**Reviewer 1**

I thank the reviewer for their new comments on the revised manuscript.

**GENERAL COMMENTS**

There are several improvements in this revised manuscript compared with the original version. First, the statistical testing of the findings is now more rigorous and the found correlations are more cautiously interpreted. Second, the revised manuscript highlights a possible (although weak) connection between September snow cover in Northeastern Siberia and Winter NAO, which has not been proposed before. Third, a more detailed comparison with earlier studies has been added to Section 5. Finally, some earlier text and figures have been deleted.

I have no remaining major concerns on this study. However, its main value as I see it is still more in the negative than in the positive findings. Rather than demonstrating a clear connection between Eurasian autumn snow cover and winter Arctic Oscillation (AO), the study effectively documents the weakness and ephemeral nature of any such connections.

From the reader point of view, the first half of the manuscript is easy to follow. However, Section 4.2 and to some extent 5 are heavy due to the large number of details reported in the text. Omitting some of the details would therefore be beneficial, even though it is difficult to give point-to-point suggestions of what to omit. Yet, for example, the timing of the individual maxima and minima in the correlation time series generally would not need to be reported, since this is subordinate to the main finding that the correlations have been widely variable.

I have removed several sentences across Sections 4.2, 4.3 and 5.

Although I would like to avoid suggestions that risk the further lengthening of the manuscript, I still make one. To complement the "frequency of significant decadal correlations" analysis in Sections 4.2-5 (which is needed but somewhat complicated), it would be useful to also report the average correlations between the various snow cover indexes and the winter AO, for the whole 1836-2015 period. These could be easily included as an additional column of maps in Figure 8 and as numerical values written directly in the time series plots (Figs. 7, 9 and 12). I leave it to the author to decide whether averages of the running 10-year correlations or the correlations of annual values in the whole 1836-2015 time series are more suitable for this.

This has been completed as requested, with a focus on the average of the running 10-year correlations. In summary, Fig. 8 has been expanded as requested and numerical correlation coefficient values added to Figs. 7, 9 and 12 with additional associated text in Sections 3.2, 4.2, 4.3 and 5.

Before the detailed comments, two generic technical issues:

1. The dashed lines in many of the time series plots (as well as in the map in Fig. 2) appeared very faint in this revised manuscript. This might partly be because the figures have been compressed to too low resolution – an interpretation supported by the fact that the merged pdf file for the revised manuscript was a factor of five smaller than the pdf of the original version. Still, it would be better to make all the dashed lines (including the vertical dashed lines in some of the time series plots!) systematically thicker to avoid this problem.

While I think the majority of the issues with the figures are associated with the compression, I have made the dashed lines thicker (also see comments from the Editor)

2. In several places in Section 4.2, the first year of the analysis is reported as 1831 (or the first decade as 1831-1840) although 20CRv3 is only available from 1836. Please check this throughout.

Thank you for spotting these issues: all corrected.

DETAILED COMMENTS

1. L113. high and low

Done

2. L130. and describe the different

Done

3. L237-238. "multi-sensor" and "system" repeated

Done

4. L371. SCI_09 in brown and SCI_11 in blue?

Done

5. L428-429. in the low frequency of periods positive SCI_10 - AO correlations?

Corrected to, “for the low frequency of periods with positive SCI_10 -AO correlations”

6. L443. from 20CRv3 and ERA5 (2003-12 to 2012-21) are shown as red and blue

Done

7. L478. frequency of significant decadal relationships

Done

8. L540. "situated" is repeated

Done

9. L553. Is this really a "response" to SCI_09 NE anomalies or a signature of the circulation type that causes these anomalies?

'Response' changed to 'contemporaneous change'

10. L560. at high latitudes

Done

11. Figure 10. Add the headings "Surface air temperature", "Precipitation" and "Z(500 hPa)" above the three panels.

Done

12. L704-705. Combine the two incomplete sentences: "... (SCI_09NE), and ...".

Done

13. L706. Providing an average correlation of -0.18, SCI_09 NE still appears to be a very weak predictor.

As I have switched to focusing on the mean decadal correlation, the text around this value has been changed as has the value itself (–0.23), which is still significant at $p < 0.01$ based on the Monte Carlo analysis. However, I do agree with the reviewer and have added a couple of new sentences in Sections 4.2 and 5 that are not specific to the SCI_09 NE region but note the ephemeral nature of the strong SC-AO relationships, which means that overall, they are relatively weak predictors of the winter AO. These are:

"However, the mean decadal correlation is only statistically significant for SCI_09: while the value of –0.19 is significant at $p < 0.01$, based on the Monte Carlo analysis, for the complete time series it appears a weak predictor."

"Overall, SCI_09_NE, SCI_11_SW and the Nov_SNOWI dipole index of Han and Sun (2018) can be considered similarly robust across the 180 years of 20CRv3: indeed, the mean decadal correlation coefficients for these three SC indices are –0.23, 0.25 and –0.22, respectively. Thus, while these values all indicate a significant relationship with the following winter AO — at $p < 0.01$, based on the Monte Carlo analysis — their relatively small magnitude demonstrates the ephemeral nature of the relationships"

14. L718. "a simultaneous signature" would be more suitable than "an immediate

response", given that these circulation anomalies are more likely a cause than a consequence of the SC anomalies.

‘an immediate response changed to ‘a contemporaneous signature’

15. L723-725. I agree with this need of model experiments, even though these experiments would most likely confirm that the response is very weak.

Agreed, but it should provide direct information on the mechanism involved

16. Figure S5 is blurred. Please provide a higher-resolution version.

Yes, not sure what happened there but will double-check the uploaded file this time

**Editor**

- Figure 3: “black horizontal line” (in particular after 1992) and “vertical dashed red line”
- Figure 4: “vertical dashed red lines”
- Figure 5: “dotted lines”
- Figure 7: “dashed lines” and “black dashed horizontal lines”
- Figure 9: “brown dotted line” and “similar black lines”
- Figure 10: purple, green, and yellow contours
- Figure 12: “brown dotted line” and “similar black lines”
- Figure S4: “dashed lines” and “black dashed horizontal lines”
- Figure S5: All the numbers and texts

All changes made as requested