Reviewer(s)' Comments to Author:

Reviewer: 1

Comments to the Author

The content of the manuscript looks OK, but still needs focus on its main findings and contribution to the science. Moreover, it needs a lot of works/corrections for grammar and typos.

Thank you for the comments.

Main findings:

(1) SH may not be the dominant factor for the super deep CBL over the Taklimakan desert. As explained in lines 392~426, in addition to the surface sensible heat, the intensity of the entrainment process determines the increase in the CBL. The entrainment rate w_e is a valuable indicator of the development of the structure of the PBL. The rate of growth of the CBL is mainly determined by the entrainment rate w_e at the inversion layer without considering large-scale vertical motion. w_e usually has a positive correlation with the amount of heat flux at the inversion layer $\overline{\left(w'\theta_v'\right)_h}$ and large LES experiments show that $\overline{\left(w'\theta_v'\right)_h}$ is about 0.2 times the surface flux of the buoyancy $\overline{\left(w'\theta_0'\right)}$. During the period from 1100 to 1400 BJT, a larger sensible heat flux is clearly correlated with stronger turbulent entrainment and warmer air from the free atmosphere entraining into the Mixing Layer. As a result, the CBL develops rapidly and warms too quickly in the early simulation phase due to the clear increase in temperature and strong vertical mixing in the model. The reduction in the sensible heat flux reproduces the evolution of the desert PBL better in the early simulation phase because the HFX-75% and Noah simulations produce the smallest simulation errors in both temperature and moisture. However, the height of the CBL and the potential temperature for HFX-75% and

Noah reach >5000 m and 323.2 K, respectively, at 1700 BJT. For the rest of the day, the rate of increase in the height of the CBL slows due to the deep CBL (>5000 m), which requires more heat for the increase in the depth of the PBL. w_e decreases with increasing intensity of the inversion, which inhibits the mixing and entrainment processes. These two factors limit the growth of the CBL when the height is >5000 m in this deep desert event. Therefore, increasing the sensible heat flux from 75 to 125% significantly reduced the total time required for the increase in the CBL to a relatively low altitude (<5000 m) at the middle and preliminary stages of the development of the CBL, rather than produces a higher CBL at a later stage.

(2) The SH is an important factor affecting the super deep CBL. Although SH is not dominant factor in this super deep CBL case, the CBL of Taklimakan need several days of favorable environment to reach its super depth (> 4000m), and Sustained high temperature and SH is the crucial factor for CBL to develop from shallow to deep CBL.

It needs a lot of works/corrections for grammar and typos.

We have used professional English language edit service (Lucid Paper) to correct grammar and typos in the manuscript.

Certificate

Reference number: 2018-061601

Date: 21 June 2018

Contact author: Hongxiong XU

Manuscript: Performance of Weather Research and Forecasting Model Large Eddy Simulations in modeling the convective boundary layer over the Taklimakan Desert, China

This document certifies that the above-detailed manuscript was edited by a native English-speaking expert at LucidPapers on the date stated.

Following the editing process, the editor's overall assessment is that:

The manuscript will be ready for consideration by the target journal once the edits have been checked and approved/rejected as necessary.	
The manuscript may or will require modifications to the text in response to the editor's comments/queries, but further professional editing is unlikely to be needed.	
The manuscript requires modifications to the text in response to the editor's comments/queries, and further professional editing may be needed.	☑
The manuscript requires modifications to the text in response to the editor's comments/queries, and further professional editing is more than likely going to be needed.	
The manuscript requires modifications to the text in response to the editor's comments/queries, and further professional editing is strongly recommended.	

Signed:

Colin Smith
Chief Editor
LucidPapers

Reviewer: 2

Comments to the Author

Review comments on the revised version of "Characteristics over the Taklimakan Desert: A Real Test Case" (ACTA-E-2018-0001.R1)"

Many changes were made through the authors' efforts in the revised manuscript. However, the grammar errors continue to occur almost everywhere in this updated version. A heavy English edit work is required to improve the writing. It is strongly recommended to seek a professional language edit service.

Thank you for the comments.

We have used professional English language edit service (Lucid Paper) to edit and improve the English writing.

Certificate

Reference number: 2018-061601

Date: 21 June 2018

Contact author: Hongxiong XU

Manuscript: Performance of Weather Research and Forecasting Model Large Eddy Simulations in modeling the convective boundary layer over the Taklimakan Desert, China

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The manuscript requires modifications to the text in response to the editor's comments/queries, and further professional editing is more than likely going to be needed.	
The manuscript requires modifications to the text in response to the editor's comments/queries, and further professional editing is strongly recommended.	

Signed:

Colin Smith
Chief Editor
LucidPapers

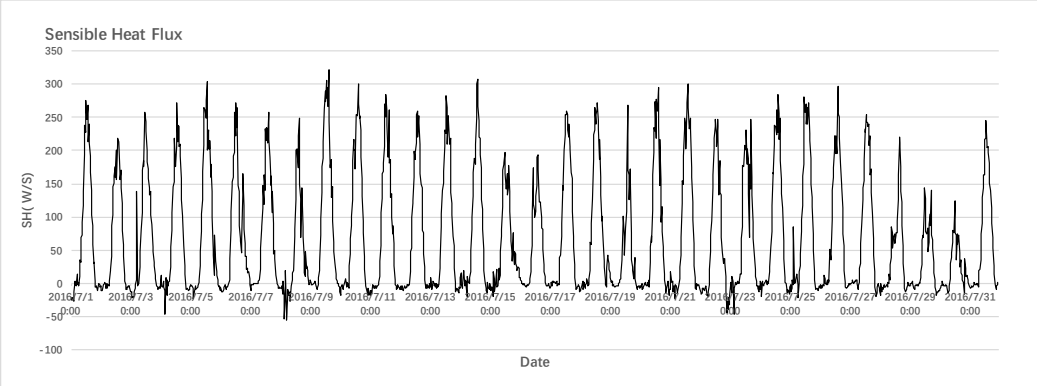
As pointed out in the first turn review, it is not useful to present the impact of the ingest frequency of the lateral boundary conditions on the large-eddy simulation (LES) results if the WRF/LES has a capability of running the online-coupling mode.

Thank you for the comments.

Yes, it is not useful to test the frequency of the lateral boundary conditions especially in two-way nest mode (online-coupling). However, one of our aims is to assess the contribution of uncertainties in LBC to the typical behavior of super deep PBL processes. LBC frequency sensitive experiments are still kept, because these experiments can provide an explanation of the important role of LBC play in LES. As showed by the experiments, LBC may be more important than the physics schemes used in the model.

In addition, the simulated sensible and latent heat fluxes presented in Figures 4 and 10 are not accepted for publication without further improvement. As pointed by the authors, the observed sensible heat flux could be too low on July 1, 2016. What about the observational data for other days? Did the authors see the similar low observed sensible heat fluxes on other days since you have one-month data in July 2017?

Yes, we see the similar low observed sensible heat fluxes on other days in July 2017. Wang et.al., statics the PBL height of Tazhong during July 2016. The number of days when the PBL exceeds 4,000 m depth is 8, and that of higher than 3,000 m is 20. However, most of observed deep PBL cases show similar low observed sensible heat fluxes as on July 1, 2016 (Figure b3).



Over-predicted latent heat flux in the first several simulation hours should be alleviated by setting the initial soil moisture in the simulations as the observed value. Did the authors try that?

Thank you for the comments.

Yes, we have tried to set the initial soil moisture in the simulations as the observed value (experiment EXP_SMOIST). In EXP_SMOIST experiment, initial soil moisture was simply minus 0.05 (difference between model and observation over Tazhong station, Figure b1).

Over-predicted latent heat flux the first several simulation hours are largely reduced in EXP_SMOIST. The large overestimate of soil moisture makes LH (Figureb2 b, f) from the

model continue to increase. As a result, near-surface of model is in agreement with observation (Figure b2 d). However, the results from CTRL experiment are closer to EXP_SMOIST experiment after 3 hours' spin-up. The large overestimate of soil moisture at initial stage(0~3hours) may have little impact on the large over-prediction of sensible heat flux during 3~12 hours' simulation.

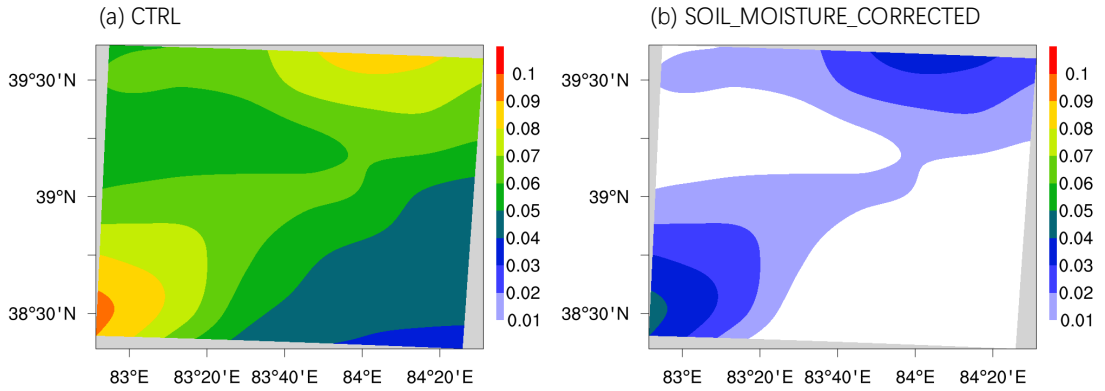


Figure b1 Soil moisture from model initial condition for (a) CTRL, (b) SOIL MOISTURE CORRECTED

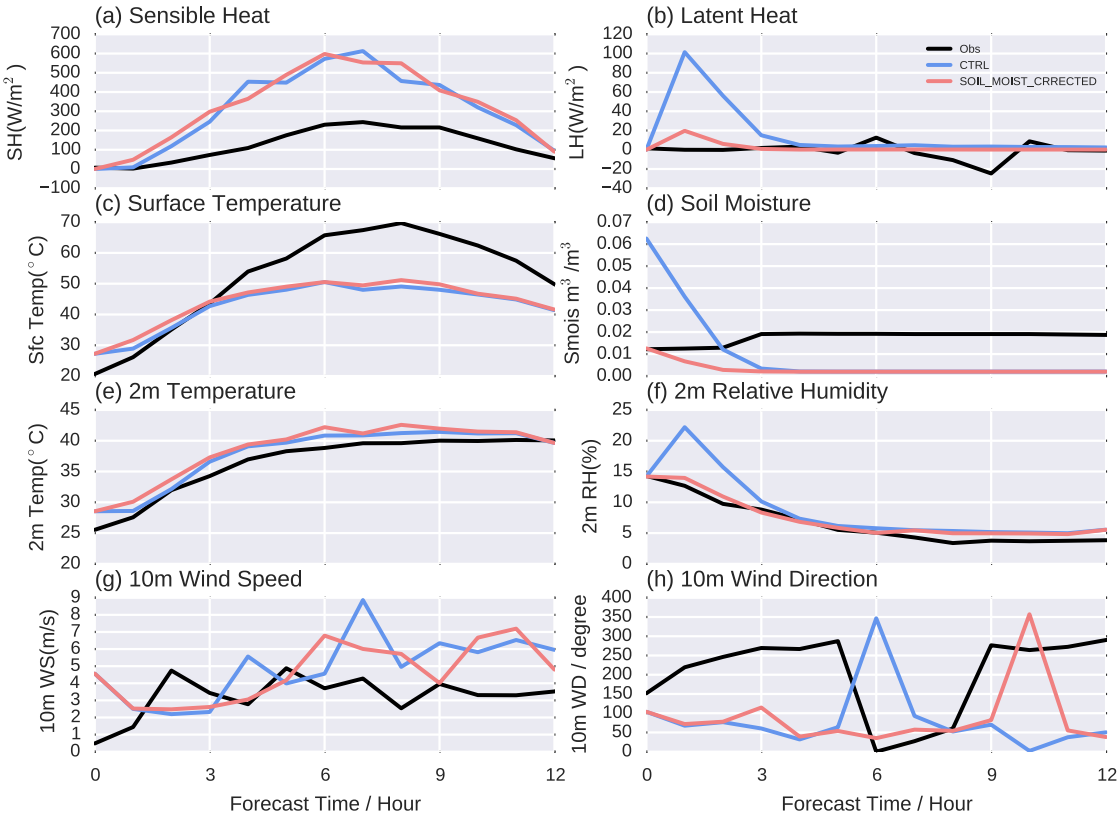


Figure b2 the same as Figure4, but for initial soil moisture sensitive experiment.

It is noted that the great efforts were made to improve the manuscript. However, another major revision is needed before it is accepted for publication.

Thank you for the comments.

More specific comments are found below.

1. The LES results presented in Figures 4 and 10 need further improvements. It is suggested to use the observed soil moisture as the initial condition for the new LES runs.

Yes, we have tried to set the initial soil moisture in the simulations as the observed value (experiment EXP_SMOIST). In EXP_SMOIST experiment, initial soil moisture was simply minus 0.05 (difference between model and observation over Tazhong station, Figure b1).

Over-predicted latent heat flux the first several simulation hours are largely reduced in EXP_SMOIST. The large overestimate of soil moisture makes LH (Figureb2 b, f) from the model continue to increase. As a result, near-surface of model is in agreement with observation (Figure b2 d). However, the results from CTRL experiment are closer to EXP_SMOIST experiment after 3 hours' spin-up. The large overestimate of soil moisture at initial stage(0~3hours) may have little impact on the large over-prediction of sensible heat flux during 3~12 hours' simulation.

2. Lines 398-399, the authors pointed out that the sensible heat (SH) may not be the dominant factor for the development of the deep CBL over the Taklimakan desert. However, in the conclusion part (line 461), the authors highlight that the SH is an important factor affecting the CBL depth over dominant. Please have double check and make them to be consistent? It should be very careful to make the former statement. If this were the case, that would be a big finding from this study?

Thank you for the comments.

(1) SH may not be the dominant factor for the super deep CBL over the Taklimakan desert. As explained in lines 392~426, in addition to the surface sensible heat, the intensity of the entrainment process determines the increase in the CBL. The entrainment rate w_e is a valuable indicator of the development of the structure of the PBL. The rate of growth of the CBL is mainly determined by the entrainment rate w_e at the inversion layer without considering large-scale vertical motion. w_e usually has a positive correlation with the amount of heat flux at the inversion layer $\overline{(w'\theta_v')_h}$ and large LES experiments show that $\overline{(w'\theta_v')_h}$ is about 0.2 times the surface flux of the buoyancy $\overline{(w'\theta_0')}$. During the period from 1100 to 1400 BJT, a larger sensible heat flux is clearly correlated with stronger turbulent entrainment and warmer air from the free atmosphere entraining into the Mixing Layer. As a result, the CBL develops rapidly and warms too quickly in the early simulation phase due to the clear increase in temperature and strong vertical mixing in the model. The reduction in the sensible heat flux reproduces the evolution of the desert PBL better in the early simulation phase because the HFX-75% and Noah simulations produce the smallest simulation errors in both temperature and moisture. However, the height of the CBL and the potential temperature for HFX-75% and Noah reach >5000 m and 323.2 K, respectively, at 1700 BJT. For the rest of the day, the rate of increase in the height of the CBL slows due to the deep CBL (>5000 m), which requires more heat for the increase in the depth of the PBL. w_e decreases with increasing intensity of the inversion, which inhibits the mixing and entrainment processes. These two factors limit the growth of the CBL when the height is >5000 m in this deep desert event. Therefore, increasing the sensible heat flux from 75 to 125% significantly reduced the total time required for the

increase in the CBL to a relatively low altitude (<5000 m) at the middle and preliminary stages of the development of the CBL, rather than produces a higher CBL at a later stage.

(2) The SH is an important factor affecting the super deep CBL. Although SH is not dominant factor in this super deep CBL case, the CBL of Taklimakan need several days of favorable environment to reach its super depth (> 4000m), and Sustained high temperature and SH is the crucial factor for CBL to develop from shallow to deep CBL.

3. L136: The setting of vertical levels of the WRF/LES simulations is not correct. It is impossible that the vertical level starts from 1130.473m.

Sorry for the mistake, 1130.473m is altitude. We have changed "height for lowest 20 levels" to "altitude for lowest 20 levels"

4. Please make sure all the abbreviated terms are defined at the place where they appear at the first time. Please define GPS at Line 45, and check the same issue throughout the manuscript.

Ok.

5. Line 48: Change "relative warmer" to "relatively warmer".

Ok.

6. Lines 50-51, change "Lateral Boundary Layer(LBC)" to "lateral boundary layer (LBC)". Please add one space before "(". There are many similar errors in other places of the manuscript.

Ok.

7. Please be careful to use the upper case for the first letter of a word. Here "Lateral Boundary Layer" is one example （L50-51）. More similar problems include "china" (L73), "Vertical" (L288), "Large-scale" (L300), "Specified LBC" (L319), etc. I am not going to list all of them here. It is the authors' responsibility to correct all the problems.

Ok. We have changed "Lateral Boundary Layer" to "china", "Vertical", "Large-scale" (L300), and "Specified LBC" to "Lateral Boundary Condition (LBC)", "China", "vertical", "large-scale" (L300), and "specified LBC" respectively. We also carefully corrected similar problems in the manuscript.

8. Please pay more attention to the usage of past tense and singularity of verbs. Some examples include "model show…" (L206), "but model produce" (L223-224), "… temperature are …" (L245),

"Figure 5 compare" (L327), etc. There are too many errors like this. The authors should be able to correct and avoid them.

Ok.

9. Lines 52-54. Please rewrite the sentence starting with "It is found ….". It is difficult to understand the authors' meaning.

We have changed "It is found that larger domain size varies the distance of the area of interest from the LBC, is efficient to reduce the influences of large forecast error near the LBC." to "It is found that larger domain size varies the distance of the area of interest from the LBC, is efficient to reduce the influences of large forecast error near the LBC." to "It is found that larger domain size varies the distance from the area of interest to the LBC, which is efficient to reduce the influences of large forecast error near the LBC."

10. Please change "locates" to "located".

Ok.

11. Line 70: Please add year after Wang et al.

Thank your comment, we didn't add year because the paper is still under review.

12. Line 81, please rewrite the sentence "This fundamentally restrict the development of understanding desert and surrounding area".

Ok, we have changed "This fundamentally restrict the development of understanding desert and surrounding area" to "This fundamentally restrict further understanding desert and surrounding area"

13. Line 86, "To fill in the gaps of Taklimakan desert" is ugly.

Ok, we have changed "To fill in the gaps of Taklimakan desert" to "To fill in the gaps in the available data for the Taklimakan Desert".

14. Line 97, "PBL can heavily impacted"?

Ok, we have changed "PBL can heavily impacted" to "PBL can severely impacted".

15. Line 98, "One way to tackle complex turbulent flows in weather forecast models is Large eddy simulation (LES)….." needs an improvement. Please correct. Again, there is no need to redefine LES if it is defined previously.

Ok.

16. Line 112, what is the LBCs?

We have changed "lateral boundary conditions (LBCS)" to "lateral boundary conditions (LBCs)".

17. Line 118, For the statement of "this paper is to examine assess the skillfulness….", please delete examine or assess.

Ok, we have deleted "examine"

18. Lines 136-138, what is the unit of the height?

The units are meter.

19. Line 140, please change the sentence "The sizes of model grids are 411 ×321 791x651 211x201 and 403x406 respectively." to "The numbers of model grids from the outmost to the innermost domains are 411× 321, 791×651, 211×201, and 403×406, respectively". Several similar issues can be found in other places such as Lines 139, 207-208, etc. Please pay more attention on how to use ",".

Ok.

20. Lines 258-260, how can you attribute the reason to the potential temperature lapse rate?

Yes, this may be due to the differences in the potential temperature lapse rate above the top of the mixing layer between the observations and the simulated results. The stronger simulated inversion layer restricts the development of the CBL.

21. Line 266, please define CBLH. Please check out throughout the manuscript.

We have changed "CBLH" to "CBLH (Convective Boundary Layer Height)"

22. Line 301, "may resulted in" => "may result in".

Ok

23. Line 318, for "LES simulation", please delete "simulation" since LES has included.

Ok

24. Lines 330-331, for the sentence "However, the comparison results reveal that discrepancies among different experiments are large for CBL"? What does the "discrepancy" represent?

Thank you for the comments. "discrepancy" represent moisture and temperature profile in CBL. We have changed "However, the comparison results reveal that discrepancies among different experiments are large for CBL" to "the results show that there are large discrepancies in the CBL structure among the different experiments".

25. Using "The" or "the" correctly is a big challenge. It seems that the authors have a big trouble of using "the" or "The". For example, on Lines 331, "CBL" should be "the CBL". There are too many issues like this.

Ok.

26. Line 350, the sentence "CBL, the instantaneous vertical velocity fields for the horizontal are displayed in" is incomplete. Please correct.

Ok, we have changed “CBL, the instantaneous vertical velocity fields for the horizontal are displayed in” to “CBL, the instantaneous vertical velocity fields are shown in Figure 7”

27. L353-357, figure number is missing.

Ok, we have changed “(a)” and “(b, c)” to “(Figure 7a)”and “(Figure 7 b, c)”respectively.

28. Line 374: import or important?

Ok, we have changed “import” to “important”.

29. Line 375, “surface-land schemes” should be “land-surface schemes”.

Ok.

30. Line 376: “the difference between model and observation” should be “the difference between simulations and observations”. Similar issues can be found other places too.

Ok.

31. Lines 382-384, please rewrite the sentence “The results … 125%”.

Ok.

32. Line 414, what do the large LES experiments mean?

We have deleted “large”.

33. Lines 446-447, please rewrite the sentence “Overestimation of CBL profile may be caused by discrepancy between model and measurement initially”.

Ok.

34. Lines 527-528: (d) “surface temperature (°C)” is not matched with Figure 4.d.

Sorry for the mistake, we have corrected the caption of Figure 4.

35. Line 534, please add “,” between (a), (b), (c), and (c).

Ok.

36. Line 535, change “01 Jul2016” to “01 July 2016”. Check the same issues in other places too.

Ok.

37. Figure 7, please add labels to x-axis and y-axis for all the four panels.

Ok.

38. I have to say that it is difficult to list all of the writing errors here since there are too many.

Thank you for the comments. We have tried our best to avoid writing errors and used professional English language edit service (Lucid Paper) to edit and improve the English writing

Editor(s)' Comments to Author:

Comments to the Author:

While the reviewers appreciated the efforts the authors spent during the revision, they still raised issues regarding English writing and too large model bias of surface fluxes.

Please be more careful for writing and improve introduction to put this work into the perspective.

Also please carefully address the 2nd reviewer's remaining concern.

Thank you for the comments.

(1) We have carefully replied reviewers' remaining concern and rewritten part of the introduction to make it clear.

(2) We have used professional English language edit service (Lucid Paper) to edit and improve the English writing.