

# Coastal front formation at the Llobregat delta. Preliminary study



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Red MM5,  
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# Overline

1. Rain ranges anomaly. Climatology
2. Coastal front hypothesis
3. 2-3 September 2000 episode
4. MM5 simulation setup
5. Results
6. Conclusions

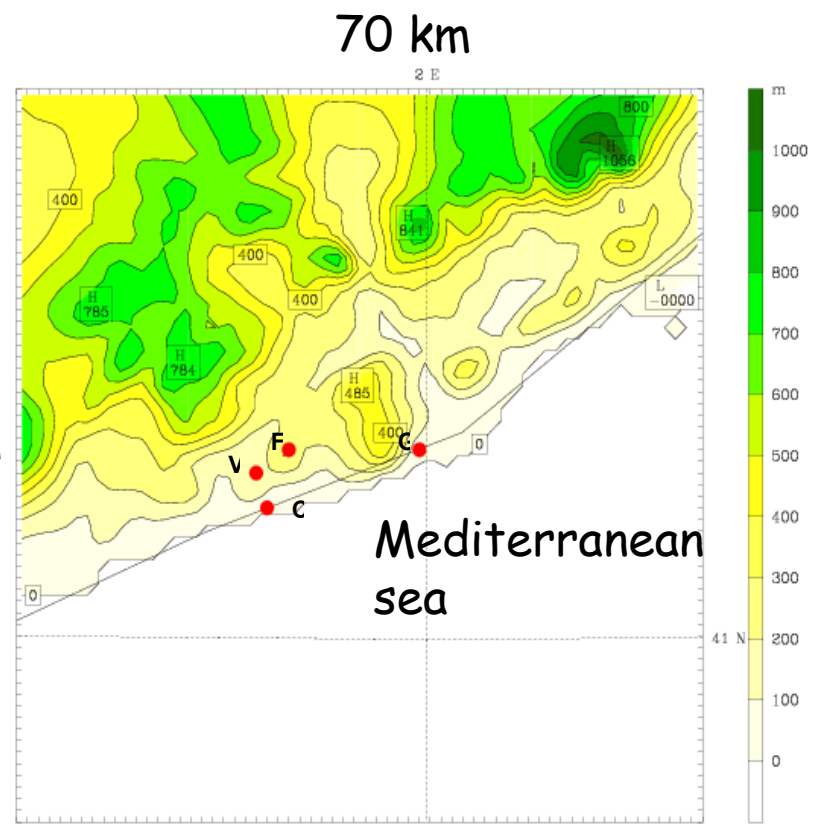
Work done to obtain the Diploma Thesis of a 3 year technical studies  
(academic use of the MM5 model)

# Rain ranges anomaly

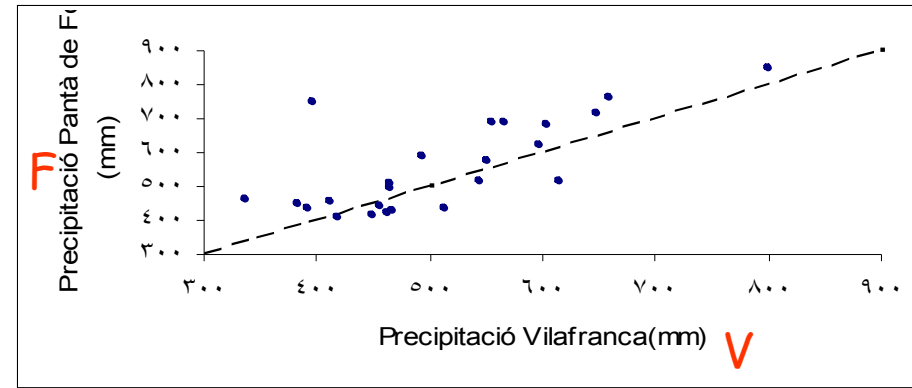
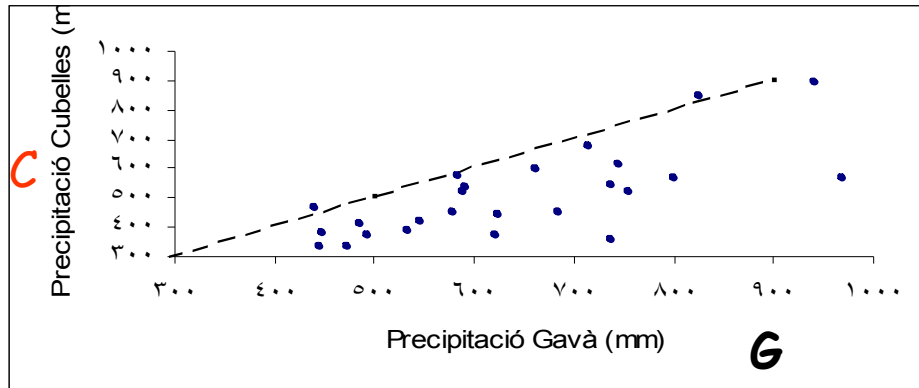
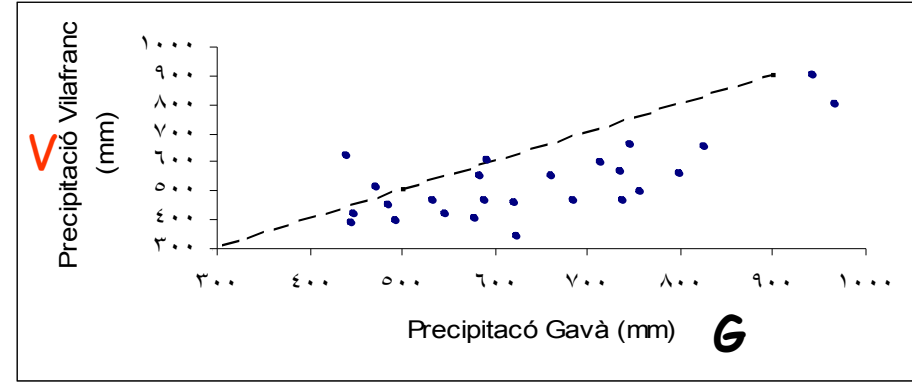
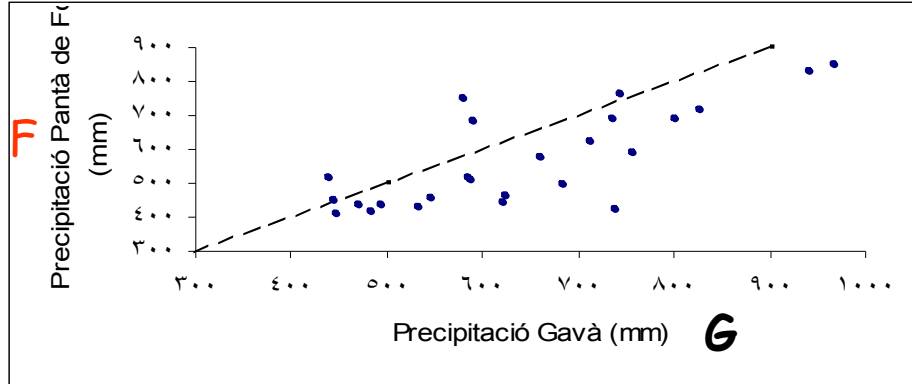


West Mediterranean coast  
Llobregat delta  
Orography influence

70 km

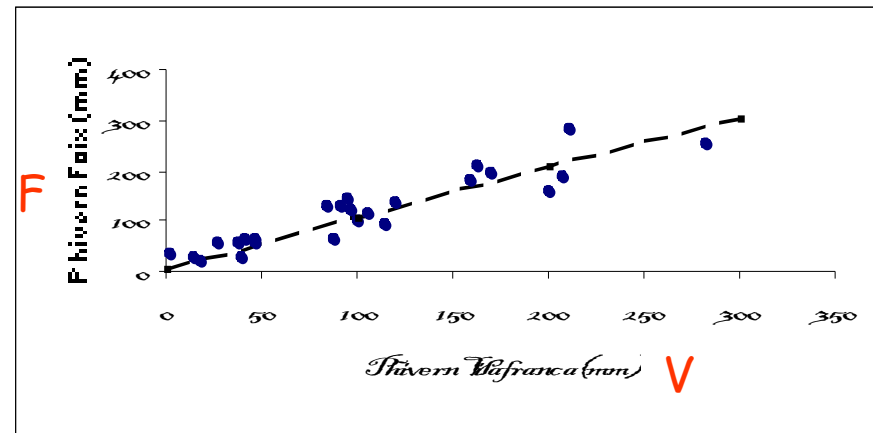
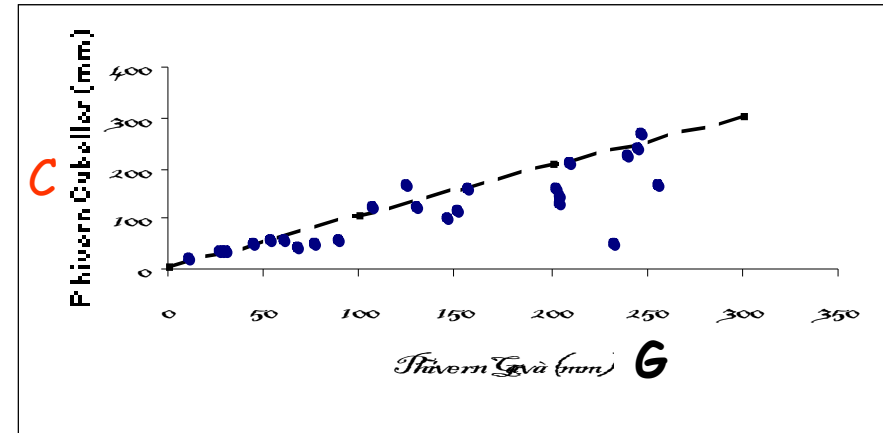
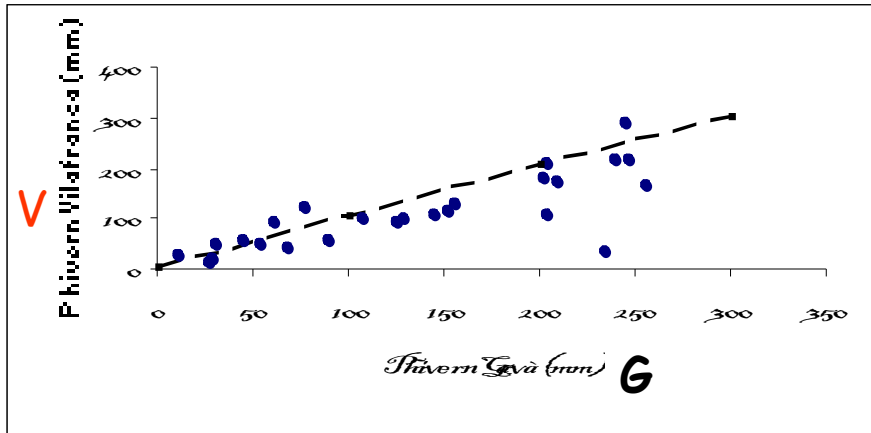


# Annual precipitation (1978-2005)



Larger precipitation at the delta station (**G**)  
Similar precipitation in the other stations  
Driving mechanism?

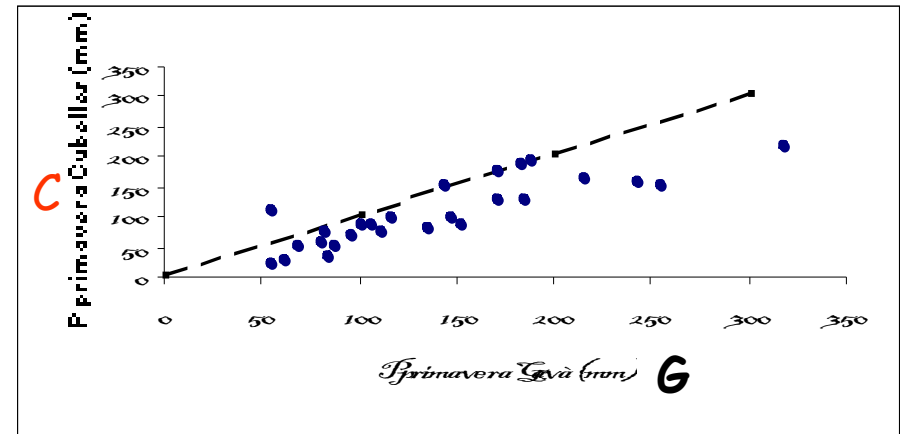
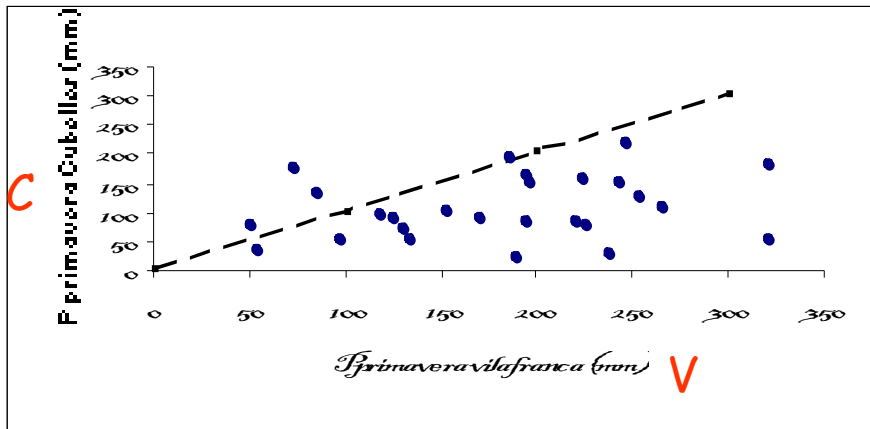
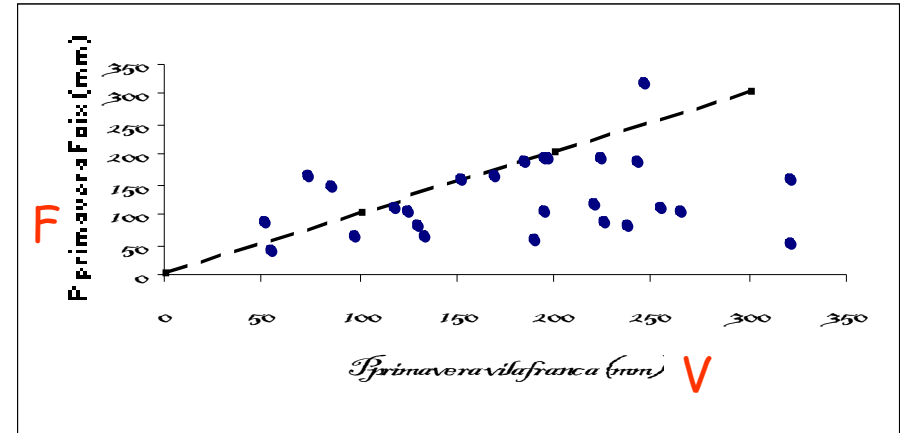
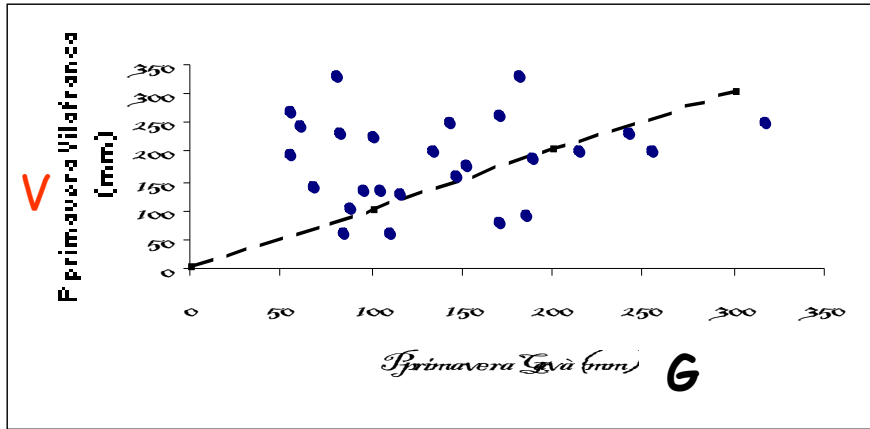
# Winter (1978-2005)



Larger precipitation at the delta station (G)  
Similar precipitation in the other stations  
Driving mechanism?

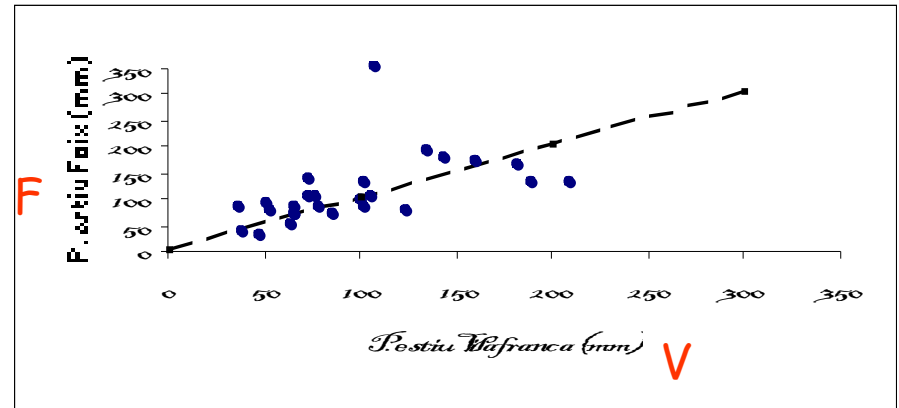
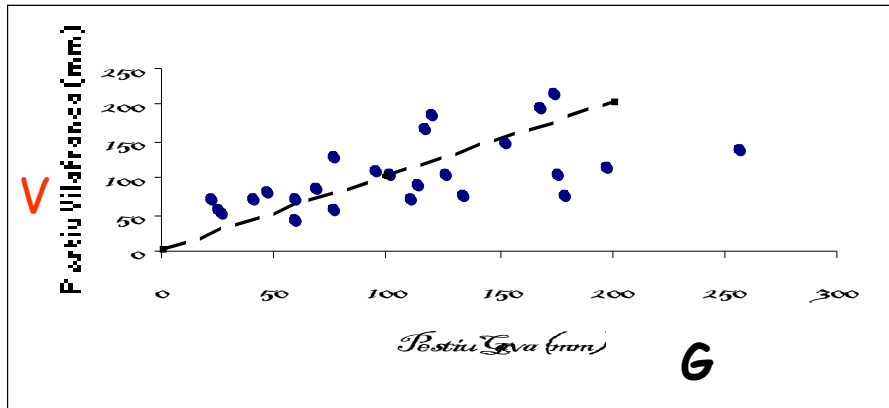
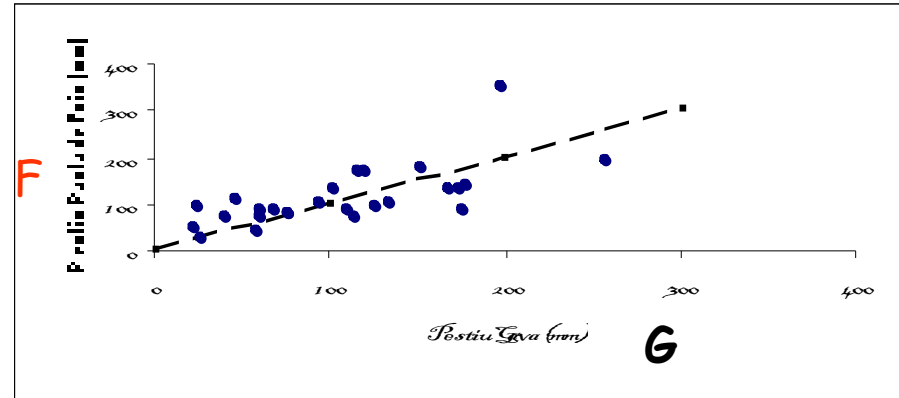
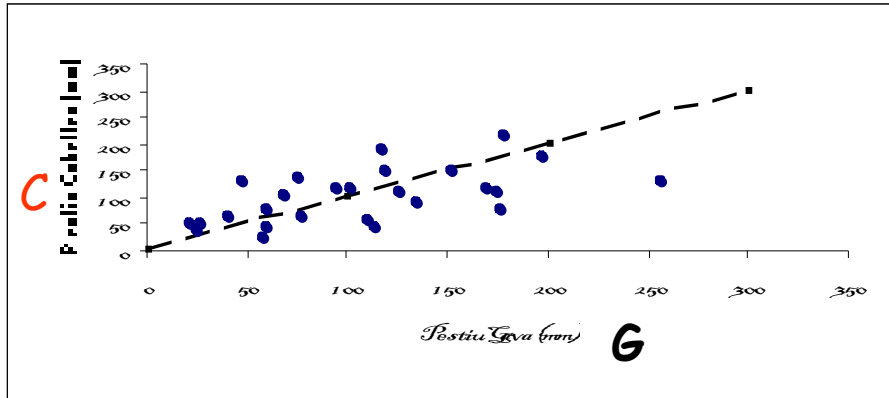


# Spring (1978-2005)



Associated to frontal systems related to low pressure centers located north of the area.  
Large precipitation at the northern station (V)

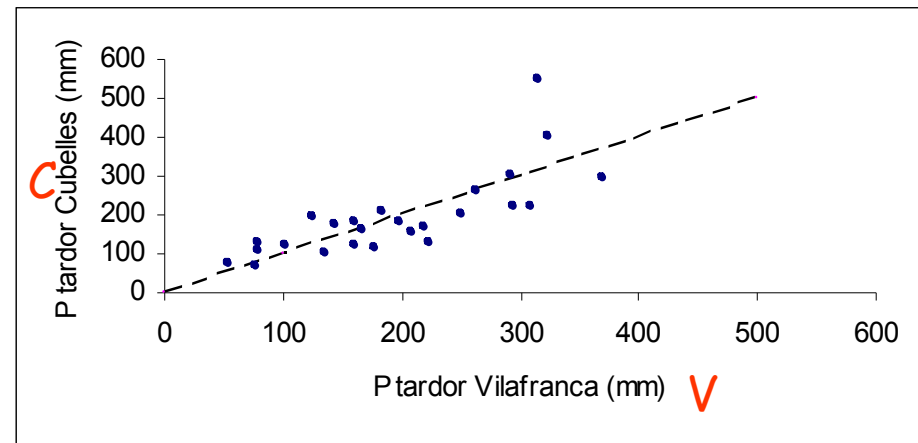
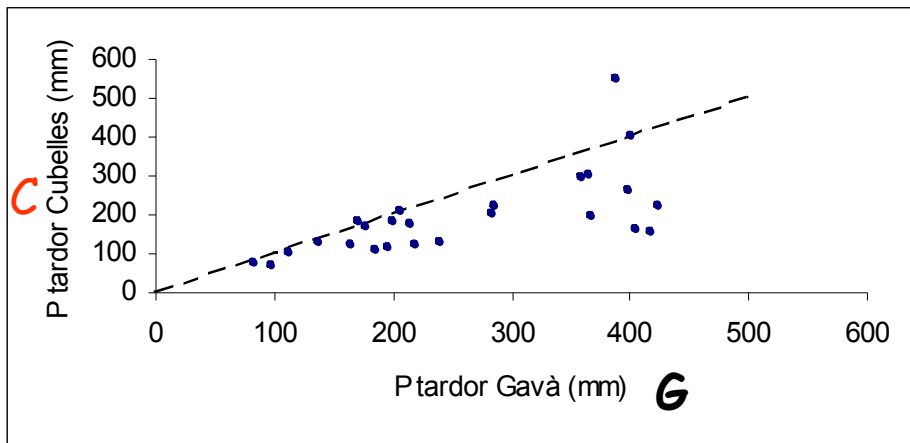
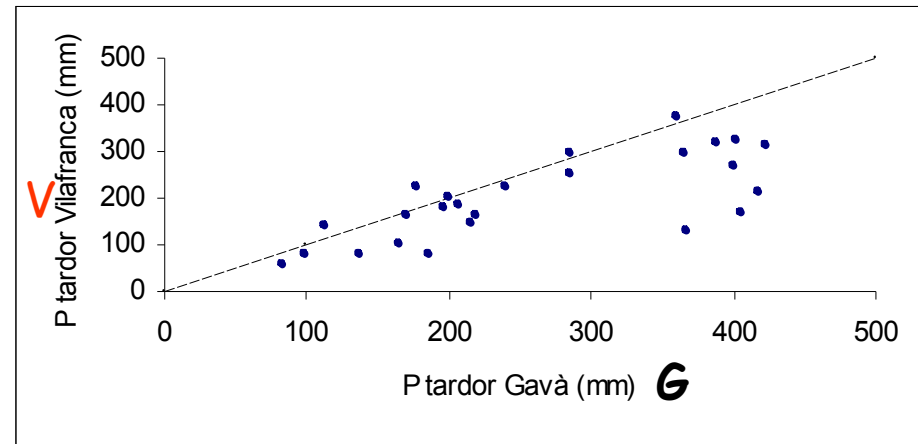
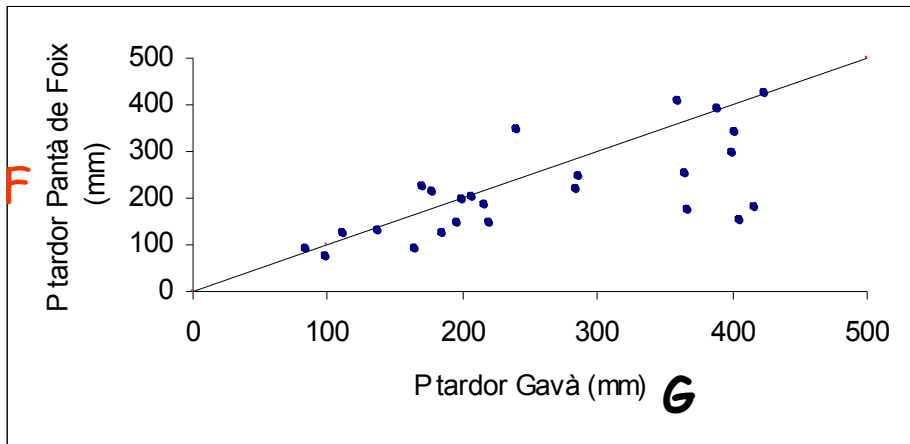
# Summer (1978-2005)



Similar precipitation in all the stations  
Mainly produced by thunderstorms



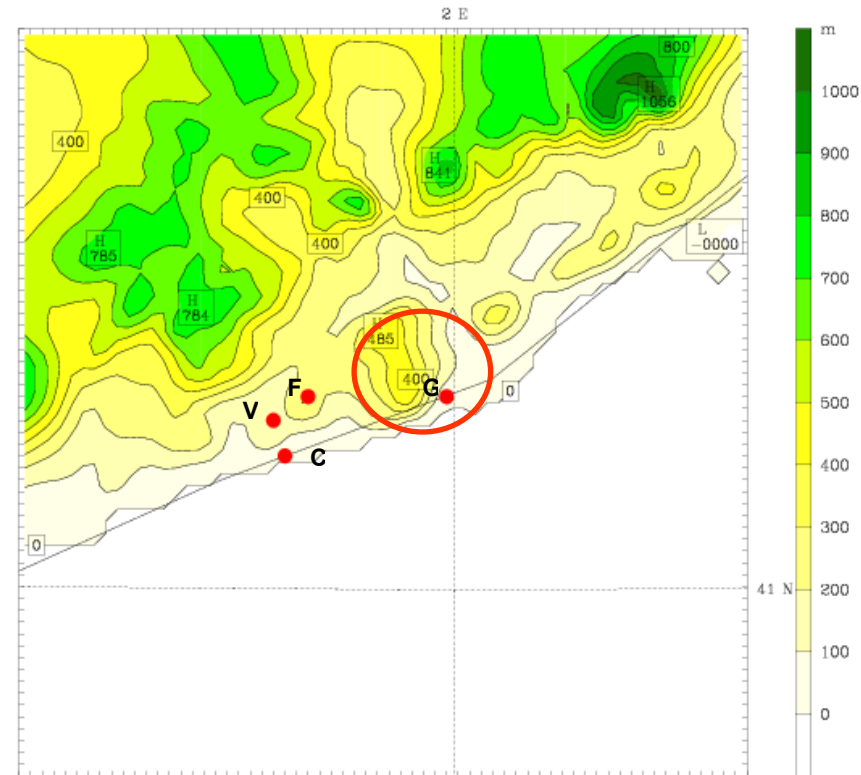
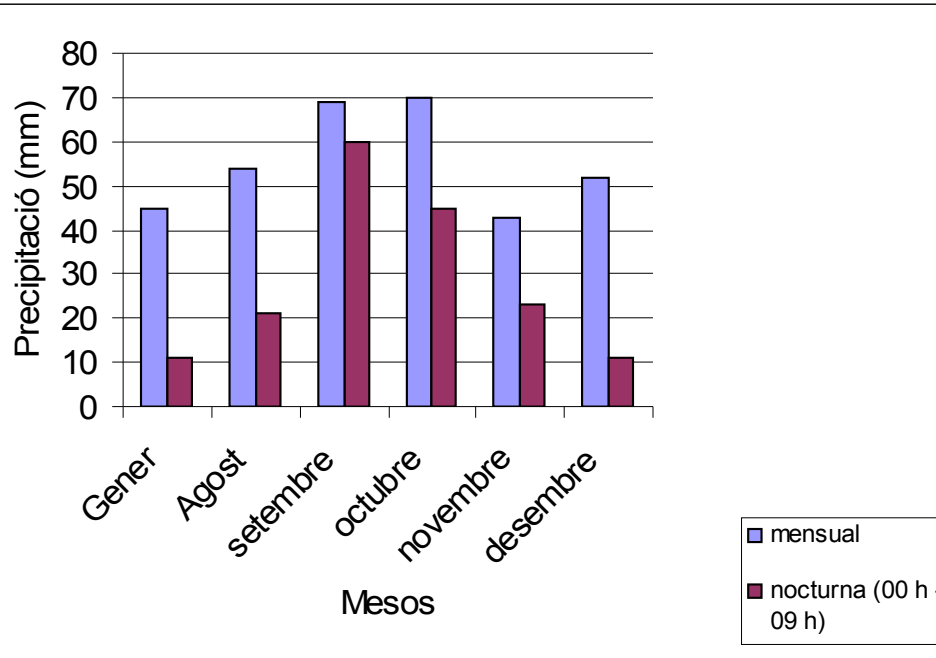
# Fall (1978-2005)



Large precipitation at the delta station (**G**)  
Similar precipitation in the other stations  
Produced only by easterly warm air intrusion?

# Summary

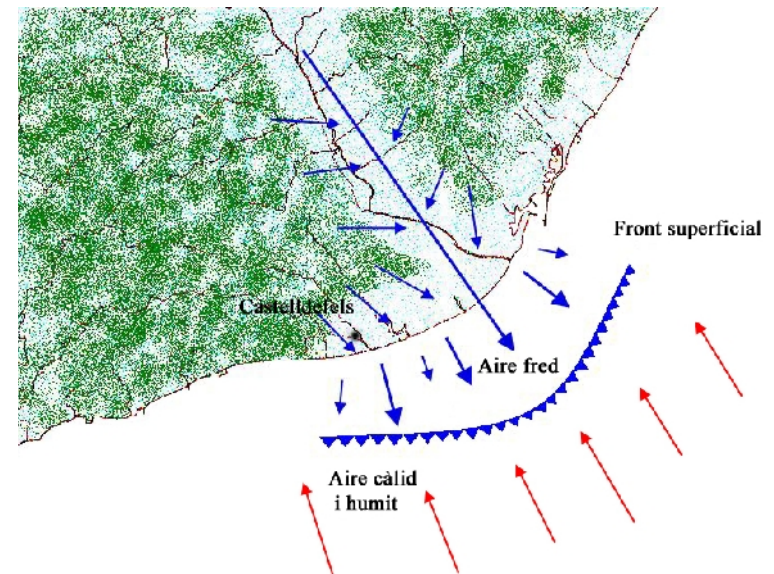
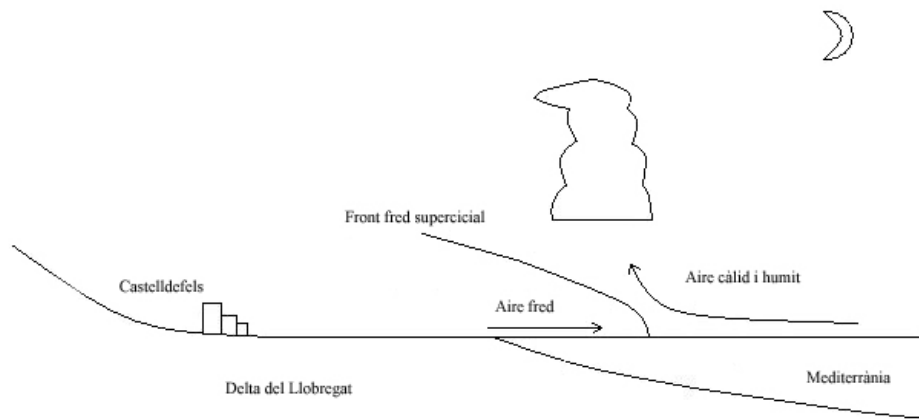
- Large spatial variability. Concentrated near the delta.
- During late summer/fall.
- Nighttime precipitation.



	Annual	Spring	Summer	Fall	Winter
<b>Cubelles</b>	503	106	97	195	105
<b>Foix (pantà)</b>	560	128	109	213	110
<b>Gavà</b>	645	140	108	261	136
<b>Vilafranca</b>	581	182	98	197	104

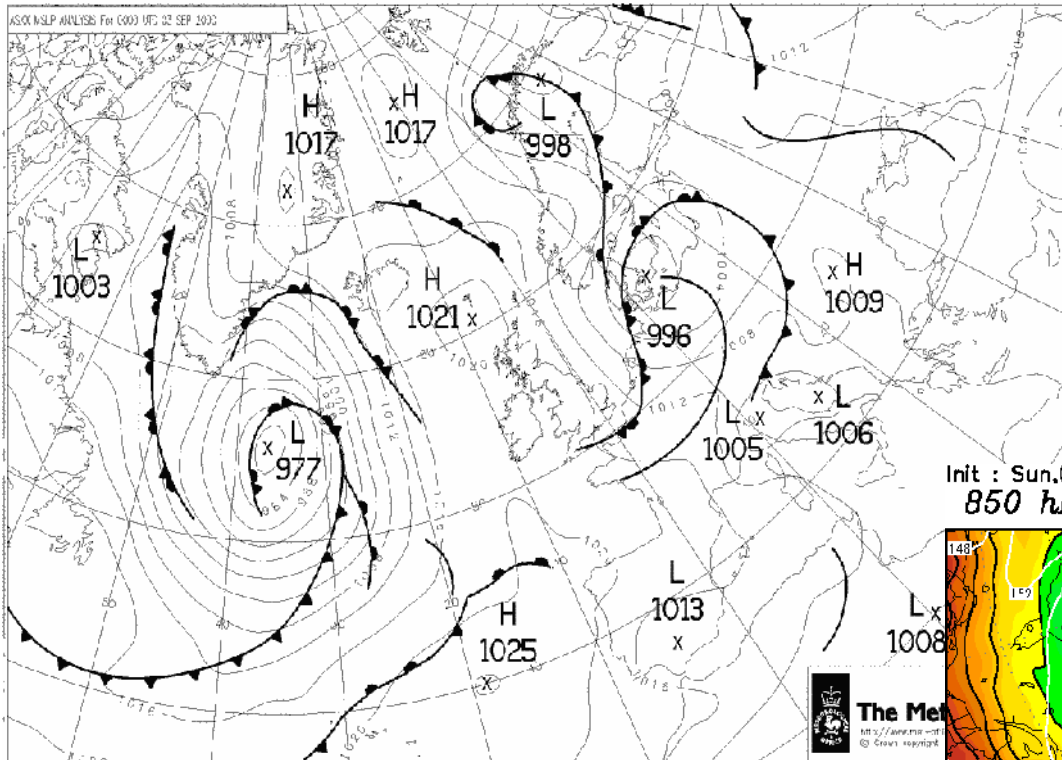
# Coastal fronts hypothesis

- Nocturnal land breeze:
  - Sea surface temperature around 26 °C
  - Long nights, important land cooling (land breeze)
- Drainage winds along the Llobregat delta and small torrents of the surrounding hills.
- Enlarging of the offshore cool flux at the coast.
- The front is limited south and north by two surrounding small mountains.



# September 2-3 2000 episode

Come to you via Top Karten (<http://www.wetterzentrale.de/topkarten/>)  
Source (.lit: Files): <http://weather.noca.gov>

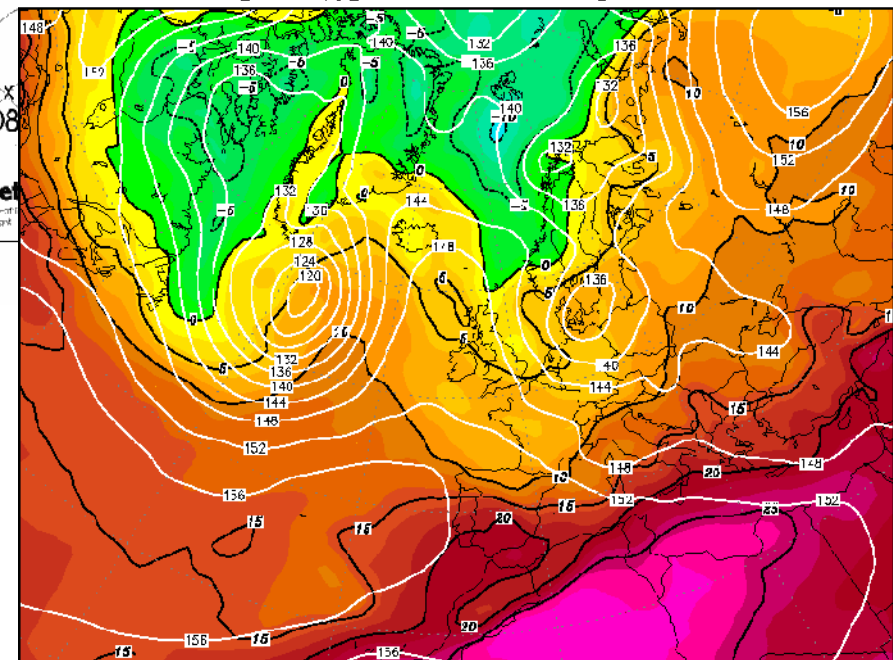


Low pressure at center Europe  
Light surface winds  
850 hPa light westerly winds

Init : Sun,03SEP2000 00Z

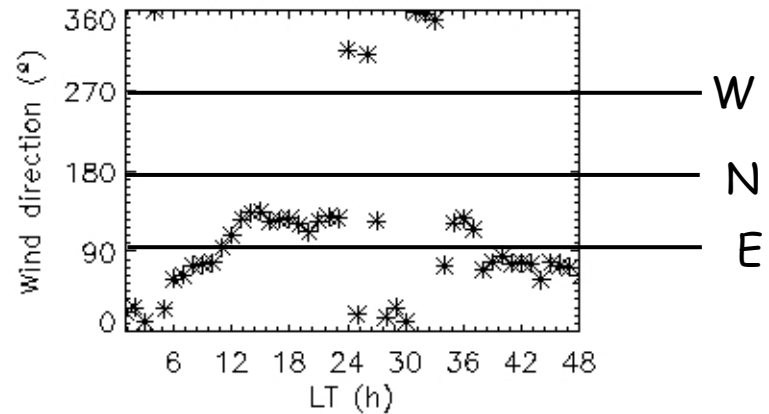
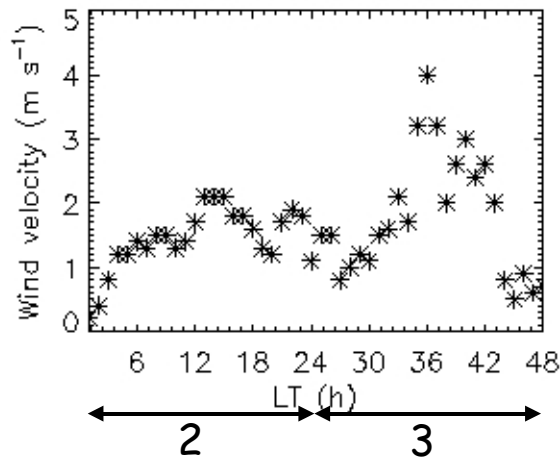
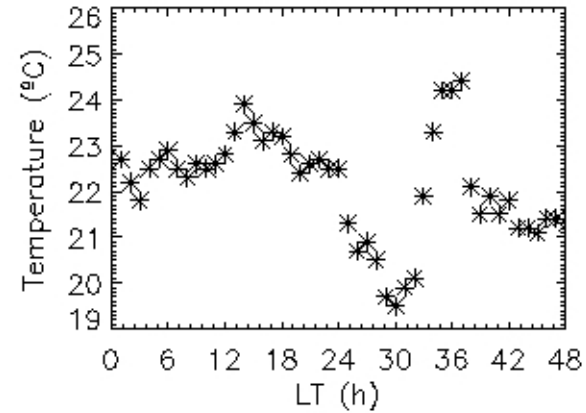
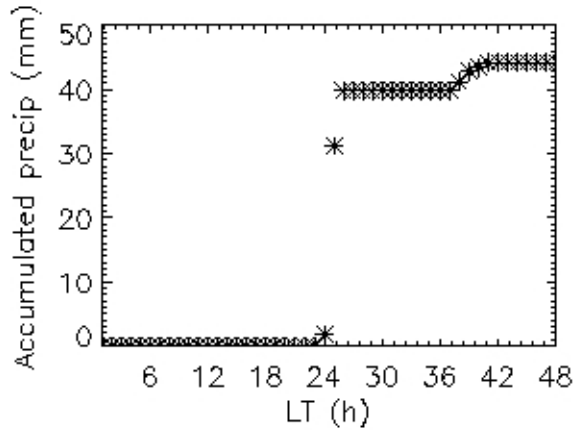
Valid: Sun,03SEP2000 00Z

850 hPa Geopot. (gpm) und Temperatur (Grad C)



Daten: 00z-Lauf des MRF/AVN-Modells des amerikanischen Wetterdienstes  
Wetterzentrale Karlsruhe  
Top Karten : <http://www.wetterzentrale.de/topkarten/>

# Local observations: Gava-Viladecans



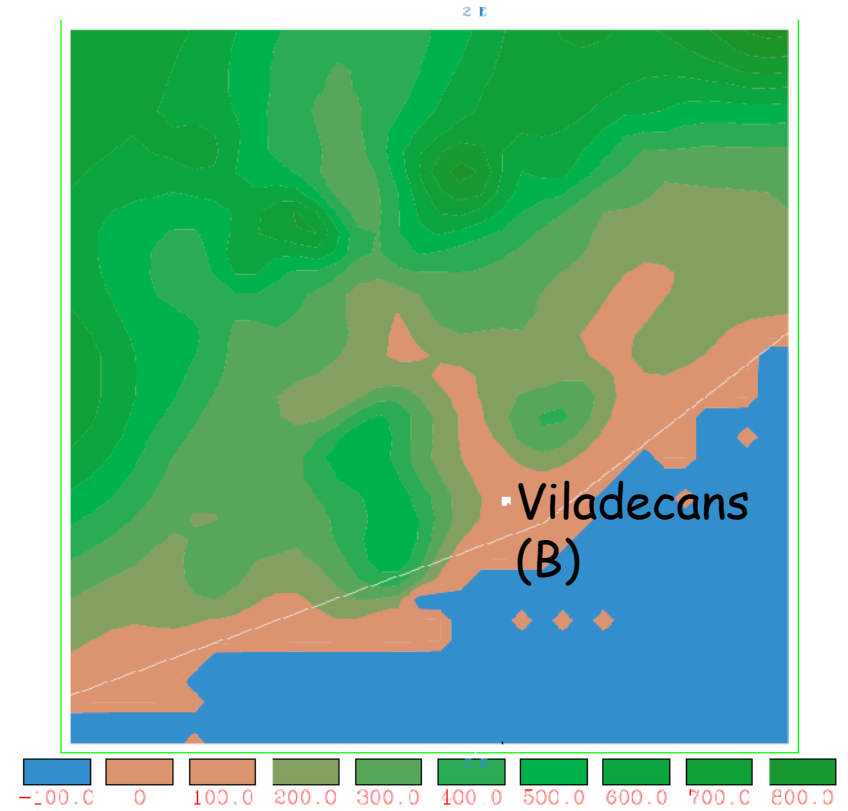
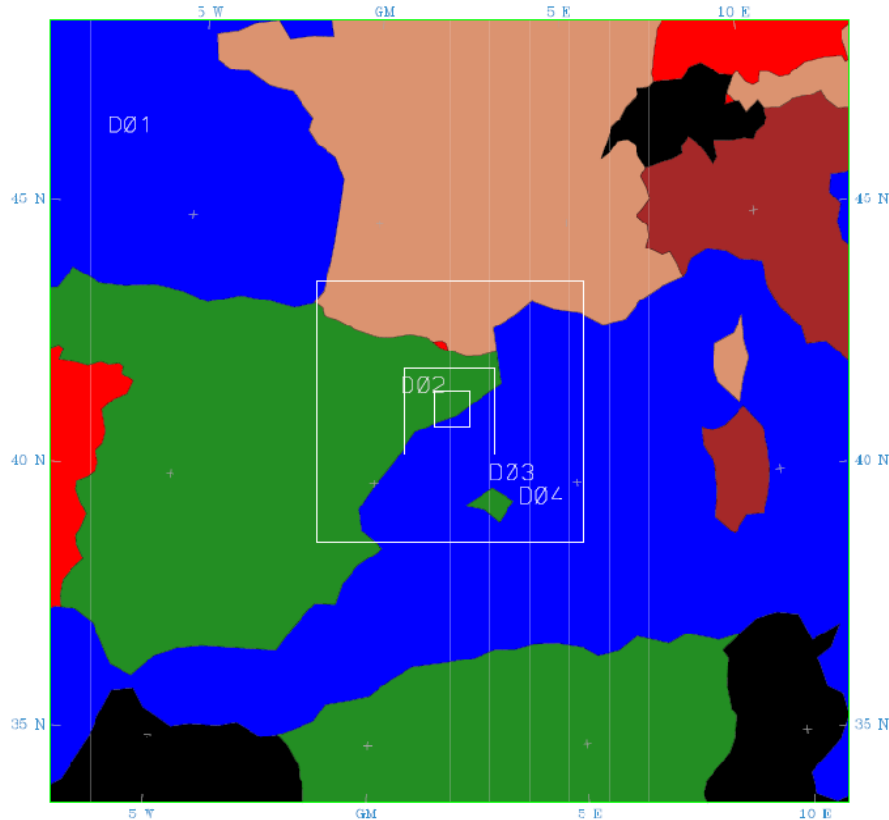
Change in the wind direction during the night.  
Winds coming mainly from the north-east

Radar images (from 0 to 6UTC every 10 min)





# Simulation characteristics



Domain	Resolution (km)	Number of points
1	27	40x40
2	9	37x34
3	3	52x52
4	1	70x70

27 vertical levels

- Moisture scheme: Simple ice
- Convection scheme: Kuo, Grell, none, none.
- PBL: MRF
- Atmospheric radiation: cloud

# 6. Results (Domain 3)

Air convergence at the Llobregat delta 0-6UTC (03/09)

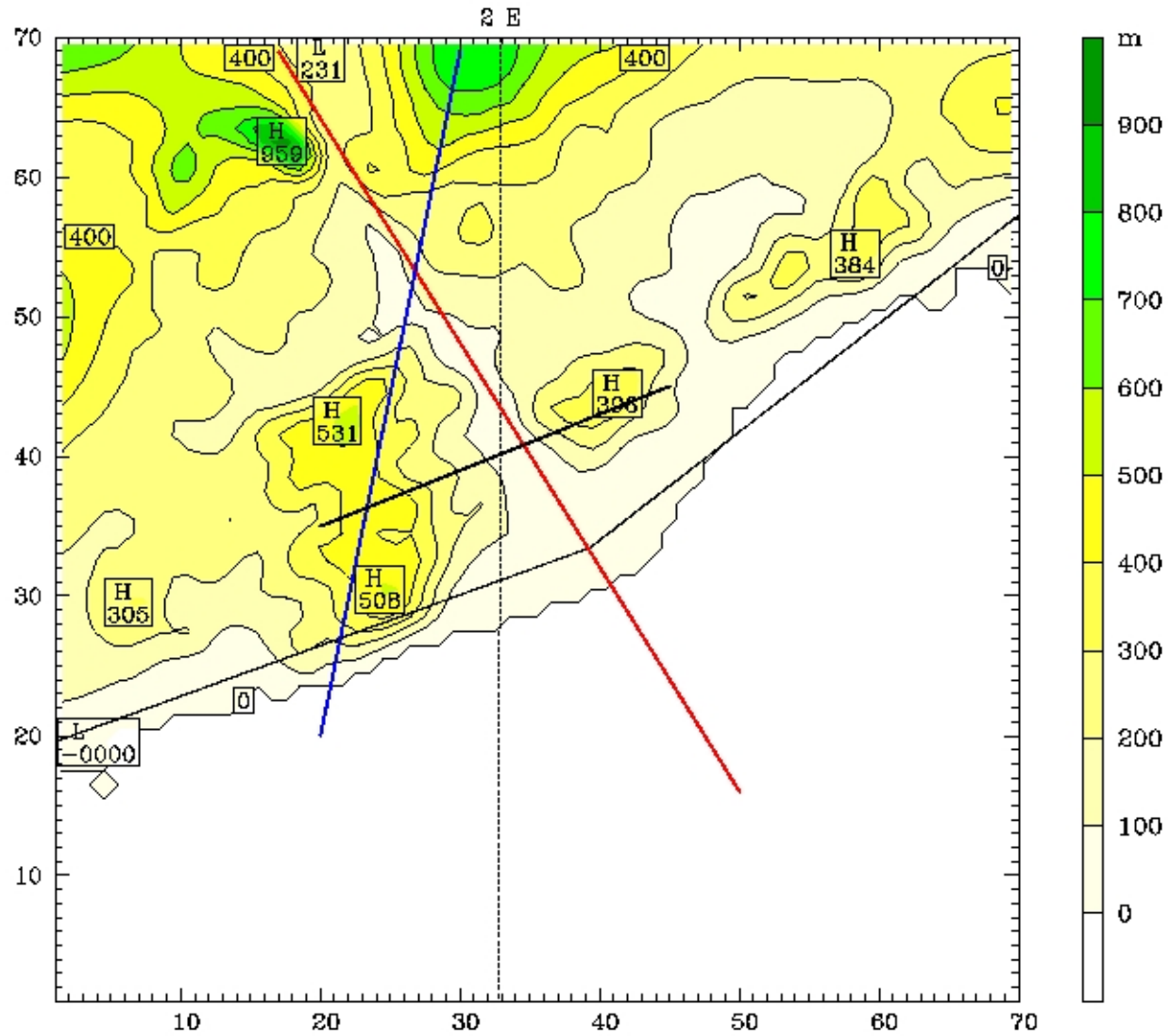
Wind pattern and accumulated precipitation 0-6UTC (03/09)

# 6. Results (Domain 4)

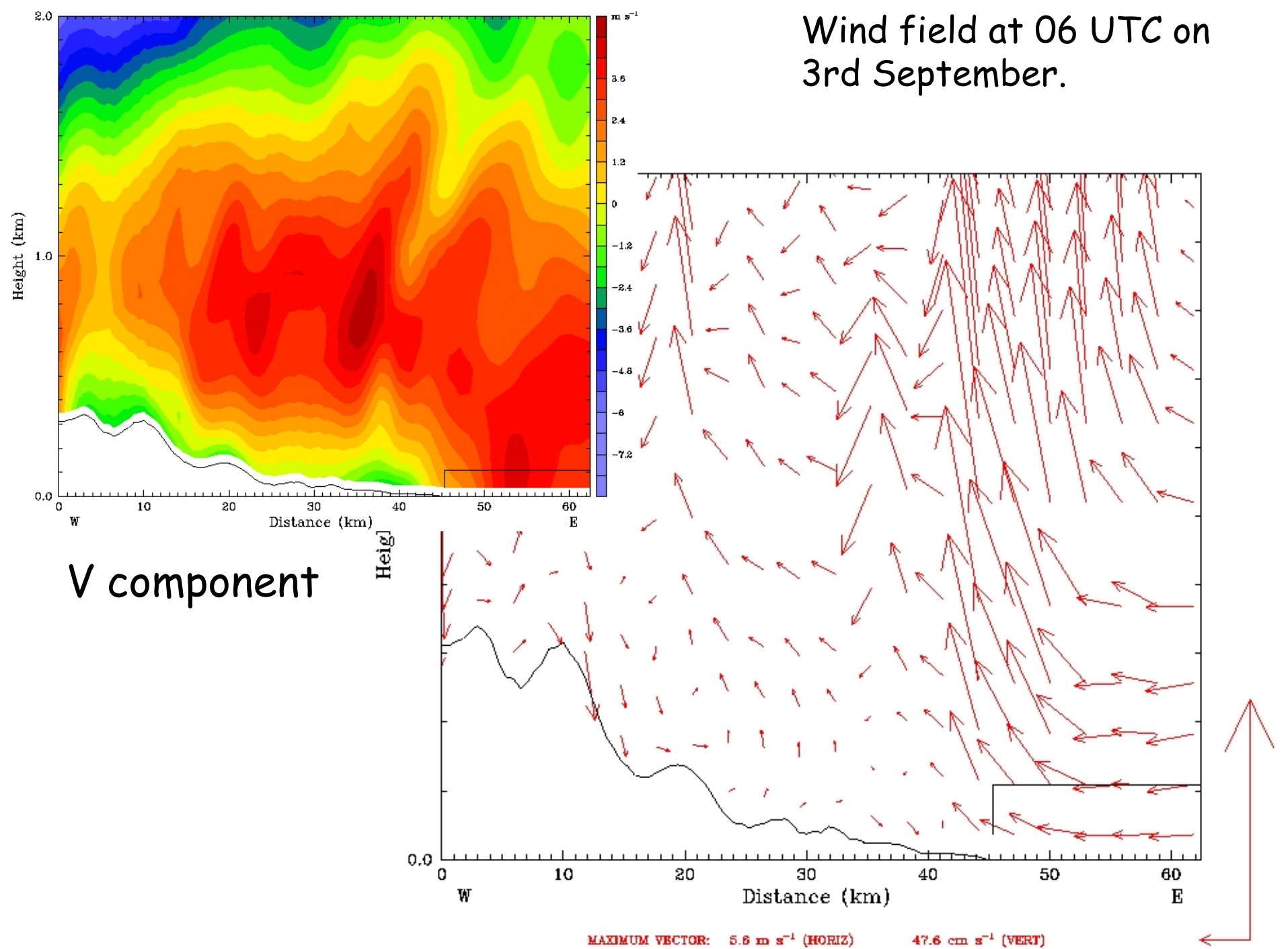
Air convergence at the Llobregat delta 0-6UTC (03/09)

Wind pattern and accumulated precipitation 0-6UTC (03/09)

# Vertical cross sections

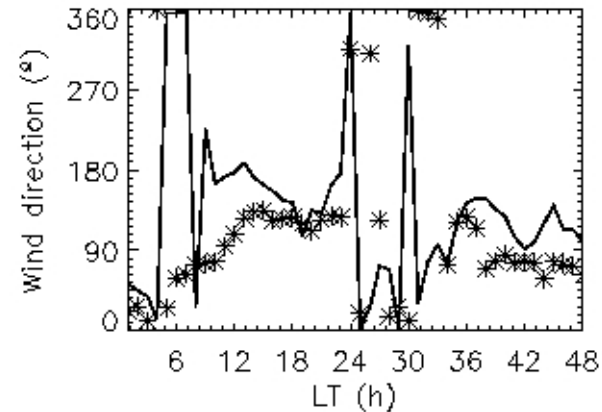
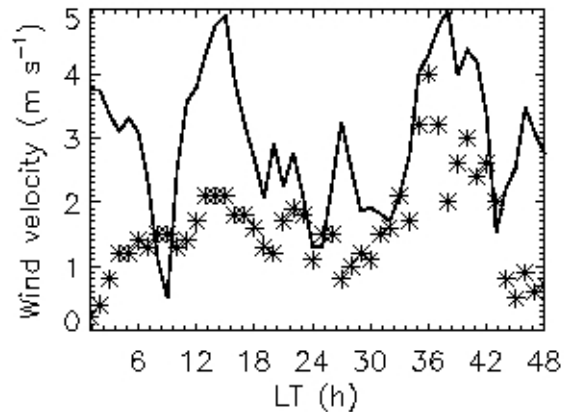
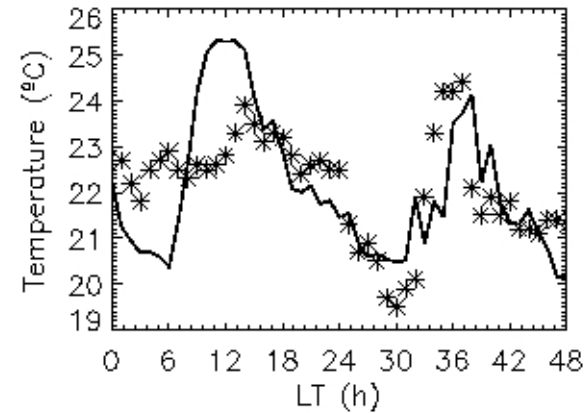
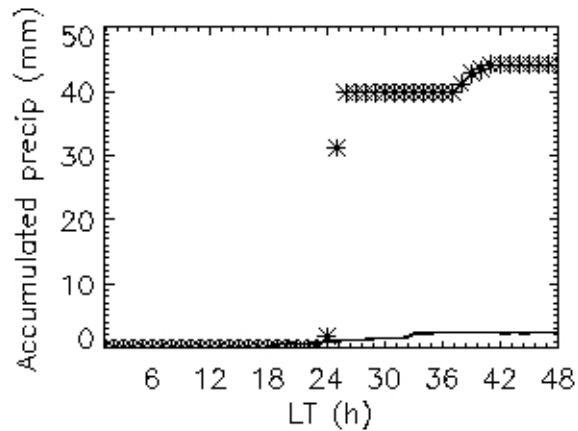


Wind field at 06 UTC on  
3rd September.





# MM5 vs observations (Viladecans weather station)



Temperature and winds are well reproduced.  
Rainfall rates are clearly underestimated.

# Conclusions

- Climatology shows that precipitation rates have a great spatial variation.
- Most of precipitation episodes of the delta area occur during fall and nighttime.
- This fact can be associated to by the development of a coastal front that is restricted to the delta area. Fundamental mechanisms are related to land breeze, drainage winds and high sea surface temperature.
- An episode produced by this type of front has been studied using observations and MM5 simulations.
- MM5 simulation reproduce precipitation rates but not the spatial distribution.
- The MM5 simulation is able to reproduce the drainage winds along the valley and the coastal front.

Additional episodes will be studied.