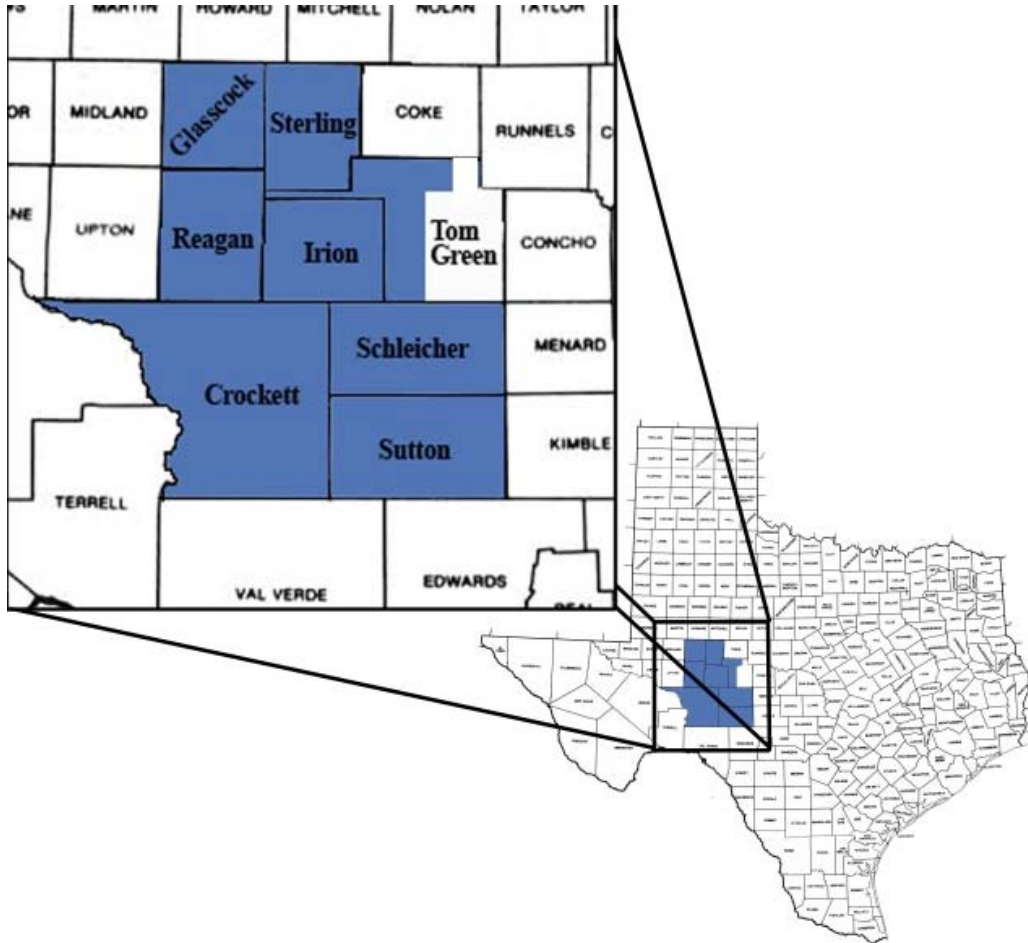


2011 ANNUAL REPORT WEST TEXAS WEATHER MODIFICATION ASSOCIATION



West Texas Weather Modification Association
8696 Hangar Road
San Angelo, TX 76904

West Texas Weather Modification Association 2011 Annual Report

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Seeding operations began on April 20, 2011 lasting through the 11th of October, 2011. The 2011 season will be remembered for some time as 73 different records were broken, extreme heat and extremely dry conditions lasted through the spring and summer months. Despite 6 less operation days compared to 2010, 128 different clouds were seeded with 1,311 total flares, compared to 127 clouds in 2010. Pilots were asked to go airborne 72 times during the season with 11 reconnaissance flights. During those 72 flights, pilots were airborne for a total of 179.63 hours. Six pilots were available during the season, with one departing after August. Another pilot moved on at the end of the season.

From April 20th through August 2nd, Meteorologist Robert Rhodes performed missions before Meteorologist-in-training Jonathan Jennings took over. Meteorologist Jennings performed 18 missions under the training of Active Influence and Scientific Manager (AISM) Dr. Arquímedes Ruiz-Columbié, South Texas Weather Modification Association Meteorologist Todd Flanagan and Southwest Texas Rain Enhancement Association Meteorologist Stephanie Beall. Despite a mid-season change in Meteorologist, performance in the final evaluation was graded as “excellent.”

The 2011 season was extremely dry with annual precipitation measured at 9.23”, 12.02” below normal. Along with the extreme drought the area also dealt with extreme heat. Temperatures of 100°F or greater were recorded a record 100 times during the year. Among those 100 days, 37 days recorded temperatures of 105°F or greater, also a record. The annual average temperature for Mathis Field in San Angelo, TX was a record 69.3°F. The months of August (89.7°F), July (89.6°F) and June (88.6°F) of 2011 are now the 3 warmest months on record for San Angelo, TX. A total of 29 record high temperatures were recorded while 32 record high minimums, 2 record low maximums, 6 record low minimums, 3 record rainfalls and 1 record snowfall were also recorded during the 2011 season. The hottest day of the year was May 28th, 2011 with a high temperature of 110°F. The coldest day occurred on February 10th, 2011 with a low of 12°F. Precipitation in the amount of 2.56” fell on October 9th, 2011, one day after 1.24” was recorded. The total rainfall on those two days accounted for 41% of the annual precipitation.

The final evaluation report completed by AISM Dr. Ruiz-Columbié stated that 13 operations days were qualified as those with excellent performance. Another 14 days were qualified as very good, 5 good and 1 day with only fair performance. Only one missed opportunity was found on the 30th of June over Sterling County. Of the 128 clouds seeded, 87 were categorized as small. An increase of lifetime by 63% was found as well as increases in volume (43%) and area (40%). Precipitation mass increased 97% while clouds were targeted with 85% timing. Moving onto the 19 large clouds that were seeded, increases of lifetime (23%), area (26%) and volume (25%) were also found. Precipitation mass was increased by 54% with timing of 98%. A total of 22 Type B clouds were seeded with a timing of 93%. Increases of lifetime (3%), area (5%) and volume (4%) were found while precipitation mass increased 8%. Percent increase of rainfall area wide ranged from 19% (Sterling County) to 25% (Reagan, Schleicher Counties). The area average saw an increase of precipitation by 23%, a total of 1.11 inches, or 603,400 acre-feet. Along with Glaciogenic seeding the WTWMA also conducted 4 cases of Hygroscopic seeding. Although still experimental, these four cases showed increases of lifetime (44%), area (59%) and volume (25%).

Jonathan A. Jennings
Meteorologist, West Texas Weather Modification Association

Dr. Arquímedes Ruiz-Columbié

Active Influence & Scientific Management

Cloud seeding operations 2011 began over the West Texas Weather Modification Association target area in April. This annual report serves as a summary of results. A total of **128 clouds** were seeded and identified by TITAN in **36 operational days**.

Table 1 in page 1 summarizes the general figures:

Table 1: Generalities

First operational day: **April 20th 2011**

Last operational day: **October 11th 2011**

Number of operational days: 36

(Two in April, two in May, four in June, nine in July, eight in August, ten in September and one in October)

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

Thirteen with excellent performance

Fourteen with very good performance

Five with good performance

One with fair performance

Three experimental days (July 1st, August 28th, and September 17th)

Number of seeded clouds: 128 (87 small, 19 large, 22 type B)

Missed Opportunities: None (with lifetime longer than 45 minutes)

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 87 small seeded clouds which obtained proper control clouds.

Table 2: Seeded Sample versus Control Sample (87 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	65 min	40 min	1.63	63 (44)
Area	60.6 km ²	43.3 km ²	1.40	40 (41)
Volume	217.0 km ³	151.9 km ³	1.43	43 (40)
Top Height	8.9 km	8.4 km	1.06	6 (3)
Max dBz	58.5	56.2	1.04	4 (3)
Top Height of max dBz	4.0 km	4.0 km	1.00	0 (3)
Volume Above 6 km	67.3 km ³	44.9 km ³	1.50	50 (37)
Prec.Flux	396.3 m ³ /s	261.9 m ³ /s	1.51	51 (43)
Prec.Mass	1816.9 kton	848.8 kton	2.14	114 (97)
CloudMass	142.6 kton	96.7 kton	1.47	47 (39)
η	12.7	8.8	1.44	44 (41)

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 444 flares were used in this sub-sample with an excellent timing (**85 %**) for an effective dose about **40 ice-nuclei per liter**. The seeding operation for small clouds lasted about **10 minutes** in average. An excellent increase of **97 %** in precipitation mass together with an increase of 39 % 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 (44 %), area (41 %), volume (40 %), volume above 6 km (37 %), and precipitation flux (43 %) are notable. There are slight increases in top height (3 %) and maximum reflectivity (3 %).

The seeded sub-sample seemed 41 % more efficient than the control sub-sample. Results are evaluated as **excellent**.

An increase of 97 % in precipitation mass for a control value of 848.8 kton in 87 cases means:

$$\Delta_1 = 87 \times 0.97 \times 848.8 \text{ kton} = 71\ 630 \text{ kton} = 58\ 092 \text{ ac-f}$$

Large Clouds

The sub-sample of 19 large seeded clouds received a synergetic analysis. In average, the seeding operations on these large clouds affected 71 % of their whole volume; with an excellent timing (98 % of the material went to the clouds in their first half-lifetime). A total of 371 flares were used in this sub-sample for an effective dose about **70 ice-nuclei per liter**.

Also in average, large clouds were 31 minutes old when the operations took place; the operation lasted about 37 minutes, and the large seeded clouds lived 295 minutes.

Table 3 shows the corresponding results:

Table 3: Large Seeded Sample versus Virtual Control Sample (19 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	295 min	240 min	1.23	23
Area	1421 km ²	1128 km ²	1.26	26
Volume	5870 km ³	4679 km ³	1.25	25
Volume Above 6 km	2191 km ³	1770 km ³	1.24	24
Prec.Flux	9150 m ³ /s	7196 m ³ /s	1.27	27
Prec.Mass	115 582 kton	75 053 kton	1.54	54

An increase of 54 % in precipitation mass for a control value of 75 053 kton in 19 cases may mean:

$$\Delta_2 = 19 \times 0.54 \times 75\ 053 \text{ kton} = 770\ 044 \text{ kton} = 624\ 506 \text{ ac-f}$$

Type B Clouds

The sub-sample of 22 type B seeded clouds received a synergetic analysis. In average, the seeding operations on the type B clouds affected 15 % of their whole volume; with an excellent timing (93 % of the material went to the clouds in their first half-lifetime). A total of 496 flares were used in this sub-sample for an effective dose ~ **70 ice-nuclei per liter**.

Also in average, type B clouds were 110 minutes old when the operations took place; the operation lasted about 45 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 (22 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	300 min	290 min	1.03	3
Area	2331 km ²	2229 km ²	1.05	5
Volume	11821 km ³	11315 km ³	1.04	4
Volume Above 6 km	5692 km ³	5461 km ³	1.04	4
Prec.Flux	61124 m ³ /s	58367 m ³ /s	1.05	5
Prec.Mass	75 944 kton	70 319 kton	1.08	8

An increase of 8 % in precipitation mass for a control value of 70 319 kton in 22 cases may mean:

$$\Delta_3 = 22 \times 0.08 \times 70\,319 \text{ kton} = 123\,761 \text{ kton} = 100\,371 \text{ ac-f}$$

$$\text{The total increase: } \Delta = \Delta_1 + \Delta_2 + \Delta_3 = 782\,969 \text{ ac-f}$$

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	9	11	53 400	1.11	4.88 in	23 %
Sterling	12	14	66 100	0.84	4.18 in	19 %
Reagan	8	15	61 400	0.98	3.91 in	25 %
Irion	17	22	79 700	1.42	6.87 in	21 %
Tom Green	9	14	62 600	1.54*	6.83 in	23 %
Crocket	21	28	114 800	0.77	3.37 in	23 %
Schleicher	29	34	96 000	1.37	5.48 in	25 %
Sutton	23	31	69 400	0.90	4.08 in*	22 %
Total	128	169	603 400			
Outside TA			~ 180 000			
Average (only for the bold values)				1.11	4.95 in	23 %

(*) 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, 2 large cloud, and 1 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	65 min	45 min	1.44	44 (30)
Area	56.1 km ²	35.2 km ²	1.59	59 (60)
Volume	210.3 km ³	168.7 km ³	1.25	25 (38)
Top Height	9.1 km	9.1 km	1.00	0 (0)
Max dBz	57.4	45.8	1.25	25 (2)
Top Height of max dBz	4.3 km	4.0 km	1.08	8 (2)
Volume Above 6 km	66.6 km ³	71.9 km ³	0.93	-7 (30)
Prec.Flux	558.7 m ³ /s	149.4 m ³ /s	3.74	274 (79)
Prec.Mass	2135.0 kton	390.9 kton	5.46	446 (279)
CloudMass	166.8 kton	101.9 kton	1.64	64 (41)
η	12.8	3.8	3.37	237 (172)

A total of 5 BIP and 1 hygroscopic flare were used in this sample with a mediocre timing for a glaciogenic dose of about 15 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 the last two years (seasons 2009 and 2010).

The type B seeded cloud (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 one type B case (dual seeding: glaciogenic plus hygroscopic)

	Before	during (Hygroscopic Treatment)	30-minutes after
# cells	2.0	1.0	2.0
PrecMass per scan	542 kton	869 kton	867 kton
Top of MaxdBz	4.5 km	6.0 km	4.9 km
Centroid height	4.8 km	4.8 km	4.9 km

The average affected volume for this case was 20 %, whereas the timing was 100 %, with a silver iodide dose of about 125 ice-nuclei per liter. The glaciogenic dose was clearly a dynamic one, but the observed reaction after the hygroscopic seeding was pale and it is hard to find a well-defined signal.

Corresponding Increases:

	Seeded	Control	Simple Ratio	Increase (%)
Area	443 km²	410 km²	1.03	3
PrecMass	57 665 kton	49 175 kton	1.17	17

$$\Delta = 1 \times 0.17 \times 49\,175 \text{ kton} = 8\,360 \text{ kton} = 6\,780 \text{ ac-f}$$

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

Table 8: Two large seeded cases (dual seeding: glaciogenic plus hygroscopic)

	Before	during (Hygroscopic Treatment)	30-minutes after
# cells	3.5	4.5	5.5
PrecMass per scan	1013 kton	1672 kton	1976 kton
Top of MaxdBz	4.9 km	4.5 km	4.4 km
Centroid height	5.2 km	5.0 km	4.7 km

Corresponding Increases:

	Seeded	Control	Simple Ratio	Increase (%)
Area	870 km²	697 km²	1.25	25
PrecMass	61 525 kton	36 614 kton	1.68	68

$$\Delta = 2 \times 0.68 \times 36\,614 \text{ kton} = 49\,795 \text{ kton} = 40\,384 \text{ ac-f}$$

In this case, the observed increase in the average number of cells after seeding did correspond with an increase in Precipitation Mass per scan but with decreases in top height of maximum reflectivity and Centroid height. Those changes were associated to a perfect timing (100 %) and a relatively low silver iodide average dose (30 ice-nuclei per liter) and may indicate that the hygroscopic material went into the storms when the target units were still growing and supplied enough large droplets which became ice particles. Probably more ice particles were produced by the hygroscopic material. Again, the sample (two cases) 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 for the last two years).

Final Comments

- 1) Results are evaluated as **excellent**;
- 2) The micro-regionalization analysis showed increases per county; seedable conditions were more frequent over the southern zone of the target area (Crockett, Schleicher and Sutton Counties); the average increase in precipitation, referred to the seasonal value, is about **23 %**;
- 3) Radar estimations of precipitation should be considered as measurements of trend. Nevertheless, seeding operations appeared to improve the dynamics of seeded clouds;
- 4) During its first half, Season 2011 was affected by La Niña conditions which explained why only 8 operational days took place between April and June. ENSO neutral conditions dominated during the summer with 27 operational days. As La Niña conditions reappeared in October, only one more operational day occurred at the end of the season.
- 5) Some hygroscopic seeding operations were done and although the sample is still too small for any strong statement, the results for the last three seasons are promissory and appear to suggest that the hygroscopic seeding material may impact the ice phase of seedable clouds.

West Texas Weather Modification												
2011 Flight Summary												
March												
Date	Number	Call Sign	Takeoff	Landing	Duration	BIP	Hygro	Agl	Seeded	Pilot	Dirty Cloud	ug/m ³
SubTotal					0.00	0		0				
Total					0.00	0		0				
West Texas Weather Modification												
2011 Flight Summary												
April												
20-Apr	1	N8549P	1950	2230	2.80	14		728	lr,Sc	L.Sleeper	Smoke/Dust	N/A
	2	N5141P	2030	0020	3.40	48		1,248	lr,Sc,SU	Zesch	Smoke/Dust	N/A
24-Apr	3	N8549P	2345	0055	1.20	2		104	Cr	E.Sleeper	Smoke/Dust	N/A
SubTotal					7.40	64		1,976				
Total					7.40	64	0.00	1,976				
West Texas Weather Modification												
2011 Flight Summary												
May												
6-May	4	N7924P	2205	2340	1.30	0		0	recon	Filburn	Smoke	2-4
9-May	5	N8549P	2330	2340	1.10	0		0	recon	E. Sleeper	Smoke	3-5
11-May	6	N7924P	1640	1830	1.80	12		312	Su	Filburn	Smoke	3-5
22-May	7	N6909P	2100	2250	1.90	0		0	Malfunction	Wilsak	Smoke	6-8
	8	N7924P	2200	0100	3.00	26		676	Cr, Gl	Filburn	Smoke	6-8
29-May	9	N8549P	0025	0025	1.00	0			recon	Sleeper	Smoke	8-10
SubTotal					10.10	38		988				
Total					17.50	102	0.00	2,964				
West Texas Weather Modification												
2011 Flight Summary												
June												
Date	Number	Call Sign	Takeoff	Landing	Duration	BIP	Hygro	Agl	Seeded	Pilot	Dirty Cloud	ug/m ³
8-Jun	10	N8549P	2340	0035	2.00	0		0	recon	L. Sleeper	smoke/sulfate	6-8/1-2
15-Jun	11	N7924P	2300	0045	2.10	11		286	Sterling	Filburn	Smoke	3-5
18-Jun	12	N8549P	2124	0036	3.20	17		884	Gl, lr, St, Tg	E. Sleeper	Smoke	3-5
	13	N6909P	2300	0025	1.50	12		312	Reagan	L. Sleeper	Smoke	3-5
19-Jun	14	N5141P	2310	0140	2.50	3		78	Crockett	Wilsak	Smoke/Dust	20/3-6
	15	N8549P	2305	0040	1.90	13		676	Cr, Re	E. Sleeper	Smoke/Dust	20/3-6

21-Jun	16	N6909P	2155	2344	2.80	30		780	Gl, St	L. Sleeper	Smoke	3-5
	17	N5141P	2245	0150	3.08	50		1,300	Gl, Re, St	Wilsak	Smoke	3-5
	18	N8549P	0005	0125	1.30	12		624	Gl, Ir, Re, St, Tg	L. Sleeper	Smoke	3-5
SubTotal					20.38	148	0.00	4,940				
Total					37.88	250	0.00	12,844				

West Texas Weather Modification

2011 Flight Summary

July

1-Jul	19	N7924P	2150	2302	1.20	5		130	Sc, Tg	Filburn	Dust	40-80
2-Jul	20	N7924P	2200	0100	3.00	40		1,040	Sc, Su	Filburn	N/A	N/A
7-Jul	21	N8549P	2350	0045	1.90	6		312	Su	L. Sleeper	smoke/sulfate	1-2/1-2
	22	N6909P	2350	0150	2.00	16	1	416	Su	E. Sleeper	smoke/sulfate	1-2/1-2
12-Jul	23	N6909P	0015	0120	1.10	0		0	recon	Sleeper Jr	N/A	N/A
16-Jul	24	N6909P	2020	2255	2.80	35		910	Re, St	L. Sleeper	N/A	N/A
	25	N5141P	2045	2305	2.60	15		390	Gl	Wilsak	N/A	N/A
18-Jul	26	N6909P	2040	0010	3.10	30		780	Sc,Su	L. Sleeper	N/A	N/A
	27	N8549P	0010	0115	1.10	2		104	Sc	Sleeper Jr	N/A	N/A
19-Jul	28	N8549P	1745	2230	5.00	47	1	2,444	Cr,Ir,Sc,Su	L. Sleeper	N/A	N/A
	29	N6909P	1925	2230	3.20	18		468	Cr,Sc,Su	E. Sleeper	N/A	N/A
	30	N7924P	2215	2355	1.60	4		104	Sc	Filburn	N/A	N/A
	31	N5141P	2215	0010	2.00	4		104	St	Wilsak	N/A	N/A
20-Jul	32	N6909P	1935	0020	4.70	54	2	1,404	Ir, Sc, Su	L. Sleeper	N/A	N/A
22-Jul	33	N7924P	2225	2305	0.90	0		0	Recon	Filburn	N/A	N/A
29-Jul	34	N7924P	2000	0020	4.60	28		728	Gl,Re	Filburn	N/A	N/A
	35	N6909P	2325	0200	2.60	18		468	Su	Sleeper Jr	N/A	N/A
30-Jul	36	N5141P	2030	0000	3.50	17		442	Cr	Wilsak	N/A	N/A
SubTotal					46.90	339	4	10,244				
Total					84.78	589	4	18,148				

West Texas Weather Modification

2011 Flight Summary

August

Date	Number	Call Sign	Takeoff	Landing	Duration	BIP	Hygro	AgI	Seeded	Pilot	Dirty Cloud	ug/m ³
2-Aug	37	N6909P	0000	0135	1.70	8		208	Sc,Tg	Sleeper Jr	Smoke	1-2
10-Aug	38	N8549P	2155	0110	3.25	12		624	Rg, Cr, Sc, Ir	E. Sleeper	N/A	N/A
	39	N7924P	2328	0120	2.00	29		754	Rg, St,	Filburn	N/A	N/A
11-Aug	40	N8549P	1415	1545	1.50	0		0	Recon	E. Sleeper	N/A	N/A
	41	N7924P	2107	0105	4.00	48	1	1,248	Sc, Su, Cr, Ir	Filburn	N/A	N/A
	42	N5141P	2306	0125	2.00	32		832	Gl, Su, Ir, St	Wilsak	N/A	N/A

12-Aug	43	N8549P	2120	2230	1.10	0		0	Recon	E. Sleeper	N/A	N/A
	44	N8549P	2245	01215	1.50	4		104	Cr	E. Sleeper	N/A	N/A
14-Aug	45	N7924P	1800	2300	5.00	53	1	1,378	Su, Sc	Filburn	N/A	N/A
	46	N8549P	2115	2320	2.00	11		572	Su, Sc	E. Sleeper	N/A	N/A
25-Aug	47	N8549P	2025	2245	2.40	19		520	Rg, St, Rg	E. Sleeper	N/A	N/A
	48	N7924P	2025	0110	4.90	46	1	1,196	St, Rg, Cr, Su	Filburn	N/A	N/A
28-Aug	49	N8549P	2315	2440	1.50	1		26	Su	Sleeper Jr	N/A	N/A
29-Aug	50	N7924P	1922	0000	4.60	69	1	1,794	Sc, Su, Cr	Filburn	N/A	N/A
	51	N8549P	2020	2355	3.50	22		572	Ir, St, Cr	E. Sleeper	N/A	N/A
SubTotal					44.75	354	6.00	11,908				
Total					129.53	943	10.00	30,056				

West Texas Weather Modification

2011 Flight Summary

September

3-Sep	52	N7924P	1800	2030	2.50	23	1	598	Su, Cr	Filburn	N/A	N/A
	53	N8549P	1810	2101	2.80	12		312	Su, Cr	Sleeper Jr	N/A	N/A
4-Sep	54	N8549P	1408	1542	1.60	0		0	Recon	Sleeper Jr	N/A	N/A
14-Sep	55	N7924P	2030	0030	4.00	45	1	1,170	Ir, St, Rg, GL	Filburn	N/A	N/A
16-Sep	56	N7924P	2035	2301	2.70	19	1	494	Ir, Sc, Su	Filburn	N/A	N/A
17-Sep	57	N7924P	1600	1700	1.00				Recon	Filburn	N/A	N/A
	58	N8549P	2135	2235	1.00	4		104	TG	Sleeper Jr	N/A	N/A
18-Sep	59	N7924P	2045	0035	3.80	62		1,612	Sc, Su, Ir, Cr	Filburn	N/A	N/A
	60	N8549P	2100	2333	2.60	22		572	Sc, Su	Sleeper Jr	N/A	N/A
21-Sep	61	N7924P	1930	0020	4.90	76		1,976	Ir, Sc, Cr,	Filburn	N/A	N/A
	62	N5141P	2130	0015	2.50	28		728	Gl, St, Rg, IR	Wilsak	N/A	N/A
26-Sep	63	N7924P	2110	2335	2.70	36	1	936	Rg, Ir, Sc	Filburn	N/A	N/A
27-Sep	64	N7924P	2055	2240	2.70	54		1,404	Ir, Sc, Su	Filburn	N/A	N/A
	65	N5141P	2055	2243	1.90	14		364	Cr, Ir	Wilsak	N/A	N/A
28-Sep	66	N7924P	2035	0010	3.60	56		1,456	Cr, Rg, Ir, Sc, Su	Filburn	N/A	N/A
	67	N5141P	2109	2312	2.00	20		520	Gl, Rg, Ir	Wilsak	N/A	N/A
29-Sep	69	N7924P	1938	2215	3.80	10		260	Cr, Rg, Su	Filburn	N/A	N/A
		N7924P	New	NS2 Flares		20		Error due	to misfire	Filburn	N/A	N/A
	70	N5141P	2037	2245	2.00	16		416	Gl, Rg	Wilsak	N/A	N/A
SubTotal					48.10	517	4.00	12,922				
Total					177.63	1460	14	42,978				

West Texas Weather Modification

2011 Flight Summary

October

Date	Number	Call Sign	Takeoff	Landing	Duration	BIP	Hydro	AgI	Seeded	Pilot	Dirty Cloud ug/m ³	
11-Oct	71	N5141P	1910	2010	1.00			0	Recon	Wilsak/Filburn	N/A	N/A

11-Oct	72	N5141P	2100	2200	1.00	14		364	St, GI	Filburn	N/A	N/A
SubTotal					2.00	14	0.00	364				
Total					179.63	1474	14.00	43,342				

March 2011 Operations Report

No operations were conducted in March.

The month of March contained 00 days of operations

Date	Flares	Counties seeded
Total Flares: 00		

The general weather pattern for March began with warm temperatures under a quasi-zonal upper level pattern. Several troughs developing over California sped across the Desert Southwest and Texas Panhandle providing windy and dry conditions with dryline advancements across the target area. Dry vegetation and soils allow for several wildfires to spark over West Texas during the first week of the month. Nevertheless, a cold front early on the 5th allow for five hundredths of an inch of rain. Temperatures were above normal the beginning of the month with temperatures in the 80s and San Angelo tied a record of 91 on the 4th.

Fair weather and warming temperatures prevailed through the middle of the month. Convective weather officially began March 18 as a cold front approached the northern target border and dryline situated west of the target. Storms fired up near Ft. Stockton and along the northern border - moving north and east eluding the necessity for launching a mission. A very mild low-level low over the central Rockies on the 18th failed to provide significant dynamics.

Warm temperatures continued through the last full week in March; a couple more potent surface systems passed over the central Plains without precipitation for West Texas. A trough dropped into Texas during the last few days of the month cooling temperatures down the 60s for highs but began to warm up once again March 31.

March held below average rainfall and above average temperatures. Totals at San Angelo, Midland, and Abilene are below the monthly normal for March. San Angelo received .10 inches and was .89 inches below normal. Abilene received .40 inches and was 1.01 inches below normal. Midland received .04 inches in March and was .38 inches below normal. All three sites are below normal for annual precipitation. San Angelo recorded 1.09 inches, Abilene 2.01, and Midland .11 inches. Respectively, each site was below normal by 1.90, 1.50, and 1.42 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>	0.00	Ozona	0.00	Vancourt
0.10	Mathis Field	0.00	Iraan	
0.40	Abilene	0.03	Sterling City	<u>Wunderground</u>
0.00	Junction			0.05
0.04	Midland	<u>CocoRahs</u>		0.00
0.11	Big Spring	0.00	Eldorado	<u>Other</u>
		0.00	Knickerbocker	0.03
<u>Utah Mesonet</u>		0.00	Garden City	0.00
0.00	Barnhart	0.00	Ozona (15mi SSW)	0.00
0.00	Sonora	0.00	Iraan	0.00
0.00	Cox Ranch	0.00	Iraan	

April 2011 Operations Report

April 20, 2011 - Seeding operations were conducted over Irion (19), Schleicher (39), and Sutton (4) counties. 62 flares were burned within 7 cells merging into mainly one large cluster. A frontal boundary, weak shortwave, and moisture combined to promote thunderstorms over the eastern target. This is the first day for seeding in April and 1st day for seeding during the season.

April 24, 2011 - Seeding operations were conducted over Crockett (2) County. 2 flares were burned within 1 small cell. A retreating dryline late in the afternoon helped to promote a small cloud. This is the second day for seeding in April and 2nd day for seeding during the season.

The month of April contained 2 days of operations

Date	Flares	Counties seeded
20	62	Irion, Schleicher, Sutton
24	2	Crockett
Total Flares: 64		

The general weather pattern for April began with a large ridge over the southern Plains promoting temperatures well over average. Hot, dry, and windy conditions prevailed the first few days of the month breaking daily high records at San Angelo and Abilene on the 2nd and 3rd. The ridge passed by and a surface cold front maintained windy conditions but dropped temperatures to below normal for the 4th and the 5th of the month. Temperatures warmed up once again as a trough deepened over the Rockies during the following week. Rain finally fell over parts of the target area Sunday evening of the 10th but San Angelo did not receive a fair amount. The southern target fared best as the dryline moved westward after dark and the approaching cold front collided. Hot and dry conditions prevailed through the middle of the month with wildfires common across the state. Dewpoints dropping into the 10-30 degree range, temperatures approaching 100° and winds gusting over 20mph hampered firefighters.

A frontal boundary, insurgence of gulf moisture, and weak shortwave ahead of a trough on April 20th allowed for afternoon seedable thunderstorms and the start of the 2011 season. An upper level trough lingered for four days with thunderstorms over parts of central and west Texas. Seeding occurred for the second day as a dryline retreated westward late in the evening. Atmosphere was not as conducive over the target area as it was near Abilene and northeastward where tornadic storms occurred. The month of April finished off with hot and dry conditions leading to multiple wildfires across Texas.

April held below average rainfall and above average temperatures. Totals at San Angelo, and Midland are below the monthly normal for April but Abilene managed to have above normal monthly rainfall due to a single event. San Angelo received .03 inches and was 1.57 inches below normal. Abilene received 2.42 inches and was .77 inches above normal. Midland received .00 inches in April and was .38 inches below normal. All three sites are below normal for annual precipitation. San Angelo recorded 1.12 inches, Abilene 4.44, and Midland .11 inches. Respectively, each site was below normal by 3.47, 0.74, and 2.15 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.

NWS

0.03 Mathis Field
2.42 Abilene
0.59 Junction
0.62 Sonora
0.00 Midland
0.00 Big Spring

0.20 Sonora
0.31 Cox Ranch
0.18 Ozona

CocoRahs

1.02 Eldorado
0.47 Knickerbocker
0.00 Garden City
0.45 Ozona (15mi SSW)
0.00 Iraan

0.06 Vancourt

Wunderground

0.00 Sterling City
0.04 Mertzon

Other

0.03 San Angelo (7NW)
0.02 St. Lawrence
0.00 Mertzon

Utah Mesonet

0.16 Barnhart

May 2011 Operations Report

May 11, 2011 - Seeding operations were conducted over Sutton (12) County. 12 flares were burned within 2 small cells. A dryline and upper level system moving east during the morning allowed for marginally seeable conditions.

May 22, 2011 - Seeding operations were conducted over Crockett (12) and Glasscock (14) County. 26 flares were burned within 2 storms. A dryline and sufficient surface heating allowed for seedable thunderstorms. This is the second day for seeding in May and 4th day for seeding during the season.

The month of May contained 2 days of operations

Date	Flares	Counties seeded
11	12	Sutton
22	26	Crockett, Glasscock, Sterling
Total Flares: 38		

The general weather pattern for May began with significantly cooler temperatures following a deep trough and strong surface cold front. Temperatures rose back above 80° by the 3rd and near 90° by the 6th of the month. Mostly zonal flows aloft persisted through the first week while a shortwave trough attempted to bring thunderstorms to parts of West Texas late afternoon May 6. Ridging returned to West Texas for the following week. An omega structured synoptic pattern developed mid-month with a ridge over Texas through the 17th but a closed low deepened over the Rockies and moved slowly eastward bringing thunderstorms to West Texas early morning May 20. An upper level trough built up across the Pacific Northwest and shifted over the Desert Southwest while a mid-level low moved across the Plains. Limited upper level forcing was available over West Texas during the next several days; however, during late afternoon of the 23rd a surface low and associated dryline developed seedable thunderstorms over the western target. Hot, Dry, and windy conditions prevailed for the better part of the last week of May as a mild ridge over Texas expanded east and northward, then retrograded westward over Texas. Several 100° degree days occurred bringing the total seasonal days above the century mark to 10. An upper level ridge built in over the Mid-Atlantic and Southeast end of the month backing up over east-central Texas.

May held below average rainfall and above average temperatures. Totals at San Angelo, Midland, and Abilene are below the monthly normal for May. San Angelo received 1.36 inches and was 1.73 inches below normal for May. Abilene received 1.11 inches and was 1.72 inches below normal. Midland received .05 inches in May and was 1.74 inches below normal. All three sites are below normal for annual precipitation. San Angelo recorded 2.48 inches, Abilene 5.55, and Midland 0.16 inches for year-to-date. Respectively, each site was below normal by 5.20, 2.46, and 3.89 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>	0.21	Cox Ranch		
1.36	Mathis Field	0.20	Ozona	<u>Wunderground</u>
1.11	Abilene	0.15	Sterling City	0.19
0.78	Junction			0.37
0.05	Midland	<u>CocoRahs</u>		<u>Other</u>
0.15	Big Spring	0.46	Eldorado	1.06
<u>Utah Mesonet/HADS</u>		1.40	Knickerbocker	0.34
0.38	Barnhart	0.08	Ozona (15mi SSW)	
0.10	Sonora	1.68	Vancourt	

June 2011 Operations Report

June 15, 2011 – Seeding operations were conducted over Sterling County. A total of 11 flares were burned within 3 cells. A dryline bulge and weak impulse moving east during the morning allowed for marginally seedable clouds.

June 18, 2011 - Seeding operations were conducted over Irion (2), Glasscock (6), Reagan (12), Sterling (7), and Tom Green Counties (2). 29 flares were burned within 6 small cells. A dryline and sufficient surface heating allowed for seedable thunderstorms.

June 19, 2011 - Seeding operations were conducted over Crockett (10) and Reagan (6) Counties. 16 flares were burned within 1 small cell. A dryline and sufficient surface heating allowed for seedable thunderstorms.

June 21, 2011 - Seeding operations were conducted over Glasscock (41), Irion (3), Reagan (17), Sterling (26), and Tom Green (5) Counties. 92 flares were burned within numerous cells along a frontal boundary moving southward through the target area. This is the fourth day for seeding in June and 8th day for seeding during the season.

The month of June contained # days of operations

Date	Flares	Counties seeded
15	11	Sterling
18	29	Glasscock, Irion, Reagan, Sterling, Tom Green
19	16	Crockett, Reagan
21	92	Glasscock, Irion, Reagan, Sterling, Tom Green
Total Flares: 148		

The general weather pattern for June began with temps some 10-15 degrees above normal with two subtropical ridges across the lower half of North America, one over the Mid-Atlantic with another over NWRN MX. The latter feature kept W TX hot, dry, and windy through the first week, however, the 2nd week saw one seedable day as the combination of deeply mixed boundary layer and steep lapse rates led to scattered late afternoon showers and storms from the TX Panhandle SWRD into the Trans-Pecos. Due to the well-mixed boundary layer and meager moisture, these storms were really high based. Some of the bases were right near 14,000 ft. Obviously, this made seeding operations a challenge. During the third weekend of the month a large trough developed across the western US suppressing the subtropical ridge into Mexico. This led to a pair of active dryline days for seeding. A few days later a cold front dropped southward and stalled out right through the target area and was the focus for a slow-moving broken squall line of storms later that afternoon. This proved to be the most successful operational day of the year to date. The big winner in precip totals on this day was Paint Creek at 2.09 inches. With the passage of the squall line and cold front, the atmosphere was scoured of moisture leaving the rest of the month hot and dry.

June held below average rainfall and above average temperatures. Totals at San Angelo, Midland, and Abilene are below the monthly normal for June. San Angelo received 0.46 inches and was 2.06 inches below normal for June. Abilene received 0.93 inches and was -2.13 inches below normal. Midland received no rain in June and was 1.71 inches below normal. All three sites are below normal for annual precipitation. San Angelo recorded 2.94 inches, Abilene 6.48, and Midland 0.16 inches for year-to-date. Respectively, each site was below normal by 7.26, 4.59, and 5.60 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.

NWS

0.46 Mathis Field

0.93 Abilene

0.52 Junction

0.00 Midland

0.00 Big Spring

Utah Mesonet/HADS

0.27 Barnhart

0.80 Sonora

0.49 Cox Ranch

0.27 Ozona (15mi SSW)

DNA Sterling City

CocoRahs

0.51 Eldorado

0.96 Knickerbocker

0.00 Ozona (26.8 SW)

DNA Vancourt

Wunderground

1.60 Mertzon

Other

1.02 San Angelo (7NW)

0.25 St. Lawrence

July 2011 Operations Report

July 01, 2011 – Seeding operations were conducted over Schleicher (4) and Tom Green (1) counties. 5 flares were burned within 1 small cell. Added moisture from remnants of T.S. Arlene combined with hot well-mixed atmosphere allowed for seedable thunderstorms.

July 02, 2011 - Seeding operations were conducted over Schleicher (22) and Sutton (18) Counties. 40 flares were burned within numerous small cells. A hot and well mixed atmosphere with remnant moisture from T.S. Arlene allowed for seedable thunderstorms.

July 07, 2011 - Seeding operations were conducted over Sutton (23) County. A shortwave embedded within the upper ridge helped initiate thunderstorm activity across southern TA. 22 flares were burned within 5 cells.

July 16, 2011 - Seeding operations were conducted over Glasscock (15), Reagan (18), and Sterling (17) Counties. A shortwave embedded within the upper level ridge helped initiate marginal clouds. 50 flares were burned within 10 cells.

July 18, 2011 - Seeding operations were conducted over Schleicher (30) and Sutton (2) Counties. A shortwave embedded within the upper level ridge helped initiate marginal clouds. 32 flares were burned within 10 small cells.

July 19, 2011 - Seeding operations were conducted over Crockett (17), Irion (7), Schleicher (26), Sterling (4), and Sutton (19) Counties. A shortwave embedded within the upper level ridge helped develop good clouds. 73 flares were burned within 14 clouds.

July 20, 2011 - Seeding operations were conducted over Irion (7), Schleicher (26), and Sutton (19) Counties. A shortwave embedded within the upper level ridge helped develop marginal clouds. 54 flares were burned within 10 small clouds.

July 29, 2011 - Seeding operations were conducted over Glasscock (14), Reagan (14), Schleicher (2) and Sutton (16) Counties. An upper level low over northern Mexico allowed for marginally seedable clouds. 46 flares were burned within 17 small clouds.

July 30, 2011 - Seeding operations were conducted over Crockett (17) County. An upper level low over north-central Mexico allowed for marginally seedable clouds. 17 flares were burned within 5 small clouds. This is the ninth day for seeding in July and 17th day for seeding during the season.

The month of July contained 9 days of operations

Date	Flares	Counties seeded
01	5	Schleicher, Tom Green
02	40	Schleicher, Sutton
07	22 +1H	Sutton
16	50	Glasscock, Reagan, Sterling
18	32	Schleicher, Sutton
19	73 +1H	Crockett, Irion, Schleicher, Sterling, Sutton
20	54 +2H	Irion, Schleicher, Sutton
29	46	Glasscock, Reagan, Schleicher, Sutton
30	17	Crockett
Total Flares: 339 + 4H		

July started off with T.S. Arlene making landfall across central Mexico. While not making a direct impact into the Northwestern Gulf, Arlene did throw some Gulf moisture toward west Texas, which helped ignite a couple of seeding days early on in the month. Once the moisture decreased the upper ridge built back in and left the region high and dry for another week. An upper level ridge centered over Texas for the first half of the month shifted over the central Plains allowing for easterly flow along the southern periphery of the ridge to set over central Texas. Impulse shortwaves pushing through easterly flow, increased moisture and record heating allow for an active pattern to set up. Temperatures above 100° persisted throughout the month except for the 1st and 30th. While temperatures were hot and moisture was available mid month, clouds remained very low profile, marginally seedable.

July held below average rainfall and above average temperatures. Totals at San Angelo, Midland, and Abilene are below the monthly normal for July. San Angelo received a trace of rain and was 1.1 inches below normal for July. Abilene received only a trace of rain and was -1.87 inches below normal. Midland received a trace of rain in July and was 1.89 inches below normal. All three sites are below normal for annual precipitation. San Angelo recorded 2.94 inches, Abilene 6.48, and Midland 0.16 inches for year-to-date. Respectively, each site was below normal by 8.36, 6.48, and 7.49 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>	0.06	Cox Ranch	0.00	San Angelo (10.4E)
T Mathis Field	0.13	Ozona (15mi SSW)		
T Abilene	0.07	Sterling City	<u>Wunderground</u>	
0.55 Junction	0.15	Sheffield	0.00	Mertzon
T Midland			<u>Other</u>	
0.22 Big Spring	<u>CocoRahs</u>		0.00	San Angelo (7NW)
<u>Utah Mesonet/HADS</u>	0.13	Eldorado	0.11	St. Lawrence
0.00 Barnhart	0.71	Knickerbocker	0.00	Big Lake
0.63 Sonora	0.88	Ozona (26.8 SW)	0.00	Wall

August 2011 Operations Report

August 02, 2011 – Seeding operations were conducted over Schleicher (4) and Tom Green (4) Counties. Although clouds remained small 8 flares were burned within 3 small clouds. A southwesterly flow produced enough moisture and heating for convection to occur.

August 10, 2011 - Seeding operations were conducted over Schleicher (4), Crockett (2), Irion (8), Reagan (12), and Sterling (15) Counties. 41 flares were burned within 12 clouds. A southwesterly flow coupled with a weak boundary produced enough moisture, heating and lift for convection to occur.

August 11, 2011 - Seeding operations were conducted over Schleicher (12), Crockett (6), Irion (7), Sutton (34), Glasscock (9) and Sterling (11) Counties. 80 flares were burned within 15 clouds. A southwesterly flow coupled with a boundary produced enough moisture, heating and lift for convection to occur.

August 12, 2011 - Seeding operations were conducted over Crockett (4) County. 4 flares were burned within 2 marginal clouds. Circulation over the San Angelo area created overcast conditions throughout much of the target area. A few clouds were able to get enough heating and lift to develop, however only two became seedable.

August 14, 2011 - Seeding operations were conducted over Sutton (30), Schleicher (33) and Crockett (2) Counties. 65 flares were burned within 16 clouds. An outflow boundary provided enough lift to fire up storms.

August 25, 2011 - Seeding operations were conducted over Sutton (8), Crockett (31), Reagan (10), Glasscock (9) and Sterling (8) Counties. 66 flares were burned within 13 clouds. An extension of a cold front pushed through the area coupled with strong afternoon heating allowing for convection to occur.

August 28, 2011 - Seeding operations were conducted over Sutton (1), County. 1 flares were burned within 1 very small clouds. Day time heating surpassed the convective temperature allowing for showers and storms to produce east of target area.

August 29, 2011 - Seeding operations were conducted over Sutton (14), Crockett (9), Sterling (2), Irion (16) and Schleicher (51) Counties. 92 flares were burned within 16 clouds. Dryline coupled with daytime heating allowed enough lift to develop storms along the eastern target.

The month of August contained 8 days of operations

Date	Flares	Counties seeded
02	8	Schleicher, Tom Green
10	41	Schleicher, Crockett, Irion, Reagan, Sterling
11	79+1H	Schleicher, Crockett, Irion, Sutton, Glasscock, Sterling
12	4	Crockett
14	64+1H	Sutton, Schleicher, Crockett
25	66	Sutton, Crockett, Reagan, Glasscock, Sterling
28	2	Sutton
29	91+1H	Sutton, Crockett, Sterling, Irion, Schleicher
Total Flares: 355+3H		

The beginning of August was dominated by a large high pressure and strong low level jet bringing the San Angelo area to 100+ degrees for the first 11 days of the month. Some small convection occurred early in the month in Schleicher and Tom Green counties however most of the target remained dry until the 10th of August. A surface low produced a boundary layer that draped across West Texas producing showers and thunderstorms in our northern and western counties on the 10th and 11th of August. On the 13th of August, a large scale rain system moved in from the north providing 5+ inches of rain in some areas of San Angelo. Flooding occurred throughout Tom Green county resulting in Flash Flood Warnings. Similar conditions occurred on the 14th however an outflow boundary and lack of cloud cover in the southern counties produced seedable clouds. The 12th (99°F), 13th (85°F) and 14th (91°F) were the only days of the month that did not reach the century mark due to the extensive cloud cover and rainfall. On the 15th of August a large ridge draped across Texas brought hot and dry weather back to the target area. Southerly flow and an 850 millibar thermal ridge brought 100°F temperatures back as well as dry conditions as no recorded precipitation occurred until the 25th. On the 25th a shortwave trough allowed for conditions to set up nicely for frontogenesis to occur allowing a lifting mechanism to produce rain showers and thunderstorms. Rain showers and storms occurred throughout most of the target area resulting in seeding operations over Sutton, Crockett, Reagan, Glasscock and Sterling Counties. The frontal boundary moved eastward allowing some dry weather to return, however a stray storm occurred on the 28th of August despite the lack of upper level dynamics. Daytime heating surpassed the forecasted convective temperature resulting in one small rain shower over Sutton County. One day later, on the 29th, a surface low pressure set up a dryline over the eastern half of the target area. Sutton, Crockett, Sterling, Irion and Schleicher Counties all had rain showers and storms. The 30th and 31st of August saw a return to hot and dry weather as zonal flow aloft prohibited any further development.

August held below average rainfall and above average temperatures for San Angelo and Midland. Abilene saw above normal rainfall and temperatures during August. San Angelo (Mathis Field) received a 1.64 inches of rain and was 0.51 inches below normal for August. Locally, however, more rainfall fell during the event from the 12-14th of August. Abilene received 3.91 inches of rainfall giving them 1.41 inches above normal for the month. Midland received a 0.45 inches of rain in August and was 1.33 inches below normal. All three sites are below normal for annual precipitation. San Angelo has recorded 4.58 inches, Abilene 10.39 inches, and Midland 0.61 inches for year-to-date. Respectively, each site was below normal by 9.38, 6.48, and 9.05 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>	0.24	Cox Ranch	<u>Wunderground</u>
1.64 Mathis Field	0.00	Ozona (15mi SSW)	0.00 Mertzson
3.91 Abilene	1.26	Sterling City	<u>Other</u>
0.34 Junction	0.59	Christoval	5.88 San Angelo (7NW)
0.45 Midland	<u>CocoRaHS</u>		2.29 St. Lawrence
0.30 Big Spring	0.42	Eldorado	0.03 Big Lake
<u>Utah Mesonet/HADS</u>	0.76	Knickerbocker	1.48 Wall
0.00 Barnhart	0.52	Ozona (26.8 SW)	
0.23 Sonora	2.72	Garden City	

September 2011 Operations Report

September 03, 2011 – Seeding operations were conducted over Sutton (10) and Crockett (25) Counties. 35 flares were burned within 5 marginal clouds.

September 14, 2011 - Seeding operations were conducted over Sterling (12) Reagan (10) Irion (4) and Glasscock (20) Counties. 46 flares were burned within 9 marginal clouds.

September 16, 2011 - Seeding operations were conducted over Schleicher (16), Irion (2) and Sutton (2) Counties. 20 flares were burned within 6 marginal clouds.

September 17, 2011 - Seeding operations were conducted over Tom Green (4) County. 4 flares were burned within 1 very marginal cloud.

September 18, 2011 - Seeding operations were conducted over Irion (6), Schleicher (20), Sutton (46) and Crockett (12) Counties. 84 flares were burned within 19 clouds.

September 21, 2011 - Seeding operations were conducted over Irion (20), Schleicher (32), Glasscock (10), Sterling (4) Reagan (4) and Crockett (26) Counties. 96 flares were burned within 21 clouds.

September 26, 2011 - Seeding operations were conducted over Irion (22), Schleicher (4) and Reagan (10) Counties. 37 flares were burned within 6 clouds.

September 27, 2011 – Seeding operations were conducted over Schleicher (26), Irion (8), Crockett (10), Sutton (12) and Tom Green (2) Counties. 58 flares were burned within 14 clouds.

September 28, 2011 – Seeding operations were conducted over Irion (4), Crockett (16), Sutton (18), Reagan (22), Glasscock (10) and Schleicher (6) Counties. 76 flares were burned within 12 clouds.

September 29, 2011 - Seeding operations were conducted over Crockett (18), Sutton (5), Reagan (11) and Glasscock (12) Counties. 46 flares were burned within 16 clouds.

The month of September contained 10 days of operations

Date	Flares	Counties seeded
03	35	Sutton, Crockett
14	45+1H	Sterling, Reagan, Irion, Glasscock
16	19+1H	Schleicher, Irion, Sutton
17	4	Tom Green
18	84	Irion, Schleicher, Sutton, Crockett
21	96	Irion, Schleicher, Glasscock, Crockett, Sterling, Reagan
26	36+1H	Irion, Schleicher, Reagan
27	58	Irion, Schleicher, Crockett, Sutton, Tom Green
28	76	Irion, Crockett, Sutton, Reagan, Glasscock, Schleicher
29	46	Crockett, Reagan, Glasscock, Sutton
Total Flares: 499+3H		

September held below average rainfall and above average temperatures for San Angelo, Abilene and Midland. San Angelo (Mathis Field) received a 0.43 inches of rain and was 2.03 inches below normal for September. Abilene received 0.24 inches of rain in September and was 2.00 inches below normal. Midland received 1.59 inches of rainfall putting the rainfall total 0.27

inches below normal. All three sites are below normal for annual precipitation. San Angelo has recorded 5.01 inches, Abilene 10.63 inches, and Midland 2.20 inches for year-to-date. Respectively, each site was below normal by 11.61, 8.66, and 9.45 inches for the year.

Dating back to 2003, September of 2011 was the most active month in the West Texas Weather Modification Association. Despite having a long dry period from September 4th through the 13th, 10 days of operations were conducted as many small shortwave troughs pushed cold fronts across West Central Texas.

The month started off with an upper level ridge that allowed dry conditions to persist for the first few days of the month. With a large 850mb thermal ridge, temperatures were in the upper 90's, even reaching triple digits on the 3rd. Due to the extreme heat on the 3rd coupled with a cold frontal passage, some convection was triggered over Crockett and Sutton counties resulting in operations. Once the cold front moved on, a large dome of high pressure built over the target area keeping conditions dry and temperatures only slightly above normal. It wasn't until the 14th of September that the weather pattern became more active. A shortwave trough stayed north of the area allowing for a low pressure center to form over the north Texas panhandle. A frontal boundary formed and pushed to the south into the target area. With abundant moisture and temperatures reaching near the century mark, showers and thunderstorms developed ahead of a cold front and along an outflow boundary from storms over Coke County. Showers and storms continued along the front on the 15th, however storms were not seedable as they were not convective in nature. With that said, showers and storms on the 15th left behind outflow boundaries for storms on the 16th. Cold air aloft triggered very small convective storms on the 16th. Operations were conducted however clouds were very marginal, at best. Similar conditions occurred on the 17th but convection was very isolated as only one storm fired up within the target and lasted only a few minutes. The 18th was much more active as a very textbook severe weather day was set up. The only ingredient missing was abundant moisture. With that said, widespread showers and thunderstorms fired up across the target area as CAPE values approached 2,000 J/kg. Three days later, the system that created the instability on the 18th pushed a cold front through the region on the 21st. Showers and thunderstorms fired up ahead of and along the cold front. As the frontal passage occurred, temperatures fell for a short time. The high temperature on the 22nd in San Angelo, TX was only 79°F. Conditions stayed dry through the 25th as a high pressure pushed into the area for a short time. The month of September ended with active weather. A cut-off low formed just to the northeast of the target area resulting in northwest flow aloft. Cold air advection in the upper levels created instability as showers and thunderstorms fired up on the 26th through the 29th. Operations occurred on all four days as widespread showers and thunderstorms fired up ahead of and along a cold front. The frontal passage occurred early in the morning on the 30th which ended the month of September very dry and seasonable.

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>	0.68	Cox Ranch	<u>Wunderground</u>		
0.43	Mathis Field	0.71	Ozona (15mi SSW)	0.00	Mertzon
0.24	Abilene	0.17	Sterling City	<u>Other</u>	
0.85	Junction	0.29	Christoval	0.05	San Angelo (7NW)
1.59	Midland	<u>CocoRaHS</u>		0.14	St. Lawrence
0.24	Big Spring	0.14	Eldorado	0.43	Big Lake
<u>Utah Mesonet/HADS</u>		0.14	Knickerbocker	0.08	Wall
0.41	Barnhart	0.72	Ozona (26.8 SW)	0.41	Sutton Co. Avg.
0.56	Sonora	0.28	Garden City		

October 2011 Operations Report

October 11, 2011 – Seeding operations were conducted over Sterling (12) and Glasscock (2) Counties. 14 flares were burned within 2 small clouds.

The month of October contained 1 day of operations

Date	Flares	Counties seeded
11	14	Sterling, Glasscock
Total Flares: 14		

October held above average rainfall and above average temperatures for San Angelo and Abilene while Midland was below normal rainfall and above average temperature. San Angelo (Mathis Field) received 2.91 inches of rain and was 0.18 inches above normal for October. Abilene received 4.09 inches of rain in October and was 1.1 inches above normal. Midland received 1.46 inches of rainfall putting the rainfall total 0.27 inches below normal. All three sites are below normal for annual precipitation. San Angelo has recorded 7.92 inches, Abilene 14.72 inches and Midland 3.66 inches for year-to-date. Respectively, each site was below normal by 11.34, 7.46 and 13.31 inches for the year.

Although it was a very quiet month in terms of operations, October did provide some relief in terms of overall rainfall. The start of the month was warm and dry as the area sat under a large ridge. A deep upper trough provided favorable dynamics to allow a very potent low pressure system to form over the four corners region. This system pushed into the target area on the morning of October 8th. Plenty of moisture was available from a strong low level jet and couple that with the dynamics aloft San Angelo saw its first wide spread rain event of the winter. San Angelo received 2.91 inches of rain on the 8th while adding another 0.27 inches on the 9th. The total rainfall on the 8th of October was a new daily record. Storm totals for the area ranged from 2.5 – 5 inches which helped keep the 2011 season away from the record books for driest year on record. On the 11th of October a few storms fired up in the northwest counties. Surface convergence and temperatures in the mid-80's near Midland provided enough energy for convective storms. Seeding operations were conducted which resulted in 14 flares being burned in two smaller clouds. A warming trend continued from that point onto the 17th. A high temperature of 97°F was a record high for the day breaking the 93°F mark that was set in 1993. The intense heat didn't last long as a very strong cold front pushed through the area overnight. High temperatures on the 18th only reached 70°F, a 27°F difference within 24 hours. The frontal passage provided very gusty winds. San Angelo recorded a wind speed of 39 mph. This was the system that provided the famous haboob (dust storm) over Lubbock, TX. Another warming trend began from the 20th through the 26th before another potent cold front passed by. This time a 26 degree temperature difference was recorded as high temperatures on the 27th only reached 61°F. The front did provide some rainfall for the area, mainly from San Angelo to Big Lake and areas north. On the morning of the 29th very clear skies and calm winds set up rapid radiational cooling. Temperatures throughout the target area dipped below the freezing mark. San Angelo recorded a low temperature of 31°F as frost was reported in low lying areas. The month ended with a high temperature of 80°F on Halloween day as another large ridge placed itself over West Central Texas.

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.

NWS

2.91 Mathis Field
4.09 Abilene
3.88 Junction
1.46 Midland
1.88 Big Spring

Utah Mesonet/HADS

2.16 Barnhart
1.14 Sonora

1.77 Cox Ranch
1.80 Ozona (15mi SSW)
2.53 Sterling City
2.00 Christoval

CocoRahs

2.80 Eldorado
2.64 Knickerbocker
1.83 Ozona (26.8 SW)
1.18 Garden City

Wunderground

4.86 Mertzon

Other

2.69 San Angelo (7NW)
1.38 St. Lawrence
2.84 Big Lake
3.13 Wall