

“How do clouds and turbulence shape the northeasterly low-level jet of a summertime Arctic cyclone during its cold core transition?”

by

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Recommendation: major revisions

General Comments:

The manuscript investigates the origin of a low-level jet in a specific Arctic cyclone case that was observed during the THINICE campaign. While the analysis and method seem interesting, the manuscript would significantly benefit from a more streamlined structure, as it is often difficult to follow the presentation. In particular, the text could also be more precise with less repetition. For example, it is not necessary to repeat large parts of the figure caption in the main text. Instead, the main text could focus on the scientific discussion with a pointer to the figure at the end of the sentence. Furthermore, parts of the method are sometimes repeated in the main text and for the trajectories important methodological information is in the main text, whereas it would have helped the flow and better readability to ensure that the method section is complete to focus on the scientific discussion in the main part of the manuscript.

While the introduction lists several studies related to Arctic cyclones and cyclones in general, it fails to directly motivate the study at hand. The problem statement of the manuscript in the last but one paragraph does not connect well to the previous paragraphs. The authors should try to more directly address the gap in the research and motivate the research question at hand for the presented study. This would help the flow of the introduction and into the main part of the manuscript.

The equations (1) and (2) are not equivalent to equations (3) and (4). If zeta is the 3D absolute vorticity vector, it also includes derivatives of vertical velocity. However, these derivatives of vertical velocity were dropped in equations (3) and (4). A justification needs to be given for this neglect. Especially for mesoscale circulations, which as a key topic of this manuscript, gradients in vertical velocity can contribute significantly to the vorticity vector and hence PV.

Overall, it is not clear what the manuscript aims to achieve in terms of scientific advancement. While the analysis is sound with interesting results, the context of how these results address a scientific question that contributes to an advancement of our understanding is not clear. In the synthesis, all results are briefly repeated, and a short discussion is presented to put the findings into context with previous studies that mainly already found very similar results. The authors need to focus more on the scientific gaps they aim to address and how their analysis contributes to answer specific research questions. It would also be of great use if the authors discuss their findings in more detail, instead of the more descriptive presentation in the manuscript. Also, it is not clear why the PV framework was chosen for this specific analysis. What is the concrete scientific question that the authors are trying to address and why is hence the chosen methodology the most adequate. Given that this study is focused on one single case, it is also not clear

how the presented findings might be more generally applicable, or how the authors envision that more general conclusions can be drawn from their findings.

The flow of the manuscript could also be improved if some figures would be combined, which would also ease comparison. For example, figures 5 and 6; 7, 8, and 9; 10 and 11; 1 and 13.

The authors are encouraged to perform a grammatical check of the entire manuscript, as there are several sentences that require some attention. Only a few specific cases are indicated in the specific comments below.

The manuscript would benefit from a more succinct presentation with a clearer motivation as well as a more concise conclusion on how the presented analysis closes the research gap, which needs to be clearly outlined in the introduction.

Specific Comments:

Line numbers refer to the ones on the manuscript.

L42: summertime

L54: Ertel

L95: "...”?

L182: reanalysis

L209: non-conservative

L222: reveals