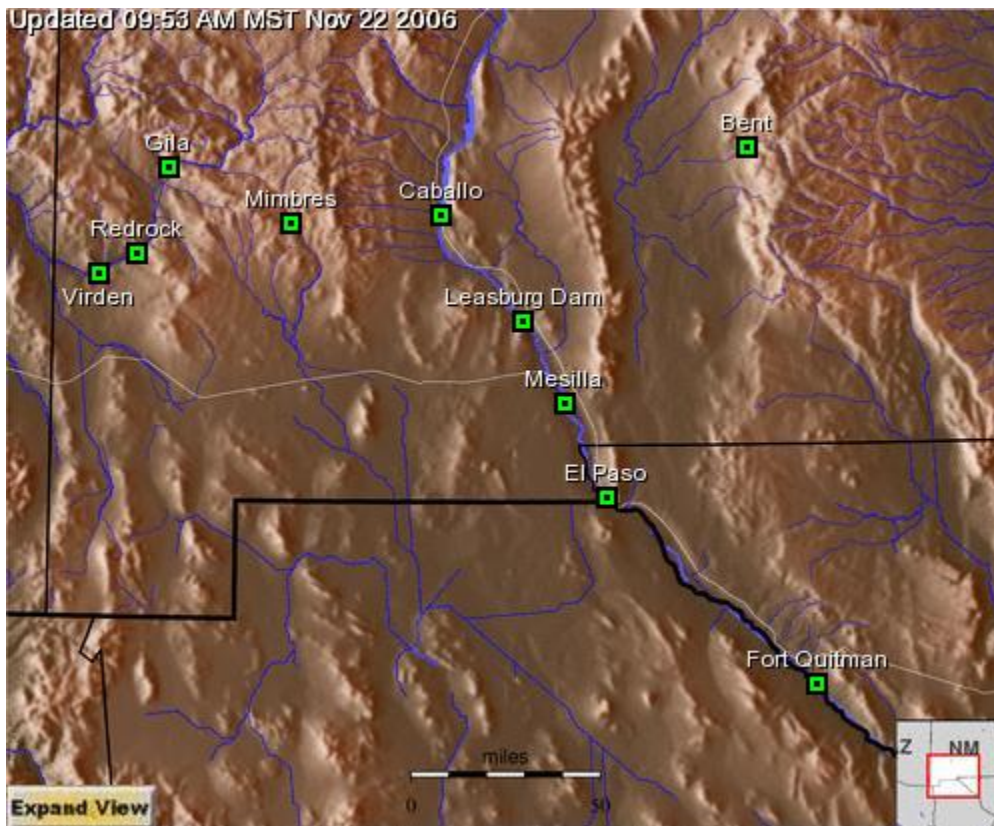


Comparison of River Gauge Response During the Monsoon Season of 2006 Over the Central Rio Grande River.

1. Introduction

The recent heavy rainfall of July, August and early September of 2006 gave forecasters a chance to observe the relationship between climatologically extreme rainfall amounts and flooding along a stretch of the Rio Grande River in southern New Mexico and far West Texas. This was done by comparing the peaks of specific river gauges and elapsed time and magnitude of change to gauges further downstream. Unfortunately, for forecasters, there is not much in the way of historical data to look at. While Elephant Butte Reservoir was completed in 1916, and Caballo Reservoir was completed in 1938, there is sparse historical data of flooding along this section of the Rio Grande River. Prior to this year there was a heavy rainfall event in 1999, when heavy rains just below Caballo Reservoir caused some minor flooding in the vicinity of Radium Springs, New Mexico. In addition to the lack of cases with widespread, heavy rainfall over the area in question, the other limiting factor is the age of the river gauges, as all 3 gauges are less than 10 years old. The specific section of the Rio Grande river to be looked at includes the portion of the river from Hatch, New Mexico downstream to El Paso, Texas. This includes river gauges near Radium Springs/Leasburg Dam (LBDN5), near Mesilla (MSLN5), and near El Paso (EPRT2).



2. Background

The summer of 2006 saw a very strong monsoon pattern, with tropically saturated air persisting over the area, and with few if any breaks in the moisture. The early August event was characterized by a sub synoptic scale upper low circulation that persisted for several days over south central New Mexico and western Texas. Embedded convection was common throughout this period, which is atypical with the usual monsoon pattern. Monthly total rainfall for July, August and September averaged about three to five inches over much of this area of the Rio Grande, with a three month total of 10-15 inches.

Rainfall across this area throughout the latter half of the summer was not only heavier than normal, but also much more widespread than normal. This resulted in large, basin-wide runoff contributions to the river that normally do not occur. This paper will look at river gauge responses to four specific events: the minor flooding events of August 16, August 22, August 29, and September 3-4. I did not include the major rain event of August 1-2. This actually produced the highest gauge reading of the entire summer, but since heavy rainfall was limited mostly to the El Paso area, there was little or no response in the other gauges upstream.

Rainfall amounts are expressed as 24 hour radar estimated totals from midnight to midnight. Tables following each entry date show time of peak, lag time of peak, percentage increase of peak, and ratios of the various increases in river height. One last note of importance; the occurrences of the levee breaches near Hatch on a tributary of the Rio Grande undoubtedly lessened the input of water into the Rio Grande. This will be very important to keep in mind for future river flooding events. Charts of the gauges will also be included at the end. Unfortunately, these charts were unavailable for the September 3-4 event.

3. Data

August 16 - This event began on August 14 with mostly light but widespread rainfall of 0.25-0.75 inches over much of the area. On August 15, light rainfall of 0.25-0.75 inch fell between Las Cruces and El Paso while widespread rainfall of 0.75-1.25 inches fell north of Las Cruces, including isolated amounts of 2.5 inches. On August 16 when minor flooding began, widespread rainfall of 0.5-1.0 inches fell over most of the area. In addition, due to heavy rains in the vicinity of Hatch, the swollen Placitas arroyo caused a levee to breach near Hatch, with moderate to severe flooding in that town.

Gauge	Time of Peak	% Increase of Peak
Leasburg	16/1.29 AM	42%
Mesilla	16/7.19 AM	38%
El Paso	16/4.52 PM	73%

	Lag Time Between Crests		Ratio of the % of Increase
Leasburg to Mesilla	5h 50m	Mesilla/Leasburg	0.9
Mesilla to El Paso	9h 33m	El Paso/Leasburg	1.7
Leasburg to El Paso	15h 23m	El Paso/Mesilla	1.9

August 22 - August 21 kicked off this event, with 0.1-0.5 inches of rainfall south of Las Cruces, and rainfall of 0.5-1.25 inches from Las Cruces north. On August 22 scattered amounts of 0.25 inch or less fell south of Las Cruces, while widespread rainfall of 0.5-1.0 fell north of Las Cruces, including isolated amounts up to 1.5 inches. Due to more heavy rain in the Hatch area, a levee on the Placitas arroyo once again failed, sending flood waters into town.

Gauge	Time of Peak	% Increase of Peak
Leasburg	22/10.16 AM	161%
Mesilla	22/1.47 PM	32%
El Paso	22/11.57 PM	81%

	Lag Time Between Crests		Ratio of the % of Increase
Leasburg to Mesilla	3h 31m	Mesilla/Leasburg	0.2
Mesilla to El Paso	10h 10m	El Paso/Leasburg	0.5
Leasburg to El Paso	13h 41m	El Paso/Mesilla	2.5

August 29 - Rainfall south of Las Cruces on August 28 was light to non-existent, while north of Las Cruces widespread rainfall of 0.5-1.0 inch of rain fell, with isolated amounts of 2.0 inches once again near Hatch. On August 29 rainfall once again missed much of the area south of Las Cruces, but a large area of heavy rain totaling 0.5-1.25 inches fell north of Las Cruces, with isolated amounts of 2.5 inches.

Gauge	Time of Peak	% Increase of Peak
Leasburg	29/4.35 AM	253%
Mesilla	29/7.42 AM	67%
El Paso	29/6.14 PM	85%

	Lag Time Between Crests		Ratio of the % of Increase
Leasburg to Mesilla	3h 7m	Mesilla/Leasburg	0.3
Mesilla to El Paso	10h 32m	El Paso/Leasburg	0.3
Leasburg to El Paso	13h 39m	El Paso/Mesilla	1.3

September 3-4 - This event actually began on August 31, as widespread rain of 0.25-0.75 inches fell across the entire area, and a large area of 0.75-1.5 inches fell around Las Cruces. September 1 saw 0.5-1.0 inches falling across the entire area with large areas of 0.75-1.25 inches fallen from Las Cruces north. On September 2 0.25-0.50 inches fell across the entire area, while on September 3 heavy widespread rainfall of .75-1.5 inches fell, with isolated areas of 2.5 inches. Finally, on September 4, widespread areas of 0.5-1.0 inches fell.

Gauge	Time of Peak	% Increase of Peak
LEASBURG	3/9.07 PM	71%
MESILLA	4/1.45 AM	15%
EL PASO	4/10.17 AM	24%

	Lag Time Between Crests		Ratio of the % of Increase
Leasburg to Mesilla	4h 38m	Mesilla/Leasburg	0.2
Mesilla to El Paso	8h 32m	El Paso/Leasburg	0.3
Leasburg to El Paso	13h 10m	El Paso/Mesilla	1.6

4. Concluding Remarks

Lag Time Between Crests				
	Aug 16	Aug 22	Aug 29	Sep 3-4
Leasburg to Mesilla	5h 50m	3h 31m	3h 7m	4h 38h
Mesilla to El Paso	9h 33m	10h 10m	10h 32m	8h 32m
Leasburg to El Paso	15h 23m	13h 41m	13h 39m	13h 10m

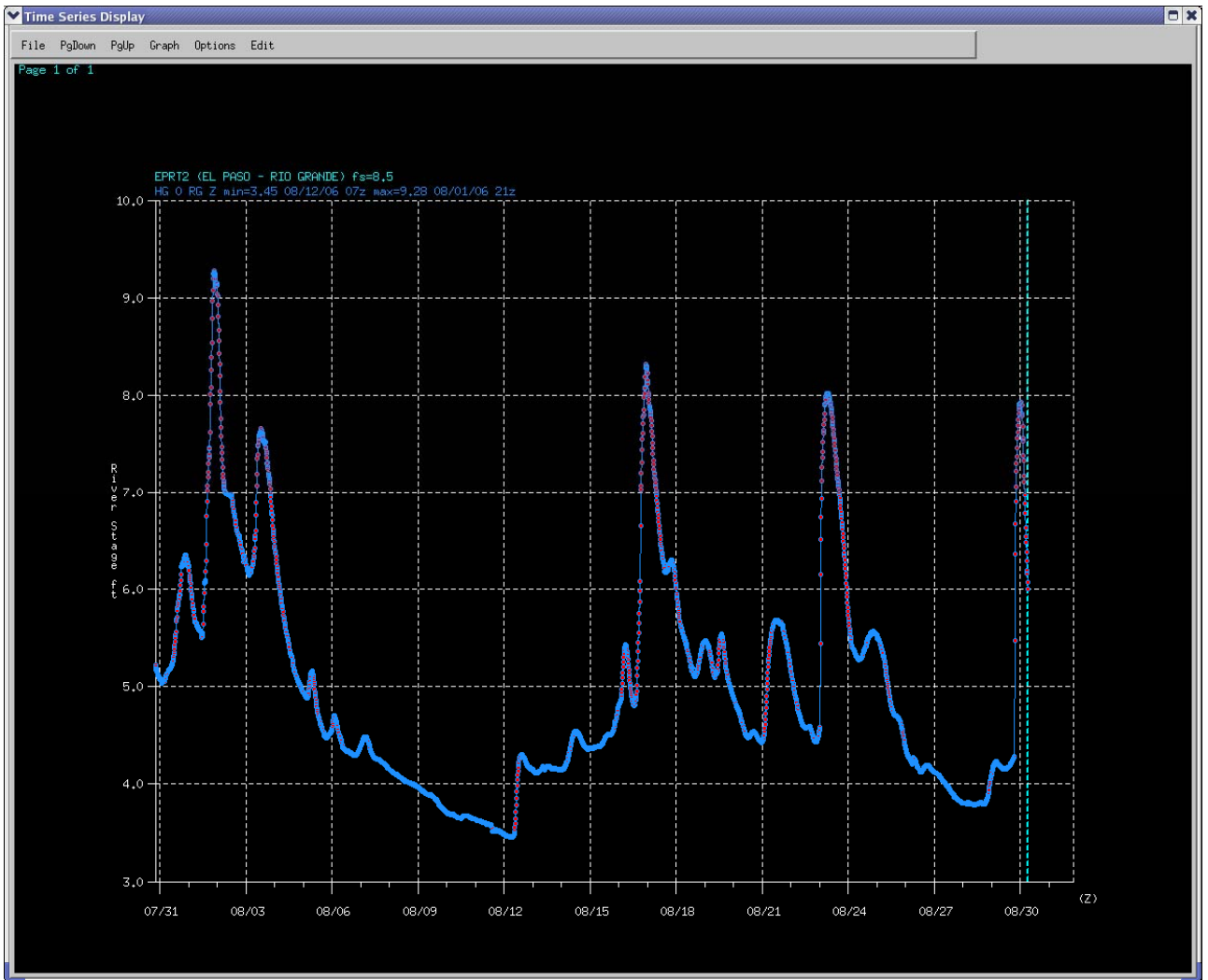
Ratio of the % Increase				
	Aug 16	Aug 22	Aug 29	Sep 3-4
Mesilla/Leasburg	0.9	0.2	0.3	0.2
El Paso/Leasburg	1.7	0.5	0.3	0.3
El Paso/Mesilla	1.9	2.5	1.3	1.6

As is evident from the table summaries, lag times between crests at the various gauge sites was somewhat uniform and consistent. Crest lag time from Leasburg to Mesilla varied from about 3 hours to 5 hours. Lag times from Mesilla to El Paso were roughly 8 hours to 10 hours, while from Leasburg to El Paso the lag time was roughly 13 hours to 15 hours.

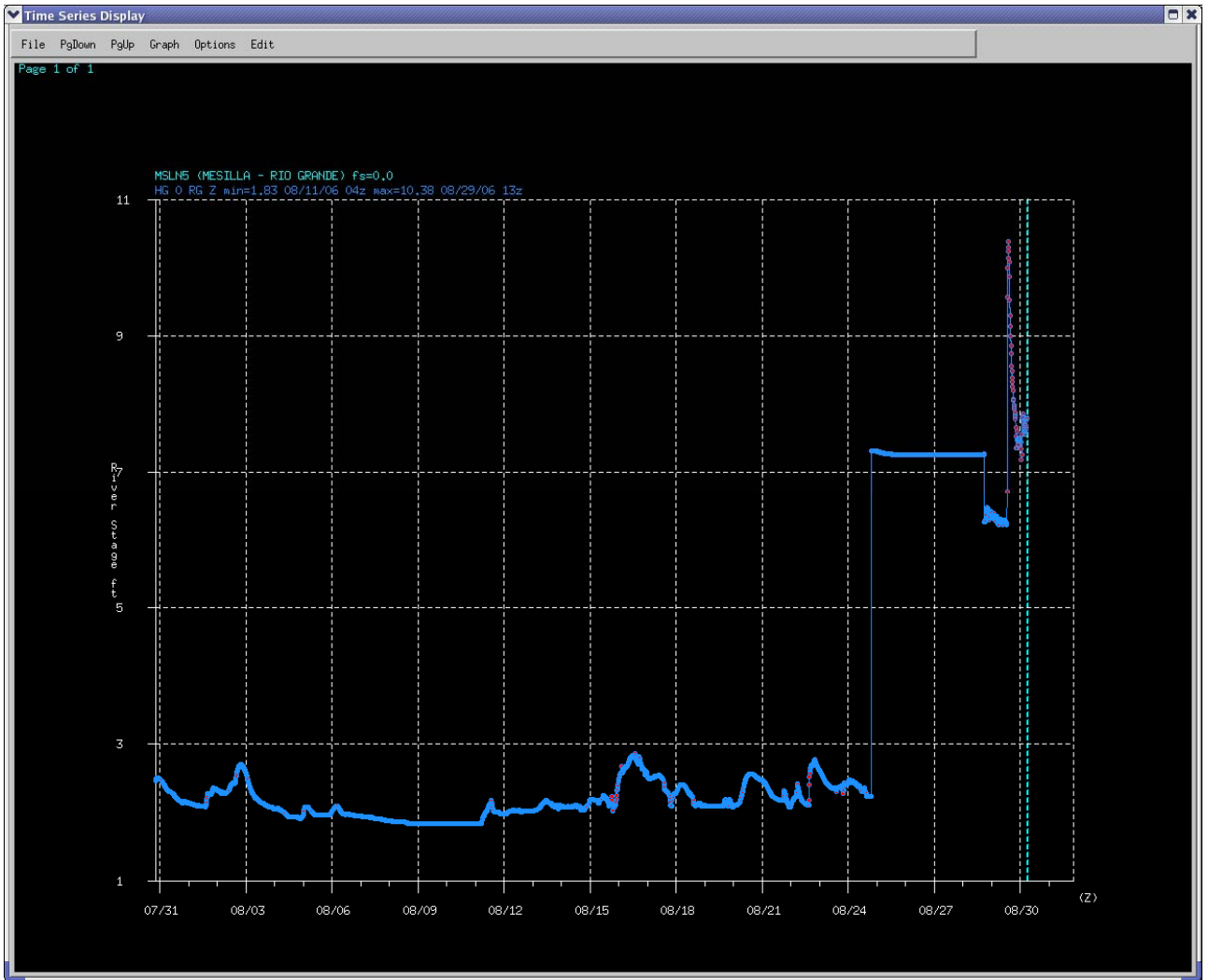
The ratio of the percentage of increase between the sites showed more variability, although if one treats August 16 as an outlier, the other 3 cases are pretty consistent. I recommend using this parameter with more caution.

Acknowledgements: I would like to thank Tim Brice (Lead Forecaster WFO El Paso), and Val MacBlain (SOO WFO El Paso) for their assistance in preparing this paper.

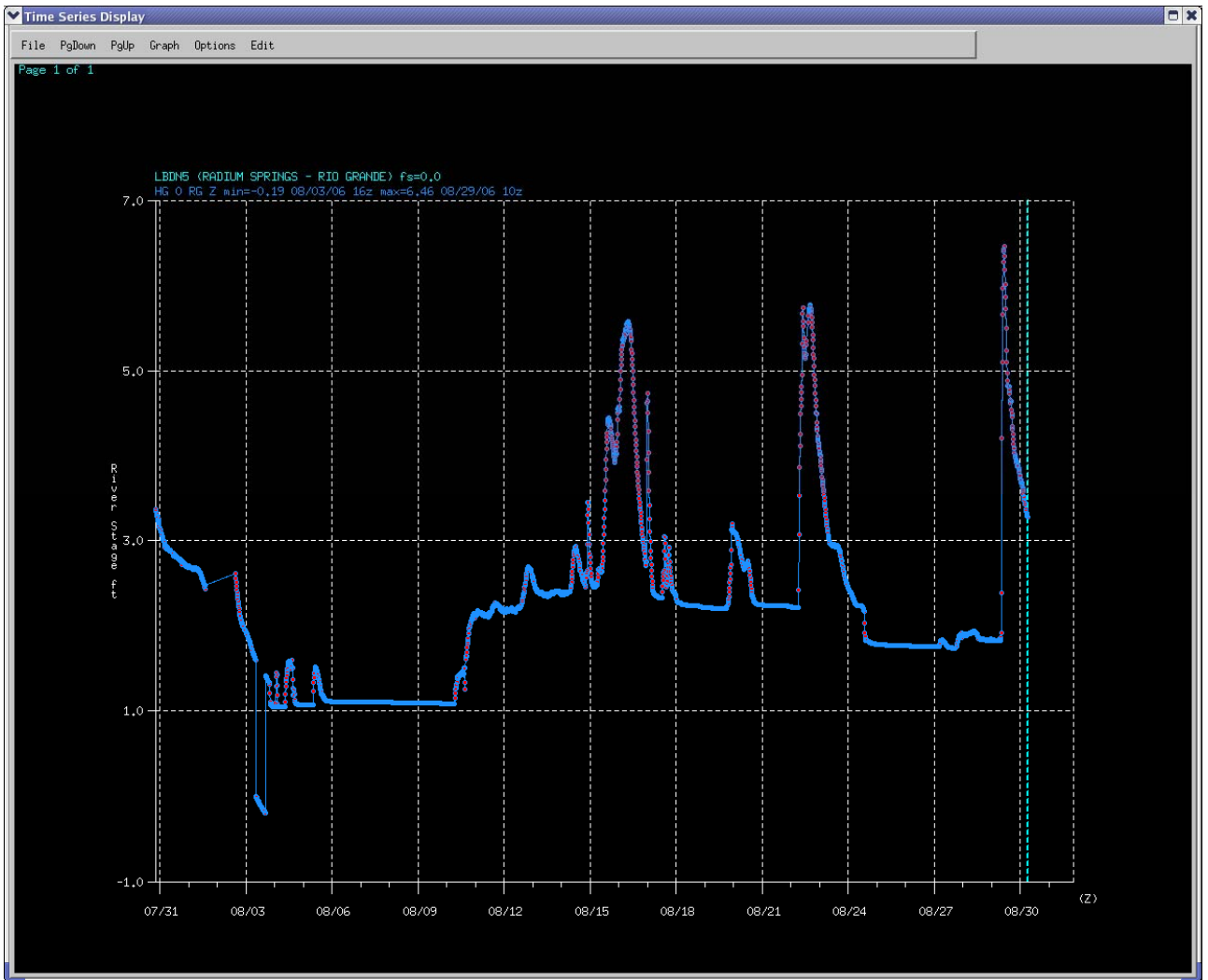
El Paso (EPRT2) Gauge for August 2006:



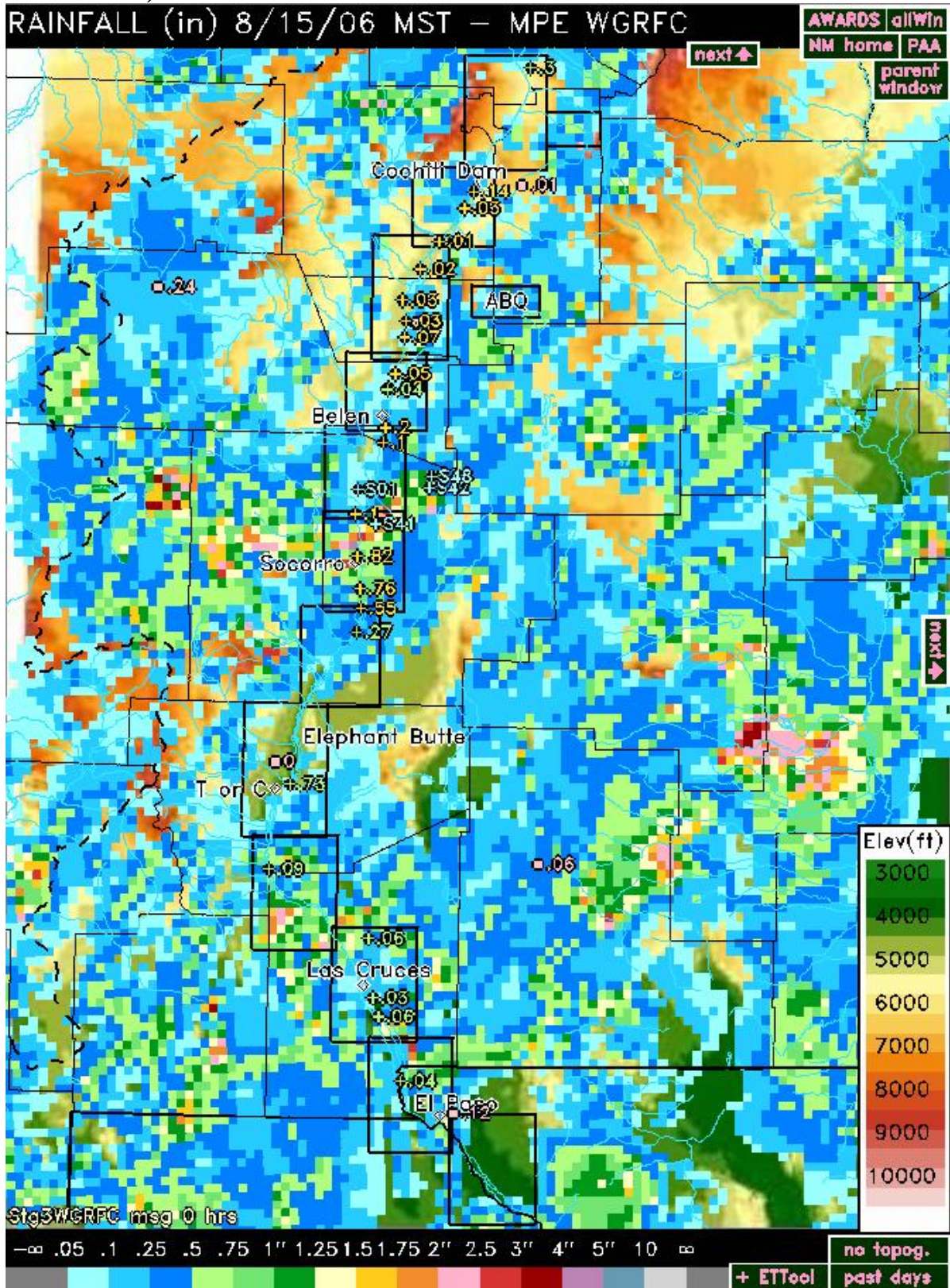
Mesilla (MSLN5) Gauge for August 2006: note-level was adjusted from meters to feet during the month.



Leasburg (LBDN5) Gauge for August 2006:

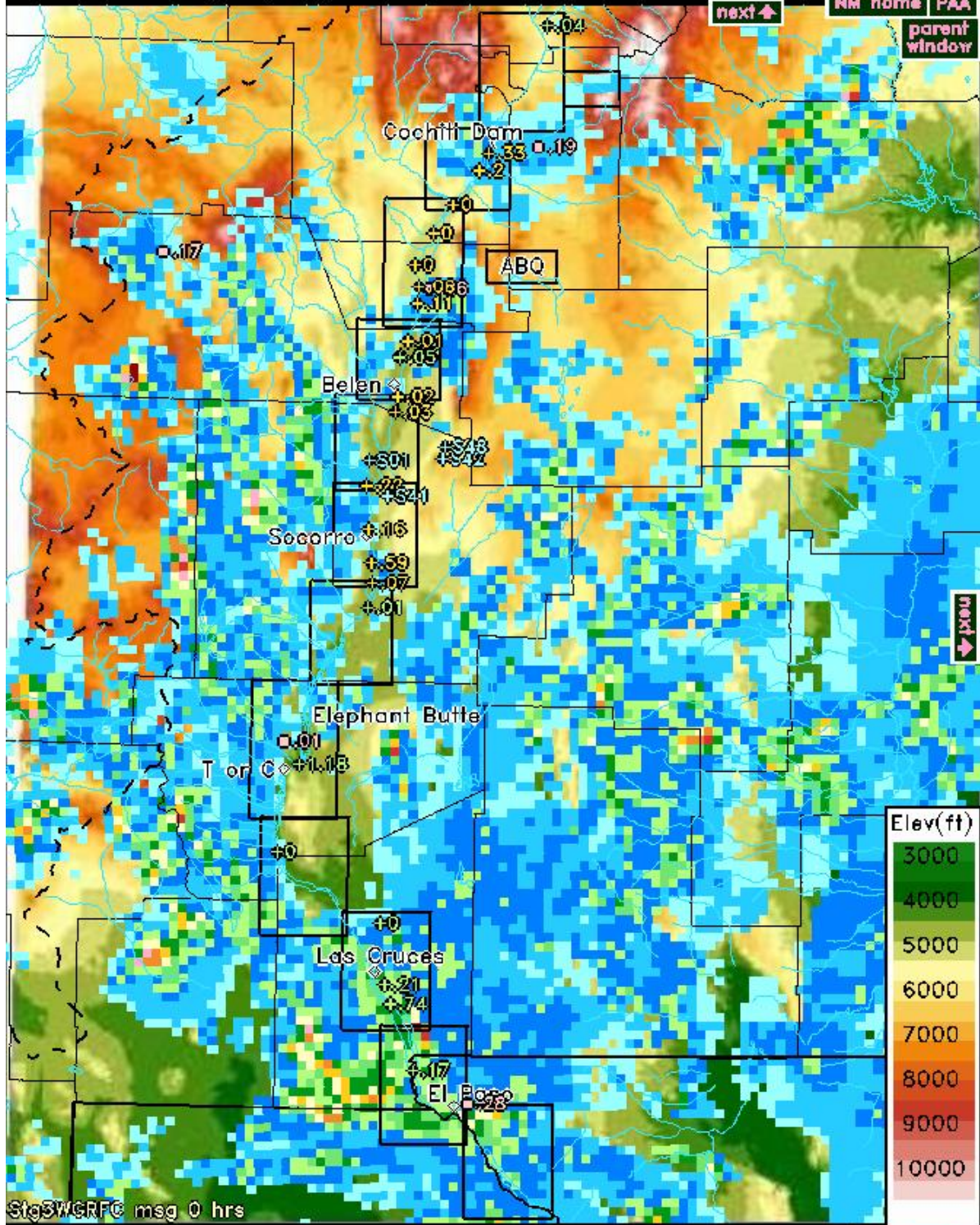


Radar estimated daily rainfall (Courtesy of U.S. Bureau of Reclamation)



RAINFALL (in) 8/16/06 MST – MPE WGRFC

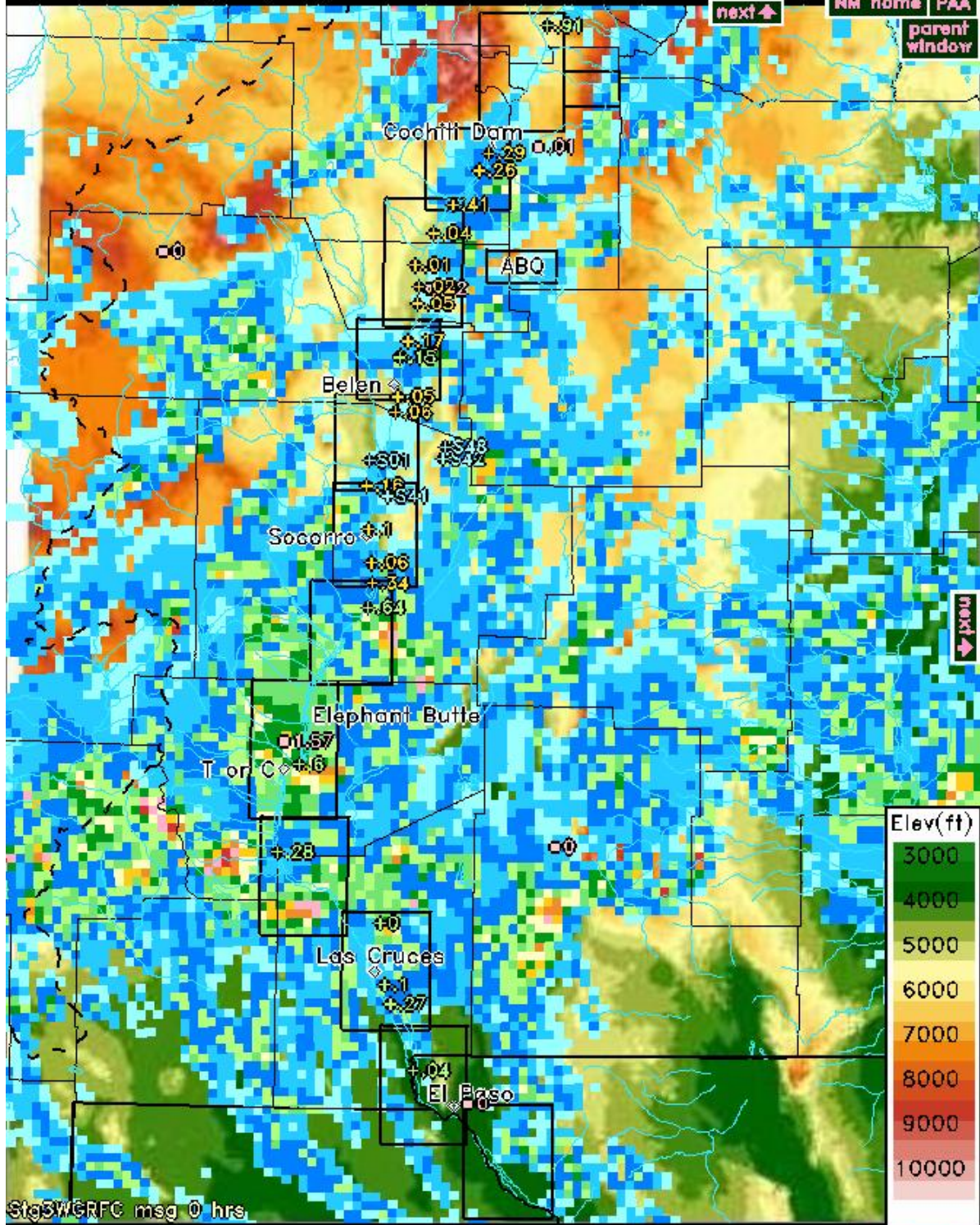
AWARDS allWin
NM home PAA
parent window



+ ETTool
no topog.
past days

RAINFALL (in) 8/21/06 MST – MPE WGRFC

AWARDS allWin
NM home PAA
parent window



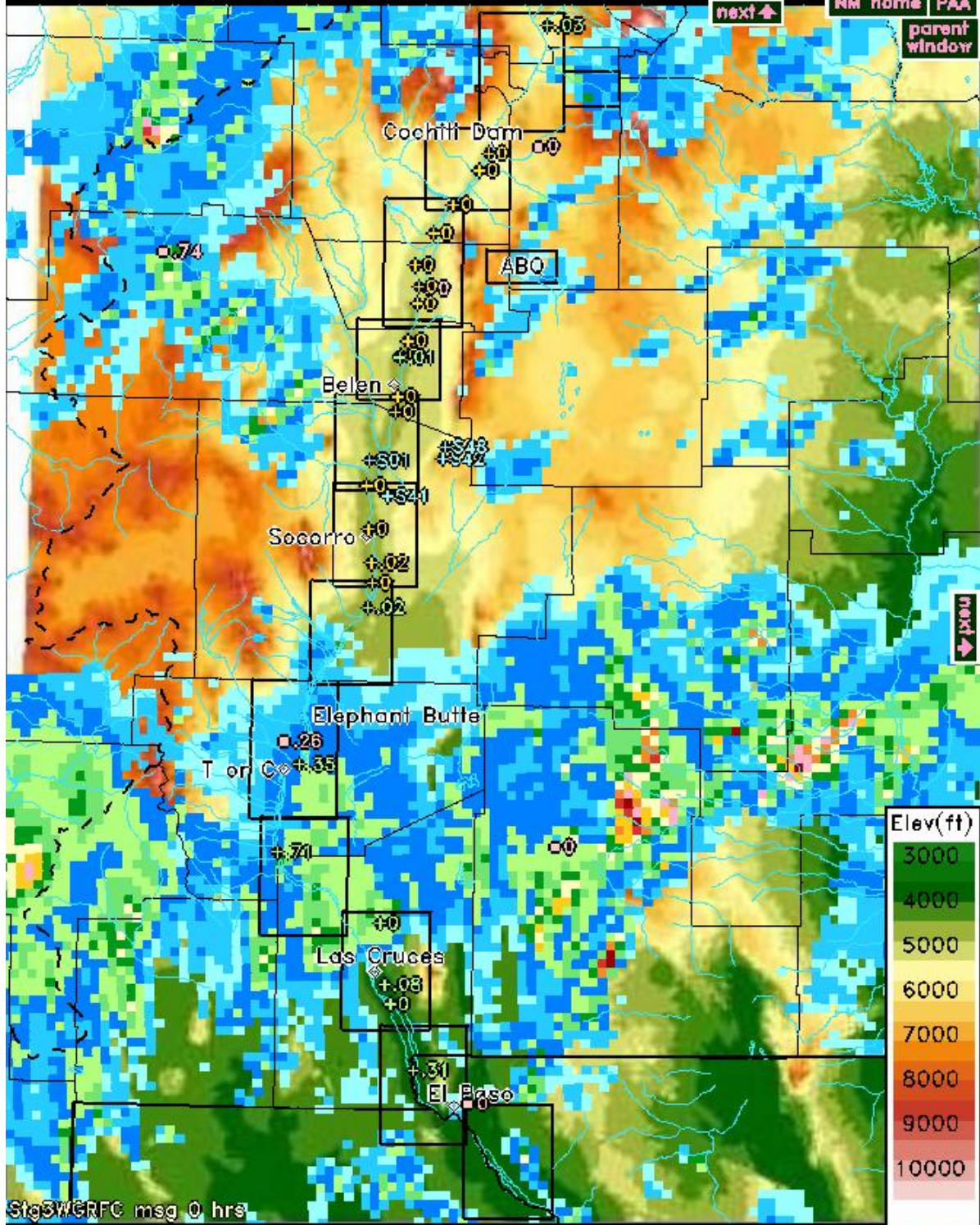
StgSWGRFC msg 0 hrs

-∞ .05 .1 .25 .5 .75 1" 1.25 1.5 1.75 2" 2.5 3" 4" 5" 10 ∞

no topog.
past days
+ ETTool

RAINFALL (in) 8/22/06 MST – MPE WGRFC

AWARDS allWin
NM home PAA
parent window



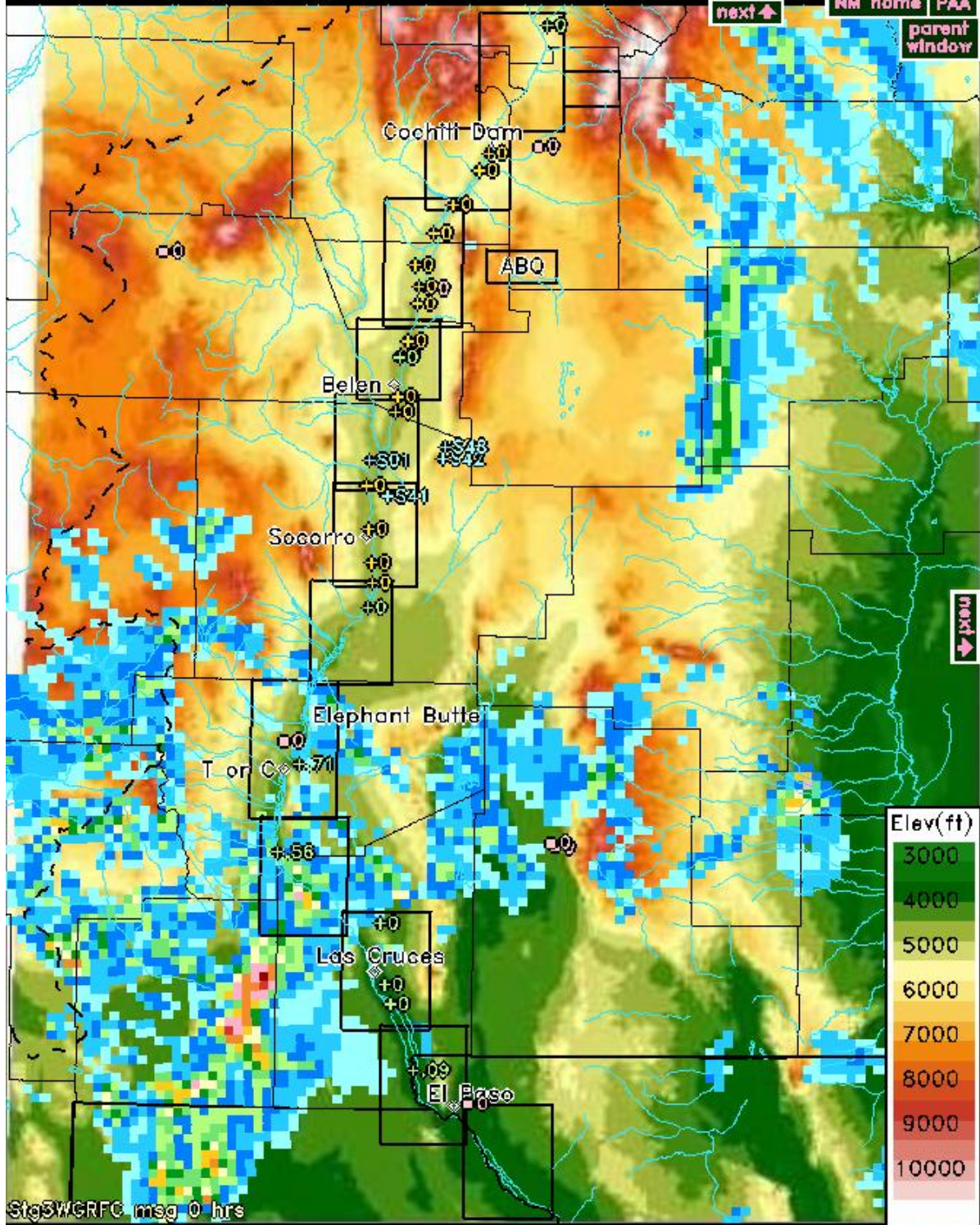
∞ .05 .1 .25 .5 .75 1" 1.25 1.5 1.75 2" 2.5 3" 4" 5" 10 ∞

+ ETTool

no topog.
past days

RAINFALL (in) 8/28/06 MST – MPE WGRFC

AWARDS allWin
NM home PAA
parent window

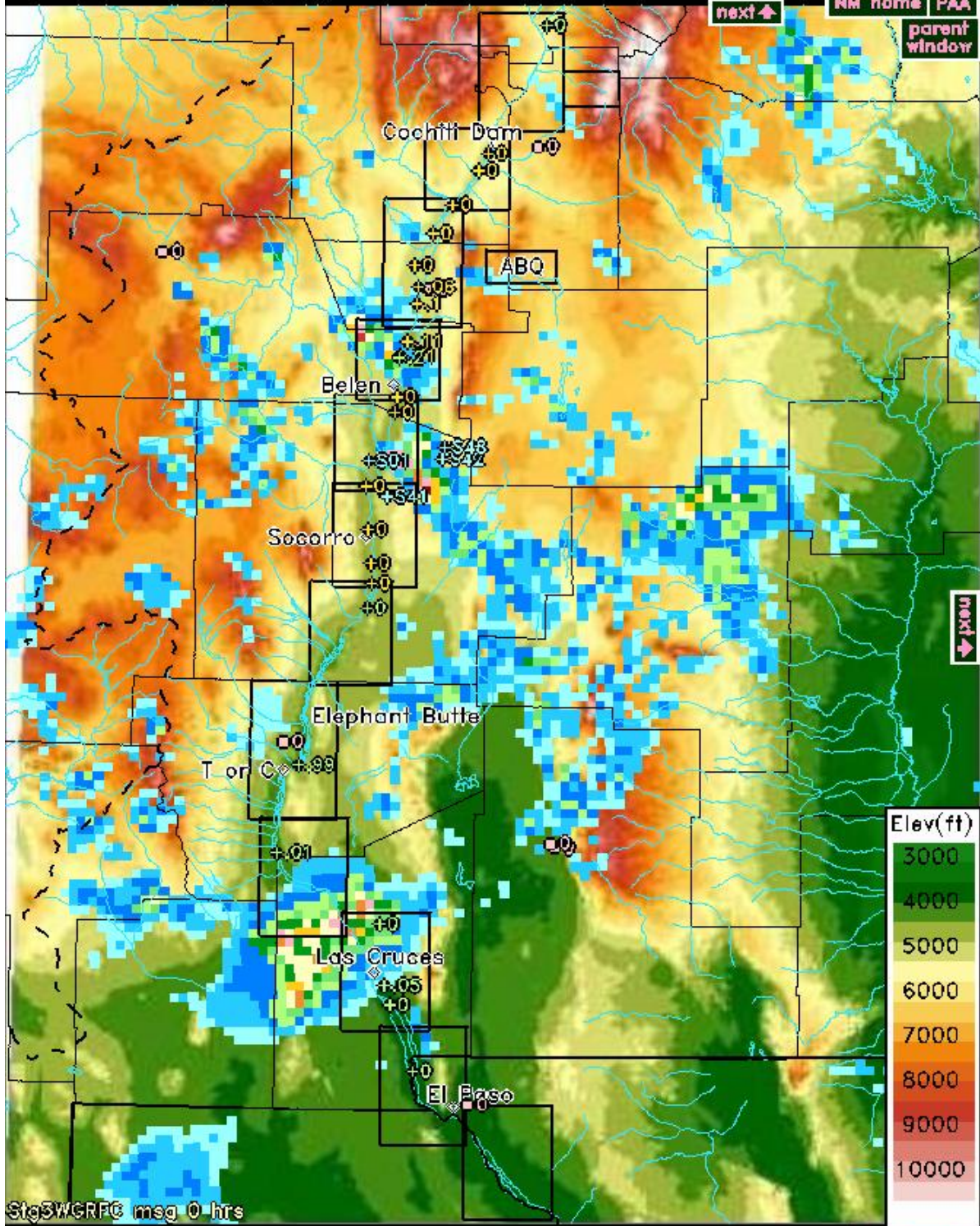


Stg3WGRFC msg 0 hrs

no topog. past days
+ ETTool

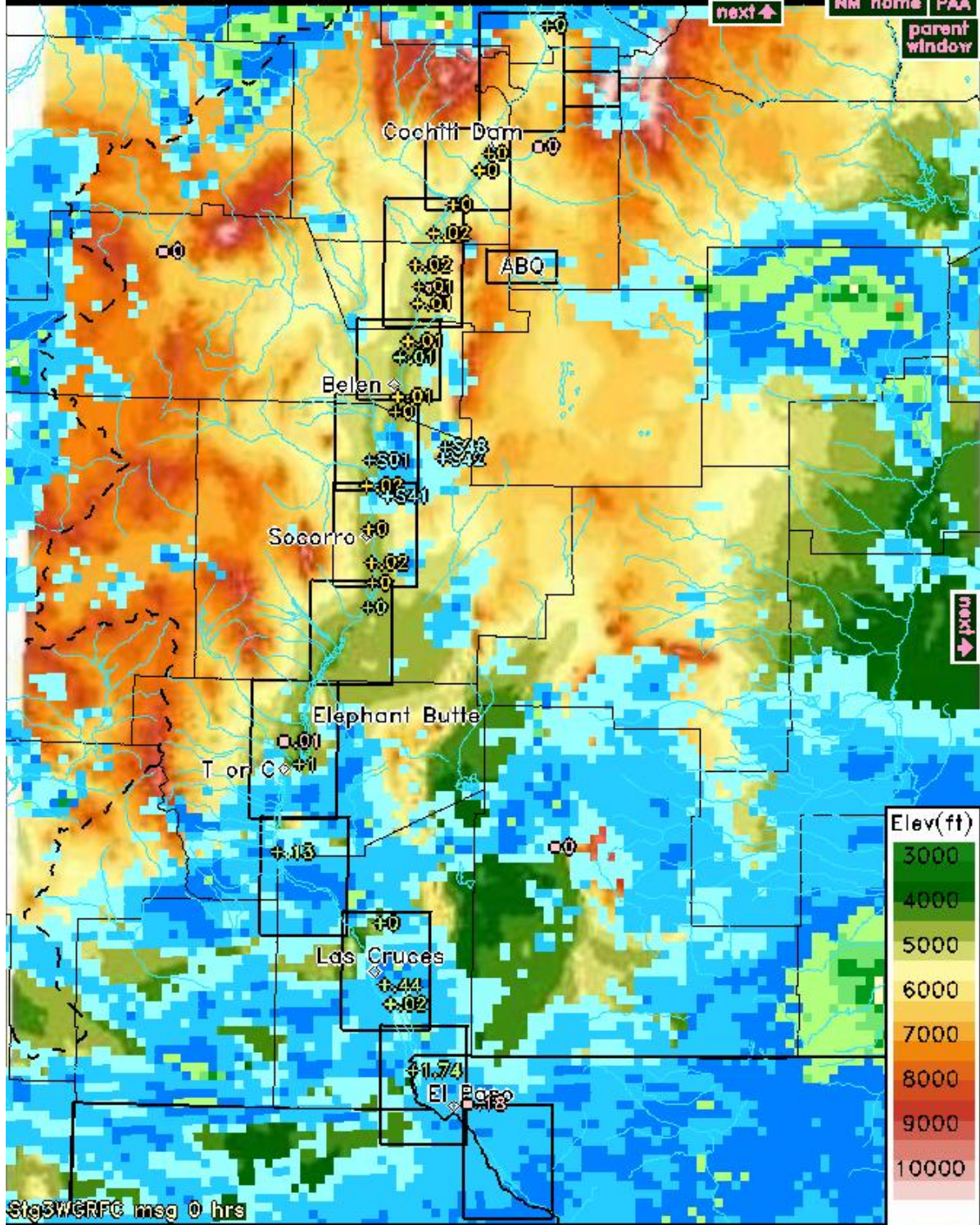
RAINFALL (in) 8/29/06 MST – MPE WGRFC

AWARDS allWin
NM home PAA
parent window



RAINFALL (in) 9/02/06 MST – MPE WGRFC

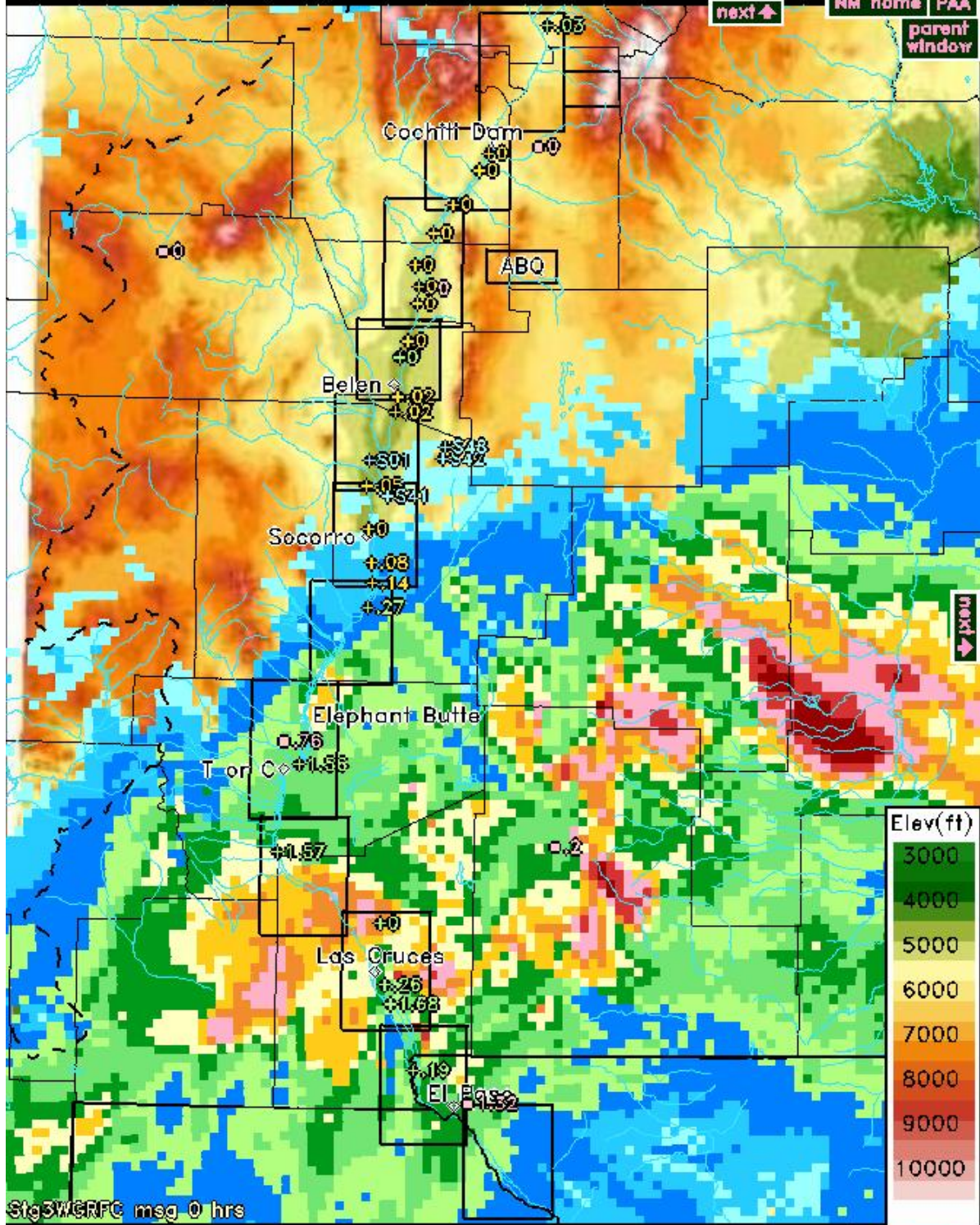
AWARDS allWin
NM home PAA
parent window



no topog.
past days
+ ETTool

RAINFALL (in) 9/03/06 MST – MPE WGRFC

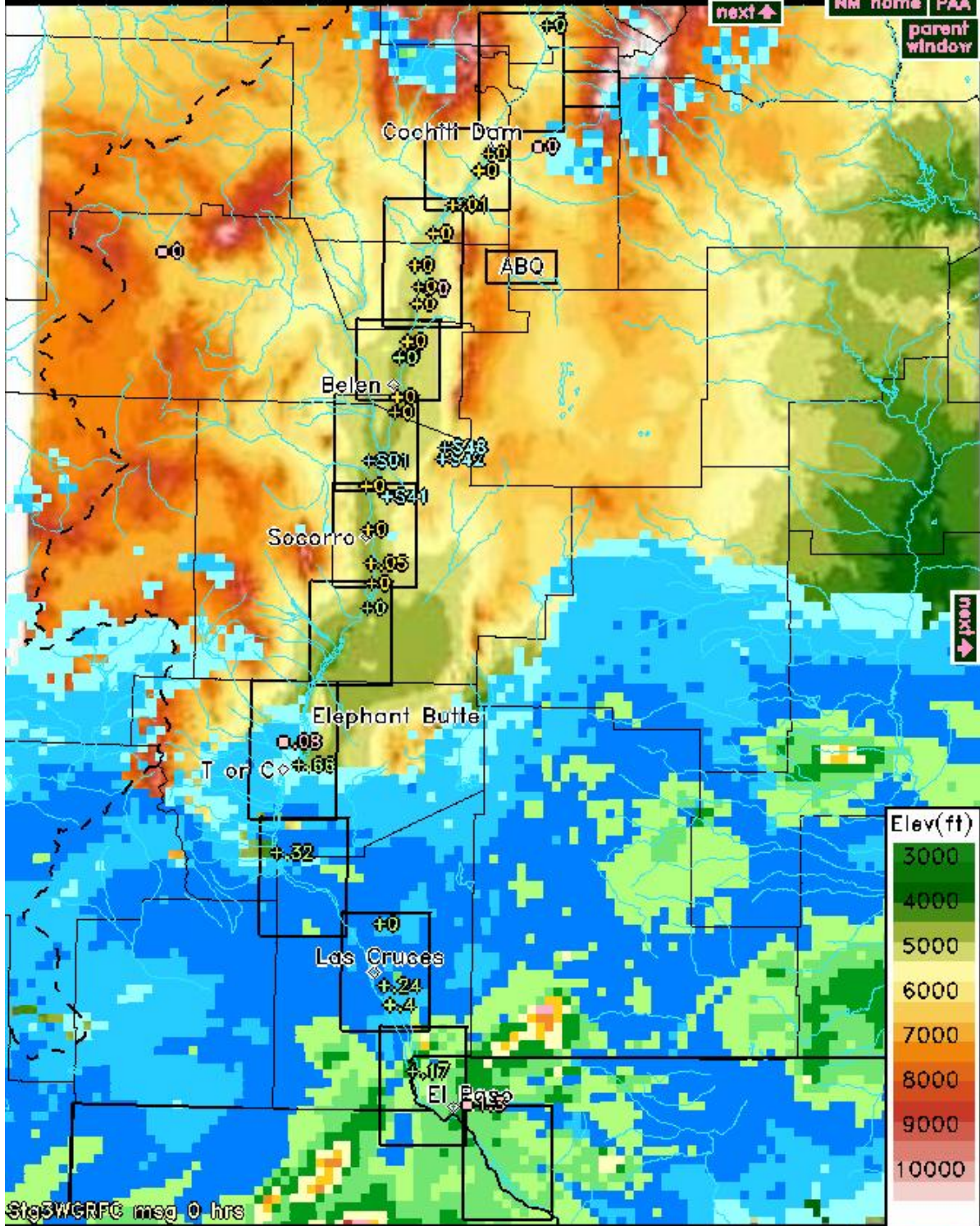
AWARDS allWin
NM home PAA
parent window



+ ETTool
no topog.
past days

RAINFALL (in) 9/04/06 MST – MPE WGRFC

AWARDS allWin
NM home PAA
parent window



no topog.
past days
+ ETTool