Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
https://doi.org/10.5194/amt-2022-86-RC2, 2022

Comment on amt-2022-86

Anonymous Referee #2

Referee comment on "Detection and analysis of cloud boundary in Xi'an, China, employing 35□GHz cloud radar aided by 1064□nm lidar" by Yun Yuan et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-86-RC2, 2022

This manuscript combines lidar and Ka-band millimeter-wave cloud radar (MMCR) to study the cloud macrophysical properties in Xi'an. The authors propose a local method for lidar and MMCR, but without enough details. It would be more interesting if detailed descriptions are added in this manuscript. The statistical analysis is kind of superficial and the English writing needs a full editing. It is difficult to follow for several times. Thus, I recommend a major revision and suggest the authors to rearrange this manuscript carefully.

Major comments:

The title "Lidar and MMCR applied for the study on cloud boundary detection" indicates the manuscript will mainly focus on instruments and method, while the "statistical analysis of cloud distribution in Xi'an region" imply a systematically study for the local cloud distribution. This causes the keynote of the whole text not clear. Which part the authors want to focus, the method or statistical analysis? This would affect the structure of manuscript. Additional, both the method and statistical analysis of the manuscript as current form are not very clear.

The two flow charts of lidar and radar, i.e., Figure 2 and 6, are complex, but the text is too short. I can't tell if they are novel compared with previous methods. If the authors emphasize their method is well-improved, they should carefully introduce this part and show the difference and improvement from others'.

The authors claimed several times "This study will combine the advantages of lidar and MMCR in detecting clouds". While it seems that the results are just simply calculated from the two instruments, respectively. I was hoping some more in-depth combination, like DARDAR for the space-born radar and lidar (Delanoe and Hogan, 2008), whose method is associated with the specific radar/lidar raw observational value.

One-year observation might be too short for statistics analysis of cloud in section 4.2, especially only 302 days of MMCR and 126 days of lidar.

Most of the conclusions (line 413-423) are not new. There are many studies using collocated radar and lidar observation for cloud research, e.g. (Borg et al., 2011) (Dong et al., 2010) (Protat et al., 2011) and so on, which have shown similar results.

Minor comments:

Line 9, "he" should be "the"

Line 11, The SNR and SNR_{min} in the abstract should be explained and given the full description.

Line 14, what does the “rules” mean?

Line 33, what is “high change rate”

Line 35-36, remove “direction”, …has always been important for cloud physics.

Line 50,” dP/dr”, what is P and r, what is “negative to positive”, you mean the value of dP/dr, from negative to positive? Please rephrase this sentence.

Line 54, what is “detail debugging”

Line 59, “but the cloud bottom and cloud top detected by this method will be overestimated and underestimated respectively”. Does this mean the method would miss some part of cloud, i.e., detect some real cloud signal as noise? This manuscript really needs complete English editing.

Line 65, what is “library”. Line 65-67 is different to understand.

Figure 1. The area could be lager, at least shows some of the “Guanzhong Basin”, “Weihe River Basin”, “Loess Plateau”, “Qinling Mountains” as you described in line 88-90. What does the while line mean? Is it really necessary to show the negative elevation in your color bar?

Line 99, what is “HT101”?

Line 113-114 is difficult to understand.

Line 116 and line 120, should the N_{bcak} be N_{back}?

Figure 2. “yes” and “no” may be marked in the wrong place. They should be marked after a judgment statement, i.e., “>”, “<” or “==”, rather than equations. The symbols in the text should be explained. What is “sort”, “Pe”? What is the relationship between the three main boxes? It is hard to follow just from line 134-135.

Figure 3. The box, axis, tick should be black. The other figures in the manuscript should be changed too. Why the time in title is different with the time in figure? What is the unit of x axis? I notice there are some signal below the blue base line in figure b, especially below cloud base height, around 8 km, 6 km and 4 km. The slope is obviously different with the fitting slope. Does this influence your detection? What is the vertical dashed line in figure c?

Figure 6. The "thresh of XXX" should be "Larger/Smaller than thresh of XX". Generally, it should be a judgment statement.

Line 176, what is N_{ts}?

Line 184-185, please do not use both ">" and "less than" in one sentence. What is the unit of "velocity" and "velocity spectrum width"? And why you choose such thresholds?

Figure 7. Is the unit of velocity spectrum width in figure c "m/s"? Figure a, echo emissivity factor is the same as "reflectivity factor"?

Line 212, What is "time-height-indicator information"? Do you mean "vertical profile"?

Line 214-215, “After 05:00, the cloud layer developed deeper”. Does this infer from Figure 9, the MMCR observation? It would be clearer if you combine Figure 8, 9 and 10 together to see the difference of the two instruments. Same as Fig 11-13, and Fig 14, 15.

Line 216, “Rainfall begins at 06:00”, how do you get the time of rainfall, do you have rain gauge or other observations? Please explain this in Section 2.

Figure 8. What is the stripe in figure b around 23:00-01:00? Does this affect your detection results? What does the “SNR>5.2” in figure c stand for?

Line 228, what is “interference signals”

Line 232, “the cloud layer starts at 03:00”, does this mean the signal before 03:00 is not cloud?

Line 253-254, “From the characteristic distribution of the P_{new_sp} signal in Fig. 11b), the low-level cloud rained from 18:30 to 18:45”, how does this be concluded, just by the sudden decree of cloud base?

Line 273, “During the period from 15:00 to 01:00”, where is “15:00” in figure 12?

Figure 13, Could you please at least use one specific color/line style/marker to represent one property (cloud base or top/first or second layer/lidar or MMCR)?

Line 294, “Case three studies of precipitating cloud”, the figures of case one and two are also have been marked with rainfall. If you want to discuss precipitating cloud separately, the case one and two should be non-precipitating cloud.

Line 310, what is “rain storage”?

Figure 15. How the cloud base height being determined for precipitating cloud, such as after 11:00? I don’t think the cloud base height around 0 km is appropriate. This may explain why the cloud base height in figure 19 has a such huge peak at lower level.

Line 338, the 126 days of lidar observations seems too short for one year. Can the authors explain why is that? Is there any issue of the lidar, if so, does this issue affect the observed results?

Line 341-342, “we plan to employ MMCR data to replace the data of periods when the lidar is not running” What do you mean by “replace”? You mean the MMCR data are only useful when lidar is not running? Generally, I am not sure the purpose of Figure 16 and Table 3.

“bottom of MMCR is blurred” in Table 3, what does this mean? Are the results of table 3 accomplished by manual selection?

Line 379, “20217” should be “2017”.

Line 385-386, “The months with the largest (96%) and smallest (42%) cloud occurrence frequencies are August and December, respectively.” Does this mean the Jinghe National Meteorological Station are nearly covered by cloud during the whole month of August? Does it make any sense?

Line 390-391 and figure 18b, how the “normalized monthly distribution” be calculated? “the minimum cloud amount is 0.65 in spring and the maximum is 2.46 in summer”, how do these two numbers be inferred?

Reference:

Borg, L. A., Holz, R. E., and Turner, D. D.: Investigating cloud radar sensitivity to optically thin cirrus using collocated Raman lidar observations, Geophysical Research Letters, 38, L05807, 10.1029/2010gl046365, 2011.

Delanoe, J., and Hogan, R. J.: A variational scheme for retrieving ice cloud properties from combined radar, lidar, and infrared radiometer, Journal of Geophysical Research-Atmospheres, 113, 10.1029/2007jd009000, 2008.

Dong, X., Xi, B., Crosby, K., Long, C. N., Stone, R. S., and Shupe, M. D.: A 10 year climatology of Arctic cloud fraction and radiative forcing at Barrow, Alaska, Journal of

Geophysical Research, 115, 10.1029/2009jd013489, 2010.

Protat, A., Delanoe, J., May, P. T., Haynes, J., Jakob, C., O'Connor, E., Pope, M., and Wheeler, M. C.: The variability of tropical ice cloud properties as a function of the large-scale context from ground-based radar-lidar observations over Darwin, Australia, Atmospheric Chemistry and Physics, 11, 8363-8384, 10.5194/acp-11-8363-2011, 2011.