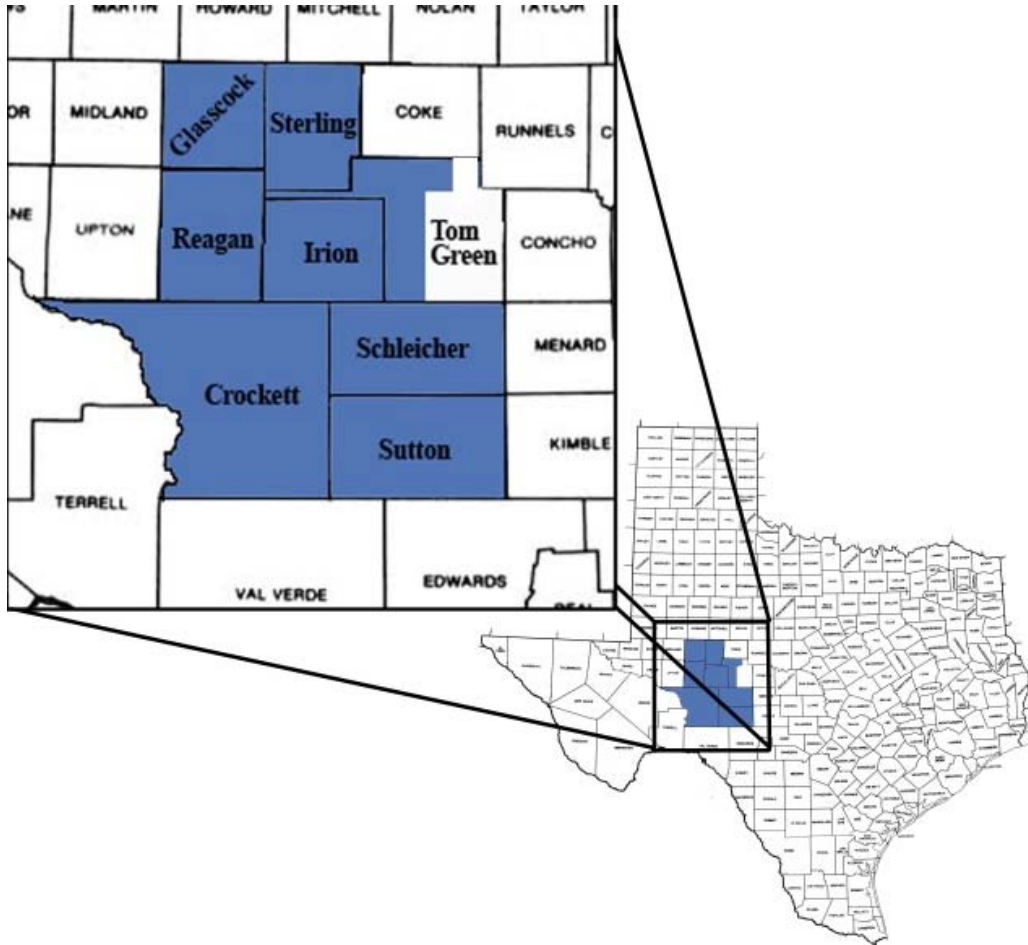


2010 ANNUAL REPORT WEST TEXAS WEATHER MODIFICATION ASSOCIATION



West Texas Weather Modification Association
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West Texas Weather Modification Association 2010 Annual Report

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Seeding operations started on March 8th and ended on September 12th with 43 operational days. The season was governed largely by high pressure with a long string of 100° days from July through August. 127 clouds were seeded with 1,995 flares during 76 flights. The number of seeded clouds is near average since changing radar sources from 74-C to WSR-88D feed. 6 reconnaissance flights were flown while making an attempt to find seedable clouds on marginal days. Pilots flew 185.6 flight hours. Six part time pilots including two new pilots made for nearly seamless missions during the season.

Weather Decision Technologies, Inc. fixed minor issues with Thunderstorm Identification, Tracking, Analysis and Nowcasting (TITAN) software providing no lost data and very good operations throughout the season. The computer system is a little over a year old without major hiccups.

2010 was a rather dry year. Annual rainfall (20.13in) at San Angelo was very near yet slightly below normal. Precipitation and percent of normal maps show that much of West Texas was well below normal for the majority of the season. San Angelo managed to be mostly above normal with monthly precipitation from January through August but a change in weather patterns governed by ENSO lead to less precipitation for the last quarter. July marked the wettest month of the season when Hurricane Alex struck the coast of northern Mexico and remnants moved up the Rio Grande.

The statistical reports conducted by Active Influence and Scientific Management (AISM) shows the majority of seeding operation result was excellent or very good; with an average seasonal increases to precipitation at 21%. Arrival time to small clouds (91%) was excellent. Small clouds showed increases for precipitation mass at 111%, cloud mass increases of 52%, lifetime increases at 47%, increases to cloud area at 36%, cloud volume increases of 38%, and volume above 6Km of 31%. Increases in precipitation mass by county were shown between 14% and 34%. Crockett and Schleicher Counties both returned 14%. Schleicher County was most favored in number of seeded clouds. In addition to Glaciogenic seeding, West Texas also continued a case study using one supplementary hygroscopic flare. Unfortunately, only a small number of cases could be matched with a proper control sample. Further information can be read in the AISM evaluation. Total increases in precipitation for the target area were calculated at 1,615,985 acre-feet.

Robert Rhodes
Meteorologist

Dr. Arquímedes Ruiz-Columbié

Active Influence & Scientific Management

Cloud seeding operations 2010 began over the West Texas Weather Modification Association target area in March. This annual report serves as a summary of results. A total of **127 clouds** were seeded and identified by TITAN in **43 operational days**. Table 1 in page 1 summarizes the general figures:

Table 1: Generalities

First operational day: **March 8th 2010**

Last operational day: **September 12th 2010**

Number of operational days: 43

(Two in March, none in April, four in May, ten in June, twelve in July, ten in August, and five in September)

According to the daily reports, operational days were qualified as:

Twenty-one with excellent performance

Eleven with very good performance

Five with good performance

Three with fair performance

Three operational days with corrupted data (June 1st and 2nd, and July 6th)

Number of seeded clouds: 127 (78 small, 26 large, 23 type B)

Missed Opportunities: 1 (~ 0.8 %)

Storm # 2985: June 30 at 20:28:00 over Sterling County

Small Clouds

Evaluations were done using TITAN and NEXRAD data.

Table 2 shows the results from the classic TITAN evaluation for the 78 small seeded clouds which obtained proper control clouds.

Table 2: Seeded Sample versus Control Sample (78 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	65 min	40 min	1.63	63 (47)
Area	63.2 km ²	41.8 km ²	1.51	51 (36)
Volume	235.9 km ³	147.7 km ³	1.60	60 (38)
Top Height	8.7 km	8.0 km	1.09	9 (5)
Max dBz	52.2	50.3	1.04	4 (2)
Top Height of max dBz	3.8 km	3.7 km	1.03	3 (0)
Volume Above 6 km	67.7 km ³	41.5 km ³	1.63	63 (31)
Prec.Flux	474.6 m ³ /s	290.5 m ³ /s	1.63	63 (30)
Prec.Mass	2162.8 kton	852.4 kton	2.54	154 (111)
CloudMass	172.8 kton	106.7 kton	1.62	62 (52)
η	12.5	8.0	1.56	56 (39)

Bold values in parentheses are modeled values, whereas η is defined as the quotient of Precipitation Mass divided by Cloud Mass, and is interpreted as efficiency. A total of 505 flares were used in this sub-sample with an excellent timing (**91 %**) for an effective dose about **70 ice-nuclei per liter**. The seeding operation for small clouds lasted about **10 minutes** in average. An excellent increase of **111 %** in precipitation mass together with an increase of 52 % in cloud mass illustrates that the seeded clouds grew at expenses of the environmental moisture (they are open systems) and used only a fraction of this moisture for their own maintenance. The increases in lifetime (47 %), area (36 %), volume (38 %), volume above 6 km (31 %), and precipitation flux (30 %) are notable. There are slight increases in top height (5 %) and maximum reflectivity (2 %).

The seeded sub-sample seemed 52 % more efficient than the control sub-sample. Results are evaluated as **excellent**.

An increase of 111 % in precipitation mass for a control value of 852.4 kton in 78 cases means:

$$\Delta_1 = 78 \times 1.11 \times 852.4 \text{ kton} = 73\,801 \text{ kton} = 59\,852 \text{ ac-f}$$

Large Clouds

The sub-sample of 26 large seeded clouds received a synergetic analysis. In average, the seeding operations on these large clouds affected 61 % of their whole volume; with a perfect timing (100 % of the material went to the clouds in their first half-lifetime). A total of 524 flares were used in this sub-sample for an effective dose about **85 ice-nuclei per liter**.

Also in average, large clouds were 25 minutes old when the operations took place; the operation lasted about 43 minutes, and the large seeded clouds lived 270 minutes.

Table 3 shows the corresponding results:

Table 3: Large Seeded Sample versus Virtual Control Sample (26 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	270 min	220 min	1.23	23
Area	1309 km ²	1098 km ²	1.19	19
Volume	5402 km ³	4495 km ³	1.20	20
Volume Above 6 km	1850 km ³	1583 km ³	1.17	17
Prec.Flux	10452 m ³ /s	8981 m ³ /s	1.16	16
Prec.Mass	143 232 kton	97 269 kton	1.47	47

An increase of 47 % in precipitation mass for a control value of 97 269 kton in 26 cases may mean:

$$\Delta_2 = 26 \times 0.47 \times 97\,269 \text{ kton} = 1\,188\,627 \text{ kton} = 963\,977 \text{ ac-f}$$

Type B Clouds

The sub-sample of 23 type B seeded clouds received a synergetic analysis. In average, the seeding operations on the type B clouds affected 16 % of their whole volume; with a very good timing (71 % of the material went to the clouds in their first half-lifetime). A total of 728 flares were used in this sub-sample for an effective dose ~ **105 ice-nuclei per liter**.

Also in average, type B clouds were 125 minutes old when the operations took place; the operation lasted about 54 minutes, and the type B seeded clouds lived ~ 300 minutes.

Table 4 shows the results:

Table 4: Type B Seeded Sample versus Virtual Control Sample (23 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	300 min	290 min	1.03	3
Area	4376 km ²	4191 km ²	1.04	4
Volume	19225 km ³	18378 km ³	1.05	5
Volume Above 6 km	6904 km ³	6642 km ³	1.04	4
Prec.Flux	30066 m ³ /s	28956 m ³ /s	1.04	4
Prec.Mass	385 150 kton	352 732 kton	1.09	9

An increase of 9 % in precipitation mass for a control value of 352 732 kton in 23 cases may mean:

$$\Delta_3 = 23 \times 0.09 \times 352\,732 \text{ kton} = 730\,155 \text{ kton} = 592\,156 \text{ ac-f}$$

The total increase: $\Delta = \Delta_1 + \Delta_2 + \Delta_3 = 1\,615\,985 \text{ ac-f}$

Micro-regionalization

Increases in precipitation mass were analyzed county by county in an attempt to better describe the performance and corresponding results. **Table 5** below offers the details:

County	Initial Seeding	Extended Seeding	Acre-feet (increase)	Inches (increase)	Rain (season value)	% (increase)
Glascock	10	14	108 200	2.25	12.80 in	18 %
Sterling	13	22	232 900	2.82	17.55 in	16 %
Reagan	15	24	206 100	3.29	12.23 in*	27 %
Irion	19	29	196 000	3.49	10.23 in	34 %
Tom Green	18	28	174 400	4.29**	14.43 in	29 %
Crocket	12	19	247 300	1.67	11.66 in	14 %
Schleicher	26	29	129 000	1.84	13.06 in	14 %
Sutton	14	20	171 800	2.23	11.69 in*	19 %
Total	127	185	1 371 500			
Outside TA			~ 244 500			
Average (only for the bold values)				2.74	12.96 in	21 %

(*) Missed data recreated by spatial interpolation

(**) One half of the Tom Green Area considered

(**Initial seeding** means the counties where the operations began, whereas **extended seeding** means the counties favored by seeding after the initial operations took place).

Hygroscopic Cases

Some hygroscopic seeding operations were done in order to explore its potentialities. These operations took place as a complement of the main glaciogenic seeding operations. A total of 4 cases were achieved (1 small cloud, 1 large cloud, and 2 type B clouds). Results are described below.

Table 6 illustrates the results corresponding to the small seeded case.

Table 6: Hygroscopic Seeded Sample versus Control Sample (1 couple, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	85 min	45 min	1.89	89 (70)
Area	137.7 km ²	81.6 km ²	1.69	69 (82)
Volume	567.6 km ³	357.6 km ³	1.59	59 (63)
Top Height	10.9 km	9.8 km	1.11	11 (6)
Max dBz	58.2	53.9	1.08	8 (4)
Top Height of max dBz	4.2 km	3.9 km	1.08	8 (0)
Volume Above 6 km	193.5 km ³	119.2 km ³	1.62	62 (27)
Prec.Flux	1487.4 m ³ /s	960.6 m ³ /s	1.55	55 (56)
Prec.Mass	7849.6 kton	1839.2 kton	4.27	327 (198)
CloudMass	484.6 kton	334.3 kton	1.45	45 (46)
η	16.2	5.5	2.95	195 (105)

A total of 5 BIP and 1 hygroscopic flare were used in this sample with a perfect timing for a glaciogenic dose of about 10 ice-nuclei per liter. Despite this static dose, the seeded sample shows like-dynamic responses (see the increases) probably suggesting that the hygroscopic material was able to provide enough ice particles in order to reach dynamic dose levels. Although results from such a small sample should be considered only preliminary, they have come to corroborate similar results from last year (season 2009).

The two type B seeded clouds (dual seeding) deserved a synergetic analysis scan by scan. Table 7 shows the results for some selected variables before, during and 30 minutes after the hygroscopic treatment:

Table 7: Average of two Type B cases (dual seeding: glaciogenic plus hygroscopic)

	Before	during (Hygroscopic Treatment)	30-minutes after
# cells	3.4	2.5	2.5
PrecMass per scan	356 kton	1258 kton	1062 kton
Top of MaxdBz	4.5 km	5.5 km	4.2 km
Centroid height	4.6 km	4.9 km	4.9 km

The average affected volume for these two cases was 15 %, whereas the average timing was 50 %, with an average effective dose of about 200 ice-nuclei per liter. Although the dose was clearly a dynamic one, the observed reaction after seeding was pale and it is hard to find a well-defined signal.

For the large seeded cloud, table 8 shows the corresponding results:

Table 8: One large seeded case (dual seeding: glaciogenic plus hygroscopic)

	Before	during (Hygroscopic Treatment)	30-minutes after
# cells	3.3	3	3.1
PrecMass per scan	252 kton	686 kton	673 kton
Top of MaxdBz	3.7 km	3.0 km	4.9 km
Centroid height	4.5 km	4.3 km	4.5 km

In this case, the observed increase in the average number of cells after seeding together with an increase in top height of maximum reflectivity and Centroid height were associated to a perfect timing (100 %) and may indicate that the hygroscopic material went into the storms when the target units were still growing. It might suggest that probably more ice particles were produced by the hygroscopic material. However, the

silver iodide dose in this case was relatively high (190 ice-nuclei per liter) and it should have been a major impact. Again, the sample (one case) is still too small to have any statistical significance, although supports the idea that the hygroscopic material might have affected the ice phase of the target units (like the cases last year).

Final Comments

- 1) Results are evaluated as **excellent**;
- 2) The micro-regionalization analysis showed increases per county; seedable conditions were more frequent over the central zone of the target area (Reagan, Irion, Schleicher and Tom Green Counties); the average increase in precipitation, referred to the seasonal value, is about **21 %**;
- 3) Radar estimations of precipitation should be considered as measurements of trend. Nevertheless, seeding operations appeared to improve the dynamics of seeded clouds;
- 4) Season 2010 was a very atypical one which began under the influence of El Niño conditions. However, in July a rapid transition to neutral conditions over the Equatorial Pacific Ocean seemed to indicate that La Niña conditions were going to take place by late summer. This forecast was very accurate and the late 2010 season was under the current La Niña conditions which provide less moisture from the Pacific and therefore less fuel for the convective activity over the target area. It may explain the early closing of WTWMA cloud seeding operations.
- 5) Some hygroscopic seeding operations were done and although the sample is still too small for any strong statement, the results are promissory and appear to suggest that the hygroscopic seeding material may impact the ice phase of seedable clouds.

West Texas Weather Modification												
2010 Flight Summary												
March												
Date	Number	Call Sign	Takeoff	Landing	Duration	BIP	Hygro	AgI	Seeded	Pilot	Dirty Cloud ug/m ³	
8-Mar	1	5141P	1635	1910	2.70	18		468	Sc,Su	Filburn/Sleeper	N/A	N/A
24-Mar	2	7924P	1945	2250	3.10	39		1,014	Cr,Sc,Su	Filburn/Sleeper	N/A	N/A
SubTotal					5.80	18		1,482				
Total					5.80	57		1,482				
West Texas Weather Modification												
2010 Flight Summary												
April												
11-Apr	3	6909P	2155	2225	0.90	0		0	Recon	Sleeper L.	Smoke	1-2
SubTotal					0.90	0		0				
Total					6.70	57	0.00	1,482				
West Texas Weather Modification												
2010 Flight Summary												
May												
14-May	4	6730Y	1710	1910	2.00	2		52	Gl	Sleeper E.	N/A	N/A
	5	6730Y	2130	2300	1.50	20		520	Ir,St,Re,Tg	Sleeper E.	N/A	N/A
15-May	6	6730Y	1620	1730	1.10	0		0	Recon	Sleeper L.	N/A	N/A
17-May	7	6730Y	1715	2230	3.40	27		702	Gl,Re,St,Tg	Filburn/Sleeper	N/A	N/A
	8	6730Y	2310	0130	2.50	21		546	Cr	Filburn/Sleeper	N/A	N/A
24-May	9	7924P	2105	2250	1.90	0		0	Recon	Filburn	N/A	N/A
	10	7924P	2320	0050	1.60	28		728	Sc,Tg	Filburn	N/A	N/A
25-May	11	6730Y	1930	2230	3.00	49		1,274	Sc	Sleeper L.	N/A	N/A
	12	5141P	2035	0000	3.20	74		1,924	Ir,Sc,Su,Tg	Zesch	N/A	N/A
SubTotal					20.20	221		5,746				
Total					26.90	278	0.00	7,228				
West Texas Weather Modification												
2010 Flight Summary												
June												
Date	Number	Call Sign	Takeoff	Landing	Duration	BIP	Hygro	AgI	Seeded	Pilot	Dirty Cloud ug/m ³	
1-Jun	13	7924P	2320	0005	1.00	5		130	Sc	Filburn	Smoke	1-2
2-Jun	14	6730Y	1945	2145	2.00	60		1,560	Gl,lr,Re,St,Tg	Sleeper L.	Smoke	1-2

	15	7924P	2000	2140	2.10	22		572	Ir,St,Tg	Filburn	Smoke	1-2
	16	6730Y	2230	0050	2.20	25		650	Cr,Sc,Su	Sleeper L.	Smoke	1-2
	17	5141P	2310	0145	2.70	104		2,704	Su	Zesch	Smoke	1-2
14-Jun	18	5141P	0050	0200	1.60	23		598	Gl	Sleeper L.	N/A	N/A
24-Jun	19	6730Y	2015	0005	3.80	71		1,846	Cr,Sc,Su	Sleeper/Sleeper	Smoke	1
	20	7924P	2025	0100	4.80	32		832	Cr,Ir,Sc,Tg	Filburn	Smoke	1-2
25-Jun	21	6730Y	1815	2210	4.10	66		1,716	Gl,Ir,St,Tg	Sleeper/Sleeper	N/A	N/A
	22	7924P	1900	2330	4.70	48		1,248	Ir,Re,St,Tg	Filburn	N/A	N/A
	23	5141P	2130	0000	2.80	42		1,092	Ir,Sc,Su,Tg	Zesch	N/A	N/A
26-Jun	24	5141P	2205	0010	2.40	26		676	Cr	Sleeper L.	Smoke	1
27-Jun	25	7924P	1850	2350	5.30	60		1,560	Cr,Gl,Ir,Re,St	Filburn	N/A	N/A
	26	5141P	1945	0015	4.60	78		2,028	Cr,Ir,Re,Su,Tg	Sleeper/Sleeper	N/A	N/A
28-Jun	27	5141P	1835	2115	2.90	36		936	Cr,Sc,Su	Sleeper Jr.	N/A	N/A
29-Jun	28	5141P	1650	1835	1.90	4		104	Cr,Re	Sleeper E.	N/A	N/A
	29	7924P	1945	2200	2.30	18		468	Gl,Re	Filburn	N/A	N/A
	30	5141P	2355	0125	1.90	4		104	Tg,Sc	Sleeper E.	N/A	N/A
30-Jun	31	5141P	2005	2215	2.20	14		364	Gl,Re,St	Sleeper E.	N/A	N/A
SubTotal					55.30	738	0.00	19,188				
Total					82.20	977	0.00	45,604				
West Texas Weather Modification												
2010 Flight Summary												
July												
6-Jul	32	5141P	2215	2310	1.90	17	1	884	Sc,Su	Sleeper L.	N/A	N/A
7-Jul	33	5141P	1735	2235	3.10	18		936	Gl, St	Sleeper E.	N/A	N/A
	34	6730Y	2245	0145	2.80	21		1,092	Cr,Re,Tg	Sleeper Jr.	N/A	N/A
8-Jul	35	6730Y	2030	2200	1.80	6		156	Sc	Sleeper E.	N/A	N/A
12-Jul	36	6730Y	2315	0215	3.00	63		3,276	Cr,Re,St,Tg	Sleeper L.	N/A	N/A
18-Jul	37	5141P	2220	0005	1.50	4		208	Sc	Sleeper L.	N/A	N/A
19-Jul	38	5141P	1955	2130	1.70	7		182	Sc	Sleeper L.	N/A	N/A
21-Jul	39	5141P	2140	2355	2.30	18		468	Ir,Sc,Su,Tg	Sleeper E.	N/A	N/A
22-Jul	40	5141P	2145	2325	1.90	2		104	Sc	Sleeper L.	N/A	N/A
23-Jul	41	5141P	0005	0140	1.90	11		572	Sc,Tg	Sleeper Jr.	N/A	N/A
26-Jul	42	6730Y	1855	1950	0.90	4		208	St	Sleeper L.	N/A	N/A
	43	5141P	2030	2345	3.40	31		1,612	Sc,St,Su	Sleeper L.	N/A	N/A
27-Jul	44	5141P	2005	2035	0.50	0		0	recon	Sleeper L.	N/A	N/A
	45	5141P	2315	0045	1.40	9		468	St,Tg	Zesch	N/A	N/A

28-Jul	46	5141P	1755	1935	1.60	12		312	Gl,Tg	Sleeper L.	N/A	N/A
	47	6730Y	2305	0030	1.20	6		156	Sc,Tg	Sleeper Jr.	N/A	N/A
SubTotal					30.90	229	1	10,634				
Total					113.10	1,206	1	37,050				

West Texas Weather Modification

2010 Flight Summary

August

Date	Number	Call Sign	Takeoff	Landing	Duration	BIP	Hygro	AgI	Seeded	Pilot	Dirty Cloud ug/m³	
6-Aug	48	7924P	2130	0130	4.30	42		1,092	Ir,Sc,Su	Filburn	N/A	N/A
	49	5141P	2225	0130	3.20	54	1	1,404	Cr,Ir,Sc,St	Zesch	N/A	N/A
8-Aug	50	5141P	2300	0105	1.70	18		468	Ir,Sc	Sleeper Jr.	N/A	N/A
10-Aug	51	5141P	2300	0100	1.90	11		286	Su	Sleeper L.	N/A	N/A
11-Aug	52	6730Y	1845	2230	3.70	48	2	1,248	Cr,Ir,Re,Tg	Sleeper L.	N/A	N/A
	53	5141P	1850	2115	2.50	24		624	Gl,Ir,St,Tg	Sleeper E.	N/A	N/A
	54	6909P	2100	2300	2.10	7		182	Gl,Re	Wilsak/Bozzell	N/A	N/A
12-Aug	55	6730Y	2045	2305	2.50	18		468	Ir, Re, St	Sleeper L.	N/A	N/A
	56	5141P	2130	2335	2.10	8		208	Gl, Ir, St	Sleeper E.	N/A	N/A
15-Aug	57	7924P	0015	0115	1.10	0		0	recon	Filburn	N/A	N/A
16-Aug	58	5141P	2255	0025	1.30	4		104	Su	Sleeper L.	N/A	N/A
17-Aug	59	5141P	2105	0015	3.10	19		494	Ir,Su, Tg	Sleeper E.	N/A	N/A
	60	6730Y	2115	0020	3.20	47		1,222	Ir,St,Re,Tg	Sleeper L.	N/A	N/A
18-Aug	61	5141P	1850	2145	2.90	45		1,170	Ir,Re,Sc,Su,Tg	Sleeper E.	N/A	N/A
	62	7924P	2010	2305	3.20	10		260	Gl,St	Filburn	N/A	N/A
	63	6909P	2020	2330	3.20	27		702	Cr,Ir,Tg	Wilsak/Sleeper	N/A	N/A
24-Aug	64	6730Y	2000	2355	4.20	69	1	1,794	Cr,Ir,Sc,Tg	Sleeper L.	Dust/Sulfate	30/1
	65	5141P	2030	0045	4.20	119		3,094	Cr,Ir,Re,Sc,Su,Tg	Zesch	Dust/Sulfate	30/1
	66	7924P	2345	0055	1.40	2		52	Re	Filburn	Dust/Sulfate	30/1
31-Aug	67	6730Y	2125	2255	1.60	11		286	Gl,St	Sleeper L.	N/A	N/A
SubTotal					53.40	583	4.00	15,158				
Total					166.50	1789	5.00	52,208				

West Texas Weather Modification

2010 Flight Summary

September

1-Sep	68	6730Y	2310	0105	2.20	50	1	1,300	Gl,Re,St	Sleeper E.	N/A	N/A
2-Sep	69	5141P	1920	2300	3.50	60		1,560	Cr,Ir,Sc,Tg	Sleeper L.	N/A	N/A

	70	6909P	2330	0110	1.70	6		156	Cr	Wilsak/Sleeper	N/A	N/A
	71	5141P	2330	0115	1.80	4		104	Cr	Sleeper Jr.	N/A	N/A
10-Sep	72	5141P	2115	2315	1.90	25		650	Sc	Sleeper E.	N/A	N/A
11-Sep	73	5141P	2015	2325	2.10	25		650	Sc,Su	Sleeper Jr.	N/A	N/A
12-Sep	74	5141P	1945	2325	3.70	30		780	Cr, Re	Sleeper Jr.	N/A	N/A
	75	5141P	2345	0050	1.10	6		156	Ir,Re	Sleeper Jr.	N/A	N/A
24-Sep	76	7924P	2230	2335	1.10	0		0	recon	Filburn	N/A	N/A
SubTotal					19.10	206	1.00	5,356				
Total					185.60	1995	6.00	57,564				

March 2010 Operations Report

March 8, 2010 - Seeding operations were conducted over Schleicher (10) and Sutton (8) Counties. 18 flares were burned within 3 small cells along a line. An upper level low and cold front produced marginal thunderstorms in the morning.

March 24, 2010 - Seeding operations were conducted over Crockett (11), Schleicher (10), and Sutton (18) Counties. 39 flares were burned within 2 small cells and one large cell with good results. A dryline produced marginal thunderstorms during mid-afternoon. This is the second day for seeding in March and 2nd day for seeding during the season.

The month of March contained 2 days of operations

Date	Flares	Counties seeded
8	18	Schleicher, Sutton
24	39	Crockett, Schleicher, Sutton
Total Flares: 57		

The general weather pattern for March began with cool temperatures but began to see an increasing number of low-pressure systems move across northern Mexico and into western Texas. Afternoon Temperatures hovered between 50 and 80 degrees for the first half of the month with the exception of the 14th where 87° was reached. That last week of March yielded a warmer than average period as mostly zonal conditions transitioned into a large trough over the western states pulling in warm southerly winds. Windy conditions were prevalent as strong surface lows migrated across the state.

Seeding opportunities were very marginal with temperatures only near 70 degrees but proved to be very beneficial for training a new weather modification pilot.

March continued an above normal precipitation pattern with three episodes of rainfall at San Angelo. Totals at San Angelo, Midland, and Abilene rose above the monthly normal for March. San Angelo received 1.17 inches and was .18 inches above normal. Abilene received 1.76 inches and was .35 inches above normal. Midland received .59 inches in March and was .17 inches above normal. All three sites pushed further above normal for annual precipitation. San Angelo recorded 6.05 inches, Abilene 7.09, and Midland 3.76. Respectively, each site was above normal by 3.06, 3.58, and 2.23 inches for the year.

Monthly rain gauge measurements from nearest locations inside and out of the target area recorded either by the National Weather Service, Weatherbug Sites, Wunderground or Mesowest sites are provided.

<u>NWS</u>	1.02	Ozona	1.68	Vancourt
1.17	Mathis Field	0.51	Iraan	
1.76	Abilene	1.75	Sterling City	<u>Wunderground</u>
1.65	Junction			1.20
0.59	Midland	<u>CocoRahs</u>		0.63
0.81	Big Spring	1.34	Eldorado	<u>Other</u>
		1.39	Knickerbocker	1.06
<u>Utah Mesonet</u>		0.70	Garden City	0.34
1.16	Barnhart	0.77	Ozona (15mi SSW)	1.38
1.76	Sonora	0.51	Iraan	
0.75	Cox Ranch	0.48	Iraan	

April 2010 Operations Report

April passed without operations.

The month of April contained 0 days of operations

Date	Flares	Counties seeded
Total Flares: 000		

The general weather pattern for April began with a potent high amplitude trough over the Rockies and northern Mexico pushing through Texas on the first Friday of the month. A cold front associated with the system brought early morning non-seedable thunderstorms to West Texas. A potent trough brought very good rains to West Texas between the 14th and 16th of the month. Temperatures throughout the month remained on the cool side for the most part but began to rise into the mid-upper 80s during the last week with the exception of a cold front on the 27th. While the month passed without seedable conditions, rainfall during the middle of the month maintained an above average precipitation pattern. A squall line, moved from west of the target on the evening of the 23rd to east of the target into the morning of the 24th dropped around a quarter of an inch across the region. El Niño persists late winter through early spring. El Niño based predictions for above average rainfall late winter through early spring and below normal temperatures have been reasonably correct.

April rainfall occurred mainly during one event across the region. Totals at San Angelo, Midland, and Abilene rose above the monthly normal for the month. San Angelo received 2.65 inches and was 1.05 inches above normal. Abilene received 1.87 inches and was .20 inches above normal. Midland received 2.03 inches in April and was 1.30 inches above normal. All three sites pushed further above normal for annual precipitation. San Angelo recorded 8.70 inches, Abilene 8.96, and Midland 6.12. Respectively, each site was above normal by 4.11, 3.78, and 3.86 inches for the year.

Monthly rain gauge measurements from nearest locations inside and out of the target area recorded either by the National Weather Service, Weatherbug Sites, Wunderground or Mesowest sites are provided.

<u>NWS</u>	2.56	Cox Ranch	1.79	Iraan	
2.65	Mathis Field	2.80	Ozona	2.69	Vancourt
1.87	Abilene	2.63	Iraan		
3.51	Junction	1.50	Sterling City		
2.03	Midland			<u>Wunderground</u>	
3.36	Big Spring			2.64	Sterling City
		<u>CocoRahs</u>		0.49	Mertzon
		2.28	Eldorado	<u>Other</u>	
		2.38	Knickerbocker	2.91	San Angelo (7NW)
<u>Utah Mesonet</u>		4.48	Garden City	2.69	St. Lawrence
2.40	Barnhart	1.13	Ozona (15mi SSW)	3.06	Mertzon
N/A	Sonora				

May 2010 Operations Report

May 14, 2010 – Seeding operations were conducted over Glasscock (2), Irion (2), Reagan (8), Sterling (8) and Tom Green (2) Counties. 22 flares were burned within 1 large system. A frontal boundary produced marginally seedable thunderstorms during mid-afternoon.

May 17, 2010 - Seeding operations were conducted over Crockett (21), Glasscock (7), Reagan (8), and Sterling (12) Counties. 48 flares were burned within 2 large clouds, one with multiple cells. An MCS moving south from the Panhandle and storms moving west from Trans-Pecos brought seedable storms.

May 24, 2010 - Seeding operations were conducted over Schleicher (21) and Tom Green (7) counties. 28 flares were burned within 3 small clouds merging into one. Sufficient surface heating and shortwave influence helped to promote marginally seedable clouds.

May 25, 2010 - Seeding operations were conducted over Irion (10), Schleicher (70), Sutton (16), and Tom Green (27) counties. 124 flares were burned within 10 clouds merging mostly into one. Sufficient surface heating and shortwave influence helped to promote seedable clouds. This is the fourth day for seeding in May and 6th day for seeding during the season.

The month of May contained 4 days of operations

Date	Flares	Counties seeded
14	22	Glasscock, Irion, Reagan, Sterling, Tom Green
17	48	Crockett, Glasscock, Reagan, Sterling, Tom Green
24	28	Schleicher, Tom Green
25	124	Irion, Schleicher, Sutton, Tom Green
Total Flares: 222		

The general weather pattern for May began with mostly zonal flow across Texas. Mild shortwave troughs translated across the central Plains but without precipitation for most of Texas. The first week of May saw warmer temperatures reaching the upper 90s but strong capping inversion prohibited thunderstorms. Cold fronts continue to dip through Texas during the first week also without precipitation but dropping temperatures from upper 90s to low 80s. Temperatures in the mid and upper 90s on the 10th of May, a dryline, and moist surface dewpoints were not enough parameters to develop thunderstorms as a shortwave trough passed over Oklahoma and Kansas. Seedable thunderstorms were as close as Abilene. Upper level trough over the Rockies and into Mexico through the 3rd weekend of the month maintained mostly cloudy skies inhibiting seedable conditions. Seeding operations did occur mid month, but conditions were not entirely favorable for seeding given that visibility was poor for pilots. A During the weekend of the 22nd, a blocking ridge set up again over the Great Lakes and south, holding a trough over the Rockies and Desert Southwest. A dryline over New Mexico and Trans-Pecos held firm keeping West Texas out of the thunderstorms contention except on the 24th when upper level trough and shortwave influence aided to produce thunderstorms. Conditions were once again very marginal under mostly cloudy skies. Conditions for seeding were better on the 25th when a similar synoptic setup to the day before and mostly sunny skies promoted thunderstorms. A mild upper level ridge developed over Texas and the Desert Southwest late month ending chances for seedable clouds. Thunderstorms continued to develop over Trans-Pecos and eastern New Mexico but were not able to reach the western target.

May rainfall occurred more sporadically than earlier in the season. Totals at San Angelo and Midland fell below monthly averages, but Abilene maintained above monthly normal for May. San Angelo received 1.42 inches and was 1.67 inches below normal. Abilene received 3.60 inches and was .77 inches above normal. Midland received 1.65 inches in May and was .14 inches below normal. All three sites remained above normal for annual precipitation. San Angelo recorded 10.12 inches, Abilene 12.56, and Midland 7.77. Respectively, each site was above normal by 2.44, 4.55, and 3.72 inches for the year.

Monthly rain gauge measurements from nearest locations inside and out of the target area recorded either by the National Weather Service, Weatherbug Sites, Wunderground or Mesonet sites are provided.

NWS

1.42 Mathis Field
 3.60 Abilene
 2.42 Junction
 0.59 Midland
 1.28 Big Spring

0.71 Ozona
 1.04 Iraan
 1.49 Sterling City

CocoRahs

1.21 Eldorado
 0.45 Knickerbocker
 0.46 Garden City
 0.52 Ozona (15mi SSW)
 1.04 Iraan

2.97 Vancourt

Wunderground

2.33 Sterling City
 0.28 Mertzon

Other

1.35 San Angelo (7NW)
 0.56 St. Lawrence
 0.36 Mertzon

Utah Mesonet

0.48 Barnhart
 0.09 Cox Ranch

June 2010 Operations Report

June 1, 2010 - Seeding operations were attempted over Schleicher (5) County. 5 flares were burned within 1 breathing cloud. Sufficient surface heating developed one marginal cloud.

June 2, 2010 - Seeding operations were conducted on parts of all counties: Crockett (2), Glasscock (8), Irion (28), Reagan (10), Schleicher (15), Sterling (36), Sutton (112) and Tom Green (10). 211 flares were burned within 1 very large track cloud with numerous strong cells. An upper low over West Texas, sufficient surface heating, and dryline fueled strong seedable storms.

June 14, 2010 - Seeding operations were conducted Glasscock (23) County. 23 flares were burned within 1 very large track cloud with numerous strong cells. A dryline to the west and frontal boundary to the northern produced seedable thunderstorms.

June 24, 2010 - Seeding operations were conducted over Crockett (27), Irion (4), Schleicher (22), Sutton (48), and Tom Green (2) Counties. 103 flares were burned within 1 very large track cloud with more than 11 additional cells. An upper low over southeast Texas and sufficient surface heating allowed for very good cloud seeding.

June 25, 2010 - Seeding operations were conducted over Glasscock (29), Irion (32), Reagan (12), Schleicher (7), Sterling (23), Sutton (3), and Tom Green (50) Counties. 156 flares were burned within 1 very large track cloud with more than 22 additional cells. An upper low over central Texas and sufficient surface heating allowed for very good cloud seeding.

June 26, 2010 - Seeding operations were conducted Crockett (50) County. 26 flares were burned within 1 merged cloud with 3 additional cells. A trough over eastern New Mexico and Trans-Pecos and surface heating developed a thunderstorm.

June 27, 2010 - Seeding operations were conducted Crockett (31) County, Glasscock (10) County, Irion (47) County Reagan (28) County, Sterling (8) County, Sutton (10) County, Tom Green (4) County. 138 flares were burned within 1 large merged cloud with more than 11 additional cells. A remnant outflow boundary and MCV over northern target developed seedable thunderstorms.

June 28, 2010 - Seeding operations were conducted Crockett (8) County, Schleicher (6) County, and Sutton (22) County. 36 flares were burned within 3 clouds. A cold front aided to develop seedable clouds.

June 29, 2010 - Seeding operations were attempted over Crockett (3) County, Glasscock (6), Reagan (13) Schleicher (2) County, and Tom Green (2) County. 26 flares were burned within 9 clouds. A weak area of low pressure over West Texas produced marginally seedable conditions.

June 30, 2010 - Seeding operations were attempted over Glasscock (1), Reagan (11) and Sterling (2) County. 14 flares were burned within 5 clouds. Moist easterly upslope and surface heating produced marginal showers. This is the tenth day for seeding in June and 16th day for seeding during the season.

The month of June contained 10 days of operations

Date	Flares	Counties seeded
1	5	Schleicher
2	211	Crockett, Glasscock, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green

14	23	Glasscock
24	103	Crockett, Irion, Schleicher, Sutton, Tom Green
25	156	Glasscock, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
26	26	Crockett
27	138	Crockett, Glasscock, Irion, Reagan, Sterling, Sutton, Tom Green
28	36	Crockett, Schleicher, Sutton
29	26	Crockett, Glasscock, Reagan, Schleicher, Tom Green
30	14	Glasscock, Reagan, Sterling
Total Flares: 738		

The general weather pattern for June began with a mostly zonal flow from coast to coast; but with shortwave influence over the Desert Southwest and southern Plains, seedable thunderstorms were possible. A dryline moving into the western target June 2 also made for explosive thunderstorm development; storm bases became higher as the storms matured. Ridging became most prominent over the Southeast through middle of June; although dryline influence over the Permian Basin and frontal boundary over the southern Panhandle allowed for one evening with showers and thunderstorms on the 14th. Hot and dry conditions were prevalent under an upper level ridge while mild surface features also moved away from West Texas mid-month. Upper ridge and dry conditions persisted until the last week of the month. Upper ridge became centered north of Texas with easterly flow dominant over Texas; moist easterly upslope flow allowed for seedable conditions from the 24th from the 28th although conditions became less seedable by the 28th and nearly unseedable on the 29th. Hurricane Alex began to approach the northern Mexico coastline late on June 30. Seeding did occur once again on the 30th, however conditions limited inflow and response was minimal.

April rainfall occurred mainly during one event across the region; the last couple days during the month. Totals at Midland, and Abilene rose above the monthly normal for June. San Angelo received 1.96 inches and was .56 inches below normal. Abilene received 3.32 inches and was .26 inches above normal. Midland received 3.97 inches in June and was 2.26 inches above normal. All three sites remained further above normal for annual precipitation. San Angelo recorded 12.08 inches, Abilene 15.88, and Midland 11.74. Respectively, each site was above normal by 1.88, 4.81, and 5.98 inches for the year.

Monthly rain gauge measurements from nearest locations inside and out of the target area recorded either by the National Weather Service, Weatherbug Sites, Wunderground or Mesowest sites are provided. *suggests error in dataset*

<u>NWS</u>	1.83*	Ozona	1.91	Vancourt
1.96	Mathis Field	2.68	Iraan	
3.32	Abilene	1.97	Sterling City	<u>Wunderground</u>
1.65	Junction			2.58
3.97	Midland	<u>CocoRahs</u>	1.54	Mertzson
2.04	Big Spring	1.42		<u>Other</u>
		2.25	Knickerbocker	1.79
<u>Utah Mesonet</u>		1.70	Garden City	2.07
1.18	Barnhart	1.43	Ozona (15mi SSW)	2.74
3.45*	Cox Ranch	2.68	Iraan	

June 2010 Operations Report

July 6, 2010 - Seeding operations were attempted over Schleicher (5), and Sutton (12) County. 17 flares were burned within 5 clouds. Shear axis and surface heating produced marginal showers.

July 7, 2010 - Seeding operations were attempted over Crockett (14), Glasscock (7), Reagan (3), Sterling (11), and Tom Green (4) County. 39 flares were burned within 11 clouds. Shear axis and surface heating produced marginal showers.

July 8, 2010 - Seeding operations were attempted over Schleicher (6) County. 6 flares were burned within 1 cloud. Shear axis and surface heating produced marginal showers.

July 12, 2010 - Seeding operations were attempted over Crockett (2), Irion (2), Reagan (45), Sterling (9), and Tom Green (5) Counties. 63 flares were burned within 6 clouds, one with several cells. Shear axis and surface heating produced marginal showers.

July 18, 2010 - Seeding operations were attempted over Schleicher (4) County. 4 flares were burned within 1 very marginal cloud in response to surface heating and a weak surface low.

July 19, 2010 - Seeding operations were attempted over Schleicher (7) County. 7 flares were burned within 3 very marginal clouds in response to surface heating and a weak surface low.

July 21, 2010 - Seeding operations were attempted over Irion (3), Schleicher (3) Sutton (6), and Tom Green (6) Counties. 18 flares were burned within 8 very marginal clouds in response to surface heating and a weak surface low.

July 22, 2010 - Seeding operations were attempted over Schleicher (3) County. 2 flares were burned within 2 very marginal clouds in response to surface heating and a weak low.

July 23, 2010 - Seeding operations were attempted over Schleicher (4) and Tom Green (7) Counties. 11 flares were burned within 3 very marginal clouds in response to surface heating and a weak low.

July 26, 2010 - Seeding operations were attempted over Schleicher (10), Sterling (16), and Sutton (9) Counties. 35 flares were burned within 4 clouds in response to surface heating and an upper low.

July 27, 2010 - Seeding operations were attempted over Sterling (3), and Tom Green (6) Counties. 9 flares were burned within 3 clouds in response to surface heating and an upper low.

July 28, 2010 - Seeding operations were attempted over Glasscock (4) Schleicher (4), and Tom Green (10) Counties. 18 flares were burned within 4 clouds in response to surface heating and an upper low. This is the twelfth day for seeding in July and 28th day for seeding during the season.

The month of July contained 12 days of operations

Date	Flares	Counties seeded
6	17	Schleicher, Sutton
7	39	Crockett, Glasscock, Reagan, Sterling, Tom Green
8	6	Schleicher
12	63	Crockett, Irion, Reagan, Sterling, Tom Green
18	4	Schleicher
19	7	Schleicher

21	18	Irion, Schleicher, Sutton, Tom Green
22	2	Schleicher
23	11	Schleicher, Tom Green
26	31	Schleicher, Sterling, Sutton
27	9	Sterling, Tom Green
28	18	Glasscock, Schleicher, Tom Green
Total Flares:		229

The general weather pattern for July began with non-seedable conditions under a very moist tropical atmosphere caused by remnant moisture from Hurricane Alex moving into northeastern Mexico. A shear axis set up over West Texas as a strong ridge over the Mid-Atlantic and weaker ridge over the Desert Southwest spun a minor disturbance over the region. Moisture began to diminish through the first week of the month as the shear axis weakened as well. Precipitation was plentiful during the first 4 days; rain became less common through the 6th when operations were attempted on very marginal, low top clouds. Two additional days for attempt at operations occurred under very marginal conditions; low tops, precipitation cores only 4-6km where -5°C was ~6km. Tropical conditions and associated tropical low (TD2) became less evident into the 2nd week of the month but dewpoints remained in the upper 60s and low 70s throughout the target area. Seedable conditions occurred on the 12th given upper level shortwave and associated surface trough. Upper level ridge set in more so on the 13th prohibiting thunderstorms across the region. While an upper level ridge maintained its position over the south; the center migrated from the Desert Southwest to the Southeast during the middle part of the month. Very marginal showers developed over the southeast target associated with a very weak mesoscale low within moist southerly flow and into the last week similar very marginal showers and storms developed due to an upper low moving slowly westward across Texas. An upper level ridge built in over Texas the last two days of the month in addition to surface high pressure shifting westward from the western Gulf of Mexico.

July rainfall occurred throughout the month; majority of rainfall was natural during the first 10 days. Totals at San Angelo, and Abilene rose above the monthly normal for July; Midland was very close as well. San Angelo received 1.73 inches and was .63 inches above normal. Abilene received 6.20 inches and was 4.50 inches above normal. Midland received 1.85 inches in July and was .04 inches below normal. All three sites were above normal for annual precipitation. San Angelo recorded 13.81 inches, Abilene 22.08, and Midland 13.59. Respectively, each site was above normal by 2.51, 9.31, and 5.94 inches for the year.

Monthly rain gauge measurements from nearest locations inside and out of the target area recorded either by the National Weather Service, Weatherbug Sites, Wunderground or Mesowest sites are provided.

<u>NWS</u>	5.71	Ozona	4.35	Vancourt
1.73	Mathis Field	3.39	Iraan	
4.50	Abilene	3.59	Sterling City	<u>Wunderground</u>
3.37	Junction			4.25
1.85	Midland	<u>CocoRaHS</u>	1.42	Mertzson
2.39	Big Spring	3.22	Eldorado	<u>Other</u>
		2.95	Knickerbocker	4.81
<u>Utah Mesonet</u>		3.38	Garden City	3.48
4.12	Barnhart	5.17	Ozona (15mi SSW)	3.46
3.68	Cox Ranch	4.03	Iraan	

August 2010 Operations Report

August 6, 2010 - Seeding operations were conducted over Crockett (9), Irion (24) Schleicher (17), Sterling (10), and Sutton (36) Counties. 96 flares were burned within 19 clouds in response to surface heating and a frontal boundary.

August 8, 2010 - Seeding operations were conducted over Irion (8) and Schleicher (10) Counties. 18 flares were burned within 4 clouds in response to surface heating and an upper low.

August 10, 2010 - Seeding operations were conducted over Sutton (11) County. 11 flares were burned within 4 very marginal clouds in response to surface heating.

August 11, 2010 - Seeding operations were conducted over Crockett (2), Glasscock (2), Irion (33), Reagan (21), Sterling (16), and Tom Green (5) Counties. 79 flares were burned within 21 clouds in response to surface heating.

August 12, 2010 - Seeding operations were conducted over Glasscock (5), Irion (10), Reagan (3), and Sterling (8) Counties. 26 flares were burned within 12 clouds in response to surface heating.

August 16, 2010 - Seeding operations were attempted over Sutton (4) County. 4 flares were burned within 1 cloud in response to sufficient surface heating.

August 17, 2010 - Seeding operations were attempted over Irion (19), Reagan (9), Sterling (10), Sutton (16), and Tom Green (12) counties. 66 flares were burned within 14 clouds in response to surface heating.

August 18, 2010 - Seeding operations were attempted over Crockett (21), Glasscock (6), Irion (10), Reagan (2), Schleicher (26), Sterling (4), Sutton (2), and Tom Green (11) counties. 82 flares were burned within 15 clouds in response to a frontal boundary and surface heating.

August 24, 2010 - Seeding operations were conducted over Crockett (61), Irion (28), Reagan (14), Schleicher (50), Sutton (15), and Tom Green (22) counties. 190 flares were burned within 18 cells belonging to a large cluster of storms in response to a frontal boundary and surface heating.

August 31, 2010 - Seeding operations were attempted over Glasscock (5) and Sterling (6) Counties. 11 flares were burned within 3 small-marginal clouds in response to surface heating and a shortwave. This is the tenth day for seeding in August and 38th day for seeding during the season.

The month of August contained 10 days of operations

Date	Flares	Counties seeded
6	96	Crockett, Irion, Schleicher, Sterling, Sutton
8	18	Schleicher, Irion
10	11	Sutton
11	79	Crockett, Glasscock, Irion, Reagan, Sterling, Tom Green
12	26	Glasscock, Irion, Reagan, Sterling
16	4	Sutton
17	66	Irion, Reagan, Sterling, Sutton, Tom Green
18	82	Crockett, Glasscock, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green

24	190	Crockett, Irion, Reagan, Schleicher, Sutton, Tom Green
31	11	Glasscock, Sterling
Total Flares: 583		

The general weather pattern for August began with a strong surface high pressure centered over Louisiana and a ridge similarly over Texas and Arkansas. The ridge held over Texas or slightly east throughout the first week of the month prohibiting showers and thunderstorms over West Texas. Moisture over the region also decreased to more typical values. A weak stalled frontal boundary shifted over the target area August 6th while the upper level ridge remained entrenched over the south; marginally seedable clouds scattered across the target area. Upper level ridge maintained position over Texas during the 2nd week although a weak upper level TUTT low helped generate marginal clouds between the 6th and 8th of the month. Upper level ridge persisted into the middle of the month; significant surface heating with temperatures at or above 100° for 26 consecutive days during the period helped to pop up marginal showers. A potent low pressure system over Canada and associated frontal boundary pushed through West Texas on the 24th providing widespread showers and thunderstorms over the target. Seeding operations went very well for this event. Surface high pressure filled in over a large area following a cold front which ended the heat wave bringing temperatures to below or near 90 for the following two days. High pressure and ridging brought temperatures back to the mid 90s for the last few days of the month; 100° on the final day bringing the total number of days for the summer above the century mark to 40 days.

August rainfall was very scattered with mostly small amounts across the region. Totals at San Angelo, Midland, and Abilene fell below the monthly normal for August. San Angelo received 1.10 inches and was .95 inches below normal. Abilene received .40 inches and was 2.23 inches below normal. Midland received .44 inches in August and was 1.33 inches below normal. All three sites remained above normal for annual precipitation. San Angelo recorded 14.91 inches, Abilene 22.48, and Midland 14.03. Respectively, each site was above normal by 1.56, 7.08, and 4.61 inches for the year.

Monthly rain gauge measurements from nearest locations inside and out of the target area recorded either by the National Weather Service, Weatherbug Sites, Wunderground or Mesowest sites are provided.

<u>NWS</u>	0.16	Ozona	1.08	Vancourt
1.10	Mathis Field	0.80	Iraan	
0.40	Abilene	1.96	Sterling City	<u>Wunderground</u>
0.85	Junction			1.87
0.44	Midland	<u>CocoRaHS</u>	0.16	Mertzson
0.31	Big Spring	2.37		<u>Other</u>
		0.65	Knickerbocker	3.08
<u>Utah Mesonet</u>		0.63	Garden City	0.31
0.49	Barnhart	1.62	Ozona (15mi SSW)	0.68
1.87	Cox Ranch	0.80	Iraan	

September 2010 Operations Report

September 1, 2010 - Seeding operations were conducted over Glasscock (13) Reagan (20), and Sterling (17) Counties. 50 flares were burned within 1 large track moving into the target while building new cells.

September 2, 2010 - Seeding operations were conducted over Crockett (16), Irion (16), Schleicher (34), and Tom Green (4) Counties. 70 flares were burned within 10 clouds sparked by an outflow boundary.

September 10, 2010 - Seeding operations were conducted over Schleicher (25) County. 25 flares were burned within 3 named cells in response to surface heating.

September 11, 2010 - Seeding operations were conducted over Schleicher (7) and Sutton (18) Counties. 25 flares were burned within 3 named cells in response to surface heating.

September 12, 2010 - Seeding operations were conducted over parts of Crockett (4), Irion (4), and Reagan (28) Counties. 36 flares were burned within 6 named clouds in response to surface heating along a remnant outflow boundary. This is the fifth day for seeding in September and 43rd day for seeding during the season.

The month of September contained 10 days of operations

Date	Flares	Counties seeded
1	50	Glasscock, Reagan, Sterling
2	70	Crockett, Irion, Schleicher, Tom Green
10	25	Schleicher
11	25	Schleicher, Sutton
12	36	Crockett, Irion, Reagan
Total Flares: 206		

The general weather pattern for September began with a dirty ridge centered over the Desert Southwest and thermal ridge over Texas providing sufficient surface heating to develop thunderstorms for day 1 and 2. A mild upper level ridge and surface high pressure fell in on the 3rd and held weather at bay through the 7th as a Tropical Storm moved on shore at the Texas Gulf. Tropical Storm Hermine developed over the southwestern Gulf and moved northward onto the Texas Gulf coast moving up through west-central Texas. An upper level ridge became more pronounced once again over Texas; surface moisture remained prominent and surface heating given temperatures in the mid 90s providing additional chances for seedable clouds during a 3day period from the 10th through 13th. High pressure set in for the following 10 days with fair yet hot and sticky conditions. A cold front approached West Texas on the 24th and 25th bringing very good rains across the area. Very moist conditions brought mostly cloudy conditions and poor conditions for seeding. An attempt at the best clouds of the day on the 24th found multiple layered bases with negligible inflow. Following the cold front, the atmosphere was completely changed to a stable and much drier environment. High pressure at surface and ridge brought cooler evenings from the mid 50s to upper 80s in the afternoon for the remaining days in the month.

September rainfall occurred during several events throughout the month; the final event between the 24th and 25th was natural rainfall. Totals at San Angelo, and Abilene were below the monthly normal for September; Midland was just barely above. San Angelo received 1.72 inches and was 1.23 inches below normal. Abilene received 2.44 inches and was .47 inches below

normal. Midland received 2.35 inches in September and was .04 inches above normal. All three sites were above normal for annual precipitation. San Angelo recorded 16.63 inches, Abilene 24.92, and Midland 16.38 inches. Respectively, each site was above normal by .33, 6.61, and 4.65 inches for the year.

Monthly rain gauge measurements from nearest locations inside and out of the target area recorded either by the National Weather Service, Weatherbug Sites, Wunderground or Mesonet sites are provided.

NWS

1.72 Mathis Field
 2.44 Abilene
 1.85 Junction
 2.35 Midland
 0.69 Big Spring

Utah Mesonet

0.65 Barnhart

0.49 Cox Ranch
 0.34 Ozona
 0.41 Iraan

CocoRahs

1.68 Eldorado
 1.17 Knickerbocker
 2.18 Garden City
 0.66 Ozona (15mi SSW)

2.94 Vancourt

Wunderground

3.98 Sterling City
 2.01 Mertzson

Other

2.15 San Angelo (7NW)
 2.61 St. Lawrence
 1.70 Mertzson