

LEARNING FOR THE FUTURE FROM THE OBSERVATION AND MODELLING OF MEDICANES



Universitat de les Illes Balears

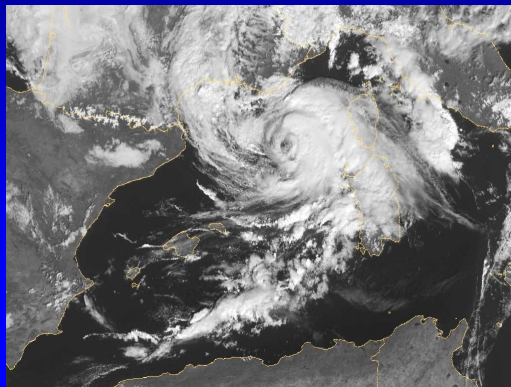
R. Romero

European Climate Research Alliance (ECRA) - General Assembly 2015

MOTIVATION

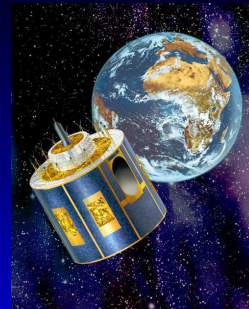
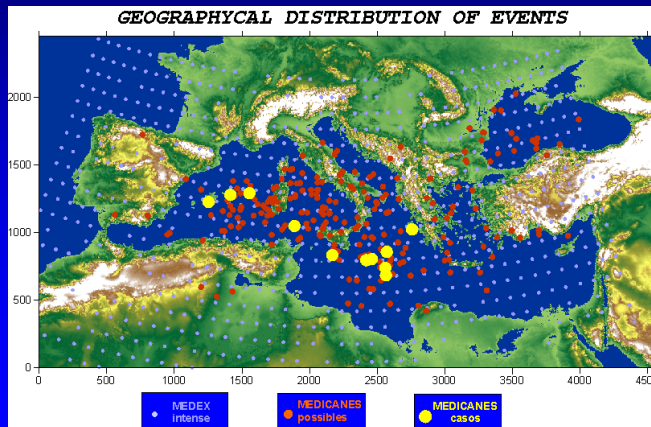
Medicanes or “Mediterranean hurricanes” are **extreme windstorms** potentially threatening the islands and coastal areas:

- Are there favoured locations for medicane development ?
- How intense can they become ?
- How could they react in frequency and intensity to global warming ?



LONG-TERM RISK OF MEDICANES ???

- Only 1-2 cases per year !!!
- *Impractical* evaluation with standard methods



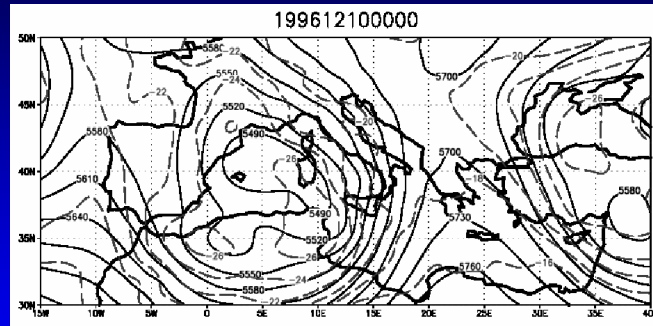
Data base (satellite)
(Tous and Romero, 2012)

FOUR APPROACHES

- **APPROXIMATION:** Large scale ingredients
-
- **FIRST METHOD:** Nested climate simulations
 - **SECOND METHOD:** Global climate simulations (**HR**)
 - **THIRD METHOD:** Statistical-deterministic approach

APPROXIMATION: Large scale ingredients

- Cut-off, cold-core lows in the upper and middle troposphere:



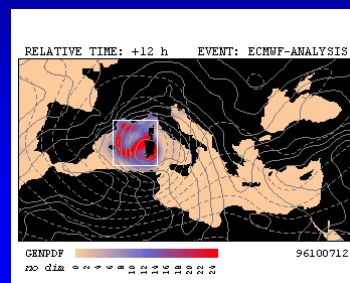
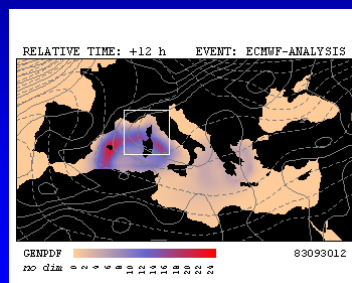
- But the infrequent occurrence of medicanes suggests that **additional and very special meteorological conditions** are necessary for these storms to occur ...

APPROXIMATION: Large scale ingredients

- Application of an **empirical index of genesis**:

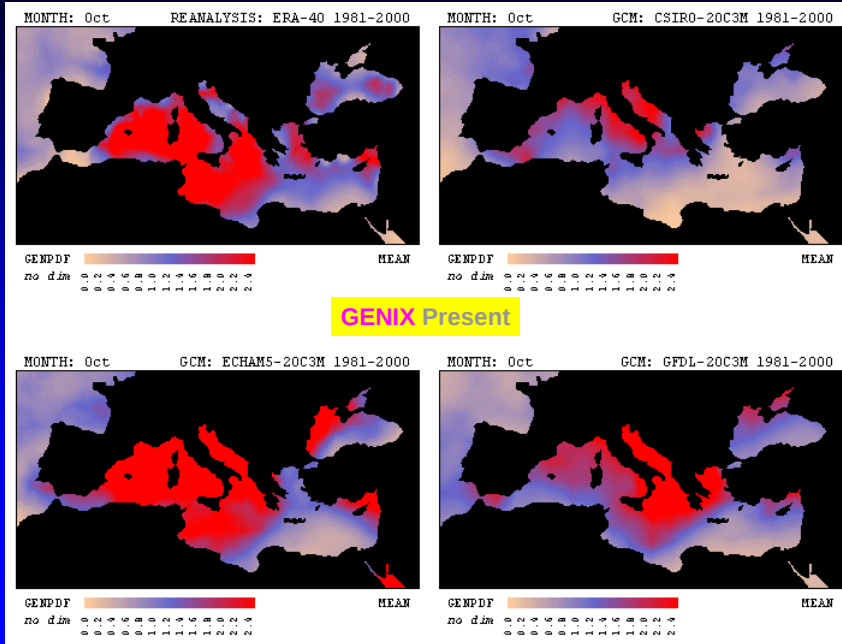
$$I = 10^5 \eta \left(\frac{H}{50} \right)^3 \left(\frac{V_{pot}}{70} \right)^3 \left(1 + 0.1 V_{shear} \right)^{-2},$$

GENIX parameter
(Emanuel and Nolan, 2004)

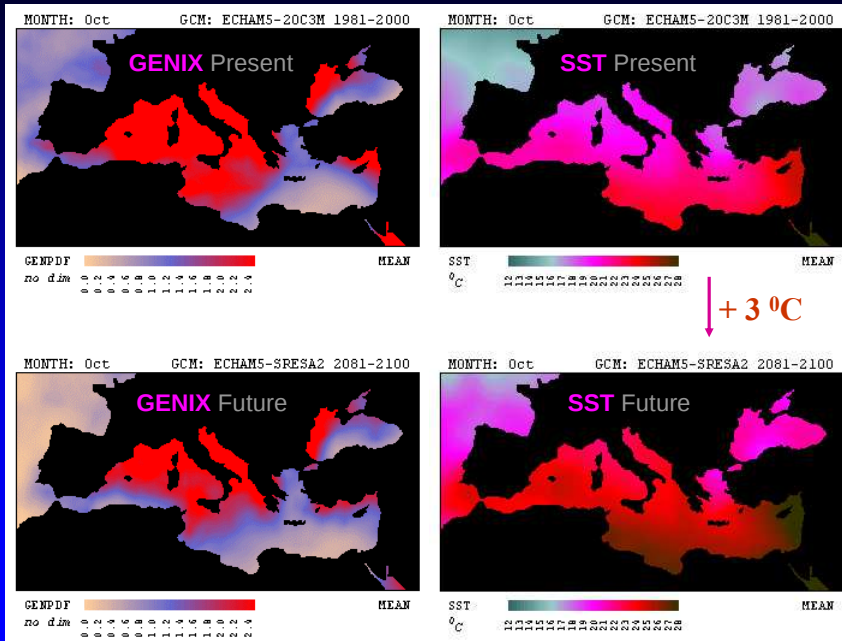


- Necessary but no sufficient ingredients ...

APPROXIMATION: Application



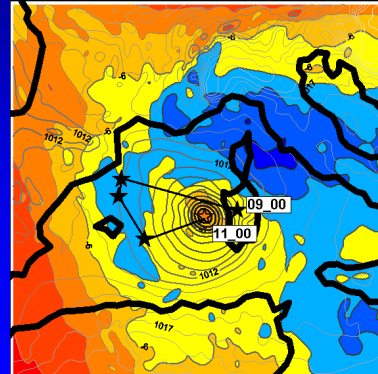
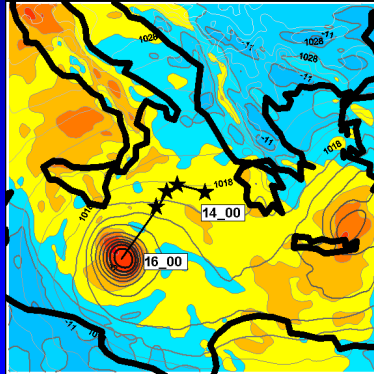
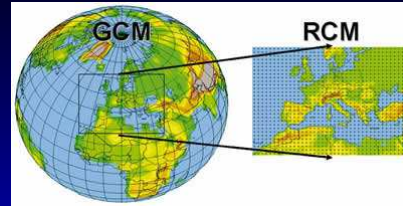
APPROXIMATION: Application



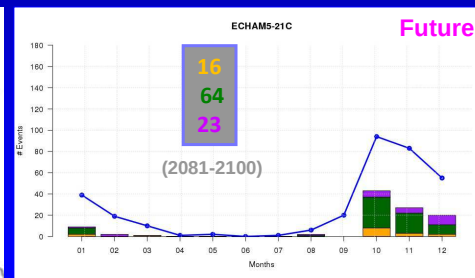
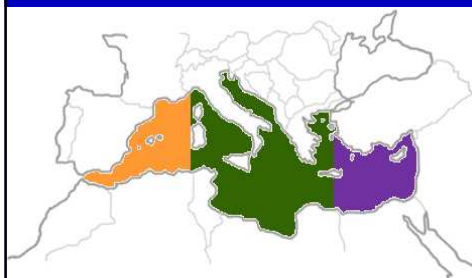
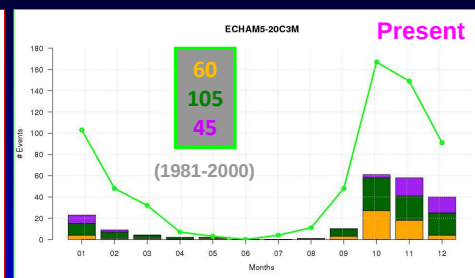
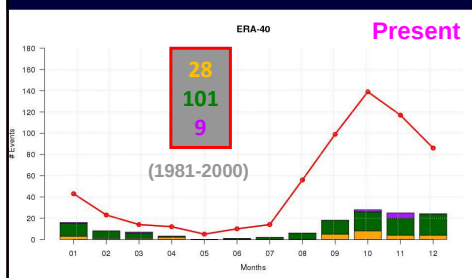
FIRST METHOD: Nested climate simulations

- **High computational cost !!!**
(even for guided simulations)

- And only a **limited number of cases**
(although several GCMs / scenarios)

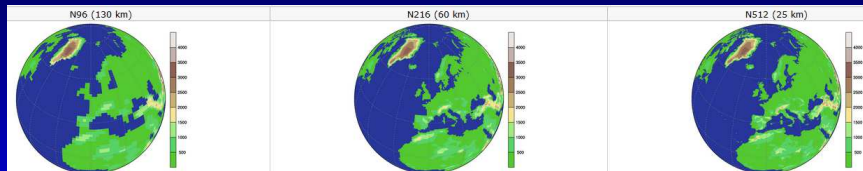


FIRST METHOD: Application

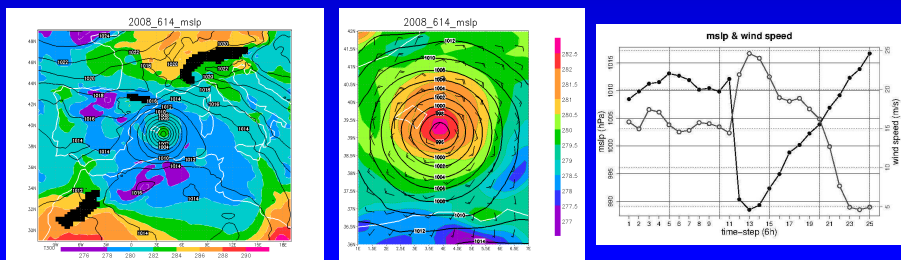


SECOND METHOD: Global climate simulations (HR)

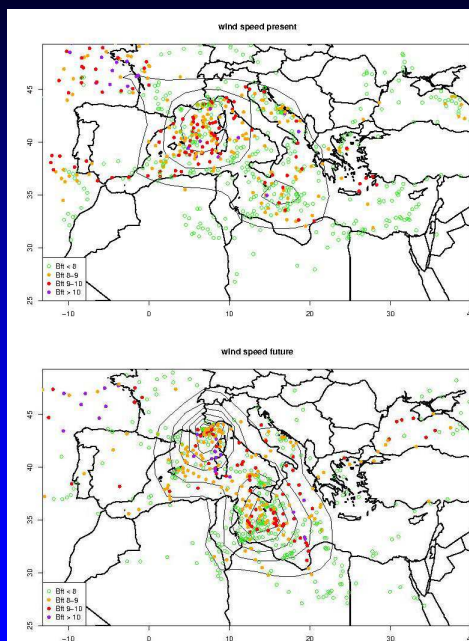
- **Detection and tracking** of intense, symmetric, warm-core cyclonic disturbances (i.e. **medicane**s) generated in the weather-resolving global simulations by **HadGEM3 N512 (25 km)** (UPSCALE project)



- In spite of the **HR**, only **“big” medicane**s can be captured ...

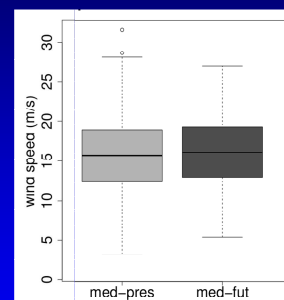


SECOND METHOD: Application



PRESENT

65 med / 26 yr



FUTURE

44 med / 26 yr

THIRD METHOD: Statistical-deterministic approach

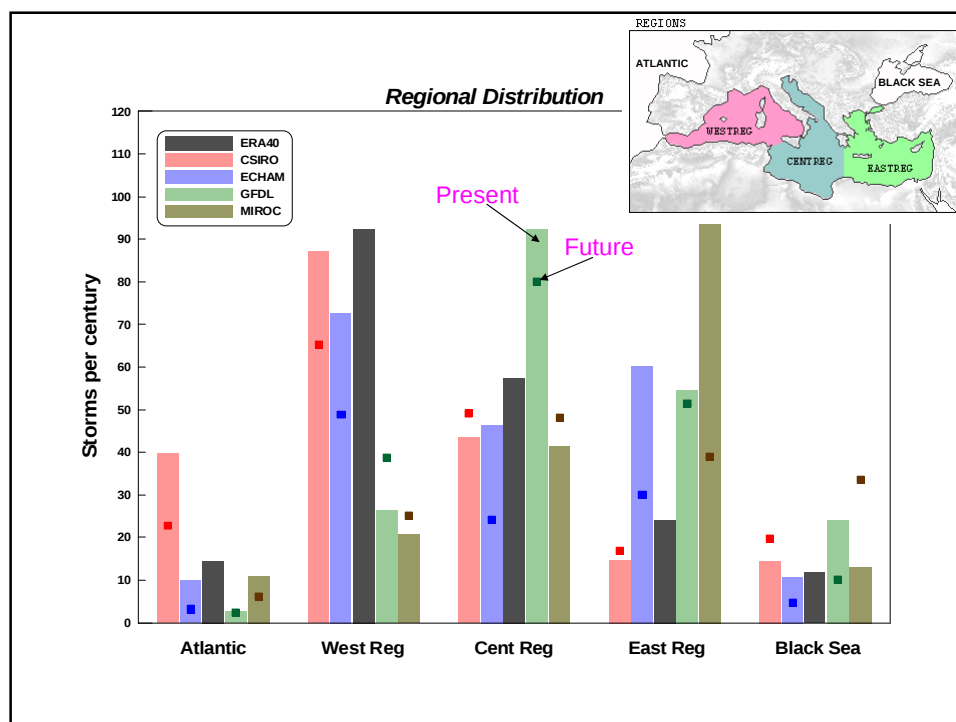
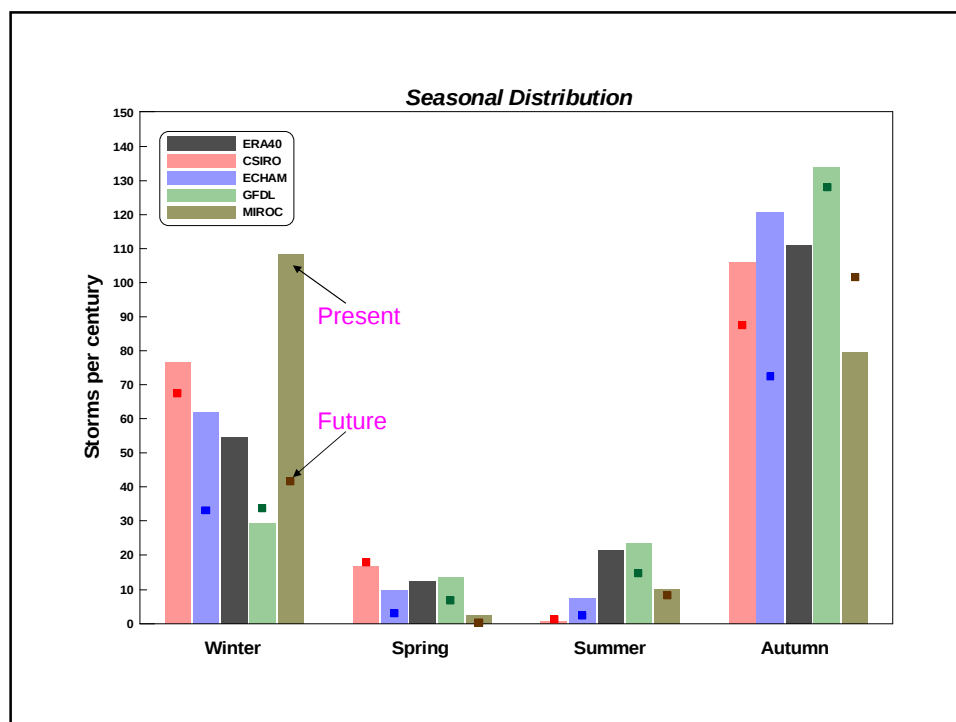
- Adaptation of the pioneering method of **Kerry Emanuel** (MIT, USA)
- Low-cost generation of **thousands of synthetic storms !!!**
- **Statistically robust** assessment of the spatio-temporal risk function (e.g. calculation of **return periods** for extreme winds)



THIRD METHOD: Application

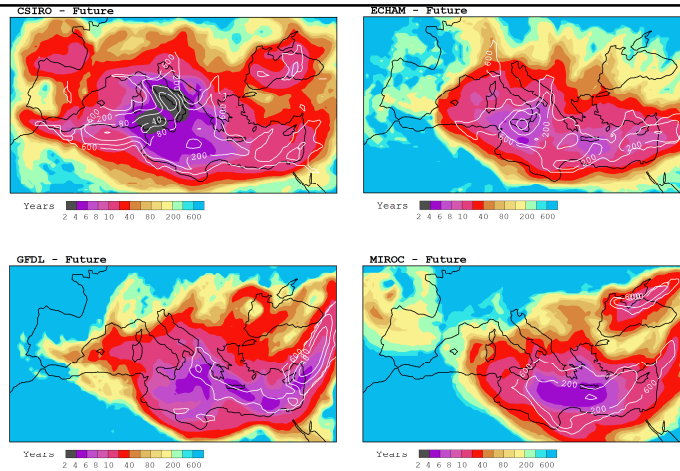
We **synthetically** generate a total of **~15000 potential tracks** for each climate/model. These are simulated with a fast atmosphere-ocean coupled model **and checked for intensification**:

Climate Scenario	Reanalysis or GCM	Successful Storms	Storms per century
PRESENT 1981 – 2000	ERA40	3048	200
	CSIRO	3286	200
	ECHAM	1924	200
	GFDL	1343	200
	MIROC	1567	200
FUTURE 2081 – 2100 SRES A2	CSIRO	2857	174
	ECHAM	1072	111
	GFDL	1226	183
	MIROC	2389	152



FUTURE

> 34 kt
> 60 kt



SUMMER 2015 ...

- Results for MEDICANES will be updated using 30 CMIP5 models (uncertainty?)
- We will apply the "same" method to investigate the future of POLAR LOWS

THANK YOU FOR
YOUR ATTENTION !!!