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Editor-in-Chief
Atmospheric Chemistry and Physics
Dear Editor:

Please find the revised version of “Possible mechanisms of summer cirrus clouds over the Tibetan Plateau”. We value the comments received greatly and have accepted and incorporated essentially all of the reviewers' suggestions into the manuscript. The point-by-point replies to the reviewers' comments are enclosed.

We appreciate you very much for your editorial effort to this manuscript.

Sincerely yours,
Qianshan He

1. This concise paper describes the feature of the summer cirrus clouds over the Tibetan plateau, particularly the cirrus top heights. Three potential formation mechanisms which determine the cirrus top height over the Tibetan Plateau have been proposed and evidence has been discussed. While I wonder if there are other potential mechanisms which also play a role (I think there might be), this study provides valuable information and results regarding the characteristics and formation of cirrus clouds over Tibetan Plateau. Thus, I would recommend its consideration for publication after some minor changes. 2. Zhang et al. "Possible mechanisms of summer cirrus clouds over the Tibetan Plateau"

Most references used in this study are those before 2013, some recent studies are worthy to review and cite.

Response: Thank you for the suggestion. Yes, the formation of cirrus requires joint efforts of sufficiently cold and moist atmospheric conditions, favorable convective activities as well as possible condensation nucleus. Other potential mechanisms, such as the Rossby wave (Dai, Wu, Song, & Liu, 2018) could also play a role. Our study tends to address the most dominating mechanisms to generate cirrus over the Plateau and provide an insight into their physical process. Therefore, other relatively trivial and less significant mechanisms are ignored in this paper. In the future, we will explore other mechanisms more thoroughly by case study if possible.

The above statements have been added at line 227-232 as well as the references.

References after 2013 have been cited.

Line 17-25, Regarding the abstract, a little more information about the relative importance of the three mechanisms at different locations/conditions would be helpful.

Response: The abstract has been modified at Line 24-26.

Line 29-32, You may rephrase this sentence a little bit.

Response: The sentence has been rephrased at Line 31-32.

Line 41-43, Two other recent references could be also cited here, which are Yang et al. (202, doi: 10.1016/j.atmosres.2020.104927) and Zhao et al. (2019, DOI:10.1002/joc.5975). They found that associated with the topographic effects and the transport of moisture air, the cirrus clouds are found more from March to May.

Response: The references are added.

Line 56-60, when we talk about the occurrence, characteristics and potential causes form ground-based observations, we usually took use of radar and lidar observations, such as Zhao et al. (2016, http://dx.doi.org/10.1175/JAMC-D-16-0038.1) for ice clouds and (2017, doi: 10.1016/j.atmosres.2017.02.002) for liquid clouds over the Tibetan Plateau. However, we should note that when using lidar observations, it is rare to examine them based on top height due to the attenuation of lidar signals, unless the clouds are thin without any other clouds below. Actually, with strong attenuation ability, radar (such as Zhao et al., 2016) can provide the characteristics (temporal and spatial distribution) of ice clouds over the Tibetan Plateau.

Response: Thanks for the comments. The statements have been added at line 56-62 as well as the references.

Line 75-76, we know that the third Tibetan Plateau Atmospheric Experiment was carried out in 2014 and 2015, it might be valuable and interesting to compare the findings from Calipso with that from ground-based remote sensing observations.

Response: Thanks for the comments. Our study is consistent with the third Tibetan Plateau Atmospheric Experiment both in terms of cirrus height (9-16 km) as well as the mechanism (deep convection). The related statements are added in Line 118-120 and Line 167.

Another question, Calipso observation only occurs at 1:30 PM in a 16-day cycle, how could this represent the characteristics of cirrus for a day. As Wang and Zhao (2017,

doi:10.1002/2016JD025954) indicated, even for MODIS which pass two times a day, the representation time error due to single time observation could be large when considering daily average or even monthly average.

Response: Our study is based on the distribution of the total cirrus occurrence numbers detected by CALIPSO during the June-August period from 2012-2016. It is the climatology results instead of the daily or monthly average. The larger the cirrus occurrence number, the more cirrus are guaranteed at least during the 1:30 PM local time. Yes, our study is somehow deficient due to the sampling time, but the conclusions we draw from the 5-year data can still represent the characteristics of cirrus over the entire Tibetan Plateau to a certain extent.

Line 93, Using superscript for Wm-2

Response: Corrected.

Line 117, large number of

Response: Corrected.

Line 125-126, actually, the heat pump effect could be further enhanced by the absorption of solar radiation by transported absorbing aerosols such as black carbon and dust, as indicated by zhao et al. (2020, https://doi.org/10.1093/nsr/nwz184).

Response: The comments have been added at Line 124-126.

Line 128-129, I am not sure if it is possible to get the radiation balance from CERES. If it is, you may check the consistency between CERES observations and ERA5.

Response: CERES provides radiation observation. The global ERA-Interim monthly surface incident shortwave radiation product had an overall correlation coefficient of 0.95, a bias of 11.25 Wm^{-2} and an RMSE of 27.70 W m^{-2} by comparing with the CERES data (Zhang et al., 2016). ERA5 has better performance with reduced errors (ERA5- CERES) than ERA-Interim did (Hogan et al., 2017). Therefore, ERA5 radiation product is reliable. Our study aims to compare the radiation cooling with latent heat, sensible heat and evaporation. It would be

more consistent if we use the same reanalysis product. CERES alone can only provide the radiation date. The possible inconsistency between CERES and ERA5 can bring bias to our analysis when we try to compare radiation with other physical processes.

Line 134, "Fig. 3b and Fig. 3c show the …"

Response: Corrected.

Line 140-141, is this a typo "with terrain height larger than 4500 km"?

Response: Corrected as "with terrain height larger than 4500 m". The sentence is rephrased at Line 145-146.

Line 144, you may rephrase this sentence to make it more clear "Still, the weak vertical motion in the upper layers prohibits the vertical growth of cirrus".

Response: The sentence is rephrased as "the weak vertical motion above 300 hPa further prohibits the vertical growth of cirrus to a larger height" at Line 146-147

Dai, G., Wu, S., Song, X., & Liu, L. (2018). *Optical and geometrical properties of cirrus clouds over the Tibetan Plateau measured by lidar and radiosonde sounding at the summertime in 2014.* Paper presented at the Optics and Photonics for Energy and the Environment.

Hogan, R. J., Ahlgrimm, M., Balsamo, G., Beljaars, A., Berrisford, P., Bozzo, A., . . . Lang, S. (2017). *Radiation in numerical weather prediction*: European Centre for Medium-Range Weather Forecasts.

Zhang, X., Liang, S., Wang, G., Yao, Y., Jiang, B., & Cheng, J. (2016). Evaluation of the reanalysis surface incident shortwave radiation products from NCEP, ECMWF, GSFC, and JMA using satellite and surface observations. *Remote Sensing, 8*(3), 225.