Review of "Physical Processes Leading to Extreme Day-to-day Temperature Change - Part II: Future Climate Change"

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submitted to Weather and Climate Dynamics

General comment:

In this paper, the authors investigate extreme day-to-day temperature changes and how these are projected to evolve under future climate conditions. They analyse an ensemble an ensemble of simulations with a climate model, comparing results for the present climate with ERA5 reanalysis data to build confidence in the model performance, before examining projected future changes. The strongest projected changes in day-to-day temperature variability are found for DJF, with decreases in the extratropics and increases in the tropics. The authors further analyse associated changes in flow patterns and in the contributions from adiabatic warming, diabatic heating, and advection by accumulating the respective terms along computed backward trajectories. They identify a reduced contribution from advection as the main driver of decreasing day-to-day temperature changes in the extratropics in DJF, while increases in the tropics are largely attributed to changes in adiabatic and diabatic warming.

Overall, I find the study interesting and the results valuable. In particular, the successful implementation of trajectory calculations within a climate model framework is a notable strength of the paper, as such analyses are often challenging due to the limited temporal and spatial resolution of typical climate model output.

That said, I believe the presentation of the material could be substantially improved. My comments below are therefore mainly concerned with the clarity and structure of the presentation, rather than with the underlying scientific approach or results.

Major comments:

1) The descriptions in the manuscript are often quite lengthy and at times somewhat repetitive. For example, results are first presented for DJF warming events in the present and future, then DJF cooling events, followed by JJA warming and cooling events, and subsequently for the tropics. To enhance reader engagement, it might be helpful to introduce the figures once and then focus more on highlighting the key differences, while keeping the descriptions concise and emphasizing the essential points.

2) Playing the devil's advocate: How physically meaningful are the computed trajectories within the atmospheric boundary layer and especially in the tropics where turbulent mixing is intense? I think a brief discussion on the limitations or uncertainties associated with the trajectories in these regions would strengthen the study.

Minor comments:

L15/16: The mention of a "clear dipole pattern" is somewhat confusing to me. You mention a "clear dipole pattern", but then for JJA the pattern does not clearly take a dipole form. Consider rephrasing.

L18: "only" instead of "also"?

L19: I think you should be more careful here when writing "due to Arctic Amplification".

L37: “imperative” is a very strong word. I would be a bit more moderate here.

L56: “for the past” instead of “in the past”?

L63: I would avoid citing Mayer (2025) when discussing the importance of diabatic heating, as Mayer (2025) emphasizes the role of advection in temperature extremes rather than adiabatic or diabatic processes.

L69: “process understanding” instead of “processes understanding”?

L95: “use” instead of “utillise”

L106: In its current position, the formula does not appear to be well integrated into the text. The same applies to Eq. (2).

L110: Why are these seasons “key seasons”? Rather explain or omit the “key”.

L124-127: I would omit the lengthy description of all the individual grid points in the supplement.

Eq. (2): It might be helpful to write out the integrals explicitly to clarify exactly which terms are being computed.

Eq. (2): Why do you accumulate over 3 days? Is there a physical reason? Have you tested the sensitivity of your results to other accumulation periods?

L134-136: It is not clear what is meant by “mean temperature difference” or “mean adiabatic compression.” Consider clarifying the meaning of “mean” here.

L147/148: There seems to be a contradiction: first, the results are said to fit ERA5 “in many regions,” then to deviate “in large parts.” Consider clarifying this.

Figure 1, 2, 3, etc.: I think it would be helpful to use white color for small deveations around 0.

L162: The pattern does not appear as “distinct” to me.

L166/167/177: Phrases like “changes are driven by”, “increases due to”, or “influence” imply causality to me. Since the decomposition (into σ_T and autocorrelation) is “just” descriptive, I think you avoid implying causality.

L179/180: The statements about Chile are contradictory: first mentioning it as an exception, then saying “(apart from Chile).” Consider clarifying.

Figure S3: The description is very detailed, but the figure is in the supplement. Consider either shortening the description or moving the figure to the main text.

Figure 3/4/7/12/13: The figures are very small, which makes it difficult for the reader to fully appreciate their content.

L208: omit the “future” as projected already implies future?

L239: Out of curiosity: Do you have an idea why the contribution of the diabatic heating is larger in the CESM-LE compared to ERA5? Could this relate to vertical resolution?

L245: When mentioning “Rossby wave propagation,” consider providing supporting evidence or omitting the comment.

L253: I was stumbling across the formulation “This reduction is because ...”

L585: “driven by” and “due to” as before. I think you should refrain from implying causality here.

Several transition words (e.g., “conversely” in L627, “however” in L583, and “in contrast” in L660) do not seem appropriate in their current context and may be misleading. Revisiting these connectors could help improve clarity and flow.