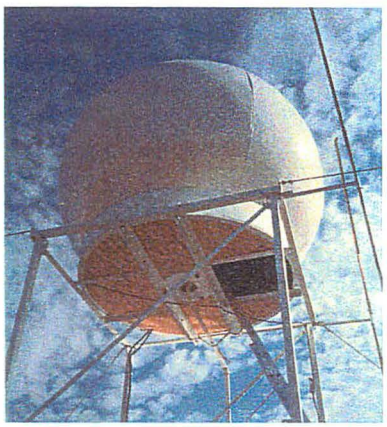
Edwards Aquifer Precipitation Enhancement Program

Final Report 2000



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February 2001

A program designed for the Seeding of Convective Clouds with Glaciogenic Nuclei to Augment Precipitation for the Edwards Aquifer region.

By

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EXECUTIVE SUMMAR

This report summarizes the activities and data collected during the 2000 field operations of the Edwards Aquifer Precipitation Enhancement Program. This was the second year of a program conducted by Weather Modification Inc. (WMI) of Fargo, North Dakota, for the Edwards Aquifer Authority (the Authority) of San Antonio, Texas. The program was funded by the Texas Natural Resource Conservation Commission and the Authority, with the sole intent being enhancement of precipitation through cloud seeding. The project area was 6.37 million acres across south Texas, covering all or parts of 12 counties including Real, Uvalde, Kerr, Bandera, Medina, Kendall, Bexar, Blanco, Comal, Hays, Guadalupe, and Caldwell. Seeding operations were conducted 24 hours-a-day, seven days-a-week from March 1st through November 30th.

The facilities and procedures for this project were as follows. One C-band weather radar, computers, and a communications system were set up in Hondo, Texas, to monitor storms and control aircraft. The radar operated continuously throughout the nine-month period. The storms, as detected by radar, were posted on the WMI Internet Home Page at 30-minute intervals, thus allowing remote near real-time viewing o operations. Two specially equipped cloud seeding aircraft were dedicated to the project; both were stationed at the centrally located Hondo Regional Airport in Hondo, Texas. This maximized coverage of the target area and minimized response times.

New and improved formulations of silver-iodide pyrotechnics and acetone solutions were used to generate high concentrations of very fast acting ice-nuclei. High performance aircraft crewed by experienced pilots and directed by experienced radar meteorologists treated developing regions of the storms by direct injection of the seeding agents.

The 2000 field program successfully achieved its objective, to seed those cells thought to have the potential to produce precipitation. During the nine-month project, the two aircraft safely completed 82 flights totaling 218.80 hours. A total of 29.3 kg of seeding agent was dispensed in the form of 1,144 ejectable flares and 106 gallons of silver iodide - acetone solution, which was burned in wing-tip generators.

This final report for 2000 provides a general overview of the program and describes the methodology used. Pictures, tables, graphs, and references are used to summarize the operational activities. All of the project's radar data, meteorological data, and reports (weekly operations summaries and monthly reports) have been recorded onto CD-ROM and are available to the Authority.

ACKNOWLEDGEMENTS

WMI wishes to acknowledge the support of Bobby Bader, Hondo Field Office Manager, Edwards Aquifer Authority and George Bomar, Senior Technical Specialist, Wate Quantity Division, Texas Natural Resource Conservation Commission. Their continued assistance and cooperation was greatly appreciated.

A number of agencies and people deserve recognition and thanks. The assistance of Air Traffic Control (ATC) facilities at Houston is gratefully acknowledged. The excellent cooperation by the ATC played an important role in allowing the project pilots to treat developing storms in an efficient and timely manner. Special thanks are extended to the City of Hondo and Rusty Lindeman, Airport Manager at Hondo Airport. The City o Hondo provided the property where the WMI radar trailer was sited and authorized the use of the radar tower. The cooperation of these people contributed to the success of the project.

WMI also acknowledges the contributions, teamwork, and professionalism of the staff. They were: Jason Straub, radar meteorologist; Michele McVenes, Shane Johnson, Eric Brusven, Troy Seidel, Jody Fischer, Jason Tomlinson, Stan Mason, Brad Bjerke, Bob Stauffacher, Rob Gall, and Steve Ternes, project pilots; Kelly Bosch, Frans Lynch, Scott Wing, and Jon Clark, electronics technicians; and Jim Heimbach, who filled in during Jason's vacation. The staff performed well as a team.

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INTRODUCTION

Significant benefits are realized from increased precipitation. Agricultural gains include increased crop yields, improved grazing conditions, reduced irrigation costs and improved water quality. Societal benefits include increased reservoir capture of runoff, where it is used for drinking water supplies and recreational purposes.

The Edwards Aquifer region's precipitation distribution averages 24" across the region, but just slightly higher in the northeast (Figure 1).

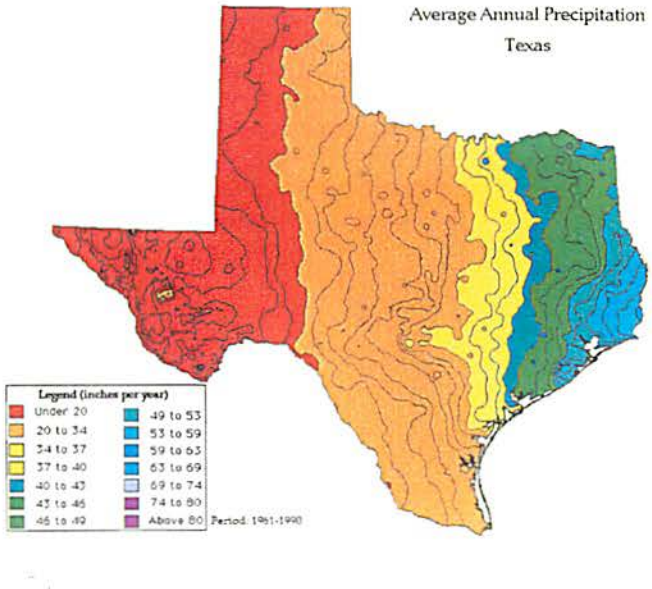

Figure 1: Annual Precipitation for Texas.

The Edwards Aquifer Precipitation Enhancement Program (EAPEP) target area covered 6.37 million acres covering all or parts of 12 Counties in south central Texas, including parts of the Texas Hill Country. The target area, relative to the other programs in the state, is shown in Figure 2. Two aircraft specially equipped to dispense silver iodide were stationed in Hondo. The radar was also located at the Hondo airport.

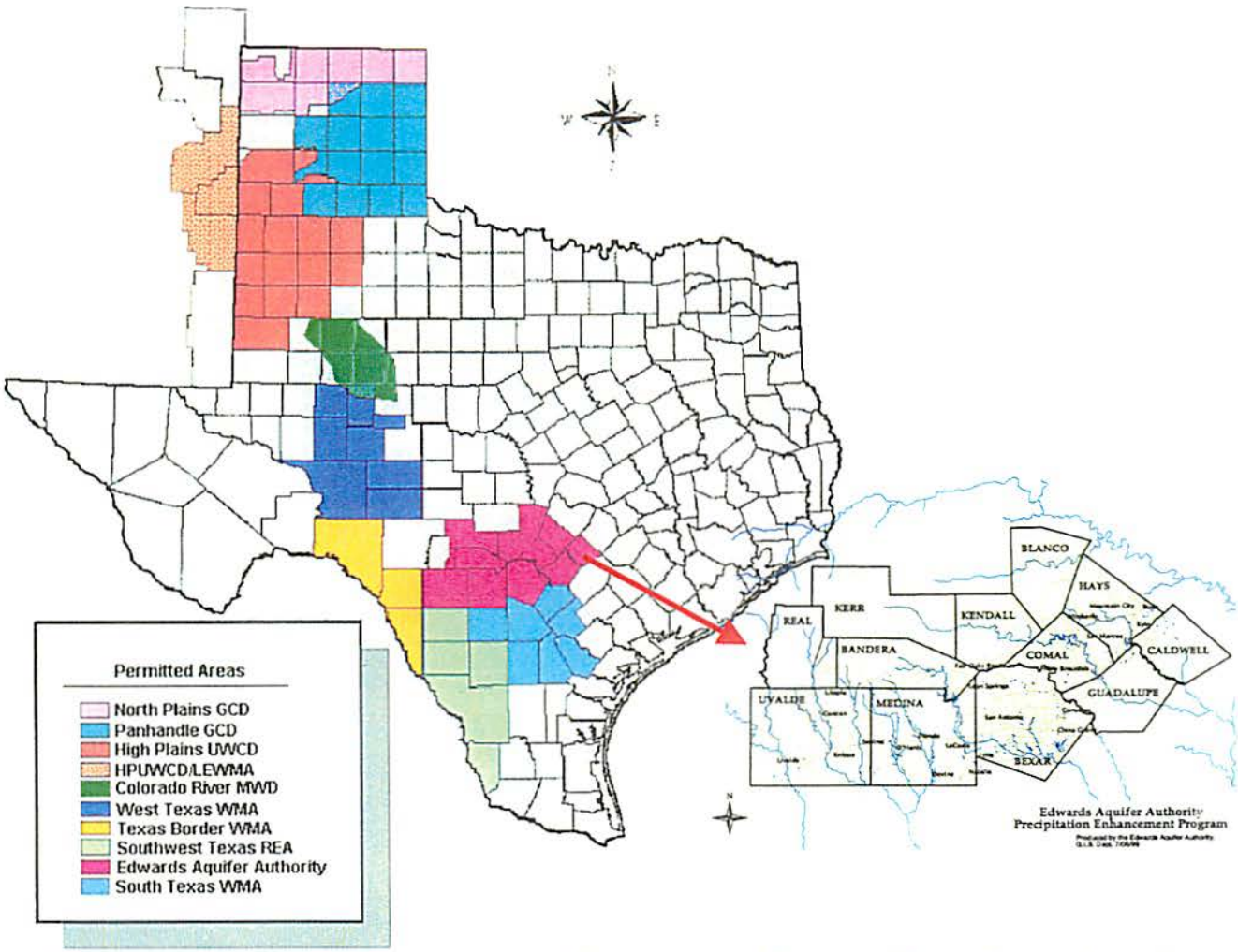

Figure 2: Edwards Aquifer Precipitation Enhancement Program Target Area in Relation to the other Texas Programs

Weather Modification Inc. (WMI) has been a leader in the field of precipitation augmentation since the early 1960's. With extensive knowledge and experience in cloud seeding technology, WMI is recognized for its successful operations in Texas, Oklahoma, the northern Great Plains, Alberta, Canada, and numerous other cloud modification projects around the world. WMI was awarded the contract to conduct the Edwards Aquifer Precipitation Enhancement Program (EAPEP) in December 1999, to provide the requisite personnel and equipment for the 12-county rain enhancement project.

WMI conducted the operational 2000 cloud-seeding field season from March 1st through November 30th, 2000. The project is based upon the technology developed and

employed in the long-term operational projects that have been in continuous operation in North Dakota since the late 1960's.

This program utilizes the latest cloud seeding technology available. Project strengths include:

- An improved, fast-acting, high-yield formulation silver iodide seeding solution, used in the wing-tip ice nuclei generators;
- High performance twin-engine turbocharged Cessna 340 aircraft, for quick response and timely cloud treatment;
- Experienced meteorologists and flight crews to direct and conduct the seeding activities;
- Direct injection of seeding agents as the primary treatment method; and,
- Real-time GPS-based aircraft tracking and seeding data telemetry to the radar, superimposed on the evolving radar depiction of the storm systems to ensure treatment of the most suitable candidates and facilitate the direction of the seeding aircraft.

In addition, the ejectable flares used for treatment at cloud top in the 2000 project were advanced pyrotechnics manufactured by Ice Crystal Engineering, LLC, of Davenport, North Dakota.

PROJECT OBJECTIVES

The goal of the EAPEP is to enhance rainfall in the target area by using state-of-the-art cloud seeding technology and procedures in the treatment of suitable convective clouds.

It is the objective of Weather Modification, Incorporated (WMI) to aid the Authority in attaining the project objective by providing:

1. 24 hours-a-day, 7 days-a-week weather surveillance using one C-band weather radar.
2. Cloud seeding capability through the use of two specially equipped aircraft.
3. The capability for analysis by recording radar and aircraft data during cloud seeding operations.

An ancillary goal is to conduct the operations safely with due regard for life and property on the ground and in the air.

OVERVIEW OF METHODS

The Authority's objective is to seed clouds with silver iodide to augment naturally-occurring precipitation. Seeding agent can be delivered to suitable clouds by aircraft using one of two methods:

1. Direct injection by release of cloud seeding agents at cloud top; or
2. Release of ice nuclei into the updraft by sub-cloud base seeding.

Cloud Seeding Methodology-Seeding Techniques for Rainfall Increase

In **cloud base seeding**, silver iodide complexes are produced either by the combustion of acetone-based solutions or by the burning of silver-iodide flares attached to racks on the trailing edges of the wings. The nuclei thus produced are ingested by the target clouds' updrafts, transported upward to the regions containing supercooled liquid water, and mixed through a significant portion of the cloud volume, where nucleation (freezing) occurs (Boe et al. 1997). If treatment is timely, the seeding agent should reach the supercooled portions of the cloud at about the time the cloud top is growing through the -10°C level. Nucleation in these seeded clouds is believed to occur, on average, at temperatures about 5 to 10°C warmer than most natural nucleation. Given typical cloud

growth rates, this affords a "head start" in precipitation development on the order of 3 to 5 min (for example, see Smith et al. 1997).

In **direct-injection seeding**, ejectable silver iodide flares are used. Again, clouds growing through the -10°C level are targeted. The seeding flares are placed into the supercooled cloud where nucleation is desired, so the updrafts in these cases are relied upon only to provide a continuing source of condensate, not to transport the seeding agent upward from cloud base. This delivery technique thus requires less anticipation on the part of those directing the seeding and may have a more immediate effect.

In both cases, the intent is to glaciate portions of the cloud, initiating ice development minutes earlier than would naturally have been the case (Kahan et al. 1995). For smaller or more isolated convective towers, glaciogenic seeding may accelerate hydrometeor growth sufficiently to allow the cloud to produce precipitation-sized hydrometeors during its short lifetime (microphysical effects, see Silverman 1986), while adding buoyancy that may stimulate updrafts and prolong the cloud lifetime as well (dynamic effects, see Rosenfeld and Woodley 1993, Rosenfeld et al. 1994, and Rosenfeld and Woodley 1996). Both contribute to increased precipitation production.

Storm cells (defined by radar) with maximum reflectivity greater than 35 dBZ within the cloud layer above the -5°C level, located within the project areas are seeding candidates. Radar observers and aircraft controllers are responsible for making the "seed" decision and directing the cloud seeding missions. Patrol flights are generally launched before clouds meet the radar reflectivity seeding criteria. These patrol flights provide an immediate response to developing cells. In general, a patrol is launched in the event of visual reports of vigorous towering cumulus clouds or when radar cell tops exceed 22,000 ft (22 kft) height on days when the forecast calls for precipitation.

More than one aircraft may be launched, depending upon the number of storms in each area, the lead time required for a seeding aircraft to reach the proper location and altitude, and projected overlap of coverage and on -station time for multiple aircraft missions. Only one aircraft can generally work safely at cloud top and one aircraft at cloud base for each storm.

The decision to seed either at cloud top or cloud base is based upon storm structure, visibility, cloud base height, and the time available for aircraft to reach seeding altitude.

Cloud base seeding is conducted by flying just below cloud base, within the main inflo of single cell storms, or within the inflow associated with the growth of new cloud turrets (often in advance of the shelf cloud) located on the upshear side of multicell storms.

Cloud top seeding is typically conducted between -5°C and -15°C. The 20-gram flares fall approximately 4,000 ft (approximately 10°C) during their approximately 40-sec burn time. The seeding aircraft penetrate the edges of single convective cells meeting the seeding criteria (Figure 3). For multicell storms, or storms with new cloud turrets developing on their flanks (feeder clouds), the seeding aircraft penetrate and seed the tops of the developing cumulus towers on the upshear sides of convective cells, as they grow up through the -10°C altitude.

Figure 3: A cloud seeding aircraft dropping ejectable flares at cloud top (photo courtesy John Ulan).

According to the operations plan, if the radar reflectivity criteria are met, seeding of all cells is to be continued. However, seeding is effective only within cloud updrafts and in the presence of supercooled cloud water, i.e. the developing stage of the thunderstorm. The mature and dissipating stages of a storm should be seeded only in hail suppression programs, and then only if the maximum reflectivity is particularly severe and there is evidence (visual cloud growth, or tight reflectivity gradients) indicating the possible presence of embedded updrafts.

Seeding Rate

A seeding rate of one 20-gram flare every 5 seconds is used while in updraft during cloud penetration. A slightly higher rate is used, especially for hail suppression (e.g. 1 flare every 2 seconds), if updrafts are very strong (e.g. > 2000 ft/min) and the storm is particularly intense. Passes are repeated as new turrets grow to aircraft altitude. If none do, the crew may wait 5 to 10 minutes to allow for the seeding material to take

effect, as evidenced by visual signs of glaciation. This ensures the optimum usage of seeding agent. Calculations and laboratory tests show that this seeding rate will initially produce more than 1300 ice crystals per liter.

For cloud base seeding, the two wing-tip generators are used. Cloud base seeding passes are repeated until no further updraft (inflow) is found. Base seeding is not conducted if downdrafts are encountered at cloud base, since downdrafts are indicative of the dissipating stage.

Seeding Materials

Silver iodide is dispensed using ejectable flares and acetone burners. The silver-iodide and acetone seeding solution recipe used in 2000 appears below.

2000 WMI Airborne Generator Seeding Solution

Chemical Formulation: 2% AgI - 0.5 NH_4I - 0.1 $C_6H_4Cl_2$ - 1.0 $NaClO_4$

Recommended Burn Rate: ~2.5 gallons per hour

Nucleation Mechanism: Condensation Freezing

Total Solution Weight: 33.5 lbs.

Volume: ~ 5.0 gallons, scale for other amounts

Aerosol Produced by Combustion: $AgI_{0.85}AgCl_{0.15}NaCl$

Constituent	Chemical Formulation	Molecular Wt.(g/mole)	Mass (g)	Weight (lb.)	Volume (gal)
Silver Iodide	AgI	234.77	304.2	0.67	n/a
Ammonium Iodide	NH_4I	144.94	93.9	0.21	n/a
Paradichloro-benzene	$C_6H_4Cl_2$	147.00	19.0	0.042	n/a
Sodium Perchlorate, 98%	$NaClO_4$	140.48	181.8	0.40	n/a
Water	H_2O	17.99	607.7	1.34	0.202
Acetone	$(CH_3)_2CO$	58.08	13985.5	30.84	4.645

Table 1: Silver Iodide - Acetone Solution Specifics

An acetone generator is shown in Figure 4. The acetone burners require considerable preventive maintenance in order to function properly and reliably. Crews kept a close watch of igniter rods, valves, and seals to ensure reliable operation.

Figure 4: An acetone generator on a Cessna 340 aircraft.

In 2000, WMI used silver iodide flares manufactured by Ice Crystal Engineering, LLC (ICE) in Davenport, ND. These ejectable flares contain 20 grams of seeding material, burn for approximately 40 seconds, and fall approximately 4,000 ft.

Flare Tests

The ice nucleating effectiveness of the ICE flares used by WMI are documented (Demott, 1999). The Cloud Simulation and Aerosol Laboratory at Colorado State University has performed routine testing of the ice nucleating ability of aerosols produced from cloud seeding flares for many years (Garvey, 1975). The primary product of the laboratory characterization is the "effectiveness plot" for the ice nucleant, which provides the number of ice crystals formed per gram of nucleant burned as a function of a range of cloud temperatures.

Specified temperatures for testing in the isothermal cloud chamber were -4°C, -6°C, and -10°C. Three pyrotechnics were tested at each temperature. The liquid water content of the chamber clouds was set to 0.5 g/m^3 and 1.5 g/m^3, which is quite representative for clouds in south Texas. The average effectiveness at each cloud temperature are given in Table 2.

Temperature (°C)	Effectiveness (# ice nuclei/g)
-4.0°C	1.04×10^{11}
-6.1°C	6.62×10^{12}
-10.5°C	3.07×10^{13}

Table 2: Average Ice Nuclei Effectiveness of ICE Silver Iodide Flares per gram of at 1.5 g/m^3 Liquid Water Content.

Significant conclusions from these recent tests for the ICE flares (Table 2) are:

1. The aerosol particles produced by the new ICE pyrotechnics were highly efficient ice nucleating aerosols. Yield values were approximately $1x10^{11}$, $5x10^{12}$, and $3x10^{13}$ ice crystals per gram pyrotechnic at -4°, -6°, and -10°C in 1.5 g/m ^{3} clouds in the CSU isothermal cloud chamber. Improvement compared to the previous pyrotechnic formulation used by ICE was modest at -6°C, but most significant (factor of 3 increase in yield) at -4°C.

2. The ICE pyrotechnics burned with a fine smoke and a highly consistent burn time of ~ 37 seconds.

3. Rates of ice crystal formation were very fast, suggestive of a rapid condensation freezing process. The balance of observations showed no significant difference in the rate data obtained at varied cloud densities, supporting a conclusion that particles activate ice formation by condensation freezing. (DeMott, 1999)

PROGRAM ELEMENTS AND INFRASTRUCTURE

A schematic figure of the operational elements for the precipitation enhancement project is shown in Figure 5 on the next page. Details of the individual elements are described in more detail in the following sections.

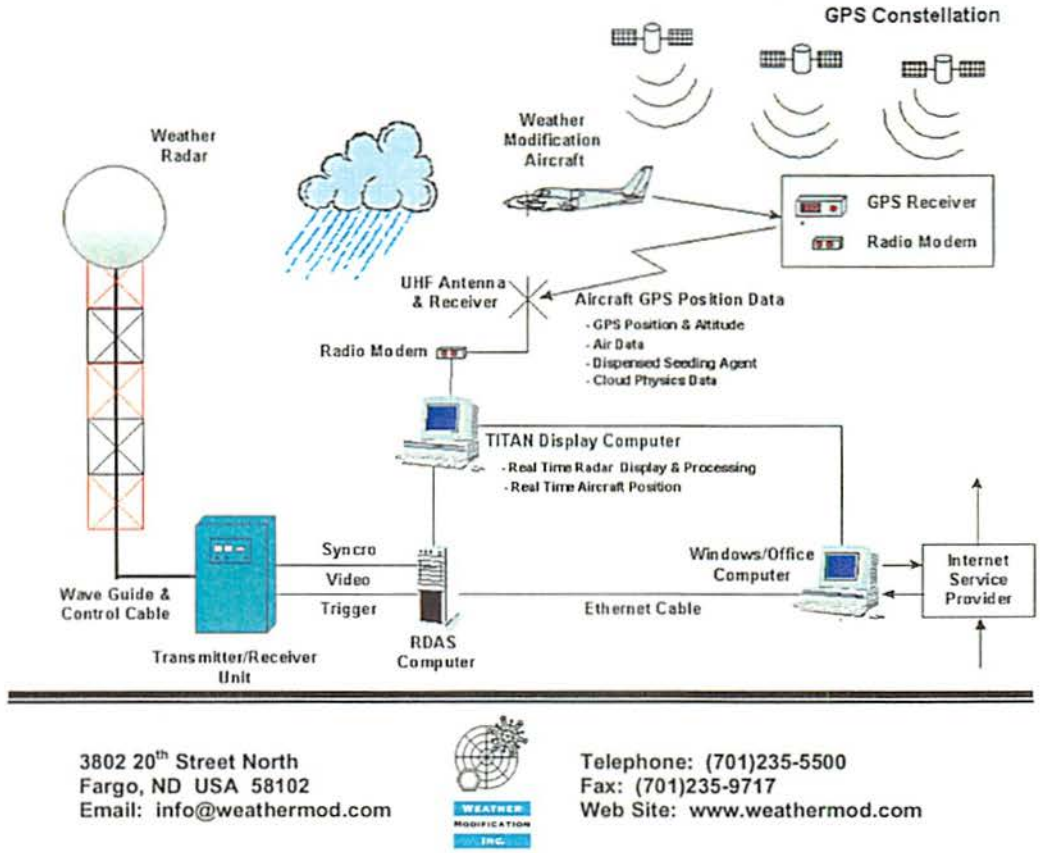

Figure 5: A schematic of the operational elements of the Edwards Aquifer Precipitation Enhancement Program.

Air Traffic Control

Prior to the start of field operations, Federal Aviation Administration (FAA) Air Route Traffic Control Centers (ATC) facilities were notified of the planned weather modification flights to be conducted over south Texas from March 1st through November 30th, 2000. Permission was granted by ATC to file pre-defined flight plans for the project aircraft, with special designations and fixed transponder codes, as Seed 1 for Cessna 340 N340FR and Seed 2 for Cessna 340 N340AX, both stationed in Hondo. Direct dial-up telephone numbers were used to notify air traffic controllers of cloud seeding launches. Aircraft were launched to specific locations defined by Very High Frequency (VHF) Omnidirectional Range (VOR) and DME (Distance Measuring Equipment) coordinates. Clearances were given to project aircraft within a 10 nautical mile radius of the specified storm locations. Cloud top aircraft were given 2,000-ft clearance above their altitude and 5,000 ft below their altitude. Cloud base aircraft were given a +/-1,000-ft altitude clearance. This procedure worked very well in general. On a few occasions, seeding aircraft were asked to climb to a higher altitude or to suspend seeding a few times to

allow other commercial aircraft to pass below them. The ATC clearances and codes are shown in Figure 6.

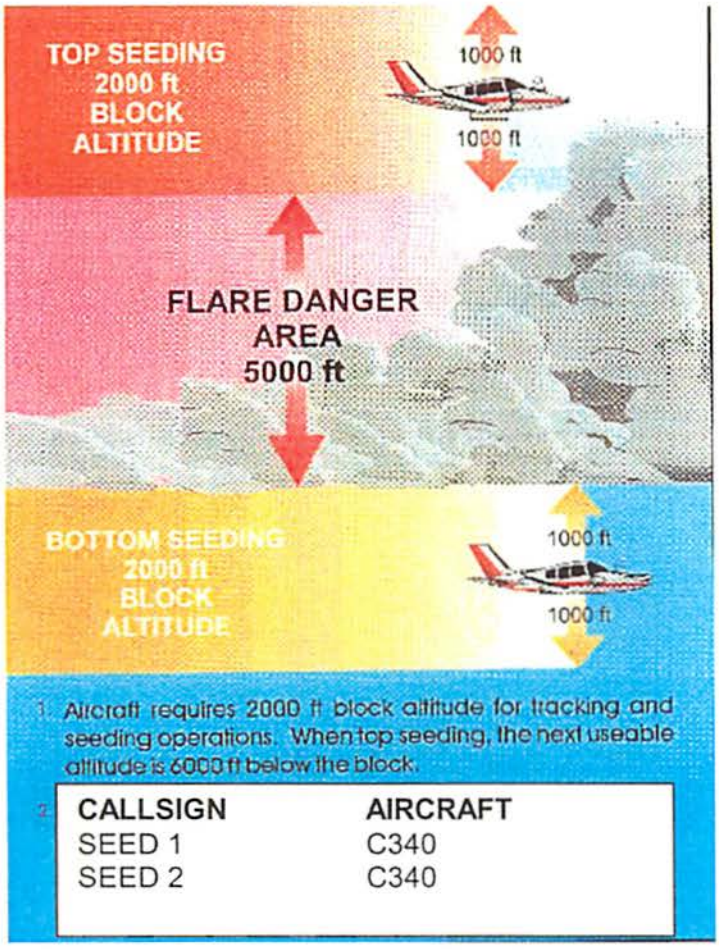

Figure 6: Schematic figure showing aircraft cloud seeding block altitudes required for Air Traffic Control (ATC).

RADAR CONTROL AND COMMUNICATIONS CENTER

The radar control room contains a newly-designed WMI radar console, the RDAS radar acquisition computer, the AIRLINK computer with radio telemetry modem for GPS tracking information, as well as the TITAN computer and display. The project meteorologist communicate with the seeding aircraft using a VHF radio.

Weather Radar

The project weather radar was located on a radar tower previously used by the National Weather Service in Hondo, shown in Figure 7. The radar is an Enterprise Electronics Corporation WSR-74C, C-band radar with an 8-ft diameter antenna. The radar operated around the clock throughout the operational period of March 1st through November 30th. A

gas-powered generator was used to provide emergency power in the case of a power failure. Commercial power was very reliable at the radar during the summer. The emergency generator was not called upon during the operations, but it was tested frequently. On December 1st, the radar was shut off for the season, however the tower, radar transmitter and display equipment will remain in place, waiting for next year.

Figure 7: Hondo Radar Site

The radar signal processor is an RDAS (Radar Data Acquisition System) produced by Electronic Systems Development, South Africa. The display and analysis system is the TITAN (Thunderstorm Identification, Tracking, Analysis, and Nowcasting system) software package available from the National Center for Atmospheric Research (Dixon and Wiener 1993). More details and examples of the TITAN system displays and products are given in a later section. The weather radar offered by WMI is a sensitive instrument capable of detecting rainfall rates of 1mm/hr or less out to 70 nautical mile (NM) range. Storm echoes can be displayed on either the Plan Position Indicator (PPI) or Range Height Indicator (RHI) displays. Echo intensity and echo top height can also be measured.

Radar Calibration Checks

The quantitative use of radar requires that various parameters of the system be aligned and calibrated. With regular calibration, the radar provided accurate measurement of storm position and intensity.

The terms within the radar equation relating to the radar hardware and electrical components are constants. For water (cloud droplets and rain drops), the radar equation then takes the form (Rinehart, 1997):

$$z = C\, p_r\, r^2$$

Thus, calculation of the radar reflectivity factor, z, is simply a matter of getting the power from a target, p_r, of known range, r (times a constant, C, the radar constant). The ne RDAS radar acquisition software performs digital signal processing to simulate a quadratic response of the receiver output (Terblanche, 1996) and uses a reference range of 100 km. The Hondo radar was found to be stable within +/-1 dB from day to day, and the radar constant varied by less than 1 dB over the summer.

Aircraft Flight Tracking Global Positioning System (GPS)

The radar-equipped WMI operations center also received, displayed, and recorded data from the aircraft GPS tracking systems. This system superimposed the aircraft positions on the radar PPI display, enabling the meteorologist to accurately direct the seeding aircraft to optimum seeding locations within the storm system. The color-coded aircraft position on the PPI display allowed discrimination between each project aircraft. A sample flight track plot for both aircraft is shown in Figure 8.

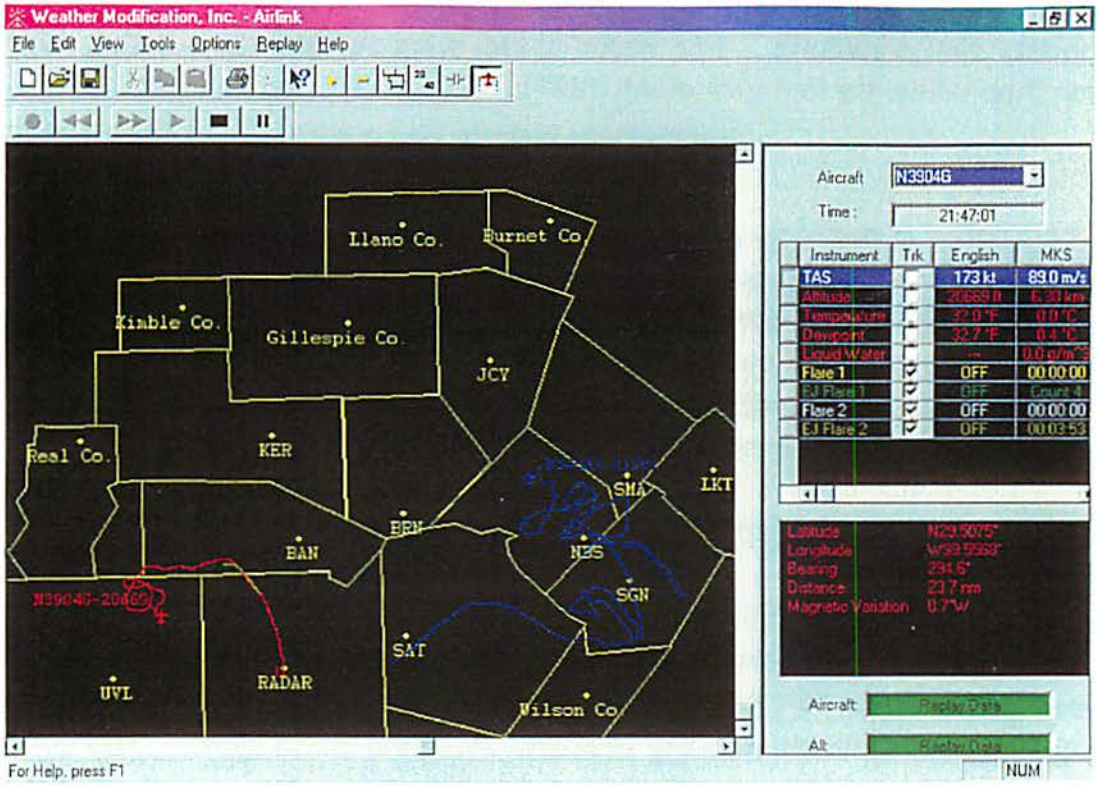

Figure 8: Aircraft Global Positioning System (GPS) flight tracks, seeding locations, and real-time meteorological information via the AIRLINK telemetry system.

The AIRLINK display is shown in Figure 8. AIRLINK is a windows-based program that allows the meteorologist to track and display the seeding events: i.e. the exact times and locations of flare drops and total time and locations of the acetone generator usage.

Meteorological Data

WMI meteorologists used data from the Internet for forecasting purposes. Daily synoptic observations and upper air data were used to determine the atmospheric conditions (temperature, humidity, pressure, and wind field) over the project area. The radar and satellite data were also used to support operations. The list of some of the Internet web pages utilized by the meteorologists includes:

Ohio State University Gopher	http://asp1.sbs.ohio-state.edu/
Unisys Weather	http://weather.unisys.com/
UCAR	http://www.rap.ucar.edu/weather/
Storm Prediction Center	http://www.spc.noaa.gov/
Intellicast Weather	http://www.intellicast.com/
WMI Index of /radar/Hondo	http://www.weathermod.com/

Access to high quality, real-time weather information was readily available on the Internet. WMI made special arrangements to automatically access the necessary analyses and

prognostic weather charts to properly prepare a daily weather and operations/updat briefing for the program.

Daily Briefings

All project staff participated in a briefing session each day at 12 noon that included summary of the previous day's operations (if any), discussion of the weather situation presentation of the weather forecast and operations meteorological statistics, equipment status reports, and operations plans for the day. All staff were equipped with either pagers or cellular telephones to allow constant communications day or night. The daily briefin was important in maintaining the team spirit, communications, and cooperation.

Coordinated Universal Time

Coordinated Universal Time (UTC) is used as the standard for record keeping during the project where operational days are observed. The time was formerly called Greenwich Mean Time (GMT) and is the accepted international standard of time for general aviation and meteorological observations, reporting, and communication. Although a seeding operation may occur on two separate UTC 'days', it is recorded as the same day for operational purposes. In Texas, UTC is five hours ahead of Central Daylight Time (CDT). For example, if seeding operations commenced at 5 PM CST (2200 UTC) on May 1st and continued until 9 PM CST (0200 UTC), the 'operational day' would be logged as May 1 although operations continued into May 2 nd on the UTC clock. UTC can be converted to Central Daylight Time (CDT) by subtracting 5 hours. UTC can be converted to Central Standard Time (CST) by subtracting 6 hours.

The standard convention incorporated by the Texas project is to express all aircraft, radar, and meteorological times in UTC, however, for convenience, the summary tables are all organized according to the local calendar "storm" day. In other words, a storm that occurred on the evening of May 1st, 2000 at 8:00 p.m. (0100 UTC, May 2nd, 2000) is shown to occur on May 1st in all of the project summary tables and logs.

Seeding Amounts

The amount of seeding agent dispersed on each day of operations during the 2000 season is shown in Figure 9. A total of 29.3 kg of seeding agent was dispensed on 45 days of cloud seeding. Seeding flights were performed from March 6 th through November 2nd of the operational period.

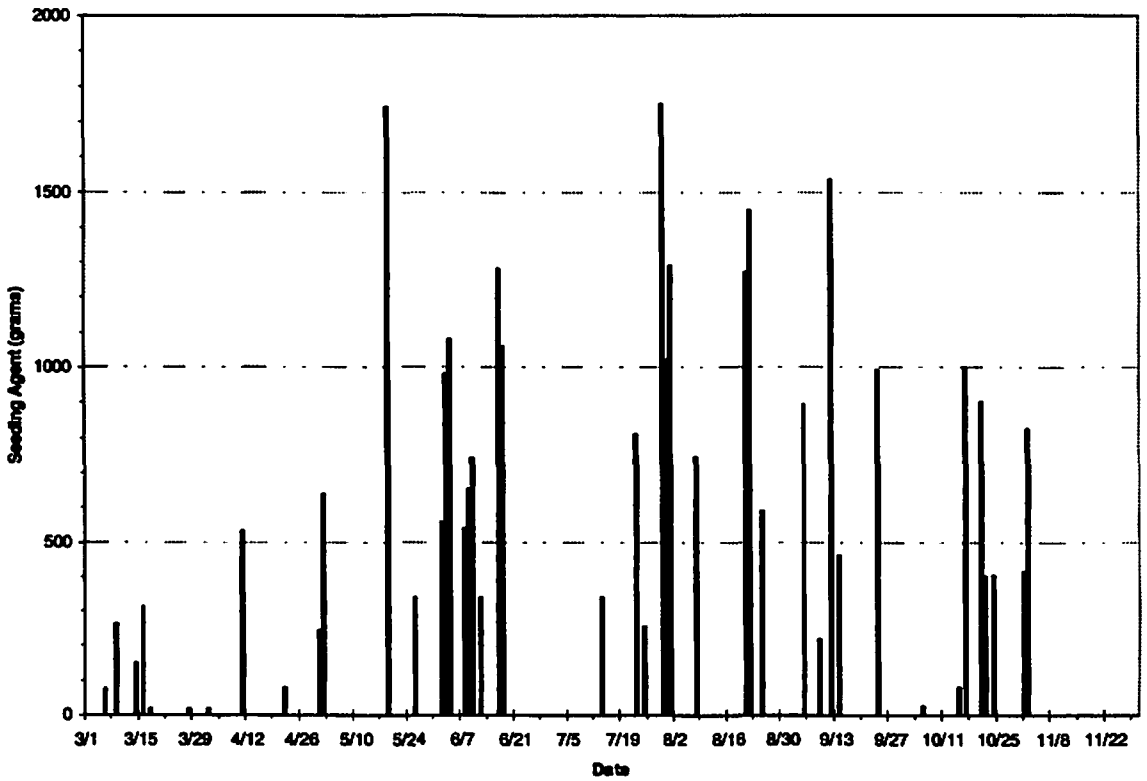

Figure 9: Amount of Seeding Agent dispensed per operational day in 2000.

Figure 9 shows that the most active days of the season were July 30, May 19, and September 12, with more than 1500 grams of seeding agent being dispersed on each day. There were 10 days on which more than 1000 grams of seeding agent were dispersed. That is 22.2% of the days on which seeding took place.

The amount and type of seeding material used on the project during the 1999 and 2000 seasons are shown in figure 10. The figure shows that more silver iodide - acetone solution was used this season than during the 1999 season but that fewer ejectable flares were used.

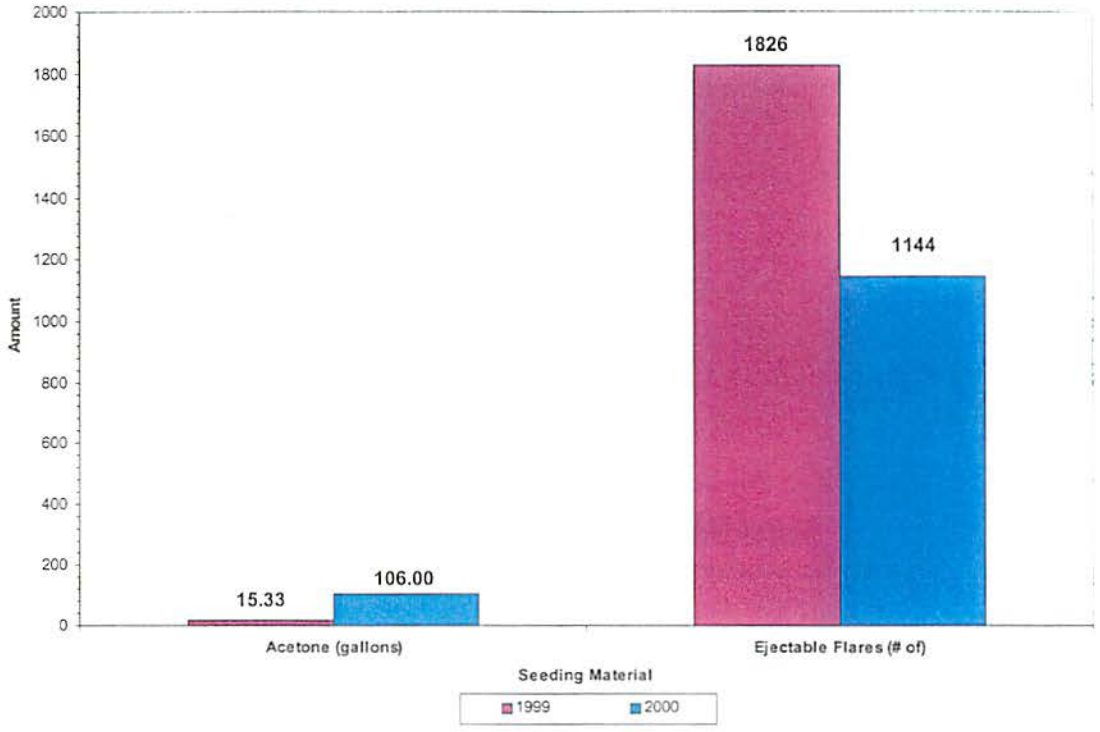

Figure 10: Amount and Type of Seeding Materials Used, 1999 and 2000 Seasons.

Weather Forecasting

The project meteorologist provided a detailed weather forecast each day that was communicated to the project pilots. The forecast was developed using real time weather information obtained from the Internet from a wide range of weather-associated sites. The decision-making flow chart for the Edwards Aquifer Precipitation Enhancement Program is shown in Figure 11.

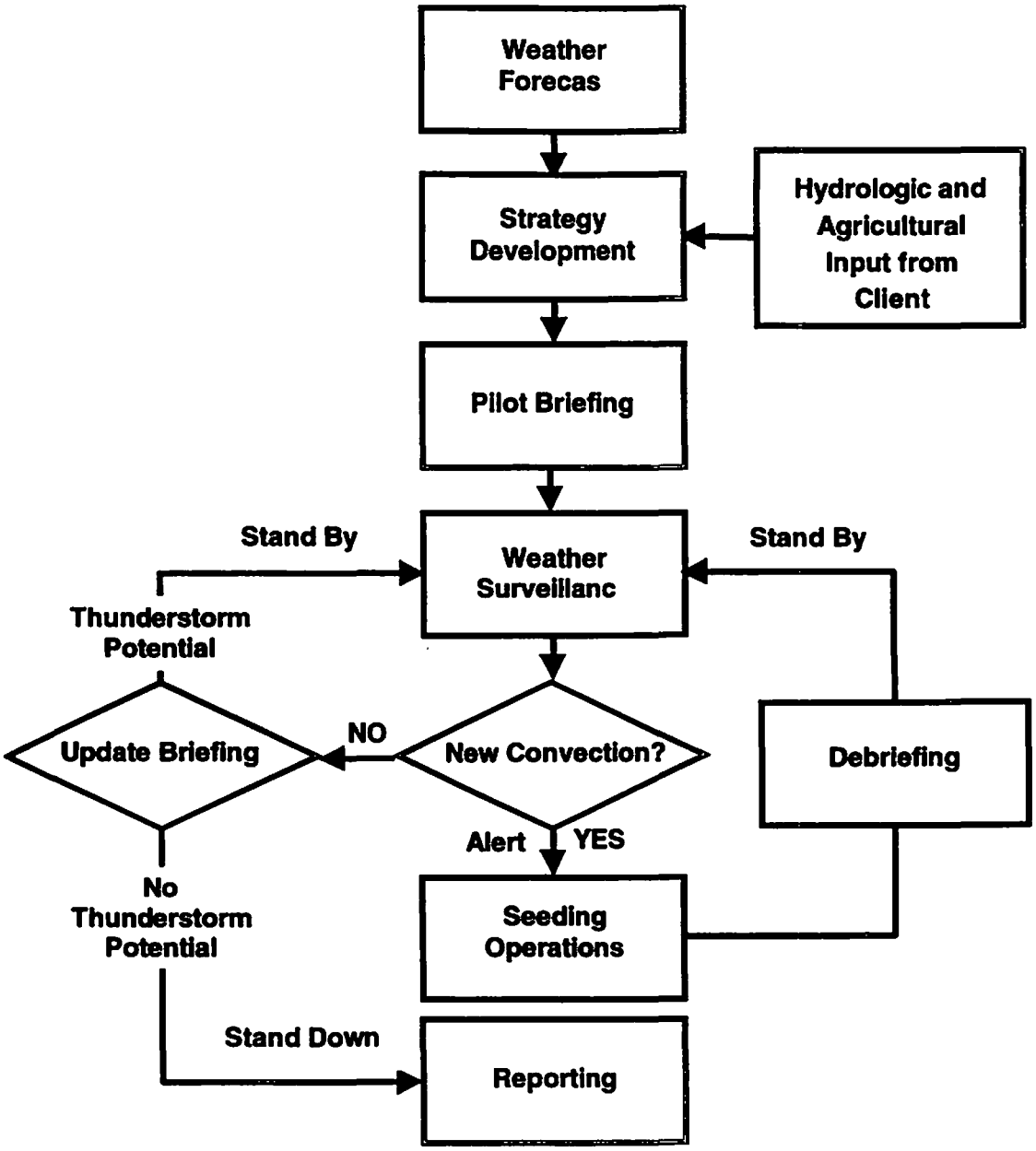

Figure 11: Decision-Making Flow Chart for the Edwards Aquifer Precipitation Enhancement Program.

Project meteorologists routinely used the following data to prepare a daily operations briefing for the EAPEP:

- Regional upper air analyses at 850 mb, 700 mb, 500 mb, and 200 mb.
- A representative atmospheric sounding from Del Rio or Corpus Christi when available.
- Surface analysis of the United States.

- Current computer models (ETA, RUC, NGM, etc.).
- National Weather Service (NWS) zone forecasts
- National and regional radar summaries
- Satellite imagery
- Storm Prediction Center (SPC) Convective Outlooks (AC)

All of the meteorological data collected during the field season has been stored on CD-ROM for future reference purposes.

For simplicity, the weather forecast was once again subjectively synthesized into a single number referred to as the "convective day category" or CDC. This technique was developed for the Alberta Hail Suppression Project by Strong (1979) and gives the cloud conditions and possibility of seeding activity for the day. A description of the weather conditions for each CDC is given in the Table 3. With higher CDC values, there is generally a better chance of finding precipitation enhancement opportunities.

CDC	Description
-3	No deep convection
-2	Overcast nimbostratus, producing rain
-1	Broken to overcast conditions with some rain
0	Cumulus clouds with tops warmer than –5°C
+1	Towering Cumulus, short-lived convective targets not suitable for seeding
+2	Towering Cumulus, long-lived convective targets suitable for seeding
+3	Mesoscale Convective Systems (MCSs), storms systems, or line storms
+4	Deep convection with hail potential
+5	Deep convection containing hail & threat of severe weather

Table 3: Description of Convective Day Category (CDC) values.

The chronology of daily CDC (convective day category) values for Hondo is shown in Figure 11 and as a frequency of occurrence histogram in Figure 12.

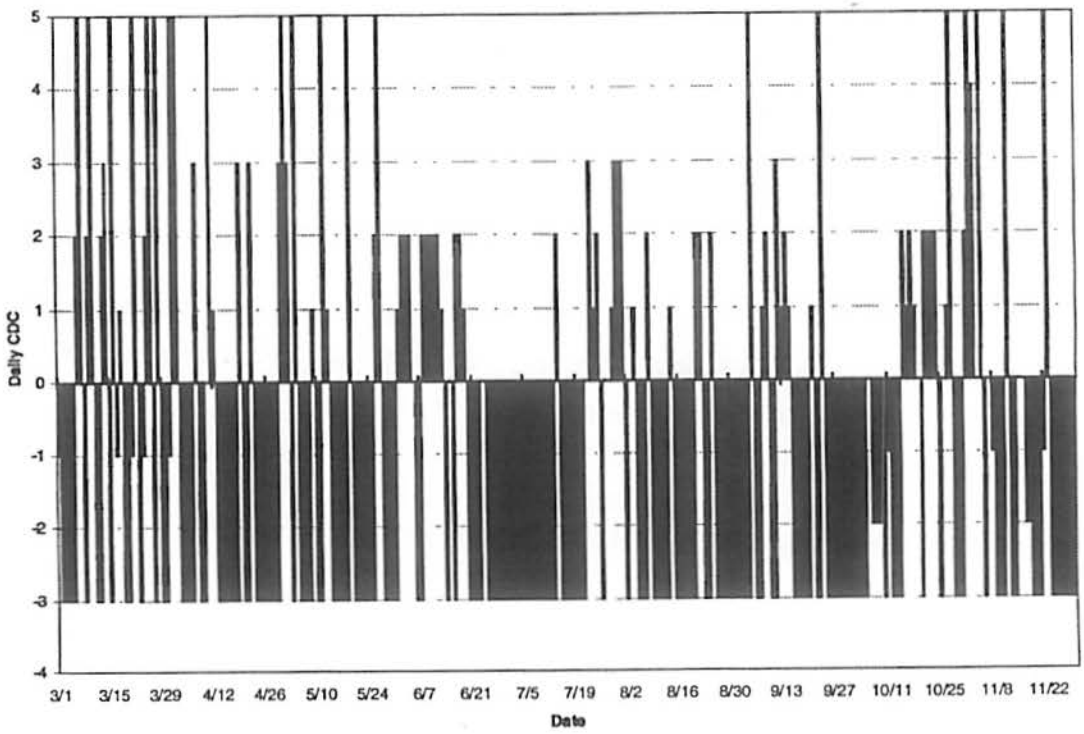

Figure 12: The chronology of daily CDC values for Hondo.

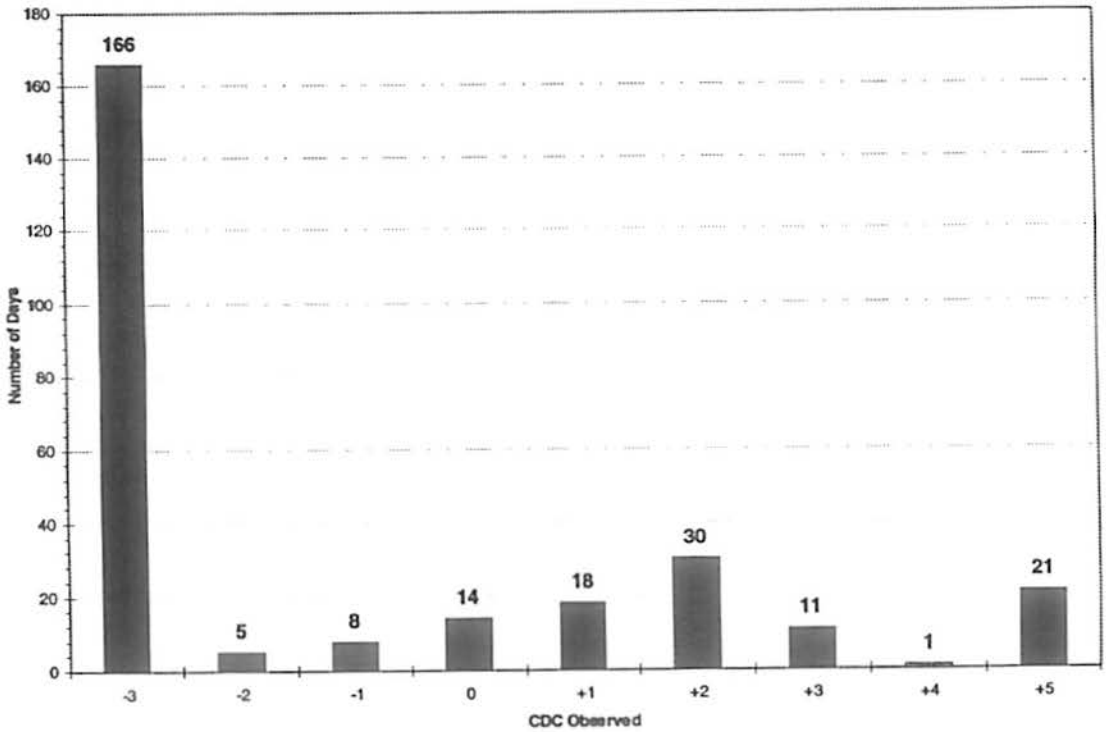

Figure 13: CDC values for Hondo as a frequency of occurrence histogram.

Both figures 12 and 13 show that the majority of the days of the project had CDC values of '-3' (refer to Table 3 on page 25 for definitions of the various CDC values). There were 21 days with a CDC value of '+5' indicating the potential threat of severe weather. Since this was a rain enhancement program, severe weather is not treated. Therefore, it can be inferred that only days with CDC values ranging between '0' and '+4' had conditions suitable for possible seeding missions. There were 74 days with CDC values in that range during the 2000 season. In other words, 26.9% of the days of the 2000 season had conditions suitable for possible seeding missions.

Forecasting Performance

The following table indicates the forecasting performance for the Edwards Aquifer Precipitation Enhancement Program with respect to the forecast and observed weather conditions as defined by the CDC. The forecasts were verified by the meteorologist's own observations, checking the weather conditions as reported by the National Weather Service, and by the reports from project personnel. Referring to Table 4, the exact forecast type of weather was observed on 184 of 274 days or 67.2% of the time. The forecast was correct to within one CDC on 206 days or 75.2% of the time.

Observed Convective Day Category (CDC) Weathe

Forecast CDC	-3	-2	-1	0	+1	+2	+3	+4	+5	
-3	125				3	1				129
-2	1	3								4
-1	4		3			1				8
0		1	2	7					1	11
+1	19			1	1	4	1		1	27
+2	11	1	1	3	11	23	3		2	55
+3	4		2	2	2		7		3	20
+4				1				1		2
+5	2				1	1			14	18
	166	5	8	14	18	30	11	1	21	274

Percent correct exact CDC category = 184 of 274 = 67.2%
Percent correct within one CDC category = 206 of 274 = 75.2%

Table 4: Table of Forecast versus Observed CDC Daily Value

Flight Operations

Two specially equipped cloud seeding aircraft were dedicated to the project. The aircraft and crews provided 24-hour coverage, seven days a week throughout the period. Both aircraft were stationed in Hondo, permitting flight crews to see the radar before launches, and a fast response to launch decisions.

When development of convection was unlikely, the seeding aircraft were placed on *weather watch*. The pilots were free to do as they wished but still required to carry their pager or cell phone. When convective development was imminent or was occurring, the seeding aircraft were placed on *stand-by*. *Stand-by* occurred when clouds were not yet seedable, but the aircraft were required to launch and reach a target cloud within 30 miles of the airport 45 minutes after the request to launch had been made by the meteorologist. When seedable clouds were imminent all aircraft were placed on *alert* and aircraft were able to launch and reach the target cloud within 30 miles of the airport in 25 minutes after the request to launch had been made by the meteorologist. Aircraft were available and prepared to commence a seeding mission at any time and the seeding of a storm often continued after darkness with due regard to safety. The meteorologist provided frequent updates of the status as the day progressed.

Flight Hours

A total of 218.80 hours were flown during the 2000 season. Figure 14 shows the Hondo flight hours for each month in 1999 and 2000. The main difference between the two seasons is that the 2000 season started earlier and ended later than the 1999 season. Each month, during both seasons, had fairly similar flight hours, within 10 hours, except for May and August. May saw nearly 15 fewer flight hours in the 2000 season as compared to the 1999 season while August saw approximately 17 more flight hours in the 2000 season than in the 1999 season.

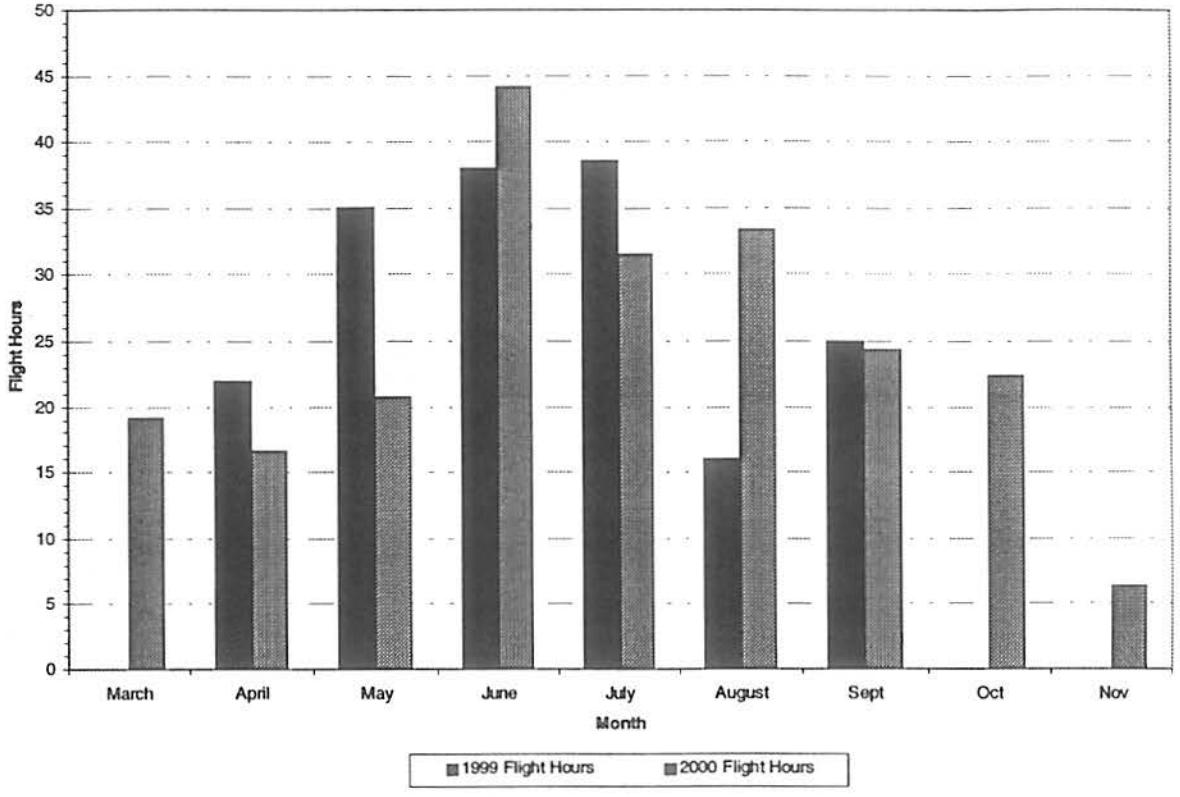

Figure 14: Hondo flight hours for 1999 and 2000

The cumulative flight hours and seeding agent used throughout the project for the 1999 and 2000 seasons are shown in figure 15. The graph shows that both seasons had nearly the same amount of flight hours through the middle of September (the end of the 1999 season). However, the 2000 season lasted 2 $^{1}/_{2}$ months longer than the 1999 season and, thus, accumulated more flight hours. Even though the 2000 season was longer than the 1999 season, the 1999 season saw more seeding agent dispersed. The total number of flight hours for the 2000 season (218.80 hrs) was 25.1% more than the 1999 total (174.93 hrs). The amount of seeding agent dispersed during the 2000 season (29.3 kg) was 21.9% less than that dispersed during the 1999 season (37.5 kg).

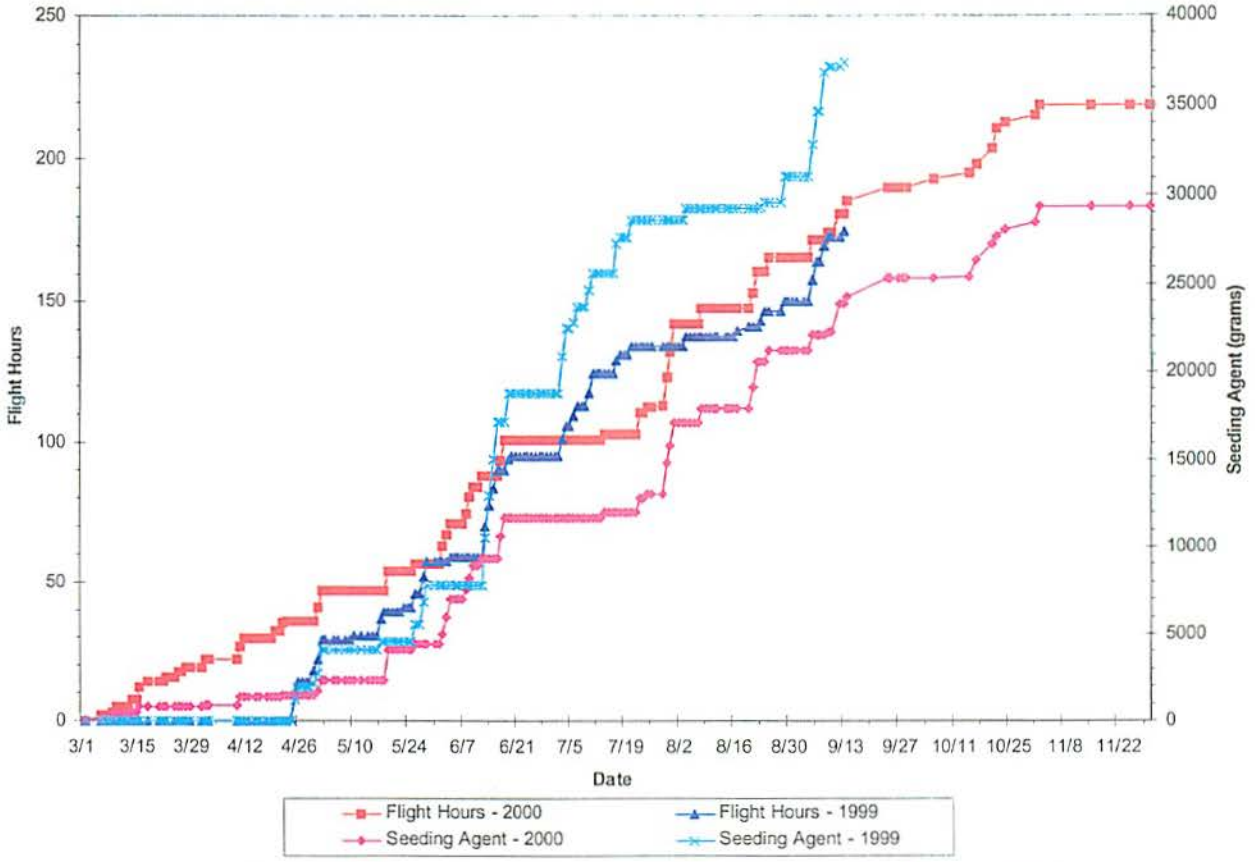

Figure 15: Flight Hour Progression during EAPEP 1999 and 2000

Cloud Seeding Aircraft

Cessna 340 Aircraft

Cloud seeding was conducted using two Cessna 340 aircraft equipped with ejectable flare racks and acetone burners. The aircraft registered as N340FR, designated as Seed 1, is shown in Figure 16 on the next page. Cessna 340 aircraft are pressurized, twin-engine, six cylinder, turbo-charged, fuel-injected, all weather aircraft. Both C340 aircraft have a weather avoidance radar and a GPS navigation system. The maximum operating altitude is approximately 30 thousand feet with a flight endurance of 5 hours. The C340's indicated air speed for cloud penetrations is typically 155 knots. The nominal rate of climb is 1000 ft/min from sea level to 16 thousand feet, and 700 ft/min from 16 to 20 thousand. Each C340 aircraft carried 204 20-gram ejectable silver iodide flares and two seven-gallon acetone burners. Complete specifications for the C340 are given in Appendix E.

Figure 16: Cessna 340 Cloud Seeding Aircraft.

Radar Data Acquisition, Display, and Archival

The radar data are first ingested by the Radar Data Acquisition System (RDAS), which samples directly the raw radar signal and, using the latest calibration data, processes it. Separate, but in parallel with the RDAS, is the AIRLINK system, which acquires, via radio modem, flight telemetry data from the aircraft. The AIRLINK system processes and displays the flight data, but also transforms it into a format compatible with the primary radar display system. The primary radar display and processing system in the WMI field office facility in Hondo utilizes the TITAN (Thunderstorm Identification, Tracking, Analysis, and Nowcasting) software package. On a large, user-interactive screen, TITAN displays and manipulates the radar data provided by RDAS, with GPS-based flight tracks provided by AIRLINK superimposed. This integrated, state-of-the-art system provides the user-meteorologist with comprehensive real-time information about storm location, development (and decay), movement, history, and intensity, as well as accurate aircraft position and seeding data. For an example, see Figure 17.

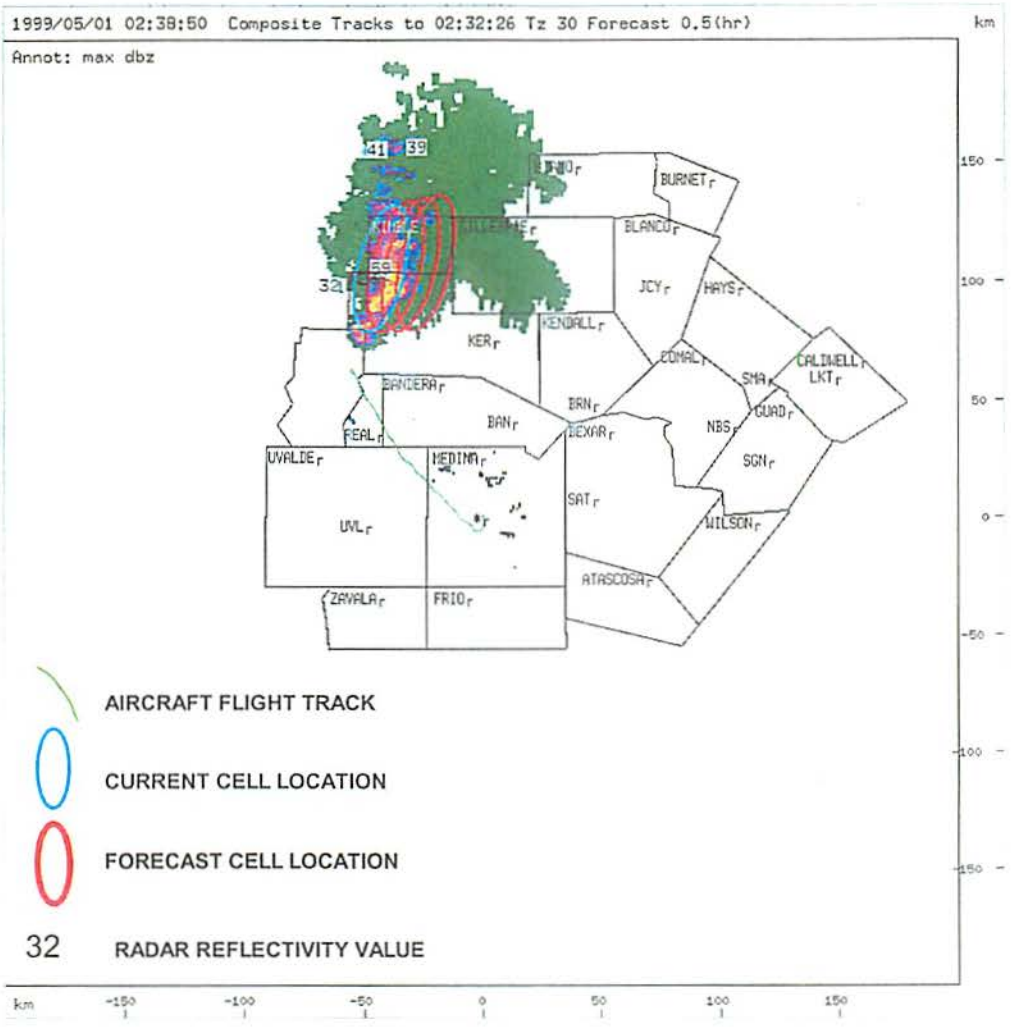

Figure 17: TITAN image of a thunderstorm from Hondo

Both the weather radar data and GPS flight track data were archived on CD-ROM for later playback and future analysis. A color printer was used to print hard copies of the radar echo and flight tracks. These also depicted the target area and county boundaries.

A TITAN radar map was automatically posted on an Internet web site every half-hour providing public access to near real-time project data. These maps displayed storm radar reflectivity data, as well as project GPS aircraft positions.

TITAN Radar Displays

Weather Modification Inc. has acquired the TITAN radar analysis and display software through the National Center for Atmospheric Research (NCAR) in Boulder, CO. TITAN is a software system that ingests radar data, converts it into Cartesian coordinates, identifies individual storm cells, displays past storm tracks, and projects future storm position, based on current movement (Dixon and Wiener, 1993). TITAN computes and displays a number of relatively sophisticated storm and track parameters in real-time. Among these are vertical and horizontal storm cross-sections, vertically-intregrated liquid water content (VIL), and history of maximum storm echo height, height of the maximum reflectivity, and so forth. A detailed description of TITAN's storm and track properties can be found in Mather et al. (1996). The Hondo TITAN system was set to objectively track storm cells having a radar reflectivity greater than 30 dBZ.

CASE STUDIES

June 2, 2000 Case Study

Overview

A trough of low pressure pushed through the target area during the afternoon, sparking showers and thunderstorms. Seedable targets were few and far between, but when they developed, seeding aircraft were available.

Seeding Summary

A cold front was settling into the northern sections of Texas, with moisture from the Gulf of Mexico slowly pushing northward ahead of it. This triggered isolated showers and thundershowers as daytime heating peaked. At 2:50 CDT (Figure 18) a group of small cells began to develop and push northward into the target area. Within 30 minutes after seeding began, impressive growth of the seeded cells was noted, whereas the unseeded cells outside the target area had trouble holding together (Figure 19). After another hour's seeding, the treated cells merged into one main complex 20 miles in diameter, with unseeded cells still not persisting more that 15 minutes (Figure 20). One and one half hour after seeding ceased, the large seeded complex continued to rain, while the unseeded cells had completely dissipated. In this case, the seeded cells held together for over 2 hours longer than the unseeded cells, and spread appreciable rainfall amounts over a much larger area (Figures 21-23).

Flight Totals

Seed 1 (N340FR)

Flight Time:	3 hrs 37 min
Ejectable Flares:	19
Counties Seeded:	Guadalupe, Comal, and Hays

TITAN Images

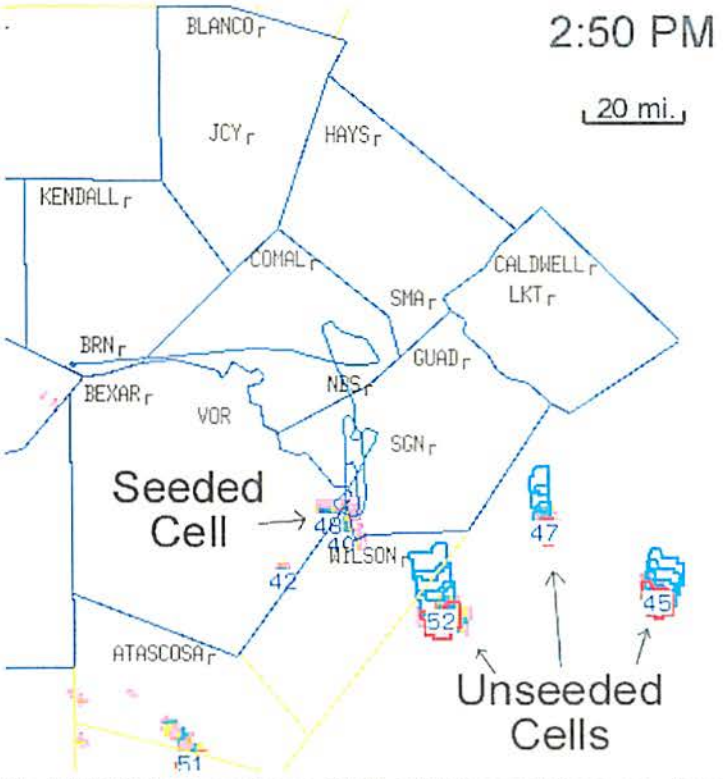

Figure 18: TITAN Image from 2:50 PM Local Time on June 2, 2000

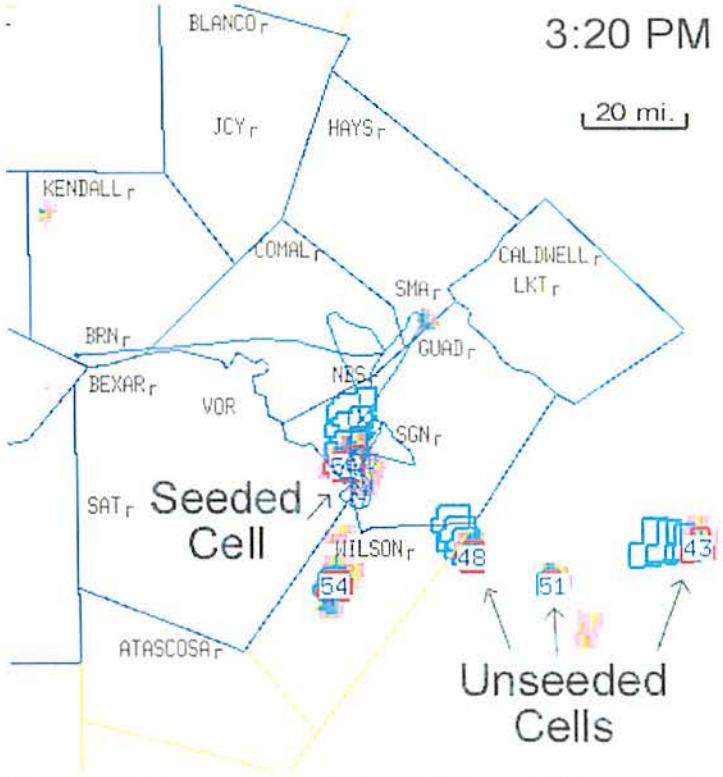

Figure 19: TITAN Image from 3:20 PM Local Time on June 2, 2000

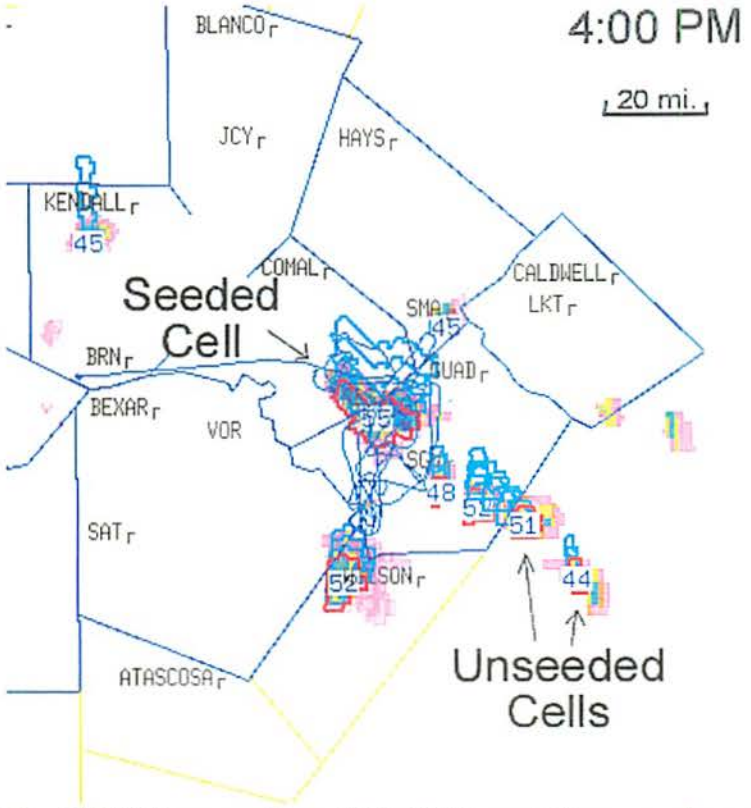

Figure 20: TITAN Image from 4:00 PM Local Time on June 2, 2000

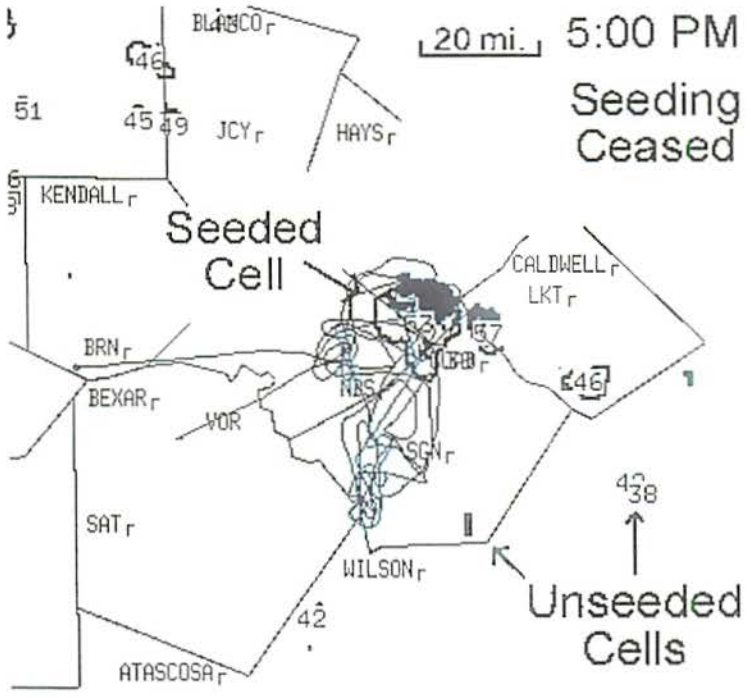

Figure 21: TITAN Image from 5:00 PM Local Time on June 2, 2000

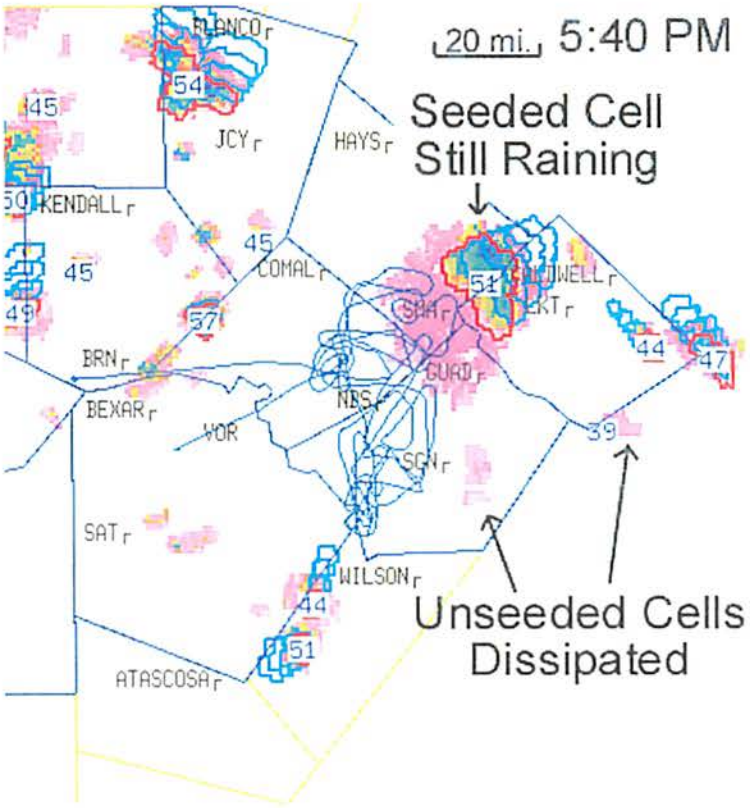

Figure 22: TITAN Image from 5:40 PM Local Time on June 2, 2000

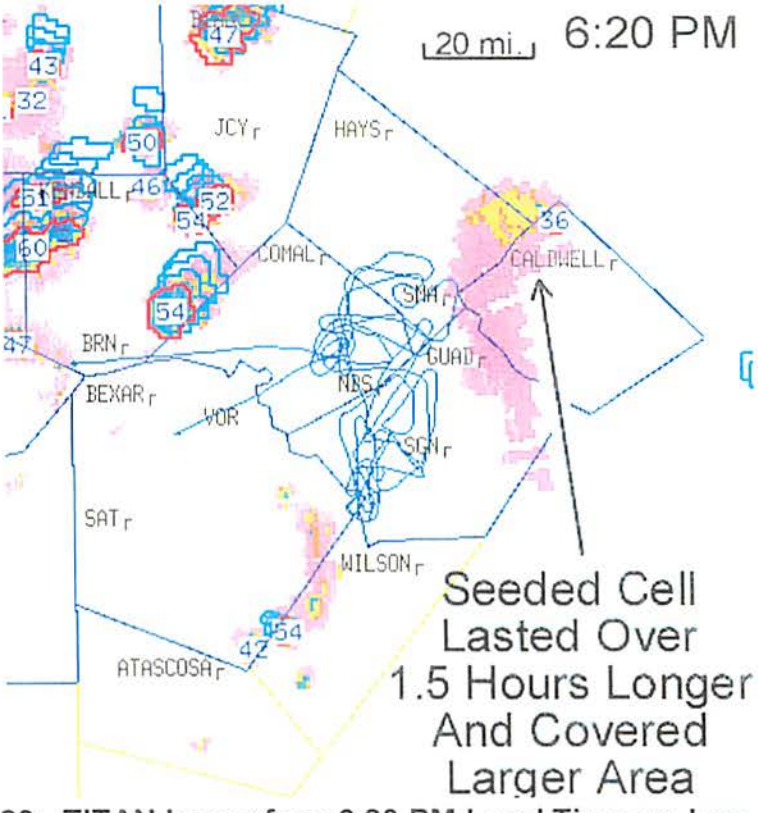

Figure 23: TITAN Image from 6:20 PM Local Time on June 2, 2000

September 5, 2000 Case Study

Overview

Temperatures soared on September 5, as southwest winds pushed hot desert air up from Old Mexico. The day's high in San Antonio was 111°F, while Hondo and Austin reached 112°F, all records. Even with high pressure entrenched over Texas, the extreme temperatures were sufficient to break the capping inversion and produce some isolated, high-based showers. The activity quickly dissipated at sunset, with loss o daytime heating.

Seeding Summary

The first showers developed north of the area, where the capping inversion was weaker, and started drifting south. Figures 24 through 28 show that the cells seeded over the target area persisted and rained significantly longer. For example, a cell outside the target area that wasn't seeded lasted only 1.5 hours, while the cell that was seeded stayed together for 3.5 hours. The rain on this day wasn't widespread, but any rain that fell helped to cool an extremely hot landscape.

Flight Totals

Seed 2 (N340AX)

Flight Time:	3 hrs 21 min
Ejectable Flares:	29
Counties Worked:	Kerr, Kendall, Bandera, Uvalde, Medina, Bexar, and Comal

Seed 1 (N340FR)

Flight Time:	2 hrs 50 min
Burner Time:	Left - 0 hrs 9 min
	Right - 2 hrs 0 min
Counties Worked:	Medina and Uvalde

TITAN Images

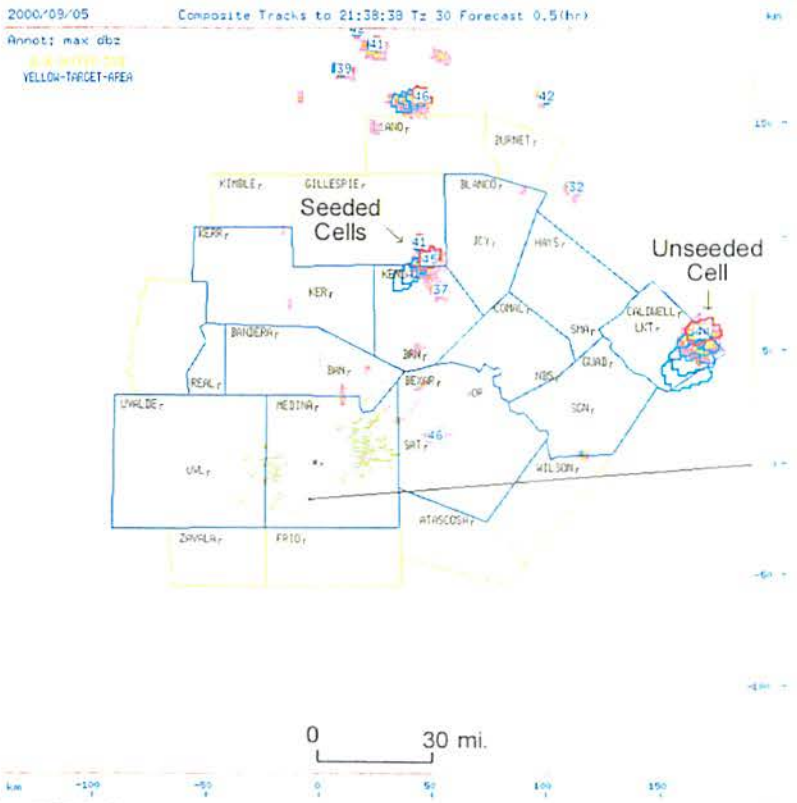

Figure 24: TITAN Image from 4:40 PM Local Time on September 5, 2000

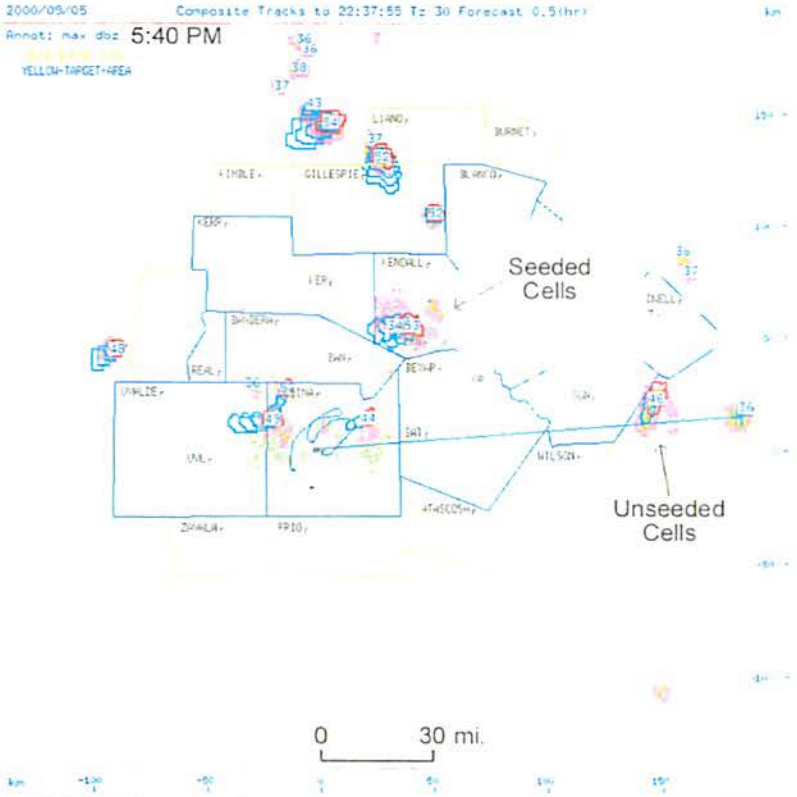

Figure 25: TITAN Image from 5:40 PM Local Time on September 5, 2000

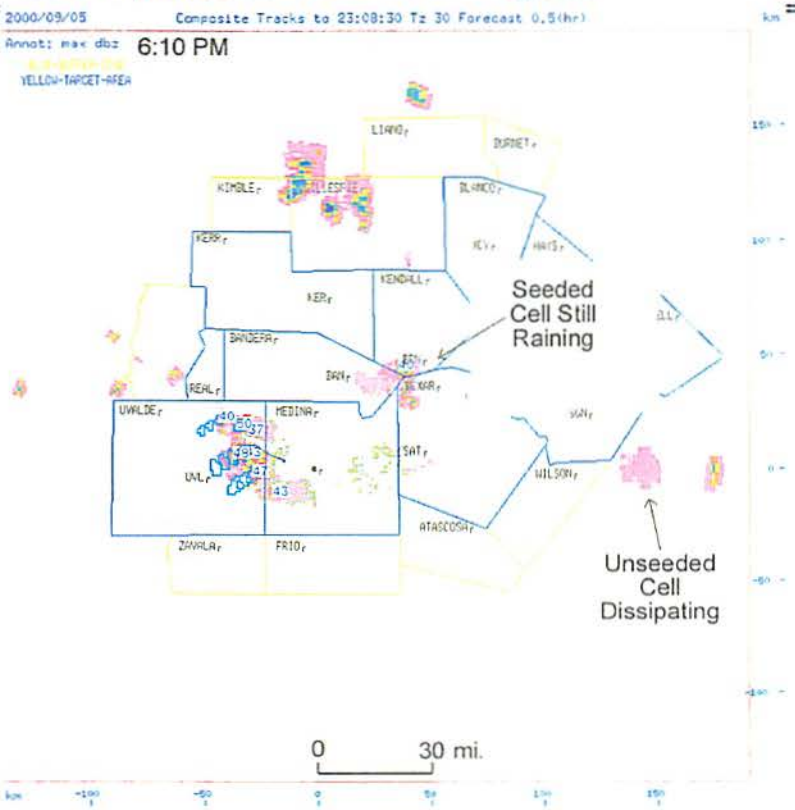

Figure 26: TITAN Image from 6:10 PM Local Time on September 5, 2000

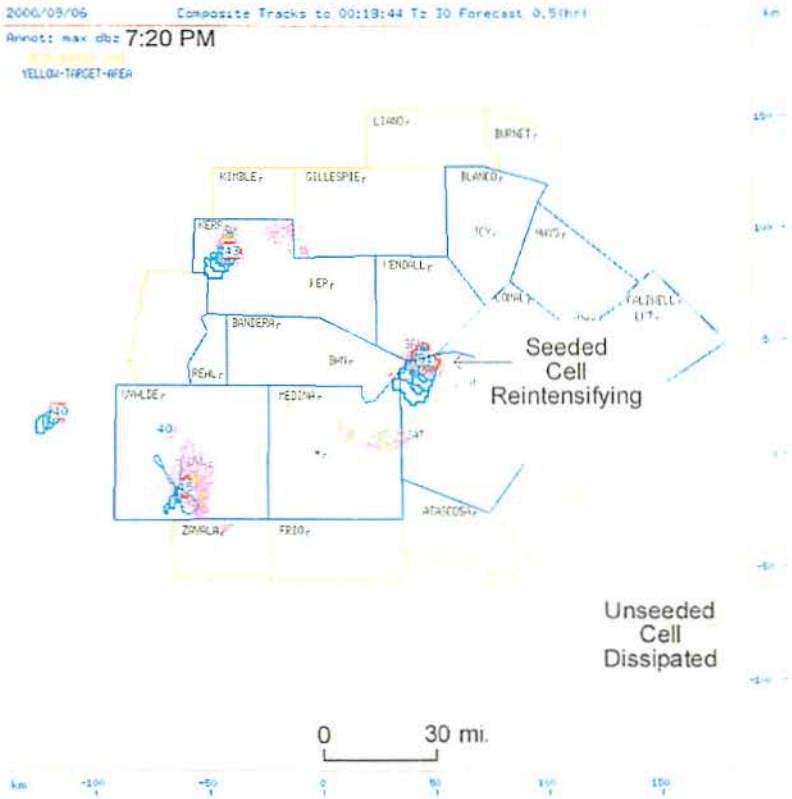

Figure 27: TITAN Image from 7:20 PM Local Time on September 5, 2000

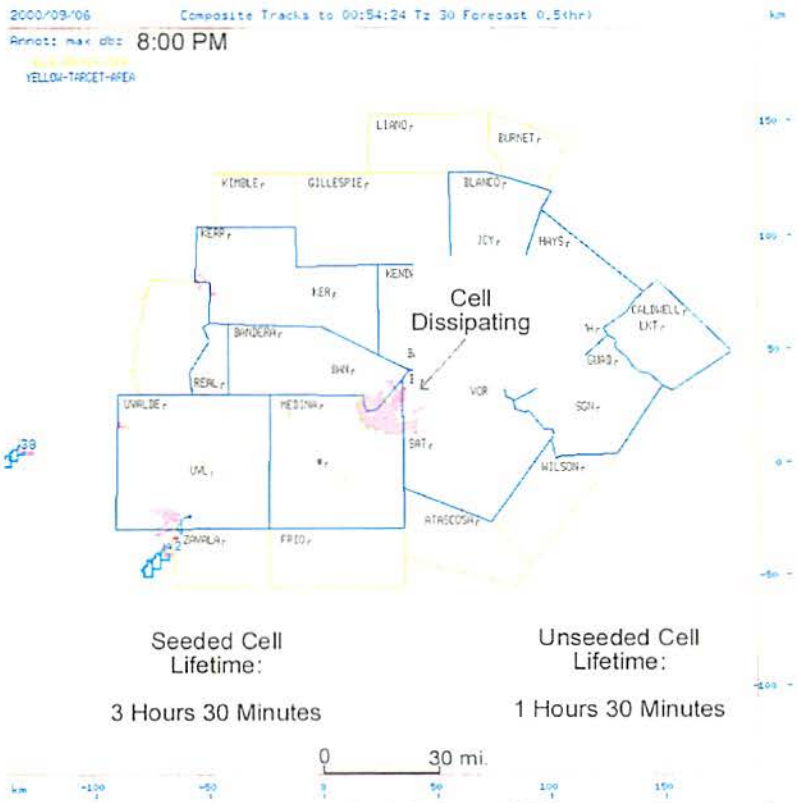

Figure 28: TITAN Image from 8:00 PM Local Time on September 5, 2000

October 22, 2000 Case Study

Overview

On October 22, a large upper-level low pressure center pushed southward across the Texas Panhandle toward the target area, destabilizing the air mass over the target area.

Seeding Summary

The approaching upper-level low destabilized the atmosphere enough for afternoon heating to produce showers and a few thundershowers, aided by the southerly inflow o Gulf moisture. Seeding began at 7:24 pm CDT, as cells began to develop in the western portions of the target area. As seeding progressed, the seeded cells grew in area, with some cell mergers. As sunset drew near, the sea breeze boundary weakened, decreasing the focus for shower development. Seeding helped developed cells persist and rain over greater areas than the unseeded cells, which quickly dissipated (see Figures 29-36).

Flight Totals

Seed 2 (N340AX)

Flight Hours:	2 hrs 15 min
Ejectable Flares:	11
Counties Seeded:	Bandera and Real

TITAN Images

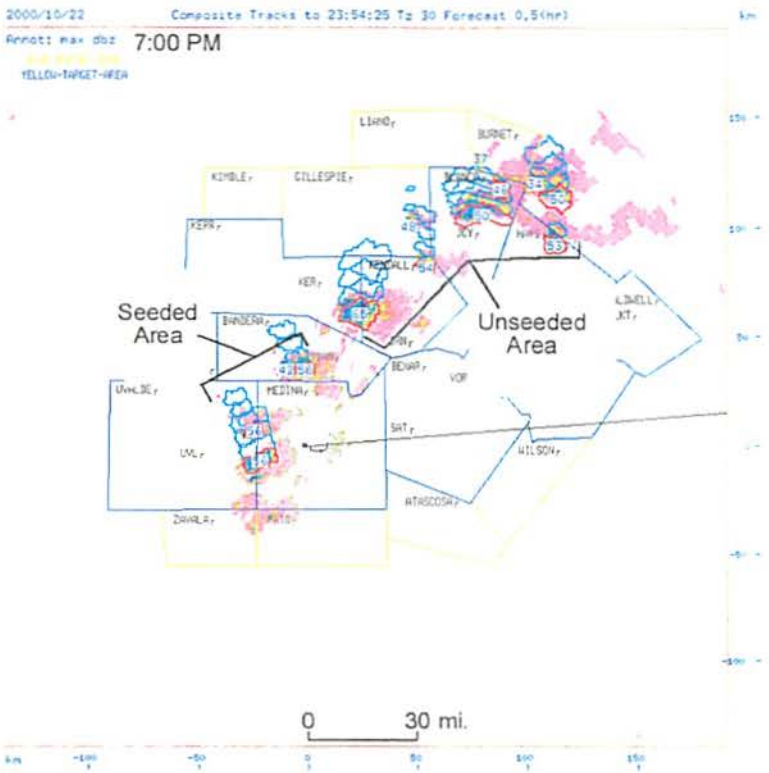

Figure 29: TITAN Image from 7:00 PM Local Time on October 22, 2000

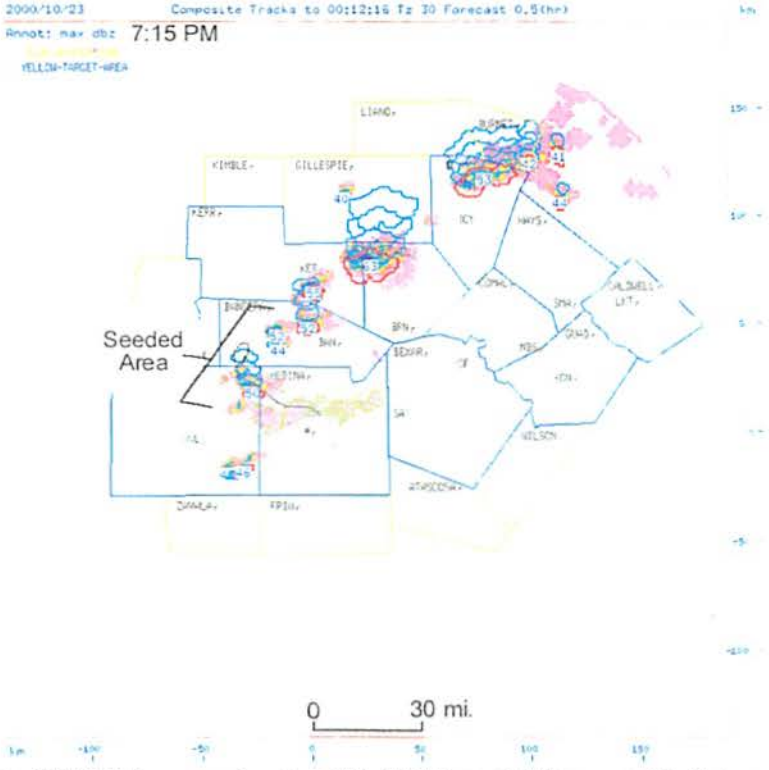

Figure 30: TITAN Image from 7:15 PM Local Time on October 22, 2000

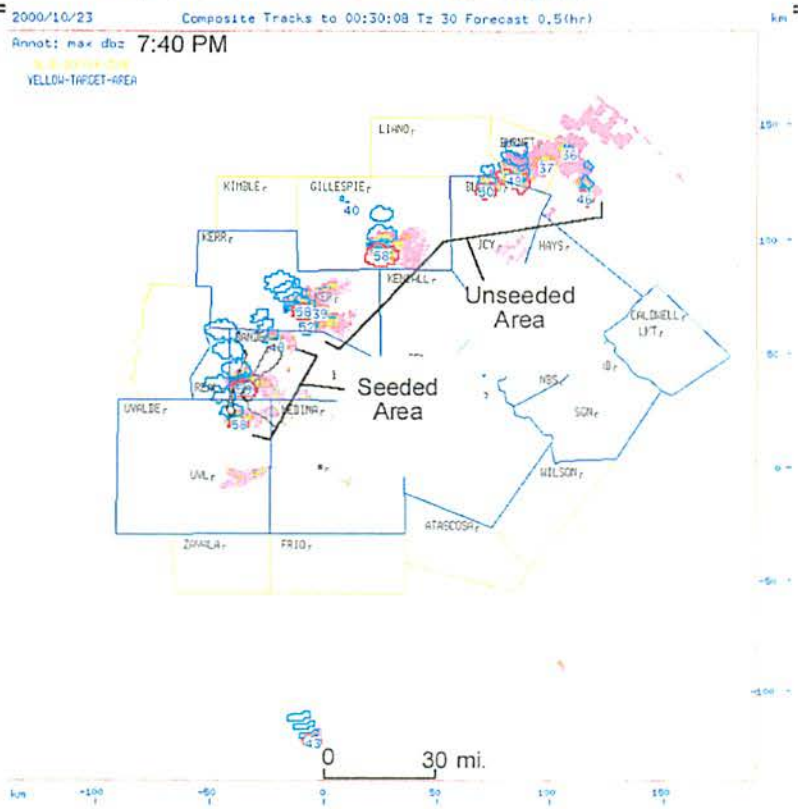

Figure 31: TITAN Image from 7:40 PM Local Time on October 22, 2000

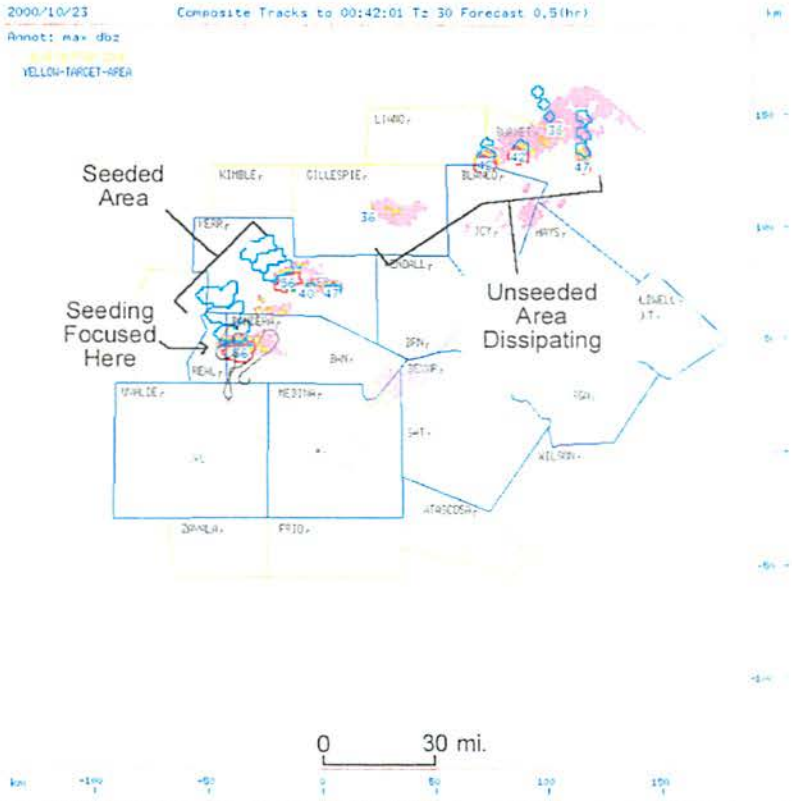

Figure 32: TITAN Image from 7:50 PM Local Time on October 22, 2000

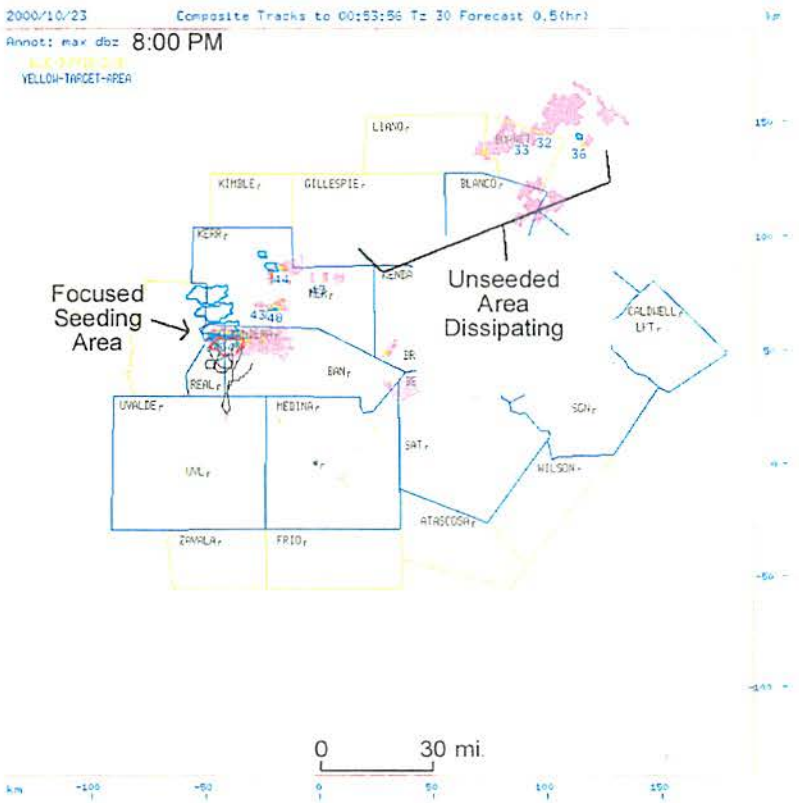

Figure 33: TITAN Image from 8:00 PM Local Time on October 22, 2000

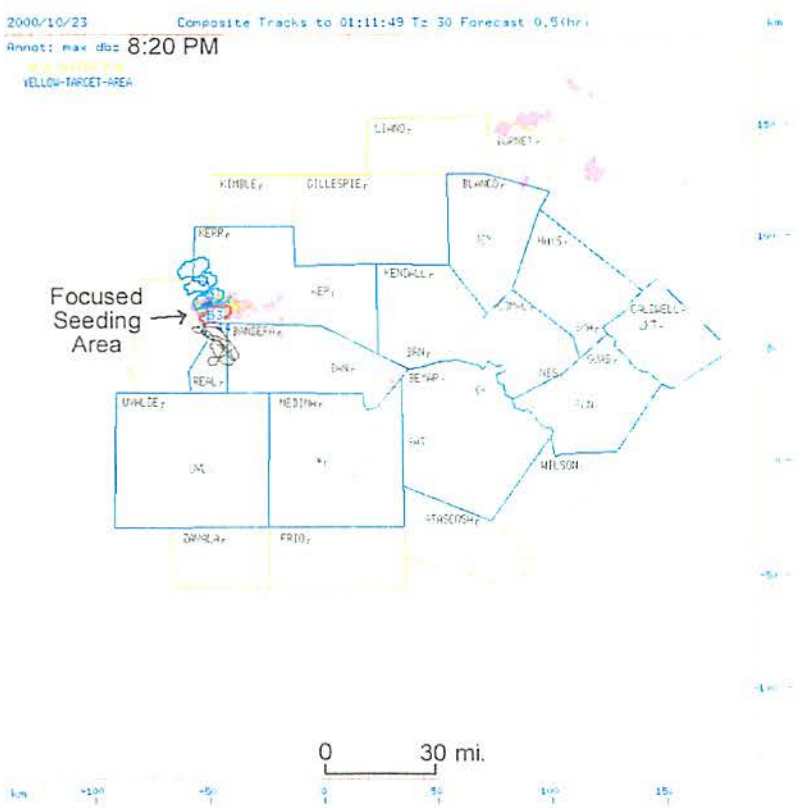

Figure 34: TITAN Image from 8:20 PM Local Time on October 22, 2000

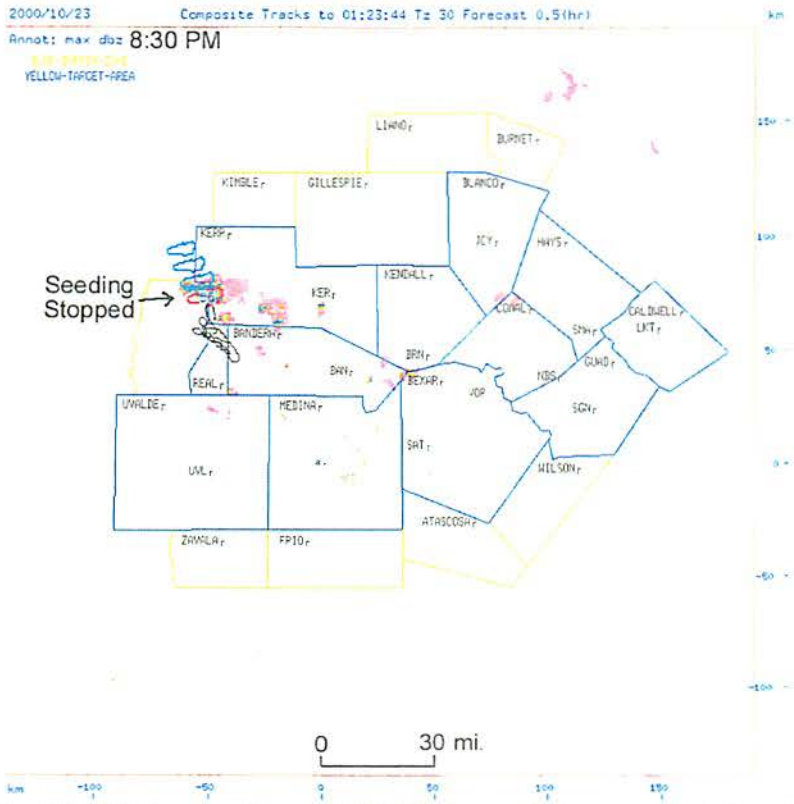

Figure 35: TITAN Image from 8:30 PM Local Time on October 22, 2000

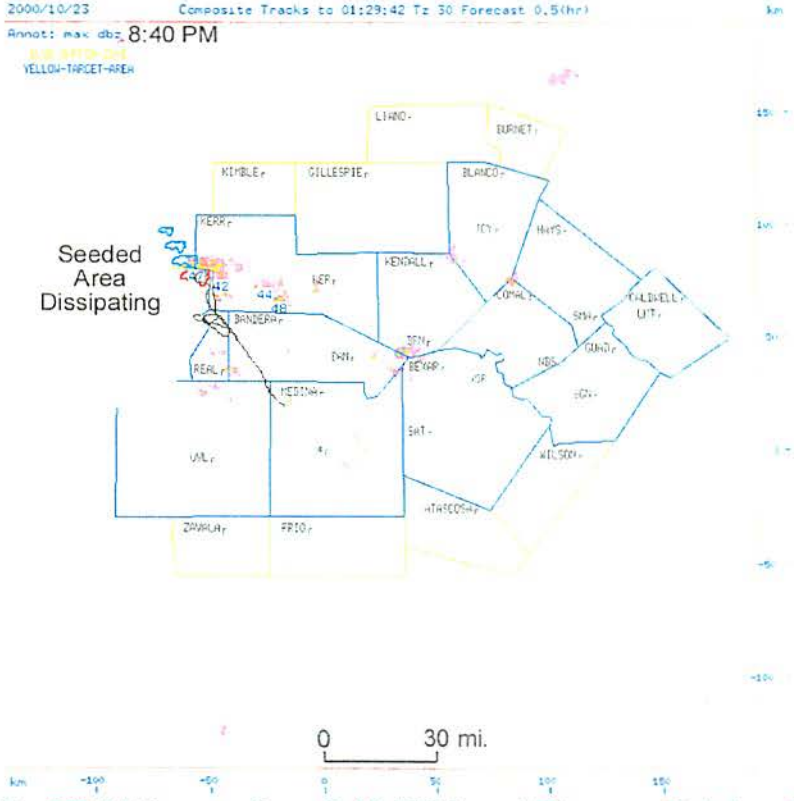

Figure 36: TITAN Image from 8:40 PM Local Time on October 22, 2000

CONCLUSION AND RECOMMENDATIONS

The 2000 field operations were very successful. During the nine-month project, the aircraft safely completed 82 seeding and reconnaissance missions. These flights totaled 218.80 hours on 45 days, and dispersed a total of 29.3 kg of seeding in the form of 1,144 ejectable flares and 106 gallons of silver iodide - acetone solution burned in the wing-tip generators. Comparison with the previous season reveals similar totals even though the program was longer. This reflects the sustained period of extremely dry conditions from mid-June to mid-August, which was not experienced in 1999.

A detailed assessment of the seeding effectiveness is beyond the scope of the present contract of WMI. Some preliminary analyses of the TITAN radar storm tracking data support the physical hypotheses of accelerated precipitation development and the promotion of rain within storms.

To improve operations in subsequent years, WMI recommends the following:

1. Maintaining a project time period of six months, from April 1 to September 30 with options to begin a month earlier (in March) and to extend the projec through the month of October, if necessary. The rainiest periods around south Texas are during the late spring and early autumn, with May and Septembe being the rainiest months of the year. Extending the project, specifically through September, would provide additional valuable opportunities for recharging the Edwards Aquifer during peak convective rainfall periods.

2. The 15-mile buffer zone around the southeastern edge of the target area wa not always sufficient. Most summertime precipitation events pushed in from th southeast, along the sea breeze boundary. The Authority may wish to conside the possible expansion of this zone to provide increased opportunity to begin t work more of such convection as it moves northward into the target area.

3. The Authority is encouraged to involve university scientists and other experts to analyze the radar and aircraft data that is archived from the operation.

Weather Modification, Inc. looks forward to continuing operations with the Edwards Aquife Authority and achieving our objective of increasing rainfall.

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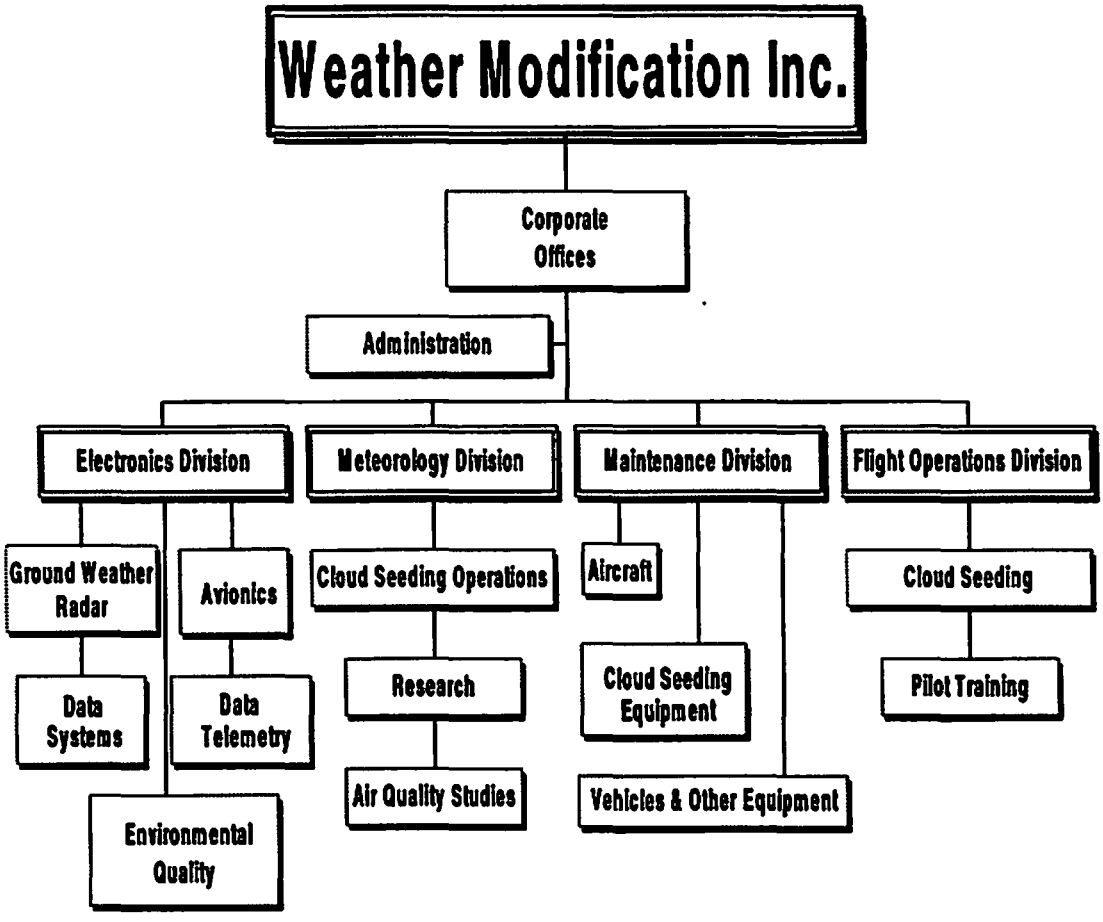
Appendix

A. Organization Chart



B. List of Texas Reports

Report	Description	Author	Frequenc
Flight Log	Description of seeding mission including amount and location of seeding material dispensed, flight crewmembers and remarks.	Pilot	Each Flight
Hobbs Sheet	Running list of takeoff and landing times and flight crew for each aircraft flight.	Pilot	Each Flight
Chemical Inventory Log	Amount of seeding material on hand after subtracting material used and adding shipments received.	Pilot	Weekly
Equipment Log	Status of project equipment including radar, computers and airplanes.	Meteorologist	Dail
Meteorological Log	List of meteorological parameters used as seeding criteria and in weather forecasting.	Meteorologist	Dail
Forecast Sheet	Graphical and textural information describing the state of the atmosphere, the day's forecast and forecast verification.	Meteorologist	Dail
Daily Operations Summary	Textural description of the day's weather and weather modification activities in a table format.	Meteorologist	Dail
Storm Summary	Description of weather modification operations for a particular event including weather conditions, aircraft activity and storm damage.	Meteorologist	Each Seeding Operation
Weekly Report	Compilation of reports describing each week's activities. Report includes daily operations summary, flight forms, equipment log and a table of flight hours and seed material used. Submitted to Client.	WMI	Weekly
NOAA Daily Log	Federal report of seeding activities including amount, location and type of nucleant material used and duration of activities. Submitted to Client.	WMI	Dail

C. Aircraft Flight Summary Tables

Edwards Aquifer Precipitation Enhancement Program 2000
Operations Flights

Date	Aircraft	Take-off	Landing	Duration	eject	acetone	Type
March 6, 2000	340FR	23:43	1:29	1:46		31	seed
March 9, 2000	340FR	23:42	0:52	1:10	11	17	seed
March 10, 2000	340FR	17:45	19:37	1:52			recon
March 14, 2000	340AX	13:40	15:45	2:05	3	37	seed
March 14, 2000	340AX	19:05	19:50	0:45			repos
March 16, 2000	340AX	19:55	22:29	2:34		30	seed
March 16, 2000	340AX	22:59	0:55	1:56	12		seed
March 18, 2000	340AX	0:52	2:59	2:07	1		seed
March 23, 2000	340AX	14:00	15:30	1:30			recon
March 26, 2000	340AX	22:42	0:44	2:02			recon
March 28, 2000	340FR	23:53	1:16	1:23	1		seed
April 2, 2000	340FR	13:40	16:45	3:05	1		seed
April 11, 2000	340FR	19:30	23:45	4:15	24	22	seed
April 12, 2000	340FR	21:03	22:39	1:36			recon
April 12, 2000	340AX	13:30	15:16	1:46			recon
April 20, 2000	340AX	4:00	6:30	2:30			recon
April 22, 2000	340FR	23:34	2:16	2:42	4		seed
April 23, 2000	340FR	2:53	3:37	0:44		2	repos
May 1, 2000	340FR	16:37	18:37	2:00		79	seed
May 1, 2000	340AX	14:00	17:03	3:03	1	12	seed
May 2, 2000	340FR	22:37	0:53	2:16	21	2	seed
May 2, 2000	340AX	12:50	16:35	3:45	11	2	seed
May 19, 2000	340FR	20:46	0:25	3:39	63	2	seed
May 19, 2000	340AX	20:15	23:40	3:25	24	2	seed
May 26, 2000	340FR	21:20	23:57	2:37	17	2	seed
June 2, 2000	340FR	18:43	22:20	3:37	19		seed
June 2, 2000	340FR	22:45	1:45	3:00	9		seed
June 3, 2000	340FR	17:27	21:10	3:43	49	2	seed
June 4, 2000	340FR	17:40	21:40	4:00	54		seed
June 8, 2000	340FR	19:15	23:02	3:47	27	2	seed
June 9, 2000	340FR	13:10	16:20	3:10	16		seed
June 9, 2000	340FR	19:55	22:54	2:59		137	seed
June 10, 2000	340AX	18:12	21:00	2:48	37		seed
June 10, 2000	340AX	22:30	23:00	0:30			repos
June 12, 2000	340FR	17:33	21:25	3:52	17	2	seed
June 17, 2000	340FR	0:23	2:14	1:51	2	2	seed
June 17, 2000	340AX	20:50	0:30	3:40	62		seed
June 18, 2000	340FR	14:23	18:12	3:49	11		seed
June 18, 2000	340AX	21:40	1:05	3:25	42		seed
July 14, 2000	340FR	22:59	1:15	2:16	17		seed
July 23, 2000	340FR	20:47	0:40	3:53		184	seed
July 23, 2000	340AX	19:31	23:00	3:29		148	seed
July 25, 2000	340AX	23:31	1:42	2:11	11	15	seed

July 29, 2000	340FR	19:15	19:45	0:30			recon
July 30, 2000	340FR	17:51	21:44	3:53	69	2	seed
July 30, 2000	340FR	22:46	0:18	1:32		12	seed
July 30, 2000	340AX	18:22	20:50	2:28		89	seed
July 30, 2000	340AX	21:47	23:55	2:08		48	seed
July 31, 2000	340FR	17:40	22:00	4:20		223	seed
July 31, 2000	340AX	18:15	22:10	3:55	24		seed
July 31, 2000	340AX	23:32	0:30	0:58			repos
August 1, 2000	340FR	18:12	22:13	4:01	23	70	seed
August 1, 2000	340FR	22:58	0:44	1:46		55	seed
August 1, 2000	340AX	19:07	23:05	3:58	16	84	seed
August 8, 2000	340FR	22:01	0:17	2:16	15	16	seed
August 8, 2000	340AX	21:15	0:45	3:30		167	seed
August 21, 2000	340FR	22:52	1:45	2:53	39	2	seed
August 21, 2000	340AX	18:15	20:35	2:20	24	2	seed
August 22, 2000	340FR	20:16	23:50	3:34	52		seed
August 22, 2000	340AX	18:50	23:15	4:25		168	seed
August 25, 2000	340FR	19:23	0:03	4:40		242	seed
September 5, 2000	340FR	22:08	0:58	2:50		129	seed
September 5, 2000	340AX	21:32	0:53	3:21	29		seed
September 9, 2000	340AX	23:00	1:40	2:40		89	seed
September 12, 2000	340FR	22:14	1:42	3:28	63		seed
September 12, 2000	340AX	23:55	2:40	2:45		114	seed
September 14, 2000	340FR	19:37	0:12	4:35		189	seed
September 24, 2000	340FR	22:00	23:44	1:44		52	seed
September 24, 2000	340AX	21:05	0:05	3:00	43	2	seed
October 6, 2000	340FR	12:50	14:30	1:40	1		seed
October 6, 2000	340FR	22:13	23:45	1:32		2	recon
October 15, 2000	340AX	19:35	21:35	2:00	4		seed
October 17, 2000	340FR	13:42	16:24	2:42	50		seed
October 21, 2000	340FR	23:29	1:51	2:22	37		seed
October 21, 2000	340AX	17:35	20:55	3:20	8		seed
October 22, 2000	340FR	14:16	16:20	2:04	9		seed
October 22, 2000	340FR	19:03	20:17	1:14			recon
October 22, 2000	340FR	21:00	22:14	1:14			recon
October 22, 2000	340AX	23:45	2:00	2:15	11		seed
October 24, 2000	340FR	20:43	22:44	2:01	13	58	seed
November 1, 2000	340AX	16:53	19:40	2:47	9	96	seed
November 2, 2000	340AX	20:00	23:35	3:35	38	26	seed

Total number of flights: 82
Total flight time: 218 hours and 49 minutes
Ejectable flares used: 1,149
Wing-tip generator usage: 2,669 minutes or 44 hours and 29 minutes

D. Daily Operations Summary

Date	Weather	Activities Summary
1 Mar 2000, Wednesday	What could have been an active start to the ne project was decidedly not so. A dryline that was expected to cross the northern section of th target area did not develop as expected, leaving a cloudy day to start, with clearing during the afternoon.	No seeding operations from Hondo.
2 Mar 2000, Thursday	The dryline that was expected yesterday crossed the target area uneventfully. Behind it, clear skies and slightly cooler air prevailed.	No seeding operations from Hondo.
3 Mar 2000, Friday	Today was sunny and unseasonably warm. A couple stray clouds temporarily blocked the sun but only for a short time.	No seeding operations from Hondo.
4 Mar 2000, Saturday	The day started out cloudy due to moisture from the Gulf of Mexico slowly pushing up against th Hill Country. Later in the day the winds shifte and skies started to clear.	No seeding operations from Hondo.
5 Mar 2000, Sunday	Moisture from the gulf kept skies mostly cloudy during the day. The cloud deck broke late in the day as drier air pushed in from the west.	No seeding activities from Hondo.
6 Mar 2000, Monday	Another dull gray day. Enough of a southeasterly wind blew today to spark a coupl showers at the edge of the Hill Country. Thes showers weakened as the winds died down around sundown.	One seeding flight was flown during the evening hours in Kendall and Comal Counties. Engine On: 2343Z Engine Off: 0129Z Time: 1 hour 46 minutes Seeding: Right Acetone Burner – 31 minutes
7 Mar 2000, Tuesday	Severe weather along a strong dryline/cold front drove into the target area late Tuesday evening. All activity was severe, thus unworkable.	No seeding activities from Hondo.
8 Mar 2000, Wednesday	With the dryline through the area, the atmosphere stabilized, keeping skies mostly clear.	No seeding activities from Hondo.
9 Mar 2000, Thursday	A weakened cold front from Tuesday drifted back across the area causing a couple large thunderstorms to develop i Medina County. These storms dropped up to an inch of rain an pea to marble sized hail around Hondo. These storms quickly died at sundown.	One seeding flight was flown during the evening hours in Medina and Atascosa Counties. Engine On: 2342Z Engine Off: 0052Z Time: 1 hour 10 minutes Seeding: 11 Ejectables Right acetone burner – 9 minutes Left acetone burner – 8 minutes
10 Mar 2000, Friday	Very severe weather pushed into the target area during the afternoon dropping rainfall up to 3 inches across Llano County, along with hail up to 2 inches in diameter. All activity was severe, prohibiting seeding	No seeding activities from Hondo.
11 Mar 2000, Saturday	Very stable air behind yesterday's dryline/clod front led to very clear skies and coole temperatures in the middle 60s.	No seeding activities from Hondo.
12 Mar 2000, Sunday	Sunny and cool. Stable air continued from yesterday, keeping temperatures in the mid 50s.	No seeding activities from Hondo.
13 Mar 2000, Monday	Mostly clear and warmer. Gulf moisture returned ahead of an advancing system. Skies were mostly clear.	No seeding activities from Hondo.
14 Mar 2000, Tuesday	Upper level low pressure moved in from old Mexico up across the Gulf Coast, causing rain across all of south central Texas. Convective rains developed early morning, but later developed into a large shield of stratus rain. Th rain confined itself to a line south and east of San Antonio to Austin. All rain pushed off to th east late.	One seeding flight was flown during the early morning i Atascosa and Medina counties. Engine On – 1340Z Engine Off – 1545Z Time – 2 hours 5 minutes Seeding: Right Acetone Burner – 37 minutes

		Ejectable Flares - 3
15 Mar 2000, Wednesday	Stable air behind the low pressure system kept skies mostly clear.	No seeding activities from Hondo.
16 Mar 2000, Thursday	A strong clod front pushed into the northern section of the target area, sparking showers and thunderstorms. The dryline pushed in from the west, causing the cold front to intensify an make most thunderstorms severe. These lines pushed into eastern Texas early overnight.	Two seeding flights were flown during the afternoon and evening in Gillespie, Kendall, Blanco, Medina, and Bexar Counties. Flight 1 – base seed Engine On – 1955Z Engine Off – 2229Z Time – 2 hours 34 minutes Seeding: Right Acetone Burner – 30 minutes Flight 2 – top seed Engine On – 2259Z Engine Off – 0055Z Time – 1 hour 56 minutes Seeding: Ejectable Flares - 12
17 Mar 2000, Friday	Stable, dry air behind yesterday's cold front kept skies clear and temperatures cooler.	No seeding activities from Hondo.
18 Mar 2000, Saturday	The day started out with thick fog, which broke just after noon. A mostly sunny afternoon gave way to a dryline/clod front combination late that sparked popcorn variety showers across the NE section of the target. A large cap inhibited large-scale convection from occurring.	One seeding flight was flown during the late evening hours around Blanco, Hays, and Burnet County. Engine On – 0052Z Engine Off – 0259Z Time – 2 hours 7 minutes Seeding: Ejectable Flares – 1 (Hays)
19 Mar 2000, Sunday	Quiet weather behind strong cold front due to stabilized atmosphere kept skies clear.	No seeding activities from Hondo.
20 Mar 2000, Monday	Another quiet day under the strength of upper level high pressure.	No seeding activities from Hondo.
21 Mar 2000, Tuesday	Return flow on the back side of high pressur increased low level moisture, making for a cloudy morning with breaking during the afternoon.	No seeding activities from Hondo.
22 Mar 2000, Wednesday	Severe weather developed in the Texas Panhandle during the early afternoon. This activity was expected to push into the target area during the evening, but stalled in west central Texas. No activity entered the area, so skies were mostly sunny and very warm.	No seeding activities from Hondo.
23 Mar 2000, Thursday	Yesterday's severe weather finally pushed int the target area around daybreak this morning, but in a very weakened state. The whole line dissipated as it crossed the area, fully dissipating as it pushed through San Antonio. The rest of the day was partly cloudy and much drier.	One reconnaissance flight was flown during the morning hours in Bandera and Medina Counties. Seed 1 – top recon Engine On – 1400Z Engine Off – 1530Z Time – 1 hour 30 minutes
24 Mar 2000, Friday	Leftover boundaries from Thursday's cold front popped up showers across northern Texas, but were unable to develop into southern Texas during peak afternoon heating.	No seeding activities from Hondo.
25 Mar 2000, Saturday	More minor boundaries popped showers and thunderstorms across Texas, but again didn't develop into the target area.	No seeding activities from Hondo.
26 Mar 2000, Sunday	A dry line pushed through the target area late afternoon sparking a couple severe thunderstorms in the northeast corner. Thes storms pushed through quickly.	One reconnaissance flight was flown during the early evening in Gillespie an Blanco Counties. Seed 2 (340AX) – recon Engine On – 2242Z Engine Off – 0044Z Time – 2 hours 2 minutes
27 Mar 2000, Monday	A quiet day behind the dry line with mostly sunny skies. Southeasterly flow late brought a return to low level moisture.	No seeding activities from Hondo.
28 Mar 2000,	The dryline pushed through the target area again	One seeding flight was flown during the evening around

Tuesday	today, sparking showers and thunderstorms. These storms dropped hail to the size of golf balls around San Antonio. These storms weakened and pushed away after sunset.	Medina and Bexar Counties. Engine On – 2353Z Engine Off – 0116Z Time – 1 hour 23 minutes Flares – 1 Ejectable
29 Mar 2000, Wednesday	Another calm day behind the dry line with mostly sunny skies and windy north winds.	No seeding activities from Hondo.
30 Mar 2000, Thursday	Another calm day in advance of a strong upper level system cutting off in the desert southwest.	No seeding activities from Hondo.
31 Mar 2000, Friday	Clouds began to thicken today in advance of the upper level low. Also, moisture started to retur northward off the gulf.	No seeding activities from Hondo.
1 April 2000, Saturday	Showers and thunderstorms expected during the day kept out of the target area, pushing to the north. Overnight, showers and thunderstorms developed off the Mexico mountains and pushed into the target area. All of these storms were severe, thus were unseedable.	No seeding activities from Hondo.
2 April 2000, Sunday	Southwesterly flow off the Pacific combined with low-level moisture from the Gulf of Mexico sparked numerous severe thunderstorms during the entire day. All storms were severe, thus precluding any seeding activity.	One seeding flight was flown during the early morning hours around Zavala and Uvalde Counties. Seed 1 (N340FR) – top seed Engine On – 1340Z Engine Off – 1645Z Time – 3 hours 5 minutes Seeding – Ejectable Flares – 1 (Uvalde)
3 April 2000, Monday	A quiet and stable air mass behind yesterday's cold front kept skies sunny and cool.	No seeding activities from Hondo.
4 April 2000, Tuesday	Another mostly sunny day under strong high pressure. High temperatures were in the upper 70s.	No seeding activities from Hondo.
5 April 2000, Wednesday	With high pressure moving to the east, winds started to turn out of the south. This brought th gradual return of Gulf moisture and warmer temperatures during the day.	No seeding activities from Hondo.
6 April 2000, Thursday	Another day of southerly winds brought deeper Gulf moisture. High temperatures today were in the middle to upper 80s.	No seeding activities from Hondo.
7 April 2000, Friday	A cold front drove across the target area during the evening and early overnight hours. One thunderstorm quickly developed and became severe in Burnet County, but dissipated just as quickly after sunset. As the front crossed the area, winds shifted from the south to the north and gusted to over 30 miles per hour, announcing the arrival of much colder air in the hill country and South Central Texas.	No seeding activities from Hondo.
8 April 2000, Saturday	A breezy and much cooler day for the area as high pressure settled in behind the cold front. Highs today were around 70.	No seeding activities from Hondo.
9 April 2000, Sunday	Mostly clear conditions with high pressure in control for one more day.	No seeding activities from Hondo.
10 April 2000, Monday	Moisture return off the Gulf of Mexico combined with warmer temperatures to create enough lift to spark areas of showers. But with upper level high pressure still in the area, no convection was able to build higher than 12 thousand feet, thus not reaching below freezing temperatures.	No seeding activities from Hondo.
11April 2000, Tuesday	Another day of moisture from the southeast along with heating sparked showers and thunderstorms. Unlike the previous day's activity, high pressure had moved to the east, allowing precipitation to make it t seedable levels and temperatures.	One seeding flight was flown by Seed 1 during the afternoon and evening hours in Kendall, Kerr, and Comal Counties. Seed 1 (N340FR) – top seed Engine On – 1930Z Engine Off – 2345Z Time – 4 hours 15 minutes

		Flares – Ejectables – 24 (Kendall – 14, Comal – 7, Kerr – 3) Acetone burners Right – 12 minutes Left – 12 minutes
12 April 2000, Wednesday	A dryline drove through the target area during the overnight hours, sparking severe thunderstorms. These storms pushed out before sunrise. During the afternoon, the trailing col front pushed through. With most moisture being pushed out by the dryline, activity was a lot weaker. All activity that developed was very icy and low in liquid moisture. This activity pushed out during the evening.	2 recon flights were flown today, one during the morning and one during the evening hours. Seed 2 (N340AX) – top recon Engine On – 1330Z Engine Off – 1516Z Time – 1 hour 46 minutes Seed 1 (N340FR) – top recon Engine On – 2103Z Engine Off – 2339Z Time – 2 hours 36 minutes
13 April 2000, Thursday	Drier and more stable air behind the dryline/cold front kept skies mostly sunny and mild.	No seeding activities from Hondo.
14 April 2000, Friday	Another humid day of mostly sunny skies and warm temperatures in advance of another dryline expected Saturday.	No seeding activities from Hondo.
15 April 2000, Saturday	The dryline expected to push through during th day today never made it, keeping skies mostly clear and the area under humid conditions.	No seeding activities from Hondo.
16 April 2000, Sunday	Hot and humid flow off the Gulf made for miserable day without a cloud in the sky.	No seeding activities from Hondo.
17 April 2000, Monday	Another hot and humid day with high temperatures in the 90s.	No seeding activities from Hondo.
18 April 2000, Tuesday	The streak of hot and humid days continued with more 90 degree weather.	No seeding activities from Hondo.
19 April 2000, Wednesday	A dryline set up in the Panhandle but did not threaten the target area until after midnight. Overnight, showers and thunderstorms developed along an advancing dryline through the target area. These storms pushed through by noon Thursday.	One recon flight was flown during the overnight hours by Seed 2 around Uvalde, Medina,' Guadalupe, and Caldwell Counties. Seed 2 (N340AX) – top recon Engine on – 0850Z Engine Off – 1130Z Time – 2 hours 40 minutes
20 April 2000, Thursday	Skies were mostly sunny and the atmosphere was very dry behind the dryline.	No seeding activities from Hondo.
21 April 2000, Friday	Dry air behind the dryline stabilized th atmosphere, resulting in a clear and warm day across South Texas.	No seeding activities from Hondo.
22 April 2000, Saturday	A dryline set up again in the Panhandle during the day and slowly pushed through the target area. Ahead of the dryline, showers and thunderstorms developed associated with a minor shortwave. These showers pushed out during the late evening. The dryline did not exit the target area until Sunday.	One seeding flight was flown during the evening hours in Kerr County. Seed 1 (N340FR) – top seed Engine On – 2334Z Engine Off – 0216Z Time – 2 hours 42 minutes Flares – 4 Ejectable Kerr)
23 April 2000, Sunday	Drier and more stable air pushed in behind yesterday's dryline, clearing skies an temperatures rising into the upper 90s, even 100 in Hondo.	No seeding activities from Hondo.
24 April 2000, Monday	Slow moisture return from the gulf began today, but skies remained clear under upper level hig pressure. Temperatures were only in the mid 90s.	No seeding activities from Hondo.
25 April 2000, Tuesday	Another day of mostly clear skies and hot temperatures across South Texas.	No seeding activities from Hondo.
26 April 2000, Wednesday	A dryline building in the Texas Panhandle faile to push into the target area during the evening. Several thundershowers developed off the Mexican Rockies, but quickly lost strength as they crossed into the U.S.	No seeding activities from Hondo.
27 April 2000,	The dryline made another attempt to push int	No seeding activities from Hondo.

Thursday	the target area, but once again stalled befor reaching the area.	
28 April 2000, Friday	Several showers developed on the mountains in Eastern Mexico, but quickly dissipated as they moved eastward.	No seeding activities from Hondo.
29 April 2000, Saturday	Another day of late afternoon showers developing off the Mexican Rockies moved along the Rio Grande, but didn't cross into the U.S.	No seeding activities from Hondo.
30 April 2000, Sunday	An upper level low pressure system that stalled over the Texas Panhandle sparked showers and thunderstorms across Texas today, but no showers developed into the target area until after dark.	No seeding activities from Hondo.
1 May 2000, Monday	During the night, a severe squall line race through the target area, dropping over an inch of welcome rain over most of South Central Texas. This line exited the area before sunrise, but residual showers behind the line remained for most of the morning. Most of the residual showers were of the stratus variety, limiting seeding options, but conditions improved as more solar heating took effect. These showers pushed out of the area during the early afternoon. More showers developed again afte sunset when another minor disturbance rotated through the area.	Two seeding flight were flown during the morning hours, one by each aircraft, in Kerr, Uvalde, Bandera, Kendall, Gillespie, an Blanco Counties. Flight 1: Seed 2 (N340AX) – top seed and base seed Engine On – 1400Z Engine Off – 1703Z Time – 3 hours 3 minutes Flares – 1 ejectable, 12 minutes acetone (6 minutes left and right burner) Flight 2: Seed 1 (N340FR) – base seed Engine On – 1637Z Engine Off – 1837Z Time – 2 hours Flares – Acetone burners: 1 hour 19 minutes (1:18 right side, 0:01 left side)
2 May 2000, Tuesday	More showers present at sunrise today were associated with the upper level low stalled over the Red River. Like yesterday's showers, today's activity was of th stratus variety. Occasional convective targets were available as the morning progressed. These showers moved out of the area around noon. During the afternoon, isolated showers developed along an outflow boundary left over from the morning's convection. This shower moved ESE into the target area, dissipating after sunset.	Two seeding flight were flown, one by Seed 2 during th morning in Bexar and Atascosa Counties, and during the late afternoon by Seed 1 i Kimble and Kerr Counties. Flight 1: Seed 2 (N340AX) – top seed Engine On – 1250Z Engine Off – 1735Z Time – 4 hours 45 minutes Flares – 11 ejectable flares Flight 2: Seed 1 (N340FR) – top seed Engine On – 2237Z Engine Off – 0053Z Time – 2 hours 16 minutes Flares – 21 ejectable flares, 2 minutes acetone burners (1 minute each side)
3 May 2000, Wednesday	A lull in activity from the upper low today brought about a partly cloudy and humid day with highs in the upper 80s.	No seeding activities from Hondo.
4 May 2000, Thursday	Another disturbance rotated around the upper level low now centered in northeast Texas. This sparked severe thunderstorms, starting around the Waco area and backbuilt southwestward down I-35, building into San Antonio around 10 PM. This thunderstorm dropped hail the size of golfballs over northeastern portions of the target area. This storm finally dissipated around midnight.	No seeding activities from Hondo. No cloud seeding flights are permitted during severe weather events.
5 May 2000, Friday	A repeat of yesterday's thunderstorm activity was expected to build into the northeastern target area again today, but outflow from the original thunderstorms could not overcome strong capping inversion.	No seeding activities from Hondo.
6 May2000,	The upper level low started pulling away from	No seeding activities from Hondo.

Saturday	the target area today into central Kansas, leaving skies partly to mostly sunny and warm. High temperatures were in the upper 80s with dewpoint in the middle 60s.	
7 May 2000, Sunday	Subsident motion under an upper level ridge kept skies clear and temperatures warm with highs in the low 90s. That combined with dewpoints in the low 70s led to a very muggy day.	No seeding activities from Hondo.
8 May 2000, Monday	Another day under strong high pressure kept skies clear and the air muggy.	No seeding activities from Hondo.
9 May 2000, Tuesday	An upper level trough pushed through the area late this afternoon. Isolated showers developed during the evening in the extreme northeastern target area, but did not hold together for more than 20 minutes.	No seeding activities from Hondo.
10 May 2000, Wednesday	Upper level high pressure restrengthened over Texas, keeping skies clear and temperatures in the 90s.	No seeding activities from Hondo.
11 May 2000, Thursday	High pressure remains in control of the area's weather today with clear skies and hot temperatures.	No seeding activities from Hondo.
12 May 2000, Friday	A strong cold front pushed through Texas today, sparking a line of severe thunderstorms i central Texas. This line pushed into the target area during the late night hours, dropping copious amounts of rainfall for all of South Texas. This line quickly pushed out of the target area into Deep South Texas later overnight.	No seeding activities from Hondo. Cloud seeding not permitted during severe weather.
13 May 2000, Saturday	Stable and less humid air behind yesterday's front led to a mostly sunny day with highs only in the upper 70s.	No seeding activities from Hondo.
14 May 2000, Sunday	A minor upper air disturbance resulted in cloudy skies during the day, but without any significant lifting in the atmosphere, no convection was able to develop.	No seeding activities from Hondo.
15 May 2000, Monday	Strong high pressure built over the central U.S. today, keeping skies clear. Lower level moisture off the Gulf of Mexico led to a hot and muggy day.	No seeding activities from Hondo.
16 May 2000, Tuesday	Another day dominated by strong upper level high pressure.	No seeding activities from Hondo.
17 May 2000, Wednesday	High pressure stayed in control of South Texas today as the high started drifting eastward.	No seeding activities from Hondo.
18 May 2000, Thursday	A strong cold front pushing in from the northwest progressed as far as a Dallas to Midland line today before stalling. Skies around the target area remained clear.	No seeding activities from Hondo.
19 May 2000, Friday	A secondary cold front helped push the first cold front from yesterday into the target area today. During the afternoon, thunderstorms pushed into the northwestern target area, while a minor boundary pushed into the southeast corner. These two boundaries combined over the target area, dropping rainfall amounts in excess of four inches in localized areas. Storms became severe as the evening progressed, thus ending any seeding operations for the day. The main cold front exited the target area overnight.	Two seeding flights were flown during the afternoon, one by Seed 1 i Bexar and Medina Counties, and one b Seed 2 i Kerr, Bandera, Uvalde, and Medina Counties. Seed 2 (N340AX) – top seed Engine On – 2015Z Engine Off – 2340Z Time – 3 hours 25 minutes Flares – 24 ejectables, 2 minutes acetone (1 minut right side , 1 minute left side) Seed 1 (N340FR) – top seed Engine On – 2046Z Engine Off – 0025Z Time – 3 hours 39 minutes Flares – 63 ejectables, 1 dud, 2 minutes acetone (minute right side, 1 minute left side)
20 May 2000, Saturday	Moisture trapped at mid levels from yesterday's storms kept skies cloudy for most of the day. This kept temperatures below normal in the middle 70's. The cooler temperatures combine	No seeding activities from Hondo.

	with a more stable atmosphere behind the front kept any convection from forming.	
21 May 2000, Sunday	High pressure building in from the west kept skies clear and temperatures high.	No seeding activities from Hondo.
22 May 2000, Monday	Another day dominated by an upper level high pressure system. Muggy gulf moisture led to hot and humid conditions across the area.	No seeding activities from Hondo.
23 May 2000, Tuesday	More hot and humid conditions under slo moving high pressure with highs in the low to middle 90s.	No seeding activities from Hondo.
24 May 2000, Wednesday	Upper level high pressure was the strongest today, leading to high temperatures in the middl to upper 90s, with areas to the south and west of the area reaching well over 100 degrees.	No seeding activities from Hondo.
25 May 2000, Thursday	The high pressure area is being pushed toward the east by an upper level trough from the northwest. Conditions today were still hot and muggy with highs only in the low 90s.	No seeding activities from Hondo.
26 May 2000, Friday	An upper level shortwave, combined with lo and mid level moisture sparked showers and thunderstorms across the area today. Most showers today had little liquid water at preferred seeding levels, but seedable candidates were available. This shortwave moved toward the northeast during the night. Seeding was suspended as heating subsided around sunset.	One seeding flight was flown by Seed 1 during the evening hours in Real, Bandera, and Kerr Counties. Seed 1 (N340FR) – top seed Engine On – 2120Z Engine Off – 2357Z Time – 2 hours 37 minutes Flares – 17 ejectables
27 May 2000, Saturday	Severe thunderstorms developed along a "cold" front in north central Texas during the afternoon. This line pushed through the target area during the night, dropping up to an inch of rainfall.	No seeding activities from Hondo. Seeding not permitted during severe weather.
28 May 2000, Sunday	High pressure began to build into the area, keeping skies mostly clear, and temperatures around 90 degrees.	No seeding activities from Hondo.
29 May 2000, Monday	Another day dominated by strong high pressure kept skies clear and temperatures warm.	No seeding activities from Hondo.
30 May 2000, Tuesday	Another hot and humid day with moisture flo from the Gulf of Mexico. Temperatures were in the middle 90s.	No seeding activities from Hondo.
31 May 2000, Wednesday	One more day under dominant high pressure kept skies clear.	No seeding activities from Hondo.
1 June 2000, Thursday	High pressure started to drift toward the east today. This allowed showers to develop alon the Rio Grande Valley, but these showers did not build into the target area.	No seeding activities from Hondo.
2 June 2000, Friday	A trough of low pressure pushed through th target area during the afternoon, sparkin showers and thunderstorms. Seedable targets were few and far between, but when they developed, seeding aircraft were available.	Seed 1 flew two seeding flights during the afternoon and evening. Flight 1 was flown in Guadalupe, Comal, and Hays Counties, while Flight 2 was flown in Medina and Bandera Counties. Seed 1 (N340FR): Flight 1 – top seed Engine On – 1843Z Engine Off – 2220Z Time – 3 hours 37 minutes Flares – 19 ejectables Flight 2 – top seed Engine On – 2245Z Engine Off – 0145Z Time – 3 hours Flares – 9 ejectables
3 June 2000, Saturday	A minor shortwave rotated around the main upper level low, which was centered in th Texas panhandle. This shortwave sparked showers, which moved across the target area during the day, dropping up t a inch of rain. This shortwave pushed out of the target area during the late evening.	Seed 1 flew one seeding flight during the afternoon and evening hours in Uvalde, Real, Medina, Bandera, Kerr, and Kendall Counties. Seed 1(N340FR) – top seed Engine On – 1727Z Engine Off – 2110Z Time – 3 hours 43 minutes

		Flares – 49 ejectable
4 June 2000, Sunday	A weak cold front pushed through the target area during the afternoon, sparking showers and thunderstorms. This line quickly exited South Central Texas during the early evening hours.	Seed 1 flew one seeding flight during the afternoon in Kerr, Bandera, Uvalde, an Medina Counties. Seed 1 (N340AX) – top seed Engine On – 1740Z Engine Off – 2140Z Time – 4 hours Flares – 53 ejectables
5 June 2000, Monday	Occasional showers popped up during the early morning hours, but were unseedable since the top of the showers did not reach above the freezing level. These showers quickly dissipated later in the morning. The rest of the day was mostly sunny and warm.	No seeding activities from Hondo.
6 June 2000, Tuesday	A quiet day with much drier air kept South Central Texas skies sunny. Temperatures in the low 80s and dewpoints in the 50s led to a beautiful late spring day.	No seeding activities from Hondo.
7 June 2000, Wednesday	Another dry day under dominant high pressure kept skies mostly sunny.	No seeding activities from Hondo.
8 June 2000, Thursday	Low level moisture started to return as the high pressure area started to drift to the east. This along with an active seabreeze boundary led to scattered showers, mainly in the eastern half of the target area. These showers dissipated after sunset.	Seed 1 flew one seeding flight during the afternoon in Caldwell, Hays, Blanco, Kendall, and Bexar Counties. Seed 1 (N340AX) – top seed Engine On – 1915Z Engine Off – 2302Z Time – 3 hours 47 minutes Flares – 27 ejectables, 2 minutes acetone (1 minute left, 1 minute right)
9 June 2000, Friday	Moisture throughout the atmosphere, partially caused by the remnants of Tropical Depression One, sparked showers and thunderstorms across the area today. During the morning, showers were confined to the eastern target area. These showers worked their way westward early afternoon, covering most of the target area with beneficial rainfall. Later afternoon saw flash flood warnings as rainfall amounts of 3 to 5 inches were reported. All showers slowly dissipated after sunset.	Seed 1 flew two seeding flight during the day. One flight in Comal, Kendall, Blanco, and Gillespie Counties, while the other flight was in Uvalde County. Seed 1 (N340AX): Flight 1 – top seed Engine On – 1310Z Engine Off – 1620Z Time – 3 hours 10 minutes Flares – 16 ejectable Flight 2 – base seed Engine On – 1955Z Engine Off – 2254Z Time – 2 hours 59 minutes Flares – acetone burners – 2 hours 17 minutes Left burner – 2 hours Right burner – 17 minutes
10 June 2000, Saturday	Another day with copious atmospheric moisture and no capping inversion. Showers and thunderstorms developed across Texas during the morning, adding to yesterday's rainfall amounts. Seeding today was limited to areas that received little rainfall yesterday. Rain continued until the loss of daytime heating after sunset. More reports of 2 to 4 inches of rainfall were received again today.	Seed 2 flew one flight during the early afternoon in Medina County. Seed 2 (N340FR) – top seed Engine On – 1812Z Engine Off – 2034Z Time – 2 hours 22 minutes Flares – 37 ejectables
11 June 2000, Sunday	More moisture from the remnants of Tropical Depression One sparked showers and thunderstorms today across the region, adding to the copious amounts of precipitation that have fallen in the last 3 days. These showers weakened after sunset.	No seeding activities from Hondo. Flash flooding potential was too high to attempt seeding.
12 June 2000, Monday	Today was another day with rainfall from the tropical depression, although moisture was starting to disperse. Showers were weaker and farther between. These showers weakened after peak heating.	Seed 1 flew one flight during the afternoon in Bexar, Kendall, Comal, Kerr, Bandera, and Medina Counties. Seed 1 (N340FR) – top seed Engine On – 1733Z Engine Off – 2125Z

		Time – 3 hours 52 minutes Flares – 17 ejectables, 2 minutes acetone (1 minute right burner, 1 minute left burner)
13 June 2000, Tuesday	Mid-level warm air capped off the atmosphere, keeping widespread convection from forming as in the last couple days. A couple showers developed on a seabreeze boundary, but were short-lived and not conducive to seeding. These quickly dissipated at sunset.	No seeding activities from Hondo.
14 June 2000, Wednesday	A strong cap kept convection from forming again today. Winds off the Gulf of Mexico subsided, keeping th seabreeze front from forming.	No seeding activities from Hondo.
15 June 2000, Thursday	The seabreeze was able to form again today, but showers that formed on it were short lived and the tops of the showers were above freezing.	No seeding activities from Hondo.
16 June 2000, Friday	No atmospheric forcing around the target area kept skies mostly clear.	No seeding activities from Hondo.
17 June 2000, Saturday	Moisture from the remnants of the Tropical Storm Bud in the SE Pacific pushed over the target area, weakening the cap and allowing convection to fire during the afternoon. Most of today's activity was concentrated on an outflo boundary from storms that had built up around the Waco area. These showers dissipated afte sunset.	Two seeding flight were flown today, one by Seed 2 during the afternoon in Guadalupe, Comal, Bexar, and Wilson Counties, and one by Seed 1 during the evening in Medina County. Seed 2 (N340AX) – top seed Engine On – 2050Z Engine Off – 0030Z Time – 3 hours 40 minutes Flares – 62 ejectables Seed 1 (N340FR) – top seed Engine On – 0023Z Engine Off – 0214Z Time – 1 hours 51 minutes Flares – 2 ejectables, 2 minutes acetone (1 minute right burner, 1 minute left burner)
18 June 2000, Sunday	Showers and thunderstorms developed again today along multiple outflow boundaries from thunderstorms along a cold front in North Texas. These showers dropped copious amounts of rai across the area. The showers dissipated around sunset.	Two seeding flight were flown during the day, one by Seed 1 i Kerr an Uvalde Counties, and one by Seed 2 in Medina, Bandera, Kendall, Kerr, Blanco, Comal, and Hays Counties. Seed 1 (N340FR) – top seed Engine On – 1423Z Engine Off – 1812Z Time – 3 hours 49 minutes Flares – 11 ejectables Seed 1 (N340AX) – top seed Engine On – 2140Z Engine Off – 0105Z Time – 3 hours 25 minutes Flares – 40 ejectables
19 June 2000, Monday	Only an isolated thundershower briefly developed along a seabreeze front during th late afternoon, but this shower quickly dissipated. The atmosphere was humid enough for showers today, but without any organized trigger other than th seabreeze, no convection was able to fire.	No seeding activities from Hondo.
20 June 2000, Tuesday	An outflow boundary from thunderstorms in the San Angelo area swept through the target area during the morning and early afternoon. This boundary was unable to spark any showers. The rest of the day was mostly sunny and seasonable.	No seeding activities from Hondo.
21 June 2000, Wednesday	Upper level high pressure began to strengthen from the east today, keeping convection from firing.	No seeding activities from Hondo.
22 June 2000, Thursday	Strong high pressure dominated the weather of South Central Texas today, keeping skies mostly clear and temperatures in the lower 90s.	No seeding activities from Hondo.

23 June 2000, Friday	Another day under strong high pressure led to another normal early summer afternoon with highs in the 90s.	No seeding activities from Hondo.
24 June 2000, Saturday	A minor area of weakness in the upper level hig pressure allowed some mid level cloudiness t move in from the west today, but this weakness was unsuccessful in firing any convection.	No seeding activities from Hondo.
25 June 2000, Sunday	Strong summer high pressure kept skies sunny with high temperatures in the middle 90s.	No seeding activities from Hondo.
26 June 2000, Monday	Today was another mostly sunny day under strong upper level high pressure.	No seeding activities from Hondo.
27 June 2000, Tuesday	The seabreeze front set up today off the Gulf of Mexico, but winds across the target area were strong enough to disrupt it. This kept showers from moving into the area.	No seeding activities from Hondo.
28 June 2000, Wednesday	Today was another quiet day under the influenc of strong upper level high pressure.	No seeding activities from Hondo.
29 June 2000, Thursday	Weakness in the area's dominant high pressure moved into central Texas today. This allowed the front that was stalled along the Red River t push farther south. Unfortunately, it was only able to push as far south as the Temple/Killee area before the high pressure restrengthened over the area overnight.	No seeding activities from Hondo.
30 June 2000, Friday	Today continued the trend of mostly sunny days underneath the influence of summertime hig pressure.	No seeding activities from Hondo.
1 July 2000, Saturday	Another day of sun under high pressure today with temperatures in the middle 90s.	No seeding activities from Hondo.
2 July 2000, Sunday	Strong summer high pressure kept skies sunny with high temperatures in the middle 90s.	No seeding activities from Hondo.
3 July 2000, Monday	Today was another mostly sunny day under strong upper level high pressure.	No seeding activities from Hondo.
4 July 2000, Tuesday	The strong summer high pressure is in full effect across the U.S. centered over easter Oklahoma, keeping skies across the area clear with temperatures in the middle to upper 90s.	No seeding activities from Hondo.
5 July 2000, Wednesday	Today was another quiet day under the influenc of the strong upper level high pressure.	No seeding activities from Hondo.
6 July 2000, Thursday	Still hot and sunny under high pressure.	No seeding activities from Hondo.
7 July 2000, Friday	A little less of an onshore breeze allowed a couple minor seabreeze showers to develop along the Gulf Coast, but these showers did not approach the target area.	No seeding activities from Hondo.
8 July 2000, Saturday	Another day of sun under high pressure today with temperatures in the middle 90s.	No seeding activities from Hondo.
9 July 2000, Sunday	Light winds allowed the sea breeze front t become active along the coast today, but this boundary was unable to reach the target area before sundown.	No seeding activities from Hondo.
10 July 2000, Monday	High temp in Hondo: 100 Strong high pressure continues to hold convection in check across South Central Texas. The sea breeze boundary reached the target area, but without any convective activity.	No seeding activities from Hondo.
11 July 2000, Tuesday	High temp in Hondo: 101 High pressure continues to heat all of Texas, with most of the area reaching triple digits.	No seeding activities from Hondo.
12 July 2000, Wednesday	High temp in Hondo: 102 Another day of hot and dry weather across the target area.	No seeding activities from Hondo.
13 July 2000, Thursday	High temp in Hondo: 103 Still hot, and getting hotter.	No seeding activities from Hondo.

14 July 2000, Friday	High temp in Hondo: 104 A cold front across the Red River valley was able to push into central Texas this afternoon. Outflow boundaries that pushed into the northern target area combined with the extremely high temperatures to erode the cap to spark showers and thunderstorms. Rainfall reports of ½ to ¾ inches were common in Kerr County.	One seeding flight was flown during the afternoon in Kerr, Bandera, and Real Counties. Seed 1 launched at 2259Z to seed on showers pushin into NW Kerr County along an outflow boundary. On ascent, the 0 degree level was observed at 16 kft. The first seeding was done at 2341Z in Kerr County, where 700 foot per minute (fpm) updrafts and good supercooled liquid water was found. Seeding continued along the outflow boundary across Kerr, Bandera, and Eastern Real Counties with updrafts between 300 and 700 fpm found in turrets. At around 0030Z, conditions quickly changed to downdrafts of 400 to 700 fpm as towers quickly started to collapse as peak heating waned. Seed 1 RTB at 0048Z. Seed 1 (N340FR) – top seed Engine On – 2259Z Engine Off – 0115Z Time – 2 hours 16 minutes Flares – 17 ejectables, 2 minutes acetone (1 minut right burner, 1 minute left burner)
15 July 2000, Saturday	High temp in Hondo: 105 Yesterday's front quickly retreated back to the north, leaving another extremely hot day with highs between 100-108.	No seeding activities from Hondo.
16 July 2000, Sunday	Hot and dry conditions led to temperatures in th low 100's across the area.	No seeding activities from Hondo.
17 July 2000, Monday	High pressure firmly planted overhead led to another hot and dry day with highs in the tripl digits.	No seeding activities from Hondo.
18 July 2000, Tuesday	Strong high pressure still in the area kept temperatures high.	No seeding activities from Hondo.
19 July 2000, Wednesday	High pressure started to drift westward into the Texas Panhandle. This did not affect th temperatures across South Central Texas.	No seeding activities from Hondo.
20 July 2000, Thursday	High pressure continues to drift into Ne Mexico. This allowed a cold front to drift into northern Texas. An outflow boundary pushed through the eastern half of the target area during the morning, but did not spark any showers.	No seeding activities from Hondo.
21 July 2000, Friday	The front remains stationary across northern Texas, dropping outflow boundaries. But these outflow boundaries didn't spark any showers. Temperatures remained high in the upper 90s and lower 100s.	No seeding activities from Hondo.
22 July 2000, Saturday	A stronger push of northerly winds started forcing the front slowly southward. This front pushed as far south as Waco during the day, then stalled again. High temperatures were again around the century mark.	No seeding activities from Hondo.
23 July 2000, Sunday	A storm system moved from the north through the target area. This was associated with a cold front extending from Texas to the eastern Carolinas.	Seeding Operations were conducted on this date, however, specifics must await return of Jason Straub.
24 July 2000, Monday	The col front which brought the storm system of yester had moved south out of any influence of the target area. The axis of the upper ridge was centered over the over the Four Corners area. There was some afternoon convection, but it was sparse.	No seeding operations were conducted today J.A. Heimbach on site to fill in for Jason Straub while on vacation.
25 July 2000, Tuesday	The strong upper highridge remained centered over the Four Corners area. Over the eastern U.S. was a trough, which was loosing some of its broad coverage. The east-west portions of the ridge produced north-northwesterly flow, bringing in cool-air advection over the target area. This destabilizing was somewhat offset by the	Seed 2 (N340FR) was launched (engines on) at 2332z for cloud top seeding of a system moving into the northern buffer area; Gillespie County. Seed penetrated the W – S Em periphery finding some liquid water and vertical motion as it seeded imbedded convection. The storm slowly decreased in area as it moved south-southwest. At 0056z, Seed 2 descended

	dryness of the air mass, requiring convective temperatures at the forecast maximum temperatures. There was a stationary front extending from Austin eastward which could have been a focus for thundershowers; however, this was not the case. Convection appeared on th Hondo radar at approx. 2215, north of the target area as th maximum temperatures were being reached. The storm grew and moved/propagated generally to the south.	to cloud base, cancelled IFR and did some cloud-bas seeding, primarily i Kerr County. This was done until 0120z, then the aircraft returned to base. Engines were off at 0142z Seed 2: N340FR Rain Flight time: 2.11 hr Flairs: 11 EJ Generators: Rt* burner: 0.25 h *Note: Airlink indicated Lt. burner.
26 July 2000, Wednesday	The upper high dominated the southwest and was centered over the Four Corner areas. Th upper trough which covered a large area the past week had diminished in magnitude, but still controlled the weather along the Mississippi and east. A stationary front was located over central Texas, and continued to the New Orleans area and east. This front did not contribute muc more than serve as a focal point for air mass convection. The air mass over the target area was very dry and somewhat more stable than the previous day. Some stratocumulus formed in the afternoon, but n seedable convection formed.	No flight operations were conducted today. B. Baden and a FOX News team visited the site.
27 July 2000, Thursday	The upper ridge held over the southwest, and there was some appearance of an omega shape to the upper pattern over CONUS. For the target area, this provided a capping subsidence inversion at approx. 750 mb. The convective temperature of 35C was reached, however, 40C was needed to break this cap. No fronts or troughs were evident in TX to help focus convection. Later in the afternoon some convection occurred near the Texas coast in response to sea breeze convergence. This was evident on the radar and quickly dissipate before moving further inland to the target area. In the AM Oklahoma and northern Texas had TSRA triggered by vertical motion at the 70 mb level. This did not influence the target area,	No flight operations were conducted on this date.
28 July 2000, Friday	Although the upper high/ridge continued t dominate the southwest, it slowly retrograded, and the upper trough over the Mississippi Valley began to build south-southwest to the Gulf. Though not bringing convection to the target area, this pattern indicated a changing pattern, and a cold front over the central plains moved southward bringing showery weather into northern Texas. Over the target area, there was only fair weather cumulus, light southerly winds and no significant echoes.	No flight operations were conducted on this date
29 July 2000, Saturday	The upper ridge continued its slow retrogression west of the Four Corners area. The upper trough over eastern CONUS moved through th Mississippi Valley down to south Texas. During the AM, a vorticity maximum traveled across Oklahoma and Missouri. The surface reflection of this was a cold front which slowly sagged southward into Texas. This was readily apparent on the Satellite VIS imagery. The air mass over the target area was dry, limiting the occurrence of storm formation; however, the focusing of the frontal boundary permitted a line of convection to form with morning heating north of the target area. Cells within this line moved	Seed 1 was launched for a recon. Flight at 0015z (engines on) to northwest Kerr Co., with the possibility of conversion to cloud-base seeding. Cloud-bas treatment was specified for expedience. Shortly after takeoff, the radar imagery indicated rapid dissipation, and seed 1 was called back. Engines off was at 0045zz. Seed 1 : N340FR Reconnaissance Flight time: 0.5 hr

	southward. The movement was slow and did not reach the target area until approx. 2230z. By dusk, the line was well on its way to dissipating.	
30 July 2000, Sunday	The upper high/ridge became a large closed high over several days whose center ha retrograded to the Nevada/Utah border. The trough over the Mississippi Valley dominated the eastern CONUS and there were indications of it closing over Missouri. The northerly winds over Texas provided some cooling from the unseasonably hot temperatures. A quasistationary front which arrived as a cold front yesterday provided showers over sout Texas this morning. The line of activity dissipated in the early morning, then the front acted as a focal point for development in a unstable air mass. Several complexes developed around 1600z. These grew and propagated, and finally several merged to form into a line which passed over the Hondo area at approximately 2100z. About this time the line was dissipating. The N, NE and E, ne complexes were developing at the same time. New development continued to form in a general N-S orientation. A second flight was required of both aircraft, with new complexes developing over the eastern half of the target. These systems propagated further to the east and by 0000z were no longer influencing the target. Preliminary reports show the San Antonio area received approximately 1/3 in from the storm which was welcomed with the water restrictions currently in place.	Seed 1 was launched (engines on) at 1751z for cloud-top treatment on a line which initially popped up NW of the radar in Kerr County. The original comple dissipated while reforming to the west of Real County. The eastern portions were seeded, then vigorous ne development occurred to the east in Bandera County. Multiple zones of new development were seeded in Kerr and Bandera counties. By 1945, the two complexes being treated merged int a N-S line, of which Seed 1 worked the northern half in central Bandera County and Kerr County. This complex was the last remainin complex of what was formally a strong N-S line. Seed RTB's to refuel at 2111zand engines were off at 2144z. Seed 2 was launched at 1822z for cloud-base treatment of a line which formed south of the complex being worked by Seed 1. Positioning was difficult due to the GPS tracking being in error on the Airlink (Fixed by flight 2). As a result, Seed 2 initially seeded the base of th system being treated by Seed 1. The left burner started the first of two burns at 1855z. Seed 2 then moved toward the complex which was WNW of the radar i Uvalde and Medina counties. Updraft estimates of up to 600 fpm were encountered. At approx. 2030, Seed reported a weakening of the southern portions of the line. Seed 2 was told to RTB to be sure to land prior to the storm reaching Hondo, and to repair th Airlink system. Engines were off at 2050z. After refueling, Seed 2 was launched for a second flight at 2147z for cloud-base seeding of an active system in the San Antonio area. By the time Seed 2 got to th San Antonio area, the initial development was diminishing and an area of new development was evident to the east. This was treated as it moved out of the target, then buffer area of Wilson County. By 000z, there was no seedable activity in the southern half of the target. Seed 2 RTB'd with engines off at 2355z. Seed 1 launched for a second flight to a line moving int the northern buffer areas. Engines on time was at 2246z. Seed 1 went to Blanco, eastern Llano and western Burnet counties to cloud-base seed the remnants of a line. To the east outside the target area a new complex developed, which propagated to the southwest and Seed 1 went to a point southwest of this system. Finding nothing worthwhile, Seed 1 left the area at 2340z, and engines off time was 0018z. Seed 1 (N340FR): Flight 1 – top seed Engine On – 1751Z Engine Off – 2144Z Time – 3 hours 53 minutes Flares – 69 ejectables Flight 2 – base seed Engine On – 2246Z Engine Off – 0018Z Time – 1 hour 32 minutes Flares – acetone burners – 13 minutes (right burner: 12 minutes, left burner 1 minute) Seed 2 (N340AX): Flight 1 – base seed

		Engine On – 1822Z Engine Off – 2050Z Time – 2 hours 28 minutes Flares – acetone burners – 1 hour 29 minutes (all left side) Flight 2 – base seed Engine On – 2147Z Engine Off – 2355Z Time – 2 hours 8 minutes Flares – acetone burner – 48 minutes (all right side)
31 July 2000, Monday	The upper high/ridge remained firmly established over western CONUS, centered over th Nevada/Utah border. The upper trough had closed off and the axis of the trough extended into southern Texas. On the surface there was a WSW – ENE trough just to the north of the target area. In the early AM, mid level overcast conditions remained from the previous convective activity which slowly dissipated. The air mass was moist with advection from the Gulf and remained somewhat unstable due to cool air advection aloft. Shortly after the noon CDT hour, convection started and shortly thereafter several complexes were observed over the northern half of the target. By 180 a SW – NE line and a W – E line to the north were formed. The W – E line moved to southward and by 1930z had dominated the activity. In general Seed 2 worked the northern areas and Seed the southern complexes. Numerous additional complexes formed and moved generally southward while propagating southwestward. By 2200, the cirrus shield and late hour reduced surface heating enough to eliminate most of th active areas. For those looking after case studies, the cloud-base seeding by Seed 1 circa 1800 – 1845z may have some potential.	Seed 1 was launched at 1740zz (engines on) for could-top treatment of a complex NE of th Hondo radar in Kendall County. Movement of the line was eastward and propagation was to the southwest. Unfortunately al traffic in the SAT area precluded filing for clout top. Therefore, cloud-base treatment was done. Seed 1 worked the northern edge of the line then turned to the west to work the south end of a W – E line i Kerr, Kendal and Blanco counties. This general area was repeatedly traversed until 1950 when the original SW – NE line had dissipated and was raining out. Seed 1 then shifted westward to a weakening complex in Bandera County which was part of the W – E line moving southward. AT 2000 Seed 1saw vigorous ne growth in the Hondo area which could not be observed by the radar. Multiple cloud-base passes were made on this system. Hondo had TSRA at about this time. Seed 1 continues base seeding this area as a new comple developed to the west and started back to base at 2143z. Engines were off at 2200z. At 1915zz Seed 2 was launched for cloud-top treatment of a line of new development in Kerr County. Seed 2 was far enough west of the DFW – SAT corridor to get ATC clearance to work an area in Kerr an Gillespie counties. Unfortunately, the GPS-derived location was inoperable and tracking of Seed 2 was not possible on the Titan system. Seed 2 found new development i these counties in spite of the W – E line movin southward. At approx. 2040z, areas of opportunity were outside the original clearance and ATC was at times crowded. Seed 2 moved to the western portions of a complex in Uvalde County, but its route to Hondo was blocked by this storm as was the Uvalde Airport. For safety reasons, Seed 2 diverted to Del Rio and landed, with engines off at 2210z Seed 2 returned to Hondo with engines on from 2332z to 0030z. Seed 1 (N340FR) – base seed Engine On – 1740Z Engine Off – 2200Z Time – 4 hours 20 minutes Flares – Acetone burners – 3 hours 43 minutes (left burner: 2:03, right burner: 1:40) Seed 2 (N340AX): Flight 1 – top seed Engine On – 1815Z Engine Off – 2210Z Time – 3 hours 55 minutes Flares – 24 ejectables Flight 2 – reposition Engine On – 2332Z Engine Off – 0030Z Time – 58 minutes

1 August 2000, Tuesday	The upper high began to build eastward, centering on the Four Corners area. The upper trough, whose axis had a SW – NE orientatio opened up and slowly moved eastward, and off the Texas coast. This pattern maintained the northerly flow aloft, though weaker than previously. The northerly flow aloft helpe maintain instability; however, rising mid- and upper heights began a stabilizing trend late i the day. At the surface one or more troughs, oriented WSW – ENE brought clouds and rain to southern and eastern Texas in the morning. Early clearing and ample moisture provided the impetus for convection by the noon CDT hour. With time the seemingly random formation of echoes formed into a loose W – E line through the middle of the target. The W – E lin continued to regenerate and move southward. As this dissipated or moved out of the target area, new development occurred in Kerr and Kendal counties at about 2100z. By 0000z, these cells rapidly dissipated and there were no further significant echoes in the target area.	Seed 1 was launched (engines on) at 1812z for cloud top treatment on an area of rapidly evolving radar returns in Real and Bandera counties. The initial fix had to be moved slightly eastward to get a block cleared by ATC. This was still i Bandera County. Seed 1 worked several complexes on this W – E line as it moved south, remaining in Bandera, Medina and Atascosa counties. At approx. 2020, the MOA's in this area got hot an Seed 1 changed to cloud-base seeding, making multipl passes of the southern periphery of this system. This system dissipated by 2200z and Seed 1 RTB to refuel and reload, with engines off at 2213z. Seed 2 launched towards activity east of San Antonio at 1907z for cloud-top treatment of activity i Bexar and Wilson counties. The tops of the portions in Bexar County were seeded with drop flares until the ATC clearance was lost due to MOA activation. Seed 2 went to cloud-base and treated the northern side of a comple in Medina and Bexar counties. Little inflow was found there and Seed 2 started to move to a complex in Bandera, but changed heading to a vigorous system in Kendall County which had its southern periphery seeded at cloud-base. As this system was treated, it propagated into a W – E line and Seed 2 continued t seed at cloud-base until RTB for fuel started at 2247z. Engines off at 2305z As Seed 2 returned to base, Seed 1 began to launch towards Kerrville to continue treating the same system at cloud-base. Engines were on at 2258z. The system was in Kerr, Bandera, and Kendall counties. The eastern portion of this dissipated by 2230 and a ne cell developed to the northwest, still i Kerr County. This was seeded at cloud base until it dissipated after 0000z. Seed 1 then returned to base and engines were off at 0044z. Seed 1 (N340FR): Flight 1 – top and base seeding Engine On – 1812Z Engine Off – 2213Z Time – 4 hours 1 minute Flares – 23 ejectables, acetone burners – 1 hour 10 minutes (all right side) Flight 2 – base seed Engine On – 2258Z Engine Off – 0044Z Time – 1 hour 46 minutes Flares – acetone burners – 55 minutes (all left side) Seed 2 (N340AX) – top and base seeding Engine On – 1907Z Engine Off – 2305Z Time – 4 hours 2 minutes Flares – 16 ejectables, acetone burners – 1 hour 24 minutes (all right side)
2 August 2000, Wednesday	Seabreeze activity formed on the Gulf Coast today, but was unable to spark showers in th target area.	No seeding activities from Hondo.
3 August 2000, Thursday	Minor high pressure kept skies mostly sunny and temperatures in the upper 90s.	No seeding activities from Hondo.
4 August 2000, Friday	An upper level low-pressure area caught in th easterlies drifted off the Gulf across South Central Texas during the day. Unfortunately, mid-level dry air kept convection from firing over a widespread area and kept any convection that	No seeding activities from Hondo.

	did fire from lasting more than 20 minutes. What little convection there was all dissipated after sunset.	
5 August 2000, Saturday	Yesterday's upper level low has pushed to position over El Paso, TX, and is still moving westward. Skies were partly to mostly sunny, with no showers being observed on radar.	No seeding activities from Hondo.
6 August 2000, Sunday	Hot and dry today with high temperatures hovering around 100 degrees.	No seeding operations from Hondo.
7 August 2000, Monday	Another hot and dry day with temperatures around 100.	No seeding operations from Hondo.
8 August 2000, Tuesday	A tropical area of low pressure in the southern Gulf of Mexico helped push ample moisture across the target area today. This along with highs in the upper 90s and low 100s and seabreeze boundary were able to spark numerous showers. These showers pushed across the target area from SE to NW during th afternoon, exiting during the late evening.	Two seeding flights were flown during the afternoon hours. Seed 2 launched to base seed the northern sections of the outflow boundary, seeding in Comal, Hays, Blanco, Kendall, Bandera, Kerr, and Gillespie Counties. Seed 1 launched to do top seeding on the southern half of the boundary, seeding in Medina, Bandera, Uvalde, and Real Counties. Seed 2 (N340AX) – base seed Engine On – 2115Z Engine Off – 0045Z Time – 3 hours 30 minutes Flares – acetone burners – 2 hours 17 minutes (all right side) Seed 1 (N340FR) – top and base seed Engine On – 2201Z Engine Off – 0017Z Time – 2 hours 16 minutes Flares – 15 ejectables, acetone burners – 16 minutes (15 minutes left side, 1 right side)
9 August 2000, Wednesday	Residual moisture from yesterday was unable to break the cap today, so skies remained mostly sunny and temperatures again soared to around the century mark.	No seeding operations from Hondo.
10 August 2000, Thursday	Once again dry and hot with highs in the lo 100s.	No seeding operations from Hondo.
11 August 2000, Friday	Another hot day. A couple showers were able to break through the cap northwest of the target area, but moved westward and did not stay together for longer than ½ an hour.	No seeding operations from Hondo.
12 August 2000, Saturday	Another hot and dry day today with highs still in the low 100s	No seeding operations from Hondo.
13 August 2000, Sunday	Calm and subsident air ahead of Tropical Storm Beryl kept skies mostly sunny and temperatures in the upper 90s.	No seeding activities from Hondo.
14 August 2000, Monday	High pressure overhead was stronger than Tropical Storm Beryl, which pushed westward into Mexico. A couple seabreeze-influenced showers developed during peak heating, but quickly dissipated.	No seeding activities from Hondo.
15 August 2000, Tuesday	Expected influence from T.S. Beryl was again deflected to the south, making landfall 115 miles south of Brownsville. The only influence from Beryl was a thick layer of cirrus clouds, which kept temperatures i the mid to upper 80s.	No seeding activities from Hondo.
16 August 2000, Wednesday	The remnants of Beryl kept pushing into Mexico, taking with it the moisture and high cloud cover. Clear skies led to temperatures around 100 degrees.	No seeding activities from Hondo.
17 August 2000, Thursday	Another clear day with highs in around 10 degrees.	No seeding activities from Hondo.
18 August 2000, Friday	High pressure centered over northern Texas is still dominating the weather, keeping skies clea and temperatures unseasonably hot.	No seeding activities from Hondo.
19 August 2000, Saturday	Another day of unseasonably hot and dry weather with temperatures around 100 degrees.	No seeding activities from Hondo.

20 August 2000, Sunday	An unseasonably hot dry day across the southern U.S., with highs in the upper 90s to 100.	No seeding activities from Hondo.
21 August 2000, Monday	Another hot day with highs in the upper 90s. Seabreeze showers developed during the lat afternoon, dissipating just before sunset.	Two flights were flown during the late afternoon an evening hours, one by Seed 1 in Bexar, Kendall, Kerr, and Bandera Counties, and one by Seed 2 i Medina, Bandera, and Uvalde Counties. Seed 1 (N340FR) – top seed Engine On – 2252Z Engine Off – 0145Z Time – 2 hours 53 minutes Flares – 39 ejectables, acetone burners – 2 minutes (1 minute each side) Seed 2 (N340AX) – top seed Engine On – 2315Z Engine Off – 0135Z Time – 2 hours 25 minutes Flares – 24 ejectables, acetone burners – 2 minutes (1 minutes each side)
22 August 2000, Tuesday	Another hot day with heating of the day showers along the seabreeze boundary. These showers again dissipated before sunset.	Two flight were flown during the afternoon hours, one by Seed 2 in Hays, Burnet, an Blanco Counties, and one by Seed 1 i Atascosa, Bexar, Medina, and Bandera Counties. Seed 2 (N340AX) – base seed Engine On – 1850Z Engine Off – 2315Z Time – 4 hours 25 minutes Flares – acetone burners – 2 hours 18 minutes Seed 1 (N340FR) – top seed Engine On – 2026Z Engine Off – 2350Z Time – 3 hours 34 minutes Flares – 52 ejectables
23 August 2000, Wednesday	Another hot dry day, but stronger high pressure kept seabreeze activity from developing.	No seeding activities from Hondo.
24 August 2000, Thursday	Another day of possibl seabreeze showers came up empty with heat and high pressure dominating the area.	No seeding activities from Hondo.
25 August 2000, Friday	A minor disturbance/weakness rotating around the upper level high pressure sparked showers over the hill country today, with spotty reports of ¼ to ½ inch of rain. These showers moved westward and weakened at sunset.	One seeding flight was flown during the afternoon by Seed 2 i Medina, Uvalde, Real, Bandera, and Bexar Counties. Seed 2 (N340AX) – base seed Engine On – 1923Z Engine Off – 0003Z Time – 4 hours 40 minutes Flares – acetone burners – 4 hours 2 minutes (left burner: 1:44, right burner: 2:18)
26 August 2000, Saturday	High pressure built back in today, keeping skies sunny and temperatures again in the upper 90s.	No seeding activities from Hondo.
27 August 2000, Sunday	High pressure stationed over northern Texas is keeping skies sunny and temperatures continued well above normal around 100.	No seeding activities from Hondo.
28 August 2000, Monday	Another day, another 100 degrees. The heat over the south central U.S. continues, with Dallas/Ft. Worth receiving the brunt of the heat between 105-110.	No seeding activities from Hondo.
29 August 2000, Tuesday	Dominant high pressure continues to keep precipitation at bay, with highs still reaching over 100 degrees.	No seeding activities from Hondo.
30 August 2000, Wednesday	Still extremely hot and dry with highs around 10 degrees.	No seeding activities from Hondo.
31 August 2000, Thursday	The heat continues for the area as high pressure is anchored over Texas and has nothing to dislodge it. Highs are still hovering around the	No seeding activities from Hondo.

	100-degree mark. San Antonio set its dail record high at 103.	
1 September 2000, Friday	Another day of heat with highs breaking more records. San Antonio hit 103 again, while Hondo reached 105.	No seeding activities from Hondo.
2 September 2000, Saturday	More record-breaking heat as the high interacts with a southwest wind off the Mexican deserts, sending temperatures soaring well into the 100s.	No seeding activities from Hondo.
3 September 2000, Sunday	Sunny and hot with temperatures will into th triple digits. High pressure is well in control of the state's weather.	No seeding activities from Hondo.
4 September 2000, Monday	Sunny with record heat. The high temperature in San Antonio was 109, which set the city all time record high.	No seeding activities from Hondo.
5 September 2000, Tuesday	Another sunny day with record heat. Today's high in San Antonio was 111, while Hondo and Austin reached 112. All of these were all time record high temperatures. All this heat was ahead of a "cold" front moving in from northeast Texas. Convection fired late in the afternoon along the front. This activity dissipated around sunset with the loss of daytime heating.	Two seeding flights were flown during the afternoon, one by Seed 2 i Kerr, Kendall, Bandera, Uvalde, Medina, Bexar, and Comal Counties, and one by Seed 1 in Medina and Uvalde Counties. Seed 2 (N340AX) – top seed Engine On – 2132 Engine Off – 0053 Time – 3 hours 21 minutes Flares – 29 Ejectable flares Seed 1 (N340FR) – bottom seed Engine On – 2208Z Engine Off – 0058Z Time – 2 hours 50 minutes Flares – acetone burners – 2 hours 9 minutes (right burner – 2 hours, left burner – 9 minutes)
6 September 2000, Wednesday	Yesterday's "front" pushed through during the predawn hours, but only switched the winds around to the north. During the afternoon, skies remained mostly sunny and temperatures moderated to around 100 degrees.	No seeding activities from Hondo.
7 September 2000, Thursday	Another day of temperatures around 100 with mostly sunny skies. High pressure back i control of the region's weather.	No seeding activities from Hondo.
8 September 2000, Friday	A low-pressure area from the Gulf of Mexico spread low-level moisture across the area. This combined with moderate heating sparked very isolated showers, all of which only lasted about 20 minutes. These few showers had all dissipated before sunset.	No seeding activities from Hondo.
9 September 2000, Saturday	Another day of higher humidities and heating le to more popcorn showers. These showers were longer living, and more widespread. Most showers would get icy tops once they reache 12 thousand feet, which is unfavorable for seeding, but as the day progressed favorable targets were available for work. All showers dissipated after sunset.	One seeding flight was flown during the late afternoon by Seed 2 i Bexar, Comal, Hays, Caldwell, and Guadalupe Counties. Seed 2 (N340AX) – base seed Engine On – 2300Z Engine Off – 0410Z Time – 2 hours 40 minutes Flares – acetone burners – 1 hour 29 minutes (all left side)
10 Septembe 2000, Sunday	Hot and humid weather today with highs in the middle 90s. Moisture off the Gulf of Mexico interacted with the seabreeze boundary, sparking a couple small showers. These showers were very short lived.	No seeding activities from Hondo.
11 Septembe 2000, Monday	A clear day with highs again in the middle 90s. High pressure kept convection from firing today.	No seeding activities from Hondo.
12 Septembe 2000, Tuesday	A combination outflow boundary/"cold" front sparked a solid line of showers and thunderstorms during the afternoon. This line stretched from west to east across the target area, moving to the south. Rainfall measurements of up to 1.5 inches were reported from Kerrville to the west side of San Antonio.	Two flights were flown during the afternoon hours, on by Seed 1 i Kerr, Bandera, Medina, and Bexar Counties, and one by Seed 2 in Comal, Kendall, Blanco, Guadalupe, and Bexar Counties. Seed 1 (N340FR) – top seed Engine On – 2214Z

	Behind the main line of convection, stratus showers remained for a couple hours afte sunset. All precipitation ended during the early overnight hours.	Engine Off – 0142Z Time – 3 hours 28 minutes Flares – 63 ejectables Seed 2 (N340AX) – base seed Engine On – 2355Z Engine Off – 0240Z Time – 2 hours 45 minutes Flares – acetone burners – 1 hour 54 minutes (all right side)
13 Septembe 2000, Wednesday	Moisture remaining from yesterday's boundaries was expected to spark scattered showers. Unfortunately, the lack of boundaries kept most showers at bay. What little activity that sprang up quickly dissipated. All activity over Texas dissipated after peak heating.	No seeding activities from Hondo.
14 Septembe 2000, Thursday	Scattered showers and thunderstorms moved into the eastern target area during the afternoon. These showers drifted toward the southwest across the San Antonio area. As this drifted out of the area, a secondary line developed across the northern area. This line slowly drifted nort out of the target area. All the activity weakened considerably at sunset with the loss of peak heating.	One seeding flight was flown during the afternoon hours by Seed 1 i Comal, Guadalupe, Hays, Bexar, Blanco, Medina, Bandera, and Kerr Counties. Seed 1 (N340FR) – base seed Engine On – 1937Z Engine Off – 0012Z Time – 4 hours 35 minutes Flares – acetone burners – 3 hours 9 minutes (left burner – 11 minutes, right burner – 2 hr 58 min.)
15 Septembe 2000, Friday	Moisture from yesterday's showers popped a couple minor showers in SW Uvalde County during the afternoon, but these showers quickly moved southwestward out of the area. The rest of the afternoon was partly cloudy as upper level clouds from the early shower covered most of South Central Texas.	No seeding activities from Hondo.
16 Septembe 2000, Saturday	Overnight a cold front pushed through the target area. The only effects on the target area were to dry the atmosphere out and lower temperatures. The day was mostly sunny with a high only around 90 degrees.	No seeding activities from Hondo.
17 Septembe 2000, Sunday	A quiet day across South Central Texas with highs in the low to mid 80s.	No seeding activities from Hondo.
18 Septembe 2000, Monday	Another sunny day as high pressure stays anchored over Texas. Highs today were in the 80s.	No seeding activities from Hondo.
19 Septembe 2000, Tuesday	Southerly winds started pushing warmer air from Mexico into the area, pushing highs back into the 90s.	No seeding activities from Hondo.
20 Septembe 2000, Wednesday	Another warm day, with low-level moisture starting to return to South Central Texas off the Gulf of Mexico. Skies remained clear with highs in the mid 90s.	No seeding activities from Hondo.
21 Septembe 2000, Thursday	A cold front pushing in from the north was expected to settle across the target area during the afternoon unexpectedly stalled further north. Only a couple minor showers developed, but since they were far removed from the front, they quickly dissipated.	No seeding activities from Hondo.
22 Septembe 2000, Friday	Another warm and humid day as temperatures soared into the upper 90s.	No seeding activities from Hondo.
23 Septembe 2000, Saturday	Another record-setting day as San Antonio tied its record high at 99 degrees. But relief is i sight in the coming days as a strong, season-changing front is now in the Texas Panhandle...	No seeding activities from Hondo.
24 Septembe 2000, Sunday	A season-changing cold front barreled through the target area during the day, bringing with it vast amounts of precipitation. The leading edge of the precipitation moved into the northwestern target area during the mid afternoon. Scattered showers and thunderstorms developed along th line as it pushed south. Severe weather	Two seeding flights were flown during the afternoon, one by Seed 1 i Medina, Bexar, Comal, Guadalupe, and Wilson Counties, and one by Seed 2 i Uvalde and Medina Counties. Seed 2 (N340AX) – top seed Engine On – 2105Z

	developed just east of Del Rio and migrated westward along the line through Uvalde, Medina, and Bexar Counties, dropping around 1.5 inches of rain and winds blowing up to 50 miles per hour. All convective activity pushed out of th target area around 9PM, leaving behind a wide area of stratus showers. All rain ended overnight.	Engine Off – 0005Z Time – 3 hours Flares – 43 ejectables Seed 1 (N340FR) – base seed Engine On – 2200Z Engine Off – 2344Z Time – 1 hour 44 minutes Flares – acetone burners – 52 minutes (all left side)
25 Septembe 2000, Monday	An extremely airmass behind yesterday's cold front cleared skies and dropped high temperatures into the lower 70s. Lo temperatures were in the low to mid 40s, with some lower reading in the Hill Country. Autumn has arrived.	No seeding activities from Hondo.
26 Septembe 2000, Tuesday	Another cool and dry day with more high temperatures in the middle 70s.	No seeding activities from Hondo.
27 Septembe 2000, Wednesday	High pressure has set up control over the southern U.S., keeping skies clear and temperatures below normal. Highs today were around 80.	No seeding activities from Hondo.
28 Septembe 2000, Thursday	Another day of mild temperatures and clear skies. Highs today were again around 80.	No seeding activities from Hondo.
29 Septembe 2000, Friday	With high pressure sitting overhead, Gulf moisture is pushed away, leaving the air dry. This allows the temperatures to fluctuate over a wide range. Today's highs were in the mid 80s, with lows around 50.	No seeding activities from Hondo.
30 Septembe 2000, Saturday	Another day of dry weather, but with winds starting to turn more from the southeast, humidity starts to rise and temperatures start to rise and don't get as low at night. Today's hig was in the upper 80s with lows in the upper 60s.	No seeding activities from Hondo.
1 October 2000, Sunday	Mostly clear skies prevailed as high pressure stayed in control of the weather in Texas. Highs were in the low to mid 80s.	No seeding activities from Hondo.
2 October 2000, Monday	Another day of northeasterly winds kept moisture from returning off the Gulf of Mexico. This kept skies clear and temperatures around average at 85 degrees.	No seeding activities from Hondo.
3 October 2000, Tuesday	Winds are starting to turn around from the southeast, so low-level moisture is starting t return. This in turn, although not raising temperatures significantly, did raise the heat index to where the temperature felt like it was in the lower 90s.	No seeding activities from Hondo.
4 October 2000, Wednesday	Another warm and humid day with highs in the mid 80s again. Moisture is starting to return. Hurricane Keith is back into the Bay of Campeche and is expected to move into Mexico and spread moisture northward into South Texas.	No seeding activities from Hondo.
5 October 2000, Thursday	The calm before the storm. The cold front is moving into north Texas, while moisture is pushing in from Hurricane Keith, which has already made landfall around Tampico, Mexico. Skies were partly cloudy, most of which was high clouds from Keith.	No seeding activities from Hondo.
6 October 2000, Friday	The cold front pushed through South Central Texas during the morning hours, sparking showers across the area. The front quickly pushed through to a Laredo/Corpus Christi line, where it stalled. These showers were very icy, with no liquid moisture available for seeding. Moisture from the remnants of Hurricane Keith pushed over the cold front and forme stratus showers over most of the southern third of Texas. These showers continued overnight.	One seeding flight and two recon flights were flown during the day. The one seeding flight was during the morning by Seed 1 in Uvalde County. Seed 1 (N340FR) – top seed Engine On – 1250Z Engine Off – 1430Z Time – 1 hour 40 minutes Flares – 1 ejectable Seed 2 (N340AX) – top recon

		Engine On – 1335Z Engine Off – 1515Z Time – 1 hour 40 minutes Seed 1 (N340FR) – top recon Engine On – 2213Z Engine Off – 2345Z Time – 1 hour 32 minutes
7 October 2000, Saturday	More stratus showers from the combination of the cold front and Keith gave South Texas a thorough soaking. Another factor added to the overrunning episode as moisture from Tropical Storm Olivia in the Eastern Pacific pushed alon by the Jet Stream. These showers also continued through the overnight hours.	No seeding activities from Hondo.
8 October 2000, Sunday	The cold front that pushed through the area last week has stalled in Mexico and across Deep South Texas. Behind this front temperatures ar stuck in the lower 40s, a full 30 degrees belo average. The southern branch of the jet stream is pushing mid-level moisture from the remnants of Tropical Storm Olivia into Texas. This moisture is being pushed over the shallow layer of cold surface air, resulting in a thin layer of stratus rain. The rains continued through th overnight hours. Since the clouds were of th stratus variety, seeding was unsuitable an would have been detrimental.	No seeding activities from Hondo.
9 October 2000, Monday	Another day of overrunning stratus rains across all of South Texas. These rains continued most of the day and night. Again, due to the makeup of the clouds in the area, seeding would have been counter-effective.	No seeding activities from Hondo.
10 October 2000, Tuesday	The rains started to wane as Tropical Storm Olivia dissipated in the eastern Pacific. All told, rainfall amounts from the past few days ranged from 3 to 6 inches. Skies remained cloudy after rains halted.	No seeding activities from Hondo.
11 October 2000, Wednesday	Another day of cloudy weather, with an isolated morning showers. Highs remained in the lo 50s.	No seeding activities from Hondo.
12 October 2000, Thursday	Another day of cloudy weather, but winds starte to turn more out of the south. This helpe temperatures get into the low 60s.	No seeding activities from Hondo.
13 October 2000, Friday	Skies started to clear across the area as minor high pressure moved across Texas. This helpe push temperatures into the upper 70.	No seeding activities from Hondo.
14 October 2000, Saturday	Another day of partly cloudy skies ahead of a cold front in the Texas Panhandle through Oklahoma. Temperatures were in the lower 80s, but moisture from the Gulf of Mexico made it feel much muggier.	No seeding activities from Hondo.
15 October 2000, Sunday	Showers pushed into the area today ahead of a low-pressure area in southern California. Most showers were icy and unresponsive to seeding. These showers dissipated around sunset.	One seeding flight was flown during the afternoon in Real County. Seed 2 (N340AX) – top seed Engine On – 1935Z Engine Off – 2135Z Time – 2 hours Flares – 6 ejectables
16 October 2000, Monday	Dry air at upper levels kept showers from forming for most of the day. A couple small showers did develop during peak heating, but didn't last more than 20 minutes. Activity ceased during the early evening.	No seeding activities from Hondo.
17 October 2000, Tuesday	A very wet day as a Pacific shortwave slowly pushed across Texas. Early morning rains dropped copious amounts of rainfall i Bandera, Medina, and Bexar Counties. Rainfall reports	One seeding flight was flown during the morning hours by Seed 1 i Uvalde County. Seed 1 (N340FR) – top seed

	ranged from 2.5 inches in NW San Antonio, to 4.25 inches in Hondo, to over 6 in southern Bandera County. Widespread flooding was reported. Most rains were of th stratus variety, which are unfavorable for seeding. Most rains subsided around midnight.	Engine On – 1342Z Engine Off – 1624Z Time – 2 hours 42 minutes Flares – 50 ejectable flares
18 October 2000, Wednesday	Residual moisture from Tuesday's rains sparked isolated heating-of-the-day showers. None of these showers lasted more than 20 minutes. These few showers subsided after peak heating around 6 PM.	No seeding activities from Hondo.
19 October 2000, Thursday	A mostly clear but humid day. A couple showers popped up during the afternoon, but were short-lived and didn't reach a height above the freezing level.	No seeding activities from Hondo.
20 October 2000, Friday	Increased drying at middle levels of the atmosphere kept any convection from firin today. Skies remained mostly clear.	No seeding activities from Hondo.
21 October 2000, Saturday	Showers and thunderstorms were present during most of the day as an upper level low over the southeastern U.S. started pushing shortwaves over Texas. Several waves of rainfall pushed across the area, one during the morning, one during the evening, and one overnight. These waves continued to drop rainfall across South Texas	Two seeding flight were flown today, one by Seed 2 during the early afternoon in Medina, Bexar, Comal, Guadalupe, and Hays Counties, and one by Seed 1 during the early evening in Guadalupe County. Seed 2 (N340AX) – top seed Engine On – 1735Z Engine Off – 2055Z Time – 3 hours 20 minutes Flares – 9 ejectable flares Seed 1 (N340FR) – top seed Engine On – 2329Z Engine Off – 0151Z Time – 2 hours 22 minutes Flares – 37 ejectables
22 October 2000, Sunday	A large upper level low-pressure area pushed across the Texas Panhandle today. This combined with low and mid level moisture sparked showers and thunderstorm across the area. These showers continued until just afte sunset. More widespread stratus rains developed late overnight over most of the western half of the area.	Two seeding flights and 2 recon flights were flown today. One seeding flight was by Seed 2 during the evening i Bandera and Real Counties. One seeding flight was by Seed 1 during the afternoon in Guadalupe County. Seed 1 (N340FR) – top seed Engine On – 1416Z Engine Off – 1620Z Time – 2 hours 4 minutes Flares – 9 ejectable flares Seed 1 (N340FR) – top recon Engine On – 1903Z Engine Off – 2017Z Time – 1 hour 14 minutes Seed 1 (N340FR) – top recon Engine On – 2100Z Engine Off – 2214Z Time – 1 hour 14 minutes Seed 2 (N340AX) – top seed Engine On – 2345Z Engine Off – 0200Z Time – 2 hours 15 minutes Flares – 11 ejectable flares
23 October 2000, Monday	The widespread rains that started last night continued during most of the day, dropping copious amounts of rain across the area. Rainfall estimates of over 5 inches were observed on radar, with actual reports of 5-8 i Kerr and Bandera Counties. This brought about multiple flash flood warnings during most of th day.	No seeding activities from Hondo. Seeding not conducted during flash flooding.
24 October 2000,	Isolated showers popped up during the morning	One seeding flight was flown during the afternoon by

Tuesday	over the western half of the target. Showers were more focused over the eastern half of the target area. These showers dissipated at sunset.	Seed 1 i Guadalupe, Comal, and Hays Counties. Seed 1 (N340FR) – top seed Engine On – 2043Z Engine Off – 2244Z Time – 2 hours 1 minute Flares – 13 ejectable flares
25 October 2000, Wednesday	The low over the Panhandle pushed northeastward through Minnesota, taking with it the rain from the last few days. Cloud cover kept any heating from developing any convection.	No seeding activities from Hondo.
26 October 2000, Thursday	A little clearing allowed cumulus clouds to develop, but these were not able to make it to the freezing level, thus they were unfavorable for seeding.	No seeding activities from Hondo.
27 October 2000, Friday	Another day of lowered convection which again was unsuitable for seeding.	No seeding activities from Hondo.
28 October 2000, Saturday	Another upper level low pushed over Ne Mexico and the Panhandles, dragging a col front through central Texas. This front pushed t a Del Rio/Junction line. A severe thunderstorm pushed through Kimble and Gillespie County moving northeastward.	No seeding activities from Hondo.
29 October 2000, Sunday	Residual moisture from last week's rains subsided during the early morning hours, an without a focus to work with, skies remained mostly cloudy but non precipitous.	No seeding activities from Hondo.
30 October 2000, Monday	Another day in between upper level systems kept skies partly cloudy with highs in the middl 70s.	No seeding activities from Hondo.
31 October 2000, Tuesday	The next upper level system started to push into the Texas Panhandle today sparking severe weather there. Here, skies remained partly cloudy as surface moisture fro the Gulf started t increase over South Central Texas.	No seeding activities from Hondo.
1 November 2000, Wednesday	The line of thunderstorms from the Panhandle yesterday reached the target area during th morning today along with the influence of another upper level low-pressure area. This area quickly moved through the target area. Scattered light showers continued through the rest of the day.	One flight was flown during the morning hours by Seed 2 in Real an Bandera Counties. Seed 2 (N340AX) – top seed Engine On – 1653Z Engine Off – 1940Z Time – 2 hours 47 minutes Flares – 9 ejectable flares, acetone burners – 1 hour 36 minutes (1:05 left, 0:31 right)
2 November 2000, Thursday	Showers and thunderstorms developed as the upper level low combined with abundant moisture from the Pacific. Severe weather popped up as these conditions combined with heating and wind shear i the mid and upper level of the atmosphere. The severe weather was confined to the eastern half of the target area. These thunderstorms weakened as heating subsided at sunset. More rains developed late night, sparking flash flood warnings for every county in the target area.	One seeding flight was flown during the afternoon in Uvalde, Medina, and Frio Counties. Seed 2 (N340AX) – top seed Engine On – 2000Z Engine Off – 2337Z Time – 3 hours 37 minutes Flares – 38 ejectables, acetone burners – 26 minutes (all right side)
3 November 2000, Friday	Large-scale rains covered the area again today, adding to the flash flooding.	No seeding activities from Hondo. Seeding not conducted due to flash flooding
4 November 2000, Saturday	A quick break from the heavy rains that covered the target area.	No seeding activities from Hondo.
5 November 2000, Sunday	A strong cold front pushed through the target area today, sparking a line of severe thunderstorms.	No seeding activities from Hondo.
6 November 2000, Monday	Stable air behind yesterday's cold front cleared skies and kept temperatures in the middle 50s.	No seeding activities from Hondo.
7 November 2000, Tuesday	A quick moving upper level disturbance pushed through the area, but only sparked light rain showers. These showers were not convective, thus were unseedable.	No seeding activities from Hondo.
8 November	Another day of light showers, mainly during the	No seeding activities from Hondo.

2000, Wednesday	morning hours.	
9 November 2000, Thursday	A partly cloudy day today as yesterday's disturbance moved off to the east.	No seeding activities from Hondo.
10 November 2000, Friday	Another day of partly cloudy weather with highs in the lower 70s. South winds helped start t push Gulf moisture northward.	No seeding activities from Hondo.
11 November 2000, Saturday	High clouds ahead of an advancing cold front kept skies gray. No precipitation was contained within these clouds.	No seeding activities from Hondo.
12 November 2000, Sunday	Severe weather sparked by a strong cold front erupted north and east of San Antonio. Multiple tornado warnings were issued, but no official tornadoes were reported in the target area. These storms pushed eastward out of the area during the evening as the cold front rushe through. Temperatures dropped almost 20 degrees as the front passed.	No seeding activities from Hondo. Seeding not conducted on severe thunderstorms.
13 November 2000, Monday	A stabl airmass behind yesterday's cold front cleared skies and let temperatures fall overnight into the upper 30s. Highs only rebounded into the upper 50s.	No seeding activities from Hondo.
14 November 2000, Tuesday	Another day of stability kept skies clear and temperatures below average.	No seeding activities from Hondo.
15 November 2000, Wednesday	Moisture return ahead of the next weather system clouded up skies early. During the day, southwesterly winds at upper level pushed over low level northeasterly winds, creating a classic overrunning pattern of stratus rains.	No seeding activities from Hondo.
16 November 2000, Thursday	More overrunning led to more stratus rain during most of the day.	No seeding activities from Hondo.
17 November 2000, Friday	Another day of overrunning precipitation, but over a smaller area.	No seeding activities from Hondo.
18 November 2000, Saturday	One more day of overrunning conditions gave areas a total of 2-3 inches of rain over the last 4 days.	No seeding activities from Hondo.
19 November 2000, Sunday	Clearing skies behind last week's upper al disturbance, along with lower dewpoints led to beautiful fall day across South Texas. With clear skies, temperatures dropped into the upper 30s overnight.	No seeding activities from Hondo.
20 November 2000, Monday	Another day of mostly clear skies and mil autumn temperatures.	No seeding activities from Hondo.
21 November 2000, Tuesday	One more day of nice weather ahead of a advancing cold front pushing into New Mexico.	No seeding activities from Hondo.
22 November 2000, Wednesday	Winds from As the cold front pushed towards th area, light showers started to develop late in th evening. These showers were short and unseedable.	No seeding activities from Hondo.
23 November 2000, Thursday	The cold front barreled through the target area during the evening, sparkin rapidly-developing thunderstorms on a line from Austin to Sa Antonio. Within ½ hour of first developing, these storms were declared severe and thus were unseedable. This line of thunderstorms quickly moved eastward with the cold front through the Houston area.	No seeding activities from Hondo.
24 November 2000, Friday	Clear and stable air behind the cold front brought a beautiful day for most of Texas. A couple mid-level clouds developed during the afternoon, which had wrapped around the low in Arkansas.	No seeding activities from Hondo.
25 November 2000, Saturday	Another day of clear blue skies as the stable high pressure held firm control over the area's weather.	No seeding activities from Hondo.
26 November 2000, Sunday	Upper-level high pressure is keeping skies mostly clear and temperatures in the middle 60s.	No seeding activities from Hondo.
27 November 2000, Monday	Winds have started to turn to out of the south, which is bringing moisture up from the Gulf of Mexico. It is a slow process, as clouds are	No seeding activities from Hondo.

	thickening very slowly from the south.	
28 November 2000, Tuesday	A minor cold front pushing in from the north was unable to spark showers due to the limite moisture available. Skies were cloudy all day and highs were in the middle 60s.	No seeding activities from Hondo.
29 November 2000, Wednesday	Stable air behind the cold front kept skies mostly clear and temperatures in the lower to middle 60s.	No seeding activities from Hondo.
30 November 2000, Thursday	Minor low-level moisture return help skies cloud over during the early afternoon. This kept hig temperatures in the upper 50s.	No seeding activities from Hondo.

E. Specifications for Cessna C-340 Aircra

Power Type, Turbocharged piston twin engine
6290 lbs gross weight
4400 lbs empty weight (typical)
1890 lbs useful load (typical)
310 hp per engine
280 mph max speed
263 mph rec. cruise
82 mph stall dirty
183 - 203 gals fuel capacity
29,800 feet all engine service ceiling
15,800 feet single engine service ceiling
1650 feet per minute all engine rate of climb
315 feet per minute single engine rate of climb
2175 feet for take off over 50 foot obstruction
1615 feet for take off ground roll
1850 feet land over 50 foot obstruction
770 land ground roll
34 ft. 4 in. length
12 ft. 7 in. height
38 ft. 1 in. wing span

F. Glossary of Terms and Acronyms

Definitions are those found within the Glossary of Meteorology, where applicable. Italicized print in this section indicates an alternative glossary entry that the reader may also wish to review.

AirLink—Exclusive aircraft position and data telemetry system developed by Weather Modification, Inc.

AgI– see *silver iodide.*

AMS– American Meteorological Society, 45 Beacon Street, Boston, MA 02108-3693.

ASCE—American Society of Civil Engineering, Reston, Virginia.

attenuation– in physics, any process in which the flux density (or power, amplitude, intensity, illuminance, etc.), of a "parallel beam" of energy decreases with increasing distance from the energy source, for example, the reduction of intensity of the electromagnetic wave (radar signal) along its path from and back to the radar. Attenuation thus lessens the ability o a radar to sense all clouds and precipitation, such that the depicted information is inaccurate or incomplete.

burn-in-place flare– a pyrotechnic device burned in a fixed position, such as the trailing edge of an aircraft wing. Compare *ejectable flare.*

Cartesian coordinates – The common X-Y coordinate system, where positive X is distance east, and positive Y is distance north. Negative X is therefore west, and negative Y, south. For example, Cartesian coordinates of X=30 mi, Y= -30 mi, would be a point 30 mi east and 30 mi south, or 42.4 mi southeast. See also, *Polar coordinates.*

CCN– cloud condensation nuclei. The tiny particles, either liquid or solid, upon which condensation of water vapor first begins in the atmosphere, they are necessary for the formation of cloud droplets.

CDC – Convective Day Category. Numerical value accorded each forecast to indicate the scale of storm development expected on that day. CDC values range from –3 (no seedable weather assured) to +5 (severe weather likely).

CD-ROM—compact disk, read-only memory. The common compact diskette (CD) used for data archival and musical recordings.

CDT – Central Daylight Time. Five hours slower than GMT, CUT, and UTC. For example, 5:00 p.m. CDT equals 10 p.m. (22:00) GMT.

cell– a convective element (cloud) which in its life cycle, develops, matures, and dissipates, usually in about 30 min.

cloud base seeding—the release of cloud seeding agent into updrafts beneath developing cloud turrets, which transport the seeding agent aloft into the precipitation development zones.

cloud droplets– a particle of liquid water from a few microns to tens of microns in diameter, formed by condensation of atmospheric water vapor, and suspended in the atmosphere with other droplets for form a cloud. These liquid water droplets are too small to precipitate.

cloud model– physical description of cloud processes programmed into a computer to simulate cloud development and evolution. Very useful in understanding the relative importance of the many factors that influence cloud development, and the only way in which *exactly the same cloud* can be both seeded and unseeded.

coalescence– in cloud physics, the merging of two water drops into a single larger drop. This occurs through the collision or two drops, which then unite.

conceptual model– a theoretical model of hail development, based upon current knowledge and scientific concepts. See also *cloud model.*

control area– an area where cloud seeding operations do not take place, preferably similar in character and near to the *target area.* The behavior of storms over the control area is compared to those treated over the target area, to assess differences and thus measure project effectiveness. See also , *target area, seeding area,* and *seeded area.*

CUT – Coordinated Universal Time. See also, *UTC, GMT.* Five hours ahead of Central Daylight Time; for example, 10:00 p.m. CUT (22:00) equals 5:00 p.m. (17:00) CDT.

dBZ— measurement of radar reflectivity. An open-ended, logarithmic scale. With common weather radars, a value of 20 dBZ typically denotes the threshold for the lightest precipitation, while 45 dBZ is commonly taken to be the threshold reflectivity for hail.

direct targeting– the placement of seeding agents directly into the target cloud mass by release during penetration by aircraft.

droplet spectrum– the numbers and sizes of the droplets within the cloud volume o interest.

dynamic seeding– the treatment of clouds with the intent of utilizing the latent heat produced by additional freezing and perhaps in some cases by condensation or deposition to invigorate cloud development.

EAA – Edwards Aquifer Authoriy, San Antonio, Texas.

EAPEP—Edwards Aquifer Precipitation Enhancement Program.

ejectable flares– pyrotechnic devices that are ignited and released (ejected) from aircraft. Compare *burn-in-place flare.*

FAA– Federal Aviation Administration. The governmental entity that regulates aircraft operations, safety, and use of airways in the United States. Analogous entities also exist in most other nations.

flanking line– developing convective cells on the flank (side) of a mature thunderstorm.

glaciogenic– causing the formation of ice.

glaciogenic seeding– treatment of clouds with materials intended to increase and/or initiate the formation of ice crystals.

GMT – Greenwich mean time, same as Universal Time Coordinates (UTC) or Coordinated Universal Time (CUT). Five hours ahead of Central Daylight Time; for example, 10:00 p.m. GMT (22:00) equals 5:00 p.m. (17:00) CDT.

GOES– Geostationary Operational Environmental Satellite. These are the latest NOAA weather satellites, presently operational over the continental U.S.

GPS– Global Positioning System. A global, satellite-based navigation positioning system which provides consistently accurate positions.

graupel– white, opaque, approximately round (sometimes conical) ice particles having a snow-like structure, and about 2-5 mm in diameter. Also known as snow pellets, they form in convective clouds when supercooled water droplets freeze to an ice particle upon impact.

hail– Precipitation in the form of balls or irregular lumps of ice, always produced by convective clouds, nearly always by cumulonimbus. An individual unit of hail is called a hailstone. By convention, hail has a diameter of 5 mm or more.

hydrometeor– any product of condensation or deposition, or condensation and freezing, in the atmosphere. This includes cloud water or ice of any size, either suspended in the air or precipitating.

hygroscopic– pertaining to a marked ability to accelerate the condensation of water vapor; having the property of attracting water, or having the effect of encouraging the formation of larger droplets.

hygroscopic seeding– treatment of clouds with hygroscopic materials which encourage the formation of larger droplets, changing the cloud droplet spectrum in such a way as to enhance development of precipitation through coalescence.

ice nucleus– any particle that serves as a nucleus for the formation of ice crystals in the atmosphere.

IFR - Instrument Flight Rules. The FAA regulations pertaining to flight at altitudes of 18,000 feet above mean sea level or higher over U.S. airspace, or in any meteorological conditions necessitating the use of aircraft instrumentation for safe navigation.

IN– see *ice nucleus.*

***in situ* measurement**– measurements made in place, as within the cloud of interest. Compare *remote sensing.*

JWM– Journal of Weather Modification, the official journal of the Weather Modification Association.

KCl– see *potassium chloride.*

latent heat– The heat released or absorbed per unit mass by a system in a reversible, isobaric-isothermal change of phase. More simply, the heat released when water vapor condenses (latent heat of condensation), or when liquid water drops freeze (latent heat of fusion). In the case of water droplets freezing upon contact with hail, the latent heat elevates the surface temperature of the growing hailstone.

mb -- millibar, a unit of pressure. Standard sea level pressure is 1013.25 mb. Upper atmosphere weather charts are routinely prepared for 1000 mb (roughly sea level),

850 mb (about 5,000 ft), 7000 mb (about 10,000 feet), 500 mb (about 18,000 ft), 300 mb (about 30,000 ft), 250 mb (about 35,000 ft), and 200 mb (about 40,000 ft).

NCAR– National Center for Atmospheric Research, P.O. Box 3000, Boulder, CO, 80307-3000.

NOAA– National Oceanic and Atmospheric Administration, U.S. Department o Commerce. The parent organization of the U.S. National Weather Service, and the federal agency to which all U.S. weather modification activities must be reported.

nowcasting– very short-term forecasting, from the present to about 30 minutes.

Polar coordinates -- a coordinate system in which the direction is specified in degrees (from zero to 360), and a range provides the distance. For example, polar coordinates of 135° direction and 42.4 mi range specify a location 30 mi east and 30 mi south, or in the southeast.

potassium chloride– KCl, a simple salt often used as a primary ingredient in hygroscopic cloud seeding pyrotechnics.

radiosonde (or rawinsonde)– an instrument package that senses and transmits weather information such as pressure, temperature, and humidity. Radiosondes are carried aloft by weather balloons twice daily from numerous sites all over the world, and can also be employed by projects to bolster local forecasting efforts.

raindrop– a drop of water of diameter greater than 0.5 mm falling through the atmosphere. In careful usage, falling drops with diameters lying in the interval 0.2 to 0.5 mm a called drizzle drops rather than raindrops, though this is frequently overlooked.

RDAS – Radar Data Acquisition System. The hardware and software that acquires the radar data and passes it on to TITAN for further processing and display. RDAS also controls the radar itself.

remote sensing– the remote measurement of properties of interest, as with radar and satellite. Compare *in situ measurement.*

response time– the time that elapses from identification of a seeding opportunity until the release of seeding agent actually begins.

seeding agents – agents dispensed by any means in or near a cloud volume which are intended to modify (seed) the cloud characteristics.

silver iodide– AgI, a common glaciogenic seeding agent.

sodium chloride– NaCl, the chemical composition of common table salt. Because of its hygroscopic properties, historically, it was occasionally used for hygroscopic seeding. Hygroscopic seeding agents have more recently employed potassium chloride (KCl).

supercell– thunderstorms characterized by an intense, quasi-steady state mature updraft. Such storms account for a large fraction of all tornadoes, and much of the large hail.

supercooled water– water, still in liquid state, at temperatures less than 0°C (32°F). Under ideal conditions in the free atmosphere, water may exist in a supercooled state to temperatures as cold as -40°C (-40°F).

target area– the area for which cloud seeding operations are targeted, usually near a *control area* similar in character and climatology. The behavior of treated storms over the target area is compared to untreated storms over the control area, to assess differences and thus measure project effectiveness. See also , *control area*, *seeding area*, and *seeded area*.

terminal velocity– the particular falling speed, for any given object moving through a fluid of specified physical properties, at which the drag forces and buoyant forces exerted by the fluid on the object just equal the gravitational force acting on the object. For hydrometeors, the greatest fall speed relative to the surrounding air that a hydrometeor will attain, as determined by the mass of the particle and frictional drag of the air through which it is falling.

thermal– a relatively small-scale, rising current of air produced when the atmosphere is heated enough locally by the earth's surface to produce absolute instability in the lowest layers.

TITAN– Thunderstorm Identification, Tracking, Analysis, and Nowcasting. Software for the display and analysis of weather radar data, widely used in operational convective cloud seeding programs.

UTC – Universal Time Coordinates. See also *GMT*, *CUT*. Five hours ahead of Central Daylight Time; for example, 10:00 p.m. UTC (22:00) equals 5:00 p.m. (17:00) CDT.

VIL– vertically integrated liquid. A radar estimate of the cloud liquid water, from the lowest angle sampled through cloud top. Used as an indicator of the presence o hail, and also of updraft vigor.

wing-tip generator– ice nucleus generators mounted at the tips of aircraft wings, or sometimes below the wings, also usually near the ends.

WMA– Weather Modification Association, P.O. Box 26926, Fresno, CA 93729-6926.

WMI—Weather Modification, Inc., Fargo, North Dakota.

WMO– World Meteorological Organization, 7 bis, Avenue de la Paix, CH 1211 Geneva 2, Switzerland.

WSR-74C – The 1974 vintage weather radars, built by Enterprise Electronics Corporation, deployed in the U.S. by the National Weather Service during the 1970's. These radars are often reconditioned and equipped with TITAN for use by television stations, universities, and weather modification programs.