

## Response to reviewer 2.

I thank the referee for the constructive review. The comments are contributing to an overall improved manuscript.

### Specific comments:

Reviewer: *L. 148-149. For Noer list, which time steps is used track point with hourly resolution or timesteps identified from satellite images? If the author uses hourly data, that might also affect the high match rate.*

Response: L. 133-134 states: "Track points are at hourly resolution due to interpolation between locations identified from satellite images." I do not think that the interpolation has a large influence on the match rate, since the matching requires that the cyclone track is located within 150 km for at least half of the track points of the PL. Interpolation is increasing the amount of track points, however the criteria has to be satisfied for the same fraction of track points (half).

Reviewer: *Table1: I suggest adding region and period for each PL list to this table. This would be helpful for reads.*

Response: Thanks for the suggestion, both is added.

Reviewer: *L. 200. Please add a brief description of how to calculate the vertical shear, especially, vertical levels used for the calculation, although it was given in Stoll et al. (2021)*

Response: A mathematical description of the calculation of the wind shear strength and angle has been added.

Reviewer: *L. 215: PL lists used to derive the PL criteria is only from Northern hemisphere. This might cause some bias in the PLs in southern hemisphere as the environment of the PLs are slightly different between both hemispheres. Although there is not any PL list with sufficient quality for southern hemisphere, I suggest noting that the PL criteria is derived from PLs in only northern hemisphere.*

Response: I formulated the following paragraph to clarify: "The distributions in the parameters utilised for the PL criteria (Fig. 1 are quite similar for the five PL lists from the Northern Hemisphere, expressing that the criteria are independent of the region and the producer of the list. Also, the mesocyclone list of Verezemskaya from the Southern Ocean presented in the supplement qualitatively agrees with the PL lists, pointing towards general applicability of the PL criteria in both hemispheres. Further, the distributions of the PLs and cyclones are distinct from each other, demonstrating that the parameters are successful for separation. "

Reviewer: *L. 215: I suggest that the author explains why these variables were tested for PL criteria before giving the criteria. I suppose that is because these variables are associated with the PL characteristics. The first paragraphs of 3.1.1, 3.1.2, 3.2, and 3.3 would suit this purpose.*

Response: I reformulated the beginning of Section 3 for this issue: "Different parameters are compared for their ability to separate between PLs and other cyclones (Tab. 2, Fig. 1, 2). Included are parameters that were found successful by Stoll et al. (2018) and new parameters that are expected to capture the characteristics of PLs or their environments." I think it is better to keep the motivation of each of the variables at the beginning of the paragraph that describes the derivation of the individual criteria to avoid jumping back and forth in the content.

Reviewer: *Fig.1: Could you indicate the values used for the criteria in the figure?*

Response: The values of the criteria are provided in Table 2 and in the text. Further, the triangle of the list with the weakest threshold indicates the criteria in Figure 1. I think indicating the values in the figure would make it rather more confusing. If you disagree, I would be interested in a specific suggestion on how the values should be indicated.

Reviewer: *L. 245: I do not agree that the  $U_{10m} > 15\text{m/s}$  can be ignored, because this criterion is important for hazards. However, when this criterion is applied to model outputs, the maximum wind strongly depends on the model grid spacing. Thus, I agree that the authors use vorticity criterion. I suggest removing "and can be ignored when utilizing the relative vorticity"*

Response: The sentence "Hence,  $U_{10m} > 15\text{ m s}^{-1}$  may be considered necessary due to the definition of Rasmussen and Turner (2003), but it is not a sufficient criterion for identifying PLs and can be ignored when utilizing the relative vorticity." is reformulated to: "Hence, a near-surface wind criteria is unnecessary for the detection of PLs when a criteria is applied that ensures a strong mesoscale vortex, as the here utilized relative vorticity criteria."

Reviewer: *L. 387-388: Why both miss and false-positive rates in Smirnova list is higher than those in Golubkin list? Usually there are trade-off relation between miss and false-positive rates.*

Response: I agree that one would expect such a trade-off relation if both lists largely agree on their interpretation of PLs and their method of detection, however disagree on the threshold at which a system is included to the list. However, the interpretation of PLs or method of detection can also be quite different. The Golubkin and Rojo list appear to agree more to each other than to the Smirnova list. For example the former two include synoptic weather maps to their procedure of PL detection, which is not the case for the latter. To clarify this, I added another sentence to the manuscript:

”This expresses that the Rojo and Golubkin list agree more on their interpretation of a PL and detection method than the Rojo and Smirnova list.”

Reviewer: *L. 407-409: There are two types of false positives in a reanalysis. One is a cyclone that is detected as a PL but is not considered as reasonable detection. The other is a cyclone that is detected as a PL and considered as reasonable detection but do not exist in the real atmosphere. The author examined only the former. The latter false positive should be evaluated by comparing the detected PLs with observation such as satellite images.*

Response: I agree that it would be beneficial to compare some of the polar tracks to satellite images. Unfortunately the Dundee satellite retrieving station ([http://due.esrin.esa.int/page\\_company69.php](http://due.esrin.esa.int/page_company69.php)) does not operate anymore. I have not found another place where satellite images from high latitudes are provided open source. I would be interested if you could point out one.

Regarding your comment, I think it is unlikely ERA-5 is producing spurious PLs out of nowhere. ERA-5 is fundamentally relying on data assimilation, including satellite images. If a satellite image would display no PL, the data assimilation would ”remove” the PL from the ERA-5 product.

ERA-5 is closely connected to the analysis step of the operational forecast from ECMWF. From my observation the operational forecast is not producing spurious non-PLs at the analysis step or the short-term forecast. Hence, I think my evaluation of false-positives is trustworthy even without comparing to satellite imagery.

Reviewer: *L. 444-445: Some references are required for this sentence.*

Response: Indeed, references are added.

## **Technical corrections**

Reviewer: *L. 62. effected  $\Rightarrow$  affected*

Response: Thanks.

Reviewer: *L. 491: count  $\Rightarrow$  are counted*

Response: Thanks.

Reviewer: *L. 620: know  $\Rightarrow$  known*

Response: Thanks.

Reviewer: *L. 667: Stratospheric 1 Warmings  $\Rightarrow$  Stratospheric Warmings*

Response: Thanks.