

Dear Thijs,

Thank you very much for handling our manuscript (egosphere-2023-347). We have substantially revised the manuscript by addressing all the reviewers' comments. The revisions in the manuscript and the reply to the comments are marked in blue. Thank you very much.

Sincerely,

Changwei Liu (liuchw8@mail.sysu.edu.cn)
On behalf of all the authors

Anonymous Referee #1

Summary: The authors have adequately addressed my previous comments. I also find that the quality of the manuscript, including the language, has been significantly improved. I only have a few additional minor comments.

Response: Thank you very much for your time and effort in reviewing our manuscript. We have revised the manuscript accordingly. The revisions in the manuscript and the reply to the comments are marked in blue.

Minor comments:

1, I would suggest add "the" in the title, "Characteristics of the atmospheric boundary layer height over the Arctic Ocean during MOSAiC"

Response: Revised as suggested.

2, line 20-22: this is not very accurate. The summer temperature inversion is intensified because of warm air advection with surface temperature constrained by melting, but by surface melting.

Response: Thank you very much for pointing this out. We have revised the sentence as "Temperature inversions in the winter and summer are intensified by seasonal radiative cooling and warm air advection with surface temperature constrained by melting, respectively, leading to the low ABLH at these times."

3, line 22-23: Although friction velocity is a surface variable, it is actually not only related to surface characteristics. I would not use it as representing near-surface conditions. Just say that ABL variation is correlated with friction velocity and TKE dissipation rate. Also, the reviewer needs to elaborate on "these basic variables" or reword this sentence by avoiding such vague language.

Response: Thank you very much for pointing this out. We have revised the sentence as

“Meteorological and turbulence variables also play a significant role in ABLH variation, including near-surface potential temperature gradient, friction velocity, and TKE dissipation rate.”

4, line 135: suggest remove “strongly”

Response: Revised as suggested.

5, line 137: suggest remove “predominately”

Response: Revised as suggested.

6, line 200-201: it’s still confusing to me in terms of “multiple profiles”. I think it should be “The gray dashed horizontal lines in each panel denote the atmospheric boundary-layer height (ABLH) estimates based only on the profile shown in that panel (e.g., in panel the gray dashed horizontal line is determined only using the profile of θ_E)”.

Response: Revised as suggested.

7, line 331: “regardless of Ric” seems too strong. I don’t see a proof of this statement.

Response: Thank you very much for pointing this out. We have removed the relevant statement.

8, line 452-453: it should be “could have been potentially impacted by more open-surface water conditions”

Response: Revised as suggested.

9, line 499-501: this sentence is not very accurate. Epsilon is the dissipation rate. It can only indicate the rate at which the TKE is changing, not the magnitude of TKE itself.

Response: Thank you very much for pointing this out. We have revised the sentence as “The ε indicates the rate at which the TKE is changing, and the high value of ε means well-developed turbulence”

10, line 529: suggest change “an indicator” to “indicators”

Response: Revised as suggested.

11, line 545: suggest remove “the unique characteristics of” and “in detail”

Response: Revised as suggested.

12, line 590: “that” should be removed.

Response: Revised as suggested.

Anonymous Referee #2

Summary: The authors have done a good and thorough work to take into account the raised concerns. The manuscript can be published pending some editorial items:

Response: Thank you very much for your time and effort in reviewing our manuscript. We have revised the manuscript accordingly. The revisions in the manuscript and the reply to the comments are marked in blue.

Ln 222: K/km -> km-1

Response: Revised as suggested.

Ln 224: m/s -> ms-1

Response: Revised as suggested.

Table 1: the bias is missing a unit in the header. Also I do not understand the bias values, since I expect them to be in the same order of magnitude as for MEAE. Is this really the bias in meters?

Response: Thank you for your helpful comment. Actually, the *bias* in our manuscript is defined as a dimensionless metric. According to Eq. (4), the range of bias can be $[-2, 2]$, and algorithms perform well as bias is close to 0. This bias definition helps avoid the influence of ABLH (H_{obs}) itself on the bias values. For this comment, we have added a “dimensionless” into the *bias* metric description.

Equation 7: I think each term in the denominator should be in brackets and then squared (i.e. not the gradients of u^2 and v^2).

Response: Revised as suggested.

Ln 365: the Obukhov length. Please add “at the surface” behind “length”

Response: Revised as suggested.

Ln 458: remove space after first)

Response: Revised as suggested.

Ln 483:divided into (a), (b), and (c). Please reword. Just mention panel a represents Oct-Jan, panel b Feb-May and panel c) Jun -Sep.

Response: Revised as suggested.

Ln 661: remove space in “L ow”

Response: Revised as suggested.

Ln 684: ‘new Arctic.’. Remove dot behind Arctic.

Response: Revised as suggested.