# Colorado-New Mexico Regional Extreme Precipitation Study

#### Bill Kappel, Applied Weather Associates Dam Safety 2018 Seattle, WA



Colorado Water Conservation Board Colorado Division of Water Resources CO-NM REPS

New-Mexico Office of the State Engineer



Colorado-New Mexico Regional Extreme Precipitation Study

### **Project Overview**

- Task 1 Deterministic PMP
- Task 2 Precipitation Frequency
- Task 3 Dynamic modeling analysis
  - Very complex region, lots of challenges = fun
  - Extensive review process
    - 19 member review board
    - State dam safety
  - Final product significantly enhance through collaboration, review and sharing of data
  - Produced the best science and standard of practice





### **Study PMP Locations**







Colorado Water Conservation Colorado Division of Water Resources Diffice ineer

### **Short List Locations**







louetor

Mexico





Colorado Water Conservation Board Colorado Division of Water Resources CO-NM REPS Colorado-New Mexico Regional Extreme Precipitation Study

hiladelphia

### **Example SPAS Storm Output**









Maximum Rainfall in Inches

#### SPAS 1652 DAD Curves Zone 1 September 20 (0800UTC) to September 25 (0700UTC), 1961





Index Hour

### In-place Storm Maximization Example

#### How much bigger could a storm have been







Colorado Water Conservation Board Colorado Division of Water Resources

of the State Engineer Colorado-New Mexico Regional Extreme Precipitation Study





Associate

Nsim = 1000; g75 = 1.48; g50 = 1.461; g25 = 1.439

6

# DAD Comparisons







Colorado Water Conservation Board Colorado Division of Water Resources CO-NM REPS Colorado-New Mexico Regional Extreme Precipitation Study



### HRRR Data-Develop Rainfall Only Grid



1) Rattlesnake, ID SPAS 1274 analysis compared to WRF re-analysis



### Rattlesnake, ID Nov 1909



1) Rattlesnake, ID SPAS 1274 analysis with WRF added



#### **Colorado Rainfall to Precipitation PF**





#### HRRR Rain to All Precip Adjustments







#### **Temporal Distribution of PMP**





### **Temporal Distribution of PMP**







Colorado Water Conservation Board Colorado Division of Water Resources CO-NM REPS Colorado-New Mexico Regional Extreme Precipitation Study



#### **Example PMP Results**







Colorado Water Conservation Board Colorado Division of Water Resources CO-NM REPS Colorado-New Mexico Regional Extreme Precipitation Study

New-Mexico Office of the State Engineer

14

### Average Recurrence Interval of PMP

#### Local Storm 2hr





#### Local Storm 6hr





Colorado Water Conservation Board Colorado Division of Water Resources CO-NM REPS Colorado-New Mexico Regional Extreme Precipitation Study



### Average Recurrence Interval of PMP

#### Applied Weather Associates

#### General Storm 48hr

#### Tropical Storm 48hr







Colorado Water Conservation Board Colorado Division of Water Resources

CO-NM REPS Colorado-New Mexico Regional Extreme Precipitation Study



# Constructing the PMP Tool Storm Databases



	🗿 ArcCatalog - D:\GIS\CO_NM\Temp\Sample Tool Image\PMP	_Evaluation_Tool\lr	nput\DAD_Tables.gdb	>\SPAS_1074_1									
Two key GIS	GIS <u>File Edit View Go</u> Geoprocessing Customize Windows Help												
apodatabasos	: 📤   🖴 📾   🖹 💼 🗙   ::: :::: :::: ::: : ::: : 🔍   🐺 👼	🚬   🐜 🖕 i 🔍 🤅	२, १७ ⊘   ♦ ⇒	0 I III -									
yeoualabases	D:\GIS\CO_NM\Temp\Sample Tool Image\PMP_Evaluation_Tool\Input\DAD_Tables.gdb\SPAS_10 V												
provide input for PMP	: 🔁 🗈 🥃												
tool:	Catalog Tree	Contents Preview	Description										
		OBJECTID*	AREASQMI	H_01	H_02	H_03	H_04	H_05	H_06	H_12	H_18 ^		
0 DAD Tables	DAD_Tables.gdb		2 1	1.49	2.14	3.07	3.73	4.12	4.19	5.17	5.4		
<ul> <li>Storm Adi Tables</li> </ul>	■ SPAS_1074_1		3 10	1.43	2.04	2.96	3.61	4	4.11	5.08	5.3		
	SPAS_10/4_2		4 25	1.35	1.95	2.85	3.49	3.86	3.96	4.92	5.14		
Geodatabases are	SPAS 1075 2		5 50	1.28	1.82	2.68	3.28	3.64	3.74	4.67	4.88		
nonulated with info	SPAS_1075_3		7 150	1.15	1.54	2.27	2.82	3.15	3.25	4.12	4.32		
	E SPAS_1075_4	1	B 200	1.12	1.48	2.17	2.7	3.02	3.13	3.97	4.17		
from each storm and	Von_Storm_Data.gdb     Grid Pariate		9 300	1.07	1.4	2.04	2.55	2.85	2.96	3.76	3.96		
	Grid_Points		1 500	0.97	1.33	1.89	2.43	2.63	2.04	3.49	3.69		
can be edited as	S Vector Grid	12	2 1000	0.83	1.16	1.68	2.09	2.34	2.45	3.12	3.32		
	☑ Vector_Grid_Outline	13	3 2000	0.69	1.01	1.48	1.83	2.07	2.18	2.78	3.02		
needed	🖃 🧊 Storm_Adj_Factors.gdb		4 3500	0.59	0.9	1.33	1.65	1.85	1.95	2.5	2.79		
DAD Johlas adh	🗄 🖶 General		5 5000 6 7500	0.33	0.02	1.08	1.33	1.52	1.62	2.33	2.49		
DAD_Tables.gdb	🗄 🔁 Local	17	7 10000	0.41	0.64	0.95	1.17	1.38	1.48	1.92	2.38		
come directly from	SPAS 1074 1	► 18	B 15000	0.34	0.54	0.8	0.98	1.15	1.25	1.74	2.18		
come unecuy nom	SPAS_1074_2	19	9 20000	0.29	0.46	0.68	0.83	0.72	1.07	1.58	1.57		
SPAS output	SPAS_1075_1	2	1 50000	0.12	0.24	0.41	0.49	0.58	0.63	0.95	1.28		
	• SPAS_1075_2	2	2 59841	0 11	0.21	0.3	0.36	0 42	0 47	0.82	1 12 4		
	SPAS_1075_3		10 [		2)						,		
	SPAS_1075_4      E Script		18 • •1	(of 2	2)								
		Preview: Tal	ble	$\sim$									
	File Geodatabase Table selected												



Colorado Water Conservation Board Colorado Division of Water Resources

**CO-NM REPS** Colorado-New Mexico Regional Extreme Precipitation Study



### Constructing the PMP Tool Storm Databases



#### Storm Center Tab

_							Storm Rep. Dew Point					Climatological Max. Dew Point					
	SPAS Storm ID	LON	LAT	ELEV	ELEV Round	Td	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	Td	T <sub>d</sub> Round	Precip. Water @ 30,000 ft	Precip. Water @ Storm Elev.	PW Lookup Table Column	Avail. Moisture	IPMF
Storm Center Location	1074_1	-111.771	30.646	2,770	2,800	73.50	2.67	0.63	69	2.035	75.80	76.0	2.99	0.68	74	2.310	1.135

*Red	va	lues	are	input
	pai	rama	aters	

100-year Precipitatio	1
i-hour Precip 24-hour	Precip Precip. Source
5.5	24h Precip (New Mexico)

- Excel is used to construct Storm Adjustment Factors at each grid point for each storm.
- Hold storm center, maximization, transposition (GTF/MTF), transposability, and final adjustment factor information.

Adjusted\_Rainfall 🚽 Storm Center / GTF / MTF / Precipitable Water Table / 🐲 /

ID	STORM	LON	LAT	ZONE	ELEV	IPMF	MTF	GTF	TAF	TRANS			
1	1074_1	-108.825	31.250	13	6,489	1.14	1.00	1.11	1.26	1			
2	1074_1	-108.800	31.250	13	6,850	1.14	1.00	1.18	1.33	1			
3	1074_1	-108.850	31.275	13	5,360	1.14	1.00	0.95	1.08	1			
4	1074_1	-108.825	31.275	13	5,959	1.14	1.00	1.00	1.13	1			
5	1074_1	-108.800	31.275	13	6,682	1.14	1.00	1.05	1.19	1			
6	1074_1	-108.775	31.275	13	6,920	1.14	1.00	1.14	1.30	1			
7	1074_1	-108.275	31.275	13	4,993	1.14	1.00	0.81	0.92	1			
8	1074_1	-108.250	31.275	13	4,821	1.14	1.00	0.78	0.89	1			
9	1074_1	-108.950	31.300	13	5,367	1.14	1.00	0.99	1.13	1			
10	1074_1	-108.925	31.300	13	5,477	1.14	1.00	0.96	1.09	1			
11	1074_1	-108.900	31.300	13	5,317	1.14	1.00	1.00	1.14	1			
12	1074_1	-108.875	31.300	13	5,274	1.14	1.00	0.95	1.07	1			
13	1074_1	-108.850	31.300	13	5,275	1.14	1.00	0.94	1.07	1			
14	1074_1	-108.825	31.300	13	5,476	1.14	1.00	0.94	1.07	1			
15	1074_1	-108.800	31.300	13	5,761	1.14	1.00	0.97	1.10	1			
16	1074_1	-108.775	31.300	13	6,973	1.14	1.00	1.10	1.25	1			
17	1074_1	-108.350	31.300	13	5,067	1.14	1.00	0.83	0.95	1			
18	1074_1	-108.325	31.300	13	4,925	1.14	1.00	0.80	0.90	1			



Colorado Water Conservation Board Colorado Division of Water Resources

Colorado-New Mexico Regional Extreme Precipitation Study

**CO-NM REPS** 





#### Adjusted Rainfall Tab

#### **Example PMP Results-DAD Curves**



Weather

### Summary



- Extensive collaboration required to solve incredibly complex problem
- 100's of storm investigated/used = Robust results based on data
- Utilized Task 3 gridded HRRR model output and WRF reanalysis
- Numerous sensitivities applied to ensure reasonableness
  - Task 2 Average Recurrence Interval
  - NOAA Atlas 14 comparisons
  - Comparisons against previous AWA studies
- Important input from CO-NM dam safety
  - Resulted in significant improvements in development process and output
  - Improvements will be utilized in current and upcoming studies
- Dynamic updates going forward

#### Questions: Bill Kappel, 719-488-4311

#### billkappel@appliedweatherassociates.com



Colorado Water Conservation Board Colorado Division of Water Resources CO-NM REPS Colorado-New Mexico Regional Extreme Precipitation Study

