

Tornadoes over complex terrain: an analysis of the August 28th 1999 tornadic event in eastern Spain

V. Homar, R. Romero,
C. Ramis y S. Alonso

M. Gayà



Universitat de les
Illes Balears



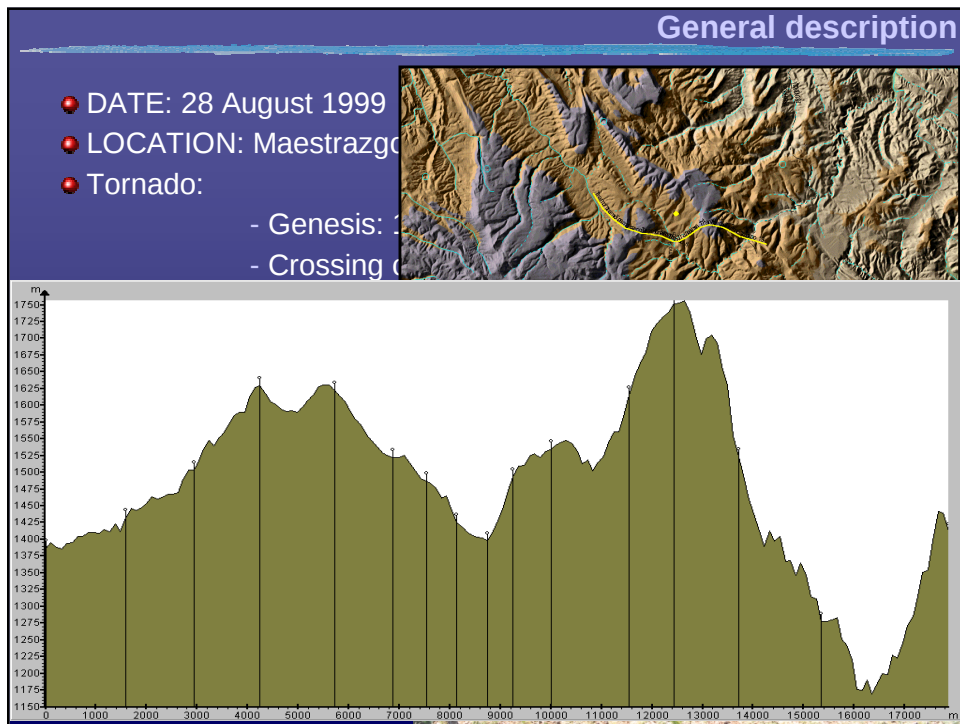
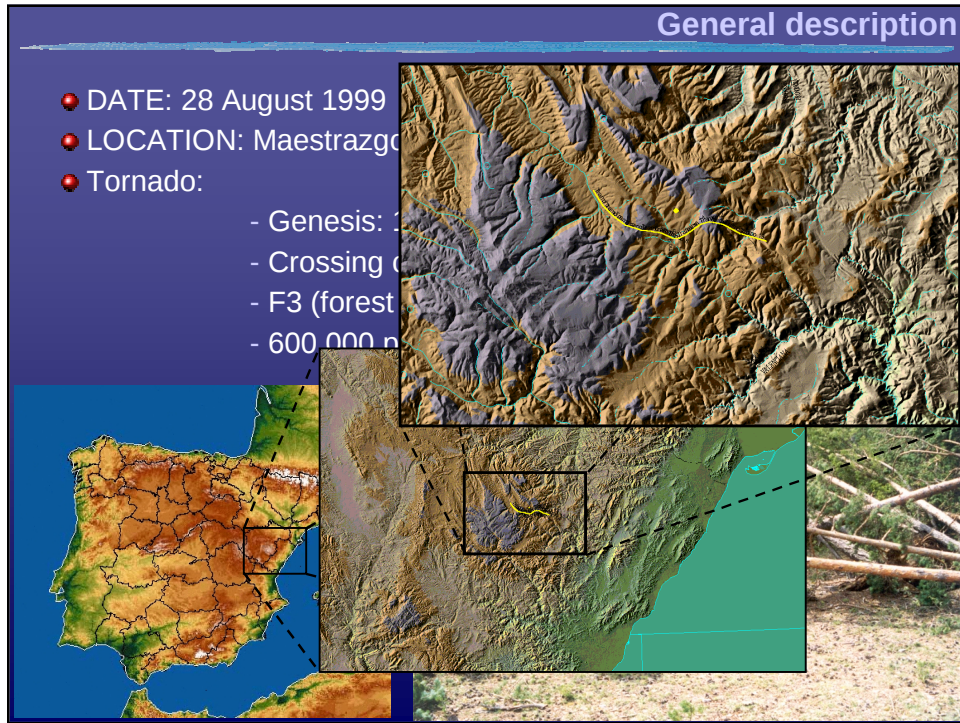
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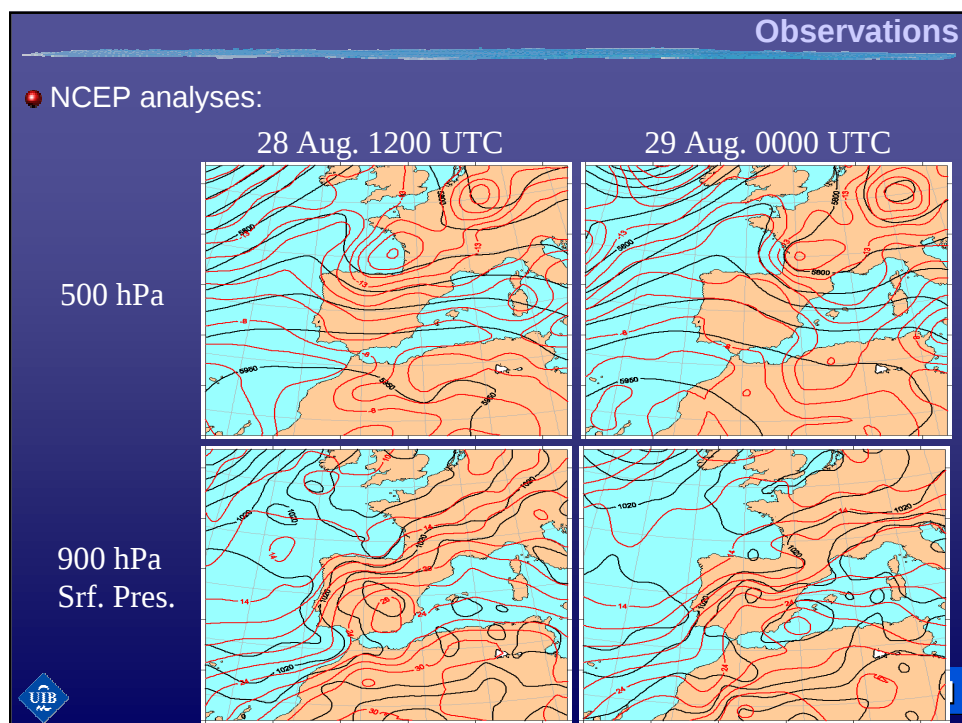
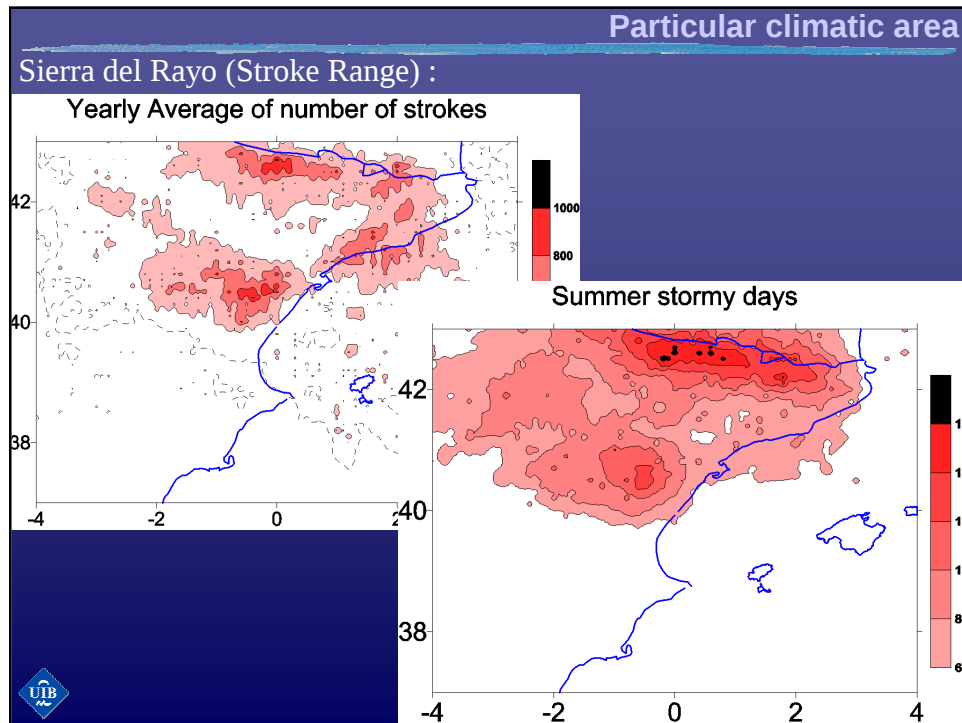
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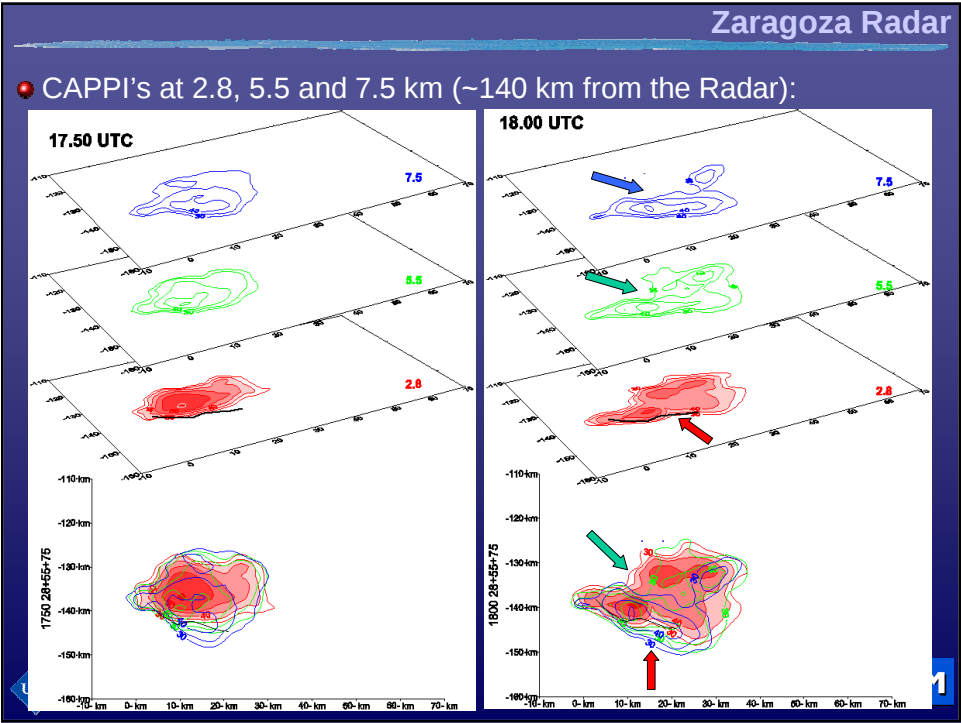
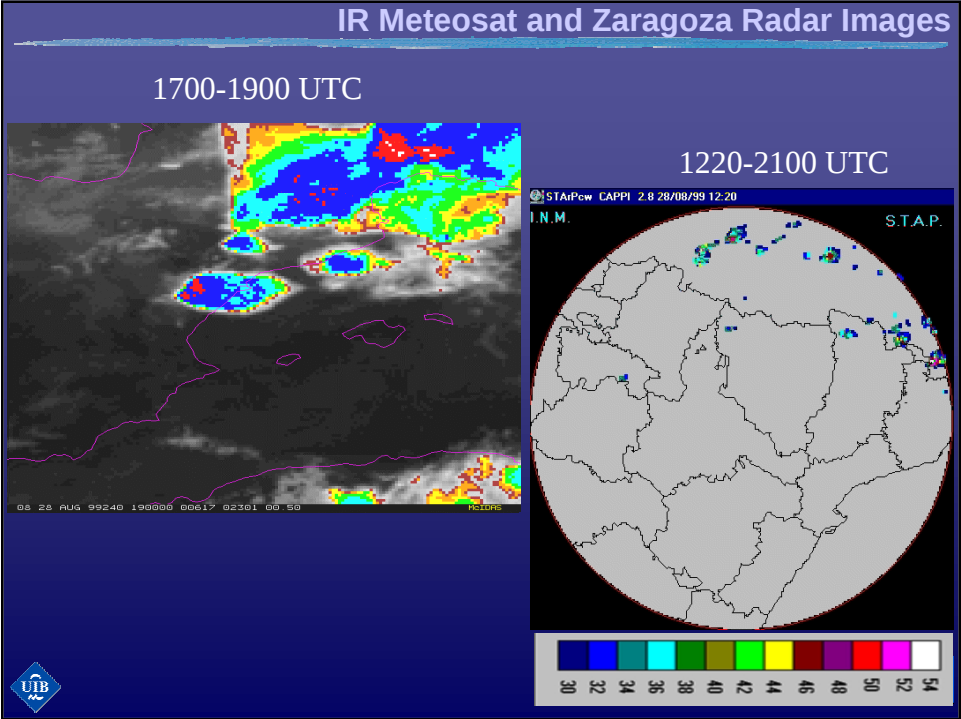
General description

- DATE: 28 August 1999
- LOCATION: Maestrazgo area, Iberic System
- Tornado:
 - Genesis: 1730-1800 UTC. Lasted for 15-20 min
 - Crossing complex terrain
 - F3 (forest damage estimation: Espejo&Sanz, INM)
 - 600,000 pines up-rooted, 4,000,000 m²







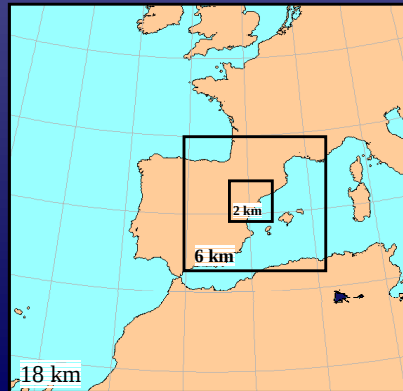


Numerical simulations

- MM5 V3.5 model
- IC and BC: Corrected NCEP analyses every 12 h
- 3 domains of 151x151, nested using 2-way interaction
- Simulation :

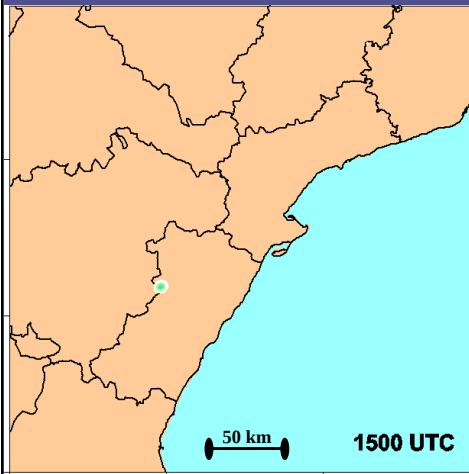
28/00 21 h 28/21

28/11 10 min. output DOM3

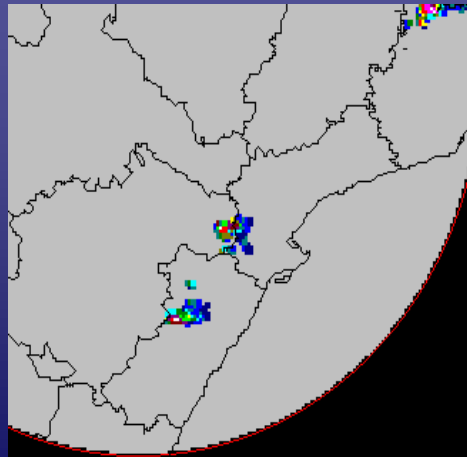


Model Validation

- Model **predicted** rainwater vs Radar **measured** reflectivity:

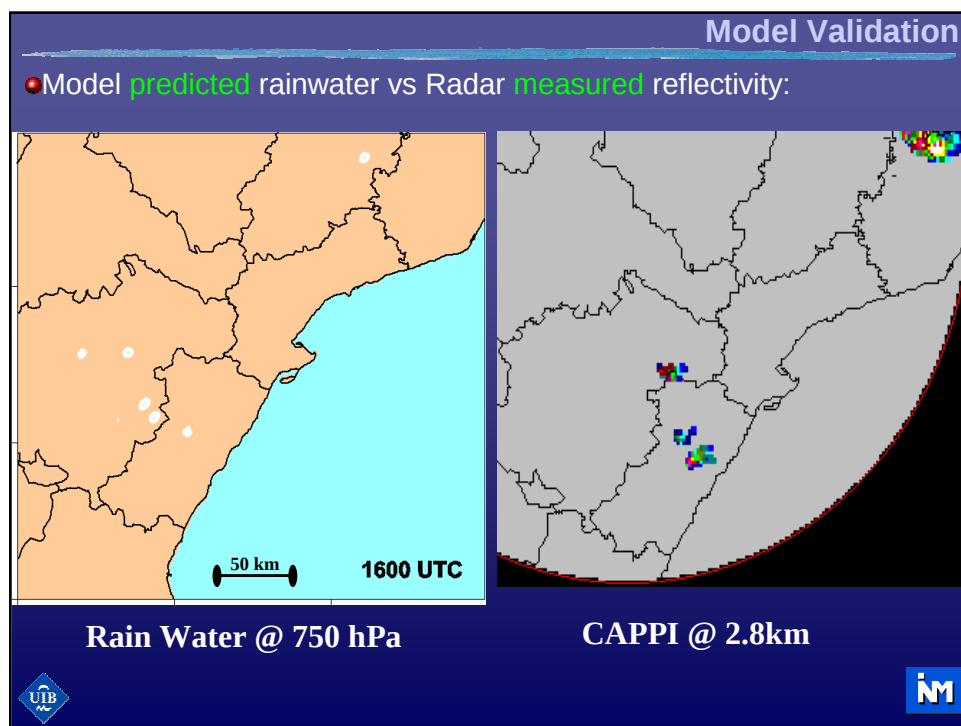
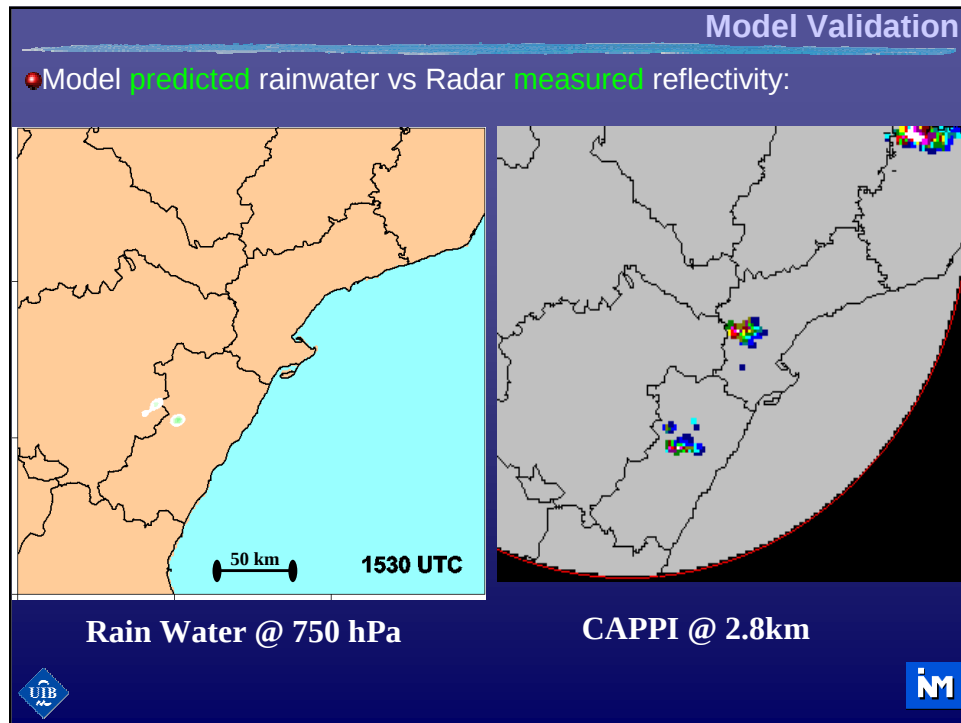


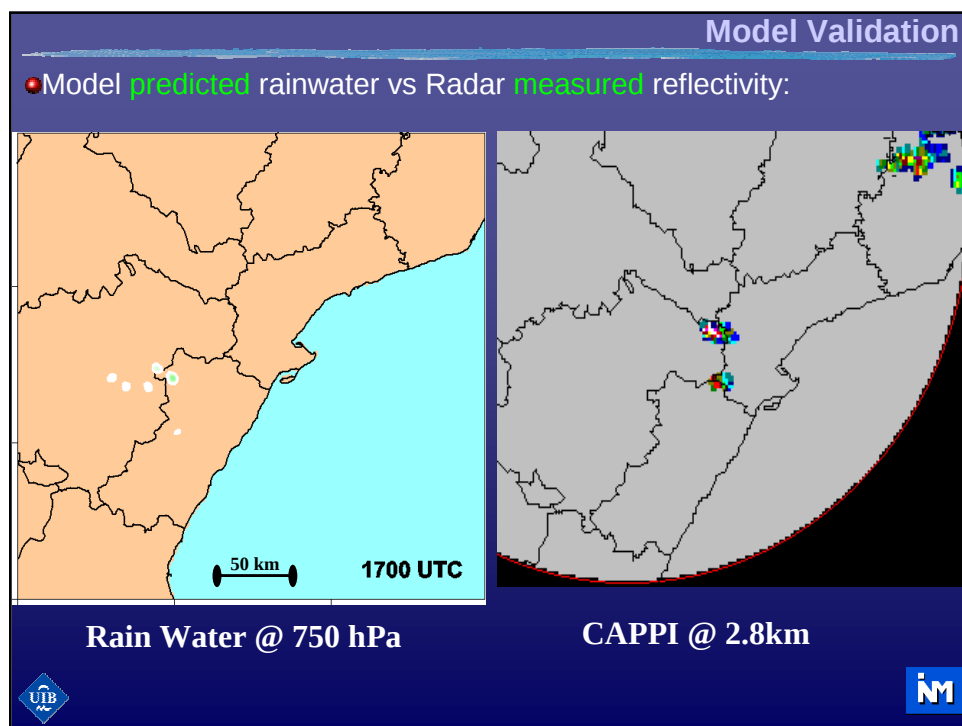
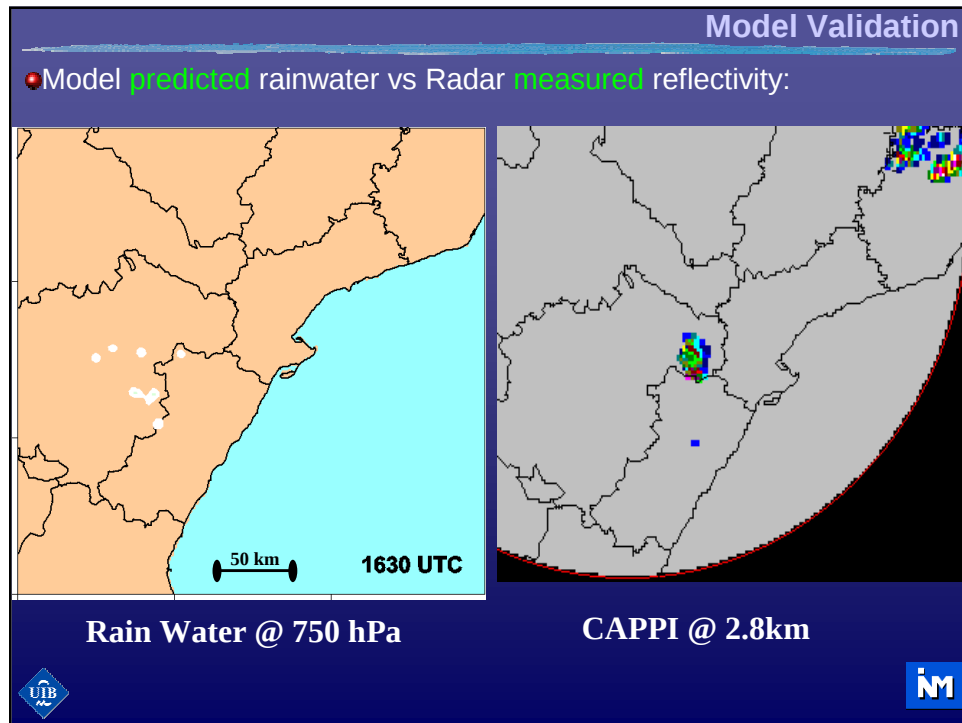
Rain Water @ 750 hPa

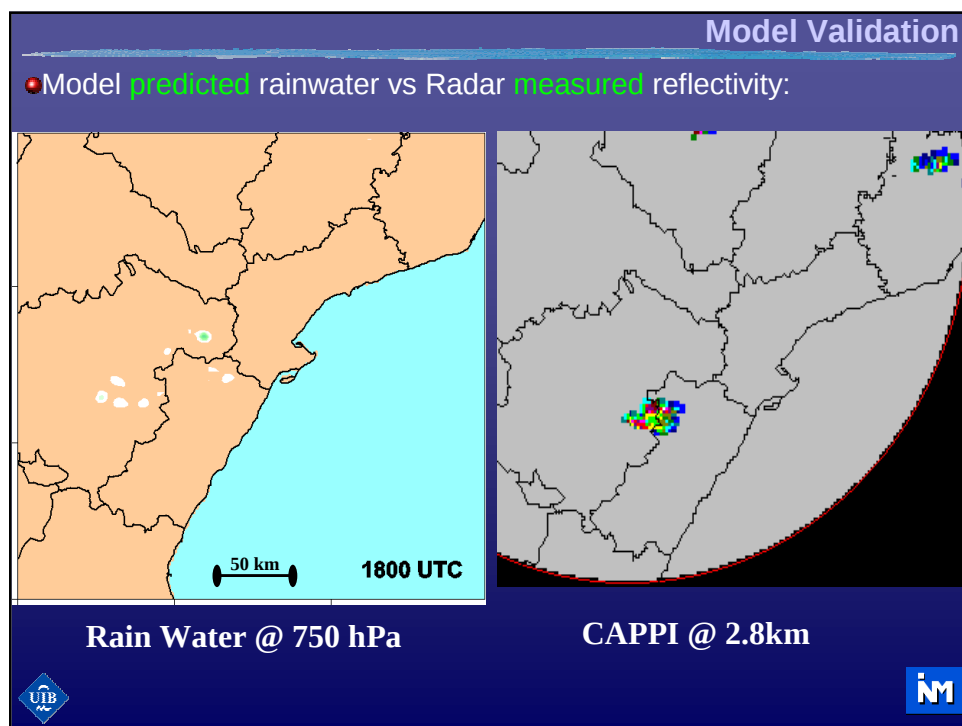
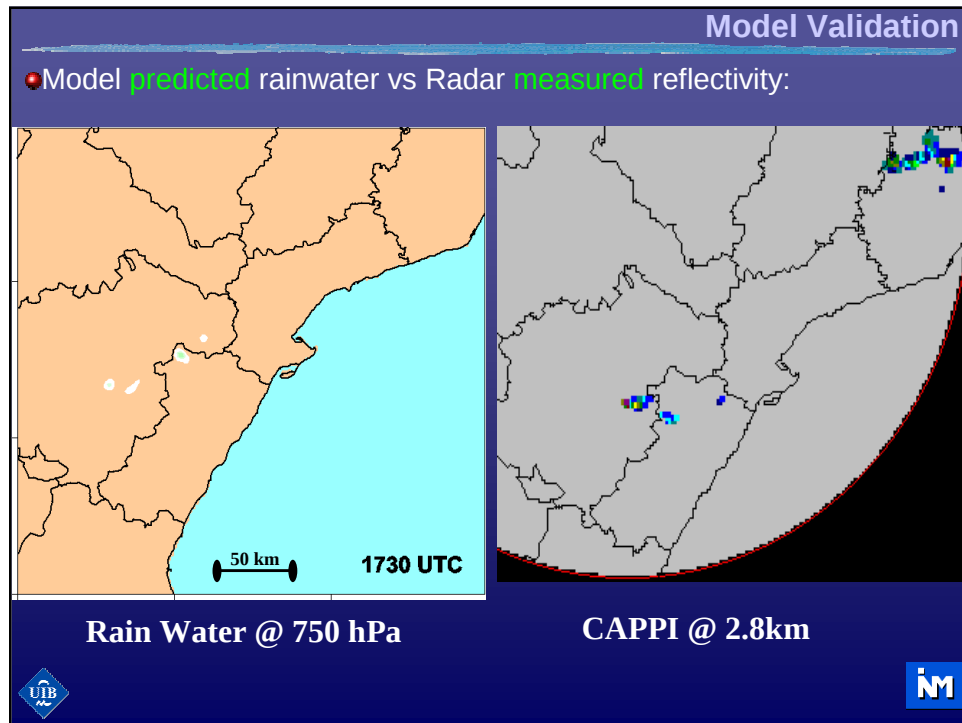


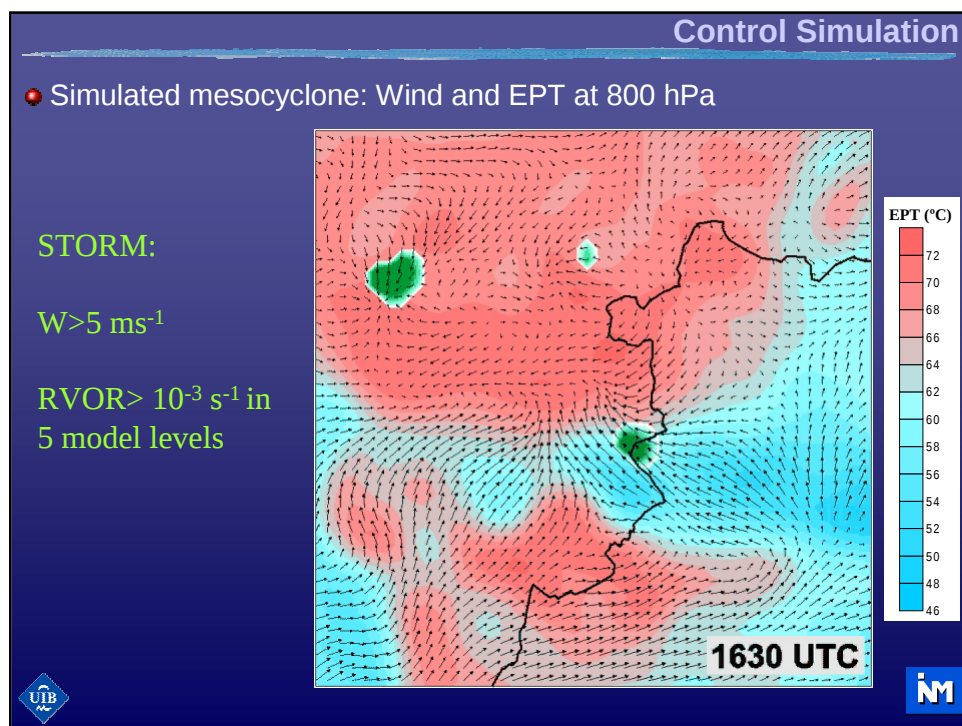
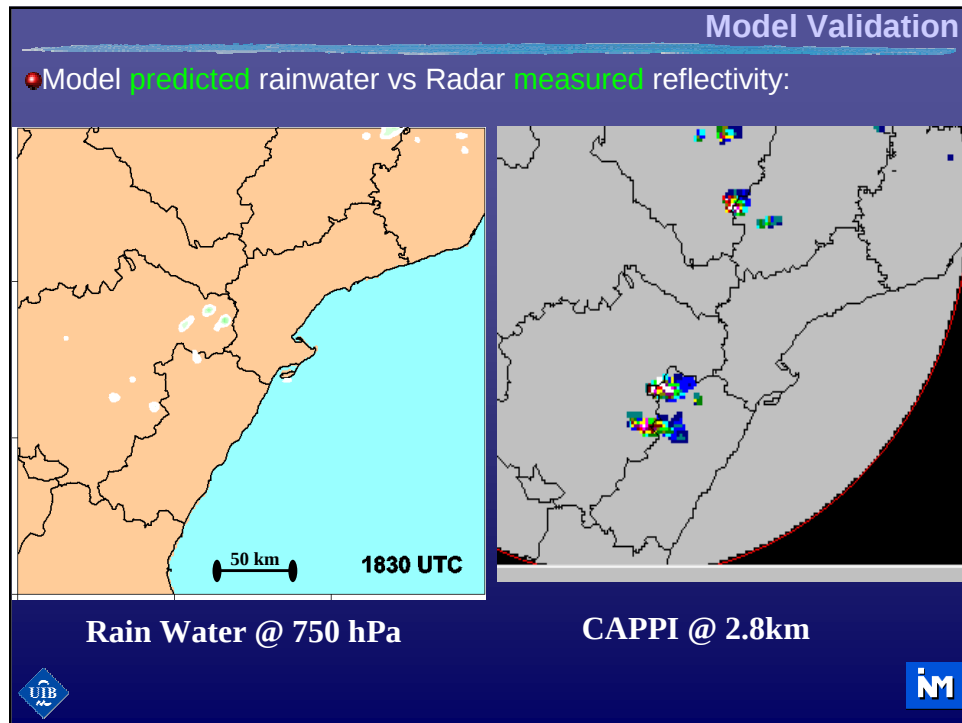
CAPPI @ 2.8km

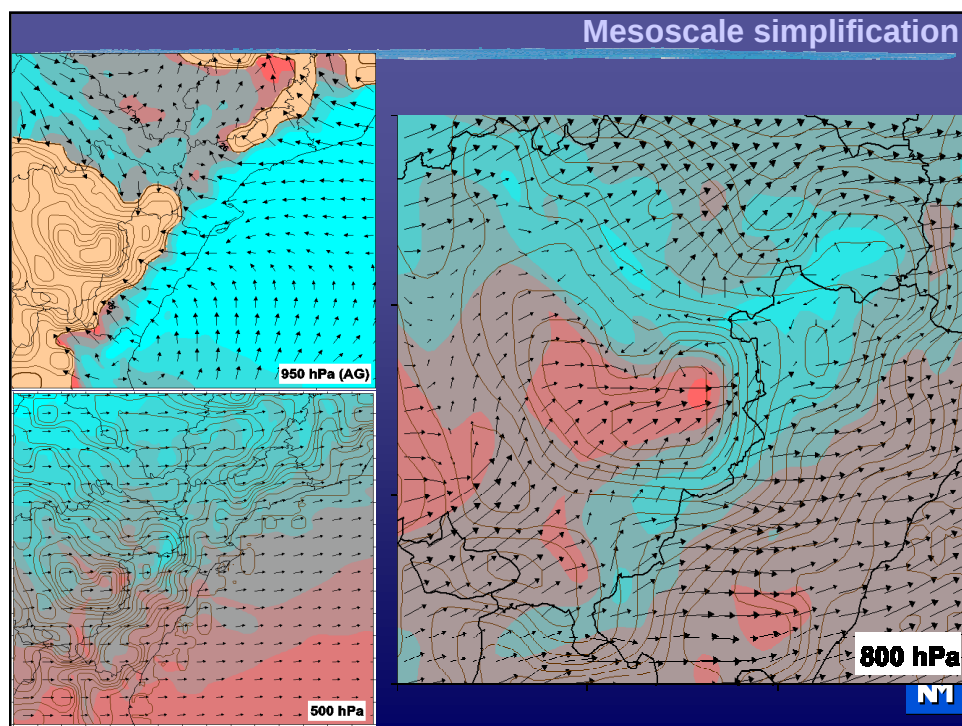
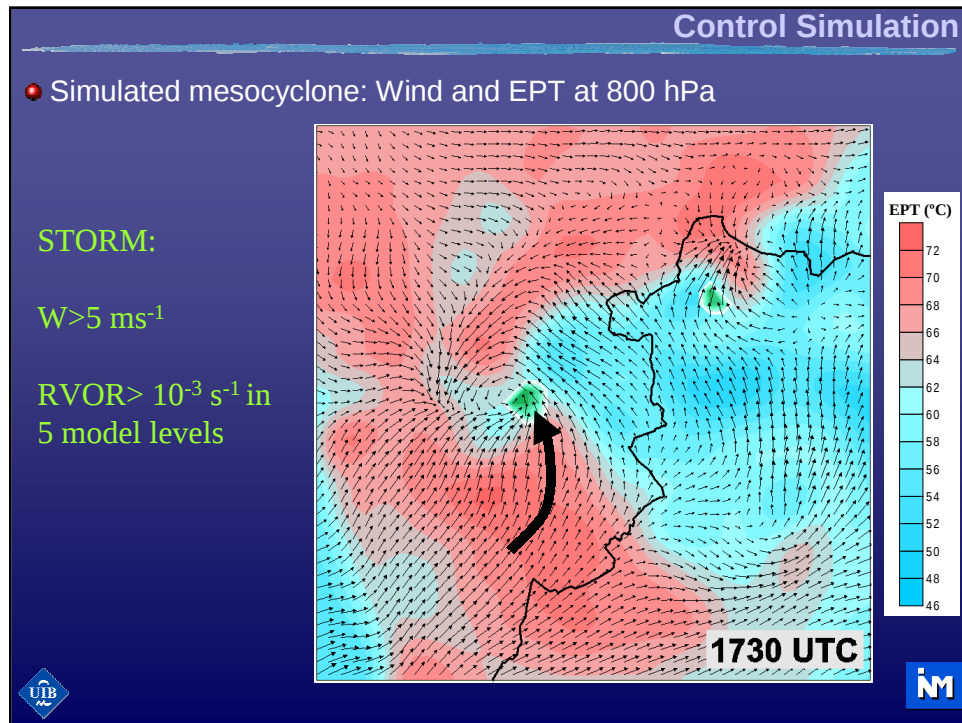






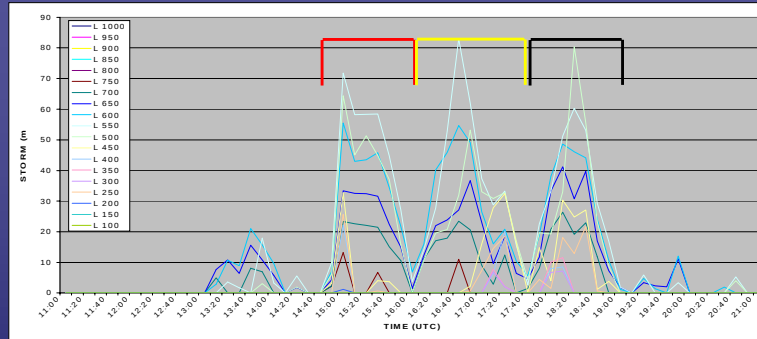




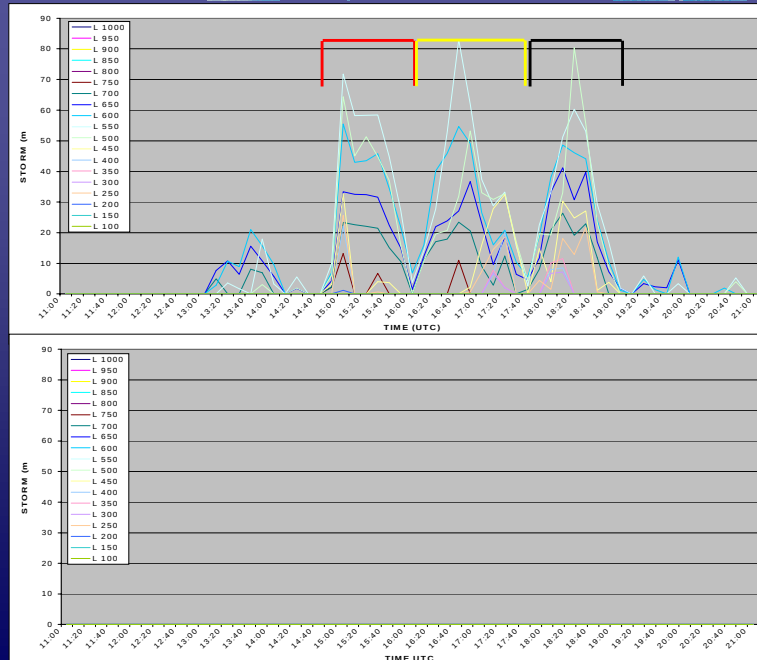


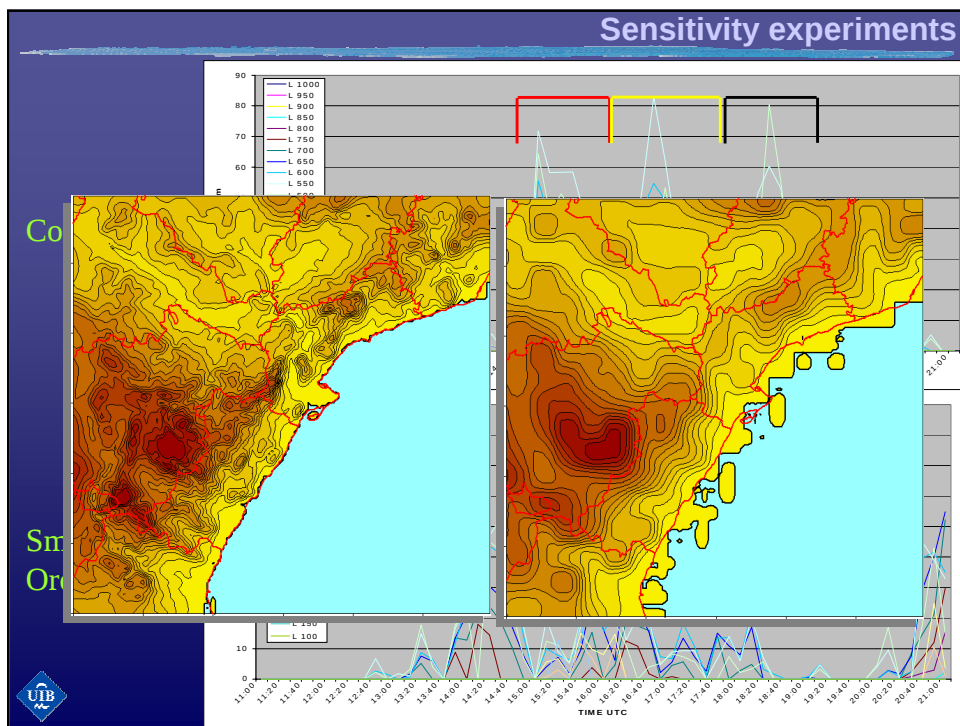
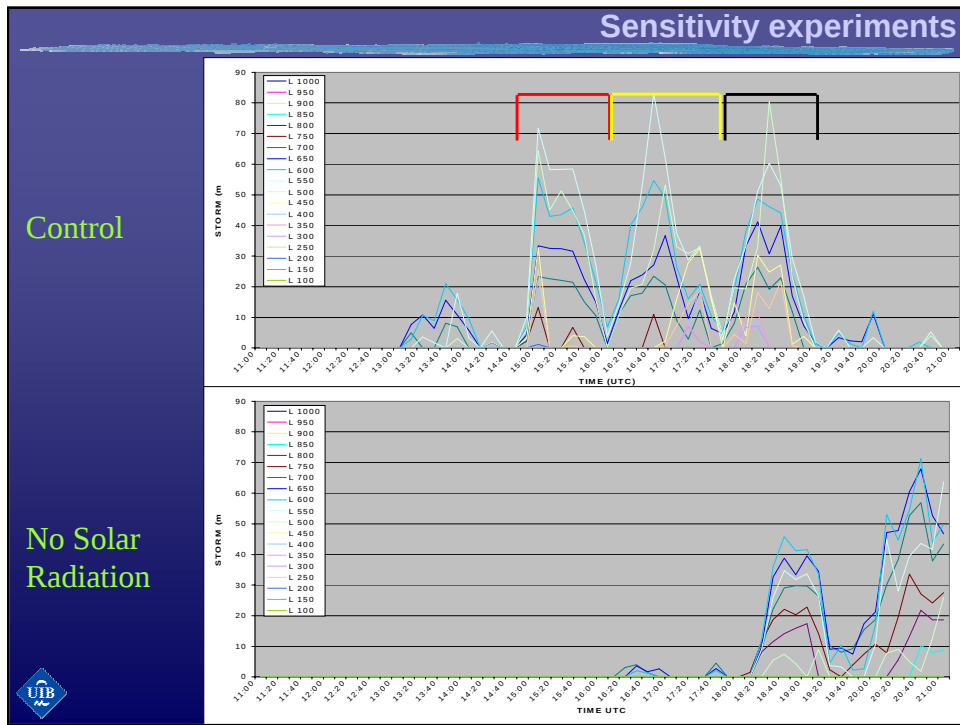
Sensitivity experiments

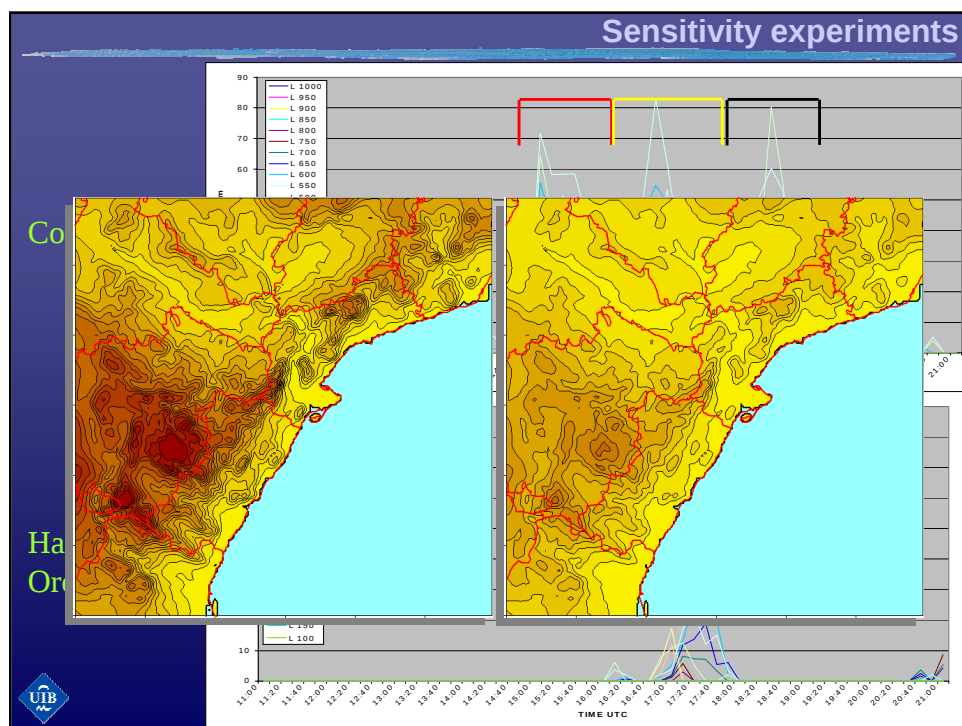
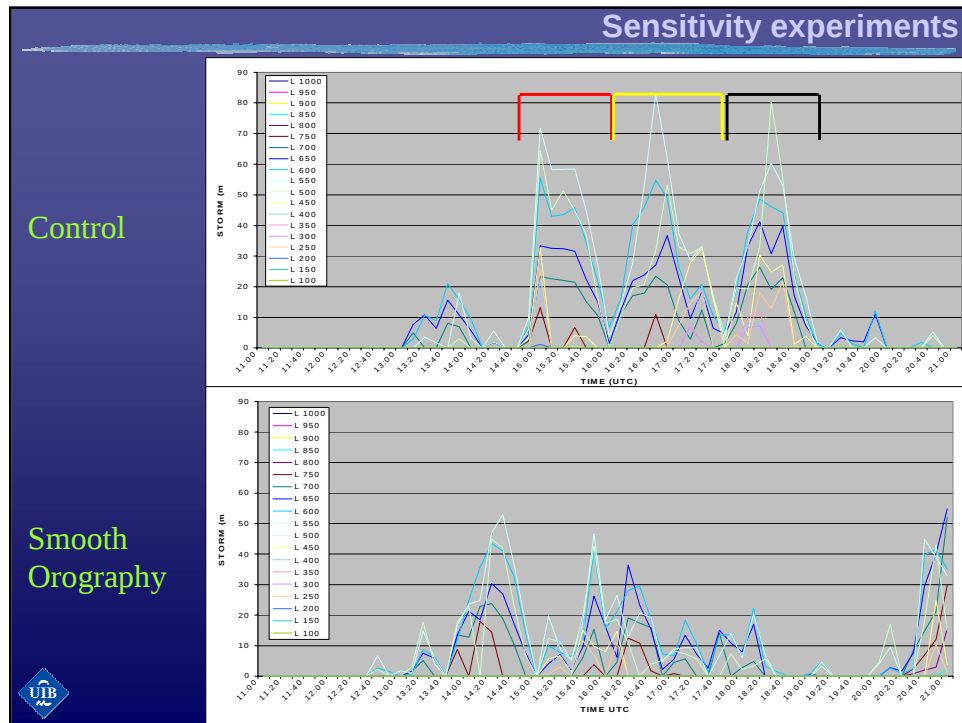
Control

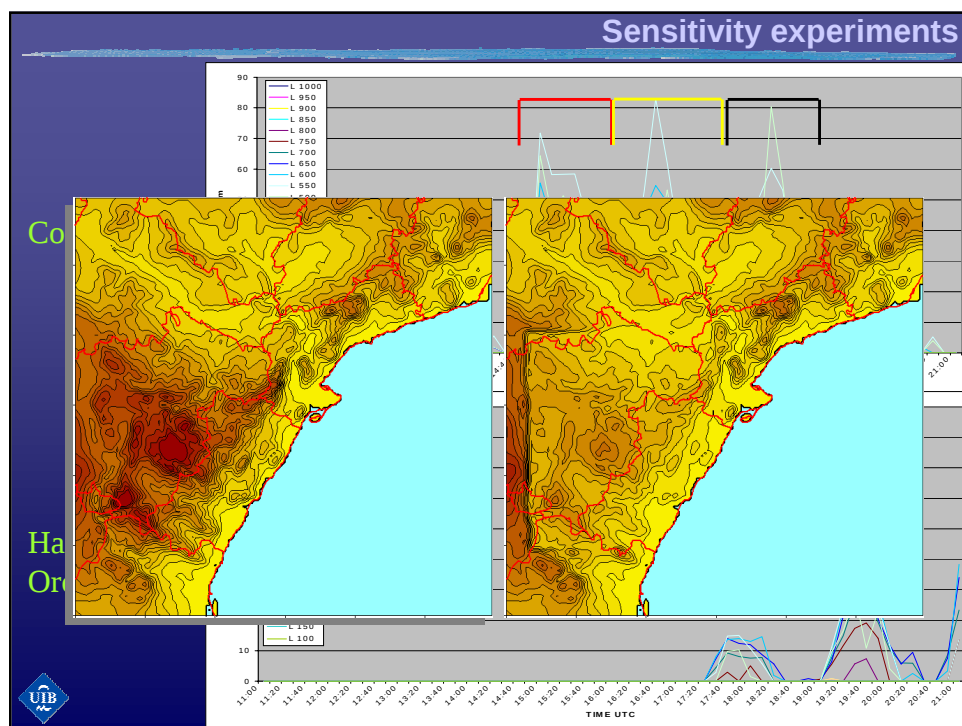
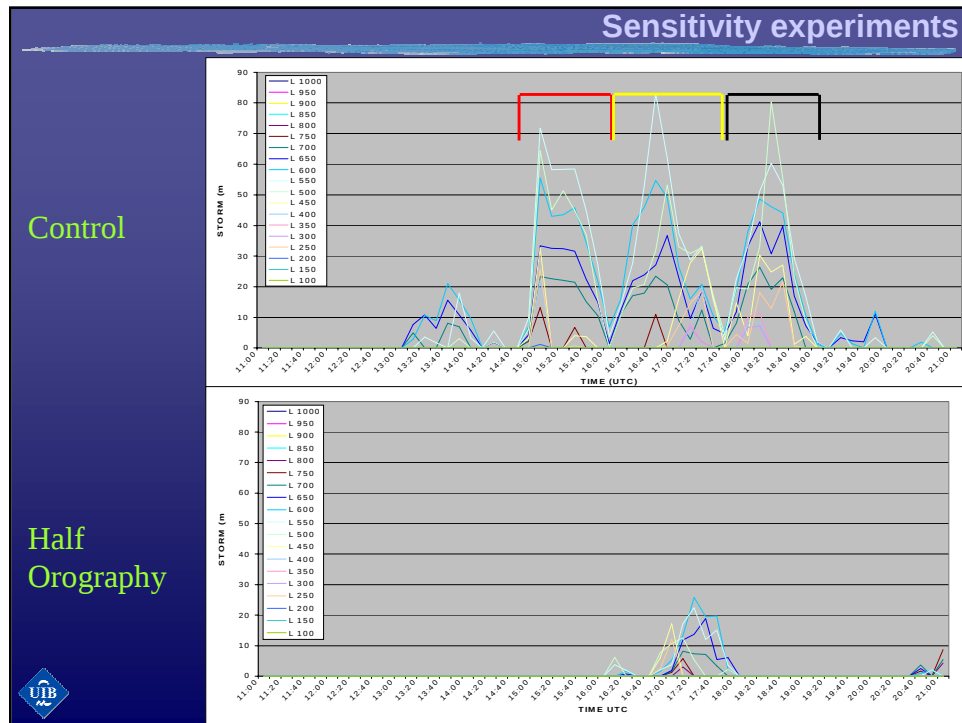


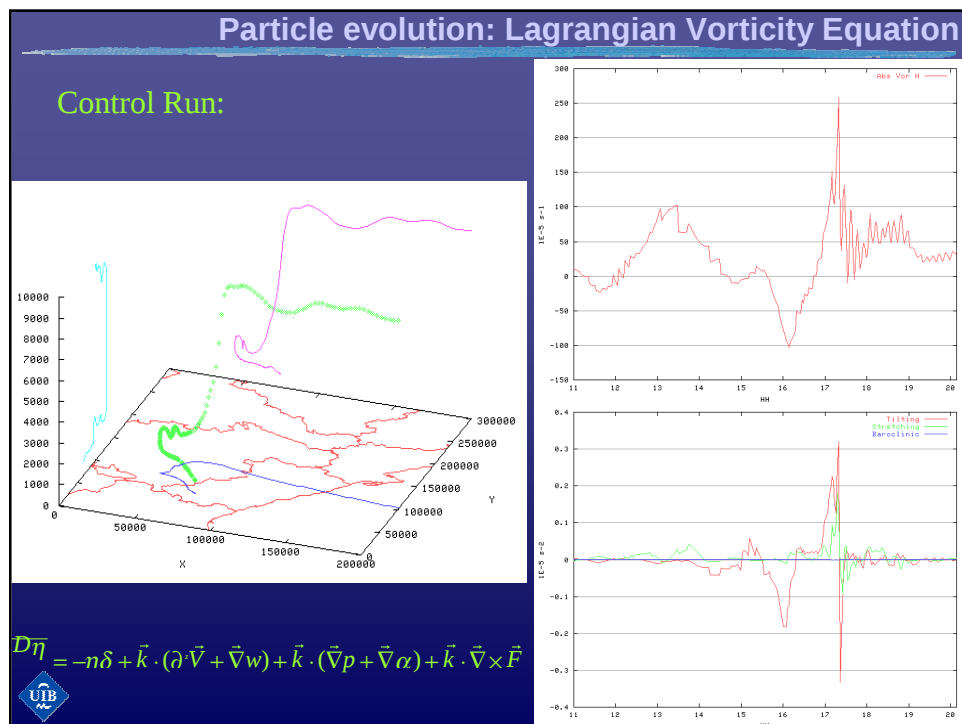
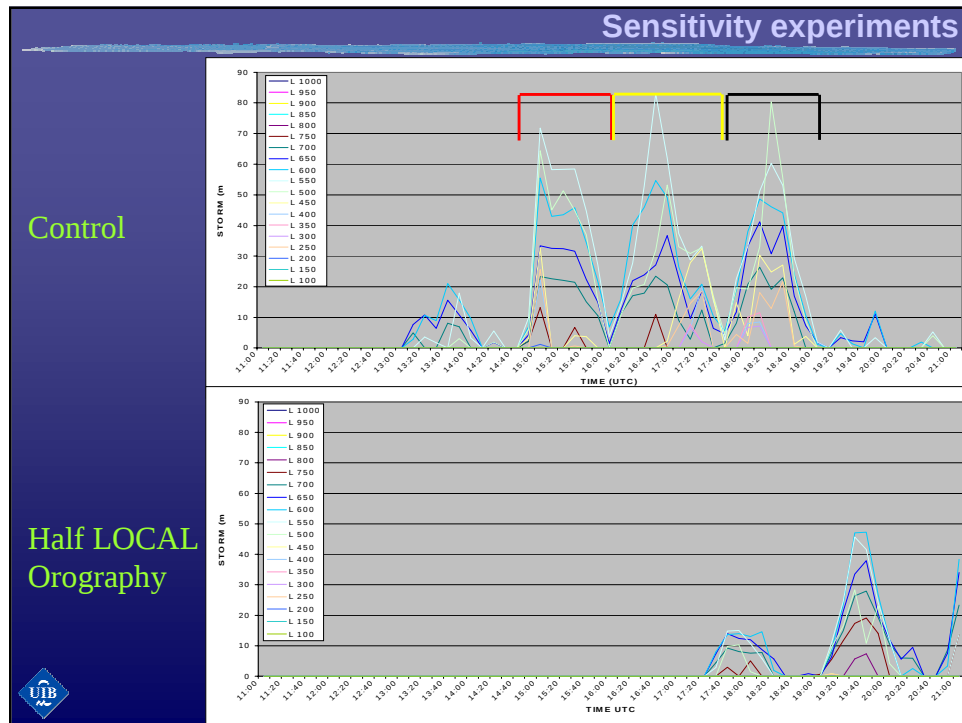
Flat
orography





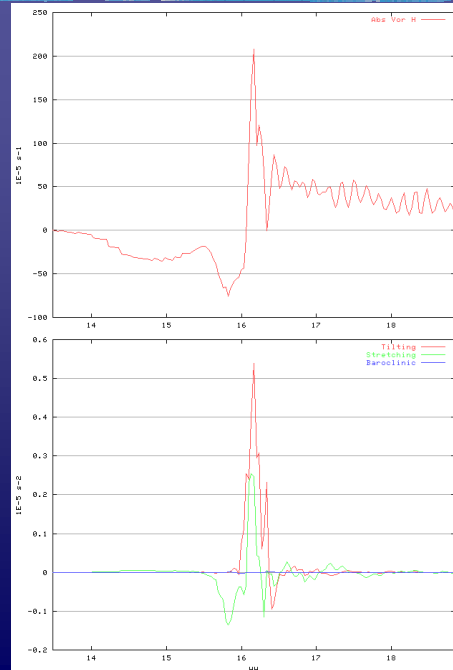
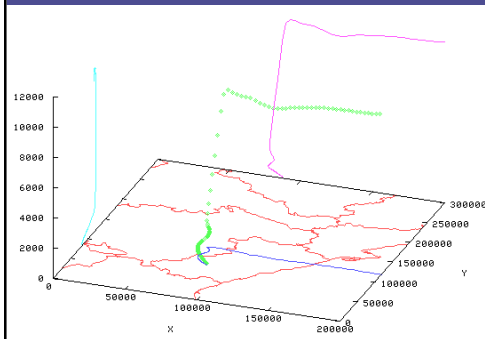






Particle evolution: Lagrangian Vorticity Equation

Smooth orography Run:



Conclusions

- A tornado with an intensity of **F3** occurred on **August 28 1999**, over the Iberian System close to a range called "**Sierra del Rayo**"
- The area is particularly interesting as a **Storm nest** for its climatic persistency of active storms
- **Synoptic maps** for the particular case study show the presence of a **thermal low** over the Iberian peninsula together with a **weak cold trough** crossing northeastern Spain at the upper levels
- **Satellite and Radar** images show moist deep convection over northeastern Iberian Peninsula and the development of the tornado-producing storm, which shows **signals of WER and RIN**
- **MM5 simulations** capture notably well the convective activity over the region and reveals the presence of determinant agents in the area: **Sea breeze, Mountain breeze and particular topographic configuration** which favours the wind convergence and the increase of the convective instability
- Sensitivity experiments confirm the **crucial effect** of the **orography (local)** and the **diurnal radiative heating** on the storm generation in the region

