



Severe storm with intense gust front



Face of South of the Sierra Guadarrama (Madrid). 22-Junio-2005

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INTRODUCTION

During the 22nd of June of 2005 an intense storm developed over the Sierra del Guadarrama. This was an intense gust front that produced gusts well over 100 km/h. The origin of this front is a convective storm and its associated downward flow of air, crashing onto the ground and flowing, intensely and at the surface level, outwards in all directions (see exhibit 0). Gusts fronts exist in all thunderstorms, although with varying force. This type of fronts even influence surrounding storms; some even helping generate new ones and dissipate others. When the downflow of air is very intense it is called a "downburst" or a "microburst". As we all know, in order for a storm to be described as "severe", it must carry winds equal to or in excess of 50 knots (about 90 Km/h). Even though there are neither official measurements of the event in the Manzanares el Real dam area nor in the location where we experienced the severe weather episode, in the Los Rancajales urbanization, located in the NW slopes of the San Pedro hill, where the wind speeds were much higher, we know that in the nearest weather station, in a military base known as FAMET de Colmenar (about 10Km south of the where the gust front was at its most active,) the gusts reached a speed of 80 Km/h. However, we must also acknowledge that we were not able to confirm that the episode was indeed a downburst, due to the fact that we did not investigate the effects of the event in the area. Nevertheless, the images are eloquent enough and a clear tendency for the air to flow downward can be seen in them.

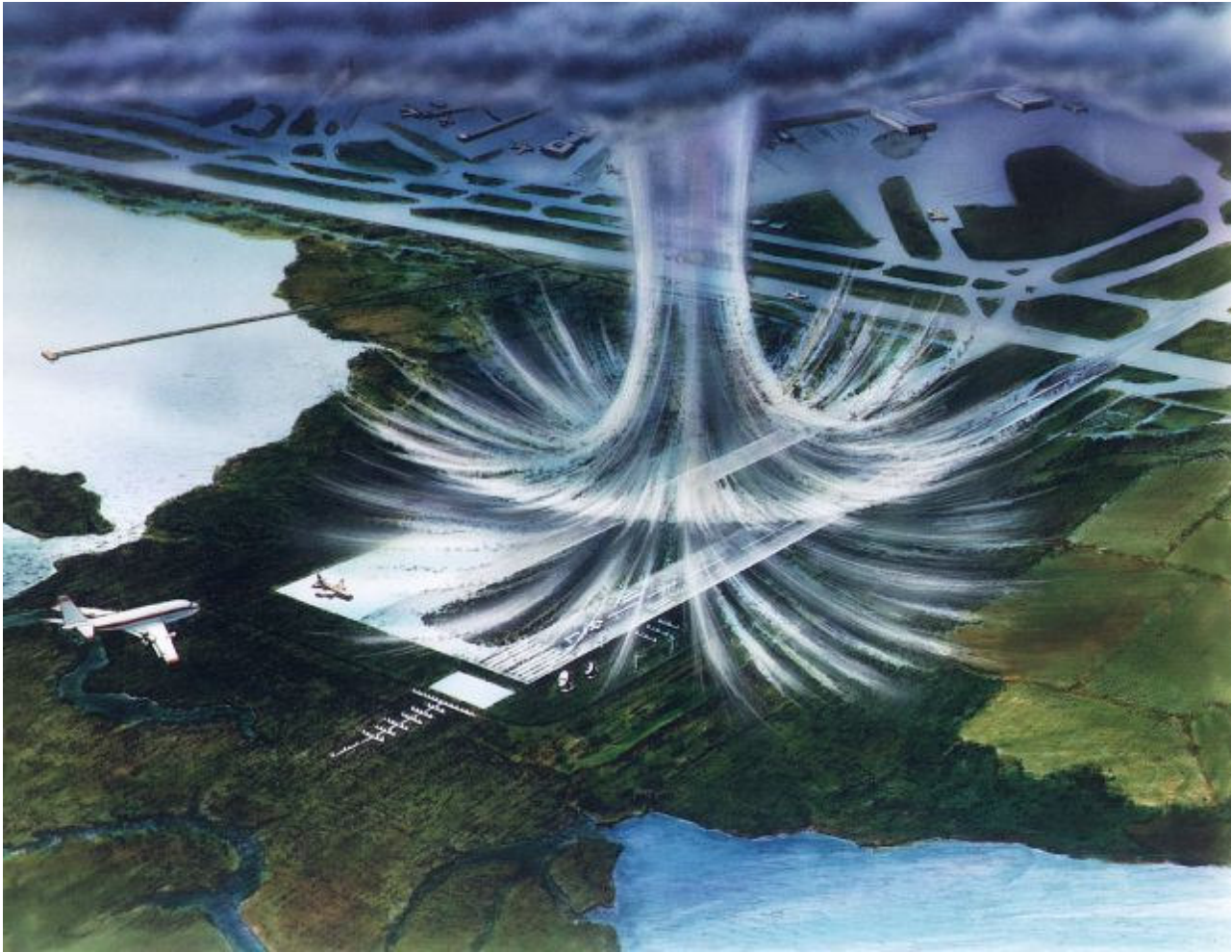


Exhibit . 1

Source: <http://www.princeton.edu/~stengel/Microburst.JPG>

Let's now look at the nature of downdrafts and gust fronts in a little more detail:

As we can see from exhibit 0, when the downdraft crashes against the ground, the air flows in all directions. The line of separation between the cold, downward flowing, air current and the warm surface is known as "gust" or "gust front" (see exhibit 1). Although easy to spot to the trained eye, the occurrence of a gust front might seem like a cold front to the uninformed observer. When a gust front occurs, winds change direction and speed violently, with speeds that, occasionally, surpass 55 knots. At the same time temperature also drops violently (7 to 10°) while the heavy air mass of the downdraft increases surface barometric pressure. Sometimes the increase in pressure can be in the order of millibars, creating a small area of high surface barometric pressure known as "mesohigh". When this pocket of cold air sinks, it eventually becomes "trapped," at the surface level, sometimes even for hours on end after the storm activity has ceased.

SEVERE THUNDERSTORM

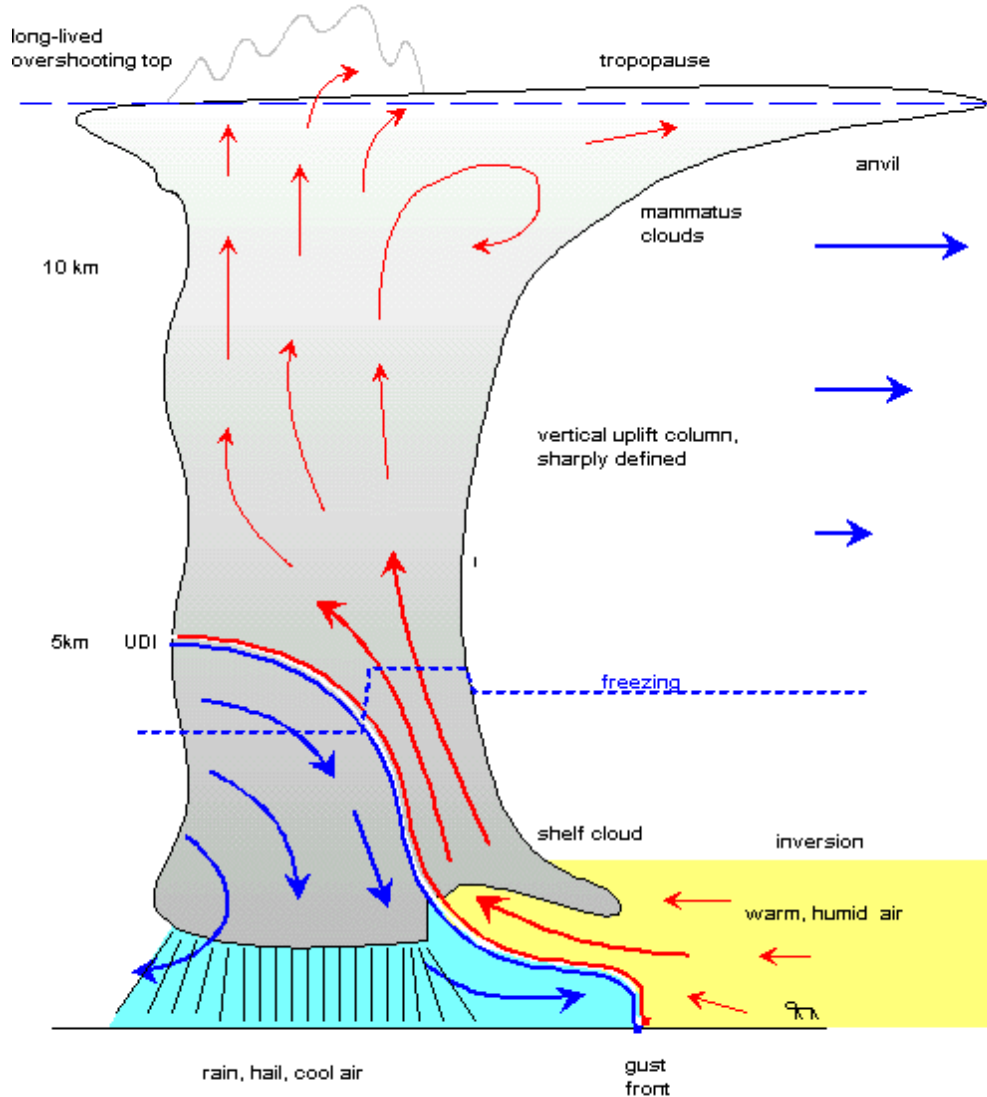


Exhibit . 1

Source: <http://www.casdn.neu.edu/~geology/department/staff/naylor/geo1158/thunder2.gif>

Airflow is very turbulent along the front axis of the gust front. Due to this, airborne and ground particles are scooped up and whirled around, forced upward and finally forming a roller-like cloud known as "haboob". Moreover, since the warm and humid air ascends along the front axis of the gust front, it can also create what's known as a "shelf cloud," also known as "arcus". This type of cloud can linger for a long time when the atmosphere around its base is stable. The shelf cloud is adhered to the base of the storm.

Occasionally threatening and sinister clouds form in the back of the storm. These clouds, which flow around the storm's horizontal axis, are known as "roll clouds". Whenever the front axis of the gust front forces the warm and humid air upwards, it (sometimes) helps develop new convective cells. If the downward airflow is intense enough, it produces downbursts, microbursts or macrobursts.

Downburst can be classified as macroburst (diameter > 2.5 miles) and microburst (diameter < 2.5 miles). These intense downward flowing air currents are often accompanied by hail, due to the fact that as hail descends it also pulls the surrounding air downward. As hail descends, it gets progressively cooler, due to the fact that as it works its way downward part of its humidity evaporates, becoming more compact and in essence less resistant to air, hence falling progressively faster. We must point out the fact that a gust front is not the same as a downburst. The later only exists when the winds associated with the downward flow of air reaches speeds equal to or higher than 60-75 meters per second.

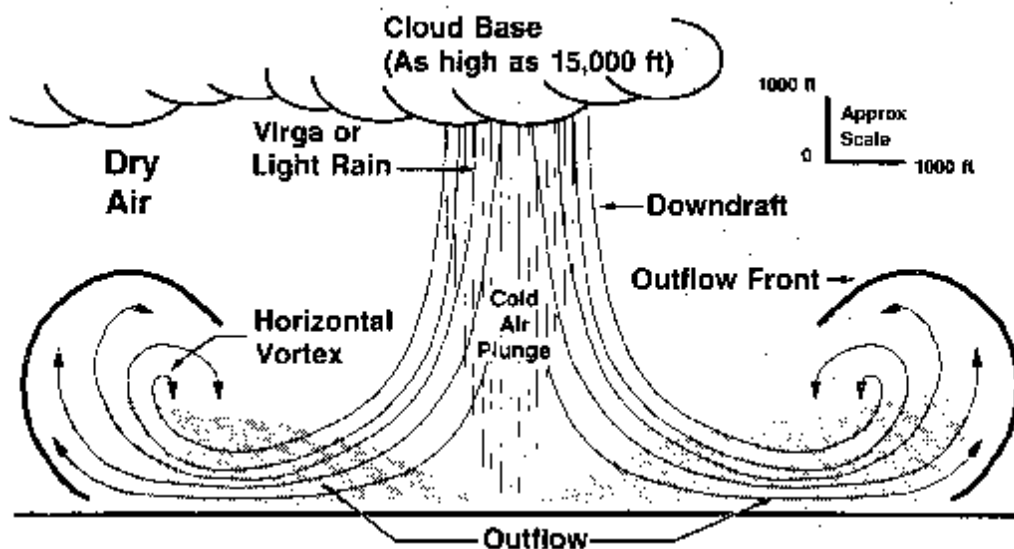


Exhibit .2

Source: http://www.math.unl.edu/~jfisher/NSF_96/images/micro3.gif

The vantage point chosen to photograph this storm (see exhibit 3) is situated in the proximity of the San Pedro hill, which in different circumstances or time of year is an extraordinary lookout point of the highest peaks in the Sierra de Guadarrama. This area is also known as the "long rope". Moreover, sunsets over the Manzanares del Real dam are nothing short of "divine"... in essence, a privileged perspective of nature. Should you wish to visit, all you have to do is follow (national road) M-607 to the fork on the road that goes into a town called Colmenar Viejo. Next, follow the signs that lead you to Guadalix de la Sierra and/or Helicopter Base (FAMET). Once you reach the newly laid road pavement, about 3-4 kilometers, make the left that takes you into an urbanization (signs everywhere). About 1 kilometer after that, once you see a group of antennae you'll have to go over a small bridge from which the views will amaze you. From this vantagepoint you'll also be able to see the northern slopes of the above mentioned hill and the town of Soto del Real at your feet, and of course, the Sierra (range) right in front of our noses..

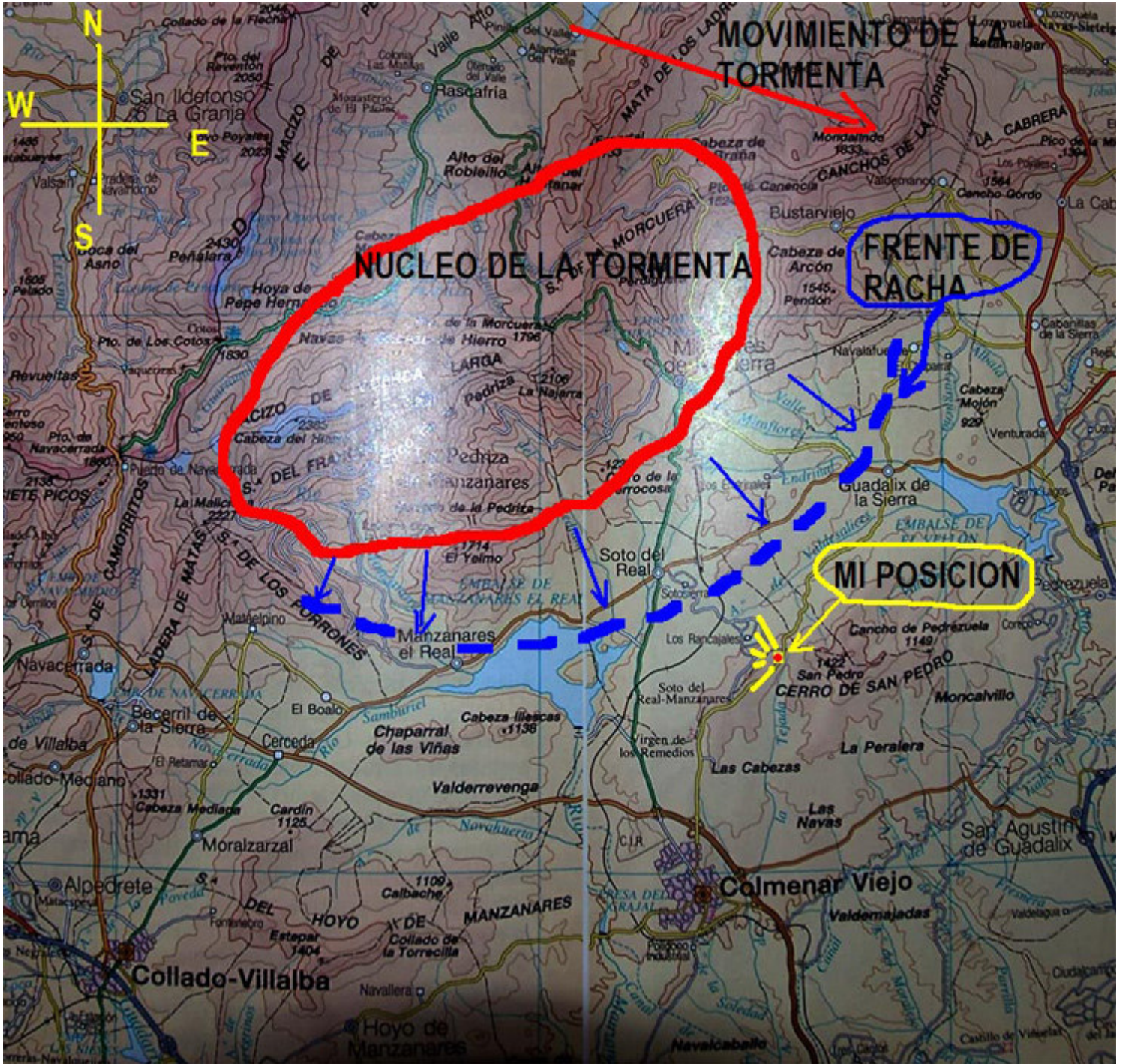


Exhibit.3

MAPS AND IMAGES OF THE WEATHER SITUATION THAT LED TO THE ABOVE EVENT

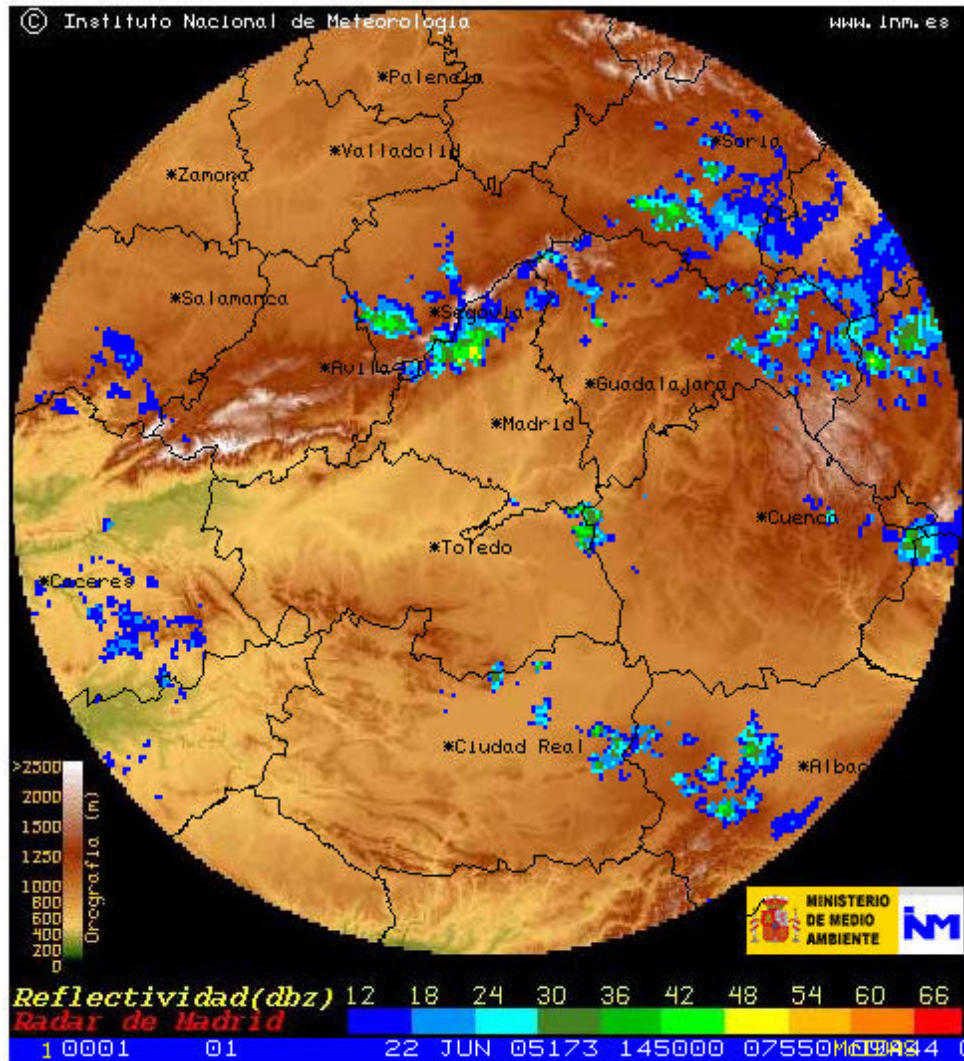
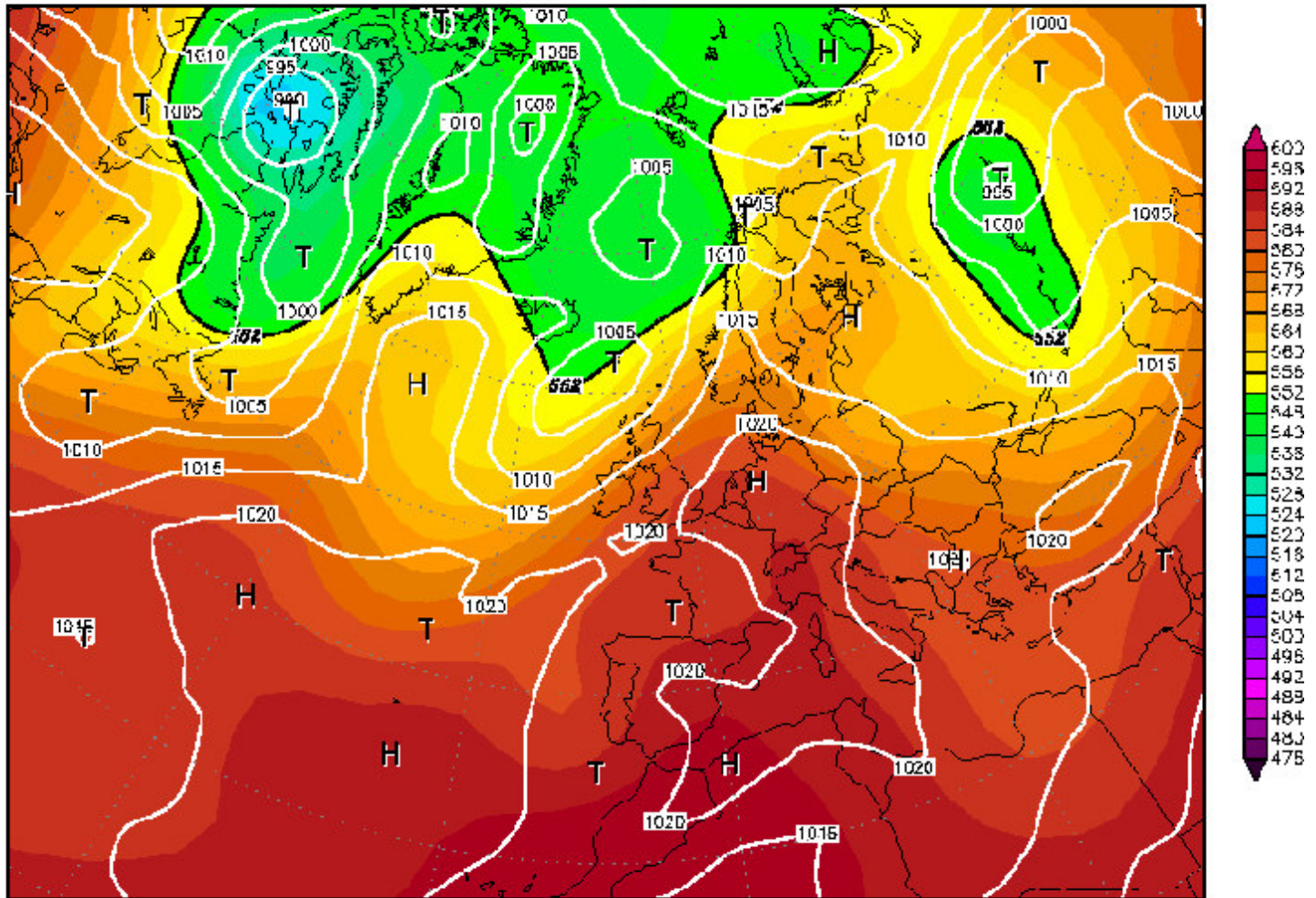


Exhibit .4

Madrid radar image from INM (National Meteorological Service) at 14:50 hours, while the storm is in full fledge.

23JUN2005 00Z

500 hPa Geopotential (gpm) und Bodendruck (hPa)



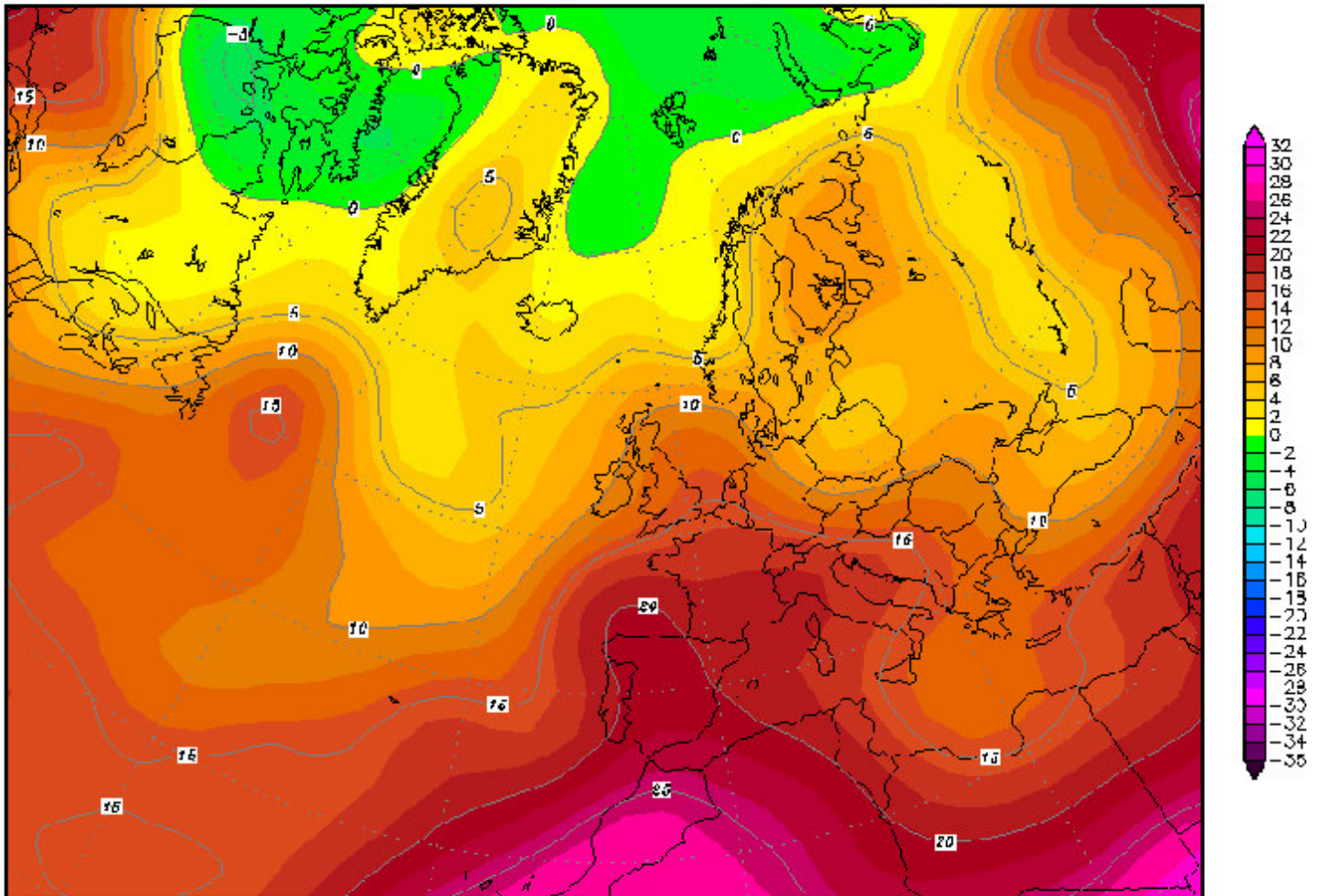
Daten: Reanalysis des NCEP
(C) Wetterzentrale
www.wetterzentrale.de

Exhibit.5

Geopotential map at 500mb and PSL of the 23rd of June of 2005 at 0:00 hours.

23JUN2005 00Z

850 hPa Temperatur (Grad C)

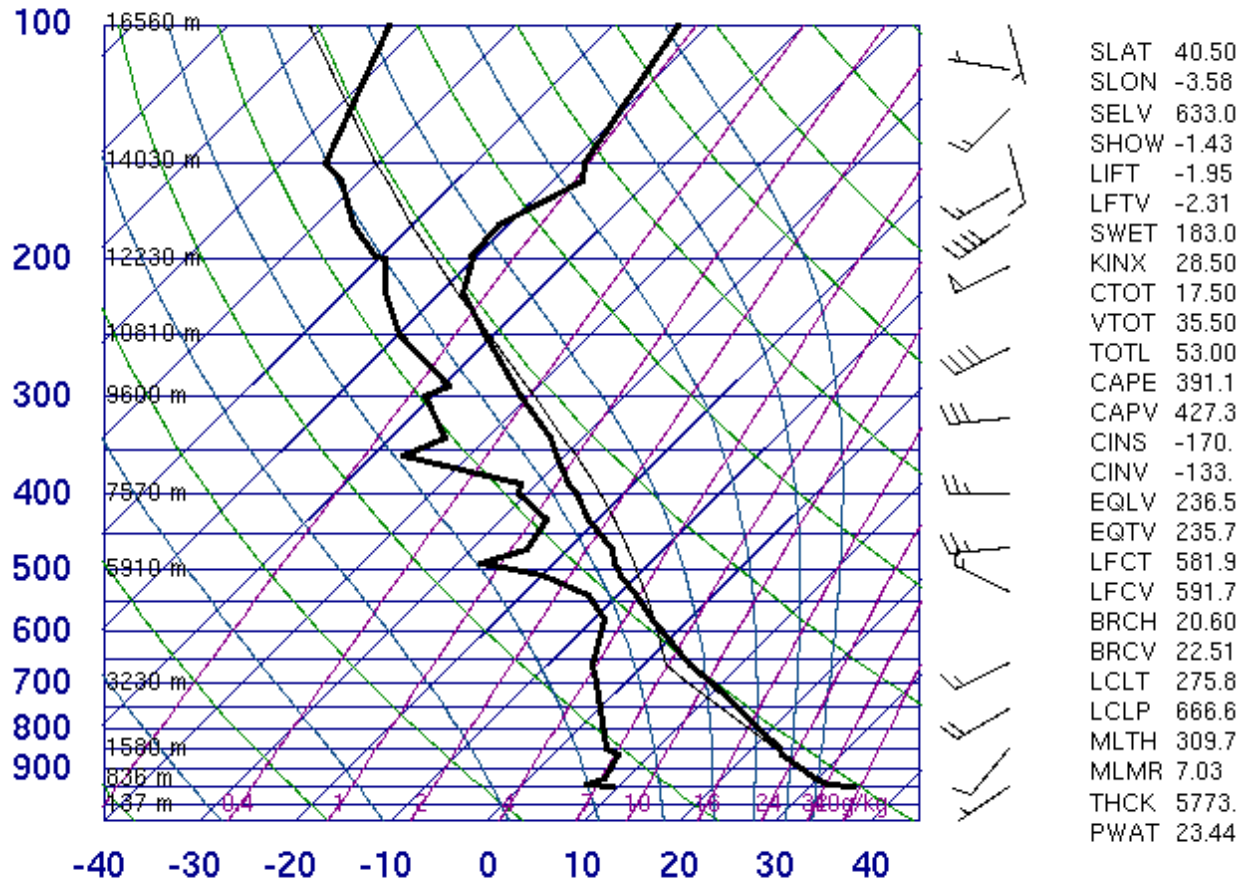


Daten: Reanalysis des NCEP
(C) Wetterzentrale
www.wetterzentrale.de

Exhibit.6

Temperature map at 850mb on the 23rd of June of 2005 at 0:00 hours.

08221 LEMD Madrid



12Z 22 Jun 2005

University of Wyoming

Exhibit.7

Survey of Madrid from the 22nd of June of 2005 at 12:00 (1)

Station: 08221 Madrid Barajas (LEMD) Date: 22 Jun 2005 Time: 1200Z

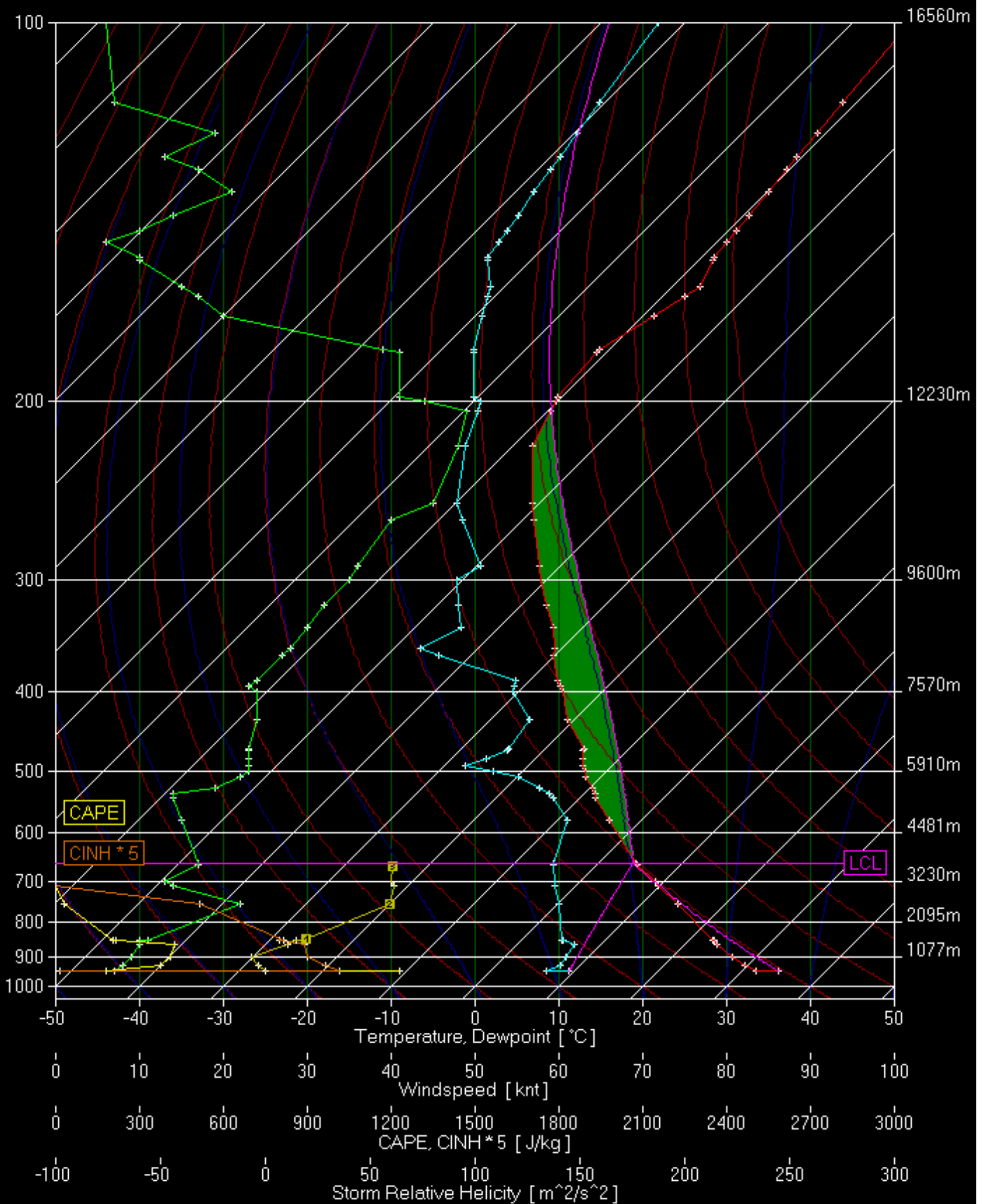


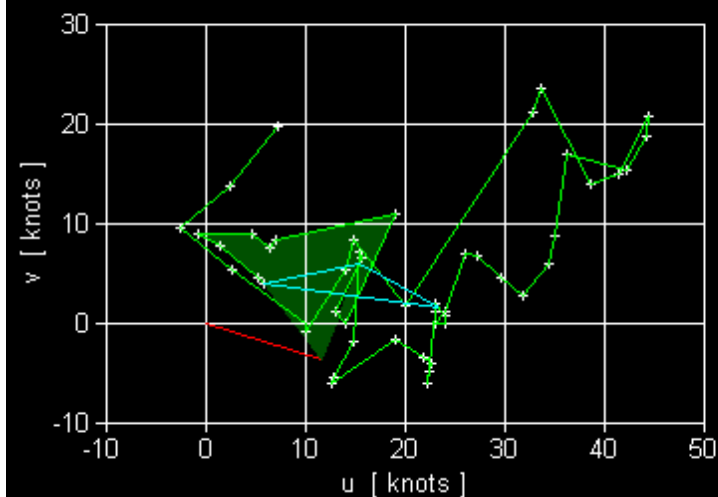
Exhibit.8

Survey of Madrid from the 22nd of June of 2005 at 12:00 (2)



Exhibit.9
 Survey of Madrid from the 22nd of June of 2005 at 12:00 (3)
 Note the elevated CAPE and Lifted indexes.

Station: 08221 Date: 22 Jun 2005 Time: 1200Z



Wind Parameters

Storm Direction:	287.62 [°]
Storm Motion:	12.13 [knots]
Storm Relative Helicity:	60.97 [m ² /s ²]
Wind Shear Dir Sfc - 3000:	257.81 [°]
Wind Shear Sfc - 3000:	9.87 [knots]
Wind Shear Dir 3000 - 6000:	299.76 [°]
Wind Shear 3000 - 6000:	9.14 [knots]
Wind Shear Dir Sfc - 6000:	277.94 [°]
Wind Shear Sfc - 6000:	17.76 [knots]

Exhibit.10

Hodographic image of the survey of Madrid from the 22nd of June of 2005 at 12:00

Madrid had been out of "luck" all week. During this time severe weather activity could be seen in the distance, towards the city of Guadalajara and the Sistema Central mountain range...10 days in all, in which we were relegated to mere spectators. Nonetheless, we had not lost hope, and today, the 22nd of June of 2005, we had a gut feeling that something was going to happen. At 14:00 hours, photographs 1, 2, 3, 4 and 5; the Sierra de Guadarrama showed some decent development. Taking advantage of my 8 to 4 schedule, as soon as I got out of work I headed directly toward the storm, which was now enveloping the SE side of the Sistema Central range, from the slopes of the Monte Abantos, in El Escorial, to the Sierra de Ayllón range, even though the nucleus of the storm looked like it was moving towards the slopes of the Cuerda Larga (tight rope) and la Pedriza.

At 16:00 hours, and after getting out of a traffic jam in Madrid's M-40 and M-607, while comfortably sitting in a lookout point in the town of Colmenar-Viejo/Guadalix de la Sierra, I decided to move to the San Pedro hill. I could see the entire Sierra de Guadarrama range submerged in a dark gray fog, as can be seen in photographs 6, 7 and 8. It was from here that I observed the "best" storm of the year, without a shadow of a doubt. I waited patiently, while thunder could be heard in the distance, for a supercell to form right over la Pedriza. Lightning could be seen over la Bola, Cabezas and la Najarra (all mountaintops), repeatedly, although I was not able to take any shots of them. In the mean time, the clouds were getting darker and darker by the minute, sometimes even greenish and even reddish!.

I was just amazed at what was going on (at about 17:00 hours,) it looked very "apocalyptic". Although the gust front was just magnificent, the hurricane-like winds did not allow me to take many decent shots of the event. Without any precipitation at all, the temperature dropped dramatically, from 36° to 18° in just ½ an hour (as registered by my car thermometer). For a few minutes the rocks at la Pedriza hill acquired an incredible reddish tonality, as opposed to the dark grayish/blue of the surrounding mountains. We can see this light effect in photographs 9, 10 and 11. The hail trails were getting closer, from Soto del Real, so when they were about 1 kilometer from my position, not knowing whether the hail was going to be small or tennis ball-sized, I ran to the car so to avoid any unnecessary risks. See photographs 12 to 20. In photograph 21 you can clearly see the outline of the buildings in Madrid, between the blanket of rain and hail.

Once the rain and hail stopped, the temperature had gone down to 14°, as you can see in photographs 22 and 23, and on my way to Madrid, a couple of minutes later, the temperature had abruptly gone back up to 32°. While driving toward the capital of Spain I took a few shots of the cumulus congestus that you can see toward the end of this report, photographs 24 and 25. Had I not gone storm hunting I wouldn't have experienced this magnificent event. Madrid has been, up until now, storm free all year. All the photographs have been taken with a Nikon D70 and the lenses are 18-70 DX, which, I must say, has done its job admirably, while my Canon is still being repaired from an earlier "incident".

Our friend Stormwatch, at Meteored.com, remarked::

The report was excellent, and the choice of vantagepoint was superb. Coincidentally, I work at the meteorological offices of the FAMET, very close to where you experienced this storm, although I was not there at the time due to the fact that I am attending some INM seminars. I saw the storm episode from Alcobendas, must've been around 17:15 or so, where the wind gusts were very strong and the visibility (due to the suspended dust) was only 1 kilometer. No rainfall though. A friend of mine at the FAMET offices in Colmenar has told me that wind gusts reached 80 Km/h and the temperature drop, as well as the "ferocity" of the sky, were "impressive" to his account and opinion. Thank you for sharing your experience.



Exhibit-1



Exhibit-2



Exhibit-3



Exhibit-4



Exhibit-5



Exhibit-6



Exhibit-7



Exhibit-8



Exhibit-9



Exhibit-10



Exhibit-11



Exhibit-12



Exhibit-13



Exhibit-14



Exhibit-15



Exhibit-16



Exhibit-17



Exhibit-18



Exhibit-19



Exhibit-20



Exhibit-21



Exhibit-22



Exhibit-23



Exhibit-24



foto-25

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