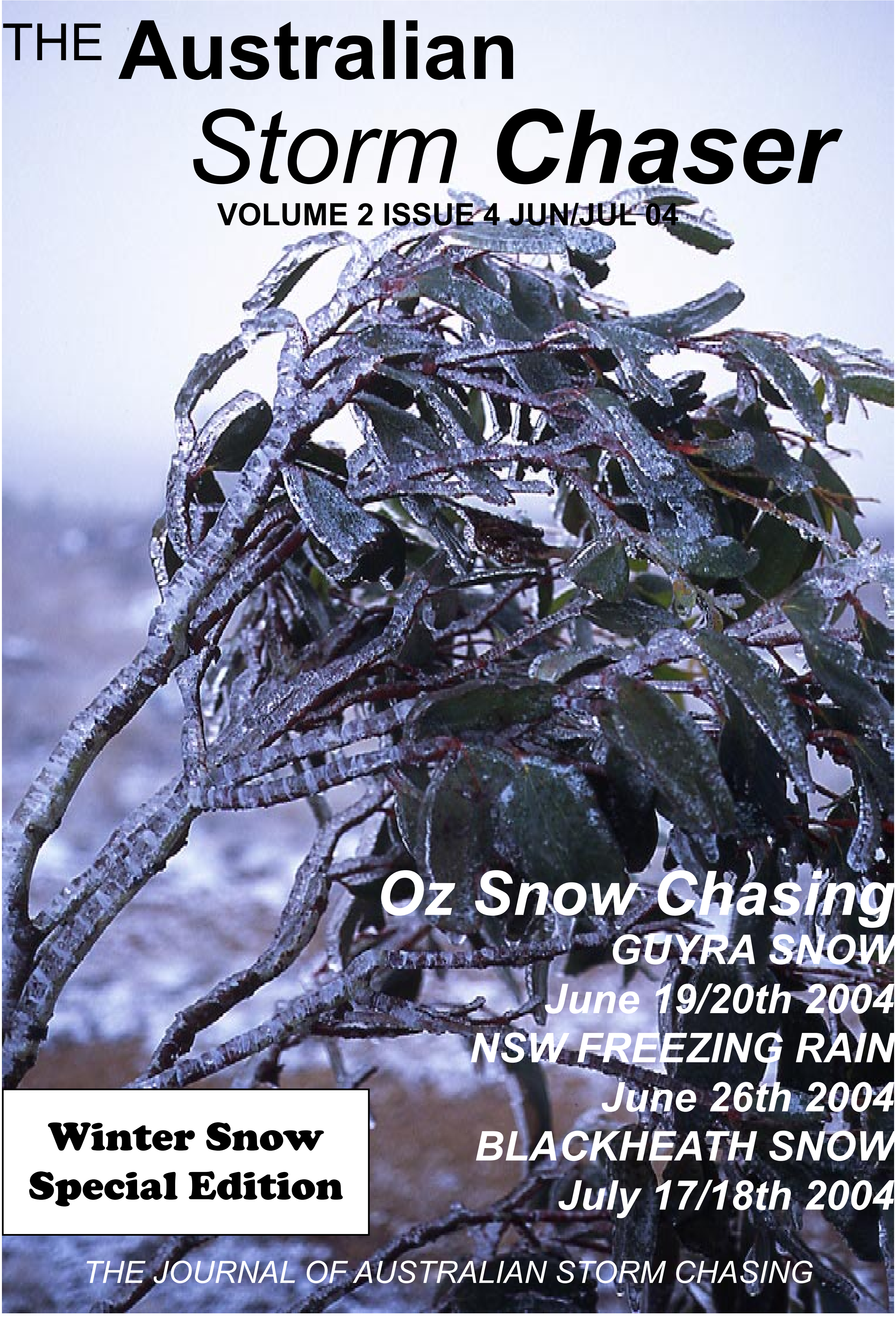

THE **Australian**

Storm **Chaser**

VOLUME 2 ISSUE 4 JUN/JUL 04

Oz Snow Chasing

GUYRA SNOW
June 19/20th 2004
NSW FREEZING RAIN
June 26th 2004
BLACKHEATH SNOW
July 17/18th 2004

Winter Snow Special Edition

THE JOURNAL OF AUSTRALIAN STORM CHASING

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Editorial Staff

Submissions

All submitted articles must be in MS Word format with photos and graphics in a separate file. Articles can be submitted by post on CD, email jbrislane@optusnet.com.au for address or alternatively articles that aren't too large can be submitted via email to mpiper@bigpond.net.au or jbrislane@optusnet.com.au

100 kb is large enough for picture files and please give credits when taking pictures or graphics from sources other than yourself.

Pictures or information submitted without due credit will be discarded. Articles may be shortened or altered for editorial purposes.

Letter from the Editor

Welcome to the June/July edition of the ASC Journal, the Journal of Australian Storm chasing!

June and July are usually two of the most boring months of the year for storm chasers. It's a long wait until the heat returns and the thunderstorms come back and so a lot of Australian storm chasers turn their attention to another weather phenomenon that is unique to winter. Snow! I personally love it and I know a lot of other chasers who feel the same way.

Most years would see the Tablelands west of Sydney receive at least a few falls of snow during winter. But because of the predominately south west flow we get, the Blue Mountains, being east of the Great Dividing Range and a bit lower, tend to miss out on a lot of the snow falls. And when they do get snowfalls, it's usually not as deep or prolonged as it is further west. So this year we gained great satisfaction in seeing snowfalls on both the Central Tablelands and the Blue Mountains.

There were at least 6 good snow events on the tablelands this year and we managed to see not only snow but ice as well from a rare freezing rain event! We intercepted the ice rain on the 26th of June and we intercepted a nice snowfall at Blackheath in the Blue Mountains on the 17th of July. Michael Bath, Dave Ellem and others intercepted snow on the Northern Tablelands on the 19th of June. It's has been lacking that far north in recent years and so when the opportunity came they took it. And lastly I intercepted the biggest snow day on the Central Tablelands since 2001 on the 4th of August when up to 15cm of snow blanketed the peaks west of Sydney and heavy snowfalls occurred throughout the day.

So this month we have a feast of snow experiences for you to enjoy as well as some US storm chasing experiences from Ted Best. There is also an informative article by David Croan on chasing the Riverina region of New South Wales.

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Rare Freezing Rain Event

Oberon New South Wales

June 26th 2004

By Jeff Brislane and Matt Piper

I have been to Oberon many times to see snow over the years. I have seen deep snow and shallow snow and no snow and every other type and depth of snow in between. But until this day I had never seen Ice in the extent that I saw it on this day. And to be honest, I don't if I will ever see ice again like I saw it on this day. To continue this story we have to go back to the week before on Saturday the 19th of June.

Our regular monthly meeting was on tonight and the main subject was Jimmy and Dave's latest storm chasing adventure to Tornado alley. But while I was excited by the prospect of some serious tornado footage, my thoughts kept drifting to the possibility on snowfalls on the central ranges behind Sydney. Cold air was blasting up with a cold front and all available information was suggesting that snow would accumulate down to about 1000 metres and to a depth of up to 15cm along the highest parts of the Great Dividing Range. It was the most exciting cold outbreak since the legendary 2000 event, and it was the buzz on all the weather forums that week.

By late Saturday afternoon a cold front cloud mass was crossing the Blue Mountains and Matt and I decide that we would go to the meeting in Windsor via Bell in the upper Blue Mountains, in the hope of seeing some flakes falling. We were disappointed to find that in fact, nothing had made it across except some light rain. Oh well, it was a nice drive anyway. That evening after the meeting was over, we all gathered around a computer to see what was happening with the cloud mass that was bringing the snow. By now it should have been covering the Central Tablelands in fine white powder, but in fact the system had faltered and was starting to fall away to the south. This was bad news, but for me I was kind of happy because I didn't have a car yet to chase in. The work Ute just couldn't muster up enough traction to be considered safe!

A couple of the guys decided to go anyway and we told them not to expect much as the cloud band looked to have failed to come through as predicted. Snowfalls would probably be light and also be over by the time they got there. Well the next day we found out that there had in fact been a god cover of snow down to about 1200 metres and that there were also some intermittent snowfalls that morning as well. I was disappointed to have missed out but still, the work Ute would have been too dangerous out there to have considered going.

Next week things changed completely. I picked up a new 4wd vehicle and another cold front system was forecast to come through over Friday night. We watched with anticipation as Friday came and everything was going to plan. That night I watched on my computer as a nice cluster of convective cumulus came towards the Central Tablelands ahead of the cold front. They were dropping some heavy showers as they approached the ranges and with plenty of cold air, every indication was that they would dump a fair amount of snow over the higher parts of the mountains. This dumping would also occur in the early morning hours so temperatures at 1200 meters and above were sure to drop to near freezing or below.

With much anticipation we headed out the next morning. I picked up Matt at 6am and we were off to what we thought would be a winter wonderland. We were hoping to see at least 10cm of snow on the ground and with a new 4wd; I was looking forward to driving through it. At Mount Boyce I stopped to refill the tank for the day ahead. I was hoping that there would be a dusting of snow up there at the top of the Blue Mountains, but there was nothing. I asked the girl inside the Caltex if it had snowed at all, but the answer was no. It had rained briefly, but that was it. Oh well, it doesn't always make over the Central Ranges I thought to myself.

We got to Hampton just before daylight and as we drove through the village we could make out a light dusting of snow on some of the rooves. There were a couple of light showers here but nothing white. Just a bit of very cold drizzle. We passed over the highest point on Duckmaloi Road after sun up, and only found the lightest dusting of snow there. I was concerned now as the elevation there is over 1200 metres, which should have been high enough for good snow cover. I wondered now if we were going to se any snow at all.

We had decided this morning that we would go the long way around to Shooters Hill via Black Springs. We headed through Oberon and we were happy to see that the western side of town had received a light dusting of snow. That was just the encouragement we needed. About halfway to Black Springs we climbed up over the 1200 metre contour to finally find that there was some consistent snow on the ground. I was relieved now and hoped that it would get better as we climbed up to 1300 metres closer to Shooters Hill.

It didn't.

We made it wombat ridge and were disappointed to find that the snow above 1300 meters was no better than below. It was thin cover to say the least. We didn't even bother stopping to get out. We rounded the ridge and made it to Shooters Hill to find the same scene. Light snow and lots of wet ground. It was like it rained instead of snowed. But that couldn't be right because all the available information indicated temperatures cold enough for snow, so what happened? At 1050 meters the temperature had dropped to 2 degrees, so surely at 1300 metres the temperature should have been below 0.5.

We got out and looked around anyway. It was bitterly cold and the wind was blowing to about 25 to 35knts. The wind chill would have been around –7 to –10 degrees. I can't remember who noticed it first, but one of us noticed that all then trees were bent right over and creaking as if under a huge weight. We looked a bit closer and then realised that they were covered in ice. And I mean thick ice, thick as one of your fingers. It was absolutely amazing and something I wasn't prepared for. I snapped a few photos and Matt took some video and then we headed off along the ridge north to see the extent of the snowfall.

Everywhere along the road above 1300 meters, the trees were covered in ice. It was the same thickness and it was eerie the way they swayed and groaned under the weight. The only thing that we could remotely connect it to was memories we had of seeing ice storm events on TV from North America. It looked exactly the same.

After about 20 minutes thinking about what we had s een, we came to the conclusion that the lack of snowfall we found was probably because of the occurrence of a rare freezing rain event. Instead of getting the 5 to 10 cm's of snow we thought was possible, the snow must have passed through a warm layer and melted to rain before landing at ground level above 1300 metres, where the temperature was below freezing again. Consequently the rain refroze instantly into ice on everything it touched. When the conditions are right, this process can result in rapid accumulations of ice.

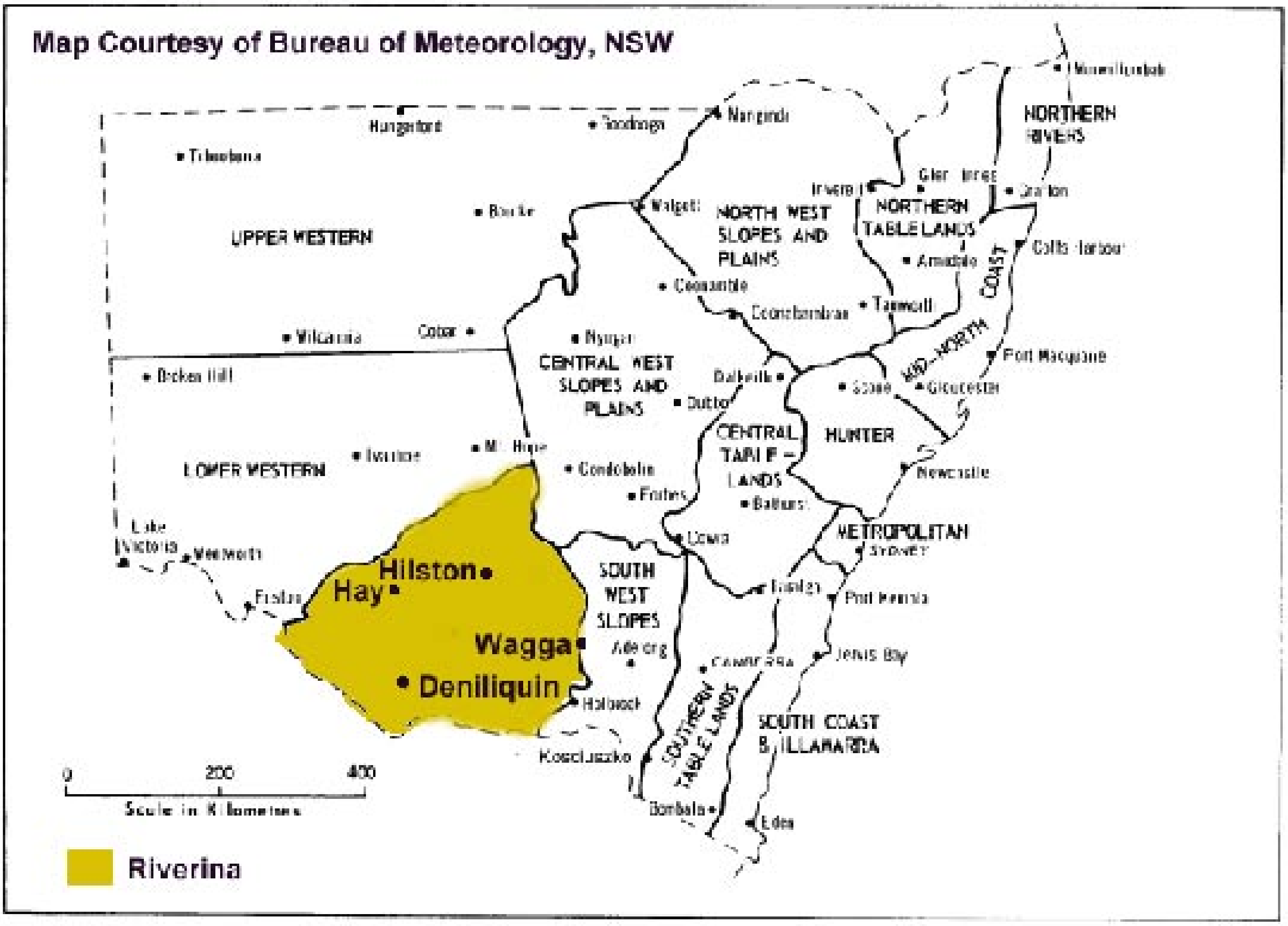
After looking around Shooters Hill Road, we decided to head to Mount Trickett to see if there was any ice there. It turned out that apart from some ice high up on the tower, there was hardly any ice there at all, and nothing on trees like it was back over at Shooters Hill. There also appeared to be a bit more snow on the ground and in the trees here. We stayed here for about 30 minutes and watched in amazement as it began to snow big chunky flakes with the air temperature at +3 degrees! To think that we couldn't get snow over at Shooters Hill (1345m) at 1degree, but at Mount Tricket (1355m) it was snowing at 3 degrees. Very Weird!

After this we went for a bit of four wheel driving down to Mount Werong, and on the way back home we went via Shooters Hill again to take one last look. We were shocked to find that the snow had completely vanished by 11:30am! There wasn't much there to start with, but for it to melt in only a couple of hours was new too us. We got up to the towers and discovered something new about ice. When it's starting to melt up on a 100 ft high tower, stand back! There were massive shards of ice dropping off as they lost their grip in the warmer air temps. The ice made it too dangerous to get out of the car so we watched from inside and got some footage and then headed for home.

We were disappointed about the lack of snow, but at the same time we new we had seen something rare and amazing. Ice is just beautiful and it's the part of winter landscape that we just don't get in Australia very often, and especially not for long when it does happen.

Since we got back there has been debate regarding the validity of the nature of the event that occurred, as to whether it was freezing rain or not. But we believe that it certainly was. It is not an impossible phenomena in South East Australia and it has happened before only recently in the Snowy Mountains, this being documented by the BoM. Also of note is the fact that a number of meteorologists from the BoM have viewed the footage since the event and have concluded that freezing rain was the likely culprit. My only dream now is to see ice rain occur on top of 20 cm's of snow. That would be Fantastic!

Location, Location,
The N.S.W. Riverina



For many years I had wondered about storm chasing the Riverina district of NSW. Well, finally, after years of waiting, the opportunity arose during the early part of December 2003. An inland trough would persist over the area for several days. It coincided with our ASC annual storm chase vacation. For me, personally, to venture out to this region was as much a fact-finding mission as it was a storm-chasing expedition. I was always looking for an excuse to make the 9 hour drive from Sydney. As our group made it west of Lockhart the country flattened spectacularly. Developing Cbs littered the sky…

"The Riverina Region extends from about Narrandera westwards towards the border of South Australia. It is characterized by extremely level conditions, so that the rivers have the habit of delta-streams and distributaries are common. In local floods the water at times flows upstream."
Reference: THE TOPOGRAPHY OF AUSTRALIA, Australian Bureau of Statistics Rainfall across the region is the range 400-500mm per year and thunderdays averaged 15 per annum during the period 1995-2000. The storm-limiting factor during spring and summer is getting southward transport of sufficient quantities of low-level moisture. From a chaser's perspective, it is not the place you would go to sit-it-out in the hope of seeing powerful storms. However, when the moisture is in place, watch out -- the area is then frequently impacted by severe thunderstorms, particularly during November and December. There have been quite numerous tornado reports from the region over the years.

The road network is reasonable in the east and more sparse further west, particularly around Hay. The Sturt Highway runs generally west from Narrandera, The Newell highway NNE to SSW from West Wyalong, Burley Griffin Way east from griifth to meet the Nerwell, and the Cobb Highway runs NS through hay. While the major waterways have beautiful stands of eucalypts, in general the land has been cleaered to the extent that trees are few and far between across very large areas. There are several beaut towns to get some rest, such as Hay, or for the café set, Griffith has a great alfresco culture for a celebratory meal.

…. as our group headed west along the Mid-Western HWY towards Hay, the developing Cbs had exploded and a powerful supercell was moving east, fuelled by CAPE values in excess of 3000 J/kg. As is the case on the USA Great Plains, the incredible landscape accentuates the enormity of the storms. The area is 'panhandle flat', the horizon seems endless, the landscape is vast; almost overwhelmingly so.

If pressed, I would say, based on topography and road network, that this is the best storm chasing country in Australia bar none.

Reality Check: A Case Study of Visual and Radar Observation of the June 12, 2003 Supercells

Ted Best, KD5JEO, Collin County ARES

Abstract

A case study of two supercells in northwest Texas is presented. Doppler WSR-88D base reflectivity radar images are compared to visual observations. The storms occurred near the dryline, and their structure and evolution is analyzed. The importance of visual observations is reinforced. Both storms showed evidence of rotation, and one showed visual evidence of a rear flank downdraft (RFD) with a brief tornado. Rotation at cloud base was visible over 30 minutes prior to the appearance of a visible funnel, but a prototypical wall cloud lowering was not observed. Although radar images show a hook echo signature for both storms, evidence for the RFD and tornado were only identifiable in visual observations of the storms. Convective outlook products provided an accurate forecast of the occurrence, timing, and evolution of the storms six hours in advance.

Introduction

Because of the physical limitations of the current Doppler radar network, visual observation of thunderstorms, or storm spotting, is an important component of the Integrated Warning System (IWS) (Doswell, 1999.) "Ground truth" is a term that meteorologists use to refer to reports from storm spotters. Direct comparison of "ground truth" and radar observation promotes a better understanding of the advantages and limitations of each.

In this paper, a case study with visual and radar observation of two supercell thunderstorms is examined. The supercell thunderstorm is defined scientifically as a thunderstorm with a persistent, rotating updraft (Doswell, 1990.) Visually distinct variants of the supercell are discussed in the literature, but are more difficult to define with precision, and collectively represent a spectrum of characteristics defined primarily by the amount and location of visible precipitation with respect to the updraft (Doswell, 1990.)

The three supercell types commonly referred to in increasing order of visible precipitation are low precipitation (LP) (Bluestein and Parks, 1983), classic (Moller, 1994), and high precipitation (HP) (Moller, 1990.) In addition to visible differences, these storm types may also show recognizable differences in radar reflectivity signatures. In the case of LP supercells, limited precipitation may make them difficult to identify by radar reflectivity alone (Moller, 1994.) The storms in this case study show characteristics of the LP and classic types.

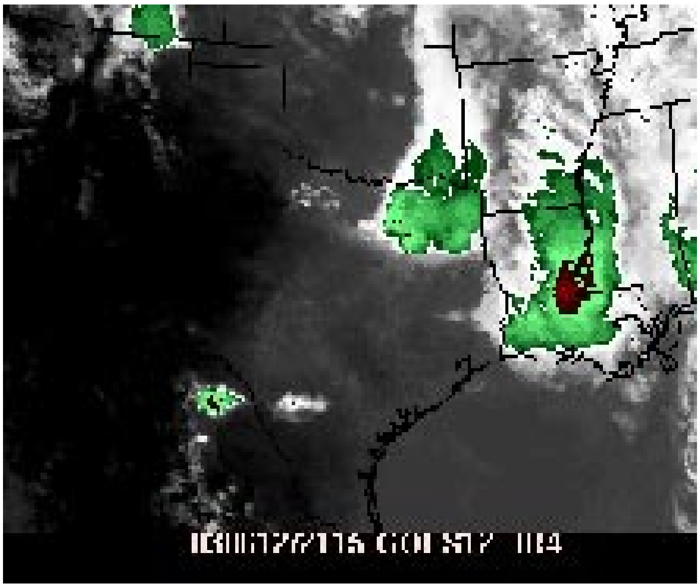
In addition to the spectrum of supercell characteristics, it is recognized that supercells are not static entities, but that they may evolve over time (Doswell, 1990.) Characteristics of a supercell are related to the environment in which they form, and their evolution can be influenced by a variety of factors, including changes in their environment. One such change may be the evolution of other storms in their proximity. In this case study, two supercells evolved in close proximity to each other.

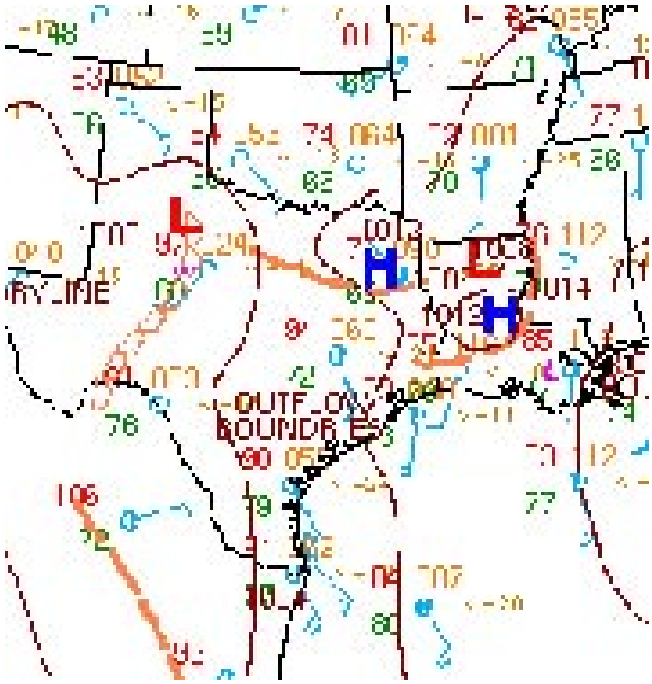
Setting the Stage

June 12, 2003 was an active weather day across north Texas. A linear, north-south mesoscale convective system (MCS) moved across the area between 0300 UTC and 0900 UTC, and by 1500 UTC, another MCS cluster was developing in southern Oklahoma, centered near Ardmore (ADM).

By 1730 UTC, the leading edge of the second MCS became more linear and was crossing the Red River, moving south with a west-east orientation.

The second MCS was important in establishing an outflow boundary that would later help to focus stronger, more isolated convection in northwest Texas (**Fig. 1.**) The same area in northwest Texas had been undergoing rapid heating under clear skies for most of the morning.

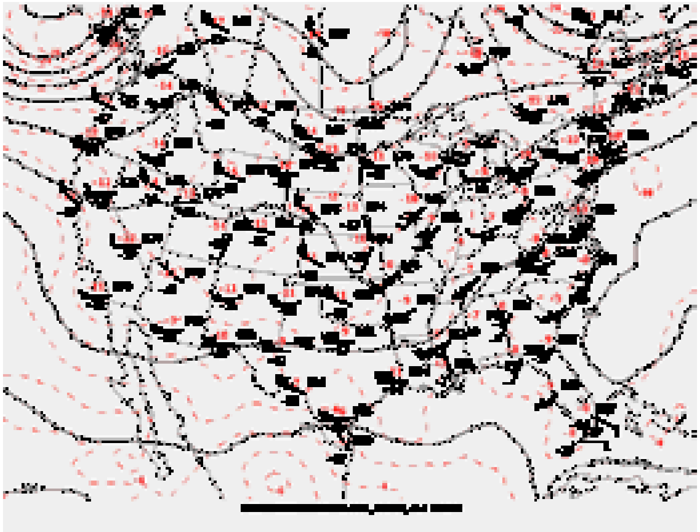


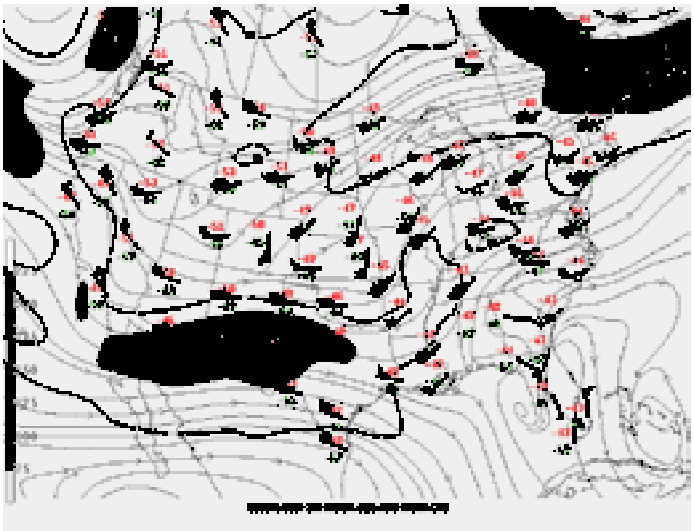


In addition to outflow boundaries, there were several influences that would aid strong convection in northwest Texas. On the synoptic scale, a split flow regime was in place over the continental US with a southern stream 100 knot jet max (streak) over Midland, Texas (MAF) at 1200 UTC, placing northwest Texas in the left exit region of the jet streak by mid-afternoon (**Fig. 4**.)

Upward vertical motion is favored in the left exit region of the jet streak (Johnson and Mapes 2001.) Winds at the 500 mb level were 40 knots (**Fig. 3**) and 70 knots at 250 mb (**Fig. 4**) at 0000 UTC 13 June 2003. The surface dryline, which had retreated into far west Texas overnight, mixed eastward rapidly under strong surface heating to near a Childress-San Angelo (CDS-SJT) line by late afternoon (2100 UTC) with an eastward "bulge" into northwest Texas (**Fig. 2**.)

A surface low over west Texas was driving southeasterly surface winds ahead of the dryline with a pressure fall of 1.6 mb in 3 hours at Abilene, Texas. A moisture axis with upper 60s F dewpoints at the surface extended north to Altus, Oklahoma (LTS), and rich moisture was evident on the 850 mb analysis with 20 C dewpoints. A capping inversion at 850 mb (approx. 1.5 km) also appeared on the Ft. Worth 0000 UTC 13 June 2003 sounding (**Fig. 6**.)





The Storm Prediction Center Day 1 Convective Outlook issued at 1630 UTC indicated that “MORE SIGNIFICANT CONVECTION IS EXPECTED TO DEVELOP LATE THIS AFTERNOON AS THE AIR MASS SOUTH OF THE RED RIVER BOUNDARY AND EAST OF THE DRYLINE BECOME EXTREMELY UNSTABLE……DEEP LAYER SHEAR AROUND 35 KTS SHOULD SUPPORT SUPERCELLS WITH VERY LARGE HAIL…DAMAGING WINDS, AND PERHAPS A TORNADO OR TWO DURING THE FIRST FEW HOURS AFTER INITIATION.”

Storm Scale Observations

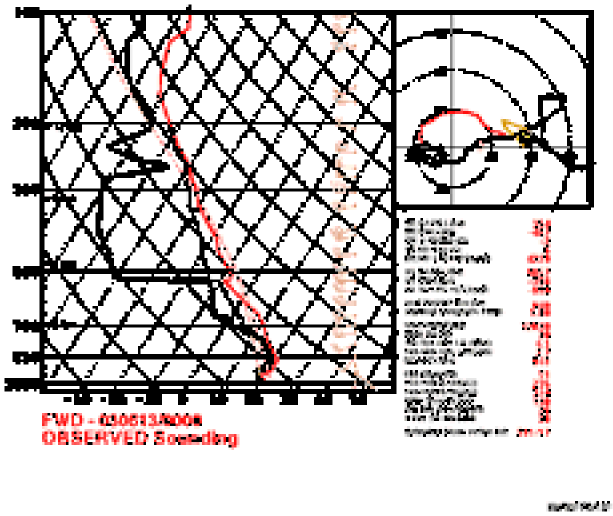
The intersection of dryline and outflow boundary was analyzed in northwest Texas near Throckmorton. The 1940 UTC measured surface temperature at Graham, Texas, 30 miles (48 km) east of Throckmorton, was 92 F with a dewpoint of 74 F. At 2120 UTC in Throckmorton, the temperature measured 95 F with a dewpoint of 67 F. Towering cumulus were visible north of Throckmorton with anvils (**Fig. 5**).

Cumulus were also visible on the 2115 UTC IR satellite image (**Fig. 1**). With temperatures east of the dryline warming into the lower 90s F in northwest Texas, MLCAPE values reached 4000 j/kg. 0-6 km shear values reached 35 knots, marginally sufficient for supercell rotation, but the Ft. Worth sounding (160 km southeast) indicated strong directional shear in the 0-3 km layer (**Fig. 6**).

The first storm (referred to here as the Olney, Texas supercell) that began to show evidence of storm scale organization was approximately 20 miles (30 km) northeast of Throckmorton. Visual observation at 2137 UTC showed a weak anvil and low level inflow indicated by low clouds. At 2150 UTC, a flared rain-free base was observed from a closer vantage point.

Based on the 2120 UTC surface temperature and dewpoint at Throckmorton, the lifting condensation level (LCL) was estimated to be 1558 m (1.56 km) above ground level (AGL.) This is a relatively high value and represents an above average LCL compared to all supercells studied by Rasmussen and Blanchard (Rasmussen and Blanchard, 1998.) Their study examined 6000 soundings from 1992 and found in part that supercells producing significant tornadoes (F2 or greater) have lower LCLs than those that produce only large hail (2 in. diameter or greater.)

In their study, the average LCL for a supercell with a significant tornado was 0.78 km compared to 1.23 km for supercells without, although these numbers may vary significantly on the thunderstorm scale (Rasmussen and Blanchard, 1998.) Markowski, for example, using data from VORTEX, found that storm-relative helicity (SRH) varies significantly over small space and time scales (Markowski, 1997.)



Olney Supercell: Visual and Radar Observation

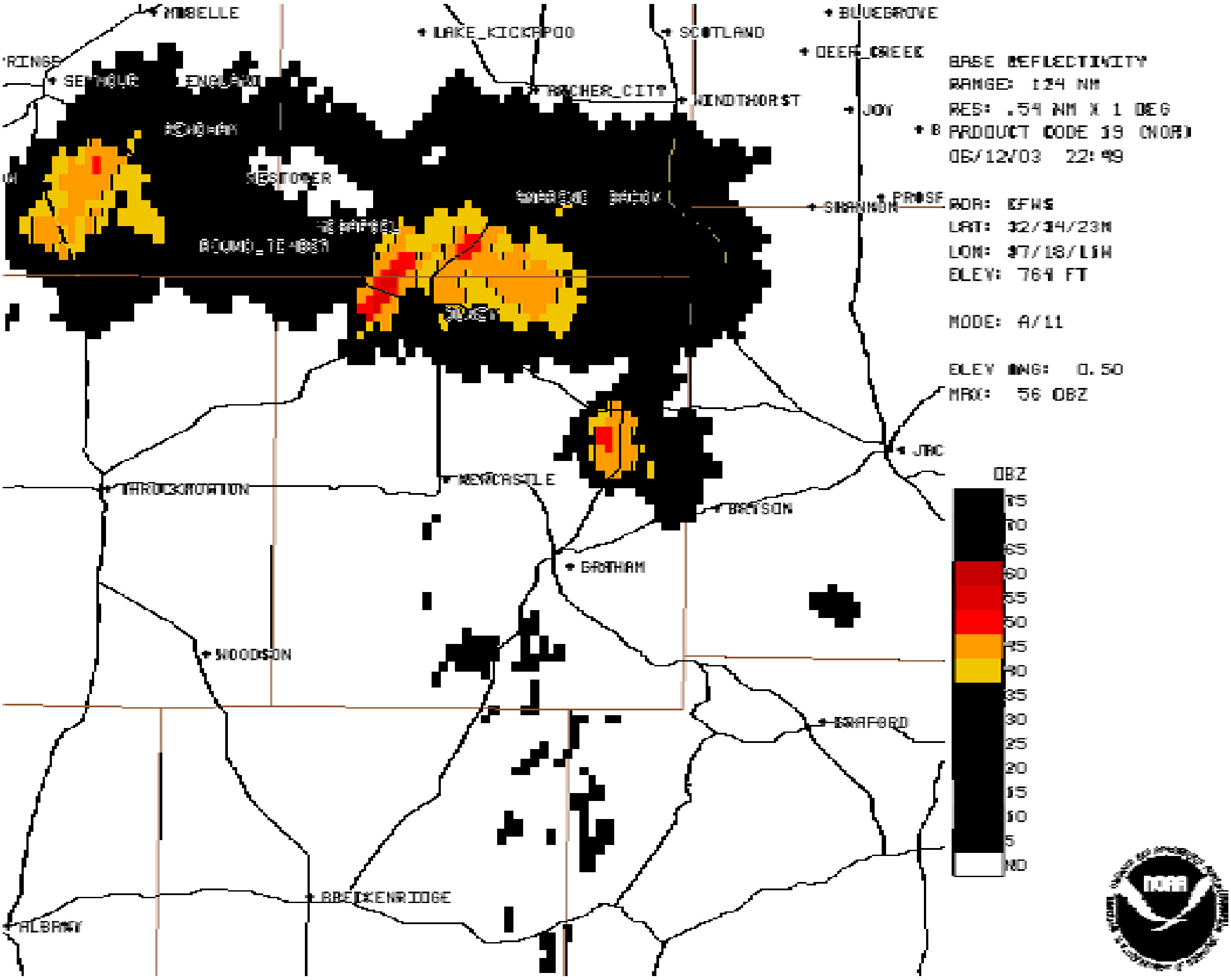
The Ft. Worth, Texas WSR 88D Doppler radar site (KFWS) was approximately 100 miles (160 km) southeast of the storms. With a base reflectivity tilt of 0.5 degrees, the altitude of the radar beam was approximately at the 3 km level in the storms. For simplicity, only base reflectivity images from Ft. Worth are presented here. The base reflectivity images offer an important but limited view of the storm structure.

Precipitation cores from both storms first appeared on the 2201 UTC radar mosaic image. In the previous image at 2133 UTC, no organized precipitation echoes were visible. The eastern cell (Olney supercell) first showed a radar precipitation core near Olney, Texas. A flared rain free base was visible as early as 2150 UTC. The first visible precipitation appeared at 2204 UTC, corresponding to the first Doppler radar image of the storm at 2201 UTC.

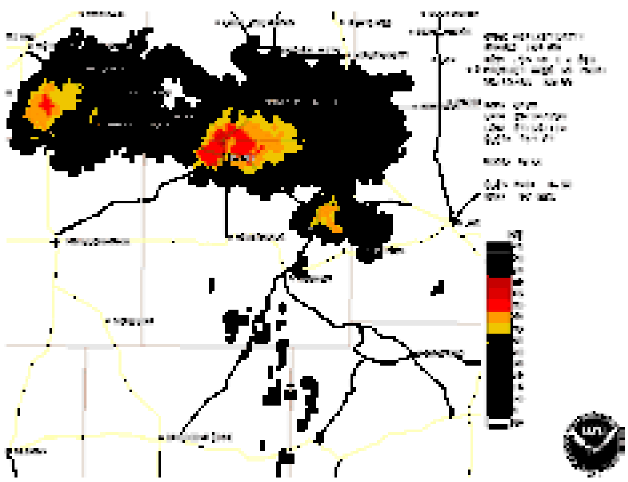
A spotter report of 1 inch diameter hail was made at 2214 UTC. At 2216, evidence of a clear slot and associated rear flank downdraft (RFD) subsidence had appeared, and rotation was seen under the rain free base in weakly organized cloud fragments, but a distinct lowering or wall cloud failed to materialize. The lack of a lowering or wall cloud in this case may indicate a weak low level mesocyclone or dry inflow resulting from a weak precipitation core, but in either case, the storm showed persistent visible evidence of rotation.

The storm persisted for another 30 minutes, gradually forming a more defined clear slot and inflow band. At 2250 UTC a distinct clear slot and “horseshoe” updraft formation were visible (**Fig. 7**.) Although the hook echo is characteristic of storms with a mesocyclone (Burgess and Ray 1986), the RFD may be difficult or impossible to detect in the base reflectivity images.

The 2249 UTC radar base reflectivity image shows no evidence of an RFD, but a distinct hook echo and inflow notch were apparent on the radar image near Olney, Texas (**Fig. 8**.)



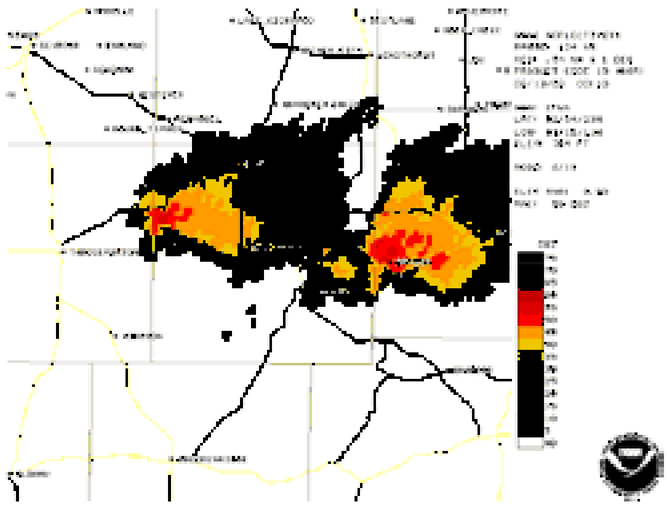
On the 2254 UTC radar image, precipitation had intensified around the hook formation (**Fig. 10**.) A brief tornado was observed near the clear slot at 2254 UTC, 36 minutes after recognition of rotation at the storm base (**Fig. 9**.) Although the tornado was brief (<30 seconds) and barely visible, spotters verified a touchdown 4 miles (6 km) west of Olney. Hail (1.75 inch diameter) was reported at 2255 UTC 2 miles (3 km) west of Olney under the main precipitation core. At the same time, precipitation was visible north of the rain-free base, and the storm had taken on a classic supercell appearance.



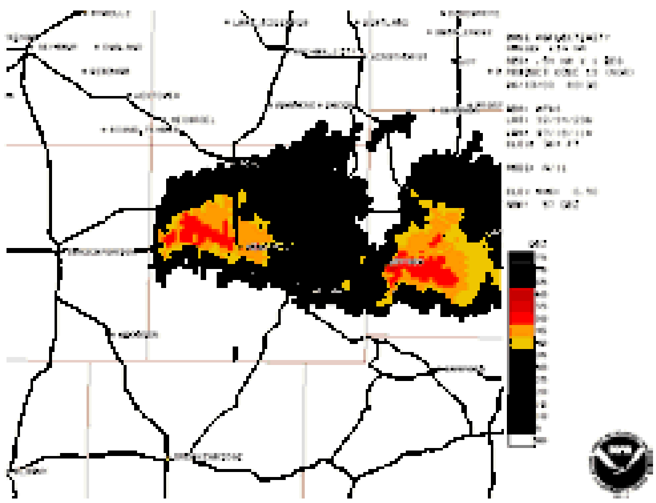
Over the following 30 minutes, the storm became less organized in appearance, and by 2323 UTC, the precipitation core had intensified visually (**Fig. 11**.)

Young County Supercell

Approximately 15 miles (24 km) west of the Olney supercell, a second and equally persistent storm was visible on radar images. Initially, the Young County supercell showed a smaller reflectivity core on radar (**Fig. 8**), more typical of a low-precipitation (LP) supercell, but the reflectivity core grew substantially in just over one hour (**Fig. 15**.) Visually, the Young County storm showed some characteristics of an LP supercell, pronounced striations, flared base, compact updraft tower, and weak visible precipitation, but at times, the visible precipitation curtain (**Fig. 12)** was more indicative of a classic supercell. Radar images, (**Fig. 13 and 15**) were also more indicative of a classic supercell.



The Young county storm maintained a visually distinct rotating updraft tower for more than one hour. During this time, the visible precipitation curtain was at times visibly opaque (**Fig. 12**) and at other times more transluscent (**Fig.14**.) The storm showed pronounced horizontal striations and mid-level inflow bands (**Fig. 14**.) Although time-lapse video revealed updraft rotation, no wall cloud or tornado was observed. The smooth appearance of the lower third of the updraft tower may indicate forced ascent through a capping inversion layer. By 0020 UTC there was a significant increase in the size of the precipitation core on the radar image (**Fig. 15**) compared to the first image at 2249 UTC (**Fig. 8**.) The storm moved slowly southeastward and produced 1.75 inch diameter hail at 0042 UTC in Newcastle, Texas.



Storm Interaction

The proximity of the two supercells in this case may have played an important role in their evolution. The Olney supercell developed a much larger and more intense reflectivity core (at the 3 km level) than the Young county storm. We can only speculate that part of the reason for the larger and more intense precipitation core on the Olney storm was a result of ice crystal seeding from the Young County cell. Anvil level winds were west or west-northwest which may have pushed some of the Young County anvil into the Olney storm. Another important variable is storm relative wind. The Young County storm may have obstructed the mid level winds and effectively decreased the storm relative winds seen by the Olney storm. The weaker storm relative winds on the Olney storm may have allowed more precipitation to fall near the updraft (**Fig. 11**) as opposed to less visible precipitation in proximity to the updraft in the Young County storm (**Fig. 12.**) The difference is also observed in the radar signatures (**Fig. 10** and **Fig. 15**.) Increased precipitation and storm-relative helicity (SRH) may have been important for tornadogenesis in the Olney storm.

The proximity of the two cells stayed approximately constant over an 80 minute time scale at about 33 miles (53 km.) The motion was also about equal with a southeasterly direction of travel (120°) at approximately 24 mph (38 km/h.) Using the 0000 UTC 13 June 2003 Ft. Worth sounding (**Fig. 6**), this direction is to the right of the 0-6 km mean wind shear as expected. A motion vector to the right of the mean wind shear is expected for a clockwise turning hodograph (Weisman and Klemp 1986.)

Conclusions

An active severe weather scenario produced a two supercell thunderstorms in close proximity that showed characteristic rotation and persistence. Visual observation revealed storm characteristics that were not seen in Doppler radar base reflectivity images including a rear flank downdraft with associated clear slot, and a brief tornado. The storms formed in an environment that produced relatively high LFCs, which have been shown to be less favorable for tornado occurrence. In spite of the high LFC, one storm produced a brief tornado. Tornado precursors including an RFD and rotation at storm base were identified visually 30 minutes prior to the tornado sighting, although another common visual precursor, the wall cloud, failed to fully develop in either storm. Interaction between the storms may explain some of the differences in visual structure and evolution with the downwind storm producing more visual precipitation near the updraft base. Visual observations verified the SPC 1630 UTC Convective Outlook which called for late afternoon storm initiation in northwestern Texas, supercells with large hail, and potential for tornadoes during the first few hours after storm initiation.

Acknowledgements

I wish to thank Al Moller for his review of an earlier version of the manuscript, insightful comments, and discussion on this event. I would also like to thank John Kobar of the National Climatic Data Center for his assistance in retrieving radar images. I am also grateful to Skip Ely for his review of an earlier version and three additional reviewers, Larry Page, Bill Ice, and Jack Hopka. I am appreciative for the efforts of the Storm Prediction Center to provide, via the Internet, upper air, satellite, and surface images used in this paper. My thanks also go to Jimmy Deguara whose storm intercept skills contributed greatly to our ability to observe the storms at the right time and place.

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Fig. 7. Looking north at 2250 UTC 12 June 2003 with precipitation and clear slot.

Fig. 8. Base reflectivity at 2249 UTC 12 June 2003 showing developing precipitation core, inflow notch, and observer position.
Fig. 1. GOES12 IR 2115 UTC 12 June 2003 satellite image showing MCS over eastern north Texas towering cumulus to the west.
Fig. 2. 2100 UTC 12 June 2003 surface analysis showing dryline surface low, and outflow boundary across north Texas.
Fig. 5. Towering cumulus 1 mile west of Throckmorton, Texas at 2102 UTC 12 June 2003 indicating strong instability.
Fig. 6. 0000 UTC 13 June 2003 sounding at Ft. Worth, Texas showing directional shear in lowest 3 km and capping inversion.
Fig. 9. Looking north with tornado visible as needle-shaped condensation funnel at 2254 UTC 12 June 2003.
Fig. 10. Base reflectivity at 2254 UTC 12 June 2003 showing hook and inflow notch.
Fig. 12. Looking west at 0006 UTC 13 June 2003. Updraft tower shows flaring at base and horizontal striations. Precipitation is visible on right.
Fig. 13. Base reflectivity at 0010 UTC 13 June 2003 with observer and approximate mesocyclone indicated.
Fig. 14. Looking west at 0016 UTC 13 June 2003 showing inflow bands and flaring of rain-free base.
Fig. 15. Base reflectivity at 0020 UTC 13 June 2003 with approximate observer and mesocyclone positions indicated.
Fig. 11. Visual image at 2323 UTC 12 June 2003 showing increase in visible precipitation as storm structure evolves.
Fig. 3. 500 mb heights 0000 UTC 13 June 2003 showing 40 kt. westerly wind over northwest Texas.
Fig. 4. 250 mb heights 000 UTC 13 June 2003 showing split flow regime and jet maximum and 70 kt. westerly wind over northwest Texas.

Blue Mountains Snow

Blackheath N.S.W.

17-18th Of July 2004

By Jeff Brislane

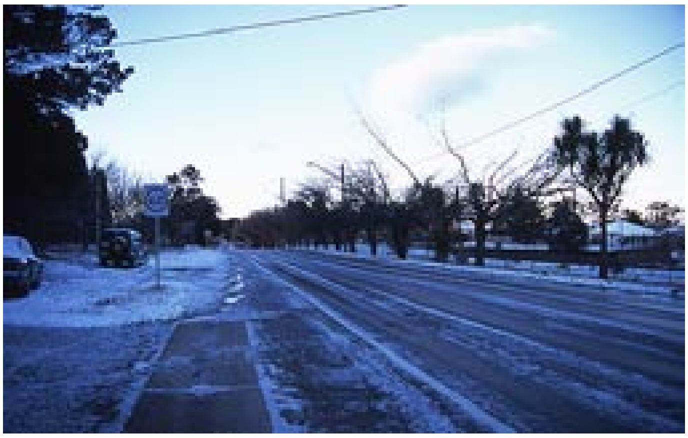
Saturday the 17th of July was another meeting night for the Australian Storm Chasers in western Sydney. We were meeting as usual in Windsor and for the second month in a row, our meeting date coincided with a low-pressure system and an associated cold outbreak. Although for the first time this winter, the focus of the approaching cold air and snowfalls would be the Blue Mountains west of Sydney.

Not wanting to miss out on snow on our own doorsteps, we (Matt Piper, Jimmy Deguara and Myself) had booked accommodation in Blackheath in anticipation of it being the probable focus of most of the snow activity. The air this time as opposed to previous outbreaks was coming up in an almost southerly flow, which is more ideal for snow on the Blue Mountains, which usually misses out when the flow is more south- westerly. And Blackheath seems to be the best place for snowfalls when the cold air is more southerly.

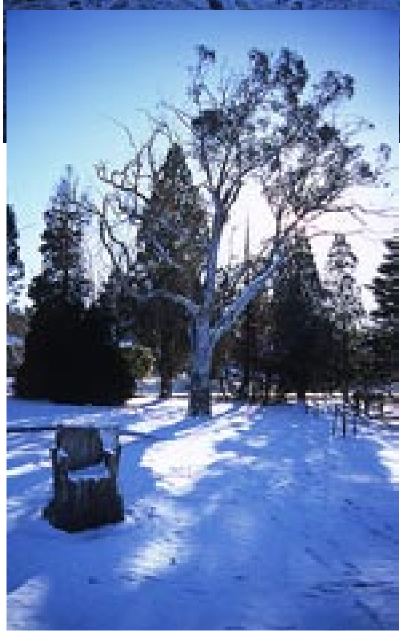
Just before Matt and I left for the meeting we were watching the current observations in amazement. The cold air was only 200km's south and it was now snowing in Goulburn at an altitude of 680 metres above sea level! Goulburn hasn't had snow in years so this got us pretty excited. It seemed that the cold air mass was leaving a trail of low level snow as it pushed it's way up the Southern Tablelands. We were now dreaming of being snowed in by a foot of white gold! If only.

The meeting went as planned and Matt and Myself decided to leave a bit earlier than usual in order to get to Blackheath before the snow started. Max King had also decided to come up, as well as David Croan and Owen Porter. Seems like we were going to have a snow party! I had one problem though. I had my work ute for the night, which would be no good on snowed over roads. So while the others went straight up Bells line of road, Matt and I went back to Blaxland so I could drop my car off. We then caught a train from Blaxland to Blackheath and we met Jimmy, Max, Dave and Owen at the Gardiners Inn Hotel on the Highway at Blackheath. It had already snowed lightly before we got there but it was only a precursor to the main event. We relaxed in the warmth of the Gardiners Inn Hotel over a few beers and watched the replay of the rugby and waited.

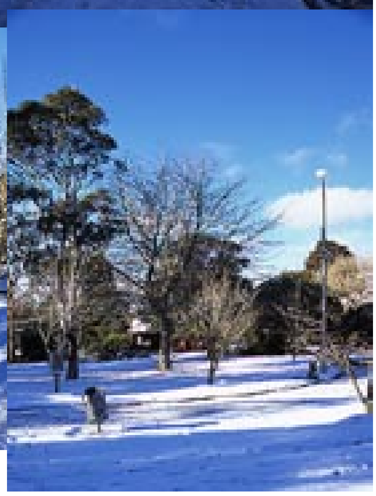
After about 30 minutes it hit with a vengeance. The snow was bucketing down, and it would go on and off for over an hour. By the time it was finished there was 2cm's of snow on everything. We left the pub when they kicked us out in the early morning. We wandered back to the motel and watched some videos before calling it a night. After we got up the next morning we went back into town for breakfast and a look around.









Blackheath was a different town with a coating of snow and we took plenty of photos before we packed up and went for a drive out to Mt Trickett were the snow was a lot deeper but melting rapidly under the warm sun.

What a great way to spend a weekend. A storm chasers meeting followed by a train trip to a pub to have a few beers with mates and nice little snowfall to boot! And who said winter weather is boring?

Guyra Snow 19th June 2004

by Michael Bath and Dave Ellem

While snow is naturally associated with the idea of winter, it is not something encountered by residents of the coastal plains of the Northern Rivers, however when conditions are right, it only takes a trip onto the nearby Northern Tablelands to experience some of the white stuff falling!

For nearly the entire seven days leading up to the actual event, forecast models were looking good for some snow on the ranges of NSW right up onto the Northern Tablelands. GASP and GFS were both forecasting 500hPa thicknesses down to 5360 metres or lower for the 152E 30S area - centred around Armidale to Glen Innes. Subsequent runs kept the forecast fairly consistent in the location of the pool of cold air, but played with the amount of moisture likely. A problem was that the prefrontal cloud band was likely to be ahead of the temperatures low enough to produce snow. There was also some doubt as to the timing of the coldest air, with some runs pushing its arrival to Sunday afternoon, though it finally settled on early AM Sunday. Later GASP and LAPS model analysis revealed the 540 "snow line" arrived on the highest part of the Northern Tablelands just as the last part of the prefrontal cloud mass was clearing out. The timing was ideal for brief Saturday evening snow described below. The colder air moved in overnight with 536 thickness analysed for 10am Sunday. There was very little moisture left by the time the cold pool reached the Northern Tablelands, but there was sufficient remaining and enough orographic lift for cumulus and stratocumulus to form predawn and persist for a few hours into the late morning.

It had been a couple of years since a decent snow setup for the Northern Tablelands, so the NE NSW storm chasers, turned snow chasers for the storm chasing off season, were excited about the prospects of being able to head up to the Northern Tableland and see some snow. For me personally, I had never seen snow actually falling, so I was very eager to see what all the excitement of falling snow was about!

We had an Australian Severe Weather Association meeting in SE QLD to attend in the morning, so Michael Bath, Rodney Wallbridge and myself set off at 7.30am on Saturday morning to attend the meeting. The meeting was thoroughly enjoyed, despite having a BBQ in strong westerly winds with a dew point of -10C! Just after 3pm Michael, Rodney and myself set off for Guyra, where it looked almost certain to snow by around midnight. Clyve Herbert and Jane ONeil, some weather gurus visiting from Victoria who had attended the meeting followed us down. We stopped at Tenterfield for some hot chips for dinner at around 6.30pm before setting off again. Between Glen Innes and Guyra it was quite exciting watching the temperature drop into low single figures, and with some heavy showers occurring, it was looking great for some snow to occur! We arrived at Guyra at around 8pm with the temperature hovering around 2C and showers still occurring. After getting into the motel and quickly turning the heaters on, Clyve pointed out that the occasional snow flake could now be observed falling amongst the rain. The next hour or so was spent looking at the latest satpic and obs on the laptop, until an SMS from Anthony Cornelius, who was traveling down with a few others to meet us, informed us that it was snowing heavily just north of Guyra. We set out to Ben Lomond to try and meet up with them (not realising we passed by them when we drove out of town!) and experienced some sleet on the trip to Ben Lomond, where the road peaks just above 1400m. On the return trip however, we began to experience some heavy snow and there was much excitement as the almost blizzard like conditions saw heaps of snow being blow towards the car!

We stopped at a service station at Guyra at around 9.30pm to get out and enjoy the snow! I was amazed at how the snow fell almost peacefully - not like the noisy ‘ping’ noises you hear on a tin roof from a normal shower! We played around in the snow for around 10 minutes before returning to the motel and meeting up with Anthony and the gang. The snow soon eased off, and it appeared from the satpic that it would not snow again until morning, so after farewelling the Victorians, we headed off to bed!

I awoke to the 6am alarm and below freezing temperatures, but no snow! However by the time I had showered and put my 4 layers of clothing on, snow was beginning to fall! Unfortunately the moist air had moved out to sea earlier than expected, so we were only left with low level convection, resulting in lighter falls of smaller snow flakes. It snowed on and off all morning, getting reasonably heavy at one point around 8.30am, and so around 1-2cm of snow accumulated on the ground.

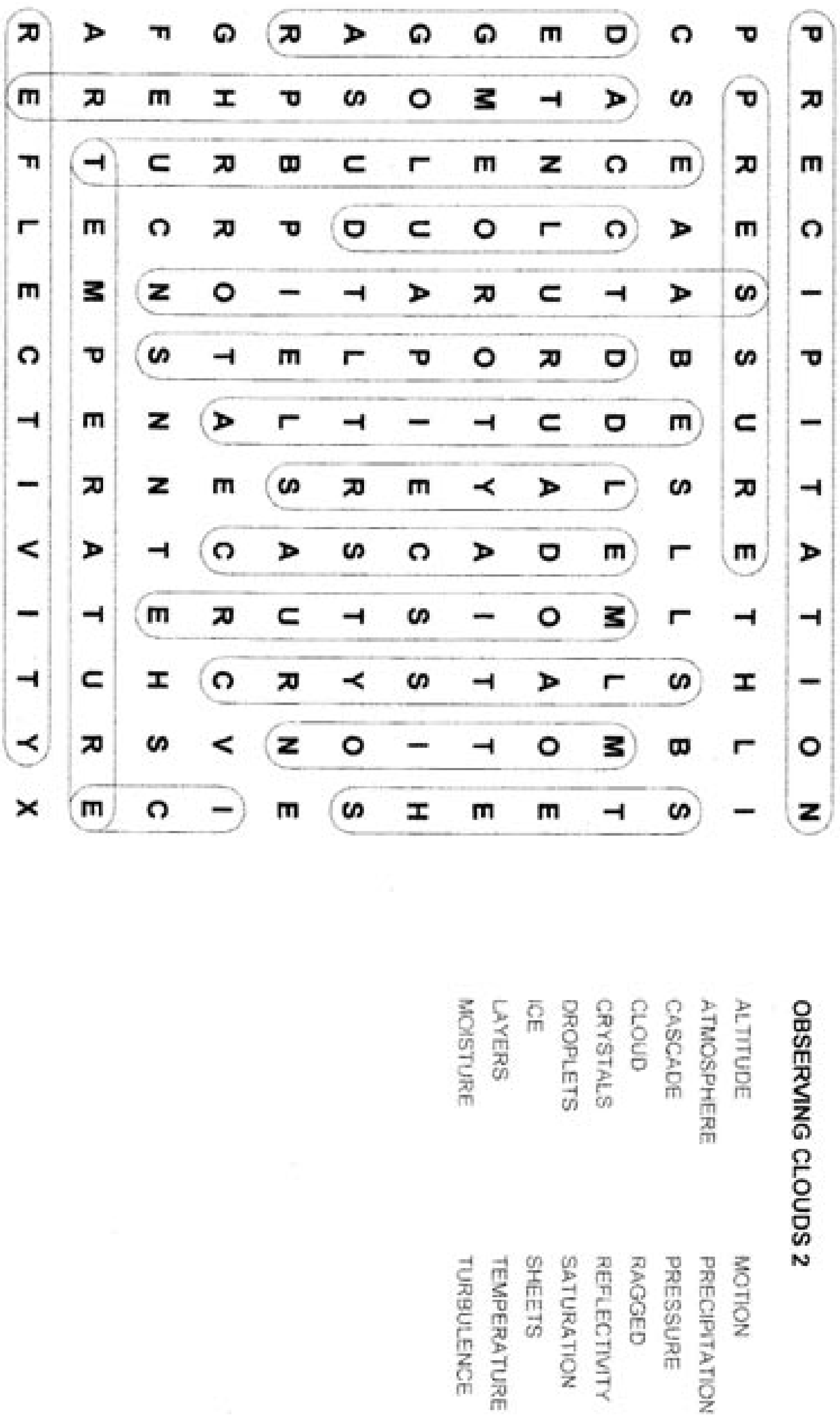
At around 9.30am we left the motel and headed to Ben Lomond to see if much snow was falling there. It snowed during most of the trip, and some nice accumulations of snow could be seen in the paddocks either sides of the road. We stopped down Inn Road to get some snow photos in a paddock, and mucked around there for around half an hour before heading back towards Guyra. The sky was beginning to clear and more snow falls were looking unlikely.

We did however encounter more snow showers just outside of Guyra! The decision was made to head towards Black Mountain, south of Guyra, to see what had fallen there. We encountered more snow while stopped for some more photos of the snow accumulated on some trees and dead branches at around 11am.

After this we headed back to the motel in Guyra for a BBQ in the snow! It was mostly tiny hail that was falling while we were cooking the BBQ though, and by the time we had finished lunch, it appeared as though the snow event was over! We said our goodbyes and headed towards Glen Innes, then turning down the Old Grafton Road to take the scenic route to Grafton through the Mann National Park. The scenery was quite spectacular, and was a great way to finish a fantastic weekend! We arrived back home in Lismore to clear skies at around 6pm.



Observing Clouds Puzzle 2 Solution



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