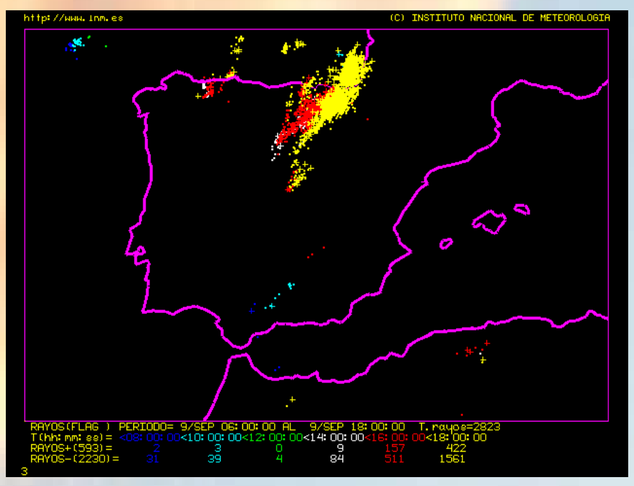
SEVERE THUNDERSTORMS SEPTEMBER 9 , 2004(SQUALL LINE)

Mª Pilar Sanz Moral , Tecnico Superior de Estudios y Desarrollos (pilar.s@inm.es)
José Luis Arteche García, Tecnico Superior de Estudios y Desarrollos (jlag@inm.es)
Francisco Javier Ortiz Berenguer, Tecnico Superior de Estudios y Desarrollos (job@inm.es)
Meteorological Centre in Cantabria and Asturias

SPANISH METEOROLOGICAL INSTITUTE (INM)

INTRODUCTION

During the evening of 9th September 2004, heavy storms took place in the Basque Country (Alava y Guipúzcoa) in the eastern part of the North Coast of Spain. They caused heavy rainfall, large hail (45 mm in diameter) and strongs winds of more than 60 Km/h, 90 Km/h in several places (maximum: 117 Km/h).



LIGHTNING FROM 06Z TO 18Z

DEFINITIONS

Squall Line: Atmospheric phenomenon, characterized by un abrupt and large increase of wind speed with a duration of the order of minutes which diminishes rather suddenly. It is often accompanied by showers or thunderstorms. (OMM)

***Squall Line Radar Pattern*:** is formed by a group of cells in a line. Each of them has high reflectivities values. Their radar frame is a line with several elements, which have strong echoes (more than 40 dbz) embebed in a larger area. The echoes at high levels toward the front part, with a structure similar to the multicell storm type. Cells in the south rear and those which have an anomalous movement respect to the others, can turn into a more severe type.

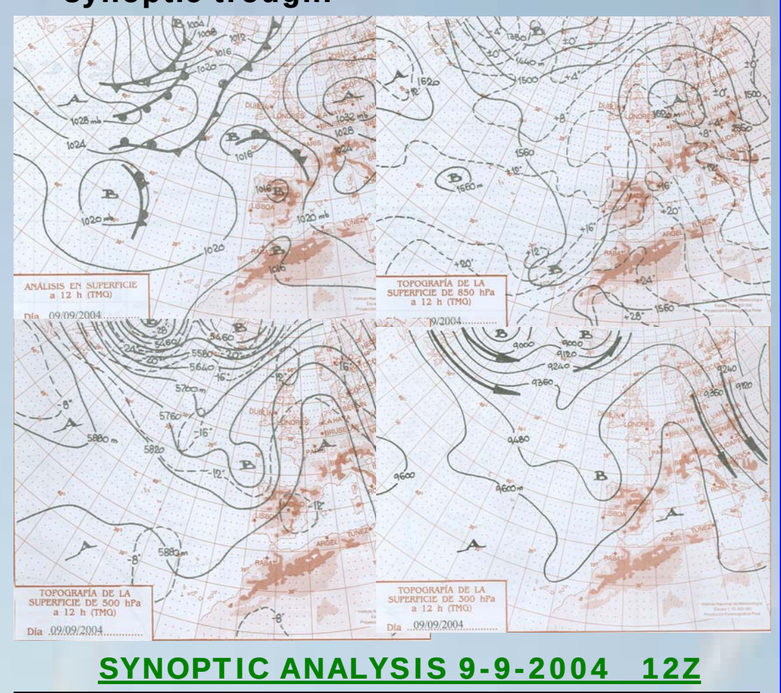
CMI **(Maximum Reflectivity Combined Images)** are radar images, in which all the Cartesian volume of data are taken into account, and a "vertical cut" is produced. The product is a depiction of the maximum data in the vertical area of each point and their height. The threshold is 12 dbz. Their appearance allows us to know the type of convection.

VIL (Vertical Integrated Liquid). **Is produced by summarizing the water contents for all eight levels in an XYZ volume. The result is a two dimensional matrix (pixel picture: 240x240 elements) where each element shows the total amount of water which is over this element. The result is in Kg/m².**

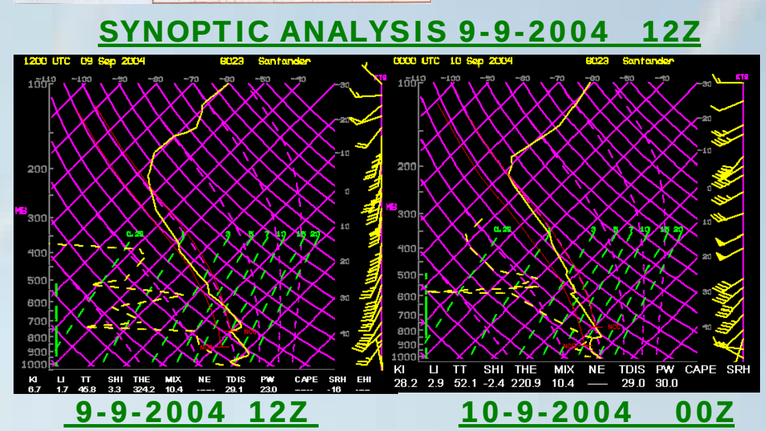
WINR ***(Wind relative images from doppler radar).*** **Doppler radar gives information about the wind velocity radial component. The color mixture is blue- green, when approaching the radar and red-orange-yellow when going away from the radar.**

SYNOPTIC SITUATION AND SOUNDINGS

The synoptic environment for that day shows the presence of a low on the Iberian peninsula, with the passage of an upper level trough that advanced eastward. The 500 Hpa analysis shows temperatures -12ºC accompanying the synoptic trough.



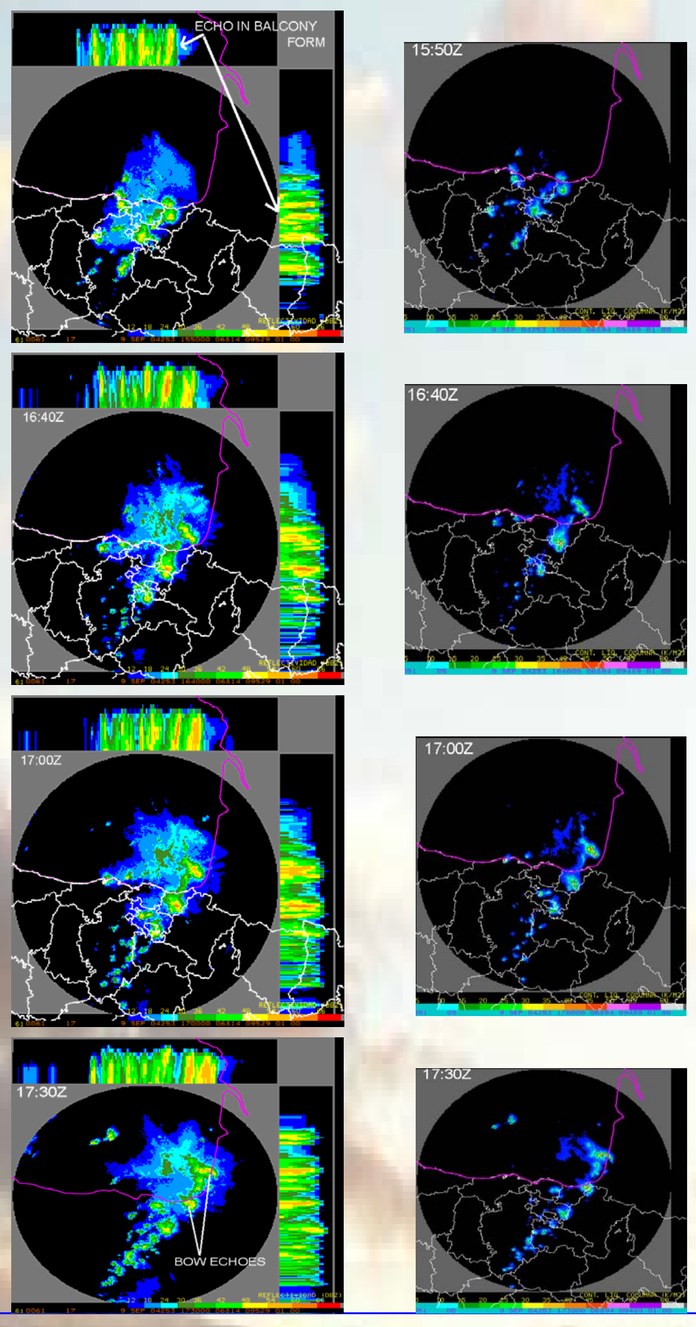
SYNOPTIC ANALYSIS 9-9-2004 12Z



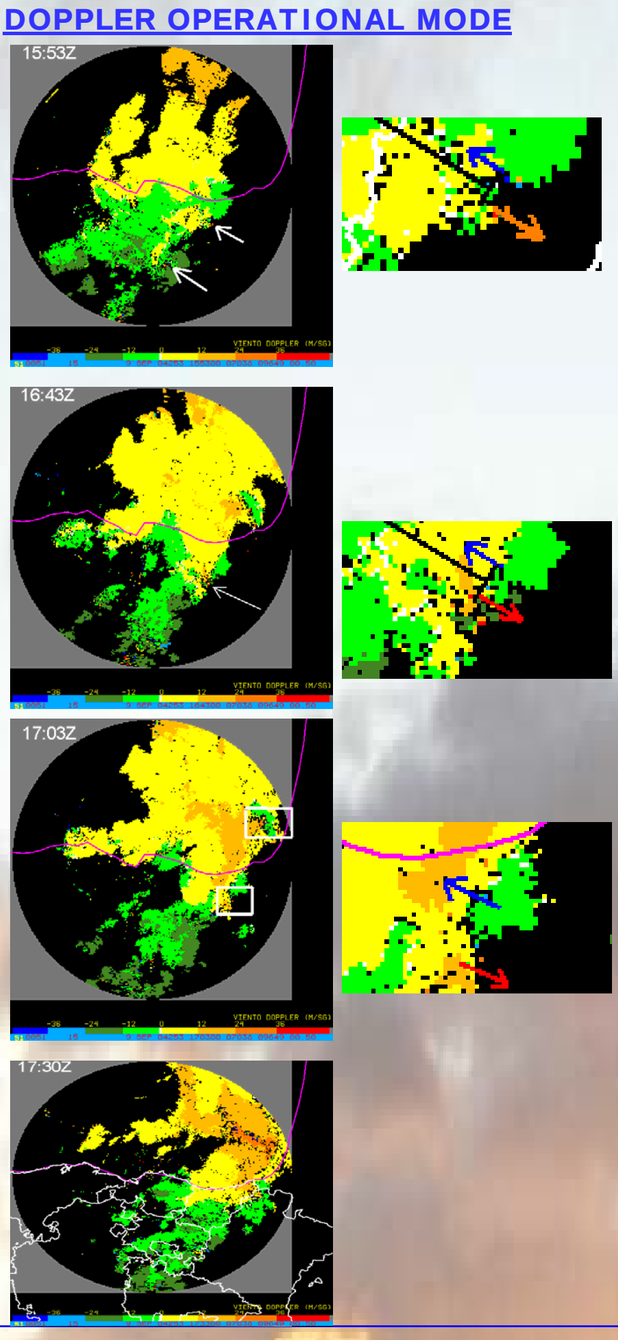
9-9-2004 12Z 10-9-2004 00Z

Soundings from 12Z to 00Z : high values in precipitable water, potential instability from surface to 500 Hpa, strong winds from SW in all levels, and a dry layer near 700 Hpa in soundings before to the storm (12Z) and significant values in vertical shear (CIZBL6).

RADAR IMAGERY: CMI, VIL NORMAL OPERATIONAL MODE



RADAR IMAGERY: WINr DOPPLER OPERATIONAL MODE



In radar images from this day, one can appreciate the convective system pattern at the maximun activity time. In vertical profile images: CMI (normal operational mode) it is easy to see the strong development that reached the convective cells and the "echoes in balcony form", that are typical in severe convection.

Both in CMI and VIL images (Vertical Integrated Liquid) it is possible to see the evolution of the system into the "squall line" structure. The high reflectivity values reached correspond, in this case, to the occurrence of hail.

The wind Doppler images from radar , show the possible presence of a mesocyclone in middle levels. However, it´s necessary to take into account that the signal was far from the place of radar (centre in image) and, for this reason, the radar data is not completely reliable. In any case, these signals were coincided with the stronger winds.

Echotop images (not showed here) shows that echoes bigger or equal of 12 decibels risen 14 Km, that means strong updraught.

All of them is typical in a Squall Line (in Radar Pattern).

CONCLUSION

Radar study showing a severe convection case, with "squall line" attributes. The radar images allow us to typify the situation. For this proposal, vertical reflectivity profiles in "Normal operational mode" are presented . Moreover, relativity velocity in "Doppler operational mode" is presented too, and can prove the severity of the phenomenon .

At the moment, and in relation to forecasting large hail, there is not a reliable method for forecasting it, but it can use VIL density data (VIL/ECHOTOP) because, in some cases, it is better than the day´s VIL. In any case and when severe convection is expected, hail presence is almost definite, though it will not necessarily reach the surface.

All of them (radar images: VIL, wind structures in Doppler, etc) are used in operational forecasting and surveillance, and allow monitoring and warning this kind of phenomenon .

Radar C- band; beam elevation: 0.5º; Res: 2Kmx2Km; Coverage (normal operational mode): 240 Km in radio; Wave length: 5 cm

Radar C- band; beam elevation: 0.5º; Res: 1Kmx1Km; Coverage (Doppler operational mode): 120 Km in radio; Wave length: 5 cm