MULTISCALE NUMERICAL STUDY OF THE 10-12 NOVEMBER 2001 STRONG CYCLOGENESIS EVENT IN THE WESTERN MEDITERRANEAN

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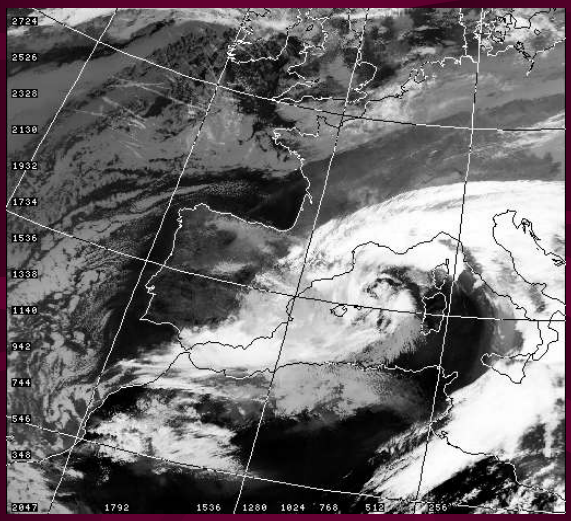
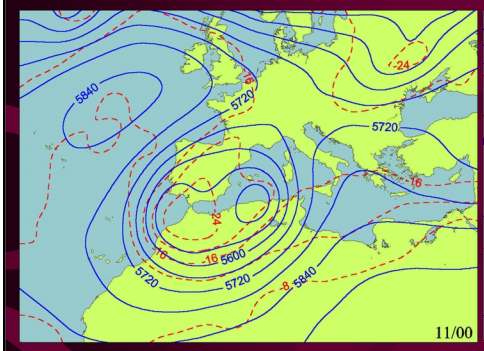
We present a diagnostic study and numerical simulations of a strong cyclogenesis event that took place on 10-12 November 2001 in the western Mediterranean area using the MM5 mesoscale model and the potencial vorticity (PV) inversion algorithm.



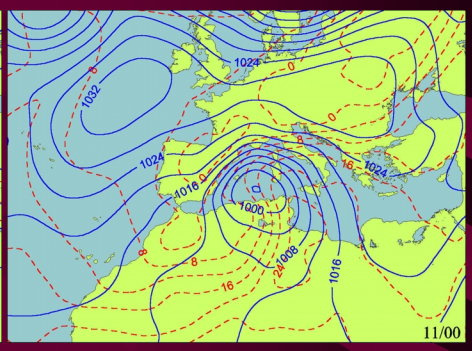
Ch4-IR NOAA image (11 November, 2001 / 13.29 UTC)

NCEP-BASED METEOROLOGICAL ANALYSES

Mid-Upper levels (H 500 / T 500)



Low levels (SLP / T 925)

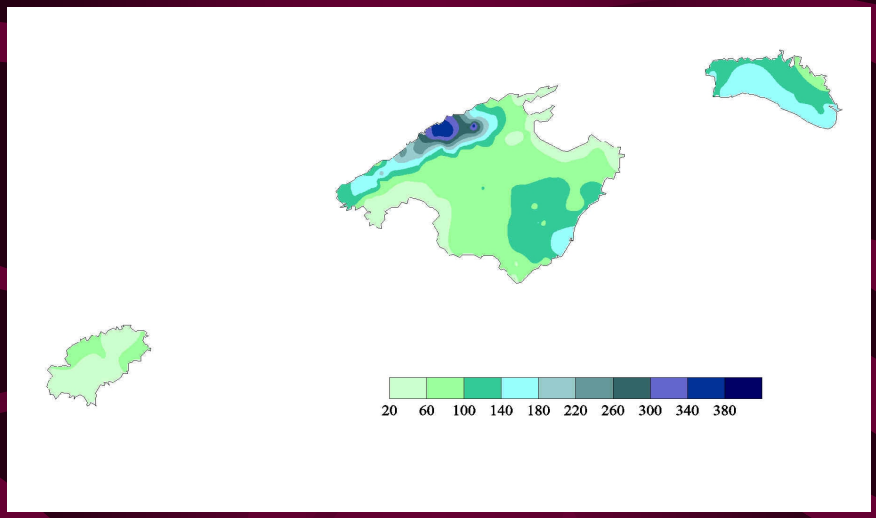


In the Balearic Islands:

Up to 400 mm/24 h,

150 km/h winds and 12 m sea waves and,

floods and severe damages on coasts



Observed rainfall (in mm) from Instituto Nacional de Meteorología on 10 and11 November, 2001 in the Balearic Islands

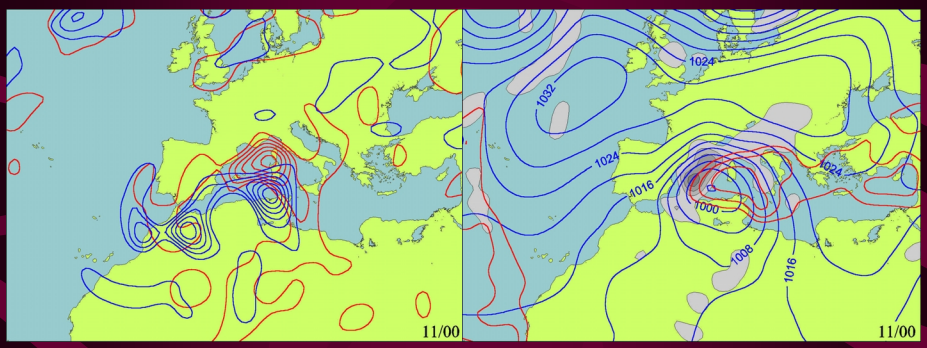
Some effects of the cyclone in the Balearics Islands

Some effects of the cyclone in the Balearics Islands

Some effects of the cyclone in the Balearics Islands

DIAGNOSIS OF THE EVENT:

Strong dynamical forcing and
heavy precipitation promoted



QG upward forcing (700-200 / 1000-700) Other ingredients (CI 1000-500 / WVFC 1000-700)

THE DIAGNOSTIC SYSTEM:

We have used the piecewise PV inversion technique developed by Davis and Emanuel and published in the *Monthly Weather Review, 1991*), which is based in the Charney nonlinear balance equation.

In our case study:

1. Time interval:
   From 9-Nov-2001 at 0:00 to 12-Nov-2001 at 12:00 each 12 h,
   from NCEP meteorological analyses.

2. Reference state:
   7-day time average for the period from 7-Nov-2001 at 0:00 to 14-Nov-2001 at 0:00.

3. Anomalies:

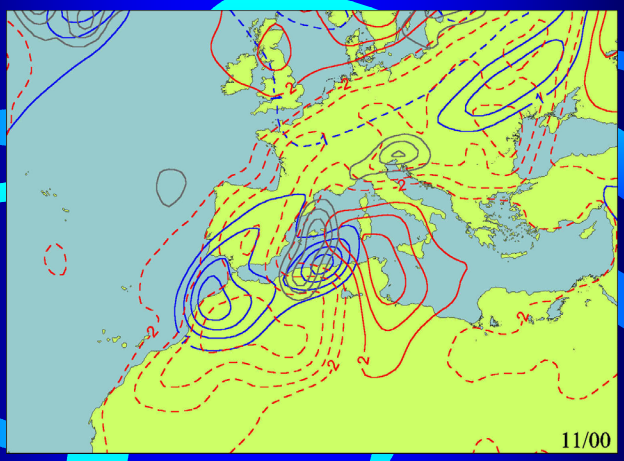
ULev	PV perturbation above 700 hPa
LLev	Surface thermal anomaly and PV perturbation below 700 hPa
DIAB	Positive PV perturbation below 500 hPa in areas with RH > 70%

PV-based DIAGNOSIS

ULev PV perturbation above 700 hPa

LLev Surface thermal anomaly and PV perturbation below 700 hPa

DIAB Positive PV perturbation below 500 hPa in areas with RH > 70%



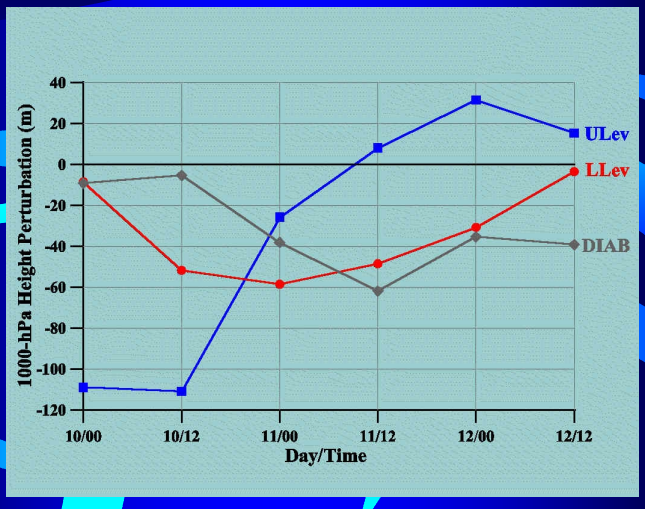
PV-based DIAGNOSIS

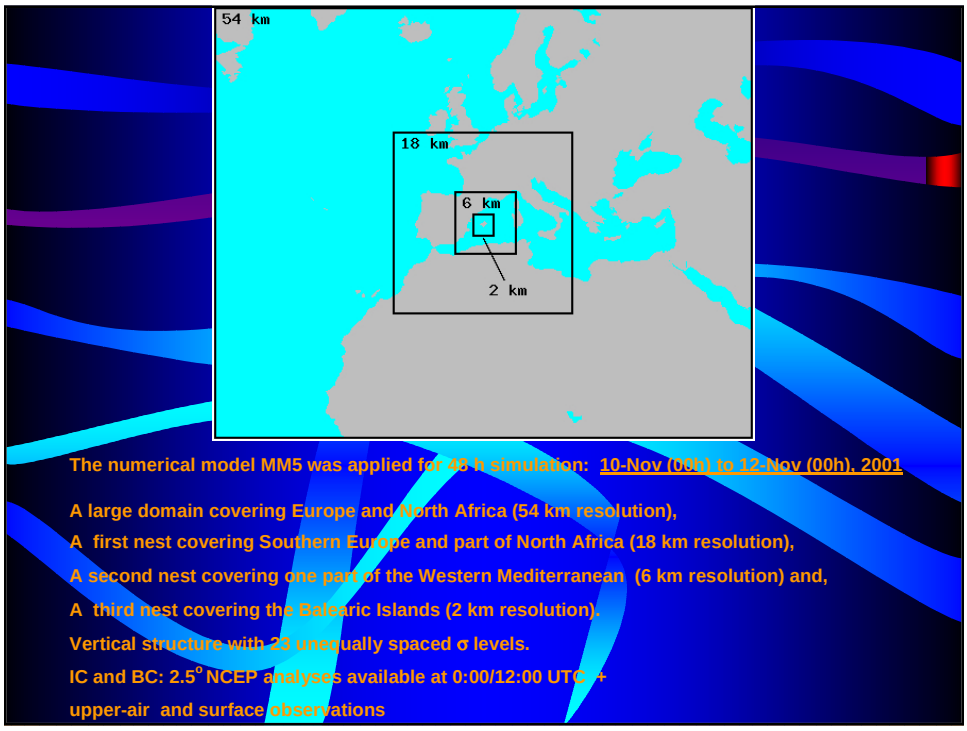
ULev PV perturbation above 700 hPa

LLev Surface thermal anomaly and PV perturbation below 700 hPa

DIAB Positive PV perturbation below 500 hPa in areas with RH > 70%

Contribution to the surface cyclone height perturbation





The numerical model MM5 was applied for 48 h simulation: 10-Nov (00h) to 12-Nov (00h), 2001

A large domain covering Europe and North Africa (54 km resolution),

A first nest covering Southern Europe and part of North Africa (18 km resolution),

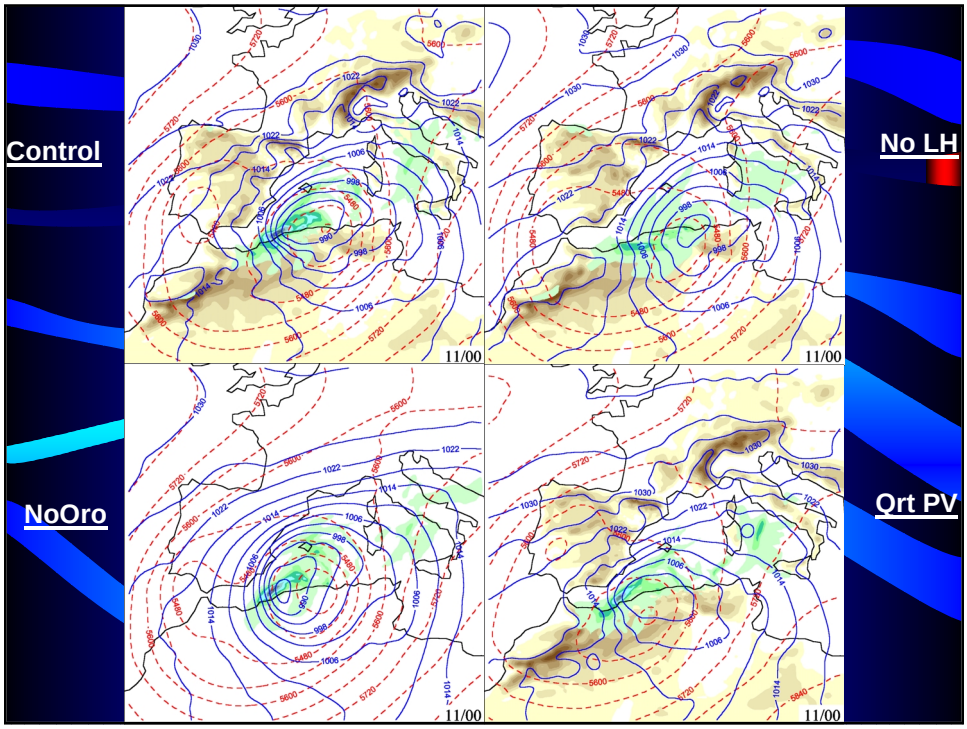
A second nest covering one part of the Western Mediterranean (6 km resolution) and,

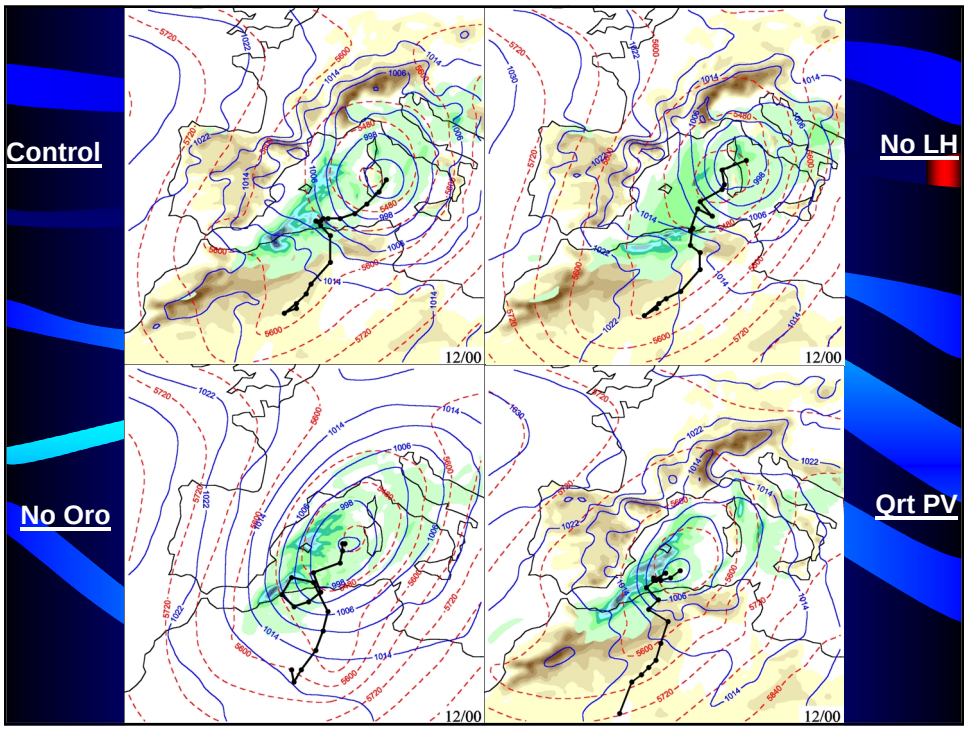
A third nest covering the Balearic Islands (2 km resolution).

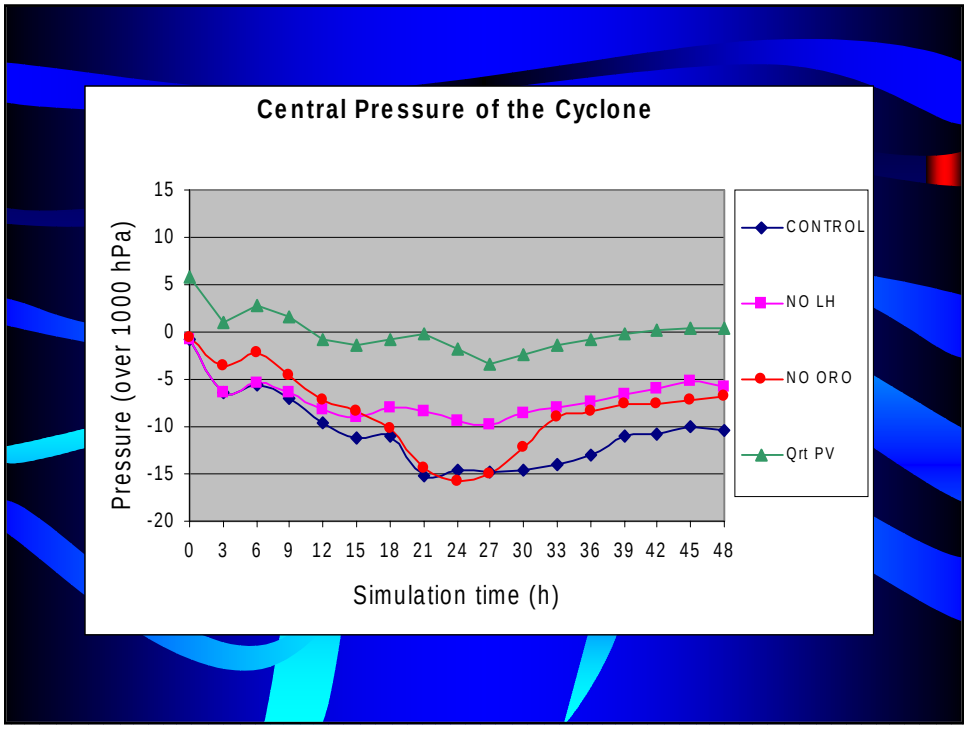
Vertical structure with 23 unequally spaced σ levels.

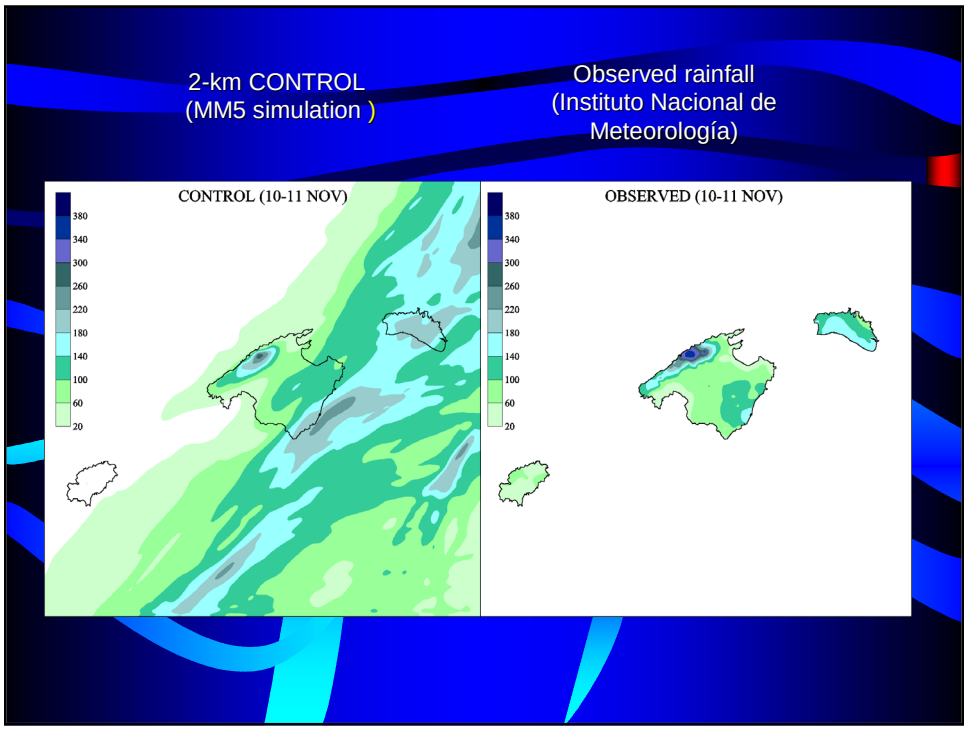
IC and BC: 2.5° NCEP analyses available at 0:00/12:00 UTC +

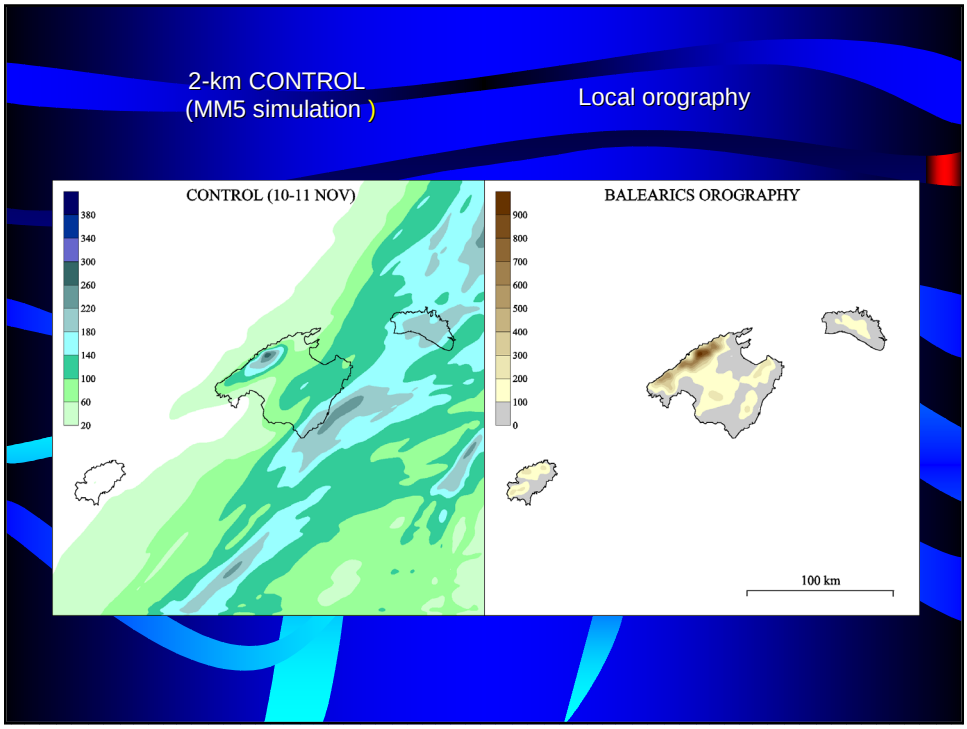
upper-air and surface observations




Control
No LH
No Oro
Qrt PV
12/00
12/00
12/00
12/00

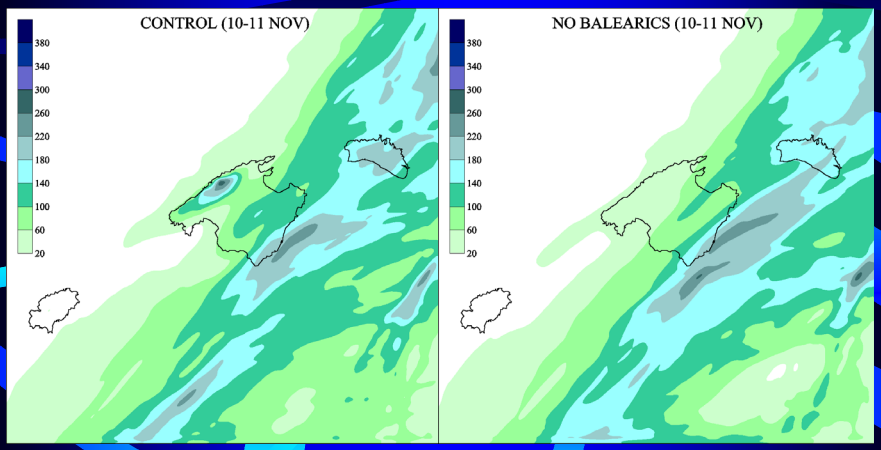

Central Pressure of the Cyclone
Pressure (over 1000 hPa)
15
10
5
0
-5
-10
-15
-20
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48
Simulation time (h)
CONTROL
NO LH
NO ORO
Qrt PV


2-km CONTROL
(MM5 simulation)
Observed rainfall
(Instituto Nacional de
Meteorología)
CONTROL (10-11 NOV)
OBSERVED (10-11 NOV)
380
340
300
260
220
180
140
100
60
20


2-km CONTROL
(MM5 simulation)
Local orography
CONTROL (10-11 NOV)
BALEARICS OROGRAPHY
380
340
300
260
220
180
140
100
60
20
900
800
700
600
500
400
300
200
100
0
100 km

2-km CONTROL
(MM5 simulation)

2-km No ORO
(MM5 simulation)



CONCLUSIONS

We have studied an extreme cyclogenesis event in the western Mediterranean, that is, the worst storm affecting the Balearic Islands in the last years.

From diagnosis:

A strong dynamical forcing for upward motion (and surface pressure fall).

Continuous moisture supply at low levels for heavy precipitation to occur.

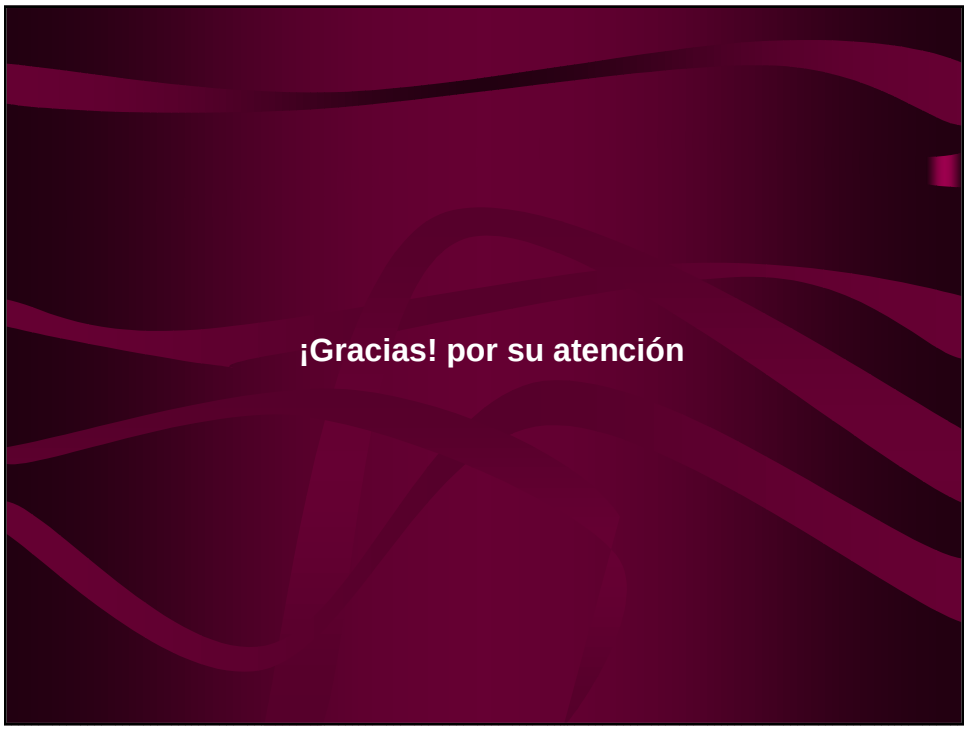
The Baroclinic development plus diabatic contribution from condensation.

Some typical sequence of many extratropical cyclones.

From numerical simulations:

Local orographic forcing was crucial for the flood-procucing rainfall.

The latent heat release (LH) and the orography (Oro) modulated the deepening rate and trajectory of the cyclone.


¡Gracias! por su atención