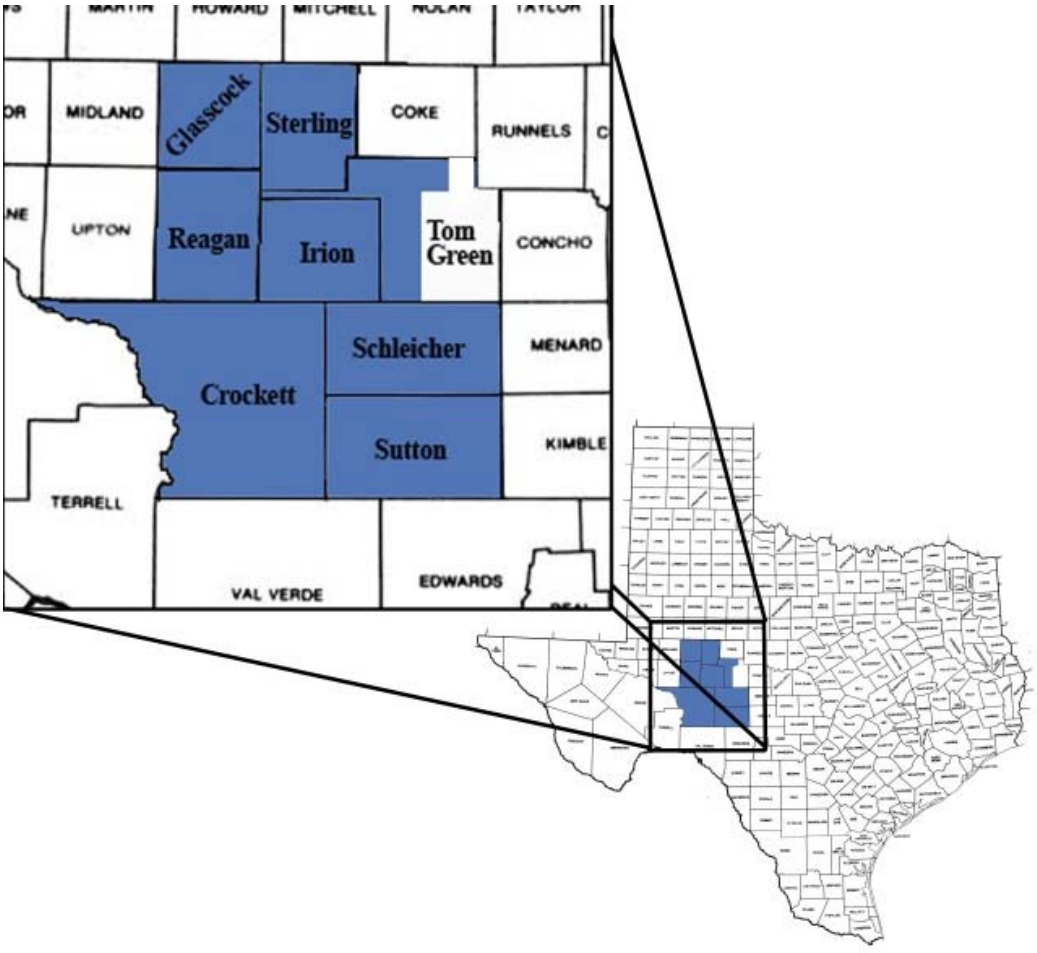
2009 ANNUAL REPORT
WEST TEXAS WEATHER MODIFICATION ASSOCIATION



West Texas Weather Modification Association
8696 Hangar Road
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West Texas Weather Modification Association
2009 Annual Report

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Seeding operations started on March 25th and ended on October 8th with 56 operational days. The number of operational days is the most on record for West Texas; previously, operations were conducted over 53 days in 2006. 190 clouds were seeded with 2,382 flares during 103 flights. The number of seeded clouds is the most since changing radar sources from 74-C to WSR-88D feed. 9 reconnaissance flights were flown while making an attempt to find seedable clouds on marginal days. Pilots flew 267 flight hours. Full time pilot, Levi Sleeper, flew for the duration of the season; part time pilot availability and erratic storm development throughout the season made for a few late flight initiations. Some moderate repairs on aircraft, mainly Piper Aztec 6730Y, had minor affects on operations.

Weather Decision Technologies, Inc. built a new computer with Thunderstorm Identification, Tracking, Analysis and Nowcasting (TITAN) software before the 2009 season. A new software build associated with the National Weather Service radar data feed caused the old system to be unreliable. The new system performed very well with a few minor tweaks as the season began. A series of strong thunderstorms late July caused several power outages; it is believed, a lightning strike on July 29 zapped numerous office components including the flight track data recorder and serial port of the new system. Unfortunately, fight track images were not available for the remainder of the season.

2009 was a rather wet year. As of November 16, a value (23.85in) at San Angelo was above normal by 4.27 inches. Top 10 rainfalls at the San Angelo Regional airport during April and July in addition to periodic large rainfall events throughout the summer led to a well above normal season. Midland International was well below normal until July, following 6.55in. August was the most active this season with 13 operational days. Precipitation and percent of normal maps show that much of Texas was well below normal except for West Texas and parts of central Texas during March and April. Most of Texas was dry through May. Western parts of the target area were well above normal in June and West-central Texas above normal in July. West Texas is shown to be dry August through September but drought stricken east-central and south Texas began to see some relief. The 2009 tropical season was very limited in the Atlantic Ocean and Caribbean without Hurricanes moving onto the Texas Gulf Coast. The Pacific tropical season was more active with several instances of tropical moisture moving over Mexico and into West Texas.

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 17%. Arrival time to small (91%) was excellent. Small clouds showed increases for precipitation mass at 102%, cloud mass increases of 55%, lifetime increases at 27%, increases to cloud area at 39%, cloud volume increases of 41%, and volume above 6Km of 48%. Increases in precipitation mass by county were shown between 6% and 35.5%. Crockett County was below 10% but the low value is a consequence of large area. Reagan County was most favored in number of seeded clouds. In addition to Glaciogenic seeding, West Texas also started a case study using one supplementary hygroscopic flare. Unfortunately, only 3 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 1,851,542 acre-feet.

Robert Rhodes
Meteorologist

ANNUAL EVALUATION REPORT 2009 WTWMA (San Angelo)

Arquímedes Ruiz-Columbié
Active Influence & Scientific Management

Cloud seeding operations 2009 began over the West Texas Weather Modification Association target area in March. This annual report serves as a summary of results. A total of **190 clouds** were seeded and identified by TITAN in **56 operational days**. Table 1 in page 1 summarizes the general figures:

Table 1: Generalities

First operational day: **March 25th 2009**
Last operational day: **October 8th 2009**

Number of operational days: 56
(One in March, three in April, ten in May, twelve in June, nine in July, thirteen in August, seven in September, and one in October)

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

Thirty with excellent performance
Fourteen with very good performance
Ten with good performance
Two with fair performance

Number of seeded clouds: 190 (90 small, 55 large, 43 type B, and two with non-proper files)

Missed Opportunities: 3 (~ 1.6 %)

May 22nd: Cloud # 3471 over Tom Green County

August 2nd: Cloud # 1130 over Crockett County

September 5th: Cloud # 1284 over Sutton County

Small Clouds

Evaluations were done using TITAN and NEXRAD data.

Table 2 shows the results from the classic TITAN evaluation for the 90 small seeded clouds which obtained proper control clouds.

Table 2: Seeded Sample versus Control Sample (90 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	70 min	50 min	1.40	40 (**27**)
Area	73.7 km^2	50.5 km^2	1.47	47 (**39**)
Volume	268.1 km^3	177.2 km^3	1.51	51 (**41**)
Top Height	8.8km	8.3 km	1.06	6 (**3**)
Max dBz	51.8	50.1	1.03	3 (**1**)
Top Height of max dBz	3.9 km	3.9 km	1.00	0 (**-5**)
Volume Above 6 km	78.4 km^3	48.9 km^3	1.60	60 (**48**)
Prec.Flux	510.9 m^3/s	308.6 m^3/s	1.66	66 (**63**)
Prec.Mass	2567.5 kton	1187.2 kton	2.16	116 (**102**)
CloudMass	187.0 kton	115.9 kton	1.61	61 (**55**)
η	13.7	10.2	1.34	34 (**30**)

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 371 flares were used in this sub-sample with an excellent timing **(91 %)** for an effective dose about **65 ice-nuclei per liter**. The seeding operation for small clouds lasted about **7.5 minutes** in average. An excellent increase of **102 %** in precipitation mass together with an increase of 55 % 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 (27 %), area (39 %) volume (41 %), volume above 6 km (48 %), and precipitation flux (63 %) are notable. There are slight increases in top height (3 %) and maximum reflectivity (1 %).

The seeded sub-sample seemed 30 % more efficient than the control sub-sample. Results are evaluated as **excellent**.

An increase of 102 % in precipitation mass for a control value of 1187.2 kton in 90 cases means:

Δ_1 = 90 x 1.02 x 1187.2 kton = 108 985 kton = 88 387 ac-f

Large Clouds

The sub-sample of 55 large seeded clouds received a synergetic analysis. In average, the seeding operations on these large clouds affected 50 % of their whole volume; with an excellent timing (91 % of the material went to the clouds in their first half-lifetime). A total of 1072 flares were used in this sub-sample for an effective dose about **90 ice-nuclei per liter**.

Also in average, large clouds were 36 minutes old when the operations took place; the operation lasted about 40 minutes, and the large seeded clouds lived 240 minutes.

Table 3 shows the corresponding results:

Table 3: Large Seeded Sample versus Virtual Control Sample (55 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	240 min	215 min	1.12	12
Area	1281 km^2	1102 km^2	1.16	16
Volume	5777 km^3	4937 km^3	1.17	17
Volume Above 6 km	2403 km^3	2013 km^3	1.19	19
Prec.Flux	11641 m^3/s	9390 m^3/s	1.24	24
Prec.Mass	120 291 kton	89 920 kton	1.34	34

An increase of 34 % in precipitation mass for a control value of 89 920 kton in 55 cases may mean:

Δ_2 = 55 x 0.34 x 89 920 kton = 1 681 504 kton = 1 363 700 ac-f

Type B Clouds

The sub-sample of 43 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 (89 % of the material went to the clouds in their first half-lifetime). A total of 922 flares were used in this sub-sample for an effective dose ~ **40 ice-nuclei per liter**.

Also in average, type B clouds were 120 minutes old when the operations took place; the operation lasted about 52 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 (43 couples, averages)

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	280 min	270 min	1.04	4
Area	4535 km^2	4344 km^2	1.04	4
Volume	18866 km^3	18043 km^3	1.05	5
Volume Above 6 km	6425 km^3	6112 km^3	1.05	5
Prec.Flux	27902 m^3/s	26285 m^3/s	1.06	6
Prec.Mass	154 637 kton	143 182 kton	1.08	8

An increase of 8 % in precipitation mass for a control value of 143 182 kton in 43 cases may mean:

Δ_3 = 43 x 0.08 x 143 182 kton = 492 546 kton = 399 455 ac-f

The total increase: $\Delta = \Delta_1 + \Delta_2 + \Delta_3$ = 1 851 542 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	**19**	**27**	**280 300**	**5.84**	**16.06 in**	**36 %**
Sterling	**20**	**34**	**232 900**	**4.74**	**25.47 in**	**19 %**
Reagan	**33**	**43**	**220 200**	**3.51**	**16.10 in***	**22 %**
Irion	**30**	**42**	**202 300**	**3.60**	**16.82 in**	**21 %**
Tom Green	**15**	**35**	**215 700**	**5.31****	**20.90 in**	**25 %**
Crockett	**24**	**34**	**146 200**	**0.98**	**16.13 in**	**6 %**
Schleicher	**29**	**45**	**201 100**	**2.88**	**20.06 in**	**14 %**
Sutton	**20**	**32**	**146 400**	**1.90**	**13.96 in**	**14 %**
Total	**190**	**292**	**1 645 100**			
Average (only for the bold values)				**3.15**	**18.19 in**	**17 %**

(*) Missed data recreated by spatial interpolation
(**) One half of the Tom Green Area considered

(**Initial seeding** means the counties were 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 5 cases were achieved (3 small clouds, 2 type B clouds). Results are described below.

Table 6 illustrates the results corresponding to the three small seeded cases.

Table 6: **Hygroscopic Seeded Sample versus Control Sample (3 couples, averages)**

Variable	Seeded Sample	Control Sample	Simple Ratio	Increases (%)
Lifetime	85 min	70 min	1.21	21 (**10**)
Area	129.9 km2	69.0 km2	1.88	88 (37)
Volume	680.4 km3	332.3 km3	2.04	104 (**35**)
Top Height	12.4 km	10.1 km	1.23	23 (**6**)
Max dBz	56.8	52.4	1.08	8 (**2**)
Top Height of max dBz	3.7 km	4.0 km	0.93	- 7 (**0**)
Volume Above 6 km	341.4 km3	160.5 km3	2.13	113 (**42**)
Prec.Flux	1270.7 m3/s	542.6 m3/s	2.34	134 (**63**)
Prec.Mass	6646.0 kton	2674.0 kton	2.41	141 (**120**)
CloudMass	518.0 kton	247.4 kton	2.09	109 (**34**)
η	12.8	10.8	1.19	19 (**64**)

A total of 22 BIP and 4 hygroscopic flares were used in this sample with a perfect 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. However, results from such a small sample should be considered only preliminary and more dual operations have to be done in order to reach some significance.

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	3.5	5	5.5
PrecMass per scan	3286 kton	8241 kton	9187 kton
Top of MaxdBz	4.7 km	4.9 km	4.9 km
Centroid height	5.9 km	5.4 km	6.0 km

The systematic increases in the average number of cells and in average precipitation mass per scan seem to indicate that the hygroscopic material went into the storms with excellent timing since the target units were still growing at the time of seeding. Additionally, the average top height of maximum reflectivity slightly raised during the seeding actions, whereas the average reflectivity Centroid height was decreasing at the time of seeding but in the next 30 minutes increased 0.6 km (~ 2000 feet), suggesting that probably more ice particles were produced by the hygroscopic material (notice that at the reported height, above 5 km, the water is at least in a supercooled state). Again, the sample 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.

The evaluation of weather modification actions always brings back the question about causality (the sequence cause-effect and the explanation of what is happening). Hygroscopic seeding is not an exception. In our case, causal relationships are complex and subtle because the complexity of the processes that produce precipitation involves numerous factors from different scales (planetary, synoptic, mesoscale, and microscale). **Cloud seeding should be considered as a contributory cause,** whereas cloud seedability has to be regarded as the main cause responsible for the precipitation events. It is probably hard to understand, but this distinction is vital for any evaluation to be objective: **the contributory cause is only partly responsible for the final effect**.

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, and Tom Green Counties); the average increase in precipitation, referred to the seasonal value, is about **17 %;**

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 2009 was above normal in rainfall amounts over the target area, and also generous in seedable conditions.

West Texas Weather Modification												
2009 Flight Summary												
March												
Date	**Number**	**Call Sign**	**Takeoff**	**Landing**	**Duration**	**BIP**	**Eject.**	**Agl**	**Seeded**	**Pilot**	**Dirty Cloud ug/m³**	
25-Mar	1	6730Y	1635	2030	4.00	40		1,040	Ir, Sc, Su, Tg	L. Sleeper	Dust	20
	2	5141P	1920	2120	2.00	20		520	Sc, Su	Eggemeyer	Dust	20
SubTotal					4.00	40		1,560				
Total					4.00	60		1,560				
West Texas Weather Modification												
2009 Flight Summary												
April												
11-Apr	3	6730Y	2340	110	1.30	0		0	recon	L. Sleeper	Smoke/Dust	1 / 40
16-Apr	4	5141P	2200	2345	1.70	5		130	Gl	L. Sleeper	N/A	N/A
23-Apr	5	5141P	2048	2210	1.30	4		104	Gl	L. Sleeper	N/A	N/A
	6	5141P	2350	135	1.50	13		338	Gl, Re, St	L. Sleeper	N/A	N/A
26-Apr	7	6730Y	2220	2330	2.50	11		286	Cr,Gl,Re	L. Sleeper	smoke	2
	8	5141P	2120	2450	3.50	17		442	Gl, Sc	E. Sleeper	smoke	2
SubTotal					11.80	50		1,300				
Total					15.80	110	0.00	2,860				
West Texas Weather Modification												
2009 Flight Summary												
May												
12-May	9	6730Y	2200	0050	2.50	20		520	Gl, Re	L. Sleeper	smoke	2
13-May	10	6730Y	1455	1520	0.70	0		0	recon	L. Sleeper	smoke	2
16-May	11	6730Y	1600	1700	0.90	0		0	recon	L. Sleeper	smoke	1
	12	6730Y	1900	1940	0.70	2		52	Tg	L. Sleeper	smoke	1
22-May	13	6730Y	1750	2040	2.90	30		780	Sc, Su	L. Sleeper	N/A	N/A
	14	5141P	1915			4	Landing Gear Inc.	104	Ir	Eggemeyer	N/A	N/A
	15	6730Y	2135	2300	1.50	4		104	Ir, Sc, Su,	L. Sleeper	N/A	N/A
23-May	16	6730Y	1655	1945	3.00	33		858	Ir, Sc, Tg	L. Sleeper	N/A	N/A
	17	7924P	1740	2250	5.10	67		1,742	Cr,Ir,Re,Sc,Su	Eggemeyer	N/A	N/A
	18	6730Y	2020	2230	2.10	12		312	Su	L. Sleeper	N/A	N/A
24-May	19	7924P	1830	2245	4.30	31		806	Ir, St, Tg	L. Sleeper	N/A	N/A
	20	6730Y	1915	2220	3.30	14		364	Ir, Sc, Su,	E. Sleeper	N/A	N/A
25-May	21	7924P	2115	0045	3.80	42		1,092	Gl, Re, St	L. Sleeper	N/A	N/A

26-May	22	7924P	2100	0140	4.40	82		2,132	Gl,St	Zesch	N/A	N/A
	23	6730Y	2125	0125	4.00	51		1,326	Gl, St,Tg	L. Sleeper	N/A	N/A
28-May	24	7924P	1940	2310	3.70	34		884	Cr,Gl,Ir,Sc,St	L. Sleeper	N/A	N/A
	25	6909P	2130	0040	3.10	28		728	Gl,Re,St	Linderman	N/A	N/A
	26	6730Y	2320	0200	2.80	36		936	Cr, Ir,Sc,Tg	E. Sleeper	N/A	N/A
30-May	27	7924P	1835	2235	4.00	39		1,014	Cr, Sc, Su	L. Sleeper	Sulfate	1
31-May	28	7924P	2210	0110	3.00	53		1,378	Gl, Re, TgP	L. Sleeper	N/A	N/A
SubTotal					55.80	582		15,132				
Total					71.60	692	0.00	17,992				
West Texas Weather Modification												
2009 Flight Summary												
June												
Date	**Number**	**Call Sign**	**Takeoff**	**Landing**	**Duration**	**BIP**	**Eject.**	**Agl**	**Seeded**	**Pilot**	**Dirty Cloud ug/m³**	
2-Jun	29	6730Y	2225	2355	1.60	9		234	Cr	L. Sleeper	N/A	N/A
	30	7924P	0015	0145	1.60	32		832	Tg, St	Zesch	N/A	N/A
	31	6730Y	0025	0155	1.50	15		390	Gl, St	L. Sleeper	N/A	N/A
6-Jun	32	6730Y	2150	0140	3.90	54		1,404	Cr,Gl,St,Re	L. Sleeper	Dust	10
7-Jun	33	6730Y	2105	0105	4.00	28		728	Cr,Gl	L. Sleeper	N/A	N/A
8-Jun	34	6909P	2205	2335	1.30	9		234	Gl	Baker	N/A	N/A
10-Jun	35	6730Y	1950	2350	4.00	61		1,586	Cr,Gl,Su	L. Sleeper	N/A	N/A
	36	7924P	2130	0020	2.90	17		442	Cr,St	Zesch	N/A	N/A
13-Jun	37	7924P	2140	2225	0.90	0		0	recon	L. Sleeper	N/A	N/A
	38	7924P	2250	0050	2.00	14		364	Gl,Re	L. Sleeper	N/A	N/A
19-Jun	39	5141P	2120	0010	2.80	14		364	Ir, Sc, Tg	L. Sleeper	N/A	N/A
	40	5141P	0035	0035	1.20	8		208	Ir, Sc	L. Sleeper	N/A	N/A
25-Jun	41	6730Y	2145	2325	1.40	0		0	recon	L. Sleeper	N/A	N/A
26-Jun	42	6730Y	1845	2255	4.10	29		754	Sc,Su	L. Sleeper	N/A	N/A
27-Jun	43	6730Y	2000	2250	2.80	19		494	Gl,Ir, Re,Tg	L. Sleeper	N/A	N/A
	44	6730Y	2325	0045	1.70	9		234	Ir, Sc	L. Sleeper	N/A	N/A
28-Jun	45	6730Y	1800	2210	4.30	59		1,534	Cr,Ir,Sc,Tg	L. Sleeper	N/A	N/A
	46	5141P	1920	2305	3.70	40		1,040	Gl, Ir,Re,St	Zesch	N/A	N/A
29-Jun	47	6730Y	1845	2245	4.00	51		1,326	Cr, Ir,Sc,Tg	L. Sleeper	N/A	N/A
	48	6909P	1910	2230	3.50	19		494	Ir, St, Tg	Baker	N/A	N/A
	49	5141P	2225	0130	3.00	45		1,170	Cr,Gl,Ir,Re,Sc	Zesch	N/A	N/A
	50	6730Y	2315	0130	2.10	18		468	Sc,Su	L. Sleeper	N/A	N/A
30-Jun	51	6730Y	1820	2140	3.20	26		676	Sc,Su	L. Sleeper	N/A	N/A

	52	5141P	1850	2150	2.40	40		1,040	Gl	Zesch	N/A	N/A
SubTotal					63.90	487	0.00	12,168				
Total					135.50	1,159	0.00	42,328				
West Texas Weather Modification												
2009 Flight Summary												
July												
1-Jul	53	6730Y	1940	2155	2.80	*8*		*416*	Cr, Gl	L. Sleeper	N/A	N/A
	54	6730Y	2345	0055	1.00	0		*0*	recon	L. Sleeper	N/A	N/A
2-Jul	55	6730Y	1835	2145	3.10	*9*		*468*	Cr, Ir,Sc	L. Sleeper	N/A	N/A
	56	7924P	1905	2355	4.70	57		1,482	Cr,Gl,Ir,Re,St,Sc	Zesch	N/A	N/A
	57	6730Y	2220	2355	1.70	*10*		*520*	Ir,Sc,Su,Tg	L. Sleeper	N/A	N/A
4-Jul	58	6730Y	2255	0120	2.30	*8*		*416*	Gl,Re,St	L. Sleeper	N/A	N/A
17-Jul	59	7924P	1830	2000	1.50	14		364	Sc, Su	L. Sleeper	Dust	20
	60	6730Y	2035	2250	2.70	27		702	Cr, Re	L. Sleeper	Dust	20
18-Jul	61	6730Y	1600	1755	1.90	*11*		*572*	Su	L. Sleeper	Dust	20
	62	6730Y	1940	2030	0.80	*1*		*52*	Sc	L. Sleeper	Dust	20
20-Jul	63	6730Y	1615	1845	2.50	6		*312*	Ir,Sc	L. Sleeper	Dust	30
	64	6730Y	2100	2315	2.30	9		*468*	Re	L. Sleeper	Dust	30
21-Jul	65	6730Y	1530	1630	1.00	0		*0*	recon	L. Sleeper	Dust	40
22-Jul	66	6730Y	1650	2005	3.20	23		*1,196*	Cr,Ir,Sc,Tg	L. Sleeper	Dust	60
29-Jul	67	7924P	2200	0120	3.30	48		1,248	Cr,Ir,Sc,Tg	L. Sleeper	Dust	40
31-Jul	68	6730Y	1845	1940	0.80	8		208	Ir	L. Sleeper	Dust	20
	69	5141P	2050	2250	2.00	16		416	Sc,Tg	L. Sleeper	Dust	20
	70	5141P	0000	0200	2.10	12		312	Cr	Zesch	Dust	20
SubTotal					39.70	267	0	9,152				
Total					175.20	1,426	0	39,312				
West Texas Weather Modification												
2008 Flight Summary												
August												
Date	**Number**	**Call Sign**	**Takeoff**	**Landing**	**Duration**	**BIP**		**Agl**	**Seeded**	**Pilot**	**Dirty Cloud ug/m³**	
1-Aug	71	6730Y	1905	2130	2.40	21		546	Cr,su	L. Sleeper	Dust	40
	72	5141P	2155	0120	3.30	40		1,040	Cr,Ir,Re,Sc,Tg	L. Sleeper	Dust	50
2-Aug	73	6730Y	2015	2325	3.10	33		858	Cr,Re	L. Sleeper	Dust	50
11-Aug	74	5141P	1840	2130	1.90	33		858	Cr,Ir,Re,St	L. Sleeper	Dust	40
	75	5141P	2200	0020	2.40	37		962	Cr,Ir,Sc,Su	L. Sleeper	Dust	40

12-Aug	76	5141P	1855	2155	3.00	25		650	Sc,Su	L. Sleeper	Dust	40
	77	6909P	1955	2135	1.50	5		130	Cr,Ir	Baker	Dust	40
	78	5141P	2220	0040	2.60	25		650	Ir, Gl, St, TG	L. Sleeper	Dust	40
	79	6909P	0000	0110	1.10	1		26	Re	Baker	Dust	40
13-Aug	80	7924P	2000	0025	4.20	35		910	Cr,Ir,Re,Sc,Su	L. Sleeper	Dust	40
14-Aug	81	6730Y	2100	2150	0.80	0		0	recon	L. Sleeper	Dust	20
15-Aug	82	6730Y	2145	0035	2.90	34	*2 Hygro*	884	Re, St,Tg	L. Sleeper	Dust	30
	83	6909P	2215	0045	2.50	18		468	Re	Baker	Dust	30
16-Aug	84	6730Y	2235	2350	1.20	4		104	Gl	L. Sleeper	Dust	20
20-Aug	85	6730Y	2145	2325	1.70	12	*1 Hygro*	312	Gl,St	L. Sleeper	Dust	20
	86	7924P	2250	0010	1.60	13	*1 Hygro(250g)*	338	Sc,Tg	Zesch	Dust	20
21-Aug	87	6730Y	1930	2110	1.80	2		52	Cr	L. Sleeper	N/A	N/A
22-Aug	88	5141P	1925	2310	3.60	55		1,430	Cr,Gl,Ir,Re,Sc,St,Tg	L. Sleeper	N/A	N/A
23-Aug	89	5141P	2255	0015	1.20	8		208	Sc	L. Sleeper	N/A	N/A
27-Aug	90	6730Y	2000	2240	2.60	35		910	Cr,Ir,Re,Sc,St,Su	L. Sleeper	N/A	N/A
	91	7924P	2055	0000	3.40	65		1,690	Cr,Ir,Sc,Su,Tg	Zesch	N/A	N/A
28-Aug	92	6730Y	1430	1600	1.50	3		78	Re	L. Sleeper	N/A	N/A
	93	6730Y	1755	2105	3.30	38		988	Gl, Ir,Re,St	L. Sleeper	N/A	N/A
	94	6909P	1830	1930	1.00	1		26	Gl	Baker	N/A	N/A
SubTotal					54.60	543	0.00	14,118				
Total					229.80	1969	0.00	53,430				
West Texas Weather Modification												
2008 Flight Summary												
September												
4-Sep	95	6730Y	2045	0000	3.30	15		390	Re, Sc	L. Sleeper	N/A	N/A
5-Sep	96	6730Y	1805	2105	3.00	32		832	Ir, Re, St	L. Sleeper	Sulfate	1
	97	5141P	1830	2105	2.70	18		468	Ir, Sc, Su,Tg	E. Sleeper	Sulfate	1
	98	6730Y	2145	2310	1.40	23		598	Ir,Sc,Tg	L. Sleeper	Sulfate	1
6-Sep	99	6730Y	1905	2020	1.40	5		130	Sc	L. Sleeper	Sulfate	1
	100	6730Y	2100	2330	2.40	26		676	Cr,Ir,Re,Sc,St,Tg	L. Sleeper	Sulfate	1
8-Sep	101	5141P	1850	2220	3.30	52		1,352	Cr,Ir,Re,St,Tg	L. Sleeper	N/A	N/A
	102	7924P	2100	0010	3.20	29		754	Cr,Ir,Sc,Su	E. Sleeper	N/A	N/A
9-Sep	103	6730Y	1730	2045	3.30	50		1,300	Gl,Ir,Re,St, Tg	L. Sleeper	N/A	N/A
	104	5141P	1900	2150	2.80	38		988	Ir, Sc,Su	Eggemeyer	N/A	N/A
10-Sep	105	6730Y	2000	2230	2.50	22		572	Gl,Re,St	L. Sleeper	N/A	N/A
20-Sep	106	7924P	1940	2310	3.50	49		1,274	Cr,Ir,Re,Sc,St,Su,Tg	L. Sleeper	Sulfate	1

SubTotal					32.80	359	0.00	9,334				
Total					262.60	2328	0.00	62,764				
West Texas Weather Modification												
2008 Flight Summary												
October												
Date	**Number**	**Call Sign**	**Takeoff**	**Landing**	**Duration**	**BIP**	**Eject.**	**Agl**	**Seeded**	**Pilot**	**Dirty Cloud ug/m³**	
6-Oct	107	6730Y	1620	1720	1.00	0		0	recon	L. Sleeper	N/A	N/A
8-Oct	108	6730Y	1725	1805	0.55	6		156	Ir	L. Sleeper	N/A	N/A
	109	6730Y	2150	2335	1.60	42		1,092	Gl,Re	L. Sleeper	N/A	N/A
	110	7924P	2350	0055	1.30	12		312	Gl,Re	L. Sleeper	N/A	N/A
SubTotal					4.45	60	0.00	1,560				
Total					267.05	2388	0.00	64,324				

March 2009 Operations Report

March 25, 2009 - Seeding operations were conducted over Irion (3), Schleicher (12), Sutton (40), and Tom Green (5) Counties. 60 flares were burned within 7 large clouds. An upper level trough, surface low with trough over West Texas, and dryline produced strong thunderstorms early in the day. This is the first day for seeding in March and 1st day for seeding during the season.

The month of March contained 1 day of operations

Date	Flares	Counties seeded
25	60	Irion, Schleicher, Sutton, Tom Green
Total Flares: 60		

The general weather pattern for March began with a ridge dominating the southern Plains pushing above normal temperatures through the first week. On March ninth a deep trough over the Desert Southwest and northern Mexico brought pacific moisture into Texas. A dryline set up just west of the target area, which suggested the possibility for the first storms of the season. Full time pilot and Meteorologist were waiting all afternoon for storms; but decided they would not be developing until too late. Unfortunately, storms did fire over Midland County extending northeast over Glasscock just before 7PM. Mostly cloudy skies prevailed the following day without precipitation. Mostly cloudy skies, rain, and cold temperatures followed a cold front on the 11th with rain showers continues through the 13th with between 1 and 2 inches of rain over the target area. Mild temperatures and mostly sunny skies were associated with a largely zonal ridge into the official spring. A large trough digging into the west coast on the vernal equinox pushed Pacific moisture into Texas with a strong low-level jet. A strong surface low over Colorado provided breezy conditions and mild temperatures. Cloud cover with this system was dominant, reducing chances for greater instability. Rain and storms were limited to the Texas Panhandle on the evening of the 21st. While the surface low strengthened over Colorado, a dryline rested over West Texas, without sufficient surface heating or forcing; thunderstorms eluded West Texas until Wednesday March 25. The large trough persisted across the southern Rockies, and a shortwave pushed through West Texas to create dynamics necessary for storms. A potent dryline also setup over West Texas. The morning was socked in with ceiling at or below 2000ft. At around 11AM, ceilings began to break, storms began to fire, and the pilot was in route. The 2009 season began with good results over Irion, Schleicher, Sutton, and Tom Green. A blizzard followed up the start of the season over the Texas Panhandle and Oklahoma while West Texas returned to dry conditions with a brief cool down associated with a strong cold front. West Texas volleyed between warm and cool days as a series of low develops over the Rockies and crossed the southern Plains. Precipitation was limited to two sets of events over the target area.

Rainfall for January and February was much below normal across the target area with totals less than half an inch. Totals at San Angelo rose above the monthly normal in March. The majority of the target area received un-seedable rain March 10-13 and the eastern target received seedable thunderstorms March 25th. Abilene and San Angelo were below normal for the year receiving 1.88 and 2.27 through March; .01 and .74 inches above normal. Midland received .56 inches in March, .82 inches for the year and .71 inches below normal.

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
1.73 Mathis Field
1.42 Abilene
3.42 Junction
0.56 Midland
0.33 Big Spring

AWS
1.33 Grape Creek
0.24 Eldorado MS
0.09 McCamey

Utah Mesonet
1.19 Barnhart
1.76 Sonora
0.73 Big Lake
2.88 Cox Ranch

CocoRahs
2.14 Eldorado
1.56 Knickerbocker
1.30 Garden City
1.94 Ozona (15mi SSW)
1.38 Iraan
0.99 Iraan
1.47 Vancourt

Wunderground
1.29 Sterling City
1.38 Mertzon

Other
1.01 San Angelo (7NW)
0.72 St. Lawrence
1.60 Mertzon

April 2009 Operations Report

April 16, 2009 - Seeding operations were conducted Glasscock (5) County. 5 flares were burned within 1 small cloud. An upper level trough and dryline produced strong thunderstorms in the afternoon mainly west and north of the target.

April 23, 2009 - Seeding operations were conducted over Glasscock (9), Reagan (2), and Sterling (7) Counties. 18 flares were burned within 6 small clouds. An upper level shortwave trough and dryline produced high-based thunderstorms in the afternoon and evening.

April 26, 2009 - Seeding operations were conducted over Crockett (4), Glasscock (16), Reagan (3), and Schleicher (5) Counties. 28 flares were burned within 3 large clouds. A surface low with associated dryline produced severe thunderstorms west of target moving into target late afternoon. This is the third day for seeding in April and 4th day for seeding during the season.

The month of April contained 3 days of operations

Date	Flares	Counties seeded
16	5	Glasscock
23	18	Glasscock, Reagan, Sterling
26	28	Crockett, Glasscock, Reagan, Schleicher
Total Flares: 51		

April 2009 was rather wet across parts of Texas given several trough/ridge passages. The month was also rather cool since surface moisture produced stratus over the region many days. The target area received two periods of flooding rains; April 16-17th and April 26-27th. Opposite of significant moisture, seeding events on the 23rd found extremely high base thunderstorms caused by thunderstorm initiation behind the dryline where dewpoints were in the 30s. Seeding operations in April were good, although inhibited by either mostly cloudy skies or too high cloud base.

Rainfall in April was very good over much of the target area. San Angelo received the 7th most rainfall on record. Midland and Abilene remain below monthly and annual normal. Abilene is below normal for the year receiving 1.07 inches during the month and 2.95 for the year. San Angelo had a one-day record rainfall on the 27th totaling 2.28inches. San Angelo received 4.61 inches in April and 6.88 this year. Midland received .29 inches in April, .1.11 inches for the year. Annual departures from normal are: Abilene -2.23, San Angelo +2.29, and Midland -1.15.

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

4.61	Mathis Field
1.07	Abilene
5.09	Junction
0.29	Midland
0.53	Big Spring
4.25	Sonora

AWS

2.21	Grape Creek

Utah Mesonet

3.15	Barnhart
1.77	Cox Ranch
4.97	Ozona (15mi SSW)
2.54	Iraan

Wunderground

1.47	Sterling City
2.12	Mertzon

CocoRahs

4.93	Eldorado
3.05	Knickerbocker
1.20	Ozona
1.39	Iraan
4.09	Vancourt

Other

2.48	San Angelo (7NW)
1.44	St. Lawrence
2.42	Mertzon

May 2009 Operations Report

May 12, 2009 - Seeding operations were conducted over Glasscock (5) and Reagan Counties. 20 flares were burned within 2 clouds. An upper level impulse and dryline produced thunderstorms west of the target mid afternoon.

May 16, 2009 - A seeding operation was attempted over Tom Green (2) with a reconnaissance over Reagan Counties. 2 flares were burned within 1 small cloud. An upper level trough and cold front produced less than marginal seedable clouds over the target.

May 22, 2009 - Seeding operations were conducted over Irion (9), Reagan (4), Schleicher (15), and Sutton (10) Counties. 38 flares were burned within 7 clouds. A shear axis centered over the target area produced showers and thunderstorms.

May 23, 2009 - Seeding operations were conducted over Crockett (20), Irion (29), Reagan (24), Schleicher (17), Sterling (6), Sutton (12), and Tom Green (4) Counties. 112 flares were burned within 10 clouds. A shear axis centered over the target area produced showers and thunderstorms.

May 24, 2009 - Seeding operations were conducted over Irion (8), Schleicher (8), Sterling (7), Sutton (2), and Tom Green (20) Counties. 45 flares were burned within 11 clouds. A shear axis centered over the target area and sufficient surface heating produced showers and thunderstorms.

May 25, 2009 - Seeding operations were conducted over Glascock (8), Reagan (8), and Sterling (7) Counties. 42 flares were burned within 3 clouds. A surface trough over West Texas and sufficient surface heating produced a thunderstorm over Reagan County, traveling northeast.

May 26, 2009 - Seeding operations were conducted over Glascock (93), Sterling (23), and Tom Green (17) Counties. 133 flares were burned within 8 clouds with multiple cells, which merged into one large cloud system. A surface trough, dryline, and upper level trough produced thunderstorms over the northern target.

May 28, 2009 - Seeding operations were conducted over Crockett (6), Glascock (23), Irion (23), Reagan (3), Schleicher (15), Sterling (14), and Tom Green (14) Counties. 98 flares were burned within 9 clouds with multiple cells, many of which merged into a large cloud system. An upper level trough and surface heating produced seedable thunderstorms over the target.

May 30, 2009 - Seeding operations were conducted over Crockett (22), Schleicher (4), and Sutton (13) Counties. 39 flares were burned within 9 clouds, some of which merged into one. Mainly surface heating, in combination with a surface perturbation caused seedable storms to develop along the southern border.

May 31, 2009 - Seeding operations were conducted over Glasscock (25), Reagan (26), and the Tom Green Panhandle (2). 53 flares were burned within 3 clouds, part of a large cloud system with multiple convective cells. Surface heating and a shortwave trough produced seedable storms over the western target. This is the tenth day for seeding in May and 14th day for seeding during the season.

The month of May contained 10 days of operations

Date	Flares	Counties seeded
12	20	Glasscock, Reagan
16	2	Tom Green
22	38	Irion, Reagan, Schleicher, Sutton
23	112	Crockett, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
24	45	Irion, Schleicher, Sterling, Sutton, Tom green
25	42	Glasscock, Reagan, Sterling
26	133	Glasscock, Sterling, Tom Green
28	98	Crockett, Glasscock, Irion, Reagan, Schleicher, Sterling, Tom Green
30	39	Crockett, Schleicher, Sutton
31	53	Glasscock, Reagan, Tom Green Panhandle
Total Flares: 582		

May 2009 began with a strong ridge presiding over Texas and the southern Plains with hot temperatures and dry conditions prevailing. A couple of seeding days during the middle of the month was normal while a period of rainy conditions during the memorial weekend kept pilots busy. A shear axis centered over central Texas on the 22nd of the month produced afternoon thunderstorms throughout the Memorial Weekend. A surface trough and sufficient surface heating continued to promote thunderstorms into the following week. A frontal boundary glided across Texas on the 26th enhancing the potential for seedable thunderstorms during the active week. Aforementioned frontal boundary surpassed the target overnight into the 27th leaving the target dry and a weak surface trough developed on the 28th providing another fair seeding day. Mother nature allowed for a dry day over the target on the 29th then a surface trough and surface heating combined with a developing low over the Desert Southwest during the last weekend in may giving two more very good seeding days.

Rainfall in May was very good over parts of the target area. Mathis Field in San Angelo received. Midland, Abilene, and San Angelo remain below annual normal. Thunderstorms veered away from San Angelo during the month. The number of seeding days was above normal this month. San Angelo received 0.12 inches in May and 7.00 this year. Midland received .45 inches in May, 1.56 inches for the year. Abilene received 3.28, 6.23 inches this month. Annual departures from normal are: Abilene –1.78, San Angelo –0.68, and Midland –2.49.

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

0.12 Mathis Field
3.28 Abilene
2.55 Junction
0.45 Midland
0.75 Big Spring
1.04 Sonora

Utah Mesonet

1.86 Barnhart
1.28 Cox Ranch
6.91 Ozona (15mi SSW)
1.02 Iraan

Wunderground

4.75 Sterling City
1.26 Mertzon

CocoRahs

2.30 Eldorado
2.07 Knickerbocker
0.81 Ozona
1.26 Iraan
2.96 Garden City

Other

0.62 San Angelo (7NW)
0.87 St. Lawrence
1.25 Mertzon

June 2009 Operations Report

June 2, 2009 - Seeding operations were conducted over Crockett (9), Glasscock (2), Sterling (27), and Tom Green (18). 56 flares were burned within 4 clouds, most of which merge into one large cloud system. Surface heating and a shortwave trough produced seedable storms over the western target.

June 6, 2009 - Seeding operations were conducted over Crockett (8), Glasscock (42), Reagan (2), and Sterling (2). 54 flares were burned within 3 clouds with multiple cells, two of which merge into one large cloud. A dryline and a shortwave trough produced seedable storms over the western target.

June 7, 2009 - Seeding operations were conducted over Crockett (16) and Glasscock (12). 28 flares were burned within 2 clouds with multiple cells. A dryline and a trough produced seedable storms over the western target.

June 8, 2009 - Seeding operations were conducted over Glasscock (9). 9 flares were burned within 1 cloud. A dryline produced a seedable storm over Glasscock County and further north.

June 10, 2009 - Seeding operations were conducted over Crockett (66), Glasscock (1), Sterling (7), and Sutton (4). 78 flares were burned within 3 clouds; one severe storm crossed Crockett County. A shortwave trough produced marginally seedable clouds and a severe storm for the western target.

June 13, 2009 - Seeding operations were conducted over Glasscock (8) and Reagan (6). 14 flares were burned within 1 cloud over Glasscock County. A shortwave trough produced a short-life seedable cloud over Glasscock.

June 19, 2009 - Seeding operations were conducted over Irion (7), Schleicher (10), and Tom Green (5). 22 flares were burned within 6 clouds. A shortwave trough produced marginal clouds. This is the seventh day for seeding in June and 21st day for seeding during the season.

June 26, 2009 - Seeding operations were conducted over Schleicher (9), and Sutton (20). 29 flares were burned within 11 small clouds. A shortwave trough and surface heating produced marginally seedable clouds.

June 27, 2009 - Seeding operations were conducted over Glasscock (2), Irion (16), Reagan (2), Schleicher (6), and Tom Green (2). 28 flares were burned within 9 small clouds. A meso-low and surface heating produced marginally seedable clouds.

June 28, 2009 - Seeding operations were conducted over Crockett (23), Glasscock (8), Irion (27), Reagan (12), Schleicher (13), Sterling (6), and Tom Green (10). 99 flares were burned within 20 clouds. A frontal boundary and surface heating produced seedable clouds throughout the target.

June 29, 2009 - Seeding operations were conducted over Crockett (22), Glasscock (12), Irion (11), Reagan (22), Schleicher (37), Sterling (8), Sutton (9), and Tom Green (12). 133 flares were burned within 36 clouds, many of which merged together with other cells. A frontal boundary and surface heating produced seedable clouds throughout the target.

June 30, 2009 - Seeding operations were conducted over Glasscock (40), Schleicher (15), and Sutton (11). 66 flares were burned within 5 clouds, two of which were large clouds with multiple cells. A frontal boundary and surface heating produced seedable clouds throughout the target. This is the twelfth day for seeding in June and 26th day for seeding during the season.

The month of June contained 12 days of operations

Date	Flares	Counties seeded
2	56	Crockett, Glasscock, Sterling, Tom Green
6	54	Crockett, Glasscock, Reagan, Sterling
7	28	Crockett, Glasscock
8	9	Glasscock
10	78	Crockett, Glasscock, Sterling, Sutton
13	14	Glasscock, Reagan
19	22	Irion, Schleicher, Tom Green
26	29	Schleicher, Sutton
27	28	Glasscock, Irion, Reagan, Schleicher, Tom Green
28	99	Crockett, Glasscock, Irion, Reagan, Schleicher, Sterling, Tom Green
29	133	Crockett, Glasscock, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
30	66	Glasscock, Schleicher, Sutton
Total Flares: 487		

June 2009 began as May had left off with a persistent trough over Baja sending shortwave impulses into the southern Plains. A ridge dominated East Texas and held shortwave influence to the western target area through the first week of the month. Shortwave influence managed to bring seedable thunderstorms a couple more days through the second week. Upper level ridging took hold during the third week until the 19th when the ridge moved east and southerly flow pulled moisture into West Texas. A trough over the Desert Southwest and Mexico also aided to develop thunderstorms over Mexico, which brought an MCS to the western target area early morning. Mostly cloudy skies, un-seedable showers persisted through the afternoon then turned marginally seedable late afternoon. Another MCS moved north through the western target on the 20th with similar un-seedable conditions through the afternoon. The ridge took hold again temporarily turning into a long last week of seeding. The ridge maintained position over West Texas but airmass thunderstorms persisted over 5 days with a frontal boundary lingering over the target area during the last two days. High moisture content and temperatures near 100 degrees for 14 days during the month yielded an above average seeding month.

Rainfall in May was very good over parts of the target area but missed some areas almost completely. Mathis Field in San Angelo recorded 1.74 inches. Midland, Abilene, and San Angelo remain below annual normal. Abilene recorded 2.68 inches in June and 8.91 inches this year. Midland recorded 2.33 inches in June and 2.33 inches for the year. Annual departures from normal are: Abilene –2.16, San Angelo –1.46, and Midland –1.67.

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

1.74 Mathis Field
2.68 Abilene
1.12 Junction
2.33 Midland
1.38 Big Spring
2.83 Sonora

Wunderground

8.02 Sterling City
1.92 Mertzon

CocoRahs

0.77 Eldorado
1.35 Knickerbocker
2.45 Ozona (26 SW)
2.02 Ozona (30 SW)
2.36 Iraan
3.51 Garden City

Utah Mesonet

2.72 Barnhart
3.48 Cox Ranch
4.37 Ozona (15mi SSW)
2.14 Iraan

Other

3.96 San Angelo (7NW)
2.76 St. Lawrence
1.78 Mertzon

July 2009 Operations Report

July 1, 2009 - Seeding operations were conducted over Crockett (6) and Glasscock (2). 8 flares were burned within 2 clouds. A surface trough and sufficient surface heating produced marginally seedable clouds over the western target.

July 2, 2009 - Seeding operations were conducted over Crockett (4), Glasscock (20), Irion (18), Reagan (5), Schleicher (17), Sterling (10), Sutton (1), and Tom Green (1). 76 flares were burned within 29 clouds, some of which merged together. A surface trough and sufficient surface heating produced marginally seedable clouds over the target area.

July 4, 2009 - Seeding operations were conducted over Glasscock (3), Reagan (3), and Sterling (2). 8 flares were fired within 3 clouds. A surface trough and sufficient surface heating produced seedable clouds over the northern target.

July 17, 2009 - Seeding operations were conducted over Crockett (17), Reagan (10), Schleicher (2), and Sutton (12). 41 flares were fired within 6 clouds, which had multiple cells. Outflow boundaries produced clouds that moved into the eastern target and later the western target.

July 18, 2009 - Seeding operations were conducted over Schleicher (1) and Sutton (11). 12 flares were fired within 2 clouds. A frontal boundary produced clouds that moved into the eastern target.

July 20, 2009 - Seeding operations were conducted over Irion (3), Reagan (9), and Schleicher (3). 15 flares were fired within 5 clouds. Remnant MCS from overnight convection spawned an MCV causing additional thunderstorms.

July 22, 2009 - Seeding operations were conducted over Crockett (5), Irion (10), Schleicher (3), and Tom Green (5). 23 flares were fired within 7 clouds with multiple cells. MCS moving eastward and associated new convection produced some seedable conditions.

July 29, 2009 - Seeding operations were conducted over Crockett (2), Irion (29), Schleicher (7), and Tom Green (10). 48 flares were fired within 7 clouds with multiple cells. A frontal boundary and surface heating produced seedable conditions.

July 31, 2009 - Seeding operations were conducted over Crockett (12), Irion (8), Schleicher (14), and Tom Green (2). 34 flares were fired within 6 clouds with multiple cells. A frontal boundary produced seedable conditions. This is the ninth day for seeding in July and 35th day for seeding during the season.

The month of July contained 9 days of operations

Date	**Flares**	**Counties seeded**
1	8	Crockett, Glasscock
2	76	Crockett, Glasscock, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
4	8	Glasscock, Reagan, Sterling
17	41	Crockett, Reagan, Schleicher, Sutton
18	12	Schleicher, Sutton
20	15	Irion, Reagan, Schleicher
22	23	Crockett, Irion, Schleicher, Tom Green
29	48	Crockett, Irion, Schleicher, Tom Green
31	36	Crockett, Irion, Schleicher, Tom Green
Total Flares: 267		

July 2009 began as June had left off with a persistent trough over Baja and a ridge over Texas and New Mexico. While the ridge maintained position over the region, surface troughs and high levels of moisture maintained convective activity during the first few days. The ridge moved east during the first week with center over parts of East Texas, dominating weather through the middle of the month. 100-degree afternoons persisted for 14 days while the ridge shifted east and back to the Desert Southwest mid Month. The ridge centered over Arizona and New Mexico allowed for shortwaves within north-northwesterly flow to influence West Texas during the late half of the month. Monthly precipitation pushed the region above the annual normal by the 20th of the month and an additional heavy rain event on the 22nd put the region well above normal. A drier period for the target area occurred from the 23rd to the 28th although thunderstorms were present outside the target area and within the target over some areas during the overnight hours. The upper ridge retained position over Baja and Mexico through the end of the month with shortwave influence over parts of Texas bringing chance thunderstorms. Surface frontal boundaries and outflow boundaries also provided subtle lifting mechanism for which bountiful surface moisture and surface heating could use to develop thunderstorms. A desert Southwest high pressure ridge began to strengthen end of the month, but ample moisture and a frontal boundary allowed for seedable thunderstorms once again.

Rainfall in July was very good over most of the target area. Areas to the north, such as Abilene, were left out of these Julys' heavy rains. Mathis Field in San Angelo recorded 4.64 inches; an 8th place highest rainfall. Midland international recorded 6.55 inches; a 5th place highest rainfall. Abilene recorded 2.56 inches in July and 11.47 inches this year. Monthly departures from normal were: Abilene +.86, San Angelo +3.54, Midland +4.66. Annual departures from normal were: Abilene –1.30, San Angelo +2.08, and Midland +2.79.

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

4.64	Mathis Field
2.56	Abilene
3.81	Junction
6.55	Midland
1.71	Big Spring
1.62	Sonora

Wunderground

3.55	Sterling City
3.39	Mertzon

CocoRahs

3.73	Eldorado
1.97	Knickerbocker
0.30	Ozona (26 SW)
0.86	Iraan
3.03	Garden City
0.49	Sheffield

Utah Mesonet

1.56	Barnhart
2.82	Cox Ranch
0.43	Ozona (15mi SSW)
0.90	Iraan

Other

4.82	San Angelo (7NW)
4.55	St. Lawrence
5.49	Mertzon
6.86	NE Sutton

August 2009 Operations Report

August 1, 2009 - Seeding operations were conducted over Crockett (26), Irion (2), Reagan (16), Schleicher (2), Sutton (14), and Tom Green (1). 61 flares were fired within 8 clouds with multiple cells. A frontal boundary and surface heating produced seedable conditions.

August 2, 2009 - Seeding operations were conducted over Crockett (14) and Reagan (19). 33 flares were fired within 3 clouds with multiple cells. A boundary and surface heating produced seedable conditions.

August 11, 2009 - Seeding operations were conducted over Crockett (17), Irion (9), Reagan (22), Schleicher (9), Sterling (8), and Sutton (10) Counties. 70 flares were fired within 8 clouds with multiple cells. A shortwave and surface heating produced seedable conditions.

August 12, 2009 - Seeding operations were conducted over Crockett (5), Irion (11), Glasscock (2) Reagan (1), Schleicher (12), Sterling (3), Sutton (12), and Tom Green (10) Counties. 56 flares were fired within 14 clouds with multiple cells. Outflow boundaries and surface heating produced seedable conditions.

August 13, 2009 - Seeding operations were conducted over Crockett (4), Irion (1), Reagan (9), Schleicher (4), and Sutton (17) Counties. 35 flares were fired within 5 clouds with multiple cells. Outflow boundaries and surface heating produced seedable conditions.

August 15, 2009 - Seeding operations were conducted over Reagan (22), Sterling (26), and Tom Green (4) Counties. 52 flares were fired within 7 clouds, some with multiple cells. A surface trough and surface heating produced seedable conditions.

August 16, 2009 - Seeding operations were conducted over Glasscock (4) County. 4 flares were fired within 1 cloud with a couple cells. Surface heating produced marginal short-lived clouds.

August 20, 2009 - Seeding operations were conducted over Glasscock (4), Schleicher (8), Sterling (8), and Tom Green (5) Counties. 25 flares were fired within 4 clouds. An approaching front and surface heating produced seedable clouds.

August 21, 2009 - Seeding operations were conducted over Crockett (2) County. 2 flares were fired within 1 small cloud. Remnant frontal boundary and surface heating produced seedable clouds.

August 22, 2009 - Seeding operations were conducted over Crockett (2), Glasscock (2), Irion (8), Reagan (21), Schleicher (2), Sterling (16), and Tom Green (4) Counties. 55 flares were fired within 8 clouds with multiple cells.

August 23, 2009 - Seeding operations were conducted over Schleicher (8) County. 8 flares were fired within 2 small clouds. Surface heating produced marginally seedable clouds.

August 27, 2009 - Seeding operations were conducted over Crockett (36), Irion (20), Reagan (6), Schleicher (5), Sterling (4), Sutton (13), and Tom Green (16) Counties. 100 flares were fired within 10 clouds with multiple cells. Surface heating and a frontal boundary produced thunderstorms across the target.

August 28, 2009 - Seeding operations were conducted over Glasscock (9), Irion (8), Reagan (18), and Sterling (17) Counties. 42 flares were fired within 10 clouds with multiple cells. Surface heating and a shortwave trough produced thunderstorms across the target. This is the thirteenth day for seeding in August and 48th day for seeding during the season.

The month of August contained 13 days of operations

Date	Flares	Counties seeded
1	61	Crockett, Irion, Reagan, Schleicher, Sutton, Tom Green
2	33	Crockett, Reagan
11	70	Crockett, Irion, Reagan, Schleicher, Sterling, Sutton
12	56	Crockett, Irion, Glasscock, Reagan, Schleicher, Sterling, Sutton, Tom Green
13	35	Crockett, Irion, Reagan, Schleicher, Sutton
15	52 +2H	Reagan, Sterling, Tom Green
16	4	Glasscock
20	25 +2H	Glasscock, Schleicher, Sterling, Tom Green
21	2	Crockett
22	55	Crockett, Irion, Glasscock, Reagan, Schleicher, Sterling, Tom Green
23	8	Schleicher
27	100	Crockett, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
28	42	Glasscock, Irion, Reagan, Sterling
Total Flares: 543		

August 2009 began as July had left off with a frontal boundary lingering across west-central Texas and a large ridge over the Desert Southwest pushing northwesterly driven shortwaves across the region. The ridge moved over western Texas during the first week of the month and ceased thunderstorm activity over much of the region for the following week. Thunderstorm activity returned to parts of West Texas mid-month while still under a ridge. Surface trough and lingering frontal boundary promoted thunderstorms over a six-day period. The upper ridge strengthened again and persisted over the region through the next several days. While the ridge maintained position of the region, a frontal boundary moved across Northwest Texas and meandered over central Texas allowing for marginal thunderstorms over a four-day period between the 20th and 23rd pushing the seasonal operations to 46 days. A strong ridge returned to the region once again during the last full week with a trough digging into the Texas Panhandle four days later. Seedable conditions were present for two days to end off the month with 13 operational days. The ridge built in again during the last weekend of the month. Four hygroscopic flares were burned within four randomized cases in addition to regular Glaciogenic seeding during two operational seeding days.

Rainfall in August was on the shy side over most of the target area. Most of the months seeded thunderstorms were outside the reach of rain gauges. Mathis Field in San Angelo recorded 1.89 inches and 15.27 for the year. Midland International recorded .03 inches and 10.47 for the year. Abilene recorded 1.25 inches in August and 12.72 inches this year. Monthly departures from normal were: Abilene -1.38, San Angelo -.16, and Midland –1.74. Annual departures from normal were: Abilene –2.68, San Angelo +1.92, and Midland +.98.

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

1.89	Mathis Field
1.25	Abilene
0.04	Junction
0.03	Midland
0.59	Big Spring
0.27	Sonora

Wunderground

1.27	Sterling City
0.59	Mertzon

CocoRahs

0.05	Eldorado
1.35	Knickerbocker
0.15	Ozona (26 SW)
0.00	Iraan
1.03	Garden City
0.48	Sheffield

Utah Mesonet

0.70	Barnhart
1.59	Cox Ranch
0.00	Ozona (15mi SSW)
2.05	Iraan

Other

0.71	San Angelo (7NW)
0.95	St. Lawrence
0.79	Mertzon

September 2009 Operations Report

September 4, 2009 - Seeding operations were conducted over Reagan (7), Schleicher (7), and Tom Green (1) Counties. 15 flares were fired within 5 small clouds. Surface low and sufficient surface heating produced marginal thunderstorms.

September 5, 2009 - Seeding operations were conducted over Irion (20), Reagan (22), Schleicher (17), Sterling (4), Sutton (7), and Tom Green (3) Counties. 73 flares were fired within 20 clouds, some of which had multiple cells. Mid-level trough and sufficient surface heating produced seedable thunderstorms.

September 6, 2009 - Seeding operations were conducted over Crockett (2), Irion (11), Reagan (1), Schleicher (11), Sterling (2), and Tom Green (4) Counties. 31 flares were fired within 9 clouds. Mid-level shortwave trough and sufficient surface heating produced seedable thunderstorms.

September 8, 2009 - Seeding operations were conducted over Crockett (30), Irion (16), Reagan (14), Schleicher (3), Sterling (8), Sutton (6), and Tom Green (4) Counties. 81 flares were fired within 11 clouds, many with multiple cells. Shortwave trough and sufficient surface heating produced seedable thunderstorms.

September 9, 2009 - Seeding operations were conducted over Glasscock (20), Irion (8), Reagan (12), Schleicher (12), Sterling (6), Sutton (24), and Tom Green (6) Counties. 88 flares were fired within 13 clouds, many with multiple cells. Shortwave trough and sufficient surface heating produced seedable thunderstorms.

September 10, 2009 - Seeding operations were conducted over Glasscock (20), Reagan (12), and Sterling (6) Counties. 22 flares were fired within 5 marginal clouds. Low and sufficient surface heating produced marginally seedable thunderstorms.

September 20, 2009 - Seeding operations were conducted over Crockett (20), Irion (2), Reagan (8), Schleicher (9), Sterling (6), Sutton (2), and Tom Green (2) Counties. 49 flares were fired within 4 clouds merging together. A trough and sufficient surface heating produced seedable thunderstorms. This is the seventh day for seeding in September and 55th day for seeding during the season.

The month of September contained 7 days of operations

Date	**Flares**	**Counties seeded**
4	15	Reagan, Schleicher, Tom Green
5	73	Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
6	31	Crockett, Irion, Reagan, Schleicher, Sterling, Tom Green
8	81	Crockett, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
9	88	Glasscock, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
10	22	Glasscock, Reagan, Sterling
20	49	Crockett, Irion, Reagan, Schleicher, Sterling, Sutton, Tom Green
Total Flares: 359		

September 2009 began as August had left off with a ridge holding warm and sunny skies over the region. A surface low developed over Texas on the fourth and produced very marginal clouds for the next several days. Marginal conditions were result of very minimal forcing and low

convective temperatures. Thunderstorms held off a day on the seventh and returned for an additional three days with more widespread convection. Showers and thunderstorms from the eighth through tenth were mostly very marginally seedable, although some storms seeded at the most opportune time responded well. Pilots had difficult times finding inflow in mostly cloudy and increasing difficult flight level conditions. A stagnant low over central Texas during the time brought very good rains to West Texas through the 13th of the month. The low moved off into East Texas on the 14th and high pressure built in over the region for the next week. Mostly sunny mornings yielded several mostly cloudy days through the next week. A trough began to deepen over the southern Rockies the weekend of the 18th and persisted over the southern Plains through the next week; seedable thunderstorms presented themselves on the 20th and a frontal boundary on the morning of the 22nd brought mostly cloudy and cooler temperatures to the region. Upper low spun over the central Rockies and southern Plains for the week. A ridge built in over the southern Rockies pushing upper low into the Great Lakes through the weekend of the 26th and while a mild ridge maintained influence over the Desert Southwest; a strong cold front pushed south through Texas on the last Monday of the month. Neither rain nor colder temperatures pushed into West Texas with the cold front but mild evening temperatures and fair afternoons persisted.

Rainfall in September was very good over most of the target area. Mathis Field in San Angelo recorded 5.66 inches and 20.93 for the year. Midland International recorded 2.47 inches and 12.94 for the year. Abilene recorded 3.55 inches in September and 16.27 inches this year. Monthly departures from normal were: Abilene +0.64, San Angelo +2.71, and Midland +.16. Annual departures from normal were: Abilene –2.04, San Angelo +4.63, and Midland +1.21.

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

5.66 Mathis Field
3.55 Abilene
4.75 Junction
2.47 Midland
0.52 Big Spring
1.69 Sonora

Wunderground

3.44 Sterling City
3.27 Mertzon

Other

5.34 San Angelo (7NW)
1.21 St. Lawrence
3.47 Mertzon

CocoRahs

3.64 Eldorado
3.60 Knickerbocker
2.20 Ozona (26 SW)
1.57 Garden City

Utah Mesonet

2.04 Barnhart
1.25 Cox Ranch
0.29 Ozona (15mi SSW)
0.49 Iraan
2.00 Sterling City

October 2009 Operations Report

October 9, 2009 - Seeding operations were conducted over Glasscock (34) Irion (6), and Reagan (14) Counties. 54 flares were fired within 2 clouds, one with multiple cells. A trough, dryline, and surface heating produced strong seedable thunderstorms. This is the first day for seeding in October and 56th day for seeding during the season.

The month of September contained 1 day of operations

Date	Flares	Counties seeded
8	54	Glasscock, Irion, Reagan
Total Flares: 54		

October was quite warm during the first week. Mild ridge over Texas and strong persistent trough elongated over the northern Plains, central Rockies, and California coast gathered a warm and very moist airmass over Texas through the 8th of October. Mostly cloudy skies during the time period hampered most convection; Thursday the 8th saw clouds dissipate early afternoon and surface heating combined with a very strong trough/dryline to promote strong thunderstorms over the northern target. A cold front followed with an additional surge of cold air through the weekend. Drizzle under cloudy skies continued into the 2nd Monday of the month with showers ending and mostly sunny skies returning to West Texas through the next week. A large ridge built in over the Desert Southwest through the 17th that would bring fair temperatures along the northwesterly flow. A low-pressure system developed over the central Rockies by the 19th increasing windy conditions across the region and bringing rain to West Texas on the 21st. High pressure returned for a few days then an additional surface trough and deep upper level trough into Mexico promoted showers and a few thunderstorms across West Texas on the 26th. The system did not produce much precipitation for West Texas.

Rainfall in October was good over most of the target area. Mathis Field in San Angelo recorded 2.92 inches and 23.85 for the year. Midland International recorded 0.96 inches and 13.90 for the year. Abilene recorded 3.40 inches in October and 23.85 inches this year. Monthly departures from normal were: Abilene +.50, San Angelo +.35, and Midland -.81. Annual departures from normal were: Abilene –1.54, San Angelo +4.98, and Midland +0.40.

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

2.92 Mathis Field
3.40 Abilene
3.69 Junction
0.96 Midland
0.84 Big Spring
0.56 Sonora

Wunderground

2.70 Sterling City
1.34 Mertzon

Other

3.09 San Angelo (7NW)
3.43 St. Lawrence
1.36 Mertzon

CocoRahs

2.50 Eldorado
3.05 Knickerbocker
2.46 Ozona (26 SW)
1.78 Garden City
2.00 Iraan
0.10 Sheffeild

Utah Mesonet

2.04 Barnhart
2.20 Cox Ranch
2.04 Ozona (15mi SSW)
1.42 Iraan
2.99 Sterling City