Volume 4, Issue 1 September 1, 2010

The Texas Weather Modification COURIER

WMA 2010 Annual Meeting in New Mexico

By Todd Flanagan

The 2010 Annual Meeting of the Weather Modification Association (WMA) took place in Santa Fe, New Mexico, from April 21-23 at the Inn and Spa at Loretto. As always, members from around the world were in attendance to hear talks on various aspects of weather modification ranging from operational to research-oriented programs, winter to summer weather modification and statistical to modeling approaches.

The first series of presentations dealt with statistical modeling and analysis. One paper discussed the use of a regression model to address the problem of non-stationarity when looking at analyzing a weather modification program. The second paper discussed a series of statistical techniques which were used to produce a signal that determined the effect of long-term seeding in a wintertime project in central California. The next series of presentations dealt with hurricane modification and modeling of such modifications. In one paper, the use of various aerosols to modify/weaken hurricanes was shown; in the second paper virtual seeding flights were constructed to show their effects on the intensity of simulated hurricanes. The majority of the afternoon talks dealt with summertime precipitation enhancement program updates from various projects around the world. Several keynote talks ended the day; among them, one discussed a new particle sensor that may be able to detect cloud seeding signatures while the second talk discussed TITAN, the

WMA Continues on Page 6

Inside this issue:

Tommy Shearrer, STWMA manager and TWMA president, Archie Ruiz, Active Influence and Scientific Management, and Todd Flanagan, STWMA meteorologist and WMA president, receive awards at the annual WMA meeting in Santa Fe, New Mexico.

Texas Project Updates 2009 Results and 2010 Operational Updates

Southwest Texas Rain Enhancement Association

By Stephanie Beall

After a busy end to the seeding season in 2009, the early part 2010 continued to see a wet pattern for southwest Texas. Results from the 2009 season are presented in Table 1. Results from these tables show that during the 2009 season, a total of 80 clouds were seeded on 34 operational days. The analysis shows a total increase of 494,314 acre-feet which translates into a radar derived increase of 9 percent. The active winter and spring weather pattern can mainly be attributed to the development of a moderately strong El Niño in the fall of 2009 and its persistence into the spring of 2010. This allowed most of the target area to recover from the consecutive years of drought that occurred in 2008 and 2009. Most locations in the target area were near or above normal rainfall amounts for the start of the 2010 seeding. Plenty of rain fell in the target area during the winter months, with the spring and early summer bring just as active in terms of rainfall and, in turn, operations. The seeding season started out rather busy, with a number of seeding opportunities occurring over the spring months. The severe weather season was not as active as it usually is during the spring and as a result only four hail suppression missions took place between March and June. March typically yields a couple of flights each year, but this year no flights occurred in March. The biggest rain making systems came during the months of June and July when ENSO (El Niño-Southern Oscillation) neutral conditions transitioned to a weak La Niña. The presence of La Niña contributed to increased tropical activity which affected the coastal areas of Texas. Hurricane Alex made landfall 100 miles south of Brownsville, TX, near the end June and a poorly organized Tropical Depression moved inland at Brownsville, TX, near the beginning of July. The combination of these two tropical systems led to heavy rainfall across the southern target area. River levels along the Rio Grande River rose rapidly as a result of these two systems, and lead to historic river flooding for most of the month of July. Locations over the river and over the Rio Grande Watershed were restricted from seeding operations during the month of July. Figure 1 below shows the percent of normal precipitation for the month of July. Seeding operations did however continue across the rest of the target area and the target area saw above normal precipitatin for June and July. As the calendar shifted from July to August, rainfall decreased dramatically across the target area and most of south Texas. Most of August was characterized by hot and dry conditions, and as a result flight activity

Type of Cloud	Total amount seeded in 2009	Increase (acre-feet)
Small Cloud	37	20,978
Large Cloud	14	191,224
Type B Cloud	29	282,113
Total of all Clouds	**80**	**494,315**

Table 1 shows 2009 Active Influence and Scientific Management (AISM) analysis of the SWTREA project.

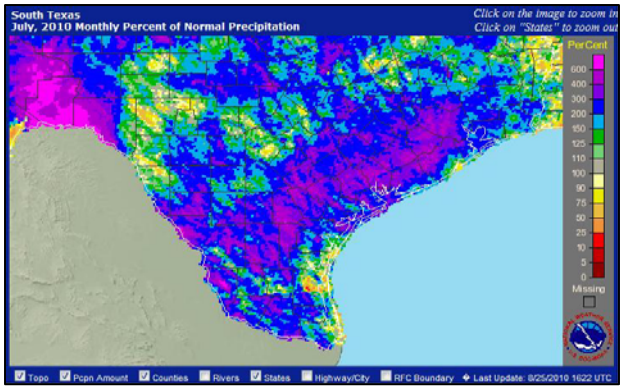

Figure 1 shows the July 2010 monthly percent of normal precipitation for South Texas.

Month	Seeding Days	Seeding Flights (Recon Flights)	AgI Used (Glaciogenic)	CaCl Used (Hygroscopic)	Flight Time (hours)
March	0	0	0	0	0
April	4	5	2,640g	0g	5
May	4	6 (2)	7,740g	2000g	19
June	5	8 (1)	7,920g	1000g	12
July	9	13 (2)	6,800g	3000g	21
August	3	5(2)	4,280g	1000g	12

Table 2 shows the 2010 flight information for the SWTREA project.

was much lower than its normal is in August. Table 2 shows flight activity for the each month of 2010. Even with August being much drier than it usually is, much of the target area is still at or above normal precipitation wise for 2010. Seeding operations continued as usually this year, with the first full year of hygroscopic seeding occurring during the 2010 season. SWTREA (Southwest Texas Rain Enhancement Association) staff and aircraft remained the same. More information about the project can be found at www.swtrea.org.

West Texas

By Robert Rhodes

Operations for 2009 began March 25th and ended October 9th with 56 operational days in between. Evaluation of the season analyzed 190 clouds over the West Texas target area. Conditions were quite favorable for seeding in 2009 allowing for the most seeded clouds and most numerous seeding days on record. Analysis of small clouds for the season noted an increase of 27 percent for lifetime of the cloud, 39 percent increase in area, and 41 percent increase in volume. Increase in precipitation mass for small clouds, which have a similar unseeded control sample, was calculated at 102 percent. Clouds identified and also analyzed as large or type-B clouds resulted in increases of 1.3 and 1.8 million acre feet over the target area. Overall analysis of seeding during 2009 suggests 17 percent increase in precipitation with above normal rainfall and generous seedable conditions. Additional information from the final analysis can be found on the website at www.wtwma.com.

West Texas started off the 2010 season very slowly with only two operational days in mid March and no operations during April. However, rainfall across the region was very good through both March and April. Rainfall continued to be generous all the way through July given a very moist, tropical environment. As of August 1st, Mathis Field received 13.81 inches and was 2.47 inches above normal. Operations became more numerous in June and July; however, tropical influence and subsidence from a rather persistent ridge held clouds to a minimal stature. The short profile of clouds continued into August as a strong upper level ridge continued to push downward on convective activity. Temperatures reached over 100° from July 28th through August 15th and were expected to continue. Although a ridge hindered convective activity through mid August, strong surface heating, outflow and frontal boundaries managed to spark off thunderstorms over 33 days through August 15th. Fifty seven flights and over 30 hours of flight time were logged during the period. When compared to 2009, the 2010 season has not been as eventful; such that by August 15, 2009, West Texas logged 83 flights and nearly 50 hours of flight time. Similarly, the 2008 season logged 50 flights and over 50hours of flight time.

The Texas weather modification programs are in the process of gathering data using hygroscopic flares in addition to glaciogenic flares. West Texas has only used a small number of hygroscopic flares in 2010, because of numerous large-merged clouds or small and weak tropical influenced clouds. It is desired to have isolated continental type clouds with cores at or above freezing level. The majority of isolated cases over West Texas have had cores at or below the freezing level. The season continues into October and follow up reports for the 2010 season can be expected this winter.

South Texas Weather Modification Association

By Todd Flanagan

The 2010 season for the South Texas Weather Modification Association (STWMA) up to this point can best be described as a bookend season, with a slow start, busy middle period and relatively slow latter part as of late August. Rainfall for the year up to date roughly mimics this pattern as well. January and February, although wetter than normal, saw rainfall that was predominantly stratiform in nature. March went by with below normal rainfall. April, although much wetter than normal in some locations, saw severe weather events which contributed to the heavy rains and were off-limits for seeding. May rainfall varied across the target area, but it was during the latter half of the month when seedable clouds finally made an appearance. Three days presented clouds suitable for seeding. In June, the weather pattern became such that disturbances affected the area approximatley twice a week, with seeding missions spread out rather evenly during the month. Seeding missions occurred on nine days during the month. Table 1 shows information about flights for the 2010 season through August 29th.

Rainfall in June was above normal across the central and northeast portions of the target area as well as the far southern reaches, while below to much below normal rainfall occurred over the northwestern third of the target area. July turned out to be quite wet for much of south Texas as several tropical waves and a decaying Hurricane Alex affected the area. Rich tropical moisture flooded the area at times, particularly at the beginning of the month right after Hurricane Alex made landfall south of Brownsville; incredible precipi-

STWMA Continues on Page 4

STWMA Continued from Page 3

table water values were measured from the RAOB at Corpus Christi at 7pm on July 1st with a value of 2.99 inches, and this was an uncontaminated sounding! The frequency of these airmass intrusions resulted in many clouds having "tropical profiles" – very efficient rain producers but not always responsive to seeding. Still, there were enough suitable clouds for eight days of seeding operations during the month. Rainfall amounts were upwards of 300 percent of normal over the southeastern half of the target area, and all but east-central Bexar County saw above normal rainfall. The excessive rains resulted in temporary no-seed zones being enforced in Wilson, Karnes and southern parts of Bee and Live Oak counties which extended into August. By August, strong mid and upper level high pressure had begun to dominate the weather over much of Texas, with a string of hot, dry days and 100°F+ temperatures. A few flights occurred during the second week of the month but seedable clouds were few and far between. The latter half of the month was a little more promising with six seeding flights over three days plus one reconnaissance flight. As of the present time, STWMA is running a bit behind the 13 year average as far as total operational days, flights and flare usage.

The rainfall pattern during the year was at least partially affected by ENSO (El Niño-Southern Oscillation) variations. A rather strong El Niño at the beginning of the year transitioned to La Niña during the summer months. El Niño typically brings cooler and wetter winters to south Texas while La Niña can contribute to somewhat wetter summers as it allows for a better environment for tropical disturbances (waves/cyclones) to move across the Atlantic and Gulf of Mexico, several of which affected south Texas.

Month	Seed Days	Flights	Hours	Flares
March	0	0	0	0
April	0	0	0	0
May	3	5 (2)	6.0	28+8*
June	9	19 (1)	27.2	231+5H
July	8	11 (1)	18.7	148
August	4	10 (2)	15.8	54+6*
Totals	24	45 (6)	67.7	461+14* +5H

Table 1 charts operations in the STWMA through August 29th. Under flights, values in parentheses indicate reconnaissance flights. Under flares, the * represents potential flare usage with randomized cases, and H represents hygroscopic flares.

Matt Pope of the STWMA returning to the hangar after a cloud seeding mission.

Panhandle Groundwater Conservation District

By Jennifer Wright Puryear

The Panhandle Groundwater Conservation District (PGCD) 2010 Precipitation Enhancement operations were ready to go in mid March; however, the first seeding flight did not occur until April 11th. During April, strong winds from the south and southeast through the middle of the month helped to set the stage with rich moisture content from the Gulf of Mexico. A mesoscale convective system (MCS) moved through on April 14-16, and another round of thunderstorms on April 19-20 and 22nd dropped large amounts of rainfall across the Texas Panhandle. The high totals were seen in a stretch between White Deer and Pampa; however, much of the Panhandle saw close to three inches. Table 1 shows the rainfall at Amarillo and White Deer compared to their departure from normals.

Month	Seeding Missions	Hours	Flares
April	6	12	45
May	7	19	56
June	10	25	292
July	16	48	242
August	8	22	187
Total	47	126	822

Table 1 shows the number of seeding mission, hours flown and flares used for the 2010 PGCD Precipitation Enhancement Program.

May and June were very similar to April except for the addition of severe weather. Four missions were ended short due to the occurrence of severe weather. The strong winds from the south and southeast continued to aide the high moisture content across the Panhandle. As in April, the high rainfall totals were seen in the middle of the Panhandle.

July was full of even more moisture content with the affects of Hurricane Alex that made landfall 100 miles south of Brownsville, Texas. The moisture was kept in place with the continuous south and southeasterly winds. This moisture combined with weak forcing allowed for several days of showers and thunderstorms. These showers and thunderstorms brought a lot of heavy rains, and with the lack of a stearring current some areas saw some flash flooding. On July 7th, a heavy rain event occurred bringing 10.5 inches of rain just east of the National Weather Service in Amarillo, which caused some flooding including Highland Park Independent School District and the Pantex Plant.

August is where the transition occurred in the Panhandle. Moisture content was still in place, but the lack of forcing has lead to the lack of showers and thunderstorms. During the few events that have occurred in the District, the clouds have been very high and less convective. A stronger cold front moved through the evening of the 14th and brought cooler temperatures and a stable atmosphere. The last week in August the Panhandle was held between an upper level ridge to the east and an upper level trough to the west, which has lead to showers and thunderstorms in eastern New Mexico, but kept the Panhandle dry.

This has been an above average seeding year at PGCD with number of flights and flares used. Table 2 below shows the number of flights including seeding and reconnaissance, number of flares used and number of hours flown. Another pilot, Aaron Woolsey, was added to the staff this year. Woolsey is trained in the Piper Comanche, and Pilot Harrison Hoffman has also been training in the Piper Aztec. During 2011, we hope to have three pilots to rotate throughout the season.

Along with the other Texas projects, PGCD is in the process of gathering data using hygroscopic flares in addition to glaciogenic flares. PGCD has only been able to use a small amount of hygroscopic flares due to the dynamics of the atmosphere. The Panhandle has mostly been characterized with weak, tropical clouds are large convective systems. A lack of isolated continental type clouds has lead to less hygroscopic flare testing.

The PGCD 2010 seeding season is expected to end on September 30th. Look for the end of season report in the next newsletter.

	Amarillo Rainfall	Amarillo Departure	White Deer Rainfall	White Deer Departure
April	3.28	1.95	4.46	2.66
May	2.19	-0.31	4.60	1.50
June	1.0	-2.28	2.06	-1.22
July	8.02	5.34	3.86	0.76
August	2.55	-0.31	1.53	-1.41

Table 2 shows rainfall in inches for the PGCD area and their departures from normals.

WMA Continued from Page 1

radar software system in use with the weather modification projects in Texas.

On the second day of the meeting, the first series of talks dealt with weather modification research and operations in Israel. A presentation on a thermodynamic profiler for weather modification operations was given as well. Late morning and afternoon talks centered on wintertime weather modification programs in the United States. The final keynote presentation of the day discussed using a vertically-pointing airborne radar to show the impact of glaciogenic seeding on snowfall from orographic clouds. At the end of the daily presentations, a poster session, which included a poster summarizing the Texas projects' activities in 2009, was held and this extended into the social hour before the banquet that evening. During the banquet, several awards were given out. Archie Ruiz from Active Influence and Scientific Management received the Black Crow Award, given yearly to a WMA member who has suffered a series of adversities or mishaps, usually a result of their own doing (for Archie, his performance in Mendoza, Argentina singing a tango was the reason for the award). Tommy Shearrer, manager of the South Texas Weather Modification Association (STWMA), president of the Texas Weather Modification Association and former WMA president, received a Weather Modification Administrator Distinguished Service Award presented by Stephanie Beall. Todd Flanagan, STWMA Meteorologist, received a Weather Modification Field Meteorologist Distinguished Service Award presented by George Bomar.

The final day of the meeting started with the business meeting, where STWMA Meteorologist Todd Flanagan was voted in as WMA president for 2010-2011. Afterwards, a special session titled "Cloud Seeding for Precipitation Enhancement: Status Update" was held with four talks being given by scientists with subtopics dealing with precipitation processes, hygroscopic seeding, wintertime glaciogenic seeding and the evolution of cloud and precipitation modeling over the past 20 years. The meeting ended at midday with attendees leaving with fresh ideas and knowledge.

The site for the 2011 Annual Meeting of the WMA was chosen to be Park City, UT.

Hygroscopic Seeding Review

By Stephanie Beall

For the past several years in Texas, only one type of seeding has been conducted. Glaciogenic seeding has been the seeding method of choice until recently and in Texas both theories of glaciogenic cloud seeding, static and dynamic, are considered feasible.

For those who need a little review, glaciogenic seeding is cloud seeding that is aimed at increasing ice nuclei into a developing cloud. This is done by introducing silver iodide in a developing turret on top of the cloud or into a developing cloud's inflow region at base. The introduction of silver iodide into the cloud increases the ice crystal concentration in clouds by either nucleating new crystals or freezing cloud droplets. When these crystals grow large enough, they become heavy and start to fall. As they fall, they melt and become rain. The process is somewhat similar when using hygroscopic material to seed. The idea of hygroscopic seeding is to introduce salt particles into the cloud in order to promote the collision-coalescence process. Clouds that are mainly warm but contain some naturally occurring ice are good candidates for hygroscopic seeding. This enables the cloud to grow taller above the freezing level, where more supercooled liquid droplets can form. The Texas programs are using a sodium chloride flare that has a specific particle size that is more conducive for Texas clouds. The burn time for a sodium chloride flare is about three to four minutes, much longer than the traditional silver iodide flares. The flare also burns much brighter than silver iodide flares with a bright pink flame. In Texas, hygroscopic seeding is currently being conducted in tandem with silver iodide seeding, when appropriate. Targeting clouds is similar when using silver iodide but hygroscopic seeding is not being used on deeper, more robust convection. In addition to the seeding technique, a randomized mentality is used. The idea is to compare these cells to cells that would otherwise be seeded only with silver iodide and then analyze these clouds to see what the difference would be.

Thus, seeding with hygroscopic material would not occur with every cloud on a particular operational day, but only a small portion of them. Hygroscopic seeding has been tested in many locations throughout the world over the past several years, with experiments conducted in South Africa, Thailand, India, and of most importance to Texas, Mexico. The Program for the Augmentation of Rainfall in Coahuila (PARC) was conducted in northern Mexico during the summers of 1997 and 1998. The experimental procedures that were used in the South African experiments were used in Mexico. The results were deemed statistically significant, similar to the Thailand and South African experiments (Silverman, 2003). The Mexican experiments showed that seeded clouds tended to live longer than unseeded clouds (Bruintjes et al., 1999). More information about hygroscopic seeding research can be obtained through project meteorologists.

References:

Bruintjes, R.T., D. W. Breed, M. J. Dixon, B. G.

Hygroscopic Continues on Page 8

2010 Texas Half-Season Cloud Seeding Report (up to June 30th)

By Dr. Arquímedes Ruiz Columbié
Active Influence & Scientific Management

This year cloud seeding operations in Texas began on March 8th when the West Texas Weather Modification Association project seeded its first storm over Schleicher and Sutton Counties. The other projects followed shortly. In general terms, warm ENSO conditions (El Niño) dominated the Equatorial Pacific Ocean at the beginning of the season (early spring) and promoted high moisture values within the cloud layer. However by May, ENSO neutral conditions took place and the aforementioned pineapple connection was over with the consequent environment dry-out.

The previous comment is illustrated by table 1 which shows the rainfall behavior at some locations over West and South Texas. Positive anomalies were observed in March and April, but negative anomalies were present in May and June.

	March	April	May	June
Amarillo	1.61 (0.48)	3.28 (1.95)	2.18 (-0.32)	1.00 (-2.28)
San Angelo	1.17 (0.18)	2.65 (1.05)	1.42 (-1.67)	1.96 (-0.56)
San Antonio	2.09 (0.20)	3.57 (0.97)	4.48 (-0.24)	4.24 (-0.06)

Table 1 shows 2010 rainfall in inches and anomalies at some location throughout the state. Source is www.weather.gov.

Projects	Operational Days	Seeded Clouds	Flares	Timing	Dose	Season Rain (inches)	Increase
PGCD (White Deer)	11	13	312	1.00	65	8.1	~ 12 %
WTWMA (San Angelo)	16	37	738	0.95	105	7.2	~ 18 %
TPWMA (Pecos)	14	16	106	0.86	35	4.1	~ 7 %
STWMA (Pleasanton)	12	39	268 5 Hygros	0.90	110	8.7	~ 8 %
SWTREA (Carrizo Spring)	13	33	457 7 Hygros	0.81	110	5.3	~ 17 %
State	66	138	1881 12 Hygros	0.90	85 i-n/l	6.7	~ 12 %

Table 2 summarizes the cloud seeding performance per project and for the whole state up to June 30, 2010.

Meet Herb Speckman from PGCD

By Jennifer Wright Puryear

Chief Pilot Herb Speckman has been with the Panhandle Groundwater Conservation District (PGCD) since the second year of the Precipitation Enhancement Program in 2000. Herb flies the District's twin engine Piper Aztec, takes care of any maintenance issues the aircraft encounters and trains any new pilots about weather modification flying.

Herb got his start with aircrafts when he enlisted in the United States Air Force (USAF) in 1953, at the age of 17. After serving 4 years in the USAF, he enrolled at Quincy College, in Quincy, Illinois, and received a Bachelor of Arts in Psychology. Herb re-entered the USAF in October of 1962, and graduated from Officer Training School and pilot training. From November 1965 until November 1966 he served as a forward air controller in Vietnam. During this time he was awarded the Silver Star, three distinguished Flying Crosses, Bronze Star and the Vietnamese Cross of Gallantry.

In December 1978, Herb left the USAF and joined General Dynamics, Aerospace Services Division, in Fort Worth, Texas, as chief of maintenance of the F-16 program in Iran. After this, he moved on in 1986 to become member of the subcontracted security police force at the Pantex Department of Energy installation in Amarillo, Texas. Pantex is where he met his wife Carol. Herb and Carol enjoy camping in their spare time, and currently reside in Canyon, Texas.

Texas Weather Modification Project's Contact Information

Panhandle Groundwater Conservation District
Jennifer Wright Puryear
P.O. Box 637
White Deer, Texas 79097
jwright@pgcd.us

West Texas Weather Modification Association
Robert Rhodes
8696 Hangar Road
San Angelo, Texas 76904
meteorologist@wtwma.com

Southwest Texas Rain Enhancement Association
Stephanie Beall
110 Wyoming Blvd
Pleasanton, Texas 78064
wxbliss21@yahoo.com

Active Influence and Scientific Management
Dr. Arquímedes Ruiz Columbié
6506 86th Street
Lubbock, Texas 79424
archie007@suddenlinkmail.com

SOAR
11555 County Road 305, P.O. Box 130
Plains, Texas 79355

South Texas Weather Modification Association
Todd Flanagan
110 Wyoming Blvd
Pleasanton, Texas 78064
toddrf72@yahoo.com

WMA Continued from Page 6

Brown, V. Salazar, and H. R. Rodriguez, 1998: Program for the augmentation of rainfall in Coahuila (PARC): Overview and preliminary results. Preprints, *Conf. on Cloud Physics and 14th Conf. on Planned and Inadvertent Weather Modification*, Everett, WA, Amer. Meteor. Soc., 600.603.

Silverman, Bernard, 2003: A Critical Assessment of Hygroscopic Seeding of Convection Cloud for Rainfall Enhancement. *Bull. Amer. Meteor. Soc.*, **84,** 1219-1230.

Texas Weather Modification Association Program Officers

President: Tommy Shearrer, Pleasanton

Vice President: C.E. Williams, White Deer

Secretary: Ed Walker, Carrizo Springs

Treasurer: Craig Funke, San Angelo

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

RETURN SERVICE REQUESTED