# Medicanes in HadGEM3 N512 climate simulations

M.Tous[(1)], G. Zappa[(2)], R. Romero[(1)] and L. Shaffrey[(2)]
[(1)]Universitat de les Illes Balears (Spain), [(2)]University of Reading (United Kingdom)

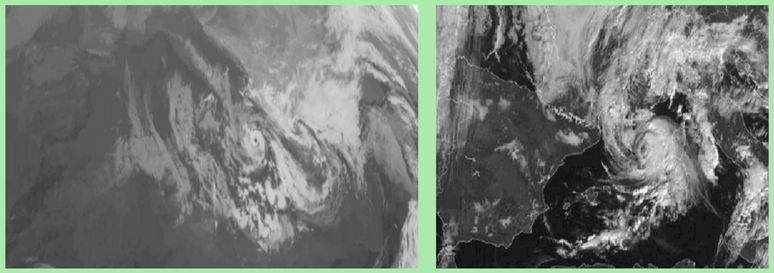


**Fig.1**. Infrared satellite images of medicane events in June 1995 (left) and November 2011 (right).

Medicanes are rare cyclones which develop over the Medirraneanean sea with similar development (based on the thermodynamical disequilibrium between the cold air and the warm sea) and properties (intense vortex with a warm core) to tropical cyclones. Although their size is smaller (with a maximum diameter usually not exceding 300 km) and they attain less intensity than tropical cyclones, the severity of the associated winds can cause substantial damage on islands and coastal areas.

## Data:

Model: HadGEM3 N512
Dates: June 1985 – May 2011 (present)
June 2085 – May 2111 (future)

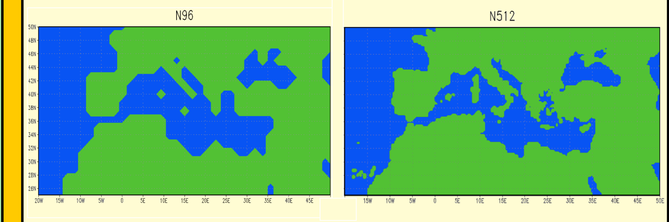



**Fig.2**. Land-sea view using different resolutions, comparing a standard IPCC class (N96, aprox. 130km) and the high resolution (N512, aprox. 25 km) of HadGEM3 simulations.

The improvement of the resolution is specially relevant in areas with complex orography and where small disturbances are frequent, like the Mediterranean basin.

Interest and concern about **how climate change will affect** extreme events are both increasing, including possible changes on the frequency and intensity of **medicanes**. Most global climate models do not have high enough resolution to represent these storms, but in this study we circumvent this problem and develop a medicane risk assessment while avoiding the use of downscaling techniques.

## Cyclone tracking:

Based on Hodges (1994)
Filtered T40-T100
Vorticity centers > $2 \cdot 10^{-5}$ $s^{-1}$
Lifetime ≥ 12 h

## Medicane requirements:

Dist. max.vort – Dist. mslp ≤ 200km
Warm core: $T_{R50}$-$T_{R200}$ ≥ 1.5ºC
High relative humidity: $h_{R100}$ ≥ 70%
Position: Mostly sea life

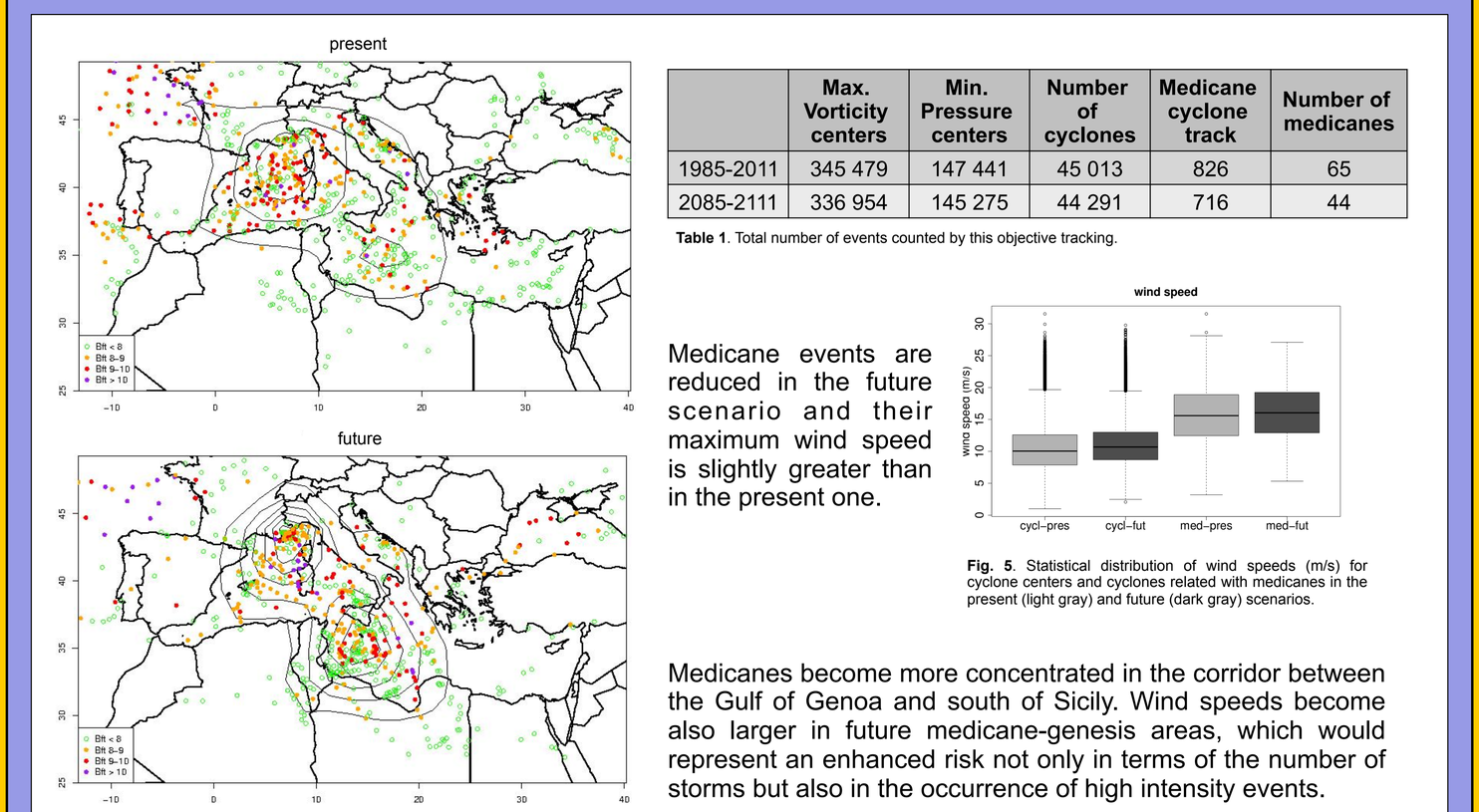



**Fig.4**. Spatial distribution of medicanes in present and future climate conditions as function of maximum surface wind speed (Beaufort scale). Contours every 10 cyclone centers per century in an area 2ºx2º.

| | Max. Vorticity centers | Min. Pressure centers | Number of cyclones | Medicane cyclone track | Number of medicanes |
|---|---|---|---|---|---|
| 1985-2011 | 345 479 | 147 441 | 45 013 | 826 | 65 |
| 2085-2111 | 336 954 | 145 275 | 44 291 | 716 | 44 |

**Table 1**. Total number of events counted by this objective tracking.

Medicane events are reduced in the future scenario and their maximum wind speed is slightly greater than in the present one.




**Fig. 5**. Statistical distribution of wind speeds (m/s) for cyclone centers and cyclones related with medicanes in the present (light gray) and future (dark gray) scenarios.

Medicanes become more concentrated in the corridor between the Gulf of Genoa and south of Sicily. Wind speeds become also larger in future medicane-genesis areas, which would represent an enhanced risk not only in terms of the number of storms but also in the occurrence of high intensity events.

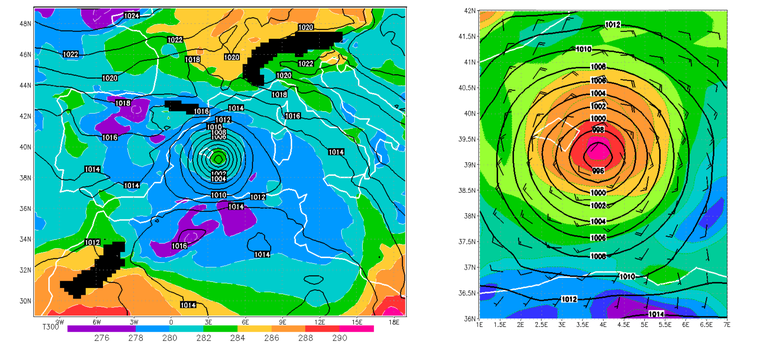
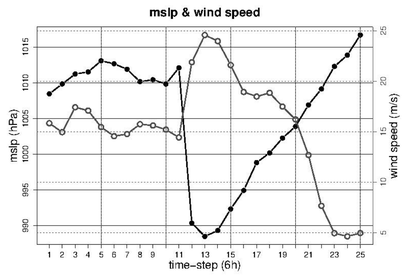


**Fig.3**. On top, temperature at 850 hPa (ºC, shaded contours) and mslp (hPa, continuous contours) for a medicane. On bottom, mslp (hPa, black dots) and maximum surface wind speed (m/s, white dots) during a detected cyclone related to a medicane event.

This is an example of how HadGEM3 N512 represents a medicane. An **isolated intense cyclone with a warm core** is observed over the Balearic Sea. Abrupt drop in mslp and severe winds (in this case, over 20m/s) are also some of the medicane characteristics.




Bibl: Hodges, K., 1994. *A general method for tracking analysis and its application to meteorological data.* Mon.Weather Rev. 122, 2573-2586.

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