Referee Comments

Contribution of the solar wind-magnetosphere-ionosphere-atmosphere coupling to rapid intensification of tropical cyclones and transition of Mediterranean subtropical cyclones to tropical-like cyclones

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This work intends to investigate the contribution of space weather events on tropical cyclone rapid intensification and the transition of Mediterranean subtropical cyclones to tropical-like cyclones. The subject of this work is interesting and would contribute significantly to the community. However, there are several scientific questions that are not addressed adequately and the relationship between the space weather events and the tropospheric meteorological weather have not been established despite having presented clearly the aspect of space and tropospheric weather. Based on the following major concerns which need to be addressed, I will suggest the paper be subjected to major revision or a resubmission should be encouraged.

Major Comments

1. All the plots of solar wind parameters are difficult to understand throughout the manuscript. The vertical axis presented only the definition and range of the solar wind parameters without the scale range given. Such plot needs to be done as stacked plots with the same horizontal axis but different vertical ranges. See sample in the link below: https://community.plotly.com/t/setting-spacing-between-stacked-subplots/78332

Reply: *All the plots* of solar wind parameters *have the scale range for each parameter on the vertical axis - minimum and maximum with units indicated. All our previous publications, see references in the manuscript, include figures with compact stack plots, rather than expanded stack plots. We have never encountered any complaints from reviewers who approved of the publications. We are not studying HSS/CIRs per se but simply identifying them. Thus, our compact stack plots are sufficient and take much less space than expanded stack plots would take.*

2. The structural composition of the entire manuscript is confusing. This made it quite challenging to follow the exact point the authors are aiming at. For instance, so many subjects (say typhoon, hurricane, tropical cyclone, convective burst, atmospheric gravity waves are introduced along the sections which are not presented chronologically. I do know and understand the exact connection the author intends to establish, however, this needs to be done with care, step by step and from one phenomenon to the other. I

therefore encourage the authors to re-structure the entire manuscript, thereby outlining result and discussion section distinctly.

Reply: *As the title indicates, the subjects of this work are tropical cyclones and Mediterranean tropical-like cyclones. Depending on where tropical cyclones occur, they are called hurricanes (north Atlantic and northeast Pacific), and typhoons (west Pacific). Section 3 deals with the SPE analysis for hurricanes. That is the first step. At the end, the reader is referred to the Supplement to view similar results for typhoons. Section 4 shows the cases of tropical cyclones in the context of solar wind. This is a similar structure adopted by Prikryl et al. (2019), and the present manuscript is a follow-up study.*

However, we may understand why this structure could be confusing for the reader, who would prefer the cases discussed first, before the statistical results. Therefore, we decided to swap Sections 3 and 4. Section 5 deals with the role of convective bursts contributing to tropical cyclone intensification. This is the next step in pursuing the same subject, followed by Sections 6 and 7. We believe that this is a logical step by step approach.

3. The superimposed epoch analysis is used mostly used for pattern determination. It is expected that after matching the occurrence times of the solar wind 1 parameters to that of the tropospheric weather event, some further analysis besides the time series matching analysis should be done to address questions such as: a. Which possible physical processes might be driving the occurrence preceding the rapid intensification of tropical cyclones and transition. b. Why does the intensification occur? c. How would the characteristics of rapid intensification / subtropical transition be in the absence of space weather events? Such questions will help establish a more solid correlation. Kindly consider addressing such questions. This will help bring something novel, different from preceding works on this subject.

Reply: *Rapid intensification of tropical cyclones is known to be primarily caused by a combination of high oceanic heat content, favorable atmospheric thermodynamics, and specific internal storm dynamics (e.g., Fischer et al., 2023; 2025). These processes are, of course, independent and occur "*in the absence of space weather"*. However, forecasting rapid intensification of tropical cyclones remains a major challenge. Please note that we are proposing that solar wind-magnetosphere-ionosphere-atmosphere coupling may only* ***contribute*** *to the processes leading to RI, as discussed in Sections 6 and 7.*

4. Section 7 is attributed to lower thermospheric gravity wave excitation at high latitude. However, the author only shows the propagation distance (vertical and horizontal) of the waves. Do the authors intend to show that AGWs are among the processes that link space weather events to subtropical/tropical tropospheric weather? If this is the case, what

physical quantity (say, momentum, energy etc) are they using to establish such link? And if this is not the case, then why was gravity wave activity introduced?

Reply: *Yes, we propose that AGWs are among the processes that link space weather events to subtropical/tropical tropospheric weather. However, these AGWs do not provide significant momentum or energy to directly influence, let alone control, the tropospheric processes, because their amplitudes are very small when they reach the troposphere. Nevertheless, they can interact with instabilities like conditional symmetric instability that are present in weather systems (as explained in Section 6) leading to latent heat release that is the source of storm energy, not the AGWs. The point to be made is that the AGWs that originate at auroral latitudes are most intensely generated following HSS/CIRs arrivals and ICME impacts.*

5. Several space weather events backdated to 1995 are being reported in the manuscript, which were considered to contribute to the said tropospheric weather events. Why do the authors present only one AGW event. Are there no AGW events for other events? Please, this question needs to be addressed.

Reply: *Generation and propagation of AGWs is a very complex subject. All we can do is to show examples to demonstrate the possibility of aurorally generated AGWs to reach the troposphere, and in the presence of instabilities to suggest they can play a role in their release. We do not have access to sophisticated tools to study gravity wave propagation in detail. Unfortunately, researchers who may have such capabilities have been so far either reluctant to consider this possibility or simply dismiss it. Besides, there is no way we could present more than one or two AGW events in one article. Thus, we reference those that have already been published.*

6. As mentioned earlier, the authors used several solar wind parameters as well as tropospheric weather parameters. However, there is no coherency in terms of the presentation, and which parameter leads to the other, especially for the tropospheric parameters. I suggest the authors make a detailed revision to address this aspect as well.

Reply: *Solar wind parameters are simply used to characterize HSS/CIRs and ICMEs in the upstream solar wind, with the OMNI data being projected to the Earth bow shock. We are not sure what coherency the reviewer is talking about. There is no direct link between solar wind parameters, which represent much rarefied solar wind medium, and any tropospheric parameters. It is pointless to ask which solar wind parameter leads to any tropospheric parameter, because of incomparable physical quantities in terms of* momentum, energy etc. *But the link between solar wind and the troposphere can be mediated by AGWs releasing/triggering instabilities that are present in the troposphere (Sections 6 and 7).*

7. There are incomplete sentences throughout the text. Kindly make a thorough revision to rectify these issues.

Reply: *We will look for any incomplete sentences throughout the text and rectify them, if we can find any.*

Thank you for your comments.

References

Fischer, M. S., P. D. Reasor, B. H. Tang, K. L. Corbosiero, R. D. Torn, and X. Chen, 2023: A Tale of Two Vortex Evolutions: Using a High-Resolution Ensemble to Assess the Impacts of Ventilation on a Tropical Cyclone Rapid Intensification Event. *Mon. Wea. Rev.*, **151**, 297–320, https://doi.org/10.1175/MWR-D-22-0037.1.

Fischer, M. S., P. D. Reasor, J. P. Dunion, and R. F. Rogers, 2025: Are Rapidly Intensifying Tropical Cyclones Associated with Unique Vortex and Convective Characteristics?. *Mon. Wea. Rev.*, **153**, 183–203, https://doi.org/10.1175/MWR-D-24-0118.1.

Hazel Olive Parmes *et al.,* 2026: Rapid intensification restructures the upper tail of tropical-cyclone storm surge extremes. *Environ. Res. Lett.* **21** 124010**DOI** 10.1088/1748-9326/ae798b