We again thank the reviewers for the careful and constructive assessment and constructive feedback. Below, we provide a detailed description of how we intend to address each of the reviewers questions.

1 General Remarks

While proof-reading our manuscript, we noticed that we accidentally provided an incorrect version of Figure 8 and we would like to replace it with the correct version in the final manuscript.
We sincerely apologize for overlooking this during the submission and review process.
Figure 8 in our original submission was generated using only the events belonging to Cluster C from the cluster analysis presented in Section 4.2. During our analysis, we created the corresponding figures for all three clusters, but these were not intended for inclusion in the manuscript. Please find these figures below (Figure 1):

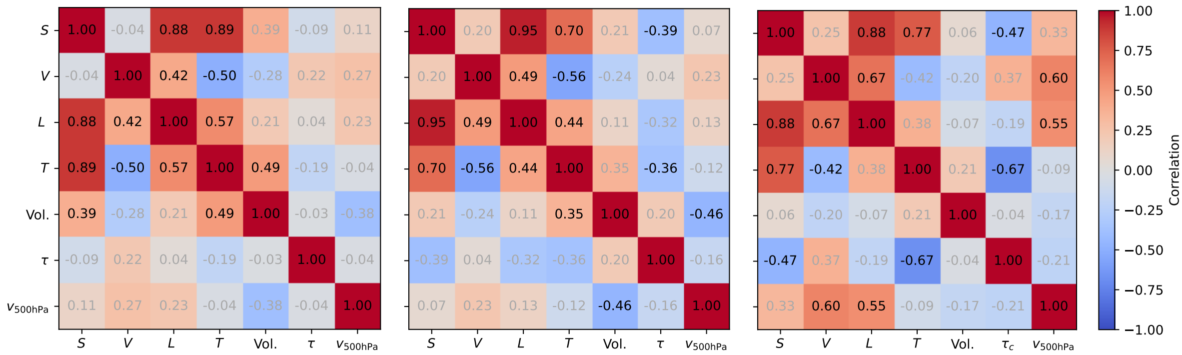

Figure 1: Pearson correlations, similar to Fig. 08 of our manuscript, but estimated based on the subsets of events assigned to cluster A (left) B (middle) and C (right).

The revised Figure 8 is consistent with the original version in terms of the signs of the correlations. However, it includes a larger number of statistically significant pairs, as it is based on the full dataset of 100 events rather than the reduced subset of cluster C. Importantly, the correlation of 0.68 between ($v_{500,\mathrm{hPa}}$) and (V), reported in line 332 of our manuscript, is correctly represented and consistently assigned in the revised figure. We apologize for the inconvenience.

2 Review 1

1. Connection to classical atmospheric scale classifications. The method explicitly references classical atmospheric scale definitions (e.g., Table 1 in Thunis and Bornstein, 1996, though equivalent figures appear in standard meteorology textbooks). It would be helpful if the authors briefly discussed how the derived length and time scales L and T can be used to classify an event within such a framework. A short clarifying paragraph in the text would strengthen the practical utility of the method. Ref: Thunis, P., and R. Bornstein (1996), Hierarchy of mesoscale flow assumptions and equations, Journal of the Atmospheric Sciences, 53(3), 380–397.

    We included a more detailed descriptions in the introduction and conclusion part of our manuscript:

    Line 40:
    The key idea in this paper is that knowledge of typical scales in the precipitation field allows us to draw conclusions about the processes that generate the precipitation field - in the spirit of a scale analysis that tells us which characteristic dynamics prevail at specific scales.

    Line 417:
    The derived characteristics establish a direct link to classical classifications of atmospheric scales (e.g., Kraus, 2004; Thunus 1996). While the present study focuses on precipitation, the same methodology can also be applied to other atmospheric variables such as wind or pressure, enabling a scale-sensitive characterization of a wide range of atmospheric processes.

2. Choice of ERA5 for physical validation. The authors use ERA5 to investigate the physical foundations of the method. It is worth clarifying why a global reanalysis product was preferred over a convection-permitting model for this purpose, given that the latter would arguably provide a more physically consistent representation of intense convective precipitation at the scales of interest.

    We included a discussion on this as follows:

    Line 188:
    Both variables are averaged over the same spatiotemporal window which is used for the WT, i.e. a four-day window over Germany (see Sect. 3.2). This large-scale averaging reduces the relevance of convection-permitting processes, which supports our choice of ERA5 data instead of smaller-scale, convection-permitting

datasets. Further, at the time of writing, convection-permitting simulations with a spatial and temporal coverage consistent with the RadKlim dataset were not available.

Line 327:
In a final step, we aim to quantify the characteristic properties using the additional data source ERA5. The characteristic variables L, T, V, and S are aggregated quantities. They are derived from precipitation over the four-day window over Germany described in Sect. 3.2, and the information contained in the wavelet spectra is further condensed into a single characteristic spatial and temporal scale. Therefore, our analysis is not designed to resolve convective-scale processes. Instead, we aim to assess whether the proposed characteristic variables are consistent with the large-scale atmospheric dynamics governing precipitation events.

3 Review 2

The authors did a good job to improve the clarity of presentation. However, one issue remains. It is unclear why the authors engineer a variable named "characteristic scale S" which is not more "characteristic" than than L, T, or speed V. I argue that S is irrelevant, because e.g. (L, V) already provides a complete physically-interpretable description. Specifically, the authors claim two things (L384-387):

1. There are two independent characteristics: speed and scale.
   → I argue that they are not independent in a functional sense. $S = L/std(L) + T/std(T), and VT = L$. Thus, $S = T \cdot (V/std(L) + 1/std(T))$. Thus, S and V are not independent.

2. S and V represent physically interpretive quantities.
   → S is a nondimensional, nonphysical, additive combination of L and T. Wouldn't it be more interpretable to stay with variables (L, T, V) ?

We agree with the reviewer that any pair of variables from L, T, V, and S provides a complete description, since they are functions of the same underlying variables, L and T. In this sense, there is no unique or preferred choice of coordinates. By introducing the characteristic variable S, we obtain a representation in terms of S and V that exhibits a correlation close to zero in our application (see revised Fig. 8 in the manuscript or Fig. 1 in this response). Thus, both variables capture different aspects of the event structure with negligible redundancy, which in turn simplifies the interpretation of S and V.
However, we agree that, from a physical perspective there is no intuitive interpretation for S, unlike for L, T, and V. We have revised the manuscript to clarify this and to avoid any implication of functional independence. In particular, we now explicitly state that the two characteristics are not independent but only weakly correlated. Specifically, we now write:

Line 382: By introducing S together with the characteristic speed V, we propose a new representation of the spatiotemporal characteristics of precipitation events. We see that the two quantities are only weakly correlated in our dataset (Fig. 08), despite both being deterministic functions of L and T. Any pair of variables among L, T, V, and S provides a complete description of the events, as they are derived from the same quantities. The choice of representation is therefore not unique, but depends on the desired interpretation. In our case, the weak correlation between S and V indicates that they capture complementary aspects of the event characteristics and provide a compact and non-redundant statistical representation.

3.1 Technical corrections:

Fig 4, caption: "Eg. 10" → Eq. 10

– Corrected.

Fig 4, caption: "white, gray and lightgray" - I only see lightgrey, grey, and black?!

– This is indeed correct. Thank you for pointing this out. We corrected the caption.

L384-385: There seems to be a duplication. "Our analysis revealed two key parameters: the characteristic scale, and the characteristic speed. By introducing the characteristic scale, we identified two independent characteristics: speed and scale."

– We revised this paragraph and removed the duplication.

L393: significance → significant

– Corrected.

L421: Wording could be made more concrete "The information about quantifiable changes supports their physical interpretation"

– We now write: ”Our scale-aware analysis of precipitation events can further provide new insights into the underlying processes, which operate across a range of spatial and temporal scales.”