Reply on RC2

Question: *The manuscript also contains several noticeable typographical, grammatical, and cross-referencing errors that need careful revision throughout. For instance, the LW and MW spectral ranges are swapped in Table 1; the phrase "The beamsare is spilt into two parts" has obvious typographical and grammatical mistakes; the expression "both ... are both designed" includes redundant wording; "can be transmitted at whole day" requires rewriting; the citation of "Table 1" in Section 3.3 should be revised to "Table 2"; "results to an extremely weak influence" ought to be corrected to "results in an extremely weak influence". Additionally, the heading of Section 5.4 incorrectly mentions dwell observation, while the section content addresses step scanning. Multiple sentences in Section 5.5 and the Abstract also suffer from grammatical flaws and redundant phrasing. Therefore, thorough English language polishing and a full consistency check across the manuscript are strongly recommended prior to publication.*

Our reply: We sincerely thank the reviewer for the careful examination of our manuscript and for identifying these typographical, grammatical, and consistency issues. We fully agree that accurate language and consistent presentation are essential for ensuring the clarity and scientific rigor of the manuscript.

We have carefully addressed all the issues raised by the reviewer and conducted a comprehensive revision and language polishing of the entire manuscript. Specifically, we have corrected the LW and MW spectral ranges in Table 1, rewritten grammatically incorrect and redundant expressions, corrected the table cross-references, and revised the heading of Section 5.4 to accurately reflect its content. In addition, the Abstract and Section 5.5 have been substantially improved, and the entire manuscript has been thoroughly checked for consistency in terminology, figures, tables, and technical descriptions.

"*1. Table 1.* *Main instrument characteristics of FY-4A GIIRS.*

Parameter	*Specification*
Spectral coverage	*Visible: 0.55–0.75 μm* *LW: 700–1130 cm^{-1}* *MW: 1650–2250 cm^{-1}*
Temporal resolution	*35 min (1000 km × 1000 km)* *67 min (5000 km × 5000 km)*
Limiting star magnitude	*6.5 Mag (visual channel)*
Radiometric calibration accuracy	*1.5 K*
Spectral calibration accuracy	*10 ppm*

2. 5.4 Analysis of Image Navigation Results Using Step Scanning Data

Figure 9 presents the laser response distributions obtained from step-scanning observations using Kriging interpolation. Two interpolation grid settings were employed to evaluate the influence of grid density on the spatial resolution of navigation deviation estimation. A grid parameter of 4 corresponds to a spatial increment of 0.25 pixels, whereas a grid parameter of 100 provides a finer increment of 0.01 pixels, enabling finer localization of the interpolated laser response peak. Figures 9a and 9b show the results obtained under strong laser signal conditions, where the interpolated response distributions exhibit a pronounced peak. In contrast, Figures 9c and 9d correspond to weak laser signals, for which multiple local peaks may occur, although a dominant peak can still be identified.

The estimated navigation deviations remain within 0.35 pixels in the EW direction and 0.45 pixels in the NS direction. The NS deviations are broadly consistent with those obtained from dwell observations. In the EW direction, step scanning provides finer spatial sampling, thereby mitigating the influence of the relatively large spacing between adjacent detectors. Combined with Kriging interpolation, this approach enables the estimation of the laser response peak position even when the observed signals are spatially discontinuous.

3. **Abstract.** *Accurate image navigation is essential for geolocating observations from the Geostationary Interferometric Infrared Sounder (GIIRS) onboard the Fengyun-4A (FY-4A) satellite. However, independent validation of its longwave infrared (LW) channel remains challenging because of its relatively low spatial resolution, staggered detector arrangement, and lack of direct star observation capability. This study presents a satellite–ground integrated approach for validating the LW image navigation accuracy using a ground-based laser positioning system (GLPS). The GLPS transmits laser signals at approximately 10.591 μm from precisely geolocated ground stations, enabling direct detection by the GIIRS LW detectors. Two dedicated observation modes, dwell observation and step scanning, are employed. A laser index algorithm is developed to identify laser signals, while a weighted gray-level centroid method and Kriging interpolation are used to estimate navigation deviations under the two observation modes, respectively. The experimental results show that the LW navigation deviations are within 0.35 pixels in the east–west direction and 0.45 pixels in the north–south direction, comparable in magnitude to the navigation deviations obtained from visible-channel observations. These findings demonstrate the feasibility of using ground-based laser measurements for independent validation of the image navigation performance of geostationary hyperspectral infrared sounders.*

5.5 Comparison with Visible-Channel Navigation Results

To assess the consistency of the GLPS-based validation results, the LW navigation deviations are compared with those obtained from visible-channel landmark observations. As described in Section 2, the visible channel supports GIIRS image navigation through star-based geometric calibration

throughout the diurnal cycle and has a higher spatial resolution. Although potential inter-channel registration errors prevent visible-channel navigation accuracy from directly representing infrared navigation accuracy, the visible-channel results provide a useful reference for comparison.

Because the two channels have different spatial resolutions, the navigation deviations are converted into kilometers for comparison. As shown in Table 3, the two approaches yield navigation deviations of comparable magnitude, although some differences remain, particularly in the EW direction. This agreement provides a consistency check that supports the plausibility of the GLPS-based results, rather than serving as direct verification of infrared navigation accuracy. The GLPS therefore remains an independent method for validating the navigation performance of the GIIRS LW channel."

All the issues identified by the reviewer have been corrected in the revised manuscript. We believe these comprehensive revisions have significantly improved the clarity, readability, consistency, and overall quality of the manuscript.

We sincerely appreciate the reviewer's constructive suggestions, which have been invaluable in improving the quality and presentation of our work.