DETECTION OF MEDITERRANEAN HURRICANES:

a challenging task aimed at assessing the risk in the present and future climate

M.Tous, R.Romero and C.Ramis

Universitat de les Illes Balears

We come from…

Universitat de les Illes Balears

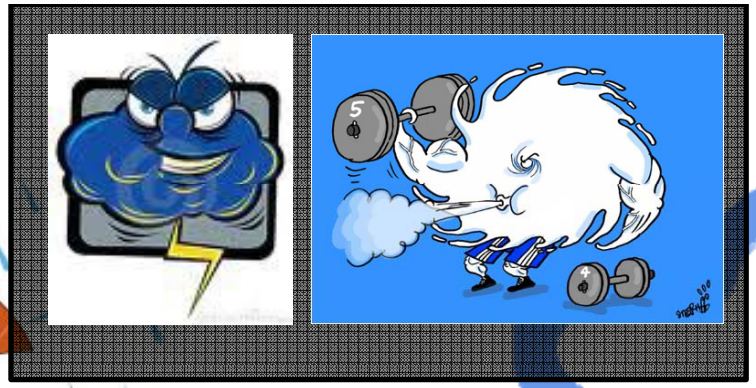
We

Universitat de les Illes Balears

We

Universitat de les Illes Balears

HEAVY RAIN



HAIL

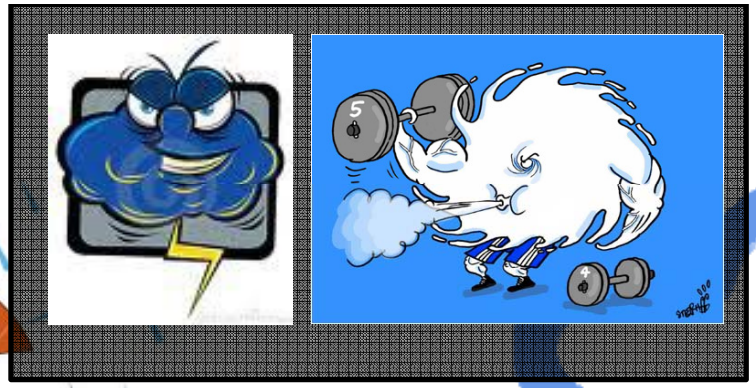
STRONG WINDS

TORNADOES

STRON

ADOES

HEAVY RAIN



HAIL

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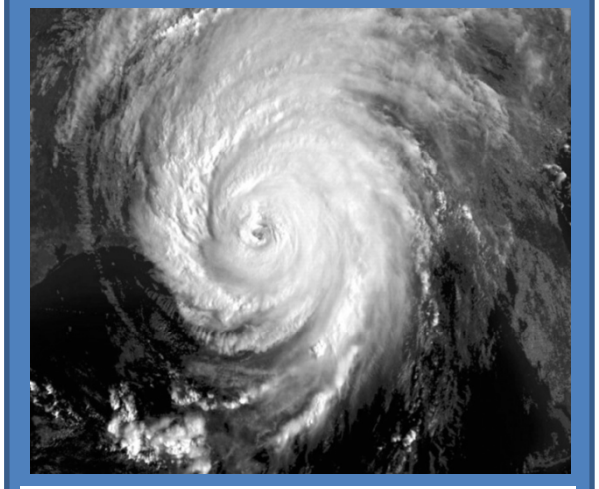
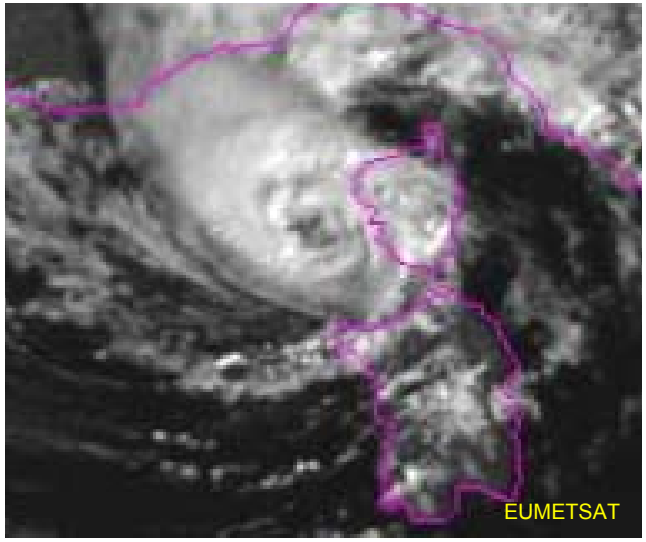
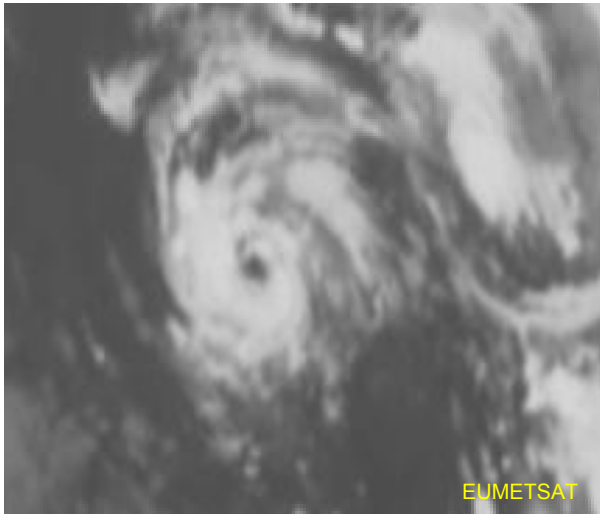
TORNADOES



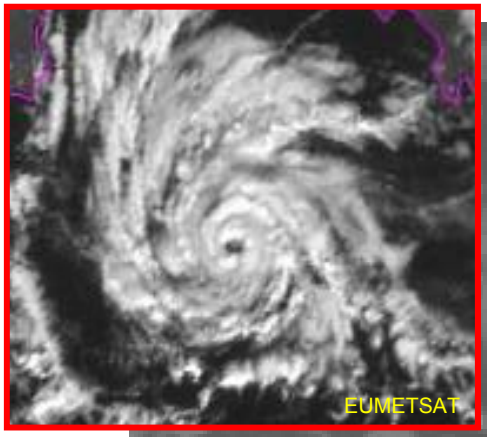
(VIS) Hurricane Katrina 2005



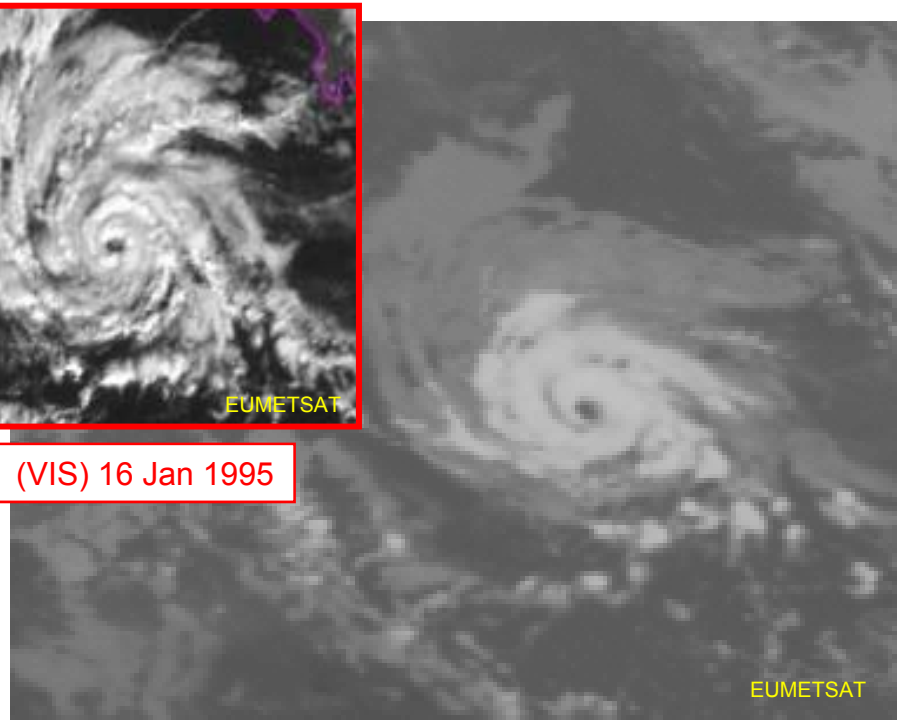
29 September 1983



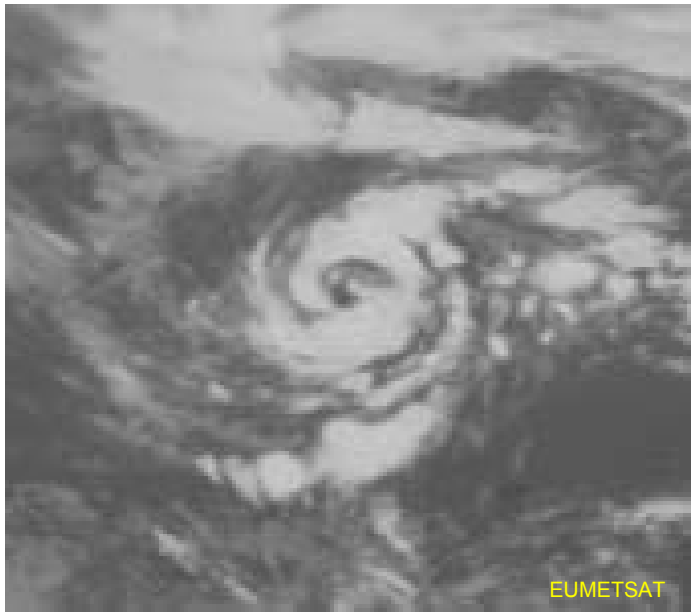
9 October 1996



(VIS) 16 Jan 1995



16 January 1995

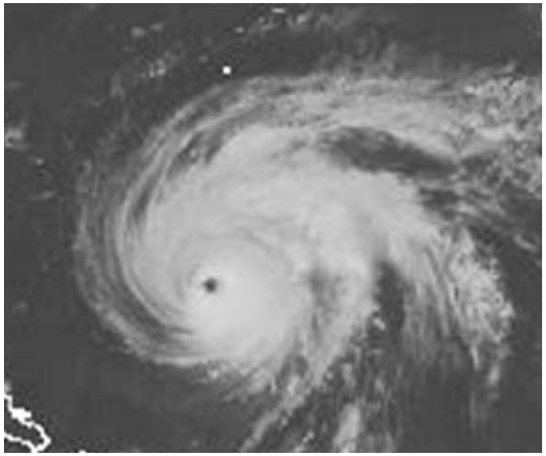


10 December 1996

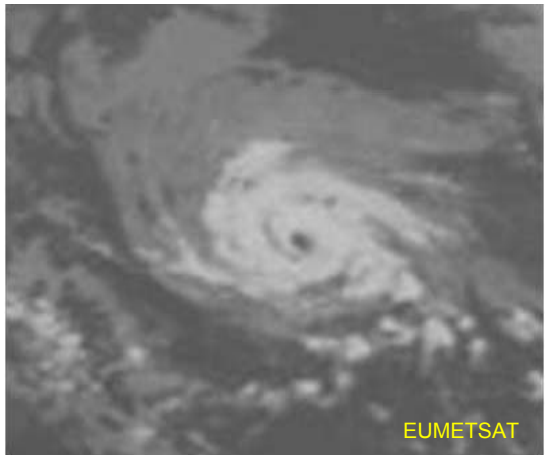
What are MEDICANES?

MEDICANES are tropical-like cyclones which develop over the Mediterranean Sea, sometimes attaining hurricane intensity.

MEDICANES operate on the thermodynamical disequilibrium between the sea and the atmosphere and in this respect, as well in their visual appearance in satellite images, are much tropical cyclones.



Hurricane Bill. Aug 2009

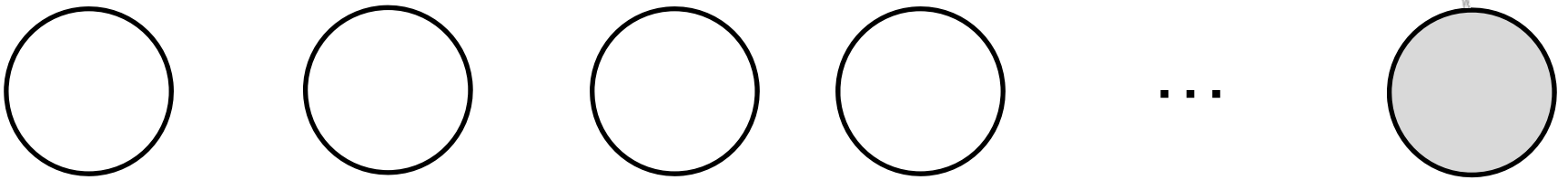


Medicane. Jan 1995

MEDICANES: Meteorological Environments, Numerical Predictability and Risk Assessment in the Present and Future Climate (MEC, CGL2008-01271/CLI)

OBJECTIVE

TO ASSESS THE MEDICANE RISK UNDER THE PRESENT AND FUTURE CLIMATE CONDITIONS.



Analysis of GCM-produced environments
+
Nested mesoscale simulations on medicane-prone days

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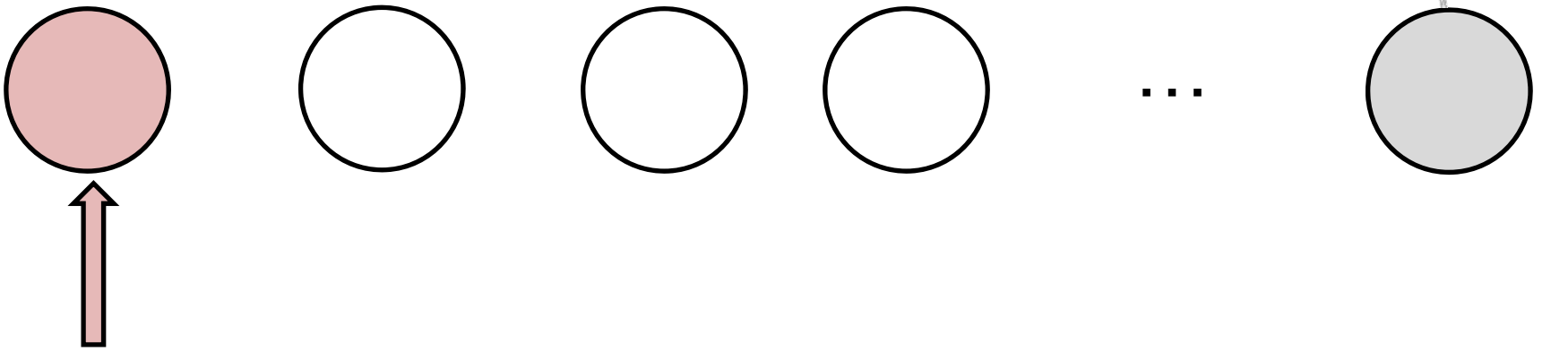


TO CREATE A DATABASE OF EVENTS.

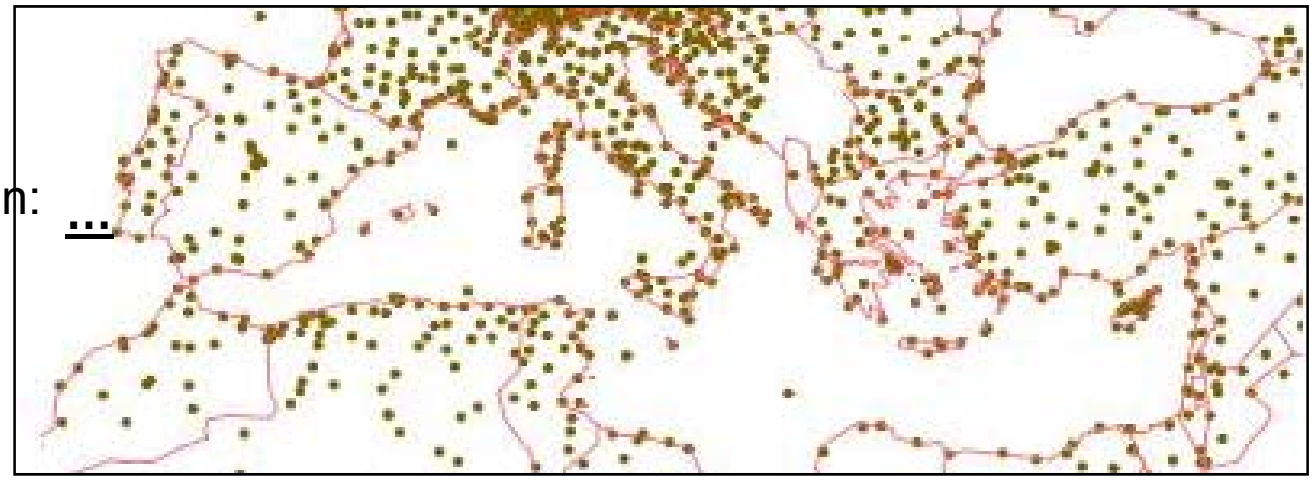
TO CREATE A DATABASE OF EVENTS

1st Option: **MEDEX Project**: AUTOMATED DATABASE

ERA-40 ⟶ 1.125º ≈ 110 km ✗ It is not enough

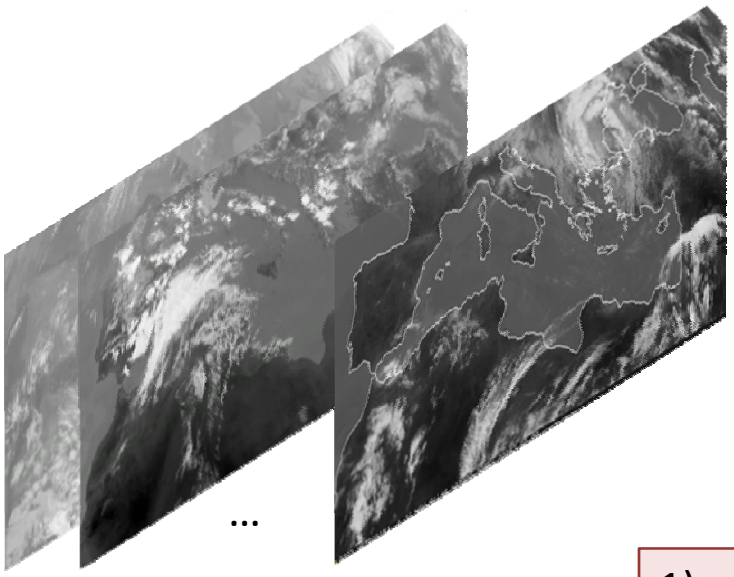
2nd Option: **OBSERVATIONAL DATABASE** ✗ We have not got data over the Mediterranean Sea

3rd Option: **...**



TO CREATE A DATABASE OF EVENTS

Our database



…

IR satellite images
(1982-2005)

Medicane criteria

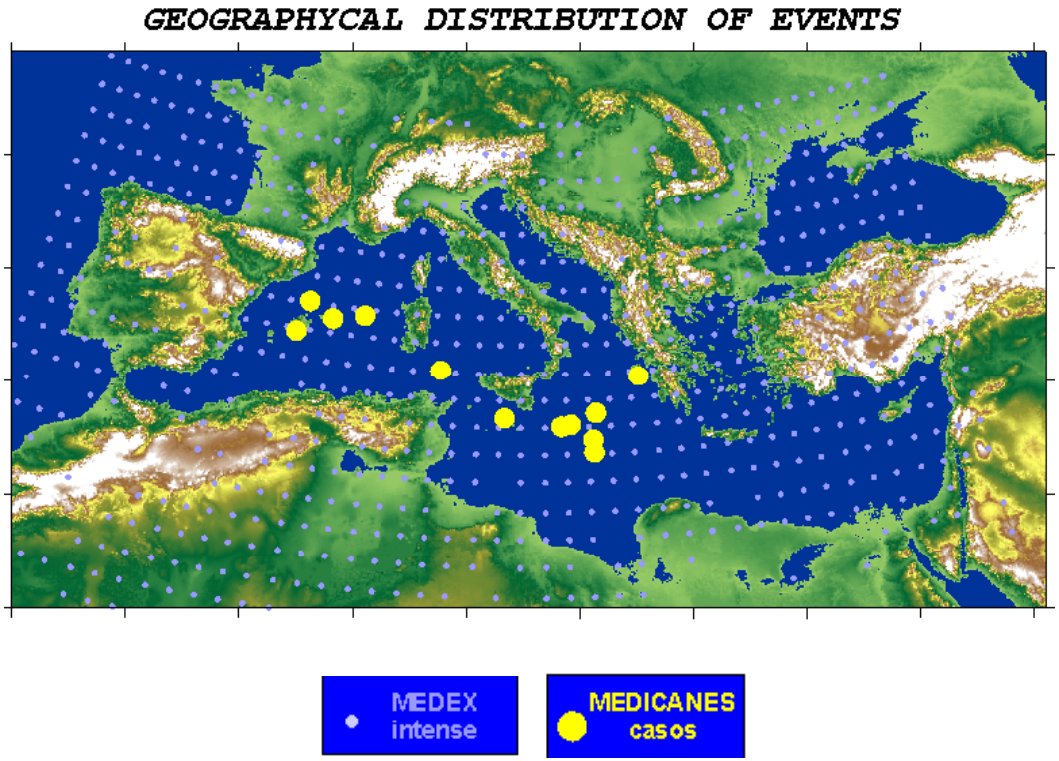
1) Continuous cloud cover
2) Cyclone eye clarity
3) Symmetric shape
4) Ø < 300 km
5) Lifetime > 6 h

12 events

TO CREATE A DATABASE OF EVENTS

Our database

Month (#medicanes)	
March (1)	September (2)
April (0)	October (1)
May (1)	November (1)
June (0)	December (4)
July (0)	January (2)
August (0)	February (0)



MEDEX Project::MEDiterranean EXperiment on
"Cyclones that produce high impact weather in the Mediterranean"

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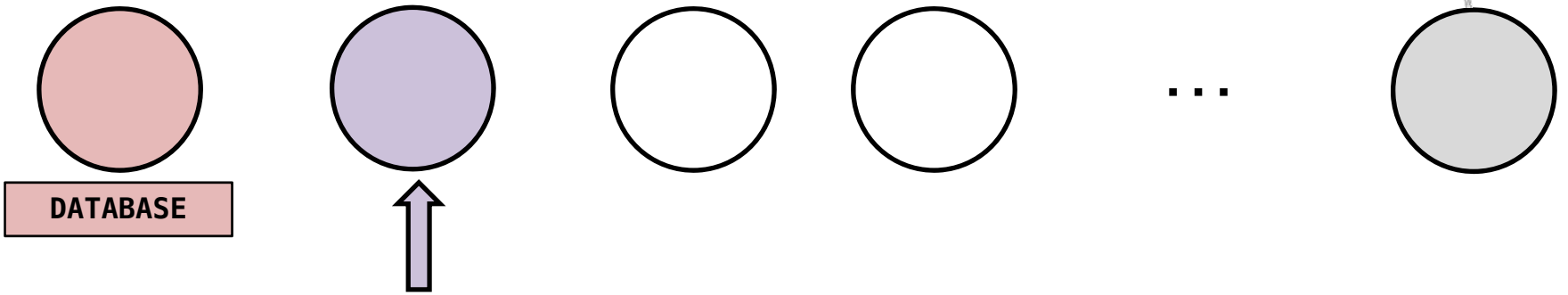
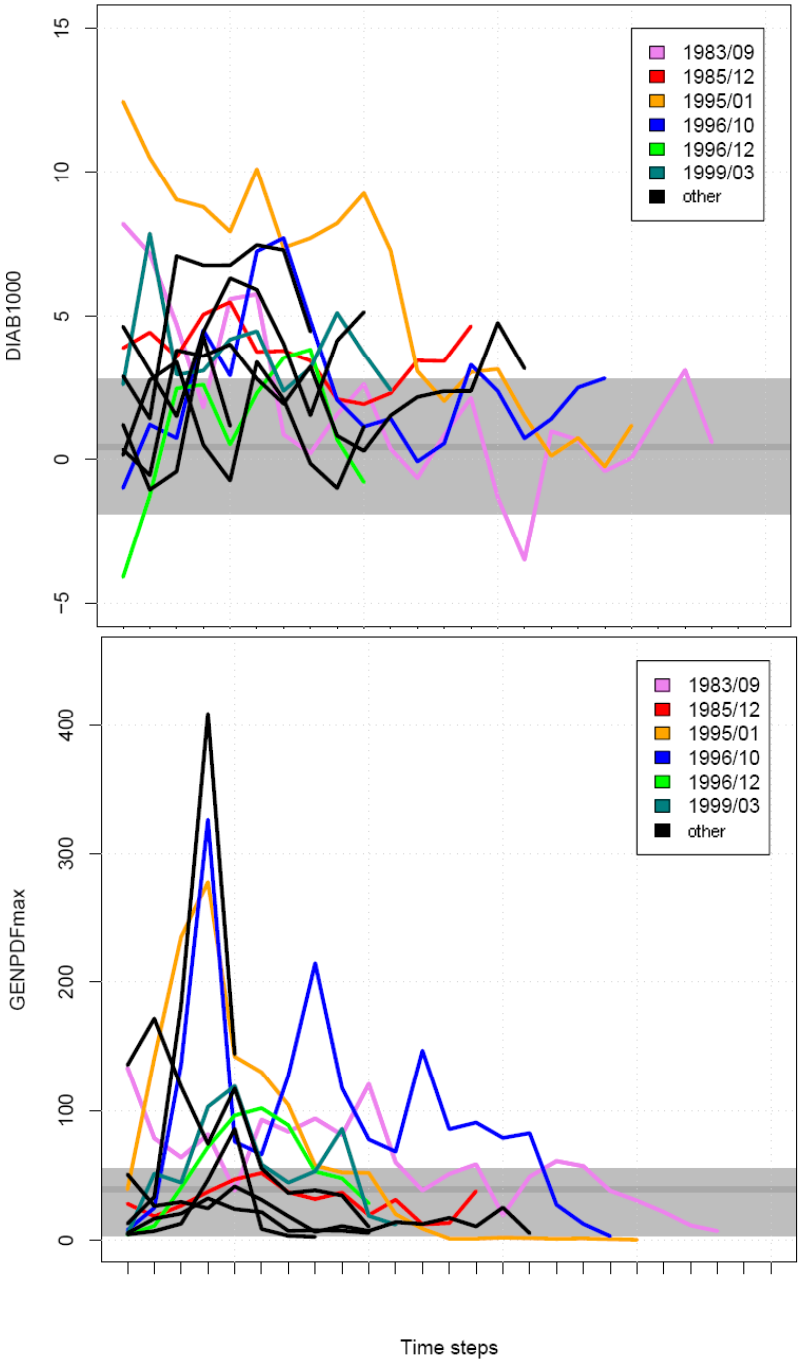
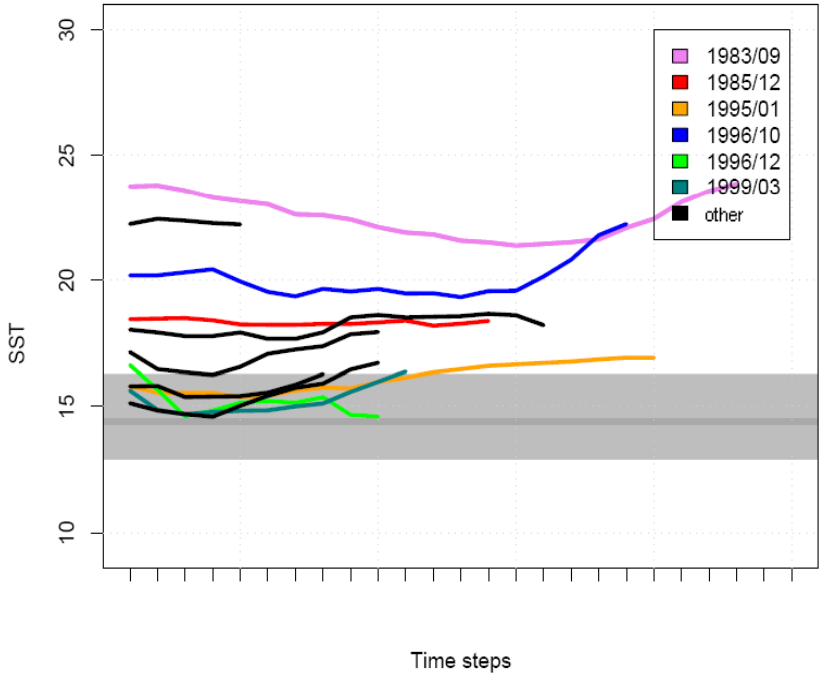


TO CHARACTERIZE METEOROLOGICAL ENVIRONMENTS FOR MEDICANE DEVELOPMENT AND MAINTENANCE.

TO CHARACTERIZE METEOROLOGICAL ENVIRONMENTS.





$$\mathbf{GENPDF} = \left|10^5 \eta\right|^{3/2} \left(\frac{H}{50}\right)^3 \left(\frac{V_{max}}{70}\right)^3 \left(1 + 0.1\, V_{shear}\right)^{-2}$$

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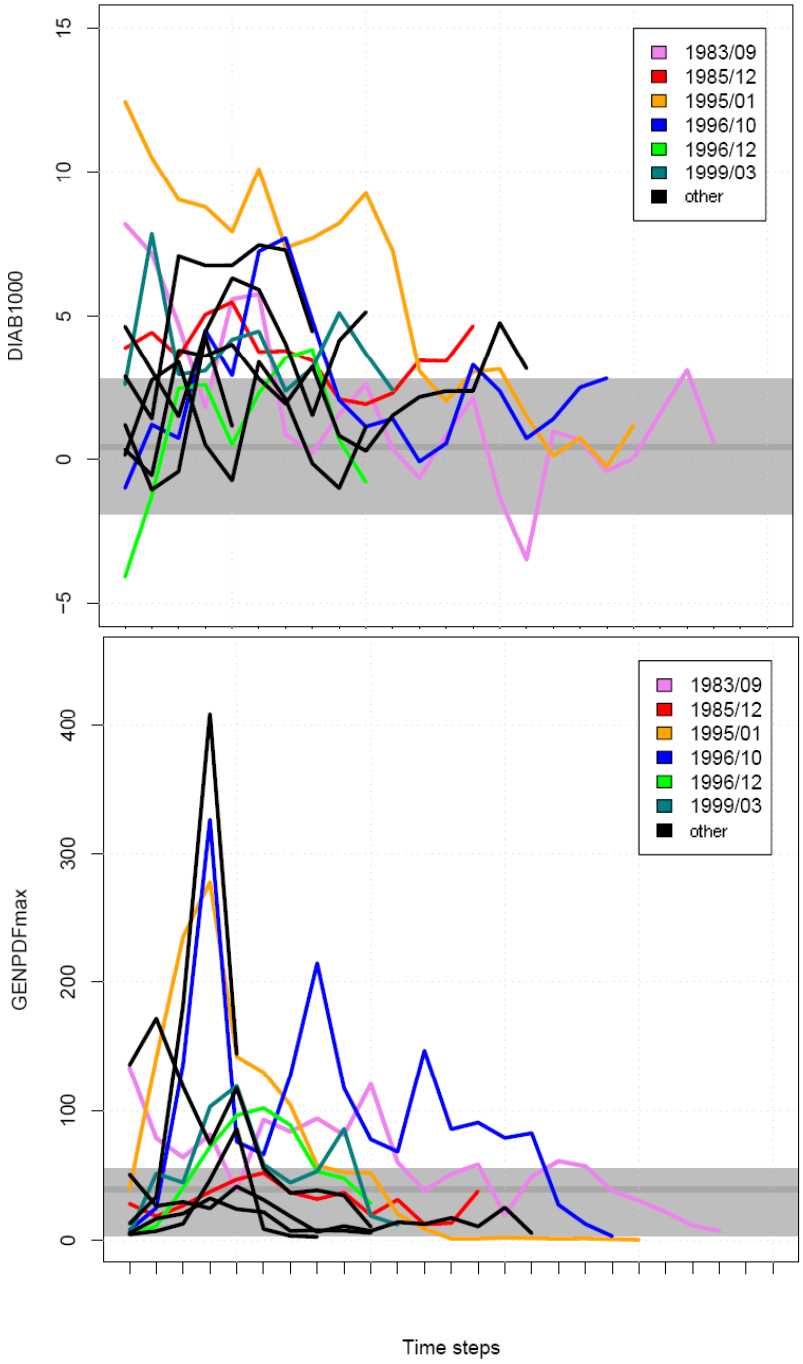
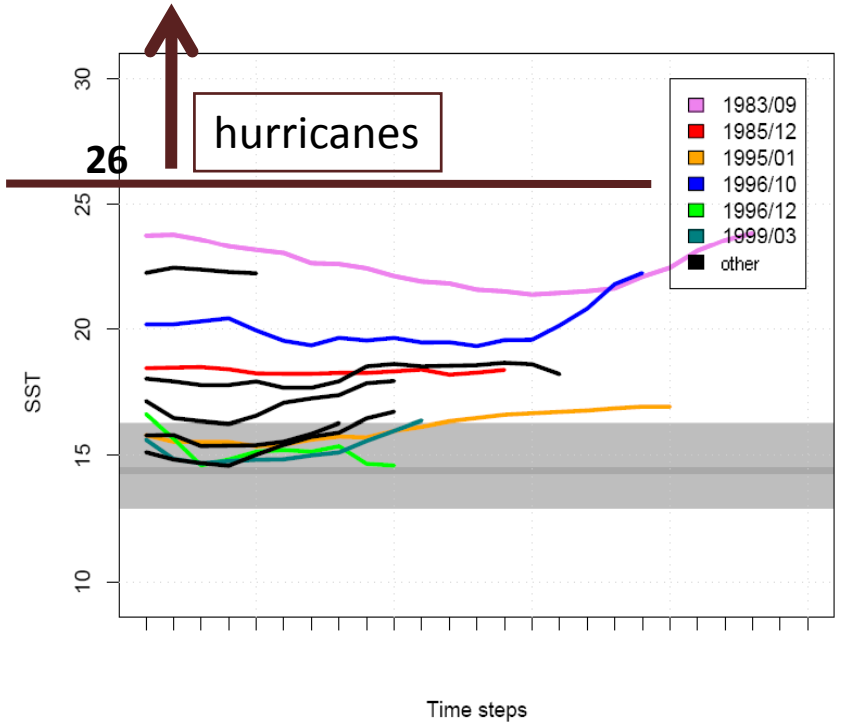


TO CHARACTERIZE METEOROLOGICAL ENVIRONMENTS.



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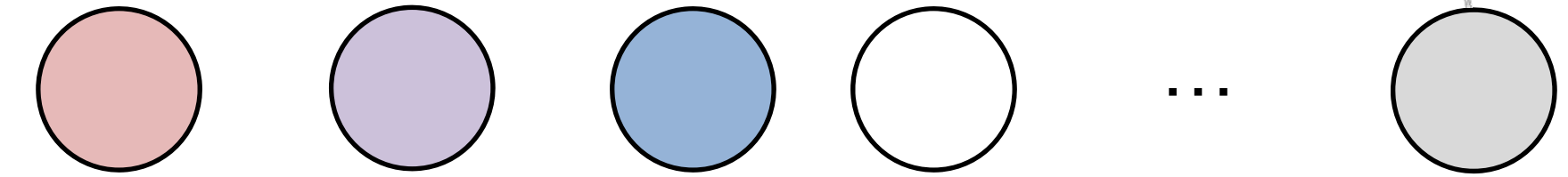


DATABASE

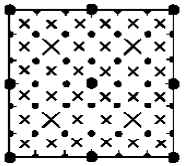
MET. ENVIRONMENTS

TO EXAMINE NUMERICAL PREDICTABILITY OF MEDICANES.

1st

MESOSCALE MODEL SIMULATION

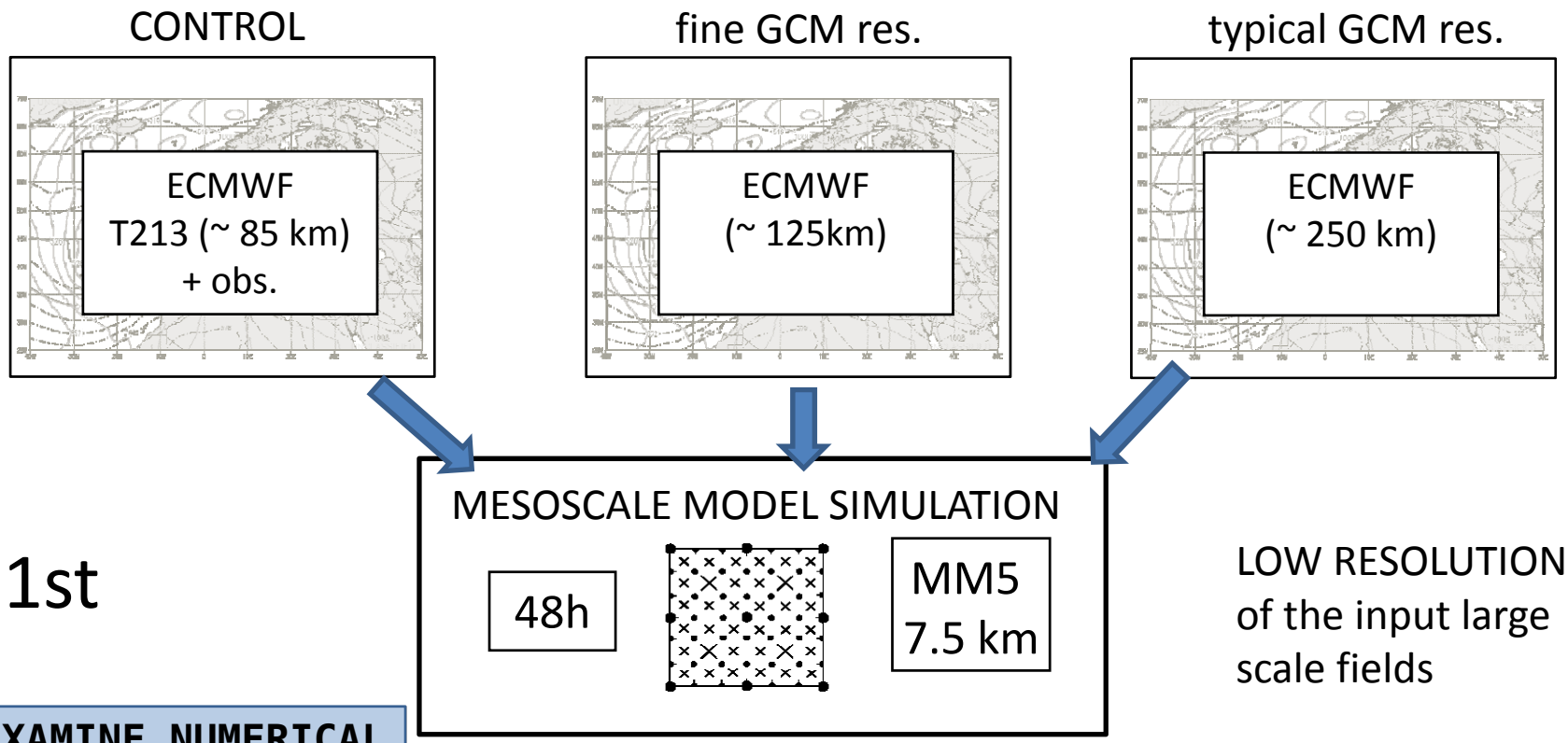
48h



MM5
7.5 km

TO EXAMINE NUMERICAL PREDICTABILITY OF MEDICANES.

2nd

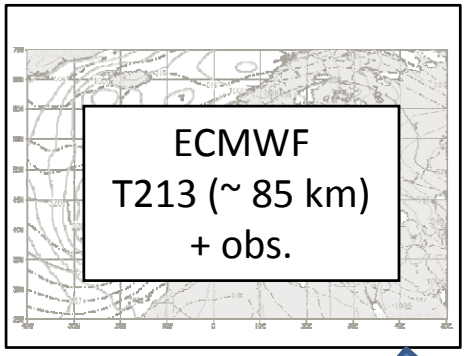


1st

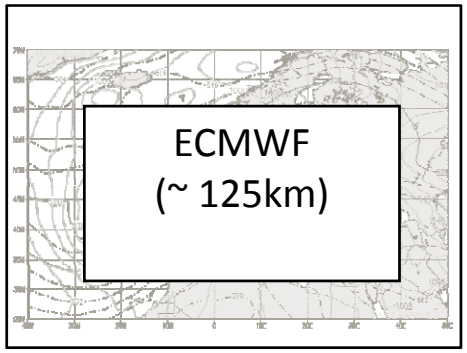
TO EXAMINE NUMERICAL PREDICTABILITY OF MEDICANES.

2nd

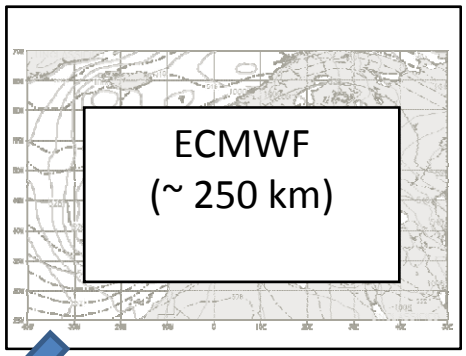
CONTROL



fine GCM res.

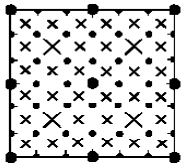


typical GCM res.



MESOSCALE MODEL SIMULATION

48h



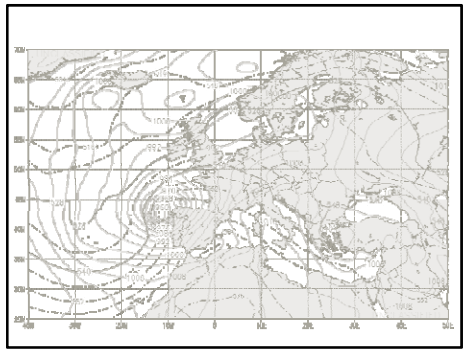
MM5
7.5 km

1st

LOW RESOLUTION
of the input large
scale fields

TO EXAMINE NUMERICAL PREDICTABILITY OF MEDICANES.

IFS - ECMWF

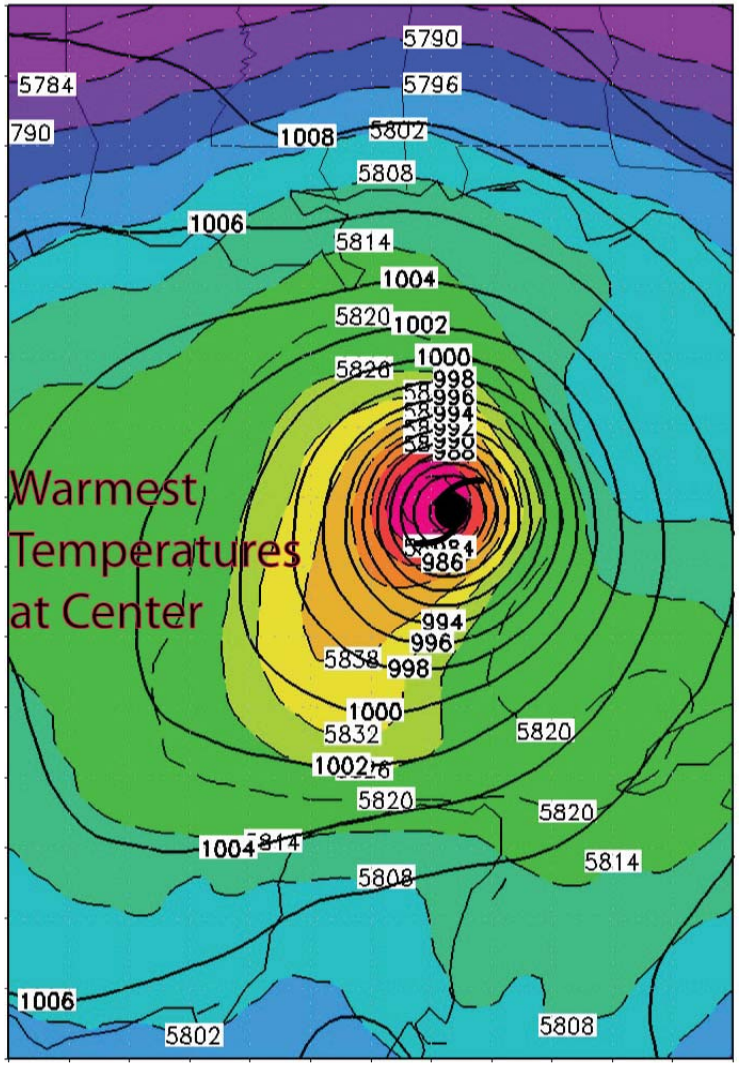


2nd

HIGH RESOLUTION
FORECAST

ECMWF
Model: IFS cycle 36
(Integrated Forecasting System)
Resolution: T1279 (~15 km)
Interpolated analysis from ERA-40

Katrina, Warm Core Low



Quasi-symmetric intense low-pressure centres at surface with an isolated warm-core structure aloft.

Sfc Isobars (solid, mb)
Sfc-500 mb Mean Temp (shaded)
12 UTC 28 Aug 2005 http://tornado.sfsu.edu/

MEDICANE January 1995

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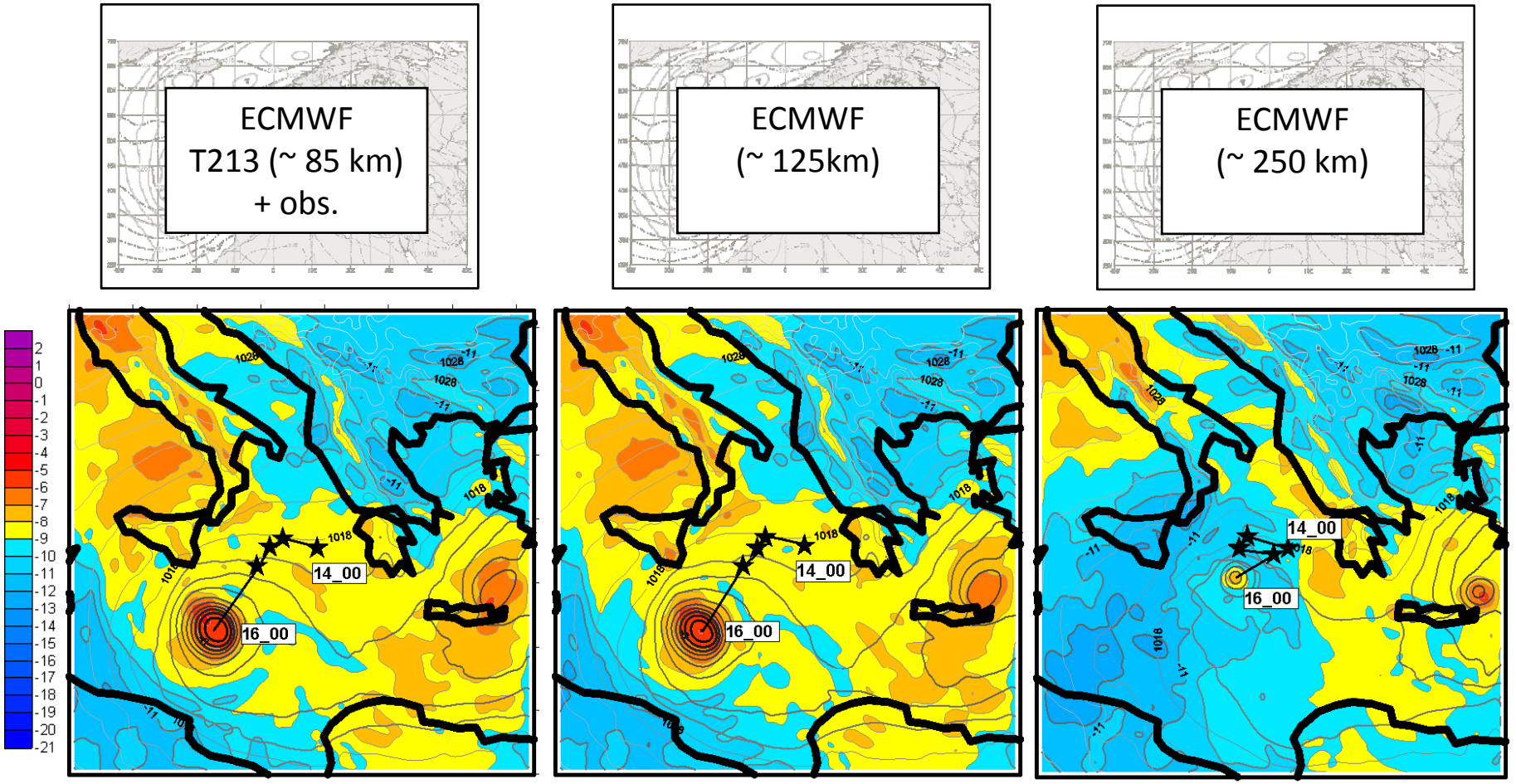
Temp.(ºC) 700 hPa



CONTROL

85 km + obs.

Fine GCM res.

125 km

Typical GCM res.

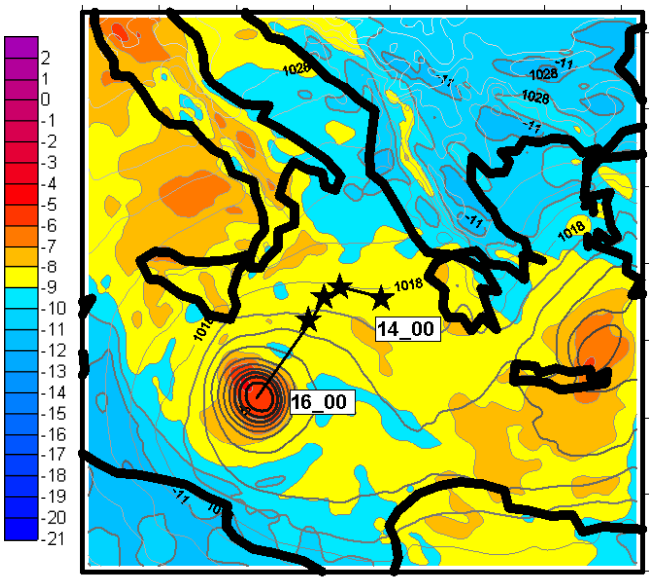
250 km

MM5

7.5 km

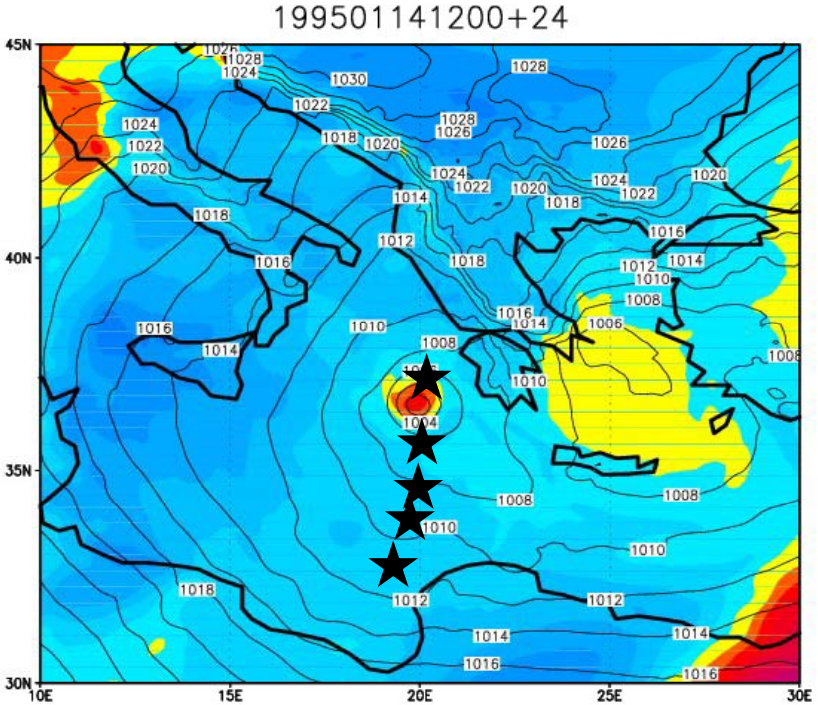
CONTROL

85 km + obs.



IFS - ECMWF

T1279 (~15 km)



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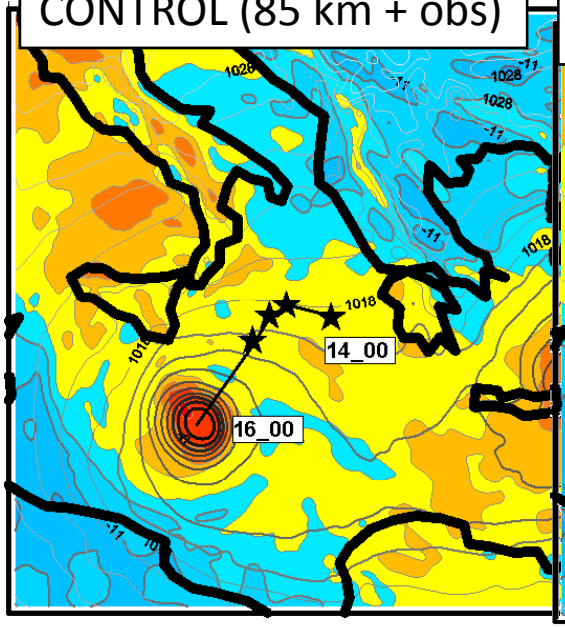
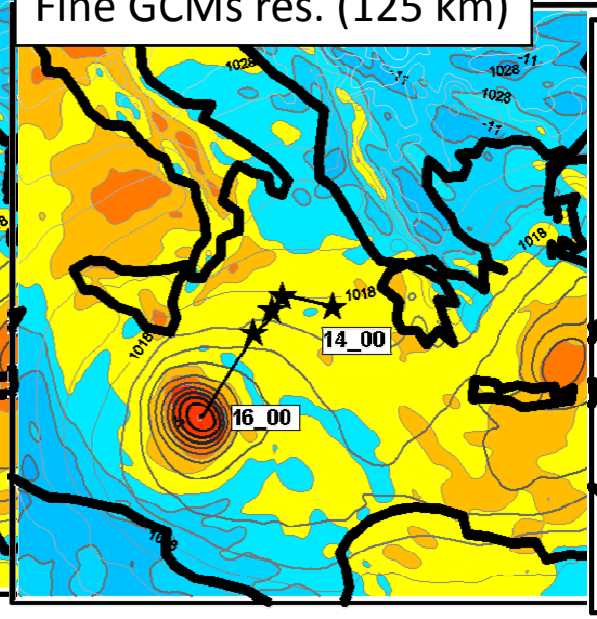
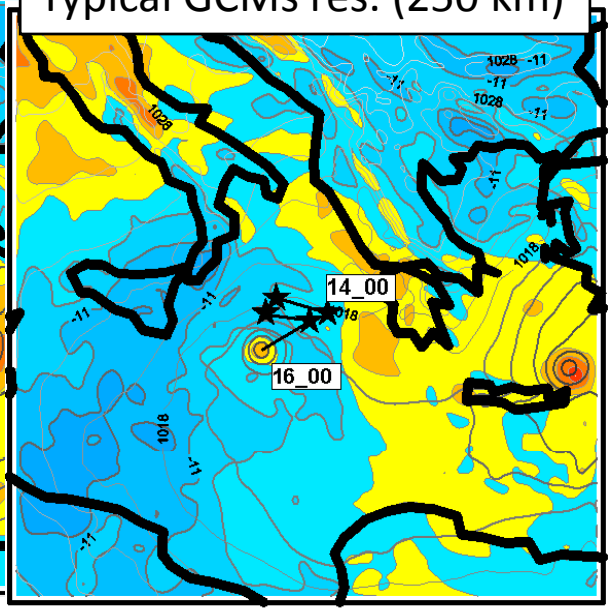


Fine GCMs res. (125 km)

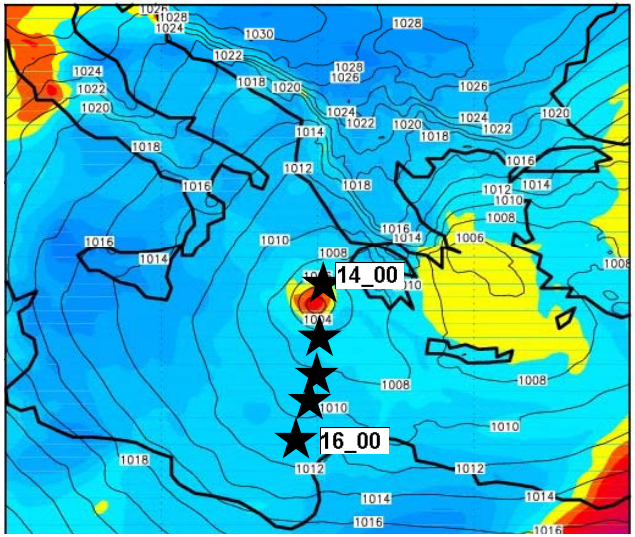


Typical GCMs res. (250 km)

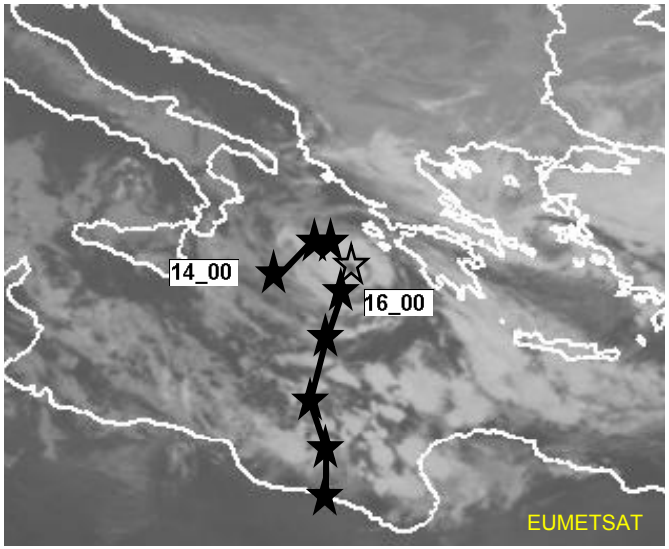


HIGH RESOLUTION FORECAST (15 km)

199501141200+24



IR SATELLITE IMAGE



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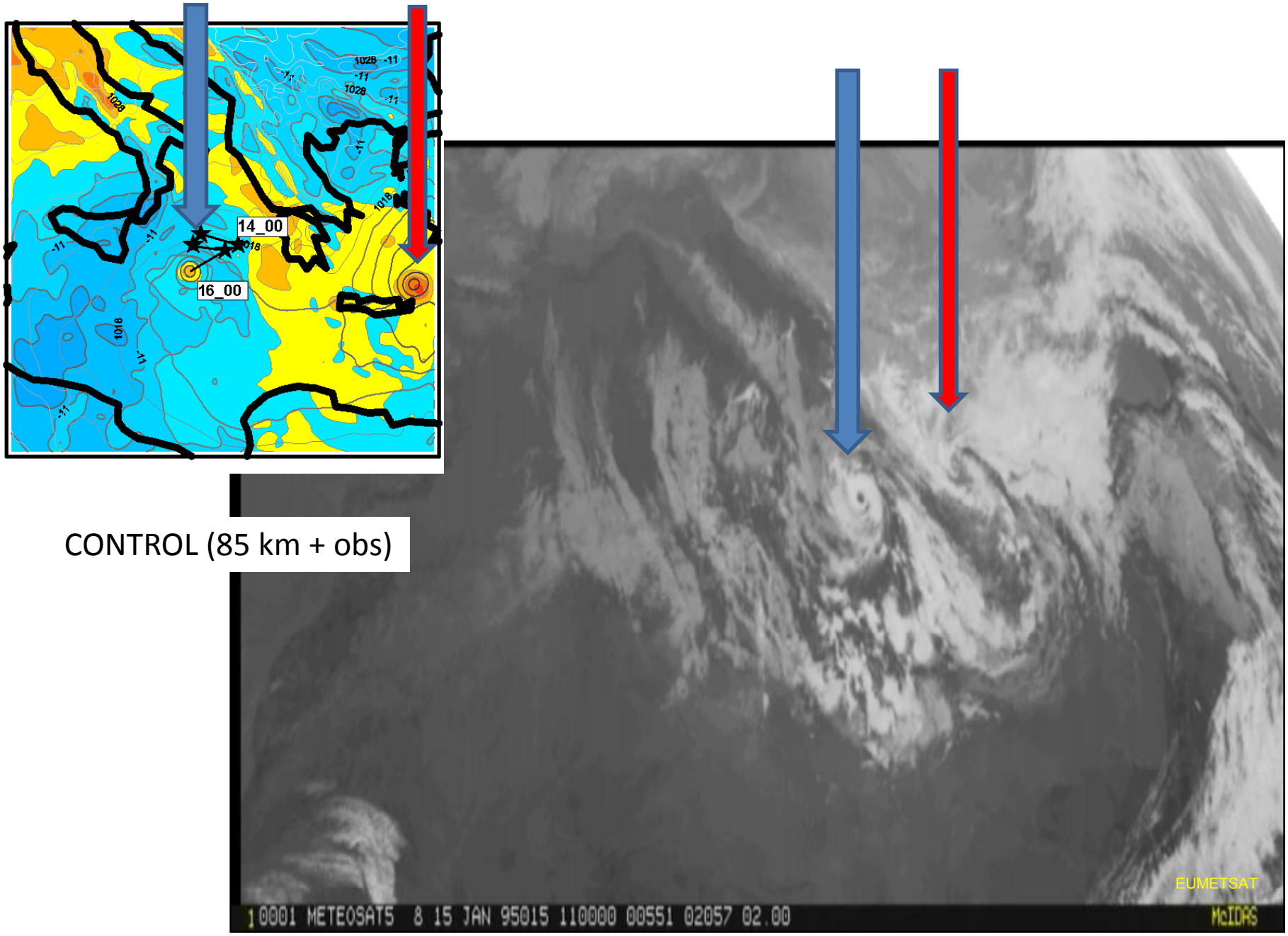

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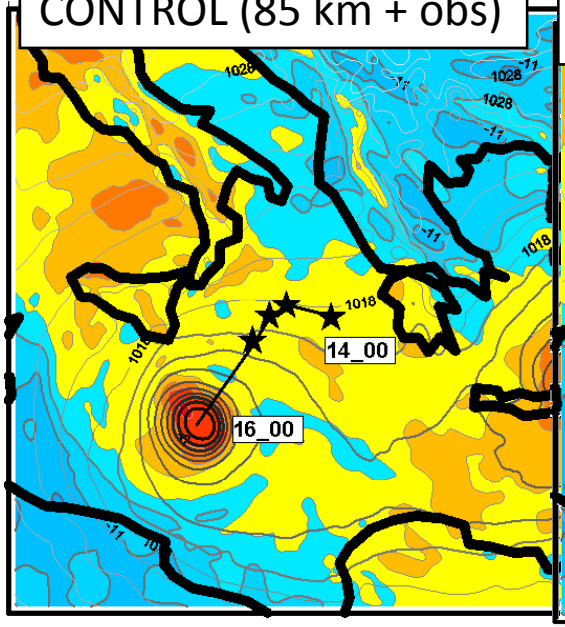
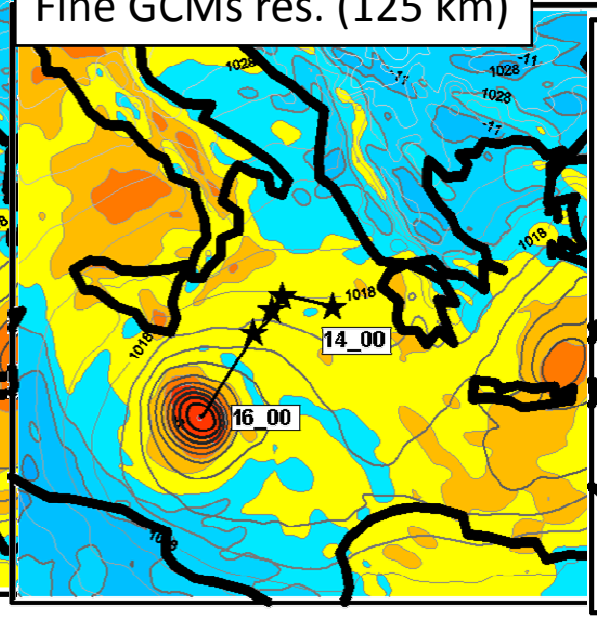
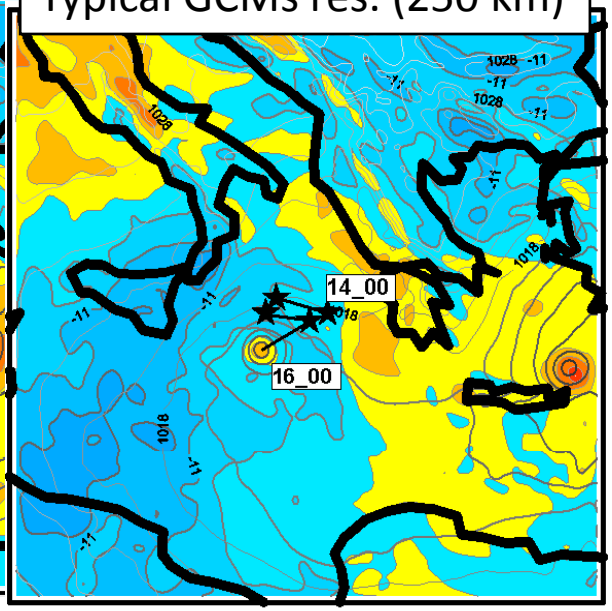


Fine GCMs res. (125 km)

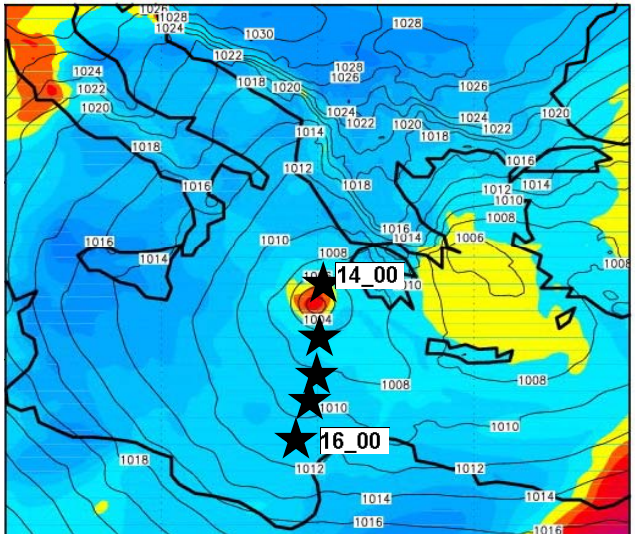


Typical GCMs res. (250 km)

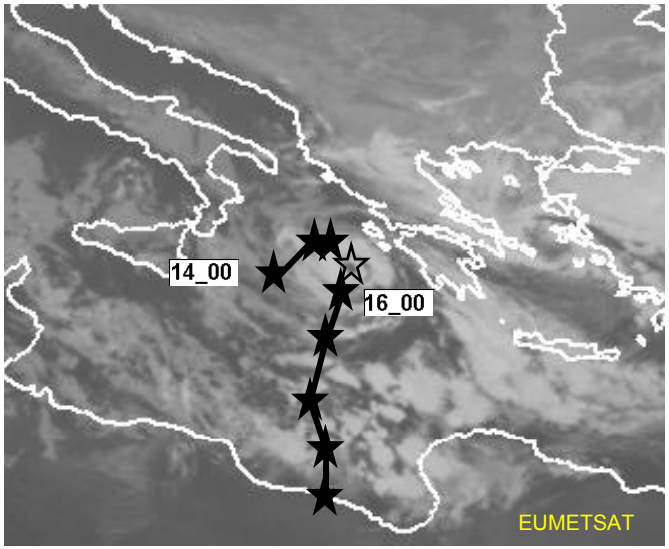


HIGH RESOLUTION FORECAST (15 km)

199501141200+24



IR SATELLITE IMAGE



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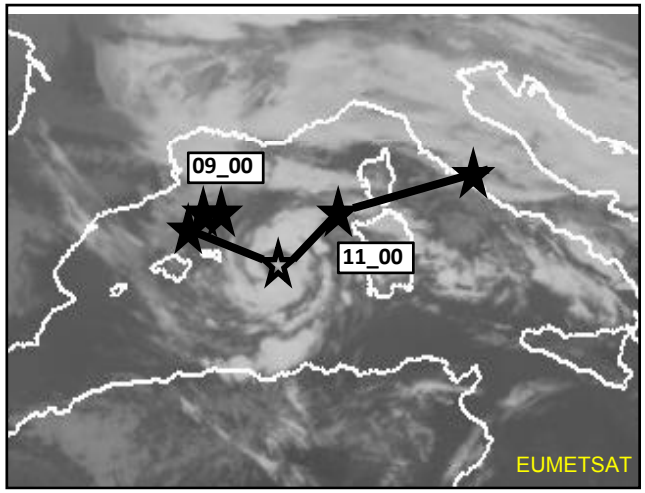
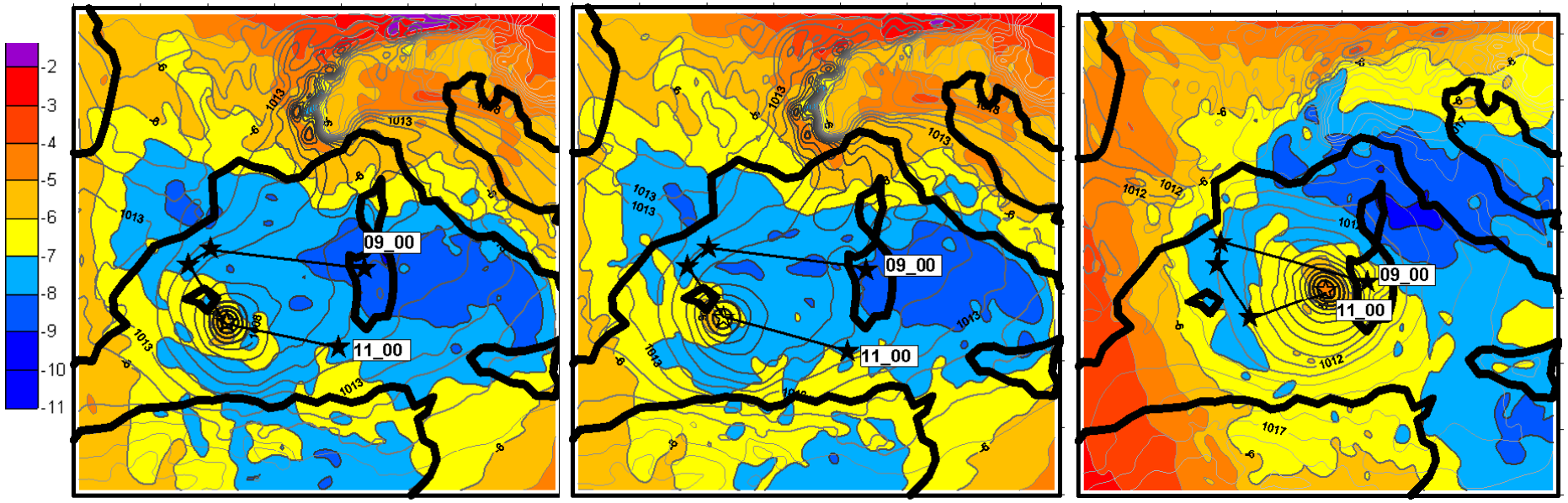
ANOTHER EXAMPLE: December 1996





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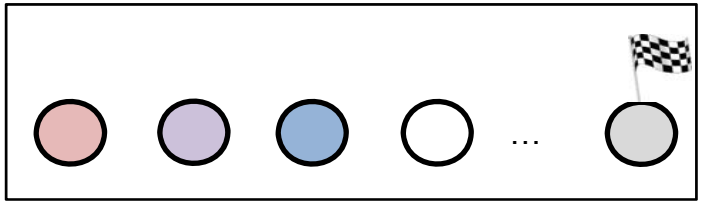


CONCLUSIONS

We could identify **12 medicanes** between 1982-2005, using only satellite images.

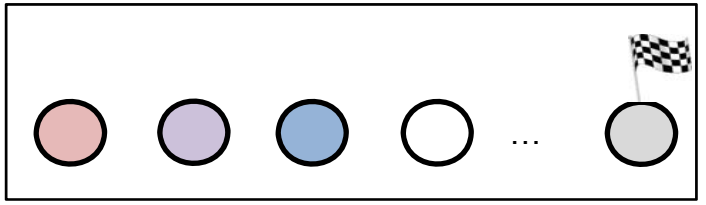
DIAB1000, GENPDF and SST are revealed as appropriate (or the best) discriminative parameters, compared against the bulk of intense cyclones (typically baroclinic cyclones).

MM5 simulations at 7.5 km forced with large-scale fields of different horizontal resolutions, are able to develop medicane-like structures, even with the coarsest input data experiments.

IFS – ECMWF experiments at 15 km exhibit less skill than the MM5 simulations: the forecasted medicanes are smaller in size and weaker in intensity.

WORKING PLAN: Evaluate the false alarm rate, improve numerical simulations, create automatic medicane detection algorithms, etc.

This fact encourages the application of mesoscale models nested in GCMs in order to assess the medicane risk under the present and future climate conditions.



ONS

- W… …n 1982-2005, using only sat…
- **DIAB1**… …evealed as appropriate (or the be… …compared against the bulk of intense …s (typi… …cyclones).
- **MM5 simulations at 7.5 km** forced with large-scale fields of different horizontal resolutions, are able to develop medicane-like structures, even with the coarsest input data experiments.
- **IFS – ECMWF experiments at 15 km** exhibit less skill than the MM5 simulations: the forecasted medicanes are smaller in size and weaker in intensity.
- **WORKING PLAN:** Evaluate the false alarm rate, improve numerical simulations, create automatic medicane detection algorithms, etc.