point-by-point response to 2^{nd} rev. of *egusphere-2023-2431*

We keep the same format as the previous "point-by-point" review, the reply to reviewers comments is written in blue here, and changes to the manuscript in red. Line numbers in my replies refer to the newer revision where the comments here are addressed.

Anonymous Referee #1

- L176ff: Why is the filtering needed before regridding? Does the regridding involve averaging of 0.32 deg information? The procedure is unclear to me and suggests that the 1.5 grid still contains local extremes from the 0.32 data, which would require justification why such extremes were representative. Why not done similarly as for the QG Omega Eq below? Please clarify.

  We acknowledge that the filtering methodology for the SGT inversion tool may lead to confusion. However, the tool has barely been employed in convection-permitting resolutions and limited area models, ours would be the first publication to report its results. We were thus concerned about the computational cost and numerical stability of the tool with inputs at such scales. Hence we decided to apply the spectral regridding to a 0.32 deg resolution, in order to reduce the extremes of unbalanced dynamics in and around convective cores, the 0.32 deg resolution is slightly coarser than the global models with parametrized convection employed by Sánchez et al. (2020) and Hardy et al. (2023). Afterwards, we applied the 1.5 deg regridding step done in both publications.

  Filtering to a lower wavenumber, equivalent to a 1.5km resolution, would retain the same grid-spacing. We are not sure how well the SGT inversion code could computationally cope with the larger arrays, and how it would converge at such very high resolutions. On the other hand, regridding to 1.5km without the spectral smoothing migh not be effective enough to reduce the unbalanced high vertical winds from the convection permitting scales, and again, we are not sure about how it will impact the convergence to the solution of the SGT inversion. The relevant lines are rewritten in L172, copied below

  Due to concerns about how the SGT inversion tool will converge with "noisy" vertical motions in the 2.2 km convective-scale model output (as previous use of this tool has used convection-parametrizing global model output), we first filter scales above wave-number 50, equivalent to a wavelength of 0.32°, following the discrete cosine filtering technique of Denis et al. (2002). High vertical winds in and around convective cores are thus filtered and are equivalent to the ones in the global model employed by Sánchez et al. (2020) and Hardy et al. (2023), where the SGT inversion tool was successfully applied. Then we follow their methodology to bi-linearly regrid the fields to a 1.5° × 1.5° ...

- L301: Why "even"? Increasing vertical shear seems to be consistent with a non-developing system. I suggest revising.

  The Sentence is rewritten at L301 and copied below, to show there are negligible differences in wind shear amongst simulations developing or failing to develop medicane Ianos.

  with negligible differences between simulations developing and not developing medicane Ianos

- L302: What is meant by "neutral"? Please clarify?

  Replaced by "weak" in L303

- L306ff: Does the increase of the thermal wind imply that the warm core strengthens? Please clarify for the non-experts of the phase-space diagrams.

  Added the sentence below at L307

  which implies that the warm core strengthens

- L312: What is meant here with "branches"? Do you refer to rain/ cloud bands? I suggest revising.

  Replaced by "cloud bands" at L313

- L315: Extending to a radius or a diameter of 500km? Please clarify.

  Extending to a diameter of approx 500km. Corrected in the text at L316

- L326: What is meant with "blending" in this context? I suggest revising.

  Replaced by "mixing" at L327.

- Pg17, discussion of PV tower: It should be noted that such a tropospheric-deep, positive PV anomaly is indeed a key feature of tropical cyclones, too.

  The following sentence is added at L361

  Such a troposphere-deep, positive PV anomaly is also a key feature of tropical cyclones (Thorpe, 1985).

- L363: How do I see the streamer intruding into the troposphere? What level is meant with lower levels? The PV tower has a warm core (high theta) up to 300 hPa, indicating diabatic origin.

  The sentence is rewritten at L365, copied below

  The PV streamer south of the PV tower intrudes into the troposphere to levels below 300 hPa.

- L509: How do we see the coupling here? We see different evolutions but how do you diagnose coupling from this figure?

  "coupling" is replaced by "connection" at L511. These couple of sentences aim to make the point that the three fields (surface pressure core, low-PV bubble and diabatic divergence aloft) look more aligned or connected in Fig. 15.h, the "good forecast", than in Fig 15.e the "poor forecast".

Anonymous Referee #2

- **Previous comment on Sections 4.1 and 4.2:(a) L197:** What is the argument to say that it becomes a medicane at this time? It is stated on the previous section of the manuscript at L209, now referenced at L229).

  Previous reply to comment: The new version has further details on the timings for medicane transition. See reply to general comment of reviewer #1.

  New comment from reviewer: As we do not have a clear definition of "Medicane" I would just say "when Ianos became a deep warm core".

  "Medicane" is replaced by "develops a deep warm core" at L230.

- **Previous comment on Section 4.3: (b) L307:** Talking about tropical-like transition here is not suitable as this is not a rubust definition in the literature. The best way to deal with this type of development is talking about the tropical transition process, to be more in line with the community that study cyclone transitions.

  Previous reply to comment: The term "tropical-like transition" is defined at L59, copied below. We replace it by, or complement it with, axisymmetric warm core or medicane in L2, L288, L340, L356 and L555 Miglietta and Rotunno (2019) conclude that the presence of a symmetric deep warm core does not imply full tropical dynamics and hence the terms "tropical-like" transition or "Mediterranean tropical-like cyclone" are often employed in the medicane literature.

  New comment from reviewer: This is related to the previous comment.

  Done at L355. All other medicane entries in the Results section are to describe "Medicane Ianos" or to describe results from cited publications. We keep these unchanged to maintain traceability with the literature.

- **Previous comment on Sections 4.5 and 4.6:** (c) L467 By watching Figure 16 (a-b), one could argue that the forcing at lower levels is stronger in (a) and, therefore, conclusions derived from Figure 15 are subject to the level of choice (700 hPa). If we choose 800 hPa or 850 hPa, for instance, conclusions could be different. Indeed, the signal seems to decrease a lot at the 700 hPa level. Please, elaborate more on this. Why not choose 800 hPa (it would still avoid boundary layer effects)? This argument of similar low-level forcing appears to be quite weak.

Previous reply to comment: It is the level chosen by Deveson et al. (2002). See reply to the first major comment of reviewer #1 ("e" in particular). The section has been entirely rewritten at L506, with new figures.

New comment from reviewer: There is a mismatch in Figure 16 regarding times in the head of the figures and figure captions and about "good" and " bad" simulations. (a) is the good simulation and (b) is the bad simulation.

Yes, reference to panels and initialisation times in the caption is wrong, thanks for spotting it! Fig 16 caption is corrected in the new manuscript, and copied below.

(a) $00Z\,15$, defined as the "good simulation" in the text, and (b) $12Z\,14$, the "poor simulation"

References

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