This manuscript proposes methods for verification of weather radar networks. Not only by ground-based radars, but also space-borme radars are used for consistency verification. I have several critical queries to be solved before the final decision.

General Comments:

- The overall direction and purpose of the manuscript remain unclear. Additionally, the description of the analysis methodology is insufficient, making it impossible to reproduce the results based on the current manuscript.

Reply: Thank you for your comments. In the revised version of the manuscript, we will clarify the research objectives, provide a more detailed description of the methodology, include a methodological framework, and specify the parameters used. These additions will help readers to better reproduce the algorithms and results presented in the paper.

- Despite the abundance of radar systems in China, the authors do not specify which radars or what time periods were used in the analysis. Furthermore, the text-only explanation of the radar locations is difficult to interpret. At minimum, a map of the radar network should be included to facilitate understanding.

Reply: In the revised version of the manuscript, we will add descriptions of the radar hardware and the analysis period, and we will include a map showing the locations of the radar network.

- The study investigates biases through comparisons between ground-based radars and between ground-based and satellite radars. However, such comparisons merely highlight the relative biases between systems, and an independent, well-calibrated reference radar is essential. Is there no such calibrated radar within the network used in this study?

Reply: In practical work, we have established a radar calibration center in Changsha, Hunan, where an S-band dual-polarization radar undergoes regular calibration and serves as the reference radar in ground-satellite comparison experiments. When analyzing the consistency of the ground-based radar network, twenty reference radars across the country (including the one in Changsha) are selected to analyze biases. This work has just started this year, and the specific selection criteria and methods are still being refined.

- It is also unclear what types of biases the authors are attempting to identify. Are these parameters that cannot be corrected through individual radar calibration, or are they related to factors like beam blockage or system biases that *can* be corrected? The manuscript lacks clarity on this point. Additionally, even if biases are identified, the manuscript does not explain how this information will be used—whether for correction or simply as observational insight.

Reply: In the analysis of radar network consistency, three metrics are used: bias, standard deviation, and correlation coefficient. Bias reflects the systematic deviations between radars, standard deviation indicates the dispersion of radar observations, and the correlation coefficient is greatly influenced by sample size, so it has not been analyzed at this stage. In practical work, once the method designed in this paper indicates that a radar exhibits bias, we conduct detailed calibration procedures, including tests for beam pointing, antenna performance parameters, transmitter output pulse width and peak power, and feeder loss. Additionally, we use methods such as Solar Calibration and Metal Sphere Calibration for verification. Issues that may be discovered include the CW output signal of the frequency source being lower than the originally recorded value, uncalibrated azimuth after radar maintenance, and errors in measuring radome/transceiver feeder losses. This paper mainly introduces a radar network consistency analysis method designed based on raw data, which serves primarily as an indication. Only after thorough calibration can the root causes be truly traced and rectification suggestions proposed. We will further elaborate on this in the revised version of the manuscript.

- Although the term "model" is used, the methodology appears to be more of a data extraction and comparison approach rather than a model in the conventional sense.

Reply: Thank you for your suggestion. In the revised version of the manuscript, we will replace the term “model” with “method”.

- The manuscript refers to numerous parameters used in data extraction, but they are scattered throughout the text and difficult to follow. Parameters such as thresholds should be clearly summarized in a table.

Reply: We have added a description of the methodological workflow and parameter thresholds to the methods section.

- From Section 3.1.3 onward, the statistical analyses lack clarity regarding which radar(s) and what data periods were used. Without a clear listing of these, the reliability and reproducibility of the analysis cannot be ensured.

Reply: We will supplement the manuscript with details on the radar hardware parameters and data periods in the revised version.

- There is insufficient explanation of the analysis methods. For example, in the paragraph starting on P.10 L.219, how was VIL calculated? Also, which radar stations correspond to Radar1 and Radar2 in Figure 7?

Reply: We will add a description of the VIL calculation method in the revised version of the manuscript and clearly specify the names of the radars used in the paper.

- In Section 3.2 and onward, only a subset of the presumably large dataset is shown. However, since the selection criteria are not explained, the reliability of the results is questionable—for example, in Figure 20.

Reply: During the comparison, we limit the range of reflectivity factor and signal-to-noise ratio to exclude the effects of rapidly changing convective precipitation and weak signals. We will provide a detailed description of the data selection criteria in the revised version of the manuscript.

Specific Comments:

- **P.3 L.78**: The phrase “corrected for frequency” is unclear, as reflectivity in the Rayleigh scattering regime is not wavelength-dependent. Please clarify what correction was applied and how.

Reply: As mentioned in line 78 of the manuscript, the FY-3G Level 2 product was used, which contains reflectivity factor products for the S-band, C-band, and X-band. These reflectivity factors have been corrected for frequency, Please refer to the following reference for the specific method used:

Wu Qiong, Yang Meilin, Chen Lin, Yin Honggang, Shang Jian, Gu Songyan. 2023. A frequency correction algorithm for spaceborne precipitation measurement radar and ground-based weather radar. Acta Meteorologica Sinica, 81(2): 353–360.

We will provide references for the specific correction methods in the revised version of the manuscript.

- **P.3 L.87**: Please write out "VCP" (Volume Coverage Pattern) in full upon first use.

Reply: We will include this in the revised version of the manuscript.

- **P.3 Figure 1**: Indicate the satellite's direction of movement directly on the figure.

Reply: We will make this revision in the revised version of the manuscript.

- **P.4 L.88**: The phrase "Evaluation results from 2024...in this study" requires a citation.

Reply: The evaluation mentioned in line 88 refers to routine assessments conducted as part of operational work, and no related papers have been published. We selected several stations to analyze and compare the consistency of ground-based observations before and after the mode switching. The change in reflectivity deviation between the two observation modes before and after mode switching is relatively small, within ±0.4 dB, indicating that the radar reflectivity remains quite consistent before and after the mode switch. The following table provides examples from the analysis.

Station ID	Model	Mode	Time	Bias(dB) VCP11-VCP21
Z9371	SAD	VCP11	2024/6/28 21:00	0.17
		VCP21	2024/6/30 20:00	
Z9376	SAD	VCP11	2024/7/1 23:00	-0.22
		VCP21	2024/7/1 22:00	
Z9377	SB	VCP11	2024/7/1 16:00	0.2
		VCP21	2024/7/1 19:00	
Z9379	SAD	VCP11	2024/7/1 21:00	-0.11
		VCP21	2024/7/1 23:00	
Z9396	SB	VCP11	2024/7/2 0:00	-0.04
		VCP21	2024/7/2 1:00	
Z9551	SA	VCP11	2024/6/27 2:00	0.1
		VCP21	2024/6/27 4:00	
Z9552	SAD	VCP11	2024/6/28 18:00	-0.19
		VCP21	2024/6/28 19:00	
Z9555	CCD	VCP11	2024/6/23 4:00	-0.14
		VCP21	2024/6/23 7:00	
Z9556	SAD	VCP11	2024/7/2 7:00	-0.09
		VCP21	2024/7/2 9:00	
Z9562	SAD	VCP11	2024/6/25 17:00	-0.4
		VCP21	2024/6/25 18:00	

- **P.4 L.96–97**: The terms "PRE" and "FRE" are undefined and should be explained.

Reply: The "PRE" and "FRE" mentioned in lines 96-97 refer to the data preprocessing module and the frequency correction module, respectively. We will include this clarification in the revised version of the paper.

- **P.4 L.102**: It is unclear what the “first and second reference frames” refer to.

Reply: The "first and second reference frames" mentioned in line 102 are indeed based on relevant literature. We will provide further explanation and add the appropriate references in the revised manuscript.

Yang Hongping, Han Wei, Wang Hui, Heng Hu,A Reference Positioning Methodology for Computing GeodeticCoordinates of Radar Echo, Meteorological Science and Technology,2023,51(1):22-30.(In Chinese)

- **P.4 L.110**: Explain how the averaging and gridding were performed. These procedures can introduce bias and should be described in detail.

Reply: The steps for satellite–ground consistency comparison are as follows:

(1) Spatial and Temporal Collocation

Begin by identifying ground-based radars (GB) whose observational coverage significantly overlaps with the FY-3G PMR (SG) scanning region. Overlap criteria require that at least 3,000 (S/C-band) or 400 (X-band) PMR grid points fall within the GB’s observation area. For temporal alignment, only data pairs where the observation times differ by less than 180 seconds are retained.

(2) Resampling

The FY-3G PMR Ku L2 product is a resampling dataset with 400 bins and a vertical resolution of 50 m, which differs from the original vertical resolution of 250 m used in the SG scanning mode. In this study, the data at each scanning track grid of SG are resampled into a four-dimensional (longitude, latitude, height, time) grid data with a vertical resolution of 250 m (80 bins) and a horizontal track resolution of 5 km, as the SG scanning mode. That is, each SG grid is 5 km × 5 km × 250 m. Measurements that are too close to or too far away from the GB stations have significant errors. Through multiple experiments, this study selects the time-paired GB reflectivity data with a distance of 50-150 km away from the stations for S/C-band GBs and 9-42 km for X-band GBs. The GB reflectivity data are then transformed into three-dimensional (longitude, latitude, height) data.

(3) Extraction of Stratiform Rain Cases

Stratiform precipitation is isolated using the precipitation classification provided by the SG product at each grid point. Both satellite and ground-based reflectivity values are further restricted to 20–35 dBZ within the 2–4 km altitude range to focus on relatively stable echoes.

(4) Pairwise Data Construction

For each spatial-temporal matchup, if multiple GB range bins correspond to a single SG grid cell, they are averaged to produce a composite GB reflectivity value. These paired values—SG and averaged GB reflectivity—form the basis for subsequent comparison.

(5) Consistency Assessment

When at least 20 such matched pairs are available, key statistical indices—namely bias, standard deviation, and correlation coefficient—are computed to quantitatively evaluate the consistency between the SG and the GB network.We will include this in the revised version of the manuscript.

- **P.6 L.120**: The term “S-PAR” is undefined and should be clarified.

Reply: S-PAR refers to S-band phased array radar. We will add this explanation in the revised version of the manuscript.

- **P.7 L.138**: The meaning of “Km = 4/3” is unclear and should be explained.

Reply: In meteorology and radar meteorology, Km=4/3 usually refers to the Effective Earth Radius Factor. We will add this explanation in the revised version of the manuscript.

- **P.7 L.160**: The variable “Hthre” should be written with a subscript for clarity.

Reply: We will make this correction in the revised version of the manuscript.

- **P.8 L.170**: If comparing a single satellite with a single ground radar, vertical resolution should not be an issue. The intent of this sentence is unclear. If multiple ground radars are being matched to one satellite, this should be clearly stated.

Reply: The description in the article is unclear. A single FY-3G PMR grid cell may contain one or more ground-based radar range bins. The reflectivity values of these range bins are averaged to obtain a new ground-based reflectivity value that corresponds to the FY-3G PMR grid cell reflectivity. The resulting pair of the FY-3G PMR grid cell reflectivity and the new ground-based reflectivity constitutes a comparison pair. By performing this spatial and temporal matching for multiple FY-3G PMR grid cells, a set of comparison pairs is formed.

- **P.11 L.244**: Justification is needed for choosing the reflectivity range of 15–35 dBZ. If rain attenuation is a concern, then strong reflectivity along the beam path should also be considered for exclusion. Please elaborate.

Reply: The range of 15–35 dBZ was chosen to retain stable stratiform precipitation echoes. Convective precipitation echoes with stronger reflectivity tend to vary rapidly, making it difficult to ensure that different radars are observing the same echo region.

- **P.11 Figure 8**: It is unclear which result corresponds to the S-band radar.

Reply: The image on the right in Figure 8 corresponds to the S-band radar. We will add this label in the revised version of the manuscript.

- **P.13 Figure 10**: The relative positions of the radars are not shown. Without this context, comparing the two radars is impossible for readers. At minimum, the coastline should be shown, and the map axes (latitude/longitude) should be consistent across both subplots.

Reply: We will revise this figure in the updated version of the manuscript.

- **P.13 Figure 11**: The figure does not indicate what parameter is being visualized. Please clarify.

Reply: The right panel in Figure 11 shows the calculated Ref SD values. Each of the first four range rings outward from the radar station represents 100 kilometers, and the outermost range ring represents 460 kilometers. We will add this explanation in the revised version of the manuscript.

- **P.14 L.280**: The term "Fuzzy logic" is mentioned without describing the actual algorithm or implementation used.

Reply: The identification and removal of radial interference echoes were mainly performed using a fuzzy logic method. Four characteristic parameters reflecting the differences between radial interference echoes and precipitation echoes were extracted from the reflectivity factor, including:

RREF, representing the continuity of the reflectivity factor along the current radial (as shown in Equations (1)-(2));

dZ, indicating the consistency of echo power in the adjacent range bins along the current radial (as shown in Equations (3)-(5));

TDBZ (unit: dB^2), expressing the local textural consistency of reflectivity along the radial (as shown in Equation (6));

SPIN, representing the sign changes of adjacent reflectivity factors within a local area (as shown in Equations (7)-(8)).

$$R_{\mathrm{REF}} = \frac{\sum_{i=0}^{N_{\mathrm{R}}} N_{\mathrm{Z}}}{N_{\mathrm{R}}} \times 100\% \tag{1}$$

$$N_{\mathrm{Z}} = \begin{cases} 1 & Z_{i,j} = Val \\ 0 & Z_{i,j} \neq Val \end{cases} \tag{2}$$

$$B_{i,j} = Z_{i,j} - 20\lg R_{i,j} \tag{3}$$

$$\overline{B} = \frac{\sum_{N_{\mathrm{R}*0.9}}^{N_{\mathrm{R}}} B_{i,j}}{N_{\mathrm{R}} * 0.1} \tag{4}$$

$$\mathrm{dZ} = B_{i,j} - \overline{B} \tag{5}$$

$$T_{\mathrm{DBZ}} = \frac{\sum_{j=-5}^{j=5} (Z_{i,j} - Z_{i,j+1})^2}{11} \tag{6}$$

$$M_{S_{\mathrm{PIN}}} = \begin{cases} 1 & \dfrac{|Z_{i,j} - Z_{i,j-1}| + |Z_{i,j+1} - Z_{i,j}|}{2} > Z_{\mathrm{thresh}} \\ 0 & \dfrac{|Z_{i,j} - Z_{i,j-1}| + |Z_{i,j+1} - Z_{i,j}|}{2} \leq Z_{\mathrm{thresh}} \end{cases} \tag{7}$$

$$S_{\mathrm{PIN}} = \sum_{j=-5}^{j=5} M_{S_{\mathrm{PIN}}} \tag{8}$$

In the equations, $Z_{i,j}$ (unit: dBZ) is the reflectivity factor at a certain range bin, *Val* is the effective detection value (unit: dBZ), $R_{i,j}$ is the distance between the range bin and the radar (unit: km), N_R is the number of range bins for the reflectivity factor, and $Z_{thresh}Z_{thresh}$ is the threshold for changes in the reflectivity factor between range bins.

For specific technical details, please refer to the following literature: Wen Hao, Zhang Lejian, Liang Haihe, Zhang Yang. 2020. "Radial interference echo identification algorithm based on fuzzy logic for weather radar." Acta Meteorologica Sinica, 78(1): 116-127. We will add this reference in the revised version of the manuscript.

- **P.14 Figure 12**: The left and right panels may be reversed—the left appears to be quality-controlled. Also, clarify which radar (and frequency band) was used to generate these results.

Reply: We will switch the order of the two panels in Figure 12 in the revised manuscript and add specific information about the radar type and frequency band.

- **P.14 Figure 13**: Specify which radar was used for these results.

Reply: We will add a description of the radar parameters used in Figure 13 in the revised manuscript.

- **P.17 Figure 16**: The axis labels are too small to read. Also, it is unclear which radar the bias was calculated from.

Reply: When analyzing ground-based consistency, we set a distance threshold between adjacent radars (for example, 200 km between S-band radars), so any two radars within this threshold can be paired for matching. For Radar 1, if it can be paired with five surrounding radars, we calculate the bias between Radar 1 and each matched radar for every volume scan according to the method described in the paper. After one volume scan, Radar 1 will have five comparison results, and we take the mean of these five results as the final result for Radar 1 at that time. In this way, if Radar 1 has a significant systematic bias, it will be reflected in the bias result. If the standard deviation is large, it indicates that the observations from this radar are more dispersed and that further calibration and detailed analysis of the hardware are necessary.

- **P.17 Figure 17**: The caption text within the figure is obscured by the data points.

Reply: We will revise Figure 17 in the updated manuscript to ensure that the caption text within the figure is clearly visible and easy to read.

- **P.20 L.362**: The abbreviation “SC” is undefined and should be explained.

Reply: SC is a model of S-band radar used in operational applications; we will provide an explanation of this abbreviation in the revised manuscript.

- **P.21 Figure 22**: This figure would be more informative if the x-axis used a time scale.

Reply: The horizontal axis in Fig. 22 represents the number of volume scans. Since results are only calculated when weather events occur and meet the threshold, the horizontal axis does not correspond to continuous time. Therefore, we chose to use the sample size to represent the horizontal axis.