Dear Dr. Raveh-Rubin,

We appreciate the thoughtful comments from the two reviewers and the editor. Based on the feedback provided, we surmise that the main concern is that there is a disconnect between the aims of the study (examining feedback mechanisms between the moist margin and extratropical Rossby waves) and the approach used, particularly the latent heating experiments.

We believe that these comments can be addressed with a substantial reframing of the work, particularly the introduction and research questions, to more accurately reflect the contents of the analysis. The motivation of this study is not to investigate the already well-documented relationship between heating, cyclones, and midlatitude Rossby waves. Instead, we are motivated by the previous studies of Robinson et al. (2024) and Robinson et al. (2025), who highlight that poleward excursions of the moist margin are strongly related to extreme precipitation outside the deep tropics. In particular, we hypothesise that moist margin "wet perturbations" (regions where the moist margin moves poleward of its usual position) may act as nuclei for interactions with the extratropics. This is exemplified in the results of Robinson et al. (2025), who demonstrate that moist margin perturbations in the proximity of extratropical PV anomalies display a prominent structure with heavy rainfall extending over a large area from the tropics to the extratropics (see their Fig. 6g-h). Associated with this is a surface trough/cyclone and a strong upper-level ridge downstream of this. The question relevant here is then "what dynamical processes are involved in such interactions that result in this configuration?". We hypothesise that mechanisms such as horizontal moisture advection and latent heating are important, which is what motivates the moisture budget and latent heating aspects of this work respectively.

In the case study analysed in this paper, a strong sub/extratropical cyclone is produced due to this interaction. Here, the "interaction" refers to the coexistence of a moist margin perturbation with an extratropical Rossby wave (most apparent on 03 Jan, e.g. see Fig 2e-f). As the cyclone strengthens and moves poleward, the moist margin becomes less important, and we move towards familiar territory as the feedbacks are directly between the cyclone's warm conveyor belt, heating, and the associated production of PV. However, we hypothesise that the initial development of the cyclone is dependent on the co-occurrence of a Rossby wave and a poleward moist margin perturbation. In this sense, the connection between the moist margin and extratropical PV is an indirect one, as pointed out both in the study and in reviewer reports.

We emphasise that the latent heating experiments are only one component of the analysis in this study. Latent heating is one mechanism proposed to be important due to the proximity to abundant moisture within the moist margin. The results of the experiments suggest that it indeed is an important mechanism to the subsequent evolution of the system.

We acknowledge that there is limited evidence of a direct connection between the moist margin and extratropical PV, which we plan to note more clearly in the revised manuscript. The key point is that being inside the moist margin permits for strong convection to occur, which can then affect the extratropical PV through upper-level divergence, if it is in the vicinity of the jet. The tropical-extratropical interaction is further exemplified by the trajectory analysis, which confirms that much of the moist air within the moist margin perturbation is indeed sourced from the tropics (Fig 6, left column).

In response to the reviewer's concerns, we will substantially amend the motivation and storyline of the manuscript. As part of the revised introduction, we will include a more detailed introduction to the moist margin and its usefulness as a diagnostic for tropical precipitation and well as its potential use for studying tropical-extratropical interactions, based on previous literature. We will also revise the research questions to be more specific, for example by outlining the specific physical processes we investigate, and the corresponding approaches used to investigate these processes. Results that do not contribute to these research questions will either be revised or removed, making the structure and presentation of results clearer.

With respect to atmospheric rivers and related phenomena, we will include a more detailed discussion of these in relation to the moist margin as part of the revised discussion. This will also include a discussion of previous literature discussing the role of latent heating in extratropical cyclones and blocking (which may also be incorporated into the introduction).

Some further modifications in response to reviewer comments include:

- We will amend the abstract to describe specific results and methodology more specifically and place these conclusions into context in the existing literature.
- More methodological details will be provided in the revised manuscript as appropriate, including relevant thresholds for the moist margin and the averaging period for Figure 11, and other details in figure captions.
- We will revise and restructure the discussion and conclusion section (Section 5) by making the key conclusions clearer and more specific, and by reducing the "future research" section in place of further contextualisation of the results in the existing literature.
- Other minor/detailed comments will be considered as appropriate.

Given that our planned revisions are mostly related to a reframing and restructure of the work, with only minor additional analysis possibly needed, we believe that we can provide a significantly improved manuscript within the two-month deadline. We anticipate that the revised manuscript will provide a clearer story of what the aims and key conclusions of this study are. We will provide a more detailed point-by-point response to all reviewer comments along with the revised manuscript at a later date.

Yours sincerely,

Corey Robinson

References:

Robinson, C. M., S. Narsey and C. Jakob (2024). "Synoptic Variability in the Tropical Oceanic Moist Margin." Journal of Geophysical Research: Atmospheres **129**(11): 1–14.

Robinson, C., S. Narsey, C. Jakob and H. Nguyen (2025). "Weather systems associated with synoptic variability in the moist margin." Weather and Climate Dynamics **6**(2): 369–385.