

Review for EGU Cryosphere: Contrasting Impacts and Mechanisms of Clustered versus Isolated Summer Atmospheric Rivers on Arctic Sea Ice Melt

The author evaluates two case studies of Arctic atmospheric rivers (ARs) and compares their radiative signatures relative to sea ice melt. The author finds that the case with successive ARs resulted in greater impact to sea ice than a single isolated AR. They claim that this reflects “a paradigm shift” in sea ice response dependent on AR frequency rather than moisture transport.

The subject matter is valuable and will be of interest to the scientific community. However, I find substantial concerns regarding the quality of the manuscript. Missing and incorrectly labeled figures makes it impossible to evaluate the claims made. The methods provided are minimal, making it impossible to replicate the analysis in the current state of the manuscript. There’s a striking lack of citations after the introduction section, which is greatly alarming. There are also formatting and language issues that severely inhibit the credibility of the manuscript. Unfortunately, many of the formatting and language issues are potential artifacts of generative AI. Whether or not it is the case, these artifacts suggest that generative AI played a larger role in the manuscript than is permitted per the Cryosphere AI policy.

Due to these concerns, I recommend rejection of the manuscript in its present form. I would be interested to see an improved version according to the comments below, but recognize the requested revisions consist of a large amount of work.

Major Comments

The precision of scientific terms should be improved. For example, the terms atmospheric river, moisture intrusion, and pulse are used interchangeably, even though ARs and moisture intrusions are well-defined concepts in relation to each other. The analysis should maintain the same term throughout or clearly distinguish ARs from MIs from pulses. Specifically, I would encourage the author to change from “pulse” to “AR” and from P1 to AR1, etc. I believe this will expand the reach of your paper as folks are more used to ARs as a term and are more likely to look for mentions of “AR” in your text, rather than pulse.

The introduction is pointedly missing a discussion of previous work on Arctic ARs on sea ice. Even though the introduction has a section titled “Dynamic and Thermodynamic Mechanisms of Sea Ice Melt”, only one of the papers cited pertains to ARs. While the

subject is relatively new, there are a handful of papers that would aid in the contextualizing of this manuscript.

The methods section needs to be reformatted. It should be written out in paragraph format, rather than in a bullet list with bold words. It also lacks a list of ERA5 variables that were used, a thorough description and justification of the ARDT used, a description of the temporal and spatial resolution of the data, a discussion of limitations and biases of the methods, and a definition of the study region. I also find the description of AR attribution lacking entirely. I wonder how the author isolated the impact of ARs versus the associated extratropical cyclones or other weather when assessing impacts on sea ice.

NSIDC was credited with the sea ice concentration data in the acknowledgements, but there was absolutely no mention of sea ice in the methods. This concerns me as the primary motivator for the analysis is the AR impact on sea ice.

The premise of the paper relies on a comparison of the two AR events, but the sea ice state is not compared. Sea ice is discussed little, especially considering the title. Please compare the initial sea ice state between the 2012 and 2020 events. How do the results account for the initial conditions being different? Was there a comparison between SIC changes for 2012 versus 2020?

The results suffer from missing or incorrectly labeled figures. I have noted these instances in the line edits. The results section also has very few precise numbers in the text, degrading the claims made that do have properly displayed figures. The results would be improved with corrected figures, added values in the main body text, a discussion of statistical significance throughout, and a discussion of the limitations of the study.

Often, the text claimed that figures displayed different periods than provided. Each figure and analysis should explicitly describe which months and years were used in their calculation.

I could not find a single citation after the introduction, even though larger claims are made, and broader context is given throughout the paper. This is very alarming to me. I think this issue alone could be grounds for rejection.

The entire manuscript has nonstandard formatting issues, some of which signal the usage of generative AI. There were two instances of bullet lists in the methods and in the conclusion. These should be written in paragraph form. Only proper nouns and acronyms should be capitalized, and bold and italicized text should not be used. Variables do not need to be capitalized when discussing them, even if the letters are capitalized in the acronym. Throughout, there are terms with quotation marks and capitalization. From Section 3.4 onwards, these terms are also bold. Section 4.4 also features italicized text to

convey emphasis or occasionally for acronyms (i.e., “LW” line 371, “DLR” line 375). Please remove all quotation marks around terms unless they are being coined by you and are central to your analysis or are quoted from another paper, in which case add the citation. There were also grandiose statements with the same structure known to be typical of GenAI: “The xx is not merely xx; but instead, xx very large or pointed claim.” See lines 130-140, lines 202-204, lines 224-225, lines 233-235, lines 286-287, lines 304-306, lines 379-380, lines 434-435. Even if generative AI did not entirely write these sections, the formatting is nonstandard and degrades the credibility of the manuscript.

I also had some concerns with the tone used, which was not academic. I have classified the tonal issues into three categories below:

1. Casual or business-speak language. Examples: “synergy” (line 163, 238, 254, 399), “synergistic” (line 138, 231), “synergizes” (line 161), “Thermodynamic Pressure Cooker” (line 198), “snapshot” (line 238), “dipped into the negative zone” (line 280), “thermodynamic scout” (line 412).
2. Extreme language without quantitative support. Examples: “catastrophic” (line 169, 239, 329, 383), “colossal” (line 171), “extreme thermodynamic stability” (line 174), “extremely short window” (line 266), “the most devastating... consequence” (line 274), “final thermodynamic proof” (line 371).
3. Inappropriate evocation of violence. Examples: “violent” (line 266), “assault” (lines 157, 301), “thermodynamic defense” (line 256), “tactical multi-stage assault” (line 260).

The end of the manuscript contains many strong claims that include words like “definitive proof”. I do not find these claims reflective of the work in the study. The conclusion should be rewritten to reflect the work performed and highlight the limitations of the interpretability of the findings, especially in the context of Arctic regime change.

Minor Comments

Figures

Figure captions should be revised and any discussion within them should be removed. Commas within and before units should also be removed.

Please add labels for each location mentioned in your results on at least one figure.

Figure 1. It would be interesting to add another line for sea ice extent to further demonstrate your point of 2012 and 2020 being low sea ice years.

Figure 3. Please add the AR outlines to this figure and define the time period each panel is averaged or summed over. It would be helpful to add contours of critical levels. For example, you use 0.3 as a threshold for Fig 3b. It would also be helpful to center the colorbar of Fig 3c on 273.15 K. What does the black contour describe? If it is the ice edge, how did you define the ice edge?

Figure 4. This caption belongs to a different figure. Or is this the wrong image based on your written results? How did you define the melt line?

Figure 4a. Very interesting figure that serves as the link to your primary research question regarding the impact of ARs on sea ice. However, I do not believe you reference this panel at all?

Figure 4b. Does not show Qnet, and P2 occurred prior to any panel of the figure (Line 272).

Figure 4f. Why not center the color bar at zero with a diverging colormap like the other figures?

Figure 5. The text discusses a separate set of analysis variables. In no figure does the (a) panel show a decline in surface albedo from 0.65 to 0.45 between July 20 and July 27 (line 289).

Figure 6. Remove commas within variable units. “Spatial attribution”: include details about this in your methods. How exactly do you attribute the daily fluxes to hourly ARs and what is displayed here? Add description of the black contour. The SIC change plot does not look cohesive within the AR shape. Do you have any ideas as to why?

Fig 6b is IVT and SLP, not clouds? Line 217.

Fig 6f. Same as 4f.

Figure 8. Two panels described in caption that do not match the three panels displayed.

Technical corrections

I do not see where some of the findings in the abstract come from, particularly the last few sentences. Please include more specific information or more closely mirror the structure of the primary conclusions.

Only write out acronyms (i.e., ARs) when introducing them for the first time. Otherwise use the acronym. There are many examples of missing spaces when beginning a new sentence. Please address this issue throughout.

It would be beneficial to introduce the 2020 cAR event much earlier. Describe where and when each AR happened and the changes in the sea ice. Then, as a suggestion, you could discuss further context, and finally the in-depth analysis and results.

Throughout the 2012 section, you compare the 2012 iAR to the 2020 cAR event. Relative to the length of the 2020 discussion, 2012 has little. Could you combine 3.4 with the 2012 section? It would be helpful for Figure 7 to be discussed and referenced earlier.

Section 4.4. Remove italics and bold words. What about your study suggests something about the New Arctic at large? If you had compared a cAR prior to the shift with the 2020 event, you could argue this more effectively. Otherwise, a larger scope is required to make these definitive claims. This entire section needs citations. Are there any studies showing that cARs are becoming more common?

Section 4.5 Rewrite this section in standard format. I am also confused by the last paragraph. The mentions of other mechanisms seem to come from nowhere. I do not believe you have proved that cARs are “the most potent catalyst of rapid and non-linear cryospheric change”.

Title. The paper primarily dissects the impacts and mechanisms of a clustered AR in July 2020. It briefly compares it to an isolated AR in 2012 which was associated with a highly impactful cyclone. I find the title slightly misleading but could be persuaded otherwise.

Abstract. Please make it clear that your paper analyzes two cases studies. Otherwise, it seems like you are making broad claims about findings not included in the manuscript.

The remaining minor comments are provided by line order:

Line 2. Atmospheric River does not need to be capitalized.

Line 5. Space before new sentence.

Line 6. Paradigm shift seems extreme given you discuss two separate events.

Line 7. No quotations marks.

Line 8. “at the melting point”. At or above 273.15 K?

Line 9. “despite potentially higher peak intensities” Do you mean IVT?

Line 10. “partial thermodynamic recovery” How much?

Line 12. “moisture pulses” Are these separate from the ARs?

Line 12. Space before new sentence.

Line 13. “significantly higher number of cumulative melt days” How many? What was the significance?

Line 15. Please quantitatively describe this in some way.

Line 19. This is a stylistic choice, but I do not find it necessary for each paragraph to be a subsection. Instead, you can achieve the same effect with in-text transitions.

Line 21. Citation?

Line 23. Citation?

Line 24. Citation?

Line 25. Write out CMIP6.

Line 28. Citation?

Line 29. Space before new sentence.

Lines 27-32 only include one citation. It would be useful to include other studies, especially ones that focus on the Arctic.

Line 31. No quotation marks.

Line 34. No capital Atmospheric Rivers.

Line 34. The papers referenced are about global atmospheric rivers, not about in the context of Arctic moisture intrusions.

Line 37. Formatting issue in citation.

Line 38. Space before new sentence.

Line 38. “High Arctic” to “high Arctic”

Line 39. Cite second sentence in this line.

Line 41. To 273.15 or above 273.15 K?

Line 42. No comma before unit

Line 43. “importance of these moisture intrusions” this subsection is about ARs. There is another paper that looks at Arctic ARs over sea ice that I would include in this section:

<https://doi.org/10.1029/2024JD042521>

Lines 43-44. These studies look at winter and spring, but you are looking at summer. Could you add a sentence connecting this back to summer?

Line 49. No quotation marks.

Line 50. Space before new sentence.

Line 51. What do you mean by AR transport? Typically, I have seen this term refer to ARs transporting something, rather than the circulation pattern transporting the AR. Polar anticyclones are well known steering mechanisms of ARs, are you referring to that? You could add citations supporting this.

Line 58. ARs or moisture intrusions? Please define the difference.

Line 59-60. "However, recent extreme melt seasons, such as the record-breaking July 2020 event..." Single event? Or the whole month? Season?

Line 62. Space before new sentence.

Line 63. Citation?

Line 68. "driving" to "drivers".

Line 71. "extreme isolated synoptic forcing" Some of these terms feel contradictory, what do you mean by this?

Line 73. Space before new sentence.

Lines 74-78 belong in Data.

Line 74. Predictive capabilities of what?

Line 74. Write out ERA5.

Line 75. Which synoptic features? Can you include a citation specific to ARs?

Line 75. Please provide more details regarding biases related to snow cover.

Line 77. "we" to "I" or use the passive tense.

Line 82. Remove "temporal", frequency already implies time.

Line 83. Space before new sentence.

Line 84. Write out IVT.

Line 84. "differences in the surface energy budget" between iARs and cARs?

Line 93. "we" change to "I" or passive tense

Lines 94-97 should go with AR identification.

Line 99. Was the accumulation assumed constant throughout the day? How accurate is that assumption, especially considering the translation speed of ARs? How does this affect your findings?

Line 99. Please provide explicit definitions for each variable in equations.

Line 101. “each hour of the day”. Which days (all days, all days in summer, all days in July) was this climatology calculated over and compared to for your anomaly calculations? Why did you choose the 1990-2020 climatology, especially since Fig 1 includes the entire satellite era?

Line 104. In what way is it adapted for the Arctic?

Line 107. “Based on the research code”, no code is provided in your data availability statement. Does this mean that you used tARget version 2 AR detection algorithm (Guan and Waliser 2019)? Or adapted from it? Please expand on this.

Line 107. “target sector”, how do you define sectors? It would be helpful to include place name labels on one of your figures.

Line 107. “if:The” space, no capital T.

Line 108. Local meaning at each grid point?

Line 108. Space after climatology, no comma between 18 and hours. Space before new sentence.

Line 110. In what way did you use Guan and Waliser (2019) and Ralph et al. (2019)?

Line 113. “our” to “I”

Line 114. “quiescent.” Not a commonly used word, I would choose a different word to improve readability and accessibility. Remove quotation marks. Remove “:”.

Line 117. Don’t need a new line for this equation, you can write it in paragraph form.

Line 117. Why did you use 120 hours to define an isolated AR? Please provide more justification for this choice. How are your results sensitive to this choice?

Line 121. Are pulses different from ARs? How do you distinguish multiple ARs from each other? Where do you define their occurrence? Over the same location or within the same sector?

Line 122. See line 117.

Line 128. What do you mean by DLR-driven melt mechanism? “Melt Energy” does not need capitalization nor quotation marks. How do you define this precisely with your input data? Why do you use ≥ 273.15 K as the melting point rather than >273.15 K?

Line 131. Space before new sentence. Did you check for normality when performing the Student’s t-test? Did you instead consider using a Mann Whitney U test, for example? How do you determine where to spatially apply this calculation? Are anomalies calculated spatially within each AR or is it an average within each event?

Line 132. I’m a bit confused by this. What do you mean by the melting in 2020 being statistically distinguishable from the melting in 2012? What statistical analysis was performed?

Line 136. Citation?

Line 137. What about over your study period? Can you provide a quantitative answer?

Line 138. No capitals in written-out form of SIC. Also cite this.

Lines 141-143. Remove capital letters and quotation marks.

Lines 143-148 lack any citations.

Line 149. How do you define a “definitive “Regime Shift””? Did you perform some statical analysis like a change point detection or a Mann-Whitney U-test?

Line 150. How much did the variability increase?

Line 151. Citation? Please provide definition for the MIZ in terms of SIC.

Line 153. Remove quotation marks and add citations throughout this paragraph.

Line 156. The 2020 AR event?

Line 157. Did you calculate the trend to support the “increasing frequency”? How much did it increase?

Line 159. Please cite this claim. How did you determine this?

Line 160. No capitals except for SIC.

Line 163. ARs

Line 164. What was the cumulative impact of ARs quantitatively?

Line 164-165. Citation?

Line 167. So, is it the preconditioning of the sea ice that was the primary factor of the cAR impact? Or was it the preconditioning due to the cAR? What was the exact state prior (quantitatively) to the cAR? How did each AR contribute to the total change?

Line 168. Please change this section heading to reflect its subject of the 2020 event.

Line 169. What do you mean by fundamentally? Were there no other factors at play?

Line 170. No capitals, space between 500 and hPa without a comma.

Line 172. No capitals if not a proper noun.

Lines 172-183. Citations? After looking further, I was unable to find citations in the rest of the manuscript. Please either reference one of your figures or another paper when you provide explanations.

Line 175. No quotations, no capitals. I'm going to refrain from mentioning this issue again. Please address it where it appears.

Line 177. How did the ARs align with the dynamic corridor? Was their IVT directionally cohesive with the circulation, for example?

Line 189. "perfectly" seems like strong language. Do you have a value to back this up?

Line 191. Did you track where the moisture came from to make this claim?

Line 193. Are you referring to the MIZ here?

Line 194. "most rapid retreat" add reference to relevant SIC difference plot.

Line 196. Citations? Can you add specificity to the Arctic?

Line 199. If I'm not mistaken, "stationarity" invokes statistical analysis. Was this intended? This is also a suitable place to add other papers that have documented high pressure as drivers of polar AR trajectories.

Line 206. What do you mean by proximal? Proximate sounds like spatially close by to me.

Line 209. In the summer specifically.

Line 211. "we" to "I" or passive tense.

Line 213. If this is central to your discussion, please include quantitative definition, or at least a more exacting one.

Line 213, 215-216, 216-219. Citation?

Line 218. What was the substantial fraction?

Line 222. 850 hPa and 950 hPa

Line 223. Can you reference a figure here? To show which levels this occurred at?

Line 224. Can you provide a brief description of the feedback?

Line 226. Where do you show the temperature on the sea ice?

Line 228. Collocate and colocate (or co-locate) are different words.

Line 228. What was the impact exactly?

Line 229. Where do you show this? Did you look at melt pond formation?

Line 231. How much does the sea ice thin as a response to just DLR?

Line 233. Citation related to sea ice sensitivity or tipping points.

Line 236. Was this section before the ARs? It seems concurrent. Did particular ARs precondition the atmosphere out of the three? When did each happen? Which AR resulted in the greatest change? How similar were their trajectories? How did you identify the remnant impact of their moisture and where it was located?

Line 242. Are the IVT filaments greater than 300 kg/m/s? The colors look lighter to me. What do you mean by “arteries” of the clustered AR events?

Line 244. What do you mean by “Transpolar Drift stream”? Could you define exactly where this is?

Line 244. Albedo does not have units. Please include a citation for the decrease of 0.3 as being a critical threshold or explain further.

Line 246. Space before new sentence.

Line 248. Please add this isotherm to the relevant map.

Line 249. How do you define maximum vulnerability?

Line 249. What is an AR pulse? Is it distinct from an AR? Or does it describe a specific variable?

Line 250. Where do you show this?

Line 252. Where do ARs make landfall? Can you mark this on Fig 3?

Line 253. You mention 50 MJ/m² as a value for Fig 3d but it is not labeled on the scale nor do I see values in that range on the figure itself.

Line 255. What is the difference between an IVT pulse and an AR pulse? If they are the same, please just use “AR”.

Line 256. “thermodynamic defense” please use more precise language.

Line 260. I find the term “tactical multi-stage assault” inappropriate for an academic paper.

Line 262. Fig 4a shows July 26-28, not July 18-28.

Line 264. What was the actual IVT of the AR?

Line 265. Citation?

Line 266. What is the normal return frequency for July AR? How do you define extremely short here?

Line 268. Can you show that the atmosphere was saturated from the previous AR?

Line 269-270. “nearly 100%” ; what was the actual value? Where do you show this?

Line 271. What do you mean by “non-descending plateau”?

Line 272. Formatting issue on Qnet.

Line 274. Please explicitly define thermodynamic locking.

Line 276. Citation?

Line 276. Fig 4b is only one day, not 240 hours.

Lines 277-278, 279-280, 280-282. Please cite or show this.

Line 282. How did you define the cumulative melt line? What do you mean by exponential-like increase? Please include values here. I also don’t see a difference plot or a trend. What then is the melt relative to? How did you measure the “efficiency” of the ARs? Are you inferring that all melt in the Arctic Circle was attributed to the ARs? How did you separate the impact of the ARs from other factors?

Line 283. What was the temperature after each AR?

Lines 285-287. How does Figure 5 provide this evidence? I do not see anything about the optical properties of the sea ice. What do you mean by “synchronization” of the albedo feedback? How are you so confident that isolated events cannot match the speed of optical property alteration?

Line 288. There are no panels in Figure 5. In no figure do I see a drop in albedo from 0.65 to 0.45.

Line 289-290. Citation? How do you know the surface is dominated by melt ponds and leads?

Line 291. Citation?

Line 292. Incorrect figure, also formatting issues on Qnet. Where do you show that the melt ponds expanded and coalesced without interruption? I do not see any analysis of melt ponds.

Line 293. Why is 0.5 a critical threshold for albedo? Citation?

Line 294. Remove em dash. Do you show this accelerated melting in the lulls?

Line 297. “near-perfect synchronization”; please quantify.

Line 298. Wrong figure? I don’t see any of this.

Line 299. Statistically significant?

Line 301. Please quantitatively define the compromised structural integrity of sea ice.

Line 301. How did you define and calculate the tipping point?

Line 302. Accelerated rate compared to what?

Line 303. Remove em dash. Add reference to figure showing that the snow cover was gone.

Line 209. Remind us why you are comparing the 2020 cAR to the 2012 iAR? Specifically, why did you choose the 2012 AR as opposed to any other iAR?

Line 310. “two weeks”; you only show a few days?

Line 312. Figure 6a is SIC change. How do you define fast moving? Space before new sentence.

Line 313. Remove em dashes. What was the 2020 average?

Line 314. How much smaller? Please provide value.

Line 315. How quickly did it dissipate?

Line 316. Could you quantitatively compare the spatial persistence between 2020 and 2012 events? How do you define the preconditioning of the ice pack from the AR?

Line 320-323. Where do you show TCC and q?

Line 323. Space before new paragraph.

Line 325. Could you explain more why you use the term “ceiling” when referring to the cAR event? I believe earlier in the manuscript you discussed the vertical distribution of the AR but did not display it.

Line 327. “Flash”; please use more precise language.

Line 329. Just melting in general, right? Not necessarily “catastrophic” melting.

Line 331. LHF is Fig 6d. Did it actually reach $>40 \text{ W/m}^2$? It’s not labeled on the figure.

Line 333. Space before new sentence.

Line 335. Where do you show this? How quickly did this happen?

Line 337. How do you know it came from the melt ponds? Where spatially did the evaporative cooling occur?

Line 338. How do you define “Super-AR”? How does the Super-AR IVT compare to each of the ARs in the 2020 cluster? Were the clustered ARs moderate? Please include exact values.

Line 342. Remove em dash.

Line 343. “thermal stacking”, previously you use the term thermodynamic locking, are these similar?

Line 343-344. “that the ice pack could utilize its vast area and the intervening dry windows to shed the excess energy delivered by the AR.” Where do you show this? How does the ice pack use its vast area to shed excess energy?

Line 345. I agree but I do not feel convinced by your arguments. Why do the 2020 and 2012 events allow such a large claim to be made? Can you cite other papers?

Line 351. Use either AR or moisture intrusion for clarity.

Line 353. I don’t see Q_{net} ever being negative in Figure 7, how would it return to a negative state?

Line 355. How does polar day (summer) affect the nocturnal radiative cooling?

Line 356. I don’t see negative values here. The scale of Q_{net} goes from 0 to 350.

Line 357. What did you calculate this from?

Line 359. Referring to your figures, could you provide a more detailed explanation of why frequency is more potent than IVT?

Line 359. “Any single pulse”. Could you contextualize the 2012 event in its extremity? I’m not convinced that just this one event is representative of all other iARs.

Line 361. What variables did you use to calculate daily melt? Over which surfaces? Did you constrain just the sea ice co-located with an AR?

Line 363. What were the actual values and p-values of the slope?

Line 364. Please explain your calculation resulting in 32%.

Line 365. “We” to “I” or passive tense. Please also define phase-change preconditioning.

Line 371. Incorrect figure. “final thermodynamic proof” I would reword this to avoid the word “proof”.

Line 375. DLR does not need to be italicized.

Line 376. There is no albedo shown in Figure 5.

Line 377. “Runaway state”; please explain this more.

Line 378. “rapidity” over what time period?

Line 378. Does tipping point in this case mean crossing the 0.5 surface albedo? Could you cite other papers here?

Line 379-380. This is a very large claim that I do not feel you substantially support with your results. You studied one cAR event. How can you claim that cARs are the “primary architects” of the new Arctic sea ice regime, which has been widely studied and documented without examining cARs?

Line 382. Again, a stylistic choice but I would remove the subsections here.

Line 384. Cite and discuss these previous studies. How do their findings compare to yours?

Line 385. ARs, not moisture intrusions. “More decisive factor” than what? What are the other factors in sea ice pack collapse?

Line 386. “high-resolution temporal evolution” what was the temporal resolution of these figures? I don’t believe it was ever defined.

Line 387. “the transition” Do you mean that we are seeing more cARs over time? Do you show this? You did not include the figure showing the linearity/non-linearity, please revisit this conclusion.

Line 389-390. If it was an isolated event, it should not have a recovery window since there is no second event, right?

Line 391. Please use more precise language than “shed”.

Line 393. Did you define what the sensitivity was?

Line 395. “Definitive proof” is a strong statement.

Line 397. Incorrect figure. I don’t believe I saw this anywhere.

Line 397. To support this conclusion, it would be nice to explicitly compare the values of the surface temperature between the three ARs in the text.

Line 400. “spatial correlation”; did you calculate the correlation?

Line 405. This should be in the methods section. You also do not discuss statistical significance here.

Line 407. This figure was not present in the analysis.

Line 409. Please write this out. What was the cumulative melt? For the denominator, do you mean the change in IVT over time? I’m slightly confused here. Can you explain how you arrived at this formula, why, its physical interpretation, and its limitations?

Line 412. Where did you show that it had zero thermal resistance?

Line 413-415. Citation?

Line 298-431. This formatting raises major red flags for generative AI. Improving this section would improve the manuscript’s credibility.

Code availability. No AR detection algorithm was credited with the ARs used, but no code was developed? Please clarify this.

Data availability. The NSIDC dataset was not described in the data section.

Acknowledgements. “The author also thanks Gemini for providing language editing during the preparation of the manuscript”. The Cryosphere AI policy details that “(assistive) AI can be used to improve sentence structure and readability of manuscripts including punctuation, grammar, and spelling checks... (generative) AI must not be used for text or interpretations.” I have major concerns that generative AI was used to for the text, beyond grammar and spelling checks.