We thank the anonymous referee for very thorough and constructive comments. Below are our responses to the comments. The response (in blue) follows each comment.

Anonymous Referee #2

This paper proposes a improved cloud detection algorithm for ground-based sky camera observation, combining the differencing and threshold scheme. In addition, a new feature derived from the RGB channels is introduced to treat the effect of atmospheric scattering. Comparisons with other cloud detection methods prove the advantage of the proposed method.

Major comment

I recognize that the main difficulty of cloud detection for sky camera images is due to dark clouds and circumsolar regions. This study that intends to overcome the difficulty is significant for ground-based sky observation and the concept of the proposed algorithm is scientifically reasonable. The purpose of this study is appropriate to the journal. However, I recommend to publish this paper after some revision, because explanations for several points seems to be insufficient as follows:

1. P6 Line 22:"We have built a real clear sky background library (CSBL), which consists of many real clear sky images", how are the clear sky images extracted from sky camera data for creating CSBL? I have read the paper Yang et al. (2016), but the procedure to extract the clear sky data is also not described in detail. I think that the accuracy of the proposed algorithm strongly depend on the quality of CSBL. In particular, how does the extraction of clear sky images avoid falling into a circular argument, i.e., cloud detection must be required for cloud detection.

Answer: The CSBL library includes the initial creation phase and the subsequent update phase. At the initial stage, the brightness histogram of each TCI image is analyzed. When the histogram shows significant unimodal distribution and the peak of the histogram is on the low brightness side, the image can be considered as clear sky (Yang et al., 2015). Then the image is rotated by an angle equal to its solar azimuth angle. The rotated image is one of background images in the CSBL library, which consists of series of real clear sky images with a solar zenith angle interval of 1°. At the update stage, the results of cloud detection and brightness histogram analysis are combined to determine whether the image is clear sky. Considering the aerosols and climate seriously affect the brightness distribution of the clear sky background, the CSBL library is updated on each clear sky day to ensure that the clear sky background image with the closest date as the TCI image is available for cloud detection.

The above explanation will be added into the revised manuscript.

2. How are the threshold values determined, and are the values fixed or dependent on season and/or time? Furthermore, I think that not only the threshold algorithm but also the differencing algorithm needs to define the "threshold" for the difference of RAS to detect

clear-sky (and cloudy) areas, and how is this determined?

Answer: We have mentioned threshold setting in Page 6, Line 19-21 in the original manuscript. To better explain the details, we modified this sentence as

"A suitable threshold is the key of a successful cloud detection algorithm. An exact threshold should be higher than the sky background brightness and lower than the cloud brightness. That means the accurate threshold is depend on local climatic conditions. Since the sky background is mainly related to the aerosol/molecules scattering intensity in the RAS channels and the aerosol concentration above the Tibetan Plateau is very low in most cases, a fixed threshold of 10 is set for the binarization of the RAS channels in our experiments."

Due to the potential difference in aerosol loading in two different images (days), the clear sky backgrounds in the reference image and in the processing image may not be the same. We assume that the difference or the noise level in the clear sky background is small. Therefore, we set a threshold of 10 for the differencing algorithm.

These details will be added in the revision.

3. In addition to the estimation of error rate for each cloud type (Table 1), it may be better to present the error rate for the cases of visible and invisible sun, to emphasize the advantage of the proposed algorithm.

Answer: Thanks for the suggestions. In the previous manuscript, we simply took the absolute value for the error rate in Table 1. In order to show whether the algorithms are over or under estimate the results, we recalculated the error rate and the standard deviation for each algorithm. Since the GBSAT and CSBD algorithms are aimed at partly cloudy images, they are not suitable for the clear sky and overcast images. Here we only compared the results of R/B, multicolor and DTCA, which are shown in the new Table 1.

Table 1. The recognition errors rate of different cloud detection algorithms

	Clear sky		Cirriform		Cumuliform		Stratiform		Mixed cloud		Total	
	Avg	Std	Avg	Std	Avg	Std	Avg	Std	Avg	Std	Avg	Std
R/B	3.7	1.3	-24.5	16.7	-4.1	13.0	-2.9	9.3	-10.4	13.8	-7.7	15.3
Multicolor	43.5	15.0	-18.6	42.0	-4.6	40.6	-63.1	30.7	-26.9	38.3	-13.9	48.9
DTCA	2.5	2.5	-19.6	15.6	-0.4	9.3	-2.2	5.0	-6.5	11.5	-5.2	12.5

Here, negative values denote underestimation, and positive values mean overestimation. The conclusions are similar to the qualitative assessment: the multicolor algorithm is poor for all types of TCI images, the identification precision is low for the cirriforms in the R/B algorithm, and DTCA algorithm has the best identification effectiveness for all test images. The average recognition error rate of DTCA algorithm is -5.2%, but the error rate is -19.6 for the cirriforms, which means it still underestimate some thin clouds.

In addition to evaluate the error rate for each cloud type as Table 1, we also compared the errors rate under different sun conditions. We randomly selected 100 total sky images (50 visible sun cases and 50 blocked sun cases) from the mixed cloud type for quantitative evaluation of cloud detection algorithms. The results are shown in Table 2. The CSBD algorithm performs well under visible sun conditions, but poor under fully blocked sun conditions. The DTCA algorithm obtains the best recognition accuracy under both conditions.

Table 2. The recognition errors rate under different sun conditions

	Visible sun		Blocked sun	
	Avg	Std	Avg	Std
R/B	-8.8	13.6	-15.2	13.9
Multicolor	31.8	25.2	-24.3	32.0
CSBD	0.5	14.9	-15.5	25.2
DTCA	-2.2	10.2	-5.9	10.1

Both Table 1 and Table 2 will be added in the revised manuscript.

Detailed comments

P4 Line 11: "distinquish" should be "distinguish".

Answer: We will revise it in the revised manuscript.

P4 Line 21: define the variables R, G, B with unit (and then Y and RAS). Are these intensity of radiance or reflectance or others?

Answer: The raw data captured by the visible sensor represents the radiance intensity. The R, G, and B channels are converted from the raw data using linear or nonlinear processing. All these variables (included R, G, B, Y, and RAS) have no units. They are in unsigned 8-bit format with each pixel in the range of 0-255.