GLOBAL WEATHER AND CLIMATE CONSULTING, LLC

TODD MORRIS

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EXPERT WITNESS REPORT OF TODD MORRIS
CERTIFIED CONSULTING METEOROLOGIST (CCM)

Enami
V.
State of Arizona

I-17 Incident
Rainfall Review
Aug 5, 2019

July 7, 2021

Date/Time of Incident:	Aug 5, 2019, at approximately 12:50 MST
Incident Location:	I-17 NB at MM 314 or 34.8434N/111.6035W
Prepared for:	Brandon Millam, Partner Doyle Law Group

Compensation for my services in this matter are $275.00 per hour for report writing and records review, consultations, and other non-testimony services; $400.00 per hour for examination, deposition, arbitration and/or trial testimony; $125.00 per hour for travel.

My CV is attached hereto for the use of the reader and includes my publications over the past 10 years as well as the cases in which I have testified at trial or at deposition over the past 4 years.

Assignment

I was tasked with reviewing the rainfall records for the specific date of Aug 5, 2019, at the incident location. This report summarizes that review and also places the rainfall event in a climate perspective.

Forensic weather investigations are similar to performing a storm survey or damage assessment, something I did on a regular basis as a meteorologist with the National Weather Service during my 34.5 years of service. This process follows a strict methodology of collecting information, evaluating the merit of that information, comparing that information to normal, analyzing the pertinent data, and finally drawing a conclusion.

Methodology

I began by collecting and evaluating pertinent weather records for the date given and surrounding the subject location. These records included:

- National Weather Service (NWS) certifiable surface weather observations for all known observations within a 10-mile radius for Aug 5, 2019, if any
- NWS certifiable cooperative weather data for Aug 5, 2019, if any
- NWS certifiable Storm Data (including local storm reports) for Aug 2019
- NWS certifiable Climatological Data (CD) publications for Aug 2019 plus the Annual CD for 2019
- NWS certifiable Daily Weather Maps (surface and aloft) for Aug 3-5, 2019
- NWS certifiable forecasts for the incident location including any watches, warnings, or advisories plus statements for Aug 3-5, 2019
- NWS certifiable WSR-88D Weather Radar data (base reflectivity and velocity data) for Aug 5, 2019
- NWS certifiable NOAA visible and infrared satellite imagery for Aug 5, 2019
- NWS certifiable Advanced Hydrologic Prediction Service (AHPS) observed precipitation for Aug 5, 2019
- Yavapai County Regional Flood Control District certifiable hourly/sub-hourly ALERT rainfall data for nearby stations for Aug 5, 2019
- Citizen Weather Observer Program (CWOP) surface weather observations for all known observations within a 10-mile radius for Aug 5, 2019
- Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) surface weather observations for all known observations within a 10-mile radius for Aug 5, 2019
- U.S. Drought Monitor data for Jan - Aug 2019

I also examined related video from network media as well as postings on social media such as Facebook and Twitter.

Background/Climatology

The incident location, located along I-17 in southern Coconino County at an elevation of 6470 ft MSL and just 23 miles from Flagstaff, enjoys a variety of weather throughout the year. This includes both cold winters and a mild pleasant summer. Located just below the Mogollon Rim and at the edge of the Colorado Plateau, the weather is more akin to Flagstaff, AZ than to the arid desert climate found further to the south. There are two separate rainfall seasons. The first occurs during the winter months from December through March when the region is subjected to transitory large scale weather systems, often originating from the Pacific Ocean. Nearly 47% of the annual precipitation (both rain and snow) occurs during this period[1].

The second rainfall season occurs during mainly July-September when Arizona is subjected to widespread yet sporadic thunderstorm activity whose moisture supply originates in the Gulf of Mexico, in the Pacific Ocean off the west coast of Mexico and in the Gulf of California[2]. More commonly called Monsoon Season, August is climatologically in the heart of the annual North American Monsoon[3][4] season in central/northern Arizona. Almost 30% of the annual precipitation (rainfall) received at the incident location occurs during this period[5].

Rainfall associated with monsoon thunderstorms can be very sporadic and short-lived with one location reporting an intense downpour for maybe 15-20 minutes and just 5 miles away it can be completely dry[6]. Primarily a rain-producing phenomena, capable of producing flash floods, monsoon thunderstorms are convective in nature and thus can be accompanied by strong and damaging winds, hail, dangerous lightning, and even occasional tornadoes.

On occasion, dissipating tropical weather systems from the eastern Pacific will bring substantial rainfall to the region, especially in October.

Figure 1 below provides the long-term climate monthly normal rainfall for this region and depicts the two distinct rainfall seasons.

[1] https://azclimate.asu.edu/files/2016/02/TM-273-Climate-of-Flagstaff.pdf
[2] https://azclimate.asu.edu/climate/climate-of-phoenix-summary/
[3] https://www.wrh.noaa.gov/twc/monsoon/monsoon_whatis.php
[4] https://www.wrh.noaa.gov/twc/monsoon/monsoon_NA.php
[5] https://xmacis.rcc-acis.org/
[6] https://climas.arizona.edu/sw-climate/monsoon

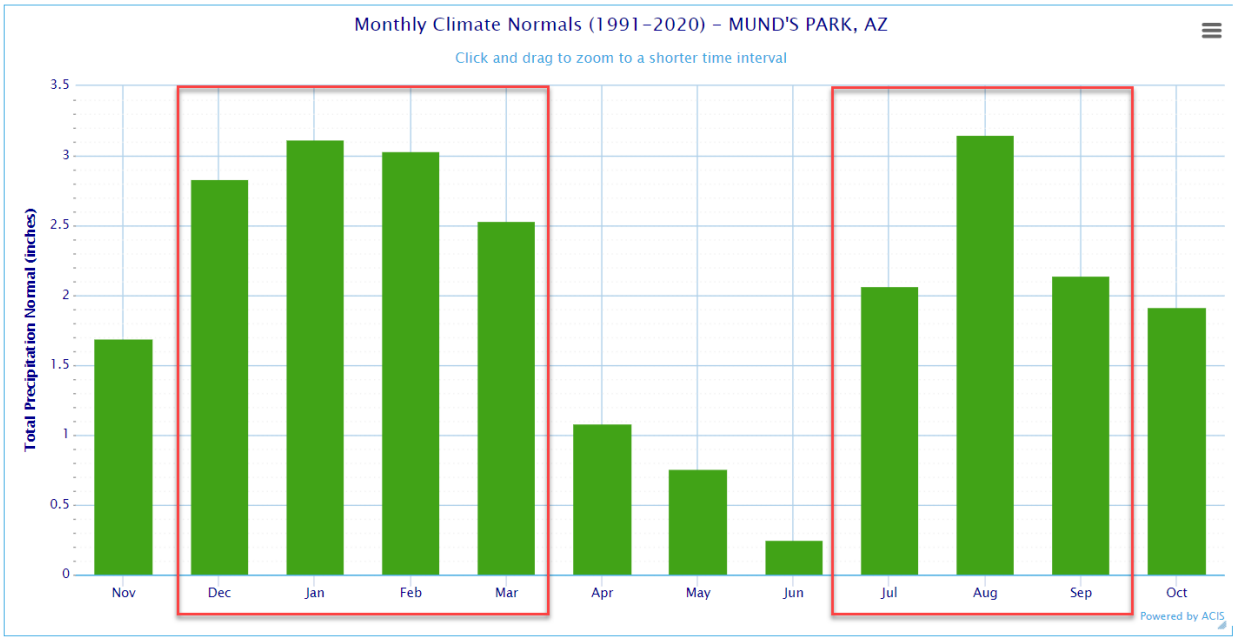

Figure 1 – Monthly Climate Normal Rainfall for Munds Park, AZ

For climate purposes, the long-term climate station in Munds Park, AZ was used given this station has the longest record of any active rain gauge in a 10-mile radius with a complete record dating from 1986 to 2017. The station itself is 6.7 miles north of the incident location and is located at the same elevation.

For my actual hourly rainfall analysis, several other rain gauges within a 10-mile radius were used. See both Table 1 and Fig. 2 for reference. The Bar M Canyon rain gauge, owned and operated by the U.S. Geological Survey (USGS), proved most useful given this station provides data at 15-min intervals and is located a mere 1.3 miles north of the incident location.

Metadata								
ID	Name	Type	Lat	Lon	Elev	Dist	Obs Time	Min Freq
	Incident Location		34.8434	-111.6035	6470	0		
BRMA3	Bar M Canyon near Woods Cyn	HADS	34.8614	-111.6053	6382	1.3N	NA	15 Min
YLBA3	Lee Butte	YFCD	34.8342	-111.5372	7378	3.8E	NA	10 Min
OMPA3	Munds Park	YFCD	34.9322	-111.6503	6447	6.7NW	NA	10 Min
YAPA3	Apache Maid	YFCD	34.7497	-111.5619	6320	6.9S	NA	10 Min
DW5827	Munds Park CWOP	CWOP	34.9448	-111.6333	6637	7.2N	NA	10 Min
OCPA3	Coyote Park	YFCD	34.9761	-111.6367	6960	9.3N	NA	10 Min
HAPA3	Happy Jack Ranger Station	HADS	34.7425	-111.4094	7504	13.1SE	NA	15 Min

NOTES
CWOP = Citizen Weather Observer Program
YFCD = Yavapai Flood Control District ALERT
HADS = Hydrometeorological Automated Data System

Table 1 – Metadata for Rain Gauges Used in Analysis

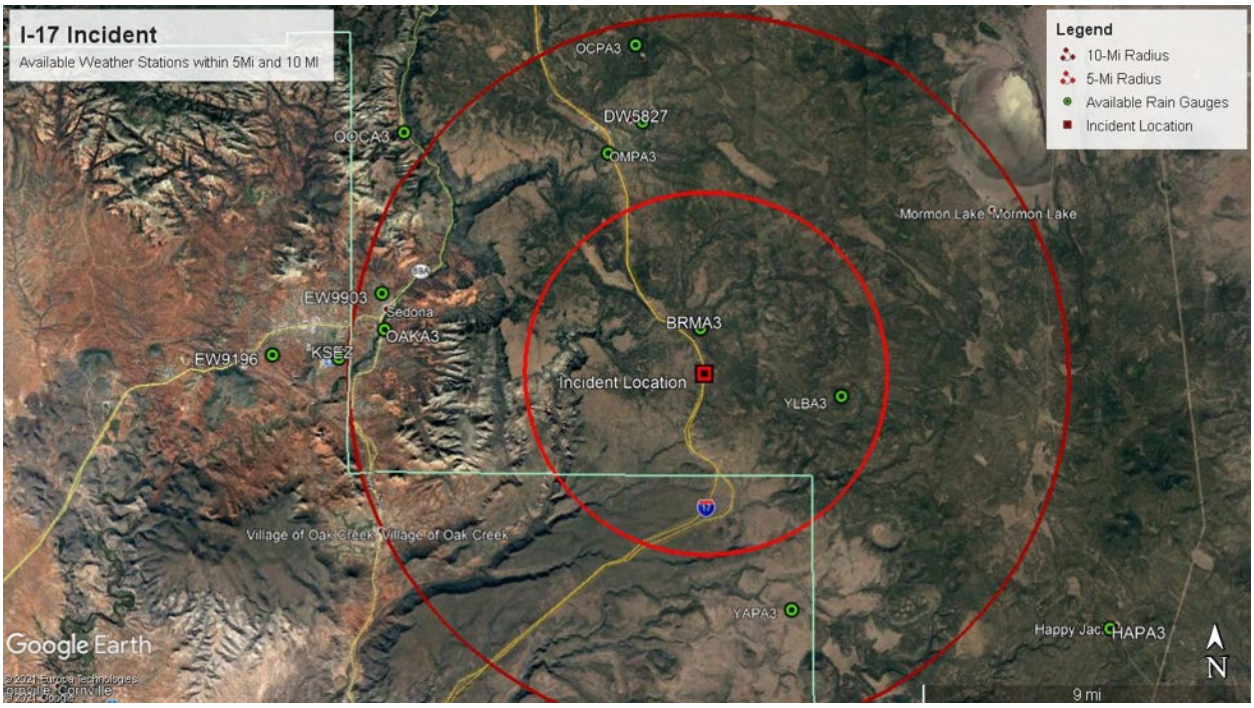

Figure 2 – Mapped Rain Gauges Used in Analysis

Analysis

Weather in the southwest is highly influenced by the position and strength of a dome of warm high-pressure in the upper levels of the atmosphere during the monsoon months. Small movements or relocations of this high-pressure center can mean the difference between a day ripe for thunderstorms and a day of hot dry sunshine. In addition, the amount and distribution of low-level moisture across the desert southwest is the other factor important for general thunderstorm development. In the non-monsoon months, rain versus no rain is highly predicated on the existence and strength of passing weather systems.

Prior to Aug 5, 2019, much of Arizona including the incident location had seen well below normal rainfall during the summer monsoon months. This was true not only for the early part of the 2019 summer monsoon season but also the 2018 summer monsoon season as a whole. Thus, when a return to a more normal summer monsoon pattern was advertised by weather computer models, the National Weather Service in Flagstaff, AZ, that serves the incident location, was quick to begin getting the message out to the public and the media. See Fig. 3 below.

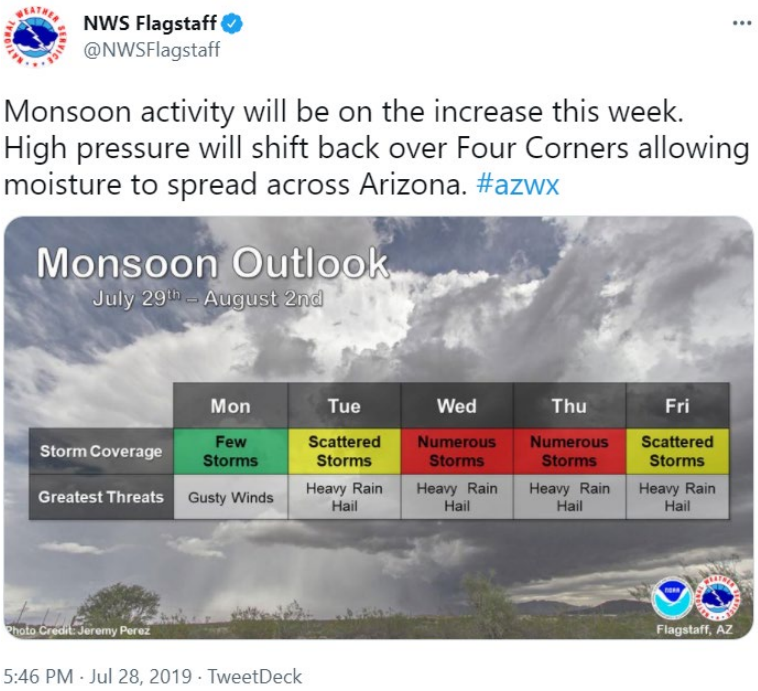

Figure 3 – NWS Messaging on Twitter – 5:46 PM MST 28 Jul 2019

This social media messaging by the NWS in Flagstaff, AZ continued well into the first few days of August 2019. Figure 4 is the social media messaging issued by the NWS in Flagstaff, AZ on the morning of Aug 5, 2019. It clearly addresses the monsoon thunderstorm threats, including the possibility of locally heavy rains.

Figure 4 – NWS Messaging on Twitter – 6:08 AM MST 5 Aug 2019

Weather maps from the NWS's Weather Prediction Center[7] (WPC) set the stage for the weather activities for the day. The upper atmosphere weather map on the morning of Aug 5, 2019, showed the upper level high-pressure centered over eastern Arizona. See Fig. 5(L). At the surface, a weak low-pressure system was centered near Blyth, California with a weak surface front extending eastward from the low to near Phoenix, Arizona. See Fig. 5(R). It would be along and just north of this weak surface front where sufficient moisture existed for thunderstorm development later in the day.

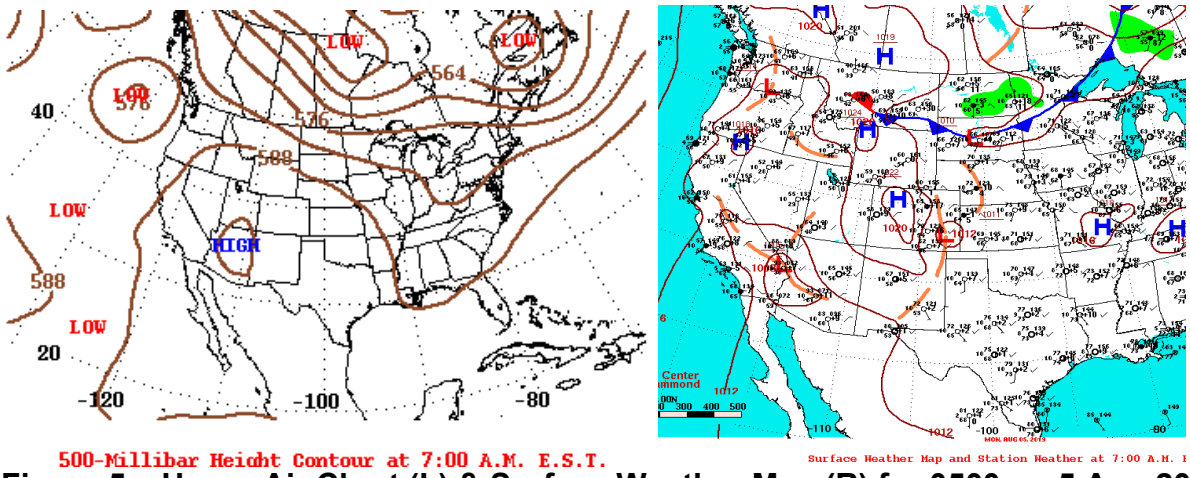

Figure 5 – Upper Air Chart (L) & Surface Weather Map (R) for 0500 on 5 Aug 2019

Satellite imagery from the National Environmental Satellite Data and Information Service[8] (NESDIS) on the morning of Aug 5, 2019, showed considerable convective clouds already widespread across north-central Arizona from west of Flagstaff to east of Payson. See Fig. 6.

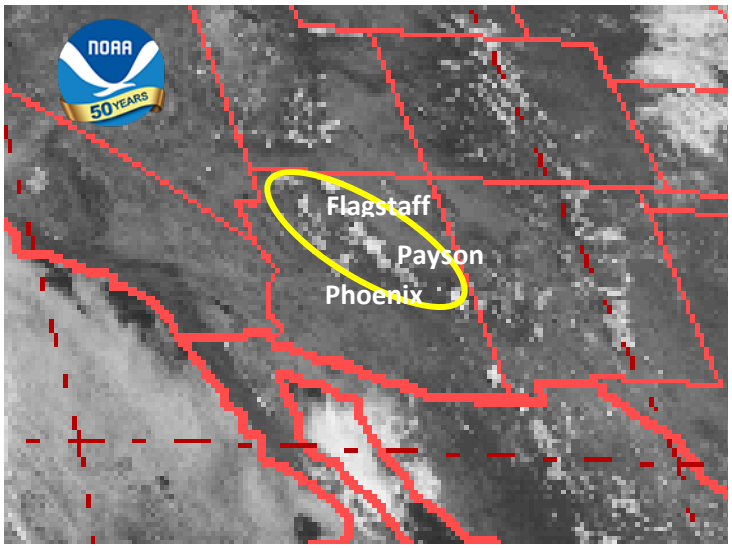

Figure 6 – Visible Satellite Imagery for 11:00 AM MST on 5 Aug 2019

[7] https://www.wpc.ncep.noaa.gov
[8] https://www.nesdis.noaa.gov

Showers and thunderstorms began developing shortly before 11:30 am, both southeast and northwest of the incident location. This coincided nicely with the position of the previously mentioned weak surface front. See Fig. 7 (Yellow dot depicts incident location).

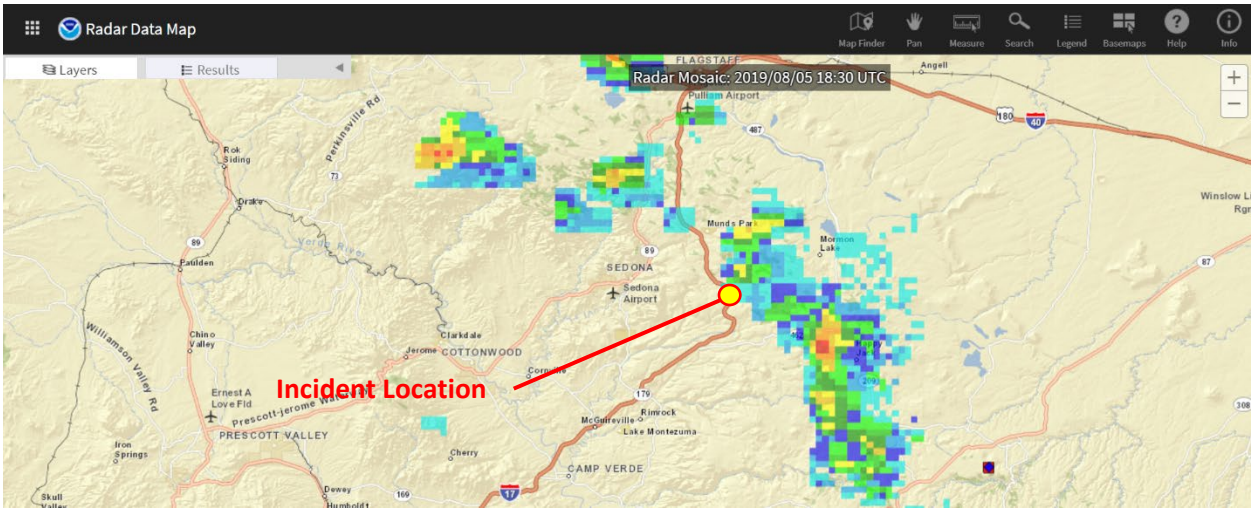

Figure 7 – NWS WSR-88D Radar Image for 11:30 AM MST on 5 Aug 2019

The storm motion with these developing storms was reported as moving very slowly to the north at less than 10 mph. At this time, radar indicated that light rain would be falling at the incident location.

By 12:05 pm, radar showed a much stronger thunderstorm with embedded heavy rain approaching the incident location from the southeast. See Fig. 8. This storm was likely producing moderate to heavy rain as it slowly passed over the incident location during the subsequent 20 minutes.

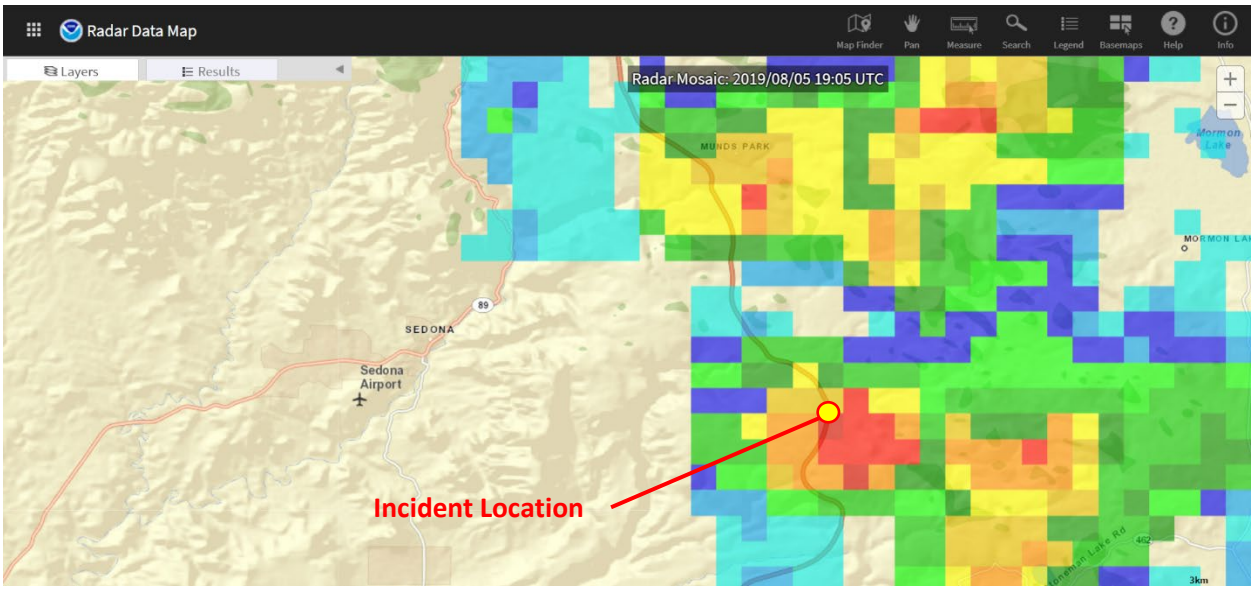

Figure 8 – NWS WSR-88D Radar Image for 12:05 PM MST on 5 Aug 2019

The NWS in Flagstaff, Arizona quickly and accurately identified this developing storm and issued a Significant Weather Advisory for the incident location at 12:14 pm MST. This advisory was issued to the public and also received by local and national media. It also was transmitted on Twitter. See Fig. 9. Advisories are designed to notify the public and emergency officials of the possibility of hazardous weather such as winds in excess of 40 mph, penny size hail, and heavy rainfall associated with strong thunderstorms.

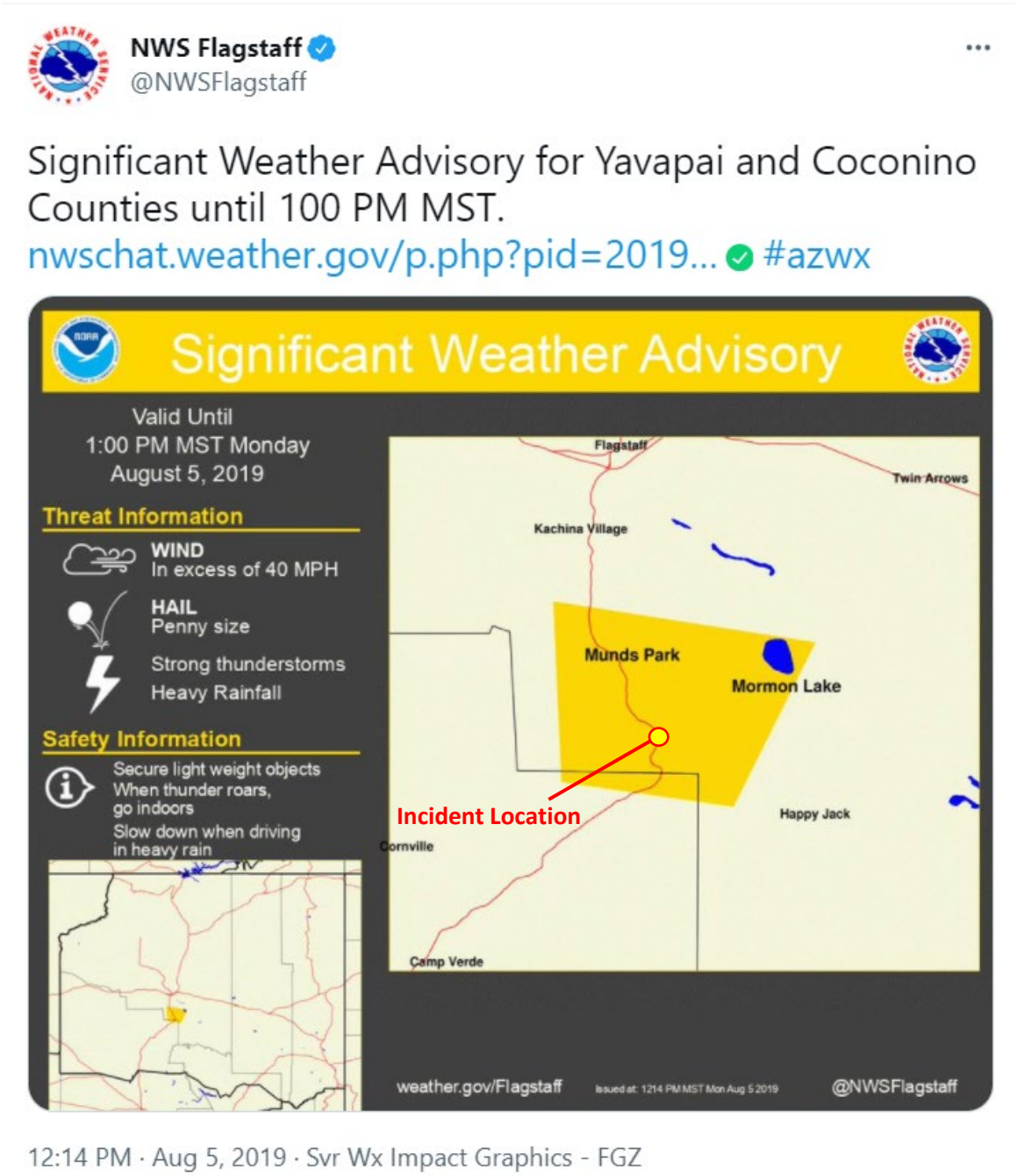

Figure 9 – NWS Messaging on Twitter – 12:14 PM MST 5 Aug 2019

Over the next 20-30 minutes, this thunderstorm slowly moved over the incident location, accompanied by moderate to heavy rainfall. See Fig.10.

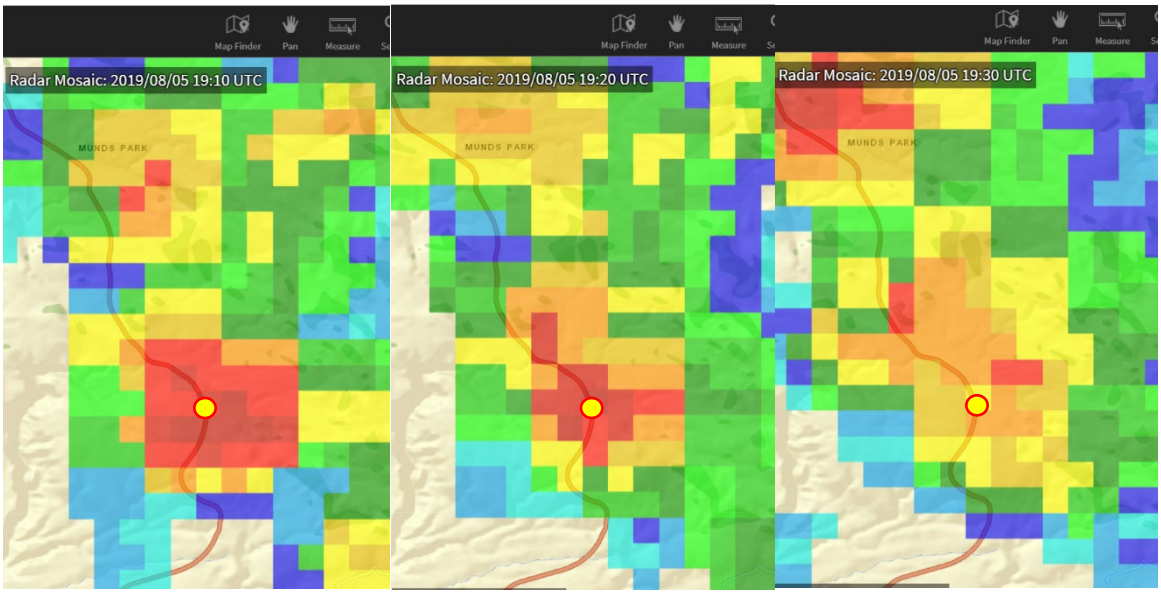

Figure 10 – NWS WSR-88D Radar Images for 12:10-12:30 PM MST on 5 Aug 2019

The NWS 1-Day Quantitative Precipitation Estimate (QPE)[9] for Aug 5, 2019, can be seen in Fig. 11. This QPE image is a multi-sensor approach to estimating how much rain fell at each location and combines radar estimates, actual ground rainfall gauge reports, and satellite precipitation estimates[10]. Identified in this figure is the incident location as well as the closest reliable operational rain gauge – Bar M Canyon a mere 1.3 miles to the north.

For the 24-hour period ending at 7:00 am MST on Aug 6, 2019, the QPE was between 0.25-0.50” of rainfall at the incident location. For the nearby Bar M Canyon gauge, the QPE was closer to 0.75” of rainfall.

[9] https://water.weather.gov/precip/index.php
[10] https://water.weather.gov/precip/about.php

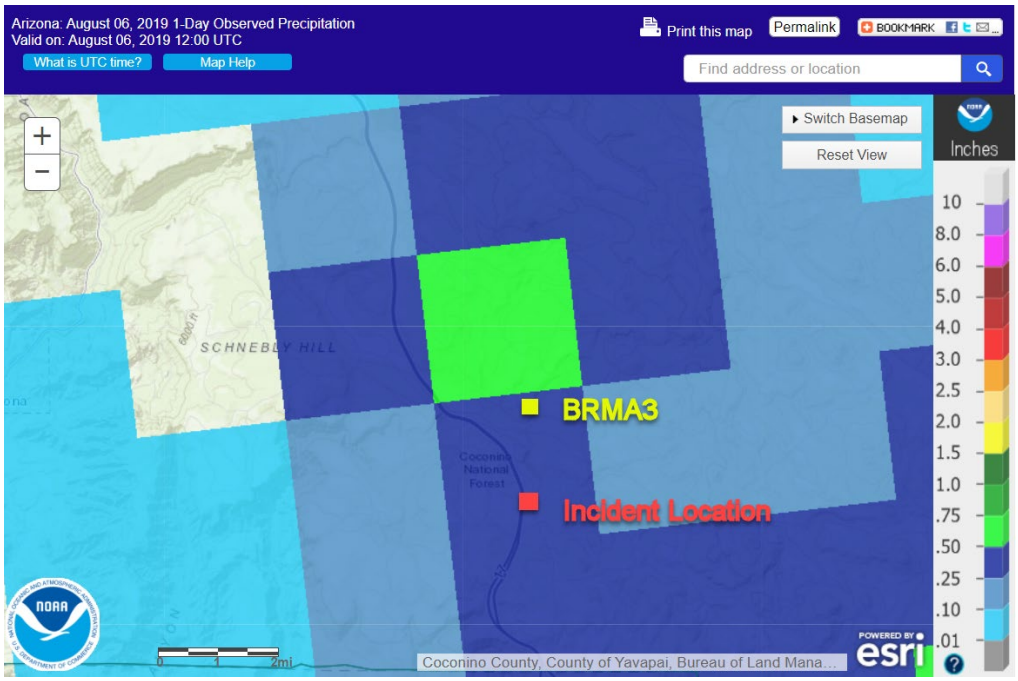

Figure 11 – NWS 1-Day Quantitative Precipitation Estimate for 5 Aug 2019

Table 2 provides the 3-day rainfall totals for the stations identified in Table 1 above. Values in green in Table 2 depict a daily rainfall total at or above 0.50 inches. This is a good example of the nature of summer monsoon thunderstorms. Rainfall can fall in one location and a mere 5 miles away; it can be completely dry. It is worth noting here that the actual measured daily rainfall at the Bar M Canyon gauge, corresponds very closely to the 1-day QPE for that location found in Fig. 11. This should give the reader confidence in the amount estimated for the incident location where no actual ground measuring gauge existed.

I-17 Incident Daily Rainfall				
Station Name	8/3/2019	8/4/2019	8/5/2019	3-Day Total
Bar M Canyon near Woods Cyn	0.00	0.00	0.76	0.76
Lee Butte	0.24	0.00	0.04	0.28
Munds Park	0.00	0.00	0.12	0.12
Apache Maid	0.12	0.00	0.00	0.12
Munds Park CWOP	0.13	0.03	0.35	0.51
Coyote Park	0.04	0.19	0.20	0.43
Happy Jack Ranger Station	0.02	0.00	0.39	0.41

Table 2 – Daily Rainfall for Rain Gauges Used in Analysis

Table 3 provides the observed hourly rainfall totals for the stations identified in Table 1 above. The hourly data in this table clearly shows that the weather event was short-lived and limited to just one hour between 12 noon and 1:00 pm MST. Again, this is the nature of summer monsoon thunderstorms; short and intense bursts of rain, followed by dry conditions.

I-17 Incident Hourly Rainfall																								
Station Name	8/5/2019																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Bar M Canyon near Woods Cyn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lee Butte	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Munds Park	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apache Maid	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Munds Park CWOP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coyote Park	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Happy Jack Ranger Station	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:

Values in Green are at/above 0.25 inches

Values in Blue are at/above 0.50 inches

Table 3 – Observed Hourly Rainfall Totals – 5 Aug 2019

One might ask how common is it for this amount of rain to fall in one hour in this location? The National Oceanic and Atmospheric Administration (NOAA), the parent agency for the NWS, provides point precipitation frequency estimates with 90% confidence.[11] Table 4 below is the point precipitation frequency estimate for the incident location. It shows for 0.76" of rainfall in a period of 1 hour, a recurrence interval of once every year.

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION

NOAA Atlas 14, Volume 1, Version 5

PF tabular | PF graphical | Supplementary information | Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.264** (0.226-0.310)	**0.342** (0.292-0.400)	**0.460** (0.391-0.536)	**0.555** (0.470-0.646)	**0.688** (0.580-0.799)	**0.797** (0.667-0.925)	**0.914** (0.757-1.06)	**1.04** (0.850-1.21)	**1.22** (0.980-1.43)	**1.38** (1.09-1.63)
10-min	**0.402** (0.344-0.471)	**0.521** (0.444-0.608)	**0.699** (0.595-0.816)	**0.845** (0.716-0.983)	**1.05** (0.882-1.22)	**1.21** (1.01-1.41)	**1.39** (1.15-1.62)	**1.58** (1.29-1.84)	**1.86** (1.49-2.18)	**2.09** (1.65-2.47)
15-min	**0.499** (0.427-0.584)	**0.645** (0.551-0.754)	**0.867** (0.738-1.01)	**1.05** (0.887-1.22)	**1.30** (1.09-1.51)	**1.50** (1.26-1.75)	**1.72** (1.43-2.00)	**1.96** (1.60-2.28)	**2.30** (1.85-2.70)	**2.59** (2.05-3.07)
30-min	**0.671** (0.574-0.787)	**0.869** (0.742-1.01)	**1.17** (0.994-1.36)	**1.41** (1.20-1.64)	**1.75** (1.47-2.03)	**2.03** (1.69-2.35)	**2.32** (1.92-2.70)	**2.64** (2.16-3.07)	**3.10** (2.49-3.63)	**3.49** (2.76-4.13)
60-min	**0.831** (0.711-0.974)	**1.08** (0.918-1.26)	**1.45** (1.23-1.69)	**1.75** (1.48-2.03)	**2.17** (1.82-2.51)	**2.51** (2.10-2.91)	**2.87** (2.38-3.34)	**3.27** (2.67-3.80)	**3.84** (3.08-4.50)	**4.32** (3.42-5.11)
2-hr	**0.968** (0.847-1.11)	**1.23** (1.07-1.41)	**1.62** (1.41-1.86)	**1.94** (1.68-2.22)	**2.40** (2.06-2.75)	**2.78** (2.37-3.18)	**3.19** (2.69-3.66)	**3.64** (3.03-4.17)	**4.29** (3.50-4.94)	**4.84** (3.87-5.58)
3-hr	**1.06** (0.939-1.21)	**1.34** (1.19-1.53)	**1.71** (1.51-1.95)	**2.03** (1.79-2.31)	**2.49** (2.17-2.83)	**2.87** (2.48-3.26)	**3.29** (2.81-3.73)	**3.74** (3.16-4.26)	**4.39** (3.64-5.03)	**4.93** (4.02-5.69)

Table 4 – NOAA-Atlas 14 Point Precipitation Frequency Estimates for the Incident Location

[11] https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=pa

Conclusions/Opinions

Based upon the provided data and after reviewing all the information, it is my professional opinion that:

1. August 5, 2019 was a typical summer monsoon day in north-central Arizona.
2. The weather event that transpired was identified and well-advertised by the NWS several days in advance.
3. The storms on this day were sporadic in nature and slow moving.
4. One such sporadic and slow-moving monsoon storm moved over the incident location during the 12 noon to 1:00 pm MST time period.
5. Rainfall estimates at the incident location during this 1-hour were between 0.25-0.50".
6. Nearby estimates/observed totals were as high as 0.76" of rainfall.
7. This amount of rainfall in one hour is not excessive or abnormal for this location or this time of year and statistically happens at least once per year, if not multiple times per year.

Certification

I certify that the above information contained in this report is true and accurate to the best of my ability and that all analysis and findings expressed in this report were made with accuracy as a professional meteorologist within a reasonable degree of meteorological certainty.

Todd Morris

Todd Morris, CCM
Global Weather and Climate Consulting, LLC

EXPERT QUALIFICATIONS

Professional Experience

President at Global Weather and Climate Consulting LLC

November 2013 – Present (7.5 years)

AMS Certified Consulting Meteorologist (CCM) providing expert witness testimony at trial and depositions as a subject matter expert (SME) on weather, water, marine & climate matters. Including data acquisition, analyses, and reports. Meteorological support to TV/film/commercial productions as well as insurance claims. Also, meteorological considerations for homeland security, counterterrorism, and emergency response.

- Recent clients include:
  - Chevron Corporation
  - Los Angeles Department of Water and Power
  - California Department of Forestry and Fire Protection
  - California Department of Transportation
  - Long Beach Container Terminal
  - City of Santa Barbara
  - City of Los Angeles
  - Gila Valley Irrigation District
  - Signature Aviation
  - Worley Parsons Engineering
  - Toyota Motor Company
  - Chevrolet Automobile Corporation
  - Laguna Art Museum
  - Saatchi & Saatchi Advertising Company
  - Believe Media Company
  - Bridgestone Corporation
  - Southern California Edison
  - Nevada Department of Justice
  - Pacific Gas & Electric

- Recent cases include:
  - Vasquez v. Los Angeles Unified School District – Plaintiff **(Deposition Given)**
  - City of Los Angeles v. Tetra Design Inc. – Plaintiff **(Deposition Given)**
  - Streightiff v. Hilton – Defendant
  - Nuno, Alyssa v. City of Santa Barbara – Defendant
  - Anderson v. State of Arizona & United States of America – Plaintiff
  - AIG v. Signature Aviation – Defendant **(Deposition Given)**

- Dept. of Forestry & Fire Protection v. California Resources Corporation, et al - Plaintiff
- CalFire v. Southern California Edison Company – Plaintiff
- Bisogno, Robin, et al v. CA Dept. of Transportation – Defendant
- Sliskovich v. Mid-Century Insurance Company – Defendant
- Noble Textile, Inc. v. United Specialty Insurance Company – Defendant
- Lou v. Little Lake City School District – Defendant **(Deposition Given)**
- Valerie Meyers v. National Weather Service (NWS) – Defendant **(Deposition x 2)**
- Citizens Against Radiation Exposure (CARE) v. National Weather Service
- 82 additional cases as an associate to Air, Weather and Sea Conditions, Inc.

Regional Coordinator for Impact-Based Decision Support Services at National Weather Service Western Region Headquarters (Retired) – Salt Lake City, UT

January 2011 – January 2016 (5 years)

Brought the weather decision needs of federal, state, local and tribal partners/stakeholders together with the services and capabilities of the NWS forecast offices in the western U.S. Supported NWS efforts in the west to create an Operational Decision Support Division and an enhanced Regional Operations Center function including the selection of staff, creating/modifying policy/procedures, and providing recommendations/ input to senior staff. Supported efforts to meet NWS Strategic Plan goals of a Weather Ready Nation.

Acting Meteorologist in Charge at National Weather Service - Phoenix, AZ

March 2015 - June 2015 (4 months)

Managed all weather forecast/support activities for central Arizona and southeast California including WFO PSR. This included managing office operations and systems, managing observational networks, providing leadership and oversight to all staff and programs within area of responsibility and within the confines of the mission of the NWS. This included managing and directing day-to-day operations of the WFO including the issuance of forecasts, outlooks, watches, warnings, the oversight of the public service unit, cooperative observer program and NOAA Weather Radio Program.

Acting Deputy Regional Director at National Weather Service - Western Region Headquarters – Salt Lake City, UT

August 2012 - October 2012 (3 months)

Assisted in providing leadership, direction, management and supervision of NWS Western Region. Developed short and long-range plans, including new approaches to problems, and required resources given existing capabilities.

Physical Scientist at National Weather Service - Los Angeles/Oxnard, CA

2003 - 2011 (8 years)

Program management of several critical operational office programs within WFO Los Angeles/Oxnard.

Subject-Matter-Expert (SME) for Los Angeles Terrorism Early Warning Group (TEW) – Los Angeles, CA
2005-2009 (4 years)
Provided weather support/briefings to the TEW (run by Los Angeles County) for exercises and emerging threats. This included analysis of meteorological conditions and their impact on planning, preparedness, and emergency response.

Meteorologist in Charge (MIC) at National Weather Service - Los Angeles/Oxnard, CA
1994 - *2003 (9 years)*
Managed all weather forecast/support activities for southern California including WFO LOX and 1 CWSU. This included managing office operations and systems, managing observational networks, providing leadership and oversight to all staff and programs within area of responsibility and within the confines of the mission of the NWS. This included managing and directing day-to-day operations of the WFO including the issuance of forecasts, outlooks, watches, warnings, the oversight of the public service unit, cooperative observer program and NOAA Weather Radio Program.

Deputy Meteorologist in Charge (DMIC) at National Weather Service - Los Angeles, CA
1992 - 1994 (2 years)
Managed and directed day-to-day operations of the WSFO including the issuance of forecasts, outlooks, watches, warnings, the oversight of the public service unit and NOAA Weather Radio Program.

Meteorologist in Charge (MIC) at National Weather Service - Santa Maria, CA
1990 - 1992 (2 years)
Supervised all weather services/support at a small WSO whose primary responsibilities were agricultural forecasting, pilot briefings and surface observations.

Evaluations Officer at National Weather Service - Milwaukee, WI
1988 - 1990 (2 years)
Performed service evaluations of all FSS's and WSO's within the state of Wisconsin as well as forecast responsibilities on all forecast desks including public, marine, aviation and severe weather.

General Forecaster at National Weather Service - Milwaukee, WI
1985 - 1988 (3 years)

Meteorologist Intern at National Weather Service - Reno, NV
1981 - 1985 (4 years)

Certifications

Certified Consulting Meteorologist
American Meteorological Society License #702 February 2014

NWS Weather Observer
Department of Commerce National Weather Service June 1981

Private Pilot
Department of Transportation Federal Aviation Administration January 1978

Professional Affiliations

American Meteorological Society (AMS), Certified Consulting Meteorologist (CCM)
National Council of Industrial Meteorologists (NCIM), Full Member
American Meteorological Society (AMS), Full Member
National Weather Association (NWA), Full Member
Los Angeles Terrorism Early Warning Group (TEW)
National Weather Service (NWS) Weather Spotter
Community Collaborative Rain, Hail & Snow Network (CoCoRaHS) Member
International Association of Emergency Managers (IAEM), annual Conference Member

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Honors and Awards

Bronze Medal Group Award
Department of Commerce
January 2015
For the provision of an integrated set of innovative decision support services during the on-going California Drought Emergency.

Bronze Medal Group Award
Department of Commerce
December 2008
For outstanding forecasting and briefing efforts over an extended period to the DHS/FEMA (JFO), established in response to the October 2007 southern CA fire siege.

Gold Medal Group Award
Department of Commerce
January 2005
For the service provided during the southern CA rain/floods of Jan. 2005.

Silver Medal Group Award
Department of Commerce
November 2004
For weather support given to firefighting personnel during the wildfires of Oct./Nov. 2003.

Bronze Medal Group Award
Department of Commerce
December 1998
For public service performed resulting in lives/property saved during the El Nino events of 1997/98.

Isaac Cline Award
National Weather Service - Los Angeles
August 2008
For providing exceptional and dedicated support of operations over an extended period to the DHS/FEMA Joint Field Office, established in response to the October 2007 southern CA fire siege.

Certificate of Appreciation
Tri-Advisory Conference - National Ski Patrol, Far West Division
November 2006
In providing education in the name of service and safety.

30 Year Length of Service Award
Department of Commerce
February 2012
In recognition of 30 years of government service.

Projects

Climate Information for Disaster Management - Bridging the Weather and Climate Timescales
February 2015 to January 2016
Members: Todd Morris, Andrea Bair, Alison Meadows, Zack Guido, Mike Crimmins, Robert Scripp, Jonathan McLeod

Co-author The Federal Emergency Management Agency (FEMA) Region IX (CA, AZ, NV, and Pacific Islands) has based disaster management preparations on weather information for decades. Climate information, which conditions weather risk, however, has been underutilized. The Climate Assessment of the Southwest (CLIMAS), the National Weather Service (NWS) Western Region, and the Response Division of FEMA Region IX have co-designed a hydroclimate dashboard tool that is integrated into FEMA disaster management, stewarded by the NWS, and studied by CLIMAS. The hydroclimate dashboard includes a short narrative and supporting graphics and information that cover historical climate risk, current conditions, and climate outlooks. The dashboard provides an opportunity to leverage climate information to help FEMA Region IX better monitor, anticipate, and prepare for potential disaster.

Weather (and Decision Support) for Emergency Managers

October 2012 to January 2013

Members: Todd Morris, Jay Rosenthal

Co-author Basic meteorological concepts and understanding play a big role in the response to this nation's natural and man-made disasters, as well as planned responses to terrorist threats against urban and rural areas. Issues such as land-sea breeze circulations, mountain and valley winds, coastal cloud cover, vertical and horizontal wind shear, normal diurnal fluctuations, and the impact of certain predictable and terrain enhanced windstorms all play crucial roles in determining who is at risk, and what strategies are most effective in minimizing harm to people and structures. The ability of the National Weather Service, with its Incident Meteorologists and decision support services, together with rapidly advancing technology in assimilating data over small time and spatial scales, provides the emergency manager or incident commander with a host of essential real-time support capabilities. This paper attempts to identify and highlight the value of this real-time support capability.

Weather Support to FEMA/DHS Joint Field Office Established in Response to the Devastating Southern California Wildfires of October 2007

October 2007 to July 2008

Members: Todd Morris, Eric Boldt

Author An Incident Support Specialist Overview - On October 24, 2007, President George W. Bush, signed a Major Disaster Declaration for the State of California for severe wildfires affecting Southern California. The Disaster Declaration put into motion federally funded and state coordinated response and recovery efforts, including establishing a FEMA/DHS Joint Field Office. Weather support for this function was provided by an Incident Support Specialist (ISS) from the National Weather Service in Los Angeles/Oxnard, CA. This paper is an overview of those local efforts, including the products and services provided, and an examination of the complexities involved. It also discusses the lessons learned and the successes realized.

History of Weather Observations Los Angeles, CA 1847-1948

January 2006 to January 2006

Members: Todd Morris, Glen Conner, Curt Kaplan

Contributor The turbulent times in California brought the United States Army to the Los Angeles area. An Assistant Surgeon accompanied the small force to provide medical care for the 121 soldiers in Kearny's Dragoons. On the morning of 5 June 1847, duty required Assistant Surgeon, Dr. John S. Griffin of that unit, to record the weather conditions at his post in El Pueblo de Los Angeles. On 20 June 1847, he began recording the "clearness of the sky" and in July he recorded rainfall when it occurred. So began the first official weather observations in Los Angeles. From our vantage point one hundred sixty-nine years later, we are astounded by the survival of that record. Equally astounding is the succession of improvements in meteorology that have occurred between that first observation and the forecasts now being generated by the modern National Weather Service Forecast Office for the Los Angeles area.

NOAA Technical Memorandum NWS WR-261 - Climate of Los Angeles

January 1999 to October 2001

Members: Todd Morris, David Bruno, Gary Ryan, Curt Kaplan

Contributor and Editor We hope and trust that readers will find The Climate of Los Angeles, California to be both useful and informative, not only as a data source, but as an important document that broadens the understanding of weather and climate systems that affect southern California.

National Weather Digest, Volume 14, Issue 4, Pages 14-18 - "The Possible Influence of an Existing Snow Field on the Track of a Surface Low Pressure-A Case Study"

January 1989 to November 1989

Members: Todd Morris

Author One of the challenges for meteorologists who deal with winter storms is accurately forecasting the position and track of the surface low-pressure center. This can help determine not only precipitation type but also where the greatest amount of precipitation will fall. A case study was examined which fit an "old and unwritten" rule of thumb. This theory is that the surface low-pressure center will track along the southern edge of an existing snow field. The case study fit perfectly, physical reasoning is included, and further investigations are encouraged.

Skills & Expertise

Meteorology	**Coordination**	**Preparedness**
Weather	**Coaching**	**Air Quality**
Climatology	**Training**	**GIS**
Weather Forecasting	**Policy**	**CAMEO**
Environmental Science	**Government**	**Weather Radar**
Decision Support	**Remote Sensing**	**Environmental Policy**
Incident Command Sys/NIMS	**Weather Observing**	**Storm Surveys/Damage Assess**
Program Management	**Hydrology**	**Hazard Mitigation**
Project Management	**Severe Weather**	**Technical Writing**
Budget Monitoring	**Emergency Management**	**Technical Support**
Research	**Disaster Response**	**Strategic Planning**

Education

FEMA – Washington, D.C.

Occupational Certificates, Incident Command System/NIMS (ICS 300, 400, 700, 800), 2008-2010

Emergency Management Institute - Emmetsburg, MD
Occupational Certificate, Emergency Management, 2008 - 2008

Texas A&M University
Occupational Certificate, Emergency Management, 2006 - 2006

NTL Institute - Alexandria, VA
Occupational Certificate, Human Interaction, 2003 - 2003

Army Management Staff College - Ft. Belvoir, VA
Occupational Certificate, Personnel Management, 2001 - 2001

SUNY Albany
Coursework completed, Radar Meteorology/Hydrology, 1984 - 1984

University of Wisconsin-Madison
Bachelor of Science (BS), Meteorology, 1978 – 1982
