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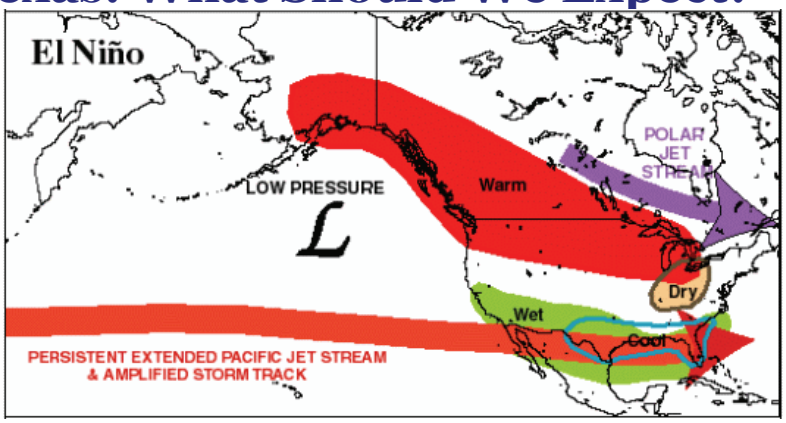
The Texas Weather Modification COURIER

El Niño and Texas: What Should We Expect?

By Todd Flanagan

Everyone's heard of El Niño at some point in time, usually from a media source. From major winter storms affecting California to a reduction in the number of hurricanes, the effects of El Niño and its counterpart, La Niña, are far reaching and widely varied. With an El Niño pattern currently in progress, what effects can be expected in Texas?



NOAA's Climate Prediction Center depicts a typical El Niño pattern during the winter months over the Pacific and North America.

It may be prudent to first of all touch on what exactly El Niño refers to. In the equatorial Pacific, and in all oceans, water temperature fluctuations depend on several factors, including oceanic currents and ongoing weather. Historical accounts from Peru indicate that there were periods where warmer water currents would be present off the coast. The currents usually coincided with the

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Inside this issue:

South Texas Drought 2009

Throughout most of 2009, drought was an all too familiar sight in south Texas. Only near the end of September did the rains finally return. The drought of 2009 was the continuation of an 18 month drought that occurred over south Texas, especially along portions of the middle Texas coast. Normal weather features such as tropical waves and tropical cyclones give coastal areas a big chuck of their annual rainfall. However, with the development of El Nino and the persistent drought, not much rainfall occurred this summer due to the absence of these tropical features. The area did receive rainfall during the spring months, but like most spring time weather it was convective in nature and only isolated locations benefited from this. During the summer, the drought continue to feed off of itself, as little rain falling allows for very little soil moisture to be evaporated back into the

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Texas Project Updates
A Review of 2009

West Texas
Weather Modification

By Robert Rhodes

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

As of December 13th, San Angelo was above normal by 4.56 inches with a total of 24.93 inches. Midland International recorded 14.40 inches, which is nearly normal. Top 10 rainfalls at the San Angelo Regional airport during April and July in addition to periodic large rainfall events throughout the summer led to a well above normal season. Midland International was well below normal until July, following 6.55 inches. August was the most active this season with 13 operational days. Precipitation and percent of normal maps show that much of Texas was well below normal except for West Texas and parts of central Texas during March and April. Most of Texas was dry through May. Western parts of the target area were well above normal in June and West-central Texas above normal in July. West Texas is shown to be dry August through September but drought stricken east-central and south Texas began to see some relief. The 2009 tropical season was very limited in the Atlantic Ocean and Caribbean without Hurricanes moving onto the Texas Gulf Coast. The Pacific tropical season was more active with several instances of tropical moisture moving over Mexico and into West Texas.

The statistical reports conducted by Active Influence and Scientific Management (AISM) shows the majority of seeding operation result was excellent or very good; with an average seasonal increases to precipitation at 17%. Arrival time to small (91%) was excellent. Small clouds showed increases for precipitation mass at 102%, cloud mass increases of 55%, lifetime increases at 27%, increases to cloud area at 39%, cloud volume increases of 41%, and volume above 6Km of 48%. Increases in precipitation mass by county were shown between 6% and 35.5%. Crockett County was below 10% but the low value is a consequence of large area. Reagan County was most favored in number of seeded clouds. In addition to Glaciogenic seeding, West Texas also started a case study using one supplementary hygroscopic flare. Unfortunately, only three cases could be matched with a proper control sample. Further information can be read in the AISM evaluation. Total increases in precipitation for the target area were calculated at 1,851,542 acre-feet.

WTWMA (2002-2009)					
	Seeded Clouds	Operational Days	Flares Used	Increase Million ac-f	Annual Rainfall
2002	285	47	3024	0.78	14.41
2003	265	50	3184	0.76	19.76
2004	109	46	1140	1.35	30.48
2005	133	39	1524	1.26	20.40
2006	157	53	1810	1.70	17.65
2007	95	46	1166	1.19	32.05
2008	78	38	1420	1.18	19.00
2009	190	56	2382	1.85	*24.93

Above: Table 2 an annual comparison from 2002 to 2009 with number of seeded clouds through each season, total number of flares used, estimated annual increases, and rainfall recorded at Mathis Field in San Angelo.

2009	Days	Seed Flights	Recon Flights	Flight Hours	Flares	Rainfall: Mathis
March	1	2	0	4	60	1.73
April	3	5	1	11.8	50	4.61
May	10	18	2	55.8	582	0.12
June	12	22	2	63.9	487	1.74
July	9	18	2	39.7	267	4.64
August	13	23	1	54.6	543	1.89
September	7	12	0	32.8	359	5.66
October	1	3	1	4.5	54	2.92
Totals	56	103	9	267.1	2402	*23.86

Above: Table 1 shows 2009 operations broken down by month with number of flights, flight hours, number of flares and rainfall received at Mathis Field San Angelo.

South Texas Weather Modification Association

By Todd Flanagan

The 2009 season marked the 13th year of operations for the South Texas Weather Modification Association. In terms of operations, it was a near-normal year with 76 seeding flights over 44 days, with an additional 13 reconnaissance flights. This compares to the 12-year average of 39 seeding days, 69 seeding flights and 7 reconnaissance flights. The long-term drought that began near the end of 2008 continued for much of the year before a dramatic shift in the weather patterns – likely attributed to the onset of El Niño in September. Despite the drought, there were many small convective clouds that presented themselves for seeding opportunities, and these accounted for the majority of seeding events during the year. Also, with the purchase of the Aztec twin engine plane late last year nighttime seeding became possible.

The first opportunity for seeding came on March 26th when a powerful storm system affected the state. A flight was launched but eventually low ceilings and the onset of severe weather resulted in the flight being a reconnaissance only. April would come and go with no seeding opportunities and below normal rainfall for the majority of the area; one exception was northern Wilson County where excessive rains from thunderstorms resulted in over six inches of rainfall in that area. During a two-day period in the second week of April, record lows in the mid 30s were followed by record highs near 100°F.

The month of May would turn out to the busiest May since the inception of the program with 25 flights taking place over ten days, primarily during the latter half of the month. The spotty nature of the convection meant that while some areas ended up with above normal rainfall, others wound up with below normal rainfall. May also signaled the return of the counties within the jurisdiction of the Edwards Aquifer Authority, where a randomized experiment is ongoing. Only one day presented a case suitable for the randomized seeding protocol to be enacted.

June, normally one of the wetter months of the year, turned out to be extremely dry with most locations in the target area receiving less than a quarter inch of rainfall. Five days during the month presented seedable clouds, including the first night mission on June 2nd. Around mid-month, a strong area of high pressure aloft parked over the area with a string of 100°F+ highs occurring. This was a foreshadowing of the intense heat that would follow later in the summer.

July was a normal month in terms of the amount of seeding activity that occurred, with 11 days seeing seeding operations take place; these were spread out throughout the month. Normally by July, most of the convection is generated by sea breeze activity or within a tropical air mass. Both were largely absent this month, with the majority of convection moving into the area from the north. The intense heat continued, with over 20 days of highs at or above 100°F. The experimental use of hygroscopic flares for seeding began in July, but these were used sparingly.

The intense heat continued into and peaked in August, with over 25 days recording highs at or above 100°F. The June to August period would end up being the hottest three month period ever for many locations in south Texas. By month's end, Pleasanton had recorded 67 days with highs at or above 100°F! Rainfall was scarce as it was in June, with all but two small areas in the target area seeing well below normal rainfall. Still, small convective clouds were present on several days, with ten days seeing seeding operations take place. The majority of these missions occurred during the last week, when a major change in the weather pattern began.

September finally brought the welcome rains that were sought after for many months, with the vast majority of the target area seeing above normal rainfall spread out evenly through the month. Some locations saw in excess of 10 inches of rain. Tropical air mass intrusions with exceptionally high precipitable water values were common; unfortunately this also resulted in many unsuitable clouds for seeding. Still, there were eight days during the month where seeding occurred. Another randomized case occurred on September 1st. The final day of seeding for the year occurred on September 28th. Wet weather continued through October, November and into December with the El Niño signal strengthening in the Pacific.

The annual radar analysis provided by Active Influence and Scientific Management showed that once again, seeding effects were

Month	Seed Days	Flights	Hours	Amounts
March	0	(1r)	0.5	0
April	0	0	0	0
May	10	25 (6r)	48.9	11,680g
June	5	8	16.6	4,560g
July	11	23 (3r)	44.7	14,320g+6,000g
August	10	17	28.2	6,600g+3,000g
September	8	15 (3r)	21.8	4,920g+2,000g
TOTALS	**44**	**89 (13r)**	**160.7**	**42,080g+11,000g**

Above: Table shows summary of operations in 2009. Under Flights, r refers to reconnaissance flight only, while the values to the right of the plus sign under Amounts refer to the amount of hygroscopic material (CaCl) used for seeding.

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STWMA Continued from Page 3

positive in south-central Texas. The analysis indicated an average increase in rainfall of 11%, translating to over 540,000 acre-feet of water from 131 seeded clouds.

Southwest Texas Rain Enhancement Association

By Stephanie Beall

2009 was a usual one for sure over the southwestern most portion of Texas. Weather wise, it was a mostly hot and dry summer for most locations. Weather modification wise it was actually above average. This is typically a very true relationship in regards to a dry summer and an active weather modification season. Usually in a drought, there is a lack of suitable clouds to go after. This makes the weather modification project operators even more diligent in their efforts to increase rainfall over the area. As a result, there were more reconnaissance flights this year than normal, with a total of 16 occurring during 2009. The spring months offered a slow start to weather modification activities, with the exception of spring, while the rest of the season was quiet busy. The busiest month of the season was May, with a number of hail suppression flights taking place and in turn, a large amount of seeding material used. Flight activity seemed to pick up near the latter half of the season as the strong high that dominated the weather pattern for much of the summer months weakened. This information can be seen in Table 1. Another strange occurrence this year was that for the first time in six years, no flights occurred in the month of October. This was due to a number of the systems being embedded, which means that the thunderstorms were embedded in light rain, or low ceilings which hampered seeding at base. Table 2 shows how 2009 compared with the past two seeding seasons. One thing to remember when looking at this table is to remember that 2008 was a drought year and 2007 was a very wet year. In drought years, weather modification activities are more frequent and in wet years they are less frequent due to possible flooding and suspensions of operations due to very wet conditions. Project staff remained the same as last year as did the project target area. For the most part, the 2009 year was a tough one due to drought but none the less allowed for a successful seeding season.

2009	Seed Flights	Recon Flights	Flight Hours	Flares	Amount of AgI (g)
March	2	1	3.3	31	1,240
April	1	1	2.95	53	2,120
May	11	4	30.85	364	14,560
June	7	2	11.6	155	6,200
July	11	4	27.45	231	9,240
August	9	1	18.85	130	5,200
September	10	3	17.95	119	4,720

Above: Table 1: Southwest Texas Rain Enhancement's flight activity for 2009.

	Total number of flights (recon + seeding)		Flight Time (hours)		Number of Flares		AgI Used	
Month	**2007**	**2008**	**2007**	**2008**	**2007**	**2008**	**2007**	**2008**
March	1	0	1.16	0	26	0	1040	0
April	4	5	2.9	7.05	15	137	600	5360
May	6	6	10.6	5.96	120	144	4800	5760
June	5	8	6.85	14.25	50	115	2000	4600
July	1	9	1.2	10.9	11	119	440	4760
August	13	18	23.4	30.7	160	229	6400	9160
September	4	5	3.65	8.35	13	127	520	5080
October	4	1	4.55	1.05	30	14	1100	560

Above: Table 2: Historical Seeding Information 2007-2008

Panhandle Groundwater Conservation District

By Jennifer Wright

The conclusion of the Panhandle Groundwater Conservation District's (PGCD) 2009 Precipitation Enhancement Program marked the tenth year of cloud seeding in the Texas Panhandle. This season began with the first mission on April 26th and concluded on September 25th with the last mission. The mission on September 25th was the latest season flight since the inception of the program in 2000. Typically, the season runs from April 15th until September 30th; however, if suitable opportunities are present before the 15th the season will commence.

The 2009 seeding season contained 25 days with seeding events, which consisted of 32 seeding missions and 23 reconnaissance missions. Several days during the summer were marginal days for thunderstorm development, which resulted in more reconnaissance missions than any other year in the past. According to Active Influence and Scientific Management, during the seeding events we seeded 32 clouds which consisted of nine small clouds, 10 large clouds and 13 type B clouds. The seeding of these clouds helped to produce an additional 717,900 acre-feet of water which translates to on average about 1.65 inches across the water District. Taking into account the raw rain gauge data the 1.65 inches can be translated to a 10 percent increase per county in rainfall received.

The economic value of this additional 10 percent of rainfall remained about the same as the 2008 season. The total cost of the seeding program in 2009 was $200,693. Considering this figure plus what an additional 1.65 inch per acre is worth the District cost per acre is about five cents.

While most of the south Texas cloud seeding projects report about a strong drought the Texas Panhandle experienced exactly the opposite. April, the start of the season, began a little dry with the majority of the Panhandle considered moderately dry by the U.S. Drought Monitor. During May and June, the Texas Panhandle was mostly drought free, and this is also when the majority of the seeding missions took place. There were six seeding days in May and seven days in June. July's weather pattern was dominated by high pressure; therefore, only one seeding day occurred and the Panhandle began to see some dry areas set in. August through September saw the return of the seasonal cold fronts and trough passages which brought many opportunities for rainfall. Any dry areas that were present in July were all clear as of November.

All of the counties within PGCD received more rainfall in 2009 than in 2008 from April to October. (Table1) Rick Husband International Airport in Amarillo recorded 8.07 inches of rainfall in August, which beat the record of 7.55 inches in 1974, according to the National Weather Service in Amarillo, Texas.

Normally, during the seeding season the weather events are concentrated either in the west or in the east in the Panhandle; however, that did not occur this year. Most of the weather events included all or most of the Texas Panhandle; therefore, the seeding was spread out through all of the District Counties. Donley County saw the most seeding days with 10 followed by Carson and Gray counties with nine days. The least amount of seeding days occurred in Potter and Wheeler counties with only five days.

This years season brought a few changes to the project. A new pilot, Harrison Hoffman, joined the staff in June. Also, a new upgraded TITAN computer (Thunderstorm Identification, Tracking Analysis and Nowcasting) supplied by Weather Decision Technologies, Inc. was put into operations. The upgraded systems were put in place in all of the Texas projects. These new computers were necessary to handle the National Weather Service radar upgrades to super resolution in 2008.

The 2009 seeding season was overall very average, but successful with an average increase of rainfall of 10 percent throughout the PGCD counties. The Texas Panhandle was very lucky to not participate in the drought that dominated south and southwest Texas.

April - October Rainfall Averages Comparing 2008 to 2009			
	2008	2009	
Armstrong	14.54	17.75	**3.21**
Carson	16.34	23.22	**6.88**
Donley	17.05	16.97	**0.08**
Gray	17.60	19.43	**1.83**
Potter	16.61	14.09	**2.52**
Roberts	18.12	16.99	**1.13**
Wheeler	22.33	19.05	**3.28**
District Normal 16.43			

Above: Table one shows the difference in rainfall from the 2008 season to the 2009 season from April to October.

2009	Days	Seed Flights	Recon Flights	Flight Hours
April	2	3	3	7
May	6	9	0	18
June	7	9	6	30
July	1	1	6	10
August	4	5	6	19
September	5	5	2	11
Totals	25	32	23	95

Above: Table 2 gives an overview of the seeding season at PGCD by month. It gives the number of days seeded, number of seed and recon flights and the number of flight hours.

El Niño Continued from Page 1

Christmas season, which is how the term "El Niño" or, the Christ Child came to be. What would eventually be discovered is that this warming of the waters would have effects not just in the vicinity of Peru, but worldwide. Not until the late 1960s would a more detailed description of the mechanism and effects of this phenomenon be formulated. With El Niño, water temperatures in the equatorial Pacific are warmer than normal, officially defined as a positive temperature anomaly of at least 0.5°C lasting over five consecutive three-month periods. This increase in ocean temperature results in a slough of consequences that are experienced worldwide. In some areas drought develops, while heavy precipitation occurs in other locations. Air currents aloft are even affected, and this has profound effects on storm development. Some locations experience colder weather, others will see warmer temperatures. What does El Niño mean for Texas?

The Pacific jet stream tends to be more zonal and further south, carrying disturbances rapidly across the ocean towards North America. These disturbances will also carry more moisture picked up from warmer waters at lower latitudes. These storms then move across the southern half of the country with increasing frequency, resulting in higher than average rainfall along with cooler temperatures due in part to increased cloud cover. This is not an absolute expectation, but climate records do indicate that during El Niño cooler winters and wetter weather has occurred in Texas, particularly central and southern Texas 60-80% of the time (depending on the three-month cluster one is looking at). In terms of the current weather, it doesn't at all seem surprising that above normal rainfall and below normal temperatures have returned to a good portion of Texas during the fall and early winter months at a time when the El Niño signal has strengthened. This has followed a drought period in southern Texas, which coincided with the most recent La Niña episode.

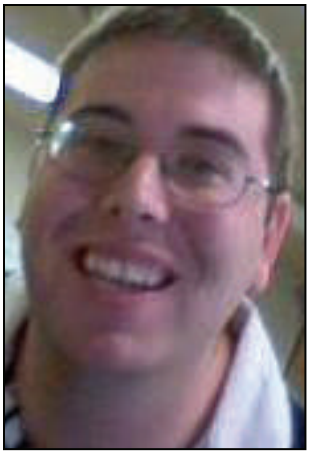
In the summer the effects of El Niño on Texas weather are less certain. However, increased easterly trade winds attributable to El Niño result in the shearing apart of tropical systems as they move westward which coincides with fewer tropical cyclones in the Atlantic basin, and one could surmise that this potentially results in less tropical rainfall for central and southern Texas. This is shown to be the case in the Caribbean Sea, where many of the tropical cyclones that would affect Texas would emanate from.

The current forecast calls for the El Niño signal to remain into the early spring of 2010, possibly longer. Subsequently, above normal rainfall and below normal temperatures are forecast for central and southern Texas through the March-April-May period. This is a welcome relief from the intense drought of 2008-2009.

*Article written with references/information taken from the Climate Prediction Center's El Niño webpage.

Meet Levi Sleeper of the TWMA

By Levi Sleeper

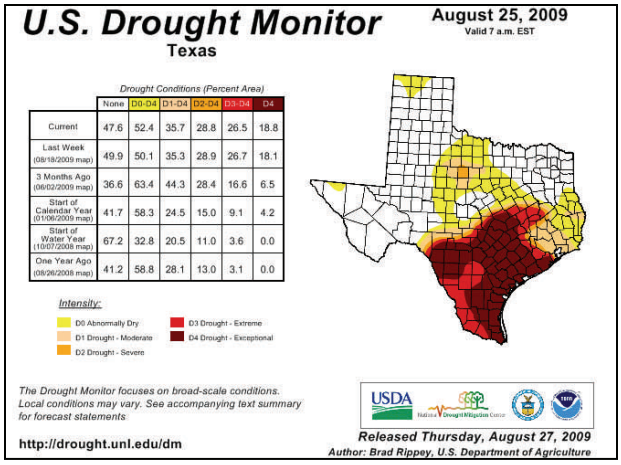


Levi Sleeper was born on October 29, 1983, in Tulsa, Oklahoma. At the time, he had a 13-year-old sister Barbra, and a brother Earl Jr. that had just turned 2. His dad was a corporate pilot at the time, flying airplanes and helicopters for a Caterpillar dealer. Shortly after Levi was born, the U.S. Customs Service hired his Dad at a California base. Levi and family spent two years in California, and in 1989, moved back to Oklahoma just outside of Oklahoma City to a town named Mustang. They lived in Mustang until December of 1996, when they moved to San Angelo. Levi attended Junior High and High School in San Angelo; following Graduation in 2002, he went to Oklahoma State University through 2005 earning a Bachelors Degree in Aviation Science.

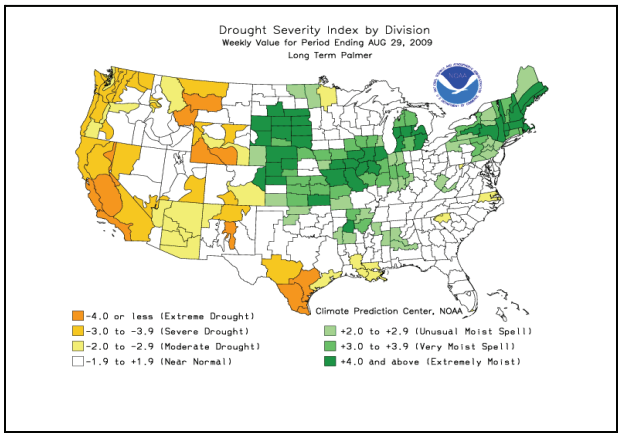
Levi began flying while in High School, and knew that was what he wanted to do as a career. His first solo flight occurred on his 16th Birthday, and he received his Private license by his 17th Birthday. Before leaving for college, Levi had finished up his instrument ticket, and then received his commercial single, multi, CFI, CFII, and MEI during his stay at Oklahoma State. Upon graduation in 2005, Levi moved back to San Angelo to be a full time cloud seeding pilot building the coveted multi-engine time required to go to the airlines. At the time, he had about 1000 hours total and 100 multi. He seeded clouds for West Texas Weather Modification during the summer season, and in August of 2005, received a class date with Mesa airlines to fly the Beech 1900D. He flew for Mesa for only one year aboard the 1900D; flew all over the country to small cities that had Essential Air Service. After a year, he was hired to fly the Embraer 145 at ExpressJet Airlines. These are the 50 seat regional jets everyone flies on today. Levi worked there for three years, and when the economy stumbled; facing pay cuts and possibly a move, he decided to leave. Levi then went to work for an air Ambulance Company flying a Diamond Jet for a few months out of San Antonio, before deciding to make the move back to San Angelo to fly cloud seeding Pipers once again. Levi returned to San Angelo, full Circle, the year is now 2009!

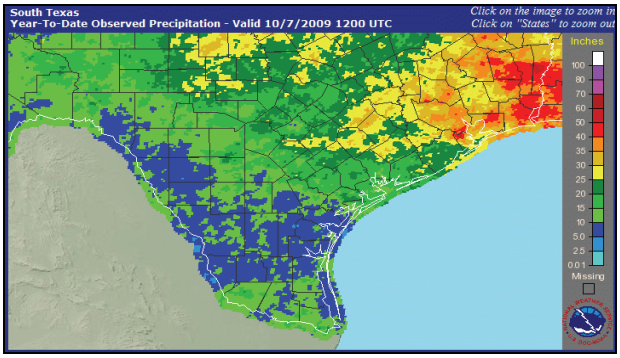
Drought Continued from Page 1

atmosphere, leaving even less moisture in the air for any incoming weather system to work with. Most of the summer was busy weather modification wise, even with exceptional drought conditions over the area, demonstrating an extremely aggressive seeding approach to the drought. As can be seen in Figure 1, which shows the drought monitor for the end of August, most locations over south Texas were classified as in exceptional drought. Also, the Palmer index indicates very dry conditions over Texas which can be seen in Figure 2. Locations across most of south Texas were 10-15 inches below normal by the time rain began to return to the area in September. The worst hit areas were along the mid Texas coast, with Corpus Christi only receiving about 15 percent of its normal rainfall for the year through October. The added addition of a very hot summer made the drought seem much longer, with most locations over south Texas averaging about 50 days of 100°F or better during the summer of 2009. Conditions have improved dramatically since the summer but some locations are still on the edge of being in drought once again. With the very likely chance of El Nino bringing much needed rain to the area over the winter, drought conditions are likely to ease across most of south Texas into 2010.



Above: Figure 1 shows the drought monitor for Texas on August 25, 2009. Below: Figure 2 shows the Palmer Drought Severity index for the week ending August 29,2009.





Above: Figure 3 shows year-to-date precipitation for South Texas through October 17, 2009.

TWMA Annual Meeting Recap

By Jennifer Wright

Every year after the summer weather modification seasons have ended across the state, the Texas Weather Modification Association (TWMA) likes to get all the project's staff together to discuss individual project season activities, new and on-going research in the state and outside of the state, and any other discussion topics relevant to cloud seeding.

This years participants were West Texas Weather Modification Association (WTWMA), South Texas Weather Modification Association (STWMA), Southwest Texas Rain Enhancement Association (SWTREA), Panhandle Groundwater Conservation District (PGCD), and Active Influence and Scientific Management (AISM). The meeting was held in San Angelo, Texas, in the WTMA office from October 21st—23rd.

On October 21st, Archie Ruiz of AISM gave a presentation on hail and hygroscopic seeding. The WTMA, STWMA and SWTREA all participated in an experimental study on hygroscopic seeding this season, and Ruiz shared the results of some hygroscopic seeding missions and the impacts the different seeding material had on the clouds in relation to the current seeding agent. All projects present presented a season recap in the afternoon.

On October 22nd, the projects discussed the new TITAN computer system upgrades, and what problems have occurred and how to rectify those problems. Stephanie Beall, meteorologist, from the

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State of Texas Evaluation 2009
Active Influence & Scientific Management

By Archie Ruiz

Cloud seeding missions began in March and ended in October. Panhandle Groundwater Conservation District (PGCD), West Texas Weather Modification Association (WTWMA), South Texas Weather Modification Association (STWMA), Southwest Texas Rain-Enhancement Association, and Trans-Pecos were included within the 2009 Evaluation.

A total of 466 clouds were seeded and identified by Thunderstorm Identification Tracking Analysis and Nowcasting (TITAN) software over 171 target area operational days. 91 operational days were qualified as excellent, 40-very good, 27-good performance, 5-fairperformace, and three were categorized as experimental. For the 466 clouds; 218 were designated small clouds, 126 large clouds, and 117 Type-B seeded clouds.

Small Clouds were seeded with 914 flares and received an excellent timing of 86% for an effective dose of 55 ice-nuclei per liter. Individual cells likely received closer to the desired dosage of 100 ice-nuclei per liter. An excellent increase of 95 % in precipitation mass together with an increase of 43 % in cloud mass illustrates that the seeded clouds grew at expenses of the environmental moisture (they are open systems) and used only a fraction of this moisture for their own maintenance. The increases in lifetime (27 %), area (35 %), volume (34 %), volume above 6 km (39 %), and precipitation flux (42 %) are notable. There are slight increases in maximum reflectivity (1 %), and in top height (3 %). The seeded sub-sample seemed 40 % more efficient than the control sub-sample. Results are evaluated as **excellent** for this sub-sample. The Estimated increases received from small clouds are 170,545 acre-feet.

Large clouds received 1,879 flares with an effective dose near 75 ice-nuclei per liter. In average, large clouds were 29 minutes old when the operations took place; the operation lasted about 32 minutes, and the large seeded clouds lived 215 minutes (3 hours and 35 minutes). The Estimated increases received from large clouds are 2,264,139 acre-feet. Similarly, Type-B clouds received 2,223 flares with an effective dose near 60 ice-nuclei per liter. In average, type B clouds were 124 minutes old when the operations took place; the operation lasted about 39 minutes, and the type B seeded clouds lived 295 minutes (4 hours and 55 minutes). The Estimated increases received from Type-B clouds are 1,331,414 acre-feet.

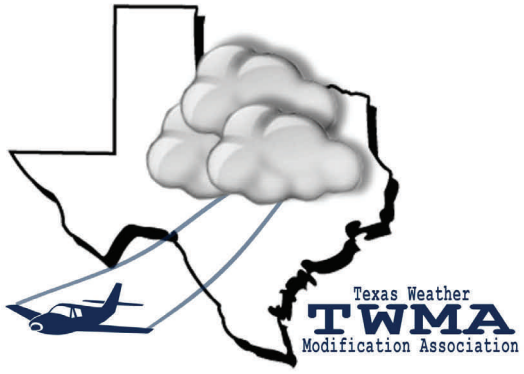
The total increases over the State of Texas throughout the 2009 season are estimated at 3,766,098 acre-feet. Percent of increases are broken down per county of the seeded region; PGCD micro-regionalization shows 15.6% increases over Donley and 4.2% over Roberts. Pecos shows Ward County allowed for 22.6% increases and 3.7% over Culberson. The best increases for West Texas were 36% over Glasscock County and least of 6% over Crockett County (mainly due to county size). SWTREA held an 11.9% increase over Uvalde and 6.6% increase over La Salle. STWMA best results were seen over McMullen County at 16.1% and 5.8% over Bandera. South and Southwest Texas saw a significant drought throughout the seeding season holding average rainfall over the State of Texas to nearly 12inches.

Results for the 2009 season were evaluated as excellent and a typical average seasonal value per average increase in precipitation of 11.5% was recorded. Anti-hail seeding operations appeared to partially mitigate hail formation in corresponding storms. Texas Weather Modification also began to use salt flares in addition to Silver Iodide flares in 2009. Too few cases were evaluated to gain a respective statistical evaluation; however, use of both flares appear to have a positive affect.

TWMA Continued from Page 7

SWTREA gave a presentation on the drought that lasted through much of the summer in south and southwest Texas, and Todd Flanagan, meteorologist, from the STWMA talked about El Niño and its' affects on Texas. In the afternoon, Matt Pope, STWMA, talked about aviation in regards to doing weather modification.

On October 23rd, a round table discussion was held where many topics including the TWMA newsletter, TWMA handbook and the 2009 Semi-annual Weather Modification Association meeting. Being able to visit and listen to what other projects throughout the state are doing always proves to be beneficial for all attendants.



Meet Robert Rhodes of the WTWMA

By Robert Rhodes

Readers are cordially invited to meet the Meteorologists of Texas Weather Modification in the first piece of autobiographies; additional information on the remaining meteorologists will be seen in later editions of the newsletter.

Robert was born in Dallas, Texas, January of 1983, moving from Garland to Plano for grade school through 10th grade. Robert and family moved to Pennsylvania where his parents grew up. He finished high school and attended California University of Pennsylvania (Cal) where he obtained his Bachelors of Science in Meteorology. Cal gave Robert several chances to return to the Great Plains and study storms up close, watching the evolution of storms from blue sky to chasing tornadic supercells.

When asked, "Why did you choose to study the weather?" Robert said it was one of two interests. He really didn't know what he wanted to do through the last year of high school, but weather and photography were the only considerations. In addition, he said, "there was a storm a number of years back; I had jumped off the school bus to find myself nearly off my feet in a ridiculous storm." Apparently, he was dropped off at his stop at the moment a microburst flowed vigorously through the area. It was that moment, he later decided was a leading factor in understanding the power and awe behind the weather.

Following graduation in May 2006, Robert returned home to Texas, waiting for the job searches to lead him to his next stop. Finding jobs in meteorology is rather difficult, the community is small but there are a wide variety of positions between private and government. Robert received a call from the Texas Weather Modification Association within a month of returning

Photo take by Robert Rhodes. Photography is one of Robert's many hobbies, and he especially enjoys photographing weather.

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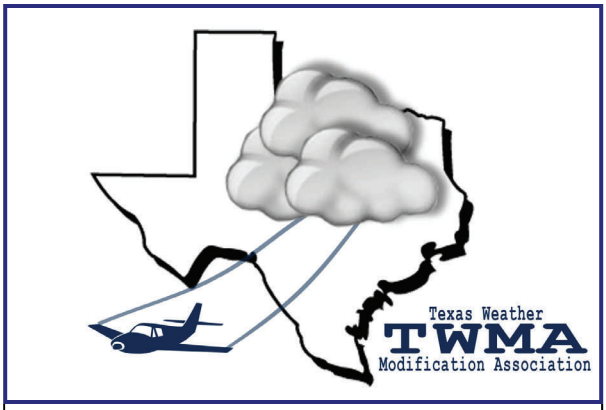

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