

Coyote Crier

The Spotter News for Southeast Arizona

National Weather Service, Tucson AZ

December 1996 Vol. 3, No. 2

The National Weather Service SKYWARN Weather Spotter Program

The 800 number is here!

1-800-238-3747

We now have an 800 number for spotters only to call in reports. Rather than making a collect call, those outside of Tucson can use the 800 number. If your call is local, continue using 670-6526 or 670-6118.

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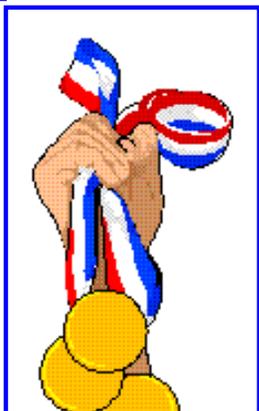
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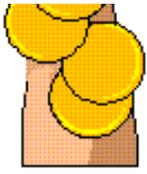
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Summer Olympic Weather Forecasting

by Paul Flatt

Its 10:30 A.M. and the phone rings. "This is the velodrome. We have a race scheduled at



11:15 A.M. that will last until 12:00 noon. Will the rain end in time for the race and will it stay dry until the race is over?" The forecaster replied that the rain would end at 11:00 and another rain shower would move over the area at 12:00 noon. Questions like this were asked several times per day during the summer Olympics in Atlanta. Using the latest technology to observe and forecast the weather, we answered these questions with unparalleled accuracy.

I was one member of the 19 person team of forecasters (15 from the United States, three from Canada, and one from Australia) assembled in Atlanta in late June to provide weather forecasts for the summer games. We spent the first two weeks training on the new equipment and orienting ourselves to the weather patterns of northern Georgia. The next four weeks we provided site specific forecasts and warnings to each of the venue locations.

Each venue location received a forecast of general weather conditions expected over the next five days. The first two days were broken down into three hour increments while the 3rd through 5th day was more general in nature. In addition to the general forecast, we provided site specific warning and statements as needed for a variety of weather conditions. Each location had specific weather criteria they were to be warned about. Some locations needed information about thunderstorms and strong winds, other locations needed information about wind shifts, and the velodrome needed information on dew formation as well as thunderstorms and wind. The velodrome is a banked bicycle track made of wood. Any amount of water on the track makes the track too slick to use.

The weather during the Olympics was quite varied. We had some hot days with a heat index approaching 105, we had some cool days with light rain lasting most of the day, and we had plenty of warm muggy days with showers and thundershowers. The tool that proved to be most beneficial was the WSR-88D radar. Using the radar we forecast the development and movement of showers. We also had use of a special computer model that forecast the basic weather parameters on a grid just over 1 mile on each side. This compares to models in use throughout the rest of the NWS that are 50 miles on each side. This model was able to predict the placement of rain showers and wind shifts on a much finer scale than is available with the standard computer models. One special tool we had was a three-dimensional display of the model output. This display allowed us to see in three dimensions how clouds and winds would develop over a 24-hour time frame. The display we used was difficult to use at times but shows promise for future use as computers become more powerful.

My duties during the Olympics varied from the short term forecaster (less than six hours), long term forecaster (days one through five) and media relations. While working the media relations shift I was interviewed by several international television crews. The startup of MSNBC occurred shortly before the start of the Olympics and I did two live interviews with MSNBC. Hurricane Bertha skirted the coast just before the Olympics started and I was interviewed by Atlanta TV stations on the track Bertha was going to take.

While in Atlanta I was able to attend two events: an evening at the Olympic Stadium for track and field and the super-heavyweight weight lifting event. At the track and field event I saw Carl Lewis win his gold for the long jump and Michael Johnson win the gold for the 400M race. The mix of forecasters that were brought together turned out to be a fantastic team. Being part of this team was the experience of a lifetime and will always be fondly remembered.

So, how did the forecast for the velodrome turn out? The rain ended at 11:05, the race started at 11:15, the next rain shower moved over the velodrome at 12:05. Just another day forecasting at the Olympics.

Winter Spotting Criteria

Just a reminder of what you should be watching for during the winter months...

	Heavy Rain	1/2 inch or more per hour, or storm total of 1+ inches.
	High Wind	Estimated/measured 50+ mph
	Flooding	Of any kind, road damage, major bank erosion.
	Heavy Snow	Accumulating at 1 inch or more per hr, total of 3+ inches
	Low Visibility	1/4 mile or less, any reason

Also Any weather-related death, injury, or damage.

New Satellite Technology at NWSO Tucson

by Darren McCollum



A key piece of the modernized National Weather Service will be the detailed analysis of satellite imagery. In preparation for the demands of future satellite analysis the NEXRAD Weather Service Office (NWSO) at Tucson has obtained a new satellite data display computer called RAMM Advanced Meteorological Satellite Demonstration and Interpretation System (RAMSDIS). RAMSDIS was developed to allow forecasters to become familiar with new satellite data and products. It is a test bed for the types of computer software that will be used when the Automated Weather and Information Processing Systems (AWIPS) workstation arrives at the NWSO, Tucson.

The most important aspect of RAMSDIS is speed! It can handle more data more quickly than any of our previous

satellite computers. It is run on a PC using the OS/2 operating system. A Pentium chip is the engine that drives this speedster! A faster computer means we can run longer loops, more loops, shorter time steps between frames in a loop, use higher image resolutions and apply nifty analysis tools as never before. To give you an idea, it would take approximately 100 of our previous satellite systems, all hooked together, to approach the performance level of just one RAMSDIS.

A loop of high resolution satellite images can be created in just a few seconds using RAMSDIS and numerous loops can be stored at once. On the old system it would have taken a couple minutes to plot up just one of these loops. RAMSDIS allows the detailed analysis of the progress and structure of weather systems from large Pacific storm systems right down to individual thunderstorm cells. Another advantage of RAMSDIS is that numerous satellite loops can be stored at once. With a simple stroke of the keypad the forecaster can look at a visible imagery loop, another stroke and within seconds an infrared loop appears another stroke and water vapor imagery appears.

RAMSDIS also allows the forecaster to pick an area on which to center the satellite loop or image with ease. So if you want the image centered over Las Vegas instead of Tucson we only enter a few commands and in seconds the image is recentered. The color enhancement of satellite imagery can be rapidly adjusted using a computer mouse control on RAMSDIS. This feature allows us to investigate cloud structure, height, movement, boundaries at all levels, temperature differences, topographic differences etc. in great detail. This function is critical when determining the structure of the overall weather pattern and individual storms. Another RAMSDIS option is to average satellite images over a number of hours. This is useful if you want to estimate precipitation amounts under clouds or identify which areas have received the most sunshine during the day (especially important for forecasting instability and thunderstorms). RAMSDIS also allows the forecaster to read individual data points on a satellite image such as the temperature of a cloud top or the surface of water. We can also overlay surface and upper-air data sets on satellite imagery for quick and easy analysis. On top of all this RAMSDIS allows the forecaster to easily archive satellite data sets for case studies that can be used for training other staff members.

RAMSDIS is compact, fast and versatile. It makes use of the dramatic technological advances that allow for rapid data processing, easy handling of graphics images and the archive of data. In the future even further advances will be made allowing model data and satellite data to be combined.

In the next Coyote Crier I will talk about the new GOES-8 and -9 satellites, the latest generation of satellite imagery, data and products.



The Storm of the Summer

by Andy Bryant

Up until September 3rd, Tucson had seen a few impressive storms during this summer's monsoon. However, the thunderstorms on the morning of September 3rd that pounded the city put the previous storms to shame and made their mark as the most severe and destructive storm outbreak of the summer.

Thunderstorms began to develop just north of the Santa Catalinas at about 5 a.m. and moved south over the Foothills area of Tucson. Individual storm cells continued to develop over this area during the next 4 hours. This redevelopment of storms over the same area is called "train-echoing." Doppler radar showed individual storm cells moving to the south, with new ones developing to the north. So, just like a train with many cars passing over the same point, several storm cells passed over Tucson's north side.

Storms were not limited to just the north side of town. The official rainfall at the National Weather Service office was 1.45 inches, with between 1 and 2 inches reported in most areas of the city. However, the Foothills area was the hardest hit, with between 2 and 5 inches of rain, damaging winds, large hail, and very frequent lightning. Spotter 191, located near Craycroft and River Roads, reported a storm total of 4.8 inches with significant damage to their property. Spotter 114, at Swan and River, measured 3.96 inches, with most of that falling in a two-hour span. These are only two of the many reports that NWS Tucson received that morning.

With all that water falling out of the sky, normally-dry washes filled rapidly, and many flowed out of their banks, washing out roads and filling several homes with mud. This was the epitome of a flash flood event, and many morning commuters were surprised by the rapidly-rising water. Between 30 and 40 rescues were made of motorists trapped in flooded roadway dips and washes. Thankfully, no lives were lost. Even after the water passed, many roads remained closed for several hours due to the mud, rocks, and debris left behind.

The flow in the Rillito River at Dodge Blvd. peaked at nearly 10,000 cubic feet per second, the highest flow at this gage since the winter of 1993. This flow, combined with runoff from the other storms around Tucson and Green Valley, resulted in an impressive bank-to-bank flow on the Santa Cruz River at the Ina Road Bridge, as shown in the picture below.

Along with the very heavy rainfall and flash-flooding, this event was unusual due to its time of occurrence. Summer-time thunderstorms typically occur in the afternoon or evening, but the September 3rd event happened in the morning. The cause of these storms is not completely clear, but obviously the daytime solar heating which causes convection did not play a direct role. Often times, outflow boundaries, which are winds that flow out of collapsing storms, are another factor in thunderstorm development. It appears that an outflow boundary from storms around Flagstaff the previous evening may have traveled all the way to southern Arizona and interacted with a very unstable atmosphere over the Catalinas and Tucson's north side, resulting in the early-morning explosion of thunderstorms over Tucson.

The storms of September 3rd reminded everyone in Tucson and southern Arizona of the awesome power of thunderstorms and flooding, and how quickly nature can bring the routine of city life to a stand-still. The NWS staff is very appreciative of the many spotter reports of heavy rain and flooding which assisted us in getting out timely Severe thunderstorm and Flash Flood warnings and statements to the public.

Here's a condensed collection of forecaster John Glueck's monthly climate summaries for the months June through November of this year...

...3RD WARMEST JUNE ON RECORD...

Well-above normal temperatures and no measurable rainfall dominated the June weather stories. The average temperature was 87.4 degrees or 3.6 degrees above normal and ranks as the third warmest June on record. This marks the twelfth consecutive month of above normal temperatures. Since July 1995, the average temperature has been 71.4, which ranks as the warmest July-through-June period on record. Temperature extremes in June ranged from a high of 107 degrees on the 3rd, 4th, 8th, and 19th to a low of 60 degrees on the 1st. 107 degrees recorded on the 3rd tied the daily record previously set in 1990 and 1988.

With officially no measurable rain in June, the streak of consecutive dry days hit 108. This is the third longest streak of this kind on record. The latter part of June showed indications of an early start to the monsoon season, with an official beginning on the 30th.

<u>...June 1996 stats...</u>	<u>Month</u>	<u>normal</u>	<u>departure</u>
<u>Average high temperature</u>	<u>102.3</u>	<u>99.6</u>	<u>+ 2.7</u>
<u>Average low temperature</u>	<u>72.4</u>	<u>67.9</u>	<u>+ 4.5</u>
<u>Average temperature</u>	<u>87.4</u>	<u>83.8</u>	<u>+ 3.6</u>
<u>Precipitation</u>	<u>trace</u>	<u>0.20 "</u>	<u>- 0.20 "</u>

...FIRST MEASURABLE RAIN IN OVER THREE MONTHS ON JULY 3RD...

Although still below normal, the monsoon season got off to its best start since 1990 with 1.88 inches of rain recorded at the International Airport. The past five July's (1991-1995) had well-below normal rainfall, all with less than one inch. In fact, the total rainfall in this span of July's from 1991 through 1995 is 2.08 inches. The rain gauge network across Tucson showed that the highest monthly totals occurred on the east and north side of town. The northwest side had the least amount of rain.

Two major weather stories occurred during in July. The first occurred on the 3rd, with Tucson International Airport recorded .28" of rainfall, ending the second longest streak on record of days with no measurable precipitation at 110 days. The record is 114 days, set in 1950 between September 8th and December 30th. The second main weather story was the first big severe weather outbreak that affected the Tucson metro area on the 8th. Davis-Monthan AFB recorded a 94mph peak wind gust from a severe thunderstorm, which set the state record for highest recorded peak wind. The old record was 92 mph in Mesa on August 13th, 1983.

Above-average temperatures continued for the thirteenth straight month in Tucson. Temperature extremes ranged from a high of 107 degrees on the 30th to a low of 70 degrees on the 9th and 15th. No record high or low temperatures were set during the month.

<u>...July 1996 stats...</u>	<u>Month</u>	<u>normal</u>	<u>departure</u>
<u>Average high temperature</u>	<u>100.9</u>	<u>99.4</u>	<u>+ 1.5</u>
<u>Average low temperature</u>	<u>76.3</u>	<u>73.6</u>	<u>+ 2.7</u>
<u>Average temperature</u>	<u>88.6</u>	<u>86.6</u>	<u>+ 2.0</u>
<u>Precipitation</u>	<u>1.88 "</u>	<u>2.37 "</u>	<u>- 0.49 "</u>

...WEAK TORNADO SPOTTED ON AUGUST 14TH...

Above normal temperatures continued for the fourteenth straight month in Tucson. The August average temperature of 86.4 ranks as the seventh warmest August on record. Extremes for the month ranged from a high of 106 degrees on the 12th and 13th to a low of 70 degrees on the 28th. The high of 106 degrees on the 13th tied that date's record high of 106 degrees set in 1994 and 1962.

The biggest story of the month was a very weak tornado that was spotted on the 14th near Ina and Thornydale Roads in northwest Tucson. The tornado caused little or no property damage. Precipitation for the month was below normal with 1.87 inches recorded at the International Airport. Pima County's rain gauge network around Tucson showed that most locations received between two and four inches. Summer 1996 was the second hottest on record. The average temperature was 87.4 degrees, 2.5 degrees above normal. The hottest summer on record occurred in 1994 with an average temperature of 89.9 degrees.

<u>...August 1996 stats...</u>	<u>Month</u>	<u>normal</u>	<u>departure</u>
<u>Average high temperature</u>	<u>98.2</u>	<u>96.8</u>	<u>+ 1.4</u>
<u>Average low temperature</u>	<u>74.5</u>	<u>72.1</u>	<u>+ 2.3</u>
<u>Average temperature</u>	<u>86.4</u>	<u>84.5</u>	<u>+ 1.9</u>
<u>Precipitation</u>	<u>1.87"</u>	<u>2.19"</u>	<u>- 0.32"</u>

...SEPTEMBER TEMPERATURES FIRST BELOW AVERAGE SINCE JUNE 1995...

For the first time in 14 months, Tucson recorded a month with below average temperatures. In fact, this was the coolest September in Tucson since 1985, and very cool compared to past Septembers in the 1990's. Temperatures ranged from a high of 97 degrees recorded on the 1st and 8th to a low of 60 degrees recorded on the 28th. The monthly high of 97 degrees mark the first time since 1981 that no 100 degree days were recorded during September. In 102 years of records, this has happened only 13 times.

Several storm systems moved through Tucson during the month with above normal rain recorded at the International Airport. The total of 3.68 inches was 2.01 inches above normal and ranks as the fourth wettest on record. The biggest event occurred on the 3rd when a strong system moved through the Tucson metro area before morning rush hour and dumped very heavy rain across parts of the metro area. The International Airport recorded 1.72 inches for the event, but the Foothills received between 3 and 5 inches, which led to serious flooding in the morning hours. The 1.72 inches record at the airport was the seventh wettest September day on record. The 1996 monsoon season which began in late June and lasted until September 14th was the wettest since 1990 when 9.20 inches was recorded. The 1996 monsoon rainfall total of 6.43 inches was nearly an inch above the normal monsoon rain total.

<u>...September 1996 stats...</u>	<u>Month</u>	<u>normal</u>	<u>departure</u>
<u>Average high temperature</u>	<u>89.3</u>	<u>93.3</u>	<u>- 4.0</u>
<u>Average low temperature</u>	<u>66.0</u>	<u>67.5</u>	<u>- 1.5</u>
<u>Average temperature</u>	<u>77.7</u>	<u>80.4</u>	<u>- 2.7</u>
<u>Precipitation</u>	<u>3.68"</u>	<u>1.67"</u>	<u>+ 2.01"</u>

...OCTOBER '96 -- A TALE OF TWO SEASONS...

October 1996 was definitely a tale of two seasons for residents of the Tucson metro area. The first two weeks of the month saw strong high pressure across the Western U.S. bring much above normal temperatures, on the order of 7 to 12 degrees. Daily highs during this span were all in the 90s with the thermometer topping off at a record 100 degrees on the 9th. This was the second latest occurrence of 100 degrees on record, with the latest having occurred on October 16th in 1991. Speaking of 100 degree temperatures, 1996 had 61 days of highs over 100. This is the least amount of 100+ days since 1990 when only 51 days were recorded.

From 15th through the 19th, the large-scale weather pattern across the Western U.S. changed from a high-pressure ridge to a low-pressure trough. This became apparent on the 21st as a cold front swept across the Southwest with a Tucson high of only 64 degrees. The weather pattern was now set for a stronger, much wetter system to move across the area several days later.

A very cold winter-like system, originating in the Gulf of Alaska, moved into Arizona on the weekend of the 25th through the 27th. Preceding the main weather event on the 26th, a cold front moved through the metro area on the 25th bringing wind gusts of 40 to 50 mph. Blowing dust on Interstate-10 reduced visibilities and caused some accidents. A cold, damp, dreary day then occurred on the 26th with 1.61 inches of rain recorded at the Tucson International Airport. 38 degrees, the low temperature for the month, occurred at 5:05 pm that day. The snow level dropped to 4000 feet with heavy snow above 6000 feet where a Winter Storm Warning was in effect. Mt. Lemmon reported 20 inches, and Catalina Highway was temporarily closed to all traffic except mountain residents and employees. Cold temperatures continued on the 27th with a high temperature of only 59 degrees, breaking that date's record for lowest high temperature. This also ranks as the eighth-coldest daily high temperature on record for October.

Overall, the average temperature was right at normal with above normal precipitation, which brought the yearly total above normal for the first time this year.

...

tale of two seasons...

<u>...October 1996 stats...</u>	<u>Month</u>	<u>normal</u>	<u>departure</u>	<u>Oct 1-</u>
<u>19 Oct 20-31</u>				
<u>Average high temperature</u>	<u>83.7</u>	<u>84.3</u>	<u>- 0.6</u>	
<u>92.6</u>				<u>69.8</u>
<u>Average low temperature</u>	<u>57.1</u>	<u>56.6</u>	<u>+ 0.5</u>	
<u>64.6</u>				<u>45.1</u>
<u>Average temperature</u>	<u>70.4</u>	<u>70.4</u>	<u>0.0</u>	
<u>78.6</u>				<u>57.4</u>
<u>Precipitation</u>	<u>1.74"</u>	<u>1.06"</u>	<u>+ 0.68"</u>	
<u>0.13"</u>				<u>1.61"</u>

...STRONG WINTER SYSTEM OVER THE THANKSGIVING WEEKEND...

November 1996 began very warm and ended quite cold. Strong high pressure brought above normal temperatures

to Tucson the first three weeks of the month. Highs for the 9th through the 14th were in the mid- 80s. The month ended on a cold note as a strong winter system brought much below normal temperatures over the Thanksgiving weekend. This system also produced the second winter storm of the season, with Mt. Lemmon reporting 7 inches of new snow on the 29th.

Overall, November temperatures were above normal. Temperature extremes for the month ranged from a near-record high of 87 on the 13th to a low of 31 on the 30th. Rainfall was again below normal with only .19 inches recorded at the International Airport.

<u>...November 1996 stats...</u>	<u>Month</u>	<u>normal</u>	<u>departure</u>
<u>Average high temperature</u>	<u>74.7</u>	<u>72.7</u>	<u>+ 2.0</u>
<u>Average low temperature</u>	<u>47.2</u>	<u>45.6</u>	<u>+ 1.6</u>
<u>Average temperature</u>	<u>61.0</u>	<u>59.2</u>	<u>+ 1.8</u>
<u>Precipitation</u>	<u>0.19 "</u>	<u>0.67 "</u>	<u>- 0.48 "</u>

<u>...1996 thru november...</u>	<u>Year</u>	<u>Normal</u>	<u>Departure</u>
<u>Average high temperature</u>	<u>86.0</u>	<u>83.9</u>	<u>+ 2.1</u>
<u>Average low temperature</u>	<u>58.2</u>	<u>56.1</u>	<u>+ 2.1</u>
<u>Average temperature</u>	<u>72.1</u>	<u>70.0</u>	<u>+ 2.1</u>
<u>Precipitation</u>	<u>10.50 "</u>	<u>10.93 "</u>	<u>- 0.43 "</u>

Spotter Reports

-
Here's an interesting sampling of the hundreds of reports that came in this summer:

-
7/5 #21 Nogales

Tstms moving northwest. 30-40 mph wind gust. Five miles south sky black and looks like torrential rain.

-
7/8 3:20 pm #330 Doug in Bisbee

1.04" rain in 40 minutes. Frequent lightning.

-
7/8 7:40 pm # 183 Donald in Eloy

1.3" rain in one hour.

-
8/14 5:10 pm Pima county sheriff

Report of tornado on the ground at Ina and Thornydale.

-
8/14 5:18 pm Rural Metro Engine #76

Tornado at Ina and Thornydale

-
8/16 5:26 pm #169 Brian in Tucson

68 mph peak wind measured. Visibility zero. Road barricades blown over.

-
8/17 7 pm #381 Jan in Elfrida

3" rain between 6:05 pm and 7:00 pm. Wind estimated in excess of 60 mph. Blew a one ton truck 100-150 feet. Ankle deep water flowing over area. Wind recorder blown off its stand.

-
8/18 1:40 pm #189 Chuck nr Arivaca Creek

2" rain in 20 minutes. Small hail.

-
8/27 6:08pm #328 Hundson Farms, Willcox

1.5" rain in about one hour. 30-40 mph wind

8/29 9:26 pm #327 Harold in Benson

>1" rain and still coming down heavy. Wind 54 mph.

-
9/1 6:50 pm #247 Ray in Elgin

2.4" rain. Significant flow in Babocomari River.

-
9/1 3:20 pm #315 Robert in Sierra Vista

Heavy rain and cloud to ground lightning.

-
9/3 8:40 am #191 David in Tucson

4.8" rain since 5:30 am. Flooding of backyard, water in house, damage to driveway.

-
9/3 7:40 am #134 Karl in Tucson

2.55" rain. Small hail. Sabino Creek flowing.

-
9/3 8:50 am #140 Jean in Tucson

2.89" rain.

-
9/3 1:30 pm #114 Walter in Tucson

3.96" rain in about 2 hours this morning.

9/3 2:30 pm #190 Ken in Tucson

4.00" storm total rain.

9/3 7:30 pm Pima #71 Ajo Sheriff

Roads near Organ Pipe Cactus NM impassable due to flooding.

Trail's End News Briefs

* *NWSO Tucson welcomes Rich Okulski*

Forecaster Rich Okulski recently joined the NWS team in Tucson. He and his wife, Kimberley, moved here from Medford, Oregon. He began his NWS career in Phoenix and is glad to be back in Arizona. Before his NWS career began, Rich served as an officer in the U.S. Army and is a veteran of the Persian Gulf War.

* *New Building Update*

The Environmental and Natural Resources Building at the corner of 6th and Park on the U of A campus is nearing completion. We plan to officially "move in" by February 10.

* *Thanks to Student Volunteer Travis Booth for his work on this newsletter.*



Happy Holidays from the NWSO Tucson Staff!



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John Glueck

Pat Holbrook

Jim Meyer

Rich Okulski

Sheryl Towle

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Hans Hanson

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