Follow-up Response to Reviewer 2

We sincerely appreciate your comprehensive evaluation and constructive feedback on our study. We note your concern regarding the novelty of the research methodology. Thus, in this follow-up response, we have implemented the System for Classification of Low-Pressure Systems (SyCLoPS) algorithm developed by Han and Ullrich (2025), as suggested by you, to our 20CRv3 dataset for comparative evaluation.

In your review report, you mentioned that "*The authors appear to apply two widely used trackers without any evident modification, notably when the UZ tracker has recently been enhance*". Following your advice, we have applied the SyCLoPS algorithm to extract tropical cyclone information from the 20CRv3. Then, we conducted an evaluation on the results of 2010 to compare the performance of different tracking algorithms (Fig. R1 and R2). Our analysis reveals that the OWZ algorithm (Tory et al., 2013) maintains the highest POD, followed by SyCLoPS (Han and Ullrich, 2025), and then UZ (Ullrich et al., 2021). In terms of the number of successful tropical cyclone identifications, OWZ achieved 51, followed by SyCLoPS with 47 and UZ with 43. However, when considering FAR, SyCLoPS demonstrates superior performance with only 6%, significantly lower than UZ (14%) and OWZ (26%). This indicates that while OWZ achieves the highest detection rate, it also produces more false positives. SyCLoPS offers a balanced approach with relatively high detection capability and notably low false alarm rates.

Notably, when compared to other AI-based algorithms (Accarino et al., 2023) that identify tropical cyclones from ERA5 data (Table. R1 green), the UZ and OWZ algorithms we applied to 20CRv3 also demonstrate competitive performance. Based on these quantitative results, we conclude that while algorithmic refinements contribute to improved performance, the impact on overall detection capabilities remains relatively modest. The UZ and OWZ algorithms currently employed in our study demonstrate satisfactory reliability and accuracy for our research objectives.

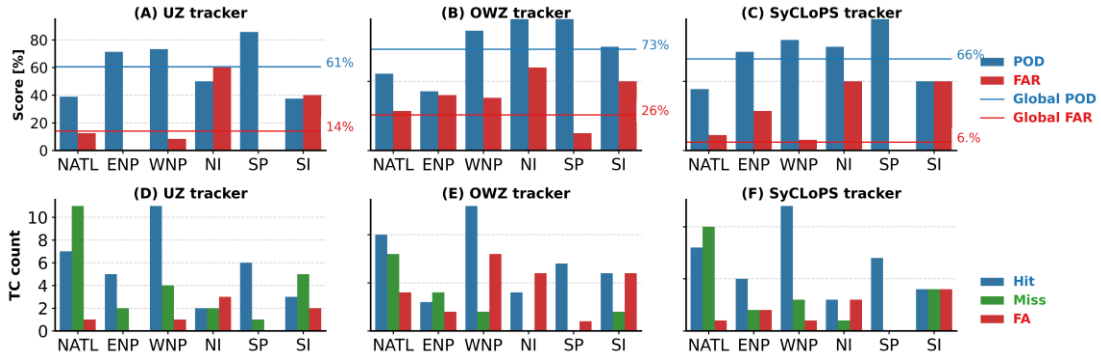

Figure R1: Accuracy of different TC tracking algorithms in identifying TCs in 2010. a–b, POD (blue bars and line, unit: %) and FAR (red bars and line, unit: %) for TC number detected by the UZ (A), OWZ (B) and SyCLoPS (C) trackers in each basin (bars), compared to the global mean (lines). Blue and red horizontal lines denote the POD and FAR over the globe. D–F, same as C–D, except for the number of hits (blue bars), misses (green bars), and false alarms (red bars) detected by the UZ (D), OWZ (E) and SyCLoPS (F) trackers.

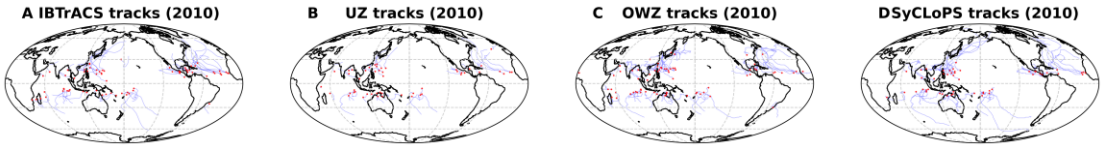

Figure R2: TC genesis locations (red dots) and tracks (blue lines) from IBTrACS (A) and tracking algorithms: UZ (B), and OWZ (C) and SyCLoPS (D) in 2010.

Table R1: The probability of detection (POD) and false alarm rate (FAR) of the global TCs detected by different trackers in the fifth generation ECMWF reanalysis (ERA5) and 20CRv3. POD (unit: %) and FAR (unit: %) of TCs detected by different trackers in the latest high-resolution ERA5 reanalysis by (Accarino et al., 2023) (green shading), (Bourdin et al., 2022) (blue shading), and RGTracks-20C (orange shading).

	Hybrid	CNRM	TRACK	UZ-ERA5	OWZ-ERA5	UZ-20CRv3	OWZ-20CRv3
POD (%)	71.49	72.77	74.37	71.54	71.75	67.62	76.56
FAR (%)	23	8.62	17.19	3.37	17.43	7.19	15.21

To further validate the algorithm performance, we selected Typhoon "MEGI" that occurred in the Western North Pacific during 2010 for detailed analysis. All three algorithms successfully detected this typhoon from the 20CRv3 and accurately

reproduced its observed track (Fig. R3). Notably, SyCLoPS provided stage classification throughout the typhoon's lifespan, with the tropical cyclone genesis and dissipation phases showing good agreement with IBTrACS observations (Fig. R4). This finding is consistent with the results reported by Han and Ullrich (2025).

We acknowledge the significant advantages of the SyCLoPS algorithm, particularly its capability to classify different developmental stages and cyclone types throughout their complete lifespans. This functionality provides invaluable information for studying tropical cyclone evolution and stage-specific characteristics that is not available through the OWZ and UZ algorithms alone. The stage classification feature represents a substantial advancement in cyclone tracking methodology, offering enhanced analytical capabilities for understanding cyclone dynamics and morphology.

Recognizing these benefits, we have initiated the application of the SyCLoPS methodology to the complete 20CRv3 dataset to supplement the RGTracks-20C database with tropical cyclone classification information. This ongoing work aims to provide the scientific community with enhanced cyclone stage categorization capabilities for more detailed climatological and dynamical studies.

Currently, we have already obtained preliminary results from our 2010 test dataset for reference and validation purposes. This additional classification information provides valuable supplementary data that complements the existing OWZ and UZ algorithm outputs. We plan to incorporate these enhanced classification features in future versions of the RGTracks-20C dataset, pending completion of the full dataset processing. Thank you once again for your valuable suggestion that help improve our dataset a lot.

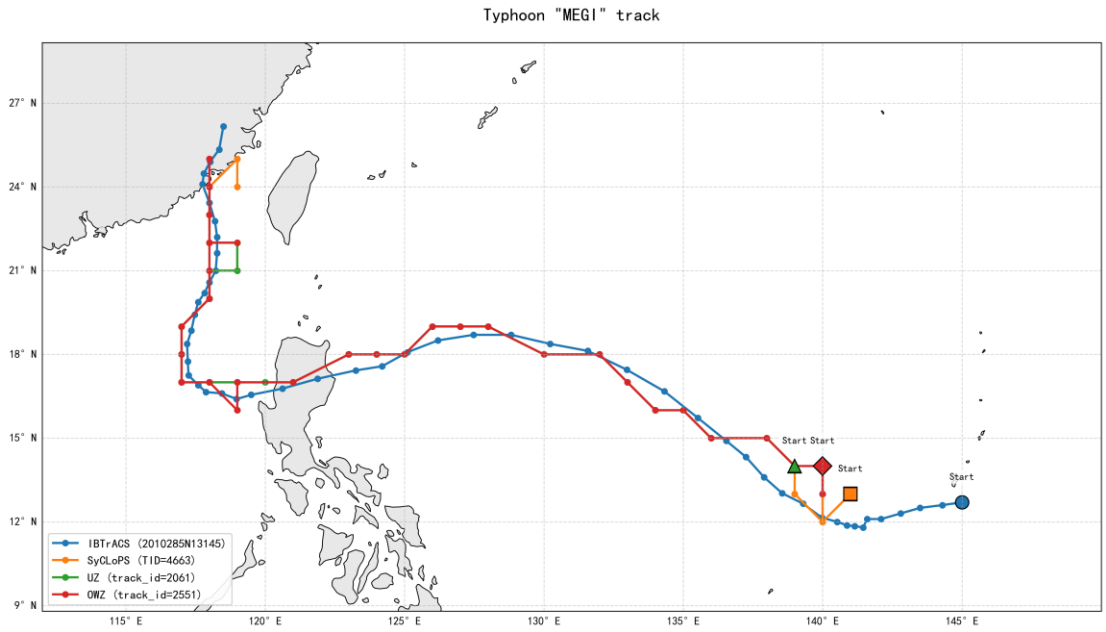

Figure R3: Best track comparison of Typhoon "MEGI" (2010) from IBTrACS and tracking algorithms: IBTrACS (blue), SyCLoPS (orange), UZ (green), and OWZ (red).

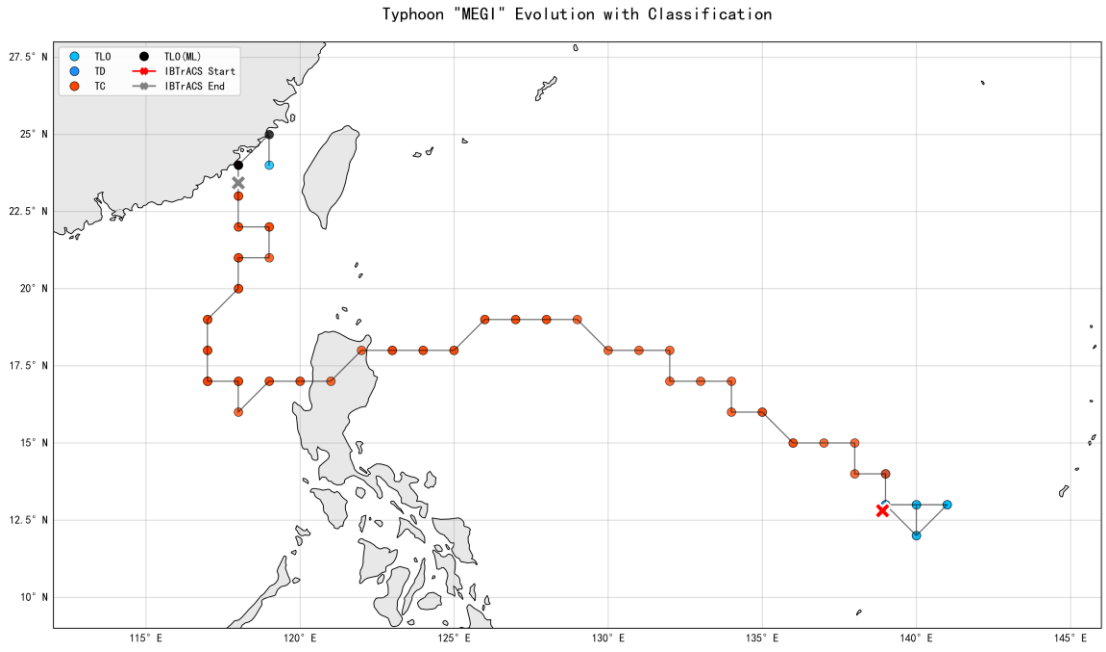

Figure R4: Classification of different low-pressure system stages during the lifetime of Typhoon "MEGI" (2010) as identified by the SyCLoPS algorithm. TLO indicates Tropical Low, TD indicates Tropical Depression, and TC indicates Tropical Cyclone. The cross marks indicate the position of the IBTrACS record start (black), the first IBTrACS tropical cyclone classification (red), and the IBTrACS record end (gray).

References

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