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 rechecked all revisions and performed grammatical corrections to help readers understand our manuscript more easily.

This document addresses reviewer comments point-by-point. Reviewer comments are presented in black italics, author responses in blue regular text, and revised manuscript text in green text.

**Reviewer #2:**

**General comments:**

This manuscript describes a polar mesoscale cyclone dataset assembled by the authors for the study of polar meteorology. In general, it is well-written, and the steps in dataset construction are well-described. The dataset compiled here definitely is useful for the community. I have some minor suggestions and comments. Once these issues are addressed, I recommend publishing this manuscript.

**Re**: We sincerely appreciate your assessment of the dataset and will rigorously consider all recommendations.

**Minor comments**

1. Title: I don't see a reason to use "Meso-Cyclone" as mesocyclone is a well-defined term in meteorology. It is just one word. Also, it is a database only for the Nordic Seas, not the entire polar oceans. It would be better to reflect this regional context in the title, or in the acronym defined for the dataset.

**Re**: Thank you for this important observation. We have revised the title to:

" IMPMCT: a dataset of Integrated Multi-source Polar Mesoscale Cyclone Tracks in the Nordic Seas."

2. Line 200, "For each vortex with available AVHRR data, …" What percentage of such vortices identified from ERA5 have AVHRR data available? This info is useful for readers. As AVHRR is on a sun-synchronous satellite, it does not have full synoptic coverage for the polar region. So the percentage of actual coverage in this context needs to be described.

**Re**: We thank you for highlighting this essential aspect for reproducibility. The

Results section now includes:

After excluding vortex tracks with >60% land presence (~20% reduction), 47,167 tracks remained for AVHRR matching. Matching required: (1) full 200-km radius coverage for individual points, (2) ≥2 matched points within ±3h of peak vorticity and ≥6 points per track lifetime. Fig. 13 shows wintertime (Nov-Apr) matching statistics: 43% of points and 61% of tracks matched on average. Only ~3% of matched tracks were incorporated into the IMPMCT dataset. This low inclusion rate stems from cloud obstruction, cloud-ice contrast limitations, temporal resolution constraints, and detection methodology (e.g., higher 2001 inclusion reflects meticulous manual identification, while 2023's lower rate resulted from post-publication incidental discoveries). Crucially, IMPMCT's cyclone proportion underestimates true PMC prevalence, as many low-cloud PMCs lack discernible features.

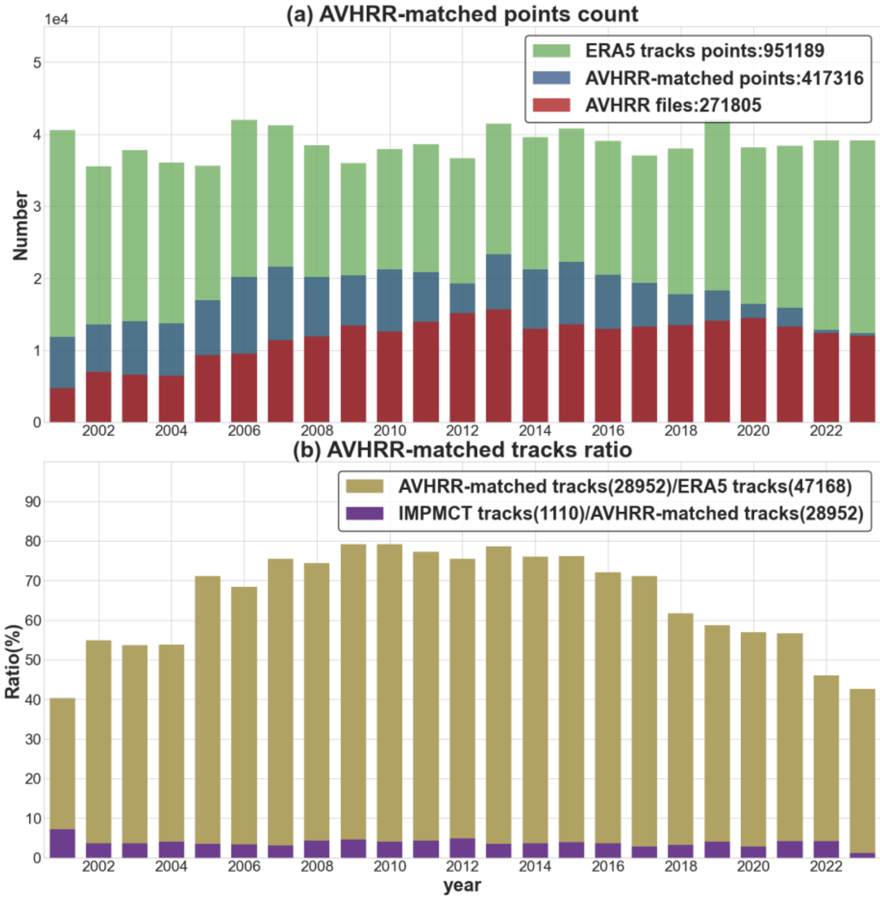


**Figure 13: Annual winter (November-April) time series: (a) ERA5-derived vortex points (green), available AVHRR files (red), and AVHRR-matched vortex points (blue). (b) Ratio of AVHRR-matched vortex tracks to ERA5-derived tracks (yellow), and ratio of IMPMCT tracks to AVHRR-match tracks (purple). Note: Bars represent distinct categories (not stacked)**

3. It is not clear to me what exact cloud properties are included in the dataset beyond the cloud morphology. Any usual cloud properties such as cloud top pressure, cloud optical depth, etc., are included? If so, it's better to specify them up front.

**Re**: Thank you for highlighting this need for clarity. The Abstract has been revised as follows:

The dataset contains 1,172 vortex tracks, 16,561 cyclonic cloud features (length, width, morphological characteristics (spiral/comma shape, center position), and 4,588 wind speed records (wind vector imagery and cyclone maximum winds). Corresponding ERA5-derived hourly vortex tracks are also provided, including 850-hPa vorticity and proximate sea-level pressure minima.

4. Table 2: Why is the matched fraction with Rojo PL tracks so low compared to the matches with the other two PL track datasets? This needs to be explained

**Re**: We sincerely appreciate your attention to this detail. Our analysis reveals two key factors for Rojo's lower match rate (71% vs. Noer's 85%): First, Rojo's direct AVHRR identification contrasts with Noer's model-interpolated hourly centers, creating greater ERA5 deviation. Second, Rojo includes secondary PL centers (54% match rate) that ERA5 resolves poorly versus major centers (80%), consistent with Stoll (2022). Fig. 1 exemplifies a frequent mismatch case where ERA5's nearest vortex center was 227 km from Rojo's observed position. For Stoll's data, we introduced "vortex matching" (99% match) to address vorticity peak misalignments from smoothing differences (Fig. S2). The manuscript text now explains:

To further investigate mismatches between the reanalysis-based tracks and existing PL datasets, we implemented a nearest-point matching analysis (Table 2). A successful nearest-point match was recorded when a PL center from any list had at least one co-temporal vortex center within 120 km (60 km for the Stoll dataset). The track-level mismatches primarily stemmed from these point-level discrepancies. Crucially, the methodological differences between datasets explain the variation: While the Noer list derives from numerically modeled and AVHRR-assimilated hourly positions (typical of operational forecasting systems), the

Rojo list relies on direct AVHRR identification at irregular temporal intervals, resulting in greater deviation from ERA5 representations. Furthermore, the Rojo compilation includes numerous secondary PL centers—features inherently less resolved by reanalysis data (Stoll, 2022)—whereas Noer focuses primarily on dominant PLs of operational significance. This distinction is clearly reflected in our analysis: Major PL centers (n=2,527) exhibited an 80% matching rate, while secondary centers (n=1,115) showed significantly lower alignment (54%), thereby reducing Rojo's overall match rate. For the Stoll dataset, we additionally calculated a vortex matching rate (Table 2), counting a match when a Stoll center fell within the spatial domain of its nearest co-temporal vortex. This metric primarily addresses positional offsets caused by vorticity peak misalignment, which appears attributable to differences in smoothing algorithms (illustrated in Fig. S2). Our implementation seems to employ stronger uniform smoothing compared to Stoll's methodology, explaining why more lenient identification thresholds yield superior track matching with Stoll’s dataset.

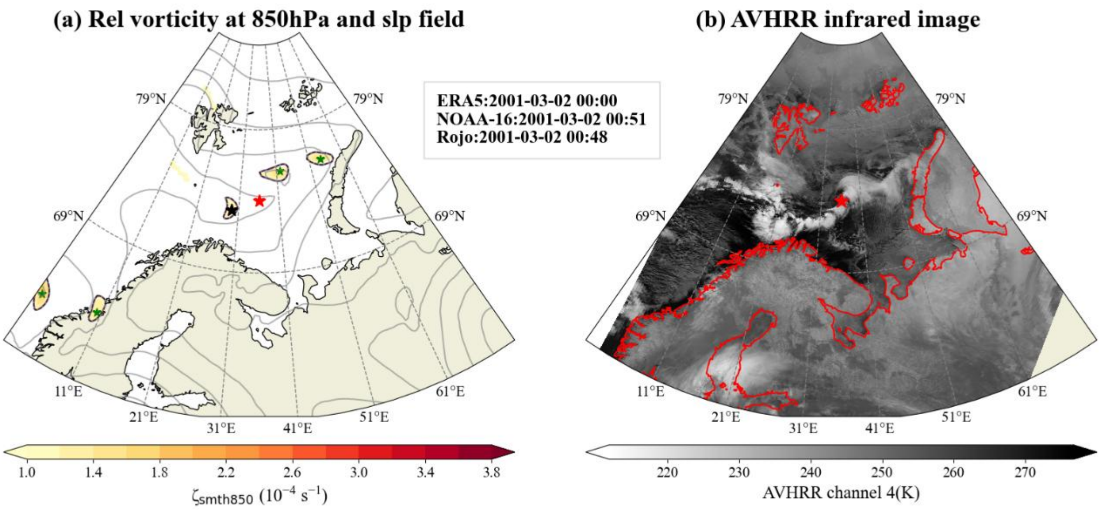


**Figure 1: (a) 850 hPa relative vorticity field obtained by ERA5 data. (b) AVHRR infrared imagery concurrent with the time step in (a). The shading represents 850 hPa relative vorticity smoothed over a uniform 60 km radius and local vorticity maxima are identified by green star symbols, while regions enclosed by solid black contours denote their borders.The red star symbol marks a mismatched cyclone center from Rojo’s PLs list, while the black star symbol marks the nearest local vorticity maxima from the cyclone center (227 km).**

**Table 1: the matching rate of the reanalysis-based track dataset for IMPMCT generation compared to other PL track datasets.**

| PL tracks | Time period | Tracks in Nordic Sea (>3hr) | Track matched fraction(%) | Points | Nearest points matched fraction(%) | Vortex matched fraction(%) |
|---|---|---|---|---|---|---|
| Noer | 2002-2011 | 114 | 87 | 1670 | 85 | - |

| | | | | | | |
|---|---|---|---|---|---|---|
| Rojo | 2000-2019 | 370 | 69 | 3642 | 71 | - |
| Stoll | 2000-2020 | 3179 | 93.68 | 75650 | 93 | 99 |

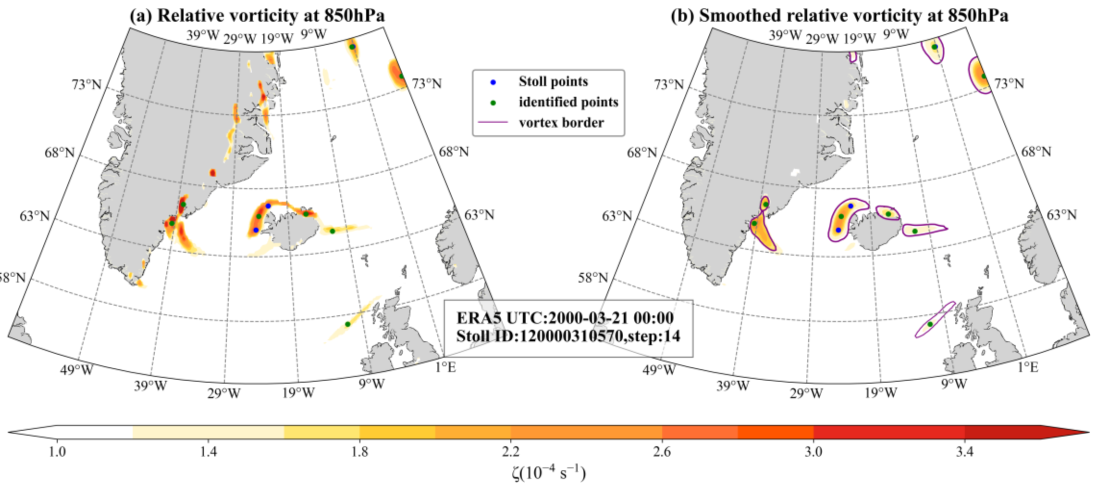


**Figure S2: ERA5 850-hPa fields: (a) Relative vorticity. (b) Uniform 60-km smoothed vorticity. Vorticity field comparison showing center displacement between Stoll (blue points) and our detection (green points)**

5. Line 598 "IMPMCT could serves as a critical benchmark for evaluating high-latitude climate model performance." It would be beneficial to elaborate on how a track-based dataset can be utilized for climate model evaluation. Are the tracks compiled here enough for robust statistics (related to comment #2 above)? What standard model output can be used directly for such comparison, or do climate models need to output high-resolution data to be used by track algorithms to generate similar datasets for comparison?

**Re**: We apologize for the oversight. A more precise statement would reference "numerical weather prediction models". The revised text clarifies:

The IMPMCT dataset serves as a critical benchmark for evaluating high-latitude numerical weather prediction model performance, while simultaneously functioning as a unique case library for comparative studies of polar lows (PLs) and polar mesoscale cyclones (PMCs) concerning their formation mechanisms, intensity thresholds, and sea-ice interaction dynamics. Furthermore, it constitutes an essential resource for enhancing polar maritime hazard forecasting. The repository of cyclone cloud morphology facilitates automated identification of model-undetected systems. This is enabled by advanced deep learning frameworks, enabling systematic evaluation of model representation fidelity for PLs/PMCs. From a climatological perspective, 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 (Stoll, 2022; Zhang et al., 2023).

6. There are occasional English typos, e.g., “could serve” not “could serves” at Line 598. A careful proofread would be helpful. I assume ESSD might have a technical editor in a later stage for such proofreading.

**Re**: We thank you for this observation. Comprehensive grammatical and spelling checks will be implemented throughout the revised manuscript.

**Reference**

Stoll, P. J.: A global climatology of polar lows investigated for local differences and wind-shear environments, Weather Clim. Dynam., 3, 483–504, https://doi.org/10.5194/wcd-3-483-2022, 2022.

Zhang, X., Tang, H., Zhang, J., Walsh, J. E., Roesler, E. L., Hillman, B., Ballinger, T. J., and Weijer, W.: Arctic cyclones have become more intense and longer-lived over the past seven decades, Commun Earth Environ, 4, 348, https://doi.org/10.1038/s43247-023-01003-0, 2023.