THE JOURNAL OF AUSTRALIAN STORM CHASING

THE Australian Storm Chaser

Feature Chase

HAIL HAIL HAIL!!!!!!!
October 25/26th, 2003
NSW SUPERCELLS

Columns

- Weather Terminology
- Global Storm News
- Photography Tips

Plus

- Weather Roundup
- Historical Events

VOLUME 1 ISSUE 3 OCT-NOV 2003

WDU ASC

WHATS INSIDE?

Letter from the Editor

Welcome to the new Oct/Nov edition of the ASC Journal, The Journal of Australian Storm Chasing!

What we have created is a whole new storm chasing publication for all Australian storm chasers. We have decided to create a Bi-monthly journal that encompasses everything the avid storm chaser wants to know about and read. And we hope that you find the new Journal to be everything you want in a storm chaser publication.

As part of the structure of the new Journal we are taking feedback from anyone out there whether good or bad. We want to know what you think and whether we can make any changes to suit you. This publication is your publication. All replies to the editor will be printed in subsequent editions just like a regular magazine. And all suggestions will be considered thoroughly by the editorial staff.

In this edition we have exclusive chase reports from the Western Sydney Supercell on the 25th of October. You will see pictures of amazing storm structure including the only funnel cloud photographed during the life cycle of this beast! You will also see pictures of the hail that reached up to 6cm! And from Tyndale Northern Rivers on the 26th we have exclusive photos of Gorilla hail that reached 9.6cm !!!

We have a great article on time-lapse photography using a still camera that will show you how easy it is and why an expensive video camera might not be as important as you think!

We also investigate the Bears Cage and it's relationship to Supercell structure in a series that will continue into future editions and cover all aspects of thunderstorm terminology.

We have a summary of the legendary May 3rd 1999 tornadic outbreak in Oklahoma and the Elsmore/Ben Lomond tornadic event from NSW. We will be introducing new tornadic events in coming editions including some classic Australian ones!

We have some amazing U.S. weather based facts and figures. Did you know that January 16th is the only day that a Tornado has never touched down in the U.S.!

And last but not least we have a weather website review and we start a glossary of weather terminology that will continue through future editions and a crossword.

So strap yourself in and hold on for the journey into the New Journal of Australian Storm Chasers. We know your going to like the ride!

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Time-lapse Photography with a Still Camera

Why use a still camera?

How many times have you ever been watching a beautiful storm updraft exploding into the atmosphere and you thought to yourself, “gee, this would make the perfect time-lapse”. And you either didn’t have a video camera or you left it at home?

For me this happens every time I chase storms because I don’t have a video camera. But all is not lost. If you have a half decent still camera, SLR or digital, then you can still take time-lapse photos that are very effective.

Now time-lapse shot with a still camera is obviously not as good in a lot of respects as time-lapse shot with a video camera. Never the less, if you don’t have a video then what else can you do? And besides, at least you come away from the storm with a visual account of its development.

How?

When you shoot time-lapse with a still camera you can experiment with any interval you want. I recommend starting at 1-minute intervals, although you could shoot anything from continuously to every 5 minutes at the most for the best effects.

I would also recommend using a sturdy tripod, although this is not absolutely necessary. The tripod helps you to keep the exact same view so that only the cloud is moving. That way you can recognise even the smallest changes in storm structure.

Digital vs. Film?

With the cheap price of 35mm print film these days I would have too say that shooting on 35mm would be slightly more advantages than shooting on digital. Why?
Because you could feasibly shoot 60 to 300 or more shots of a thunderstorm during it’s life cycle. And films natural very high resolution would mean that the equivalent for digital would require you to use the highest resolution setting which would in turn fill up your memory card very fast. There would also be an issue with a lot of digital cameras stopping to store photo information during very short shooting intervals.

How do you view them?

Just about everybody these days has a computer. And windows has a great feature in the My Photos folder called the slideshow. With this you can watch your storm unfold on your computer over and over again. You can save them to CD and play them on a compatible DVD player. There’s even probably a way that you save them onto a video and watch them like a real time-lapse. Or if you shoot them on slide film, you could use a conventional slide viewer to display them to family and friends. If you were really desperate and shot them on print film, then you could flick through the pile with your own hands to get the desired effect!

What I am saying is this. Don’t let the lack of a video camera stop you from getting out there and having a go. Below are two of my own efforts of time-lapse still photography to give you an idea as to the type of effect that you are going to get.

In the first three photos is the Camden LP super cell from February 2003. The 3 photos of the top of the storms updraft were shot within 5 minutes without a tripod.

And these last photos are of a severe storm near my house back in December 2000. These were about 2 minutes apart with the camera mounted on a tripod.

Elsmore and Ben Lomond, NSW Tornadoes

6th November 1989

Tornado	Maximum Fujita scale	Path Length
Elsmore tornado 1	F3	22km
Elsmore tornado 2	F1	5km
Ben Lomond	F2	18km

On the 6th November 1989, the two small townships of Inverell and Ben Lomond in the Northern Tablelands experienced a tornadic supercell. Both these townships, located southeast of Inverell, New South Wales were likely to have experienced the same supercell according to the Bureau of Meteorology report. The town of Elsmore faired worst with a strong tornado causing extensive damage including a few houses that were destroyed or badly damaged as well as a weaker tornado. Damage estimates by the Bureau of Meteorology survey suggest up to F3 damage on one section of the Elsmore tornado track. In approximately the same path of the supercell generally southeast, Ben Lomond scored far less damage from a third tornado passing over mostly unpopulated region.

The hailstones reported were to the size of 6.6cm suggesting this storm was almost certainly a supercell (storms producing hail >5cm diameter are most likely supercells).

The conditions that spawned the severe weather outbreak in the region are consistent with most other tornadic outbreaks – an upper trough and strong cut off low located in New South Wales. The right exit of the subtropical jet coincided with the polar jet in the upper levels over Elsmore. A 70knot 600hPa wind maximum jet was located just to the west of Elsmore near Cobar. The winds in the lowest 1.5km turned from a northeasterly to northwesterly aloft. The moisture profile was more than sufficient with enhanced drying at the 500hPa. This drying is recognised as an important feature providing downdraught support. Combined with the incredible favourable wind shear profile, the conditions were favourable for tornadic supercells.

Reference

Information derived for this very brief report is courtesy of the following report

“Report on the Elsmore and Ben Lomond Tornadoes November 1989”

Bureau of Meteorology

November 1989 February 1992

For a more detailed analysis of the conditions and the tornado damage pictures, this report is well worth a read.

This map shows the paths of the three tornadoes in relation to the townships

SUPERCELL HAILSTORM AND SQUALL LINE 25th October 2003

Western Sydney H.P. Supercell 25th of October 2003 By Jeff Brislane & Matt Piper

We had planned to chase this day but because of the ASC meeting that afternoon, it had to be local so we could make the meeting. The weather that morning was warm and overcast with Strato-cumulus cloud streaming in from the Northeast and the forecast was for afternoon thunderstorms across Western Sydney. I was picking up some photos from Penrith at about 12:30 when Matt Piper rang me to say that storms had started west of his place on the Blue Mountains and were moving east. This is were our chase began.

I rushed to his place to pick him up and on our way back down to Emu Plains I stopped at my place briefly to grab my tripod and some film. From here we headed out to the North Penrith industrial area to watch as the storm, which at this time was imbedded in low cloud, come off the ranges. Here we got the first glimpse of its structure with a cow catcher/ inflow stinger type of feature visible in the first photos.
Not long after this the rain came with lots of small pea size hail and we rang Jimmy to get an idea of what it was like on radar.

Jimmy told us that it was splitting and to make sure we got the left mover, as it already looked severe on the Sydney Radar. Armed with this information we decided to head north to get onto the other side of it. On the way up to Castlereagh Road the hail got really intense with rock hard 1cm stones pummelling the car. After heading halfway up Castlereagh Road toward the Readymix Quarry we seemed to drive out of the hail (much to my disappointment), but then after rounding the corner and heading north after the quarry the rain got a lot heavier and isolated hailstones started to fall again, only this time they were around 2cm.

The further we drove up Castlereagh Road the larger the hail became. First it was 2cm then it became 3cm's then 4cm. We were now punching the core of a H.P. Supercell (only we didn't know this at the time). When we crossed the Quarry Bridge halfway up we pulled over and watched the hailstones pummel us and everyone else on the road. I was the only car that wasn't looking to hide under a tree! Here the hailstones reached 5 to 6cm in a number of isolated stones, but the average was about 3cm.

After being smashed by large Hail we decided to head north to see if we could get a look at the structure of this beast. Just near Agnes Banks we pulled over into a new housing development and were rewarded with a clear view of the RFB area of this storm. It looked awesome. We could make out a weak looking wall cloud, multiple inflow bands, clear slot from the rear flank downdraft and of course the massive hailshaft dropping out from underneath.

After ten minutes there we decided to head east so we could stay with the storm. I drove through Agnes Banks and then turned right onto the Driftway, which we followed to Richmond Road at Bligh Park. Just before we crossed Londonderry road on the Driftway we spotted a funnel cloud under the main updraft area. It was only short lived and unfortunately it didn't connect with the ground but we did capture it on film and we noticed what appeared to be the dry slot being wrapped around the funnel.

By the time we got to Richmond road the funnel had dissipated and the storm now appeared to be developing a shelf cloud and becoming outflow dominant.
We turned east onto Richmond road and then left onto George Street and headed up to Windsor to try and stay ahead of it. From Windsor we head east on Windsor road were we got sight of the shelf cloud almost touching the ground! It was probably at this point that Riverstone was being smashed by 6cm to 7cm hailstones.

We turned left at Cattai Road and then right again onto Oakville Road and headed up the back way to Nelson. We stopped briefly near Scheyville as the north west side of the gust front overtook us and then we generally headed north to north east to see if we could get in front of it again. But we never did. After another phone call to Jimmy we decided to head north to South Maroota and meet up with Him and Geoff where they were filming the storm and subsequent lightning.

Here we saw another storm develop over the Pitt Town area,

which eventually headed north toward us with more hail and this time the heaviest rain that we had seen. Matt and I decided to leave Jimmy and Geoff and we headed north to the Old Northern Road at Maroota to try and get in front of this new storm. At one point on the Old Northern Road we had to stop as a tree had come down and blocked the road. I got out and helped some people who were trying to move it off the road in the heavy rain while Matt filmed them from the nice warm and dry car! Hmmm. We got torrential rain and small hail out of this second storm and unbeknownst to us at the time a squall line had caught up with this storm and gave us about 30 minutes worth of the heaviest rain of the day. I have a small leak in my car that has been through a lot of storms but the rain was literally pouring into my car this time!

We met up with Jimmy again but by now it was basically over. We headed back to Windsor via the Lower Portland Ferry and through Wilberforce and we got back to WDU headquarters at 4:55pm with the meeting due to start at 5pm! Talk about excellent timing!

Western Sydney Squall Line Report by James Pickett and Mario Orazem

The day began with quite a strong northerly and very low strato cu rolling in. By 8am this breeze was quite strong. Upon finishing work at 12pm low cloud was still invading the coastal suburbs and winds still quite fresh out of the NNE. Nothing could be seen except for a darkening in the far south west and north western sky. After checking radar at 1.30pm it became evident that there were possible supercells around the Richmond area moving left of the mean winds.

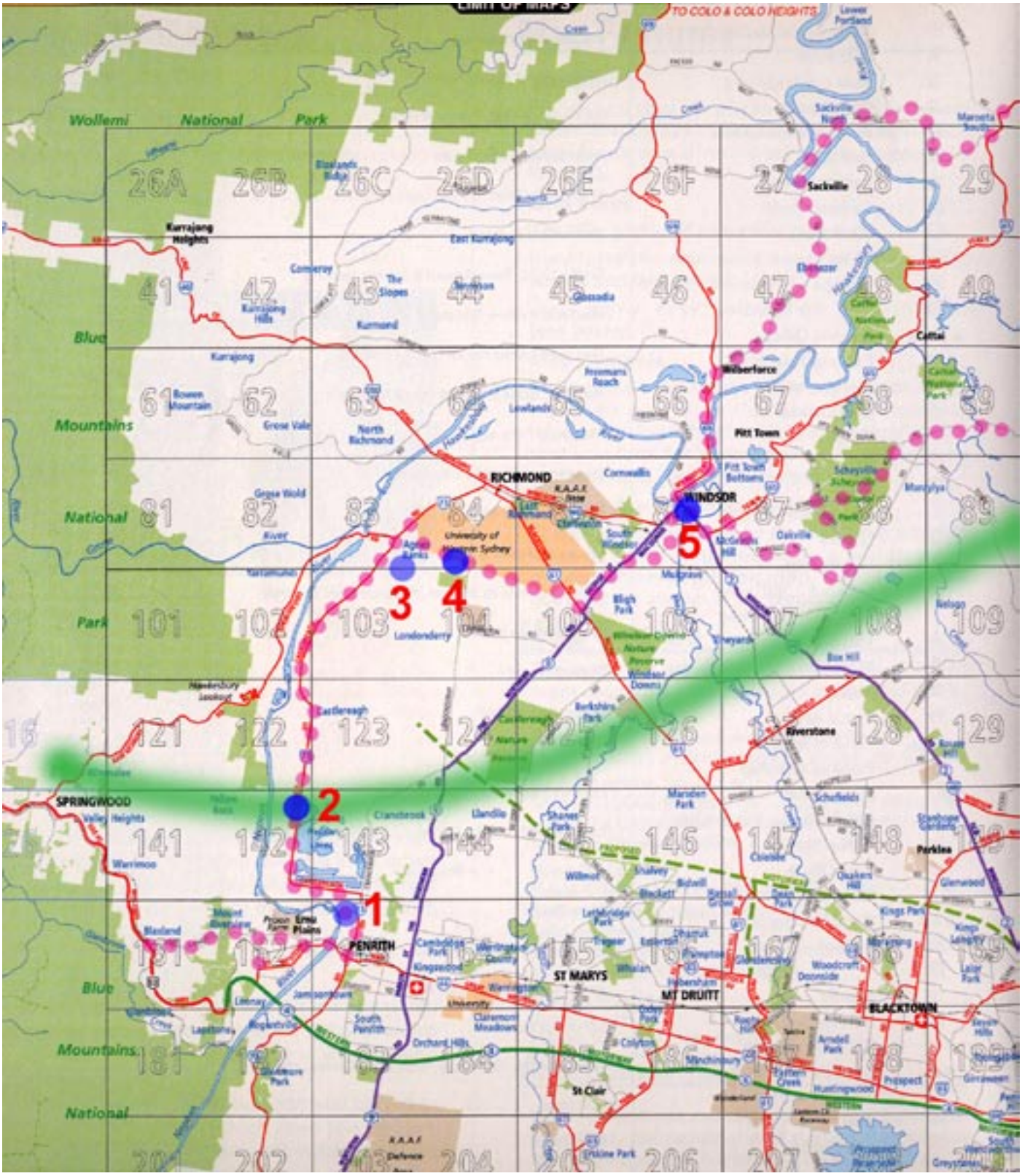
Mario and i decided then to get a move on, a very brief clearing occured and a deep blue anvil was revealed streaming out to the east-south east. Deep booms of thunder could be heard and that is from where we were, a good 50 clicks away. We then decided it would be too late to punch in on the action so decided to head west, get out of the low cloud and obtain a better view. Temp on the coast at this stage was around 22 degrees and dp around 15

Heading west we sighted the beast and could see a bit of cork srewing action on the front cell, unfortunately that one was getting a little too far away for any close observations. The cell behind it was more visible although only managed to see another massive anvil and a dense navy blue cloud base. We were now in the clearest part of Sydney and i had guessed that a line may develop north - south of the supercells and it did. As this was happening i noticed the temp dropped sharply prob outflow and veered more around to the NNW, at this stage we where in the Liverpool area.

The sky began to organise itself rapidly and before we knew it a squall line developed to our immediate west. Heading North around the Hoxton Park region it changed to a dark green colour with spectacular cgs observed, some a little to close for comfort and a nice gust front. Within minutes it hit with at least 30-40 knot squalls out of the west, the odd hail stone could be heard pelting the vehicle and bouncing off the road but only a centre-meter or so in diameter. The sky was so dense it was amazing, upon clearing us the atmosphere stabilized very quickly and you could see the back of the squall-line clearly link up with the two beasts now approaching the central coast, updraughts were still shooting up the back of them at incredible speed and the odd lightning bolt still around.

We were driving North on Richmond Rd at this stage and all the tree folage and flooding on the ground became apparent, obviously a resullt of the main supercell earlier. Small hailstones were still on the ground and a mist covered most paddocks, it was getting near to 4pm by this stage. We then met up with Jimmy and the gang for an ASC meeting:-).

To add to this, a spectacular lightning show could be seen after the meeting that lasted all night. The best i have seen in years, just off the coast. It always seems to be that way after a nasty supercell has been around !!! Maybe one day i'll catch one, lol.



Chase Map 25th October 2003

1. Cowcatcher Cloud Formation
2. Large Hailstones (5-6cm estimated maximum size)
3. Rear Flank Downdraught (RFD) and Wall Cloud
4. Funnel Cloud
5. Gustfront

Dotted Purple Line Indicates Approximate Path of Matt and Jeff's Storm Chase
Thick Green Line Indicates Approximate Path of Supercell

1

2

3

4

5

6

Explosive Supercell produces Gorilla Hail Sunday 26th October 2003

By Jimmy Deguara

I must say that since I have started chasing, October 2003 has been the most active October. It has produced some strong outbreaks with tornadic potential. Widespread severe storms have been reported mostly across New South Wales and southern Queensland during October. This event was no exception.

After an excellent chase the previous day in my local region, plans were always to chase the North Coast as the setup was quite ideal. An upper trough was expected to pass over the region allowing for destabilisation during the afternoon period. A combination of high CAPE (Convective Available Potential Energy) approximately 3000 according to model predictions (Surface Lifted Index of -8) and strong deep layer shear made for a volatile environment easily supportive of explosive supercells. The expected wind shear profile would place a strong 50knot northwesterly upper level jet over the region of northeast New South Wales and southeast Queensland. Predictions of hail to cricket ball size was not out of the question in such an environment. Only one problem, we had to get there early - 5am start! I must admit David Croan did well to wake up and be ready to be picked up.

The day was expected to be a long one since we wanted to be at work the next day. The 7 hour trip up the coast was always going to be exciting - a transition from altocumulus castellanus in the Sydney region to a rain band to a severe thunderstorm during the late morning near Nambucca Heads. Passing through smaller hailstones, we allowed this storm to pass out to sea. There was some hail cover in some of the areas so we had just missed the hail deluge. Hailstones here seemed to measure up to about 3 or 4cm in diameter. Oh and the close lightning bolt in the field - WOW!

Stopping for lunch by midday at Coffs Harbour allowed for the change to develop. Well stratocumulus and south-easterly winds was not what we bargained for. So we wasted little time in heading further north as we had planned. Just out of Woolgoolga, the situation began to change somewhat. Warmer and more humid air - dewpoints on the increase. Brighter skies on the horizon. Northeasterlies. We were entering higher CAPE more unstable air. “Look at the updraft David?” Explosive but heading out over the ocean! Certainly impressive.

At Grafton it was time to re-fuel and prepare for the chase. The afternoon that lay ahead of us in terms of severe weather potential was a long one. There was some development in regions to the north of Grafton but this looked disorganised. We placed ourselves nearby and watched our favoured area to our west. Favoured area? When we stopped just north of town, the activity to the southwest and west looked ordinary. It lacked the hard crisp updrafts and powerful side anvils representative of this environment. The air was oppressive so what direction was the wind? Westerly? I was confused. Then it dawned on me - we were in the dryline.

The activity to the north at this point began to grow larger. A backshear developed. What took place from here on would be history was beyond comprehension! The storms to our north and northeast had begun to explode at a rapid pace like very few storms in the past. Not only were they explosive though, it was the rapid organisation of the base structure. A southern flank had developed and the rain free base was gradually moving toward us. Lightning activity to our northeast increased dramatically. Time to move.

Core-punching is not for the faint-hearted and in this type of environment can be dangerous (flying shattered glass and damage to panels of the vehicle). An understanding of the storm structure is critical in determining where the largest hail would be. The structure was impressive but the updrafts were powerful particularly to the east. It was an eerie feeling. We passed through the some heavy rain initially and then hail. Two or three centimetres at first and finally golf ball sized. I phoned this into the Bureau of Meteorology since I am a storm spotter for the severe weather alert system. No sooner had I hung up did we realise that we

were entering larger hail territory. Stripped leaves and hail on the road. How big were they? David suggested we stop and measure as he had noted a few larger stones. Further though, the odd splatter and a denser cover of predominant massive hail chunks all over the road and in the field. I felt a thump at my feet - a hailstone had bounced and thumped under the car beneath the pedals causing vibrations. We passed over a tributary of the Maclean River and saw impressive splashing of hailstones. David began pointing out more 8 - 9cm hailstones. Finally, we parked on the side next to a paddock.

David wanted to lean out and pick up a stone. "You have got to be kidding" I said. "Be careful"….. Booom - one almighty thump!! Now that was a reminder if anything could convince David. Another addition to the collection of 'craters' on my vehicle. Being sporadic hail it meant David could still quickly lean forward and grab a hailstone. The sporadic activity under a mostly rain free base meant only the largest stones were falling. The field and road were littered with giant hailstones. It was a scene I personally had never observed in Australia - more reminiscent of a scene in Tornado Alley. Some more video and picture opportunities whilst David searched for more hailstones. The hail had stopped falling. Some quick measurements for recording purposes and we were off. The storm had made the split as anticipated and we wanted the left mover.

Headed for Yamba, we observed a spectacular lowered base structure and interesting features. And of course an inflow band to the east. But it was a lost cause - the storm had taken the usual path heading out over the ocean evading capture. Unfortunate! What do we do now? A phone call to Mario was simply to alert us how fast storms were moving and if we had time to intercept storms further north along the dryline. Getting back to Sydney was an option. More storms developing to the southwest and an opportunity to get back to the storm affected areas, we decided on southwest.

Back at Tyndale, scattered giant hailstones littered the lawns to our left. We stopped for more measurements. David collected whilst I filmed and photographed. Amazing to note that even about 45 minutes after the event, there were still hailstones of this size only partially melted. "Look what you left near you?" David prompted as he picked up a giant!! I must admit I missed it but look at the size of it! A quick measure and David announced conservatively 9.6cm according to the callipers. This by far easily surpasses any hailstone size I have observed on any chase. And 45 minutes of melting had taken place. It was simply unbelievable.

The storms to the southwest developed rather quickly but were not impressive. We passed through very heavy rain and small hailstones. The chase was over - time to finally make our way to Sydney.

The trip back was one of reflection and a realisation of just how big these hailstones were: the 9.6cm being larger than the hailstone officially measured during the 14th April 1999 hailstorm. It was a short but intense chase and one well worth it.

Click here for all stills listed online of this event.

Report showing pictures viewed from the north by Dave Ellem.

If you (or someone you know) have any photographs or video of this event or any other type of severe storm such as damage, the storm structure itself or hail, please feel free to contact Jimmy Deguara. Your contributions are very welcome. Please any photographs or video footage are important so don't discount anything.

FEATURE UNITED STATES EVENT

A feature event on a United States Outbreak or significant tornado event will be included in each of the new look issues of *The Australian Storm Chaser*.

May 3 1999 Tornado Outbreak

This outbreak is the most powerful outbreak in recent times in the Tornado Alley region of the United States and definitely in Oklahoma. Featured in several documentaries, it serves as a reminder just how lethal this region can become when extraordinary conditions coincide. So what was so significant about this outbreak?

Well using Fact Sheet for tornadoes produced by the National Weather Service in Norman Oklahoma, you will find some important facts and figures prior to this event

- The last F5 tornado in the state of Oklahoma was April 2, 1982 in Broken Bow in southeastern Oklahoma.
- No F5 tornadoes have ever been recorded in Oklahoma City.
- The most deadly tornado event in Oklahoma City was June 12, 1942 in southwest Oklahoma City, with 35 deaths and $500,000 in damages to 70 homes.
- The most costly tornado event in Oklahoma City occurred on March 20, 1948, with over $10 million in damages, mostly inflicted on aircraft at the Tinker Air Force base.
- The record for tornadoes in a single day in Oklahoma City is 5, which occurred during the outbreak of June 8, 1974.
- There have been 7 F4 tornadoes reported in the Oklahoma City area, with the most recent one occurring on April 30,1978.
- The most recent F4 tornado in the state of Oklahoma was Catoosa, April 24, 1993.
- The longest period without a tornado in Oklahoma City since 1950 is 5 years, 8 months (October, 1992 and June 13, 1998). The second longest stretch since 1950 occurred between June, 1981 and May, 1986.
- The most recent tornado in Oklahoma City occurred on October 4, 1998. This tornado also passed through Moore, and was rated as an F2. Another tornado moved through the northern Oklahoma City area on June 13, 1998. It damaged the facilities at the Frontier City amusement park, and was also rated as an F2.

Source “Fact Sheet for Tornadoes in the NWS Norman, Oklahoma Area”
http://www.srh.noaa.gov/oun/storms/19990503/

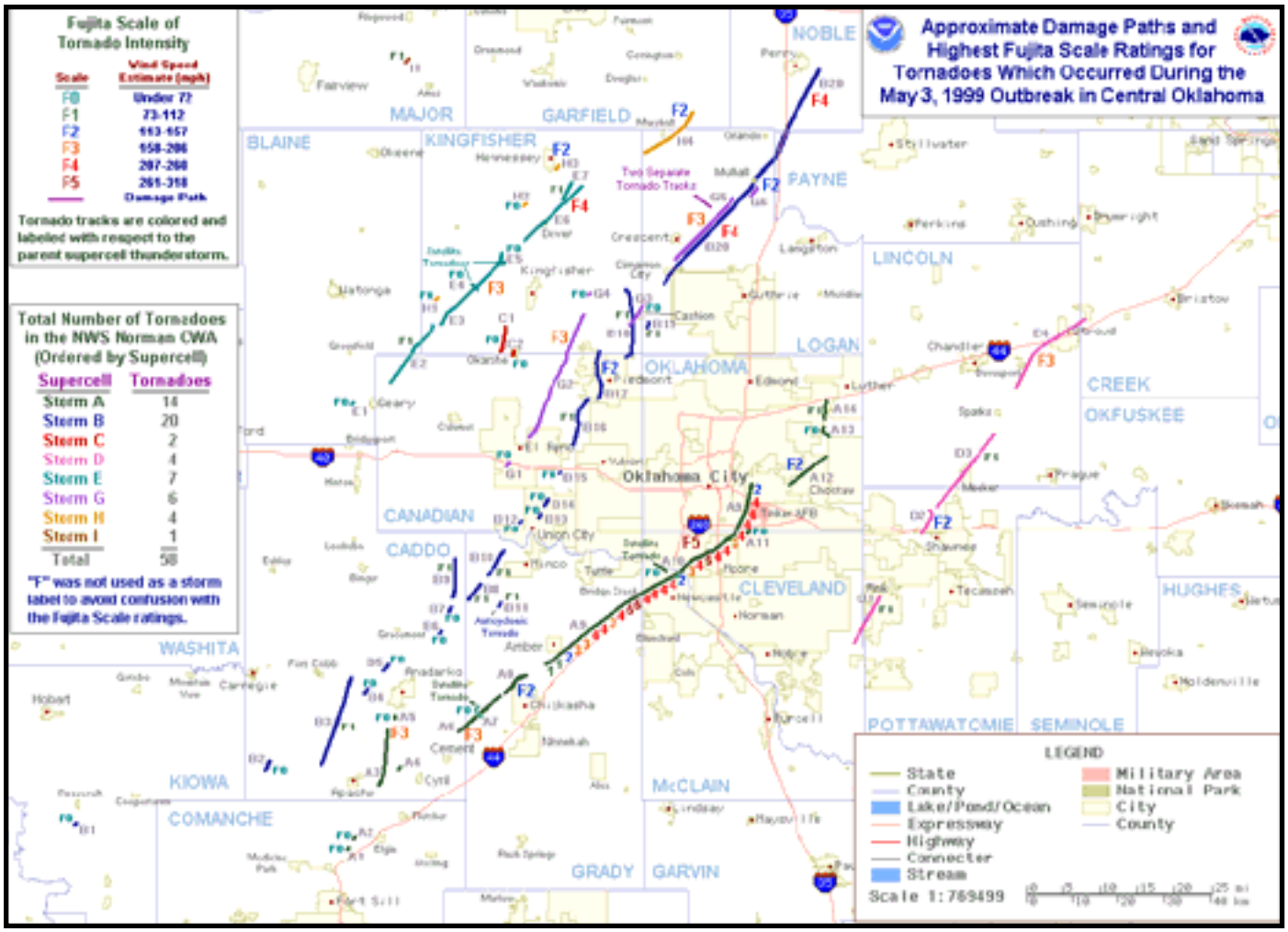
The Central Oklahoma Tornado Outbreak of May 3, 1999

On May 3, 1999, multiple supercell thunderstorms produced many large and damaging tornadoes in central Oklahoma during the late afternoon and evening hours. Some of these storms were killers, including the twisters which moved through and/or near Dover, Shawnee, Perry and Bridge Creek, and the Moore and southern Oklahoma City metropolitan areas. Additional tornadoes also hit areas in south central Kansas, eastern Oklahoma and northern Texas, with over 70 tornadoes being observed across the region. The current tornado count makes this outbreak the largest ever recorded in Oklahoma.

The latest statistics show that 40 people have died in Oklahoma due to the twisters and 675 were injured.

Many homes and businesses have been damaged or destroyed throughout the affected areas with a total damage estimate of $1.2 billion. Five deaths, 100 injuries and heavy damage were also incurred in the Wichita, Kansas metro area.

The map below shows the approximate location and paths of the most damaging tornadoes which occurred on May 3, 1999. Note: *This is a preliminary map and it does not display all of the tornadoes which occurred in Oklahoma on May 3, 1999.* Preliminary storm reports for the tornado outbreak are available here courtesy of the Storm Prediction Center. Preliminary local storm reports from NWSFO Norman are available here.



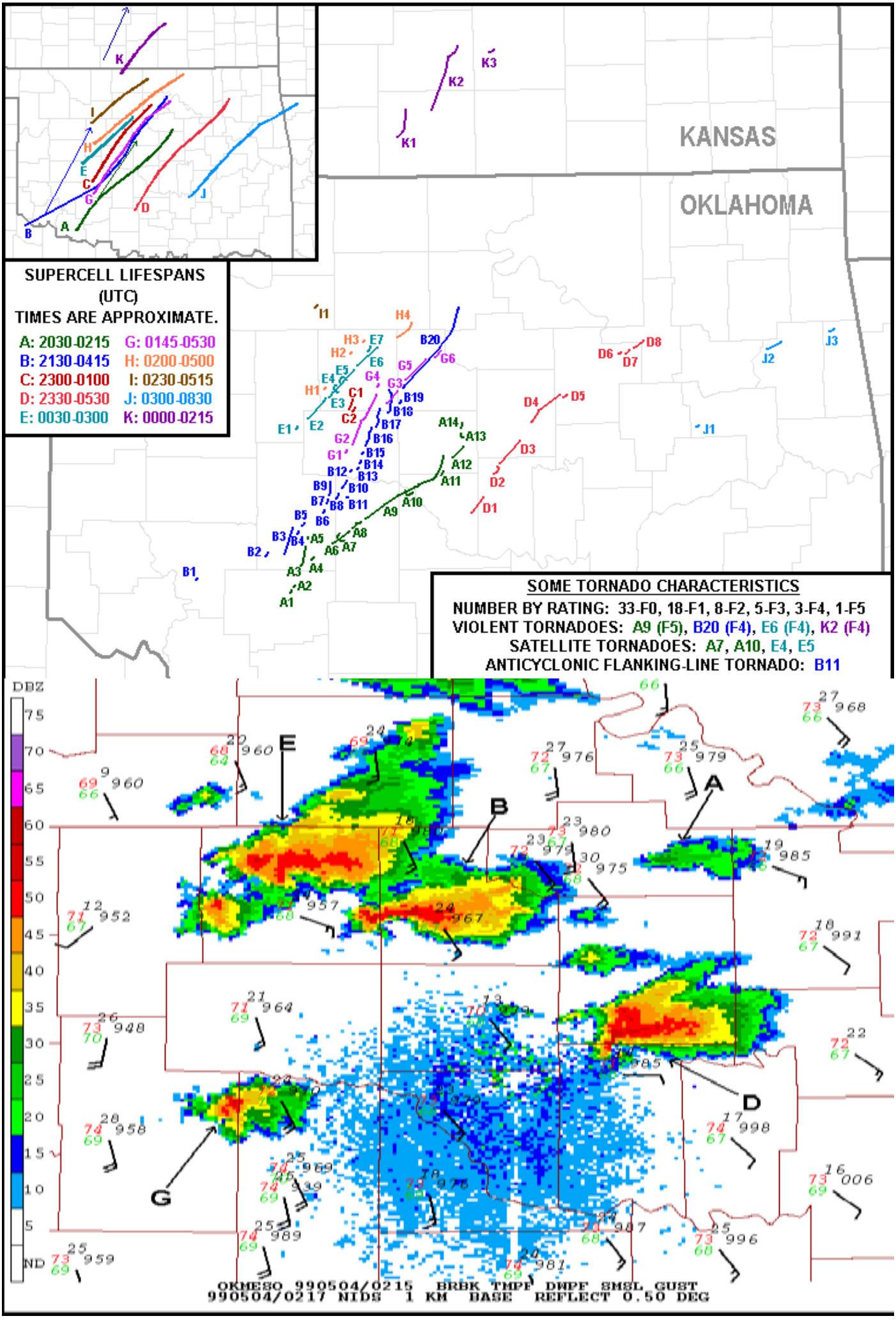
Source "The Central Oklahoma Tornado Outbreak of May 3, 1999"
http://www.srh.noaa.gov/oun/storms/19990503/index.html

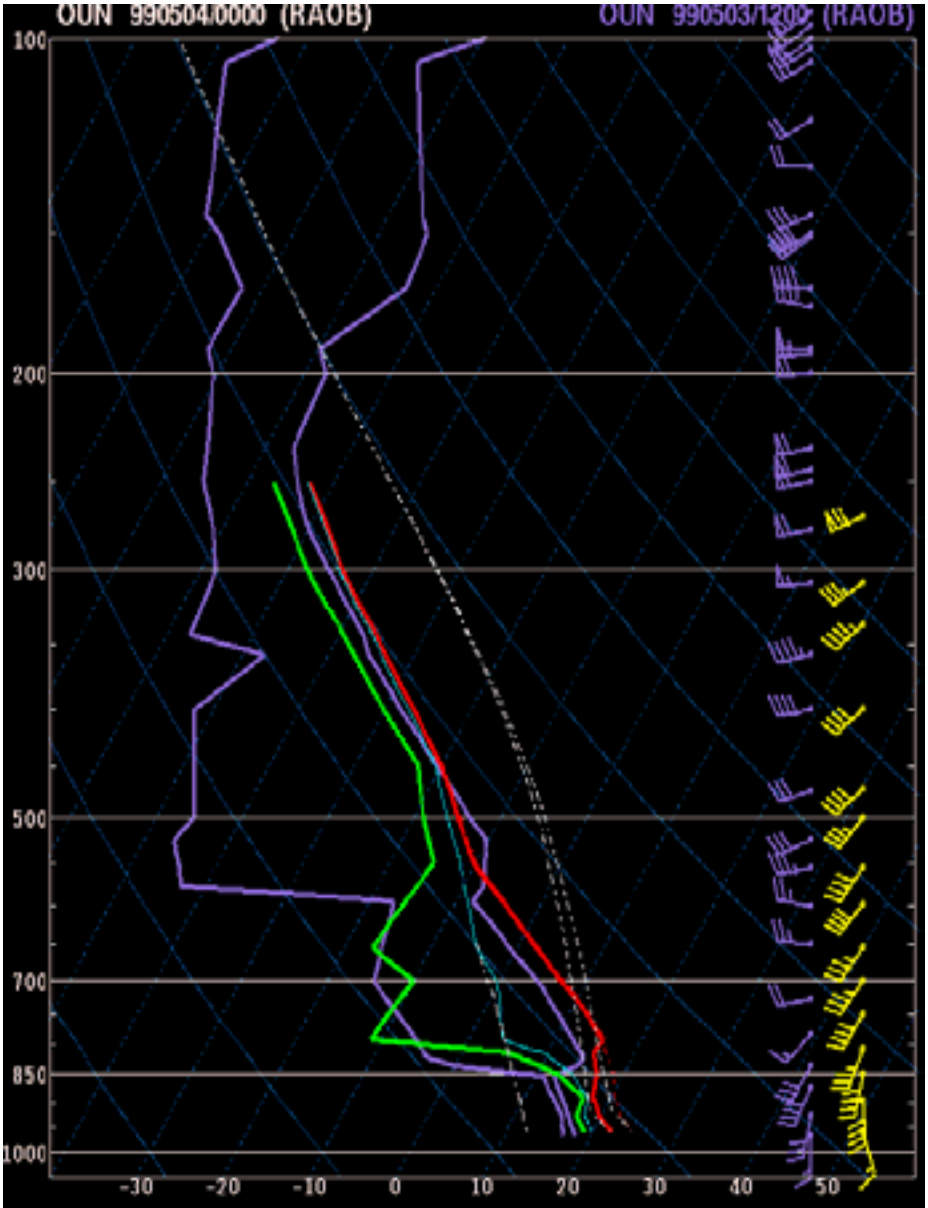
As can be observed from plotted tornado tracks, this event produced a devastating long tracked tornado with a maximum F5 rating. This tornado passed through western and southern suburbs of Oklahoma City including Moore. The State of Oklahoma received over 70 confirmed tornadoes (Officially 66 tornadoes).

The following media release makes an interesting read

Media release statement from NOAA:
http://www.publicaffairs.noaa.gov/releases2000/may00/noaa00r236.html

NOAA 2000-236
FOR IMMEDIATE RELEASE
Contact: Keli Tarp
5/1/00


SUPERCELL LIFESPANS
(UTC)
TIMES ARE APPROXIMATE.
A: 2030-0215
B: 2130-0415
C: 2300-0100
D: 2330-0530
E: 0030-0300
G: 0145-0530
H: 0200-0500
I: 0230-0515
J: 0300-0830
K: 0000-0215
KANSAS
OKLAHOMA
SOME TORNADO CHARACTERISTICS
NUMBER BY RATING: 33-F0, 18-F1, 8-F2, 5-F3, 3-F4, 1-F5
VIOLENT TORNADOES: A9 (F5), B20 (F4), E6 (F4), K2 (F4)
SATELLITE TORNADOES: A7, A10, E4, E5
ANTICYCLONIC FLANKING-LINE TORNADO: B11
DBZ
OKMESO 990504/0215 BRBK TMPF DWPF SMSL GUST
990504/0217 NIDS 1 KM BASE REFLECT 0.50 DEG



PARCEL DATA

*** MU PARCEL IN LOWEST 300mb ***

LPL: 959mb 22C / 19C 71F / 66F

CAPE =	2434 J/Kg	LI (500mb) =	-10 C
BFZL =	139 J/Kg	LImin =	M M
CINH =	-45 J/Kg	Cap =	1C / 790mb

LEVEL	PRES	HGT(AGL)	TEMP
LCL	915mb	1347ft	
LFC	751mb	6825ft	12C
EL	M	M	M
MPL	M	M	

THERMODYNAMIC DATA

------ AVAILABLE MOISTURE ------

P. Water =	1.04 in	Mean RH =	49 %
Mean W =	13.2 g/Kg	Mean LRH =	76 %
Top of Moist Lyr =	814 mb / 4620 ft		

------ CONDITIONAL INSTABILITY ------

700-500mb Lapse Rate =	22 C / 8.4 C/km
850-500mb Lapse Rate =	34 C / 7.8 C/km

------ MISC PARAMETERS ------

Total Totals =	59	K-Index =	2
SWEAT Index =	558	Max Temp =	83F
ThetaE Diff =	27C	Conv Temp =	
MHZ level =	8470ft	FGZ level =	11325ft

Suggested reading from the internet:

"The Central Oklahoma Tornado Outbreak of May 3, 1999"

http://www.srh.noaa.gov/oun/storms/19990503/index.html

Radar Loops

Radar and NSSL Experimental Algorithm analysis of the May 3, 1999 Tornado Outbreak.
http://www.nssl.noaa.gov/teams/swat/Cases/990503/case.html

http://okfirst.ocs.ou.edu/train/casestudies/03may99/loops/19990503.html

May 3, 1999 Oklahoma/ Kansas Tornado Outbreak

...What Others Are Saying and Other Links...

http://www.nssl.noaa.gov/headlines/outbreak.shtml

3 MAY 1999 OKLAHOMA CITY TORNADO CASE STUDY WEBPAGE (this page is interesting as you read the warnings changing rapidly to a more serious outbreak situation)

http://cimss.ssec.wisc.edu/smrwkshp/1999/case/Okccase.html

Some storm chase articles

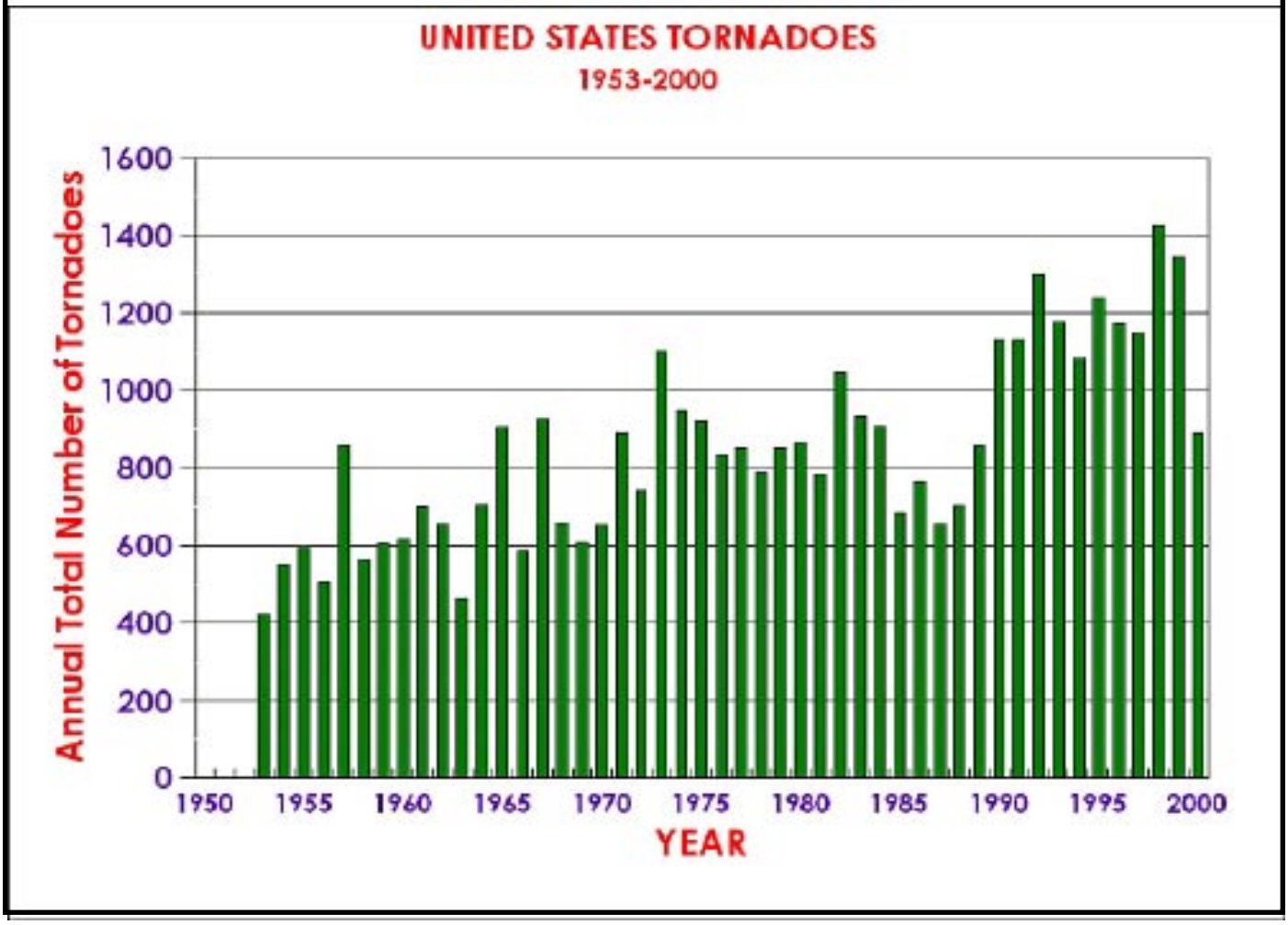
http://www.stormeyes.org/tornado/3may99/

http://www.qsl.net/ad5bn/chasepix/050399/

United States Tornado Facts

- Tornadoes have occurred in all 50 states (including Alaska!).
- The U.S. has a higher tornado density than any where else in the world.
- The Great Plains leads the U.S. in number of tornadoes.
- There are TWO major tornado alleys in the U.S. (Northeast Texas, Oklahoma, Kansas, Nebraska, Iowa, Illinois and Northeast Texas, Louisiana, Alabama, Mississippi, Florida).
- Tornadoes have occurred on all continents except Antarctica.
- Tornadoes have occurred on everyday of the year in the U.S. except on January 16.
- The U.S. peak in tornadoes occurs in May
- Peak months for tornadoes: TX (April-May), KS (May), ND (July-Aug.).
- The tornado season peaks in Winter in Southern California.
- The most violent tornadoes in the U.S. occur in Spring (especially April).
- The month with the least number of tornado deaths is July.
- 38% of tornado fatalities occur in mobile homes.
- Mobile homes do not attract tornadoes, they are just extremely vulnerable to high winds.
- 27% of tornado fatalities occur in permanent homes and 11% in vehicles.
- The deadliest tornado year since 1950 was in 1953 with 519 deaths.
- There were only 130 tornado deaths in 1998 and 95 tornado deaths in 1999 showing the value of the current warning system.

NOTE BAR GRAPH BELOW



Average No. of Tornado Deaths, 1950–1999

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
3	6	13	27	19	11	1	2	2	2	3	3

Average No. of Tornadoes, 1950–1999

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
20	22	54	109	180	171	96	60	41	29	30	17

The 25 Deadliest Tornadoes

Date	Location(s)	Deaths
1. March 18, 1925	Tri-State (Mo., Ill., Ind.)	689
2. May 6, 1840	Natchez, Miss.	317
3. May 27, 1896	St. Louis, Mo.	255
4. April 5, 1936	Tupelo, Miss.	216
5. April 6, 1936	Gainesville, Ga.	203
6. April 9, 1947	Woodward, Okla.	181
7. April 24, 1908	Amite La.; Purvis, Miss.	143
8. June 12, 1899	New Richmond, Wis.	117
9. June 8, 1953	Flint, Mich.	115
10. May 11, 1953	Waco, Tex.	114
10. May 18, 1902	Goliad, Tex.	114
12. March 23, 1913	Omaha, Neb.	103
13. May 26, 1917	Mattoon, Ill.	101
14. June 23, 1944	Shinnston, W. Va.	100
15. April 18, 1880	Marshfield, Mo.	99
16. June 1, 1903	Gainesville, Holland, Ga.	98
16. May 9, 1927	Poplar Bluff, Mo.	98
18. May 10, 1905	Snyder, Okla.	97
19. April 24, 1908	Natchez, Miss.	91
20. June 9, 1953	Worcester, Mass.	90
21. April 20, 1920	Starkville, Miss.; Waco, Ala.	88
22. June 28, 1924	Lorain, Sandusky, Ohio	85
23. May 25, 1955	Udall, Kans.	80

Information courtesy of;

http://nebraskaweather.unl.edu/severe/US_severe_climate.htm

http://www.infoplease.com/ipa/A0193170.html

WEBSITE REVIEW

Australiasevereweather.com

I spent a great deal of time this issue thinking about what weather website to review. Then I thought to myself, "why not review the very site that got me involved in the weather community in the first place"?

Australiasevereweather.com is in my opinion the foremost weather website in Australia at the present time. It has the largest and most comprehensive list of storm chasing reports of any website in this country and it would easily be in the top ten global storm chaser and weather reportage websites.

Now before you ask isn't Jimmy Deguara involved with this journal? I would like to say that he has had no input into this report in the slightest. It is based solely on my experiences with worldwide weather websites and it was also one of the first Australian weather websites that I discovered when I first got connected to the Internet. It was also through this website that I contacted Jimmy Deguara and got involved in the Australian storm chasing community.

Australiasevereweather.com (will now be abbreviated ASW) is jointly run by Michael Bath and Jimmy Deguara. It was set up in the late 1990's to cater for the ever-growing population of Australian storm chasers as a storm report archive and a source of photographic and video images. Basically this website is like a giant archive of weather experiences, the main emphasis being on storm photography and videography. For photographs alone this website is easily Australia's best with the spectacular lightning work of Michael Bath and the incredible time-lapse videography of Jimmy Deguara being standouts. And now with relative newcomer David Ellem contributing regularly, the content of ASW is enhanced even more.

On the home page you have an easily navagatable list down the left side which contains all the sites multitudes of pages. The first key is the "**Home**" key. The next key takes you to "**Weather photography**" were you'll find a massive catalogue of photo's divided into manageable categories to do with cloud features and phenomena, including lightning, tornados, hail and optical phenomena, and then underneath you'll find clouds listed in their respective classifications.

The third key down will take you to "**Storm news and storm chasing**". Here you will find a comprehensive list of storm chaser articles with photographs, going back to 1995. I have spent many hours myself reading these articles on days when I was bored. They are simply the best-presented and most thorough list in Australia.

The fourth key down will take you to "**Video movies and stills**" were you will find a list of video clips and stills form Australian chases and also the only collection of video clips and stills from Australians chasing in the USA that I have found in Australia.

The fifth key down will take you to "**Tornados**" were you will find a list of tornadic encounters from both Australia and the USA.

The sixth key down will take you to "**Weather photo catalogue**" were you will find comprehensive photo archive going back to 1987.

The seventh key down will take you to "**Bushfires**" which appears to be a relatively new section with some fire reportage and photos from the last couple of years only.

The eighth key down will take you to "**Tropical Cyclones**". Here you will find links to current TC activity

as well as an archive of previous years events that goes back to the summer of 1980/1981. You will also find an excellent and very comprehensive archive of east coast and Gulf of Carpentaria tropical cyclone impacts.

The ninth key down will take you to "**Observation techniques**" which is a handy guide to help in watching and classifying the weather from the beginner up to the more advanced.

The tenth and final key will take you to "**Weather data and links**". Here you will find links to sites that contain current and archived weather data.

This is a very well presented website with a comprehensive archive of storm chase reports and weather photo's and video. Finding information is relatively easy and if you can't find what you want then Jimmy Deguara is always happy for people to email him with questions in regards to past thunderstorm events. I think that the other thing that makes this website so good is the variety of authors who have contributed storm reports over the years. It makes for interesting and varied reading and it just reinforces the place that this website holds in the Australian storm chaser community.

My website rating **9.0/10**

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SEVERE EVENTS FROM THE PAST

On the 21st January 1986, the Central Tablelands town of Orange was hit by a certain supercell dumping hailstones to tennis ball size in diameter (up to 7cm). It produced enormous damage to crops and also in the town. An interesting feature was a possible tornado north of Orange which would have been in the correct position on the northern side of a supercell. I do recall this particular storm generating incredible northerly outflow as it passed to our north headed for the Central Coast.

counter	Event No	Begin Date/Time	Latitude	Longitude	Nearest Town	District	Tornado	Hail Size (cm)	Event Comments
1052	20950.00	21 Jan 1986 14:00	33.28	149.10	ORANGE	CENTRAL TABLELANDS	No	7.00	GOLF BALL TO TENNIS BALL SIZE HAIL,4.5 CM - 7 CM, $9.48 MILLION,UNCONFIRMED TORNADO BURRENDONG DAM (NTH OF ORG

GLOSSARY and LP SUPERCELL DISCUSSION

Our first glossary topic is on supercell definitions and in particular, LP supercells. There has been some discussion recently about three Australian storm events that have been classified as LP supercells by chasers on the ground. An overseas observer has now looked at photographs, video and radar of these events and classified all three as Classic supercells. Some relevant terminology, courtesy of the Oklahoma Climatological Survey, follows:

LP Storm (or LP Supercell) - **L**ow-**P**recipitation storm (or **L**ow-**P**recipitation supercell). A supercell thunderstorm characterized by a relative lack of visible precipitation. Visually similar to a classic supercell, except without the heavy precipitation core. LP storms often exhibit a striking visual appearance; the main tower often is bell-shaped, with a corkscrew appearance suggesting rotation. They are capable of producing tornadoes and very large hail. Radar identification often is difficult relative to other types of supercells, so visual reports are very important. LP storms almost always occur on or near the dry line, and thus are sometimes referred to as dry line storms.

Clear Slot - a local region of clearing skies or reduced cloud cover, indicating an intrusion of drier air; often seen as a bright area with higher cloud bases on the west or southwest side of a wall cloud. A clear slot is believed to be a visual indication of a rear flank downdraft.

Supercell (or Supercell Storm) - a violent thunderstorm which can produce hail and large tornadoes and containing updrafts and downdrafts that are nearly in balance, allowing it to maintain itself for several hours

Hook (or Hook Echo) - a radar reflectivity pattern characterized by a hook- or crescent-shaped extension of a thunderstorm echo, usually in the right-rear part of the storm (relative to its direction of motion). A hook often is associated with a mesocyclone, and indicates favorable conditions for tornado development.

HP Storm (or HP Supercell) - High -**P**recipitation storm (or **H**igh -**P**recipitation supercell); a supercell thunderstorm in which heavy precipitation (often including hail) falls on the trailing side of the mesocyclone. Precipitation often totally envelops the region of rotation, making visual identification of any embedded tornadoes difficult and very dangerous. Unlike most classic supercells, the region of rotation in many HP storms develops in the front-flank region of the storm (i.e., usually in the eastern portion). HP storms often produce extreme and prolonged downburst events, serious flash flooding, and very large damaging hail events. There is also an excellent reference document that can help all chasers in classifying storms. It is called: Tornadoes and Tornadic Storms: A Review of Conceptual Models by CHARLES A. DOSWELL III and DONALD W. BURGESS, *National Severe Storms Laboratory, Norman, Oklahoma 73069 USA*

The link to this document is:

http://www.cimms.ou.edu/~doswell/TSIII/TSIII_concept.html
Links to information about the storm events in question are:
http://australiasevereweather.com/storm_news/2003/docs/200310-04.htm
http://australiasevereweather.com/storm_news/2003/docs/200302-01.htm
http://australiasevereweather.com/storm_news/2001/docs/200109-02.htm
If you have the time, it is an interesting exercise to read the definitions, the conceptual models (in particular, the section on hybrid storms) and the written accounts of the chasers along with the photographic evidence and the meteorological information, especially radar.

CHASE JARGON

Your about to enter the **BEAR'S CAGE**

Definition:

Bear's Cage - [Slang], a region of storm-scale rotation, in a thunderstorm, which is wrapped in heavy precipitation. This area often coincides with a radar hook echo and/or mesocyclone, especially one associated with a HP storm. The term reflects the danger involved in observing such an area visually, which must be done at close range in low visibility.
(Reference: "NOAA Technical Memorandum", NWS SR-145, Michael Branick)

Imagine. You're in business - all the hours spent interrogating models, and all your 'busts' preceding seem suddenly worthwhile. This time, you've nailed a monster. You head west along a deserted Australian highway. The dark horizon ahead signifies a serious storm. Conditions are ideal for monster supercells. On closer approach, the enormity of the storm is dramatically revealed. You fumble for your video camera and start shooting video from the front seat. Before long, a dark blue-green tinged cloud base and precip. curtain comes into view. A shelf cloud and its associated laminar banding penetrate high into the storm, ahead and off to your right. But this is no squall line. Swirling white scud clouds contrast against the ink blue precipitation core, nearly touching the grown ahead of you, not chaotically, however. The process is all very organised. Cloud elements are streaming into the core, which lay ahead beyond the ghostly-white fractus. Inflow winds, at your black, warrant you placing a firm grip on your tripod. CG lightning bolts strobe a few miles in front of you. To your left, a smooth beaver tail penetrates into the heart of the storm. Your basic instinct is to get out of here. 'No way' you think to yourself. Time to get in the vehicle, absolutely, but getting out of the area is the last thing on your mind. This is a storm chaser's nirvana.

Looking towards the bear's cage of a supercell storm near Cobar, NSW. Inflow on the left, outflow on the right, bear's cage in the middle. You don't want to go in there!

The storm has now edged dangerously close. Defiant, you stand your ground, in the 'safety' of your vehicle. How bad can it be? You're about to find out. Now, only a km away, you can now see precipitation curtains wrapping in from the right side - the storm has strong rotation. CG bolts stab the ground all around you followed by sharp booms of thunder. Northeast swing around to the north and reach gale force. Within seconds your visibility has gone to zero. Winds from your northwest are now incredible as driving rain rapidly turns to large hail; the hail quickly grows in size, threatening to shatter the driver's side windows. The combined noise is just deafening.

Hailstones from the bear - a supercell thunderstorm near Tyndale, northern NSW. This storm produced hailstones measured to 9.6cm in diameter. Hail of this size can literally destroy your vehicle, and is life-threatening if you are caught out.

The sky has an eerie olive green hue - all you can do is dive down on the floor in front of the backseat to protect yourself. Suddenly, the onslaught ceases leaving only occasional giant-sized hailstones falling. To your left, a large, white rapidly-rotating funnel cloud protrudes from the cloud base - too close and moving generally
towards you, though you convince yourself it will pass by to your south. Suddenly the rain and hail onslaught resumes, this time with winds swing around to the southmore - the winds are insane and you cant see a thing. Finally, after 20 terrifying minutes that seemed an eternity, your ordeal is over. The back of the storm edges east and you view a giant updraft, towering some15km up above you. You just had a close encounter with the bear's cage!

In the bear's cage near Mullaley, NSW. Winds estimated at 150km/h, golfball sized hailstones being driven into the window, and zero visibility. This resulted from a miscalculation of the local road network and extremely rapid storm intensification, all in an effort to get on the eastern side of the storm for better viewing. Lesson learnt!

Core-punching, although never advisable under any circumstances, is in reality, not life-threatening in many situations. Garden-variety (non-severe) thunderstorms might spray you with some heavy rain and gusty winds. Lightning, of course, is an ever-present danger with any thunderstorm. Core-punching supercells is, however, extremely dangerous practice. You are literally putting yourself in the mouth of an angry storm. A storm that can quite easily claim your life. Chase strategy involves putting yourself in the best position to view the storm, as opposed to becoming its victim. A few simple checks can make all the difference.

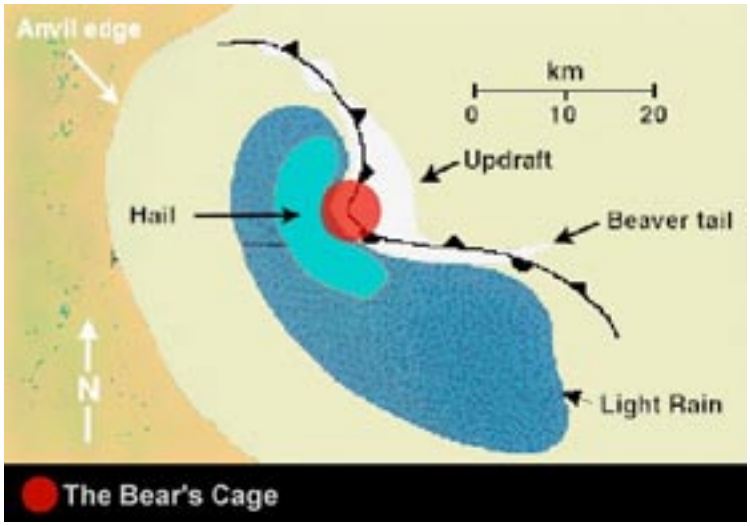
On the morning of chase day:

• based on your forecast, determine likely storm motion vectors and speed.
• consider the likelihood of severe storms/supercells developing.
• study a detailed road map of your target area. Don't risk unsealed roads, and always ensure you have good escape options to avoid being caught in the bear's cage.

Once on a storm,

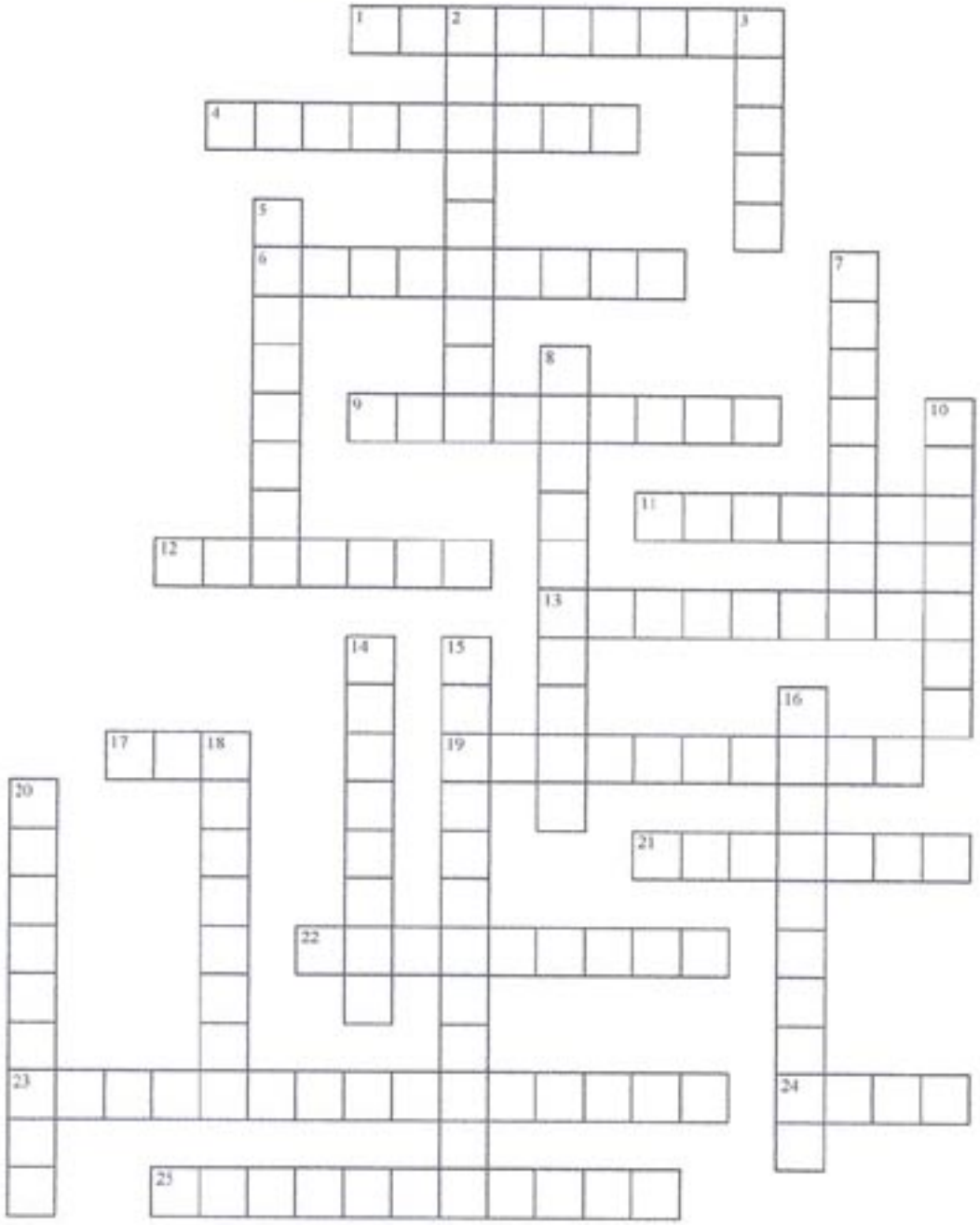
• be observant of storm motion and of course evolving storm structure.
• consult your compass frequently, don't assume. Windy Australian roads can leave the best navigator disoriented
• don't be so enamoured with the storm so as to forget your safety factor. Ironically, the visually most spectacular storms are often the most dangerous.

Finally, always remember any storm, severe or not, can present hazardous driving conditions, such as slick roads and poor visibility. Lightning, of course, is an ever-present danger with any thunderstorm. A bit of extra planning will ensure that you keep yourself safe, as well giving you the best chance of bringing home top-notch photos.



Low level cross section of an HP supercell. The bears cage (shaded red) co-incides with the storms low-level mesocyclone. Precipitation from the rearflank downdraft (RFD) is wrapped around the perimeter of the low-level mesocyclone. This region is a focus of severe weather in a supercell thunderstorm, and wrap-around precipitation can dangerously obscure tornadoes from an observer.

ASC Crossword No 1



ACROSS

1 A small downward flowing region of air descending rapidly towards the surface and spreading outwards.
4 Small scale column of air that sinks rapidly toward the ground, usually accompanied by precipitation as in a shower or thunderstorm.
6 A large thunderstorm with a persistent rotating updraft and is responsible for most giant hail events, strong damaging winds and sometimes tornadoes.
9 Convective Available _____ Energy.
11 A violently rotating column of air in contact with the ground and extending from the base of a thunderstorm.
12 Smooth non-turbulent flow.
13 What day of the week did the 1999 Sydney Hailstorm occur?
17 Bureau of Meteorology.

DOWN

2 It is sometimes said "We do not get these in Australia"
3 Acronym of British Stormchasing Organisation.
5 Line joining areas of equal temperature.
7 Very fast blowing snow.
8 Beaver's tail.
10 A line connecting points of equal precipitation amount.
14 The name given to the temperature at which water vapour changes to liquid form.
15 "The storm came back on itself"
16 A strong downdraft resulting in a localised outward burst of damaging winds on or near the ground.
18 Rounded, smooth sack-like protrusions hanging from the underside of a cloud.
20 A localised, persistent and rotating lowering from a rain-free base.

19 A process caused by warm rising air.
21 A small scale current of rising air.
22 Another term for overshooting top.
23 A dome-like protrusion of the top of a thunderstorm, representing a very strong updraft and hence a higher potential for severe weather with that storm.
24 Precipitation composed of white or translucent ice crystals.
25 _____ in a horizontal wind field indicates that more air is entering a given area than is leaving at that level.

To complete crossword simply print it out and fill in. The answers will be provided with the next issue.