SOUTH TEXAS WEATHER MODIFICATION ASSOCIATION

EDWARDS AQUIFER AUTHORITY TARGET AREA

Looking north from near Pearsall on May 10, 2007 at seeded clouds in Medina County.
Photo: Ed Walker

2007 REPORT

2007 FINAL REPORT

for the

SOUTH TEXAS WEATHER MODIFICATION ASSOCIATION

EDWARDS AQUIFER AUTHORITY TARGET AREA

by

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THE YEAR IN REVIEW

STWMA continued to conduct cloud seeding operations over the tri-county EAA target area in 2007, marking year number six. The past year was rather wet, with several intense rainfall episodes occurring in south-central Texas primarily in the May through August period. On several occasions event totals topped ten inches. Because of the persistent heavy rains and subsequent flooding, seeding operations were conducted on fewer days than in years past. 2007 was comparable to 2002, the last time destructive flooding occurred within the target area. Operations took place on eleven days, with cloud seeding occurring on eight of these days. This compares with 14 days of seeding in 2006, 25 days of seeding in 2005, 20 days of seeding in 2004, 22 days in 2003, and 8 days in 2002.

One of, if not the best day for cloud seeding this past year was on May 10 (photo on cover) when an upper low over north-central Texas helped ignite showers and thunderstorms across the target area. Aggressive seeding of developing showers and thunderstorms took place, with several cells merging into a line that traversed the central and southern EAA target area and continued all the way to Corpus Christi by late that evening. Another day of seeding took place on the 24th. It would be nearly two months before another day of seeding would occur; a reconnaissance flight took place on July 14th but convection would die before the plane arrived. Between June and mid-August, over 20 inches of rain fell over a good portion of south-central Texas. Suspensions took their toll on seeding, with over six weeks of down time. It was a bittersweet result: Although we did not seed as many clouds as years past, the drought had come to a temporary end. Seeding operations resumed in mid-August, with the bulk of the seeding missions for 2007 taking place between August 15th and September 1st. A recon flight on September 27th would be the final flight for the EAA target area for the year.

The annual evaluation conducted by Archie Ruiz at Active Influence is not available for this report.

At the request of the EAA, the STWMA began a three-year experiment within the EAA target area where randomized seeding would take place. With a bit of guidance from the National Center for Atmospheric Research (NCAR), a randomization protocol was developed that would guide both the pilot and the meteorologist in conducting a randomized seeding experiment. The flight to the area of developing convection would take place and the pilot would determine if the activity was seedable based on cloud appearance, inflow strength and location. Once a seedable candidate was found, the randomized decision procedure would take place. This involves both the meteorologist and pilot opening an envelope, inside of which would be a card with either "SEED" or "NO SEED" written on it. The meteorologist would convey his envelope content to the pilot, but the pilot would not tell the meteorologist what was in his envelope. If both envelopes matched, the pilot would seed the cloud. He would continue the mission as usual, burning flares as long as conditions warranted. If the envelopes did not match, the pilot would continue to fly in the favorable location, but only "pretending" to burn flares as long as conditions warranted. By doing the randomization in this manner, only the pilot truly knows if the

cloud or clouds were seeded. The cards and notes for each day were to be placed into separate manila envelopes for future analysis, the purveyor of which has yet to be determined. Radar data from each day was also to be saved, again for future analysis. There were a few exceptions to the randomization enactment. If the activity was on the edge of the target area about to exit, if the clouds were too small, or if warnings were issued, the randomized protocol was not put into effect.

As it turns out, 2007 was not the best year for starting this experiment. The weather was not very cooperative, with only five of the eight days allowing for the randomized protocol to be enacted. In addition, it was not until late June before the protocol was developed. It is the hope of the STWMA that the upcoming seasons will be more favorable for continuing the randomized experiment.

2007 FLIGHT LOG

Date	Plane	Flight No.	Take Off Time	Landing Time	Total Time	No. Flares Used	Amount of AgI (g)	Flare Locations
10-May	47P	1	20:40	0:15	3.6	60	2400	Bexar, Medina, Uvalde
24-May	7AA	2	20:15	22:05	1.8	9	360	Medina
14-Jul	7AA	3	21:40	22:10	0.5			Recon to Bandera Co., convection died early
15-Aug	7AA	4	20:35	22:50	2.3	11	440	Medina - 11
21-Aug	47P	5	22:10	23:20	1.2	6	240	Bexar - 3; Medina - 3
26-Aug	09P	6	20:30	21:55	1.4			Recon to Medina Co.
29-Aug	09P	7	21:50	23:20	1.5	4	160	Bandera - 4
30-Aug	47P	8	19:20	21:45	2.4	20	800	Bexar - 9; Medina - 11
31-Aug	47P	9	17:55	18:55	1	2	80	Medina - 2
1-Sep	09P	10	18:50	21:15	2.4	12	480	Bandera - 4; Medina - 8
27-Sep	09P	11	20:40	22:05	1.4			Recon to Bandera Co.
		11 flights			**19.5**	**124**	**4960**	**8 seeding flights; 3 recon flights**

MAY 2007

May was a month of contrast over the EAA target area. While eastern Bexar County had below normal rainfall for the month, central and western areas, particularly Bandera County, saw well above normal rainfall. Several severe weather episodes affected the target area this month, the majority of which took place at night. As such, seeding did not take place. For the month, there were two days on which seeding activity took place, with radar trends and satellite imagery suggesting a good to excellent response to the seeding. 69 flares were used for seeding (Bexar - 7; Medina - 59; Uvalde - 3), totaling 2760g of AgI.

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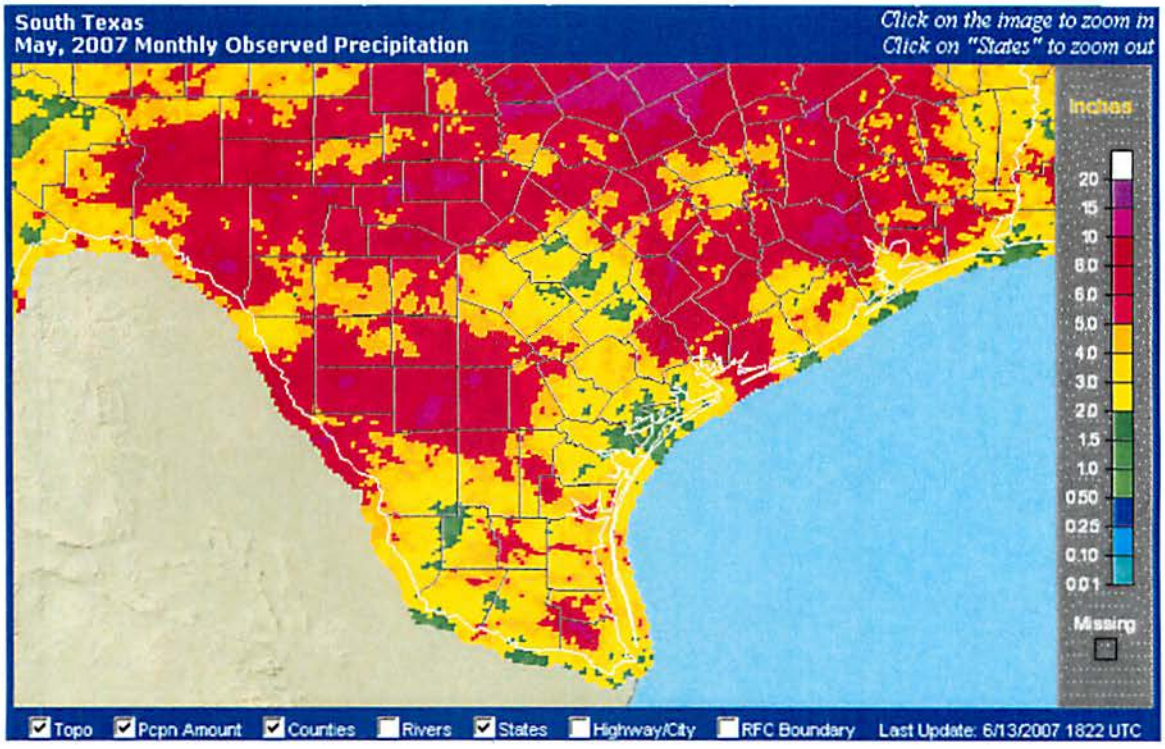
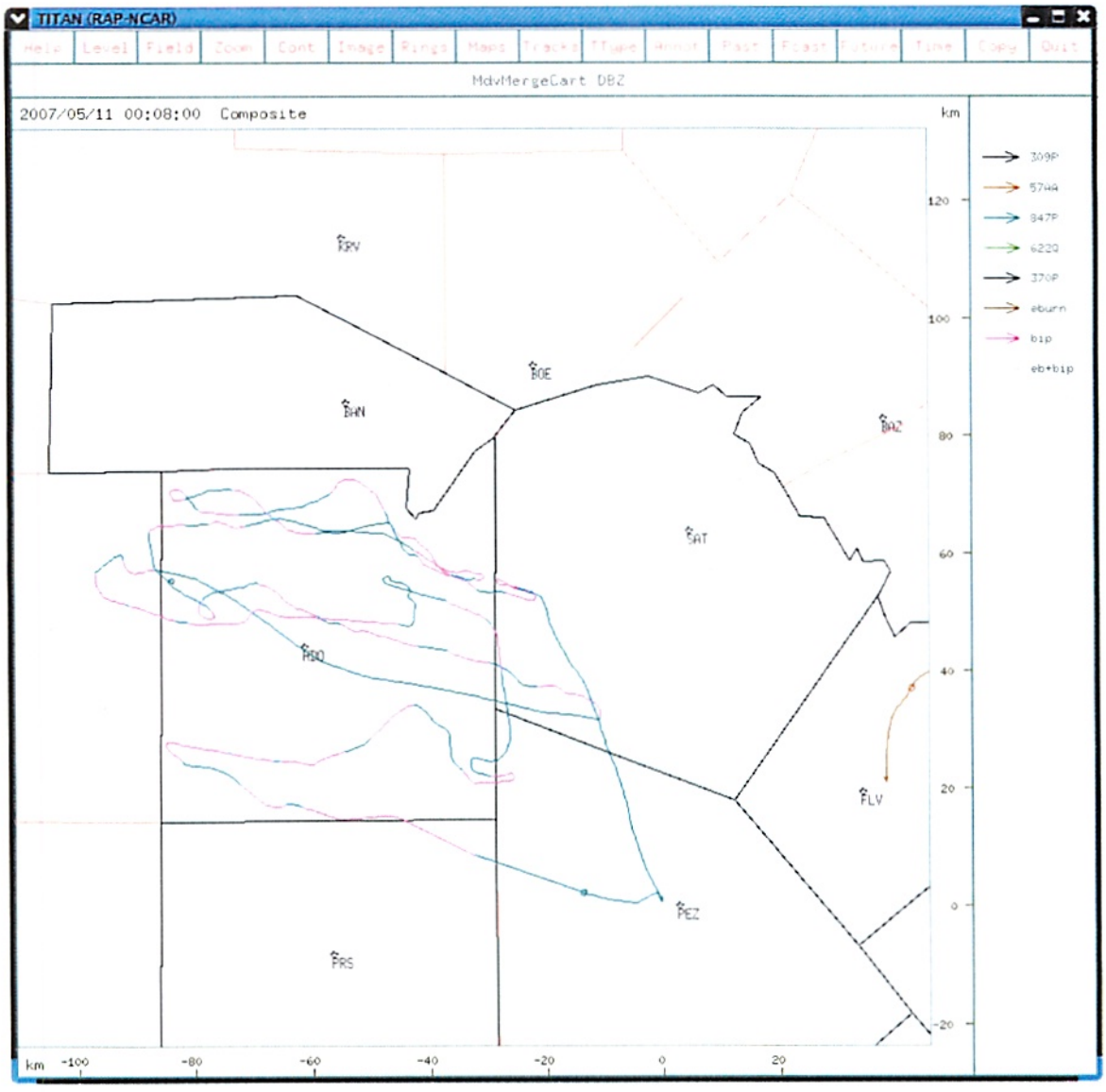


MAY 10

The upper level low that provided several days of rain to west Texas was finally making a move to the east and southeast, and was located over central Texas early in the afternoon. Cold temperatures aloft associated with the low were helping to destabilize the atmosphere. In addition, a vort max was rotating around the underside of the low, moving across south-central Texas. Although the moisture profile over the target area wasn't as good as previous days, it was sufficient to provide fuel for developing showers and thunderstorms as surface heating approached its diurnal peak. Initial convection took place near Medina Lake at mid-afternoon, at which time a flight was dispatched to investigate. Good inflow was found in this area where several clouds were building, and seeding commenced. Several cells were seeded, with the first cell moving across western and central San Antonio before dissipating in southeastern Bexar County. The second seeded cell appeared to have a better response, with an increase in areal coverage and an increase in intensity as it moved southeast in a similar fashion to the first cell. This second cell lasted longer, making it to south of Floresville before dissipating. Additional activity was seeded in Medina County that merged into a short line that moved across Medina and western Bexar counties, eventually exiting the tri-county area. This activity, incidentally, continued southeastward to Tilden and George West before finally dissipating just north of Corpus Christi around mid-evening.

60 flares were used for seeding (Bexar - 7; Medina - 50; Uvalde - 3), totaling 2400g of AgI.


TITAN (RAP-NCAR)
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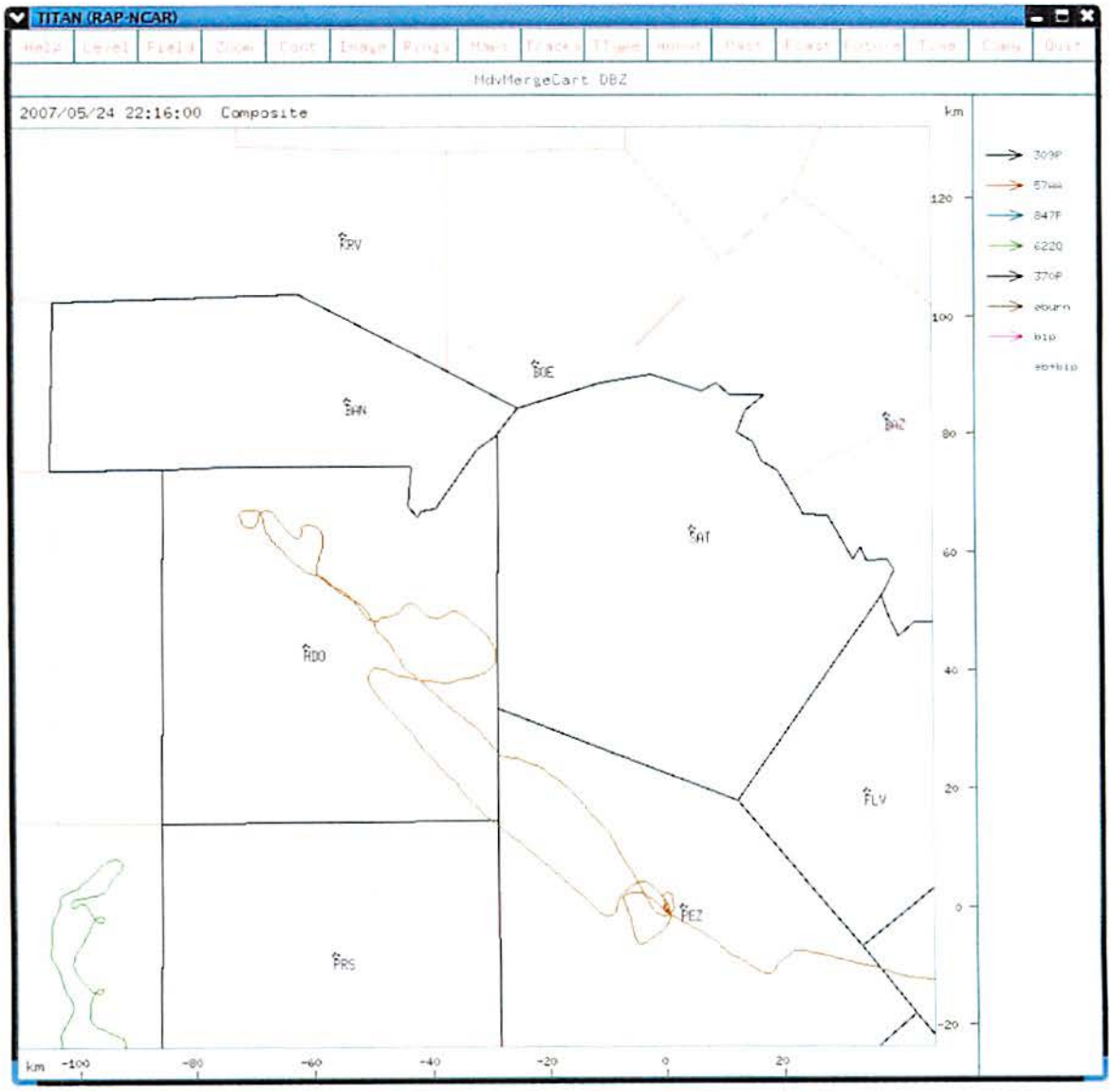
MAY 24

Most of the active storm systems were located well to our north, with no real discernable features over Texas to provide widespread lift. There was a weak frontal/outflow boundary north of the Hill Country, but this had no impact on our weather today. A weak wind field allowed for a surge of moisture to come in off the Gulf in what looked like a seabreeze front, but was not well-defined. Still, with some solar heating, showers and thunderstorms developed, particularly near the leading edge of this surge. Pilots were not available until mid-afternoon, so until then, convection was not seeded. Once a plane did launch, some activity was seeded in Medina County. This activity appeared to respond well, with an increase in areal coverage and expansion of moderate reflectivity values. This activity exited the target area north of Bandera County, still precipitating. Overall, a good day.

9 flares were used for seeding in Medina County, totaling 360g of AgI.



JUNE 2007

June continued the trend of wet weather that affected the area in May. The entire target area accumulated over three inches of rainfall with isolated spots near ten inches. Despite the heavy rainfall, seeding did not take place during the month due either to unfavorable cloud conditions or flood warnings being issued. We had one reconnaissance flight on the 14th to Bandera County, but no seeding took place due to lack of inflow. Activity seeded on the 16th south of the EAA target area affected the southern half of Bexar and Medina counties. The subtropical ridge of high pressure that normally occupies the southern part of the country by this time of year was split into two ridges, with Texas located in between. This was a favorable area for upper level lows to develop and meander over the area, the reason such copious amounts of rainfall occurred.

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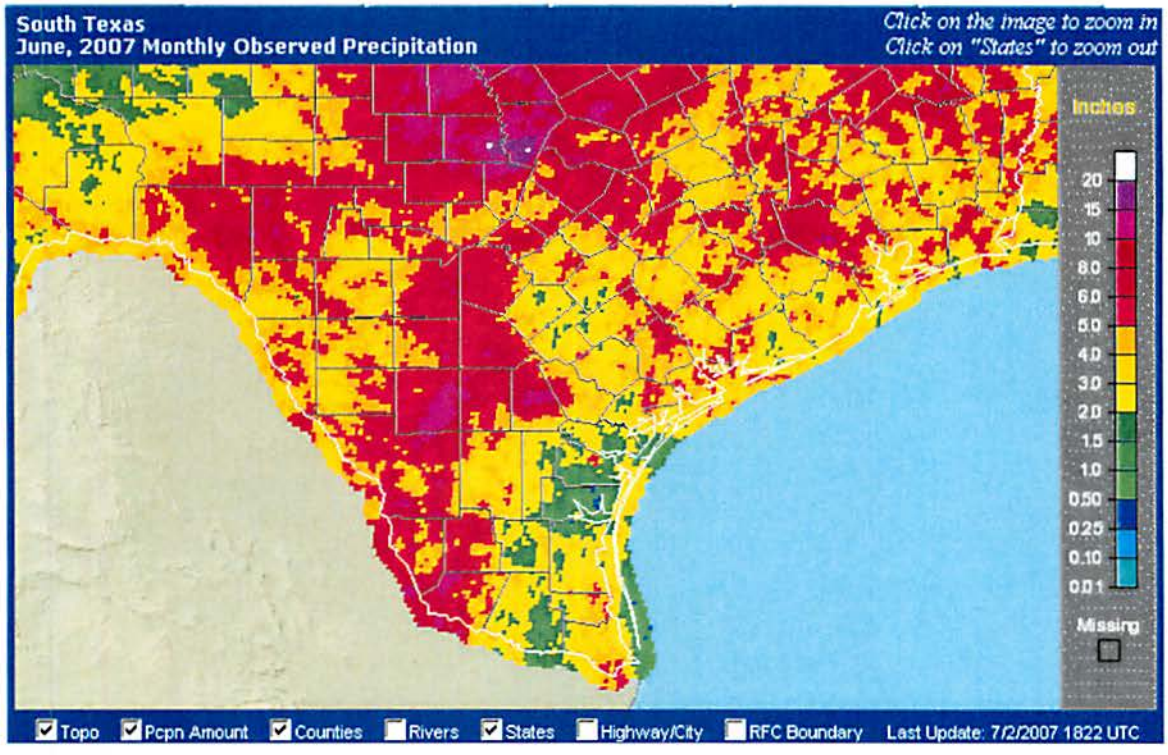

JULY 2007

May was wet. June was wetter. July ended up being wetter still, with many locations reporting in excess of ten inches; in fact, over 20 inches of rain fell in northwestern Medina County. Flooding was an ongoing problem for much of the month. Because of this, the project stood down for much of the month to allow for soils to drain and rivers to come down into their banks. This was a very slow process due to the near-daily rains that fell. No seeding missions occurred during the month.

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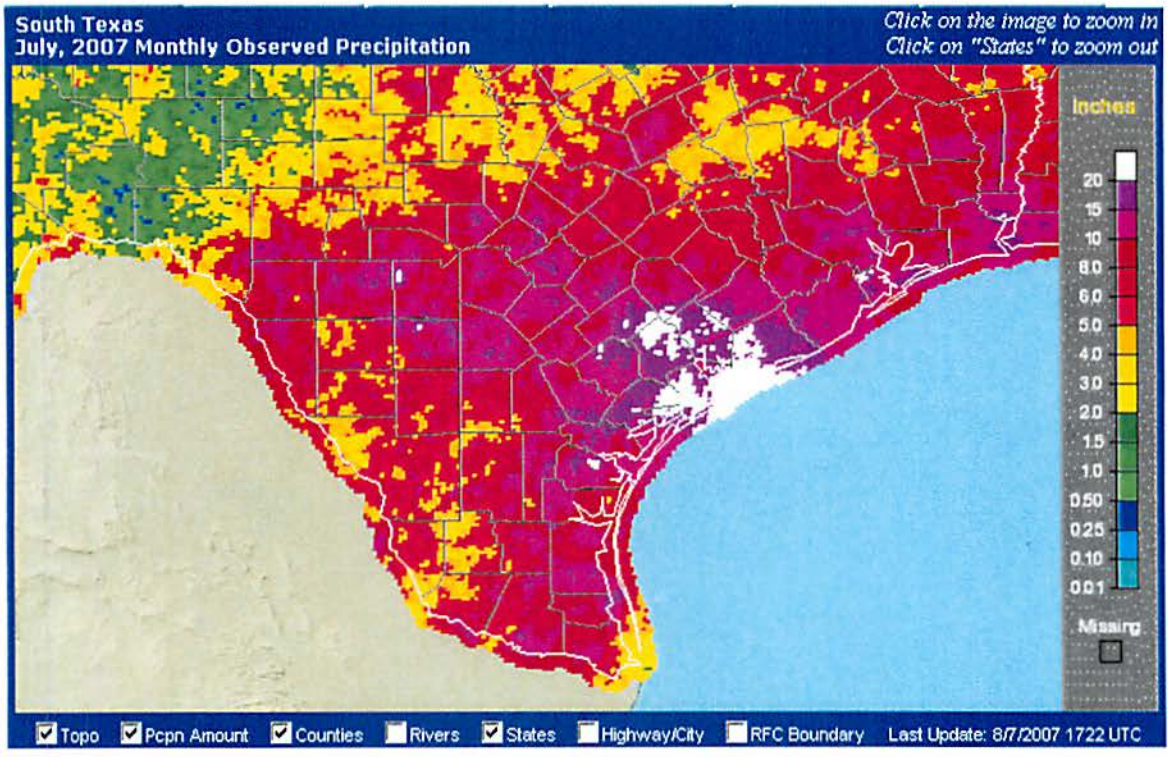

AUGUST 2007

The wet trend of the past few months continued into August, although most of the rainfall occurred during the second half of the month as the first two weeks saw high pressure affect the area. One notable weather event was the remains of Tropical Storm Erin moving through the area on the 16th and 17th. Widespread three to seven inch rainfall totals were reported, with spotty amounts in excess of 8 inches in Bexar County. The remainder of the month saw several days with convection and seeding take place.

For the month, a total of 43 "potential" flares were used for seeding (potential is used since some of these flares may not have been burned due to the randomized procedure in effect), totaling 1720g of AgI. Of these, four were in Bandera County, 12 were in Bexar County, and 27 were in Medina County. Seeding occurred on five days during the month, with a sixth day only seeing a reconnaissance flight take place.

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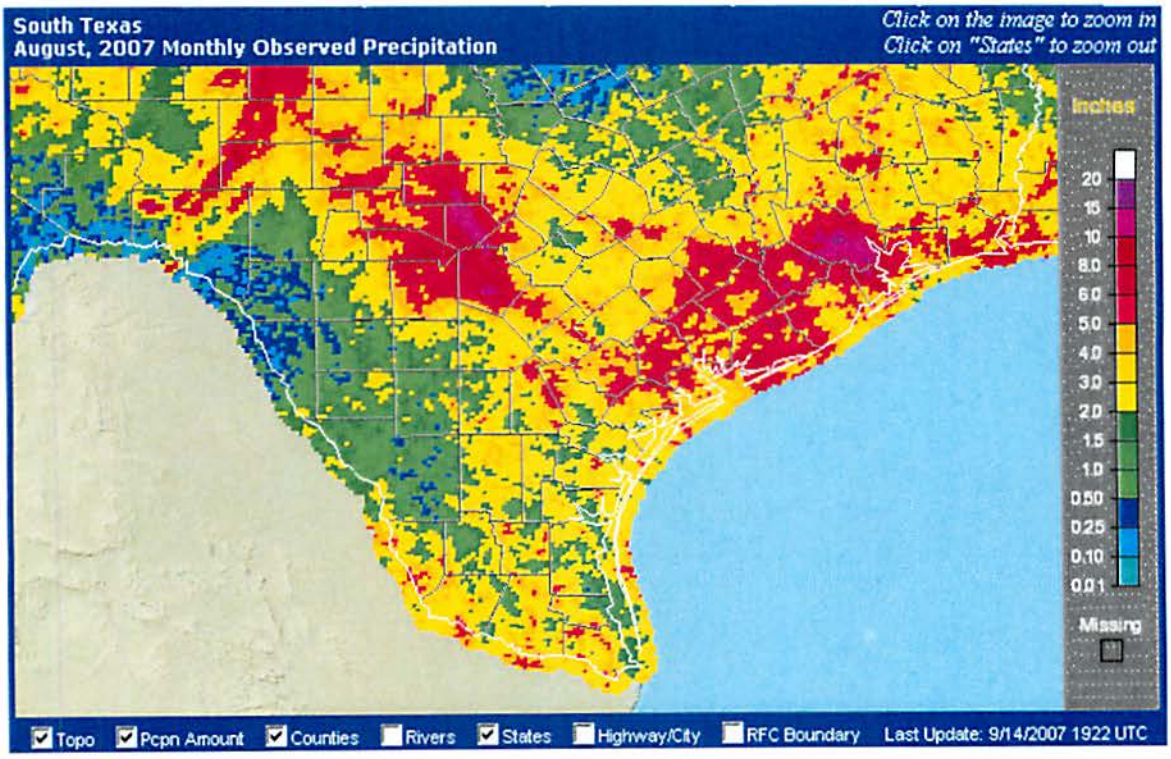
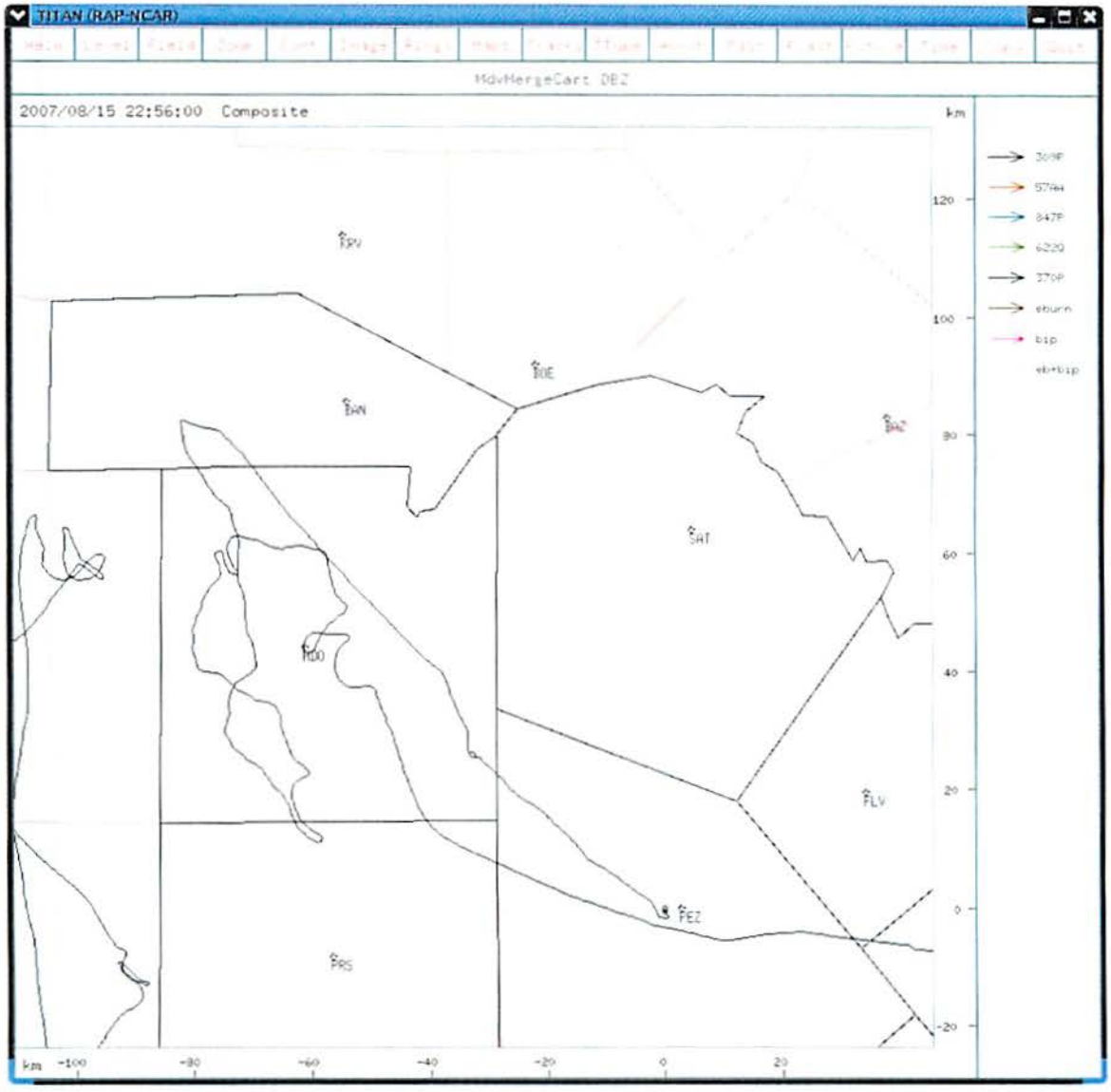


AUGUST 15

Deeper moisture was advecting into south Texas ahead of approaching Tropical Storm Erin. An outer rain band was approaching the area during the afternoon hours. Out ahead of this band, strong surface heating allowed for a few scattered showers and thunderstorms to develop over the northwest and central target area with a westward movement. A plane was dispatched to investigate the activity in Medina County. Upon reaching the convection near Hondo, the pilot reported high bases (>5500'). As this activity was within the EAA target area, the randomized seeding protocol was put into effect. Most of the activity did not last too long, although one cell that may or may not have been seeded traveled well into Uvalde County. The mission was terminated early with the approach of the rainbands from Erin.

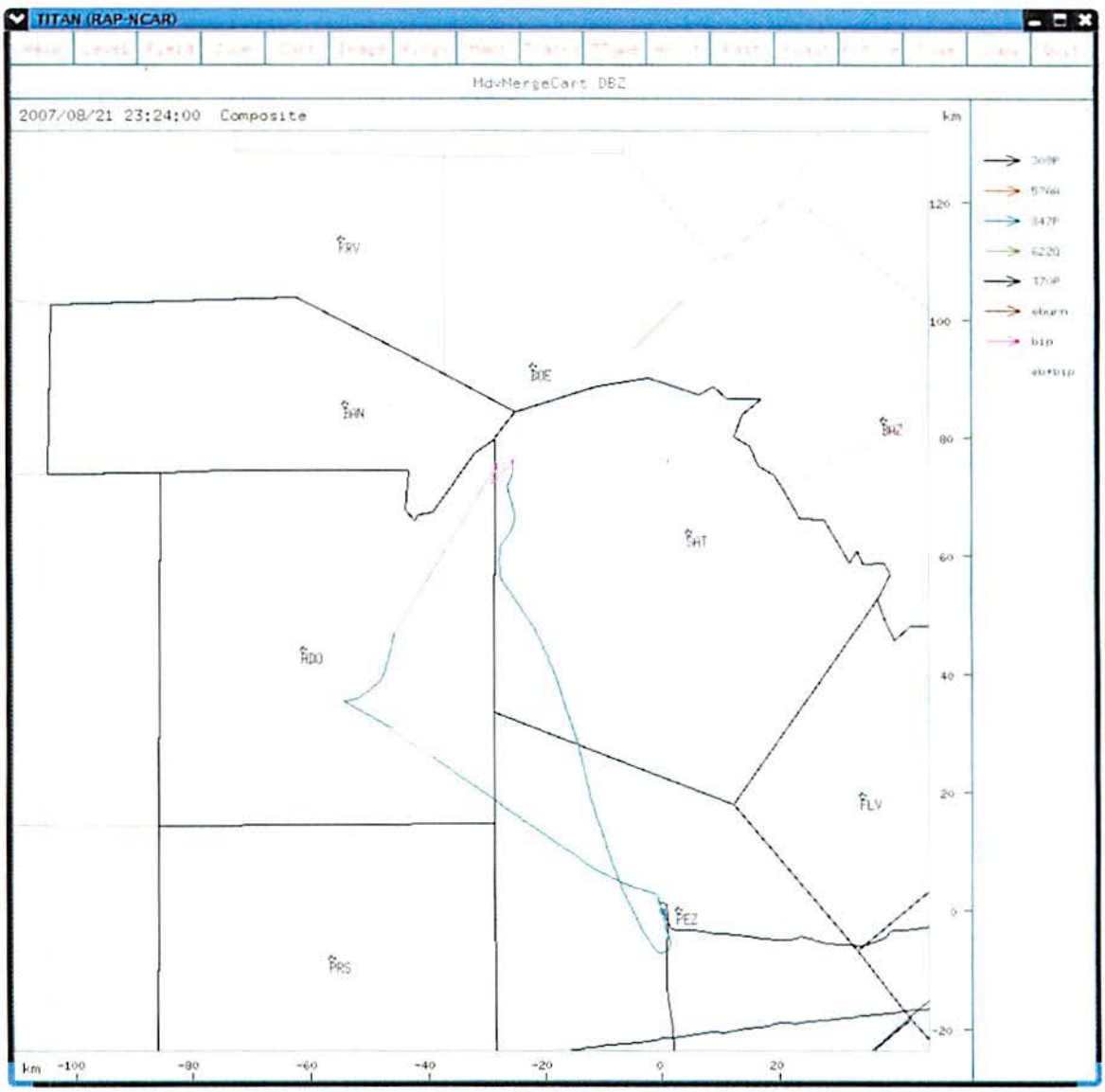
11 "potential" flares were used for seeding in Medina County, totaling 440g of AgI.



AUGUST 21

A TUTT was pushing into Mexico and was centered near Monterrey in the morning. This put south Texas on the favored eastern side for lift and convective development. Indeed, a surge of high-PW moisture moved northwest across the area during the morning and afternoon hours, with convection developing as daytime heating increased. A plane was dispatched late in the afternoon to investigate small cells in Bexar and Medina counties. Seeding took place in these counties without the randomized procedure put into effect due to error on the part of the meteorologist. The activity was short-lived. Overall most activity diminished after an hour.

Six flares (Bexar - 3; Medina - 3) were used for seeding, totaling 240g of AgI.



AUGUST 29

Morning convection near the coast helped spread a mid and high level deck of cloud over south Texas which approached the southern target area during the afternoon hours. Around mid-afternoon, convection developed over the western target area just north of the mid level cloud deck. A flight was launched to investigate the activity in Medina and Bandera counties, where the randomized seeding protocol was enacted. This area of convection organized into a small line with very heavy rainfall and a Flood Advisory was eventually issued for this area. Overall it was not the best of days for seeding due to the tropical nature of the convection.

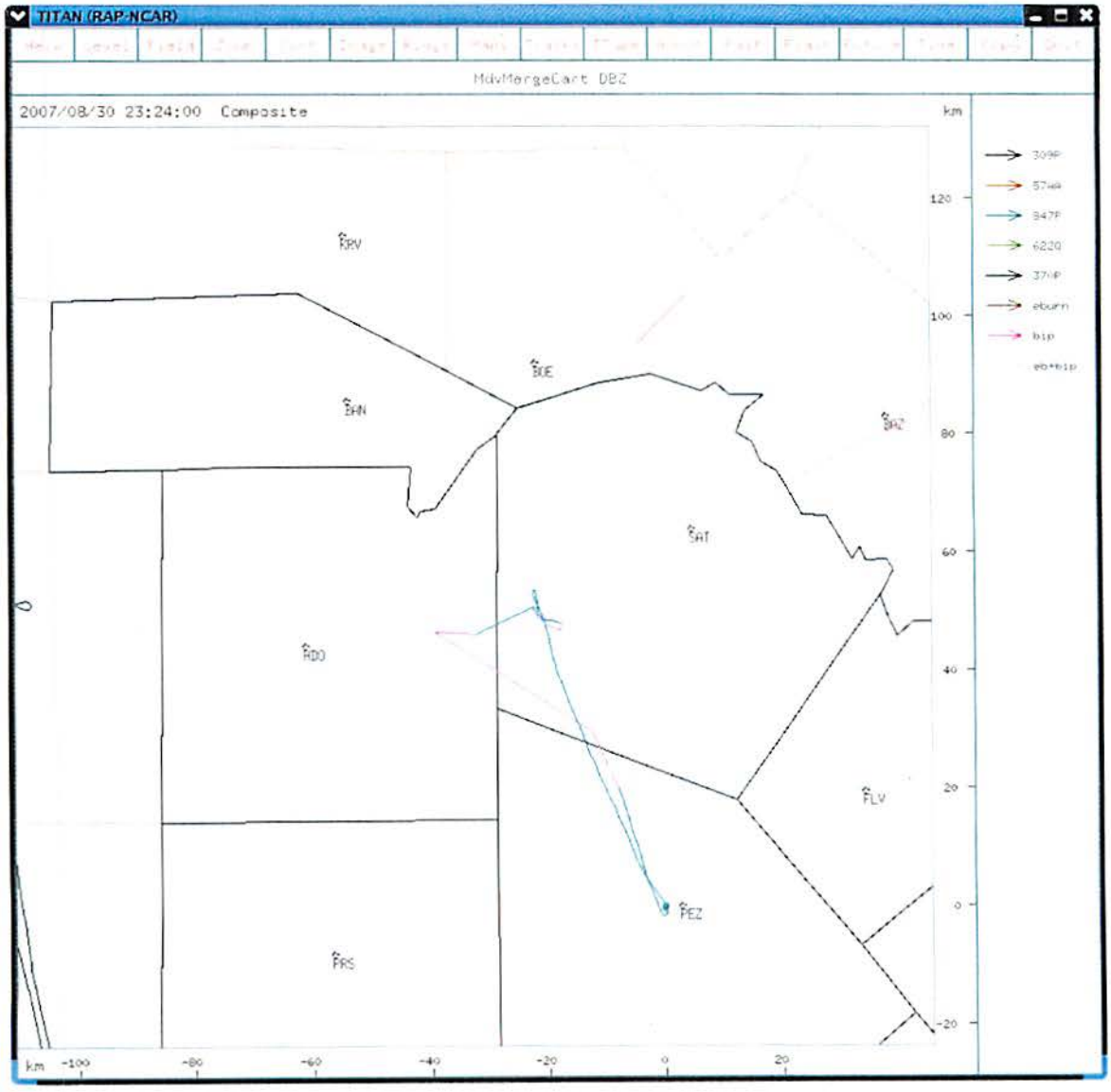
Four "potential" flares were used for seeding in Bandera County, totaling 160g of AgI.

Due to telemetry and internet problems, a flight track for this day is not available.

AUGUST 30

A very juicy airmass was in place over south Texas as tropical moisture was pooling ahead of a front located over central Texas. Convection began in the morning hours near the coast where the trough had helped generate tropical showers and thunderstorms. Early in the afternoon popcorn-type showers began to develop over the Escarpment as convective temperatures were reached and diffluent flow aloft aided upward motion. Very weak northeast winds over the area resulted in a slow southwest motion to the cells. A flight was launched at 1920 UTC to investigate development in Bexar and Medina counties. Once it was determined that convection was seedable, the randomized protocol was enacted. Three cells had this procedure performed. With no other activity in the target area, the pilot returned to base. It appears that all of the potentially seeded clouds merged together into one line that moved southwest towards Frio County during the late afternoon hours.

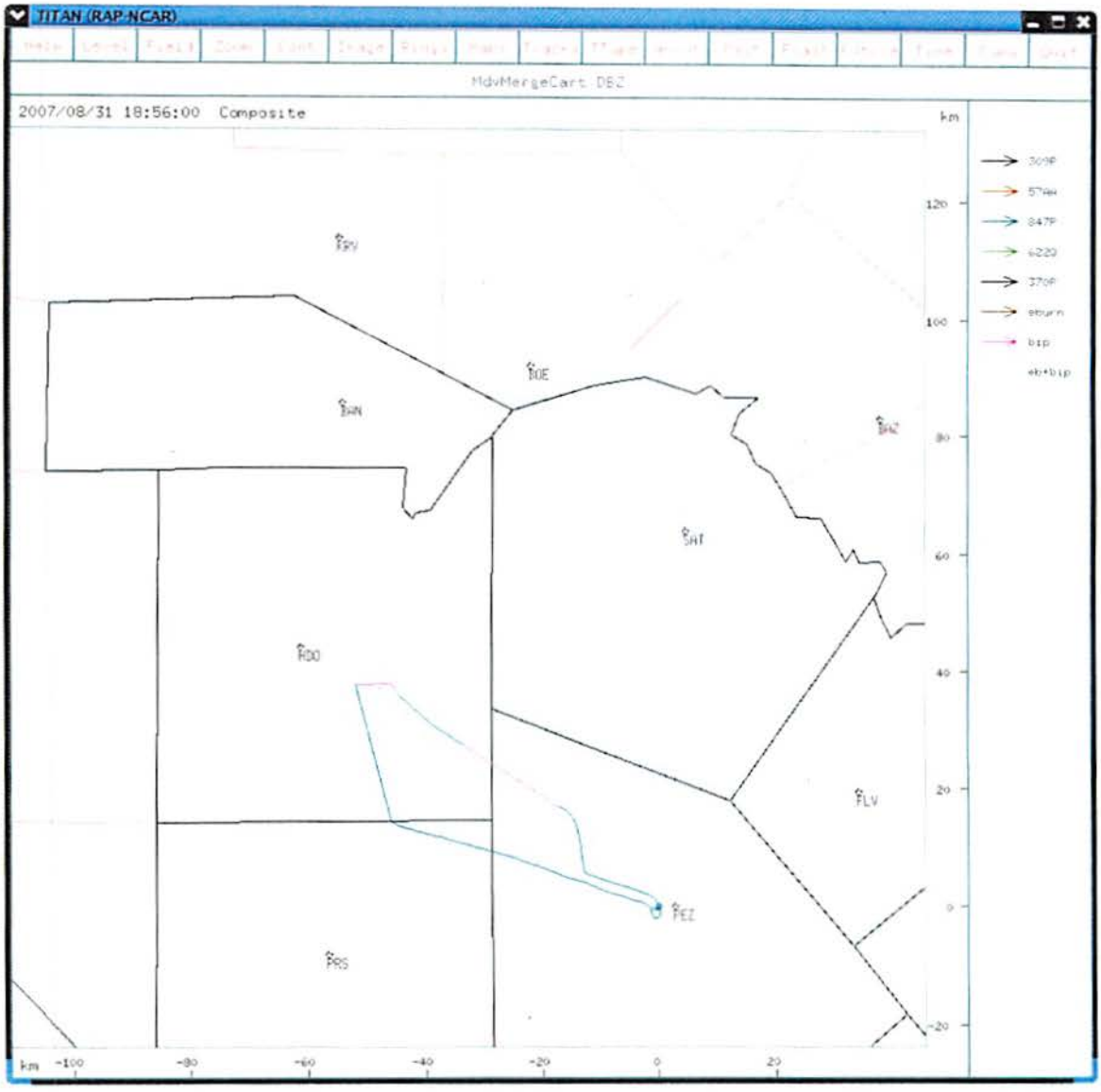
20 "potential" flares (Bexar - 9; Medina - 11) were used for seeding, totaling 800g of AgI.



AUGUST 31

Scattered tropical showers and thunderstorms developed along the Escarpment during the noon hour and a flight was launched to investigate. Weak inflow was found and the randomized seeding procedure was put into effect. Inflow was spotty at best and the convection, although producing heavy rainfall, was low-topped.

Two "potential" flares were used for seeding in Medina County, totaling 80g of AgI.



SEPTEMBER 2007

September started out on the wet side, with scattered showers and thunderstorms developing on the 1st in a tropical airmass. This happened to be the only day of the month where seeding took place within the tri-county area. Although rains fell on a few more days during the month, cloud profiles were unfavorable for seeding (low-topped, for example). While some areas received above normal rainfall (western Bexar/eastern Medina counties), others were drier than normal (central Medina, eastern Bexar counties). Temperatures were certainly warmer than normal as the area did not see any strong frontal passages which typically resume during September.

For the month, there was one day on which seeding took place and one day where a reconnaissance flight took place. Two flights were logged. A total of 12 "potential" flares (Bandera - 4; Medina - 8) were used for seeding, totaling 480g of AgI.

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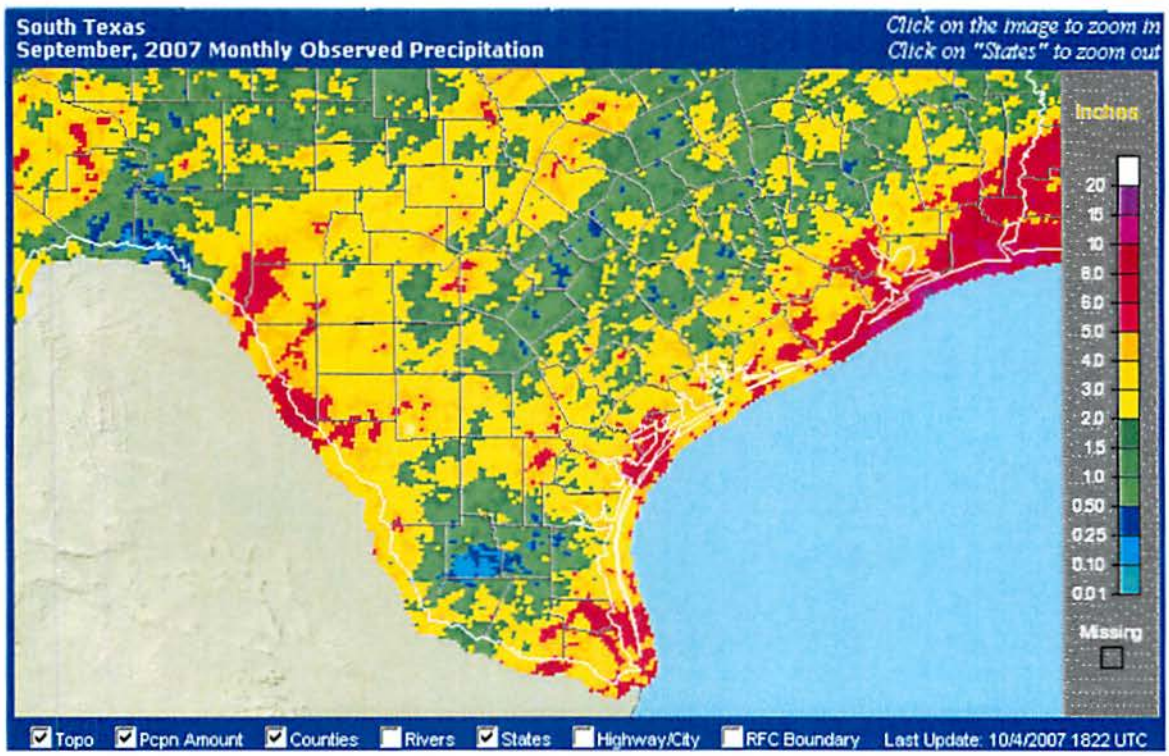
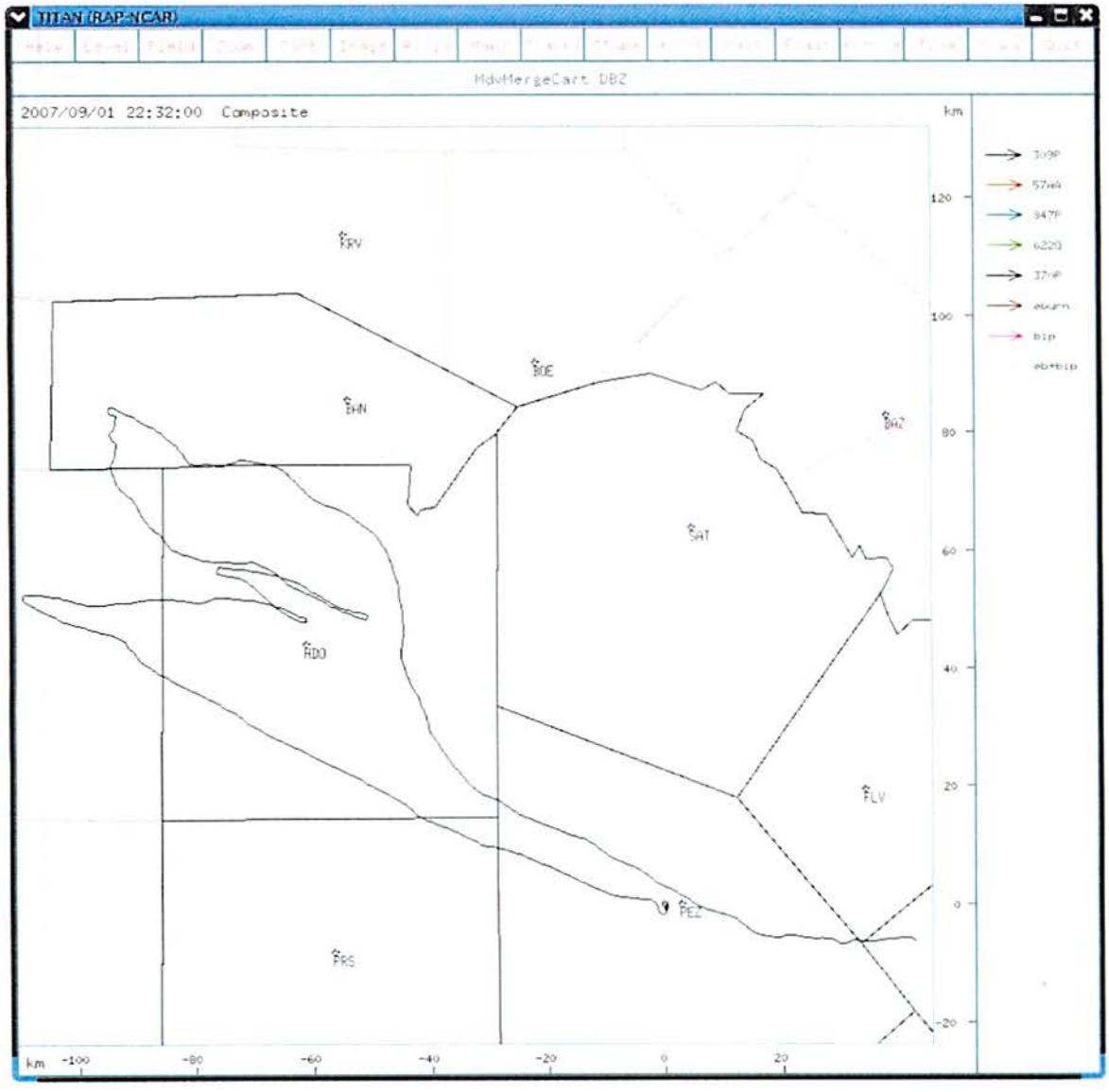


SEPTEMBER 1

An upper level trough axis extended southwest across the region and a circulation had developed near Del Rio around the noon hour. With clouds rapidly eroding across the region, daytime heating destabilized the atmosphere, and showers and thunderstorms began to develop. However, sky conditions today were very hazy and visibility was an issue during the seeding flight. Warm cloud bases were reported during the mission. A randomized seeding flight took place during the early afternoon hours, with one cloud in each of Medina and Bandera counties being investigated.

A potential of 12 flares were used (Bandera - 4; Medina - 8), totaling 480g of AgI.



APPENDIX

Mesoscale Convective System (MCS) is a large complex of showers and thunderstorms at least 100 km (~60 miles) across, and may be as large as 500 km (~310 miles) across.

Vorticity maxima, or vort max as referred to in this report, is defined as a pocket of the atmosphere where rotation of the air about a vertical axis is maximized.

Shortwave, or shortwave trough, refers to a small-scale area of lower pressure, sometimes accompanied by showers and thunderstorms.

Cell refers to an updraft-downdraft couplet in a cloud. Clouds with several updraft-downdraft couplets are called **multicell** clouds. A storm with a single updraft-downdraft couplet (often rotating) that lasts for several hours is called a **supercell.**

Pre-frontal trough refers to an elongated area of low pressure found ahead of an advancing cold front. In south Texas, the passage of a pre-frontal trough usually signals the end of precipitation, as winds tend to turn more to the west or northwest, cutting off moisture supply.

Precipitable Water is the total amount of water vapor in a column of air above a given location. This value is expressed in inches. High precipitable water values (>1.5 inches) are indicative of the potential for heavy rain. Tropical airmasses usually have a precipitable water value in excess of two inches.

Convective temperature is the temperature required at or near the ground in order for convection (surface-based) to occur.

TUTT, or Tropical Upper Tropospheric Trough, refers to a upper level cold core area of low pressure found in the tropical and sub-tropical regions of the Earth. These disturbances are sometimes associated with shower and thunderstorm activity, and are associated with tropical waves.

Theta-e, or equivalent potential temperature, is the temperature a parcel or bubble of air would reach if it was lifted until all of the moisture condensed out, then brought back down to 1000 mb (at/near surface). A forecaster looks at theta-e to see how moisture is distributed over a region. High theta-e values are associated with moist airmasses, which storms may develop in and feed on.

Jet streak refers to the maximum wind speed within a river of faster-moving air (jet stream). Forecasters may look for jet streak locations at 850mb, 700mb, 500mb, and 250 mb in order to assess the possibility of strong/severe thunderstorms.

Cap refers to a warm layer of air aloft which acts as a lid, suppressing convection. The strength of the cap varies with time and location.

Convective Inhibition is the amount of energy required to overcome the cap, or the amount of energy required by a parcel of air to initiate deep convection (i.e., thunderstorms).

Lifetime refers to the length of time a cloud was detected on radar, with a reflectivity maximum of at least 32 dBZ.

ACKNOWLEDGEMENTS

2007 appeared to be yet another successful year of cloud seeding within the Edwards Aquifer Authority target area. The success of the project comes about through the hard work of many people, and it is here where gratitude must be expressed.

Our two "heads of state", if you will, Tommy Shearrer and Mike Mahoney, continue to do many hours of work to ensure that the project gets past any red tape and runs as smoothly and efficiently as possible. Many thanks go their way, as the project would likely be lost without them. Thanks also go to the board members who regularly meet to discuss purchases, improvements, seeding methods, and any other factors that affect the way the program is run. Their input in the past has helped run a successful program, and we hope they will continue their good work. We certainly couldn't have the great planes and the successful flights without the hard work of our pilots: Craig Funke, Larry Dement and Robert "Butch" Card. We must also thank Craig for completing the annuals on our planes. Thanks must also go out to Candi Gonzales, who handles much of the laborious paperwork for the project, and to Larry Akers, who keeps our radar in tip-top shape. Speaking of radars, we must thank the crew at WDT, Inc. for providing us with the NEXRAD feed. The cloud seeding projects may not be here had it not been for George Bomar, who works with the projects and the Department of Licensing and Regulations - thank you. Thanks also to Rick Illgner, Len Wagner and the EAA for working with us this year and in the years to come. The crew at SWTREA deserves thanks for working together with the STWMA to make weather modification operations run more smoothly. Finally, thanks go out to the public, most of who continue to believe in our project and our mission. Without your approval, our project would cease to exist. Thank you all!

Rainfall maps for 2007 came from the following website:
http://www.srh.noaa.gov/rfcshare/precip_analysis_new.php