

General comments

This study examines the characteristics of the Arctic atmospheric boundary layer (ABL), more specifically the surface mixed layer (SML), during the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAIC) campaign, using measurements from a tethered balloon platform including in-situ turbulence measurements. The measured profiles of the turbulence dissipation rate are used to diagnose the depth of the SML. This diagnosis serves as a reference for the evaluation of the bulk Richardson method and the surface flux-based method. I think the most significant result of the study is the determination of a critical bulk Richardson number for the diagnosis of the height of the SML. Furthermore, two typical states of the Arctic ABL were observed and characterized: cloudless situations with a stable and shallow ABL, and cloudy conditions with a mixed ABL. The paper is nicely organized and mostly well written. The presentation is mostly clear. While I think the paper may be acceptable with only minor revisions following the comments below, I think it could be significantly strengthened following the suggestions of the other reviewer.

Specific comments

1. L23-L24: “... plays an important role as stable stratification hampers the vertical exchange and leads to a near surface warming contribution to Arctic amplification...”. This is not clear to me. Wouldn't more stable conditions and reduce vertical exchange lead to surface cooling?
2. L172-L173: “For surface temperature, we use observations at the 2 m height”. Would this not lead to a significant underestimation of the true surface inversion strength? Please comment on the differences.
3. L205: “with a less well mixed, neutrally stratified layer below the inversion” What do you mean? To me the sub-cloud layer looks like a rather well-mixed turbulent layer.
4. L208: “a slightly stably stratified layer”. Seems still rather stable to me. Do you mean a “less stably stratified layer”?
5. L209-L210: “Near the surface, the wind speed increases with height, peaking at about 50 m again and continuing almost constantly until the maximum height of the profile.” I find this sentence unclear, please reformulate.
6. L261: “the differences for the two mean case depending...” What do you mean? Please clarify.
7. Fig 3: The near surface conditions (with strong gradients) are difficult to see. You might want to increase the size of the panels.

Technical comments

8. L23: vertical extend --> vertical extent
9. L203: alternates between two cloudless and cloudy --> alternatives between cloudless and cloudy
10. L214: almost linearly increases --> increases almost linearly
11. L214: The new paragraph should start with “The example for vertical stratification under cloudy conditions...”
12. L221: decrease almost abruptly --> decrease quite abruptly
13. L231: As it is often --> As is often
14. L232: already begins clearly inside --> already begins inside
15. L237: near surface --> near the surface
16. L238: low values --> lower values
17. L241: turbulence continuously reaches --> turbulence reaches
18. L280: SML height smaller than 150 m --> SML height less than 150 m
19. L298: at the low humidities --> at low humidity values
20. Fig. 11: at surface --> at the surface