Dear Reviewer,

We appreciate and thank you for your comments. Please find below some thoughts, replies and specifications of changes we made as a response to your suggestions. All changes and added sentences based on suggestions imposed by both RC1 and RC2 (you) are highlighted in red in the revised manuscript.

The manuscript is clear, and the results are interesting. The manuscript builds on previous work looking at the role of diabatic heating on blocking more generally, with similar methods, but extends it by focussing on the important impact of Arctic warming. As noted by another reviewer, there is a body of literature specifically on the dynamics of Ural blocks and their impact on the Arctic, and the new results here should be placed into the context of these studies in more detail (specifically, how diabatic heating and cyclone interaction relate to other physical mechanisms of block development); however, since other comments already raise this issue, I do not pursue it further. With this caveat, I recommend the manuscript be accepted for publication once the following comments have been addressed.

We appreciate your remark on this issue, as also raised by other comments, and have added clarifying and complementing paragraphs and sentences in Sections 1.1, 1.2 and 7, further discussing the various processes involved in Ural blocking development (L87, L568) and the importance of diabatic heating as amplifier of the blocks (L105, L572) or its decay (L580). Furthermore, the impact of blocks on the temperature anomalies in the Arctic is further enriched with more recent literature, as is found in the introduction (L68) and in the discussion (L527, L560) sections.

General comments:

Title: The study focusses on wintertime warm extremes, and this should be mentioned in the title.

We have followed your advice and added “wintertime” prior to “warm extremes” in the title.

L5: The period of study should be mentioned here (1979-2017).

We agree on this and have added “within the period 1979-2016.” In the end of the sentence in (L5).

L13: ‘the contribution of diabatic heating to these blocks is around 60%’ does not make sense. Please be more precise.

We have changed “; the contribution of diabatic heating to these blocks is again around 60 % for six-day back-trajectories,” to “ Around 60 % of the six-day back-trajectories started from these blocks experience diabatic heating,”.

L89 and L95: ‘wintertime Arctic warm extremes’ is more accurate than ‘Arctic warm extremes’ (unless there are no warm extremes outside of winter, according to your definition, in which case this would be worth mentioning).

Thank you, we have added the word ”wintertime” (now L110 and L117).

Fig 1 caption: It took me a while to see the horizontal blue line (the cyan and light blue lines look very similar, especially against the blue shading!). Is there a better choice of colours?

Based on the comments from R1, we have changed the cyan dotted line to orange dotted line (see new figure in the revised manuscript).

L135: For clarity, is the overlap condition based on number of grid points or area?

The overlap condition is based on the blocking mask, which consists of grid points of zeros and ones.

L152: Please describe the release grid more precisely.

We added a clarification regarding the release grid of trajectories: "More specifically, trajectories are initialized at every grid point within the blocking mask, horizontally equally at every 80km × 80km grid and vertically every 50hPa between 500 and 150hPa" (L173).

Fig 10 caption: I found the terminology here confusing because word the density is ambiguous. Consider rewriting (e.g. perhaps something like: 'Spatial distribution of the locations of maximum heating for the trajectories within the heating regime initialized from Ural (a) and Scandinavian (b) blocks. Shading shows the density of trajectories at the time of maximum 6-hourly heating, defined as the percentage of the total number of heated trajectories per unit area. …').

We agree with you and have changed the figure caption to: "Spatial distribution of the locations of maximum heating for the trajectories within the heating regime initialized from Ural (a) and Scandinavian (b) blocks. Shading shows the density of trajectories at the time of maximum 6-hourly heating, defined as the percentageof the total number of heated trajectories per unit area (here5◦×5◦)."

Line 499: 'sea-loss' -> 'sea-ice loss'

Thank you for noticing our mis-spelling. We have changed it accordingly (L523).

L564: I do not think your results prove that 'Diabatic heating plays an important role in the dynamics of high-latitude blocking', as claimed. You have shown very clearly that most air parcels entering the blocks do undergo diabatic heating, but of course that does not necessarily mean that the diabatic heating is important for the block evolution. Indeed, you have selected cases whereby warm moist air moves north and enters the Arctic, and it is hard to envisage that happening without diabatic heating occurring. Having said that, I do agree it is certainly likely to play a role. But the language used here should represent the results of the paper more faithfully.

We agree and have rephrased the sentences in the paper where we stated "diabatic heating plays an important role in the dynamics of high-latitude blocking" (now L614, as well as L363 and L443). Furthermore, based on your comment, we have added new sentences in the introduction and discussion sections to clarify the role of diabatic heating associated with Ural blocks (see red text).

Kind regards,
Sonja Murto & co-authors