Dear editor and reviewer:

On behalf of my co-authors, we thank you very much for giving us an opportunity to revise our manuscript, we appreciate editor and reviewers very much for their positive and constructive comments and suggestions, especially in the part of research data and methods.

We have studied reviewer's comments carefully and have made revision which marked in red in the paper. We have tried our best to revise our manuscript according to the comments. Please see below our replies in detail. Attached please find the revised version, which we hope reviewer would be satisfied with our answers and the revision we provided.

We would like to express our great appreciation to reviewer for comments on our paper. Looking forward to hearing from you.

Yours sincerely,

Shuai Li
College of Environmental Science and Engineering Donghua University
2999 Renmin North Road, Songjiang District, Shanghai
Mobile: (86)13999856917
Email: rainlishuai@163.com

Reviewer 3:

Q1. Line 15: You say the ground-based observations are manually observed TCC. However, in the answer to reviewer 1, Q10, you write that the ground-based observation are artificial positive zenith observations? Can you clarify within the paper what kind of ground-based observations were used.

Response: We apologize for the ambiguity caused by our earlier answer to reviewer 1, Q10. The ground-based observations are manually observed TCC, that means, human-eye observation on the ground. We have clarified that in Line 118-119: Manually observed TCC are the human-eye observations on the ground.

Q2. Further, the matching principle is not clear: manually observed TCC are according to the WMO synoptic code in oktas and satellite observation are given in percentage (0 to 100). If it is manually observed TCC. What is the unit with which TCC is observed and what are average visibility ranges at the station? How do you convert the ground-based observation to 0-100%? All this information should be provided to the reader in the paper. If it is artificial positive zenith observation, what instrument is used? What is the error of the instrument and what is the measurement principle?

Response: The ground-based observations are manually observed TCC. We added the specifications of manually observed TCC and the TCC conversion method in Line 118-127 and 148-160.

In Line 118-127: Manually observed TCC are the human-eye observations on the ground, they are collected five times a day (at 00:00, 03:00, 06:00, 09:00, and 12:00 UTC), with values ranging from 0 to 10. The observations follow the specifications outlined below: when the sky is entirely clear, the TCC is recorded as 0; if the sky is completely covered by clouds, it is recorded as 10; if the sky is fully covered by clouds but openings in the clouds allow glimpses of the sky, it is recorded as 10-; When there are a few clouds in the sky, amounting to less than 0.5 of the sky's coverage, the TCC is recorded as 0; When visibility is impaired due to phenomena such as haze, suspended dust, sandstorms, or blowing sand, rendering the determination of TCC either entirely or partially indiscernible, the TCC is recorded as “ – ”. If clouds occupy one-tenth of the sky, the TCC is recorded as 1; if they occupy two-tenths of the sky, it is recorded as 2, and so forth, following a similar progression for different levels of cloud coverage.

In Line 148-160: The specific data processing methods are as follow. ① To mitigate the impact of short-term weather changes on ground observations, reduce data fluctuations caused by observational errors, and enhance data stability, the stations with continuous observations for 20 days or more are selected to enhance data stability (Liu et al., 2016); the abnormal observations, including missing data and outliers (observations < 0 or > 10 or the records are " – "), are removed from the dataset during the preliminary quality control of the ground observation data. ② The ground observation TCC reflects the cloud cover within a certain range around each observation point, the area can reach several kilometers or even more than ten kilometers, for satellite observation TCCPs, only the radiation ratio at grid points is considered. Therefor for satellite products, the TCC at each station is determined by averaging the cloud amounts of all grid points within a 10 km radius centered on the station's location. ③ Using the observation time, latitude and longitude information of the observation stations, the TCC observed by the GOS are matched with those observed by the satellite, and the total number of matched data is 80,855.

In addition, because FY-2F/CTA observations are provided as integer values from 0 % to 100 %, they are converted into tenths from 0 to 10, as listed in Table 1 (Kim et al., 2023).

Table 1. Tenth cloud cover conversion table of satellite (%) and ceilometer (okta) cloud cover.

%	≤5	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	>95
Okta	0	1	2	2	3	4	5	6	6	7	8
Tenth	0	1	2	3	4	5	6	7	8	9	10- / 10

Q3. Line 136: What do you mean with abnormal observations? Please clarify what criteria you have used to filter the ground-based observations.

Response: We added the description of abnormal observations in Line 150-152: the abnormal observations, including missing data and outliers (observations < 0 or > 10 or the records are " – "), are removed from the dataset during the preliminary quality control of the ground observation data.

Q4. Line 137: Why do you only use data from stations with more than 20 days of continuous observations? Please provide more information.

Response: The reason we used data from stations with more than 20 days of continuous observations is: To mitigate the impact of short-term weather changes on ground observations, reduce data fluctuations caused by observational errors, and enhance data stability, the stations with continuous observations for 20 days or more are selected to enhance data stability (Liu et al., 2016). We added this part in Line 148-150.

Q5. Line 138: The matching criteria of ground and satellite data are not sufficiently described in the paper. Please provide the information on the used radius of the FY-2F/CTA observations around the ground-based station. Also as asked by reviewer 2, Q6, the number of pixels taken out of the satellite should be provide in the method part of the paper. Response to question Q6 from reviewer 2: How can the manual cloud cover extend be the same as the satellite? The manual TCC depends on the visibility at time of observation at the station. Please state clearly in the method part what the radius around the station is you have used for the comparison of the satellite observations. The sample size and matching radius should be explained in the methods part. The same holds for the allowed time difference you used for the comparison.

Response: We added the matching criteria of ground and satellite data in Line 152-156: The ground observation TCC reflects the cloud cover within a certain range around each observation point, the area can reach several kilometers or even more than ten kilometers, for satellite observation TCCPs, only the radiation ratio at grid points is considered. Therefor for satellite products, the TCC at each station is determined by averaging the cloud amounts of all grid points within a 10 km radius centered on the station's location.

Q6. The matching principle and the precision analysis is similar to Kim at al. (2023). The paper should be cited.

Response: We have carefully read the article by Kim et al. (2023) and cited it in Line 158-159.

Q7. Line 169: please state clear that X0 are the data from the observation site and X those from the satellite.

Response: We added the description of X and X_0 in Line 190-191: Where N represents the number of matched samples, X are the FY-2F/CTA observations and X_0 are the ground-based manual TCC observations.

Q8. The number of matches given in the Figure captions are not clear. According to Figure 2, you have in total of 80855 matches. But in Figure 5 the total number is 264. In the paper the figures need more explanation. What data are used, how do you filter the data, and the number of matching points.

Response: We added the description of data in Line 235-238 and Line 277-282.

In Line 235-238 Figure 2. The precision, consistency and error spatial distribution map of FY-2F/CTA products in Xinjiang. Where, from Figures (a) to (i) denote PR, FR, MR, CR, SR, WR, Bias, MAE, RMSE respectively. The data is based on the hourly TCC of FY-2F/CTA and ground-based manual observations. The total number of all valid matches is 80855, among them, 29750 are distributed in NX, 10884 are distributed in Tianshan and 40221 are distributed in SX.

In Line 277-282: Figure 5. The scatter plot of FY-2F/CTA compared to ground-based manual TCC observations in Xinjiang. The data is the monthly average TCC of FY-2F/CTA and ground-based manual observations. It is based on the hourly data of FY-2F/CTA and GOS in January, April, July and October (the total sample points of 66 GOS are 7634, 7235, 7592, 7554, respectively), and after summing and average calculation, the monthly average TCC of FY-2F/CTA and ground-based manual observations of stations are obtained. Therefore, in this figure, the total number of all valid matches is 264, among them, 66 in January, 66 in April, 66 in July, and 66 in October.

Q9. The FY-2F/CTA products (as for example written in the Figure caption 6) should be introduced in the methods part of the paper.

Response: We added the introduction of FY-2F/CTA products in Line 130-137: Among them, FengYun-2F (FY-2F) is the fourth geostationary satellite developed by China independently. It is equipped with various detection channels, including visible light (0.5 - 0.9 μm), mid-wave infrared (3.5 - 4.0 μm), thermal infrared (infrared channel 1(10.3 - 11.3 μm), infrared channel 2(11.5 - 12.5 μm) and water vapor (6.3 - 7.6 μm)). The satellite provides observational data every half hour, allowing for improved monitoring of the entire process of cloud formation, development, and dissipation. The cloud products of FY-2F include cloud cover, cloud type, cloud top temperature, among others. FY-2F/CTA represents its TCC product, the spatial resolution is $0.1^{o} \times 0.1^{o}$, temporal resolution is 1 hour, and the projection method is equal latitude and longitude projection. This configuration enables enhanced monitoring capabilities for the complete lifecycle of clouds.