This study focused on melt advance in the Laptev and East Siberian seas between 1979-2018 using the passive microwave melt onset dataset. They defined melt advance as the percentage of the area that had experienced melt onset by the end of May each year. They split up these advances based on four different scenarios: fast LS, fast ESS, slow and fast and analyzed the specific SEB and atmospheric terms associated with each. This was an interesting study and I enjoyed reading it, however I think some things could be improved upon. For one, I think clouds should be included in this study as they significantly affect the shortwave and longwave radiation and might help explain some of the contradicting statements, etc (see below). I like the concept of the melt advance metric that they made up, but I would not consider it a new dataset, as they are just taking the melt onset dataset and looking at the number of pixels that experienced melt by the end of May. It does not appear to increase the predictive skill of the September sea ice extent compared to melt onset or sea ice concentration. It would also be good to include the turbulent flux terms/figures in the main body of the text and go into this a bit more. I think this paper needs a series of revisions in order for it to be accepted for publication.

R: Thanks for the constructive comments from the referee. Please see reply as below.

Line 28: ‘over’ should be ‘cover’.

R: Corrected.

Line 38: this sentence needs a source.

R: Agree.

the Arctic has a faster warming trend than elsewhere on the planet, especially in the lower troposphere during the cold season (Cohen et al., 2014; Screen and Simmonds, 2010; Serreze et al., 2009).

Line 39: there are many factors which contribute to Arctic amplification, not just the exchange of energy from the ocean to the atmosphere. please see Taylor et al., 2022 (Taylor, P. C., Boeke, R. C., Boisvert, L. N., Feldl, N., Henry, M., Huang, Y., ... & Tan, I. (2022). Process drivers, inter-model spread, and the path forward: A review of amplified Arctic warming. *Frontiers in Earth Science*, *9*, 758361.)

R: Yes. Atmospheric and oceanic heat transport, along with local positive feedbacks, may also contribute to Arctic Amplification. We also cite the study mentioned above.

Line 54: I would also include Markus et al., 2009 and Stroeve et al., 2014 in this list of citations.

R: Added.

Line 68: I wouldn’t sure the term ‘ice block’ I would use ‘the most persistent sea ice coverage…’

R: “the most persistent sea ice coverage” seems better and we adopt this suggestion.

Line 80: Are there a lot of missing MO values in the Markus passive microwave melt onset dataset?

R: Not much, but for the sake of statistics covering the whole research area in the Laptev Sea and East Siberian Sea, we adopt the method of alternative MO by SAT (example can be seen in Figure 2, Liang and Su (2021)). We also add this information in the Data and Methods.

Although the missing values are not quite a lot, the analysis here requires that the whole research area in the Laptev Sea and East Siberian Sea is covered.

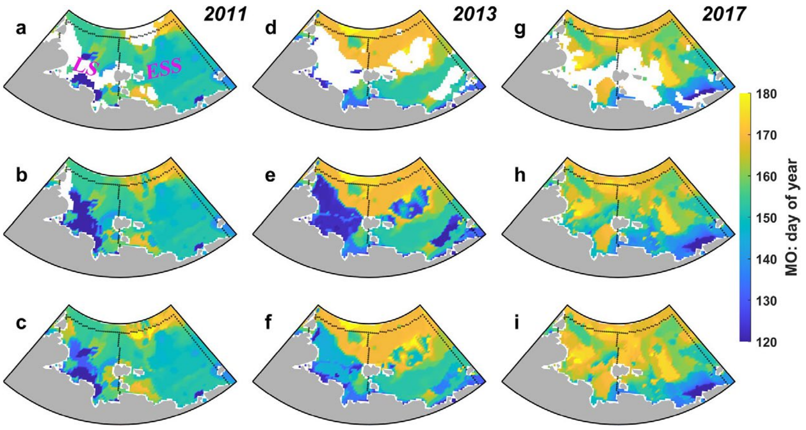

Figure 2, Liang and Su (2021): Comparison of the MO around the Laptev Sea (LS) and the East Siberian Sea (ESS), including the (a, d, and g) original results from the passive microwave (PMW) algorithm, (b, e, and h) the results filled with surface air temperature (SAT) based MO, and (c, f, and i) results filled with corrected SAT based MO. The three columns are for 2011, 2013, and 2017, respectively. Black dotted lines denote the boundaries of the LS and the ESS.

Line 84: Why use the OSI SAF SIC dataset? Why not the NASA team, etc?

R: No particular reason for this choice except that ERA5 to some extent incorporates the OSI SAF SIC dataset (Hersbach et al., 2020), which may keep the consistency between the atmospheric reanalysis and sea ice cover. Based on this comment, we also examine the results from the NASA team, which shows basically the same patterns in May as OSI SAF.

We also examine SIC dataset by the NASA Team algorithm (Cavalieri et al., 1996), which shows basically the same patterns in May as OSI SAF.

Sentence on line 117: I think that the average MO date is also useful and will also be different every year, because it means that an earlier MO for more of the region, then this would be a similar metric to melt advance because a larger area would have melted possibly in May. The average MO is also date dependent.

R: Agree. The two metrics should closely relate to each other. We suggest that we can retrieve the Melt Advance at the end of May, if we can get real-time satellite MO for the region, which may help improve timely seasonal prediction.

For the seasonal prediction of summer sea ice, this metric of Melt Advance is in essence similar to the average MO date, but may have advantages if we can get real-time satellite MO for the region. Then, at the end of May or other specific date, we can get the MA pattern which supports timely seasonal prediction in a current year.

Line 227: couldn't you see this with the latent heat flux anomalies? This might be useful to include or you discuss more.

R: This is a good suggestion. We expect that reduced sea ice cover in the LS will naturally enable more moisture to be released from the exposed ocean water. Actually, turbulent heat loss (latent heat and sensible heat loss) toward atmosphere weakens in the LS (Fig. S4). This suggests that warmer and moister atmosphere is mainly a result of air mass transport and reduces turbulent heat loss from the surface.

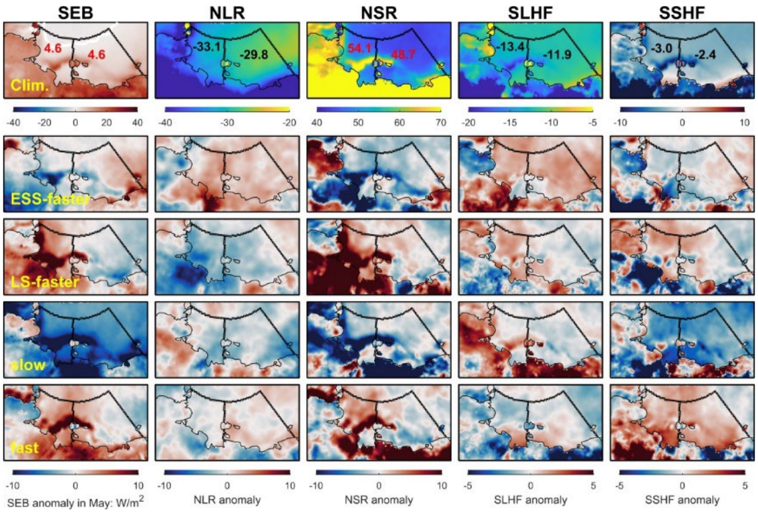

Fig. S4 Climatological distribution of surface energy balance components in May (first row) and composite anomalies for the four scenarios (lower four rows). The relevant variables include SEB, NLR, NSR, SLHF, and SSHF in May, respectively. Numbers within the LS and ESS are the region-mean values for each sea.

Paragraph beginning on Line 252: Can you say anything about the atmospheric state during the years with the strong NSR? Are there significantly less clouds during those times which is also driving the increase in shortwave into the surface? I think this needs to be addressed as well. I assume in the years with increased water vapor and humidity that there are more clouds associated with this as well. I know you say the albedo increases due to the increase in sea ice concentration which makes sense, but also during these slow melt advance years, are there any fresh snowfall events which would increase the albedo?

R: We also look at downward shortwave radiation, which tends to be less when NSR is strong. This is expected with increased water vapor. In this sense, surface solar radiation absorption is mainly related to the surface type and albedo. We also try to include analysis of clouds, but the results are not quite promising, which should be *related to the cloud uncertainty in the data. It is helpful that we would later include analysis about snowfall events.*

Line 263: Please cite these studies that have shown this.

R: Added.

Mortin et al. (2016) argued that on a synoptic scale, increased water vapor in the atmosphere favors stronger DLR, which promotes sea-ice surface melting.

Paragraph on line 258: I am confused by how a warm and wet atmospheric environment could also have higher solar radiation. Normally a wet atmospheric is accompanied by more clouds and increased downwelling longwave radiation, so even if the albedo is lowered it might not offset the decrease in incoming shortwave radiation due to increased clouds.

R: This seems a good point to discuss. Indeed, a warm and wet atmosphere is associated with decreased incoming shortwave radiation. Statistics here suggest that lower albedo plays a bigger role and results in higher absorbed solar radiation. This part may be an open question given that the radiation effects of clouds can be uncertain.

Figure 5: Perhaps adding in the correlation coefficient on each graph would be helpful.

R: Added.

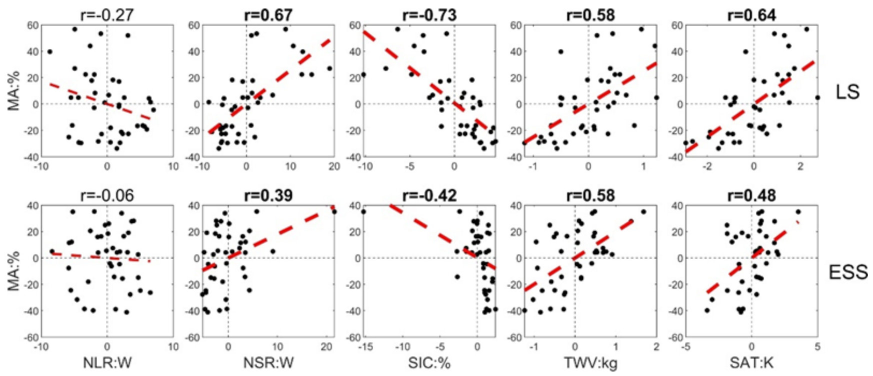

Fig. 5

Figure 7: what are the pink and yellow dots? A more descriptive figure caption is needed.

R: They show positive surface energy balance (SEB) and Melt Advance pattern, respectively. We enrich the figure caption now.

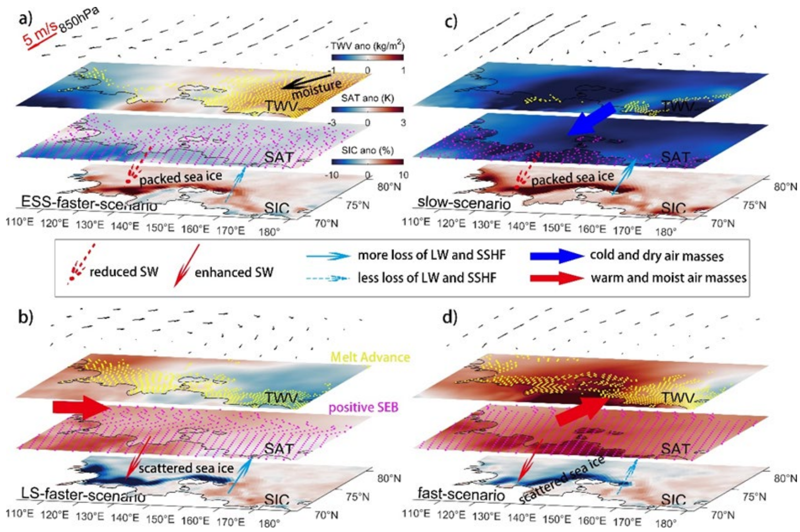

Fig. 7. Schematic processes under the four scenarios of sea ice Melt Advance in the LS and ESS. a) ESS-faster-scenario; b) LS-faster-scenario; c) slow-scenario; d) fast-scenario. For each scenario, four layers represent composite anomalies of wind fields at 850 hPa, TWV, SAT, and SIC, respectively. Thin arrows denote shortwave radiation (red), and longwave radiation and sensible heat flux (cyan), while solid and dashed types suggest the fluxes enhanced or weakened. Bold blue arrow refers to transport of cold and dry air masses, while bold red arrow refers to warm and moist advection. Yellow dots superimposed upon TWV show Melt Advance by the end of May. Magenta dots upon SAT denote positive surface energy balance (SEB).

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