25 September 2024

Dear Reviewer 3,

We appreciate your time reviewing and providing constructive feedback on our revised paper. We have considered your remarks, and our responses are found below in **bold**.

Thank you again for your constructive review of our paper.

Sincerely,
Tom Ballinger
Corresponding Author

RC3 Comments

Review of "Concurrent Bering Sea and Labrador Sea ice melt extremes in March 2023: A confluence of meteorological events aligned with stratosphere-troposphere interactions"

I did not review this paper in its first round, however the editor asked me to offer my thoughts on the revised submission. I will focus my comments on the stratosphere-troposphere coupling parts of the paper. (I do not consider myself qualified to review the other aspects of the paper, and will not include them in my review.)

The language used to associate the melt events with SSWs is too strong. There is strong evidence that blocking near Greenland is indeed a byproduct of SSWs, however there is no evidence that SSWs are typically followed by blocks (or any robust climate anomalies for that matter) near the Bering Sea. There is actually a reasonably large literature on whether (if at all) SSWs are followed by a Pacific sector impact (e.g. Dai et al 2024 and references therein). There is no robust response in reanalysis data. However many models simulate a response (though clearly not a block as was observed in March 2023) for reasons that are still not fully understood.

To some degree the authors note this in the paragraph starting near line 320, however there are some additional papers that they might consider citing in this paragraph listed below.

Given this, the strongest claim that can be made is that the block over Greenland is likely associated with the SSW, however the block over Alaska had nothing to do with it, and may have instead been associated with the La Nina event. To be specific, I think the language used near line 63, 237-238, and 299 is too strong, even as the paragraph starting near line 320 is reasonable.

Dai, Y., P. Hitchcock, and I. R. Simpson, 2024: What Drives the Spread and Bias in the Surface Impact of Sudden Stratospheric Warmings in CMIP6 Models?. J. Climate, 37, 3917–3942, https://doi.org/10.1175/JCLI-D-23-0622.1.

Zhang, J., Tian, W., Pyle, J.A., Keeble, J., Abraham, N.L., Chipperfield, M.P., Xie, F., Yang, Q.,

Mu, L., Ren, H.L. and Wang, L., 2022. Responses of Arctic sea ice to stratospheric ozone depletion. Science Bulletin, 67(11), pp.1182-1190.

Liang, Yu-Chiao, Young-Oh Kwon, Claude Frankignoul, Guillaume Gastineau, Karen L. Smith, Lorenzo M. Polvani, Lantao Sun et al. "The Weakening of the Stratospheric Polar Vortex and the Subsequent Surface Impacts as Consequences to Arctic Sea Ice Loss." Journal of Climate 37, no. 1 (2024): 309-333.

Kelleher, Michael E., Blanca Ayarzagüena, and James A. Screen. "Interseasonal connections between the timing of the stratospheric final warming and Arctic sea ice." Journal of Climate 33, no. 8 (2020): 3079-3092.

We appreciate the reviewer's perspectives as fair points are made about toning down the language in various places involving SSW impacts on subsequent high-latitude tropospheric circulation features. We have made an effort to do this through the revised manuscript as recommended. Moreover, in revised Section 3.2 and Section 4 we explicitly note that following SSWs that blocking anticyclone formation over the Greenland/Labrador region, such as occurred in March 2023, is typical (e.g., Baldwin et al., 2021). However, the development of mid-tropospheric ridging patterns in and around the Alaska region during this time is more likely to be a signature of the La Niña background state than in response to the SSW event.

Rather than include the reviewer's literature recommendations into the revised text, we bring attention to Section 4 modifications around new Figure S1 (see supplemental material and below). As stated in the first paragraph of this section, "A longitude-pressure analysis (Figure S1) revealed that a SSW in February 2023 was strongly linked to the mid-tropospheric height increases over the Labrador Sea region in early March, while the height increases over the Bering Sea were isolated to the troposphere, and were likely linked to a fortuitous shift of the large-scale La Nina-related ridging over the North Pacific into the Alaskan region." We believe these changes more accurately reflect the confluence of processes that shaped this concurrent event.

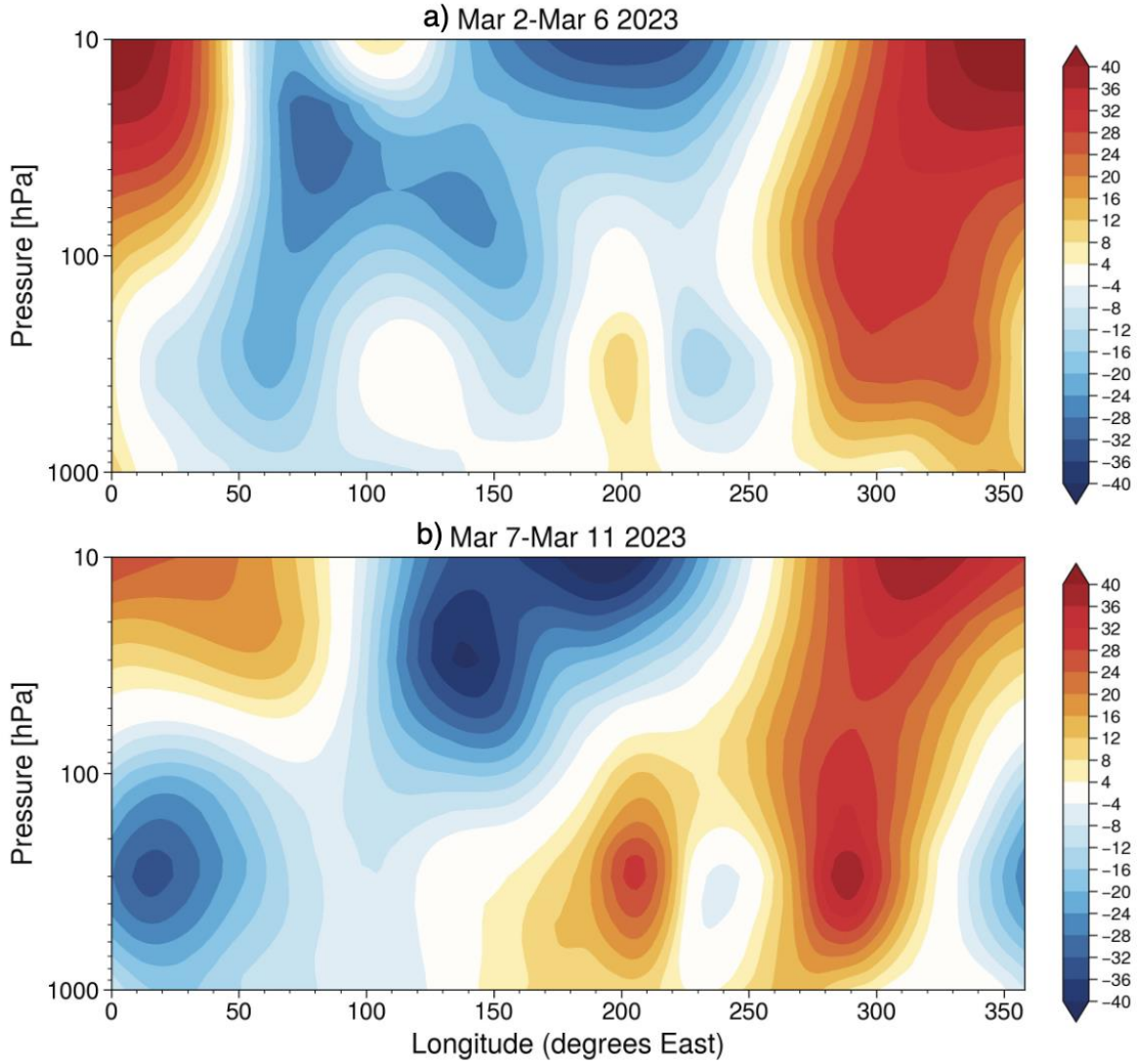

Figure S1. The 45-75°N eddy geopotential height anomalies (m) as a function of pressure versus longitude. These anomalies are calculated as the deviation from the zonal-mean for the periods relative to the 1979-2023 climatology for a) March 2-6 and b) March 7-11 2023.