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Title: Measurement report: The promotion of low-level jet and thermal-effect on development of deep convective boundary layer at the southern edge of the Taklimakan Desert

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Dear Editors

On behalf of the co-authors, thank you for giving us an opportunity to revise the manuscript. We appreciate the great efforts and constructive comments from the reviewers, which improve the quality of the manuscript significantly. We have revised the manuscript carefully according to the reviewers' comments and suggestions. Our point-by-point responses are appended below. All changes made in the revised manuscript are marked in light blue. Attached please find the revised version of the manuscript, which we would like to submit for your kind consideration. We are looking forward to hearing from you!

Best regards!

Sincerely yours,

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Reviewer #1:

Comments and Suggestions for Authors:

1. Most of my concerns have been well addressed. However, the research question is still yet established. The introduction left me the impression that you have the observations at the Minfeng station, and you just report the observations. Please elaborate why the deep convective boundary layer over Minfeng station is important instead of saying that you have the unique observations.

Response: Thank you for pointing out these problems in the manuscript. The manuscript has been greatly improved with your comments. We illustrated the importance of the study of deep convective boundary layer at Minfeng station from three aspects.

First of all, the Taklimakan Desert is an important dust source area in China. Under the influence of the deep convective boundary layer and the driving force of the northern slope of the Tibet Plateau, dust aerosol in the study site can rise to higher than 7 km (Meng et al., 2019), which affects regional and even global precipitation, cloud cover, and material circulation during long-distance transportation (Ge et al., 2014; Huang et al., 2014).

Secondly, the formation of the deep convective boundary layer is often accompanied by strong mixing of atmospheric pollutants in the vertical direction. At the study site, the annual average number of days with dust weather is 113.5 (Yang et al., 2016), and the number of days with a boundary layer height exceeding 4 km in summer is more than that observed at other major weather stations in the Taklimakan Desert (Wang et al., 2019). Studying the deep convective boundary layer is helpful for understanding the formation and evolution of dust pollution weather and contributes to the management of the ecological environment.

Thirdly, in the study area, special meteorological phenomena such as drought, severe convective weather, dust storms, gales, low-level jets, wind shear, and others often occur concomitantly with the development of the deep convective boundary layer (Su et al., 2024; Wang et al., 2016; Ge et al., 2016). Therefore, studying the deep convective boundary layer holds significant research importance for understanding these special meteorological phenomena.

Change: P2L24-P3L2. “The unique geographical location of the study site (TD, slope terrain, Kunlun Mountains, TP) makes the formation mechanism of the deep CBL not only complex but also highly significant. For example, within the study area, special meteorological phenomena such as drought, severe convective weather, dust storms, gales, low-level jets, wind shear, and others frequently occur concomitantly with the development of the deep CBL (Su et al., 2024b; Wang et al., 2016; Ge et al., 2016). The annual average number of days with dust weather is 113.5 (Yang et al., 2016), and during summer, the number of days with a BLH exceeding 4 km surpasses that observed at other major weather stations within the TD (Wang et al., 2019). Investigating the deep CBL is instrumental in comprehending the formation and evolution of dust pollution weather and contributes to the management of the ecological environment. Furthermore, under the combined influence of the deep CBL and the driving force emanating from the northern slope of the TP, dust aerosols within the study site have the capability to ascend to heights exceeding 7 km (Meng et al., 2019), ultimately impacting regional and potentially even global precipitation patterns, cloud cover, and material circulation during their long-distance transportation (Ge et al., 2014; Huang et al., 2014)”.

References:

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2. Also, please check the revised manuscript. Seems to be too many 'on the other hand' ... As I suggested already, please find a native speaker to revise the language.

Response: Thank you for your kind reminder. We have made great efforts to improve the smoothness and grammar of the sentences in the manuscript.

Change: P1L17-18. “During the stage of LLJ preceding the formation of the deep CBL, the LLJ had adequately prepared the conditions for the development of the deep CBL in terms of momentum, energy, and material”.

P1L19. “which leads to the formation of LLJ”.

P1L19-20. “thereby reducing the energy demand for the breakdown of this layer”.

P1L23. “the passage of a cold front”.

…

P2L20-23. “The deep CBL facilitates cloud formation in the late afternoon. This cloud formation not only leads to substantial surface cooling but also causes the momentum in the upper part of the boundary layer to transport downward, resulting in dust emissions”.

…

P8L1-2. “This resulted in a high concentration of CNR values being distributed below 1 km, which serves as a material foundation for boundary layer development”.

…

P12L1-2. “The persistent high solar radiation resulted in a surface sensible heat flux exceeding 300 W m-2 near the study site (at 16:00 LT), leading to highly efficient atmospheric heating”

…

Reviewer #2:

Comments and Suggestions for Authors:

1. The authors did a really thorough and careful job in responding to the comments and revising the summaries. They not only added explanatory materials in the attachment, but also provided a detailed explanation of the algorithm's doubts. The quality of the revised manuscript has improved significantly. I highly recommend accepting this manuscript with just a few minor modifications.

Response: Thank you for your recognition of this work. We have made great efforts to improve the quality of the article again.

2. P11 Line29, please correct "more coarse" in "Compared with the CDWL data, the temporal and spatial resolution of the ERA5 reanalysis data is more coarse" as "coarser" or "much coarser".

Response: Thank you for your kind reminder. We have rewritten this sentence.

Change: P12L8-9. "the ERA5 reanalysis data exhibit coarser temporal and spatial resolution, and the calculation method for the BLH also differs".

3. Authors are advised to standardize the journal name in references by using either the full name or abbreviation as per the specific requirements of ACP journal. e.g., P20 Line17, Line24, Line28, P21 Line2, P23 Line23.

Response: Thank you for your kind reminder. We have carefully checked the correctness of the references.

Change: P20L14-15. "Browning, K. and Wexler, R.: The determination of kinematic properties of a wind field using Doppler radar, Journal of Applied Meteorology and Climatology, 7, 105-113, 10.1175/1520-0450(1968)007<0105:TDOKPO>2.0.CO;2, 1968.".

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