

The authors are grateful to the editor and all reviewers for their time and energy in providing helpful comments that have improved the manuscript. In our revised paper, we re-checked all revisions and performed grammatical corrections to help readers understand our manuscript easier. In this document, reviewer' comments have been answered point by point. Referee comments are shown in black italics and author responses are shown in blue regular text and revised version of the manuscript is shown in green text.

General comments:

My assessment is that the manuscript has been substantially clarified and only have one remaining point that requires further consideration. The data base contains scatterometer wind speeds, while for vorticity analysis the scatterometer spatial derivatives are of more interest as they are closely associated with deep moist convection and cyclonic activity. It would in fact make a lot of sense to use these observed fields for a PL/PMC identification, rather than ERA5, as ERA5 is rather coarse (Belmonte Rivas et al., 2019). The instantaneous curl and divergence data are available as CMEMS L3 data (while CMEMS L4 contains corrected ERA5 winds).

It would hence be of great interest to add these fields to the data base, while I understand that this is a lot of work (resulting in a new manuscript I guess). Nevertheless, some of the paragraphs on scatterometry should be adapted to embrace this potential, while in the current version rather the regretful limited use of the full potential appears to be highlighted.

This manuscript stresses the use of scatterometer wind speed (not vector or spatial derivatives) and SLP. SLP is obviously associated with the scatterometer wind vector field, while mainly depicting the barotropic component. Scatterometer vector fields and spatial derivative observations are hence more meaningful to depict PLs/PMCs than SLP or other model-based variables.

Re: We sincerely appreciate your recognition of the revised manuscript and the time and effort you dedicated. Furthermore, your reminder made us realize the importance of scatterometers, particularly their derivatives, for characterizing the dynamic features of PMCs/PLs, as well as the concerns regarding ERA5's ability to consistently and systematically represent PMCs. These points will be further emphasized in the text.

Minor revision

198: Vogelzang and Stoffelen (2022) appears in the text, but not in the references.

Re: Thanks. We have added this literature to the reference list.

200: wind patterns; here divergence and vorticity (curl) patterns can be added as these are produced as L3 CMEMS products. Moreover, I noted earlier that King et al. (2022) show their intimate relationship with deep convection processes, albeit in the tropics. It of interest to highlight this.

Re: Thank you for your suggestion. We have emphasized here that vorticity and divergence are equally important information alongside direct wind speed data: These advanced instruments are specifically engineered to deliver accurate (e.g., ASCAT-A zonal/meridional wind component error standard deviations of $\sim 0.37/0.51$ m s⁻¹ and ASCAT-B of $\sim 0.39/0.44$ m s⁻¹, Vogelzang and Stoffelen 2022), high-resolution, continuous wind vector measurements

under all weather conditions, offering comprehensive global coverage of near-surface wind patterns. The full potential of these measurements extends to their spatial derivatives, specifically vorticity and divergence, which are closely associated with deep moist convection and cyclonic activity (King et al., 2022).

488: “what is retrieved from scatterometer wind measurements may not always reflect cyclone-induced circulation, but could also include contributions from large-scale advective wind”. As curl is well measured by scatterometers as well as divergence, recognizing vortices in scatterometers in a strong background flow is not difficult at all. I suggest: “scatterometer wind speeds may not always reflect cyclone-induced circulation and could include contributions from large-scale advective wind. By using the spatial derivatives from scatterometer wind vector fields, vortical structures or divergent flows near the surface associated with PLs/PMCs become easily visible (King et al., 2022)”.

Re: Thank you for your suggestion. We have corrected our statement in the original text to describe the importance of vorticity and divergence: It is important to recognize that scatterometer wind speeds may not always reflect cyclone-induced circulation and could include contributions from large-scale advective wind. By using the spatial derivatives from scatterometer wind vector fields, vortical structures or divergent flows near the surface associated with PLs/PMCs may become easily visible (King et al., 2022).

498-511: Fig.12 remains unconvincing in my view, as divergence and curl from the scatterometer are not explicitly shown. They are available in the CMEMS wind TAC: <https://doi.org/10.48670/moi-00183>. As probably exists in ERA5 for this case, I imagine also the surface winds show an elongated vortical structure and certainly convergence associated with the weak disturbance in Fig. 12b. It could also be that ERA5 is a bit too enthusiastic with vortical signal and coincidentally AVHRR shows remnants of a deceased disturbance? From my experience, the link between model winds and IR imagery is weaker than the link between surface vector winds and imagery. Please reconsider the text and the figure or remove it altogether.

Re: Thank you for your suggestion. For Fig.12, we have calculated and supplemented the more direct vorticity distribution, and emphasized the value of the spatial derivatives of scatterometer data. The case shown in Fig.12b is indeed the early stage of a cyclonic process, perhaps a moment when clouds appear before the surface circulation becomes fully established; therefore, we have also added a brief supplementary explanation:

It is important to recognize that scatterometer wind speeds may not always reflect cyclone-induced circulation and could include contributions from large-scale advective wind. By using the spatial derivatives from scatterometer wind vector fields, vortical structures or divergent flows near the surface associated with PLs/PMCs may become easily visible (King et al., 2022). For instance, Fig. 12a illustrates a system with a well-defined cyclonic circulation where the high wind speeds at its head are clearly associated with the cyclone itself. The fine-scale and complex structure of the corresponding vorticity field exhibit a strong and organized vorticity signature coincident with the cloud vortex, confirming the presence of an intense mesoscale vortex and a trailing shear line. In contrast, Fig. 12b shows a

case where the wind field is largely straight and convergent in the ambient flow, accompanied by only a weak vorticity signal ($1 \times 10^{-4} \text{ s}^{-1}$) localized near the cloud eye and lacking any broader organized cyclonic structure, suggesting that the surface circulation appears to be either not yet formed or obscured. Due to technical constraints, additional parameters such as vorticity and divergence are not provided alongside wind speed. Nevertheless, they retain substantial application potential, as evidenced by the vorticity structures revealed in Fig. 12, which demonstrate the value of scatterometer spatial derivatives in elucidating the complex dynamical features of mesoscale systems.

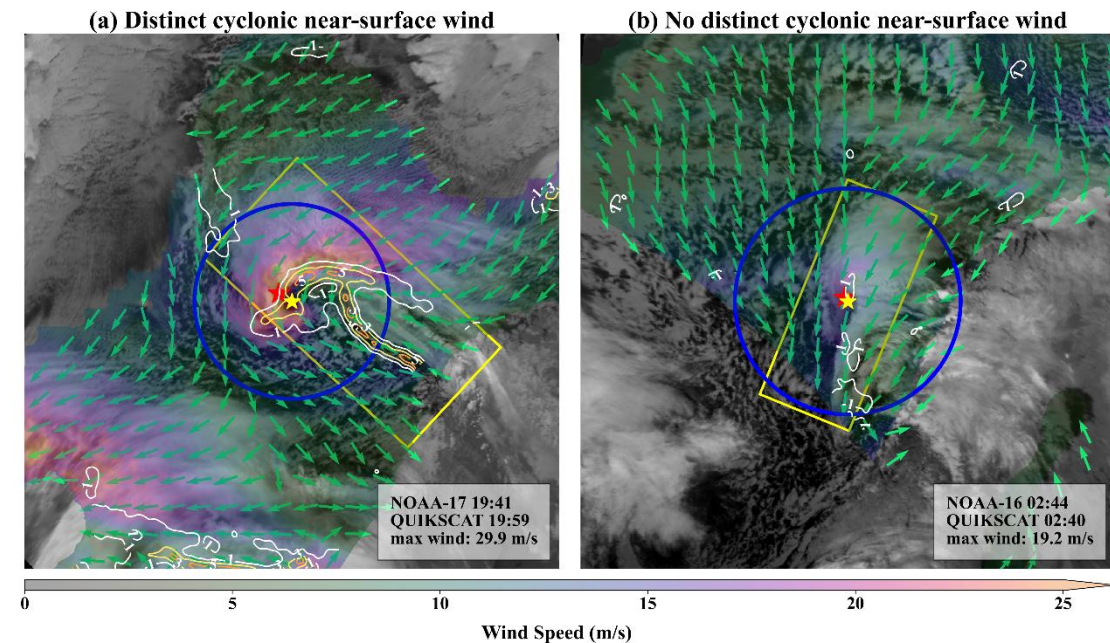


Figure 12: VCI images overlaid with near-surface wind speeds for cyclones exhibiting strong (a) and weak (b) cyclonic near-surface wind patterns. Color shading represents QuickSCAT-measured 10m near-surface wind speeds, with green arrows indicating corresponding wind vectors. Yellow borders denote the cyclones' bounding oriented box. Blue circular border represents the search range. Yellow and red stars indicate the cyclone center and maximum wind speed point locations. The vorticity calculated from the wind fields is shown as white-to-red contours, with units of 10^{-4} s^{-1} .

730: Here I suggest to promote the L3 scatterometer products containing the spatial derivatives of the instantaneous scatterometer wind vector observation fields. Certainly, the current golden age of wind scatterometry would help the future data base, if maintained.

Re: Thank you for your suggestion. In the discussion section describing the CMEMS wind products, we have emphasized the unique value of scatterometer spatial derivatives: In such cases, a more reliable validation method may be provided by the hourly bias-corrected sea surface wind product from the E.U. Copernicus Marine Service Information (CMEMS, <https://doi.org/10.48670/moi-00185>). Such product systematically corrects ECMWF ERA5 model fields using scatterometer observations to reduce persistent biases and includes uncertainty estimates. Furthermore, the L3 scatterometer products available through CMEMS, which contain the spatial derivatives of the wind vector fields (vorticity and divergence), offer a more direct characterization of the dynamical core of mesoscale systems. These observed fields hold significant potential for refining objective identification criteria, moving beyond a reliance on wind speed thresholds alone.

765: I sincerely doubt that this resource permits establishment of comprehensive objective identification criteria based on reanalysis data, thereby enabling robust analysis of climate-scale trends and genesis potential shifts in PL/PMC activity. We've noticed that ERA5 PLs/PMCs are strongly affected by the presence of scatterometers for data assimilation and, similarly, other observing systems may affect mesoscale activity trends through variable sampling over the ERA5 reanalysis period. Please remove this statement that is not proven in this manuscript.

Re: Thank you for your suggestion. We fully understand your concern. The original text has now been removed.

Reference:

King, G. P., Portabella, M., Lin, W., and Stoffelen, A.: Correlating extremes in wind divergence with extremes in rain over the tropical atlantic, Remote Sensing, 14, 1147, <https://doi.org/10.3390/rs14051147>, 2022.