

Response to Reviewer's Comments:

I've found that the first author has carefully responded to all of my questions in detail. I would like to thank the first author for his/her efforts for improving the manuscript. In particular, Figure S3, Figure R2 and Figure S4 are key figures that can nicely explain the different sea ice responses to the summer AD during the early vs. recent periods. Therefore, these plots need to appear as main figures and need to be illustrated more in detail. I am surprised to see that these nice plots (Figures S3, S4, R2) are in the supplementary information (or just for response to the reviewer).

I recommend publication subject to the following minor revision, but they are mandatory. I am willing to review the revised manuscript once more.

We appreciate additional comments from the reviewer. We reflect all the comments from the reviewer and please find our line-by-line responses below.

(1) Mechanisms: I cannot understand why it is important to show Figure 7 (surface air temperature anomalies associated with AD during the early and the recent periods). Instead, Figures S3, S4 (supp. Fig 3 and Fig 4) and R2 (response Fig 2) can nicely illustrate the mechanisms of sea ice loss during the summer AD events. These plots, Figures S3, S4 and R2 need to appear as main figures in the main text and need to be illustrated more in detail. Instead, I recommend moving the current Figure 7 (SAT anomalies) to supplementary information.

→ As suggested, we move Figs. S3 and S4 to Figs. 7 and 10, respectively. In addition, Fig. R2 becomes Fig. 8 in the revised manuscript. Old Fig. 7 has been moved to the supplementary figure as in Fig. S1.

→ The text has been modified to reflect these changes (P5, L5-7; P8, L14-26; P9, L6).

(2) In particular, Figure R2 nicely presents the intensification of Beaufort Gyre over the last decade. Please see Zhang et al. (2016). "The Beaufort Gyre intensification and stabilization: A model-observation synthesis". I strongly recommend introducing Zhang et al (2016) and explaining Figure R2 more in detail.

→ Yes, the surface albedo decrease in the Beaufort Sea seems to be related with the intensification of the Beaufort High and the Beaufort Gyre.

→ As the study of Zhang et al. (2016) regarding the intensification of the Beaufort Gyre is better connected with Figure 2b showing the intensification of anticyclonic circulation anomalies in the Beaufort Sea, we introduced their study after Fig. 2b (P6, L2-3).

(3) Shortwave radiation (page 8, lines 19 – 20): "The surface heat flux anomalies are mostly contributed by the changes in the shortwave radiation terms (not shown)"

This result should be shown as a main figure and should be explained more in detail.

→ Following the reviewer's comment in 1), we also add the albedo change pattern in Fig. 8, which also demonstrates the importance of the shortwave radiation change. Avoiding redundancy in the text, we decide to show the figures for each flux term change in the supplementary material (P8, L23; Supplementary Fig. S3).

(4) Surface Albedo changes (page 8, lines 21 – 22): "The response of surface albedo becomes larger and much clearer."

This is a main finding of this study and needs to be emphasized more – I strongly recommend illustrating this finding in the Abstract.

→ We add it in the abstract (P1, L19-21).

(5) OLR (page 8, lines 11 – 14): "It is also found that the regressed OLR.. increase (decrease) of solar radiation".

It is difficult to follow what the authors are trying to say. Do the authors argue that the increased OLR (less clouds) can melt more sea ice by increasing downward shortwave radiation at the surface? The increased downward shortwave radiation is usually compensated by the decreased downward longwave radiation. So, it is difficult to conclude that the increased OLR can melt more sea ice in the summer.

→ We originally suggest anticyclonic circulation anomalies tend to decrease cloudiness and thereby increase net downward shortwave and OLR. Much resemblance in the regression pattern between OLR and 850-hPa temperature indicates this relationship. However, we do not carefully separate the cloud radiative effects in the reanalysis between shortwave and longwave radiation, because existing reanalyses such as in the NCEP/NCAR R1 data used in this study may contain large uncertainty in the estimates. Therefore, we discard the relevant discussion (P8, L20).

(6) Pattern correlation (page 7, lines 1 – 4): I appreciate adding this explanation. However, I suggest adding this calculation ($r=0.76$ as 95% confidence interval) in the supplementary information. Also, there is no illustration on the spatial pattern correlation of AD between the early and the recent periods: in the previous manuscript, the pattern correlation between Fig. 4c and 4d was written as 0.58, but in this revised version the correlation coefficient is missing. The authors may have accidentally deleted this illustration.

→ Following the reviewer's comment, we moved the explanation to the supplementary material. We also indicate the value ($r=0.58$) in the main text (P7, L11-14).

(7) Page 7 line 20: "although the persistence of the observed AO index is too short to connect the winter AO with the summer sea ice extent"

I cannot understand this analogy. Williams et al (2016) emphasized the importance of AO- induced precondition not the persistence of seasonal AO.

→ Agreed and removed the phrase in the text (P7, L28).

(8) Color bars of Figure 2a and Figure 6: I suggest changing the color of Figure 2a and Figure 6 to reds (warm colors).

→ Modified as suggested (Figs. 2a, 6, 8c, and 8f).

(9) The impact of transpolar drift on summer sea ice loss (page 2 lines 14 – 24): Park and Stewart (TC 2016) also showed that the southerly wind strengthening can effectively decrease summer sea ice cover over the Pacific sector of the Arctic.

Park, H.-S. and A. L. Stewart, 2016: An analytical model for wind-driven Arctic summer sea ice drift, *The Cryosphere*, 10, 227-244.

→ The paper is referenced in the main text (P2, L20-22).

(10) Summary and Conclusion: This section need to be rewritten after adding Figures S3, S4 and R2 as main figures and after revising their illustrations on the mechanisms.

→ We revised the summary and conclusion (P11, L24-27).

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