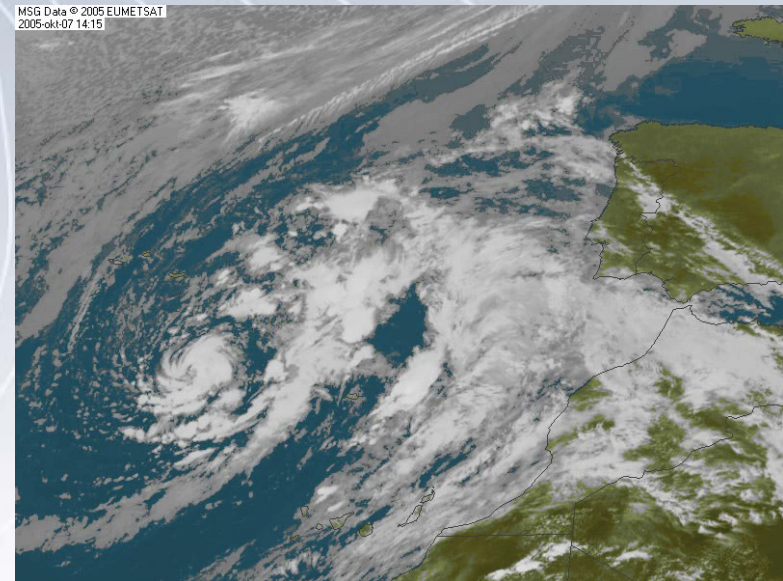


# Recent ET/STC/TT near Iberian Peninsula and Canary Islands

ET, Extratropical Transition  
STC, SubTropical Cyclogenesis  
TT, Tropical Transition



Francisco Martín and Fermín Elizaga  
AEMet  
[francisco.martin@inm.es](mailto:francisco.martin@inm.es)

- Why are we here?

In 2005 and 2006, three tropical cyclones, TC, in origin made landfall in Spanish Atlantic areas

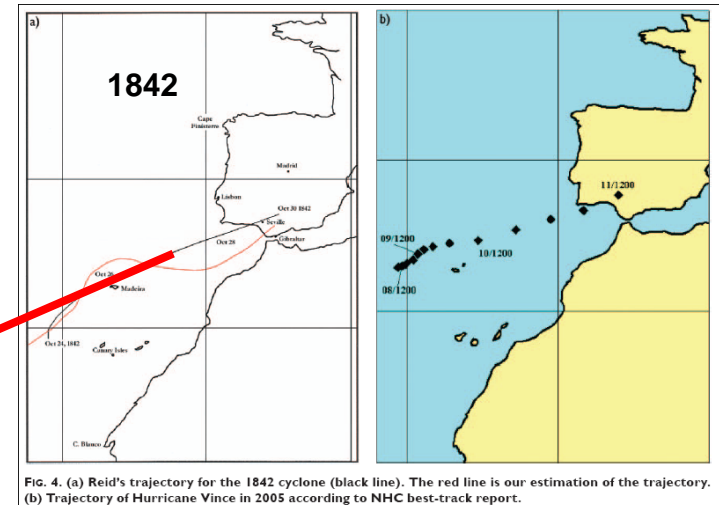
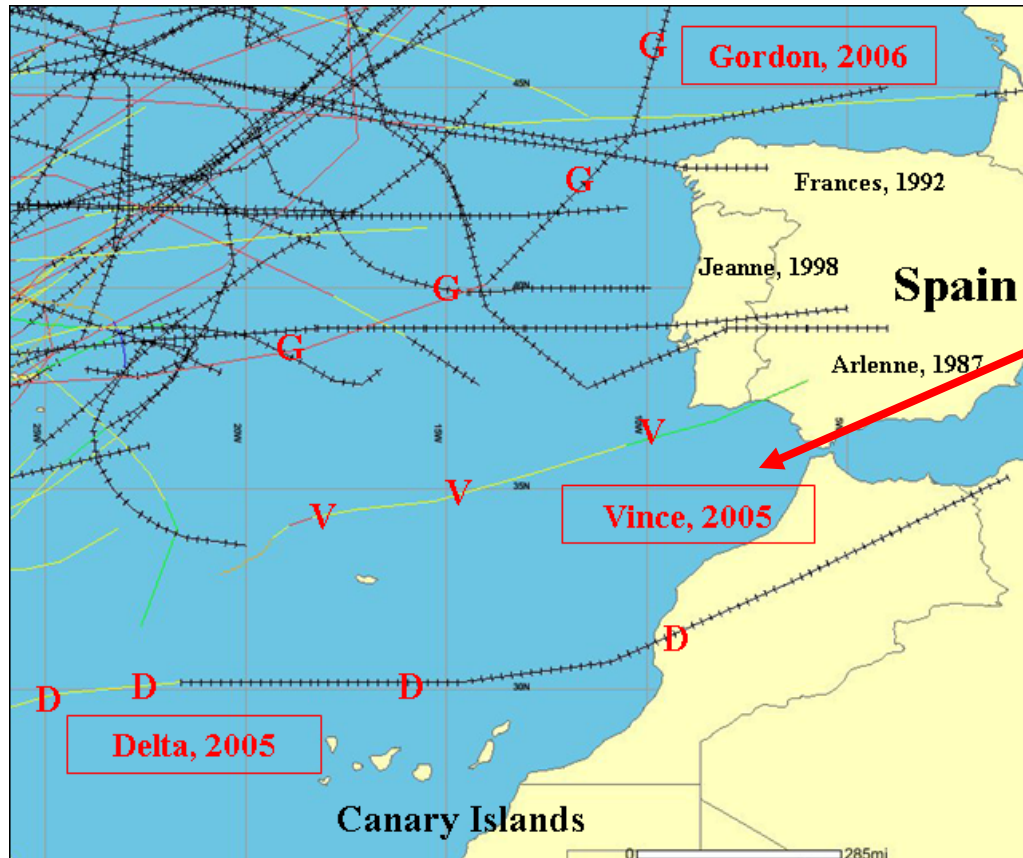
Two of them suffered a reintensification process during its extratropical transition, ET, generating hazardous weather conditions

**These are the main reasons!!!**

# Summary

- 2005-2006 Atlantic hurricane seasons close to Spain: a short review
- Forecasting problems: lessons learned
- Main actions and activities from INM-AEMet
- Conclusions

# Close-up view of historical tracks of tropical cyclones: 1851-2007, ... but



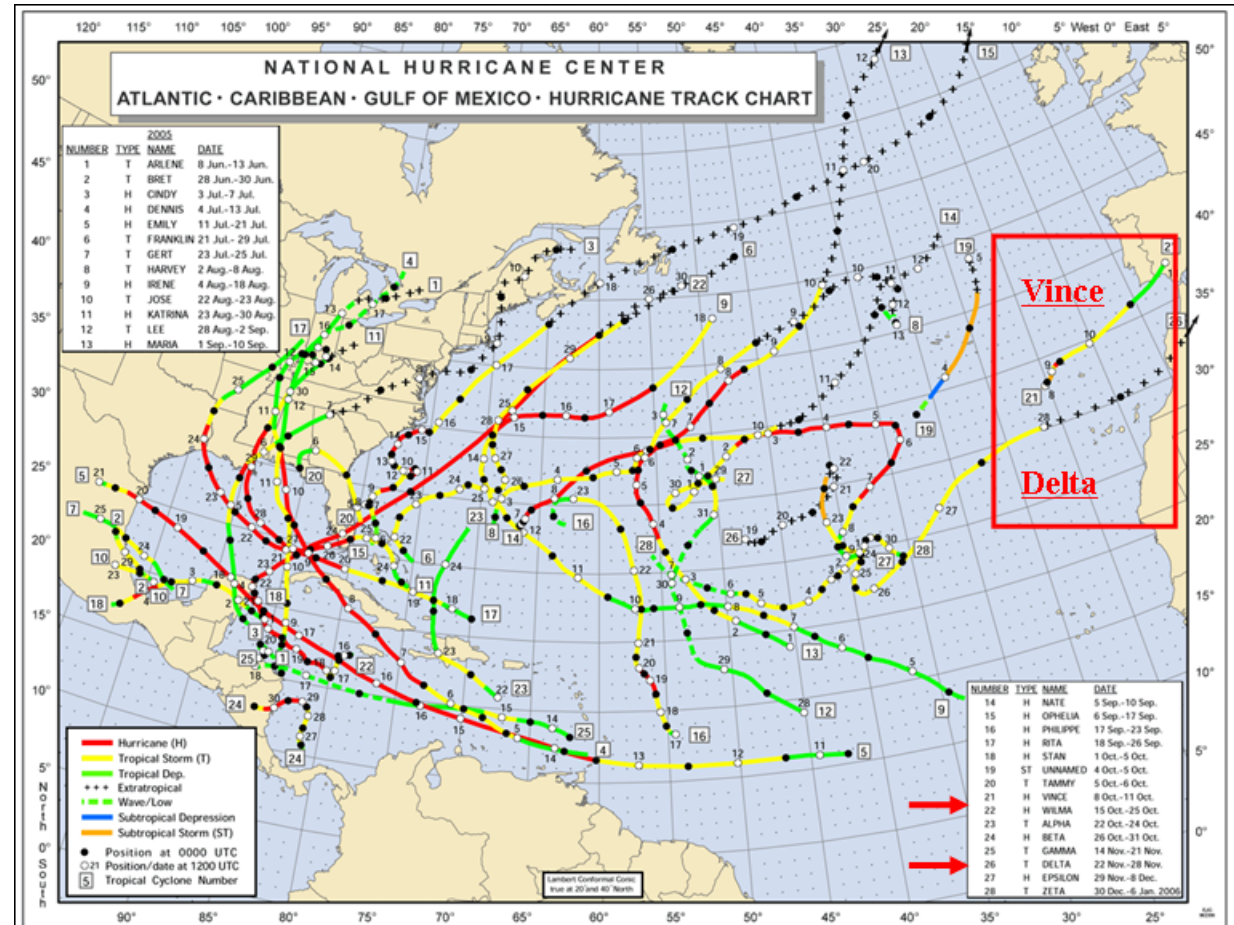
## - A HISTORICAL ANALOG OF 2005 HURRICANE VINCE

BY J. M. VAQUERO, R. GARCÍA-HERRERA, D. WHEELER, M. CHENOWETH, AND C. J. MOCK  
The passage of Hurricane Vince as a tropical depression over Spain and Portugal was once thought to be a unique historical event, but documents show that a rare tropical storm similarly struck southwest Spain in October 1842.  
*Bull. Amer. Meteor. Soc*, Feb 2008, 191-201.



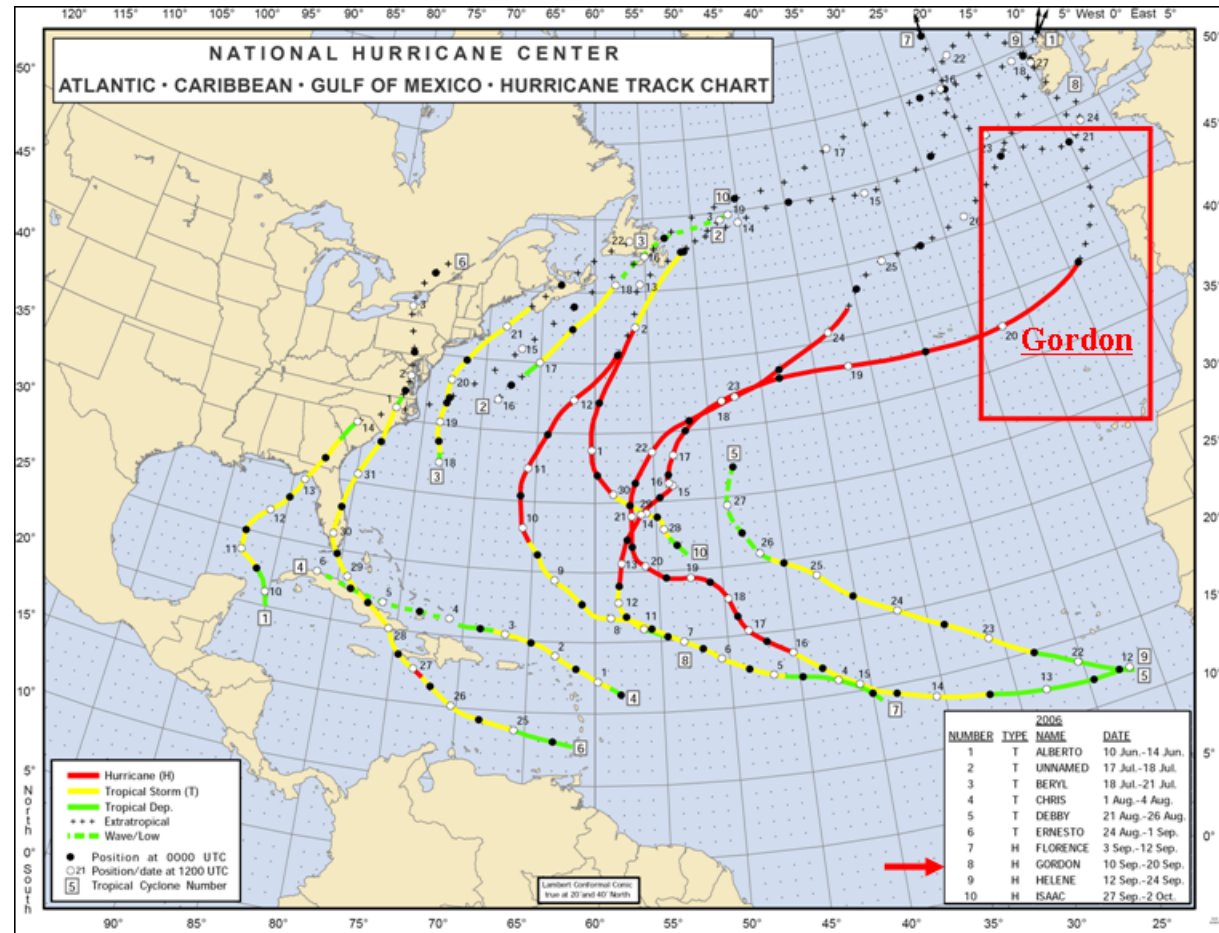
Recent ET/STC/TT near Iberian Peninsula and Canary Islands

# Atlantic hurricane season in 2005



Recent ET/STC/TT near Iberian Peninsula and Canary Islands

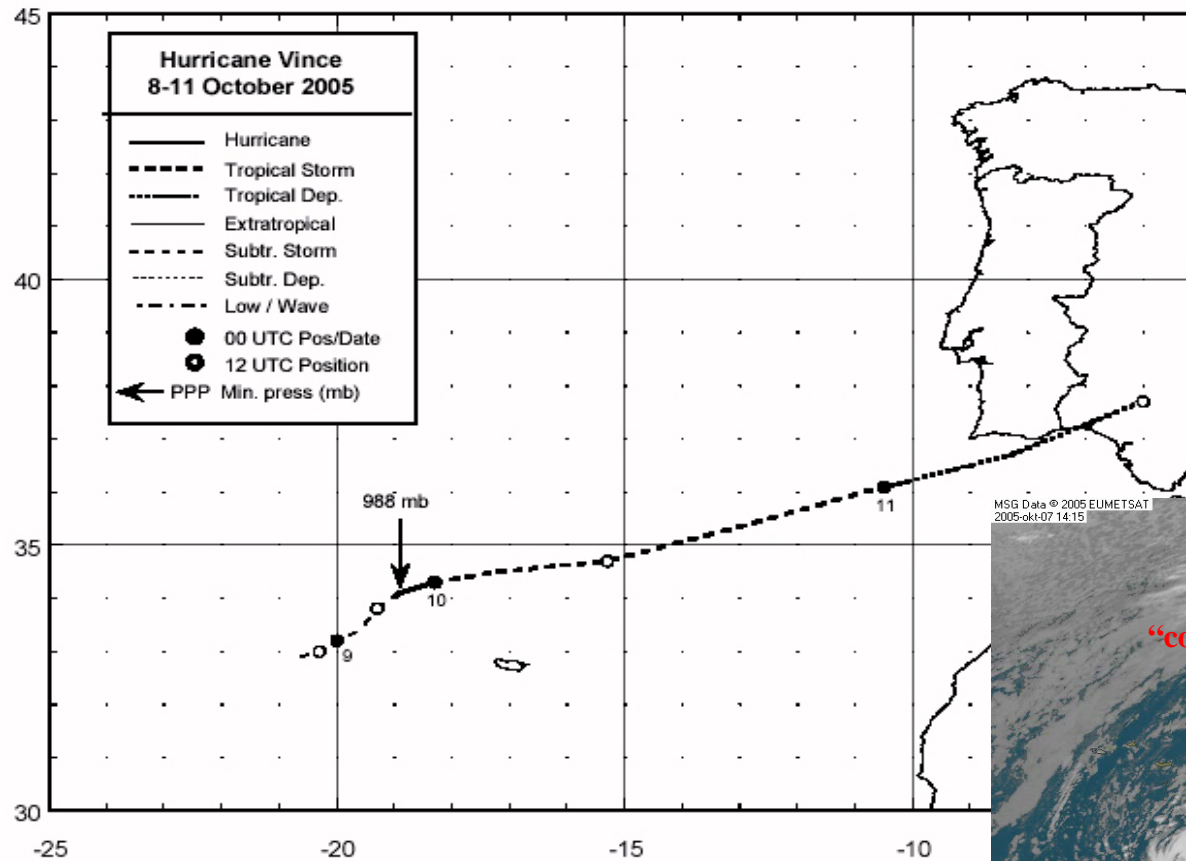
# Atlantic hurricane season in 2006



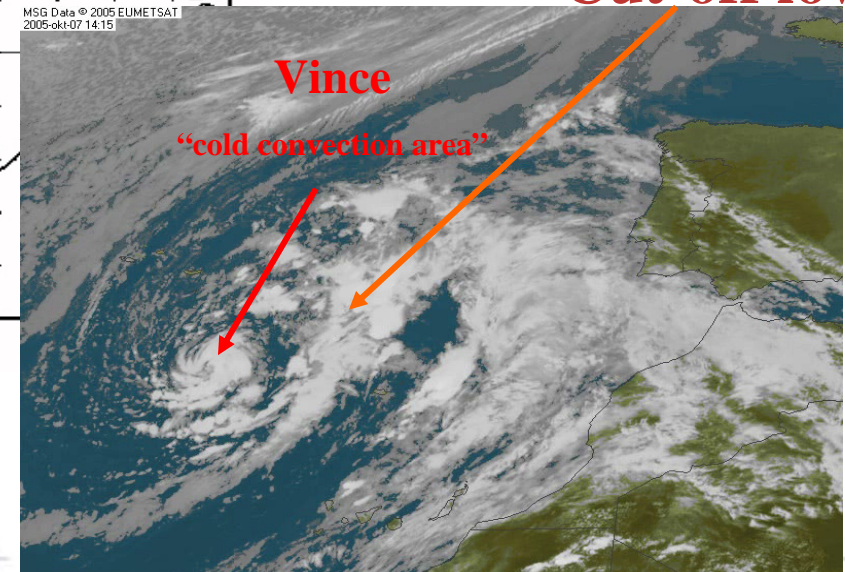
Source, NHC

# Recent ET/STC/TT near Iberian Peninsula and Canary Islands: Best-track of hurricane Vince

8-11 Oct. 2005



Cut-off low

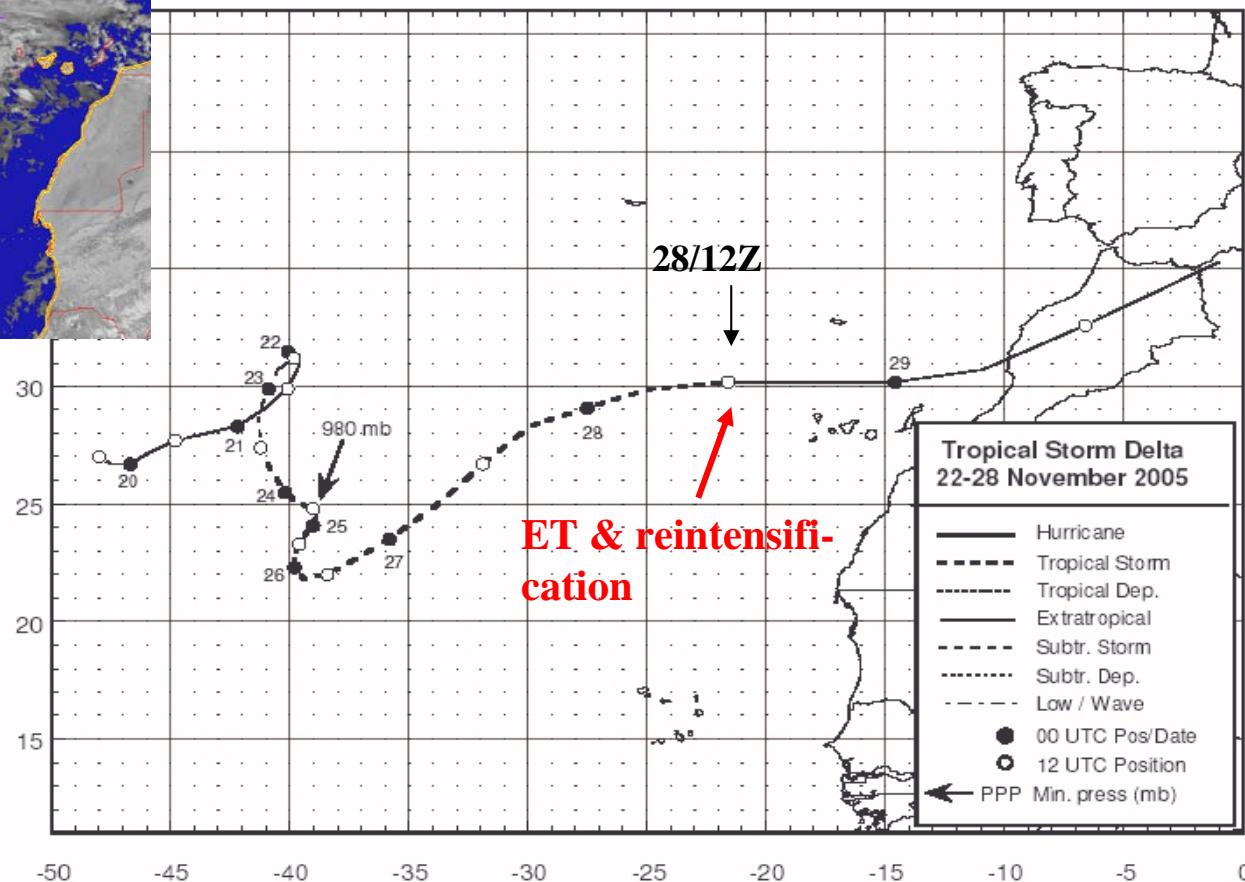
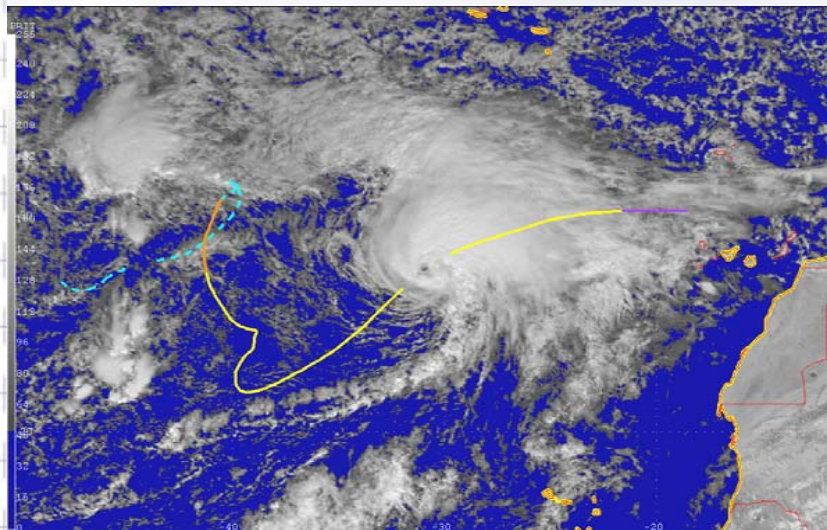


Source, NHC



Recent ET/STC/TT near Iberian Peninsula and Canary Islands:  
Best-track of Tropical storm Delta

22-28 Nov. 2005

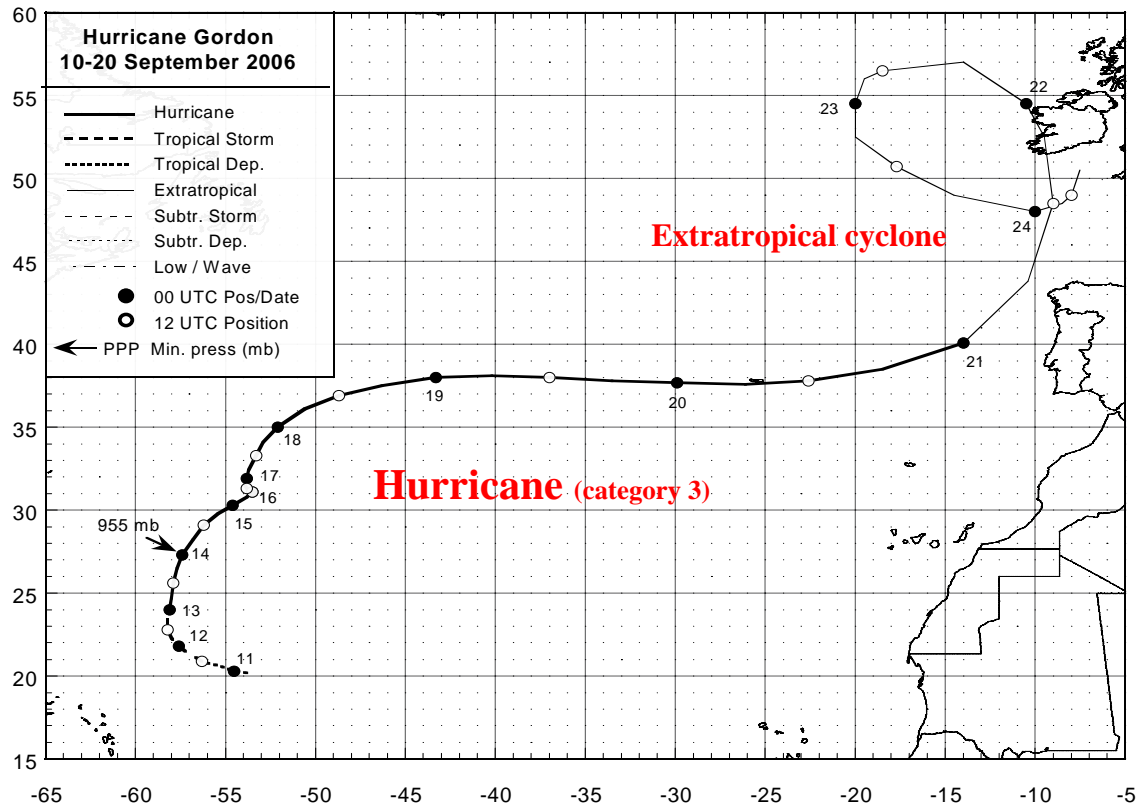


Source, NHC

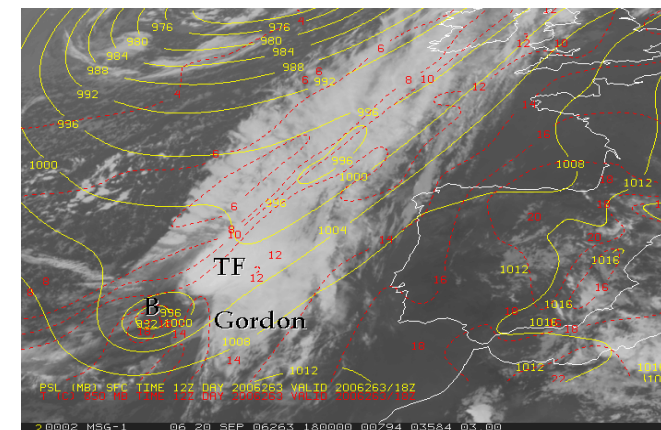
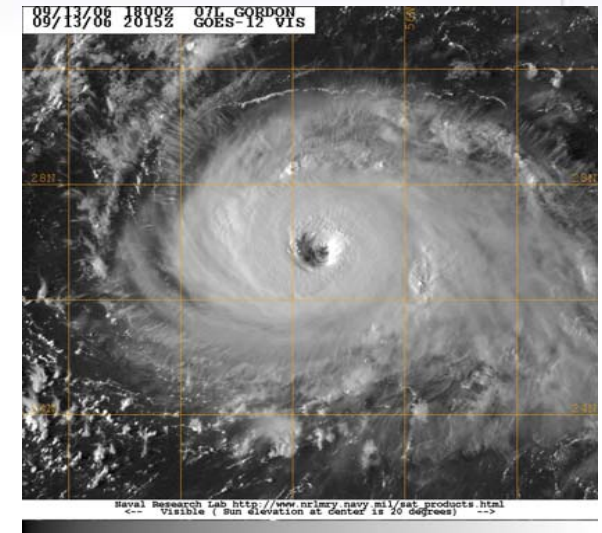


# Recent ET/STC/TT near Iberian Peninsula and Canary Islands: Best-track of hurricane Gordon

**10-20 Sept. 2006**  
**Category 3**



Source, NHC



## Some internal activities related to TC and ET

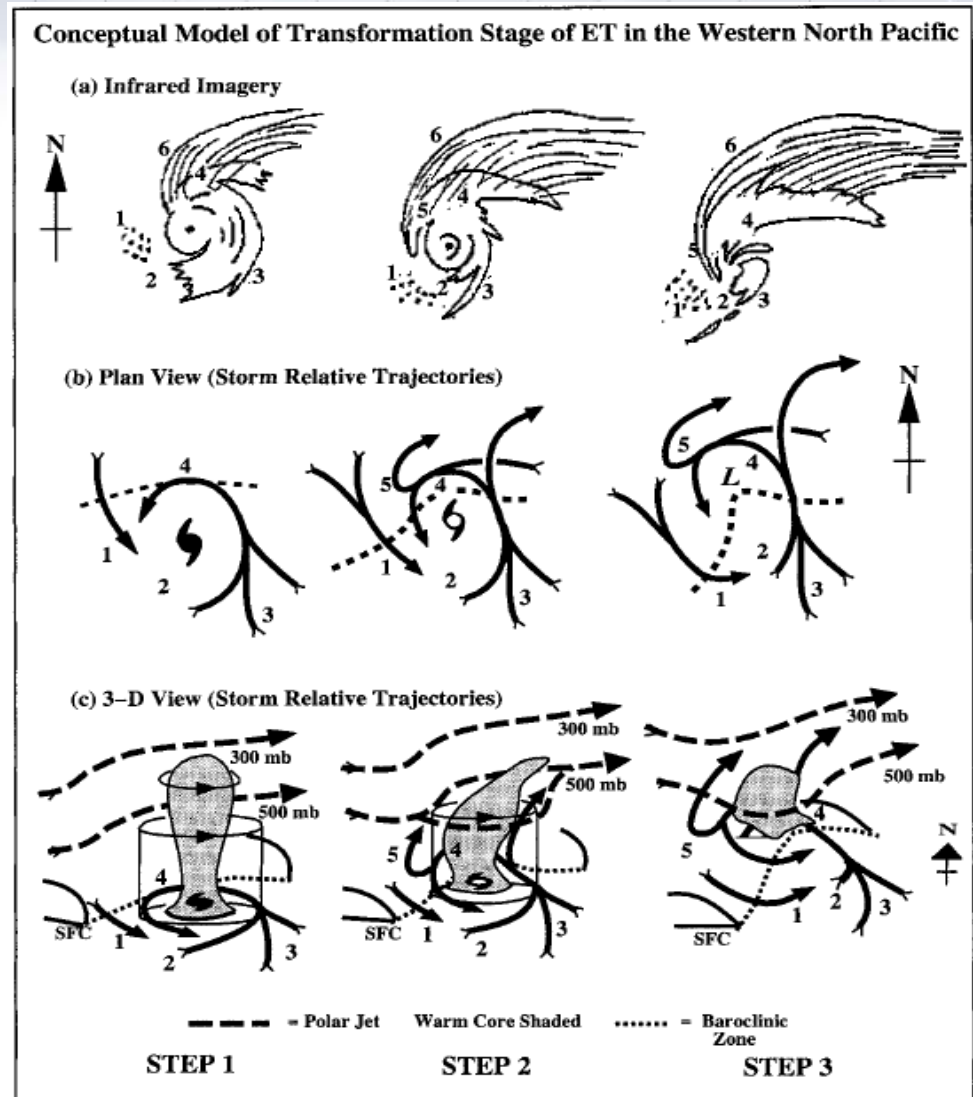
- Updating of tropical training material and bibliography
- Delta case study: numerical simulations
- Enhancing some research and operational activities related to (sub)tropical meteorology
- Cooperation with NHC
- Participation in some tropical conferences and working groups
- Revising INM/AEMet warning system

## Training material: ET and Klein conceptual

Problems to resolve in near real time:

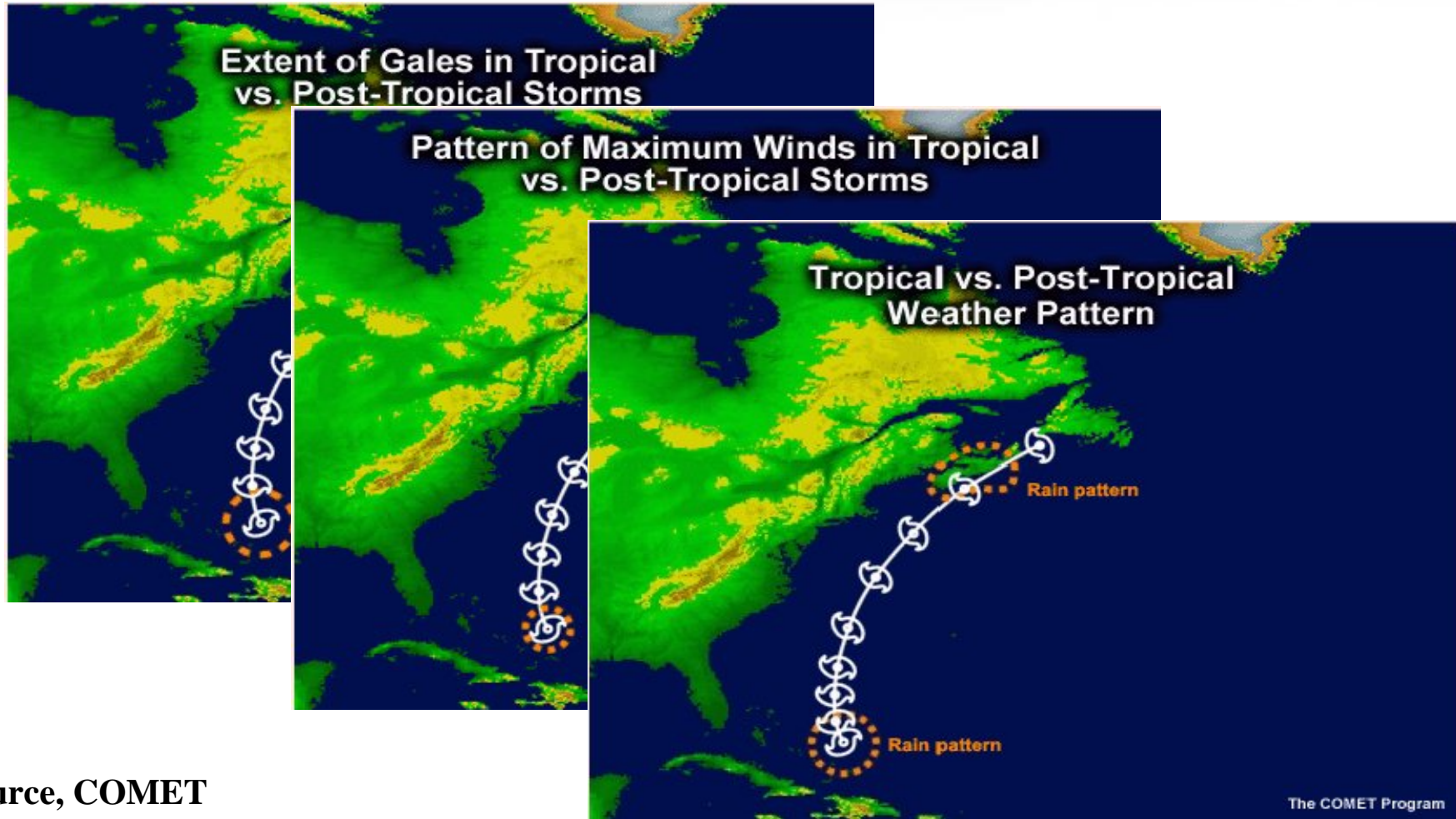
### Problems to resolve in near real time:

- Uncertainty, errors, or deviation of NWP models: probabilistic forecasts
- Where are the main precipitation region and the wind maxima zones?
- Local factors: Orographic interactions and local effects !!



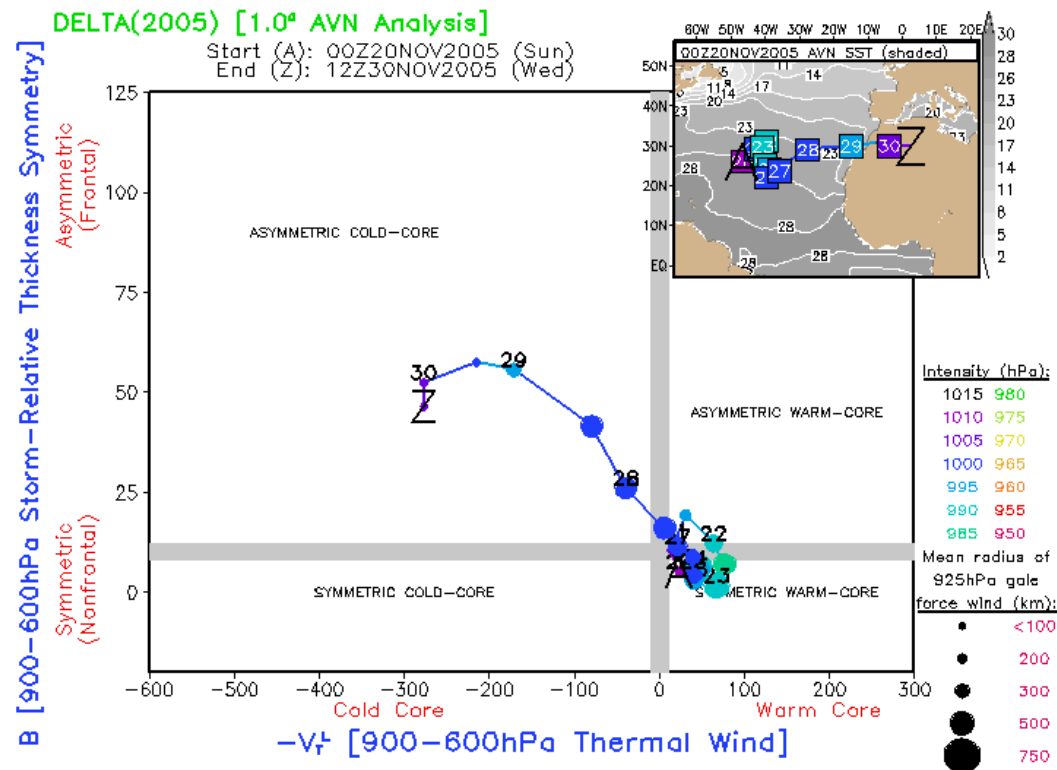


## ET properties: COMET modules



Source, COMET

## Training material and future actions: diagram phases



Source, Florida State University

<http://moe.met.fsu.edu/cyclonephase/>

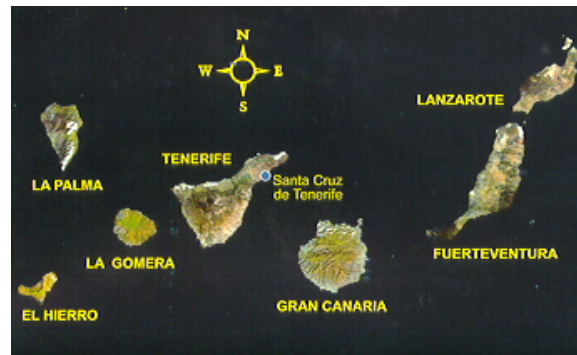
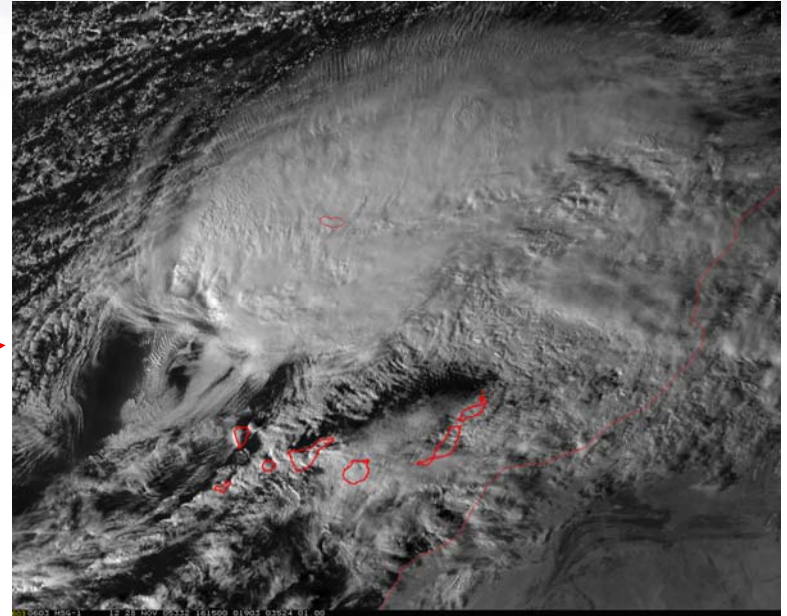
# Tropical storm DELTA

## A surprising case

### 22-28 Nov 2005

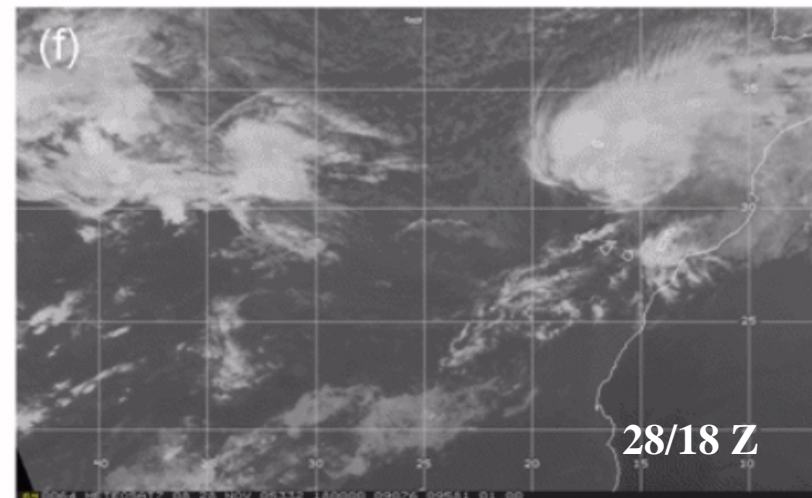
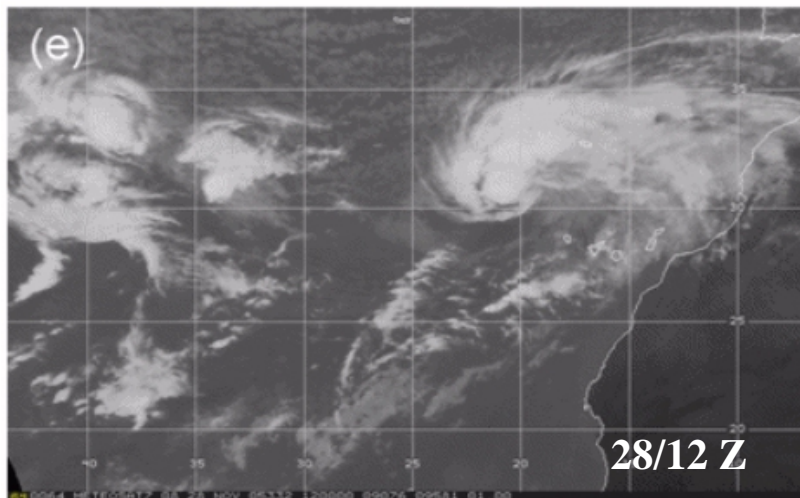
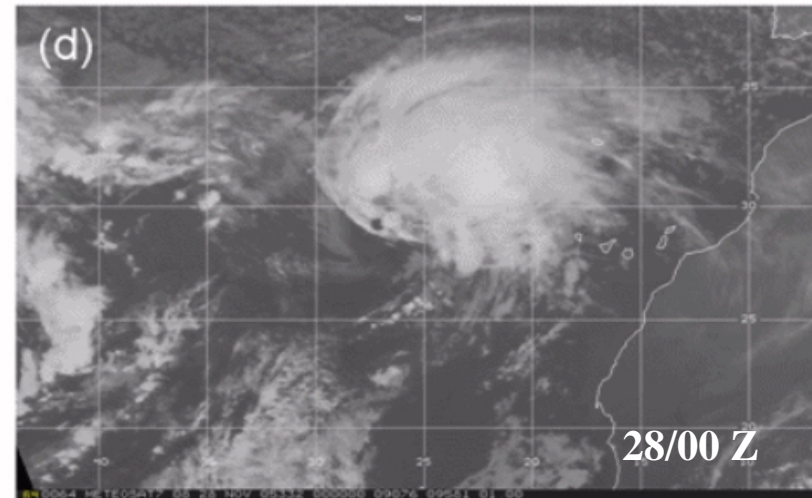
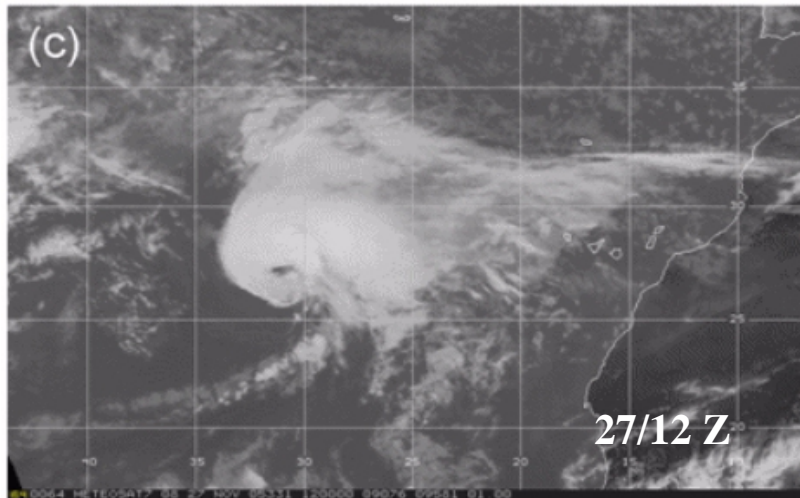
TT → TC → ET

28-29 Nov 2005

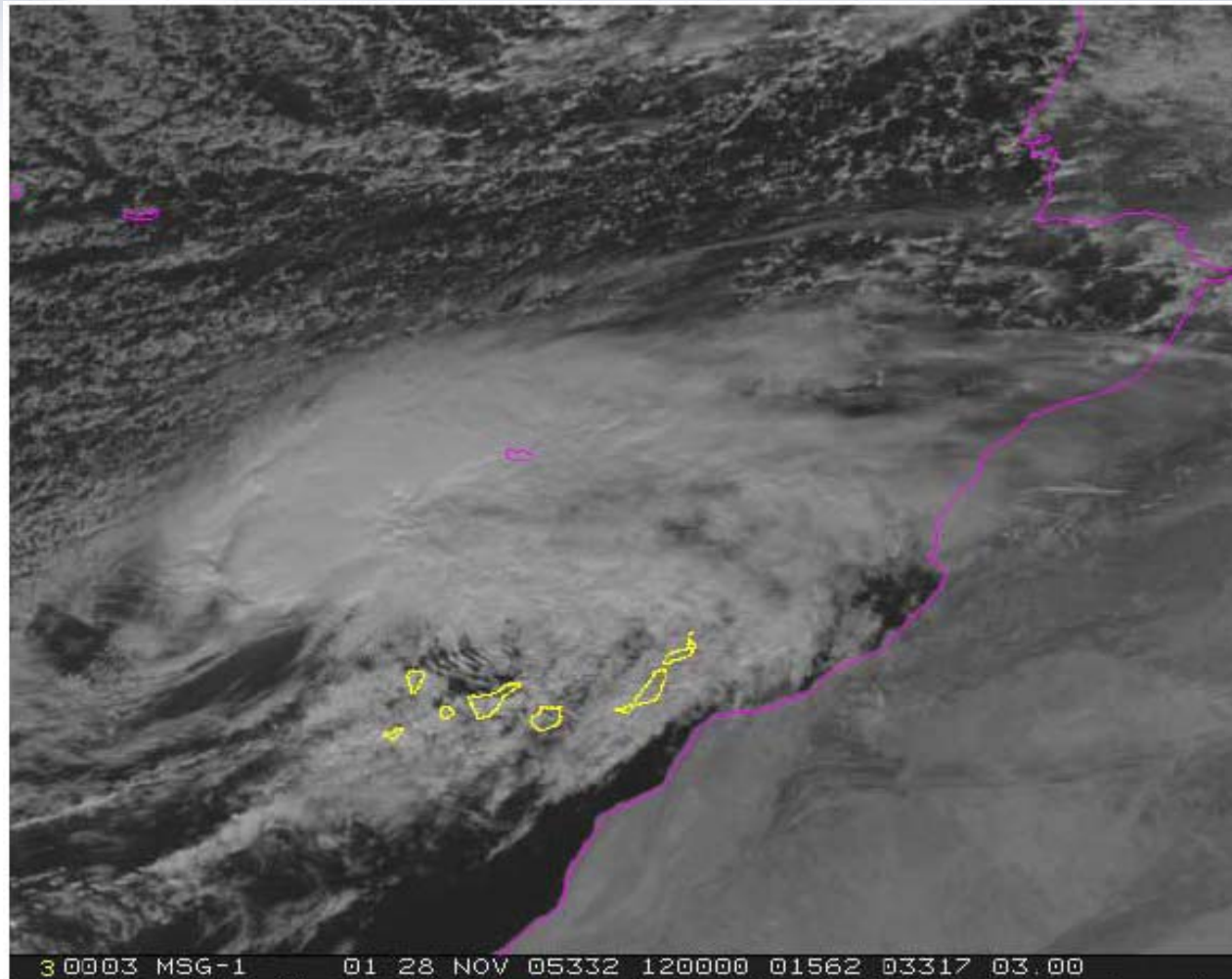




## Delta and its Extratropical Transition, ET



VISO.6 MSG1  
28 Nov. 2005 12Z



Ex Delta and reintensification: a new forecasting challenge  
Local and orographic effects

## Wind speeds and maximum gusts in Canary Islands from ex-Delta

	<u>Wind speed</u>	<u>Time</u>		<u>Gust speed</u>	<u>Time</u>
	Viento medio	Hora (UTC)		Racha Máxima	Hora (UTC)
La Palma	W 98 km/h	20:00		152 km/h	20:00
El Hierro	NW 83 km/h	18:00		136 km/h	18:20
La Gomera	SW 80 km/h	18:30		120 km/h	18:48
Tenerife Sur	W 87 km/h	21:30		134 km/h	21:38
Tenerife Norte	NW 116 km/h	21:30		147 km/h	21:30
Gran Canaria	SW 65 km/h	21:00		102 km/h	21:00
Fuerteventura	SW 74 km/h	22:30		100 km/h	22:30
Lanzarote	SW 70 km/h	24:00		91 km/h	24:00

**Topographically induced wind effects were very important!!**

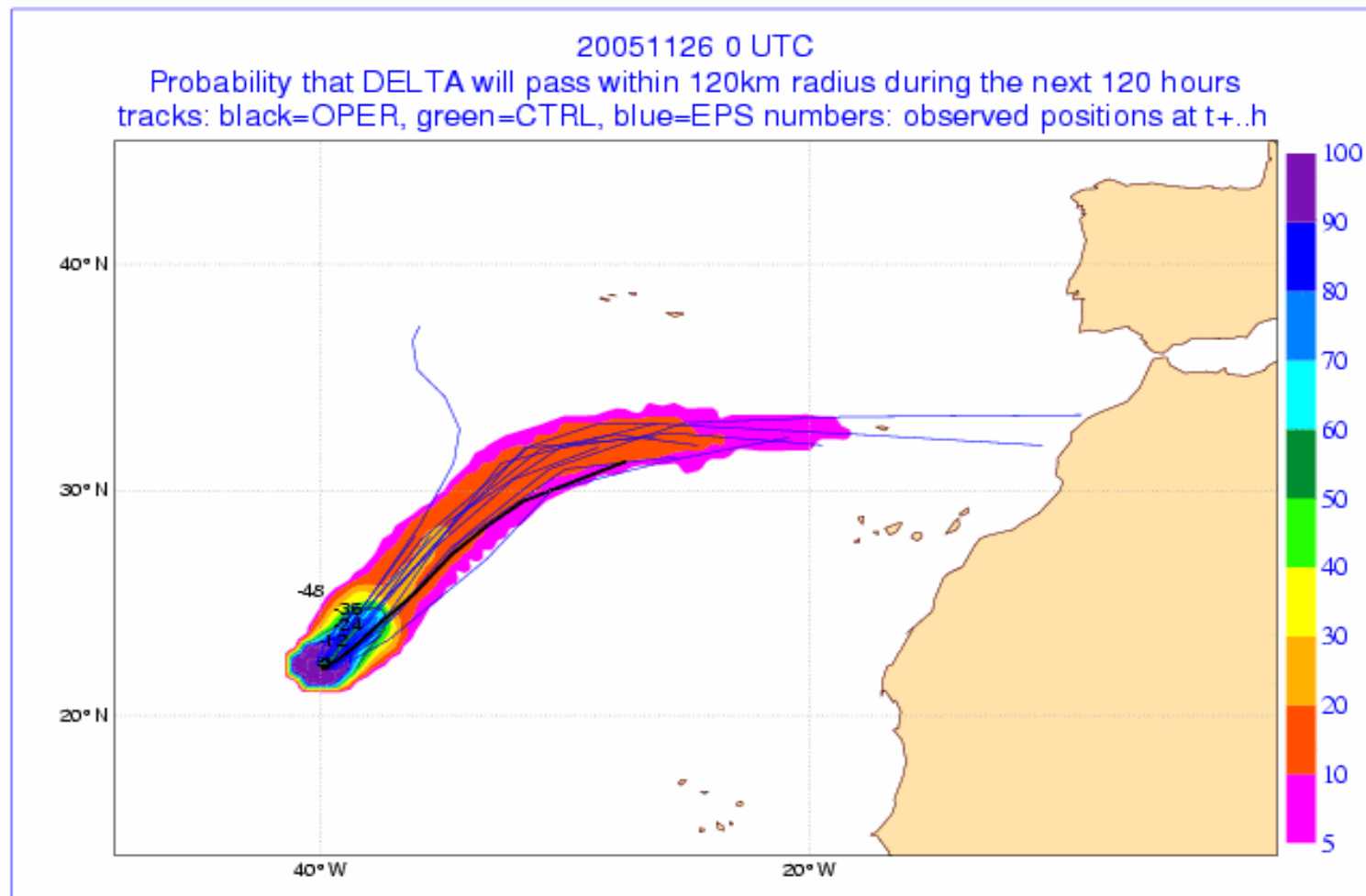
### Tropical Cyclones:

- Tropical depresión: wind speed less than 63 km/h
- Tropical storm: 63 - 118 km/h
- Hurricane: more than 118 km/h



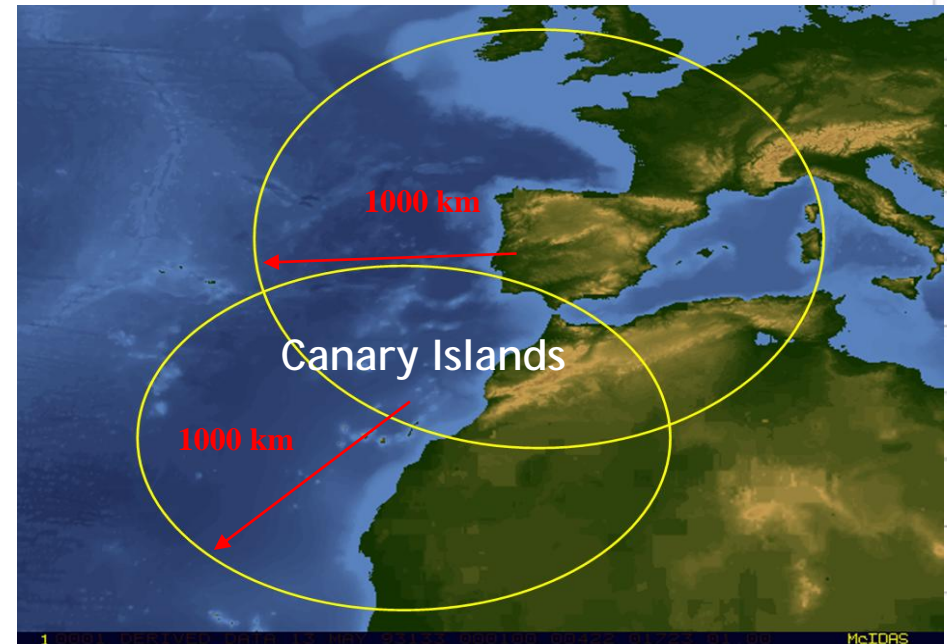
Source, NHC (image courtesy Lixion Avila)

## Trajectories and forecasting uncertainty from ECMWF EPS model Delta case



## Warning Systems & Meteoalerta for TC and ET at AEMet

- Before 2006, TC and ET were not specifically included in the INM-AEMet warning systems
- Currently, TC and ET are considered in the meteorological warning system as a “special warning event”
- But its associated wind, precipitation and sea waves are considered in the Spanish “Meteoalerta” project



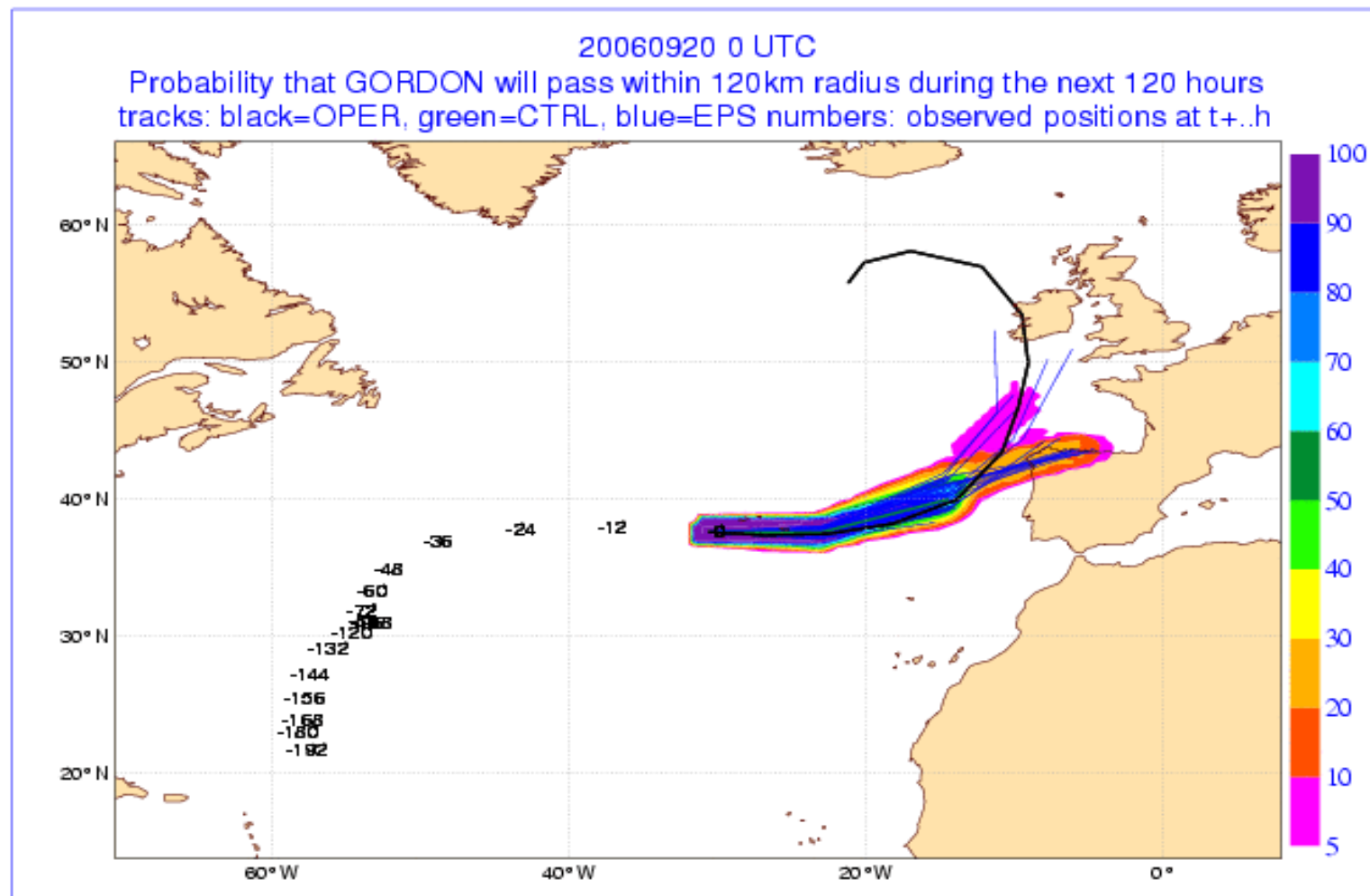


Warning Areas for TC and Meteoalerta project  
Example of Gordon Case

- Since 2006 coordination between NHC and INM-AEMet forecasting Service (National Forecasting Center) may be established when a TC is approaching to Spain: special warning messages are issued when a TC is close to Spain (distance < 1000 km)
- Winds, precipitation and sea waves associated with TC or ET are considered in the Spanish “**Meteoalerta**” project: Gordon case example

## Gordon

### Probability of tracks of ECMWF models: deterministic and EPS



## INM's special warnings for TC or ET near Spain

### "BODY" of the message:

- Meteorological phenomena and associated surface-weather conditions (wind, precipitation, waves,...)
- Affected areas
- Forecast period
- Probability of the events
- Synoptic setting: short description
- Next special warning and issue time

This information is issued by National Forecasting Center to:

- INM/AEMet web page
- Media: TV radio, etc.
- Civil Protection Authorities



MINISTERIO  
DE MEDIO AMBIENTE

SECRETARÍA GENERAL PARA LA PREVENCIÓN DE  
LA CONTAMINACIÓN Y DEL CAMBIO CLIMÁTICO

INSTITUTO NACIONAL DE METEOROLOGÍA

#### **INSTITUTO NACIONAL DE METEOROLOGÍA AVISO ESPECIAL DE FENÓMENOS ADVERSOS**

AVISO ESPECIAL NÚMERO 2/2006

EMITIDO A LAS 13:00 HORA OFICIAL DEL 18/09/2006

#### **EL INSTITUTO NACIONAL DE METEOROLOGÍA INFORMA:**

- 1.- **Fenómeno meteorológico:** Vientos muy fuertes, ocasionalmente huracanados, y temporal muy duro, con mar arbolada.
- 2.- **Ámbito geográfico:** Cuadrante noroeste peninsular y zonas marítimas al oeste de la península y Cantábrico.
- 3.- **Comienzo de la situación:** Miércoles 20 de septiembre en el mar, afectando a últimas horas del día a zonas terrestres.
- 4.- **Duración:** Hasta finales del jueves 21 de septiembre.
- 5.- **Grado de probabilidad:** Muy probable (70%-80%).
- 6.- **Descripción de la situación meteorológica:** La interacción del ciclón tropical Gordon con una depresión extratropical dará lugar a una borrasca atlántica extraordinariamente profunda al oeste de la Península, que se trasladará rápidamente hacia las Islas Británicas. Esta borrasca comenzará a afectar a las zonas marítimas situadas entre Azores y la Península durante el miércoles, originando vientos extremadamente fuertes y mar arbolada con olas de hasta 8 metros.

El jueves provocará vientos muy fuertes, ocasionalmente huracanados (superiores a 120 km/h), en el cuadrante noroeste peninsular, especialmente en Galicia, donde se podrán producir precipitaciones localmente intensas.

7.- **Notificación de actualizaciones futuras o de finalización:** El INM emitirá un nuevo Aviso Especial hoy lunes 18 de septiembre a las 23:00, y recomienda un seguimiento más detallado y actualizado de esta situación atmosférica a través de sus predicciones y avisos de fenómenos adversos. Todo ello puede consultarse en la página web: [www.inm.es](http://www.inm.es)

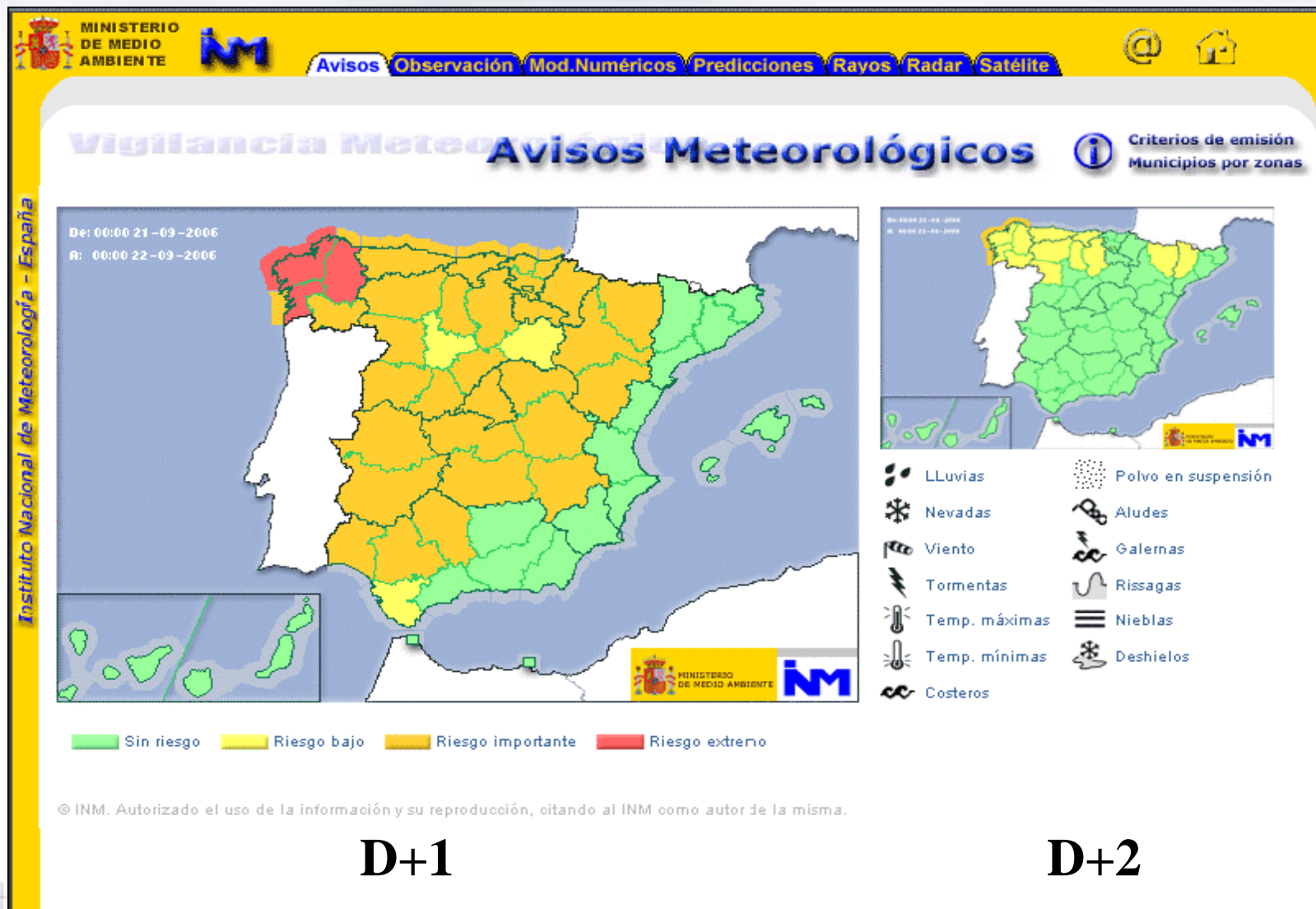
CORREO ELECTRÓNICO: CNPJT@INM.ES

LEONARDO PRIETO CASTRO, 8  
E - 28040 MADRID  
TEL. 91 581 9630  
FAX: 91 581 98748



## Meteoalerta: Gordon case

### Short range warnings



- International Workshop about subtropical cyclones and Extratropical Transitions to be hold in Madrid (8-9 May 2008)
- Increase the cooperation with NHC: training courses, lectures, ..
- To attend technical conferences of WMO AR IV
- Evaluation campaigns

# Conclusions

- Three Atlantic tropical cyclones in origin, (Delta-05 and Gordon-06) or a similar to tropical one (Vince-05), have recently affected Spain
- AEMet has enhanced its internal and external activities related to tropical and subtropical meteorology as well as forecasting tasks: technical coordination with NHC
- AEMet is increasing the relationship and cooperation with the technical committees of WMO RA (Regional Association) IV
- AEMet is promoting tropical/subtropical meteorology courses, lectures, workshops, etc.
- TC/ET and Spanish Meteoalerta/warning system: AEMet will issue special warning messages when a TC or an ET is taking place near Spain (distance < 1000 km). Surface weather conditions and forecasts are included in our Meteoalerta system

**Remarks.** Tropical and subtropical meteorology in Spain is not just only associated with TC and ET: Spain is affected by other types of tropical/subtropical disturbances



**Thanks very much for  
your attention!!**