Title: TAMS: A Tracking, Classifying, and Variable-Assigning Algorithm for Mesoscale Convective Systems in Simulated and Satellite-Derived Datasets
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MS type: Methods for assessment of models

General comments

This preprint introduces the Tracking Algorithm for Mesoscale Convective Systems (TAMS), highlighting its development, features, and usability. The introduction offers a comprehensive overview of tracking methodologies, setting a strong foundation for understanding TAMS. Originally focused on analyzing mesoscale convective systems (MCSs) over Africa using satellite data, TAMS has evolved into an open-source Python package for tracking and classifying both observed and simulated MCSs. Notable advancements on tracking MCSs algorithm include support for unstructured grids and grid-independent tracking, enhancing its versatility and applicability. The paper meticulously details each algorithmic step, visualization techniques, and post-processing tools, making it accessible and informative. Additionally, it outlines available settings, helper functions, and ongoing development goals, underscoring TAMS' adaptability and broad utility. Overall, the manuscript presents TAMS as a cutting-edge, adaptable, and freely available tracking algorithm, suitable for the "methods for assessment of models" type. Moreover, the TAMS documentation page offers additional details and visual aids to enhance understanding of the tracking process. Overall, the manuscript provides valuable insights into the development and application of TAMS, contributing significantly to the field of MCSs tracking and assessment. With minor revisions and clarifications, it will be well-suited for publication.

Specific comments

Line 76: Could you kindly clarify if the 'fixed climatological zonal propagation speed' corresponds to the 'u projection' as discussed in Lines 187 and Table 1? If so, would it be possible to include this abbreviation at Line 76 for clarity? Alternatively, if they are not the same, could you please elaborate on what the 'u projection' refers to at Line 187? Additionally, could you briefly explain how the fixed climatological zonal propagation speed operates, including the atmospheric level used? Should users provide this information, or is it already incorporated into the algorithm? Furthermore, which dataset is utilized to derive this climatological data? Is it based on an average spanning 30 years? Would it be advisable for users to provide average winds for the same period they are tracking the MCSs? Lastly, considering its longitudinal focus, how does the tracking algorithm accommodate regions where the mean flow is latitudinal, such as low-level jet regions along mountainous areas in the USA and South America?

Line 120: It might be beneficial to clarify whether the variable assignment method allows for the identification of the environment in which the MCSs develop, or if its primary function is to assist in defining the MCSs based on various criteria, similar to the approach used in the Prein et al. (2024) study.

Section 2.1 Identification: It would be beneficial to include a concise description of the necessary setups. For example, clarifying whether it is required to provide information regarding the timestep, grid spacing, and structure of the input file could enhance understanding. Additionally, it would be beneficial to discuss why the default thresholds used to define the cloud elements (CE) are the chosed ones and whether users can modify them. Additionally, recommendations for modifications, particularly in scenarios such as tracking MCSs over South America as in Prein et al. (2024), should be provided. Explaining the factors considered when making adjustments and outlining best practices would enhance user understanding.

Line 173: It would be beneficial to provide a brief description of forward linking and recommend its usage under specific circumstances. Additionally, elaborating on the ongoing development of linking methods and their significance would enhance the understanding of their importance. Clarifying whether these methods cater to specific regions or different types of systems would also add valuable insights into their applicability and utility.

Section 2.3 and Table 1: This is another intriguing and positive aspect of TAMS that sets it apart from other algorithms. Further clarification on the definition of MCCs, particularly regarding eccentricity, would be beneficial. Is it essential for the eccentricity to be less than or equal to 0.7 throughout the lifespan of all MCSs to be considered an MCC?

Line 224: The mention of "CCCs, which include squall-line type convection" might cause confusion. It would be beneficial to briefly define "squall line type convection" and clarify why the MCCs in the algorithm cannot be of that type.

In Section 2.4, elaborating on the assignment of variables would enhance understanding of this critical aspect of the tracking algorithm. For example, the mention of computing related statistics (line 234) warrants further explanation. It would be helpful to briefly describe the nature of these statistics—are they averages related to the entire MCSs or to the CE elements? Additionally, it could be beneficial to clarify if users can select the type of statistics to be computed.

The significance of Figure 9 lies in its portrayal of MCS intensity across different categories. However, clarity is needed regarding whether the information pertains to a single moment of the MCS lifecycle (one CE), an individual value within this CE, or an average of the entire lifecycle. Such clarity is crucial for understanding and comparing the intensity of these systems over large timescales and across different regions. Depending on the objective or approach, employing a kernel of pixels to define the most intense region of the CE could be beneficial, drawing inspiration from methodologies outlined by Machado et al. (1998) and Vila et al. (2008). This suggestion holds potential for future implementation within TAMS.

Technical corrections

I would kindly suggest to review overall the text in order to not repeat defined terms. For instance, "tropical cyclones" could be defined in line 69 and not later at line 101. Similarly, "cloud elements" were defined in lines 72-73 and did not need redefinition in line 96. Please review all acronyms throughout the text for consistency. Please review the consistent usage of terms such as IR, TCC, and Tb throughout the manuscript.

Line 22: Please check for typographical ("[...] MCSs. (An MCS [...])") for clarity and consistency.

Line 88: Please double-check the reference to "MCSs Africa" for accuracy.

Line 168: Kindly review for clarity regarding the MPAS data being referenced.

Lines 219 and 223: Please confirm if "MCC" is intended instead of "MCS" in these lines.

Line 131: Please provide the TAMS GitHub access link. This addition will enhance accessibility for readers interested in accessing the algorithm as they are reading.

Line 181: Please clarify the reference to "ID". Specify the term's meaning and relevance within the context of the manuscript.

Figure 7 caption: Please verify the correct year, as it appears to be 2022 instead of 2002. Kindly confirm.

Figure 8 caption: Please include information about the domain used in Figure 8. Is it the same as in Figure 7?

Figure 9 caption: Please add corresponding legends (a) and (b) for clarity. Consider reordering the elements to list area-mean rain rates first, followed by (a), and then the minimum Tb, designated as (b).

Line 260: Please consider reviewing and rephrasing "reaching its 'precipitation rates peak'".

References

Machado, L. A. T., Rossow, W. B., Guedes, R. L., & Walker, A. W. (1998). Life Cycle Variations of Mesoscale Convective Systems over the Americas. *Monthly Weather Review*, 126, 1630–1654. https://doi.org/10.1175/1520-0493(1998)126%3C1630:LCVOMC%3E2.0.CO;2

Prein, A. F., Feng, Z., Fiolleau, T., Moon, Z. L., Núñez Ocasio, K. M., Kukulies, J., Roca, R., Varble, A. C., Rehbein, A., Liu, C., Ikeda, K., Mu, Y., & Rasmussen, R. M. (2024). Km-Scale Simulations of Mesoscale Convective Systems Over South America—A Feature Tracker Intercomparison. *Journal of Geophysical Research: Atmospheres*, 129(8), e2023JD040254. https://doi.org/10.1029/2023JD040254

Vila, D. A., et al. (2008). Forecast and tracking the evolution of cloud clusters (ForTraCC) using satellite infrared imagery: methodology and validation. *Weather and Forecasting*, 23, 233–245. https://doi.org/10.1175/2007WAF2006121.1