Reviewer #2:

Antarctic sea ice and snow play an important role in regulating the global climate system. However, scare observations limit our understanding of atmosphere-sea ice-ocean interaction processes in Antarctic. The aim of this study is to improve our understanding of the temporal evolution of sea ice and snow around East Antarctica based on in-situ observations, reanalysis, and simulations. This study starts from presenting the evolution of sea ice thickness and snow depth by using the SIMBA measurements collected at Khalifa site. Then this study provides a wealth of analysis on atmospheric rivers. Overall, I recommend the publication of this study but suggest that the major revisions are needed before publication.
REPLY: We would like to thank the reviewer for going through the manuscript in detail and sharing several constructive comments/suggestions that helped to substantially improve the quality of the work. Below we list them and reply to each separately, highlighting where in the text changes, if any, are made.

My biggest concern is that the transition from observation analysis (Sec. 3) to AR analysis (Sec 4) is vague or invalid. This makes the paper appear as two separate parts, lacking overall coherence. In the part of observation analysis, the result shows that ST increases during ARs due to precipitation, and SIT increases by 0.04 m during the 14 November AR due to snow-ice interactions. But in my opinion, the authors do not fully explain the direct impacts of ARs on changes in ST and SIT. I think the following questions should be answered at least, otherwise, it would be far-fetched to directly connect the extensive analysis of AR in the remaining part of the article.
REPLY: We agree with the reviewer that in the original submission the analysis of the observational data collected during July-November 2022 was incomplete and lacked a clear link to the meteorological fields. In addition, and following the comments by reviewer #1, we have used ERA-5 to extract the ARs instead of MERRA-2 and have computed the uncertainty in the ST and SIT estimates. Following this, we only have one intense AR during July-November 2022, on 14 July, and the variations of SIT during the passage of the AR are within the uncertainty range, meaning only ST changed during the event. We found that ST did not increase during the heavy snowfall associated with the AR owing to the strong winds (speeds >30 m s^{-1}) that likely prevented snow's accumulation, as reported in the literature at the Mawson (and nearby) Station during strong wind episodes. In fact, the Foehn effects that followed the AR led to a decrease in ST. We have rewritten the discussion of Figs. 3 (lines 385-440) and 4 (lines 442-463) and updated them, in the case of Fig. 3 by also adding relevant meteorological fields and the uncertainty of the ST and SIT estimates. Section 4 now features the period 11-16 July 2022, and we provide a direct link with the analysis performed in section 3: e.g., we now compare the PWRF-predicted snow thickness with that observed *in-situ* (Fig. 8f) and also conduct the SMB analysis for the model forecasts (Fig. S5). This ensures that Sections 3 and 4 are not disconnected, with the model outputs used to better understand the effects and structure of the AR.

- What are meteorological conditions near the sea ice surface during ARs? How do meteorological conditions affect the SIT and ST variations?
REPLY: In light of the reviewer's comment, we have added to Fig. 3 the hourly air temperature, relative humidity, and horizontal wind direction and speed to complement the SMB analysis and to compare with the *in-situ* ST and SIT measurements. We now explicitly discuss the role of the meteorological conditions on ST during the AR passage (lines 418-436; the SIT variations are within the uncertainty range) and Foehn

effects (lines 421-432). The effects of different meteorological phenomena on ST are now quantified (lines 400-416).

- It seems that precipitation plays an important role in affecting ST variations. What are the special features of the increase in ST during ARs compared to the ST increase during other snowfall events?
REPLY: As we now highlight in the text (lines 427-432), during the AR we do not see an increase in ST as the strong winds, with speeds in excess of 30 $m\,s^{-1}$, likely prevent its local accumulation, as reported to be the case in the literature in windy conditions. During non-AR snowfall events, when the wind speed is low (e.g. on 16 July when it dropped below 2 $m\,s^{-1}$) we do see an increase in ST (on this day by 0.02 m; lines 432-436). In this regard, AR and non-AR snowfall events have a different impact on the SMB. Our study highlights the fact that AR events are not synonym of net snow accumulation and that this depends on other factors such as winds and temperature. Without in-situ measurements this couldn't be discovered.

- Why does the SIT only increase during the 14 November AR period, while it does not increase during other ARs?
REPLY: When accounting for the uncertainty in the SIT estimates that arise from the methodology used to compute it, we do not see an increase during the passage of the 14 July AR: as stated in the text (lines 436-440), its 0.02 m variation is within the uncertainty range. As we only have one AR during the study period following a change in the methodology (ARs are now extracted using ERA-5's IVT instead of MERRA-2's vIVT; lines 331-334), we have to be careful not to generalize to the passage of ARs. As we note in the text (lines 438-440 and 865-868), a longer measurement period that comprises multiple AR passages would be needed for a robust conclusion of the effects of ARs on ST and SIT to be reached.

On the other hand, I suggest the authors to add the analysis of observed near-surface meteorological elements (e.g., wind speed, wind direction, air temperature and humidity.) near the observation site and its impacts on ST and SIT variations.
REPLY: We would like to thank the reviewer very much for his/her suggestion, which we implemented in Figs. 3 and S5, that allowed for a more insightful and detailed discussion of the effects of different atmospheric processes on the ST and SIT measurements (lines 400-416 and 418-436).

Specific comments:

1. Lines 508~509：How do you infer that SIT changes are mainly caused by oceanic forcing? From Figure 2, it can be seen that changes in SIT are mainly controlled by the growth and melting at the bottom, but it cannot be directly attributed to oceanic forcing, as the growth and melting of ice at the bottom is the result of competition between oceanic heat flux and conductive heat flux, and the conductive heat flux also depends on how much energy the ice absorbs from the atmosphere.
REPLY: We agree with the reviewer and would like to thank him/her for pointing out the role of the atmospheric forcing on the SIT variations, which we neglected to mention in the text, referring only to the oceanic heat flux. We have rephrased the sentence accordingly (lines 387-390).

2. Lines 514~520：How does equation 10 consider the process of snow-ice transition? This may affect the explanation of changes in ST with SMB.
REPLY: The SMB, defined in new equation (3), considers the different sources and sinks of snow, and does not explicitly represent the snow-ice transition process, even though snow-ice processes (e.g.,

conversion of ice to snow) are indirectly accounted for. We have rephrased the sentence the reviewer is referring to (lines 394-400) and have also expanded the discussion of Fig. 3 (lines 385-440), now with the addition of four meteorological fields that allow for a more comprehensive analysis (and quantification) of the effects of atmospheric processes on the ST variability.

3. Line 522：Add a space between “sea-ice” and “SMB”, and delete “.” before Foehn.
REPLY: In the revised version of the manuscript the referred sentence was removed. In any case, we corrected similar typos elsewhere in the text (e.g. in line 775).

4. Figure 3: The line for SMB is always covered by P line, and the line for M is also invisible. It is easy to cause misunderstandings. I suggest redesigning the display of results, perhaps using dual y-axis can solve this problem.
REPLY: We thank the reviewer for his/her suggestion. As we now state in the caption of Fig. 3 and in the text (lines 413-414), the snowmelt (M) term is zero for the full 08 July - 30 November measurement period. We have experimented with different options and decided to multiply the blowing snow divergence (D) term by two in Fig. 3b for easiness of visualization, stating it in the figure legend and caption, instead of using a dual y-axis. We believe the readability of Fig. 3 has been improved following the reviewer’s input.

5. Line 540~542: How should I understand the ST is decreasing during blocking high events, but the occurrence of blocking coincides with the the passage of ARs and ARs always lead to an increase of ST as the observations present?
REPLY: We apologize for the lack of clarity in the text and have rephrased the sentence accordingly (lines 442-446). As noted in the reply to the reviewer’s major concern and in the text (lines 426-436), at the Mawson Station we do not see an increase in ST in association with the passage of the 14 July 2022 AR, the only AR that impacted the site during the study period. In fact, ST decreases because of Foehn effects. Also, having blocking does not necessarily mean there will be ARs, and not all warm and moist air intrusions meet the strict intensity and geometric requirements of an AR. In addition, and following the reviewer’s specific comment #6, we use the 40 m s^{-1} threshold of the Pook Blocking Index to diagnose blocking events (stipple in Figs. 4a and 4d), meaning no blocking events around the site during July-November 2022 (lines 452-456).

6. Figure 4: How to identify the blocking from Figure 4a and 4d?
REPLY: Following the definition of the Pook Blocking Index, equation (S6), positive values indicate weaker mid-latitude (50º-60ºS) westerlies and/or anomalous westerlies at lower- (35º-40ºS) and higher- (65º-70ºS) latitudes, and hence a blocked extratropical westerly flow. We use as threshold 40 m s^{-1} to identify blocking events (stipple in Figs. 4a and 4d). We have updated the discussion in the text accordingly (lines 442-458).

7. Lines 852~853: The evidence is weak to make this conclusion.
REPLY: We have rephrased the referred sentence following the revised discussion of Fig. 3. In particular, we now state that the variability in ST is linked to precipitation (snowfall), Foehn effects, blowing snow, and episodic warm and moist air intrusions, which can lead to variations of up to ±0.08 m in a day (lines 792-795), and not just to the warm and moist low-latitude air occurrences.

8. Lines 854~856: Only the increase of 0.06 m in ST during the 14 November AR period is given in the result part.
REPLY: Following an update to the methodology used to diagnose ARs, we only have one AR during the study period, on 14 July 2022. During this event, the 0.02 m change in SIT is within the uncertainty range, while the up to 0.04 m variation in ST is likely due to Foehn effects and snowfall. We have rephrased the text accordingly (lines 797-798).

9. Lines 865~866: This is contradictory to your statement given in Lines 568~569.
REPLY: We agree with the reviewer that this sentence is incorrect and have removed it from the revised version of the manuscript.