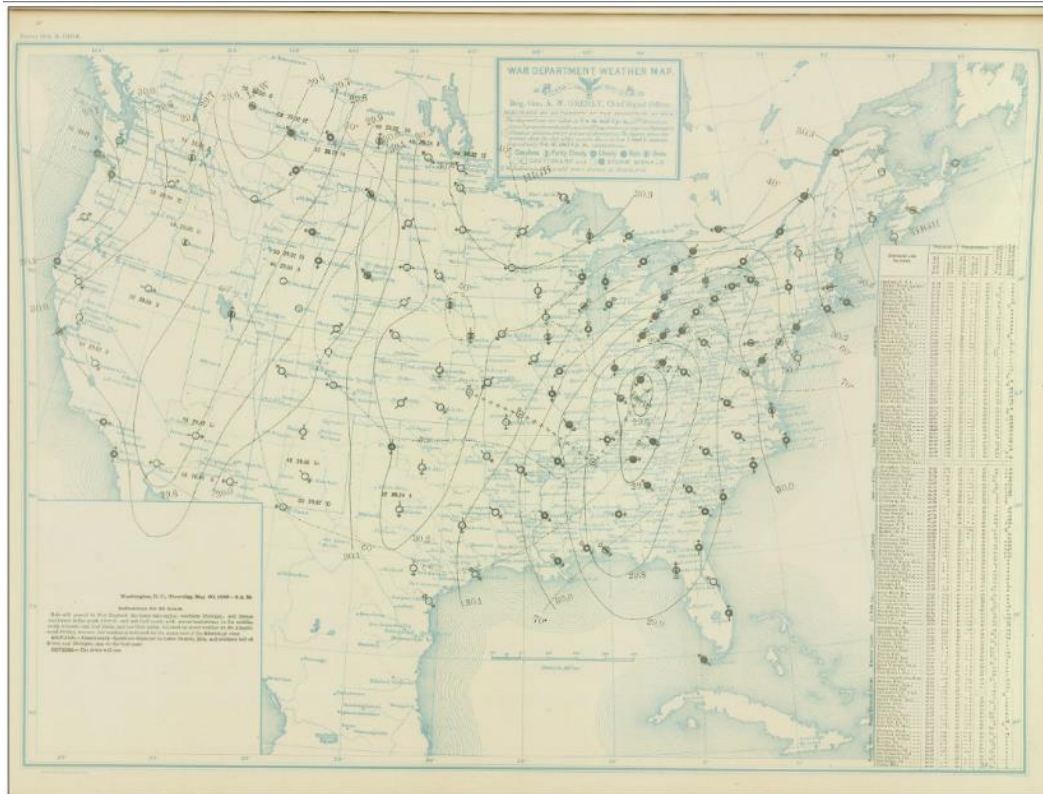


## MASS RAINFALL CURVES

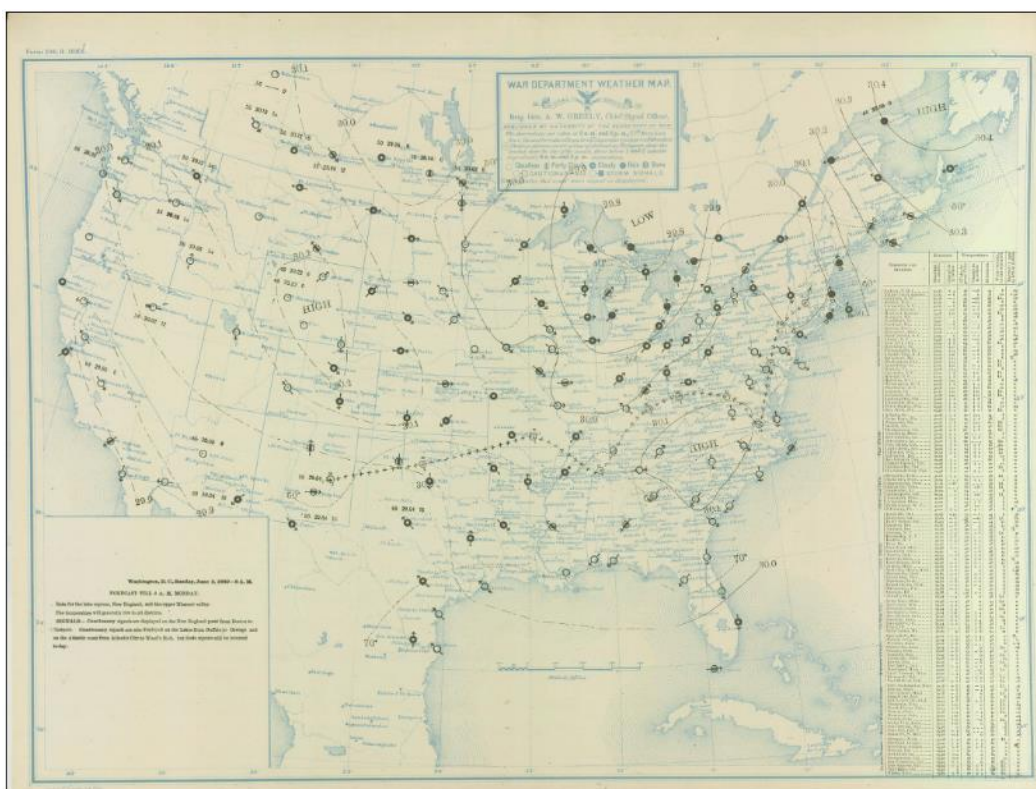
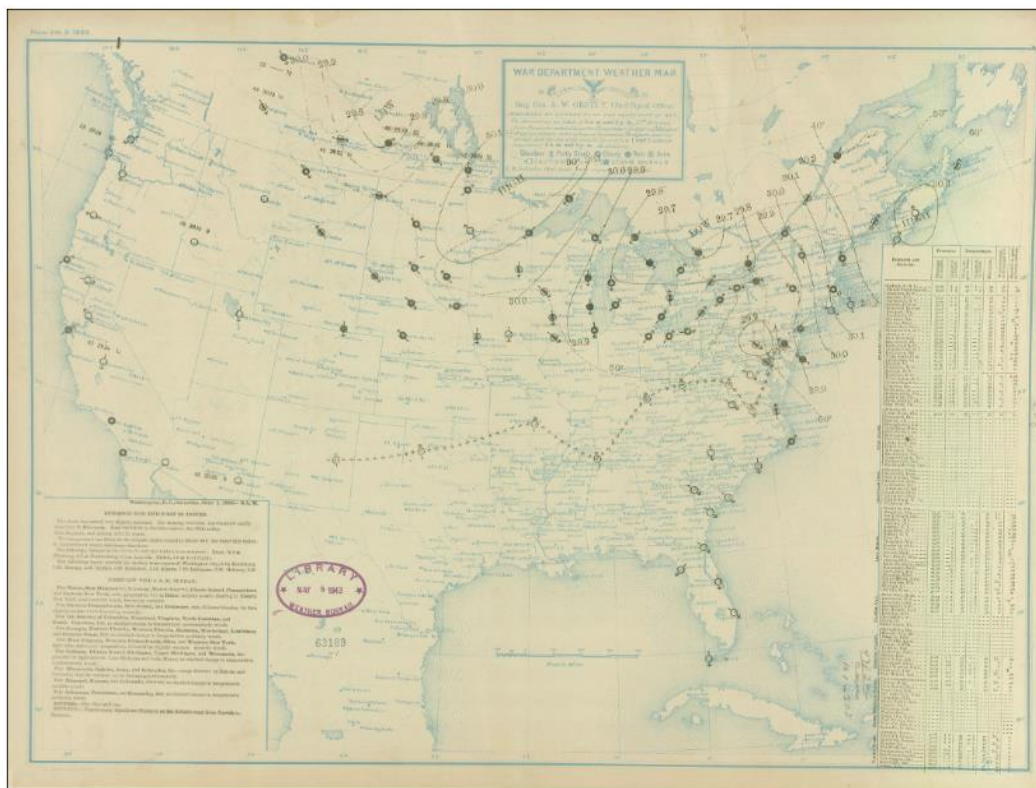


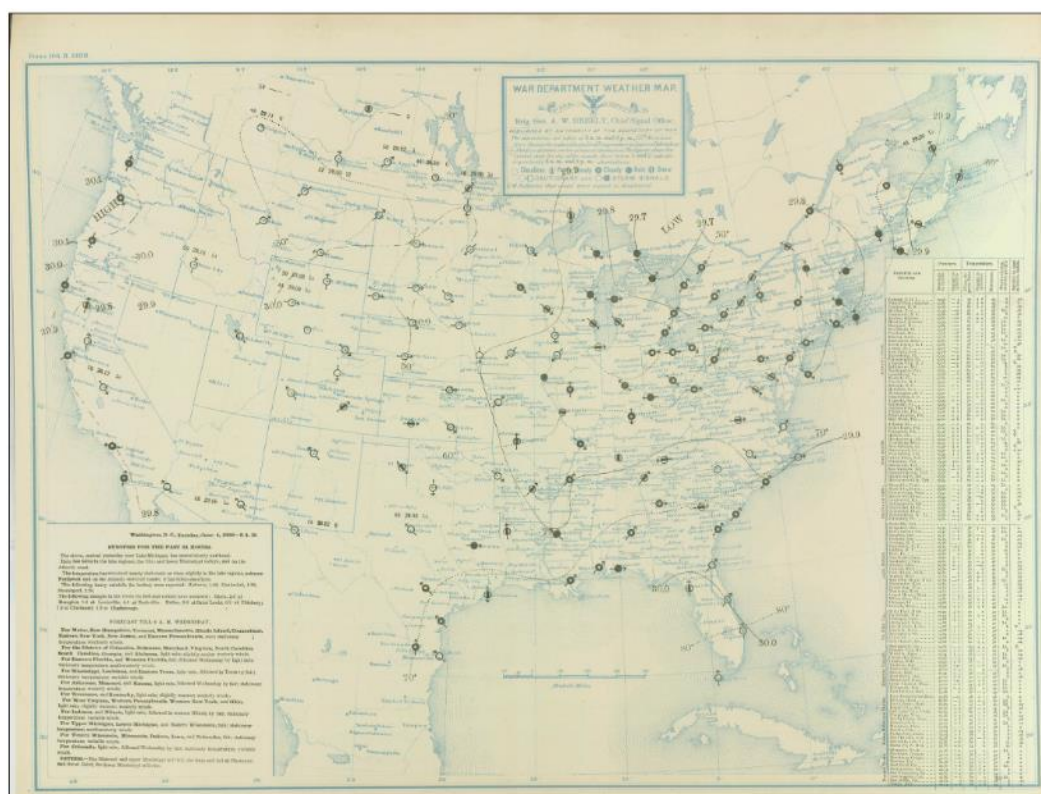
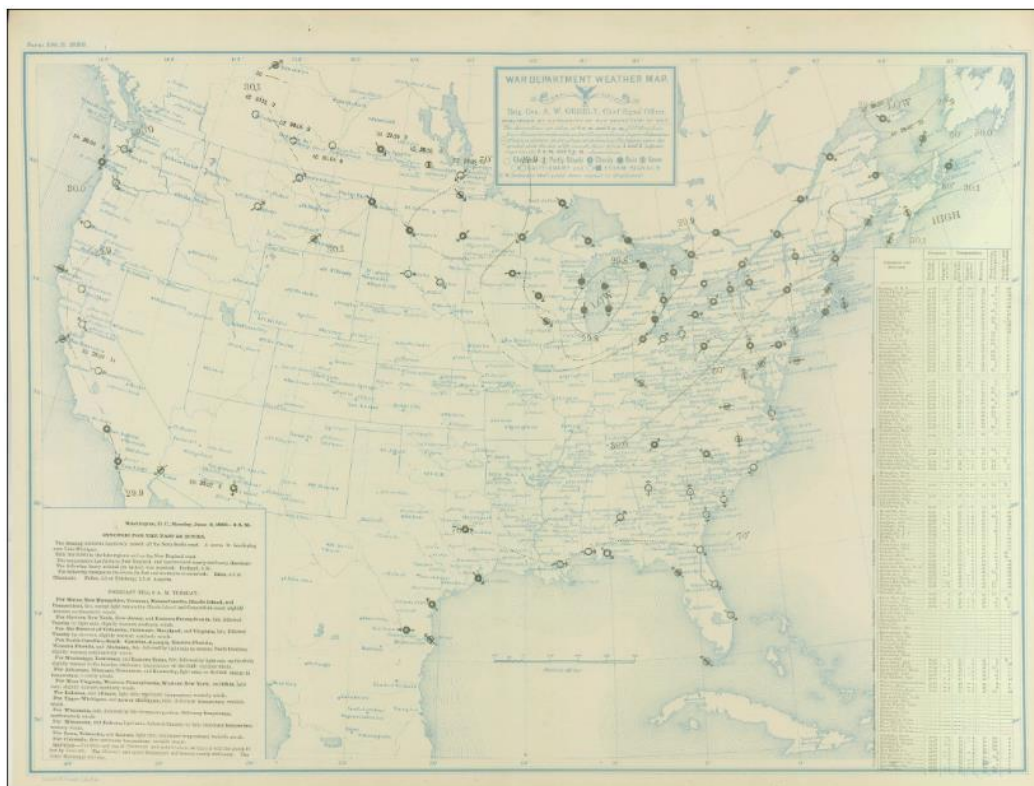




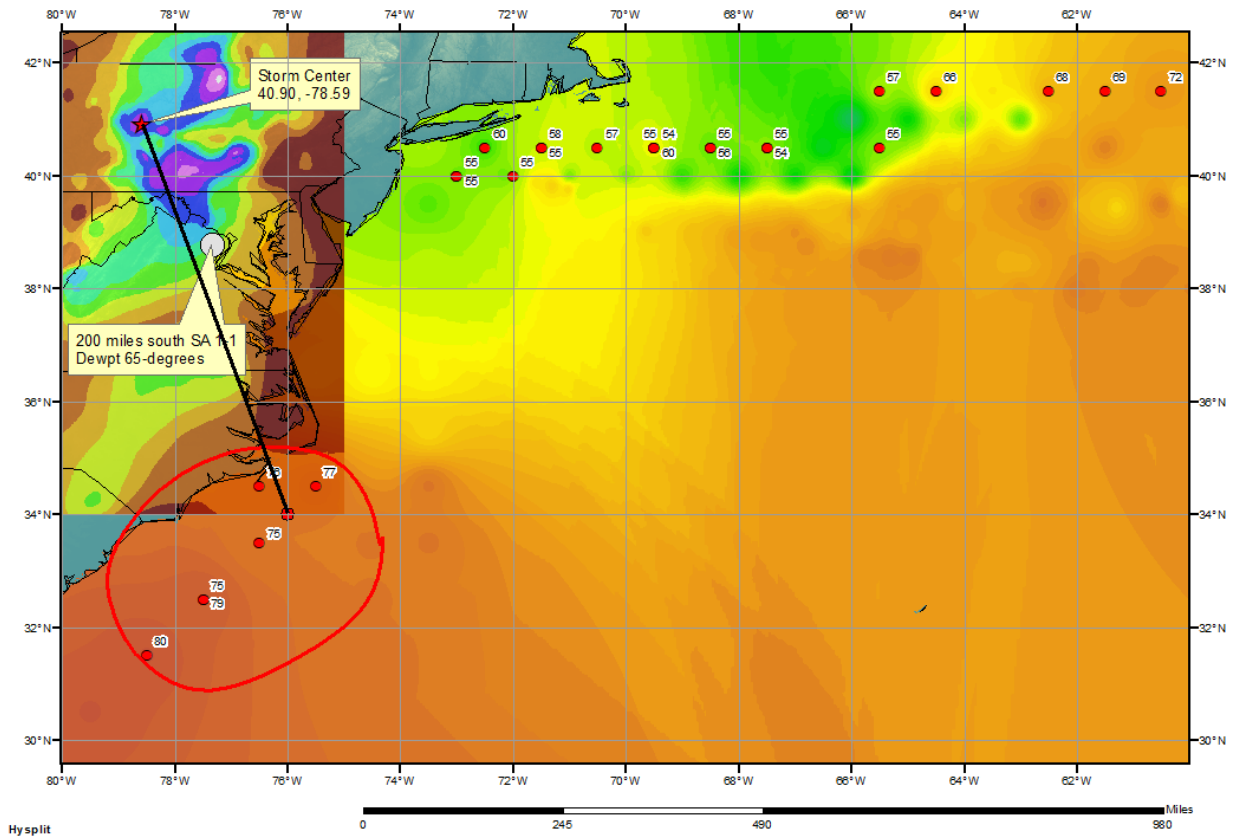








# SPAS 1339\_2 Wellsboro, PA Storm Analysis May 31, 1889



## Storm Precipitation Analysis System (SPAS) For Storm #1339\_3 SPAS Analysis

**General Storm Location:** Wellsboro, PA region, caused the Johnstown Flood

**Storm Dates:** May 29 (0600) - June 3 (0500), 1889

**Event:** Flash Flood Event

### DAD Zone 3

**Latitude:** 40.3958

**Longitude:** -76.9292

**Max. Grid Rainfall Amount:** 9.19"

**Number of Stations:** 176 (33 Daily, 5 Hourly, and 138 Supplemental)

**SPAS Version:** 9.5

**Basemap:** Monthly Weather Report Isohyetal Grid

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

**Radar Included:** No

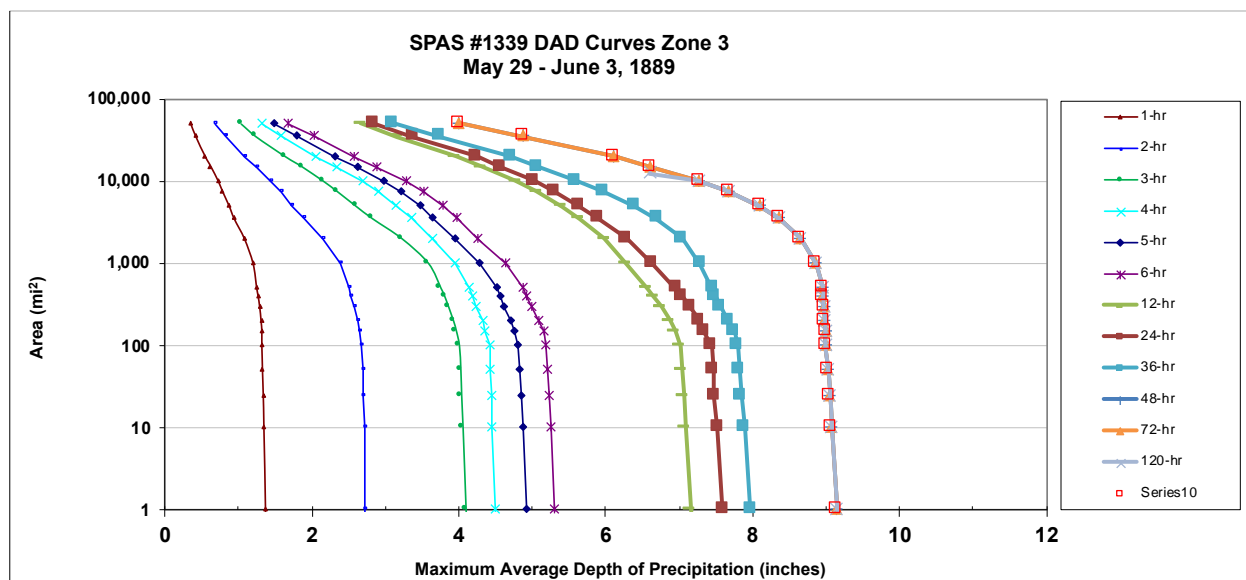
**Depth-Area-Duration (DAD) analysis:** Yes

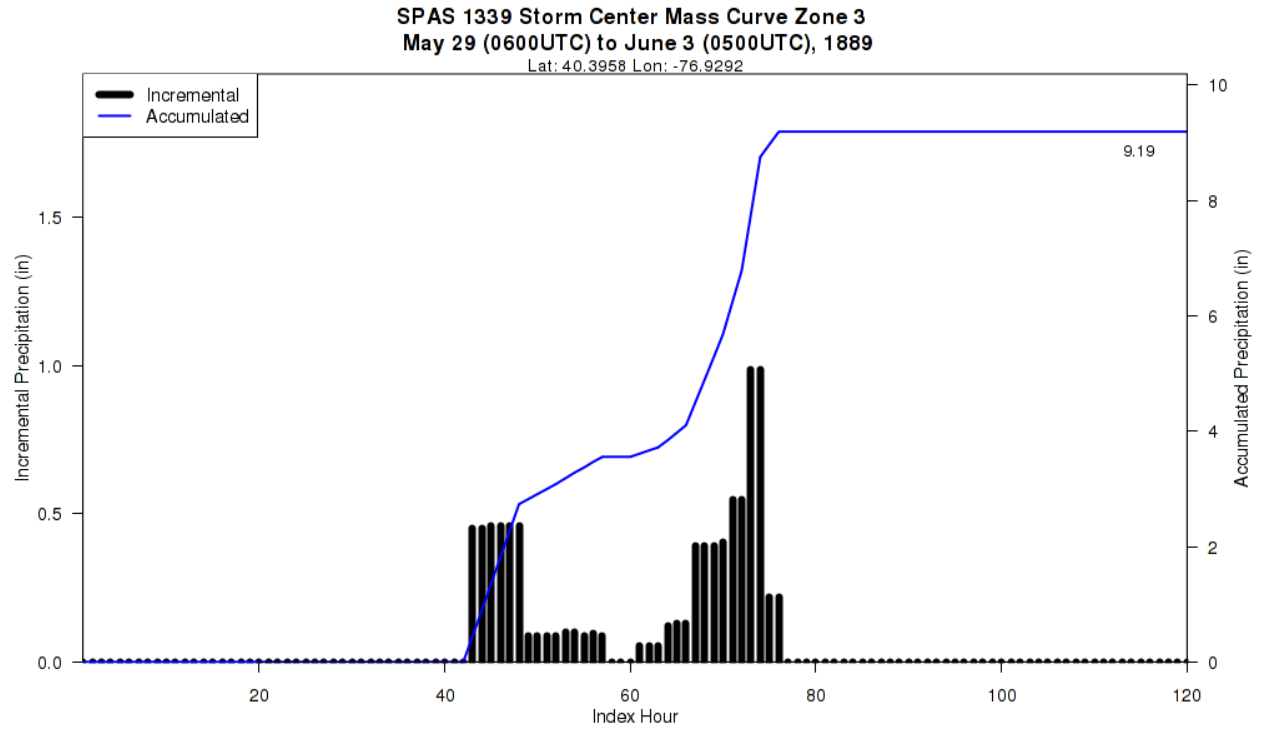
**Reliability of results:** This analysis was based on hourly data, daily data, and supplemental station. We have a high degree of confidence in the station based storm total results, the spatial pattern is dependent on the basemap, and the timing is based on hourly stations. The timing of rainfall accumulation at sub daily timescales is uncertain because of the lack of hourly data available for the storm. The mass curve represents our best evaluation based on USACE analyses and bucket survey reports.

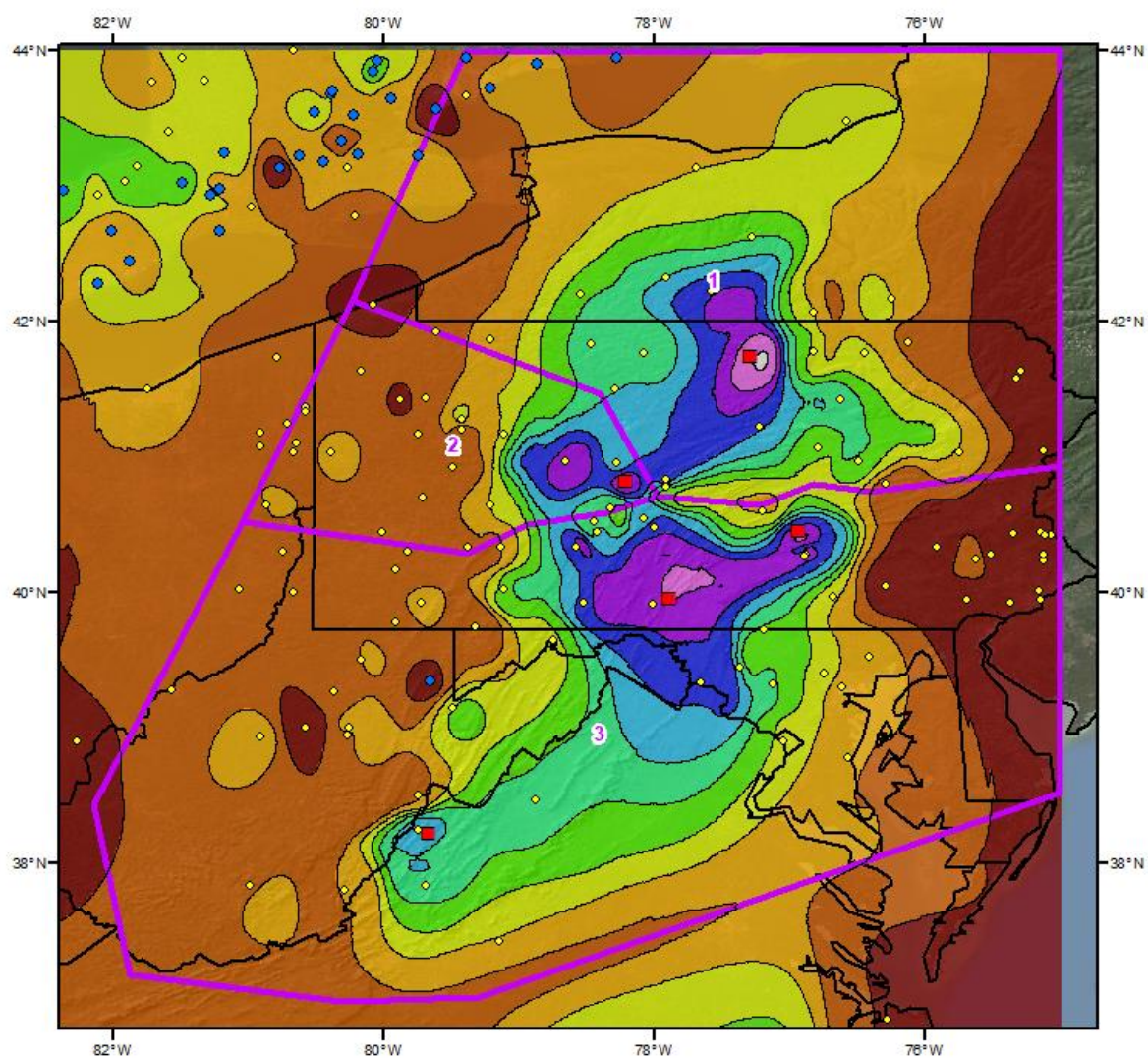
							Storm Rep. SST					Climatological Max. SST					IPMF	
	SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
Storm Center Location	1339_3	-76.9292	40.3958	389	400	15-Jun	77.00	3.14	0.11	76	3.030	80.91	81.0	3.77	0.12	84	3.650	1.205



Storm 1339 <b>Zone 3</b> - May 29 (0600 UTC) - Jun. 03 (0500 UTC), 1889													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
areasqmi	Duration (hours)												
	1-hr	2-hr	3-hr	4-hr	5-hr	6-hr	12-hr	24-hr	36-hr	48-hr	72-hr	120-hr	Total
0.4	1.37	2.74	4.11	4.52	4.93	5.34	7.19	7.62	8.01	9.18	9.18	9.18	9.18
1	1.37	2.73	4.09	4.50	4.92	5.31	7.16	7.60	7.98	9.15	9.15	9.15	9.15
10	1.35	2.71	4.05	4.46	4.87	5.25	7.09	7.52	7.89	9.08	9.08	9.08	9.08
25	1.34	2.70	4.03	4.44	4.86	5.23	7.06	7.48	7.85	9.05	9.05	9.05	9.05
50	1.33	2.69	4.02	4.43	4.84	5.21	7.04	7.46	7.82	9.03	9.03	9.03	9.03
100	1.32	2.68	4.00	4.42	4.81	5.19	7.02	7.44	7.80	9.00	9.00	9.00	9.00
150	1.32	2.64	3.96	4.36	4.75	5.15	6.94	7.34	7.75	8.99	8.99	8.99	8.99
200	1.31	2.62	3.92	4.32	4.71	5.09	6.87	7.27	7.67	8.98	8.98	8.98	8.98
300	1.29	2.57	3.85	4.24	4.62	5.00	6.75	7.15	7.56	8.97	8.97	8.97	8.97
400	1.27	2.54	3.80	4.18	4.56	4.93	6.65	7.04	7.49	8.96	8.96	8.96	8.96
500	1.25	2.51	3.75	4.13	4.51	4.87	6.56	6.95	7.45	8.96	8.96	8.96	8.96
1,000	1.20	2.39	3.58	3.94	4.29	4.65	6.28	6.63	7.29	8.86	8.86	8.86	8.86
2,000	1.08	2.15	3.22	3.64	3.94	4.26	5.98	6.28	7.04	8.65	8.65	8.65	8.65
3,500	0.94	1.89	2.82	3.35	3.65	3.98	5.64	5.90	6.70	8.37	8.37	8.37	8.37
5,000	0.87	1.73	2.59	3.14	3.47	3.78	5.40	5.64	6.40	8.10	8.10	8.1	8.1
7,500	0.78	1.57	2.34	2.91	3.21	3.52	5.06	5.30	5.96	7.67	7.67	7.67	7.67
10,000	0.72	1.44	2.15	2.70	2.99	3.29	4.78	5.02	5.59	7.26	7.26	7.26	7.26
15,000	0.62	1.24	1.86	2.35	2.62	2.89	4.31	4.56	5.07	6.60	6.60	6.6	6.6
20,000	0.54	1.09	1.63	2.06	2.31	2.58	3.96	4.24	4.70	6.11	6.11	6.11	6.11
35,000	0.41	0.83	1.23	1.57	1.79	2.02	3.16	3.38	3.74	4.88	4.88	4.88	4.88
50,000	0.34	0.68	1.03	1.31	1.49	1.68	2.66	2.83	3.11	4.00	4.00	4	4



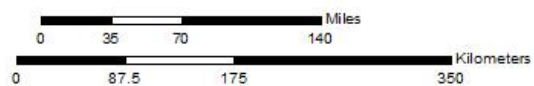




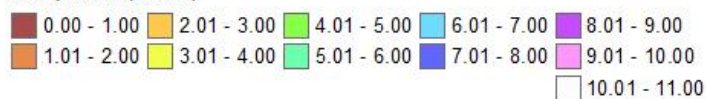
**Total Storm (120-hr) Precipitation (inches)**  
**May 29 (0600 UTC) - June 3 (0500 UTC), 1889**  
**SPAS 1339 - Wellsboro, PA**

#### Gauges

- Daily
- Hourly
- Supplemental



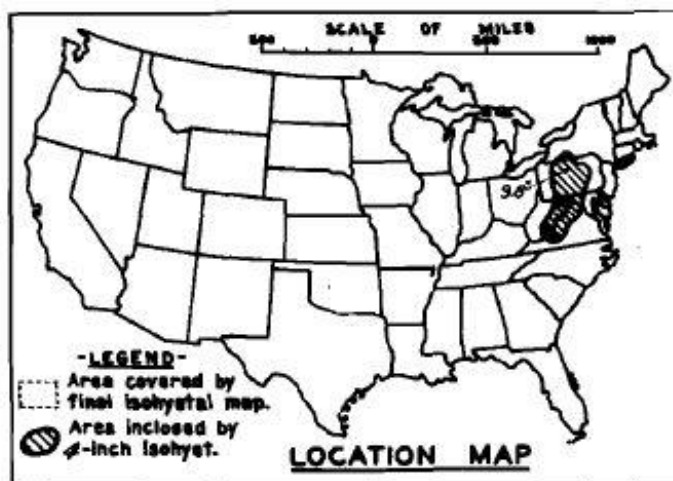
#### Precipitation (inches)



7/11/2014

DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS

**STORM STUDIES - PERTINENT DATA SHEET (REV.)**

Storm of 30 May- 1 June 1889

Assignment SA 1-1

Location Pa., Md., Va., W. Va.

Study Prepared by:

Middle Atlantic Division

Baltimore District Office

Part I Reviewed by H. M. Sec. of  
Weather Bureau, 7/15/41Part II Approved by Office, Chief  
of Engineers for Distribution  
of Factual Data, 3/29/43Remarks: Center at  
Wellsboro, Penna.

Dewpt. 65° - Ref. Pt. 200° S

Grid D-6

**DATA AND COMPUTATIONS COMPILED****PART I**

Preliminary isohyetal map, in 1 sheet, scale 1:2,500,000

Precipitation data and mass curves:

(Number of Sheets)

Form 5001-C (Hourly precip. data) ----- -

Form 5001-B (24-hour " " " " ) ----- 22

Form 5001-D ( " " " " " ) ----- -

Misc. precip. records, meteorological data, etc. ----- -

Form 5002 (Mass rainfall curves) ----- 22

**PART II**

Final isohyetal maps, in 1 sheet, scale 1:2,500,000

Data and computation sheets:

Form S-10 (Data from mass rainfall curves) ----- 3

Form S-11 (Depth-area data from isohyetal map) ----- 1

Form S-12 (Maximum depth-duration data) ----- 5

Maximum duration-depth-area curves ----- 1

Data relating to periods of maximum rainfall ----- 1

**MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES**

Area in Sq. Mi.	Duration of Rainfall in Hours										
	6	12	18	24	30	36	48	60			
10	7.4	8.6	9.1	9.2	9.2	9.7	9.8	9.8			
100	7.2	8.3	8.9	9.0	9.0	9.6	9.6	9.6			
200	7.1	8.2	8.7	8.8	8.8	9.3	9.4	9.4			
500	7.0	8.0	8.5	8.6	8.6	9.0	9.1	9.1			
1,000	6.7	7.7	8.2	8.3	8.3	8.7	8.8	8.8			
2,000	5.8	6.5	7.7	7.8	8.0	8.4	8.6	8.5			
5,000	3.9	4.9	6.4	6.8	7.5	8.0	8.1	8.1			
10,000	2.8	4.0	5.0	5.7	7.0	7.6	7.7	7.7			
20,000	2.1	3.2	4.0	4.7	6.3	6.8	7.0	7.0			
50,000	1.4	2.4	3.1	3.6	4.8	5.4	6.6	5.6			
82,000	1.0	1.8	2.4	2.8	3.7	4.1	4.4	4.4			

Form S-2

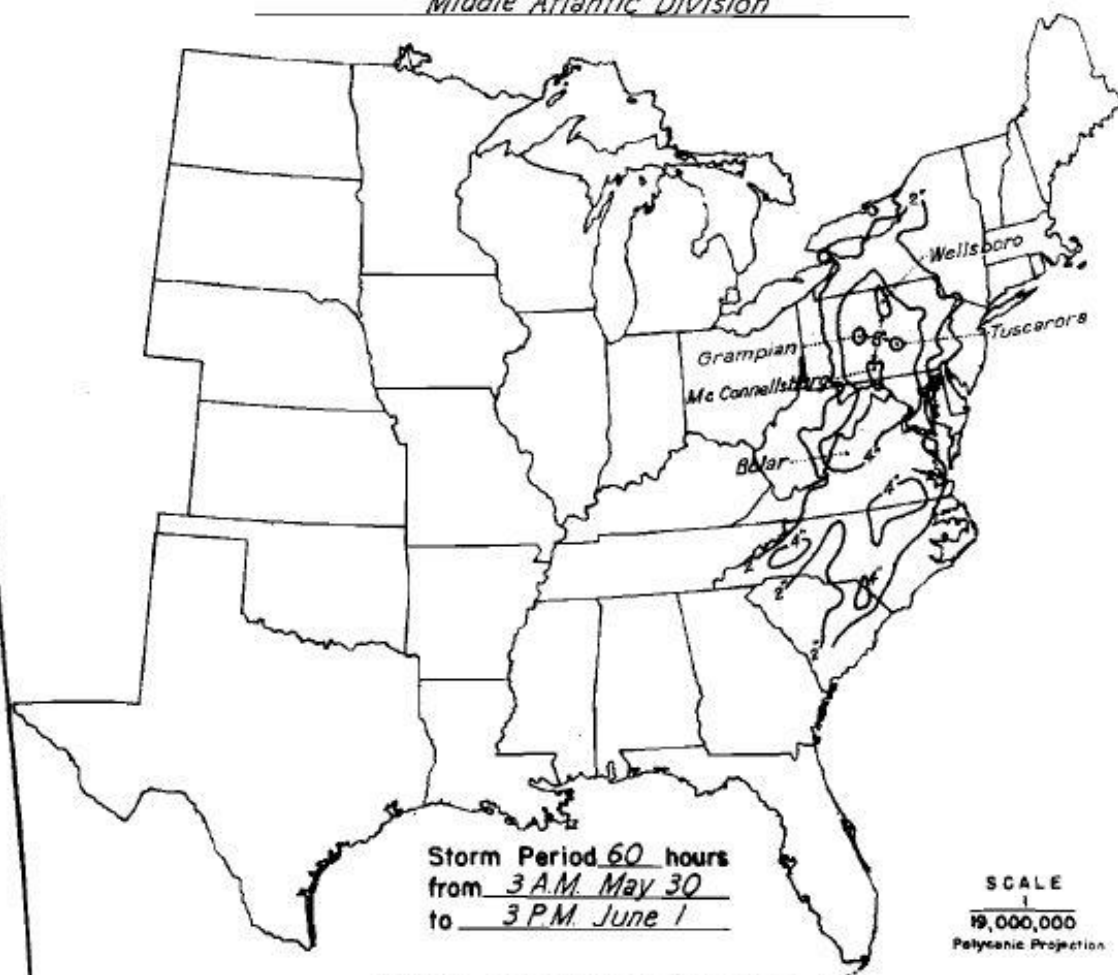


PART OF THE ARMY

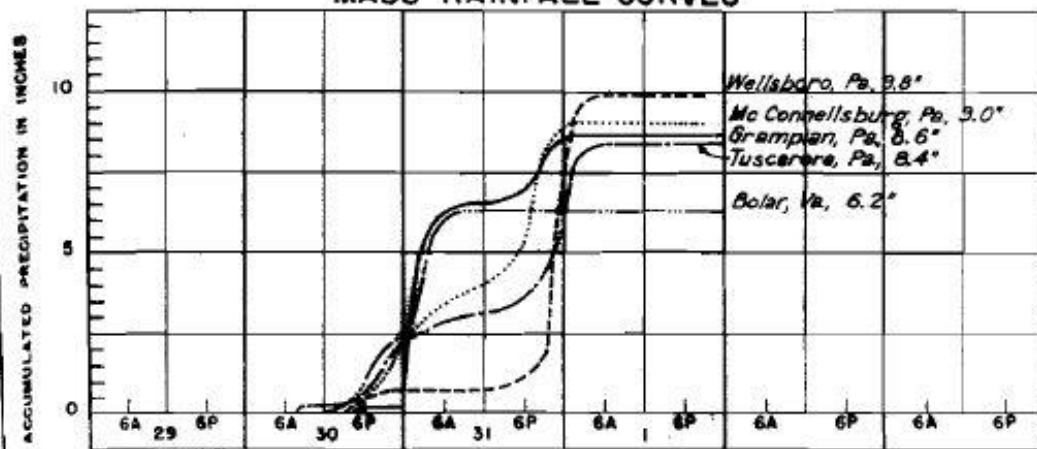
CORPS OF ENGINEERS

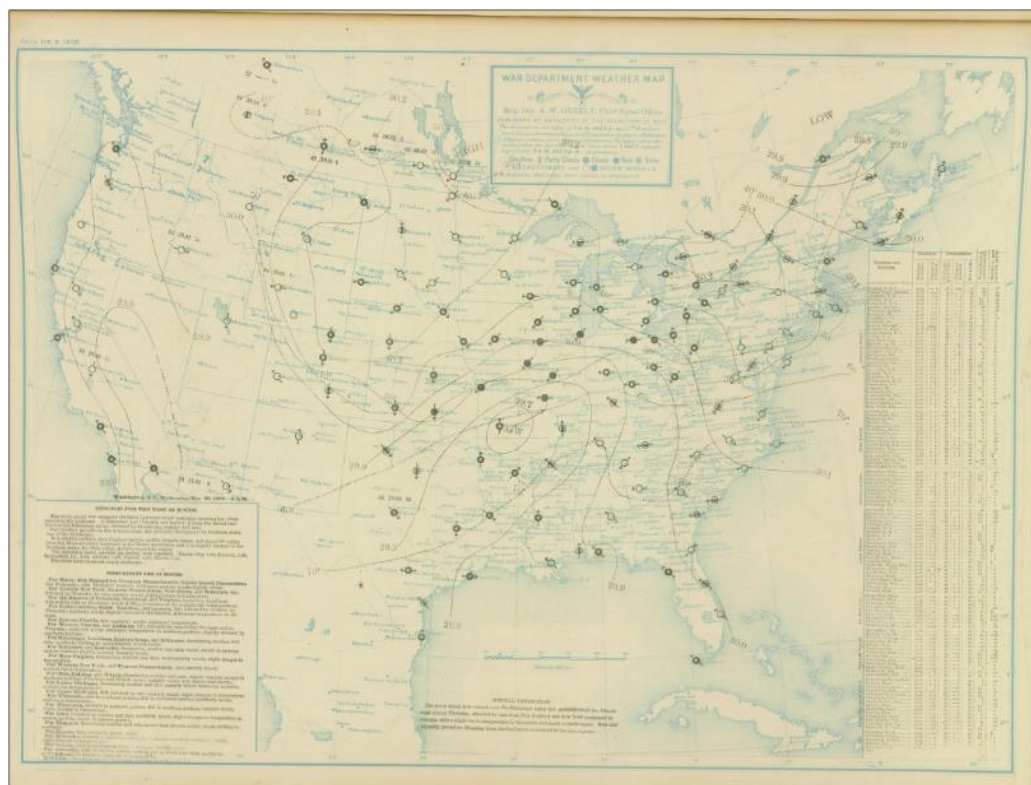
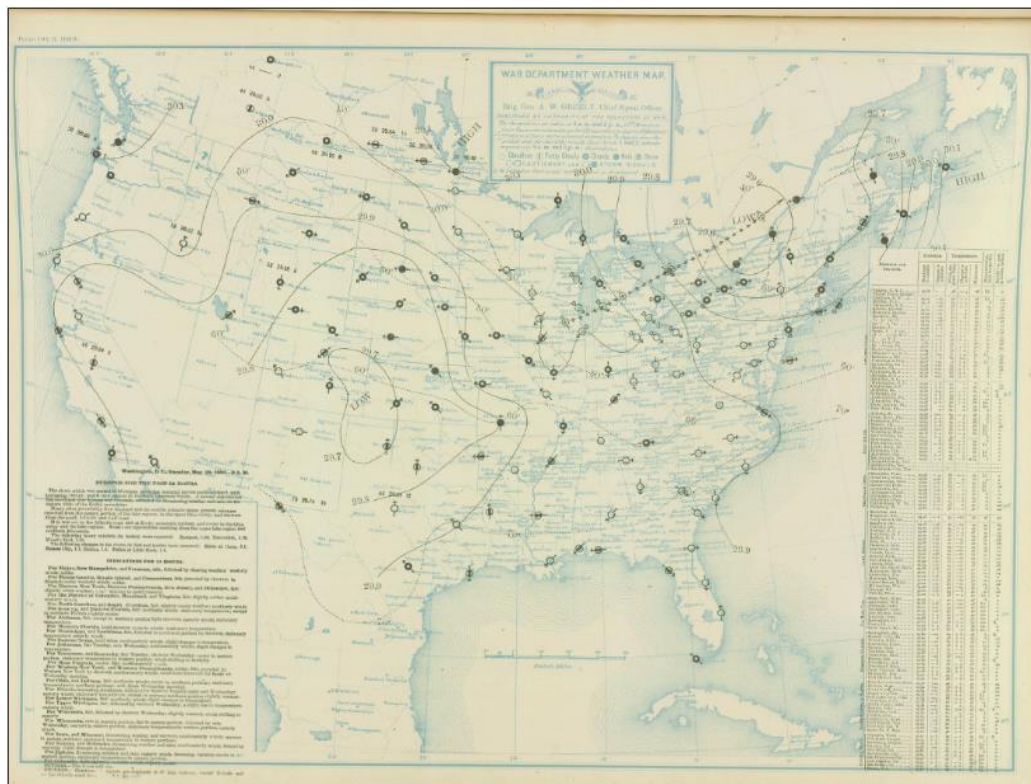
## STORM STUDIES - ISOHYETAL MAP

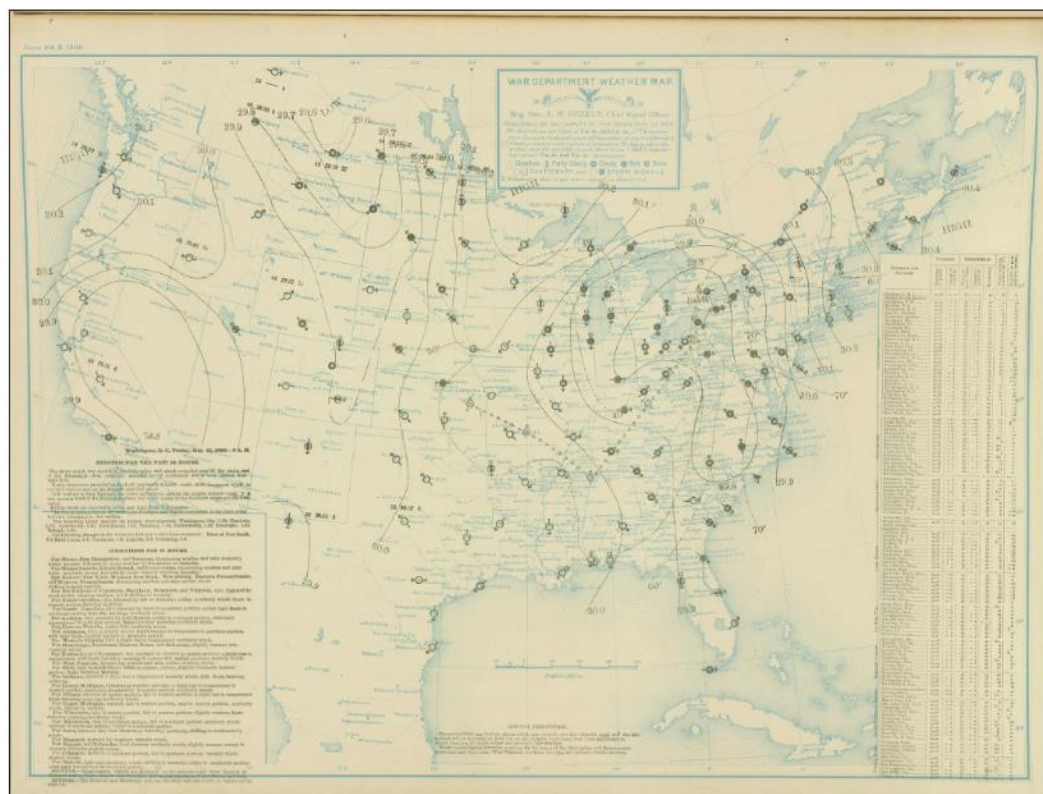
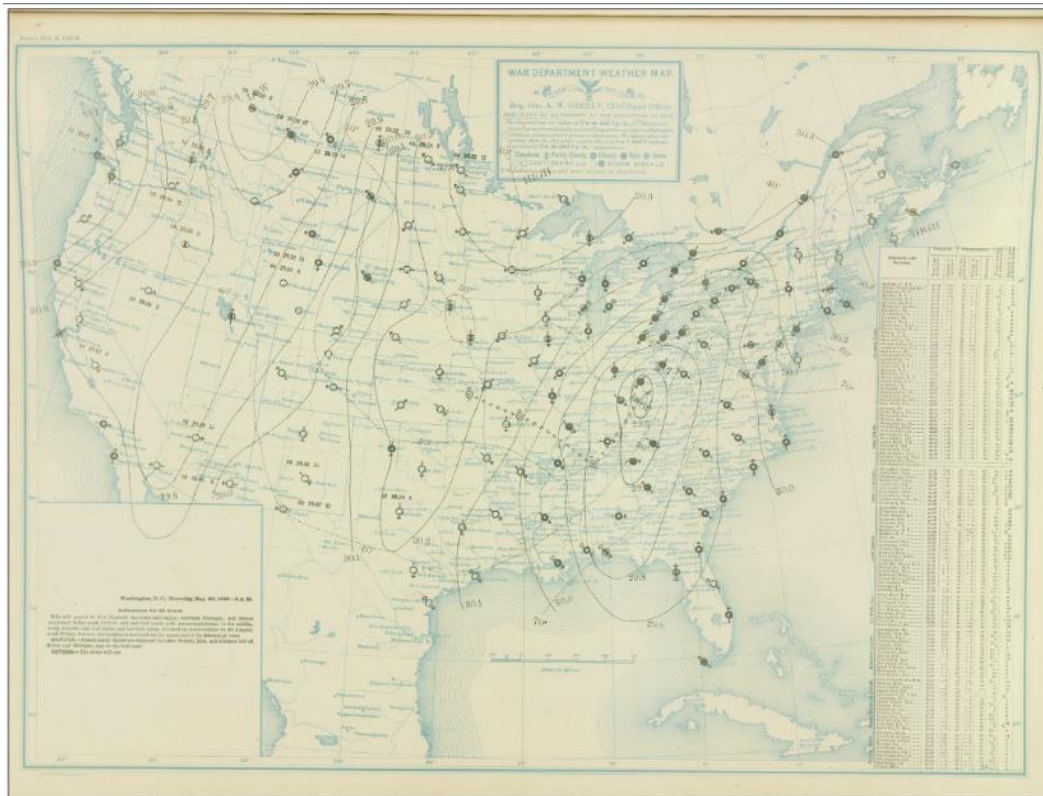
Storm of May 30 - June 1, 1889 Assignment SA-1-1  
 Study Prepared by: Baltimore, Md. District  
Middle Atlantic Division



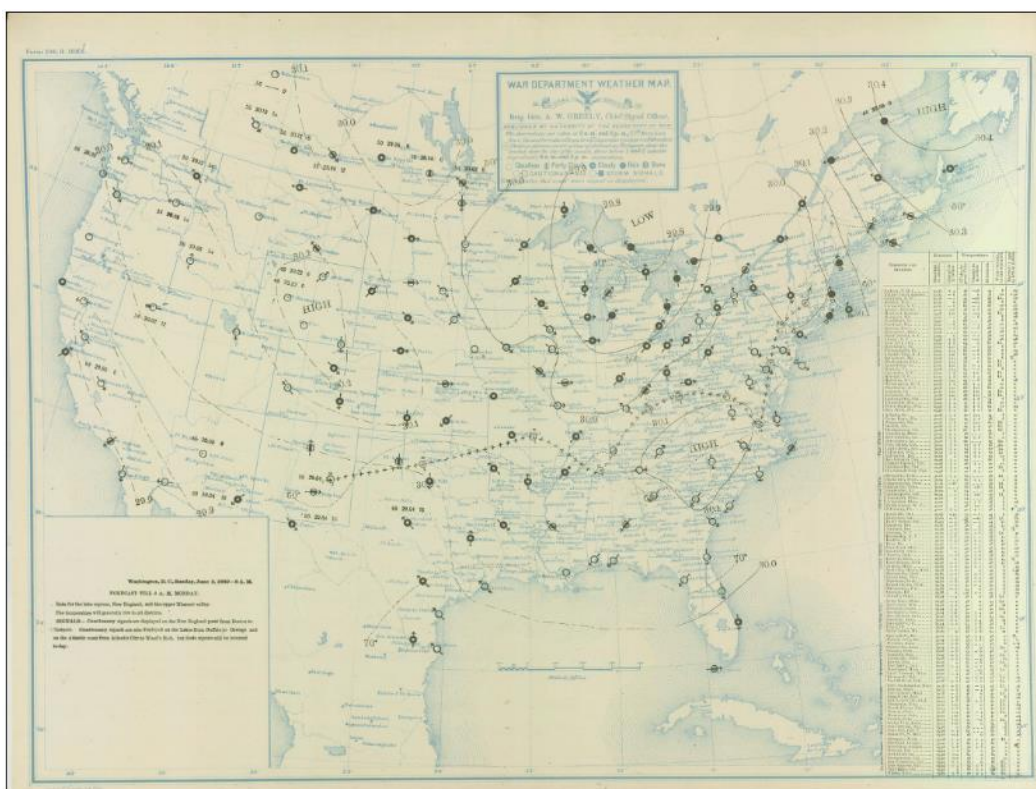
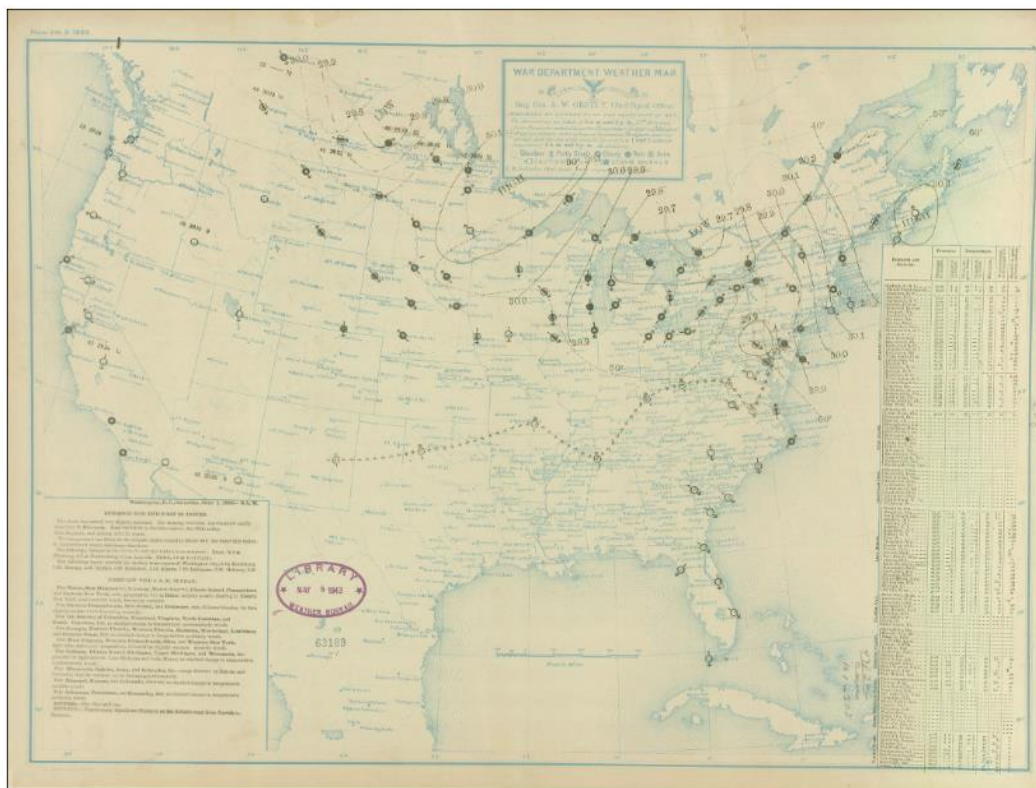
## MASS RAINFALL CURVES



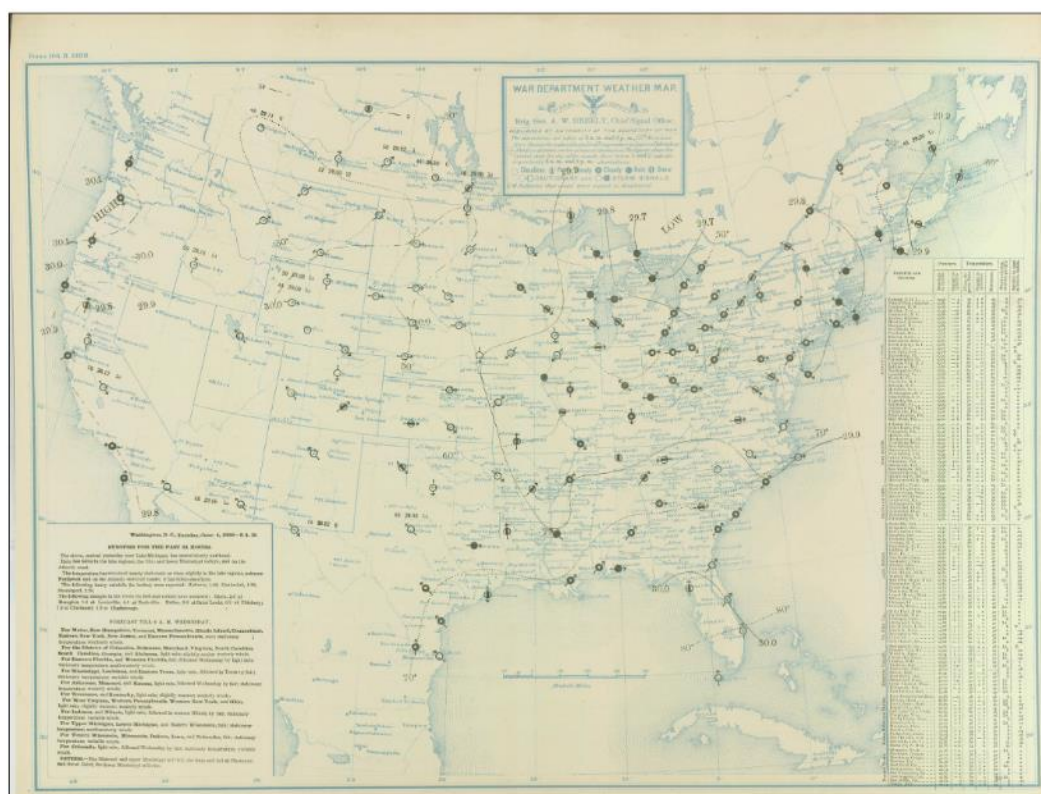
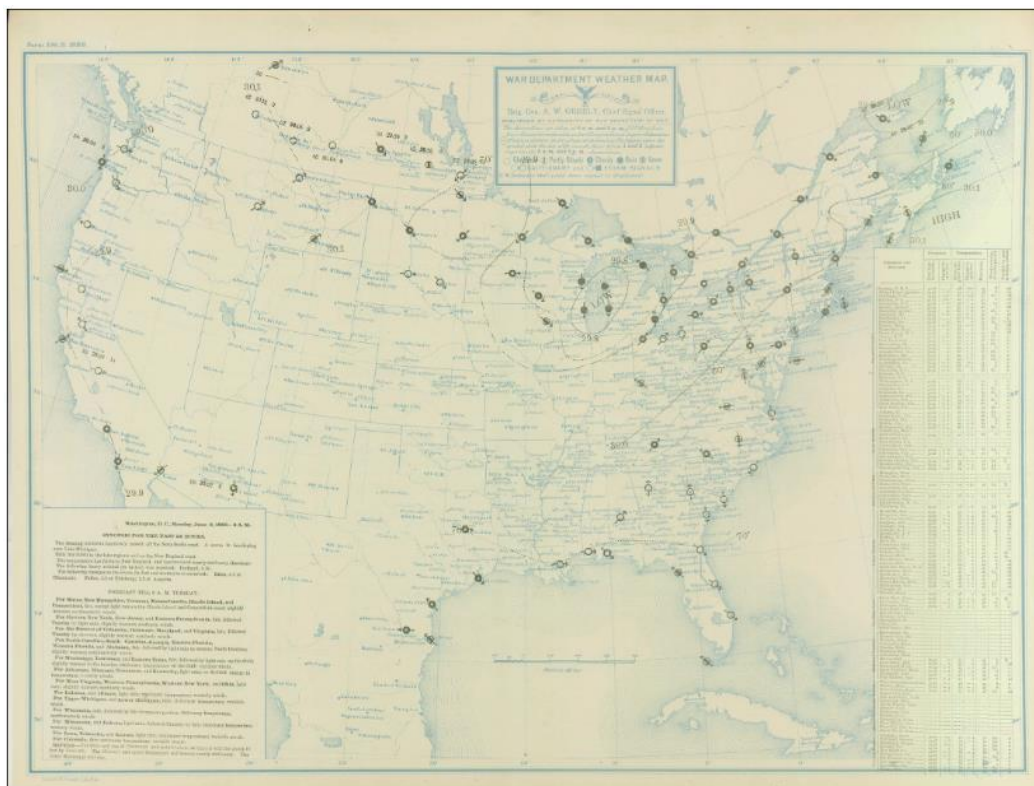




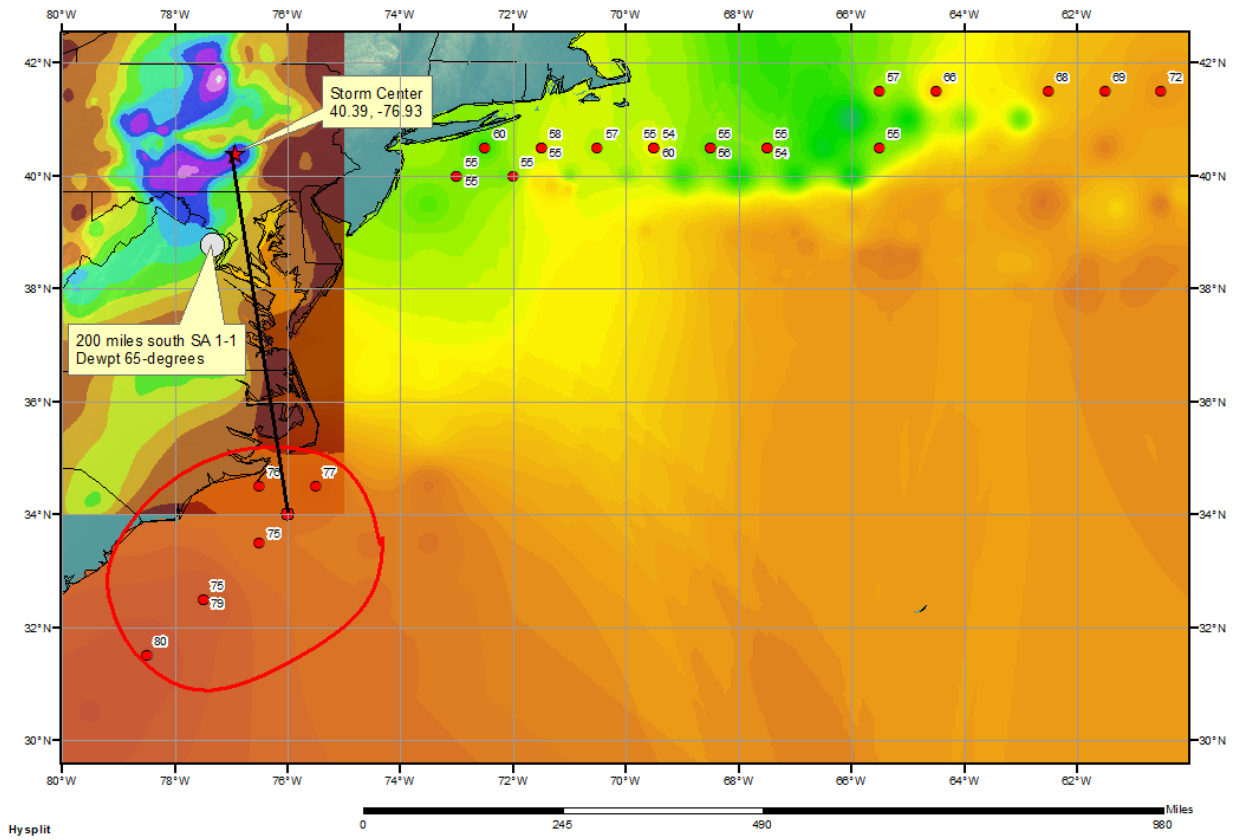








# SPAS 1339\_3 Wellsboro, PA Storm Analysis May 31, 1889



## Storm Precipitation Analysis System (SPAS) For Storm #1566\_1

### SPAS Analysis

**General Storm Location:** Paterson, NJ

**Storm Dates:** October 7 (0600) – October 12 (0500), 1903

**Event:** Synoptic, Remnants of hurricane

#### DAD Zone 1

**Latitude:** 40.9375

**Longitude:** -74.1375

**Max. Grid Rainfall Amount:** 15.96"

**Max. Observed Rainfall Amount:** 15.51"

**Number of Stations:** 356 (2 Hourly, 7 Hourly Pseudo, 262 Daily, 85 Supplemental)

**SPAS Version:** 10.0

**Basemap:** Blended basemap based on USACE GL 4-9 and conus\_prism\_ppt\_in\_1971\_2000\_10

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

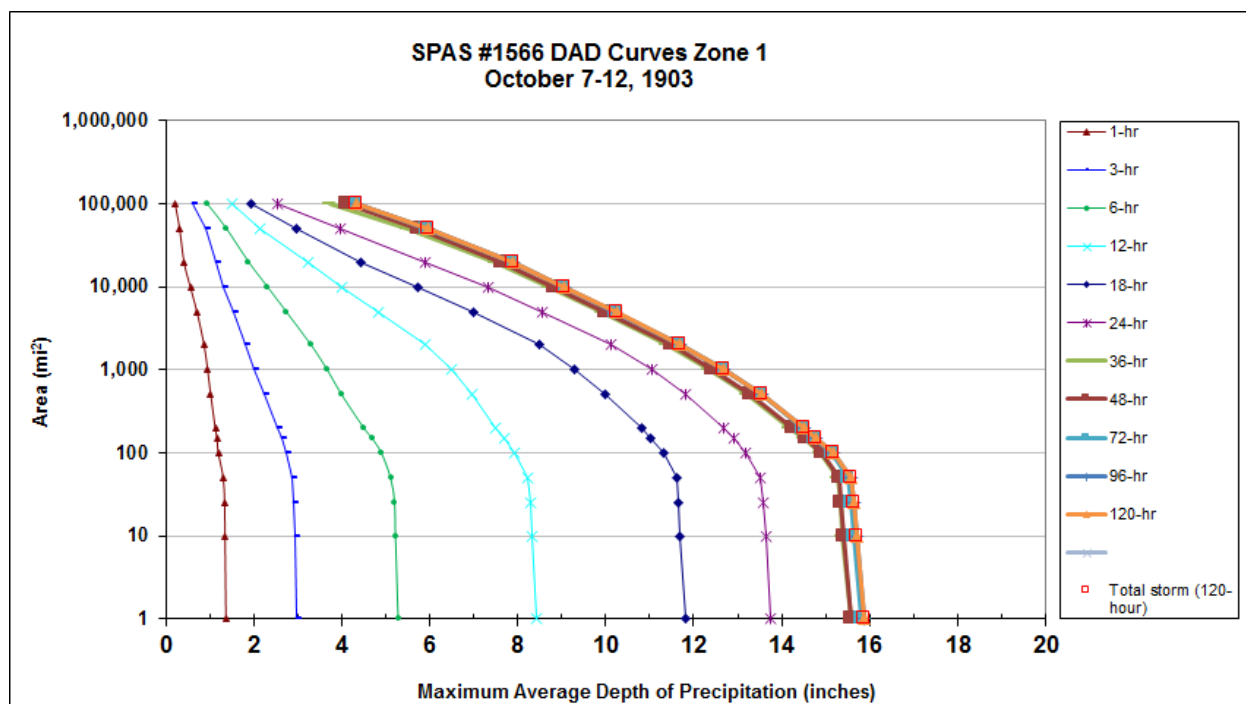
**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

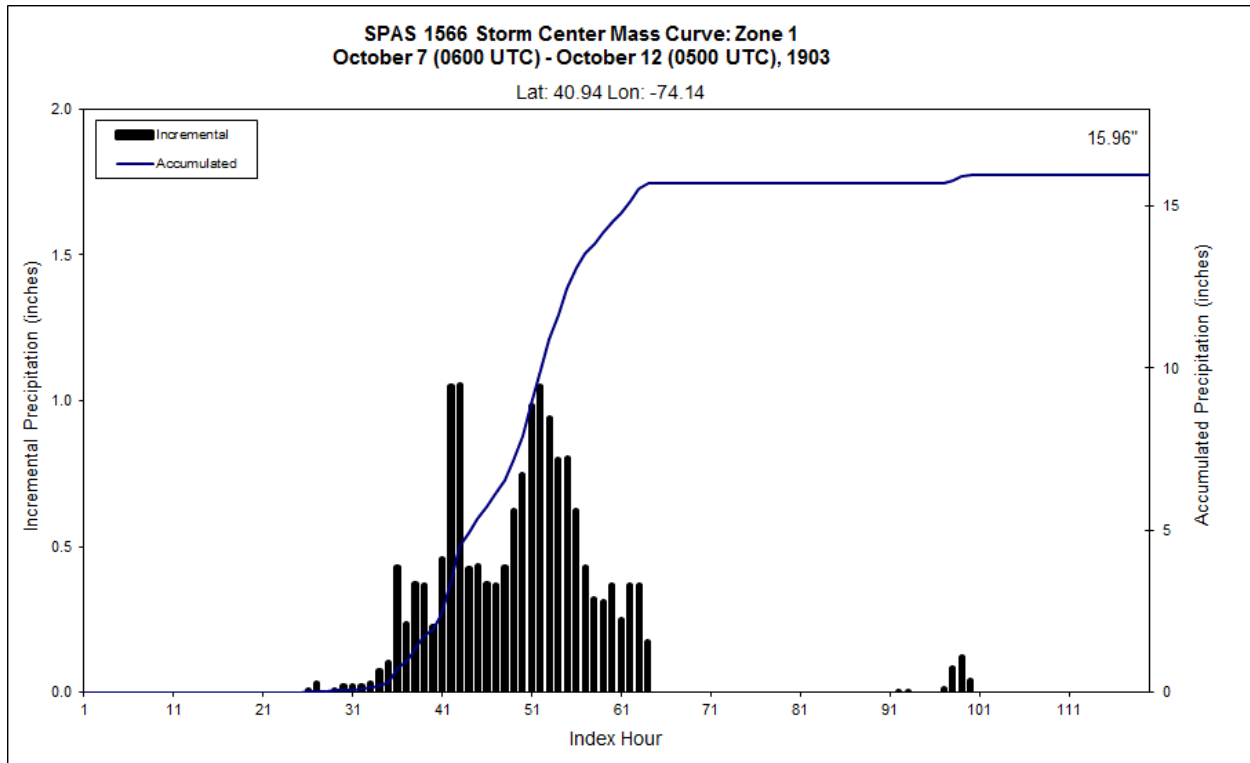
**Reliability of results:** This analysis was based on 356 hourly stations (USACE GL 4-9, USGS, NCDC and EDADSV2 storm report mass curves), daily data and supplemental station data. We have a good degree of confidence for the station based storm total results. The spatial pattern is dependent on the blended basemap (USACE GL 4-9 and conus\_prism\_ppt\_in\_1971\_2000\_10). Spatially, it looks very similar to the rainfall analysis from USACE (see below). There is a good degree of confidence with the timing based on the hourly stations near the storm center. Some daily stations were moved to supplemental due to timing issues.

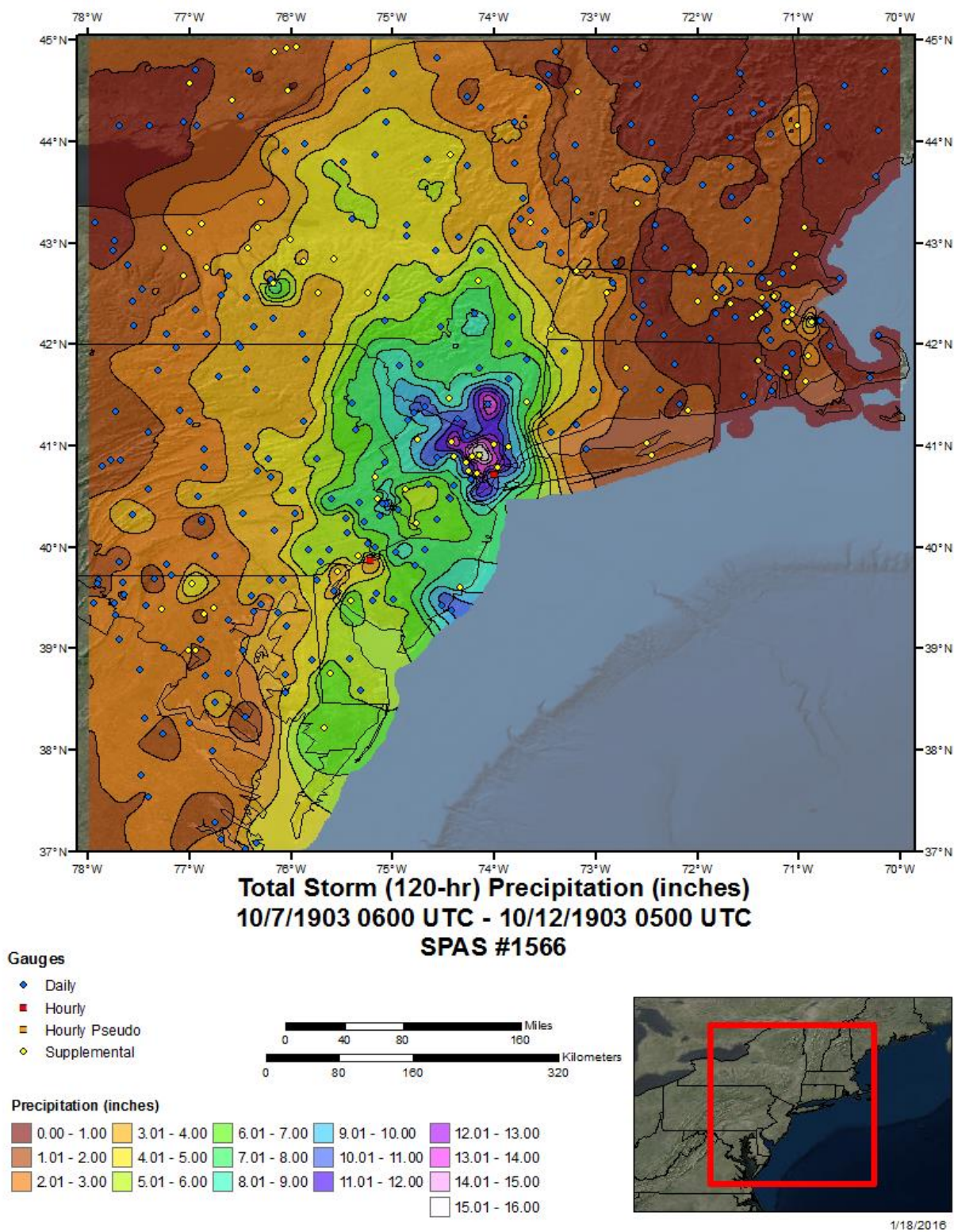
							Storm Rep. SST					Climatological Max. SST					IPMF	
	SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
Storm Center Location	1566_1	-74.1375	40.9375	60	100	25-Sep	72.50	2.54	0.03	67	2.510	78.14	78.0	3.29	0.03	78	3.260	1.299

Storm 1566 Zone 1 - October 7 (0600 UTC) - October 12 (0500 UTC), 1903													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
areasqmi	Duration (hours)												
	1-hr	3-hr	6-hr	12-hr	18-hr	24-hr	36-hr	48-hr	72-hr	96-hr	120-hr		Total
0.4	1.38	2.97	5.31	8.46	11.88	13.82	15.62	15.66	15.88	15.92	15.92		15.92
1	1.37	2.96	5.29	8.42	11.83	13.76	15.56	15.59	15.81	15.86	15.86		15.86
10	1.35	2.93	5.23	8.32	11.70	13.63	15.39	15.42	15.64	15.70	15.70		15.70
25	1.34	2.92	5.21	8.28	11.65	13.57	15.33	15.35	15.57	15.64	15.64		15.64
50	1.31	2.86	5.12	8.22	11.61	13.51	15.28	15.30	15.52	15.58	15.58		15.58
100	1.20	2.75	4.91	7.94	11.31	13.17	14.89	14.92	15.14	15.18	15.18		15.18
150	1.17	2.64	4.70	7.68	11.03	12.90	14.50	14.53	14.75	14.79	14.79		14.79
200	1.13	2.53	4.51	7.51	10.82	12.67	14.19	14.24	14.47	14.50	14.50		14.50
500	1.03	2.24	4.01	6.97	9.99	11.81	13.20	13.28	13.53	13.55	13.55		13.55
1,000	0.96	2.02	3.68	6.49	9.28	11.05	12.36	12.43	12.68	12.69	12.69		12.69
2,000	0.88	1.80	3.31	5.91	8.49	10.11	11.37	11.47	11.69	11.69	11.69		11.69
5,000	0.72	1.53	2.75	4.84	7.00	8.55	9.91	10.00	10.22	10.23	10.24		10.24
10,000	0.57	1.32	2.32	4.02	5.74	7.33	8.72	8.82	9.05	9.06	9.07		9.07
20,000	0.43	1.14	1.89	3.25	4.44	5.91	7.50	7.62	7.88	7.90	7.91		7.91
50,000	0.33	0.90	1.39	2.16	2.96	3.96	5.49	5.73	5.95	5.97	5.98		5.98
100,000	0.23	0.62	0.95	1.52	1.94	2.55	3.75	4.11	4.33	4.34	4.35		4.35









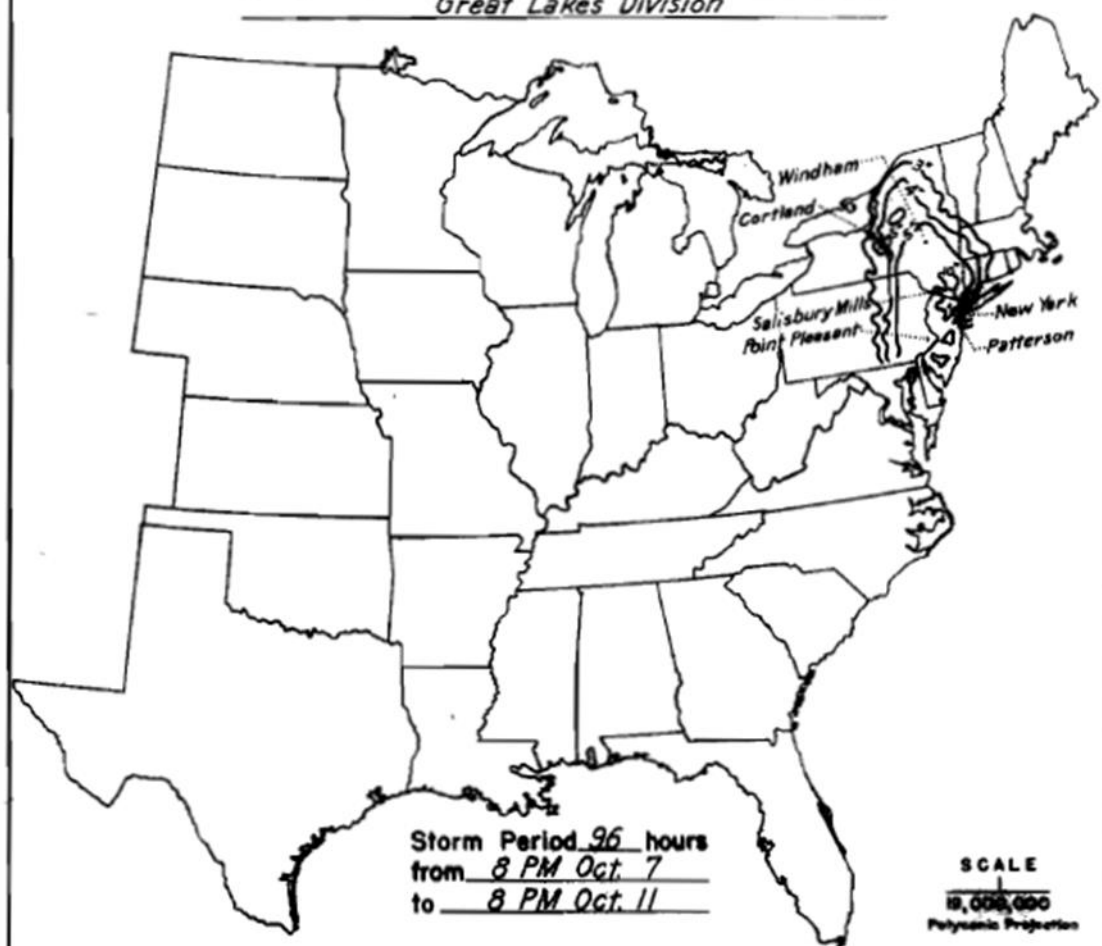


WAR DEPARTMENT

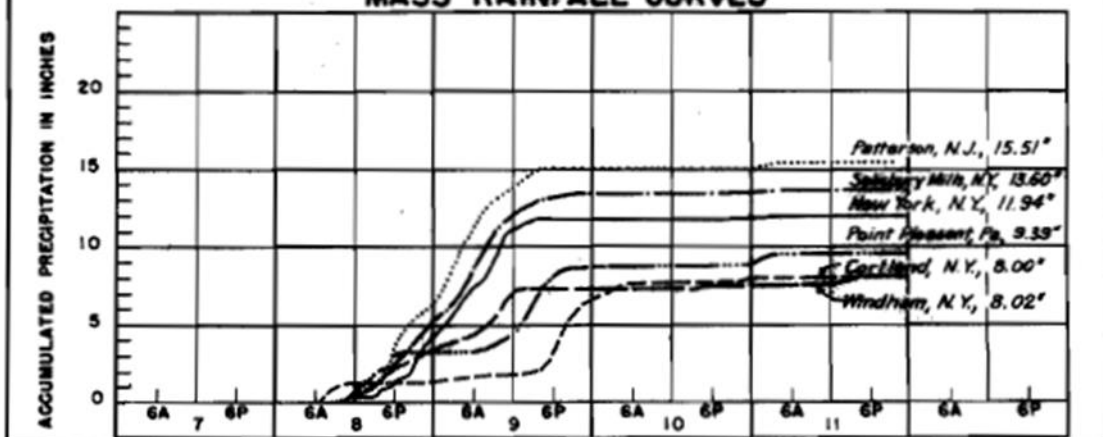
CORPS OF ENGINEERS, U. S. ARMY

## STORM STUDIES - ISOHYETAL MAP

Storm of October 7-11, 1903 Assignment GL 4-9  
 Study Prepared by: Buffalo, N.Y. District  
Great Lakes Division

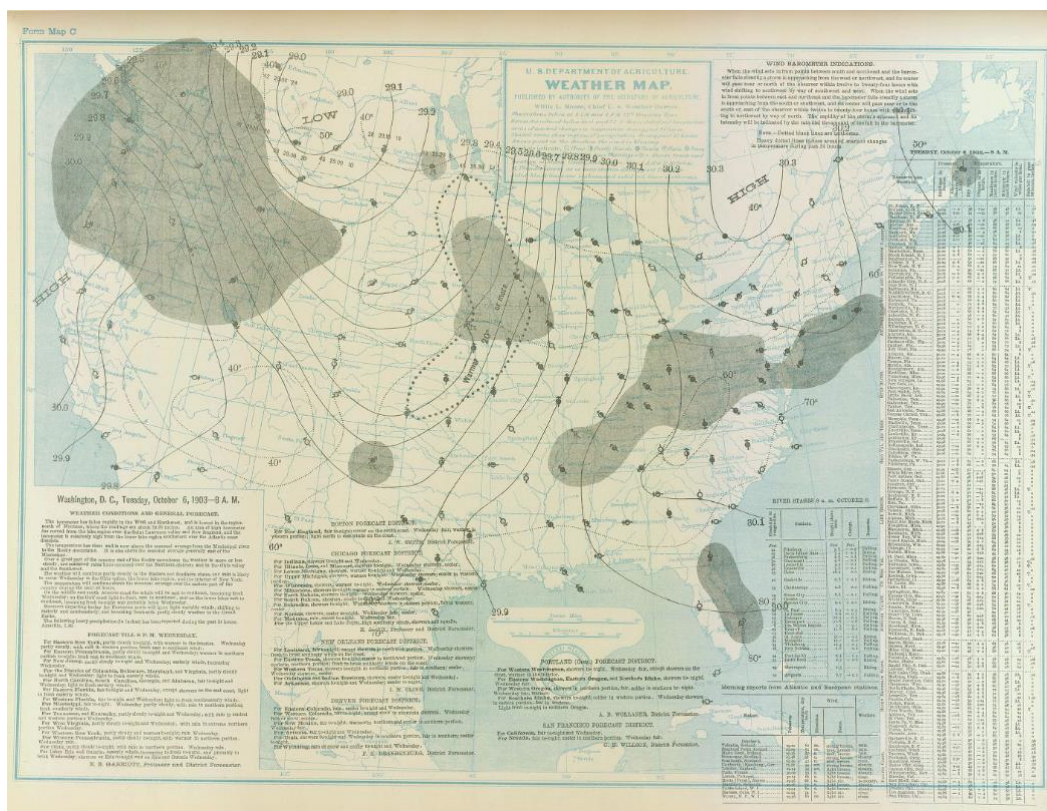
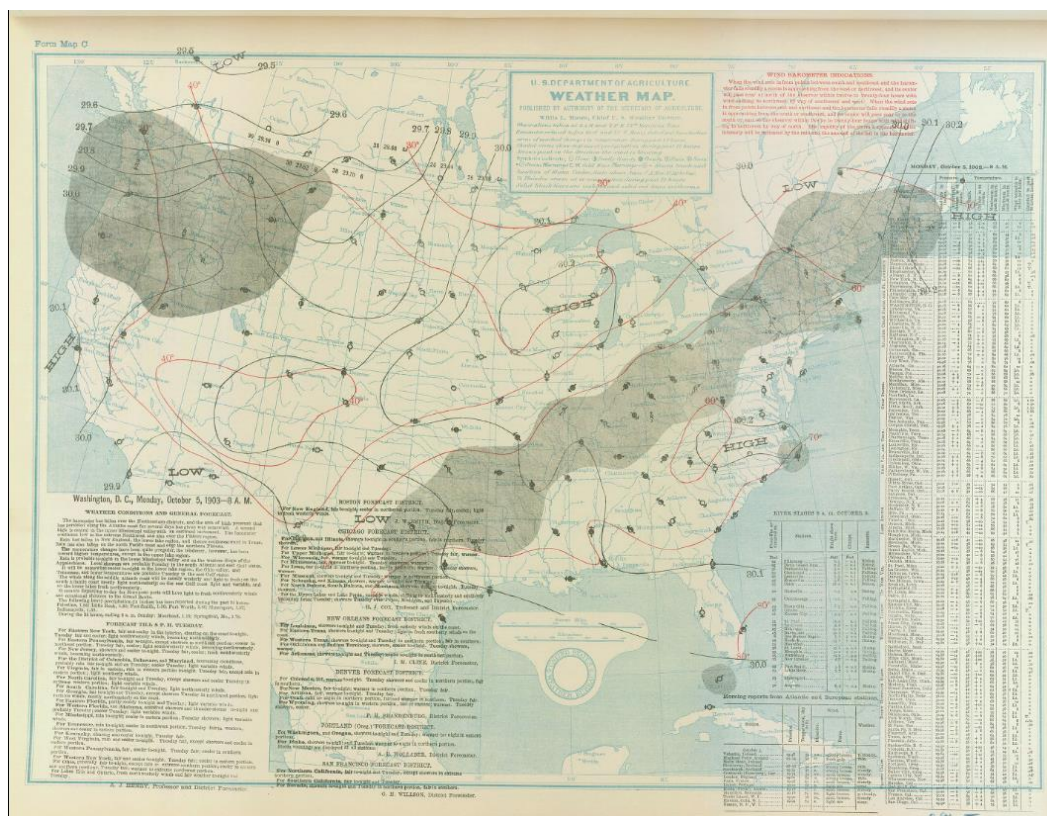


## MASS RAINFALL CURVES

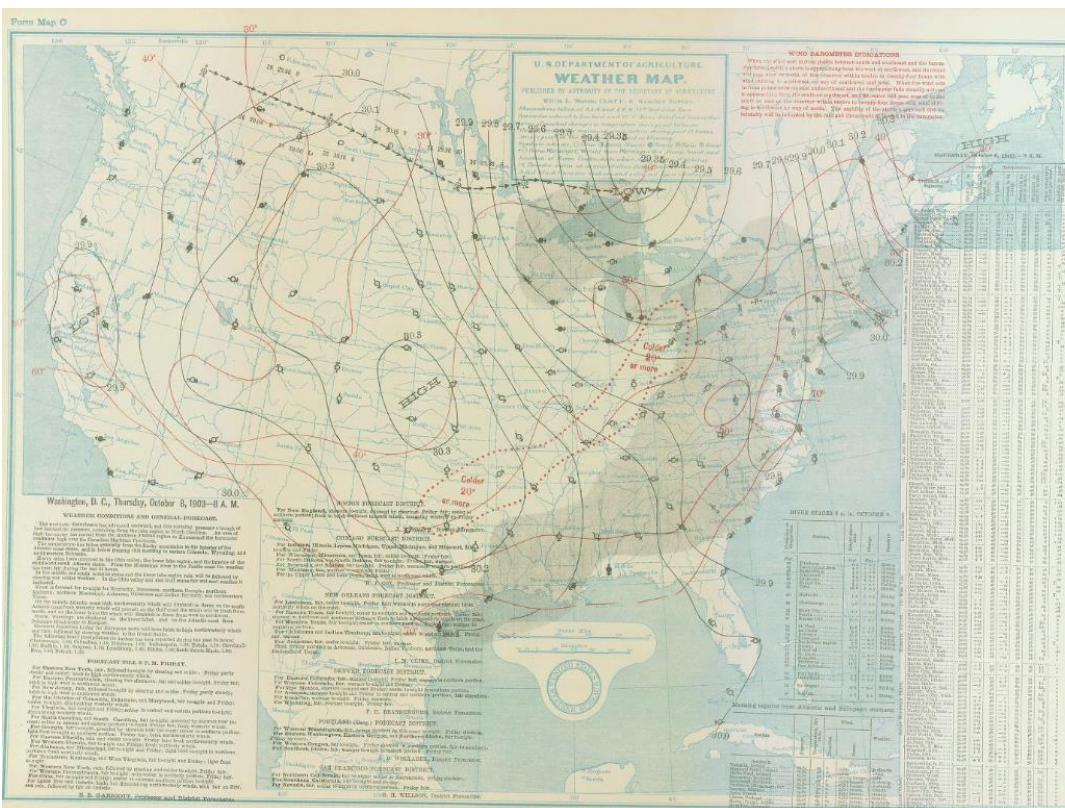
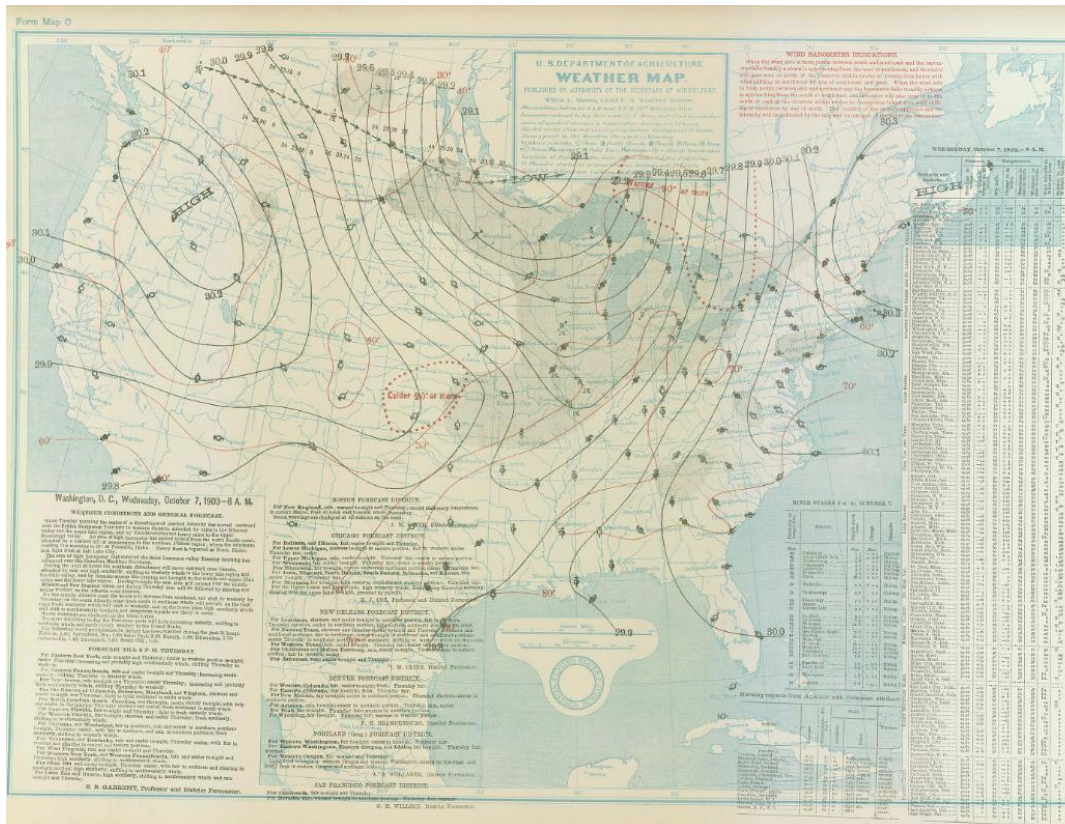


FORM 8-3E

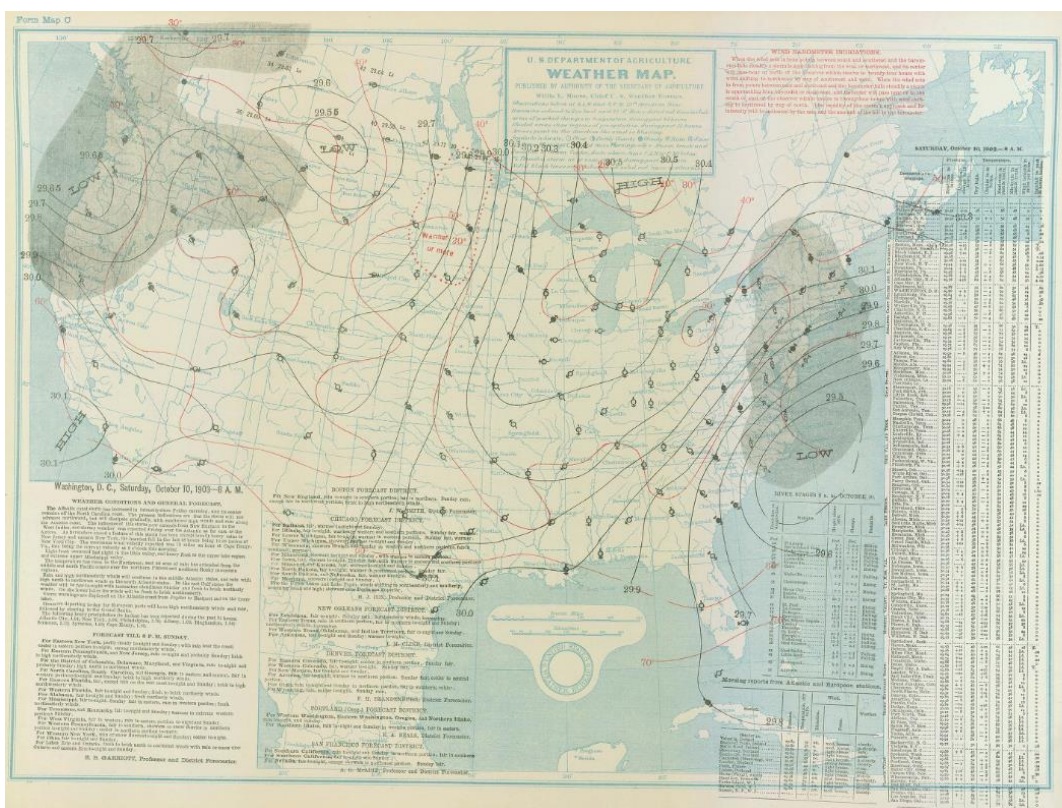


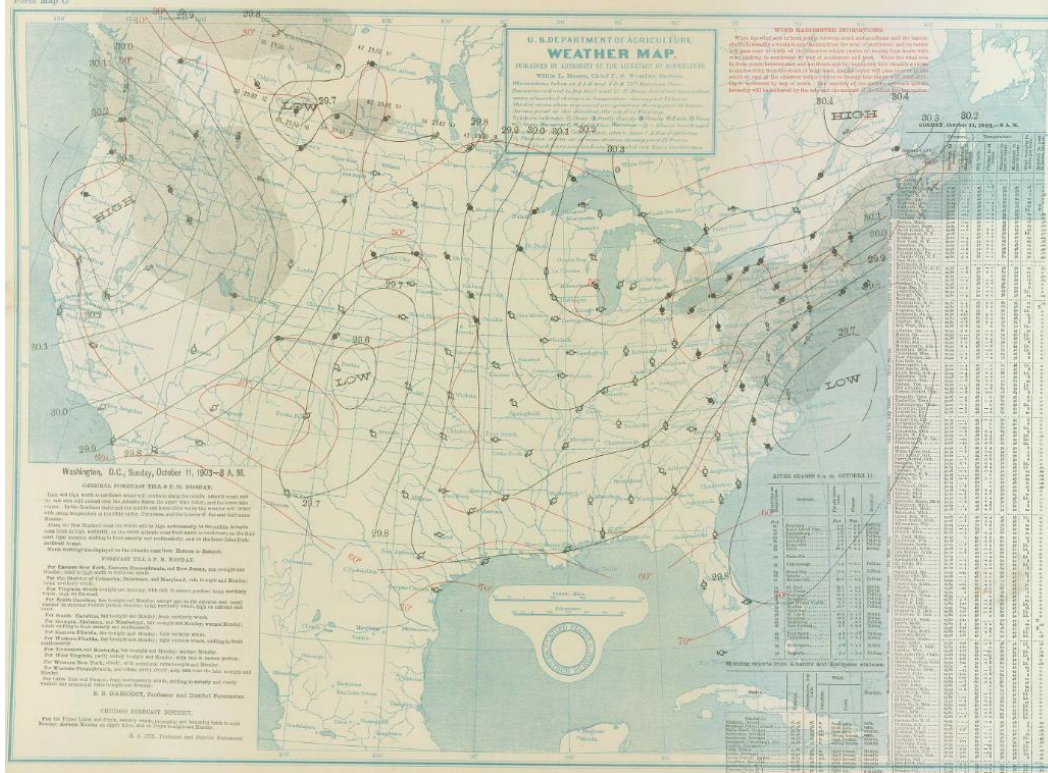




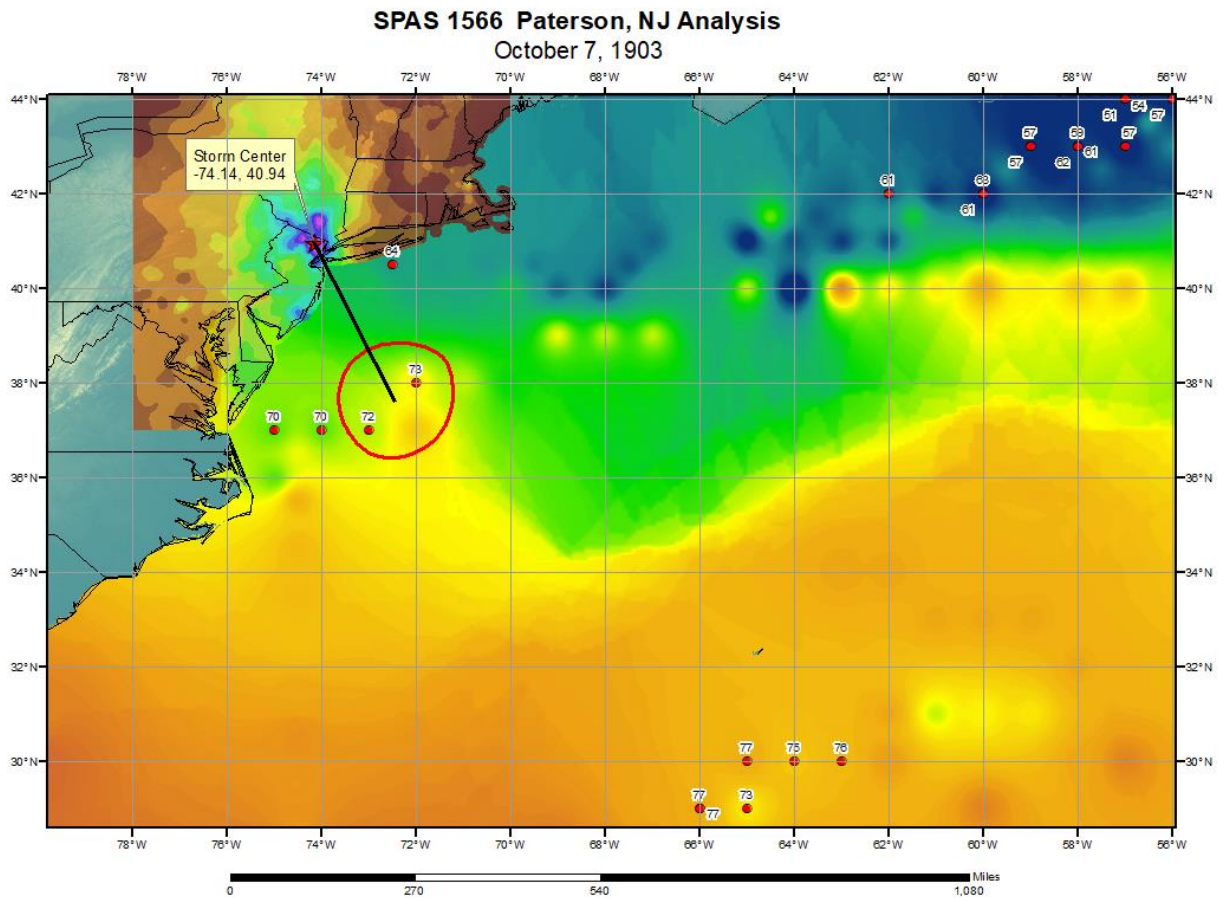


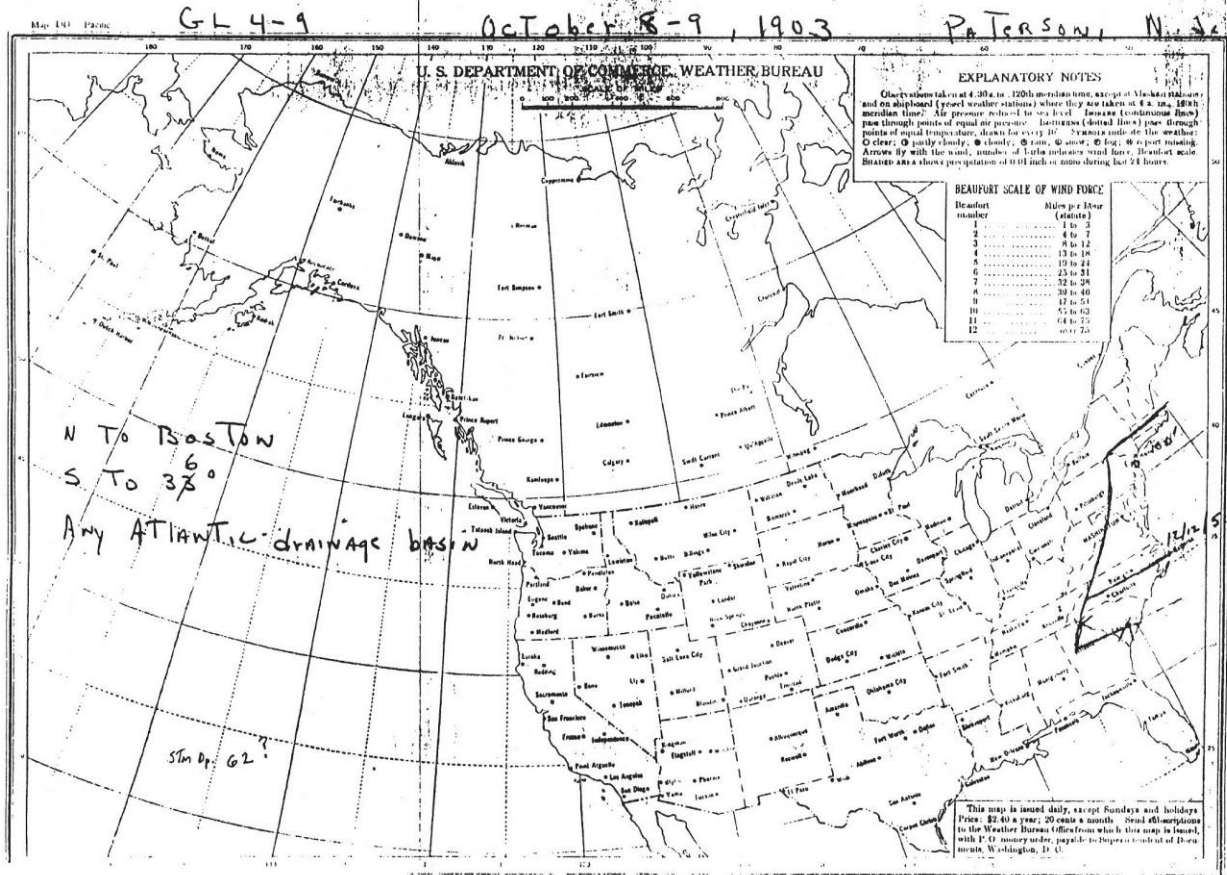












## Storm Precipitation Analysis System (SPAS) for Storm #1680 (rerun of 1006\_1) SPAS Analysis

**General Storm Location:** West Shokan, NY

**Storm Dates:** October 14-17, 1955

**Event:** Frontal System Moving Offshore, Moisture from Hurricane Katie

### DAD Zone 1

**Latitude:** 41.95

**Longitude:** -74.320

**Max. Grid Rainfall Amount:** 18.50"

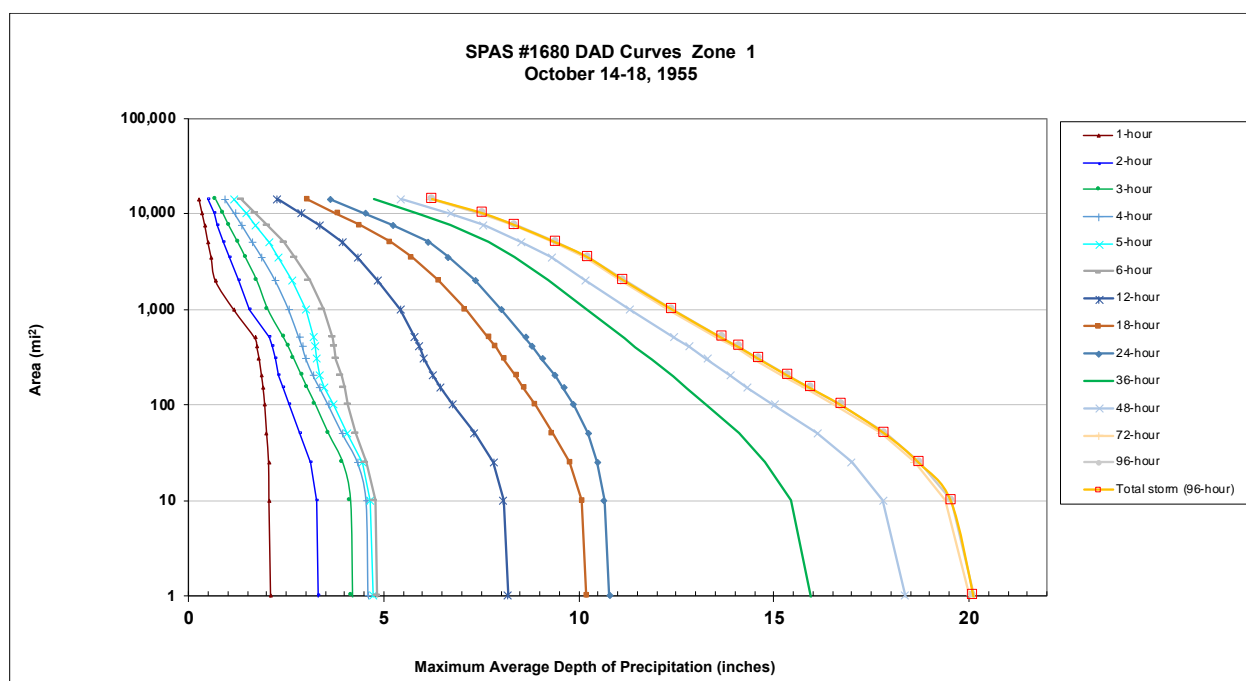
**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

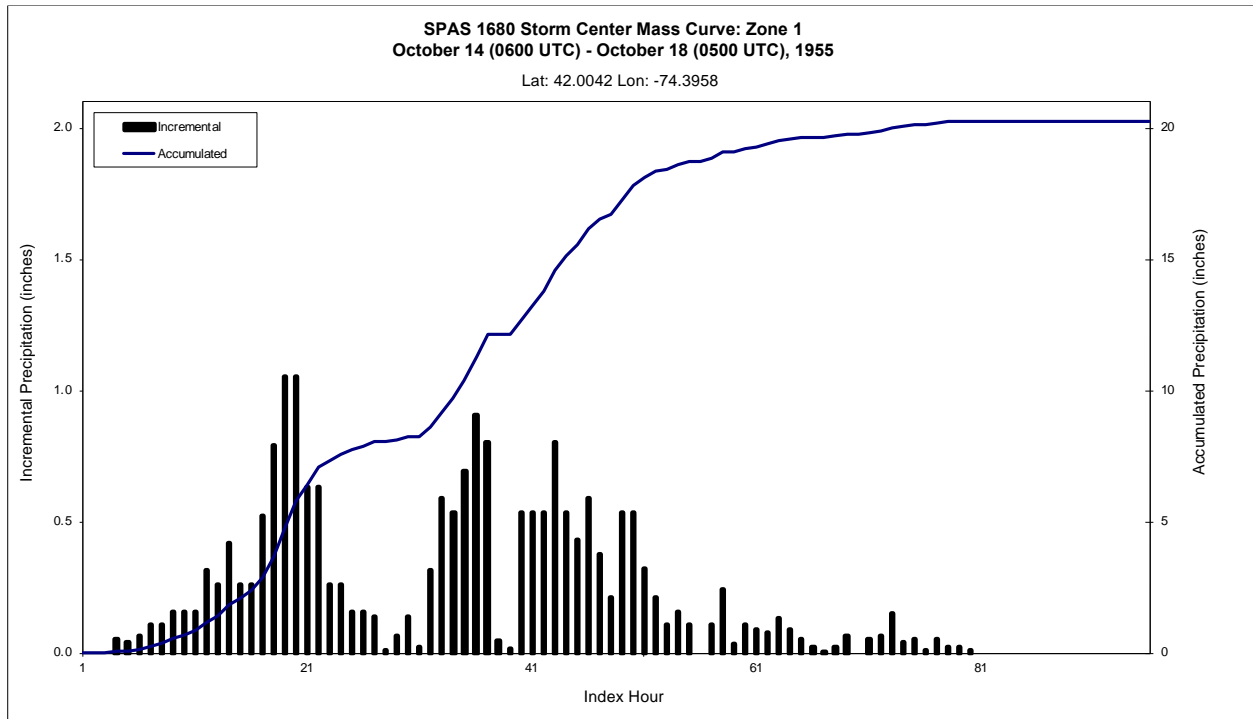
This storm was re-run through SPAS (updating SPAS 1006 to SPAS 1680). This changed the storm center location elevation and affected the IPMF when compared to previous AWA studies. This changed the storm center elevation used in the IPMF calculations and resulted in the slight variance (1%). The storm representative location and value are the same, 78F.

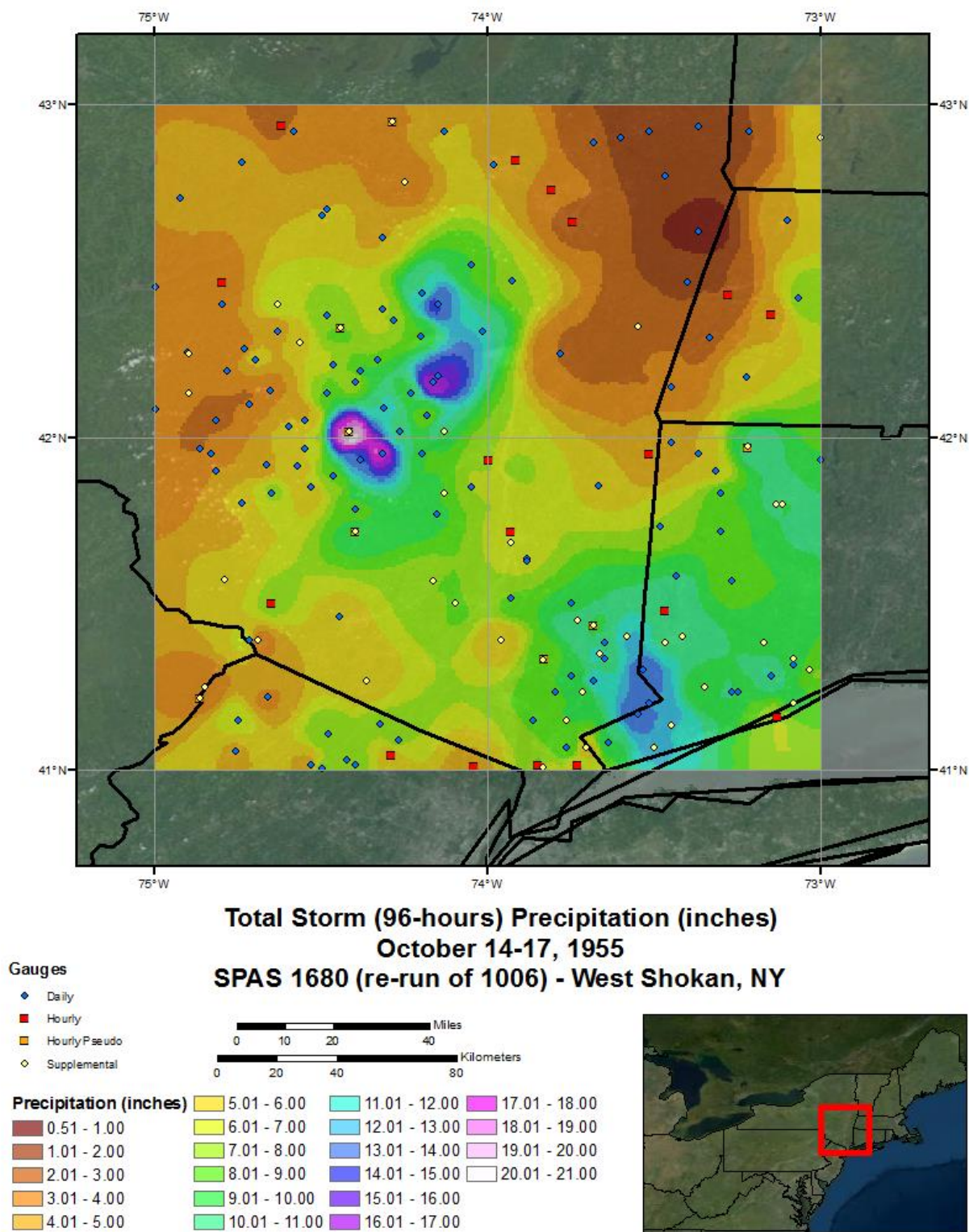
	SPAS Storm ID	LOn	LAT	ELEV	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
Storm Center Location	1680_1	-74.3958	42.0042	3,548	3,500	1-Oct	78.00	3.29	0.89	78	2.400	81.50	81.5	3.86	1.00	85	2.860	1.192

Storm 1680 - October 14 (0600 UTC) - October 18 (0500 UTC), 1955													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
Area (mi <sup>2</sup> )	Duration (hours)												
	1	2	3	4	5	6	12	18	24	36	48	72	96
0.4	2.11	3.34	4.22	4.63	4.75	4.85	8.22	10.25	10.83	16.03	18.48	20.15	20.27
1	2.10	3.32	4.20	4.61	4.73	4.83	8.18	10.21	10.78	15.93	18.36	20.02	20.13
10	2.06	3.28	4.15	4.56	4.67	4.78	8.07	10.09	10.65	15.43	17.79	19.41	19.55
25	2.05	3.13	3.95	4.34	4.45	4.55	7.81	9.77	10.48	14.77	16.99	18.60	18.73
50	2.00	2.85	3.59	3.95	4.06	4.28	7.32	9.32	10.24	14.10	16.12	17.73	17.86
100	1.95	2.58	3.26	3.59	3.70	4.10	6.78	8.88	9.87	13.29	15.01	16.58	16.73
150	1.91	2.42	3.05	3.37	3.48	4.00	6.46	8.60	9.61	12.77	14.34	15.81	15.95
200	1.87	2.30	2.91	3.21	3.35	3.91	6.26	8.39	9.40	12.43	13.91	15.25	15.39
300	1.81	2.22	2.71	3.02	3.29	3.78	6.04	8.08	9.06	11.86	13.30	14.51	14.64
400	1.75	2.15	2.57	2.93	3.25	3.74	5.91	7.87	8.82	11.46	12.84	14.01	14.12
500	1.70	2.08	2.45	2.84	3.21	3.70	5.80	7.69	8.63	11.17	12.46	13.57	13.68
1,000	1.15	1.57	2.04	2.57	2.99	3.45	5.42	7.08	8.01	10.18	11.29	12.28	12.39
2,000	0.68	1.27	1.76	2.23	2.65	3.10	4.84	6.40	7.35	9.22	10.16	11.06	11.16
3,500	0.57	1.05	1.47	1.89	2.31	2.73	4.32	5.72	6.65	8.37	9.30	10.15	10.23
5,000	0.49	0.89	1.28	1.65	2.05	2.44	3.93	5.16	6.14	7.68	8.52	9.33	9.41
7,500	0.41	0.74	1.05	1.38	1.70	2.02	3.34	4.39	5.23	6.71	7.55	8.32	8.38
10,000	0.34	0.64	0.90	1.19	1.46	1.72	2.90	3.82	4.54	5.93	6.74	7.51	7.56
14,212	0.26	0.50	0.71	0.94	1.15	1.35	2.28	3.03	3.62	4.75	5.44	6.19	6.24

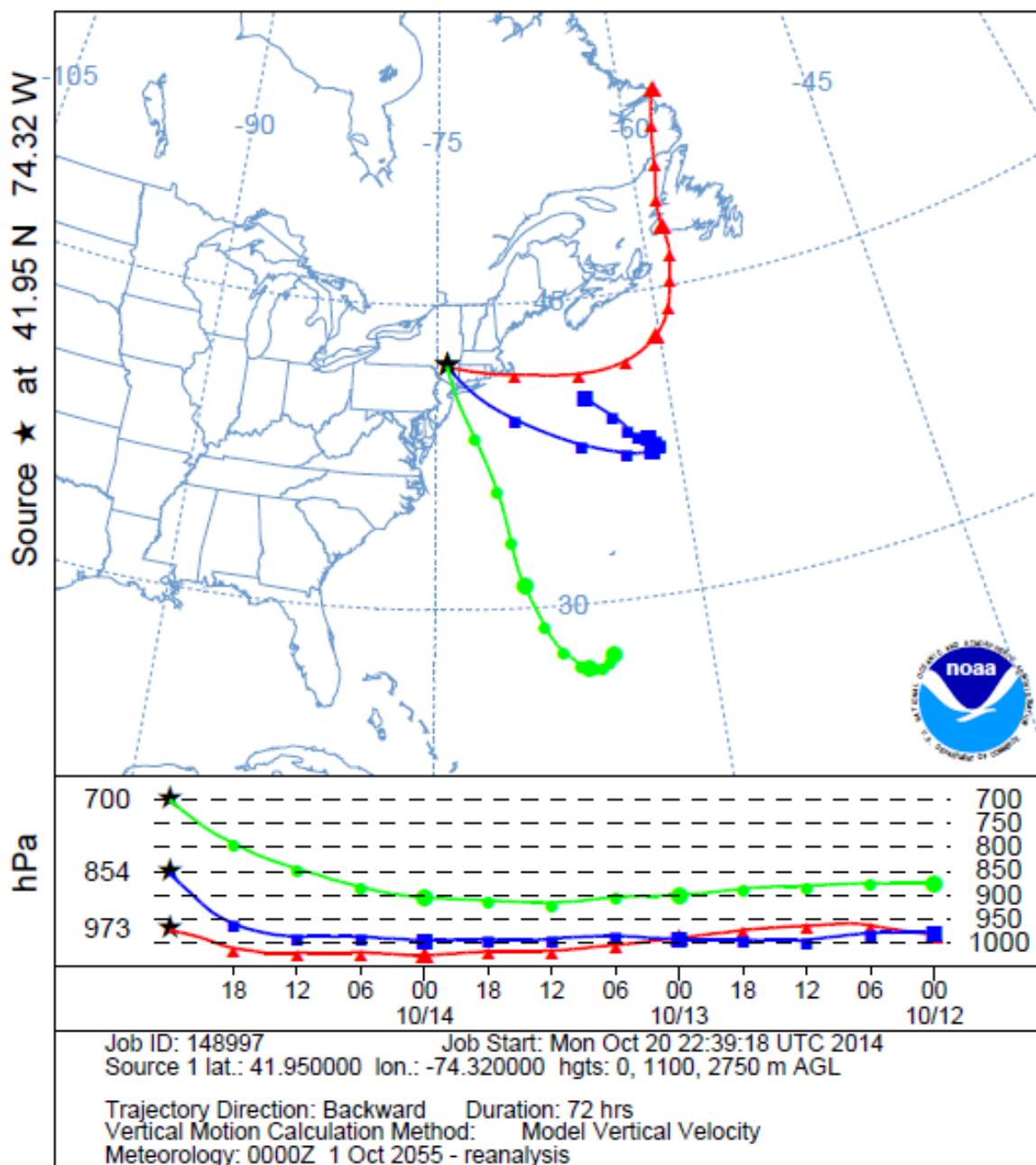




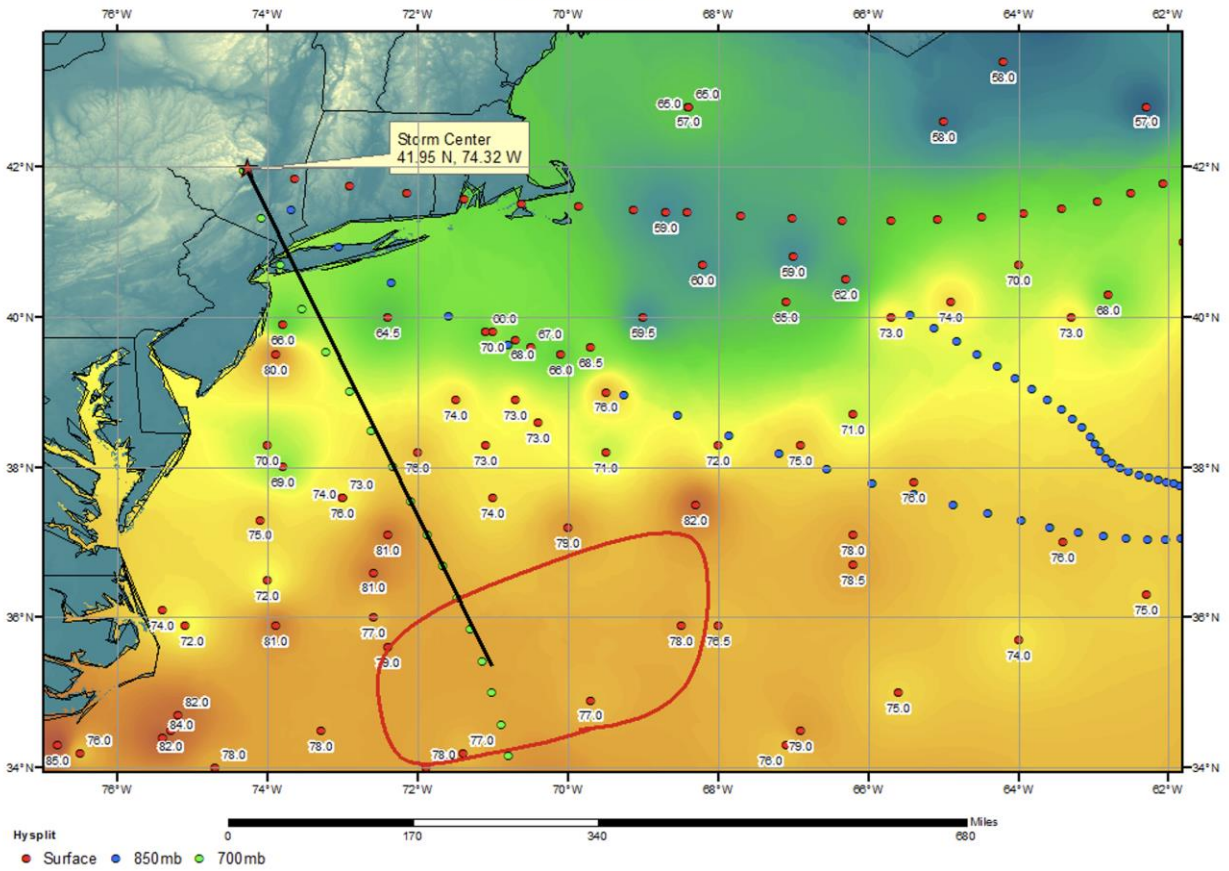




NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 15 Oct 55  
 CDC1 Meteorological Data



**SPAS 1680 West Shokan, NY Storm Analysis**  
October 13, 1955





## Storm Precipitation Analysis System (SPAS) For Storm #1403

### SPAS Analysis

**General Storm Location:** Pinkham Notch, NH, Re-run of SPAS 1203 - added area to west and south to capture complete storm total isohyetal pattern. New England and adjacent portions of Quebec, Canada

**Storm Dates:** May 27-June 3, 1984

**Event:** Synoptic

#### DAD Zone 1

**Latitude:** 44.2708

**Longitude:** -71.3042

**Max. Grid Rainfall Amount:** 12.98"

**Max. Observed Rainfall Amount:** 12.64" (Mt. Washington, NH)

**Number of Stations:** 754 (360 Daily, 80 Hourly, 3 Hourly Estimated, 7 Hourly Estimated Pseudo, 38 Hourly Pseudo, 262 Supplemental, and 4 Supplemental Estimated)

**SPAS Version:** 9.5

**Base Map Used:** Mean (1981-2010) PRISM May Precipitation blended with Canada elevation

**Spatial resolution:** 30 seconds

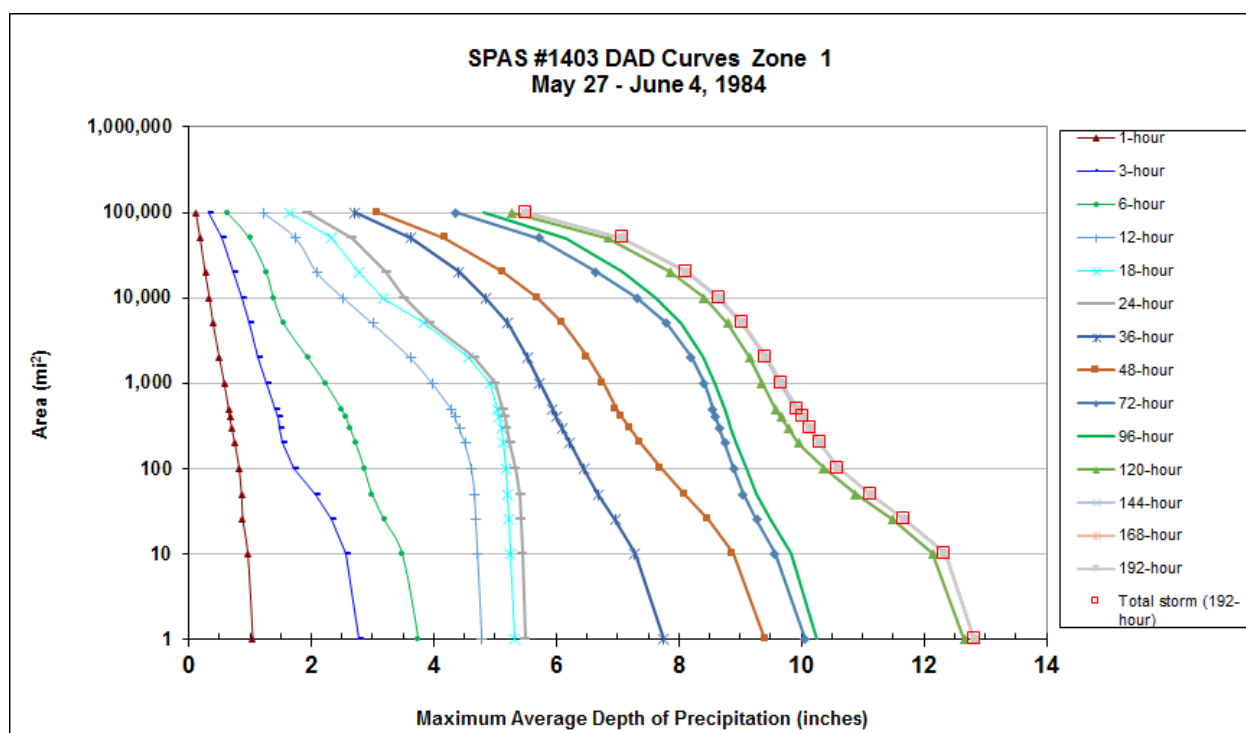
**Radar Included:** No

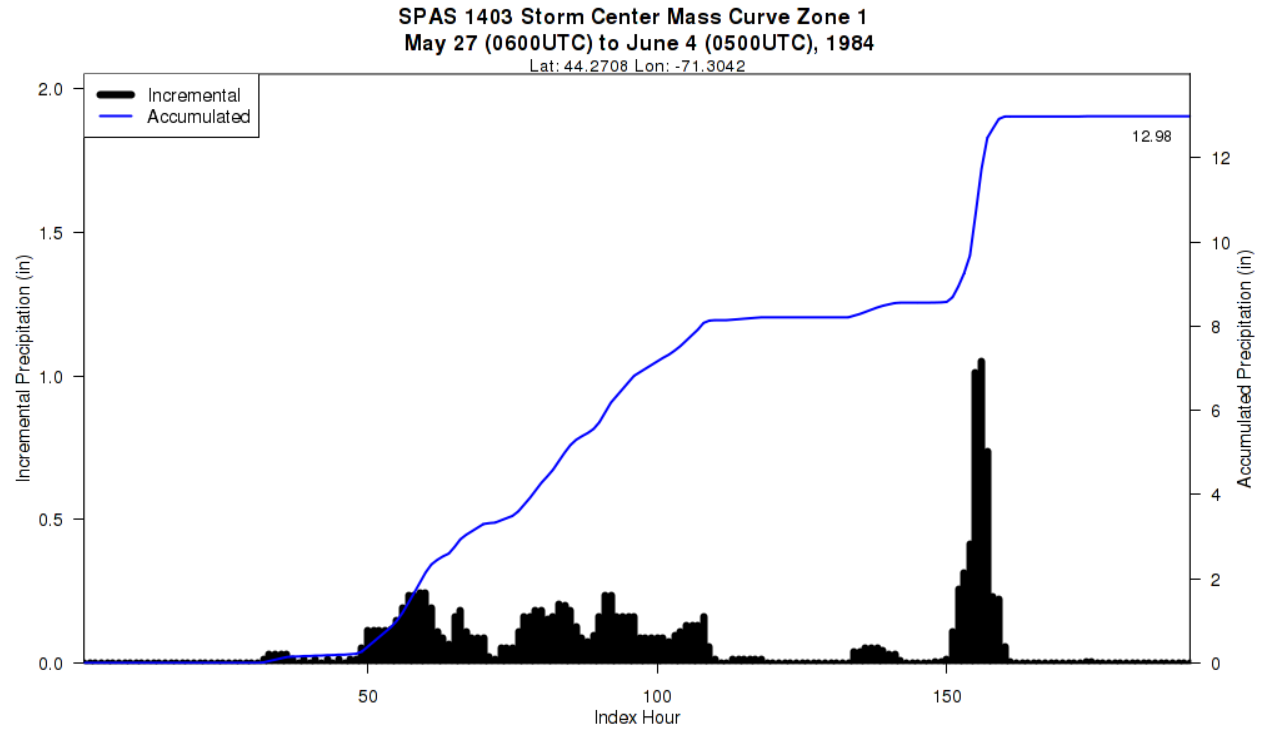
**Depth-Area-Duration (DAD) analysis:** Yes

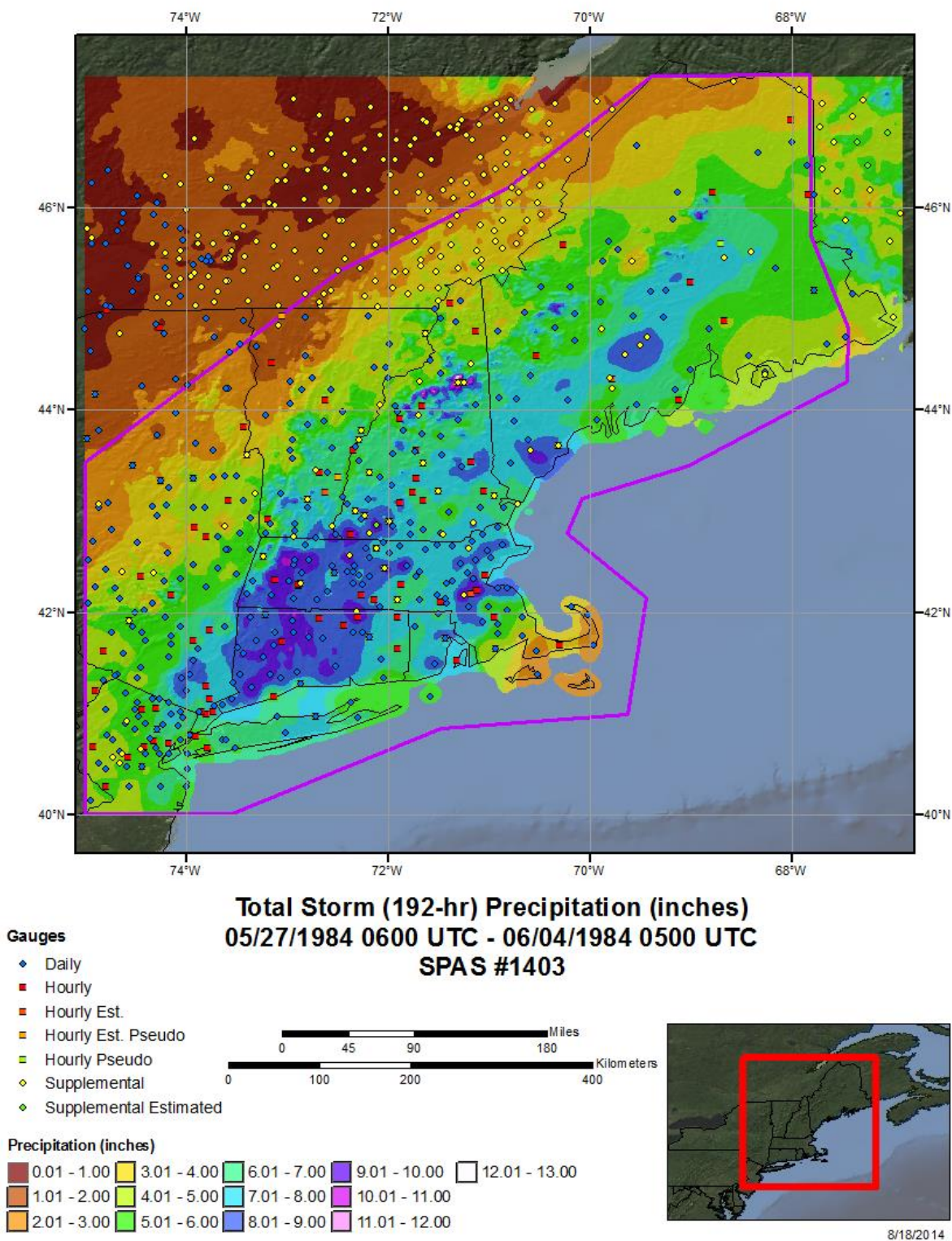
**Reliability of results:** With the exception of areas in Quebec, we have a great deal of confidence in the magnitude and spatial distribution of rainfall for this analysis given the relatively high number of gauges. We couldn't find any hourly data across Quebec, but we did accumulate a great deal of storm totals from the Global Historical Climate Network database, so although we have confidence in the magnitudes we don't have confidence in the timing across Quebec; for these reasons, we elected to keep Quebec out of the DAD zone

SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. Dew Point					Climatological Max. Dew Point					IPMF	
						T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1403_1	-71.3042	44.2708	6.238	6,000	15-Jun	70.00	2.25	1.06	62	1.190	75.58	75.5	2.92	1.29	73	1.630	1.370

Storm 1403 - May 27 (0600 UTC) - June 4 (0500 UTC), 1984														
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)														
Area (mi <sup>2</sup> )	Duration (hours)													
	1	3	6	12	18	24	36	48	72	96	120	144	168	192
Total														
0.4	1.05	2.80	3.79	4.81	5.34	5.51	7.85	9.53	10.18	10.34	12.76	12.93	12.93	12.93
1	1.04	2.77	3.75	4.79	5.31	5.49	7.75	9.41	10.06	10.26	12.66	12.83	12.83	12.83
10	0.96	2.57	3.49	4.72	5.24	5.44	7.28	8.88	9.57	9.84	12.15	12.34	12.34	12.34
25	0.88	2.34	3.20	4.69	5.22	5.42	6.96	8.48	9.27	9.49	11.50	11.68	11.68	11.68
50	0.86	2.07	3.00	4.67	5.20	5.41	6.68	8.10	9.05	9.26	10.89	11.12	11.13	11.13
100	0.82	1.71	2.87	4.62	5.18	5.33	6.45	7.71	8.90	9.09	10.37	10.60	10.60	10.60
200	0.75	1.54	2.73	4.51	5.14	5.24	6.22	7.38	8.75	8.94	9.96	10.30	10.31	10.31
300	0.70	1.49	2.64	4.42	5.10	5.19	6.09	7.20	8.66	8.85	9.79	10.13	10.14	10.15
400	0.67	1.45	2.57	4.35	5.07	5.16	6.00	7.07	8.60	8.79	9.67	10.00	10.03	10.03
500	0.65	1.41	2.50	4.29	5.04	5.13	5.94	6.98	8.55	8.74	9.58	9.91	9.94	9.94
1,000	0.58	1.28	2.24	3.98	4.91	5.00	5.73	6.76	8.41	8.58	9.36	9.64	9.67	9.67
2,000	0.50	1.12	1.95	3.62	4.57	4.66	5.53	6.50	8.20	8.39	9.15	9.40	9.42	9.42
5,000	0.40	0.98	1.56	3.01	3.83	3.94	5.21	6.10	7.80	8.04	8.80	9.03	9.04	9.05
10,000	0.34	0.86	1.39	2.53	3.17	3.51	4.84	5.69	7.32	7.61	8.41	8.64	8.65	8.66
20,000	0.27	0.73	1.27	2.09	2.77	3.22	4.41	5.13	6.65	7.08	7.86	8.12	8.13	8.13
50,000	0.19	0.53	1.00	1.75	2.32	2.67	3.63	4.19	5.71	6.16	6.85	7.07	7.08	7.08
100,000	0.12	0.33	0.64	1.22	1.65	1.94	2.71	3.09	4.36	4.82	5.27	5.49	5.50	5.50

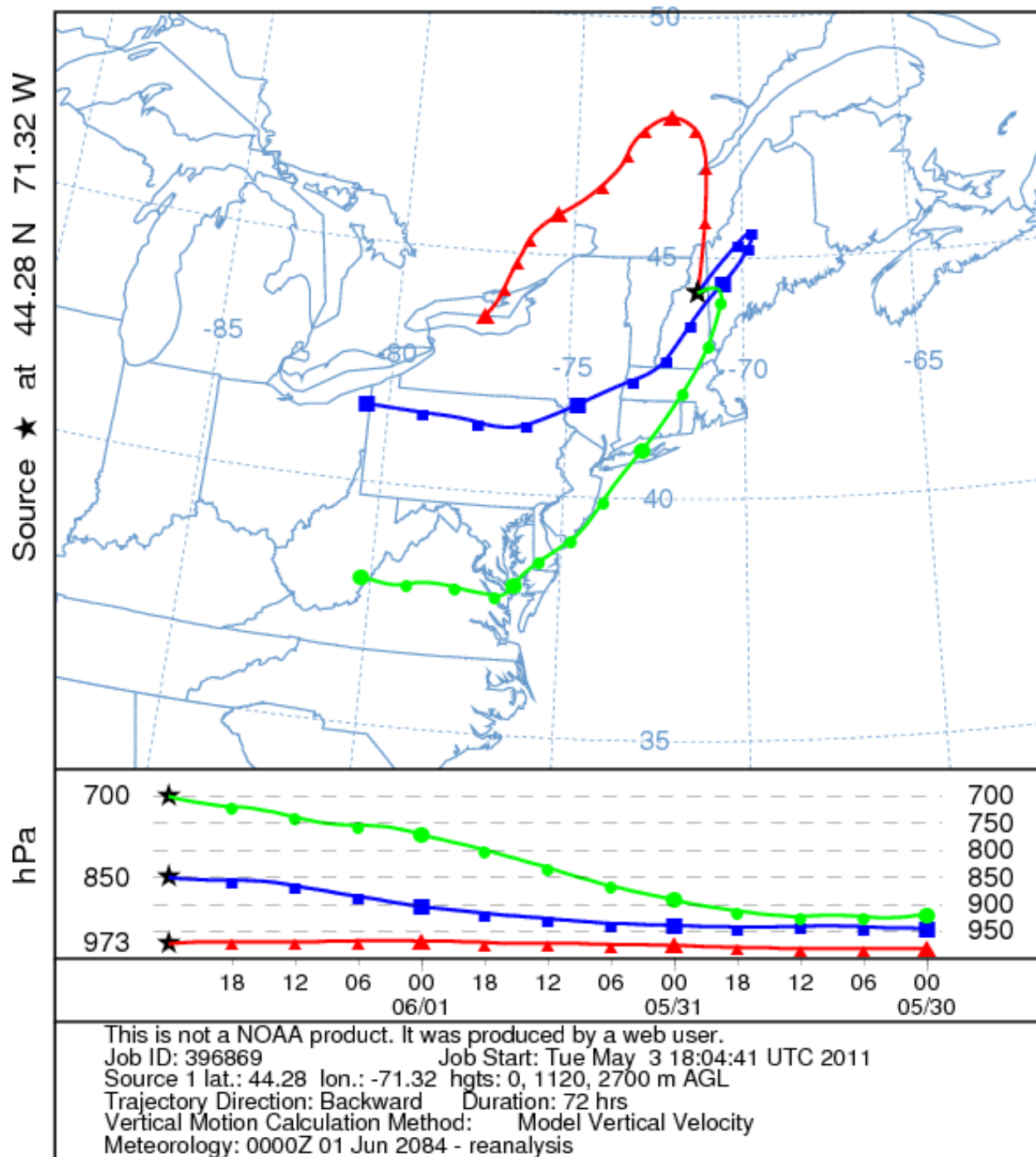






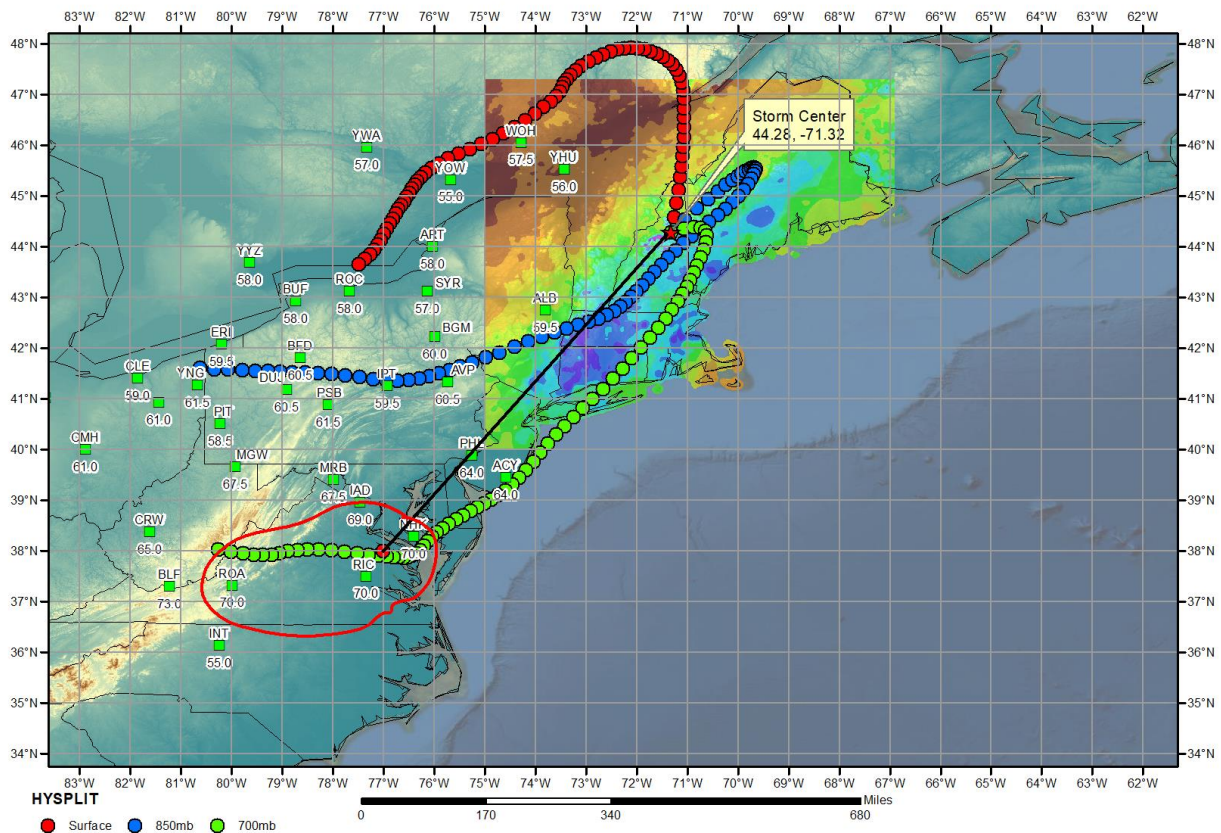


NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 02 Jun 84  
 CDC1 Meteorological Data



## SPAS 1403 Pinkham Notch, NH Surface Dewpoint Temperatures (F)

May 31 - Jun1, 1984



## Storm Precipitation Analysis System (SPAS) For Storm #1533\_1 SPAS Analysis

**General Storm Location:** Mid Atlantic, Montebello, VA

**Storm Dates:** October 31 – November 7, 1985

**Event:** Remnants of Hurricane Juan becoming an extratropical cyclone

### DAD Zone 1

**Latitude:** 37.8125

**Longitude:** -79.1625

**Max. Grid Rainfall Amount:** 22.56"

**Max. Observed Rainfall Amount:** 19.76" at Montebello 3 NE, VA

**Number of Stations:** 1050 (696 Daily, 183 Hourly, 0 Hourly Estimated, 62 Hourly Pseudo, 109 Supplemental, and 0 Supplemental Estimated)

**SPAS Version:** 10.0

**Base Map Used:** PRISM July (1981-2010) precipitation

**Spatial resolution:** 0.2606

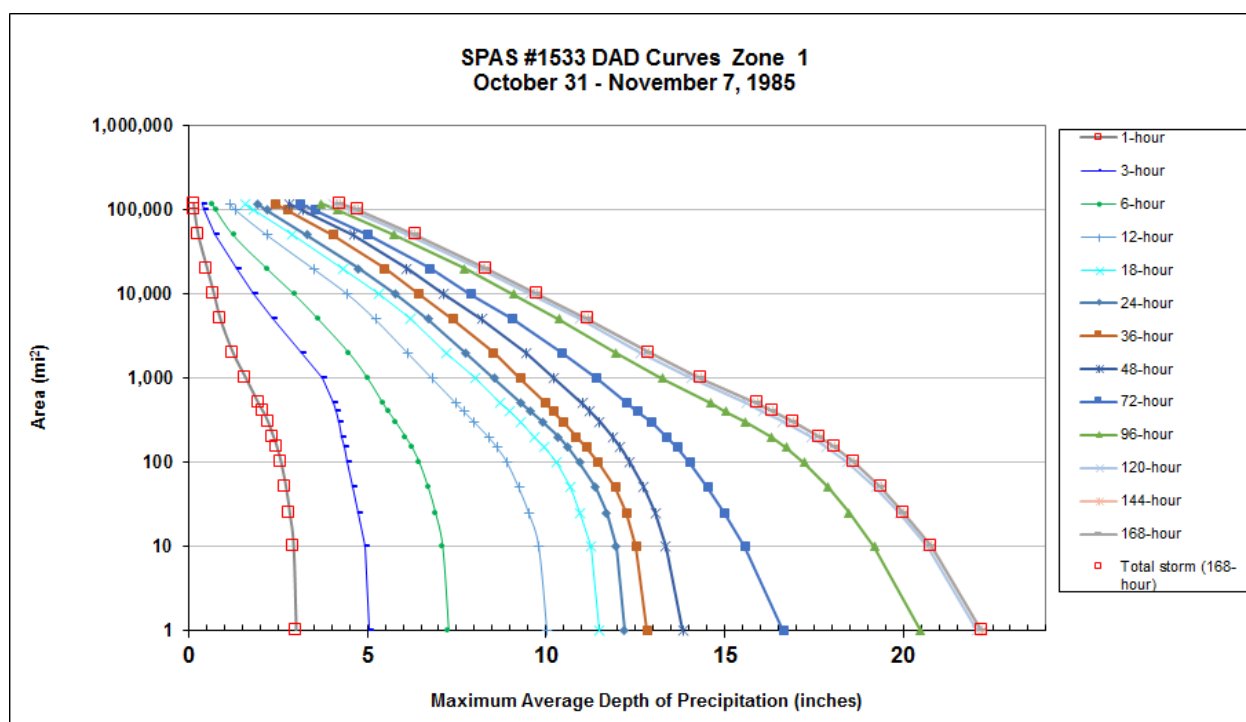
**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

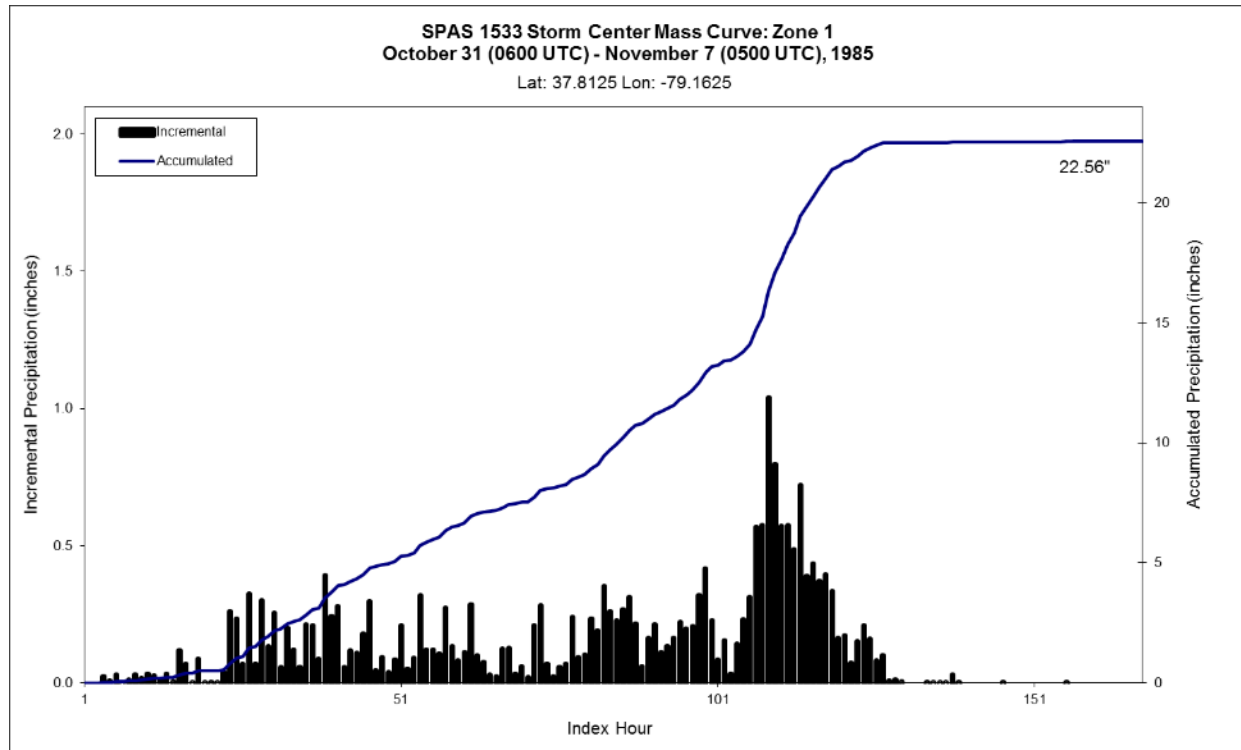
**Reliability of results:** With the density of stations available for this storm and with how closely the resulting SPAS analysis was to the observations, this analysis is deemed quite reliable.

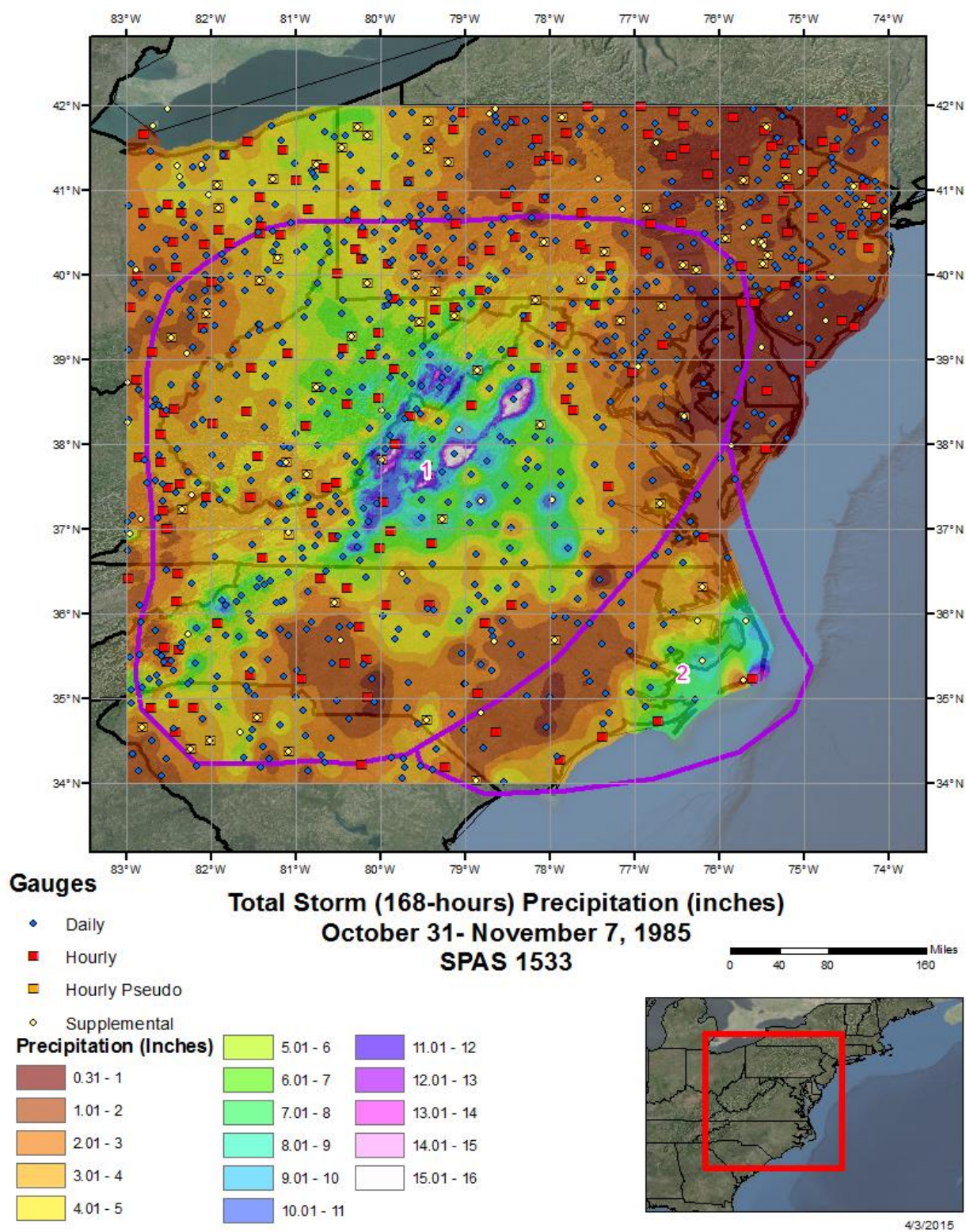
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1533_1	-79.1625	37.8125	3,982	4,000	17-Oct	76.50	3.07	0.96	75	2.110	79.51	79.5	3.52	1.05	81	2.470	1.171

Storm 1533 - October 31 (0600 UTC) - November 7 (0500 UTC), 1985														
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)														
Area (mi <sup>2</sup> )	Duration (hours)													
	1	3	6	12	18	24	36	48	72	96	120	144	168	Total
0.4	3.02	5.10	7.32	10.11	11.59	12.28	12.95	13.98	16.81	20.72	22.31	22.44	22.44	22.44
1	3.00	5.06	7.27	10.03	11.50	12.19	12.83	13.83	16.64	20.49	22.07	22.20	22.20	22.20
10	2.93	4.93	7.10	9.80	11.25	11.97	12.53	13.35	15.57	19.19	20.67	20.79	20.79	20.79
25	2.82	4.76	6.90	9.52	10.97	11.69	12.25	13.07	14.99	18.48	19.89	20.00	20.00	20.00
50	2.72	4.60	6.70	9.24	10.67	11.39	11.94	12.74	14.53	17.90	19.24	19.38	19.38	19.38
100	2.58	4.45	6.45	8.91	10.28	10.95	11.47	12.35	14.02	17.22	18.44	18.64	18.64	18.64
150	2.47	4.36	6.25	8.63	9.96	10.62	11.13	12.08	13.67	16.72	17.87	18.10	18.10	18.10
200	2.37	4.30	6.07	8.39	9.69	10.34	10.85	11.86	13.37	16.30	17.41	17.66	17.66	17.66
300	2.22	4.21	5.80	8.00	9.28	9.90	10.48	11.51	12.95	15.57	16.63	16.92	16.92	16.92
400	2.08	4.14	5.59	7.71	8.97	9.57	10.21	11.23	12.57	15.02	16.07	16.36	16.36	16.36
500	1.95	4.07	5.44	7.49	8.73	9.31	10.00	11.01	12.28	14.63	15.62	15.91	15.91	15.91
1,000	1.60	3.75	5.01	6.81	8.02	8.55	9.28	10.23	11.43	13.25	14.09	14.34	14.34	14.34
2,000	1.24	3.16	4.49	6.13	7.23	7.74	8.53	9.43	10.45	11.94	12.64	12.88	12.88	12.88
5,000	0.89	2.37	3.64	5.23	6.21	6.70	7.40	8.21	9.07	10.37	10.96	11.17	11.17	11.17
10,000	0.71	1.83	2.96	4.45	5.34	5.80	6.46	7.15	7.89	9.09	9.58	9.76	9.76	9.76
20,000	0.52	1.36	2.21	3.50	4.32	4.76	5.49	6.11	6.75	7.73	8.13	8.30	8.32	8.32
50,000	0.27	0.75	1.27	2.21	2.88	3.30	4.05	4.62	5.03	5.76	6.14	6.34	6.36	6.36
100,000	0.16	0.44	0.77	1.32	1.82	2.19	2.77	3.20	3.54	4.17	4.55	4.74	4.76	4.76
118,957	0.14	0.37	0.67	1.16	1.60	1.93	2.43	2.81	3.12	3.71	4.06	4.23	4.25	4.25

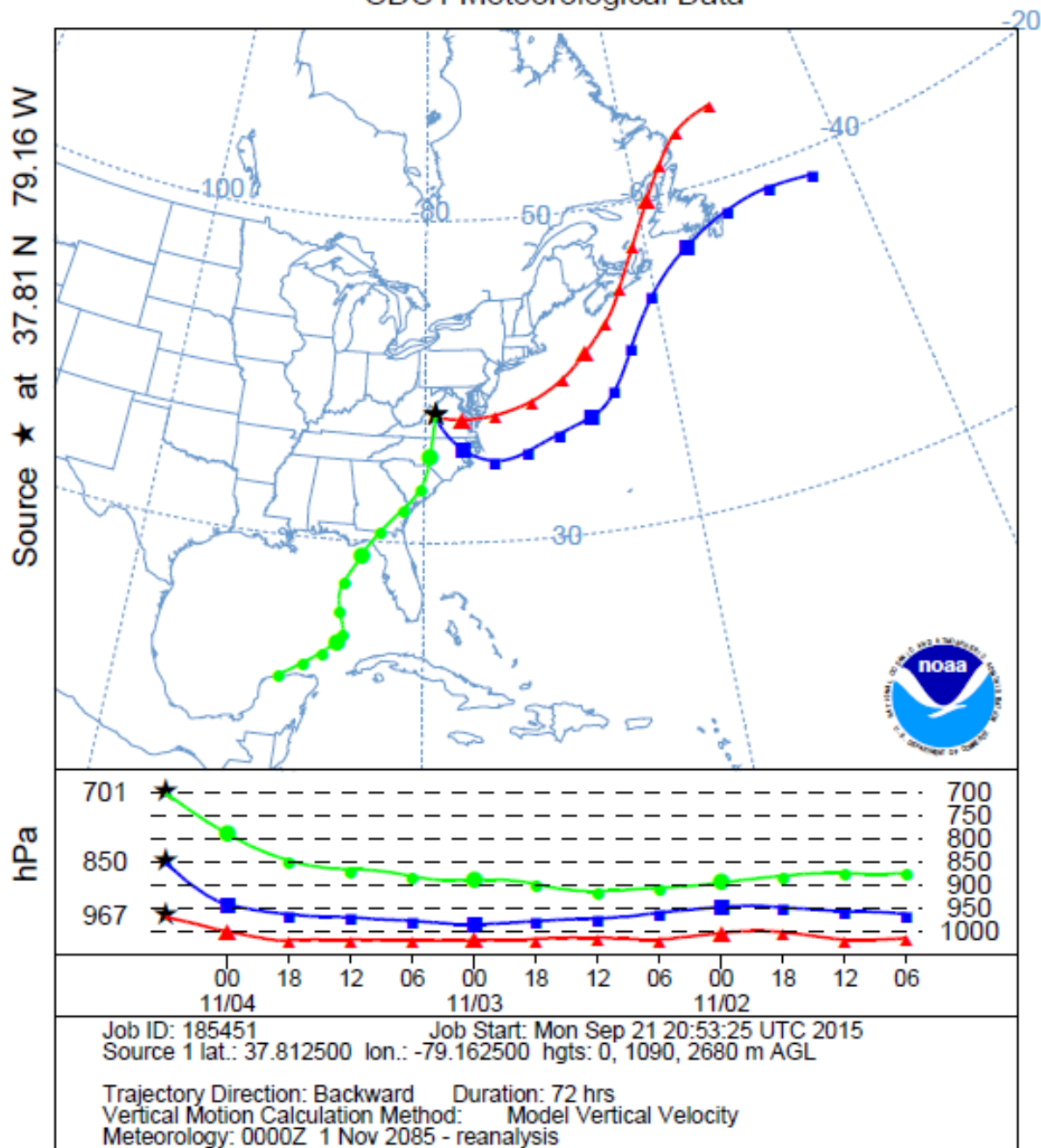






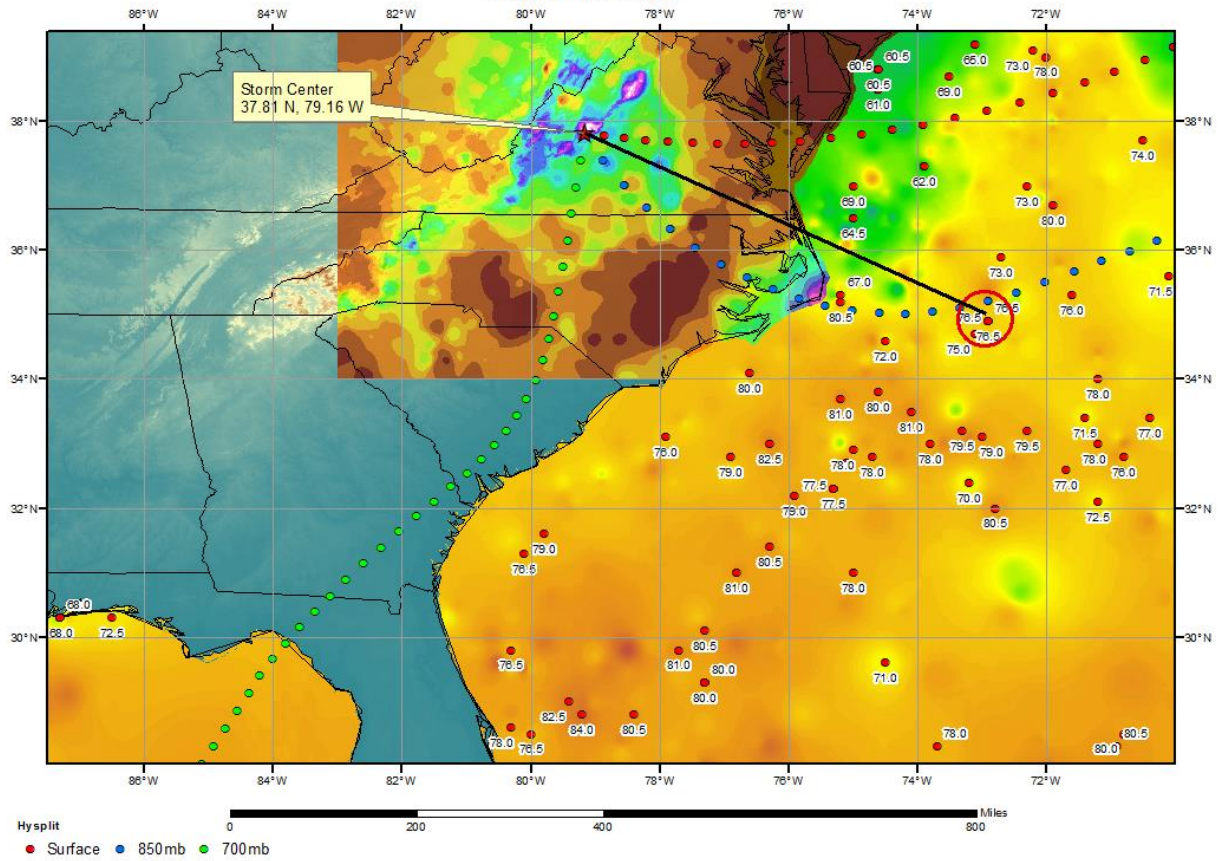


NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0600 UTC 04 Nov 85  
 CDC1 Meteorological Data





# SPAS 1533 Montebello, VA Storm Analysis November 3, 1985





## Storm Precipitation Analysis System (SPAS) for Storm #1742\_1 (rerun SPAS 1025) SPAS-NEXRAD Analysis

**General Storm Location:** Pinkham Notch-Gorham Inland storm center

**Storm analysis domain:** 44.8, -72.5, 40.5, -68.0

**Storm dates:** October 19-23, 1996

**Event:** Synoptic

**SPAS version:** 10.0 (See Appendix A for a brief description of SPAS)

**Base map used:** Default ZR Relationship 250<sup>1,2</sup>

**Grid cell resolution (sqmi):** 0.35

**Radar included:** Yes

**Number of stations:** 219 stations

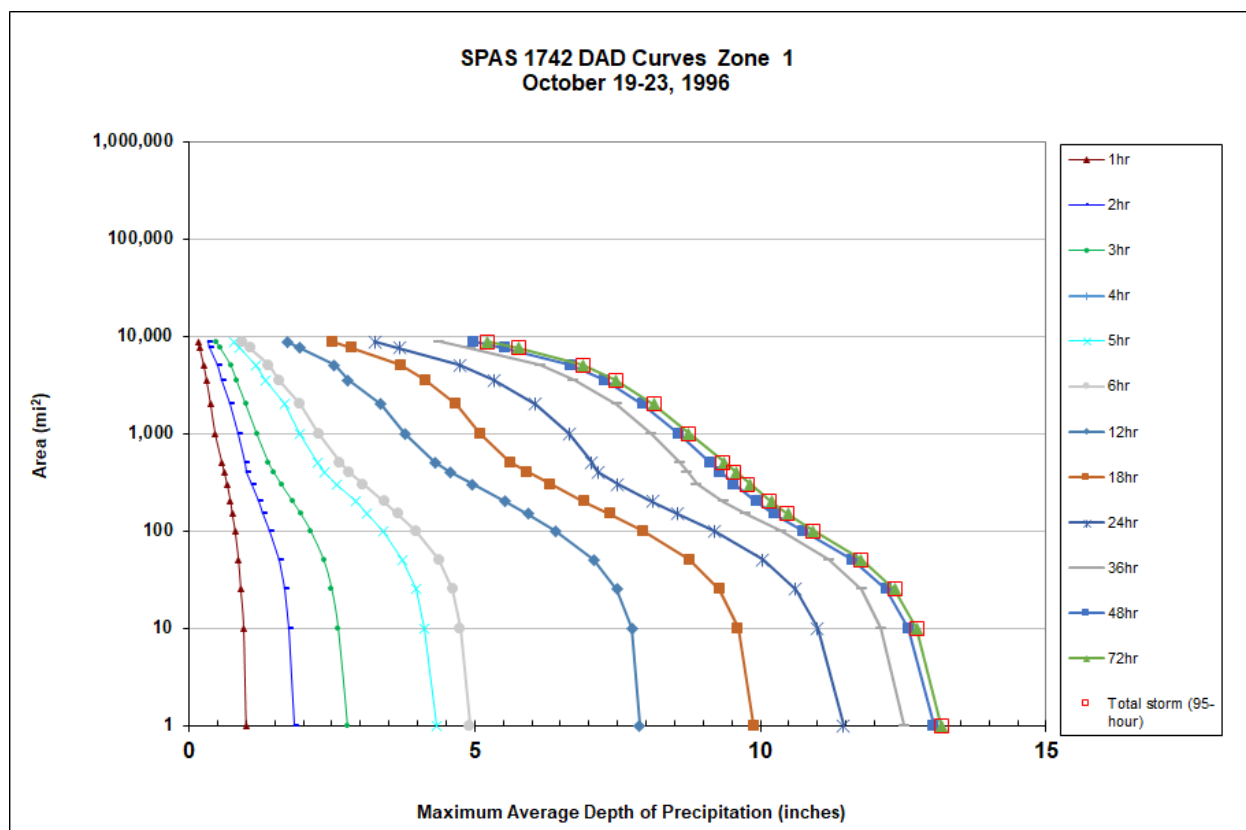
### Reliability of results:

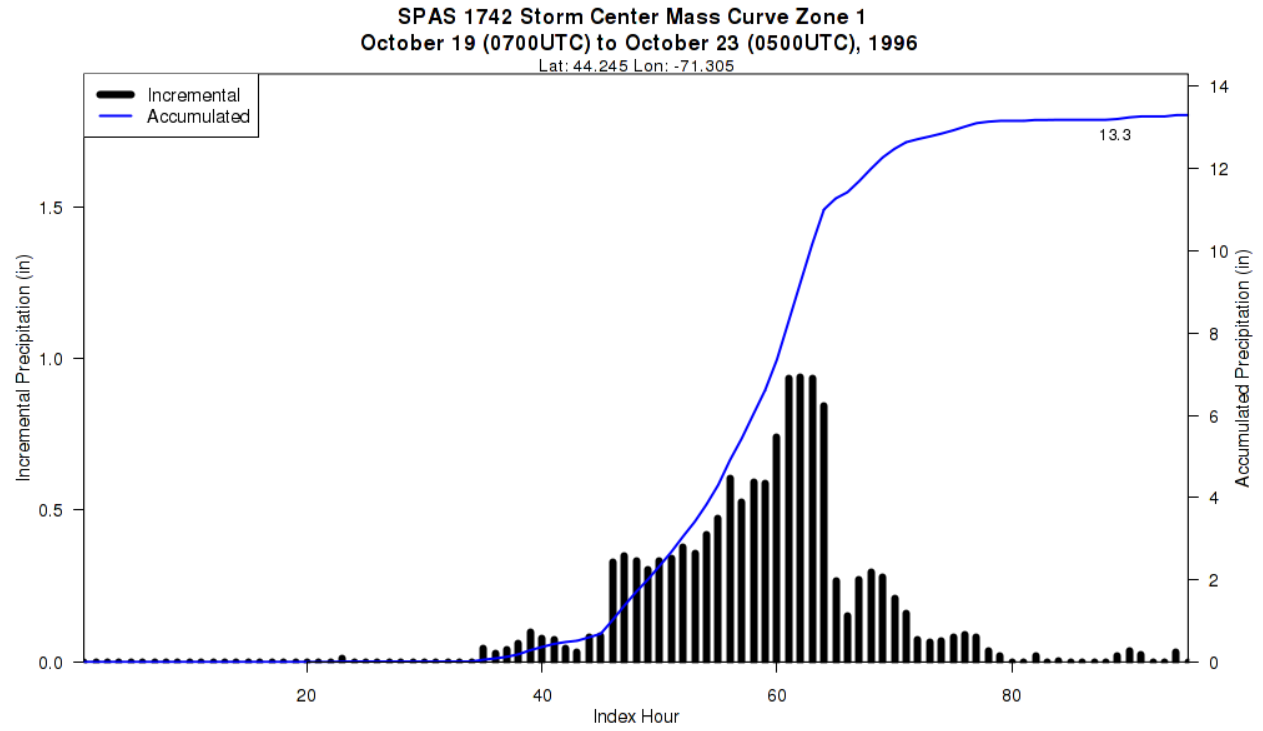
This analysis was based on 219 hourly stations, daily data, supplemental station data and radar data. We have a good degree of confidence for the radar and station based storm total results. The spatial pattern is fully dependent on the radar data and basemap. Timing is based on hourly stations and sun-hourly data is based on 5-minute radar data. Several daily stations were moved to supplemental due to timing issues and to ensure data consistency.

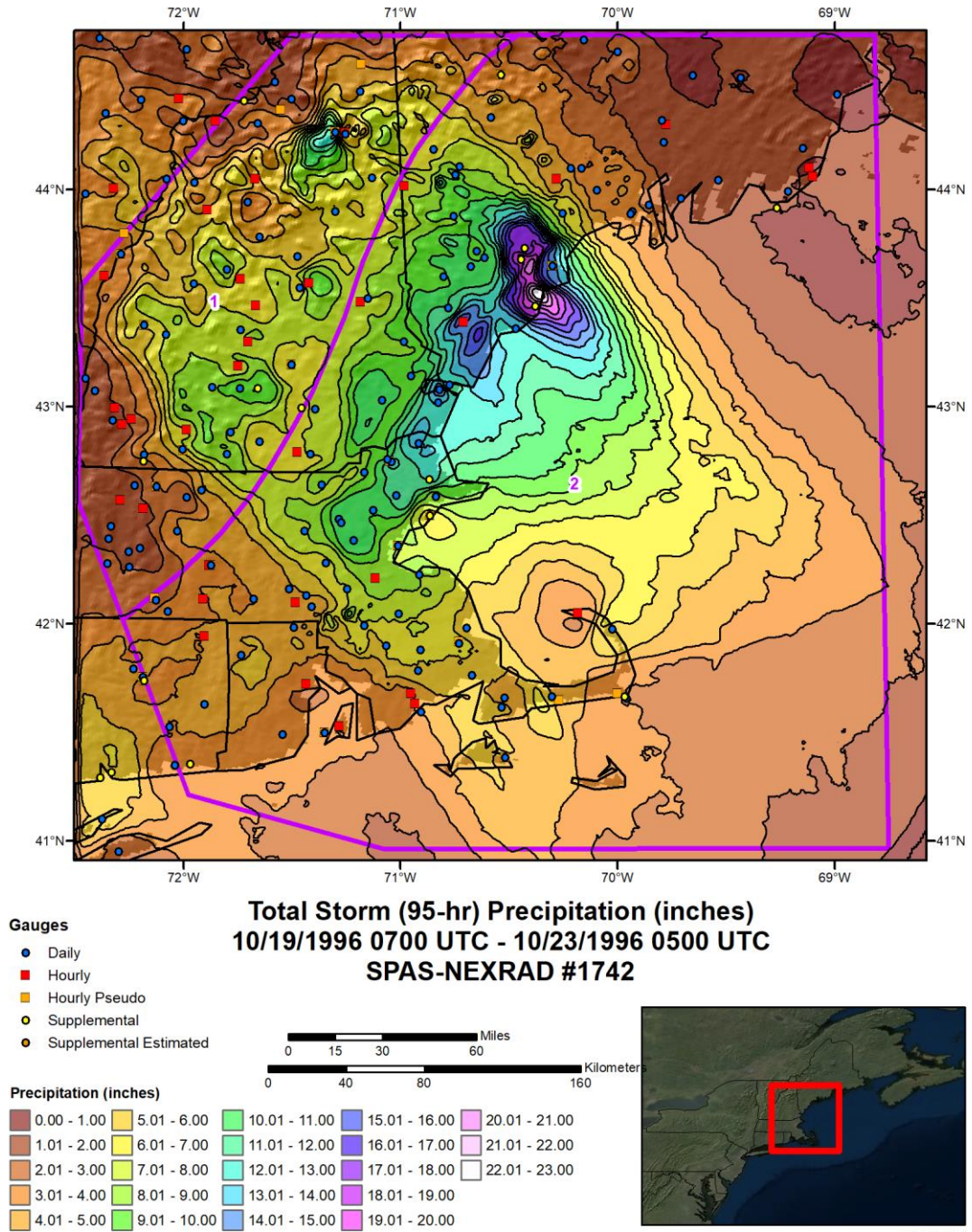
Gauge Type	Description	Abbr.*	No. of stations
Hourly	Hourly gauges with complete or nearly complete, incremental hourly precipitation data	H	39
Hourly estimated	Hourly gauges with some estimated hourly values, but otherwise reliable	HE	0
Hourly pseudo	Hourly gauges with reliable temporal precipitation data, but the magnitude is questionable in relation to co-located daily or supplemental gauges	HP	24
Hourly estimated pseudo	Combination of hourly estimated and hourly pseudo	HEP	0
Daily	Daily gauge with complete data and known observation times	D	140
Daily estimated	Daily gauges with some or all estimated data	DE	0
Supplemental	Gauges with unknown or irregular observation times, but reliable precipitation data	S	16
Supplemental estimated	Gauges with estimated precipitation values based on other information such as radar, pre-existing total storm isohyetal maps or public storm reports	SE	0

						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1742_1	-71.3050	44.2450	4,276	4,300	5-Oct	75.00	2.85	0.96	72	1.890	79.14	79.0	3.44	1.10	80	2.340	1.238

SPAS 1742 - October 19 (0700 UTC) - October 23 (0500 UTC), 1996													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
Area (mi <sup>2</sup> )	Duration (hours)												
	1hr	2hr	3hr	4hr	5hr	6hr	12hr	18hr	24hr	36hr	48hr	72hr	95hr
0.4	1.01	1.87	2.80	3.64	4.38	4.97	7.94	9.97	11.56	12.65	13.15	13.28	13.28
1	1.00	1.85	2.77	3.60	4.33	4.92	7.89	9.89	11.45	12.52	13.03	13.16	13.16
10	0.96	1.74	2.61	3.43	4.12	4.75	7.75	9.61	11.00	12.11	12.59	12.73	12.73
25	0.91	1.67	2.50	3.31	3.97	4.61	7.49	9.28	10.62	11.77	12.21	12.35	12.35
50	0.87	1.57	2.36	3.11	3.74	4.38	7.08	8.76	10.04	11.20	11.61	11.76	11.76
100	0.81	1.42	2.13	2.81	3.39	3.97	6.41	7.95	9.19	10.36	10.75	10.93	10.93
150	0.76	1.30	1.96	2.57	3.12	3.66	5.93	7.37	8.56	9.75	10.24	10.48	10.47
200	0.73	1.22	1.82	2.38	2.91	3.42	5.54	6.92	8.11	9.36	9.93	10.20	10.16
300	0.67	1.09	1.62	2.12	2.59	3.05	4.96	6.33	7.50	8.89	9.54	9.83	9.76
400	0.62	1.01	1.49	1.96	2.38	2.80	4.57	5.92	7.15	8.72	9.30	9.57	9.53
500	0.58	0.98	1.40	1.85	2.24	2.64	4.30	5.62	7.05	8.59	9.12	9.37	9.35
1,000	0.46	0.87	1.19	1.60	1.95	2.27	3.78	5.10	6.65	8.09	8.57	8.75	8.75
2,000	0.38	0.73	1.00	1.36	1.67	1.94	3.36	4.67	6.06	7.49	7.95	8.14	8.15
3,500	0.31	0.58	0.84	1.10	1.34	1.58	2.78	4.14	5.34	6.74	7.27	7.47	7.48
5,000	0.26	0.50	0.74	0.96	1.17	1.39	2.55	3.70	4.74	6.15	6.67	6.89	6.90
7,500	0.19	0.37	0.56	0.73	0.89	1.07	1.95	2.85	3.68	4.93	5.53	5.78	5.78
8,652	0.17	0.33	0.49	0.64	0.78	0.94	1.72	2.51	3.25	4.39	4.99	5.23	5.23

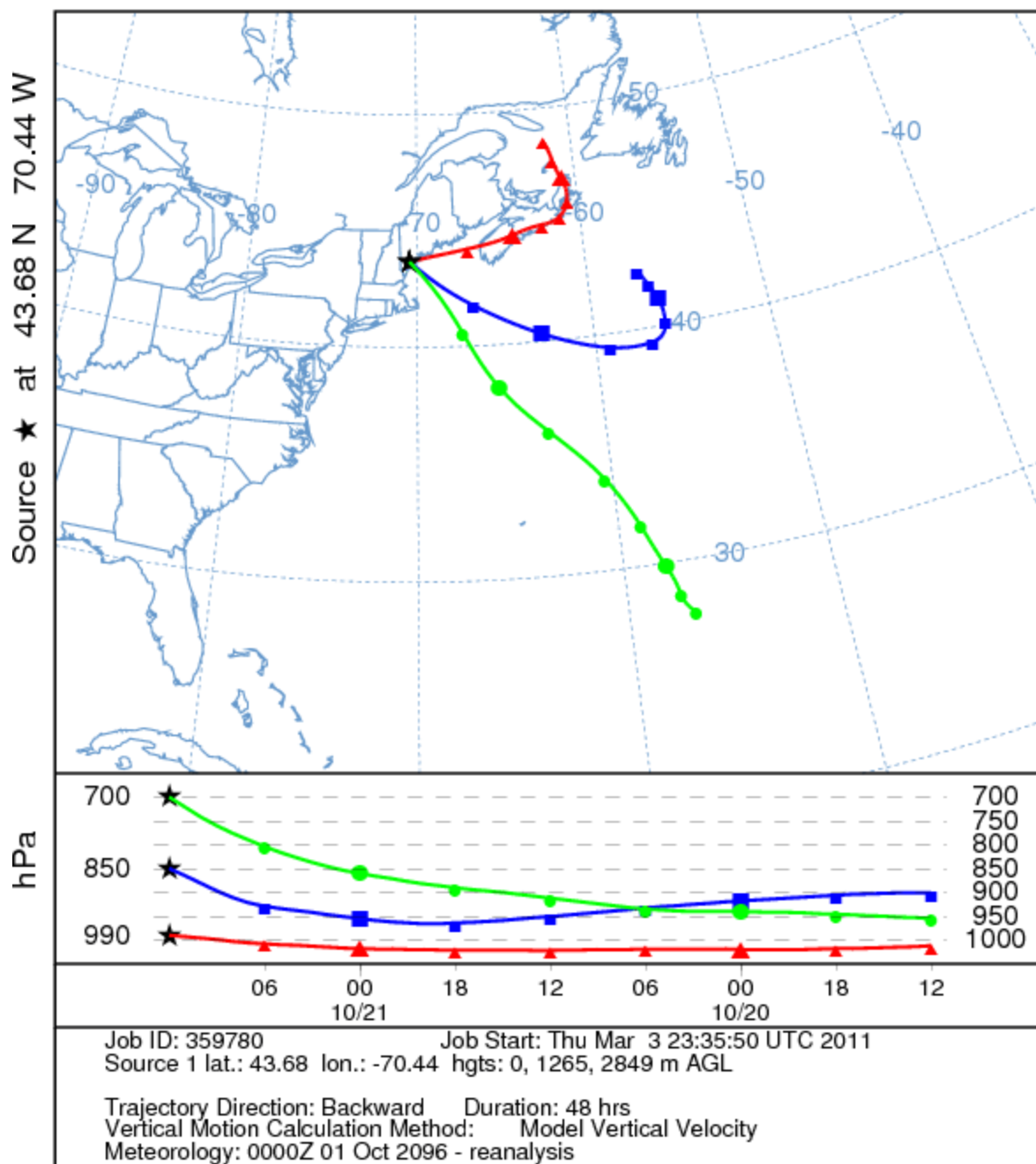




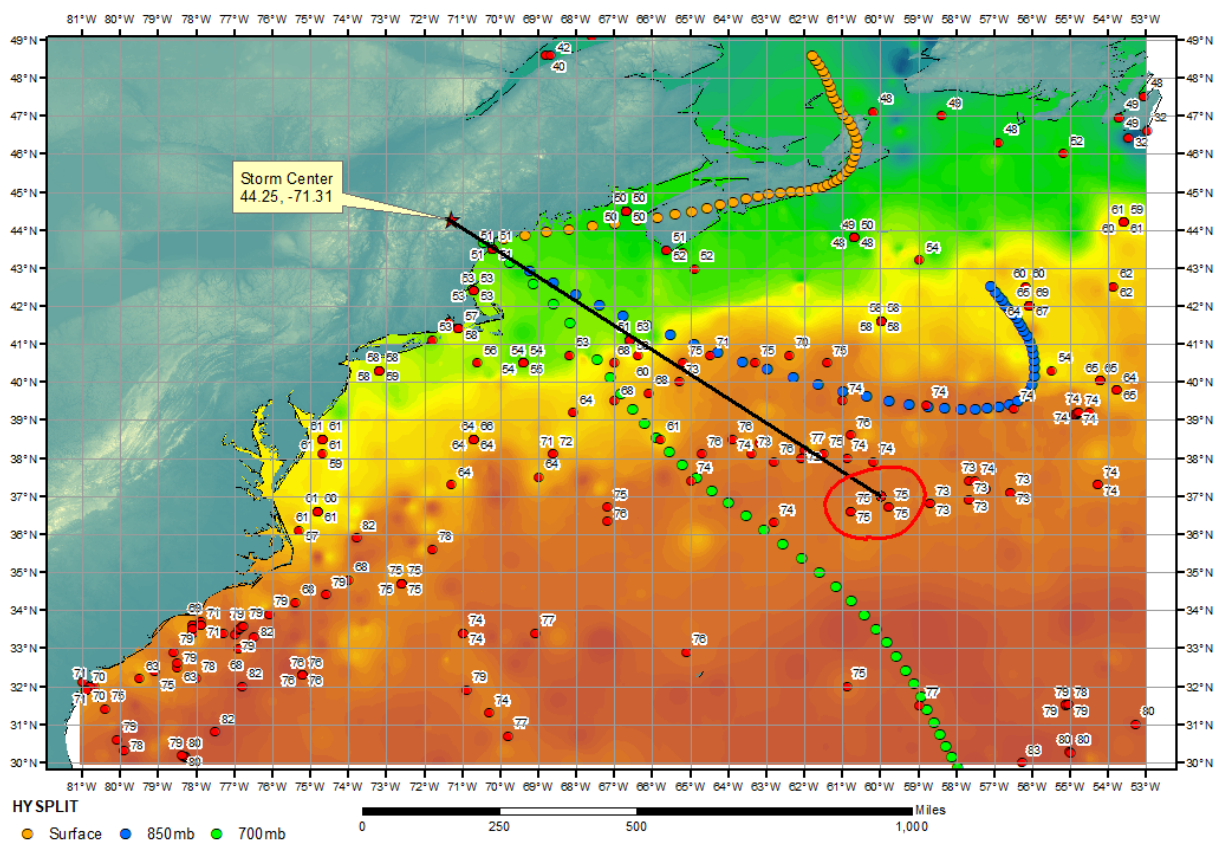




NOAA HYSPLIT MODEL  
Backward trajectories ending at 1200 UTC 21 Oct 96  
CDC1 Meteorological Data



**SPAS 1742 Sea Surface Tempertures (F)**  
October 21, 1996



## Storm Precipitation Analysis System (SPAS) for Storm #1742\_2 (rerun SPAS 1025) SPAS-NEXRAD Analysis

**General Storm Location:** Pinkham Notch-Gorham Inland storm center

**Storm analysis domain:** 44.8, -72.5, 40.5, -68.0

**Storm dates:** October 19-23, 1996

**Event:** Synoptic

**SPAS version:** 10.0 (See Appendix A for a brief description of SPAS)

**Base map used:** Default ZR Relationship 250<sup>1,2</sup>

**Grid cell resolution (sqmi):** 0.35

**Radar included:** Yes

**Number of stations:** 219 stations

### Reliability of results:

This analysis was based on 219 hourly stations, daily data, supplemental station data and radar data. We have a good degree of confidence for the radar and station based storm total results. The spatial pattern is fully dependent on the radar data and basemap. Timing is based on hourly stations and sun-hourly data is based on 5-minute radar data. Several daily stations were moved to supplemental due to timing issues and to ensure data consistency.

Gauge Type	Description	Abbr.*	No. of stations
Hourly	Hourly gauges with complete or nearly complete, incremental hourly precipitation data	H	39
Hourly estimated	Hourly gauges with some estimated hourly values, but otherwise reliable	HE	0
Hourly pseudo	Hourly gauges with reliable temporal precipitation data, but the magnitude is questionable in relation to co-located daily or supplemental gauges	HP	24
Hourly estimated pseudo	Combination of hourly estimated and hourly pseudo	HEP	0
Daily	Daily gauge with complete data and known observation times	D	140
Daily estimated	Daily gauges with some or all estimated data	DE	0
Supplemental	Gauges with unknown or irregular observation times, but reliable precipitation data	S	16
Supplemental estimated	Gauges with estimated precipitation values based on other information such as radar, pre-existing total storm isohyetal maps or public storm reports	SE	0

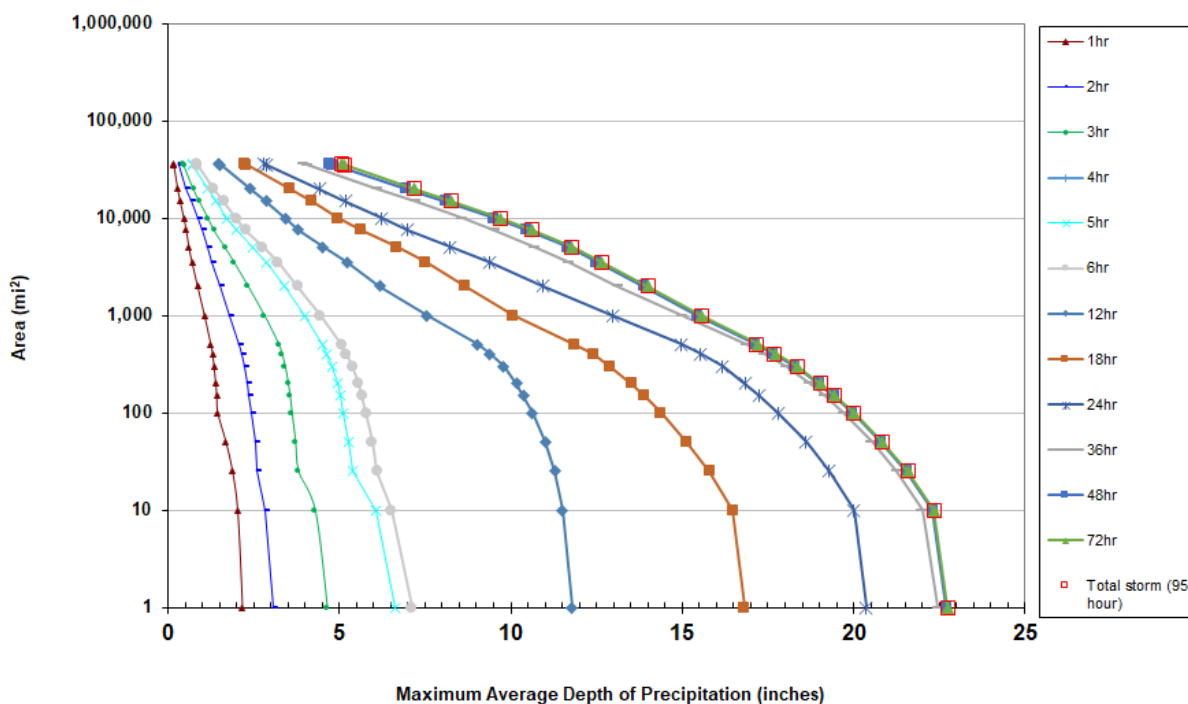
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1742_1	-71.3050	44.2450	4,276	4,300	5-Oct	75.00	2.85	0.96	72	1.890	79.14	79.0	3.44	1.10	80	2.340	1.238

### SPAS 1742 - October 19 (0700 UTC) - October 23 (0500 UTC), 1996

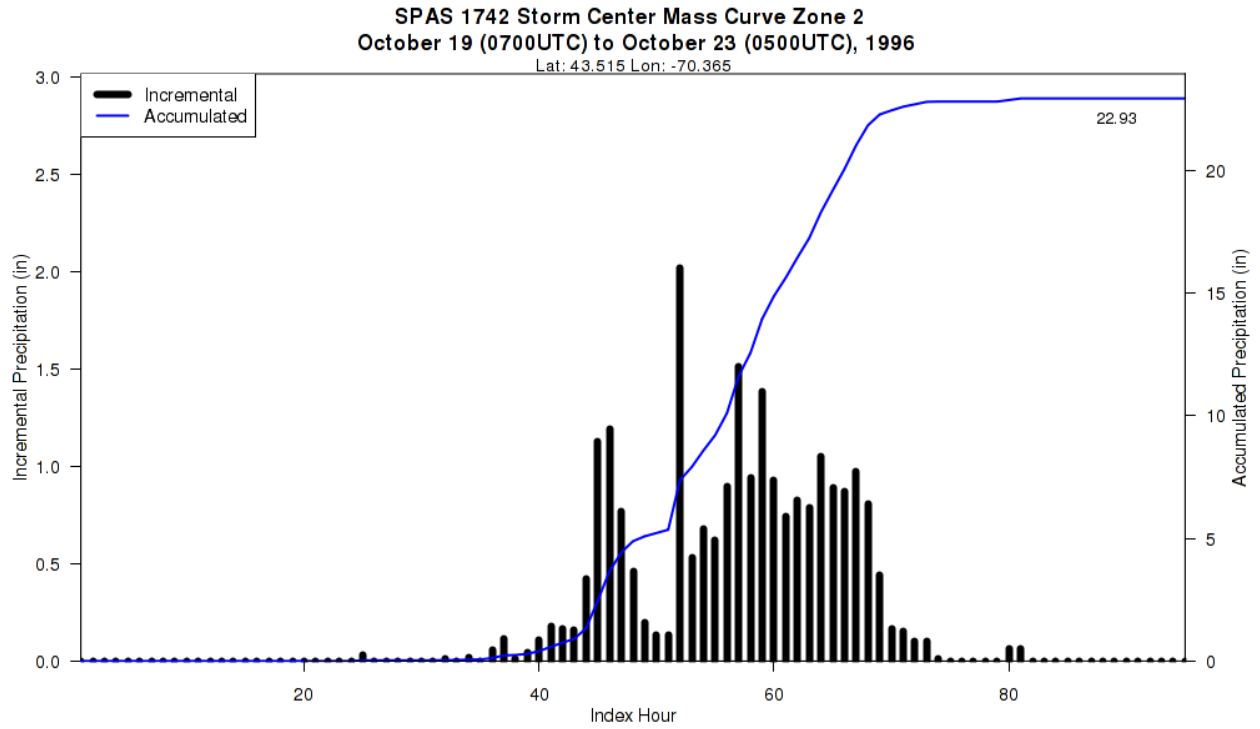
#### MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)

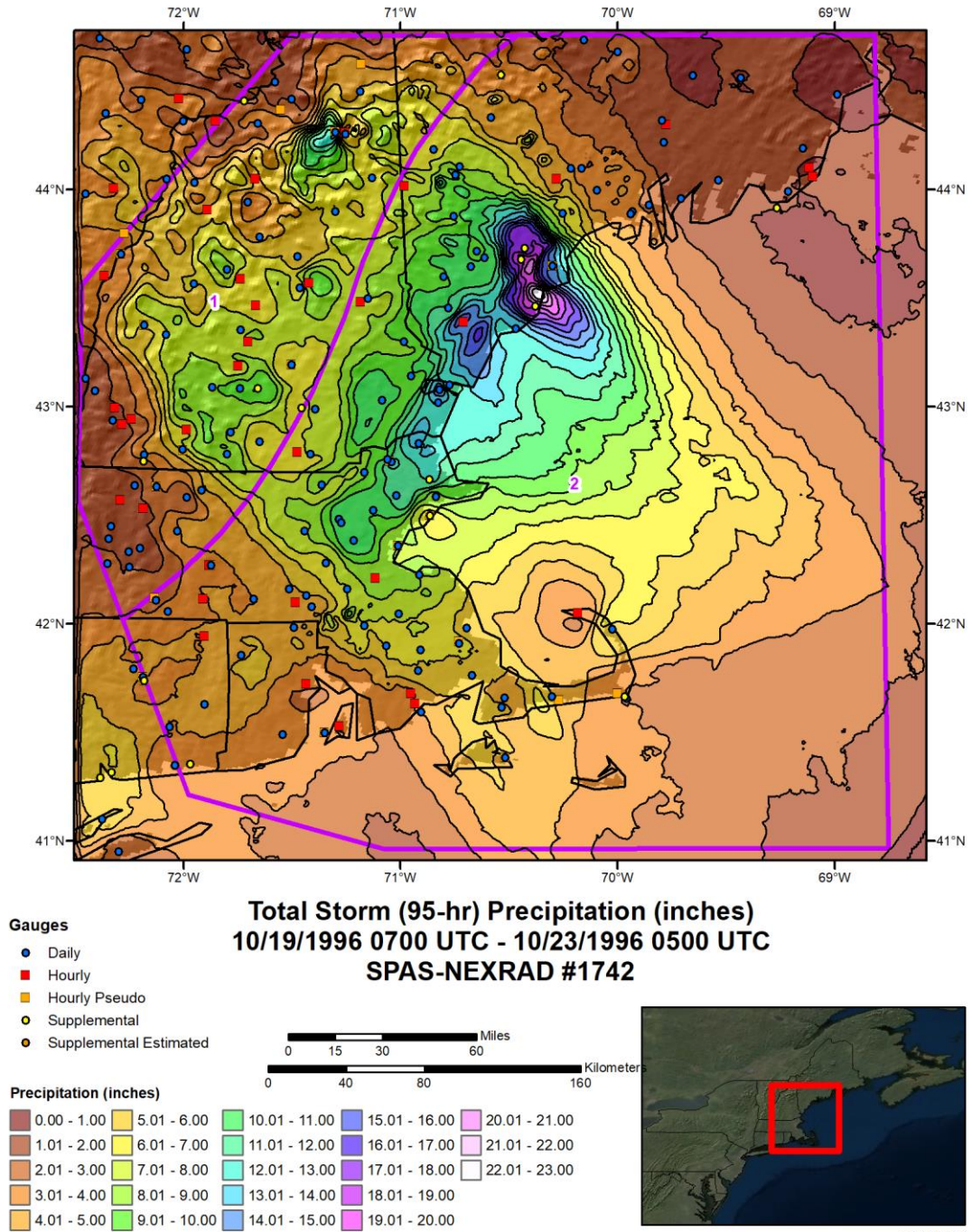
Area (mi <sup>2</sup> )	Duration (hours)												
	1hr	2hr	3hr	4hr	5hr	6hr	12hr	18hr	24hr	36hr	48hr	72hr	95hr
0.4	2.19	3.13	4.69	5.97	6.72	7.19	11.88	16.94	20.51	22.55	22.86	22.90	22.90
1	2.17	3.09	4.63	5.89	6.64	7.11	11.79	16.81	20.37	22.47	22.70	22.74	22.75
10	2.03	2.83	4.28	5.40	6.08	6.51	11.50	16.47	20.01	22.00	22.30	22.35	22.36
25	1.88	2.60	3.80	4.78	5.39	6.09	11.28	15.80	19.29	21.27	21.55	21.58	21.58
50	1.69	2.54	3.71	4.57	5.26	5.95	11.01	15.12	18.60	20.52	20.79	20.82	20.82
100	1.45	2.45	3.61	4.44	5.12	5.78	10.63	14.38	17.80	19.70	19.97	20.00	20.00
150	1.42	2.37	3.55	4.37	5.02	5.65	10.37	13.89	17.25	19.16	19.42	19.44	19.44
200	1.39	2.32	3.50	4.30	4.93	5.55	10.17	13.52	16.84	18.72	18.98	19.02	19.02
300	1.34	2.22	3.41	4.19	4.78	5.37	9.79	12.89	16.17	18.03	18.28	18.34	18.34
400	1.30	2.14	3.32	4.07	4.64	5.20	9.39	12.40	15.54	17.40	17.64	17.73	17.69
500	1.25	2.07	3.23	3.96	4.50	5.05	9.03	11.85	14.97	16.87	17.13	17.22	17.17
1,000	1.06	1.81	2.81	3.45	3.98	4.45	7.56	10.07	12.96	14.99	15.44	15.55	15.55
2,000	0.86	1.52	2.33	2.89	3.39	3.78	6.17	8.68	10.95	13.12	13.87	13.99	13.99
3,500	0.70	1.28	1.93	2.43	2.88	3.21	5.22	7.51	9.37	11.68	12.51	12.65	12.65
5,000	0.61	1.14	1.66	2.08	2.47	2.77	4.53	6.67	8.24	10.69	11.67	11.78	11.78
7,500	0.53	0.98	1.34	1.68	2.00	2.26	3.80	5.63	6.99	9.52	10.46	10.63	10.63
10,000	0.46	0.86	1.17	1.45	1.72	1.98	3.42	4.96	6.23	8.60	9.51	9.68	9.68
15,000	0.35	0.66	0.91	1.14	1.38	1.62	2.86	4.2	5.18	7.23	8.1	8.27	8.27
20,000	0.28	0.52	0.74	0.94	1.14	1.33	2.41	3.56	4.42	6.12	6.95	7.2	7.2
35,000	0.17	0.32	0.46	0.59	0.72	0.85	1.52	2.28	2.86	4.06	4.79	5.13	5.14
35,842	0.16	0.32	0.45	0.58	0.71	0.83	1.49	2.23	2.8	3.97	4.7	5.05	5.06

### SPAS 1742 DAD Curves Zone 2 October 19-23, 1996

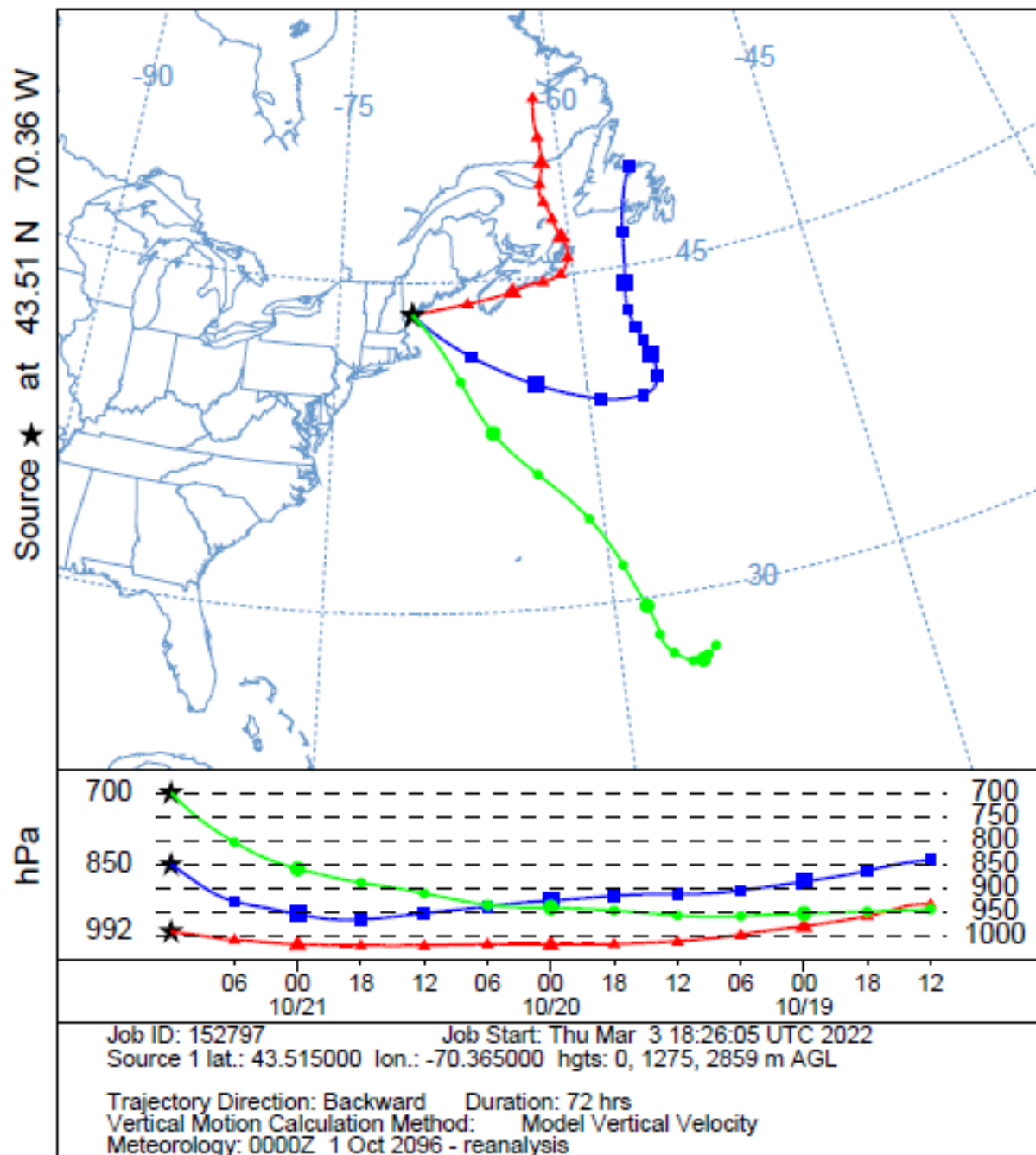




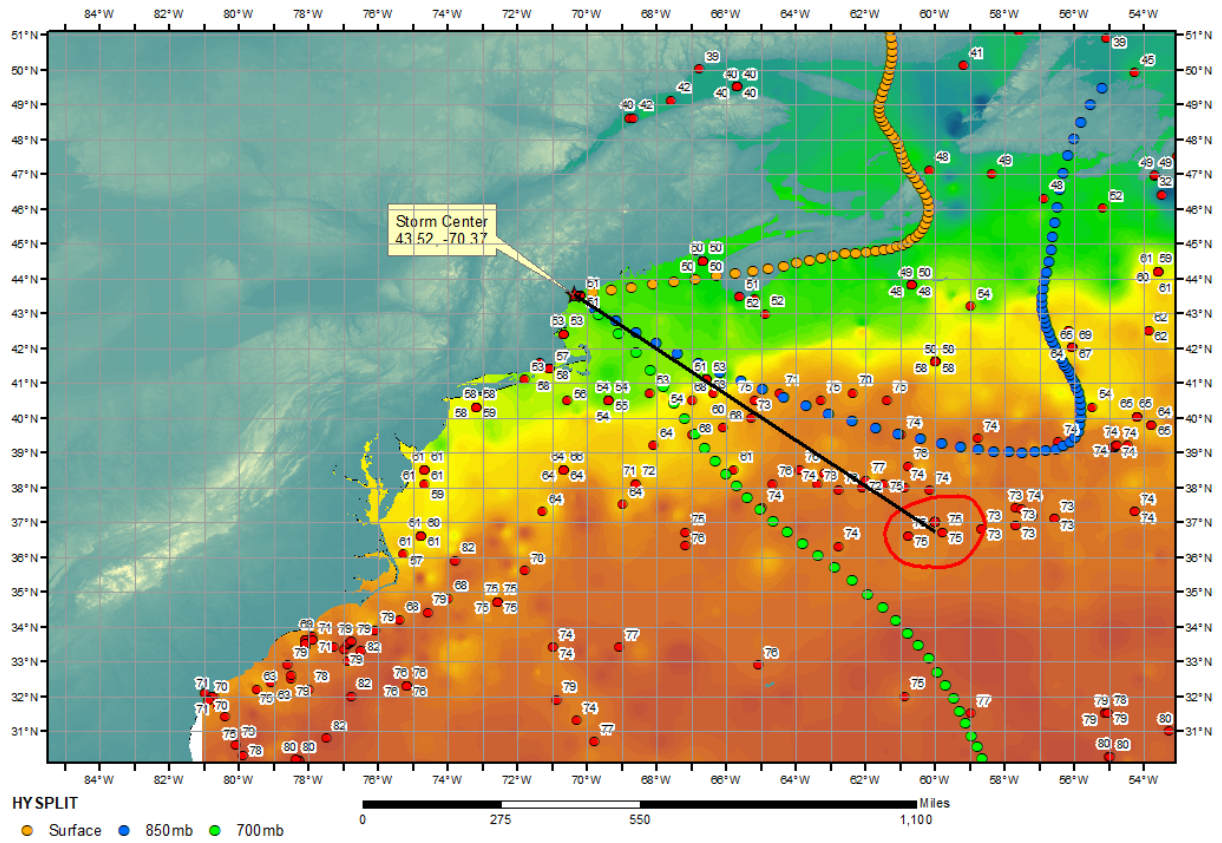




NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 21 Oct 96  
 CDC1 Meteorological Data



SPAS 1742\_2 Sea Surface Temperatures (F)  
October 21, 1996





## Storm Precipitation Analysis System (SPAS) For Storm #1201\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Halifax, VT-New England (Maine, New Hampshire, Vermont, western Massachusetts, and adjacent portions of Canada)

**Storm Dates:** October 7-11, 2005 (10/7/2005 0900 UTC – 10/10/2005 0000 UTC)

**Event:** Synoptic plus tropical storm (Tammy) remnants

### DAD Zone 1

**Latitude:** 42.7699

**Longitude:** -72.7500

**Max. Grid Rainfall Amount:** 15.40"

**Max. Observed Rainfall Amount:** 15.60 inches at Halifax, VT (all but 0.20" of this fell during the CPP, hence the maximum point rainfall is 15.40"). 12.75 inches was reported at Gunstock Ski Area, VT – although considered "unofficial," this was reported in Storm Data so it was accepted into this analysis.

**Number of Stations:** 462 (126 Daily, 87 Hourly, 1 Hourly Estimated, 40 Hourly Pseudo, 206 Supplemental, and 2 Supplemental Estimated)

**SPAS Version:** 8.5

**Base Map Used:** Mean (1971-2000) PRISM October Precipitation

**Spatial resolution:** 36 seconds (0.34 sq-mi)

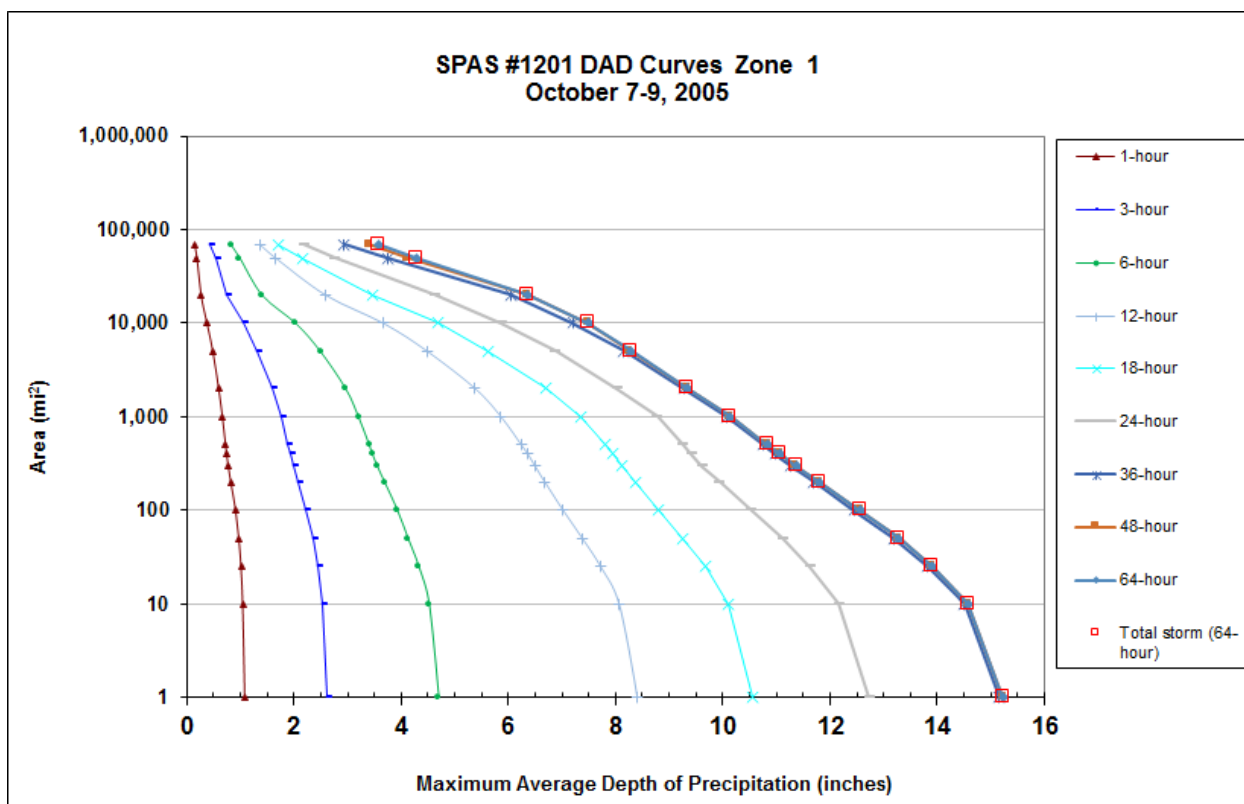
**Radar Included:** Yes (KGYX, KBW, KCXX, KENX and Canadian radar WVVY\*\*)

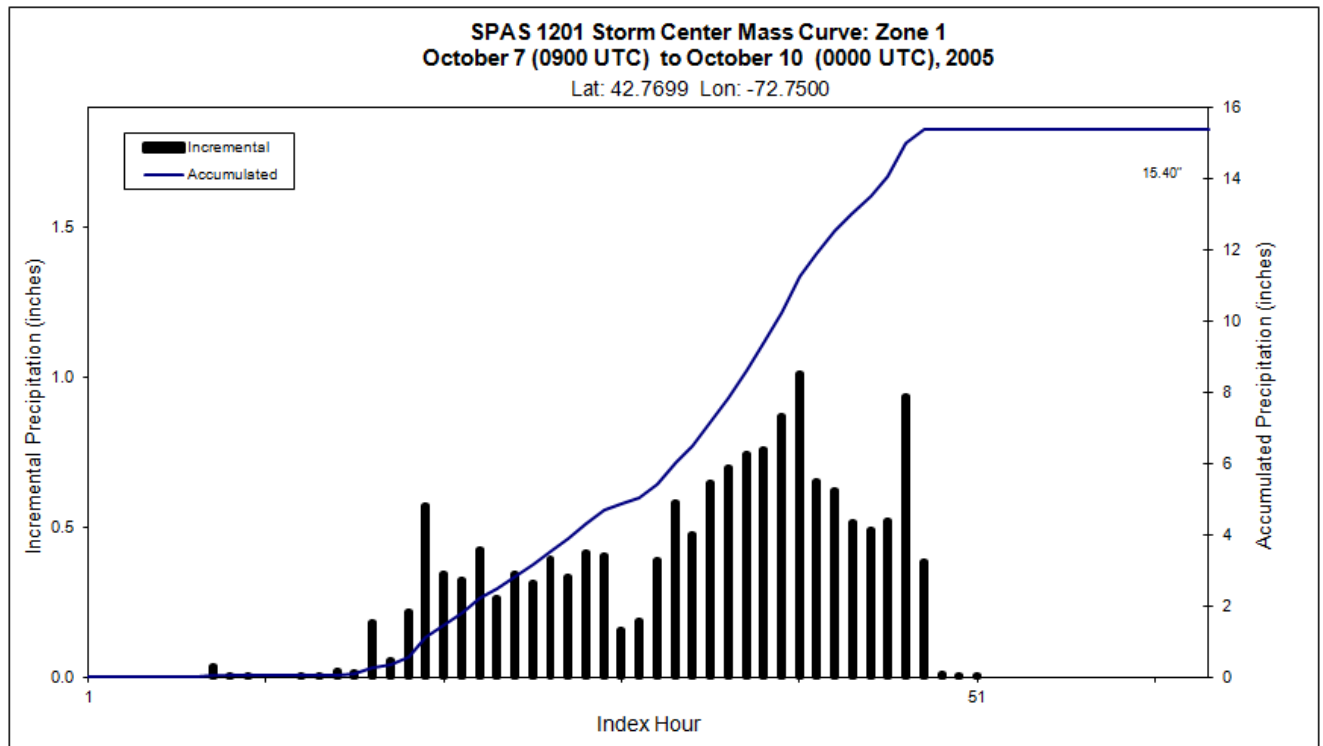
**Depth-Area-Duration (DAD) analysis:** Yes\*

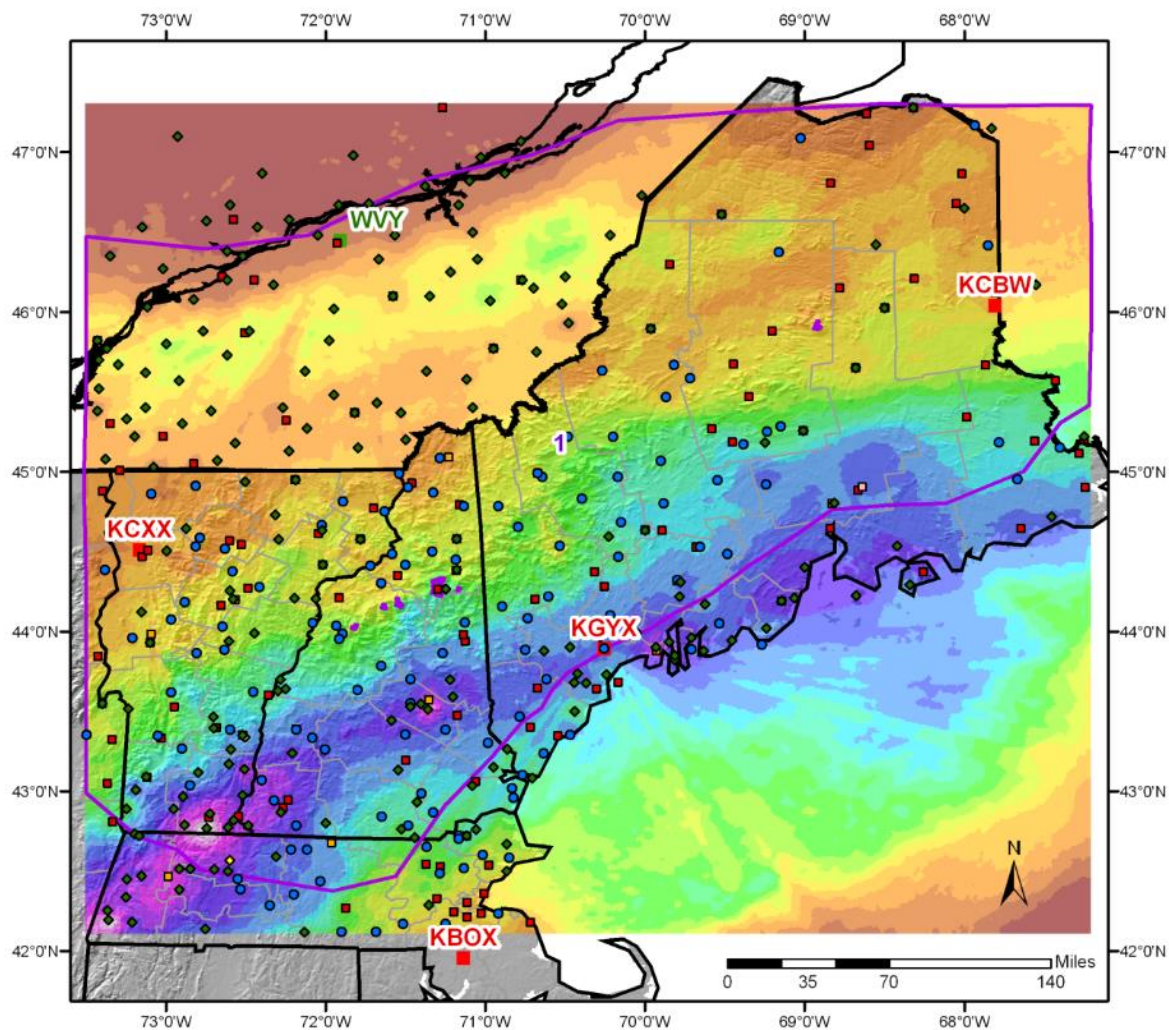
**Reliability of results:** Given the extensive gauge data and decent radar data, we have a great deal of confidence in the magnitude and spatial distribution of rainfall for this analysis. The only exception to this is across north-central Vermont where a large radar blockage area exists; fortunately however, relatively light rainfall occurred across this area. \*\*Also, Canadian radar data is only available every 10-minutes, instead of 5-minutes in the U.S., so that forced all of the radar data to a 10-minute time step – although not significant, this too diminished the overall accuracy of this analysis slightly.

						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1201_1	-72.7500	42.7699	1,485	1,500	24-Sep	80.00	3.60	0.43	82	3.170	82.66	82.5	4.03	0.45	87	3.580	1.129

Storm 1201 - October 7 (0900 UTC) - October 10 (0000 UTC), 2005										
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)										
Area (mi <sup>2</sup> )	Duration (hours)									
	1	3	6	12	18	24	36	48	64	Total
0.4	1.09	2.64	4.74	8.48	10.67	12.86	15.32	15.38	15.38	15.38
1	1.09	2.62	4.70	8.40	10.56	12.73	15.16	15.23	15.23	15.23
10	1.05	2.53	4.52	8.06	10.10	12.16	14.50	14.58	14.58	14.58
25	1.02	2.44	4.33	7.72	9.67	11.63	13.83	13.91	13.91	13.91
50	0.98	2.35	4.13	7.38	9.26	11.12	13.19	13.29	13.29	13.29
100	0.92	2.23	3.93	7.02	8.80	10.53	12.45	12.57	12.57	12.57
200	0.83	2.08	3.69	6.68	8.37	9.94	11.70	11.80	11.80	11.80
300	0.78	1.99	3.55	6.49	8.13	9.62	11.27	11.36	11.37	11.37
400	0.75	1.94	3.46	6.36	7.96	9.41	10.98	11.07	11.07	11.07
500	0.73	1.89	3.40	6.24	7.81	9.26	10.76	10.84	10.84	10.84
1,000	0.67	1.76	3.20	5.86	7.36	8.78	10.07	10.14	10.14	10.14
2,000	0.60	1.61	2.96	5.38	6.69	8.03	9.28	9.34	9.34	9.34
5,000	0.49	1.32	2.49	4.49	5.63	6.88	8.16	8.27	8.29	8.29
10,000	0.38	1.07	2.03	3.67	4.69	5.87	7.21	7.49	7.49	7.49
20,000	0.27	0.75	1.40	2.59	3.48	4.63	6.04	6.36	6.36	6.36
50,000	0.19	0.54	0.98	1.65	2.16	2.77	3.74	4.13	4.28	4.28
69,105	0.15	0.44	0.82	1.36	1.71	2.19	2.94	3.40	3.57	3.57

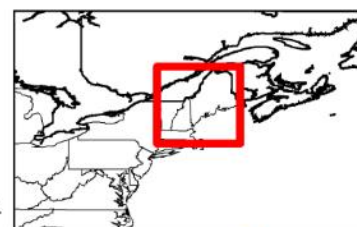
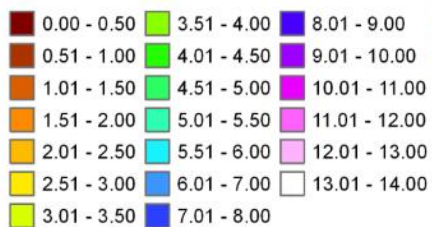






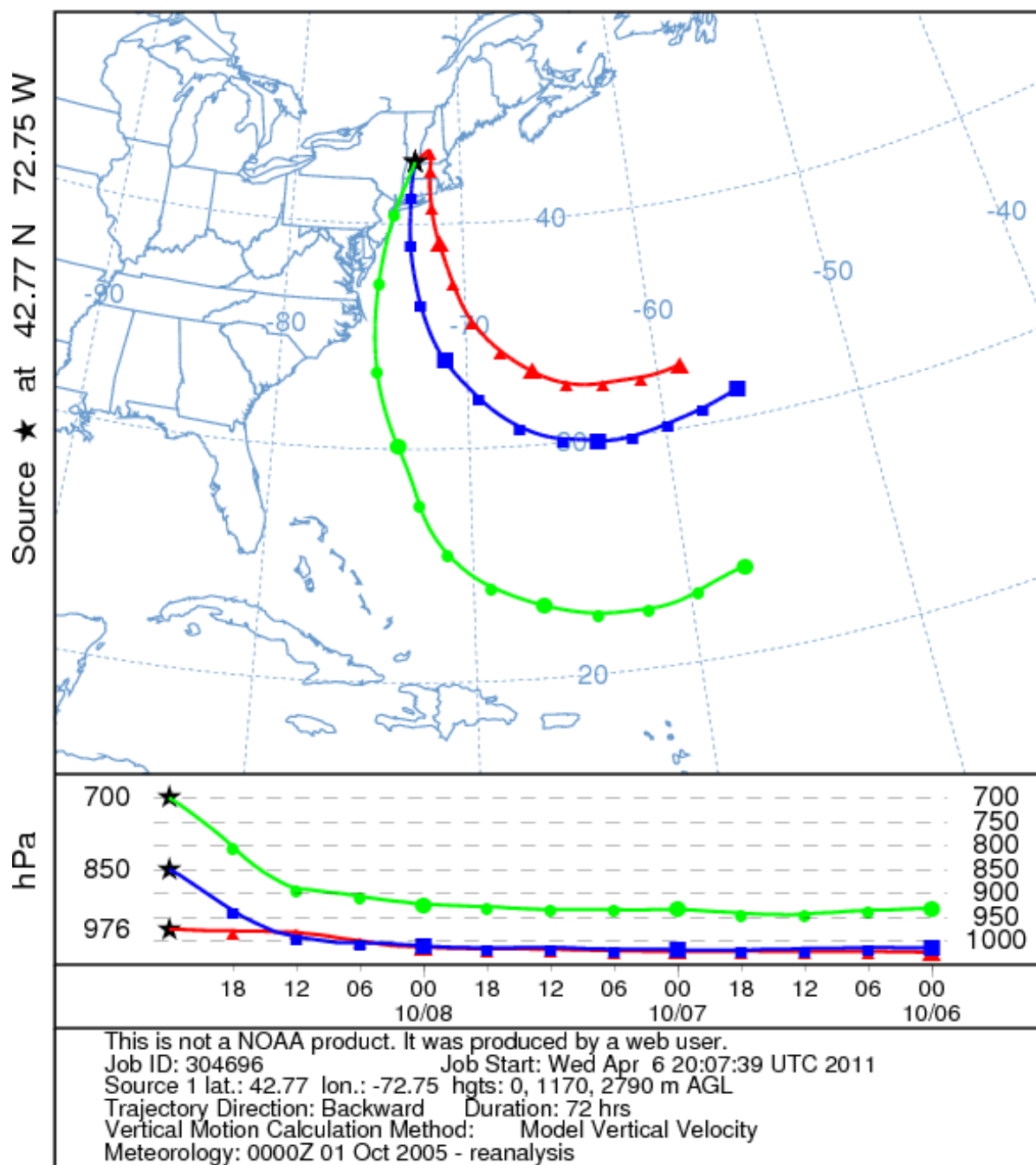
Total 64-hour Precipitation (inches)  
 October 7-11, 2005  
 10/7/2005 0900 UTC - 10/10/2005 0000 UTC  
 SPAS #1201

#### Precipitation (inches)

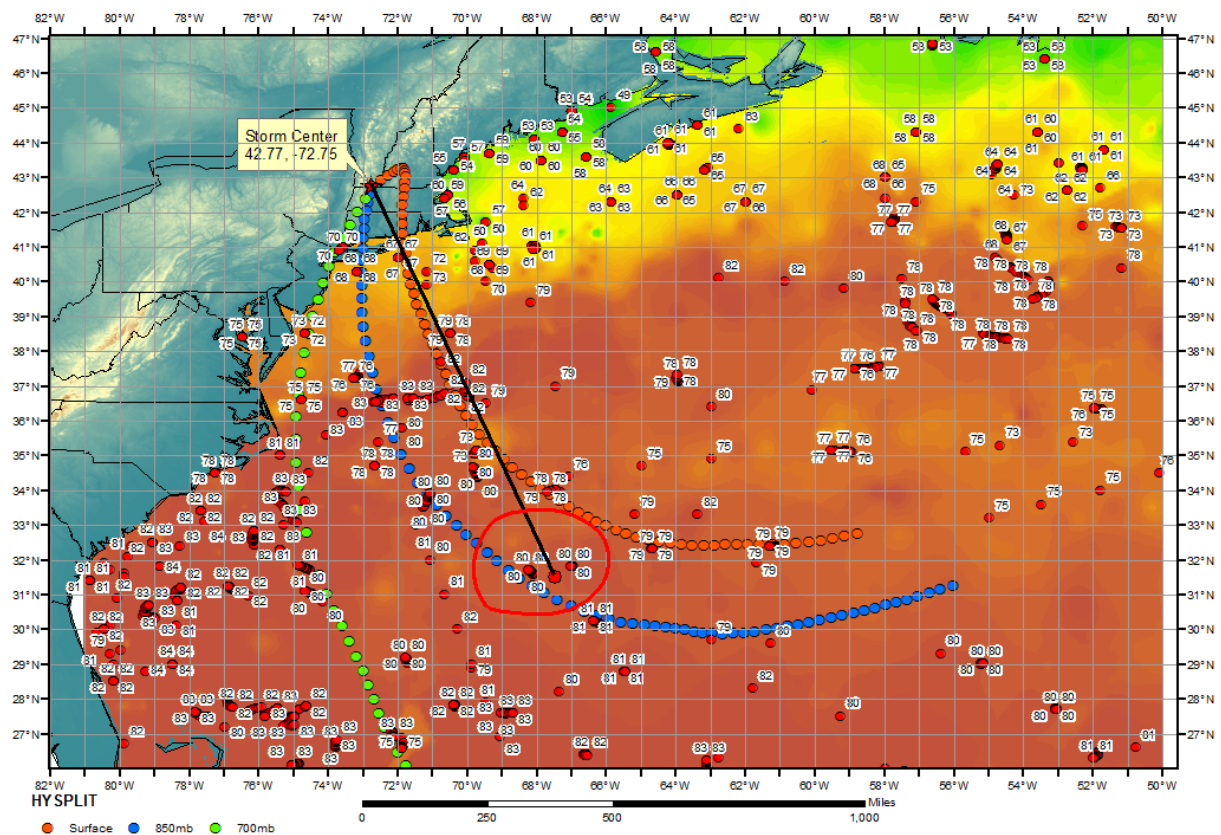




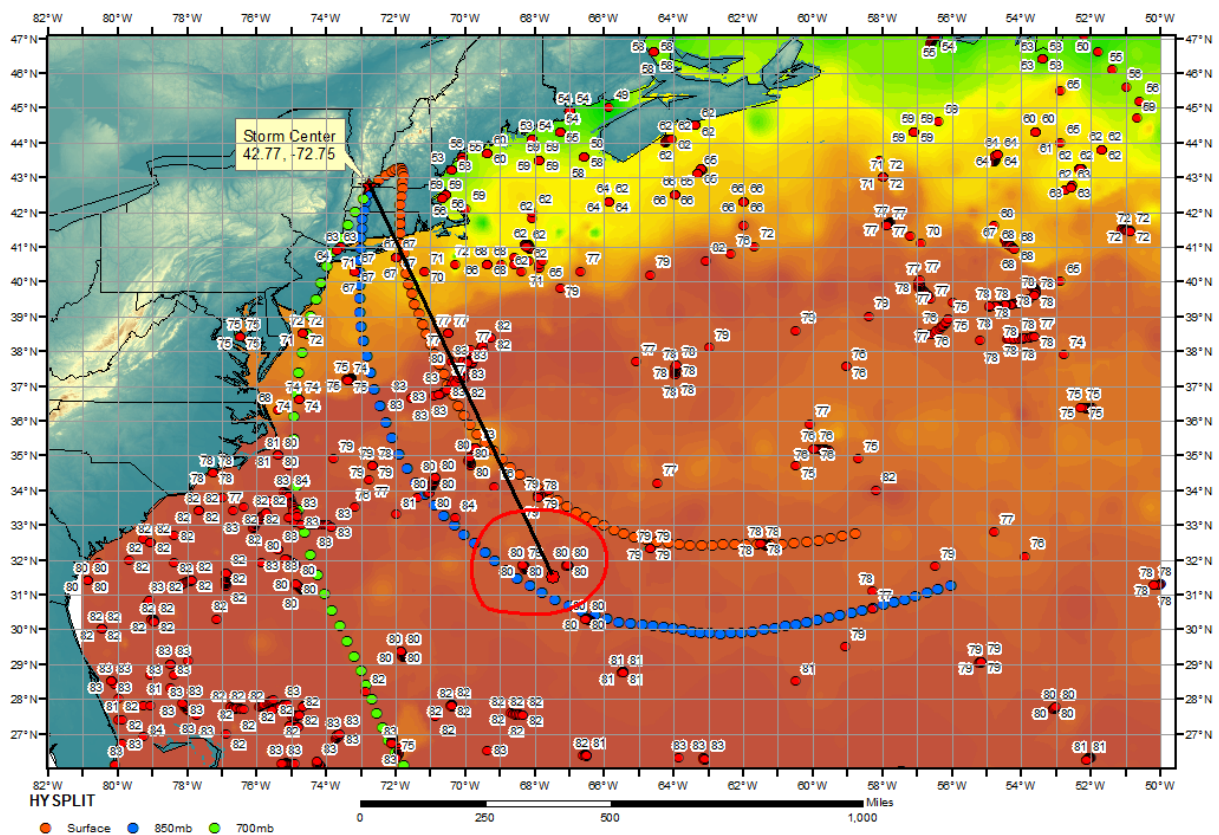
NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 09 Oct 05  
 CDC1 Meteorological Data



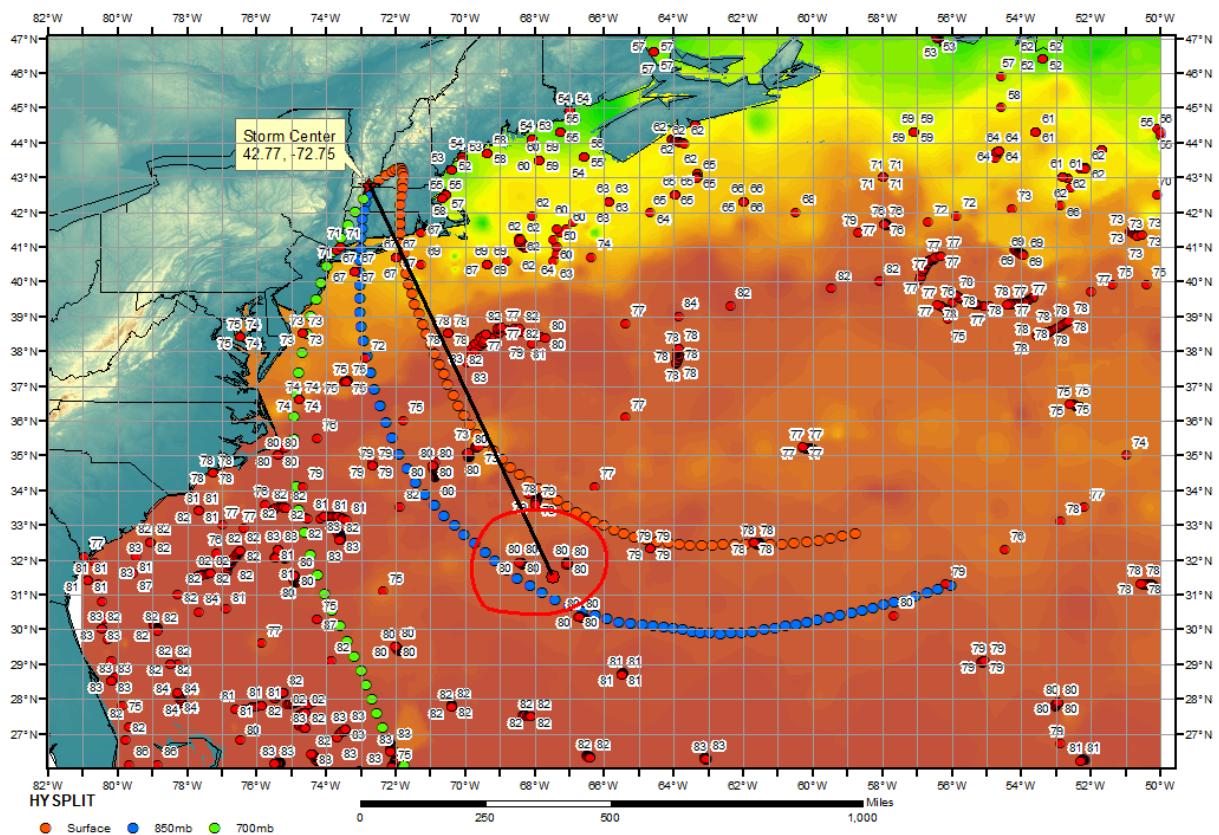
SPAS 1201 Halifax, VT Sea Surface Temperatures (F)  
October 6, 2005



SPAS 1201 Halifax, VT Sea Surface Temperatures (F)  
October 7, 2005



**SPAS 1201 Halifax, VT Sea Surface Temperatures (F)**  
October 8, 2005





## Storm Precipitation Analysis System (SPAS) For Storm #1047\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Tamaqua, PA

**Storm Dates:** 6/26/2006 0100Z – 6/28/2006 1000Z

**Event:** Frontal system-general storm

**DAD Zone 1**

**Latitude:** 41.675

**Longitude:** -75.375

**Max. Grid/Radar Rainfall Amount:** 12.26" (Grid/Pixel Point)

**Max. Observed Rainfall Amount:** 11.79" (11.97" grid cell at Aldenville, ALDP1)

**Number of Stations:** 491 (99-hourly, 21 hourly estimated, 78-daily 293-supplemental) gauging stations within the defined search domain.

**SPAS Version:** 4.0

**Base Map Used:** No

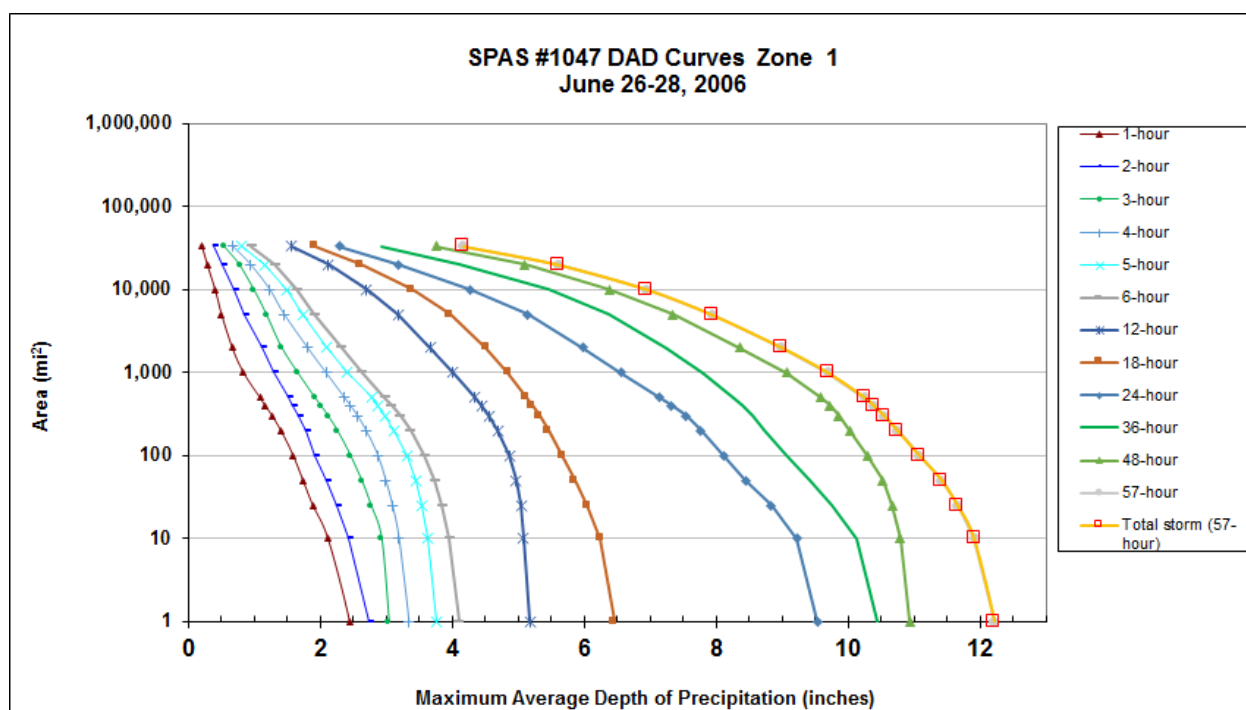
**Spatial resolution:** 0.36 mi<sup>2</sup>

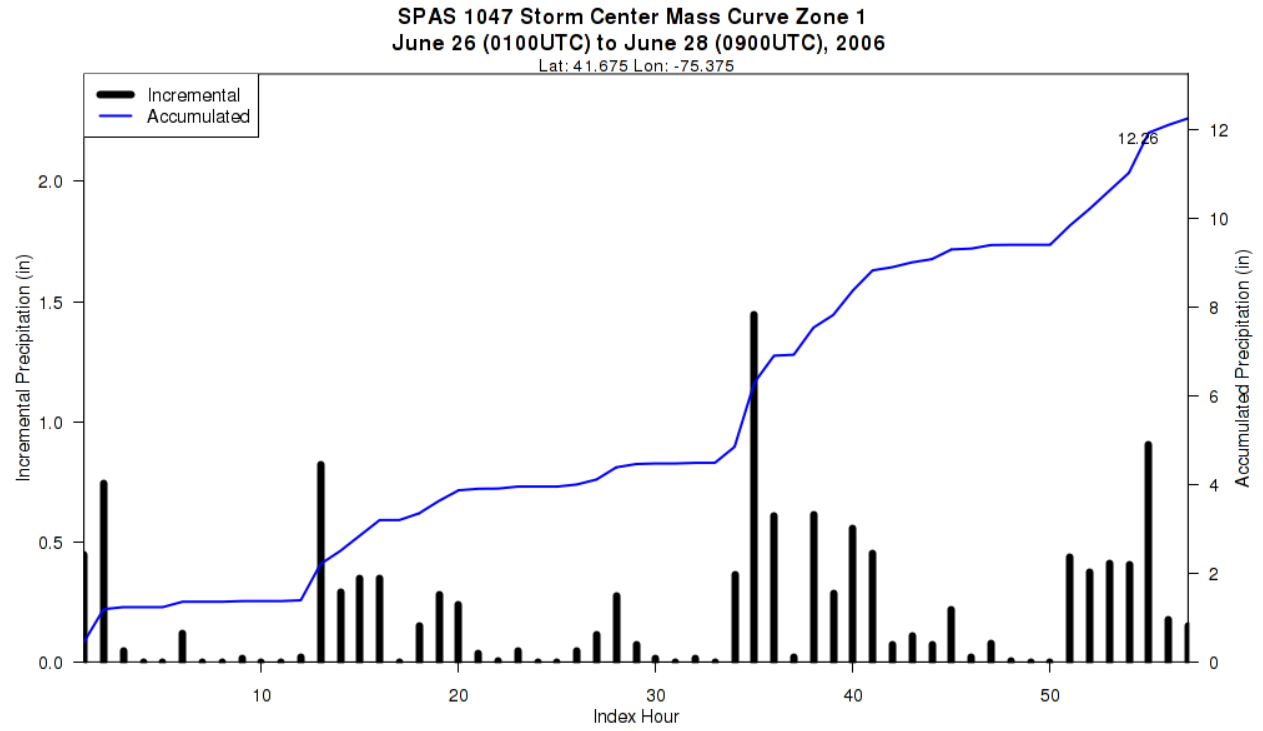
**Radar Included:** Yes (multiple stations were merged)

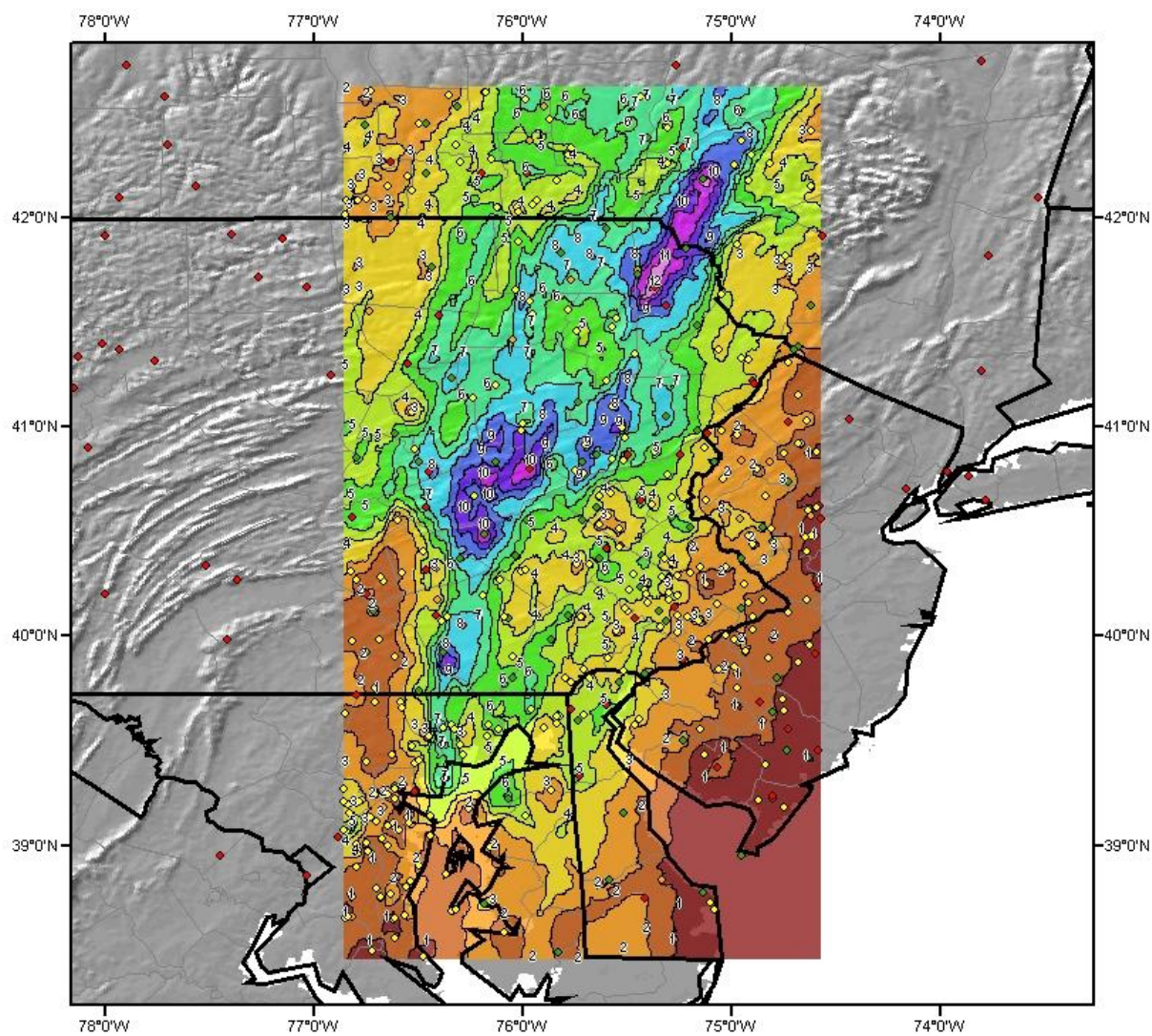
**Depth-Area-Duration (DAD) analysis:** Yes: 1, 2, 3, 4, 5, 6, 12, 18, 24, 36, 48, & 57 hours

SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. Dew Point					Climatological Max. Dew Point					IPMF	
						T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1047_1	-75.3750	41.6750	1,260	1,300	10-Jul	70.50	2.31	0.28	63	2.030	76.10	76.0	2.99	0.33	74	2.660	1.310

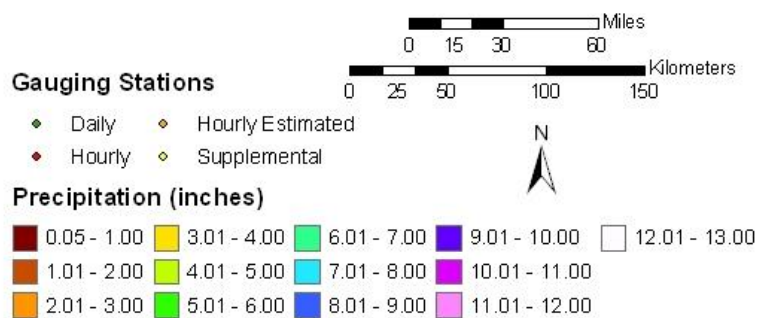
Storm 1047- June 26 (0100 UTC) - June 28 (0900 UTC), 2006													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
Area (mi <sup>2</sup> )	Duration (hours)												
	1	2	3	4	5	6	12	18	24	36	48	57	Total
0.4	2.49	2.77	3.06	3.38	3.79	4.15	5.23	6.49	9.57	10.49	10.98	12.26	12.26
1	2.45	2.73	3.03	3.34	3.76	4.10	5.18	6.45	9.54	10.45	10.94	12.22	12.22
10	2.12	2.42	2.92	3.19	3.63	3.95	5.08	6.24	9.22	10.13	10.79	11.91	11.91
25	1.89	2.24	2.76	3.09	3.54	3.84	5.04	6.04	8.83	9.76	10.67	11.66	11.66
50	1.74	2.09	2.62	2.99	3.44	3.73	4.97	5.86	8.45	9.41	10.52	11.42	11.42
100	1.59	1.92	2.45	2.87	3.31	3.58	4.86	5.67	8.11	9.07	10.29	11.08	11.08
200	1.40	1.77	2.25	2.69	3.12	3.36	4.69	5.46	7.77	8.74	10.03	10.75	10.75
300	1.27	1.67	2.11	2.56	2.99	3.21	4.55	5.32	7.54	8.55	9.86	10.55	10.55
400	1.16	1.59	2.00	2.45	2.88	3.08	4.44	5.21	7.32	8.40	9.72	10.39	10.39
500	1.08	1.51	1.91	2.36	2.77	2.97	4.34	5.12	7.14	8.27	9.59	10.25	10.25
1,000	0.83	1.30	1.65	2.08	2.40	2.63	4.01	4.84	6.56	7.79	9.07	9.69	9.69
2,000	0.66	1.12	1.41	1.80	2.10	2.32	3.66	4.51	5.98	7.24	8.36	8.99	8.99
5,000	0.50	0.85	1.18	1.45	1.74	1.91	3.17	3.97	5.14	6.37	7.34	7.93	7.93
10,000	0.40	0.69	0.99	1.23	1.49	1.64	2.70	3.39	4.26	5.46	6.38	6.95	6.95
20,000	0.28	0.52	0.77	0.94	1.16	1.31	2.12	2.61	3.18	4.10	5.10	5.60	5.60
33,237	0.20	0.37	0.54	0.67	0.81	0.95	1.56	1.92	2.29	2.93	3.75	4.17	4.17







**Total Rainfall (57-hours)**  
**Tamaqua, PA 2006 Storm**  
**Storm #1047 June 26 (0100 Z) to 28 (1000 Z), 2006**

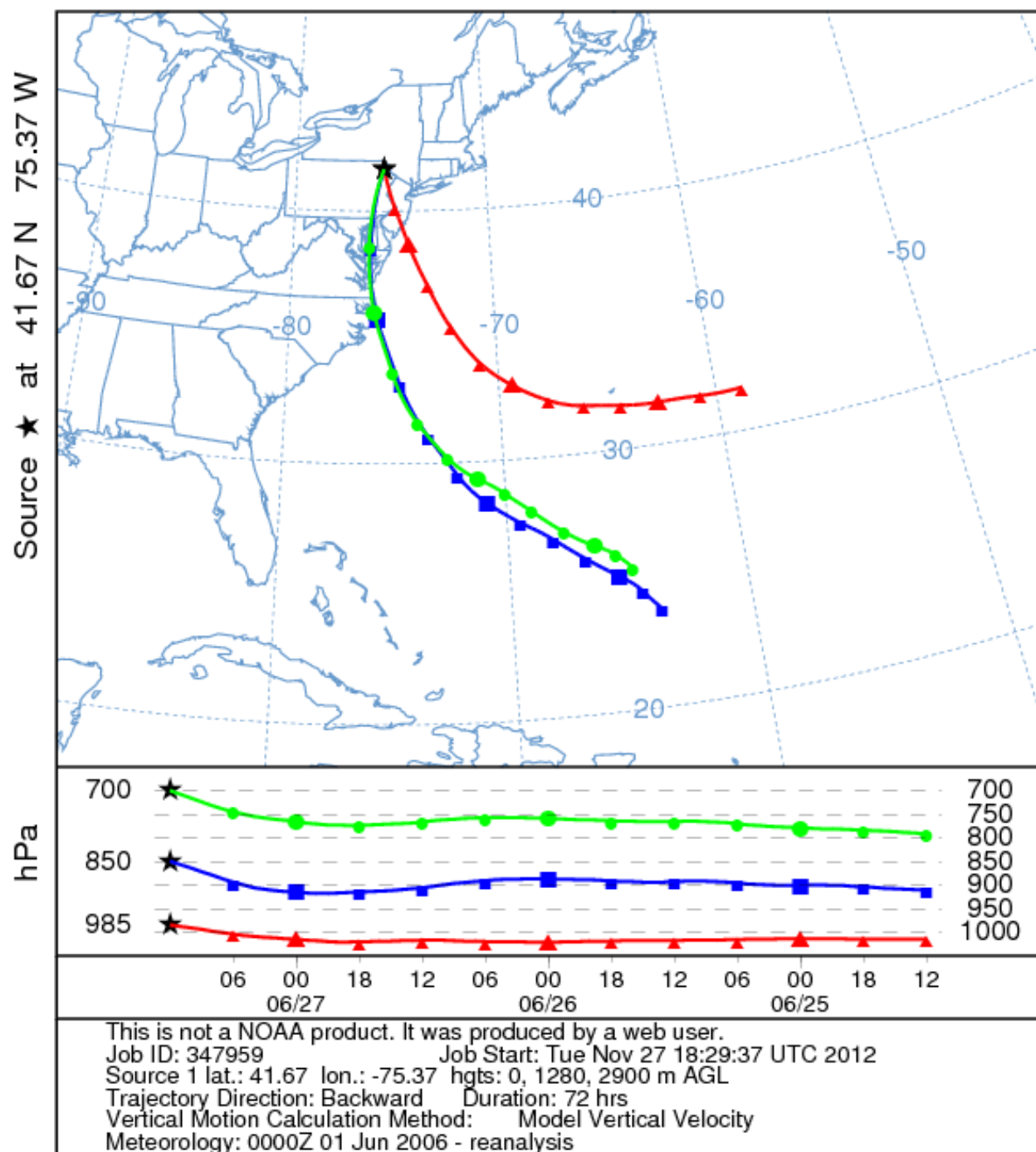


Coordinate system: GCS North American 1983  
 Scale: 1:2,975,355

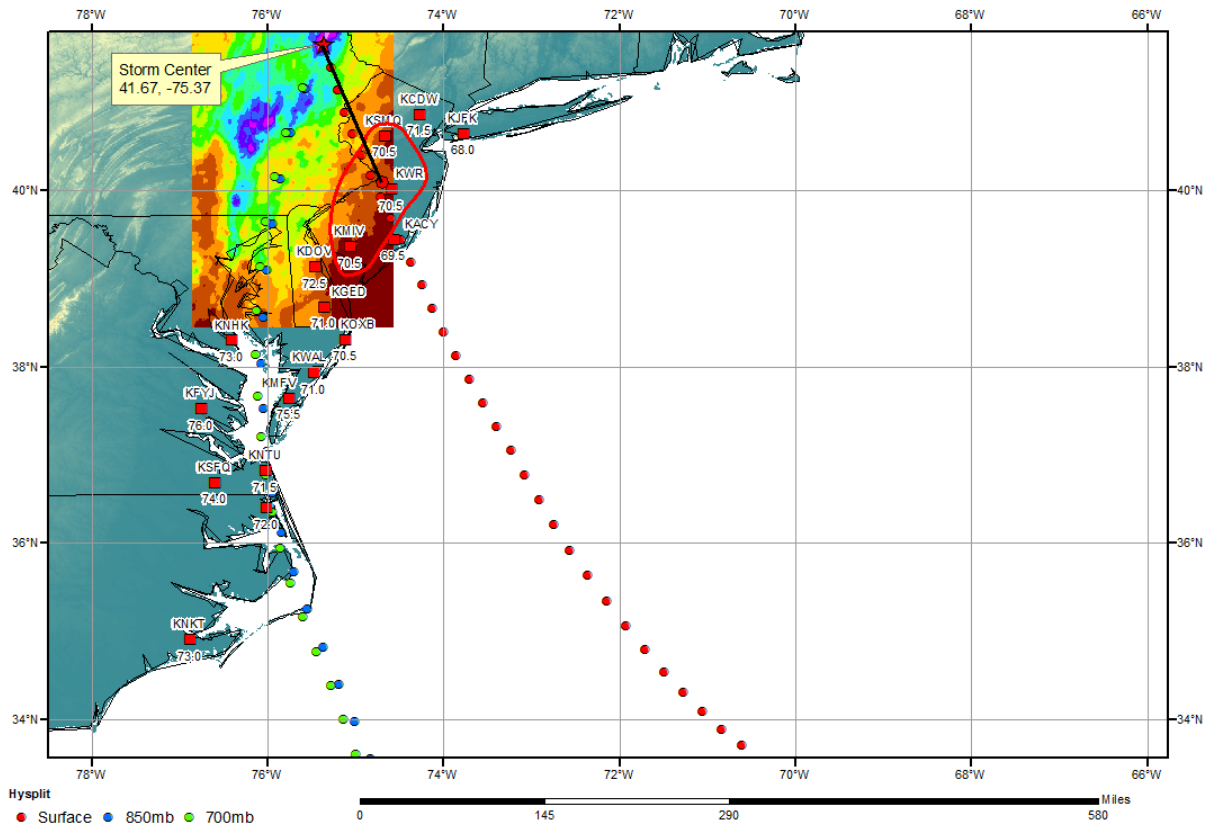
NR5527AWA December 20, 2007



NOAA HYSPLIT MODEL  
Backward trajectories ending at 1200 UTC 27 Jun 06  
CDC1 Meteorological Data



# SPAS 1047 Tamaqua, PA Storm Analysis June 24-26, 2006



## Storm Precipitation Analysis System (SPAS) For Storm #1041\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Central Park, NY

**Storm Dates:** 4/15/2007 0300Z – 4/16/2007 1700Z

**Event:** Nor'Easter

**DAD Zone\_1**

**Latitude:** 41.11 degrees

**Longitude:** -73.44 degrees

**Maximum SPAS Rainfall Amount:** 9.44" (Grid/Pixel Point)

**Maximum Rain Gauge Amount:** 9.30" (Rivervale, NJ)

**Number of Stations:** 307 (105-hourly, 14-hourly pseudo, 188-daily convert to supplemental) gauging stations within the defined search domain.

**SPAS Version:** 4.0

**Spatial resolution:** 44.179 seconds

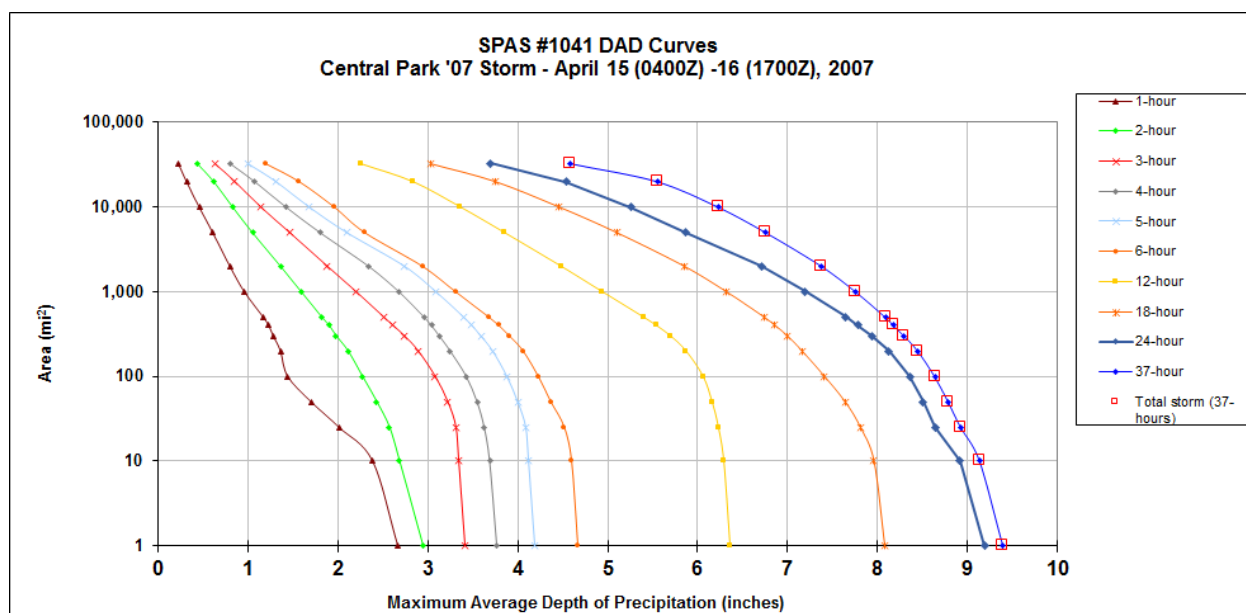
**Radar Included:** Yes

Radar reflectivity data was used from the KDIX and KENX radars. After sectorization optimization, the scan-scale precipitation grids were summed and blended (from KDIX- and KENX-based radars) into seamless hourly grids.

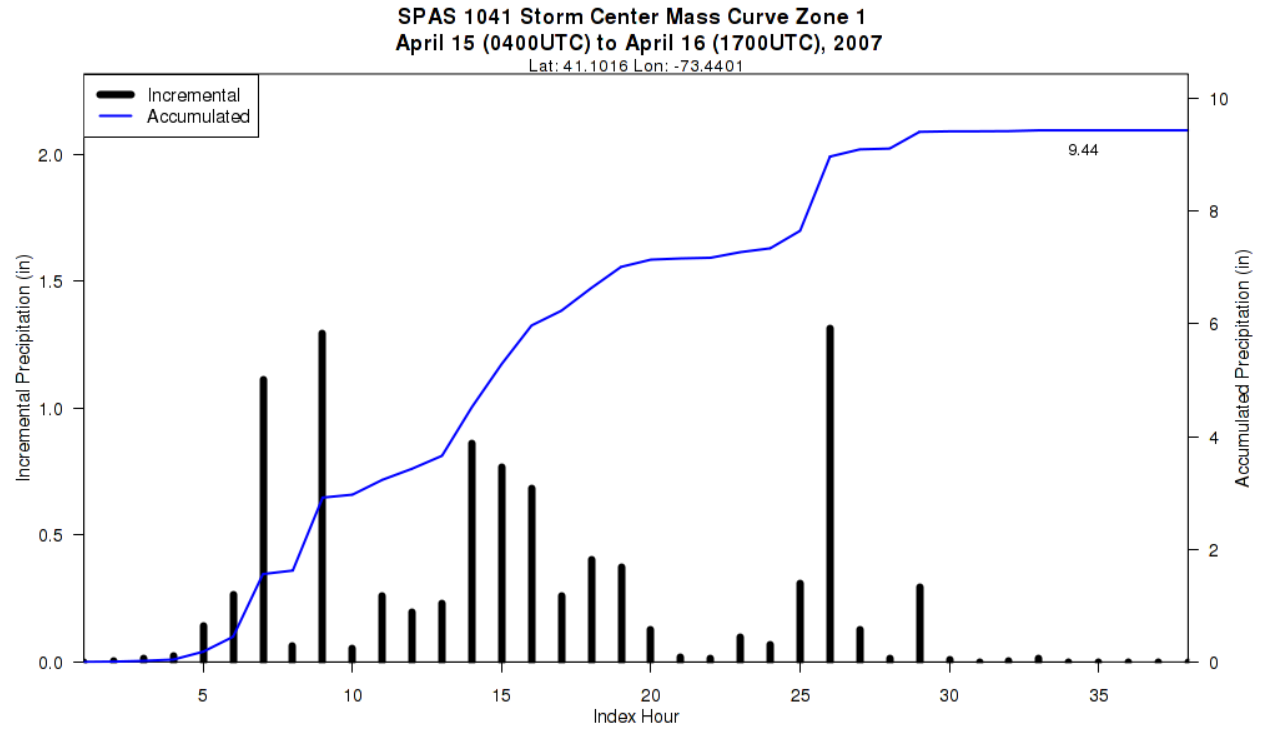
**Depth-Area-Duration (DAD) analysis:** Yes

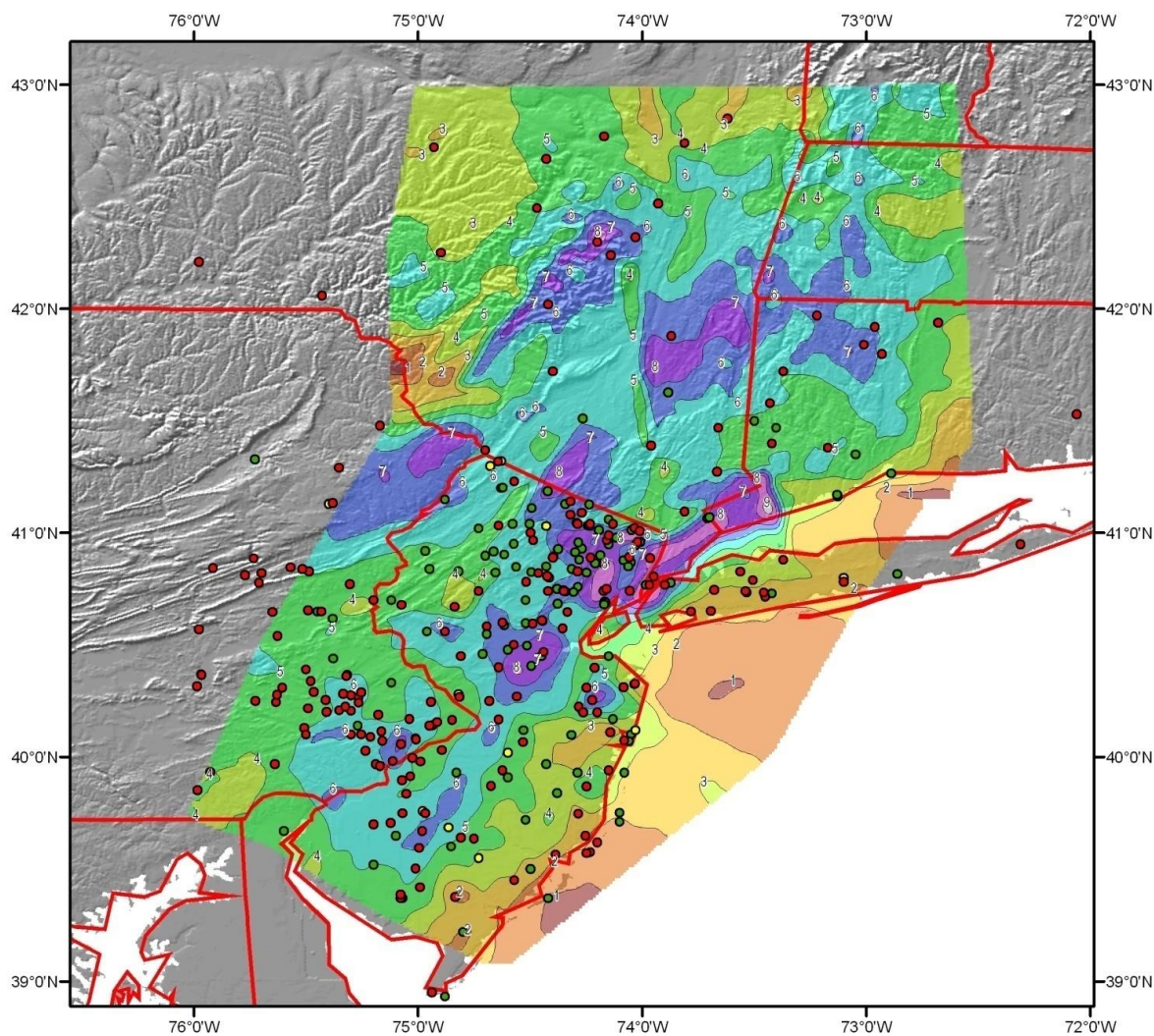
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1041 1	-73.4400	41.1100	122	100	1-May	71.00	2.36	0.02	64	2.340	74.00	74.0	2.73	0.03	70	2.700	1.154

Storm 1041 - Central Park '07 Storm - April 15-16, 2007											
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)											
Area (mi <sup>2</sup> )	Duration (hours)										
	1	2	3	4	5	6	12	18	24	37	Total
0.4	2.66	2.96	3.43	3.79	4.21	4.69	6.38	8.10	9.23	9.44	9.44
1	2.66	2.94	3.41	3.77	4.19	4.67	6.36	8.08	9.19	9.40	9.40
10	2.38	2.68	3.34	3.69	4.12	4.60	6.29	7.96	8.92	9.14	9.14
25	2.01	2.57	3.31	3.63	4.09	4.52	6.23	7.81	8.64	8.93	8.93
50	1.70	2.43	3.22	3.55	4.00	4.37	6.16	7.64	8.51	8.79	8.79
100	1.44	2.27	3.08	3.43	3.88	4.23	6.06	7.41	8.36	8.64	8.64
200	1.36	2.11	2.89	3.25	3.72	4.06	5.87	7.16	8.13	8.45	8.45
300	1.28	1.98	2.74	3.13	3.59	3.91	5.70	7.00	7.94	8.30	8.30
400	1.23	1.90	2.61	3.04	3.49	3.79	5.54	6.86	7.78	8.18	8.18
500	1.17	1.82	2.51	2.96	3.40	3.68	5.40	6.74	7.65	8.09	8.09
1,000	0.96	1.59	2.20	2.68	3.09	3.31	4.94	6.32	7.20	7.76	7.76
2,000	0.80	1.36	1.88	2.34	2.74	2.94	4.48	5.85	6.71	7.38	7.38
5,000	0.61	1.05	1.46	1.80	2.10	2.30	3.85	5.10	5.87	6.76	6.76
10,000	0.46	0.83	1.14	1.42	1.68	1.96	3.36	4.46	5.26	6.23	6.23
20,000	0.32	0.62	0.85	1.07	1.31	1.57	2.83	3.75	4.54	5.55	5.55
32,549	0.23	0.44	0.63	0.80	1.00	1.20	2.25	3.03	3.70	4.59	4.59

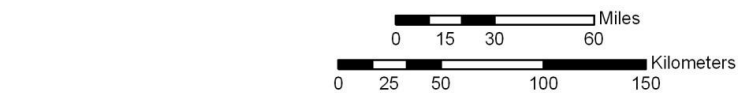








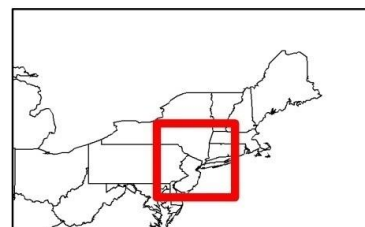
**Total Rainfall (37-hours)**  
**Central Park '07 Storm**  
**Storm #1041 April 15 (0400 Z) to 16 (1700 Z), 2007**



#### Gauging Stations

- Hourly
- Hourly pseudo
- Daily supplemental

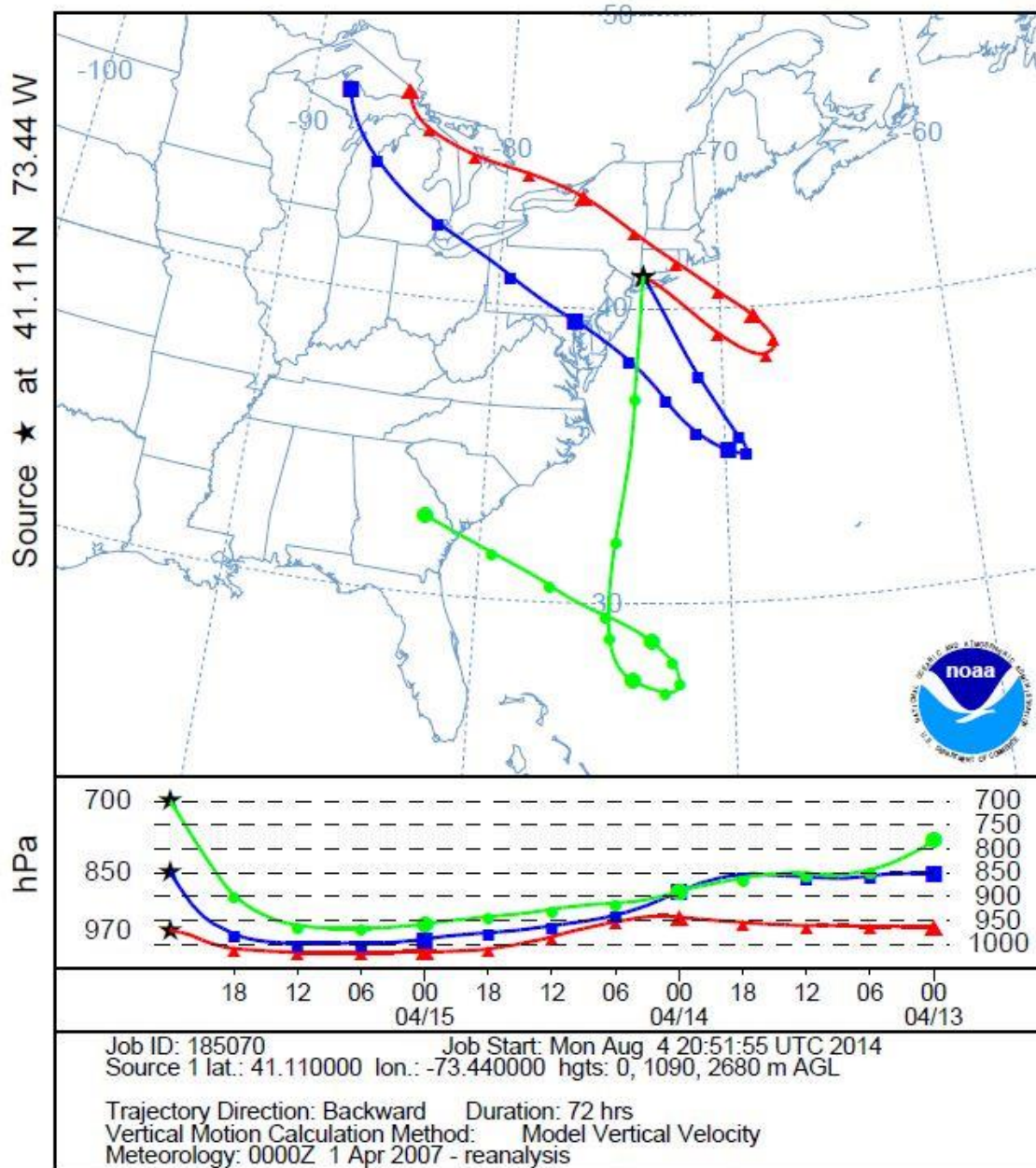
#### Precipitation (inches)



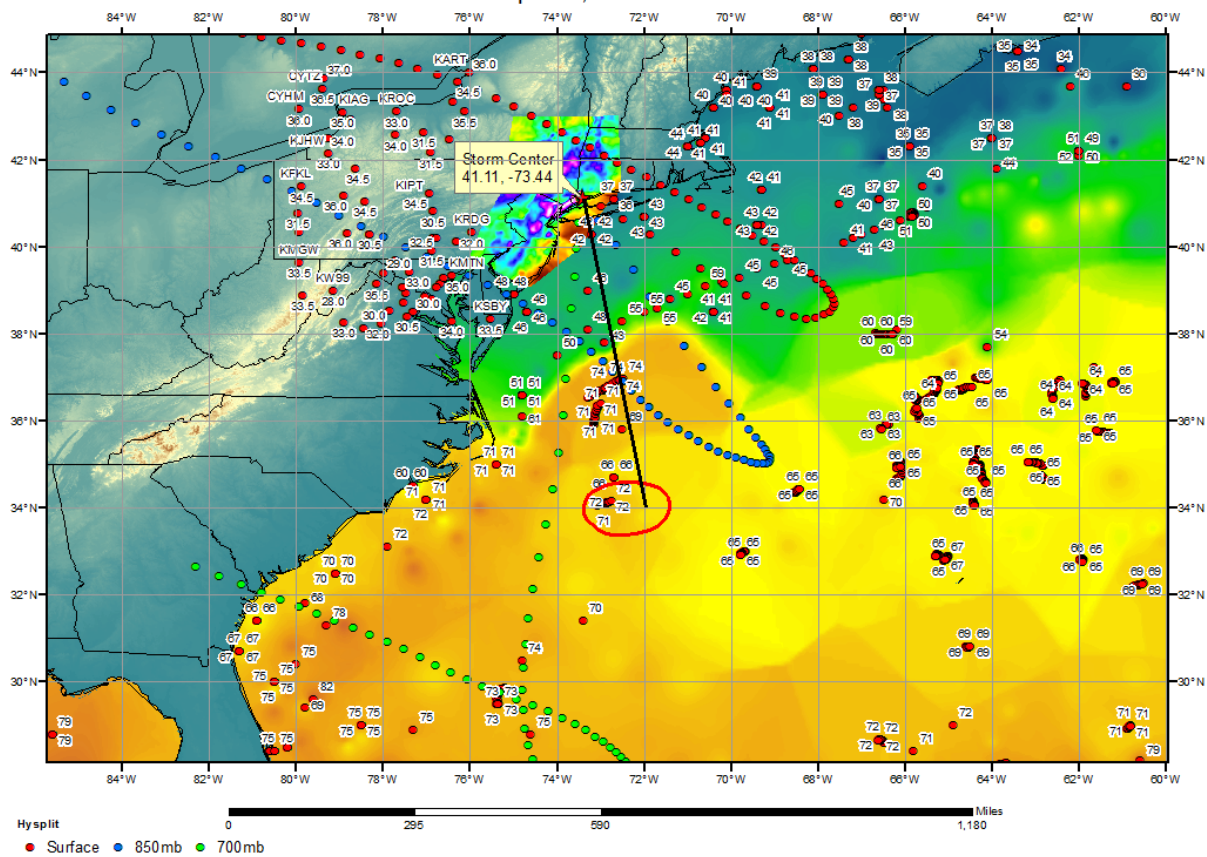
Coordinate system: GCS North American 1983  
 Scale: 1:2,784,567

Metstat/AWA December 13, 2007

NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 16 Apr 07  
 CDC1 Meteorological Data



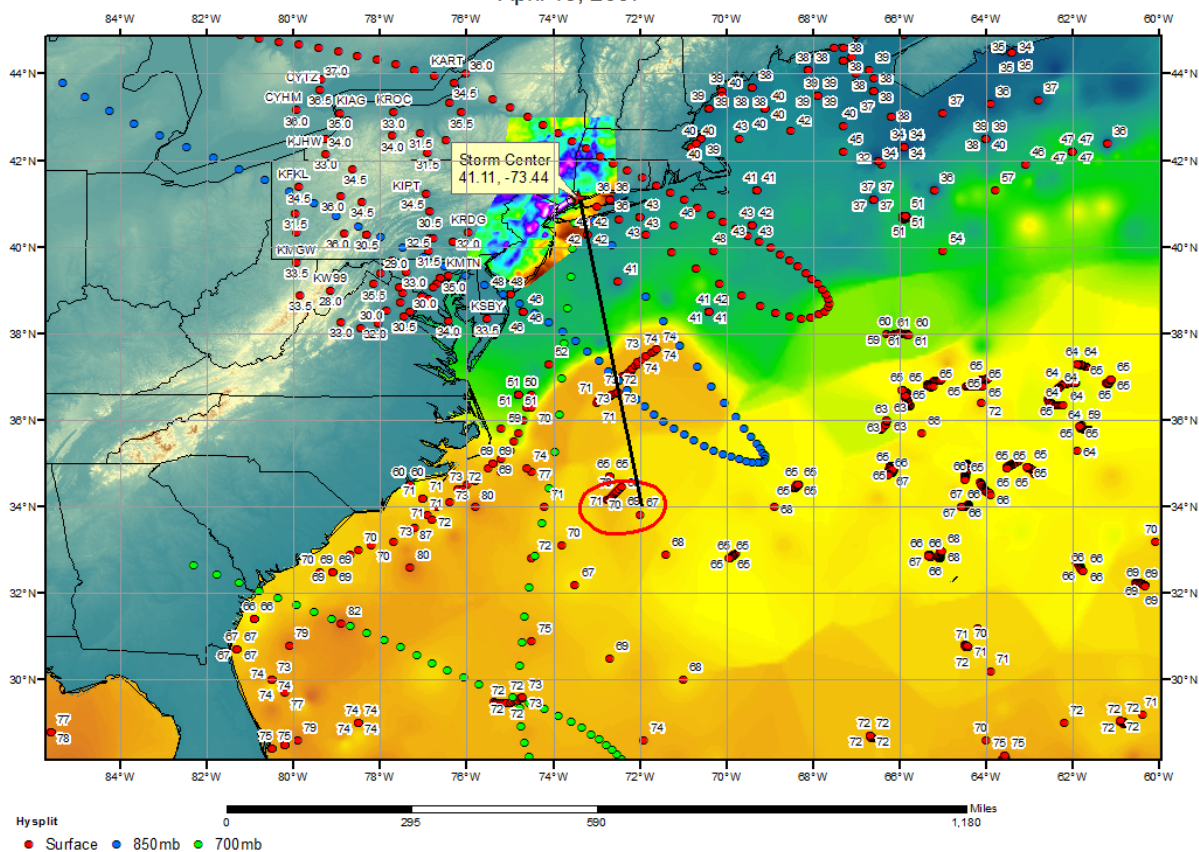
**SPAS 1041 Norwalk, CT Storm Analysis**  
April 14, 2007





## SPAS 1041 Norwalk, CT Storm Analysis

April 15, 2007



## Storm Precipitation Analysis System (SPAS) For Storm #1298\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Harrisburg, PA, Mid-Atlantic States

**Storm Dates:** September 4, 2011 – September 9, 2011 (96-hours analyzed)

**Event:** Front Systems Pulling in Moisture from Remnants of Tropical Storm Lee

### DAD Zone 1

**Latitude:** 39.985

**Longitude:** -76.495

**Max. Grid Rainfall Amount:** 18.32"

**Number of Stations:** 3135 (522 Daily, 1118 Hourly, 7 Hourly Estimated, 179 Hourly Pseudo, 1304 Supplemental, 5 Supplemental Estimated)

**SPAS Version:** 9.5

**Base Map Used:** NWS Stage 4 Storm Total Precipitation 4-km grid

**Spatial resolution:** 36 seconds

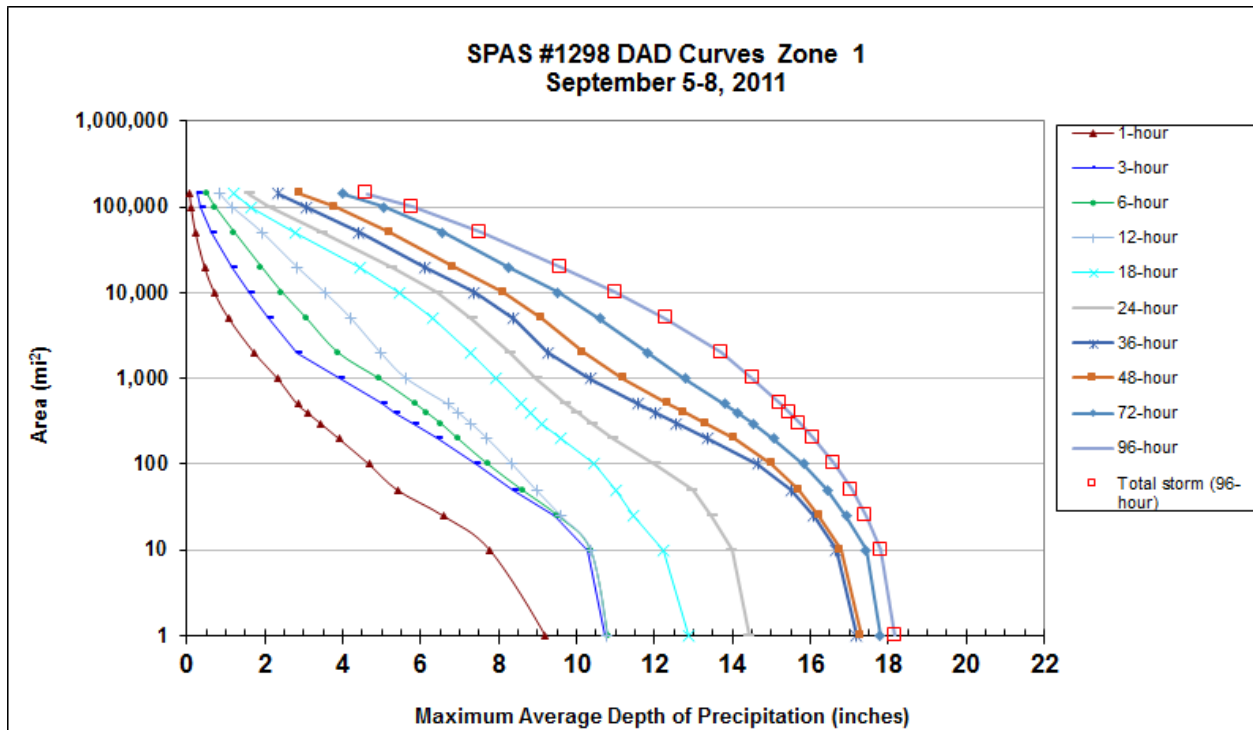
**Radar Included:** Yes

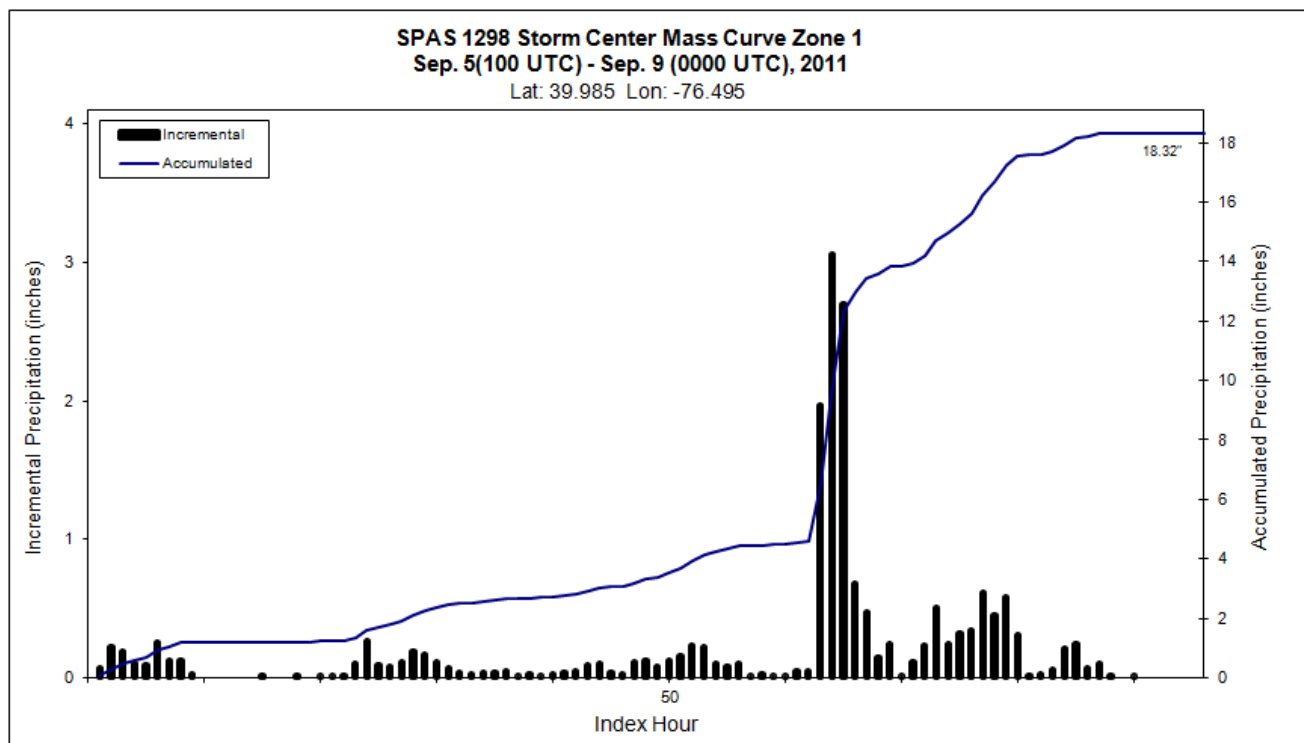
**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of Results:** This storm was particularly difficult given large amount of data that required extensive QC. A great deal of effort was put into QCing the hourly data. When in doubt, the station was often simply removed. Fortunately, this storm occurred during the CoCoRaHS era, so it coupled with NCDC data, provided a spatially dense sample size for anchoring the precipitation magnitudes. Good radar data was also available and helped overcome the limited hourly data, particularly in areas where pseudo hourly gauges (based on the radar data and SPAS-generated ZRs) were added to the analysis. All in all, however, we are confident in the results of this analysis with the exception of areas across southeastern Virginia, where the analysis struggled with the extremely heavy rain from thunderstorms late in the analysis period occurred. The number of high hourly estimates (station data only) and the use of the dynamic and/or Tropical storm ZR relationship to create the estimated gridded precipitation created higher 1-hour precipitation values than is typically observed in a SPAS analysis. Again, this can be attributed to the estimated station hourly values, the Tropical storm ZR and residual adjustments, the large storm domain, the tropical and convective mix of precipitation that occurred during the storm within the large domain. Then, for DAD calculations, the hourly grids (with numerous high precipitation estimates) are used to calculate the DAD information.

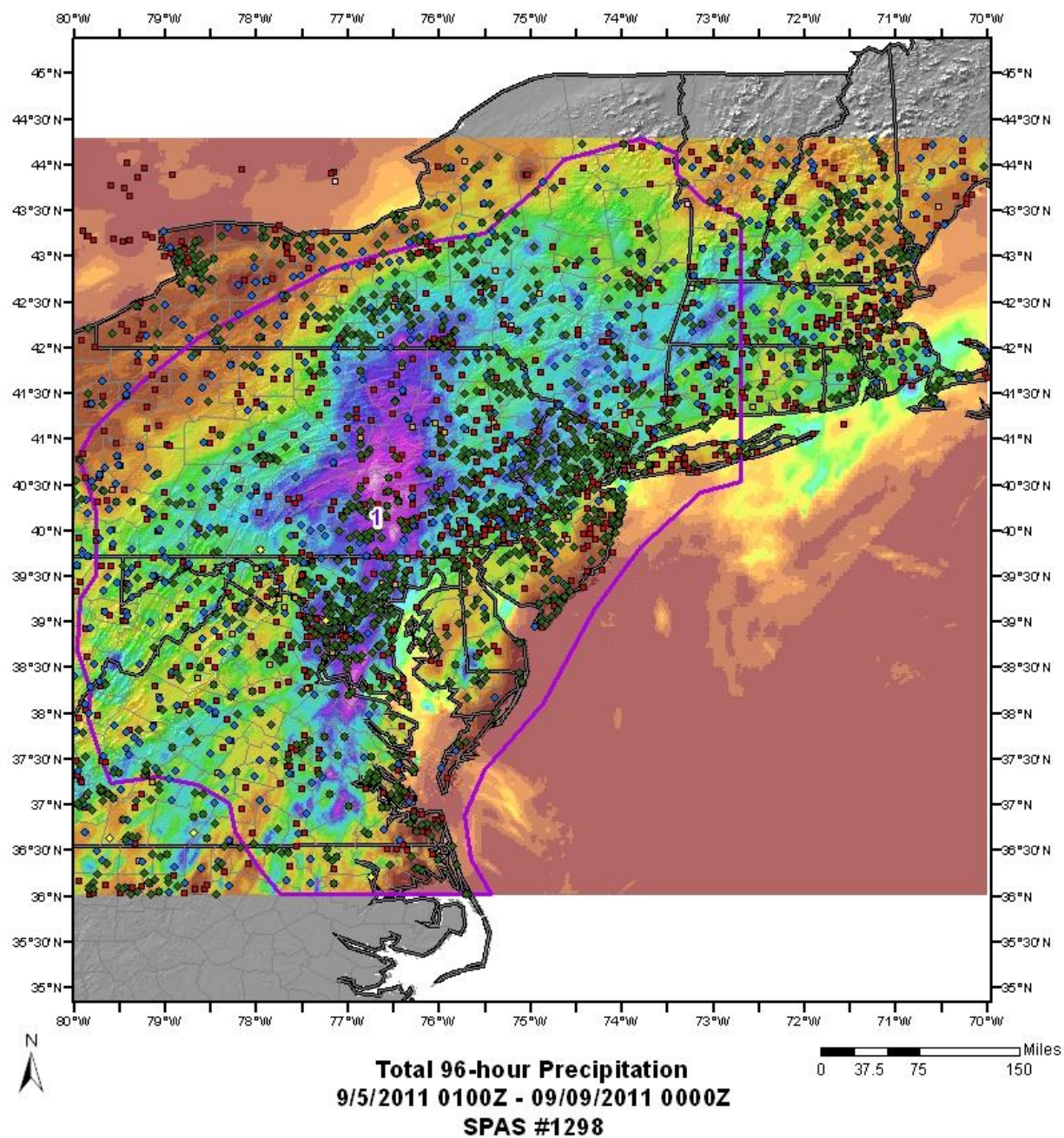
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1298_1	-76.4950	39.9850	226	200	20-Aug	81.50	3.86	0.06	85	3.800	83.79	84.0	4.30	0.07	90	4.230	1.113

Storm 1298 - September 5 (0100 UTC) - September 9 (0000 UTC), 2011											
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)											
Area (mi <sup>2</sup> )	Duration (hours)										
	1	3	6	12	18	24	36	48	72	96	Total
0.4	9.44	10.84	10.89	10.89	12.99	14.56	17.37	17.47	17.94	18.31	18.31
1	9.21	10.75	10.80	10.79	12.87	14.44	17.19	17.30	17.80	18.17	18.17
10	7.79	10.30	10.36	10.37	12.23	13.98	16.67	16.79	17.44	17.82	17.82
25	6.60	9.44	9.53	9.60	11.46	13.47	16.09	16.23	16.93	17.43	17.43
50	5.42	8.38	8.61	8.97	11.00	12.97	15.51	15.70	16.44	17.06	17.06
100	4.69	7.40	7.73	8.35	10.43	12.02	14.65	15.02	15.82	16.62	16.62
200	3.91	6.43	6.95	7.71	9.59	10.95	13.37	14.07	15.05	16.09	16.09
300	3.44	5.82	6.51	7.29	9.11	10.39	12.57	13.31	14.53	15.73	15.73
400	3.11	5.34	6.15	6.96	8.81	10.02	12.01	12.77	14.13	15.46	15.46
500	2.85	5.00	5.88	6.70	8.59	9.73	11.59	12.37	13.80	15.25	15.25
1,000	2.34	3.92	4.92	5.63	7.93	8.97	10.35	11.21	12.78	14.54	14.54
2,000	1.74	2.83	3.87	4.97	7.29	8.28	9.26	10.17	11.82	13.73	13.73
5,000	1.09	2.11	3.06	4.21	6.32	7.31	8.39	9.13	10.61	12.30	12.30
10,000	0.72	1.62	2.44	3.54	5.47	6.42	7.38	8.13	9.52	11.01	11.01
20,000	0.47	1.15	1.90	2.82	4.45	5.25	6.10	6.86	8.25	9.58	9.58
50,000	0.24	0.64	1.21	1.93	2.77	3.47	4.42	5.20	6.57	7.54	7.54
100,000	0.13	0.37	0.71	1.15	1.65	2.12	3.06	3.81	5.07	5.80	5.80
141,829	0.09	0.26	0.50	0.84	1.20	1.61	2.35	2.92	4.02	4.62	4.62

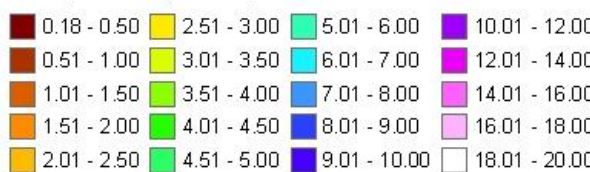








### Precipitation (inches)

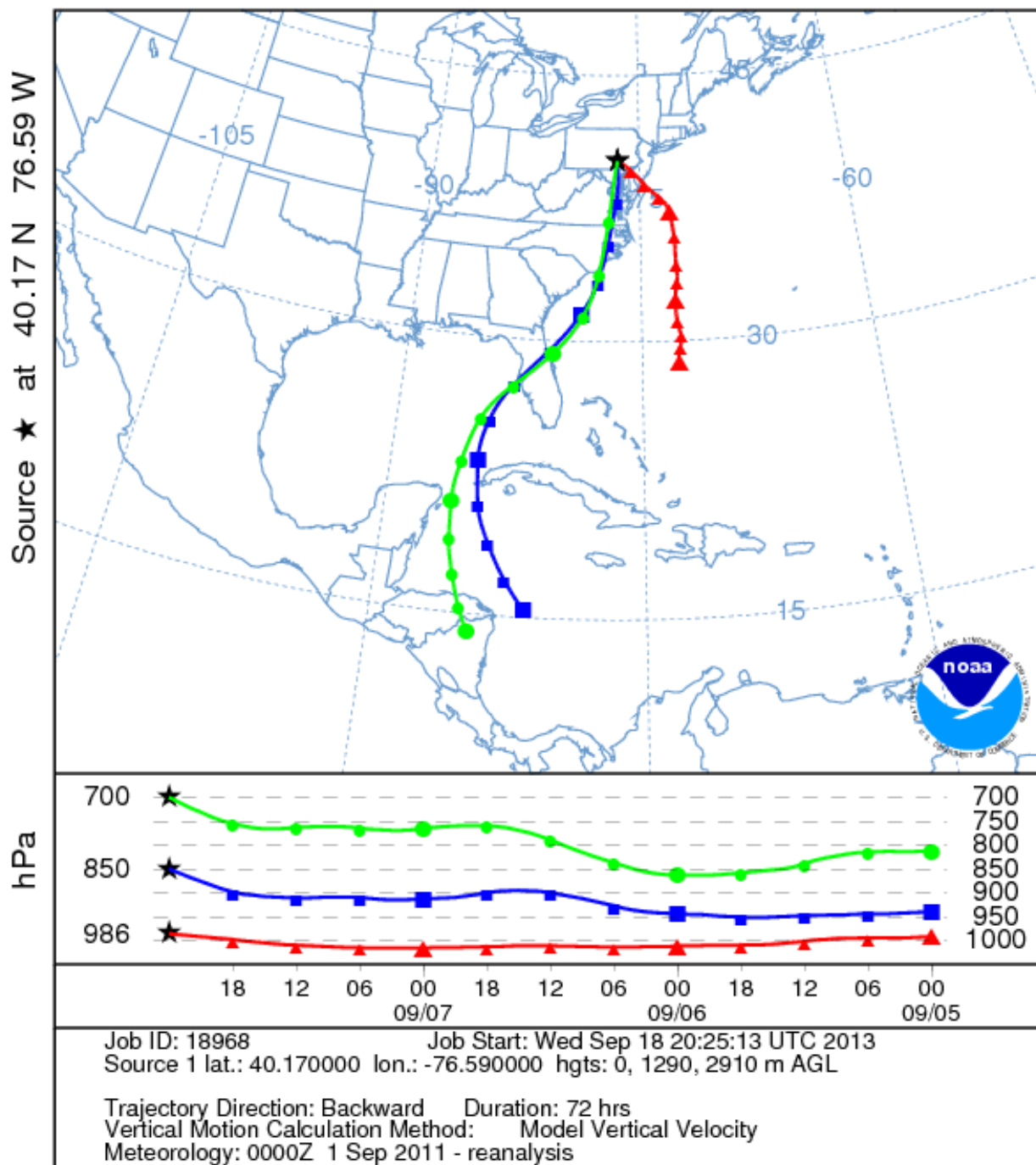


### Stations

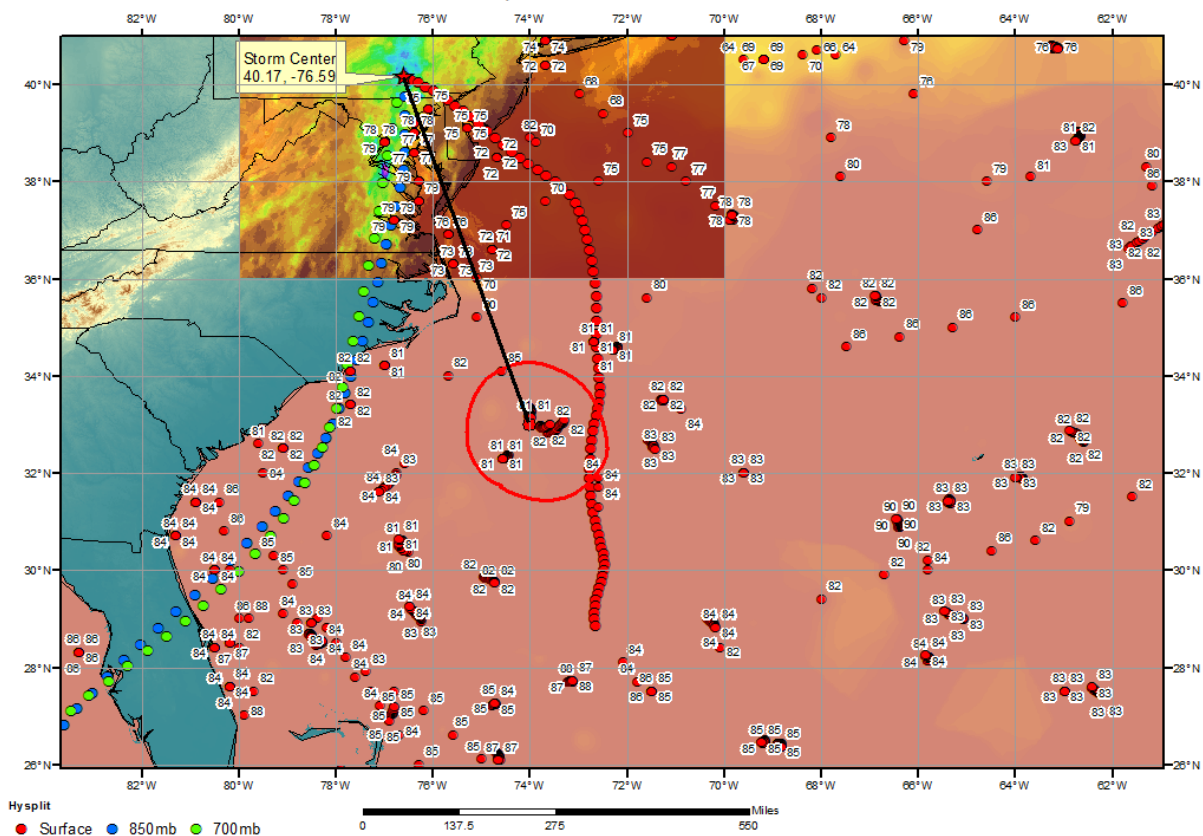


NCEP/NCAR, Inc. 09/26/2013

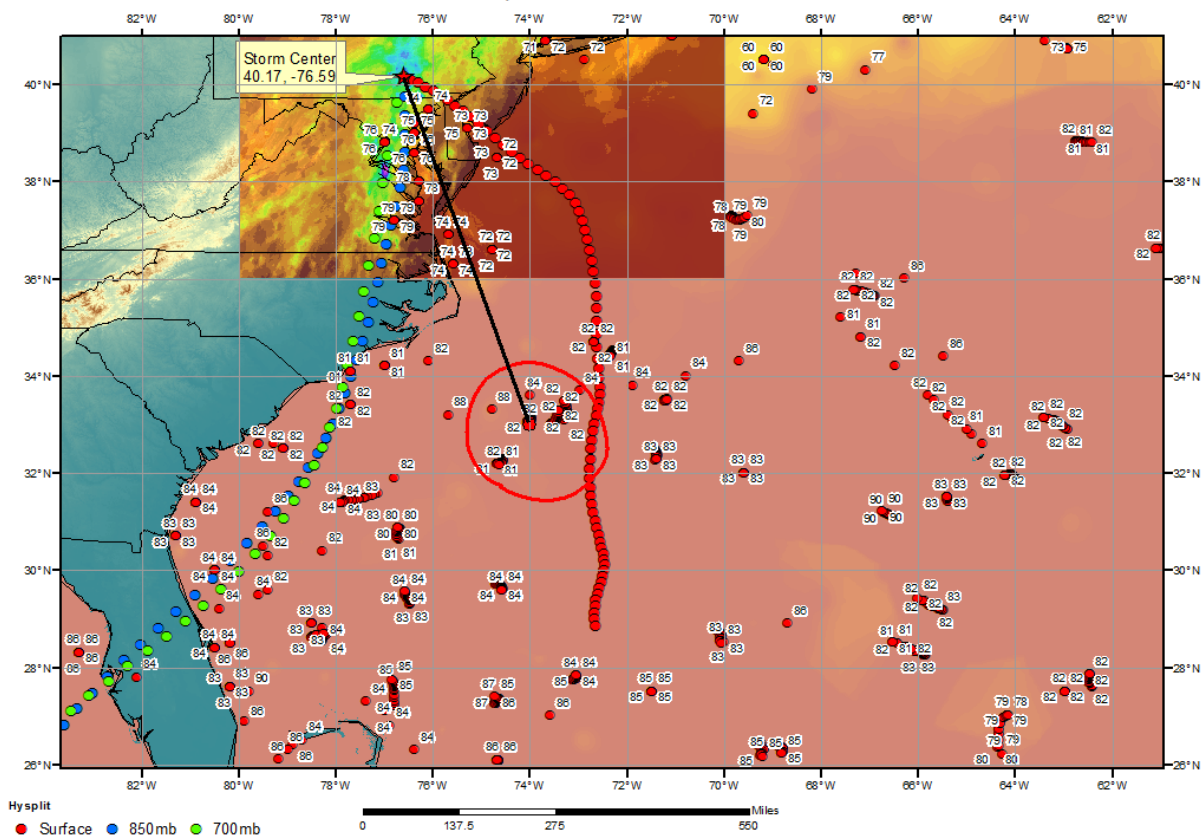
NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 08 Sep 11  
 CDC1 Meteorological Data



**SPAS 1298 Harrisburg, PA Tropical Storm Lee Storm Analysis**  
September 5, 2011



**SPAS 1298 Harrisburg, PA Tropical Storm Lee Storm Analysis**  
September 6, 2011





## Hybrid Storms

## Storm Precipitation Analysis System (SPAS) For Storm #1275\_2 SPAS-NEXRAD Analysis

**General Storm Location:** Montgomery Dam, PA, Pennsylvania, West Virginia, Virginia, Ohio, New York, Kentucky

**Storm Dates:** September 17-19, 2004

**Event:** Hurricane Ivan Extratropical Transition Interacting with a Front

### DAD Zone 2

**Latitude:** 40.605

**Longitude:** -76.465

**Max. Grid Rainfall Amount:** 8.80"

**Max. Observed Rainfall Amount:** 8.80"

**Number of Stations:** 955 (550 Daily, 183 Hourly, 62 Hourly Pseudo, and 160 Supplemental)

**SPAS Version:** 9.5

**Basemap:** PRISM 30-yr Mean (1981-2010) September Precipitation

**Spatial resolution:** 0.01 (~ 0.40 mi<sup>2</sup>)

**Radar Included:** Yes

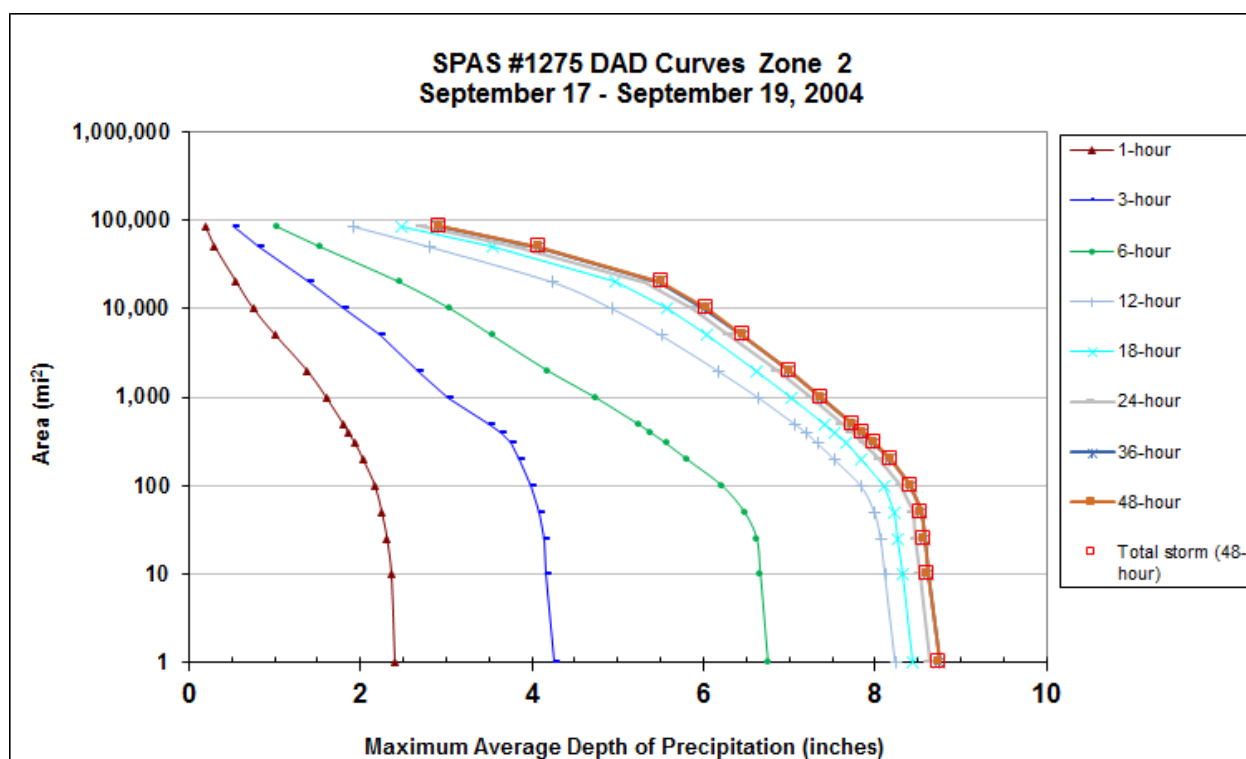
**Depth-Area-Duration (DAD) analysis:** Yes

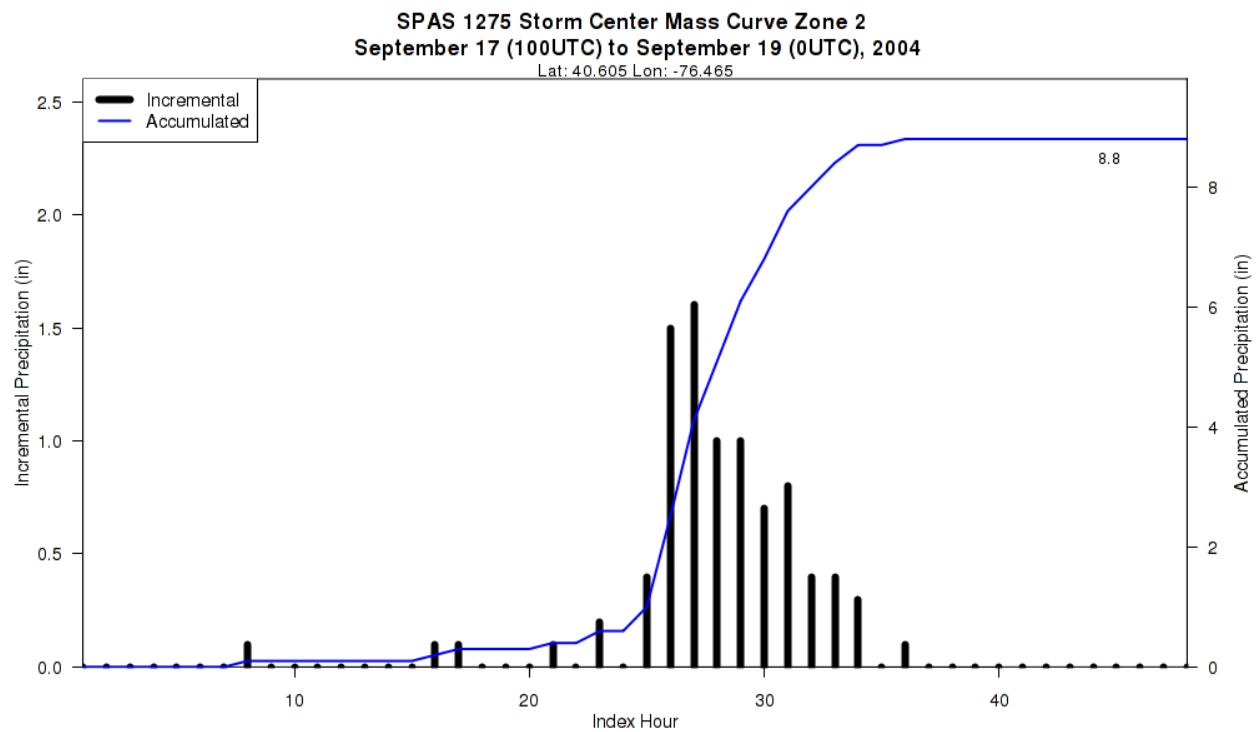
**Reliability of results:** This analysis was based on hourly data, daily data, supplemental station data and NEXRAD Radar. We have a high degree of confidence in the radar/station based storm total results, the spatial pattern is dependent on the radar data and basemap, and the timing is based on hourly and hourly pseudo stations.

SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. Dew Point					Climatological Max. Dew Point					IPMF	
						T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1275_2	-76.4650	40.6050	1,602	1,600	1-Sep	72.00	2.47	0.36	66	2.110	77.29	77.5	3.22	0.43	77	2.790	1.322

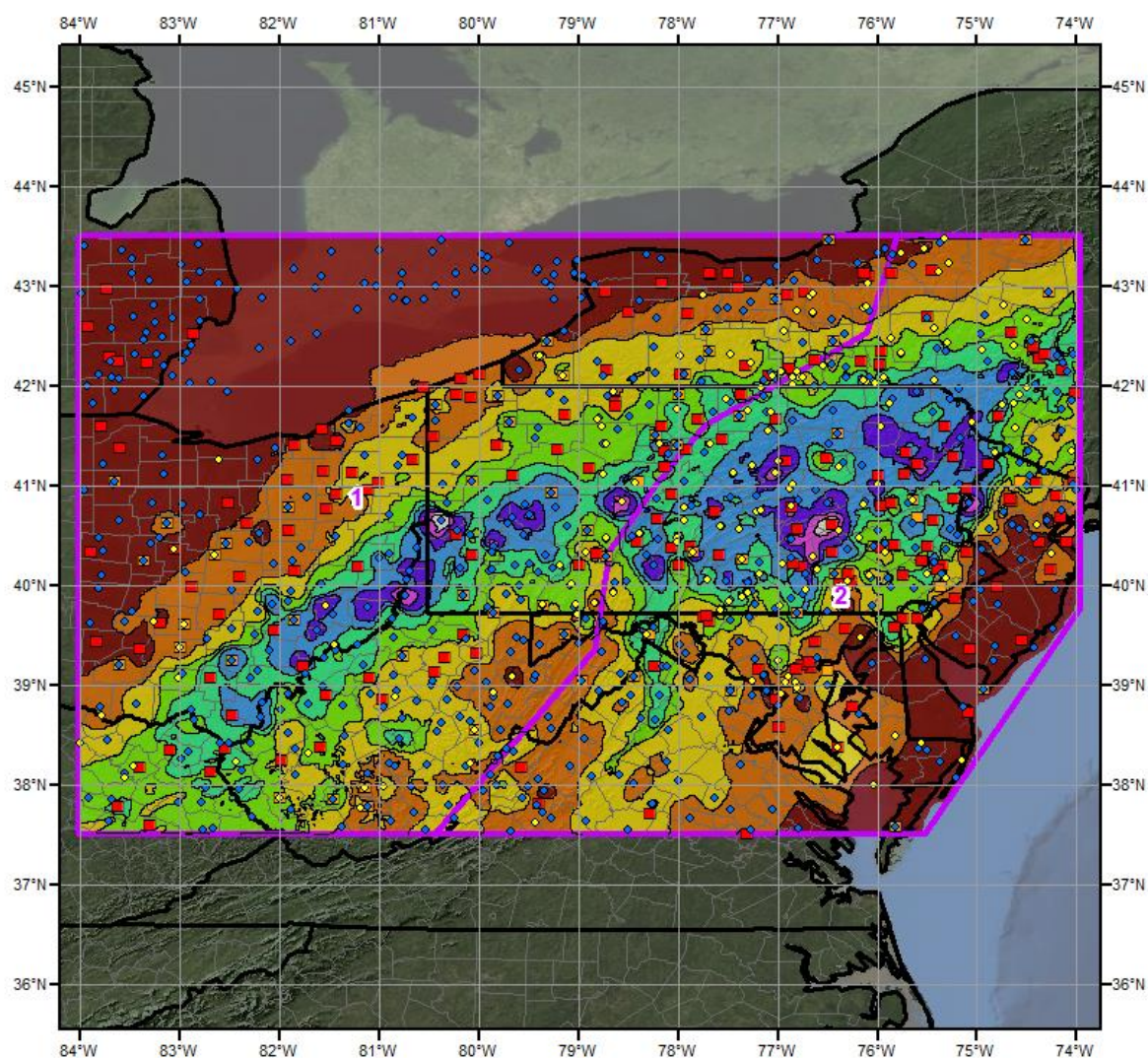
**Storm 1275 - September 17 (0100 UTC) - September 19 (0000 UTC), 2004**  
**MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)**

Area (mi <sup>2</sup> )	Duration (hours)								
	1	3	6	12	18	24	36	48	Total
0.4	2.42	4.26	6.79	8.29	8.49	8.69	8.79	8.79	8.79
1	2.40	4.25	6.75	8.24	8.44	8.64	8.75	8.75	8.75
10	2.36	4.17	6.66	8.12	8.32	8.52	8.62	8.62	8.62
25	2.31	4.14	6.62	8.07	8.27	8.47	8.58	8.58	8.58
50	2.25	4.08	6.48	8.00	8.23	8.44	8.54	8.54	8.54
100	2.17	3.99	6.22	7.84	8.10	8.30	8.41	8.41	8.41
200	2.03	3.86	5.81	7.53	7.83	8.05	8.17	8.18	8.18
300	1.94	3.76	5.57	7.34	7.66	7.87	7.99	8.00	8.00
400	1.86	3.65	5.39	7.20	7.52	7.73	7.85	7.86	7.86
500	1.80	3.51	5.24	7.07	7.41	7.61	7.74	7.74	7.74
1,000	1.60	3.03	4.74	6.64	7.02	7.25	7.37	7.37	7.37
2,000	1.38	2.68	4.19	6.17	6.62	6.86	6.99	7.00	7.00
5,000	1.01	2.22	3.54	5.51	6.03	6.30	6.46	6.46	6.46
10,000	0.75	1.80	3.05	4.94	5.57	5.88	6.02	6.04	6.04
20,000	0.55	1.39	2.46	4.24	4.98	5.32	5.49	5.51	5.51
50,000	0.30	0.81	1.54	2.81	3.55	3.85	4.08	4.09	4.09
84,744	0.19	0.53	1.03	1.92	2.48	2.71	2.90	2.92	2.92





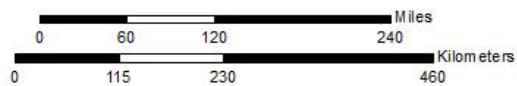




**Total Storm (48-hr) Precipitation (inches)**  
**September 17 (0100 UTC) - 19 (0000 UTC), 2004**  
**SPAS-NEXRAD 1275**

#### Gauges

- ◆ Daily
- Hourly
- Hourly Pseudo
- ◆ Supplemental



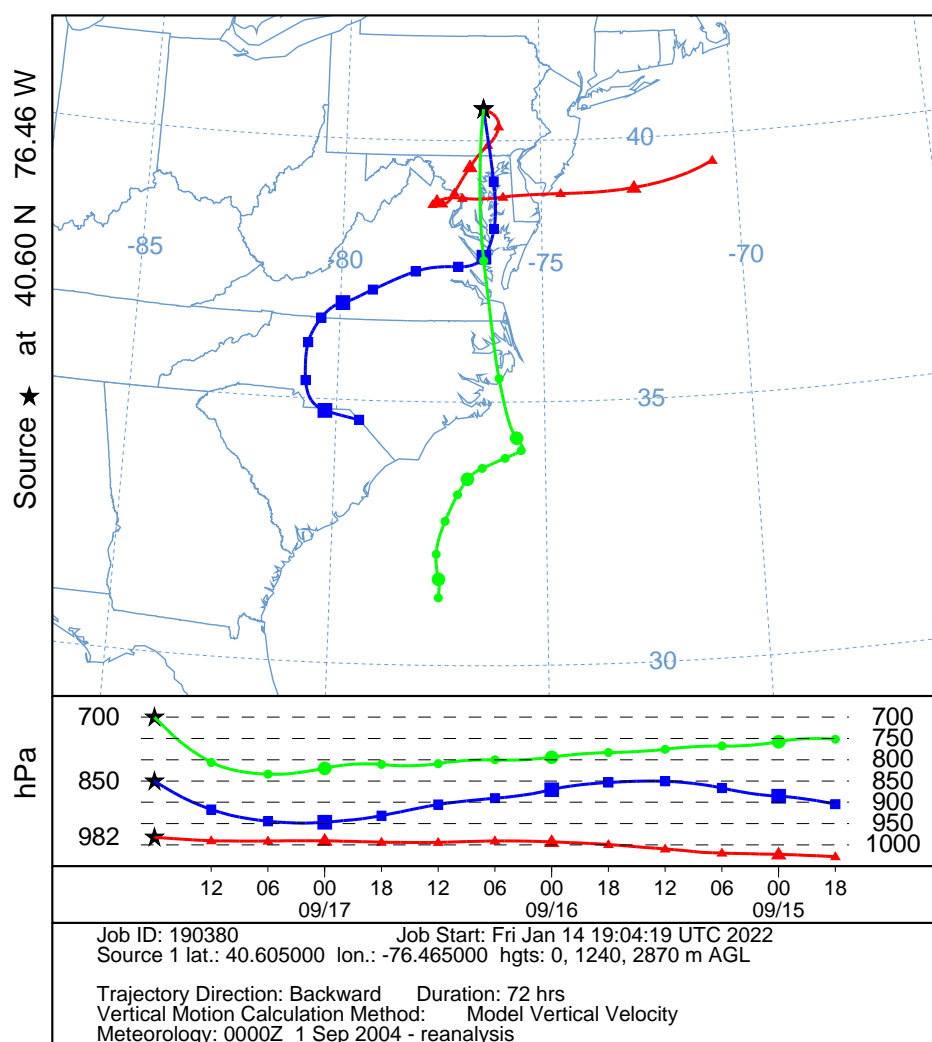
#### Precipitation (inches)

- |             |             |             |             |             |
|-------------|-------------|-------------|-------------|-------------|
| 0.00 - 1.00 | 2.01 - 3.00 | 4.01 - 5.00 | 6.01 - 7.00 | 8.01 - 9.00 |
| 1.01 - 2.00 | 3.01 - 4.00 | 5.01 - 6.00 | 7.01 - 8.00 |             |

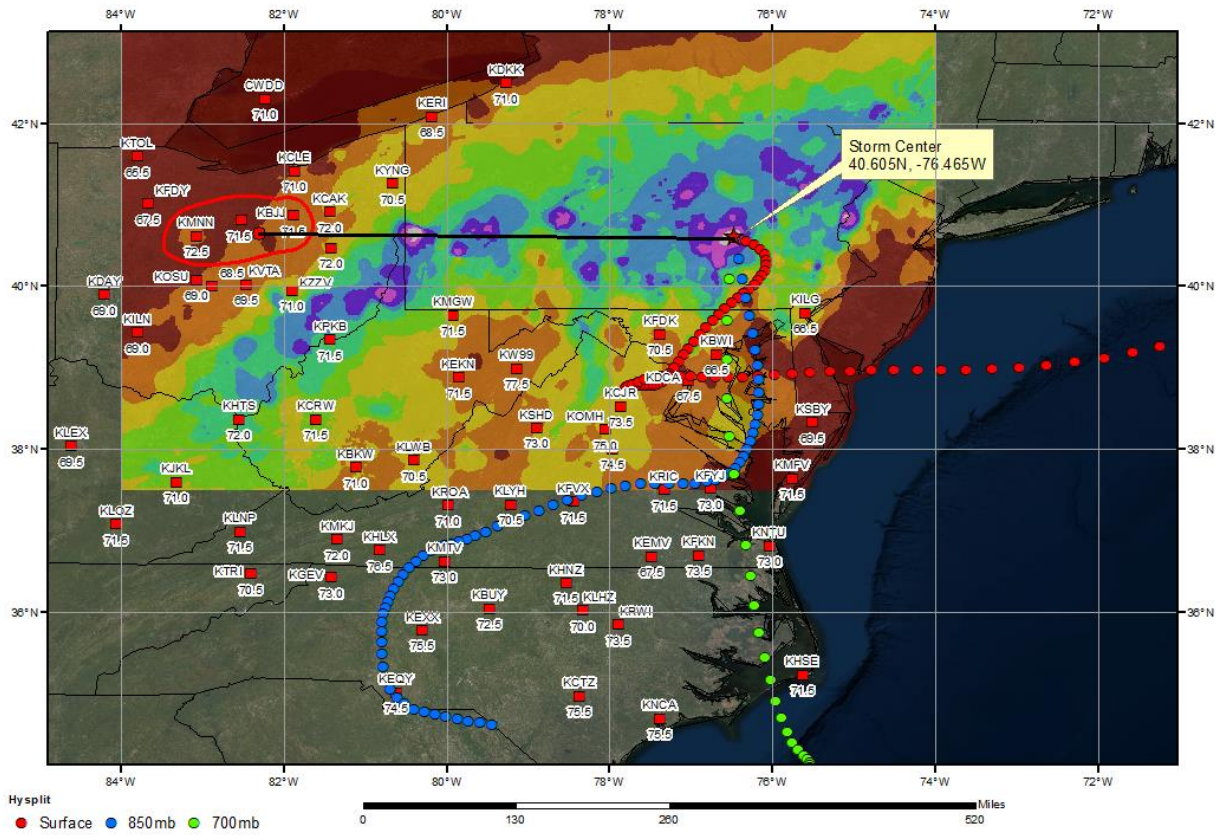


5/14/2013

NOAA HYSPLIT MODEL  
Backward trajectories ending at 1800 UTC 17 Sep 04  
CDC1 Meteorological Data



**SPAS 1275\_2 Storm Analysis**  
September 14-17, 2004



## Storm Precipitation Analysis System (SPAS) For Storm #1340\_1

### SPAS Analysis

**General Storm Location:** Big Meadows, VA (USACE SA 1-28a)

**Storm Dates:** October 12-17, 1942

**Event:** This storm had characteristics of both a general storm and was enhanced by remnant tropical moisture from a system well offshore.

#### DAD Zone 1

**Latitude:** 38.5458

**Longitude:** -78.4042

**Max. Grid Rainfall Amount:** 19.77"

**Max. Observed Rainfall Amount:** 18.92"

**Number of Stations:** 587 (423 Daily, 2 Hourly, 3 Hourly Pseudo, and 159 Supplemental)

**SPAS Version:** 9.5

**Basemap:** PRISM October 1942 Precipitation

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

**Radar Included:** No

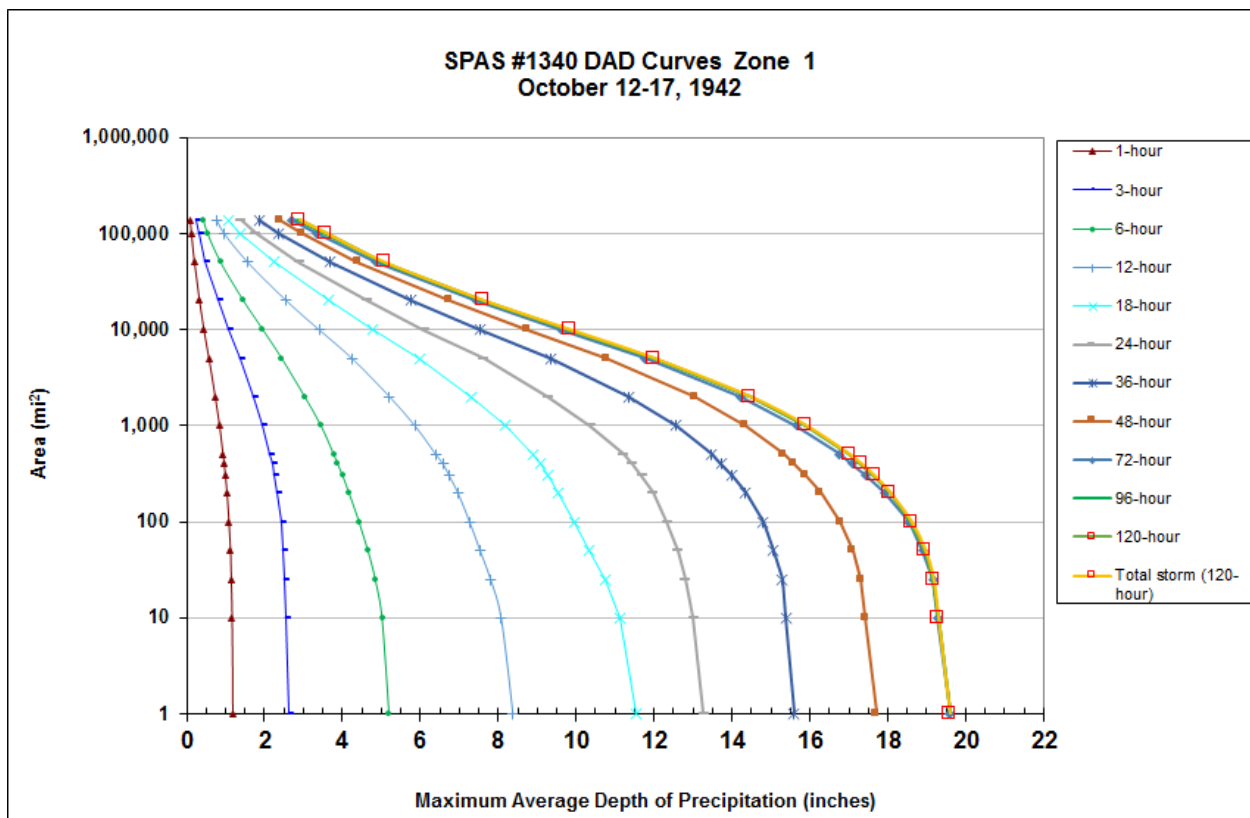
**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of results:** This analysis was based on digitized hourly data from the USACE SA 1-28a mass curves, daily data, and supplemental station data. The lack of hourly data and having to digitize the USACE mass curves resulted in SPAS mass curves which are smoothed and are likely not representative of the true hourly accumulation. We have a good degree of confidence in the station based storm total results, the spatial pattern is dependent on the basemap, and the timing is based on hourly stations.

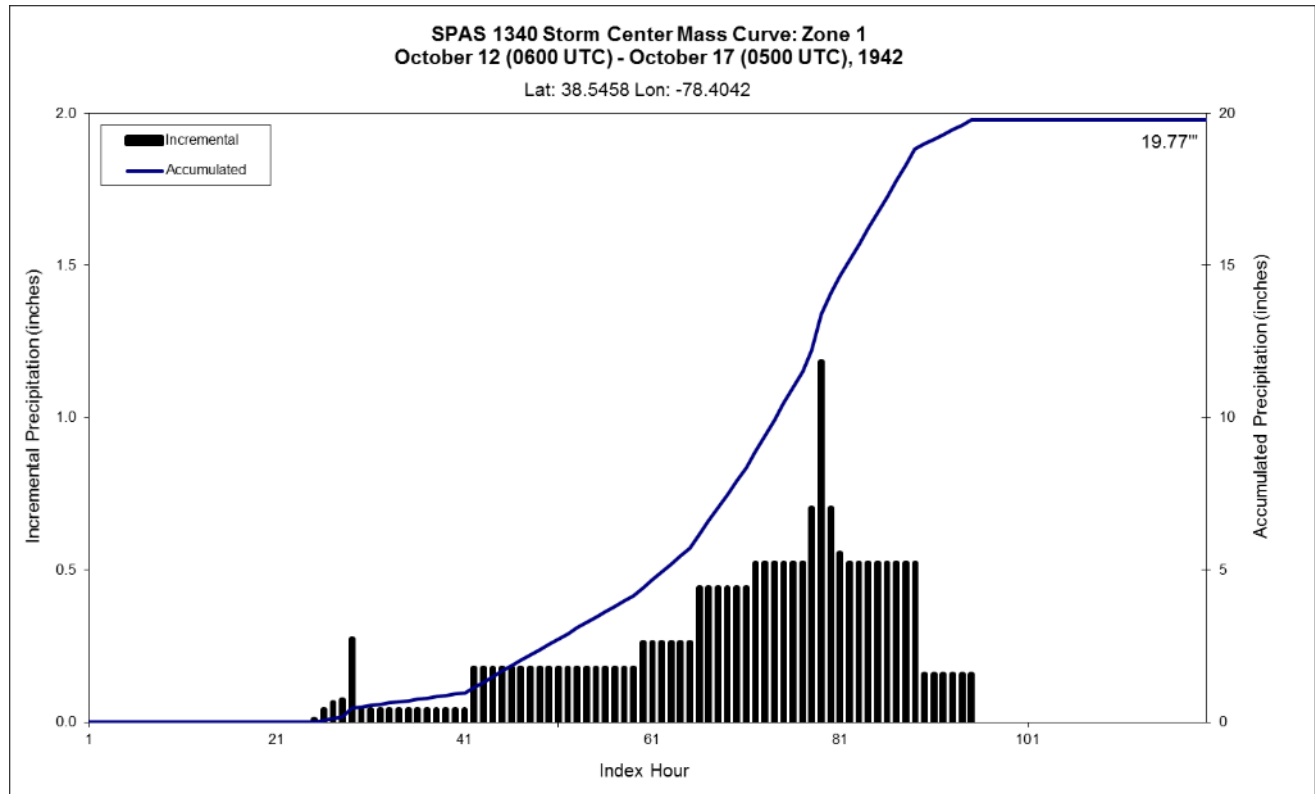
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1340_1_GEN	-78.4042	38.5458	3,299	3,300	1-Oct	78.00	3.29	0.84	78	2.450	81.50	81.5	3.86	0.95	85	2.910	1.188

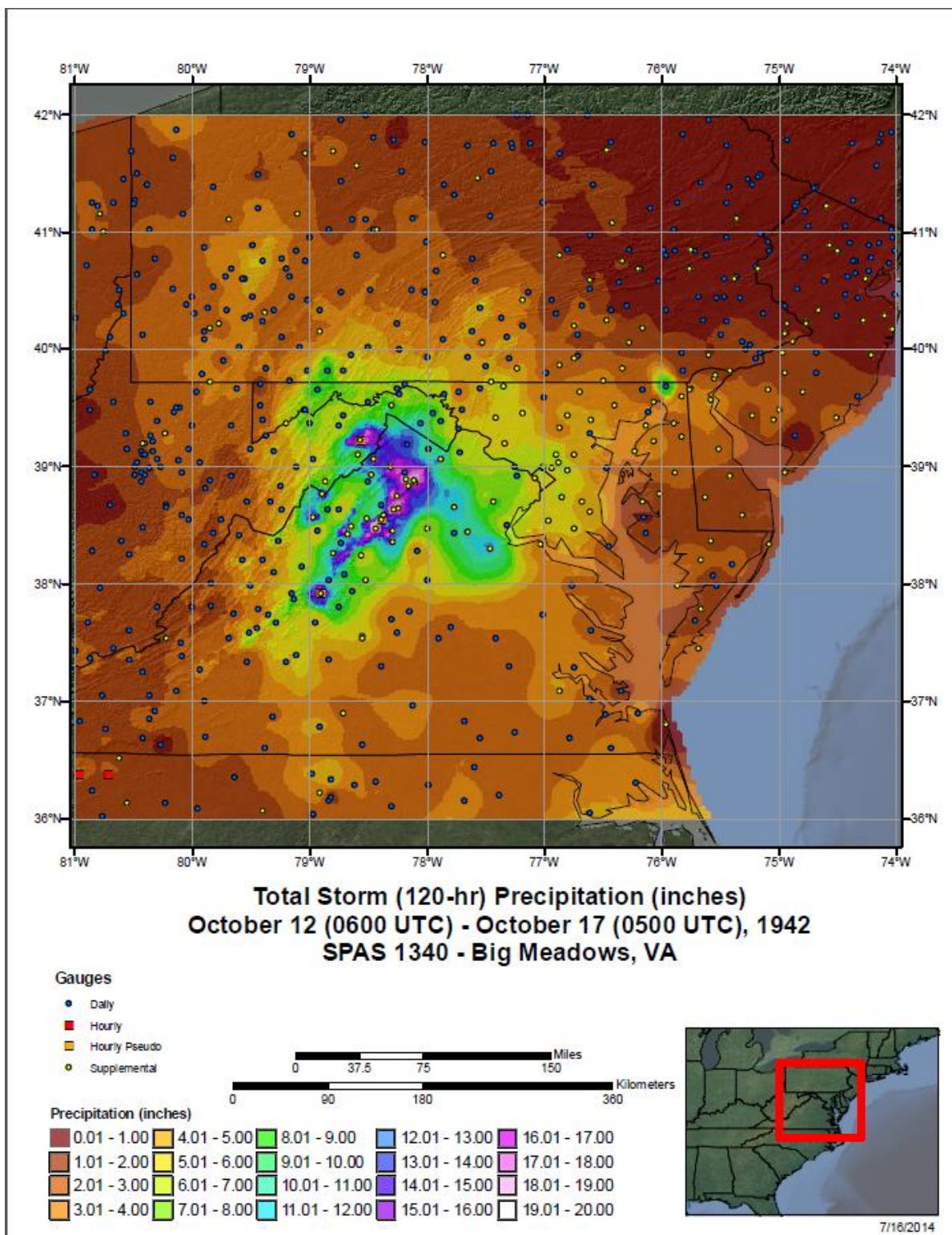


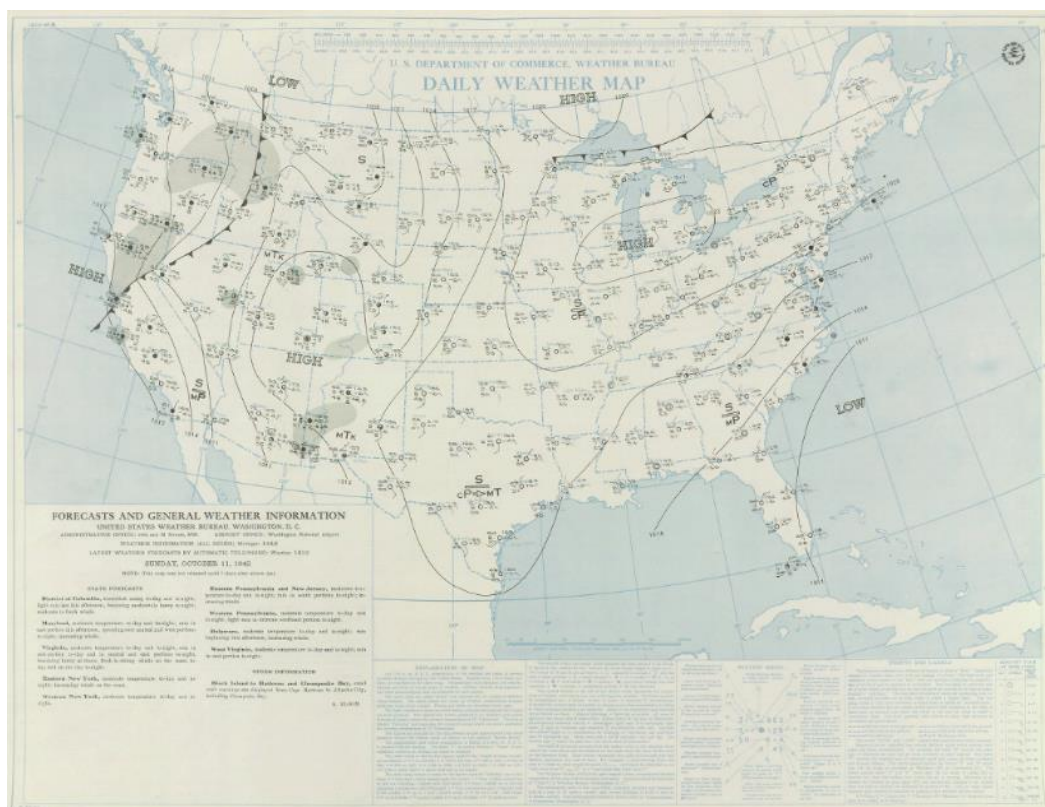
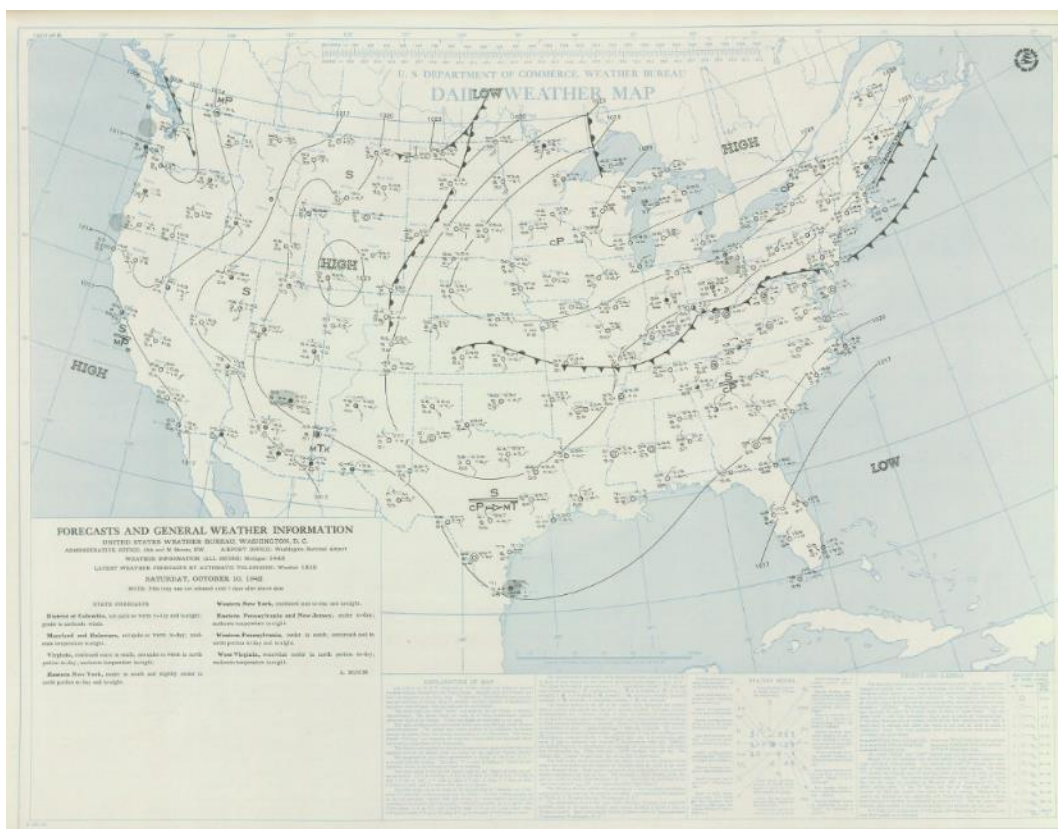
Storm 1340 - October 12 (0600 UTC) - October 17 (0500 UTC), 1942												
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)												
Area (mi <sup>2</sup> )	Duration (hours)											
	1	3	6	12	18	24	36	48	72	96	120	Total
0.4	1.18	2.63	5.25	8.44	11.63	13.37	15.70	17.82	19.71	19.71	19.71	19.71
1	1.18	2.62	5.21	8.37	11.54	13.27	15.60	17.71	19.59	19.59	19.59	19.59
10	1.16	2.56	5.03	8.07	11.12	13.01	15.38	17.43	19.28	19.29	19.29	19.29
25	1.14	2.52	4.86	7.80	10.73	12.79	15.29	17.32	19.16	19.17	19.17	19.17
50	1.12	2.49	4.67	7.53	10.35	12.60	15.07	17.10	18.89	18.96	18.96	18.96
100	1.08	2.42	4.44	7.26	9.97	12.33	14.80	16.79	18.54	18.60	18.60	18.60
200	1.03	2.32	4.18	6.96	9.54	11.96	14.35	16.27	17.92	18.05	18.05	18.05
300	0.99	2.25	4.02	6.74	9.26	11.68	14.01	15.89	17.44	17.65	17.65	17.65
400	0.96	2.20	3.89	6.58	9.07	11.43	13.73	15.59	17.08	17.31	17.31	17.31
500	0.93	2.15	3.79	6.40	8.88	11.21	13.47	15.32	16.76	17.01	17.01	17.01
1,000	0.84	1.96	3.46	5.86	8.18	10.36	12.57	14.34	15.65	15.90	15.90	15.90
2,000	0.73	1.72	3.04	5.21	7.31	9.27	11.34	13.04	14.22	14.46	14.46	14.46
5,000	0.57	1.38	2.45	4.25	5.99	7.63	9.34	10.78	11.78	11.99	12.00	12.00
10,000	0.44	1.08	1.96	3.40	4.79	6.10	7.54	8.75	9.62	9.81	9.83	9.83
20,000	0.33	0.80	1.46	2.56	3.63	4.63	5.77	6.76	7.44	7.60	7.62	7.62
50,000	0.20	0.47	0.87	1.57	2.24	2.88	3.69	4.39	4.87	5.03	5.08	5.08
100,000	0.12	0.31	0.53	0.96	1.38	1.77	2.35	2.95	3.34	3.50	3.58	3.58
138,434	0.09	0.23	0.42	0.76	1.09	1.39	1.86	2.38	2.7	2.82	2.89	2.89



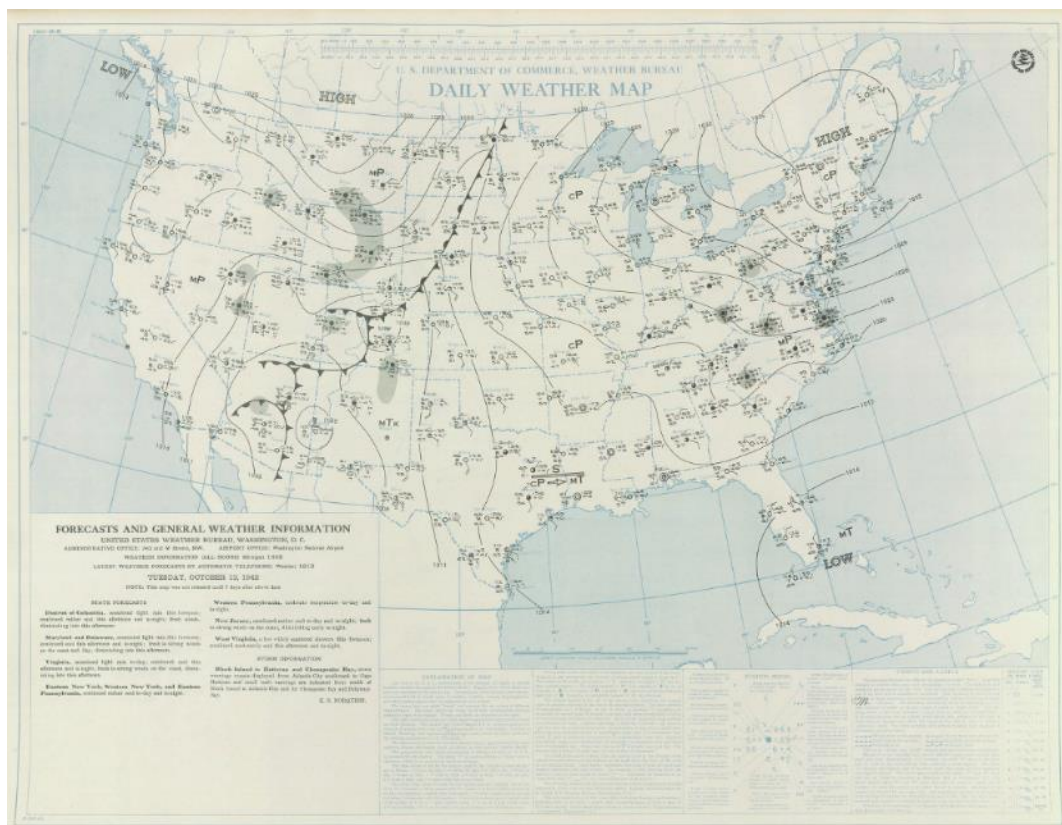
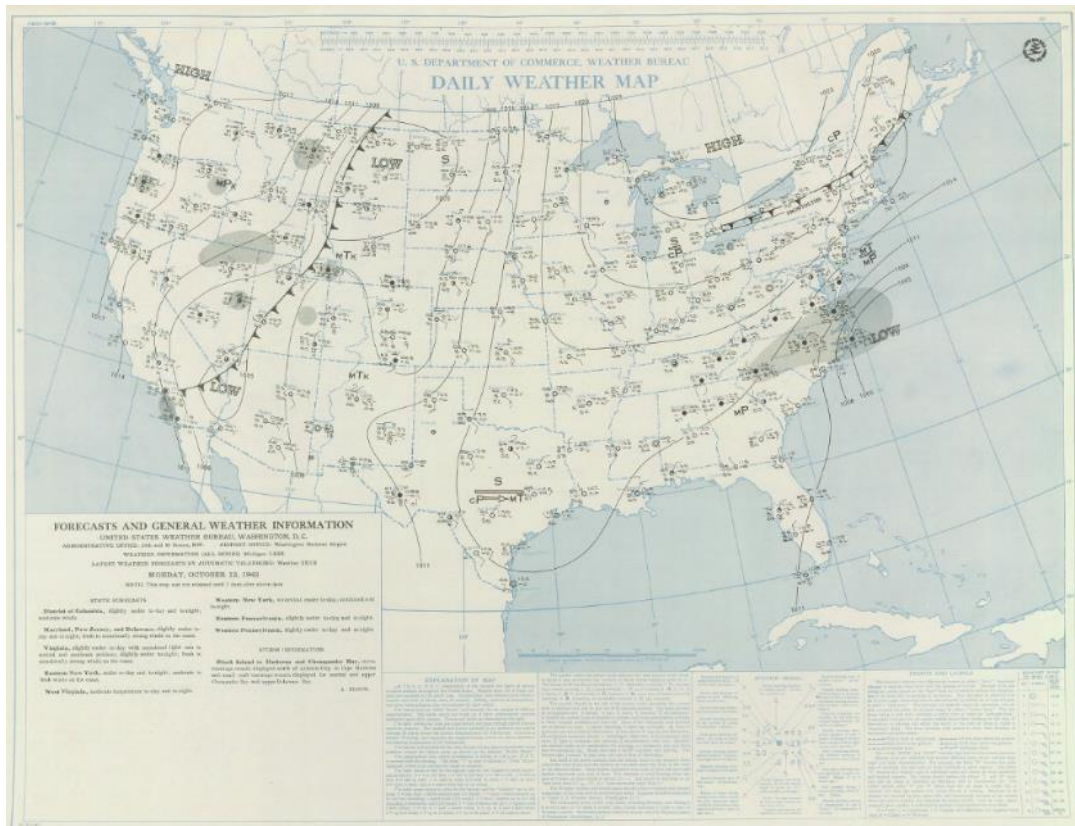




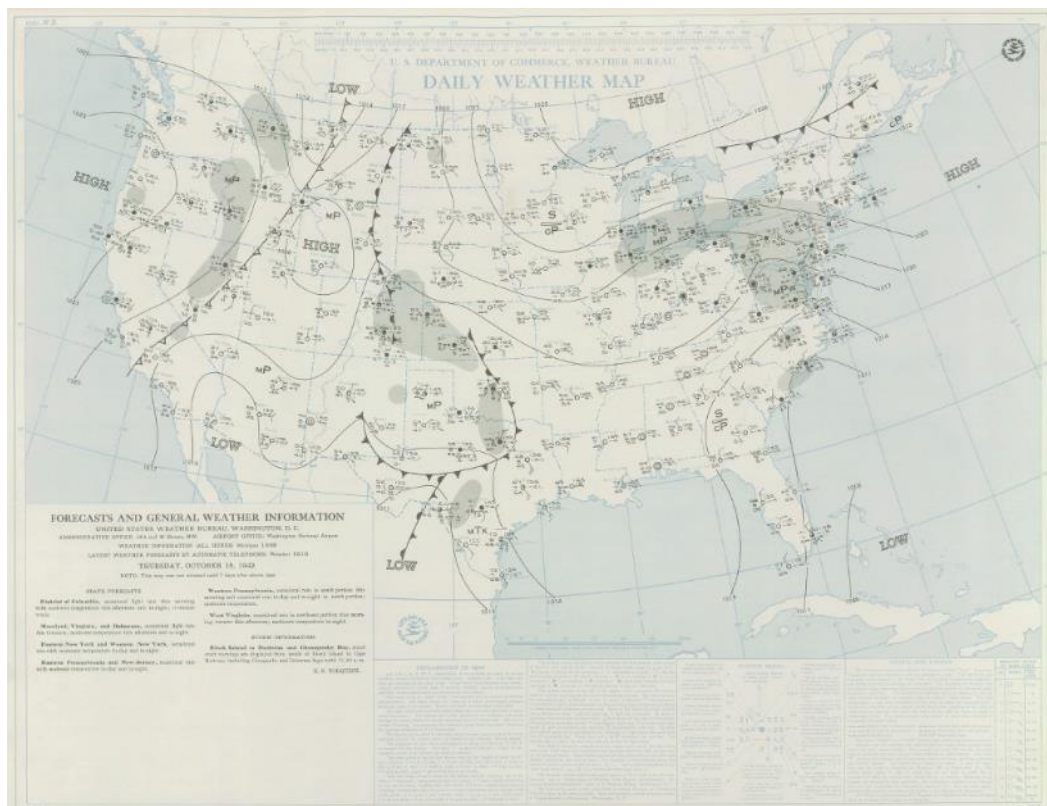
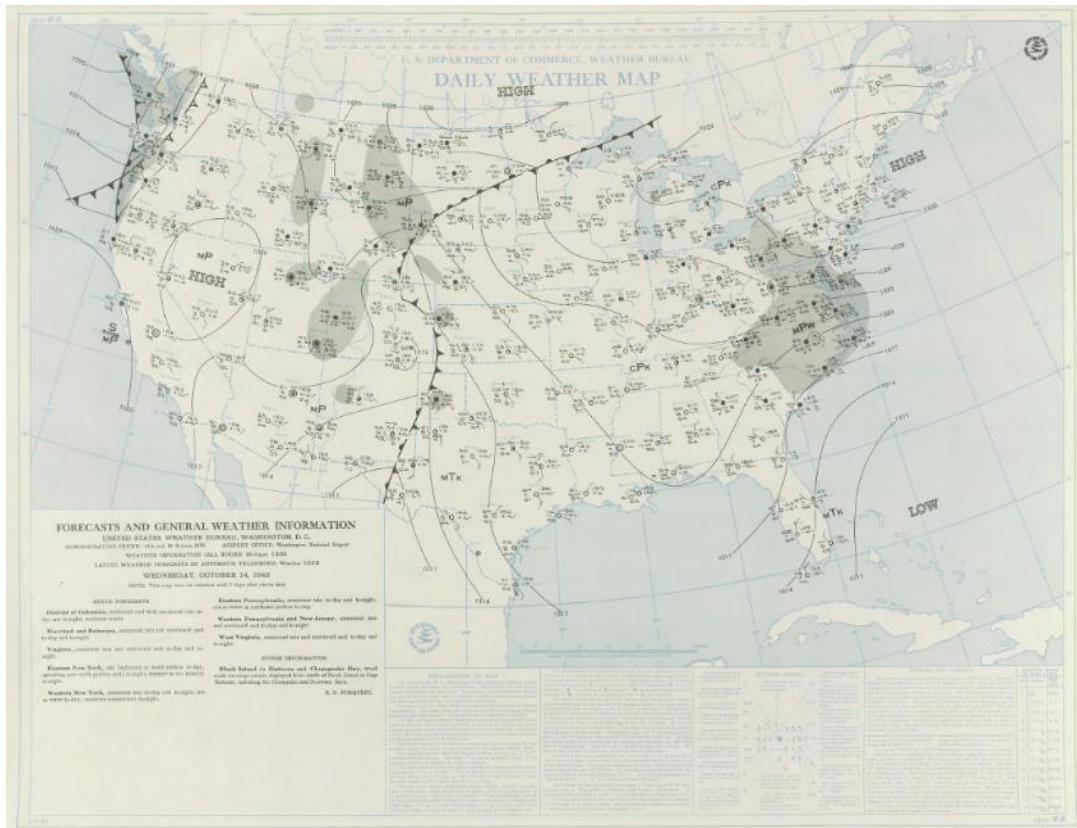


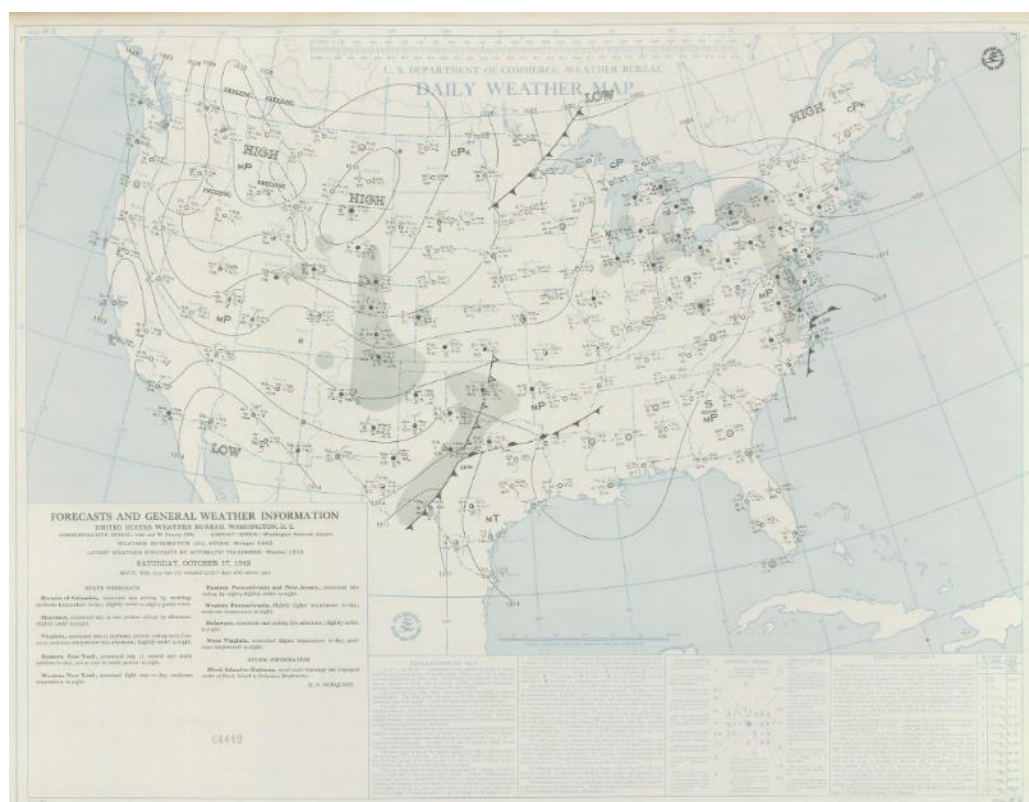
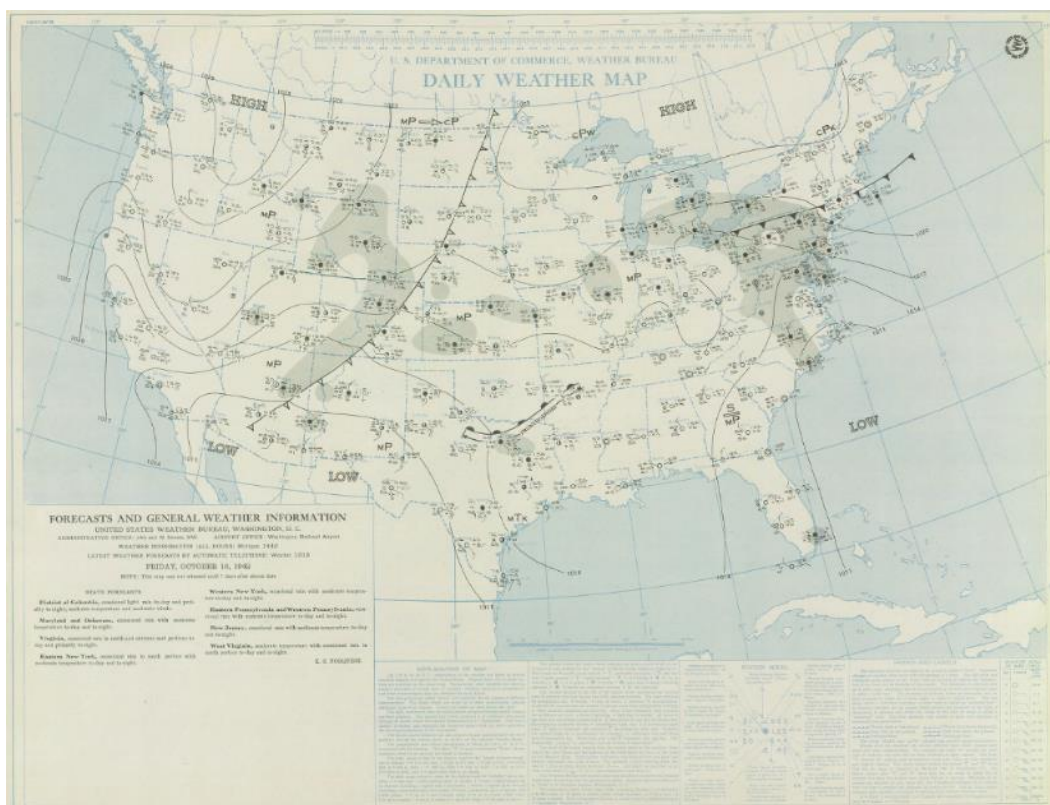


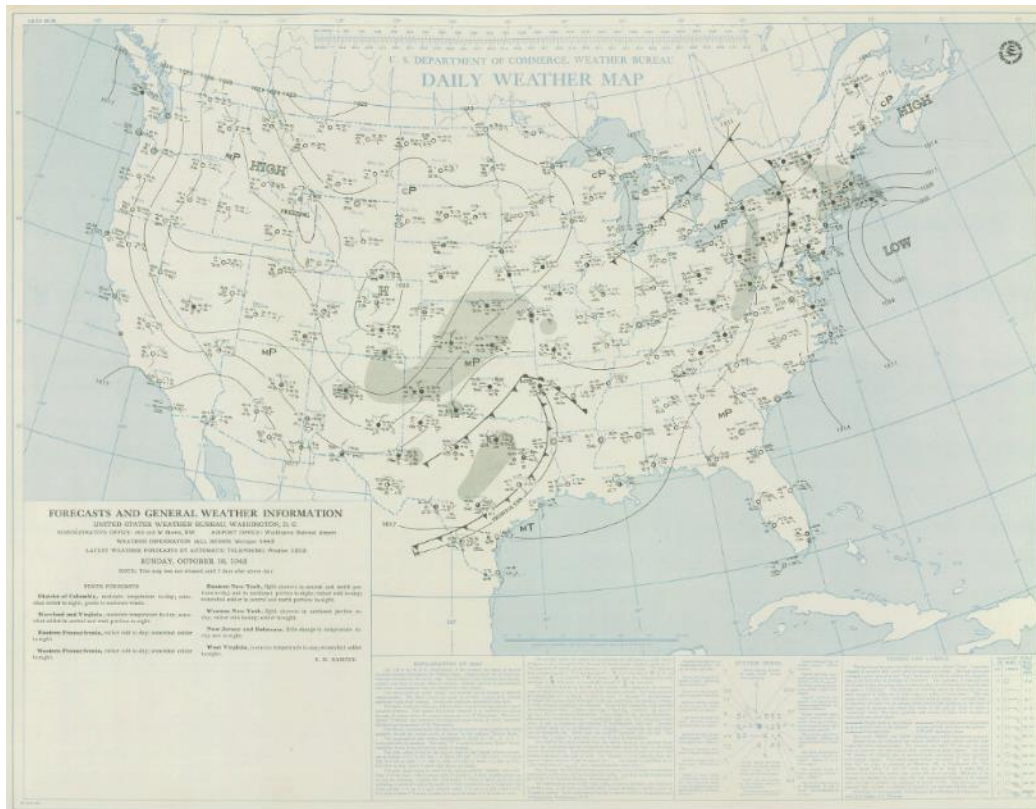






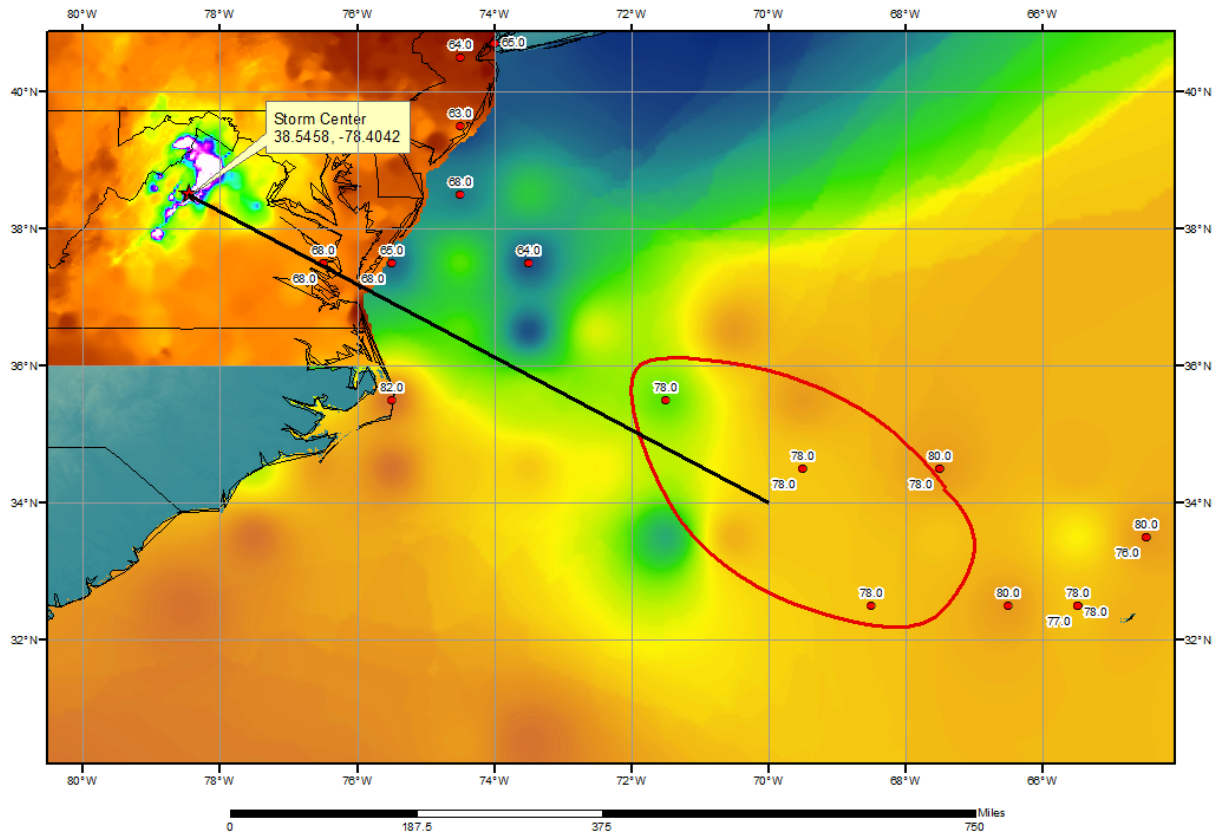








# SPAS 1340 Big Meadows, VA Storm Analysis October 13, 1942





## Local Storms

## Storm Precipitation Analysis System (SPAS) For Storm #1547\_1

### SPAS Analysis

**General Storm Location:** Catskill, NY

**Storm Dates:** July 26, 1819

**Event:** Convective Thunderstorm

**DAD Zone 1**

**Latitude:** 42.1842

**Longitude:** -73.8688

**Max. Grid Rainfall Amount:** 18.23"

**Max. Observed Rainfall Amount:** 18.00"

**Number of Stations:** 1 (0 Daily, 1 Hourly, 0 Hourly Pseudo, and 0 Supplemental)

**SPAS Version:** 10.0

**Basemap:** HMR 1 isohyetal pattern (HMR 1 Figure 25)

**Spatial resolution:** 0:00:15 second (~ 0.15 mi<sup>2</sup>)

**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of results:**

This analysis was based on one hourly estimated station from HMR 1 and timing based on HMR 1 and the American Journal of Science and Arts vol. IV 1822. However, there is no explicit hourly data through the 24-hour period. Therefore, the hourly accumulation beyond the 1-hour duration and the total storm duration are artificially created and likely unrealistic. We have a good degree of confidence in the storm total results, the spatial pattern is dependent on the basemap (HMR 1 Isohyetal), the timing is based on data hourly HMR 1 and the American Journal of Science and Arts vol. IV 1822 description. We only have a high degree of confidence in the 1-, 3-, and 8-hr point values, the remaining durations are estimates based on the storm event description in the American Journal of Science and Arts.

							Storm Rep. Dew Point					Climatological Max. Dew Point					IPMF	
	SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
Storm Center Location	1547_1	-73.8688	42.1842	0	0	15-Jul	72.50	2.54	0.00	67	2.535	78.28	78.5	3.37	0.00	79	3.365	1.130

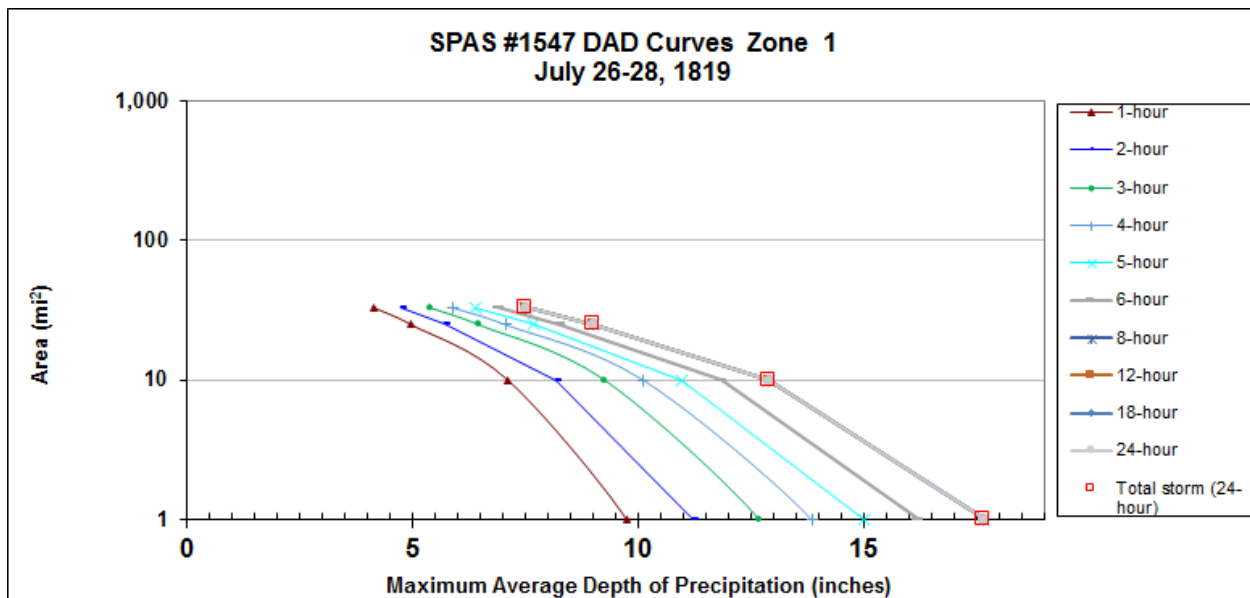
The IPMF for this storm was developed using data from other similar local storms as there was no information available to derive the actual value. We have used both 72.5 and 73 as the storm representative value in various studies, but only for comparison purposes to derive the IPMF of 1.13 from the original analysis, it does not have any actual data basis. The data in the table provided were used originally to try and derive an inflow vector and storm representative location. Discussions with various review communities and comparisons with other storms resulted in a capped IPMF of 1.13. The values in the example table provide an average storm representative value of 72.5 and climatological maximum of 78.5. However, the hard cap of 1.13 is applied based on it being such a unique/extreme event where applying a lower IPMF made sense (similar to other very extreme short duration events like Tyro, VA;

Simpson, KY; Smethport, PA; Rapidan, VA and trying to be sure the resulting 1-hour depths did not significantly exceed world record levels.

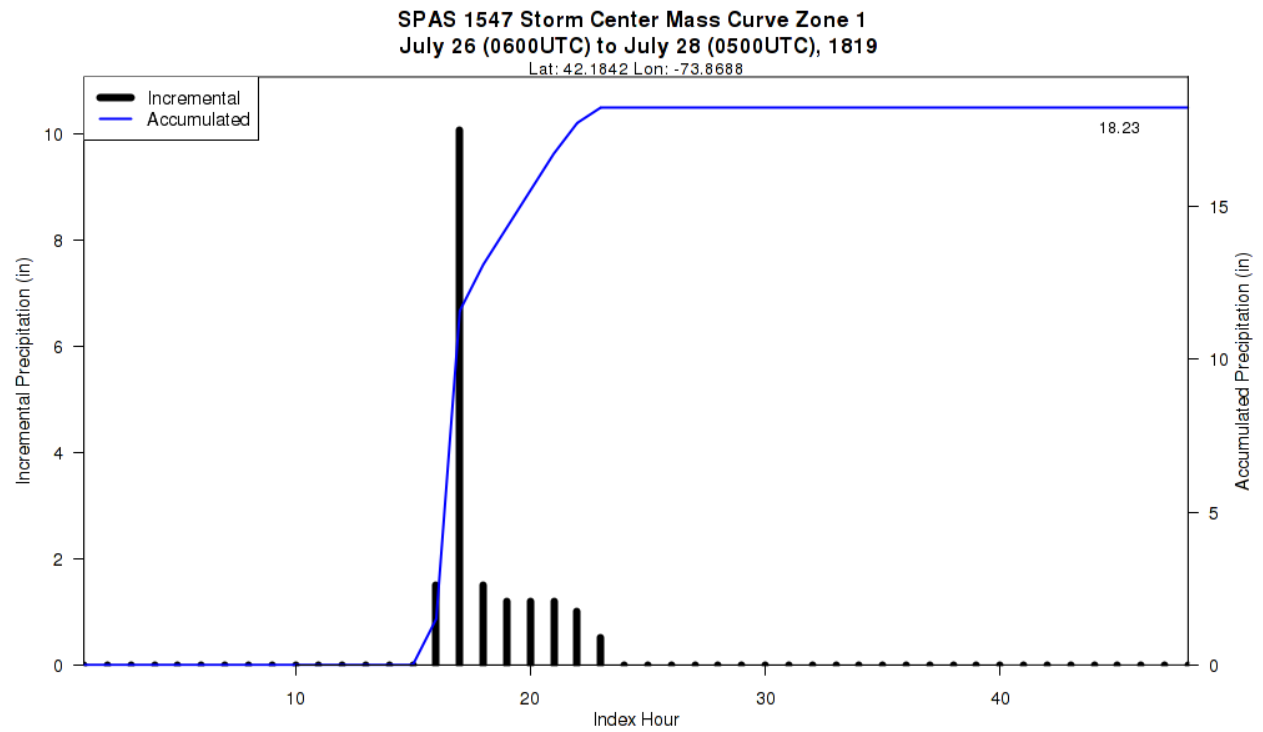
Therefore, the IPMF is set to 1.13 (as was done in adjacent studies). This was discussed on detail during the development of the Pennsylvania statewide PMP study (see Section 7.3). The table below provides the storms investigated.

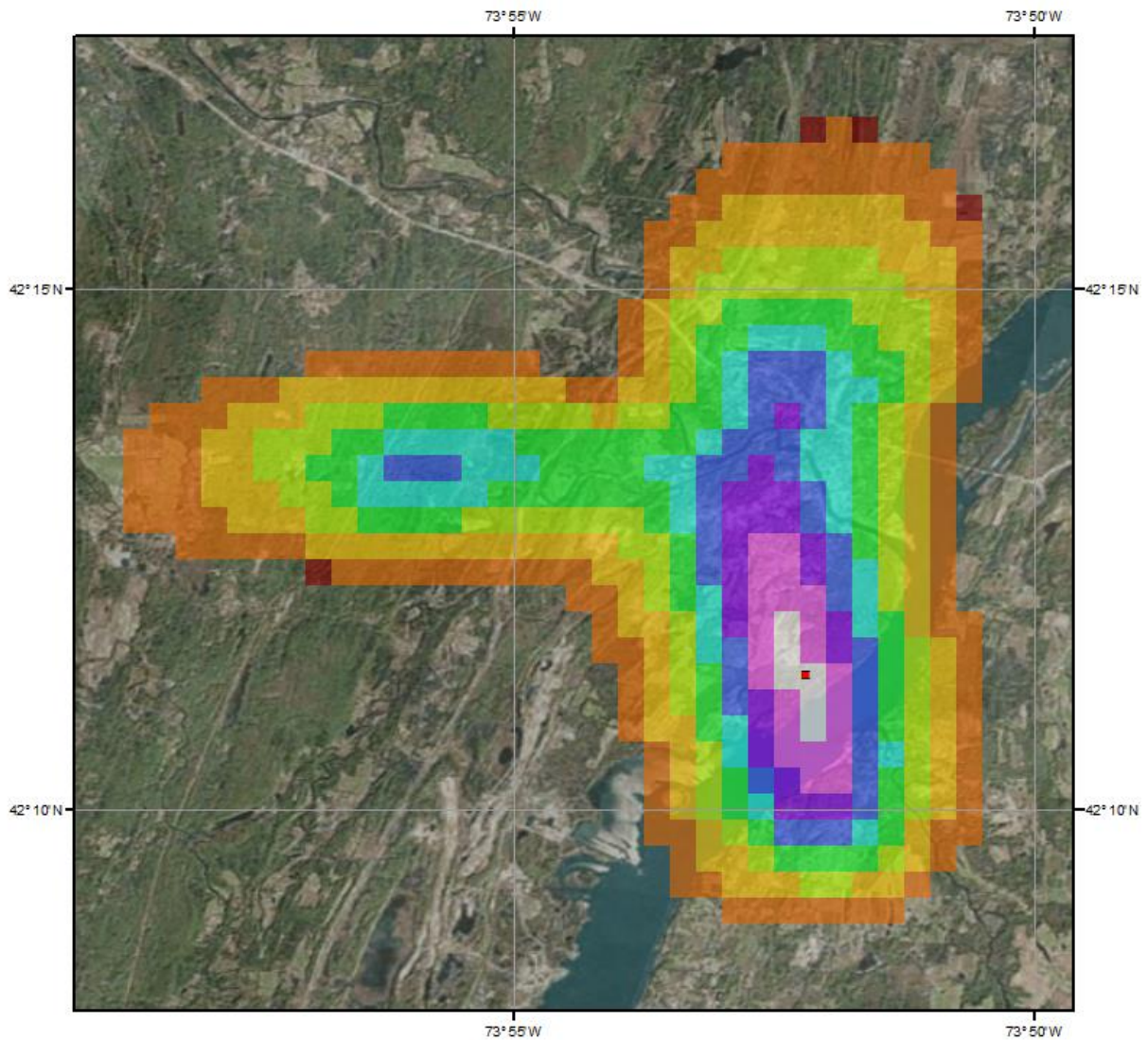
SPAS ID	Storm Location	Inflow Direction	Compass Direction	Inflow Distance	Td or SST	Temporal Trans Date	Storm Rep	IPMF
SPAS 1017	Sparta	ENE	67.5	65	Td	15-Aug	68	1.47
SPAS 1040	Tabernacle	SSW	202.5	110	Td	30-Jul	74	1.26
SPAS 1550	Johnstown	SW	225	85	Td	15-Jul	75	1.17
SPAS 1049	Delaware County	S	180	40	Td	1-Jul	71	1.28
SPAS 1546	Little River	E	90	120	Td	30-Jun	70.5	1.36

Storm 1547 - July 26 (0600 UTC) - July28 (0500 UTC), 1819											
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)											
Area (mi <sup>2</sup> )	Duration (hours)										
	1	2	3	4	5	6	8	12	18	24	Total
0.4	9.95	11.44	12.91	14.11	15.30	16.49	17.98	17.98	17.98	17.98	17.98
1	9.75	11.21	12.68	13.85	15.02	16.19	17.66	17.66	17.66	17.66	17.66
10	7.12	8.19	9.26	10.12	10.97	11.83	12.90	12.90	12.90	12.90	12.90
25	4.98	5.73	6.47	7.07	7.67	8.27	9.01	9.01	9.01	9.01	9.01
33	4.15	4.77	5.40	5.90	6.39	6.89	7.51	7.51	7.51	7.51	7.51





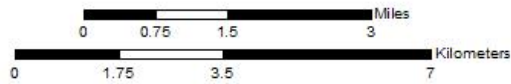




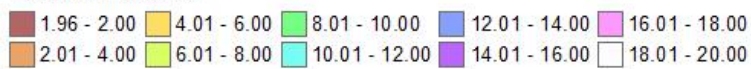
**Total Storm (48-hr) Precipitation (inches)**  
**07/26/1819 0600 UTC - 07/28/1819 0500 UTC**  
**SPAS #1547**

**Gauges**

■ Hourly Estimated



**Precipitation (inches)**



6/25/2015

## Storm Precipitation Analysis System (SPAS) For Storm #1489\_1

### SPAS Analysis

**General Storm Location:** Jewell, MD

**Storm Dates:** July 25-30, 1897

**Event:** Local Convective

**DAD Zone 1**

**Latitude:** 38.729

**Longitude:** -76.571

**Max. Grid Rainfall Amount:** 15.88"

**Max. Observed Rainfall Amount:** 14.70"

**Number of Stations:** 312

**SPAS Version:** 10.0

**Base Map Used:** Conus\_prism\_ppt\_in\_1981\_2010\_07

**Spatial resolution:** 30 seconds

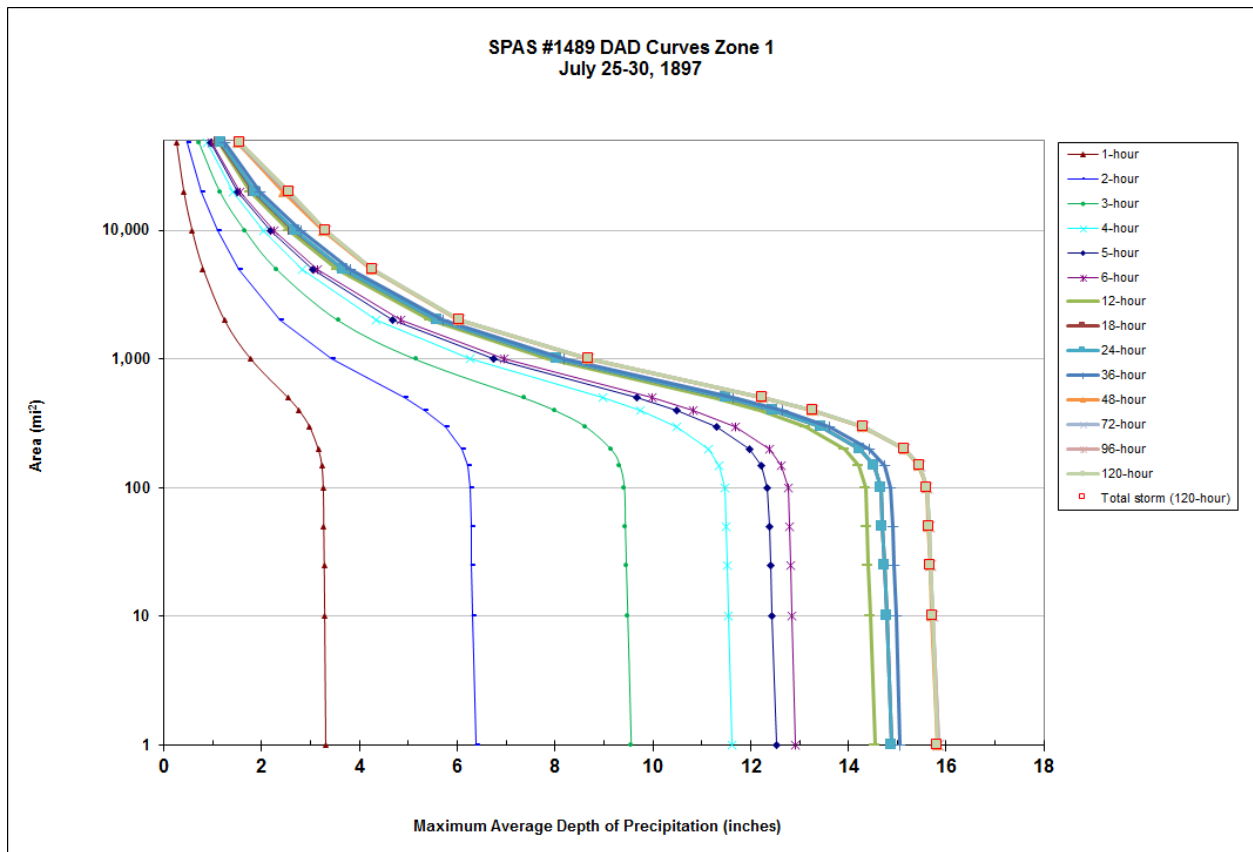
**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

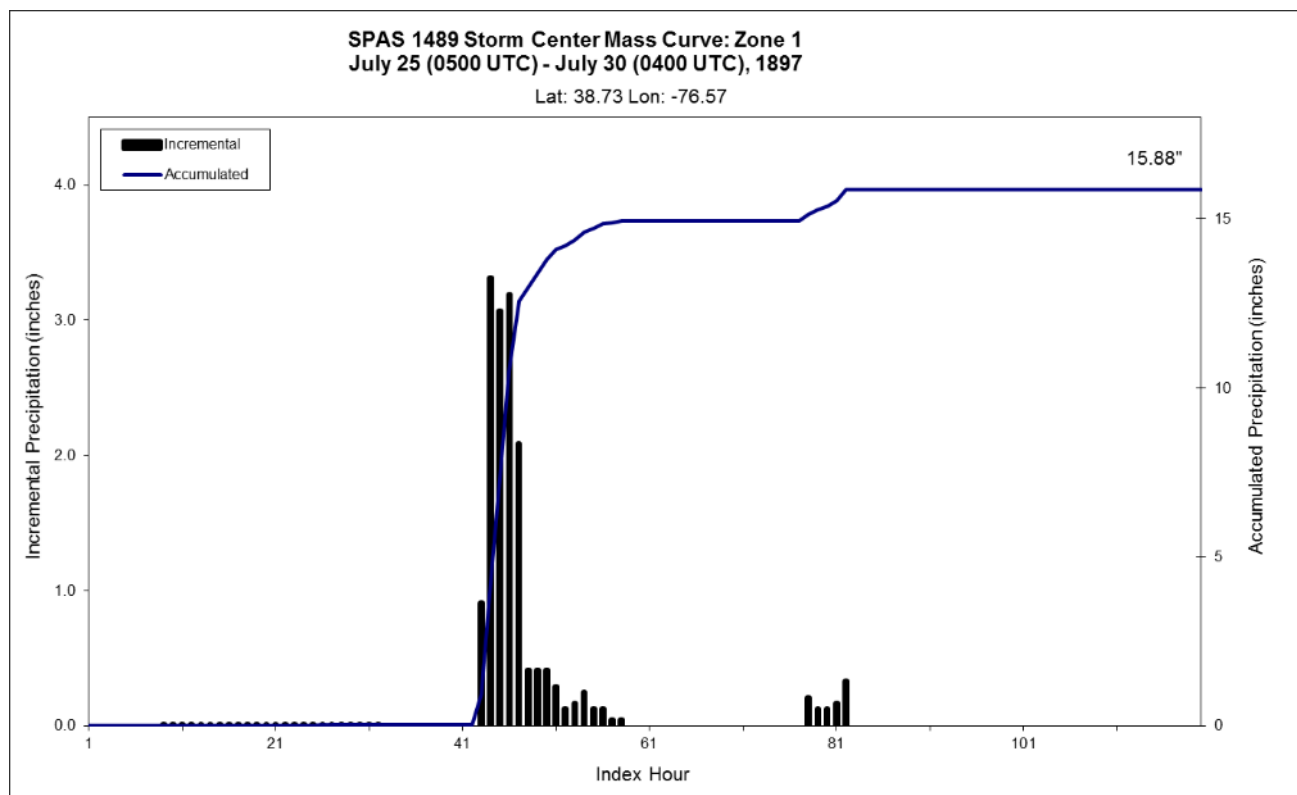
**Reliability of Results:** This storm is originally USACE NA 1-7a and 1-7b. This analysis was based on hourly pseudo data, daily data and supplemental station data. We have a good degree of confidence for the station based storm total results. The spatial pattern is dependent on the basemap and we have a high degree of confidence with the timing based on the location of the four hourly pseudo stations (see below). One hourly USACE mass curve captured the largest storm center at Jewell, MD allowing high confidence in the spatiotemporal isohyetal pattern of this critical location. Many daily stations lacked timing, so they had to be converted into supplemental stations. Due to the four hourly pseudo stations being consistent in timing, there isn't much issue with having to turn so many daily stations into supplemental stations.

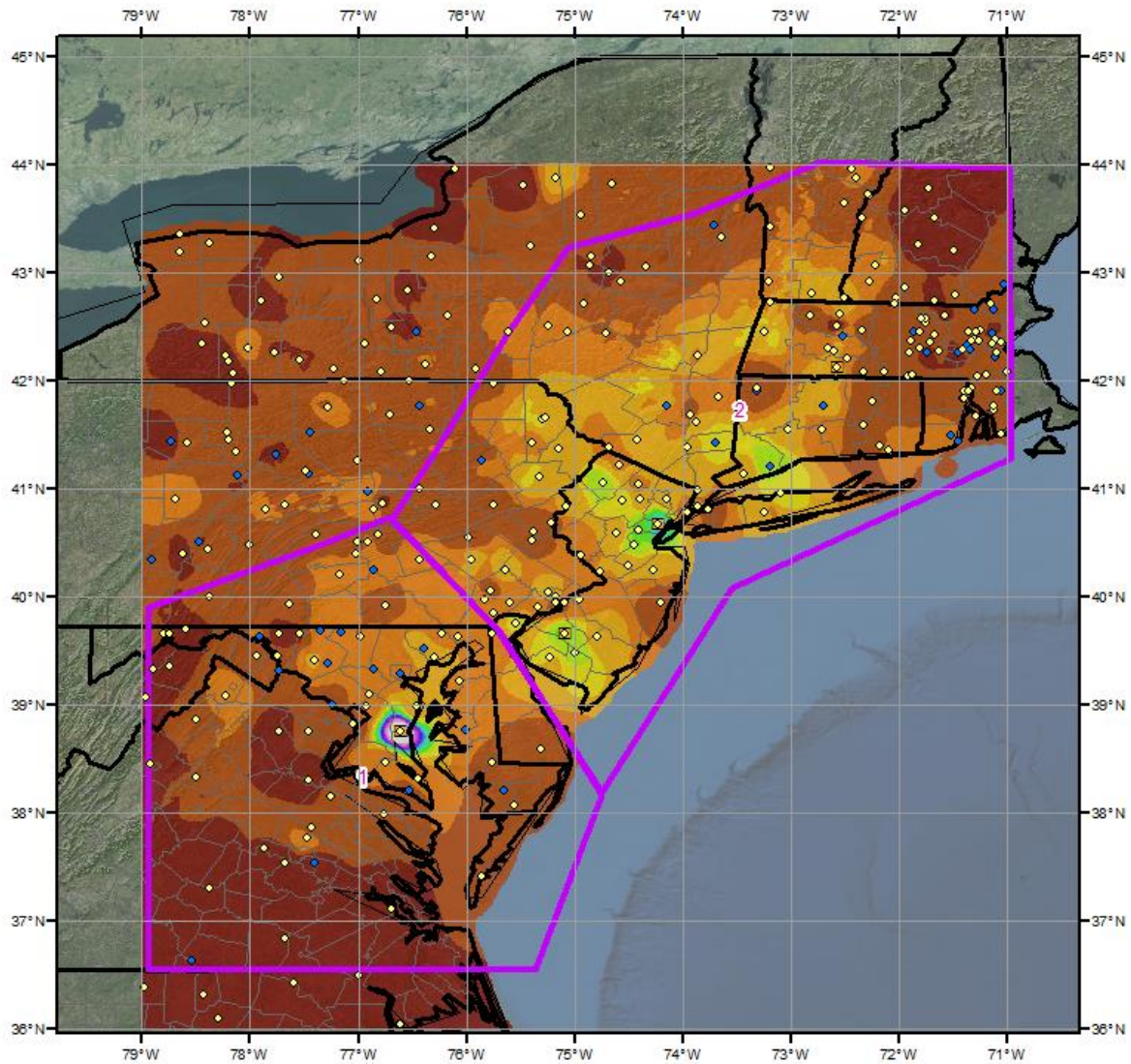
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1489_1	-76.5710	38.7290	163	200	10-Aug	71.50	2.42	0.05	65	2.365	79.00	79.0	3.44	0.06	80	3.380	1.429

Storm 1489 Zone 1 - Jul. 25 (0500 UTC) - Jul. 30 (0400 UTC), 1897															
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)															
areasqmi	Duration (hours)														
	1	2	3	4	5	6	12	18	24	36	48	72	96	120	Total
0.4	3.31	6.38	9.57	11.66	12.56	12.95	14.59	14.92	14.92	15.10	15.85	15.87	15.87	15.86	15.86
1	3.31	6.38	9.55	11.63	12.53	12.92	14.56	14.89	14.89	15.06	15.82	15.84	15.84	15.82	15.82
10	3.29	6.32	9.48	11.55	12.44	12.84	14.45	14.78	14.78	14.97	15.71	15.73	15.73	15.72	15.72
25	3.28	6.30	9.45	11.52	12.41	12.81	14.41	14.73	14.73	14.93	15.67	15.68	15.68	15.68	15.68
50	3.27	6.28	9.43	11.49	12.38	12.79	14.38	14.70	14.70	14.90	15.64	15.65	15.65	15.65	15.65
100	3.26	6.27	9.41	11.47	12.35	12.76	14.35	14.67	14.67	14.87	15.60	15.61	15.61	15.61	15.61
150	3.23	6.22	9.32	11.35	12.23	12.63	14.21	14.53	14.53	14.73	15.44	15.46	15.46	15.46	15.46
200	3.16	6.09	9.14	11.13	11.99	12.38	13.93	14.24	14.24	14.44	15.14	15.16	15.16	15.16	15.16
300	2.98	5.75	8.62	10.50	11.31	11.68	13.14	13.44	13.44	13.62	14.29	14.30	14.31	14.31	14.31
400	2.77	5.33	8.00	9.74	10.49	10.83	12.19	12.46	12.47	12.64	13.26	13.27	13.28	13.28	13.28
500	2.55	4.91	7.37	8.97	9.67	9.98	11.24	11.49	11.49	11.65	12.23	12.24	12.25	12.25	12.25
1,000	1.78	3.43	5.15	6.27	6.75	6.97	7.85	8.04	8.05	8.18	8.67	8.69	8.70	8.70	8.70
2,000	1.24	2.37	3.57	4.35	4.69	4.85	5.45	5.59	5.60	5.71	6.02	6.04	6.05	6.05	6.05
5,000	0.80	1.53	2.31	2.83	3.04	3.14	3.56	3.67	3.68	3.81	4.24	4.27	4.28	4.28	4.28
10,000	0.57	1.10	1.66	2.03	2.18	2.25	2.57	2.66	2.68	2.80	3.27	3.30	3.32	3.32	3.32
20,000	0.40	0.76	1.15	1.41	1.51	1.56	1.78	1.84	1.87	1.97	2.45	2.51	2.56	2.56	2.56
48,380	0.25	0.47	0.72	0.88	0.95	0.98	1.12	1.15	1.17	1.24	1.50	1.53	1.56	1.56	1.56









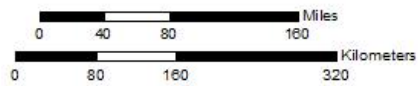
### Total Storm (120-hours) Precipitation (inches)

July 25 - 29, 1897

SPAS 1489 - Jewell, MD

#### Gauges

- ◆ Daily
- Hourly
- Hourly Pseudo
- ◇ Supplemental



#### Precipitation (inches)

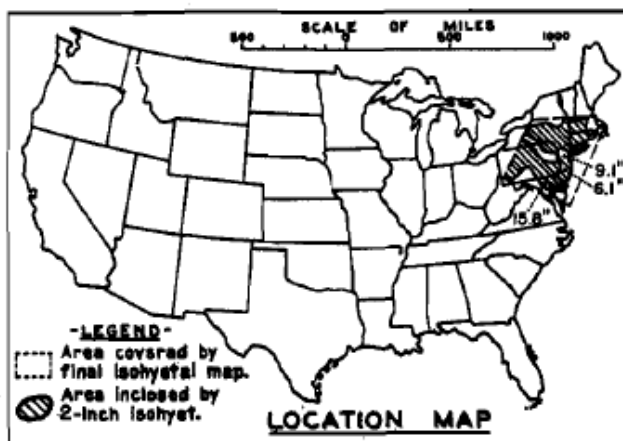
0.00 - 1.00	4.01 - 5.00	8.01 - 9.00	12.01 - 13.00
1.01 - 2.00	5.01 - 6.00	9.01 - 10.00	13.01 - 14.00
2.01 - 3.00	6.01 - 7.00	10.01 - 11.00	14.01 - 15.00
3.01 - 4.00	7.01 - 8.00	11.01 - 12.00	15.01 - 16.00



4/2/2015

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

**STORM STUDIES - PERTINENT DATA SHEET**

Storm of 26-29 July 1897

Assignment NA 1-7

Location Northeast U. S.

Study Prepared by:

North Atlantic Division

New York District Office

Part I Reviewed by H. M. Sec. of Weather Bureau, 3/1/40

Part II Approved by Office, Chief of Engineers for Distribution of Factual Data, 12/27/46

Remarks: TOTAL STORM

Centers at

Jewell, Md., Elizabeth and

Clayton, N. J.

**DATA AND COMPUTATIONS COMPILED****PART I**Preliminary isohyetal map, in 1 sheet, scale 1:2,500,000

Precipitation data and mass curves:

(Number of Sheets)

Form 5001-C (Hourly precip. data).....	13
Form 5001-B (24-hour " " " " ).....	74
Form 5001-D ( " " " " " " ).....	—
Misc. precip. records, meteorological data, etc.....	3
Form 5002 (Mass rainfall curves).....	42

**PART II**Final isohyetal maps, in 1 sheet, scale 1:1,000,000

Data and computation sheets:

Form S-10 (Data from mass rainfall curves).....	5
Form S-11 (Depth-area data from isohyetal map).....	2
Form S-12 (Maximum depth-duration data).....	5
Maximum duration-depth-area curves.....	3
Data relating to periods of maximum rainfall.....	2

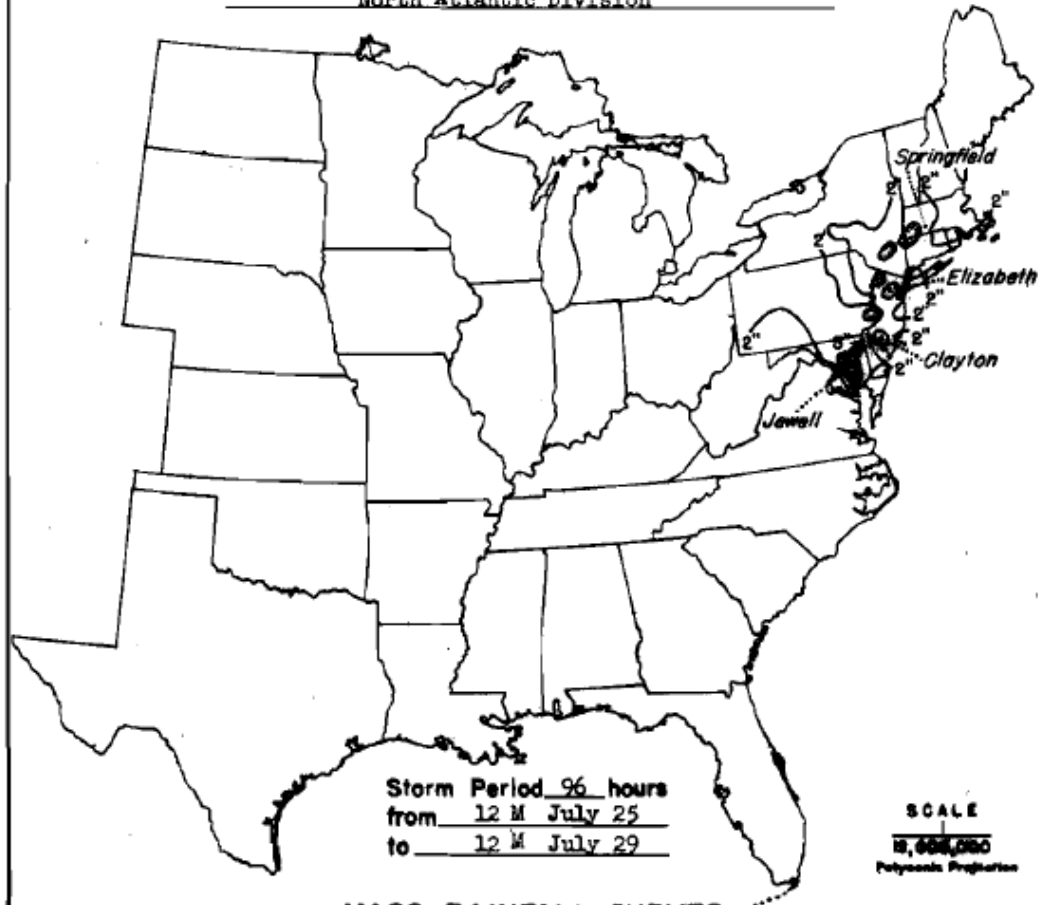
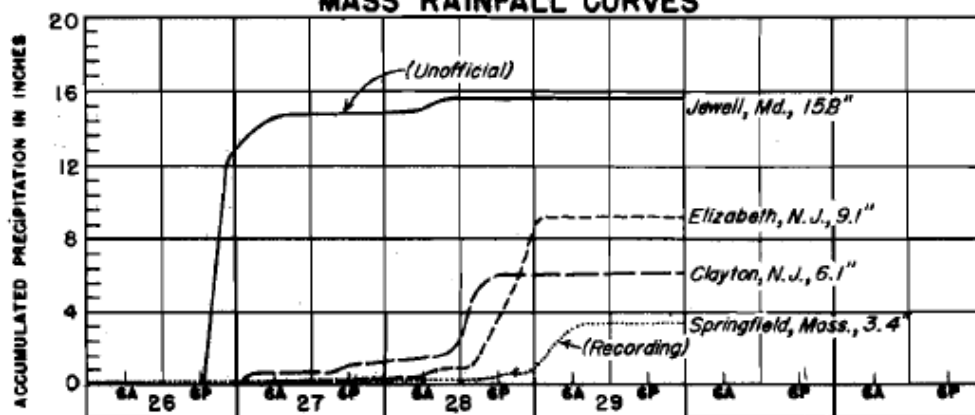
**MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES**

Area in Sq. Mi.	Duration of Rainfall in Hours									
	6	12	18	24	30	36	48	60	72	96
10	13.0	14.5	14.7	14.7	14.7	14.7	15.8	15.8	15.8	15.8
100	10.5	11.7	11.9	11.9	11.9	11.9	12.8	12.8	12.8	12.8
200	9.4	10.5	10.6	10.6	10.6	10.6	11.5	11.5	11.5	11.5
500	7.5	8.3	8.5	8.5	8.5	8.5	9.2	9.2	9.2	9.2
1,000	5.5	6.0	6.2	6.2	6.2	6.2	7.0	7.0	7.0	7.0
2,000	3.7	4.2	4.5	4.6	4.7	4.7	5.2	5.2	5.2	5.2
5,000	2.3	3.1	3.3	3.3	3.4	3.7	3.8	3.9	4.0	4.1
10,000	1.5	2.6	2.8	2.9	2.9	3.3	3.5	3.6	3.7	3.8
20,000	1.1	2.1	2.4	2.5	2.6	3.0	3.2	3.5	3.6	3.6
32,000	0.9	1.7	1.9	2.0	2.1	2.5	2.8	3.3	3.4	3.4

Form S-2

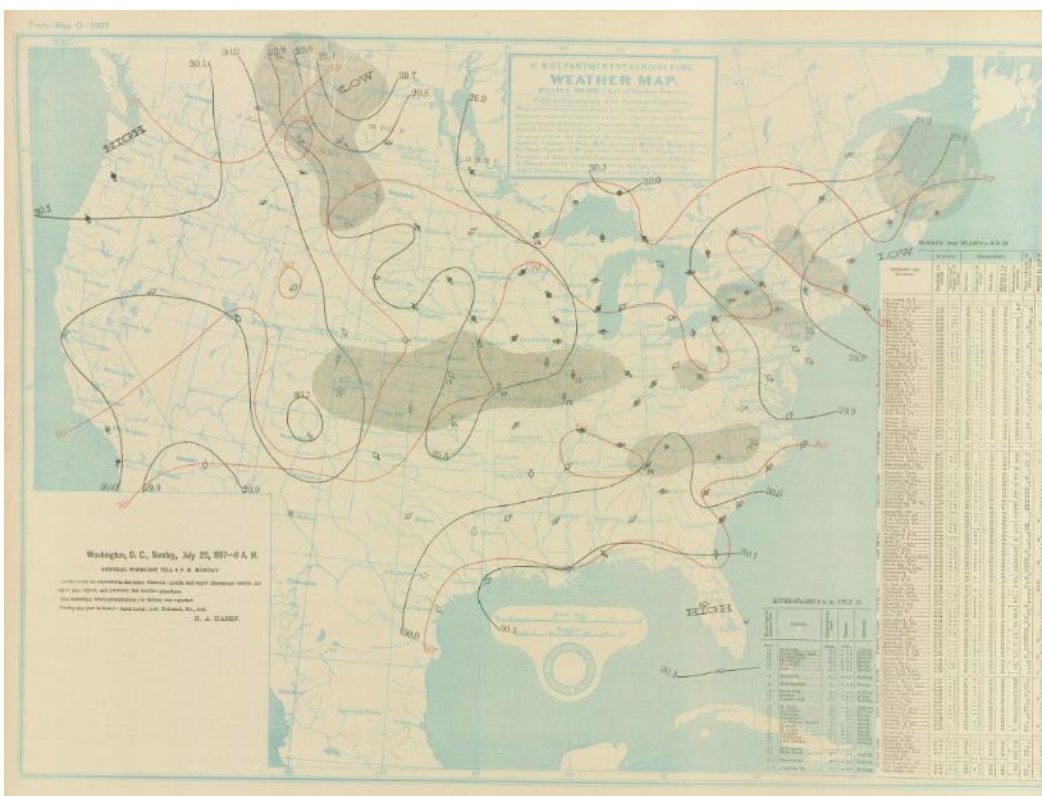
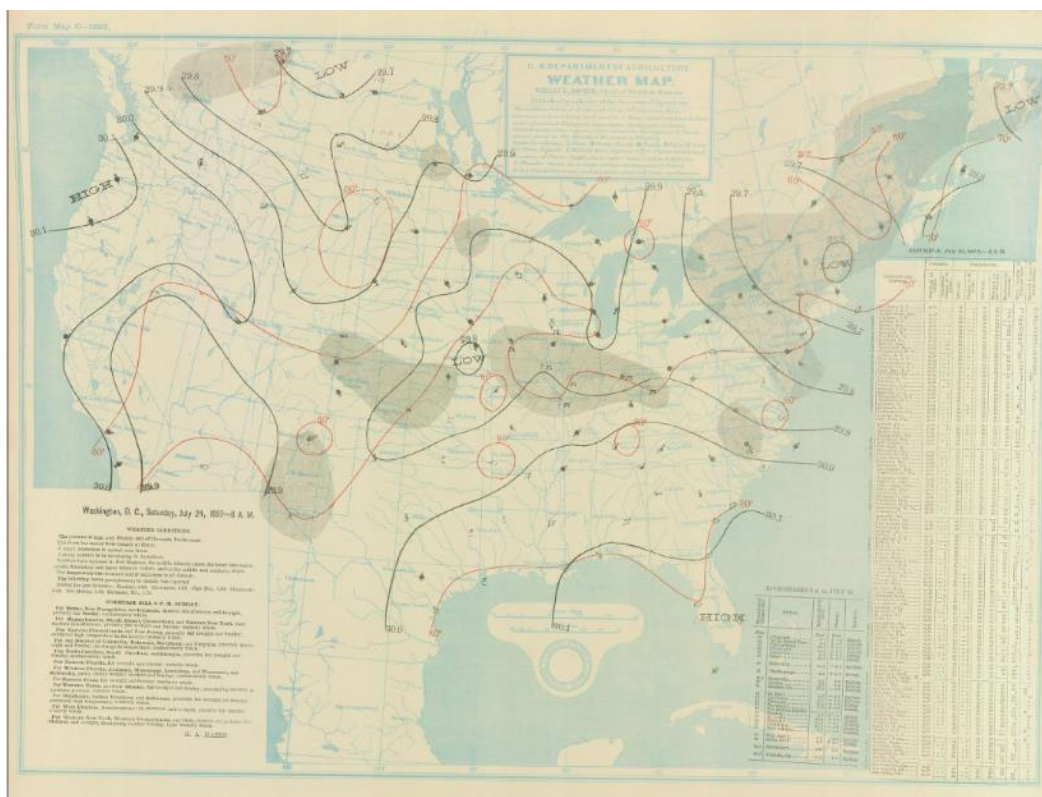
WAR DEPARTMENT

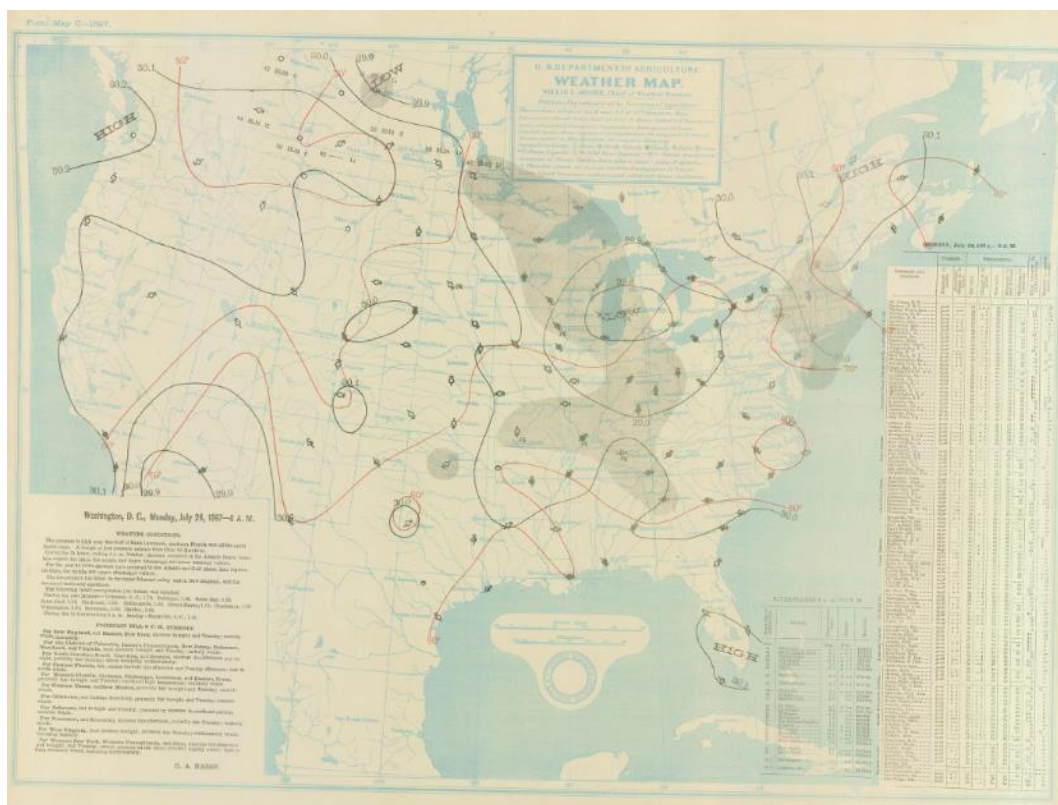
CORPS OF ENGINEERS, U. S. ARMY

**STORM STUDIES - ISOHYETAL MAP**Storm of July 26-29, 1897Assignment NA 1-7Study Prepared by: New York, N. Y. District  
North Atlantic Division**MASS RAINFALL CURVES**

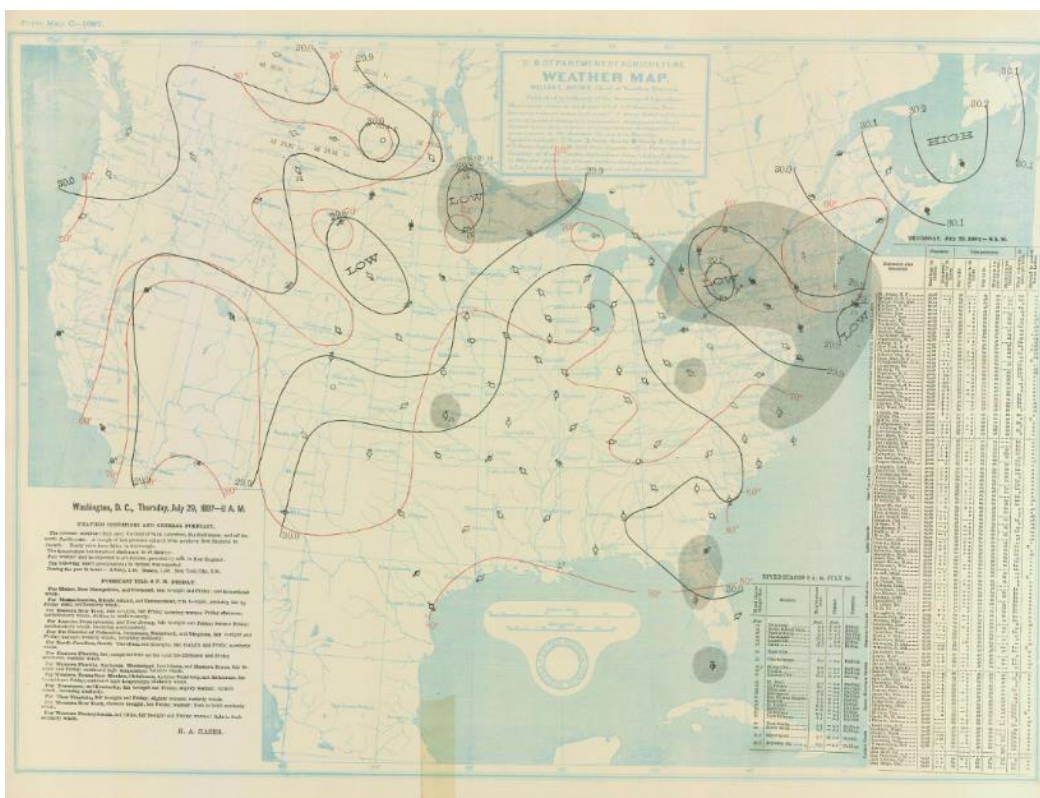
FORM 3-EE



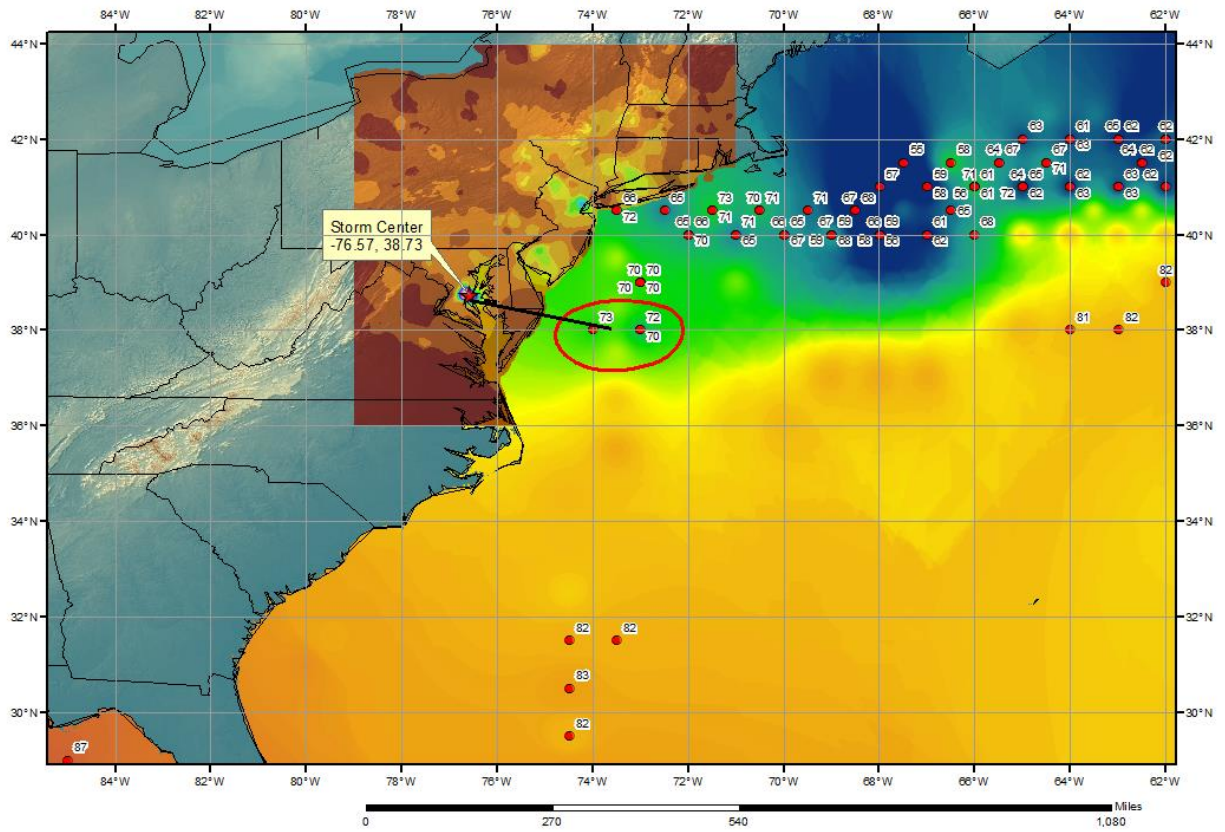






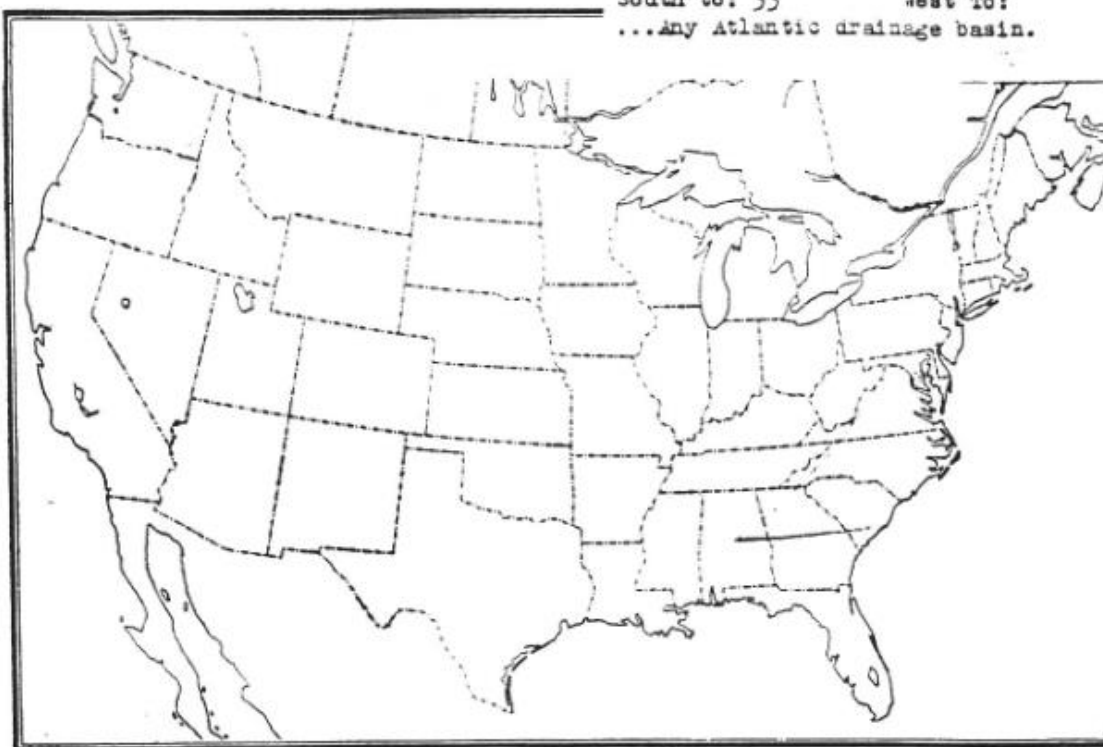


**SPAS 1489 Jewell, MD Storm Analysis Zone 1**  
July 24 - 28, 1897





SA 1-7...July 20-29, 1897...Jewell. ...  
 12-hr. rwd 70(27th)...70 ESE..to 78.  
 North to: border East to: ..  
 South to: 33 West To:  
 ...Any Atlantic drainage basin.



Controlling map, 2 1000' scale = 1" = 10 miles

## Storm Precipitation Analysis System (SPAS) For Storm #1534\_1 SPAS Analysis

**General Storm Location:** Ewan, NJ (USACE NA 2-4), re-run SPAS 1023

**Storm Dates:** August 31 - September 2, 1940

**Event:** Hurricane

**DAD Zone 1**

**Latitude:** 39.6875

**Longitude:** -75.1807

**Max. Grid Rainfall Amount:** 24.30"

**Max. Observed Rainfall Amount:** 24.00"

**Number of Stations:** 58 (2 Daily, 27 Hourly, 1 Hourly Pseudo, and 28 Supplemental)

**SPAS Version:** 10.0

**Basemap:** Blended PRISM September 1940 Ppt with SPAS Ppt

**Spatial resolution:** 0:00:30 second (~ 0.3 mi<sup>2</sup>)

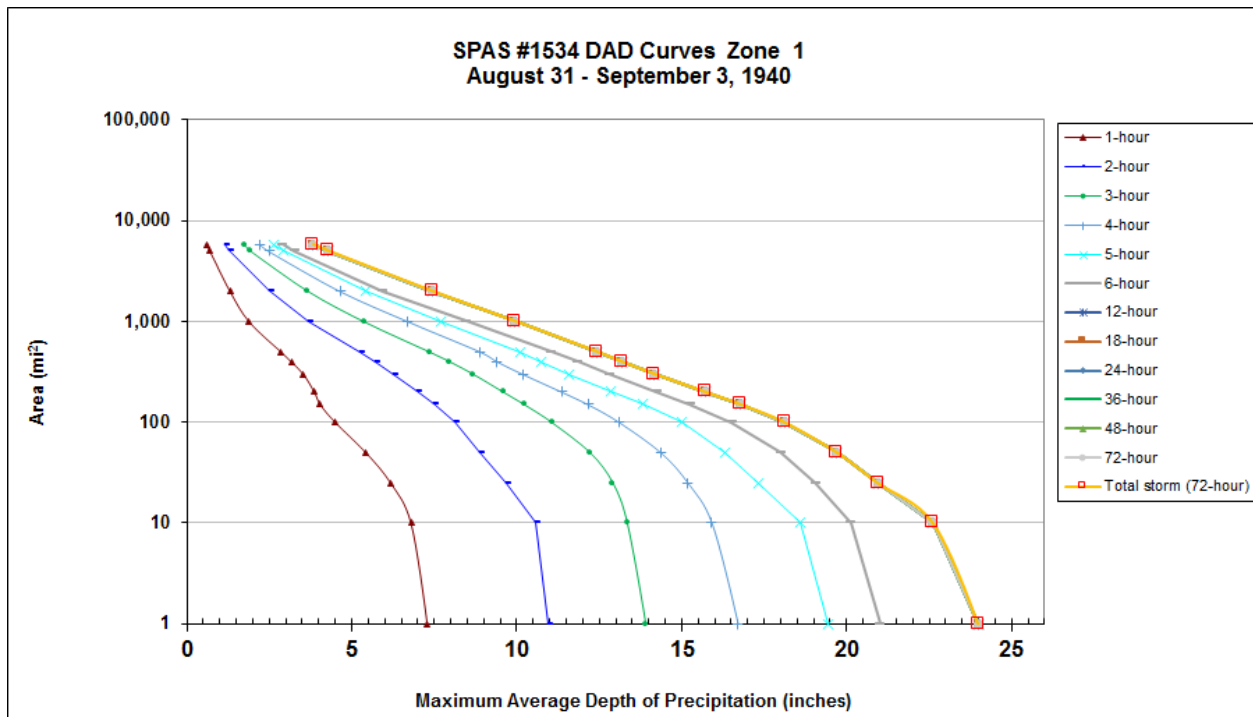
**Radar Included:** No

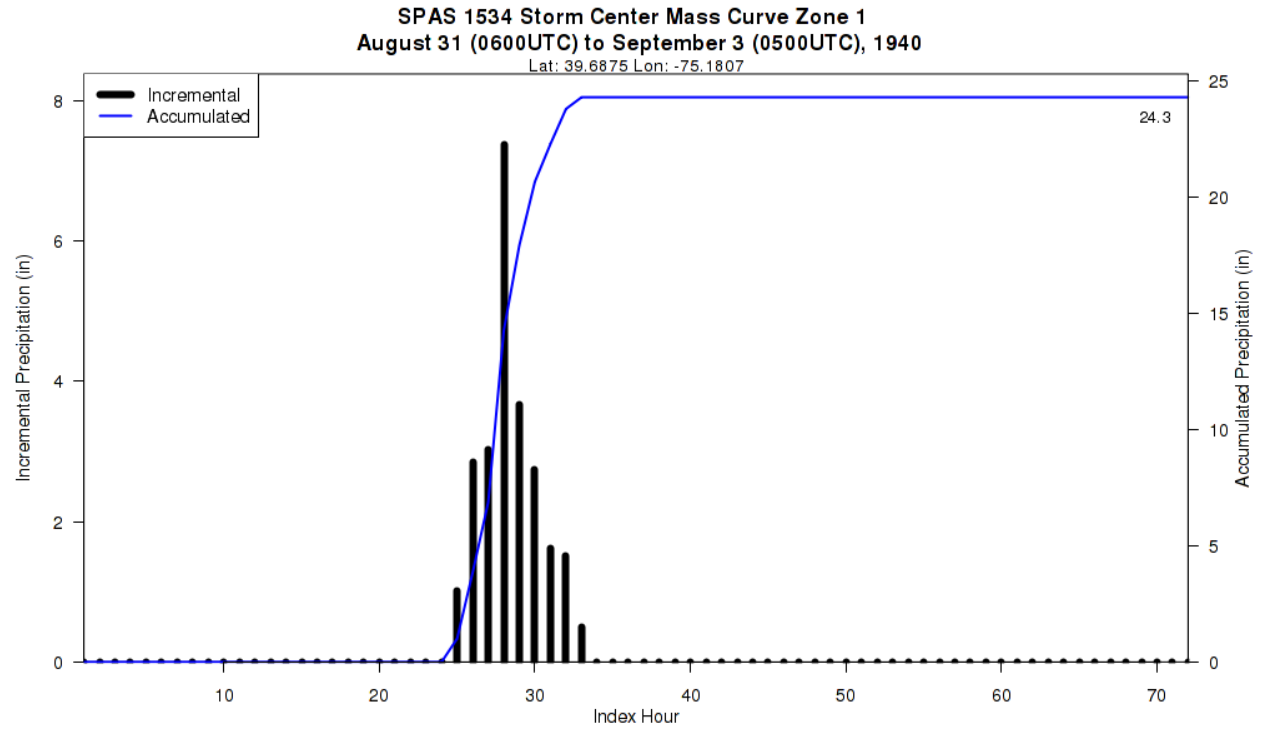
**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of results:** This analysis was based on hourly data, daily data, supplemental station data and bucket survey data. Twenty-seven hourly station, from the USACE NA 2-4 report, were digitized and used in the analysis. Data from SPAS 1023 were used in the analysis, additional data extraction was also completed. We have a good degree of confidence in the station based storm total results, the spatial pattern is dependent on the station data and the basemap, the timing is based on hourly and hourly pseudo stations.

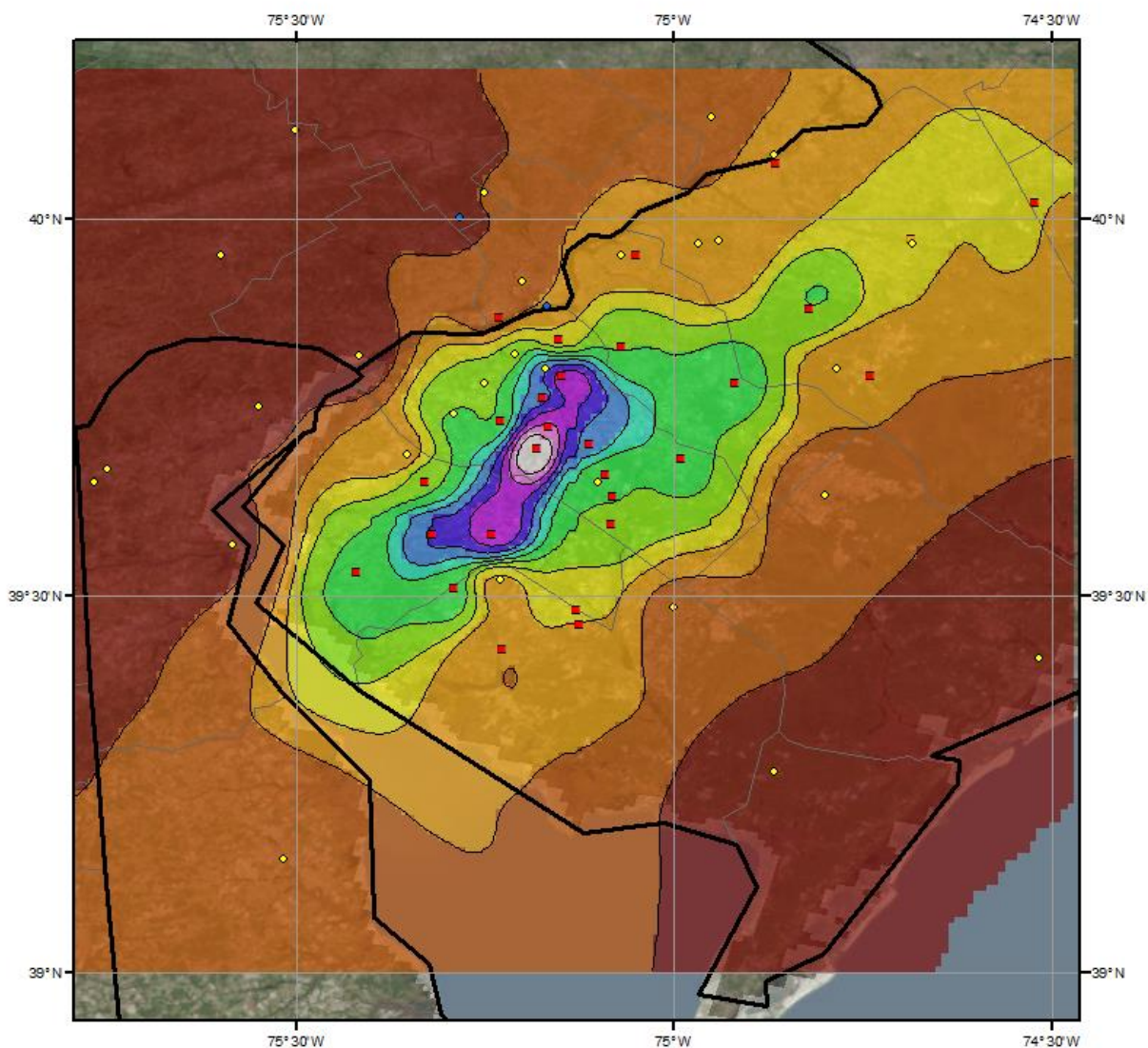
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1534 1	-75.1807	39.6875	103	100	15-Aug	76.00	2.99	0.03	74	2.960	80.00	80.0	3.60	0.03	82	3.570	1.206

Storm 1534- August 31 (0600 UTC) - September 3 (0500 UTC), 1940													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
Area (mi <sup>2</sup> )	Duration (hours)												
	1	2	3	4	5	6	12	18	24	36	48	72	Total
0.4	7.35	11.02	14.02	16.85	19.58	21.20	24.20	24.20	24.20	24.20	24.20	24.20	24.20
1	7.29	10.95	13.90	16.70	19.42	21.02	23.99	23.99	23.99	23.99	23.99	23.99	23.99
10	6.80	10.59	13.34	15.91	18.60	20.13	22.62	22.62	22.62	22.62	22.62	22.62	22.62
25	6.19	9.69	12.91	15.19	17.33	19.05	20.94	20.94	20.94	20.94	20.94	20.94	20.94
50	5.44	8.89	12.22	14.37	16.32	18.00	19.71	19.71	19.71	19.71	19.71	19.71	19.71
100	4.51	8.12	11.06	13.11	14.99	16.51	18.11	18.11	18.11	18.11	18.11	18.11	18.11
150	4.05	7.50	10.23	12.17	13.83	15.25	16.78	16.78	16.78	16.78	16.78	16.78	16.78
200	3.87	6.99	9.59	11.37	12.87	14.24	15.71	15.71	15.71	15.71	15.71	15.71	15.71
300	3.54	6.28	8.68	10.19	11.57	12.79	14.18	14.18	14.18	14.18	14.18	14.18	14.18
400	3.17	5.70	7.97	9.41	10.76	11.85	13.18	13.18	13.18	13.18	13.18	13.18	13.18
500	2.86	5.25	7.35	8.90	10.11	11.05	12.42	12.43	12.43	12.43	12.43	12.43	12.43
1,000	1.89	3.68	5.36	6.71	7.70	8.47	9.96	9.96	9.96	9.96	9.96	9.96	9.96
2,000	1.31	2.51	3.66	4.65	5.41	5.94	7.43	7.43	7.43	7.43	7.43	7.43	7.43
5,000	0.70	1.30	1.92	2.49	2.94	3.25	4.28	4.28	4.28	4.28	4.28	4.28	4.28





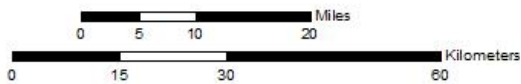




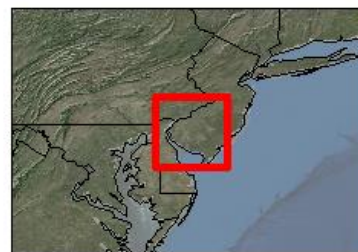
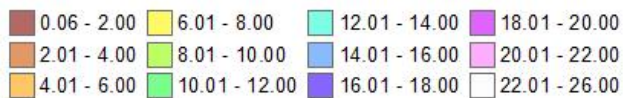
**Total Storm (72-hr) Precipitation (inches)**  
**08/31/1940 0600 UTC - 09/03/1940 0500 UTC**  
**SPAS- #1534**

**Gauges**

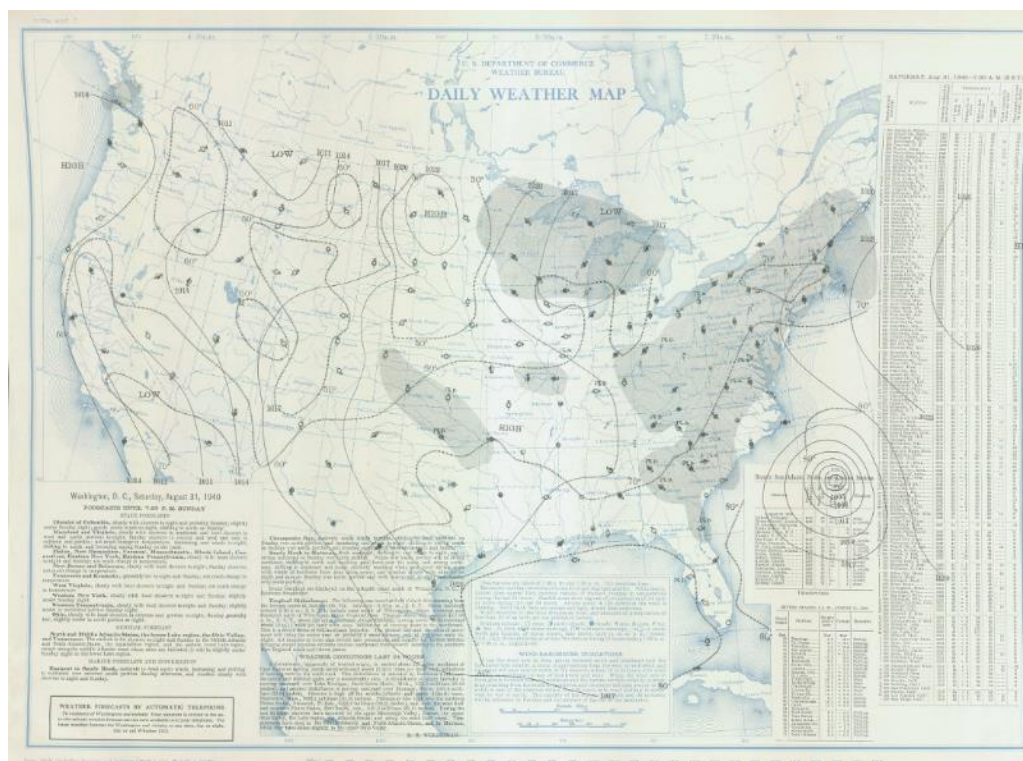
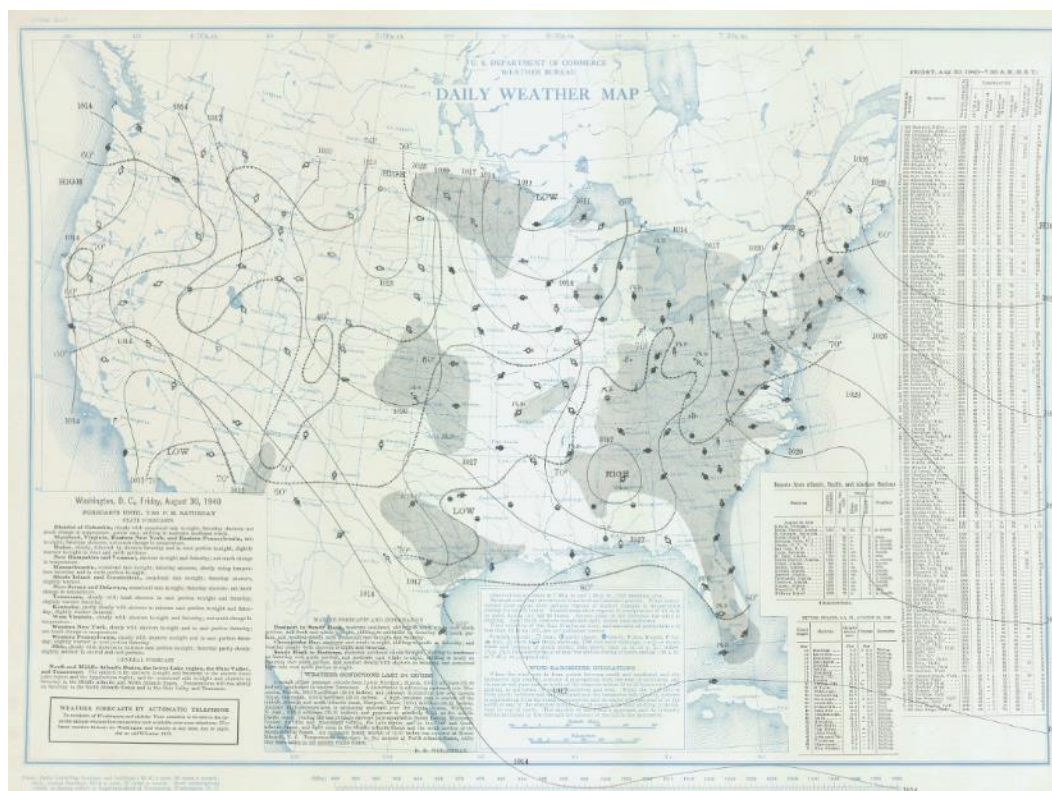
- ◆ Daily
- Hourly
- Hourly Pseudo
- ◆ Supplemental



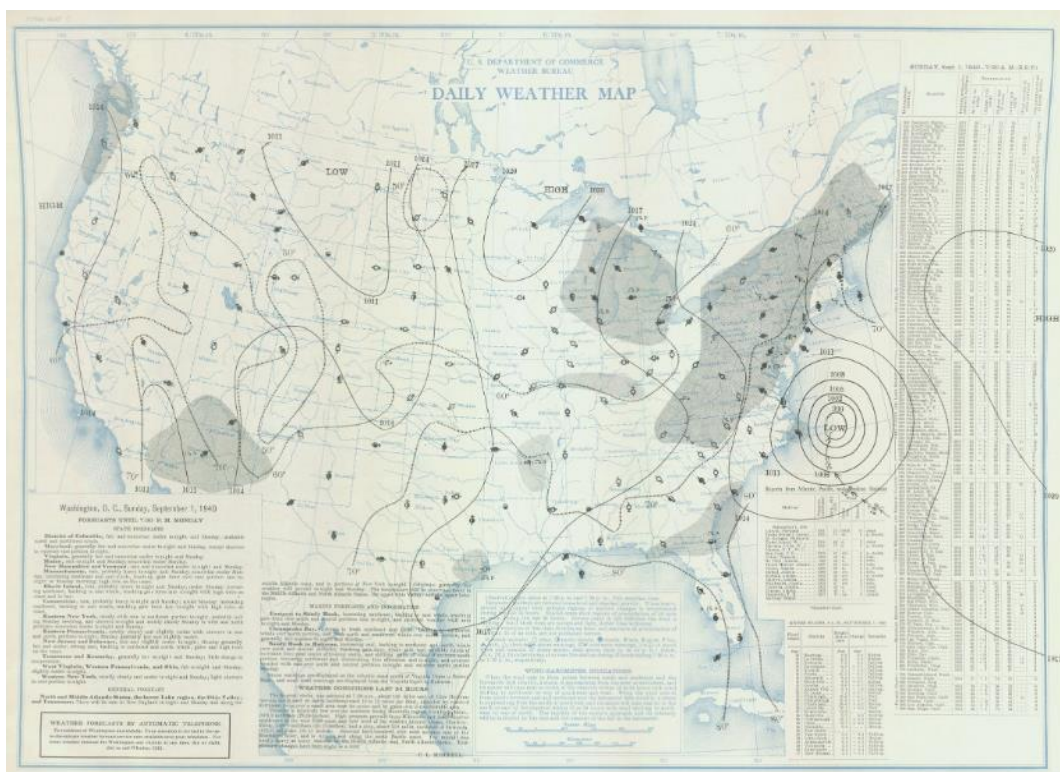
**Precipitation (inches)**



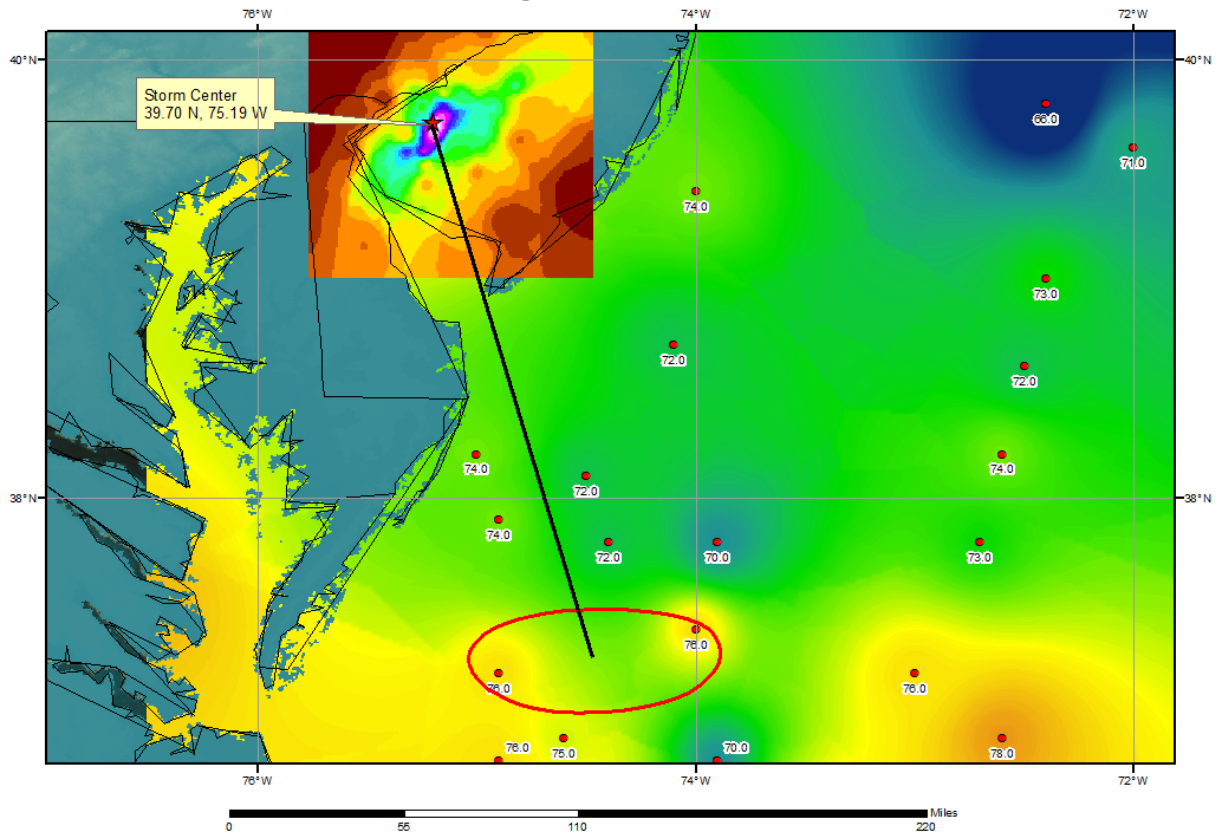
6/8/2015



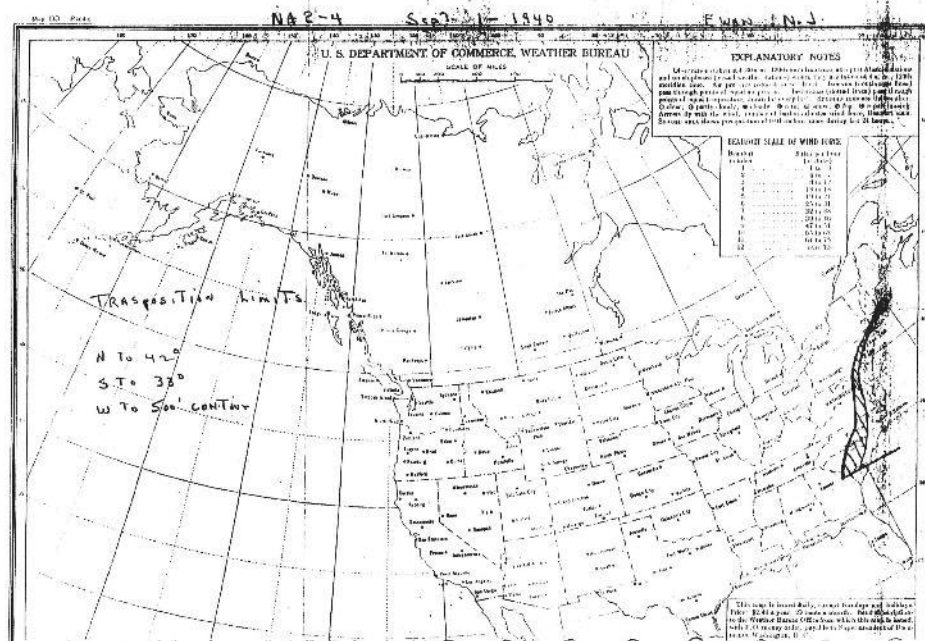




# SPAS 1023 Ewan, NJ Storm Analysis August 30, 1940







## Storm Precipitation Analysis System (SPAS) For Storm #1406\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Rapidan, VA - Marion County

**Storm Dates:** June 26 – 27, 1995

**Event:** Orographic

**DAD Zone 1**

**Latitude:** 38.415

**Longitude:** -78.335

**Max. Grid Rainfall Amount:** 28.39" in 41 hours

**Max. Observed Rainfall Amount:** 27.4" – Storm Center as indicated by Sterling WSR-88D in Smith et al., 1995 Catastrophic rainfall from an upslope thunderstorm in the central Appalachians: The Rapidan storm of June 27, 1995

**Number of Stations:** 295 (220 Daily, 48 Hourly, 18 Hourly Pseudo and 9 Supplemental)

**SPAS Version:** 10

**Basemap:** PRISM June 1981-2010; ippt\_allsites\_1406\_sum\_in (SPAS-NEXRAD hrly basemap)

**Spatial resolution:** 00:00:36

**Radar Included:** Yes

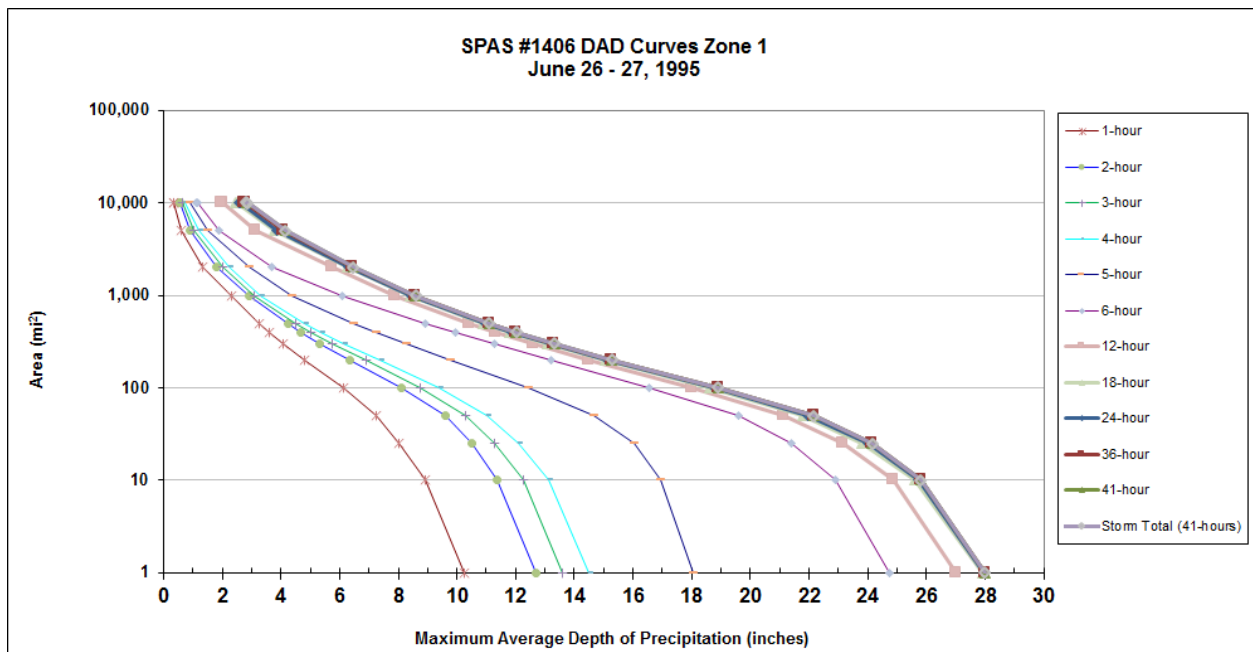
**Radar Beam-Blockage shapefile created:** Yes

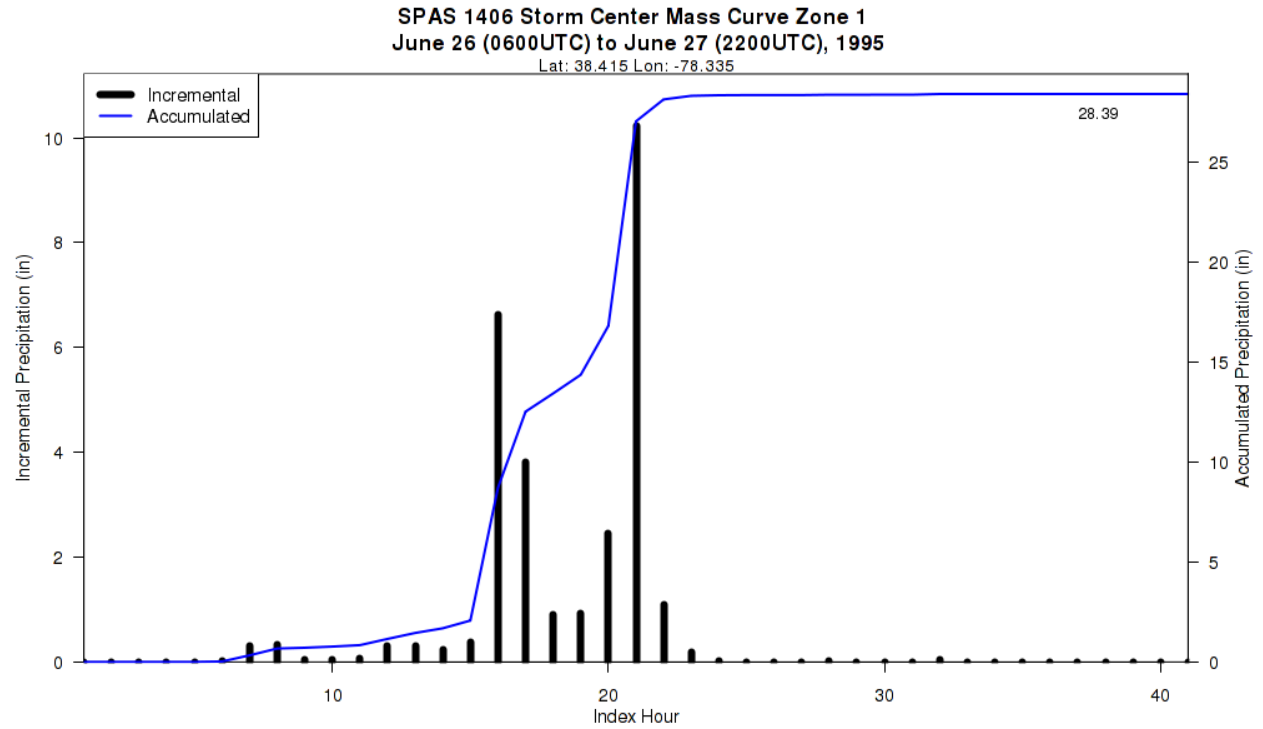
**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of results:** This analysis was based on hourly data, daily data and supplemental station data paired with SPAS-NEXRAD. We have a high degree of confidence for the radar and station based storm total results. The spatial pattern dependent on the basemap and radar data with a high degree of confidence with the timing based on hourly and hourly pseudo stations.

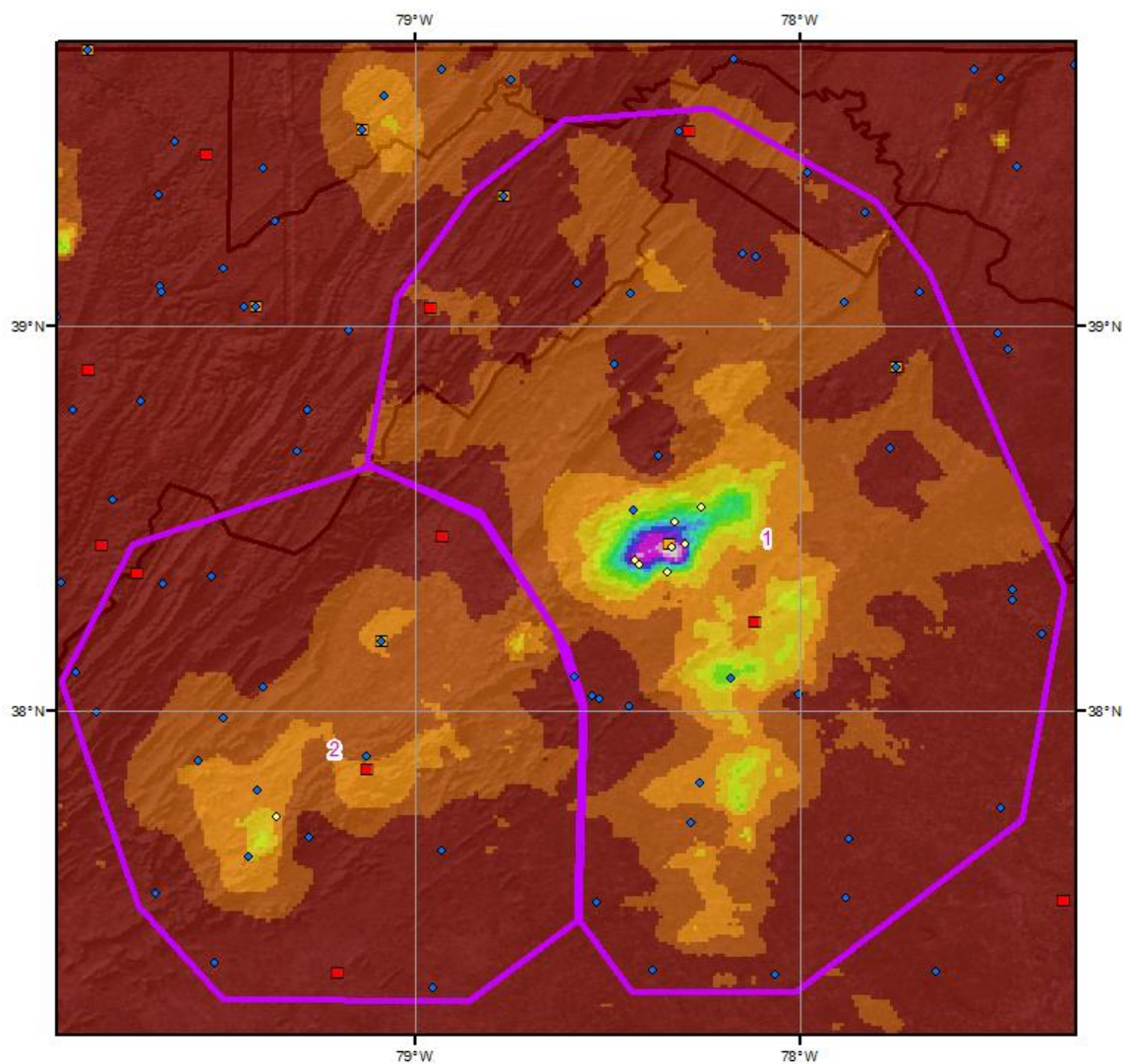
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1406_1	-78.3350	38.4150	1,288	1,300	10-Jul	82.00	3.95	0.39	86	3.560	83.84	84.0	4.30	0.42	90	3.880	1.090

Storm 1406 Zone 1 - June 26 (0600 UTC) - June 27 (2200 UTC), 1995												
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)												
areasqmi	Duration (hours)											
	1	2	3	4	5	6	12	18	24	36	41	Total
0.4	10.4	12.9	13.8	14.7	18.3	25.1	27.4	28.3	28.3	28.4	28.4	28.4
1	10.3	12.7	13.6	14.5	18.1	24.8	27.0	27.9	28.0	28.0	28.0	28.0
10	8.9	11.4	12.3	13.1	16.9	22.9	24.9	25.6	25.7	25.8	25.8	25.8
25	8.0	10.5	11.3	12.1	16.0	21.4	23.2	23.8	24.0	24.2	24.2	24.2
50	7.2	9.6	10.3	11.0	14.7	19.6	21.2	21.8	21.9	22.2	22.2	22.2
100	6.1	8.1	8.8	9.4	12.4	16.6	18.0	18.6	18.8	18.9	18.9	18.9
200	4.8	6.3	6.9	7.4	9.8	13.2	14.5	15.0	15.2	15.3	15.3	15.3
300	4.1	5.3	5.8	6.2	8.3	11.3	12.6	13.1	13.2	13.3	13.3	13.3
400	3.6	4.7	5.0	5.4	7.3	10.0	11.3	11.8	11.9	12.0	12.0	12.0
500	3.3	4.2	4.5	4.8	6.5	8.9	10.4	10.9	11.0	11.1	11.1	11.1
1,000	2.3	2.9	3.1	3.3	4.4	6.1	7.9	8.4	8.5	8.6	8.6	8.6
2,000	1.3	1.8	2.0	2.2	2.9	3.7	5.8	6.3	6.3	6.4	6.5	6.5
5,000	0.6	0.9	1.1	1.2	1.5	1.9	3.2	3.8	3.9	4.1	4.2	4.2
10,000	0.4	0.6	0.6	0.7	0.9	1.2	2.0	2.5	2.6	2.8	2.9	2.9
10,196	0.4	0.6	0.6	0.7	0.9	1.1	2.0	2.5	2.6	2.8	2.8	2.8









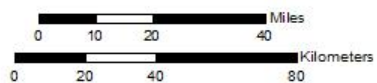
### Total Storm (41-hours) Precipitation (inches)

June 26 - 27, 1995

SPAS 1406 - Rapidan, VA

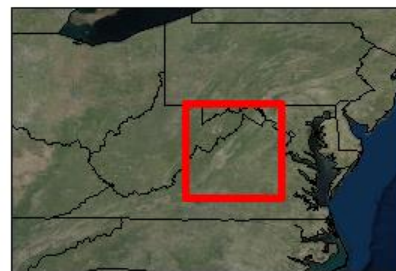
#### Gauges

- ◆ Daily
- Hourly
- Hourly Pseudo
- ◇ Supplemental



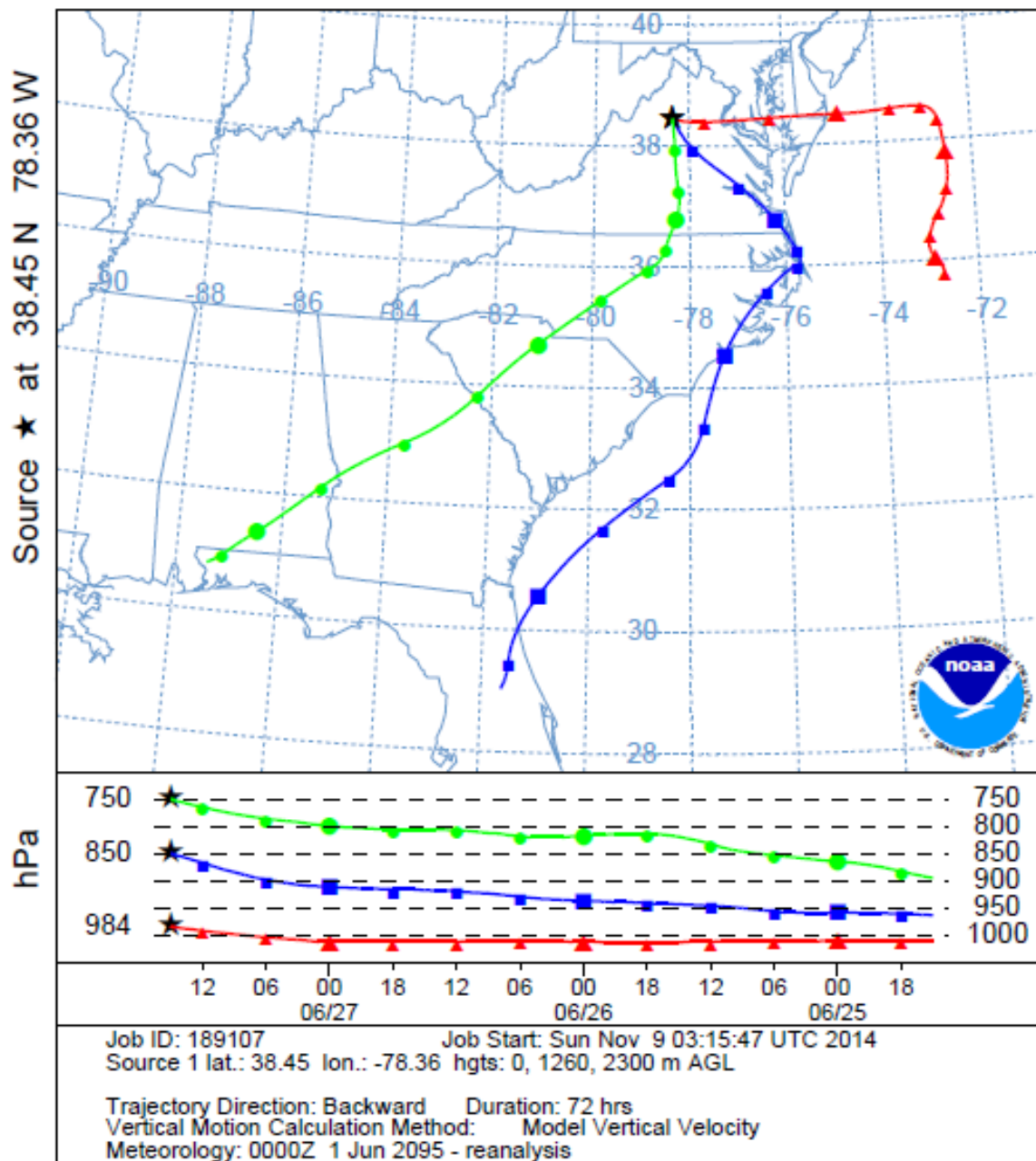
#### Precipitation (inches)

0.00 - 2.00	8.01 - 10.00	16.01 - 18.00	24.01 - 26.00
2.01 - 4.00	10.01 - 12.00	18.01 - 20.00	26.01 - 28.00
4.01 - 6.00	12.01 - 14.00	20.01 - 22.00	
6.01 - 8.00	14.01 - 16.00	22.01 - 24.00	



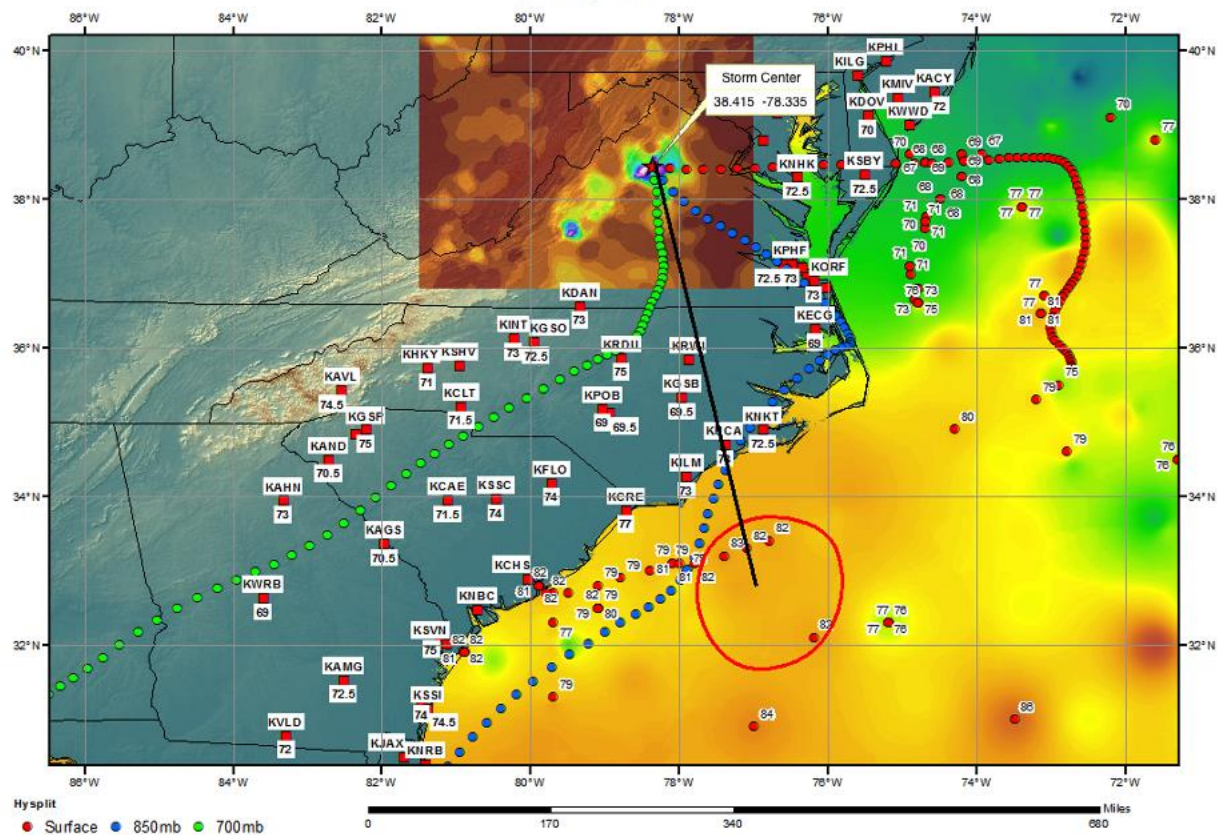
11/3/2014

NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1500 UTC 27 Jun 95  
 CDC1 Meteorological Data



## SPAS 1406 Rapidan, VA Storm Analysis DAD 1

June 24, 1995



## Storm Precipitation Analysis System (SPAS) For Storm #1818\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Atlantic City, NJ

**Storm Dates:** August 20-21, 1997

**Event:** Convective

**DAD Zone 1**

**Latitude:** 39.505

**Longitude:** -74.435

**Max. Grid Rainfall Amount:** 14.28"

**Max. Observed Rainfall Amount:** 13.78"

**Number of Stations:** 205

**SPAS Version:** 10

**Basemap:** PRISM August 1981-2010

**Spatial resolution:** 00:00:36

**Radar Included:** Yes

**Radar Beam-Blockage shapefile created:** Yes

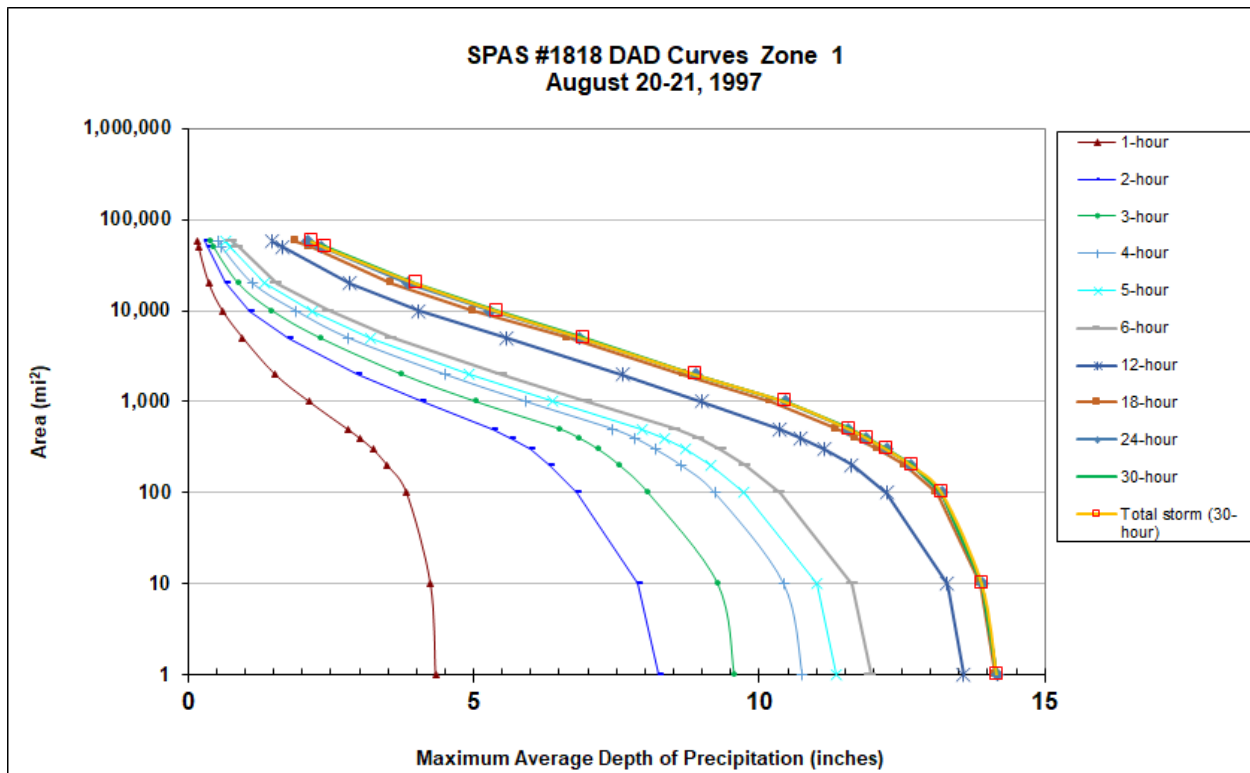
**Depth-Area-Duration (DAD) analysis:** Yes

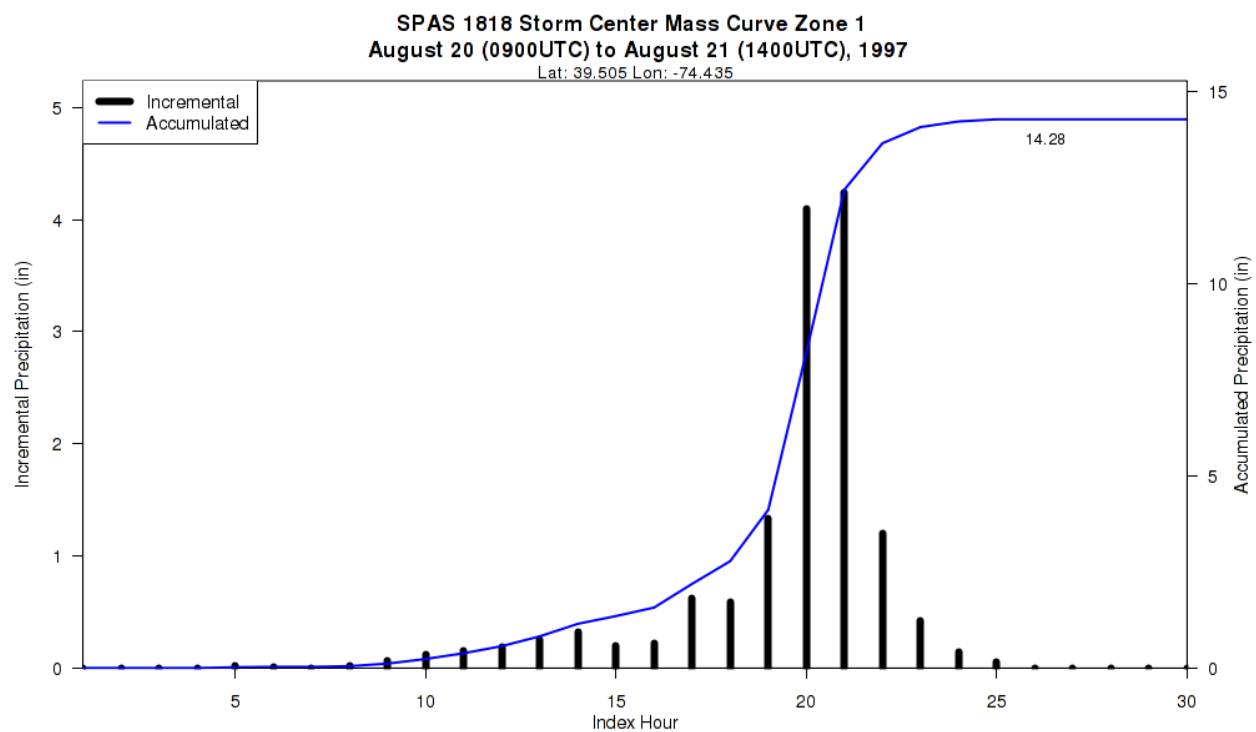
**Reliability of results:** This analysis was based on 205 hourly stations, daily data, supplemental station data, and radar data. We have a good degree of confidence for the station based storm total results. The spatial pattern is dependent on the radar data, gauge data, and basemap. There is a good degree of confidence with the timing based on the hourly stations near the storm center. Some daily stations were moved to supplemental due to timing issues.

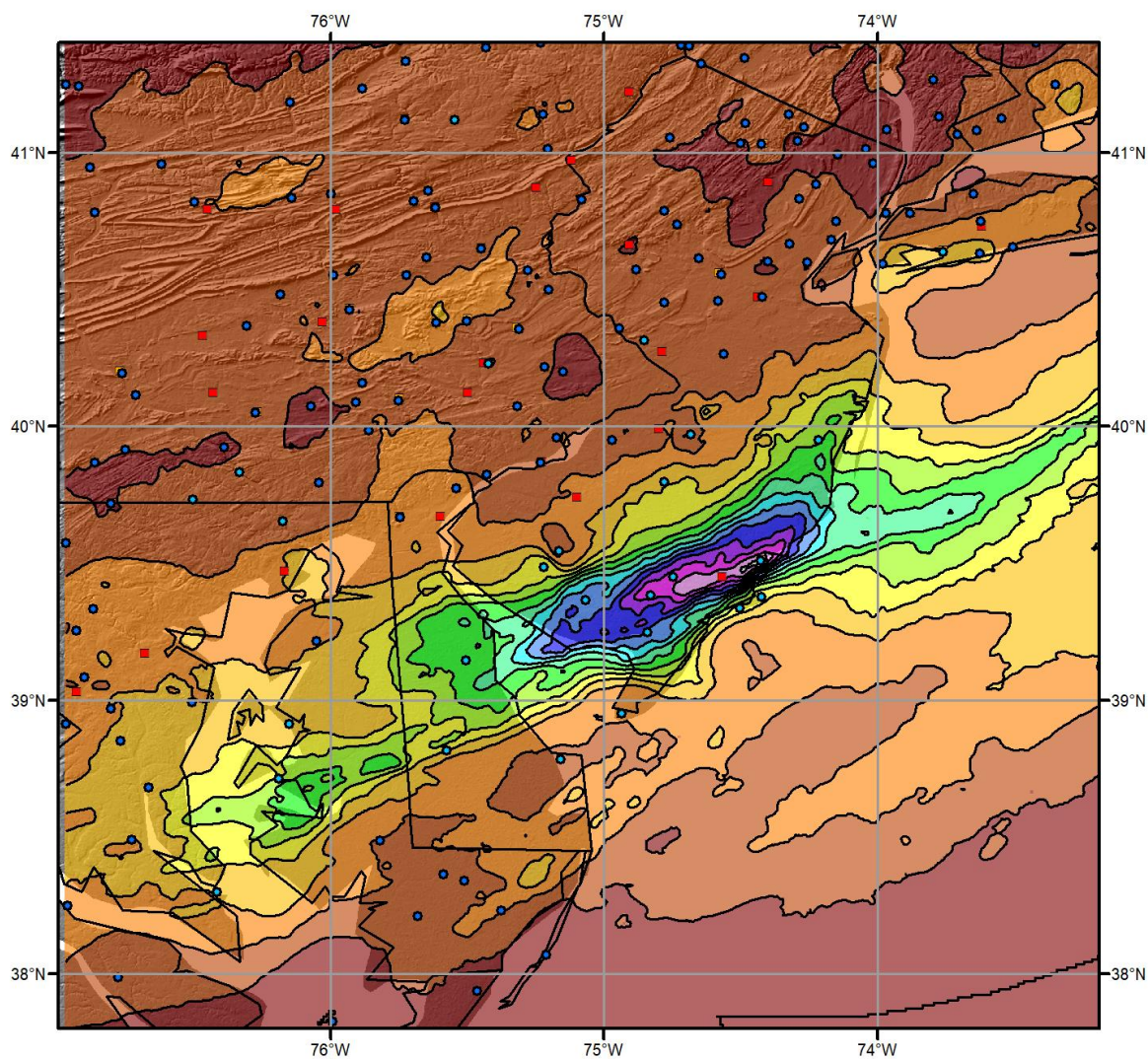
	SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	Storm Rep. Dew Point					Climatological Max. Dew Point					IPMF	
							T <sub>d</sub>	Precip. Water @ 30,000 ft.	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft.	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
Storm Center Location	1818_1	-74.4350	39.5050	1	0	6-Aug	78.00	3.29	0.00	78	3.290	81.54	81.5	3.86	0.00	85	3.860	1.173



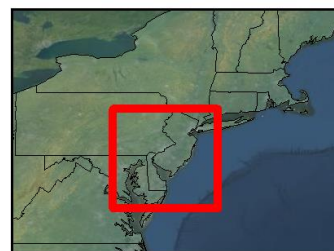
Storm 1818 - August 20 (0900 UTC) - August 21 (1400 UTC), 1997											
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)											
Area (mi <sup>2</sup> )	Duration (hours)										
	1	2	3	4	5	6	12	18	24	30	Total
0.4	4.38	8.33	9.66	10.86	11.45	12.07	13.68	14.24	14.27	14.27	14.27
1	4.34	8.24	9.57	10.76	11.35	11.96	13.57	14.13	14.16	14.16	14.16
10	4.25	7.87	9.28	10.43	11.02	11.63	13.29	13.86	13.90	13.90	13.90
100	3.83	6.80	8.06	9.22	9.74	10.36	12.23	13.10	13.20	13.20	13.20
200	3.49	6.32	7.56	8.63	9.16	9.75	11.61	12.54	12.66	12.67	12.67
300	3.24	6.00	7.19	8.18	8.71	9.33	11.15	12.09	12.23	12.24	12.24
400	3.00	5.66	6.85	7.82	8.34	8.94	10.72	11.68	11.87	11.89	11.89
500	2.79	5.34	6.52	7.44	7.94	8.53	10.35	11.36	11.57	11.59	11.59
1000	2.12	4.07	5.05	5.92	6.39	6.99	8.99	10.21	10.45	10.47	10.47
2000	1.52	2.96	3.75	4.49	4.92	5.50	7.60	8.68	8.88	8.89	8.89
5,000	0.96	1.75	2.33	2.81	3.20	3.57	5.56	6.65	6.85	6.92	6.92
10,000	0.60	1.08	1.48	1.88	2.18	2.47	4.04	4.99	5.29	5.41	5.41
20,000	0.36	0.67	0.89	1.12	1.33	1.55	2.84	3.57	3.86	4.00	4.00
50,000	0.18	0.34	0.46	0.58	0.75	0.88	1.64	2.13	2.32	2.41	2.41
58,097	0.16	0.30	0.41	0.52	0.65	0.77	1.47	1.90	2.09	2.17	2.17





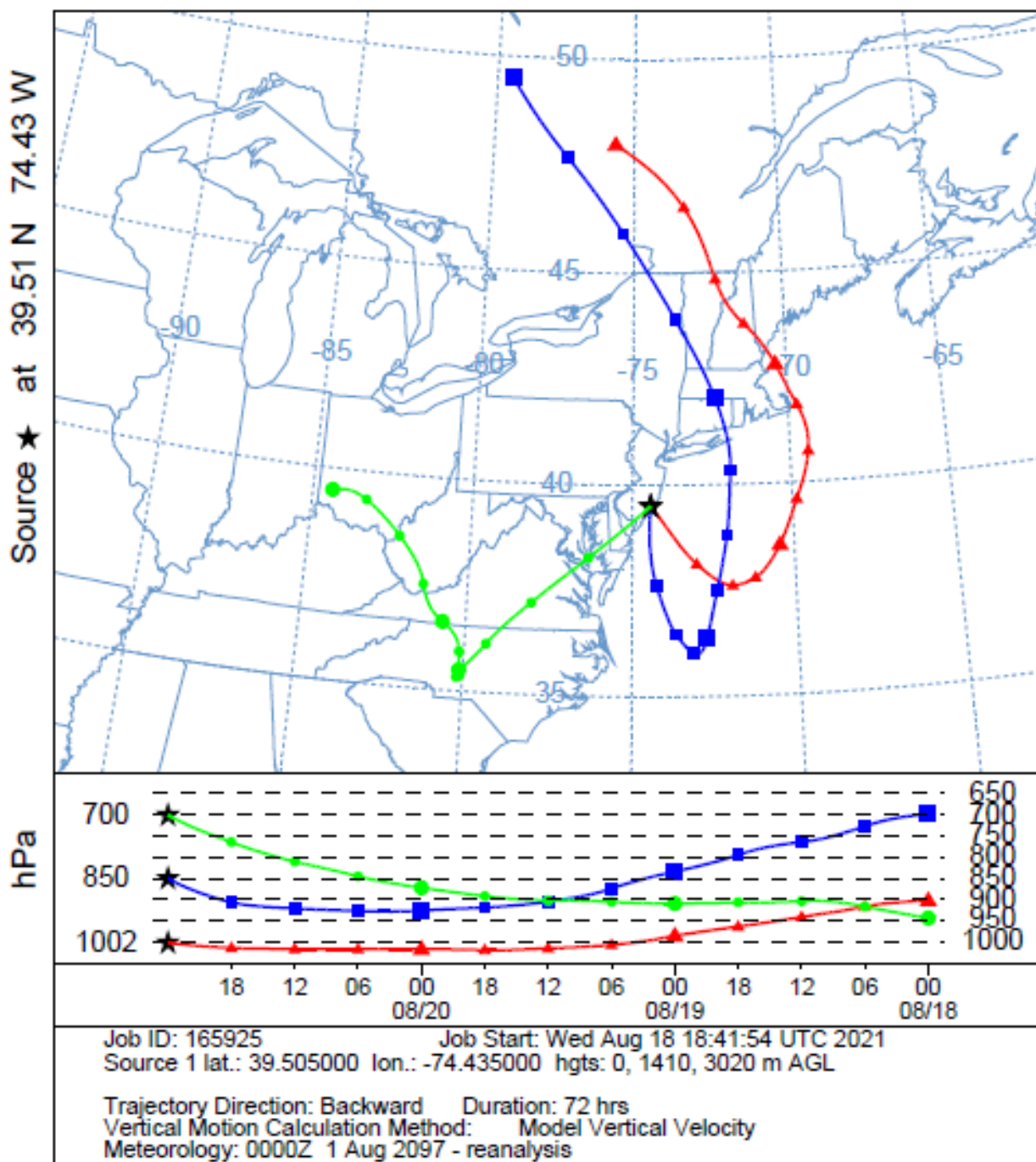


**Total 30-hour Precipitation (inches)**  
**August 20 (0900UTC) - August 21 (1400UTC), 1997**  
**SPAS-NEXRAD 1818**



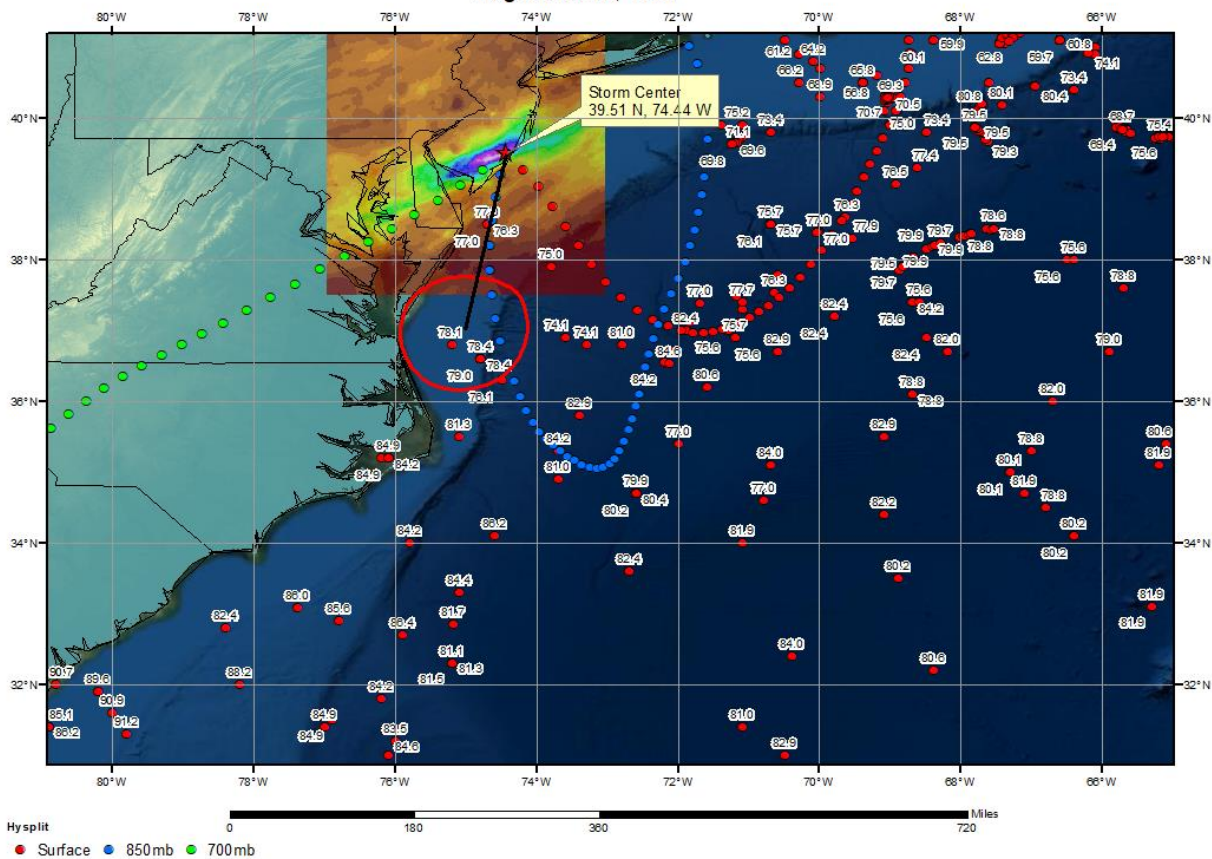
08/6/2021

NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 21 Aug 97  
 CDC1 Meteorological Data





**SPAS 1818 Atlantic City, NJ Sea Surface Temperatures (F)**  
August 19-20, 1997



## Storm Precipitation Analysis System (SPAS) For Storm #1017\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Sparta, NJ

**Storm Dates:** August 11-12, 2000

**Event:** Local Thunderstorm

**DAD Zone 1**

**Latitude:** 41.03

**Longitude:** -74.64

**Rainfall Amount:** 16.70"

**Number of Stations:** 179

**Base Map Used:** A mosaic (KDIX, KOKX, KBGM and KDOX) total estimated radar rainfall grid.

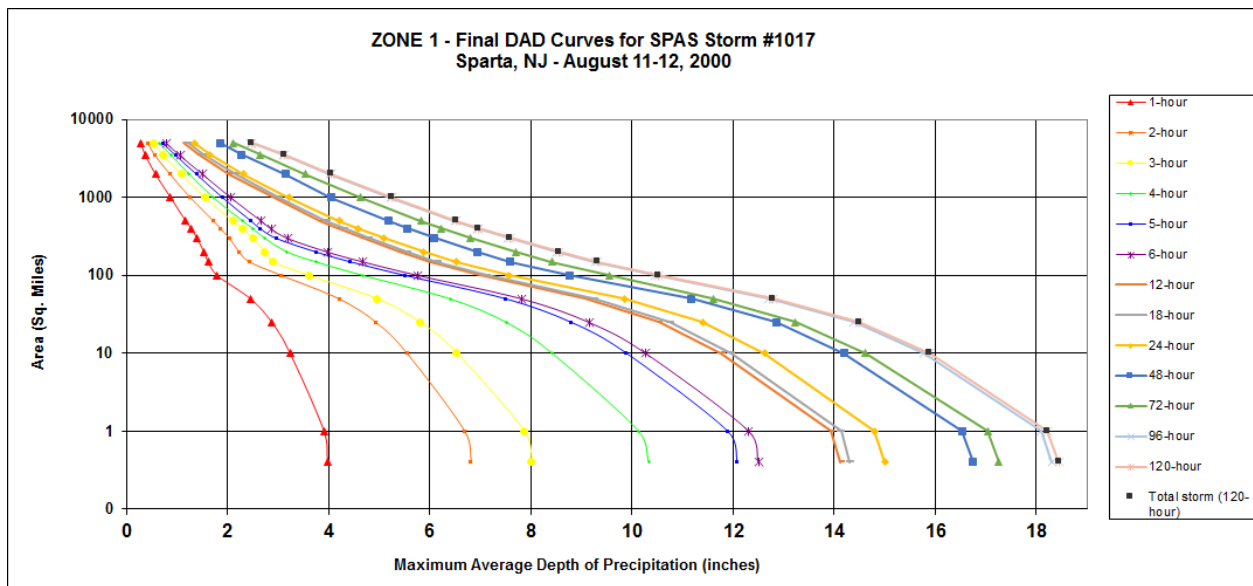
**Spatial resolution:** 30 seconds

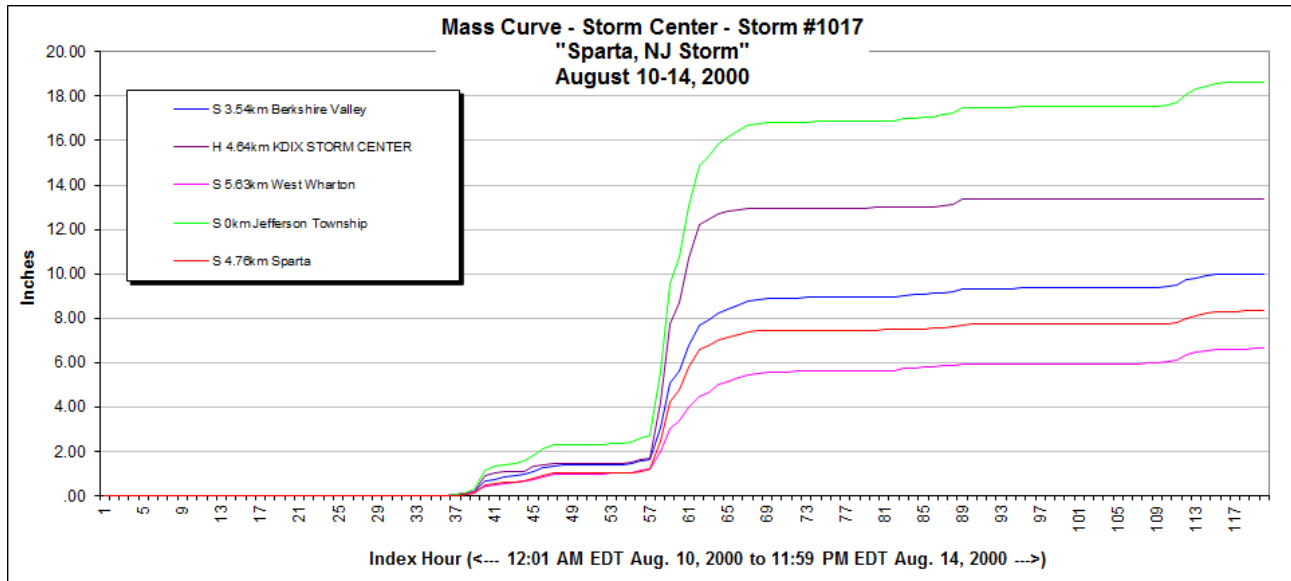
**Radar Included:** Yes

**Depth-Area-Duration (DAD) analysis:** No

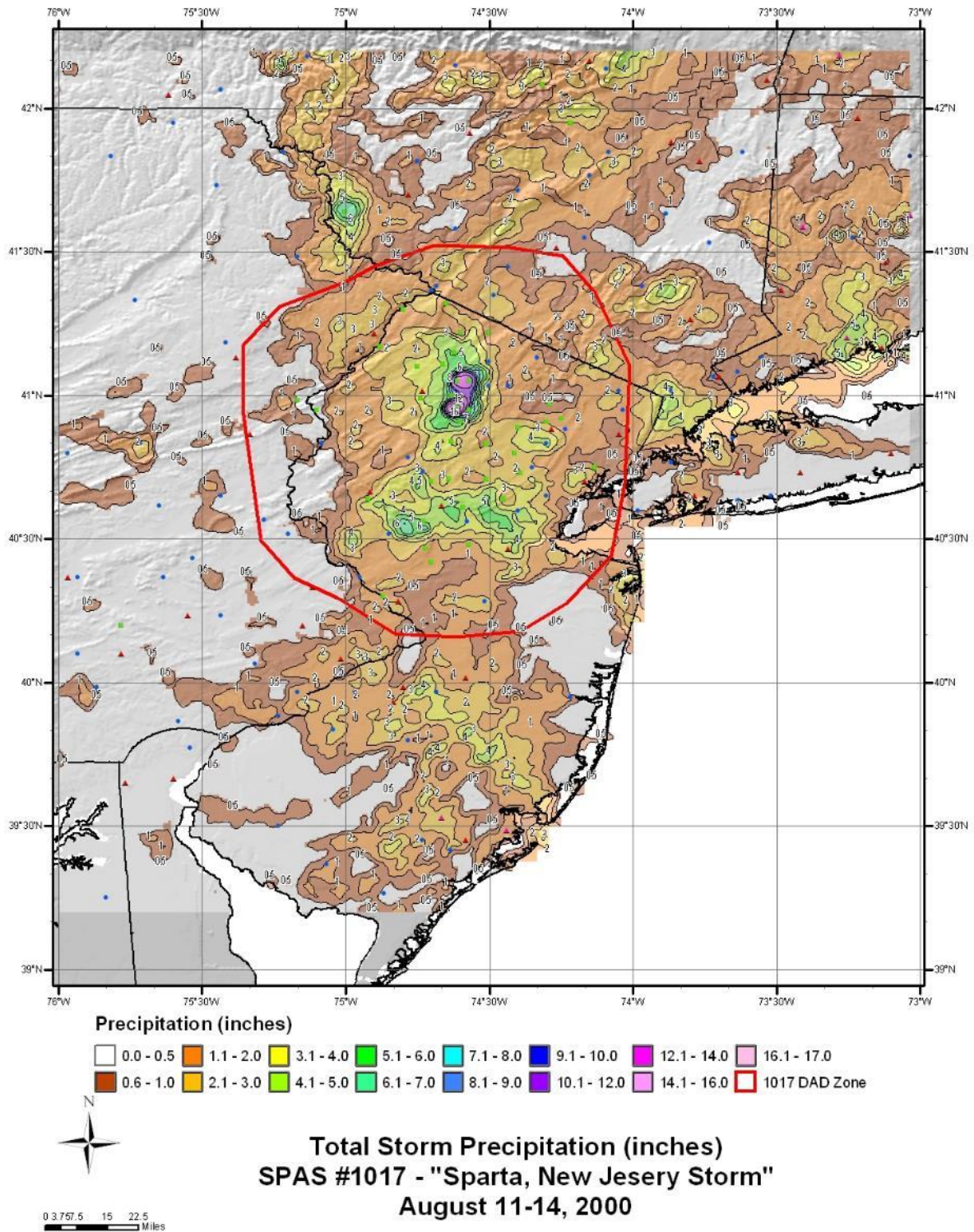
						Storm Rep. Dew Point					Climatological Max. Dew Point						
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1017_1	-74.6400	41.0300	796	800	15-Aug	68.00	2.05	0.16	58	1.890	77.07	77.0	3.14	0.21	76	2.930	1.500

Storm 1017 - Sparta, NJ, August 11-12, 2000														
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)														
Duration (hours)														
Area in Sq. Mi.	1	2	3	4	5	6	12	18	24	48	72	96	120	Total
0.4	4.0	6.8	8.0	10.3	12.1	12.5	14.1	14.3	15.0	16.8	17.3	18.3	18.4	18.4
1	3.9	6.7	7.9	10.1	11.9	12.3	13.9	14.1	14.8	16.5	17.0	18.1	18.2	18.2
10	3.2	5.5	6.5	8.4	9.9	10.3	11.8	12.0	12.6	14.2	14.6	15.8	15.9	15.9
25	2.9	4.9	5.8	7.5	8.8	9.2	10.5	10.8	11.4	12.9	13.2	14.4	14.5	14.5
50	2.5	4.2	5.0	6.4	7.5	7.8	9.1	9.2	9.8	11.2	11.6	12.7	12.8	12.8
100	1.8	3.1	3.6	4.7	5.5	5.8	7.0	7.1	7.6	8.8	9.6	10.5	10.5	10.5
150	1.6	2.4	2.9	3.7	4.4	4.7	6.0	6.2	6.5	7.6	8.4	9.3	9.3	9.3
200	1.5	2.2	2.7	3.2	3.8	4.0	5.4	5.5	5.9	6.9	7.7	8.5	8.6	8.6
300	1.4	2.0	2.5	2.7	3.0	3.2	4.7	4.8	5.1	6.1	6.8	7.5	7.6	7.6
400	1.3	1.9	2.3	2.5	2.6	2.9	4.2	4.3	4.6	5.6	6.2	6.9	7.0	7.0
500	1.2	1.7	2.1	2.3	2.5	2.7	3.8	4.0	4.2	5.2	5.8	6.5	6.5	6.5
1000	0.9	1.3	1.6	1.7	1.9	2.1	2.9	3.0	3.2	4.0	4.6	5.2	5.3	5.3
2000	0.6	0.9	1.1	1.2	1.4	1.5	2.0	2.2	2.3	3.1	3.5	4.0	4.1	4.1
3500	0.4	0.6	0.7	0.9	1.0	1.1	1.4	1.5	1.7	2.3	2.6	3.1	3.1	3.1
5000	0.3	0.4	0.5	0.7	0.7	0.8	1.1	1.2	1.3	1.9	2.1	2.5	2.5	2.5



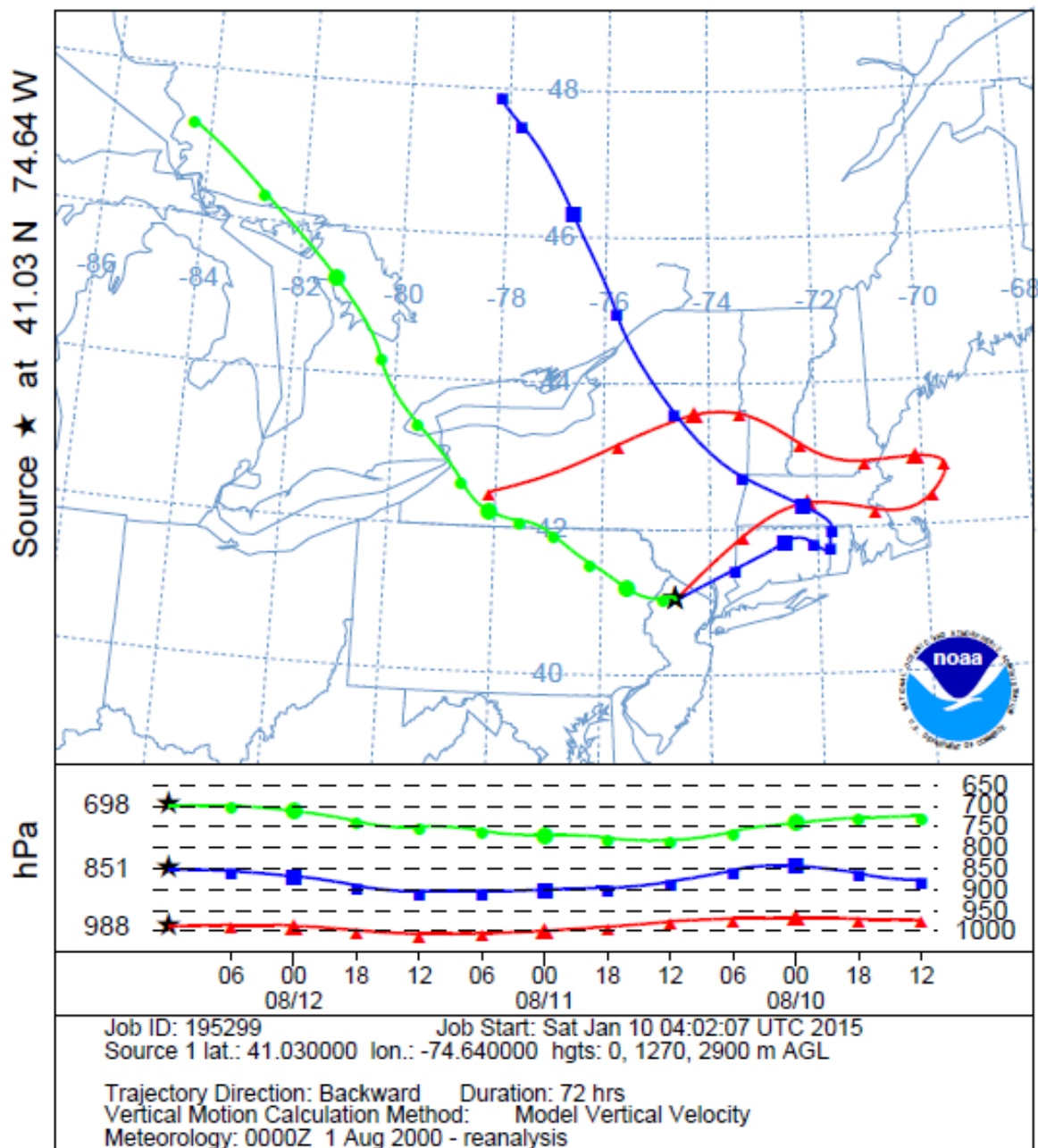




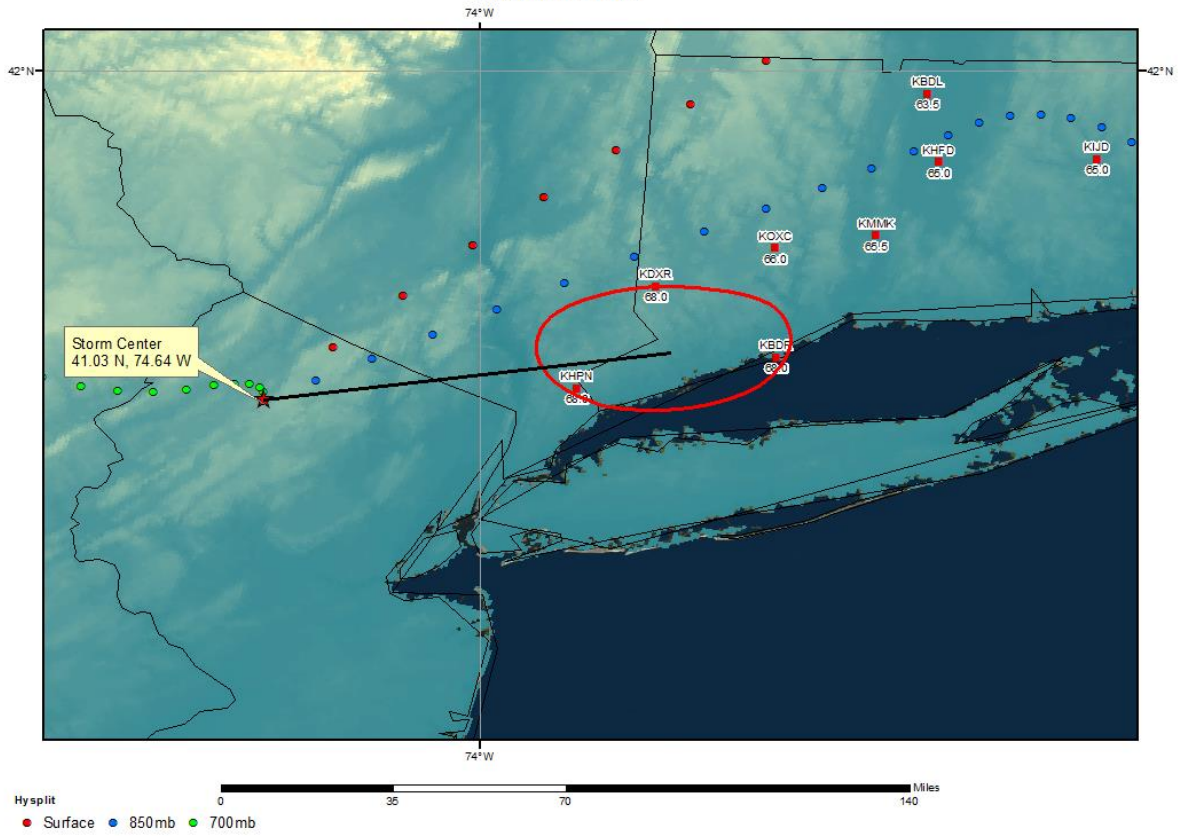


TWP 5/11/2005

NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 12 Aug 00  
 CDC1 Meteorological Data



# SPAS 1017 Sparta, NJ Storm Analysis August 11, 2000



## Storm Precipitation Analysis System (SPAS) For Storm #1040\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Tabernacle, NJ

**Storm Dates:** 7/12/2004 0600Z – 7/13/2004 0800Z

**Event:** Convective Thunderstorm

**DAD Zone 1**

**Latitude:** 39.88

**Longitude:** -74.69

**Rainfall Amount:** 15.63" (Grid/Pixel Point)

**Number of Stations:** 319 (131-hourly, 2-hourly pseudo, 118-daily, and 68-supplemental) gauging stations within the defined search domain.

**SPAS Version:** 3.0

**Base Map Used:** No

**Spatial resolution:** 0.005944 decimal degrees (21.386139 seconds)

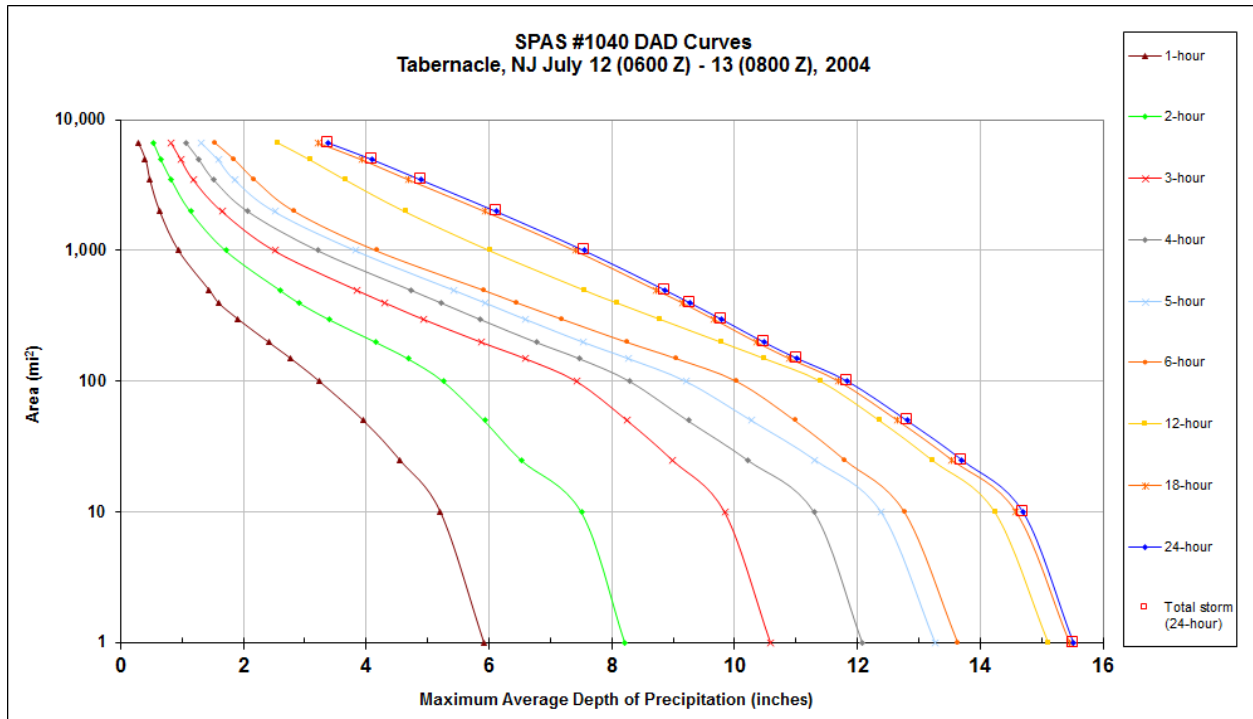
**Radar Included:** Yes

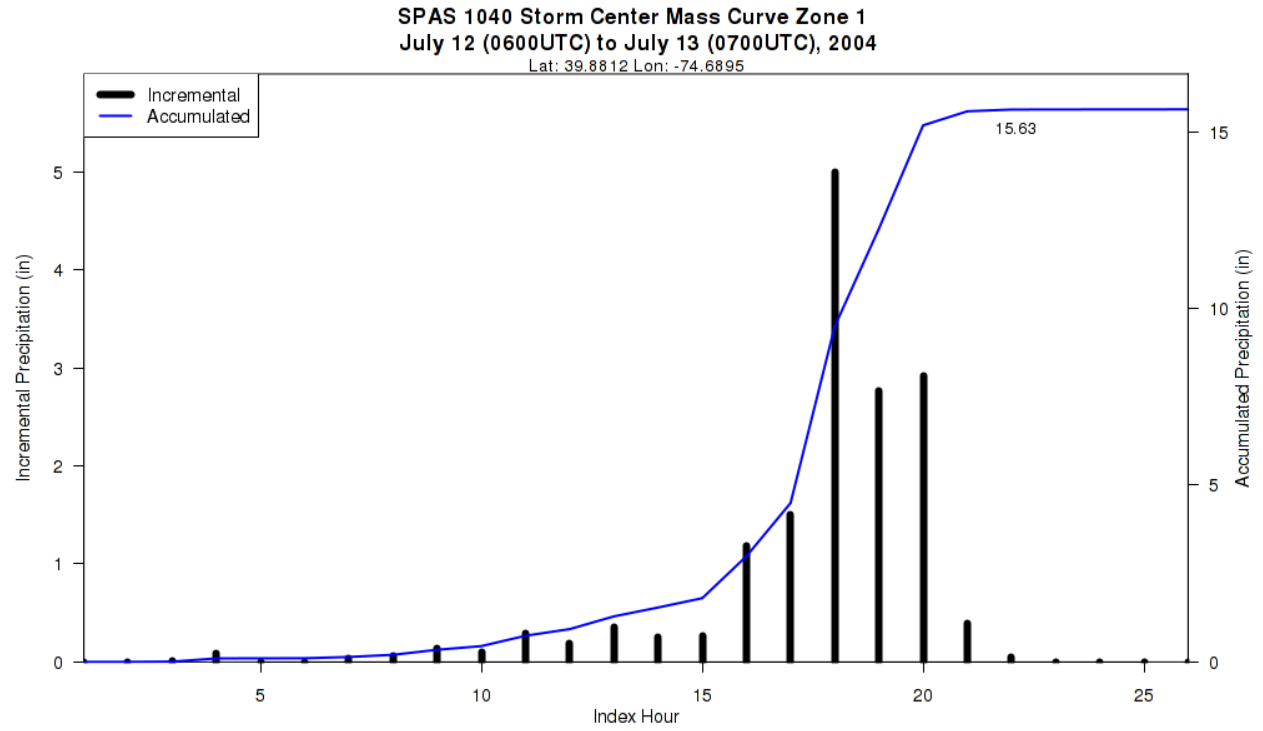
**Depth-Area-Duration (DAD) analysis:** Yes

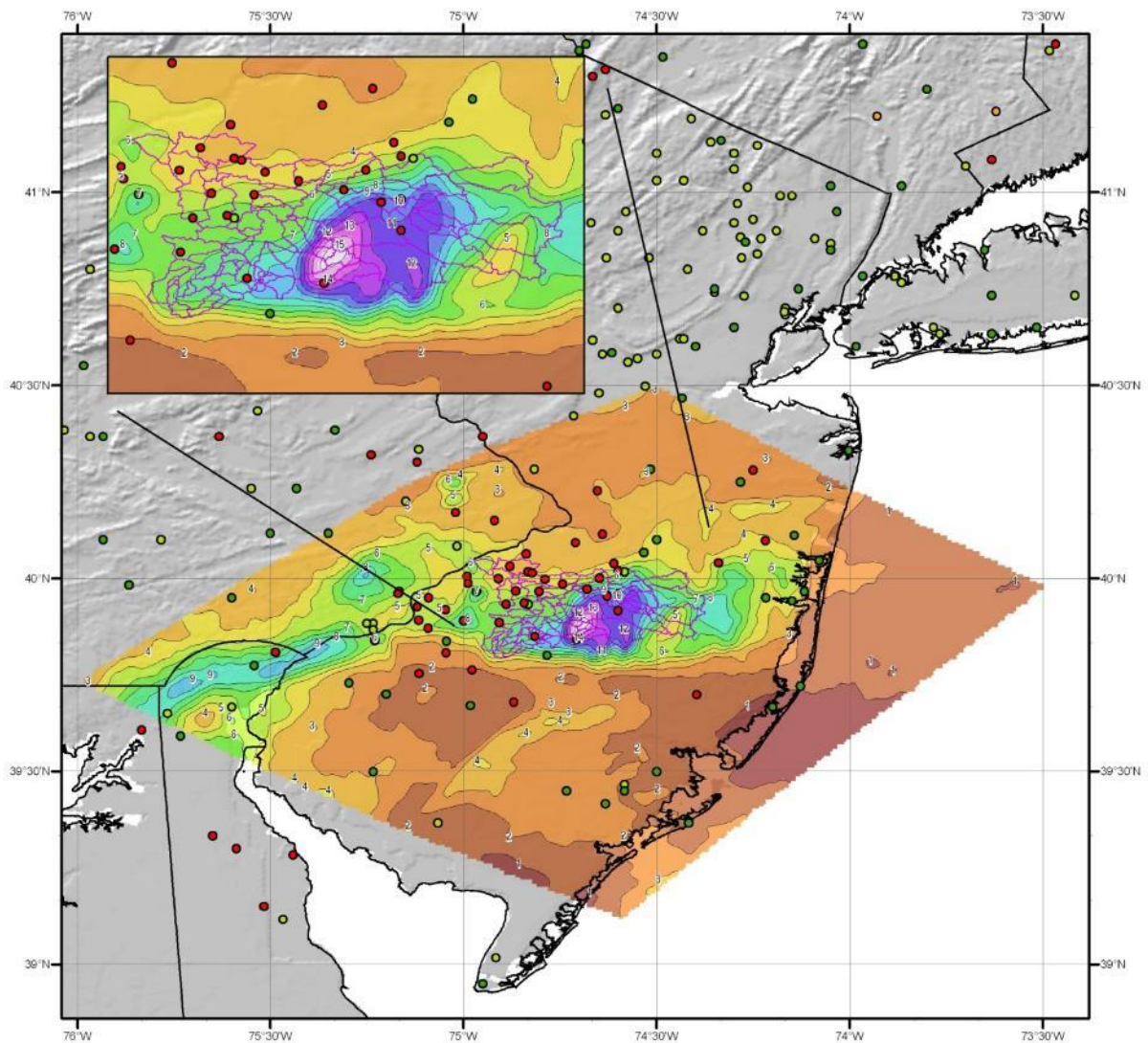
						Storm Rep. Dew Point					Climatological Max. Dew Point						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	T <sub>d</sub>	Precip. Water @ 30,000	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1040_1	-74.6900	39.8805	56	100	30-Jul	74.00	2.73	0.03	70	2.700	79.00	79.0	3.44	0.03	80	3.410	1.263



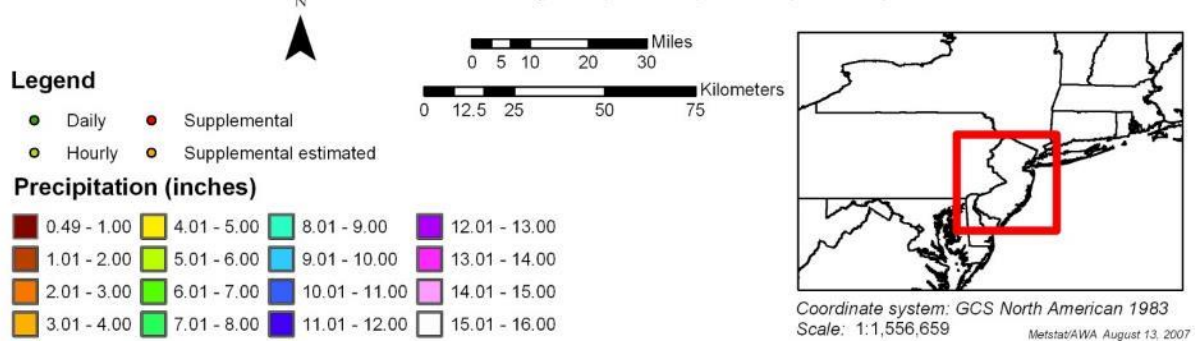
July 12-13, 2004 Storm											
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)											
Area (mi <sup>2</sup> )	Duration (hours)										total
	1	2	3	4	5	6	12	18	24		
1	5.9	8.2	10.6	12.1	13.3	13.6	15.1	15.5	15.5		15.51
10	5.2	7.5	9.8	11.3	12.4	12.8	14.2	14.6	14.7		14.69
25	4.6	6.5	9.0	10.2	11.3	11.8	13.2	13.5	13.7		13.70
50	4.0	5.9	8.3	9.3	10.3	11.0	12.4	12.7	12.8		12.81
100	3.2	5.3	7.4	8.3	9.2	10.0	11.4	11.7	11.8		11.84
150	2.8	4.7	6.6	7.5	8.3	9.1	10.5	10.9	11.0		11.02
200	2.4	4.2	5.9	6.8	7.5	8.3	9.8	10.4	10.5		10.48
300	1.9	3.4	4.9	5.9	6.6	7.2	8.8	9.7	9.8		9.78
400	1.6	2.9	4.3	5.2	5.9	6.5	8.1	9.2	9.3		9.27
500	1.4	2.6	3.9	4.7	5.4	5.9	7.6	8.7	8.9		8.87
1,000	0.9	1.7	2.5	3.2	3.8	4.2	6.0	7.4	7.6		7.56
2,000	0.6	1.1	1.7	2.1	2.5	2.8	4.6	5.9	6.1		6.12
3,500	0.5	0.8	1.2	1.5	1.9	2.2	3.7	4.7	4.9		4.89
5,000	0.4	0.7	1.0	1.3	1.6	1.9	3.1	3.9	4.1		4.10
6,721	0.3	0.5	0.8	1.1	1.3	1.5	2.6	3.2	3.4		3.38



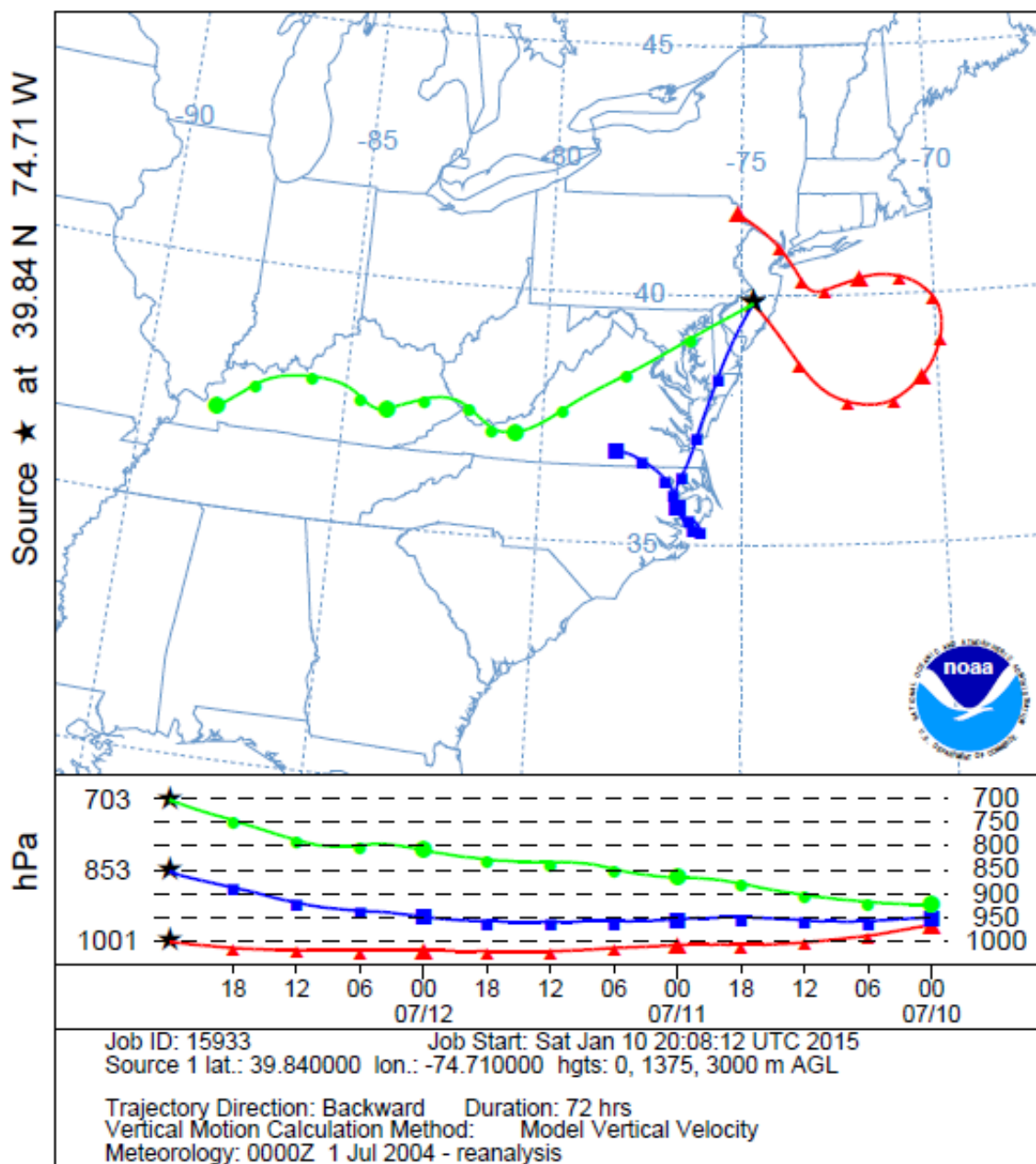




**Total Rainfall (26-hours)**  
**Tabernacle, New Jersey Storm**  
**SPAS Storm #1040- July 12 (0600 Z) to 13 (0800 Z), 2004**

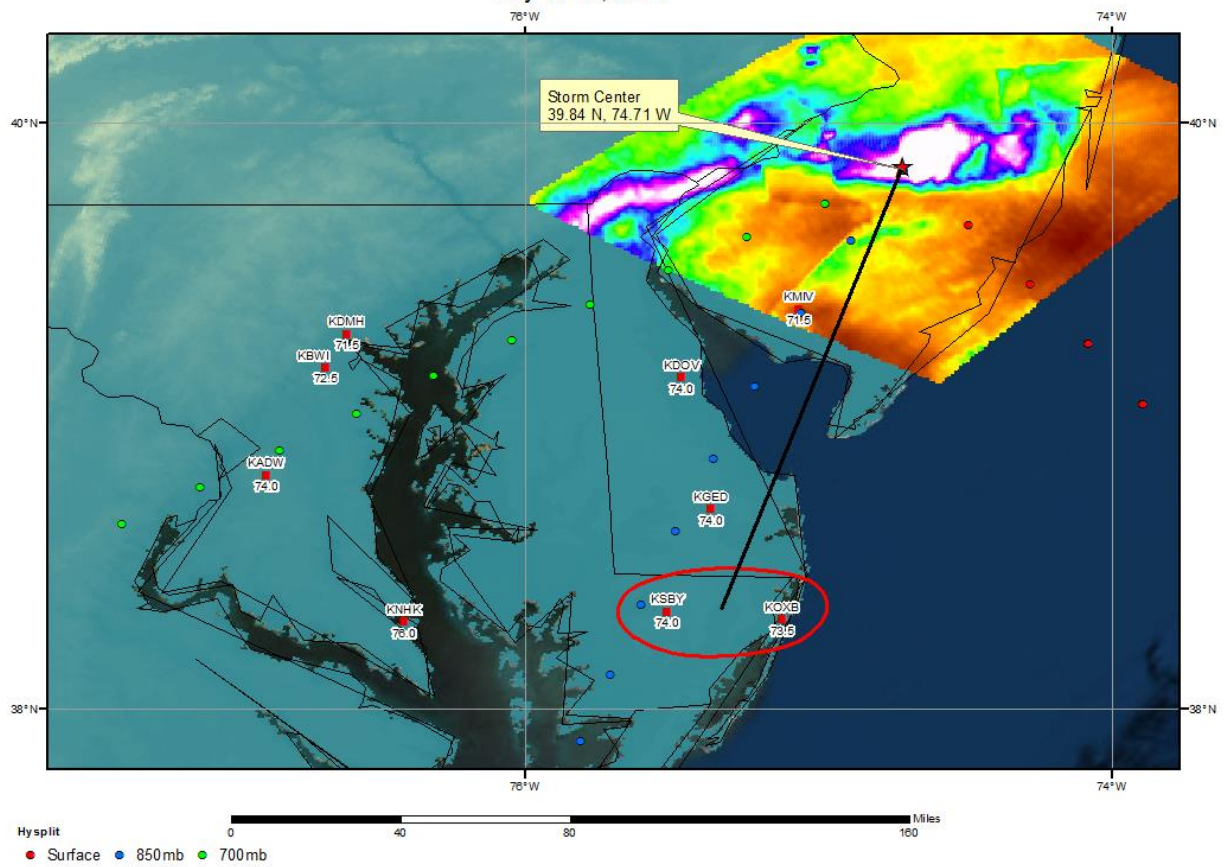


NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 13 Jul 04  
 CDC1 Meteorological Data





# SPAS 1040 Tabernacle, NJ Storm Analysis July 11-12, 2004



## Storm Precipitation Analysis System (SPAS) For Storm #1049\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Delaware County, NY

**Storm Dates:** 6/19/2007 1600Z – 6/20/2007 0700Z

**Event:** Cloudburst Thunderstorm

### DAD Zone 1

**Latitude:** 42.01

**Longitude:** -74.90

**Max. Grid/Radar Rainfall Amount:** 11.69" (Grid/Pixel Point)

**Max. Observed Rainfall Amount:** 11.10" (9.58" grid cell at Bucket Data 6 "Upper Spring Brook", this station is located at a large precipitation gradient. Bucket Data 7 "Lower Spring Brook" Max. Obs 11.00" 10.38 Grid Cell)

**Number of Stations:** 65 (17-hourly, 1 hourly pseudo, 29-daily, 18-daily supplemental) gauging stations within the defined search domain.

**SPAS Version:** 5.0

**Base Map Used:** No

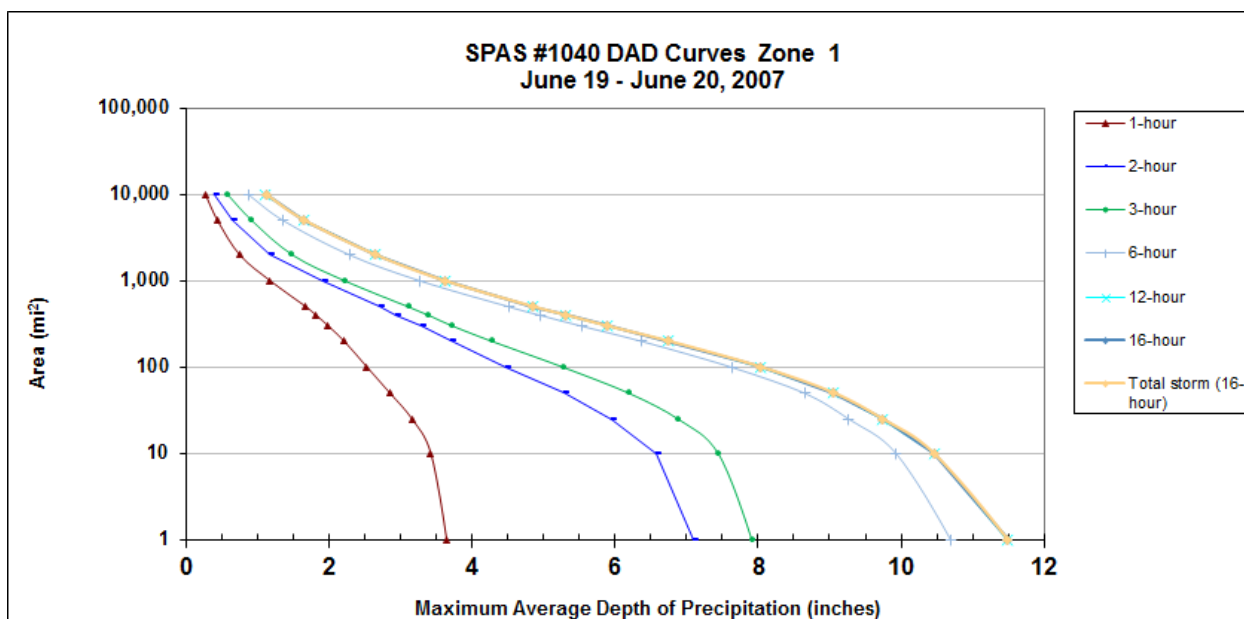
**Spatial resolution:** 0.36 mi<sup>2</sup>

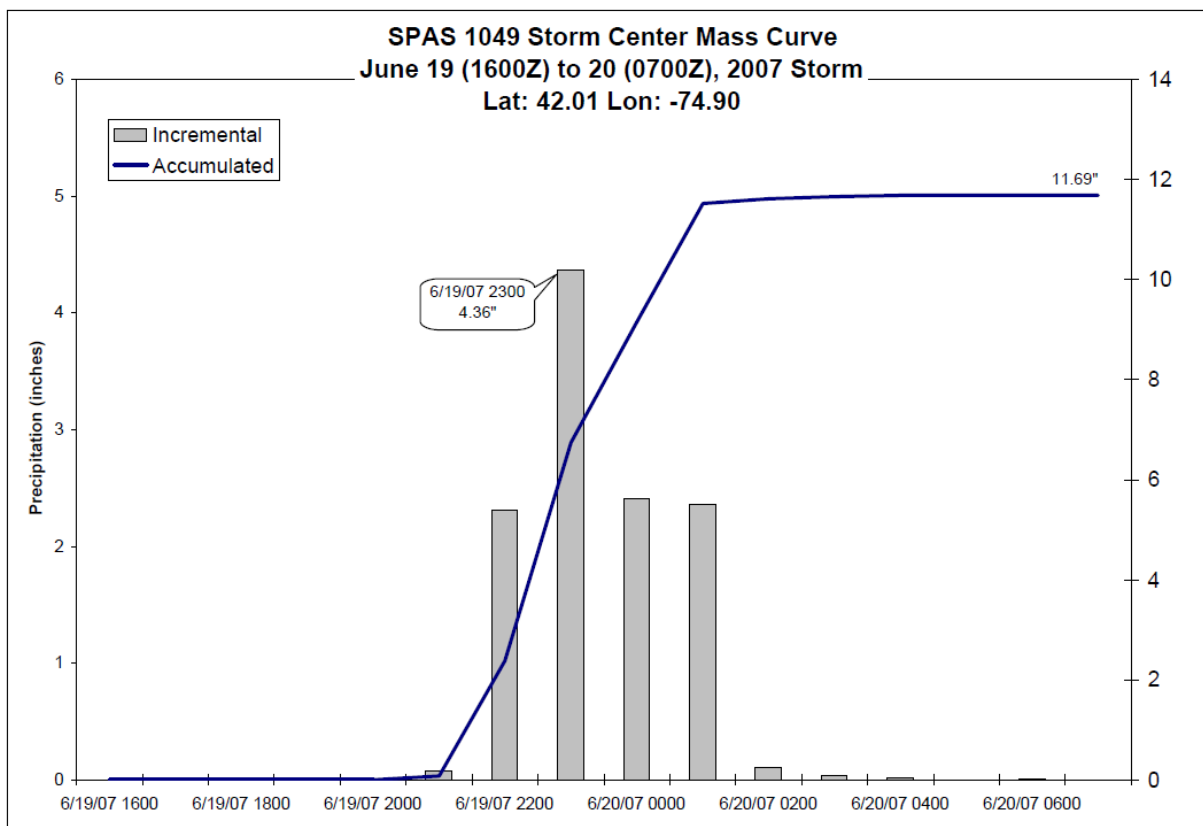
**Radar Included:** Yes, Weather Decision Technologies (WDT) Level-II radar reflectivity data based on Binghamton, NY (KBGM) NEXRAD.

**Depth-Area-Duration (DAD) analysis:** Yes: 1, 2, 3, 4, 5, 6, 12, & 16 hours

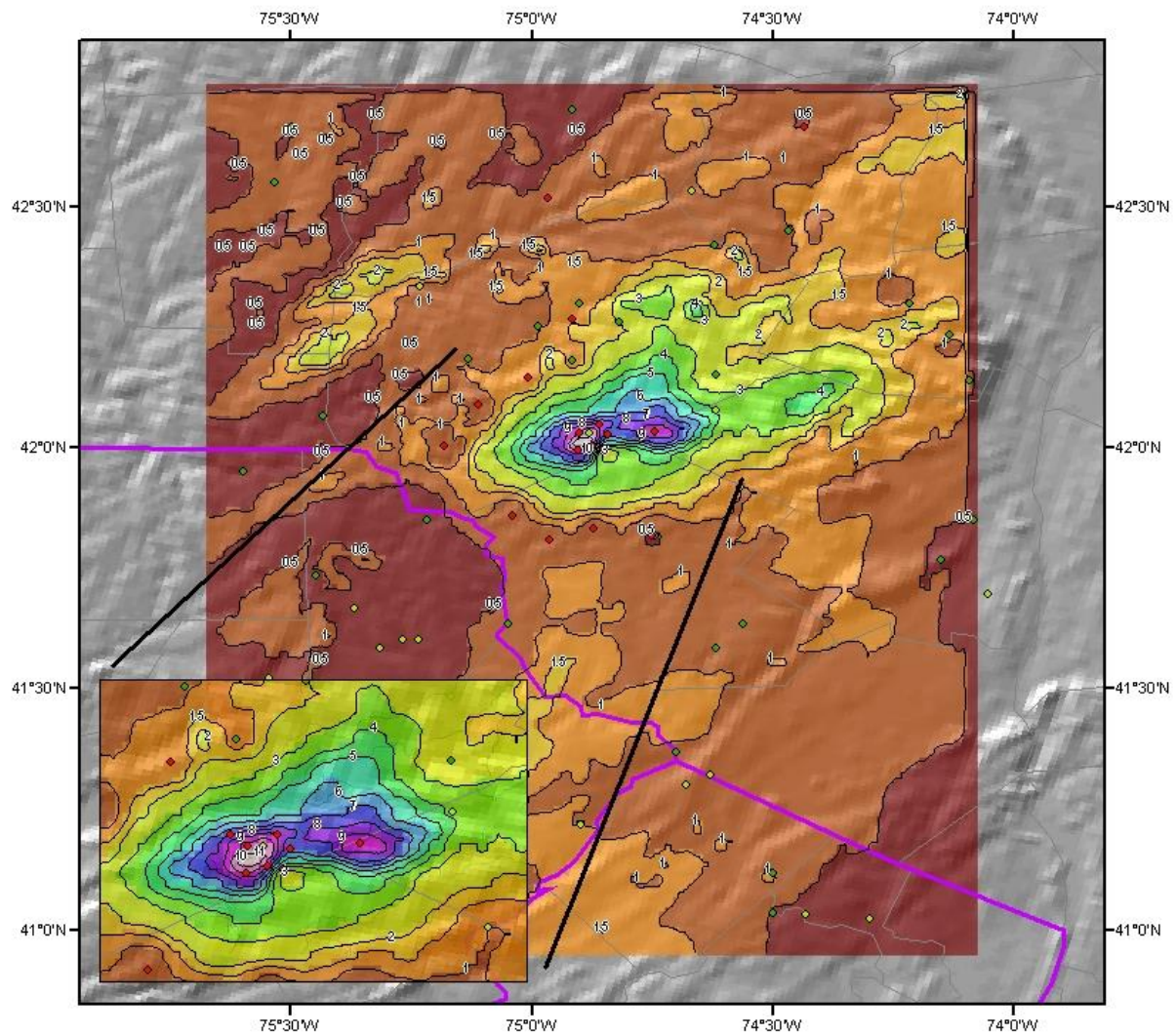
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. Dew Point					Climatological Max. Dew Point					IPMF	
						T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1049_1	-74.9000	42.0100	2,157	2,200	1-Jul	71.00	2.36	0.46	64	1.900	77.34	77.5	3.22	0.57	77	2.645	1.392

Storm 1049 - June 19 (1700 UTC) - June 20 (0800 UTC), 2007							
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)							
Area (mi <sup>2</sup> )	Duration (hours)						
	1	2	3	6	12	16	Total
0.4	3.67	7.19	8.00	10.82	11.69	11.69	11.69
1	3.63	7.10	7.92	10.69	11.49	11.49	11.49
10	3.41	6.57	7.45	9.93	10.46	10.46	10.46
25	3.15	5.94	6.89	9.27	9.74	9.74	9.74
50	2.84	5.28	6.20	8.65	9.06	9.06	9.06
100	2.52	4.48	5.28	7.63	8.04	8.04	8.04
200	2.20	3.70	4.28	6.37	6.74	6.74	6.74
300	1.98	3.28	3.73	5.53	5.88	5.88	5.88
400	1.81	2.94	3.39	4.95	5.31	5.31	5.31
500	1.67	2.71	3.11	4.52	4.85	4.85	4.85
1,000	1.17	1.91	2.22	3.27	3.61	3.61	3.61
2,000	0.74	1.17	1.48	2.28	2.63	2.64	2.64
5,000	0.43	0.63	0.91	1.35	1.64	1.65	1.65
10,000	0.26	0.39	0.57	0.86	1.09	1.11	1.11









**Total Rainfall (16-hours)**  
**Delaware County, NY 2007 Storm**  
**Storm #1049 June 19 (1600 Z) to 20 (0700 Z), 2007**



#### Gauging Stations

◆ Daily ◆ Hourly ◆ Hourly Pseudo ◆ Supplemental

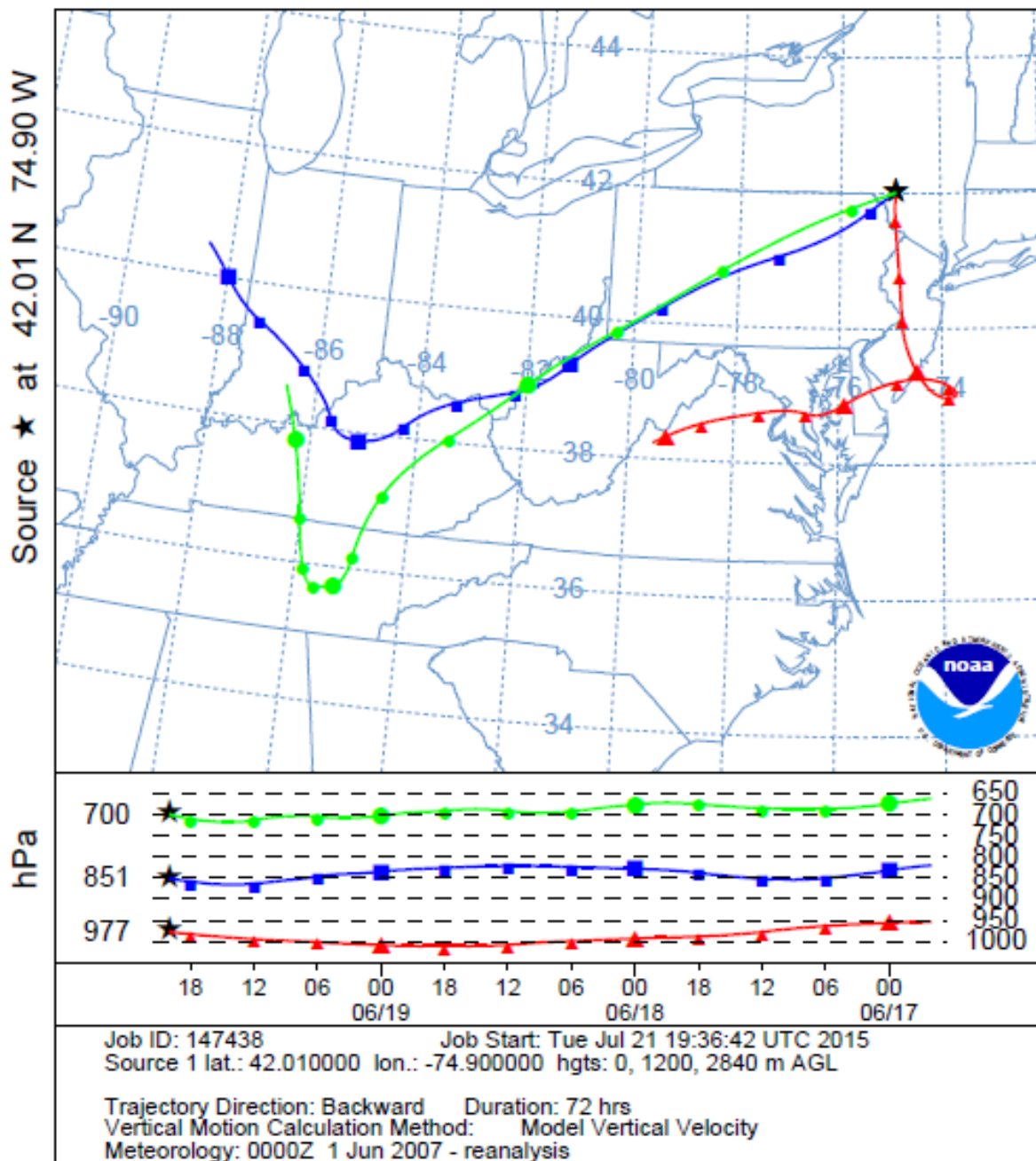
#### Precipitation (inches)



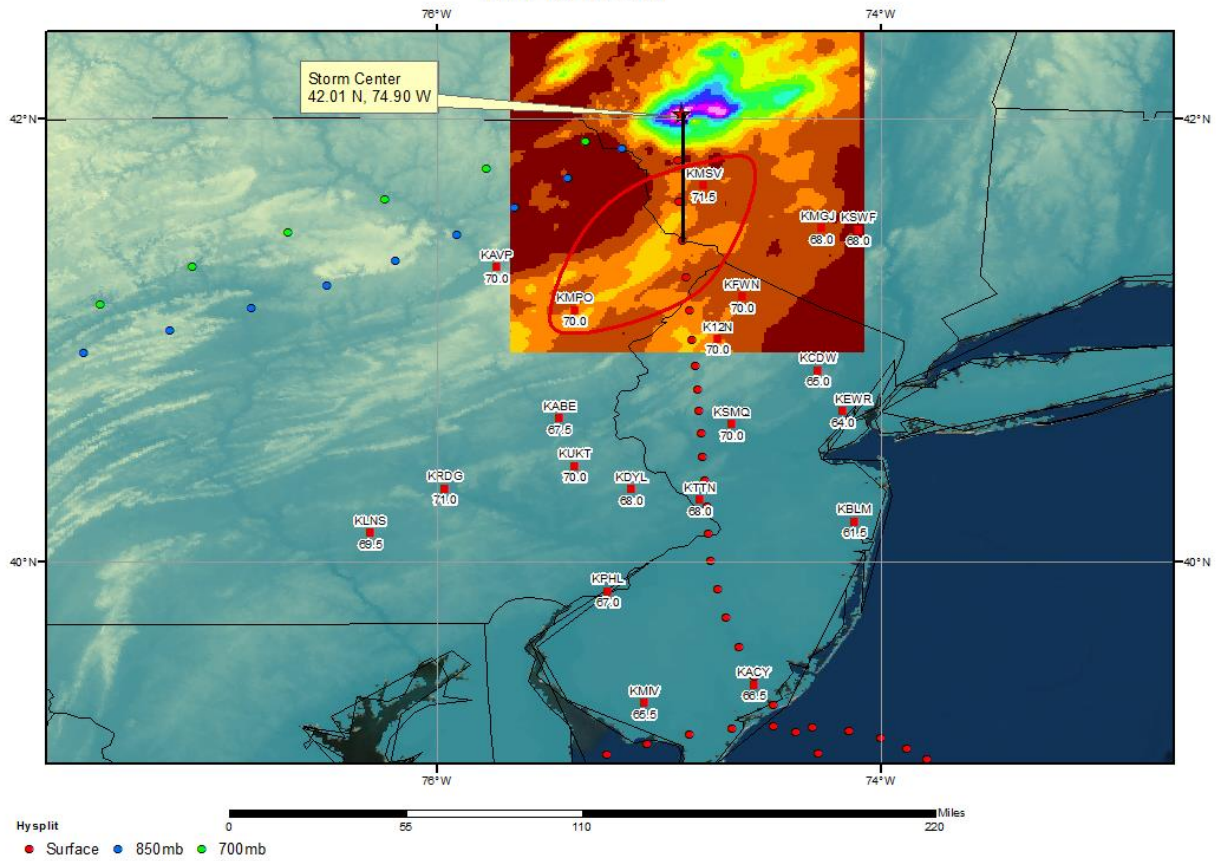
Coordinate system: GCS North American 1983  
 Scale: 1:1,290,388

Map Date: May 5, 2008

NOAA HYSPLIT MODEL  
 Backward trajectories ending at 2000 UTC 19 Jun 07  
 CDC1 Meteorological Data



# SPAS 1049 Delaware County, NY Storm Analysis June 18-19, 2007



## Storm Precipitation Analysis System (SPAS) For Storm #1415\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Islip, NY

**Storm Dates:** August 13, 2014

**Event:** Convective

**DAD Zone 1**

**Latitude:** 40.805

**Longitude:** -73.065

**Max. Grid Rainfall Amount:** 14.23"

**Max. Observed Rainfall Amount:** 13.51"

**Number of Stations:** 253 (96 Daily, 97 Hourly, 11 Hourly Pseudo, 49 Supplemental, and 0 Supplemental Estimated)

**SPAS Version:** 9.5/10.0

**Basemap:** Default ZR Radar Estimated Rainfall

**Spatial resolution:** 0.01 (~ 0.40 mi<sup>2</sup>)

**Radar Included:** Yes

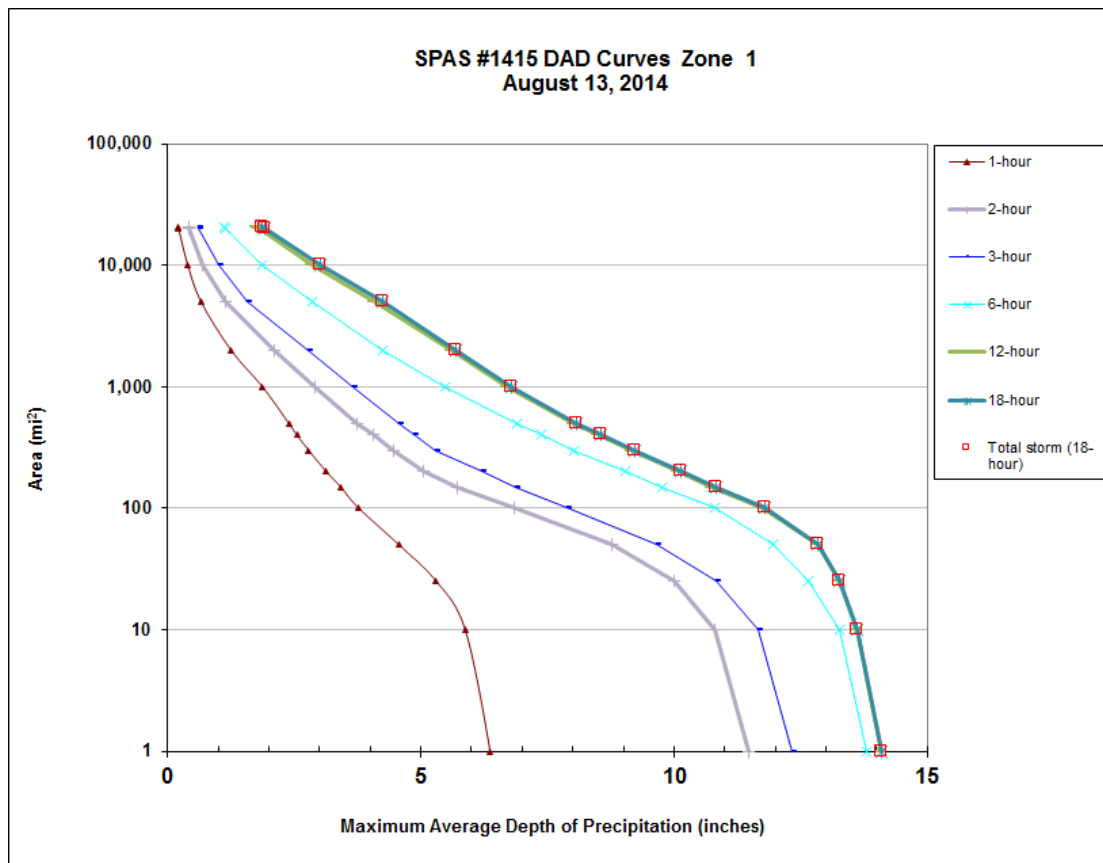
**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of results:** This analysis was based on hourly data, daily data, supplemental station data and NEXRAD Radar. We have a high degree of confidence in the radar/station based storm total results, the spatial pattern is dependent on the radar data and basemap, and the timing is based on hourly and hourly pseudo stations.

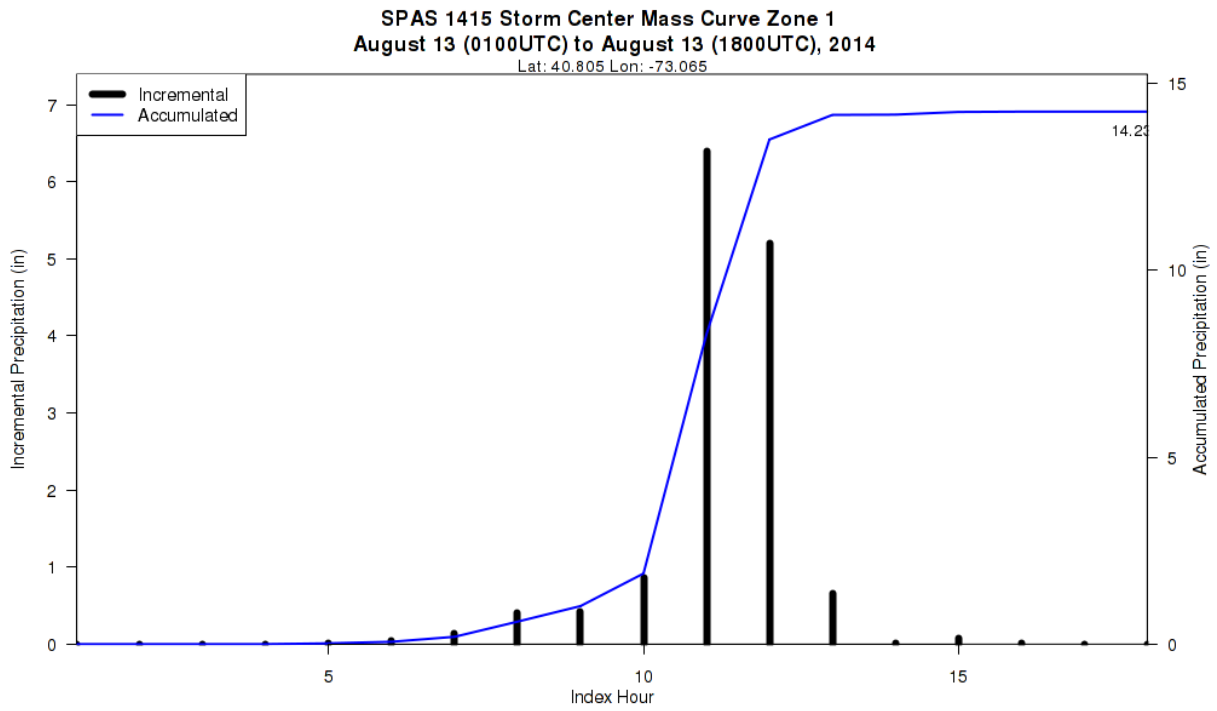
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1415_1	-73.0650	40.8050	80	100	15-Aug	76.50	3.07	0.03	75	3.035	78.50	78.5	3.37	0.03	79	3.335	1.099

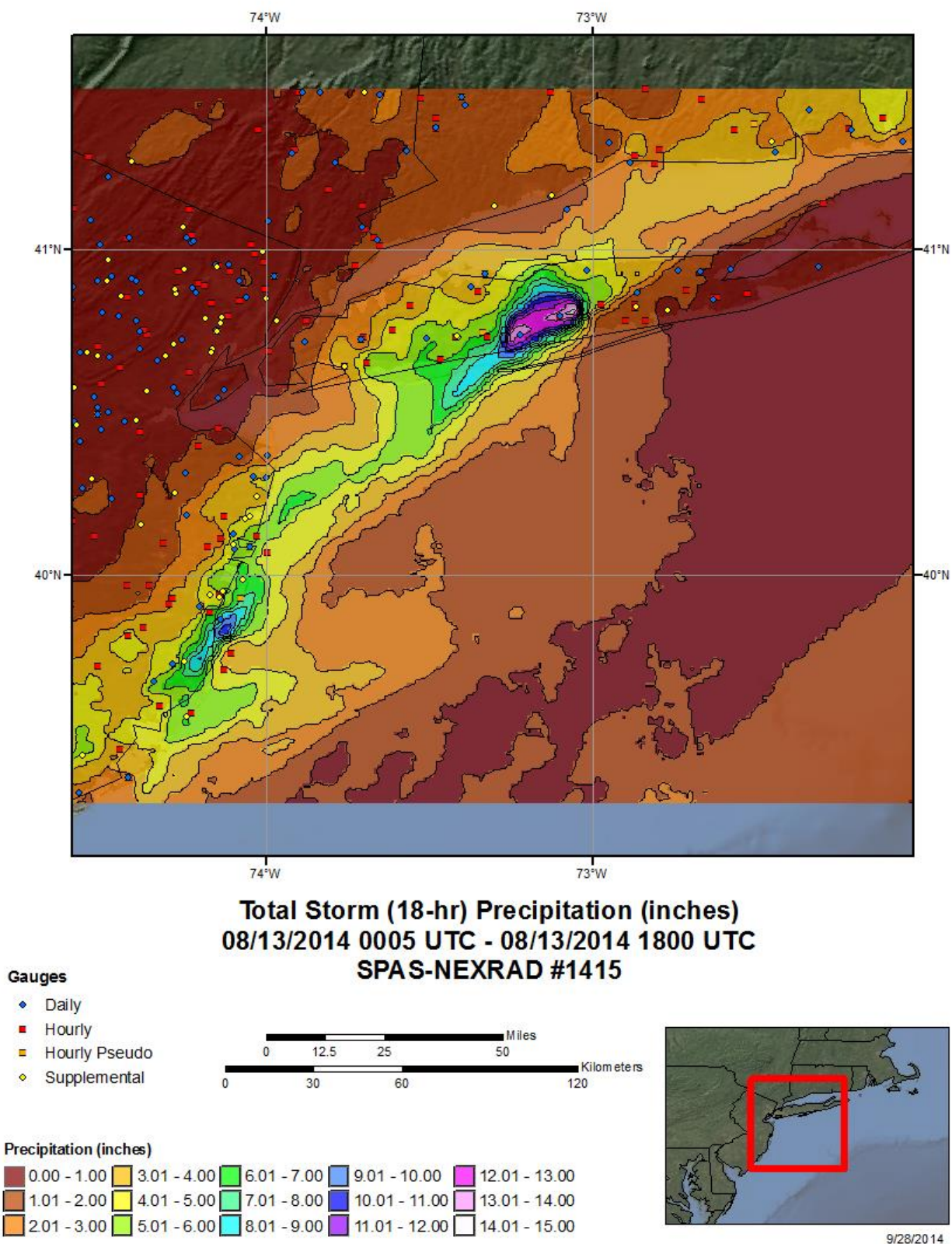


SPAS 1415 - August 13 (0100 UTC) - August 13 (1800 UTC), 2014							
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)							
Area (mi <sup>2</sup> )	Duration (hours)						
	1	2	3	6	12	18	Total
0.4	6.43	11.59	12.46	13.94	14.22	14.22	14.22
1	6.36	11.46	12.33	13.81	14.09	14.09	14.09
10	5.87	10.79	11.66	13.27	13.60	13.61	13.61
25	5.30	10.00	10.84	12.64	13.26	13.27	13.27
50	4.56	8.77	9.66	11.96	12.84	12.85	12.85
100	3.77	6.83	7.88	10.81	11.75	11.78	11.78
150	3.41	5.72	6.87	9.75	10.76	10.83	10.83
200	3.13	5.05	6.20	9.03	10.08	10.14	10.14
300	2.78	4.46	5.28	8.03	9.16	9.23	9.23
400	2.55	4.06	4.86	7.37	8.50	8.56	8.56
500	2.39	3.74	4.56	6.89	8.01	8.08	8.08
1,000	1.87	2.91	3.65	5.49	6.72	6.79	6.79
2,000	1.25	2.11	2.78	4.24	5.60	5.69	5.69
5,000	0.66	1.14	1.58	2.85	4.10	4.24	4.24
10,000	0.40	0.70	1.01	1.87	2.85	3.01	3.01
20,000	0.22	0.43	0.62	1.15	1.81	1.91	1.91
20,565	0.21	0.42	0.60	1.13	1.77	1.87	1.87

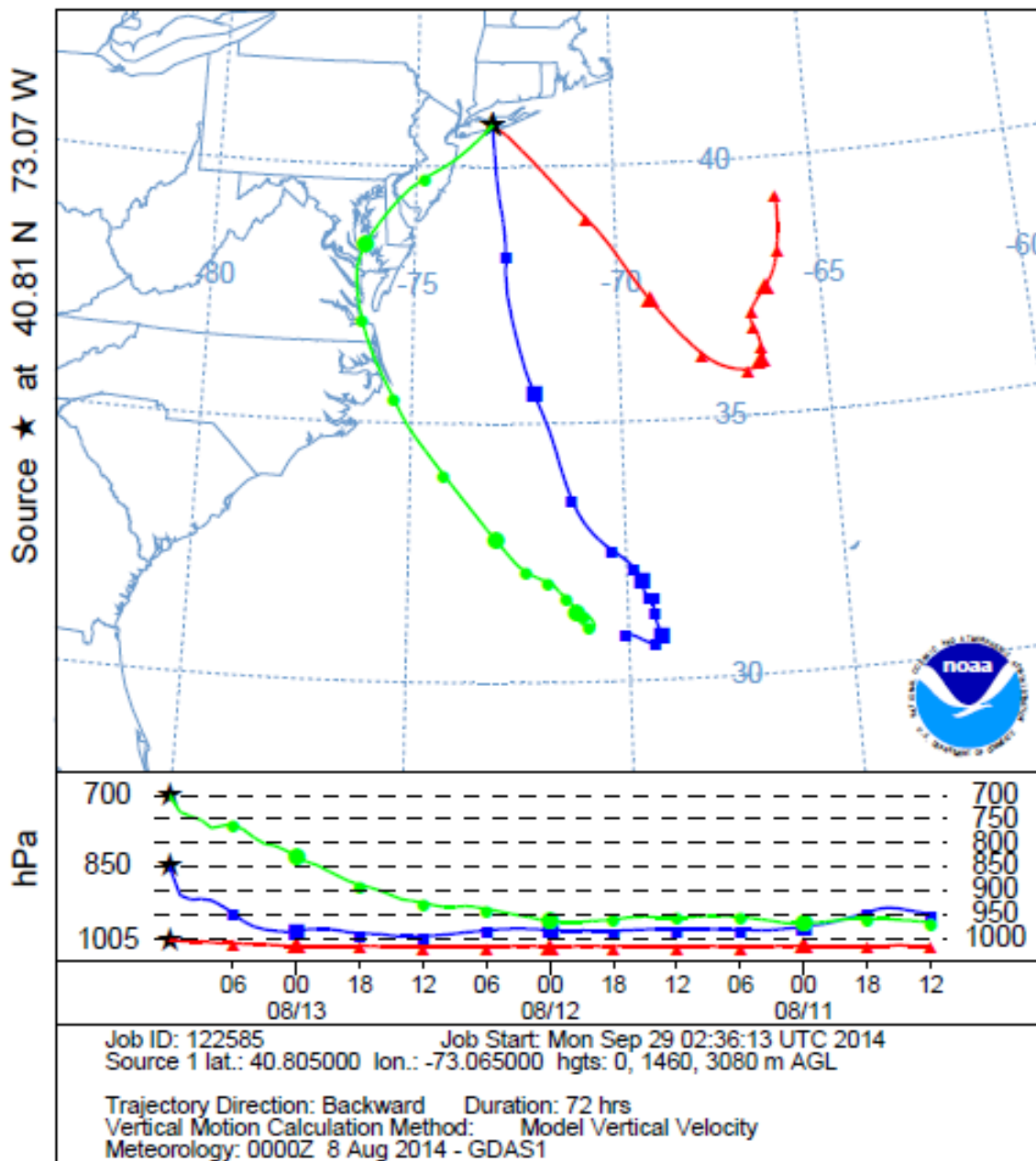




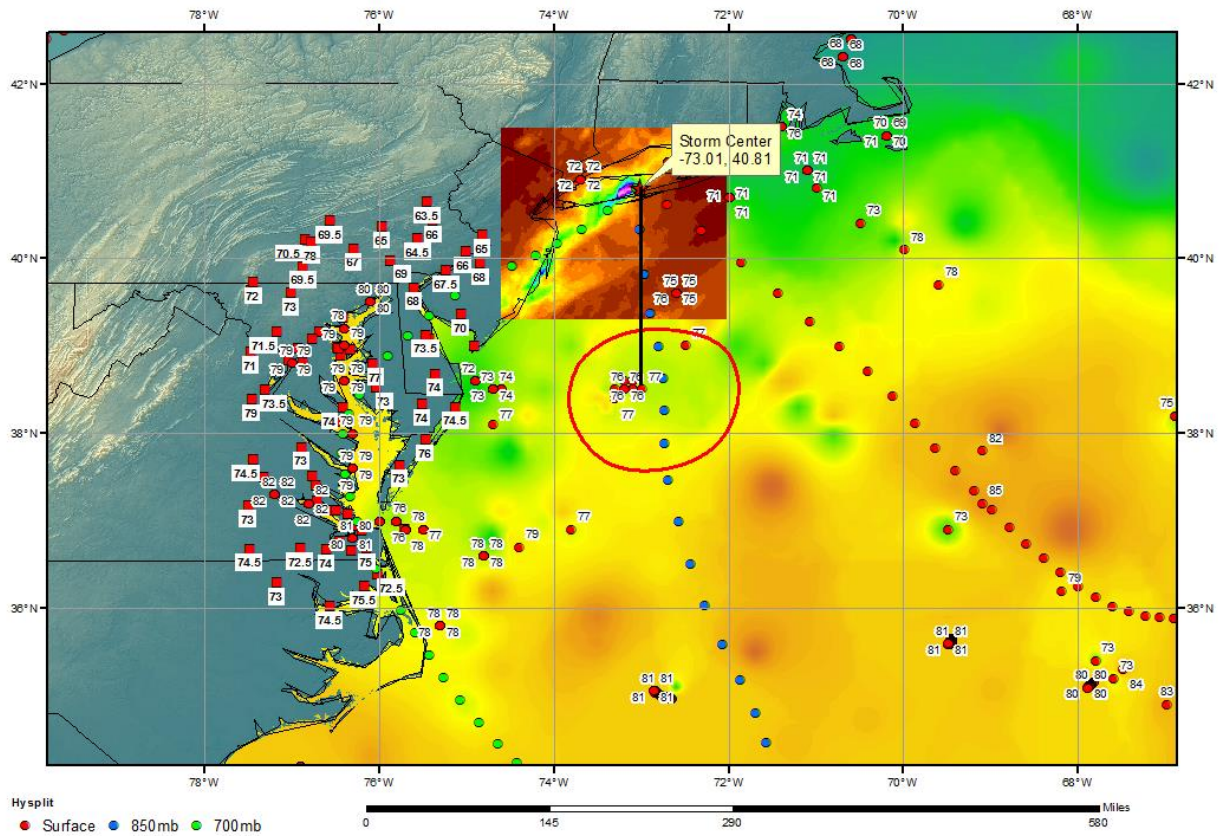




NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 13 Aug 14  
 GDAS Meteorological Data



**SPAS 1415 Islip, NY Storm Analysis**  
August 12, 2014



## Storm Precipitation Analysis System (SPAS) For Storm #1700\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Ellicott City, MD

**Storm Dates:** May 27-28, 2018

**Event:** Convective

**DAD Zone 1**

**Latitude:** 39.2650

**Longitude:** -76.7550

**Max. Grid Rainfall Amount:** 14.22"

**Max. Observed Rainfall Amount:** 13.38"

**Number of Stations:** 963

**SPAS Version:** 10.0

**Basemap:** Precipitation derived from SPAS Default ZR

**Spatial resolution:** 0.01 decimal degree (0.37-sqmi)

**Radar Included:** Yes

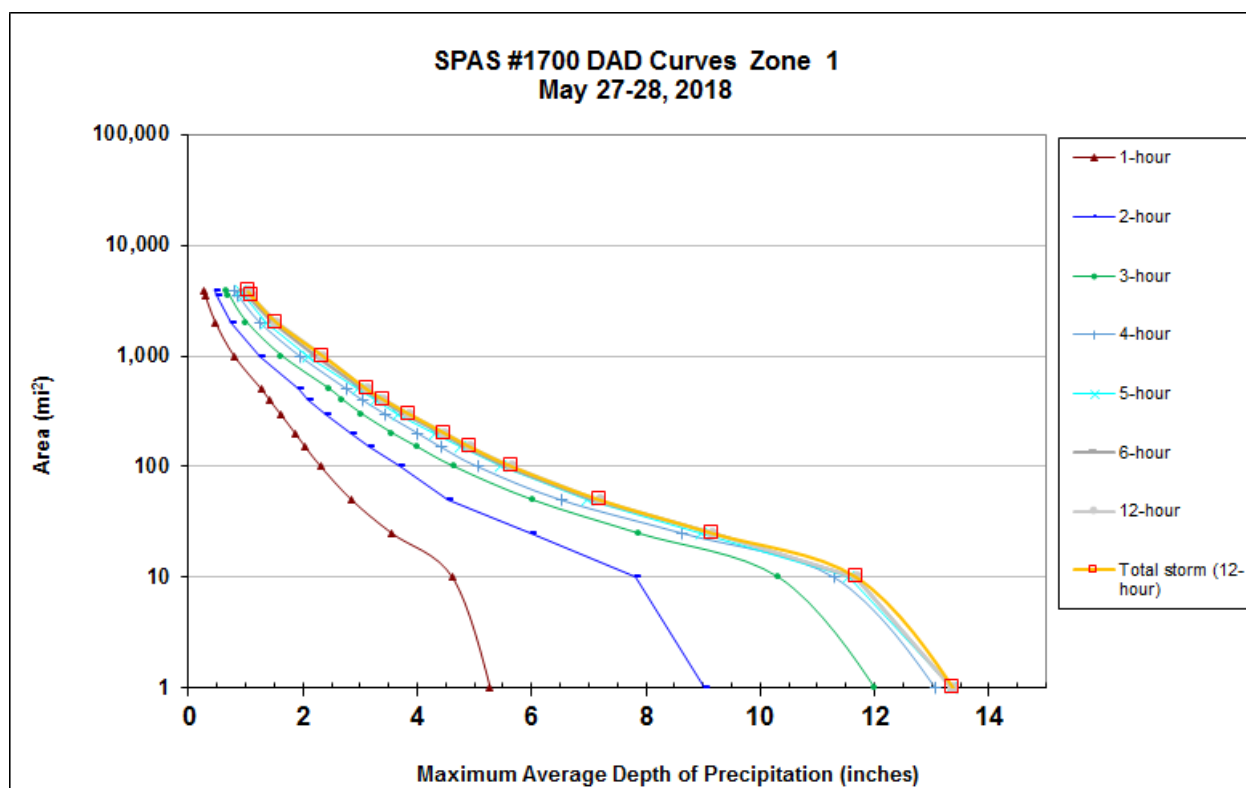
**Depth-Area-Duration (DAD) analysis:** Yes

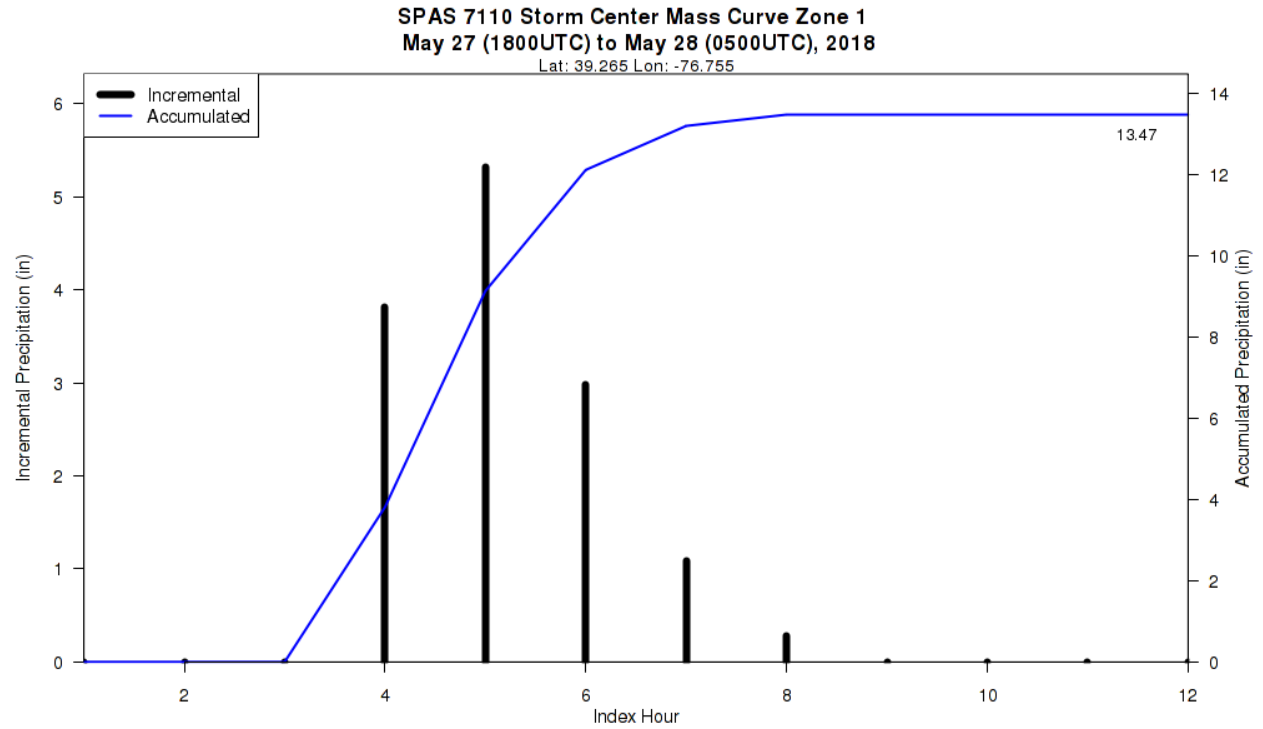
**Reliability of results:** This analysis was based on 963 hourly stations, daily data, supplemental station data, and radar data. We have a good degree of confidence for the radar adjusted and station based storm total results. The spatial pattern is dependent on the radar data, gauge data, and basemap. There is a good degree of confidence with the timing based on the hourly stations near the storm center. Some daily stations were moved to supplemental due to timing issues.

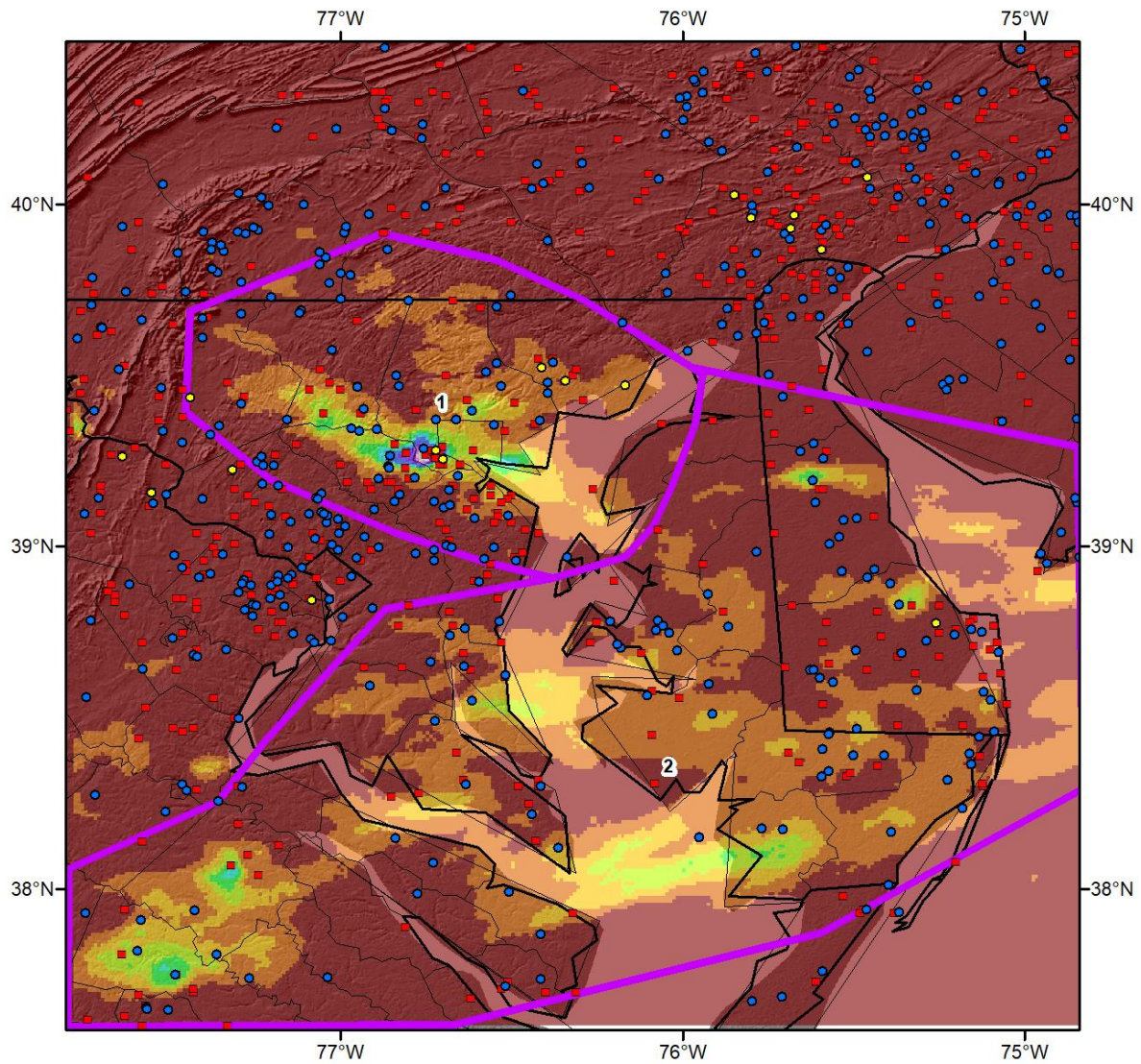
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. Dew Point					Climatological Max. Dew Point					IPMF	
						T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1700_1	-76.7550	39.2650	404	400	10-Jun	73.50	2.67	0.10	69	2.565	77.10	77.0	3.14	0.11	76	3.030	1.181



Storm 1700 - May 27 (1800 UTC) - May 28 (0500 UTC), 2018								
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)								
Area (mi <sup>2</sup> )	Duration (hours)							
	1	2	3	4	5	6	12	Total
0.4	5.31	9.12	12.10	13.18	13.46	13.46	13.46	13.46
1	5.27	9.03	12.00	13.07	13.35	13.37	13.37	13.37
10	4.61	7.81	10.32	11.30	11.56	11.68	11.68	11.68
25	3.55	6.00	7.87	8.64	8.98	9.16	9.16	9.16
50	2.85	4.53	6.02	6.52	6.98	7.10	7.19	7.19
100	2.31	3.68	4.64	5.06	5.46	5.57	5.66	5.66
150	2.04	3.17	4.00	4.42	4.75	4.85	4.93	4.93
200	1.86	2.85	3.56	4.01	4.30	4.40	4.48	4.48
300	1.60	2.39	3.02	3.43	3.67	3.77	3.85	3.85
400	1.41	2.10	2.69	3.04	3.26	3.35	3.42	3.42
500	1.27	1.91	2.46	2.77	2.97	3.05	3.12	3.12
1,000	0.79	1.24	1.62	1.94	2.09	2.22	2.35	2.35
2,000	0.47	0.75	1.01	1.25	1.36	1.46	1.54	1.54
3,500	0.29	0.50	0.70	0.87	0.97	1.04	1.10	1.10
3,826	0.27	0.46	0.65	0.81	0.90	0.97	1.04	1.04



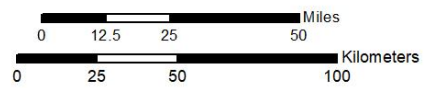




**Total 12-hour Rainfall (inches)**  
**05/27/2018 1800 UTC - 05/28/2018 0500 UTC**  
**SPAS-Nexrad 1700**

**Gauges**

- Daily
- Hourly
- Supplemental



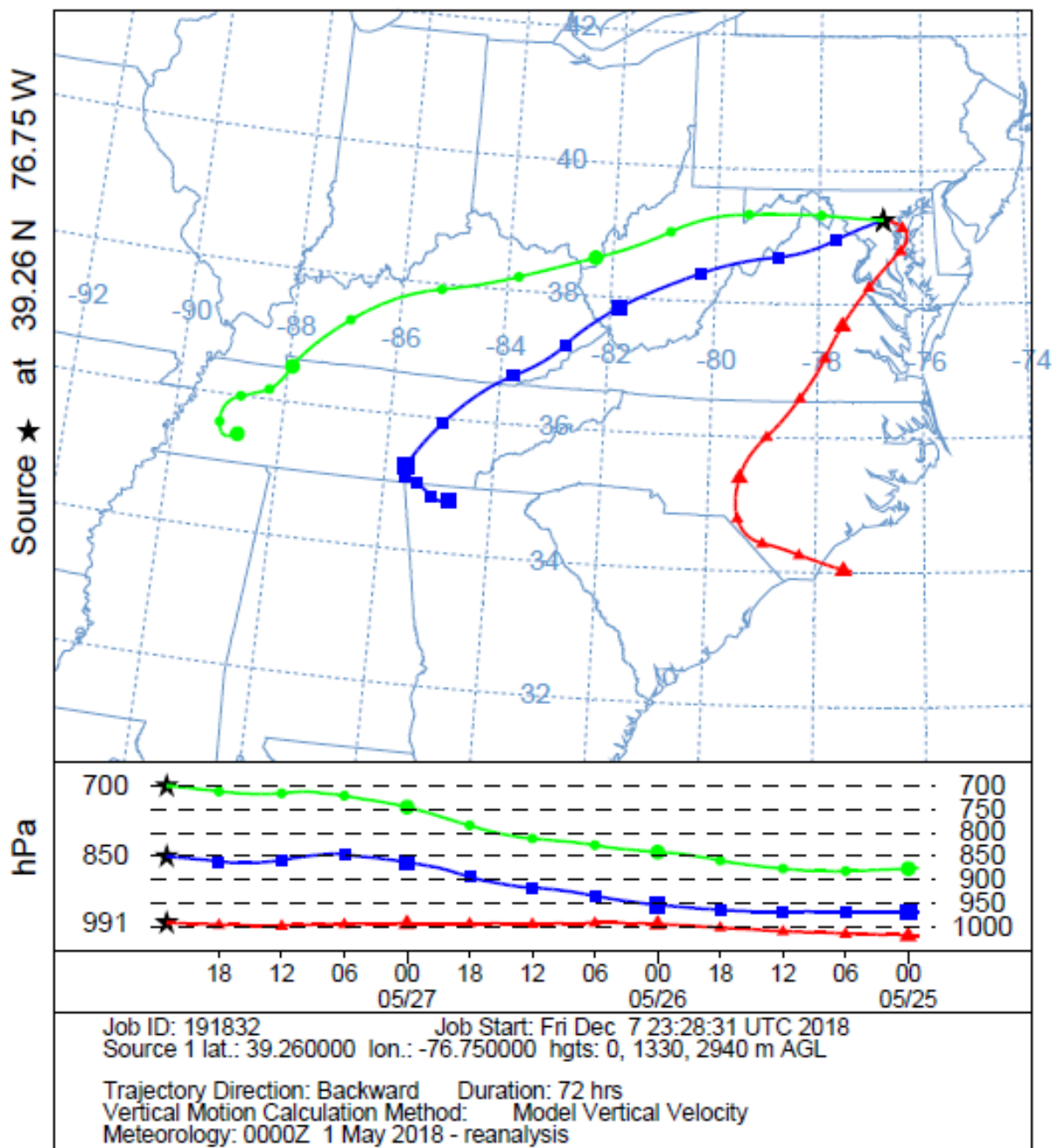
**Precipitation (inches)**

- |             |             |             |              |               |
|-------------|-------------|-------------|--------------|---------------|
| 0.00 - 1.00 | 2.01 - 3.00 | 4.01 - 5.00 | 6.01 - 8.00  | 10.01 - 12.00 |
| 1.01 - 2.00 | 3.01 - 4.00 | 5.01 - 6.00 | 8.01 - 10.00 | > 12.00       |



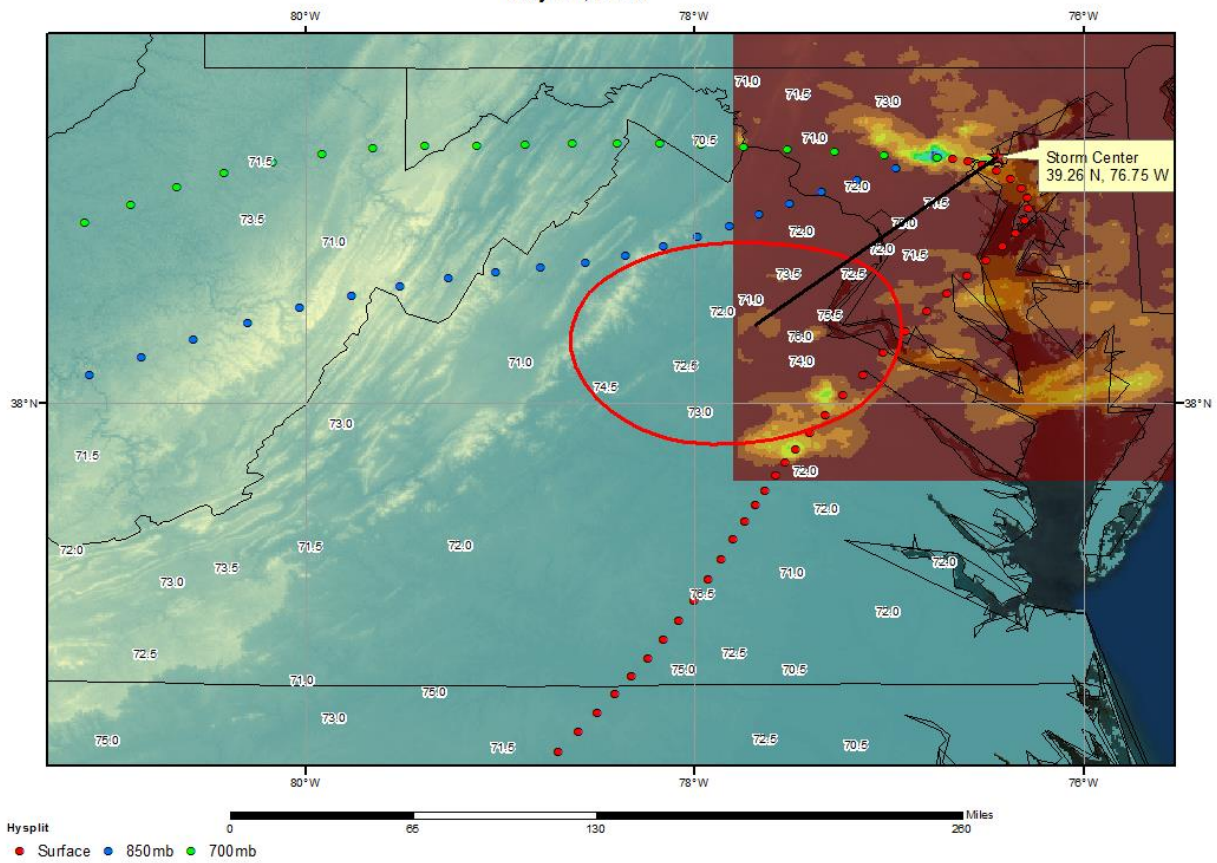
12/10/2018

NOAA HYSPLIT MODEL  
 Backward trajectories ending at 2300 UTC 27 May 18  
 CDC1 Meteorological Data





**SPAS 1700 Ellicott City, MD Storm Analysis**  
May 27, 2018





## **Tropical Storms**

## Storm Precipitation Analysis System (SPAS) For Storm #1565\_1 SPAS Analysis

**General Storm Location:** Paterson, NJ

**Storm Dates:** September 20-25, 1882

**Event:** Tropical storm four

**DAD Zone 1**

**Latitude:** 40.8875

**Longitude:** -74.0958

**Max. Grid Rainfall Amount:** 17.88"

**Max. Observed Rainfall Amount:** 17.80"

**Number of Stations:** 22 (3 Hourly Pseudo, 19 Supplemental)

**SPAS Version:** 10.0

**Basemap:** Blended basemap based on USACE NA 1-3 and conus\_prism\_ppt\_in\_1971\_2000\_09

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

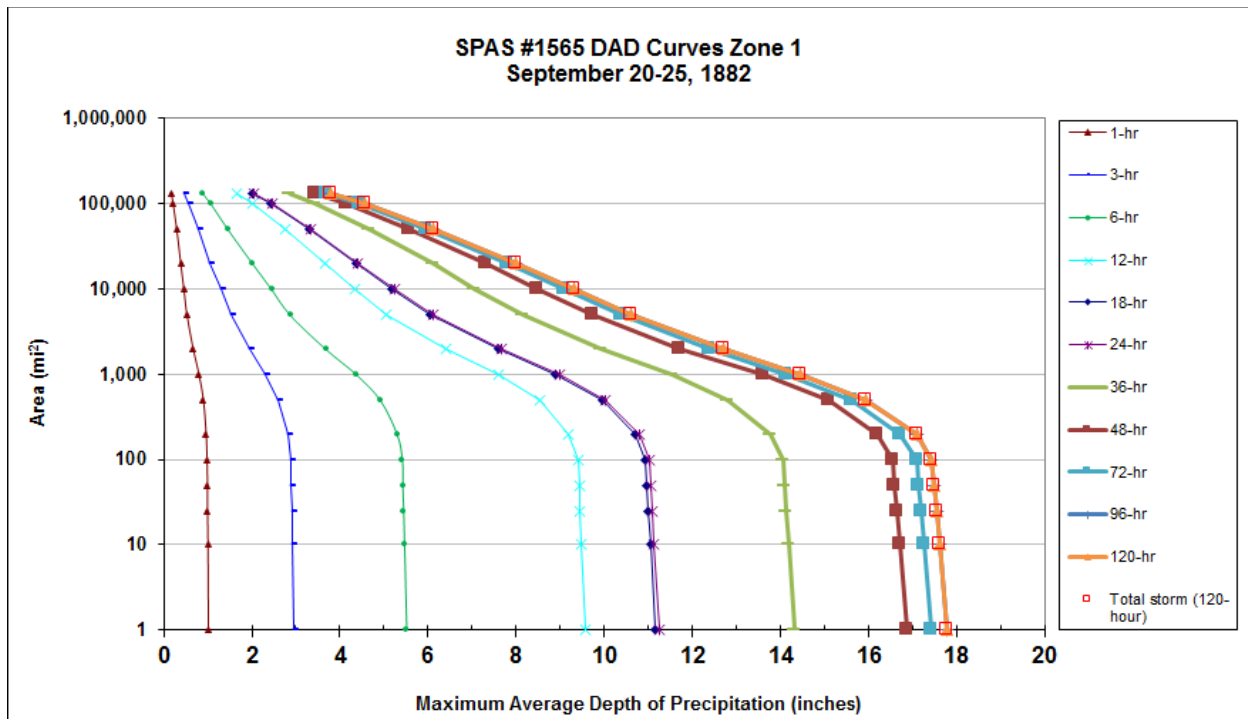
**Reliability of results:** This analysis was based on 22 hourly stations (USACE NA 1-4), daily data and supplemental station data. We have a lower degree of confidence for the station based results, limited station density surrounding storm center make rainfall spatial pattern and DAD values questionable. The spatial pattern is dependent on the blended basemap (85% of the USACE NA 1-3 isohyetal pattern and 15% of the conus\_prism\_ppt\_in\_1971\_2000\_09 climatology). Spatially, it looks very similar to the rainfall analysis from USACE. There is a good degree of confidence with the timing based on the USACE hourly stations near the storm center. Daily stations were moved to supplemental due to timing issues.

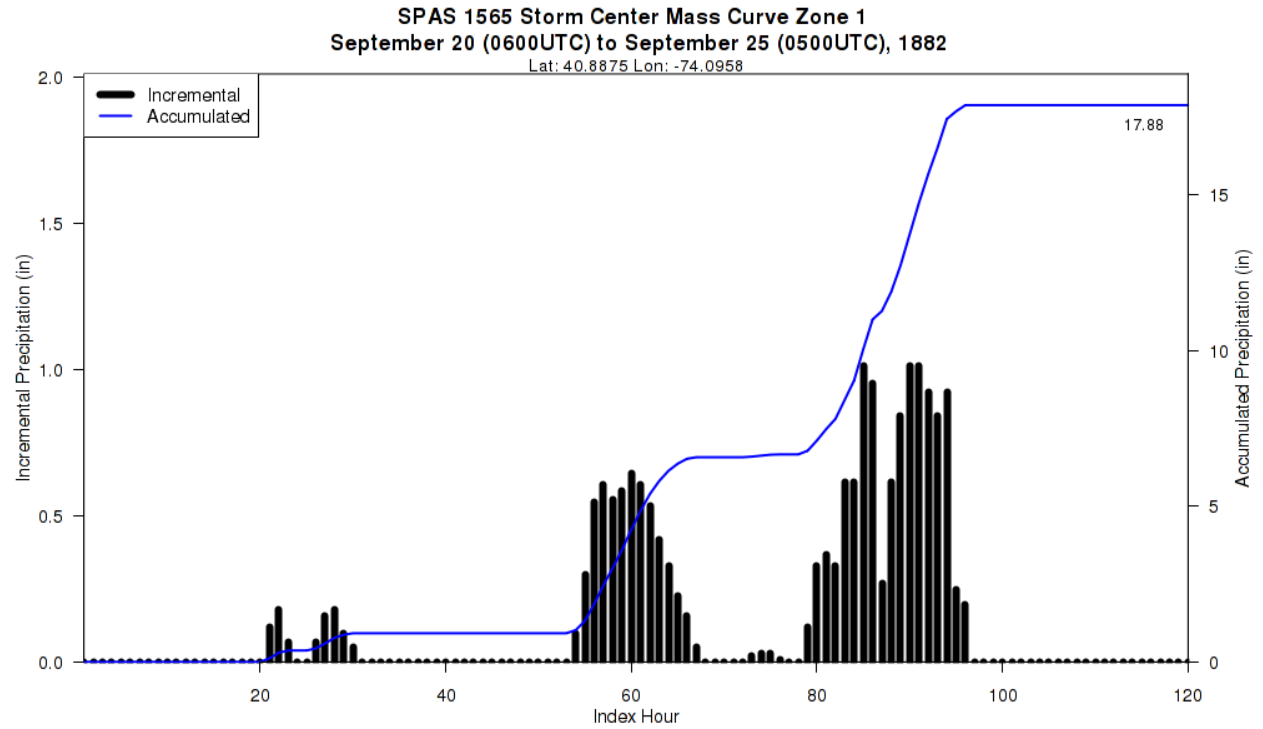
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1565_1	-74.0958	40.8875	52	100	7-Sep	80.00	3.60	0.03	82	3.570	83.00	83.0	4.12	0.03	88	4.090	1.146

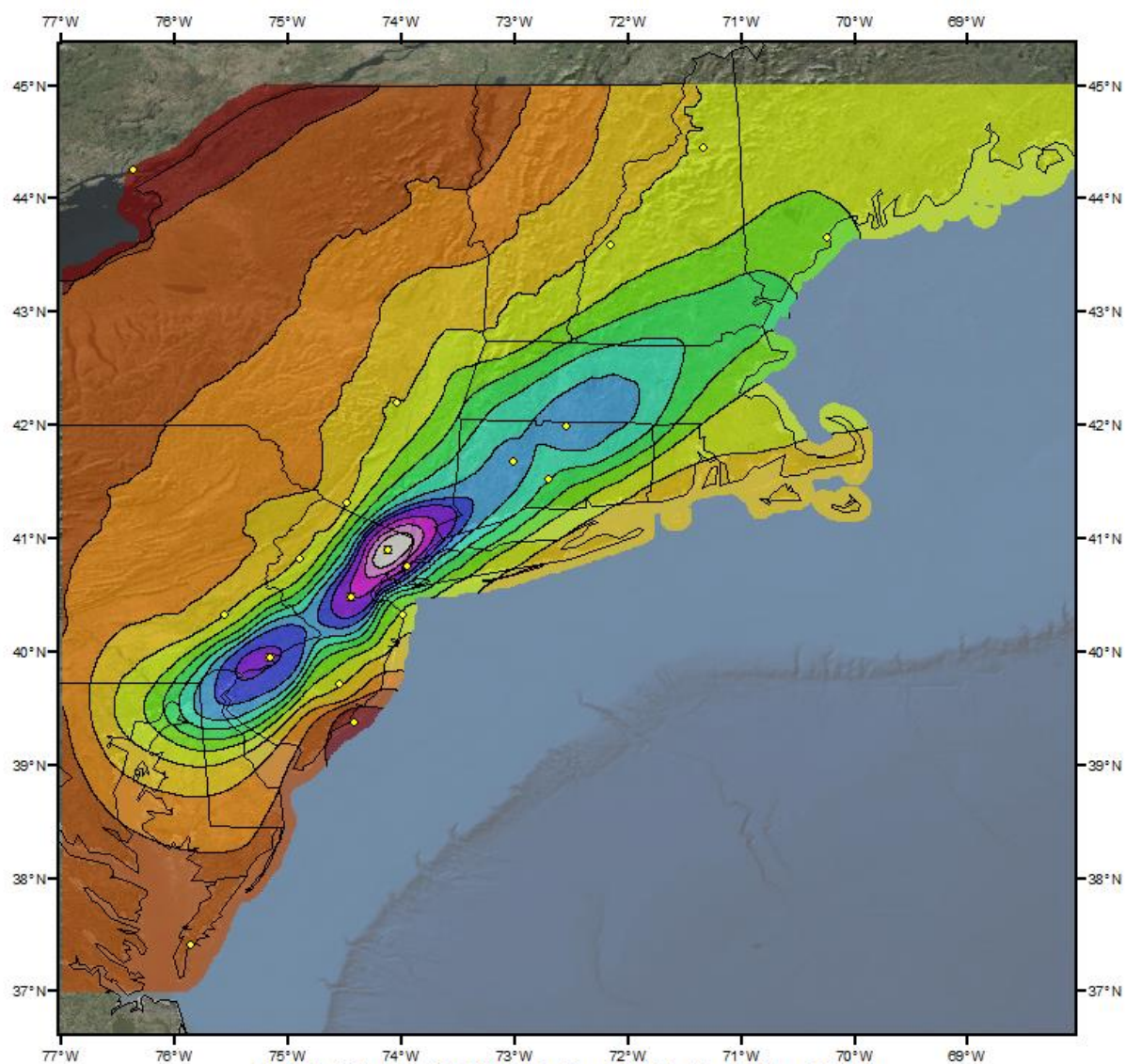
The storm representative value for this storm was calculated based on other similar storm events, in similar locations, and with similar synoptic patterns as the same time of the year. This was because there was insufficient observational data to derive the storm presentative value. This was initially completed as part of the Ashokan Reservoir PMP study. The following comment is noted from the Ashokan Reservoir PMP study Appendix F and the table below that is what the comment was referring to and the data used to develop the back calculated storm representative value and location. The table below provides the similar storm events utilized to derive the storm representative location and value.

	Storm Name	Inflow Direction	Inflow Direction	Inflow Distance		Temp Trans Date	Storm Rep	IPMF
	Tuckerton	SSE	157	305	SST	15-Aug	81	1.07
	Pinkham	SE	135	475	SST	5-Sep	75	1.23
	Irene	SSE	157	585	SST	15-Aug	81.5	1.08
	Harrisburg	SSE	157	500	SST	20-Aug	81.5	1.09
	Zerbe	ESE	112	610	SST	5-Jul	78	1.1
	Upper Shemando	ESE	112	480	SST	3-Sep	80.5	1.07
	West Shokan	SSE	157	510	SST	1-Oct	78	1.12
	Peekamoose	SE	157	785	SST	15-Aug	79	1.21
	Average		143	530		15-Aug	79.5	1.12
SPAS 1565	Paterson	40.890	-74.100	35	69	7-Sep	80	1.15

Storm 1565 Zone 1 - September 30 (0600 UTC) - September 25 (0500 UTC), 1882												
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)												
areasqmi	Duration (hours)											
	1-hr	3-hr	6-hr	12-hr	18-hr	24-hr	36-hr	48-hr	72-hr	96-hr	120-hr	Total
0.4	1.01	2.94	5.54	9.61	11.19	11.28	14.38	16.92	17.48	17.84	17.84	17.84
1	1.01	2.94	5.52	9.58	11.15	11.24	14.33	16.86	17.41	17.78	17.78	17.78
10	1.00	2.91	5.47	9.49	11.05	11.14	14.20	16.71	17.25	17.61	17.61	17.61
25	0.99	2.91	5.45	9.46	11.00	11.10	14.14	16.65	17.19	17.54	17.54	17.54
50	0.99	2.90	5.43	9.43	10.97	11.07	14.10	16.60	17.14	17.49	17.49	17.49
100	0.98	2.88	5.42	9.41	10.94	11.04	14.07	16.55	17.10	17.44	17.44	17.44
200	0.96	2.81	5.30	9.19	10.71	10.80	13.76	16.20	16.73	17.09	17.09	17.09
500	0.90	2.61	4.92	8.53	9.96	10.04	12.82	15.09	15.60	15.95	15.95	15.95
1,000	0.80	2.32	4.38	7.62	8.90	8.99	11.54	13.61	14.12	14.46	14.46	14.46
2,000	0.67	1.94	3.68	6.42	7.59	7.67	9.93	11.71	12.37	12.70	12.70	12.70
5,000	0.53	1.53	2.88	5.05	6.06	6.11	8.15	9.73	10.38	10.62	10.62	10.62
10,000	0.46	1.29	2.46	4.35	5.17	5.23	7.05	8.47	9.10	9.32	9.32	9.32
20,000	0.39	1.06	2.03	3.65	4.38	4.42	6.11	7.31	7.81	8.00	8.00	8.00
50,000	0.30	0.78	1.48	2.75	3.32	3.34	4.65	5.58	5.96	6.12	6.12	6.12
100,000	0.22	0.56	1.09	2.02	2.44	2.46	3.45	4.14	4.45	4.58	4.58	4.58
134,576	0.18	0.47	0.90	1.67	2.02	2.04	2.85	3.43	3.68	3.78	3.78	3.78







**Total Storm (120-hr) Precipitation (inches)**  
**09/20/1882 0600 UTC - 09/25/1882 0500 UTC**  
**SPAS #1565**

#### Gauges

- ◆ Daily
- Hourly Pseudo
- ◇ Supplemental



#### Precipitation (inches)

0.00 - 1.00	3.01 - 4.00	6.01 - 7.00	9.01 - 10.00	14.01 - 16.00
1.01 - 2.00	4.01 - 5.00	7.01 - 8.00	10.01 - 12.00	16.01 - 18.00
2.01 - 3.00	5.01 - 6.00	8.01 - 9.00	12.01 - 14.00	



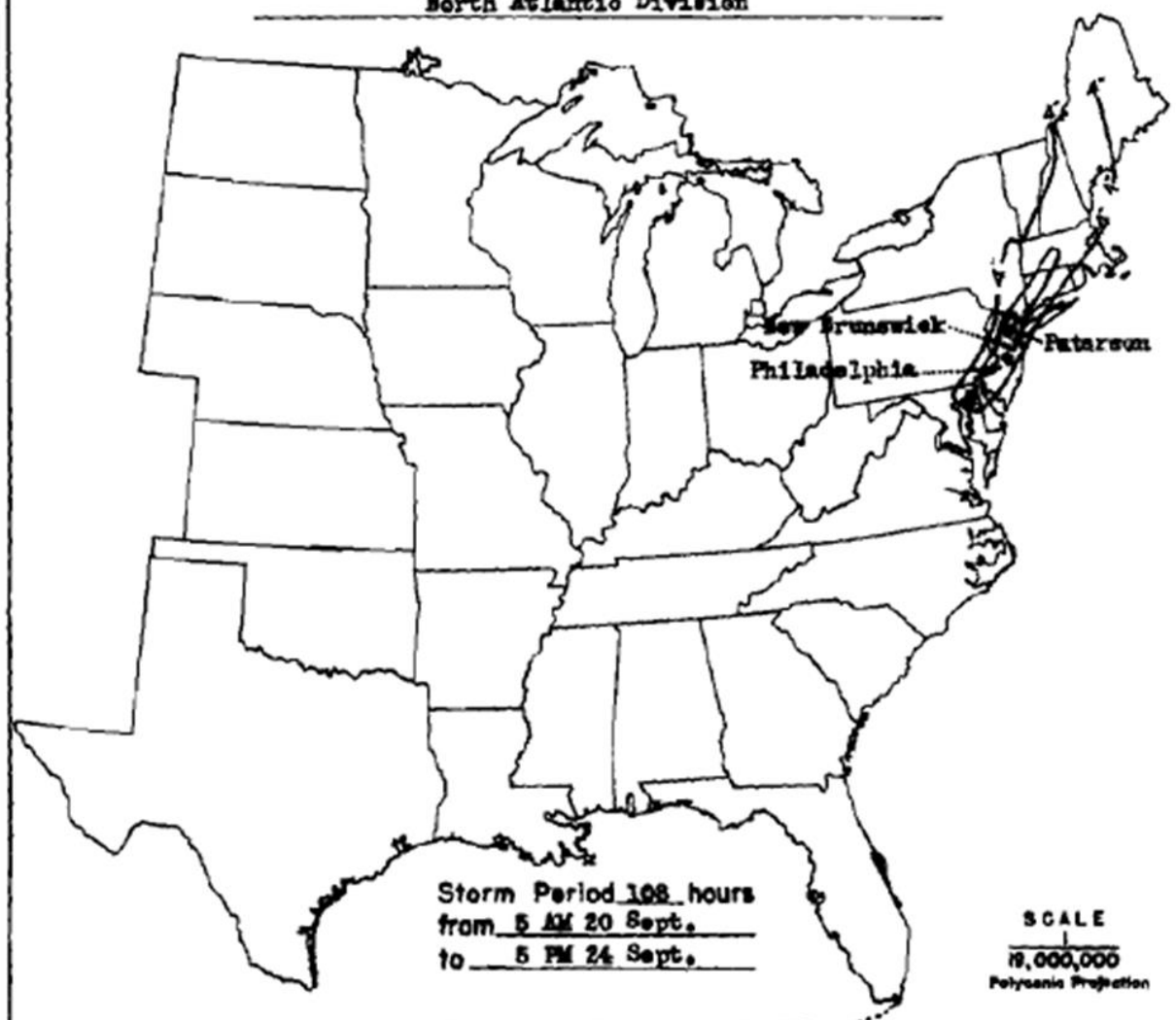
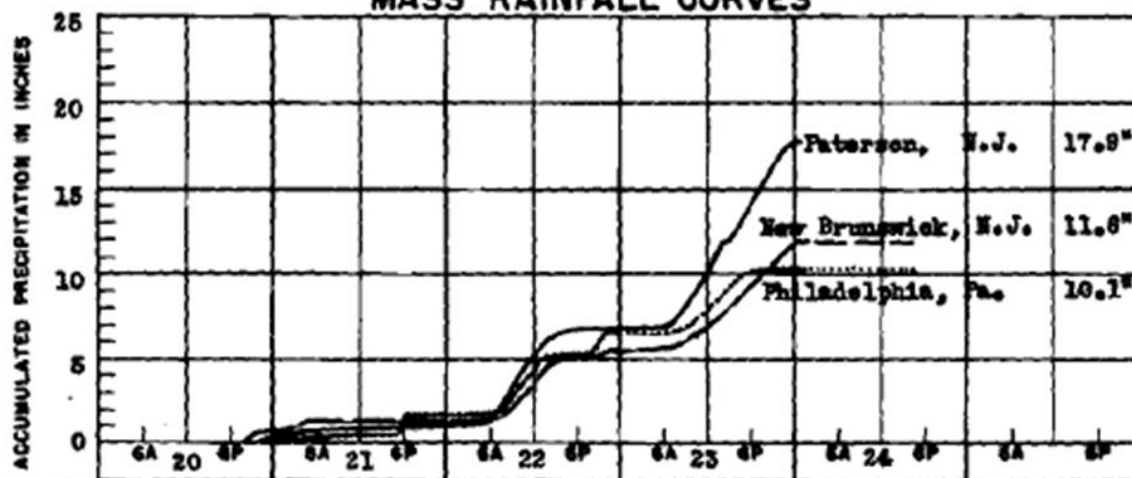
1/19/2016



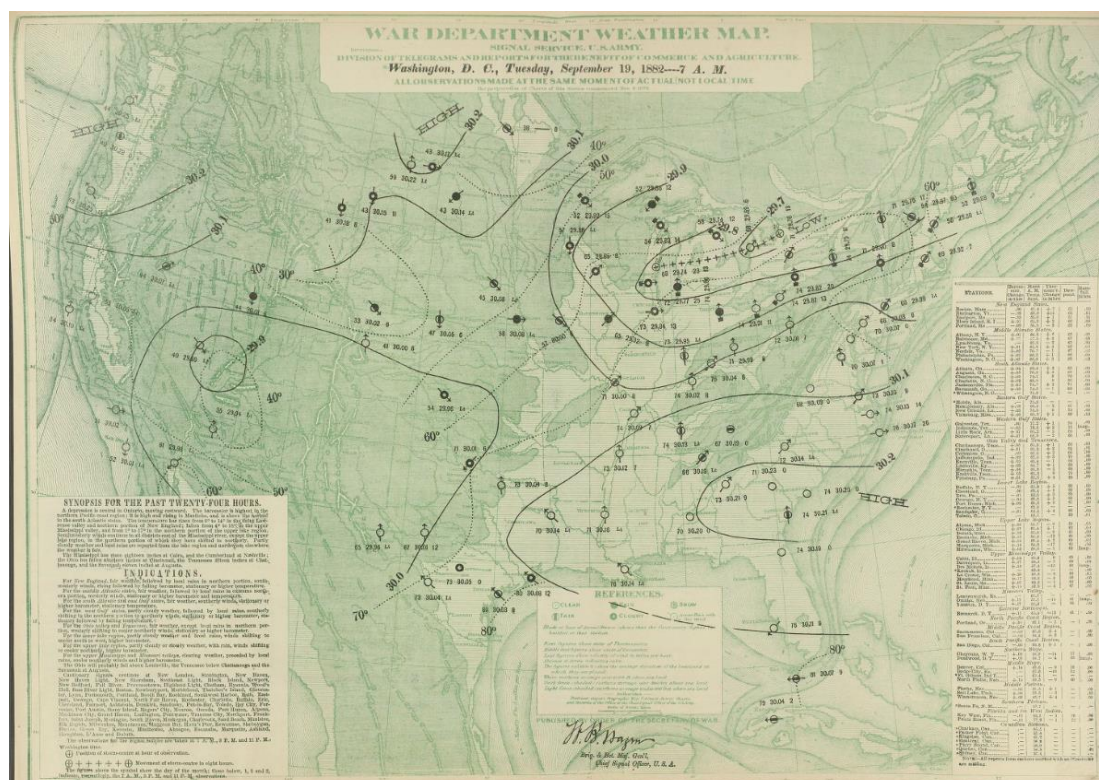
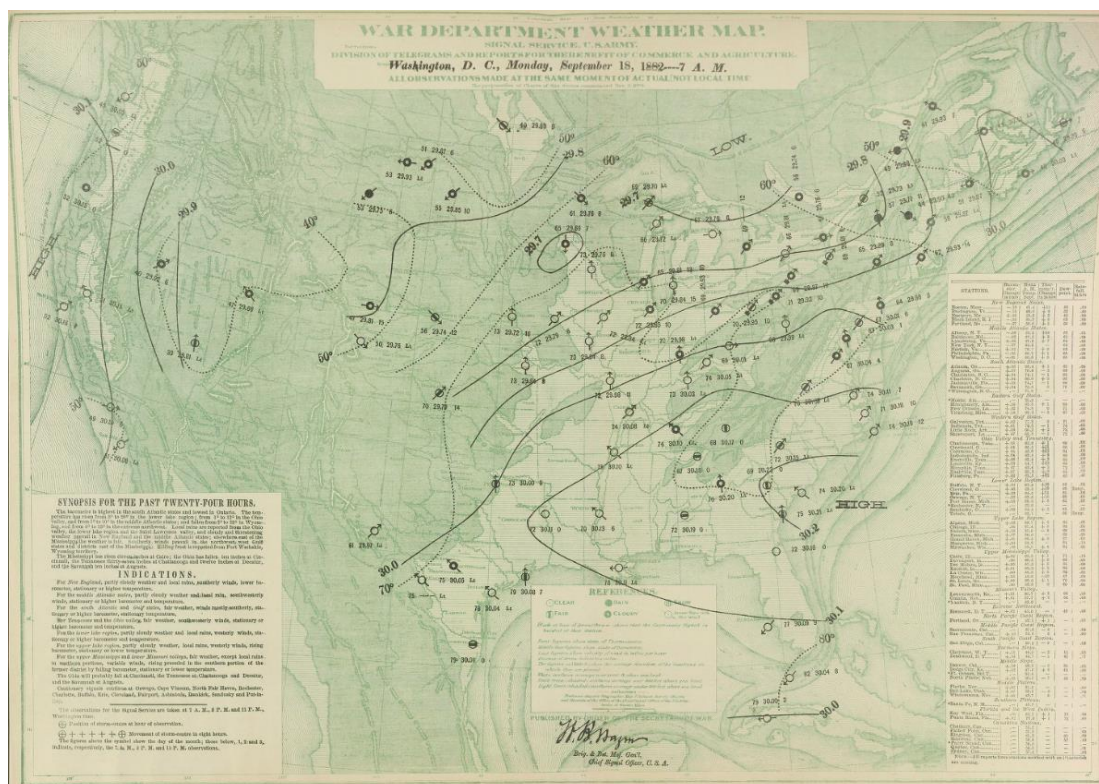


DEPARTMENT OF THE ARMY

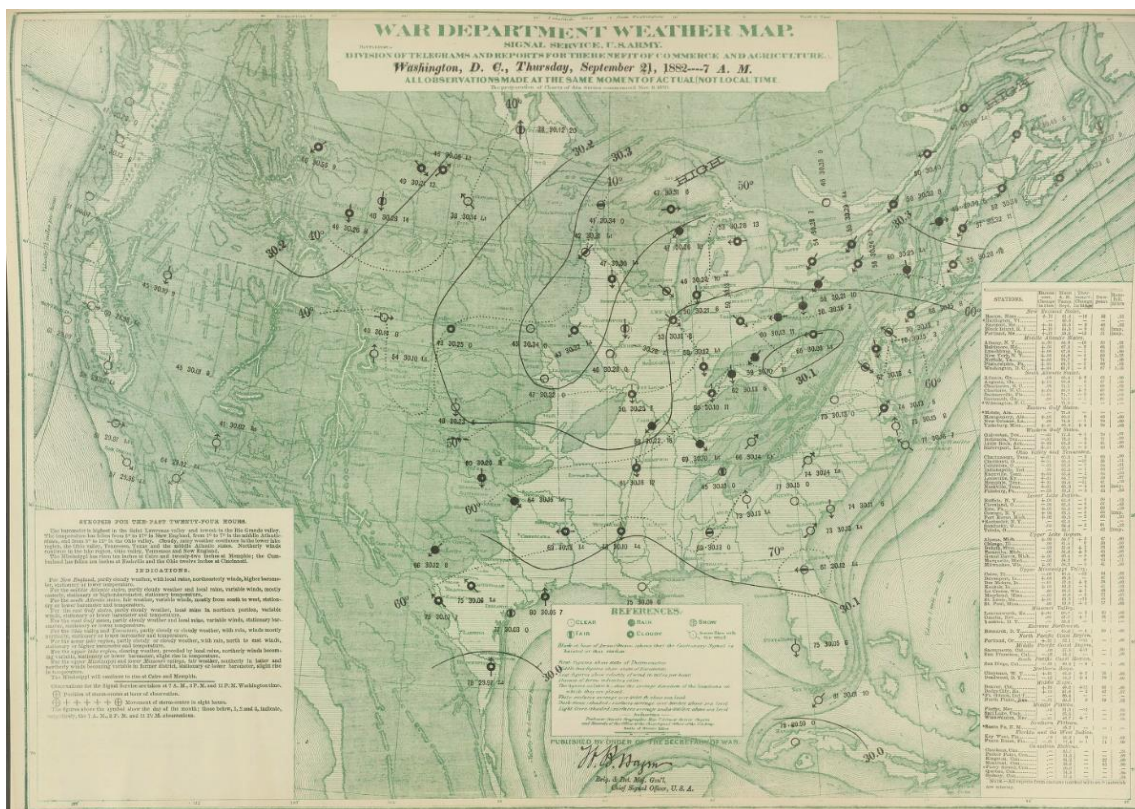
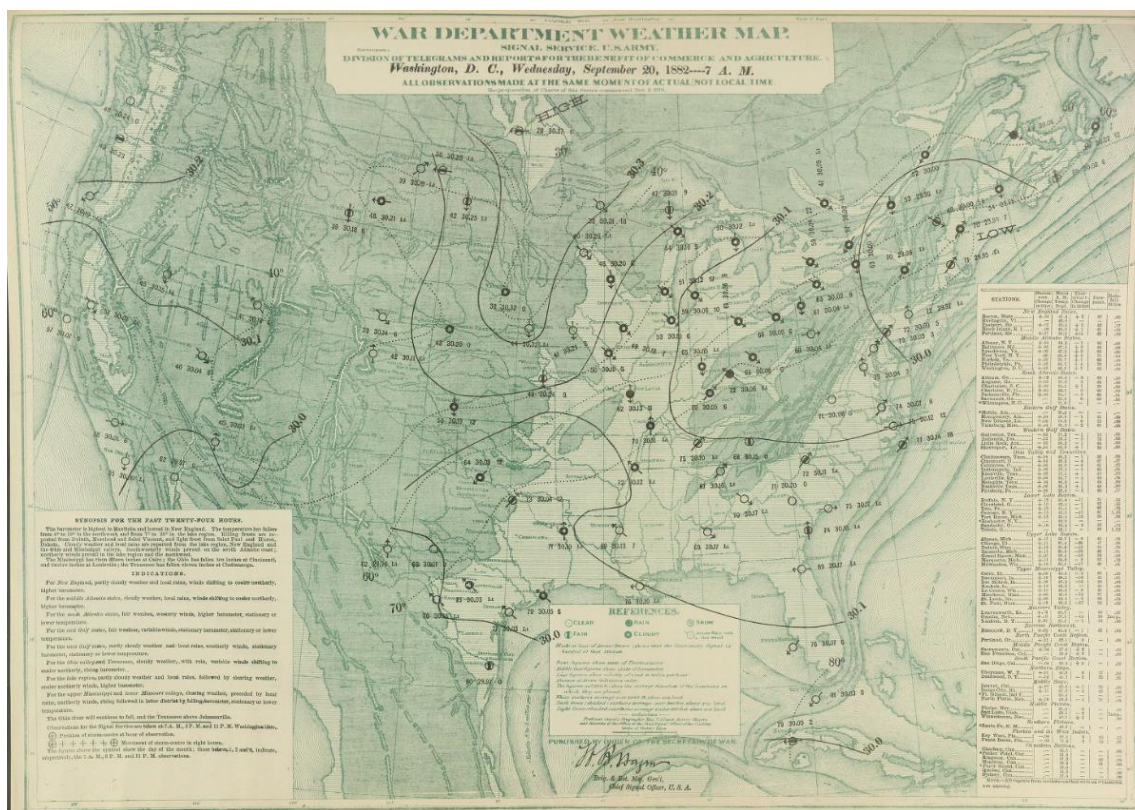
CORPS OF ENGINEERS

**STORM STUDIES - ISOHYETAL MAP**Storm of 20-24 September 1882Assignment NA 1-3Study Prepared by: New York, N.Y. District  
North Atlantic Division**MASS RAINFALL CURVES**

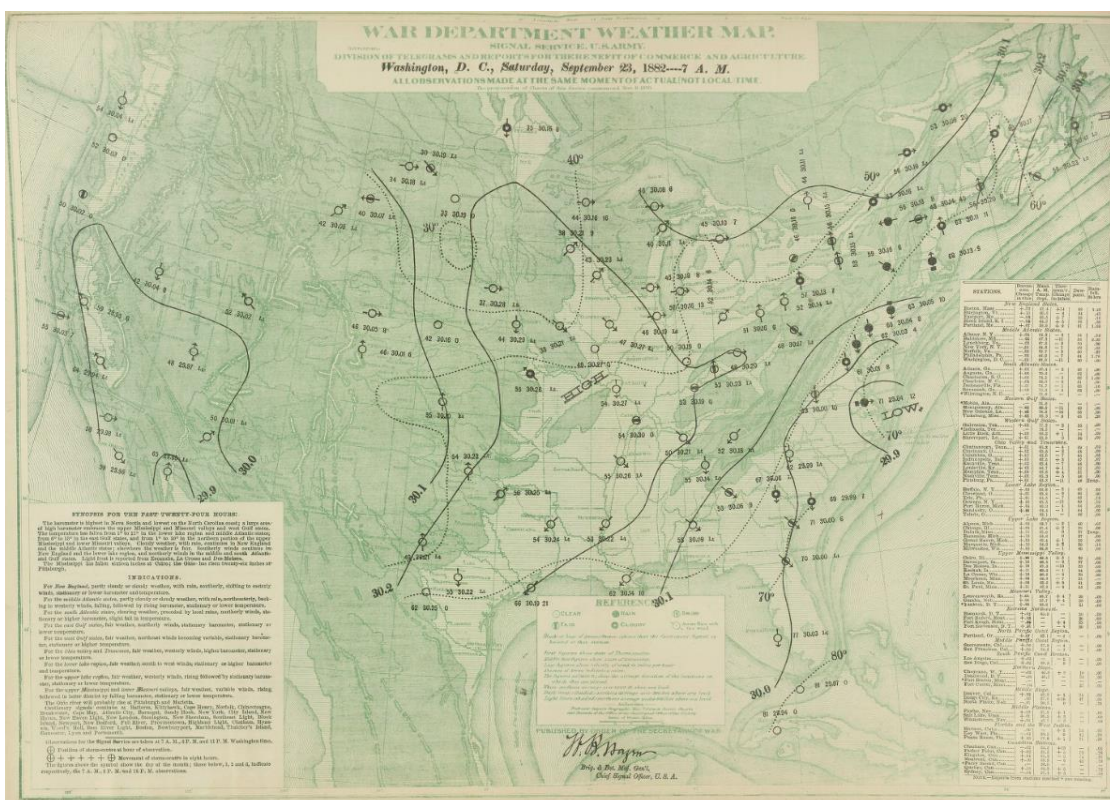
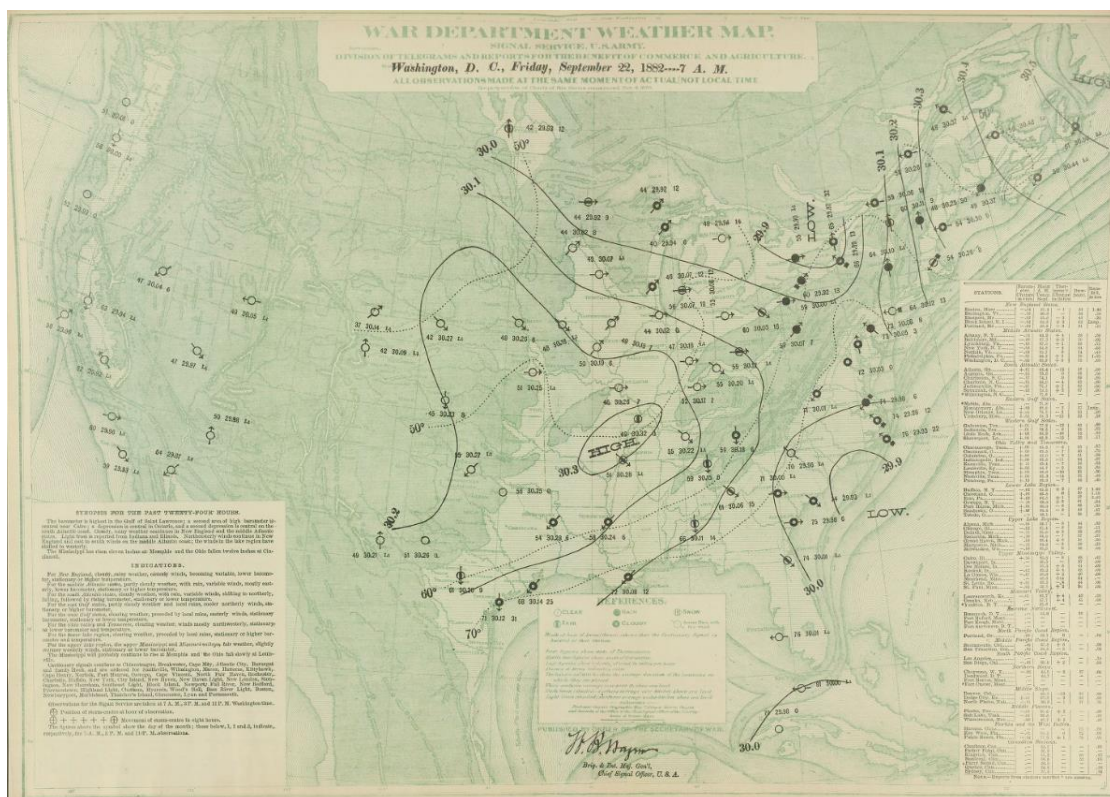
FORM 8-32



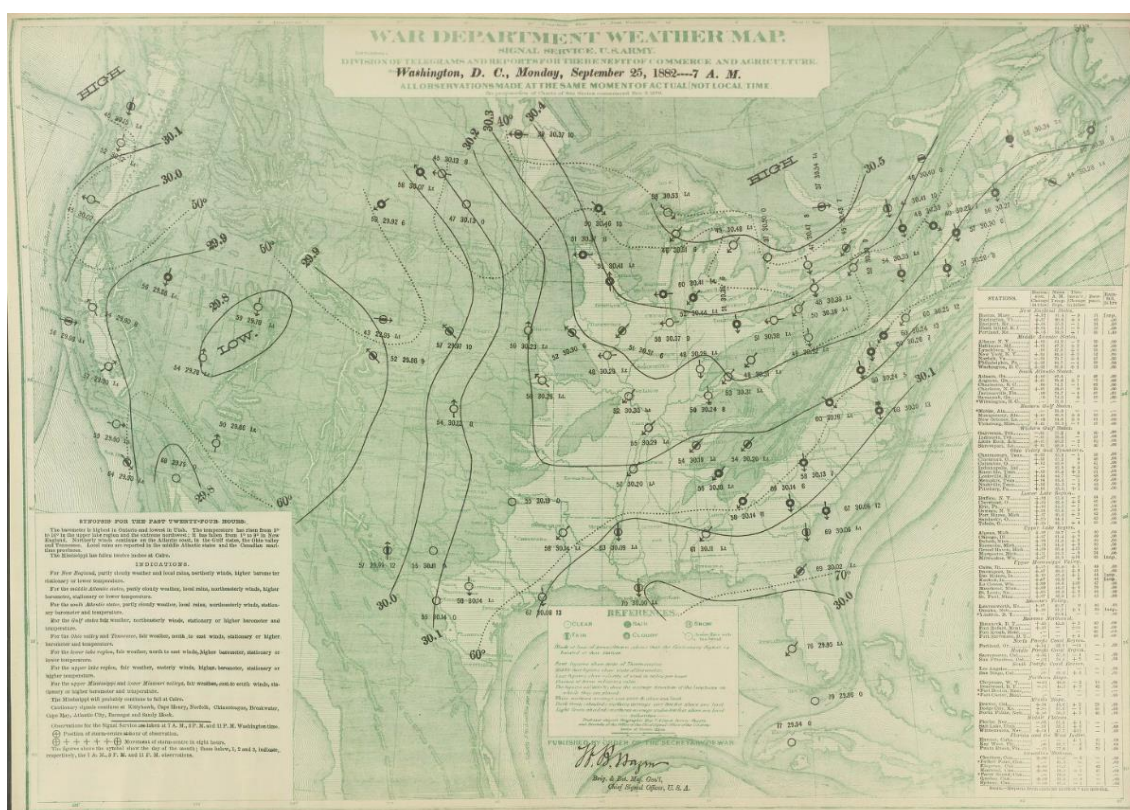
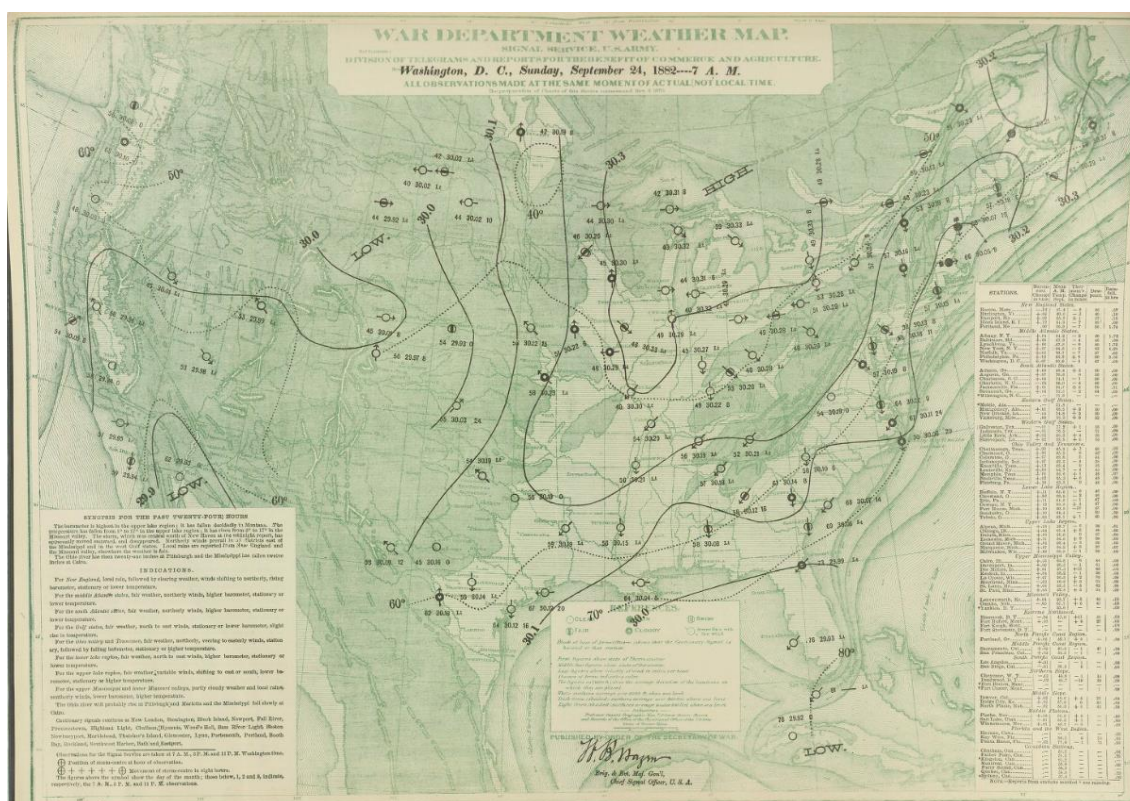




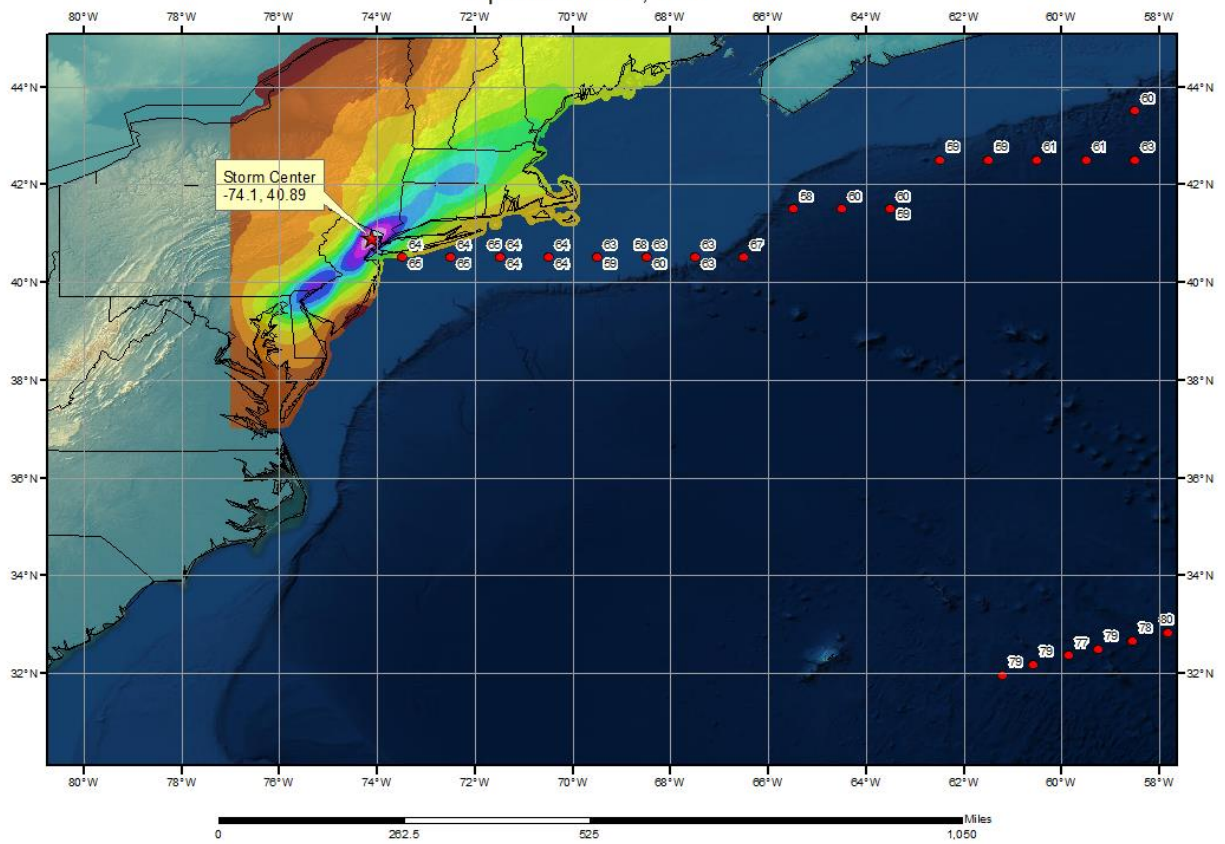








**SPAS 1565 Paterson, NJ Analysis**  
**September 18-25, 1882**



## Storm Precipitation Analysis System (SPAS) For Storm #1299\_1 SPAS Analysis

**General Storm Location:** North Carolina and South Carolina

**Storm Dates:** July 13-17, 1916

**Event:** Alta Pass, NC (SA 2-9) and Kingstree, SC (SA 2-9a)

### DAD Zone 1

**Latitude:** 35.8792

**Longitude:** -81.8708

**Max. Grid Rainfall Amount:** 24.90"

**Max. Observed Rainfall Amount:** 23.73"

**Number of Stations:** 240 (194 Daily, 1 Hourly, 6 Hourly Pseudo, and 39 Supplemental)

**SPAS Version:** 9.5

**Basemap:** PRISM July 1916 Precipitation

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

**Radar Included:** No

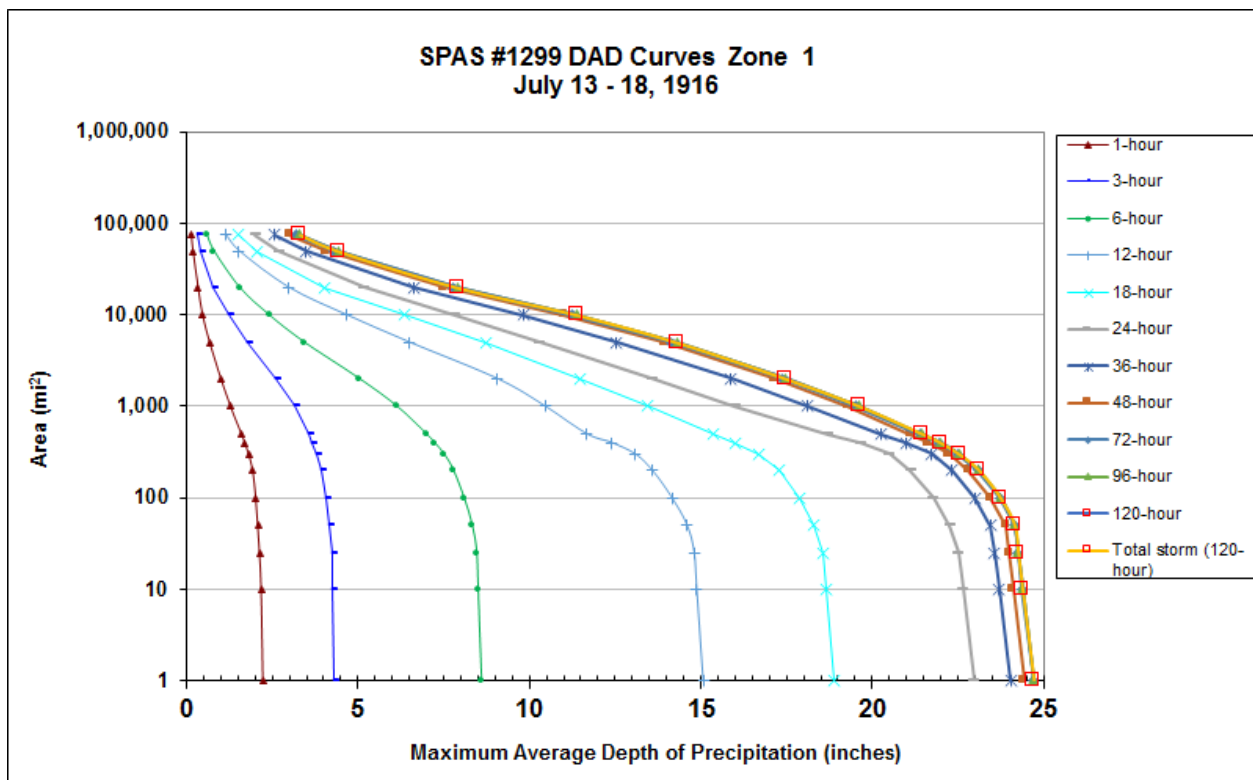
**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of results:** This analysis was based on hourly data, Hourly pseudo data (derived from storm study mass curves), daily data, and supplemental station data. We have a high degree of confidence in the station based storm total results, the spatial pattern is dependent on basemap, and the timing is based on hourly and hourly pseudo stations.

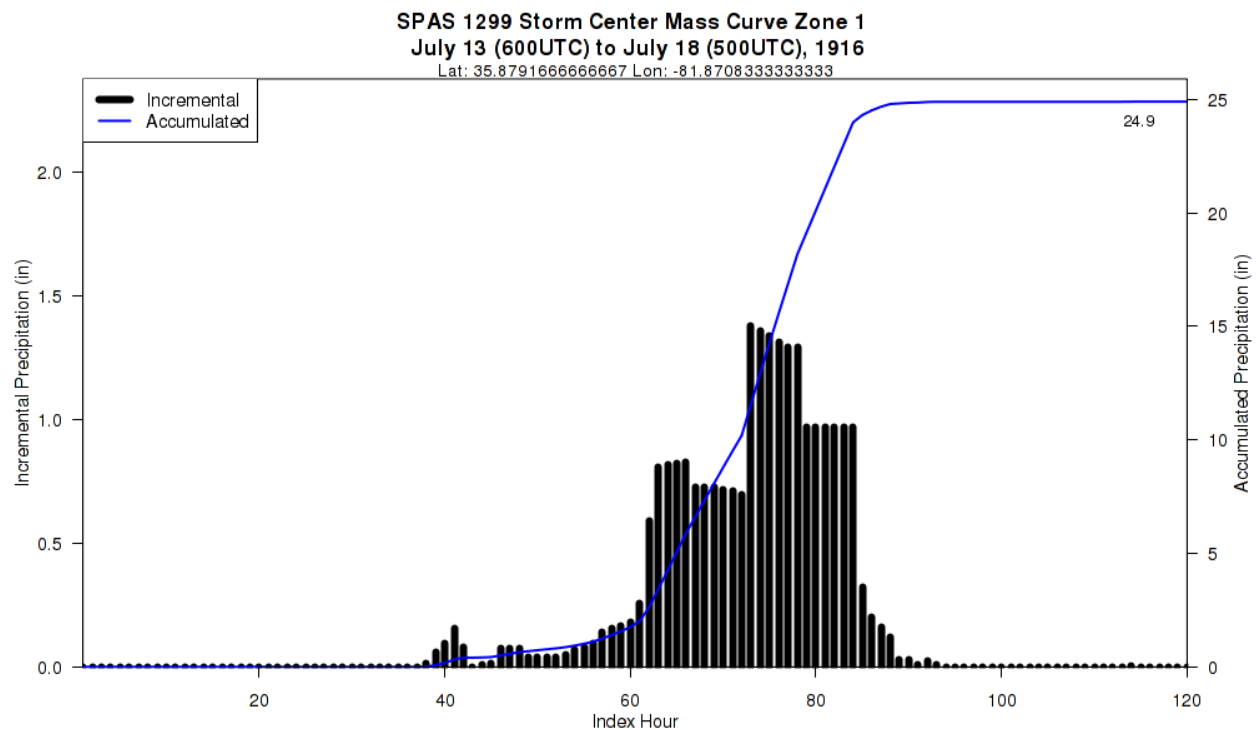
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	Storm Rep. Dew Point					Climatological Max. Dew Point					IPMF	
						T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1299_1	-81.8708	35.8792	1,968	2,000	15-Jul	74.00	2.73	0.47	70	2.260	78.50	78.5	3.37	0.54	79	2.825	1.250

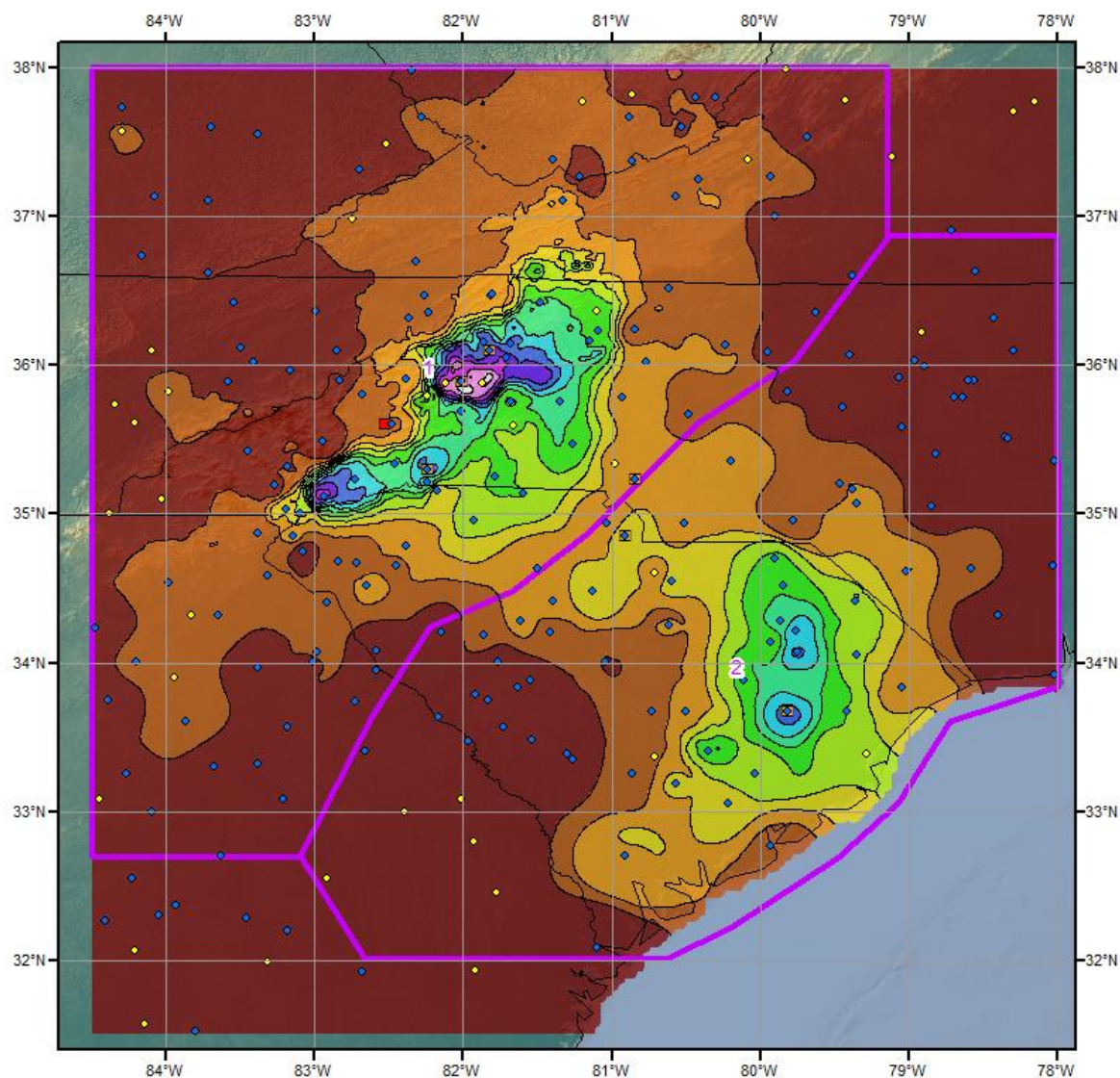


Storm 1299 - July 13 (0600 UTC) - July 18 (0500 UTC), 1916												
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)												
Area (mi <sup>2</sup> )	Duration (hours)											
	1	3	6	12	18	24	36	48	72	96	120	Total
0.4	2.26	4.33	8.65	15.14	18.98	23.10	24.17	24.57	24.84	24.84	24.84	24.84
1	2.24	4.31	8.61	15.07	18.89	22.97	24.04	24.44	24.70	24.71	24.71	24.71
10	2.19	4.26	8.51	14.88	18.65	22.64	23.70	24.12	24.37	24.38	24.38	24.38
25	2.14	4.23	8.47	14.81	18.55	22.51	23.57	24.00	24.24	24.25	24.25	24.25
50	2.09	4.18	8.34	14.60	18.29	22.25	23.46	23.90	24.15	24.15	24.15	24.15
100	2.03	4.07	8.10	14.16	17.88	21.78	22.99	23.44	23.72	23.74	23.74	23.74
200	1.94	3.93	7.79	13.58	17.27	21.11	22.34	22.82	23.09	23.11	23.11	23.11
300	1.82	3.79	7.52	13.09	16.71	20.49	21.73	22.23	22.50	22.54	22.54	22.54
400	1.71	3.66	7.24	12.41	16.01	19.66	20.99	21.64	21.93	22.00	22.00	22.00
500	1.61	3.56	7.00	11.67	15.37	18.72	20.28	21.11	21.39	21.46	21.46	21.46
1,000	1.29	3.16	6.14	10.46	13.43	16.00	18.12	19.28	19.52	19.64	19.64	19.64
2,000	1.01	2.61	5.05	9.07	11.47	13.57	15.88	17.13	17.37	17.49	17.49	17.49
5,000	0.68	1.78	3.44	6.51	8.74	10.31	12.55	13.93	14.15	14.31	14.31	14.31
10,000	0.47	1.24	2.40	4.66	6.34	7.83	9.82	11.01	11.24	11.39	11.39	11.39
20,000	0.34	0.78	1.54	2.97	4.01	5.18	6.63	7.52	7.76	7.89	7.89	7.89
50,000	0.19	0.41	0.79	1.52	2.04	2.69	3.49	4.07	4.31	4.42	4.42	4.42
75,378	0.14	0.30	0.58	1.12	1.51	1.99	2.58	3.01	3.20	3.31	3.31	3.31





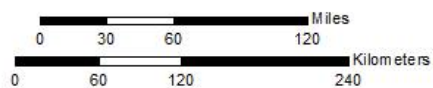




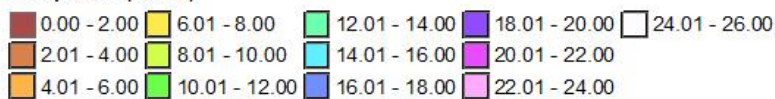
**Total Storm (120-hr) Precipitation (inches)**  
**July 13-17, 1916 - Alta Pass, NC**  
**SPAS 1299**

**Gauges**

- ◆ Daily
- Hourly
- Hourly Pseudo
- ◆ Supplemental



**Precipitation (inches)**



9/06/2013

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY

**STORM STUDIES - PERTINENT DATA SHEET**

Storm of July 13 - 17, 1916

Assignment S A 2 - 9

Location N.C. and S.C.

Study Prepared by:

South Atlantic Division

Charleston District Office

Part I Reviewed by H. M. Sec. of  
Weather Bureau, 10/18/39Part II Approved by Office, Chief  
of Engineers for Distribution  
of Factual Data, 6/16/45Remarks: TOTAL STORM AREA  
Centers at: Altapass, N.C.  
and Kingstree, S.C.**DATA AND COMPUTATIONS COMPILED****PART I**

Preliminary isohyetal map, in 1 sheet, scale 1 : 1,000,000

Precipitation data and mass curves:

(Number of Sheets)

Form 5001-C (Hourly precip. data)----- 10

Form 5001-B (24-hour " " " )----- 27

Form 5001-D ( " " " " " )----- -

Misc. precip. records, meteorological data, etc.----- -

Form 5002 (Mass rainfall curves)----- 26

**PART II**

Final isohyetal maps, in 1 sheet, scale 1 : 1,000,000

Data and computation sheets:

Form S-10 (Data from mass rainfall curves)----- 3

Form S-11 (Depth-area data from isohyetal map)----- 3

Form S-12 (Maximum depth-duration data)----- 12

Maximum duration-depth-area curves----- 1

Data relating to periods of maximum rainfall----- 2

**MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES**

Area in Sq. Mi.	Duration of Rainfall in Hours										
	6	12	18	24	30	36	48	60	72	96	108
10	8.0	12.6	17.0	22.2	22.9	23.0	23.2	23.7	23.7	23.8	23.8
100	7.2	12.0	15.6	19.3	20.8	21.1	21.7	22.1	22.1	22.2	22.2
200	6.9	11.7	15.0	18.3	19.9	20.3	20.9	21.3	21.4	21.4	21.4
500	6.4	11.1	13.9	16.6	18.3	18.8	19.5	19.8	20.1	20.1	20.1
1,000	5.9	10.4	12.9	15.0	16.7	17.3	18.1	18.4	18.6	18.7	18.7
2,000	5.1	9.3	11.6	13.3	14.9	15.5	16.3	16.6	16.8	16.9	16.9
5,000	3.9	7.4	9.3	10.9	12.0	12.6	13.4	13.6	13.8	14.0	14.0
10,000	3.0	5.5	7.2	8.6	9.4	9.9	10.6	10.8	11.0	11.2	11.2
20,000	2.1	3.8	5.0	5.9	6.6	7.3	8.0	8.2	8.4	8.6	8.6
37,000	1.3	2.2	3.0	3.8	4.7	5.6	7.0	7.5	7.8	8.1	8.1

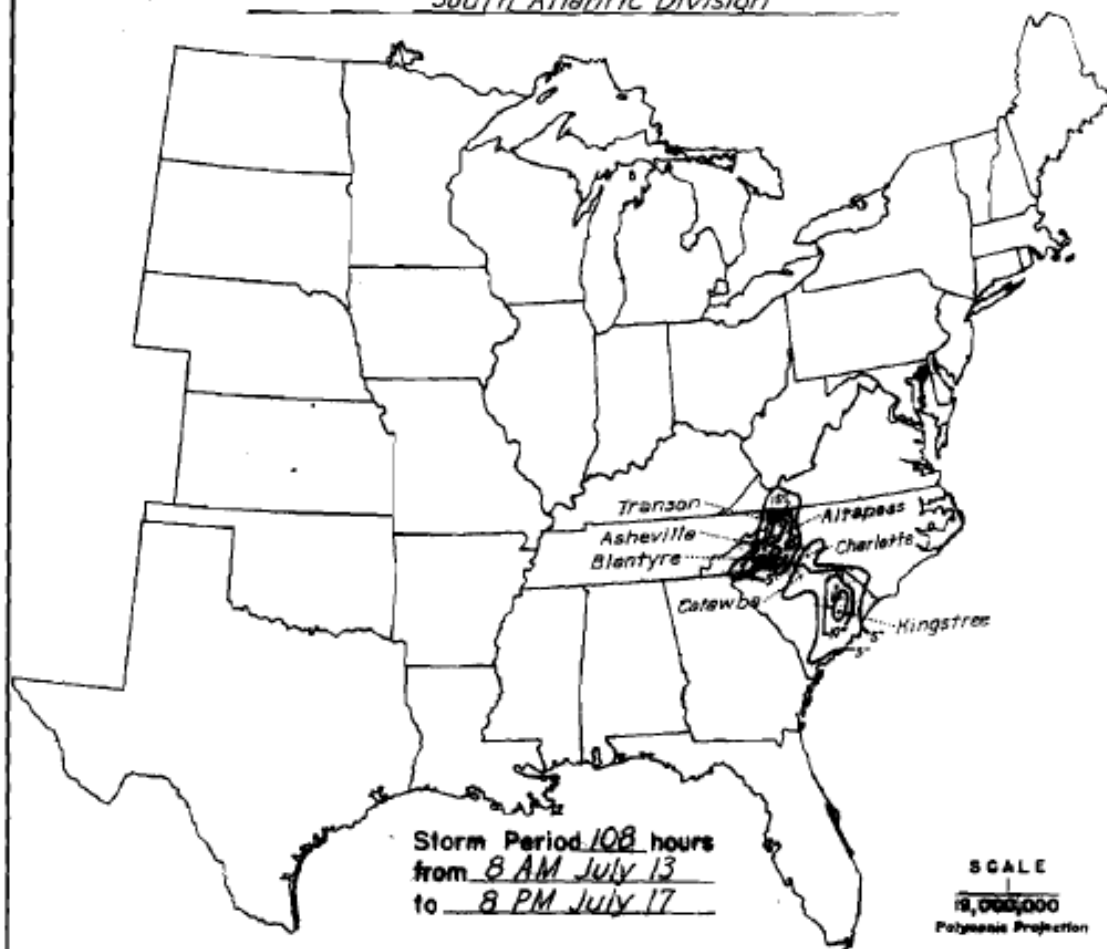
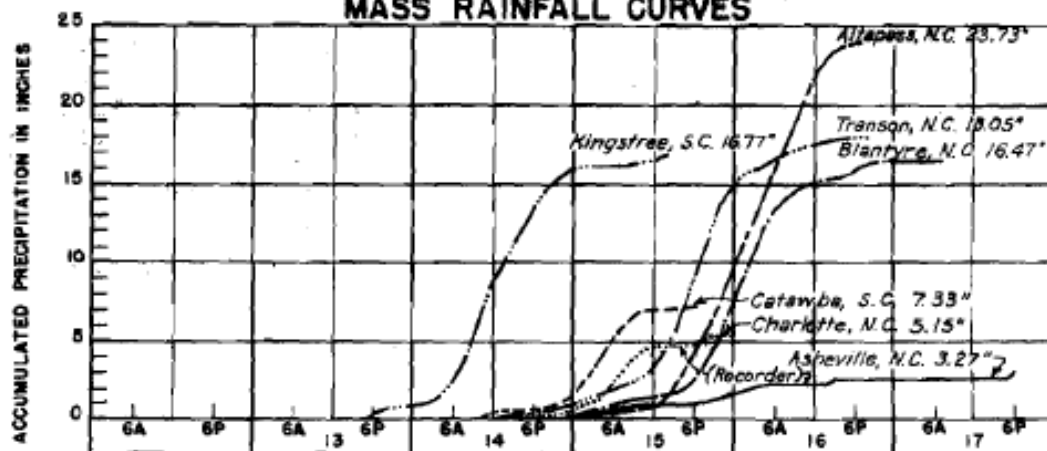
Form S-2

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

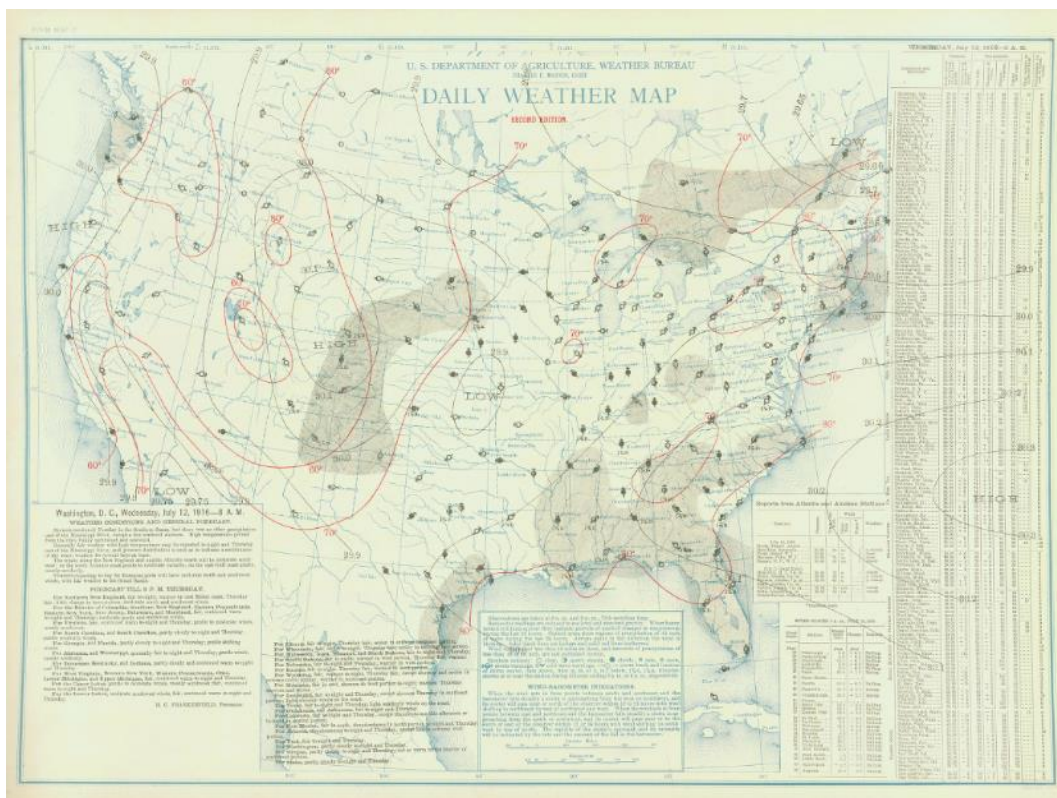
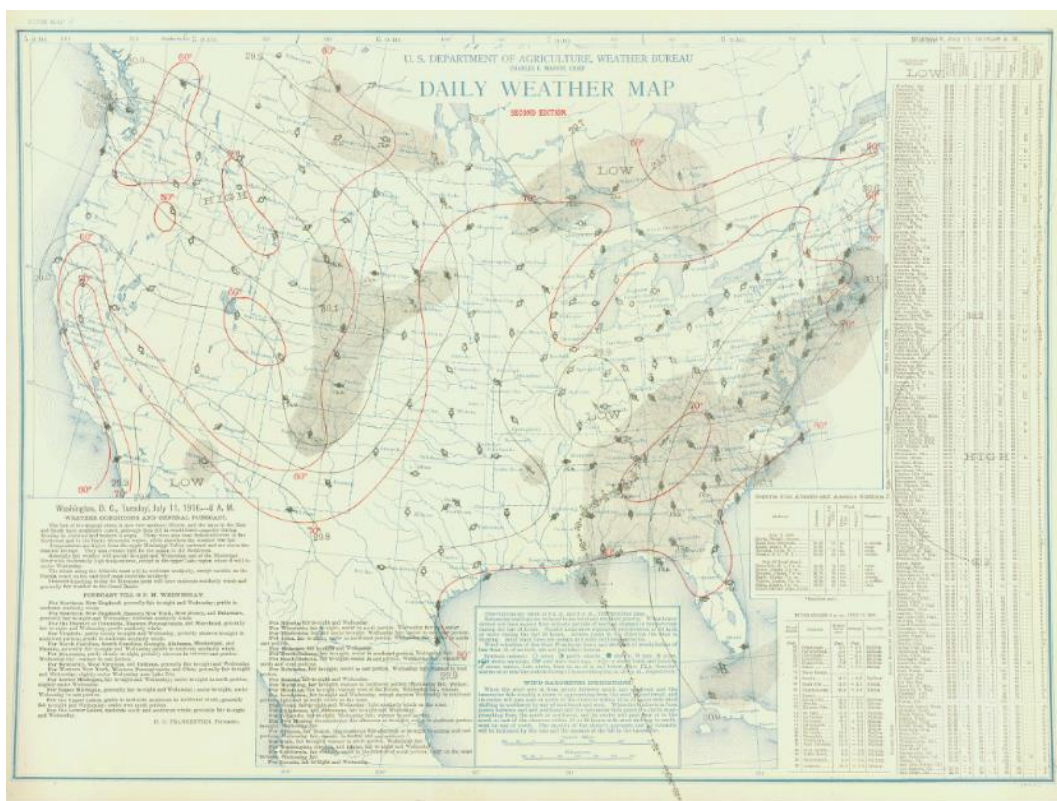
**STORM STUDIES - ISOHYETAL MAP**

Storm of July 13-17, 1916 Assignment SA 2-9  
 Study Prepared by: Charleston S. C. District  
South Atlantic Division

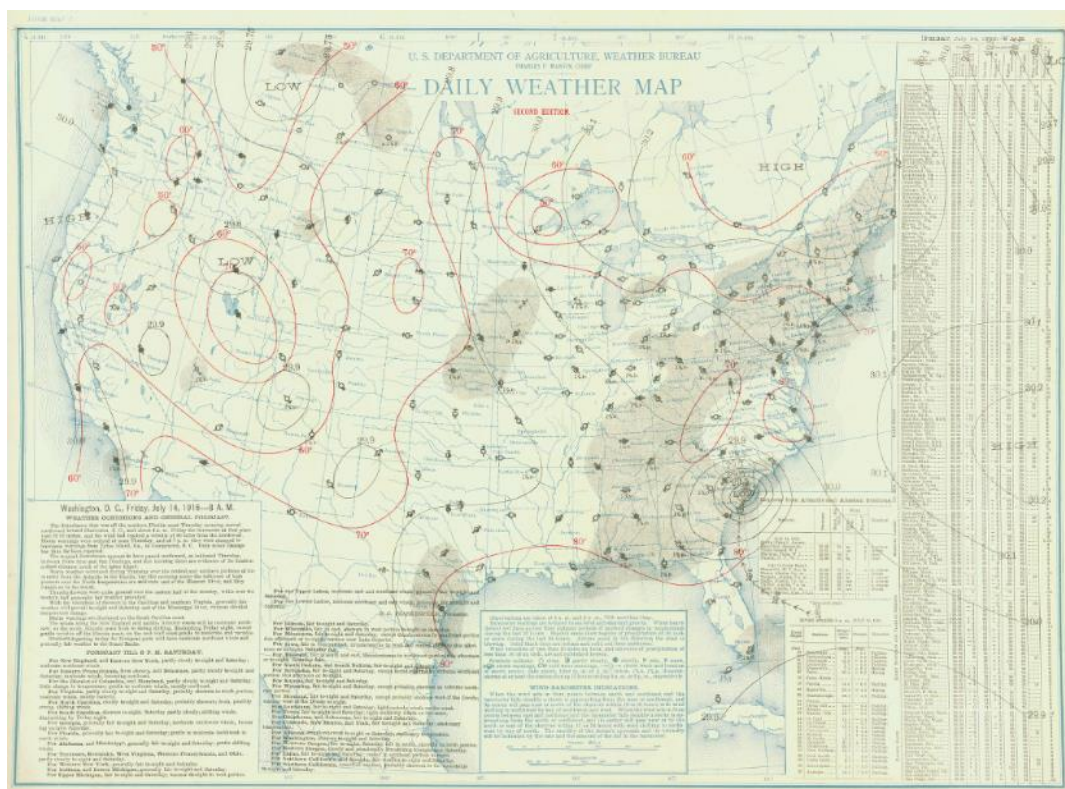
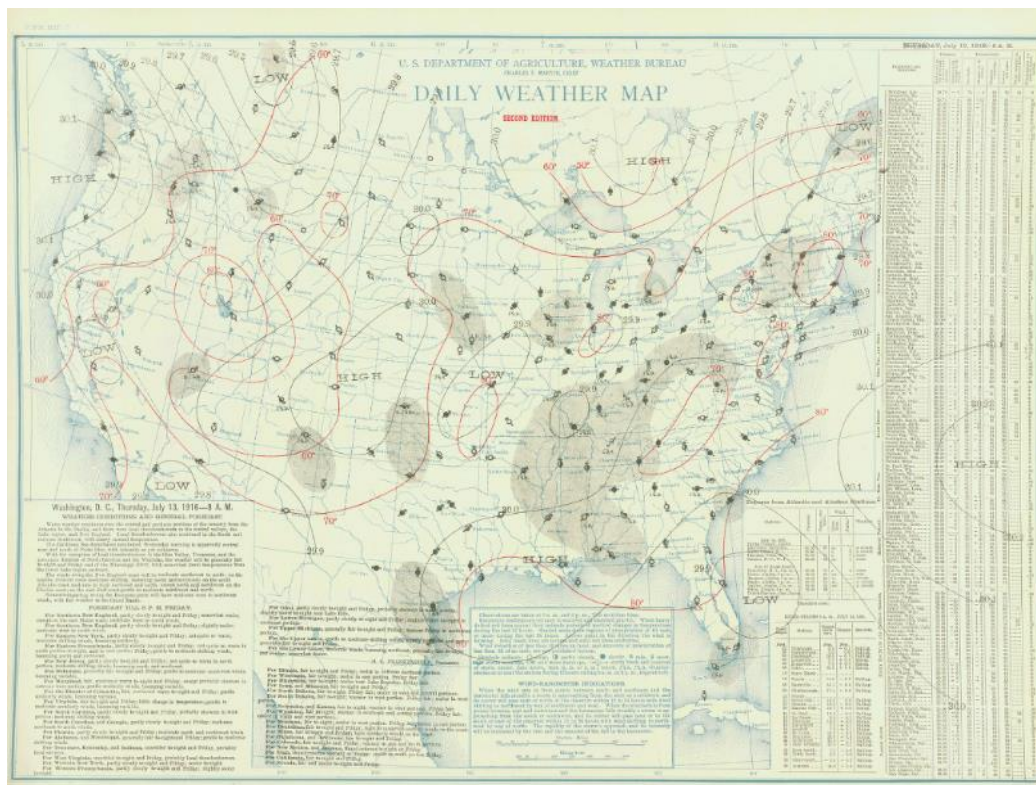
**MASS RAINFALL CURVES**

FORM 5-3E

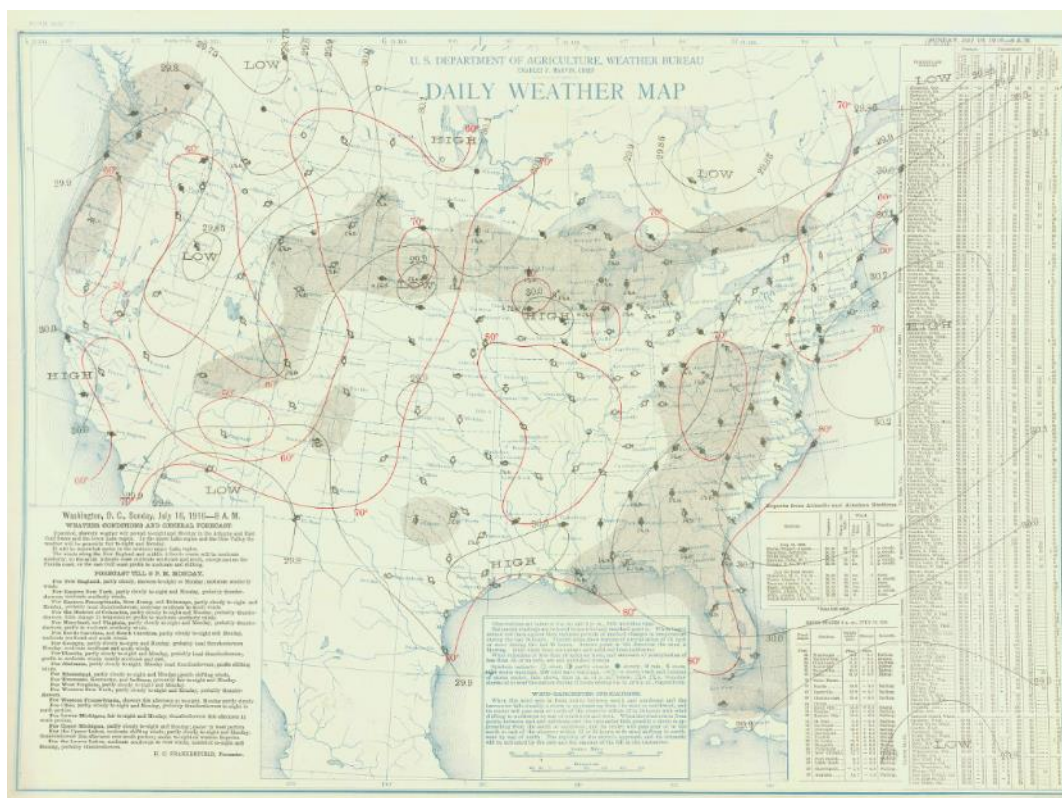
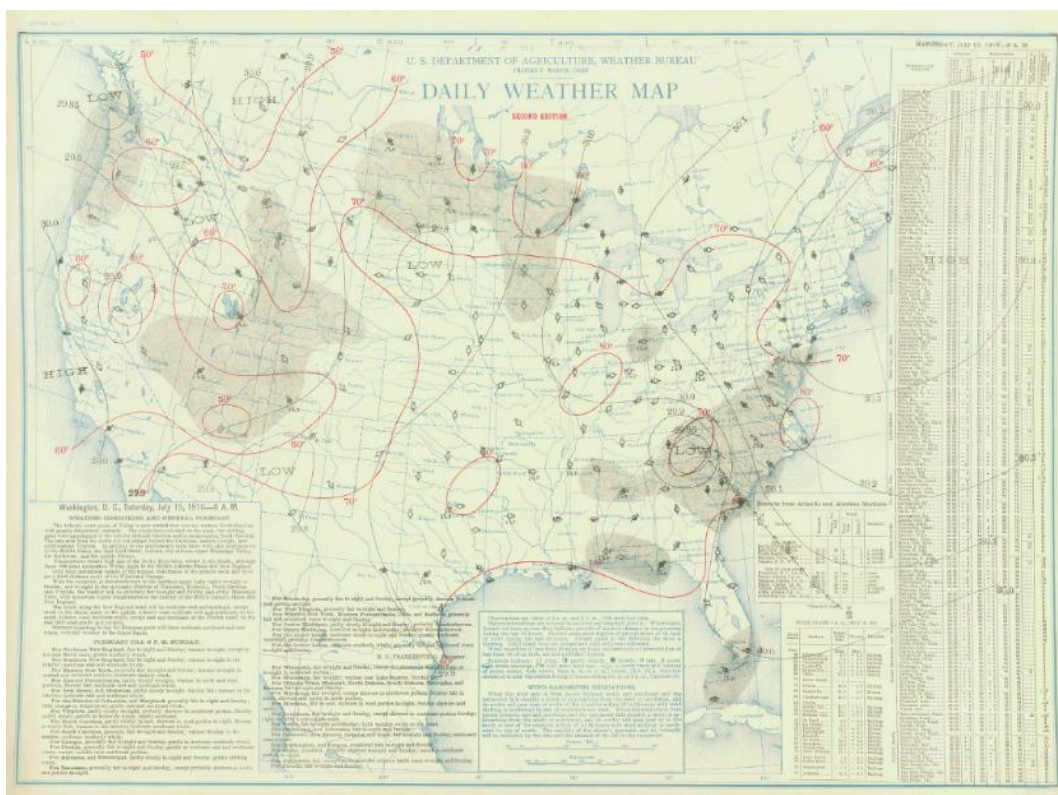


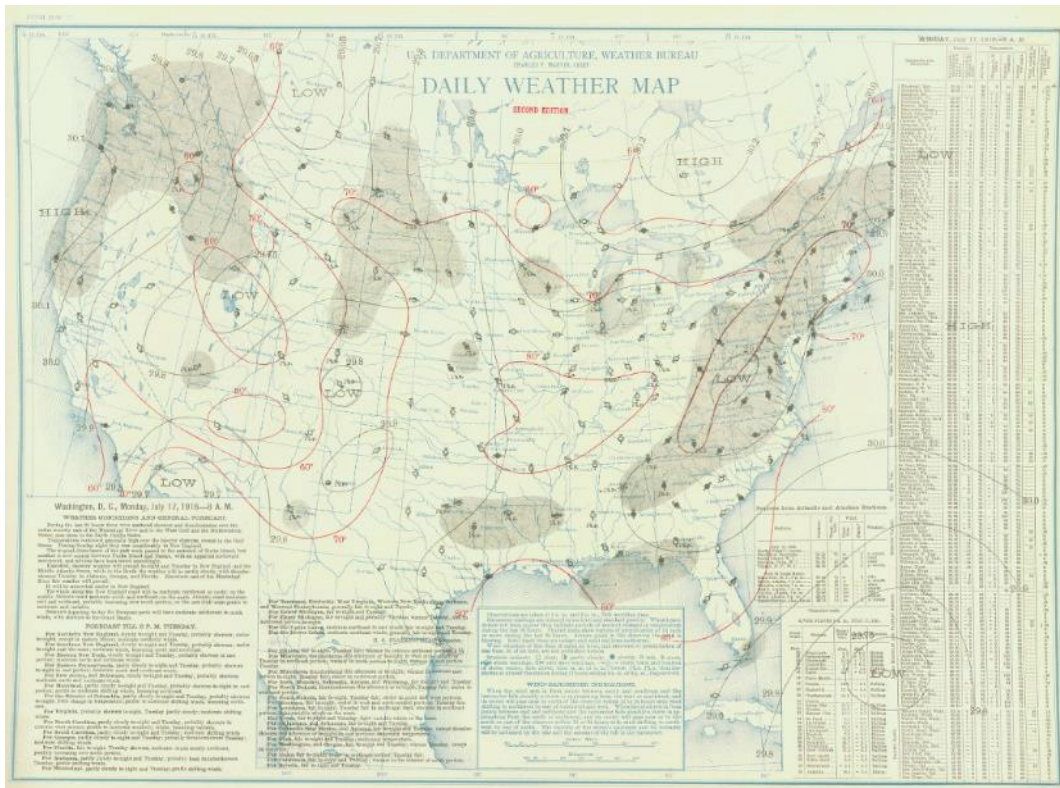














50

## FLOODS AND FLOOD CONTROL

TVA 3414 (WCP-2-46)  
Tennessee Valley Authority

Hydraulic Data Division

Observed and Maximum Factors of  
Storm Adjustment and Transposition

Storm of July 13-17, 1916

Adjusted to Storm Date

Area Of Observed Storm					Area Of Transposition				
Location Western North Carolina					Basin French Broad above Asheville				
Inflow Direction SE-310					Inflow Direction SSE				
Inflow Barrier H= 1600 Ft.					Inflow Barrier H'= 2000 Ft.				
Dew Point Station Charlotte, N. C.					Maximum Dew Point Location From Inflow				
Distance to Barrier 70 Miles					Barrier 50 Miles NNE of Augusta, Ga.				

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
T Hours	DP(obs) Degrees	DP(max) Degrees	We(obs) Inches H= 1600	We(max) Inches H'= 2000		R	D(obs) Inches	D(max) Inches
1								
3								
6	74.8	76.9	1.42	1.57		1.104	6.0	6.6
12	74.5	76.6	1.40	1.55		1.107	10.4	11.5
18	74.2	76.3	1.37	1.51		1.101	13.0	14.3
24	74.0	76.1	1.35	1.49		1.103	15.1	16.7
30	73.8	75.9	1.33	1.47		1.105	16.8	18.6
36	73.6	75.7	1.31	1.45		1.107	17.4	19.3
42	73.6	75.7	1.31	1.45		1.107	18.1	20.0
48	73.5	75.6	1.30	1.44		1.108	18.2	20.2
54								
60								
66								
72	72.9	75.0	1.25	1.39		1.111	18.7	20.8
78								
84								
96								

Computed by JEH

Checked by AGK

FIGURE 47.—Example of method used to adjust and transpose storms.

## Storm Precipitation Analysis System (SPAS) For Storm #1490\_1

### SPAS Analysis

**General Storm Location:** Easton, MD

**Storm Dates:** September 2 -9, 1935

**Event:** Hurricane

**DAD Zone 1**

**Latitude:** 38.8625

**Longitude:** -76.0708

**Max. Grid Rainfall Amount:** 17.00"

**Max. Observed Rainfall Amount:** 16.70" at Easton, MD

**Number of Stations:** 441

**SPAS Version:** 10.0

**Basemap:** Conus\_prism\_ppt\_in\_1981\_2010\_09

**Spatial resolution:** 00:00:30

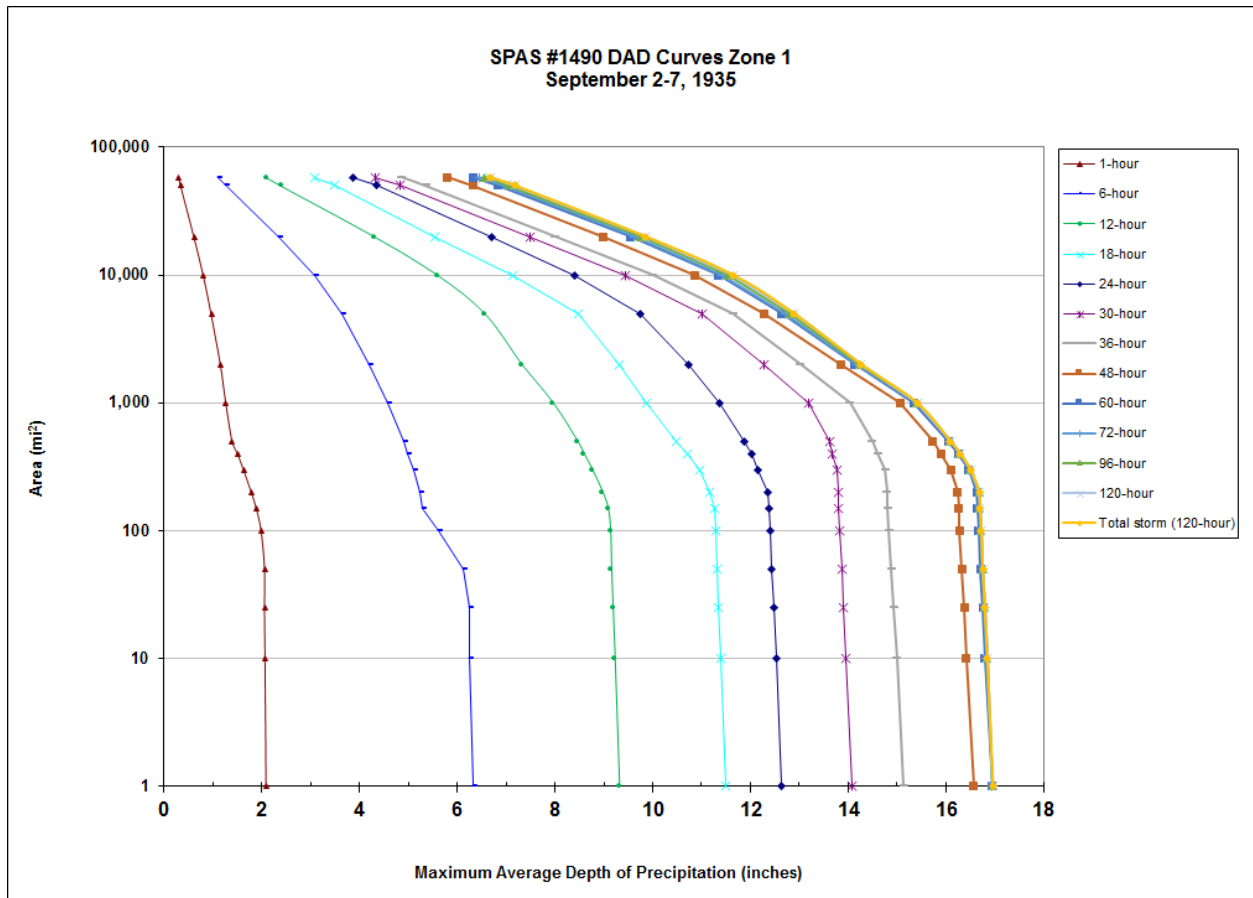
**Radar Included:** No

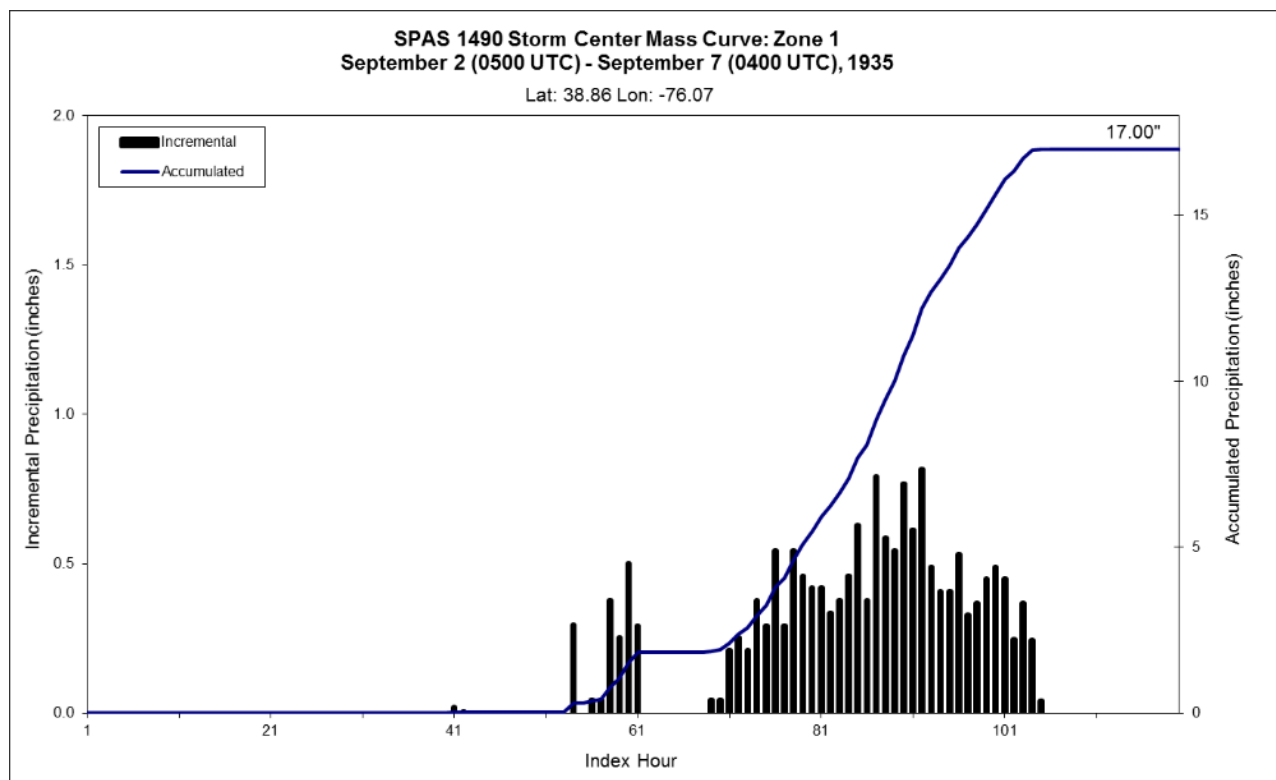
**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of results:** This storm is originally USACE SA 1-26. This analysis was based on hourly pseudo data, daily data and supplemental station data. We have a good degree of confidence for the station based storm total results. The spatial pattern is dependent on the basemap and we have a high degree of confidence with the timing based on the location of the five hourly pseudo stations (see below). One hourly USACE mass curve captured the largest storm center at Easton, MD allowing high confidence in the spatiotemporal isohyetal pattern of this critical location. Some daily stations lacked timing, so they had to be converted into supplemental stations. The five hourly pseudo stations were consistent in timing with one another. There was no hourly data after the 6th, but so timing of the supplemental stations thereafter is linear in trend. There isn't much if any precipitation that SPAS has falling on the 7th (no more than 0.5" at the very most).

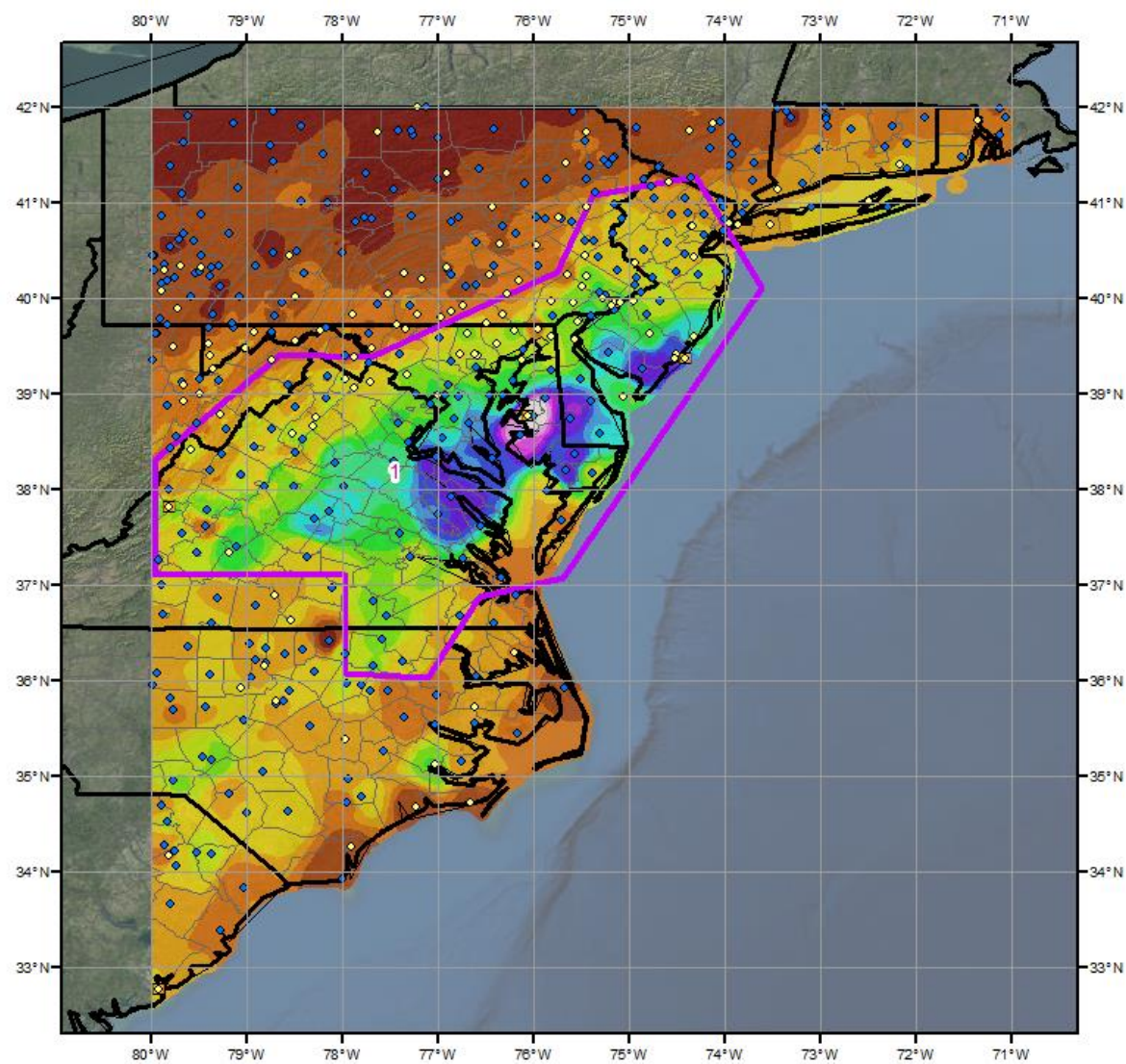
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1490 1	-76.0708	38.8625	57	100	20-Aug	80.50	3.68	0.03	83	3.650	82.00	82.0	3.95	0.03	86	3.920	1.074

Storm 1490 Zone 1 - Sep. 2 (0500 UTC) - Sep. 7 (0400 UTC), 1935													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
areasqmi	Duration (hours)												
	1	6	12	18	24	30	36	48	60	72	96	120	Total
0.4	2.10	6.35	9.33	11.53	12.69	14.13	15.14	16.60	16.98	16.98	17.00	17.00	17.00
1	2.09	6.33	9.31	11.49	12.64	14.08	15.14	16.56	16.94	16.95	16.96	16.96	16.96
10	2.07	6.26	9.22	11.39	12.52	13.96	14.99	16.42	16.80	16.82	16.84	16.84	16.84
25	2.06	6.24	9.18	11.35	12.47	13.91	14.93	16.37	16.75	16.78	16.79	16.79	16.79
50	2.06	6.12	9.15	11.32	12.43	13.87	14.88	16.32	16.71	16.75	16.75	16.75	16.75
100	1.99	5.62	9.13	11.29	12.40	13.83	14.83	16.28	16.67	16.71	16.72	16.72	16.72
150	1.89	5.30	9.08	11.27	12.38	13.81	14.81	16.26	16.64	16.69	16.69	16.69	16.69
200	1.79	5.24	8.97	11.17	12.36	13.80	14.79	16.24	16.63	16.68	16.68	16.68	16.68
300	1.63	5.10	8.76	10.95	12.16	13.77	14.75	16.10	16.46	16.49	16.49	16.50	16.50
400	1.51	4.99	8.59	10.71	12.02	13.68	14.60	15.89	16.25	16.29	16.29	16.29	16.29
500	1.40	4.90	8.46	10.49	11.87	13.61	14.49	15.73	16.05	16.08	16.09	16.09	16.09
1,000	1.27	4.59	7.96	9.87	11.36	13.18	14.03	15.06	15.34	15.39	15.40	15.41	15.41
2,000	1.16	4.19	7.32	9.31	10.74	12.29	13.02	13.84	14.13	14.16	14.22	14.26	14.26
5,000	0.97	3.64	6.56	8.49	9.75	11.01	11.64	12.27	12.64	12.70	12.81	12.89	12.89
10,000	0.81	3.08	5.59	7.15	8.41	9.45	10.00	10.86	11.35	11.41	11.54	11.64	11.64
20,000	0.62	2.35	4.30	5.54	6.71	7.50	8.00	8.98	9.55	9.63	9.75	9.85	9.85
50,000	0.35	1.26	2.39	3.48	4.34	4.82	5.36	6.32	6.84	6.96	7.06	7.18	7.18
57,977	0.31	1.11	2.10	3.09	3.88	4.32	4.86	5.80	6.32	6.45	6.56	6.67	6.67









### Total Storm (144-hours) Precipitation (inches)

September 2 - 7, 1935

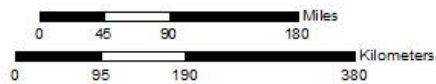
SPAS 1490 - Easton, MD

#### Gauges

- ◆ Daily
- Hourly
- Hourly Pseudo
- ◇ Supplemental

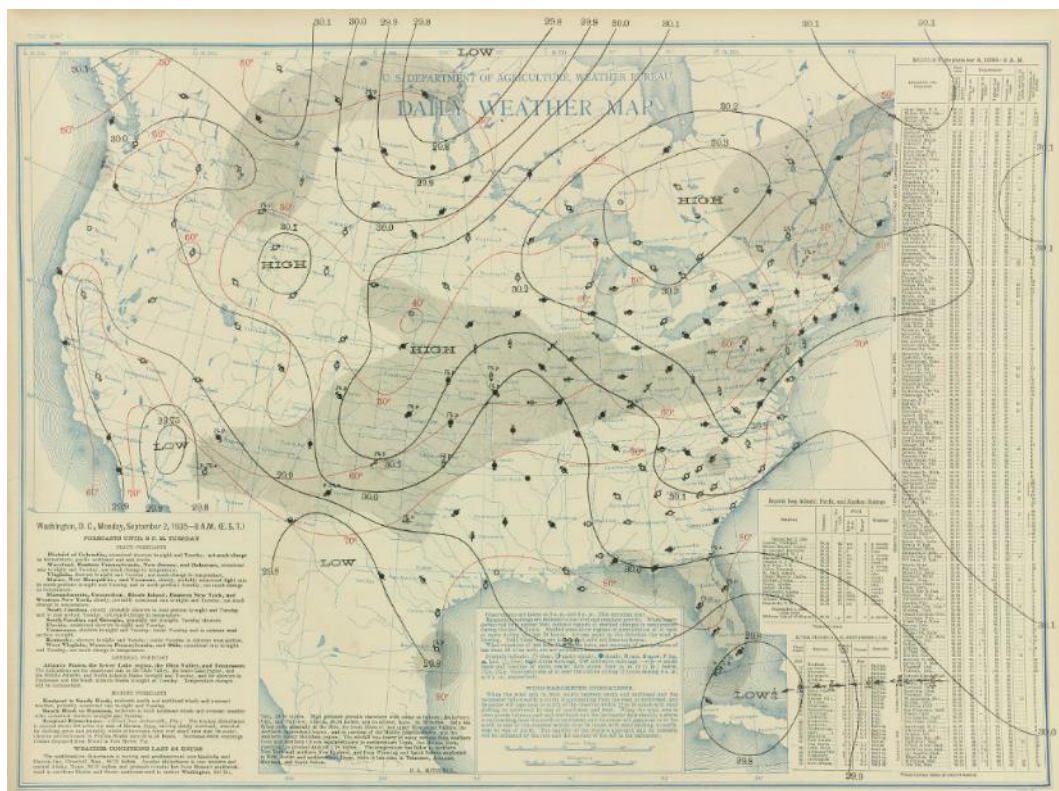
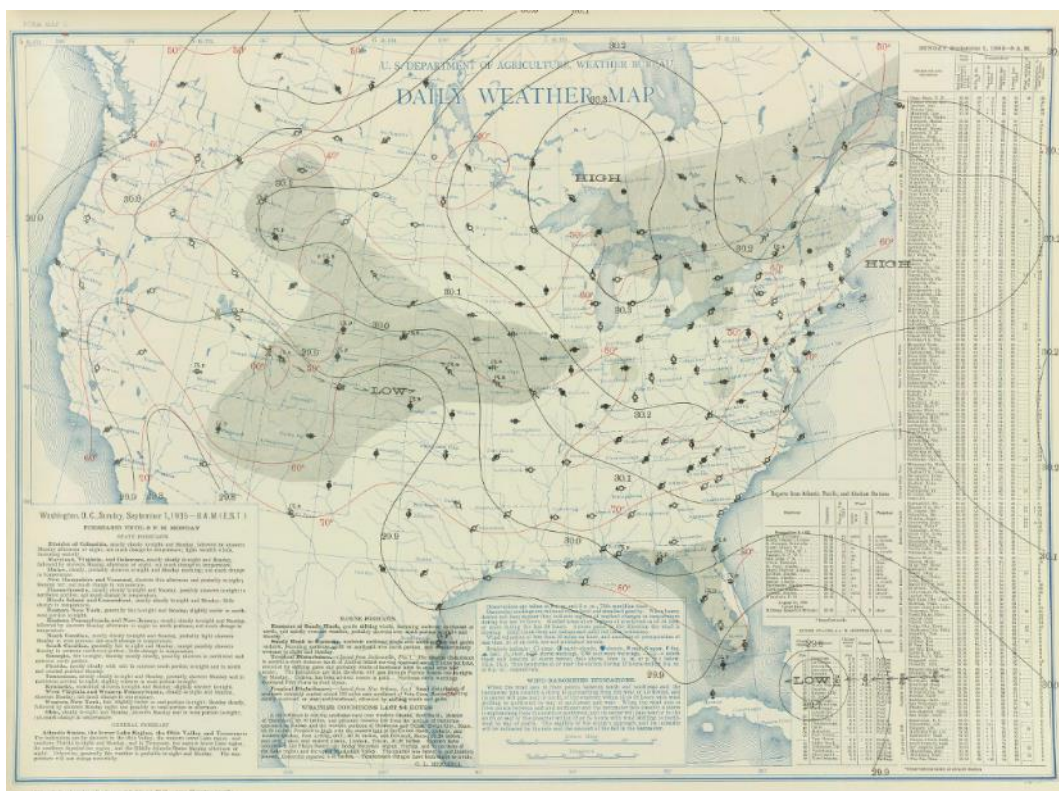
#### Precipitation (inches)

0.00 - 1.00	4.01 - 5.00	8.01 - 9.00	12.01 - 13.00
1.01 - 2.00	5.01 - 6.00	9.01 - 10.00	13.01 - 14.00
2.01 - 3.00	6.01 - 7.00	10.01 - 11.00	14.01 - 15.00
3.01 - 4.00	7.01 - 8.00	11.01 - 12.00	15.01 - 16.00
			16.01 - 17.00

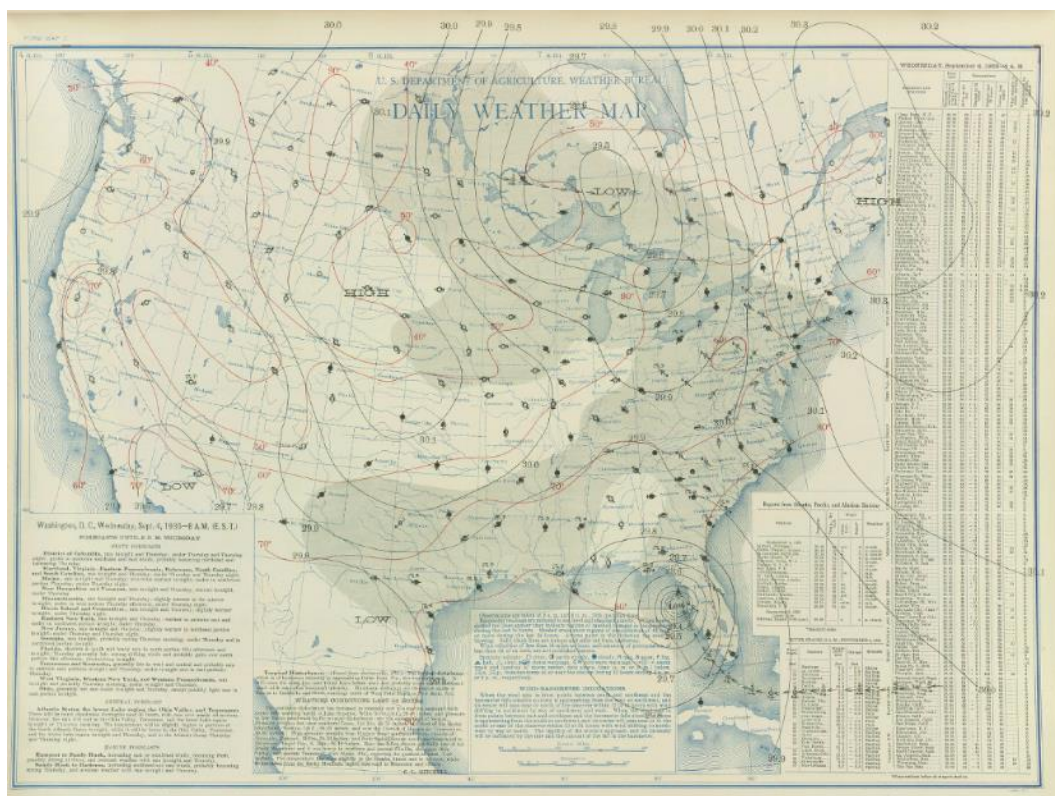
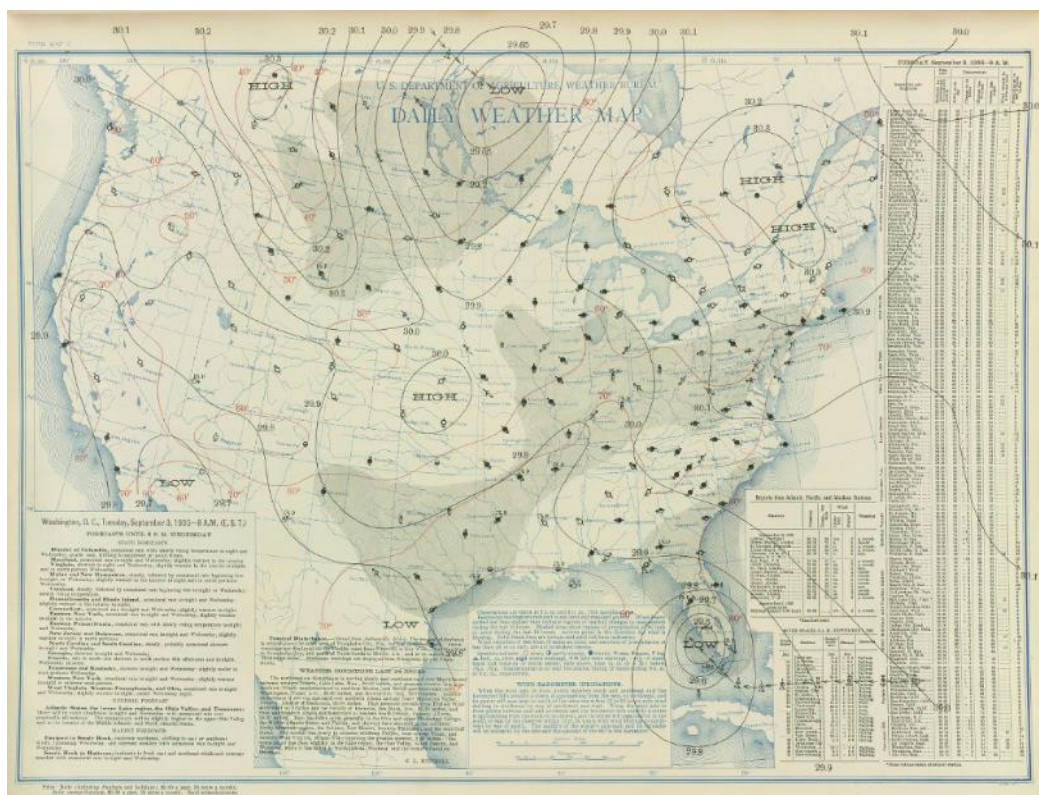


4/3/2015

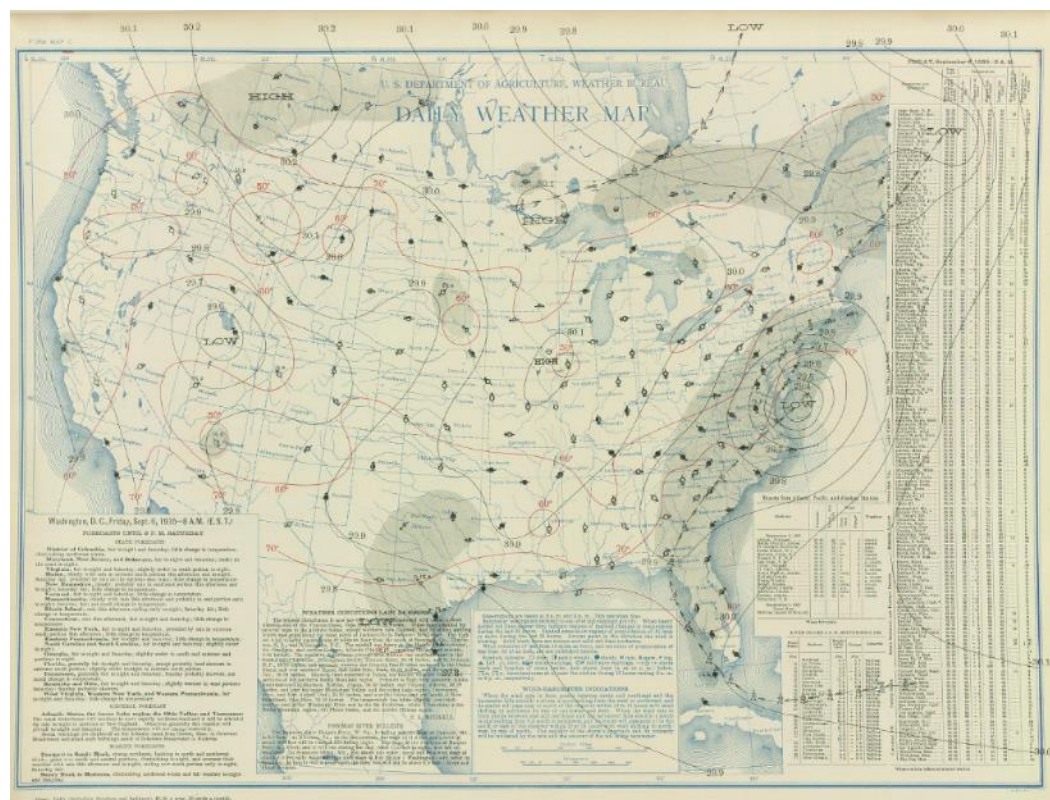
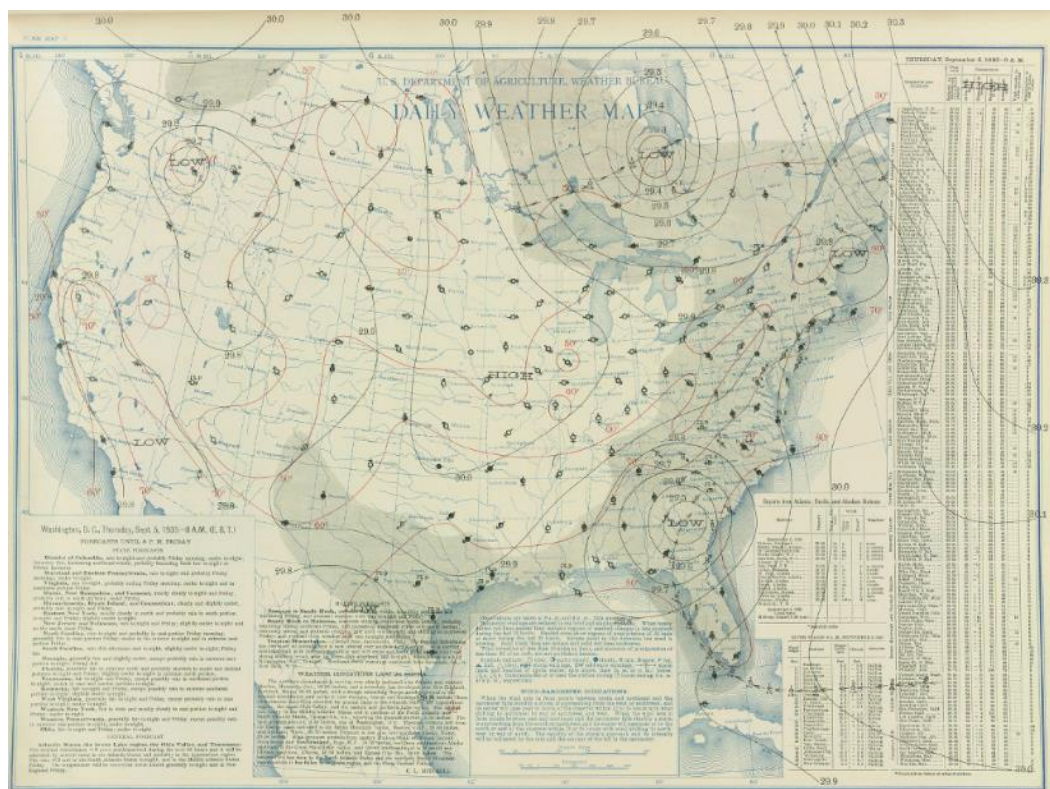




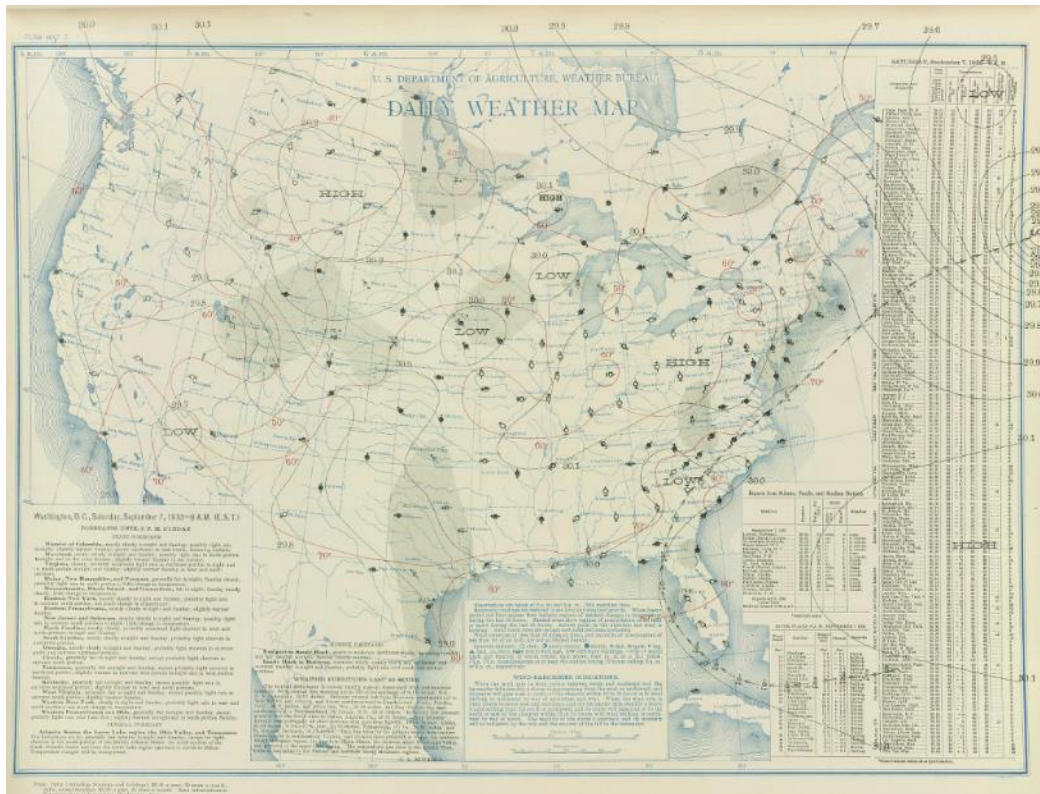




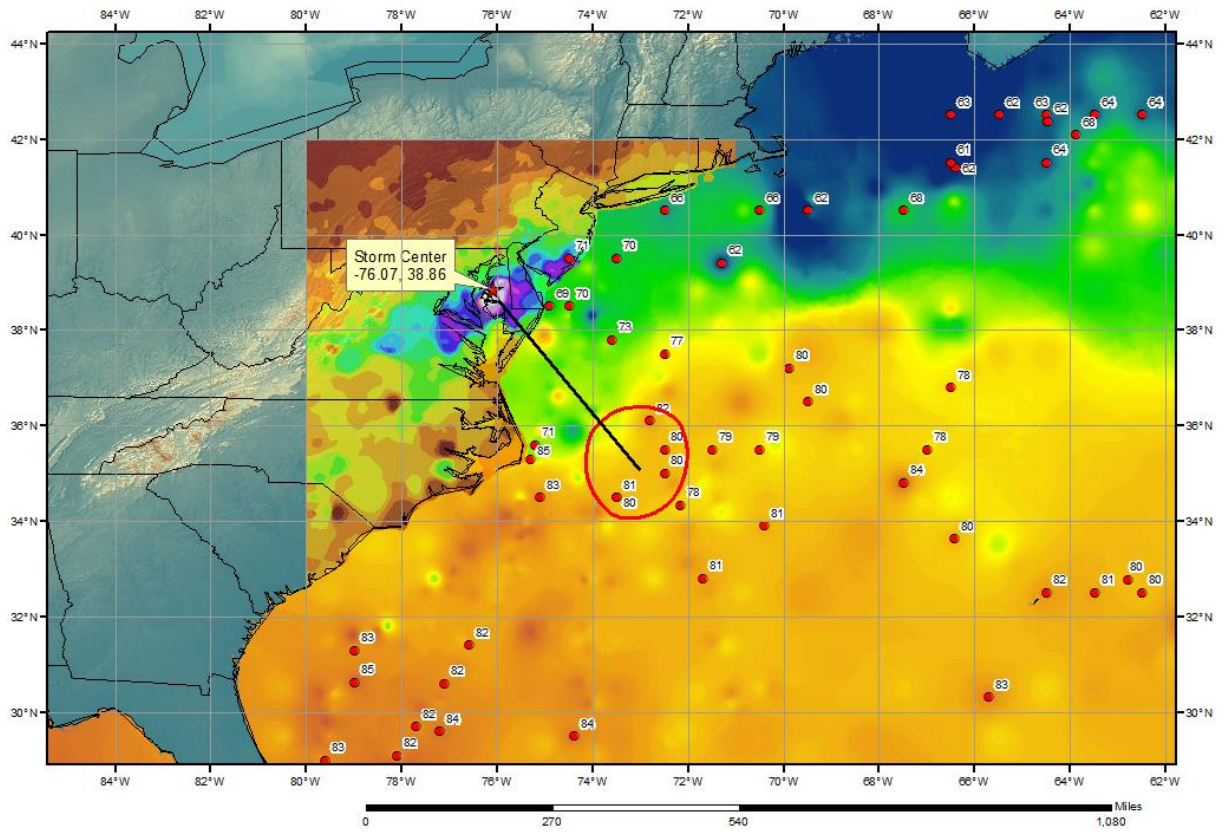








# SPAS 1490 Easton, MD Storm Analysis September 4, 1935



## Storm Precipitation Analysis System (SPAS) For Storm #1341\_1 SPAS Analysis

**General Storm Location:** Buck, CT

**Storm Dates:** September 17-23, 1938

**Event:** New England Hurricane of 1938

### DAD Zone 1

**Latitude:** 41.5542

**Longitude:** -72.6542

**Max. Grid Rainfall Amount:** 18.06"

**Max. Observed Rainfall Amount:** 17.10"

**Number of Stations:** 602 (416 Daily, 4 Hourly, 1 Hourly Pseudo, and 181 Supplemental)

**SPAS Version:** 9.5

**Basemap:** PRISM September 1938 Precipitation Grid

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

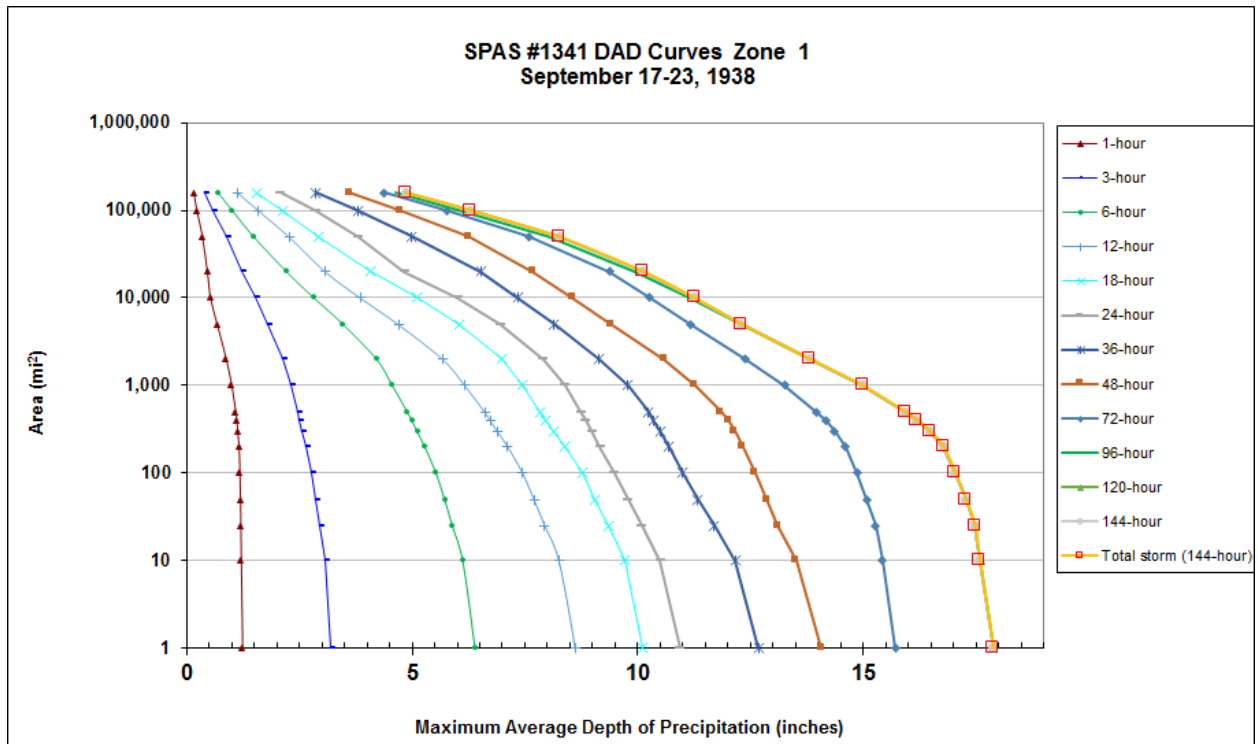
**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

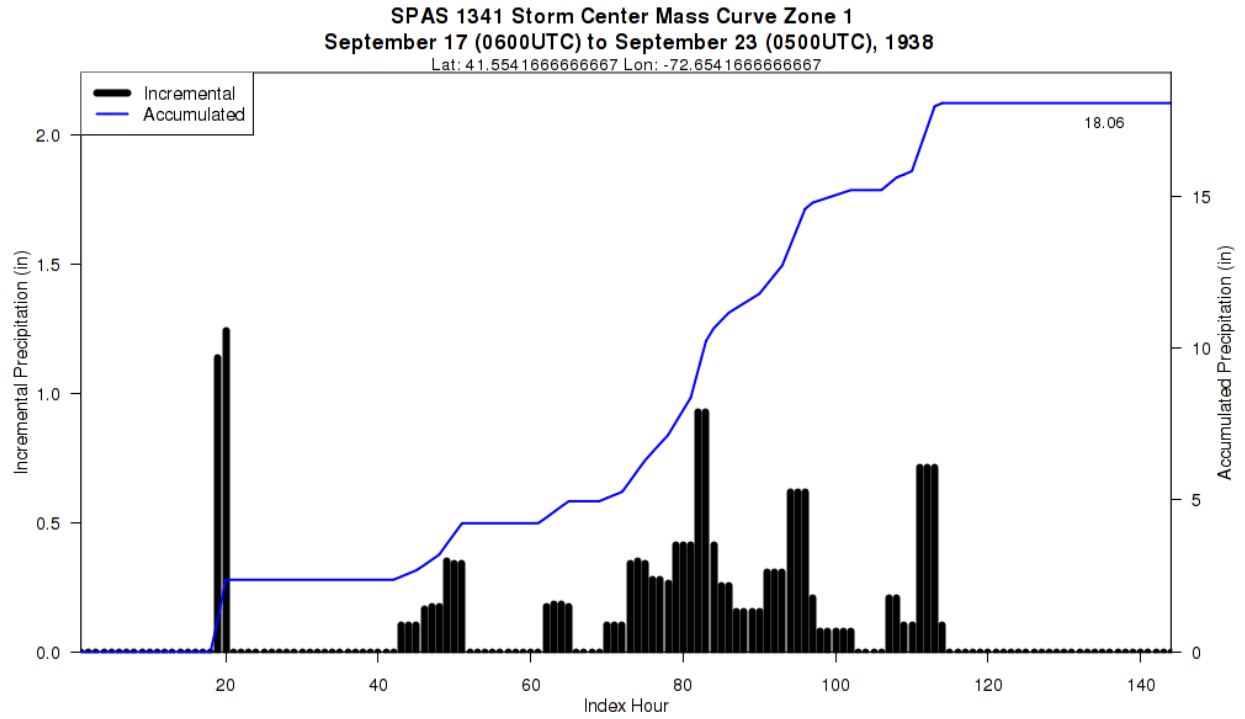
**Reliability of results:** This analysis was based on digitized hourly data from the USACE NA 2-2 mass curves, daily data, and supplemental station. The lack of hourly data and having to digitize the USACE mass curves resulted in SPAS mass curves which are smoothed and are likely not representative of the true hourly accumulation. We have a high degree of confidence in the station based storm total results, the spatial pattern is dependent on the basemap, and the timing is based on hourly stations.

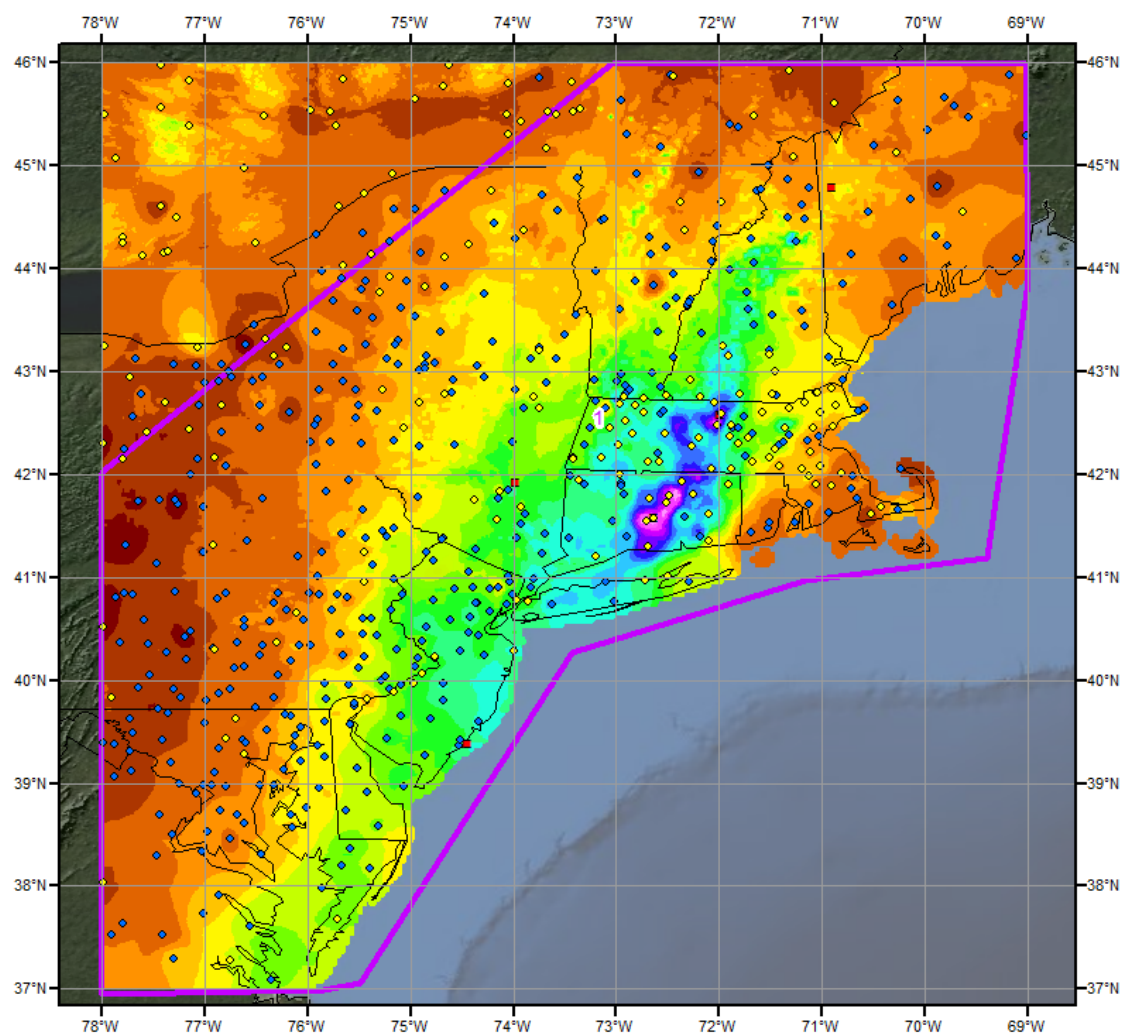
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1341_1	-72.6542	41.5542	126	100	5-Sep	80.00	3.60	0.03	82	3.570	83.60	83.5	4.21	0.03	89	4.180	1.171

Storm 1341 - September 17 (0600 UTC) - September 23 (0500 UTC), 1938													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
Area (mi <sup>2</sup> )	Duration (hours)												
	1	3	6	12	18	24	36	48	72	96	120	144	Total
0.4	1.24	3.23	6.45	8.68	10.20	11.03	12.78	14.19	15.84	18.00	18.00	18.00	18.00
1	1.23	3.20	6.40	8.61	10.12	10.94	12.68	14.08	15.72	17.88	17.88	17.88	17.88
10	1.20	3.08	6.13	8.25	9.70	10.49	12.16	13.52	15.43	17.59	17.59	17.58	17.58
25	1.19	2.96	5.90	7.94	9.34	10.09	11.69	13.11	15.28	17.47	17.47	17.47	17.47
50	1.18	2.87	5.73	7.70	9.05	9.78	11.33	12.86	15.07	17.27	17.27	17.27	17.27
100	1.17	2.78	5.54	7.45	8.76	9.48	10.99	12.60	14.86	17.04	17.04	17.04	17.04
200	1.15	2.65	5.29	7.12	8.38	9.16	10.70	12.33	14.61	16.77	16.77	16.77	16.77
300	1.12	2.57	5.12	6.89	8.14	8.98	10.50	12.15	14.37	16.47	16.47	16.47	16.47
400	1.10	2.51	5.00	6.73	7.97	8.85	10.35	12.01	14.16	16.18	16.18	16.18	16.18
500	1.08	2.47	4.90	6.61	7.84	8.74	10.24	11.84	13.96	15.92	15.92	15.92	15.92
1,000	0.99	2.32	4.57	6.17	7.43	8.39	9.79	11.27	13.26	14.98	14.98	14.98	14.98
2,000	0.87	2.13	4.22	5.68	6.98	7.90	9.15	10.58	12.39	13.82	13.86	13.82	13.82
5,000	0.67	1.81	3.48	4.70	6.05	6.94	8.14	9.41	11.16	12.27	12.30	12.30	12.30
10,000	0.52	1.51	2.83	3.86	5.11	6.00	7.34	8.56	10.27	11.17	11.26	11.26	11.26
20,000	0.45	1.21	2.22	3.08	4.08	4.82	6.52	7.68	9.37	9.94	10.12	10.12	10.12
50,000	0.34	0.89	1.49	2.28	2.91	3.79	4.99	6.25	7.58	8.00	8.25	8.25	8.25
100,000	0.22	0.57	1.01	1.60	2.13	2.85	3.79	4.74	5.76	6.03	6.29	6.29	6.29
159,120	0.15	0.40	0.70	1.14	1.54	2.08	2.86	3.61	4.39	4.62	4.86	4.86	4.86





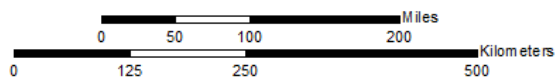




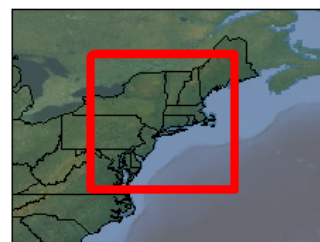
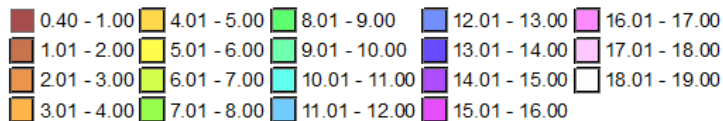
**Total Storm (144-hr) Precipitation (inches)**  
**September 17 (0600 UTC) - September 23 (0500 UTC), 1938**  
**SPAS 1341 - Buck, CT**

#### Gauges

- ◆ Daily
- Hourly
- Hourly Pseudo
- ◆ Supplemental



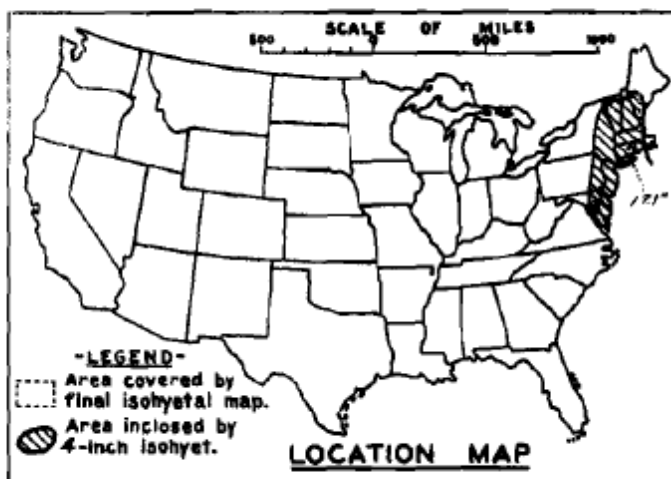
#### Precipitation (inches)



7/16/2014

DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS

**STORM STUDIES - PERTINENT DATA SHEET**

Storm of 17-22 Sept. 1938  
 Assignment NA 2-2  
 Location New England  
 Study Prepared by:  
 North Atlantic Division  
 Philadelphia District Office

Part I Reviewed by H. M. Sec. of  
 Weather Bureau, 7/17/47  
 Part II Approved by Office, Chief  
 of Engineers for Distribution  
 of Factual Data, 7/8/48  
 Remarks: Centers at Buck,  
 Conn. and Barre, Mass.  
 Dewpt. 68°- Ref. Pt. 100 SW  
 Grid D-3

**DATA AND COMPUTATIONS COMPILED****PART I**

Preliminary isohyetal map, in 2 sheet, scale 1: 1,000,000

Precipitation data and mass curves:

(Number of Sheets)

Form 5001-C (Hourly precip. data)----- 109  
 Form 5001-B (24-hour " " )----- 135  
 Form 5001-D ( " " " " )----- -  
 Misc. precip. records, meteorological data, etc.----- 35  
 Form 5002 (Mass rainfall curves)----- 135

**PART II**

Final isohyetal maps, in 1 sheet, scale 1,000,000

Data and computation sheets:

Form S-10 (Data from mass rainfall curves)----- 18  
 Form S-11 (Depth-area data from isohyetal map)----- 3  
 Form S-12 (Maximum depth-duration data)----- 9  
 Maximum duration-depth-area curves----- 1  
 Data relating to periods of maximum rainfall----- 2

**MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES**

Area in Sq. Mi.	Duration of Rainfall in Hours										
	6	12	18	24	30	36	48	60	72	96	120
10	6.4	8.2	9.6	11.3	12.2	13.2	14.3	15.0	15.8	16.9	17.1
100	5.0	6.8	8.3	9.5	10.4	11.4	13.0	14.0	15.1	16.5	16.8
200	4.6	6.3	7.8	9.0	9.8	10.9	12.4	13.4	14.8	16.1	16.4
500	4.1	5.6	7.1	8.3	9.0	10.2	11.6	12.6	14.2	15.4	15.7
1000	3.7	5.1	6.6	7.7	8.4	9.6	11.0	12.0	13.8	14.6	15.0
2000	3.3	4.6	6.0	7.2	7.8	9.0	10.4	11.3	13.2	13.8	14.2
5000	2.7	3.9	5.1	6.3	6.9	8.2	9.5	10.3	12.0	12.4	12.8
10000	2.3	3.3	4.4	5.7	6.2	7.4	8.6	9.6	10.9	11.3	11.6
20000	1.9	2.8	3.8	4.9	5.5	6.4	7.5	8.6	9.6	10.0	10.3
50000	1.4	2.1	2.8	3.7	4.2	4.8	5.8	6.6	7.3	7.7	8.0
67000	1.2	1.9	2.5	3.3	3.7	4.2	5.1	5.9	6.5	6.8	7.1

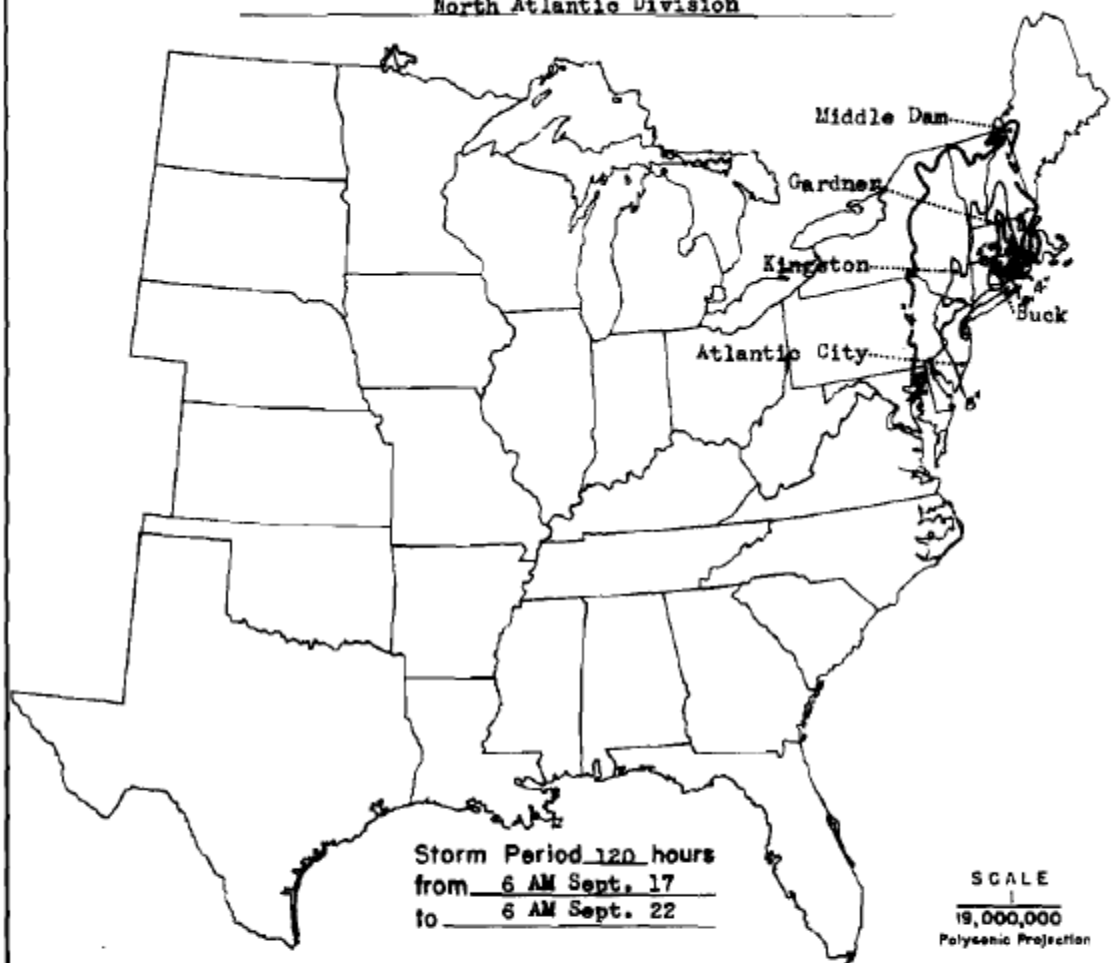
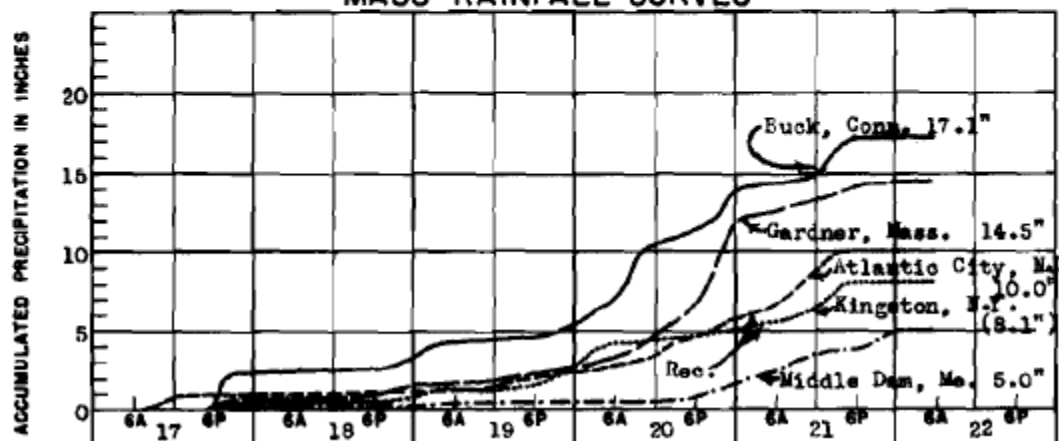
Form S-2

DEPARTMENT OF THE ARMY

CORPS OF ENGINEERS

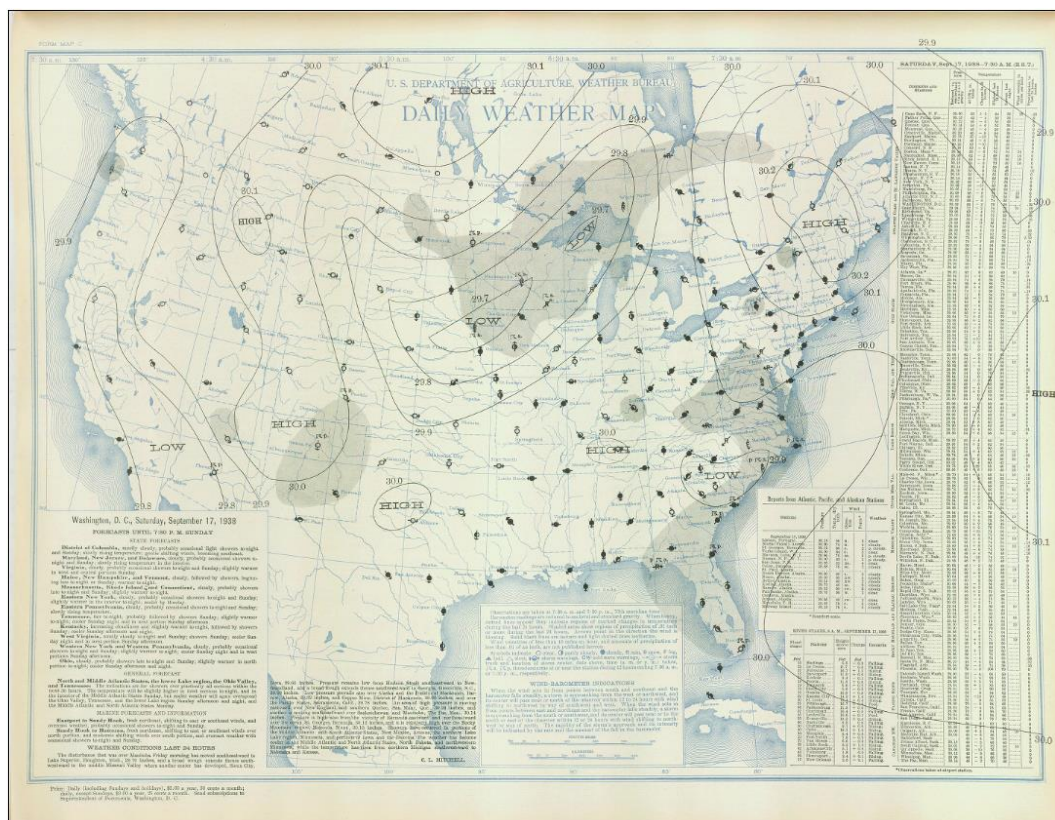
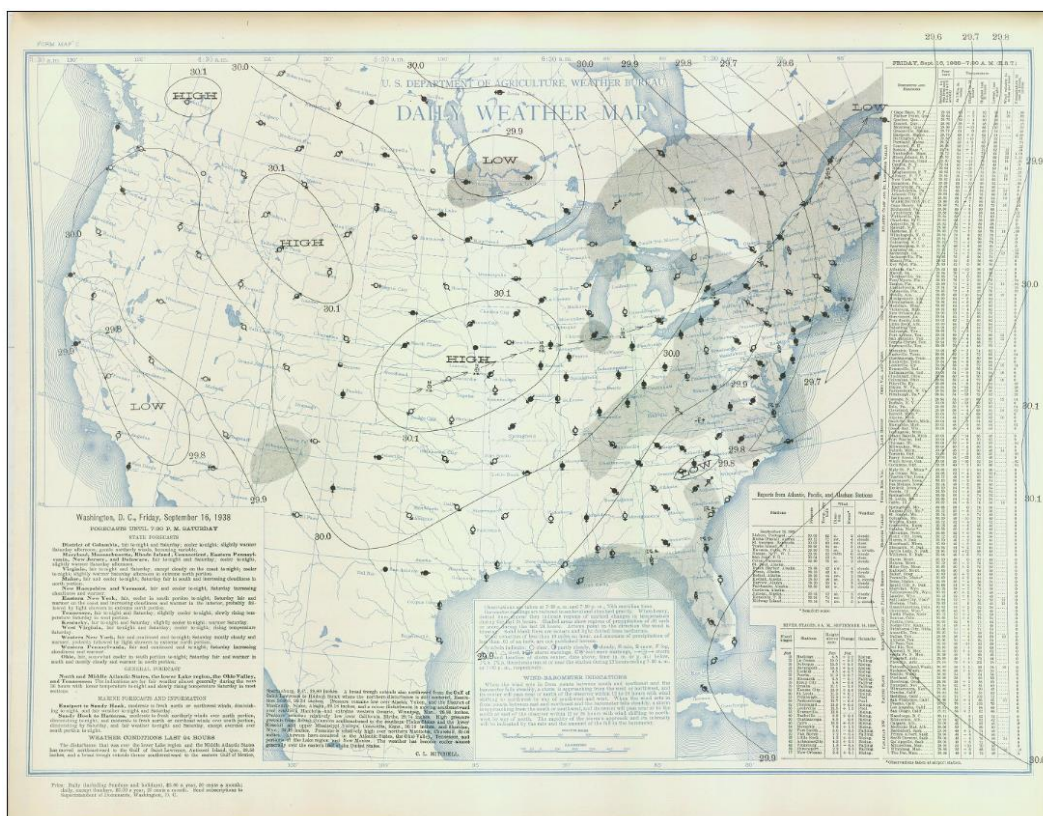
**STORM STUDIES - ISOHYETAL MAP**

Storm of 17-22 September 1938 Assignment NA 2-2  
 Study Prepared by: Philadelphia, Pa. District  
North Atlantic Division

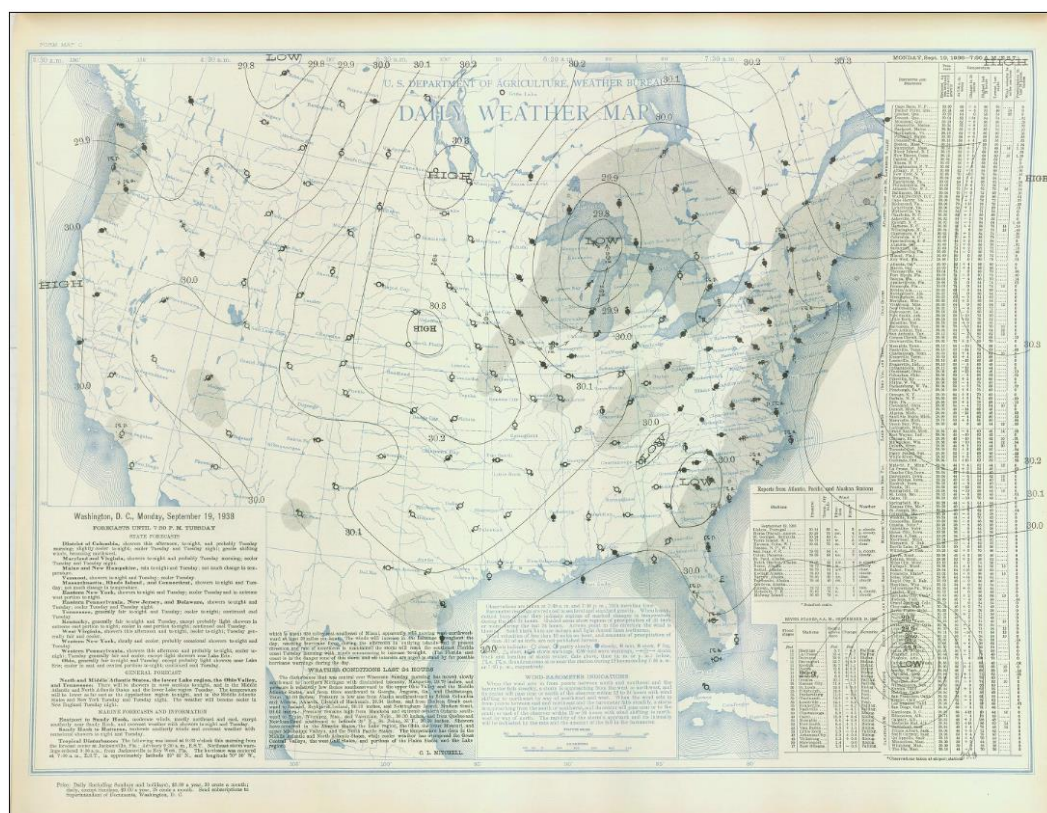
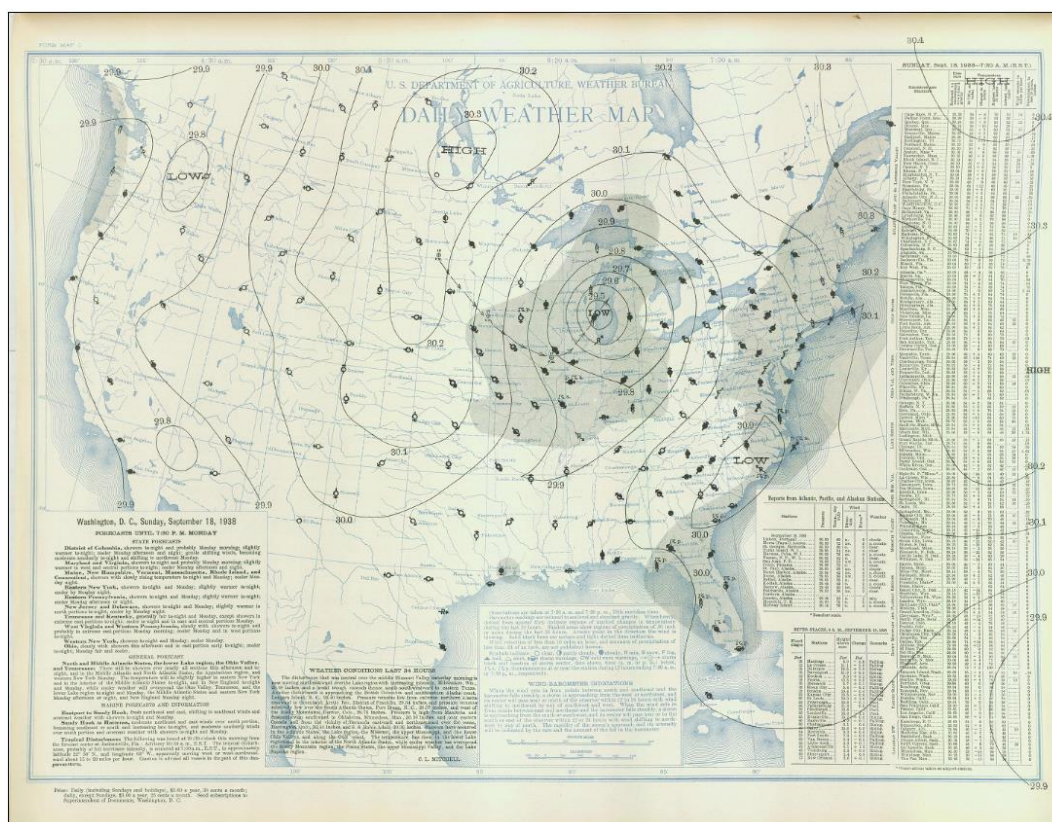
**MASS RAINFALL CURVES**

FORM 3-35

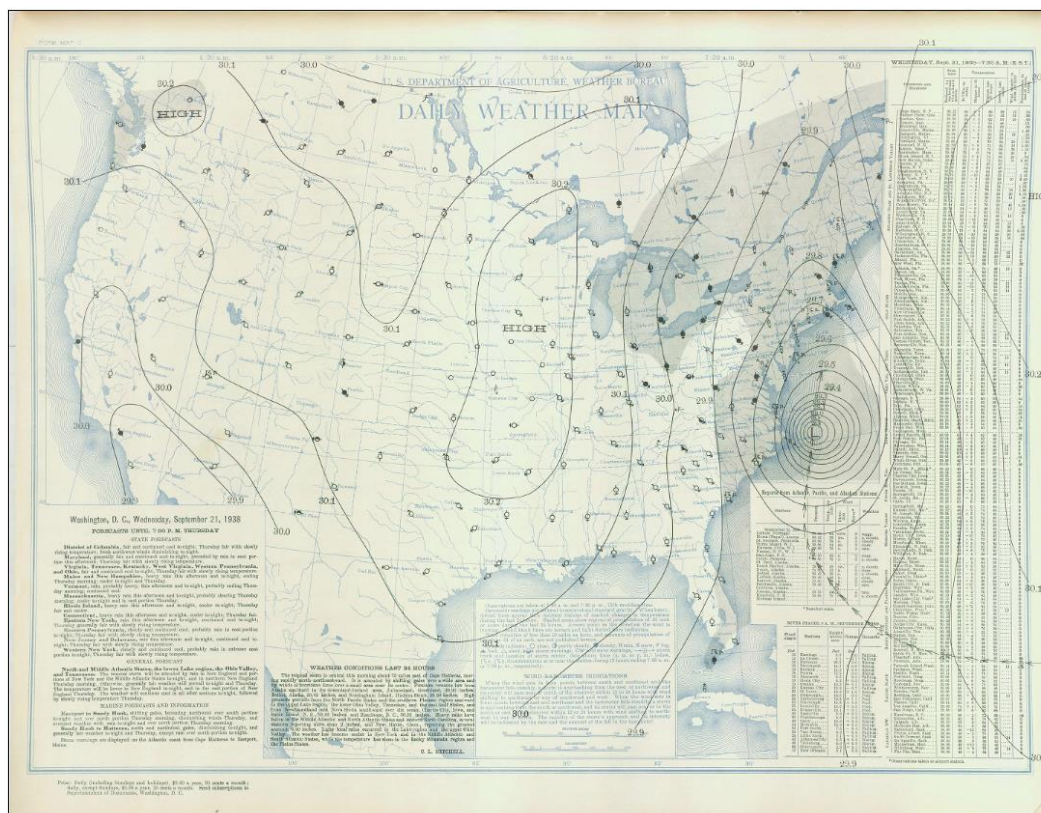
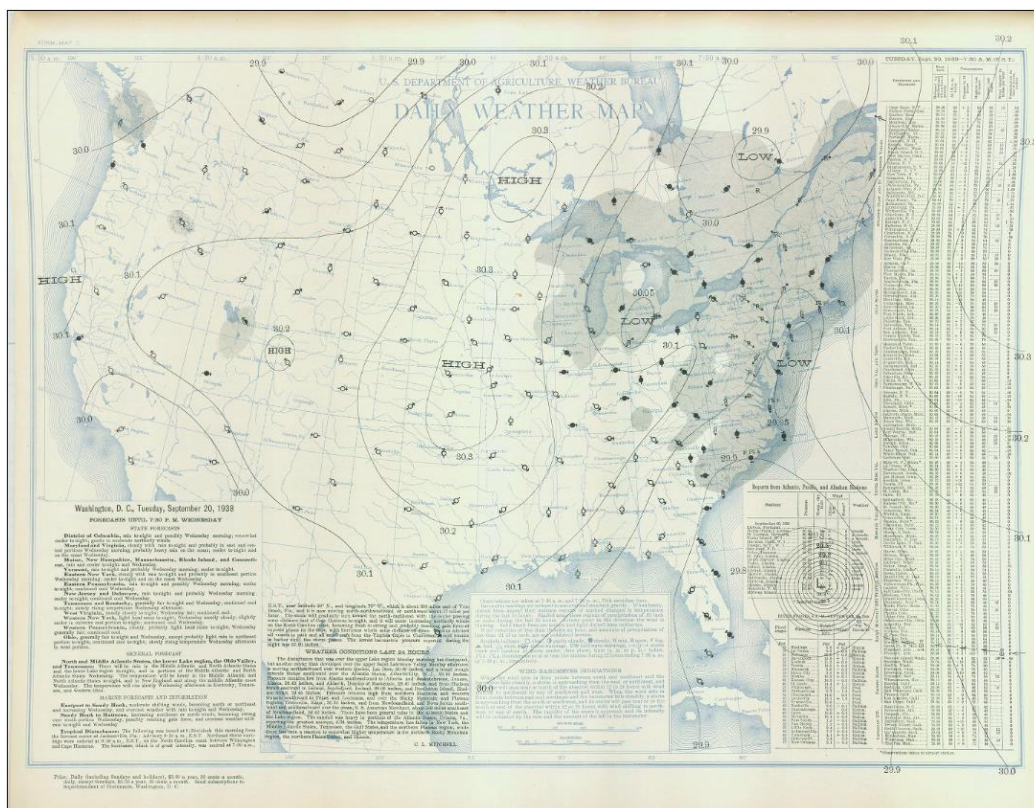




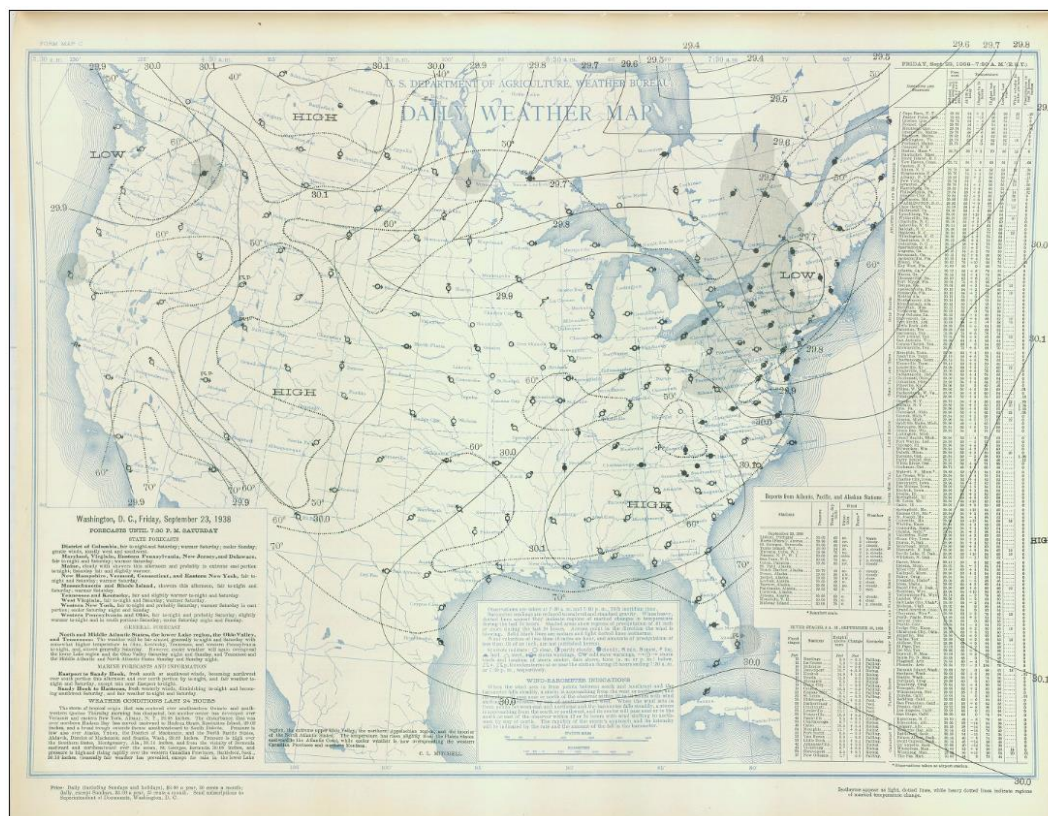
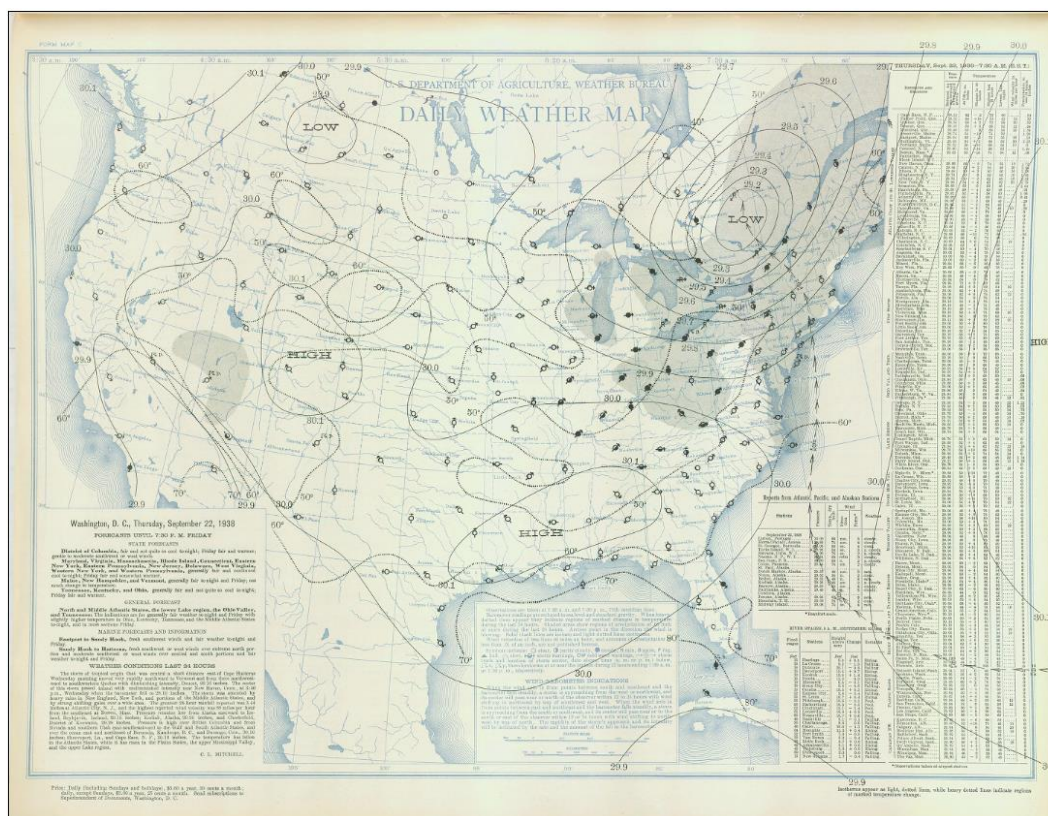






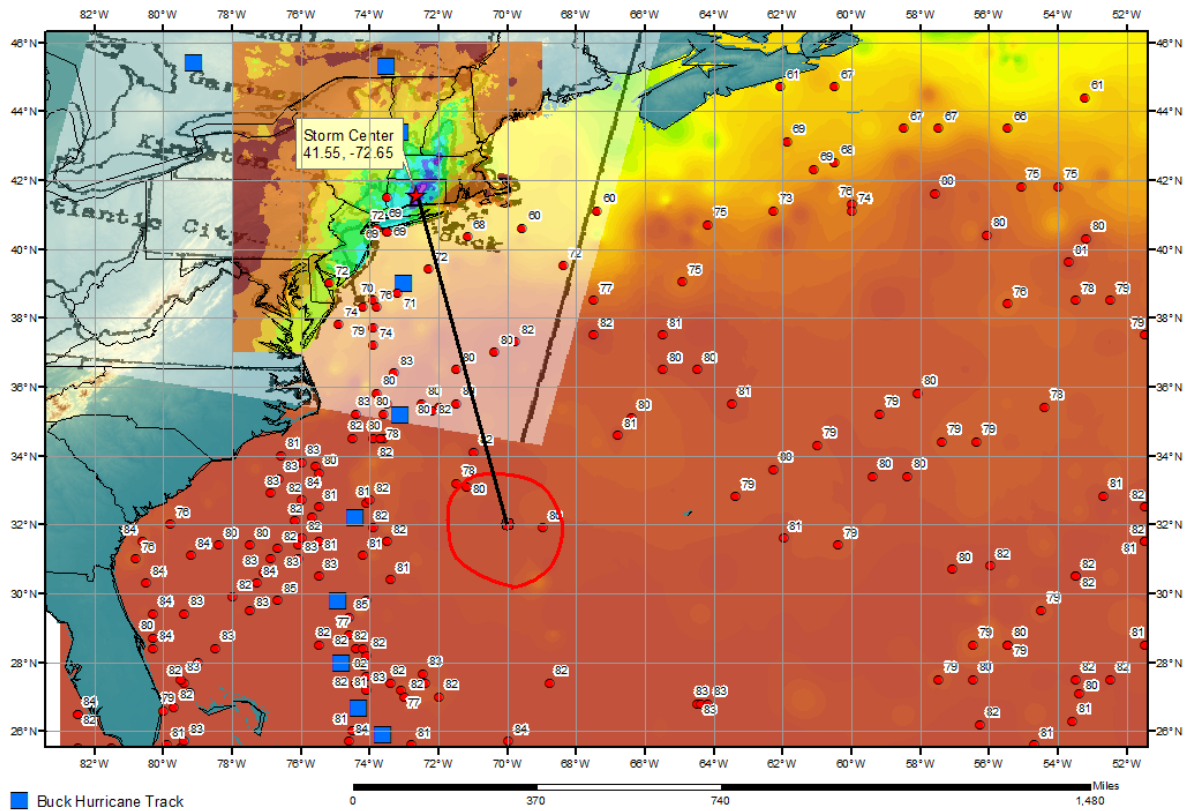




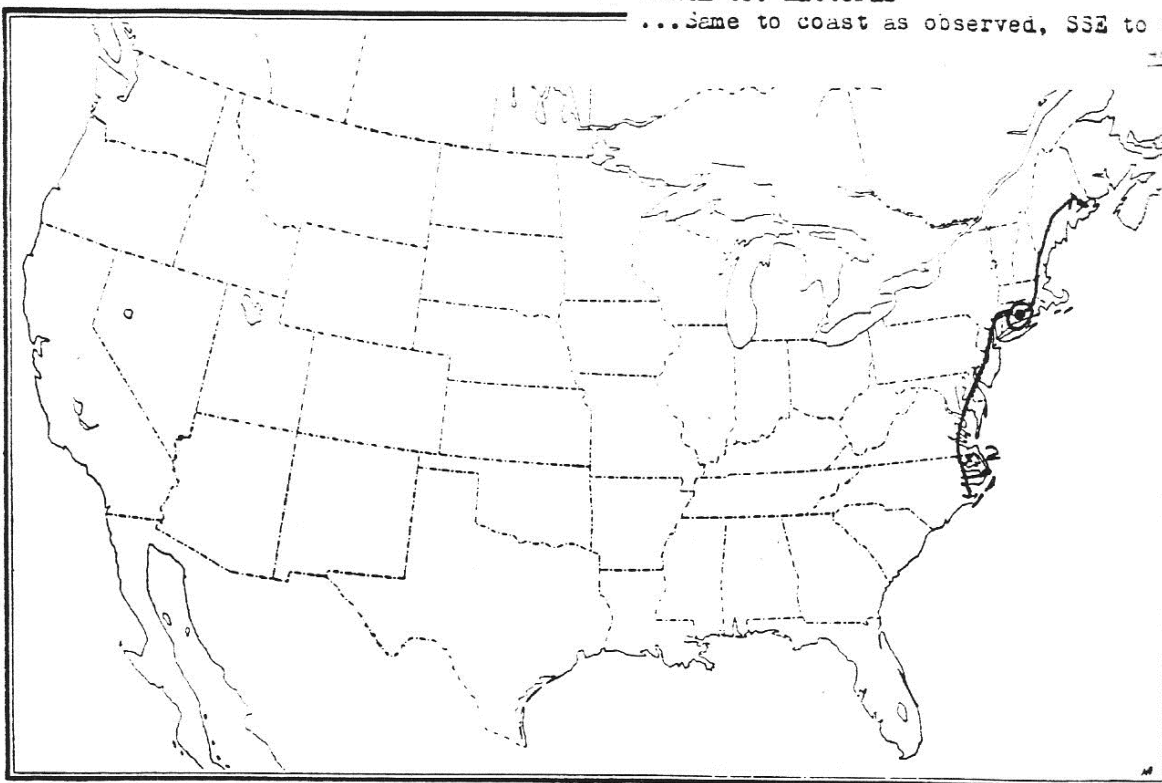




**SPAS 1341 USACE NA 2-2 Buck, CT Storm Analysis**  
**September 19, 1938**



MA 2-2..Sept. 19-21, 1958..Buck, Conn.  
12-mr. rTd 68(19th)..100 SW..to 75, 41  
North to: border  
South to: matteras  
...Same to coast as observed, SSE to S



## Storm Precipitation Analysis System (SPAS) For Storm #1567\_1

### SPAS Analysis

**General Storm Location:** Tuckerton, NJ

**Storm Dates:** August 18-20, 1939

**Event:** Synoptic, Remnants of hurricane

#### DAD Zone 1

**Latitude:** 39.679

**Longitude:** -74.271

**Max. Grid Rainfall Amount:** 18.07"

**Max. Observed Rainfall Amount:** 18.00"

**Number of Stations:** 92 (7 Hourly, 2 Hourly Pseudo, 51 Daily, 32 Supplemental)

**SPAS Version:** 10.0

**Basemap:** conus\_prism\_ppt\_in\_1971\_2000\_08

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

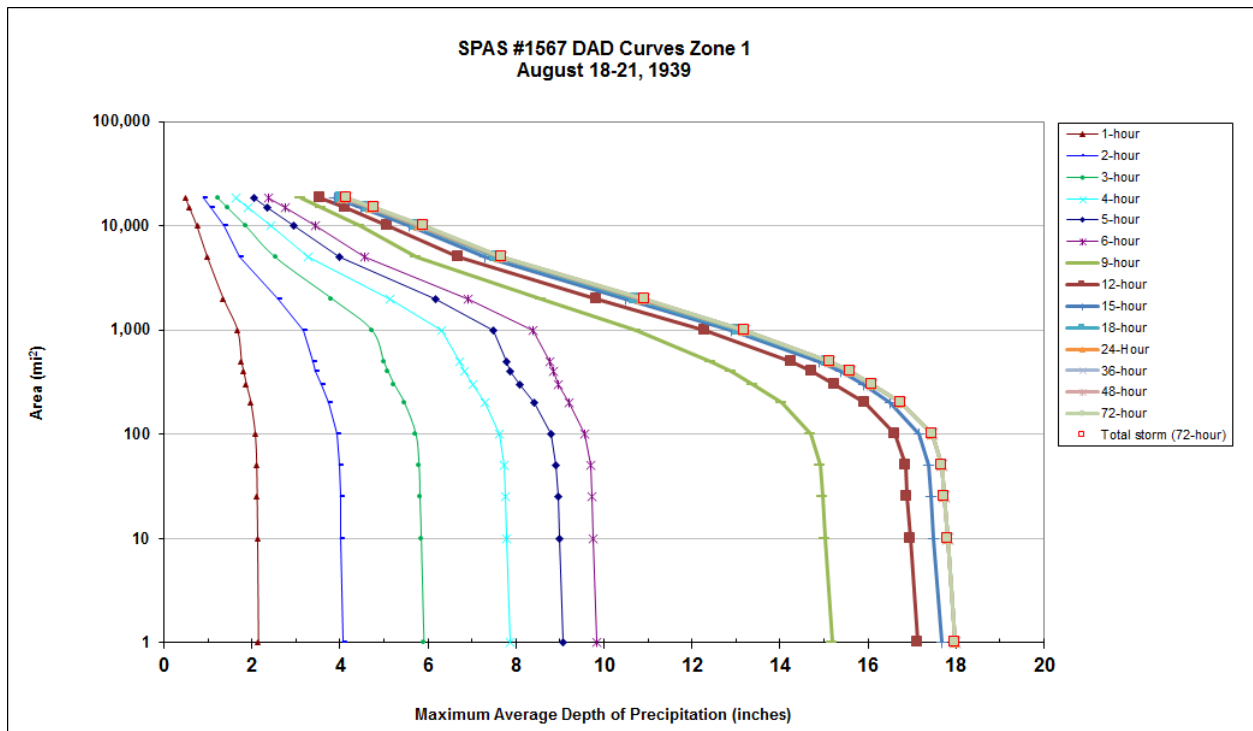
**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

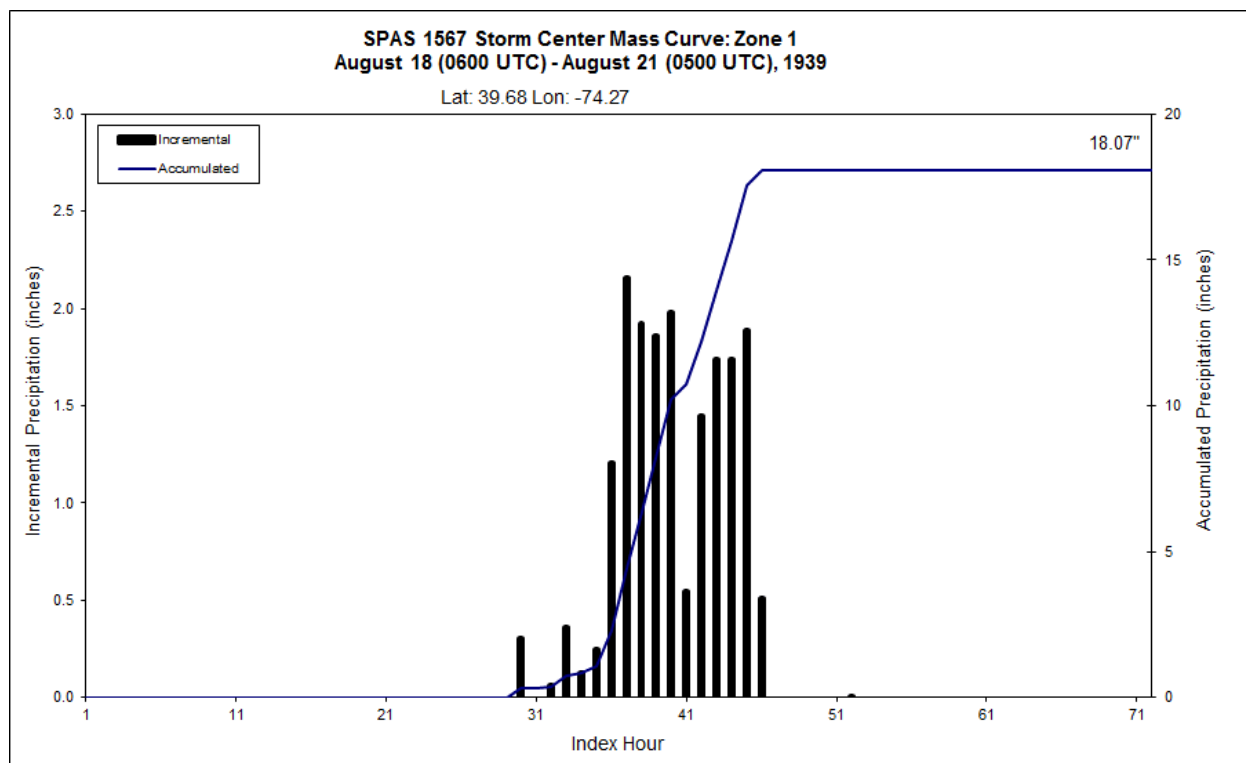
**Reliability of results:** This analysis was based on nine hourly stations (USACE NA 2-3, NCDC and EDADSV2 storm report mass curves), daily data and supplemental station data. We have a good degree of confidence for the station based storm total results. The spatial pattern is dependent on the basemap (conus\_prism\_ppt\_in\_1971\_2000\_08). Spatially, it looks very similar to the rainfall analysis from USACE (see below). There is a good degree of confidence with the timing based on the hourly stations near the storm center. Some daily stations were moved to supplemental due to timing issues.

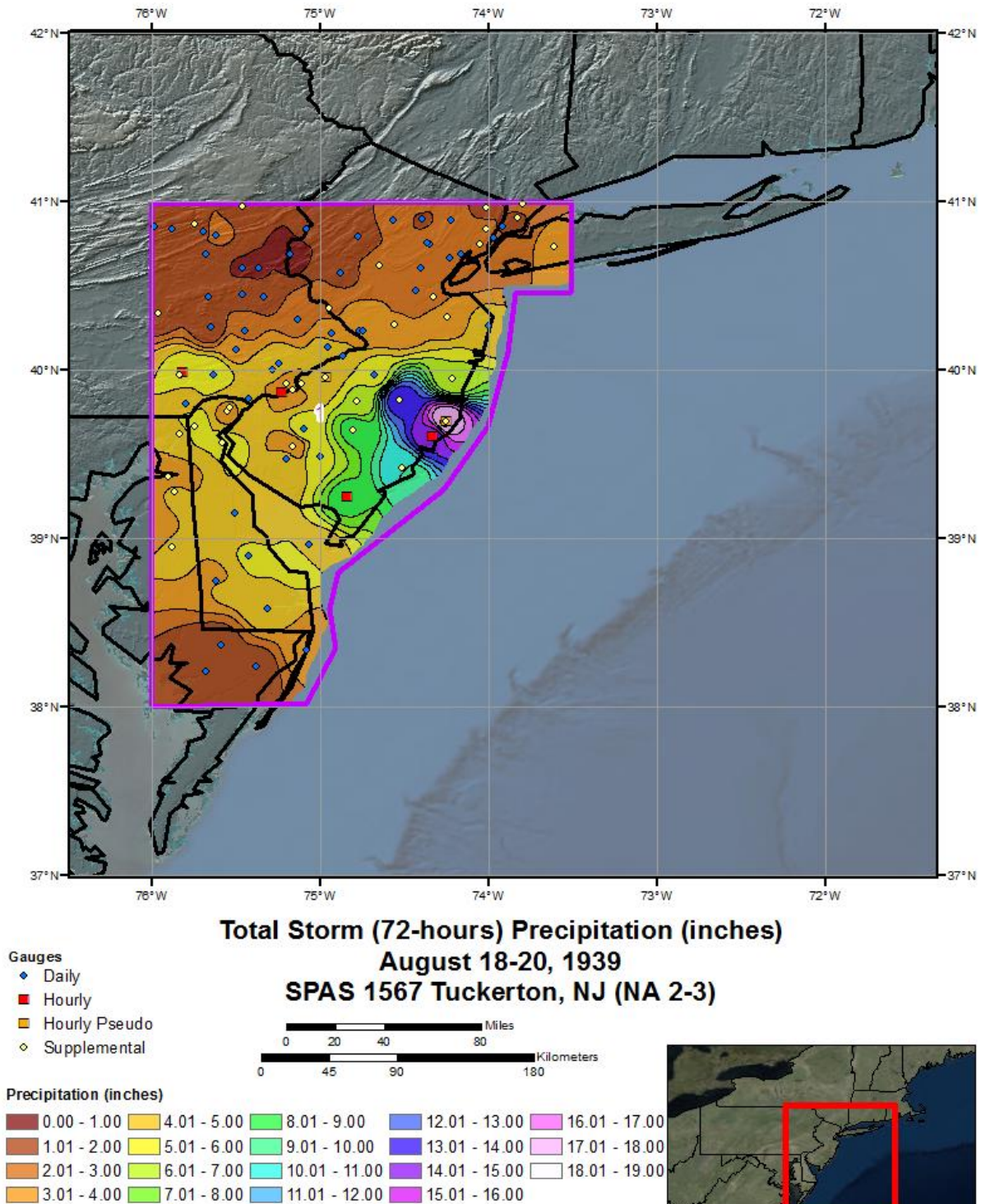
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1567_1	-74.2710	39.6790	19	0	15-Aug	81.00	3.77	0.00	84	3.770	82.50	82.5	4.03	0.00	87	4.030	1.069

Storm 1567 Zone 1 - Aug. 18 (0600 UTC) - Aug. 21 (0500 UTC), 1939															
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)															
areasqmi	Duration (hours)														
	1	2	3	4	5	6	9	12	15	18	24	36	48	72	Total
0.4	2.15	4.07	5.92	7.90	9.10	9.89	15.24	17.20	17.74	18.04	18.04	18.04	18.04	18.04	18.04
1	2.14	4.06	5.90	7.87	9.07	9.85	15.18	17.13	17.67	17.97	17.98	17.98	17.98	17.98	17.98
10	2.12	4.02	5.84	7.79	8.98	9.75	15.03	16.97	17.50	17.81	17.81	17.81	17.81	17.81	17.81
25	2.11	4.01	5.81	7.76	8.95	9.72	14.97	16.90	17.44	17.74	17.74	17.74	17.74	17.74	17.74
50	2.10	4.00	5.79	7.74	8.92	9.69	14.93	16.85	17.39	17.69	17.69	17.69	17.69	17.69	17.69
100	2.07	3.93	5.72	7.63	8.79	9.56	14.71	16.62	17.17	17.45	17.45	17.45	17.45	17.45	17.45
200	1.97	3.74	5.46	7.30	8.42	9.21	14.04	15.92	16.50	16.74	16.75	16.75	16.75	16.75	16.75
300	1.87	3.57	5.23	7.02	8.09	8.97	13.39	15.26	15.89	16.09	16.10	16.10	16.10	16.10	16.10
400	1.81	3.45	5.09	6.84	7.88	8.84	12.89	14.74	15.38	15.57	15.59	15.59	15.59	15.59	15.59
500	1.76	3.38	4.99	6.72	7.78	8.76	12.43	14.26	14.90	15.09	15.14	15.14	15.15	15.15	15.15
1,000	1.67	3.16	4.72	6.31	7.48	8.38	10.75	12.29	12.89	13.07	13.18	13.19	13.20	13.20	13.20
2,000	1.35	2.60	3.81	5.13	6.17	6.92	8.58	9.83	10.49	10.71	10.86	10.91	10.92	10.92	10.92
5,000	0.99	1.73	2.53	3.28	3.98	4.57	5.74	6.68	7.29	7.54	7.62	7.65	7.69	7.69	7.69
10,000	0.75	1.37	1.86	2.43	2.96	3.45	4.45	5.09	5.57	5.75	5.80	5.84	5.89	5.89	5.89
15,000	0.58	1.06	1.44	1.91	2.36	2.76	3.59	4.12	4.48	4.65	4.69	4.73	4.78	4.78	4.78
18,353	0.50	0.91	1.24	1.65	2.04	2.37	3.10	3.56	3.89	4.05	4.08	4.13	4.16	4.16	4.16









WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

**STORM STUDIES - PERTINENT DATA SHEET**

Storm of August 19, 1939

Assignment NA 2 - 3

Location N.J. Pa. Del.

Study Prepared by:

North Atlantic Division

Philadelphia District Office

Part I Reviewed by H. M. Sec. of  
Weather Bureau, 11/7/40Part II Approved by Office, Chief  
of Engineers for Distribution  
of Factual Data, 6/24/44

Remarks: Centers at

Manahawkin &amp; Tuckerton, N.J.

**DATA AND COMPUTATIONS COMPILED****PART I**

Preliminary Isohyetal map, in 1 sheet, scale 1 : 1,000,000

Precipitation data and mass curves:

(Number of Sheets)

Form 5001-C (Hourly precip. data)----- 30

Form 5001-B (24-hour " " )----- 28

Form 5001-D ( " " " " )----- 1

Misc. precip. records, meteorological data, etc.----- 9

Form 5002 (Mass rainfall curves)----- 28

**PART II**

Final isohyetal maps, in 1 sheet, scale 1 : 1,000,000

Data and computation sheets:

Form S-10 (Data from mass rainfall curves)----- 2

Form S-11 (Depth-area data from isohyetal map)----- 1

Form S-12 (Maximum depth-duration data)----- 2

Maximum duration-depth-area curves----- 1

Data relating to periods of maximum rainfall----- 1

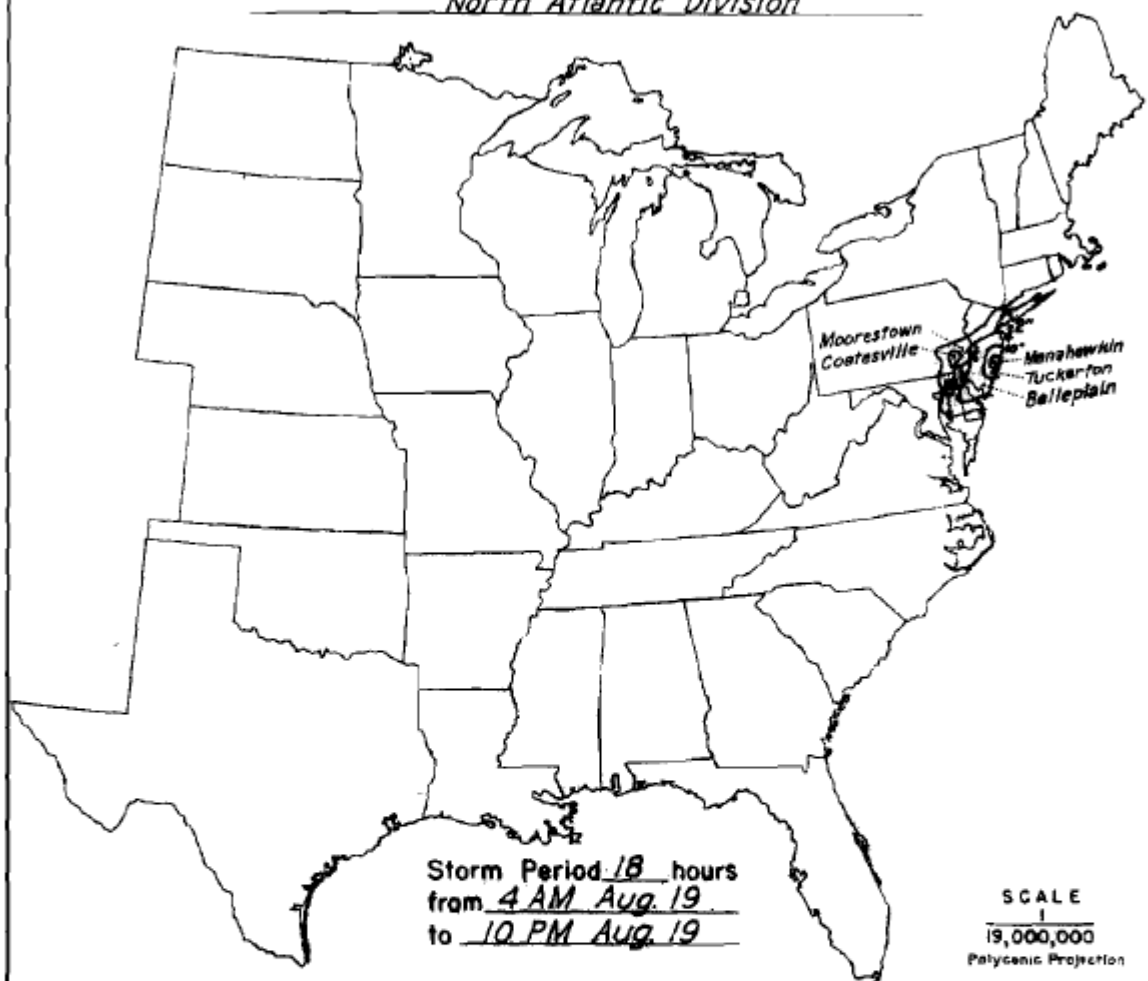
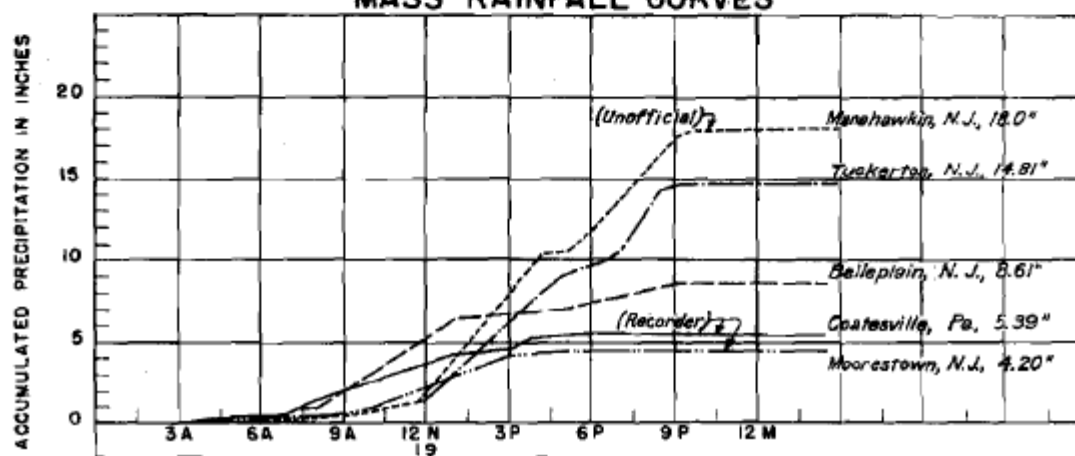
**MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES**

Area in Sq. Mi.	Duration of Rainfall in Hours											
	3	6	9	12	15	18						
10	6.4	9.7	14.3	17.1	17.6	17.8						
100	6.1	9.0	13.4	15.8	16.3	16.5						
200	5.8	8.6	12.8	15.1	15.6	15.7						
500	5.4	7.9	11.3	13.4	14.0	14.1						
1,000	4.7	7.0	9.4	11.3	12.0	12.2						
2,000	3.7	5.8	7.3	8.9	9.6	10.0						
5,000	2.2	4.0	5.2	6.2	6.7	7.1						
10,000	1.5	2.9	4.0	4.6	5.0	5.4						

Form S-2

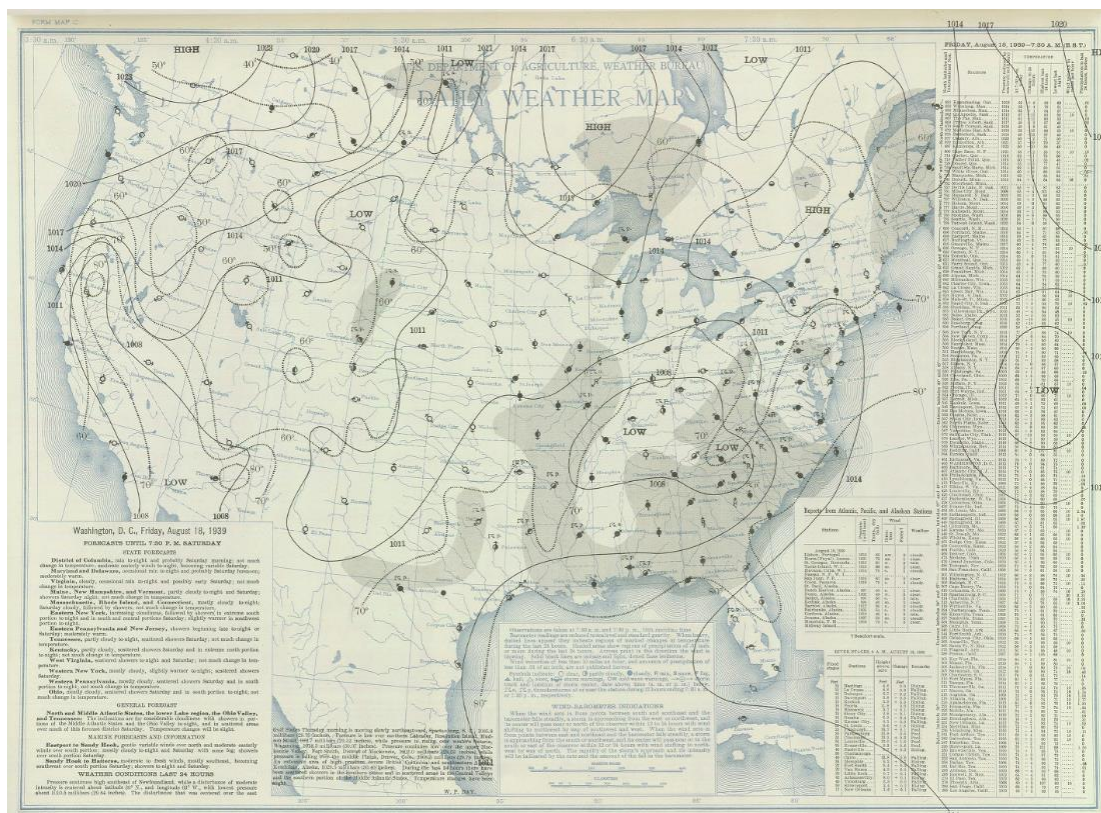
WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARMY

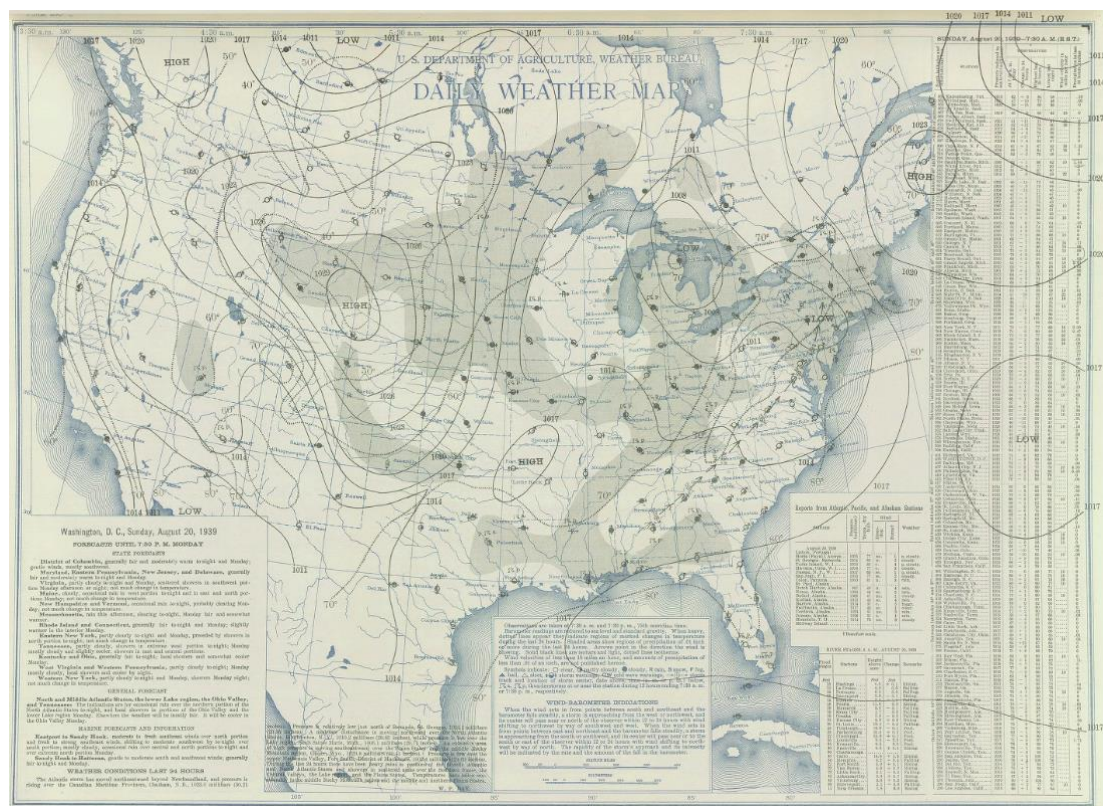
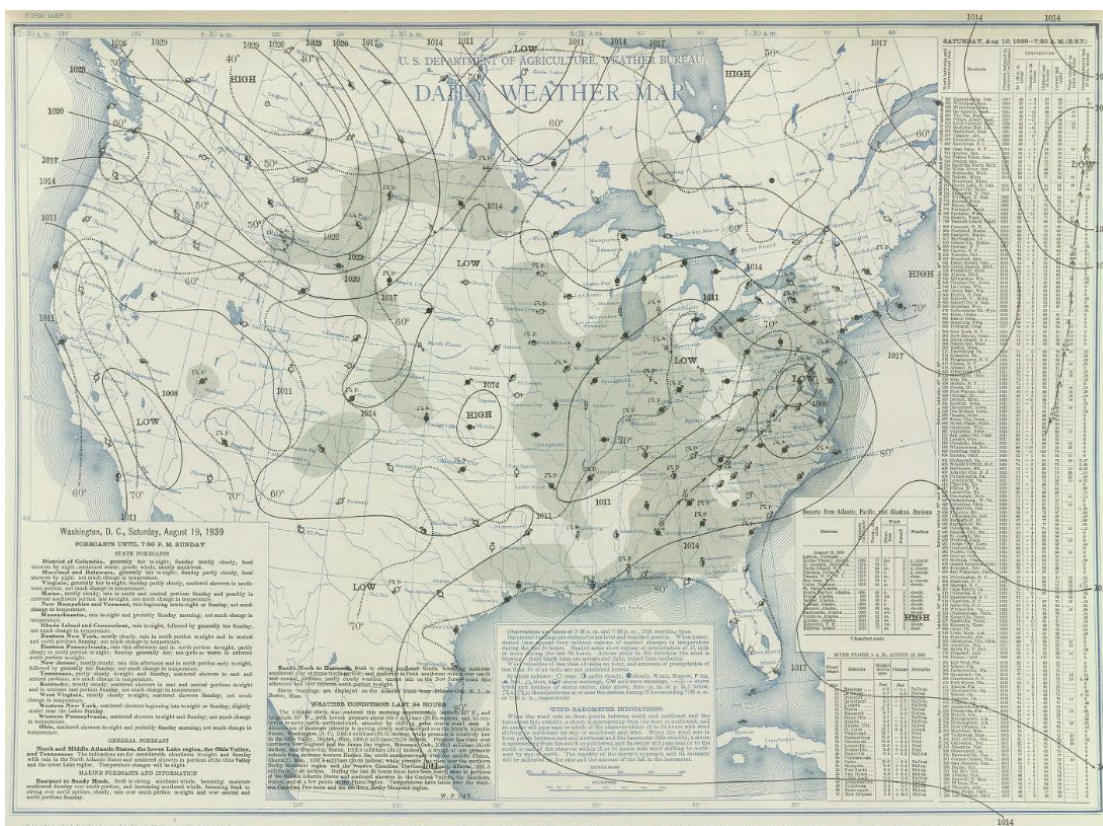
**STORM STUDIES - ISOHYETAL MAP**Storm of August 19, 1939 Assignment NA-2-3Study Prepared by: Philadelphia, Penna. District  
North Atlantic Division**MASS RAINFALL CURVES**

FORM 8-3E





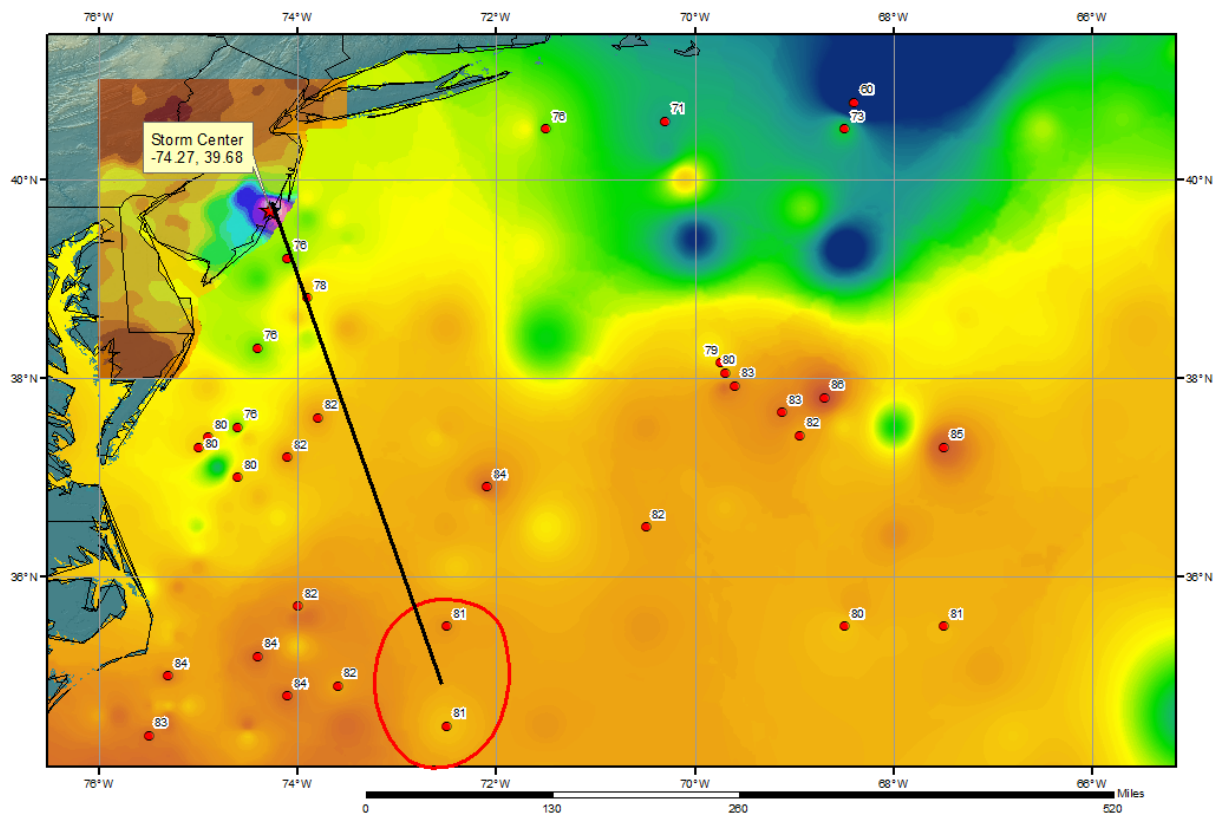








# SPAS 1567 Tuckerton, NJ Storm Analysis August 17, 1939





## Storm Precipitation Analysis System (SPAS) For Storm #1679\_1 SPAS Analysis

**General Storm Location:** Slide Mountain, NY

**Storm Dates:** August 10-15, 1955

**Event:** Hurricane Connie Remnants

### DAD Zone 1

**Latitude:** 42.0208

**Longitude:** -74.3958

**Max. Grid Rainfall Amount:** 15.20"

**Max. Observed Rainfall Amount:** 15.15"

**Number of Stations:** 292

**SPAS Version:** 10.0

**Basemap:** Isohyetal Map

**Spatial resolution:** 0.2479

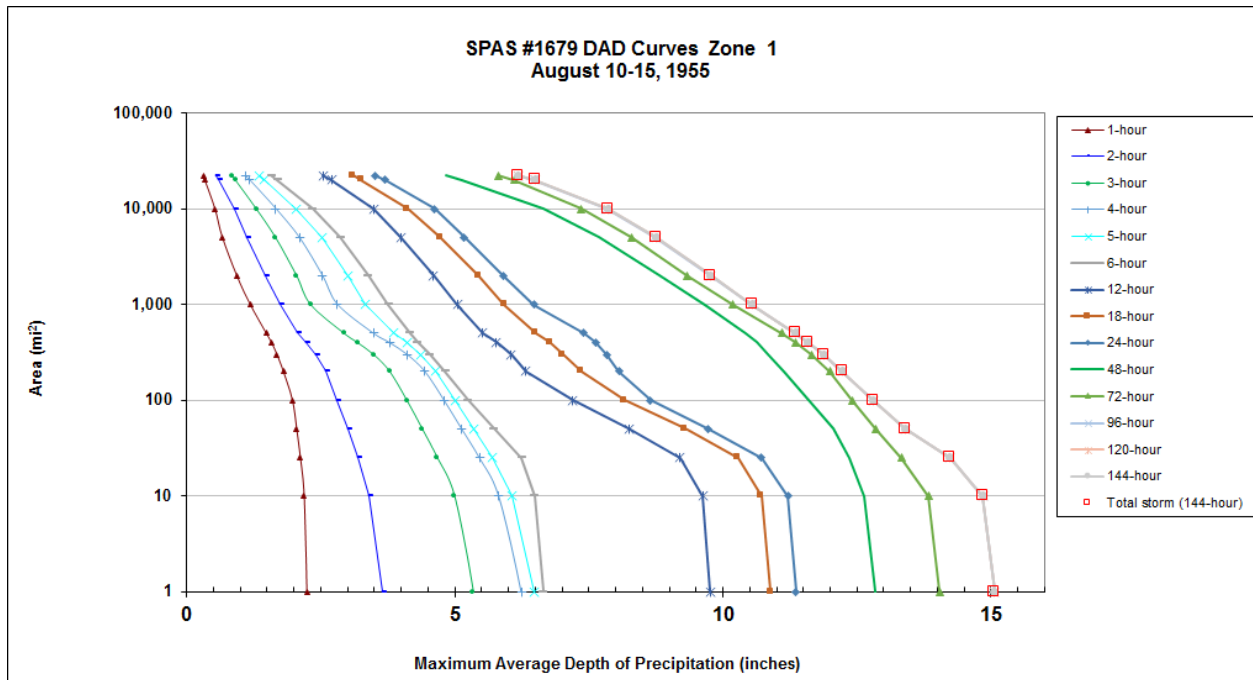
**Radar Included:** No

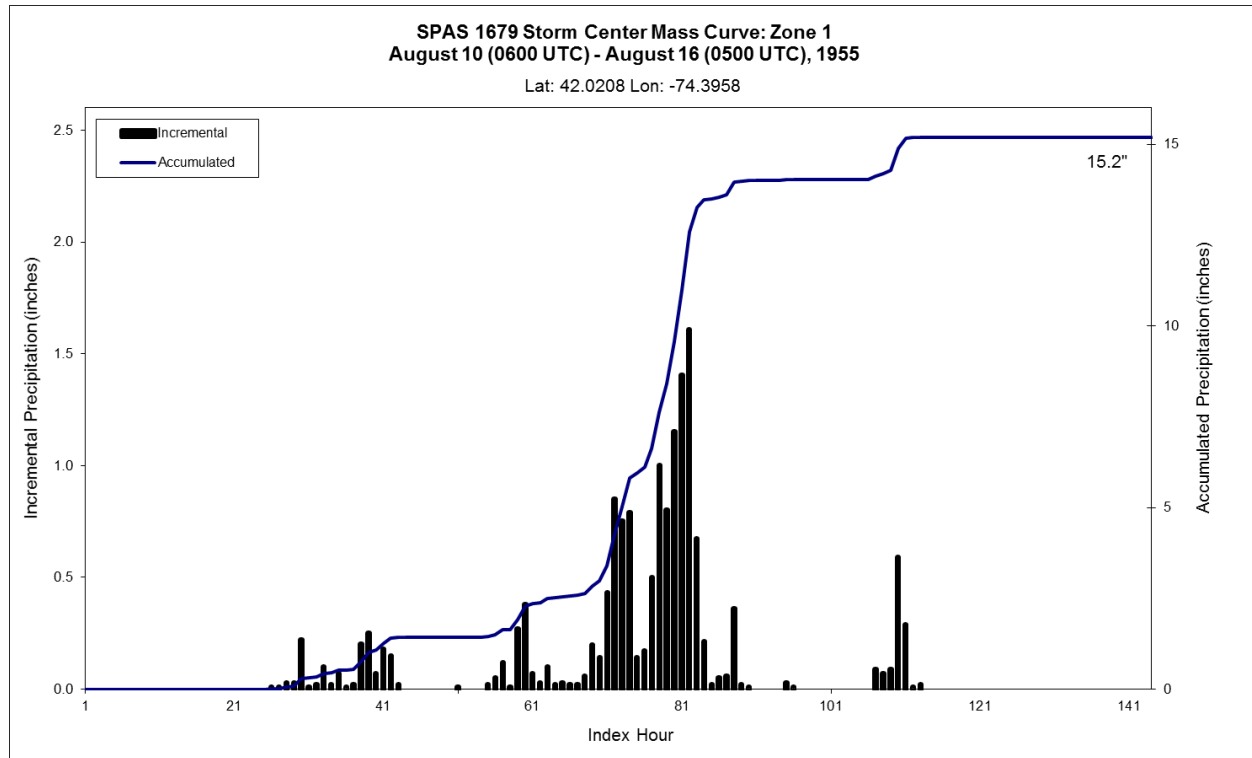
**Depth-Area-Duration (DAD) analysis:** Yes

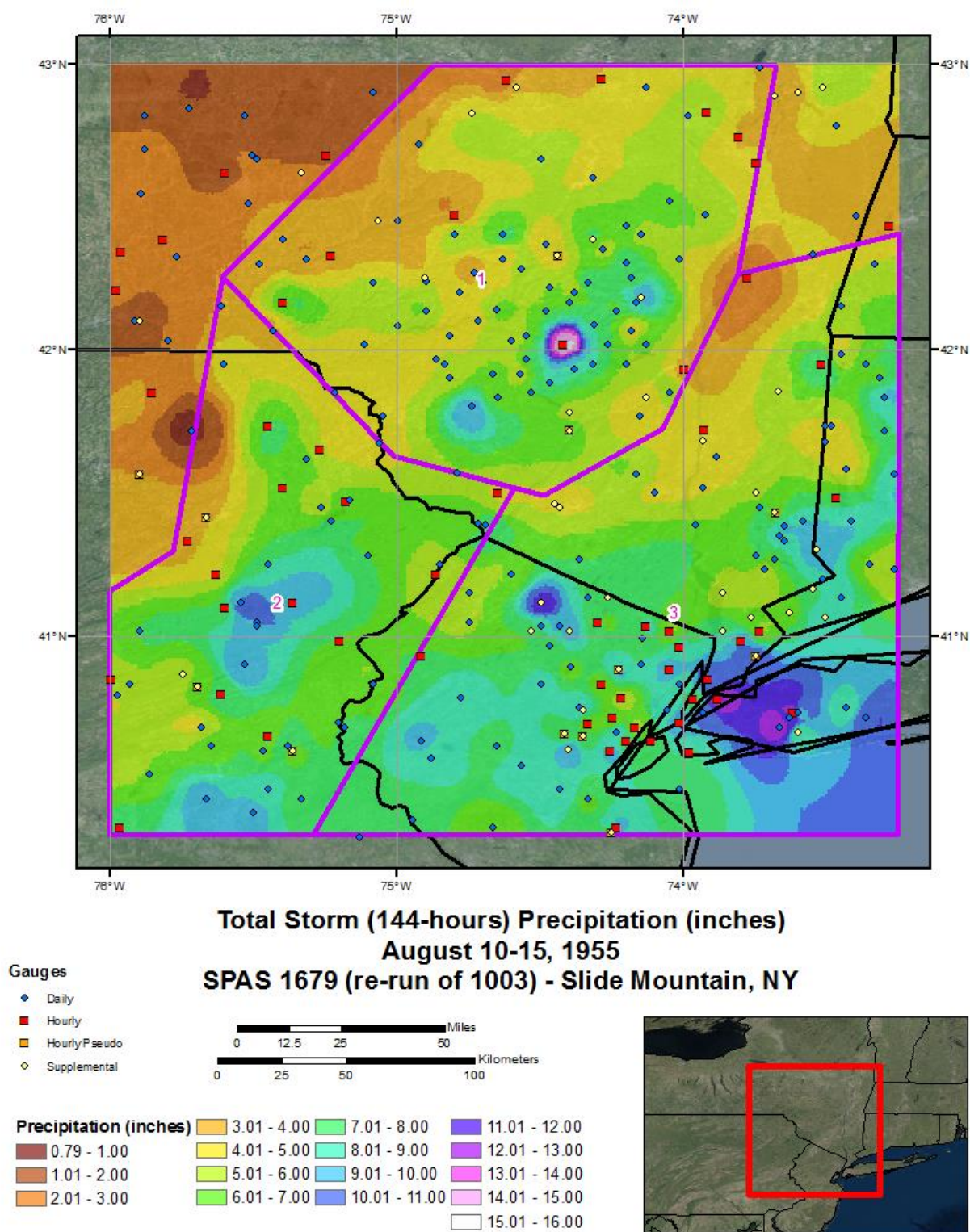
**Reliability of results:** This analysis was based on 292 hourly stations, hourly pseudo, daily data and supplemental station data. We have a good degree of confidence for the station based storm total results. The spatial pattern is dependent on the isohyetal basemap. Timing is based on the hourly and hourly pseudo stations. Several daily stations were moved to supplemental due to timing issues and to ensure data consistency.

						Storm Rep. Dew Point					Climatological Max. Dew Point						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1679_1	-74.3958	42.0208	2,798	2,800	5-Aug	73.00	2.60	0.62	68	1.980	76.00	76.0	2.99	0.68	74	2.310	1.167

Storm 1679 - August 10 (0600 UTC) - August 16 (0500 UTC), 1955														
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)														
Area (mi <sup>2</sup> )	Duration (hours)													
	1	2	3	4	5	6	12	18	24	48	72	96	120	144
0.4	2.25	3.68	5.38	6.29	6.55	6.70	9.82	10.95	11.42	12.90	14.12	15.15	15.15	15.15
1	2.24	3.64	5.34	6.24	6.49	6.65	9.76	10.89	11.36	12.83	14.04	15.07	15.07	15.07
10	2.19	3.40	4.99	5.82	6.07	6.49	9.62	10.72	11.21	12.64	13.83	14.85	14.85	14.85
25	2.12	3.19	4.67	5.46	5.69	6.24	9.20	10.28	10.72	12.35	13.33	14.24	14.24	14.24
50	2.05	3.00	4.39	5.13	5.36	5.73	8.25	9.29	9.72	12.05	12.84	13.40	13.40	13.40
100	1.97	2.80	4.10	4.80	5.01	5.24	7.20	8.16	8.65	11.60	12.41	12.80	12.80	12.80
200	1.80	2.59	3.78	4.44	4.65	4.82	6.32	7.36	8.06	11.14	11.99	12.23	12.23	12.23
300	1.68	2.42	3.48	4.11	4.36	4.53	6.05	7.01	7.83	10.85	11.65	11.88	11.88	11.88
400	1.58	2.23	3.18	3.78	4.10	4.30	5.77	6.77	7.63	10.64	11.35	11.57	11.58	11.58
500	1.48	2.06	2.93	3.48	3.85	4.16	5.52	6.51	7.41	10.43	11.10	11.34	11.35	11.35
1,000	1.18	1.75	2.31	2.81	3.32	3.76	5.05	5.92	6.47	9.67	10.19	10.53	10.54	10.54
2,000	0.93	1.47	2.05	2.53	3.00	3.38	4.60	5.44	5.90	8.82	9.33	9.76	9.78	9.78
5,000	0.66	1.13	1.66	2.10	2.53	2.86	3.99	4.73	5.18	7.69	8.29	8.72	8.75	8.75
10,000	0.52	0.90	1.30	1.66	2.04	2.35	3.48	4.12	4.62	6.66	7.36	7.82	7.85	7.85
20,000	0.33	0.60	0.91	1.17	1.44	1.69	2.70	3.26	3.70	5.14	6.11	6.48	6.50	6.50
22,085	0.31	0.55	0.85	1.09	1.35	1.58	2.54	3.11	3.51	4.83	5.81	6.17	6.18	6.18

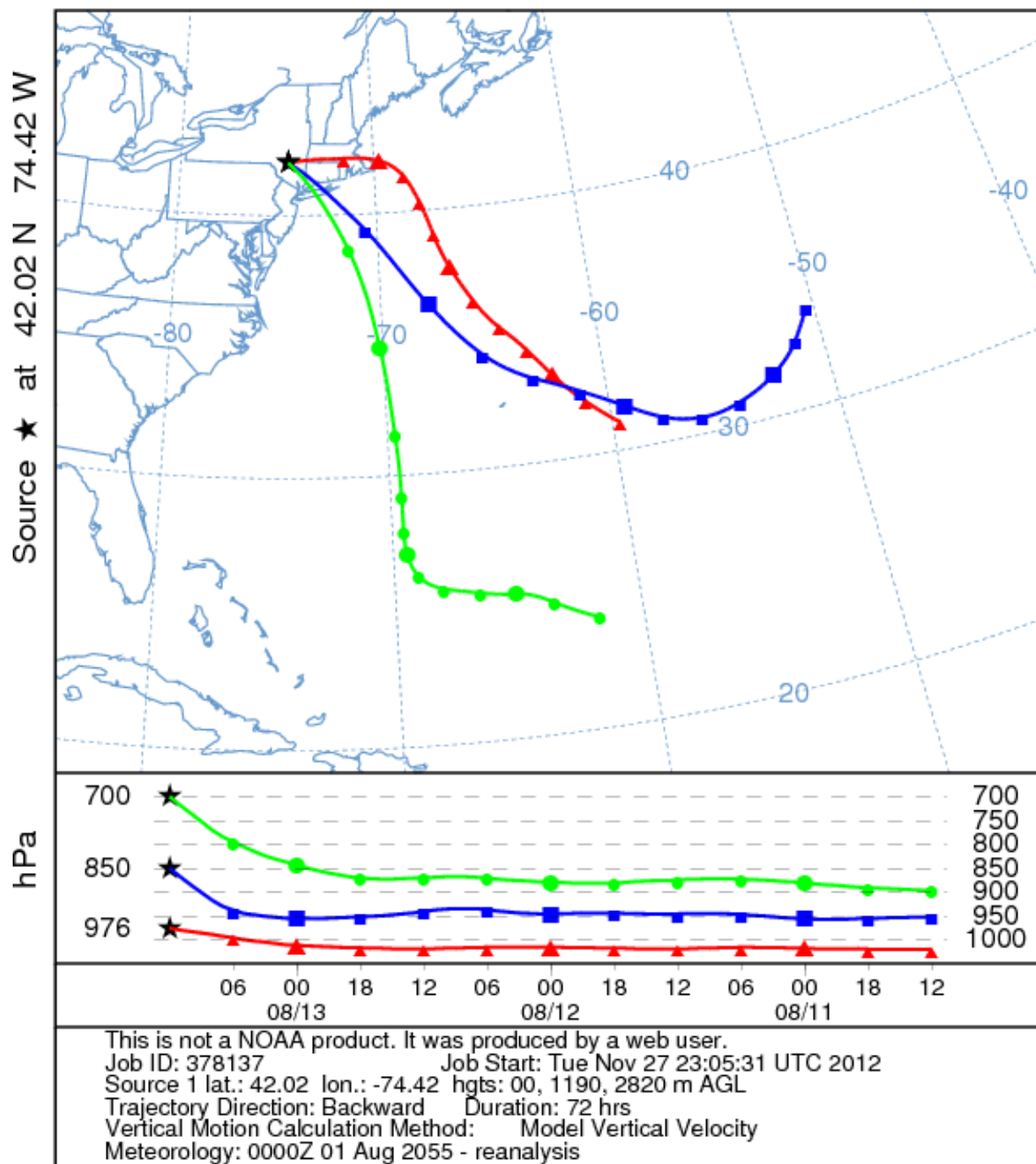




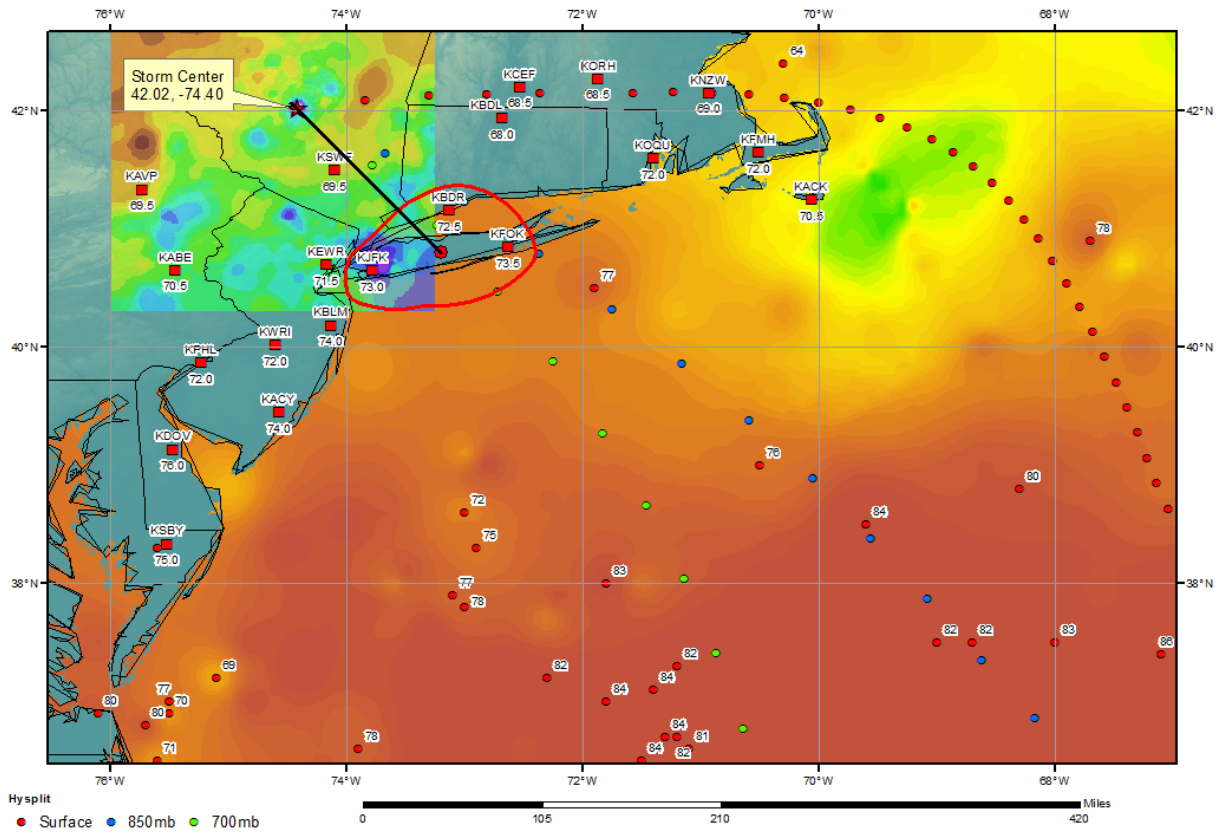




NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 13 Aug 55  
 CDC1 Meteorological Data



**SPAS 1679 Slide Mtn, NY Storm Analysis**  
**(Re-run of SPAS 1003)**  
**August 11-12, 1955**



## Storm Precipitation Analysis System (SPAS) For Storm #1491\_1 SPAS Analysis

**General Storm Location:** Tyro, VA (Tropical Storm Camille)

**Storm Dates:** August 18-20, 1969

**Event:** Tropical Storm Camille

**DAD Zone 1**

**Latitude:** 37.8125

**Longitude:** -79.0042

**Max. Grid Rainfall Amount:** 27.23"

**Max. Observed Rainfall Amount:** 27.00"

**Number of Stations:** 512 (363 Daily, 75 Hourly, 33 Hourly Pseudo, and 41 Supplemental)

**SPAS Version:** 10.0

**Basemap:** Blended USGS total storm map and PRISM August 1969 Precipitation

**Spatial resolution:** 0:00:30 second (~ 0.3 mi<sup>2</sup>)

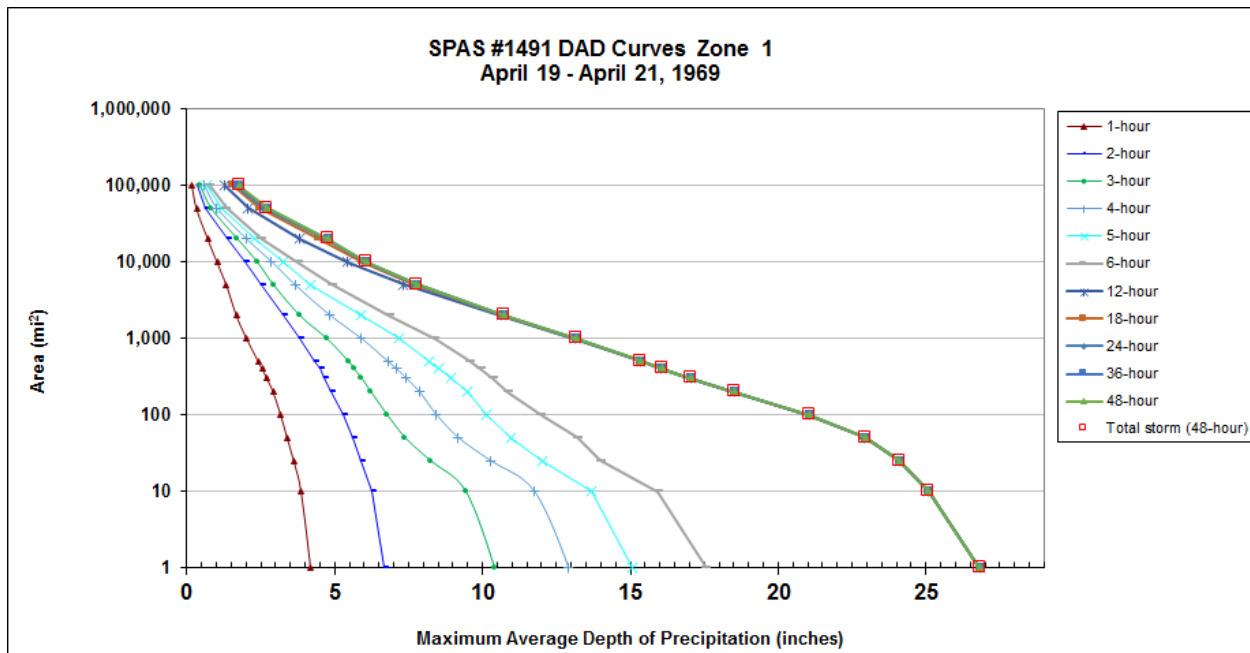
**Radar Included:** No

**Depth-Area-Duration (DAD) analysis:** Yes

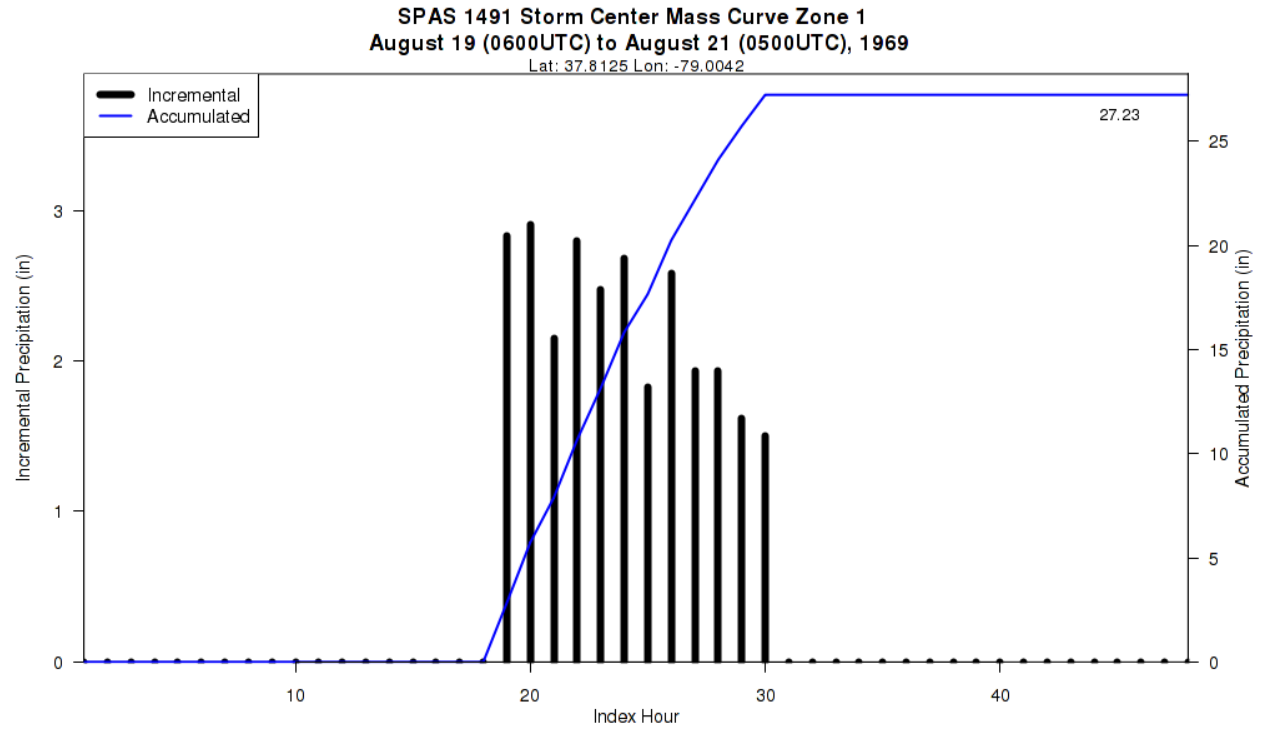
**Reliability of results:** This analysis was based on hourly data, daily data, supplemental station data and bucket survey data. Hourly station USACE Tyro, VA was digitized from the USACE Storm Studies report. Bucket survey rainfall timing and magnitude at the storm center (Tyro, VA) were diligently recorded and utilized in the SPAS storm analysis. We have a good degree of confidence in the station based storm total results, the spatial pattern is dependent on the station data and the USGS basemap, the timing is based on hourly and hourly pseudo stations. \*\*\* Could not match the 22.0" rainfall amount in 6-hours based on the USACE Storm Study report (Listed as Station R, "Tyro, VA").

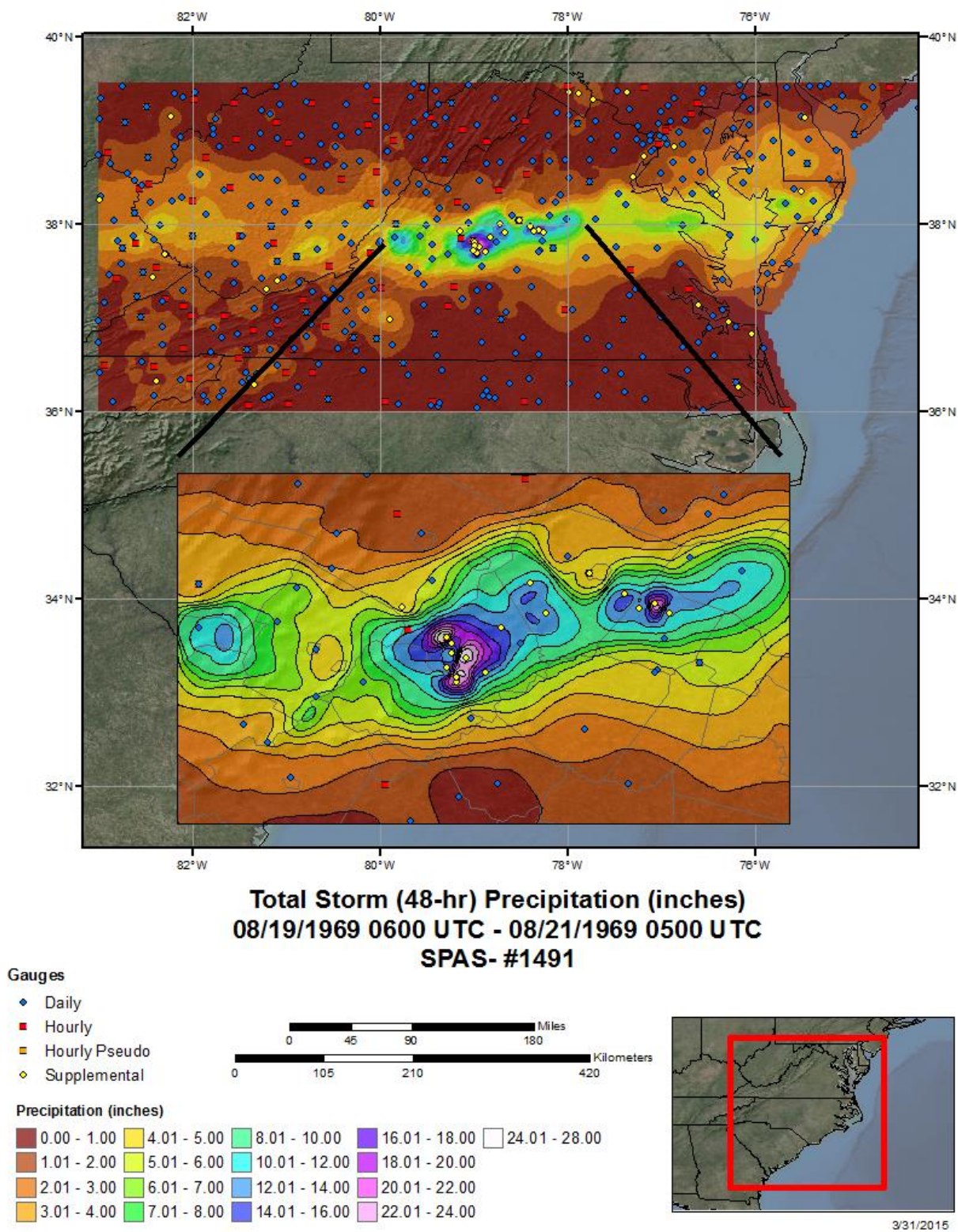
						Storm Rep. Dew Point					Climatological Max. Dew Point						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1491_1	-79.0042	37.8125	799	800	5-Aug	77.50	3.22	0.22	77	3.000	79.00	79.0	3.44	0.23	80	3.210	1.070


Storm 1491 - August 19 (0600 UTC) - August 21 (0500 UTC), 1969												
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)												
Area (mi <sup>2</sup> )	Duration (hours)											
	1	2	3	4	5	6	12	18	24	36	48	Total
0.4	4.24	6.74	10.51	13.07	15.22	17.76	27.11	27.11	27.11	27.11	27.11	27.11
1	4.19	6.67	10.39	12.91	15.05	17.57	26.83	26.83	26.83	26.83	26.83	26.83
10	3.87	6.25	9.42	11.75	13.68	15.94	25.09	25.09	25.09	25.09	25.09	25.09
25	3.62	5.91	8.23	10.27	12.02	14.00	24.11	24.11	24.11	24.11	24.11	24.11
50	3.40	5.60	7.38	9.18	10.97	13.21	22.93	22.93	22.93	22.94	22.94	22.94
100	3.18	5.28	6.77	8.44	10.15	11.99	21.05	21.06	21.06	21.07	21.07	21.07
200	2.92	4.88	6.22	7.86	9.47	10.86	18.51	18.52	18.52	18.52	18.52	18.52
300	2.71	4.65	5.91	7.41	8.92	10.34	17.04	17.05	17.05	17.05	17.05	17.05
400	2.55	4.49	5.65	7.08	8.54	9.93	16.05	16.07	16.07	16.08	16.08	16.08
500	2.42	4.33	5.46	6.79	8.20	9.57	15.33	15.35	15.36	15.36	15.36	15.36
1,000	2.02	3.82	4.72	5.89	7.18	8.38	13.13	13.17	13.17	13.18	13.18	13.18
2,000	1.68	3.26	3.81	4.83	5.88	6.84	10.63	10.69	10.72	10.74	10.74	10.74
5,000	1.34	2.54	2.93	3.65	4.18	4.90	7.34	7.67	7.74	7.78	7.78	7.78
10,000	1.02	1.98	2.38	2.86	3.26	3.75	5.44	5.94	6.03	6.09	6.09	6.09
20,000	0.71	1.38	1.71	2.00	2.29	2.53	3.83	4.47	4.70	4.76	4.77	4.77
50,000	0.33	0.63	0.83	1.01	1.20	1.34	2.06	2.47	2.60	2.70	2.72	2.72
100,000	0.18	0.35	0.45	0.57	0.67	0.77	1.28	1.57	1.65	1.75	1.76	1.76

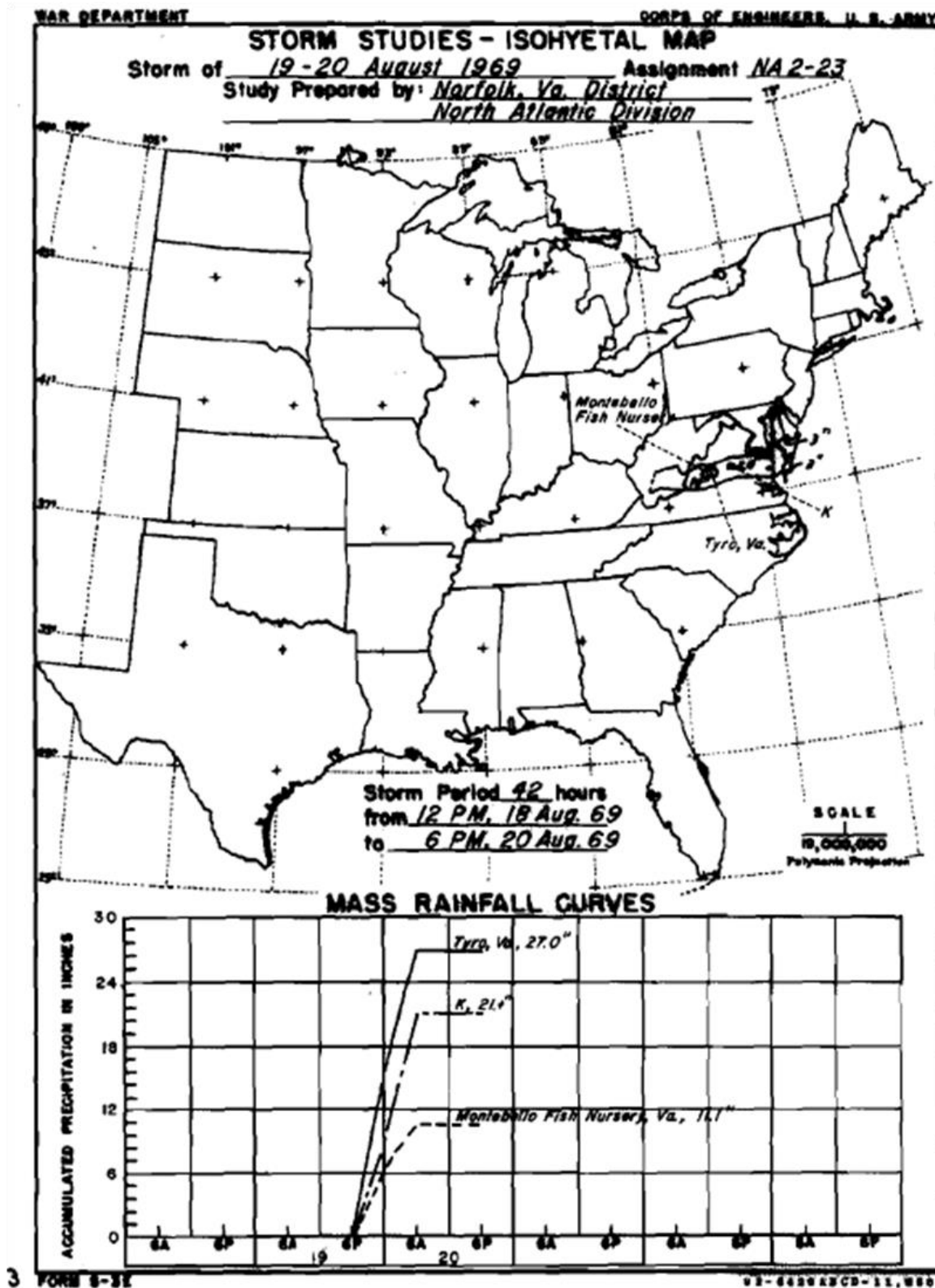






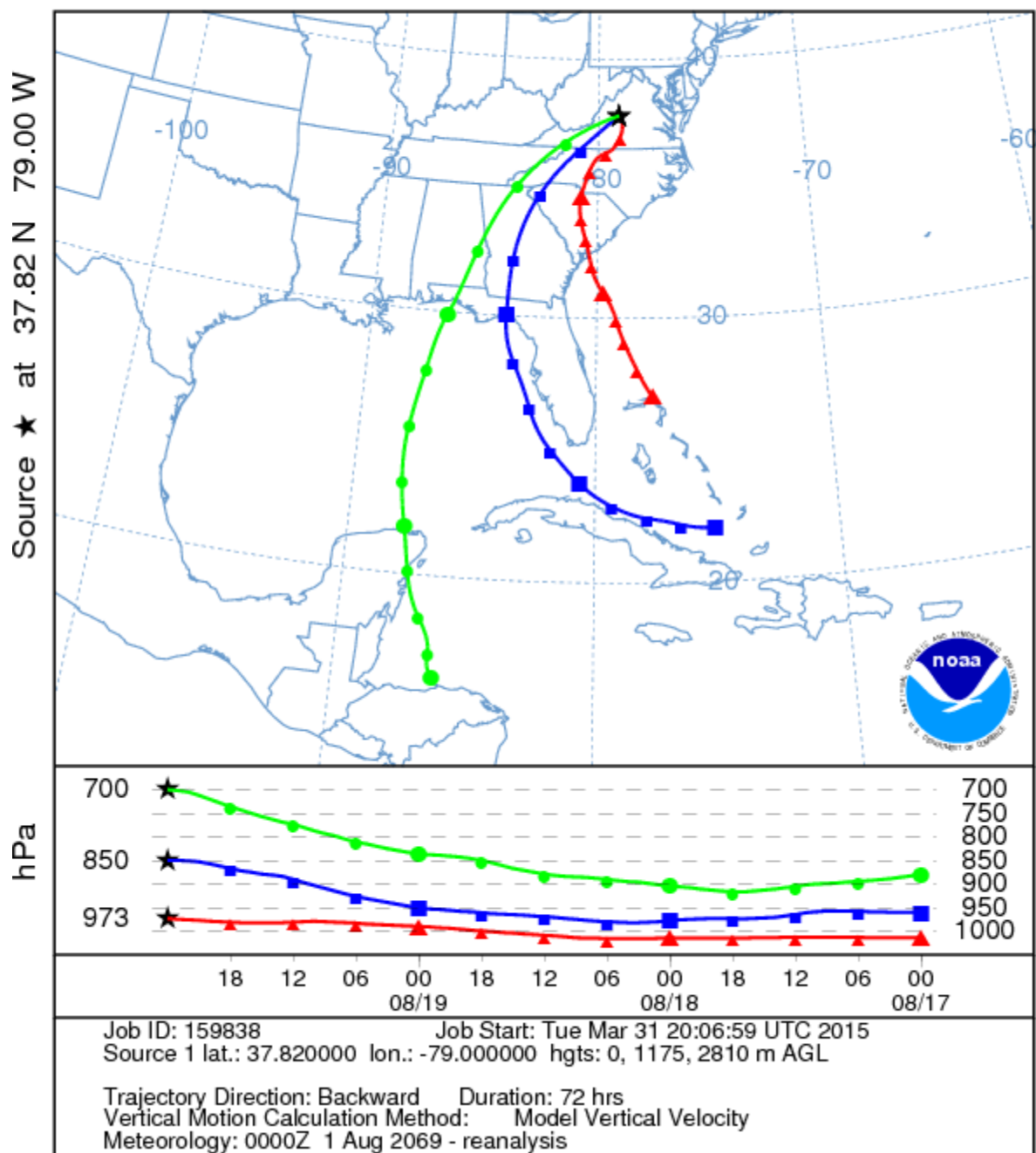


WAR DEPARTMENT		CORPS OF ENGINEERS, U. S. ARMY									
<b>STORM STUDIES - PERTINENT DATA SHEET</b>											
		Storm of <u>19-20 August 1969</u> Assignment <u>SA 2-23</u> Location <u>W. Va., Va., Md., &amp; Del.</u> Study Prepared by: <u>North Atlantic Division</u> <u>Norfolk District Office</u>									
		Part I Reviewed by Hydromet. Sec. of Weather Bureau <u>10/22/70</u> Part II Approved by Office, Chief of Engineers for distribution of factual data, <u>5-8-73</u> Remarks <u>Center near Tyro, Va.</u> <u>Dewpoint 76° - Ref. Pt. 150</u> <u>South</u> <div style="text-align: right;">Grid</div>									
<b>DATA AND COMPUTATIONS COMPILED</b>											
<b>PART I</b>											
Preliminary Isohyetal map, in <u>1</u> sheet scale <u>1:500,000</u>											
Precipitation data and mass curves:		(Number of Sheets)									
Form 5001-C (Hourly precip. data)		11									
Form 5001-B (24-hour " " " " )		11									
Form 5001-D ( " " " " )		30									
Miscel. precip. records, meteorological data, etc.		11									
Form 5002 (Mass rainfall curves)		30									
<b>PART II</b>											
Final isohyetal maps, in <u>1</u> sheet scale <u>1:500,000</u>											
Data and computation sheets:											
Form S-10 (Data from mass rainfall curves)		5									
Form S-11 (Depth-area data from isohyetal map)		1									
Form S-12 (Maximum depth-duration data)		16									
Maximum duration-depth-area curves		1									
Data relating to periods of maximum rainfall		3									
<b>MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES</b>											
Area in Sq. Miles	Duration of Rainfall in Hours										
	6	12	18	24	30	36	48	60	72	96	120
Max. Station	22.0	27.0	27.0	27.0	27.0	27.0	27.0				
10	14.2	25.4	25.4	25.4	25.4	25.4	25.4				
50	13.5	23.2	23.2	23.2	23.2	23.2	23.2				
100	12.9	21.7	21.7	21.7	21.7	21.7	21.7				
200	11.7	19.6	19.6	19.6	19.6	19.6	19.6				
500	9.8	16.3	16.3	16.3	16.3	16.3	16.3				
1,000	8.1	13.5	13.5	13.5	13.5	13.5	13.5				
2,000	6.3	10.7	10.9	10.9	10.9	10.9	10.9				
5,000	4.4	7.5	8.0	8.0	8.0	8.0	8.0				
10,000	3.3	5.8	6.3	6.3	6.3	6.3	6.3				
15,000	2.8	4.9	5.3	5.3	5.3	5.3	5.3				

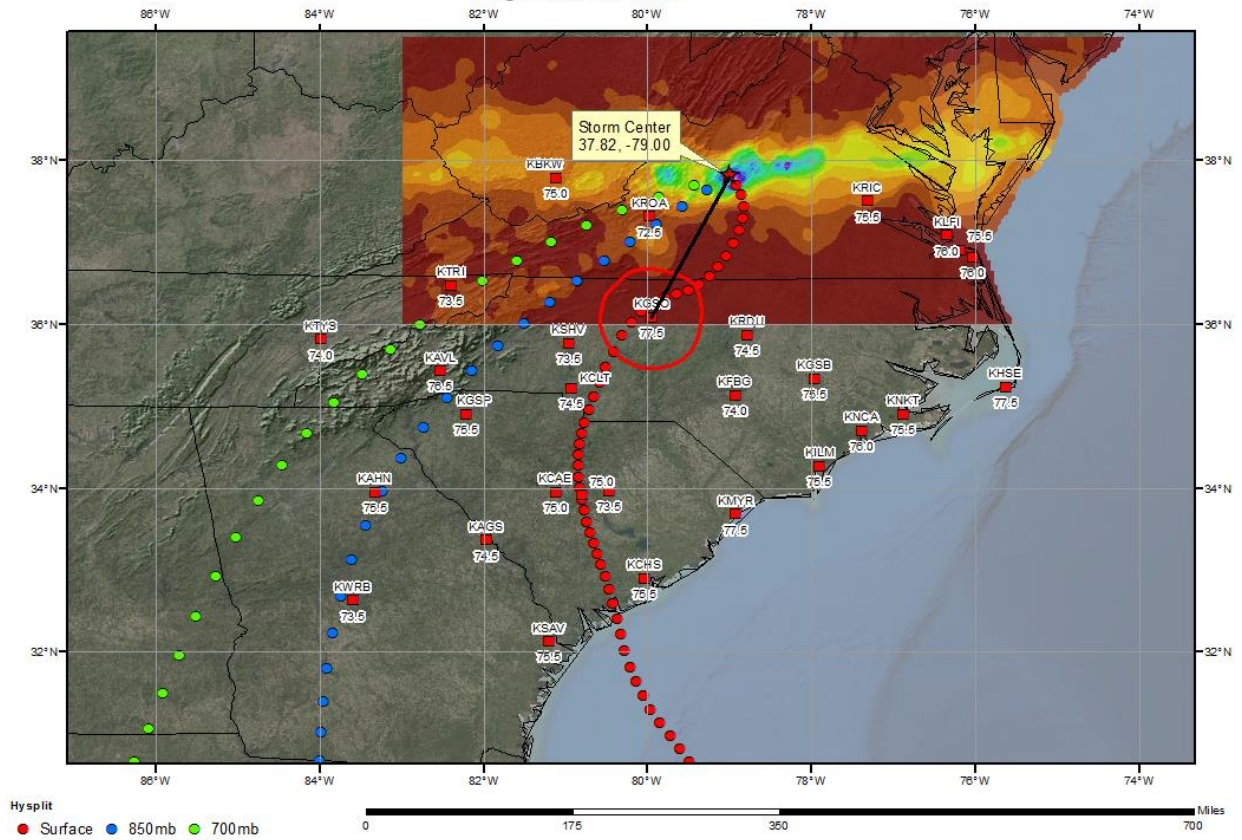




NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 20 Aug 69  
 CDC1 Meteorological Data



# SPAS 1491 Tyro, VA OR Storm Analysis August 18-20, 1969



## Storm Precipitation Analysis System (SPAS) For Storm #1243\_1 SPAS Analysis

**General Storm Location:** Westfield, MA

**Storm Dates:** August 15-24, 1955

**Event:** Tropical, Hurricane Diane

**DAD Zone 1**

**Latitude:** 42.12

**Longitude:** -72.70007

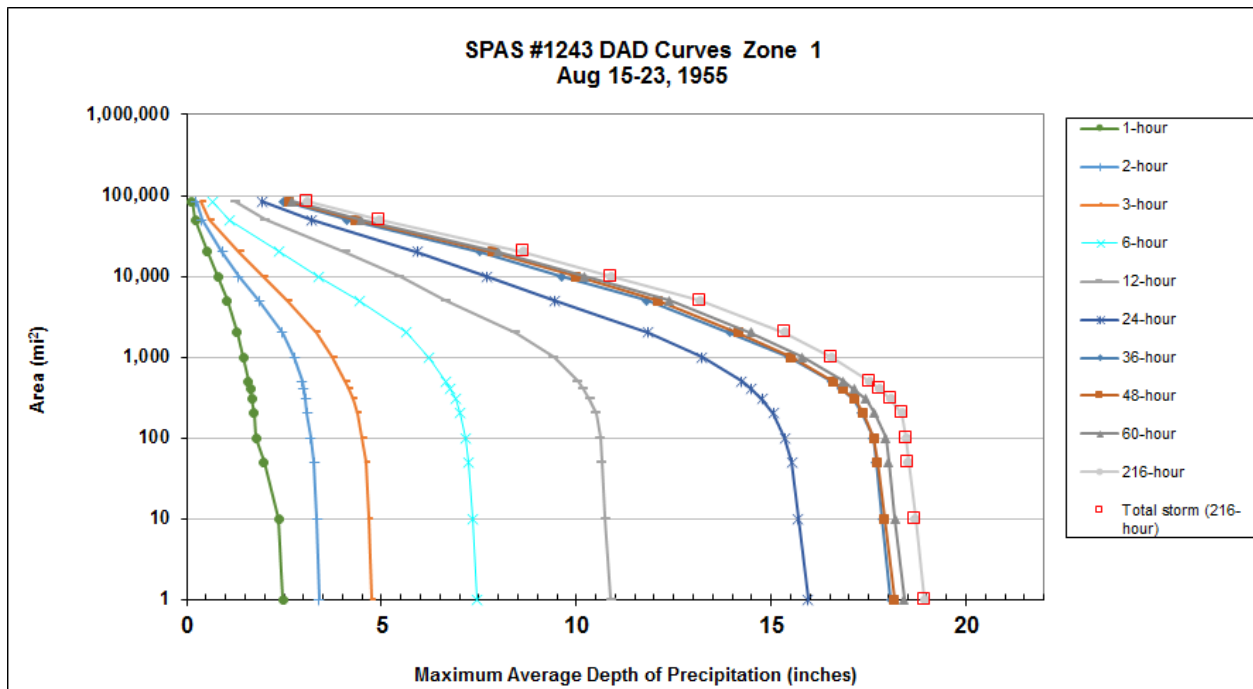
**Max. Grid Rainfall Amount:** 18.93"

**Radar Included:** No

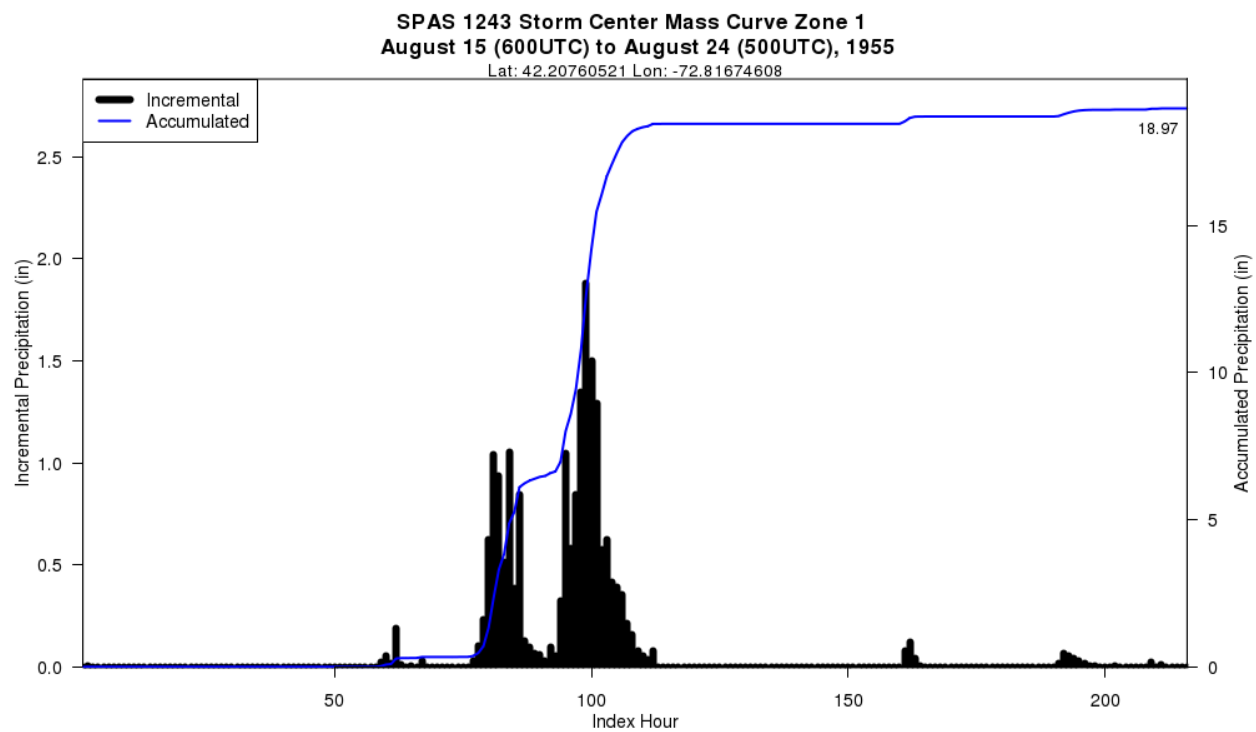
**Depth-Area-Duration (DAD) analysis:** Yes

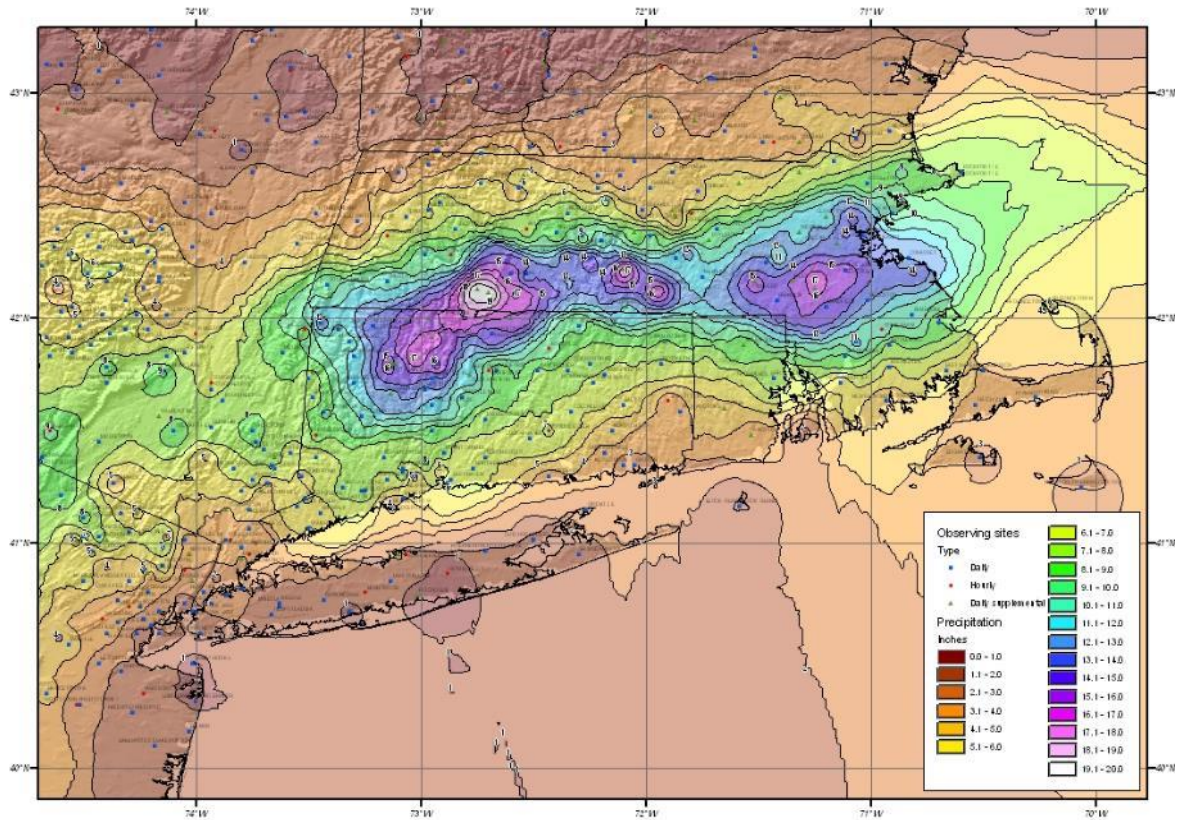
					Storm Rep. Dew Point					Climatological Max. Dew Point						
LON	LAT	ELEV_FT	ELEV Round	Trans Date	T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
-72.7000	42.1200	265	300	15-Aug	75.00	2.85	0.08	72	2.770	76.77	77.0	3.14	0.08	76	3.060	1.105

Storm 1243- Aug 15 (0600 UTC) - Aug 24 (0500 UTC), 1955											
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)											
Area (mi <sup>2</sup> )	1	2	3	6	12	24	36	48	60	216	Total
0.4	2.48	3.40	4.74	7.46	10.89	15.95	18.08	18.16	18.42	18.93	18.93
1	2.48	3.40	4.74	7.46	10.89	15.95	18.07	18.16	18.41	18.93	18.93
10	2.37	3.35	4.67	7.33	10.75	15.70	17.85	17.90	18.18	18.70	18.70
50	1.99	3.27	4.60	7.24	10.66	15.53	17.69	17.72	18.01	18.53	18.53
100	1.78	3.18	4.51	7.17	10.62	15.35	17.62	17.64	17.94	18.46	18.46
200	1.72	3.09	4.37	7.02	10.50	15.05	17.33	17.36	17.66	18.35	18.35
300	1.67	3.05	4.26	6.89	10.35	14.76	17.12	17.15	17.44	18.07	18.07
400	1.63	3.00	4.16	6.77	10.18	14.50	16.81	16.84	17.13	17.80	17.80
500	1.59	2.96	4.07	6.65	10.03	14.24	16.54	16.58	16.86	17.52	17.52
1000	1.45	2.77	3.75	6.23	9.41	13.23	15.45	15.52	15.80	16.55	16.55
2,000	1.29	2.45	3.32	5.64	8.43	11.84	13.93	14.15	14.48	15.34	15.34
5,000	1.04	1.85	2.58	4.43	6.64	9.43	11.81	12.09	12.39	13.17	13.17
10,000	0.80	1.33	1.96	3.40	5.46	7.70	9.62	9.99	10.21	10.89	10.89
20,000	0.54	0.91	1.35	2.39	4.07	5.92	7.54	7.84	8.01	8.64	8.64
50,000	0.23	0.39	0.58	1.10	2.01	3.20	4.12	4.33	4.47	4.94	4.94
84,856	0.14	0.24	0.36	0.65	1.23	1.93	2.49	2.62	2.71	3.09	3.09



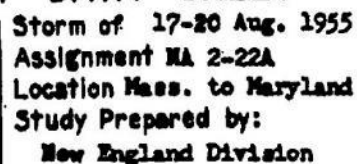






Total Storm Precipitation  
Westfield, MA Storm Center  
August 15-23, 1955

TWP June 3, 2003



Part I Reviewed by H. M. Sec. of  
Weather Bureau, Dec. 1955  
Part II Approved by Office, Chief  
of Engineers for Distribution  
of Factual Data, 1/8/59  
Remarks: Center at Westfield,  
Mass., Dewpt 74°, Ref. Pt.  
105 S.

Grid D-3

### DATA AND COMPUTATIONS COMPILED

## PART I

**Preliminary Isohyetal map, in 1 sheet, scale 1:1,000,000**

**Precipitation data and mass curves:**

(Number of Sheets)

Form 5001-C (Hourly precip. data)-----	280
Form 5001-B (24-hour " " )-----	0
Form 5001-D ( " " " " )-----	91
Misc. precip. records, meteorological data, etc.-----	0
Form 5002 (Mass rainfall curves)-----	689

**PART II**

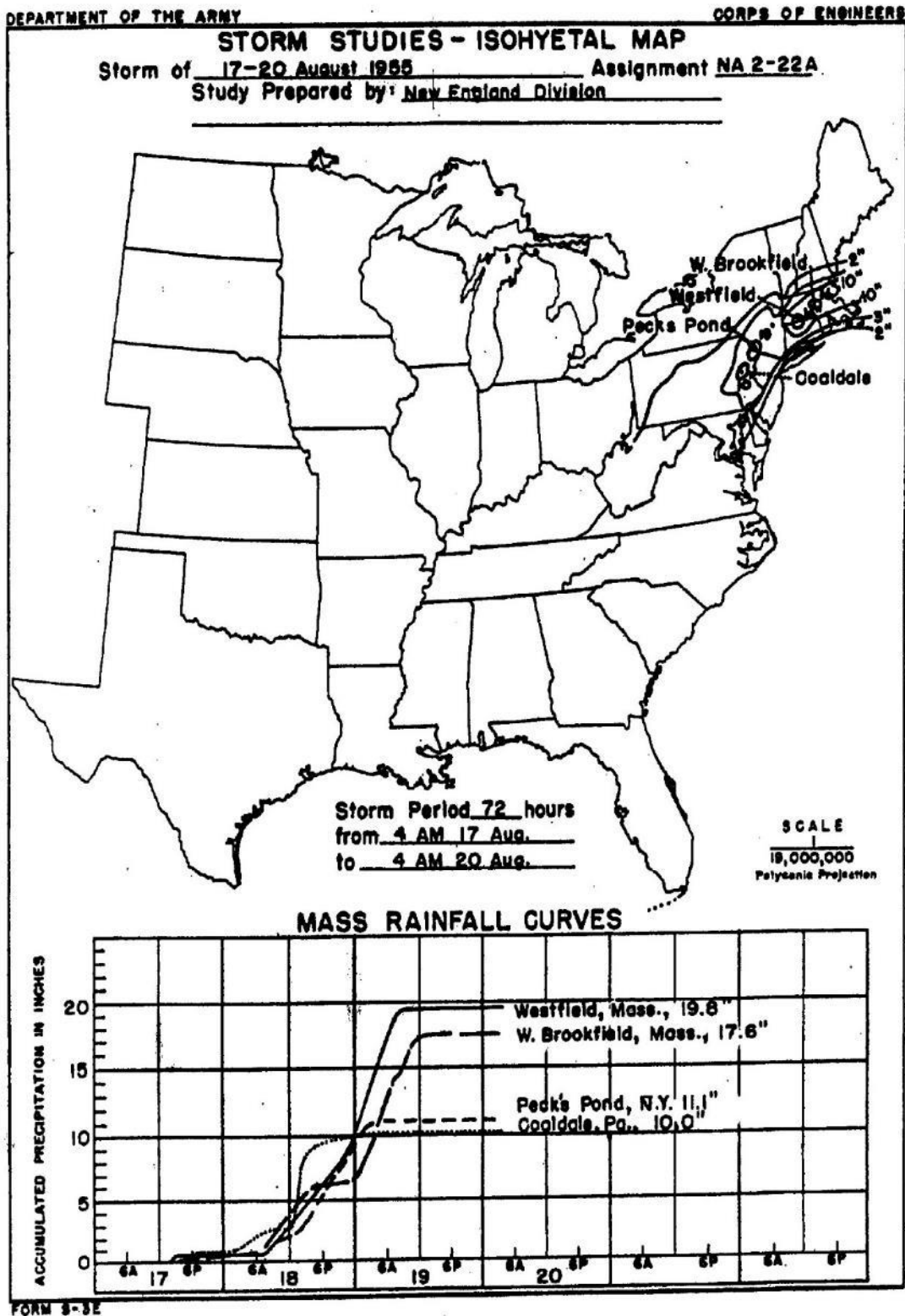
Final Isohyetal maps, in 1 sheet, scale 1:1,000,000

**Data and computation sheets:**

Form S-10 (Data from mass rainfall curves)-----	4
Form S-11 (Depth-area data from isohyetal map)-----	3
Form S-12 (Maximum depth-duration data)-----	9
Maximum duration-depth-area curves-----	2
Data relating to periods of maximum rainfall-----	0

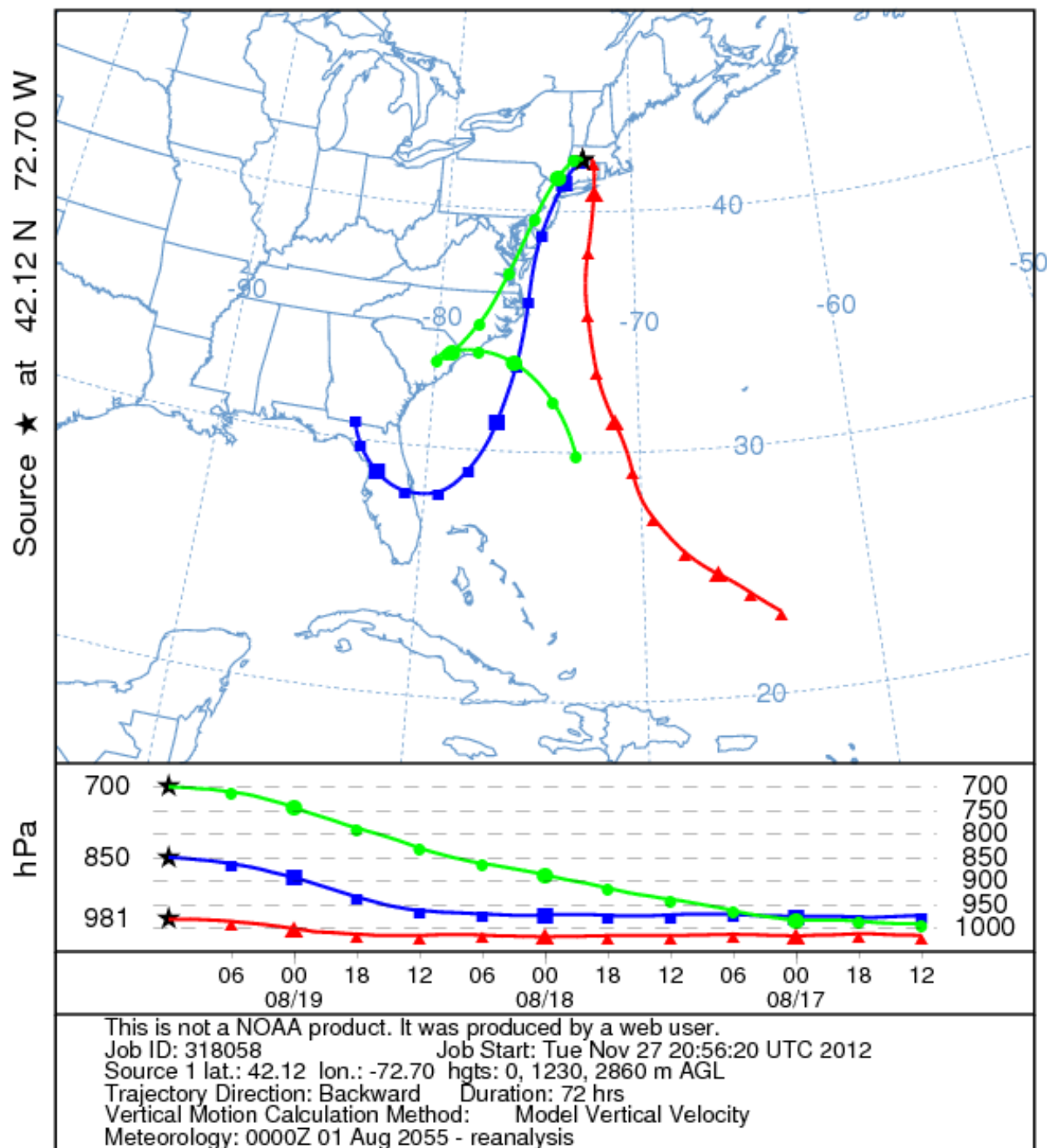
**MAXIMUM AVERAGE DEPTH OF RAINFALL IN INCHES**

Form 3-2

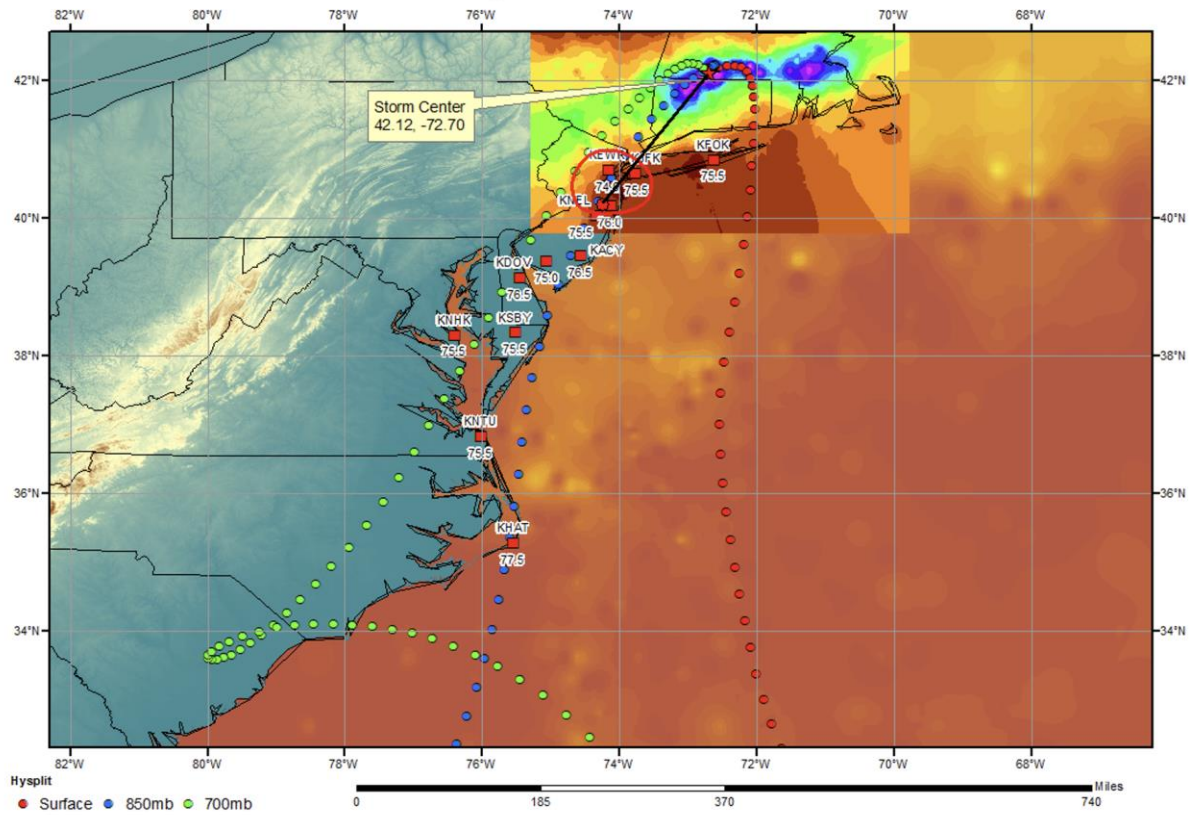




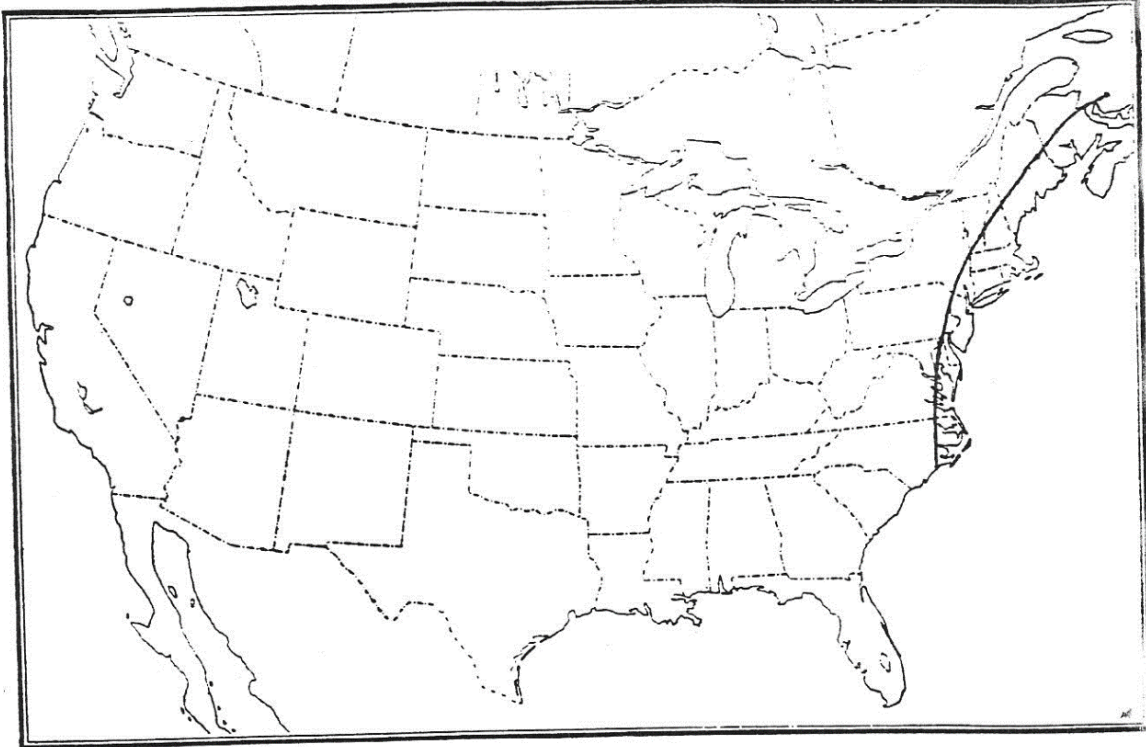
NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 19 Aug 55  
 CDC1 Meteorological Data



**SPAS 1243 Westfield, MA Storm Analysis**  
August 16-19, 1955



10/1 2-2214 Aug 11 2011  
Westfield, Mass 1055 740



## Storm Precipitation Analysis System (SPAS) For Storm #1276\_2

### SPAS Analysis

**General Storm Location:** Zerbe, Pennsylvania

**Storm Dates:** June 18-24, 1972

**Event:** Hurricane Agnes

#### DAD Zone 2

**Latitude:** 40.5375

**Longitude:** -76.6208

**Max. Grid Rainfall Amount:** 18.79"

**Max. Observed Rainfall Amount:** 18.50"

**Number of Stations:** 1272 (874 Daily, 173 Hourly, 51 Hourly Pseudo, and 174 Supplemental)

**SPAS Version:** 9.5

**Basemap:** PRISM 30-yr Mean (1971-2000) June Precipitation

**Spatial resolution:** 00:00:30 (~ 0.30 mi<sup>2</sup>)

**Radar Included:** No

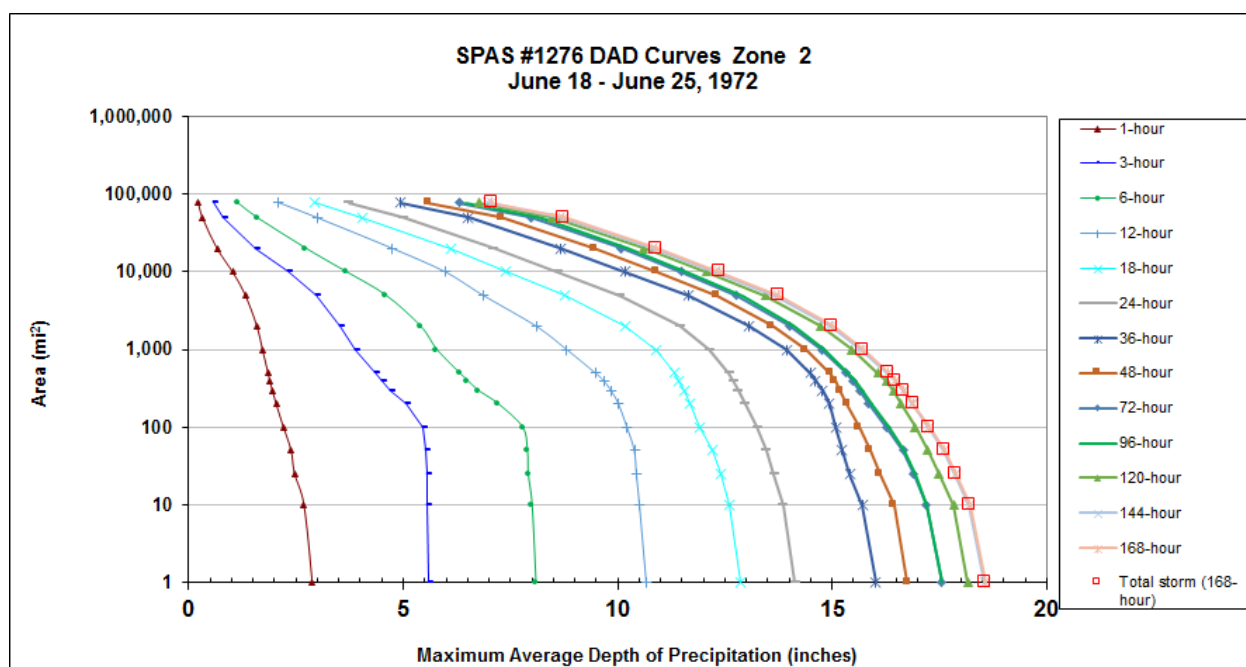
**Depth-Area-Duration (DAD) analysis:** Yes

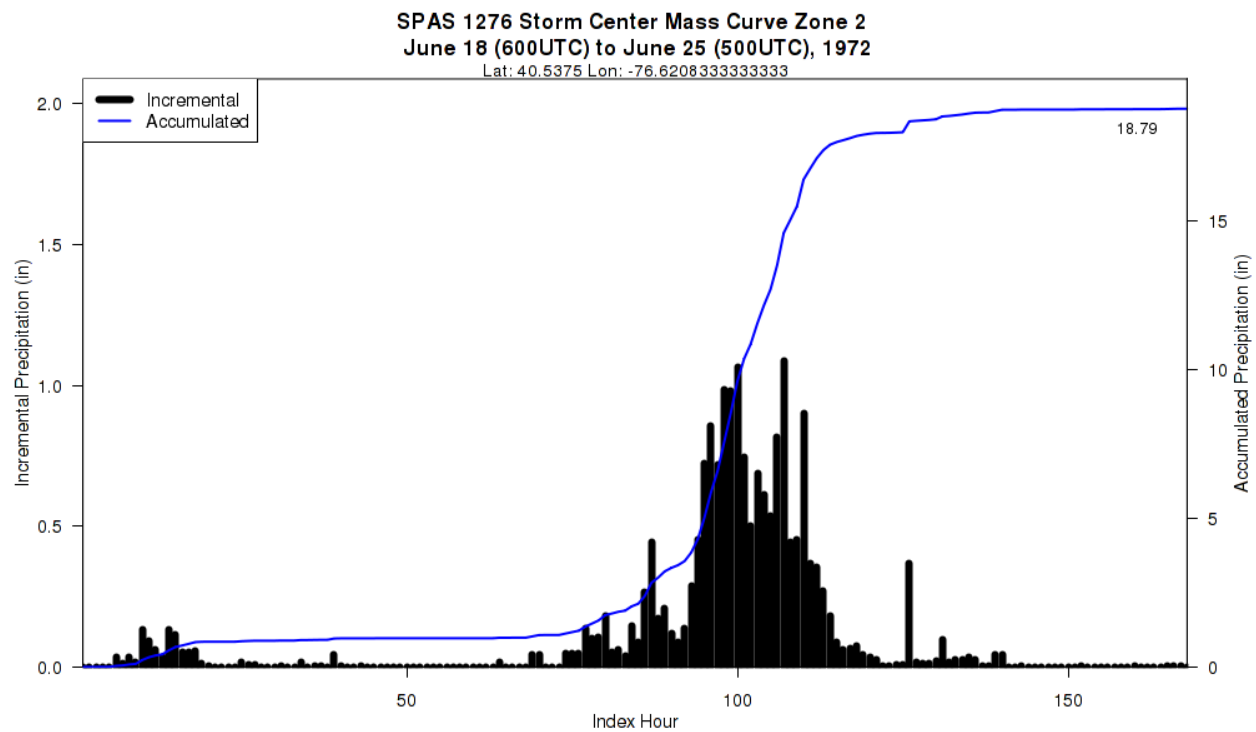
**Reliability of results:** This analysis was based on hourly data, daily data, supplemental station data and bucket survey data from the USGS report. We have a high degree of confidence in the station based storm total results, the spatial pattern is dependent on basemap, and the timing is based on hourly and hourly pseudo stations.

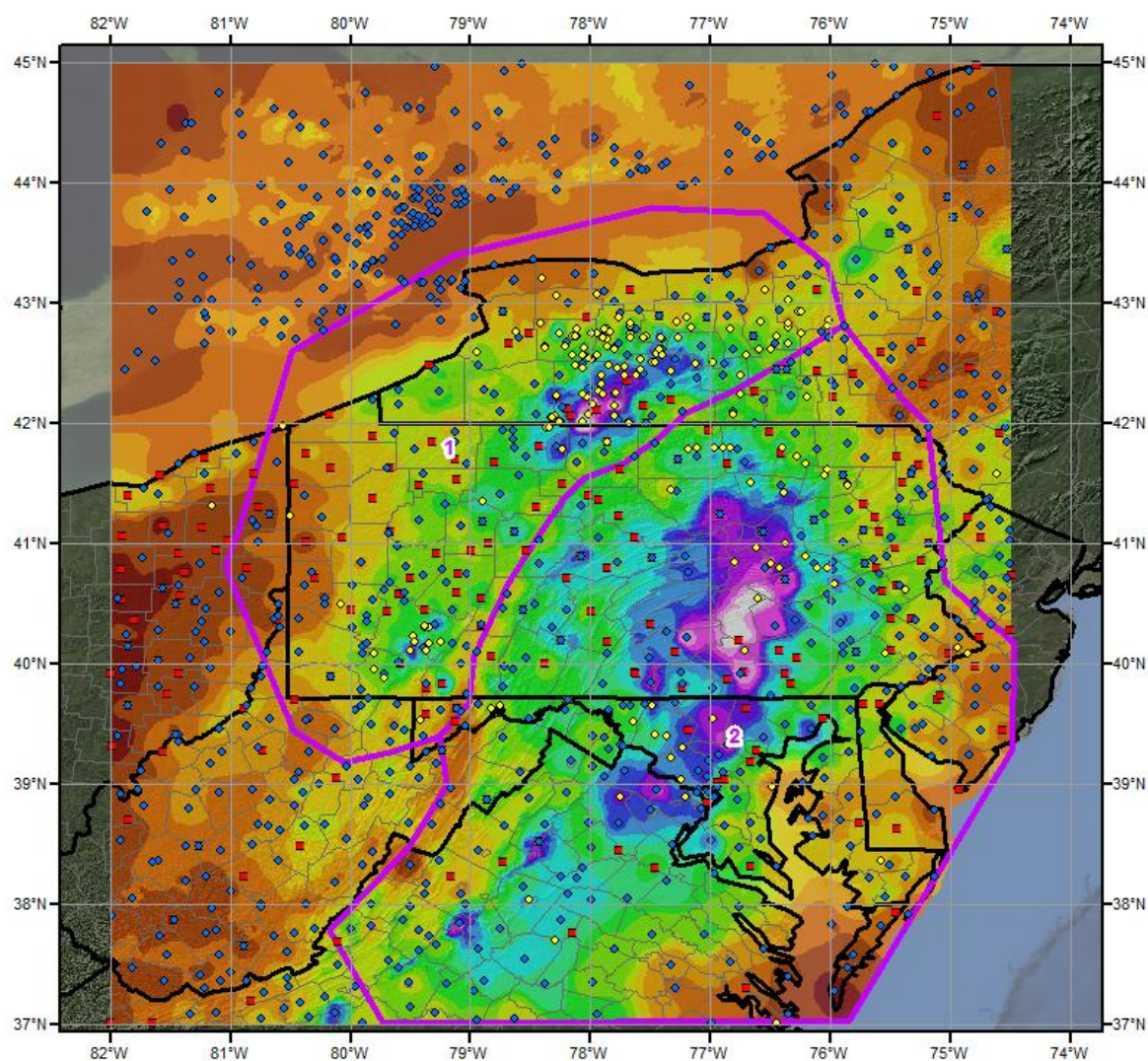
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft.	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft.	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1276_1	-76.6208	40.5375	1,617	1,600	5-Jul	78.00	3.29	0.43	78	2.860	80.25	80.5	3.68	0.48	83	3.200	1.119



Storm 1276- June 18 (0700 UTC) - June 25 (0600 UTC), 1972														
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)														
Area (mi <sup>2</sup> )	Duration (hours)													
	1	3	6	12	18	24	36	48	72	96	120	144	168	Total
0.4	2.90	5.62	8.10	10.74	12.96	14.25	16.13	16.89	17.69	17.73	18.31	18.69	18.72	18.72
1	2.88	5.60	8.08	10.67	12.86	14.14	16.01	16.76	17.55	17.58	18.17	18.56	18.58	18.58
10	2.69	5.57	7.99	10.51	12.59	13.86	15.70	16.44	17.19	17.21	17.83	18.19	18.22	18.22
25	2.47	5.55	7.90	10.44	12.40	13.64	15.41	16.12	16.90	16.95	17.49	17.87	17.88	17.88
50	2.39	5.54	7.88	10.39	12.21	13.46	15.23	15.88	16.65	16.68	17.23	17.61	17.63	17.63
100	2.21	5.45	7.77	10.22	11.92	13.25	15.08	15.62	16.26	16.31	16.93	17.24	17.26	17.26
200	2.04	5.05	7.20	10.02	11.69	12.97	14.93	15.34	15.86	15.92	16.61	16.87	16.89	16.89
300	1.95	4.72	6.73	9.84	11.55	12.81	14.78	15.18	15.64	15.70	16.42	16.66	16.68	16.68
400	1.89	4.50	6.49	9.67	11.43	12.69	14.61	15.06	15.48	15.53	16.26	16.47	16.48	16.48
500	1.85	4.34	6.30	9.48	11.31	12.59	14.49	14.96	15.33	15.38	16.07	16.29	16.32	16.32
1,000	1.72	3.88	5.77	8.81	10.89	12.13	13.93	14.38	14.76	14.82	15.46	15.66	15.72	15.72
2,000	1.59	3.54	5.39	8.10	10.19	11.44	13.06	13.60	14.00	14.08	14.72	14.93	15.00	15.00
5,000	1.32	2.97	4.58	6.86	8.78	10.06	11.66	12.32	12.78	12.90	13.45	13.67	13.76	13.76
10,000	1.02	2.30	3.66	5.98	7.39	8.59	10.17	10.91	11.48	11.60	12.07	12.27	12.37	12.37
20,000	0.66	1.56	2.72	4.75	6.11	7.11	8.66	9.45	10.08	10.23	10.61	10.80	10.90	10.90
50,000	0.32	0.82	1.58	2.99	4.05	4.99	6.52	7.28	7.97	8.16	8.47	8.64	8.75	8.75
77,770	0.22	0.57	1.12	2.10	2.95	3.73	4.94	5.58	6.30	6.46	6.76	6.97	7.05	7.05



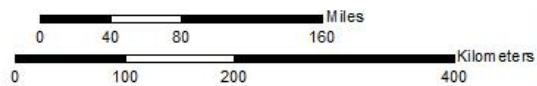




**Total Storm (168-hr) Precipitation (inches)**  
**June 18-24, 1972**  
**SPAS 1276**

#### Gauges

- ◆ Daily
- Hourly
- Hourly Pseudo
- ◆ Supplemental

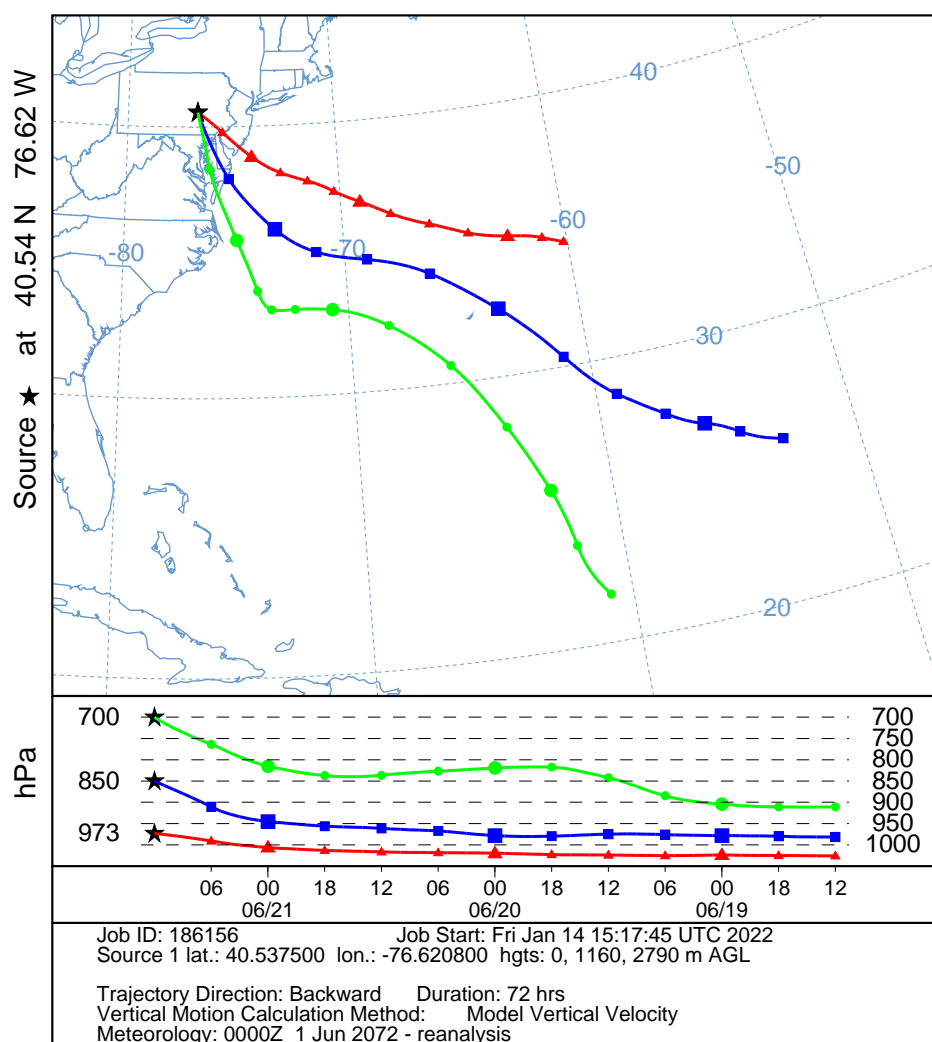


#### Precipitation (inches)



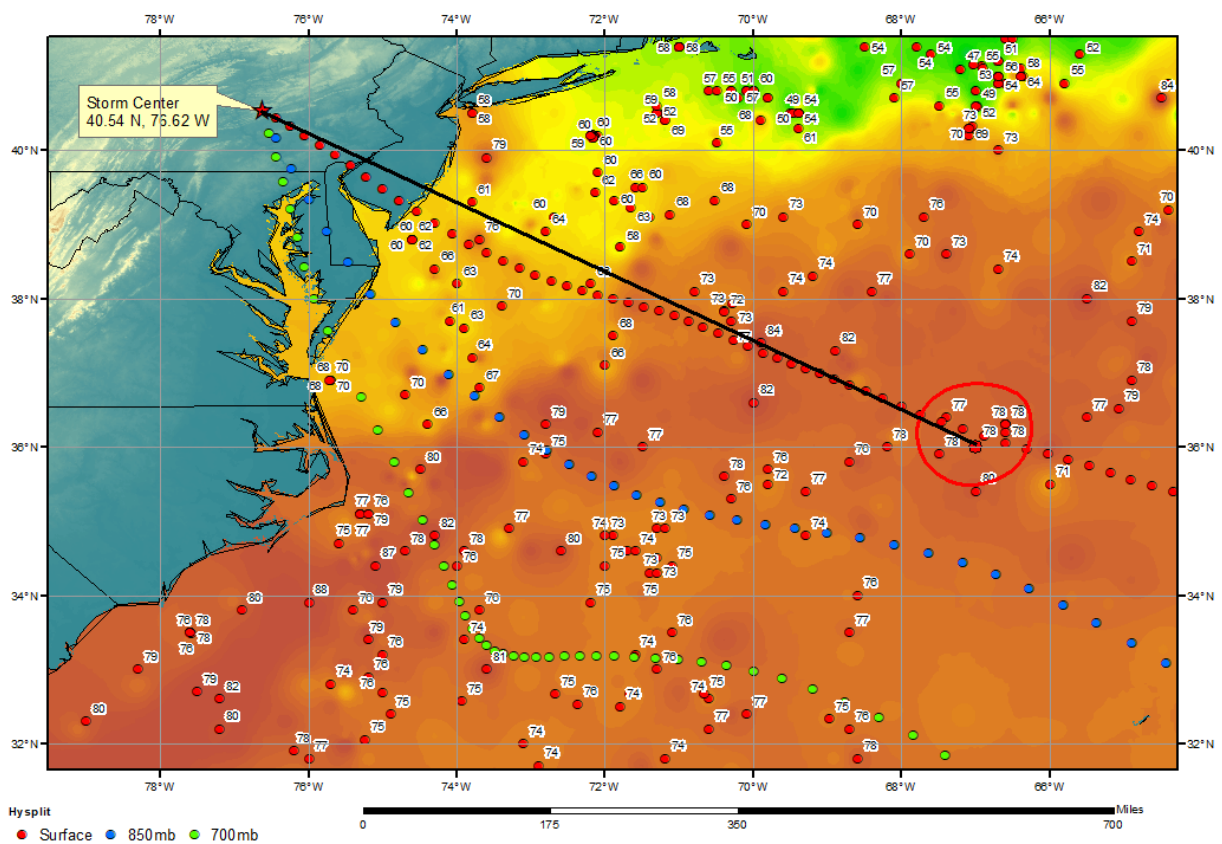
5/15/2013

NOAA HYSPLIT MODEL  
Backward trajectories ending at 1200 UTC 21 Jun 72  
CDC1 Meteorological Data

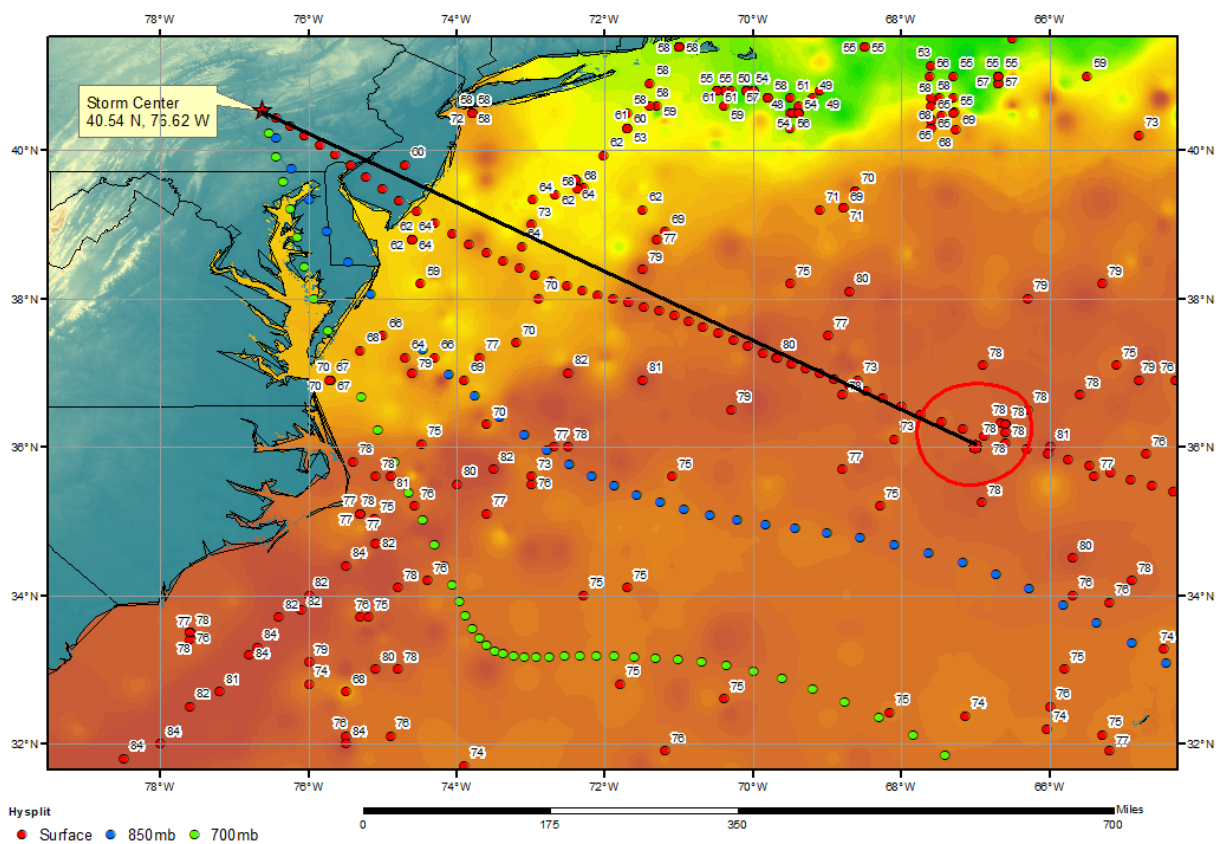


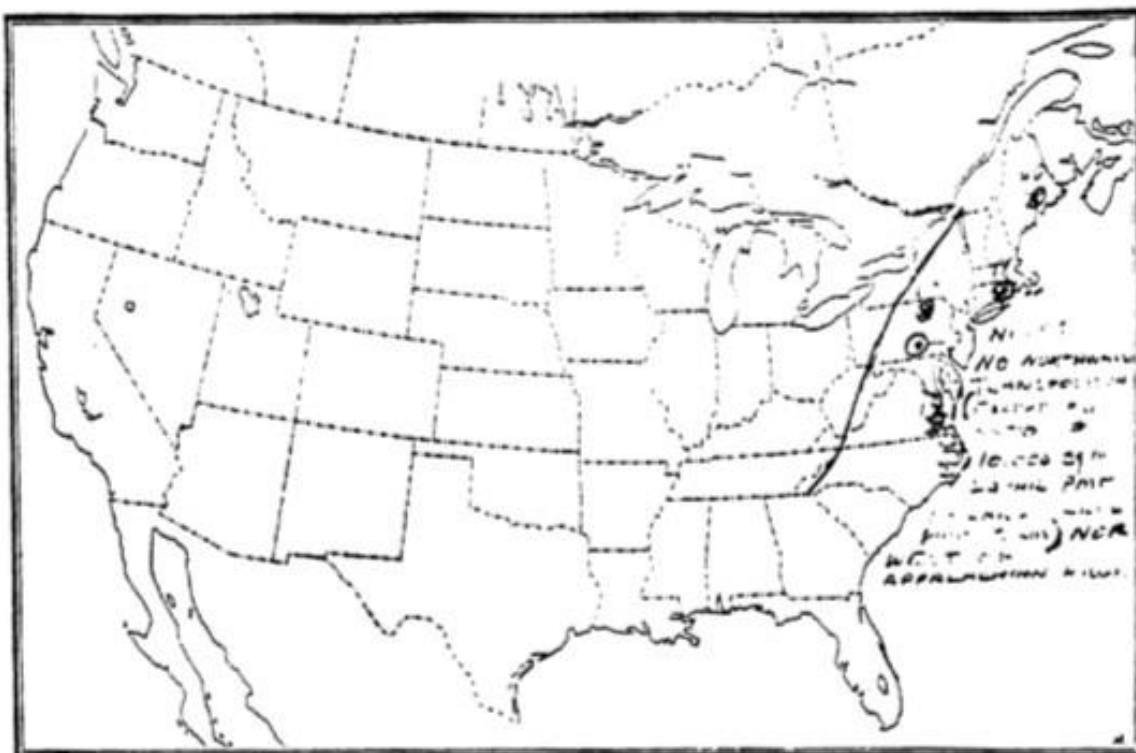


SPAS 1276\_2 Zerbe, PA Storm Analysis  
June 18, 1972



SPAS 1276\_2 Zerbe, PA Storm Analysis  
June 19, 1972





## Storm Precipitation Analysis System (SPAS) For Storm #1552\_2 SPAS-NEXRAD Analysis

**General Storm Location:** Eastern Seaboard

**Storm Dates:** September 13, 1999 – September 17, 1999

**Event:** Hurricane Floyd

### DAD Zone 2

**Latitude:** 37.2750

**Longitude:** -76.5550

**Max. Grid Rainfall Amount:** 19.22"

**Max. Observed Rainfall Amount:** 18.13" at Yorktown, VA

**Number of Stations:** 974 (430 Daily, 97 Hourly, 46 Hourly Pseudo, 1 Hourly Estimated Pseudo, 397 Supplemental, and 3 Supplemental Estimated)

**SPAS Version:** 10.0

**Base Map Used:** Continental United States 2-year 24-hour basemap (conus\_0002y24h)

**Spatial resolution:** 0.3736

**Radar Included:** Yes

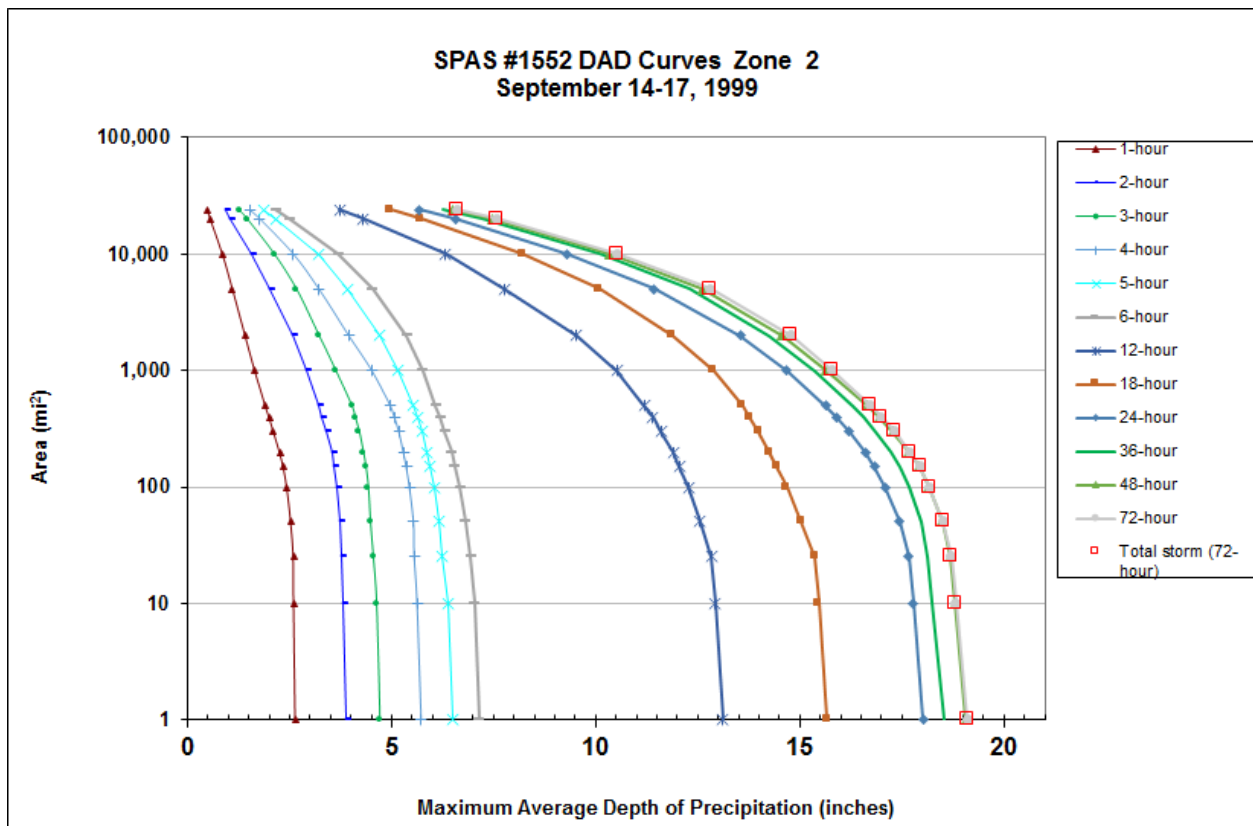
**Depth-Area-Duration (DAD) analysis:** Yes

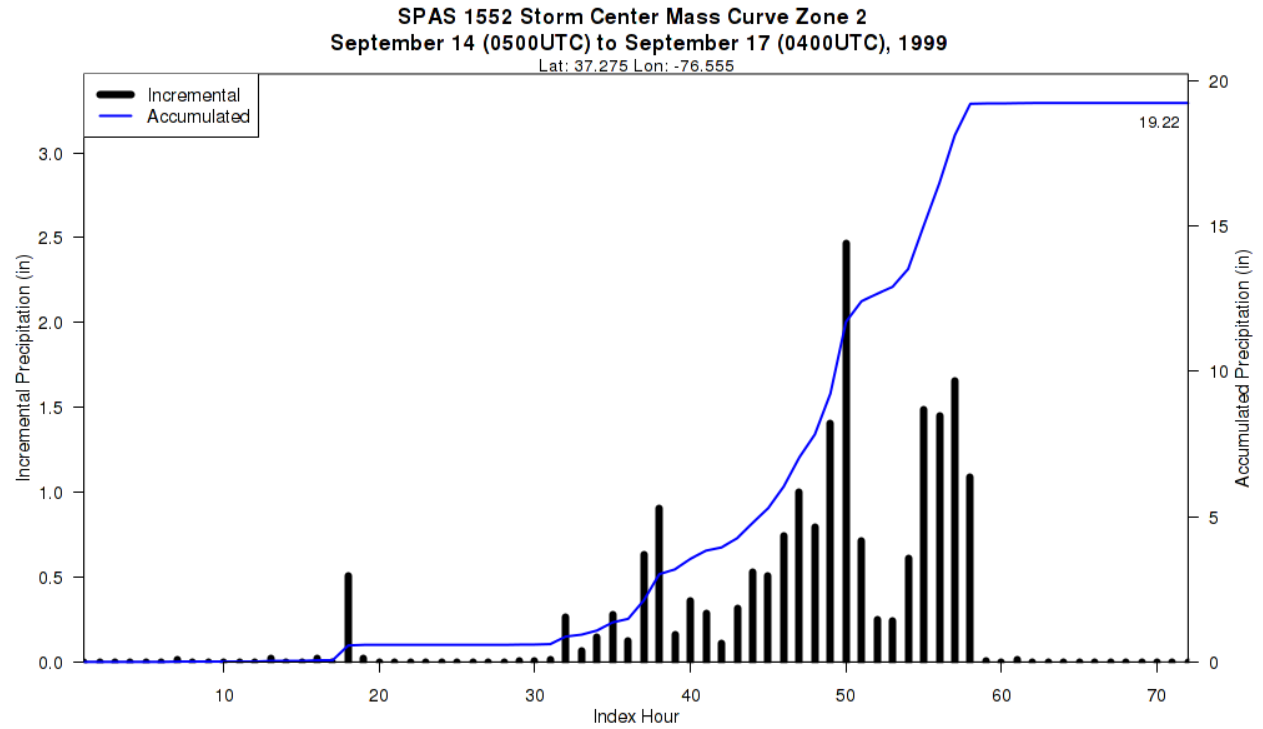
**Reliability of results:** 397 supplemental stations were added to ensure the data matches what can actually occur and that the data more closely resemble reports from this storm. Many of these stations were incorporated from previous analyses of Hurricane Floyd (SPAS storms 1002 and 1012) along with other storm data reports. Due to the orientation and integrity of the station data, three additional stations were incorporated. Lack of hourly stations in east central North Carolina forced the creation of a radar estimated hourly pseudo station to assist in timing and intensity. With the density of stations available for this storm and with how closely the resulting SPAS analysis was to the storm data report, this analysis is deemed quite reliable.

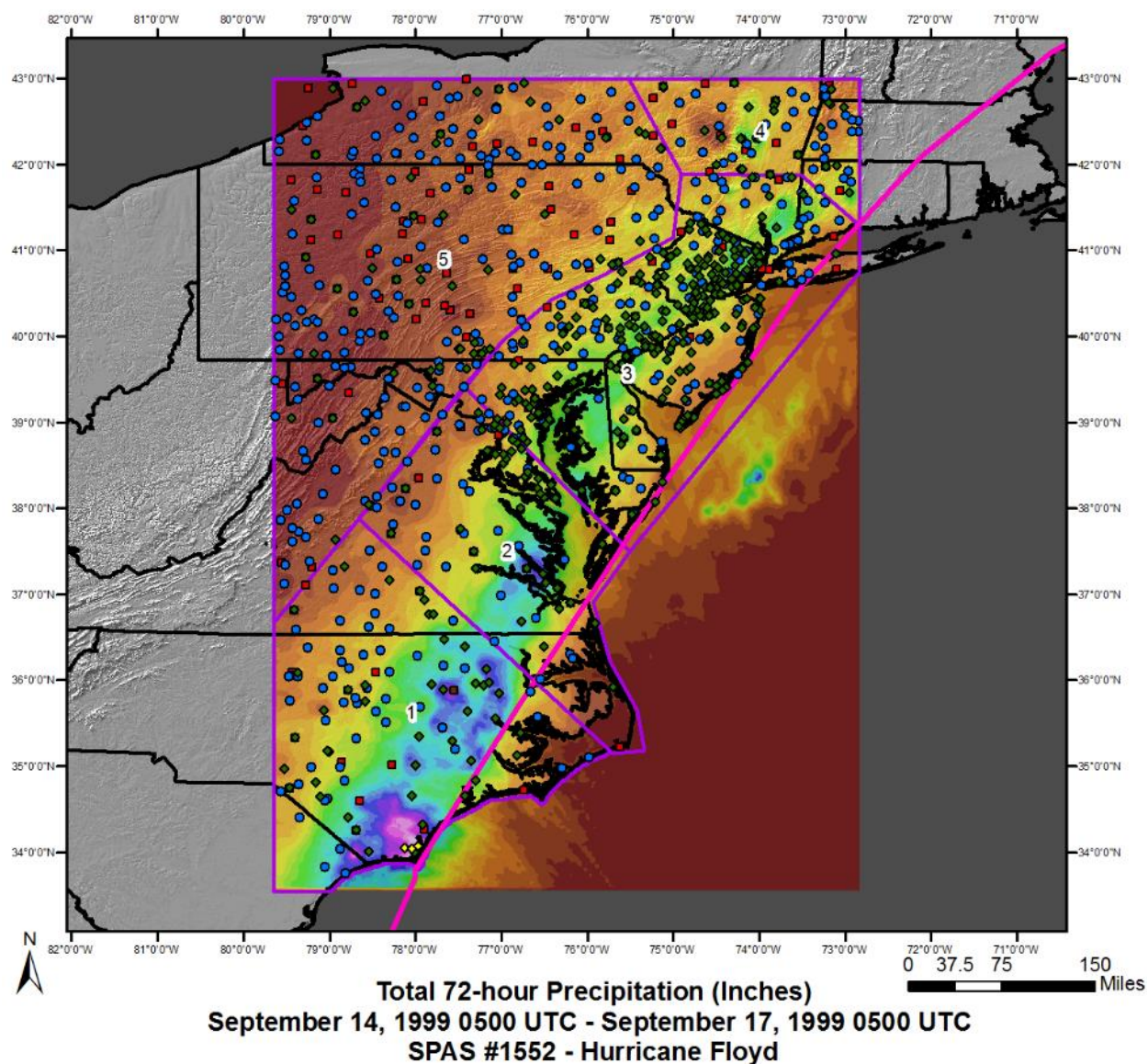
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1552_2	-76.5550	37.2750	0	0	1-Sep	78.00	3.29	0.00	78	3.290	82.00	82.0	3.95	0.00	86	3.950	1.201



Storm 1552 - September 14 (0500 UTC) - September 17 (0400 UTC), 1999													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
Area (mi <sup>2</sup> )	Duration (hours)												
	1	2	3	4	5	6	12	18	24	36	48	72	Total
0.4	2.67	3.90	4.73	5.76	6.54	7.18	13.19	15.76	18.13	18.64	19.18	19.21	19.21
1	2.65	3.87	4.70	5.73	6.50	7.14	13.12	15.67	18.03	18.53	19.07	19.10	19.10
10	2.61	3.80	4.62	5.63	6.39	7.03	12.93	15.46	17.77	18.25	18.80	18.82	18.82
25	2.60	3.78	4.54	5.56	6.23	6.93	12.83	15.37	17.67	18.14	18.69	18.71	18.71
50	2.54	3.73	4.47	5.54	6.16	6.81	12.56	15.03	17.44	17.99	18.48	18.51	18.51
100	2.44	3.66	4.42	5.44	6.03	6.67	12.27	14.68	17.09	17.68	18.15	18.17	18.17
150	2.35	3.59	4.36	5.36	5.95	6.55	12.05	14.43	16.83	17.47	17.92	17.94	17.94
200	2.26	3.53	4.30	5.29	5.86	6.46	11.90	14.26	16.60	17.22	17.67	17.69	17.69
300	2.11	3.41	4.20	5.18	5.74	6.30	11.61	13.99	16.22	16.86	17.28	17.34	17.34
400	2.00	3.30	4.10	5.07	5.62	6.19	11.39	13.77	15.89	16.54	16.94	17.00	17.00
500	1.91	3.21	4.02	4.97	5.51	6.08	11.19	13.59	15.63	16.29	16.66	16.74	16.74
1,000	1.65	2.90	3.63	4.52	5.16	5.76	10.52	12.89	14.69	15.38	15.66	15.80	15.80
2,000	1.41	2.56	3.22	3.95	4.72	5.36	9.53	11.89	13.55	14.24	14.56	14.79	14.79
5,000	1.10	2.03	2.67	3.22	3.91	4.52	7.76	10.09	11.43	12.31	12.60	12.81	12.81
10,000	0.85	1.57	2.13	2.59	3.20	3.69	6.31	8.20	9.29	10.10	10.33	10.51	10.51
20,000	0.55	1.06	1.47	1.77	2.17	2.50	4.31	5.73	6.56	7.24	7.45	7.58	7.58
23,888	0.48	0.92	1.27	1.52	1.88	2.16	3.72	4.98	5.68	6.27	6.49	6.60	6.60





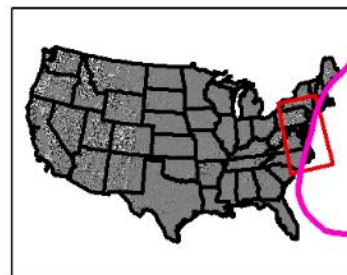


### Precipitation (inches)

0.00 - 1.00	9.01 - 10.00	18.01 - 19.00
1.01 - 2.00	10.01 - 11.00	19.01 - 20.00
2.01 - 3.00	11.01 - 12.00	20.01 - 21.00
3.01 - 4.00	12.01 - 13.00	21.01 - 22.00
4.01 - 5.00	13.01 - 14.00	22.01 - 23.00
5.01 - 6.00	14.01 - 15.00	23.01 - 24.00
6.01 - 7.00	15.01 - 16.00	24.01 - 25.00
7.01 - 8.00	16.01 - 17.00	
8.01 - 9.00	17.01 - 18.00	

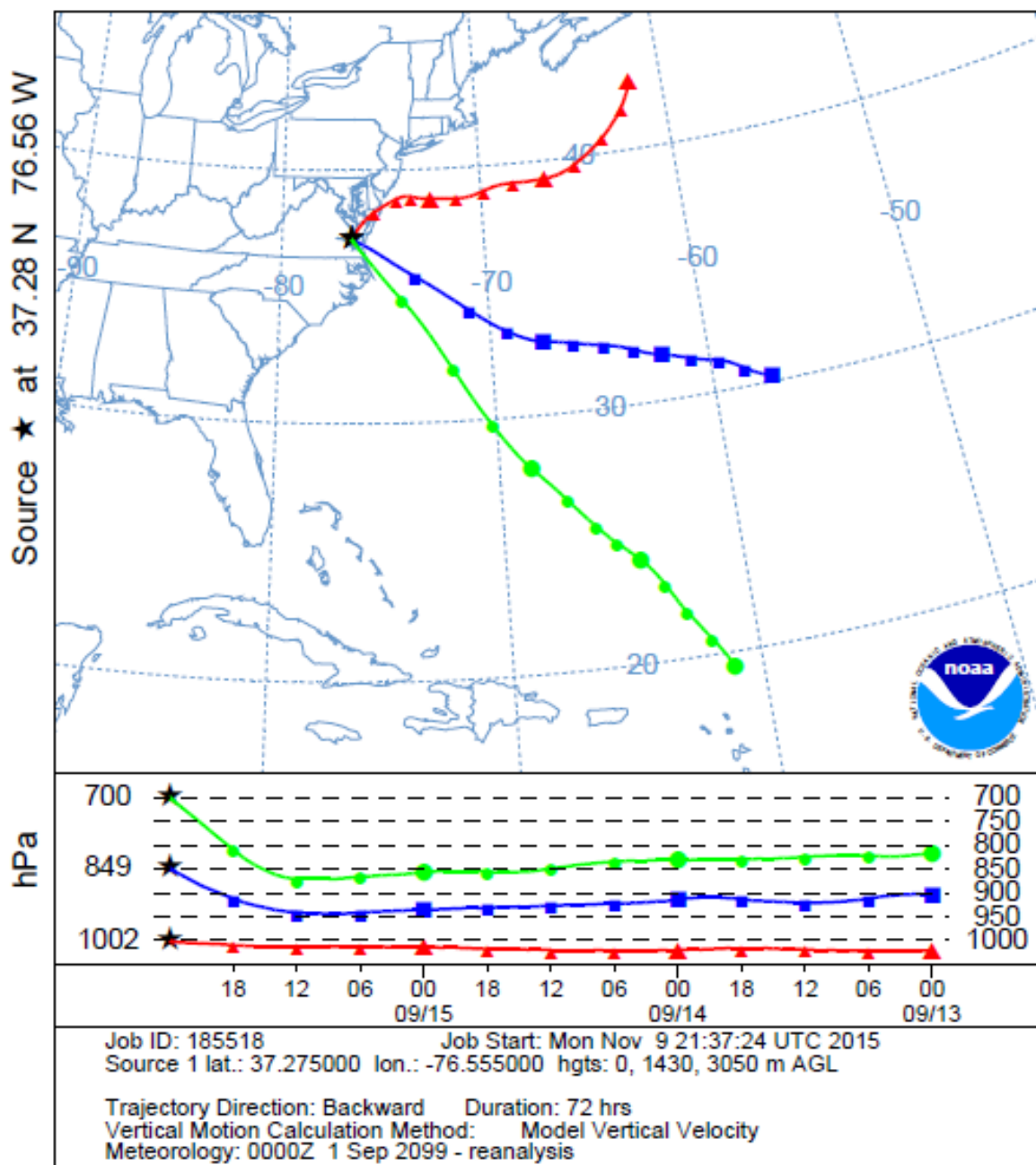
### Stations

- Daily
- Hourly
- Hourly Estimated Pseudo
- Hourly Pseudo
- Supplemental
- Supplemental Estimated



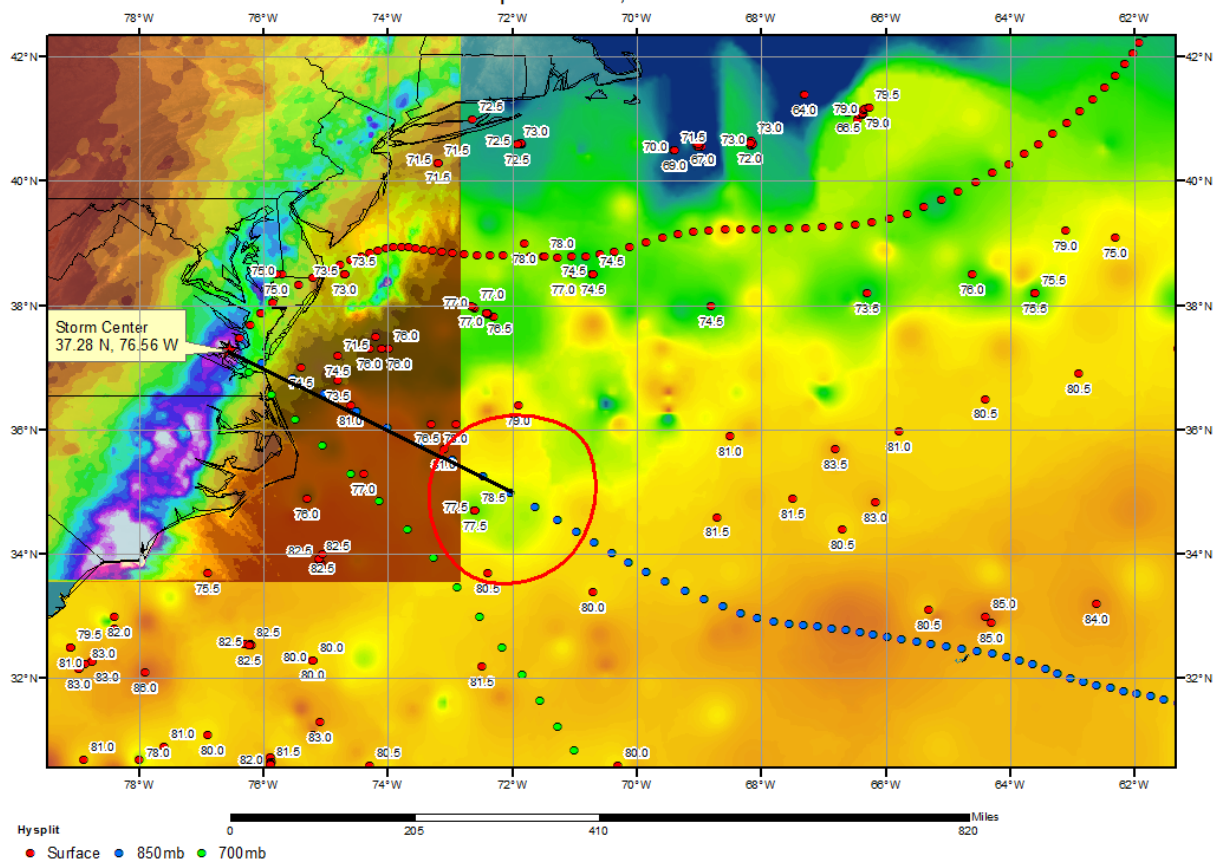
WJM 09/14/2015

**NOAA HYSPLIT MODEL**  
**Backward trajectories ending at 0000 UTC 16 Sep 99**  
**CDC1 Meteorological Data**

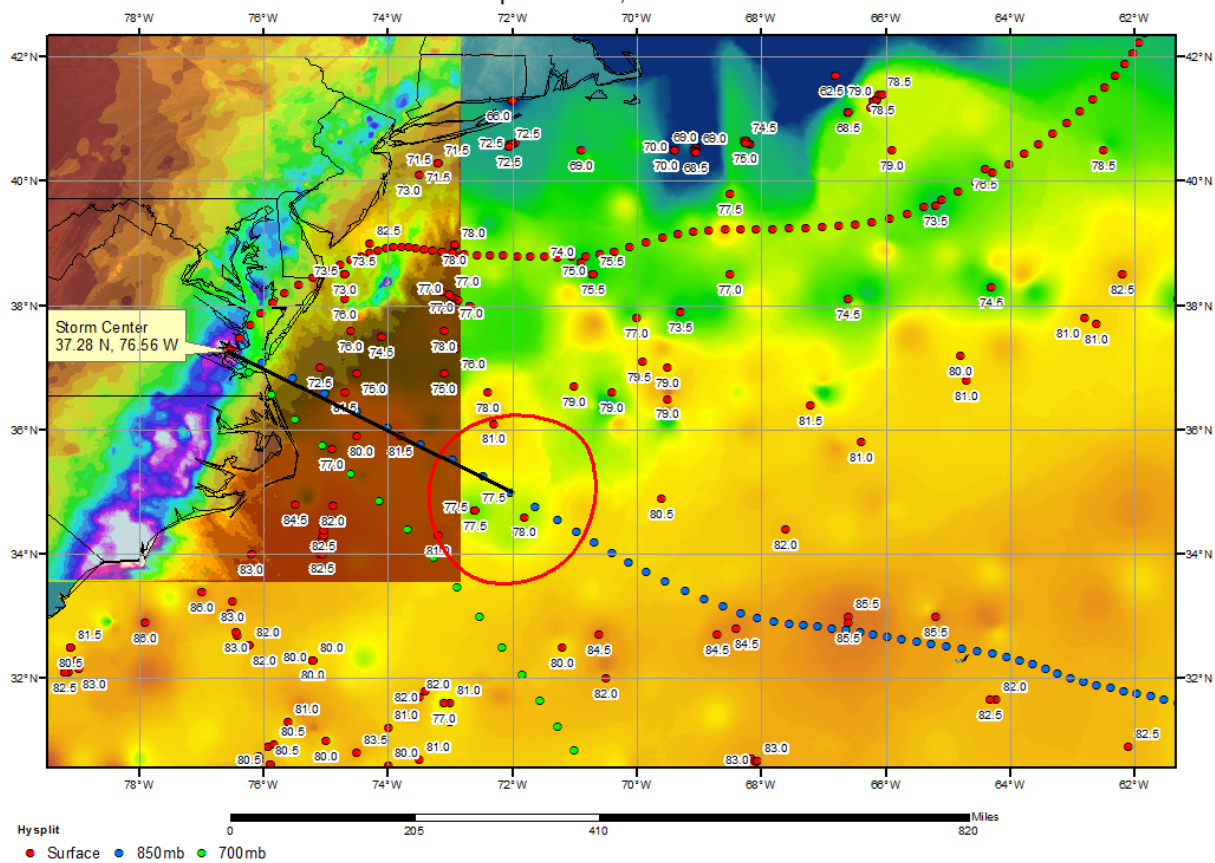




**SPAS 1552 Yorktown, VA Sea Surface Temperatures (F)**  
September 14, 1999



**SPAS 1552 Yorktown, VA Sea Surface Temperatures (F)**  
September 15, 1999



## Storm Precipitation Analysis System (SPAS) For Storm #1552\_3 SPAS-NEXRAD Analysis

**General Storm Location:** Eastern Seaboard-Pompton Lake, NJ center

**Storm Dates:** September 13, 1999 – September 17, 1999

**Event:** Hurricane Floyd

### DAD Zone 3

**Latitude:** 40.9950

**Longitude:** -74.2850

**Max. Grid Rainfall Amount:** 14.62"

**Max. Observed Rainfall Amount:** 14.45" at Pompton Lake, NJ

**Number of Stations:** 974 (430 Daily, 97 Hourly, 46 Hourly Pseudo, 1 Hourly Estimated Pseudo, 397 Supplemental, and 3 Supplemental Estimated)

**SPAS Version:** 10.0

**Base Map Used:** Continental United States 2-year 24-hour basemap (conus\_0002y24h)

**Spatial resolution:** 0.3736

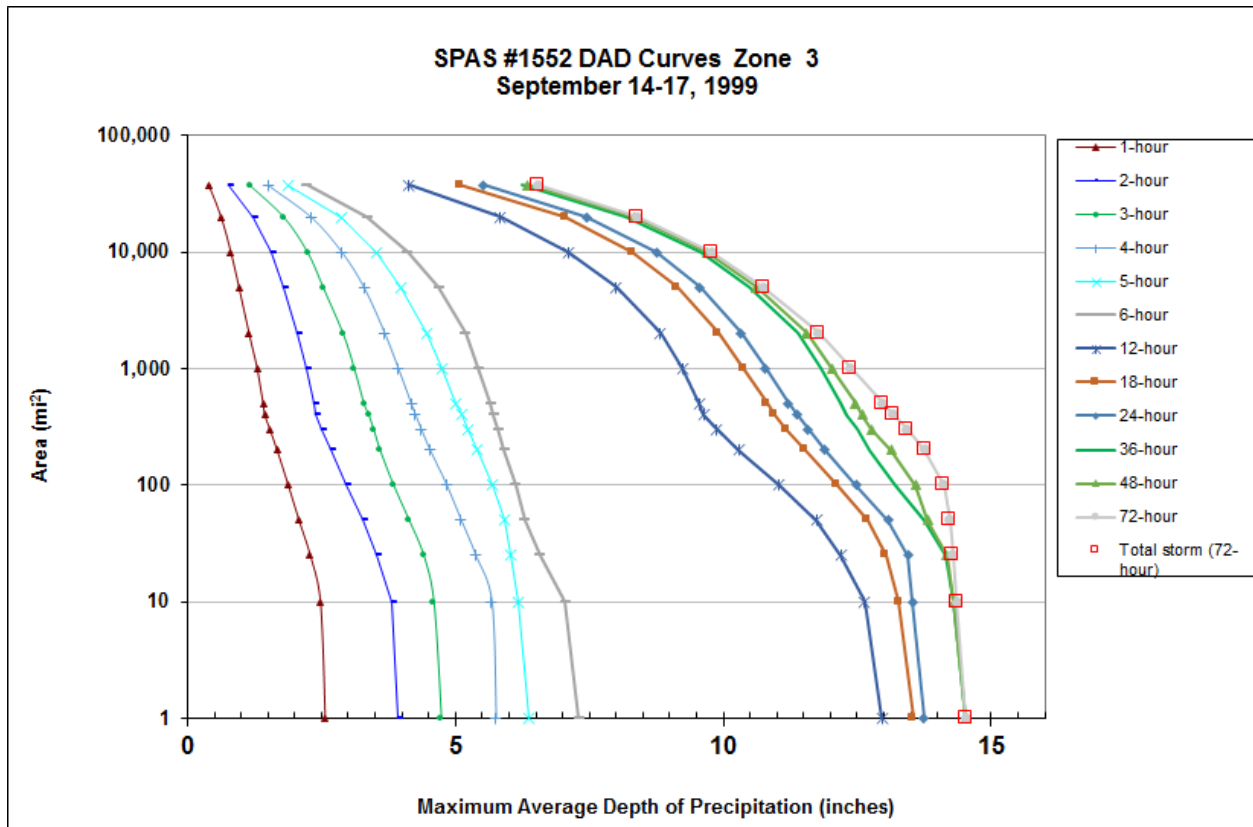
**Radar Included:** Yes

**Depth-Area-Duration (DAD) analysis:** Yes

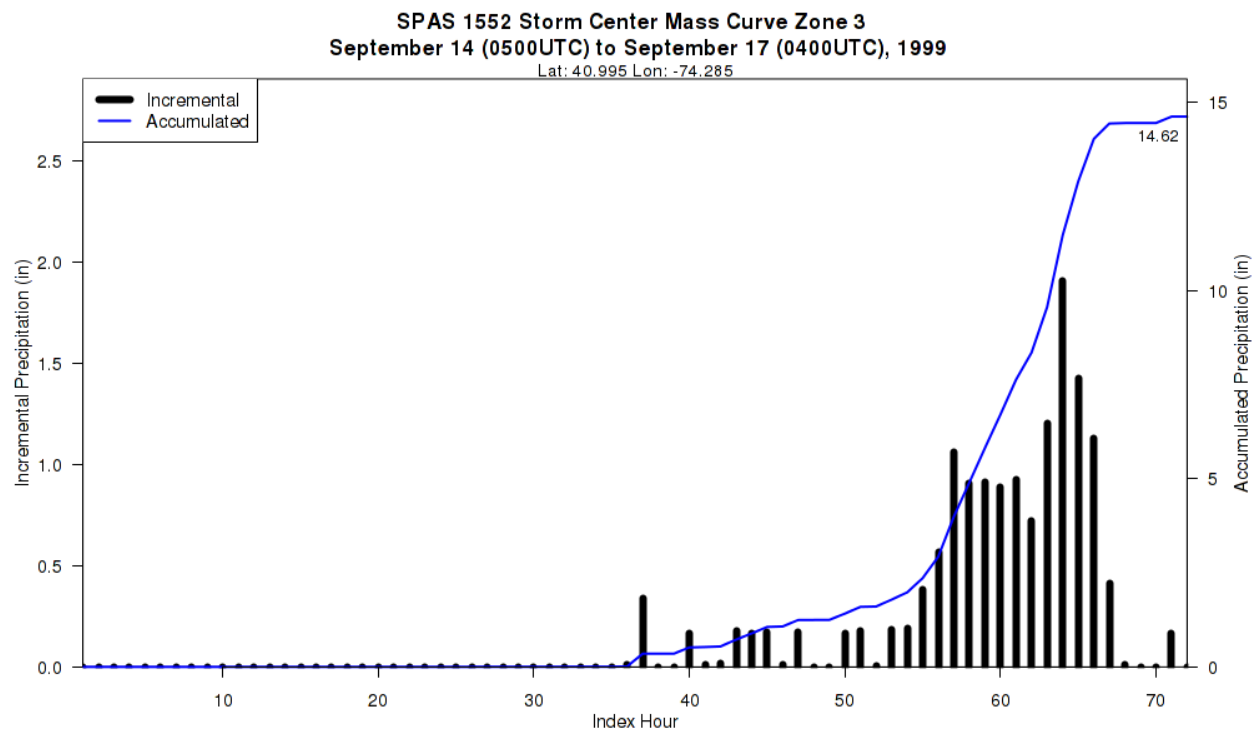
**Reliability of results:** 397 supplemental stations were added to ensure the data matches what can actually occur and that the data more closely resemble reports from this storm. Many of these stations were incorporated from previous analyses of Hurricane Floyd (SPAS storms 1002 and 1012) along with other storm data reports. Due to the orientation and integrity of the station data, three additional stations were incorporated. Lack of hourly stations in east central North Carolina forced the creation of a radar estimated hourly pseudo station to assist in timing and intensity. With the density of stations available for this storm and with how closely the resulting SPAS analysis was to the storm data report, this analysis is deemed quite reliable.

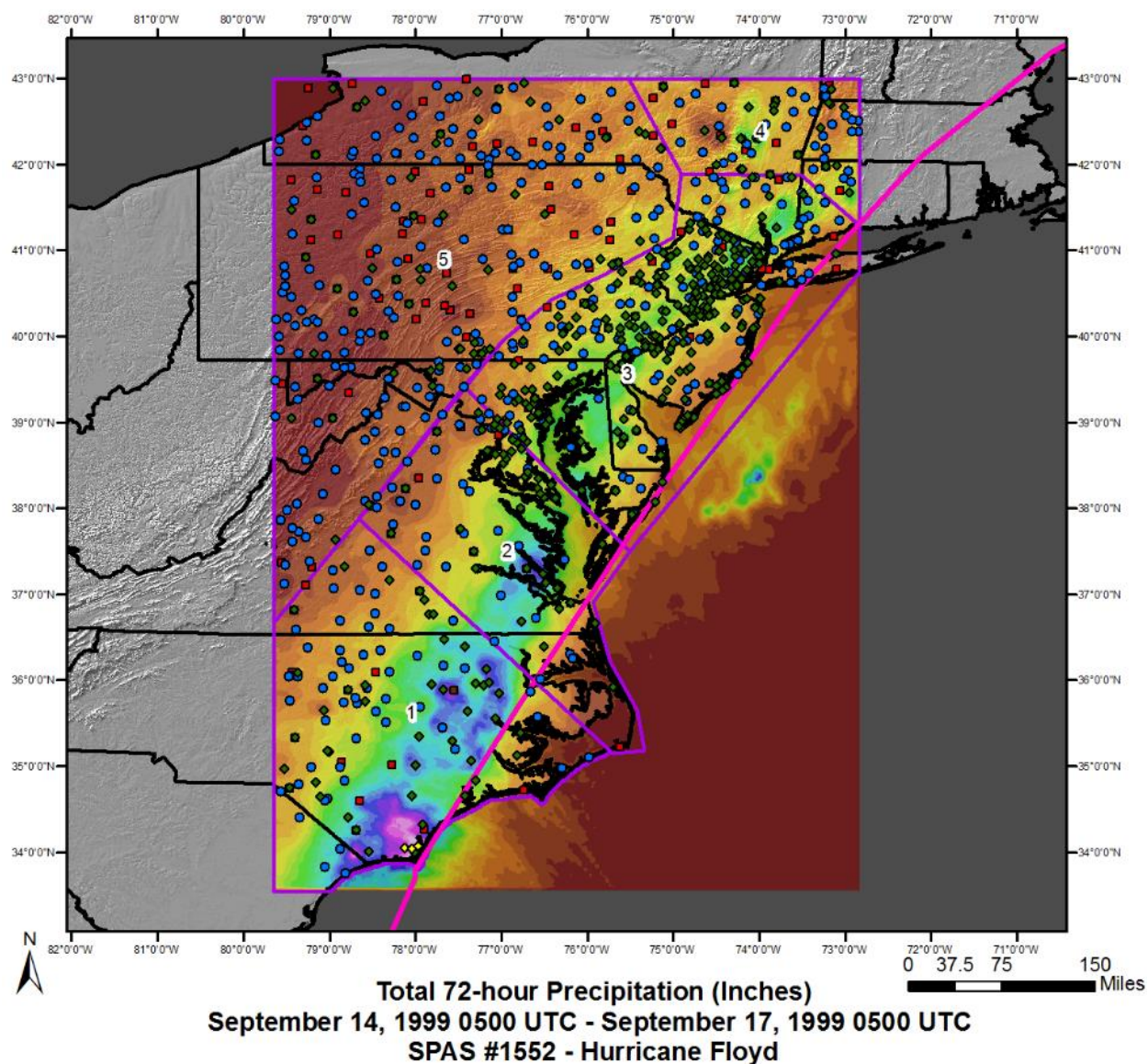
	SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
							SST	Precip. Water @ 30,000 ft.	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft.	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
Storm Center Location	1552_3	-74.2850	40.9950	214	200	1-Sep	78.50	3.37	0.06	79	3.305	82.50	82.5	4.03	0.06	87	3.970	1.201

Storm 1552 - September 14 (0500 UTC) - September 17 (0400 UTC), 1999													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
Area (mi <sup>2</sup> )	Duration (hours)												
	1	2	3	4	5	6	12	18	24	36	48	72	Total
0.4	2.59	3.96	4.77	5.79	6.42	7.37	13.04	13.64	13.83	14.60	14.61	14.61	14.61
1	2.57	3.93	4.73	5.75	6.37	7.30	12.96	13.54	13.74	14.51	14.52	14.53	14.53
10	2.48	3.80	4.59	5.67	6.17	7.04	12.64	13.27	13.53	14.28	14.30	14.35	14.35
25	2.29	3.54	4.40	5.37	6.03	6.58	12.20	13.04	13.45	14.14	14.17	14.28	14.28
50	2.08	3.26	4.13	5.10	5.91	6.29	11.74	12.69	13.08	13.76	13.82	14.23	14.23
100	1.88	2.96	3.84	4.83	5.69	6.12	11.05	12.12	12.48	13.21	13.59	14.12	14.12
200	1.67	2.67	3.59	4.52	5.40	5.91	10.29	11.52	11.90	12.74	13.14	13.76	13.76
300	1.54	2.51	3.47	4.36	5.23	5.79	9.87	11.17	11.59	12.49	12.77	13.43	13.43
400	1.44	2.40	3.38	4.25	5.11	5.71	9.64	10.96	11.38	12.31	12.59	13.17	13.17
500	1.41	2.35	3.29	4.17	5.02	5.65	9.55	10.81	11.22	12.19	12.46	12.97	12.97
1,000	1.30	2.23	3.11	3.93	4.75	5.43	9.24	10.37	10.79	11.82	12.03	12.38	12.38
2,000	1.15	2.05	2.90	3.68	4.47	5.19	8.83	9.90	10.33	11.38	11.56	11.78	11.78
5,000	0.96	1.79	2.53	3.29	3.99	4.69	8.00	9.14	9.57	10.48	10.62	10.75	10.75
10,000	0.81	1.57	2.24	2.88	3.52	4.10	7.11	8.30	8.75	9.56	9.69	9.78	9.78
20,000	0.63	1.23	1.80	2.31	2.86	3.35	5.84	7.04	7.45	8.19	8.32	8.40	8.40
37,520	0.40	0.78	1.17	1.51	1.88	2.22	4.13	5.08	5.53	6.24	6.35	6.53	6.53





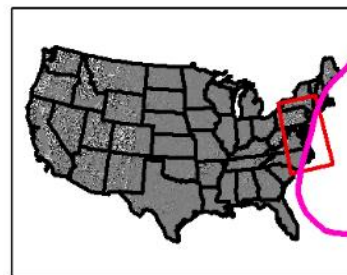


**Precipitation (inches)**

0.00 - 1.00	9.01 - 10.00	18.01 - 19.00
1.01 - 2.00	10.01 - 11.00	19.01 - 20.00
2.01 - 3.00	11.01 - 12.00	20.01 - 21.00
3.01 - 4.00	12.01 - 13.00	21.01 - 22.00
4.01 - 5.00	13.01 - 14.00	22.01 - 23.00
5.01 - 6.00	14.01 - 15.00	23.01 - 24.00
6.01 - 7.00	15.01 - 16.00	24.01 - 25.00
7.01 - 8.00	16.01 - 17.00	
8.01 - 9.00	17.01 - 18.00	

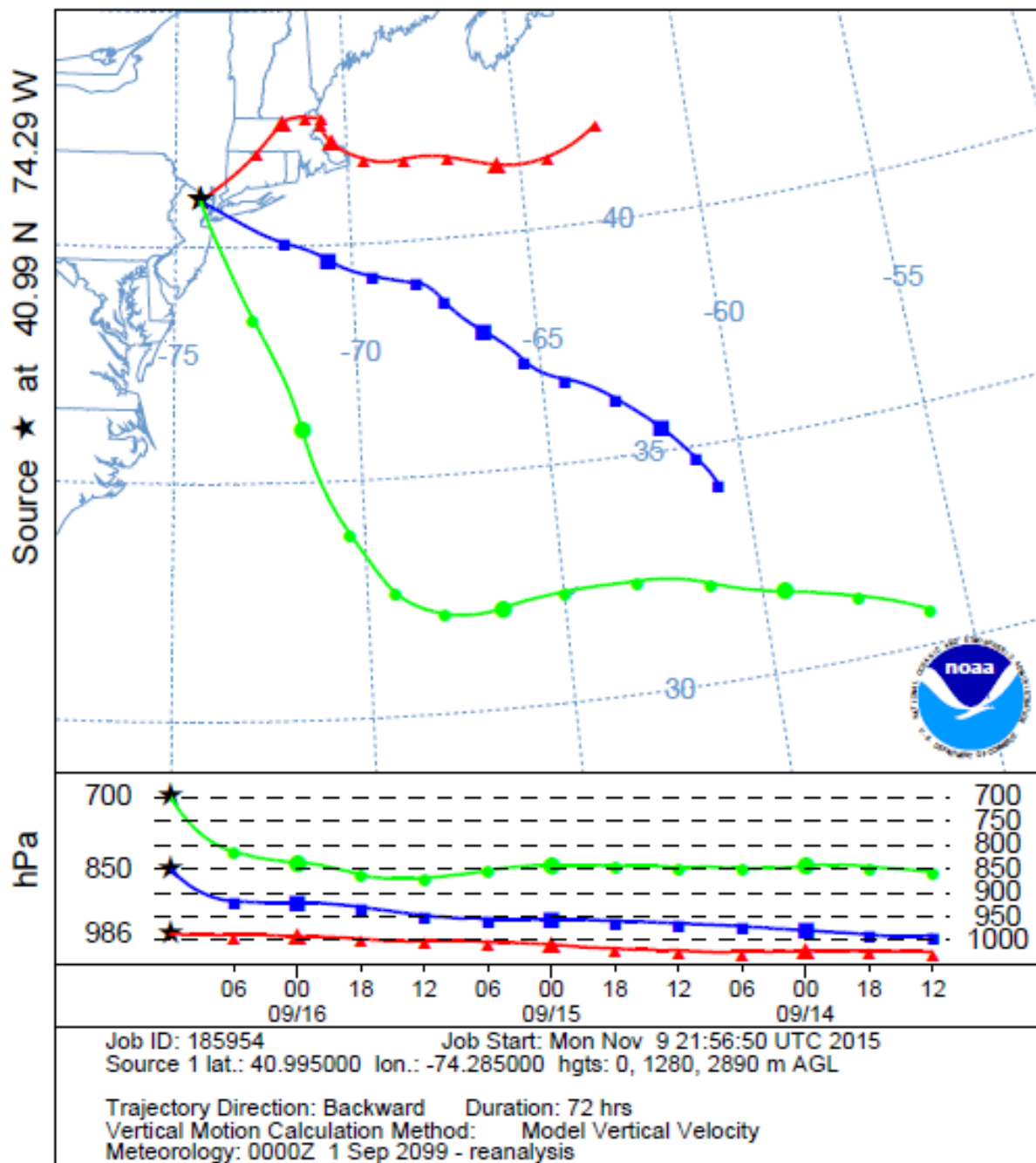
**Stations**

- Daily
- Hourly
- Hourly Estimated Pseudo
- Hourly Pseudo
- Supplemental
- Supplemental Estimated

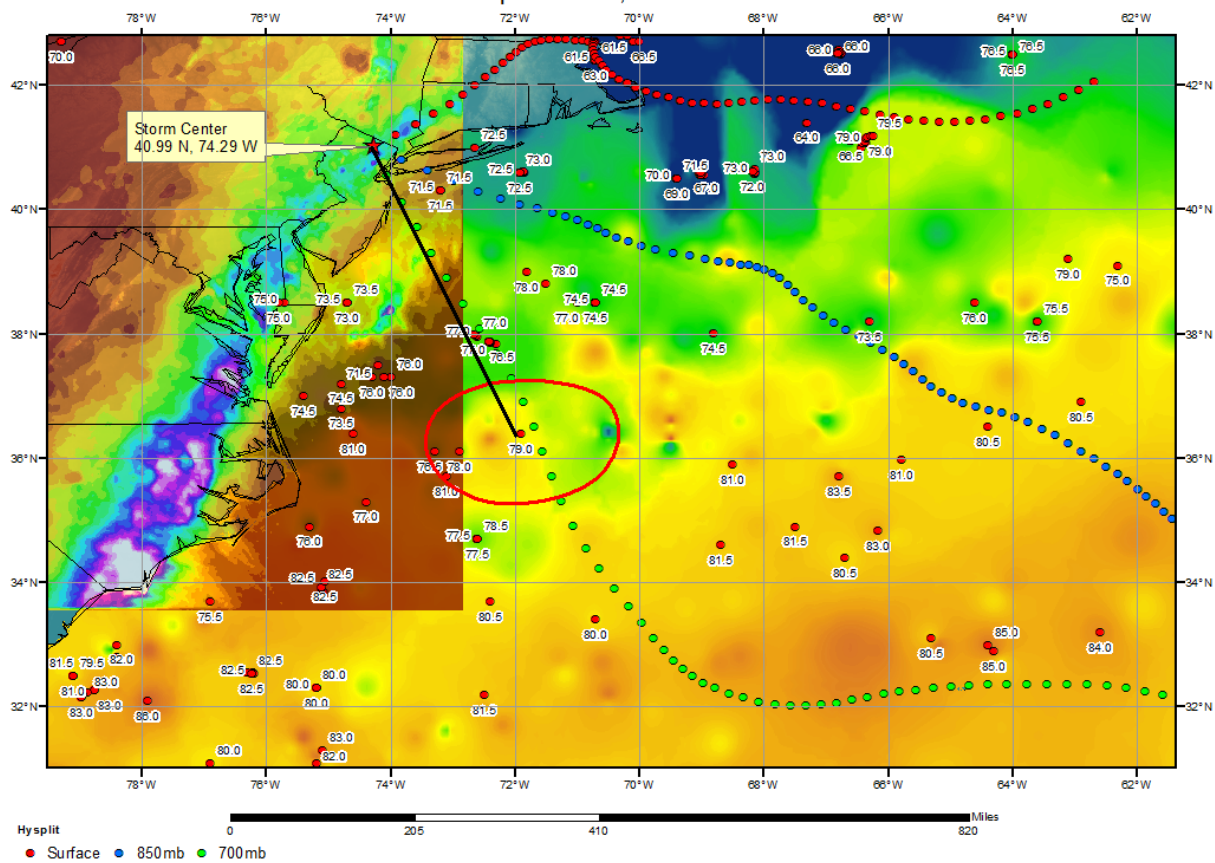


WJM 09/14/2015

NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 16 Sep 99  
 CDC1 Meteorological Data

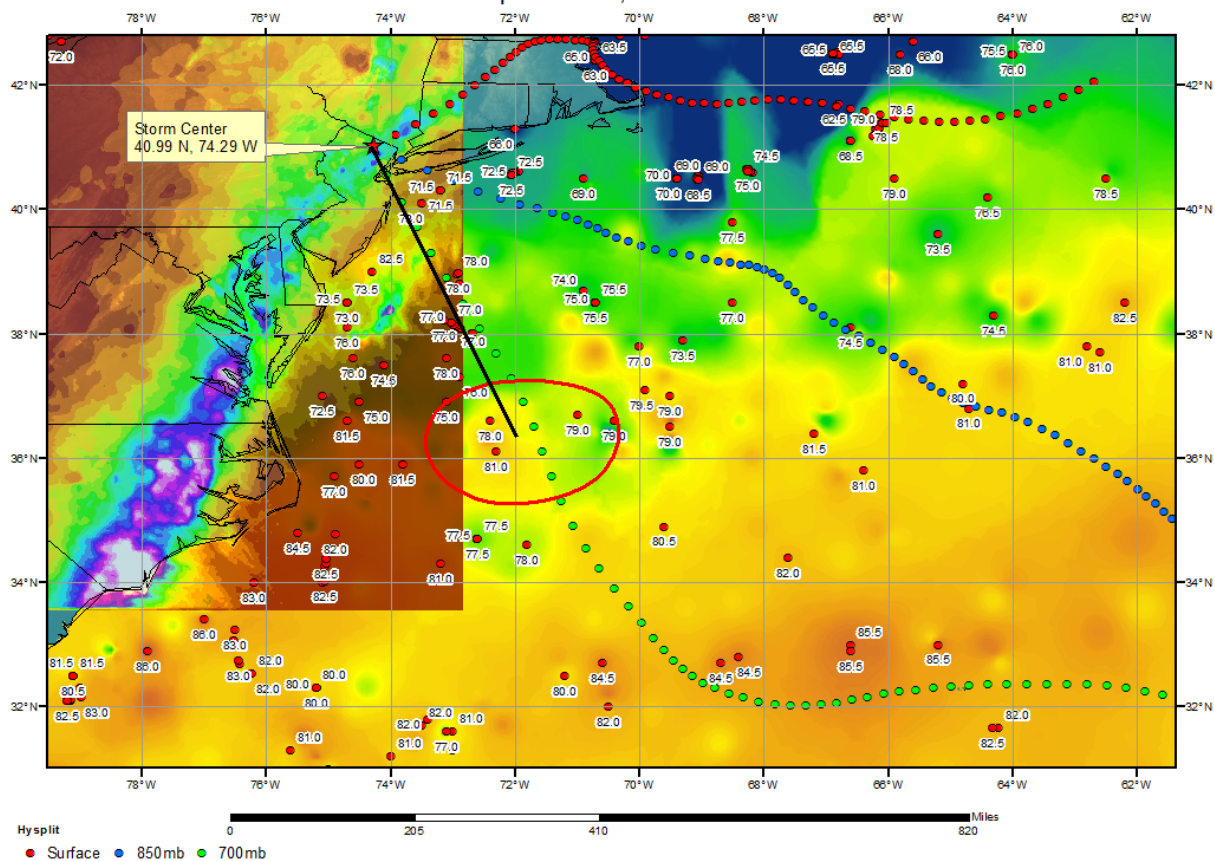


**SPAS 1552 Pompton Lake, NJ Sea Surface Temperatures (F)**  
**September 14, 1999**





**SPAS 1552 Pompton Lake, NJ Sea Surface Temperatures (F)**  
September 15, 1999



## Storm Precipitation Analysis System (SPAS) For Storm #1552\_4 SPAS-NEXRAD Analysis

**General Storm Location:** Eastern Seaboard-Cairo, NY center

**Storm Dates:** September 13, 1999 – September 17, 1999

**Event:** Hurricane Floyd

### DAD Zone 4

**Latitude:** 42.2950

**Longitude:** -74.0050

**Max. Grid Rainfall Amount:** 11.71"

**Max. Observed Rainfall Amount:** 11.74" Cairo, NY

**Number of Stations:** 974 (430 Daily, 97 Hourly, 46 Hourly Pseudo, 1 Hourly Estimated Pseudo, 397 Supplemental, and 3 Supplemental Estimated)

**SPAS Version:** 10.0

**Base Map Used:** Continental United States 2-year 24-hour basemap (conus\_0002y24h)

**Spatial resolution:** 0.3736

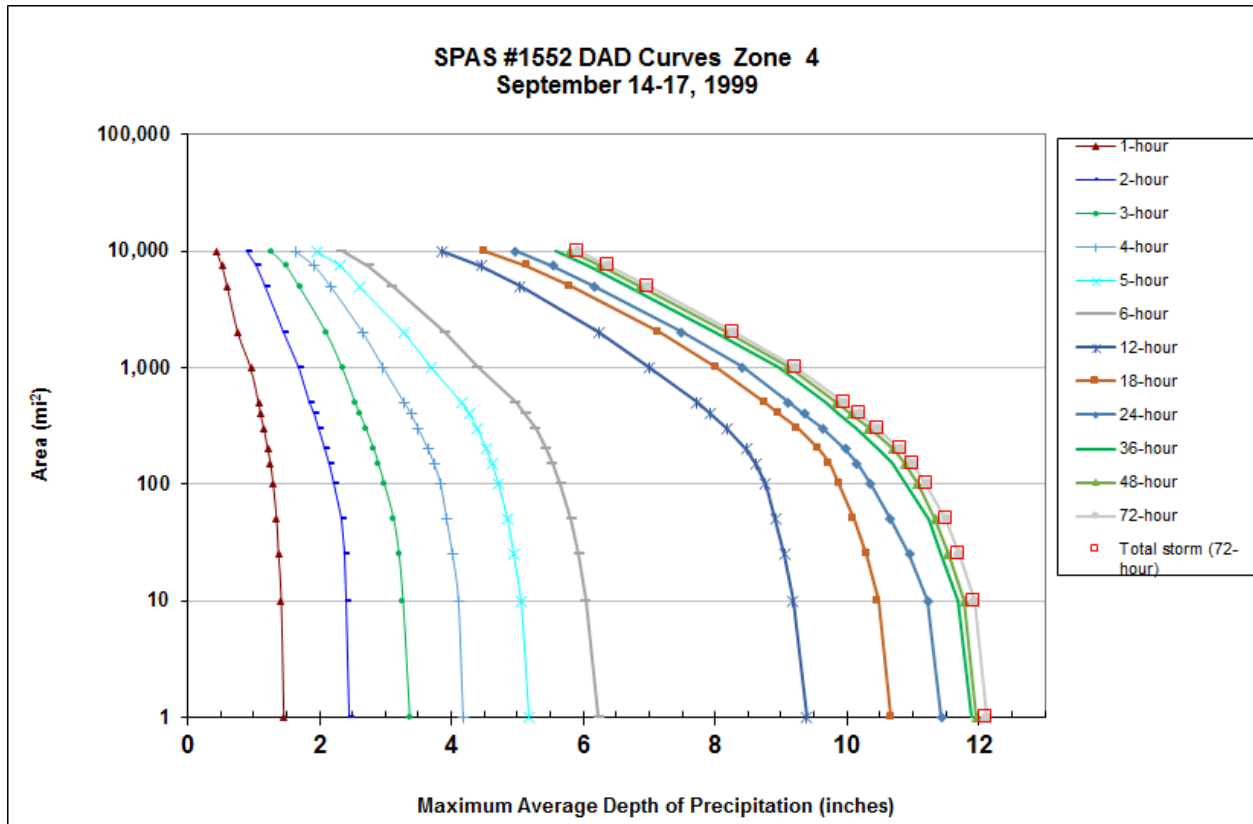
**Radar Included:** Yes

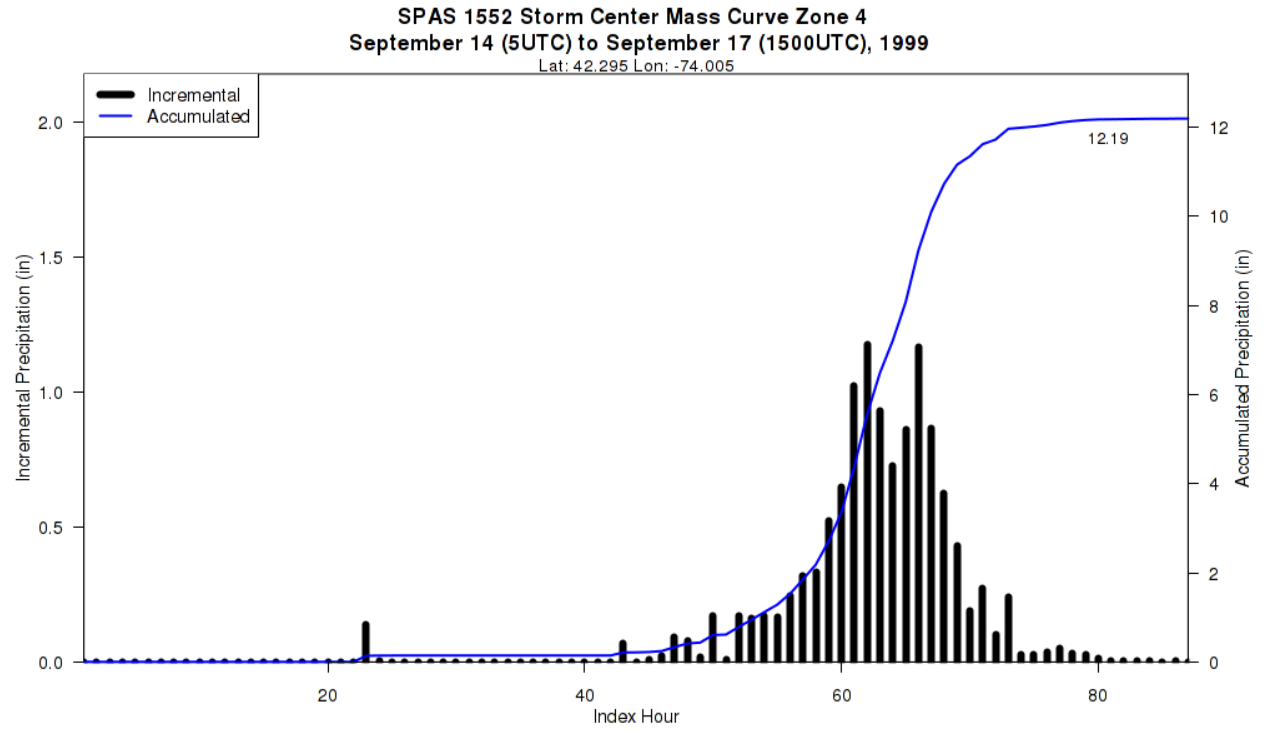
**Depth-Area-Duration (DAD) analysis:** Yes

**Reliability of results:** 397 supplemental stations were added to ensure the data matches what can actually occur and that the data more closely resemble reports from this storm. Many of these stations were incorporated from previous analyses of Hurricane Floyd (SPAS storms 1002 and 1012) along with other storm data reports. Due to the orientation and integrity of the station data, three additional stations were incorporated. Lack of hourly stations in east central North Carolina forced the creation of a radar estimated hourly pseudo station to assist in timing and intensity. With the density of stations available for this storm and with how closely the resulting SPAS analysis was to the storm data report, this analysis is deemed quite reliable.

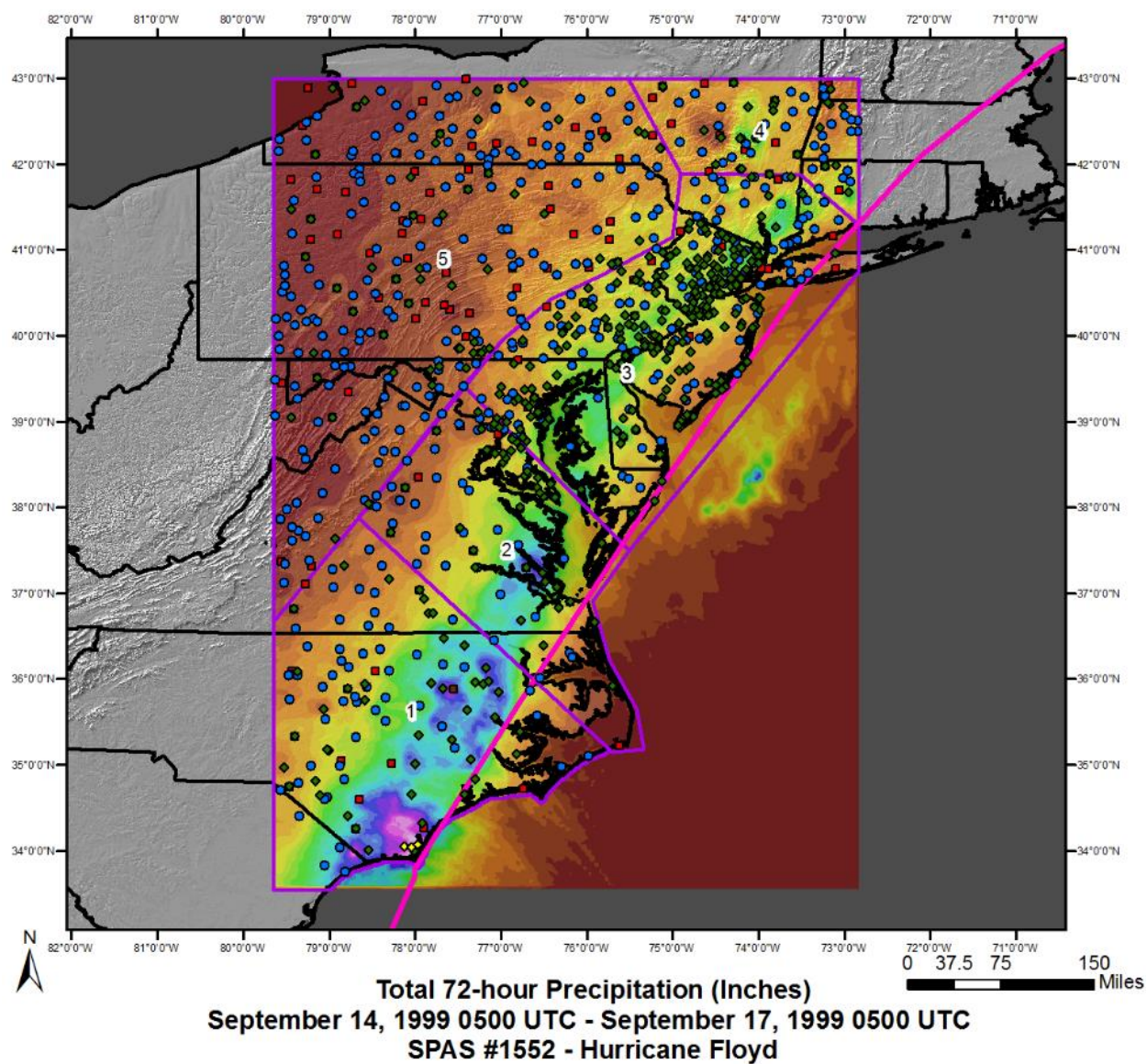
	SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
							SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
Storm Center Location	1552_4	-74.0050	42.2950	412	400	1-Sep	78.50	3.37	0.12	79	3.250	82.50	82.5	4.03	0.12	87	3.910	1.203

Storm 1552 - September 14 (0500 UTC) - September 17 (0400 UTC), 1999													
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)													
Area (mi <sup>2</sup> )	Duration (hours)												
	1	2	3	4	5	6	12	18	24	36	48	72	Total
0.4	1.48	2.46	3.40	4.21	5.22	6.28	9.47	10.74	11.51	11.97	12.03	12.18	12.18
1	1.46	2.45	3.37	4.18	5.17	6.23	9.39	10.67	11.43	11.90	11.96	12.11	12.11
10	1.42	2.40	3.27	4.11	5.05	6.04	9.18	10.47	11.22	11.69	11.78	11.93	11.93
25	1.38	2.38	3.21	4.02	4.95	5.93	9.05	10.30	10.95	11.43	11.54	11.70	11.70
50	1.35	2.33	3.13	3.93	4.86	5.82	8.91	10.11	10.66	11.24	11.34	11.50	11.50
100	1.30	2.22	2.99	3.84	4.71	5.66	8.77	9.88	10.36	10.90	11.07	11.20	11.20
150	1.26	2.14	2.90	3.74	4.63	5.53	8.62	9.73	10.15	10.68	10.88	11.00	11.00
200	1.22	2.08	2.83	3.65	4.54	5.44	8.47	9.57	9.98	10.49	10.70	10.81	10.81
300	1.16	1.98	2.71	3.50	4.39	5.27	8.18	9.25	9.63	10.14	10.34	10.46	10.46
400	1.11	1.91	2.62	3.39	4.27	5.12	7.93	8.97	9.35	9.87	10.07	10.19	10.19
500	1.08	1.86	2.55	3.29	4.16	4.97	7.72	8.75	9.11	9.67	9.84	9.96	9.96
1,000	0.96	1.69	2.35	2.97	3.70	4.40	7.00	8.01	8.42	8.95	9.11	9.22	9.22
2,000	0.77	1.46	2.11	2.66	3.28	3.90	6.23	7.15	7.49	7.99	8.18	8.28	8.28
5,000	0.61	1.19	1.70	2.17	2.62	3.10	5.04	5.81	6.16	6.66	6.86	6.98	6.98
7,500	0.53	1.05	1.50	1.92	2.31	2.74	4.46	5.15	5.54	6.10	6.27	6.39	6.39
10,000	0.45	0.90	1.28	1.64	1.97	2.34	3.85	4.50	4.98	5.59	5.79	5.92	5.92





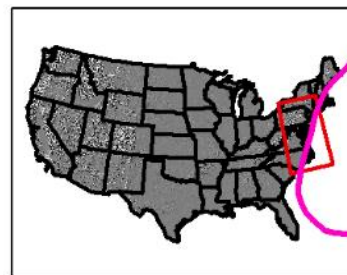


**Precipitation (inches)**

0.00 - 1.00	9.01 - 10.00	18.01 - 19.00
1.01 - 2.00	10.01 - 11.00	19.01 - 20.00
2.01 - 3.00	11.01 - 12.00	20.01 - 21.00
3.01 - 4.00	12.01 - 13.00	21.01 - 22.00
4.01 - 5.00	13.01 - 14.00	22.01 - 23.00
5.01 - 6.00	14.01 - 15.00	23.01 - 24.00
6.01 - 7.00	15.01 - 16.00	24.01 - 25.00
7.01 - 8.00	16.01 - 17.00	
8.01 - 9.00	17.01 - 18.00	

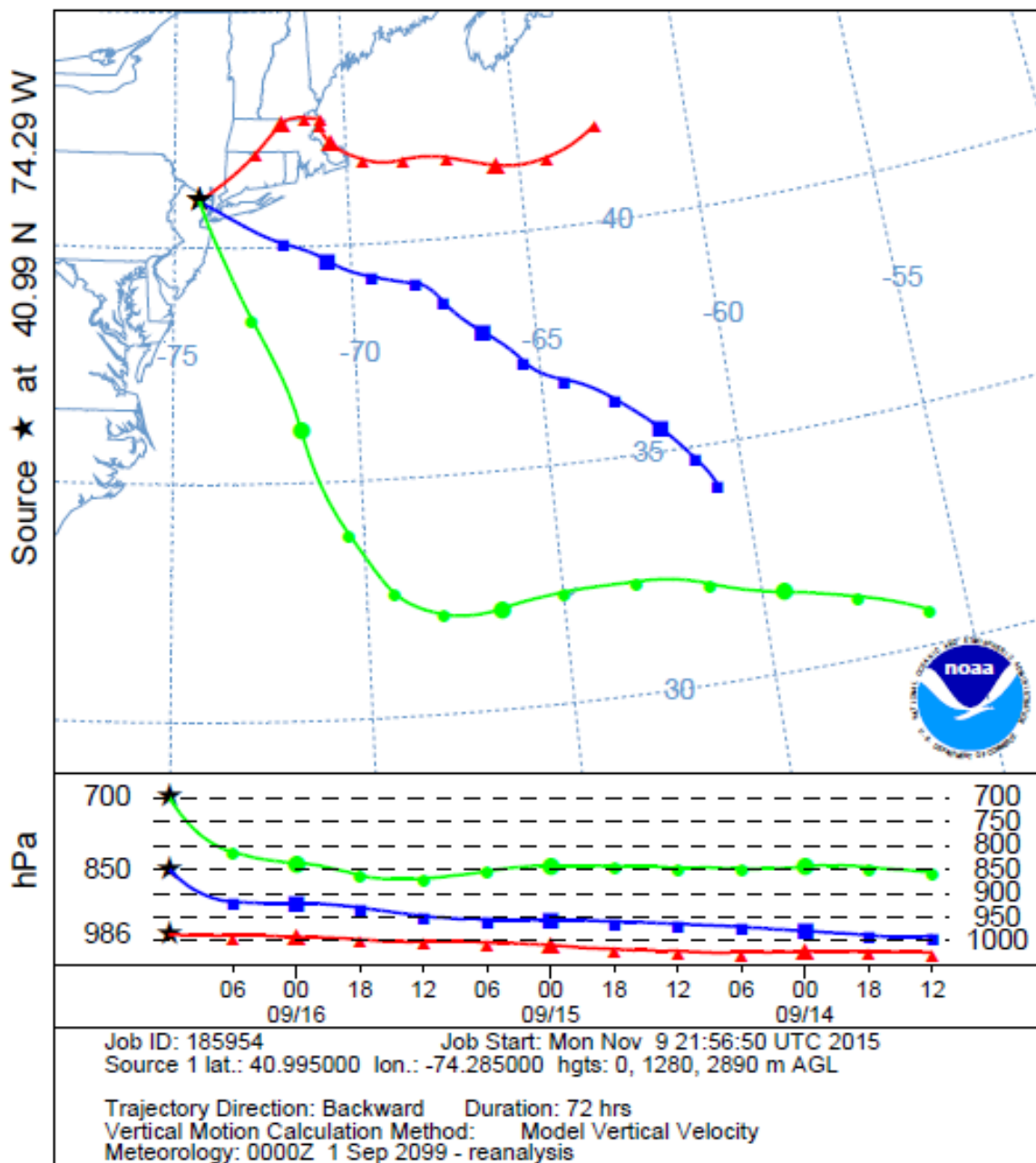
**Stations**

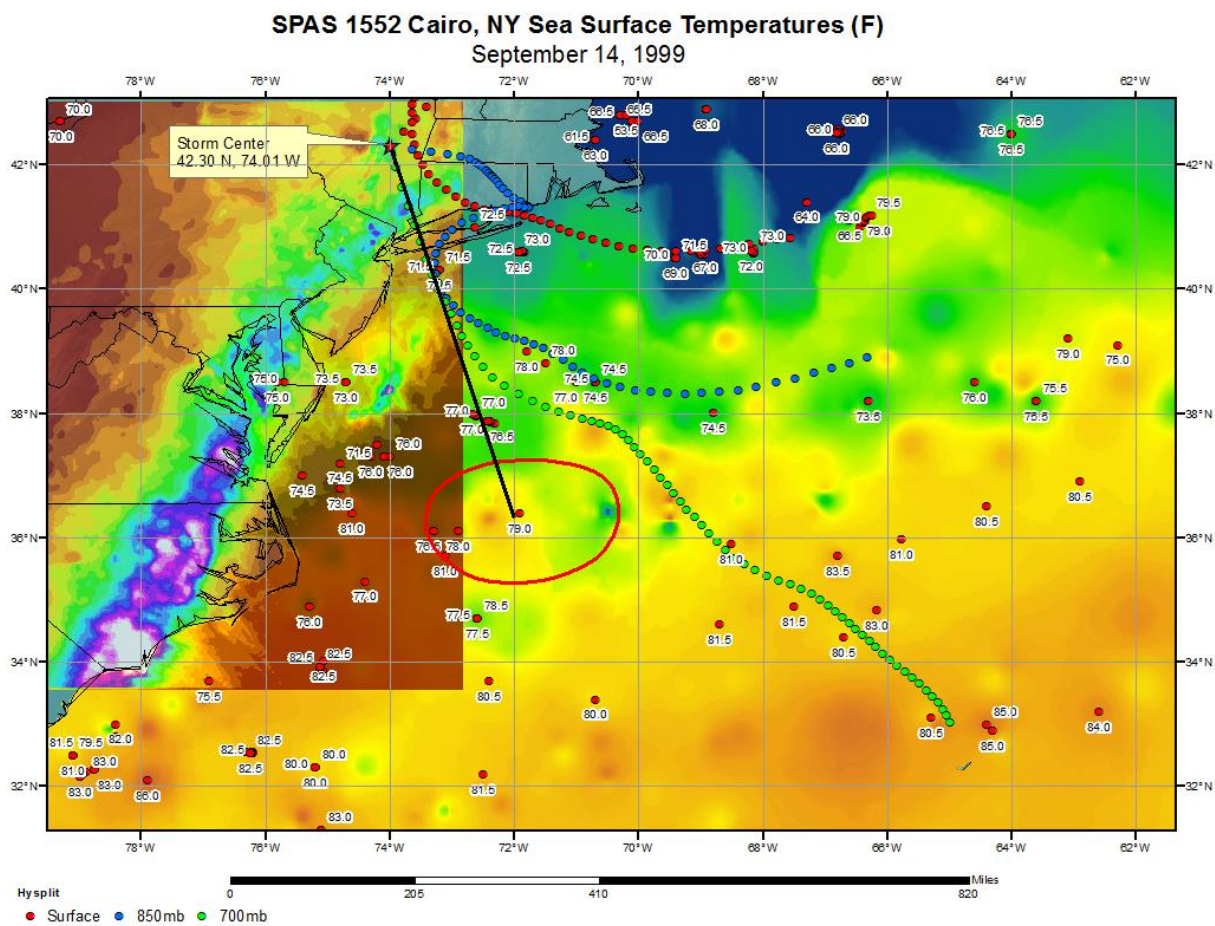
- Daily
- Hourly
- Hourly Estimated Pseudo
- Hourly Pseudo
- Supplemental
- Supplemental Estimated



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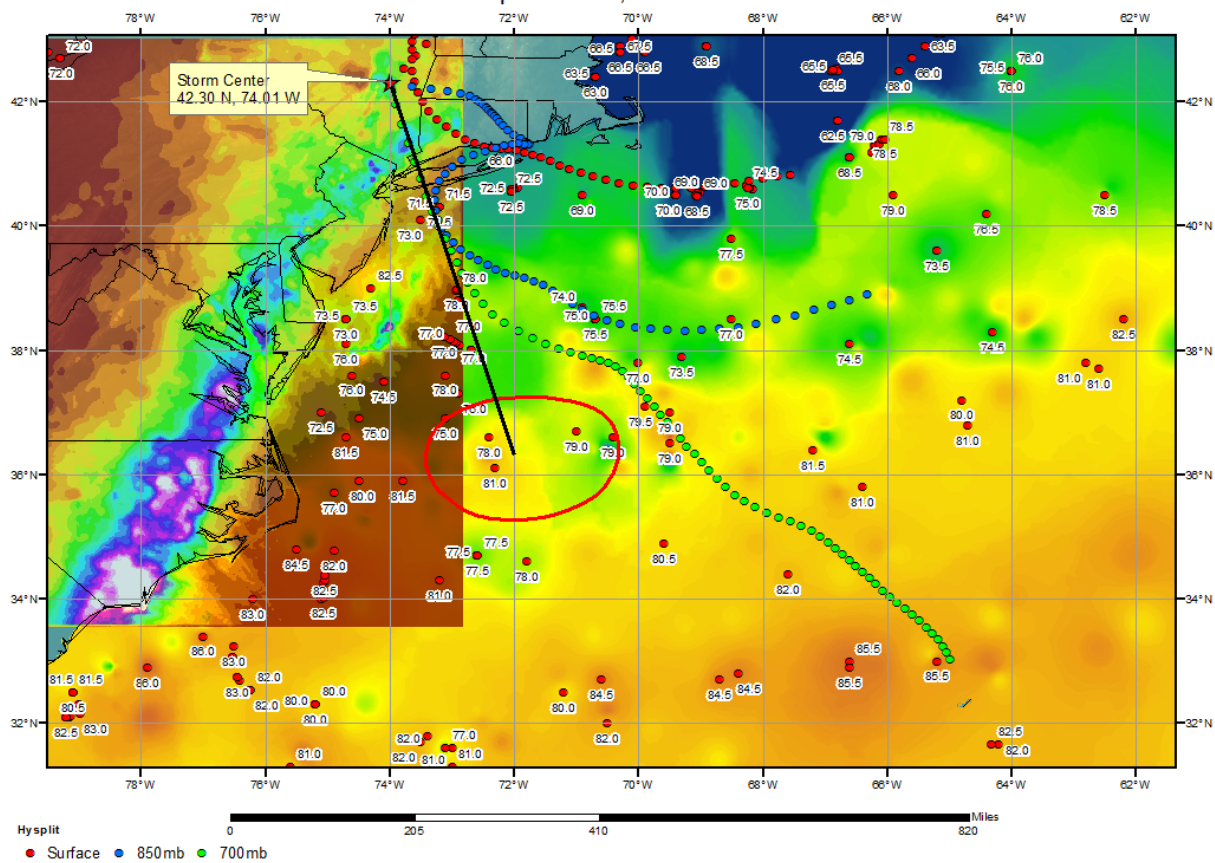
NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 16 Sep 99  
 CDC1 Meteorological Data







**SPAS 1552 Cairo, NY Sea Surface Temperatures (F)**  
**September 15, 1999**





## Storm Precipitation Analysis System (SPAS) For Storm #1535\_2 SPAS-NEXRAD Analysis

**General Storm Location:** Upper Sherando, VA-Mid-Atlantic States – Hurricane Isabel

**Storm Dates:** September 17 – September 20, 2003

**Event:** Hurricane Isabel

### DAD Zone 2

**Latitude:** 37.9125

**Longitude:** -79.0292

**Max. Grid Rainfall Amount:** 20.22"

**Max. Observed Rainfall Amount:** 20.20" at Upper Sherando, VA

**Number of Stations:** 1085 (681 Daily, 157 Hourly, 51 Hourly Pseudo, and 196 Supplemental)

**SPAS Version:** 10.0

**Basemap:** Mean annual maximum 48-hour precipitation associated with MLCs

**Spatial resolution:** 0.2606

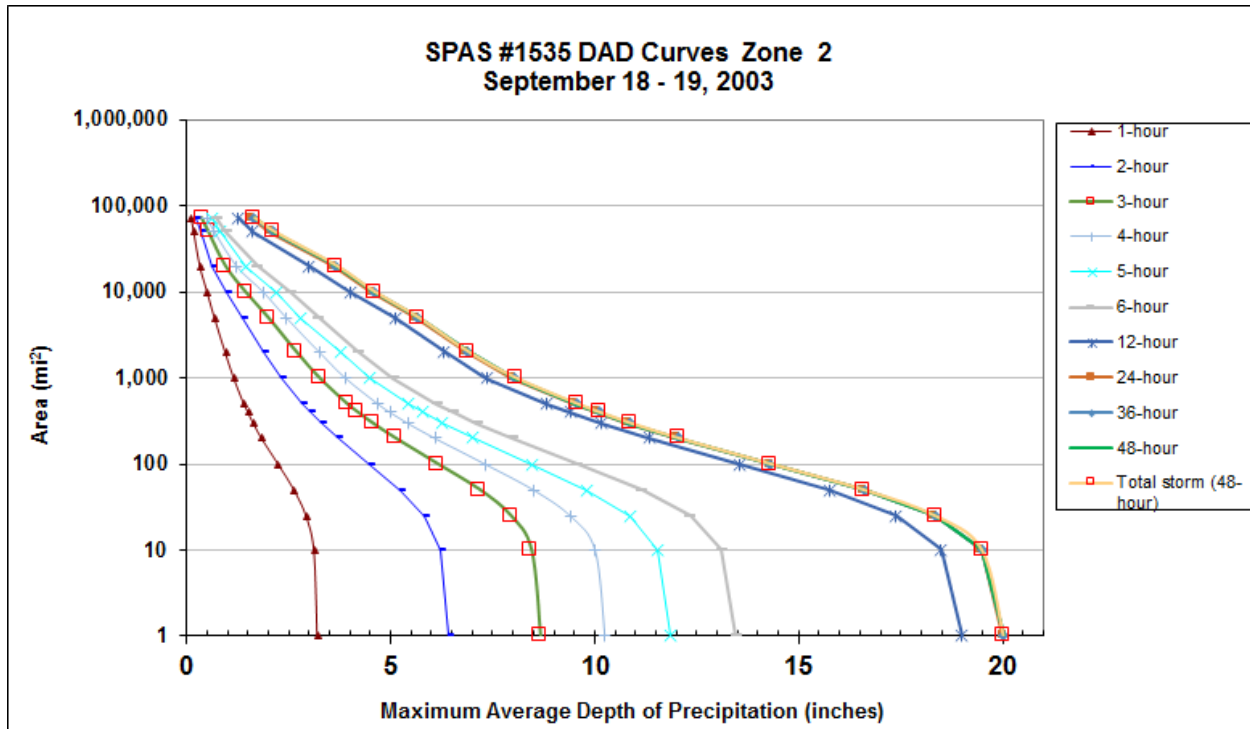
**Radar Included:** Yes

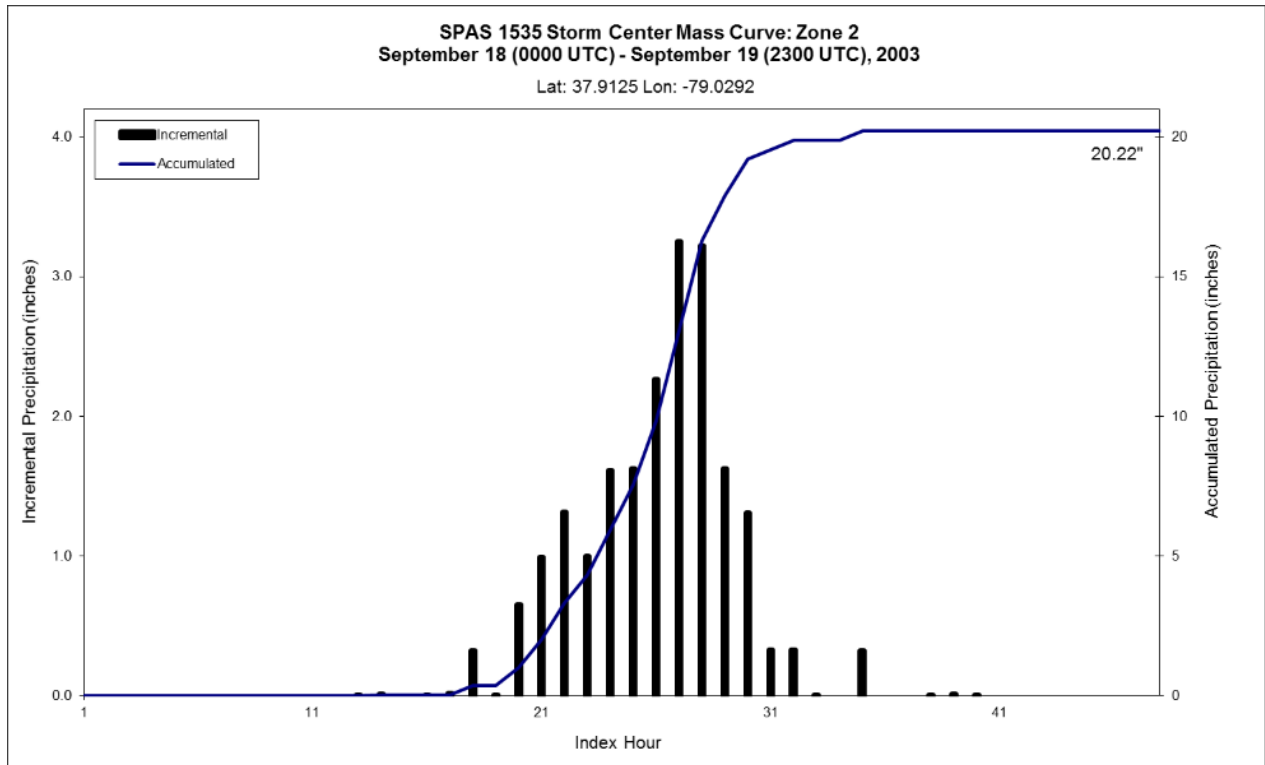
**Depth-Area-Duration (DAD) analysis:** Yes

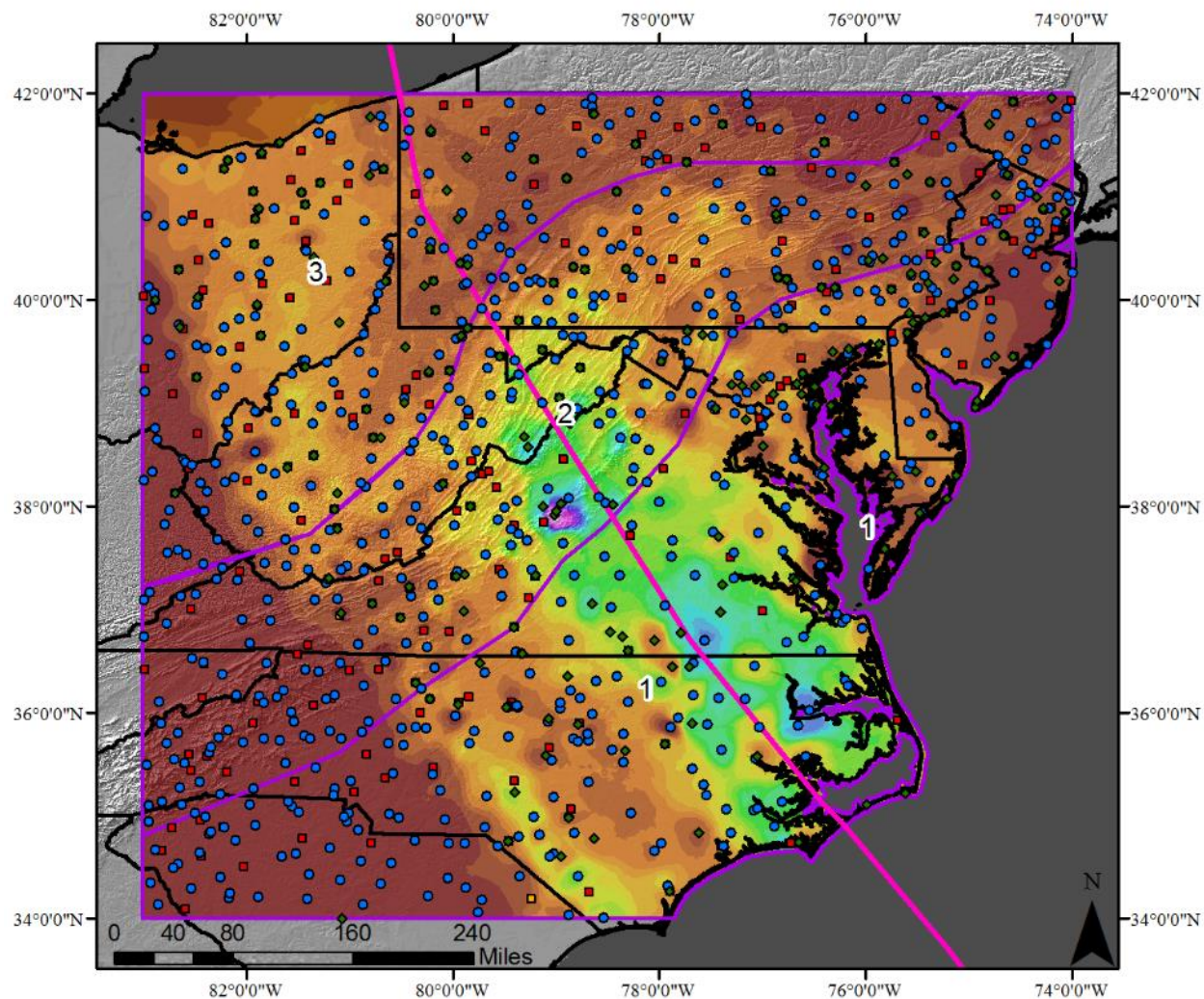
**Reliability of results:** One Hundred ninety-six supplemental stations were added to ensure the data matches what can actually occur and that the data more closely resemble reports from this storm. Due to the orientation and integrity of the station and radar data, these stations were retained to depict the storm precipitation pattern and intensity. A radar beam blockage mask was applied for regions of the storm domain where radar coverage was not available along with blocked radar beams from the Appalachian Mountains. With the density of stations available for this storm and with how closely the resulting SPAS analysis was to the storm data report, this analysis is deemed quite reliable.

						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1535_2	-79.0290	37.9125	2,294	2,300	3-Sep	80.50	3.68	0.67	83	3.010	83.23	83.0	4.12	0.70	88	3.420	1.136

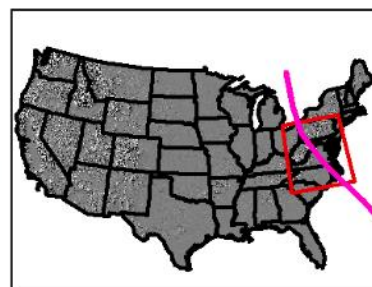
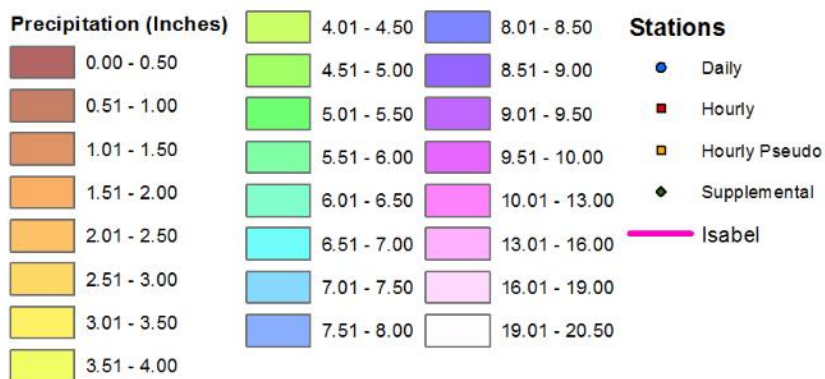
Storm 1535- September 18 (0000 UTC) - September 19 (2300 UTC), 2003											
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)											
Area (mi <sup>2</sup> )	Duration (hours)										
	1	2	3	4	5	6	12	24	36	48	Total
0.4	3.24	6.45	8.71	10.33	11.94	13.55	19.13	20.14	20.16	20.16	20.16
1	3.21	6.41	8.66	10.26	11.87	13.47	19.00	20.01	20.02	20.02	20.02
10	3.13	6.23	8.44	10.02	11.56	13.11	18.48	19.48	19.49	19.49	19.49
25	2.94	5.84	7.94	9.42	10.87	12.33	17.39	18.33	18.34	18.34	18.34
50	2.65	5.25	7.18	8.52	9.82	11.15	15.74	16.60	16.61	16.59	16.59
100	2.26	4.48	6.15	7.33	8.45	9.59	13.54	14.30	14.31	14.31	14.31
200	1.85	3.70	5.11	6.09	7.02	7.98	11.33	12.01	12.04	12.04	12.04
300	1.65	3.29	4.55	5.42	6.26	7.12	10.17	10.82	10.86	10.86	10.86
400	1.52	3.03	4.19	4.99	5.77	6.54	9.40	10.06	10.11	10.11	10.11
500	1.42	2.84	3.93	4.69	5.42	6.13	8.84	9.51	9.56	9.57	9.57
1,000	1.17	2.32	3.25	3.89	4.50	5.06	7.36	7.98	8.05	8.06	8.06
2,000	0.96	1.89	2.69	3.25	3.76	4.21	6.30	6.85	6.91	6.91	6.91
5,000	0.70	1.37	2.00	2.44	2.81	3.24	5.11	5.62	5.68	5.68	5.68
10,000	0.52	0.99	1.44	1.87	2.19	2.55	4.00	4.52	4.60	4.60	4.60
20,000	0.34	0.63	0.95	1.21	1.45	1.73	2.99	3.59	3.66	3.67	3.67
50,000	0.19	0.35	0.53	0.67	0.84	0.97	1.62	2.04	2.12	2.14	2.14
71,969	0.13	0.25	0.37	0.49	0.61	0.73	1.27	1.58	1.64	1.66	1.66







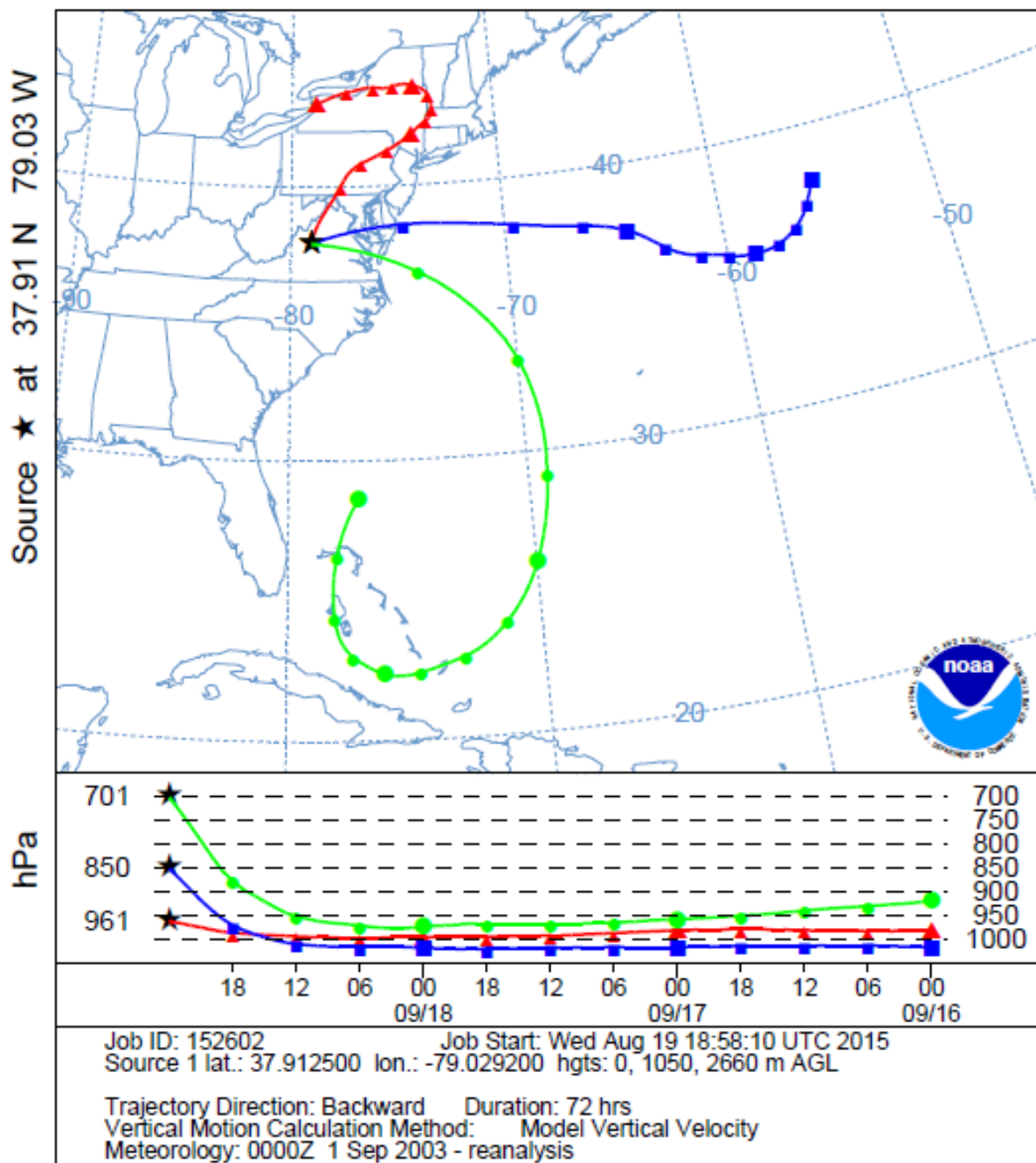
**Total 48-hour Precipitation (Inches)**  
**September 18, 2003 0000 UTC - September 20, 2003 0000 UTC**  
**SPAS #1535-Hurricane Isabel**



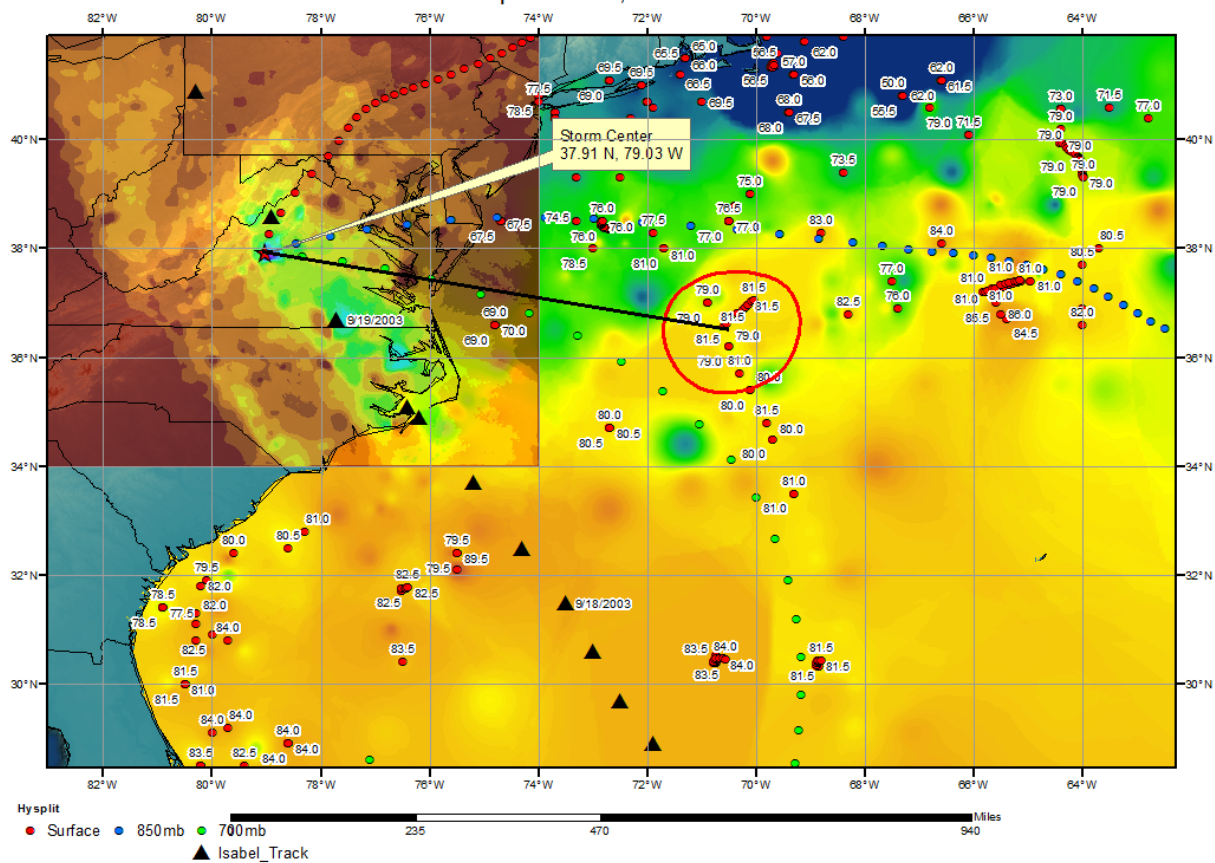
WJM 08/10/2015



NOAA HYSPLIT MODEL  
 Backward trajectories ending at 0000 UTC 19 Sep 03  
 CDC1 Meteorological Data



**SPAS 1535 Upper Sherando, VA Sea Surface Temperatures (F)**  
**September 18, 2003**



## Storm Precipitation Analysis System (SPAS) For Storm #1551\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Virginia, North Carolina, Maryland

**Storm Dates:** August 30-31, 2004

**Event:** Convective/Remnants of Hurricane Gaston

### DAD Zone 1

**Latitude:** 37.705

**Longitude:** -77.375

**Max. Grid Rainfall Amount:** 14.38"

**Max. Observed Rainfall Amount:** 12.60" at Richmond, VA

**Number of Stations:** 199 (108 Daily, 46 Hourly, 14 Hourly Pseudo, 1 Hourly Estimated Pseudo and 30 Supplemental)

**SPAS Version:** 10.0

**Basemap:** us\_ppt\_in\_map\_1961\_1990\_usda\_northamerica

**Spatial resolution:** 00:00:36

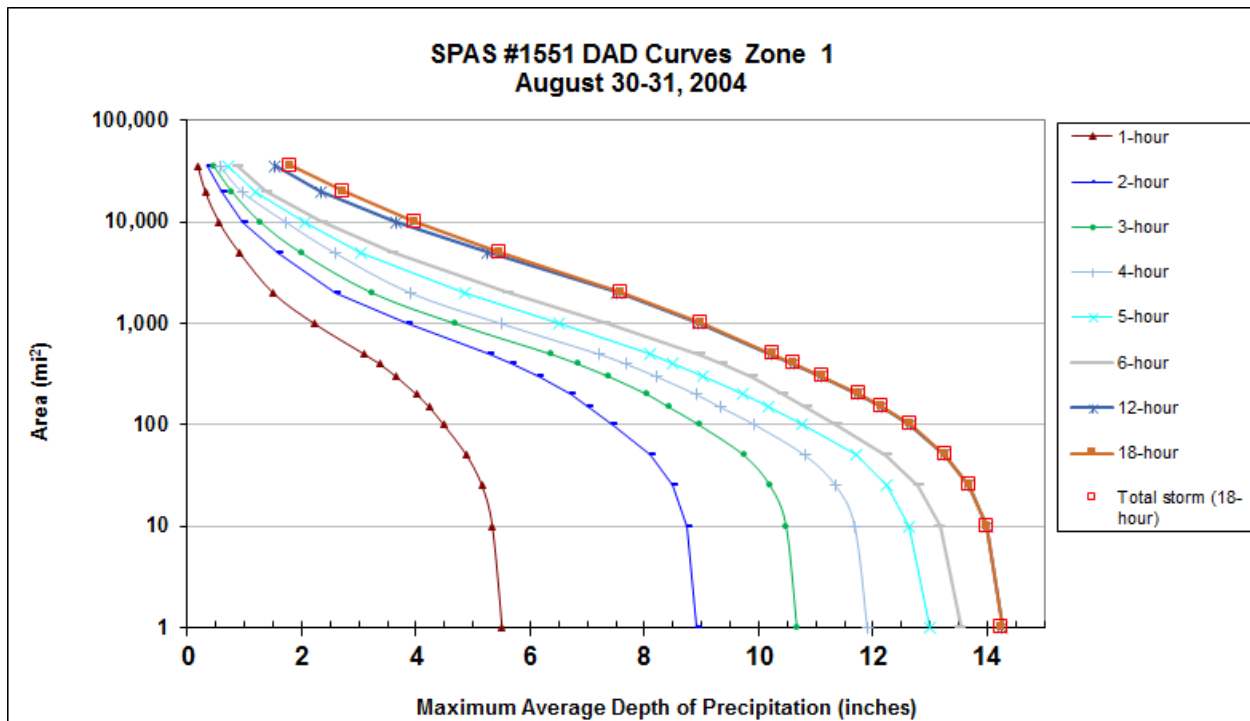
**Radar Included:** Yes

**Depth-Area-Duration (DAD) analysis:** Yes

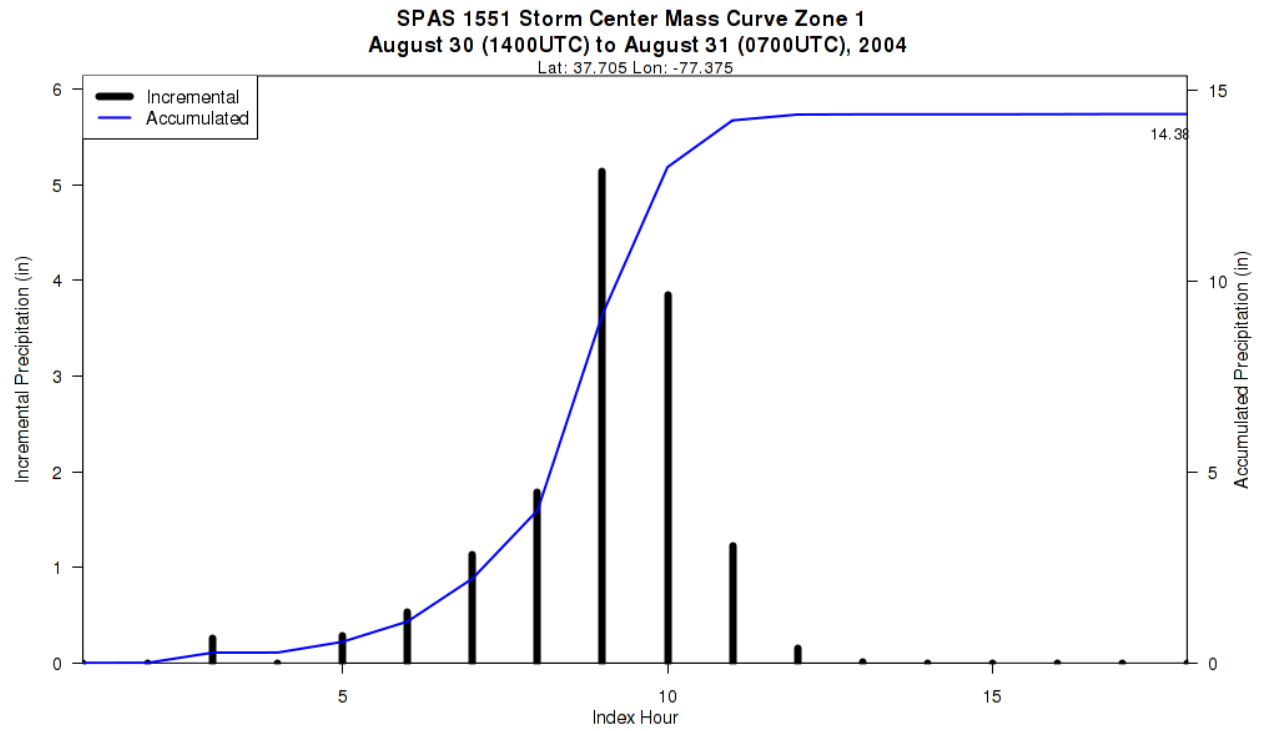
**Reliability of results:** This analysis was based on several hourly data, daily data, supplemental station data and one hourly estimated pseudo station. We have a good degree of confidence for the station based storm total results. The spatial pattern is dependent on the basemap (us\_ppt\_in\_map\_1961\_1990\_usda\_northamerica). The radar data was also excellent with very little beam blockage. There is a high degree of confidence with the timing based on the several hourly and hourly pseudo stations. Some daily stations were moved to supplemental due to timing issues or removed due to erroneous storm precipitation observations. A couple hourly stations were changed to hourly pseudo stations due to values being too low (affecting the integrity of the spatial pattern) when compared to nearby hourly stations.

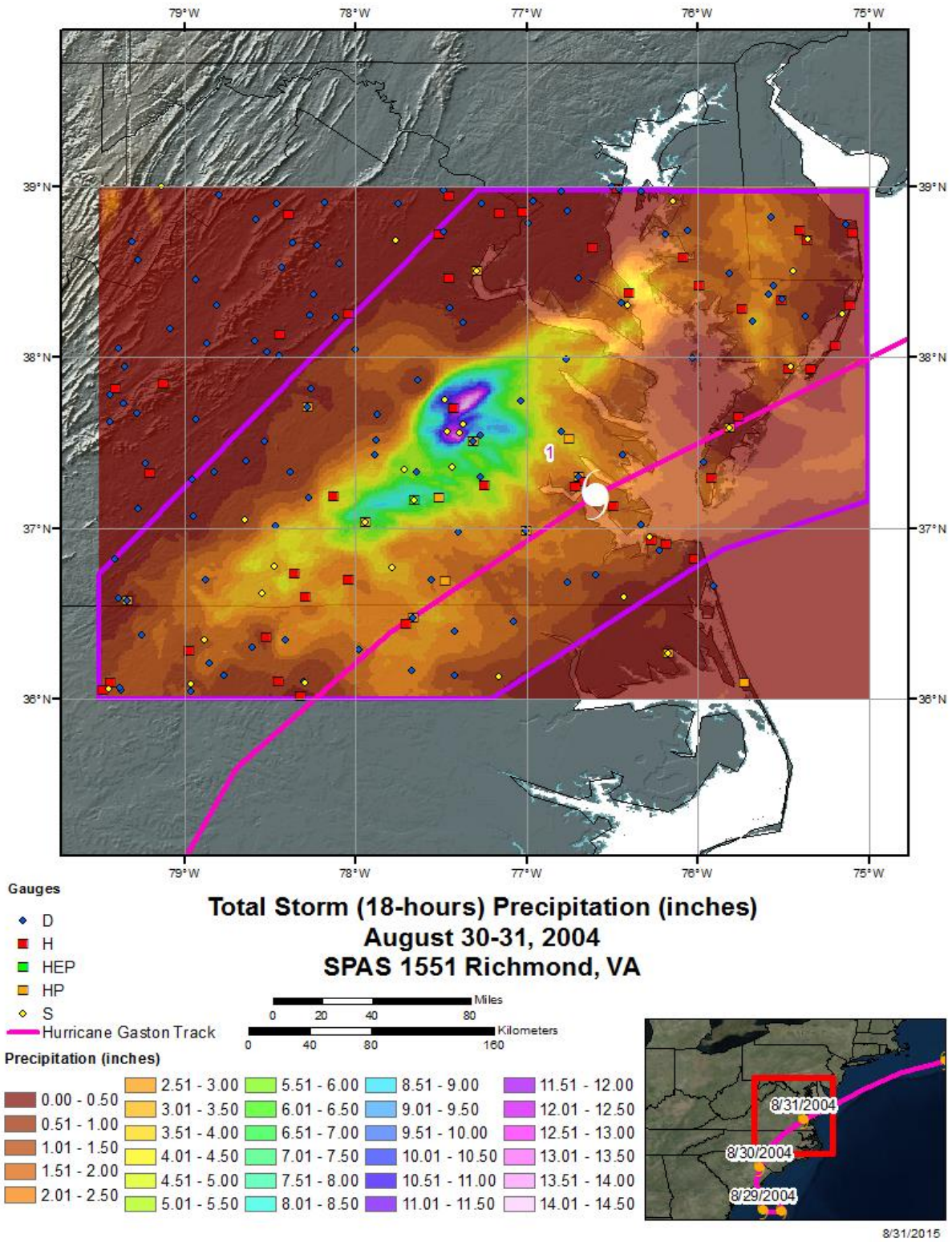
						Storm Rep. SST					Climatological Max. SST						
SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Trans Date	SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
1551_1	-77.3750	37.7050	182	200	15-Aug	81.00	3.77	0.06	84	3.710	82.50	82.5	4.03	0.06	87	3.970	1.070

Storm 1551 - August 30 (1400 UTC) - August 31 (0700 UTC), 2004									
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)									
Area (mi <sup>2</sup> )	Duration (hours)								
	1	2	3	4	5	6	12	18	Total
0.4	5.56	8.98	10.77	11.99	13.12	13.65	14.36	14.37	14.37
1	5.51	8.91	10.68	11.90	13.00	13.53	14.26	14.26	14.26
10	5.34	8.75	10.49	11.68	12.64	13.17	14.00	14.00	14.00
25	5.16	8.49	10.21	11.35	12.25	12.79	13.67	13.69	13.69
50	4.89	8.09	9.75	10.81	11.70	12.23	13.25	13.27	13.27
100	4.49	7.44	8.96	9.93	10.77	11.37	12.65	12.67	12.67
150	4.23	7.01	8.43	9.32	10.17	10.84	12.16	12.17	12.17
200	4.01	6.71	8.05	8.90	9.72	10.43	11.75	11.77	11.77
300	3.65	6.14	7.38	8.21	9.01	9.89	11.10	11.12	11.12
400	3.36	5.68	6.83	7.67	8.49	9.36	10.61	10.63	10.63
500	3.09	5.28	6.36	7.20	8.10	8.96	10.22	10.25	10.25
1,000	2.22	3.86	4.69	5.49	6.52	7.31	8.94	8.99	8.99
2,000	1.50	2.58	3.24	3.91	4.86	5.61	7.52	7.59	7.59
5,000	0.91	1.59	1.99	2.58	3.05	3.59	5.25	5.47	5.47
10,000	0.55	0.97	1.28	1.73	2.06	2.36	3.65	3.98	3.98
20,000	0.31	0.59	0.78	0.96	1.18	1.38	2.33	2.74	2.74
35,657	0.18	0.34	0.46	0.58	0.71	0.87	1.53	1.81	1.81

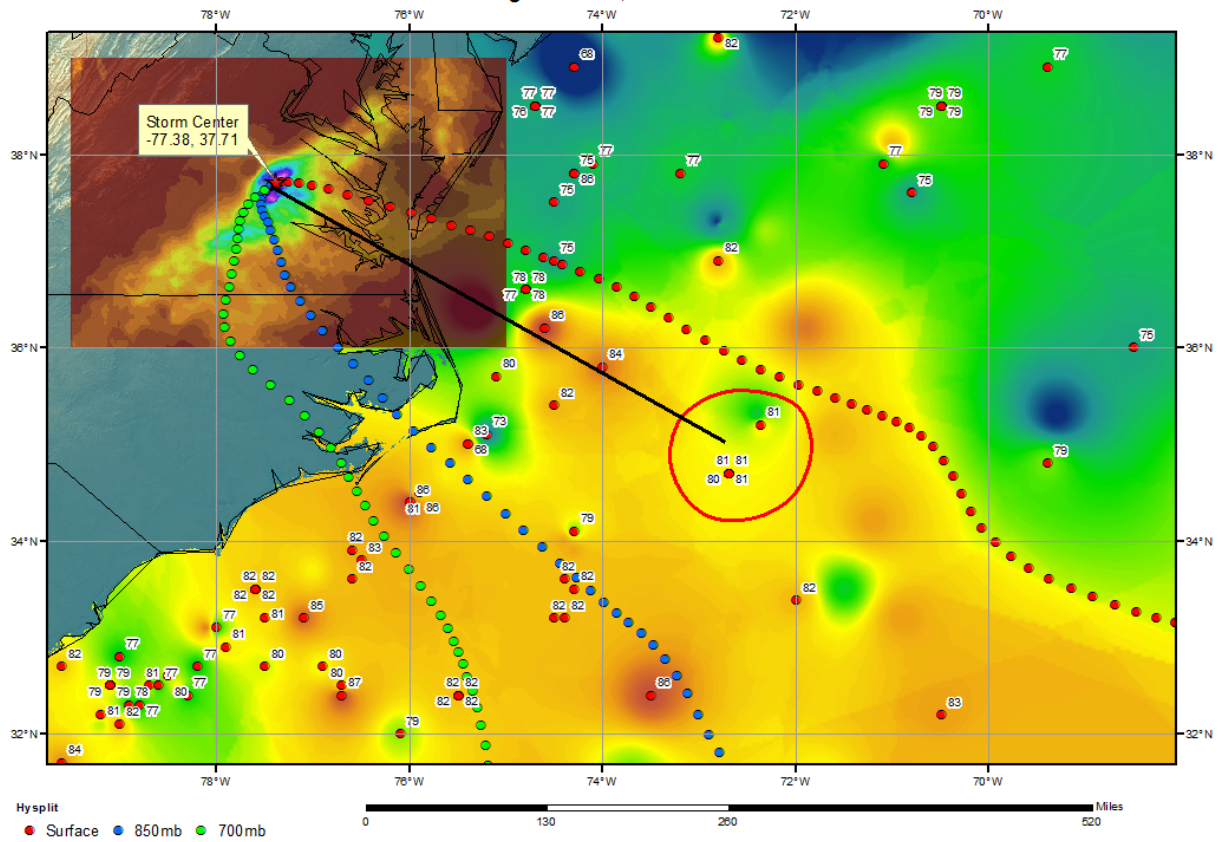








**SPAS 1551 Richmond, VA Storm Analysis**  
August 29-30, 2004



## Storm Precipitation Analysis System (SPAS) For Storm #1224\_1 SPAS-NEXRAD Analysis

**General Storm Location:** Maplecrest, NY-Northern New Jersey, southeastern New York, extreme eastern Pennsylvania, western Connecticut, western Massachusetts and southwestern Vermont.

**Storm Dates:** Aug. 27, 2011 12Z - Aug. 29, 2011 05Z (42-hours)

**Event:** Hurricane Irene

**DAD Zone 1 – Catskills and portions of south-western NY**

**Latitude:** 42.30

**Longitude:** -74.16

**Max. Grid Rainfall Amount:** 22.91"

**Max. Grid Rainfall Amount:** 10.96"

\* Note: The DAD zone 3 storm center is situated on the eastern boundary of the DAD zone and should be considered carefully given entire storm around the center was NOT analyzed.

**Number of Stations:** 797 (1 Daily\*\*, 228 Hourly, 0 Hourly Estimated, 0 Hourly Estimated Pseudo, 71 Hourly Pseudo, 493 Supplemental, and 4 Supplemental Estimated) \* Note: The DAD zone \*\* Note: Given the recentness of this storm event, daily data from our internal/NCDC-based database was not available.

**SPAS Version:** 9.0

**Basemap:** PRISM Mean (1971-2000) August precipitation

**Spatial resolution:** 36 seconds (~0.36 mi<sup>2</sup>)

**Radar Included:** Yes

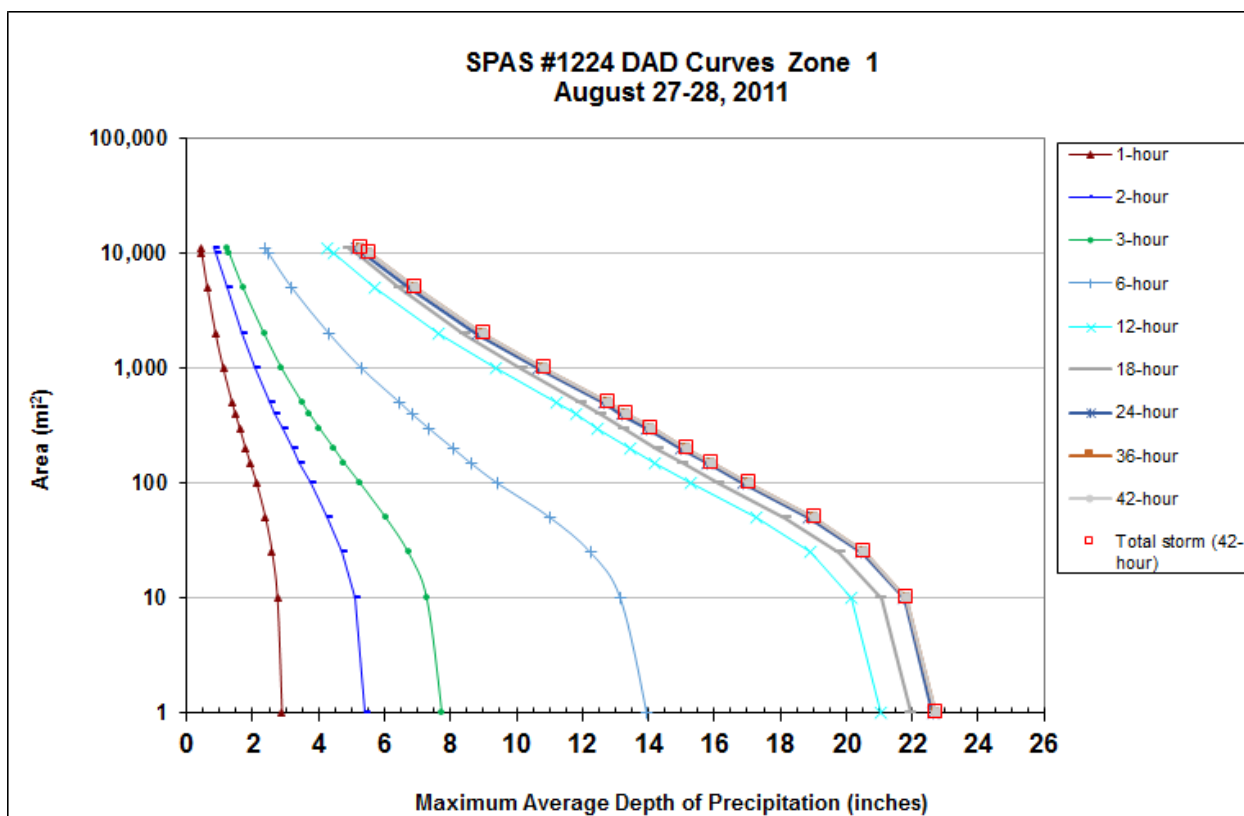
**Depth-Area-Duration (DAD) analysis:** Yes

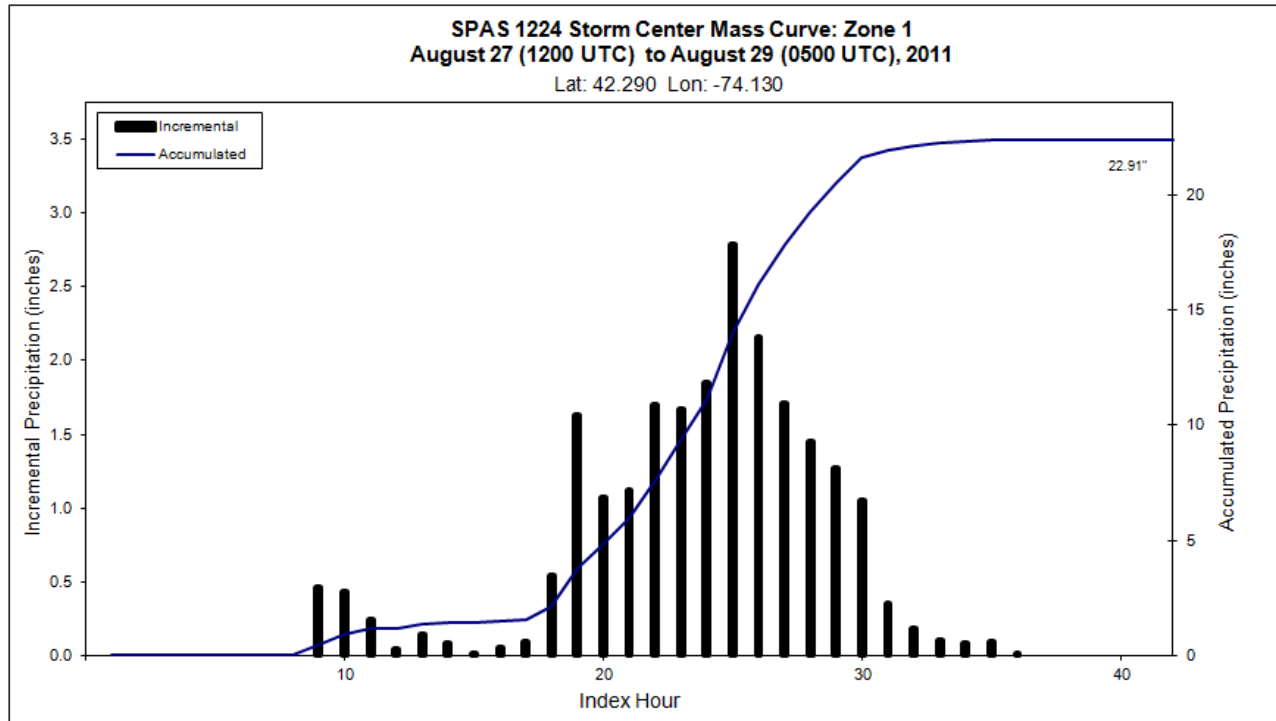
**Reliability of results:** Given the largely unblocked, clean and QC'd radar data coupled with extensive gauge data, we have a high degree of confidence in the results of this analysis.

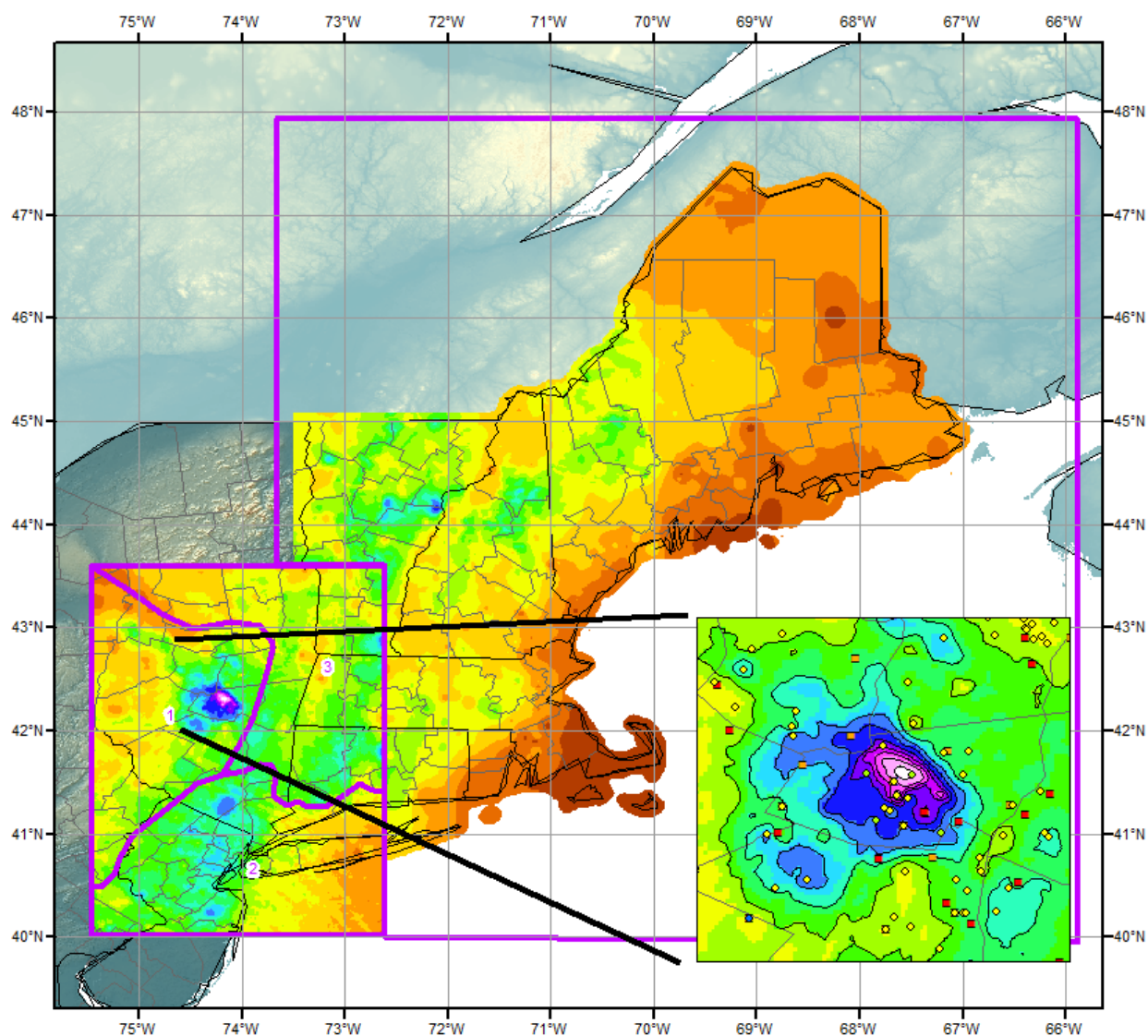
SPAS Storm ID	LON	LAT	ELEV_FT	ELEV Round	Trans Date	Storm Rep. SST					Climatological Max. SST					IPMF	
						SST	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	SST	SST Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column		Avail. Moisture
1224_1	-74.1600	42.3000	2,264	2,300	15-Aug	81.50	3.86	0.68	85	3.180	83.32	83.5	4.21	0.71	89	3.500	1.101



Storm 1224 - August 27 (1200 UTC) - August 29 (0500 UTC), 2011										
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)										
Area (mi <sup>2</sup> )	Duration (hours)									
	1	2	3	6	12	18	24	36	42	Total
0.4	2.92	5.44	7.84	14.11	21.24	22.14	22.79	22.89	22.89	22.89
1	2.89	5.39	7.74	13.96	21.05	21.96	22.63	22.72	22.72	22.72
10	2.75	5.09	7.28	13.16	20.14	21.06	21.76	21.84	21.84	21.84
25	2.59	4.71	6.72	12.25	18.89	19.79	20.46	20.57	20.57	20.57
50	2.39	4.27	6.04	11.03	17.26	18.15	18.88	19.05	19.05	19.05
100	2.12	3.75	5.26	9.43	15.27	16.14	16.90	17.07	17.07	17.07
150	1.93	3.43	4.78	8.61	14.18	15.03	15.76	15.93	15.93	15.93
200	1.79	3.21	4.47	8.08	13.46	14.29	15.00	15.17	15.17	15.17
300	1.61	2.91	4.03	7.34	12.46	13.25	13.94	14.10	14.10	14.10
400	1.48	2.69	3.73	6.83	11.80	12.56	13.20	13.36	13.36	13.36
500	1.38	2.52	3.51	6.47	11.19	11.98	12.66	12.82	12.82	12.82
1,000	1.11	2.06	2.88	5.30	9.37	10.17	10.68	10.86	10.86	10.86
2,000	0.88	1.67	2.35	4.31	7.66	8.42	8.83	9.01	9.01	9.01
5,000	0.63	1.21	1.71	3.18	5.70	6.47	6.77	6.95	6.95	6.95
10,000	0.46	0.89	1.29	2.47	4.46	5.17	5.40	5.57	5.57	5.57
11,085	0.44	0.85	1.23	2.36	4.26	4.93	5.14	5.29	5.30	5.30



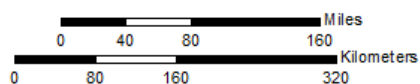




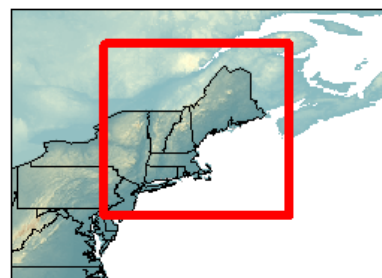
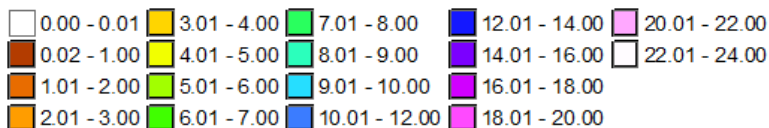
**Total Storm Precipitation**  
**Hurricane Irene August 27-29, 2011**  
**SPAS 1224**

**Gauges**

- ◆ Daily
- Hourly
- Hourly Pseudo
- ◆ Supplemental
- ◆ Supplemental Estimated

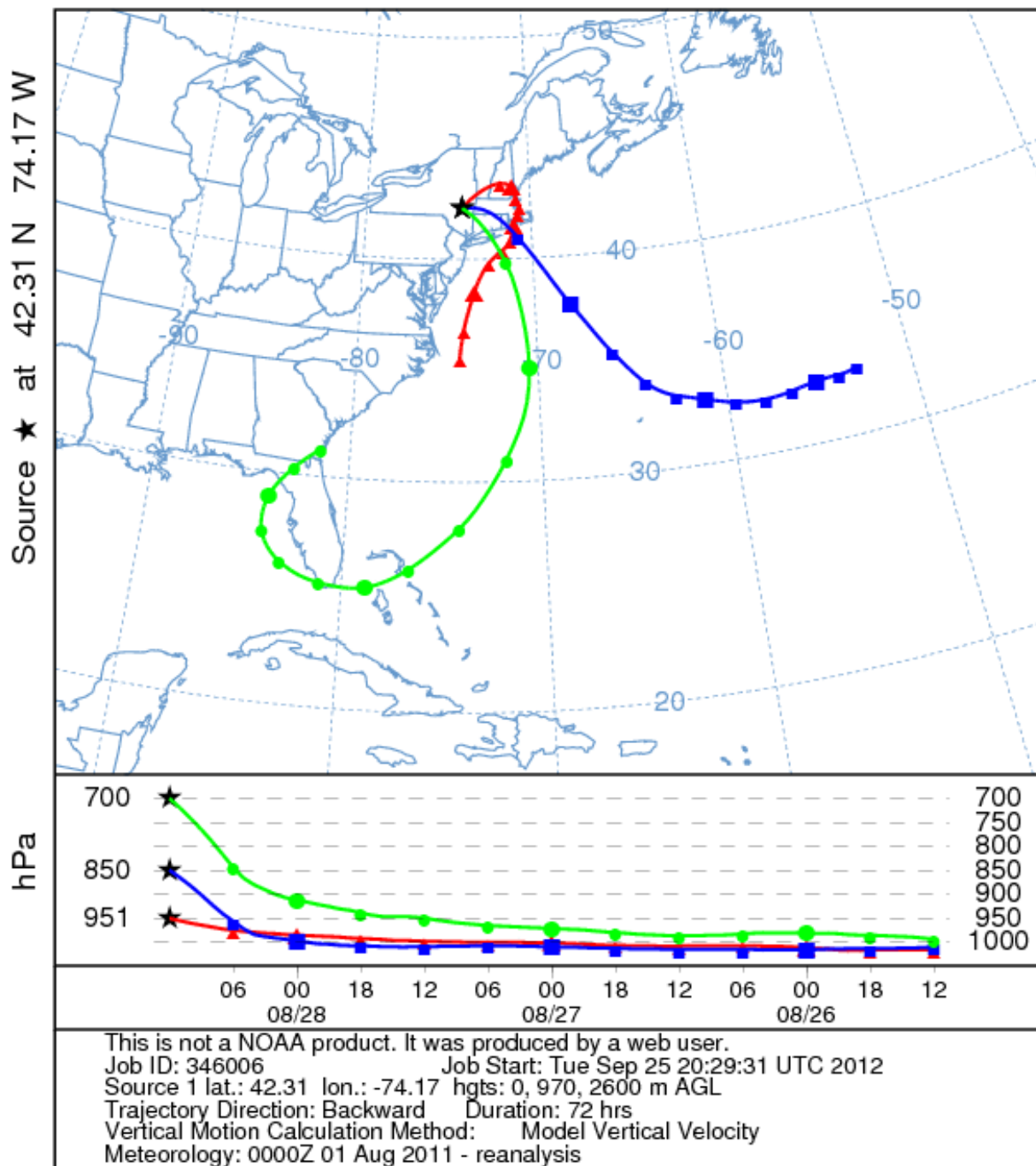


**Precipitation (inches)**



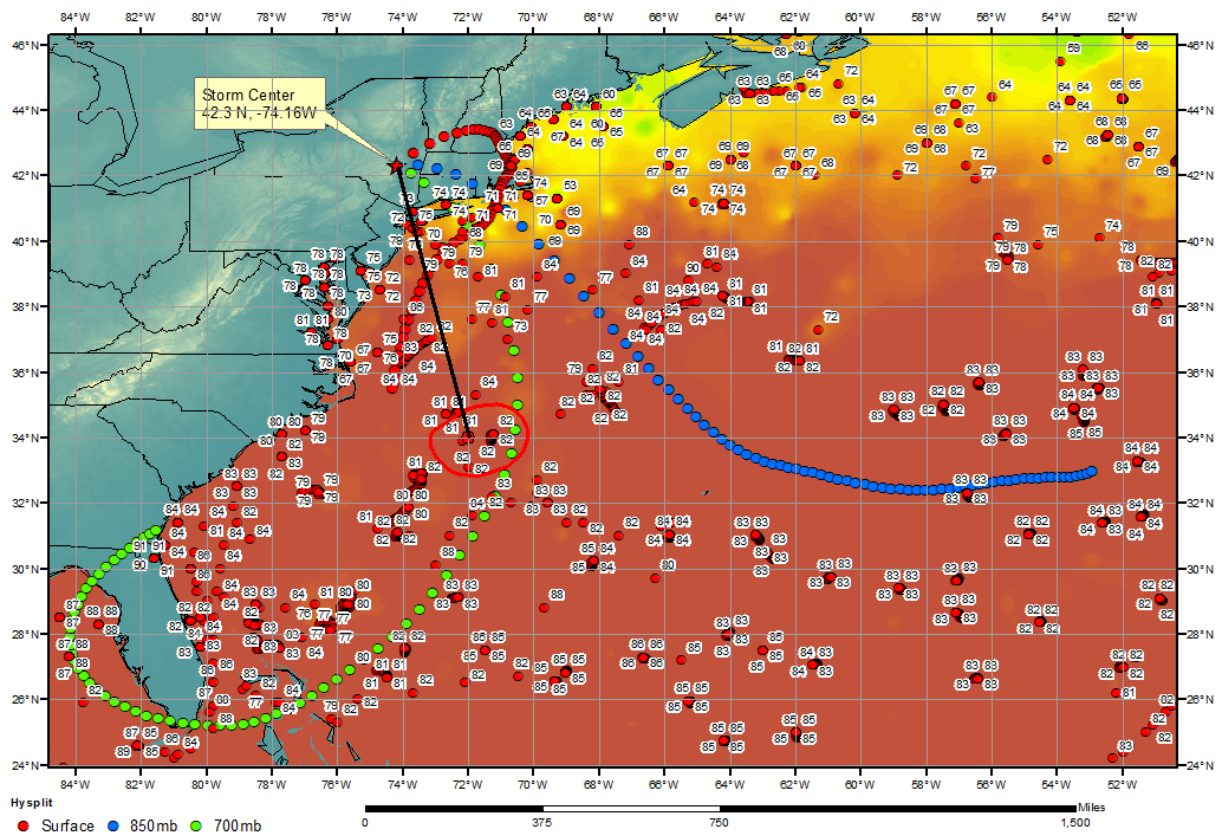
1/15/2013

NOAA HYSPLIT MODEL  
 Backward trajectories ending at 1200 UTC 28 Aug 11  
 CDC1 Meteorological Data





**SPAS 1224 Maplecrest, NY Hurricane Irene Storm Analysis**  
August 27, 2011



## Storm Precipitation Analysis System (SPAS) For Storm #1891\_1

### SPAS-NEXRAD Analysis

**Storm analysis domain:** 45.0,-83.0,36.0,-69.0  
**Storm dates:** August 30 – September 3, 2021  
**Event:** Hurricane Ida  
**SPAS version:** 10.0 (See Appendix A for a brief description of SPAS)  
**Base map used:** 90/10 weighted Radar vs. Basemap  
**Grid cell resolution (sqmi):** 0.3618  
**Radar included:** Yes  
**Number of stations:** 3316 stations

Gauge Type	Description	Abbr.*	No. of stations
Hourly	Hourly gauges with complete or nearly complete, incremental hourly precipitation data	H	311
Hourly estimated	Hourly gauges with some estimated hourly values, but otherwise reliable	HE	0
Hourly pseudo	Hourly gauges with reliable temporal precipitation data, but the magnitude is questionable in relation to co-located daily or supplemental gauges	HP	12
Hourly estimated pseudo	Combination of hourly estimated and hourly pseudo	HEP	3
Daily	Daily gauge with complete data and known observation times	D	2708
Daily estimated	Daily gauges with some or all estimated data	DE	0
Supplemental	Gauges with unknown or irregular observation times, but reliable precipitation data	S	281
Supplemental estimated	Gauges with estimated precipitation values based on other information such as radar, pre-existing total storm isohyetal maps or public storm reports	SE	1

#### Reliability of results:

This analysis was based on 3316 hourly stations, daily data and supplemental station data. We have a good degree of confidence for the station based storm total results. The spatial pattern is fully dependent on the radar grids, basemap and gauge stations. Timing is based on hourly and hourly pseudo stations. Several daily stations were moved to supplemental due to timing issues and to ensure data consistency.

#### Domain and Data:

SPAS storm number: 1891  
 Lat/Lon box: 45.0,-83.0,36.0,-69.0  
 Begin date: 8/30/2021 for hourly stations, 8/31/2021 for daily  
 End date: 9/3/2021

Number of hours (for hourly data): 120

Number of days (for daily data): 5

#### **RADAR:**

Begin date: 8/31/2021 1000 UTC – 9/2/2012 1300 UTC

Number of Radar hours: 52

#### **Results:**

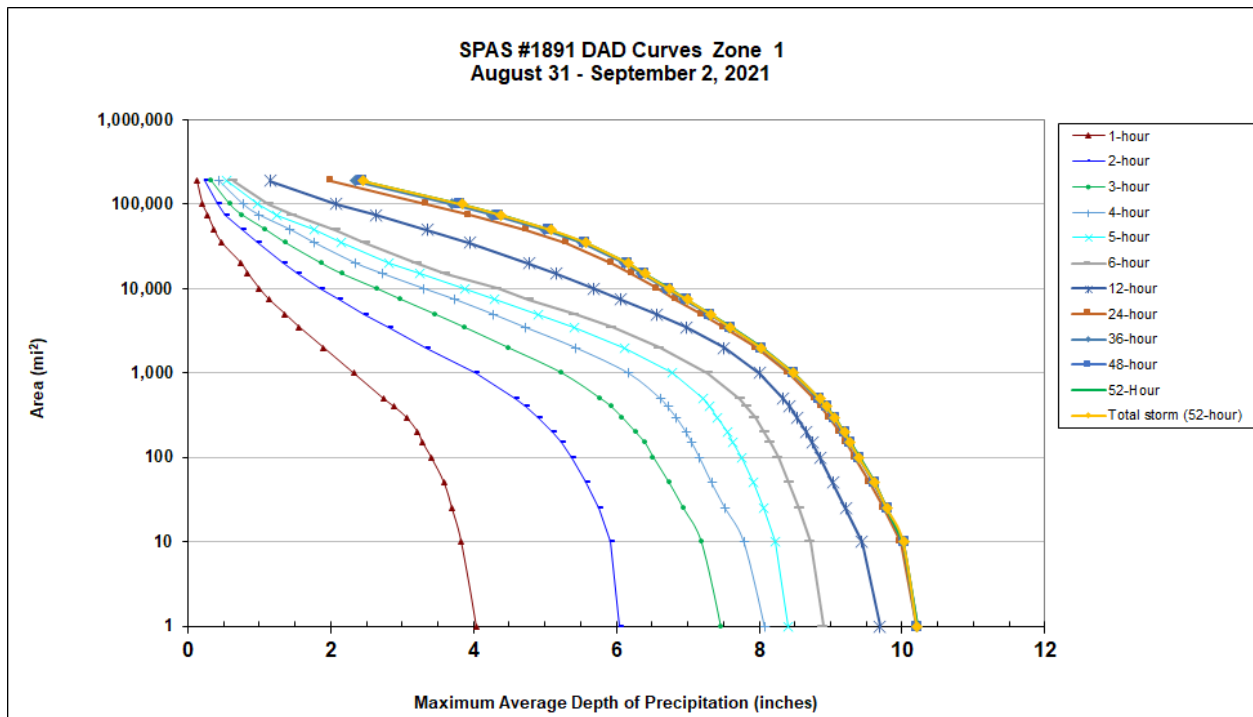
The results of this analysis are provided among several deliverables in separate files. Appendix B contains a list of deliverables associated with this analysis.

#### **Miscellaneous notes:**

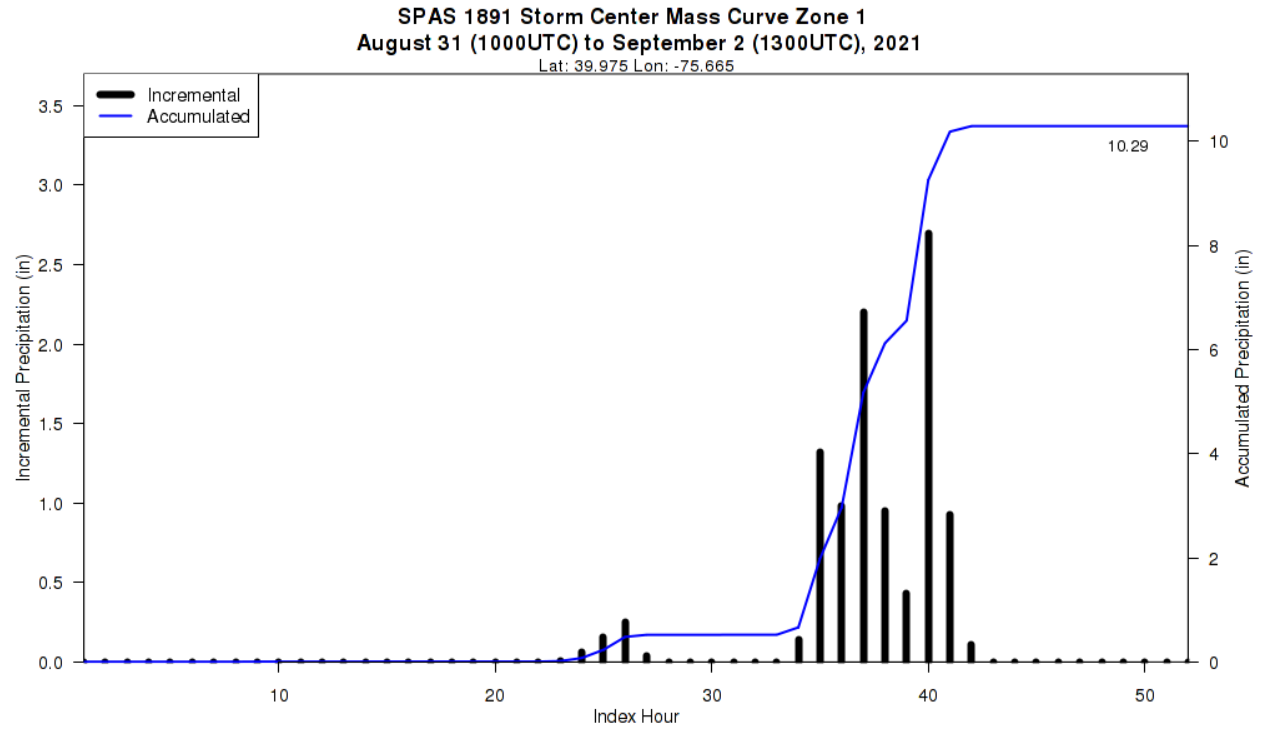
Radar grids provided good coverage for this analysis. However, there were a few small areas with noticeably high values that were obviously an artifact, so a beam blockage mask was created to correct those. Several stations showing up as outliers with significantly lower precip were removed across the whole domain. With the large amount of data, doing this did not have much impact on the overall total storm. A couple of hourly estimated pseudo stations were created through radar estimated values in places where hourly maximum intensities were in question. Doing so helped the maximum intensities be closer to actual observed intensities whether that be through the station data or articles found online.

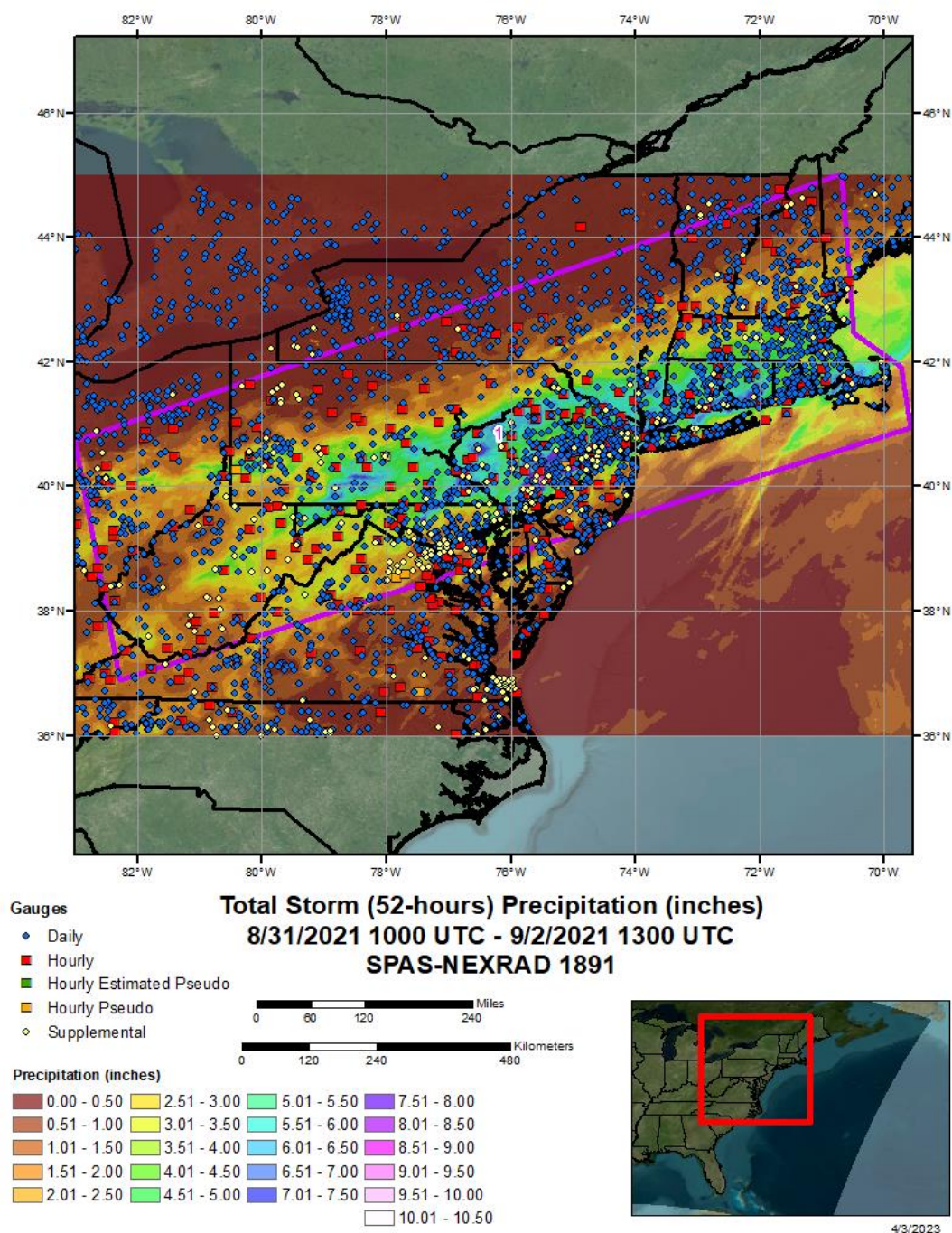
				Storm Rep. Dew Point					Climatological Max. Dew Point						
LAT	ELEV	ELEV Round	Trans Date	T <sub>d</sub>	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	T <sub>d</sub>	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
39.9750	258	300	18-Aug	78.00	3.29	0.08	78	3.210	80.00	80.0	3.60	0.09	82	3.510	1.093

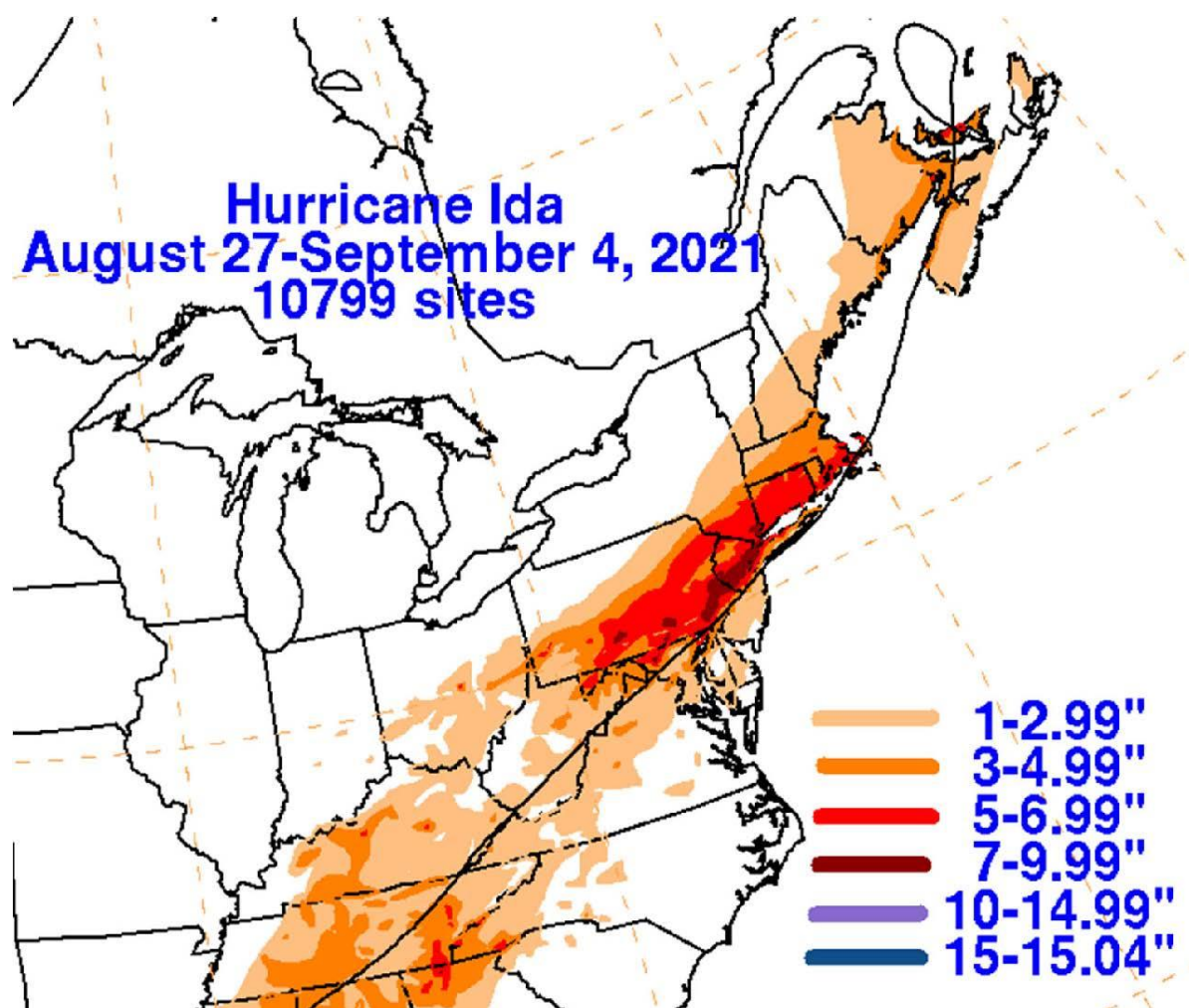
Storm 1891 - August 31 (1000 UTC) - September 2 (1300 UTC), 2021												
MAXIMUM AVERAGE DEPTH OF PRECIPITATION (INCHES)												
Area (mi <sup>2</sup> )	Duration (hours)											
	1	2	3	4	5	6	12	24	36	48	52	Total
0.4	4.08	6.08	7.52	8.16	8.46	8.97	9.76	10.27	10.28	10.28	10.28	10.28
1	4.04	6.04	7.46	8.08	8.40	8.90	9.69	10.20	10.20	10.21	10.21	10.21
10	3.83	5.92	7.19	7.79	8.23	8.72	9.44	9.98	10.02	10.02	10.02	10.02
25	3.70	5.75	6.94	7.53	8.06	8.56	9.21	9.74	9.78	9.79	9.79	9.79
50	3.59	5.57	6.74	7.34	7.91	8.42	9.03	9.55	9.60	9.62	9.62	9.62
100	3.41	5.37	6.52	7.17	7.75	8.27	8.85	9.34	9.38	9.40	9.40	9.40
150	3.29	5.23	6.40	7.06	7.63	8.16	8.74	9.22	9.26	9.28	9.28	9.28
200	3.22	5.11	6.27	6.98	7.56	8.08	8.66	9.13	9.18	9.19	9.19	9.19
300	3.06	4.90	6.08	6.84	7.42	7.94	8.53	8.98	9.03	9.05	9.06	9.06
400	2.89	4.73	5.93	6.72	7.30	7.82	8.43	8.87	8.92	8.94	8.94	8.94
500	2.74	4.59	5.78	6.62	7.21	7.73	8.34	8.78	8.83	8.84	8.85	8.85
1,000	2.32	4.03	5.24	6.17	6.79	7.28	8.00	8.41	8.47	8.48	8.48	8.48
2,000	1.90	3.33	4.49	5.43	6.12	6.61	7.51	7.96	8.02	8.03	8.03	8.03
3,500	1.56	2.81	3.87	4.72	5.41	5.94	6.98	7.50	7.58	7.60	7.60	7.60
5,000	1.36	2.47	3.46	4.27	4.90	5.42	6.56	7.19	7.29	7.30	7.32	7.32
7,500	1.13	2.12	2.98	3.73	4.30	4.78	6.07	6.83	6.95	6.98	6.99	6.99
10,000	1.00	1.86	2.65	3.31	3.87	4.33	5.68	6.57	6.69	6.73	6.74	6.74
15,000	0.84	1.53	2.16	2.73	3.24	3.61	5.16	6.22	6.35	6.39	6.40	6.40
20,000	0.74	1.33	1.87	2.35	2.82	3.22	4.78	5.94	6.12	6.16	6.17	6.17
35,000	0.47	0.97	1.37	1.77	2.15	2.49	3.95	5.30	5.52	5.56	5.58	5.58
50,000	0.36	0.76	1.09	1.43	1.77	2.07	3.35	4.74	5.00	5.06	5.08	5.08
75,000	0.27	0.53	0.76	0.99	1.24	1.47	2.63	3.94	4.26	4.35	4.38	4.38
100,000	0.20	0.41	0.59	0.77	0.98	1.13	2.08	3.34	3.70	3.81	3.84	3.84
189,402	0.12	0.23	0.33	0.43	0.54	0.64	1.15	2.01	2.34	2.43	2.45	2.45

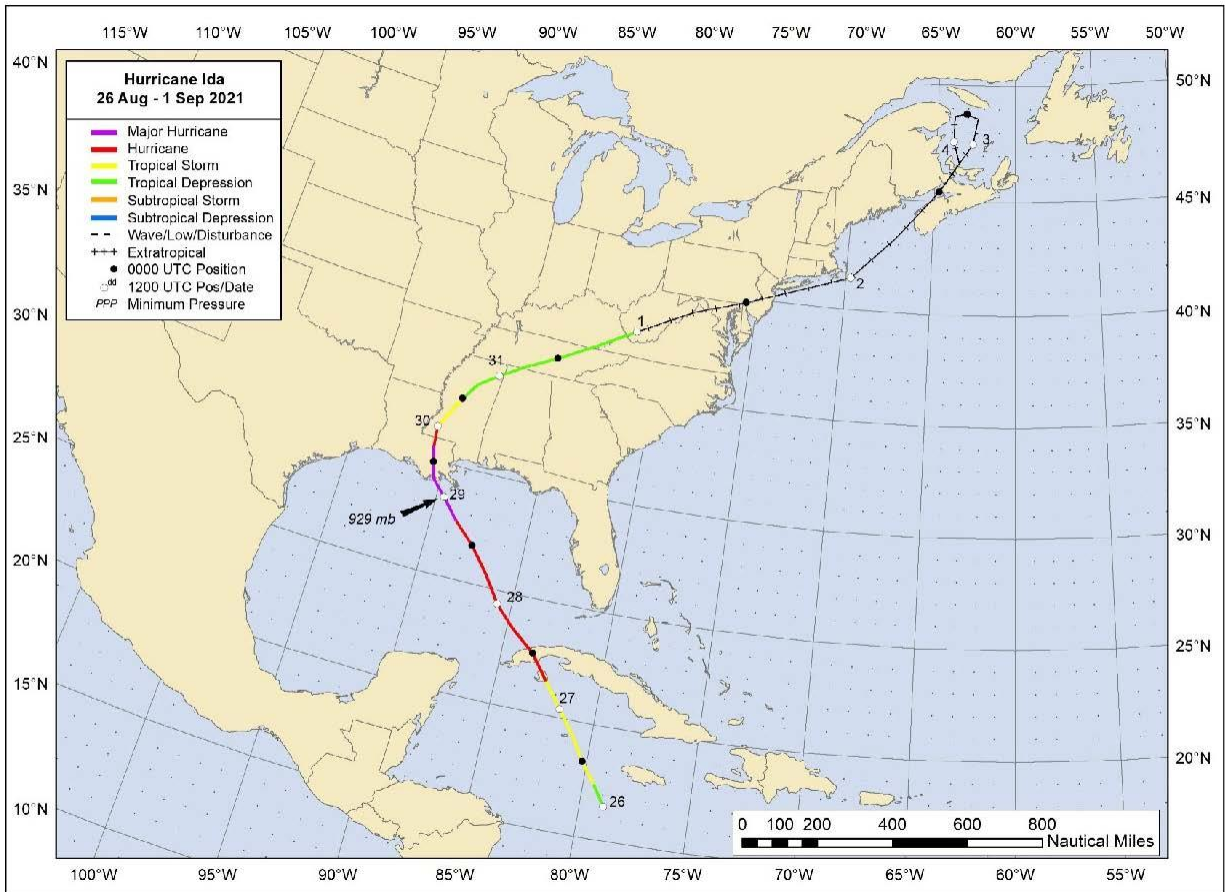






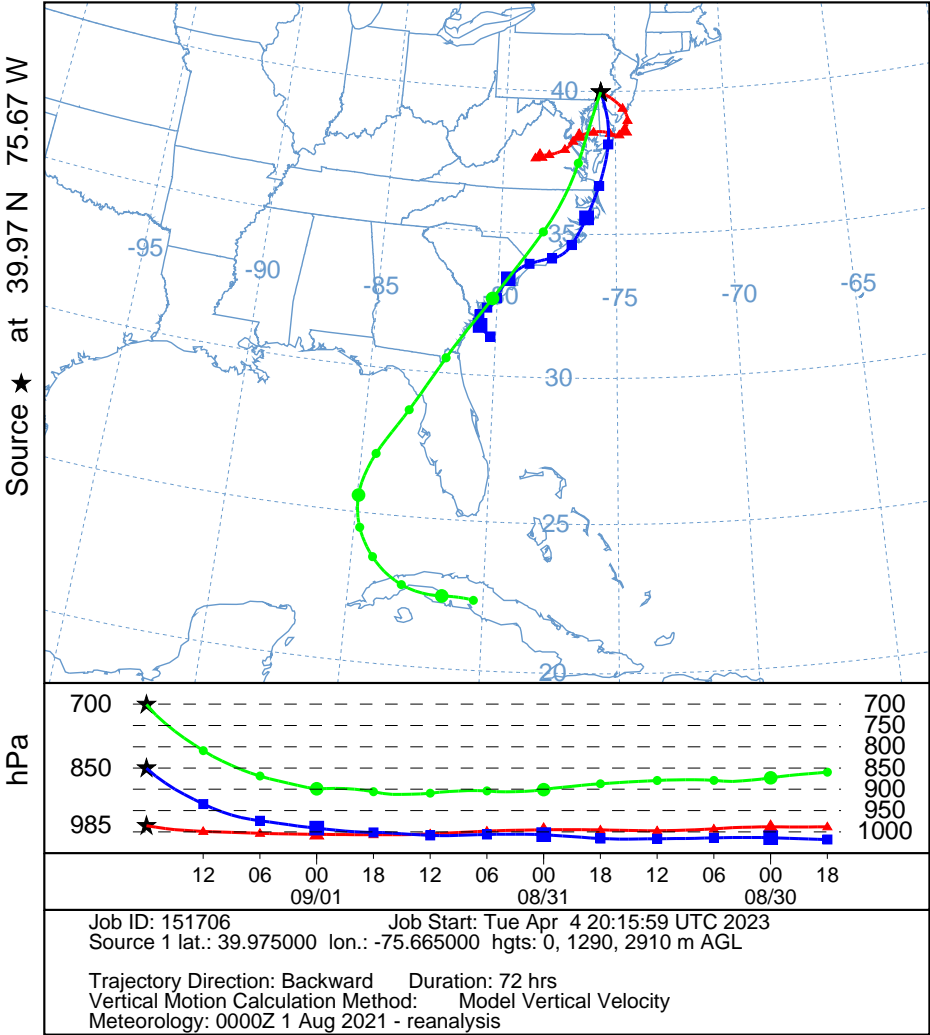








NOAA HYSPLIT MODEL  
Backward trajectories ending at 1800 UTC 01 Sep 21  
CDC1 Meteorological Data



**SPAS 1891 Downington, PA Dew Point Temperatures (F)**  
September 1, 2021

