REUNIÓN PREDIMED

19-20 Abril 2012

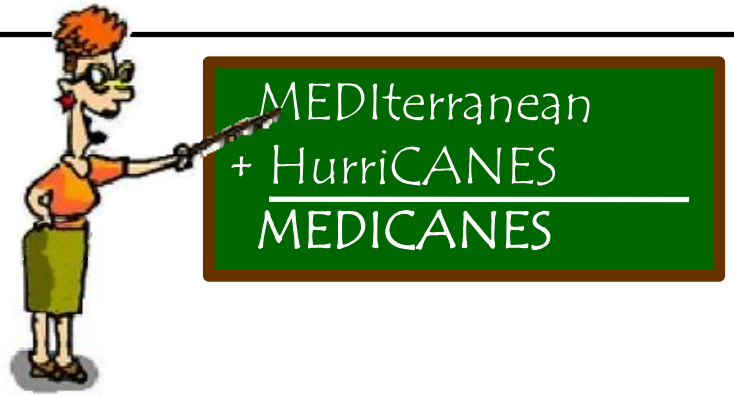
RESUMEN DE RESULTADOS OBTENIDOS

Y TRABAJO ACTUAL DEL PROYECTO

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

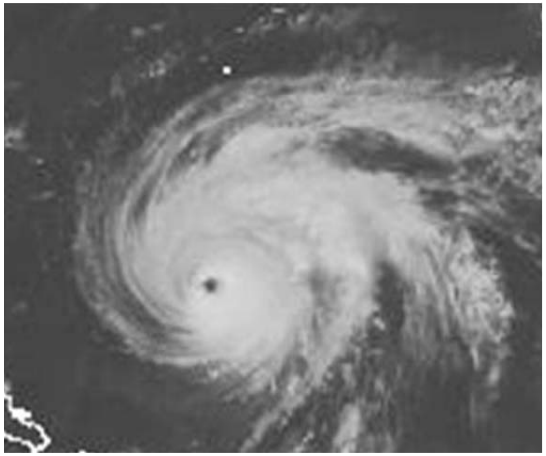
Maria Tous, UIB

What are MEDICANES?

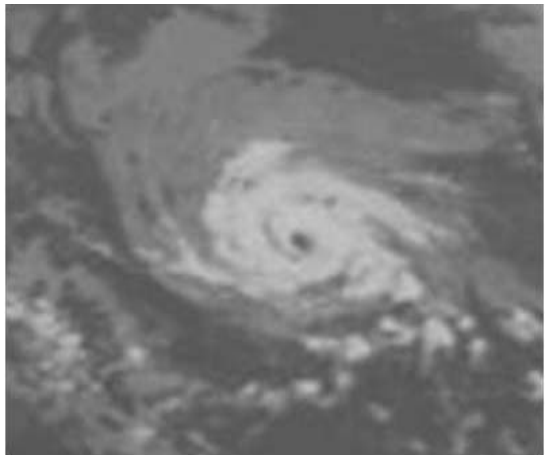


MEDICANES are tropical-like cyclones which develop over the Mediterranean Sea, sometimes attaining hurricane intensity.

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



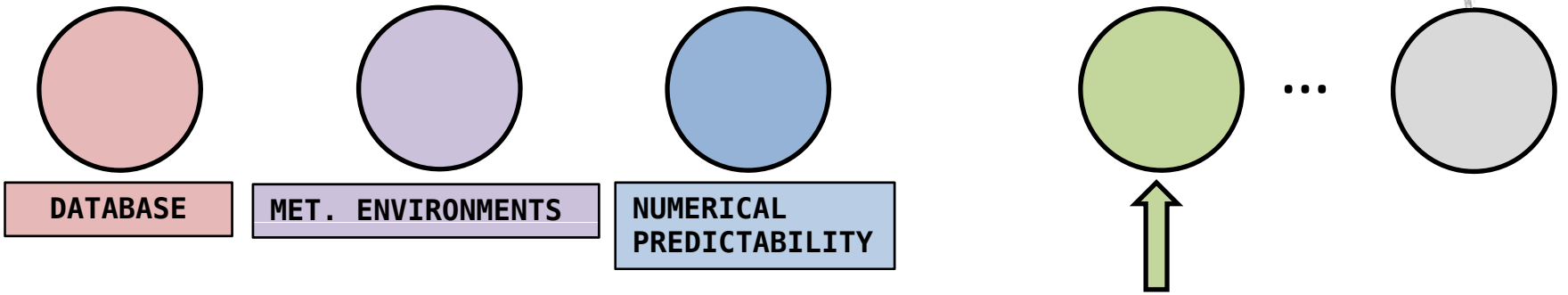
Medicane. Jan 1995

METEOSAT

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.

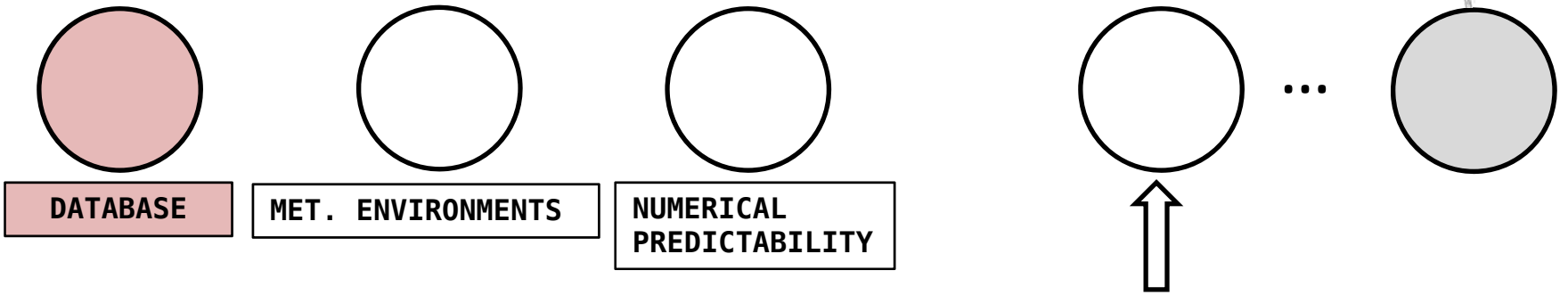


QUANTITATIVE ASSESSMENT OF MEDICANE RISK UNDER FUTURE CLIMATE CONDITIONS USING MM5 MODEL

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

OBJECTIVE

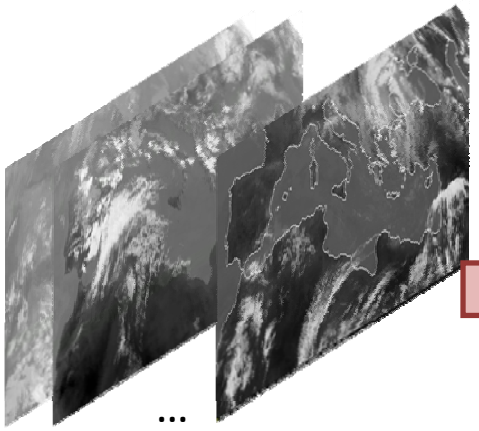
TO ASSESS THE MEDICANE RISK UNDER THE PRESENT AND FUTURE CLIMATE CONDITIONS.



QUANTITATIVE ASSESSMENT OF MEDICANE RISK UNDER FUTURE CLIMATE CONDITIONS USING MM5 MODEL

TO CREATE A DATABASE OF EVENTS

Our database



…

IR satellite images (1982-2005)

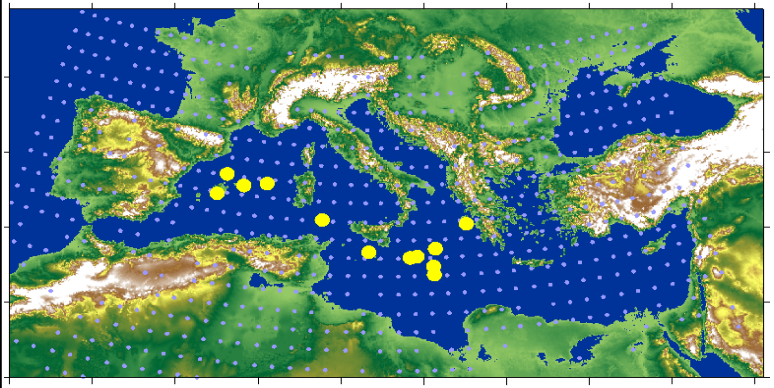
Medicane criteria

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

12 events

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)

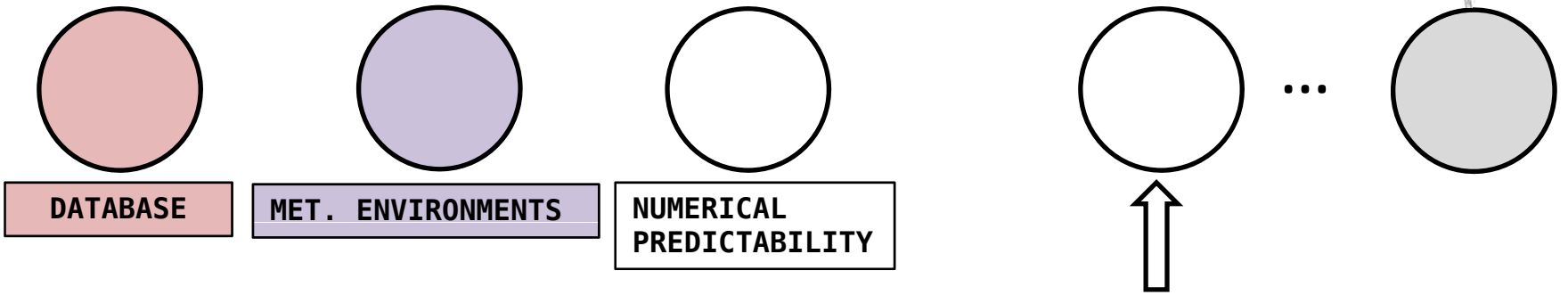
GEOGRAPHYCAL DISTRIBUTION OF EVENTS



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

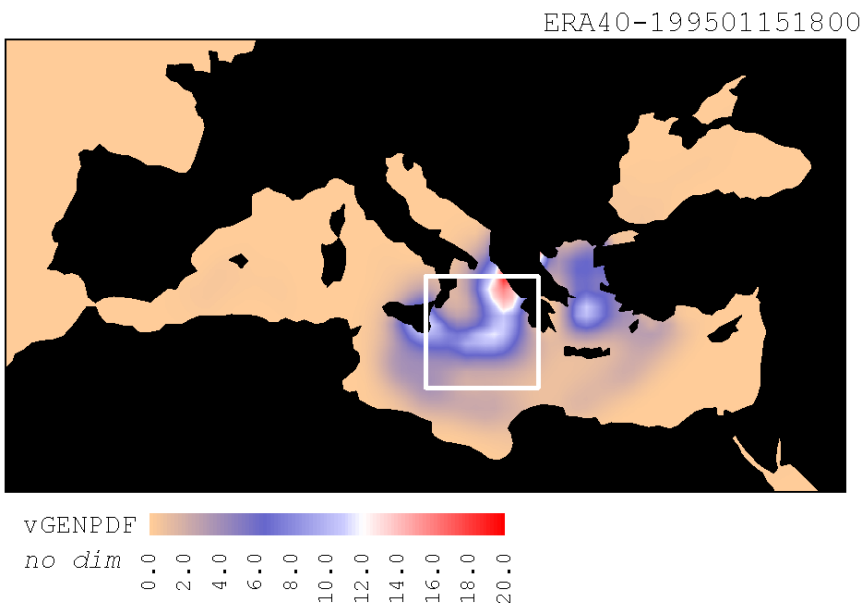
OBJECTIVE

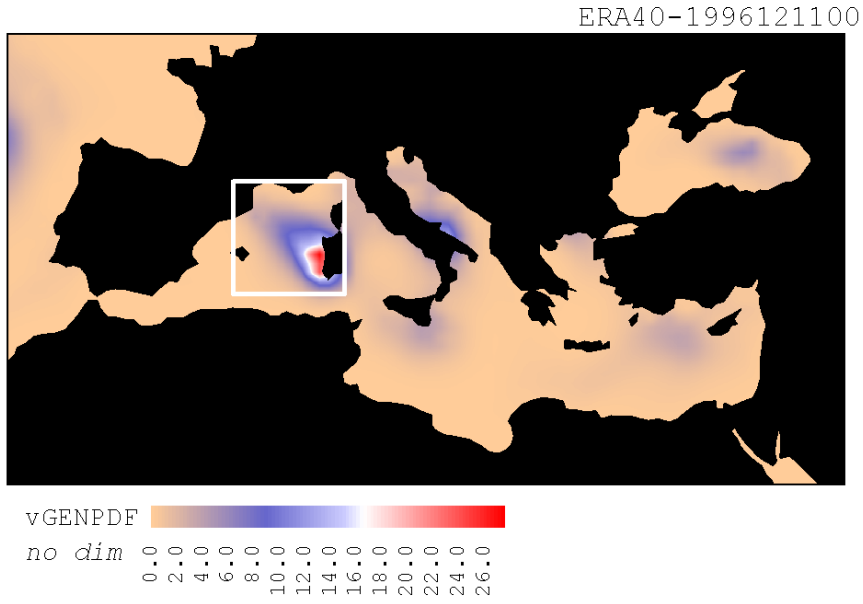
TO ASSESS THE MEDICANE RISK UNDER THE PRESENT AND FUTURE CLIMATE CONDITIONS.



QUANTITATIVE ASSESSMENT OF MEDICANE RISK UNDER FUTURE CLIMATE CONDITIONS USING MM5 MODEL

AVOR850 (η)	Low-tropospheric vorticity
DIAB1000	Diabatic contribution to surface level equivalent potential temperature
RH600 (H)	Mid-tropospheric relative humidity
SST	Sea Surface Temperature
VSHEAR8525 (V_{shear})	Tropospheric wind shear
MAXWS (V_{max})	Idealized maximum surface wind speed
GENPDF	Empirical genesis index

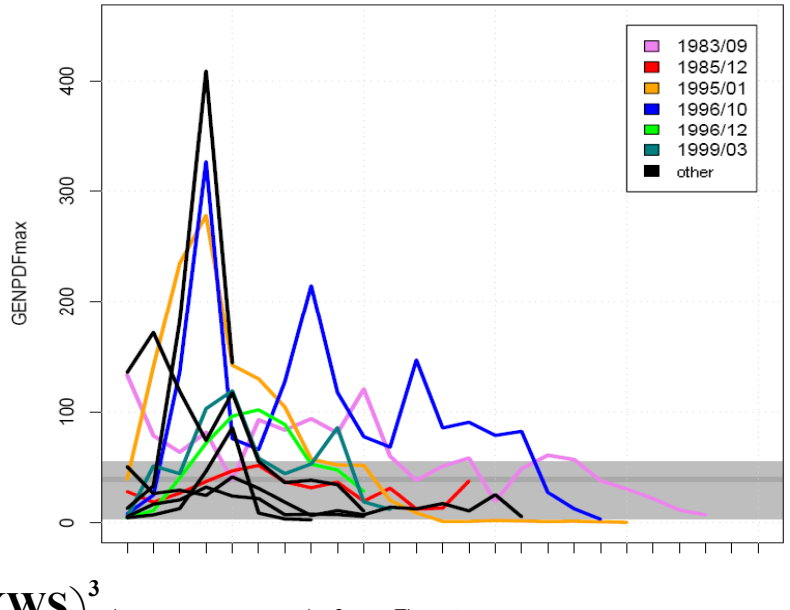


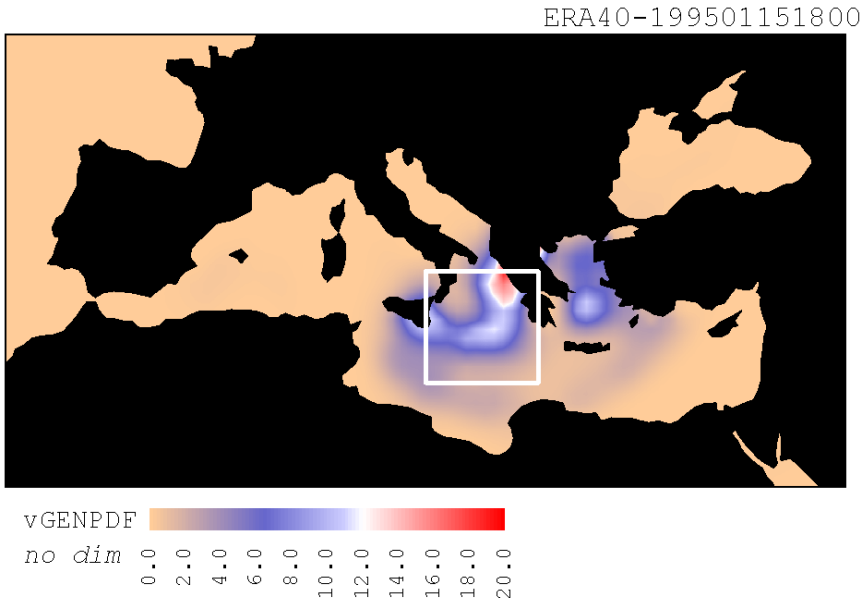


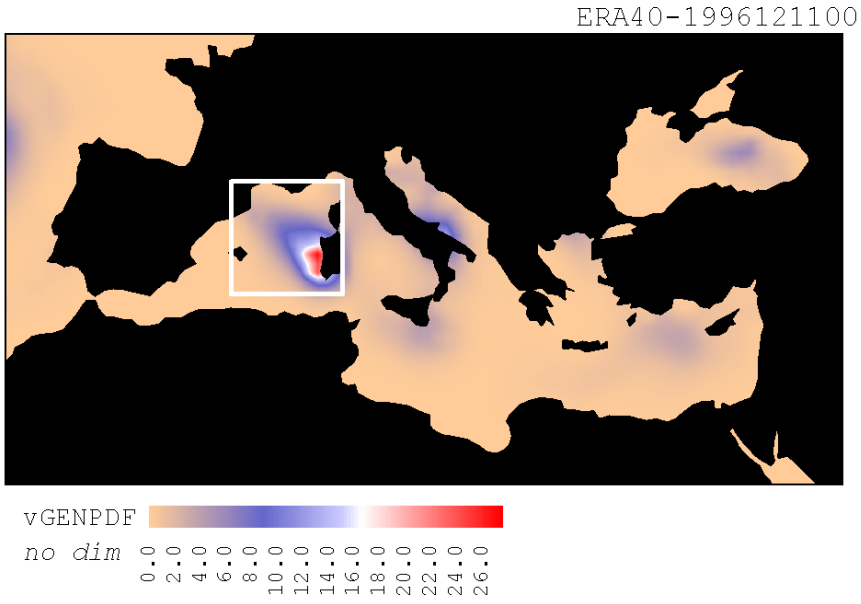
AVOR850 (η)
DIAB1000
RH600 (H)
SST
VSHEAR8525 (V_{shear})
MAXWS (V_{max})
GENPDF

$$\mathbf{MAXWS} \approx \frac{C_k}{C_D}\frac{T_S - T_0}{T_0}(k_0^* - k)$$

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



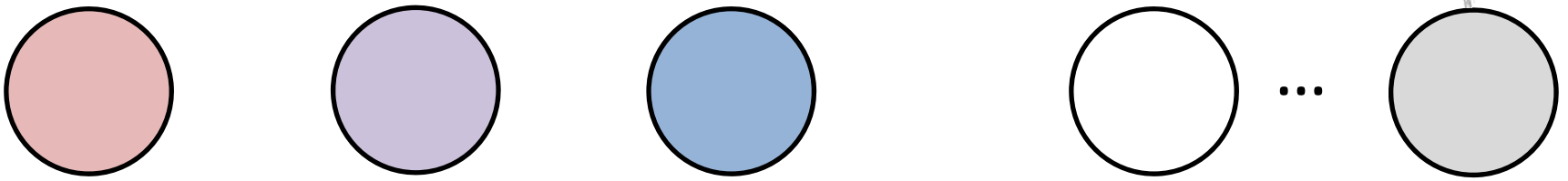




MEDICANES: Meteorological Environments, Numerical Predictability and Risk Assessment in the Present and Future Climate (MEC, CGL2008-01271/CLI)

OBJECTIVE

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



DATABASE

MET. ENVIRONMENTS

NUMERICAL PREDICTABILITY

QUANTITATIVE ASSESSMENT OF MEDICANE RISK UNDER FUTURE CLIMATE CONDITIONS USING MM5 MODEL

CONTROL

ECMWF
T213 (~ 85 km)
+ obs.

fine GCM res.

ECMWF
(~ 125km)

typical GCM res.

ECMWF
(~ 250 km)

MESOSCALE MODEL SIMULATION

48h

196x196

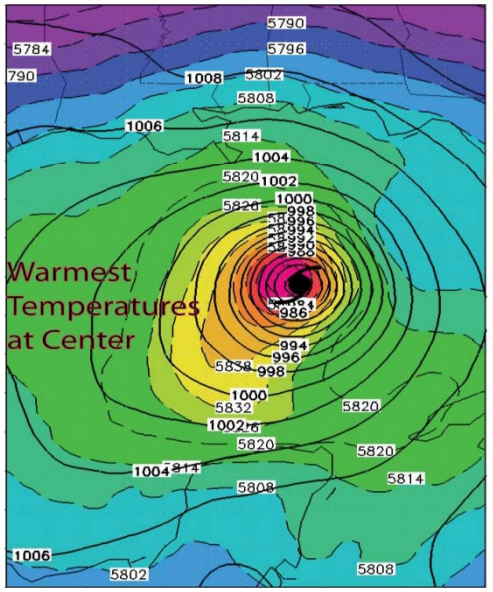
MM5
7.5 km

LOW RESOLUTION of the input large scale fields

TO EXAMINE NUMERICAL PREDICTABILITY OF MEDICANES.

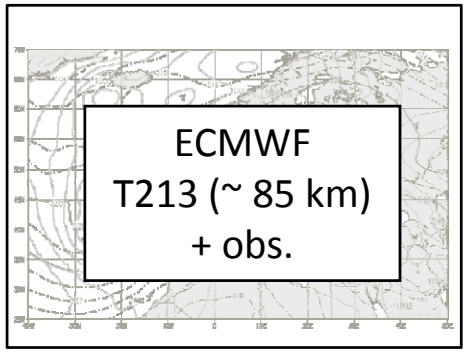
Quasi-symmetric intense low-pressure centres at surface with an isolated warm-core structure aloft.

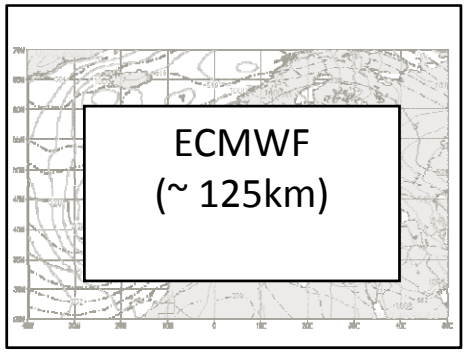
Katrina, Warm Core Low

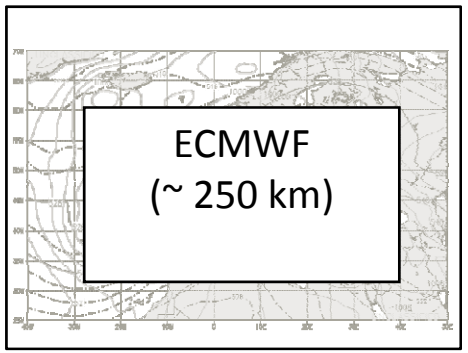


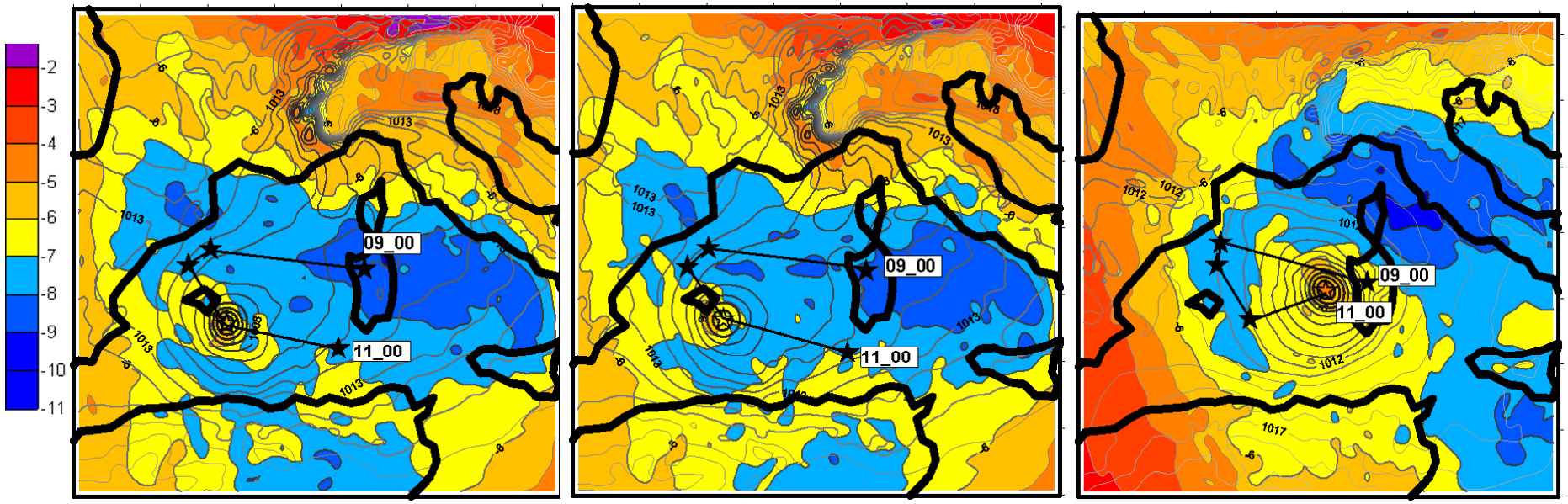
Sfc Isobars (solid, mb)
Sfc-500 mb Mean Temp (shaded)
12 UTC 28 Aug 2005

http://tornado.sfsu.edu/









CONTROL
85 km + obs.

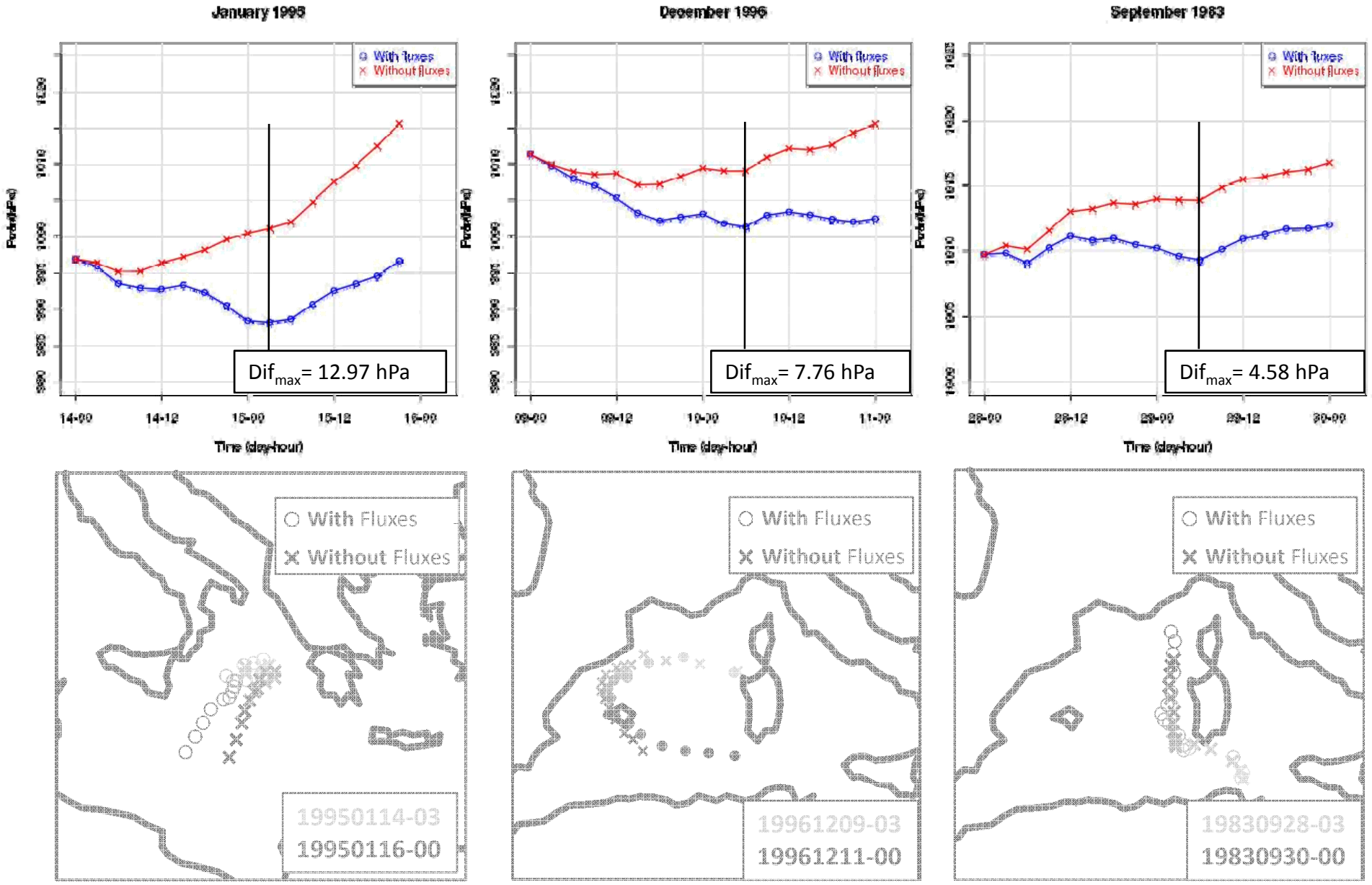
Fine GCM res.
125 km

Typical GCM res.
250 km

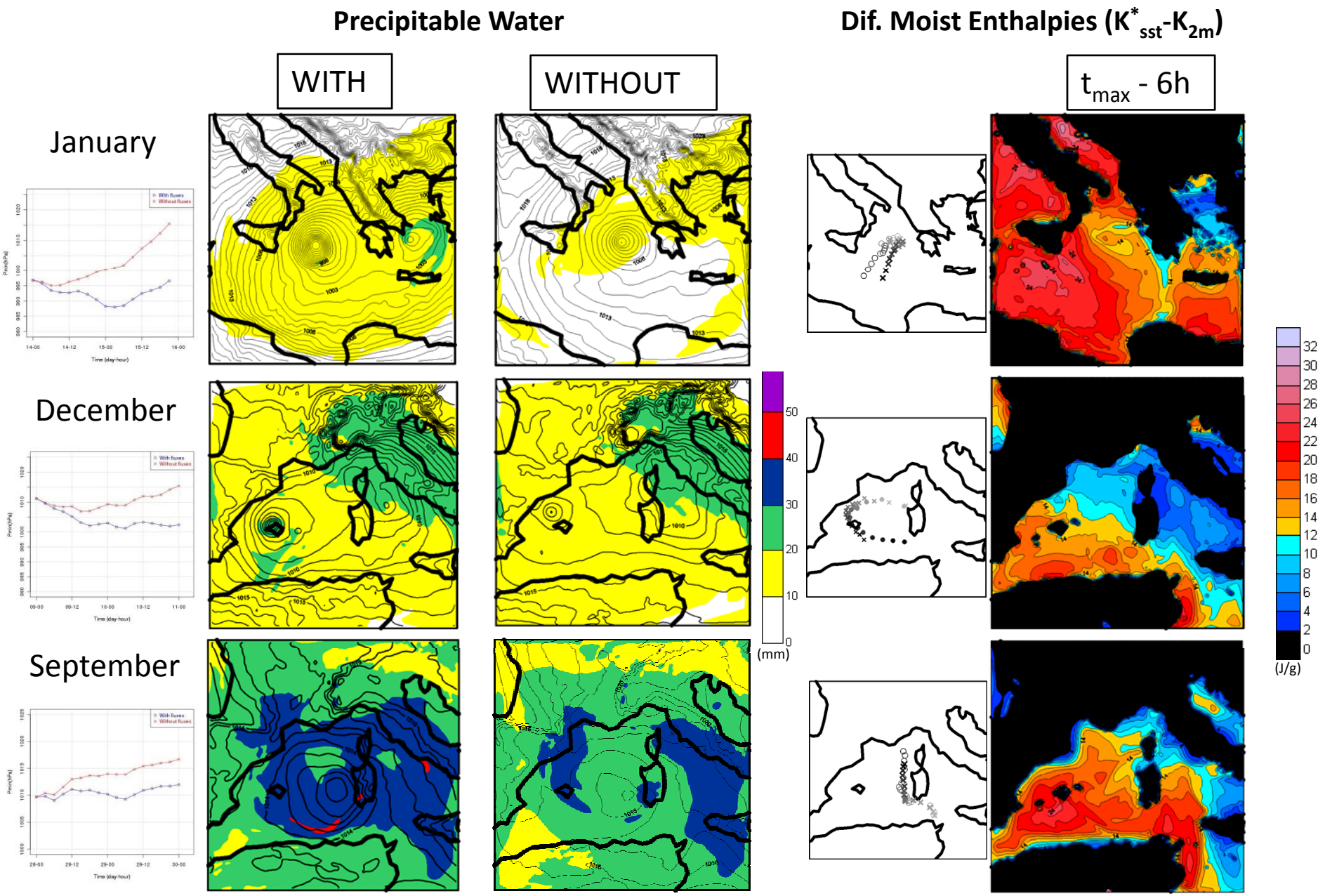
MM5
7.5 km

Contours: PSEALVL every 1 hPa. Colored:Temp.(ºC) 700 hPa

2.- Do surface heat fluxes influence in medicane properties?



Do surface heat fluxes influence in medicane properties (central pressure)?



Do surface heat fluxes influence in medicane properties (central pressure)?

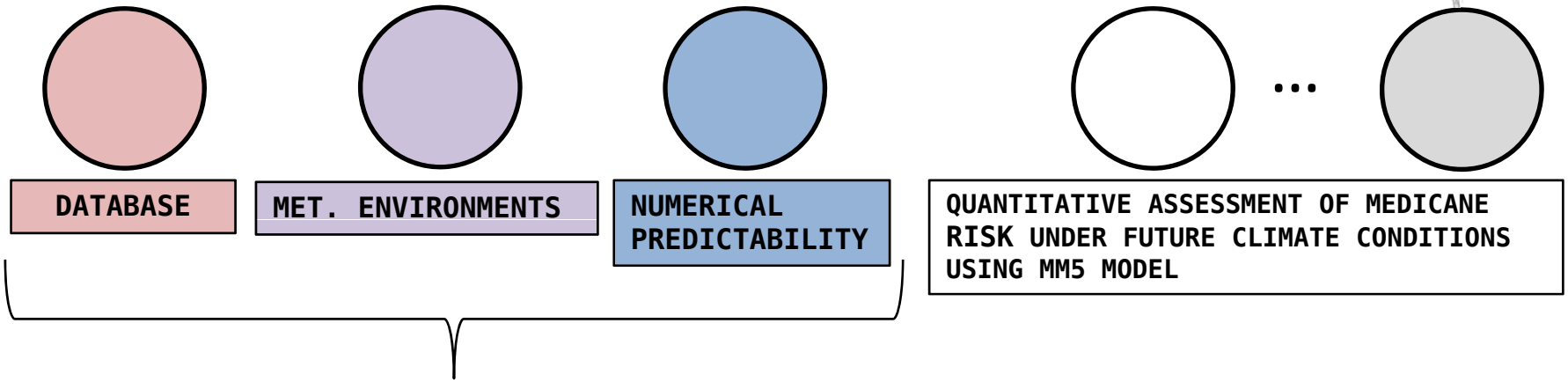
M01	M02	M03	M04
M05	M06	M07	M08
M09	M10	M11	M12

Table 2: Summary of sensitivity test. Influence on medicane trakectory: light, moderate and dark shaded circles indicate, respectively, TR1, TR2, TR0 type results (see text). Influence on medicane intensity: light, moderate and dark shaded backgrounds indicate, respectively, IN1, IN2 and IN0 type results (see text). White boxes indicate the three medicane events that produced inadequate CTR simulations.

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.

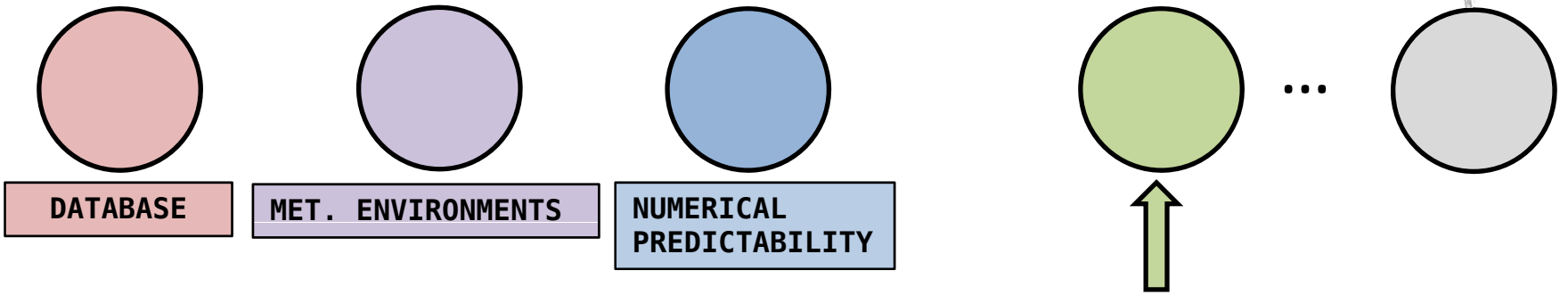


(1) Tous, M. and R.Romero. 2011. Medicanes: criteris de catalogació I explocarió dels ambients meteorològics. *Tethys* **8**: 55-63, DOI: 10.3369/tethys.2011.8.06
(2) Tous, M. and R.Romero, 2012. Meteorological environments associated with medicane development. *Int. J. Climatol*, DOI:10.1002/joc.3428
(3) Tous, M., R.Romero and C.Ramis. Surface heat fluxes influence on medicane trajectories and intensification. *Atm. Res*. (submitted)

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.



QUANTITATIVE ASSESSMENT OF MEDICANE RISK UNDER FUTURE CLIMATE CONDITIONS USING MM5 MODEL

Using genesis by random seeding

Using MM5 model

Growing the database

1.- Natural process:

Past: no fiable measures

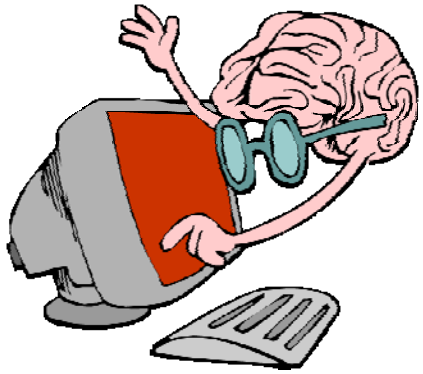
Future: no patient

ONE order the magnitude increased:

# Events	# Years
~10	20
~100	200

2.- Create by ourself:

Machines or dancing



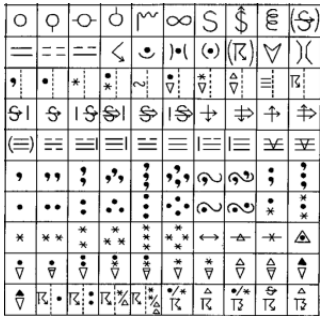
Other machines (computers) + brains

Genesis by random seeding

1.- Sowing the seeds

Initial track points are randomly distributed: These “seeds” are planted everywhere and at all times, SST, season or other factors.

2.- Looking the weather



The ambient flow varies randomly in time, but it is constructed so that its mean, variance, and covariances conform to the climatology.

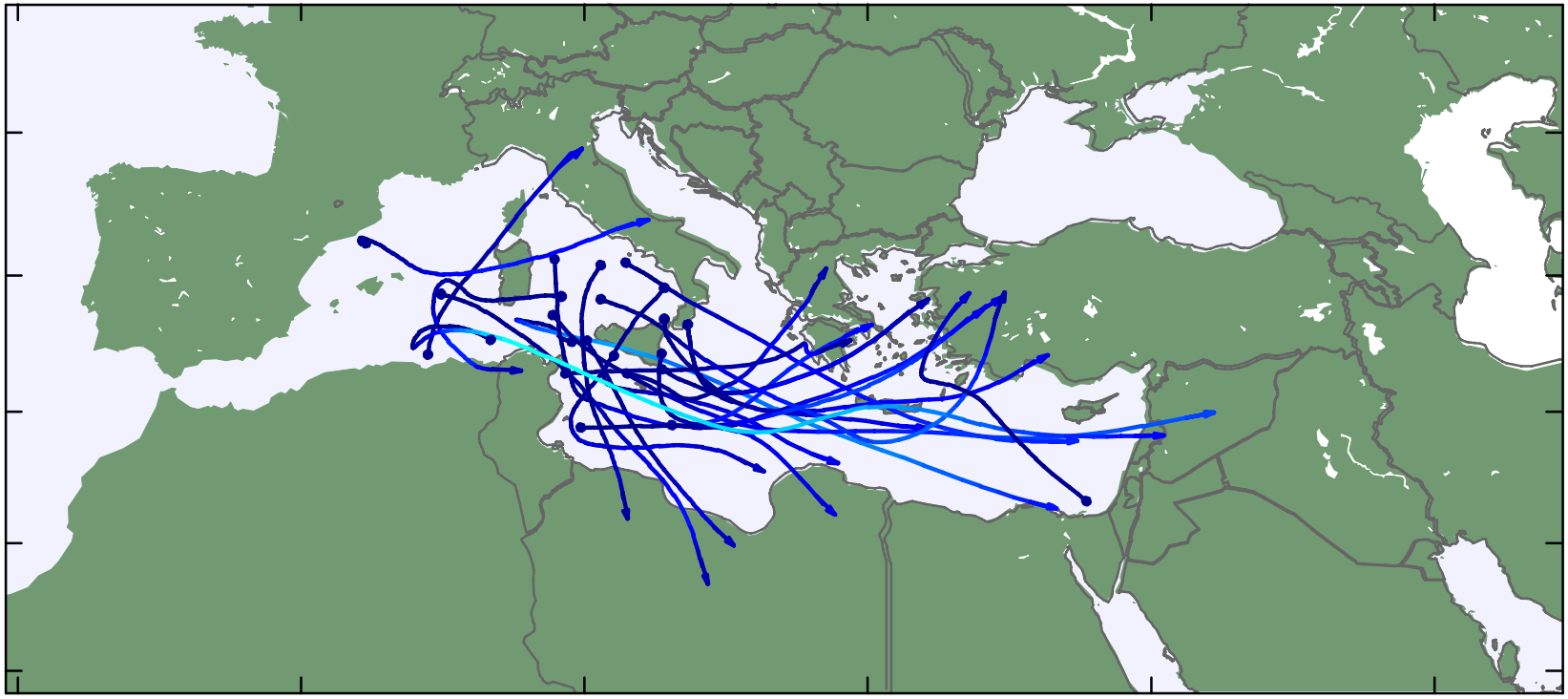
3.- Analyzing the benefits

Genesis is defined for the synthetic events as the first point at which the maximum winds exceeded 15 m/s .

Emanuel et al. 2008: Emanuel, K., R. Sundararajan and J. Williams; Hurricanes and Global Warming

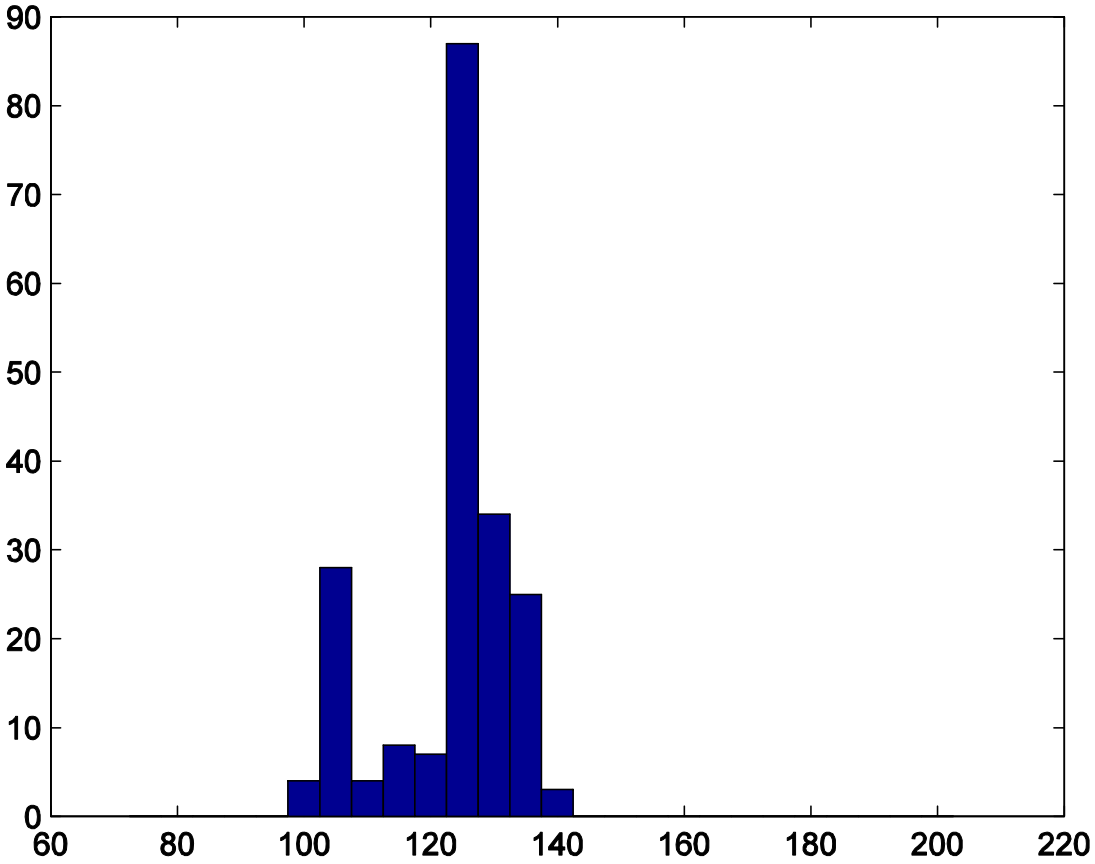
Some results for MEDICANES

Track of 25 random synthetic medicane tracks



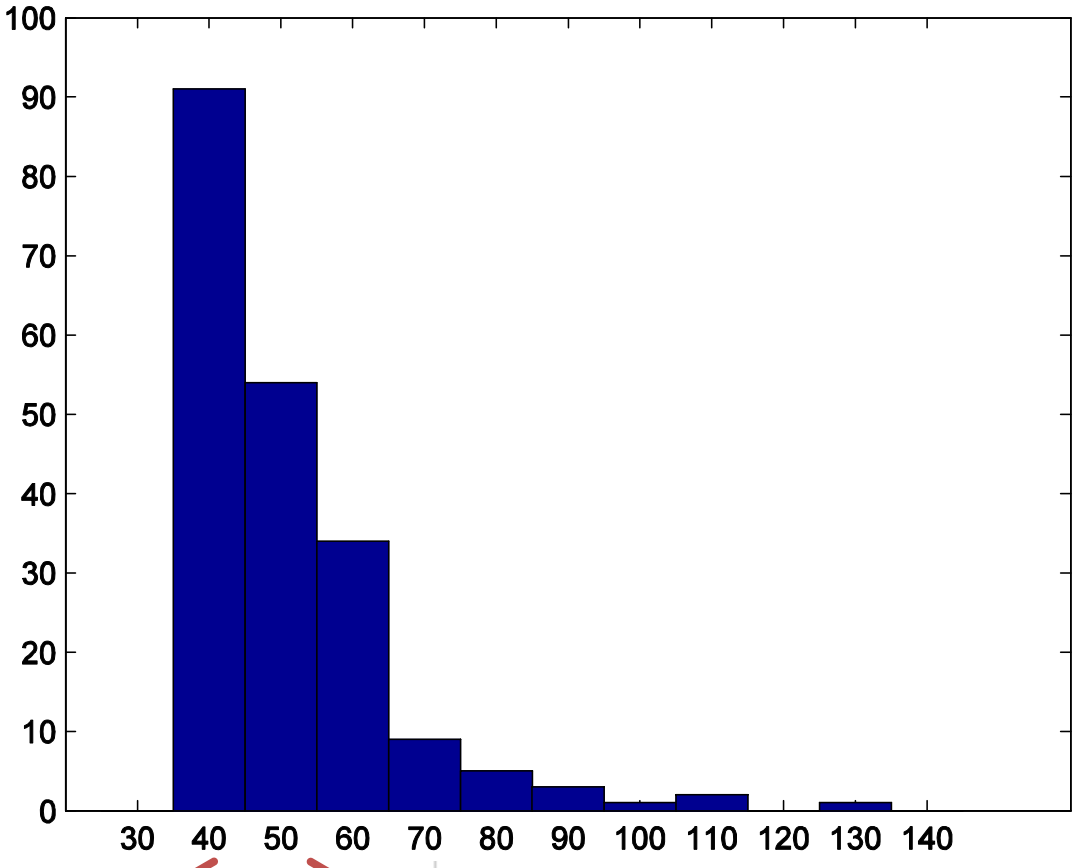
Some results for MEDICANES

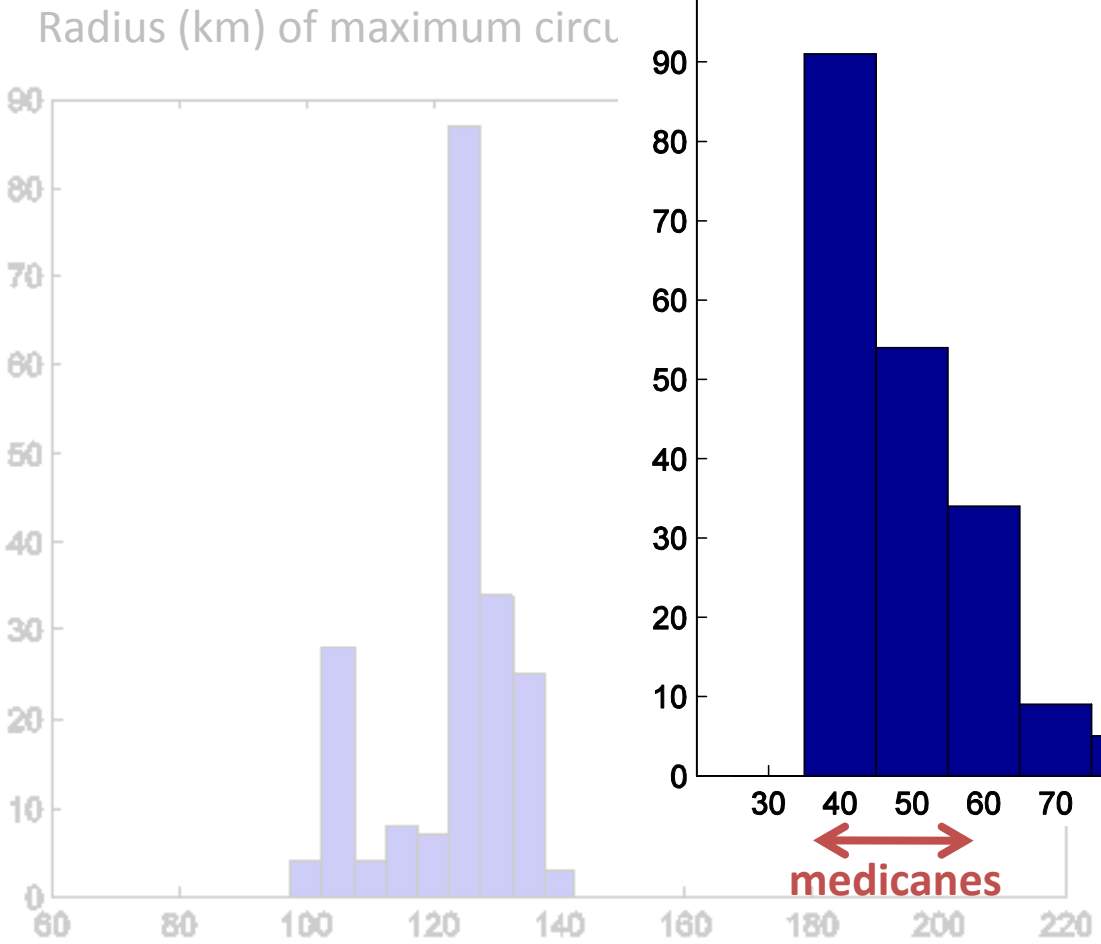
Radius (km) of maximum circular wind in each event



Some results for MEDICANES

The maximum surface wind spead (m/s) in each event



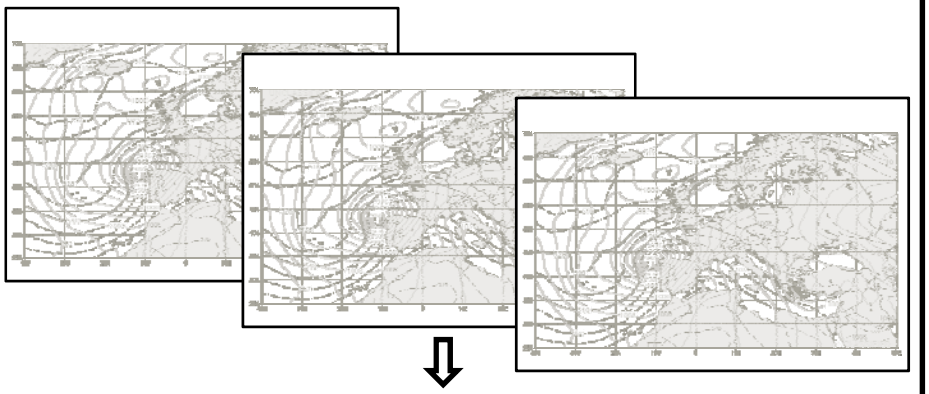


Using MM5 model

date	lon	lat	grid-x	grid-y	exceedance
810107	17.69	39.27	51	24	0.159670E+01
810107	17.71	39.73	51	25	0.306760E+01
810107	18.29	39.25	52	24	0.369950E+01
810107	18.31	39.72	52	25	0.612820E+01
810107	18.86	38.77	53	23	0.103998E-01
810107	18.89	39.23	53	24	0.495270E+01
810107	18.92	39.69	53	25	0.831910E+01
810107	18.94	40.16	53	26	0.500250E+01
810107	18.97	40.62	53	27	0.265200E+00
810107	19.48	39.21	54	24	0.551520E+01
810107	19.52	39.67	54	25	0.963280E+01
810107	19.55	40.13	54	26	0.647710E+01
810107	20.08	39.18	55	24	0.419090E+01
810107	20.12	39.64	55	25	0.802140E+01
810108	19.07	42.01	53	30	0.177650E+01
810109	17.73	40.20	51	26	0.163740E+01
810109	17.77	41.12	51	28	0.110200E+00
810109	18.31	39.72	52	25	0.115350E+01
810109	18.36	40.64	52	27	0.559810E+01
810109	18.39	41.11	52	28	0.585480E+01
810109	18.42	41.57	52	29	0.515080E+01
810109	18.44	42.03	52	30	0.300340E+01
810109	18.92	39.69	53	25	0.273870E+01
810109	18.94	40.16	53	26	0.710520E+01
810109	18.97	40.62	53	27	0.987270E+01
810109	19.01	41.08	53	28	0.128090E+02
810109	19.04	41.55	53	29	0.144827E+02
810109	19.07	42.01	53	30	0.141458E+02
810109	19.52	39.67	54	25	0.351660E+01
810109	19.55	40.13	54	26	0.797480E+01
810109	20.12	39.64	55	25	0.296890E+01
810109	22.55	34.87	60	15	0.121800E+01
810109	22.60	35.32	60	16	0.151330E+01
810109	22.65	35.78	60	17	0.179200E+01
810109	22.71	36.24	60	18	0.256540E+01
810109	22.76	36.69	60	19	0.343570E+01
810109	23.10	34.82	61	15	0.656400E+00
810109	23.16	35.28	61	16	0.399620E+01
810109	23.22	35.73	61	17	0.221650E+01
810109	23.27	36.19	61	18	0.311830E+01
810109	23.33	36.65	61	19	0.405510E+01
810109	23.39	37.11	61	20	0.463600E+01
810109	23.45	37.56	61	21	0.403380E+01
810109	23.78	35.69	62	17	0.272370E+01
810109	23.84	36.14	62	18	0.255140E+01
810109	23.90	36.60	62	19	0.337150E+01
810109	23.97	37.06	62	20	0.390250E+01
810109	24.03	37.51	62	21	0.370040E+01
810109	24.34	35.63	63	17	0.215230E+01
810109	24.40	36.09	63	18	0.278000E+01
810109	24.47	36.55	63	19	0.252230E+01
810109	24.54	37.00	63	20	0.315800E+01
810109	24.61	37.46	63	21	0.324960E+01
810109	24.97	36.03	64	18	0.102990E+01
810109	25.04	36.49	64	19	0.207900E+01
810109	25.11	36.95	64	20	0.279800E+01
810109	25.19	37.40	64	21	0.307900E+01
810109	25.76	37.34	65	21	0.985003E-01
810110	23.11	39.45	60	25	0.116260E+01
810110	23.45	37.56	61	21	0.804560E+01
810110	23.64	38.94	61	24	0.713320E+01
810110	24.03	37.51	62	21	0.976080E+01
810110	24.10	37.97	62	22	0.133412E+02
810110	24.16	38.43	62	23	0.135967E+02
810110	24.23	38.89	62	24	0.918080E+01

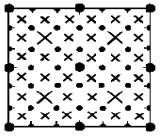
⋮

Date + lat-lon (maximum excedence)



MESOSCALE MODEL SIMULATION

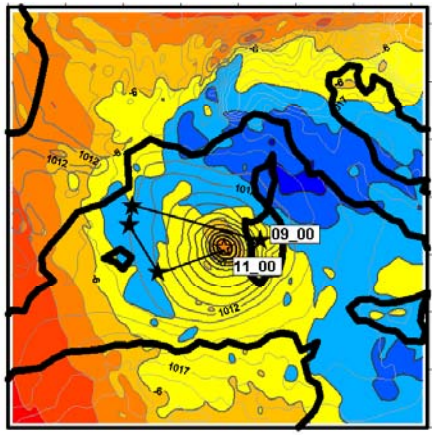
48h



196x196

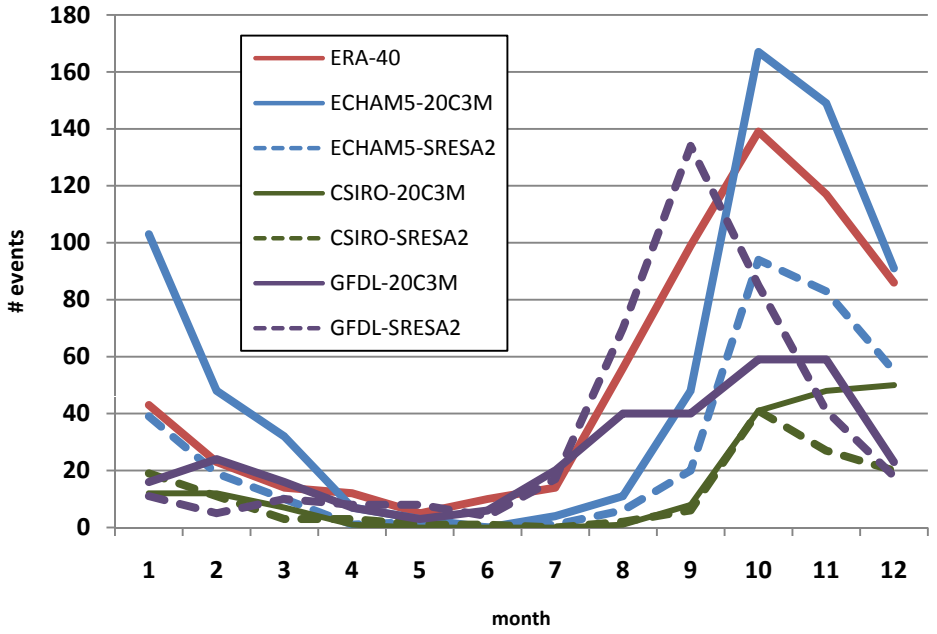
MM5
7.5 km

AUTOMATIC DETECTION PROCESS



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

MODEL	PRESENT	FUTURE	
ERA-40	YES		
ECHAM5	20C3M	SRESA2	SRESA1B
MIRO	20C3M	SRESA2	SRESA1B
CSIRO	20C3M	SRESA2	SRESA1B
GFDL	20C3M	SRESA2	SRESA1B

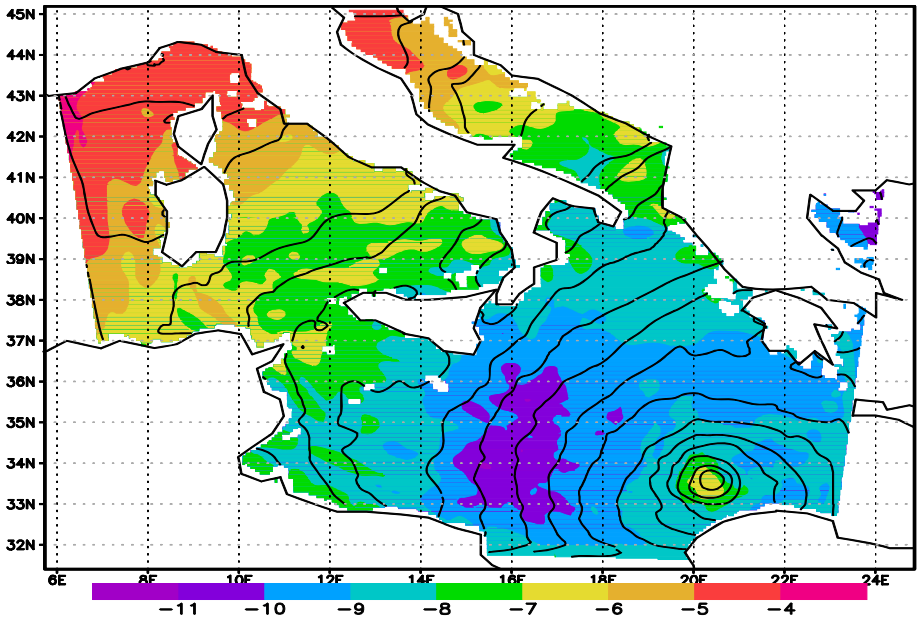


⇨

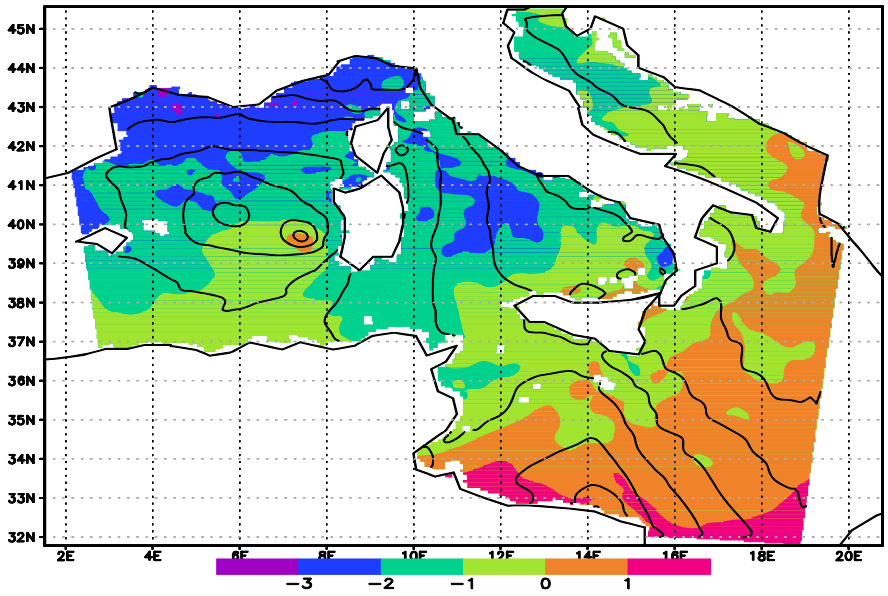
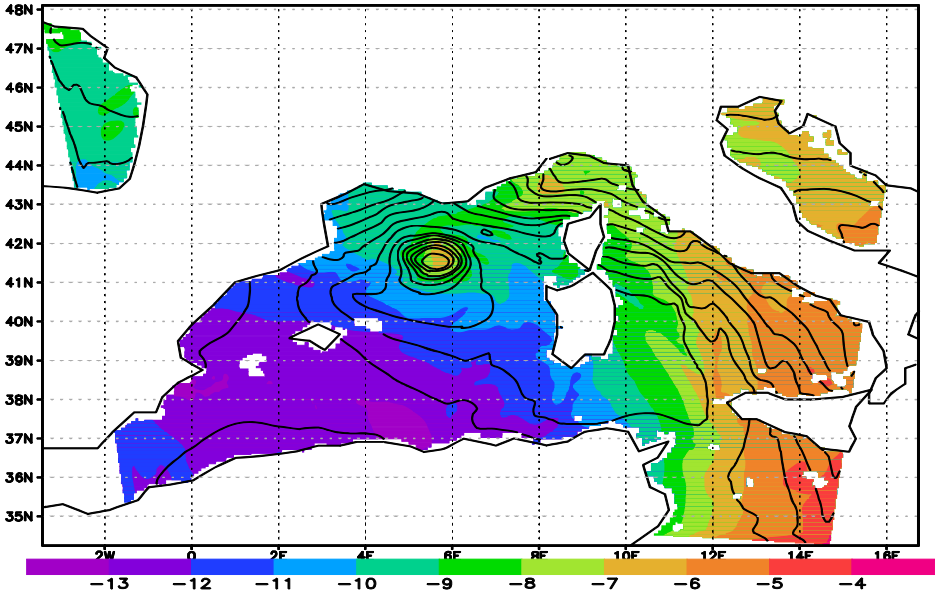
MODEL/MONTH	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
ERA-40	43	23	14	12	5	10	14	56	99	139	117	86	**618**
ECHAM5 20C	103	48	32	7	3	0	4	11	48	167	149	91	**663**
ECHAM5 A2	39	19	10	1	2	0	1	6	20	94	83	55	**330**
CSIRO 20C	12	12	7	1	0	0	0	1	8	41	48	50	**180**
CSIRO A2	19	11	3	3	1	1	0	2	6	41	27	20	**134**
GFDL 20C	16	24	16	7	3	6	20	40	40	59	59	23	**313**
GFDL A2	11	5	10	8	8	4	17	70	134	85	41	18	**411**

	ERA-40
1983-09-29	
1984-04-07	
1984-12-29	
1985-12-14	
1991-12-05	
1995-01-15	
1996-09-12	
1996-10-07	
1996-12-10	
1998-01-26	
1999-03-19	

Era40-1995-01-15



Era40-1983-09-29



Era40-1996-12-10