

Performance Status of FY-4B/GIIRS

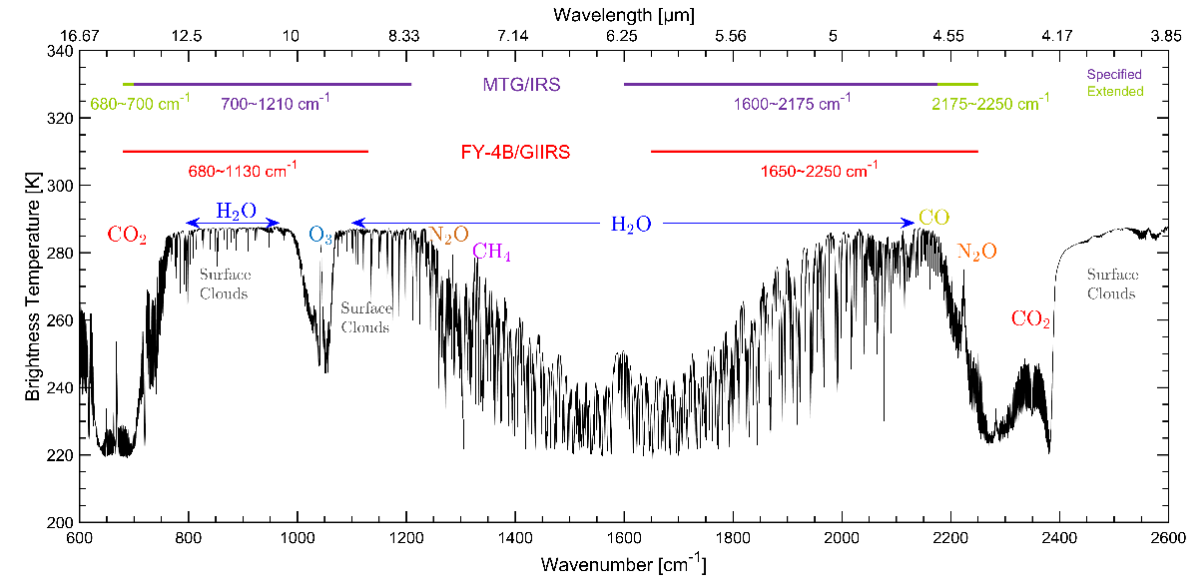
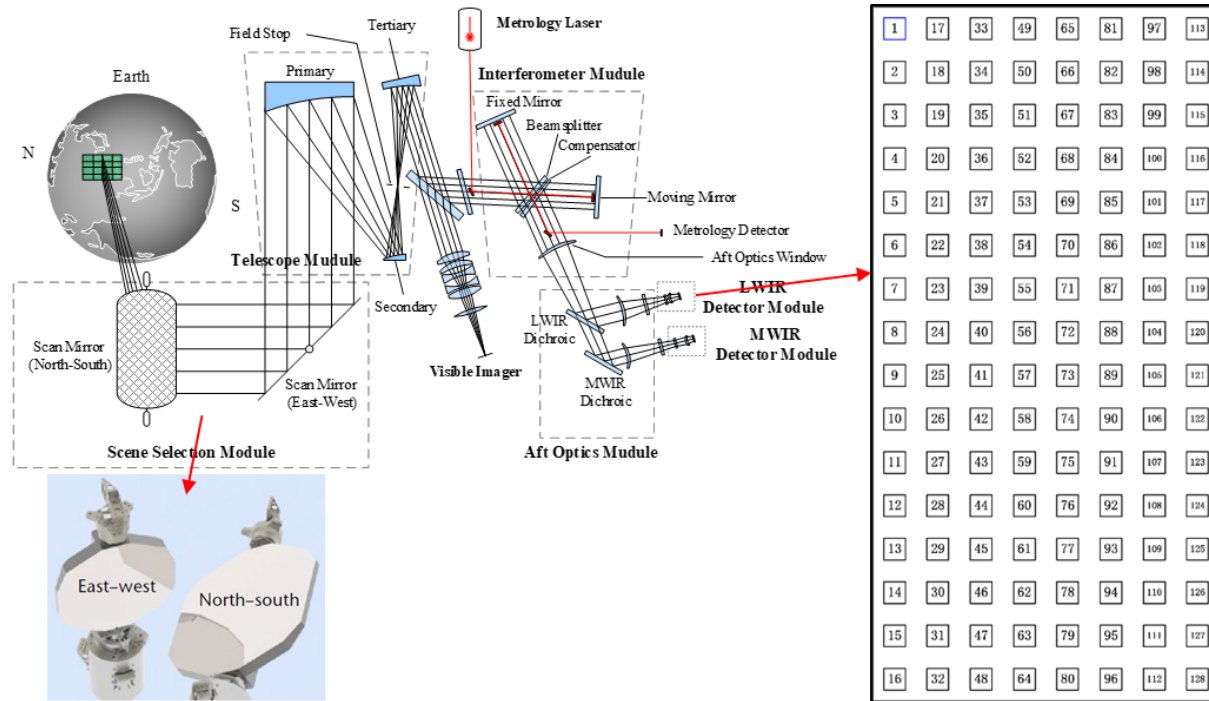
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June 17, 2026, NSMC, Beijing



1. FY-4B/GIIRS Instrument and Observation Overview

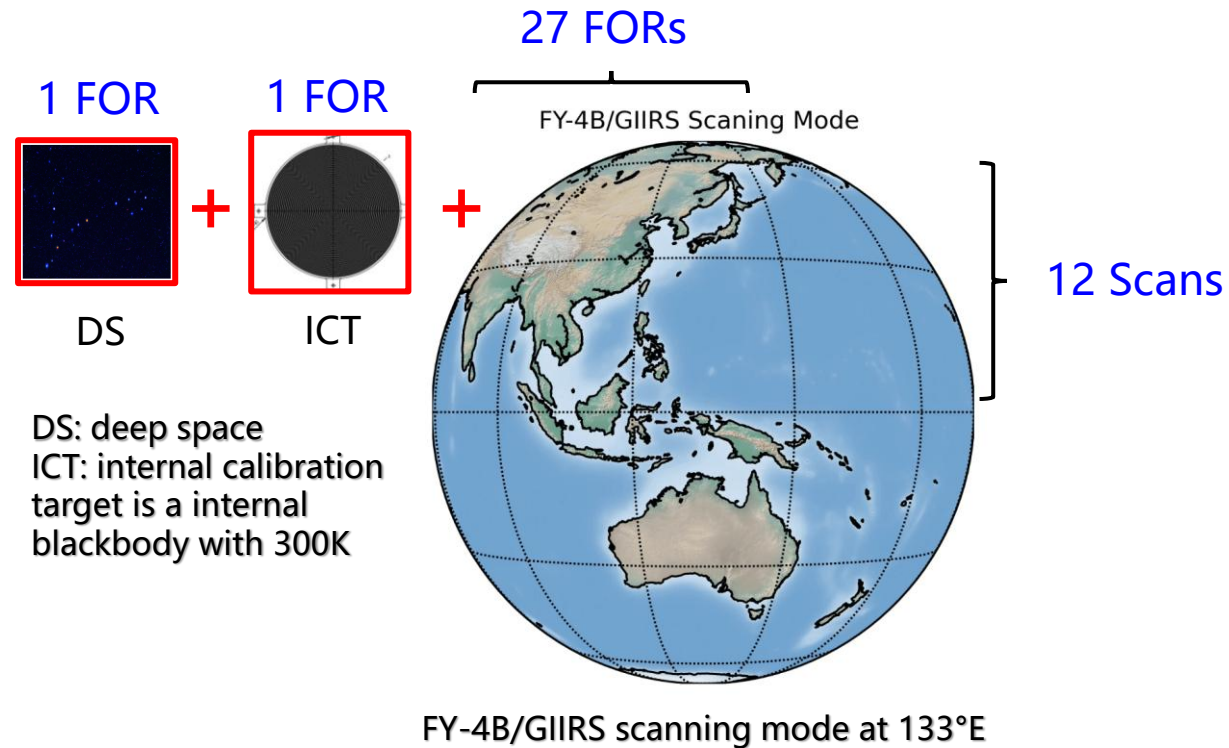


Two-mirror orthogonal scanner

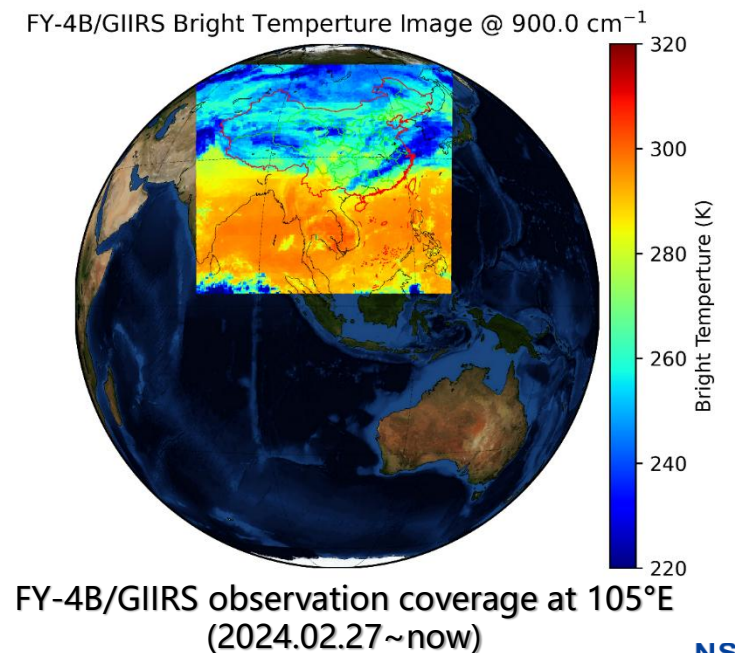
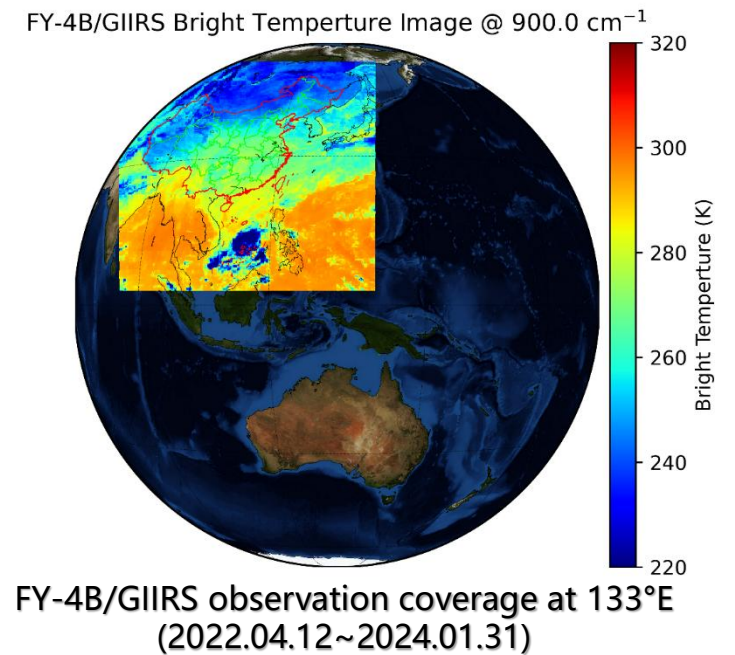
IR detector with 16×8 sparse layout

- The FY-4B/GIIRS (GIIRS-B) was launched on June 3, 2021. Since June 29, 2022, NSMC has operationally disseminated the L1 radiation products for almost four years.
- The sounder is a Fourier transform spectrometer based on Michelson interferometer and measures the upwelling IR radiance in two spectral bands: the long-wave IR (LWIR) band from 680 to 1130 cm^{-1} , and the mid-wave IR (MWIR) band from 1650 to 2250 cm^{-1} .
- Each band is equipped with a sparsely arranged detector of 16×8 pixels.

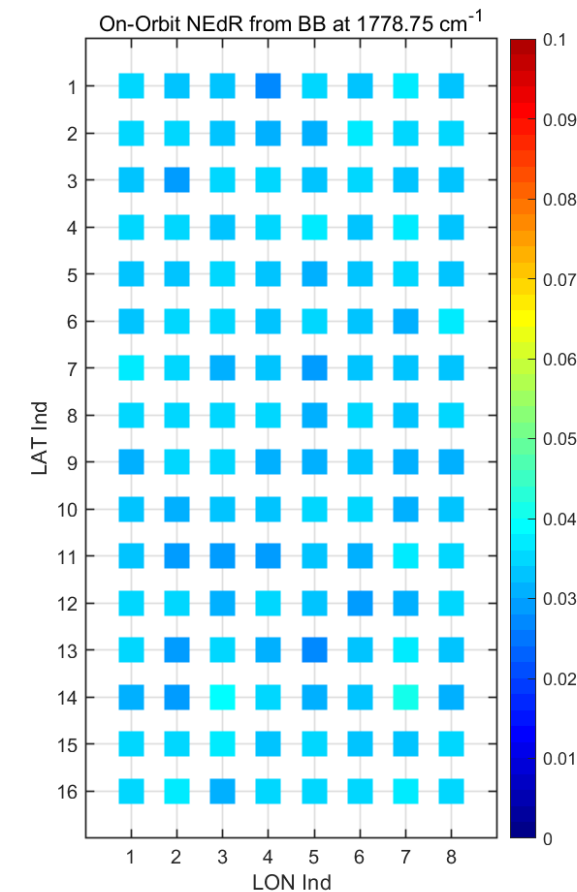
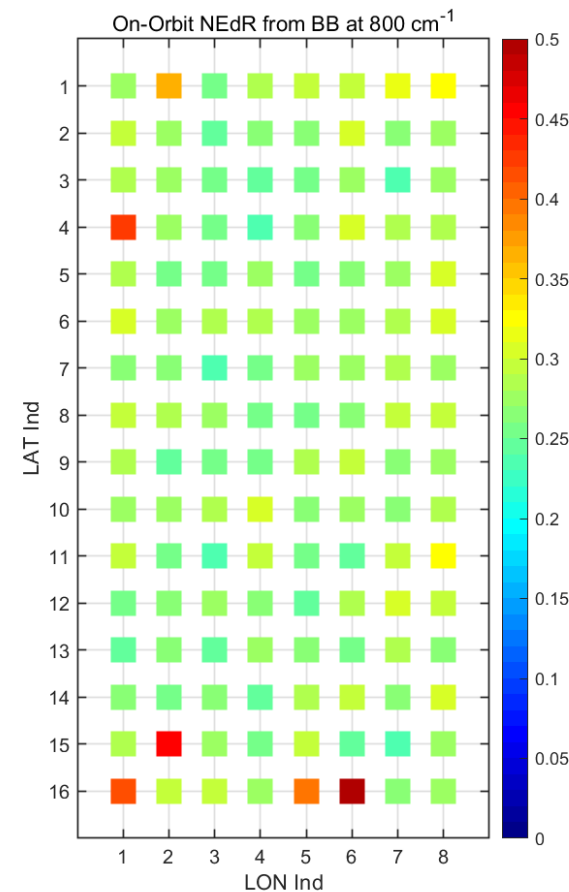
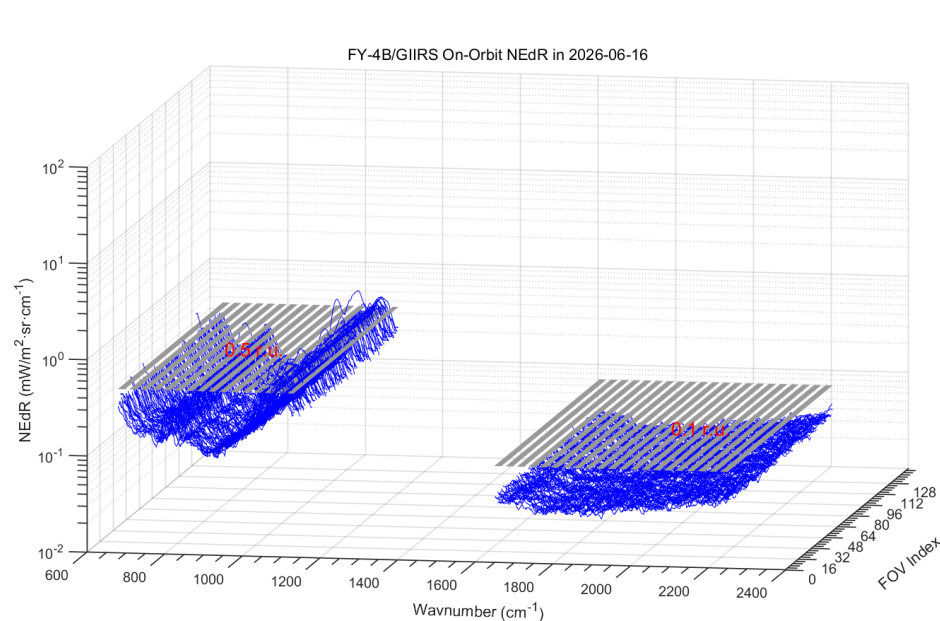
1. FY-4B/GIIRS Instrument and Observation Overview



- GIIRS-B scans the Earth in a "step-stare" mode. At each dwell, it collects 128 interferograms in 10.4 s, and then jumps to the next adjacent dwell. The spatial sampling on the Earth surface is 12 km at Nadir, and one dwell covers an area of 384×192 km.
- Due to the small size of the detector, the observation mainly covers China zone and its surroundings. One coverage consists of 27 dwells × 12 scans, and takes about 1.5 hours. At the beginning of each Earth scan sequence, a DS view and a ICT view are observed and used for radiometric calibration.
- From 2022.04.12 to 2024.01.31, FY-4B satellite was operated at 133°E. In February of 2024, as FY-4A is about to run out of fuel, FY-4B satellite drifted from 133°E to 105°E to take over the observation of FY-4A. Since 2024.02.27, FY-4B/GIIRS has been operated at 105°E.

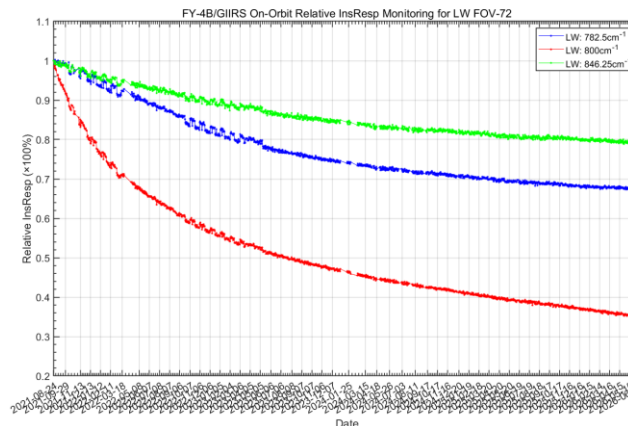
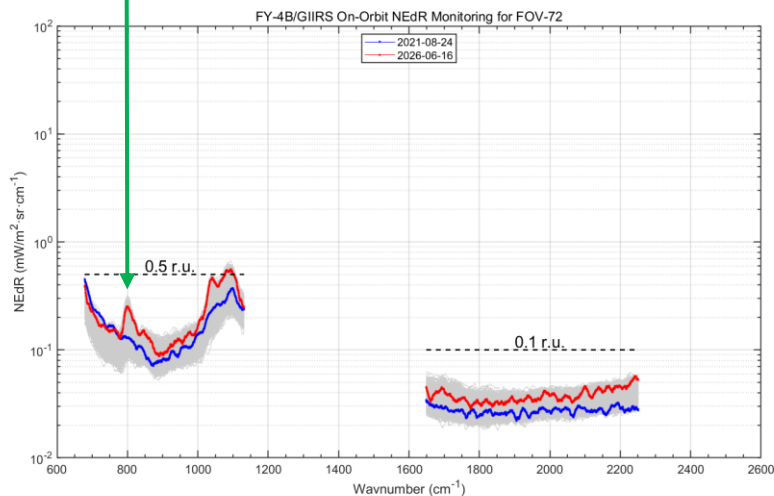
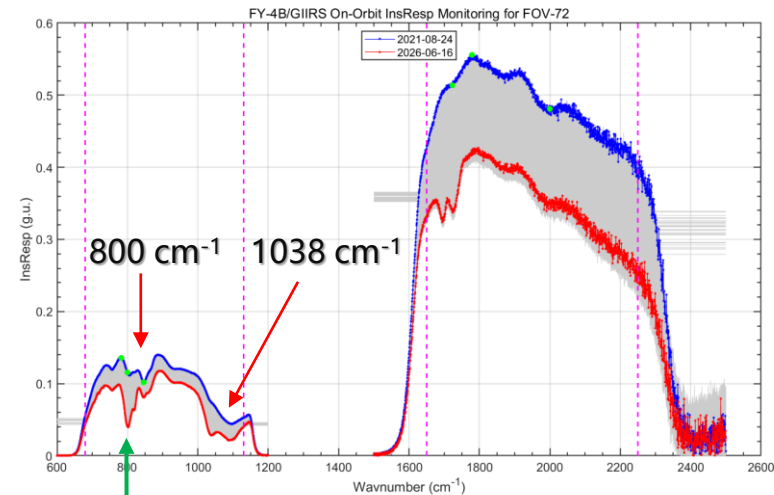


2. On-board performance and stability: Noise wrt instrument responsivity

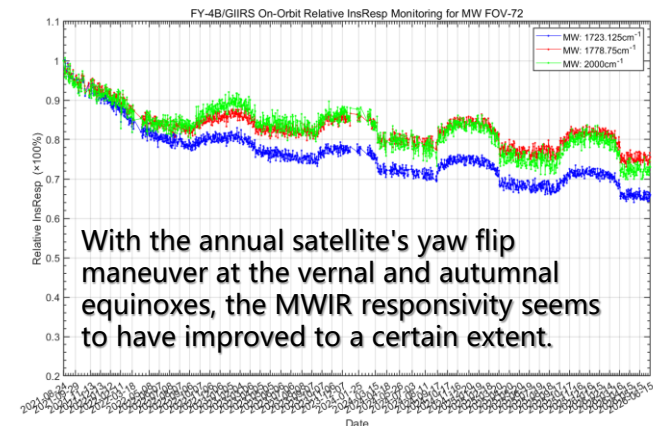


➤ FY-4B/GIIRS noise performance (characterized by NEdR) is evaluated using calibrated radiance of BB and DS. Due to defects in LWIR detector, the NEdR of Pixel-16, -17, -31, -96 is larger than others, especially that of Pixel-96.

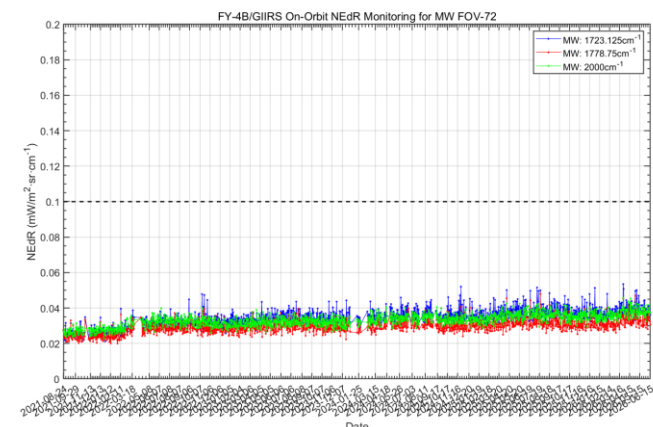
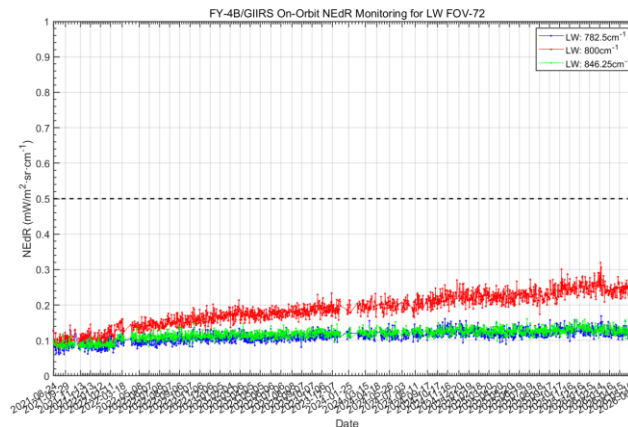
2. On-board performance and stability: Noise wrt instrument responsivity



35%

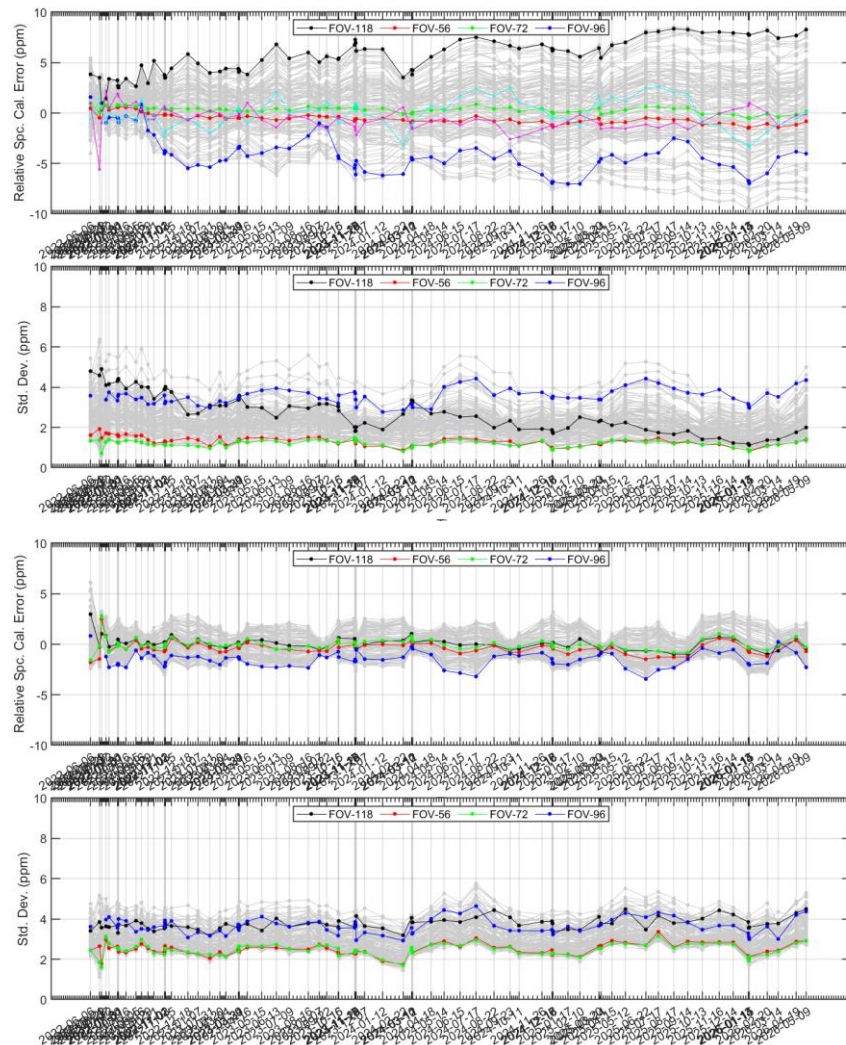


With the annual satellite's yaw flip maneuver at the vernal and autumnal equinoxes, the MWIR responsivity seems to have improved to a certain extent.

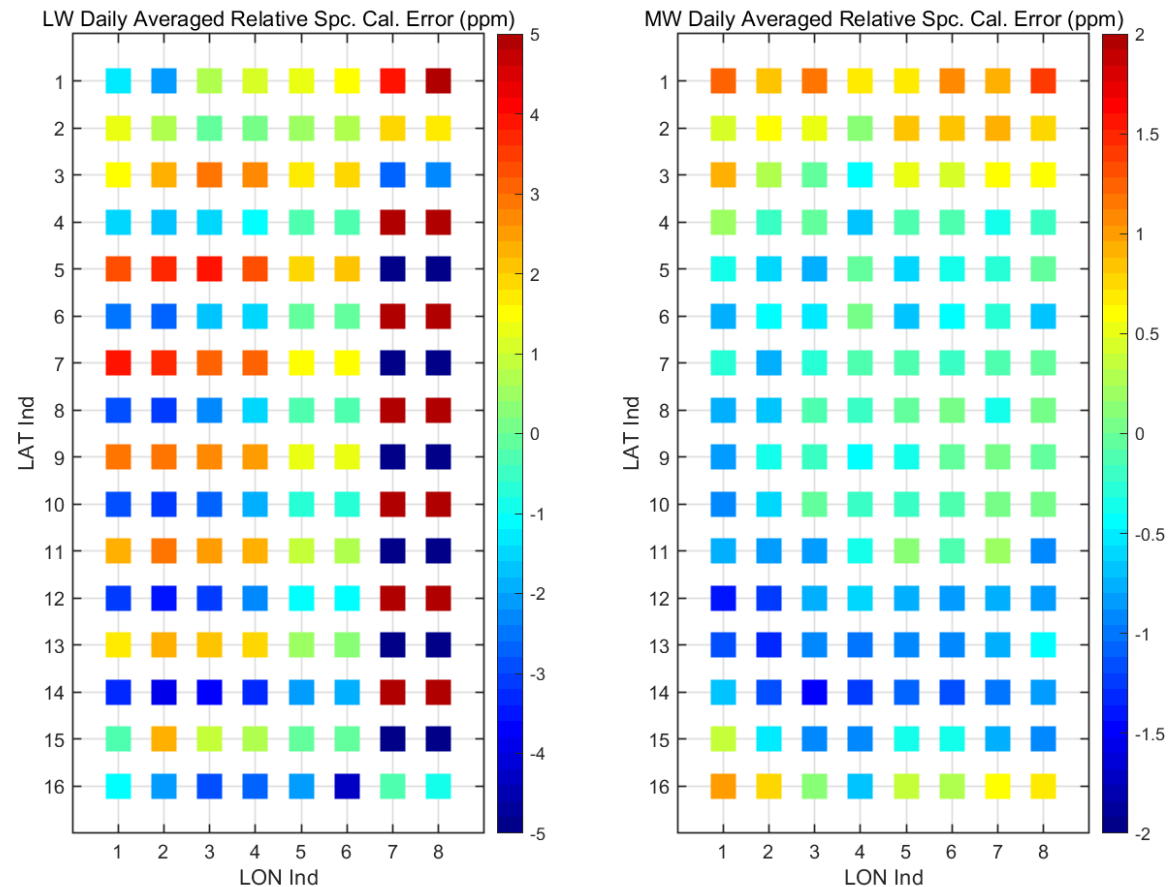


- Due to the icing of volatile silica gel on the cold optics, GIIRS spectral responsivity (transmittance) gradually decreases over time. Especially at the channel of 800 cm⁻¹, as of June 2026, the InsResp has decreased by 60% compared to the early launch. And also the NEdR degraded as the InsResp decrease.
- Unfortunately, the sounder docent has blowdown piping, so the spectral responsivity and sensitivity cannot be recovered through heat decontamination.

2. On-board performance and stability: spectral calibration accuracy

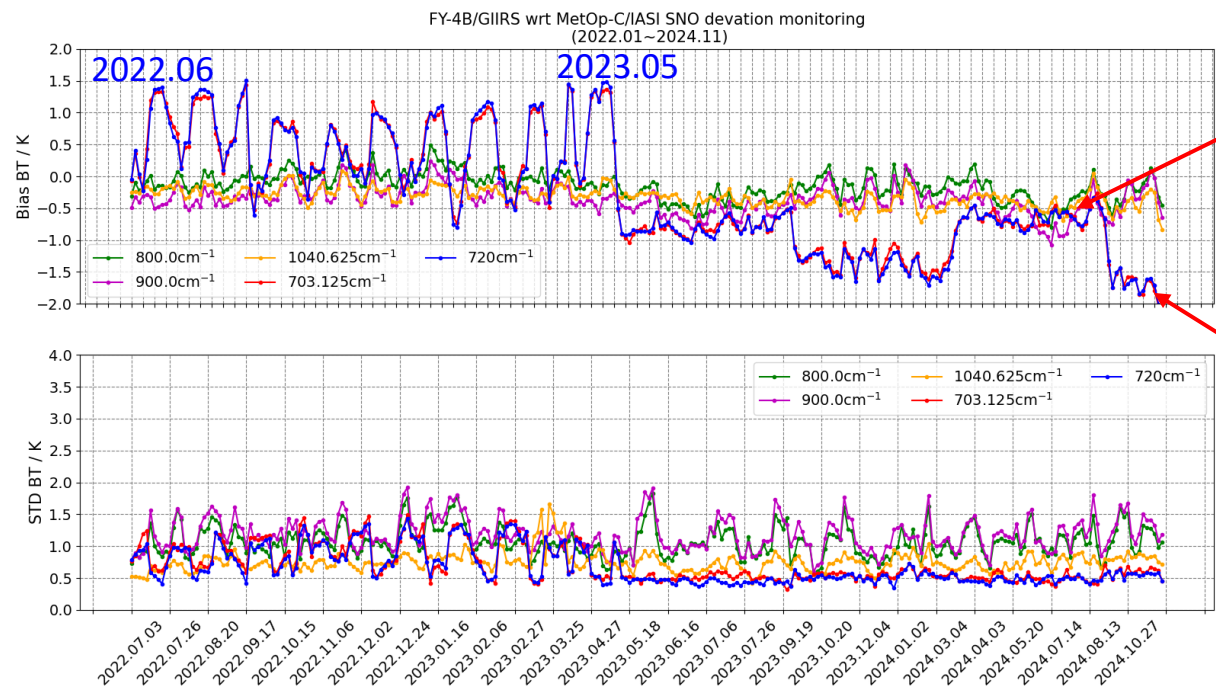


The reference spectrum in LWIR is on the CO₂ spectral window of 700~750 cm⁻¹, and in MWIR is on the upper H₂O window of 1680~1720 cm⁻¹.

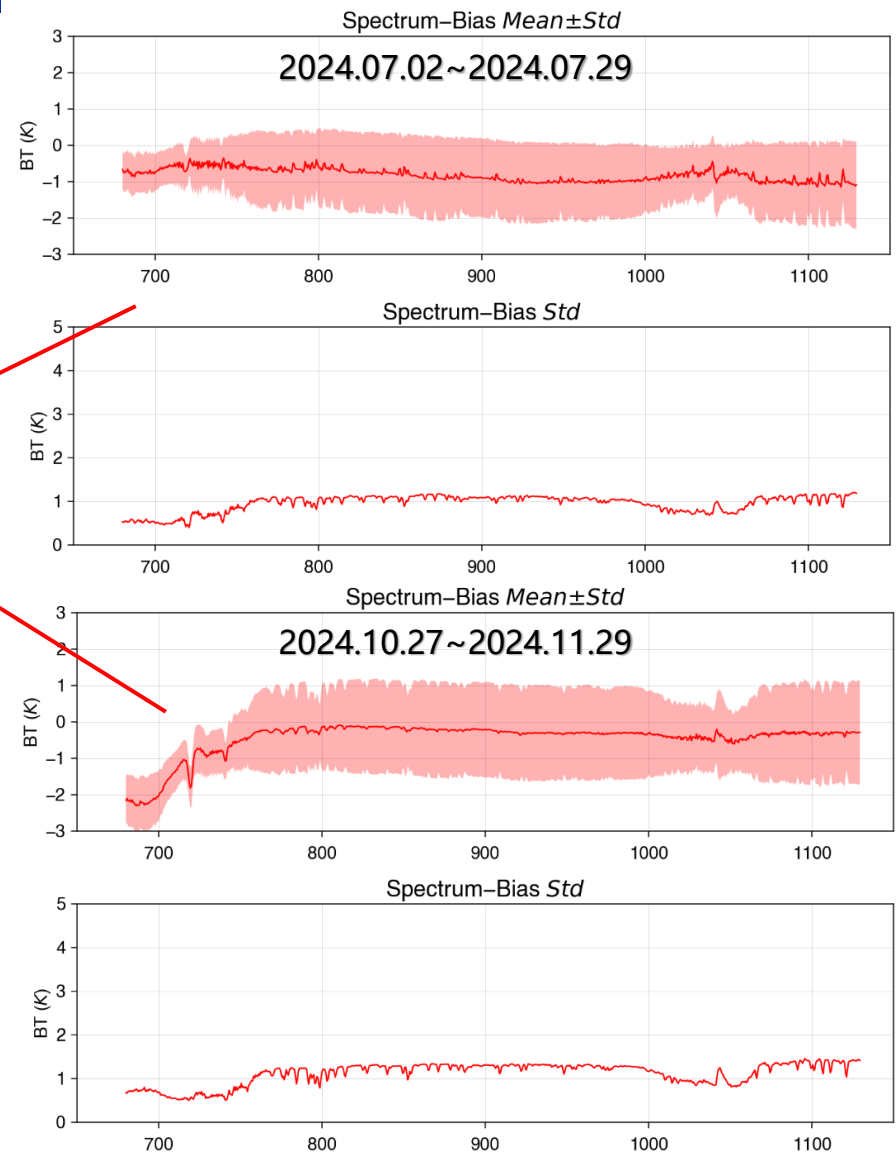


- The spectral accuracy is evaluated by comparing GIIRS measurements with LBLRTM simulated ones. Based on the results of a four-year monitoring, the average relative deviation is within 10ppm.
- Unfortunately, due to the signal crosstalk between adjacent pixels in LWIR detector, combined with optical axis thermal fluctuation, the spectral accuracy presents oscillations and seasonal fluctuations, while the MWIR detector has no signal crosstalk and only shows seasonal fluctuations.

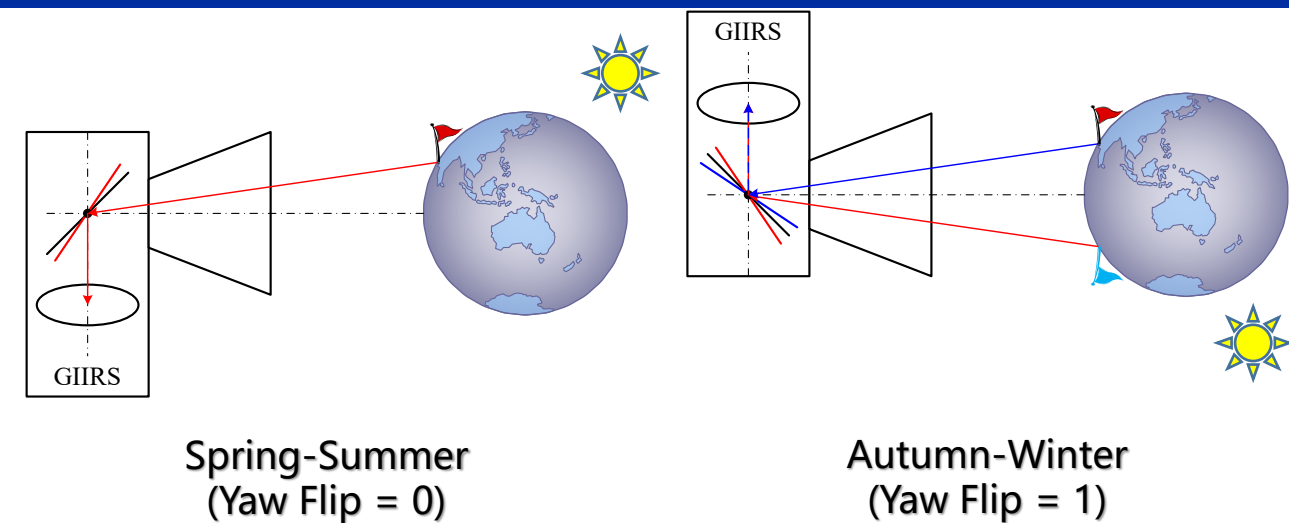
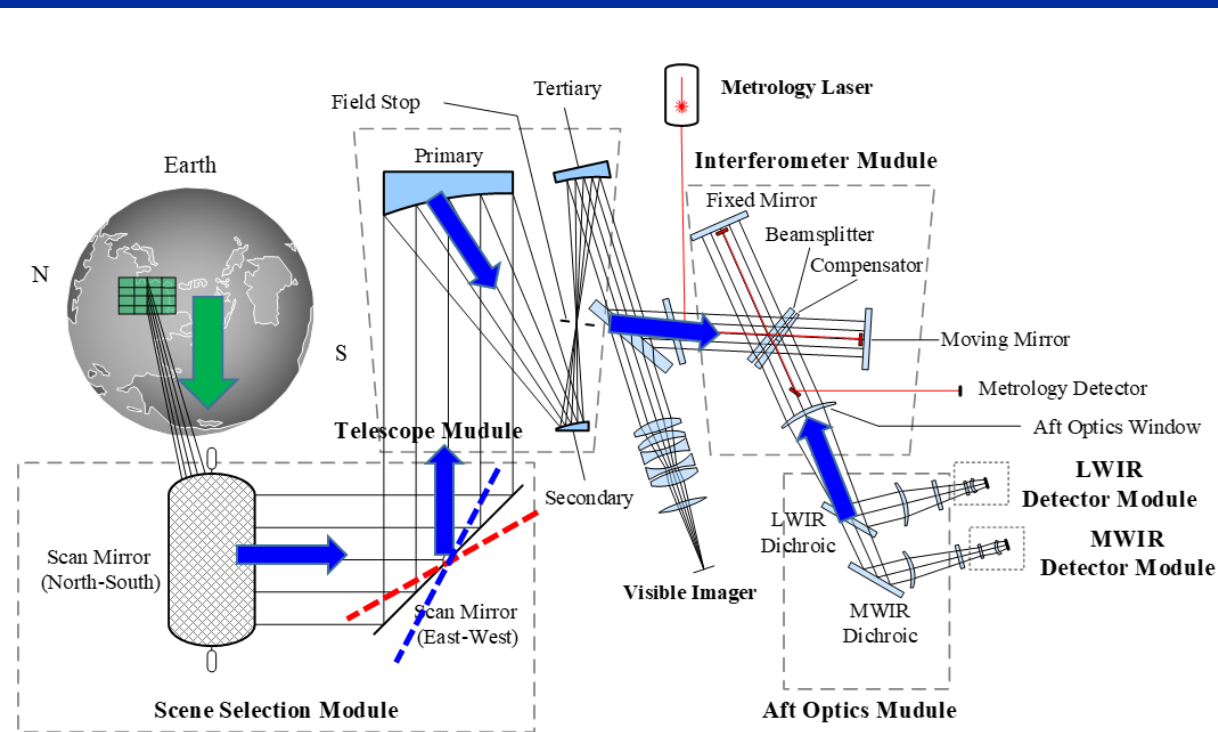
3. Recent activities for radiometric calibration improvement



- During the first two years (2022~2023) of monitoring the stability of radiometric calibration, we found that the radiometric deviation in LWIR 15 μm CO₂ absorption band was very unstable.
- This is caused by the background radiation changing with the Angle of the scanning mirror.



3. Recent activities for radiometric calibration improvement



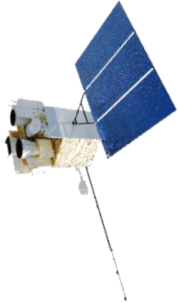
EW mirror position angle 1: more self-emission into FOV
EW mirror position angle 2: less self-emission into FOV

- Due to sunlight, the self-emission of the scanning mirror of geostationary instruments is the main contributor to changing the background radiation.
- Since GIIRS-B uses a two-mirror orthogonal scanner, the change of the north-south scanning mirror accompanying the satellite flipping maneuvers is the root cause of the radiation mutation.
- Recently, we have developed a scanning mirror induced deviation correction algorithm to improve the radiometric calibration.

4. Results: LWIR spectral deviation of GIIRS-IASI SNOs

GIIRS-IASI SNO Criteria:
Time difference: ≤ 1200 s
Pixel distance: ≤ 12 km
Zenith angle difference: $|\cos(\text{zen1})/\cos(\text{zen2}) - 1| \leq 0.01$
Scene homogeneity:
 $\text{StdDev}(\text{AGRI_B13})/\text{Mean}(\text{AGRI_B13}) < 1\%$

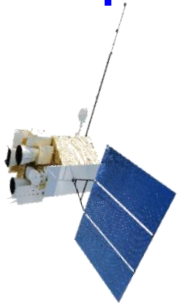
Yaw Flip = 0



N
↑
↓
S

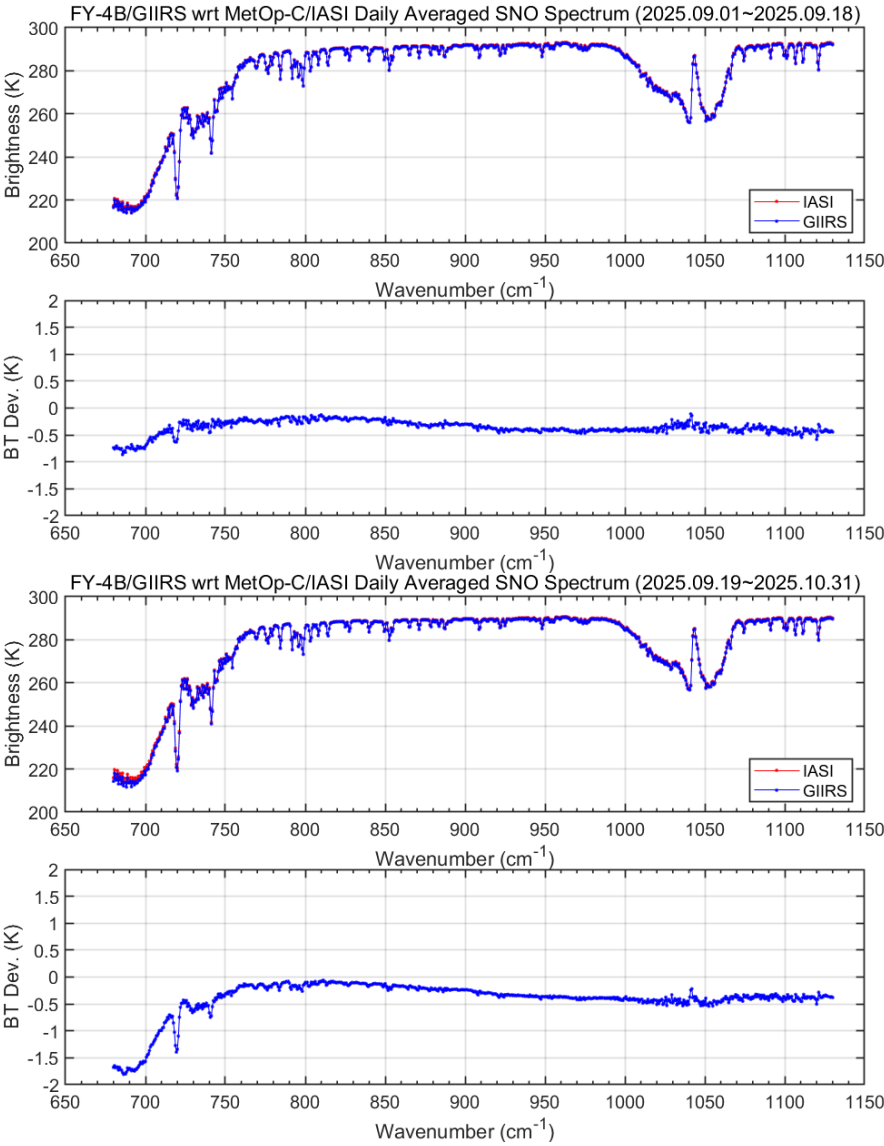
Spring-Summer

Yaw Flip = 1

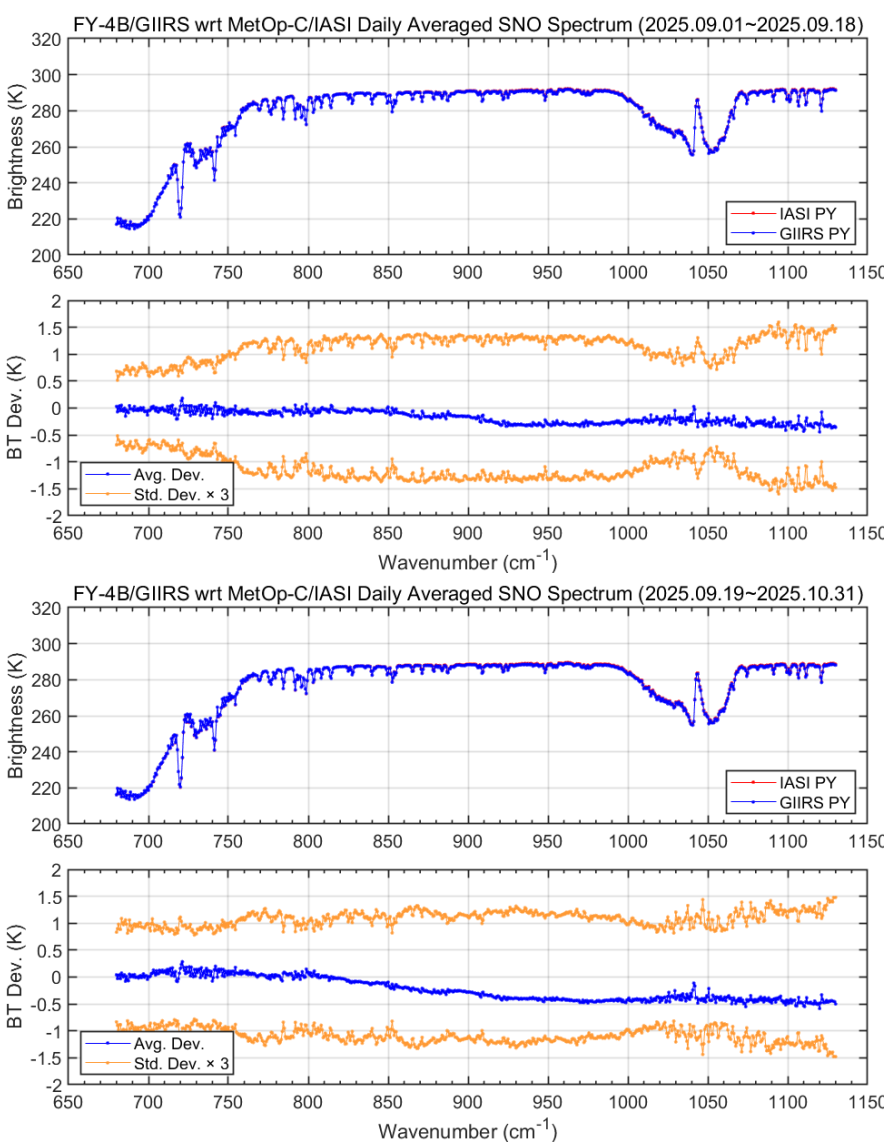


N
↑
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S

Autumn-Winter

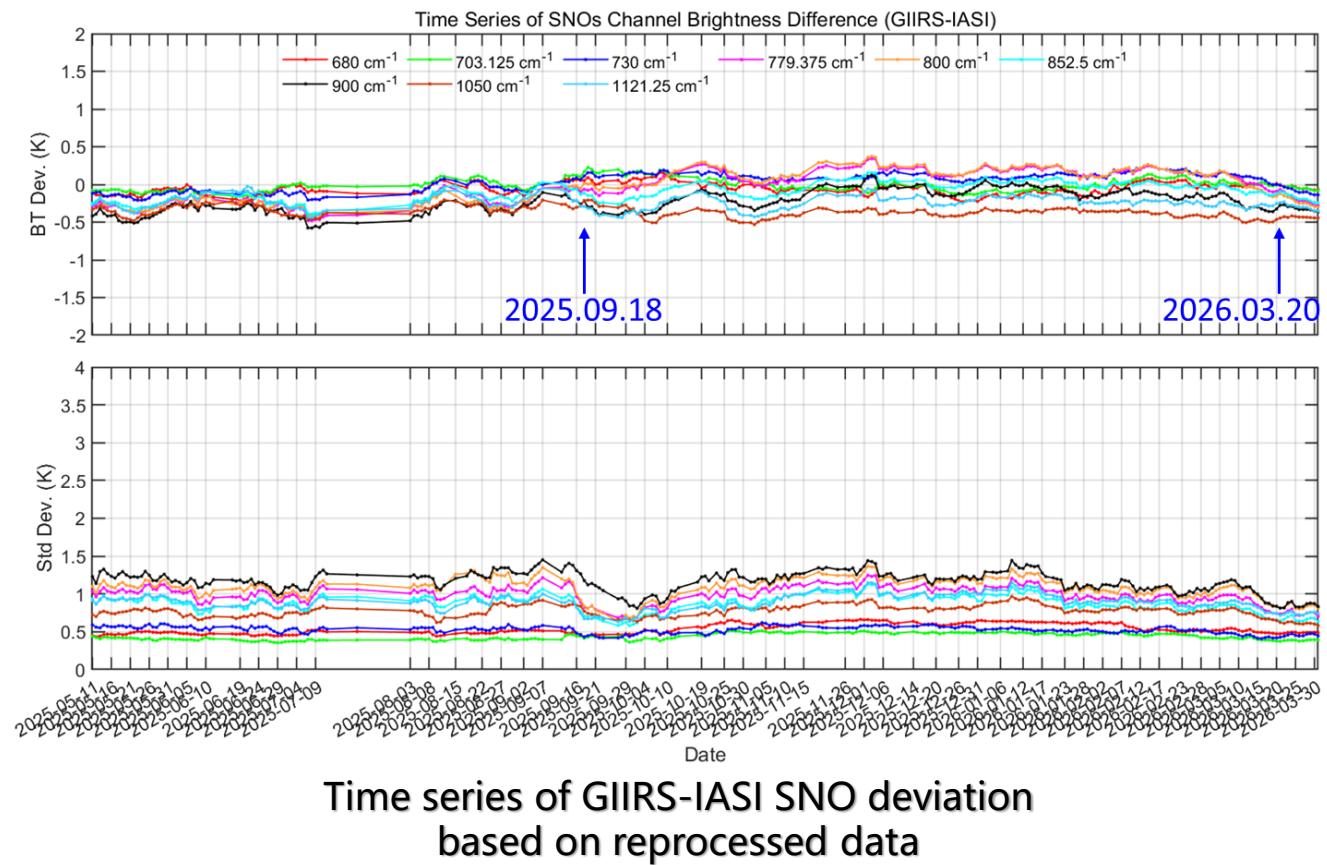
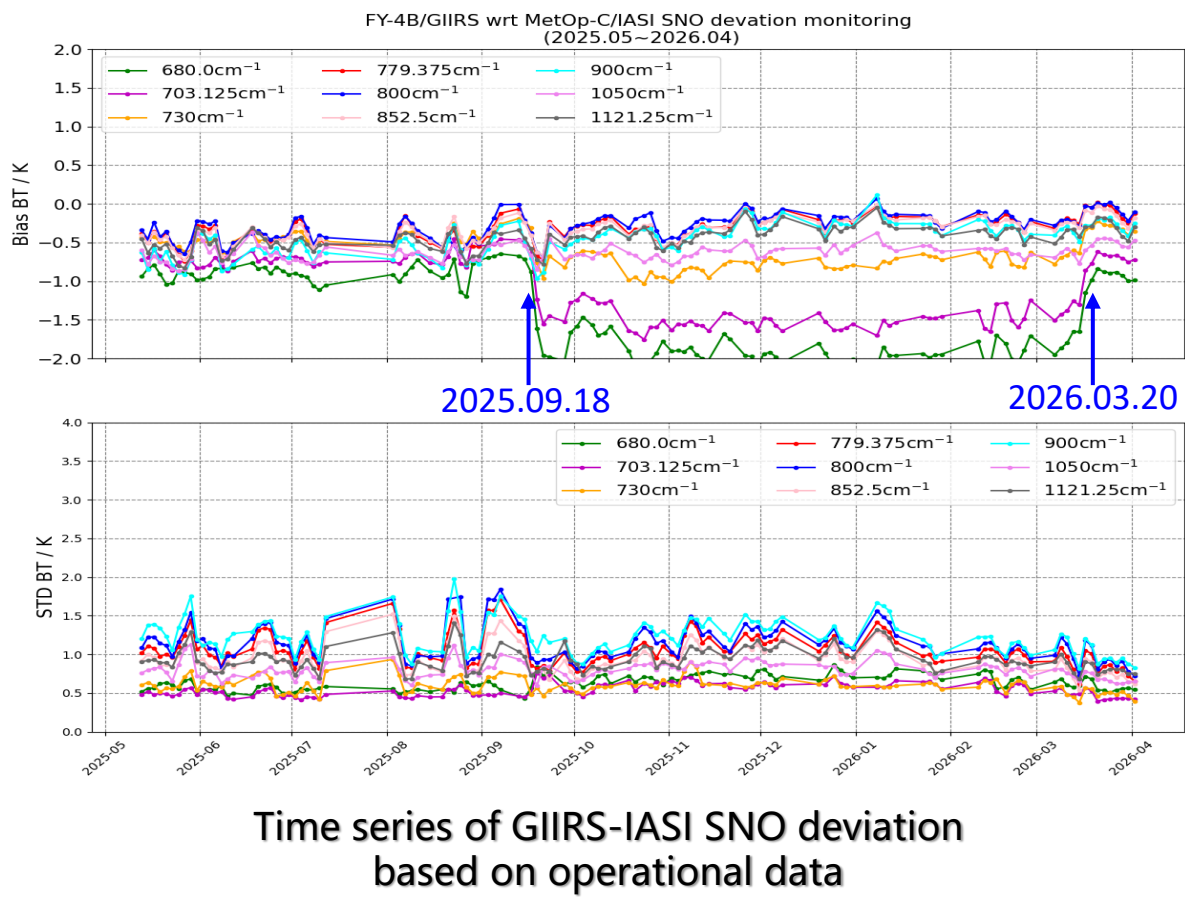


GIIRS-IASI SNO spectral deviation using operational data



GIIRS-IASI SNO spectral deviation using reprocessed data

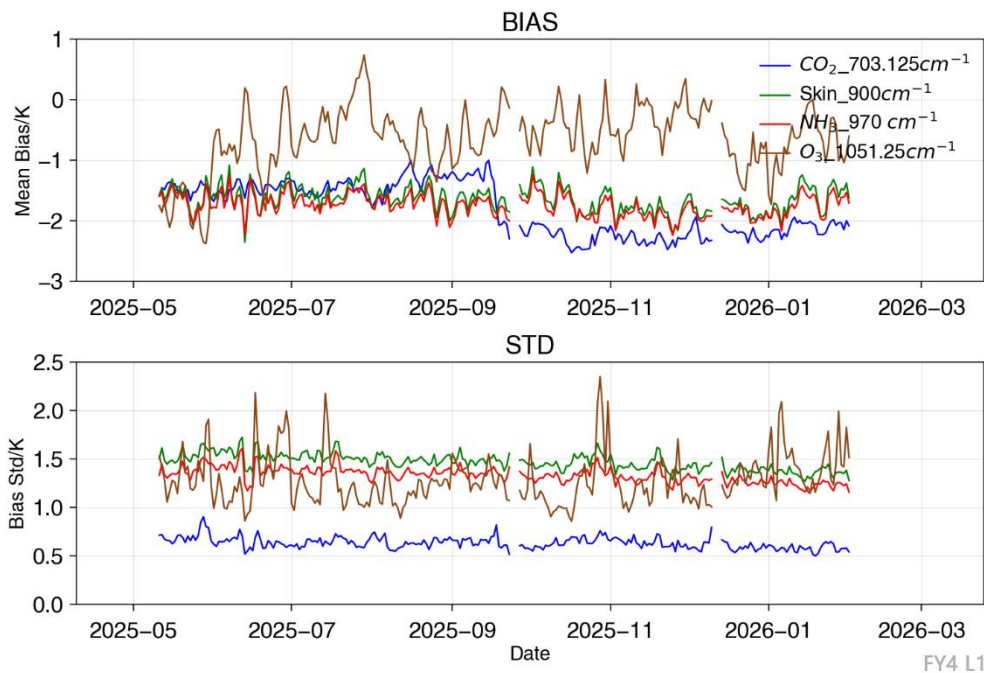
4. Results: Time series of GIIRS-IASI SNOs deviations in LWIR channels



- The time series of GIIRS-IASI SNOs radiometric deviations, which fully covers one cycle during which the satellite performed two Yaw-Flip maneuvers respectively at the autumnal equinox in 2025 and the vernal equinox in 2026.

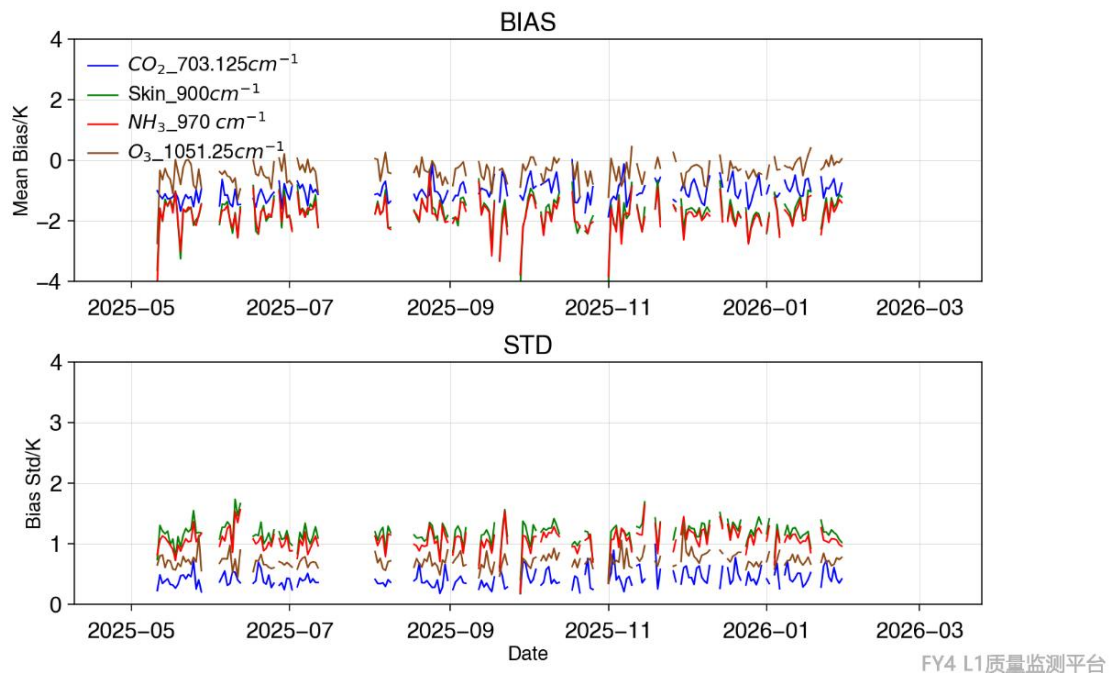
4. Results: Time series of O-B based on GIIRS-IASI SNOs data

FY4B GIIRS LW FOV



Time series of channel O-B deviation using GIIRS-B operational data
(2025.05.11~2025.01.31)

FY4B GIIRS LW ERA5 SNO FOV



Time series of channel O-B deviation using GIIRS-B reprocessed data
(2025.05.11~2025.01.31)

- The RTM is RTTOV 12.1;
- The NWP background used for O-B analysis of GIIRS operational data is based on the CMA GRAPES forecasts, while for O-B of reprocessed data is ECMWF ERA5 reanalysis.

5. Next Plan

- We plan to update the GIIRS-B L1 business processing algorithm this month.
- In my opinion, to facilitate the use of data by users, the file names and data formats should remain unchanged. Only the calibration software version number in the file attributes needs to be updated.
- But this is not the final decision.

Attribute Creation Order: Creation Order NOT Tracked

Number of attributes = 58

Add AttributeDelete Attribute

Name	Array Size	Value[50](...)	
AdditionalAnnotation	Scalar	Lu Lee	
Begin Line Number	1	1	
Begin Pixel Number	1	1	
Begin_Wavenumber	2	678.75, 1648.75	
CAL_SoftwareUpdate_Date	Scalar	2022-06-17	
CAL_Software_Version	Scalar	V1.1.0	V1.2.0
Calibration Quality	1	0	
Coefficient Index Revision Date	Scalar	2022-06-17	
Current_Dwell_Index	1	15	
Current_Region_Task_Index	1	9	
Data Creating Date	Scalar	2026-01-05	
Data Creating Time	Scalar	00:07:35.975	
Data_source_Flag	1	0	
Dataset Name	Scalar	GIIRS L1 Data	
EWMirror_Scan_Direction	1	1	
Earth/Sun Distance Ratio	1	0.9833075191	
End Line Number	1	16	
End Pixel Number	1	8	
End_Wavenumber	2	1131.25, 2251.25	
File Alias Name	Scalar	GIIRS_L1	
File Name	Scalar	FY4B- GIIRS- _N_REGC_...	
IRChannel_Number	2	725, 965	
Incomplete Scans	1	65535	
L1_Quality_Flag	1	1	
LWIGM_Valid_Frames	1	8	
Laser_wavelength	1	852.356	
MWIGM_Valid_Frames	1	8	
NR_Software_Version	Scalar	V0101	
NSMirror_Scan_Direction	1	0	
Number Of Scans	1	65535	
Oblateness	1	0.003352892	
Observing Beginning Date	Scalar	2026-01-05	
Observing Beginning Time	Scalar	00:05:54.925	
Observing Ending Date	Scalar	2026-01-05	
Observing Ending Time	Scalar	00:06:05.125	

That's all Folks
Thank you for your attention

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