MESOSCALE NUMERICAL SIMULATIONS OF MEDICANES:
Comparison against satellite-derived trajectories and isolation of key physical processes

M.Tous, R.Romero and C.Ramis
**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](image1.png)

![Medicane. Jan 1995](image2.png)

Mesoscale numerical simulations of medicanes: Comparison against satellite-derived trajectories and isolation of key physical processes
Our database

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

TO CREATE A DATABASE OF EVENTS

IR satellite images (1982-2005)

12 events

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Objectives

1.- To check if numerical simulations are able to reproduce the medicanes

2.- To evaluate the influence of surface heat fluxes in medicane properties

MESOSCALE MODEL SIMULATION

- ECMWF T213 (~ 85 km) + obs.
- MM5 7.5 km
- 48h

* Intense cyclone
* Warm core
1.- Are numerical simulations able to reproduce the medicanes?

YES
Objectives

1.- To check if numerical simulations are able to reproduce the medicanes

- ECMWF T213 (~ 85 km) + obs.
- MM5 7.5 km

MESOSCALE MODEL SIMULATION

- 48h
- * Intense cyclone
- * Warm core

2.- To evaluate the influence of surface heat fluxes in medicane properties

- With fluxes
- Without fluxes

- * Trajectories
- * Central pressure
2.- Do surface heat fluxes influence in medicane properties?

<table>
<thead>
<tr>
<th>DATE</th>
<th>Influenced Trajectory</th>
<th>Influenced Central Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>September 1983</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>January 1995</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>December 1996</td>
<td>SLIGHTLY</td>
<td></td>
</tr>
</tbody>
</table>
2.- Do surface heat fluxes influence in medicane properties (trajectory)?

YES
2.- Do surface heat fluxes influence in medicane properties (trajectory)?

SLIGHTLY
2.- Do surface heat fluxes influence in medicane properties (trajectory)?: NO
2.- Do surface heat fluxes influence in medicane properties *(trajectory)*?

Fluxes can influence the trajectories of medicanes, but sometimes this influence is small or almost indistinguishable.
2. - Do surface heat fluxes influence in medicane properties?

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

**January 1995**
- With Fluxes: 
- Without Fluxes: 
- $D_{\text{max}} = 12.97 \text{ hPa}$

**December 1996**
- With Fluxes: 
- Without Fluxes: 
- $D_{\text{max}} = 7.76 \text{ hPa}$

**September 1983**
- With Fluxes: 
- Without Fluxes: 
- $D_{\text{max}} = 4.58 \text{ hPa}$
2.- Do surface heat fluxes influence in medicane properties (central pressure)?

**Precipitable Water**

<table>
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<th>WITH</th>
<th>WITHOUT</th>
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<tr>
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**Dif. Moist Enthalpies ($K_{sst}^{*} - K_{2m}$)**

$t_{max} - 6h$
2.- Do surface heat fluxes influence in medicane properties (central pressure)?

Fluxes influence the intensity of medicanes.

Medicanes need moist environments (i.e. high values of precipitable water). These conditions are regulated by the Mediterranean surface fluxes.
Conclusions & Further Work

* **Numerical simulations are able to reproduce medicane events (intense cyclones with warm core).**

• **Surface heat fluxes influence the medicane development, helping to intensify the storm when it moves over areas with high sea-atmosphere moist enthalpy differences.**

• **These results reinforce the idea of an important role of air-sea interaction for Medicane development, but the crucial factor seems to come from dynamic forcing.** New experiments with weakened (or strengthened) upper-level PV anomalies are underway.