SYNOPTIC AND MESOSCALE ASPECTS OF TWO FLASH FLOOD EVENTS IN EASTERN SPAIN PRODUCED BY LONG-LIVED QUASISTATIONARY MCSs: ROLE OF ATLAS MOUNTAINS AND LATENT HEAT RELEASE

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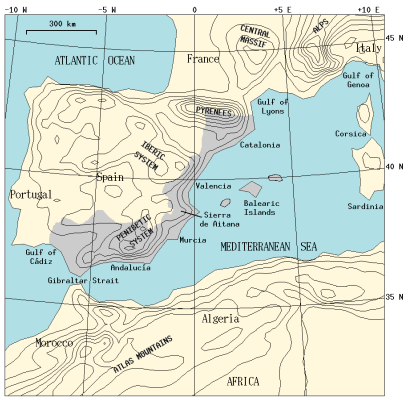


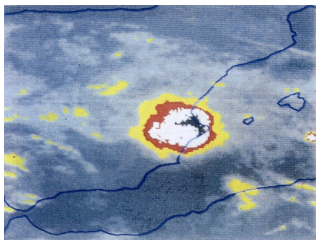
THE EVENTS

GANDIA (3-4 Nov. 1987)

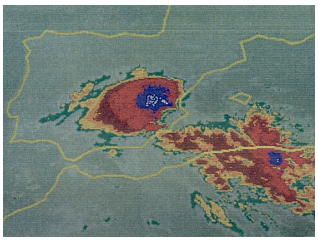
MCS (33 h)
Circular shape (~200 km diameter)
1000 mm / 36 h in **Gandia**

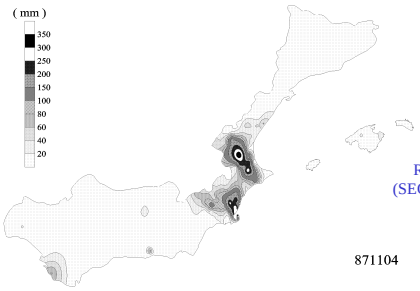
TOUS (20 Oct. 1982)

MCC (>12 h)
>400 mm
Dam breaking in **Tous**



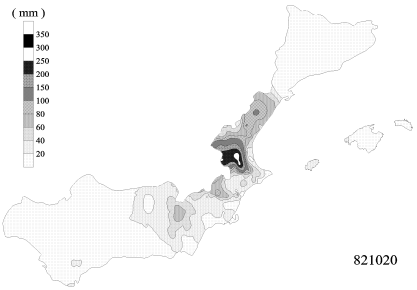
INFRARED METEOSAT





RAINFALL (SECOND HALF)

871104



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GANDIA

Stationary / Weak pattern

Cold-core cut-off low

Algerian low / moist LLJ

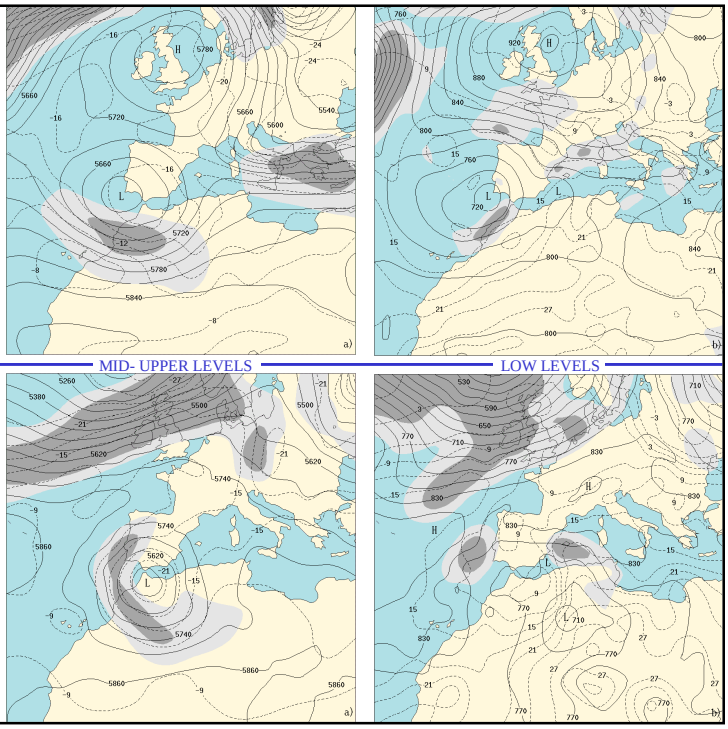
SYNOPTIC ENVIRONMENT

TOUS

Evolving / Strong pattern

Cold-core cut-off low / ULJ

Baroclinicity / moist LLJ



MESOSCALE NUMERICAL SIMULATIONS

*** PSU-NCAR mesoscale model (non-hydrostatic version MM5)**

*** Simulations:**

- 2 domains: 82x82x31 (60 and 20 km)
- Interaction: two-way
- I.C and B.C: NCEP global analysis + Surface and Upper air obs.
- GANDIA: 36 h, from 00 UTC 3 Nov. 1987
- TOUS: 24 h, from 00 UTC 20 Oct. 1982

*** Physical parameterizations:**

- PBL: Based on Blackadar (1979) scheme (Zhang and Anthes 1982)
- Ground temperature: Force-restore slab model (Blackadar 1979)
- Radiation fluxes: Considering cloud cover (Benjamin 1983)
- Explicit convection: Cloud water, rainwater, cloud ice and snow (Zhang 1989)
- Parameterized convection: Coarse: Betts-Miller (1986) / Fine: Kain-Fritsch (1990)

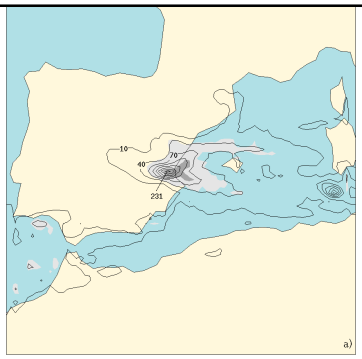
GANDIA

Location / Stationarity: well
QPF: underestimated

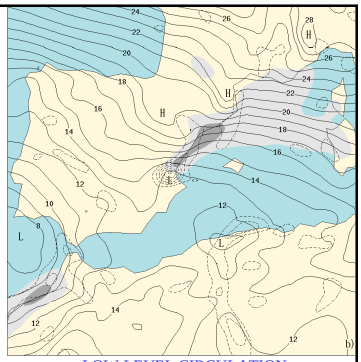
Algerian low / Mesolow
Convergence ahead of LLJ

FULL SIMULATION

PRECIPITATION



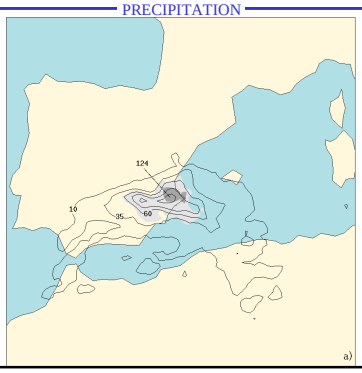
LOW-LEVEL CIRCULATION

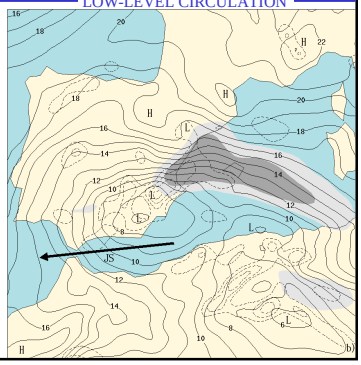


TOUS

Location / Stationarity: well
QPF: underestimated

Westward-moving low / ULJ
Embedded mesolow
Convergence over SE Spain



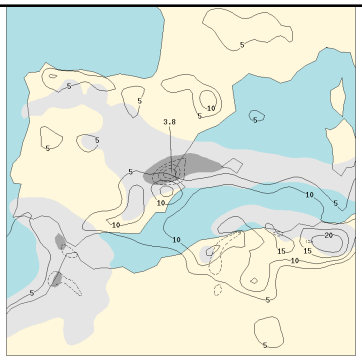


GANDIA

Strong WV flux convergence
Boundary of instability
E-W elongated moist tongue

FULL SIMULATION

WV FLUX CONV. / CONVECT. INST. / PW

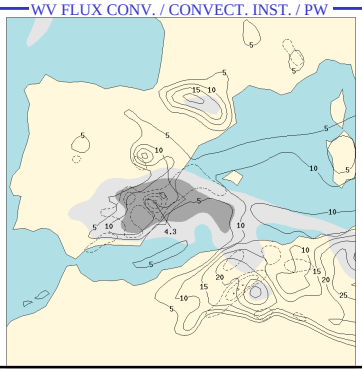


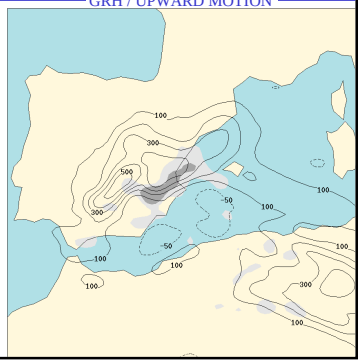
GRH / UPWARD MOTION

TOUS

Strong WV flux convergence
Convective instability
High values of PW

Frontogenesis acting on the
S-N temperature gradient



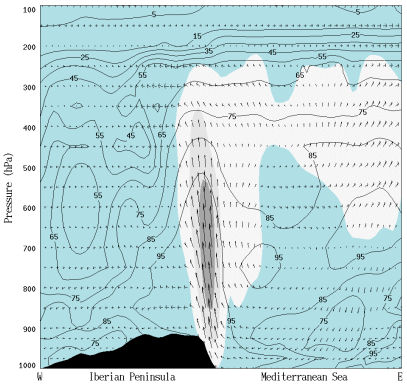


FULL SIMULATION

GANDIA

Coastal plume of moist, ascending air
Precipitation efficiency / Mesolow

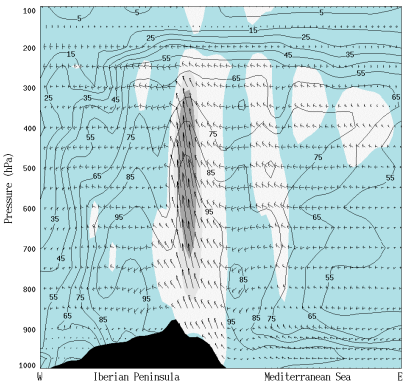
Local orography → 60% precipitation



TOUS

Deep plume of moist, ascending air / Dynamic forcing
Precipitation efficiency / Mesolow

Local orography → 30% precipitation



W-E CROSS SECTION
(CIRCULATION / RELATIVE HUMIDITY)

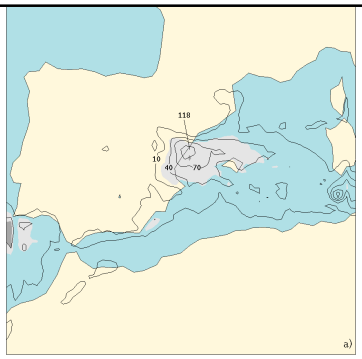
GANDIA

Rainfall suppression
No inland peak

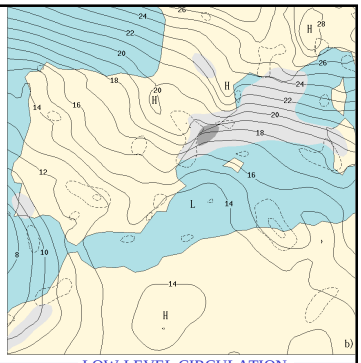
SLP appreciably modified
Less convergence / Shift LLJ

NO ATLAS
NO LATENT HEAT

PRECIPITATION



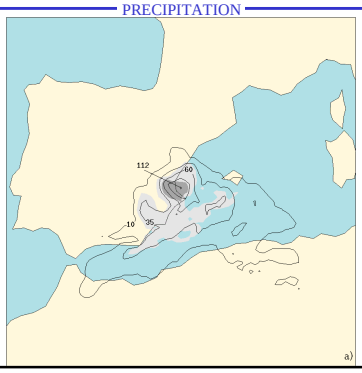
LOW-LEVEL CIRCULATION

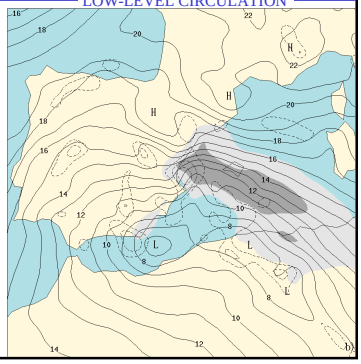


TOUS

Rainfall suppression
No inland structure

SLP appreciably modified
Shift Low / LLJ
Weak convergence SE Spain





FACTOR SEPARATION STUDY

Method of Stein and Alpert (1993)

n factors → **2^n simulations**

Experiment	Atlas orography	Latent heat exchange
F_0	no	no
F_1	yes	no
F_2	no	yes
F_{12}	yes	yes

a. Effect of the Atlas Mountains = $F_1 - F_0$

b. Effect of the Latent heat = $F_2 - F_0$

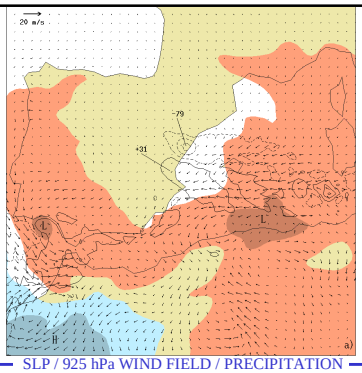
c. Effect of the interaction Atlas/Latent heat = $F_{12} - (F_1+F_2) + F_0$

GANDIA

Extensive pressure decrease over the Mediterranean

Cyclogenesis / Enhancement of easterlies and convergence

Southward shift of the rainfall activity



SLP / 925 hPa WIND FIELD / PRECIPITATION

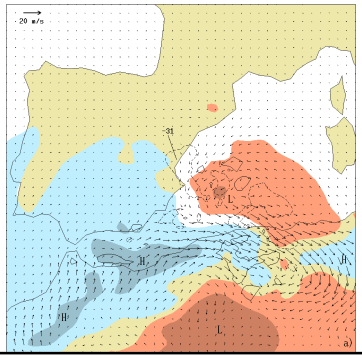
EFFECT
ATLAS MOUNTAINS

TOUS

Pressure decrease limited to the east of the Balearics

Northerly winds and offshore outflows over eastern Spain

General rainfall suppression



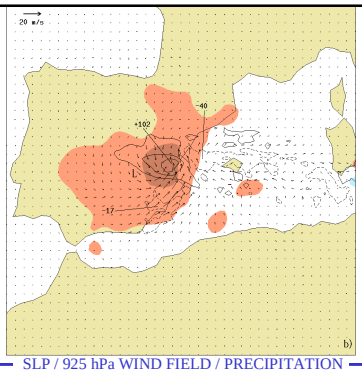
GANDIA

Mesolow over eastern Spain

Intense mesoscale cyclonic circulation / strong convergence

Focusing of rainfall over central Valencia

EFFECT
LATENT HEAT



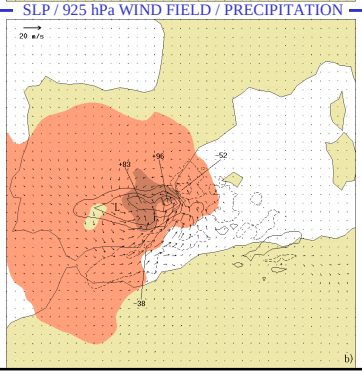
SLP / 925 hPa WIND FIELD / PRECIPITATION

TOUS

Mesolow over southeastern Spain

Intense vortex / strong convergence line

Substantial rainfall enhancement (elongated structure)

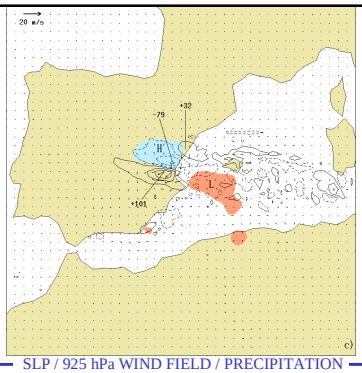


GANDIA

Complex pattern in space and time

Southward shift of the rainfall activity

EFFECT
ATLAS MOUNTAINS / LATENT HEAT

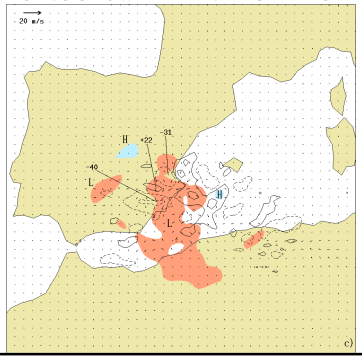


SLP / 925 hPa WIND FIELD / PRECIPITATION

TOUS

Complex pattern in space and time

General rainfall suppression over land



CONCLUSIONS

*** Synoptic-scale similarities, but also unique characteristics:**
- Gandia: Long-lasting and dynamically weak context
- Tous: Relatively strong dynamic forcing and baroclinicity

*** Stationary character of the MCSs linked to:**
- Gandia: Stagnancy of the large-scale pattern
- Tous: Westward-moving disturbance

*** Mesoscale models represent a valuable forecasting tool:**
- Location and Stationarity: Good guidance (Topography !!!)
- QPF: Understimates (Deep convection !!!)

*** Atlas mountains:**
- Gandia: Modulation by lee cyclogenesis (fits conceptual model)
- Tous: Irrelevant or even negative (exception '' '')

*** Latent heat:**
- Gandia: Strongly positive interaction
- Tous: '' '' ''

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