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We deeply thank the reviewer for her/his thoughtful comments and suggestions, which benefited the improvement of this manuscript. Below are the responses to her/his comments.

General comments

The paper of Huo et al compares the cloud top height retrievals of MODIS collection 6, AHI product distributed by JAXA and a ground based Ka-band radar for the region of Beijing. It discusses the differences of the products as function of the cloud base height and cloud depth. The paper is clearly structured and sufficiently well written, but some formulations could be clearer and some typos have to be corrected. These findings are interesting for users of the satellite cloud top height CTH products. The paper would gain a lot, if MODIS and AHI are compared to the Ka-band radar exactly in the same way (plot Fig 4a and 7a in the same way, plot 4b also for AHI, plot 7b also for MODIS, plot Fig 5 for AHI. . .). The paper would also gain by an extended discussion, e.g. the difference between the radiatively effective CTH (expressed here as "radiation center of the cloud") and the radar CTH was first mentioned in the summary. It might be worth to include a complete discussion chapter. I support that a small summary of the Håkansson et al. 2018 should be included here.

Thank reviewer. According to both reviewers' suggestions, many modifications have been made in this manuscript and hope the revised manuscript can meet the approval of reviewer.

Specific comments

1. Line 12: Specify here, that you refer to cloud base height: "especially clouds higher than 4km" e.g. write especially when the cloud base height is higher than

According to reviewer's advice, the sentence is revised as "*especially when the cloud base height is higher than 4 km*"

2. Line 12/13/14: Like Nina Håkansson mentioned, these lines should be reformulated, maybe like this: MODIS CTH larger than 6km show a good agreement with the radar CTH when the cloud depth is large and larger differences when the cloud depth is small.

Radar measures cloud depth and cloud base height. Only the MODIS CTH is from MODIS. Both high MODIS CTHs and low MODIS CTHs are the top heights of clouds with various cloud base heights and cloud depths. It is possible that a low MODIS CTH is retrieved from the cloud with higher base height since the base height is reported by radar. To avoid confusion, this sentence is revised as "It was found that MODIS CTHs with greater value (i.e. > 6 km) showed smaller difference to radar CTH than those MODIS CTHs with lower value (i.e. < 4km)."

3. Line 15: I am a bit puzzled by this: The average MODIS CTH is 1.1km lower than the average CTH of the Ka-band. The average AHI CTH is 1.1km lower than the average CTH of the Ka-band. But still the average AHI CTH is 0.64 km lower than the average MODIS CTH. Shouldn't the difference between AHI and MODIS be close to 0 km? Could you comment on this, please?

For the comparison MODIS vs. Ka-band, AHI vs. Ka-band or MODIS vs. AHI, we collocate the CTH data individually. Thus, the three comparison results are based on different samples. It is the main reason why the difference between AHI and MODIS is not close to 0 km. Another reason may be related with the statistical method. The new Table 3 presents an overview of the statistical results in which the median and peak differences of D_{ar} and D_{mr} are different.

To avoid the confusion, this sentence "*Statistical analysis showed that the average AHI CTHs were lower than the average MODIS CTHs by -0.64 ± 2.36 km*" is revised as "Statistical analysis showed that the CTH difference between two satellite instruments AHI and MODIS was lower than the difference between satellite instrument and ground-based Ka-band radar.

4. Line 21: clouds to influence GCM by many more processes, e.g. water transport, radiative transfer, lightning activity, aerosol transport...; maybe write: "for example" as the cloud vertical distribution determine. . .

It has been revised according to reviewer's suggestion.

5. Line 24: replace "modeled stratocumulus CTHs with satellite retrievals" with "stratocumulus CTHs retrieved from satellite observations"

Sorry for our poor writing. Reviewer's advice is different to what we want to express. This sentence is revised as "Comparisons of stratocumulus CTHs simulated by GCMs with retrieved from satellite...."

6. Line 19 to 24: could be written a bit more smoothly.

We have made some minor revisions according to reviewer's advice.

7. Line 30: IR brightness temperature of "the" cloud

"the" is added.

8. Line 30: for instance, "that a" cloud. . .

It has been revised as "that an opaque cloud can be"

9. Line 31: Ground based lidar often does not detect cloud tops.

"Some" is added.

10. Line 35 to 45: The references of the MODIS validation that are discussed more in detail are all very old (1999, 2002, 2008). As this paper deals with MODIS collection 6, I suggest to update this section.

According to reviewer's suggestion, we add and update recent references in the manuscript.

11. Line 51: Mouri et al (2016) found that the CTH (of a ground based radar? where?) was underestimated?

It is the "AHI CTH". The sentence is revised as "Mouri et al. (2016) reported that the AHI CTH was underestimated compared with the MODIS and CALIOP data over two weeks of measurements". In the study of Mouri et al. (2016), the place is not mentioned.

12. Line 48 / 51: Zhou says that CTH by ground based radar are higher compared to satellite CTH (AHI), but Mouri says CTH (by ground based radar?) was underestimated compared to satellite CTH (MODIS). Could you comment on why the results are different, please.

Sorry for our poor writing, resulting in reviewer's misunderstanding. Zhou et al. compared the CTH retrieved from AHI radiance data using a different CTH retrieval algorithm with the CTH derived from Ka-band radar. Zhou's CTH retrieval algorithm is not the AHI CTH retrieval algorithm. Mouri compared the AHI CTH with the CTH derived from MODIS and CALIOP.

Studies of Zhou and Mouri are the publications what we can find at present about investigating the CTHs derived from AHI measurements. The comparison dataset are different and the retrieval

algorithm are also different, so the results are different.

13. Line 35 to 57: might be better structured: describe roughly satellite and ground based CTH retrievals, comment on their differences describe global evaluations and describe expected differences (state of the knowledge today); write why local evaluations are important; reason, why this paper brings additional insight; comment on, why the region of Beijing is interesting

Yes. We revised this section according to both reviewers' comments and hope those revisions can be accepted.

14. Line 71: I suggest to move the equations after the sentence: Equation (1) to (3) present the theory of the CO₂-slicing technology. Equation 1: R_{clr} must be written in large letters; please explain R_{bcd} in the text below (I guess this stands for radiance of clouds with emissivity of a black body) Equation 2 and Equation 3: "dp" is missing at the ends of each integral; You could add a citation here for these equations, e.g. the CLOUD TOP PROPERTIES AND CLOUD PHASE ALGORITHM THEORETICAL BASIS DOCUMENT, Menzel et al.

Thank reviewer for his careful reviewing and we are very sorry for our carelessness. Equation 1: R_{clr} is revised in large letter. Explanation of the R_{bcd} is added. "dp" is added in Eq.2 and Eq.3.

The sentence is revised according to reviewer's suggestion.

15. Line 74: replace "is the radiance measured" with "is the measured radiance"

It is revised.

16. Line 81: give a few examples of MODIS collection 6 evaluations

This has been added in the introduction.

17. Line 83: the spatial resolution (of the cloud product?)

Cloud products of Collection 5 and Collection 6 have different spatial resolutions. This sentence is reformulated.

18. Line 92: target area and landmark areas

It is revised.

19. Line 95: radiative transfer code (Eyre 1991) developed by EUMETSAT "with" input

It is revised as "The AHI CTH retrieval algorithm uses radiative transfer codes (Eyre 1991) developed by EUMETSAT and Numerical Weather Prediction temperature and humidity profile data to calculate the radiance of four infrared bands (wavelengths 6.2, 7.3, 11.2 and 13.3 μm)."

20. Line 104: Avoid the brackets The Ka-band polarization Doppler radar "using a wave-length of 8.55 mm"

It is revised according to reviewer's advice.

21. Line 133ff: reformulate the last 3 sentences: Zhou used -40 bBZ, but in this study we choose -45 dBZ, as we wanted to include clouds with weak return signals.

These sentences are revised according to both reviewers' comments. Ka-band radar equipped with magnetron-type transmitter can transmit stronger signals than the radar with all-solid transmitter. So, it can detect weaker returns.

22. Line 127: specify what you mean by "period"

It is revised as "For clouds detected in a period (i.e. within 5 min or 15 min),...."

23. Table 1 add space between number and physical units

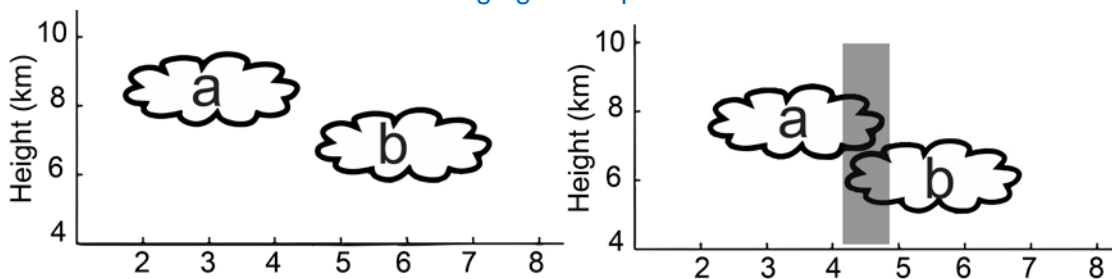
They have been added.

24. Line 126 to 131: this is already comparison technique and should be move the chapter 3

These sentences describe how radar CTH is calculated or derived. It might be better in section 2.3.

25. Line 128: I don't understand this sentence: "For multi-layer clouds, the CTH is also the average of all cloudy profiles even if the upper-level cloud do not cover the lower-level cloud, rather than the average CTH of the upper-level clouds."; Does the upper-level cloud not always cover the lower level cloud by definition? Please comment on, why you choose to average the CTH of the upper cloud layer and the lower cloud layer. (If I understand this correctly.)

Another reviewer also has confusions. Sorry for our poor usage of English language. These sentences are revised. The following figure helps to make it clearer.



In the left figure, final radar CTH is the average CTH of all cloudy profiles of cloud 'a' and cloud 'b'. In the right figure, final radar CTH is the average CTH of all cloudy profiles of cloud 'a' and part cloudy profiles of cloud 'b' (where cloudy profiles in the gray frame are not included). We did not use the mean CTH of the upper-level cloud 'a' as final radar CTH because that might bring more bias to what satellite measures within an area.

26. Line 131: Could you comment on the accuracy of the Radar CTH measurement, please. Does the radar always sees the uppermost cloud boundary. Or is it possible that attenuation is so strong that you cannot see through the cloud, e.g. during a strong precipitation event.

Yes. Ka-band radar has an algorithm to correct the reflectivity attenuation due to water vapor and oxygen but the attenuation by cloud and precipitation has not been calibrated. Attenuations due to cloud and precipitation will affect the determination of cloud top and the cloud top height is probably underestimated. We now cannot tell the accuracy. But the error is expected to be minor since radar has a stronger signal transmitter and its vertically pointing mode limits the attenuation paths, which are should be less than 16 km.

27. Line 137: Improve sentence: "MODIS CTH data measured transiently cover an area"

The sentence is revised.

28. Line 137/138: use superscript for exponents km^{**2} and m s^{**-1}

They are revised.

29. Line 138: "line" -> a scanning line with constant elevation

It is revised.

30. Line 138: what about wind speeds below and above 10 m/s?
If the moving speed becomes higher (or lower), the required time for scanning same path will decrease (or increase).
31. Line 147: I would reformulate this: "the MODIS spatial resolution has been increased"; Maybe: depending on the viewing geometry of the individual satellite overpasses, the sampling location and their distances from each other vary, see Fig 2.
It has been revised according to reviewer's advice.
32. Line 148: Please specify more clearly "the climatological distribution of clouds". Do you refer here to the distribution of the cloud movement?
Same question is asked by another reviewer. Could you please see my replies to the comments of that reviewer (Comment 20)?
33. Line 156: Please specify north-south and east-west resolution of the AHI product. Maybe add: "Due to the Himawari-8 viewing geometry", the AHI CTH data have . . .
It has been revised according to reviewer's advice.
34. Line 164: difference between the radar and MODIS (AHI) -> difference between MODIS (AHI) and the radar
The equations are separated. The sentences are revised according to reviewer's advice.
35. Equation 4: write this as two equations to avoid confusion with the notation $f(x)=y$
The equations are separated.
36. Line 173: add plus-minus signs here: less than "+/-"0.25 km, . . . less than "+/-"0.5 km,. . . less than "+/-"1.0 km
They are revised according to reviewer's advice.
37. Line 175 / Figure 4: I suggest to make Fig 4 and Fig 7 the same, so that it is easy to compare.
Figure 4 and Fig.7 are revised. Both revised figures present scatter map and the distribution of difference. In Fig.4, data are separated by day and night because they are from two satellites (Terra and Aqua). In Fig.7, it is not necessary to make such separation because data come from one satellite.
38. Line 191 / Figure 5: In the text, you discuss CTH difference as a function of cloud depth (5a) and CTH difference as a function of CBH. Therefore, I suggest to swap x and y-axis. I also suggest to do a similar figure also for the CTH comparison between AHI and Ka-radar. You might consider to write "D_{mr}" instead of "CTH Difference"
"CTH difference" is replaced with "D_{mr}".
The impacts of depth on the retrieval algorithm can be seen clearly from current Figure 5. We do not revise them. But if reviewer insist, we can make modification.
39. Line 204: Add more space between Table 2 and Line 204
They have been added.

40. Line 219++: make a italic "r" in D_ar in this line and all following occurrences
All have been revised.
41. Line 224 / Figure 7: For 7a, use same length for x and y-axis as well as same length. For 7b, you might consider to write "D_ar" instead of "CTH Difference"
They have been revised.
42. Line 231: . . . which might "be" due to
It has been revised.
43. Line 234 / Figure 8: In Fig 8a you might comment on the occurrence peaks of cloud optical thickness = 100 and 150.
The COTs are from AHI. Uncertainties of the retrieved COT are not available at present.
44. Line 250 / Figure 9: You might consider to plot best fit lines in these diagrams.
According to two reviewer's comments, Fig.9 has been revised.
45. Line 253-255: The description of the location "subtropical monsoon zone" might already be interesting in the reasoning why you wrote the paper at the end of the introduction.
Yes. We reformulate this section to make the expression smoother.
46. Line 265: Here a discussion chapter is missing.
Sorry. In fact, the summary chapter includes some discussions. We make some minor revisions and change the section title.
47. Line 268: uncertainty of the theoretical assumptions -> uncertainty caused by the theoretical assumptions
It is added.
48. Line 271: the CTHs retrieved from passive sensors . . . were on average 1.1 km lower compared with the . . .
It is revised according to reviewers' advice.
49. Line 274: The argument, that the CTH retrieved by satellite
It is revised.