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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Detection and thermal description of medicanes from numerical simulation" *by* M. A. Picornell et al.

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We would like to thank the anonymous reviewer for his valuable comments and suggestions.

MAJOR POINTS:

1. P7425L1 (Page 7425 Line 1): compared to Hart (2003), you use slightly shallower layers. Anyway, the motivations for such a change are not clear. Is this change suggested "a posteriori" by the results of your analysis? This is an interesting point to discuss more in the detail.

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In the Mediterranean the 600-300 hPa layer is probably too high to look for a warm-core induced by latent heat release, coming from convection. In fact deep convection top is defined by the tropopause level, which is higher in the tropical and subtropical latitudes than in the Mediterranean ones (see Fig. 4.7 in Palmén and Newton, 1969). In accordance with this, the average annual distribution of the tropopause level, obtained from the NCEP/NCAR reanalysis for the 1981-2010 period (data provided by the NOAA/OAR/ESRL PSD, from their Web site at from http://www.esrl.noaa.gov/psd/), locates tropopause between 120-150 hPa in the tropical and subtropical latitudes whereas in the Mediterranean ones tropopause level varies from 180 to 210 hPa. Moreover, in case of medicane at upper levels the meteorological frame is usually dominated by a cut-off low or a deep cold trough (Emanuel, 2005) and therefore the tropopause is even lower during these events. For all these reasons the upper layer of exploration was lowered to 700-400 hPa; the lower layer would then be 1000-700 hPa, but 1000 hPa is too influenced by the terrain and the final election is 925-700 hPa.

To clarify this point we propose to include the following paragraph in Page 7425 Line 2 (after "... of Hart have been explored."):

" In the Mediterranean latitudes the 600-300 hPa layer is probably too high to look for a warm-core induced by latent heat release, coming from convection. In fact deep convection top is defined by the tropopause level, which is higher in the tropical and subtropical latitudes than in the Mediterranean ones (see Fig. 4.7 in Palmén and Newton, 1969). Furthermore, in case of medicane at upper levels the meteorological frame is usually dominated by a cut-off low or a deep cold trough (Emanuel, 2005), where the tropopause level is lower than generally. For all these reasons the upper layer of exploration was lowered to 700-400 hPa; the lower layer would then be 1000-700 hPa, but 1000 hPa is too influenced by

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the terrain and the final election is 925-700 hPa. "

The following reference will be included in "References" section:

Palmén, E., and Newton, C. H.: Atmospheric circulation systems: their structure and physical interpretation. Vol. 603. New York: Academic Press, 1969.

2. P7429L14: " ... the cyclone is not well simulated and therefore not classified as medicane.": In Rasmussen and Zick (1987) it is shown the presence of a upper-level warm-core, which is confined in your simulations in the lower layer. Maybe your simulations reflect better the real vertical profile of temperature in the cyclone? Alternatively, what do you think could be the reasons of the simulation failure? Please, discuss about these points.

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Although the model is able to handle a large amount of information, we think that the analysis made by Rasmussen and Zick (1987) based on the observations is more correct and reliable than the simulation because it better explains the evolution that the cyclone followed and the caused effects.

Rasmussen and Zick (1987) concluded that convection is an important factor in the formation and continued existence of the vortex. Perhaps the model does not deepens the cyclone enough maybe due to lack of convergence, lack of instability or lack of water content. An in-depth study of expected convective precipitation would confirm this hypothesis.

3. Section 4: it would be interesting in the discussion to include some considerations about the duration and radius of the medicanes you find, e.g. comparing your

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results with Table I in Tous and Romero (2013) and Table 1 in Miglietta et al. (2013).

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In the manuscript, the ranges of the warm-core radius and cyclone radius were erroneous and have been corrected (from 100-140 km to 90-180 km and from 150-300 km to 90-250 km) accordingly with figures 2b, 4b, 6b and 9b.

The following paragraph (in Page 7434 Line 8):

" We can summarize that in three of four cases an intense small cyclone is forecasted with appropriate thermal structure, that is, it is symmetric and with a deep warm-core. Warm-core radii vary from about 100 km during the most intense period up to around of 140 km. Cyclone radii range from values higher than 300 km, corresponding to parent lows, to 150 km, at the time when medicane is shrunk. "

shall be replaced by

" Comparing our results with those obtained in previous studies based on a larger number of cases, three of four cyclones are developed in two preferred areas of occurrence, the Ionian Sea and the surroundings of the Balearic Islands, identified by Miglietta et al. (2013) and in agreement with Tous and Romero (2013). Another cyclone developed west of Sardinia, region where other medicanes are also located in the two aforementioned papers. We can summarize that in three of four cases an intense small cyclone is forecasted with appropriate thermal structure, that is, it is symmetric and with a deep warm-core. Warm-core radii vary from about 90 km during the most intense period up to around of 180

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km. Cyclone radii range from 90 km, at the time when medicane is shrunk, up to 250 km, corresponding to parent lows. These values are slightly higher than the obtained by Tous and Romero (2013) and Miglietta et al. (2013), as it can be seen in Table I of both papers. These small differences were expected because different methods have been used to measure them. Besides, the initial state of the cyclone can include extensive cyclone phase corresponding to the parent low. The total lifetime of the cyclone is generally shorter than that obtained by Tous and Romero (2013), however the time that has characteristics of quasi-tropical cyclone is higher than that obtained by Miglietta et al. (2013). "

MINOR POINTS:

1. P7418L4: change into "are of small size" OR "are small sized". OK

2. P7419L19: " ... as a new key mechanism ... ": Really, a role of jet in the development of these cyclones was already identified in Reale and Atlas (2001) [their Subsection 5.b]

   Reale, O., and R. Atlas (2001), Tropical cyclone-like vortices in the extratropics: Observational evidence and synoptic analysis, Wea. Forecasting, 16, 7–34.

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   The text can be changed to:

   " ... into the cyclone phase space and jet crossing is highlighted as a key mechanism for this transformation. "

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3. P7420L11: change into " ... have been established ... ". OK

4. P7421L17: I think that a paper to cite, though not exactly pertinent to the construction of methods to detect medicanes from numerical models systematically, is Romero and Emanuel (2013):

   Romero, R., and K. Emanuel (2013), Medicane risk in a changing climate, J. Geophys. Res. Atmos., 118, 5992–6001, doi:10.1002/jgrd.50475.

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   The proposed reference will be included in "References" section. The following paragraph will be included in Page 7421 Line 17 (after "...grid spacing of 25 km."):

   " From another point of view, Romero and Emanuel (2013) apply a statistical deterministic approach that entails the generation of thousands of synthetic storms from the ERA40 reanalysis and from four different global climate models (GCMs), with the aim of assessing medicane risk under current and future climate conditions. This method produces statistically large populations of events and unprecedented wind risk maps for the Mediterranean region. "

5. P7424L17: change into " ... by Chaboreau et al. (2012), who used a radius of 200 km, and Miglietta et al. (2011), who chose a radius of 100 km (but verifying the results were consistent in a range of values), obtaining ... "

   Miglietta, M. M., A. Moscatello, D. Conte, G. Mannarini, G. Lacorata, and R. Rotunno (2011), Numerical analysis of a Mediterranean "hurricane" over south-eastern Italy: Sensitivity experiments to sea surface temperature, Atmos. Res., 101, 412–426.

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Proposed text and reference will be included in the text.

6. P7424L20: change into " ... as suggested in Hart ... ". OK

7. P7424L22: you define the mean radius of the warm core anomaly but do not define the radius of the cyclone (shown in Figs. 2,4,6,9). If you use the extension of the most external closed isobar, I think that the task of identifying this line would be pretty complex in some cases. Discuss about that.

Cyclone domain is limited by the zero-vorticity line (See P7423L10). This line is obtained from sixteen radii, defined as the distances from cyclone centre to zero-vorticity points, in sixteen directions around the pressure minimum. The mean radius of cyclone is obtained from these sixteen radii. (See Picornell et al. 2001 and Campins et al. 2006 for more details).

8. P7425L16: change into "... in the Western Mediterranean in early Fall and two ...". OK

9. P7425L25: why do you use ERA-40 and not the higher resolution ERA-INTERIM?

Originally, ERA-Interim ran from 1989 onwards. Our simulations ran in mid-2011 and at this time two of the four cases, January 1982 and September 1983 events, were not in the period covered by the ERA-Interim reanalysis yet. Therefore the

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ERA40 reanalysis was used as starting analysis.

Dee, D. P., Uppala, S. M., Simmons, A. J., Berrisford, P., Poli, P., Kobayashi, S., Andrae, U., Balmaseda, M. A., Balsamo, G., Bauer, P., Bechtold, P., Beljaars, A. C. M., van de Berg, L., Bidlot, J., Bormann, N., Delsol, C., Dragani, R., Fuentes, M., Geer, A. J., Haimberger, L., Healy, S. B., Hersbach, H., Hólm, E. V., Isaksen, L., Kållberg, P., Köhler, M., Matricardi, M., McNally, A. P., Monge-Sanz, B. M., Morcrette, J.-J., Park, B.-K., Peubey, C., de Rosnay, P., Tavolato, C., Thépaut, J.-N. and Vitart, F.: The ERA-Interim reanalysis: configuration and performance of the data assimilation system. Q.J.R. Meteorol. Soc., 137: 553–597. doi: 10.1002/qj.828, 2011.

http://www.ecmwf.int/publications/library/do/references/show?id=90276

10. P7426L18: change into "... moved north-eastward". OK

11. P7427L13: change into " ... very close each other (see ... ". OK

12. P7427L14: change into " ... disagreeing with the pressure ... ". OK

13. P7431L24: change into "off-shore Spain,". OK

14. P7435L11: change into " ... different future scenarios as well as ... ". OK

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15. FIGURE 1: ALGERIA $->$ ARGELIA; Peloponnesus is much more to the south

Names in Figure 1 have been corrected

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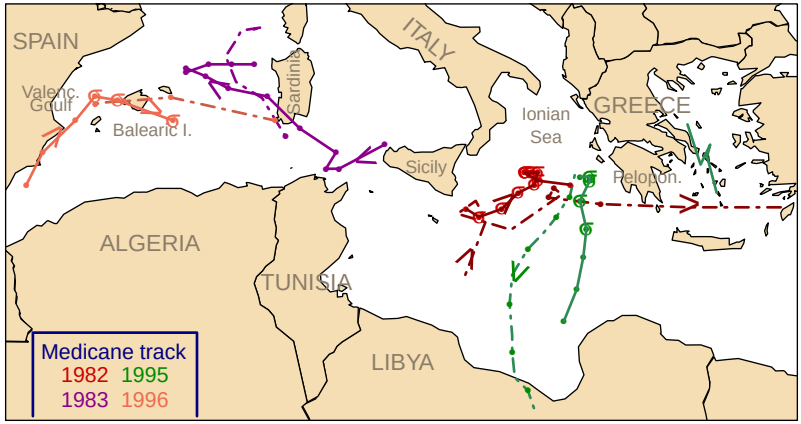

Fig. 1.

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