REAL-TIME MEDITERRANEAN CYCLONE PREDICTION FROM NWP MODELS

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At AEMET a specific procedure for real-time tracking and operational forecast of Mediterranean cyclones has been implemented. It is based on some available automatic tools to detect and characterize cyclones, as a cyclone tracking algorithm and the cyclone phase diagrams. The typology of these cyclones is very varied, from weak to very intense ones, and ranges from extensive extratropical cyclones to small cyclones with tropical characteristics.

In order to focus attention on the role played by different types of cyclones in determining weather in our region, in a first phase, the high resolution deterministic forecast from ECMWF IFS, ECHRES model, is used to forecast cyclones over the whole Mediterranean region. Special attention is paid to forecast cyclones related to severe weather events, and in particular tropical like cyclones or medicanes, that occasionally cause strong winds and heavy precipitations in the Mediterranean and its coastal areas, in order to warn of the risk with required accuracy and anticipation. A monthly cyclone database and a medicane database are being built from the ECHRES analyses and the ERA5 reanalysis, respectively.

The probabilistic prediction from the EPS is especially suitable to forecast extreme phenomena of small size and low frequency, as medicanes. Some products are provided in order to present to the forecasters the large amount of information derived from these models both in a detailed manner and in a concise and clear way. In a second phase, the procedure will be applied to a probabilistic NWP model, the $\gamma - SREPS$, with 2.5 km resolution, over the Western Mediterranean.

Mediterranean Cyclone Description Tools

Cyclone tracking (Picornell et al. 2001)
+
Cyclone Phase Space (Hart 2003)

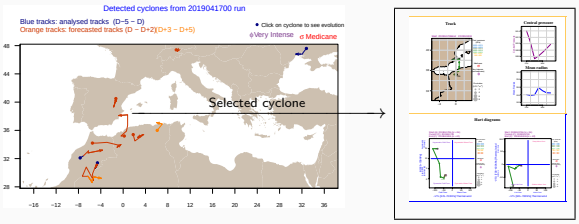
Medicane definition from NWP Models

- Very intense cyclone: $\nabla p \geq 3{,}2\, hPa/100\, km$
- Thermally symmetric cyclone: $B < 10\ m.$
- Deep Warm Corei: $-V_T^L > 0$ y $-V_T^U > 0$

(Picornell et al. 2014)

Cyclone forecast products from ECHRES

Twice a day, the tracks of the analysed and forecasted cyclones are obtained from ECHRES model. By clicking on its initial position, cyclone evolution is shown:



- Different forecast cyclone evolutions from different runs can be compared.
- For each center, information about minimum pressure value, when maximum intensity is reached or transition tropical occurs is supplied.

Cyclone database from ECHRES analysis

From the daily cyclone analyses a monthly cyclone database is being built, in order to update mediterranean cyclone climatology. A collection of cases of interest is provided and also can be useful to advance in the typologies of cyclones and to verify their prediction. Some trends in the cyclone lifespan, evolution and intensity, among other other features, can be detected.

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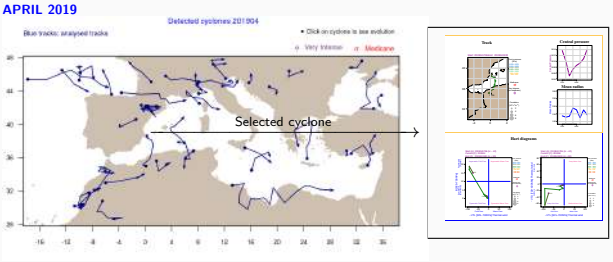


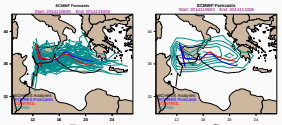
Cyclone Forecast Graphical Products from ECENS

The probabilistic prediction from the EPS is especially suitable to forecast intense cyclones, sometimes related to severe weather. Some products has been provided in order to summarize predominant characteristics but showing extreme values.
Currently, these products are not operational and have only been obtained for the Qendresa medicane forecast using the EPS from ECMWF IFS, ECENS.

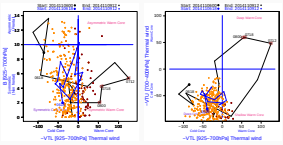
Stamp map: Each stamp represents one ensemble member forecast of cyclone track.

EPS-grams of Mean MSLP gradient and MSLP computed from 51 members of ECENS

(Picornell & Campins, 2018)



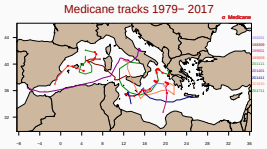
Forecast tracks from ensemble members & Track probability



Cyclone Phase Diagrams: Analysed (black line) and forecast cyclone evolution by ECHRES. Points: intense and very intense forecast cyclones by ECENS.

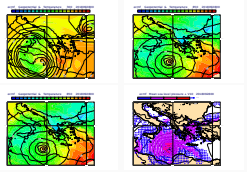
Towards a Medicane climatology from ERA5 reanalysis

- The complete set of ERA5 reanalysis data from 1979 onwards containes 40 years of weather data.This reanalysis makes possible to track the medicanes of the last four decades from the same NWP model.
- By using this procedure for full period, some medicane features (frequency, tracks, intensity, tropical transition time) are described, which allows moving towards an objective definition of a medicane (still in process) and towards a climatology of this type of cyclones (currently under construction).

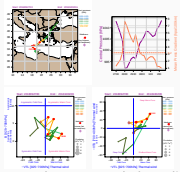


This climatology can be used as a reference to evaluate possible effects of climate change in the frequency and intensity of these quasi-tropical cyclones.

How is Zorba medicane, which occurred last November 2018, tracked from ERA5 reanalysis?



Geopotential fields and MSLP 2018092800, when Tropical Transition takes place.



Track, central pressure and phase diagrams

Future work

- This website aims to be a space to gather information on various aspects of Mediterranean cyclones. It will be completed as new results become available.
- The procedure will be applied to higher resolution NWP models, the $\gamma - SREPS$, with 2.5 km resolution, over the Western Mediterranean.The high resolution probabilistic prediction from the EPS is especially suitable to forecast extreme phenomena of small size and low frequency, as medicanes.
- During the 'Storm Naming Campaign' each storm with an impact upon Europe should be named only one way by the meteorological services and by the media. The tracking procedure can help to identify these storms over the Western Mediterranean area, responsibility of Southwest regional group. An objective definition of these storms can be proposed for further campaigns.

References

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http://mediterranean-cyclones.aemet.es
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